MSc Program
Environmental Technology & International Affairs

TU WIEN CONTINUING EDUCATION CENTER

diplomatische akademie wien
Vienna School of International Studies
École des Hautes Études Internationales de Vienne

Solar Photovoltaic Array Sizing as an initial investment in SPVWPS in megacities: The case of Mexico City's groundwater wells

A Master's Thesis submitted for the degree of
“Master of Science”

supervised by
Dr. Norbert Kreuzinger

Liliana Morales Rodriguez

01528140

Vienna, 10.09.2018

Affidavit

I, **LILIANA MORALES RODRIGUEZ**, hereby declare

1. that I am the sole author of the present Master's Thesis, "SOLAR PHOTOVOLTAIC ARRAY SIZING AS AN INITIAL INVESTMENT IN SPVWPS IN MEGACITIES: THE CASE OF MEXICO CITY'S GROUNDWATER WELLS", 61 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 10.09.2018

____

Signature

Abstract

Megacities in developing countries are increasingly struggling to meet the water and energy needs to efficiently provide both services to the population. Recognized as the water-energy nexus, it intends to highlight the interdependence of one another: water operations need energy; and energy operations need water. Thus, renewable energies like Solar Photovoltaic Water Pumping Systems present a groundbreaking opportunity for megacities in the developing world to transform from a fossil-fuel based system to a renewable one. These systems have the potential to ameliorate the supply and distribution part of the water-energy nexus whilst attracting long-term economic and environmental benefits.

The overall purpose of this investigation is to analyze the potential of installing proper sized PV arrays in a megacity in the developing world. This recommendation is made as an alternative to the reliance on conventional electricity for groundwater pumping in domestic urban supply. Secondly, it aims at taking Mexico City's 528 public urban groundwater wells as a study case to determine the size and capacity of the system in order to assess if it is enough to cover the electricity ne eds for groundwater pumping. The third aim is to study if the investment in the system at such a large scale is financially realistic. Lastly, the fourth goal of this study was to explore the potential environmental benefits that the installation of a PV array system could generate.

By contemplating a 30-year duration scenario (2016-2045), this study found that the calculation of the PV array sizing displays that its installation is feasible from a capacity point of view. With an overall capacity of 204,104,250 watt-peak, the system would be able to cover the annual electricity needs of 299,595,632 kWh for the 528 public urban wells in Mexico City.
Furthermore, by calculating SACMEX's expenditure (at present value) on conventional energy in the next 30 years, it was revealed that 818,258,300 USD would potentially be spent annually only for pumping and distributing groundwater.

Hence, if SACMEX considered investing in the installation of 647,950 panels, it would benefit from more than 800 million dollars in savings (over the 30-year period), and it would also profit from returning the potential daily surplus produced by the system to the electricity grid. By returning the potential surplus, SACMEX's could, on the one hand, possibly compensate its expenditure on conventional electricity, and on the other hand, sell the electricity to CFE, suggesting the possibility of receiving revenue.

Table of Contents

List of Abbreviations

CECs	Clean Energy Certificates
CENACE	National Center for Energy Control
CO_2	Carbon Dioxide
CRE	Energy Regulating Commission
IEA	International Energy Agency
INERE	National Inventory of Renewable Energies
MCMA	Mexico City and its Metropolitan Area
PEMEX	Mexican Oils
PV Array	Photovoltaic Array
SACMEX	Water System of Mexico City
SEMARNAT	Ministry of Environment and Natural Resources
SENER	Ministry of Energy
SHCP	Ministry of Finance and Public Credit
SPVWPS	Solar Photovoltaic Water Pumping Systems

Acknowledgments

First and foremost, I would like to use this space to extend my gratitude to my parents, Lilia and Jorge. Without your incredible support, this thesis would not have been possible. Thank you for sharing your passion towards the environment with me, your knowledge, and most importantly your love. I dedicate this work to you.

I would also like to thank and congratulate all my friends and colleagues from the ETIA9 cohort. Your friendship and support during these tough two years made my heart get filled with joy and great memories that I will forever cherish. Special thanks to Michael, Anastasia, and Lisa, who have become my best friends and family throughout this fun and difficult process.

Last but not least, I would like to thank my supervisor, Dr. Norbert Kreuzinger for always pushing me to work harder and for sparking my interest in this important topic.

1. Introduction

Megacities in developing countries are increasingly struggling to meet the water and energy needs to efficiently provide both services to the population. The relationship between these two sectors started to get recognized until recently. Recognized as the water-energy nexus, it intends to highlight the interdependence of one another: water operations need energy; and energy operations need water. Figures show that approximately 2 billion people in developing countries around the world don't have access to safe drinking water, and that 1.3 billion people do not have access to electricity (WWAP 2014). Consequently, it is no coincidence that both of these figures align so well, since it is common that this when a part of the population lacks on one, they lack on the other one as well.

Furthermore, this nexus is being constantly pressured by external factors such as the water-energy-food nexus, urbanization, population growth, and climate change (Olsson 2012). Firstly, agriculture accounts for approximately 70% of the total global freshwater withdrawals, making it the largest user of water (FAO 2014). Secondly, megacities are growing at a very fast pace due to massive migration from rural areas to urban ones. Currently, megacities account for 10 percent of the world's population (UN DESA 2014). Thirdly, it is estimated that by 2050, the global population will increase from 7.6 to 9.8 billion, consequently increasing the demand of both sectors (UN DESA 2014). Lastly, as a direct consequence of the above-mentioned factors, the extent of fossil fuels used in the water and energy sectors are leading to an uncontrollable rise in the amounts of CO_2 emissions, consequently creating an unsustainable cycle.

For these reasons renewable energies present a great opportunity in megacities in the developing world. The constant market drops on the costs of installation, operation, and repair of these technologies, are making them more attractive to the public and private sector. Solar photovoltaic (SPV) energy generation is one of the most popular, cost-efficient and durable technologies in the market. Nevertheless, solar photovoltaic water pumping systems (SPVWPS) present a groundbreaking opportunity for developing megacities to enhance the efficiency of the pumping and supply aspects water-energy nexus. The photovoltaic array (PV array) is the most important feature of this technology since it is the most cost-intensive element of the system (accounting for almost 80 percent). Therefore, proper sizing is crucial to achieve the desired work efficiency (Kalamkar and Sontake 2016) .

This paper will study the case of Mexico City and its water-energy nexus, focusing on its pumping and distribution aspect. The goal is to demonstrate the feasibility of transitioning from a fossil-fuel based water pumping system to an entirely renewable one through the SPWPS. This study suggests that with an initial investment in the PV array aspect of the SPWP system, Mexico City's water management institution, SACMEX, could potentially create profit and contribute to the reduction of national CO_2 emissions. This case study analyzes the prospect of installing 647,950 panels photovoltaic panels with an investment of 571,491,900 USD for 528 public urban groundwater wells in Mexico City. This was achieved by calculating the PV array for every well, to later performing a cost-benefit analysis to determine its profitability for the following 30 years. In addition, the prospective financial and environmental benefits of reducing CO_2 emissions will be examined. Consequently, this research will attempt to demonstrate the potential that large-scale PV array installations can have in megacities in the developing world. Finally, it is important to acknowledge that, while there exists data in regard to regional and national levels, local-level information is still scarce not only for Mexico, but for many locations around the world. The data analyzed in this study was provided by SACMEX, the only governmental institution appointed for water management in Mexico City. Furthermore, while the data is precise, there are some groundwater wells that present little to no information but are counted for the overall result of this study.

2. Goals and objectives

This paper will study the case of Mexico City and its water-energy nexus, focusing on demonstrating the feasibility of SACMEX's transition from a fossil-fuel based groundwater pumping supply system to an entirely renewable one through SPWPS. This will be achieved by exploring the economic and environmental viability of installing proper sized PV array systems in its 16 municipalities and 528 groundwater wells as part of an initial investment in SPVWPS. Consequently, demonstrating the feasibility of transitioning towards renewable energy systems on a large scale like a megacity in the developing world. Ultimately, this analysis will attempt to answer the following questions:

1. Is the PV array's capacity enough to cover the daily/annual supply of electricity needed to provide the daily drinking water needs of each of the 528 wells?
2. What are the environmental benefits of installing PV arrays in the 528 groundwater wells of Mexico City?

3. Is it financially viable for SACMEX to transition from a fossil fuel-based groundwater pumping and supply system to a renewable one by investing in PV arrays at such a large scale?

3. Structure

This investigation aims at analyzing the potential of installing several proper sized PV arrays in a megacity in the developing world as an alternative on the reliance of conventional electricity for pumping groundwater for domestic urban supply. Secondly, it aims at taking Mexico City's 528 groundwater wells as a study case to determine the size and capacity of the system in order to assess if it is enough to cover the electricity needs for groundwater pumping. The third aim is to study if the investment on the system at such a large scale is economically feasible. Lastly, the fourth goal of this study is to explore the potential environmental benefits that the installation of a PV array system could generate.

4. Water-energy nexus

4.1. Water-Energy-Food Nexus

Historically, water, energy and food issues have been managed separate of one other as their interlinkage was not acknowledged until recently. The relationship between water, energy and food has always been considered essential and therefore has always been present (*Figure 1*). However, it was until the Annual Assembly of the World Economic Forum in 2008, that the necessity of developing a better comprehension of the nexus was raised. The approach of the nexus remarks the importance of considering external factors like feedback between the human and natural systems is towards integrating policy making, management, and governance to ultimately increase resource use efficiency across sectors (FAO 2014). The core of the nexus is to offer mechanisms for the adoption of decisions related to the economy, environment and social welfare. In regard to food and water, figures show that agriculture accounts for approximately 70% of the total global freshwater withdrawals (FAO 2014). Hence, making it the largest user of water.

Furthermore, energy is required to supply crops with water, dispose of it, recycle it, and the list goes only goes on. In addition, energy is also required to transport and distribute food and treat or incinerate the waste related to food and/ or agriculture. Studies show that 30-50% of the food that is produced globally goes to waste, implying that up to 1.25 trillion m^3 of water and 1.5% of energy are wasted every year (FAO 2014). On top of that, as a direct consequence of population growth, projections show that there will be an increase in food production of around 60% by the year 2050. Likewise, global energy consumption will rise close to 80% by 2035, and water withdrawals up to 50% by 2025, however, the latter only in developing nations (FAO 2014).

It is important to notice, that currently the per capita consumption of food – fruits, vegetables, and livestock products has been steadily increasing, bringing along environmental degradation and socioeconomic problems due to the unequal distribution (Olsson 2012). In the 1970s the global per capita food supply was of 2400 *kcal,* whilst in 2000 it was 2800*kcal*, and all of this despite the population growth (Olsson 2012). Moreover, in an attempt to reduce greenhouse gas emissions, the cultivation of agricultural products to produce biofuels are being encouraged. The main problem with this is that developed countries are growing crops in developing ones, negatively impacting food prices, increasing the demand for water, and consequently energy. Finally, it is important to understand that these three factors are significantly related to one another, and "therefore, response options should ensure the sustainability of the environment and people's livelihoods" (FAO 2014). These figures must be utilized to encourage an efficient creation, implementation, planning, and monitoring of policies that can be relatable to developing and developed nations to use as a template to raise awareness and incentives resource sustainability around the globe.

