MSc Program
Renewable Energy in Central and Eastern Europe

Analysis of the (renewable) energy situation of Bulgaria, Hungary and Romania from an environmental perspective - including derived inputs for energy&environment engagements in these countries

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PREFACE

Climate change threatens the basic elements of life for people around the world – access to water, food production, health, and the use of land and the environment [1]

In order to keep the planet below the 2-degree danger threshold agreed by the UNFCCC, global GHG emissions need to start to decline by 2015; this is only possible through rapid upscaling of renewable energy policies as soon as possible in as many countries as possible. [2]

It is technically feasible to supply everyone on the planet in 2050 with the energy they need, with 100% of this energy coming from renewable sources [3]

Eastern Europe can provide a good return on green investments: The region's relatively skilled labour force can be absorbed by a dynamic green economy, supported by an increasingly vibrant private sector to multiply the level and impact of green investment. There is thus a solid potential in this region to create decent jobs in green or newly greened activities, such as renewable energy, waste recycling or energy-efficiency retrofits[4]***.***

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1 Stern, N. (2007) The Economics of Climate Change: The Stern Review, Cambridge University Press

2 IPCC (2012) Renewable Energy Sources and Climate Change Mitigation, Special Report of the
Intergovernmental Panel on Climate Change, Cambridge University Press

3 WWF (2011):The Energy Report: 100% Renewable Energy by 2050, p.23, Gland. Also available online at
wwf.panda.org/what_we_do/footprint/climate_carbon_energy/energy_solutions/renewable_energy/sustainable_energy_report/

4 UNECE (2012), From Transition to Transformation: Sustainable and Inclusive Development in Europe and Central Asia, p. 10., 163pp., Geneva, Switzerland

ABSTRACT

This thesis investigates the energy situation in Bulgaria, Hungary and Romania from an environmental point of view. The analysis of the three countries' shows that all three countries are below their national CO_2-reduction targets for 2020. However, the countries' current energy use is very inefficient with e.g. Bulgaria having the worst energy efficiency within the EU. Therefore, investments into energy efficiency measures as well as increasing the share of renewable energy still makes lot of sense for the countries to benefit economically, socially and environmentally.

The countries renewable energy potentials are considerable and varied. Biomass provides the highest potential of renewable energy technologies for all three countries, followed by hydro energy for Bulgaria and Romania. However, when comparing these potentials with the countries' current energy demand (which is order of magnitudes higher), it remains questionable if there is enough availability of renewable energy to substantially reduce and ultimately replace the countries' existing heavy dependence on fossil fuels and nuclear energy.

From an environmental perspective, solar and wind energy are generally considered to be the renewable energy technologies with comparatively lower environmental impacts followed by biomass and hydro. As the countries show highest potentials for biomass and hydro energy, the devleopment of "sensitivity maps" is suggested to identify "no go areas" as well as potential sites for such installations to ensure the sustainable extension of renewables.

Finally some possibilites for a climate&energy engagement in the three countries are provided. Above all, the development of an "integrated energy vision" is suggested as one respective key element that involves all stakeholders to reflect the current energy demand, define the most sustainable energy mix in the long-term and derive conculsions what needs to be done today to get there.

EXECUTIVE SUMMARY

This thesis investigates the energy situation in Bulgaria, Hungary and Romania from an environmental point of view. The emphasis is laid on the countries' existing (renewable) energy supply situation as well as analysing their performance with regards to the existing EU climate&energy framework. From this, some conclusions are drawn whether the three countries are pursuing a transition towards a low-carbon future, i.e. a future leading to a 80-95% reduction of greenhouse gas emissions by 2050. Energy efficiency will only be briefly mentioned, highlighting its priority before only increasing the energy supply side.

With regards to CO_2-emissions, all three countries are below their set Kyoto targets with Bulgaria about 42% under the Kyoto target, Hungary about 36% and Romania about 44%. This means that the three countries are emitting significantly less than their targetted "quotas". Two key reasons for that are the continued phasing out of heavy polluting industries since the political changes post-1989 as well as still lower levels of household consumption compared to Western European countries. This fact though, does not suggest that a reduction of the countries' carbon footprint is of no priority. All three countries show a very high energy inefficiency (or energy intensity), i.e. BG showing by far the worst energy inefficiency followed by RO coming in third and HU coming in seventh among the EU-27. With a better energy efficiency performance and advancing a domestic renewable energy supply the countries could derive considerable advantages economically (e.g. better balance of trade), environmentally (e.g. reduced carbon footprint) as well as socially (e.g. more "green jobs").

With regards to energy supply, all three countries' existing energy mix is heavily based on fossil fuels and nuclear energy. However, each country has provided a more or less ambitious National Renewable Energy Action Plan to increase the share of renewables. BG has set their goal to increase the share of renewable energy from currently (2010) about 10% to 16% by 2020, HU from currently about 7% to 14,7% (even beyond their EU agreed goal of 13%) and RO increasing it from currently about 17,5% to 24% by 2020.
With regards to renewable energy potentials, all three countries have considerable and varied available resources and possibilities. For all three countries, biomass

energy seems to be most important with estimated annual technical potentials in the dimension of about 96 PJ for Bulgaria, a range of about 40-140 PJ for Hungary and about 316 PJ for Romania. The second most relevant renewable energy technology for Bulgaria and Romania seems to be hydro energy with about 18 PJ for Bulgaria and about 129 PJ for Romania. Due to its flat topography, for Hungary hydro power is of no particular importance. Rather geothermal energy plays a considerable role for Hungary with estimated maximum potentials in the range of about 10 PJ/year.

Bulgaria’s current (2009) energy demand is in the range of about 876 PJ/year, that of Hungary about 1.055 PJ/year and that of Romania about 1.200 PJ/year. When comparing these demand figures with the above mentioned renewable energy potentials for biomass and hydro energy, it becomes clear that all countries need to considerably invest into energy efficiency measures in addition to pushing renewable energy to be able to step-wise replace their fossil/nuclear energy base with renewables. What needs to be also considered in this respect is how much of these technical potentials can effectively be realised when also considering environmental aspects to ensure the extension of renewable energy installations is sustainable in all aspects.

Subsequently, four of the major renewable energy technologies for the three countries – i.e. wind, solar, hydro and biomass energy – are discussed from an environmental point of view with regards to associated environmental impacts. Above all, it is recommended to develop an overall, integrated low-carbon energy vision for the countries beyond the year 2020 analysing the existing energy demand and questioning anticipated future energy demands first, before focusing on extending the (renewable) energy supply, potentially posing risks on reducing the countries’ natural capital. From the three countries, only for Hungary such a national energy vision beyond 2020 could be found. Such a vision seems to be an advantage being able to initiate appropriate steps now shaping the long-term transition towards a renewable future energy (supply) as early as possible (of course if respective legislation is introduced based on such a vision paper).

In terms of a further extention of the mentioned renewable energy technologies it is important to balance different needs and interests (e.g. economic, social, environmental, technical). As biomass energy seems to provide the largest renewable potentials for all three countries as well as hydro energy for Bulgaria and Romania, environmental attention may be focused on these two renewable energy technologies. It is suggested to develop “sensitivity maps” for these renewable energy technologies, also for wind energy, to be able to identify environmentally suitable areas for wind parks, biomass or hydro energy plants as well as “no go” areas that are left undisturbed to conserve the countries’ natural capital.

Based on the above compilation, an outline of some possibilities for a climate&energy engagement in the three countries is finally presented aimed at supporting a reduction of the countries’ carbon footprint while safeguarding the region’s unique natural capital. The recommendations for such a climate&energy engagement in the three countries include policy work (national and EU level), corporate engagement as well as demonstration projects (one representative case study presented in Annex 2).

In light of the commonly agreed goal to keep climate change within acceptable limits, the thesis shall be seen as one contribution to ongoing discussions of the required transition to a low-carbon energy future with all the associated challenges along that way finding appropriate compromises of differing viewpoints - this thesis is intended to emphasise the environmental perspective providing one guiding element for an environmental engagement to promote a sustainable energy future in Bulgaria, Hungary and Romania.

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1. INTRODUCTION

Climate change is already a reality. And it is not just the environment which is suffering. According to the UN World Health Organisation (WHO) climate change is already causing more than 150.000 deaths per year[5]. Financially and economically, climate change could prove disastrous. The Stern Report estimated that GDP could be reduced by as much as 5% per year, up to 20% by the year 2050[6].

The Intergovernmental Panel on Climate Change (IPCC), the world's foremost authority on climate change, states in its most recent comprehensive assessment (IPCC 4th Assessment Report, 2007) that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level[7]".

A low-carbon economy is often defined by meeting the world's energy needs using up to 80-95% renewable energy by 2050 (intended goals of the EU-27), some even suggesting an energy supply of 100% renewables (WWF, 2011). A ground-breaking study in this respect, the "WWF Energy Report" (WWF, 2011) presents detailed scenarios to demonstrate that "a fully renewable energy future is not an unattainable utopia. It is technically and economically possible" – without irrecoverable losses of biodiversity or ecosystem services[8].

Such a renewable low-carbon energy future which is technically and economically possible only requires political will to be implemented. In a way, this report tests

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5 World Health Organisation (WHO) (2005) Fact Sheet: Climate and Health. July 2005, available online at www.who.int/globalchange/news/fsclimandhealth/en/index.html

6 Stern (2006) The Stern Review: The Economics of Climate Change – from the executive Summary of the Stern Review, available online at http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/sternreview_index.htm

7 IPCC (2007) Climate Change 2007 – Synthesis Report, p.30,

8 WWF (2011) The Energy Report - 100% Renewable Energy by 2050, p.23

whether the “political will” for such a low-carbon future exists in the three Eastern European countries selected for this study (Bulgaria, Hungary and Romania).

Several key (environmental) stakeholders work on a low-carbon development and climate policy, clean and smart energy, forests and climate, climate finance, and climate business engagement, in order to map out a “climate-safe future” for people and nature globally as well as in the three countries. Such a "climate-safe" future is often described to include (WWF, 2011):

- **Advocating a new international climate agreement** – one that is just and legally binding
- **Promoting energy efficiency** – the most rapid and cost-effective way to reduce CO2 emissions
- **Promoting renewable energy sources** – like wind, solar, and geothermal power – while safeguarding biodiversity and intact nature
- **Preventing greenhouse gas emissions from deforestation** – currently responsible for 20% of all emissions
- **Developing and promoting climate change adaptation strategies** – to safeguard the most vulnerable people and the most exposed ecosystems

In WWF’s “Energy Report” 10 key recommendations are provided as overall “guidelines” towards achieving a 100% renewable energy future (WWF, 2011), these are:

1. CLEAN ENERGY: Promote only the most efficient products. Develop existing and new renewable energy sources to provide enough clean energy for all by 2050.
2. GRIDS: Share and exchange clean energy through grids and trade, making the best use of sustainable energy resources in different areas.
3. ACCESS: End energy poverty: provide clean electricity and promote sustainable practices, such as efficient cook stoves, to everyone in developing countries.

4. MONEY: Invest in renewable, clean energy and energy-efficient products and buildings.
5. FOOD: Stop food waste. Choose food that is sourced in an efficient and sustainable way to free up land for nature, sustainable forestry and biofuel production. Everyone has an equal right to healthy levels of protein in their diet – for this to happen, wealthier people need to eat less meat.
6. MATERIALS: Reduce, re-use, recycle – to minimize waste and save energy. Develop durable materials. And avoid things we don't need.
7. TRANSPORT: Provide incentives to encourage greater use of public transport, and to reduce the distances people and goods travel. Promote electrification wherever possible, and support research into hydrogen for shipping and aviation.
8. TECHNOLOGY: Develop national, bilateral and multilateral action plans to promote research and development in energy efficiency and renewable energy.
9. SUSTAINABILITY: Develop and enforce strict sustainability criteria that ensure
   renewable energy is compatible with environmental and development goals.
10. AGREEMENTS: Support ambitious climate and energy agreements to provide global guidance and promote global cooperation on renewable energy and efficiency efforts.

This vision of WWF, as a key environmental stakeholder with regards to climate&energy, shows that a 100% renewable energy future is only attainable with far-reaching improvements in energy efficiency across the board as the by far most important aspect above all others.

Thus, this thesis takes as its premise that the transition to a low-carbon economy is only possible through the widespread adoption of both energy efficiency measures on the one hand and renewable energy on the other.

For EU Member States, the emissions targets (see section 2.5 below) are set in relation to the EU's overall Kyoto target and translated into national law. Even if countries such as Bulgaria, Hungary, and Romania are currently well below their

Kyoto-agreed target – and can therefore in theory increase their GHG emissions – it still makes economic sense to invest into renewable energy and energy efficiency.

All three countries have drawn up plausible and achievable programmes on both energy efficiency and renewable energy adoption, in line with EU targets and seeking to use a several different climate-relevant funds programmes as sources of finance. These are described more in later chapters but are linked to the "20-20-20" EU target: a 20% reduction in energy consumption as a result of advances in energy efficiency, a 20% share of energy coming from renewable sources, and an overall 20% drop in greenhouse gases (GHG) by the year 2020.

This thesis aims to act as one guiding element for environmental stakeholders in finding interventions and entry points related to the selected three countries where it is possible to make a difference in terms of a movement towards a green economy powered by 100% renewable energy, and at the same time safeguard the region's unique flora and fauna.

1.1 PURPOSE AND SCOPE OF THE THESIS

The purpose of this study is to act as one guiding element for a climate&energy engagement in Bulgaria, Hungary and Romania, by mapping out their energy situation and potentials for moving towards a low-carbon future. Specifically, by investigating the potential for renewable energy development, the study will:

- assess,
- review,
- analyses and
- offer some recommendations.

The general idea behind the study is that, given the paramount importance of energy and climate to nature conservation, disparate sources of information on energy usage, renewable energy potential, energy efficiency potential, policy obstacles and opportunities, ongoing projects and good examples, and especially the overlap between nature and energy are pulled together into one place, to act as one guiding element for reference and for decision-making.

The thesis, as already noted, addresses renewable energy and just briefly also energy efficiency. It is widely acknowledged that a successful transition to a low-carbon future requires investment into both, and that generally speaking a switch to renewable sources of energy should be preceded by energy efficiency measures, in order to maximise impact and cut energy wastage, to then gradually transition across to safer, cleaner sources of power.

The aims of the study are therefore:

- to pull together relevant information concerning renewable energy in Bulgaria, Hungary and Romania in terms of energy usage, renewables status and potential, and relevant environmental issues related to the three countries' major renewable energy technolgies, i.e. wind, biomass, solar and hydro energy;

- to assess these countries' information in light of the European Union's long-term visioning and strategy towards the development of a low-carbon future; and
- to make some recommendations regarding possible interventions for a climate& energy work in Bulgaria, Hungary and Romania.

1.2 THE COUNTRIES' RELEVANCE REGARDING A CARBON FOOTPRINT REDUCTION ENGAGEMENT

One key reason to work on a carbon footprint reduction, climate mitigation and adaptation in the three countries from an environmental point of view is to aim at conserving the countries' unique natural capital as for example indicated by WWF's Global Conservation Strategy defining 238 global priority ecoregions, amongst them the Danube-Carpathian ecoregion including Bulgaria, Hungary and Romania (Olson and Dinerstein, 2002). The Danube Basin and surrounding Carpathian Mountains (see Fig. 1: Map of the Danube-Carpthian Region below) are listed as one of these most valuable priority places for biodiversity conservation on the planet (called the Danube-Carpathian Ecoregion) and contains some of the most spectacular and valuable natural capital in the world.

Fig. 1: Map of the Danube-Carpthian Region (Source: WWF, 2012)

The Danube-Carpathian region: *Europe's treasure chest for nature*

***Blue Danube*.** The Danube River basin is the most international river basin in the world, draining 19 countries on its 2.800 km journey from the Black Forest in Germany to the Black Sea. From the largely untamed middle and lower stretches of the river to the spectacular Danube Delta at its mouth, the Danube is home to some of the world's richest wetlands.

***Green Carpathians*.** The Carpathian Mountains are Europe's last great wilderness area – a bastion for large carnivores, with over half of the continent's populations of bears, wolves and lynx, and home to the greatest remaining reserves of old growth forests outside of Russia.

The twin ecoregions, which are part of the Greater Black Sea Basin, have been identified by WWF as among the most valuable ecoregions on Earth.

Key environmental stakeholders, as for example WWF, will focus their activities over the next years in this Danube-Carpathian region on the one hand on seeking to secure and even enhance the valuable biodiversity and ecosystems in the region, including the globally important wetland areas of the Danube Basin as well as Europe's greatest remaining old growth forests outside of Russia. This **"**green infrastructure**"** provides a host of valuable ecosystem goods and services, from biodiversity to clean water, flood management as well as climate regulation – goods and services that we are only beginning to really appreciate, but that nevertheless provide the foundations for our economies and well-being (WWF, pers. comments).

Focus will also be put on the special opportunity that the region has to develop a long-term, sustainable **"**green economy**"** by building on the region's special strengths and opportunities, including its prodigious natural capital, significant potential for resource efficiencies and de-carbonisation as well as the development aid and investment that is pouring into the region from the EU as well as private sector.

These twin aims – green infrastructure and green economy – go hand in hand and are crucial for responding to the outstanding challenges of climate change and biodiversity loss that we face within the region and across the globe.

Considering this unique treasure of wildlife, biodiversity and vast areas of still unspoilt nature of this globally recognized ecoregion, the necessary transition to a green/low-carbon economy with an expected rise in the amount of renewable energy installations as one key element of this development, will almost certainly lead to increasing conflicts of interests regarding nature conservation on the one hand versus climate protection through more (renewable) energy infrastructure on the other.

In addition, with a total population of 120 million people and dynamic economies, the region's resource use will further grow rapidly, especially regarding resources for energy production.

Some key reasons to work towards a carbon footprint reduction in the three countries as indicated by WWF include:

- Selected CEE countries have a (far) greater footprint intensity per GDP than Western European countries. The key factor is energy, which accounts for more than half of the total footprint for most of the post-Soviet countries.
- Foreign Direct Investment has a long-term interest in CEE as: 1) a major European source of raw materials; 2) a good location for production or services given relatively cheap labor costs and location in or near the EU

market; 3) an expanding market, with growing household income and consumer demand.

- As a result, CEE is a priority for many major companies' operations, including Coca-Cola, IKEA, Lafarge and SABMiller leaving an increasing carbon footprint in the region. For many of these companies, the region is seen as a whole and not as individual countries, with RoI costed regionally, not on a country basis.
- CEE is a major European producer of grains, timber, paper and pulp, with further growth expected in future as food and raw materials prices rise. Ukraine has some of the most fertile agricultural land in the world.
- As the EU introduces tougher limits for carbon emissions and energy production, there is growing attention to CEE as a source of carbon "leakage", with energy generation and carbon-intensive industries moving from the EU to neighboring countries.
- Austrian companies hold a key role in the development of CEE countries and have taken their share of opportunities arising from EU enlargement. Austria is the largest foreign investor in Slovenia, Serbia, Romania and Bulgaria; among the top 3 investors in Hungary, Slovakia and the Czech Republic; and relies on the CEE countries for 23% of its exports.

Too often climate change is used as a pretence to carry out every (technically possible) action to reduce the carbon footprint. Reducing carbon emissions is obviously an urgent endeavour anywhere in the world, but when destroying nature and biodiversity in doing so, the whole point is missed. Hence, a particular focus in an climate & energy engagement in the countries will be to promote the right, environmental-friendly balance of reducing carbon emissions without harming nature as well as to show with (field) projects and initiatives that a 80-95% reduction of CO_2-emission is possible without destroying or harming ecosystems or loosing biodiversity.

2. ANALYSIS OF THE CURRENT ENERGY SITUATION, PARTICULARLY REGARDING RENEWABLE ENERGY

As noted above, energy and environment policies in the three countries are strongly guided by EU legislation, policy and programming framework and all three countries are moving, through the EU “Energy and Climate Package”, towards fulfilling their targets within the European 20-20-20 framework by the year 2020, namely:

- 20% reduction of EU greenhouse gas emissions below 1990 levels
- 20% of EU energy consumption to come from renewable resources
- 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency.
- 10% biofuels mandatory blending in transportation fuels
  (this thesis will not analyse and discuss this “fourth” aspect of the EU Climate&Energy package and its implications regarding the future of mobility as such and whether e.g. a transition to electric mobility questions this mandatory biofuels goal)

These so-called “20-20-20 targets” became law in June 2009. Two key policy documents have been developed by each Member State in response to these targets, namely the

1. National Energy Efficiency Action Plan (NEEAP); and the
2. National Renewable Energy Action Plan (NREAP).

Whilst representing an important step forward in integrating policies towards a sustainable energy future, these documents do not go beyond 2020. They did not need to, after all. For how long the Member States of the EU can maintain such short-sightedness is in question.

In its 2011 Communication “Roadmap' the European Commission urges each Member State to develop national low carbon roadmaps, if not already done[9].

[9] European Commission (2011) A Roadmap for moving to a competitive low carbon economy in 2050, COM2011 (112 Final), p.14., Brussels, Belgium

Unfortunately, the over-arching vision is often missing in Member States, and as described later, national integrated visions running to 2050 are quite rare.

However, these two policy plans do nevertheless set the scene for implementation of appropriate energy efficiency and renewable energy initiatives up to 2020, for the most part. Produced in 2010 and 2011, in response to the requirements of the Directive 2009, there are many positive intentions contained in all three countries' plans. At a macro-policy level, these include:

- Recognition that the move towards a low-carbon future is necessary
- Acknowledgement that both energy efficiency measures and a switch to renewable energy are required
- Demonstration of a commitment to strive towards meeting the 20-20-20 targets.

At a more detailed level, looking at the three countries in question, there are also many good examples of policy intention within the plans, including for example:

- Hungary's placing of renewable energy and energy efficiency at the heart of a proclaimed push for a green economy, recognising the opportunities for job creation, an end to fuel dependency, and rural development;
- Romania's going beyond the EU 20-20-20 targets to propose more ambitious targets of 33% renewable by 2010, 35% by 2015, and 38% by 2020[10];
- Bulgaria's intention to set up a Public Information Service for renewable energy, including an accessible GIS system, containing mapped information regarding renewable energy potential as well as environmentally sensitive areas, Natura 2000 designations, etc[11].

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[10] Government of Romania, Law 220/2008 modified and completed with Law 139/2010, quoted by Birdlife International (2012) *Wind Energy Development in Dobrogea Region: Inadequate Implementation of the EU Nature Directives is Resulting in Site Deterioration and Species Disturbance*, 4pp.

[11] Republic of Bulgaria (2010) *National Renewable Energy Action Plan*, Ministry of Economy, Energy and Tourism, 216pp, June 2010, p.45, Sofia, Bulgaria.

Some more prominent issues regarding administration and procedures include sometimes rather cumbersome administrative systems: Bulgaria for example has the highest “wait time” for installation of simple roof top solar panel of approximately 50 weeks, compared to Germany where the time delay is less than a quarter of this[12];

What seems to be required from an environmental point of view and with regards to an appropriate positioning of points towards a low-carbon future, is a more integrated and more longer-term vision for such a low-carbon energy future. Hungary has such a perspective, recently publishing its Energy Strategy for the period until 2030, with a view also beyond to 2050[13]. However, neither Bulgaria nor Romania have such a vision beyond 2020, and this may prove careless regarding the increasing attention to rising energy costs as well as the overall environmental necessity towards “decarbonisation”.

The European Commission is ready to assist countries to develop such a strategic climate/energy roadmap or vision, also promotes available tools for this, and will be using the opportunity of the review and planning for the next Multi-Annual Financial Framework to see from where funding supports can be tapped for financing the longer-term transition.[14] Thus an opportunity exists to receive support towards the development of a stakeholder-shared, inclusive and integrated energy vision, or strategy, for reaching a low-carbon future.

In the next section, the three countries are briefly analysed respectively with regards to their energy usage and potential, policy frameworks, vision and strategy, and movement (or otherwise) towards a low-carbon future.

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12 IEA (2012) Tracking clean energy progress – Energy technology perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial, p.30., Paris, France.

13 Government of Hungary (2012) National Energy Strategy 2030, Ministry of National Development, 132pp., Budapest, Hungary.

14 European Commission (2011) A Roadmap for moving to a competitive low carbon economy in 2050, COM2011 (112 Final), 15pp., Brussels, Belgium

2.1. BULGARIA

Summary Facts of Bulgaria's energy status quo
• Bulgaria is the least energy-efficient country in the EU. • Bulgaria's share of renewables in its energy mix is currently about 10% (2010) dominated by biomass energy. Bulgaria's renewable goal until 2020 is to increase its share to 16% mainly coming from an increase in biomass energy. • The re-structuring of Bulgaria's economy and the closure of heavy industries has led to a falling total energy use, but GHG emissions particularly from households and transport sectors are steadily increasing. • Energy usage is dominated by imported oil and gas (from Russia) and nuclear, and it seems that Bulgaria continues to base their energy mix to a considerable extent on fossil fuel sources and on nuclear. However, substantial renewable potential is recognised especially in wind, biomass and solar. • There is no long-term, integrated energy strategy or vision beyond 2020, whilst the national Energy Strategy to 2020 and its associated national plans (NREAP and NEEAP) have been criticised for a lack of transparency and inadequate discussion involving relevant stakeholders. • There is in part adequate programming and policies in place for both renewable and especially energy efficiency, but associated market mechanisms are often not progressive or attractive enough for substantial action to happen. • Implementation on renewables is mixed, with a revoking of the subsidies on biofuels for transport, a "silent moratorium" on wind projects, and the prioritisation of coal and nuclear meaning that renewables growth is fragmentary and too slow considering the formulated intentions and opportunities. • From the information compiled in the section below, it seems questionable if Bulgaria is taking adequate steps towards a low-carbon future as available potentials of both energy efficiency and renewable energy are used only to a limited extent.

Bulgaria's national Energy Strategy runs only until 2020 and focuses heavily on the need to reduce the country's fossil fuel dependency, which is notable since it is almost entirely made up of imports (oil, gas and nuclear fuel) from one country, namely Russia. 70% of its total energy needs are met in this way, with 100% of its oil and almost 100% of its gas originating from Russia, with the latter supplied along a single route, through Ukraine.

Priority areas laid out in this Energy Strategy include the exploration for additional fossil fuel sources such as shale gas and deep-sea drilling for oil and gas offshore in the Black Sea; further support to the nuclear sector; infrastructural investments related to gas pipelines; and investment in new plants and upgrading of old plants for burning indigenous coal (low-grade lignite). Renewable sources of energy are mentioned as priority seven out of a list of eleven[15].

Great emphasis is also placed on energy efficiency, almost seemingly to the cost of other opportunities. The strategy links the achievement of the (%-based) renewable targets to direct reductions in overall demand through energy efficiency. Significant steps in this direction included the establishment of a “National Agency for Energy Efficiency” (EEA) called the “Sustainable Energy Development Agency (SEDA)” as the legal successor of the EEA, aiming at integration of policies and approaches, and a Bulgarian Fund for Energy Efficiency, through a public-private partnership.

Capturing this and other efforts is the National Energy Efficiency Action Plan (or NEEAP, from 2011-2013)[16]. In noting that more than 50% of primary energy consumption is lost during transformation, transmission and distribution (the EU-27 average is 37%), the NEEAP notes that Bulgaria is approximately halfway (23% savings achieved) towards its 2020 target of reducing primary energy consumption by 50%.

15 Government of Bulgaria (2011a) Energy Strategy of the Republic of Bulgaria till 2020, for Reliable, Efficient and Cleaner Energy, 46pp., Sofia Bulgaria.

16 Government of Bulgaria (2011b) Second National Energy Efficiency Action Plan, 2011-2013, 88pp., p.9., Sofia Bulgaria.

These measures on energy efficiency seem vital given that according to the energy company ABB, Bulgaria's thermal power plant efficiency (28%), rate of electricity loss during transmission (16%) and carbon dioxide emission per kWh (499 gCO_2/kWh) rank Bulgaria as "amongst countries with the lowest performance"[17]. The carbon emissions rate is 50% higher than the EU-27 average and is largely due to the dominance of coal and low grade lignite in the energy mix (and would be worse were it not for the high contribution of nuclear energy).

As noted in the previous chapter, and in keeping with the rest of the EU-27, Bulgaria's total final energy consumption has been falling since 1999, although total consumption by transport has been quite rapidly rising (+44% and almost all due to increased road transportation of +46%). Industry consumption declined almost across the board (-34%) with especially large drops in the heavy industries of iron and steel (-77%) and chemicals (-43%). Household consumption fell by a small amount (-3%) probably due to a falling resident population than to any energy efficiency or consumption developments (see also Table 1: Energy Consumption in Bulgaria 1999 to 2009).

Table 1: Energy Consumption in Bulgaria 1999 to 2009 by sector and sub-sector (mTOE)

Energy Consumption	**1999** (and % of total)		**2009** (and % of total)		**% change**	Comments
Total	**8.87**		**8.60**		**- 3.0**	
Industry (*of which*)	**3.68**	**(41.5%)**	**2.43**	**(28.3%)**	**-34.0**	
Iron and steel	*0.94*	*(10.6%)*	*0.22*	*(2.6%)*	*-76.6*	
Chemical	*1.06*	*(11.9%)*	*0.61*	*(7.1%)*	*-42.5*	
Glass and pottery	*0.50*	*(5.6%)*	*0.52*	*(6.0%)*	*+4.0*	
Food, drink, tobacco	*0.32*	*(3.6%)*	*0.26*	*(3.0%)*	*-18.8*	
Paper and pulp	*0.10*	*(1.1%)*	*0.07*	*(0.8%)*	*-30.0*	
Transport (*of which*)	**2.03**	**(22.9%)**	**2.93**	**(34.1%)**	**+44.3**	
Road	*1.74*	*(19.6%)*	*2.55*	*(29.7%)*	*+46.6*	
Air	*0.12*	*(1.1%)*	*0.18*	*(2.3%)*	*+50.0*	
Rail	*0.09*	*(1.0%)*	*0.06*	*(0.7%)*	*-33.3*	

[17] ABB (2011a) Bulgaria – Energy Efficiency Report 2011, 6pp., available on http://www05.abb.com/global/scot/scot316.nsf/veritydisplay/7c7691d00398dc8bc12578aa004c5320/$file/bulgaria.pdf

Inland waterways	*0.003 (0.03%)*	.		
Households	**2.19 (24.7%)**	**2.12 (24.7%)**	**-3.2**	Population fell by 7% from 8.2 to 7.6[18] million for same period[19]
Services	**0.65 (7.3%)**	**0.94 (10.9%)**	**+44.6**	
EU-27 (of which): *Industry* *Transport* *Households* *Services*	**1113 (100%)** *319 (29%)* *340 (31%)* *291 (26%)* *123 (11%)*	**1114 (100%)** *269 (24%)* *368 (33%)* *295 (26%)* *141 (13%)*	**+0.1** -16 +8 +1 +15	

As noted above, for example, Bulgaria's carbon efficiency is actually worsening, (European Commission, 2011, p.141 Eurostat data) suggesting that at the macro-level, structural or political problems exist which are preventing the country from moving meaningfully towards a greener energy mix.

