Master's Thesis

Revitalization of Branch line railways in Lower Austria
Case study of the Donauuferbahn

TU Wien, Faculty of Civil Engineering

MASTERARBEIT

Revitalisierung Nebenbahnen von Niederösterreich
Am Beispiel die Donauuferbahn

eingereicht an der Technischen Universität Wien, Fakultät für Bauingenieurwesen

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Abstract

Throughout Europe there is a growing movement to revitalize branch line railways as key components of attractive regional transportation networks. Innovative solutions and new mobility concepts have revived lines that just decades seemed certain to be closed. The issue of climate change mitigation has further renewed interest in developing public transport throughout Europe and branch lines can play an important role in these climate goals. The state of Lower Austria once had an extensive branch line network. However, the network has been gradually trimmed back, with large waves of closures occurring in 1988 and 2010 with 100s of miles of railway closed. This thesis will study the history and cause behind the mass railway closures to develop a strategy for revitalization. Railways are strongly affected by local conditions; therefore, it is not possible to develop an overall solution for all Lower Austrian branch lines.

The Donauuferbahn was one of the most controversial closures and will be the focus of the scientific work to investigate the technical and operational feasibility of upgrading and reactivating traffic to branch line routes. Since 2010, there has been no regular operation on the entire line in Lower Austria, but only tourist summer operation, with part of the line being abandoned altogether. The potential demand for returning the line to regular service was estimated based on quantitative transport modeling methods. The railway shares characteristics with the successfully reactivated Vinschgaubahn in South Tyrol, which along with other relevant precedents will be used to develop an overall strategy to revitalize the railway as an attractive public transport route. The results of the study show that there is demand for the resumption of regular rail service and that the reintroduction of regular passenger services is technically and operationally possible. The reactivation of railway services is dependent on necessary local and political support.

Kurzfassung

In ganz Europa gibt es eine wachsende Bewegung zur Wiederbelebung von Nebenbahnen als wichtige Bestandteile attraktiver regionaler Verkehrsnetze. Innovative Lösungen und neue Mobilitätskonzepte haben Strecken wiederbelebt, deren Stilllegung noch vor wenigen Jahrzehnten sicher schienen. Die Frage des Klimaschutzes hat das Interesse am Ausbau des öffentlichen Verkehrs in ganz Europa weiter verstärkt, und Nebenbahnen können eine wichtige Rolle bei der Erreichung dieser Klimaziele spielen. Das Bundesland Niederösterreich verfügte einst über ein umfangreiches Nebenbahnnetz. Das Netz wurde jedoch schrittweise reduziert, wobei es 1988 und 2010 zu großen Schließungswellen kam, bei denen Hunderte von Kilometern an Bahnstrecken stillgelegt wurden. In dieser Arbeit werden die Geschichte und die Gründe für die massenhaften Bahnschließungen untersucht, um eine Strategie für die Wiederbelebung zu entwickeln. Nebenbahnen sind stark von den lokalen Gegebenheiten betroffen, daher ist es nicht möglich, eine Gesamtlösung für alle niederösterreichischen Nebenbahnen zu entwickeln.

Die Donauuferbahn ist ein der meist umstrittene strecken Stilllegungen und der Schwerpunkt der wissenschaftlichen Arbeit war die Untersuchung der technischen und betrieblichen Machbarkeit zur Ertüchtigung und Reaktivierung des Verkehrs auf diese Strecke. Seit 2010 gibt es in Niederösterreich auf der gesamten Strecke keinen regulären Betrieb mehr, sondern nur noch einen touristischen Sommerbetrieb, wobei ein Teil der Strecke ganz aufgegeben wurde. Darüber hinaus wurde das Nachfragepotential für die Wiederaufnahme des Regelbetriebes auf Basis einer quantitativen Verkehrsmodellierung abgeschätzt. Die Bahn hat einige Gemeinsamkeiten mit der erfolgreich reaktivierten Vinschgaubahn in Südtirol, die zusammen mit anderen relevanten Präzedenzfällen genutzt werden, um eine Gesamtstrategie zur Wiederbelebung der Bahn als attraktive öffentliche Verkehrsstrecke zu entwickeln. Die Studie hat gezeigt, dass durch die Wiederaufnahme die Wiederaufnahme hohe Nachfragepotentiale gegeben sind und dass die Einführung eines regelmäßigen Personenverkehrs technisch und betrieblich möglich ist. Ohne die notwendige politische Unterstützung des Vorhabens ist die Umsetzung allerdings schwierig.

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1 Introduction

The Wachau in the eastern state of Lower Austria one of Austria's most popular tourist regions. Located northwest of Vienna this segment of the Danube River valley is known for its wineries and picturesque century old villages. Through this landscape stretches a railway line, appearing harmonious with the landscape with artfully designed tunnels, bridges, and attractive stations, seemingly a perfect gateway into the area. However, since 2010 the rails lay silent half the year. Only in the summer months do trains operate through the Wachau, and only on an infrequent schedule. The story of the Donauuferbahn is not a singular one, but rather part of a systemic closure of branch line railways throughout the state of Lower Austria.

The issue of branch line railways has been a topic of much debate in the field of transportation research for the last half century. The issue is not solely an Austrian one, but one that has affected all of Europe, and many other parts of the world. It is part of a larger issue of how public transport should be provided to rural areas without the population density to support financially sustainable public transit, and whether it should be provided at all.

In the face of rising motorization, these railway lines faced decades of neglect, as railway companies considered them too expensive to maintain in comparison to their ridership and freight potential. From the postwar period onwards, there were mass closures of branch lines in most western European nations as railways concentrated on developing high speed lines and suburban commuter services. However, in the past two decades there has been a resurgence of branch line routes as local governments realize they can provide an alternative to exponential motorization that has followed the withdrawal of railways from rural regions. Reactivated branch lines have found specific success in areas with sensitive environmental conditions where the increase in motorization is especially damaging. New transport concepts such as the development of transport associations has helped branch lines be redeveloped as cores to a comprehensive transport network.

This thesis will examine the causes of the decline of the Lower Austrian branchline network and examine the specific case study of the Donauuferbahn as an example for the revitalization of the branchline network. This chapter will provide an overview of the general area of study and the specifics of the Austrian condition. It will highlight the importance of the provision of public transport and the necessary role of rural railways.

1.1 Public transport – an introduction

The concept of public transportation as we know it today dates back to the early 1800's when cities started to grow outside of the scale traversable on foot, and intercity connections grew in importance. Throughout the world there are numerous approaches and interpretations of what is public transport, its importance, and whether it should even be the responsibility of a society to provide such services. With the growth of new mobility concepts, the definition of what constitutes as public transport has become blurred. In general, public transport has the following characteristics:

- Vehicles are shared by users
- Accessible for anyone to use (theoretical possibility to use service)
- Line and schedule-oriented system.

In Austria public transport is legally defined by the Öffentlicher Personennah- und Regionalverkehrsgesetz (Public local and regional transport regulation). The act provides the following definition for public transport with differentiation between local and regional transport.[1]

> (1) Local passenger transport within the meaning of this Federal Act is understood to mean transport services that satisfy the transport needs within an urban area (urban traffic) or between an urban area and its surrounding area (suburban traffic).
>
> (2) Regional passenger traffic (traffic in rural areas) within the meaning of this Federal Act is traffic that does not fall under the scope of Paragraph 1 that meets the traffic needs of a region or rural area.

The law provides further distinctions between commercial services which operate without subsidy and those which operate on a subsidized basis. For the basis of this thesis public transport will be considered as all route-based services that operate on a regular schedule which are offered within the study area. This includes those services which only run-on demand like some rural on demand routes but will not consider ride sharing and micro mobility.

In many large cities life without public transport is unthinkable, it is the backbone of the urban environment without which it would collapse. Throughout the world, it is rare to find a city where public transport does not play a role in the transport environment, even if that role varies greatly from place to place. Public transport even in these areas is rarely profitable, only in rare cases of very high utilization such as in Japan or where low-quality services with low operating costs such as in private buses in developing countries is this the case. Public transit is viewed for the most part, even in auto centric countries such as the United States, as a public good, something that must be subsidized to at least some extent as its external value is greater than its revenue potential.

However, outside of the major cities and their sphere of influence the role of public transport is very much in question. Due to population spread, the provision of rural public transport here was never one that was overly profitable. Nor historically were they a part of daily life for many in rural regions before city-oriented commuting became commonplace. The character of public transport in these rural regions generally reflected these realities with often infrequent schedules and slow speeds. In the age of mass motorization, it's roll in rural areas has been called into question. Furthermore, the second half the 20th century has seen a steady, and likely irreversible decline in the population of rural regions, further calling into question the needs to serve these areas. The "ghost" buses and trains of rural regions with low ridership are a popular target for politicians looking to cut government budgets. Even in countries with good public transport networks, more and more areas continue to become inaccessible without a car due to the retreat of public transport from rural areas. The provision of public transport is not free and must come from the same budget as many other social needs. The question becomes then why it is important as a society to pay for such services. What are the benefits of doing so and what are the negative consequences of the elimination of public transport services?

1.2 The importance of public transport

The availability of public transport has a critical role in the interaction of the population with the physical environment. Historically cities and settlements have evolved based on distances that humans could traverse on foot as most of the population had no access to even horse carriages. Public transport, in general has developed in a manner compatible to this historic spatial structure. Due to the stop-based nature of public transport lines, sufficient density is needed at each stop for the

[1] (BMDW, 2021)

transport service to operate economically, therefore it is in the interest of the operator that dense development forms around stations and stops. This traditional development structure has many benefits in that it encourages walkability and reduces vehicle trips. This fosters more social relationships between residents, health benefits from an active lifestyle and reduced vehicle emissions. Furthermore, it reduces the total human footprint on the land allowing for more land to remain in its natural state or productive uses such as agriculture or forestry.

In contrast, the automobile allows for development to spread out at a very low density across the landscape, with the human scale of places entirely lost. This can most prevalently be seen in the United States where large areas of land around cities have been consumed by low density suburban development only accessible with a car. Once housing is built to the scale of the automobile, all other land uses follow so that eventually one must use a car for every trip. This automobile dependence has numerous negative side effects. The energy consumption of automobile centric areas is exponentially larger than those with public transport and a development structure centered around it. This leads to an increase of both local emissions as well as climate change causing greenhouse gases.

In Austria, personal automobiles are responsible for almost 90% of both the energy consumption and energy consumption in the passenger transport sector. By contrast the railway sector consumes only 2.2% of the total energy requirements and produces only 0.7% of the emissions. In 7 Austrian states the transport sector is the biggest contributor to the total CO_2 emissions.[2] The problems are similar in the freight transport sector with trucking contributing the vast share of emissions while railways contribute a negligible amount. In terms of emission balance, no mode of longer distance transport can come close to that of the railway. Unlike other modes where solutions using batteries and hydrogen are still in development to reduce emissions, electrified railways have been fully emission free when powered by sustainable energy for over 150 years.

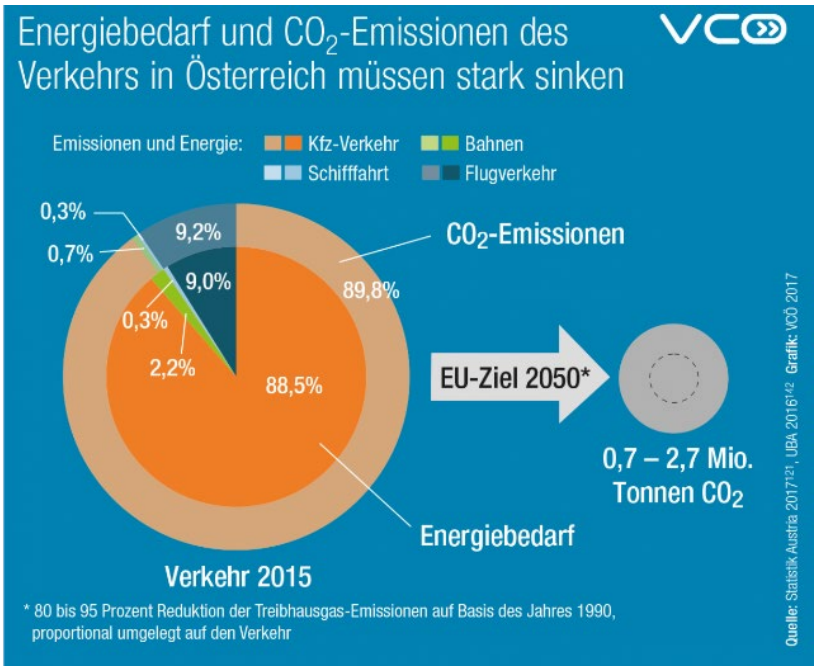


Figure 1: Share of emissions by mode in the passenger transport sector in Austria. Source: VCOE

The electrification of personal automobiles will reduce point source emissions, but they will do little to reduce overall energy consumption. Sustainable energy sources have limited capacity and if electric cars must be charged with energy from fossil fuels there is only a transfer of emissions. There are further issues with the environmentally destructive mining of the rare elements required for batteries.

[2] (VCOE, 2018)

Automobiles themselves require tremendous space consumption compared to other transport modes. Automobiles are incredibly space inefficient both while in motion and parked, requiring lanes generally 3 meters wide or greater while travelling, and vast areas of paved parking. The vehicles stay inactive most of the day and require large amounts of often public land for their storage. This storage space has no productive use, and in cities and settlements land that could otherwise be productively used must be sacrificed. Average vehicle occupancy in Europe ranges from 1.1-1.2 for work trips to 1.6-2.0 for leisure trips[3], so an average of 7 square meters is needed just to transport on average one person. No innovation in automobile technology will solve this fundamental issue of inefficient use of space, in fact the common trend is towards larger and larger vehicles.

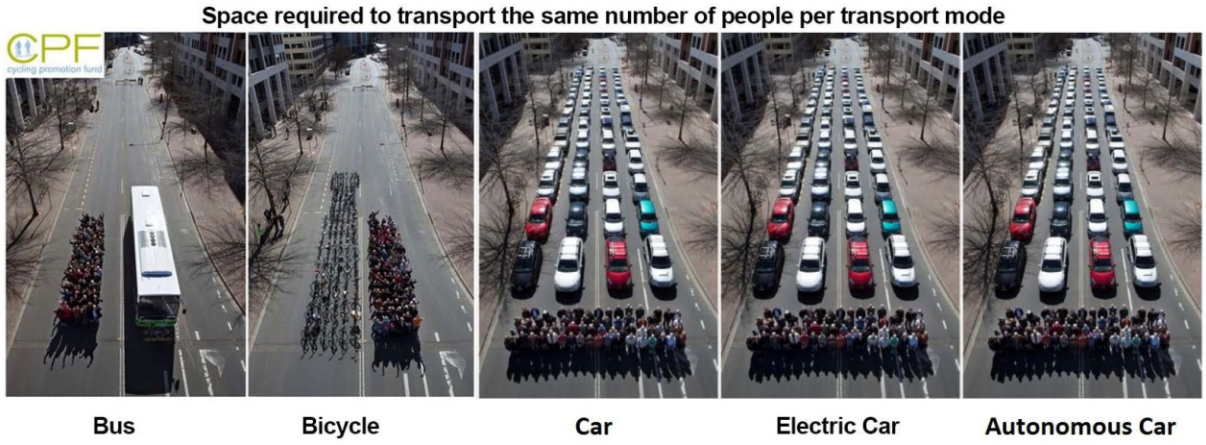


Figure 2: Space required to transport the same number of people per transport mode. Source: https://humantransit.org/2012/09/the-photo-that-explains-almost-everything.html

Auto oriented development has further social effects. Without a public transport infrastructure and with distances too far for non-motorized mobility, the youngest, oldest and disabled members of society in particular lose their mobility options, often stunting their abilities for have a productive social life without dependence on others.[4] For even those with a car, the cost of vehicle ownership can be a hardship, an expensive vehicle breakdown could lead to the loss of a job in areas where no other transport options exist, and the costs of vehicle ownership can compound other problems like the unexpected loss of a job.

When all or most trips are made by car, the possibilities for social interactions decrease, leading to increased isolation and loss of community. Similarly, when the car become the go to for all trip purposes, the active exercise that is built into a normal day in a walkable community must be replaced by the person actively seeking out exercise. It is a no coincidence that the United States with its car centric culture has one of the highest obesity rates in the world. The impacts are also felt economically and help to consolidate economic power with larger corporations. Smaller businesses located in historic centers which were built for walkability increasingly struggle against shopping centers with convenient car access. These shopping centers generally cater to larger businesses such as chain stores and more money thereby leaves the community. This phenomenon is not just important to cities but for rural areas as well, where the historical town and village settlement structures are threatened.

The provision of effective public transport is vital for mitigating the impacts of climate change and for maintaining livable communities.

[3] (EEA, 2020)

[4] (Berg, 2018)

1.3 Importance of rural railway transport

The trend in rural regions of Austria, and in fact in many countries in Europe has been the substitution of branch line railways with buses. Buses have lower operating costs, are more flexible in their routing and in some cases can be faster due to the construction of new roads compared to old railways. Branch line railways have been generally in the last decades viewed negatively by the railway companies, as lines that are a maintenance drain and services that must be subsidized. For decades there has been a push to close more and more of these lines. The question therefore stands whether branch line railways are a needed part of a modern public transport system or whether buses can fulfill this role better.

In passenger transportation, there is often, at least in the European context a preference for rail transport from the passenger side. Some benefits of rail transport practical; rail vehicles through having their own alignment can provide faster trips than buses which must operate on the same roads than cars, rail vehicles generally offer more space and in touristic regions can also easily be used for bike transport, and when the quality of vehicles is equal provide better riding comfort. From the operational side railways can be more easily electrified with technology that dates back over 100 years and capacity can be increased easily with the addition of vehicles.

However, perhaps more important than these practical reasons are the subjective ones that play a major role in whether a user will choose to use public transport at all. Studies have shown that railways, when other factors are equal are much more attractive to passengers. The case for this in a large part psychological and varies from area to area based on the characteristics of each system. In 2001 a study was carried out by the University of Dresden on the preference between train and bus in rural areas. The study surveyed residents in the towns of Annaberg-Buchholz and Bischofswerda in former East Germany and gave respondents a hypothetical situation whether they would choose a bus or a train with the same travel time, same ticket price and same access conditions. Overall, 63% of the respondents chose train indicating a significant rail bias even in rural areas.[5] The questionnaire further broke down the responses into why the respondents chose selected either rail or bus.

The following factors were the primary reason for choosing train.

- Emotional attributions (38%)
- Activity space (12%)
- Contra bus arguments (7%)
- Seats (5%)
- Attributions to guideway (5%)

The most important subcategories for first attributions for the bus decision were:

- Routing (23%)
- Emotional attributions (19%)
- Experience (13%)
- Attributions to guideway (9%)

The study concluded that the choice of train over bus was largely driven by emotional reasons, the study further states that while bus routes may be well liked by regular, long-term users, they struggle to attract new users.[6] The specific subjective preferences of railways vary by user group but include the following; Even if a bus is technically faster than the railway, the railway has a perceived sense of

[5] (Megel, 2001)

[6] (Megel, 2001)

being quicker (except in cases of significantly longer travel time) due to it being on a separate right of way. A bus that operates in mixed traffic will always remind passengers that they are moving on the same path as cars but at a slower speed. These factors are especially important when considering replacing rail services with bus, which has been shown to reduce ridership. Studies carried out in West Germany in the 1980s showed that only 50% of former railway passengers used the replacement bus services. [7]

For tourists, and infrequent users of a system, railways are generally much more comprehensible. The basic principles of train travel are relatively similar in most countries; however, bus travel varies greatly between countries in terms of quality, and usage. Generally, information provided to passengers is less comprehensible than for rail systems, which due to their fixed route structure are relatively easy to understand. With the implementation of high-quality service and good customer information, a bus service can sometimes overcome these perceptions.

Similarly, to passenger services, freight services on branch line railways has also been in steady decline in the last decades. Single wagon freight traffic has steeply declined across Europe, with European railways having shifted their focus towards handling unit trains for bulk goods. These services however are vital in rural areas where the loss of rail services mean trucks driving directly through town centers. Trucking contributes exponentially more to road wear and emissions than passenger vehicles, as such the retention of freight rail services have an empirical importance. Freight rail service, even if carried out by diesel traction on branch lines is far more environmentally friendly and more cost effective for bulk shippers. The provision of rail service is often vital for attracting and maintaining the attractivity of a region for industry.

It is however not productive to frame the transportation discussion as one of bus vs rail, both have important roles to play. However, a bus network oriented towards a well-managed branch line railway offers significant advantages over one that must fulfill all transport needs by itself.

1.4 Problem statement and research question

Since the advent of mass motorization, regional railways throughout Austria and in general western Europe have been in decline. While a great deal of investment has been made in mainline routes and in new high-speed projects, many regional railway lines have been left with marginal service or closed all together. While the new high-speed lines offer the chance for major infrastructure spending, popular with politicians as highly visible accomplishments and with the private sector due to the large amount of construction required, they lose much of their value when regional connections are lost. When people are no longer able to complete major segments of the trip chain with rail transport, its likely they choose another mode altogether, especially over moderate to low distances. The closure of regional rail lines locks entire regions out of the rail transport system. Buses, which share their route with individual traffic is no substitute for a proper regional rail line and has limited possibilities to become more attractive than individual travel where motorization rates are high.

The situation with regional rail lines is particular problematic in the state of Lower Austria. Starting in the 1980's ÖBB began closing or selling off regional lines that they deemed to be unprofitable. In 2010 ÖBB divested in approximately 600 kilometers of trackage in Lower Austria which was sold to the state. After the sale the state was free to choose what to do with the lines. In many cases that has been the outright abandonment or sale to a private group for touristic services. As such large parts of the state

[7] (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

have been left entirely without rail transport, with bus replacement services often offering little real competition to individual motorized transport.

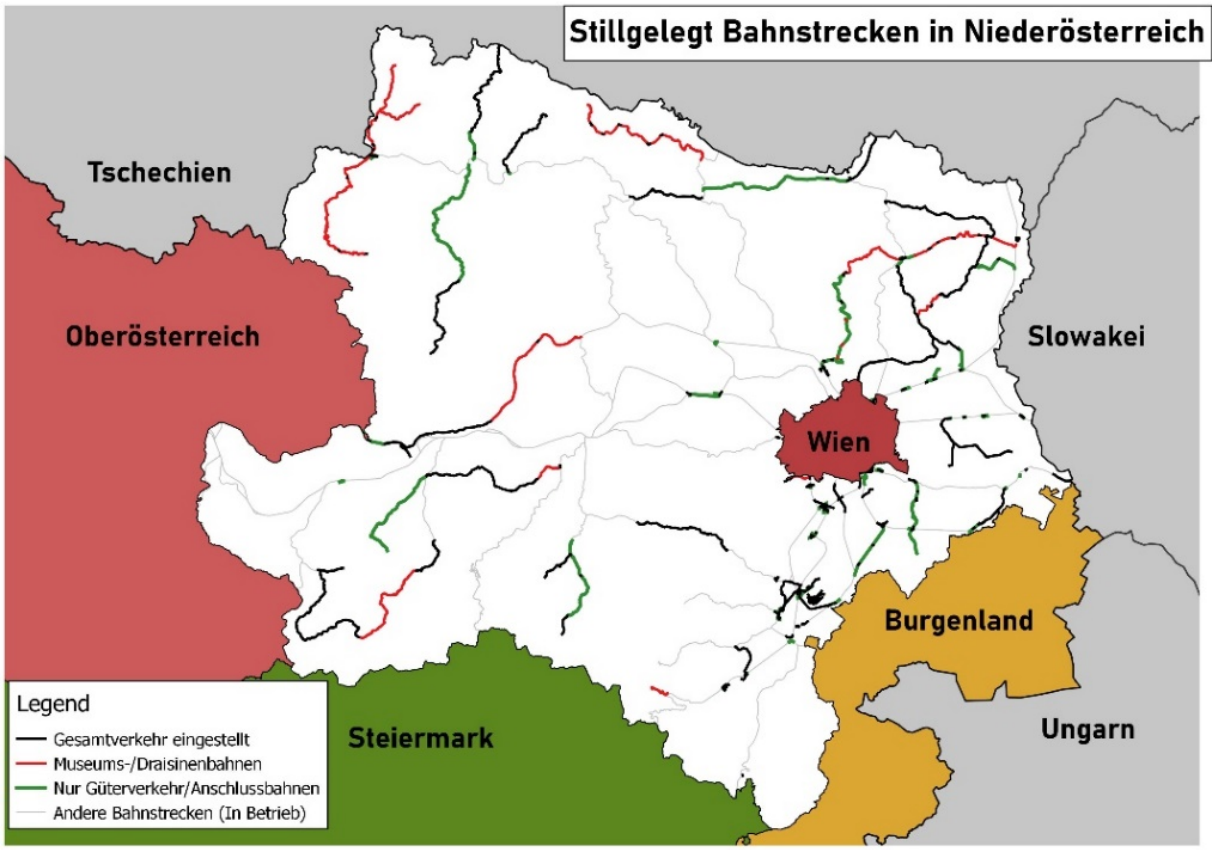


Figure 3: Map of closed railways in Lower Austria. Own map, data Source: (Strommer, 2020)

However, this fate was not inevitable. Elsewhere in Austria and in surrounding nations the regionalization of local railway lines has resulted instead in a resurgence of lines that the national operator wanted to close. In Italy's South Tyrol the Vinschgaubahn once faced a similar fate to many Lower Austrian branch lines. The line 60-kilometer line operated through an important tourism valley between Meran and Mals, however for many reasons the line was closed by the Italian state railway in 1990. However, to combat rising traffic issues the line was purchased by the state of South Tyrol and reactivated in 2005. The line has been very successful with trains well patronized and operating on frequent intervals. Success has hinged on numerous factors, but import is that a transport plan was developed so that the railway does not function as a separate entity but part of a larger integrated transport and urban planning ecosystem.

The thesis will focus on two primary research questions; firstly, what factors led to the decline and closure of the Lower Austrian branch line network. Secondly, how can best practices for branch lines applied in other states in Austria and abroad be applied to revitalize Lower Austrian branch lines.

The thesis thus will be divided into two distinct segments; the first will deal establish the historic and political background of the closure of branch lines in Lower Austria. This segment will evaluate which factors and which actors were most responsible for the closures, and what steps were tried to retain these lines. This understanding of the historic situation will form a basis for future planning.

Branch line railway all have their own individual characteristics, and it is impossible to design a generic solution for all Lower Austrian branch lines. Therefore, the thesis will focus on a line known as the Donauuferbahn, a former secondary line the follows the Donau River between Krems an Donau and Mauthausen, a distance of 107 km. The line passes through the popular Wachau tourist district, forming a part of the UNESCO World heritage area. However, since 2010 the portion of the line in Lower Austria has been without regular service. Part of the line from Krems to Emmersdorf is now operated only during the summer by NÖVOG (Niederösterreichische

Verkehrsorganisationsgesellschaft), a touristic operator owned by the state of Lower Austria. However, from Emmersdorf to the Upper Austrian the line has been abandoned altogether with the rails removed. The line, like the Vinschgaubahn passes through a popular tourist region and has similar potential to attract tourist and locals alike when properly managed.

1.5 Motivation

Branch line railways play a vital role in an effective transport system and are often the only reliable and efficient transportation mode for many rural regions. The closure of these railways leaves large areas without any public transportation with bus transport often providing an insufficient substitute. Entire segment of society, typically the youngest and oldest risk losing their mobility when these railways are closed.

The reason for the closure of these railway lines is manifold, and include increased competition from the road transport, declining rural populations and a drive to make the railways more profitable and market oriented.

However, as the impacts of rising global emissions and the poor land use development patterns of the last half century become apparent, the local railways stand to play a key role in mitigating these problems. Transportation contributes 16% of the total greenhouse gas emissions worldwide, of these emissions the road sector is by far the greatest contributor. Worldwide the road sector contributes 74% of the total transport sector emissions.[8] In Austria, where a large percent power is generated by hydro and renewable energy, the transport sector has a larger share of overall emissions, contributing 30% to overall GHG emissions of which all but 2% are from road traffic.[9]

Furthermore, transport is one of the only sectors where emissions are actually rising whereas all other sectors have made significant efforts to reduce their impact.[10] While the air transport sector plays a role here, the primary driver of increased transport emission is rising motorization.

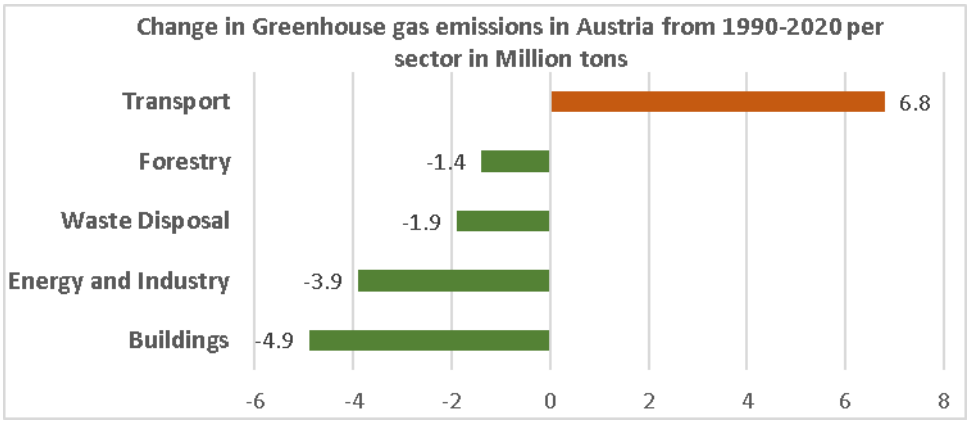


Figure 4: Change in emissions per sector between 1990 and 2020 with transportation in orange. Source VCOE, Unweltbundesamt Austria

Aside from direct emissions, the provision of efficient public transportation is key to maintaining and developing sustainable land use patterns. In countries and regions where the automobile has become the dominant form of transport the traditional town and city-based settlement structure has been replaced with a suburban one that consumes valuable greenfield land that would otherwise help with carbon uptake.

[8] (Ritchie, 2020)

[9] (Umweltbundesamt, 2019)

[10] (VCOE 2021) – See Figure 3

Rail transport is by far the most sustainable transport mode and contributes just 1 % to worldwide GHG emissions and in Europe an even lower value due to a high degree of electrification.[11] Rail transport similarly is ideal for promoting compact development structures with development naturally focusing on rail transport hubs if quality service is available. With a general worldwide trend of declining rural populations, the provision of high-quality branch line railways with good connections to major job centers is vital to maintaining the attractivity of rural areas.

The issue of branch line railways has been a topic of intense debates for decades within Austria and has been extensively studied. However, the issue is far from an exclusively Austrian one, rather a European wide one. In Western Europe countries branch line railways have been in decline since the 1950s, as countries followed the same patterns of mass motorization. However, the situation was different in Eastern Europe and in other parts of the world where either through policy or economic reasons the automobile did not emerge as the primary transport mode in the postwar era. Today however the same scenario from the 1950s is now being repeated in eastern Europe as government and EU funding is funneled into the construction of fast highways and motorization grows at an exponential pace. Outside of Europe in developing nations the same situation has either already played out as in most of South America or will likely in the next years in countries such as India where vast highway systems are being built and motorization is rising.

The thesis is written with the intent of both providing a useful analysis of the situation in the Austrian context but also transfer the experiences of the Lower Austrian branch line problem and potential solutions to an international basis.

1.6 Methodology

The issue of branch line railways has been an important topic in Austrian transport research since at least the 1980s when the first large wave of branch line closures began. This thesis will rely on past thesis projects and reports conducted at the TU Wien and other academic institutions as primary sources.

To understand why the branch line rail network in lower Austria has precipitously declined, it is important to understand the full context of the situation, both in terms of historical and current societal context. The study will begin with a full exploration of the development of railways in Austria and general transportation policies, especially in the postwar era of mass motorization. This historical analysis will rely on several sources including books on the Austrian railways, scientific papers as well historical documents such as newspaper articles, legislation and minutes from parliamentary proceedings. Sources written in the context of the era will help show the attitudes of the time and how they shaped the development of the rail system. Furthermore, interviews have been conducted with those experienced with Austrian transport policy and involved in the transport industry at the time.

The analysis of the case study will begin similarly with a historical analysis of the region and the railway. The history of the line is in a large part sourced from the book “Mit der Donauuferbahn von Krems nach Grein”.[12] The analysis of the case study will be interlinked with the previous research of the Austrian railway network to see how the lines fate is intertwined with the branch line network as a whole.

Even in this era of high-quality satellite maps and Google Streetview, there is no substitute for a site visit to understand the actual conditions. Multiple field visits have been carried out to assess both the current operations of the railway and how the railway fits in with the larger spatial structure of the area. A number of statistical sources will be used to develop a clear picture of the current situation. These include statistics on population, travel trends, tourism. These statistics will largely come from

[11] (Ritchie, 2020)

[12] (Hofstetter, 2018)

official sources, the state of Lower Austria publishes an annual report with data on a Gemeinde level, including population and auto ownership per household. Due to the ongoing Corona crisis, statistics from 2019 have been used, when possible, to avoid showing distorted travel patterns. The long-term effects on both commuter, and tourist traffic are not yet known and as such consideration of the pre 2020 situation is the most prudent at this point.

To assess the railways transport potential, the “Verkehrswert” or transport value model will be used. The model has been used in numerous past studies carried out by the TU Wien FVV (Forschungsbereich für Verkehrsplanung und Verkehrstechnik /Research institution for transport planning and transport technology) and is well suited to modelling public transport demand. An analysis of the catchment area of the railway will be done with GIS (Geographic Information System) using the spatial analysis method which provides a more accurate picture of the actual catchment area by walking and where there are potential gaps in the walking network. Data used will primarily be sourced from OpenStreetMap’s in shapefile format.

Based on this assessment of the lines potential a list of measures based on the common best practice and successful precedent studies will be developed. A timetable will be developed using the software FBS (Fahrplanbearbeitungssystem). The software allows the user to develop timetables based on track and vehicle parameters. Operational and infrastructure costs will be developed based on the timetable parameters.

1.7 Language and frame of reference

This thesis focuses on a subject in a German speaking country, therefore German terms with translations will be present throughout. Use of the original German terms preserves its usability within the geographical subject area and preserves the original intent of terms when no direct translation is available. Certain German terms and acronyms, in particular when referring to agencies, places and specific concepts will be used where translation would reduce clarity. Further, these terms when used in plural will use the German form of pluralization. The thesis is written in a way that explains the political, geographical and social context of Austria for reads that are unfamiliar with the characteristics of the region.

Many reference materials are in German, a large amount of translation was needed. In the case of print sources this has been done manually. In the case of documents available online, this has been done with a combination of automatic translation tools with manual corrections.

The study is written in American English but has been written with European railway terminology. All numbers are written in English format with periods as decimal separators and commas for thousand separators.

2 Nebenbahn (Branch line): Definition, importance, and issues

Railway lines in Austria can generally be defined as falling into the following three categories as defined by the 1957 Eisenbahngesetz (Railway Act)[13]

Mainlines and High-Performance lines (Hauptbahnen und Hochleistungstrecken): These lines connect major cities and are primary arteries for freight and passenger traffic. The Eisenbahngesetz states the following (translated): *"Mainlines are railway lines for public traffic that are of great transport significance. These lines generally have great importance for international freight and passenger traffic along major European axis, as well in most cases for regional transport."*

Austria does not have any true high-speed lines but has instead developed so-called high-performance railway lines. These lines are characterized by electrification, moderately high speeds (up to 250 km/h) and at least 2 tracks with sufficient opportunities for high-speed services to overtake slower ones. Where possible curvature has been reduced to allow for continuous higher speed operation, generally with new alignments requiring large amounts of bridges and tunnels. ETCS signaling has generally been implemented or is planned to be implemented, dispatching is generally carried out remotely in either case. So far, the high-capacity line concept has only been carried out on the east-axis, on the Westbahn between Vienna and Salzburg and between Wörgl and Innsbruck. There are currently 3 base tunnel projects that are intended to convert further lines to high performance specifications.

On other mainlines that are not considered high performance lines, conditions greatly vary. In Austria, almost all mainlines are electrified with a few exceptions such as the Marchegger Ostbahn between Vienna and Bratislava which is still in the process of being electrified. However, many are single track, often with dispatching carried out locally from stations.

Nebenbahnen, or branch line railways are defined in Austria by the Eisenbahngesetz as railway lines that are of lower transport importance than mainlines (Hauptbahnen) but are still considered and regulated as railways rather than tramways. They differ also from "Anschlussbahnen" or connecting railways as they operate with scheduled operation and for publicly offered freight and passenger service rather than solely to serve one customer. The function of branch lines can be further defined as railway lines with lower, only regional transport importance.[14] They serve primarily as a feeder to the mainline railways. Of the approximately 5.600 Km railway network in Austria, 2,800 km are considered as branch lines.[15]

Anschlussbahnen: Anschlussbahnen or connecting railways are generally railway lines not considered as part of the mainline railway network, and traditionally are for connecting customer facilities. They are regulated with less stringent requirements than regular railways, and as such are required to be physically separated from the mainline railways, generally with a split point derail (Gleissperre) that can only be opened with permission of the dispatcher.[16] In some cases, lines that were previously branch lines have been converted to connecting lines to serve remaining freight customers. In general, Anschlussbahnen have slow operating speeds, lack electrification and operate under different, less stringent rules than mainline railways. Regular passenger transport under a public service contract is not allowed due to these reduced safety standards, limited passenger service (without a public service obligation) is permitted.[17]

Branch line railways were generally some of the last lines to be built, as they served areas that were of secondary or only regional transport importance. These railways were generally built with a lower

[13] (BMDW, 1957).

[14] (Catharin, 2015)

[15] (VCOE, 2018)

[16] (Knoll, 2021)

[17] (Knoll, 2021)

budget resulting in tracks closely following the contours of the land to minimize the number of cuts, fills and civil structures needed. This results in alignments with lots of horizontal and vertical geometry which limits both the maximum speed and the maximum tonnage. Roads that were subsequently built generally followed more direct alignments and as such personal transport as well as buses were often able to offer faster journey times than the branch lines. Additionally, these low-cost construction methods generally led to the lines being further away from town centers, further reducing the railways competitive edge. Towns served by local railways are generally of the size where they cannot support a feeder bus network but still the walking distances to the station remain long, leaving the lines as easy targets for parallel bus services and personal transport. This dynamic is well illustrated by the case of the Gleichenberger Bahn in Styria. The winding alignment results in much longer travel times than the bus between the two main towns, and as such the line is facing closure despite being fully electrified.

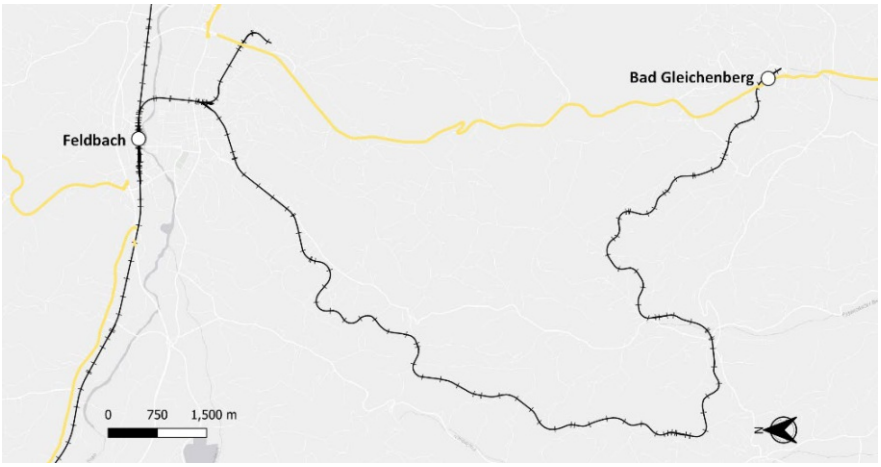


Figure 5: alignment of the Gleichenberger Bahn in comparison to the road between the two points. Source: Own map, OSM data

While line speed is rarely important for freight, the generally undulating profile of many local railways means that the weight and length of freight trains is generally restricted or requires the use of multiple locomotives further increasing operating costs. Due to both surrounding development and the relatively low profit return from the branch lines, significant realignments to speed up journeys on these lines is generally out of the question.

Despite these problems, the branch line railways are an important part of the railway network, without the branch line network, many parts of the country would be cut off from the rail network. Despite decades of migration to urban areas, approximately 41% of the Austrian population still lives outside of cities (in settlements under 50,000 people).[18] For this segment of the population, branch line railways play a vital role for accessibility.

[18] (OECD, 2020)

3 Expectations for modern public transport and rail transport systems

In an era with the mass availability of automobiles and high-quality road infrastructure, the public transport sector must provide an attractive, punctual, and competitive service that is on par with individual transport offers. The role of public transport also must shift from one oriented towards only for specific trip purposes such as weekday commuting or weekend tourism, to one that is useable for a wide variety trip types. This requires a customer-oriented system with frequent headways, well organized transfers and interchanges, a transparent and attractive fare system, and comfortable vehicles accessible to those with reduced mobility. The Verkehrsclub Österreich, one of the primary public transport advocacy groups in Austria, lists the following specific requirements for a modern public transportation system.[19]

- Integrated Taktfahrplan with regular interval time (Minimum of an hourly schedule)
- Optimal transfer possibilities between all transport modes (intermodal interfaces)
- Punctuality and reliability
- No unnecessary parallel routes
- Simple and unified tariff systems, with easy access to ticketing
- Integrated offer of bike and car sharing with mobility card
- Appealing appearance of vehicle, tickets, timetable and stations. Sufficient place in the vehicle to work
- Flexibility to provide additional transport services
- Intermodal information system and unified marketing

Some of these requirements, such as interval based scheduling and integrated ticketing has become widespread in the German speaking world but are less common elsewhere and will therefore be explained in the following subchapters.

[19] (Tomberger, 2016) (VCÖ, 2014)

3.1 Taktfahrplan – Interval timetable

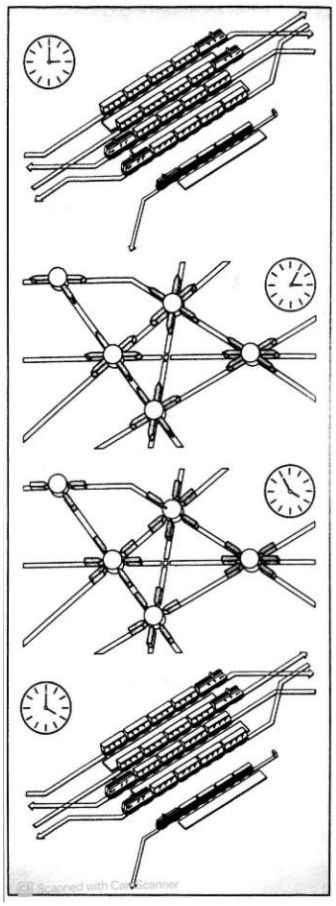


Figure 6: Concept drawing for the Bahn2000 proposal. (Krauechi, 2004)

In German speaking countries, the implementation of a so called Integraler Taktfahrplan, or Integrated interval schedule has become a priority. The system has two components: first, trains and other included modes operate on regular intervals, for example at 0 and 30 of every hour. This makes the schedule easier to remember for travelers and simplifies network planning from the operational side. This is combined with a network of timed transfers, described as long enough but not too long under which trains would arrive and depart designated node stations simultaneously allowing for transfers to and from all locations served by the lines radiating from the node.[20]

The general concept of both interval scheduling and timed transfers has been around for many decades with the technique first employed in the so called "Star timetable" in the Paris tram network in the 1800s, with the first mainline rail example adopted in the Netherlands in early 1900s.[21] However, the Integraler Taktfahrplan concept as applied today was first implemented by the Swiss railways in the 1980s. In the 1960s, Switzerland like most European nations was faced with the impacts of developments of motorways and mass motorization. The railways faced with this competition saw the need to modernize the network. Unlike some other surrounding nations, Switzerland eschewed the development of traditional high-speed lines and instead made targeted improvements in key parts of the network. In 1984 the concept for a complete reform of the Swiss rail network based on the Taktfahrplan was announced under the name Bahn2000.

Important stations with multiple lines would be designated as "Taktknoten" or Interval nodes where all trains would meet to allow for timed transfers. To enable the necessary journey times between cities needed to maintain the network of timed transfers, selected infrastructure improvements were made to improve speeds where needed to meet the required interval times.[22] The timed transfer system was particularly important for coordination with the many narrow gauge lines, as direct trains were impossible and in other places to keep core segments from being weighed down by multiple trains needing to use core segments to reach various destinations. The reduction of waiting time is an important factor in making public transport more attractive as waiting time is perceived more negatively compared to in vehicle time.[23] This is especially true for rural areas where waiting areas are poor and in colder weather which Switzerland experiences for much of the year. A high level of reliability is allowed in part that the Taktfahrplan strategy of running only as fast as needed to allow for coordination leaves more slack time in the timetable for delay recovery. In the case of delays, good communication between train staff and dispatcher is needed to coordinate for delay recovery and whether connections can still be made in the case of late trains. The Bahn 2000 system was implemented in its first form in 2004 which marked the biggest timetable change in Swiss railway history. With the opening of new line improvements such as the Lötschberg and Gotthard Base tunnels the system has been further expanded. The program has been considered a major success and has played an important role in boosting rail and transit ridership

[20] (Krauechi, 2004)

[21] (Garstenauer, 2020)

[22] (Krauechi, 2004)

[23] (Waiting time perceptions at transit stops and stations: Effects of basic amenities, gender, and security, 2016)

in Austria. Between 2004 when the program was implemented, and 2019 the volume of rail passenger transport has grown by 31%.[24]

Austria has tried since the early 1990s to implement a nationwide Taktfahrplan. In 1991 the New Austro Takt 91 was implemented, the plan introduced hourly Intercity services on all core routes and an improvement of both service frequency and transfer times for many branch lines and secondary routes. However, the program incurred significant operating costs, and due to the political climate of the time was phased out in the mid-1990s with a reduction in service. Since then, the concept has been gradually reintroduced across Austria since 2008 with full implementation planned for 2025. In Germany the implementation of a nationwide "Deutschlandtakt" is in the long-term transport strategy but considerable infrastructure work, including a large backlog of deferred maintenance is required before reliability levels are sufficient to implement the plans. Currently many local Taktknoten exist within networks of lines in Germany and the system in this localized form has spread to other countries particularly in regional areas with low traffic density, for example the diesel network in the northern part of the Czech Republic around Liberec.[25]

3.2 Integration of public transport: Verkehrsverbund

A common problem that has historically faced public transport on the regional and in some cases even city level is the fragmentation of services. Historically different types of services such as bus and rail were operated by different companies with little to no cooperation on pricing and scheduling. Merging these longstanding entities, sometimes privately owned is a difficult task that is rarely attempted, furthermore such consolidation may not even be desired as the specialized competencies of each system may function better under separate management. In German speaking countries a common solution to the problem is the creation of Verkehrsverbünde or Transport Associations. These Transport Associations serve as a coordinating agency which handle ticketing and scheduling for all transport modes, while the individual operators remain responsible for the provision of transportation itself.

The idea was first implemented in the 1960s in Hamburg, Germany. Like many cities, Hamburg had a large but fragmented transport system with a S-Bahn system operated by the Federal railway, a U-Bahn, bus and tram network operated by the city and ferries and further buses by private operators. Schedules were not aligned for logical connections between modes and in many cases, there was parallel traffic from different operators. Similarly, fares were not interchangeable leading some passengers to have to take longer connections to stay within one carrier. These parallel services and lack of interchanges were both a drain financially on the state as well as a hinderance to increasing public transport usage in the face of rising motorization. The creation of the Hamburg Verkehrsverbund (HVV) in 1965 led to a massive reorganization of the cities transport network and a major increase in service quality.[26] The Verkehrsverbund structure is now almost universal in German speaking countries, with further application in other countries such as the Czech Republic and Hungary. The typical tasks of a Verkehrsverbund are[27]:

1. Network planning, both for new lines and restructuring of the bus network to serve as feeders for the rail network instead of stand-alone services.
2. Prepare schedules that take into consideration transfers between modes, arrange logical and convenient transfers

[24] (Verband Oeffentlicher Verkehr, 2017) (Statista, 2019)

[25] Based on own experience travelling in the region.

[26] (Seifert, 2018)

[27] (Vuchic, 1972)

3. Developing tariff system and calculating shares of total revenue that would be disbursed to individual operators.
4. Public relations including publishing schedules.
5. Applying for federal and state level funds.

3.3 Barrier free access

The accessibility of public transport to all users, including those with disabilities has become an important issue in the last 3 decades. One major issue for the design of new and renovated transit facilities is the provision of level boarding where the users can go from the platform to the transit vehicle without any stairs or impediments. Throughout the sector there have been large strides towards accessibility, however rail continues to lag behind in this regard. Most local buses in service in German speaking nations have a low floor design which allows wheelchair users to access the vehicle. However due to the long lifespan of rail vehicles there are many high floor vehicles still in service today and some that will likely continue in service for the foreseeable future due to cost of replacement. Similarly, the provision of level boarding generally requires high platforms which can be expensive to implement, particularly on branch lines which already face funding issues.

Within the EU Barrier free access regulations are set by EU Regulation No. 1300/2014. The regulation sets out the TSIs (Technical Specification for Interoperability) for railway infrastructure and vehicles. The regulations set out a gradual approach to the implementation of barrier free access. Per the regulation the TSI's must be implemented for all new rolling stock purchases and all new infrastructure development. The requirements only apply to existing infrastructure and rolling stock when it is subject to renewal or upgrading. For rail vehicles however, in practice many older designs are impossible to retrofit for full barrier free access. The regulations allow for innovative approaches to be taken to meet the requirements where full reconstruction based on the TSI's is not practical.[28]

[28] (EU, 2014)

4 Austria background information

As this study is written in an international context, a short introduction to Austria and its society is needed. The evolution of the branch line railways in Austria did not happen in a vacuum and was influenced by numerous historical factors and societal trends that need to first be understood.

The modern-day Austria is a landlocked central European nation. The country's geography is varied, with the west and south dominated by the mountains of the Alps, while to the northeastern portion of the country is characterized by generally flat to rolling terrain. Climatically the eastern half of the country falls into the Pannonian climate zone and experiences warmer temperatures than the more mountainous east. The country is bordered by Germany and the Czech Republic to the north, Switzerland and Lichtenstein to the west, Italy and Slovenia to the south and Hungary and Slovakia to the east. The country today has a population of approximately 8.9 million. The population, while growing is increasingly concentrated in urban areas, with rural areas generally losing population. The country has 5 major cities (over 100,000 inhabitants), all of which are state capitals. The capital city of Vienna has itself 1.9 million residents and the combined population of the 5 urban centers is approximately 2.5 million.

As typical of western Europe, Austria is moving increasingly towards a service economy, this is especially true of the western half of the country, which is highly mountainous with little room for industry and whose economy is largely focused on tourism. However, the country still has an important manufacturing sector. The Voestalpine steel mill is known as Europe wide as the primary source for quality steel needed for automobile manufacturing. Several highly specialized manufacturers of world-wide renown are located in Austria, such as Plasser & Theurer, which manufacturers track maintenance machines, and Doppelmayr, which manufacturers cable cars. The country has large timber supplies and, as such, a well-developed forestry and paper industry.[29] Farming still plays an important role throughout the country, with cattle and dairy farming being of primary importance in the mountainous regions, while much of the land in the flatter east is used for crop agriculture. The country is also an important route for transit traffic between Germany and other central European nations and Mediterranean and Adriatic ports.

Prior to the end of the first World War, the country was the center of the vast Austro-Hungarian Habsburg empire. The impacts of the Habsburgs can still be easily seen today in the build environment, railways and culture of Austria and its neighboring countries, all of which contain territory that was once that of the Habsburg Empire. The countries well developed railway system is in a large part a legacy of the Habsburg times with few significant lines built after the end of WWI. The history of Austria in the later 20th century has been heavily shaped by Europewide events, namely the second world war and the erection and later dismantling of the Iron Curtain. During the second world war the country was annexed by Nazi Germany, which had long term repercussions in the postwar years. After nearly a decade of rule by the allied powers, the country again became an independent republic in 1955. The country avoided a division into an east and west sector like in Germany through maintaining neutrality. This position allowed the country to develop relations with both the east and western block, however the countries position against the iron curtain led to serious economic disadvantages, particularly for the east of the country. Following the fall of the iron curtain, the country has again found itself at the crossroads of Europe and an advantageous geographical location for trade.

[29] (Export Enterprises SA, 2020)

4.1 Political administration

Since its independence in 1955 Austria has been a federalist constitutional republic, where power is shared between the federal government and the nine states. State governments consists of the Landeshauptmann, or state governor and his aides. The state governor serves both as the representative of the state in external matters (negotiations with the federal matters) and serves as the state's highest executive. The state parliament is responsible for the legislation of state laws and hold most of the power in the political system. The parliament is elected every 5 years with the last election held in 2020. The candidates chosen by the party based on how many votes it receives. The parliament is also responsible for the appointment of the state governor.[30]

Beyond the state level, territory is divided into further subdivisions. Below the state level, territory in Austria is divided into 94 Bezirke (districts). The structure of the Bezirke dates primarily back to 1868 when the Bezirk reform established the current administrative form, however exact boundaries have changed since then. The districts are responsible for enforcements of federal law and are generally the main contact citizens will have with the state and are responsible for tasks such as license issuance. District are headed by a district governor (Bezirkshauptmann); however they do not have a geographic capital.

Under the Bezirke are the Gemeinden or municipalities of which there are currently 2,095 in Austria. The municipalities can consist of a single town or a collection of towns in rural areas. Municipalities have many responsibilities regarding the local area. They are responsible for spatial planning, maintenance and development of public facilities and enforcement of local laws and setting taxes. On the local levels the municipalities have significant power. Municipalities are controlled by a mayor and municipal council (Bürgermeister and Gemeinderat), both of which are elected directly by the citizens.

Gemeinden in rural areas are generally composed of Ortschaften (villages or localities). Ortschaften are historical designations and are now primarily used for statistical purposes and descriptive purposes. They no longer have any administrative role.

4.2 Austrian political landscape and impact on transport policy

The branch line Issue is a highly political issue, and the outcomes were not solely the result of actual transport demand but rather political processes. As such an overview of the major political parties and their views in terms of transportation policies is important to understanding the issue. Politics is always open to interpretation, and this segment only intends to provide a high-level overview of the parties and their positions. As with most constitutional democracies, Austria has a range of political parties. Historically, the two major political parties have been the SPÖ and the ÖVP. The SPÖ was traditionally the countries leftist party and the ÖVP the conservative party. Both parties in the current landscape however can be seen to be center parties. In recent years there has been a growth of other parties on both the left and right side of the political spectrum. The following is a summary of political parties in Austria.

The Social Democratic Party of Austria (SPÖ) – Red: The SPO is Austria's historic leftist party and traces its roots back to the original Social Democratic Party founded in 1889. The original Social Democrats were one of the driving forces for the establishment of the new republic in 1918 and were historically very strong in Vienna leading to cities name during this time of Red Vienna. The prewar party had Marxist leanings and branded themselves as such as a worker's party. With the rise of first the Austro-Fascist movement, and the following Anschluss by Nazi Germany, the Social Democratic party was banned for nearly two decades. The new party was established in 1945 at the end of the second world

[30] (Austrian Embassy Washington, 2021) (NOE Landtag, 2021)

war. The new party initially had the same Socialist ideology, but since then efforts to attract a larger group of voters have led the party to become more centrist.[31] The SPÖ, due to being a worker's party was historically a strong backer of the railways and generally opposed to the expansion of the highway network. The party has particularly high level of support with the railway unions and thus the SPÖ had a particular incentive to support the railway. However, the party's allegiance to the labor unions was led to the view by opposition they resisted modernization efforts that could have made the railways more economical to operate.[32] As the party has shifted to the center, so have their transportation policies, a comparison of the statements from SPÖ members on the branch line issues in the 1990s versus their actions today such as the support for the Lobau Tunnel in Vienna clearly shows this.

Österreichische Volkspartei (ÖVP): - Black/Turquoise The ÖVP is Austria's Christian conservative party and was founded after the second world war. The party is the successor to the 1890s established Christian Social Party, a populist right wing party that would eventually take control of the country in what has been dubbed as the Austro fascism immediately preceding the Anschluss. The ÖVP positioned itself as an anti-Marxist party in opposition to the SPO, and generally considered as financially conservative. In recent years there has also been a shift to the party rightwards in terms of social issues. The ÖVP, as fiscally conservative party has in general been an opponent of subsidizing the railways, except in the areas of long distance and suburban traffic where it could be profitable or at least be a clear economic driver. The party long sought to reduce the railways deficits and generally argued for the closure of the branch line rail network. However, it should be noted that the ÖVP is a large party that encompasses many groups, and it cannot be universally said that the whole party is opposed to the railways and public transportation.[33]

Freiheitliche Partei Österreichs (FPÖ) - Blue: The FPO is Austria's far right party and was founded in 1955 with many of its original members having strong ties to the Nazi Anschluss era government. In the early 1980s the party shifted to the left and formed a coalition with the SPO. however, under the leadership of Jörg Haider from the 1980's onward, the party returned to its far-right roots with a new focus on anti-immigration policy. The party achieved significant power under Haider, gaining control in the government in coalition with the ÖVP in the early 2000s. However, with Haider's death in 2008 and the Ibizia affair in 2019 the party has lost much of their popularity. In terms of highway policy, the FPO has in recent years positioned itself in support of highways and car infrastructure, a trend shared with other far right parties like the AfD in Germany.[34]

Green Party: The Green party in Austria was established in 1986 as a party focused on environmental issues. The party can in generally described as left wing, with the party platform being particularly concerned about environmental and climate issues. Their platform has also come to include many left-wing social issues. In terms of transport policies, the party has taken over much of the former role of the SPO in terms of advocating for the railways and public transport.

The New Austria and Liberal Forum (NEOS) - Pink: The NEOS is one of Austria's newest parties founded only in 2012. The party is generally centralist liberal party with views falling between the ÖVP and Green party, generally favoring the fiscal conservatism while having similar social views as the Greens.[35]

The issue of transportation policy is hardly a black and white (or in this case black and red) political issue. Unlike in countries like the United States, it cannot be said that any one party is completely

[31] (Walker, 2021)

[32] (Nationalrat, 2000)

[33] (Walker, 2021)

[34] (APA/Red, 2020), (Walker, 2021)

[35] (Thömmes, 2019)

against public transport or the railways. Opinions further vary from state to state, with even far right parties in generally left leaning areas supporting public transport projects. For example, in Innsbruck which is a more left leaning part of the country even the FPO was in favor of the preservation of a regional interurban tram line.[36] Similarly, rail transport megaprojects such as the construction of Austria's many base tunnels have broad among Austria's conservative parties. However, transport politics have been and will likely continue to be a heavily polarized subject.

4.3 Lower Austria background

The state of Lower Austria will be the focus of this thesis and further background on the state and its politics is required. The state is the largest of Austria's 7 federal states and is located in the countries far east. The state is bounded to the north by the Czech Republic, to the east by Slovakia and Hungary, and internally by the Austrian states of Burgenland, Styria, and Upper Austria. The state has a varied geography, the southern portion of the state encompasses the eastern end of the Alps with high mountains. However much of the state is composed of rolling hills and flatter terrain. Development as a result has historically been more spread than in the mountainous provinces of the western part of the country.

Historically the state was divided into 4 Viertel or quarters. Prior to the creation of the Bezirke in 1868 these Viertel were used in an administrative capacity, however today they are purely descriptive. The four original Viertel are the following:

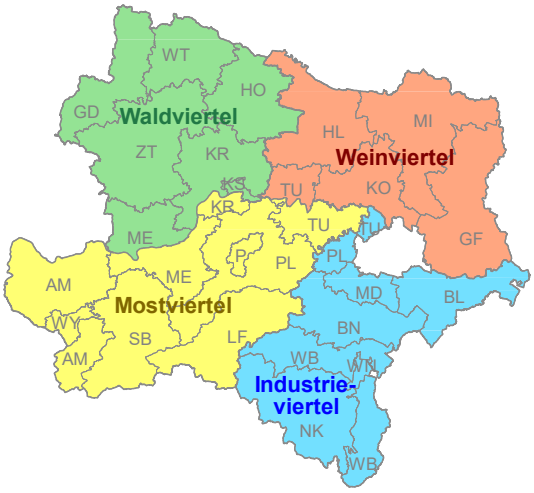


Figure 7: Historic Viertel overlaid with modern Bezirk boundaries. Source: Wikipedia creative commons

- **Waldviertel:** Translated the regions name means forest quarter, and the region as suggested is dominated by a hilly landscape and heavy forest cover. The region extends from the Czech border as far south as the Danube River where the topography and demographics dramatically change. Large parts of the quarter are sparsely populated. The major population centers of the Viertel are Krems, Zwettl, Gmund, Waidhofen an der Thaya and Horn with both Krems and Zwettl having over 10,000 residents.
- **Weinviertel:** The Weinviertel, as the name implies is one of the largest wine growing regions in Austria and is responsible for 30% of the countries wine production. The Viertel is located north of the Danube and extends from the edge of Vienna to the Czech and Slovak borders. The area is dominated by rolling hills and in general has a low population density. The largest city of the Viertel (outside of the Vienna suburban area) is Mistelbach with over 11,000 residents.
- **Mostviertel:** The Mostviertel is the southwest quarter of the state and is named after a typical cider made from fruit of the region. The region is bounded to the north by the Danube River and to the south by the border with Styria. The geography varies from the flat to rolling hills along the Danube, the edge of the Eastern Alps Mountain range in the south. The Viertel's tallest mountain peak is the Ötscher which stands at over 1800 meters tall. The quarter contains several important cities, namely St. Pölten, Amstetten, Waidhofen and der Ybbs and

[36] (Czingulszki, 2019)

Melk.[37] The city of St. Pölten has a population of 54,000 residents, making it the most populous in Lower Austria.

- **Industrieviertel**: The Industry Viertel encompasses the part of the state south of Vienna and developed a large industrial presence due to the construction of the Südbahn and the presence of ample flat land in the vicinity of Vienna, one of the first railway lines in Austria. The Viertel's major center is Wiener Neustadt with a population of 46,500 residents. While the area south of Vienna is largely flat, the quarters southern portion is very mountainous and contains the states tallest peak, the Schneeberg which is just over 2000 meters high.

Today the term Viertel is interchangeably used with the official designation of Hauptregionen. Due to growth of the state's center around St. Pölten a 5th region, NÖ-Mitte, or Lower Austria center was created in 2001. The region is based around St. and encompasses the eastern part of the Mostviertel.

The state was historically centered around Vienna with the national capital also serving as that of the state. The relation between Lower Austria and Vienna had long been strenuous, culturally the two states were vastly different, with Vienna long being a stronghold of leftism while Lower Austria was traditionally Christian and conservative. Following the fall of the Habsburg monarchy, the Lower Austrian's feared the leftists taking control of the state as Vienna had a substantial influence over the less populated lower Austria. Similarly, those inside Vienna feared being under the control of the conservative leaders of Lower Austria.[38] Vienna, even in this time had a population greater than the rest of Lower Austria with at the time of the formation of the first republic having just under 60% of the population of the combined state, furthermore, the residents of the city contributed 80% of total tax revenues for the state. The city had many of its own needs in the post war era to address, and the politicians had little interest in their tax money going to finance rural municipalities in Lower Austria. Therefore, in 1921 Vienna and Lower Austria were officially separated through the "Trennungsgestzt", however Vienna would remain Lower Austria's administrative capital. [39] For Lower Austria, the split was an economic disaster as the state lost much of its financial means without the tax money from Vienna. Meanwhile, Vienna under the leadership of the socialists and freed from the burden of supporting the large rural areas of Lower Austria embarked on a massive social program to rebuild the city in the image of socialism, which gave the city the nickname of Red Vienna. New taxes were put in place on luxury goods to finance the development of mass amounts of public housing to solve the cities crippling housing problems, and vast sums were invested in the expansion of public transport. This mass spending within the city while Lower Austria suffered brought about further tensions between the two states.[40] The tensions broke out in full scale armed conflict during the short Austrian Civil war in 1934 when the paramilitary forces from the socialist and conservative parties fought. The dynamic between the two states has remained, though with the expansion of the Vienna metropolitan area into the Lower Austrian periphery the tensions have somewhat eased and there is more cooperation between the states. Politically however the two remain foils to each other, with Vienna being overwhelmingly left wing, and Lower Austria highly conservative. Lower Austria now has the second largest population in Austria, in a large part due to the expansion of the Vienna metropolitan area.

[37] (city-map.at, 2021)

[38] (Renner, 2018)

[39] (Wien Gesichte Wiki, 2021)

[40] (Renner, 2018)

Despite the two states tenuous relations, the administrative capital remained in Vienna, however ever since the split of the states there was debate whether to establish a new capital. In 1986 a vote was held on both whether to create a separate capital for Lower Austria and which city should become the new capital. 56% of voters said yes to the creation of a separate state capital and St. Pölten easily won out of the proposed cities with 44% with Krems following at 29%. The move to St. Pölten was carried out in the following decades and completed in 1997.[41]

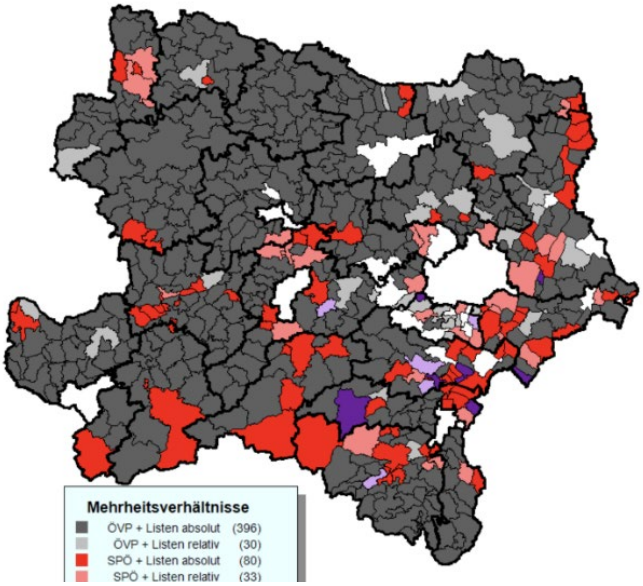


Figure 8: Map of Lower Austria showing political party in control per Gemeinde. Source: NOE Landersregierung

Lower Austria, like all other states in Austria is controlled by of a state parliament (Landtag) and a Landesregierung (State government). The state parliament is composed of 56 seats with members elected for every 5 years, there are no term limits for term limits for either parliament members or the state governor.[42] The state parliament has for decades been controlled by the conservative ÖVP, the SPÖ however controls significant areas especially in the surroundings of Vienna, as well as most significant urban areas. In the 2020 election the ÖVP garnered 52.7% of the vote, the SPÖ 27.8 with all other parties receiving less than 10%.[43]

The transport policy of the state is heavily influenced by the long-term control of the ÖVP, and the lack of term limits meant that certain individuals were able to set policy for decades. Particularly influential was Dr. Erwin Proll who served between 1981 and 1992 as Deputy Governor and then as governor until 2017.[44] His influence was instrumental in shaping the transport policies from the 1970s to the present day, and the entire branch line closure process happened under his leadership. The historical tension between Vienna and Lower Austria plays a further role in the state rail and public transport policy. While the primarily motivations of the ÖVP, as other conservative parties are on principle to reduce government expenditure, the distaste for the railways can also been seen to stem from the fact that they were viewed as asset of the left, and therefore Vienna. Indeed, the railways were a historically left organization as a bastion of organized labor, and the management of the railways up until the late 1990's had come exclusively from the left. While it is difficult to judge exact political motives, these subjective factors cannot be separated from the discussion of Austrian branch line problem, nor the future of rail transport in Lower Austria.