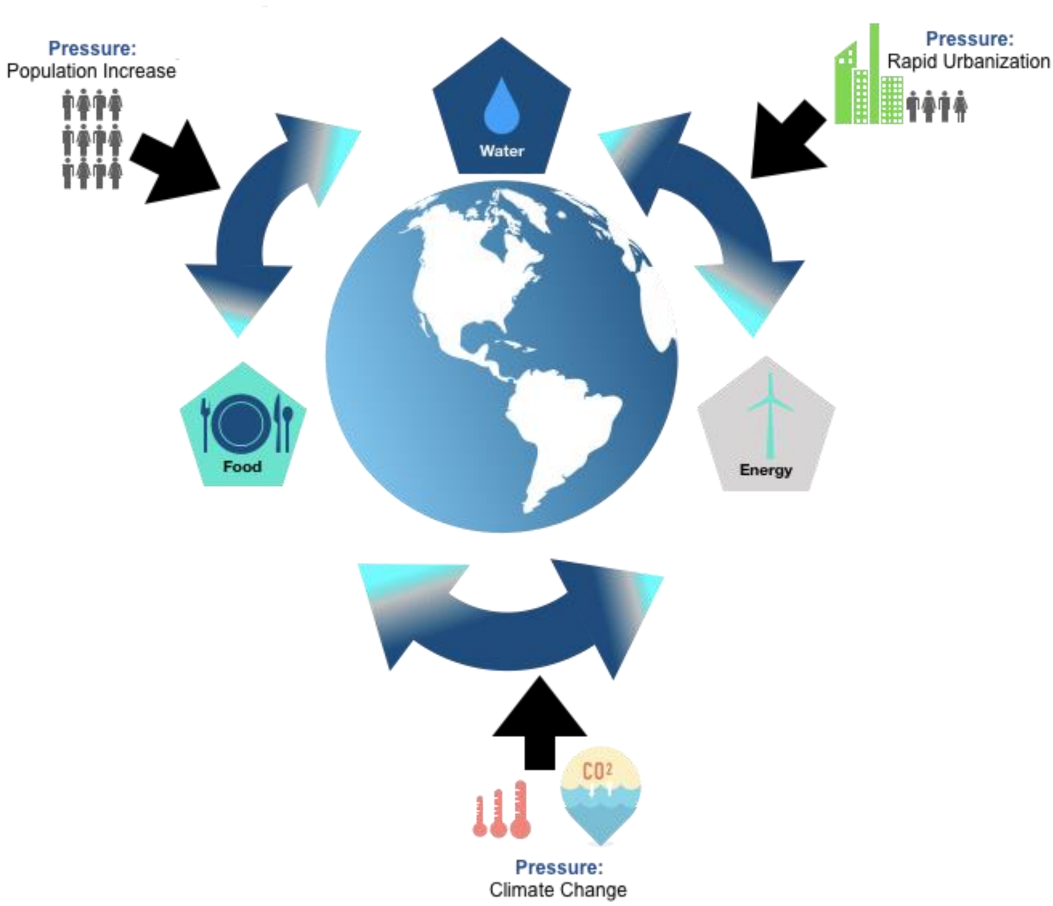

Figure 1: Water-energy-food nexus

(Source: own depiction after: FAO. Walking the Nexus Talk: Assessing the Water-Energy-Food Nexus in the Context of the Sustainable Energy for All Initiative. Rome, 2014.)

4.2. Water-Energy Nexus

As previously mentioned, one can now assume that water and energy operations are directly dependent of one another to be able to fully operate. The water-energy nexus (*Figure 2*) demonstrates the interdependence between water and energy (Wen, et al. 2017). Decision makers rarely considered the impact of energy policies or infrastructure plans on water resources – like supply or quality. Moreover, water policies were also not considered to have a big impact on energy related plans – e.g. energy consumption, sources or management (WWAP 2014). On the one hand, water needs energy for every step in the urban water cycle to work efficiently – i.e. extraction, transportation, supply, etc. On the other hand, energy needs water for energy generation processes like fuel production or cooling of power generating sources. Consequently, the choices made for one sector will impact the other and vice-versa. Hence, the water-energy nexus highlights the significant need of planning and managing both sectors together.

Nevertheless, this relationship is not entirely intrinsic, the choices taken in regard to water and energy can and will also influence other sectors related to climate, food or the economy (WWAP 2014).

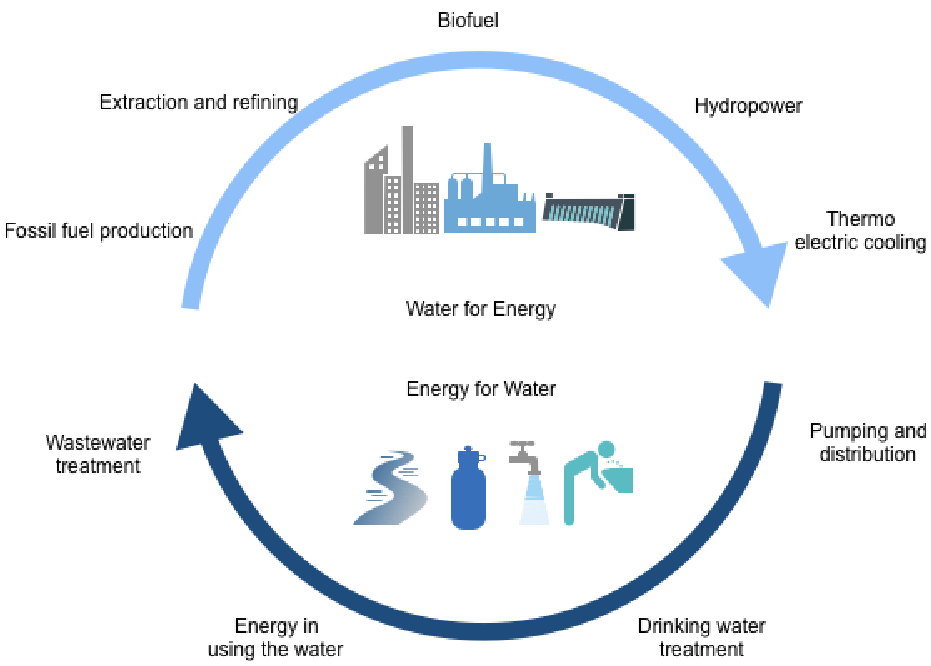

Figure 2: Water-Energy Nexus

(Source: own depiction after: Olsson, Gustaf. Water and Energy: Threats and Opportunities. London: IWA Publishing, 2012.)

The United Nations World Water Assessment Programme estimates that in 2015, approximately 2 billion people around the world did not have access to safe water. Furthermore, 1.3 billion people do not have access to electricity. These figures speak for themselves, since usually the part of the population that lacks on one, lacks on both – especially in developing countries (WWAP 2014).

4.3. Global Water Resources

Nearly 75% of the Earth's surface is covered by water. However, only 2.5% of global water resources are considered to be freshwater (US Geological Survey 1993) (*Figure 3*). Out of this percentage, only 1% is available for human consumption. Nearly 70% of the freshwater resources are comprised in glaciers and ice caps, while the rest are either deep in the ground or in bodies that are so contaminated that the water they contain can no longer be consumed by humans (Olsson 2012). Moreover, decades ago, it was an assumption that freshwater bodies eventually replenished and could be exploited indefinitely. However, this is not the case, freshwater sources are being overexploited to a point of no return. Most freshwater sources do not replenish at the same rate as they are being exploited – some take weeks, decades, centuries, and in some cases, the replenishment does not happen at all (Olsson 2012). These negative impacts on water sources can be attributed to anthropogenic causes such as an accelerated population growth, an increase of water resources utilized for industry, land-use, and life style changes, climate change, and more (Morales-Novelo, Revollo-Fernandez and Rodriguez-Tapia 2017). Studies predict that the influence of these global trends will lead to an increased demand for water by 50% by 2030. Also, projections display that by 2050 the population will increase to a total of 2 billion worldwide, implying that water demands will increase by 400% for industrial use, 140% for energy generation, and 130% for household use (WWAP 2014). Last but not least, by the same year, it is expected that more than 40% of the global population will be living in areas of severe water stress as a result of the constant strain put on freshwater bodies (WWAP 2014).

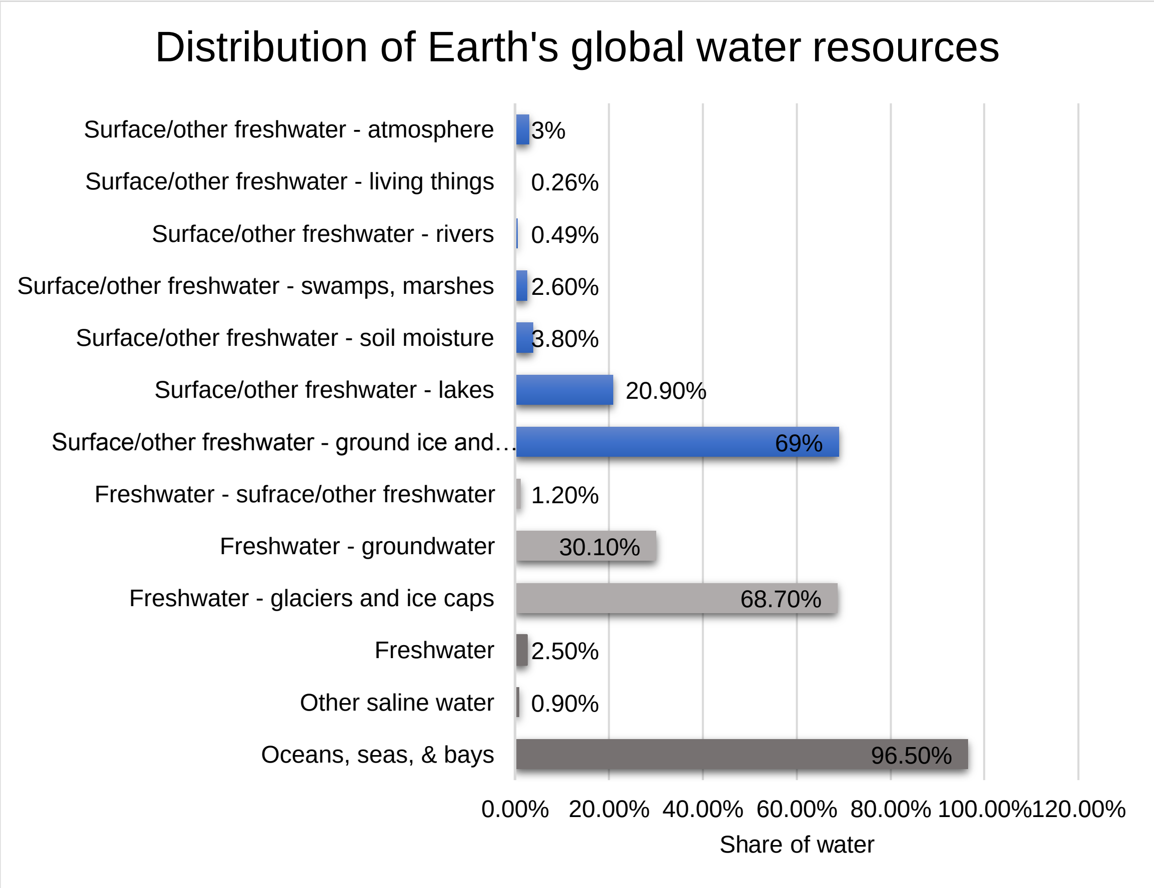

Figure 3: Distribution of Earth's Global Water Resources

(Source: own depiction after: US Geological Survey. "Statista - The Statistics Portal." Distribution of Earth's Global Water Resources. 1993. www.statista.com/statistics/564724/distribution-of-earths-water-resources (accessed 10 2017, 02).)