Bulgaria also has the cheapest electricity in the EU at 0,0934 EUR/KWh, approximately a third to a half of that in Germany (0,2781) and Austria (0,2128). In part an understandable reflection of the country's low GDP (in fact the lowest in the entire EU, and standing at just 44% of the EU-27 average in 2010[20]), this governmental subsidy on energy and fuel consumption nonetheless sends out a “perverse incentive” for over-usage as well as a negative subsidy against new technologies and renewable sources attempting to break into the market.

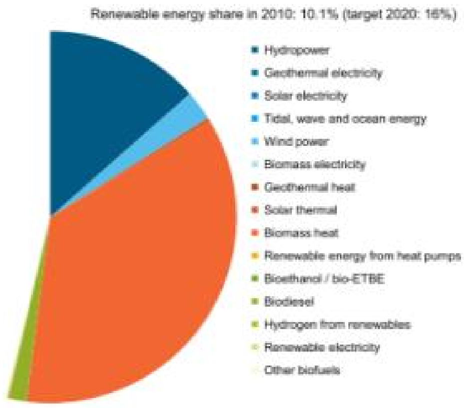
18 Eurostat figures available at http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tps00001&plugin=1 accessed on 10 May 2012

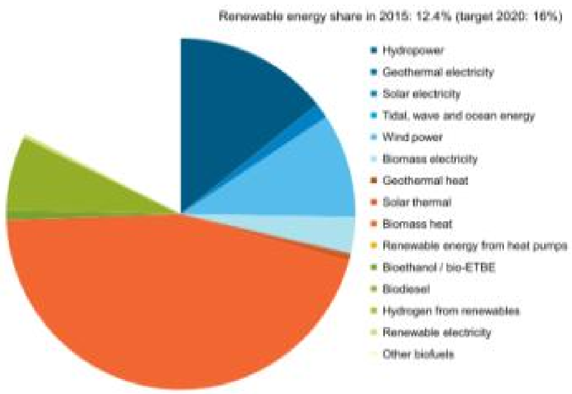
19 Eurostat figures available at http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tps00001&plugin=1 accessed on 10 March 2012

20 From Eurostat available at: http://epp.eurostat.ec.europa.eu/tgm/table.do tab=table&init=1&plugin=1&language=en&pcode=tec00114 accessed on 28 March 2012

Regarding renewable energy, the current and projected shares of different renewable groups are illustrated in the figures (Fig. 2) and table (Table 2) below[21]:

Fig. 2: Three figures showing the present and projected renewable energy share of Bulgaria in 2010, 2015 and 2020.





[21] Beurskens, Hekkenberg, and Vethman (2011) Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States, 270pp., p. 210, ECN and EEA Report.

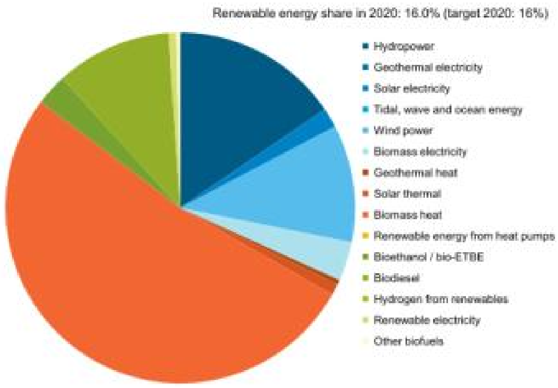

Renewable energy share in 2020: 16.0% (target 2020: 16%)
Hydropower
Geothermal electricity
Solar electricity
Tidal, wave and ocean energy
Wind power
Biomass electricity
Geothermal heat
Solar thermal
Biomass heat
Renewable energy from heat pumps
Bioethanol / bio-ETBE
Biodiesel
Hydrogen from renewables
Renewable electricity
Other biofuels

Table 2: Present and projected renewable energy shares of Bulgaria in 2005, 2010, 2015 and 2020

			2005						2010						2015						2020						Page
			[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	
Renewable production	Electricity	Hydropower < 1MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	103
		Hydropower 1MW - 10 MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	103
		Hydropower >10MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	103
		Hydropower (subtotal)	3068	264	99.8	26.6	8.4	2.6	3223	277	83.9	26.5	8.9	2.7	3417	294	49.8	22.4	9.3	2.8	3712	319	48.8	18.6	10.1	3.0	103
		Geothermal	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	110
		Solar photovoltaic	0	0	0.0	0.0	0.0	0.0	12	1	0.3	0.1	0.0	0.0	343	29	5.0	2.2	0.9	0.3	435	37	5.7	2.2	1.2	0.3	121
		Concentrated solar power	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	121
		Solar (subtotal)	0	0	0.0	0.0	0.0	0.0	12	1	0.3	0.1	0.0	0.0	343	29	5.0	2.2	0.9	0.3	435	37	5.7	2.2	1.2	0.3	121
		Tidal, wave and ocean energy	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	128
		Onshore wind	5	0	0.2	0.0	0.0	0.0	605	52	15.8	5.0	1.7	0.5	2293	197	33.4	15.0	6.2	1.9	2592	223	34.1	13.0	7.1	2.1	139
		Offshore wind	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	139
		Wind power (subtotal)	5	0	0.2	0.0	0.0	0.0	605	52	15.8	5.0	1.7	0.5	2293	197	33.4	15.0	6.2	1.9	2592	223	34.1	13.0	7.1	2.1	139
		Solid biomass	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	490	42	7.1	3.2	1.3	0.4	514	44	6.8	2.6	1.4	0.4	149
		Biogas	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	313	27	4.6	2.0	0.8	0.3	351	30	4.6	1.8	1.0	0.3	149
		Bioliquids	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	149
		Biomass (subtotal)	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	803	69	11.7	5.3	2.2	0.7	865	74	11.4	4.3	2.4	0.7	149
		Total (according to Template Tables 10a/b)	3073	264	**100.0**	26.7	8.4	2.6	3840	330	**100.0**	31.6	10.5	3.2	6856	590	**100.0**	44.9	18.6	5.6	7604	654	**100.0**	38.1	20.8	6.1	-
		Sum of all technologies (Template Tables 10a/b)	3073	264	100.0	26.7	8.4	2.6	3840	330	100.0	31.6	10.5	3.2	6856	590	100.0	44.9	18.6	5.6	7604	654	100.0	38.1	20.8	6.1	-
		Gross final RES-E consumption (Template Table 4a)		264	99.9	26.6	8.4	2.6		330	99.9	31.5	10.5	3.2		590	100.1	44.9	18.6	5.6		654	100.0	38.1	20.8	6.1	76 – 79
	Heating and cooling	Geothermal		n.a.	0.0	0.0	0.0	0.0		1	0.1	0.1	0.0	0.0		3	0.3	0.2	0.1	0.0		9	0.8	0.5	0.2	0.1	154
		Solar thermal		n.a.	0.0	0.0	0.0	0.0		6	0.8	0.6	0.1	0.1		11	1.2	0.8	0.2	0.1		21	1.9	1.2	0.5	0.2	160
		Solid biomass		724	100.0	73.1	15.9	7.0		734	99.1	70.2	16.3	7.1		916	97.1	69.8	20.2	8.6		1053	95.5	61.3	22.7	9.8	168
		Biogas		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		13	1.4	1.0	0.3	0.1		20	1.8	1.2	0.4	0.2	168
		Bioliquids		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	168
		Biomass (subtotal)		724	100.0	73.1	15.9	7.0		734	99.1	70.2	16.3	7.1		929	98.5	70.8	20.5	8.8		1073	97.3	62.5	23.1	10.0	168
		Aerothermal heat pumps		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0	174
		Geothermal heat pumps		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0	174
		Hydrothermal heat pumps		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0	174
		Renewable energy from heat pumps (subtotal)		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	174
		Total (according to Template Table 11)		724	**100.0**	73.1	15.9	7.0		741	**100.0**	70.8	16.5	7.1		943	**100.0**	71.8	20.8	8.9		1103	**100.0**	64.2	23.8	10.3	-
		Sum of all technologies (Template Table 11)		724	100.0	73.1	15.9	7.0		741	100.0	70.8	16.5	7.1		943	100.0	71.8	20.8	8.9		1103	100.0	64.2	23.8	10.3	-
		Gross final RES-H/C consumption (Template Table 4a)		724	100.0	73.1	15.9	7.0		741	100.0	70.8	16.5	7.1		943	100.0	71.8	20.8	8.9		1103	100.0	64.2	23.8	10.3	76 – 79
	Transport	Bioethanol / bio-ETBE		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		19	11.4	1.4	0.7	0.2		60	19.9	5.5	2.0	0.6	180
		Biodiesel		0	0.0	0.0	0.0	0.0		33	91.7	3.2	1.2	0.3		140	84.3	10.7	4.8	1.3		220	72.8	12.8	7.5	2.0	186
		Hydrogen from renewables		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	190
		Renewable electricity		3	100.0	0.3	0.1	0.0		3	8.3	0.3	0.1	0.0		7	4.2	0.5	0.2	0.1		15	5.0	0.9	0.5	0.1	198
		Other biofuels		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		7	2.3	0.4	0.2	0.1	204
		Total (according to Template Table 12)		3	**100.0**	0.3	0.1	0.0		36	**100.0**	3.4	1.3	0.3		166	**100.0**	12.6	5.7	1.6		302	**100.0**	17.6	10.2	2.8	-
		Sum of all technologies (Template Table 12)		3	100.0	0.3	0.1	0.0		36	100.0	3.4	1.3	0.3		166	100.0	12.6	5.7	1.6		302	100.0	17.6	10.2	2.8	-
		Gross final RES-T consumption (Template Table 4a)		3	100.0	0.3	0.1	0.0		36	100.0	3.4	1.3	0.3		166	100.0	12.6	5.7	1.6		302	100.0	17.6	10.2	2.8	76 – 79
		RES-T including Article 21.2 (Template Table 4b)[e]		0	0.0	0.0	0.0	0.0		30	83.3	2.9	1.1	0.3		115	69.3	8.8	4.0	1.1		204	67.5	11.9	6.9	1.9	76 – 79
	All RES excl. co-operation mech.	Gross final RES consumption (Template Table 4a)		991		100.0	37.5	9.6		1107		105.8	39.9	10.6		1699		129.4	58.6	16.0		2059		119.8	69.7	19.2	76 – 79
		Sum totals Template Tables 10a/b, 11, 12 (corr. Art 5(1))		988		99.7	37.4	9.6		1104		105.6	39.8	10.6		1692		128.8	58.4	15.9		2044		119.0	69.2	19.0	-
		Sum all technologies in Template Tables 10a/b, 11, 12		991			37.5	9.6		1107			39.9	10.6		1699			58.6	16.0		2059			69.7	19.2	-
	Co-operation mechanisms	Transfer from other Member States and third countries		0		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0	76 – 79
		Transfer to other Member States		0		0.0	0.0	0.0		61		5.8	2.2	0.6		386		29.4	13.3	3.6		341		19.8	11.6	3.2	76 – 79
	All RES incl. co-operation mech.	Total (Template Table 4a)		991		**100.0**	37.5	9.6		1046		**100.0**	37.7	10.1		1313		**100.0**	45.3	12.4		1718		**100.0**	58.2	16.0	76 – 79
Final consumption	Electricity	reference scenario[f]		3129						3130						3355						3597					64
		additional energy efficiency[f]		3129			**100.0**	30.3		3130			**100.0**	30.1		3171			**100.0**	29.9		3348			**100.0**	29.3	65
	Heating and cooling	reference scenario[f]		4543						4851						5640						6193					66
		additional energy efficiency[f]		4543			**100.0**	44.0		4492			**100.0**	43.2		4539			**100.0**	42.8		4638			**100.0**	43.2	67
	Transport	reference scenario[f]		2642						2830						3191						3473					68
		additional energy efficiency[f]		2642			**100.0**	25.6		2776			**100.0**	26.7		2898			**100.0**	27.3		2952			**100.0**	27.5	69
	Total before aviation reduction	reference scenario[f]		10314						10811						12186						13263					70
		additional energy efficiency[f]		10314				**100.0**		10598				**100.0**		10608				**100.0**		10738				**100.0**	71
	Total after aviation reduction	reference scenario[f]		n.a.						n.a.						n.a.						n.a.					72
		additional energy efficiency[f]		n.a.				0.0		n.a.				0.0		n.a.				0.0		n.a.				0.0	73
Target		Transport fuels target																								10.0	-
		Overall renewable target[g]						9.4						10.7						12.4						16.0	33

[a] The percentages refer to the values in the column '[ktoe]' and express the share of the renewable technology in the sector-total (RES-E, RES-H/C or RES-T, see values highlighted in bold).
[b] The percentages refer to the values in the column '[ktoe]' and express the share of the renewable technology in total RES (if applicable including co-operation mechanisms, see value highlighted in bold).
[c] The percentages refer to the values in the column '[ktoe]' and express the share of the renewable technology in the sector total of the final gross energy consumption ('*Additional energy efficiency scenario*' only), see values highlighted in bold).
[d] The percentages refer to the values in the column '[ktoe]' and express the share of the renewable technology in the total final gross energy consumption (*before aviation reduction of the Additional energy efficiency scenario*), see value highlighted in bold).
[e] Art. 21.2 adjustment refers to double counting of certain biofuels (times 2) and and renewable electricity in road transport (times 2.5).
[f] In 'Final consumption' values for the year 2005 refer to the 'base year' in Template Table 1 (see Table 47 (page 64) to Table 56 (page 73).)
[g] For the years 2005 and 2020 the shares as defined in Annex I of Directive 2009/28/EC are presented, for the years 2010 and 2015 it is referred to the trajectory periods 2011-2012 and 2013-2016.
General: where is referred to Tables 1, 4a, 10a/b, 11 and 12 it is meant to the Template, prepared by the European Commission and available for download at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009D0548:EN:NOT

The Bulgarian National Renewable Energy Action Plan (NREAP, from 2010) contains many measures for developing the country's renewable potential, but as shown in the country's Energy Strategy to 2020, the main focus of energy supply is placed firmly in the nuclear sector, supported by continued coal usage. Nuclear production is planned to increase by 2 GW, whilst coal-fired production is foreseen to continue to be central to electricity needs[22]. Such emphasis is not indicative of Bulgaria's intended move towards a low-carbon future.

That the government seemingly does not prioritise renewables is further underlined by the abandonment of the obligatory share of biofuels in transport (set by the EU Directive on the Promotion of the use of biofuels and other renewable fuels for transport, 2003/30/EC), a move which led to increases in the usage of diesel[23], contravening the directive and contradicting the country's set targets.

The NREAP does nonetheless include many existing and planned measures which are aimed at boosting renewable energy development and deployment. Existing measures, such as feed-in tariffs, obligatory and priority connections, long-term purchasing agreements and the like were deemed to have boosted the sector and "given a strong impetus to initial investments" but proven insufficient to ensure uptake at the required magnitude, so several new measures were proposed seeking to "remove the administrative, technical, and financial barriers"[24].

It is unclear what these planned measures will deliver.

The situation regarding wind energy projects in Bulgaria seems to be complex. The private sector has rushed to express interest in Bulgarian wind development, in part encouraged by the range of instruments and supports offered by the government,

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22 WWF and Ecofys (2011) Bulgaria – Climate Policy Tracker, 4pp factsheet, November 2011, Brussels, Belgium.

23 WWF and Ecofys (2011) Bulgaria – Climate Policy Tracker, 4pp factsheet, November 2011, Brussels, Belgium.

24 Republic of Bulgaria (2010) National Renewable Energy Action Plan, Ministry of Economy, Energy and Tourism, 216pp, June 2010, p.45, Sofia, Bulgaria.

including a reasonable feed-in tariff noted above. However, as a result of various financial and administrative problems, actual implementation has largely failed to materialise, at least in a way of which neutral observers might approve. Consequently, at a time when other countries (including Hungary and Romania) have been rapidly expanding their wind power year-on-year, in Bulgaria a "silent moratorium" or break in approvals has been in place for almost two years, since June 2010.

The respective problems reportedly include:

- the request for permission, and in fact actual siting, of wind turbines in environmentally sensitive and Natura 2000 areas;
- the conversion of usage designation for land from agricultural to non-agricultural, in anticipation of wind turbine development, which then failed to materialise; and
- tenders for investment not backed by actual required resources, financial and otherwise.

Biomass is also a targeted potential renewable source for the country. Foreign investors are looking to build new biomass power stations which would help the government reach its target of 433 MW by 2020. Last year energy and water giant GDF Suez announced its intention to build four such plants at a cost of 100 million Euros[25]. There is also an increasing number of solar farms[26].

As mentioned above, the Bulgarian energy strategy does not look beyond 2020. From an environmental point of view emphasising the need for a long(er)-term vision moving a country towards a low-carbon future[27], this absence of an energy plan beyond 2020 is considered to be strongly needed to set the course towards such a

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25 Energy Daily News (2011) GdF eyes biomass plants in Bulgaria, news article from 8 April 2011, available at http://www.energydailynews.com/biogas-market-in-south-eastern-europe/175-gdf-eyes-biomass-plants-in-bulgaria

26 EBRD (2011) Renewables Initiative: List of Projects – Bulgaria, online database accessed on 10 May 2012, available at http://www.ebrdrenewables.com/sites/renew/countries/Bulgaria/default.aspx#projects

27 Mr Georgi Stefanov, WWF Climate Policy Officer in Bulgaria, personal communication January 2012

low-carbon energy development in Bulgaria as early as possible. A second major obstacle towards a low-carbon energy future, reportedly, is that the analysis of possible measures is being done in an non-transparent and unparticipatory manner, meaning that the decision-making and subsequent development of measures does not enjoy widespread input or support from the civil society, and also possibly omits serious consideration of alternatives (such as greater emphasis and investment into renewables)[28].

Thus, Bulgarian policy and political leadership appears to be serious about using the potentials regarding energy efficiency, but less proactive towards using the country's renewable energy potentials, with the status quo of oil, gas and nuclear appearing to stay dominant. The country's available great renewable energy potential is unlikely to be tapped.

[28] Mr Georgi Stefanov, WWF Climate Policy Officer in Bulgaria, personal communication January 2012

2.2. HUNGARY

Summary Facts of Hungary's energy status quo
• Hungary's share of renewables in its energy mix is curently about 7,4% (2010) dominated by biomass energy. Hungary's renewable goal until 2020 is to increase its share to 14,7% above the set EU target for Hungary of 13%, mainly coming from an increase in biomass energy as well as from geothermal energy and biofuels. • Hungary's long-term energy mix continues to be based heavily on fossil fuel sources and on nuclear. • The re-structuring of Hungary's economy and closure of heavy industries has led to a falling total energy use and advances in energy efficiency but GHG emissions particularly from households and transport sectors are steadily increasing. • Energy usage is dominated by imported oil and gas, but substantial renewable potential is recognised especially in biomass, biofuels, geothermal, and (less) solar. • Energy policy is governed by an over-arching, integrated, visionary Energy Strategy to 2050, one of few European countries to have articulated this. • A "Green Economy" is recognised as the way forward for environmental, economic and social reasons and energy is placed within this context with multiple benefits to be gained especially from renewable energy and energy efficiency measures. • Appropriate programming and policy for both renewable and energy efficiency existing, but associated market mechanisms seem sometimes not progressive or attractive enough. • From the information compiled in the section below, it seems that Hungary takes important steps towards the country's low-carbon future development, however, it remains unsettled whether these steps substantially detach Hungary from their continued focus on fossil fuels using the country's available potentials of renewables as well as energy efficiency.

Hungarian climate and energy policy is – unlike in Bulgaria and Romania – guided in part at least by an over-arching, integrated, long term vision and strategy which looks in detail beyond the 20-20-20 timescale up to 2030, with a view to 2050[29].

Consideration of energy supply and demand takes as its starting point the fact the Hungary is hugely dependent upon imports for meeting its energy requirements, with more than 80% of its crude oil and 83% of its natural gas coming from abroad, mostly from Russia and Ukraine[30]. This situation strongly influences Hungary's energy policy and shapes the National Energy Strategy 2030, which seeks to promote the so-called Nuclear-Coal-Green energy mix which the government believes is the most secure way to safeguard the country's energy needs.

The Climate Change Act 2007 (Act LV) based on the implementation framework of the UNFCCC and its Kyoto Protocol created a framework for building Hungary's ability to adapt to and mitigate against climate change. It prescribed the preparation of a national climate change strategy (NCCS) for Hungary, consequently drafted and approved in 2008, by Parliament Decree 29/2008 (III. 20.). The NCCS contains an extensive chapter on both mitigation and adaptation and identifies key objectives and actions to be implemented for 2008-2025. The Climate Change Act 2007 also required that the Hungarian Government adopt National Climate Change Programmes (NCCP) every two years.

The first revision of the NCCS mandated by the Climate Change Act 2007 will take place before the end of 2013. The revised version extended the timeframe of the strategy to 2030 with a 2050 outlook. As part of the revised NCCS, Hungary intends to prepare a national adaptation strategic framework by 2013. This will provide further information on climate change science, observations and sectoral impact assessments. It will be based on a robust metadata base, called the National Adaptation Geographical Information System (NAGIS), the feasibility study of which

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29 Government of Hungary - Ministry of National Development (2012) National Energy Strategy 2030, 132pp., Budapest, Hungary.

30 Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary, p.11.

is currently in progress. This system will be the first comprehensive, countrywide tool to provide high-resolution results of quantified expected trends and the associated uncertainty of local and regional exposure, sensitivity and adaptive capacity for different hazards. It will also to provide input data for spatial and sectoral vulnerability studies.

The table below (Table 3: Energy consumption in Hungary 1999 to 2009) shows the energy usage for the country. Total energy consumption in Hungary for the last decade has shown a slight increase, entirely due to rising transport levels which almost doubled (+46%) including in especially road (+53%), and to a lesser extent, air transportation (+10%). Industry consumption declined by a quarter (25%) and household consumption declined by a small amount (4%) which is probably due to a falling population rather than to increases in energy efficiency.

Indeed, the government itself notes that of a total of 4,3 million homes nationwide, 70% fail to meet modern functional technical and thermal engineering requirements, and that the typical energy consumption for heating in a flat in Budapest is still twice that of a similar unit in Vienna[31].

Table 3: Energy Consumption in Hungary 1999 to 2009 by sector and sub-sector (mTOE)

Energy Consumption	**1999** (and % of total)		**2009** (and % of total)		**% change**	Comments
Total	**16.28**		**16.41**		**+0.8**	
Industry (*of which*)	**3.55**	**(21.8%)**	**2.67**	**(16.3%)**	**-24.8**	
Iron and steel	*0.70*	*(4.3%)*	*0.48*	*(2.9%)*	*-31.4*	
Chemical	*0.82*	*(5.0%)*	*0.50*	*(3.0%)*	*-39.0*	
Glass and pottery	*0.62*	*(3.8%)*	*0.46*	*(2.8%)*	*-25.8*	
Food, drink, tobacco	*0.50*	*(3.1%)*	*0.40*	*(2.4%)*	*-20.0*	
Paper and pulp	*0.17*	*(1.0%)*	*0.12*	*(0.7%)*	*-29.4*	
Transport (*of which*)	**3.27**	**(22.9%)**	**4.78**	**(34.1%)**	**+46.2**	
Road	*2.87*	*(17.6%)*	*4.39*	*(26.6%)*	*+53.0*	
Air	*0.21*	*(1.3%)*	*0.23*	*(1.4%)*	*+9.52*	
Rail	*0.19*	*(1.2%)*	*0.17*	*(1.0%)*	*-10.5*	

31 Government of Hungary (2012) National Energy Strategy 2030, p.13

Inland waterways	- -	- -		
Households	**5.77 (35.4%)**	**5.52 (33.6%)**	**-4.3**	Population fell by 2% for same period from 10.2 million to 10.0 million[32]
Services	**2.96 (18.2%)**	**2.99 (18.2%)**	**+1.0**	
EU-27 (of which): *Industry* *Transport* *Households* *Services*	**1113 (100%)** *319 (29%)* *340 (31%)* *291 (26%)* *123 (11%)*	**1114 (100%)** *269 (24%)* *368 (33%)* *295 (26%)* *141 (13%)*	**+0.1** -16 +8 +1 +15	

Regarding renewable energy, the current and projected shares of different renewable groups are illustrated in the figures (Fig. 3) and table (Table 4) below[33].

[32] Eurostat data available at http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tps00001&plugin=1 accessed on 28 March 2012

[33] Beurskens, Hekkenberg, and Vethman (2011) Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States, 270pp., p. 238, ECN and EEA Report.

Fig. 3: Three figures showing the present and projected renewable energy share of Hungary in 2010, 2015 and 2020.

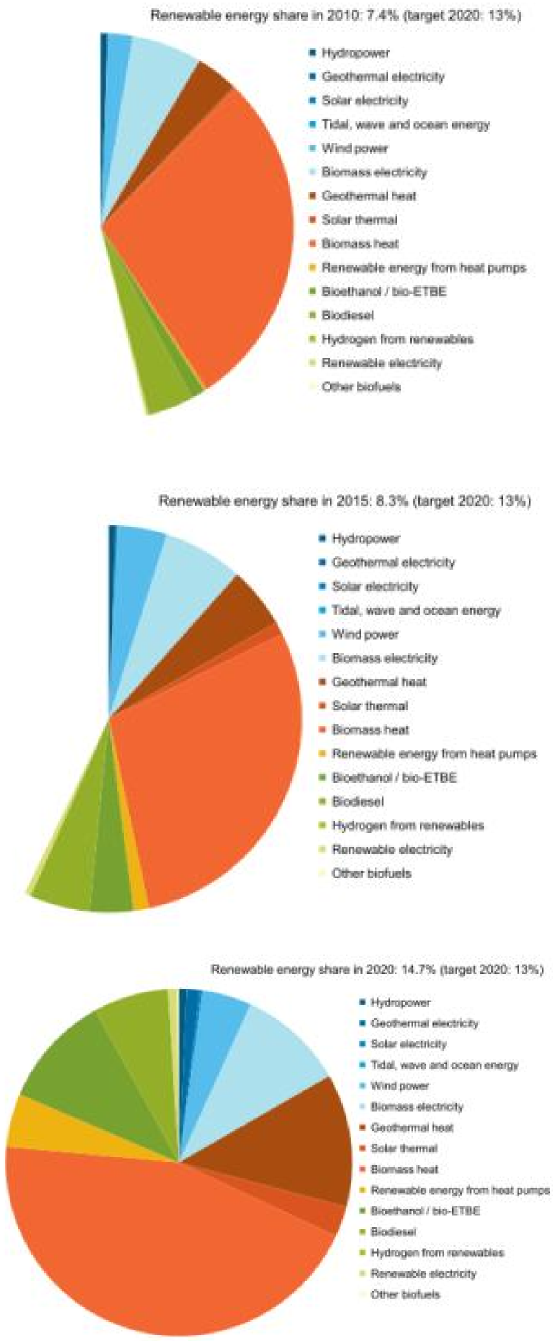


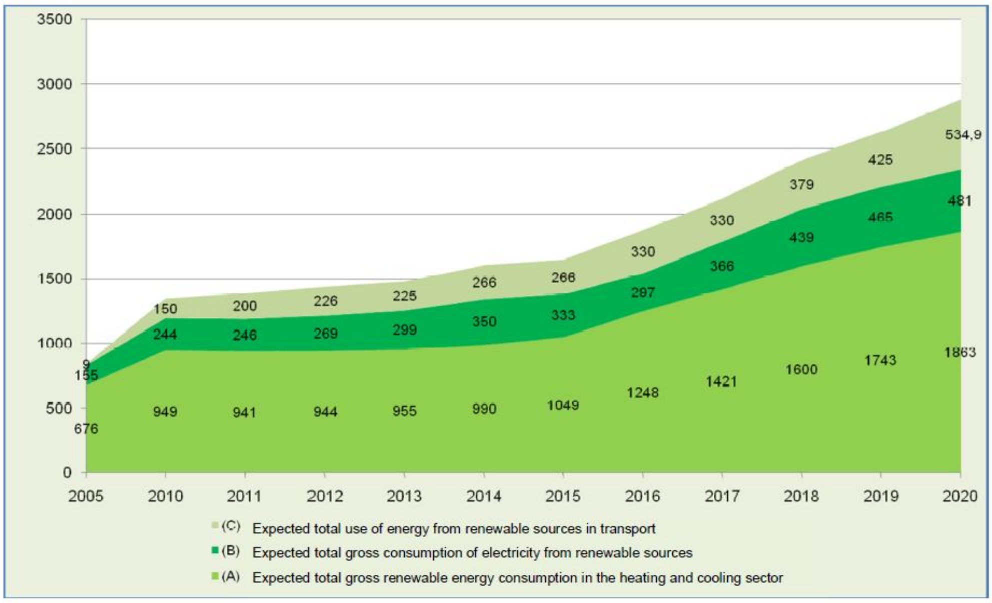
Table 4: Present and projected renewable energy shares of Hungary in 2005, 2010, 2015 and 2020