[41] (noe ORF.at, 2016)

[42] (NÖ Landtag)

[43] (NÖ Landesregierung, 2020)

[44] (Amt der NÖ Landesregierung, Pressedienst, 2021)

5 Historical analysis

This chapter will provide a background on the development of the railways in Austria and specifically the branch line railway network in Lower Austria. The chapter will provide context for further exploration of the specific case study.

5.1 Early history of railways in Austria

Austria was one of the pioneers of railway construction and the railways have continued to play an important role in the country's development up to the present day. The railway era in Austria began in 1837 with the opening of the first 13 km segment of the Kaiser-Ferdinand Nordbahn between Deutsche Wagram and Florisdorf near Vienna. From then on railway development continued at a rapid pace with lines radiating in all directions out of Vienna to the far reaches of the Habsburg empire. In 1853 a Europewide milestone was reached in Austria with the completion of the Semmering Railway, the first adhesion mountain railway in Europe. With these advances in railway engineering and vehicle technology railways were able to spread to the most mountainous regions of the country.[45]

The railways changed the fundamental organization of the socio-economic landscape. Prior to the invention of the railway the only modes of transport available were those powered by the force of nature. Important cities were typically only found along navigable waterways or the sea as these presented the only opportunity for trade that was not constricted by the volumes that a horse could transport at slow speeds. With the advent of the steam locomotive, trade and movement of people were no longer constricted by the geography of rivers or the biological strength of animals. Heavy volumes of cargo could be transported nearly as efficiently over land as water and passengers could travel at speeds far surpassing what was possible with natural forces.

This started a trend that continues today in where wealth is determined by access to fast transport modes. Today that is considered to be highways and even more so now the internet, but in the 1800s the relevance of a place was determined by whether it received a railway connection. Towns lobbied the State railway company to build a station in their town and there was often fierce competition and political maneuvering as to which towns the line would serve. Towns the railway lines bypassed struggled for their existence as people and jobs moved to the well-connected towns along the main railway lines.

The construction of the mainline railways in Austria was carried out by the state railway company, the kkStB, (kaiserlich-königlichen Staatsbahnen) and the entities primary goals were to serve the strategic needs to the Austrian empire. Namely facilitating goods traffic along important trade routes, connecting major cities, and providing a strategic network on which to move troops in the case of war or need to suppress dissent in the far corners of the empire. Therefore, the needs of smaller towns and less important economic regions were not a primary concern for the state railway company. Towns located in geographically difficult to reach locations and not on a major trade route were particularly vulnerable to being left unserved, and thus becoming irrelevant.

In response to this, Lokalbahnen or local railways started to emerge across the country in areas that had been passed over by the mainline railways. These railways were generally constructed to lighter standards and for lower speeds, sometimes even with a track gauge smaller than the standard 1435 millimeters, particularly in mountainous regions. These railways helped communities bypassed by the main lines stay competitive as well as provided important feeder traffic to the mainlines. Institutionally the railways were generally setup as private companies outside of the kkStB, either owned by private enterprises or the local government. In the flatter region of the country a network of local railways

[45] (Wien Gesichte Wiki, 2021)

spread out like spiderwebs connecting the small towns of the regions. The construction of the railway network continued up to the outbreak of WWI, indeed at this point there were still numerous further lines planned. By this time the mainlines had all been built, these new lines would primarily have been "Stitchbahnen" which were short lines that served to better connect a town center with a mainline on the outskirts of a town. Additionally, it was planned to connect several dead-end branch lines to form new through routes.[46]

However, with Austro-Hungary's defeat in WWI, the situation for construction of new railways dramatically changed. The imperial railways were reorganized into a state-run organization, which from 1923 carried the name Österreichische Bundesbahn (BBÖ), was now only concerned with transport within the newly formed borders versus over a sprawling empire. Austria struggled to transform one of the largest territories in Europe to a small landlocked state with limited natural resources. The new nation had hardly the capital to operate the existing system let along build new lines. The immediate postwar years were plagued with coal shortages and even important lines like the Vienna Stadtbahn were unable to operate.[47] In addition to the financial and resource crisis, advancements in internal combustion engine technology and its application to road vehicles stunted further development of local railways. One of the last lines to be constructed was the 26 km extension from Ruprechtshofen to Gresten to an existing 760mm line in Lower Austria.[48]

5.2 A history of railway line closures in Lower Austria

The Austrian railway network reached its peak length in approximately 1930 from which time the network has contracted except for the new high-performance lines built in modern day. This segment will explore in more detail the closure of railway lines in Lower Austria in the second half of the 20th century and 21st century interwoven with the overall development of the transportation system of Austria. This includes both complete line closures as well as lines where regular passenger traffic has been withdrawn with the line remaining open for freight and tourist traffic. Not included in this analysis are lines that were operated exclusively as freight railways from the start, such as those belonging to industrial concerns or "Schleppbahnen" which served large industrial parks. Information for the tables in this segment was compiled primarily from the papers "Haben Nebenbahnen noch Zukunft?" (Part 1 and 2) by Walter Brenner, „Die Auswirkungen vom Rückgang des Schienenverkehrs in Niederösterreich" by Ferdinand Proidl and the website of Johannes Strommer. [49]

The introduction of internal combustion buses and paved rural roads put the weaker branch lines in a tenuous position as they were unable to compete with the lower operating costs of buses which did not have to pay for their own infrastructure, nor expensive staffing of stations. The Kraftfahrliniengesetz (motorbus line regulation) was introduced in 1932 to regulate the operation of buses and included measures that were intended to protect the railways from competition. The railway companies were granted concessions to operate bus lines in the sphere of influence of their lines to fulfill the following goals[50]:

- Provide feeders to the railway lines and expand their coverage
- Connect settlements not directly located on the railway
- Provide a replacement for uneconomical railway operations
- Protection of the railway's catchment area from competition from private bus operators.

[46] (Strommer, 2020)

[47] (Wien Gesichte Wiki, 2021)

[48] (Strommer, 2020)

[49] (Haben Nebenbahnen noch Zukunft? (Teil 1), 2016) (Proidl, 2018) (Strommer, 2020)

[50] (Csizmadia, 2000)

In 1931 the ÖBB began its foray into the bus market with the purchase of the existing Lastwagen und Omnibus-Betriebs-GmbH (LOBEG), an operator of bus transport in the Vienna suburban area which was subsequently reorganized as the Kraftwagenbetriebs der Österreichischen Bundesbahnen (KÖB). The company began services in the periphery of the railway area and by the early 1930s already had 600 buses in service.[51] The railways often instituted parallel bus lines in order to fulfill these concessions and prevent other bus operators from opening parallel routes. While these routes began as protection measures for the railways, on many branch lines they emerged as competitors themselves.[52]

Some closures or withdrawal of passenger services occurred as early as the 1930s such as the Lokalbahn Neukirchen - Willendorf or the short 5 KM line to Orth an Donau.[53] In the case of these early closures, buses were generally able to equally fulfill the feeder roles of these short railway lines. The closures would not have a significant impact on the railway system compared to the changes that would occur in the post WWII era. In the interwar era the following lines in Lower Austria were closed:

Table 1: Lines closed between 1930 and 1944.[54]

Segment	**KM**	**Withdrawal Passenger service /Abandonment**	**Notes**
Novosedly (CZ)-Wildendürnbach	4	1930	Closed and removed due to low traffic after division of Austro Hungary
Mödling - Hinterbrühl	4.5	1932	Electric interurban line, closed due to parallel bus service
Felixdorf - Tattendorf	10.9	1932	Passenger service withdrawn 1932, segment Blumau to Tattendorf abandoned. Rest still in use as Anschlussbahn
Sollenau - Steinabrückl	6.7	1937	
Breitstetten – Orth a. d. D.	5.7	1937	Freight service until 1998
Sum	**31.8**		

The German Anschluss and the outbreak of WWII initially brought additional traffic to the rails. Several freight only lines briefly had passenger traffic during Anschluss period exclusively for commuter traffic to important war time production factories.[55]

The annexation by the Third Reich brought to Austria the new transport system of the autobahn. As with the railways before, the new fast transportation system was used to secure power over large areas. Additionally, the system was conceived as a massive jobs project to boost the employment rates of the Reich, though in reality much work was quickly taken over by mechanized equipment. Though by the end of the war relatively little of the planned Reichsautobahn network within Austria had been completed, the Nazi planners laid out the framework of what would become Austria's autobahn network. Simultaneously the Nazi's helped develop the automobile industry as a source of economic development. Automobiles were intended as a short-term consumer good which the people would seek after, promoting economic growth. The laws regarding the built form of the city were even

[51] (ÖBB-Postbus GmbH, 2007)

[52] (Csizmadia, 2000), (RIS, 1931)

[53] (Fotoklub Probsdorf, 2020)

[54] Sources: (Haben Nebenbahnen noch Zukunft? (Teil 1), 2016), line lengths from Wikipedia

[55] (Haben Nebenbahnen noch Zukunft? (Teil 1), 2016)

changed to accommodate the automobile with the introduction of the "Reichsgarageordnung" which introduced the now well-known concept of parking minimums in Austria.[56] These developments would be further manifested in the mass motorization era following the war.

5.3 Postwar development in the era of mass motorization

Following WWII there were numerous changes resulting from the erection of the Iron Curtain which divided the capitalist and communist spheres of influence in Europe. Suddenly historically important connections to Czechoslovakia, Hungary and Yugoslavia disappeared. The new borders blocked the flow of passengers almost entirely and restricted trade from all countries bordering Lower Austria. Many secondary cross border lines were closed due to the expense of border controls compared to the relatively low traffic volumes. The remaining segments before the border were vulnerable to further closure as often, they lost their primary traffic sources and ended in rural areas near the border.

Table 2: Postwar line abandonments in Lower Austria between 1945 and 1959.[57]

Segment	KM	Withdrawal Passenger service /Abandonment	Notes
Fratres – Slavonice	5	1948	Abandoned due to erection of Iron Curtain, partially removed.
Wolfsthal-Slovakian border	4.6	1945	Pressburgerbahn electric interurban, abandoned due to erection or iron curtain. Track removed 1959
Fischamend-Götzendorf	24	1951	Passenger service ended in 1951, line remains in service for freight.
Bruck a. d. Leitha – Petronell	14.2	1952	Passenger service withdrawn 1952. Partially still in service for freight
Liesing (Wien)-Waldmühle-Kaltenleutgeben	6.7	1952	1952 passenger service withdrawn, Waldmuehle to Kaltenleutgeben abandoned, rest still retained for freight and now touristic use.
Sum	**54.5**		

Unlike after the first world war, Austria saw an economic resurgence following the end of WWII. The immediate postwar era was characterized by a war-torn economy and famine due to the destroyed industry and labor shortage in the agriculture industry. However, with the introduction of the Marshall plan in 1947 the economy quickly rebounded. The Marshall Plan was a US program to revive the economy of western European countries, with the hidden aim of hindering the spread of communism further westwards.

By this time the US was well advanced in its transformation into an auto oriented society. Naturally, with the heavy American influence on Austria and Europe in general began to follow the same trend. Between 1950 and 1960 the motorization rate increased by more than 700%, a rate that would be quickly overtaken in the following decades. The increase in motorization naturally meant that many trips were now being made by car versus by public transport or non-motorized modes. From 1973 to 1981 the share of work commutes made by car rose drastically from 36 to 50%.[58]

[56] (Knoflacher, 2009)

[57] Sources: (Haben Nebenbahnen noch Zukunft? (Teil 1), 2016), line lengths from Wikipedia

[58] (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

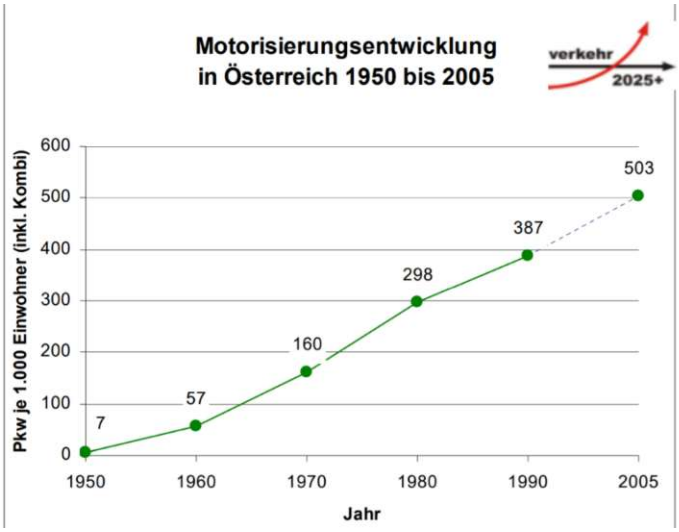


Figure 9: Growth in motorization rate in Austrian from 1950-2005. Source: (BMVIT, 2009)

As during the NS regime, the construction of autobahns was considered a vehicle for economic growth and employment. In 1952 Austria was in the midst of an economic crisis with a stagnant economy and high unemployment, caused by then Chancellor Julius Raab's austerity policies intended to reduce nation debt.[59] The crisis reached its height in January 1953 with unemployment levels between 280,000 and 300,000 people.

The decision to restart autobahn construction, which had been stopped approximately in 1942 as the war turned against the Nazis, was made by finance minister ÖVP (Austria Peoples Party) Dr. Reinhard Kamitz. Kamitz was a staunch defender of NS economic policies until the end and lobbied hard for the construction of new autobahns.[60] This was strongly opposed by the SPÖ, however in 1954 the construction of new autobahns was incorporated into the Bundestrassegesetz, the law regulating federal roads with initially only a route from Vienna to Salzburg planned.

The autobahns were funded as part of the "Austrian Investment program". Three billion schillings, or approximately 110 million Euros were allocated for the construction of autobahns over the next 5 years.[61] Subsequent amendments designated hundreds of further kilometers to be built. The era from the 1950's to the mid-1980s became known as the autobahn Euphoria as the network expanded at a rapid pace with little care to the costs or further implications.[62] In the decade from 1954 to 1964 there was an explosion in autobahn construction with the total kilometers rising from 317 in 1954 to 1,780 in 1964.[63]

The autobahns were not only expensive to construct, but their use also came at a direct loss of the state railway system. Freight in particular flowed rapidly to the road due to the low cost of trucks that paid nothing for the use of their infrastructure. The Austrian government with the construction of the autobahns was destroying its own railway network, often to the benefit of private industry.

Unlike the railway, the autobahns in their original form recouped none of their investment as they were free to use for all users. The primary beneficiaries were the automobile manufacturing companies, constructions firms and private freight haulers at the expense of the Austrian taxpayer.

In the 1960s worldwide the automobile was seen as the future, and funding for roadways vastly outstripped that for rail and public transport. As shown Figure 10 between 1964 and 1984 250 billion Austrian schillings (Approximately 16.4 billion euros)[64] were invested in road construction, meanwhile only a fifth of the money was invested in the modernization of the railways.[65]

[59] (ASFINAG, 2012)

[60] Ibid.

[61] (Kreuzer, 2007)

[62] (ASFINAG, 2012)

[63] (ASFINAG, 2012)

[64] 1989 value, conversion by https://fxtop.com/en/historical-currency-converter.

[65] (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

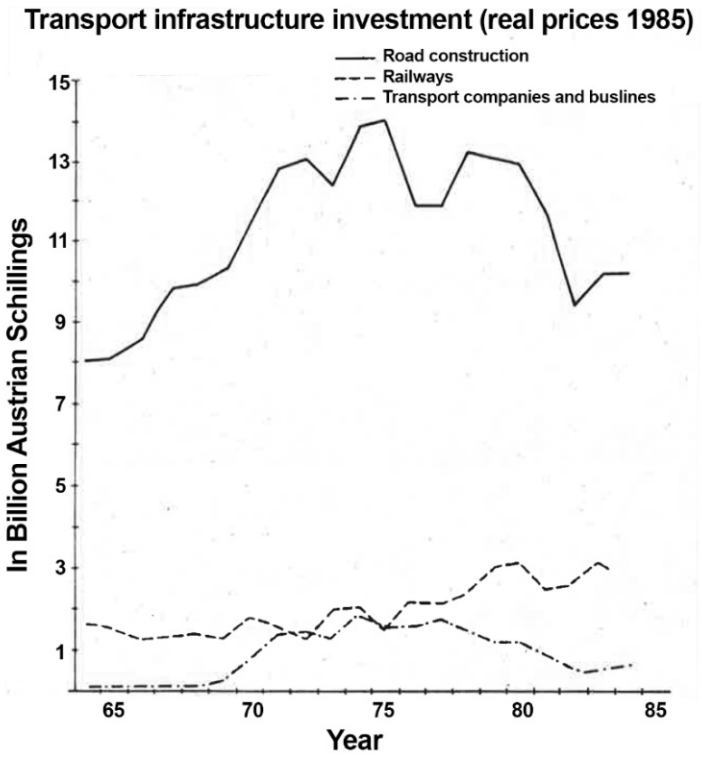


Figure 10: Investment in transport infrastructure construction by the Federal government, states and municipalities. 1964-1984. Source: (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

It was not just the automobile that was a problem but also the bus. The operation of bus services in the new Austrian republic was regulated by the Kraftfahrliniengesetz of 1952. Like most laws, the Kraftfahrliniengesetz was based on the pre-Anschluss laws and gave railways the same rights to operate buses in their sphere of influence. Following the war, the railways bus subsidiary was reestablished as the ÖBB KWD (Kraftwagendienst or Motor wagon service).[66] With the improving quality of roads and a railway network that was worn down by war use, the ÖBB often found it cheaper to implement parallel rail replacement bus services on branch line routes. The ÖBBs own buses soon became one of the railways biggest competitors in rural regions.

In the postwar years, the ÖBB began to lose massive amounts of both freight and passenger traffic to the roads. While there was significant investment into mainline routes with a push towards full electrification, in many parts of the country the branch lines were forgotten and viewed as obsolete. The first discussions of the so called “branch line problem” appeared in the industry press in the middle 1960’s and various studies were conducted on the viability of individual branch lines.[67] The railways due to the lower budget and many modernization needs completely halted investment other than regular maintenance in the branch line network from 1968 onwards.[68] With this investment stop, and the increasing investment in road traffic the branch line railways became viewed by the public as old fashioned and outmoded. The branch line network composed of 30% of the entire network and as such the negative connotations of branch line rail services spread to that of the entire ÖBB, leading many to abandon the railway altogether.[69]

The effects up till the 1980s however in terms of line abandonments was relatively minimal, only lines with very low traffic were closed, however the loss of traffic combined with high upkeep expenses

[66] (ÖBB-Postbus GmbH, 2007)

[67] (Zellhofer, 2018)

[68] (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

[69] Ibid

were leading the railways towards a financial disaster. Between 1960 and 1985 the following lines were closed in Lower Austria:

Table 3: Withdrawal of passenger services between 1960 and 1985.

Segment	KM	Withdrawal Passenger service /Abandonment	Notes
Lokalbahn Payerbach-Reichenau /Rax	6.1	1963	Freight operation until the 1980s, now museum railway. Last segment to Raxseil cable car base station removed.
Enzersdorf bei Staatz–Poysdorf	9.1	1977	Track removed shortly after closure.
Thayatalbahn (Gilgenberg - Fratres)	4	1977	Now bike path
Götzendorf – Mannersdorf	5	1982	Freight traffic
Sum	**24**		

By the mid-1980s the railways were in a terrible financial state. The branch lines were in a death spiral and closure seemed all but inevitable for many lines. A combination of factors faced the local railways.

Most importantly was the mass motorization that had overtaken the country, rural railways were especially vulnerable as traditional rail schedules provided limited time-based availability compared to the constant availability of autos. The introduction of autos also shifted traditional commuting patterns which were often linked to rail connections. With the suburbanization of the country, working places became more widely spread out, making effective public transport coverage difficult.

Industries also shifted their freight traffic to trucks which offered cheaper and more flexible service. This loss of freight traffic was particularly damaging as the freight traffic often cross subsidized the loss-making passenger operations on many branch lines.

As a state-run organization, the railways were historically seen as an employment program, as such there was little motivation to employ labor saving technology. Most stations even on lightly trafficked lines were still staffed by an operator responsible for operation of the signals and switches, as well as issuing tickets, in some cases station even had separate signal tower and road crossing gate operators.

Trains generally operated with both a conductor and locomotive driver. In addition to the personnel issues, the vehicles and infrastructure were outdated and often in poor state of repair. The branch lines were almost entirely unelectrified in Lower Austria and trains were operated either with locomotive hauled stock or old railcars. Locomotive hauled trains normally consisted of rebuilt prewar era 4 axle wagons known as Spantenwagen. These cars were rebuilt from the so called Donnerbüchse (Thunderboxes) wagons, which were named for their poor riding quality and noise. Locomotives were typically class 2050 or 2043/2143 class diesels which were multipurpose high horsepower diesels that were overpowered for the task. Railcars were a more attractive option for low traffic lines but at this point the stock of the ÖBB consisted of largely outdated vehicles, with some dating back to the 1930s and the newest from the late 1950s.

Infrastructure maintenance was deferred which led to lines having many slow orders (Langsamfahrstellen). This created a vicious cycle in where declining infrastructure conditions led to lower speeds and a declining attractiveness of the line for passengers.

The KWD's parallel bus service however in many cases saw increased frequency, lower prices and more modern vehicles. The buses usually drove directly in the town and village centers, thereby making them

more attractive to the often further away railway stations. Furthermore, the buses often operated directly to the main commuter destination whereas changes from branch line to mainline trains were generally required and often not well timed.[70] The competition between the two services was intentionally done to as the railways saw it easier to close the lines than try to face the complicated labor and equipment issues required to keep the branch lines viable.

In 1986 the railways presented the new planning concept “Die Neues Bahn” or “The New Railway”. The plan was based on a study by the American consulting firm A.D. Little and presented a plan based on that of the West German Deutsche Bahn. The plan called for the Westbahn and Südbahn to be converted into high-speed lines with establishment of an Intercity/Interregio network between major cities. The provision of regional traffic was to be potentially shifted to buses. The plan further stated for the railways to achieve profitability and to finance the construction of the high-speed lines, unprofitable branch lines and secondary routes must be closed.[71]

5.4 Nebenbahnverordnung of 1987

The plans for achieving the goals of the New Railway concept were further advanced with 1987 amendment to the Eisenbahngesetz, the “Nebenbahnverordnung” (Branch line Railway Act). The act set a time limit on the public service obligations of the federal state for many loss-making local railways owned by the ÖBB throughout Austria but with a particular concentration in Lower Austria. The act set out three timelines for the end of public subsidies for branch line operations. Most lines were given until 2001, while less profitable ones until 1991. Several lines however, the termination of service had already been decided and the end of public service obligation was set for 1988. The plan aimed to reduce the network by 35% from around 5600km in 1987 to 3650 km in 2002.

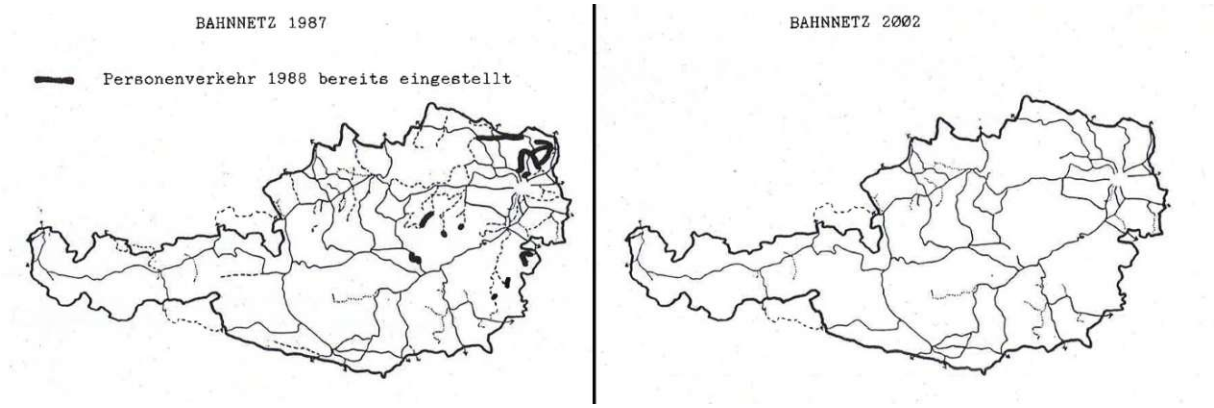


Figure 11: Planned reduction of the Austrian railway network based on the "Neues Bahn" plan.

Source: (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

The plan foresaw the retreat of the railway from vast swaths of the country railway network, including even the capital of the state of Burgenland.[72]

The law was composed of 5 subsections. The first three subsections listed the lines that were considered unprofitable, with relevant figures. For some lines it was proposed to discontinue service completely, and for others either passenger or freight traffic. For these lines three deadlines for the end of public subsidies were given, 2001, 1991 and 1988. The following table shows the breakdown of

[70] (Csizmadia, 2000)

[71] (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

[72] Ibid

route kilometers into the 3 deadline categories. The full table of line segments to be closed with relevant statistics can be found in Annex 5.4.

Table 4: Summary of route kilometers with relevant traffic statistics to be closed through the Nebenbahnverordnung. Source: (RIS, 1987)

§ 1. ÖBB must fulfill public service obligations until December 31, 2001.					
Transport of freight and passengers	**Passengers in 1000's**	**Freight in 1000 t**	**Length in kilometers**	**Losses per cost basis**	**Losses per invoices**
				In Million schillings	
a.) transport of freight and passengers					
Total	9,700	3,857	889	967	743
Total Lower Austria	6,117	3,263	511	533	399
b.) transport of passengers					
Total/Total Lower Austria	290	-	45	70.5	62.5
c.) *Transport of freight*					
Total	-	2,278	578	290	211
Total in Lower Austria	-	616	257	123	82
§ 2. ÖBB must fulfill public service obligations until December 31, 1991.					
a.) transport of freight and passengers					
Total	1,499	382	221	245	181
Total Lower Austria	806	72	108	110	87
b.) transport of passengers					
Total	907	-	286	193	152
Total Lower Austria	294	-	107	61	48
c.) transport of freight					
Total	56	68	43.3	36	56
Total Lower Austria	23	43	32.5	27.5	23

Subsection 3 of the law set out conditions for the continued operation of the loss-making lines. The operations were in principle to be carried out as per the status quo. Services could be reduced if there was a reduction in demand and no increase in volumes could be expected. However, it provided little room for the expansion of services, requiring the service expansion to offset by an increase in volume of the same amount (passenger kilometers or ton kilometers). Subsection 4 set out the conditions under which ÖBB could close branch lines listed before the planned dates: If traffic volumes decline permanently and replacement traffic can be provided by other modes, or in regions where transport can be adequately fulfilled by other modes the ÖBB can apply for a discontinuance of service under Section 29 of the railway act. (See section 6.2). The final subsection, 5 listed the routes that were to be closed in conjunction with the approval of the act, with the discontinuance of public subsidies planned for December 31st, 1988. The routes to be immediately closed were primarily in Lower Austria and included most of the Weinviertel branch line network including the former Stammersdorf Lokalbahn in the outskirts of Vienna. A full list of routes that were planned to be closed in 1988 through the act is available in Annex 5.4.

The law was fully intended as a way for the railways to dispose of the unprofitable branch line network. The law made it on the other hand quite difficult for the railways to increase the attractivity of the

branch lines as train frequency could only be improved if there was already a demand. Naturally without a more attractive schedule, the demand will likely never come.[73]

5.4.1 Discussion of the Nebenbahnverordnung in the Lower Austrian parliament

The law prompted heated debate in the Lower Austrian parliament. The following is a condensed excerpt from the March 19th, 1987, meeting of the Lower Austrian parliament which has been provided to show the prevailing opinions of the time. The meeting is led by Erwin Pröll (ÖVP), the long serving Deputy Governor (Landeshauptmann) of Lower Austria, who presided over nearly the entire branch line closure era. Opinions are given by several members of the SPÖ and ÖVP, with the SPO strongly speaking out for the preservation of the branch line network. The ÖVP does not explicitly state at this point that the entire branch line network needs to be closed like in later years, but that significant reductions and transport reorganization is needed. Both parties are critical of how the ÖBB has managed the branch line network and lay much of the blame for the current situation on the railway. The chapter contains several excerpts from the arguments of parliament members on both sides in translated form and edited for relevance. These statements reflect the prevailing attitudes of the time.

The meeting is opened by Erwin Pröll who answers two primary questions; firstly what is the view of the state of Lower Austria on the Nebenbahnverordnung, and second what was the current state of the implementation of the transport association for the northern Weinviertel.

Pröll states that the view of the state government was that that the issue of branch line railways cannot be dealt with separately from the rest of the public transport system. Preservation of the railway system was not the issue at stake rather the preservation of public transport in an economical manner. Where the railway could not be economically operated replacement bus traffic should be implemented. At the same time investment should be made it to the remaining branch line railways so that they become more attractive for potential customers. These surviving branch lines should form the backbone for the local public transport in the region with other services oriented towards the rail line as feeders. The closure of branch lines should only be done with local negotiations to ensure that adequate replacement traffic can be set up with input from local authorities. More transport organizations (Verkehrsverbund) should be set up including the branch line railways where they are to remain. Discontinuance of rail passenger traffic should only be carried If there can be a significant improvement in the public transport system through replacement traffic and coordination through the transport associations.

The state in general is in favor of the preservation of rail infrastructure for freight transport as additional trucks bring higher road wear, higher costs for users and externalities for residents in surrounding areas. Goods that must begin the journey on a truck will rarely be reloaded on the rail, thus direct railway connections to industries must be preserved where possible.

The second important question for the governor was the implementation of the Weinviertel transport association. Pröll states that the implementation was planned for 1988 and was a key mitigation measure of the resolution of the branch line issue. He states that further transport associations were also under development for other parts of Lower Austria.

Pröll' s arguments while attempting to project a neutral view, indicate a reluctance to finance the money losing branch lines and view that replacement bus traffic is an acceptable condition for most cases. This would be the reality in the following years. The creation of the Transport Associations, while an improvement in the overall transport quality would be used as a cover for closing the railway lines now that the bus and rail tariffs were integrated. The implementation of transport associations could have had a far larger impact if it was coupled with a rehabilitation of the branch line network.

[73] (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

Mag. Edmund Freibauer, also a member of the ÖVP was more critical of the planned branch line closures and especially of how the ÖBB had handled the branch lines up to this point. Freibauer points out that while he is in agreeance with the Proll that regional approaches must be taken, that the issue was not solely the 11 branch lines to be closed in 1988 but indeed the entire Lower Austrian branch line network which the law authorizes for closure at a later date. Regarding the ÖBB's handling of the branch line network Freibauer states the following:

> *"1987 is the big anniversary year of the Austrian Federal Railways. 150 years of the railway are now being celebrated and, according to Federal Minister Streicher, it should be the year of death for the branch lines.*
>
> *The ÖBB has starved the branch lines for years and the railway cannot be released from its responsibility without further ado. We must keep asking the following questions to those responsible for the Federal Railways:*
>
> 1.) *Why has the ÖBB failed to modernize the branch lines?*
> 2.) *Why did the railway compete with and ruin the branch lines through parallel traffic through its own KWD subsidiary?*
> 3.) *Why is the railway so incredibly unfashionable and immobile in many areas?*
> 4.) *Why is the timetable and travel time on many routes worse than in times of the monarchy?*
> 5.) *Why do the timetables often not match the changed operating times of the companies and the lesson times of the schools?*
> 6.) *Why are connections from train to train and from bus to train not aligned in many cases?*
> 7.) *Why are there no computers for scheduling?*
> 8.) *Why is freight transport with express cargo handling so cumbersome, bureaucratic and extremely expensive?*
> 9.) *Why is there no overall traffic concept with a corresponding value for the branch lines in passenger and freight traffic?*
> 10.) *Why has there been an investment halt in the branch lines for 20 years?*
>
> *The federal railways starved the branch lines and today it is no longer possible to determine whether there is actually no need for them or whether potential customers in passenger and freight traffic are only missing because the branch lines are deliberately run in an unattractive manner. There has been an undisputed halt to investment on the branch lines for 20 years. The trains, the timetables, the travel times are catastrophic. Nevertheless, we believe that the solution of the branch line question does not have to be in the form of a pure closure concept, but investments in promising parts of the branch line network can create new opportunities for the branch lines, partly in passenger traffic and especially in freight traffic.*
>
> *Transport associations are not a substitute for the branch lines but is certainly an important instrument for avoiding parallel traffic between the railway, the KWD of the railway and other buses.*

Freibauer lists a set of demands for the Federal government regarding the railways in Lower Austria. These demands included the following:

- Modernization and electrification of secondary manliness into Vienna that were important for commuter traffic.
- Modernization of all railway lines around St. Pölten in preparation for the move of the Lower Austrian capital. Additionally, bus traffic should be reoriented towards the new capital
  - Accelerate expansion of the park and ride system in Lower Austria to shift traffic from road to rail
  - Establish a northern Weinviertel tariff zone as a precondition to approval of the Nebenbahnverordnung (the Weinviertel would be the most heavily impacted by the act

with most of its railways scheduled to be closed already in 1988). Additionally, the development of further tariff zones around other Lower Austrian regional centers.

- No discontinuance of branch lines until regional agreements for appropriate replacement traffic for passenger and freight transport have been reached. Freibauer notes that even then 4.4 million journeys per year were made by rail just in the sparsely populated northern Weinviertel, so the task of setting up replacement traffic was not trivial. Routes that remain open should be modernized and electrified to become attractive for passengers.

Most of the demands from Freibauer for the improvement of commuter traffic towards Vienna and St. Pölten would be met. Almost all mainlines into Vienna are now electrified and most lines into St. Pölten have received some degree of modernization and the Wieselbus system was set up specifically to serve the new capital. Freibauer accurately lists most of the problems plaguing the branch line railways and places the blame for the most part rightly on the ÖBB for the present situation. On face level his comments present an optimistic approach that the issues with the branch lines can be resolved through modernization and tariff improvements, however the policies of the ÖVP over the next decades would instead choose the simpler and in the short term more cost-effective solution of the near complete closure of the branch line network.

The SPÖ at the time was still very much a labor party and voiced complete opposition to the measures, as well as skepticism for the solutions proposed by the ÖVP. Representative Karl Gruber is the first to speak on the behalf of the SPO and states that the party considers that the Nebenbahnverordnung is only a proposal and does not need to be accepted at all. In the view of the SPÖ the ÖVP was rushing into agreement that the closure of the branch lines was a foregone conclusion that needed to be mitigated and not outright rejected. Gruber states that the delayed establishment of the Weinviertel transport association should be completed before any negotiations on the branch line closures take place as the implantation of the tariff association should include new strategies for the revitalization of the Weinviertel branch lines. Grubers testimony states that even then the environmental benefits of the railway were well known, and that precedents already existed at this point for the development of attractive local railways. Citing how other states such as Styria have been able to maintain attractive branch line routes thanks to the railways never being incorporated into the ÖBB. Gruber states the false economy of cutting branch line routes without considering environmental externalities, and that the government pays far more to subsidize road traffic:

> *. The economy pays 60 billion schillings a year for all car traffic alone. The deficit of the railway is a maximum of 5 billion schillings. There are constant warnings against the death of forests due to acid rain (Waldsterben) The scientists warn the politicians to take quick measures, to take action, because this forest decline is progressing rapidly. This state of affairs must be stopped. Shifting freight traffic to heavy trucks would be a scandal against the environment and a reduction in the quality of life of the population. Loads that are stolen from the rails never come back onto the rails. The noise pollution and the pollutant emissions from the additional truck fleet must also be included in the public service calculation.*

In response to Gruber, Edgar Schoeber of the ÖVP replied stating the railways were of secondary importance to the complete transport concept and the finances of the state. Schoeber states that Gruber is painting the issue solely as a political black vs red issue, and that the ÖVP is just as interested in finding a proper solution to the issue. Schoeber states that indeed the same discussions with fierce debates occurred in 1968, but however since an overall solution was then not found, the problems have been further postponed today, it would instead be better to find a long-term solution rather than trying to continue the status quo. In the following quote Schoeber makes it clear that economic factors should play the primary role in the decision of how to develop the overall transport solution:

I see the problem as follows: I am not in favor of the "closure" solution and agree that there are other factors beyond the economic aspects are decisive for the management of railway lines. I state that here in principle. But, of course, economic efficiency and the economic aspect are also justified, and when one speaks of responsibility here, then that also applies to public funds. How does it say in the Constitution? Economy, economy, practicality! Well, we cannot completely ignore that, and that must also be a point to be dealt with in connection with this question. And it's also very clear that the branch line issue cannot be resolved separately as a branch line issue but can be seen in the entire transport network and in the overall traffic situation.

The railway for a long time was the only transport mode for the region, and as such they became complacent, and did not orient themselves towards customer needs. Now that there are alternatives the customers are leaving, but the railways have not changed their strategy. In the current atmosphere it is hard for the railways to win any new customers. A large timber company in Randegg proposed a new sawmill that would produce 35-50 new jobs, but because there was no concrete plan for the future of the Obergradendorf-Gresten railway, they could not risk such an investment in the case the railway is then closed.

Therefore, I believe further pushing the issue down the road and maintaining the status quo is not an appropriate solution, as the uncertainty will cost even more customers. I therefore see it as a very important task for the railways to win new customers, to make the railways more attractive, and that that would perhaps also be a point that the future some branch would no longer need to be questioned. In summary, I conclude that we are not the ones who say, close or not to close, but that we want to see this from the point of view of economic efficiency. The focus should be on an inexpensive solution for the customer - population, region, and economy. And that is why we will not ignore sensible solutions in terms of price."

Finally, before the conclusion of discussions on the topic Ferdinand Icha of SPÖ spoke about the negatives of the park & Ride expansion proposed by the ÖVP. The Park and Ride's, while bringing traffic to the mainline would be poised to rob the branch lines of their remaining customers. Icha states the following:

There has been a gigantic social change in the last twenty or thirty years. One must be able to speak openly about it. Millions of people have bought a car, and not just so that they have it at home, but rather so that they can drive these cars. And when I talk about our regional railway again: in Stetten, in Harmannsdorf or further out in Rußbach, people have 1.5 or 2 km to the train station and then a train stops there three or four times a day. Even if a train stops there fifteen times a day, you will get into your car, drive into Korneuburg at best and get on the express train there, because we have set up a "park and ride" area there. Our state railways will find it very difficult to cope with this problem in passenger transport.

We also fully agree that freight traffic must be preserved. We do not want that every barrel that comes in from Ernstbrunn goes through our main square. We do not want freight transport in all places to move by road because that is simply impossible from the environmental point of view and from the point of view of safety. There has been a rethink here in the last ten years. For twenty years private transport was everything, the car was everything, and only since the early 1970s has there been a rethink that the car is no longer everything. We put things up for discussion against which the automobile lobby immediately protest. But we think that the time is right now to invest more in public transport, to find the right combination."

Figure 12:Poster advertising the replacement of the Schweinbarther Kreuz rail service with buses. Source: VOR, Matthias Michaelis

Throughout the meeting the ÖVP repeatedly made the claim that they were in favor of an overall transport solution rather than a specifically railway one. While the overall sentiment is accurate in that the transport network must be treated as a whole, in reality it meant they favored replacement of most lines with buses rather than investment in revitalization of the railway. Today the same ideas are still sold as "improvements" when railway lines are replaced by lower capacity buses which are prone to being stuck in traffic. Figure 13 shows posters hung at stops on the Schweinbarther Kreuz railways just before the termination of railway service in 2019. The poster tout's improvements to service hours with more early and late connections, central locations of the bus stops, a new central transfer point in Raggendorf, and most astoundingly that buses new diesel buses would provide a reduction in emissions. The claims here range from somewhat from dubious to complete falsehoods. Additional courses could have been implemented on the railway as well, the new "central" transfer point in Raggendorf is in fact directly adjacent to the former train station. The last point is particularly egregious in comparing the emissions from the already 30-year-old Class 5047 railcars with new buses. Such false comparisons between a neglected rail service and a new bus service aim to hide the true intent of the change, which is financial. While the new bus offer may indeed be more attractive than the neglected rail service, it presents a false choice. The retention and improvement of the railway in combination with better connections with the bus networks could have brought the same and most likely more improvements.

Icha of the SPÖ correctly points out that the park and ride initiative was further undermining the branch line railways. With the Schweinbarther Kreuz this was the case as well. The Schweinbarther Kreuz ended at Obersdorf where the line met the Laaer Ostbahn where passengers could change to regional and S-Bahn trains towards Vienna. However, at this station there was also a large park and ride lot. The provision of these park and ride lots at directly took passengers away from the branch lines. When given a choice between a neglected slow branch line and faster roads the result is hardly surprising in highly motorized regions.

Both the SPÖ and the ÖVP seemed in agreement that the railways should at least be preserved for freight traffic, but this went against the current trends in the rail freight industry. Freight traffic on most of these branch lines was minimal and with the introduction of cheap trucking had been in freefall decline. The branch line freight operations were labor intensive, requiring powerful diesel locomotives that sometimes would be used to transport only a handful of freight wagons to the remaining customers. Labor costs were also high as these local collector trains often required a crew of up to 3 people to handle all the shunting enroute. On many lines, particularly in the flatlands of the Weinviertel and Waldviertel, freight traffic was almost entirely seasonal and dependent on the grain harvest or beet harvest, with almost no other significant customers.

The railways across Europe indeed desired to reduce single wagon freight traffic and downsize the costly infrastructure such as a shunting yard needed for this traffic. In Germany even the individual track switches were a target, and during the MORA C rationalization plan of the 1990s the Deutsche Bahn removed thousands of customer switches which did not meet the cutoff for minimum

carloadings.[74] Unlike passenger traffic, freight at this time received little to no subsidies, and without passenger traffic it was difficult to justify track maintenance on these branch lines in absence of a major freight customer. Even today rail freight sees minimal operating subsidies in Europe outside of Switzerland, however some programs have been developed to fund connecting tracks and container terminals.

At the same time the intermodal freight transport revolution kicked off in earnest. The ISO container was becoming the loading unit of choice for freight transport due to its ability to be handled on multiple transport modes, and the railways saw this as a way of reaching both reach customers away from the railway lines as well as an alternative to costly branch line freight operation. In Austria combined transport started as early as 1980 with the opening of the Salzburg Liefering container terminal.[75] Railways tried to market their combined transport services to customers as alternative to direct service via the branch lines, however as correctly stated by Gruber in his testimony that loads that are taken from the rails rarely return. If freight is moving within Austria or even to neighboring countries, there is often little incentive to reload it onto a train. Many customers who lost their direct railway sidings were left with a bad taste in their mouths and had no desire to return to the railways via combined transport.

In 1987 the Lower Austrian parliament was controlled by the ÖVP with 54,6% of the seats compared to the SPÖs 41,2%. Despite the heated discourse and opposition from the SPÖ the law was enacted in June 1987. The law sealed the fate of many local railways throughout Austria. With the passage of the law ÖBB now had a way out of the operation of unprofitable branch lines. With the withdrawal of public subsidies for the 11 listed lines, 1988 was a particular dark year for the branch lines in Austria. The year saw the withdrawal of passenger services from most lines in the Weinviertel. The following table summarizes the fate of the lines closed through the Nebenbahnverordnung

Table 5: Withdrawal of passenger service from 1986-1990

Segment	**KM**	**Withdrawal Passenger service**	**Notes**
Thayatalbahn (Waidhofen an der Thaya - Gilgenberg)	21	1986	Track removed, partially bike path
Zwettl - Martinsberg Gutenbrunn	36	1986	Up to Waldhausen still used by freight, Waldhausen – Martinsberg -Gutenbrunn removed 2014.
Gmund-Litschau (Waldviertelbahn)	25	1986	Freight traffic up to 2001, transferred to state of Lower Austria 2010 for touristic use
Alt Nagelberg – Heidenreichstei	13.2	1986	Freight traffic up to 1992, then taken over by private organization for tourist service
Dobermannsdorf–Poysdorf	20	1987	Track removed 2012
Stammersdorf Lokalbahn (Stammersdorf – Obersdorf)	12	1988	Track removed in 1995.
Ybbstalbahn Bergstrecke (Lunz Am See - Kienberg/Gaming)	16	1988	1990 reopened as museum railway
Pulkautalbahn (Zellerndorf–Sigmundsherberg)	20	1988	In service for freight until 1998. Potentially will be reactivated for museum use.
Markt St. Aegyd-Kernhof	5	1988	Partially converted to bike path

[74] (Schmidt, 2018)

[75] (CTE, 2011)

Korneuburg–Hohenau	80	1988	Freight and tourist traffic
Hohenruppersdorf–Dobermannsdorf	25	1988	Track removed; 4 km segment reactivated 2004 before closing again in 2010
Gaweinstal-Brünner-Straße–Mistelbach	12	1988	Partially in use for freight traffic
Sum	**285**		

The next deadline for the withdrawal of subsidies was reached in 1991, however the deadline for the closure of most of these lines was extended until 1994.[76] In 1991 no closures occurred as was originally planned.

5.5 The New Austrotakt

The original plan of the New Railway to create two high speed rail corridors was not fully implemented. The railways decided that instead of following the German model, it would instead look to the Swiss model of an integrated Taktfahrplan. The provision of an integrated Taktfahrplan ran directly against the idea of the Nebenbahnverordnung and the mass closure of branch lines, thus again there was hope for some of the more well used branch lines, particularly those originating from planned "Taktknoten".[77] In 1991 the NAT 91, or New Austrotakt schedule was unveiled. The schedule was the brainchild of the then director of the ÖBB Dr. Heinrich Übleis and was based on the Swiss Bahn 2000 project. Like the Swiss project the aim was a gradual implementation dependent on several infrastructure improvements.

The first phase of the plan was put in place with the 1991 timetable change and saw overnight a major increase in the service offer. Service intervals on most intercity lines were increased and many branch lines even saw improved connections to mainline services. It was foreseen that plan would be implemented in 4 states with the 2nd and 3rd to be completed between 1995 and 1997 and with full implementation by 2000.[78]

The implementation of the new Taktfahrplan was however problematic, due to the quick rollout insufficient preparation had been made and problems with punctuality threatened the well-functioning of the system. There was overall no consensus at the federal level like there was in Switzerland on the implementation of the plan nor its goals. The infrastructure measures proposed by the plan similarly did not correspond to the actual needs for a Taktfahrplan. For a Taktfahrplan the most important element is the reliability of the connection, line speed improvements should mainly be conducted when necessary to achieve the desired travel time on the segment. The following projects were listed as part of the NAT 91, but few of them had any major significance for the Taktfahrplan concept.[79]

- Reconstruction and quadruple tracking of 60% of the Westbahn.
- Construction of the Semmering Base tunnel
- Construction of Brenner Base tunnel
- Reconstruction of the Tauern Railway
- Reconstruction of the Phyrn Railway
- Establishment of Vienna central station
- Double tracking of the Arlbergbahn

[76] (RIS, 1991)

[77] (Die "Neue Bahn" in der region - rueckzug oder ausbau, 1989)

[78] (Oberegger, 2011)

[79] (Oberegger, 2011)

While the construction of a new central station in Vienna and reconstruction of the Westbahn were key component for the implementation of the timetable, the projects that would take up the most money were the two base tunnels which would have little impact on the plan, indeed the Taktfahrplan has today been implemented on the Südbahn between Vienna and Graz without the completion of the Semmering Base tunnel. Furthermore, if these projects were truly considered necessary for the implantation of the project, it would have been very optimistic to consider it possible to complete them in the timeframe projected for the full introduction of the NAT 2000.

The early 1990's brought in major changes to the European railway scene with the introduction of the EU Directive 91/440. The liberalization directives were intended to increase competition within the railway sector by opening infrastructure to private operators. To comply with these new EU regulations, in 1992 the Austrian government signed into law a new version of the Eisenbahngesetz. This new version of the law simultaneously repealed the Nebenbahnverordnung, and under the new law the provision of local passenger service was shifted to a public service obligation contract with the states ordering passenger traffic on each line.[80] The infrastructure however continued to be owned by the newly separated ÖBB Infrastructure and in many cases, conditions continued to deteriorate. The new law shifted ÖBB's company structure towards that of a private company, and there was again a renewed focus on profitability. In 1993 Übleis retired as director of the ÖBB and his successor, Dr. Herbert Draxler did not share his vision for the Taktfahrplan. The federal government's spending on the ÖBB had been steadily rising throughout the 1990's and the country was going through an economic recession. Draxler was therefore pushed to reduce the operating expenses of the ÖBB, and the NAT 91 services increases would be an early target. The NAT had achieved an impressive 7% passenger growth, however Draxler did not feel that this was worth the significant increase in expenses. In a 1993 interview Draxler specifically stated that the ÖBB did not consider it economically viable to maintain the new frequent intervals in more rural areas, by that meaning primarily the branch line routes.[81]

Thus in 1996, Austria's first experiment with a nationwide Taktfahrplan came to an end. The new timetable, known as the OPV 96 OPV 96 (Optimierter Personenverkehr/Optimized passenger transport) was a radical reversal of the NAT 91. The frequency of IC services on mainline routes were reduced, the timed connections were in many places broken due to the reduction of offer, and branch line connections were significantly reduced. The plan instead focused on improving speeds on a few core routes and improved frequencies around metropolitan areas.[82] While cost was ostensibly the reason for the cancellation of the NAT, at the same time the ÖBB was committing to new mega projects such as the 1995 announced Koralm base tunnel. The 30 km tunnel project is to link Graz and Klagenfurt with a new high-performance connection; however, it does not fall on any European axis, nor is it aligned with the major freight rail traffic flows. These projects proposed in the distant future increased modal share and faster connections, meanwhile the gains of the NAT, which had already successfully increased passenger volumes by 7% on the existing system was effectively discarded. Any savings from the discontinuance of the NAT were quickly lost in the massive infrastructure investments in base tunnels that were to follow.

[80] (Joos, 2010)

[81] (Oberegger, 2011)

[82] (Uttenthaler, 2005)

5.6 Renewed branchline closure discussions

While the network in Lower Austria managed to remain relatively intact throughout the 1990s, with no real significant line closures, cost cutting was again on the agenda as the turn of the century approached. In the mid-1990s the ÖBB introduced a new categorization system for their network, with lines falling into A, B, and C categories. The routes in the C-Network were exclusively branch lines, and by this time most of the C network was in Lower Austria. The lines in the C network were considered marginal by the ÖBB and though the Nebenbahnverordnung had been repealed, ÖBB still wished to dispose of these lines.

In May 2000, ÖBB director Draxler announced the companies plan to close 80% of the branch line network including all remaining narrow-gauge lines. The plan would see the ÖBB dispose of the entire C-Network nationwide amounting to 1700 km, or 30% of the rail network. Draxler stated the plan was in response to the governments demand for the railway to reduce costs by 9.1 billion schillings over the next 3 years. Per the ÖBB the branch line network cost 1.5 billion schillings per year, and the plan would see most routes replaced by buses, or service reduced. Where possible the ÖBB wished to transfer lines to the regional government or in the case of touristic use to tourist associations or private organizations for further development.[83]

As with the Nebenbahnverordnung in the 1980's, the proposal prompted fierce debates in both the national and Lower Austrian parliament. Even more pronounced than in the 1988 debates was the divided opinion of the ÖVP (joined by the FPÖ) and the SPÖ (joined by the Greens). The ÖVP argues that the C-network, while accounting for 28% of the total network, contributes only 1% to the total passenger kilometers and 1% of the net freight tons. Meanwhile the infrastructure costs for these lines are 1.2 billion schillings per year, (87 million euros) and passenger traffic requires an annual 500 million Schillings (36 million euros) per year of subsidy. In this regard the ÖVP speaker states he agrees with the ÖBB's position as these lines have less than a 10% cost returns. The ÖVP makes further accusation that the taxpayers are financing ghost trains without purpose to rural areas of the country and that in fact these trains are bad for the environment as well. Most prominently, the ÖVP accuses the SPÖ of directly being responsible for the current state of the railways due to the inflexibility of labor agreements.

The Greens and SPÖ argued similarly as they had in 1988 that the empty trains are a result of the failed policies of the railways to implement attractive schedules and introduce new rolling stock. The so-called ghost trains were the direct result of a long-standing lack of investment. Furthermore, that the railways were a vital part of mitigating the increasingly clear issue of climate change, and that attractive, locally based strategies should be implemented. The Greens correctly state that despite what the ÖVP stated about the energy usage of the "ghost trains" that the railways accounted for only 4% of total energy in transportation in Austria, with the road sector contributing 81%.[84]

While the ÖVP's position is hardly surprising based on history, important points are raised by ÖVP on the over-employment in some sectors of the ÖBB, he lists the specific example of manned grade crossings that due to labor agreements could not be automated. This indeed is a situation that persists on numerous local railway lines and a labor is a significant contributor to the operating costs. Historically as the ÖBB was a state-run enterprise, it was a politically sensitive issue to consider reducing the companies labor force and the company was viewed as a job creation service. With the

[83] (Lampl, 2000)

[84] (Nationalrat, 2000)

increased pressure for the company to operate as a profitable business the railway was in many areas completely unprepared to handle this labor issue.

While no nationwide solution had been found, the year 2001 saw several branch lines close. The sale of several more lines for operation by a private operator was also under preparation, including the sale of the Ybbstalbahn to the NÖVOG.[85] Under Draxler the railway cut 16,000 jobs systemwide, but Draxler himself was out of a job at the ÖBB in 2001. Ironically, he was ousted due to his oppositions to the division of ÖBB into several separate enterprises including the full privatization of the cargo segment. His branch line plan however likely won him little political support among affected areas and with the Green and SPÖ parties. Draxler, even after his departure was adamant in the need to close the branch line railways. When asked in a 2003 interview what his greatest failure at the ÖBB was, Draxler replied: "In my efforts to close branch lines, I failed because of local and regional politicians who believe that the world will collapse if one ghost train runs less. Ms. Forstinger (The Transportation Secretary at the time), too, apparently wants to keep the branch lines so as not to upset any mayors. This political benefit costs us two billion shillings a year in national wealth."[86]

To replace Draxler the ÖBB brought in Rüdiger vorm Walde from the BVG (Berlin Verkehrsbetriebe). Vorm Walde put on hold most of Draxler's plans for mass closures, and the ÖBB stated it would continue operations of the lines until regional solutions could be found.[87]

Regional negotiations between Lower Austria and the federal government were carried out in 2003 to ensure funding and continued operation of the Mariazeller, Ybbstal and Waldviertel narrow gauge lines. There was great hope that this would finally result in much needed investment in the lines, and there were even proposals to convert parts of the Mariazeller and Ybbstal line to standard gauge for better integration into the local transport offer.[88]

Most of the lines proposed to be closed in 1991 by the Nebenbahnverordnung outlived their expiration date and relatively few segments were closed in the 1990s and early 2000s. Between 1990 and 2009 traffic (passenger and in some cases freight) was withdrawn on the following lines in Lower Austria:

Table 6: Line closures in Lower Austria 1990-2009

Segment	KM	Withdrawal Passenger service	Notes
Wieselburg - Gresten	24	1992	Due to low capacity and high freight traffic volumes, line was closed to passenger traffic. Converted from 760mm to 1435mm in 1998, passenger traffic not resumed.
Gaweinstal Brünner Straße–Bad Pirawarth.	4	1995	Abandoned, track removed
Wittmansdorf -Wöllersdorf	6	1997	Former access to the Gutensteinerbahn from Vienna, obsolete with establishment of Wiener Neustadt Taktknoten. Track removed 2015
Gmund- Groß Gerungs (Waldviertelbahn)	43	2001	Incremental tourist traffic development, transferred to land of Lower Austria in 2010
Drösing–Zistersdorf	11	2001	In use for freight traffic

[85] (Nykodem, 2009)

[86] (Format, 2001)

[87] (Nykodem, 2009)

[88] (Nykodem, 2009)

Freiland–Türnitz	9	2001	Converted to bicycle path
Retz-Drosendorf	40	2001	Summer tourist traffic from 2002
Gramatneusiedl - Wampersdorf	13,5	2002	Due to high freight traffic volumes, local passenger service discontinued.
Lokalbahn Siebenbrunn–Engelhartstetten	22	2003	Tracks removed starting from 2013, converted to bike path
Leobersdorfer Bahn (Weißenbach-Neuhaus – Hainfeld)	25	2004	Track removed 2017
Donauuferbahn Sarmingstein (OÖ) - Spitz	50	2009	Spitz to Emmersdorf later reactivated, Weitenegg-Weins removed starting in 2018
Sum	**234**		

Two of the lines closed during this period, the Retz-Drosendorf line and the Waldviertel narrow gauge line would be retained for tourist service. These early experiences would be the basis of subsequent branch line development in Lower Austria. The most significant closures in this time were the middle segments of the Leobersdorferbahn and the Donauuferbahn, the closure of these lines was labelled by some as salami tactics, that through removing the middle segment the remainders on either side could then be slowly trimmed back. The decision to close these lines came despite that only a few years prior to the closures significant rehabilitation work had been done to the affected parts. Both the middle segments of the Donauuferbahn and the Leobersdorfer Bahn had been received new sleepers and even new expensive bridge replacements.[89]

The closure of the Leobersdorfer Bahn cut a direct route between St. Pölten and Wiener Neustadt, the two most important cities in Lower Austria. Instead, all passengers travelling between the city pairs must transfer in Vienna.

5.7 Regionalbahnen Concept 2006

Rüdiger vorm Walde did not last long as the head of the ÖBB and was forced out under similar situations as Draxler over the sectorization of the ÖBB. Under vorm Walde there were few major changes or new policies, and he was generally unable to navigate the highly political nature of the position.[90] In 2004 he was replaced by Martin Huber. Huber was notable as the first conservative (ÖVP) aligned head of the ÖBB and oversaw the sectorization of the ÖBB concern that even Draxler had tried to block. There were further calls for massive personnel cuts with Huber planning to reduce employment to 40,000. Huber's time also saw the ÖBB follow the path of the German Deutsch Bahn and invest increasingly in foreign freight logistic services. The ÖBB's freight sector was privatized as Rail Cargo Group and expanded quickly into Hungary and Slovenia.[91]

Huber again picked up where Draxler had left off on the branch line issue. In August 2006 the ÖBB unveiled a new RegioBahnen" concept which once again called for the closure or sale of most of the branch line network. Lines in the former C category were listed now categorized as either category Z or W. Lines in the Z category were planned to be abandoned, while the future of the lines in the W category were uncertain and dependent on finding regional solutions. In Lower Austria most of the

[89] (Populorum, 2020)

[90] (Profil, 2004)

[91] (OE24.at, 2008)

branch line network was to be divested along with the entire narrow-gauge network. In most cases Huber proposed the replacement of rail services with buses, promoting them as a better option due to their ability to directly serve town centers.[92]

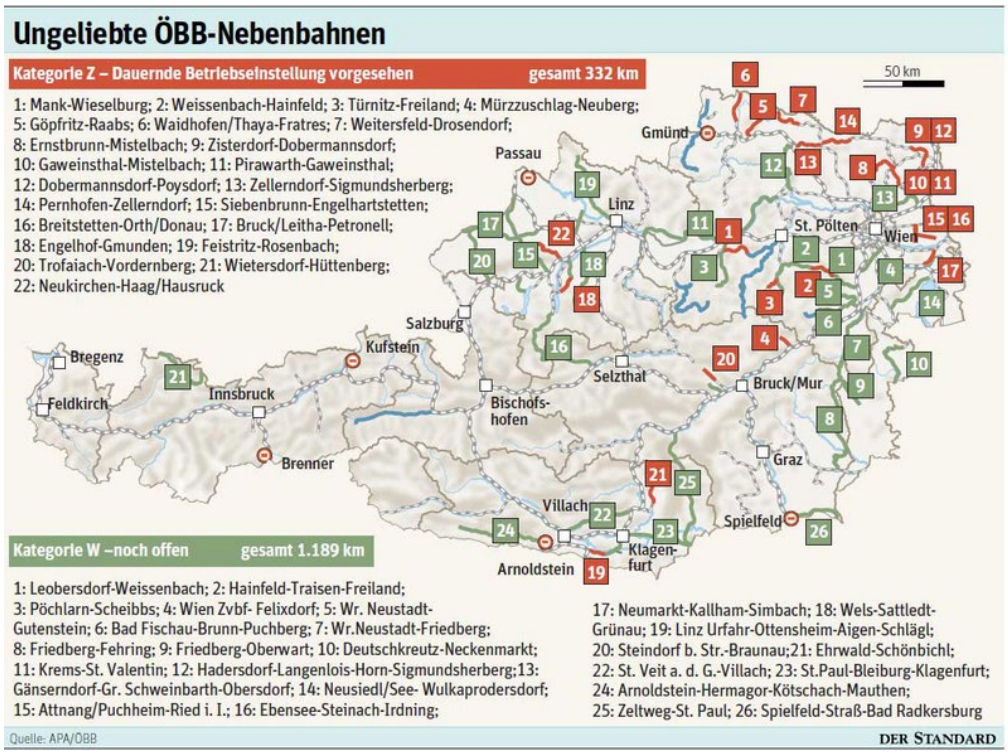


Figure 13: List of proposed line closures based on Regional Railway concept. Source: Der Standard - https://www.derstandard.at/story/1285199117464/nebenbahnen-stille-stilllegung

The plan was intended to diffuse some of the pushback that was seen with Draxler's plans by providing a clear path to developing local transport solutions for affected lines. The ÖBB stated that no closures would occur before 2008 by which time negotiations could be conducted. However, the motivations of the plan were the same in that it was intended as a way for ÖBB to rid itself of the branch lines to focus on their core network. ÖBB estimated at the time that the divestment of the full 1600 km of trackage could save the railway between 2.5 and 3 million euros a year which it wanted to invest into the core network and specifically the expensive base tunnel mega projects.[93]

The implementation of the plan however once again faced pushback, even in Lower Austria where the still serving Governor Erwin Pröll was initially hailed as the savior of the branch lines due to early opposition to the plan.[94] The ever-revolving door of management at the ÖBB continued to spin and in 2008. Huber was again replaced as the government decided the ÖBB needed a change in direction.[95] Like Draxler before him, Huber had failed to implement his drastic branch line closure program and during his time in office no branch lines were closed. However systematic deferred maintenance was continued on the on the lines that ÖBB wished to get rid of in a form of self-sabotage that they hoped would eventually free them from operation of the branch line network.[96]

[92] (ORF, 2006)

[93] (ORF, 2006) (Knoll, 2021)

[94] (Die Presse, 2008)

[95] (OE24.at, 2008)

[96] (Pruckner, 2009)

Huber was replaced by Peter Klugar who was more traditionally aligned with the SPÖ. Klugar wished to proceed in some degree with the implementation of the branch line concept but sought to assuage the concerns stating there would be no massive closure wave, only lines for which no regional solutions could be found.[97] In the following two years the ÖBB under Klugar and the Lower Austrian government negotiated the future of the branch line network and a solution for public transportation in the affected regions. In January 2010 the two parties jointly announced an agreement. The deal would see approximately 600 km on 28 routes sold to the state. The sale included all remaining narrow-gauge lines still owned by the ÖBB and almost all other lines listed in category Z. To maintain these lines the federal government agreed to an infrastructure packet where the federal government would contribute 45 million euros with the state allocating a matching sum, the ÖBB would provide an additional 50 million euro grant for a total of 140 million euros. Furthermore, the ÖBB agreed to invest in the modernization of the remaining branch lines that would stay under their control such as the Erlauftal and Traisentalbahn. The agreement was hailed by the responsible parties as a step towards the revitalization of branch lines in Lower Austria, the federal infrastructure Doris Bures minister going so far to say the agreement as a major step toward the revitalization of the network, saying it brought the railways towards a Swiss model of regionalization.[98]

The lines transferred to the state were in varied condition, many still had regular passenger traffic, but others had already been out of service for several years at this point. The following table is a list of the lines transferred to the state and their status in 2010 and the final fate after the takeover by the state.

Table 7: Lines to be transferred to the NÖVOG and status in 2010[99]

Segment	KM	Status 2010	Current state
Lines with regular service			
St. Pölten - Mariazell (Mariazellerbahn)	84.2	In regular passenger service up to Mariazell	Regular and tourist traffic with significant upgrades
Obergrafendorf-Wieselburg an der Erlauf (Krumpe)	37.5	Regular service up to Mank, Mank to Wieselburg out of service	Touristic service on short km segment between Ober-Grafendorf and Haag-Kleinsierning. Rest of line abandoned
Krems – Sarmingstein (OÖ) (Donauuferbahn)	60	Regular passenger traffic until Emmersdorf	Touristic traffic Krems- Emmersdorf, Weitenegg – Weins abandoned, Weins – Sarmingstein freight use only
Thayatalbahn	34.5	Regular passenger service Schwarzenau – Waidhofen a.d. Thaya	Track retained up to Waidhofen a.d. Thaya. Rest of line converted to bike path.
Out of service due to needed repairs			
Waidhofen – Lunz (Ybbstalbahn 760mm)	53.5	Out of service due to flood damage	Waidhofen to Gstadt retained for regular service. Remainder abandoned, right of way reused for bike trail.
Gstadt – Ybbsitz (Ybbstalbahn 760mm)	5.7	Out of service due to flood damage	Abandoned and removed
Lines with tourist traffic			

[97] (Die Presse, 2008)

[98] (OTS, 2010)

[99] (Pawek, 2010), (Welche Rolle spielt die NÖVOG, 2011) (Populorum, 2021) – multiple pages

Retz-Drosendorf	40	Seasonal tourist service	Seasonal tourist service
Waldviertel Schmalspurbahn	68	Regular service ended in 2010 but touristic services had already been started in interim	Seasonal tourist service
Alt-Nagelberg - Heidenreichstein	13.2	Seasonal tourist service by Wackelstein Express foundation since 1992.	Seasonal tourist service
Schneebergbahn	9.85	Regular tourist traffic	Seasonal tourist service
Lines with no passenger traffic or completely closed			
Freiland-Türnitz	9.2	Passenger traffic ended in 2001	Abandoned, converted to bike path
Göpfritz-Raabs	19.5	Passenger service discontinued 1986, freight 2001	Abandoned
Ernstbrunn-Mistelbach	18	Tourist use until 1999	Seasonal draisine use
Zellerndorf-Sigmundsherberg	17	Used for occasional nostalgic trips up to 1998	Potential for reopening as tourist line by Waldvierteler Eisenbahnmuseum
Siebenbrunn-Leopoldsdorf - Engelhartstetten	22	Freight up to 2003	Abandoned 2013, now bike path
Wiessenbach-Neuhaus - Hainfeld	24.8	Passenger service discontinued 2004	Abandoned
Breitstetten-Orth an der Donau	6	Freight up to 1998	Abandoned
St Aegyd - Kernhof	5	Track already removed by 2001	Abandoned
Sulz Nexing -Zistersdorf	11	Passenger service up to 2005	Abandoned
Gaweinstal-Paasdorf bei Mistelbach	9	Passenger service up to 2004	Abandoned
Pirawarth-Gaweinstal	4	Passenger service up to 1995	Abandoned
Enzersdorf-Poysdorf	9	Abandoned 1977	Abandoned
Dobermannsdorf-Poysdorf	20	Freight up to 2001	Abandoned
Bruck an der Leitha-Petronell	6	Freight service on partial route. Passenger service withdrawn 1952	Active as freight siding up to km 2.6, rest abandoned

The final agreement saw the state purchasing the lines from the ÖBB for 15 million euros, a price in hindsight that was too high given the condition of many of the lines. The 140 million Euro branch line grant on the other hand was completely insufficient for the large network the state had acquired. In truth this money was only intended to be enough for the rehabilitation of one line, the Mariazellerbahn which would serve as an example of the positive benefits brought about from the transfer of the branch

lines to the local authorities.[100] Following the purchase the lines were put under the administration of the NÖVOG, the state's transportation organization that until this point was primarily responsible for organization of the "Wieselbus" regional bus services around St. Pölten but had taken on some rail duties with the operation of the Schneeberg rack railway.[101]

At this point there was great hope that the takeover of the lines by the land could lead to positive regional solutions as had been the case in other states such as in Salzburg with the takeover of the Pinzgaubahn from the ÖBB, or the development of the long state owned Murtalbahn in Styria. Johann Heuras, the Verkehrslandesrat of Lower Austria (ÖVP) was quoted in 2010 "We have not taken railways over to close them, I would like to clearly state, we want to make the railways more attractive, we want to modernize them and better equip them."[102] However, as in past discussions there was a vast gap in the words and actions of the ÖVP controlled government.