4.4. Water and Poverty

Presently, the developing regions of the world are the ones that present the biggest deficiencies when it comes supplying basic services like safe drinking water or electricity to the population. The enlarged stress that is being put on renewable but finite water resources is mounting as population growth and economic development continue to develop at the current rate (Olsson 2012). Moreover, if unsustainable practices to supply water continue, it is expected that even developing nations will experience water supply deficiencies and/or lack of water. Moreover, the United Nations Environment Program calculates that:

> “By 2050, 1.8 billion people will live in countries with "absolute" water scarcity and two-thirds of the world population could be under water stress conditions”.
>
> (Olsson 2012)

The United Nations classifies water stress and scarcity as both natural and anthropogenic phenomena. When the annual water supply of a certain area decreases to 1700m^3 per capita or less, it is considered to be water stress. Supply of 1000m^3 per capita or less is defined as water scarcity, and a supply below 500m^3 per capita implies absolute water scarcity (WWAP 2014). Likewise, a lack of access not only to water, but quality water, is a parameter to determine if a region, household, or person is living under poverty conditions. Lastly, water pollution is a general problem in developing countries. Water bodies are constantly polluted from discharges of untreated or poorly treated water from domestic and/or industrial waste. Surface water is the most commonly body affected by pollution. Pollutants ranging from organic to heavy metals pose an enormous risk to human health (Morales-Novelo and Rodriguez-Tapia 2017). health related problems regarding poor quality of water account for roughly 80 percent of infections in the developing world and are the second biggest cause of death in children (Olsson 2012).

4.5. Water for Energy

Two main energy sectors involve water as an important input for them to function. Firstly, the power sector is the largest source of water withdrawals, accounting for up to 88 percent. Fossil fuels, nuclear and renewable energies account for this percentage –

accounting for 57, 28, and 2 respectively (*Figure 4*) (IEA 2016). The vast amount of water extracted by these power generating sources derives from surface water and is used for cooling purposes. Most of the withdrawn water for the latter purpose is later returned to its main source – even though at different temperatures, which entails thermal pollution. The most commonly used technologies for cooling these sources are i.e.: open-loop cooling; closed-loop cooling, and dry cooling (IEA 2016). Nevertheless, the amount of water these sources potentially require, are highly influenced by several factor such as the fuel mix, turbine design and weather (IEA 2016). While thermal plants – operating with fossil fuels – represent the main withdrawal source, renewable energies have shown a constant decrease in the volume of water withdrawn and used. This happens mainly because renewable energies such as solar PV and Eolic, need little to no water while operating – usually water is only needed for general maintenance and cleaning (IEA 2016).

Secondly, primary energy production, the water withdrawals related to it are much smaller than that of the power sector. Coal, oil and natural gas – conventional and unconventional, and biofuels account for a total of 12 percent, with 3, 2, 0, and 7 percent of the withdrawals respectively (IEA 2016). Firstly, coal production is mainly associated to the mining sector. While water used in this sector is feasible for reuse, it requires to be treated for contamination. Also, mining processes put freshwater sources at risk of pollution due to potential run-off, drainage, spills or discharges of mining-related contaminated water into groundwater sources. Additionally, the amounts of water needed for conventional and unconventional oil production highly depend on the technology that is being used, the scale of operations, and the frequency of drilling. For instance, water injection to improve oil recovery requires almost ten times more water than primary recovery. The same happens with unconventional oil and gas production, it is slightly less water-intensive since it does not use water for fracturing (IEA 2016). Nevertheless, primary energy production accounts for the largest share of water consumption, representing 64 percent - compared to 36 percent of the power sector (IEA 2016). Predictions show that this trend is not likely to change; primary energy production is expected to keep increasing to almost 60 percent by 2040. Comparatively, water withdrawals will also increase, but only by 1.5 percent by the same year (IEA 2016).

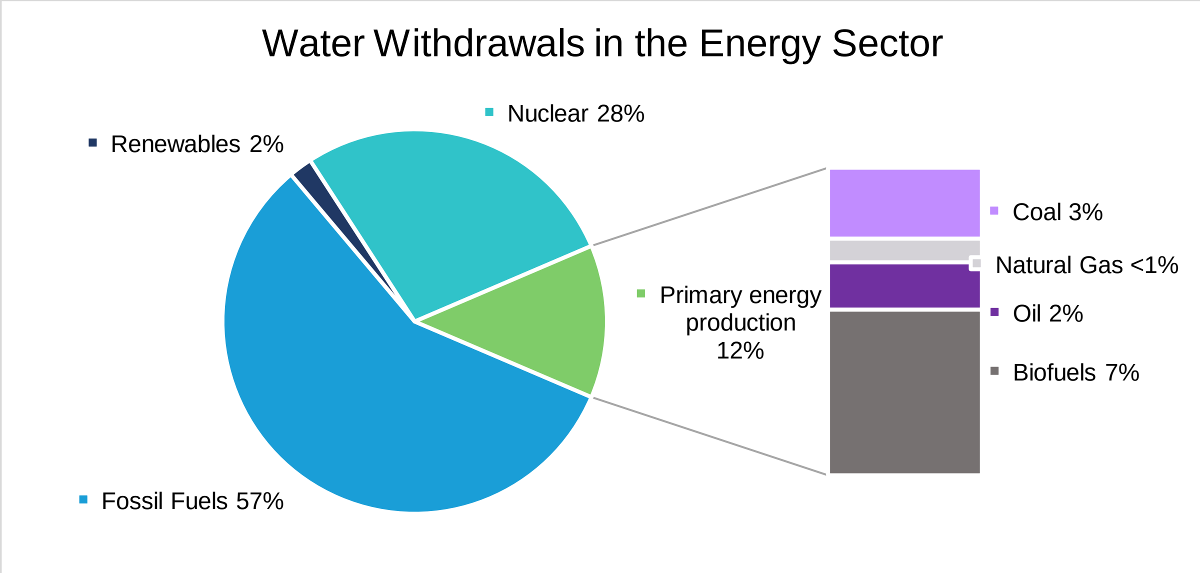

Figure 4: Water Withdrawals in the Energy Sector

(*Source: own depiction after: IEA. Water Energy Nexus. Paris: OECD, 2016.)*

4.6. Energy for Water

In regard to the management and development of hydrological resources, energy for water has an overriding importance. The infrastructure of water resources fully depends of its energy use during all of its cycle – ranging from desalination, transport, collection, and distribution to waste water treatment (Chandel, Chandel and Nagaraju Naik 2015). Evidently, each of these stages require different amounts of energy. These amounts broadly depend on several factors such as source of extraction, distance, inefficiencies and topography (IEA 2016). So far, estimating the worldwide energy use for water operations has been unsuccessful. There are no concrete studies that quantify the energy needs in the global water sector. However, in an effort to get a worldwide estimation, organizations such as the International Energy Agency agree that to be able to obtain a concrete aggregate, all the major processes in the water sector must be considered (IEA 2016).

In an attempt to quantify the energy needs in the global water sector, The International Energy Agency developed an outlook in which it includes processes in which the energetic consumption is designated to treat, process, or transport water from or to the end user (IEA 2016). These processes are namely: water supply and transfer, water treatment, water distribution, wastewater collection, and wastewater treatment. Firstly, to be able to meet the supply and transport needs of water, energy is required. Water extraction is one of the most energy-intensive processes of the water cycle. It accounts for approximately 0.5 million barrels of diesel fuel per day, hence, approximately 310TWh of electricity consumed every year. Additionally, when a country suffers from water stress, its government is forced to undertake large-scale measures to be able to increase its supply coverage. These projects entail the long-range transport of water, and therefore an increase in the demand of energy to do so. Long-distance water transportation accounts for the annual use of approximately 70TWh of electricity (IEA 2016).

The next step of the cycle is to treat the collected water. On the one hand, to make it feasible for human consumption and on the other hand, to comply with national drinking water standards. Depending on the source from which the water was extracted, contaminants, sediments, and chemicals are removed using mechanical screens and sedimentation. Evidently, these processes entail energetic use. However, the amount of energy required for water treatment is usually only a fraction – 65TWh of electricity – in comparison to that needed to extract water (IEA 2016). However, the freshwater source plays a very important role in terms of energetic use. While surface water is less energy-intensive, it is common that it is heavily polluted – mostly in developing countries. Comparatively, groundwater is seven times more energy-intensive as it must be pumped from very deep levels. However, it will be less contaminated, therefore requiring less treatment. Consequently, developing countries tend to rely more on groundwater than on surface water (IEA 2016).

Table 1: Water Losses of Public Supply in Different Countries (in percentage).
(Source: IEA. Water Energy Nexus. Paris: OECD, 2016.)

Country	Water losses in public supply (%)
China	19%
European Union	24%
India	48%
United States	12%

Water distribution requires a lot of energy due to the fact that it must be pumped to the end-user. Once again, the energetic needs depend on the source of extraction, distance, inefficiencies and topography of a location. The IEA estimates that every year 180TWh of electricity are required to cover the global water distribution needs. Moreover, in developed and developing countries there are daily water losses. These losses are related to the ageing of pipes, decreased or insufficient levels of maintenance, pipe leaks, and even theft. Table 1 illustrates some of the percentage of water losses in the public supply in both developed and developing countries. Although the biggest losses occur in Asian developing countries, losses in regions like the European Union are so high, they can be compared to the annual water withdrawal of Korea of 13 billion cubic meters (IEA 2016).

Finally, once water is serviced to the end-user, it must be collected and transported to be treated. These processes involve the use of energy and are done so that the responsible authority or operator can discharge this wastewater safely to reduce the risk of environmental and human health risks. However, this is a process that is not standardized internationally. In developing countries municipal wastewater that is not collected can account up to 60-95 percent, and globally over percent (IEA 2016). It is estimated that the global energy consumption for wastewater treatment is around 200TWh or one percent of the total energy consumption (IEA 2016). However, in developing countries it is the largest energy consumer in the water sector. The energetic needs for wastewater treatment are influenced by five factors: allocation of wastewater collected and treated; level of groundwater infiltration and rainfall into the sewage system; treatment level, contamination level, and the energy efficiency of the operations (IEA 2016).

To sum up, the annual energy consumption in the water sector is roughly of 120 million tons of oil equivalent of energy, or 4 percent of the total global electricity consumption (IEA 2016). Of this total, 40 percent corresponds to extraction; 25 percent to wastewater treatment, 20 percent for distribution (IEA 2016).

4.7. Pressures on the Water-Energy Nexus

4.7.1. Urbanization and Population Growth

Every year, the world's population grows by 70 million. More than 50 percent of this growth occurs in urban areas (Olsson 2012). *Figure 5* displays the degree of urbanization by continent as of 2017. While the worldwide percentage is of 54 percent, it is important to notice that there is no pattern regarding developed or developing nations – meaning that urbanization and development do not go hand-in-hand in most of the cases. Furthermore, North America has the highest urbanization rate, followed by Latin America and the Caribbean with 81 and 80 percent, respectively. Europe (74%) and Oceania (69%) come next, lastly followed by Asia (49%) and Africa (41%) (Population Reference Bureau 2017).