			2005						2010						2015						2020						Page
			[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	
Renewable production	Electricity	Hydropower < 1MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	103
		Hydropower 1MW – 10 MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	103
		Hydropower >10MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	103
		Hydropower (subtotal)	0	0	0.0	0.0	0.0	0.0	194	17	6.8	1.2	0.5	0.1	196	17	5.1	1.0	0.4	0.1	238	20	4.3	0.7	0.5	0.1	103
		Geothermal	n.a.	n.a.	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	29	2	0.7	0.2	0.1	0.0	410	35	7.3	1.2	0.8	0.2	110
		Solar photovoltaic	n.a.	n.a.	0.0	0.0	0.0	0.0	2	0	0.1	0.0	0.0	0.0	26	2	0.7	0.1	0.1	0.0	81	7	1.4	0.2	0.2	0.0	121
		Concentrated solar power	n.a.	n.a.	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	121
		Solar (subtotal)	0	0	0.0	0.0	0.0	0.0	2	0	0.1	0.0	0.0	0.0	26	2	0.7	0.1	0.1	0.0	81	7	1.4	0.2	0.2	0.0	121
		Tidal, wave and ocean energy	n.a.	n.a.	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	128
		Onshore wind	n.a.	n.a.	0.0	0.0	0.0	0.0	692	60	24.3	4.4	1.6	0.3	1377	118	35.5	7.2	2.9	0.6	1545	133	27.6	4.6	3.0	0.7	139
		Offshore wind	n.a.	n.a.	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	139
		Wind power (subtotal)	0	0	0.0	0.0	0.0	0.0	692	60	24.3	4.4	1.6	0.3	1377	118	35.5	7.2	2.9	0.6	1545	133	27.6	4.6	3.0	0.7	139
		Solid biomass	n.a.	n.a.	0.0	0.0	0.0	0.0	1870	161	65.8	12.0	4.4	0.9	1988	171	51.3	10.4	4.2	0.9	2688	231	48.0	8.0	5.2	1.2	149
		Biogas	n.a.	n.a.	0.0	0.0	0.0	0.0	85	7	3.0	0.5	0.2	0.0	262	23	6.8	1.4	0.5	0.1	636	55	11.4	1.9	1.2	0.3	149
		Bioliquids	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	149
		Biomass (subtotal)	0	0	0.0	0.0	0.0	0.0	1955	168	68.8	12.5	4.6	0.9	2250	193	58.0	11.7	4.7	1.0	3324	286	59.4	9.9	6.5	1.5	149
		Total (according to Template Tables 10a/b)	n.a.	n.a.	0.0	0.0	0.0	0.0	2843	244	**100.0**	18.2	6.7	1.3	3878	333	**100.0**	20.2	8.1	1.7	5597	481	**100.0**	16.7	10.9	2.4	-
		Sum of all technologies (Template Tables 10a/b)	0	0	0.0	0.0	0.0	0.0	2843	244	100.0	18.2	6.7	1.3	3878	333	100.0	20.2	8.1	1.7	5598	481	100.0	16.7	10.9	2.5	-
		Gross final RES-E consumption (Template Table 4a)		n.a.	0.0	0.0	0.0	0.0		244	99.8	18.2	6.6	1.3		333	99.9	20.2	8.1	1.7		481	99.9	16.7	10.9	2.4	78 – 79
	Heating and cooling	Geothermal		n.a.	0.0	0.0	0.0	0.0		101	10.6	7.5	1.0	0.6		147	14.0	8.9	1.4	0.7		337	19.2	12.4	3.6	1.8	154
		Solar thermal		n.a.	0.0	0.0	0.0	0.0		6	0.6	0.4	0.1	0.0		31	3.0	1.9	0.3	0.2		82	4.4	2.8	0.8	0.4	160
		Solid biomass		n.a.	0.0	0.0	0.0	0.0		812	85.6	60.4	7.7	4.4		800	76.3	48.5	7.4	4.0		1225	65.8	42.5	12.4	6.2	168
		Biogas		n.a.	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		30	2.9	1.8	0.3	0.2		56	3.0	1.9	0.6	0.3	168
		Bioliquids		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0	168
		Biomass (subtotal)		0	0.0	0.0	0.0	0.0		812	85.6	60.4	7.7	4.4		830	79.1	50.4	7.7	4.2		1281	68.8	44.5	13.0	6.5	168
		Aerothermal heat pumps		n.a.	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		2	0.2	0.1	0.0	0.0		7	0.4	0.2	0.1	0.0	174
		Geothermal heat pumps		n.a.	0.0	0.0	0.0	0.0		5	0.5	0.4	0.0	0.0		28	2.7	1.7	0.3	0.1		107	5.7	3.7	1.1	0.5	174
		Hydrothermal heat pumps		n.a.	0.0	0.0	0.0	0.0		1	0.1	0.1	0.0	0.0		7	0.7	0.4	0.1	0.0		29	1.6	1.0	0.3	0.1	174
		Renewable energy from heat pumps (subtotal)		0	0.0	0.0	0.0	0.0		6	0.6	0.4	0.1	0.0		37	3.5	2.2	0.3	0.2		143	7.7	5.0	1.4	0.7	174
		Total (according to Template Table 11)		n.a.	0.0	0.0	0.0	0.0		949	**100.0**	70.6	9.0	5.2		1049	**100.0**	63.7	9.8	5.3		1863	**100.0**	64.7	18.9	9.5	-
		Sum of all technologies (Template Table 11)		0	0.0	0.0	0.0	0.0		925	97.5	68.8	8.8	5.1		1045	99.6	63.4	9.7	5.3		1863	100.0	64.7	18.9	9.5	-
		Gross final RES-H/C consumption (Template Table 4a)		n.a.	0.0	0.0	0.0	0.0		949	100.0	70.6	9.0	5.2		1049	100.0	63.7	9.8	5.3		1863	100.0	64.7	18.9	9.5	78 – 79
	Transport	Bioethanol / bio-ETBE		5	100.0	0.0	0.1	0.0		34	22.7	2.5	0.8	0.2		106	39.8	6.4	2.2	0.5		304	56.8	10.6	5.7	1.5	180
		Biodiesel		0	0.0	0.0	0.0	0.0		110	73.3	8.2	2.7	0.6		144	54.1	8.7	2.9	0.7		202	37.8	7.0	3.8	1.0	186
		Hydrogen from renewables		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	190
		Renewable electricity		0	0.0	0.0	0.0	0.0		6	4.0	0.4	0.1	0.0		15	5.6	0.9	0.3	0.1		24	4.5	0.8	0.4	0.1	198
		Other biofuels		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		1	0.4	0.1	0.0	0.0		5	0.9	0.2	0.1	0.0	204
		Total (according to Template Table 12)		5	**100.0**	0.0	0.1	0.0		150	**100.0**	11.2	3.7	0.8		266	**100.0**	16.1	5.4	1.3		535	**100.0**	18.6	10.0	2.7	-
		Sum of all technologies (Template Table 12)		5	100.0	0.0	0.1	0.0		150	100.0	11.2	3.7	0.8		266	100.0	16.1	5.4	1.3		535	100.0	18.6	10.0	2.7	-
		Gross final RES-T consumption (Template Table 4a)		n.a.	0.0	0.0	0.0	0.0		150	100.0	11.2	3.7	0.8		266	100.0	16.1	5.4	1.3		535	100.0	18.6	10.0	2.7	78 – 79
		RES-T including Article 21.2 (Template Table 4b)[e]		5	100.0	0.0	0.1	0.0		177	118.0	13.2	4.3	1.0		310	116.5	18.8	6.3	1.6		598	111.8	20.8	11.2	3.0	78 – 79
	All RES excl. co-operation mech.	Gross final RES consumption (Template Table 4a)		n.a.		0.0	0.0	0.0		1344		100.0	32.9	7.4		1648		100.0	33.5	8.3		2879		100.0	53.8	14.7	78 – 79
		Sum totals Template Tables 10a/b, 11, 12 (corr. Art. 5(1))		5		0.0	0.1	0.0		1337		99.5	32.8	7.3		1633		99.1	33.2	8.3		2855		99.2	53.4	14.5	-
		Sum all technologies in Template Tables 10a/b, 11, 12		5			0.1	0.0		1319			32.3	7.2		1644			33.4	8.3		2879			53.8	14.7	-
	Co-operation mechanisms	Transfer from other Member States and third countries		n.a.		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0	78 – 79
		Transfer to other Member States		n.a.		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0	78 – 79
	All RES incl. co-operation mech.	Total (Template Table 4a)		n.a.		0.0	0.0	0.0		1344		**100.0**	32.9	7.4		1648		**100.0**	33.5	8.3		2879		**100.0**	53.8	14.7	78 – 79
Final consumption	Electricity	reference scenario[f]		3609						3682						4169						4506					64
		additional energy efficiency[f]		3609			**100.0**	18.1		3675			**100.0**	20.1		4118			**100.0**	20.8		4418			**100.0**	22.5	65
	Heating and cooling	reference scenario[f]		12192						10520						11008						10412					66
		additional energy efficiency[f]		12192			**100.0**	61.2		10497			**100.0**	57.5		10742			**100.0**	54.3		9877			**100.0**	50.3	67
	Transport	reference scenario[f]		3964						4107						5005						5492					68
		additional energy efficiency[f]		3964			**100.0**	19.9		4083			**100.0**	22.4		4922			**100.0**	24.9		5349			**100.0**	27.2	69
	Total before aviation reduction	reference scenario[f]		19909						18309						20288						20525					70
		additional energy efficiency[f]		19909				**100.0**		18255				**100.0**		19782				**100.0**		19644				**100.0**	71
	Total after aviation reduction	reference scenario[f]		n.a.						n.a.						n.a.						n.a.					72
		additional energy efficiency[f]		n.a.				0.0		n.a.				0.0		n.a.				0.0		n.a.				0.0	73
Target		Transport fuels target																								10.0	-
		Overall renewable target[g]						4.3						6.0						8.2						13.0	56

[a] The percentages refer to the values in the column '[ktoe]' and express the share of the renewable technology in the sector-total (RES-E, RES-H/C or RES-T, see values highlighted in bold).
[b] The percentages refer to the values in the column '[ktoe]' and express the share of the renewable technology in total RES (if applicable including co-operation mechanisms, see value highlighted in bold).
[c] The percentages refer to the values in the column '[ktoe]' and express the share of the renewable technology in the sector total of the final gross energy consumption ('*Additional energy efficiency scenario*' only), see values highlighted in bold.
[d] The percentages refer to the values in the column '[ktoe]' and express the share of the renewable technology in the total final gross energy consumption (*before aviation reduction* of the *Additional energy efficiency scenario*), see value highlighted in bold.
[e] Art. 21.2 adjustment refers to double counting of certain biofuels (times 2) and and renewable electricity in road transport (times 2.5).
[f] In 'Final consumption' values for the year 2005 refer to the 'base year' in Template Table 1 (see Table 47 (page 64) to Table 56 (page 73).)
[g] For the years 2005 and 2020 the shares as defined in Annex I of Directive 2009/28/EC are presented, for the years 2010 and 2015 it is referred to the trajectory periods 2011-2012 and 2015-2016.
General: where is referred to Tables 1, 4a, 10a/b, 11 and 12 it is meant to the Template, prepared by the European Commission and available for download at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009D0548:EN:NOT

The Hungarian government plans for renewables to grow as per the figure (Fig. 4) below[34].

Fig. 4: Planned development path of renewable energy sources between 2005 and 2020 in Hungary (ktoe)



This growth seeks to exploit the country's great natural advantage for geothermal, as well as increasing uptake of wind, solar and especially biomass generated power. Hydropower expansion is expected to be confined to “dwarf hydroelectric plants” and “flow-through turbines”, both smaller scale constructions with outputs in the range of 10 MWE and 100-500 kWE respectively.

The geothermal gradient in Hungary is one and a half times (150%) the global average. To date, some agro-industrial facilities (including horticulture) and a limited number of residential units exploit this resource, but it is expected to become second only to biomass in terms of renewable contribution to the energy mix by 2020.

34 Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary, p.26.

Hungarian planning on energy efficiency and renewable energy recognises the green economic model and the emerging energy transition as an opportunity for the country in terms of economic, social and environmental development[35][36].

Biomass expansion is seen as the main thrust and central pillar of the renewable strategy, building on the country's strong agricultural tradition, the continuing centrality of that sector to the economy and country as a whole, and perceived advantages in agro-ecological factors. The figure below (Fig. 5) from the Hungarian NREAP (2010, p.213) quantifies and illustrates this pre-eminence clearly.

Fig. 5: Amount of renewable energy in Hungary (NREAP, 2010)

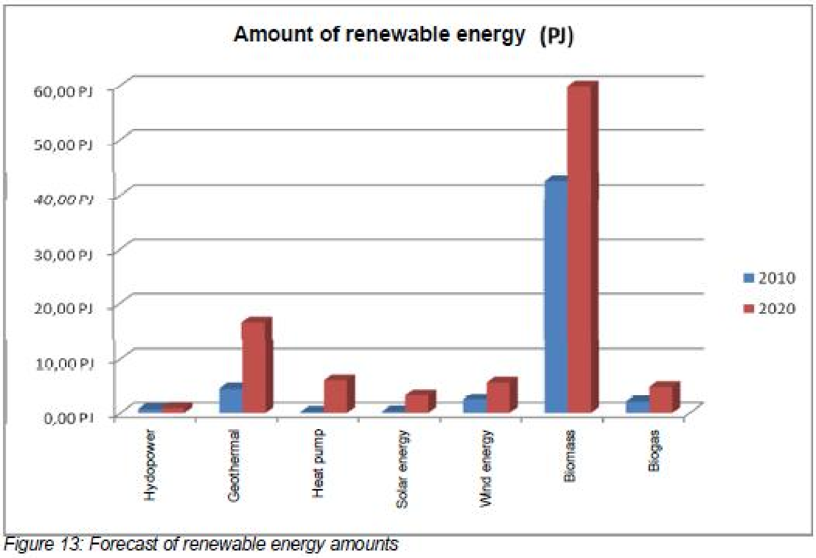


Figure 13: Forecast of renewable energy amounts

35 Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary.

36 Government of Hungary (2011) Second National Energy Efficiency Action Plan of Hungary (until 2016 with an outlook to 2020, Ministry of National Development, 73pp., October 2011, Budapest, Hungary.

Biomass sources are expected to move increasingly towards the (re-)use of agricultural residues, wastes, and by-products, with energy crops (ligneous and herbaceous plants) also experiencing growth. The use of agricultural residues may reach 50% of biomass total source by 2020.

This is to be hoped, since at present much wood is used in biomass power stations, including logs imported from Slovak and Ukrainian forests in the Carpathian mountains.

Noting that the limiting factors to renewable growth are often financial, the plan urges the adoption of economic or financial instruments to reduce the country's dependence on fossil fuels, which continue to be economically more viable as a result of “non-internalisation” of external costs such as environmental damages, climate change, and the cost of initial capital investment e.g. in the gas distribution network[37].

In keeping with its overall strategy, the government plans to widen the instruments and incentives available for accelerating the uptake of renewable energy. Examples are listed in the table below (Table 5), from the Hungarian NREAP (2010)[38]:

[37] Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary, p.22.

[38] Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary, p.11.

Table 5: Areas of financial state interventions in Hungary to promote the spreading of individual types of renewable energy sources (NREAP, 2010).

Name	Production support	Indirect incentives	Investment support	Green financing
Hydropower	X		X	X
Wind energy	X			
Geothermal energy	X		X	X
Solar energy	X	X	X	X
Heat pumps	X	X	X	X
Biomass	X		X	X
Biogas	X		X	X
Biofuel		X	X	X

Such interventions are translated into activities through the development of a series of measures which are summarised in the NREAP (Government of Hungary 2010: p214-216) and which will be activated in the new national development plan (or “New Szechenyi Plan”), see table below (Table 6):

Table 6: State support measures and programmes in Hungary to promote renewable energy (NREAP, 2010).

No	Description
Support measures and programmes	
1	Investment support between 2011 and 2014
2	Launch of a new, independent operational programme for energy in 2014
3	Investment programmes financed from the EU ETS
4	More active participation in programmes under direct Community financing and other types of Community financing
5	Development of a green economy
Other (market, budgetary) financial incentives	
6	Green financing (green bank or targeted refinanced loans)
7	Research and development in renewable energy sources
8	Support for the off-take of green heat from 1 October 2012
9	Mandatory off-take of electricity (MOT)
10	Benefits for heat pumps, geo-tariffs
11	Specification of mandatory biofuel admixture
Regulatory incentives	
12	Drafting of a new act on sustainable energy management
13	Relaxation of the conditions for biogas feed-in through a legislative amendment
14	Review and simplification of the regulatory and authorisation system
15	Review of spatial plans, creation of regional energy concepts
16	Specification of a mandatory renewable energy source ratio in new building energy legislation (EU obligation)
Programmes and other measures	
17	Integrated information and awareness-raising programme
19	Creation of an energy consultancy network, development of a green economy information database (online platform)
20	Energy programme for the buildings of public institutions
21	Green employment (public employment programme) for low-qualification workforce
22	Training programme for highly qualified workforce
23	Programmes with short training time requirements
24	Training programmes with medium-term time requirements
25	Programmes with higher education time requirements
26	Facilitation of the use of biofuels in mass transportation
27	Agricultural energy programme
28	Creation of a standard information document providing a comprehensive and transparent description of the new, simplified regulation of authorisation procedures, and making it available on the websites of administrative bodies
29	Preparation of the administration participating in authorisation procedures for the application of amended legislation on those procedures

Meanwhile, in the transport sector, biodiesel (or agrodiesel) is promoted by the government and readily available throughout the country at selected filling stations and in April 2012 the national oil company MOL, together with the power company ABB, opened the first ever ultra-fast DC charger for electric vehicles, capable of charging a car in 15 to 30 minutes. The station itself is built using re-cycled materials, features roof-top solar panels, and charging of vehicles is free[39].

The range of supports and encouraging policies has also led to rapid and expanded private investment in biofuels (including maize-powered biogas[40],meat-processing waste biogas[41], and sewage sludge biogas[42]).
Thus, the many policies and programmes in the national framework seemingly support the overall long-term strategy of de-coupling from fossil fuels. This does seem indicative of a move towards a low-carbon future.

It should be remembered, however, that the Hungarian “Coal-Nuclear-Green” strategy requires continued and increasing investments in the fossil fuel and nuclear sectors, thus bringing into question the opportunity cost of the strategy vis-a-vis greater and faster alignment with an environmentally safe and renewable energy future.

The question concerning Hungary then, is not whether the current policy and programming framework supports the country's move towards a low-carbon future, as it seemingly does when considering the above outlined information. The question

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39 ABB (2012) ABB delivers ultra-fast charging for electric cars at the “petrol station of the future” in Hungary - unique in Europe, article from www.abb.com on 27.04.2012

40 Budapest Business Journal (2011b) Hungrana to spend HUF 3 bln on biogas furnace, online article from 2 May 2011 at http://www.bbj.hu/business/hungrana-to-spend-huf-3-bln-on-biogas-furnace_57517

41 The Bioenergy Site (2011a) Meat processing waste for renewable energy, online article from 6 October 2011, at http://www.thebioenergysite.com/news/9702/meat-processing-waste-for-renewable-energy

42 The Bioenergy Site (2011b) Hungarian plant utilises sewage sludge, online article from 29 July 2011, at http://www.thebioenergysite.com/news/9269/hungarian-plant-utilises-sewage-sludge

might be rather if it is enough, and whether implementation is proceeding quickly enough. More detailed analysis would be needed at national level to explore this answer.

2.3. ROMANIA

Summary Facts of Romania's energy status quo
• Romania is the 3rd least energy-efficient country in the EU (after Bulgaria and Estonia). • Romania's long-term energy mix continues to be based heavily on fossil fuel sources and on nuclear energy. However, Romania's energy mix currently features 17,5% of renewable sources (2010), dominated by biomass and hydro energy. Further potential is recognised especially in additional biomass and hydro energy in addition to a mix of increasing other renewables like wind or solar (Romania's renewable goal until 2020 is to increase its share of up to 24%). • Romania's re-structuring of its economy and the closure of heavy industries has led to a falling total energy use, but GHG emissions from households and transport sectors are increasing.. • There is no long-term, integrated energy strategy or vision post-2020. • Adequate programming and policies in part exist for both renewable and energy efficiency, with features such as a Green Certificate Scheme, but associated market mechanisms are often not progressive or attractive enough, and problems or delays exist in actual implementation. • Romania is a country with a great diversity of domestically-available renewable energy sources. Its potential for energy self-sufficiency can be considered high and it has enacted some progressive energy policies to date. The problem appears to be in implementing these policies: problems with hydro power development, controversies and legal challenges concerning wind and the (apparent) lack of an over-arching, integrated, long-term national energy strategy are the challenges confronting the country • From the information compiled in the section below, it seems that Romania is only gradually moving towards a low-carbon future. It remains unsettled whether these steps lead to substantially detaching Romania from their continued focus on fossil fuels, to increasingly take advantage of the country's available potentials of renewables as well as energy efficiency.

Romania is blessed with abundant renewable energy sources and also has significant scope for energy efficiency measures.

As an early ratifier of the Kyoto Protocol and one of the first countries to qualify for Joint Implementation (JI) projects on greenhouse gas emission reductions, since 2000 Romania has implemented a series of innovative renewable energy projects including on biogas, geothermal, and sawdust technologies for electricity or heating generation[43]. The importance of energy efficiency was also recognised early and the first national action plan (or NEEAP) was published for the period 2007-2010[44].

Yet there is seemingly no over-arching, publically available, officially published, national long-term strategy which guides and integrates the various efforts[45].

The Romanian government recognises the potential of renewables, especially biomass, hydro and wind, and similarly to Bulgaria and Hungary, seeks to develop these as well as nuclear energy in order to further reduce emissions. Coal also remains important, and the country is unusual in Europe as having its own onshore oil deposits as well as natural uranium.

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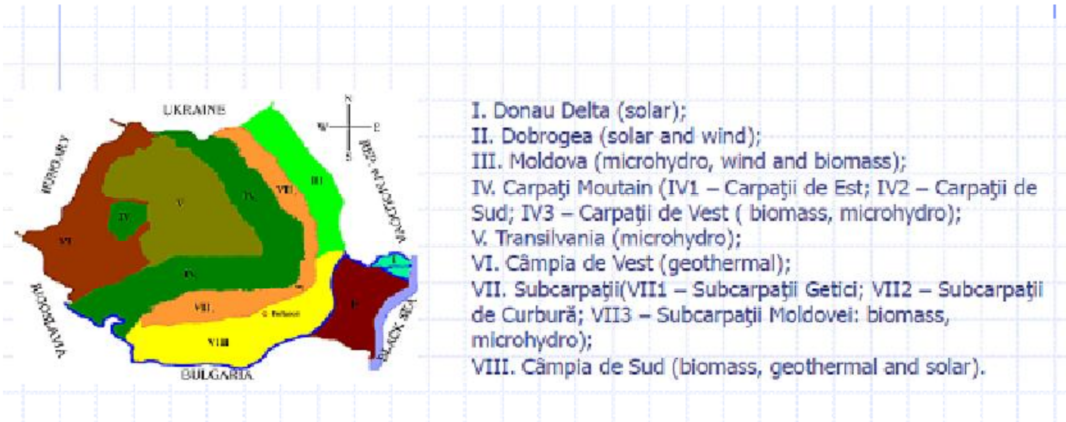
43 Government of Romania (2010) National Renewable Energy Action Plan, 203pp., Bucharest.

44 Government of Romania (2007) First National Action Plan for Energy Efficiency, 2007-2010, 41pp., Bucharest, Romania.

45 The WWF office in Romania could not locate a National Energy Strategy. The closest document to this was a powerpoint presentation by the General Director Energy, Oil and Gas - Mr. Alexandru Sandulescu - entitled “Romanian Energy Sector and the National Energy Strategy” delivered to the 6th Emerging Europe Energy Summit, 4-5th November 2011.

Fig. 6: Map showing the distribution of renewable energy potentials in various regions in Romania (Source: "Sunshine Solar", renewable energy developer, www.sunshinesolarenergy.com/romania_solar_potential.php, 2012)



Regarding renewable energy, the current and projected shares of different renewable groups are illustrated on the figure (Fig. 7) and table (Table 7) below[46].

[46] Beurskens, Hekkenberg, and Vethman (2011) Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States, 270pp., p. 250, ECN and EEA Report.

Fig. 7: Three figures showing the present and projected renewable energy share of Romania in 2010, 2015 and 2020.

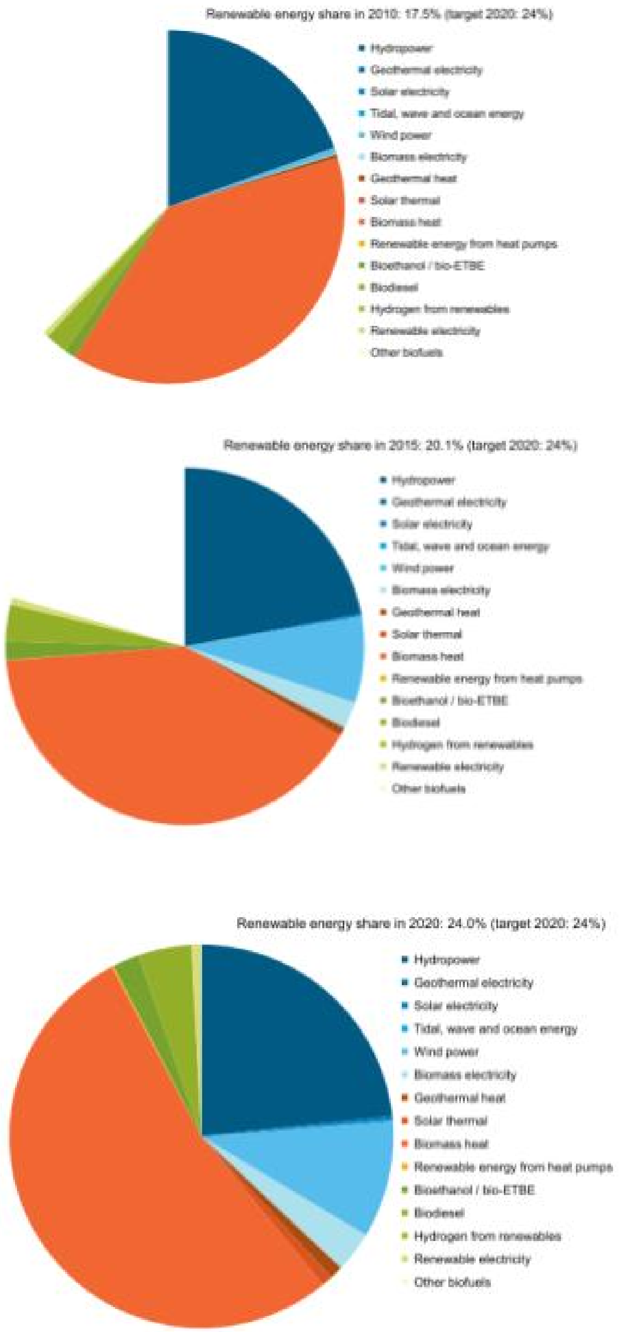


Table 7: Present and projected renewable energy shares of Romania in 2005, 2010, 2015 and 2020