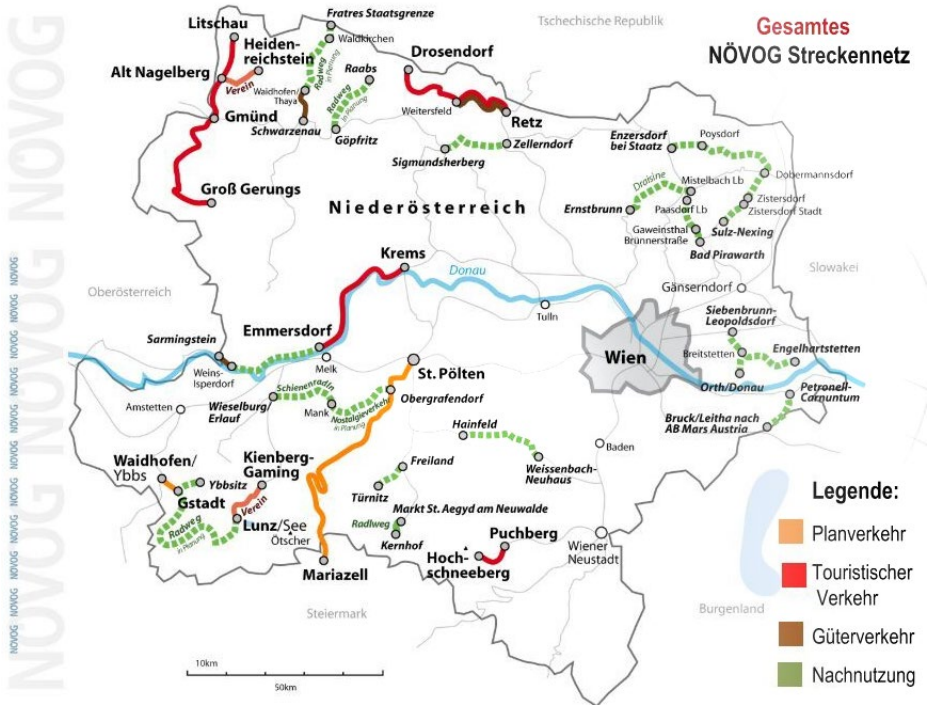


Figure 14:Map of lines taken over by the NÖVOG with planned disposition. Source: (NÖVOG, 2021)

Without further federal financing, and the unwillingness of the ruling ÖVP party to invest more state funds into the branch line network, the rest of the lines faced a dark future. Of the other lines taken over by the state, only the Waldviertel narrow gauge network, the Retz-Drosendorf Reblaus express and part of the Donauuferbahn would see any further investment, and only for touristic use. That these lines survived at all is largely due to local support of the communities. Along both the Waldviertel and Reblaus Express, the communities lobbied hard for the lines to be saved for touristic use and coordinated with the NÖVOG whereby the communities would set up events to attract tourists and NÖVOG would provide trains. The arrangement has proven very successful and has secured the lines futures. However, in other places where there was far less community support, along the Ybbstalbahn there was little fight for the preservation of the line except for a small contingent primarily consisting of rail enthusiasts who wanted the line saved for touristic purposes. Despite the significant transport

[100] (Knoll, 2021)

[101] (Grossmaier, 2010)

[102] (ORF, 2011)

potential in both touristic and commuter traffic along the Waidhofen-Ybbsitz segment, without the communities support the line was abandoned.[103]

The federal government for its part was also unwilling to provide support for the reactivation of transferred lines, even in the case of projects with international interest. Since the fall of the Iron Curtain, it had long been planned to rebuild the cross-border line between Waidhofen an der Thaya in the Waldviertel with the Czech city of Slavonice. The project was listed until 2001 in the as a high priority in the Lower Austrian state transport concept. At the time only 8 km of track was missing that would need to have been rebuilt and on the Czech side of the border rehabilitation up to Slavonic had been carried out. However, with the takeover of the line by the state, the plans fell to the wayside and the line north of Waidhofen has since become a bike trail. [104]

The Mariazellerbahn, due to both its importance to the state capital, its touristic and commuter potential, and importantly a high level of support from the local community did substantially benefit from the transfer and funding provided by the federal government. Until the takeover the line had however seen minimal investment, still utilizing the same 1910s era electric locomotives that had served since the electrification of the line in 1911 hauling decades old wagons. The line has since seen significant modernization with new low floor “Himmelstreppe” EMUs from Stadler as well as the reconstruction of important stations to allow barrier free access.

Of the 600 km of track taken over by the land of Lower Austria, only 96.5 km remained with regular passenger service after the takeover with a further 142 remaining for tourist services. Some other segments were retained for sporadic tourist or freight use, but the majority have been abandoned and removed. The state has in many cases chosen to convert the right of ways to bicycle paths instead of reactivating the railways.

In addition to the lines transferred to the NÖVOG the following branch lines lost service in 2010:

Table 8: Lines closed in 2010 not included in transfer to state of Lower Austria

Segment	KM	Withdrawal Passenger service	Notes
Erlauftalbahn (Scheibbs - Kienberg/Gaming)	10	2010	Sold to Ybbstal Bergstrecke organization. Track removed in 2015, potential for future reactivation as extension of 760mm Ybbstalbahn museum railway.
Schrambach- Markt St. Aegyd	20	2010	Only freight traffic since 2010
Schwarzenau-Zwettl	21	2010	Only freight traffic since 2010
Bad Pirawarth - Sulz-Nexing	9	2010	Track intact, museum use

5.8 Further closures up to present day

2010 did not mark the end of line closures in Lower Austria. With the sectorization of the ÖBB, the cargo sector was privatized as Rail Cargo Austria, and with the privatization came an increased focus on profitability which in turn meant a focus on block trains and reduction in single wagon traffic. Freight traffic on most branch lines was never particularly profitable, requiring large train crews for shunting work and on many lines, trains would operate with only a few wagons behind powerful but fuel hungry

[103] (Knoll, 2021)

[104] (Kortschak, 2010)

diesel locomotives. However, the provision of freight service was typically supported on both sides of the political aisle an alternative to undesirable heavy truck traffic through constituents' towns. Furthermore, the loss of freight rail access reduced the economic potential of local industries, especially those that needed to transport bulk goods like the agricultural and forestry sector. In 2010 the railway announced that they wanted to close 135 loading points, many of them on branch lines. The tariff per wagon for many of the remaining loading points on branch lines would also be raised to 150 euros per wagon. If that was not bad enough a minimum of payment for the transport of 4 wagons was required even if fewer wagons were actually needed.[105] It was estimated that these changes would shift 3 million tons per year from the railway to the road in Lower Austria alone resulting in approximately 1200 more truck trips per day.[106] This had the desired effect of running off most smaller customers who only shipped limited numbers of wagons. Without the freight traffic, several lines that had previously lost their passenger service, such as the southern segment of the Schwarzenau-Martinsberg-Gutenbrunn line were abandoned.

In 2019 the state and the ÖBB decided to end service on what is known as the Schweinbarther Kreuz, the last remains of the once large Stammersdorfer Lokalbahn network that was mostly closed as a result of the Nebenbahnverordnung. The area lies near to the edge of Vienna with significant potential for commuter traffic and its closure has been highly controversial. The lines have no freight traffic but are being retained for the moment while their ultimate fate is decided.

The Ybbstalbahn, which had already been reduced to a short stub between Waidhofen a.d. Ybbs and Gstadt in 2010 will be further destroyed due to the wish of a private industrial concern to expand their factory over land used by the railway.[107] With only a 3 km segment remaining in service it is not unlikely that this last remnant of the Ybbstalbahn will soon be completely closed. However, even the small remainder still sees the highest passenger numbers of all NÖVOG lines, except for the Mariazellerbahn, largely due to school traffic.

Table 9: Branch line closures in Lower Austria between 2010 and present

Segment	**KM**	**Withdrawal Passenger service**	**Notes**
Schweinbarther Kreuz	35	2019	Tracks retained for potential reactivation
Ybbstalbahn (Pestalozzistraße – Gstadt)	2,5	2020	Passenger service withdrawn, land to be used for industrial development.

There have on the other hand been success stories. Both the Schneebergbahn and the Gutensteiner Bahn from Wiener Neustadt had been marked for closure after 2001. With the introduction of the Wiener Neustadt Taktknoten the lines attractivity increased. In 2019 parallel bus traffic along both lines was finally ended seemingly signaling that the line has a long-term future.[108] The Gutenstein branch also benefits from large volumes of freight traffic to an important cement work and a paper mill which has helped secure its existence. The Schneeberg Bahn benefits from tourism to Schneeberg

[105] (Zellhofer, 2018) (ORF.at, 2010)

[106] (35. Landtagssitzung, 2011)

[107] (Mackinger, 2020)

[108] (Sanz, 2020)

with connections to the cog railway. The “Innere Aspanbahn” also remains in service for weekday only traffic, however the line remains largely unmodernized and unutilized to its full potential.

The lines that were taken over by the state of Lower Austria have exclusively been used for tourist use. The following ridership figures were recorded for the NÖVOG operated lines in 2019.[109]

Table 10: Ridership on NÖVOG owned lines in 2019. Source: NÖVOG

Line	Operating season	Ridership 2019
Mariazellerbahn	All year	579,000
CityBahn Waidhofen	All year	202,000
Schneeberg Cog Railway	May - November	178,000
Wachaubahn	March - November	38,000
Waldviertelbahn	May - November	30,000
Reblaus Express	May to November	24,000
Total		1,051,000

While the railways can in some cases be considered successful cases as tourist operation, there are opportunities for ridership lost by lack of integration with the local transport organization. While some lines such as the Waldviertel narrow gauge line are best suited as heritage railways due to the much faster travel time by bus, others like the Donauuferbahn have significant potential for both tourist and regular service which cannot be unlocked with the current operating plan.

Three decades after the passage of the Nebenbahnverordnung in 1988, most of the closures that were originally planned in Lower Austria have occurred. While there have been considerable efforts to preserve some lines for tourism, vast areas of Lower Austria have lost regular rail service as a result.

5.9 Historical takeaways

With the loss of approximately 1000 KM of railways in Lower Austria between 1980 and the present, it begs the question of who is really to blame and if the fate was inevitable. As is normally the case, there are many answers and many parties that bear responsibility. The following are some of the primary factors responsible for the decline in the branch line network.

- **Systemic issues:** Some branch lines truly did have systemic issues that regardless of measures to increase attractiveness would have had a hard time surviving. This is particularly true of some lines in the Weinviertel and upper Waldviertel which served very sparsely populated open territory but due to their low-cost construction had very poor alignment. With the construction of more direct roads, it would have been hard for these lines to remain viable except significant investment in realignment.
- **Lack of investment:** The ÖBB was too slow to adapt to the changing realities of the transport sector after WWII. While new roads were being built and automobile ownership was skyrocketing, the railway remained in many places still in the prewar era, with steam locomotives and old wagons often providing poor passenger comfort and slow schedules. Despite the availability of lightweight diesel railcars on the market from the early 1950s on, steam traction survived on branch lines well into the 1970s. This old rolling stock furthermore had a dramatically higher operating cost than newer equipment. Similarly,

[109] (Kiefer, 2019)

disinvestment in infrastructure resulted in longer travel times than necessary, even at higher speeds many branch lines were already at a disadvantage to the road compared due to their alignment.

- **Parallel bus traffic:** The operation of parallel bus traffic on many lines was an important reason for the decline. The buses operated directly through town centers, offered new vehicles while the railways were still running decades only stock, and often operated directly to main commuter destinations while branch line train users often had poorly timed changes.
- **Attractivity measures came too late:** The branch lines first started to receive some attention in the 1980s with the introduction of cost saving measures such as track warrant control to reduce operating costs and the introduction of modern railcars. However, by this point the branch lines had developed such a poor reputation that proved difficult to overcome, both politically and from the passenger perspective.
- **Development of P&R:** The development of park and ride stations at mainline rail stations, while intended to increase ridership on main commuter routes was detrimental to the use of branch lines as feeder routes. With high level of motorization in rural areas, there was little incentive to use branch line trains when free parking was provided at mainline rail stations.
- **Poorly oriented timetables:** Timetables were historically oriented only around traditional working hours, providing little flexibility and making the trains unsuitable for other trip purposes other than commuter trips. As typical employment patterns changed with a shift to a post-industrial economy the railways failed to adapt their timetables. The biggest missed chance for the revitalization of the branch lines was the rollback of the NAT 91 timetable which greatly increased the attractivity of the branches with timed connection to mainline and suburban trains.

6 Regulatory and organizational framework

The following segment will examine the legal structure of the railways in Austria, regulations applying to railways and especially closure and abandonment of railway lines.

6.1 Legal organization of the Österreichische Bundesbahn (Austrian Federal Railway)

The legal conditions for the operation of the railway network in Austria has played a large role in the decisions taken regarding line closures. Normally, state railway companies do not make a profit and require some form of subsidies. The mechanisms and degree of subsidization have varied through the railway's history. Following the collapse of the Habsburg empire at the end of WWII in 1918 the railway networks in the respective countries were reorganized. After several reorganizations the railway was reincorporated as the Österreichische Bundesbahn, or Austrian Federal Railway through the Federal Railway Act of 1923. The act established the railway as a separate economic body, releasing it from direct state control and instead allowing it to operate as an independent entity under commercial principles. The reorganization had several stipulations regarding the railway's profitability. The railways were guaranteed subsidies in the event that expenditures exceeded the railways income, in addition to a fixed yearly subsidy for capital expenditures. The reorganization of the federal railways was intended to have two main purposes: On the one hand, the detachment from the federal administration should reduce bureaucracy and thus enable a more rapid reaction to the increasing demands of economic life. On the other hand, the new company should act independently of the state financial policy and raise the funds for the operation and important investments itself. However, due to the rapid transformation and the lack of legal framework, this project was doomed to failure from the start.[110] This was compounded by rapid inflation in the postwar economy as well as a large amount of deferred maintenance from the war years that now had to be rectified.

With the incorporation of the Austria into the German Reich in 1938 there were significant changes to the railway regulations, however as the laws of the postwar government were based on those before the Anschluss, they had little lasting impact.[111] After the war the Constitutional Transition Act of May 1, 1945 rolled back all laws from the Nazi occupation time and reinstated the prewar constitution from 1929 as a provisional measure. The railway was again to be operated under commercial principles but did not immediately regain its status as an independent entity. [112]

In 1969, considerably after the founding of the second republic, the Austrian Federal Railways were reincorporated as an independent entity with the Federal Railway Act of 1969. The law states again that the railways were to be operated according to commercial principles with the operational purpose of providing transport services according to demand. The railways have a duty to maintain as well as improve their infrastructure according to this operational purpose. The law set out the following conditions for subsidies in **§ 18:**

> *To compensate for loss of income tariff reductions in rail transport of the Austrian Federal Railways that are not granted out economic considerations (social and subsidy tariffs) is in the federal draft budget for the years 1970 to 1974 an amount of 350 million Schilling (approximately 122 million Euro not adjusted for inflation) to be quoted in the chapter "Traffic". The amount of subsidies to*

[110] (Dornig, 2019)

[111] Ibid.

[112] Ibid.

compensate for loss of income from social and subsidy tariffs from 1975 onwards will be estimated by the Federal Minister for Transport and Nationalized Enterprises in Agreement with the Federal Minister of Finance on the occasion of the preparation of the federal budget drafts proposed by the federal government."

The next major change to the railway act came in 1984, when the services of the ÖBB were divided into a commercial and public sector. Public sector was understood to mean the transport of people and goods as well as the necessary construction and maintenance of the facilities required for this. However, these had to be in the public interest and appear necessary in the field of transport, economic, financial and environmental policy in particular, but the ÖBB could not provide them with due regard for the principles of commercial management ÖBB by ordinance. The 1984 reorganization brought about the requirement for more transparency in the accounting of these expenses. [113]

The development of the European Community into the current European Union brought about numerous regulatory changes for railways in the EU block. The legislation, known as the First Railway Directive, was designed to introduce competition to the railway marketplace and allow for greater integration across the entire EU rail network.[114] Primary among the requirements was the necessity to separate the railway operating companies from the railway infrastructure to allow for neutral access to the infrastructure. This required major changes to the regulations regarding railways in all member states. Thus in 1992 the Federal Railway Act was significantly amended with the Federal Railway Act of 1992. The act further shifted the now divided ÖBB further towards the structure of a private company with the government as the owner. The railways could now act with more independence to ensure their profitability. The responsibility for financing services on unprofitable lines no longer fell to the ÖBB but rather the federal and state governments who needed to provide subsidies as part of a transport contract if services were to continue to run. Services could also be bided to another private operator rather than the ÖBB, which has become commonplace in Germany since the railway reform but still uncommon in Austria.

6.2 Regulations pertaining to railway closure and service discontinuance in Austria

As in most countries, the closure of a railway line is a process that requires many legal steps. The closure of a line can have widespread impacts and the process usually seeks to avoid closure if possible such as requiring the railway be sold to anyone with an interest in operating it when the current party is no longer interested. Input from the community is also weighed in the decision whether to allow the closure. Railway construction and operation in Austria has since 1956 been overseen by the Bundesministerium für Verkehr und Elektrizitätswirtschaft (Federal Ministry for Transport and Electricity Industry), today known as the Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie (Federal Ministry for Climate protection, energy, mobility, innovation and technology), abbreviated earlier as BMVIT, now BMK. The railways are regulated under the Eisenbahngesetz (Railway Act) which was first passed in 1957 and has been amended since. Subsections 28 and 29 contain the regulations regarding the discontinuance of service and abandonment of railway lines.

[113] (Dornig, 2019)

[114] (Tunnicliffe, 2019)

Subsection 28 of the act contains regulations regarding discontinuance of railway service due to unprofitability. The following is a translated summary of *§ 28*:

- If the operation of a railway line is not financially sustainable, the authority can permit the railway company to temporarily or permanently discontinue service
- Except in cases of a temporary disruption in operation or discontinuance due to safety reasons, a temporary discontinuance of service of a financially unsustainable line is allowed for a maximum of three years.
- The request for discontinuance must indicate what steps the operator take to ensure the security of the railway during discontinuance and what steps will be taken to maintain the line during the discontinuance
- Before approval for permanent discontinuance is granted it must be demonstrated that efforts made by the applicant railway undertaking to continue operations on commercially justified terms have been unsuccessful and there have been no reasonable offers from other parties to continue service
- If the permanent discontinuation of the operation of a railway or a section thereof is approved, the authority shall at the same time declare the concession to have expired.

Subsection 29 contains the regulation for the permanent abandonment of a railway corridor. The following is a translated summary of *§ 29*:

- At the request of a railway operator, the board can grant permission to discontinue all or part of traffic on a railway line if operations cannot be expected to continue in a financially sustainable way. In cases of public railways, permission of discontinuance may be granted only if a replacement service which serves the public needs and is economically viable is ensured
- If the complete and permanent discontinuation of the operation of a railway or line segment) is approved, the authority shall at the same time declare the concession for the railway or segment to have expired. It shall also decide, in accordance with the requirements of public safety, which railway facilities are to be removed and which construction measures are to be taken to restore the condition that existed prior to the construction of the railway.
- At the request of the concessionaire or the operating company, the authority shall authorize the abandonment of stations or stops if the railway company, considering the public interests, cannot be expected to keep them in operation economically

An important distinction in comparison to Germany, where many line reactivations have taken place, is that it is not possible to deactivate a line (Stilllegungsverfahren), where the line is put out of service for an indefinite period of time but retains its legal status as a railway. The Eisenbahngesetz per SS. 28 allows only for a temporary discontinuance of the line for 3 years, after which a decision must be made whether to reactivate or file for abandonment. If an abandonment procedure (Auflassungsverfahren) is carried out, the railway line loses its legal rights as a railway and simply becomes property.[115] Unlike in some countries like the United States, the land does not however automatically revert to adjacent property owners. The inability to simply deactivate a line plays a significant role as to why there have been no railway reactivations in Austria. Once the abandonment procedure is completed, the legal process for reactivation is as complicated as for the construction of a new line, requiring full planning permissions, environmental studies, and other legal proceedings. Furthermore, the regulations of SS 29 often require the infrastructure owner to completely dismantle the railway infrastructure A

[115] (Knoll, 2021)

potential alternative is to convert the railway to an Anschlussbahn, whereby the requirements for the line's maintenance are lower. This has been the method employed by the NÖVOG on their remaining lines, including the ones with active service. If there is interest a museum group can take over maintenance responsibilities for the owner, and work towards reactivation. This has been done for the NÖVOG owned line from Sigmundsherberg to Zellerndorf segment where the Sigmundsherberg railway museum has assumed responsibility for the lines maintenance, and thus is still officially in service despite no service trains having been run in decades.[116]

6.3 Organization of railways in present day Austria

The Austrian railway network has historically been mainly operated by the Austrian Federal Railways with some Lokalbahnen remaining under regional control. Overall, there have been relatively few new participants to the railway market with historic Lokalbahnen continuing their original role. Out of the country's approximately 5,600 km network, only 800 km are owned by private (non ÖBB) railways.[117]

6.4 Current structure of ÖBB since implementation of first railway directive

The ÖBB network is consists of the Kern and Ergänzungsnetz (Core and supplementary network). The core network are the mainline routes with high volumes of traffic and generally electrified and at least partially double tracked. The supplementary network consists of the remaining branch lines which are generally not electrified and single track. The designation replaces the former ABC network designation used up to 2000. Under the previous schema mainlines were listed as A, secondary routes as B and C for branch lines and any remaining narrow-gauge lines. With the large sale of branch lines to the state of Lower Austria in 2010 the railways rid itself of most lines with a C designation. The primary planning document for the ÖBB is currently the Zielnetz 2025+ which sets out the railway's investment plan for its network for the next decade, as the plan for the implementation of a nationwide Taktfahrplan.

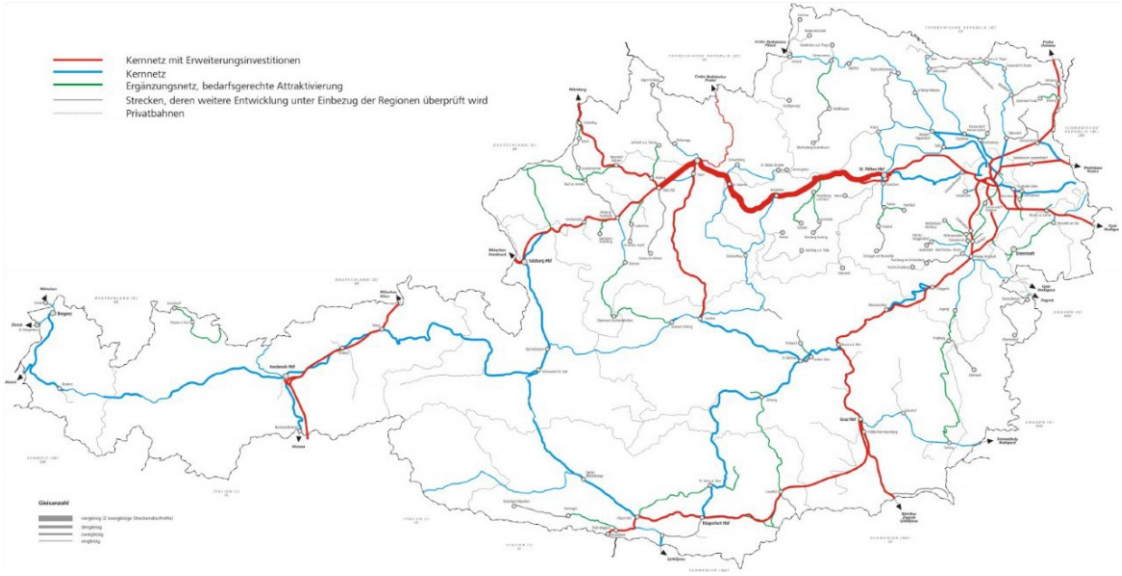


Figure 15: ÖBB network map showing the core and supplementary network, along with other lines in grey where regional development is planned. Source: ÖBB Zielnetz 2025+

[116] Ibid

[117] (VCOE, 2018)

6.5 Organization of the NÖVOG

Lower Austria, due to the federalization of the Niederösterreichische Landesbahnen in 1922, has no long-standing private railways on its territory with some small exceptions such as the Wiener Lokalbahn. In 1993 the land of Lower Austria founded the NÖVOG or Niederösterreichische Verkehrsorganisationsgesellschaft (Lower Austrian Transport Organisation Company). The organization was founded in conjunction with the state capital relocation to St. Pölten. It was projected that the move would change transport flows and it was deemed necessary to reorient the public transport network to handle these new flows. The company's original task was the development of a new express bus network to serve destinations where no good rail connections to St. Pölten existed. The NÖVOG continued in a largely planning role in the early years, coordinating transport coordination as well as organization of subsidies.[118] The company took on its first operating role in 1997 when it assumed operation of the Schneeberg Cog railway in a joint venture with the ÖBB. The organizations' role greatly changed in 2010 with the large transfer of branch lines to the state of Lower Austria. The NÖVOG assumed control of the administration of these lines. It became responsible both for the operation of lines that were to be retained but also the disposal of lines that the state was not interested in operating. Since 2010 the NÖVOG has operated the Mariazeller Bahn, the Wachaubahn, the CityBahn Waidhofen, the Waldviertel Schmalspurbahn and the Reblaus Express with a total of 251 km in operation.[119] With the exception of the Mariazellerbahn and the CityBahn Waidhofen the NÖVOG operations are operated entirely as tourist services and operate only during the summer tourist season. The CityBahn Waidhofen is fully integrated into the VOR tariff system while the Mariazellerbahn is partially integrated and does not participate in some VOR offers like the weekend Freizeit tickets.

6.6 Organization of public transport in Lower Austria (VOR)

Until 2016 Lower Austria was divided between two different Transport Associations. The VOR (Verkehrsverbund Ost Region) was responsible for Vienna and Vienna oriented traffic from the suburban regions. The VVNB (Verkehrsverbund Niederösterreich und Burgenland) was responsible for all traffic that falls outside of the sphere of influence of Vienna.

Figure 16: Map of traffic zones in Austria before merger of the VOR and VVNB. Source: https://docplayer.org/docs-images/57/41197213/images/2-0.png

[118] (Grossmaier, 2010)

[119] (NÖVOG, 2021) Includes lines without regular service

The VOR Is the oldest transport association in Austria and its origins date back to 1973 when the Federal Government and states agreed to form a transport association to provide an attractive transport solution for the many commuters into Vienna. The association was officially founded in 1983.[120]

The VVNB was an amalgamation of several smaller tariff organizations in Lower Austria and Burgenland. The first transport association in the area was the Verkehrsverbund Nördliches Weinviertel (NWV) which was founded in 1988. The tariff organization was a direct result of the Nebenbahnverordung and the integration of all bus lines and the remaining ÖBB mainlines was done as a compensatory measure for the closure of the majority of the Weinviertel branch line network.[121] The VVNB at the end was composed of the Regionalverbünde Nördliches Weinviertel (NWV), the Waldviertel Verkehrsverbund (WVV), the Zentralraum/Mostviertel Verkehrsverbund (ZMV), the NÖ Süd/Mittleres Burgenland Verkehrsverbund (NBV) and the Südliches Burgenland Verkehrsverbund(SBV).[122]

The VOR despite its smaller coverage area of 6,457 km² transported a far greater number of passengers than the VVNB in the last year before the two systems were merged. In 2016 the VOR transported 2,668,401 passengers were transported a year, however the vast majority, approximately 2,550,685 of the passengers of these were on the Wiener Linien network inside of Vienna (95% of the total). This means that in the 6,042 km² of the VOR zone outside of Vienna the number of daily passengers was only 117,808. The VVNB by contrast served a far less densely populated region with weaker, less centralized passenger flows. In 2016 the VVNB had only 56,907 daily passengers, half the number of the Lower Austrian part of the VOR.[123]

Table 11: 2016 ridership statistics for the VOR and VVNB.

Association	Coverage area	Area population	Daily ridership	Ratio passenger/resident
VOR (Total)	6,457 km²	2,533.,889	2,668,401	1.05
VOR (W. Linien)	415 km²	1,897,000	2,550,685	1.34
VOR (NÖ)	6,042 km²	776,546	117,808	0.15
VVNB	17,097 km²	1,100,000	56,907	0.05

The VOR and the VVNB tariff zones overlapped in many areas due to their differing functions, and complicated ticketing for many passengers. The VOR, as a Vienna centric transport organization used a ring-based system, whereas the VVNB as a regional system used a honeycomb (Waben) system. As the VOR was a Vienna based systems, some rail lines outside the normal bounds of the VOR were included but the connecting buses were not. The result was a confusing system with a minefield of exemptions and special cases that users had to consider. As such there was a longstanding desire to merge the two zones and simplify the ticketing system. The integration of the VVNB and the VOR began in 2002 with the merger of the two companies' management boards.[124] The merger of the two

[120] (AK Niederösterreich, 2016)

[121] (NÖ Landtag, 1987)

[122] (Wiener Zeitung, 2002)

[123] (AK Niederösterreich, 2016)

[124] (AK Niederösterreich, 2016)

organizations was first announced in 2010 and completed in 2016 with the complete reorganization of the tariff zone.

The new VOR tariff since 2016 is a distance and line-based system, unlike in the VVNB tariff the city tariffs are included. The zones and honeycomb structures have been eliminated and commuter tickets can be purchased based on the transport relation needed using the VOR "A to B" service.[125] The merger also brought a new effort to develop a distinct VOR brand and improved marketing, with buses and bus stops receiving a uniform design. As of the merger in 2016 the VOR had approximately 880 lines (bus, rail and tram/metro), 9000 stops with 65 million bus kilometers driven per year.[126]

6.6.1 Financing of the VOR

With a Transport Association system, the financing of public transport is more complex than when the operator is directly responsible. While most of the financing eventually comes the federal government, there are a variety of different ways the money is allocated based on the transport provider, sector and passenger group. The following diagram shows the funding allocation to the VOR following the 2016 reorganization. The following is an explanation of the various revenue streams represented on the chart

- **Direct payments by passengers (Fahrgäste):** The direct ticket sales of single tickets or otherwise non-tariff-based tickets can be done either through the transport organization or directly to the service provider. For example, rail operators such as the ÖBB and Wiener Lokalbahn offer tickets only valid on their services.
- **Bunderministerium Finanz:** The Federal Finance ministry (BMF) is responsible for setting the overall transportation budget for Austria. For state or local projects, this money is then distributed to the relevant administrative level (Laender/State, Staedte/Cities, Gemeinde/Municipality.) These finances are then passed to the Transport Organization to distribute to the various operators.
- **Bunderministerium Klimaschutz, Umwelt, Mobilität, Innovation und Technologie:** The Federal Ministry of Climate protection, environment, mobility innovation and technology (BMK), before 2020 known as the Federal Ministry of Transportation, Innovation und Technology (BMVIT) is responsible for payments of subsidies for loss making transport. The BMK is responsible for the following types of transport subsidies [127]
    - **Public Service payments to rail carriers:** Payments under transportation service contracts to rail carriers for services that are not self financing.
    - **Transportation associations:** Payments under base and funding contracts to offset the loss of revenue to transit agencies resulting from the application of the interconnected fare.
    - **Student discount:** Support for special student tickets in the transport associations.
    - **Orderer support:** Payments for transport services ordered by regional authorities, whereby individual projects can be subsidized by up to one-third of the annual costs incurred, depending on budgetary coverage.

For rail transport payments, these are funneled through the **SCHIG**, (The Schieneninfrastruktur-Dienstleistungsgesellschaft / Railway infrastructure Service company). The SCHIG is a responsible for the creation of Public Service Contracts (PSOs) with the railway operators. These contracts set the level of subsidies required versus the revenue generated by the operation. Furthermore, the SCHIG is responsible for high level timetable planning in

[125] https://anachb.vor.at/

[126] (VOR, 2016)

[127] (BMK, 2021).

relation to the establishment of a nationwide Taktfahrplan and monitoring of compliance with terms of PSO contracts.[128]

- **Bundesministerium für Familien und Jugend:** The Federal ministry of Family and Youth is responsible for the financing of free transportation for school children and apprentices. The program known as the Schuler und Lehrlingfreifahrt (SLU) provides for free transport between school/apprenticeship and home only. Other subsidized tickets are provided for youth as well.

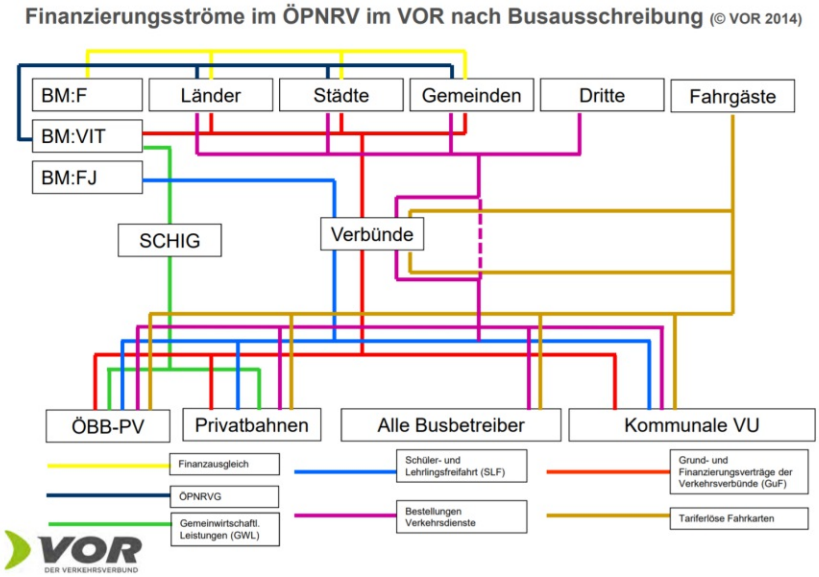


Figure 17: Finance steams for public transport in VOR. Source: VOR

[128] (SCHIG, 2021)

7 Introduction to the case study

The Donauuferbahn is one of the most controversial line closures in Lower Austria. The line, which formerly extended from Krems an der Donau to St. Valentine in Upper Austria along the northern bank of the Danube, passes through the Wachau which is one of the most important tourist regions in Lower Austria. The area which is known for its wine agriculture landscape along with historic villages has been a UNESCO world heritage site since 2000. In 2017 there were 660,000 overnight stays in the Wachau with 2 million annual visitors overall.[129] The area is a popular destination for bike tourism with the Danube bike route, which stretches from Passau to Bratislava passing through the area.

On the segment of the line between Krems and Emmersdorf the line runs through a narrow valley with all towns densely developed with centrally located stations. The line therefore was the main mode of public transport to the area for decades and had a significant importance for commuter and school traffic towards Krems.

From Emmersdorf the steep canyons on the southern side of the river give way to a flatter landscape more suitable for development. As such the main population and economic centers on this segment of the river have always been to the south. Furthermore, the railway is closely paralleled on the southern bank by the must more important Westbahn, Austria's primary East-West artery. As such the railway has long struggled to compete in this area as it does not follow the primary commuter flows. This segment was fully closed and mostly dismantled in 2018. From the town of Persenbeug the river and railway once again enter a steeply walled canyon, and the line passes through almost no further significant settlements until reaching the Upper Austrian border. In Upper Austria the line has greatly different properties than in Lower Austria, passing through several larger settlements and with a clear commuter flow towards Linz and St. Valentin. As such the line in Upper Austria has seen a continuous increase in service and is planned to be electrified in the coming years. The case study analysis will primarily consider the Lower Austrian segment of the line but will include the feasibility of reconnection with the line in Upper Austria to again form a through route.

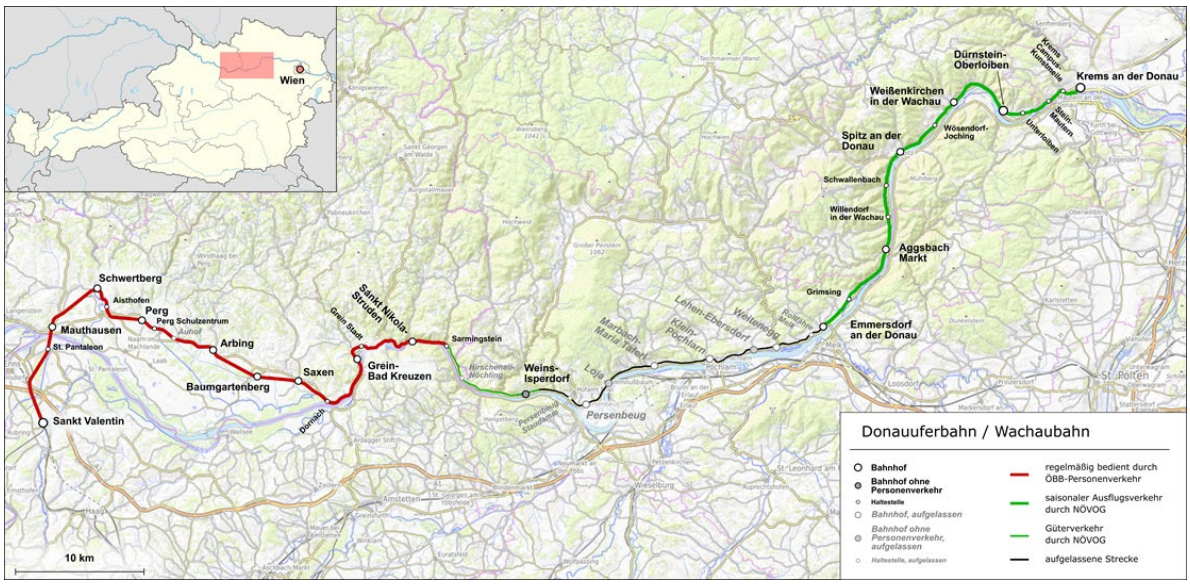


Figure 18: Map of the current state of the Donauuferbahn. Source: Wikipedia creative commons

[129] (Verein Welterbegemeinden Wachau, 2017)

7.1 Descriptive divisions of the Danube valley

The railway passes through 3 distinct regions of the Danube River valley, the Wachau, the Nibelungenau and Strugengau. These names are only descriptive and are not tied to any administrative boundaries. Wachau extends from Krems to Emmersdorf/Melk. In this segment the river is bounded by steep hillsides on both sides of the river, which has resulted in most settlements being clustered along the river. The geography also provides an ideal environment for growing wine due to the protection from wind and warmer climate due to the river. The Nibelunengau starts in Emmersdorf/Melk and extends to Persenbeug/Ybbs. The area is characterized by a steep slope on the northern side with a flatter southern bank with smaller hills. The area has therefore heavily developed on the southern side of the river while on the northern side development is largely clustered along the river. Due the exposure to wind from the south, the Nibelungengau does not have the correct climate for wine growing like the Wachau. Similarly, the area see's substantially less tourists than the Wachau with a limited number of major attractions.[130] The Strudengau encompasses the primarily Upper Austrian portion of the railway line between Ybbs and der Donau and Grein. The river in this segment is also bounded by steep hillsides on both sides of the river. The segment is one of the more remote parts of the line with only three small settlements between Ybbs and Grein on the northern side of the river, and no significant settlements on the southern side. The river in this segment was formerly one of the most dangerous with many rapids and rocky shoals, and a popular attraction for tourists. However, with the Danube regulation in the 1800s and finally the construction of the Ybbs dam in 1959 the river is now wide and placid.[131]

7.2 Administrative conditions

Before examining the railway situation of the case study, it is first important to examine the general background of the region to understand the physical and social landscape of the area. The following section will examine the geopolitical conditions of the surrounding areas before going into the history and physical conditions of the railway itself. The Donauuferbahn operates through the states of Lower Austria and Upper Austria. However, the upper Austrian segment has very different characteristics and has historically been far better utilized. The primary focus of the case study will be on the Lower Austrian segment between Krems and St. Nikola Struden, the last active station in Upper Austria. Vienna, being the population center of Austria also plays an important role due to the flow of commuters and its effect on the organization of public transport services.

[130] (Museen am Donaulimes, 2021)

[131] (Hofstetter, 2018)

The Lower Austrian segment of the line is located within the Krems and Melk Bezirke and passes through the following Gemeinde and Ortschaften:

Table 12: List of administrative jurisdictions along the Donauuferbahn.[132]

Ortshaft	**Pop**	**Gemeinde**	**Pop**
Krems (Stadt)	14,404	Krems	25,058
Stein	2,037	Krems	
Unterloiben	302	Dürnstein	843
Oberloiben	167		
Dürnstein	305		
Weißenkirchen	931	Weißenkirchen	1,399
Wösendorf	298		
Joching	148		
Spitz	1,210	Spitz	1,575
Schwallenbach	90		
Aggsbach	387	Aggsbach	637
Willendorf	153		
Grimsing	133	Emmersdorf	1765
Emmersdorf/Hofamt	865		
Weitenegg	43	Leiben	1,362
Lehen	114		
Ebersdorf	147		
Klein-Pöchlarn	1,063	Klein-Pöchlarn	1,063
Krummnußbaum a.d. Donauuferbahn	605	Marbach	1,700
Marbach	284		
Granz	211		
Gottsdorf/Metzling	767	Persenbeug-Gottsdorf	2,173
Persenbeug	1293		
Weins	331	Hofamt Priel	1,702
Nöchling	670	Nöchling	1,047
Sarmingstein	139	St. Nikola an der Donau	761

[132] (Statistik Austria, 2021) , (Statistik Austria, 2021)

7.3 Political conditions

Infrastructure issues, like all projects that require public funding and have an impact on social life are inherently political. The decisions taken regarding the Donauuferbahn and the branch line railways in general cannot be viewed without a political frame of reference. Like much of Lower Austria, the Gemeinde that the railway passes through are controlled primarily by the ÖVP. However, the Gemeinden of Leiben, Klein-Pöchlarn, Marbach and Persenbeug have been historically controlled by the SPÖ. The fact that the railway was only abandoned in the 3 SPO Gemeinde brings about further questions, if primarily speculative ones of the political motivations behind the lines closure and ultimate abandonment at the hands of the state of Lower Austria.

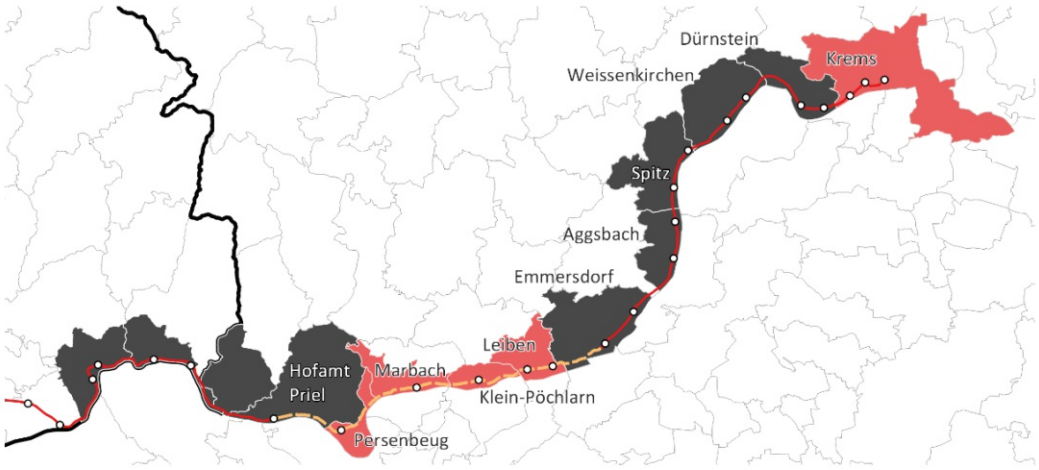


Figure 19: Political party in control of Gemeinden along the Donauuferbahn. 2021 status. Source: Data Wikipedia, map by author.

8 Historical development of the Donauuferbahn

This segment will explore in detail the history of the Donauuferbahn and its surroundings, starting with the early history of the region before the development of the railway up to the present day. The history of the railway is primarily derived from the book “Mit der Donauuferbahn von Krems nach Grein”.[133] The development of the railway will be framed in context of the overall development of the branch line railways in Lower Austria from Chapter 5.

8.1 Regional geography and early history

The study area is located at the southern extent of the Bohemian Massif. The massif, which is a block of the earth's crust bounded by faults or flexures and displaced as a unit without internal change,[134] was formed during the Variscan orogeny, a large mountain building event 370 million to 290 million years ago during the Devonian Period of the Paleozoic Era caused by the collision of two supercontinents.[135]

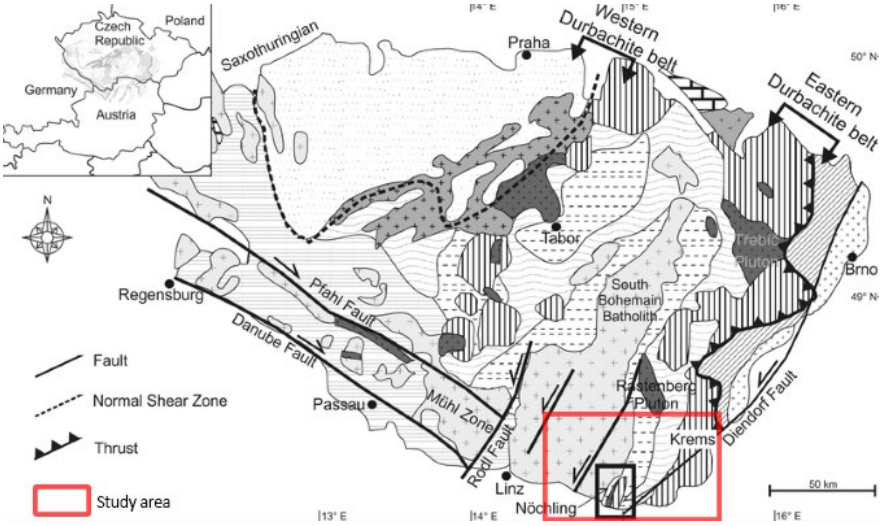


Figure 20: Geological map of the Bohemian Massif and associated fault lines. Source: https://link.springer.com/article/10.1007/s00531-015-1238-3, amended by author

The massif is bounded by several mountain ranges. The geography within the massif, which stretches across Austria, Germany, Czech Republic, and Poland, is comprised of rolling hills, and weathered crystalline rock formations. Numerous low mountain ranges can be found with a similar landscape across the massif. The edges of massif are demarcated by several fault lines. The Danube River found its natural course along this natural passage of the fault line around 3 million years ago. In the study area the river carved its way through the southern portion of the massif resulting in steep vertical canyons little flat land around the river. Between Krems and Melk the river is bounded on both sides by the steep canyon. Between Melk and Ybbs the southern side of the river is considerably flatter before going back into a steep canyon between Ybbs and Grein the river again goes into a steep canyon before emerging into a broad river valley that continues up to Mauthausen.

[133] (Hofstetter, 2018)

[134] (Merriam-Webster, 2021)

[135] (Britannica, T. Editors of Encyclopaedia, 2016)

The Danube River is one of the most important and second longest rivers in Europe. The river has its headwaters in the Black Forest region of Germany but important tributaries such as the Inn and Enns provide much of the water source from glacier and snowmelt. The river regular experiences flooding due to a variety of factors including in the winter ice jams, and development along the river has been shaped by this ever-present danger. The river plays a large role in the region's climate, typically eastern Austria is characterized by a continental climate with hot summers and cold winter. However, the river serves as a balancing agent, in the winter the water retains heat leading to milder conditions and higher humidity levels in the summer.[136] This climate has resulted in a unique ecosystem with types of flora and fauna not found elsewhere in the region. Prior to the anthropogenic changes brought about by human settlement, the landscape of the region was heavily forested, with only the steep rocky areas remaining unvegetated.[137]

Due to this favorable climate, the area was one of the first in Austria to be settled. The earliest known inhabitation of the area was approximately 43,500 years ago, some of the earliest documentation of humans in Europe.[138] The first evidence of more developed settlements in the area date to approximately 25,000 years old. In 1908 during the construction of the railway the famous Venus statue was found in Willendorf in der Wachau which was dated to this time period. Due to this early settlement, a reduction in forest cover was already evident in the Neolithic era (10,000–4,500 BC) though large-scale human cultivation and alteration of the landscape would not occur until approximately 800 AD.[139] Between approximately 100 BC and 500 AD the Danube formed the boundary between the Roman empire and the Barbarian kingdoms to the north. When the Romans realized that they would not be able to expand their kingdom further north they erected numerous defenses on the southern bank, remnants of which are still found today. Mautern an der Donau, opposite from Krems was an important defense outpost and the street layout even today reflects typical characteristics of a Roman fort.[140] Due to the warm climate and rocky soil the area was ideal for wine growing. Furthermore, the presence of the Donau River allowed the wine to be easily transported to larger markets. The production of wine began during the Roman era and greatly expanded during the Carolingian empire which succeeded the Romans in the 700-800 AD time frame. Wine was originally grown primarily by Monks from the areas monasteries and during this time much of the forest cover was cleared to make way for vineyards.[141] Due to various societal changes such as the declining importance of monasteries, competition from other wine growing regions and even changes to the climate due to the "Little ice age" (in the time period from the 16-1800's) led to fluctuation in the areas importance for wine growing. In the 19th century the regions agriculture was diversified with the introduction of apricot which also grow well with the same soil conditions. Though less known the apricots are now an important part of the area's agriculture and the city of Krems holds an apricot festival every year.[142] Regardless, the start of wine cultivation in the 800s shaped much of the modern landscape appearance the region is known for today.

The Wachau and the Danube River gorge in general due to its strategic position continued to be the division between empires and scenes of battles in the centuries to come. Even after the area came under control of Austria's long ruling Habsburg Monarchy in 1282 the area was still the scene of battles

[136] (Haus am Strom, 2021)

[137] (Republic of Austria, 1999)

[138] (The Local AT, 2014)

[139] (Republic of Austria, 1999)

[140] (Zeigler, 2018)

[141] (Gattinger, 2020)

[142] (Republic of Austria, 1999)

even up till the early 1800s. Numerous fortresses in the area bear memory to this history of conflicts.[143] With the exception of the previously mentioned Roman layout of Mautern, the basic structure of most of the Wachau towns stems from the 11th and 12 century immediately preceding the Habsburg era. Further significant expansions occurred in the 16th and 17th centuries, after which the towns stayed relatively similar until the mid-20th century.[144]

Since the start of human settlement of the area, the Danube was one of the most important trade routes of the area. Wooden rafts and boats sailed downstream with precious materials such as metals, salt, pelts, amber and wine, upon reaching their destination the boats were generally dismantled and sold for wood. Transport back upstream was a laborious process with mules on parallel tow paths slowly pulling the boat upstream against the current and such rarely conducted. Even for land-going commerce the valley of the river offered an easy path through an otherwise difficult to traverse landscape.[145] Due to its location on this important trade route, Krems was historically the center of trade in Lower Austria (outside of Vienna) and the dominant city of the region.

The invention of the steam engine in the mid-1700s and its implementation for propulsion would forever shift humans' interaction with the natural environment. With advent of steam shipping in the early 1800s goods and passengers were no longer bound to travel within the bounds of forces of nature (water and wind current) nor the body energy of humans or animals. Now transport over limitless distances were possible, bound only by a supply of fuel. The first application of the steam engine was for river transport with the first functional steamboat developed in 1783 in France. The technology was quickly seen to have revolutionary potential and countries around the world invested in the further research and development of the technology. Kaiser Franz I in Austro Hungary authorized financing for research of the technology with the primary goal of enabling Danube navigation. The implementation of river transport was seen as a way to further develop the economy and also exert further control over the then vast empire. In 1830 the state owned Donaudampfschiffgesselchaft (DDSG, Danube Steam Ship Company) was founded to operate freight and passenger services along the Danube, with the maiden voyage from Vienna to Budapest a year later.[146] On September 13th, 1837, the steamboat "Maria Anna" departed Vienna for the first time heading west reaching Linz 4 days later. The next year a regular steamboat route was established between Vienna and Linz with halts in Krems and Melk. The steam era had reached the Wachau.[147]

The glory days of the steamship were however short lived. In 1808 Richard Trevithick in England developed the first steam railway locomotive, the Coalbrookdale Locomotive. Though intended as a replacement for horses in mining operations, the invention quickly transformed the fabric of society like few others. The widespread construction of railways in the middle 1800s would have far reaching effects on the Wachau and surrounding areas. The completion of the completion of the Kaiserin Elisabeth-Bahn, todays Westbahn, in 1860 completely altered the power structure of Lower Austria. The alignment via St. Pölten shifted the power dynamic of the region, with a fast connection via railway to Vienna and Linz, St. Pölten became the regional hub at the expense of Krems.[148]

[143] Ibid

[144] Ibid.

[145] (Land Niederoesterreich, 2021)

[146] (Raditsch, 2012)

[147] (Wien Gesichte Wiki, 2021)

[148] (Stadtmuseum St. Poelten, 2008)

8.2 Early history of the Donauuferbahn

The development of railways spread rapidly throughout Austria as regions sought to maintain relevance. In 1872 the railway reached Krems, with the completion of the Kaiser Franz Josefs Bahn from Vienna via Absdorf-Hippersdorf. It was desired to extend the railway further into the Wachau, however the project faced high construction costs due to the topography and projected low revenue due to the low population and lack of potential freight traffic. An action committee was set up to develop plans for a railway into the Wachau. The first segment of the Donauuferbahn was opened in 1872 with the completion of the railway line from St. Valentine to Mauthausen including the Donau River bridge as part of the construction of the Summerauerbahn between St. Valentine and Budweis (České Budějovice). Though not part of the effort to construct a railway through the Wachau, the erection of the bridge was an important step towards the construction of the Wachau railway.

Then as today, a concession from the federal government was needed for the construction of a railway line, and in 1896 the action committee finally received support from the Reichsrat for the construction of the first section of the line from Mauthausen to Grein in Upper Austria. The segment from Mauthausen to Grein is located largely away from the Danube through relatively easy terrain with several sizeable settlements making it more economically feasible for both construction and operation. This dynamic persists up to today with the segment up to Grein being well used for passenger traffic.[149]

This segment, which was constructed as a Lokalbahn was opened 2 years later in 1898. In the same year the pre-concession was given for the construction of the railway between Krems and Grein through the Wachau. The railway alignment was approved in the next year however financial issues led to delays. After finances were secured, the Aktiengesellschaft Lokalbahn Mauthausen-Grein on December 14th, 1905, awarded construction contracts to three firms. The project was led by Civil Engineer Rudolf Mayreder, a well-known engineer then president of the Lower Austrian Engineers Chamber of Engineers (Ingenieurkammer).[150] Mayreder was also responsible for the construction of numerous railway lines including the famous Karstbahn (Bohinj Railway) in what is now Slovenia and other important civil engineering works of the time such as the Danube Regulation in Vienna.[151] Additionally, Architect Rudolf Pichler was put in charge of heritage and landscape protection (Denkmal/Naturschutz) during the construction of the railway.

It was originally foreseen that the line would run along the banks of the river. However, Pichler was concerned on the effect this would have on the appearance of the valleys landscape and that it would separate the villages from the river. Additionally, the Donau was and is prone to regular flooding, so it was decided to construct the line further away from the river at a higher elevation. This alignment changes greatly increased the cost of construction due to the need for more tunnels and the sharp curves required limit the lines maximum speed into the present day.[152] The lines many tunnels as well as the proximity to unstable rock faces led to high upkeep costs throughout the line's history.

Early railway construction in Austria placed a high value on incorporation of the railway into the natural landscape. The most prominent example of this is the Semmering railway between Gloggnitz and Mürzzuschlag. Constructed under the lead of civil engineer Karl Ritter von Gegha in the early years of railway expansion in 1854, the railway was acclaimed from the start for both opening up the landscape to visitors but also its harmonious integration into the landscape. The railway along with the

[149] (Hofstetter, 2018)

[150] (Hanus, 2014)

[151] (Österreichisches Biographisches Lexikon, 2020)

[152] (Hofstetter, 2018)

surrounding landscape has been a UNESCO protected world heritage site since 1986. The inspiration of the Semmering had a large impact on further railway construction, especially in similar areas of natural beauty like the Wachau. Mayreder and Pichler were very careful in their planning that the natural beauty of the landscapes along with the centuries old villages were not damaged.

Where it was necessary to alter the landscape or built environment changes were handled with care to minimize damage to the historic materials. In Spitz an der Donau the railway passes through a part of the 16th century old century Rathaus (city hall) which was able to be kept largely intact.

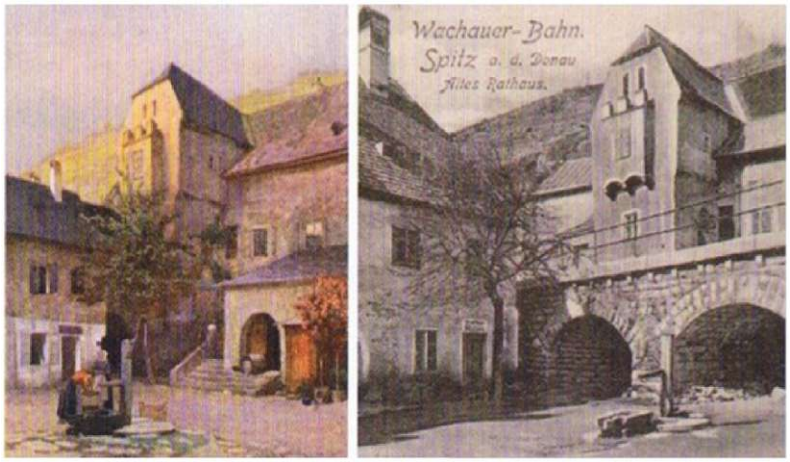


Figure 21: A before and after comparison of the Altes Rathaus in Spitz where the railway passes directly through the building. Source: (Hanus, 2014)

Pichler created standard station design with several variants was developed with a style intended to blend with the architectural vernacular of the region.

The first test run between Krems and Grein was carried out on November 9th, 1909, with the one locomotive and 16 wagons. The opening ceremony was conducted approximately a month later on December 2nd by Kaiser Franz Josef I. On December 4th, 1909, regular service began with 3 mixed train pairs. The railways operation was initially carried out by the KkStB. under contract from the Lokalbahn Aktionsgesellschaft. Trains were operated from the beginning with locomotives of the kkStB series 99, light duty 2-6-0 tank locomotives with a maximum speed of 60 km/h.[153] The maximum permitted speed on the line at this time was between 40 and 60 km/h.

The railway greatly increased the accessibility of the area which led to a strong growth of tourism and an economic boom to the area. Tourists flocked to the region to view the dramatic landscapes or visit Heurigen which are establishments on vineyard premises where local wine can be sampled. As a result, from 1912 service was increased to 6 train pairs a day. However, this trend was broken by WWI and traffic declined due to the postwar economic depression and coal shortage. As competition from road traffic increased the railways introduced new rolling stock in an attempt to reduce costs. In 1926 diesel railcars were introduced for express services reducing both travel times and operating costs. From 1927 to 1931 the BBÖ ordered 167 examples of the Class 378 2-8-2 tank locomotives. These locomotives were designed to replace the older and varied fleet of locomotives in service on branch lines throughout Austria. Though having the same top speed as the older kkStB 99's (redesignated as BBÖ Class 91s) the locomotives had a better tractive effort and the large order of locomotives helped standardize parts inventories and maintenance costs. The locomotives proved very reliable in service and were some of the last steam locomotives to operate for the Federal railways.[154]

[153] (RegioWiki AT, 2021)

[154] Ibid.

As part of the reorganization of the Austrian railway network in the post WWI era, the railway ownership was transferred to the BBÖ in 1930, 8 years after the state takeover of the Lower Austrian State railway (Niederösterreiches Landesbahn) which owned many branch lines in Lower Austria. The second world war in the following decade had little long-term impact on the railway, during the war years it saw increased use as all railway lines, but the line was for the most part spared damage due to lack of strategic importance. In the last days of the war Krems was heavily bombed including the railway station but this was quickly repaired following the end of the war.[155] The postwar rebuilding of Austria would however bring many changes to the area and the railway.

8.3 Auto oriented postwar development

Since its inception, the railway was the only efficient means of land transportation through the Wachau valley. This however changed in 1958 with the opening of the Federal Road (Bundesstraße) 3 on the northern bank of the railway.[156] With the opening of this fast road and ever-growing motorization the railway was now faced with stiff competition.

Historically there were no fixed crossings of the Danube along the entire line between Stein and Mauthausen, with ferries crossing the river at Dürnstein, Weißenkirchen, Spitz, Melk, Pöchlarn, Marbach and Ybbs. The ferries were generally operated by the municipalities and were a significant source of revenue. The southern side of the river between Emmersdorf and Persenbeug, due to its relatively flat geography and the presence of the Westbahn railway was historically better developed with more job prospects. Therefore, the segment of the railway through the Nibelungengau was always faced with lower passenger counts due to not following the main flow of transport in the area. However, the lack of a fixed connection inhibited to a large degree commuting between the two sides of the river and Krems continued to be the primary relevant destination for towns on the northern side of the river.

In the postwar era of rapid motorization however this situation changed with significant impacts on the flow of commuters in the region. The first fixed connection opened in conjunction with the hydroelectric powerplant at Ybbs-Persenbeug in 1959 allowing for a fast, high-capacity connection across the Danube. Furthermore, the dam and crossing were located significantly north of the town center of both Ybbs and Persenbeug making the crossing primarily useful for automobile users, further spurring motorization particularly on the northern bank. The railway due to its east-west orientation could not compete for these commuter flows.[157]

Further changes to the commute structures occurred in 1972 with the opening of a new dedicated road bridge between Emmersdorf and Melk, replacing the already heavily frequented ferry. Melk is a significant destination for employment and the direct connection made daily commuting from one side of the Danube more easily possible. However, the bridge also brought negative effects for the Wachau and its residents. With its opening, heavy goods vehicles from Krems could now take a shorter route through the Wachau to reach the A1 at Melk versus the longer S33 to St. Pölten. To handle the increased traffic, it was planned to widen the B3 through the Wachau. However, a survey conducted in 1983 by the Lower Austrian state government showed that 70% of the heavy vehicle traffic on the B3 was through traffic. This study along with complaints from area residents prompted the enaction of a ban in 1985 on transit of goods vehicles over 7.5 tons, on both sides of the Danube on the B3 and

[155] (Vock, 2015)

[156] (Posch, 2012)

[157] (Hofstetter, 2018)

B33. Heavy vehicles are only allowed for local traffic and the weight limit was further reduced to 3.5 tons in 2004. A third bridge at Pöchlarn was opened in 2001, once again due to the distance of the bridge from the relevant town centers it primarily benefited motorized traffic. With three fixed crossings of the Danube between Emmersdorf and Persenbeug the traffic flows of the area are oriented overwhelmingly south of the river and the importance of traffic towards Krems and thereby the railway has been severely eroded. The construction of the bridges in the Wachau segment is however prohibited due to the areas UNESCO World heritage status nor would the construction of such bridges be beneficial due to the topographical and demographic characteristics of the southern side of the river in this segment.

Throughout the 1950s and 60s the railways timetable remained relatively constant with 5 weekday train pairs traversing the entire line. With the economic recovery of the country, the replacement of steam traction started in earnest. In the early 1950s the class 5145 high speed diesel railcars with a top speed of 115 km/h were introduced for express long distance and international services. The vehicles proved immensely popular in service and much cheaper to operate than conventional trains. To replace both, steam powered services and older prewar DMUs the class 5046 was developed with a lower top speed of 100 km/h for service on secondary lines. In 1954 the 5046 diesel railcars were introduced on the Donauuferbahn followed by further vehicles of the similar 5146 series. In addition to regular services, these railcars were used for express services from Vienna continuing onto Graz during the summer tourist season. With the introduction of the new vehicles the line speed of between Krems and Grein was raised from 40-50 km/h to 75 km/h in 1967. The introduction of the class 2045 mainline diesels in 1969 spelled the end for steam traction and the line saw its last regular steam hauled train in 1972.

From the mid-1970s the offer on the middle segment of the line began to be reduced because of shifting commute patterns with the construction of the fixed river crossings at Persenbeug and Emmersdorf. As with other branch lines, the threat was not only cars but also buses operated by ÖBB's KWD subsidiary. On certain parts of the line, especially west of Spitz some degree of parallel traffic was a necessity to maintain direct bus connections between Melk and Pöchlarn and the Waldviertel hinterland. However, on the most frequented portion of the line between Spitz and Krems the KWD also operated the 1431 in parallel traffic to the railway. In 1970 the 1431 had two courses in each direction on weekdays operating up to Spitz Hinterhaus. Furthermore, little effort was made to coordinate other bus lines with the railway, while connection information was printed in the bus and rail timetables, connections were often unattractive with an hour or more of waiting in some cases. The following figures are a snapshot of the transportation situation in 1981 before the first modernization efforts began on the line.

Zug Nummer			6125	6121	6143	6123	6131	6113	6145	6103	6133
Grein Bad Kreuzen	an	...	...	...	...		7:22	8:14	...	10:30	13:10
	ab	...	4:35	...	...	5:15	7:24	8:15	...	10:31	13:10
Grein Stadt		...	4:37	...	...	5:17	7:27	8:18	...	10:34	13:13
St. Nikola-Struden Hu		...	4:43	...	...	5:23	an	8:26	...	10:42	an
Sarminstein		...	4:47	...	...	5:27	...	8:30	...	10:55	...
Hirschenau-Nöchling Hu		...	4:52	...	...	5:32	...	8:35	...	11:00	...
Weins Isperdorf		...	4:59	...	...	5:39	...	8:42	...	11:10	...
Persenbeug		...	5:07	...	...	5:46	...	8:48	...	11:18	...
Marbach-Maria Talferl		...	5:15	...	...	5:53	...	8:56	...	11:27	...
Klein-Pöchlarn		...	5:22	...	...	6:00	...	9:03	...	11:34	...
Lehen-Ebersdorf Hu		...	5:27	...	...	6:06	...	9:08	...	11:40	...
Weitenegg		...	5:31	...	...	6:10	...	9:11	...	11:44	...
Emmersdorf a d Donau		...	5:36	5:43	6:19	6:16	...	9:17	...	11:51	...
Grimsing Hu		...	5:41	5:47	6:23	6:21	...	9:22	...	11:57	...
Aggsbach Markt Hu		...	5:48	5:54	6:30	6:28	...	9:28	...	12:04	...
Willendorf		...	5:52	5:58	6:35	6:32	...	9:33	...	12:09	...
Schwallenbach		6141	5:55	6:02	6:40	6:35	...	9:36	...	12:13	...
Spitz a d Donau		5:15	6:00	6:08	6:45	6:40	...	9:43	11:15	12:19	...
Wösendorf-Joching Hu		5:20	...	6:13	6:51	6:48	...	9:48	11:20	12:24	...
Weißenkirchen i d Wachau		5:24	...	6:18	6:55	6:53	...	9:53	11:24	12:29	...
Dürnstein-Oberloiben		5:32	...	6:26	7:03	7:02	...	10:01	11:33	12:38	...
Unterloiben Hu		5:35	...	6:30	7:06	7:08	...	10:04	11:36	12:42	...
Stein-Mautern		5:39	...	6:33	7:10	7:14	...	10:08	11:40	12:46	...
Krems a d Donau	an	5:44	...	6:38	7:15	7:20	...	10:13	11:45	12:53	...
		E875	6241	↓		6173	TE877	6175	E775	6201	
Krems a d Donau	ab	5:46	6:05	6:45		7:29	8:15	10:20	11:50	13:14	...
Wien		6:58	-	-	-	8:55	9:24	11:25	13:10	-	...
Schönberg am Kamp		-	6:37	-	-	-	-	-	-	13:39	...