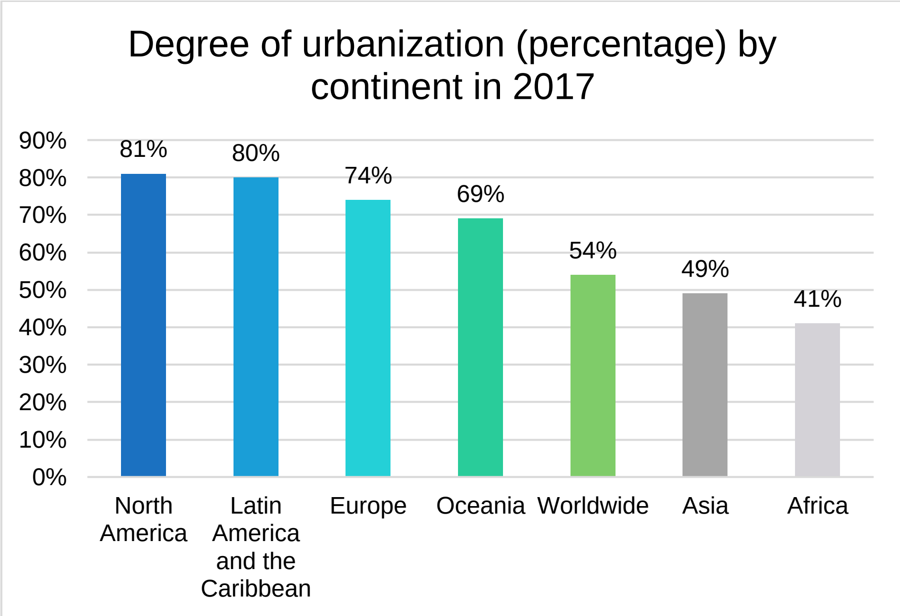

Figure 5: Degree of urbanization (percentage) by continent in 2017.
(Source: own depiction after: Population Reference Bureau. "Statista." Statista - The Statistics Portal. August -, 2017. https://www.statista.com/statistics/270860/urbanization-by-continent/. (accessed September 06, 2017).)

The constant global population growth has led to an increase in the supply and demand of water and energy-related services provided by public and private entities. This trend has been mostly observed in developing countries, thus, driving public entities and the environment at risk of not being able to deliver these services efficiently and consequently forcing the population to rely on private entities to provide for these basic services (Tortajada and Castelán 2003). Migration, urbanization, industrial activities, agriculture, dietary patterns, and even entertainment are influencing the amounts of water being extracted, transported, and consumed (Olsson 2012). Consequently, this has led to an over exploitation of ground and surface water, rivers, and other water bodies. Thus, urban regions that are already water-stressed must find sustainable measures to operate efficiently in the water sector (IEA 2016). Authors such as (Farooqui, Renouf and Kenway 2016) suggest that utilizing available water – such as rain and storm water – within urban areas to recycle it, could pose an alternative for constant growing urbanizations. Such measures are promising in some regions of the world like North America or Europe. Nevertheless, parts of Asia also have this possibility but cannot implement it because of water quality issues. Admittedly, this type of approach must be studied for particular cities, nations, or regions.

4.7.2. Climate Change

Historically, climate change is a topic that is considered an enormous challenge for the international community. Governments, scientists, economists, and international organizations now recognize their responsibility and recognize that if mitigation and adaptation measures are not taken promptly, the potential consequences could be catastrophic. During the United Nations Conference on Environmental in Rio de Janeiro in 1992, the groundwork for governments to reduce the concentration of greenhouse gasses as a way of preventing environmental risks associated to climate change (UNCED 1992). After a positive outcome, the United Nations Framework Convention on Climate Change adopted the Kyoto Protocol in 1997. In a nutshell, the target was to establish greenhouse emission reduction targets to an average of 5% against 1990, and later by 18 percent below 1990 levels. However, these targets aimed more towards industrialized countries (Lázaro 2017).

Furthermore, during the 2015 Conference of the Parties (COP21) in in Paris, France, an unprecedented number of UNFCCC members agreed on a groundbreaking document: The Paris Agreement. Moreover, after its adoption, 175 Parties have signed and ratified it. This agreement picks up on the important topics of its previous counterparts and adds the aim of keeping global temperature rise below 2 degrees Celsius – for this century (UNFCCC 2015). This goal is to be achieved through adaptation and mitigation measures that each individual ratifying country shall compromise to undertake. Through Intended Nationally Determined Contributions (INDC), each country should determine its national commitments and pledge to provide data regarding its biggest greenhouse gas emitters. Last but not least, the Paris Agreement accords that every party has a common but differentiated responsibility and capability (Lázaro 2017).

Climate change has played an important role in the interdependence of water and energy. In the water sector, there is evidence that it already has a negative impact on variables such as the hydrological cycle, water availability, water demand and water allocation. The United Nations Environment Program pinpoints six factors that are already affected by climate change and predicts the future impacts they will undergo if no measures are taken. Firstly, the amount of precipitation has decreased in southern areas between 10- and 30-degrees latitude but has increased in those areas that are located between 30- and 85-degrees latitude. Hence, leading to the next factor: precipitation intensity. Extreme rainfalls have increased and are becoming more frequent. Thus, UNEP predicts that rainfall will increase by 7% for each one-degree increase in global average temperature (Wen, et al. 2017).

Thirdly, while in some regions there will be an increase in precipitation, regions that suffer from droughts or seasonal droughts will also increase. However, climate change has influenced *spatio-temporal* trends in precipitation to a point in which some regions that suffered from draughts, have turned around and vice-versa in regions that never experienced draughts. Next, the sea level has already risen by 0.2 meters and it is expected to increase to 0.6 by 2100 as a consequence of climate change (World Bank 2009). Fifthly, the ocean's pH level's or ocean acidification has decreased from an average of 8.2 to 8.1 and it is foreseen that it will continue to drop between 7.7 and 7.8 by 2100 (World Bank 2009). Lastly, for the last 40 years, the ocean's temperature has increased by 0.5 degrees Celsius and UNEP estimates that the temperature will keep increasing, thus, negatively affecting the environment ((Wen, et al. 2017) and (World Bank 2009)).

In regard to energy, hydropower energy generation is the most affected sector since it directly depends on water, its quantity and timing. On the one hand, the constant rise in temperature during the summer entails an increase in the demand of energy for cooling purposes. On the other hand, during winter, the energy demand will lower – for heating purposes – because during the winter the temperatures will be higher than usual. Moreover, a decrease in the quantity and pressure of the water needed to go through the systems' turbines leads to a reduction in the overall energy output (World Bank 2009).

5. Megacities and the Water-Energy Nexus

5.1. Megacities

The United Nations defines megacities as those urban regions of a country that present a population of 10 million or more (Baklanov, Molina and Gauss 2016). These cities are growing at such a fast pace that they usually expand over its borders, usually known as metropolitan area, conurbation, or metroplex. In these cases, cities can grow about 20 million or more (Baklanov, Molina and Gauss 2016). It is undeniable that population growth plays a major role in giving a city the status of megacity. In the last decades, the world population has experienced a steep increase. The trend that has been observed is that this increase is more noticeable in urban areas, even though 60 years ago only 18 percent of the population was living in urban areas. The collapse of sustainable rural economy led to the migration of the population from rural to urban areas, thus making cities' population increase (Wenzel, Bendimerad and Sinha 2007).

According to the United Nations, it was until 2007 that the world's population in urban regions exceeded that of rural regions for the first time (Baklanov, Molina and Gauss 2016). Before that, megacities existed mainly in the developed world, the most important ones being Tokyo, New York, Los Angeles and Osaka – and still are up to this day (Wenzel, Bendimerad and Sinha 2007). Moreover, currently the list is made up of 31 cities, including those in developed and developing countries – ranging from a population of 10.1 million to 26.4; some examples of the biggest ones are Shanghai, Mexico City, Dhaka, Sao Paulo, and Bangkok (Wenzel, Bendimerad and Sinha 2007). Ultimately, megacities currently amount for 10 percent of the world's population (UN DESA 2014).

As a consequence of massive migration, by the year 2001, the percentage of people living in urban areas spurred from 18 to 50 percent. It is expected that by the year 2030, population will increase from 7.6 to 8.6 billion (Figure 6), and by 2050 growth will increase to an astounding 9.8 billion people (Wenzel, Bendimerad and Sinha 2007). Generally, these cities are the countries' capitals, and so are their main economic and political drivers – which is one of the main reasons as of why the population decides to migrate. Although megacities in the developed world have kept a steady growth, those in the developing world are growing twice or thrice than the country's overall population (Wenzel, Bendimerad and Sinha 2007). Therefore, massive migration in developed and developing countries foments negative impacts on their infrastructure, housing, and basic service supply.

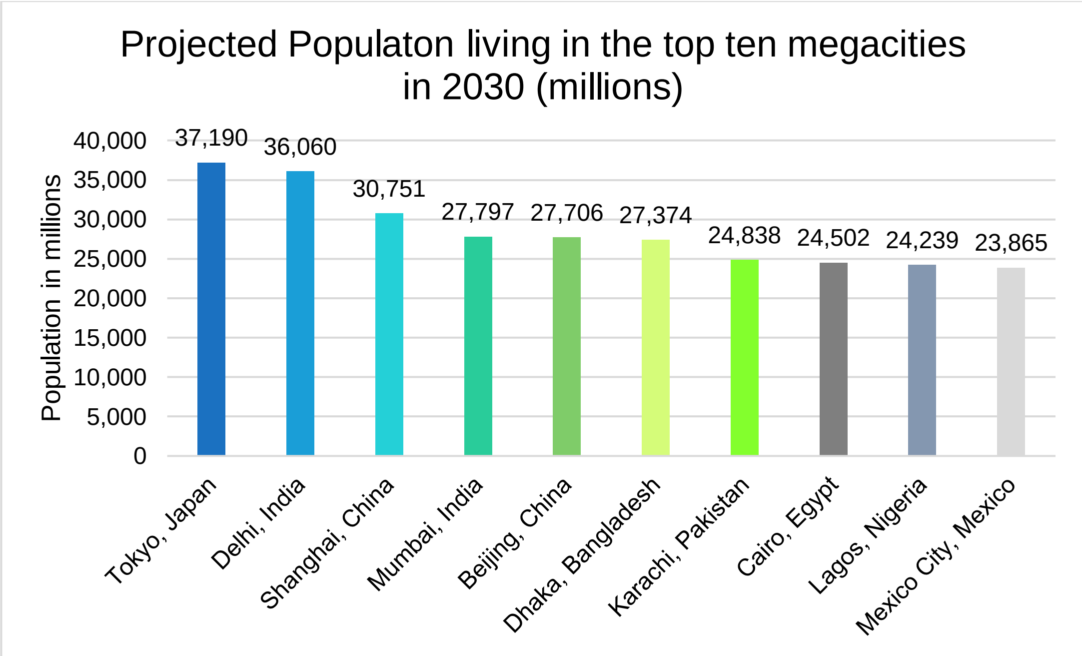

Figure 6: Projected Population Living in the Top Ten Megacities in 2030 (in millions). (Source: own depiction after: UN DESA. "Projected Population Living in The Top Ten Megacities in 2030." Statista - The Statistics Portal. July -, 2014. www.statista.com/statistics/672502/top-ten-most-populous-megcities-worldwide/ (accessed September 06, 2017).)