			2005						2010						2015						2020						*Page*
			[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	[GWh]	[ktoe]	[%][a]	[%][b]	[%][c]	[%][d]	
Renewable production	Electricity	Hydropower < 1MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	*103*
		Hydropower 1MW - 10 MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	*103*
		Hydropower >10MW	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	n.a.	n.a.	0.0	0.0	0.0	0.0	*103*
		Hydropower (subtotal)	16091	1384	100.0	28.1	30.1	5.0	16567	1425	96.9	31.5	26.6	5.5	18679	1606	67.9	27.8	28.4	5.6	19768	1700	63.0	23.4	26.8	5.6	*103*
		Geothermal	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	*110*
		Solar photovoltaic	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	180	15	0.7	0.3	0.3	0.1	320	28	1.0	0.4	0.4	0.1	*121*
		Concentrated solar power	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	*121*
		Solar (subtotal)	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	180	15	0.7	0.3	0.3	0.1	320	28	1.0	0.4	0.4	0.1	*121*
		Tidal, wave and ocean energy	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	*128*
		Onshore wind	0	0	0.0	0.0	0.0	0.0	460	40	2.7	0.9	0.7	0.2	6614	569	24.0	9.9	10.1	2.0	8400	722	26.8	9.9	11.4	2.4	*139*
		Offshore wind	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	*139*
		Wind power (subtotal)	0	0	0.0	0.0	0.0	0.0	460	40	2.7	0.9	0.7	0.2	6614	569	24.0	9.9	10.1	2.0	8400	722	26.8	9.9	11.4	2.4	*139*
		Solid biomass	0	0	0.0	0.0	0.0	0.0	48	4	0.3	0.1	0.1	0.0	1450	125	5.3	2.2	2.2	0.4	1950	168	6.2	2.3	2.6	0.6	*149*
		Biogas	0	0	0.0	0.0	0.0	0.0	19	2	0.1	0.0	0.0	0.0	600	52	2.2	0.9	0.9	0.2	950	82	3.0	1.1	1.3	0.3	*149*
		Bioliquids	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0	*149*
		Biomass (subtotal)	0	0	0.0	0.0	0.0	0.0	67	6	0.4	0.1	0.1	0.0	2050	176	7.4	3.1	3.1	0.6	2900	249	9.2	3.4	3.9	0.8	*149*
		Total (according to Template Tables 10a/b)	16091	1384	**100.0**	28.1	30.1	5.0	17094	1470	**100.0**	32.5	27.5	5.7	27523	2367	**100.0**	41.0	41.8	8.3	31388	2699	**100.0**	37.1	42.6	8.9	-
		Sum of all technologies (Template Tables 10a/b)	16091	1384	100.0	28.1	30.1	5.0	17094	1470	100.0	32.5	27.5	5.7	27523	2367	100.0	41.0	41.8	8.3	31388	2699	100.0	37.1	42.6	8.9	-
		Gross final RES-E consumption (Template Table 4a)		1347	97.4	27.4	29.3	4.9		1435	97.6	31.7	26.8	5.5		2333	98.6	40.4	41.3	8.2		2666	98.8	36.7	42.1	8.8	*76 – 79*
	Heating and cooling	Geothermal		17	0.5	0.3	0.1	0.1		25	0.9	0.6	0.2	0.1		52	1.7	0.9	0.3	0.2		80	2.0	1.1	0.4	0.3	*154*
		Solar thermal		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		14	0.5	0.2	0.1	0.0		70	1.7	1.0	0.4	0.2	*160*
		Solid biomass		0	0.0	0.0	0.0	0.0		2793	99.1	61.7	17.7	10.8		2919	97.3	50.6	16.6	10.2		3845	95.2	52.9	21.0	12.7	*168*
		Biogas		0	0.0	0.0	0.0	0.0		1	0.0	0.0	0.0	0.0		10	0.3	0.2	0.1	0.0		20	0.5	0.3	0.1	0.1	*168*
		Bioliquids		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		2	0.1	0.0	0.0	0.0		11	0.3	0.2	0.1	0.0	*168*
		Biomass (subtotal)		0	0.0	0.0	0.0	0.0		2794	99.1	61.7	17.7	10.8		2931	97.7	50.8	16.7	10.2		3876	96.0	53.3	21.2	12.8	*168*
		Aerothermal heat pumps		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		1	0.0	0.0	0.0	0.0		4	0.1	0.1	0.0	0.0	*174*
		Geothermal heat pumps		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		2	0.1	0.0	0.0	0.0		8	0.2	0.1	0.0	0.0	*174*
		Hydrothermal heat pumps		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	*174*
		Renewable energy from heat pumps (subtotal)		0	0.0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0		3	0.1	0.1	0.0	0.0		12	0.3	0.2	0.1	0.0	*174*
		Total (according to Template Table 11)		3183	**100.0**	64.7	16.9	11.6		2819	**100.0**	62.2	17.9	10.9		3000	**100.0**	52.0	17.1	10.5		4038	**100.0**	55.6	22.0	13.3	-
		Sum of all technologies (Template Table 11)		17	0.5	0.3	0.1	0.1		2819	100.0	62.2	17.9	10.9		3000	100.0	52.0	17.1	10.5		4038	100.0	55.6	22.0	13.3	-
		Gross final RES-H/C consumption (Template Table 4a)		3516	110.5	71.4	18.7	12.8		2819	100.0	62.2	17.9	10.9		3000	100.0	52.0	17.1	10.5		4038	100.0	55.6	22.0	13.3	*76 – 79*
	Transport	Bioethanol / bio-ETBE		n.a.	0.0	0.0	0.0	0.0		75	25.3	1.7	1.6	0.3		121	26.7	2.1	2.2	0.4		163	22.8	2.2	2.9	0.5	*180*
		Biodiesel		n.a.	0.0	0.0	0.0	0.0		149	50.3	3.3	3.2	0.6		242	53.3	4.2	4.5	0.8		326	45.7	4.5	5.8	1.1	*186*
		Hydrogen from renewables		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		2	0.3	0.0	0.0	0.0	*190*
		Renewable electricity		41	50.0	0.8	1.0	0.1		36	12.2	0.8	0.8	0.1		45	10.0	0.8	0.8	0.2		53	7.4	0.7	0.9	0.2	*198*
		Other biofuels		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		n.a.	0.0	0.0	0.0	0.0		7	0.9	0.1	0.1	0.0	*204*
		Total (according to Template Table 12)		82	**100.0**	1.7	2.0	0.3		296	**100.0**	6.5	6.3	1.1		454	**100.0**	7.9	8.4	1.6		714	**100.0**	9.8	12.7	2.4	-
		Sum of all technologies (Template Table 12)		41	50.0	0.8	1.0	0.1		260	87.8	5.7	5.5	1.0		408	90.0	7.1	7.6	1.4		551	77.1	7.6	9.8	1.8	-
		Gross final RES-T consumption (Template Table 4a)		58	70.9	1.2	1.4	0.2		275	92.8	6.1	5.8	1.1		436	96.1	7.6	8.1	1.5		564	79.0	7.8	10.0	1.9	*76 – 79*
		RES-T including Article 21.2 (Template Table 4b)[e]		58	70.9	1.2	1.4	0.2		275	92.8	6.1	5.8	1.1		436	96.1	7.6	8.1	1.5		564	79.0	7.8	10.0	1.9	*76 – 79*
	All RES excl. co-operation mech.	Gross final RES consumption (Template Table 4a)		4921		100.0	118.9	17.9		4529		100.0	95.9	17.5		5769		100.0	107.3	20.2		7268		100.0	129.1	24.0	*76 – 79*
		Sum totals Template Tables 10a/b, 11, 12 (corr. Art 5(1))		4807		95.6	111.3	16.7		4549		100.4	96.3	17.6		5775		100.1	107.4	20.2		7395		101.8	131.4	24.4	-
		Sum all technologies in Template Tables 10a/b, 11, 12		1441			34.8	5.2		4549			96.3	17.6		5775			107.4	20.2		7287			129.5	24.1	-
	Co-operation mechanisms	Transfer from other Member States and third countries		0		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0	*76 – 79*
		Transfer to other Member States		0		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0		0		0.0	0.0	0.0	*76 – 79*
	All RES incl. co-operation mech.	Total (Template Table 4a)		4921		**100.0**	118.9	17.9		4529		**100.0**	95.9	17.5		5769		**100.0**	107.3	20.2		7268		**100.0**	129.1	24.0	*76 – 79*
Final consumption	Electricity	reference scenario[f]		4601						5350						6189						7439					*64*
		additional energy efficiency[f]		4601			**100.0**	16.7		5350			**100.0**	20.7		5655			**100.0**	19.8		6334			**100.0**	20.9	*65*
	Heating and cooling	reference scenario[f]		18779						16056						18943						20696					*66*
		additional energy efficiency[f]		18779			**100.0**	68.2		15788			**100.0**	61.0		17572			**100.0**	61.4		18316			**100.0**	60.5	*67*
	Transport	reference scenario[f]		4139						4856						5707						6239					*68*
		additional energy efficiency[f]		4139			**100.0**	15.0		4725			**100.0**	18.3		5379			**100.0**	18.8		5628			**100.0**	18.6	*69*
	Total before aviation reduction	reference scenario[f]		27519						26261						30838						34374					*70*
		additional energy efficiency[f]		27519				**100.0**		25863				**100.0**		28606				**100.0**		30278				**100.0**	*71*
	Total after aviation reduction	reference scenario[f]		n.a.						n.a.						n.a.						n.a.					*72*
		additional energy efficiency[f]		n.a.				0.0		n.a.				0.0		n.a.				0.0		n.a.				0.0	*73*
Target		Transport fuels target																								10.0	-
		Overall renewable target[g]						17.8						19.0						20.6						24.0	*58*

[a] The percentages refer to the values in the column "[ktoe]" and express the share of the renewable technology in the sector-total (RES-E, RES-H/C or RES-T, see values highlighted in bold).
[b] The percentages refer to the values in the column "[ktoe]" and express the share of the renewable technology in total RES (if applicable including co-operation mechanisms, see value highlighted in bold).
[c] The percentages refer to the values in the column "[ktoe]" and express the share of the renewable technology in the sector total of the final gross energy consumption (*'Additional energy efficiency scenario'* only), see values highlighted in bold).
[d] The percentages refer to the values in the column "[ktoe]" and express the share of the renewable technology in the total final gross energy consumption (*before aviation reduction* of the *Additional energy efficiency scenario*), see value highlighted in bold).
[e] Art. 21.2 adjustment refers to double counting of certain biofuels (times 2) and and renewable electricity in road transport (times 2.5).
[f] In 'Final consumption' values for the year 2005 refer to the 'base year' in Template Table 1 (see Table 47 (page 64) to Table 56 (page 73).)
[g] For the years 2005 and 2020 the shares as defined in Annex I of Directive 2009/28/EC are presented, for the years 2010 and 2015 it is referred to the trajectory periods 2011-2012 and 2015-2016.
General: where is referred to Tables 1, 4a, 10a/b, 11 and 12 it is meant to the Template, prepared by the European Commission and available for download at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009D0548:EN:NOT

With half of it's electricity already coming from non-fossil sources (21% from nuclear and 29% from hydro) and a range of progressive policy and market mechanisms in place such as no barriers for import/exports, green certificates and trading, and a fully-liberalised marketplace since 2007, the Romanian energy field is "advanced compared to other countries in the region"[47]. It also has relatively efficient thermal power stations (at 30% rated by the energy company ABB as "among the best countries")[48].

Future energy needs will likely be met by a combination of (increasingly) nuclear, renewable, domestic coal and oil/gas. New units at the Cernavoda nuclear power plant are planned for opening and at least one new nuclear power plant will be constructed. Romania has reserves of natural uranium of undisclosed magnitude and these, together with its coal and lignite reserves, and some remaining oil, mean that of the three countries it is the least dependent on imports for its energy requirements.

At the same time, with its enormous potential for renewable energy, Romania could probably become energy self-sufficient.

Analysis of energy needs show a declining total consumption mainly due to drastic reduction in usage in industry, especially the heavy industry (see Table 8 below).

47 Sandulescu A. (2011) Romanian Energy Sector and the National Energy Strategy, powerpoint presentation delivered to the 6th Emerging Europe Energy Summit, 4-5th November 2011, by the General Director Energy, Oil and Gas - Romanian Ministry of Economy, Commerce , Romania.

48 ABB (2011c) Romania – Energy Efficiency Report 2011, 6pp., available on www.abb.com

Table 8: Energy Consumption in Romania 1999 to 2009 by sector and sub-sector (mTOE)

Energy Consumption	1999 (and % of total)	2009 (and % of total)	% change	Comments
Total	**22.48**	**22.13**	**- 1.6**	
Industry (*of which*) *Iron and steel* *Chemical* *Glass and pottery* *Food, drink, tobacco* *Paper and pulp*	**8.83 (39.3%)** *3.07 (13.7%)* *1.55 (6.9%)* *0.97 (4.3%)* *0.63 (2.8%)* *0.27 (1.2%)*	**6.41 (29.0%)** *1.73 (7.8%)* *2.03 (9.2%)* *0.53 (2.4%)* *0.52 (2.3%)* *0.09 (0.4%)*	**-27.4** *-43.6* *+31.0* *-45.4* *-17.5* *-66.7*	
Transport (*of which*) *Road* *Air* *Rail* *Inland waterways*	**3.29 (22.9%)** *2.58 (19.6%)* *0.13 (1.1%)* *0.33 (1.0%)* *0.22 (0.03%)*	**5.36 (34.1%)** *4.78 (29.7%)* *0.23 (2.3%)* *0.24 (0.7%)* *0.005 (§%)*	**+62.9** *+85.3* *+76.9* *-27.3* -97.7	
Households	**8.74 (24.7%)**	**8.02 (24.7%)**	**-8.2**	Population fell by 4% from 22.5 to 21.5 million for same period[49]
Services	**0.70 (7.3%)**	**1.76 (10.9%)**	**+144.3**	
EU-27 (of which): *Industry* *Transport* *Households* *Services*	**1113 (100%)** *319 (29%)* *340 (31%)* *291 (26%)* *123 (11%)*	**1114 (100%)** *269 (24%)* *368 (33%)* *295 (26%)* *141 (13%)*	**+0.1** -16 +8 +1 +15	

Romania has the lowest natural gas prices in the EU at 0,0301 EUR/kWh, less than 50% of the price in Germany (0,0615) or Austria (0,0630)[50]. It also has the 4th

[49] Eurostat figures available at http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tps00001&plugin=1 accessed 10 April 2012

[50] EU Energy Portal www.energy.eu

cheapest electricity at 0,1207 EUR/kWH, with only Bulgaria, Estonia and Latvia cheaper[51]. Furthermore, together with Bulgaria, Romania has the cheapest petrol (Euro 95) in the EU, at 1,284 and 1,286 EUR/litre respectively[52].

As is with the case for Bulgaria, governmental subsidisation of energy and fuel (for now, fossil-fuel based) is perhaps understandable given the country's low economic base – Romania's GDP is the second lowest in the entire EU after Bulgaria at just 46% of the EU-27 average in 2010[53] – yet still this governmental subsidy on energy and fuel consumption nonetheless represents a “perverse incentive” for overusage as well as a negative subsidy against new technologies and renewable sources attempting to break into the energy market.

The data reveal the wealth of renewable resources available to the country. Romania has enormous wind potential, terrestial and offshore. Reportedly, the installed capacity could be as high as 14.000 MW, and the region of Dobrogea is the “second-most favourable” location for production in the whole of Europe[54]. Investors have rushed to this and other locations in the country and wind projects have proliferated (see also Table 9 below showing a forecast of wind farms to be installed in Romania by 2013).

51 EU Energy Portal www.energy.eu

52 EU Energy Portal www.energy.eu

53 From Eurostat available at: http://epp.eurostat.ec.europa.eu/tgm/table.do tab=table&init=1&plugin=1&language=en&pcode=tec00114 accessed on 28 March 2012

54 Erste Bank study quoted on www.evz.ro available at http://www.evz.ro/detalii/stiri/dobrogea-pe-locul-doi-in-europa-ca-potential-eolian-838511.html

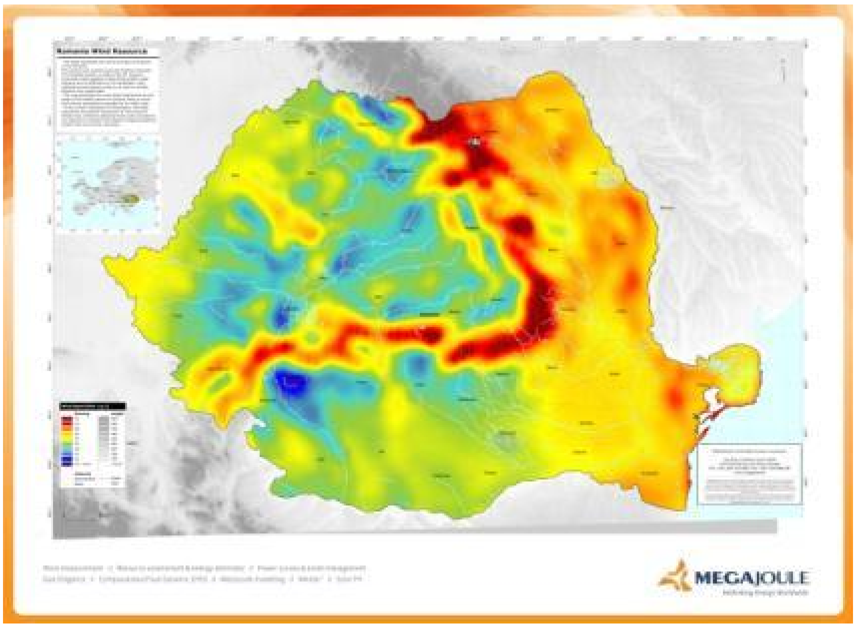
Table 9: Forecast of capacity of wind farms to be installed in Romania by 2013 (Source: Sandulescu, 2011, "Romanian Energy Sector and the National Energy Strategy" delivered to the 6th Emerging Europe Energy Summit, 4-5th November 2011)

Company	Location	MW to be installed per YEAR				
		2009	2010	2011	2012	2013
Existing	Various	14.1				
Hollrom	Baia		5			
Blue Planet	Baia		10			
Global Wind	Not disclosed		40			
EDPR Renovatio	Pestera		90			
	Cernavoda		128			
Monson	Silistea		5			
	Galbiori		5			
CEZ	Fantanele		250	50		
	Cogealac			300		
Bogaris	Harsova				72	
	Facaieni					52
	Victoria					40
IMA Partners	Casimcea, Topoog, Daieni			200	232	
Land Power	Topolog				168	
IMA Partners/Verbund	7 villages in Vaslui and Iasi			200	442.5	
Martifer	Babadag		10.5	31.5		
	Casimcea				40	
ENEL (Blue Line)	Valea Nucarilor			50	50	110
EP Energy	Chirnogeni-Independenta			80		
Iberdrola						1600
Karomex	Saraiu				40	
TOTAL		14.1	543.5	911.5	1045	1802
Grand TOTAL		4315.6				

However, the problem remains in implementation. Of the approximately 2.500 MW of extra wind power which should have come onstream by 2012, only an estimated 1.140 MW has actually materialised as of March 2012, according to the Romanian Wind Energy Association[55].

[55] Rose (2012) Europe's emerging wind power markets continue to grow even with obstacles, online article on European Wind Energy Association website at http://blog.ewea.org/2012/04/europes-emerging-wind-power-markets-continue-to-grow-even-with-obstacles/ from 19 April 2012.

Fig. 8: Romania's wind resource – showing the yearly average wind speed in Romania indicating best possible sites for further wind development (Source: RESbroker,2012, http://resbroker.files.wordpress.com/2011/10/windmap-harta-big.jpg)



Also, significant environmental concerns have been raised in relation to Romanian wind exploitation, as described in the next chapter.

The country also has enormous hydropower potential, which it has been exploiting for decades and which is the reason for Romania being largely on track towards meetings its renewable energy target. As shown in the next chapter, there are also numerous planned hydro projects on the drawing board, and the highest number of "under construction" schemes in the whole EU.

Thus, of the three countries in this study, Romania is the one with the greatest diversity of domestically-available energy sources, renewable as well as non-renewable. Its potential for energy self-sufficiency is high and it has enacted quite progressive energy policies to date. The problem appears to be in implementing the policies: problems with hydro power development, controversies and legal challenges concerning wind and the (apparent) lack of an over-arching, integrated, long-term national energy strategy are the challenges confronting the country.

2.4. CONCLUSIONS

It could be stated that energy policies need to reflect three basic needs for a society:

1. energy access and energy security, for all, in an economical way now and in future;
2. providing for adaptation to and mitigation of climate change; and
3. maintaining healthy ecosystems, which form the long-term basis for 1) and 2).

These demands interact with one another in many ways, and indeed might sometimes conflict. Careful consideration and emphasis needs therefore to be placed by policy-makers, as remarked upon by the Hungarian NREAP, to the "joint effects, the resolution of conflicts between the goals, and the achievement of the greatest possible degree of consistency[56]".

Energy efficiency and renewable energy as twin motors for transitioning to a greener, low-carbon economy have been identified by the UN, by WWF, by the IPCC, and by a host of other stakeholders.

The EU has assumed a position of global leadership on climate change, but even its own policy package is insufficient to deliver a low-carbon future by 2050.

All three countries are seeking to develop and intensify their use of coal and nuclear sources. None of the three countries has changed its policy on nuclear power in the wake of the Japanese Fukushima nuclear accident in 2011, in contrast to Belgium, Germany and Switzerland which announced intention to phase out completely, and Japan which intends to reduce its dependency in the mid- to longer term[57].

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56 Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary, p.11.

57 IEA (2012) Tracking clean energy progress – Energy technology perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial, p.24., Paris, France.

Of the three countries, only Hungary has a long term energy vision to 2030 or beyond. These deficiencies will be discussed in more detail in the following chapter.

More broadly, commentators such as the IEA note that not enough is being done to shift towards the low-carbon path, and that governments need to ensure[58]:

- effective and efficient policy design
- smooth planning and permitting processes
- broader environmental management and public acceptance
- grid integration and priority access
- market diversification
- continued support for innovation and R+D

Policy design and grid issues are largely determined by the EU framework. The three countries are following the overall EU direction and are pursuing their share of the internationally agreed targets. It has already been observed that the EU policy framework – as it stands – is insufficient to guide Europe to a low-carbon economy by 2050.

Against this background and from the information compiled in this thesis, it can be deduced that it remains questionable if the three countries will be able to establish low-carbon economies by 2050 achieving the necessary transition of their energy supply from a focus on fossil fuels now to a renewable energy linked with the far-reaching reductions in GHG emissions in the future.
This presumed inability is further indicated by:

- an insufficient visioning and a lack of a clear strategy beyond 2020 (Bulgaria and Romania);
- too great an emphasis placed currently and in the future on coal, gas and lignite (Bulgaria, Hungary, and Romania);

[58] IEA (2012) Tracking clean energy progress – Energy technology perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial, p.29-30, Paris, France.

- the continued and expanded focus and investment in nuclear (Bulgaria, Hungary and Romania);
- administrative problems with permitting, EIAs and procedures (Bulgaria and Romania);
- a lack of transparency in energy decision-making (Bulgaria and Romania);
- insufficient attention given to renewables (Bulgaria);
- and questionmarks over pricing, tariffs and market mechanisms and how they increasingly stimulate the transition to more renewables (Bulgaria and to some extent Romania)

This conclusion is notwithstanding the many positive policy and programmatic efforts outlined above towards both renewable energy and energy efficiency in all three countries.

3. ENERGY POTENTIALS INCLUDING THE COUNTRIES' PERFORMANCE AGAINST THE EU CLIMATE&ENERGY FRAMEWORK

3.1. POTENTIALS OF RENEWABLE ENERGY

As often mentioned, one of the positives concerning renewable energy is that every single country in the world has access to it, unlike fossil fuels or nuclear power, the deposits or technical capacity for which are concentrated in a very small number of countries.

2011 was a landmark year for renewables in that for the first time, total global investment in new renewable powerplants (USD 240 billion) surpassed that for fossil fuels (USD 219 billion)[59].

Bulgaria, Hungary and Romania all have significant renewable energy potential, a fact acknowledged by the governments of these countries through their planning and programming processes[60], and by the private sector, which is seeking to invest heavily in renewable energy projects across the region.

To provide estimation figures of renewable energy potentials is a difficult task as of different viewpoints, different calculations and data sources. Hence, the table below (Table 10) provides only indicative, approximate figures of estimations for key renewable energy technology potentials for the three countries according to the data sources indicated.

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59 IEA (2012) Tracking clean energy progress – Energy technology perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial, p.27., Paris, France.

60 For example, the National Energy Efficiency Action Plans (NEEAPs) and National Renewable Energy Action Plans (NREAPs), produced in 2010 and 2011 and available online at http://ec.europa.eu/energy/renewables/action_plan_en.htm for NREAPs and http://ec.europa.eu/energy/efficiency/action_plan/action_plan_en.htm for NEEAPs

Table 10: Approximate estimates/indications of technical potentials of key renewable energy technologies in the three countries shown in PJ per year (based on different sources as indicated in the footnotes).

Country	Wind potential	Solar potential	Biomass potential	Hydro potential
Bulgaria[61]	about 1,3 PJ[62]	about 2,2 PJ for PV; 8,1 PJ for solar thermal	about 96 PJ	about 17,9 PJ
Hungary[63]	about 23 PJ	about 4-10 PJ for PV; about 15 PJ for solar thermal	from about 40-80[64] up to about 140[65] PJ	no noteworthy potential (due to topography)
Romania[66]	about 16,2 PJ (only for the Black Sea cost as the most promising area)	about 4,3 PJ for PV; about 60 PJ for solar thermal (both figures if solar resource is only used for PV or solar thermal)	up to about 316 PJ	about 129 PJ[67]

[61] EBRD (2009a) Bulgaria Country Overview, factsheet from the EBRD Renewable Energy Initiative, 15pp.

[62] Sofia Energy Centre (2010) Bulgarian Theoretical and Technical Potential of RES, available online at http://www.sec.bg/userfiles/file/Solar%20Info%20Pack/Infopack_AnnexII.pdf

[63] Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), Budapest, Hungary

[64] EBRD data from Renewables Initiative: Hungary overview online at http://www.ebrdrenewables.com/sites/renew/countries/Hungary

[65] IEE project “futures-e” (2008) Deliverable D13: Characteristics of RES-e in Central and Eastern Europe, avaiable online at http://www.futures-e.org/docs.php

[66] EBRD (2009b) Romania Country Overview, factsheet from the EBRD Renewable Energy Initiative, 10pp.

[67] Institute for Studies and Power Engineering (2011) Efficient Use Of Hydroenergy Resources In Romania, Bucharest, Romania

In Bulgaria, there is good potential for renewable energies, including especially biomass, solar and biofuels. According to the EU, the total wind capacity could be about 2.200 – 3.400 MW, whilst solar is viable in the south and east, and an additional 200 MW could be generated from geothermal sources. Biomass would appear to be attractive, since approximately 60% of the territory is agricultural and much of the remainder forestry (30%)[68].

Hungary has above-average potential for geothermal energy, is suitable for wind power, solar (with potentially installable solar modules leading to very high figures), and high potential for biomass production. Hydro power is of no importance due to the (flat) topography of Hungary (see Fig. 9).

Fig. 9: Maximum potential of renewable energy in Hungary (Source: Hungarian Academy of Sciences, Renewable Energy Subcommittee)

Maximum potential renewable energy in Hungary	Potential (PJ)	Current (PJ)
Solar photovoltaic *(based on potentially installable solar modules)*	1,750	0.1
Biomass	300	49.2
Solar thermal	102.5	0.01
Geothermal	63.5	3.6
Water	14.4	0.7
Wind	532.8	0.16
Total	2,600–2,700	53.8

Romania is blessed with abundant biomass, wind, solar and hydro-electric potential, in addition to its reserves of fossil fuels.

All three countries currently utilise nuclear power and plan to continue to do so, despite e.g. the Fukushima nuclear accident prompting Germany, Switzerland and Belgium to announce their intention to phase out nuclear completely.

68 European Commission, Directorate-General for Energy and Transport (2008) Bulgaria Renewable Energy Factsheet, 3pp., Brussels.

3.2. POTENTIALS OF ENERGY EFFICIENCY

Energy efficiency is the single most important element in various the scenarios to demonstrate the possibility for 100% renewable energy by 2050[69]. Energy efficiency in all the countries of central and eastern Europe, hence also in Bulgaria, Hungary and Romania, is low.

According to the Global Footprint Network energy (carbon) accounts for more than half (54%) of our global footprint (WWF Living Planet Report, 2010). It is also, still, the fastest growing component. Any move to a ”greener economy” must therefore tackle energy. This is especially the case in CEE.

The most startling feature of the footprint for CEE, compared to the rest of Europe, is that its energy footprint is higher than in for example Austria, whilst its GDP is lower. This is normally expressed as „carbon efficiency” or energy intensity, and all countries of CEE have a very high carbon/GDP ratio, i.e. they are very inefficient in translating energy into money (either directly or expressed through e.g. heat, transportation etc.). The figure (Fig. 10) below[70] compares the EU Member States showing high positions of all three focus countries, with Bulgaria at the top with an energy intensity of approximately five times the EU average.

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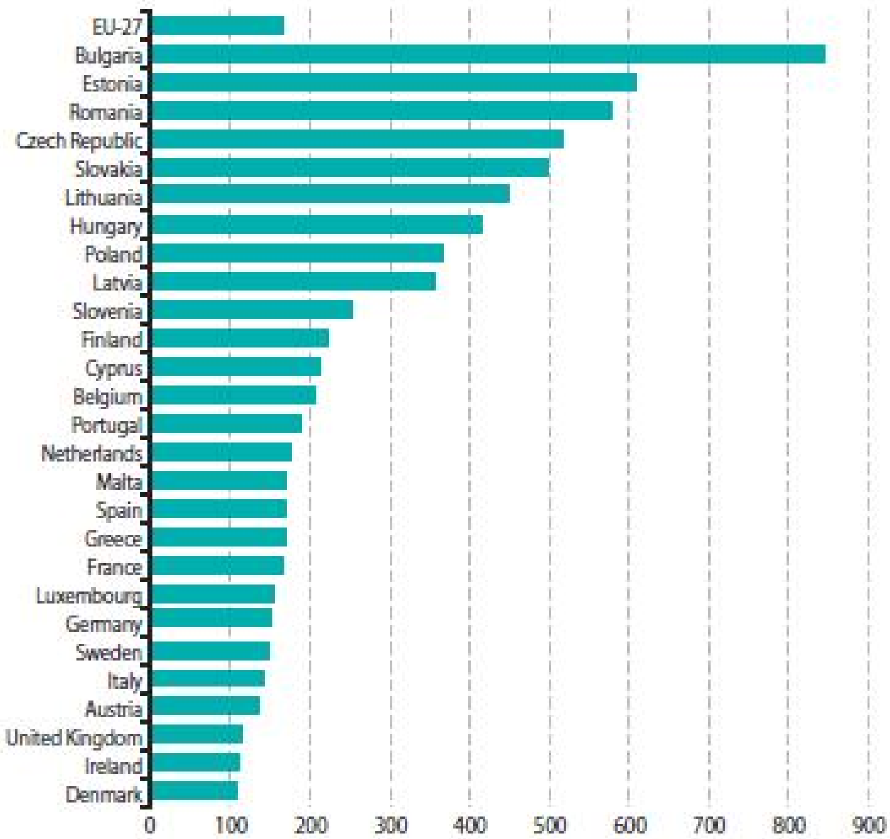
69 WWF (2011) The Energy Report - 100% Renewable by 2050, p.44

70 European Union (2011) *EUROSTAT Pocketbooks: Energy, Transport and Environment Statistics*, p.33, EU Luxembourg 218pp

Fig. 10: Energy intensity of of the EU member states (kgoe/1.000 EUR '00) – Bulgaria listed at the top, Romania on the 3rd place and Hungary 7th place (Eurostat, 2011).



What is interesting is that Bulgaria's efficiency is actually decreasing, relative to the rest of Europe, with its carbon intensity as reported to Eurostat increasing from 104% of the EU average in 2000 to 109% in 2009 (European Commission, 2011, p.141). With the exception of Malta and Luxembourg, every other country is reducing the amount of carbon used for wealth generation.

Overall and taken together, these data means there is an enormous opportunity to carve a big hole in the (global) footprint of CEE by undertaking energy efficiency measures. These could include investments into e.g. housing insulation for citizens as well as more efficient heating and cooling and lighting for commercial and industrial properties, including the tourism sector for example.

Globally, the potential for more efficient energy use in industry is enormous. Based on demonstrated industrial energy efficiency policies and commercially available technologies, industry has the potential to decrease its energy intensity and emissions by 26% and 32% respectively, thus reducing total global energy use by 8% and global CO_2 emissions by 12.4%[71].

Some aspects of the region's post-communist legacy in central planning continue to cause problems. One example is the prevalence of district-heating systems for pre-fabricated „panel" housing blocks, mostly constructed during the 1960s. Some commentators have identified a unique form of „fuel and energy poverty" where low-efficiency and high locked-in costs cause generally low-income families to become trapped in a vicious circle of debt through rising energy costs (Tirrado Herrero and Urge-Vorsatz 2010 in press).

Thus, energy efficiency and especially energy efficiency in relation to buildings (principally housing) is a very significant environmental, economic, and social issue in CEE and the three focus countries of the present study.

The most significant reason for this is historical: for decades after the Second World War, the centrally-planned „socialist" economies in CEE were driven by cheap and hugely subsidised energy, resulting in very poor building stock, inefficient and illogical heat distribution networks, and a lack of investment in efficiency measures. There was simply no incentive to save energy.

Of course, this now represents an enormous opportunity. In addition to the big three sectors of buildings, industry and agriculture, significant quantities of greenhouse gas emission savings are also anticipated[72] for energy supply, forestry, waste and transport, see figure below (Fig. 11) (with the latter's net contribution to emissions in Bulgaria and Romania continuing to grow, unlike all other sectors).