Figure 22: Timetable image of the Donauuferbahn from 1981 timetable. Only morning eastbound direction shown. Source: ÖBB Kursbuch Winter 1981, redrawn by author for clarity

The railway schedule in 1981 was primarily oriented towards the traditional work commute times, with major gaps in the timetable as long as 3 hours. For example, between 6:40 and 9:40 there were no trains between Spitz and Krems in what should have been peak commuting times, especially for the growing service sector. Some early morning courses had already been replaced by bus.

— 455 — 1431, 1438

1431 Krems an der Donau Bf—**Spitz/Hinterhaus**

km		1603	1605★	1607★		Kbl Hütteldorf Nebenstelle Krems	1604	1606	1608	
				⊖	▲		⚒			
0	...	...	11.50	16.30	17.15	ab **Krems** Bf ... an	8.10	14.10	18.55	...
2	...	...	11.55	16.35	17.20	Stein Café Homar ...	8.05	14.05	18.50	...
6	...	...	12.02	16.42	17.27	Unter Loiben Gh Knoll ...	7.58	13.58	18.43	...
8	...	...	12.04	16.44	17.29	Ober Loiben Haus Riesenhuber	7.55	13.55	18.40	...
10	...	...	12.10	16.50	17.35	Dürnstein Ortsmitte ...	7.50	13.50	18.35	...
13	...	▲	12.13	16.53	17.38	Heudürr ...	7.45	13.45	18.30	...
15	...	7.00	12.20	17.00	17.45	Weißenkirchen Gh Donauwirt ..	7.40	13.40	18.25	...
17	...	7.03	12.23	17.03	17.48	Joching Strkrz ...	7.37	13.37	18.22	...
19	...	7.05	12.25	17.05	17.50	Wösendorf Lesehof ...	7.35	13.35	18.20	...
20	...	7.07	12.27	17.07	17.52	St Michael Parkplatz ...	7.33	13.33	18.18	...
	...	7.11	12.31	17.11	17.56	**Spitz** a d D Bf ...	7.29	13.29	18.14	...
	...	7.15	12.35	17.15	18.00	an **Hinterhaus** Gh Prankl ... ab	7.25	13.25	18.10	...

Figure 23: Schedule for bus 1431 in 1981.

The service of the bus 1431 had meanwhile been increased to 3 courses per day with an extra early morning course between Weißenkirchen and Spitz. The buses generally filled in the gaps in the train timetable but operated at peak hours taking away valuable traffic from the railway. Furthermore, the tariff between bus and rail was not harmonized. The tariff for buses at this time was distance based and the 20 km between Krems and Spitz cost 16 (3.47 euros) schilling per the 1977 timetable. Per the 1981 timetable the cost for the same segment by rail was 24 schillings (5.21 euros).

8.4 Modernization of the railway

The Donauuferbahn had long been a target for closure by the ÖBB, the line was considered unprofitable due to the large number of manned stations and the relatively low ridership especially in the middle segment of the line. In the 1980s the ÖBB instituted several cost saving measures on the Donauuferbahn and other branch lines to reduce costs. The line was used as a pilot line for the implementation of Zugleitbetrieb or in US railway parlance track warrant control starting in 1983. Zugleitbetrieb is a method of train control where movement authorities for trains are given by radio by a central dispatcher. These movement authorities are given between fixed points, generally stations. When or before a train reaches the end of its movement authority it must request the next needed segment from the dispatcher and must verbally confirm when they have left the previous segment. The system is well suited for lines with relatively low utilization where the cost of station staffing can be prohibitive. Station staffing was eliminated at most of the stations on the line except for Spitz an der Donau where the central dispatching center was set up. The traditional main-distant semaphore signals were also removed with only signals indicating switch position and the integrity of level crossing protection. To enable the elimination of the station staffing crossing stations are equipped with spring switches (Ruckfallweichen) which can be driven over even when lined for the opposite track and automatically return to place. The switches at either side of the station are set for opposite tracks to allow trains to meet without any switches needing to be changed. To increase safety, vehicles assigned to the line were equipped with GPS devices, to track the position of the vehicles. If the vehicle entered a segment without permission the driver would be notified by warning tone by the dispatcher.

The operating situation was further improved starting in 1988 with the replacement of the old 5046 and 5146 diesel railcars with the newly delivered Series 5047. In these vehicles, that operated without a Zugbegleiter (train attendant), with the train driver was responsible for selling tickets, however ticket machines were soon installed in the vehicle to avoid delays from the driver having to sell tickets. In the final two decades the vehicles almost entirely took over services on the line except for some peak hour trains which operated with traditional locomotive and coach formations. The 5047 is known in Austria as the savior of the branch lines and indeed came at an important time when the entire branch line network was in danger. Almost all these vehicles are still in service today and will likely continue as the primary workhorse of the Austrian branch line network for years to come. Today however despite their robust performance and high level of passenger comfort, they are considered in need of replacement as they no longer meet the requirements for barrier free accessibility.

The 1980s however brought a further change that while was an improvement for the complete transport system had negative effects on the Donauuferbahn. For much of the lines history there were direct train services between Wien Franz Josefs Bahnhof and Mauthausen/St. Valentin. However, this changed with the electrification of the Franz Josefs Bahn between Absdorf-Hippersdorf and Krems in 1982. Passengers either had to change in Krems or locomotives had to be exchanged at Krems, this traction change was unattractive from a scheduling point of view and the number of direct trains was reduced following the electrification.

In 1991 the ÖBB introduced a new Taktfahrplan on the model of the Swiss model, named the Neuer Austrotakt (NAT 91). The Donauuferbahn was included in this timetable with a frequent, attractive schedule. In the morning peak there was a dense eastbound schedule towards Krems with 4 arrivals between 5:47 and 7:33, after which trains operated on an irregular but frequent schedule aligned with departures from Vienna. Even at this late date there were still 8 train pairs that operated along the whole line with more frequent interval between Krems and Spitz and St. Valentin and Grein. The timetable offered good connections throughout the day in all directions from Krems. During this time

the R44 line was run as a separate service between St. Pölten to Krems and Krems to Sigmundsherberg. In the direction of Sigmundsherberg there was generally a good connection though sometimes requiring a further change in Hadersdorf. In other cases, the Eilzug (Express train) connections were timed to meet the R44 again in Hadersdorf which could be useful in the chance of a late Donauuferbahn train (transfer time in Krems was only 3 minutes). However, the parallel bus service was also expanded, with the line 1431 now having 4 courses in both directions, of which most also had good connections to onward trains to St. Pölten and Vienna. In a study by Knoflacher in 1992, the railway was losing approximately 150 passengers per day to the parallel buses, even at this low level of service.[158] The railway timetable is in general was still oriented around the traditional working schedule with many early morning courses but no service at all after 8 PM.

The following is a summary of the Donauuferbahn schedule from the NAT 91, with the inclusion of onward connections.[159]

Table 13: Schedule for Krems Taktknoten under the NAT. Source: ÖBB 1991 Kursbuch

Krems Interchange – Eastbound direction				
Arrival from	**Time**	**Departure to Vienna**	**Departure to St. Pölten**	**Departure to Sigmundsheberg/Horn**
Grein -Bad Kreuzen	5:42	5:48	5:47	
Aggsbach Markt	6:15	6:18*	6:26	
Emmersdorf	6:39*	6:46	6:49	
Grein -Bad Kreuzen	7:13	7:33		7:36
Aggsbach	7:52	8:20	8:04	8:33 (from Hadersdorf)
St. Valentine	9:27	9:38		9:30 (+9:48 Hadersdorf)
Spitz	9:59	10:20	10:02	10:33 (from Hadersdorf)
St. Valentine	11:27	11:38	11:42	11:30 (+11:48 Hadersdorf)
Spitz	11:59	12:20	12:02	12:33 (From Hadersdorf)
St. Valentine	13:27	13:32	13:28	13:36
Spitz	13:59	14:20	14:02	14:33 (From Hadersdorf)
St. Valentine**	15:27	15:38	16:02	15:30 (+15:44 from Hadersdorf)
Spitz	15:59	16:20		16:33 (From Hadersdorf)
Spitz	16:34		16:49	**17:01**
St. Valentine	17:28	17:32		17:36
Spitz	18:00	18:20	18:02	18:33 (From Hadersdorf)
St. Valentine	19:27	19:38		19:48 (From Hadersdorf)
Aggsbach	19:59	20:20	20:02	20:33 (From Hadersdorf)
Spitz	**21:30**	**21:38**	21:33 (BUS)	

[158] (Knoflacher, 1992)

[159] (OEBB, 1992)

Table 14: Schedule for Krems Taktknoten under the NAT. Source: ÖBB 1991 Kursbuch

Krems Interchange – Westbound direction				
Departure to	**Time**	**Arrival from Vienna**	**Arrival from St. Pölten**	**Arrival from Sigmundsherberg/Horn**
St. Valentine	4:50			
Aggsbach Markt	6:17		5:46	6:02
St. Valentine	6:50	6:39		6:21 (Transfer Hadersdorf)
Grein	7:31	7:14	7:16	7:04
St. Valentine	8:50**	8:39	8:13	8:16(Transfer Hadersdorf)
Spitz	10:20	9:56	10:11	9:12
St. Valentine	10:50	10:39		10:16 (Transfer Hadersdorf)
Spitz	12:20	11:56	12:11	11:12
St. Valentine	12:50	12:39		12:16 (Transfer Hadersdorf)
Emmersdorf	13:36		13:26	13:14
Spitz	14:20	13:59	14:11	
St. Valentin	14:50	14:39		14:16 (Transfer Hadersdorf)
Spitz	15:35		15:26	15:12
Spitz	16:20	15:56	16:11	
St. Valentin	16:50	16:39		16:16 (Transfer Hadersdorf)
Spitz	17:06	16:59	16:57	
Marbach	17:39	17:31	17:26	17:19
Aggsbach	18:20	17:58	18:11	
Grein-Bad Kreuzen	18:50	18:40		18:21 (Transfer Hadersdorf)
Spitz	20:15	19:56	20:11	19:43 (Transfer Hadersdorf)

**Through coaches to/from Vienna*

***Direct bike train*

The NAT could indeed have been the savior of the Donauuferbahn and indeed the branch lines in general. The timetable dramatically reduced travel times through good connections, greatly increasing the viability of the branch lines. However, in 1996 the new timetable concept, known as the OPV 96 (Optimierter Personenverkehr) was a radical reversal of the changes introduced with the NAT 91. Almost all the timed connections at Krems were broken with only one pair of trains having a useable connection in Krems.[160] The new 1996 timetable also saw the elimination of all through services on the line except for the summer tourist trains. The segment from Sarmingstein to Persenbeug still saw several weekday services from Upper Austria. These were slowly cut back to Weins and eventually to St. Nikola Struden in 2001.[161]

In 2000, the Wachau was inducted into the UNESCO World Heritage List. The railway and associated structures between Krems and Emmersdorf were included in the listing, theoretically ensuring their long-term preservation. Given that the line has been abandoned starting immediately outside of the

[160] (Hofstetter, 2018)

[161] Ibid

buffer area of the Wachau, the UNESCO designation may well be a prevailing factor in the lines continued existence.

In 2000 Eric Czismadia surveyed the remaining branch lines in Lower Austria and his Diploma thesis offers a snapshot of the line at the time. By this time there was only one regular train pair that operated the whole line outside of the summer tourist season, in the summer there were a further two trains including a direct train from Vienna. In the Wachau there were 17 westbound trains and 18 eastbounds, the majority of these operated up to Emmersdorf though some terminated in Spitz or Aggsbach. Most trains were operated with the then relatively new 5047 Railcars, with only some school hour trains operating with locomotives and 3-4 Schlieren wagons. Based on Czismadia's passenger counts, taken from 35 trains the line had an average weekday ridership of 2,109 passengers. The occupancy of the trains decreased linearly with the distance from Krems. School traffic was a primary source of ridership, with on some trains school commuters making up 80 to 90% of the ridership, the line was also well used for commuters towards Vienna. The line had some of the highest ridership of the branch lines surveyed, including higher ridership than some lines that the ÖBB chose to retain in 2010. [162]

Between 1996 and 2005 the ÖBB made extensive investments in the line, with numerous bridges renovated or completely replaced between St. Nikola and Marbach. In 2002, despite the open discussion about the line's future, a new halt was opened in the western area of Krems for the new Krems Danube University. The station is situated directly in the campus and provided students a direct connection to the Krems main station.[163] Further investment was made as late as 2003 to the by then seldom used middle segment, with track renewal between Weitenegg and Lehen-Ebersdorf including a new platform at Lehen-Ebersdorf station. However, with the introduction of ÖBB's Zielnetz 2025+ planning document in 2006 there was an investment stop in all lines not included in the plan, and from then on only regular maintenance to enable daily operation was carried out. Therefore, more and more slow orders developed in the middle segment, and it became impossible to maintain the current timetable. Thus, travel times had to be lengthened, further decreasing the attractivity of the line.[164] During this time there was a private initiative to use the line for a Munich to Budapest luxury cruise train which would operate with former DB diesel ICE-TD's. However, with the deteriorating track condition of the middle segment interest waned.[165]

The Donauuferbahn had historically been an important detour route for the Westbahn, which was susceptible to flooding in certain segments. In 1993 the line fulfilled this function for one of the last times after the Westbahn was shut down due to a fatal head on collision in Melk. During the closure many long-distance passenger trains were rerouted over the Donauuferbahn. However, the 1994 Sittenbergtunnel, part of the Westbahn reconstruction project bypassed the segment between Ybbs and Krummnußbaum that was particularly susceptible to flooding. This along with modern railway practices which dictated that trains either should run as scheduled or not at all, diminished the lines importance as a detour route.

The future of the middle segment of the Donauuferbahn became abundantly clear with the introduction of the 2005 timetable. The Donauuferbahn was divided into two timetable sheets, sheet 811 from Krems-St. Nikola Struden and 133 from St. Valentin-St. Nikola signifying the end of the line

[162] (Csizmadia, 2000)

[163] (APA OTS, 2002)

[164] Field survey, (Knoll, 2013)

[165] (Knoll, 2021)

as a through route.[166] With the low track speeds due to the many slow orders, the operation of regular passenger traffic was hardly possible and from 2006 the only through service on the middle segment was the summer only "Erlebniszug". The ÖBB Erlebnisbahn was an initiative by the railways to develop tourism using the railways historic vehicle fleet. Older equipment was deployed for tourist traffic and trains were marketed to tourists and in the case of the Donauuferbahn particularly to bike tourists with the addition of a bike wagon to most trains. The trains generally operated with a Class 2143 diesel, several Schlieren wagons and a bike boxcar. Two pairs of Erlebniszüge known as *EZ Wachau* which originated in Vienna and *EZ Strudengau* which originated in Linz operated over the complete line. These trains continued as the last trains over the middle segment until their withdrawal in 2009. The Erlebnisbahn program itself would come to an end in the following years, the nostalgic program was no longer fit within the ÖBB's core mission nor the image it was looking to project. One of the last vestiges of the program, the Vienna to Danube bicycle train was discontinued in 2020 when the federal government decided not to continue funds for the service.[167] In the final years of regular service, frequent passenger service only operated on the 18 km segment between Krems and Spitz an der Donau, with limited numbers of trains continuing to Emmersdorf.[168]

8.5 Modern day developments

The 100th year anniversary of a rail line should normally be the cause for celebration but for the Donauuferbahn the 100th anniversary would also mark the lines death. The ÖBB and the state authorities, who had already agreed on the lines closure had no interest in a celebration. Nevertheless, celebrations were locally organized to both mark the anniversary of the lines opening and in attempt to draw attention to the line's future. The towns of Marbach and Persenbeug, both SPÖ districts at the time in particular held events for the anniversary. In Spitz at the ship museum a special exhibit was opened celebrating the 100th anniversary of the railway.[169]

The line was included in the sale of 630 km of track to state of Lower Austria in 2010. Regular passenger service was discontinued with the timetable change on December 11th, 2010, after which rail service was substituted by buses. Freight traffic was concurrently ended on the entire Lower Austrian segment despite the presence of several customers shipping block trains. Ironically just a month after the cessation of passenger services the area was hit by flooding up to 6 meters which shut down both the B3 and B33 highways. The flood safe railway was already closed and as such the tariff organization had to pay for bus passengers to take taxis on a long detour through the Waldviertel. As a result of this experience, a special agreement was put into place in the case of flooding where trains would operate on a special timetable with acceptance of regular VOR fares which occurred in 2014 when another round of flooding hit the area. [170]

The NÖVOG had been given an insufficient budget for the rehabilitation of the lines taken over from the ÖBB and thus money primarily went to the Mariazellerbahn, as well as the already established tourist operations on the Waldviertelbahn and Retz-Drosendorf line. Due to the 2000 induction of the Wachau, including the railway into the UNESCO World Heritage List, a complete abandonment of the line was out of the question. The state however had no interest in continuing regular passenger service

[166] (Hofstetter, 2018)

[167] (Kiefer., 2019) , (Knoll, 2021)

[168] Ibid

[169] (Hofstetter, 2018)

[170] Ibid

and instead sought to develop the line for tourist traffic. Tourist traffic was inaugurated in 2011 between Krems and Spitz with the Wiener Lokalbahn hired as the railway undertaking for operations. The equipment originally used consisted of a class 2143 diesel locomotive with Schlieren wagons purchased from the ÖBB, identical to the equipment used on the former ÖBB Erlebniszüge.[171] The initial operating concept was similar to that of the current Reblaus Express where local wine and refreshments were offered onboard the train with higher ticket prices than today. However, the concept for numerous reasons, including the short duration of the journey was not successful.[172] In 2016 the railway purchased 5 Siemens-Duewag RegioSprinter DMU's from the Vogtlandbahn in Germany which have handled services since. The vehicles were an early attempt to develop a lightweight DMU for use on branch lines to replace aging Schienenbus. Due to technical flaws only 40 examples were built. NÖVOG was able to acquire the vehicles for 3 million euros altogether including the costly installation of air conditioning as they were not previously equipped. The vehicles have since been the exclusive rolling stock in use with the Wachaubahn with the older equipment transferred to other lines or sold.

The touristic potential of the line decreases significantly west of Emmersdorf, with the primary market served being users of the Danube bicycle trail. The NÖVOG viewed the segment between Emmersdorf and Sarmingstein as having limited touristic potential and at the same time very high costs for reactivation. However, the communities along the line wanted a weekend tourist offer to be developed, as some such as Marbach rely primarily on tourism. Therefore in 2013 a study was commissioned by the NÖVOG to assess the touristic potential of the segment and develop a potential operating plan. It was estimated at the time that a tourist offer from Grein to Krems had the potential for 20,000-25,000 passenger per year. The operation would require a yearly operational subsidy of 70,000-160,000 euros per year, however the largest issue was the infrastructure costs. To renovate the infrastructure, 9.5 million euros would be needed. A further approximately 5 million would be required for attractivity measures and the acquisition of additional rolling stock. Due to this high cost the study recommended a partial implementation of this plan, with the extension of the existing tourist line Weitenegg and on the western side a tourist line from Grein to Persenbeug. [173]

The western segment of the line had in the final years a greater importance for freight traffic than for passenger. Until the discontinuance of service by the ÖBB, the railway served a ballast quarry at Loja and roundwood loadouts in Weins, Persenbeug and Klein Pöchlarn with freight trains operating three times a week.[174] The Loja quarry was and is an importance source of track ballast and at the time of closure ballast was being shipped from the quarry for use on the Westbahn 4 tracking project. Furthermore, there was significant potential for wood transport at several loading points. At Weins-Ispersdorf the Habsburg-Lothringen'sche Gut Persenbeug maintained a large wet timber storage facility[175] that had previously loaded trains. However, after the lines closure the company had to switch to truck incurring significant costs. Due to efforts by the company, the line was briefly reactivated in early 2013 for the transport of timber, however service was then discontinued again until March 2015 when regular freight service resumed. Timber trains have since operated on customer demand between Weins and the Lenzing in Upper Austria, the site of a large mill. Services are operated by Rail Cargo Austria under open access conditions from the NÖVOG. As with the segment between Krems

[171] Ibid

[172] (Knoll, 2021)

[173] (Knoll, 2013)

[174] (Hofstetter, 2018)

[175] Cut timber must be kept wet to avoid deterioration

and Emmersdorf the line was reopened as an Anschlussbahn, however almost no significant maintenance has been carried out and trains can only operate at reduced speed. [176]

With the reactivation of the Sarmingstein to Weins segment there was hope that further segments of the line could also be reopened for freight traffic. Despite the demand for rail service, there remained a question of who would pay for the rehabilitation of this segment. The line segment between the state border and Persenbeug was in the worst shape of the entire line with many defective sleepers. The two block concrete sleepers used here no longer maintained their integrity and had the tendency to flex under the weight of a train risking a derailment even at low speed.[177] The railway operator Grampet Rail Austria was interested in operating trains to serve both the quarry and the wood loading industry, however the responsibility for maintaining the infrastructure fell to the state and not the railway operators. Since 1999 the Austrian government has offered an assistance program for the construction and rehabilitation of railway sidings, and this could have provided some money towards the rehabilitation. According to the 2008 version of the BMVIT legislation, titled "Programm zur Unterstützung des Ausbaues von Anschlussbahnen" (support program for the reconstruction of connecting railways) (BMVIT, 2008), the program would cover 30% of the construction costs for rebuilding of a railway siding up to a cap of 2.5 million euros. The NÖVOG had however little interest in the project as they stood to gain only a small amount of revenue from track access fees for the freight traffic. NÖVOG wanted to the Loja work to pay for a part of the rehabilitation costs for the line and a study was carried out on the feasibility and costs.

The 2014 study however revealed higher costs than what Loja was willing to pay and without any financing from the land the fate of the segment was sealed.[178] The touristic concept up to Persenbeug was rejected for the same reason.

Due to the line's characteristics, the conversion of the line into a railbike or draisine route was not considered. Despite the attractive scenery, the ever-present chance of rockfalls and many road crossings with poor sightlines made it unattractive for this purpose. Furthermore, this usage would have required tunnels to be rehabilitated and lighted. Museum operation was also not considered as most museums in Lower Austria were already stretched thin financially and the line would be expensive to maintain on a purely volunteer basis. With no funding for the reactivation of the line for freight or tourist traffic the NÖVOG applied to abandon the line between Weitenegg and Weins in 2016.[179]

The abandonment request, (Auflassungsverfahren) was approved in June 2017 and the NÖVOG was given up to December 31st, 2019, to remove track material from the line.[180]

The lines abandonment faced a significant grass roots opposition from communities in the segment to be abandoned. Political opposition was concentrated in Persenbeug and Marbach, however in Klein Pöchlarn there was no significant opposition and the town quickly put forward a plan to purchase and repurpose the station are for additional housing. The transport advocacy group, Verkehrswende Niederösterreich organized protests under the banner "Donauuferbahn Jetzt!" in an attempt to stop the scrapping of the railway line, and particular demolition of bridges.[181] Of the affected Gemeinde Persenbeug and Marbach were most vocal in their opposition of the abandonment. Persenbeug stood

[176] (Hofstetter, 2018)

[177] (Knoll, 2021)

[178] (Schwaiger-Götsch., 2014)

[179] (Hofstetter, 2018)

[180] (Faltner, 2017)

[181] (Streimelweger, 2018)

the most to lose from the abandonment as ballast from the Loja quarry would instead have to travel by city streets.[182] The protests brought some delays, however failed to stop the scrapping of the railway. The state of Lower Austria despite the protest stated that the demolition of the line was legally required by the Eisenbahngesetz and therefore could not be stopped despite the communities wishes.[183]

The NÖVOG further wished to scrap the segment, as there were significant amounts of track material still in good condition that could be used. Indeed, much of the useable salvaged material was used for a major track renewal project on the Krems to Emmersdorf segment in 2018.[184]

Despite all the protests, the demolition of the line was carried out as planned with the final segment removed before the end of 2019. Between Emmersdorf and Weins there is already a dedicated bike path that runs directly along the river, therefore the reuse of the railway alignment here for biking was not attractive. Furthermore, the several tunnels and potential for rockfalls would be a hazard. As such the NÖVOG has begun the process of selling off the right of way. In Klein Pöchlarn the former station area has been purchased by the city for construction of new housing. In Marbach, a printing firm is looking to acquire a segment of the line in order to expand their facility. Many smaller plots along the line have been sold to adjacent property owners. However, the NÖVOG has retained the right to repurchase a 6 meter right of way for the potential reactivation, and owners do not have to be compensated for improvements made to the property. Therefore, the theoretical possibility of the lines reactivation still remains.[185]

In 2019 the NÖVOG reactivated the segment from Emmersdorf up to Weitenegg for construction trains as the former freight station provides an optimal place for staging of track construction materials. The station is planned to eventually become the end station for the Wachaubahn tourist line, as the station is more attractive than Emmersdorf with the adjacent Donausee recreational area, level with the Danube bike trail and easy offers connection possibilities for bus lines and tour buses. The activist's group, "Donauuferbahn Jetzt!"is still promoting the reconstruction of the line. The goal however has become more and more difficult by the year as more of the right of way is sold off and potentially redeveloped.[186] While the railways removal had significant opposition, there is limited political support for the reconstruction of the railways among the affected municipalities. The town of Marbach, which was most vocal in the opposition of the railway is the only one officially in the favor of the proposal for the reconstruction of the railway.[187]

8.6 Development of the railway in Upper Austria

The Donauuferbahn in Upper Austria has had a distinctly different fate from the line in Lower Austria. The railway in upper Austria has a clear commuter flow towards St. Valentine and more importantly Linz. The railway passes through several larger towns, Grein with a population of approximately 3000 and Perg with one over 7000 are particularly important stops for the railway. With its more favorable demographics and commuter flows, the line became an indispensable transport mode for the region and has been consistently improved with better schedules to increase attractiveness.[188] In 2005 the

[182] Ibid.

[183] Ibid.

[184] (Knoll, 2021)

[185] (Schweiger, 2020)

[186] (Schweiger, 2021)

[187] (Schweiger, 2019)

[188] (Hofstetter, 2018)

Ennsdorfer Schleife (connecting curve) was opened, enabling direct trains to Linz. Today trains operate on an hourly schedule up to St. Nikola Struden with more departures from Grein in peak hours. Departures alternate between terminating in St. Valentine or running directly to Linz, and during peak hour most of the line sees a half hour frequency. The line has been fully modernized with barrier free platforms and trains are operated with low floor Desiro type DMU's.

The last station in Upper Austria, Sarmingstein however lost its rail service in 2019. The decision was the result of low passenger volumes and the existence of good bus connections to the area. The stop is well served by buses 380 which operates between Waldhausen and Amstetten, and bus 389 from Waldhausen to Linz Voestalpine. operating as an express service between Grein and Linz. It should be noted here that the bus 389 operates in parallel traffic to the railway for most of its route, and is therefore not an optimal situation, however it operates with the primary intention of bringing workers to the Linz steelworks which are not easily reachable by rail. [189]

As part of ÖBB's Zielnetz 2025+ the line up to St. Nikola Struden is to be electrified, with the measures planned for completion by 2028.[190]

8.7 Historical background takeaways

The current state of the Donauuferbahn is the result of several conditions, some inherent and others created due to policy. Inherently the topography and settlement structure of the region around the railway played a major role in the line's usage. The railway has four distinct segments with different travel patterns:

- From Krems to Spitz/Emmersdorf the line is well aligned with the prevailing travel pattern towards Krems (and onward towards St. Pölten and Vienna), this is however only partially true west of Spitz where there is a significant flow towards Melk and St. Pölten via a different route. The line in this segment has a very high touristic potential and tourist traffic has always played a significant role here.
- From Spitz/Emmersdorf to Persenbeug is in general poorly oriented towards the transportation needs to the region. In this segment most of the traffic goes south of the river and Krems has hardly any influence. The construction of three road bridges and increasing motorization furthered this pattern, and direct bus services to Melk and Pöchlarn, and connection to the faster Westbahn further eroded lines usefulness in this segment. Due to the topography of the river valley in this segment, the area is significantly less interesting for tourism with only a handful of noteworthy attractions other than bicycle tourism.
- Between Persenbeug and St. Nikola the Danube valley is very sparsely populated with no significant settlements. On the Lower Austrian side, the only major settlement, Weins has a similar commuting pattern as the towns on the previous segment with most going to jobs in Ybbs or other towns south of the river. Since the full regulation of this segment of the river, the area has very little tourism draw.
- Between St. Nikola and St. Valentine the line again has a clear traffic orientation towards Linz and St. Valentine. The proximity to a major urban center, along with the presence of several significant towns which are a destination in themselves has allowed this segment to develop into a well-used regional line.

[189] OEBB Scotty, (Köck, 2019)

[190] (OEBB Infra, 2020)

The middle segment of the railway thus always faced a significant hurdle to being a viable passenger transport link due to running perpendicular to most of the transport needs and having little touristic potential. The segment was further disadvantaged due to it spanning two Federal states, historically throughout there have been issues of cross border lines being neglected due to the lack of interest of the states in financing such traffic. [191]

However, the segment had sufficient potential in freight traffic that if better supported could have allowed for the segment's survival, at least up till Persenbeug/Loja.

While the segment from Krems to Emmersdorf had clear commuter flows, the volumes are not comparable to that of the St. Nikola to St. Valentine segment which has several large Municipalities, with Grein having over 3000 residents and Perg, 7000. However, given both the potential in workday and tourist traffic, the closure of this segment to regular transport is as much due to politics as a transport demand. The following are some of the specific reasons for the lines closure:

Customer unfriendly timetables:

Historically the schedules were strictly work oriented with many trains at morning peaks and then few at other times of the day. Schedules were not adapted to the shift towards a service economy There was limited to no coordination with bus lines that could have been feeder routes, nor fare integration until late in the line's history. In the final years of the line's history after the elimination of the NAT 91 Taktfahrplan passengers generally had poor connections for onward travel from Krems.

Parallel bus traffic:

The operation of parallel bus traffic was a common reason for the declining ridership of many lower Austrian branch lines. Between Krems and Emmersdorf there was relatively little parallel traffic, with only the route 1431 providing limited service up to Spitz. However even this line cost the railway a considerable number of passengers. On the middle segment there was however several routes providing parallel traffic. This was however unavoidable as parallel operation for some distance was required to reach from the southern bank of the Danube to the Waldviertel uplands. However, there was poor coordination between these bus routes and the railway line.

Poorly targeted investment:

There was a lack of strategic planning on the side of the ÖBB on where to invest in the line in later years. Significant infrastructure renewal projects were carried out throughout the late 1990's on the entire middle segment but failed to make any specific portion more viable. For example, if investment on the middle segment was fully concentrated between Sarmingstein and Loja, the segment could have remained viable for freight service. While expensive bridge renovation projects were carried out, there was little attention to the track itself with the sleepers in place dating back over 50 years. On the other hand, the station and track structure between Weitenegg and Lehen-Ebersdorf was fully rehabilitated despite there being almost no long-term potential for this segment of the line.

Lack of political will:

The lack of political will to invest in the long-term future of the railway is the most important factor for the lines current state. Due to traffic patterns of the region, a through running line as originally envisioned was no longer logical for regular passenger traffic. However, there was sufficient demand on both ends for regular service, with strong passenger demand between Krems and Spitz/Emmersdorf, and freight traffic on the western segment up to Loja. The Lower Austrian government however showed their own lack of vision with the complete closure of the railway. For the segment between Weins and Loja where the line had the most potential, the expensive bridge rehabilitation had already been carried out and freight service could have been successfully carried out

[191] (Hofstetter, 2018)

with the rehabilitation of the track upper structure. Despite this relatively minor investment and the high overall benefit the state was unwilling to commit the funds.

9 Detailed line description and field survey

This segment will provide a detailed look at line conditions along the entirety of the Lower Austrian segment of the Donauuferbahn. The segment will provide information on the current condition as well as relevant history of each station. Historical information on the line condition has been collected from several sources cited in text, including in cab footage taken before the closure of the middle segment of the line as well as other photographic documentation. General track parameters such as the length of tunnels are from either own documentation, or from the Dokumentationszentrum für Europäische Eisenbahnforschung website[192] which has detailed photographic documentation of the line.[193]

On the active segment of the line between Krems and Emmersdorf the focus will be on the condition of station areas, current usage of buildings, the presence of attractive destinations in the area and the distance to both the town centers and the Danube bike trail. Furthermore, the presence of other public transport and their connectivity with the railway line will be examined. Details of specific bus services along the corridor will be listed in section 10.2

For the segment between Emmersdorf and St. Nikola Struden, which is either only in service for freight/work trains or removed entirely, the previously listed conditions will be examined but there will also be an emphasis on inspection of the current condition of the right of way. This includes right of way incursions through private purchase and redevelopment, as well as the physical condition of civil structures. A analysis of all civil structures is listed in Table 15. Several field visits to the active segment of the line were made using both the train and detailed visits to all stations by bike to better understand the relation between the railway and surrounding environment. For the segment between Emmersdorf and St. Nikola Struden two field surveys were conducted in August 2021 on bike and foot to determine current right of way conditions. Photographs from these field surveys are included in Annex 2.

9.1 Krems Hauptbahnhof

The line begins at Krems Hauptbahnhof which is centrally located to the city center and is a Taktknoten for REX line 4 from Vienna to Krems, and R44 from St. Pölten to Horn. Both routes have significant importance for commuter traffic to Vienna and St. Pölten respectively. Service to Vienna on the Franz-Josefs Bahnhof REX 4 line is provided with locomotive hauled double decker trains. The R44 is primarily operated with class 5147 railcars with locomotive hauled CityShuttle trains during peak commute hours. The station for most of its existence has had limited importance for long distance traffic and has long served as a primarily regional hub.

The station has five platform tracks, three run through and two stub ended. Trains from Vienna generally arrive on Track 2 to allow for easy interchange to trains on line R44 which stops directly opposite. A single underground passage connects the center platform to the station entrance building. The underground passage has elevators for barrier free access. Trains of the NÖVOG use stub ended platform 21 adjacent to the station entry building and bus terminal.

[192] (Populorum, 2021)

[193] (Populorum, 2019)

In 2020 the city inaugurated a new City Bus system which complements the existing regional Postbus offers. The system greatly improved mobility within the city and should improve the uptake of public transport in the region. The bus offer is centered around the station and is included in the Taknoten plan. City buses depart from directly infront of the station main entry while regional buses depart from 3 platforms adjacent to track 21.

Figure 24: Map of the Krems CityBus network. Source: VOR

The station is in general well equipped. The various bus halts are located conveniently directly infront of the station. Inside the station there are shops as well as restrooms. Inside the lobby building there is only one ticket machine which is a bottleneck, but one that could easily be improved. There is a large, covered bike storage place outside of the station, as well as other uncovered spots for shorter term parking. Bike rental is available at the station through NextBike. The station also has a large park and ride parking deck located above the track area with 630 spaces.[194]

9.2 Krems Campus – KM 1.6

From Krems the line heads west through the city on a grade separated right of way and at km 1.580 reaches the Krems Campus halt. The halt is the newest on the line, and only opened in 2002 just 8 years before the end of regular service. The halt was built to serve the new Krems Danube University, which opened in 1995 and gained full university status in 2004. The campus occupies the site of a former Tobacco factory from which many buildings have been repurposed.[195] The connection to Krems Campus is now served by city bus line 1 and is not served by the 715 Wachau bus line. The station platform due to its recent construction complies with barrier free standards and is well situated in relation to the University and surrounding development.

[194] (Parking List, 2021)

[195] (Danube University Krems, 2021)

Immediately after departing Krems Campus the line reaches the first of many level crossings before entering the 569-meter-long Goldberg-Tunnel. The line briefly emerges to cross the Reisperbachtalstrasse before immediately entering the 206-meter-long Steiner Tunnel.

9.3 Stein Mautern – KM 3

The next station, Stein-Mautern is located immediately at the exit of the Steiner Tunnel. The station has a single passing track that no longer sees regular use and is not equipped with spring switches. Due to the operation of the line as an Anschlussbahn, the entry switch to the station from the west must be kept aligned for the siding to stop any potential runaway wagon. The train must each time stop to line and reset the switch.

The station consists of a standard design building with a covered waiting area. The waiting room is not accessible to passengers. The station features sufficient bicycle parking but no bike sharing options in the immediate vicinity. The station is located somewhat distant from the Stein town center, but this was unavoidable due to the topography. Following the sale of the railway line to the state of Lower Austria the former freight loading area was sold for the construction of the Danube Private University campus. The University, which opened in 2009 has over 2000 students at the campus in Stein.[196] The station is located near to the Danube and adjacent to the Mautener Bridge, the oldest fixed crossing of the Danube in the region. The steel truss bridge was built in 1897 and is under historic protection, the bridge has two road lanes and has sidewalks on both sides. However due to deterioration the bridge has been closed to vehicles over 5 tons since December 2020. This includes buses which have been rerouted over the route 37 bridge in Krems. The bridge is to be renovated, with a new temporary bridge built alongside to carry traffic in the short term. The bridge renovation should be finished between 2024 and 2026 and will include widened sidewalks for bike and foot traffic.[197] The station is served by the Wachau Bus line 715 and the turnaround point for City bus 1

9.4 Unterloiben – KM 5.1

After leaving Stein the line is sandwiched between high cliffs and the Danube with the B1 road running alongside. At KM 4.209 the line enters the 77 m Rotenhof tunnel before emerging into a wide, open area between the hillsides and the river. Unterloiben station is located at KM 5.130 and is a simple halt station with no crossing loop. There are no facilities at the station except for a standard waiting shelter. The station is not centrally located and is approximately 500 meters away from the town center. However new housing is also under construction in the direct vicinity of the station.

9.5 Dürnstein-Oberloiben – KM 6.8

After leaving Unterloiben the line passes through a largely open area dedicated to wine growing. At approximately KM 6.2 the line passes the settlement of Oberloiben without stop. The next stop, Dürnstein-Oberloiben is located at KM 6.8 in the middle of the Dürnstein and Oberloiben settlements. Dürnstein is located in a particularly mountainous segment of the valley and both the railway and the B3 road bypass the town in a tunnel. The station is located approximately 500 meters from the town

[196] (DPU, 2021)

[197] (ÖAMTC , 2021)

center and an underpass is provided for pedestrians and cyclists to cross the B3. The station is served by the bus 715 at an adjacent stop.

The station is a good example of adaptive reuse of railway stations, and hosts the Wachauer Safrancafe, the café is part of a larger Safran product store and provides a draw to bring people to the station area. Visitors on the exit from the station are greeted by information signs and maps to inform them of the attractions in the area. There are multiple Heurigen, and restaurants located directly in the vicinity of the station, as well as a NextBike station.

Immediately after leaving Dürnstein the line enters the 569-meter-long Schlossberg-Tunnel, the longest on the line. For the next 5 KM up to Weißenkirchen the line hugs the steep hillsides of the river valley and there are no significant settlements with most of the area dedicated to wine cultivation.

9.6 Weißenkirchen KM 12.3

Weißenkirchen is located at KM 12,3 and is a crossing station with 1 track. The station formerly had three tracks, but one was removed around the time of the transfer to the NÖVOG. The station is somewhat removed from the town, and surrounded by vineyards, however many attractions can be reached in a few minutes walking. The town center is located approximately 200 meters away and 500 meters from the ferry to the other side of the river. The bus 715 stops nearby along the B3, additionally there is also the bus 795, a Monday to Friday service to Kottes. A next bike station is located directly on the station premises and a bike rental company operates out of the former freight station.

9.7 Wösendorf-Joching – KM 14.5

Between Weißenkirchen and the next station Wösendorf -Joching the lines surroundings are settled in medium density. The station Wösendorf-Joching is situated between the two villages and is a simple halt station with shelter. Facilities are minimal with no provisions for bike share at the station. Both towns are approximately 400-500 meters removed from the stop, with no development in the immediate vicinity of the halt.

9.8 Spitz an der Donau – KM 18.1

After leaving Joching the line passes through a short tunnel before reaching Spitz an der Donau, one of the most important stations on the line. Spitz is the operational center of the line and up to the end of regular service dispatching duties conducted here since the introduction of Zugleitbetrieb. Today dispatching is carried out at the NÖVOG central dispatching office in Laubenbachmühle, however it is planned to move dispatching for the standard gauge lines back to Spitz in 2024.[198] The station has two sidings with the mainline track in the center. The station has low gravel platforms as characteristic for crossing stations on the line. The two sidings play an important role for the annual summer solstice specials, where direct trains with nostalgic equipment operate to Spitz for the festivities. The station is well located to the town with numerous amenities in the vicinity. The ferry connecting Spitz with Arnsdorf on the south bank of the river is located approximately 450 meters from the station. The ferry carries cars as well as pedestrians and bicycles and unlike other Wachau ferries operates year-round. After departing Spitz, the line runs directly through parts of the town, in some places the railway was constructed in between existing buildings. After exiting the town, the track passes through the famous

[198] (NÖVOG, 2021), (schienenweg.at, 2021)

Teufelsmauer-Tunnel (Devils wall), the shortest tunnel on the line and for many years the shortest on the entire ÖBB network at just 12 meters long.[199] The station has the following amenities for passenger

- Covered waiting area
- Restrooms (paid)
- Covered bike racks
- Bike rental through private firm and Nextbike

The station is served by the following bus services

- Bus 715 (Krems – Melk)
- Bus 718 (Mühldorf- Pöggstall)
- Bus 719 (Ottenschlag-Melk)
- Ruffbus 722 (Jaureling)

9.9 Schwallenbach – KM 21

Schwallenbach is simple halt station with shelter located at KM 20,954. Other than a shelter, there are no facilities for passengers. A walking path along the railway to the town exists to shorten the distance. The station is well located to the town which however is small and with limited amenities. The station is located conveniently to the Danube bike path which runs through the town rather than along the river at this point. The town is served by buses 715 and 719.

9.10 Willendorf – KM 23.4

Between Schwallenbach and Willendorf the line passes through primarily wine growing areas. Willendorf station is located at KM 23.4 and is a simple halt with shelter. The platforms were rebuilt relatively recently and are at a higher level than most on the line. One anomaly compared to other halt stations is the presence of an indoor waiting room rather than a simple open shelter. The station is located on the western edge of the town but still well within walking distance. To the east the settlement of Groisbach is located approximately 850 meters away. The station is located conveniently to the Danube bike path although at a higher elevation. Willendorf is served by buses 715 and 719 which stop along the B3.

9.11 Aggsbach Markt – KM 26.1

Between Willendorf and next stop in Aggsbach Markt the line is sandwiched between the hillside and river with no significant development. Aggsbach Markt station is located at KM 26,088 and is a 3-track crossing station with boarding from the center track. The station has a standard design building with covered waiting area. There were no bike parking places observed at the station. A NextBike dock is located within convenient walking distance of the station. The station is well located within the town without major elevation difference, and there are numerous amenities in the area. The town is served by buses 715 and 719 which stop along the B3.

[199] (Populorum, 2019)

9.12 Grimsing – KM 30.9

Between Aggsbach and the next stop of Grimsing there is only minimal development. Grimsing station is located at KM 30,933 and is a simple halt station with shelter. The station is well located within the village and well located to the Danube bike trail. The village also has several amenities for tourists, as well as walking trails along the river. In addition to buses 715 and 797, the town is served by 3 courses from bus 797, a M-F Friday service from Melk to Maria Laach.

Between Grimsing and Emmersdorf the line passes through the village of Schallemmersdorf, the small village does not have a station but here the bus route 797 diverges from the B3 towards Maria Laach.

9.13 Emmersdorf – KM 34

Emmersdorf station is located at KM 34.050 and is the present-day end of the Wachaubahn tourist services. The station in Emmersdorf is a standard design and formerly had a two crossing loops. The track closest to the station has been removed to extend the platform. Boarding is done from the track closest to the station building. Platforms are low level gravel as in other crossing stations. The station at Emmersdorf is located on a hill above the main town and is reached by a narrow curving road. As such, it is not well suited to heavy bus traffic. Two seasonal bus lines and one M-F line serves the station and are coordinated with the tourist train. The situation for the bus is cramped and the bus must perform a multi-point turn the station. Under the current circumstances having more than 1 bus in the station at a time is not easily feasible. The station is directly next to the Volkschule Emmersdorf which allows for the potential for school traffic. The station has bicycle racks but lacks rental bike options, likely due to its unattractive location compared the Danube bike trail. The station is linked to the town via a staircase providing a shorter route for pedestrians which is located across the tracks form the station and accessed via a grade crossing. After Emmersdorf the railway is only in service for the operation of maintenance trains. Immediately after departing the station in Emmersdorf the line crosses the Emmersdorf Viaduct, a signature structure of the line. The line continues along a ledge high above the river towards Weitenegg, the line in this segment offers impressive views of the Danube and the Melk Abbey across the river.

The station has the following amenities for passenger

- Covered waiting area
- Restrooms
- Bike racks

Emmersdorf is served by the following bus services with some buses directly serving the station

- Bus 715 (Krems – Melk)
- Bus 719 (Ottenschlag-Melk)
- Bus 721 (Emmersdorf – Melk – Schallaburg)
- Ruffbus 722 (Jaureling)
- Bus 797 (Melk-Benking)
- Bus 790 (Melk - Pöggstall)
- Bus 791 (Melk - Pöchlarn – Pöggstall)

9.14 Weitenegg – KM 38.3

Weitenegg station is located at KM 38.288 at the end of the Weitenegger tunnel, the station had one through running mainline track and a stub ended siding. The station is bounded to the north by sheer

cliffs and is located away from most surrounding development. The station historically had more importance for freight traffic than passenger, as its location along the main road and at nearly the same level made it well suited for transloading. Significant amounts of freight traffic, primarily wood coming from the direction of Pöggstall was reloaded onto the railway here. The facilities at the station reflect this with a simple shelter.

Today Weitenegg marks the end of the intact segment of the Donauuferbahn, the segment of the line between Emmersdorf and Weitenegg was reactivated for construction trains due to the same advantageous location along the main road. The station is currently used to stockpile track material, much of which was salvaged from the abandoned segment of the line. The track extends a few hundred meters past the switch for the siding to allow access, after which it has been removed. Track in the station at Weitenegg appears generally to be in good shape. Sleepers are wooden or concrete, with the wooden sleepers having date nails from between 1985-1991.

It is eventually planned to extend the tourist railway operation up to Weitenegg, the existing end point at Emmersdorf due to its isolated location away from the town high above the river is poorly situated, particularly to cater to the important bicycle transportation market. Furthermore, Weitenegg offers much more in terms of a destination with a well-developed recreational area and several restaurants and accommodations in close proximity to the station.[200] Various plans have been proposed to make the former freight station more attractive, such as the creation of a “train hotel” from old passenger wagons, and parking space for tour buses and connecting point for buses going further into the Waldviertel.[201] Weitenegg is currently served by the buses 790 to Pöggstall, Bus 791 to Pöchlarn then onwards to Pöggstall and on summer weekends by the 722 Ruffbus.[202]

9.15 Lehen-Ebersdorf – KM 40.1

The line further on towards Lehen-Ebersdorf was retained longer than most of the abandoned segment, having been removed between 2019 and the present. The right of way is in most places still free of overgrowth and can easily be traversed on foot. Civil structures that were observable (two small stone arch bridges) appear to be in good condition with evidence of rehabilitation work in the 1996-2005 timeframe.

The station at Lehen-Ebersdorf was located at KM 40.106 The station was a simple halt with platform and shelter accessed by an access path from the west. In Ebersdorf the station was inconveniently located to much of the town with long walking distances. The main settlement of Lehen is located directly above the station at a higher elevation. However, for access to the Danube bike trail it was a convenient location with minimal elevation difference. Lehen was one of the least used in the Nibelungengau region, by the 1996/97 timetable year the station was practically in service only as an operational halt due to the need to manually activate the crossing gates for the road crossing immediately after the station requiring all 3 westbound trains to halt. However, in the westbound direction only one of 3 trains halted as the crossing was automatically activated through track relays.[203] Despite this low usage the station saw considerable investment in 2003, just 6 years before the permanent end of traffic on this segment. The new platform edge blocks are stamped with this data and photos taken before the abandonment show brand new sleepers and new gates and light at the

[200] (Knoll, 2021)

[201] (Knoll, 2013)

[202] https://anachb.vor.at/

[203] (Hofstetter, 2018)

Klaus Road crossing. The station platform and shelter remain in relatively good condition, but the area has been sealed off from the public with no planned nor foreseeable reuse.

However west of the station the right of way is broken where the Klaus Road has been regraded to provide for a better slope for the road. Further interruptions to the right of way are found at approximately KM 41.3 where the metal spans of two small bridges at the entrance to the Lehen quarry have been removed, presumably for easier access by trucks. These bridges were however in immediate need of replacement at the time of abandonment. [204]

9.16 Klein-Pöchlarn – KM 43.9

Between KM 41.4 and Klein Pöchlarn the line is difficult to access but there are limited points of interest. The Klein-Pöchlarner tunnel is sealed and access to both sides is difficult, and no inspection was possible. Klein Pöchlarn station is located at KM 43.921 and formerly had a two siding tracks. The station remained important for roundwood transloading up till the end of service in 2010.[205] All track materials have been removed and the station building is now under private ownership. Construction has already begun to convert the former station area into new housing. It appears the housing will occupy almost the entire site. NÖVOG retains the right to repurchase the 6 meter right of way to reestablish rail service, and it is planned to leave a 6-meter corridor with only removable structures. [206] However, with the redevelopment of the site for residential use, rail noise will be a major concern for any reactivation effort. The town has little touristic potential, with little in the way of interest around the station for tourists and the station is located well away from the Danube bike trail.[207]

Further parts of the line within the town including the bridge over the 44.2 appear to be in the process of being converted into a walking path. Past the KM 44.4 the right of way returns to NÖVOG ownership and is overgrown.

The station is located a significant distance from the main road, and all buses operate on the B3 with none serving the former station directly. The town is served by the following buses

- Bus 671: Erlauf – Pöchlarn – Klein Pöchlarn service, only 1 course pair per day
- Bus 785: Klein Pöchlarn - Persenbeug . Primarily operates for school transport
- Bus 788: Klein Pöchlarn – Pöchlarn with some courses to Nussdorf or Marbach. Weekend service to Maria-Taferl
- Bus 791: Melk-Emmersdorf-Klein Pöchlarn-Marbach-Maria-Tafern to Pöggstall service. The

9.17 Marbach-Maria Taferl – KM 48.4

At the KM 47.2 the line enters the settlement of Krummnußbaum an der Donauuferbahn, a town now without its namesake. The town never had a station but there are significant numbers of residences along the line. In Marbach the line from the KM 48 up to the station at 48.4 has been purchased by a private owner. The owner appears to be a former railway employee or enthusiast as the station has been well maintained in the ÖBB appearance. Furthermore, the tracks have been left within the station grounds with fruit trees now planted on the former platforms. The station is removed from the historic city center of Marbach but is very well located to the Danube bike trail. Directly across from the station

[204] (Knoll, 2013)

[205] (Ciechanowski, 2014)

[206] (Schweiger, 2020)

[207] (Knoll, 2013)

is the Wachauerhof hotel and restaurant. Marbach was historically an important station for tourist traffic, with many passengers detraining to visit the Wallfahrtskirch Maria Taferl, located on the bluff above Marbach. The pilgrimage church was a year-round source of traffic for the railway and there were at one-point plans to build a cog railway connecting the church and the station. However, with increased motorization and prevalence of tour bus firms the importance of the railway connection declined.[208] Marbach is served by buses 785, 788 and 791.

The segment immediately west of Marbach has difficult alignment conditions. In this segment there are three tunnels, two bridges and steep rockfaces adjacent to the track, partially protected by metal mesh netting. At approximate KM 50.280 in the settlement of Granz the bridge over the Krackinger Strasse has been completely removed including abutments to widen the road. This is the first of several demolished bridges between Marbach and Weins.

9.18 Loja Hartsteinwerk – KM 52.5

The Loja gravel quarry is located along the railway at KM 52.481. The quarry was historically one of the lines most important freight customers and was and is an important source of track ballast. Railway service to the quarry began in the 1920s when a large loading silo (still present but unused) was erected, and shipment by rail continued until the end of regular service in 2010.[209] The ballast from the quarry is well suited for use on high performance railway lines, but ironically the ballast must now be trucked out to a reload on the Westbahn. Between Loja and Persenbeug the B3 is inundated with truck traffic from the quarry.

To enable better access to the quarry a modern concrete bridge was demolished leaving another gap in the right of way. The railway loading silo remains intact but abandoned, its condition is unclear. It was however planned to demolish the existing silo and erect a new loading facility if the line was to be reactivated, however this did not come to occur due to the abandonment of the line.[210] The silo was capable of loading wagons both on a siding track and directly onto the mainline, it appears that in later years only loading on the mainline was carried out as with limited passenger service, capacity was not an issue. Trains would need to be shoved in reverse from Persenbeug as there was no dedicated runaround track here.

9.19 Persenbeug-Gottsdorf – KM 55

Between Loja and Persenbeug the line passes through the settlements of Metzling and Gottsdorf, these settlements however never had their own station and are today served by bus line 785 and the CityBus 4 from Ybbs. The line 4 operates on weekdays with frequent service particularly in the morning peak, but otherwise on a very limited timetable.

Persenbeug station is located at km 55 and was formerly a 4-track station with three platforms. The station area remains undeveloped, and potentially under private ownership. The former goods loading are is owned by the Habsburg-Lothringen'sche Gut Persenbeug, a Habsburg family owned forestry company that has significant timber holdings in the Waldviertel. It is unclear if their ownership of the area dates to the time when the railway was in service. The company also owns the still active wood loadout in Weins. The station is well located towards the town and the Danube bike trail, the historic

[208] (Hofstetter, 2018)

[209] (Hofstetter, 2018)

[210] (Knoll, 2014)

town center can easily be reached by foot. The station has a large bus turning loop directly in front which is still served by the bus line 785. CityBus 4 and the line 781 which operates services towards the Yspertal stops at another location closer to the old city.[211]

9.20 Weins-Ispersdorf – KM 60.2

At approximately KM 58.2 a small steel deck girder bridge has been removed. KM 58.676 is the current end of the track on the western segment of the railway. A buffer marks the end of the track, though it appears no train has used the segment down to the buffer in a long time. Track in this segment is in poor condition, the sleepers are wood with date nails between 1957 and 1960, the sleepers themselves are generally in poor condition.

At KM 60.2 the Weins-Ispersdorf station served the two small villages named. The station had minimal importance for passenger traffic but was however important operationally as a crossing point as well as for freight transport.[212] The villages are now served by Bus 781 which runs from Ybbs to the Yspertal, operating only on weekdays with increased frequencies during school season. Even during the times when the railway was active the Yspertal buses took most of the traffic with few passengers using the railway, as most traffic was destined for destinations on the south side of the Danube.[213]

At Weins all tracks are still intact but only two are still in use for freight service. The station is now under private ownership. Immediately adjacent to the station is a large pension hotel. The station is well situation to the Danube bike trail but is significantly removed from the town center.

Between Weins and Sarmingstein the track is generally in poor condition with no recent renovation work seen in the parts surveyed. The bridges however mostly appeared to be in very good condition, all steel bridges had been recently renewed with new spans and most stone arch bridges showed signs of renovation with concrete decks. The bridge over the Ysper appears to be all new construction.

9.21 Hirschenau Nöchling – KM 65.2

Hirschenau Nöchling was a small station located near the border of Lower and Upper Austria. The station served the two adjacent villages of Hirschenau which consists of only a few houses. Nöchling lay 4 km from the station and 300 meters higher. The station therefore saw very low utilization and after the timetable change in 1996 was only served by two train pairs. The station was closed in December 2004 before the full cessation of traffic.[214] The small station shelter however remains in relatively good condition and has been purchased by a private owner.

9.22 Sarmingstein – KM 68.1

At the KM 67.8 just south of Sarmingstein the ownership of the line changes from ÖBB to NÖVOG. Here there is a derailer that marks the beginning of the NÖVOG Anschlussbahn. To go behind trains must talk with the NÖVOG dispatcher.[215] The station at Sarmingstein has been without passenger service since the 2019 timetable change. It is the last of the standard Donauuferbahn style stations on the line, and the only one on the upper Austrian side which has not been modernized.

[211] https://anachb.vor.at/

[212] (Hofstetter, 2018)

[213] Ibid.

[214] (Hofstetter, 2018)

[215] Ibid.

The station was previously a further freight loading point where granite from a quarry in Gloxwald was transloaded to rail. Granite was shipped from the quarry to the station by a ropeway where it was loaded onto wagons. The quarry was however closed in 1979 and the ropeway dismantled. The second track, which was previously used for freight service was also dismantled.[216]

9.23 St. Nikola Struden. – KM 70.9

St. Nikola Struden is the current end of passenger services on the Upper Austrian portion of the route. The station has been fully modernized with high barrier free platforms and ticket vending machines. The station features the standard Donauuferbahn style waiting shelter. The station is located at a significantly higher elevation of the main road and the Danube bike trail, however much of the town is also at a higher elevation.

9.24 Civil structures inspection Weitenegg to St. Nikola

The following lists the condition of all observed civil structures on the abandoned segment between Weitenegg and Weins. Additional civil structures, particularly culverts exist in this segment but were unable to be reached due to heavy vegetation. In general, all stone bridges are in very good condition having been rehabilitated shortly before the closure of the line. Several new bridges were also constructed during this time. The condition of the tunnels is harder to assess, but inspection of two tunnels near Marbach that were accessible indicated no obviously visible defects, nor major drainage issues. On the Upper Austrian segment of the line between Weins and St. Nikola all bridges appeared in good to very good condition but were not individually documented.

Table 15: Conditions of civil structures between Weitenegg and Weins

KM	Category	Type	Visual assessment	Remarks
38.6	Culvert	Stone box	Good -Very good	Renovated, new concrete deck
38.8	Bridge - Road	Stone arch	Good -Very good	Renovated, new concrete deck
39.1	Culvert	Stone box	Good -Very good	Renovated, new concrete deck
40.1	Bridge - Stream	Stone arch	Fair	Partially demolished, renovated with concrete deck
41.3	Bridge - Road	Steel deck	Partially demolished	Metal span removed, was in poor condition
41.3	Bridge - Road	Steel deck	Partially demolished	Metal span removed, was in poor condition
43.2	Tunnel	Stone	Not reachable	Klein-Pöchlarner Tunnel. No access due to vegetation
44.2	Bridge - Stream	Metal girder	Fair	Repurposed for footpath
46.4	Bridge - Road	Stone arch	Good -Very good	Renovated, new concrete deck
47.2	Bridge - Stream	Stone arch	Good -Very good	Renovated, new concrete deck
47.8	Culvert	Concrete box	Good -Very good	Renovated

[216] Ibid.

48.2	Culvert	Concrete box	Good	Detailed inspection not possible
48.7	Tunnel	Stone	Good	Schallmarbacher Tunnel - No clearly visible deterioration
48.8	Bridge - Stream	Stone arch	Good -Very good	Renovated, new concrete deck
49	Tunnel	Stone	Good	Marbacher Tunnel - No clearly visible deterioration
49.2	Bridge - Road	Metal deck	Poor-Fair	Significant rust, condition of metal bridges difficult to assess
49.3	Tunnel	Stone	Not reachable	Trausinger Tunnel - ROW fenced, no access
49.9	Culvert	Stone box	Good -Very good	Renovated
50.2	Bridge-Road	Metal deck	Demolished!	Bridge and abutments completely removed
50.9	Culvert - Stream	Stone arch	Good -Very good	Renovated, concrete deck. Vegetation obscures view
51.1	Culvert - Stream	Stone arch	Good	Heavily overgrown, good condition but no concrete deck
51.1	Culvert - Stream	Stone arch	Good	Heavily overgrown, good condition but no concrete deck
51.5	Bridge- road	Concrete deck	Very good	Fully rebuild with concrete span and renewed abutment
52.4	Bridge-Road	Concrete deck	Demolished!	Bridge completely removed, abutments partially remain
53.9	Culvert	Stone box	Good	Heavily overgrown, appears to have concrete deck
54.4	Culvert	Concrete	Good	
55.7	Tunnel	Stone	Not reachable	Persenbeug Tunnel - No access possible due to overgrowth
56.3	Bridge-Stream	Concrete deck	Very good	New construction
56.9	Bridge-Stream	Metal deck	Very good	New bridge deck, renewed abutments
57.3	Bridge-Road	Concrete	Demolished!	Bridge completely removed 2018
57.3	Bridge - Stream	Stone arch + Metal deck	Very good	Stone arch segment renewed with concrete deck. Span over stream has new metal deck
58.2	Bridge - Stream	Metal deck	Demolished!	Small metal span removed, abutments remain
61.1	Bridge - River	Metal truss	Very good	Ysper River. New construction

9.25 Line condition summary:

Due to the nature of the narrow river valley, stations are generally well situated in regard to the surrounding towns. Most stations are also near the Danube bike trail and are attractive for cyclists. The stations in general do not offer many amenities to passengers, though there are in general good provisions for cyclists at the bigger stations. The station buildings themselves could be made more attractive if a complementary use is found for them. The station platforms pose a problem for barrier free service as in general they do not conform, and the track arrangement at crossing stations makes the reconfiguration complicated.

The situation at Emmersdorf is problematic and a solution to the connectivity between Emmersdorf and Melk will need to be solved for an effective introduction of regular public transport services.

The extension of the line towards Weitenegg seems to hold high potential both in terms of tourist traffic and in establishing a good bus transfer point. The reactivation of the line further than Weitenegg

is highly problematic as there have already been significant incursions into the right of way. The consideration of a through running route between Krems and St. Nikola Struden is now practically a theoretical exercise, as once the railway area in Klein Pöchlarn has been redeveloped, there will be a very high resistance to reconstruction of the railway. So far, no major redevelopment of the line has occurred between Lehen and Weins. The tunnels in general appear in good condition, however no detailed inspection could be made. However, the demolition numerous bridges present further obstacle to the reestablishment of rail service on this segment. Several of these bridges were either new or recently renovated, making their loss even more unfortunate. Therefore, the further analysis will focus on the revitalization of the still existing segment of the railway with secondary consideration given to the segment between Weins and Marbach. Given the lack of interest in even maintaining the existing line, the reconstruction of the line is very unlikely there is major change of transportation politics in Lower Austria.

10 Case study analysis

This segment will examine the current transportation situation along the Donauuferbahn and the potential barriers to the reactivation of the railway for regular use.

10.1 Analysis of current NÖVOG operation

Currently the NÖVOG operates tourist services branded as the Wachaubahn between Krems and Emmersdorf. The service operates as “Beschränkt-öffentlichen Verkehr” or limited public transport, due to the line’s classification as a Anschlussbahn. The line only operates during the main tourist season, with trains operating on weekends and holidays from March 20th to November 20th, with daily service between May 29th and October 3rd. Trains operate on a 2-hour interval with 4 round trips a day. The first train leaves Krems at 9:20 and the last return trip departs Emmersdorf at 17:55.

All original stations are still in service, but some are designated as request stops as indicated in the timetable. Tickets are significantly more expensive than the VOR tariff and neither the ÖBB Vorteilscard or any day ticket offers from the VOR are included. Tickets can be purchased through the NÖVOG website or onboard, where both cash and card payments are accepted. Transport of bicycles is permitted with earlier reservation, but no special provisions for bike transport is provided. In practice bicycles can also be transported without reservation when the train is not full. For visiting the area on a day trip, the Niederösterreich Card can provide good value. The card costs 63 euros and is valid for a year. The card offers either a day ticket or single return trip on all the NÖVOG lines as well as free entry into numerous different tourist attractions around Lower Austria.

The service uses modern Siemens-Duewag RegioSprinter DMU’s built between 1996 to 1999 and refurbished for the Wachaubahn. The vehicles offer the standard level of comfort expected for a regional rail service, and the large windows provide a good view of the landscape. However, the service lacks any of the nostalgic or overall touristic character of the other NÖVOG operations such as the Reblaus Express which operates with heritage vehicles and has both a dedicated bike wagon and restaurant wagon where passengers can taste local wines. Inside the vehicle brochures on both the railway and local attractions are available, overall, however the services are operated like a regular regional railway rather than a touristic one in everything but the price.

The lines infrastructure is in good condition with major rehabilitation work carried out in 2017-2018 and the trains can maintain speed throughout the journey.

Krems an der Donau - Emmersdorf an der Donau				
Wien Franz-Josefs-Bf ab	08:05	10:05	12:05	15:05
Krems an der Donau an	09:14	11:14	13:14	16:14
St. Pölten Hbf ab	08:05	10:05	(Mo-Fr) 12:39	(Mo-Fr) 15:39
Krems an der Donau an	08:41	10:41	(Mo-Fr) 13:16	(Mo-Fr) 16:12
	R 16950	R 16952	R 16954	R 16956
Krems an der Donau ab	**09:20**	**11:20**	**13:20**	**16:20**
Krems Campus-Kunstmeile	09:23	11:23	13:23	16:23
Stein-Mautern	09:26	11:26	13:26	16:26
x Unterloiben	09:31	11:31	13:31	16:31
Dürnstein-Oberloiben	09:35	11:35	13:35	16:35
Weißenkirchen i. d. Wachau	09:42	11:42	13:42	16:42
x Wösendorf-Joching	09:45	11:45	13:45	16:45
Spitz an der Donau	**09:51**	**11:51**	**13:51**	**16:51**
x Schwallenbach	09:55	11:55	13:55	16:55
x Willendorf i. d. Wachau	09:58	11:58	13:58	16:58
x Aggsbach Markt	10:01	12:01	14:01	17:01
x Grimsing	10:06	12:06	14:06	17:06
Emmersdorf an der Donau an	**10:10**	**12:10**	**14:10**	**17:08**
Emmersdorf Bf-Vorplatz ab	10:20	12:20	14:35	17:35
Melk Kremser Straße	10:27	12:27	14:42	17:42
Melk Bf-Vorplatz	10:30	12:30	14:45	an 17:45
Schallaburg an	10:40*	12:40*	14:55*	

Emmersdorf an der Donau - Krems an der Donau				
Schallaburg ab	09:45*	11:45*	14:15*	17:15*
Melk Bf-Vorplatz	10:00	12:00	14:25	17:25
Melk Kremser Straße	10:02	12:02	14:27	17:27
Emmersdorf Bf-Vorplatz an	10:10	12:10	14:35	17:35
	R 16951	R 16953	R 16955	R 16957
Emmersdorf an der Donau ab	**10:20**	**12:20**	**14:50**	**17:55**
x Grimsing	10:23	12:23	14:53	17:57
x Aggsbach Markt	10:29	12:29	14:59	18:02
x Willendorf i. d. Wachau	10:32	12:32	15:02	18:05
x Schwallenbach	10:35	12:35	15:05	18:07
Spitz an der Donau	**10:40**	**12:40**	**15:10**	**18:10**
x Wösendorf-Joching	10:45	12:45	15:15	18:15
Weißenkirchen i. d. Wachau	10:49	12:49	15:19	18:19
Dürnstein-Oberloiben	10:56	12:56	15:26	18:26
x Unterloiben	10:59	12:59	15:29	18:29
Stein-Mautern	11:04	13:04	15:34	18:34
Krems Campus-Kunstmeile	11:07	13:07	15:37	18:37
Krems an der Donau an	**11:10**	**13:10**	**15:40**	**18:40**
Krems an der Donau ab	11:51	13:43	15:51	18:51
Wien Franz-Josef-Bf an	12:58	14:58	16:58	19:58
Krems an der Donau ab	11:19	13:19	16:19	19:19
St. Pölten Hbf an	11:55	13:55	16:55	19:55

Figure 25: Timetable for the Wachaubahn 2021 with onward rail and bus connections. Source: NÖVOG

The trains are well timed with the trains from Vienna via the Franz-Josefs Bahn, from St. Pölten there is generally a 40-minute wait in Krems, though on weekdays the evening connections are better timed. In Emmersdorf there is a good bus connection that connects the railway directly to Melk railway station as well as the Schloss Schallaburg which is a major tourist attraction.