5.2. Water and Energy in Megacities

Megacities in the developed and developing world are all prone to risks. Some of these risks are associated to natural disasters, population exposure due to concentration of housing below standard construction, complex ageing infrastructure, climate change, and the dependence of the population's welfare on the proper functionality of lifeline systems – such as power, water, and communication (Wenzel, Bendimerad and Sinha 2007). In regard to water, numerous megacities in developing countries depend on groundwater. Shallow and deep well drilling is the most common technique to reach this resource. These sources grant access to water that has been at deep levels for thousands of years and is possibly feasible for human consumption. However, most groundwater sources located in megacities have a short life span because water gets extracted at a much faster pace than its natural recharge rate (Tortajada and Castelán 2003). This non-stopping stress that groundwater sources are put under, create negative consequences for these cities. Firstly, water overuse leads to the pore pressure in the wells to drop and later compress, resulting in land subsidence. For instance, Mexico City and Kolkata are sinking from a few centimeters every year (Olli 2006).

In terms of connection to the water network, up to 30% of the population living in megacities in the developing world depend on private water sources (Olli 2006). For instance, Buenos Aires, Argentina, was one of the best connected in terms of water and sanitation at the beginning of the twentieth century, but due to the rapid migration from rural areas to the capital city, the overall coverage fell around the 1940's and since then has slowly improved to almost 90 percent by 2015 (UNESCO 2016). Relatedly, Mexico City presents a water supply coverage of 98 percent, nevertheless, the eastern part of the city is mostly affected by this slight deficiency (Tortajada and Castelán 2003). The population of that area – some of the poorest municipalities, must pay up to 235 times more than the price of tap water to get access to private water vendors (Morales-Novelo, Revollo-Fernandez and Rodriguez-Tapia 2017). Similarly, in Karachi, Pakistan, people pay up to 40 times the price of tap water, also from private sources (Olli 2006). On the contrary, megacities in developed countries encounter problems that are mainly related to infrastructure ageing, as some are as old as 100 years. Conurbations like London, New York, and Paris – some of the first megacities – are very old but unlike developing megacities, they have grown at a slow pace in terms of immigration and settlement (ECOSOC 2016). Ultimately, the problems that developing megacities face concern the improvement of the system and of the water quality that is supplied to the population and not the strengthening and/ or enlargement of the system (UNESCO 2016).

Furthermore, the coverage of the energy needs required to pump and distribute water vary greatly from country to country and city to city. First of all, the energy needed to pump groundwater is vastly different than that needed to pump surface water. Additionally, an important factor regarding energy use is geography. The elevation (meters above sea level) or the type of land of a region are the ones to set the energetic consumption related to pumping and distribution. Moreover, there are not many governmental records that state the amount of electrical energy consumption for urban water supply. For instance, in the Central Valley of California, 0.60 kWh/m^3 of energy are required for ground water pumping – assuming a pump efficiency of 80% and considering an elevation of 600m. In the United Kingdom, 60% of the water treatment operations are related only to pumping (Olsson 2012). Similarly, in the United Kingdom 0.59 kWh are needed to supply 1m^3 of drinking water to the population. Also, in the Netherlands 0.47 kWh/m^3 – with 0.16 kWh/m^3 coming from renewable energy technologies; and Sweden 0.24 kWh/m^3 (Olsson 2012). Additionally, such developed countries have an interest in using renewable energy generation technologies like solar to provide and pump water in remote areas. Many of these countries show an interest towards solar energy, due to the fact that solar radiation – of 60 W or more – can be utilized to kill bacteria and viruses.

6. Solar Photovoltaic Energy Generation

6.1. Technology Overview

Solar energy is an unlimited, free resource on Earth. Thus, an important reason why it must be considered as a clean source of energy generation. It is estimated that the amount of energy received yearly from the sun to the earth is around 885 million TWh (IEA 2014). When there are clear conditions, the solar radiation reaching the Earth's surface is of approximately 1 kW/m^2. However, the amount of radiation in each region or country in the world can widely vary. Inter-tropical areas receive more radiation per land area than the places north of the Tropic of Cancer or south of the Tropic of Capricorn (IEA 2014). It has been recorded – until 2016 – that solar energy can currently account for approximately one percent of global energy generation (IEA 2016). Moreover, it must be considered that the global production is not distributed evenly, as the total installed capacity varies in every region.

Figure 7 illustrates the solar energy generation per region until 2016. Asia occupies the leading seat, with China accounting for 34,45 GW; followed by 6,6 GW in Japan; 850 MW in Korea; and 756 MW in the Philippines (IEA 2016). In the Americas, the United States' market doubled from 7,3 GW to 14,7 GW; 746 MW in Chile; and 100 MW in Mexico (IEA 2016). Furthermore, predictions indicate that emerging economies such as Mexico and Brazil will have a significant solar energy generation presence and market growth (IEA 2016). In Europe, the situation is different. There was a slowdown in the United Kingdom's market – 2012 to 2013 –, which led to a decline in the overall result of solar technology use. Nevertheless, as of 2016, the UK managed to position itself in first place for the last three years, accounting for 2 GW in 2016. Followed by Germany with 1,5 GW, France with 0,6 GW and Italy only accounting for 373 MW. Moreover, some smaller European countries such as Austria and Switzerland continue to progress but remain below the 100 MW mark (IEA 2016).

Ultimately, 2016 was a record year for solar energy generation. With the increase in the global installed capacity being the most important one; but followed by the fact that 24 individual countries passed the Gigawatt mark, thus, the global goal of 300GW has been met (IEA 2016). In addition, the price markets of solar energy generation systems have kept a constant decline over the years, making it more accessible and affordable to the domestic, public, and private sectors (SENER 2016). In terms of technology, the most common one used to produce energy from the sun is known as Solar Photovoltaic (SPV). This type of technology consists on an installation of several solar photovoltaic (PV) panels – better known as photovoltaic array (PV array), which convert sunlight into electricity. The solar panels utilized in this technology are mostly built from silicon, a which has proved to be one of the most affordable, durable, and efficient materials. Furthermore, the silicone in the panels can be *monocrystalline* or *polycrystalline,* the difference between one or the other, is that the first one has an efficiency of 22 percent, and the latter from 12 to 17 percent – but is less cost-intensive (IEA 2016). Moreover, the materials used for the PV system's production are low cost, easily repairable, and environmentally friendly, as they are made from stainless steel, glass, and plastic (Mundo-Hernandez, et al. 2014). Finally, solar photovoltaic technologies have come a long way. Presently, they are most commonly used for electricity generation in domestic, commercial, industrial, and secluded rural areas (IEA 2016). However, these technologies have the potential to be implemented in sectors beyond these. This will be further explained in the following section.

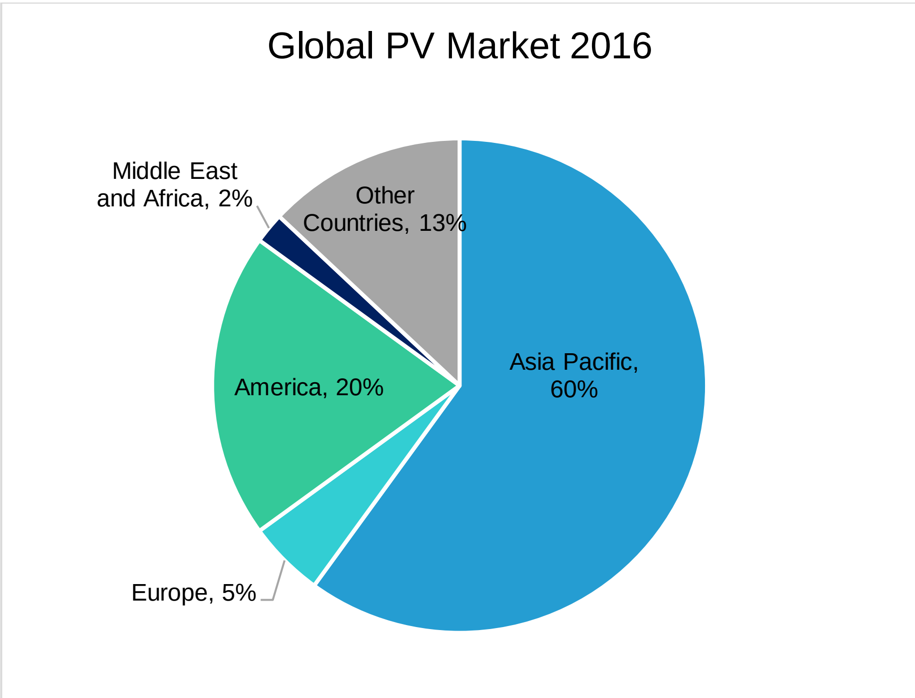

Figure 7: Global PV Market 2016.

(Source: own depiction after: IEA. 2016 Snapshot of Global Photovoltaic Markets. PV Markets, Paris: International Energy Agency, 2016.)

6.2. Solar Photovoltaic Water Pumping Systems (SPVWPS)

As previously indicated, solar technologies have more applications that only producing electricity through a photovoltaic system. Some examples of its applications are related to heating or cooling purposes; concentrated solar power (CSP) or solar thermal energy (IEA 2016). However, solar photovoltaic water pumping systems (SPWPS) are a technology that is becoming popular in the renewable energy market. This type of technology is not new, for decades its main application has been for small-scale energy generation in the agricultural sector (for water pumping for crop irrigation) and for water supply in remote areas (IEA 2016).

The principle behind SPVWPS, is that its utilizes solar radiation to generate electricity to pump water from any water body – deep drilled wells, ponds, streams, etc. To do so, a set of photovoltaic panels which are connected to a direct current or alternate current motor are installed. The PV array converts solar energy into electricity (can be direct current (DC) to alternate current (AC) or vice versa); afterwards, the motor converts electrical energy to mechanical energy, which is later converted to hydraulic energy by the pump. However, it is very important that regardless of the water body selected, the recharge rate is always faster than the extraction rate, otherwise, the pump can get damaged (Kalamkar and Sontake 2016). However, when the extraction rate is faster than the recharge, the system can still be installed but it will not be able to operate freely at all times (Chandel, Chandel and Nagaraju Naik 2015).

The materials employed in the construction of the components of a SPVWPS are high quality and low maintenance. Determining the components of a system depends on factors like the desired size of the system, the region, budget and sector of application. The characteristics of these components must match for best performance. Furthermore, every system must have the following components: PV array, pump controller/motor, inverter, and pump (Table 2). Ultimately, the systems life cycle is at approximately 30 years (Chandel, Chandel and Nagaraju Naik 2015). In the current SPVWPS market, there are two types systems: Battery-coupled surface-mounted/submersible pumps and direct coupled surface-mounted/submersible pumps. This classification depends on several variables: the source of which the water will be extracted; water level, reservoir volume, recharge rate, elevation, region of application, scale of the system, and budget.

Table 2: Components of Solar Photovoltaic Water Pumping Systems.
(Source: own depiction after: Kalamkar, Vilas R., and Vimal Chand Sontake. "Solar photovoltaic water pumping system - A comprehensive review." Renewable and Sustainable Energy Reviews (ELSEVIER), 2016: 1038 - 1067.)