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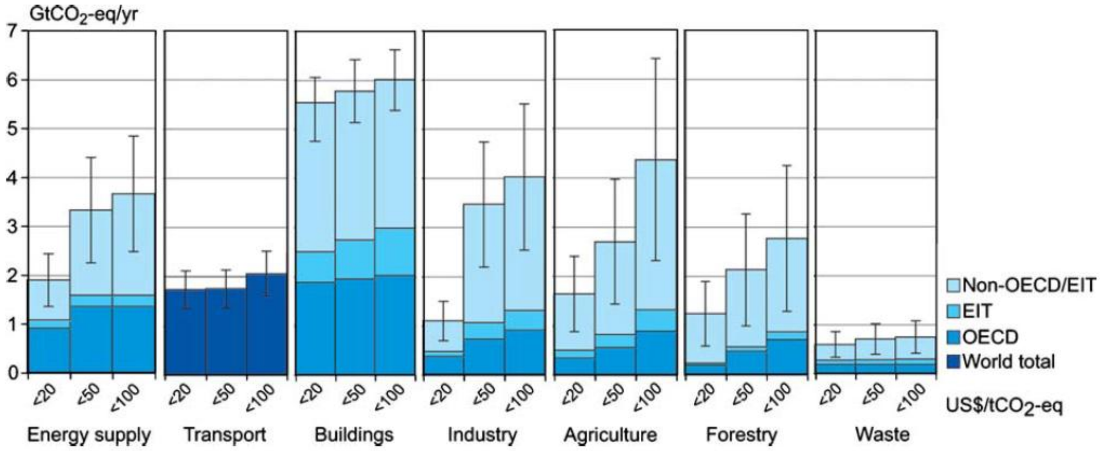
71 UNDP (2010) *How-to-Guide: Low-emission Development Strategies and Nationally Appropriate Mitigation Actions – Europe and CIS*, 100pp., p.8., also available online at http://europeandcis.undp.org/environment/show/BAD6F4DA-F203-1EE9-BBE94FE7E51D102D

72 Ürge-Vorsatz and Metz (2009) *Energy Efficiency: how far does it get us in controlling climate change*" article in Energy Efficiency 2:87-94.

Fig. 11: GHG reductions by sector (Ürge-Vorsatz and Metz, 2009 p.90)



The figure above (Fig. 11) clearly shows the pre-eminence of the building sector as the main place for high-impact energy efficiency measures. National policies have been designed to reflect this (see later sections) but progress has been rather fragmentary.

Fuller realisation of the potential savings in energy efficiency in the buildings sectors would not only reduce emissions, save companies and individual households millions of Euros, reduce the energy dependency of all three countries, as well as create green jobs, it would also blow a hole in the region's ecological footprint.

3.3. THE COUNTRIES' ENERGY SITUATION IN AN EU CONTEXT

Limiting the rise in average global temperature to $2^{O}C$ has been EU policy since 1996, whilst the UN recognised in 2010 the need to consider a $1.5^{O}C$ limit. As Member States of the European Union, Bulgaria, Hungary and Romania are bound by several relevant EU Directives relating to energy and energy efficiency, and are obliged to move (and report) towards a series of targets relating to energy efficiency, renewable energy, and emissions reductions as part of the EU's Climate and Energy Package[73], which demands by 2020:

- A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels
- 20% of EU energy consumption to come from renewable resources
- A 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency
- 10% biofuels mandatory blending in transportation fuels
  (this thesis will not analyse and discuss this "fourth" aspect of the EU Climate&Energy package and its implications regarding the future of mobility as such and whether e.g. a transition to electric mobility questions this mandatory biofuels goal)

These so-called "20-20-20 targets" became law in June 2009 and especially refer to four pieces of legislation, namely the EU Directives on:

- Eco-Design,
- Energy Services,
- Energy Performance of Buildings and
- Renewable Energy.

A full list of all relevant EU Directives and Regulations is included in Annex 2.

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[73] For example European Commission (2010) Communication COM(2010) 639 Energy 2020 A Strategy for Competitive, Sustainable, and Secure Energy (SEC(2010) 1346), 22pp., 10 November 2010, Brussels, Belgium

In terms of the 20% renewable energy target, all three countries are behind their own national targets, although with a smaller "gap" to make good by 2020 than most other EU member states. In fact, of the entire EU-27 Romania has the lowest "gap" (3.7%) to cover principally due to its well-developed - and environmentally-questionable - hydro-electric capacity, whereas Hungary's gap is 6,4% and Bulgaria's 6,7% (see Table 11 below).

Table 11: Renewable energy in final energy consumption (2020 target) (Source: Collected and Compiled by Europe's Energy Portal, www.energy.eu)

	EU Member State	2006	2007	2008	2020 Target	% To cover:	Bar Graph
1	United Kingdom	1.5 %	1.8 %	2.2 %	15 %	**12.8** %	
2	Ireland	3.1 %	3.4 %	3.8 %	16 %	**12.2** %	
3	France	9.6 %	10.2 %	11 %	23 %	**12** %	
4	Denmark	16.8 %	18.1 %	18.7 %	30 %	**11.3** %	
5	Netherlands	2.5 %	3 %	3.2 %	14 %	**10.8** %	
6	Italy	5.3 %	5.2 %	6.6 %	17 %	**10.4** %	
7	Latvia	31.3 %	29.7 %	29.8 %	40 %	**10.2** %	
8	Greece	7.2 %	8.1 %	7.9 %	18 %	**10.1** %	
9	Slovenia	15.5 %	15.6 %	15.1 %	25 %	**9.9** %	
10	Malta	0.1 %	0.2 %	0.2 %	10 %	**9.8** %	
	EU27	8.8 %	9.7 %	10.3 %	20 %	**9.7** %	
11	Belgium	2.7 %	3 %	3.3 %	13 %	**9.7** %	
12	Spain	9.1 %	9.5 %	10.7 %	20 %	**9.3** %	
13	Germany	6.9 %	9 %	8.9 %	18 %	**9.1** %	
14	Cyprus	2.5 %	3.1 %	4.1 %	13 %	**8.9** %	
15	Luxembourg	0.9 %	2 %	2.1 %	11 %	**8.9** %	
16	Lithuania	14.7 %	14.2 %	14.9 %	23 %	**8.1** %	
17	Portugal	20.5 %	22.2 %	23 %	31 %	**8** %	
18	Finland	29.2 %	28.9 %	30.5 %	38 %	**7.5** %	
19	Poland	7.4 %	7.3 %	7.8 %	15 %	**7.2** %	
20	Bulgaria	9.3 %	9.1 %	9.3 %	16 %	**6.7** %	
21	Hungary	5.1 %	6 %	6.6 %	13 %	**6.4** %	
22	Estonia	16.1 %	17.1 %	18.9 %	25 %	**6.1** %	
23	Czech Republic	6.4 %	7.3 %	7.2 %	13 %	**5.8** %	
24	Slovakia	6.2 %	7.4 %	8.3 %	14 %	**5.7** %	
25	Austria	24.8 %	26.6 %	28.3 %	34 %	**5.7** %	
26	Sweden	42.7 %	44.2 %	44.4 %	49 %	**4.6** %	
27	Romania	17.5 %	18.7 %	20.3 %	24 %	**3.7** %	

What this (Table 11) shows, is that there is still significant action required in each country in order to make good on these obligations.

In more detail for the three countries in this study, the table below (Table 12) outlines the "trajectory" of renewable energy growth up to 2020.

Table 12: Baseline and Projected Data 2005-2020 Renewable Sources (in % of Total Energy) for Bulgaria, Hungary and Romania (from Annex 1, the Directive on Renewable Energy[74])

	Base 2005	2011-12	2013-14	2015-16	2017-18	Target 2020
Bulgaria	9.4	10.7	11.4	12.4	13.7	16.0
Hungary	4.3	6.0	6.9	8.2	10.0	13.0
Romania	17.8	19.0	19.7	20.6	21.8	24.0

What this shows, is that there is still significant action required in each country in order to make good on these obligations.

To see whether Member States are moving in the right direction to "fill this gap", WWF, together with the energy consultancy Ecofys, regularly monitors policy development in the EU Member States. The latest assessment (2011) found that whilst both Hungary and Romania were moving in the right direction, Bulgaria was in fact going backwards[75] (see Fig. 12 and Fig. 13 and Table 13 below).

[74] At http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0028:EN:NOT

[75] WWF (2011) Summary Report: EU Climate Policy Tracker 2011, report produced in collaboration with Ecofys, Brussels, Belgium.

Fig. 12: Overall developments of climate&energy policy in the EU-27 from 1 July 2010 until 1 September 2011 (Source: WWF and Ecofys, 2011)

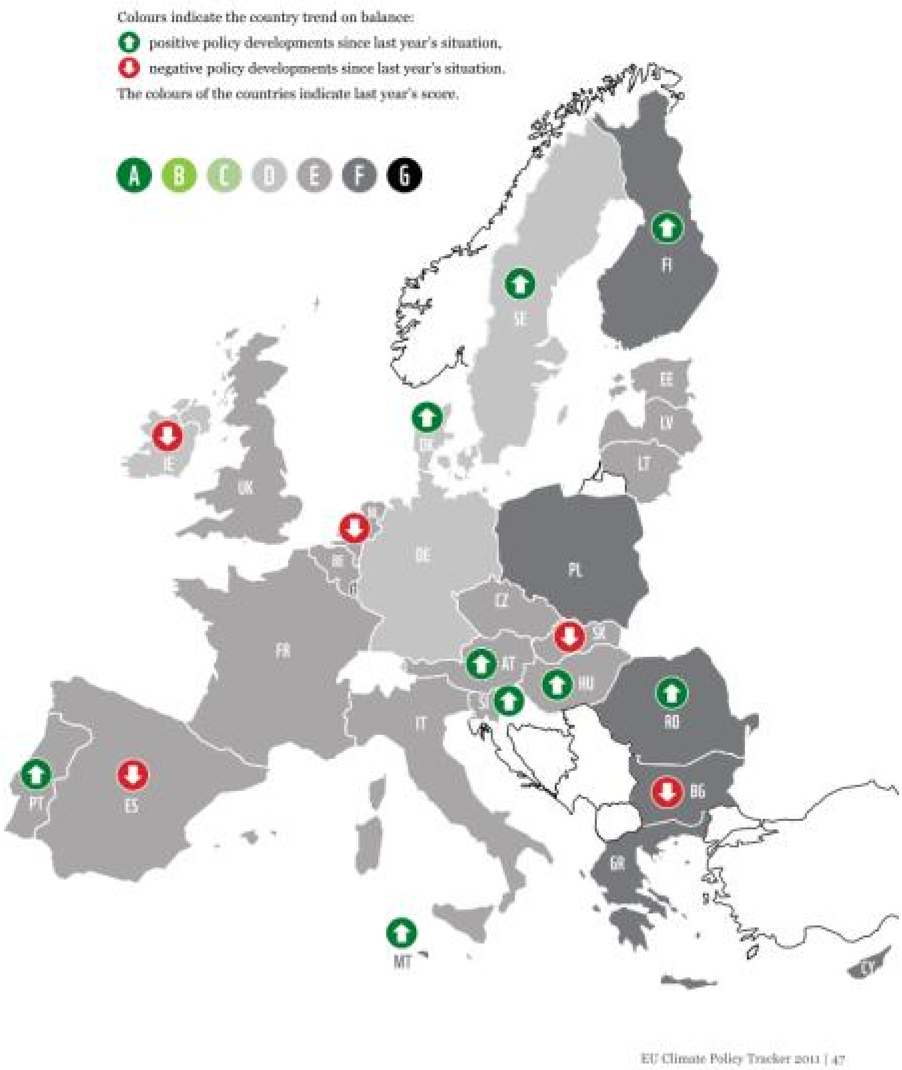

Fig. 13: Summary of policy developments per country (colours indicate the trends per policy area and sector) (Source: WWF and Ecofys, 2011)

	Renewables				Efficiency				Overarching							Total
	ELECTRICITY	INDUSTRY	BUILDINGS	TRANSPORT	ELECTRICITY	INDUSTRY	BUILDINGS	TRANSPORT	GENERAL	ELECTRICITY	INDUSTRY	BUILDINGS	TRANSPORT	AGRICULTURE	FORESTRY	
AT	↑						↑	↑			↑		↔			↑
BE	↓					↔	↓		↔							↔
BG	↔		↔	↓			↑		↔	↓					↑	↓
CY	↔						↑	↓	↔			↑				↔
CZ	↓					↑			↔			↔	↔		↑	↔
DE	↔		↔	↑		↔	↔	↑	↔	↔	↑		↔			↔
DK									↑							↑
EE	↔			↑			↑	↔	↔				↓			↔
ES	↓	↔		↔			↑	↔	↔	↓						↓
FI	↑		↑	↔	↑	↔	↑		↔						↔	↑
FR	↓				↔	↔	↔	↔	↑	↑	↔					↔
GR	↑		↑				↑		↔		↓	↔	↓		↑	↔
HU	↑					↔			↔	↑						↑
IE	↔	↓	↑	↑	↓	↔	↑		↓		↓	↔	↑	↓		↓
IT	↓		↑	↑		↔	↑	↔		↔	↔		↔			↔
LT	↑	↑	↔	↔	↑				↔	↔						↔
LU							↔		↔					↔	↔	↔
LV	↑		↑				↔						↔			↔
MT	↑	↔		↑				↑								↑
NL	↓		↓				↑	↔	↓	↓				↔		↓
PL				↓	↑		↑		↔	↔			↔			↔
PT		↑	↑	↑					↔	↑	↔	↔		↑		↑
RO				↑	↔		↑		↑	↔				↔	↑	↑
SE	↑			↑									↔			↑
SI	↔	↑	↑	↔		↑	↔		↔						↔	↑
SK	↓			↓						↔					↔	↓
UK	↓		↑	↑			↓	↔	↔	↓		↑			↔	↔

↑ positive policy developments since last year's situation,

↓ negative policy developments since last year's situation,

↔ negative and positive policy developments are balanced or new plans where issued, but not yet implemented.

When there are no policy developments, we report this as empty.

Table 13: Summary listing positive and negative policy developments regarding renewable energy and energy efficiency in 2011 (Source: WWF & Ecofys, 2010 and 2011, available online at www.climatepolicytracker.eu)

	Rating from A (good) to G (poor) 2010, 2011	Positive policy developments	Negative policy developments, gaps	Comments
Bulgaria	F, F↓	• EU Buildings Directive and Ecodesign Directive transposed in 2011 • New feed-in tariffs from April 2011 gave longer period to biomass electricity • New Forestry Law came into force, banning construction in forests and introducing the concept of ecosystem services	• Stability of support for renewables remains uncertain • Silent moratorium on renewable projects • 2020 strategy focuses on nuclear and coal • New feed-in tariffs from April 2011 gave shorter periods for solar and wind • Obligatory biofuel component in all fuels is cancelled • Legislation not yet introduced to overcome obstacles to household organisation vis-a-vis energy efficiency	No overarching, long-term strategy beyond 2020
Hungary	E, E↑	• Revised feed-in tariff system gives preference to 100% renewable generation and no longer to co-firing of biomass and coal in power stations • New feed-in tariff for combined heat and power expected during 2012 • Crisis tax of 264 million Euros divided into three years for the energy sector	• The budget for the Innovation Fund was reduced by 37 million Euros •	Since 2011, “sustainability” is part of the Constitution An integrated long-term Energy strategy exists, to 2050
Romania	F, F↑	• Subsidy scheme for hybrid and electric cars was introduced • New, long-term Afforestation Plan adopted with severe penalties for illegal cuts • Energy certificates system for buildings introduced, and Eco-design Directive	• Subsidies on coal mining to continue, including support to the modernisation of coal power plants • New feed-in tariffs from April 2011 gave longer period to biomass electricity • New Forestry Law came into force,	No publically available long-term integrated strategy beyond 2020

		introduced	banning construction in forests and introducing the concept of ecosystem services	

The specific national policy context will be explored in more detail in the next chapter, and policy recommendations will be presented, all with a view to moving these countries more rapidly towards a low-carbon economy, below.

One policy instrument which is considered to be especially influential in promoting and enabling the growth of renewable energy in a country is the energy feed-in tariff. In relation specifically to these, comparison of the different EU states is revealing.

Market signals/incentives to promote renewable energy exist in the three countries (feed-in tariff system in Bulgaria at a rate similar to other EU countries, whereas Hungarian tariffs (e.g. for solar and hydro) are low compared to other EU countries and Romania having a green certificates support scheme for renewable energy) (Table 14). Thus, while such policies and incentives exist to promote renewable energy at a more general level, the concrete implementation is lacking behind, so far at least, to actually make it happen.

Table 14: Feed-in tariffs for renewable energy sources across Europe, taken from the European Energy Portal www-energy.eu (figures in EUR/kWh and valid for 1st April 2010, the most recent data on the site).

Member state	**Windpower 'On-shore'**	**Wind power 'Off-shore'**	**Solar PV**	**Biomass**	**Hydro**
Austria	0.073	0.073	0.29 - 0.46	0.06 -0.16	n/a
Belgium	n/a	n/a	n/a	n/a	n/a
Bulgaria	0.07 - 0.09	0.07 - 0.09	0.34 - 0.38	0.08 - 0.10	0.045
Cyprus	0.166	0.166	0.34	0.135	n/a
Czech Republic	0.108	0.108	0.455	0.077 - 0.103	0.081
Denmark	0.035	n/a	n/a	0.039	n/a
Estonia	0.051	0.051	0.051	0.051	0.051
Finland	n/a	n/a	n/a	n/a	n/a
France	0.082	0.31 - 0.58	n/a	0.125	0.06
Germany	0.05 - 0.09	0.13 - 0.15	0.29 - 0.55	0.08 - 0.12	0.04 - 0.13
Greece	0.07 - 0.09	0.07 - 0.09	0.55	0.07 - 0.08	0.07 - 0.08
Hungary	n/a	n/a	0.097	n/a	0.029 - 0.052
Ireland	0.059	0.059	n/a	0.072	0.072
Italy	0.3	0.3	0.36 - 0.44	0.2 - 0.3	0.22
Latvia	0.11	0.11	n/a	n/a	n/a
Lithuania	0.10	0.10	n/a	0.08	0.07
Luxembourg	0.08 - 0.10	0.08 - 0.10	0.28 - 0.56	0.103 - 0.128	0.079 - 0.103
Malta	n/a	n/a	n/a	n/a	n/a
Netherlands	0.118	0.186	0.459 - 0.583	0.115 - 0.177	0.073 - 0.125
Poland	n/a	n/a	n/a	0.038	n/a
Portugal	0.074	0.074	0.31 - 0.45	0.1 - 0.11	0.075
Romania	n/a	n/a	n/a	n/a	n/a
Slovakia	0.05- 0.09	0.05- 0.09	0.27	0.072 - 0.10	0.066 - 0.10
Slovenia	0.087 - 0.094	0.087 - 0.095	0.267 - 0.414	0.074 - 0.224	0.077 - 0.105
Spain	0.073	0.073	0.32 - 0.34	0.107 - 0.158	0.077
Sweden	n/a	n/a	n/a	n/a	n/a
United Kingdom	0.31	n/a	0.42	0.12	0.23

What that shows, is that governments have an opportunity to be more pro-active in setting the stage for the wider deployment of renewables. The introduction and setting of progressive feed-in tariff mechanisms should therefore be a priority for the three countries.

Within the Kyoto Protocol process, Bulgaria, Romania and Hungary are among the 37 countries ("Annex I countries") commited to a collective reduction of four greenhouse gases (carbon dioxide, methane, nitrous oxide, and sulphur hexafluoride) and two groups of gases (hydroflourocarbons and perfluorocarbons) by 5.2% on average for the period 2008-2012. Table 15 below shows the progress of the countries towards meeting the Kyoto targets for GHG emission reductions. The three countries are well below their set Kyoto targets with Bulgaria about 42% under the Kyoto target, Hungary about 36% and Romania about 44% (see Table 15 below).

Whilst most countries committed to reduce against a baseline of 1990, the three study countries were amongst only 5 who negotiated to reduce against another year's baseline, for Bulgaria 1988, for Romania 1989, and for Hungary the average of years 1985-87.

Table 15: Progress towards the Kyoto Targets for Greenhouse Gas Emissions (Source: European Energy Portal www.energy.eu) (Figures are in Megaton (Mt CO2-eq). Countries in the green do well and emit less than their 2012 target. The countries in the red emit more than their Kyoto target).

EU MEMBER STATE	2003	2004	2005	2006	2007	2008	KYOTO TARGET 2012	% UNDER KYOTO TARGET
EST	21.2	21.2	20.7	19.2	22.0	20.3	40	49.25 %
LAT	10.7	10.7	10.9	11.7	12.1	11.9	23.3	48.93 %
LIT	16.7	21.1	22.6	22.8	24.7	24.3	44.1	44.90 %
ROM	-	160.1	153.7	153.9	152.3	145.9	259.9	43.86 %
BUL	-	68.9	69.8	71.5	75.7	73.5	127.3	42.26 %
HUN	83.3	79.5	80.5	78.8	75.9	73.1	114.9	36.38 %
POL	382.5	396.7	399	399.3	398.9	395.6	551.7	28.29 %
SK	51.1	49.5	48.7	49.0	47.0	48.8	67.2	27.38 %
CZ	147.5	147.1	145.6	149.1	150.8	141.4	180.6	21.71 %
SW	70.9	69.7	67	66.9	65.4	64.0	75.2	14.89 %
GR	137.2	137.6	139.2	128.1	131.9	126.9	139.6	9.10 %
UK	658	660.4	657.4	647.9	636.7	628.2	678.3	7.39 %
FR	560.9	556.1	553.4	541.7	531.1	527.0	564	6.56 %
BEL	147.6	147.6	143.8	136.6	131.3	133.3	135.9	1.91 %
GER	1024.4	1025	1001.5	980.0	956.1	958.1	972.9	1.52 %
FIN	85.4	81.2	69.3	79.9	78.3	70.1	71.1	1.41 %
								% ABOVE KYOTO TARGET
POR	83.7	84.6	85.5	84.7	81.8	78.4	77.4	1.29 %
NETH	215.4	218.4	212.1	208.5	207.5	206.9	200.4	3.24 %
IRE	68.4	68.6	69.9	69.7	69.2	67.4	63	6.98 %
IT	577.3	580.5	582.2	563.0	552.8	541.5	485.7	11.49 %
SI	19.7	19.9	20.3	20.5	20.7	21.3	18.6	14.52 %
DEN	73.6	68.2	63.9	71.0	66.6	63.8	54.8	

								16.42 %
SP	407.4	425.2	440.6	433.0	442.3	405.7	331.6	22.35 %
AUS	92.5	91.2	93.3	91.6	88.0	86.6	68.7	26.06 %
LUX	11.3	12.8	12.7	13.3	12.9	12.5	9.1	37.36 %
MAL	3.1	3.2	3.4	2.9	3.0	3.0	NO TARGET	
CYP	9.2	9.9	9.9	9.9	10.1	10.2	NO TARGET	

What the above table (Table 15) shows, is that the three countries are emitting significantly less than their targetted "quotas". In fact this is true of all the former socialist countries who left to Soviet block in the late 1980s and early 1990s, before eventually joining the EU mid to late 2000s (with the exception of Slovenia). This is amongst others largely due to two factors:

- the continued phasing out of heavy, polluting industries since the political changes and move towards a market economy post-1989 and
- the global financial recession which has further reduced output, especially industrial and manufacturing output, in the years since 2007.

The table below (Table 16) shows how this is related to the even-ing off of total energy consumption. Indeed, and similar to the overall EU-27 trend, total energy consumption in the three countries has indeed remained relatively stable between 1999 to 2009, with a marked decrease in consumption by industry more or less equalled out by increases in energy usage by transport, and to a lesser extent by services. In fact for Bulgaria, Hungary and Romania the major rise has been in transport, whilst households continue to represent a significant consumer, and therefore source of emissions.

Thus, there is no grounds for optimism or satisfaction in either the "below-quota" emissions rate or the "even-ing off" of total energy consumption in the three countries. Rather than any advances in energy efficiency, reductions have occurred as a result of the closure or downturn in economic activities, whilst the rapid increases in transport and service consumption could be expected to continue into the future. These trends are explored in more detail in the following chapter.

Table 16: Final energy consumption by sector of EU member states (Mtoe) from 1999 to 2009 (Source: Eurostat, 2010)

	Total		Industry		Transport		Households		Services	
	1999	2009	1999	2009	1999	2009	1999	2009	1999	2009
EU-27	1 113	1 114	319	269	340	368	291	295	123	141
BE	37.00	34.52	13.26	9.61	9.63	11.13	9.49	8.30	3.70	4.60
BG	8.87	8.60	3.68	2.43	2.03	2.93	2.19	2.12	0.65	0.94
CZ	23.75	24.37	9.29	8.12	4.32	6.62	6.09	5.98	2.91	2.94
DK	15.00	14.76	3.01	2.33	4.82	5.19	4.28	4.46	1.91	1.92
DE	220.83	213.28	57.00	51.79	66.97	61.74	65.95	65.79	25.17	29.32
EE	2.43	2.77	0.56	0.54	0.58	0.74	0.96	0.97	0.28	0.42
IE	9.93	11.81	2.22	2.16	3.69	4.69	2.43	3.07	1.28	1.60
EL	18.12	20.54	4.10	3.46	7.47	9.22	4.23	4.85	1.24	2.14
ES	74.41	88.97	22.34	23.79	32.02	37.84	11.78	14.89	5.88	9.11
FR	152.44	155.55	36.94	28.99	49.46	50.40	38.74	44.62	22.16	20.74
IT	124.50	120.93	38.50	29.55	42.30	42.29	29.40	28.68	10.90	16.89
CY	1.58	1.93	0.43	0.26	0.83	1.02	0.16	0.31	0.11	0.22
LV	3.38	3.91	0.64	0.65	0.68	1.03	1.41	1.52	0.52	0.57
LT	4.05	4.41	0.83	0.82	1.18	1.50	1.40	1.38	0.53	0.60
LU	3.33	4.08	0.83	0.62	1.75	2.49	0.29	0.57	0.09	0.37
HU	16.28	16.41	3.55	2.67	3.27	4.78	5.77	5.52	2.96	2.99
MT	0.31	0.44	0.04	0.07	0.14	0.25	0.07	0.07	0.04	0.05
NL	49.17	50.41	14.12	12.85	14.12	15.10	10.26	10.19	6.79	8.94
AT	23.35	26.29	6.73	8.26	6.77	8.63	6.34	6.16	2.96	2.70
PL	58.94	60.93	18.54	14.73	11.21	16.57	19.42	18.74	4.90	7.35
PT	16.78	18.20	6.03	5.18	6.07	7.34	2.78	3.20	1.25	2.05
RO	22.48	22.13	8.83	6.41	3.29	5.36	8.74	8.02	0.70	1.76
SI	4.39	4.67	1.21	1.23	1.32	1.76	1.05	1.09	0.82	0.48
SK	10.94	10.65	4.27	4.05	1.51	2.38	2.57	2.15	2.36	1.94
FI	24.21	24.02	11.57	10.12	4.47	4.81	5.16	5.37	1.50	1.85
SE	35.06	31.60	13.99	11.15	8.02	8.53	7.44	6.95	4.85	4.23
UK	151.05	137.50	36.23	27.59	52.10	53.30	42.33	40.27	17.00	14.03
IS	:	:	:	:	:	:	:	:	:	:
NO	18.64	18.09	6.79	5.63	4.77	5.02	3.93	3.99	2.35	2.57
CH	20.78	20.91	4.08	3.81	6.77	7.39	5.89	5.93	3.46	3.35
ME	:	:	:	:	:	:	:	:	:	:
HR	5.37	6.34	1.38	1.43	1.54	2.13	1.70	1.81	0.47	0.72
MK	1.63	1.64	0.48	0.42	0.40	0.43	0.45	0.54	0.23	0.24
TR	49.56	68.67	16.38	20.41	11.71	16.36	16.96	20.53	1.64	6.49

Thus, to continue to cut emissions at the rate required the need to integrate transport policies, promoting a climate-friendly transport, into specific "climate policies" is clear from the above table.

And if the downturn in industry (and therefore emissions) in CEE especially, and Europe as a whole, is a historical phenomenon which is set to continue, then energy efficiency measures should be applied to the GHG emissions from households, since this together with transport will make up an ever greater proportion of total emissions and is an area with huge potential for savings.

3.4. EU-LEVEL CLIMATE POLICY – IS IT ENOUGH?

The European Union is seen around the world as being something of a leader when it comes to preventing or rather mitigating the effects of climate change.

The climate policies of the three countries, as EU Member States, are largely influenced by EU-level policy-making. Recognised worldwide as showing leadership in progressive climate and energy policy, the question nevertheless needs to be posed: is EU-level climate policy sufficient to reach a low-carbon economy by 2050?

Of course, EU Member States are allowed to go beyond the requirements and obligations of the various directives and regulations. The fact is, however, they rarely do - with notable exceptions like Romania's declared intention to go over and above the targets for renewables (see also chapter 3.3). And this is especially true of the “new” Member States of central and eastern Europe. So, is the bar set high enough?

At the macro-level, the EU is committed to reduce GHG by at least 80% by 2050[76]. However, an agreed climate strategy which sets out how to achieve this does not yet go beyond 2020. Therefore, few if any countries have looked beyond 2020, and national policies, targets and planning are thus by definition dangerously short-term, whilst the longer-term target is not in any way binding.

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76 European Commission (2011) A Roadmap for moving to a competitive low carbon economy in 2050, Communication 2011 (

WWF and Ecofys (EU Climate Tracker, 2011) in fact estimated the current EU policy package to be only two-thirds of what would be required to secure the low-carbon 2050 reality.