The railway also offers several package deals including combined trips with cruise boats, visits to museums and multiday guided tours. These will be further explained in section 15.14.

10.2 Analysis of the VOR operations

Since the end of regular rail service in 2010 the provision of public transport has fallen to the Postbus under contract from the VOR. The bus system was reorganized in 2020 with the introduction of hourly headways and the elimination of the WL bus designations in favor of a uniform 700 series numbers for the Wachau lines.

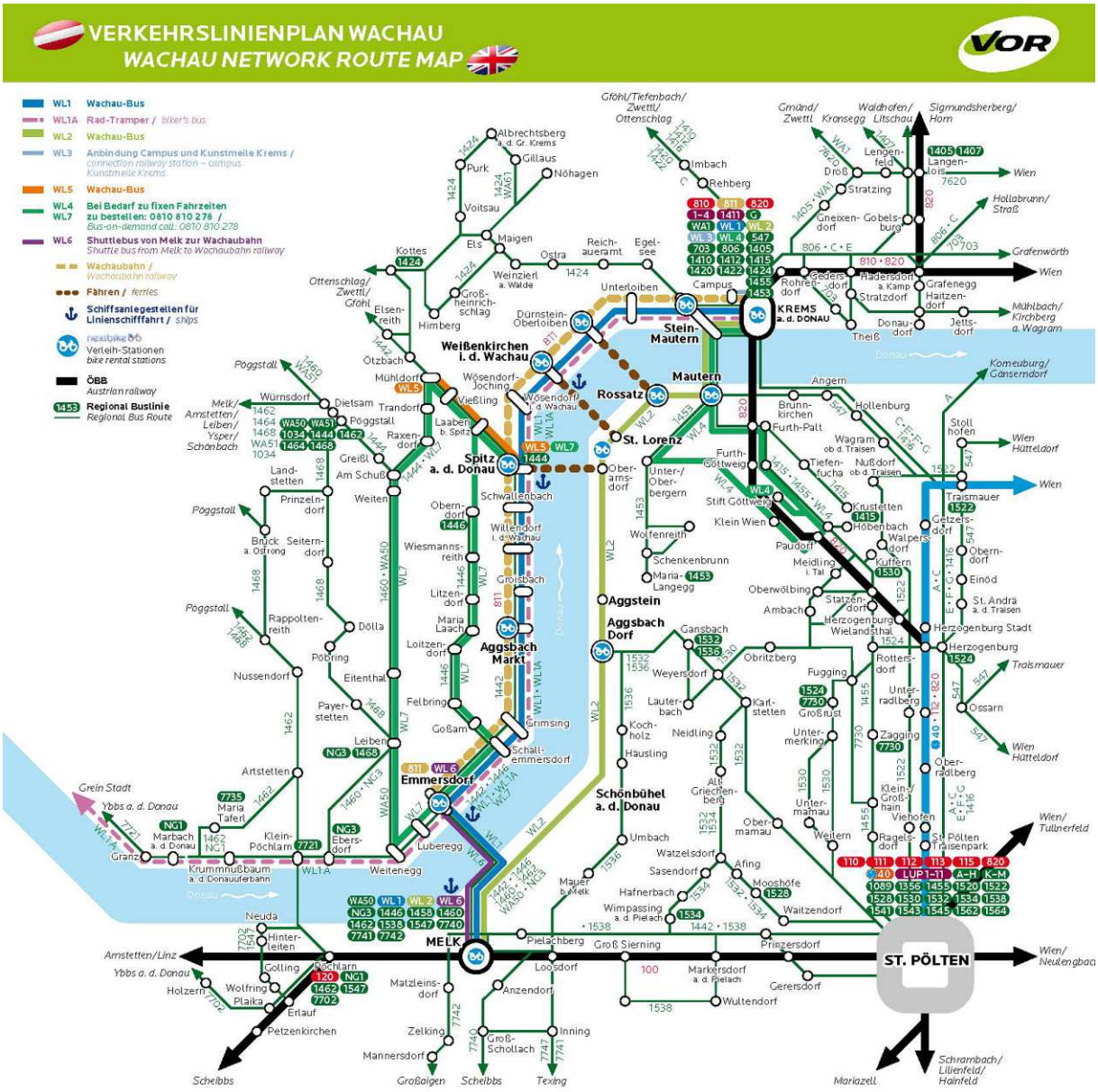


Figure 26: Network plan of VOR lines in the Wachau region, note map uses old WL series designation. Source: VOR

Since the closure of the railway dense bus offer has been developed by the VOR to serve tourists and commuters in the Wachau segment. The following bus lines operate in the Wachau:

- Bus 715 (Formerly WL1): Line 715 is intended as a direct replacement for the railway. The line operates between Krems Bahnhof and Melk Bahnhof and is coordinated with the train in Krems in both directions. Therefore, during the railways operating season, the train and bus run on the exact same schedule in the westbound direction. The bus serves approximately the same stops with only a few additional stops primarily intended for hikers or other tourists in relatively remote areas. The bus runs at a 1-hour interval on both weekdays and weekends during the peak tourist months. The journey time between Krems and Emmersdorf is 53 minutes and 63 minutes to Melk.
- Bus 720 (Formerly WL2): Line 720 serves the villages of Aggsbach (Dorf), Rossatz, Schönbühel, St. Lorenz and Mautern.
- WL1A: Line WL1A was a special “Radtramper” service designed for transporting bikes. The service operated two round trips a day between Krems and Grein making limited stops and

carried a special trailer capable of holding 24 bicycles. However, this service was discontinued after 2018 and its future reinstatement is uncertain.

- Bus 719 operates with a limited schedule for commuter traffic between Melk and Ottenschlag (in the foothills north of the Wachau). The service operates with 4 courses northbound and two southbound with 3 courses extending to St. Pölten. There is no service on weekends
- Bus 721 operates between Emmersdorf station, Melk station and Schallaburg palace during the railway operating season. The bus is intended entirely as a connector for the railway line.

Several other bus lines operate between points along the railway to destinations in the foothills above the river, these do not operate in competition with the railway and will be described in segment "Reorientation of connecting buses". Krems introduced an extensive new city bus network in 2020. The network is designed for inner city travel and is in general complementary to the railway offer, with only parallel traffic between Krems and Stein.

West of Emmersdorf the bus offer is greatly reduced due to the far lower tourism demand in the Nibelungengau region. The following bus services operate along the former railway corridor west of Emmersdorf

- Bus 790 is a Melk – Lehen – Pöggstall service. bus 790 operates 8 courses in the eastbound direction and 10 in the westbound. There is no weekend service except for one evening course on Sundays.
- Bus 791 is a Melk to Pöggstall service that operates along the railway corridor between Emmersdorf and Marbach. The bus has a timed connection in Melk with a train from St. Pölten, two courses also cross the river again at Pöchlarn and have a second connection with a train from St. Pölten. The schedule is however very limited with 4 courses in the westbound direction serving the area of the railway, in the eastbound direction there are 4 courses continuing to Melk with 3 others ending at Pöchlarn and only covering part of the area. There is no weekend service.
- Bus 785 operates between Ybbs and Pöchlarn. The bus operates with 8 courses per day on weekdays with varying origins and destinations. Some buses run through from Pöchlarn station to Ybbs station with others terminating at intermediate points. There is no weekend service.
- Bus 781 operates Between Ybbs/Persenbeug with 10 courses in the westbound direction and 6 in the eastbound direction. On weekends there is no service.

Between Melk and Ybbs the Donauuferbahn' s former catchment area is also served by trains on the Westbahn, however the large population center of Persenbeug is significantly removed from rail access due to the lack of bridges, with a 20+ minute bus ride (often with changes) to Ybbs Bahnhof required, significantly decreasing the appeal of public transport in this corridor.

The transport offer between Krems and Emmersdorf has significantly improved since 2010 with hourly bus service even on weekends during the summer. However, the offer west Emmersdorf has significantly declined compared to when the complete Donauuferbahn still saw regular service. Many towns on the northern bank have lost direct connection between one another, and there is a near complete lack of weekend service.

Comfortable modern low floor buses are used on the Wachau lines, the buses even feature USB charging for cellphones at most seats. However, the buses are limited in capacity and can overcrowded during the peak tourist season. Bike transport is generally not possible, even transport of folding bicycles can be cumbersome in compared to a train. Bus shelters are of lower quality than most of the rail stations, which even though the waiting rooms have been closed, offered a sheltered platform in most cases.

For tourists there are several different offers available. For weekend travel the VOR introduced in 2020 the Freizeit Ticket which allows for unlimited travel on the entire VOR network with some small exceptions. All buses in this region can be used with the ticket as well as regular ÖBB regional trains. The ticket costs 20 euros and is valid for one person. The ticket is available in the ÖBB app as well as ÖBB ticket machines. For travel solely within the Wachau, a day ticket is available which is valid on all Wachau Bus lines (with 700 series number) as well as on ferries for 12 euros per day. A single ticket costs 8.60 euros between Krems and Emmersdorf. Further details on VOR ticket prices can be found in the model data for the Transport Value model in Chapter 11.5.4.

10.3 Regional freight transport potential

From the beginning the Donauuferbahn had relatively little importance for freight traffic, serving only the needs of local freight customers. In the early years two Sammler Güterzug (collector freight) pairs operated over the line to service loading stations at the various stations along the line.[217] Local agricultural commodities such as wine and apricots would especially in the lines early years be transported to Vienna by rail. However, this carload freight business was generally an easy target for road transport and most of this business dried up in the immediate postwar era. The northern bank of the Donau in Lower Austria along the Donauuferbahn is in general lacking in any heavy or medium sized industry that would require rail transport. The area does have an active timber industry and regular timber loading occurred at Persenbeug, Klein Pöchlarn und Weins-Isperdorf. At Loja east of Persenbeug the Loja hardstone quarry shipped track ballast by rail right up to the lines closure in 2010. However, since the lines closure the strange situation occurs that the material for railway track construction must be shipped by truck to a transload station on the Westbahn adding many additional truck trips to the roads.

After the takeover of the line by the state of Lower Austria, there was considerable interest in the retention of the westernmost segment of the line for freight traffic. The NÖVOG commissioned a study in 2014 to examine the potential and costs involved for such a reactivation. The study found a potential for 80,000 tons of freight per year, with significant cost savings for the Loja Hartsteinwerk. At 2014 production levels the operation the transport of track ballast from the quarry required 3520 truck trips (counting empty and loaded moves) along the B3 through the town center of Persenbeug and Ybbs, with a daily average of 22 trips per day. If the freight volume was to increase to 80,000 tons yearly as projected, the number of truck trips would increase to 6400 trucks per year with an average of 40 per day.[218]

The study showed that there were no major obstacles to the reactivation of the line with almost all bridges being in good shape, only the track upper structure, primarily the sleepers were in immediate need of replacement. Despite this significant economic benefit to the region, as well as clear benefits for residents of Ybbs and Persenbeug Gemeinde, the state decided not to proceed with the reactivation of the line. There were further attempts to reactivate freight service on the line with the private railway undertaking Grampet Cargo submitting a proposal for handling freight operations. However, the main issue for the NÖVOG was the cost of infrastructure and the track access fees from one daily freight train would not provide a significant return on investment.

For a future reactivation however, freight transport has the strongest potential for the reactivation of the far westernmost segment of the railway. Thus, requirements for freight transport, particularly the

[217] (Karpf, 2009)

[218] (Knoll, 2014)

upgrade to 27-ton axle load and the provision of at least 500-meter-long sidings should be considered. The development of other freight opportunities such as long loading in Persenbeug and transloading of roll off containers should be further considered.

10.4 Barriers to the reactivation of the Donauuferbahn

Once a railway line has been taken out of operation, even temporarily, there are significant hurdles that must be crossed before service can be resumed. This segment will examine the various potential hurdles to the reactivation of the both the Krems-Weitenegg segment for regular traffic and the fully abandoned segment from Weins to Weitenegg.

10.4.1 Political and financial issues

In general, there is a low-level of support, in many cases an outright resistance in the ÖVP dominated government for the maintenance of branch line railways for regular traffic. The reactivation of the line between Emmersdorf and Krems depends on a high level of support from the population if it is to be reactivated. For the segment between Weitenegg and Weins, the reconstruction of the railway can hardly be viewed as feasible in the current political climate. While the Gemeinden in these segments are largely controlled by the SPO, even these have not endorsed or are outright against the reconstruction of the railway. The only exception is Marbach which has always been strongly in favor of the reactivation of the line due to the community's reliance on tourism.[219]

Furthermore, the internal transport politics between the NÖVOG and the Postbus group could arise if the bus offer is to be substantially reduced. Similar issues were encountered with an attempt to reactivate regular passenger service between Gmund and Litschau on the Waldviertelbahn.[220]

10.4.2 Lack of interest/acceptance by population

Since but not due to the closure of the railway line, the transport offer in the Wachau has been greatly improved. The bus 715 operates on an hourly interval schedule compared to the irregular schedule of trains during the final ÖBB days. The schedule may even be increased to 30-minute intervals in the near future.[221] The buses themselves are new and comfortable, with full barrier free accessibility. For the rail offer to be accepted it must match all these standards and exceed them. With the good bus offer, there may be a lack of interest among residents and leaders to reactivate the rail line for regular use.

10.4.3 Classification as Anschlussbahn

Due to the reclassification of the railway as an Anschlussbahn the line lost its legal categorization as a railway, and the concession for regular passenger traffic. For lines that stay in regular service, existing conditions that do not meet present day standards such as signalization, lack of barrier free access and so on are grandfathered in. However, since the line was taken out of regular service then for any reactivation full compliance with modern standards is required. Barrier free access must be enabled at all stations, either through high platforms or through other methods. Other potential safety issues may

[219] (Schweiger, 2019)

[220] (Knoll, 2021)

[221] Ibid.

emerge in the course of the reactivation, such as the need for additional signaling or further securing of the adjacent cliffsides against rockfalls, an issue that has long plagued the railway.

10.4.4 Noise concerns

Another concern is noise, the line has many unprotected grade crossings, primarily for access to fields, which require the trains horn to be sounded. In the years since the lines closure to regular service the surrounding residents may have grown accustomed to not hearing the train or new residents may have moved in which could prompt noise complaints, especially if trains are operating on hourly schedules. The horns can only be eliminated if the crossings are technically secured or eliminated.

10.4.5 Vehicles

For regular service, the existing vehicles will likely not be sufficient. The vehicles due to their light build, which is based on bus and tram design practices will likely not be able to withstand the rigors of regular usage for an extended period, and the vehicles are already over 15 years old. The vehicles will either need a midlife overhaul or potential replacement due to their bus like build quality and accompanying shorter lifespan.[222]

10.4.6 Barriers to reactivation of abandoned segment Weitenegg – Weins

The segment of the line between Weitenegg and Weins has been abandoned and therefore faces a significantly higher threshold to reactivation. As mentioned in segment 6.2, once a Auflassungsverfahren is approved the line loses its legal designation as a railway. For a reactivation the line must go through all the legal steps required for that of a new line. This includes obtaining a concession for the line's construction, which without a high number of projected passengers can on its own be a difficult step to overcome. The situation since 2010 has grown worse for the potential passenger numbers. With the completion of the high performance Westbahn and the Wienerwald tunnel, the Westbahn is now undisputedly the fastest rail connection to Vienna. The line between Persenbeug to Emmersdorf therefore has almost no value as a route to Vienna anymore.

Figure 27: Reconstruction of the Mariazellerbahn in 2020. Photo: NÖVOG

The legal issues are the most difficult part of the process to overcome, the physically reconstruction itself is in general not that much different from when a line is fully rebuilt as seen in Figure 29 which shows the 2020 rehabilitation of the Mariazellerbahn where all material down to the sub roadbed has been removed. However due to the lines particular characteristics the construction costs may be higher than expected. The abandoned segment has many tunnels which have been sealed and not maintained in the time since the line's abandonment, their condition may have significantly

[222] (Knoll, 2021)

deteriorated and could require expensive rehabilitation. Similarly retaining and stabilization walls may have decayed and stabilization of rock faces along the line may be needed. Several bridges have been removed and will need to be replaced, while other bridges were already in poor condition in 2010 and will also need rehabilitation or replacement. Furthermore, all new standards will need to be complied with, notably barrier free access at all stations and in some cases the right of way may need to be expanded to allow for safety passages along the track for workers.

Finally, most important is the danger of parts of the line being sold off to private developers for reuse. NÖVOG retains the right to repurchase a 6 meter right of way for reactivation, but any redevelopment of the property makes this politically far more difficult. So far, the alignment is still intact, but if parts of the right of way are sold and redeveloped then reactivation will become nearly impossible. The reactivation of the middle segment of the Donauuferbahn will require strong local support, strong ridership and/or freight traffic potential and an enabling political climate. Given the current funding levels for the NÖVOG and for branch line railways in Lower Austria in general, the potential for the reconstruction of this segment is low.

11 Modelling analysis

To develop a plan for the reactivation of the railway, a model for potential traffic demand will be calculated and used as input for developing an attractive transport plan. Precedents and best practices from other similar lines will be used as further input. Solutions will be developed to overcome the obstacles listed in the previous chapter.

11.1 The Verkehrswert model

For the modelling of the line's passenger potential, the "Verkehrswertmodell", or Transport Value is a method will be used. The model is similar to the more well-known gravity model and has been used in numerous past studies conducted at the TU Wien FVV. The model was originally developed by Dr. Bernhard Mai and published in the journal DDR-Verkehr in 1974. It is designed to evaluate the attractiveness of public transport connection and evaluate variants. The transport value can be calculated using the following formula.[223]

$$VW_{ij} = 10 \cdot \frac{h_k \cdot {k_ö}/{k_i} \; {Kfz}/{Ew}}{t_r \cdot l_{fw}}$$

h_k = The importance of the transport connection.

$k_ö/k_i$ = The ratio of the ticket price of the public transport service to individual transport

$Kfz\ /\ Ew$: The degree of motorization

t_r: The travel time

l_{fw}: The average travel distance

The volume of traffic is a function of the transport value and the trip generation potential (population) of the source cell and the attractivity (working places, school places, etc) of the destination cell. Due to changes in settlement structures and working patterns the original formula has only limited use in present day context.[224] Therefore, the model has been adapted whereby:

$$VW_{ij} = \alpha \cdot \frac{f_v \cdot h}{t_R \cdot f_k}$$

VW_{ij} = The Transport Value (Verkehrswert)

α: A calibration factor

f_v: A function for the location-based availability of the connection

h: A function for the time-based availability of the connection

t_R: A function for the travel time as a sum of the access time, waiting time, service time, transfer time and exit time.

f_k: A function for the cost of the connection.

The Transport Value model can be used in this adapted form to examine the viability of a transport concept and compare various route variants. The model can be used to calculate every origin-destination relation as well as every transport mode on selected route. The ratio of the transport value

[223] (Schoen, 2020) (Mai, 1974)

[224] (Schoen, 2020)

between different modes can then provide an estimation of the modal split.[225] The individual parameters are explained below:

Location-based availability f_v

The location-based availability is given by the theoretical possibility to use a transport mode. For public transport this includes all transport participants within the catchment area of a transit stop. For public transport a value of f_v=1 is applied for all users within the catchment zone. Therefore, the value of f_v for public transport is the same as the number of people calculated to be within a stop's catchment zone.

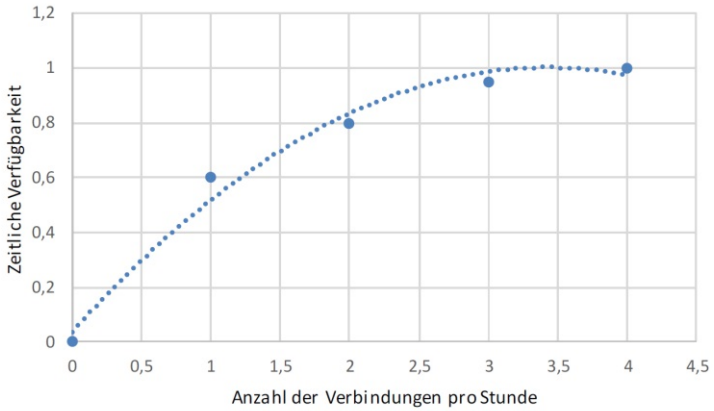
The local based availability for individual transport depends on the availability of personal vehicles. This is similar for non-motorized (bike) transport. For private transport the location availability of a transport mode can therefore be equated with the motorization level, calculated as the number of personal automobiles per 1000 residents. The value is thereby given by the formula.

$$(population \div 1000) \cdot Vehicles\ per\ 1000\ residents$$

Time-based availability (h)

The time-based availability for a transport connection describes the frequency of which a connection is available to the potential user. For personal transport, the time-based availability is unrestricted, for public transit the value is based on the interval of service. Therefore, the individual transport is assigned a value of 1 for time-based availability.

Public transport is given a value between 0 and 1. The curve is logarithmic and once service reaches a 15-minute interval it is considered on par with the private transport in terms of time-based availability.[226]



Cost function (f_k)

The cost function represents the cost of the connection for the user. For public transport this value is the derived from the cost of the ticket. Depending on the user group this can be the monthly ticket price, reduced student price, individual ticket price or other offer. For season or day tickets the price is broken down into the cost per trip.

[225] (Schoen, 2020)

[226] Ibid.

For individual motorized traffic costs are broken down into fixed and variable costs. From experience, the fixed costs of vehicle ownership such as acquisition, maintenance, taxes and insurance are considered as "sunk costs" by the users and so are generally not considered when selecting transport modes. The user considers only the variable costs even though these compose of only 12% of the full costs. As such for motorized individual traffic only the variable costs, namely fuel is considered in the equation.

Time function (t_R)

For public transport the time function includes all parts of the travel journey, namely the walk to the transit stop, the waiting time, the travel time, any transfer time and the walking time from the transit stop to the destination. Based on research by Walter,[227] passengers view different parts of the trip chain subjectively rather than objectively. Typically, a passenger prefers more in vehicle time with minimum waiting and transfer time. The following formula is used to evaluate the door-to-door journey:

$$t_R = t_{Fzu} * Z(t_{Fzu}) + t_W * Z(t_W) + t_B + t_U * Z(t_U) + t_{Fab} * Z(t_{Fab})$$

Whereby:

- t_{Fzu} is the access time from trip origin to public transport stop
- $Z(t_{Fzu})$ is the subjective rating factor for the access time
- t_W I the waiting time at the halt
- $Z(t_W)$ is the subjective rating factor of the waiting time
- t_B is the travel time
- t_U is the transfer time
- $Z(t_U)$ is the subjective rating factor for the transfer time
- t_{Fab} is the time to walk from the halt to the destination
- $Z(t_{Fab})$ is the subjective rating for the exit time

Walther defines the subjective rating factors for the mode's bus/tram, U-Bahn and S-Bahn. These time rating factors were designed for use in the urban context, thus may overestimate the time resistance factors for transport in a rural region. The following values are given for the mode S-Bahn, the most similar to regional rail.[228]

$$Z(tFzu = \ 0.574 + \ .299 * e^{0.282 * tFzu}$$
$$Z(tw) = .342 + 1.043 * e^{0.167 * tw}$$
$$Z(tu) = .194 + 0.926 * e^{0.226 * tu}$$

The resistance $Z(t_{Fab})$ for the exit time is identical to the access time.

For the examination of the existing situation, the existing situation of bus transport will also need to be examined. The subjective ratings for buses are as follows. For buses the exponential curve is significantly steeper, likely reflecting the specific perception of bus waiting areas compared to railway ones. However, as the original model is largely formulated around urban areas, the values again may be too conservative for the rural context.

$$Z(t_{Fzu}) = 0.507 + 0.269 \cdot e^{0.396 \cdot T_{fzu}}$$

[227] (Norta, 2012)

[228] Ibid.

$$Z(tw) = 1.633 + 0.257 * e^{0.459*tw}$$
$$Z(tu) = .745 + 0.284 * e^{0.438*tu}$$

The function is the result of Walter's research finding and show that the subjective travel factors can quickly outweigh the actual travel time. This is represented in the model through the exponential increase in the perceived time. For example, the walking distance to the stop is only 1 minute, this is viewed equally to 1 minute of travel time, however 6 minutes of walking is considered as 24 minutes of travel time, a dramatic increase.[229] This is even further propagated by the desire of some commuters to use their commute for additional working time, enabled by the widespread use of portable work electronics. Figure 31 shows how quickly the subjective values of non-travel time (in this example transfer time) can overcome the travel time itself.

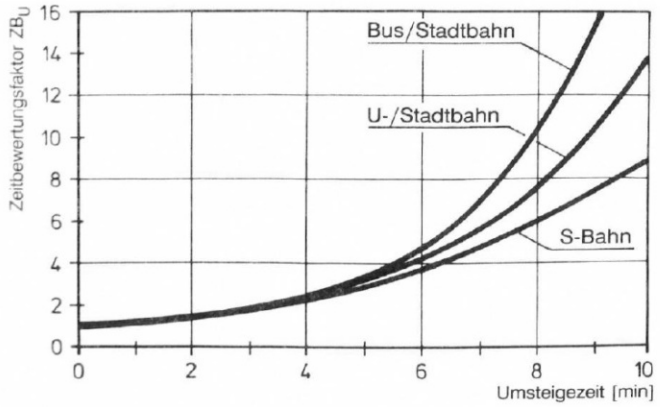


Figure 29: Perceived duration of transfer times for various transport modes. Source: Walter

For the individual motorized traffic, the function is written in the following form:

$$t_R = t_{Fzu} * Z(t_{Fzu}) + t_F + t_P * Z(t_P) + t_{Fab} * Z(t_{Fab}) * Z_{MIV}$$

The variables are the following

- t_{Fzu} is the access time from the origin to the parking spot
- $Z(t_{Fzu})$ is the subjective rating factor of the access time
- t_F is the travel time
- t_P is the parking place search time
- $Z(t_P)$ is the subjective rating of the parking place search
- t_{Fab} is the time from the parking place to the destination
- $Z(t_{Fab})$ is the subjective rating of the exit time from the parking place to the destination
- Z_{MIV} is the aggregated subjective rating factor for the private transport journey

The subjective rating factors for the individual motorized transport are given as the following:

$$Z(t_{Fzu}) = 1.0$$
$$Z(t_p) = 2.0 + 10^{-4} \cdot e^{0.8 \cdot t_p}$$
$$Z(t_{Fab}) = 2.0 + 10^{-4} \cdot e^{0.8 * t_{Fab}}$$
$$Z(_{MIV}) = 0.8507 \cdot (1 - 0.7318 \cdot e^{-0.437923 \cdot D_{ij}})$$

Whereby Dij is the distance in kilometers of the trip

[229] (Knoflacher, 2009)

Based on these values, there should be an effort to minimize transfers and waiting times, as well as providing logical access to the station to reduce access times. A properly implemented Taktfahrplan can be the key to reducing these extra times and improving the competitiveness of the system. However, push methods away from automobile traffic can be just as effective, the parking place search time and the time from the parking place to destinations has a very negative influence. If the number of parking places is reduced and/or the average walking time to the destination is increased, then the automobile will become a less attractive alternative. Concentrating parking in garages while removing street parking can greatly increase the competition between public transport and individual motorized transport.

Calibration factor

The calibration factor would ideally come from actual passenger statistics; however, these are often not publicly available. As such this data can be derived from general travel and commuting statistics. With a calibration factor the model becomes a realistic rather than purely theoretical one.

11.2 Model data

To calculate the transport value, data for each input described above must be collected. This chapter will explain the data collection process for each input. The following table shows the basic demographic data needed for the Transport Value model. The table only represents the destinations that are directly reachable by the line and therefore most relevant. As can be seen Krems dominates the statistics, and any analysis of the line will need to focus on the flow of passengers to and from Krems. Statistics on working places, schools and hotels were taken from the Austrian statistics interactive map with data from 2019.[230]

Table 16: Gemeinde level statistics on available jobs, school places, hotels, and commuter balance. Source: Statistik Austria

Gemeinde	Pop	Working places	School places	Hotel beds	Internal commuters	Incoming commuters	Outgoing commuters
Krems/Donau	24,846	19,840	5,039	1,115	5,867	12,353	5,182
Dürnstein	874	582	19	347	170	315	271
Weißenkirchen	1,427	710	52	203	334	289	423
Spitz	1581	814	97	533	364	359	458
Aggsbach	647	116	20	38	67	25	251
Emmersdorf an der Donau	1,759	396	169	253	198	136	701
Leiben	1,357	256	0	59	124	109	587
Klein-Pöchlarn	1,007	221	36	46	81	126	427
Marbach an der Donau	1,709	540	278	87	196	188	687
Persenbeug-Gottsdorf	2,168	761	147	60	236	482	908
Hofamt Priel	1,702	278	0	58	147	102	742

[230] (Bundesanstalt Statistik Österreich, 2021) (Statistik Austria, 2020)

A comparison between the working and school places compared to population shows the area has a large commuter potential. Between Krems and Spitz a significant percent of the population has the possibility of being employed locally, however in the rest of the corridor most of the population will be commuters.

Table 17: Ratio of jobs and school places to population. Source: Statistik Austria

Gemeinde	Pop	W/P	S/P
Krems/Donau	24,846	0.80	0.20
Dürnstein	874	0.67	0.02
Weißenkirchen	1,427	0.50	0.04
Spitz	1581	0.51	0.06
Aggsbach	647	0.18	0.03
Emmersdorf an der Donau	1,759	0.23	0.10
Leiben	1,357	0.19	0.00
Klein-Pöchlarn	1,007	0.22	0.04
Marbach an der Donau	1,709	0.32	0.16
Persenbeug-Gottsdorf	2,168	0.35	0.07
Hofamt Priel	1,702	0.16	0.00

W/P = working places per person, S/P = schools per person.

11.2.1 Schools traffic

School transport is an important source of traffic for local railways across Austria, typically there are extra early morning courses specifically for this purpose. The Donauuferbahn when it was still in regular service was well used by school commuters as the line has many schools within its catchment zone.[231] School children are practically captive users of the public transport network, so can be a good basis on which to build ridership. Similarly, there are many advantages to offering good services for school ages users for both the railway and users. For children it allows them freedom to travel on their own even a young age which is good for social development.[232] For the railways, the provision of good public transport for children can influence them to become regular public transport customers in the future and maybe even chose not to own a car if their experience with public transport has been positive since a young age.

[231] (Csizmadia, 2000)

[232] (Berg, 2018)

Data on locations of schools as well as the home location of children attending each school is available publicly from Statistik Austria.[233] The data on home location of school children is displayed in a 500-meter raster grid. Figure 30 shows an example of the display which appears when an individual school is clicked on in the interactive map. A key of the cell values appears on the left.

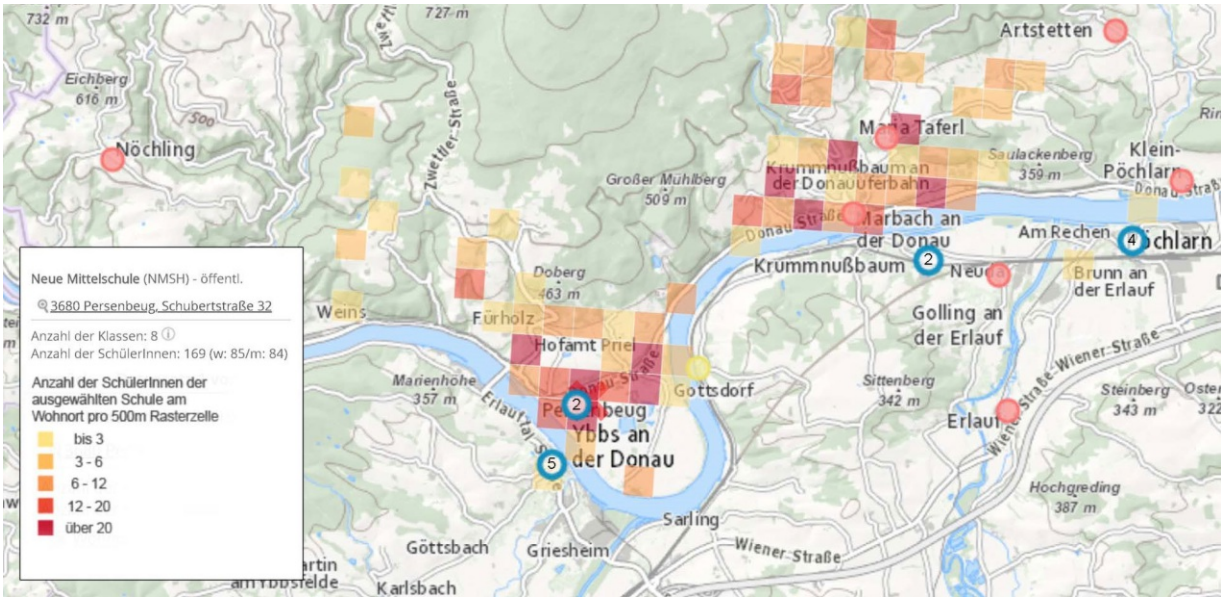


Figure 30: Example of school raster with legend. Source: Statistik Austria Schulatlas

As can be ascertained from this example, the number of students based on the cell values exceed the total number (169) that attend the Neue Mittelschule in Persenbeug. If counting just the dark red cells at their lowest possible value of 21, one already exceeds 200 students, more than the total actual number. The raster data is available for further analysis in GIS, however only at a very high price point. With this data discrepancy there is no reliable way to reconcile the cell values with the actual numbers, attempting such would be time consuming with no guarantee of a more accurate result. Therefore, all cell values will be interpreted at their lowest possible value, i.e.: 1,3,6,12 and 21. This will still result in an overestimation but should be at least useable in establishing traffic pattern trends.

For this study there are two classifications of schools that are of primary importance. The Volkschule are the most common type of school and are for children aged 6-10 for which attendance is mandatory. These schools generally serve a limited number of students and have a small catchment area consisting of the town they are located and, in some cases, the adjacent town. School children attending these schools could use the railway but generally only for one stop, this however still could be useful since development is generally quite dense due to the geography in the river valley, so their shortest path is likely along the railway line.

The second major type is the Neue Mittelschule, or simply Mittelschule (middle school). These schools are for children aged 10-14 for which attendance is mandatory.[234] These schools have a much larger catchment zone and could bring significant amount of traffic to the railway.

[233] (Statistik Austria, 2020)

[234] (BDW, 2021)

Krems has the highest concentration of schools in the area served and most diverse number of school types, school traffic to and from Krems would likely play a significant role in the line's reactivation. The following table shows the potential number of student commuters to each relevant town. The statistics show that most school commuters are either to the larger cities or to the adjacent town.

Table 18: Student commuters per origin and destination point.

Nearest Station	# of schools	# of Students	# Students per origin station																	
			Ke	Stei	Un	Dü	Weiß	Wös	Sptz	Scw	Will	Agg	Grim	Emm	Weit	Eb	K-Pö	Mar	Pers	Wein
Krems	16	5850			99	36	132	55	82	0	0	0	0	0	0	0	0	0	0	0
Krems-Campus	1	98		27	1															
Stein-Mautern	1	181			6	6	12	6	4											
Dürnstein	1	19			25															
Weissenkirchen	1	52			1			62												
Spitz	2	97				3	12	7		6	6									
Aggsbach	1	20									25									
Emmersdorf	2	189									1		14		32	16				
Klein Pochlarn	1	36																		
Marbach	1	50																	2	
Persenbeug	2	316																63		27
Not Directly on Line, only schools above Volkschule listed																				
Emmersdorf (Melk)	2	1066				3		3	23		19	17	10		3	5	33	24	70	15

11.2.2 Commuter traffic

Statistics on commuting patterns are available from Statistics Austria at a Gemeinde level through the interactive map.[235] The statistics already reveal the basic pattern that has dominated the lines history. The catchment area of Krems is strong up until Spitz and disappears entirely after Emmersdorf. Furthermore, there is a little possibility for through traffic past Emmersdorf as commuters within this segment generally commute to destinations outside the railways range. In the case of commuters towards Vienna from the lines far western segment, a routing via the Donauuferbahn is no longer attractive compared to the upgraded Westbahn. Due to the lack of road crossings of the Donau, a rail connection via Krems to St. Pölten either via Melk or Krems can still be attractive. Similarly due to the good accessibility of stations in the Wachau, and difficulty of car use in Vienna, the line would be an attractive option for commuters to Vienna.

Table 19: Commuters on a Gemeinde level along the Donauuferbahn corridor. Source: Statistik Austria 2019

Origin ↓ Destination ->	Krems	U/Dü	Weiß/Wös	Spitz/Schw	Will/Agg	Grim/Emm	Weit	K.Poch	Marb	Pers	Melk	S.Poe	Wien
Krems/Stein		95	35	25							26	951	955
Unterloiben/Dürnstein-Oberloiben	110			6								36	46
Weißenkirchen/ Wösendorf	151	23		14	2							42	27
Spitz/Schwallenbach	148	6	31		7	2					28	57	52
Willendorf/Aggsbach	46		5	24		3					20	44	15
Grimsing/Emmersdorf	27			8	1		13	4	3	7	150	112	79
Weitenegg	6			3		22		10	9	9	93	89	36
Klein Pochlarn	5					5			11	10	48	69	30
Marbach-Maria Taferl	3					3		9		39	62	69	70
Persenbeug	6							4	16		44	76	85
Weins-Isperdorf	3							3	8	81	19	48	28

[235] (Statistik Austria, 2021)

The statistics are only provided on a Gemeinde level, and due to the large size of many Gemeinden in the region further refinement is needed. To approximate better the potential users for each railway station, the population of the Ortschaft has been converted to a percentage of the population of the entire Gemeinde which is displayed in the following table.

Table 20: Population distribution of railway relevant Ortschaften within Gemeinden.

Gemeinde	Gemeinde Pop	Ortschaft	Ortschaft Pop	Station	% of Gemeinde
Krems/Donau	24,846	Krems	17509	Krems/Donau	0.70
		Stein	2037	Stein-Mautern	0.08
Dürnstein	874	Unterloiben	302	Unterloiben	0.35
		Oberloiben	167	Dürnstein-Oberloiben	0.54
		Dürnstein	305		
Weißenkirchen	1,427	Weißenkirchen	931	Weißenkirchen	0.65
		Joching	148	Wösendorf-Joching	0.31
		Wösendorf	298		
Spitz	1581	Spitz	1210	Spitz	0.77
		Schwallenbach	90	Schwallenbach	0.06
Aggsbach	647	Aggsbach Markt	387	Aggsbach Markt	0.60
		Willendorf	153	Willendorf	0.24
Emmersdorf an der Donau	1,759	Grimsing	133	Grimsing	0.08
		Emmersdorf/Hofamt	865	Emmersdorf	0.49
Leiben	1,357	Weitenegg	43	Weitenegg	0.05
		Urfahr	31		
		Lehen	114	Ebersdorf	0.19
		Ebersdorf	147		
Klein-Pöchlarn	1,063	Klein-Pöchlarn		Klein-Pöchlarn	1.00
Marbach an der Donau	1,709	Marbach	284	Marbach	0.52
		Krummnußbaum	605		
Persenbeug-Gottsdorf	2,168	Persenbeug	1293	Persenbeug	0.60
Hofamt Priel	1,702	Weins	331	Weins	0.19

To further refine the population numbers, statistics on the age breakdown of the population are used to get a closer estimate of the actual working and school age population. Data on population age per Gemeinde is available from the state of Lower Austria broken down into age categories.[236] The population between age 20 and 64 will be considered for commuters and applied to the individual town populations as a percentage. For school commuters the population between 5 and 19 is used.

[236] (Statistik Austria, 2021), (Statistik Austria, 2021)

Table 21: Population of relevant Gemeinden by age. Source: Statistik Austria

Verwaltungsbezirk / Gemeinde	Populaion 2020 by age group										
	Total	0-4	5 - 14	15 - 19	20 - 44	45 - 59	60 - 64	65 - 79	80+	% Working	% School
Lower Austria	**1,690,879**	**78,868**	**165,276**	**85,111**	**497,328**	**401,059**	**116,698**	**242,199**	**104,340**	**60%**	**15%**
Krems a.d. Donau	**24,837**	**1,124**	**1,952**	**1,099**	**7,759**	**5,549**	**1,848**	**3,843**	**1,663**	**61%**	**12%**
Dürnstein	828	31	69	40	203	193	78	151	63	57%	13%
Weißenkirchen in der Wachau	1,400	41	124	59	359	337	126	249	105	59%	13%
Spitz	1,564	58	105	77	433	373	124	259	135	59%	12%
Aggsbach	643	15	59	19	163	152	56	122	57	58%	12%
Emmersdorf an der Donau	1,753	89	184	75	516	403	131	265	90	60%	15%
Klein-Pöchlarn	1,063	65	90	39	336	229	85	158	61	61%	12%
Marbach an der Donau	1,688	82	168	81	535	368	118	244	92	60%	15%
Persenbeug-Gottsdor	2,156	99	189	108	644	531	180	280	125	63%	14%
Hofamt (Weins)	1,731	106	172	89	504	403	141	232	84	61%	15%
Leiben	1,355	53	143	79	398	310	105	195	72	60%	16%

11.2.3 Tourist traffic

Tourist journeys are harder to estimate than regular commuting trips as the source, and mode of arrival are hard to determine. Many daytrip visits do not show up in statistics at all, especially in an area where many arrive via bike. In 2019, the Wachaubahn carried 38,000 passengers during the touristic season. The railway is in operation for 164 days a year, so based on a ratio of operating days to passenger number this equals 231 passengers in tourist traffic per day. This of course is not accurate as the peak summer tourist months see substantially more traffic, at the start and end of the season the trains operate with only one vehicle due to limited demand while in the peak summer season 2-3 are used. This number is also not by itself a good estimator of the full touristic potential of the railway due to high ticket prices and lack of integration with popular tourist ticket offers.

Estimating daytrip potential is very difficult and can perhaps only be done through extensive field surveys. However, data on overnight stays and accommodation can help assess part of the tourist potential. Hotel beds and stays is another way to estimate potential tourist traffic. The number of beds per Gemeinde can be used to determine the location-based availability for tourist traffic by showing the full potential for overnight tourists. The last available data on number of beds that could be found dates from 2011. As the estimation of the tourist traffic potential is much more approximated than that for commuter and school traffic, the 2011 numbers will still provide a sufficient input. To break down the numbers to an Ortschaft level and then to that of the railway catchment zone some simplifying assumptions were used. First the number of accommodations shown on the Booking.com interactive map was used to see the total number of available accommodations per Ortschaft. These numbers were then further broken down to whether they fell inside the catchment zone previously calculated. The resulting number of beds is used as the input for the location-based availability. The total number of beds were broken down using these numbers with the simplifying assumption that beds were evenly distributed between hotels. Since tourists in general have a lower resistance to walking, as it is a one-off trip rather than daily, the entire 1000m catchment zone was considered without weighting.

To calibrate the model, data on actual numbers of visitors is needed. Statistics on the number of overnight stays are available at the Bezirk level from Statistik Austria.[237] The following data is from 2019 for towns along the railway.

Table 22: Hotel check ins and overnight stays per Gemeinde

	Arrivals			Overnight stays			
Administrative area	**Total**	**Foreigners**	**in %**	**Total**	**Foreigners**	**in %**	**Ø Stay in Days**
Krems (Land) - Bezirk	218,460	78,215	35.8	465,035	206,129	44.3	2.1
Aggsbach	4,460	3,122	70.0	7,372	5,449	73.9	1.7
Dürnstein	25,154	12,238	48.7	52,550	30,039	57.2	2.1
Spitz	28,028	13,117	46.8	65,335	36,724	56.2	2.3
Weißenkirchen in der Wachau	23,032	10,636	46.2	53,504	30,256	56.5	2.3
Melk - Bezirk	197,767	105,343	53.3	330,060	175,003	53.0	1.7
Emmersdorf an der Donau	22,435	11,494	51.2	40,551	23,107	57.0	1.8
Marbach an der Donau	9,375	7,649	81.6	13,263	10,522	79.3	1.4
Melk	52,410	32,918	62.8	78,910	49,060	62.2	1.5
Persenbeug-Gottsdorf	4,835	3,331	68.9	6,828	4,598	67.3	1.4
Pöchlarn	17,328	11,745	67.8	27,622	18,921	68.5	1.6

In total 134,647 people stay in hotels per year along the railway line, with 103,109 along the segment from Krems to Emmersdorf (not including Krems itself). Therefore, there are theoretically an additional 65,100 touristic users that have the potential to use the railway line. If an attractive tourist ticketing offer is implemented, then there is a possibility to capture a significant portion of the market.

Further data is available on a Lower Austrian level on the source of tourists, both internal and external. These statistics have been used to develop an estimation of which routes visitors will take to reach destinations in the area. For within Austria and surrounding countries (with exception of Italy due to its size) it will be assumed that visitors come from the closest geographical direction per land. For all others land it is assumed that their journeys will originate in Vienna after arriving by plane.

Among tourists from within Austria, 63% come from Lower Austria, Vienna and Burgenland, a public transport offer therefore could be very attractive for many of these visitors. A further 9% originate from Styria which per transportation routes would mean arrivals from the East. Outside of those arriving directly from Vienna or the surroundings, most would likely transfer at St. Pölten either to Krems or Melk.

From the international tourists, 54% come from Austria's neighbors with nearly half coming from Germany. Here too public transport can be a promising option especially with Austria's developed night train connections.

Due to the current arrangement of the Krems Taktknoten, arrival to the Wachau via St. Pölten and Krems is highly unattractive due to the 40-minute gap between the arrival of the R44 in Krems and the departure of bus 715. Similarly, for those arriving by train from the east, the change to Franz Josefs Bahnhof is inconvenient, especially for those not experienced with the system. For tourists arriving from international destinations by plane however, one can assume that they will spend at least one

[237] (Statistik Austria, 2019)

night in Vienna, so some will travel to via Franz Josefs Bahnhof. The following is a breakdown of potential paths for tourist visitors if one considers they all arrive by public transport. This is a very subjective assessment but serves mainly to establish the tourist potential rather than the actual demand. The daily numbers are based on a 180 day per year tourism season, as the numbers per day outside that season are low.

Table 23: Estimated breakdown of tourist flow to the Wachau by public transport

Relation	Annual	Daily
Krems-Dürnstein	7,044	39
Krems- Weißenkirchen	6,556	36
Krems-Spitz	7,946	44
Krems-Aggsbach	927	5
Krems-Emmersdorf	4,059	23
Melk-Dürnstein	4,004	22
Melk-Weißenkirchen	3,843	21
Melk-Spitz	4,622	26
Melk-Aggsbach	415	2
Melk-Emmersdorf	19,539	109
St. Pölten-Dürnstein	17,684	98
St. Pölten- Weißenkirchen	16,067	89
St. Pölten-Spitz	19,590	109
St. Pölten-Aggsbach	3,345	19
St. Pölten-Emmersdorf	17,486	97

The data collected in this segment will be used to calibrate the transport value model, which will be calculated individually for each user group.

11.2.4 Traffic pattern overview:

Based on the statistics for the various user groups, the primary flow is to and from the regional centers of the area. While there are several intermediate relations that area important, the primary flows towards the regional centers will show the most about the viability of the railway as a transport relation. Therefore, the presented Transport Value analysis will be primarily concerned with these relations.

11.3 GIS analysis

GIS, or Geographic Information Systems refers to software packages which can be used to analyze geospatial data together with statistical data. For this study, the open-source program Quantum GIS, or QGIS will be used. The program is open source and freely available, so the methods used here will be transparent and free to be replicated. In addition to the built-in features, numerous third-party plugins are available to extend the programs capabilities. For this project GIS has been used to determine the catchment area of stations, as well as to produce illustrative maps.

GIS can be used to analyze features raster and vector features. In raster format data is stored in “cells” based on the grid size of the raster. Vector features come in three types, point data, line (string), and

polygon. For this project data from the OpenStreetMap project (OSM) serves as the primary data source for vector data. Data is compiled from a variety of sources, including user input as well as open-source data released by relevant authorities. As with all user-generated data there is a risk of inaccuracy or missing information, however for GIS analysis it is the most complete and detailed worldwide dataset, the veracity of the data can be checked through comparison with satellite imagery, maps and official data where available. The data is available in shapefile format from the website Geofabrik with separate shapefiles for each type of feature. For this analysis the primary feature types are used the railway, street, and land use layers.

11.4 Determining catchment area

The catchment area is the area around a transit stop from which the station is a viable transportation alternative. Determination of a catchment zone is important for planning a new transit line or analyzing the potential for one as the geographic catchment zone defines how many potential users the system can serve. Once the geographic catchment area is defined then the number of homes, workplaces and businesses within the catchment zone can be calculated. A catchment zone is traditionally defined by a circle around the transit stop from which walking to the station is a reasonable option for most people, its radius varying according to the importance of the connection. This method however often overestimates the size of the catchment area due to the walking distance being greater than the "as the crow flies" distance due to geography, buildings, and the layout of the streets.[238] In an area like the Wachau with a river and few crossings, this is especially important as the traditional method would inadvertently include areas on the opposite bank.

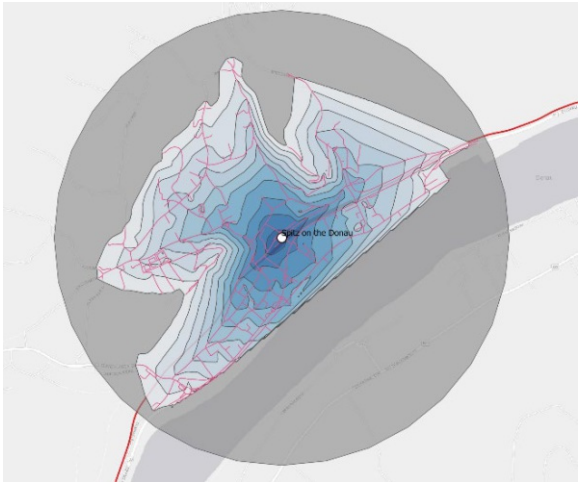


Figure 31: Comparison between standard circle method, Isochrone and Isochrone area. Source: Author illustration

Using GIS, the isochrone method can provide a more accurate result. An isochrone is used to refer to a line joining a set of points at equal travel time from a specified location, whereas isochrone area refers to the set of all points contained within an isochrone which are reachable in the specified time or less.[239] The default QGIS toolset is able to generate an isochrone using the Service Area tool, however the isochrone itself is a line type file which is not useful for further analysis of the catchment zone. Therefore, a third-party plugin is needed to generate an isochrone area. For this study the open source QNEAT3 plugin is used. The plugin creates Isochrones based on a point file representing the centroids and a road network vector file. The size of the catchment zone as well as increments can be set in the parameters. This plugin was chosen while it allowed for the calculation based on a custom road network which allow proposed changes to be incorporated into the analysis. Several other popular plug ins relied on a predefined network.

To calculate the potential users of each station, it is necessary to determine the population in the areas surrounding each transport stop. Small scale population statistics are available from Statistics Austria,

[238] (Brebia, 2008)

[239] (Using desktop GIS for the investigation of accessibility by public transport: an isochrone approach, 2000).

however only at a high price. From Statistics Austria itself the best data scale available is 10 km, which is essentially useless for this purpose. However, Eurostat has an EU wide 1 km population grid from 2018 which when clipped with other data can be used instead and provide a reasonable level of accuracy.[240] To further work with the raster data, the QGIS "Polygonise" tool was used to convert the data from raster to vector data. This results in a grid of 1 KM square polygons each attributed with the population of the area. To get a more accurate location of the population, the converted population polygon is intersected with the OSM land use layer filtered only for residential areas. The intersection provides a reasonable depiction of the population distribution that can be used for further assessment of the catchment zone. Figure 32 shows the 1 KM vectorized grid overlaid with the residential land use from OSM with a population attribute added from the grid.

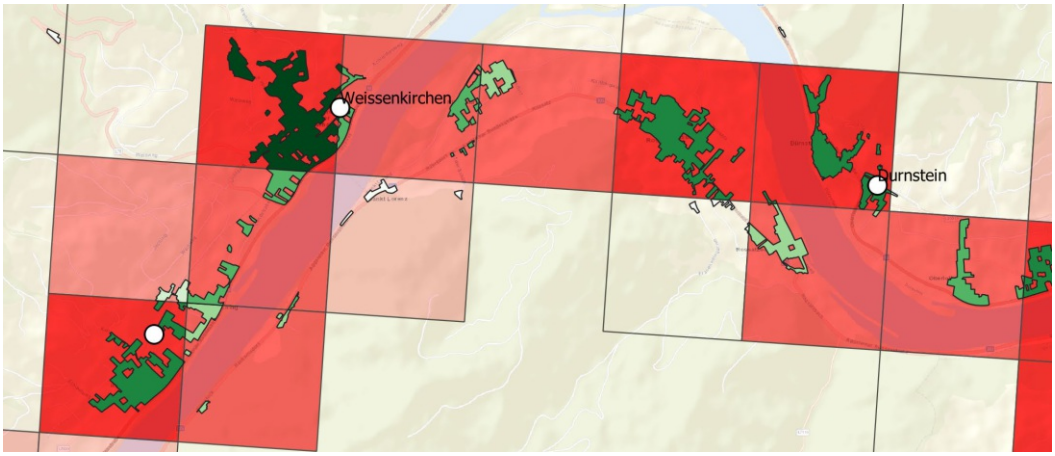


Figure 32: 1 KM Raster grid overlaid with the residential area polygons from OSM. Source: Author map

To further use these results, a simple population density figure is calculated. For this all polygons within each 1 km tile need to be merged which due to the limited scope was done manually. The QGIS field calculator was used to calculate the area of each tile from which the population density per tile can be calculated.

The definition of the catchment zone is based on research by Otto Peperna who developed a system to determine a stations attractiveness by distance. In his study Peperna defines the catchment zone of a station as 1000 meters, a definition commonly accepted for rail systems in lower density areas. The catchment zone is however in reality is not uniform with a much higher degree of users captured the closer into the station. In his Diploma thesis, Peperna developed a curve function based on empirical data to determine the attractivity based on distance.[241] The 1000-meter catchment zone is separated into 100-meter intervals with the attractivity of the stop decreasing with distance.[242]

[240] (Eurostat, 2018)

[241] (Peperna, 1982)

[242] (Schoen, 2020) (Peperna, 1982)

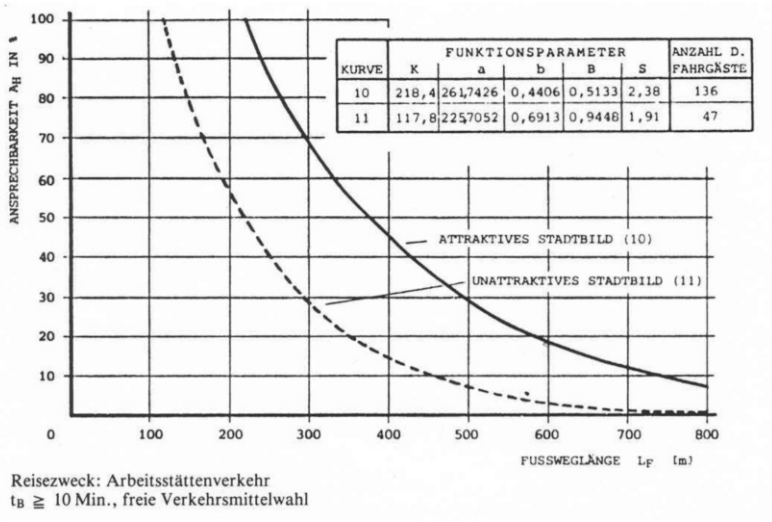


Figure 33: Curve function for the attractivity of the access to a station based on the environment. Source: Peperna

The acceptance of the stop is based largely on the built environment surrounding the access to the station, a car free or area with limited car traffic have up to a 70% greater attractivity than that of an auto oriented environment. Thus, from the curve function the following values for attractive and unattractive areas can be interpreted. [243]

Table 24: Weights based on distance from halt. Source: (Peperna)

	Weight	
Distance (m)	Unattractive	Attractive
100	1	1
200	0.75	1
300	0.4	.70
400	0.19	.45
600	0.07	.3
800	0.02	.07
1000	0.01	.02

The attractivity of the urban environment is a very subjective one, thus an inspection of the visual conditions is required. In general, the towns of the Wachau are very attractive, small narrow streets require cars to travel slowly where they are allowed, and although there are no sidewalks in most places pedestrians have near equal usage of the full street as vehicles. In the smaller villages however, the conditions are more rural and thus less attractive to pedestrians with broader and faster roads with still no dedicated sidewalks. The mental perception of a distance particularly increases in open rural areas where there is little of interest for the person walking, and when the destination can be seen long before it is reached. The open environment further gives no shelter from the element, particularly important in the winter when windy conditions often prevail in the valley. Based on visual inspection (in person and digital), the following subjective evaluation has been made for station access conditions:

[243] (Peperna, 1982) (Schoen, 2020)

- In general stations in the Wachau can be considered as having a good surrounding urban environment, thus optimistic values will be used.
- The stations of Wösendorf-Joching and Unterloiben are an exception to this rule, both have long walking distances to the station through largely open areas with no dedicated pedestrian infrastructure. Negative values will be used.
- The urban conditions along the middle segment of the line are more varied. Both Klein Klein-Pöchlarn and Marbach can be considered to have attractive urban conditions. In Klein Pöchlarn the station is away from the main road and the area is densely settled. In Marbach the access to the station is along the main B3 road, however there are nice views of the river, and the sidewalk is broad with a separate path for bicyclists. Users must walk along the B3 for 300 meters before reaching the historic center of Marbach is nearly car free.
- The access to the station in general is unattractive. Users must walk along the heavily travelled B3. Although sidewalks are provided the area can clearly be characterized as auto oriented, with the surrounding buildings in general having little interaction with the street. The B3 sees heavy traffic including many trucks. However, the historic city center of Persenbeug has attractive conditions, and if alternative paths from the station instead of the B3 are provided, the access conditions could be considered attractive.
- The conditions at Lehen-Ebersdorf and Weins can be considered to have an unattractive surrounding due to the long or indirect paths between the station and surrounding settlements.

For bus transport the same conditions can generally be considered, additionally the situation at Unterloiben/Oberloiben as well as Joching can be considered as attractive due to the bus halt positions near the town center. However, in a few cases such as Grimsing the bus stop can be considered to have a less attractive environment due to the road being on the edge of the settlement. In the cases where the bus has more attractively located stations, its effective catchment will be far greater due to the difference in weighting. This must be compensated for in any reactivation plan. The rating of each station for bus and rail is found in Annex 11.4

The Isochrones were created with the QNET3 plugin using a point file representing the location of stations as the origin point and the OSM road layer for the network. Additionally, the station platforms and access paths were added to the street network. Desire paths, such as in the case where there is no official link to the other side of the tracks (for example at Aggsbach Markt) were not included. These are added in during a later phase for suggested improvements, for the initial study only the official and legal paths are considered. Lastly the topology tolerance was set between 3 and 5 meters which allows the process to connect imperfectly joined segments.

The file outputs a series of overlapping polygons to represent each ring. For these to be useable for further analysis they need to be clipped to remove the overlapping parts. This is done by first splitting each ring into a separate layer, then the polygons are cut with one another using the “difference” tool, during this step the 500-600, 700-800 and 900-1000 rings are also dissolved together to match the categories defined by Peperna. At this stage the layer for each ring is given a new attribute with the appropriate weight from Table 23. Next the catchment zones are intersected with residential land use areas from the previous step using the “Intersection” tool, leaving just the part of the catchment area that falls within the residential land use area. Given that most of the line falls in a protection area where limited new housing can be expected or areas where the population is declining, thus evaluation of the existing housing can be considered sufficient. The visual result of this step already reveals where there are gaps in the coverage area of the railway. Between Krems and Emmersdorf most of the residential settlement areas of the towns fall into the catchment zones, however around Marbach and Persenbeug there are significant discrepancies between the station catchment areas and the overall settlements.

The following gaps in the catchment area were identified for further consideration.

- The settlement of Oberloiben falls in a gap between the catchment zones of Unterloiben and Dürnstein station.
- The Hinterhaus area of Krems falls outside of the catchment area of the station entirely. However, it is served by buses 718 and 719.
- The settlement of Schallemmersdorf falls outside the catchment zone of the railway, however it is also served by bus 797.
- The settlement of Luberegg falls outside the catchment zone of the railway, however it is served by the buses 790 and 791
- Marbach and Krummnußbaum are poorly covered by Marbach station
- Gottsdorf falls outside the catchment zone of Persenbeug-Gottsdorf station.

After the intersection with the settlement layer, the individual rings are merged back together. To obtain the results several calculations are needed. First the area of the rings is calculated using the field calculator *$area* function. Next to obtain a population per polygon the previously calculated population density is multiplied by the new area. Last the weighted population is calculated by multiplying the population by the weight factor. From here the attribute table is exported to a .csv file for further analysis in Excel. The entire process is time intensive and susceptible to both program and user error, for larger datasets it may not be practical to apply without some further automation or batching of the processes listed.

In Excel the data is sorted by the Isochrone (station) and data for each ring is summed to provide the following values.

Table 25: Number of residents within each catchment ring based on GIS analysis with weighting per Peperna

Station	100m	200m	300m	400m	600m	800m	1000m	Sum
Krems/Donau	39	108	103	87	89	44	19	489
Krems Campus	14	53	104	72	57	16	8	324
Stein/Donau	6	13	18	9	4	4	5	59
Unterloiben	1	9	4	2	5	3	1	25
Dürnstein	18	32	2	8	10	2	6	78
Weißenkirchen	0	0	12	33	85	21	2	154
Wösendorf-Joching	1	6	11	10	15	2	1	46
Spitz/Donau	11	44	52	43	52	16	2	219
Schwallenbach	0	2	15	10	9	0	0	36
Willendorf	13	18	17	18	18	4	0	89
Aggsbach Markt	5	18	18	17	28	3	1	91
Grimsing	4	20	11	15	17	1	0	67
Emmersdorf/Donau	7	26	29	23	16	3	11	115
Weitenegg	0	1	3	3	2	1	0	10
Lehen-Ebersdorf	1	4	6	4	5	2	1	23
Klein-Pöchlarn	19	45	43	64	100	18	2	291
Marbach-Maria Taferl	6	11	7	4	21	11	6	66
Persenbeug	7	14	15	24	28	7	3	98
Weins-Isperdorf	2	6	6	2	0	1	1	18
Sum								2297
Sum without Krems								1425

Through this calculation several further weak spots in the railway coverage become apparent, Weißenkirchen, despite large population has a very small number of residents in the catchment zone. This is due to the stations somewhat distant location to the town center. Weitenegg station, located significantly away from the town has the least people within the 1000-meter catchment zone, thus the station has historically had more importance for freight than passenger use as a result. The station at Lehen has very few people within its catchment zone, largely because of the height difference between the village of Lehen and distance to the settlement of Ebersdorf.

When the catchment area of the railway is compared to the Bus route 715, things however become even more critical. In most places the bus has a significantly greater catchment area. Particularly problematic is the situation in Unterloiben and Oberloiben. The station at Unterloiben is significantly far from the town and the town of Oberloiben falls between the catchment areas of Unterloiben and Dürnstein. Similarly, the bus has a far larger catchment area in Wösendorf-Joching, due to the railway station being situated directly in between the two villages while the bus has a separate stop for each. As in the last segment, the deficit of the Weißenkirchen catchment area compared to its large population is clearly apparent.

Table 26: Comparison of catchment of rail and bus along route.

Station cluster	Population of relevant Ortschafts[244]	Residents within catchment zone				
		Bus	% Population	Rail	% Population	Comparison rail vs bus%
Unterloiben	302	201	67%	25	8%	12%
Dürnstein	472	267	57%	78	17%	29%
Weißenkirchen	931	271	29%	154	17%	57%
Wösendorf-Joching	446	403	90%	46	10%	11%
Spitz/Donau	1210	273	23%	219	18%	80%
Schwallenbach	90	52	57%	36	40%	70%
Willendorf	153	143	93%	89	58%	62%
Aggsbach Markt	387	160	41%	91	23%	57%
Grimsing	133	66	50%	67	51%	102%
Emmersdorf/Donau	865	255	29%	115	13%	45%
Lehen-Ebersdorf	261	30	12%	23	9%	75%
Klein-Pöchlarn	1063	471	44%	291	27%	62%
Marbach-Maria Taferl	1110	702	63%	66	6%	9%
Persenbeug	2156	154	7%	98	5%	64%
Weins-Isperdorf	331	82	25%	18	5%	21%

West of Emmersdorf the situation become even more problematic, there is a significant population west of Emmersdorf along the railway line, but only a small fraction of it is covered by the catchment area of the existing railway stations. Particular attention will be required to expand the catchment zone of the railway in this area. Here simply adding walking paths will not solve the issue, and additional stops will likely be required. The station Weins has dramatically less people in the catchment zone than

[244] Includes the population of all relevant Ortschaften along both the railway and parallel bus line.

the bus, which is located directly in the town center. Thus, the station has historically had very low usage.

For the reactivated rail service to be accepted, it needs to provide a closer match to the ridership potential of the bus on a location basis. Therefore, measures such as the closure of gaps with new footpaths, and feeder buses need to be considered on a station-by-station basis.

11.5 Resistances for Transport Value model

11.5.1 Location based availability (Fv)

For all passengers in the previously calculated catchment zone the value Fv = 1 applies. The values calculated in QGIS however need to be further refined by age group as the data does not provide an accurate view of the real number of users. Data on age distribution per Gemeinde can be found on the Lower Austrian statistics website from which a more accurate representation of commuters and school commuters can be interpreted.

For motorized transport, the location-based availability is based on the availability of cars for the populace (motorization level). In the master's thesis from Claudio Schoen, which is a similarly focused transport study on several bus lines in the Yspertal located just north of the study area[245], Schoen states that the motorization level of the whole Melk Bezirk is swayed by the presence of Melk and Pöchlarn which both have a dense settlement structure and good railway connection. Schoen states that the motorization rate of Krems (land) is more similar to the actual conditions in other parts of the Bezirk. Given that the northern side of the river now has no rail connection and a less dense settlement structure, it can be reasonably assumed that there is a higher rate of car ownership than the Bezirk average. However, unlike the Yspertal the north side of the Donau does have several significant settlements such as Klein Pöchlarn and Perseunbeug. Therefore, a value averaged between Melk and Krems Bezirk will be used.

Table 27: Motorization rate per Bezirk

Bezirk	Autos per 1000 residents	F_v multiplier
Krems (Stadt)	593,9	.59
Krems (Land)	682,4	.68
Melk	674.3	.67

The following values for automobile location-based availability were calculated for the relevant Ortschafts along the railway line:

Table 28: Estimated number of automobiles per town for Fv value

Ortschaft	Ortschaft Pop	Fv multiplier	Fv value
Krems	17,509	0.59	10,330.31
Stein	2,037	0.59	1,201.83
Unterloiben	302	0.68	205.36
Oberloiben	167	0.68	113.56
Dürnstein	305	0.68	207.4

[245] (Schoen, 2020)

Weißenkirchen	931	0.68	633.08
Joching	148	0.68	100.64
Wösendorf	298	0.68	202.64
Spitz	1,210	0.68	822.8
Schwallenbach	90	0.68	61.2
Aggsbach Markt	387	0.68	263.16
Willendorf	153	0.67	102.51
Grimsing	133	0.67	89.11
Emmersdorf/Hofamt	865	0.67	579.55
Weitenegg	43	0.67	28.81
Urfahr	31	0.67	20.77
Lehen	114	0.67	76.38
Ebersdorf	147	0.67	98.49
Klein-Pöchlarn	1,063	0.67	712.21
Marbach	284	0.67	190.28
Krummnußbaum	605	0.67	405.35
Persenbeug	1293	0.67	866.31
Weins	331	0.67	221.77

11.5.2 Time based availability (h)

The current bus service in the Wachau operates on an hourly service, so for the initial calculations and following calculations for the revised rail service a 1-hour interval will be used. Based on Figure 28 this results in a value of h = 0.6 for public transport.