Component	**Function**
Solar PV array	Formed by several panels connected in series or in parallel which are made from *monocrystalline or polycrystalline* silicon.
Pump controller/ motor	Made from stainless steel that is corrosion and maintenance free even when exposed to harsh environmental conditions DC and AC motors are used in SPVWPS. Systems below 5 kW usually use DC motors. There are four types of DC motors: with brushes, without brushes, permanent magnet synchronous (PMSM), and induction motors.
Inverter	When an AC motor is required, an inverter (also known as controller) must be installed between the PV array and the motor. If the system is grid-connected (connected to the electricity grid), an inverter must be installed so that any surplus generated can be sent back to the network.
Pump	1. **Surface-mounted**: Used mainly to move water through a pipeline. However, they can be adjusted to work in high heads and can be developed to transport water in different elevations or long distances. Cons: They are not recommended for deep-drilled wells because their overall performance is limited. These pumps are usually exposed and

	therefore more prone to climate-related damages like freezing or breaking. These technical problems may lead to water leakages that consequently produce burning of the motor. Hence, increasing the operating costs of the system due to replacements. 2. **Submersible:** These pumps are commonly used for city and town water supply. Since they are built to work underground, they must be submerged in water to operate as they are designed to push the water to the surface with the help of a hermetically sealed motor. Hence, they are less prone to climate-related damages and can have an overall efficiency of 40 to 70 percent.
Maximum Power Point Tracker	Electronic DC to DC converter which optimizes the voltage match between the PV array and the battery bank or utility grid.
Other electronic equipment	N/A
Add-ons	**Function**
Battery	The exceeding electricity generated can be stored to be used during the night or on cloudy days. Batteries can be installed in surface and submersible pumps; however, it increases the overall cost of the system.
Storage Tank	A storage tank can be placed to store water which can be used as a backup during cloudy days or nighttime.

Battery-coupled surface-mounted/submersible pump systems entail the use of a battery/ batteries for storage or to directly supply the pump directly from the PV array. On the one hand, batteries can be used for the storage of the electricity generation or to drive the pump and is suitable to use with both types of pumps (Figure 8 and Figure). On the other hand, even though the use of batteries in the system can prolong the pumping stage and ensures pumping during low light periods or cloudy days, it increases the overall cost of the system – which makes it less feasible for large scale installations – e.g. developing megacities (Kalamkar and Sontake 2016). Additionally, the PV array's voltage is dictated by the batteries instead of by the array itself, decreasing the overall efficiency of the system. The voltage is dependent on the temperature and charge of the batteries. In a solar photovoltaic water pumping system paired with batteries, the voltage can decrease one to four volts lower than that produced by the PV array during maximum sunlight conditions (Kalamkar and Sontake 2016).

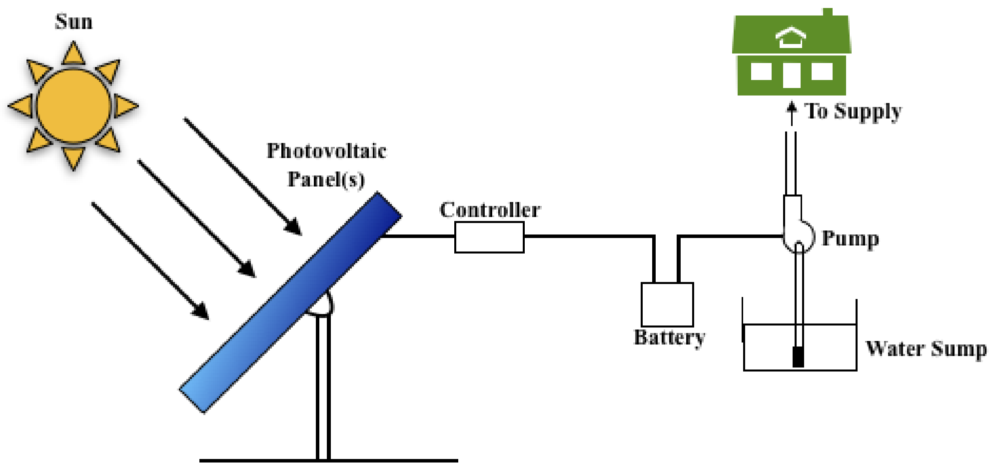

Figure 8: Battery-coupled surface-mounted pump.
(Source: own depiction after: Kalamkar, Vilas R., and Vimal Chand Sontake. "Solar photovoltaic water pumping system - A comprehensive review." Renewable and Sustainable Energy Reviews (ELSEVIER), 2016: 1038 - 1067.

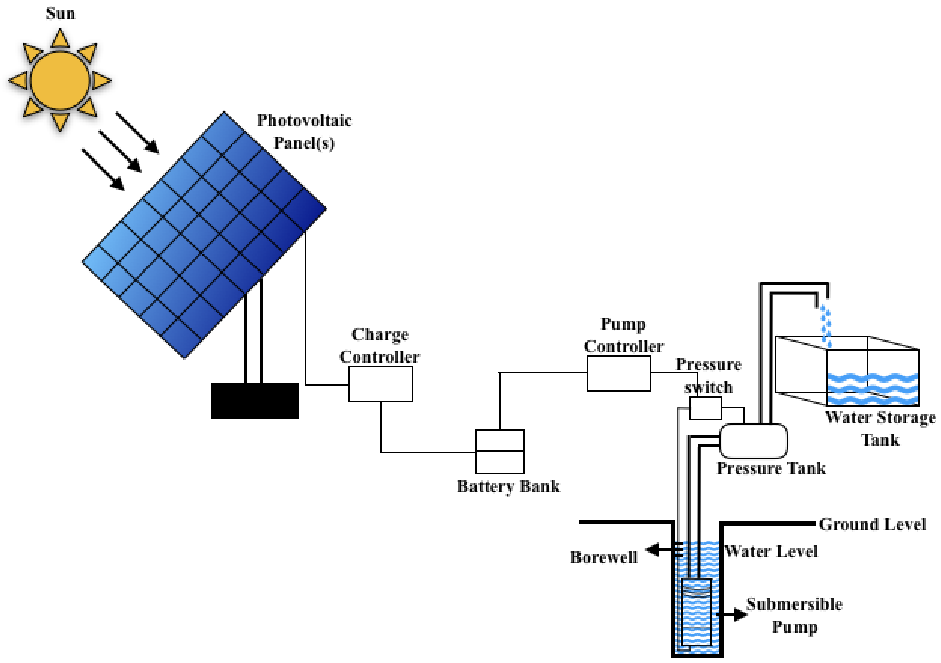

Figure 9: Battery-coupled submersible pump.

(Source: own depiction after: Kalamkar, Vilas R., and Vimal Chand Sontake. "Solar photovoltaic water pumping system - A comprehensive review." Renewable and Sustainable Energy Reviews (ELSEVIER), 2016: 1038 - 1067.)

Direct coupled surface-mounted/submersible pumps/ grid-connected systems (Figure 10 and Figure 11), supply the electricity generated by the PV array directly to the pump. Direct coupled systems are low-cost in comparison to a battery coupled systems and can also be designed to function with surface-mounted or submersible pumps. However, since they do not have a power backup, they can only work at or near 100% efficiency during optimum solar insolation – late morning to late afternoon (Kalamkar and Sontake 2016). As a result, during late afternoons and cloudy days the efficiency of the pump drops – during cloudy days it drops even more, resulting in very low volumes of water supplied. Yet, several studies point out the possibility to improve direct driven systems by adding a manual or automatic sun tracking system. Additionally, if necessary, installing a storage tank within the system is possible but in urban settings it may not work as it could take up lots of space. Tracking and storage systems can be considered, but they increase the overall cost of the system (Kalamkar and Sontake 2016).

Moreover, if this system were to be installed as part of a large-scale project – e.g. as part of a governmental plan or with governmental subsidies, the photovoltaic array can be connected to the electric power grid, therefore becoming a grid-connected system. Connecting the PV array to the electric grid through an inverter allows the system to work at almost 100 percent efficiency (Chaib, Achour and Kesraoui 2016). On the one hand, during late afternoons and cloudy days, or night time, conventional fossil-fuel based electricity can be directly taken from the power grid to compensate the reduced efficiency of the PV array. On the other hand, if the PV array produces an exceeding amount of electricity, it can be directly sent to the electricity grid, making the operation costs significantly lower (SENER 2016). Furthermore, a downside to this type of system, is that if the electricity grid loses power or shuts down, the PV system will shut down as well, regardless of the amount of solar irradiation (Chaib, Achour and Kesraoui 2016).

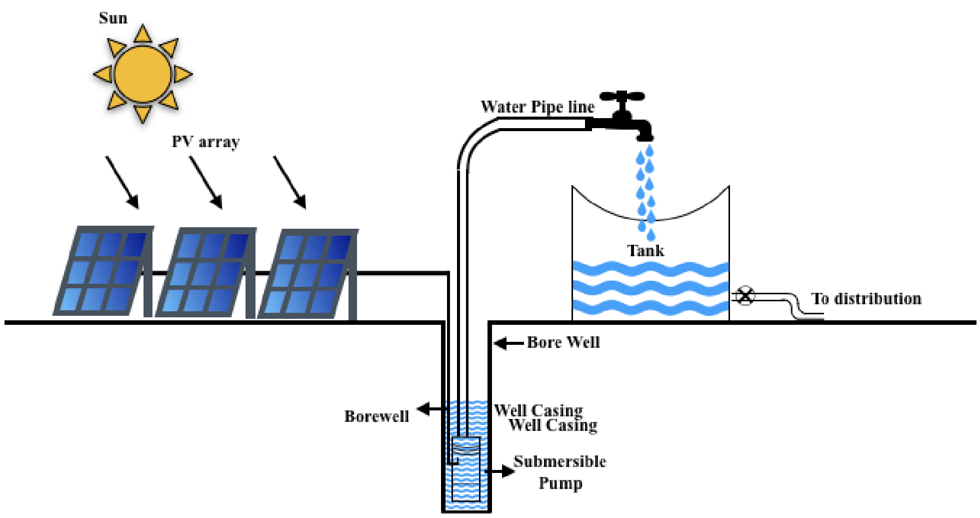

Figure 10: Direct coupled SPVWPS using a submersible pump.
(Source: own depiction after: Kalamkar, Vilas R., and Vimal Chand Sontake. "Solar photovoltaic water pumping system - A comprehensive review." Renewable and Sustainable Energy Reviews (ELSEVIER), 2016: 1038 - 1067.)

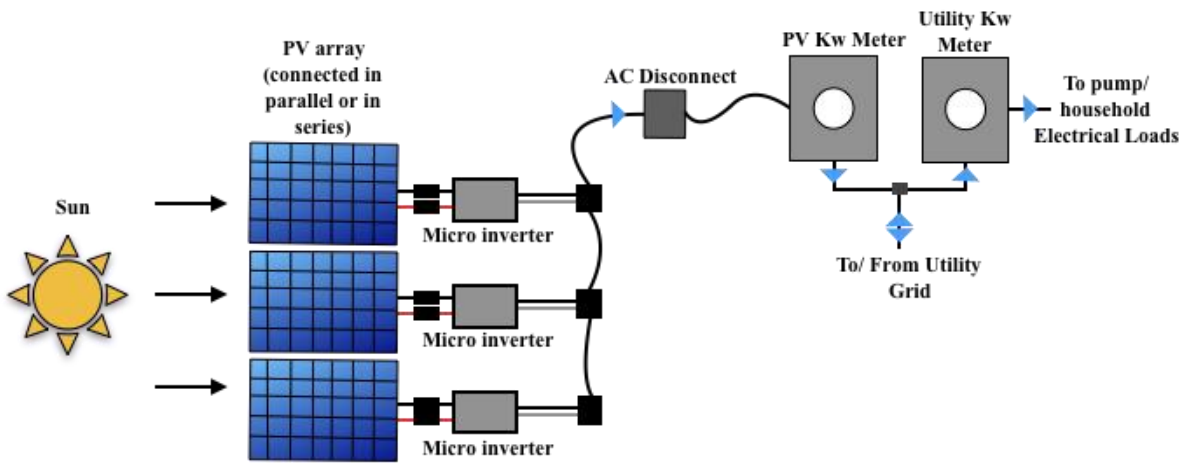

Figure 11: Grid-connected Solar Photovoltaic System.
(Source: own depiction after: Zaini, Nur Hazirah, et al. "Lightning Surge Analysis on a Large-Scale Grid-Connected Solar Photovoltaic System." Energies, 2017: 2149)

7. Case Study: Economic and environmental feasibility of installing PV arrays as an initial investment on SPVWPS in Mexico City's 528 groundwater wells

7.1. Mexico City and its Metropolitan Area

Mexico City and its Metropolitan Area (MCMA or ZMVM[1] in Spanish) is located in the Valley of Mexico (Valle de México), which is a naturally closed basin at an altitude of 2400 meters above sea level. This megacity is formed by Mexico City, Mexico State, and Hidalgo – composed by 16, 59 and one municipality respectively. It accounts for 2866 km^2 and almost 22 million inhabitants (Morales-Novelo, Revollo-Fernandez and Rodriguez-Tapia 2017). The MCMA is one of the fastest developing megacities in the world, with an estimated growth of over 20 times in the last 80 years (UNESCO 2016).