In particular, the WWF and Ecofys analysis found that the policy framework is especially poor for energy efficiency. In noting satisfactory targets and implementation plans for renewable energy, it is noted that energy efficiency policies are scattered in several directives, lack clear and measurable targets, particularly in industry. The table below (Table 17) highlights some of the policy gaps in EU policy as related to energy efficiency and renewable energy[77]:

Table 17: Policy gaps in EU policy as related to energy efficiency and renewable energy (WWF and Ecofys, 2011)

Sector	Policy Gap/s on Energy Efficiency:	Policy Gap/s on Renewables:
Electricity	Newly entered-into-force requirements of the combined heat and power (CHP) Directive are not ambitious enough Losses of electricity and heat during distribution only now included into recently proposed draft of the Energy Efficiency Directive	Subsidies on coal still allowed and will continue until 2018
Industry	To date only the Eco-Design Directive impacts on industry. The new Energy Efficiency Directive will change that but its level of ambition is only half that required to meet 2020 target. Tax levels on industry for minimum energy are too low. No targets on product redesign for energy usage, recycling etc.	Stringent sustainability requirements for biomass lacking No targets on product redesign
Buildings	Ownership and legal obstacles (including landlord/tenant dilemma in rented accommodation) are not addressed. No targets for the retro-fitting of existing housing stock. Minimum tariffs set in the Energy Tax Directive are too low to have a real	Use of biomass for heating lacks stringent sustainability criteria.

77 WWF and Ecofys (2011) Summary Report – EU Climate Policy Tracker 2011 p.18-22

	effect.	
Transport	Efficiency standards only cover passenger cars and vans – freight via waterway, rail or most damagingly road is not covered.	No legislation on the development of infrastructure for electric mobility. Biomass usage lacks stringent sustainability criteria.

The overall conclusion from this analysis is that the EU Climate and Energy package seems to be currently insufficient to move the continent towards a low-carbon future[78]. This is also the conclusion at the global scale communicated in April 2012 by OECD and the International Energy Agency (IEA) in their most recent annual assessment[79]. Remarkably, this is also the conclusion of the European Commission itself, in last year's Communication entitled “Road Map for moving towards a competitive low-carbon economy by 2050”[80] (see Fig. 14 below).

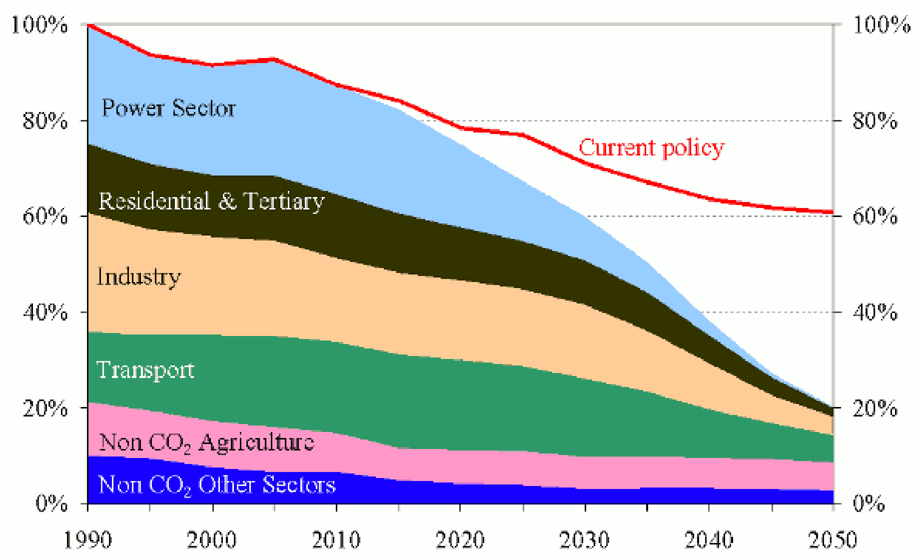
And if that is true at EU-level, it could be assumed that the situation at national level – so also in Bulgaria, Hungary and Romania – is likely to be worse still. The next chapter will deal with this hypothesis.

78 WWF and Ecofys (2011) Summary Report: EU Climate Policy Tracker 2011, report produced in collaboration with Ecofys, 36pp., Brussels, Belgium.

79 IEA (2012) Tracking clean energy progress – Energy technology perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial, 82pp., Paris, France.

80 European Commission (2011) A Roadmap for moving to a competitive low carbon economy in 2050, COM2011 (112 Final), 15pp., Brussels, Belgium

Fig. 14: EU GHG emissions towards an 80% domestic reduction (Source: European Commission, 2011[81])



81 European Commission (2011) A Roadmap for moving to a competitive low carbon economy in 2050, COM2011 (112 Final), 15pp., Brussels, Belgium

4. ENVIRONMENTAL ISSUES RELATED TO THE COUNTRIES' KEY RENEWABLE ENERGY TECHNOLOGIES

All economic activities have an impact on the environment, often negative, sometimes positive, and occasionally both. The deployment of renewable energy and energy efficiency measures, in reducing the need to use greenhouse gases emitting fossil fuels, fall into the latter category - however worthy the climate benefits of both, they nonetheless also have an impact.

For energy efficiency, the raw materials sourced, production processes, transportation, installation and disposal (i.e. the entire life cycle) of energy-efficient products need to be taken into account when assessing the environmental impact in order to make sure that so-called “rebound effects” do not undo any positive climate benefit in by far the most cases.

For renewable energy, impacts on land-use, landscape, water and biodiversity at large (habitats and species) are more direct and more visible, thus more relevant for nature conservation when assessing renewable energy projects – particularly in light of the already serious losses of biodiversity in general.

Much attention has been applied to the development of guidelines for each of the renewable groups of energy, and very often these are deliberately case-specific.
The first step in each case is obviously that any development complies with a comprehensive Environmental Impact Assessment (EIA) according to the legislation in place in the given country. However, beyond that additional concerns often need to be addressed. This chapter explores some of these concerns, beginning with the over-arching need for a comprehensive, transparent, and integrated “climate and energy policy” before any discussions concerning individual (renewable) energy projects should take place.
The chapter concludes with a first rudimentary attempt of a “environmental checklist” or “assessment tool” for environmental organisations like WWF considering impacts of (renewable) energy projects on nature, biodiversity and the wider environment.

4.1. GENERAL ENVIRONMENTAL ASPECTS REGARDING A TRANSITION TO A LOW-CARBON ENERGY FUTURE

4.1.1. The need for an Integrated Climate and Energy Policy

Reflecting its enormous strategic social and economic importance, energy planning and climate change adaptation/mitigation needs to be integrated into an overall policy and programming framework for both national and regional (EU) levels. This framework, or plan, needs to cover not only the period to 2020, to ensure compliance with the European 20-20-20 targets, but should ideally address the longer-term energy vision for a country. With such a longer term, fundamental energy vision structural decisions could be made today concerning:

- What is the most appropriate, most sustainable energy mix in the long-term for a country and what needs to be done today to get there?
- What are the policy and financial needs for this aspired energy mix?
- What are the human capacities (e.g. skills, training, job requirements etc.) and research&development needs for the technologies which make up that energy mix?
- How to address the knock-on effects of each technology in terms of environmental (including biodiversity in all its aspects) and social impacts?

Whilst this is happening to some extent at EU level and in some member states (such as the UK, and Ireland[82]) it is unfortunately absent in most of the world, including in two of the three focus countries of this study, Bulgaria, Romania.

A comprehensive, integrated, long-term energy strategy for the period beyond 2020 does not exist for Bulgaria, nor Romania. Hungary has such a strategy, published in 2012 after 1½ years of drafting, including consultation with more than 100 sets of stakeholders[83]. WWF Hungary was involved in this process and is at least partially satisfied with the results.

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82 WWF and ECOFYS (2011) Climate Policy Tracker: Bulgaria .4pp. Brussels, Belgium

83 Government of Hungary - Ministry of National Development (2012) National Energy Strategy 2030, 132pp., Budapest, Hungary.

Taking as an example, in addressing and attempting to mitigate against the negative environmental impacts of the proliferation of actual and planned hydro power projects in Austria's rivers, WWF found that the biggest over-arching need is that of a transparent, integrated, logical, strategic-level discussion, decision and plan for guiding future energy demand, useage, and therefore mix of technologies and sources[84].

By demonstrating that this proliferation is actually in contradiction with several relevant national and EU policies and laws, including the influential EU Water Framework Directive (which demands integrated management of river basins, including for energy production), WWF Austria came up with an alternative Eco-Masterplan for Austrian rivers which proposes criteria for assessing where new hydro projects could in principle be located[85].

Yet without an over-arching long-term national energy/climate change plan, the basic and first-principle question of whether additional dam structures on the rivers are actually needed, cannot be objectively answered.

At EU level, a "broad-brush" long-term vision was articulated in 2011 in the Commission's Communication entitled "A Roadmap for moving to a competitive low carbon economy in 2050"[86].
Even the oil-dependent USA has a longer-term strategy which, whilst far from complete in terms of precise targets and policies and actions, does at least map out a "secure energy future" for the world's largest economy based upon generating 80% of energy from "cleaner" sources by 2035[87].

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84 Mgr. Christoph Walder, WWF Austria, personal communication January 2012.

85 WWF Austria (2011) Executive Summary of the WWF Eco-Masterplan, Austria 3pp., Vienna, Austria

86 European Commission (2011) A Roadmap for moving to a competitive low carbon economy in 2050, COM2011 (112 Final), 15pp., Brussels, Belgium

87 Note: this includes "clean coal" as well as renewable energies. Source: The White House (2011) Blueprint for a Secure Energy Future, p.6 online document 44pp., Washington DC USA available at http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf

It seems therefore that such a vision would be helpful for Bulgaria and Romania, whose horizon runs currently only until 2020, in order to increasingly trigger the transition to a low-carbon economy.

Further good examples of what needs to be included in such an integrated plan and approach include, for France, the so-called "Negawatt Scenario"[88] which advocates for and mainstreams energy efficiency measures together with renewables, as well as WWF's "Heliosthana: A Mediterranean Sustainable Energy Country" (WWF and HBF, 2010) related to a hypothetical Mediterranean state whose energy plan is based around three pillars namely[89]:

1. Security of energy supply (diversification, stocks, access to energy, and emergency plans);
2. Economic performance (pricing regulated by an independent body, and gradual, programmed reduction and elimination by government of subsidies to fossil energies together with progressive pricing such as a low consumption social tariff); and
3. Environmental performance (internalisation of the externalities of pollution and carbon into pricing, including a progressive carbon tax, individual emissions quotas, and environmental evaluation of energy sector projects).

Once such a holistic plan and vision is in place, incorporating energy efficiency and with references made to both the overall global (or EU) targets and goals as well as local or national climate change adaptation needs, then the debate can begin as to how to supply the most appropriate, most sustainable, long-term most economically feasible energy mix. WWF published such an analysis for Germany with its "Blueprint Germany: A Strategy for a Climate-Safe 2050"[90] which drew up an

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88 See www.negawatt.org

89 WWF and HBF (2010) Heliosthana . A Mediterranean Sustainable Energy Country, report published by WWF and Heinrich Boll Foundation, 52pp., Brussels, Belgium, May 2010.

90 WWF Deutschland (2010) Blueprint Germany – A Strategy for a Climate-Safe 2050, translation of the original "Modell Deutschland – Klimaschutz bis 2050" report by Prognos and Oko-Institut, 39pp., Berlin.

integrated climate and energy programme up to 2030, with a view to hitting targets and securing multiple benefits for the economy and the environment by 2050.

Only once such an over-arching, fundamental, “first principles” type vision – including usage and efficiencies and economic growth scenarios - has been articulated, does it become appropriate to begin filling in the gaps with decisions based on technologies, locations, and trade-offs.

With regards to further developing and transforming the countries’ energy supply – particulary in the light of ultimately achieving low-carbon economies anywhere in the world – different perspectives and approaches need to be taken into account and balanced against each other: technical, economic, environmental and social aspects and needs, to name some of the most relevant ones, all have their respective advantages or disadvantages.

As this study emphasises on the environmental perspective with the underlying assumption of a progressive shift towards renewable energy sources globally reflecting the international goal to stay below the 1,5° C increase in global temperature, it is proposed to give priority to those renewable energy technologies that cause the least environmental impacts (after using all potentials of energy efficiency). Thus, from such an environmental perspective, and also based on WWF’s Energy Report (WWF, 2011), the “hierarchy of choice” regarding new renewable energy installations from a pure environmental perspective following the suggestions from the environmental organisation WWF could be:

- Wind and Solar

  followed by

- Biomass and Hydro.

Of course, as noted above, all developments and projects need to be subject to full and balanced environmental impact assessments, as theoretically guaranteed in these countries by their adoption and transposition of the EU Environmental Impact Assessment (EIA) Directive. Furthermore it is essential to point out that this “hierarchy” is also subject to each country’s individual situation regarding the availability of the different renewable energy carriers (e.g. wind situation, topography, biomass resources, solar radiation etc.). And finally, this “hierarchy” needs to be complemented by other perspectives like e.g. technical, economic or social interests, in order to connect all these arguments to come to commonly agreed solutions for reducing GHG emissions, safeguarding nature, providing prosperity, social welfare, energy independence, energy security etc.

4.1.2. Priority for energy efficiency

As written above, the transition to a low-carbon economy is only possible through the widespread adoption of primarily energy efficiency measures using all possible potentials first, and only then by a sustainable increase in renewable energy installations that do not have negative implications on biodiversity.
Energy efficiency measures benefit the environment by reducing society's demand for scarce resources. Sometimes overlooked by conservationists, the International Energy Agency (IEA) calls energy efficiency “the hidden fuel of the future” and the European Commission is clear about its significance in driving Europe towards a low-carbon future.

Tools exist for planning at national, sectoral, commercial and even household levels. The REEEP – the Renewable Energy, Energy Efficiency Partnership (global public-private partnership based in Vienna) has developed the free RETScreen (http://www.retscreen.net/) software to help planners assess energy efficiency options. It can be used worldwide to evaluate the energy production and savings, costs, emission reductions, financial viability and risk for various types of renewable energy and energy-efficient technologies. The software (available in multiple languages) also includes product, project, hydrology and climate databases, a detailed user manual, and a case-study based college/university-level training course, including an engineering e-textbook.

To sum up, promoting energy efficiency at a macro scale makes great sense in terms of its impact upon footprint reduction.

4.1.3. Special focus on conserving biodiversity

Location is key, hence the importance of mapping. Different technologies vary as to their "site-specificity" needs, for example wind generation does benefit from being located on ridges, which is negative from a landscape quality point of view, whereas solar is more or less neutral in this respect.

Innovative approaches to siting of projects can help. Recent examples include the construction of a 1,4 MW solar farm on a closed tin-mine in Cornwall, UK, and a giant 78 MW solar farm on former open-cast coal mining lands near Seftenburg in eastern Germany[91]. In these examples, industrially degraded land of low- or no-nature conservation value was "re-cycled" from formerly fossil-fuel extraction uses into clean, green energy production, at the same time preventing the potentially negative landscape or habitat or wildlife impacts had the projects been located elsewhere.

Commonsense needs to prevail in all siting decisions. Particularly important is to use an impact assessment methodology which is capable of assessing the cumulative impact of multiple projects. This is especially true in the case of wind and micro-hydro developments, where the cumulative impacts upon bird migrations, or stream integrity, might be substantially greater than the individual impact of any single project or installation. An isolated EIA which assesses only the impacts of that one installation therefore underestimates the actual impact.

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[91] CleanTechnica.com (2011) Solar farms on old mine sites shining examples of smart land use, online article by Glen Meyers, 3rd October 2011, at http://cleantechnica.com/2011/10/03/solar-farms-on-old-mine-sites-shining-examples-of-smart-land-use/

With regards to biomass energy, significant amounts of fuelwood are used for domestic heating in the three countries, especially in Bulgaria and rural Romania. Whilst theoretically a “renewable” source, fuelwood exploitation is often localised and done in a rather random way. The impact on landscape quality is often high.

Connection to a gas network reduces the amount of fuelwood burnt. Bulgaria has particularly low rates of gas connection in rural areas and the government is prioritising this as a measure designed to increase energy efficiency and quality of life.

Localised landscape quality is therefore conserved, along with related ecological functions of small woodlands that include mitigation against soil erosion and floods, acts as a habitat for birds, insects and mammals, as well as leisure and recreation values for humans.

4.1.4. First draft of an “Environmental Checklist”

The following checklist from consultations with WWF shall be seen as a first-draft rudimentary “assessment tool”, listing some exemplary types of questions which should be asked in order to assess the environmental suitability of any given proposed renewable energy project, particularly emphasising the aspect of biodiversity.

A) Is there a comprehensive, long-term, integrated energy plan or vision (in order to be able to assess the need and importance of a certain planned energy project)?

B) Does the proposed project fit into the defined supply needs projections of this energy plan?

C) Have alternatives to the proposed project (e.g. in terms of other technologies, location, size) been assessed within the context of the defined supply need projections?

D) Has an environmental impact assessment (EIA) been carried out for the proposed project?

E) Is this EIA satisfactory for environmental stakeholders, in terms of its coverage (i.e. cumulative effect, impact on nature, consideration of alternatives), its process (consultation, stakeholders, transparency) and consistency with regulations?

F) Is the proposed project located in a protected area, e.g. a Natura 2000 area or an environmentally sensitive area or a high conservation value are or a river catchment with high ecological status (achieved or potential), or any other environmental designation requiring consideration?

G) Would any threatened species listed on the Red List of Threatened Species be affected by the proposed projecct?

H) Further question to be developed in a more detailed analysis.

to be further developed.

This first-draft “checklist” makes no claim to be complete and shall be seen as a first attempt in gathering relevant environmental issues that could be investigated when assessing the need, importance and impacts of a certain (renewable) energy project. In addition to overall aspects, there is also the need to reflect in the checklist the individual case differing from country to country or project to project.

4.2. WIND ENERGY

Wind has been used for thousands of years for power through windmills, and since the 1970s has become ever more technologically advanced and commercially viable. The IPCC in the Special Report on Renewable Energy (2012) notes that Eastern Europe has particularly sizeable potential for onshore wind energy.

The rapid expansion of wind energy installations and capacity, from 14GW to about 238GW from 1999 to 2011 is unlikely to slow down (Global Wind Energy Council, 2011). As mentioned above, all three countries in this study have significant wind potential and expanding production, this is likely to intensify further in the coming decades. Wind projects have thus proliferated in the three countries in a way that other renewable technologies have not, leading to some conflicts.

At present, typical commercial wind turbines are about 65-125m tall and capable of generating on average about 3.000 - 5.000kW. In future, turbines are likely to double in height up to heights of 250m and quadruple in output up to 20.000kW (Global Wind Energy Council, 2011).

Wind has the advantage of being compatible with multi-functional land-use, being particularly suitable for development on grazing or grassland habitats and other agricultural uses.

Its environmental and ecological impacts are relatively well-known and predictable. The main impacts are on landscape quality (eyesore) and ecological quality, as a result of wildlife losses due to bird and bat collisions.

Whilst IPCC states that bird fatalities appear to be orders of magnitude lower than other anthropogenic causes of bird deaths, and that other energy supply options also impact birds and bats through collisions, habitat modifications and contributions to global climate change[92], WWF is concerned about these impacts and is working

[92] IPCC (2012) Renewable Energy Sources and Climate Change Mitigation, p.100 Special Report of the Intergovernmental Panel on Climate Change, 1076pp., Cambridge University Press, New York, USA.

towards a better understanding of the technical options available to mitigate and minimise against harmful wildlife losses.

For example in Greece, WWF has been conducting long-term and detailed research into windfarm development in the northern region of Thrace, a designated Wind Production Area (WPA). The area is also of major importance for wildlife, especially raptors (birds of prey). Working in and around the Dadia national park since 1978, WWF has been monitoring raptor populations, noting with concern the impacts since major windfarm development began in 2000.

The WPA spreads over more than 2.000km2 and covers more than 50% of the region's Natura 2000 sites, as well as overlapping with areas used by raptors. In 12 years 178 turbines in 13 windfarms have been constructed, leading to raptor mortality rates of 0,173 bird/turbine/year, including rare and endangered species, notably the Griffon Vulture (*Gyps fulvus*)[93].

Upon completion, current capacity plus an extra 300 turbines will provide 960 MW of power, but at the cost of at least 80 birds of prey and many hundreds of bats, per year. Such mortality rates will threaten the survival of several rare and endangered species, protected under EU law.

In Romania, concern is rising about the rush of wind projects in the coastal region of Dobrogea. Birdlife International estimate that of a reported 4.996 turbines in 306 projects, up to 752 are inside Natura 2000 areas[94], with a startling doubling of actual capacity in just one year, from 2010 to 2011. Such rapid growth is bound to place pressures on local administrative capacity in terms of compliance, EIA procedures, approvals and other safeguards.

93 WWF Greece (2011) Wind farms, birds and bats in Thrace: Presenting the work of WWF Greece, Position paper, 5pp., Athens, Greece.

94 Birdlife International (2012) Wind Energy Development in Dobrogea Region: Inadequate Implementation of the EU Nature Directives is Resulting in Site Deterioration and Species Disturbance, 4pp. Policy briefing note, p.3, Bucharest Romania.

Suggesting that the responsible Romanian authorities are not properly implementing the site and species aspects of the EU nature conservation legislation, Birdlife goes on to state that "wind farm projects continue to be approved and chaotically developed near or inside of Natura 2000 sites in Dobrogea without any Strategic Assessment Impact and especially the assessment of the cumulative impact of the projects[95]".

Wind farms are often portrayed by the media as being opposed by "the NIMBY crowd – the Not-In-My-Back-Yard-lobby" - people who might otherwise support alternative energy on environmental grounds, but not directly in their own region or locality. However, according to the Royal Society for the Protection of Birds (RSPB) – perhaps the foremost authority on bird conservation in the world, the reality is that if properly planned, wind farms located away from major migration routes and important feeding, breeding and roosting areas of those bird species known or suspected to be at risk, will have minimal impacts[96]. RSPB scrutinises hundreds of wind farm planning applications every year, and out of more than 1.500 plans examined to date, has opposed only 6% of them on the grounds of likely harmful impact upon bird populations[97].

As an example, RSPB (2009) produced a sensitivity map of England and Scotland which provides guidance based on 12 significant bird species at a 1 km square grid detail. This analysis conclude that for England 16% of land was "high sensitivity", 2% "medium", and the remaining 82% whilst classified as "unknown" actual is

95 Birdlife International (2012) Wind Energy Development in Dobrogea Region: Inadequate Implementation of the EU Nature Directives is Resulting in Site Deterioration and Species Disturbance, 4pp. Policy briefing note, p.3, Bucharest Romania.

96 RSPB: homepages relating to Wind Power, at http://www.rspb.org.uk/ourwork/policy/windfarms/

97 RSPB (2012) RSPB announces wind turbine plan to reduce its carbon footprint, News Item, 20 march 2012, online at http://www.rspb.org.uk/news/312085-rspb-announces-wind-turbine-plan-to-reduce-its-carbon-footprint-

recognised to contain large amounts of land with low sensitivity i.e. suitable for wind power development[98].

The analysis also included mapping of mean wind speed at 45m height, and an inventory of all wind farm projects at various stages of development, to allow for overlaying of sensitivity to renewable wind power potential and likely actual impacts.

Such mapping at the national scale would be useful in the three countries, given the controversies and risks described above. Some limited, localised mapping does exist in wind power hotspots e.g. for Romanian Dobrugea[99]. At the time of this study, WWF is not aware of national level maps for any of the three countries.

Some advantages and disadvantages with relevance for an environmental analysis of wind power according to WWF[100] (others according to footnotes) include (Table 18):

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98 RSPB (2009) Mapped and written guidance in relation to birds and onshore energy development in England, RSPB Research Report no.35., 173pp., Sandy, UK. Online at: http://www.rspb.org.uk/Images/EnglishSensitivityMap_tcm9-237359.pdf

99 WWF's Freshwater Officer for the Danube, Dr Orieta Hulea, personal communication March 2012.

100 WWF (2009) Sun, Wind, Water and More – Renewable Energy in WWF Field Projects, report of the WWF Renewable Energy Centre, 36pp., September 2009, Washington D.C., USA.

Table 18: Some exemplary advantages and disadvantages with relevance for an environmental analysis of wind energy according to WWF (WWF, 2009) (others according to footnotes).

Advantages	Disadvantages
Infinitely free source of energy	Exemplary carbon footprints of wind energy installations are in the range of about 11-19 tonnes CO_2-equivalents/GWh (most emissions come from the production of the converter and components) [101]
Investment costs of wind power installations depend very much on the size and indvidual situation with exemplary ranges from about 1.400-1.800 EUR/kW[101] Average electricity production costs again depend very much on the situation, and size of the installation, with exemplary ranges from about 0,06-0,09 EUR/kWh[101]	
Efficiency levels ranging from about 30-45% on average[101]	Largely affected by varying wind speed, as well as barometric pressure, altitude, and air temperature
Does not emit any noteworthy greenhouse gases or pollutants over the entire life cycle	Initial investment costs depend on scale, but can be considerable (incl. permissions etc.)
Lifetime span of over 15 years	Site specific technology
Little maintenance required and sometimes automatically operated	Fluctuations in energy produced, which calls for back up system or battery to store electricity, unless the system is connected to the grid
Very low amounts of fuel required (mostly in production and with some during operation)	Large scale farms may have environmental impacts, including primarily impacts on birds and bats
Can be used in conjunction with other renewable energy technologies	Reasonable knowledge of electrical systems is needed for maintenance
Not necessary for grid connection but connection is possible	

101 Kaltschmitt, M. und Streicher, W. (Hrsg.) (2009) Regenerative Energien in Österreich, Vieweg+Teubner, Wiesbaden

From the information above, potential needs for the three countries related to a further extension of wind energy and reducing potential associated environmental impacts therefore may include among others:

- Development of sensitivity maps for each country to guide future wind power project locations and define priority as well as potential “no go” areas.

- Kick-starting the Bulgarian sustainable wind development (once a long term integrated national energy and climate strategy defines what is required in this respect);

- Evaluating the Dobrugea wind farm development in Romania from the point of view of cumulative, i.e. on a Strategic Environmental Assessment (SEA) level, impacts of numerous turbine clusters on bird and bat populations, including assessing the output in light of the required long-term integrated national energy and climate strategy and its definitions of what is required;

4.3. SOLAR ENERGY (SOLAR THERMAL AND PHOTOVOLTAICS)

Solar energy is another almost limitless source of energy and the three countries have variable but relatively good solar potential (see also chapter 3). Rapid technological advances continue to make solar a more viable and flexible form of electricity when part of an appropriate energy mix, and in years much more investment can be anticipated in all three countries.

Most if not all attention and investment in CEE has been focussed on (direct) solar thermal heating of water, buildings and process heat for industry; photovoltaic conversion of direct sunshine into electricity via PV cells; and optically concentrated solar power (CSP) to obtain heated fluids for driving generators or engines.

The impacts from solar are mostly related to landscape quality on site, and related to the life-cycle of the component parts of panels, transformers, and transmission equipments (and it is important to note that these latter impacts are present for fossil-fuel powered electricity as well, in addition to their greenhouse gases). The precise types of liquids and gases used in solar thermal and PV are listed in IPCC[102].

Solar thermal heating total installations are spread around the world, although in the EU they have a strong tradition in the Mediterranean countries as for example in Spain. Photo-voltaic solar power grew globally by 35% between 2007 and 2009 and continues to grow at 16% per year. The vast majority is found in the EU, with 73%, and Spain and Germany are the leading markets[103].

The RETSCREEN renewable energy model (http://www.retscreen.net/) shows that feasibility for solar thermal and solar PV potential in the three countries is

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102 IPCC (2012) Renewable Energy Sources and Climate Change Mitigation, Special Report of the Intergovernmental Panel on Climate Change, 1076pp., p.66, Cambridge University Press, New York, USA.

103 IPCC (2012) Renewable Energy Sources and Climate Change Mitigation, Special Report of the Intergovernmental Panel on Climate Change, 1076pp., Cambridge University Press, New York, USA.

moderately high, hence It seems surprising that it does not form a stronger part of the energy mix. The reason is often because initial investments remain to be a main barrier, electricity generated from PV continues to be more expensive but the IEA and IPCC both predict falling costs associated with both thermal and PV and a growing role reflecting its huge potential[104].

Solar photovoltaic (PV) development is well underway in Hungary, with the domestic company Solar Energy Systems completing a EUR 4 Million solar panel plant in Komló last year[105], a third of the investment came from governmental and EU sources. The principal market for the equipment is Germany.

In Bulgaria there is a range of solar PV projects planned, under construction or underway, including those with Austrian investment for instance EVN's EUR 3 Million solar park near Sliven, completed in February 2010 with a 863 kWh capacity[106]. Romania is also of potential for widespread solar PV adoption.

Some advantages and disadvantages with relevance for an environmental analysis of solar thermal power generation and photovoltaic technology (PV), according to WWF (WWF, 2009)[107] (others according to footnotes), include among others (Table 19):

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104 I IPCC (2012) Renewable Energy Sources and Climate Change Mitigation, Special Report of the Intergovernmental Panel on Climate Change, 1076pp., p.71 Cambridge University Press, New York, USA.

105 Budapest Business Journal (2011) Solar Energy Systems builds HUF 1.2 billion PV cell plant., online article from 30 March 2011m at http://www.bbj.hu/business/solar-energy-systems-builds-huf-12-bln-pv-cell-plant_56899

106 The Bioenergy Site (2010) Solar park for Bulgaria, online article from 8 January 2010, available at http://www.thebioenergysite.com/news/5297/solar-park-for-bulgaria

107 WWF (2009) Sun, Wind, Water and More – Renewable Energy in WWF Field Projects, report of the WWF Renewable Energy Centre, 36pp., September 2009, Washington D.C., USA.

Table 19: Some exemplary advantages and disadvantages with relevance for an environmental analysis of solar energy according to WWF (WWF, 2009) (others according to footnotes).