Motorized individual traffic has a time-based availability of 1 for all vehicle owners, representing the constant availability of private vehicles.

When considering the hours of service for the public transport service, traffic counts from road detectors can provide a useful input to determine the peak demand hours. Statistics of the average daily traffic (DTV in German) from traffic count detectors will be used for this purpose. In the study area there are three traffic count detectors, however two are located on bridges across the Danube so not directly relevant. There is one detector location at Dürnstein which can be used to estimate traffic volumes on the eastern segment of the route.[246] The detectors distinguish between cars and trucks (or in reality any large vehicle), for the purposes of this study only the data for cars is needed. Data is available every 5 years as part of the ECE (Economic Commission for Europe) Europewide traffic survey. The last survey was conducted in 2015 and the results of the 2020 data are not available, and in any case not relevant due to the pandemic. Less detailed data showing only the daily average are available through the Austrian open data portal.[247] In 2015 the detector recorded an average of 7122 personal automobiles and in 2019 7560, an increase of 6%. Therefore, the values for personal automobiles in the 2015 data will be increased by 6%.

[246] (BMVIT, 2021)

[247] (Land Niederösterreich, 2019)

Table 29: Average number of vehicles per day on the B3 at Dürnstein tunnel

Average number of vehicles per day (JDTV) -Adjusted						
Location	Daily (0-24)	Daytime (06-19)	Night (22-06)	Evening (19-22)	Daily (non-vacation season)	Daily (Vacation season)
Dürnsteintunnel B3	7978	6888	421	669	7365	8070

Based on these statistics, approximately 8% of traffic is in the late evening and 5% at night. During the week the current bus 715 has its first eastbound departure from Melk at 05:33 and first departure from Spitz at 04:47, with last departure from Melk at 21:38. In the westbound direction the 715 departs Krems first at 5:15 at Krems and Spitz at 04:56 with the last bus leaving Krems at 22:00. Most of the traffic in the night timeslot is likely to be between 04-06 in the morning, therefore the current schedules can meet 95% of the transport needs of the corridor and can be adopted for a future rail schedule.

11.5.3 Travel time function (Tr)

The travel time value for public transport is given by the timetable. The 2021 timetables for the bus 715 and the Wachaubahn will be used for initial calculations. Despite being classed as an Anschlussbahn, the railway timetable has changed little from the days of regular service. In 1979 the fastest trip took 54 minutes, in 1992, 51 minutes. The new lighter vehicles in use by NÖVOG have better acceleration, and new alternative traction power vehicles could bring further improvements. However, the train crossing points must also be considered for any new timetable, thus the software FBS has been used to calculate a new timetable for the final scenario. For simplicity travel times are considered the same in both directions, as there are no major directional restrictions.

Table 30: Comparison of average access times between rail and bus in the Wachau.

Station cluster	Rail	Bus	Difference bus vs Rail
Unterloiben	4.69	3.37	1.33
Dürnstein	3.93	3.44	0.49
Weißenkirchen	6.77	4.56	2.21
Wösendorf-Joching	5.21	4.99	0.23
Spitz/Donau	4.85	4.39	0.46
Schwallenbach	4.80	3.52	1.28
Willendorf	4.26	3.66	0.60
Aggsbach Markt	4.86	4.34	0.52
Grimsing	4.35	3.94	0.41
Emmersdorf/Donau	4.88	4.57	0.31

The subjectively weighted non-travel time components have a large influence on the overall perceived travel time.

To calculate the access time to stations the average distance that most people walked was taken into account. The average walking distance to the station is calculated through a weighted average based on the number of residents per 100-meter ring (See Table 24). This distance is then divided by an average walking speed of 5 km/h to obtain the travel time. Comparison of the walking times to bus and rail stops reveals a further disadvantage for the railway line. Walking distances to stations is longer in almost all cases, most notably so in Weißenkirchen and Unterloiben. The subjective rating factors have a lower impact for rail transport, but such a big difference will likely have an impact on the final transport value potential.

Access conditions to all stations on the line are easy with no need to traverse stairs or use elevators. Given the high degree of punctuality in Austria, regular commuters would not have a need to arrive to the station earlier than necessary. The waiting time has a very negative impact on the travel time

perception; therefore, a low value of 2 minutes has been used to provide a balanced comparison with private traffic.

For trips requiring changes, such as to Melk, Vienna or St. Pölten transfer times per timetable have been included. Finally, there is the question of time from the end station to the destination. Given the broad spread of jobs in most of the large destinations, this could either be by foot or transfer to another line. With these varied conditions an estimation here will likely not improve the accuracy, and calculating all possible options is outside the scope of this study, therefore this time component will be omitted. The calculated travel time components will be weighted based on the subjective parameters listed in chapter 11.1.

Table 31: Travel time matrix for relevant transport modes.

Station	Travel time per mode		
	Wachaubahn	**Bus 717**	**Car**
Krems an der Donau	00:00	00:00	00:00
Krems Campus-Kunstmeile	00:03	__	00:06
Stein-Mautern	00:06	00:08	00:07
x Unterloiben	00:11	00:12	00:12
Dürnstein-Oberloiben	00:15	00:17	00:14
Weißenkircheni. d. Wachau	00:22	00:25	00:19
x Wösendorf-Joching	00:25	00:29	00:21
Spitz an der Donau	00:31	00:33	00:25
x Schwallenbach	00:35	00:37	00:29
x Willendorf i. d. Wachau	00:38	00:40	00:32
x Aggsbach Markt	00:41	00:43	00:37
x Grimsing	00:46	00:47	00:44
Emmersdorf an der Donau	00:50	00:51	00:49

The travel time matrix for individual motorized transport can be calculated using Google Maps. Google Maps takes into account average traffic, so a travel time that would include normal weekday commuting traffic was used. For eastbound trips 07:30 was used, for westbound 16:00 to match typical commuter hours. Travel times given by Google Maps vary substantially due to uncertainty of traffic levels (15+ minutes of variance seen), therefore average values are chosen. The directions have been calculated form the default location given by Google by searching the town name. These are usually relatively central and given the variance in travel time versus speed of car traffic in general the exact location is not so crucial. The travel time matrix shows a strong concurrence between all transport modes. For road traffic journeys could be considerably faster during off-peak times, however during peak times or during summer tourist season they may indeed be slower.

For private transport, it is harder to set a generic value for the subjective factors. However, an examination of the built environment can help here. The towns of the Wachau area predate the car and in general retain their same settlement structures. Therefore, not every house has a parking space, and those that do sometimes have an internal garage which can only be entered and exited slowly with the user having to exit the vehicle to open and close the door. Further the roads within most towns are narrow with low-speed limits. Therefore, 6 minutes will be factored in for both the access time on foot to the car and the driving to the main road, which will be weighted as access time. The area west of Emmersdorf has a generally higher parking availability, and here the access time will be reduced to 4 minutes. At main destinations of Krems, St. Pölten and Melk, a combined time of side road driving, waiting in traffic and parking place searching of 8 minutes will be used. For Vienna a higher value of 15

minutes will be used based on the urban conditions and parking conditions in the city. All destination cities have significant pedestrian areas in their central city, but also a high number of parking places outside these areas. The actual time again varies greatly with some workers in industrial concerns on the outskirts of town having ample parking, but those working in town having limited parking. These values are based on a general assessment of the mentioned cities, through field visits, online imagery and available statistics. The subjective view is however limited due to not experienced the conditions for driving in the area firsthand. A survey of commuters and more detailed statistics would be needed to develop more accurate subjective values.

11.5.4 Cost function (Fk)

The cost function for public transport is derived from the current VOR tariffs for bus transportation between the points on the railway. The VOR tariff includes several special tariffs including for elderly and school children. For the purposes of this study three price matrices have been calculated

1.) Full price monthly ticket, to calculate for regular work commuters

2.) School children ticket to calculate for school commuters

3.) Full fare single ticket for tourists

Monthly ticket prices are further broken down into cost per trip for use in the transport value formula. The following costs were derived from the VOR online portal, the VOR no longer uses a fare ring system but rather develops a "personal network" based on user selections. Some tickets are more expensive despite shorter distance along the railway line due to the inclusion of more lines.[248] The costs for adult commuter traffic in many rural areas compared to the quality of service provided. The cost factor therefore plays a larger role here than with school or tourist traffic. For input into the transport value model, a price per trip must be calculated. This is done by dividing the ticket cost by 2 trips a day and the average 20 working days a month (40 trips total).[249]

Monthly ticket price	Krems			Melk			St. Poelten		
	Monthly	Per Trip	Single	Monthly	Per Trip	Single	Monthly	Per Trip	Single
Krems	-	-	-	€ 118.30	€ 2.96	€ 9.80	€ 98.50	€ 2.46	€ 7.20
Krems Campus	€ 43.20	€ 1.08	€ 1.90	€ 118.30	€ 2.96	€ 9.80	€ 98.50	€ 2.46	€ 7.20
Stein	€ 43.20	€ 1.08	€ 1.90	€ 118.30	€ 2.96	€ 9.80	€ 98.50	€ 2.46	€ 7.20
Unterloiben	€ 46.30	€ 1.16	€ 2.50	€ 111.30	€ 2.78	€ 8.60	€ 111.30	€ 2.78	€ 8.60
Duernstein-Oberloiben	€ 46.30	€ 1.16	€ 2.50	€ 111.30	€ 2.78	€ 8.60	€ 111.30	€ 2.78	€ 8.60
Weißenkirchen	€ 64.20	€ 1.61	€ 3.70	€ 98.50	€ 2.46	€ 7.20	€ 118.30	€ 2.96	€ 9.80
Wösendorf-Joching	€ 64.20	€ 1.61	€ 3.70	€ 98.50	€ 2.46	€ 7.20	€ 118.30	€ 2.96	€ 9.80
Spitz an der Donau	€ 74.40	€ 1.86	€ 4.90	€ 85.70	€ 2.14	€ 6.00	€ 128.10	€ 3.20	€ 10.90
Schwallenbach	€ 74.40	€ 1.86	€ 4.90	€ 85.70	€ 2.14	€ 6.00	€ 128.10	€ 3.20	€ 10.90
Willendorf	€ 85.70	€ 2.14	€ 6.00	€ 74.40	€ 1.86	€ 4.90	€ 118.00	€ 2.95	€ 9.80
Aggsbach Markt	€ 96.50	€ 2.41	€ 6.00	€ 64.20	€ 1.61	€ 4.90	€ 111.30	€ 2.78	€ 8.60
Grimsing	€ 111.30	€ 2.78	€ 8.60	€ 46.30	€ 1.16	€ 2.50	€ 98.50	€ 2.46	€ 7.20
Emmersdorf/Donau	€ 111.30	€ 2.78	€ 8.60	€ 46.30	€ 1.16	€ 2.50	€ 98.50	€ 2.46	€ 7.20
Weitenegg	€ 118.30	€ 2.96	€ 9.80	€ 64.20	€ 1.61	€ 3.70	€ 111.30	€ 2.78	€ 8.60
Ebersdorf	€ 118.30	€ 2.96	€ 9.80	€ 64.20	€ 1.61	€ 3.70	€ 111.30	€ 2.78	€ 8.60
Klein-Pöchlarn	€ 135.10	€ 3.38	€ 12.00	€ 64.20	€ 1.61	€ 3.70	€ 111.30	€ 2.78	€ 8.60
Marbach	€ 141.00	€ 3.53	€ 13.50	€ 74.40	€ 1.86	€ 4.90	€ 118.30	€ 2.96	€ 9.80
Persenbeug	€ 144.40	€ 3.61	€ 15.80	€ 98.50	€ 2.46	€ 7.20	€ 135.10	€ 3.38	€ 12.00
Weins	€ 147.20	€ 3.68	€ 16.90	€ 111.30	€ 2.78	€ 8.60	€ 141.00	€ 3.53	€ 13.50

Figure 34: Ticket prices for selected relations. Source: VOR Preisauskunft

[248] (VOR, 2021)

[249] (Schoen, 2020)

For school commuters the cost function is practically irrelevant, the VOR offers two tickets for school attendees under 24. The Jugendticket costs only 19.60 cents per school year but can only be used for trips between school and main residence, the Top-Jugendticket costs 79 euros per school year and can be used for unlimited trips within the VOR zone. In Lower Austria there are 183 school days per year, thus considering two trips per day the cost per trip regardless of distance comes to just 5 cents per trip with the basic ticket and 21 cents per trip with the full ticket. Given the benefit of the Top-Ticket, it is assumed that without further information on uptake that the majority will use this ticket and thus this number will be used for the calculation. As the cost for the various users varies, the transport value model will be calculated for each user group separately.

For automobile transport the federal travel time cost can be used in combination with the calculated kilometers. Since 2011 this has been valued at 0.42 per km. The kilometer reimbursement is meant to cover the cost of fuel as well as ancillary costs like autobahn vignettes and long-term depreciation of the vehicle. [250] While most auto users only care about the variable costs, the KM reimbursement provides a more stable benchmark.

11.5.5 Data for calibration

Calibration data should ideally come from real world passenger statistics if available. In this region there are no officially published statistics so an interpretation of the overall transport flows must be used. For the calibration the values from 11.2 with data on commuter, school and tourist traffic are used.

11.6 Initial results of Transport Value Model

To provide a benchmark for the reactivation of the railway, the transport value has been calculated for the existing bus offer. This will provide a baseline for examining whether a better situation can be achieved with the reactivation of the railway. The catchment area of the bus has been separately calculated using the same GIS methods. The region has several distinct transport flows, and a clearer picture of the scheduling needs can be seen by viewing these first individually. The transport value model was run for the following relations, chosen due to their importance in the commuter statistics:

- Emmersdorf – Krems, plus onward trips to St. Pölten and Vienna. Trips calculated in the inward direction (towards Krems) as the population of Krems otherwise obscures the overall trend.
- Krems – Emmersdorf with onward travel to Melk and St. Pölten. Emmersdorf itself has a relatively low importance except for school traffic so journeys in this direction are analyzed in conjunction with a bus transfer to Melk.
- For the segment between Weitenegg and Persenbeug, the transport value will be calculated based on the existing bus offer. The transport value has been calculated for connections to Ybbs, St. Pölten and Melk as these are the relations most relevant for the railway. The exact routing is determined by the VOR A nach B website. For tourist purposes, public transport is practically irrelevant on segment as there are only 4 course pairs per day up to Maria Taferl that have any relevance for weekend tourist traffic. Therefore, the transport value for this segment will only be calculated for commuter traffic.

[250] (WKO, 2021)

The size of towns along the corridor greatly varies, therefore presentation of the results on a Gemeinde level provides a clearer view of overall travel patterns. When plotted on an Ortschaft level, the two larger towns, Spitz and Weißenkirchen, dominate the results due to their much higher population. The results are plotted per direction to better show the individual traffic flows.

11.6.1 Bus 715 Krems oriented traffic

Commuter traffic: Work commuter traffic provides that best indication of the concurrence between public transportation and private motorized transport along a corridor, as in a highly motorized region most users have the possibility to choose between both modes. The graph for work commuters clearly shows the pattern observed in reality, where the importance of the corridor in the direction of Krems is strong up to Spitz and drastically decreases afterwards. The stop clusters of Spitz and Weißenkirchen have high rankings due to their size. Duernstein has a significant number of people in its catchment zone and is located much nearer to Krems, therefore the relatively high value compared to the towns population.

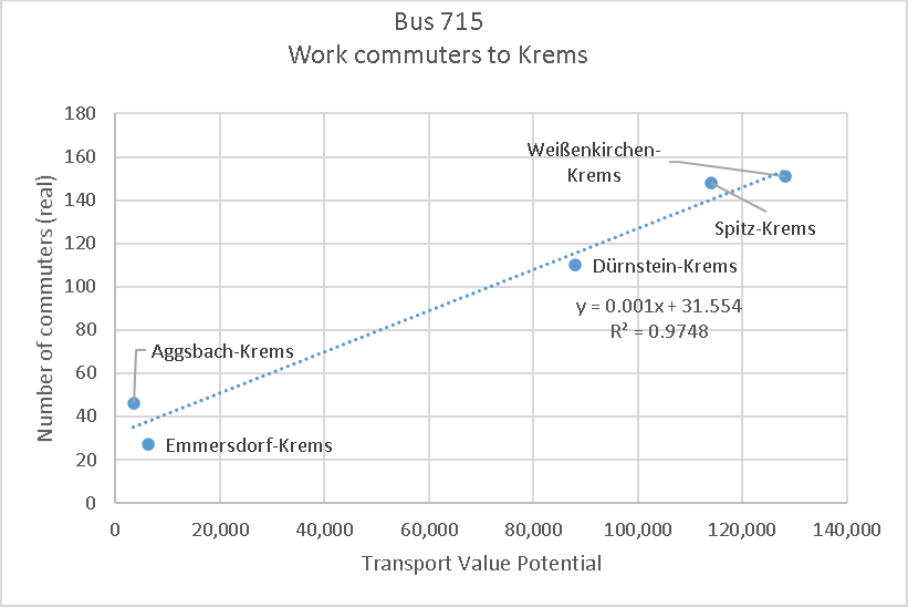


Figure 35: Transport value for work commuters towards Krems (Bus 715)

Given the high level of motorization of the area, the Transport Value potential shows a concurrence between the existing public transport offer and individual motorized transport. Due to the topography of the valley, the settlements have developed in a way that is conducive to public transport. Dürnstein has a substantially lower transport value for individual transport than for public. This can partially be explained due to Weißenkirchen and Spitz having significantly higher populations, however when one considers the population solely within the public transport catchment zone then all three cities have similar numbers of inhabitants. As with public transport Weissenkirchen has the highest value due to its proximity to Krems.

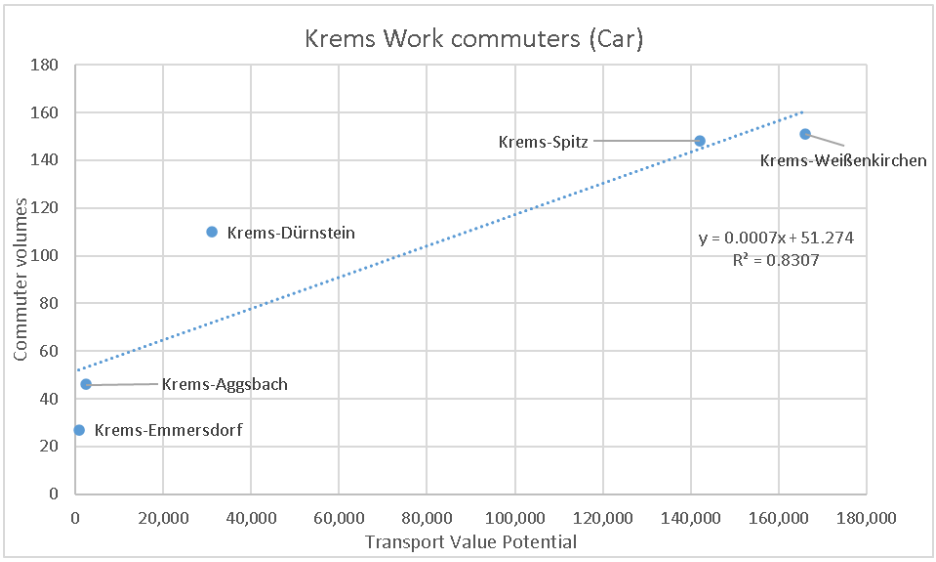


Figure 36: Transport value diagram for individual transport.

School commuters: For school commuters, only the public transport was modeled as there is generally a limited number travelling by private transport, mainly those going along with parents who commute in the same direction. In Austria the minimum age for acquiring a driver's license is 17 years old, thus there is a very low number of students driving themselves to school. Despite the importance of the connection for school users, and the low ticket price, the resulting transport value potential is low due to the relatively small percent of the population of school age, as shown in Table 20 this averages at 13% compared to approximately 60 % for work commuters.

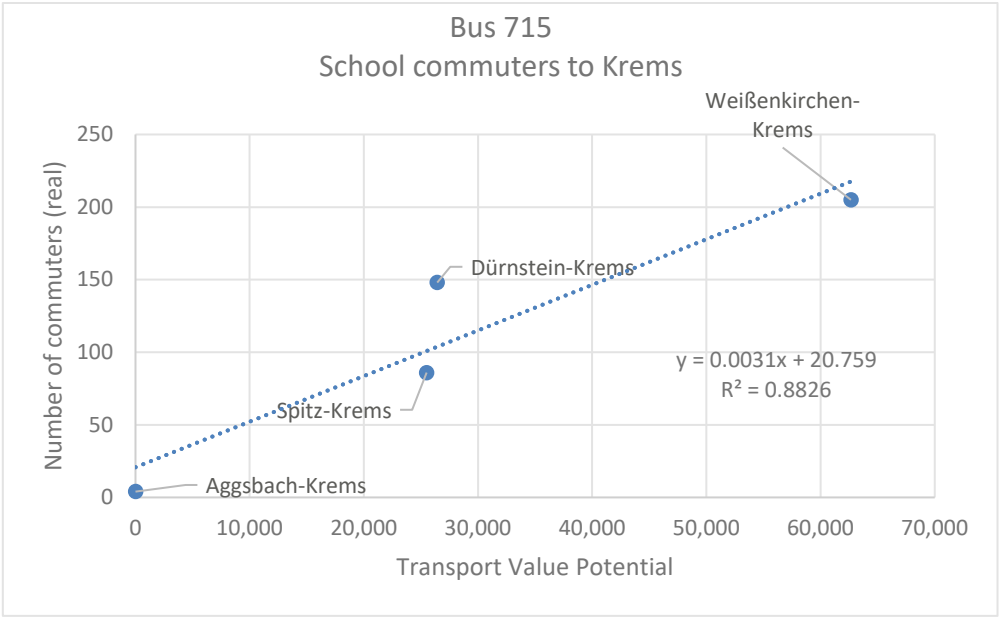


Figure 37: Transport value diagram of Bus 715 for school commuters to Krems

Tourist traffic: Tourism is one of the most important sources of traffic for public transport in the Wachau. However, based on the estimated distribution of trips shown in Table 22, the poor connectivity between St. Pölten and the Wachau will be an issue for most arrivals. In reality the longer connection times may not be as problematic in tourist traffic as it is for commuter, however this cannot be reflected without the development of a new tourism specific weighting which is outside the scope of this project.

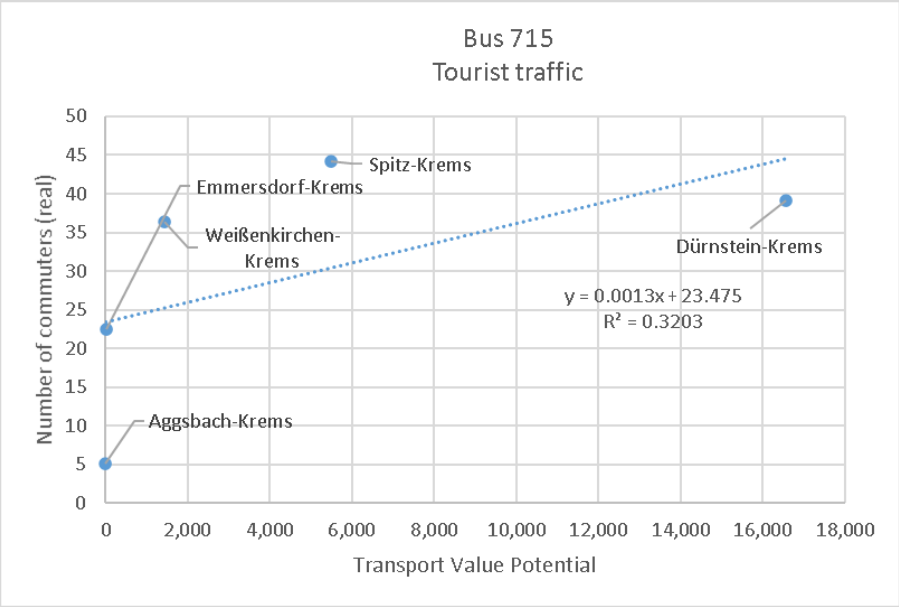


Figure 38: Transport value diagram for Bus 715 for tourist traffic

Overall, the values for tourism are low, which is to be expected based on the relatively low number of projected users solely on overnight stays. The value of Dürnstein is unusually high compared to the other values. This can likely be explained by both Dürnstein's proximity to the origin point (Krems) so both ticket cost and travel time are considerably lower than other destinations. With the available data, the model does not produce an accurate picture of the demand for tourist transport. Therefore, the remainder of the analysis will focus on commuter and school traffic, with the potential for tourist traffic explored theoretically.

11.6.2 Trips towards Melk

The Transport Value for trips towards Melk is significantly lower than towards Krems. There are several explanations for this, firstly west of Spitz up till Emmersdorf there are no major settlements. To the east of Spitz, most commuters go towards Krems, therefore they play little role here. Melk, with a population of approximately 5,200 has a much lower pull than Krems. Many commuters towards Melk continue to other destinations.

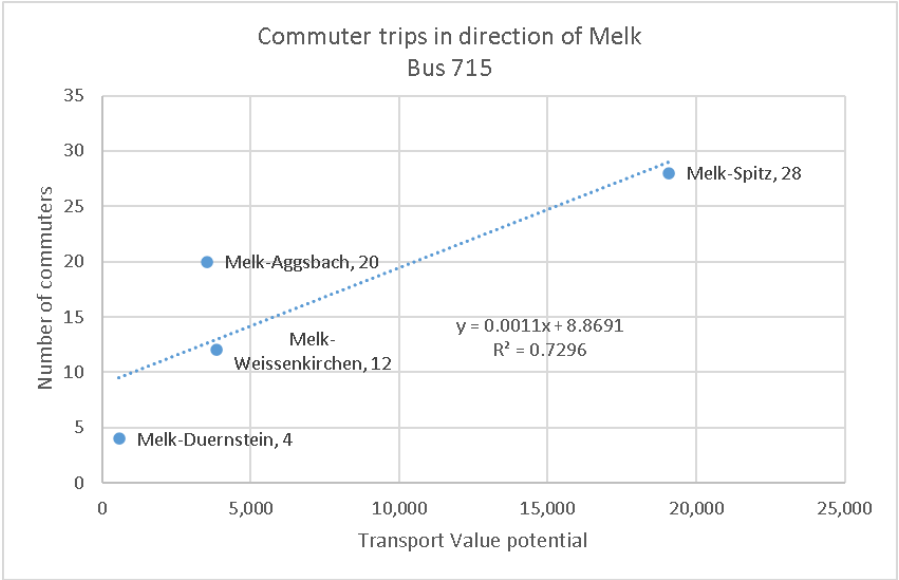


Figure 39: Transport Value diagram of bus 715 for commuter traffic towards Melk.

11.6.3 Destinations outside of the railway catchment zone

Due to the high penalty for transfers in the subjective time travel factors, short transfer times are required for connections outside of the railways catchment zone to be attractive. In Krems the current timetable of the 715 has a well-timed connection with the REX 4 towards Vienna, and the R44 towards Horn.

However, passengers towards St. Pölten from the Wachau region have no attractive option as in Krems change times are 30 minutes or longer to the R44, and in Melk there is a 15-minute transfer time to the CJX 5 line. Therefore, the values for St. Pölten are almost negligible despite being a main regional destination. Vienna, despite good connections has a very long travel time and thus is not overly attractive.

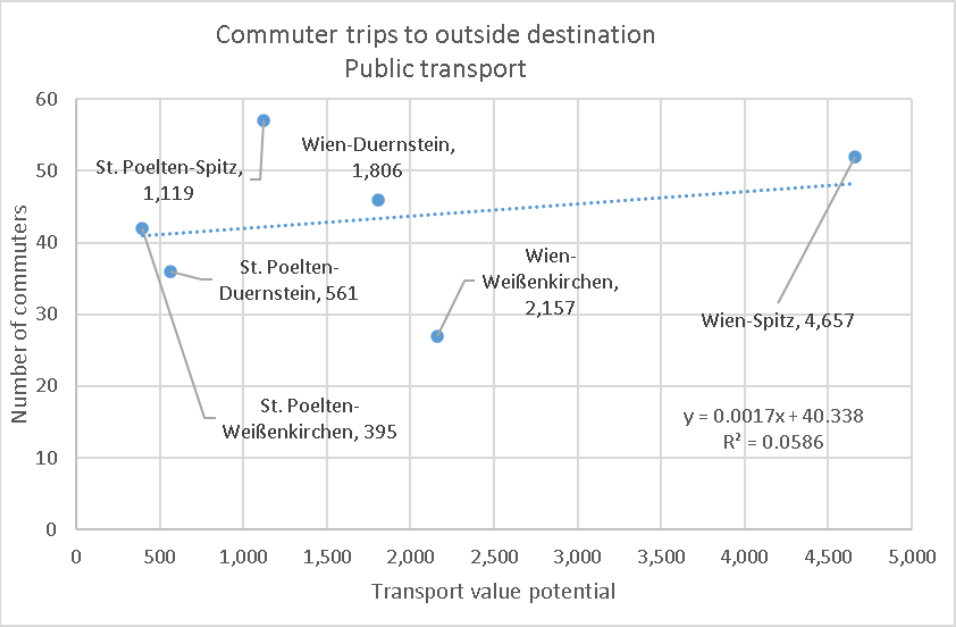


Figure 40: Commuter trips to destinations outside the railway catchment zone.

11.6.4 Middle segment

For the middle segment of the line, the primary commuter flows are all towards the southern side of the river. Thus, many commuter flows were not relevant for the railway hence the low utilization in this area. The commuter statistics show a strong commuter flow towards St. Pölten and Ybbs from lineside communities. Thus, commuter flows will be analyzed for these relations

On the middle segment there are less frequent bus services, but they are generally well timed with the trains. Services in this segment are less than hourly and sometime less than twice hourly with no fixed interval. Therefore, a Fv of 0.3 will be used for buses in this segment. Similarly, the transfer times vary greatly during the day, however using the VOR A nach B service, a connection with a favorable transfer time was chosen, as a connection with a long transfer time will have a very negative affect on the transport value.

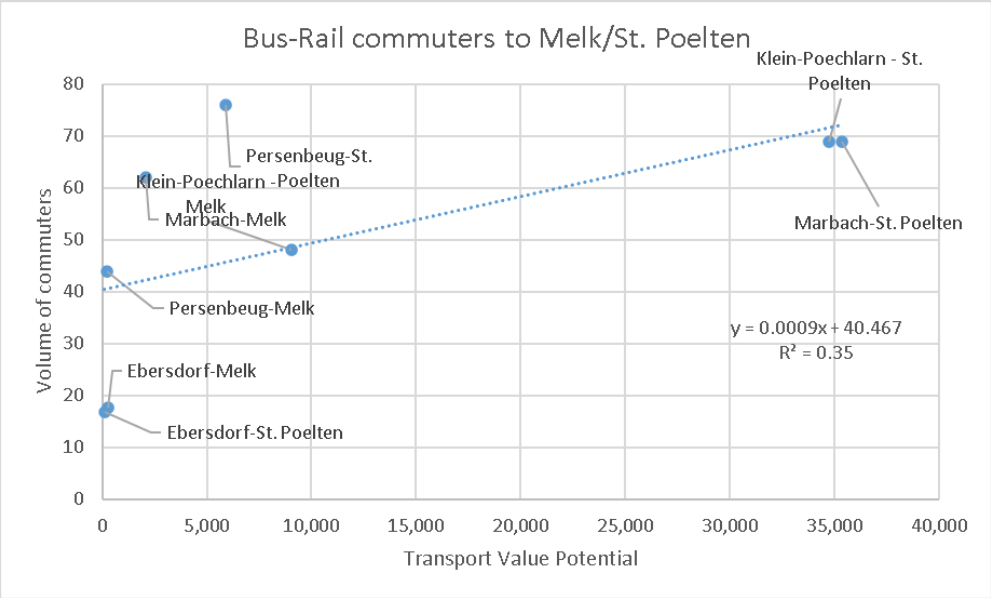


Figure 41: Transport value for commuters between Lehen and Persenbeug towards Melk and St. Pölten

Due to the significant populations of the cities on the northern bank, as well as the good alignment between the bus catchment area and population there is a strong transport value potential here. Persenbeug, despite its large population has a lower value than the other two Gemeinde on the corridor, this is due to the requirement to change buses twice and then to the train, which reduces the value of what is already the longest and most expensive trip.

11.6.5 Transport Value Model takeaways

The transport value model shows that the line between Krems and Spitz is well aligned with the travel demand towards Krems, and that the current bus offer already provides a good concurrence to individual traffic in this segment. The railway could serve as a full replacement to the parallel bus service in this segment, however certain measures are needed to increase the accessibility of some railway stations.

The catchment area of Krems practically ends in Spitz, and south of there most of the commuter traffic goes across the river to Melk, and partially onwards to St. Pölten. Thus, the reactivation of the railway with a transfer required at Emmersdorf could be viewed critically by the passengers, especially those who must again change to the train in Melk. Furthermore, there is the bus 719 which operates directly from Mühldorf to Melk. Forcing a double transfer of passengers on this line would be very unattractive. However, for the tourist market there is significant potential for the line between Emmersdorf/Weitenegg and Spitz. The travel time for this market is in general less critical so a change in Emmersdorf would not be viewed as critically. The full discontinuance of all bus lines on this segment would likely not be a good solution for passengers, therefore a hybrid operation with some direct bus services during the peak hours is proposed.

For the segment between Weitenegg and Persenbeug there is a considerable potential for the public transport, however the traffic flow is not aligned with the existing railway alignment. The current bus offer provides better service to this area than the railway, as the station locations are poorly aligned with the population spread as shown in Table 24. It is clear that if the railway is to be rebuilt then the catchment zone must be expanded, and the railway realigned with the current transport demands.

12 Operational costs for existing system

To determine the reduction or increase in expenses for a new transport concept, the costs of the existing transport service need to be determined. Railways, due to a number of factors have a higher operating cost than buses. Per the Postbus, the operational costs for regional buses are between 2.6 and 3.1 euros per kilometer.[251]

For railways the costs vary greatly with power source and vehicle type. The following is an average breakdown of the expense for railway operations per kilometer cost.

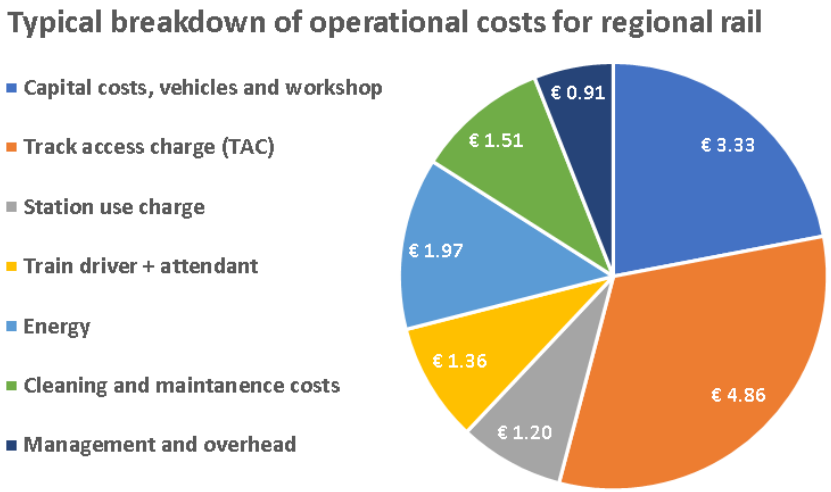


Figure 42: Breakdown of operating costs per kilometer for regional railway lines in Germany. Source: (Landesnahverkehrsgesellschaft Niedersachsen mbH (LNVG), 2014)

The biggest slice of the operating costs shown are the track access charges. However, the table is derived from the German context where track access charges are significantly higher, furthermore in the current context of the Wachaubahn, track access charges do not play a role at all.

The vehicle costs are determined by the acquisition costs, financing, depreciation, and the expected lifespan of the vehicle. The Wachaubahn's RegioSprinter vehicles were purchased in 2016 for 3.5 million euros (for 5 vehicles).[252] The yearly costs are given by the annuity rate, which is based on the interest rate (assuming the vehicle purchase was financed) and the expected lifespan of the vehicle. The annuity is given by the following formula:[253]

$$KWF = [(1 + i)^n \times i] / [(1 + i)^n - 1]$$

Where:

- i is the calculated interest rate
- n is the expected lifespan of the vehicle in years.

Based on the age of the vehicles it can be estimated that the vehicles have a remaining useful life of 10 years, with a real interest rate of 3% the annuity rate is 0.1172 and thus vehicle costs are approximately € 82,000 per vehicle per year. To calculate the vehicle cost per kilometer, the annual cost per year is divided by the annual number of kilometers. Given that the railway has more vehicles than it needs on a daily basis, the kilometers per vehicle vary. Supposing one vehicle saw every day during the operating season the maximum number of kilometers in revenue service would be approximately 46,200 km. Therefore, the vehicle costs per kilometer would be 1.77 euros per vehicle

[251] (Kaupa-Goetzl, 2021)

[252] (Amt der Niederösterreichischen Landesregierung, 2016)

[253] (2021)

kilometer. The vehicle costs make up a large percent of the total operating costs, thus railway generally have a strong incentive to keep vehicles in service for a long time. A fully depreciated vehicle will have very low vehicle costs while a new one very high. The Wachaubahn vehicles have a high vehicle cost per kilometer as due to the limited operating season they operate a very low number of kilometers per year compared to a normal regional trainset.

The maintenance costs are dependent on vehicle size and traction type, for the low capacity vehicles of the Wachaubahn a value of .65 cents per kilometer will be used based on a standardized method developed for cost benefit analysis for the German Federal Infrastructure plan (Bundesverkehrswegeplan - BVWP).[254] There are however few good academic sources for how the age of the vehicle effects the maintenance costs, thus it can be expected that in reality the maintenance costs are higher given the vehicles age.

The cost for energy is derived from the same study. For a DMU in the lightest category the study approximates a fuel consumption of .5 liters per kilometer. In Austria the before tax cost of diesel is .635 euros per liter (August 2021)[255], additionally through the Mineral Oil tax (MöSt) there is an additional 0.397 euros cost per liter.[256] Previously the railways were partially exempt from the MöSt, however this measure was cancelled as part of a 2012 austerity packet.[257] The energy costs depend greatly on the number of stops and acceleration required, the BVWP study gives an additional special energy requirement of 9 liters per vehicle hour. Further based on past studies the fuel consumption by kilometer has been multiplied by a factor of 1.3.[258] Therefore, based on 10 hours per day of vehicle use, a per kilometer energy cost of .99 cents will be considered. Austria has lower than EU average diesel prices, however additional taxes on diesel are planned in the upcoming years so this cost can be expected to rise.

The BVWP study provides a standard calculation method for labor costs for operational employees. Per job postings by the NÖVOG, the average salary for a locomotive driver is € 2253 per month gross.[259] The Wachaubahn has the additional labor expense of a train attendant. No job posting could be found for train attendant from the NÖVOG, per the BVWP study a train attendant earns 73% of the salary of a driver, resulting in a monthly a gross monthly income of €1656 per month. The costs per hour are then calculated to be 41.45 for locomotive drivers and 26.11 for the train attendant.[260] The pro kilometer costs are calculated based on the number of hours and kilometers per day. The Wachaubahn is in operation 10 hours a day (also considering time for the empty trips to and from the maintenance depot in Etsdorf-Straß Bahnhof at the end of the day). In Austria drivers can have a maximum of a 12 hour shift, and overtime applies after 8 hours, however the exact regulations depend on several factors thus for simplicity it is assumed that one driver will operate the whole 10 hour shift, and overtime will not be included in the calculation.[261] From the 4 courses a day there is a total of 273 revenue kilometers plus an additional 22 for the trip to the maintenance depot every day. Thus, the operational cost per kilometer is 1.4 for the driver and .76 for the train attendant. A further 0.50 cent cost has been added for cleaning[262]

Overhead costs generally lie between 10 to 20 percent of total costs, with smaller operators generally having lower overhead, thus a value of 10% for the overhead costs will be considered for the calculation, resulting in a value of 0.88€ per km.

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[254] (BMVDI, 2015)

[255] (BMK, 2021)l

[256] (ÖAMTC, 2021)

[257] (Bundeskanzleramt Oesterreich, 2012)

[258] RX STUDY

[259] (NÖVOG, 2021)

[260] (BMVDI, 2015)

[261] (WKO, 2019)

[262] Operating cost for the Harzer Schmalspurbahn – Railistics. Document confidential

For operation on the Wachaubahn's own infrastructure no track access charge is considered. The total costs per kilometer are the following

- Vehicle costs: 1.77 € train-KM
- Driver: 1.4 € per train-KM
- Train attendant: .88€ per train-KM
- Energy: 0.99 € per train-KM
- Maintenance costs: 0.65 € per train KM
- Overhead: 0.61 € per train KM
- Cleaning: 0.50 € per train KM

Total costs are estimated at €6.32 per train kilometer operating with a single vehicle. Overall, the calculated operational costs are on the low side for rail operations, and it is likely that real costs are higher. For operation in multiple traction the non-personnel costs double, resulting in an approximately 50% increase in operating costs.[263] The Wachaubahn operates with configurations of up to 3 vehicles. For operational configuration it will be assumed that the railway operates with 1 DMU during the early and late seasons (24 days in the spring and 19 days in the fall). Out of the remaining days in during the peak season it will be assumed that for 90 will be operated with two vehicles and 37 with three. The following is an estimate of the operating costs for the relevant transport lines in the Wachau.

Table 32: Operating costs of the existing Wachaubahn and bus 715 per year.

Line	Trip	KM Per trip	Cost per KM	Cost Trip	Trips Day	Op Day Yr	Yr Cost
Wachaubahn 1x	Krems-Emmersdorf	34.05	€ 6.32	€ 215.24	8	43	€ 74,042.03
Wachaubahn 2x	Krems-Emmersdorf	34.05	€ 9.73	€ 331.22	8	90	€ 238,480.27
Wachaubahn 3x	Krems-Emmersdorf	34.05	€ 13.13	€ 447.21	8	37	€ 132,373.20
Sum							**€ 444,895.50**
Line 715 (Week)	Krems-Emmersdorf	40	€ 2.90	€ 116.00	29	261	€ 878,004.00
Line 715 (Week)	Spitz-Krems	19	€ 2.90	€ 55.10	9	261	€ 129,429.90
Line 715 (Sat)	Krems-Emmersdorf	40	€ 2.90	€ 116.00	28	52	€ 168,896.00
Line 715 (Sat)	Spitz-Krems	19	€ 2.90	€ 55.10	4	52	€ 11,460.80
Line 715 (Sun)	Krems-Emmersdorf	40	€ 2.90	€ 116.00	24	52	€ 144,768.00
Line 715 (Sun)	Spitz-Krems	19	€ 2.90	€ 55.10	6	52	€ 17,191.20
Line 715 Total							**€ 1,349,749.90**

The Wachaubahn had in 2018 approximately 38,000 passengers per year. If one assumes that all travelled at least the full line one way with a full price, full length ticket the annual revenue would be 608,000 euros, resulting in an approximate 180,000 Euro profit. This scenario is unrealistic as it does not account for children, people travelling only the partial route, and those travelling either with a day

[263] (Landesnahverkehrsgesellschaft Niedersachsen mbH (LNVG), 2014), costs calculated with assistance of Railistics colleagues.

ticket or the Lower Austria card, however it does show that the railways touristic operations can break even, or potential turn a profit.

13 Initial transport concept

Based on the analysis of the historic situation and the transport value model the following measures are proposed for the reactivation of the Donauuferbahn. For the segment between Krems and Spitz the railway is in general well located and provides a good concurrence to both private traffic and equivalent service to the current bus service. Thus, the 715 bus should be cancelled and replaced with a reactivated rail service on an hourly schedule. The current public transport offer between the Wachau region and St. Pölten is poor, therefore it is recommended that either additional courses of the R44 are added or the trains from the Wachau are operated directly to St. Pölten. St. Pölten is an important commuting destination for both the Wachau and Krems, thus the improved connection will have significant benefits for the region. To provide a full replacement for the bus service, several gaps in the railway's catchment area need to be addressed. The following measures are proposed:

- Unterloiben and Oberloiben are poorly connected to the railway with significant walking distances. The introduction of a feeder bus or the extension of a Krems CityBus line could help maintain the public transport connections here while allowing for the termination of the parallel 715 line.
- In Weißenkirchen new paths should be created to shorten the distance between the town and the railway station.

Between Spitz and Emmersdorf, some parallel bus traffic should be retained in order not to reduce the public transport offer for passengers travelling to Melk and onward. To reduce wasteful parallel traffic certain trains in the peak hours should terminate in Spitz with a timed connection with the bus 719 which provides direct service from the Waldviertel uplands to Melk. Otherwise, a timed bus connection will be offered in Emmersdorf. In general, all bus connections should be reoriented to the railway schedule and attractive cross platform transfers should be provided. In particular, the bus 718 from Spitz should be reoriented towards the railway so that the catchment zone of the railway can be increased to include the Spitz-Hinterhaus area.

For the segment between Weitenegg and Persenbeug/Weins the situation is much more complicated. The passenger flows in this segment either go primarily towards Ybbs/Amstetten or to Melk and St. Pölten, both of which would require further changes to bus then again to another train. The Transport Value model indicates significant potential, but this is not aligned with the railway. For a useful regular passenger offer on this segment the line must be reoriented towards these destinations.

Due to both the extensive damage done to the right of way since the abandonment of the line, and the legal requirements for new line construction, reconstruction of this segment would be a difficult task. In the most pessimistic terms, without a major change in transport politics in the Lower Austrian government, the chance of reactivation is almost nonexistent. There was little support at the state level for even preservation of the line, let alone new construction and it is hard to see that changing.

Furthermore, a simple reinstatement of the line will be unlikely to be granted a concession due to the limited passenger potential. The greatest potential for this segment is a reactivation for freight traffic between Weins and Persenbeug/Loja, however again the expected transport volumes on these segments were not enough for the Lower Austrian government to feel compelled to even rehabilitate the segment, let alone completely reconstruct it. However, as this study seeks a balance between providing realistic solutions and solutions that provide the best outcome for public transport, the following solutions are proposed for the reactivation of the segment of the line between Persenbeug and Weitenegg. Political support for the line is the strongest in Persenbeug and Marbach, and as such proposals will center around solutions for these areas.

- Reconstruction of the line between Weins and Loja for freight transportation from the Loja quarry, as well as development of the loading area at Persenbeug. The volume of trucks passing through Persenbeug can significantly be reduced through this measure and thus is likely to be politically popular. Between St. Nikola Struden and Persenbeug there is very little passenger demand, and what exists can be better served by the existing bus offer. The reactivation of regular passenger service on this segment is not recommended; however, the segment does have potential for touristic and cruise trains. For the initial reactivation the continued operation as an Anschlussbahn is recommended, however the segment from Persenbeug to Loja should be built up to all standards required for a full railway.
- The line between Persenbeug and Marbach/ Krummnußbaum is well located in relation to the settlement structure of the area, which is largely located along the tracks due to topography. However, the current station arrangement is poorly suited to serve much of the area. To better serve traffic towards Ybbs and Amstetten, and to provide a full replacement for bus services, it is proposed to increase the stop density. In many areas the optimal stop location is in an area where the construction of a full platform is not possible due to space constraints. The use of shorter trainsets, such as a Stadler GTW 2/6, would allow short 50 meters platforms to be utilized. Connection onwards to Ybbs would be provided by a cross platform bus connection at Persenbeug. A direct connection to Ybbs via Persenbeug would only be possible through very high investment and the alignment would likely not offer significant advantages compared to the bus connection (see section 17.5.)
- In the eastward direction there is a strong traffic flow to both Melk and St. Pölten. However, to reach these destinations a change in both Emmersdorf/Weitenegg and Melk would be required. This option is unlikely to attract passengers from either private transport or please existing transit riders. For the construction of a new line an improved transport plan with more potential is needed in order to win a concession. Therefore, it is proposed to construct a new bridge over the Danube between Ebersdorf and Melk. This new bridge would enable direct passenger trains to St. Pölten and Melk.

These concepts will be further described in Chapter 17 along with a refined model to determine if these changes can significantly increase the attractivity of the connection.

14 Successful case study: Vinschgaubahn

In Austria there have been until now no significant line reactivations. Austria began mass closures of branch lines relatively late compared to other European countries such as West Germany, where significant closures occurred as early as the 1950s. Furthermore, as mentioned in segment 6.2 the current railway regulations make it much more difficult to reactivate a line once it has been formally abandoned through an abandonment procedure. One particularly successful line reactivation with similar characteristics to the Donauuferbahn in terms of a combined touristic and commuter potential is the Vinschgaubahn in South Tyrol. The reconstruction of this line was done with heavy involvement of the TU Wien FVV and thus a large amount of research and data is available. This line therefore will serve as the primary case study for the reactivation of the Donauuferbahn. The background information on the Vinschgaubahn is primarily sourced from the 2016 Diploma thesis by Tomberger conducted at TU Wien.[264]

The Vinschgaubahn is an approximately 60 km branch line between Meran and Mals in Italian South Tyrol. The line shares much of its early history with the Donauuferbahn. The line was built through a private concession in 1906 as an extension of the 1881 opened Bolzano to Meran railway, with operations initially handled by the kkStB Further extensions to the railway including connections to the Arlberg line and the Rhaetian Railway in Switzerland were planned, however the outbreak of World War I put an end to these plans. Following South Tyrol's annexation by Italy at the end of WWI, the railway was taken over the by the Italian state railway, the Ferrovia Stata (FS). The railway like many other branch lines in Italy suffered from systematic neglect with relatively little investment over the years. By the 1960's the FS was already considering closing the line. Passenger service was gradually reduced starting in the 1960s and the many slow orders lengthened travel time making the line increasingly less attractive. By the 1980's the line was considered as a "dead branch" by the FS and service was gradually reduced until regular service was terminated in 1990.[265] The story of the railways decline was quite like that of the Donauuferbahn and many other Lower Austrian branch lines. Parallel bus traffic took riders away from the railway and there was no overall coordination with bus lines that could have been used as feeders. The track structure as on the Donauuferbahn became progressively worse over the years due to lack of investment, and schedules became longer. As travel times increased, demand decreased and therefore the schedule interval was further reduced in a self-fulfilling cycle. Similarly, the FS had little interest in the branch line railways, also focusing on investment reconstruction of lines and developing a high-speed rail system.

Even before the official end of service, the regional government sought to take over the railway. The interest in the railway dates to the 1980s when it was planned to build a highway through the valley. However, studies from transportation experts including Knoflacher warned that the highway would not alleviate the areas connectivity problem and would bring irreversible damage to the environment and character of the valley. The residents of the valley were also against the plan and citizens groups arranged protests against the construction of the highway and for the revitalization of the railway. There was in particular a fear the new highway would lead to an influx of goods transit traffic, the effects of which the nearby Brenner pass had long suffered. There was however, along with support, significant political resistance to the reactivation of the railway, particularly the cost of rehabilitation and who would pay for it. In 1993 the state agreed to take over the railway line with the intention of reopening it, however due to legal delays the process took until 1998 to be completed. It had been

[264] (Tomberger, 2016)

[265] Ibid

originally planned to reopen the line by 1996, however due to delays in the official transfer the official reopening of the line was repeatedly postponed. There were various discussions on how the railway could be reactivated, some favored a low-cost rehabilitation reusing the existing track material and with used rolling stock. However, a study by a Swiss transportation planning expert showed that the line would be too expensive to operate unless it could reach a ridership of 1.5 million passengers per year. For this a new operating concept with good bus connections, a faster schedule and attractive new rolling stock would be required. Finally in 1999 an agreement was reached for the line's rehabilitation and reopening, the land of South Tyrol would provide 120 million euros, instead of the originally planned 40 million, to develop an attractive railway. Only the electrification of the line could not be implemented as this would require an additional 25 million. The entire upper structure of the railway including sleepers, rails and ballast were completely replaced. The lines civil structures also required significant rehabilitation with several tunnels in very poor shape and the metal spans of several large steel bridges needing replacement. As with the Donauuferbahn the railways structures were under historical protection and thus many had to be reconstructed in the same style with plans from the Austrian state archive. In addition to the renewal of the upper structure, the number of grade crossings were drastically reduced from 85 to 31. The reduction of crossings required significant negotiations with landowners and other affected parties, and was achieved through a combination of new underpasses, construction of new farm paths and bicycle ways along the tracks. The line was additionally completely signalized with the installation of a central dispatching center responsible for controlling all signals, level crossings and the passenger information system.

Stations along the line were all renovated and local businesses were sought out as tenants for the station. The stations themselves were rebuild with barrier free access but in some cases with ramps rather than fully high platforms. This solution allowed for the stations to retain their original character and save significantly on complete platform reconstruction.

The state had previously considered purchasing and rebuilding several ALn (Automotrice Leggera a nafta, Light Diesel motor car) series diesel railcars from the Italian state railways. These vehicles were reliable and widespread in Italy; however, they were by this point dated with no possibility of low floor entry, therefore it was decided to purchase new Stadler GTW 2/6 models. The vehicles have a somewhat unique design in that they have a central power module rather than an underfloor motor making more a quieter ride of the passengers. Further the module can be swapped out for an electric power module in the future.

In 2005 the line was finally reopened to much fanfare. The railway was only a part of the new transportation plan for South Tyrol which revolved around a new Taktfahrplan with better connections between lines and increased frequencies. The service on the Vinschgaubahn is operated on an hourly interval, with additional regional express trains that stop only in at important stations every two hours. The line was not only integrated into the overall transport plan, but also the areas tourism plan. The state has created a tourist offer to try to reduce visitor car traffic. Guests staying in hotels participating in the scheme are automatically offered a public transport ticket valid in the entire state for the duration of their stay. More on the offer is found in section 15.13.

It was originally expected that a reactivated railway could achieve a ridership of 1,080,000 per year, this number was already exceeded in the first year with 1,228,291 passengers in 2006 and doubled expectations by 2013 with 2,019,360 passengers. With the unexpectedly high demand, there was a need to further increase capacity.[266] However the current diesel operation was near its limit, therefore it was decided in 2014 that the entire line would be electrified. The electrification, along with the

[266] (Tomberger, 2016)

construction of some double track segments will allow both a 30-minute headway and direct connections to Bolzano. The goal is to increase ridership to 3 million passengers per year. [267]

14.1 Bicycle transport on the Vinschgaubahn

An important market sector for both the Donauufer and Vinschgaubahn is bicycle tourists. The Vinschgaubahn follows the Etschradweg (Etsch Bicycle trail), and the train offers a convenient way to reach the upper extents to the trail. The land of South Tyrol actively promotes the bicycle offer and sought for the railway to complement this offer. However, the mass transport of bicycles in the train almost immediately became a problem due to the limited capacity of the new railcars. The idea of a separate bicycle wagon was rejected due to the increased dwell time at stations for bicycle loading. [268] An alternate solution of bicycle transport by truck from Meran to Mals was implemented, however it has not been well received.

The state has therefore introduced a bicycle rental scheme to reduce the demand for bicycle transport with rental points set up at many rail stations on the reactivated line. Moreover, the land offers a combination ticket that allows both the use of the railway and the rental bike service. Since 2011 the land has offered the "Bikemobil" card which offers tourists a combined offer of public transport and bike rental with prices starting at 25 euros for one day up to 35 euros for 7 days. [269] Bikes can be picked up from 22 rental stations and there are 5000 bikes available for rent. The rental bikes are not allowed to be transported in the train. In general, the transport of bicycles is prohibited during the peak commute times between 08:00-13:00 and 15:00 to 18:00 and bicycles are subject to an additional fee. With the electrification and introduction of new vehicles, the capacity for bike transport within the trains will be increased. [270]

14.2 Vinschgaubahn takeaways

The Vinschgaubahn is one of the greatest success stories of a branch line reactivation in a touristic area. There are many factors that influenced the success of the railway, and they must be considered if one is to apply the lessons and methods to other lines.

First and foremost was the support of residents and politicians for the reactivation of the railway. Without strong grassroots local support, the reactivation of a line is hardly possible. Generally, at the federal level and even state level there is little initiative to support projects like this that are primarily of regional importance. The politicians, though not immediately in agreement, took into consideration the studies of transportation experts and were willing to go against higher level plans to build a highway through the region. Further, sufficient financial support was provided to rebuild the railway as an attractive, modern transport mode, rather than relying on half measures that may have hindered the success. The railways redevelopment was very much handled locally with high levels of community involvement, so the population was an involved stakeholder in the project.

Another key point is the railway was not reactivated as a separate project but rather as a part of a large transport and tourism development strategy. A land wide Taktfahrplan was developed, and buses were reorganized so that they could act both as feeder services and land mile transport between the railway

[267] (Laner, 2016)

[268] Ibid

[269] (IDM SÜDTIROL - Alto Adige, 2021)

[270] (Tomberger, 2016)

and town centers. The land developed numerous offers for tourists including public transport guest cards, and an integrated bike share system. The stations themselves have been developed into attractive places with tourists with locally oriented businesses occupying the station buildings.

Two critical points however must be noted. The provision of bike transport is not optimal with limited bicycle capacity in trains. The transport of bicycles is restricted by the current vehicle fleet (both internal capacity and lack of overall vehicles), line capacity and punctuality requirements. However, it would be useful to have a better rail solution such as additional bicycle trains not tied to the Taktfahrplan.

A further critical point is the that the line was not built with the requisite provisions for freight transport. Prior to the lines closure the large marble factory at Lasa shipped their products by rail. Due to the higher costs, the bridges on the line were not rebuilt to handle the heavy marble loads, therefore this traffic now must move by truck.[271]

[271] (SWR Eisenbahn-Romantik, 2018)

15 Measures for a successful reactivation of the Donauuferbahn

The following chapter will cover how the standard good practices described in Chapter 3, and the lessons from the precedent study can be implemented on the Donauuferbahn considering the local conditions and restrictions.

15.1 UNESCO considerations

Since 2000 the Wachau has been a UNESCO World Heritage site. With this designation comes a requirement to preserve the landscape from any alterations that would affects its visual and historic integrity. In cases where changes that drastically altered the landscape were made, UNESCO has taken the step of delisting the site as was the case with the Elbe River valley in Dresden after a new road bridge was constructed against the advice of the UNESCO authorities.

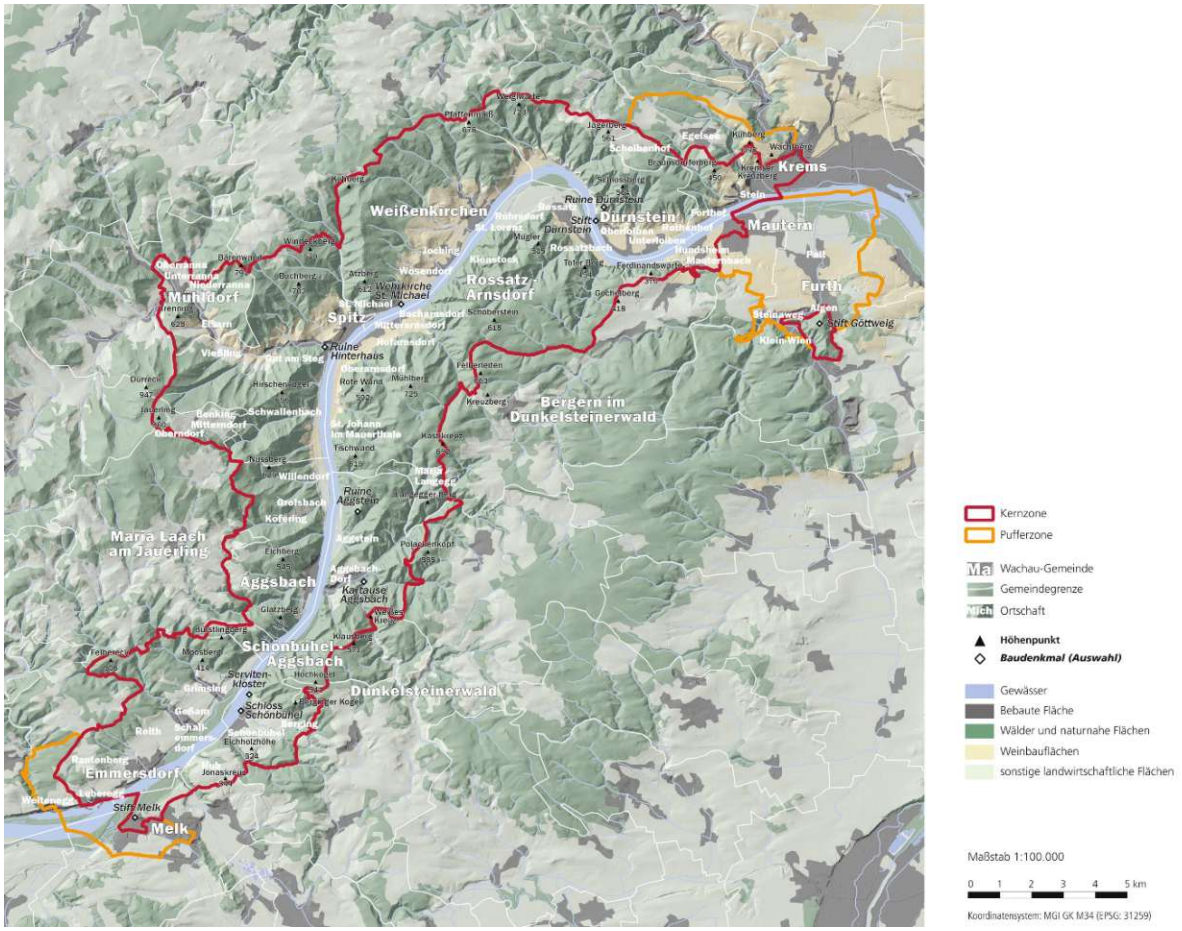

Figure 43: Map of the Wachau UNESCO area, buffer areas are shown in light yellow. Source: https://www.weltkulturerbe-wachau.at/fileadmin/Bibliothek/Wachau/Fotos/welterbegrenzen_neu.jpg

The reactivation of regular passenger service will require changes to the line's physical appearance, particularly regarding barrier free access. This will require significantly altering the looks of the stations to provide higher platforms for level boarding. Similarly, if electrification is pursued this will have a significant visual impact on the railway's appearance.

However, both measures can be carried out within the scope of the UNESCO designation, as shown in the previous case of the Semmering Railway. To the UNESCO the preservation of the railways function

is more important than the preservation of the exact appearance.[272] As long as the modifications are done in consultation with the UNESCO authorities and in a way that minimizes visual impact (such as thinner, less intrusive, catenary poles instead of the standard ÖBB concrete masts) there should be no danger of status revocation due to the reactivation of the railway.[273] In the Wachau there are already examples of significant new development, such as the SPAR supermarket in Spitz. The supermarket is built in a modern architectural style and features a large parking lot; however, the planning was done in consultation with UNESCO and local material such as stone and timber were used in the construction.[274] When designing new station platforms, care should be taken to use local and harmonious materials, rather than the standard ÖBB style high platforms.

15.2 Integration into an interval-based scheduling (Integraler Taktfahrplan)

ÖBB plans to implement a nationwide Taktfahrplan by the year 2025 under the program Zielnetz 2025+. Krems has already been developed as a regional Taktknoten with good transfer possibilities in both directions between the R44 and the REX 4. The following table shows the sequence of arrivals and departures including the touristic Wachaubahn

Table 33: Arrival and departure times for rail connections at Krems HBF.

Train	Arrival from/Time	Departure to/Time
R44	St Pölten 12:41	
Bus 715	Melk 12:42	
R44		Horn 12:44
REX 4		Wien 12:51
R16593 NÖVOG	Emmersdorf 13:10	
R44	Horn 13:10	
REX 4	Wien FJB 13:14	
R44		St. Pölten 13:19
R16593 NÖVOG		Emmersdorf 13:20
Bus 715		Melk 13:20
REX 4		Wien FJB 13:51

The connections are well arranged for commuters travelling from the Wachau to Vienna or Horn, however there is a 30-minute wait for connections to and from St. Pölten, providing a very unattractive alternative. ÖBB has begun to address this with the introduction of a 30-minute interval for the R44 during peak times on weekdays, however this connection does not benefit tourist traffic and there is still a 30-minute wait in Krems on weekends. This connection was timed in the NAT 91, however there have been numerous changes since then including the dramatic expansion of the St. Pölten Taktknoten with the reconstruction of the Westbahn. Both the R44 and the REX 4 are difficult to retime while maintaining both the schedule on the Franz-Josefs Bahn and the timed connections in St. Pölten.

To eliminate the transfer time direct trains could be operated to St. Pölten, running as express services with minimal stops. The doubling tracking of the line would allow for more reliable scheduling; however, the addition of an extra train pair is still possible with the existing single-track situation. Furthermore, has sufficient slack time that there is the potential for some delay recovery. The segment between St. Pölten and Herzogenburg is to be eventually double tracked but the planning for this has

[272] (UNESCO, 1998)

[273] (Knoll, Interview on Donauuferbahn and 2010 branch line transfer 2021)

[274] (Spitz Gemeinde, 2018)

not yet begun. Local politicians however have demanded that the ÖBB speed up the process for both the lines electrification and the double tracking project. In St. Pölten the trains will have a 10-minute connection to Railjet trains in both directions.

15.2.1 Timetable proposal

The final timetable proposal is based on providing timed connections in St. Pölten, Krems, and if the middle segment is reactivated in Lehen-Ebersdorf. The Wachaubahn will operate as the line R43, but trains will continue from Krems to St. Pölten as REX 44, the schedule used for the few existing regional express trains on this line. The following schedule was created based on analysis in FBS, the schedule has not been fully optimized with crossing times for trains longer than likely needed in reality.

REX 44		
R43/REX 44	East/Southbound	West/Northbound
Station	Arrive/Depart ↑	Arrive/Depart ↓
- RJ Vienna	:32 depart	:28 arrive
- RJ Salzburg	:30 depart	:30 arrive
St. Pölten	:21	:40
Viehofen (Technical halt)	:18	-
Herzogenburg	:10	:48
Herzogenburg-Wielandsthal	:08	:52
Statzendorf	:59/01	:59/02
Krems	:47 depart	:14 arrive
- R44 Horn	:44 depart	:10 arrive
- REX 4 Wien FJB	:51 depart	:14 arrive
R43		
Krems	:41 arrive	:19 depart
Krems Campus	:38	:22
Stein-Mautern	:36	:24
Unterloiben	:32	:26
Dürnstein	:26/30	:28/32
Weißenkirchen	:21	:37
Wösendorf-Joching	:18	:40
Spitz an der Donau	:15	:44/46
Schwallenbach	:11	:50
Willendorf in der Wachau	:07	:53
Aggsbach Markt	:00/03 x	:58/02 x
Grimsing	:55	:07
Emmersdorf an der Donau	:52	:10
Weitenegg	:47	:15
Lehen-Ebersdorf	:44	:18
- R51 to Persenbeug		25
- R51 to St. Pölten	34	

15.3 Improvement of connecting lines

All the Donauuferbahn's connecting lines; the Franz-Josephs Bahn, the Herzogenburg-Krems line and the Krems to Horns line are in need of modernization. Some of these efforts are already in planning by the ÖBB while others are being pushed by advocacy groups.

The Franz-Josefs Bahn between Vienna and Krems is the most important connection to Krems. While the line has been electrified since the mid-1970s, the segment between Absdorf-Hippersdorf and Krems is single tracked limiting capacity. Speeds are restricted by curves to 120 km/h, although with the current equipment and stopping patterns higher speeds are hardly possible. Service is for the most part provided with locomotive hauled trains and double deck coaches. Due to the heavy workday traffic on the line these trains are a practical solution despite lower acceleration times and ÖBB is currently modernizing the wagons to meet the standards for their Cityjet brand. For the further development of the Krems Taktknoten, the provision of a second main track between Krems and Hadersdorf am Kamp, where the Kamptalbahn branches off, would provide much needed scheduling flexibility in this segment.