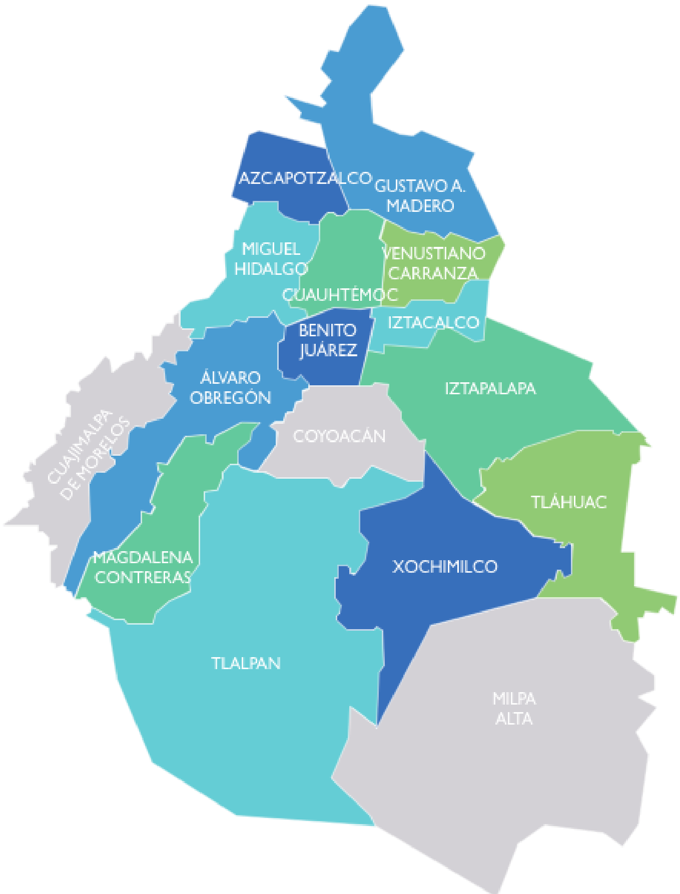

Figure 12: Mexico City's 16 Municipalities.
(Source: own depiction after: Government of Mexico City. CDMX. 05 02, 2018. http://www.cdmx.gob.mx/gobierno/delegaciones (accessed 06 01, 2018).

[1] Zona Metropolitana del Valle de México

Even though MCMA is composed out of three states that comprise 76 municipalities, it is in Mexico City (formerly known as Federal District) where the main Federal Executive Powers are located. It is formed by 16 municipalities that account for almost 9 million inhabitants (Figure 12 and Table 3) (INEGI 2015). Mexico City accounts for 16.5% of the national economic activity and it has the highest number of inhabitants per municipality in the country (Morales-Novelo, Revollo-Fernandez and Rodriguez-Tapia 2017).

Table 3: Mexico City's Population.
(Source: own depiction after: INEGI. Instituto Nacional de Estadistica y Georgrafía. 2015. http://cuentame.inegi.org.mx/monografias/informacion/df/poblacion/ (accessed August 29, 2017.)

Code	Municipality	Population
2	Azcapotzalco	400,161
3	Coyoacán	608,479
4	Cuajimalpa de Morelos	199,224
5	Gustavo A. Madero	1,164,477
6	Iztacalco	390,348
7	Iztapalapa	1,827,868
8	Magdalena Contreras	243,886
9	Milpa Alta	137,927
10	Alvaro Obregón	749,982
11	Tláhuac	361,593
12	Tlalpan	677,104
13	Xochimilco	415,933
14	Benito Juárez	417,416
15	Cuauhtémoc	532,553
16	Miguel Hidalgo	364,439
17	Venustiano Carranza	427,263
Total		8,918,653

7.2. Water Supply in Mexico City

Mexico City's water supply is covered by two main sources: local derived groundwater and imported surface water from distant basins. It covers its potable water supply of 32.3m^3 per second in the following way: 67 percent is supplied with potable water from four main sources: 55 comes from the Valley of Mexico aquifer; 12 from the Lerma Valley (70km away). The additional 33 percent comes from surface water from two sources: 3 from the southwestern springs and 30 from the Cutzamala reservoir – located 124km away from the city, in the states of Mexico and Michoacán (Morales-Novelo, Revollo-Fernandez and Rodriguez-Tapia 2017).

Estimations show that in Mexico City alone, 364 liters of water per capita per day are supplied (Tortajada and Castelán 2003). The Water System of Mexico City (SACMEX[2] in Spanish) has the duty of delivering potable water to the population. Nevertheless, the actual amount of water received per day per individual can vary significantly. The per capita average includes water use by industries, services, leakages (accounting for 40 percent or more), unauthorized usage, theft, and an unequal distribution pattern of this resource (Tortajada and Castelán 2003). Currently there are approximately 3500 groundwater wells in MCMA, but only 528 wells are public urban in Mexico City ((Ramos Leal, Noyola Medrano and Tapia Silva 2010) and (SACMEX 2016)).The depth of these wells ranges from 200 to 400 meters (Peña 2017), and in most of the cases, water is extracted from them at a higher rate than their natural recharge (Hernandez-Espiru, et al. 2014).

Moreover, 559,700,928 m^3 of water are being extracted from the 528 wells every year to a population of almost 9 million people that inhabit Mexico City. The population is represented as 2,388,534 households that are supplied by a complex pipeline network that allow to connect the water supply to as many as 2,453,770 houses (Table 4) (INEGI 2015). However, even though Mexico City is a very well-connected city to potable water – 98 percent, in a city with a density of 8.85 million people, around 48,000 households are not connected to the water network (Tortajada and Castelán 2003). Meaning that households must spend more of their income to buy potable water from private sources (Morales-Novelo, Revollo-Fernandez and Rodriguez-Tapia 2017). Usually, these sources are either buying water from mobile tanks or carrying it by hand from public faucets – with no guarantee on its quality, - which has been and still is an essential

[2] Sistema de Aguas de la Ciudad de México

problem (Morales-Novelo, Revollo-Fernandez and Rodriguez-Tapia 2017). Additionally, water supply shortages are more common in the eastern part of the city than in any other area. This area of the city is mostly inhabited by low income households, who pay up to 500% more for potable water than those registered domestic consumers (Tortajada and Castelán 2003).

The vast amounts of domestic water extractions originate from groundwater through deep drilled wells. However, due to the vast amount of water being extracted, these wells are estimated to last no more than 40 years from now (Peña 2017) and each of them is reducing their phreatic level at around one meter per year (Tortajada and Castelán 2003). Thus, when too much water gets extracted from the wells, the hydric resource gets over exploited; negatively impacting and degrading the groundwater systems. The consequences of this can be seen already, as Mexico City is sinking due to land subsidence (Olli 2006). Furthermore, the subsidence pattern has been changing widely throughout the years. Ranging from 6 centimeters between 1895 and 1952, to 17 centimeters per year between 1940 to 1970, and 9 centimeters per year from 1986 to 1991 (Hernandez-Espiru, et al. 2014).

Table 4: Groundwater distribution in Mexico City's Municipalities. (Source: own depiction after: INEGI and SACMEX)

Municipality	Annual volume of water (m3)	Houses	Households	Population
Azcapotzalco	31,945,968	117,264	114,084	400,161
Coyoacán	64,245,139	180,495	173,741	608,479
Cuajimalpa de Morelos	1,072,224	47,897	46,438	199,224
Gustavo A. Madero	5,014,224	320,756	315,788	1,164,477
Iztacalco	9,145,440	104,406	101,619	390,348
Iztapalapa	143,110,368	460,757	453,752	1,827,868
Magdalena Contreras	2,144,448	63,267	62,703	243,886
Milpa Alta	25,733,376	31,820	31,589	137,927
Alvaro Obregón	16,903,296	197,926	194,919	749,982
Tláhuac	17,187,120	91,254	90,275	361,593
Tlalpan	96,279,408	176,086	170,428	677,104
Xochimilco	89,183,808	102,778	101,124	415,933
Benito Juárez	24,030,432	141,203	132,563	417,416
Cuauhtémoc	4,036,608	173,907	168,251	532,553
Miguel Hidalgo	25,474,781	120,186	112,450	364,439
Venustiano Carranza	4,194,288	123,327	118,810	427,263
Total	559,700,928	2,453,329	2,388,534	8,918,653

7.2.1. Water System of Mexico City (SACMEX)

The management of the hydraulic infrastructure and provision of water related services of Mexico City is managed by The Water System of Mexico City (SACMEX). This agency administers the supply of drinking water, drainage and sewerage, and treatment and reuse of wastewater. It is the only agency of this nature, and it is appointed by the Federal Government and under the authority of the Ministry of Environment and Natural Resources (SEMARNAT[3] in Spanish) (Morales-Novelo, Revollo-Fernandez and Rodriguez-Tapia 2017).

7.3. Energy Supply in Mexico City

The energetic supply in Mexico is provided by the Federal Electricity Commission (CFE[4]). Unlike SACMEX, there is no single agency that manages electricity supply for the city. With the adoption of the "Energy Reform", CFE changed its legal meaning from a governmental entity to a state productive enterprise. The Federal Ministry of Energy (SENER[5]) is now the sole responsible for the coordination of the electricity sector. However, institutions like the Ministry of Finance and Public Credit (SHCP[6]) and the National Center for Energy Control (CENACE[7]) are involved in the sector to increase cost transparency, regulate subsidies to electricity end-users, and operating the national electricity system and the wholesale electricity markets – which were previously operated only by CFE (IEA 2017).

The tariff structure for electricity in Mexico is based on the type of user and region. The users are divided in the following way: domestic, agriculture, services, commercial, and industrial. Domestic consumers benefit from a subsidize of almost 65% (Mundo-Hernandez, et al. 2014). CFE divides domestic electricity tariffs into eight different levels that vary according to the electric consumption – from lowest (250kWh/month) to highest (2500kWh/month) (SENER 2016). Additionally, it is also based and based on the average minimum temperature registered during the summer season, which may vary from 25º to 32ºC (IEA 2017). However, households with a high consumption level do not benefit from this high subsidy. Moreover, tariffs for users such as households with a high

3 Secretaría de Medio Ambiente y Recursos Naturales

4 Comisión Federal de Electricidad

5 Secretaría de Energía

6 Secretaría de Hacienda y Crédito Público

7 Centro Nacional de Control de Energía

consumption level, commercial and industrial are adjusted on a monthly basis. This adjustment depends on the fluctuation in the prices of fuel and domestic inflation. Finally, tariffs for services (like wastewater and groundwater pumping), agriculture and small domestic users are not subject to the latter adjustment. On the contrary, these tariffs are adjusted based on fixed factors (IEA 2017).