<table>
<tr><th>Advantages</th><th>Disadvantages</th></tr>
<tr><td>Efficiency levels compared to other renewable energy technologies lower with exemplary ranges from about 15 to 27% (for PV even lower) [108]</td><td>Carbon footprint of solar thermal plants decrease with size, average figures indicate CO_2-emissions in the range of about 28-34 tonnes CO_2-equivalents/GWh and for PV in the range of about 40-100 tonnes CO_2-equivalents/GWh (most emissions come from the production of the components)[108]</td></tr>
<tr><td>Few criteria for site exclusion</td><td>Carbon footprint of solar thermal plants decrease with size, average figures indicate CO_2-emissions in the range of about 28-34 tonnes CO_2-equivalents/GWh and for PV in the range of about 40-100 tonnes CO_2-equivalents/GWh (most emissions come from the production of the components)[108]</td></tr>
<tr><td colspan="2">Investment costs of solar thermal installations depend very much on the size and indvidual situation with exemplary ranges from about 130 - 5.500 EUR/kW[108]

Average electricity production costs again depend very much on the situation, solar fraction and size of the installation, with exemplary ranges from about 0,128 to 0,428 EUR/kWh (for PV higher on average)[108]</td></tr>
<tr><td>Systems are flexible and can fit any size or scale of infrastructure project</td><td>In contrast to other renewable energy technologies, not constantly available (when no sunshine, during night, as well as fluctuations in performance based on weather conditions, sunlight</td></tr>
<tr><td>Produce no noteworthy greenhouse gases, pollution or noise over the entire life cycle</td><td>Considerable initial investment costs</td></tr>
<tr><td>Long expected lifespan (usually over 20 years)</td><td>Energy storage may be required when sunlight is not available (unless connected to the grid)</td></tr>
<tr><td>Low amounts of fuel required (mostly in production and with some during operation)</td><td>Need to dispose batteries if applied in environmentally safe manner</td></tr>
</table>

[108] Kaltschmitt, M. und Streicher, W. (Hrsg.) (2009) Regenerative Energien in Österreich, Vieweg+Teubner, Wiesbaden

Grid connection not essential, but possible	Some PV materials may contain toxic substances
Can be outfitted to buildings when space is unavailable	Reasonable knowledge of electrical systems is needed for maintenance

For all three countries, greater uptake of both solar thermal as well as PV energy would boost the shift towards the renewable targets and a low-carbon future. Governmental funding supports and incentives could be used to subsidise uptake, through grants for installation at the household level to larger-scale investment incentives to boost commercial solar farm developments.

4.4. BIOMASS ENERGY

Biomass and bioenergy as a group of renewable sources covers a multitude of raw materials including basic fuelwood and charcoal, wood industry by-products, by-products and waste from animal husbandry, from agriculture, and also grown-for-energy crops, as well as landfill gas and municipal solid waste. These raw materials are processed and either converted into electricity through incineration or into fuel, often diesel (so called bio-diesel).
Any assessment of the environmental impacts of biomass refer to a considerable extent to the origin of the biomass material, i.e. does the biomass come from land converted from being used to grow crops or does the biomass come from valuable high nature conservation value forests or from wood residues or

As a group, bioenergy is perhaps the most controversial of renewable energies as a result of real and perceived environmental and social impacts (mostly with regards to displacement of subsistence food crops).

With their traditionally strong agriculture and forestry sectors, Bulgaria, Hungary and Romania have particular potential in this field and as noted above bioenergy from biomass represents the central pillar of the Hungarian renewable strategy.

The IPCC notes that for bioenergies to move in a sustainable direction as a globally oriented industry, a number of pre-conditions are required, namely that[109]:

- Well working sustainability frameworks and strong policies are implemented
- Well developed bioenergy markets
- Progressive technology development e,g, biorefineries, new generation biofuels and multiple products, successful use of degraded lands
- Satellite processing emerges

109 IPCC (2012) Renewable Energy Sources and Climate Change Mitigation, Special Report of the Intergovernmental Panel on Climate Change, 1076pp., p.59, Cambridge University Press, New York, USA.

From an environmental perspective, the use of waste materials from forestry agriculture and sewage treatment is an entirely logical progression with positive spin-offs in terms of waste management, especially at local scales.

On the other hand, the proliferation and spread of “energy crops” which might displace subsistence food crops clearly has potentially harmful social impacts and in terms of biodiversity also poses unknown potential threats in terms of landscape quality, water stress from thirsty crops, habitat loss if production spreads to marginal (normally, biodiverse) lands, and possible problems associated with invasive species.

Thus, any renewables policy which includes biomass and especially biofuels must start with a sensible prioritisation of sources (i.e. wastes and residues to be utilised first) and must also be well integrated with national and global food trends, trade, and regional and rural development needs and priorities.

As described above, bioenergy is well under development in each of the three countries. Additional innovative examples of progressive biomass energy initiatives from the three countries include the TAROM Romanian Airlines and Airbus partnership to develop and test bio-jet fuel from the indigenous Romanian (non-water intensive) Camelina plant, with interventions along the supply chain including farmers, oil-refiners, and an airline in an attempt to boost the sustainability of the airline industry[110].

In Hungary, WWF Hungary worked with biomass power station AES at Tiszaujvaros and Kazincbarczika and with local communities and farmers to clear an invasive colonising bush from the floodplain for income generation and jobs through selling it as woody biomass for electricity generation, with benefits for people, nature and business[111] (see also case study in Annex 2).

110 The Bioenergy Site (2011d) Airbus and TAROM llaunch biofuel value chain, online article from 22 March 2011, at http://www.thebioenergysite.com/news/8386/airbus-and-tarom-launch-biofuel-value-chain

111 www.panda.org/europe/oemn - Tisza project 2003-2009 (see Annex 2)

Some advantages and disadvantages with relevance of an environmental analysis of biomass power generation according to WWF (WWF, 2009) (others indicated in footnotes) include among others (Table 20):

Table 20: Some exemplary advantages and disadvantages with relevance of an environmental analysis of biomass energy according to WWF (WWF, 2009) (others as indicated in the footnotes).

Advantages	**Disadvantages**
Efficiency levels depend very much on the individual situation, technology, energy use as well as losses along the supply ranging from about 50-80% on average[112]	Carbon footprint of biomass plants depend very much on the individual situation, plant size etc. and can have exemplary ranges from about 23-85 tonnes CO_2-equivalents/GWh (not regarding released CO_2 from the combustion of the biomass which might not be correct depending on the sustainability of the biomass' cultivation)[112]
Investment costs of biomass installations depend very much on the size and indvidual situation (district heating or not, source of biomass etc.) with exemplary ranges from about 400-1.100 EUR/kW[112] Average heating production costs again depend very much on the situation, size of the installation etc. with exemplary ranges from about 0,05-0,46 EUR/kWh[112]	
Usually widely available	Often long processes associated with the production of materials for biomass conversion to energy
Compared to other renewable technologies, often best suited to replace an existing fossil fuel based heating system to a renewable/biomass system (e.g. using existing storage tanks)	Depending on source of biomass conservation/biodiversity conflicts may occur when biomass comes from e.g. high conservation value forests
Renewable resource of energy when it is sustainably used and managed	Require adequate supply of resources, potentially causing potential competition in land use
Different types of conversions leading to fuel in gaseous, liquid, or solid form (for example, wood can be processed and	Production can be uneven throughout the year depending on climatic/weather

112 Kaltschmitt, M. und Streicher, W. (Hrsg.) (2009) Regenerative Energien in Österreich, Vieweg+Teubner, Wiesbaden

converted to gas, corn, wheat and other materials can be used to manufacture liquid fuel ethanol)	conditions and availability of the biomass
As long as new plant material is grown to replace that used and if well managed, biomass energy produces no net CO_2 increase.	Fossil fuels are used to harvest and manipulate biomass (very much depending on the exact situation, the fossil fuel consumption required in the entire process could even offset the carbon advantage)
Results in less waste being sent to landfills. Burning unusable waste materials such as bark, construction wastes and tree clippings helps to reduce pressure to expand local landfill sites while generating useful energy.	Certain site specific requirements and conditions associated with biogas production
Secondary slurry from biogas use can be used as fertilizer	Generally, requires assessment of environmental and social impacts on an individual basis

WWF's global policy on bioenergy makes more detailed recommendations, pointing out that the organisation "*will only support bioenergy that is environmentally, socially and economically sustainable and considers that effective measures are needed to minimize impacts and maximise benefits.*[113]"

WWF's recommendations insist that:

- Only ambitious GHG and energy efficient bioenergy pathways should be supported after taking into account both direct and indirect emissions associated with bioenergy feedstock production.
- Bioenergy production should not be established through the conversion of ecologically important ecosystems (such as natural and semi-natural forests, grasslands, wetlands and peatlands), including those that have been identified as High Conservation Value Areas (HCVAs), in order to minimize impacts on biodiversity.

[113] WWF (2012) Global Network Policy: WWF Policy on Bioenergy, 2pp., available at http://panda.org/bioenergy

- Efficient, multi-stakeholder land-use and water-use planning methods should be implemented to prevent unwanted development in HCVAs and the over-abstraction of water.

- A comprehensive approach should be implemented in the short, medium and long term to reduce/mitigate the indirect effects of bioenergy production, including indirect land-use change.

- All actors, including governments should continually monitor the relationship between bioenergy targets and access to food, and relevant policies should be adjusted accordingly. Food security should take priority over other competing uses.

- All actors involved in bioenergy development and production should establish stakeholder mechanisms to ensure that indigenous peoples likely to be affected by bioenergy development can give their prior informed consent to that development and secure relevant land and resource rights, and that all potentially-affected communities are able to a participate fully and effectively in decision-making and share in the benefits.

From an environmental point of view, the priorities for the three countries in relation to biomass bioenergy therefore can be related to the first of the IPCC recommendations above and the WWF recommendations, summarised that a strong sustainability framework needs to be developed on a case-by-case basis for each technology and/or product or crop, incorporating the water, landscape, habitat and other potential environmental impacts as well as social issues. As for the other renewable energy groups, maps of each country describing “go” and “no-go” areas should be developed for each country, based on environmental sensitivity, agri-environmental, soils, and climatic potential, access to market, and other relevant variables.

4.5. HYDRO ENERGY

Hydro is well developed in Europe and is seen by some as a clean form of renewable energy and by others as a threat to the ecological integrity of river systems. The table below (Table 21) shows hydropower capacities and potentials for each European country including the three focus countries for the present study.

Table 21: Hydropower capacities and potentials in Europe (Hydropower & Dams World Atlas, 2009)

	Capacity (MW)			Hydropower potential (GWh/year)			Actual
	Installed	Under construction	Planned	Gross theoretical	Technically feasible	Economically feasible	generation Gwh/year
Austria	12009	100	262	90000	56000	53200	35211
Belgium	107	0	n/a	600	n/a	400	359
Bulgaria	1434	91	1955,5	19810	14800	0	4610
Cyprus	1	0	0	0	23500	0	2
Czech Republic	1029	n/a	n/a	13100	3380	0	2090
Denmark	9	0	0	120	n/a	70	21
Estonia	8	1,3	5,75	1500	375	0	48
Faeroe Islands	31	0	n/a	0	250	150	96
Finland	3049	21	53	22645	16915	16024	13971
France	25400	60	418	200000	n/a	98000	68600
Germany	4310	113	20	120000	24700	20000	16975
Greece	3243	484	160	80000	20000	15000	2254
Greenland	56	15	22,5	550000	17500	0	202
Hungary	54	3	n/a	7446	4590	0	213
Irish Republic	249	n/a	n/a	1400	1180	950	725
Italy	20000	n/a	2100	190000	60000	50000	45511
Latvia	1500	n/a	n/a	7200	4000	3900	2600
Lithuania	120	3	55	6034	2464	1295	451
Luxembourg	40	0	0	175	140	137	111
The Netherlands	38	n/a	7	11396	*	130	110
Poland	839	20	406	25000	12000	7000	2042
Portugal	4959	217	1650	32150	24500	19800	12000
Romania	6422	659	1206	70000	40000	0	17105
Slovenia	1776	0	140	10000	6607	6000	4280
Spain	18559	264	n/a	162000	61000	37000	22888
Sweden	16200	10	n/a	200000	130000	90000	68400
United Kingdom	1539	n/a	n/a	0	**	0	4000
Total EU27	**122981**	**2061,3**	**8460,75**	**1820576**	**523901**	**419056**	**324875**

From the table (Table 21) above, it can be seen that hydro energy is not significant for the low-lying, flat landscapes of Hungary. Indeed, the Hungarian Government notes that "*given the small amount of electricity which can be generated, water management, environmental protection, and nature conservation interests must be given priority in catchment area management*"[114].

By contrast, hydro energy actual and potential in Bulgaria and Romania are both large and especially noteworthy are the "under construction" and "planned" categories. Romania has the largest capacity currently under construction, with its 659 MW the highest in the entire EU, and remarkably, in fact forming more than 30% of the EU-27's total hydro under construction (2.109 MW). Meanwhile Bulgaria has a similar amount planned (1.955 MW) which is the second highest in the EU after Italy and itself more than 20% of all planned EU-27 hydropower capacity.

Thus, hydro power potential in Bulgaria and Romania is large and expected to be developed, including small-scale / micro hydro power plants which are often seen as a more environmentally-friendly alternative. According to WWF, this is not always the case, including because the scattered and more localised nature of its exploitation means that planning permitting procedures and the necessary regulatory checks and balances are lacking at this level. The capacity for such EIAs, especially cumulative EIAs where multiple projects are proposed, is often weak at a local level and therefore proper environmental impact assessments are rare as pointed out by WWF[115].

Relevant experiences for Bulgaria and Romania regarding a sustainable hydro power development can be drawn from WWF's work on hydro power in Austria where a long-standing scientific, policy, mapping and communications campaign against the proliferation of hydro power structures has traditionally focused on 1) whether all the new hydro power is actually required and 2) how to locate hydro

114 Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary, p.20.

115 WWF DCP Policy Officer – Irene Lucius, personal communication, January 2012.

power plants in areas where its negative ecological impacts can be minimised. For this, WWF Austria has developed a detailed assessment of Austrian hydro power including:

- a fourfold classification of sensitivity;
- built upon ensuring compliance with the EU Water Framework Directive in terms of establishing good ecological status for waters;
- some, limited “no-go” areas;
- and emphasising the need for a strategic, long-term, integrated energy vision and planning as a pre-conditional step in a national energy and climate strategy before any deploying new energy installations.

All Austrian waters have thus been mapped according to sensitivity and therefore suitability (or not) for hydropower development (WWF Austria, 2011). This environmental analysis could be used as a model to be copied in Bulgaria and Romania as an important environmental contribution to the discussion on increasing the countries’ hydro power capacities.

Such sensitivity maps do not seem to exist either for Bulgaria, Hungary or Romania for wind power. The methodology for the Austrian hydro mapping – like the RSPB wind mapping for England and Scotland - is based on a relatively simple approach overlaying various nature conservation, habitats and species and WFD designations. Such maps could be a valuable element to back up environmental concerns in Romania and Bulgaria where hydropower development is expected to have significant environmental impacts on streamflow and channel morphology.

Furthermore, WWF International's “Dams Initiative” drew up 10 Principles for Sustainable Hydro[116] that could also be used to check the impacts of the hydro power plans in Romania and Bulgaria – although these principles primarily refer to larger hydro power plants, they can be also applied accordingly to small-scale hydro power plants:

[116] WWF (2003) Hydro power in a changing world, 4pp brochure, WWF Dams Initiative, Godalming UK.

1. Proposals for new hydropower plants must confirm to the strategic priorities and policy principles of the World Commission on Dams;
2. Governments and international agencies must prioritise investment to service the two billion people globally that are without access to electricity. More investment in small.scale, decentralised renewable energy solutions is needed;
3. CDM and JI hydropower projects should meet the Gold Standard criteria,
4. Some of the remaining unregulated rivers in areas of high conservation value should be designated by governments as “no-go” areas for hydropower schemes;
5. Siting decisions for new hydropower plants need to consider impacts in the whole river basin and opt for sites of minimum environmental impact;
6. Efficient hydropower sites that minimise the area flooded per unit of energy produced should be given preference;
7. The capacity of existing hydropower plants should be upgraded wherever possible, so as to minimise the need for new capacity;
8. Comprehensive environmental mitigation measures (such as environmental flow regimes, habitat restoration and protection, and fish ladders) need to be included in all planned and existing hydropower plants,
9. Small hydropower plants can play an important role as a renewable energy source, especially for supplying rural areas in developing countries. However they must include strict environmental mitigation measures and the cumulative impacts of a large number of small hydro plants must be considered.
10. Project developers must include all stakeholders in decision-making and ensure fair and sensitive resettlement procedures in accordance with WCD principles.

Some advantages and disadvantages with relevance for an environmental analysis of hydro power as a source of renewable energy include according to WWF[117] (others indicated in footnotes) among others (Table 22):

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[117] WWF (2009) Sun, Wind, Water and More – Renewable Energy in WWF Field Projects, report of the WWF Renewable Energy Centre, 36pp., September 2009, Washington D.C., USA.

Table 22: Some exemplary advantages and disadvantages with relevance for an environmental analysis of hydro energy according to WWF (WWF, 2009) (others as indicated in the footnotes).

<table>
<tr><th>Advantages</th><th>Disadvantages</th></tr>
<tr><td>Efficiency levels on average between about 70-90% depending on the age of the plant</td><td>Carbon footprint of hydropower plants decrease with plant’s size, average figures indicate CO_2-emissions in the range of about 3-17 tonnes CO_2-equivalents/GWh (about 90% of these emissions come from the production of the plant components)[118]</td></tr>
<tr><td colspan="2">Investment costs of hydropower plants depend very much on the size (large hydro vs small hydro), country and indvidual situation (head, discharge etc.), but are usually higher compared to other renewable technologies, with exemplary ranges from about 760-7.100 EUR/kW[118] (most costs associated with the construction of the plant)

Average electricity production costs again depend very much on the situation, country etc. and can have exemplary ranges from about 0,02 to 0,083 EUR/kWh[118]</td></tr>
<tr><td>Considered a mature, stable - in contrast to wind or solar energy (with seasonal fluctuations related to the amount of water in the river) - and long-life energy/power source with relatively low maintenance requirements.</td><td>Although considered an environmentally friendly form of energy, environmental impacts can be considerable related to:

- impacts of altering the rivers’ flow and the habitat around them
- disruptions of water and sediment flow
- impacts on surrounding as well as river biodiversity and landscape (due to a flooding of large areas etc.)</td></tr>
<tr><td>Large diversity of sizes, shapes and designs associated with a range of investment costs from very high (large hydro) to relatively minor (micro hydro) – being more or less an advantage.</td><td>Micro-hydro systems, individually causing less environmental impact than large hydro power plants although their cumulative effect is considerable, can usually only be a minor element in the “total” renewable energy mix</td></tr>
<tr><td>Minor GHG emissions over the entire life cycle.</td><td rowspan="2">Potential social impacts of large hydro power plants, i.e. when constructing dams, the reservoir may take up much of the surrounding area, this may force populations to leave their settlements (mostly due to large hydro projects in countries like Brasil, China</td></tr>
<tr><td>Ability to start and stop quickly and instantaneous load acceptance/rejection makes it suitable to meet peak demand</td></tr>
</table>

118 Kaltschmitt, M. und Streicher, W. (Hrsg.) (2009) Regenerative Energien in Österreich, Vieweg+Teubner, Wiesbaden

and for enhancing system reliability and stability.	etc.)
No noteworthy fuels required as well as no noteworthy pollutants are emitted	For large scale projects one of the most important economic disadvantages is the need for high upfront investment and long term planning.
	Small hydropower plants, especially run-off river plants without storage are dependent on precipitation. In dry hydrologic seasons, small plants may not be able to generate the expected amount of electricity.
	Dams built blocking the progress of a river in one country usually means that the water supply from the same river in the following country is out of their control. This can lead to serious problems between neighbouring countries.

From the information above, potential needs for Bulgaria and Romany related to a further extension of hydro energy and reducing potential associated environmental impacts therefore may include among others:

- First and foremost, strategic level assessments in terms of an overall need for hydro energy as identified in an over-arching, integrated long-term energy and climate strategy for the two countries.
- Mapping for river and stream sensitivity, as was done in Austria, to guide current and future hydropower planning and location (particularly relevant regarding plans for large(r) hydro power plants);
- Strengthening of local-level capacities and/or processes related to environmental impact assessments

5. THE BUSINESS CASE FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY IN THE COUNTRIES

SUMMARY

This thesis is only touching energy efficiency and its business case, also for renewable energy, just briefly flaging some respective aspects.

The business case for energy efficiency and renewable energy is hard to generalise and needs careful consideration at a range of different levels.

At national level, however, the positive social and economic impact rests on a range of benefits from the move towards a low-carbon future including freedom from dependence on imported, costly fossil fuels sources, and the substantial number of "green jobs" which are generated when investments are made into energy efficiency and renewable energy.

Extrapolating detailed employment studies for the region, would suggest that potentially more than 500.000 new green jobs could be created in the three countries through energy efficiency (retrofit) measures in buildings and some 650.000 new green jobs in the three countries through renewable energy investments.

These benefits are of course on top of the environmental benefits to society of reducing greenhouse gas emissions and consequently stemming the rate of climate change.

5.1. ECONOMIC FACTORS

When considering the business-case for renewable energy and/or energy efficiency, two over-arching considerations are important:

1. Different scales need to be distinguished: what makes clear business sense at for instance the national level might not make sense at the individual or household level, what is sensible at the international scale might not yet be economically feasible for a family etc. and

2. because of the nature of the issues and the interconnectedness of climate, energy and the environment with the economy, multiple benefits or returns accrue to investments made in renewable energy and/or energy efficiency – these might be economic returns (e.g. classic financial return-on-investment), or social returns (e.g. jobs, quality of life, health), or environmental (e.g. climate change mitigation, improved habitat, reduced risk from flooding or drought etc). The benefits – which are often in any case very difficult to quantify - often accrue to different stakeholders, making individual unit decision-making difficult.

For the international community, it is clear that without massive investment into these two sectors, and an overall drive towards a green economy which results in massive de-coupling of wealth and quality of life from fossil-based energy, by the middle of the 21st century, the costs will be enormous. The IPCC, following on from the famous "Stern Report" (Stern, 2006), is the best known source of information quantifying how much needs to be invested at the macro level and what the likely benefits are.

Measures of energy efficiency would also significantly reduce the levels of fuel dependency in the countries and ease balance of payment problems triggered by the necessity to devote foreign exchange for fuel imports, especially during the winter. One study (Ürge-Vorsatz 2010) found that a deep retrofit of Hungary's housing stock would save up to 39% of natural gas imports, and up to 59% of import needs during January, traditionally the critical month in energy security.[119]

5.2. SOCIAL FACTORS

Most stakeholders agree that the move towards a greener economy in general, and investments into renewable energy and energy efficiency in particular, offer enormous potential for job creation, in the order of tens of millions of new jobs worldwide[119]. As the world struggles to pull out of the global recession and with unemployment running at record highs, this should add momentum to any proposals for renewables and energy-efficiency measures.

Recent data from the USA highlight the employment potential of renewable energy. Perhaps the most-talked about of economic stimulus packages, the “American Renewal and Recovery Act” included significant green and energy related measures designed to contribute to President Obama's pledge to double energy from renewable sources during his term of office[120]. Investing 30% of total costs into more than 24.000 renewable projects (mostly wind and solar) the §1603 program created up to 75.000 full-time equivalent (FTE) jobs per year during the construction phase (2009-2011) and as many as 5.500 FTE jobs for the project lifetime. The initiative cost 9 billion dollars (USD) and is estimated to generate an economic output of at least 45 billion USD.

Energy efficiency measures have enormous potential for economic development and job creation. Just one study, in one country, on just one area of energy efficiency – retro-fitting of public residential properties for e.g. insulation, more efficient heating and lighting etc – found that 140.000 new FTE jobs would be created[121]. Extrapolating this for Romania and Bulgaria (with a population

119 UNEP, ILO, IOE, ITUC (2008) *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World* p.4., Report of the Green Jobs Initiative, 376pp. also available online at: http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_158727.pdf

120 Sourced from US Government website http://www.whitehouse.gov/energy/securing-american-energy#energy-menu

121 Ürge-Vorsatz et al (2010) *Employment Impacts of a Large-Scale Deep Building Energy Retrofit Programme in Hungary,* Executive Summary Report by 3CSEP, Central European University, Budapest Hungary.

respectively of 21,5 million and 7,5 million, compared to 10 million for Hungary) would mean that such an investment programme would create more than half a million jobs as well as delivering environmental, climate-relevant, and financial benefits.

The IPCC Report on Renewables estimates the scale of job creation through measures in each of the renewable forms of energy. Clearly, there is confidence at the international level that the green transition will provide a solution to the unemployment crisis, and extrapolation of IPCC figures for the three countries suggests an unmissable opportunity for multiple benefits through climate investment.

More specifically, the Hungarian government estimates that of a total of 150.000-200.000 total green jobs which could be generated by 2020, some 70.000 of them created in the energy sector[122]. If Bulgaria and Romania were to pursue a similar path, then based on their respective populations and extrapolating from the Hungarian figures, as many as some 430.000 new Romanian jobs and some 150.000 new Bulgarian jobs could be created. The indirect economic impact of such massive domestic job creation is might have considerable effects on the countries' prosperity.

122 Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary p.7.

6. POSSIBILITIES FOR A CLIMATE&ENERGY ENGAGEMENT IN THE COUNTRIES

SUMMARY

There are a range of options and opportunities for climate & energy interventions in the three countries, including policy, corporate engagement and demonstration projects.

Policy advocacy at national level could be grouped around the main need for integrated, long-term, inclusive national energy visions to be developed in Bulgaria and Romania (available in Hungary).

Beyond that, national level advocacy needs to focus on the – for a low-carbon future – inappropriate energy mix which is continuing to be supported and subsidised by governments in all three countries, with a continuing preference towards oil, gas, coal and nuclear, being one main obstacle which would require policy and political attention.

Additional possible policy requirements vary from country to country and can be assessed using for example the "WWF Heliosthana" study's[123] described steps for national planning of a low-carbon energy future.

Corporate engagement opportunities can be numerous and could offer good prospects for ecological footprint reduction, falling into three possible categories of:

1. *partnerships with business regarding renewable technologies or sectors;*
2. *partnerships with business regarding energy efficiency; and*
3. *partnerships for communications and/or policy advocacy.*

Demonstration initiatives of sustainable renewable energy projects could also be developed.

123 WWF and Heinrich Boll Foundation (2010) Heliosthana – A Mediterranean Sustainable Energy Country, 52pp., Brussels, Belgium.

6.1. CONCLUSIONS FROM THE STUDY

The challenge to transition quickly to a greener, low-carbon economy is the most pressing issue of our times and is one which is intimately linked to nature and natural resources and environmental and energy policy.

From the information compiled in this thesis, it seems that Bulgaria, Hungary and Romania are all are making progress towards this low-carbon transition, albeit more slowly (and possibly, reluctantly) than desired from the point of view of an environmental organisation expecting urgent action against climate change. Policies and the market are being implemented which enable the development and deployment of energy efficiency and renewable energy measures, but often too slowly and not at a sufficient scale. From the information provided above, this is especially true for Bulgaria and Romania, who – low economic social base notwithstanding – compared to Hungary, which has a relatively enlightened long-term energy strategy in place and which appears to recognise the benefits and opportunities which can be secured by a country which moves towards a green low-carbon economy.

Environmental organisations and their engagement could aim to help governments fill in some of the gaps which exist, by promoting alternatives, highlighting best practices, and advocating and then assisting with the development of longer-term integrated energy and nature strategies (for Bulgaria and Romania).

At the European level, such policy and engagement activities in Central and Eastern Europe could feed usefully into a pan-European push to ensure that the current round of budgetary allocation discussions for the period 2014-2020 respond to the need for boosting investments into energy efficiency and renewable energy. The approximately one trillion Euro budget could be spent on measures which not only work towards a low-carbon future but which also create jobs, reduce energy bills, and restore and conserve nature. For example, WWF argues at the European level that at least 50% of the budget needs to go in this direction[124].

[124] WWF (2011b) WWF priority demands to the Danish Presidency, 1 January – 30 June 2012, WWF position paper, 12pp., December 2011, Brussels, Belgium.

With regards to WWF's EU Climate Policy Tracker the following key "building blocks" are essential in order to achieve an "A" rating stating a good performance in terms of heading towards a low-carbon future (EU Climate Tracker, 2011):

1. Efficiency improvements as key requisite to a sustainable low-carbon future

- A fully sustainable low-carbon future is only possible if the best available energy efficiency options and technologies are fully implemented.
- Paradigm shift in industrial production: Material efficiency needs to be enhanced in addition to energy efficiency. Industrial production must be redefined to 'reduce, re-use and recycle'. It means avoiding material-intensive products and focusing on long-lasting, 100% recyclable products.
- Wide application of zero emission buildings: Buildings need to be retrofitted to very high energy efficiency standards.
- Transport: Assuming a massive shift away from individual energy-intensive mobility, the remaining passenger car fleet must meet ambitious energy efficiency requirements.
- The carbon efficiency of food should be improved. This includes reducing wastage and a shift to food with a lower carbon intensity.

2. A 100% renewable energy supply by 2050

- Mobilise all electricity supply options from sun, wind and water.
- Electric transport based on renewables is needed wherever possible. This implies almost 100% electric passenger cars and a greater use of public transport. With a 100% renewable energy supply, sustainable biomass is a very scarce resource and it should be used in areas where there are no technological alternatives, e.g. trucks, aviation and shipping, therefore, passenger cars must run on electricity with suitable batteries.
- Significant enhancement of the electricity grid is necessary. The grids should be capable of sharing and exchanging clean energy.
- Strict sustainability criteria for biofuels. To ensure that renewable energy, most particularly renewable energy from biofuels, is compatible with environmental and development goals, strict sustainability criteria should be developed and enforced.

3. **Sustainable land use**
   - Comprehensive land use strategies must be developed to solve the potential conflict in land use as agricultural areas, forests and wood production compete with each other for food production, carbon storage and as a source of biofuels.
   - Major reductions in non-energy emissions in agriculture are necessary. Where there are currently no mitigation options, research must be intensified.

4. **Prompt action**
   - Time is very short, so action must begin immediately to initiate rapid transformation.

These building blocks translate to separate targets for each of the sectors, see tabe below (Table 23).

Table 23: Sectoral targets for a low-carbon vision (EU Climate Tracker, 2011)

Sector	Target
Electricity supply	100% renewable energy supply by 2050
Industry	Around 90% reduction in greenhouse gas emissions by 2050
Buildings	Around 100% reduction of energy use for space heating, domestic hot water and air-conditioning Around 30% reduction for electricity demand for appliances and lighting
Transport	Around 90% reduction in greenhouse gas emissions by 2050
Agriculture	Around 50% reduction in greenhouse gas emissions by 2050
Forestry	Ensure forest as a carbon sink while using it for the sustainable production of biomass

Measuring Bulgaria's, Hungary's and Romania's policy frameworks in broad terms against guiding environmental policy frameworks providing pre-conditions towards a low-carbon future could a useful way to define where the impacts could be felt and the interventions made[125]:

1. As stressed above, a strategic country-wide vision might be required, one which has been developed together with stakeholders and with a structured institutional framework behind it to support its implementation.
   Status: Only Hungary has this, Bulgaria and Romania do not.
   Possible Environmental Interventions: Policy lobbying and advocacy in Bulgaria and Romania for the establishment of strategic, integrated climate&energy vision.