The line from Krems to Herzogenburg (continuing to St. Pölten) is an important but neglected line. The line has great potential for commuter traffic between Krems and St. Pölten, however it remains single track, unelectrified and in some segments with poor alignment that limits speeds. While electrification is planned for 2029, planning work has not started yet and further no double tracking or realignment is planned at this time.

As mentioned in section 15.2 the line between Herzogenburg and St. Pölten is a major capacity constraint on the relation. The double tracking of this segment is key to the improvement of the service offer and the full integration of the Wachaubahn into the Krems Taktknoten.

Line speeds north of Herzogenburg are limited to only 60 km/h in most places due to the curvature of the line. The segment between Herzogenburg and Weidling could particularly especially benefit from a realignment due to its many sharp curves. The reduction of curves and increase of the speed limit would also enable the 2015 closed halts of Kleinwien and Meidling im Tal to be reactivated, both of which are well located the surrounding village.

The line between Krems and Sigmundsherburg via Horn is in a similar state with a typical branch line alignment full of sharp curves and no electrification. For this line no electrification is planned, however it is planned to connect Horn, the district capital directly with the Franz-Josefs Bahn with a new alignment.

Currently the line between Krems and Sigmundsherberg is operated as the continuous R44 line. The line is operated with 5047 diesel railcars except for some peak hour REX 44 services which run with locomotive hauled "Wiesel" double deck coaches. If the line is to be partially electrified, then dual mode vehicles will be required to maintain the direct connection. Therefore, synergy in vehicle procurement could be possible with the Wachaubahn.

15.4 Barrier free access

The provision of barrier free access is a cornerstone of modern public transport. The current low level gravel platforms at most stations on the Donauuferbahn do not meet these standards. Additionally, as

the line was downgraded from a full railway to a connecting railway in 2010, the provision of barrier free accessibility is a requirement for the line's reactivation.[275]

The requirements for barrier free accessibility of stations in Austria is listed in the 2009 document "Requirements for barrier free railway stations"[276] The following points listed are the most relevant for the case study:

- All zones intended for passenger must be accessible to people of reduced mobility
- Movement paths are free of obstacles
- The length of the obstacle-free paths shall correspond to the shortest practical distance
- If accesses to the platform are provided at the same level as the railway track, these accesses must be barrier-free:
    - Any safety measures for passengers must also consider passengers with disabilities.
    - The boundaries of the level crossing surface shall be marked by visual and tactile markings.
    - Level crossings should be designed that standard wheelchair wheels do not get caught in the track grooves, and when possible, groove fillers should be used
- The minimum platform width is determined by the EU wide TSI-PRM (Technical standards of Interoperability – Persons with reduced mobility)
- The nominal height for platform for use with low floor vehicles should be 55 cm above the top of the railhead (ATOR). When this is not possible (for example due to curves less than 500m), 38 cm ATOR are permitted.[277]
- If elevation of the complete platform to 55 cm is not possible, part of the platform should be raised to this height. In the case of partially raised platforms it is recommended that there is at least a 2 meter long (plus stopping distance) flat area with ramps no steeper than 6%

Figure 44: Creative solutions to barrier free access. Source: (Moderne Regionalbahn, 2021)

[275] (Knoll, 2013)

[276] (BMVIT, 2009)

[277] (BMVIT, 2009)

Per the TSI-PRM standards the platform width must have the equivalent of two 80 cm paths free of obstacles, these measurements cannot include the “danger zone”, which should only be used by passengers when entering and exiting the train. The exact width of the danger zone varies based on train speed and railway rules, per ÖBB rules the danger zone for lines with a speed limit under 80 km/h is 2.20 meters from the track center. The conditions at each station are different and some will require unique solutions including changing which track the trains use for boarding. The regulations do allow for solutions other than the implementation of a full high platform at each station, Figure 46 shows measures implemented on other lines to enable barrier free access with reduced cost and visual impact.

In general, the simple halt stations on the Donauuferbahn could be modified relatively easily for barrier free access, however the larger stations will require more consideration as boarding of the train is often done from the middle of the three tracks, with only a narrow platform. However, the removal of the outer track if no longer needed is a possibility. The stations in Dürnstein and Weißenkirchen for example were previously 3 tracked but the outside track was removed around 2011, apparently without UNESCO objections.[278] Specific measures for each station are listed in section “Attractive stations”

15.5 Improved transport of bicycles

An area where the current bus offer fails is the transport of bicycles. Although bus Radtramper services were available until 2018 they had significantly lower capacity than the previous Radtramper trains that ran under during the ÖBB era. The regular buses do not permit bike transport and even transport of a folding bike can be a contentious issue when the bus is fully loaded.[279]

During the ÖBB era bicycles were transported in a single boxcar, either 2 or 4 axle based on demand. These wagons were standard freight box wagons with high floors with a portable metal ramp used to unload bikes. The unloading and loading of bicycles was naturally slow and required assistance for the train staff to unload and unload. The boxcars could be coupled to the end of a traditional locomotive hauled train or can also be hauled behind the versatile 5047 railcars which were designed to pull limited numbers of wagons. The traditional bike cars can still be seen pulled by 5047’s on the Mühlkreisbahn in Upper Austria or on the NÖVOG Reblaus Express.

Figure 45: Bike boxcar on GWTrain Regio in Czech Republic. 2018 Karl Seltenhammer, bahnbilder.de

In the Czech Republic, GW TrainRegio uses RegioSprinter trains identical to those used on the Wachaubahn with a special bike wagon coupled between a pair of units. The boxcar appears to be specially built with lighter construction than a standard freight boxcar and more doors to enable easier access to the bicycles and has pass through electrical connections for multiple unit operations. A similar solution could immediately be applied to the Wachaubahn to increase its use for bicycle transport.

[278] Google earth historic imagery

[279] Own experience

The disadvantage of using a separate bike wagon is the greater dwell times at stations. With a separate wagon the passengers or staff must retrieve the bicycle from a separate wagon rather than rolling it off the one where they are sitting. This process can add several minutes at each station where passengers unload bicycles. For touristic lines with relaxed schedules this is not a problem, however if a Taktfahrplan with guaranteed connections is implemented, a bike wagon can add too much unreliability to the timetable. For this reason, the Vinschgaubahn rejected this idea despite the high demand for bicycle transport.[280] If there is a high demand for bicycle travel to the endpoint of the line it is then possible to allow transport in the bike wagon only between the start and end point to reduce schedule uncertainty. Special bike trains with minimum timed connections could also be introduced to the schedule as long as they do not affect the punctuality of other trains.

Figure 46: Interior of 5095 railcar rebuilt for bike transport on the Murtalbahn. Author photo

Figure 47: Interior of Hungarian BzMot railcar equipped for bicycle carriage. Author photo.

If trains need to operate on a more precise schedule, then it is preferable to transport bicycles inside the passenger compartment of the vehicle. On most regular trains, provisions for bicycle transport are simply an area with foldable seats and sometimes straps to hold the bicycles in place. However, on lines where bicycles are commonly transported, a dedicated area for bicycles is needed. The Murtalbahn in Styria is heavily used by bike tourists as it parallels the popular Mur River bicycle trail. Several of their narrow gauge 5090 series wagons have been rebuilt with extended capacity for bicycles which can hang vertically on hooks thereby reducing the space inside the wagon need.

The current fleet of the NÖVOG for the Wachaubahn consists of only 4 railcars and the conversion of one to a bicycle wagon is not realistic with the reactivation of regular services. A further option is the use of an unpowered trailer vehicle with passenger access. This could be similarly positioned between two powered sets like a bicycle boxcar would be. In Hungary this solution is used on regional routes in areas popular with bike tourism with an unpowered trailer pulled behind a BzMot railcar. Given the demand for bicycle transport on the line an immediate solution to the bicycle transport issue in tourist operation should be found and the transport of bicycles should be factored in when purchasing new railcars. Given that the current service only operates a tourist service a bike boxcar should be built to increase the attractivity for bike tourists.

[280] (Tomberger, 2016)

15.6 Reducing distances to town centers

When accessing stations, passengers want the quickest path to and from the platform. Roundabout paths designed to simplify station layouts from the operational perspective are rarely well received and some passengers will probably cross at non designated areas if possible. In general, the stations on the remaining portion of the Donauuferbahn are well located with logical paths to the town center and nearby attractions. In some cases, stations are located further than optimal from town centers but due to space restrictions this situation cannot be easily altered in most cases. In some stations legal pathways across the tracks would improve accessibility. These will be covered in the segment Attractive stations on a per station basis.

Emmersdorf has the greatest accessibility issues, and problematically it is the most important transfer station on the line. The station has the largest height difference of all stations on the line with the station is located at 233 mü.A , while the Federal Highway is located at 209 mü.A.[281] Currently the options to traverse this 24 meter vertical distance is either a set of stairs or a longer switchback road which is used by the connecting bus. As the connection in Emmersdorf is critical for the well-functioning of the line it will be covered separately in a Segment 15.11

The station of Wösendorf-Joching has very low potential based on the transport value analysis due to its location directly in between the two towns. The station location made sense when the line was constructed as the trains of the era required significant time to accelerate and decelerate. With the operation of modern railcars, especially electrified one's, shorter stop distances are feasible. The separation of Wösendorf and Joching into two separate stations would allow the railway to match the coverage of the bus offer.

15.7 Attractive stations

Figure 48: Kendlbruck Halt on the Murtalbahn with signage pointing to nearby hotels. Author photo

The use of station buildings can have a large impact on the perception of passengers of the railway. Historically train stations in themselves were gathering places for the community, frequently hosting a restaurant or bar. Such is still common in much of Eastern Europe, particularly the Czech Republic where the station often doubles as the town bar. This provides amenities for those waiting for the train as well as increasing the railways connection to the community. Similar usage was once common in Austria, with ÖBB timetables from the 1980s still listing which stations had a bar or restaurant. However, this traditional function has largely been lost in recent years. The tradition can still be found on some tourist branch lines however like the Murtalbahn.[282] Finding appropriate uses for station buildings was an important part of the restoration of the Vinschgaubahn with the stations in important towns now hosting complimentary uses such as gastronomy, stores and bike repair and rental shops.[283]

[281] (Geoland.at, 2021) , Meters above the Adria, a locally used measurement for height

[282] Own observations

[283] (Tomberger, 2016)

Even small halts can be made more attractive with good signage helpful for tourists. Currently at most stations the only information available for passengers is the timetable and tariff information. In contrast on the Murtalbahn there are signs pointing to nearby hotels, restaurants, and information on attractions in the area. These measures are simple to implement but can greatly improve the passenger experience.

15.7.1 Attractive rail-bus transfer

Figure 49: Cross platform transfer at Seefeld in Tyrol on the Karwendalbahn. Author photo

The provision of easy and attractive transfers between railway and road is vital to the reorganization of traffic. The best method of providing transfers on branch line stations with simple track layout is a cross platform transfer between bus and rail. This has been implemented successfully at many stations throughout Austria. This practice reduces the needed transfer time and the passenger's perception of the transfer. If possible, the transfer area should be covered, however with the Donauuferbahn the actual design may be limited by UNESCO constraints.

15.7.2 Specific measures for Donauuferbahn stations:

This section will go over the specific attractivity measures at each station including usage of the station buildings, services available and information for tourists. With a few exceptions, the stations on the Donauuferbahn do not have any complimentary uses, with the station buildings mostly rented to private users with no facilities for passengers. The facilities for bicycles at most stations need to be improved, few offer covered storage space for bicycles, and often insufficient bike racks in general. Further facilities such as a basic self-service bike repair facilities should be provided given the importance of bike tourism in the region. The situation at most halt stations is similar, with just a shelter and posters with the timetable and fares. In general, all halt stations could use information boards with better information on the surroundings for passengers. Specific suggestions therefore will only be suggested if there is there is a location specific need.

Stein: Due to proximity to the Danube Private University, the station would be well suited for a restaurant, bar or other use that could attract students during their off time. The station does not currently have a bike share offer and this should be added. Additional signage advertising attractions in both Stein and Mautern should be placed at the exit to the station. The implementation of full barrier free platform here is difficult without the removal of the first track, therefore alternative solutions such as a partially raised platform should be considered. Alternatively track geometry should be altered to allow trains to easily use the track closer to the station without a speed penalty.

Dürnstein: Dürnstein, as mentioned in segment 9.5 already has a complimentary use with the Saffron Café occupying the building. The station has good signage on nearby attractions and walking trails, and bike rental in close proximity. However, there is a lack of covered bike parking, some of the ample auto

parking should be removed to erect a covered bike parking area. The parking on site to a large degree does not cater to rail users but rather general-purpose parking. Under the preliminary timetable concept, the station will be one of two regular crossing points. Therefore, it is proposed to add a center platform here. This should be possible as the outside track has already been removed and therefore the required space should be available. The turnouts at both ends will need to be adjusted to allow for this change.

Weißenkirchen: The station at Weißenkirchen is somewhat removed from the town, with no directly adjacent development. Therefore, it would be helpful to attract a gastronomy or retail use to make the station a more attractive destination. The station has bike rental on platform and good signage, however again covered bicycle parking is lacking and some auto parking should be repurposed. Trains at Weißenkirchen arrive on the track closest to the station building, therefore the implementation of a barrier free platform should be relatively easy. As shown in section 11.3 the distance to the station prevents it from reaching its full potential. Weißenkirchen is one of the three biggest settlements and thus it is important to rectify this situation. The construction of a path along the tracks between the station and the main street in the Altstadt would shorten the distance to the main town center.

Wösendorf-Joching: The station at Wösendorf-Joching lies too far away from both towns. With the introduction of new efficient railcars the stop spacing can be increased to better serve each community. The following diagram shows the proposed locations for the new stations.

Figure 50: New locations for Wösendorf and Joching stations. Source: Google Earth with author input

Spitz: Spitz has good facilities at the station, with a public bathroom, covered bike storage, bike rental and information signs, however a complimentary use for the station should be found. In the 1984 timetable the station was shown as having a station restaurant. Currently trains use the center track, where the construction of a barrier free platform would be difficult. Furthermore, the station is important for special trains, especially during the summer solstice. An innovative solution to barrier free accessibility is needed here are changing the track arrangement here as a reduction in the number of tracks is undesirable.

Schwallenbach:

The conditions current pathway between the town and station is insufficient and does not meet barrier free requirements. It is recommended that the pathway is widened to provide a more comfortable access path for all users. The station would benefit for better signage to attractions.

Aggsbach Markt: Aggsbach in general lacks facilities for passengers with no complimentary use of the station, no bicycle storage facilities or bike rental. Furthermore, there is no legal access between the station and the part of the town north of the station. It is recommended here that a pedestrian crossing

is built into the platform with warning equipment. Aggsbach is to be a crossing station based on the preliminary timetable, and therefore it is proposed that a similar solution as in Dürnstein is implemented, with the removal of one track for the installation for a center platform.

Grimsing: In Grimsing there are several interesting paths, including one that provides a good view of the Schloss Schönbühel on the opposite bank of the Danube. However, there is no information available to visitors here to guide them. The implementation of visitor signage is the primary attractivity measure required and the station can be upgraded with relative ease to barrier free status.

Emmersdorf: The station at Emmersdorf should be redeveloped with complementary uses. This would increase its attractivity as it is located away from other facilities. The outside track of the station has already been partially removed; thus, the construction of a barrier free platform would be relatively easy to implement.

Weitenegg: The station at Weitenegg is currently used as a storage space for track materials, and it will need to be considerably reimaged to be an attractive end point for the current tourist services and for any regular services. The erection of a barrier free platform is relatively easy as the station only has a single stub ended siding for work trains in addition to the mainline. The existing building is insufficient, and some form of new shelter should be erected with passenger facilities such as restrooms as found in Emmersdorf. Attractivity measures such as a train hotel proposed in the study by Knoll should also be considered.[284] Sufficient parking space should be provided for tour buses, as well as the potential for a cross platform transfer for buses continuing to Pöggstall. The road connection must be modified as well to allow for buses to turn into the station when arriving from the west. These measures however may be incompatible with the need of providing a maintenance depot for the line, thus some attractivity measures may not be possible if this function is to be retained.

Between Weitenegg and Sarmingstein many of the stations have been sold outright, thus there may initially be limited possibilities to introduce complimentary uses. Furthermore, all platforms will need to be built to fully barrier free standards as part of the new concessions. Similar considerations in providing for bike parking and bike share should also be considered.

15.8 Reduction of railway noise

As stated in segment 10.4.4, the potential noise impacts could be an obstacle to reactivation of the railway. Due to the many unsecured railway crossings the train must sound its horn many times throughout the journey. The existing trains are poorly soundproofed, so this is not just an annoyance for residents but also passengers. Per UIC regulation 644 the standard volume of train horns is to be between 120 and 125 decibels(a) from a distance of 5 meters.[285] This volume is at the upper limits of human hearing and long-term exposure can cause hearing damage. Even short-term exposure can be cause disturbances and increased stress levels. On one hand the horns need to be loud to perform their function, on the other hand the noise level could lead to problems with the reactivation of the railway. Therefore, a plan for reactivation should include measures to reduce this noise as much as possible.

[284] (Knoll, 2013)

[285] (Schöne, 2013)

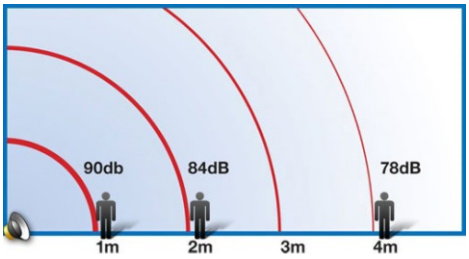

Figure 51: Propagation of sound in decibels by distance. Source: Extron.com

In Austria, trains do not need to sound the horn for crossings that are equipped with warning devices. To determine which crossings should be examined for mitigation measures, a further GIS analysis of the unprotected level crossings was carried out. According to the Inverse Square Law, the sound pressure level decreases by 6 DB(a) each time the distance from the source is doubled.

For the UIC mandated 120 DB(a) horn, the volume would decrease to 114 DB at 10 meters from the train. To calculate the sound volume over a distance the following formula is used.[286]

$$Lp(R2) = (Lp(R1) - 20 \cdot Log10(R2/R1)$$

Where:

$(Lp(R1) -$ = Known sound pressure level at the first location (typically measured data or equipment vendor data)

$Lp(R2)$ = Unknown sound pressure level at the second location

$R1$ = Distance from the noise source to location of known sound pressure level

$R2$ = Distance from noise source to the second location

85 DBs is considered the point where a sound is harmful and therefore the GIS analysis will examine what settlements lie in the zone where these sound levels would theoretically be observed. Based on formula at 300 meters a volume of 84.4 DB's would be observed. At this distance the sound would be further dampened indoors, which is the most important factor. The calculation only considers an idealized uniform propagation of noise, in reality an area like the Wachau with its tall cliffs would likely to both further propagate or in other case dampen the noise. In GIS 300-meter radii around the railway crossings has been created and then intersected with the residential land area file generated for use in the Transport Value model with the resulting area listed below. The location of crossings and safety equipment was checked through a combination of field surveys, Google Maps and in cab videos. Crossings range from full road crossings to simple field ways with a small crossing plate for farmers crossing on foot to access vineyards across the tracks. In total there are 60 unprotected grade crossings between Krems and Weitenegg.

Based on the GIS analysis it was sought to find solutions for the crossings where the horn sounds would impact the greatest number of residents. Solutions primarily center on signalizing crossings and combining crossings. In general, the signalization of crossings is only considered when the impact area is greater than 45,000 square meters and if the road has significant public traffic. Particular attention has been paid to crossings that area located directly adjacent to residential areas. A total of 11 crossings are recommended to be signaled. The construction of underpasses is far more expensive and is only recommended for two pedestrian crossings.

Seven farm crossings are recommended to be closed through the creation of trackside paths and other compensatory measures as was done on the Vinschgaubahn. The exact measures will likely have to be adjusted upon reactivation, with potentially more noise reduction measures based on residents' reactions. A table of recommendations for each level crossings is provided in Annex 15.8.

[286] (WKC, 2021)

For the segment west of Weitenegg that has been removed, the installation of warning devices at level crossings will likely be a prerequisite for the new construction. Therefore, the issue of noise will not be considered in detail.

The use of more melodic horns could help reduce the perception of noise. In North America the use of train horns is omnipresent, even at crossing that have warning devices. As such the horns have been designed to have a more melodic note, rather than the jarring and shrill honking noise produced by most European train horns.

The rolling noise from the lightweight multiple unit trains is relatively low, and as such no passive measures such as sound barriers will likely me needed. These are mainly useful along high-speed lines with heavy freight traffic, where there is significant noise generated by the train motion. Finally in addition to the noise from train horns there is also the issue of the sound and exhaust from the diesel-powered trains. Diesel railcars of today are significantly quieter and produce less emission than those than even the present RegioSprinter cars used. When the Vinschgaubahn in South Tyrol was reactivated the installation of noise barriers was initially considered, however after trial operations no noise concerns were registered, with the Stadler GTW 2/6 vehicles being far quieter than expected.[287] The issue of pollution may still be seen as an issue and alternative technology has now evolved to the point that alternatives to diesel traction should be considered.

15.9 Attractive vehicles and alternative propulsion

Due to the age of the Wachaubahn's vehicles and the likelihood of increased rolling stock requirements to enable the hourly interval, new rolling stock will be required. The acquisition of new rolling stock provides an opportunity for the railway to upgrade to new technology and eliminate some of the potential issues resulting from regular operation such as noise and emissions from diesel traction. Alternative propulsion technology has advanced far enough for mainstream adoption and will be considered instead of diesel for this study. This segment will explore the various options for propulsion as well as the design of the passenger experience of the vehicles.

15.9.1 Vehicle design

The vehicle interiors are a large part of the passenger experience and overall impression of a public transport service, therefore special attention should be paid to the vehicle design and that it is suited to local needs. The existing vehicles of the Wachaubahn, for their other faults have very large picture windows that are well suited to show off the scenic views of the line. Most modern multiple units tend to have smaller windows, with some exceptions such as the Alstom Lint series. To maintain this aspect and provide an opportunity for higher priced tourist traffic, separate panorama coaches like used on the Mariazellerbahn would provide a good solution. For tourists the provision of a certain number of openable windows, such as on the new Stadler EMU's for the Rhaetian Railway (RhB) in Switzerland would allow passengers to easily photograph the landscape.[288] As bike tourism plays a major role in the region the provision of ample bicycle storage should be provided with a dedicated bike space as discussed in section 15.5. The provision of charging ports and Wi-Fi has become somewhat standard on new vehicles, and both should be provided in a convenient manner, in many modern vehicles, such

[287] (Tomberger, 2016)

[288] Own observation 2019

as the Bombardier Talent 2 series, charging is provided as an afterthought with ports installed on a conduit above the seats which is completely impractical.[289]

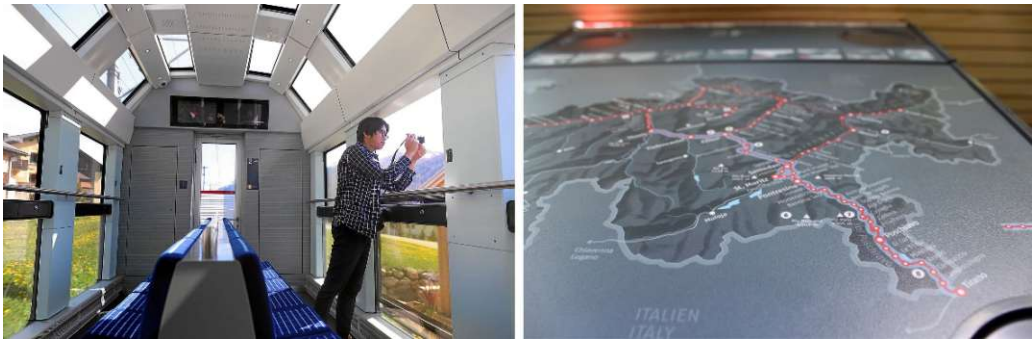

Figure 52: Attractive interior design from Stadler vehicles on the RhB. Open panorama windows allow tourist to take unobstructed landscape photos. Maps printed on tray tables provide easy reference for passengers. Source: Rhaetian Railway/ Railcolornews (left image), Author image (right)

The vehicles should have an attractive, custom designed passenger information system that provides information not only on the upcoming stations and transfer possibilities, but also the available tourist attractions in the area. The current NÖVOG trains carry brochures primarily on NÖVOG offers but this should be expanded to further information on the area and tourist attractions. Passive information systems, like maps printed on tables at the seats such as those found on the RhB are an easy and effective way to convey information to passengers.[290]

15.9.2 Electrification

In Upper Austria the electrification of the line between St. Valentine und St. Nikola-Struden is included in ÖBB's investment plan for 2021-2026.[291] If an hourly service is to be provided on the line between Krems and Weitenegg, electrification would make economic sense and provide a clear benefit over the diesel traction in terms of environmental sustainability. The provision of electrification would in the long term reduce operating costs. As noted in segment 15.115.1 the electrification of the line should not affect the lines UNESCO status. The electrification of the line would have several significant benefits. Most importantly it would greatly reduce the operating costs both due to reduction in energy cost as well as reduction of vehicle maintenance compared to diesel and other hybrid technology and longer vehicle lifespan. Vehicle procurement is also easier due to greater availability from off the shelf models, compared to the still limited selection for alternative traction. The technology is proven in comparison to battery and hybrid technology which is only now starting to come of age.

The downside of electrification is mainly the initial investment cost for the catenary as well as the maintenance of such systems. A further issue is that even though the construction of the catenary would probably face no issues due to UNESCO, it may face opposition from residents on aesthetic grounds as was the case with the Zillertalbahn. This can be mitigated somewhat through the design of catenary that is harmonious as possible with the surroundings rather than the standard ÖBB concrete masts or galvanized steel poles which have a large visual impact. The green painted lattice masts that are common in Germany for example, have a far lower visual impact.

[289] Own observations

[290] Ibid

[291] (OEBB Infra, 2020)

15.9.3 Battery electric

Battery electric vehicles are now being introduced into mainstream rail operations and are available from several manufacturers. Battery electric vehicles are especially advantageous in cases where the trains operate partially under catenary. For the existing line from Krems to Emmersdorf this would not apply except in the case of direct trains to Vienna. However, if the direct connection to Melk and St. Pölten is established on the western segment, then battery electric vehicles would be very attractive. If battery electric operation is implemented, then the end stations must be equipped with overhead catenary for charging. The use of battery electric traction would allow for an easy transition to full electric operation in the future as vehicles can be easily converted to full electrification.

15.9.4 Hydrogen

Hydrogen technology is still relatively new, but development is advancing quickly with Hydrogen powered trainsets produced by Alstom in regular operation in Germany. In Austria the ÖBB tested the Alstom Cordia LINT hydrogen MU in 2021 and the Zillertalbahn is planning to replace its existing diesel fleet with hydrogen.[292] Hydrogen fuel cell trains however have the disadvantage that they still require fuel. Hydrogen is not universally available and typically a manufacturing facility must be set up on site to fuel the vehicles. Furthermore, the procurement of hydrogen vehicles would likely preclude future investment in electrification.

15.9.5 Vehicle choice

For the initial operations, battery electric operation has the advantage that it requires only minimum infrastructure installation but also futureproofs the operation for future full electrification. Currently both Siemens and Stadler offer battery electric multiple units. Due to the varying traffic demand, it is recommended to use shorter trainsets that can be operated in multiple as is currently done with the existing fleet. These shorter vehicles are especially important for the operational concept of the rebuilt segment where there will be platforms with only 50 meters length. Vehicles should have a maximum speed of at least 160 km/h to allow for operation on mainline routes as well to enable through services.

The Peggau–Übelbach line in Styria near Graz provides a good precedent for an electrified branch line with modern vehicles. The line uses a fleet of 3 Stadler GTW 2/6s which allow the railway to serve short platforms that are in some cases more akin to tram halts. Some trains continue on the mainline from Peggau to provide direct service to Graz.[293] The GTW series has since been replaced with the Flirt, and Stadler offers a 2 segment Flirt battery version which would be ideally suited for the operational concept. Stadler is currently producing 55 of these vehicles for the NASH, the Schleswig Holstein transport organization in Germany. [294]

[292] (Reidinger, 2019)

[293] Own observations May 2021

[294] (Schaal, 2019)

15.10 Restructuring of complete transport offer

The Wachau has a trimodal public transport network made up of the railway, bus lines and ferries. For a successful reactivation of the railway good coordination with other modes of transport is necessary. The emergence of new on demand mobility services such as bike sharing and ride sharing applications is growing and will be explored in this segment. This segment will focus on the measures to restructure the transport system between Krems and Weitenegg. Measures for the middle segment of the line will be discussed in Chapter 17.

15.10.1 Elimination of parallel traffic

For a successful railway offer the parallel bus traffic must be ended. Along the railway corridor the bus line 715 operates in parallel traffic and must be discontinued. In general, the bus and rail offer have similarly located stops. Several gaps in the catchment zone were identified in section 11.3. In particular the settlements of Oberloiben, Unterloiben, Wösendorf and Joching are poorly served by the current railway stop arrangement. These communities all lay in the outer part of the 1000-meter catchment zone, and therefore the railway offer is less attractive. In addition to these issues, there are several smaller stops that will not be served at all if bus 715 is discontinued. To serve Unterloiben and Oberloiben a new feeder bus service is proposed. For Wösendorf and Joching new separate railway would increase attractivity.

- The stop Dürnstein North lies outside of the 1000-meter catchment zone of the railway station. As Dürnstein is almost fully pedestrianized neither transport mode can offer direct service to the town core.
- Abzweig, or junction Heuduerr is not served by any station, however this station has limited traffic potential. Several houses are located about 1 km uphill from the stop otherwise the area is completely rural. The location is part of Dürnstein- Waldhütten which has a total population of 45 people.[295]
- The small settlement of Sankt Michael is approximately 2 km away from the nearest station of Wösendorf-Joching. The town only has a population of 23 people of 2021, thus does not warrant a separate rail stop.[296] However, given its proximity from Spitz a feeder bus could be organized as a variant of the line 718 or 719.

In addition to the 715, between Emmersdorf and Spitz the bus 719 operates with a limited schedule for commuter traffic between Melk and Ottenschlag (in the foothills north of the Wachau). The service operates with 4 courses northbound and two southbound with 3 courses extending to St. Pölten. The cancellation of this line is a more complicated decision than the 715. For commuters to and from Ottenschlag it provides a one seat ride to either Melk or St. Pölten. Given the long distance and relatively low frequency of the line it could be viewed negatively from the passenger point of view if it is replaced with a connection requiring 2 to 3 changes and thus adding considerable time to the trip. On the other hand, if the segment from Melk is eliminated the same equipment could be repurposed to provide a better service interval from to Ottenschlag and thereby also strengthening the connection to Mühldorf. To further reduce vehicle kilometers the 719 could replace some courses of the 718 between Spitz and Mühldorf with a transfer then required in Mühldorf for onward trips to Pöggstall. The decision would require more detailed analysis on the travel demand from Ottenschlag and Mühldorf as to whether there is sufficient ridership potential for operation at a more frequent interval.

[295] (Statistik Austria, 2021)

[296] Ibid.

In Krems the bus line 717 operates between Krems Hauptbahnhof and Krems University on an hourly interval. The route operates with limited stops and is also served by lines of the Krems Stadtbus system. With a reactivation of the railway on a one hour schedule this line could be eliminated.

The southern bank of the river is served by the 720 (Formerly WL2). Due to the limited river crossings and the wider spread of villages on the southern bank there is little overlap in potential traffic flows, and thus limited to no synergy between this line and the railway.

The restructuring of parallel bus traffic between Weitenegg and Persenbeug will be covered in section 17.

15.10.2 Reorientation of connecting buses

There are several bus lines in the region that currently serve as feeders to the bus 715 and operate tangentially to the railway route to serve destinations in the Waldviertel north of the river. These buses where possible should be reoriented towards the railway to serve as feeders. The Waldviertel north of the valley is hilly and sparsely populated in comparison to the valley. Therefore, public transport services are limited, and several lines operate only on demand.

15.10.2.1 Bus 718

Bus line 719 operates from Spitz to Mühldorf with some courses continuing to Raxendorf and Pöggstall on weekdays. During the weekday there are 11 courses in the northbound direction and 14 southbound with various start/end points. During the weekend there are only 3 courses per day per direction. During the weekday courses in the early morning have a timed transfer in Spitz to route 715 in both directions while during the rest of the day generally only towards Krems with some courses having no timed transfer. On weekends all courses have a timed transfer in Spitz. With the reactivation of the railway line all buses should have a timed transfer in Spitz with the railway.

15.10.2.2 Bus 722

The line 722 is an on-demand service (Ruffbus) available from Spitz or Emmersdorf on a circular route to the foot of the Jauerling Mountain and into the Weitental valley. The bus runs on Saturdays, Sundays and public holidays between March 27 and October 26. Passengers must request the service at least 60 minutes before the scheduled departure to reserve a seat and to ensure that the bus runs. The service is aimed primarily at tourists and covers some of the area normally served by the 719 which does not operate on the weekend. The only changes to this line required are adjustment of the timetable to meet trains in Spitz (in both directions if possible) and in Emmersdorf again if possible.[297]

15.10.2.3 Bus 790/791

Bus 790 and 791 operate from Melk towards Pöggstall over different routes. These should have an additional stop at Weitenegg station and timed as well as possible with train services. The bus services can act as a feeder to the railway for passengers arriving from Pöggstall and other destinations in the Waldviertel.

15.10.3 Development of new feeder bus services

In general, due to the spread of population in the Wachau valley there is limited need to develop feeder buses. However, one area where the railway is particularly weak is between Dürnstein and Stein, where

[297] (VOR, 2021)

the settlements of Oberloiben and Unterloiben largely lay outside of the railway's catchment zone. Here a feeder bus service should be developed to close this catchment zone gap. The bus would halt at stops in Oberloiben and Unterloiben currently served by the bus 715. At Stein there would be a timed transfer to trains in both directions and from there the bus would continue across the river to Mautern, effectively providing a further destination for railway passengers.

15.10.4 Ferries

Due to the lack of bridges between Krems and Emmersdorf there are three ferries in operation between Krems and Emmersdorf with a further ferry at Marbach. This segment will evaluate whether the ferries can be used as a feeder service to the railway line and if it would be sensible to incorporate them into the integrated transport offer.

Dürnstein-Rossatz: The Dürnstein – Rossatz ferry connects Dürnstein with the towns of Arnsdorf (not to be confused with the group of 4 villages across from Spitz) and Rossatz. In Dürnstein the ferry is well located in relation to the town but requires a 500-meter walk to the train station. On the south bank the ferry is well located to the settlement of Arnsdorf but requires a longer (15+ min) walk to the larger settlement of Rossatz. Due to these factors the combined rail + ferry connection is less attractive than the 720 bus, especially for commuter traffic. For tourists Rossatz has significant importance with numerous Heurigen and the starting point of many hiking trails. Ferry timings should be adjusted, especially during tourist seasons to provide short waiting times for rail users in both directions. Appropriate signage should be provided to guide tourists to the ferry.

Weißenkirchen-St. Lorenz: The ferry at Weißenkirchen connects the town with St. Lorenz on the south bank of the river. St Lorenz is a small settlement with 10 or fewer structures, the next significant settlement is located 10 to 15 minutes away by foot. Therefore, the integration of the ferry cannot be reasonably integrated into any regular commuter traffic offer. The area however does have significant importance for tourists with numerous Heurigen and the start of several hiking trails. Similarly, signage for tourists should be provided and the ferry timed to allow for good rail connections.

Spitz-Arnsdorf: The ferry in between Spitz and the villages of Oberarnsdorf, Hofarnsdorf and Mitterarnsdorf and Bacharnsdorf has limited potential as a feeder to the railway line. The ferries southern terminus is situated directly between Hofarnsdorf and Oberarnsdorf and requires an 8–15-minute walk to both. The combined villages of Arnsdorf have few tourist draws, however the ferry dock is the start of Wachau hiking trail 10. The ferry therefore has some importance for tourist traffic but cannot be reasonably included in any regular commuter transport offer. Signage for tourists should be provided and the ferry timed to allow for good rail connections.

Marbach – Krummnußbaum: An on demand boat taxi operates between Marbach and Krummnußbaum an der Westbahn. The boat carries only pedestrians and bicycles. The southern bank of the river is well served by trains on the Westbahn and if the Donauuferbahn is reactivated so would the northern bank. The existing service is low capacity and not well suited to high volumes of commuter traffic. Outside of tourist use no major synergy between the Donauuferbahn and the ferry here is foreseen, in this segment cross river transport can be handled by buses on the fixed bridges at Emmersdorf and Pöchlarn, both of which also have significantly better rail service on the Westbahn than Krummnußbaum.

The settlement structure in general on the southern bank of the Danube is in general more spread out than on the northern side and is thus best served by the established 720 bus. Any combined transport strategy with the ferry and railway as a replacement for the bus would be a decrease in quality for residents. The existing 720 bus line should remain unchanged as there are limited synergy possibilities.

Inclusion of the ferries in the VOR offer would likely do little to bring any positive change in accessibility or modal split.

However, there are significant synergy possibilities for inclusion of the ferry in the tourist offer. The ferries are already included in the tourist ticket offer through the WachauTicket. Of primary importance is making sure the combined ferry-rail transport possibility is promoted and signage exists on both sides of the river to guide tourists.

15.10.5 Bike Sharing

The State of Lower Austria has since 2009 partnered with the Europe wide bike share company NextBike to implement bike sharing across the state, particularly in tourist regions. The system was first implemented in the Wachau in 2010 and is still being expanded with new areas such as the Waldviertel added in the in 2021.[298]

Figure 53: Regions where NextBike system is offered: Source: radland.at

The system is station based with 26 stations throughout the Wachau between Krems and Emmersdorf, including those in Krems and Melk. Bikes must be returned to stations otherwise the user is charged a 20 Euro fee. However, unlike true station-based systems like Vienna, if a station is full the bike can be independently locked and parked next to the station. Prices for the bike rental are affordable with full priced use starting at 1 euro an hour with a maximum of 10 euros for the full day. Users with a yearly VOR ticket or a ÖBB Vorteilscard (Half price card) receive a free first hour with a daily cap of 9 euros. With the Lower Austria card, the user receives a onetime credit for 24 hours of bike use. The Wachau System, along with most of the stations outside of major cities is shut down during the winter month between November 16th and March 20th.[299]

NextBikes are available directly or close to the railway stations at Krems, Krems Campus, Dürnstein, Weißenkirchen, and Spitz. Bikes are available at Aggsbach and Emmersdorf as well, but not in the immediate vicinity of the station.[300]

NextBike has the advantage over a locally developed bikeshare solution in that it is available in cities and towns all over Europe, so with one app one can rent bikes in many different cities. This reduces the barrier to use, as a potential user has the greater chance of already having the app installed and knows how to rent bicycles through the system. The NextBike system can be viewed as good practice and if the line is extending through the Nibelungengau, the NextBike system should be implemented concurrently.

[298] (Regionalentwicklung Waldviertel, 2021) (APA-OTS, 2010)

[299] (Nextbike, 2021)

[300] (Nextbike, 2021)

15.11 Improving connectivity to Melk

The elimination of parallel bus services depends on a dependable and quick transfer between railway and bus transport to reach Melk. The catchment area of Krems quickly diminishes west of Spitz and from there most traffic is destined for Melk and further destinations reached by the Westbahn. During the operating season of the Wachaubahn the bus 721 provides a link between Emmersdorf, Melk station and Schloss Schallaburg which is a popular tourist attraction located 6 km south of Melk. The bus meets most train courses at Emmersdorf with a 10-to-20-minute transfer time. The conditions for bus access to Emmersdorf are however far from ideal. Emmersdorf, as mentioned in Segment 9.13 has one of the greatest height differences between the town/main road and the railway station. Buses must drive through a narrow street in the historical center then up a switchback road to reach the station. At the station itself there is no proper turning loop for the bus which must make a three point turn in the parking lot to reverse. An increase in bus traffic through the old town may face opposition from the local populace, however the bus connection here is critical for the success of the line. The following are some possibilities for improving connectivity between Emmersdorf and Melk. The options are compared in a SWOT analysis (see Annex 15.11)

1) **Increase frequency of existing connection:** This can be considered as the "Do nothing" alternative with no additional investment costs. The existing route 721 shuttle service would be expanded to meet every train at Emmersdorf.
2) **Reroute bus 797:** The existing bus 797 would be rerouted via Emmersdorf station to meet every train. The stops at Schallemmersdorf would be abandoned and new halts would be provided at Gossam.
3) **Connection via elevator/staircase to main street:** Currently the town of Emmersdorf is reached by a stairway from the station. An elevator however could improve the connection by reducing the physical expenditure needed to reach the station, and therefore the willingness to use the railway. If such an elevator was installed it could eliminate the need for every bus to drive through the city center, however it should also be considered as a standalone feature to connect the railway and town. The placement of an elevator is problematic due buildings constructed directly against the hillside both above and below. The use of the elevator as a replacement for the direct bus service to the station is however problematic. Elevators have limited capacity and most passengers would still have to climb/descend over 100 stairs between the station and the town. Furthermore, the bus stop would likely have to be moved to provide a more direct connection and there is limited space along the road due to the new floodwall construction.

Figure 54: Potential bus routing via the Kolimanistrasse.

4) **Improving bus access to station:** To eliminate the problem of buses driving through the old town the Kolimanistrasse, which has a direct although steeply graded access to the Emmersdorf-Melk bridge could be rebuilt exclusively for bus traffic. The access road between the highway bridge and the station is gated and only allowed to be used by service vehicles. The road at the station has an elevation of 233 meters and at the intersection with the highway that of 214 meters, giving it an approximate gradient of 10%.[301] This is steep but within the tolerances for standard bus operations.[302] With this operational plan the Kolimanistrasse would remain gated and only accessible by buses, the gates would be remotely activated and linked to a set of stoplights to halt traffic for buses entering the road. Buses would turn as they do today at the station in Emmersdorf. The provision of a continuous loop road was considered but due to topography and space restrictions would be difficult to implement. Some small changes to the road layout would be needed to enable the wider bus turning radii needed. This option should reduce the travel time by bus needed and the potential disturbance from the additional bus traffic compared to driving through the old city. The solution would be relatively cost effective to implement with the only major expense being the installation of signaling at the junction. The distance is reduction is only 400 meters however it should be significantly quicker than the old alignment.

Figure 55: Drawing of potential transfer station in Schallemmersdorf

5)Relocation of bus connection to Schallemmersdorf: Schallemmersdorf does not currently have a railway station but is located where the existing bus 797 to Maria Laach diverges from the B2. The railway here is a closer to street level than at Emmersdorf and a new station could be erected directly over road L7145 to Maria Laach. This would enable a connection without the burden of instituting a new line solely to serve as a connection to the railway. Based on other halt stations on the line a platform length of 100 meters can be considered sufficient. The following station layout is proposed based on the topography of the location. Access to the road would be provided by an elevator and set of stairs. For bike riders a graded ramp would be provided.

[301] (Geoland.at, 2021)

[302] (Trans Link, 2018)

Figure 56: Potential aligment for cable car connection between Donauuferbahn and Melk.

6)Connection to Melk via cable car: This solution is far more expensive and difficult to implement than the preceding options. However, it could provide a significantly faster and higher capacity option than connecting buses. The cable car would extend from Melk station, where a cable car station would be built over the station parking lot. From there the cable car would rise to a sufficient height to cross the Westbahn before crossing the river outside of Melk and connecting to the Donauuferbahn at a newly built station at Luberegg. The alignment would require curves in the alignment, something typically avoided for cable cars but possible with new systems such as the Dopplemayr City Cable car.

Figure 57:Potential alignment of railway connection Melk-Donauuferbahn

7)Extension of the railway to Melk via new bridge: To avoid a transfer in both Melk and Emmersdorf a new railway bridge could be built crossing the Danube after Emmersdorf. This option is the most expensive and least realistic. It would also hinder reactivation of the line further towards Persenbeug and even Weitenegg

Based on this comparison, several measures can be discarded, namely the cable car and direct rail connections. As shown in the passenger statistics, the volumes of traffic on this relation do not justify the large expenditures of either project. The direct rail connection has a major disadvantage that trains will have to pass Emmersdorf then return east in order to build the bridge outside of the UNESCO zone, the connection therefore may also not be attractive in terms of travel time. However, a direct rail connection from the west could make the middle segment of the line more attractive and will be considered in section 17.3. The elimination of the direct bus interchange at Emmersdorf in favor of an elevator can also be discarded, as this will make the connection less reliable and less attractive for users due to most having to take stairs due to elevator capacity. The construction of a new station at Schallemmersdorf, while potentially appealing is not considered as the waiting space for buses here is problematic, as is space in general especially after the implementation of recent flood control measures. Further the construction of a station here will be expensive due to the requirement that it will be built partially on a bridge.

The chosen solution is the combination of several of the other possibilities with the following measures recommended:

- Opening of the Kolomanistrasse only to buses with installation of signal infrastructure and gates for bus entry to the road. In case of severe ice, the longer route through the town can be used instead.

- It should be proofed whether the 797 could be rerouted to operate via the train station. This decision will need to be made based on the average ridership of the bus. If the bus is already well used it may be problematic to use it also for transferring rail passengers. If possible, this can save on several dedicated courses.

These measures can be immediately implemented in a short time frame with existing vehicles, especially with the reduction of the bus offer in Wachau. Other non-bus options have a very high cost to benefit ratio, and likely face substantial opposition from both UNESCO authorities and residents due to the visual impacts. Furthermore, they would take far longer to implement than the reactivation of the railway. The construction of an elevator between the station and town is however recommended but as an independent measure, it is also proposed to improve the access to the existing stairway with a path directly along the tracks to the road crossing leading to the stairway.

15.12 Integration with tariff offer

Public transport in Vienna, Lower Austria and Burgenland is organized under the Verkehrsverbund Ostregion (VOR). The operations of the NÖVOG, except for the Mariazellerbahn and the CityBahn Waidhofen are considered as tourist traffic and therefore are not included in the tariff agreements. For railway lines operated by the ÖBB, both the VOR and ÖBB tariffs apply. However, ÖBB tariffs do not apply to Postbus despite them being part of the same organization. For the Wachaubahn, the state of Lower Austria wants to collect more revenue from the operation of the line than would be standard for a public transport operation. However, the current tariff prevents the railway from reaching its full ridership potential and operation as a public transport system. The table below shows a comparison between the Wachaubahn and similar branch lines around Austria. The comparison is based solely on single tickets as no monthly ticket offers are available for the Wachaubahn. The railway does offer a season card for 120 euros valid throughout the entire season. The ticket is cheaper than a day ticket above 5 days, so potentially appealing for lone term tourists. For commuters the offer is of little use due to lack of integration with other transit and operation hours that fall outside typical commute times.

Table 34: Comparison of prices between the Wachaubahn and similar tourist and branch line railways.

Line/Segment	Price Single ticket (Full)	Price Single ticket (Vorteils)	Price day ticket	KM	Price per KM (Single)	% Comp.	Verkehrsverbund?
Wachau Bahn							**No**
Krems - Emmersdorf	€16	N/A	€22	34	€ 0.47		
Krems – Spitz	€11	N/A	€15	18	€ 0.61		
Kurzstrecke	€6	N/A	€10	16	€ 0.38		
Waldviertel Bahn							No
Gmund - Litschau	€13	N/A	€17*	25	€ 0.52	10.50%	
Gmund - Groß Gerungs	€18	N/A	€23*	43	€ 0.42	-11.05%	
Reblaus Express							**No**
Retz - Drosendorf	€15	N/A	€20	40	€ 0.38	-20.31%	

Line/Segment	Price Single ticket (Full)	Price Single ticket (Vorteils)	Price day ticket	KM	Price per KM (Single)	% Comp.	Verkehrsverbund?
Retz - Hessendorf	€8	N/A	€10	23	€ 0.35	-26.09%	
Mariazellerbahn							**Partial**
St. Pölten - Mariazell	€18.7	€11.2	€36.90	84	€ 0.22	-52.69%	
Erlebniszug Leiser Berg*							**No**
Wien-Ernstbrunn			€24	42	€ 0.57	21.43%	
Murtalbahn							**Yes**
Unzmarkt-Tamsweg	€14.9	€7.3	€30	64	€ 0.23	-50.53%	VVSt
Zillertalbahn							**Yes**
Jenbach - Mayrhofen	€9.2	€4.5	€34.7	31.7	€ 0.29	-38.33%	VVT
Pinzgaubahn							**Yes**
Zell am See - Krimml	€11.1	€5.8	€22	52	€ 0.21	-54.64%	SVV

**No day ticket available, only return*

*** Full price single tickets used for cost comparison*

As can be seen the Wachaubahn is more expensive than most other NÖVOG offers, and substantially more expensive than Verkehrsverbund integrated tickets in other Federal States even without inclusion of the Vorteilscard discount. For a successful resumption of regular service, the tariff for the Wachaubahn must be adjusted to a more reasonable level. There are several possibilities for this:

- Full integration into the VOR Tariff: This would be the most simple and transparent solution for passengers, all VOR tickets including weekend Freizeit tickets would be allowed for easy user experience. ÖBB Vorteilscard discount would apply to single tickets as is common with most private railways. The Wachau Day ticket would also be valid.
- Partial integration into the VOR Tariff: VOR tariff only applies to monthly and yearly tickets. No discount for ÖBB Vorteilscard holders, VOR leisure ticket offers are not accepted or Wachau surcharge is applied in train. Only Wachau Day Ticket offer is accepted with single tickets priced lower than the 12 Euro price of the Wachau Day Ticket.
- Limited integration into the VOR tariff: VOR tariff only applies to monthly and yearly tickets. Prices for single trips stay at or near current levels. Price of Wachau Day ticket is either increased or the ticket is eliminated entirely.

For higher ridership, a full integration into the VOR tariff zone is desirable. However, with the current transport politics there is an expectation that ticket sales should cover most operating costs. For the most conservative scenario, it is recommended that tickets are priced at approximately 10 euros, with the cost of the WachauTicket increased to 15 euros. Further variants of the WachauTicket, with additional discounts for groups and longer stays should also be developed. Commuter tickets would however be incorporated into the VOR system. This higher pricing however may make it difficult to eliminate the lower cost parallel traffic and would disadvantage residents that are only occasional users of the railway that do not hold timecards.

In 2021 there will be a major change to the pricing scheme of transit tickets throughout Austria with the rollout of the 1-2-3 “Klimaticket”. The ticket is based on the idea of the Vienna 365 ticket and is priced such that a yearly ticket for each federal state will be cost 1 Euro per day, 2 euros per day for 2 states and for 3 a day the entire country. The exact details of the ticket for Lower Austria have yet to be announced but it is planned for implementation with the timetable change in winter 2021. Based on the Upper Austrian version of the ticket there will be additional surcharges for the use of transport within urban areas that have a defined urban transport network, however this will only apply to those with the 1 state ticket, and users of the yearly pass should in theory be able to use all public transport.[303]

15.13 Integration in hotel offer

In several touristic regions in Europe, public transport has been directly integrated into the hotel offer. In Germany several popular tourist areas have introduced a “Guestcard” system where tourists who stay in hotel accommodations in the region automatically receive public transport pass with their booking. Most such systems are subsidized by a tourist tax (Kurtaxe) and are designed to reduce automobile traffic in touristic areas. The Sauerland region in Germany was one of the first to introduce a guest card system, and today has one of most extensive public transport tourism offers in Germany.

The Sauerland is an approximately 4500 sq. km area in the states of Nordrhein-Westfalen and Hessen which is known for its sparsely populated mountainous landscape and is one of the only places where skiing is possible in northern Germany. The program was initiated by 5 Gemeinde in 1997 which has since increased to 9. Since 2002 the card provides access to most public transport within the area including regional rail services. The introduction of the card increased public transport ridership within the original 5 Gemeinde area from 225,000 to 350,000 users between 1998 and 2003. Despite the growth in ridership the service offer did not need to be increased as tourists typically used the services during off peak hours for commuter traffic.[304] The ticket is financed through the tourist tax which ranges from 2-3 euros a night per guest, of which a portion goes to financing the ticket.[305]

Another well-known example in Germany is the Harz region which introduced the HATIX (Harzer Urlaubs-Ticket) guest card in 2010. The Harz is a mountainous region in former border zone of East and West Germany, the area is popular for hiking, camping and other outdoor activities as well as skiing in the winter. The HATIX allows tourists to use all buses in the Landkreis Harz, as well as trams in Halberstadt. Notably however it does not allow use of either the Harz Narrow Gauge railway, which operates as a hybrid tourist and public transport service, nor the regular mainline regional rail services. The ticket has nonetheless been successful and in just a year after its introduction public transport use rose by 100,000 riders a year. Additionally, several previously unprofitable lines that were slated to be discontinued were able to be retained. The card is financed through a 3 Euro a night tourist tax of which 30 cents goes to financing the HATIX offer (as of 2012).[306]

As with many tourist destinations in countries with high car ownership like Germany many tourists arrive in the Harz by car. If tourists arrive by car, they generally are not informed about the public transport offer nor do they generally seek it out and instead default to driving everywhere with their own automobile. Here the Guestcard is particularly helpful as information is available with the tickets

[303] (OÖNachrichten, 2021)

[304] (ÖPNV-Gästekarten im Tourismus – Ein Beitrag zur Sanften Mobilität in deutschen Tourismusregionen, 2012)

[305] (imsauerland.de, 2021)

[306] (ÖPNV-Gästekarten im Tourismus – Ein Beitrag zur Sanften Mobilität in deutschen Tourismusregionen, 2012)

directly at the hotel. A survey of users of the HATIX offer found that most users found out about the offer only through their hotel.[307]

Table 35: Source of information for HATIX offer and timetable information conducted in 2012. (ÖPNV-Gästekarten im Tourismus – Ein Beitrag zur Sanften Mobilität in deutschen Tourismusregionen, 2012)

	Information source for HATIX	Information source for timetable information
Accommodations	74,0%	40,3%
Internet	13,3%	19,4%
Brochure	11,2%	19,4%
Transit stops	-	46,3%
Tourist Info	-	17,2%
Friend/Acquaintance	14,0%	-

Though conducted in 2012, the results of the survey show the continued importance of the availability of quality offline information at transport stops and at touristic locations, in addition to digital sources. 70% of users would likely have not been aware of the public transport offer at all if it was not for the information provided with the guest card at the hotel.

In the South Tyrolean Vinschgau, previously mentioned in **Error! Reference source not found.**, hotel guests in the area receive the VinschgauCard which is valid for the Vinschgaubahn and the whole public transport network of South Tyrol. Additional discounts on bicycle rental and attractions are also included in the offer. The state of South Tyrol charges a tourist tax based on accommodation type, with the tax for campsites only 85 cents per person, per night up to 1.60 euros for 4–5-star hotels. The offer of the VinschgauCard is done voluntarily by hotels, to participate in the program hotels must charge guests an additional 70 cents tax per night, per person. Of the 70 cents, 50 cents are transferred directly the SAD, the South Tyrol transport organization, the remaining 20 cents goes to Vinschgau Marketing for marketing and coordination activities. As of 2014 the VinschgauCard was offered by 160 accommodations.[308] The card offers significant savings over the cost of the South Tyrol Mobil ticket which costs between 15 euros for one day to 28 for 7 days.[309]

Lower Austria currently has a tourist tax which is set by the NÖ Tourismusgesetzes (Lower Austrian Tourism regulation) of 2010. The tax must be collected by the municipality and varies dependent on the municipality's importance for tourism, which is ranked in 4 classes. The tax varies from 0.50-2.20 euros per night per person, with the state of Lower Austria receiving 65% of this revenue and the Gemeinde 35%. The revenue goes towards promotion of tourism on the state level, and communities can apply for funding for projects that cannot be realized without support from the state. At the request of the community, this tax can be raised up to twice the amount if the community demonstrates that there are special tourist financing needs that require additional revenue. [310] The area of the Wachau falls into the highest tier of touristic destinations, with a 1.50 per night tax, thus an increase of the tourist tax could be similarly used to provide a tourist transport offer. The provision of an included transport card has been proved to increase ridership, would provide a strong incentive for tourists to use the rail and public transport network on their visit.

[307] Ibid

[308] (Bernhart, 2014)

[309] (2021)

[310] (RIS, 2021)

15.14 Incorporation into larger tourism offer and marketing

The NÖVOG offers several package deals for tourists. These offers are listed both on the railway's website and in brochures available on the train, in tourist offices and aboard other NÖVOG railways.[311] In 2021 the NÖVOG offered the following package deals.

- Short Wachau ship/rail tour: Travel by boat from Krems to Spitz and then return by train or vice versa. Several departures offered per day on weekends. 26.00 euros per person with discounts for children.
- Long Wachau ship/rail tour: Travel by boat from Krems to Emmersdorf then return by rail or vice versa. Several departures offered per day on weekends. 39.80 euros per person with discounts for children.
- Long ship/rail tour with entry into the Melk Abbey, itinerary same as previous but entry into the Melk abbey is included in the price. 52.30 euros per person.

Further offers include combined tickets for the railway and the Schallaburg museum, and the Schifffahrtsmuseum in Spitz. The railway also offers a 2-day package trip including hotel stay for 130 per person.

As previously mentioned, the railway also accepts the Lower Austria card which is useable as a day ticket for the railway. These offers provide good value for tourists and should be further developed with the reactivation of the line.

A key component to the uptake of both these tourist offers and the use of the railway for general tourist visits is to provide proper marketing. This is something the Vinschgaubahn does well with the railway featuring prominently on the South Tyrol tourism website. Special promotions should be developed to encourage visitors to leave their cars and use the public transport system for their journey.

In Lower Austria railway tourism is also often promoted through posters inside regular trains and at stations, however most examples seen are for those offers from the VOR. This should be expanded to include offers from the NÖVOG, as passengers already using public transport for their daily needs are prime targets for a public transport-based tourist offer.

[311] (NÖVOG, 2021)

16 Transport Value model for reactivated Wachau Bahn

The transport value has been recalculated for the Krems to Emmersdorf/Weitenegg segment of the Wachaubahn for commuters towards Krems. The commuter offer showed the greatest potential outside of tourism, which could not be properly assessed with available data. Therefore, it will serve as a benchmark for determining the effectiveness of the proposed measures.

The following parameters have been used for the new calculation

- Travel times are based on the timetable developed in FBS which includes crossing times found in section 15.2.1
- Ticket prices will be based on the 1-2-3 ticket pricing model and assume full integration of the Wachaubahn into the VOR. While the nationwide tickets 1-2-3 tickets are to start from October 26th, only Upper Austria has released their regional ticket. The regional ticket in Upper Austria notably does not include the central zones of Linz, Wels and Steyr. It can be assumed therefore that for Krems and St. Pölten there will also be an additional fee. For tickets including urban areas the cost of the ticket increases from 365 euros to 604. Therefore, a base monthly price of 30 euros will be used for trips not touching either of the two urban areas, and a base monthly price of 51.75 for those that do. With the same base assumption of 40 trips per month for commuters, this will mean a price of either 0.75 euros per trip or 1.29 euros. In cases where the original VOR structure costs are less, they will be used for the calculation.
- The catchment area has for Weißenkirchen, Aggsbach and Emmersdorf have been recalculated based on the proposals in section 15.7. Separate stations have been provided at Wösendorf and Joching.
- Introduction of a feeder bus serving Oberloiben and Unterloiben with timed connection at Stein and onward journey to Mautern.

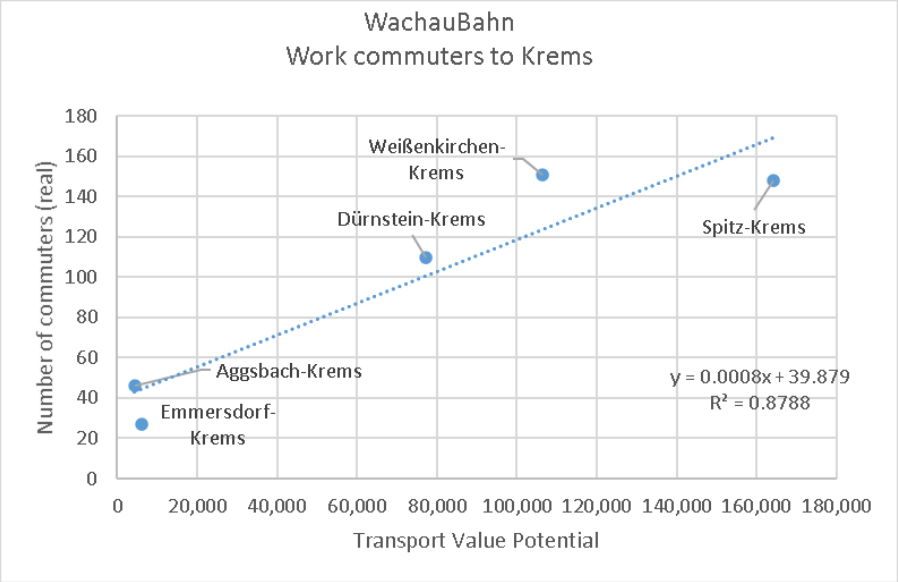

Figure 58: Transport value diagram of the reactivated Wachaubahn for commuters towards Krems.

The result of the measures leads to a transport value that comes very close to, and in the case of Spitz well exceeds that of the current bus offer. The lower value of Weißenkirchen due to the longer walking distances is still problematic, however this cannot be further mitigated due the location of the existing station, nor is moving the station practical.

17 Reconstruction of middle segment of the Donauuferbahn

This segment will look further into the reconstruction of the middle segment of the railway between Weitenegg and Persenbeug. This segment, due to being fully abandoned will require completely different considerations than the in-service segment. As the overall commuting statistics show, there is relatively little demand for commuter traffic along the railway axis, and tourist potential is significantly lower than in the Wachau. Therefore, for a new line the entire function of the line must be adapted to meet current day needs. The reconstruction of the line will be considered in three parts; initial reactivation for freight, local passenger and touristic use and finally directly connecting the railway with St. Pölten to establish regular commuter service.

17.1 Reconstruction of segment Weins to Loja for freight service

The reconstruction of this segment of the line comparatively the easiest part of the project. The right of way is for the most part intact and free of development encroachment. In general, there is political support for the project as it would remove a considerable number of heavy vehicles from driving through the center of Persenbeug and Ybbs. Between Weins and Persenbeug there are two bridges that need to be replaced. The first bridge, a small metal deck span over an irrigation canal can be easily replaced. The second bridge, over Fahrenbach Strasse at approximately KM 56.9 is more complicated. The structure was removed due to low clearance of the road below. It is proposed instead to replace the bridge with a grade crossing, the geometry, based on visual inspection and LIDAR elevation data appears to support this idea.[312] In Persenbeug at least one double ended siding track should be constructed to allow for locomotive run around and potential for additional good unloading. Provisions should be made for loading of timber as well as transhipable containers, such as with InnoFreight or RCA Mobiler system. The existing loading facility in Loja will likely not comply with modern needs. In the 2013 study on the reactivation of the line for freight, Loja stated they planned to demolish the existing silo and replace it with a new transloading facility.[313] In the last years of operation much of the loading was carried out on the main track itself, which was possible due to the lack of passenger traffic. For an initial reactivation loading would be carried out on the former mainline. With the reactivation of the full line, it is proposed to expand the loading to three tracks with two for loading of gravel wagons and one for through passenger service and locomotive run around. Furthermore, a new bridge must be built with appropriate clearances for trucks to the mine, capable of holding at least two tracks.

In general, new track construction should be done with the possibility of regular passenger service in mind, however extensive rehabilitation of the Sarmingstein to Weins segment is not recommended, as this segment has very little passenger potential at the initial stage. Electrification should not be considered at this stage as freight trains will not significantly benefit over a short distance. With the electrification of the Upper Austrian side dual mode locomotives could easily manage the last segment between St. Nikola and Loja, or combined diesel+electric locomotive pairing could be used as in other similar situations (such as on the line to Reutte in Tyrol)[314]. As stated in section 10.3 the reconstruction of this segment could remove 40 trucks per day from the B3 through Persenbeug when only accounting for traffic from the Loja quarry.

[312] (Geoland.at, 2021)

[313] (Knoll, 2014)

[314] Own observation

17.2 Increasing railway catchment zone in the Nibelungengau

The existing bus services in the Nibelungengau has a much greater coverage area than the railway, which misses large parts of the settlements along the line. Therefore, a direct replacement of the current bus services with a rail service with the former line's characteristics could be seen as a worsening of the transport offer. Therefore, it is necessary to increase the stop density of the railway to increase the catchment zone. The following map shows the proposed stations of the rebuilt railway line with the accompanying catchment zone.

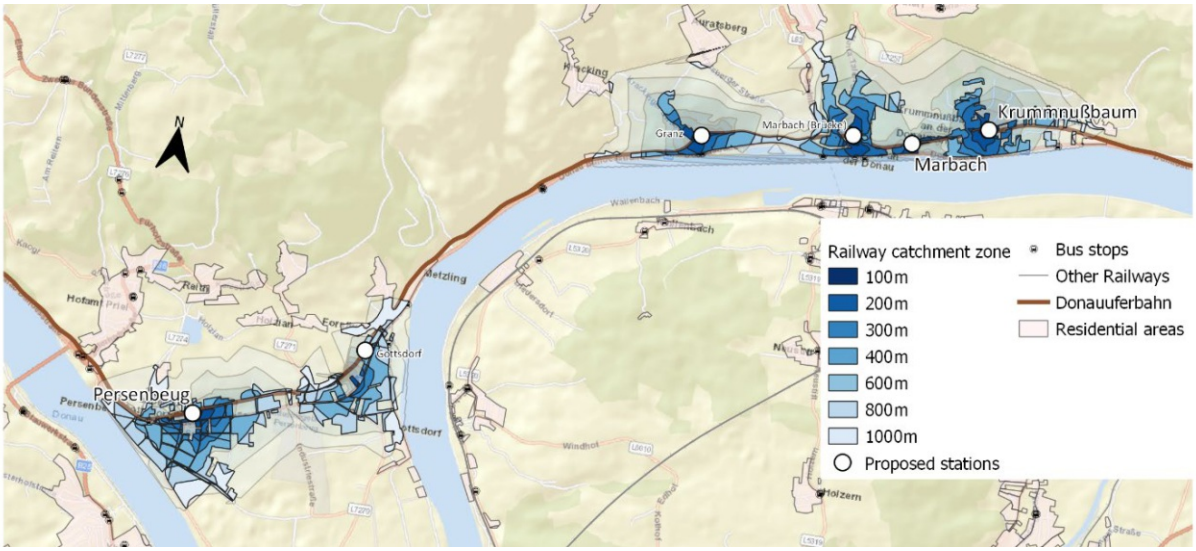

Figure 59: Catchment area of Marbach to Persenbeug with increased station density. Source: Author map

Figure 60: Übelbach Vormarkt station on the Lokalbahn Peggau–Übelbach with short platform. Source: author photo

The new stations could be constructed in a simple manner, with a short 50-meter platforms with a simple waiting shelter. The Peggau–Übelbach line in Styria provides a good precedent for this segment. The line is a historic electric local railway line in Styria owned by the Steiermark Landesbahn. The line is atypical of a branch line and more like an interurban in that it in many places has a stop spacing of less than 1 km allowing it to serve the population spread out through the valley. The service runs with modern Stadler GTW 2/6s which allow for the operation of direct trains to Graz in peak hours. The exact spacing and number of stations however will have to be decided after detailed timetable planning, as the additional stops have a major impact on the timetable.

To maintain the important connections to the south side of the Danube, bus Taktknoten should be established at Persenbeug and Marbach. Both stations have areas suitable for a bus turning loop and platform with the station in Persenbeug still serving as a bus end station. At multiple stations additional walking paths should be developed adjacent to the tracks to fill in gaps in the walking network. The station at Lehen-Ebersdorf is poorly suited to serve both communities with a significant walking

distance to most of Ebersdorf and Lehen sitting at a significantly higher elevation. To reach Lehen it is recommended to install an elevator as there is almost no horizontal distance to be covered, but a 35-meter vertical distance.