2. An energy policy should be built upon three pillars of an effective and secure system of supply, guaranteed access to energy (through a social tariff) and phase-out of fossil-based fuel sources.
   Status: All three countries are striving for the first, the second is debatable (energy poverty, as noted above, being a common occurrence), and the third is questionable in each country given the continued and in some case

125 WWF and Heinrich Boll Foundation (2010) Heliosthana – A Mediterranean Sustainable Energy Country, 52pp., Brussels, Belgium.

increasing levels of investment going to fossil fuels and nuclear power sectors.

Possible Environmental Interventions: Policy lobbying in all three countries and possibly at regional level for an low-carbon (and considered safe with regards to nuclear) future energy mix which speeds up and ensures the phase-out of fossil fuels.

3. Appropriate structural measures for energy efficiency including consumer behavioural changes (through communications and public awareness), efficient regulation (including labelling, standards and certification) and accompanying financial measures need to applied.

   Status: All three countries are striving for this.

   Possible Environmental Interventions: There could be an expanded and effective role in leading and/or supporting enhanced consumer awareness through targeted communications, perhaps alongside established actions like the “Earth Hour” annual campaign or by partnering with the private sector to promote energy efficient behaviour, products or services.

4. An assessment should be carried out of renewable energy needs (from the vision), renewable energy potential and opportunities accompanied by the necessary regulatory framework, feed-in tariffs, financing mechanisms etc.

   Status: Again all three countries are striving for this. Bulgaria seems to be less motivated by renewables than do the other two countries. Romania seems to be motivated by renewables but experiences problems with permitting and planning. Hungary seems well served in all areas but perhaps needs greater encouragement to expand renewables further at the expense of fossil and nuclear.

   Possible Environmental Interventions: Varies from country to country. In Bulgaria, it appears that hydro, wind and biomass development is fragmented and confused. Mapping of potential renewable sources would be a necessary first step, followed by analysis and partnership with other NGOs and research communities for assessing the threats to nature and opportunities for development. Likewise in Romania, with an emphasis on hydro and wind. In Hungary, the biomass development is of great importance and it might be necessary to maintain and continue some of the existing activities (see Annex 2 as an example) in this field not just for Hungary but also to serve as a possible model and a resource for other countries.

5. Take advantage of regional linkages, cross-border trading and integrated energy planning at a "supra-national" scale.
   Status: Again all three countries striving for this.
   Possible Environmental Interventions: To be developed within the respective frameworks/networks of environmental organisations.

6. Strive for long-term urban planning aiming for denser and more efficient cities, working and affordable public transport (mass transit) schemes, re-shaping of working, living and leisure patterns.
   Status: Uncertain but likely to be lacking in all three countries (WWF, pers. comments).
   Possible Environmental Interventions: After some further research there could be a niche in offering support to policy decision-makers regarding (master-) plans for longer-term "urban sustainability planning" for the future decades.

These steps are further detailed in a hypothetical model in WWF's "Helisothana" report[126] which could provide an inspirational guide for framing WWF's climate & energy work in the region.

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[126] WWF and Heinrich Boll Foundation (2010) Heliosthana – A Mediterranean Sustainable Energy Country, 52pp., Brussels, Belgium.

6.2. POSSIBLE INTERVENTIONS REGARDING A CORPORATE ENGAGEMENT

Here as well could be several opportunities for interventions, potentially falling into three possible categories:

- partnerships with business regarding renewable technologies or sectors;
- partnerships with business regarding energy efficiency and
- partnerships for communications and/or policy advocacy.

Sometimes the same partner might be appropriate for more than one.

6.2.1. Partnerships with businesses regarding renewable technologies

Partnership with the renewable energy sector seems an obvious partnership opportunity. For example, as with WWF Hungary's joint work with biomass energy sector together with a range of stakeholders including the power station AES[127], the mutual benefits of jointly researching, piloting, implementing and communicating innovative low-carbon initiatives are very great, and could be multiplied in the three countries to great effect.

Hungary could continue to focus on biomass, playing a leadership role on this and on general energy engagement as a whole; Bulgaria could focus on also on biomass and branch out on wind; and Romania could seek to partner with wind companies in Dobrogea (perhaps the world's no.1 market leader Vestas, which recently opened up a presence there[128]) as well as monitoring and contributing to the hydro debate and checks and balances through appropriate partnerships with progressive international developers.

Such partnerships often result not only in interesting and inspiring field stories concerning energy and the environment, but also often branch out into joint policy

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[127] Avis and Kokovkin (2009) Business for and from Nature, book produced from the WWF One Europe More Nature initiative, 100pp., Tallinn, Estonia.

[128] The Bioenergy Site (2011c) Vestas opens office in Romania, online article from 28 January 2011, at http://www.thebioenergysite.com/news/8012/vestas-opens-office-in-romania

work vand advocacy concerning the supports, measures, programmes and tariffs surrounding renewable energy.

Benefits of this type of engagement would include: accelerated uptake of technologies or expanded growth of sector; valuable field stories and successes; more powerful lobbying capacity when approaching government with a private sector partner; and opportunities for corporate fundraising.

6.2.2. Partnerships with businesses regarding energy efficiency

The principal area identified above in this report of prime importance for energy efficiency is the household sector. This also lends itself easily to corporate engagement. Partnerships could be formed around specific themes, such as lighting, heating, insulation, appliances, and so on. Simply using, adapting, and rolling out the Climate Savers framework in the three countries would be a no-risk way of approaching this.

Alternatively, energy efficiency could form one part of other corporate engagement strategies with companies on any type of issue – for example with the retail sector (whose energy efficiency leaves a lot to be desired), or with the extractive industries. But given the declining share of energy consumed by industry, it is not recommended to develop a sectoral type engagement. Specifically on this topic.

Benefits of this type of engagement would include: accelerated uptake of energy efficiency measures; increased public awareness of householders; expanded constituency amongst the public; significant potential for joint communications and heightened visibility, and opportunities for corporate fundraising.

6.2.3. Partnerships with businesses for communications and/or policy advocacy

Again this appears to be a no-brainer. Any of the above type of company might be interested in purely communications-oreinted work such as joint awareness raising of a sector, an issue, an opportunity (or maybe by extension a product). If the topic is climate related, multiple benefits could be reaped from such engagements.

Examples might include partnering with a retailer to highlight energy efficiency issues (and by extension, a range of energy-efficient products or services); partnering with public transport service providers to highlight the climate implications of mass transit systems vis-a-vis road transport; partnering with retailers or growers or producers to highlight footprint issues in relation to food miles, carbon content of food, consumer goods, etc.

Benefits of such communications and policy partnerships include heightened awareness amongst the general public leading to more climate-friendly consumer behaviour or strengthened lobbying capacity when working together with a private sector company.

6.3. POSSIBLE INTERVENTIONS REGARDING DEMONSTRATION INITIATIVES

Such policy work and business engagement could be complemented by demonstration initiatives – field projects or real-life initiatives which highlight an opportunity, serve as a reality-check for policy and communications, provide credibility, and enable a wider set of potential partners and stakeholders to see, feel, touch and understand the importance of a given course of action or response.

In the field of renewable energy, some institutions, like for instance WWF Hungary, have experience in initiating and implementing field projects, including but not limited to its work on floodplain biomass and other energy "crops" through the One Europe More Nature programme[129]. The Hungarian biomass project has recently been exported to Ukraine and Romania, and support should be given to its magnification.

Other useful possible demonstration projects would include: demonstration of wildlife-friendly windpower development in Romania; waste management for biogas production in Bulgaria; and a pilot project for developing and testing sustainable hydropower in e.g. Romania based on the Austrian experiences.

Benefits of this type of engagement include visible and visitable sites for communications, policy-makers, and stakeholders; heightened credibility; and on-the-ground conservation impact.

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[129] Details available at http://wwf.panda.org/what_we_do/where_we_work/project/projects_in_depth/one_europe_more_nature/?169443/Business-fromfor-Nature

7. REFERENCES

ABB (2011a): PDF „Bulgaria: Energy Efficiency Report 2011“, http://www05.abb.com/global/scot/scot316.nsf/veritydisplay/7c7691d00398dc8bc12578aa004c5320/$file/Bulgaria.pdf, viewed on March 12 2012

ABB (2011b) PDF „Hungary: Energy Efficiency Report 2011”, http://www05.abb.com/global/scot/scot316.nsf/veritydisplay/cdf28b3787b15663c12578aa004c2e3a/$file/hungary.pdf, viewed on March 24 2012

ABB (2011c) PDF „Romania: Energy Efficiency Report 2011”, http://www05.abb.com/global/scot/scot316.nsf/veritydisplay/45764d26054ba1e6c12578e20052672b/$file/romania.pdf, viewed on April 3 2012

ABB (2012) PDF „ABB delivers ultra-fast charging for electric cars at the “petrol station of the future” in Hungary - unique in Europe”, http://www.abb.com/cawp/seitp202/3176313f4ed79c6ec12579e90043bd60.aspx, viewed on April 3 2012

Avis (2011) The Ecological Footprint Of Central And Eastern Europe: Snapshot And Recommendations Report, for WWF Austria, 29pp., Vienna, Austria.

Avis and Kokovkin (2009) Business for and from Nature, book produced from the WWF One Europe More Nature initiative, 100pp., Tallinn, Estonia.

Birdlife International (2012) Wind Energy Development in Dobrogea Region: Inadequate Implementation of the EU Nature Directives is Resulting in Site Deterioration and Species Disturbance, 4pp. Policy briefing note, Bucharest Romania.

Budapest Business Journal (2011) Solar Energy Systems builds HUF 1.2 billion PV cell plant., online article from 30 March 2011m at http://www.bbj.hu/business/solar-energy-systems-builds-huf-12-bln-pv-cell-plant_56899

Budapest Business Journal (2011b) Hungrana to spend HUF 3 bln on biogas furnace, online article from 2 May 2011 at http://www.bbj.hu/business/hungrana-to-spend-huf-3-bln-on-biogas-furnace_57517

CleanTechnica.com (2011) Solar farms on old mine sites shining examples of smart land use, online article by Glen Meyers, 3rd October 2011, at http://cleantechnica.com/2011/10/03/solar-farms-on-old-mine-sites-shining-examples-of-smart-land-use/

EBRD (2009a) Bulgaria Country Overview, factsheet from the EBRD Renewable Energy Initiative, 15pp.

EBRD (2009b) Romania Country Overview, factsheet from the EBRD Renewable Energy Initiative, 10pp.

Energy Daily News (2011) GdF eyes biomass plants in Bulgaria, news article from 8 April 2011, available at http://www.energydailynews.com/biogas-market-in-south-eastern-europe/175-gdf-eyes-biomass-plants-in-bulgaria

European Commission, Directorate-General for Energy and Transport, 2008, Bulgaria Renewable Energy Factsheet, 3pp., Brussels.

European Commission (2011) A Roadmap for moving to a competitive low carbon economy in 2050, COM2011 (112 Final), 15pp., Brussels, Belgium

European Union (2011) EUROSTAT Pocketbooks: Energy, Transport and Environment Statistics, 218pp, Luxembourg.

Global Wind Energy Council (2011) Global Wind Report 2011 – Annual Market Update, Brussels

Government of Bulgaria (2011a) Energy Strategy of the Republic of Bulgaria till 2020, for Reliable, Efficient and Cleaner Energy, 46pp., Sofia Bulgaria.

Government of Bulgaria (2011b) Second National Energy Efficiency Action Plan, 2011-2013, 88pp., Sofia Bulgaria.

Government of Hungary (2010) Hungary's Renewable Energy Utilisation Action Plan (on trends in the use of renewable energy sources until 2020), 222pp., December 2010, Budapest, Hungary.

Government of Hungary (2011) Second National Energy Efficiency Action Plan of Hungary (until 2016 with an outlook to 2020), Ministry of National Development, 73pp., October 2011, Budapest, Hungary.

Government of Hungary - Ministry of National Development (2012) National Energy Strategy 2030, 132pp., Budapest, Hungary.

Government of Romania (2007) First National Action Plan for Energy Efficiency, 2007-2010, 41pp., Bucharest, Romania.

Government of Romania (2010) National Renewable Energy Action Plan, 203pp., Bucharest.

Government of Romania, Law 220/2008 modified and completed with Law 139/2010, quoted by Birdlife International, March 2012 Wind Energy Development in Dobrogea Region: Inadequate Implementation of the EU Nature Directives is Resulting in Site Deterioration and Species Distrurbance, 4pp. Policy briefing note, Bucharest Romania.

IEA (2012) Tracking clean energy progress – Energy technology perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial, 82pp., Paris, France.

IPCC (2007) Climate Change 2007 – Synthesis Report, 52pp., Synthesis Report of the 4th Assessment Report,

IPCC (2012) Renewable Energy Sources and Climate Change Mitigation, Special Report of the Intergovernmental Panel on Climate Change, 1076pp., Cambridge University Press, New York, USA.

Ministry of National Development (Hungary) (2012) National Energy Strategy 2030, 132pp., Budapest, Hungary.

National Renewable Energy Laboratory (NREL) (2012) Preliminary Analysis of the Jobs and Economic Impacts of Renewable Energy Projects Supported by the §1603 Treasury Grant Program, Technical Report NREL/TP-6A20-52739, April 2012, 33pp., Colorado USA.

Olson, D. and Dinerstein, E. (2002) The Global 200: Priority Ecoregions For Global Conservation, Annals of the Missouri Botanical Garden 89, p. 199-224

Republic of Bulgaria (2010) National Renewable Energy Action Plan, Ministry of Economy, Energy and Tourism, 216pp, June 2010, Sofia, Bulgaria.

RSPB (2009) Mapped and written guidance in relation to birds and onshore energy development in England, RSPB Research Report no.35., 173pp., Sandy, UK.

RSPB (2012) RSPB announces wind turbine plan to reduce its carbon footprint, News Item, 20 March 2012, online at http://www.rspb.org.uk/news/312085-rspb-announces-wind-turbine-plan-to-reduce-its-carbon-footprint-

Sandulescu A. (2011) Romanian Energy Sector and the National Energy Strategy, powerpoint presentation delivered to the 6th Emerging Europe Energy Summit, 4-5th November 2011, by the General Director Energy, Oil and Gas - Romanian Ministry of Economy, Commerce , Romania.

Stern, N. (2006) The Stern Review: The Economics of Climate Change from the executive Summary of the Stern Review

The Bioenergy Site (2010) Solar park for Bulgaria, online article from 8 January 2010, available at http://www.thebioenergysite.com/news/5297/solar-park-for-bulgaria

The Bioenergy Site (2011a) Hungarian plant utilises sewage sludge, online article from 29 July 2011, at http://www.thebioenergysite.com/news/9269/hungarian-plant-utilises-sewage-sludge

The Bioenergy Site (2011b) Meat processing waste for renewable energy, online article from 6 October 2011, at http://www.thebioenergysite.com/news/9702/meat-processing-waste-for-renewable-energy

The Bioenergy Site (2011c) Vestas opens office in Romania, online article from 28 January 2011, at http://www.thebioenergysite.com/news/8012/vestas-opens-office-in-romania

The Bioenergy Site (2011d) Airbus and TAROM launch biofuel value chain, online article from 22 March 2011, at http://www.thebioenergysite.com/news/8386/airbus-and-tarom-launch-biofuel-value-chain

The White House (2011) Blueprint for a Secure Energy Future, online document 44pp., at http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf

Tirrado Herrero and Urge-Vorsatz (2010 in press) Trapped in the Heat: The Post-Communist Genre of Fuel Poverty" in press, Energy Policy special edition on fuel poverty.

UNDP (2010) How-to-Guide: Low-emission Development Strategies and Nationally Appropriate Mitigation Actions – Europe and CIS, 100pp.

UNECE (2012) From Transition to Transformation: Sustainable and Inclusive Development in Europe and Central Asia, 163pp., Geneva, Switzerland

Ürge-Vorsatz and Metz (2009) Energy Efficiency: how far does it get us in controlling climate change" article in Energy Efficiency 2:87-94.

Ürge-Vorsatz et al (2010) Employment Impacts of a Large-Scale Deep Building Energy Retrofit Programme in Hungary, Executive Summary Report by 3CSEP, Central European University, Budapest Hungary

World Health Organisation (WHO) (2005) Fact Sheet: Climate and Health. July 2005, available online at www.who.int/globalchange/news/fsclimandhealth/en/index.html

WWF (2003) Hydropower in a changing world, 4pp brochure, WWF Dams Initiative, Godalming UK.

WWF (2009) Sun, Wind, Water and More – Renewable Energy in WWF Field Projects, report of the WWF Renewable Energy Centre, 36pp., September 2009, Washington D.C., USA.

WWF (2010) Living Planet Report 2010 – Biodiversity, biocapacity and development

WWF (2011) The Energy Report: 100% Renewable Energy by 2050, Gland, Switzerland.

WWF and Ecofys (2011) Summary Report: EU Climate Policy Tracker 2011, report produced in collaboration with Ecofys, 36pp., Brussels, Belgium.

WWF and Heinrich Boll Foundation (2010) Heliosthana – A Mediterranean Sustainable Energy Country, 52pp., Brussels, Belgium.

WWF and ECOFYS (2011) Climate Policy Tracker: Bulgaria .4pp. Brussels, Belgium.

WWF Austria (2011) Executive Summary of the WWF Eco-Masterplan Austria, 3pp, Vienna, Austria.

WWF Deutschland (2010) Blueprint Germany – A Strategy for a Climate-Safe 2050, translation of the original "Modell Deutschland – Klimaschutz bis 2050" report by Prognos and Oko-Institut, 468pp., Berlin.

WWF Greece (2011) Wind farms, birds and bats in Thrace: Presenting the work of WWF Greece, Position paper, 5pp., Athens, Greece.

ANNEX 1: RELEVANT EU DIRECTIVES AND COMMUNICATIONS RELATING TO ENERGY

There are many EU directives and communications related to energy, in the table below some of the most relevant are listed.

	European Energy Label
Directive 98/11/EC	Implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps.
Regulation 106/2008	On a Community energy-efficiency labelling programme for office equipment.
Directive 2003/66/EC	Implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations
Directive 2010/30/EU	Labelling and product information of energy consumption by energy-related products
	Energy Networks
Communication 677/4	Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network
Regulation 1775/2005	On conditions for access to the natural gas transmission networks.
Directive 2005/89/EC	Concerning measures to safeguard security of electricity supplyand infrastructure investment.
	Energy Efficiency / Renewables
Communication 639	Energy 2020 - A strategy for competitive, sustainable and secure energy
Communication 5174	National RE Action Plans under Directive 2009/28/EC of the European Parliament and of the Council.
Directive 2009/28/EC	On the promotion of the use of energy from renewable sources.
Communication 105	Green paper - A European Strategy for Sustainable, Competitive and Secure Energy.
Communication 105 (Annex)	Green paper Annex - What is at stake, a background document.

Communication 30	20 20 by 2020 Europe's climate change opportunity.
Communication 6817	Establishing harmonised efficiency reference values for separate production of electricity and heat.
Directive 2004/8/EC	On the promotion of cogeneration based on a useful heat demand in the internal energy market.
Directive 2005/32/EC	A framework for the setting of ecodesign requirements for energy-using products.
Directive 2006/32/EC	On energy end-use efficiency and energy services.
	Energy Efficiency in Buildings
Directive 2002/91/EC	On the energy performance of buildings.
Directive 2010/10/EU	On the energy performance of buildings. 2002/91/EC Follow-up.
	Fossil Fuels
Directive 2006/67/EC	Imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products.
Directive 2003/55/EC	Concerning common rules for the internal market in natural gas.
Directive 2004/67/EC	Concerning measures to safeguard security of natural gas supply.
Regulation 405/2003	Concerning Community monitoring of imports of hard coal originating in third countries.
	Competition
Regalation 1228/2003	On conditions for access to the network for cross-border exchanges in electricity.

ANNEX 2: EXEMPLARY CASE STUDY FOR A REPRESENTATIVE RENEWABLE ENERGY PROJECT

Hungary, Tisza Floodplains – Planting Energy for Wetland Conservation (taken from WWF, 2009)

WWF has initiated an innovative pilot project in the Tiszatarján village, next to the Tisza River in northeastern Hungary. The project's goal was to restore and diversify the area's natural floodplains and produce local renewable energy while increasing and diversifying local income streams. A new company, set up within the framework of the project by the Tiszatarján municipality and a local farmer, paid local people to cut wild bushes of the highly invasive *Amorpha* species, which was shipped to, and burnt, at a large nearby energy plant to produce "green" electricity. Large areas of land formerly covered by the *Amorpha* plant, together with less productive arable lands, are now being given back to nature to restore the floodplain's former glory. Some of the area is being replanted with willow trees, which will serve as a long-term, sustainable supply of biomass for the power plant. Participating farmers are obliged to set some lands aside for wetland and grassland conservation, the management of which will be paid for by revenues from biomass sales. Additional project mechanisms include the introduction of grazing animals, such as Hungarian grey cattle and water buffalo, to prevent the return of invasive species and to assist with grassland management. Finally, these changes provide an attractive landscape for ecotourism, which will bring in additional revenues to economically diversify and better sustain this Hungarian rural community.


Tiszatarján floodplains © WWF / JP Denruyter

Technology: In a first phase, biomass (*Amorpha fruticosa*) co-firing in a 50 megawatt coal power plant using the fluid bed technique. The long-term target is to diversify biomass sources and to move toward decentralized small capacity heat districts owned and managed by local communities along the river Tisza.

Biomass sources: Amorpha and later native willow (*Salix alba*) plantations.

1. Context

One hundred fifty years ago, the area was a beautiful mosaic of sparsely forested floodplain grasslands (similar to savannah or steppe), wetlands (e.g. oxbows, old riverbeds, clay pits), and floodplain softwood forests (mainly willow and poplar). Many landscapes and species remain, but they number far less than before. In 1989, a large part of the area was protected as a national park and internationally protected as a Ramsar wetland site. The area is home to globally significant species such as the black stork, white-tailed eagle and countless water birds that migrate to the area in the spring, including herons and geese. The area is especially noted for its "Tisza Flowering, " the mating dances of a mayfly (*Palingenia longicauda*) species, which create a breathtaking immense cloud of swarming winged insects for only three to four days each May or June.

In the 19th century, the Hungarian aristocracy introduced massive changes in the region to increase cropland areas for arable production and to seemingly improve flood protection. The result was the engineered regulation of the Tisza River within large earthen dykes, wetland drainage, the straightening of river bends and reductions in river length. Later, construction of new regulated canals and a hydropower plant led to the creation of the artificial Tisza Lake. In wetland areas within the dykes, some traditional practices were maintained, and this is where the main ecological corridor remains. Outside the dykes, new fields, settlements and roads developed. In total, the river has lost 98 percent of its floodplains.

After the Second World War, Hungarian agriculture was characterized by drastic increases in energy-intensive inputs (e.g. artificial fertilizers). Yields doubled over 25 years, while the diversity of yields decreased. As a result, traditional land-use practices declined even more.

With the end of communism in 1989, farmers were hard hit as many state-run agricultural cooperatives closed. Land parcels distributed to private owners were often too small to be financially viable, and there were difficulties in finding markets for local products such as meat and milk. Grazing almost completely stopped within the dykes as many former farmers gave up farming and many lands were left unmanaged and abandoned.

The net result of these changes was that environmental degradation proceeded, especially in former wetlands and floodplain areas. Most wetlands disappeared, both inside and outside the dykes. Many of the natural watercourses flowing to the area dried up, including streams from the nearby (Bükk) Mountains that were blocked and regulated. Groundwater levels dropped, and saline soil replaced many former floodplain grasslands, making the area dehydrated and reducing meadow fertility. The risk of floods increased (five floods in the last 10 years), because the riverbed deepened, and the floodwater retention capacity of the floodplains decreased.

Amorpha fructicosa © WWF / JP Denruyter

A major problem resulting from the decreased grazing and scything was widespread colonization by invasive species such as wild *Amorpha fructicosa* ("running acacia") in the floodplain grasslands and wetlands. Natural forest areas also disappeared, replaced mainly by hybrid poplar forests planted after World War II and with the start of intensive agriculture in the 1970s. This move toward monoculture continues today.

2. Solution

WWF's main goal was to restore the area's natural floodplains and produce local renewable energy while increasing and diversifying local income streams.

A limited company, Tiszatarján Kft, was established by the Tiszatarján municipality, and a local farmer was appointed to manage the project area (initially 53 hectares) during and after WWF's involvement. WWF then mediated an agreement between the company and the energy provider, AES Hungary, whereby the company would provide AES with biomass to produce "green" energy (which is a positive contribution in mitigating climate change). Initially, the biomass is cofired in a local 50 megawatt coal power station. The contract was based on a number of nature conservation criteria written by WWF, such as the requirement for biomass to be certified by WWF. In 2008, the municipality company contracted with local unemployed workers to cut and remove invasive *Amorpha fructicosa* from the floodplains. The resulting 400 tonnes of bundled biomass was sold to AES Hungary, generating EUR 32.000 of new income and employing two people full time and more than 30 people seasonally (including many unemployed gypsies). The company prevents the return of *Amorpha fructicosa* and replaces the plant in some less ecologically valuable, former cropland areas with energy-useful willow, a local species that will continually be cut to produce a regular supply of biomass for AES and therefore jobs and income for the community. In 2008, the first willow seedlings were planted in areas formerly covered by *Amorpha* and in former arable lands. The project will later be expanded to nearby areas where invasive species will be similarly cut and replaced with natural areas and with willows for increased green energy production. A long-term goal is for the local communities to become energy self-sufficient.

Hungary was taking measures to increase the share of renewable electricity in the country from 0,1 percent up to 3,6 percent, especially through solid-biomass combustion in old coal-fired power stations. Selling the subsequent carbon emission savings would help make those projects financially interesting. AES was the first power company involved in the joint implementation or EU Joint Implementation (JI) process and signed an agreement with the Netherlands, before the common project with WWF. This was the first ever JI project in Hungary, and each step that was taken meant breaking new ground, particularly in negotiation with the Ministry of Environment, which had never issued approvals for Kyoto Protocol transactions before. Ultimately, AES sold the emission reductions (ERUs) to the Dutch government raising more than 3 million euros of funding or some 25 percent of the project cost**,** substantially cutting the need for equity in the project.

Subsidized Floodplain Maintenance and Restoration

The contract between AES and the municipality company obliges landowners to set aside a certain amount of degraded floodplain areas and former arable land for restoration of floodplain habitats, especially wetlands and grasslands. Income earned from the selling of biomass is used by the farmer to cover the costs of maintaining the habitat. This enhances biodiversity and boosts provision of ecological services such as floodwater retention. Examples of wetland work include restoring arable lands that experience regular excess water pouring into wetlands or reed beds, prohibiting water drainage and irrigation from valuable wetlands or the use of pesticides and artificial manure, and stopping the advancement of aggressive weeds and invasive species (e.g. *Amorpha*, hybrid poplar, *Fraxinus Americana*, *Acer negundo*). Examples of grasslands work includ prohibitions on new conversions to arable land or hybrid poplar plantations, the use of pesticides, artificial manure and irrigation, and the introduction of alien species while introducing wise-scything practices for grasses.

Extensive Grazing

The company, with the help of WWF-Hungary, has reintroduced water buffalo in wetland areas and Hungarian long-horned Grey Cattle in woody grassland areas to prevent invasive species from recolonizing and to help restore the grasslands to their former species-rich glory. Another expectation is the future sale of organic beef to supplement local incomes. Semi-managed grazing also attracts new biodiversity, especially water birds around wetlands. Beavers have been reintroduced in the floodplains' project area as the former native ecological engineers are supposed to diversify the wetland's landscape and restructure floodplain habitats.

Ecotourism Expansion

The resultant improvements to the landscapes and biodiversity make the area more attractive to tourists and encourage the development of local tourism facilities. Recently, a bike trail along the top of the dykes was developed. A new ecological corridor to connect protected areas in the Mezocsát microregion with Tisza Lake is also envisioned. In July 2008 and 2009 Tiszatarján hosted the Tisza Big Jump, part of a Europe-wide public event where people jumped into their nearby rivers and lakes at exactly the same time to signify their concern for water and river ecology.

4. Outcomes and Hurdles

Since the program's inception in 2006, AES has bought more than 400 tonnes of invasive species as biomass, clearing more than 15 hectares of floodplain. After removing invasive shrubs, former floodplain habitats have been maintained by semi-natural grazing. On the pilot site, 20 hectares (owned by Tiszatarjan municipality) of wet grasslands and wetlands have been restored by water buffaloes and beavers since the summer of 2008, and 30 hectares (owned by the local farmer) of woody grassland are also being restored by (20) Hungarian grey cattle.

On the former arable land areas of the cleared floodplain, energy-useful willow plantations were established on 20 hectares in 2008. In 2009 another 10 hectares of energy plantations are to be established on former arable lands. The first harvesting activities are scheduled for next winter. This means that willows will replace *Amorpha* as a biomass source after two to three years and will subsidize nature restoration and maintenance of the floodplain habitats.

At present, the project area covers 80 hectares of floodplain areas, and WWF is planning to extend the project to neighboring villages. WWF-Hungary has started to negotiate biomass production and floodplain restoration with three more villages next to Tiszatarjan. Most of the floodplain areas are state-owned but managed by the water management authority. WWF-Hungary has turned to the water management authority with a restoration plan on cutting *Amorpha* on 600 hectares of floodplain and reintroducing new land-use practices that can be seen on the Tiszatarjan pilot site.

At the same time WWF-Hungary, AES, and the local company are negotiating a new supplier contract. AES declared that the biomass provided was satisfactory, and the power plant is ready to buy more or the same amount next year as well.

WWF-Hungary and four local municipalities are also working on a new project proposal for planning and building local heating plants in the villages in order to use local biomass for local communities. Only surplus biomass from this project would be transported to AES.

In Hungary at present, renewable electricity is mostly generated from forest biomass. WWF-Hungary aims to replace this with biomass from sustainable energy plantations and link bioenergy production directly to nature restoration. WWF-Hungaryalso wants to enhance the importance of local biomass as a source of heat for local communities. In Hungary, only renewable electricity is supported (through a feed-in tariff). For renewable energy projects based on biomass, it would also be useful to obtain subsidies for green heat.