The right of way between Loja and Marbach is largely intact, however a steel bridge at Granz was demolished which will be a further cost for the line reactivation. The station land in Marbach will also at least partially need to be repurchased, as will the right of way between the station and the KM 48. The NÖVOG does have the legal right to do so but politically this can be problematic even if the Gemeinde of Marbach is generally supportive.

17.3 Establishment of direct St. Pölten to Persenbeug passenger services

The line in its original function as a Krems – Persenbeug – Grein – St. Valentine through route is poorly aligned with current day transport needs. In the area of the middle segment of the line, St. Pölten, Melk and Ybbs are the primary commuter destinations, so a reconstruction of the line should focus on how to serve these needs. Therefore, it proposed to construct a new railway bridge linking the Donauuferbahn to the Westbahn to enable direct train services to the east. The new bridge would branch off the Donauuferbahn at Lehen- Ebersdorf and then connect to the Westbahn to the west of Melk, before the start of the Wachau buffer zone. Figure 62 shows a conceptual idea for the alignment, which is designed for at least 100 km/h so trains could enter and exit the Westbahn line without reduction in track capacity. To gain the required elevation to cross the river at the needed height for shipping, part of the line will be rebuilt at a higher level. The location was chosen because the railway is here already elevated significantly above its surrounding with a 7.5-meter height difference to the road.[315]

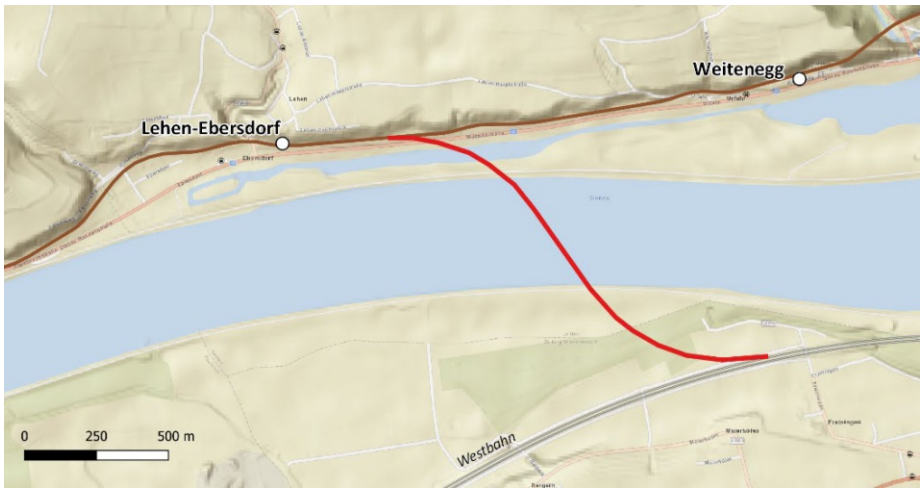

Figure 61: Proposed alignment for connecting bridge across the Danube at Lehen-Ebersdorf. Source: Own map

The provision of direct passenger service from Persenbeug to St. Pölten is the most challenging and costly component of the reactivation but the one that holds the most potential. The measure would allow the entire line to be reactivated. At the present Klein Pöchlarn presents a major issue to the plan as the station area is actively being redeveloped. Although the NÖVOG holds the repurchase rights to the land, politically this will be difficult as Klein Pöchlarn did not have any particular interest in the preservation of the line. Assuming that 6 meters of space have been saved for the reestablishment of the line, then the plan would be theoretically feasible. This change will further allow the bus offer to

[315] (Geoland.at, 2021)

be reduced in the area with buses redirected towards the now much more important railway. Electrification should be carried out on the complete segment to Persenbeug along with the construction of the bridge to allow for more flexible operations. The infrastructure should be designed to also allow freight traffic, both from Loja and in case there is a need to reroute through freight traffic over the line.

The provision of a direct bus connection between Weitenegg and St. Pölten would be an alternative, however the required change would make the connection significantly less attractive and likely fail to attract enough customers to reactivate the railway line. This solution would have been an option for a reactivated line but fails to provide sufficient benefit to justify the full reconstruction of the line.

17.4 Timetabling considerations

Under optimal conditions, trains from the R43 from Krems and trains from St. Pölten (potential designation R51) and vice versa could meet to provide a continuous connection with a cross platform change. However, there is little flexibility for the scheduling of the R43 which must make a timed connection in Krems. Similarly, there are numerous scheduling constraints on the Westbahn which must be worked around. The optimal path for a timed connection is currently occupied by the Vienna – Amstetten CJX 5 service, this train is tied to many timed connections, and thus cannot easily be rescheduled.

Examination of many scenarios in FBS shows two potential solutions to scheduling trains on this segment.

The first solution is to run coupled trains with the CJX 5 between St. Pölten and either Loosdorf or Melk. Melk would be the preferable option to reduce the impact on scheduling, however since its reconstruction around 2010 the stop was converted from a full station to a halt, meaning that there are no longer entry and exit signals, making train splitting here operationally infeasible. However, given the scope of the project it would not be unreasonable to expect that Melk could be reinstated as a station. The splitting of trains on an open line is not optimal, and delays could cause significant ripple effects to the scheduling. In St. Pölten the CJX 5 line has a long dwell time to allow for a Railjet service to overtaken, and therefore there would be sufficient time to couple and decouple trains.

Scenario 1: For this scenario there are two possible variants. To keep the CJX 5 on as close to the same schedule as possible, it would be advantageous to have the Donauuferbahn train arrive at either Melk or Loosdorf first in the eastbound direction, and then depart after the CJX in the westbound direction. In this scenario, trains would have to meet Ebersdorf where the station would be built to handle 3 trains at once. However as there will be significant construction here for the bridge, this could be accomplished in the scope of the project. However, space is still severely constrained here due to surrounding development and a creative station layout would be needed. This solution is also problematic in St. Pölten, where at the eastern end of the station there is little room for shunting maneuvers, especially during the Taktknoten time when many trains are in the station. Therefore, this scenario is likely not realistic.

Scenario 2: Due to the shunting restrictions in St. Pölten the operation of the Donauuferbahn train on the rear of the combined set in the eastbound direction and on the front in the westbound direction is preferred. This will lead to a lengthening of the travel time for the CJX 5 which needs to be rescheduled. However, the impact of this should be manageable with alteration to the schedule of the R57 to in Scheibbs, to which the train is the primary connector. In this case it is even more important to resignal Melk as a full station to allow the train combination and splitting to occur here. In this scenario R51 trains will meet in Klein Pöchlarn where the construction of a crossing loop should be significantly

easier despite the development of new housing. The solution also provides a better-timed connection at Ebersdorf to the R43.

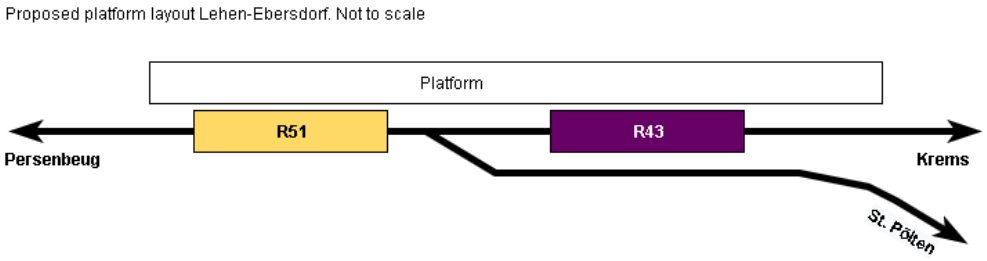

Figure 62: Diagram of proposed layout for Lehen-Ebersdorf station, scenario 2.

Overall scenario 2 is more practical and is the chosen solution for this alternative. The proposed schedule has an acceptable rolling stock utilization with three vehicle sets required, and a comfortable layover and delay recovery time of approximately 20 minutes in Persenbeug. In St. Pölten however trainsets will have to lay over an hour as both CJX trains meet in St. Pölten and performing the required shunting maneuvers during the 10-minute halt is not feasible. Vehicles for this segment must be interoperable with those in use on the CJX 5 line (Siemens Desiro ML). As this segment will be fully electrified the procurement of special alternative power vehicles will not be required.

R51	Eastbound	Westbound
Station	Arrive/Depart	Arrive/Depart
Persenbeug Bahnhof	:14	:48
Gottsdorf *	:17	:45
Granz*	:20	:41
Marbach Brücke*	:22	:40
Marbach Bahnhof	:24	:38
Krummnußbaum West*	:25	:37
Klein-Pöchlarn	:30/31	:29/32
Lehen-Ebersdorf	:34	:25
- R43 from Krems		
- R43 to Krems	:46	
Melk – (Train Splitting)	:36/38	:19/21
Loosdorf	:43	:15
Prinzersdorf	:48	:09
St. Pölten	:55	:05

Figure 63: Proposed schedule for the R51, operating in combination with the CJX 5 from Melk to St. Pölten. Calculated using FBS.

**Request stop*

The second possibility, which is easier from the scheduling perspective is the adaptation of the existing R52 line to Pöchlarn, this line could simply be adapted such that the final stop in Pöchlarn eliminated in favor of serving towns on the Donauuferbahn. The R53 does not have any interval schedule duties

in Pöchlarn and thus could be rerouted without major disruption. A Stadtbus between Pöchlarn and Klein Pöchlarn could be further established to reduce the impact on travelers to Pöchlarn. The scheduling with this option does not allow for a convenient timed connection with the R43, therefore the opportunity for regular through service is lost. To close the gap some trains could operate directly from Krems to Persenbeug, primarily during weekends and the tourist season.

The operation in combination with the CJX 5 offers the greatest benefits by allowing through service with few extra train kilometers versus ending most trains in Weitenegg or Emmersdorf. The connection of the Donauuferbahn with the Westbahn would however be a long-term, large-scale project that could warrant a large-scale schedule adjustment; indeed, the existing schedules could be completely altered by the time such a project is completed. Therefore, it is reasonable to expect that if such a project is carried out smaller issues such as the resignalling of Melk into a full station could be resolved.

17.5 Improving connectivity Ybbs-Persenbeug

Prior to 1958 a roll-on roll-off ferry existed directly between the town centers of Persenbeug and Ybbs. This was replaced with a fixed connection with the opening of the Ybbs hydropower plant and associated road.[316] This connection is located significantly upstream of both town centers and is primarily useful motorized traffic. The change reduced mobility for those commuting on foot or bike. The development further drove motorization in the area and reduced the viability of the railway. Furthermore, in this time the tramway connecting Ybbs, and its distant train station was also abandoned and replaced by buses.

As shown in the transport statistics there is a significant demand from towns on the northern bank of the river towards Ybbs. Thus, improving the connection to Ybbs for non-motorized traffic and public transit is important to the viability of the middle segment of the line.

While a direct railway connection would be optimal as it would allow for trains to continue directly on towards Amstetten and other relevant centers, the parameters for the construction of a rail bridge here are very poor. The areas along the line are heavily built up around Persenbeug, and as such the construction of a bridge in the town itself would require acquisition and demolition of structures. Crossing the river north of the Ybbs dam could be possible but with a longer travel time. On the southern side of the river there is an existing, though partially abandoned rail spur built to serve the dam. The line traverses the waterfront of Ybbs and could be an attractive option if implemented in a tram like fashion. However, the alignment has many disadvantages, north of the dam there is a significant harbor facility and as such the bridge would need to be built north of this as space would be needed to return to track level. The longer alignment is unlikely to provide a time saving compared to buses, especially with the restrictive track parameters. The alignment would not be flood proof whereas the existing road alignment is. Lastly, the southern portion of the alignment is an active freight spur, to which frequent passenger rail operations would be disruptive.

[316] (Besucherkraftwerk, 2021)

Figure 64: Potential alignment for a direct rail connection to Ybbs and bridge for non-motorized transport Source: Author drawing, Google Earth

The least intrusive way to improve the connection would be to reintroduce a ferry for non-motorized traffic, however the measure would have high operating costs and may not be sufficiently attractive.

A shorter fixed link would provide the most benefit as it would provide a constant link between the towns, permanently increasing connectivity between them. Due to the topography and space constraints, a bridge capable of handling even buses would be very difficult to build considering that at least an 8–9-meter clearance is required.[317] A pedestrian and bicycle bridge would however be relatively simple to erect with spiral ramps and elevators to gain elevation. With the construction of the bridge there is always the concern of visual impacts, however if well designed the bridge could be viewed as an addition to the city's appearance rather than a detraction. The character of the river is already significantly impacted by the Ybbs power station and there are no UNESCO concerns that apply to this segment. With the bridge, the total walking or biking distance would be a little over 1 km between the train station and town center of Ybbs. However, the bridge could also have extended local importance with the improvement of cycle infrastructure throughout the Ybbs Gemeinde, especially towards the railway station.

17.5.1 Reorganization of transport concept in region

With the increased coverage of the railway the bus offer needs to be adjusted to reduce parallel traffic as much as possible. While more difficult than on the segment from Krems to Emmersdorf, significant reduction in bus kilometers can still be achieved.

Bus 785: This line operates parallel to the railway between Persenbeug and Klein Pöchlarn with connections to Pöchlarn and Ybbs on either side. This line should be eliminated to avoid parallel traffic, its function for connecting to the south side of the river can be eliminated by timing other buses to meet the train at Persenbeug and Klein Pöchlarn. In Ybbs the buses functions can be replaced by additional courses of the city bus

Bus 788: Bus 788 operates a varied course starting at Pöchlarn towards the Waldviertel highlands with various destinations. The line does not operate in parallel traffic; however, it should be oriented, if possible, to allow for a connection between a transfer in Klein Pöchlarn for commuters continuing to Melk.

[317] (Interreg, 2021)

Bus 791: Bus 791 operates from Melk to Pöggstall via Klein Pöchlarn. The bus should be eliminated between Melk and Klein Pöchlarn and timed with the train at Klein Pöchlarn.

Ybbs CityBus 4: The Ybbs city bus 4 provides a frequent link between Persenbeug and Ybbs (including the Westbahn station). The bus should be timed to meet the train in Persenbeug as it would be the easiest schedule to adjust.

Bus 781: The bus 781 operates between Yspertal and Ybbs via Weins, an additional stop should be added at Persenbeug station to allow for the possibility to connect with rail services.

The Next Bike system should be expanded in the Nibelungengau. In Persenbeug, the extension of the service along with the new bridge could greatly help increase accessibility between the two sides of the river. Bike rental should be provided at the stations in Marbach, Persenbeug, with further rental stations throughout both Persenbeug and Ybbs.

17.6 Operational concepts for passenger service St. Nikola-Struden - Persenbeug

Between Persenbeug and St. Nikola Struden the river valley is sparsely populated, and thus there is very little potential in commuter traffic. Further, the settlements that do exist are well served by buses that continue further into the uplands. The greatest potential for this segment is bike tourist traffic. The operation of a through running bike train could be considered, potentially with the extension up to Passau if funding could be restored from the federal government. If the line is connected directly to Melk, a few peak hour trains starting in Weins could provide an attractive connection for commuters. A further idea is to include the Donauuferbahn in an Austria wide cruise train concept as was planned in the early 2000's. The cruise train could be marketed to groups that now use buses to travel between cities which could provide relief for towns and cities faced with an excess of tour bus traffic. A potential itinerary could be as follows:

- Munich airport to Salzburg (direct train will be possible with new Erdinger Ringschluss)
- Salzburg to Hallstatt, with onward journey to the Wachau via Steinach-Irding, Selzthal, Klein Reifling and St. Valentine
- Wachau to Vienna
- Vienna to Graz via Semmering mountain line.

The operation of such a train would however require the maintenance of the entire segment between St. Nikola and Persenbeug to passenger train standards, however as the trains would operate as special trains outside of a PSO, the line could still operate as an Anschlussbahn and upgrading to a full railway would not be necessary.

17.7 Transport value analysis for reconstructed line

The transport value for the reconstructed line was calculated considering the measures mentioned in the previous subsections with the same premise of 1-2-3 pricing used. The catchment area was recalculated for the stations of Persenbeug, Marbach and Lehen after modification of the street network as mentioned in section 17.2. In Persenbeug through the creation of dedicated paths away from the main B3 road the favorable weighting factors can now be used, as there is now an alternative to walking along the B3 for most access trips.

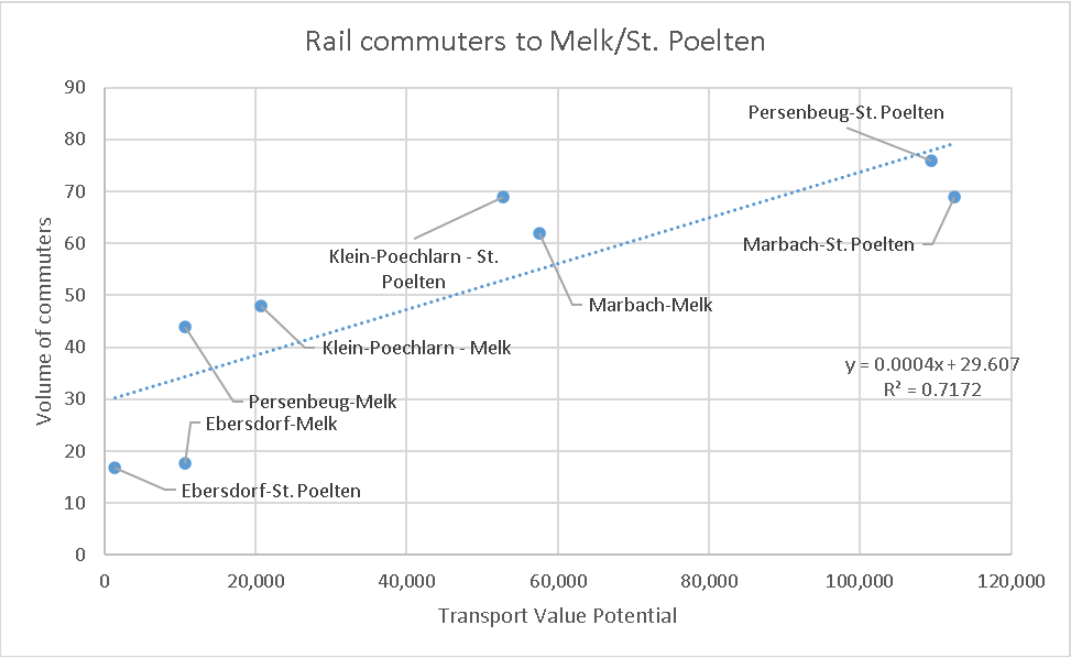

Figure 65:Figure 70: Transport value diagram for the reconstructed middle segment of the Donauuferbahn towards Melk and St. Pölten.

The result shows a promising situation for trips from Marbach and Persenbeug towards St. Pölten with transport values far exceeding that of the present bus offer. The combination of the dense stop spacing within the Nibelungengau and the fast connection to the Westbahn would provide a highly attractive public transportation option for the region.

18 Final transport concept

The final operational proposal is the introduction of a “Donau Dreieck” with trains operating in a triangle converging in St. Pölten. The triangle would consist of two lines: The R43 would operate from Klein Pöchlarn to Krems with trains then continuing to St. Pölten as an REX44 express services. The R51 would operate as a direct Persenbeug to St. Pölten service, running coupled with the CJX5 between Melk and St. Pölten.

In general, an overall speed limit of 75 km/h is proposed. The ÖBB upgraded the entire line to this speed in the 1970s and thus it should be achievable to operate at such speeds again. This will give the railway a distinct advantage compared to bus transport in the region. To achieve these speeds many crossings will need to be closed as described in segment 15.8. For the newly reconstructed line between Melk and Persenbeug a speed limit of 90 km/h in areas with significant distances between stops is proposed. As the line must be fully relaid there is the possibility to straighten curves in some areas that restrict speed. The line between Persenbeug and St. Nikola-Struden has not considered for the reactivation of regular passenger traffic. The stations at Weins and Sarmingstein are well served by buses on routes that extend further into the uplands, and in Weins the station location loation makes the railway unattractive. This segment will be used for freight with the possibility of weekend tourist passenger service.

Figure 66: Donau Dreieck transport concept map. Rail lines and timed bus connections. Author diagram

18.1 Breakdown of measures and costs

For the reactivation of the Wachaubahn for regular service and the reconstruction of the line segment from Weitenegg to Persenbeug a variety of infrastructure measures are needed. This section will provide an overview of necessary measures and the approximate costs. These measures do not include non-construction costs such as required feasibility and environmental impact studies, only those costs directly related to infrastructure.

The cost of repurchasing land that has been sold has also been omitted. There are many unforeseen costs that come with the construction or reactivation of a railway, especially in the case of the Donauuferbahn with its many tunnels and rock walls which cannot be accurately predicted without a detailed engineering survey. In a study from 2014 in context to the reactivation of the railway line

estimated maintenance costs of 175,000 per year for the tunnels.[318] However, these values can no longer be considered as a good approximation as the tunnels have now been unmaintained for over a decade and the general price of construction has increased. Therefore, a calculation of the cost for tunnel rehabilitation has been omitted.

For other construction measures the costs were estimated based on Deutsche Bahn Infrastructure Kostenkennwertekatalog (Cost value catalogue) from 2016. While there are some differences in costs between Austria and Germany, the conditions can be considered similar enough that the German catalogue can be used for a high-level cost estimation. The increase in construction costs since 2016 dynamized to the current cost level with a cost increase of 16% between 2016 und 2022.[319] The following item costs have been used for the cost estimation:

Table 36: Costs for infrastructure elements

Item	Units	Cost
Track Upper structure	Meter	€ 551
Switches (EW 190)	Item	€ 23,200
Switches (EW 2500)	Item	€ 69,600
Platform construction	Meter²	€ 360
Passenger underpass	Meter²	€ 15,080
Vollrahmen bridge 2-5 meter	Item	€ 533,194
Halbrahmen bridge 5-10 meter	Item	€ 530,816
Trough bridge (Trogbrücke)	Item	€ 808,126
Long span concrete bridge	Meter²	€ 2,680
Crossing light signal - train activated	Item	€ 32,480
Electrification (line)	Meter	€ 261
Electrification (in station)	Item	€ 58,000

The costs for bridges vary by specific type with several different options listed in the catalogue, with the cost given generally as a lump sum. The most appropriate bridge for each specific condition will be listed. For spans between 2-5 meters, the cost for a full frame (Vollrahmen) concrete bridge have been applied. For those between 5-10 meters the cost for a concrete half frame (Halbrahmen) has been used. For the remainder of the bridges which have a longer span (up to 25 meters), the costs for a steel trough bridge have been applied. The bridge designs chosen are consistent with those used for the late 1990s era rehabilitation of parts of the line. For the new Danube bridge the costs given for the construction of long span concrete bridges has been halved as the given price is for a double track construction. The following cost estimates should only be used as a minimum cost indication, many smaller item costs have been omitted and there are certain to be further unforeseen expenses.

[318] (Knoll, 2013)

[319] (Statistisches Bundesamt (Destatis), 2021)

Wachaubahn Krems to Weitenegg

The construction of barrier free platforms is the primary expense for the reactivation of the Krems-Emmersdorf segment. Additional costs may be required to comply with new railway requirements in order to upgrade the railway from a Anschlussbahn back to a full railway. The costs for various attractivity measures at each station and the redevelopment of the Weitenegg station has not been considered. The costs for the attractivity measures of the Weitenegg Station were approximated at 150-300,000 euros in the 2014 study for touristic potential.[320] The segment between Emmersdorf and Weitenegg will also require rehabilitation work for reactivation of regular service. In 2014 the costs for this segment were estimated to be in 815,000 euros for the immediate horizon with a further 515,000 euros in the 5–10-year horizon. It is unclear how much of this rehabilitation work has been carried out as part of the reactivation of the segment for construction trains. The costs for this segment have therefore not been calculated, nor has that for rehabilitation and maintenance of civil structures and track between Krems and Emmersdorf.

Table 37: Costs for the reactivation of the Krems-Weitenegg Wachaubahn.

Infrastructure item	Quantity	Cost
New Station platforms (80 x 2.5 m)	7	€ 503,440
EK signals	11	€ 357,280
Pedestrian underpasses	2	€ 271,440
Sum		**€ 1,132,160**
Electrification (m)	34500	€ 9,004,500
Station Electrification	2	€ 116,000
Sum with electrification		**€ 11,384,820**

Weins – Loja

For the reactivation of the line between Weins and Loja only for freight, the following measures have been considered. Specific measures for passenger traffic are not included. In this scenario the demolished bridge at Loja will not be replaced as this will add over a million to the construction costs. The costs include a double ended siding in Persenbeug and a single ended one in Loja.

Table 38: Infrastructure costs for the reconstruction of the Weins to Loja segment

Infrastructure item	Quantity	Cost
Mainline track (m)	6819	€ 3,757,269
Siding Persenbeug (m)	500	€ 275,500
Turnouts	3	€ 290,580
Sidings Loja (m)	500	€ 275,500
Crossing signals	7	€ 227,360
Culvert Weins	1	€ 53,319
Total sum		**€ 4,879,528**

[320] (Knoll, 2013)

Loja to Weitenegg

The costs for this segment include the reconstruction of the line between Loja and Weitenegg as well as measures necessary for the reintroduction of passenger service between Loja and Persenbeug. The electrification of the line is considered in this segment of the assessment. The costs include the reconstruction of one crossing loop at Klein Pöchlarn and Marbach.

Table 39: Infrastructure costs for the reconstruction of the Loja to Weitenegg segment

Infrastructure item	Quantity	Cost
Mainline track (m)	13,781	€ 7,593,331
Siding Marbach	150	€ 82,650
Siding Klein-Pöchlarn	150	€ 82,650
Switches	5	€ 96,860
New Station platforms (60 x 2.5 m)	8	€ 431,520
Bridge Loja - 2 tracks, 15 meters.	2	€ 1,616,251
Bridge Granz (50m)	1	€ 808,126
Bridge KM 57	1	€ 530,816
EK signals	9	€ 292,320
Electrification (m)	14,081	€ 3,675,141
Station Electrification	2	€ 116,000
Sum		**€ 15,325,665**

Klein Pöchlarn to Melk

This segment includes the cost for the reconstruction of Lehen station to accommodate two trains at once and the cost of the new Danube River bridge. The cost for signaling adjustments to the station at Melk, as well as signaling for the junction with the Westbahn are not included. These costs can vary significantly depending on the details of the specific signal system. As can be seen from this figure the cost for the new connection exceeds the entire construction cost for the segment from Weitenegg to Loja. The cost of the bridge is likely too low, there are location specific costs that cannot be easily approximated. With large infrastructure projects there is a high risk of cost escalation.

Table 40: Infrastructure costs for the new Danube River bridge between Lehen and Melk

Infrastructure item	Quantity	Cost
Track	1,530	€ 843,030
Switches	1	€ 23,200
Switch (high speed)	2	€ 139,200
New Danube bridge (m)	780	€ 14,630,616
Extension platforms Lehen-Ebersdorf (m)	76	€ 27,330
Electrification	1,530	€ 399,330
Total sum		**€ 16,062,706**

18.2 Operating costs for full transport concept

The operating costs for the full transportation plan are based on the timetable proposal found in chapters 15.2.1 and 17.4. The number of courses per day have been estimated based on the current bus schedules of the 715, considering an hourly interval between 05:00 and 22:00 with additional short courses from Spitz in the morning. On weekends, operating hours between 07:00 and 22:00 are considered. Operation with battery electric trains has been considered for the Wachaubahn. There have been relatively few orders for battery powered vehicles due to it being an emerging technology, and true costs are often difficult to determine due to manufacturers including maintenance contracts in the price. A study shows that the average cost is about 5.5-6.5 million euros per vehicle, approximately a million more than an equivalent diesel or electric MU.[321] The vehicles proposed will be relatively low capacity 2-3 segment vehicles, therefore an optimistic price of 5.5 million will be used for the operating cost calculation.[322]

For the middle segment up to Persenbeug the reactivation plan includes full electrification, therefore for the operation of this segment standard EMU's, presumably Siemens Desiro ML two segment vehicles, will be used. Per the BVWP study previously cited in Chapter 12 the cost for an EMU with low capacity (120 seats) is 3.6 million euros, 3.9 million when adjusted for inflation.[323]

To maintain the desired schedule of the R43 line a total of four battery electric vehicles will be needed. An additional vehicle will be acquired as a spare and to increase capacity during tourist season.

For the segment from St. Pölten to Persenbeug, a total of three vehicles will be needed, it is proposed here to draft an agreement with the ÖBB to utilize the spare stock pool from the railway to cover shortages. Regarding the operating kilometers per year, the number of vehicles needed is high, but this is needed to maintain the Taktfahrplan. Given that the track speed has already been raised to 75 km/h in most segments, a reduction of the number of vehicles while maintaining the Taktfahrplan is unlikely.

The acquisition cost for rolling stock combined is estimated at approximately 35.3 million euros. The operating costs per kilometer are calculated using the same methods as for the existing scenario. The railway would operate 365 days a year with different timetables on weekends and weekdays.

For maintenance costs a value of .40 cents per kilometer based on the BVWP study will be used.[324] The same labor costs for the train driver will be used. The trains will no longer need a train attendant, with tickets sold either at station vending machines or through onboard ticket machines.

For electric traction, the BVWP study states an energy consumption of 2.3 kWh per vehicle kilometer. In Austria the price for energy averaged 13 cents per kw/h for industrial customers which will be used for the calculation.[325] A special energy usage rate of 40 extra kWh's per operating hour has been used, with the assumption of 16 hours of use per vehicle. The same multiplication factor of 1.3 has been applied as well to compensate for extra acceleration and deceleration needed. For the segment between Melk and Persenbeug this has been increased to 1.7 taking into account the increased stop density.

[321] (NOW GmbH, 2020)

[322] (NOW GmbH, 2020)

[323] (O'Neill, 2021)

[324] (BMVDI, 2015)

[325] (BMK, 2020)

For the segments of the route operated on the public infrastructure of the ÖBB, a track access fee of 2.028 cents per km will be used between Krems and St. Pölten, and a 2.146 between St. Pölten and Melk.[326] Table 40 provides a summary of the costs per kilometer in the specific cost groups:

Table 41: Costs per kilometer for electric and battery vehicles.

Item	NÖVOG Infrastructure (electric)	NÖVOG Infrastructure (battery)
Vehicle costs	€ 1.39	€ 2.71
Personnel	€ 1.41	€ 1.41
Energy	€ 1.60	€ 1.60
Maintenance	€ 0.40	€ 0.40
Overhead	€ 0.48	€ 0.61
Cleaning	€ 0.50	€ 0.50
Sum	€ 5.78	€ 7.23
Sum with TAC	€ 7.92	€ 9.26

Based on the timetable and listed cost structure per kilometer, the total operation costs to serve all lines amount to approximately 9.2 million euros per year. Of these costs the Wachaubahn alone has a calculated operating cost of approximately 3 million, or approximately double that required for the current bus offer.

Table 42: Sum of operating costs for complete transport concept

Line	Trip	KM Per trip	Cost per KM	Cost Trip	Trip Day (Veh)	Trip Day (Tot)	Op Day Yr.	KM Year	Yr. Cost
R43 weekdays	Krems-Ebersdorf	40.106	€ 6.06	€242.94	8	33	261	345,433	€ 2,092,409
R43 weekends	Krems-Ebersdorf	40.106	€ 6.06	€242.94	8	33	104	137,644	€ 833,757
R43 weekends	Spitz-Krems	18.056	€ 6.06	€109.37	2	4	261	18,850	€ 114,184
REX 44 (week)	Krems St. Pölten	30.186	€ 8.09	€244.06	8	33	261	259,992	€ 2,102,127
REX 44 (weekend)	Krems St. Pölten	30.186	€ 8.09	€244.06	8	33	104	103,598	€ 837,629
R51 Week	St. Pölten - Melk Abz.	27.1	€ 6.90	€187.12	11	34	261	240,485	€ 1,660,473
R51 Weekend	St. Pölten - Melk Abz.	27.1	€ 6.90	€187.12	10	31	104	87,370	€ 603,264
R51 Week	Melk Abz. - Persenbeug	16.9	€ 4.76	€80.42	11	34	261	149,971	€ 713,661
R51 Weekend	Melk Abz. - Persenbeug	16.9	€ 4.76	€80.42	10	31	104	54,486	€ 259,279
Sum								**1,397,830**	**€ 9,216,784**

[326] (OEBB, 2020)

19 Summary and conclusions

The contraction of the Austrian branch line network is a complex issue with many factors leading to the networks decline. The branch line network has a diverse range of geography, settlement structure and line characteristics, and thus it is impossible to make an overall statement regarding the reasons for the networks decline. Lower Austria in many places is a very sparsely populated state, with the combined influence of the automobile and increased migration to cities, there were branch lines that simply could not succeed due to the settlement structure. However, this alone is not a fully explanation for the networks decline, one must only look one state over to Upper Austria with a similar geography and settlement trends for a comparison.

The issue of the settlement structure was however in many cases compounded by the physical characteristics of the railway lines. Branch lines were generally built with a low budget due to their low projected income, and therefore the alignment was poorly suited to serve the towns of the area. The alignments often followed the topography and thus lead to curving lines with low-speed limits and indirect alignments.

As with most issues with transportation policy, the ultimate downfall of the branch line railways was the mass motorization that started in the 1950s and continues nearly unabated today. In the postwar years thousands of kilometers of new roads and highways were built, and automobile ownership grew dramatically. However, almost no notable investments were made in the branch line railways, and the ÖBB declared a full investment halt in the late 1960s. Rural residents then had the choice of personal automobiles on new fast roads, or branch lines constantly worsening travel times, poor timetables and outdated equipment. It is therefore little wonder that the railways ridership massively declined in this era.

The ÖBB themselves have significant blame in the situation. Due to the often-high operating costs of the branch line railways, the federal railway viewed the lines as a lost cause and sought instead to replace their trains with their own buses operating parallel to the railway. The buses, which could use the new streets and drive directly into town centers took much of what remained of railway patronage on the branch lines. The final contraction of the branch lines was a long, drawn-out political battle, but at best for most lines it was a delayed stay on their final fate. The introduction of the Verkehrsverbund strategy and the subsequent reduction in parallel traffic came to late or not at all, in many cases the damage had already been done. 2010 marked the end of much of the branch line railway network in Lower Austria, and the transport policy of the state shows no sign of reversal with still further lines closed in 2019. The issue of branch lines is an exceedingly local one, and there is little political interest at the federal and even the state level for maintaining these lines. The experience of the Lower Austrian branch lines shows that where there was significant local support, rail lines often survived, without it the lines were abandoned. The railways in many areas developed such a poor reputation that the local populace did not care when the lines were closed, and the opinion of outside transport experts can do little to change that, especially in an environment where the government itself is not interested in the development of public transport.

Undoing the damage of a half century of car-oriented transport policy is not something that can be easily reversed. It will require a major change in policy on many levels.

Looking to the future, some immediate changes to the railway act would allow for closed railway lines to be more easily preserved for reactivation. The first would be a change to the abandonment procedures to be more in line with those found in Germany. It should be legally possible to leave a railway line in situ, retaining its legal right as a railway. Once this legal right is lost then reconstruction becomes nearly as difficult as a new construction. Further, the establishment of a national holding of

closed railway right of ways would allow the right of ways to be preserved for future use and prevent right of ways from being sold off piecemeal to private owners.

19.1 Specific conclusions for the Donauuferbahn

In comparison to many branch lines, the Donauuferbahn did not suffer as much as many lines from the mismanagement that was typically of Lower Austrian branch lines. The line had different characteristics to most, with a through running configuration and was for much of its existence a vital diversion route. The line was one of the first to be upgraded with cost saving measures like Zugleitbetrieb, and services were carried out with modern (at the time) railcars. Geographically the eastern segment of the line is well aligned with the transport needs of the area, and due to the geography, the railway line is well placed within towns, with good access condition to stations. Parallel bus service was historically minimal in compared to the railway offer, and the placement of the bus stations vs the railway did not provide many benefits. However, the line due to its many tunnels, bridges and the unstable geology along the railway line made it a maintenance headache for the railways. Towards the lines end the railway only had significant traffic between Krems and Spitz, thus the line was only of regional importance. The decision to divest of the line was a combination of these high maintenance costs, combined with the line falling outside of the ÖBBs new focus of intercity and suburban passenger transport.

The eastern segment of the line still has a strong potential to again play an integral role once again in the regional transport network. Between Krems and Weitenegg the line could be reactivated relatively easily; the infrastructure is in good condition after rehabilitation work carried out by the NÖVOG. However, due to the lines downgrade to a connecting railway, significant work would be needed to bring the line up to all modern requirements. Many of these requirements, such as barrier free access are however also a necessity for making the line attractive in a modern context. The segment from Krems to Weitenegg can be successfully reactivated for regular traffic if attractivity measures are carried out and parallel bus services are ended. The Transport Value analysis shows that with an hourly service the line can be competitive with private car traffic in this segment. The list of good practices from the Vinschgaubahn and other successful branch lines in tourist areas illustrate how the line could be made attractive to both tourists and regular commuters.

The middle segment of the Donauuferbahn presents a much greater issue. Due to the settlement structure and geography the line segment always had lower ridership, with most traffic going south of the river. The railway thus in this segment was historically neglected with little investment for many decades and the service offer was gradually decreased. The abandonment and subsequent removal of the line has further compounded the issue of reviving this segment of the line as a viable transport route. While the NÖVOG still retains a legal right to repurchase the right of way for rail service, the political realities of having to build a railway through an area that has been otherwise repurposed is a very difficult hurdle to overcome. Significant pieces of the right of way such as in Klein Pöchlarn are already in the process of being redeveloped. For this segment to be fully reconstructed there will have to be a major change in Lower Austrian transportation policy.

The reconstruction of the line will require a new concession and therefore a guaranteed demand for service. For the segment between the Upper Austrian border and Loja there still exists significant demand for freight service and customers that are interested in using rail service. These measures would be the simplest to implement as operation can be done within the existing Anschlussbahn framework. The reconstruction would also open the door to season tourist trains on the segment up to Persenbeug.

For the implementation of regular passenger service, the line must be reoriented towards the actual commuter destinations of the area. Along the middle segment there is a strong flow of commuters towards Melk and St. Pölten. To attractively reach these destinations new infrastructure is required to directly connect the railway to the Westbahn on the south side of the river. Given that the reconstruction of the railway is now a very much long-term project due to its abandonment, integration of this step should be considered for the line's reactivation. Furthermore, the railway must be better aligned with the settlement structure in the area between Persenbeug to Marbach to increase its catchment area and provide a full replacement for bus transport. With these improvements the railway can serve as an effective competitor to individual transport.

The following is a summary of the findings of this report.

Realistic, short-term measures:

The reactivation of the line between Krems and Emmersdorf for regular service, with touristic service up to Weitenegg is a practical measure that can be realistically implemented. For weekday traffic an hourly schedule up to Spitz should be provided with some trains extending beyond to Emmersdorf. For all trains there should be a timed bus connection in either Spitz or Emmersdorf for onward travel to Melk. The primary measures needed for a full reactivation of this segment is the construction of barrier free platforms and the procurement of new vehicles to enable hourly operation. For the segment between Emmersdorf and Weitenegg further rehabilitation to the track structure and reconstruction of the station in Weitenegg.

Medium term measures

The western end of the line between Weins and Loja has significant potential in freight traffic for both the Loja quarry and timber loading in Persenbeug. The reactivation of this segment would allow for the development of an additional tourist offer up to Persenbeug. The right of way in this segment is largely intact, and the reconstruction of the line would require minimal new civil structures. The railway could continue to be operated as currently designated as an Anschlussbahn, allowing both freight and tourist passenger service.

Long term measures

The Donauuferbahn between Emmersdorf and Persenbeug is not aligned with the current commute patterns, and thus a simple reconstruction of the old alignment has minimal potential, especially with the reduced tourism potential of this segment. Therefore, a new connection with the Westbahn is needed to provide a direct and attractive route to the main centers of the region. The construction of such a link would be expensive, and realistically not politically feasible under the current Lower Austrian politics. However as shown in the modelling the railway could have significant potential given the good alignment between the population spread and railway in this segment.

The closure of the Donauuferbahn and other branch line railway was largely a political decision, and their reactivation must be one as well. As national rail carriers throughout Europe increasingly concentrate on the high value markets, the future of branch line railways lie with developing local solutions. Where branch line railways have been successfully revitalized, it has been done with strong support from the local community. Successful railway reactivations must be part of a comprehensive local transportation strategy and not treated as stand-alone projects. The Donauuferbahn has the right characteristics to become a similar success story, however there must be a major shift in Lower Austrian transportation policy if this is to become a reality.

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Annex 1: Tables

Annex 5.4: Text of the Nebenbahnverordnung

§ 1. The ÖBB must fulfill public service obligations until December 31, 2001 on the following branch lines and line segments, for which the relevant traffic volumes in 1985 are shown:

a.) Provision of freight and passenger services

Route/Route segment	**Passengers in 1000's**	**Freight in 1000 t**	**Length in kilometers**	**Losses per cost basis**	**Losses per invoices**
				In million schillings	
Arnoldstein-Kotschach-Mauthen	565	29	62	54,5	38,8
Schwarzenau-Zwettl	80	59	22	19,4	14,5
Schwarzenau-Waidhofen a.d. Thaya	172	36	10	7,8	5,8
Sigmundsherberg-Hadersdorf a. Kamp	330	66	45	62,1	45,7
Retz-Drosendorf	130	139	41	35,2	26,5
Laa a.d. Thaya-Laa a.d. Thaya Stadt	30	61	2	4,2	2,8
Siebenbrunn- Leopoldsdf.-Engelhartstetten	111	32	23	19.4	14.7
Abzweigung Wien Aspanbahnhof - Wolfsthal	1748	1672	55	96,7	57,6
Wien ZVBf-Felixdorf (Innere Aspangbahn)	120	412	37	48.4	36.4
Wr. Neustadt-Friedberg	1095	276	55	112.0	79.2
Wr. Neustadt-Puchberg a. Schneeberg	571	14th	28	43.7	34.9
Puchberg a. Schneeberg Hochschneeberg	110	0.2	9	25.7	21.9
Wöllersdorf - Bad Fischau-Brunn	239	2.4	5	9.2	7.4
Wittmannsdorf - Gutenstein	270	236	34	36.9	26.9
St. Aegyd a. - Neuwald-Traisen	247	26	30	31.9	24.7
St. Pölten Schwarzenbach a.d. Pielach	511	55	39	79.5	70.5
Krems a.d. Donau - Herzogenburg	586	38	20th	51.9	39.6
Pöchlarn-Kienberg- Gaming	287	64	38	41.3	30.4
Krems a. D - Mauthausen	**477**	**172**	**112**	**153.7**	**115.3**
Linz-Urfahr-Aigen-Schlagl	205	63	58	59.2	43.3
Rohr-Bad Hall	26	8	4	7.2	5.6
Haiding-Aschach a.d . Donau	71	145	22	16.3	11.3
Steindorf bei Strasswalchen-Braunau a. Inn	427	51	40	58.3	53.0
St. Wolfgang- Schafberg Bf-Schafbergspitze	230	0.05	6th	12.8	13, 8
Zell am See-Krimml	237	18	54	55.3	47.5
Spielfeld-Strass-Bad Radkersburg	114	48	31	26.1	20.6
Innsbruck Westbf-Scharnitz	711	148	33	78.2	59.8
Total	**9,700**	**3857**	**889**	**967**	**743**

Total Lower Austria	**6,117**	**3,263**	**511**	**533**	**399**

b.) Provision of passenger service (Lines in Lower Austria in grey.)

Route/Route segment	**Passengers in 1000s**	**Length in kilometers**	**Losses per cost basis**	**Losses per invoices**
			In Million Schillings	
Schwarzenbach a.d. Pielach-Mariazell (760 mm)	290	45	70,5	62,5

c.) Provision of freight transport (lines in Lower Austria in grey)

Route/Route segment	**Freight in thousands of tons**	**Length in kilometers**	**Losses per cost basis**	**Losses per invoices**
			In Million Schillings	
Friedberg-Oberwart	42	26	12.2	9.3
Huttenberg-Launsdorf-Hochosterwitz	339	30	16.7	11.2
Weizelsdorf-Ferlach	47	6	5.1	3.5
Zwettl-Martinsberg-Gutenbrunn	144	36	17.0	11.0
Gmund-GroB Gerungs (760 mm)	23	43	21.6	18.6
Gmund-Litschau (760 mm)	21	25	17.7	13, 6
Waldkirchen a.d. Thaya-Waidhofen a.d. Thaya	33	21	6.5	2.1
Gopfritz-Raabs	37	21	7.5	6.0
Laa ad Thaya - Stadt Zellerndorf	199	36	12.7	8.9
Poysdorf-Dobermannsdorf	46	19	7.6	5.4
Mistelbach LB-Hohenau	70	28	25.4	24.3
Korneuburg-Mistelbach LB	80	49	14.6	11.3
Breitenstetten-Orth a.d. Donau	15	6	2.9	1.9
Abzweig Fischamend-Mannersdorf	335	19	21.3	17.5
Ober Grafendorf-Gresten	52	64	23.2	18.9
Lambach-Gmunden Seebf	559	28	28.6	21.4
Friedberg-Fehring	164	78	35.4	29.6
Zeltweg-Fohnsdorf	13	6	4.7	4.0
Ehrwald Zugspitzbahn-Schonbichl	59	37	9.3	5.8
Total	**2278**	**578**	**290**	**211**
Total in Lower Austria	**616**	**257**	**123**	**82**

§ 2. The ÖBB must fulfill public service obligations until December 31, 1991, on the following branch lines and line segments, for which the relevant traffic volumes in 1985 are show:

a.) the transport of people and luggage as well as freight

Route/Route segment	Passengers in 1000s	Freight in 1000 t	Length in km	Losses per cost basis	Losses per invoices
				In Million Schillings	
Neusiedl am See Wulkaprodersdorf	256	15	36	36.3	26.8
St. Paul-Lavamund	132	12	13	11.4	7.9
Drosing-Zistersdorf - Zistersdorf Stadt	109	7	12	11.6	9.1
Gross Schweinbarth-Ganserndorf	65	3	15	12.4	11.3
Obersdorf-Gross Schweinbarth	30	15	18	10.0	8.0
Turnitz-Freiland	139	11	9	10.2	6.6
Lunz am See-Waidhofen a.d. Ybbs (760 mm)	340	31	54	59.0	46.3
Ybbsitz-Gstadt (760 mm)	123	5	6th	6.8	5.4
Wels-Grunau in der Almtal	136	77	43	36.8	26.0
Vordernberg -Eisenerz	169	206	21	50.4	33.5
Total	**1499**	**382**	**221**	**245**	**181**
Total Lower Austria	**806**	**72**	**108**	**110**	**87**

b.) the transport of people and luggage

Route/Route segment	Passengers in 1000s	Length in km	Losses per cost basis	Losses per invoices
			In Million Schillings	
Friedberg-Oberwart	149	26	27.2	21.8
Huttenberg-Launsdorf-Hochosterwitz	97	30	9.3	6.8
Gmund-Gross Gerungs	71	43	19.9	16.1
Ober Grafendorf-Gresten	223	64	41.0	32.2
Lambach-Gmunden Seebf	68	28	5.3	4.8
Friedberg-Fehring	235	78	65.2	49.7
Zeltweg-Fohnsdorf	50	6	3.7	3.0
Ehrwald-Zugspitzbahn-Schonbichl	163	37	48.1	39.1
Total	907	286	193	152
Total Lower Austria	**294**	**107**	**61**	**48**

c.) the transport of freight

Route/Route segment	freight in 1000t	Length in km	Losses per cost basis	Losses per invoices
			In Million Schillings	
Parndorf-Kittsee	29	20	8.3	6.9
Alt Nagelberg-Heidenreichstein	6	14	4.5	3.9
Bruck/Leitha-Petronell-Carnuntum	5	14	9.5	7.1
Felixdorf-Blumau-NeuriBhof	2	6	9.5	8.3
Friedburg-Lengau-Schneegattern	4	5	2.5	1.6
Gaweinstal-GroB Schweinbarth	10	9	9.0	8.2

"On the routes and parts of the route (Lines in Lower Austria in **bold**) the discontinuance of all traffic (with the exception of the segment Stammersdorf-Dobermannsdorf and Ganserndorf-Mistelbach) is already planned according to § 2.

1. Deutschkreutz-Oberloisdorf
2. Oberschutzen-Oberwart
3. **Zellerndorf-Sigmundsherberg**
4. **Stammersdorf-Obersdorf**
5. **Gross Schweinbarth-Dobermannsdorf**
6. **Pirawarth-Mistelbach LB**
7. **St. Aegyd am Neuwald-Kernhof**
8. **Kienberg-Gaming-Lunz am See (760mm)**
9. Mariazell-Gusswerk
10. Murzzuschlag-Neuberg
11. Bierbaum-Neudau

On the following lines and line segments the transport of passengers and luggage is to be provided in the current scope until December 31st, 1988, at the latest.

1. **Laa ad Thaya Stadt-Zellerndorf**
2. **Poysdorf-Dobermannsdorf**
3. **Mistelbach LB-Hohenau**
4. **Korneuburg-Mistelbach LB**

On the following lines and line segments the transport of freight is to be provided in the current scope until December 31st, 1988 at the latest.

5. Oberwart-Rechnitz
6. **Laa ad Thaya-Wildendurnbach**
7. **Schwarzenbach a.d. Pielach-Mariazell**

However, if a procedure according to § 29, Paragraph 1 of the Railway Act of 1957 (discontinuance procedure) is enacted for these lines or part of the line before December 31st, 1988, with a notice authorizing the suspension of all or part of the traffic, then the public service contract ends at the time of the approved discontinuance."

Annex 11.4: Attractivity of station surroundings

Town	Rail	Bus
Krems	Yes	Yes
Krems Campus	Yes	Yes
Stein	Yes	Yes
Unterloiben	No	Yes
Dürnstein	Partially	Yes
Weißenkirchen	Yes	Yes
Wösendorf-Joching	No	Partially
Spitz	Yes	Yes
Schwallenbach	Yes	Yes
Willendorf	Yes	Yes
Aggsbach Markt	Yes	Yes
Grimsing	Yes	No
Emmersdorf/Donau	Yes	Yes
Weitenegg	Yes	Yes
Lehen-Ebersdorf	No	No
Klein-Pöchlarn	Yes	Yes
Marbach-Maria Taferl	Yes	Yes
Persenbeug	No	No
Weins-Isperdorf	No	Yes

Annex 14.8: Measures for unprotected level crossings

KM post	Street	Safety Devices	Horn?	Res. area affected (m2)	Elimination/Signaling needed
	Dr. Karl-Dorrek Strasse	Gates +Light signal	No	N/A	N/A
	Pfaffenbergweg	Light signal	No	N/A	N/A
4.2	Rothenhof	None	Yes	5,900	Combine/Signalize
4.3	Field path	None	Yes	5,900	Combine/Signalize
5.13	Unterloiben Station	None	Yes	32,574	Signalize
5.7	Unterloiben		Yes	4,600	No
	Field path		No	15,274	Combine
	Field path		Yes	16,527	Combine
6.5	Dürnstein	No	Yes	10,000	Signalize
6.9	Dürnstein Footpath	No	Yes	72,500	Relocate/Eliminate
7.6	Road	Lights	No	N/A	N/A
8.1	Field way/hiking trail		Yes	1,200	No
8.2	Footpath		Yes	1,200	No
8.4	Footpath		Yes	11,000	Close
9.3	Field path		Yes	0	No
9.6	Dürnsteiner Waldhutten		Yes	1,571	No
10.1	Footpath		Yes	1,571	No
10.15	Gravel road		Yes	0	No
10.4	Schildhutten	Light signal	No	N/A	N/A
10.5	Field Path		Yes	0	No
10.7	Field Road		Yes	0	No
11	Footpath		Yes	0	No
11.2	Foot Path		Yes	0	No
11.4	Field Road		Yes	0	No
12	Weißenkirchen	Light signal	No	N/A	N/A
12.6	Weißenkirchen (Main st.)	Gates +Light signal	No	N/A	N/A
12.65	Roellfahrstrasse	Gates +Light signal	No	N/A	N/A
13	Footpath		Yes	102,196	Close
13.2	Ritzlingbachstrasse	Gates +Light signal	No	N/A	N/A
13.4	Joching Road			18,235	No
13.6	Field path			39,925	No
14.2	Weinbergrasse			67,541	Signalize
14.4	Field path			71,300	Close
14.7	Bachgasse		Yes	123,558	Signalize
15.3	Field road		Yes	11,402	No
15.5	Foot path		Yes	0	No
15.8	Field Path		Yes	2,035	No
16.3	Field Path		Yes	20,398	No
16.6	Foot path		Yes	20,665	No
17.3	Kremser Strasse	Light signal	No	N/A	N/A
17.7	Josef Osberg Weg			60,651	Ped underpass
18.3	Oberegasse		Yes	128,698	Signalize

KM post	Street	Safety Devices	Horn?	Res. area affected (m2)	Elimination/Signaling needed
19.4	Access road		Yes	2,885	No
19.6	Footpath		Yes	0	No
20.7	Footpath		Yes	3,906	No
20.9	Field Road		Yes	40,405	No
21.1	Schwallenbach	Light Signal	No	0	N/A
21.4	Footpath		Yes	48,331	No
22.3	Field path		Yes	0	No
22.6	Field path		Yes	0	No
22.9	Field path		Yes	32,845	Close
23,4	Footpath (Willdendorf)			49,454	Ped underpass
24	Road		Yes	48,600	No
25.9	Aggsbach		Yes	88,879	Signalize
26.5	Road (Aggsbach)		Yes	154,212	Signalize
27	Road		Yes	8,130	No
27.4	Field path		Yes	0	No
27.5	Field path		Yes	0	No
27.9	Field Path		Yes	0	No
29.8	Field Path		Yes	0	No
29.9	Field Path		Yes	0	No
30	Field Path		Yes	0	No
30.5	Field Road		Yes	0	No
31	Grimsing	Gates +Light signal	No	0	N/A
33.3	Field Path		Yes	560	No
33.4	Field Path		Yes	6,400	No
34.1	Kolomanistrasse			173,401	Signalize
34.3	Field path			118,449	Potentially close
34.9	Field path		Yes	41,760	No
35.6	Seegartenweg	None	Yes	5,024	Signalize
35.8	Field path		Yes	3,500	No
36.1	Luberegg		Yes	83,571	Signalize
37.89	Am Weitenbach	Light signal	No	N/A	N/A

Annex 14.11: SWOT analysis of Melk-Emmersdorf connectivity measures

Strengths	
1	**Do nothing:** Proved connection, limited risks in terms of operational concept. Buses have waiting spot incase of delays, easy transfer for passengers.
2	**Improved road connection:** Potential for reduced travel times, may be more accepted than driving hourly buses through the old city. Buses have waiting spot incase of delays, easy transfer for passengers.
3	**Access via elevators and stairs:** Simpler and more reliable operations for buses, easier to integrate connection services into other routes.
4	**Rerouting of bus 797:** Eliminates need for dedicated connector service. Buses have waiting spot incase of delays, easy transfer for passengers.
5	**Move transfer to Schallemersdorf:** Eliminates need for dedicated connector service, shorter travel times to Melk. No stops on the 797 must be eliminated.
6	**Cable car connection:** More reliable connection, higher frequency service possible, lower operating costs.
7	**Direct rail connection:** One seat ride to Melk and onwards to St. Pölten, could increase attractivity for connections from the west as well.
Weaknesses	
1	**Do nothing:** Dedicated service to connect with the railway in Emmersdorf is required, existing route is relatively long compared to distance covered.
2	**Improved road connection:** Investment required may not offset reduction in travel time and reliability.
3	**Access via elevators and stairs:** Approximately 20 meter vertical distance must still be covered either by stairs or elevator, limited capacity of elevators. Less attractive from passenger viewpoint than direct transfer.
4	**Rerouting of bus 797:** Schallemersdorf and some stops in Gossam will lose service. Buses still must drive through old city in Emmersdorf.
5	**Move transfer to Schallemersdorf:** No convenient waiting spot for buses, road redesign difficult. Station will be expensive to construct due to part of it being on a bridge and the rest requiring earthworks.
6	**Cable car connection:** High cost, long time to implement limited ridership potential outside of rail transfer, requires construction of new rail station that would only serve as transfer point.
7	**Direct rail connection:** High cost, long time to implement
Opportunities	
1	**Do nothing:** Lower resistance compared to changing of existing routes or new construction, simple to implement
2	**Improved road connection:**
3	**Access via elevators and stairs:** May be viewed favorably in the community that even do not use the railway as it increases their accessibility.
4	**Rerouting of bus 797:** Potential to improve bus service to Maria Laach by combining it with railway feeder function, other users other than those of the railway line could benefit.
5	**Move transfer to Schallemersdorf:** Could increase viability of the railway connection through expansion of the catchment zone, favorable view from population due to increased accessibility and retention of existing bus routes.
6	**Cable car connection:** Has potential to become a tourist attraction on its own.
7	**Direct rail connection:** Potential to establish direct services for tourists and commuters to a broad number of destinations.
Threats	

1	**Do nothing:** Potential complaints due to increase in buses through the center of Emmersdorf.
2	**Improved road connection:** Hill may not be negotiable by buses in the case of ice, potential complains from resident on the street about increased bus traffic.
3	**Access via elevators and stairs:** May be viewed favorably in the community that even do not use the railway as it increases their accessibility.
4	**Rerouting of bus 797:** potential resistance from residents in Schallemersdorf and Gossam who will in some cases have longer access time to transit.
5	**Move transfer to Schallemersdorf:** Potential risk of running afoul with UNESCO protection (unlikely), establishing proper barrier free infrastructure would result in significant road narrowing, potential for opposition
6	**Cable car connection:** Could have large visual impact, high chance of problems with UNESCO authorities.
7	**Direct rail connection:** Could have large visual impact, high chance of problems with UNESCO authorities as well as local residents due to impact on landscape and noise.

Annex 2 - Photo documentation

Line condition survey: This chapter is intended as an addition to chapter 9 from the report. Photos are organized by kilometer with emphasis on showing conditions at stations and for the segment Emmersdorf to Weitenegg the condition of the right of way and civil structures. All images by author unless noted

Krems-Hauptbahnhof KM 0

Wachaubahn train at platform 21 at Krems. The track is fully electrified allowing the potential for battery vehicle charging. Platforms barrier free.

Bus platforms for Wachau lines. Limited passenger information is available directly at the bus platform.

Stein - Mautern KM 3

Krems track layout looking west. Platform 21 to the right. Photo: Wikipedia public domain

Station platform at Stein-Mautern. Boarding done from the far track. Barrier free access may require removal of the first track.

Unterloiben KM 5.1

Eastern approach to Unterloiben station. Area is nearly undeveloped, however there is attractive pedestrian infrastructure

Western exit from Unterloiben. New development can be seen in the foreground. Long distance to town center.

Duernstein KM 6.8

Large parking lot at Duernstein station, area serves as general parking rather than railway needs.

Station building in use as cafe. Valuable space directly adjacent to the platform is wasted on parking on parking for non rail users.

Duernstein - Weißenkirchen scenic impressions

Beteween Duernstein and Weissenirchen. The landscape is dedicated to wine growing with no development

Weißenkirchen - KM 12.3

Train departing Weissenkirchen, boarding done from the middle track, complicating barrier free access.

Weissenkirchen station viewed from main road crossing. Path should be created along the track from this point.

Spitz an der Donau - KM 18.1

Station at Spitz with large bus turning loop located directly adjacent ot the platform.

Next bike and covered bike rack directly on the platform.

Track layout at Spitz. Provision of barrier free platforms will require innovative solution. Modification of track layout undesirable.

Shunting of summer solstice special trains. Sharp turnout for track nearest to station can only be used at low speeds.

Schwallenbach - KM 21

Narrow walkway to reach Schwallenbach station. Will need to be modified to comply with barrier free accessibility.

Station shelter at Schwallebach.

Willendorf - KM 23.4

Shelter and platform at Willendorf/Wachau

Access to station via level crossing

Aggsbach - KM 26.1

Station building at Aggsbach. Space immediately adjacent to station is again wasted on car parking.

Looking west from Aggsbach sation. Track closest to the station is the shortest and could be potentially removed

Grimsing - KM 30.9

Grimsing station shelter

Access to Grimsing station and level crossing with new gates and lights.

Schloss Schönbühel near Grimsing station

Bus 715 and train operating parallel between Grimsing and Emmersdorf.

Schallemersdorf - KM 32.3

No station, location considered for transfer node between the railway and Melk.

Track level view of bridge at Schallemersdorf.

Emmersdorf - KM 34

Train at end station of Emmersdorf. Outside track has already been removed enabling future barrier free access.

Bus 721 arriving at Emmersdorf station

Stairs connecting Emmersdorf station to the town center.

Kolomanistrasse in Emmersdorf, potential route for bus traffic to Melk.

Emmersdorf to Weitenegg

KM : Crossing with Seegartenweg

Condition of sleepers in this section vary, some two block concrete sleepers exist and area in poor condition.

KM : Crossing with Luberegg-Hain Strasse. The line runs on a high ledge here and has impressive views of the the Melk abbey and the river.

Weitenegg Donausee

In Weitenegg the a arm of the Danube has been developed into the Donausee recreational area.

View from Donausee towards Melk

Town center of Weitenegg, the town is significantly removed from the station.

Weitenegg

Driveway to Weitenegg station, will need to be modified for bus access

Station platform at Weitenegg

Track materials salvaged from the middle segment stacked for reuse.

Example of the twin block concrete sleepers that were problematic for continued operation of the middle segment

Looking towards Weitenegg station from switch at western end.

End of operable track on the eastern end of the Donauuferbahn

Weitenegg - Lehen Ebersdorf

KM 38.6: Small box culvert past the buffers.

KM 38.7 End of intact trackage a

KM 38.7 right of way with rock cutting

KM 38.8: Right of way and track level details of stone arech underpass

KM 38.8: Stone arch underpass, structure is in good condition and recently renovated

KM 39: Renovated stone box culvert

Lehen-Ebersdorf KM 40.106

Lehen-Ebersdorf station shelter

Right of way Lehen-Ebersdorf looking east.

KM 40.106 Lehen - Ebersdof halt. 2010 vs 2021. Track materials have been removed and ballast piled in center of old alignment. 2010 image Wikipedia CC

Platform edge stamped with 2003 manufacturing date.

Lehen-Ebersdorf looking west, right of way broken to regrade road.

Road crossing at Lehen Ebersdorf 2018 vs 2021. 2018 image from Google streetview.

Lehen Ebersdorf - Klein Poechlarn

KM 41.1: Right of way condtion

KM 41.2: Former industrial buildings along right of way

KM 41.3: Removed bridges at entrance to quarry.

KM 43.1: Eastern portal of Klein-Pöchlarner Tunnel viewed from Danube road bridge

KM 43.3: Looking east towards west portal of Klein-Pöchlarner Tunnel. Impassable due to vegetation.

Klein-Pöchlarn - KM 43.921

43.7: Looking west towards Klein-Pöchlarn station

43.8: Looking west towards Klein-Pöchlarn station

43.9: Klein-Pöchlarn station building, construction of wall across former track area.

43.9: Foundations for structure being poured in former track area.

Poster advertising new development on former station site

Looking west from station

Klein-Pöchlarn - KM 43.921

Sign for water treatement facility on former railway land


Looking east towards station


KM 44.1: Bridge over small channel. Bridge is being repurposed for pedestrians.

KM 44.2: Right of way with fallen kilometer post


Artenstetter Strasse looking east


Artenstetter Strasse looking west

Klein-Pöchlarn - Marbach

KM 46.4: Arched road underpass. Bridge is in good shape with new concrete deck

KM 47.2 Krummnußbaum an der Donauuferbahn, a town without its namesake.

KM 47.2: Small arch culvert, in good condition with concrete deck.

Klein-Pöchlarn - Marbach

KM 47.8: Small concrete box culvert. Appears in good-very good shape.

KM 48.0: Sale of land to private parties with reuse.

Marbach-Maria Taferl - KM 48.4

Right of way sold to private interests. Fruit trees planted in former track area but rails have been preserved

Marbach-Maria Taferl - KM 48.4

Private owner has preserved rails and station in its late ÖBB appearance. Fruit trees have been planted on the former platforms.

Hotel Wachauerhof directly across from the station and directly acros the B3 from the Danube.

Marbach to Loja

KM 48.9: West portal of the Schallmarbacher tunnel. Note S curve in the middle of the tunnel. No visible deterioration or drainage issues.

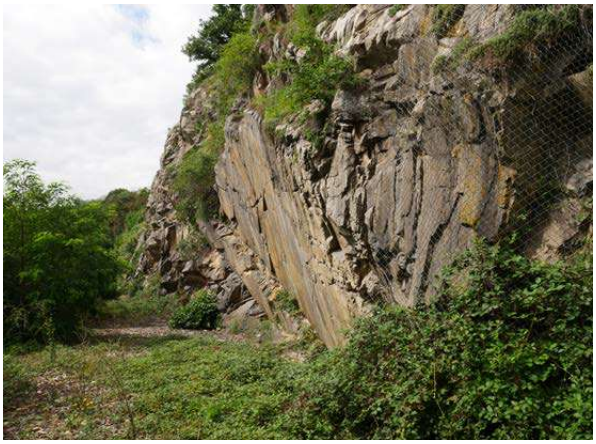
Schwallenbach

KM 48.9: Bridge over Marbach (Mar Stream) with road crossings on either end. Bridge is in good to very good condition

KM 48.9: Marbach tunnel. No visible deterioration or drainage issues.

Marbach to Loja

KM 49.2: Bridge over the Steinbachstrasse. Metal deck structure. Bridge appears in poor to fair shape with siginificant rusting.



KM 49.5: Unstable rock faces with partial metal netting.

KM 49.5: Relatively new drainage improvements along right of way.

KM 49.9: Small stone box culvert. Culvert appears in good condition and recently renovated

Property marker in Granz bearing orignial Mauthausen Grein Krems lokalbahn initials

KM 50.2: Site of demolished bridge in Granz

KM 50.9: Small arch culvert. Structure appears to be in good shape but heavily overgrown

KM 51.1: Small stone arch bridge, appears in good but unrenovated condition.

KM 51.1: Second small stone arch bridge, appears in good but unrenovated condition.

KM 51.5: Completely rebuilt concrete deck bridge in very good condition

Loja KM 52.4

KM 52.4: Concrete bridge at entry to quarry demolished for better truck access

Old loading silos, track area heavily overgrown.

Heavy truck traffic originating from the quarry.

Persenbeug -KM 55

Track alignment in Gottsdorf -Rehburg area of Persenbeug Gemeinde

Part of the right of way has been taken over for private use

Station in Persenbeug with abandoned former rack area.

Western exit of station

KM 55.5: Right of way looking west

Persenbeug - Weins

Old town area of Persenbeug

KM 56.3: New concrete bridge in very good condition

KM 56.9: New metal deck bridge over a stream

KM 57.3: Demolished bridge over the Fahrenbachstrasse

KM 57.3: Newly renewed bridge over stream

KM 57.3: Newly renewed bridge over stream

Track alignment along road elevated on a stone embankment

KM 58.2: Small metal span removed.

Weins - KM 60.2

KM 58.7: Buffer post at the end of the intact trackage

Station building in use as cafe. Valuable space directly adjacent to the platform is wasted on parking on parking for non rail users.

Date nail from 1957 on deteriorated wooden sleeper.

KM 58.8: view looking east, track shows no sign of recent use

Weins - KM 60.2

KM 60.2: Station at Weins, siding tracks are out of service.

Weins - Sarmingstein

KM 61.1: Newly constructed bridge over the Ysper river. Track is however in bad condition.

Track condition at Ysper river bridge. Degraded two block sleepers still present.

KM 65.2: Bridge at Hirschenau-Nöchling