7.4. Renewable Energy in Mexico

7.4.1. Energy Reform

Mexico's legal framework in regard to the energy sector highlights the role of the government and its institutions and functions. Moreover, in terms public policies related to the promotion of renewable energies, they have not always been a central part of decision-making processes and policy-making. However, it was until the presidential period of 2006-2012 that renewable energies started to become truly relevant (Moredia Valek , Susnik and Grafakos 2017). During this period, and in the years to follow, renewable energies are being considered as a central part of the country's development.

The promotion of renewable energy is currently being promoted by three legal documents. The most significant one is the "Energy Reform", which was agreed on 2013 and intents on transforming the country's oil, gas, and electricity sectors. Upon its adoption, it ended energetic monopolies and opened competition, allowing private investors to participate in parallel with the CFE and Mexican Oils (PEMEX[8]). With the implementation of this reform, CFE stopped being a state-owned monopoly (owning 62 percent of generating capacity) which produced approximately 55 percent of all electricity as the sole retail supplier in the country and turned into a state productive enterprise (IEA 2017). Restructuring CFE was key to introducing competition for supply and generation provided by companies unrelated to CFE. Furthermore, the SENER is now the main authority responsible for the coordination of the electricity sector. It prepares laws, decrees, and makes sure that they are being implemented. Meanwhile, the Energy Regulatory Commission (CRE[9]) is responsible of determining and setting regulated tariffs for transmission and distribution, operation of the suppliers of basic services, as well as the final rates for basic supply (IEA 2017).

---

[8] Petróleos Mexicanos

[9] Comisión reguladora de energía

As a result of the "Energy Reform", eight laws derived in terms of renewable energies. However, only two of them are of interest for this study. The "General Law for Climate Change": in essence, it set the goal of generating 35 percent of the country's energy only from renewable sources by 2024 (SENER 2016). Additionally, it centers and defines the criteria to identify regional energetic priorities and poses that the country will grow in a sustainable way and promote the sustainable management of its natural resources. This is to be achieved with the help of renewable, clean energies that help to increase the country's development while reducing its overall emissions (SENER 2016). Lastly, the "Energy Transition Law" [10] aims at establishing the legal conditions for the use of renewable energy technologies and establishes the roadmap to a less fossil-fuel dependent Mexico (IEA 2017).

7.4.2. Mexico's Commitments to Renewable Energies and Climate Change

According to the National Inventory of Greenhouse Gasses, in 2013 Mexico emitted 665 million tons of CO_2 equivalent[11] (IEA 2017). This represents 1,4 percent of the global greenhouse gas emissions. Consequently, until 2013, Mexico ranked as 12th largest greenhouse gas emitter worldwide, and the second in Latin America (World Bank 2013). In the same year, around 85 percent of the overall CO_2 emissions in Mexico were related to the energy sector. The combustion of fossil fuels accounts as the largest CO_2 emitter in the country, with nearly 421 million tones – almost 67,8 percent higher than 1990 levels. Moreover, the biggest CO_2 emitter is transport, accounting for up to 35 percent, followed by power generation (32%), industry (13,4%), and other energy industries like mining (12,1%). Meanwhile, the least emitting sectors are residential (4,2%), and commercial and other services, including agriculture, account for 3,2 percent (IEA 2017).

Mexico's government has always been compromised to reducing greenhouse gasses because it is a fact that climate change is and will continue to pose a risk to the country. Due to its geographical conditions – being surrounded by oceans in the East and West, Mexico is highly vulnerable to meteorological events. For instance, in 2014 it was estimated that damages and losses related to climate change, ascended to almost 2 million dollars (Ramos Leal, Noyola Medrano and Tapia Silva 2010). In addition, the

[10] Ley de Transición Energética

[11] Including Land use change and forestry

energy sector is prone to be affected by these risks in the following ways: firstly, estimations show that 46 percent of PEMEX's infrastructure and 30 percent of the infrastructure of CFE are prone to climate change; secondly, rising temperatures reduce the effectiveness of electricity transmission; thirdly the energy demand will increase as a direct consequence of the increased temperatures (IEA 2017). Over and about that, not only will the industry be affected, but the limited adaptation potential to climate change of almost 13 percent of the national low-income population has consequently made them be considered as "highly vulnerable" (IEA 2017). Thus, because of its propensity to climate change related risks, adaptation is of very high significance to the Mexican government.

The negative consequences associated to climate change in the country have encouraged the government to include this topic in law making and policy planning. The "Energy Reform" or the "General Law for Climate Change" are considered a to be a leading example towards adaptation to climate change. As previously mentioned, the goal for Mexico as an upper-middle income country is to reduce greenhouse gas emissions by 30 percent by 2020 and 35 percent by 2024 below the business-as-usual levels (IEA 2017).

On the international field, Mexico is a non-Annex I party to the United Nations Framework Convention on Climate Change (UNFCCC). The Mexican government has always considered that signing and ratifying commitments of this kind is of great importance and has played a leading role in encouraging others to do so as well. After the Paris Agreement was accorded, Mexico became the first emerging economy to submit its Intended Nationally Determined Contribution (INDC). In line with its commitments, Mexico set the national goal of cutting back emissions in the electricity sector by 31 percent business-as-usual emissions, its largest reduction so far. Reductions are also expected in the transport, oil and gas sector, manufacturing and agriculture (IEA 2017).

The Mexican government introduced clean energy certificates (CECs) to encourage investment and supply competition in the electricity sector. The goal of the CECs is to require retail suppliers and large consumers that do not use retail suppliers to have a share of their electricity or their consumption of electricity from renewable sources. Hence, they will be obligated to buy CECs to demonstrate their compliance of the quota obligation (IEA 2017). CECs represent a source of income for those producing clean energy along with earnings from the sale of electricity and capacity generation. These certificates are a part of the "Energy Reform" and aim at offering security to the large shares that are being invested for renewable energy projects, which generally are capital-intensive. In addition, these certificates do not expire and are bankable, which also increases the investment security. So far, the “Energy Reform” has introduced long term auctions for CECs: two auctions already took place in 2016 and resulted in a closeout of more than 14TWh of CECs. Solar Photovoltaic energy earned the vast majority of the certificates, followed by wind power (IEA 2017).

Finally, in addition to the CECs, the government also set a tax incentive which guarantees an income deduction of 100 percent for investments intended towards renewable energies. The principle behind this tax incentive applies only for systems that have an installed capacity of under 500kW (IEA 2017). However, this is still a pilot project and there is no collected data yet.

7.4.3. Renewable Energy Potential in Mexico

The ongoing efforts of the Mexican Government have proved that the renewable energies with the highest potential in the country are Eolic, solar and geothermal. According to the National Inventory of Renewable Energies (INERE[12]), the biggest proved potential for electricity generation[13] is found in solar and Eolic (SENER 2016). Furthermore, hydraulic, geothermal and biomass are also feasible but with a much lower presence (Table 5) (SENER 2016). During 2015, power generation with renewable energies represented 15.3 percent (equivalent to 47,548.7 GWh) of the national total. It is noteworthy that, wind energy showed the highest growth in the last decade with a growth rate of 106.8 percent, from 5.0 GWh to 8,745.1 GWh (SENER 2016). On the contrary, the generation of electricity by geothermal sources displays a negative average rate of annual growth, however, it has maintained its generation levels. Technologies that use solar energy, biogas and bagasse, present a sustained growth driven mostly by support programs derived from energy policies, whose objective is to promote the inclusion of these technologies in the energy mix (SENER 2016).

[12] Inventario Nacional de Energías Renovables)

[13] Potential that has been proven with technical and economic studies that proof the feasibility of its use.

Table 5: Potential of Electricity Generation with Renewable Energies in Mexico (GWh). (Source: own depiction after: SENER. Prospectiva de Energías Renovables. Mexico City: Mexican Government, 2016. Sistema Europeo de Negociación de CO2. SENDECO2. - -, 2017.)

Resources	Eolic	Solar	Hydraulic	Geothermal	Biomass
Proved	19,805	16,351	4,796	2,355	2,396

The Mexican government has defined four scenarios that show the potential of the installation of renewable energies in the country. It considers three restrictions to define four scenarios that will allow the country to utilize renewable and clean resources in the short, medium, and long term (Table 6) (SENER 2016). Scenario 1 identifies the zones with the highest potential for the development of electric generation with renewable energies but does not consider the closeness or distance to the general transmission networks. This scenario exhibits a probable installed capacity of 2.471.769 MW and a probable generation potential of 4.904.507 GWh/y[14]. Scenario 2 works the same as scenario 1, but it does consider the distance to the general transmission networks of less or equal to 20km. The probable installed capacity in this scenario is of 1.208.020 MW and a potential of generation of 2.635.105GWh/y. Scenario 3 considers the distance of the transmission networks as less or equal to 10km, in this scenario the probable installed capacity is of 377.740 MW and a potential of generation of 854.864 GW/y. Finally, scenario 4 considers a distance of more than 20km. The probable installed capacity of scenario 4 is of 980.688 MW and a potential of generation of 2.146.969 GW/y (Table 6) (SENER 2016).

Table 6: Scenarios of probable installed capacity and potential of generation in Mexico. (Source: own depiction after: *SENER. Prospectiva de Energías Renovables. Mexico City: Mexican Government, 2016. Sistema Europeo de Negociación de CO2. SENDECO2. - -, 2017.)*

Renewable Energy Type	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Probable Installed Capacity (MW)	Potential of Generation (GWh/y)	Probable Installed Capacity (MW)	Potential of Generation (GWh/y)	Probable Installed Capacity (MW)	Potential of Generation (GWh/y)	Probable Installed Capacity (MW)	Potential of Generation (GWh/y)
Eolic	583,200.00	1,486,713.00	290,249.00	740,332.00	158,302.00	402,847.00	297,444.00	750,186.00
Solar (fixed)	965,373.00	1,716,274.00	537,134.00	957,726.00	127,722.00	228,485.00	395,664.00	701,229.00
Solar (tracking)	691,925.00	1,692,453.00	379,007.00	925,270.00	89,667.00	218,658.00	287,455.00	694,568.00
Geothermal	174.00	1,373.00	399.00	3,146.00	571.00	4,509.00	125	986
Biomass	1,097.00	7,694.00	1,231.00	8,631.00	1,478.00	10,365.00	-	-
Total	2,471,769.00	4,904,507.00	1,208,020.00	2,635,105.00	377,740.00	864,864.00	980,688.00	2,146,969.00

[14] GWh/year

7.4.4. Solar Photovoltaic Energy Generation in Mexico

Mexico's potential for solar energy generation is the fifth highest in the world. Approximately three quarters of the national territory have average insolation of 6kW/h/m^2/day (SENER 2016). This represents double as much as the United States alone. Moreover, the north-eastern region of the country – in the states of Chihuahua, Sonora, and Baja California – has the most abundant solar resource, with insolation levels reaching up to 6,6kW/h/m^2/day (Figure 13) (SENER 2016).

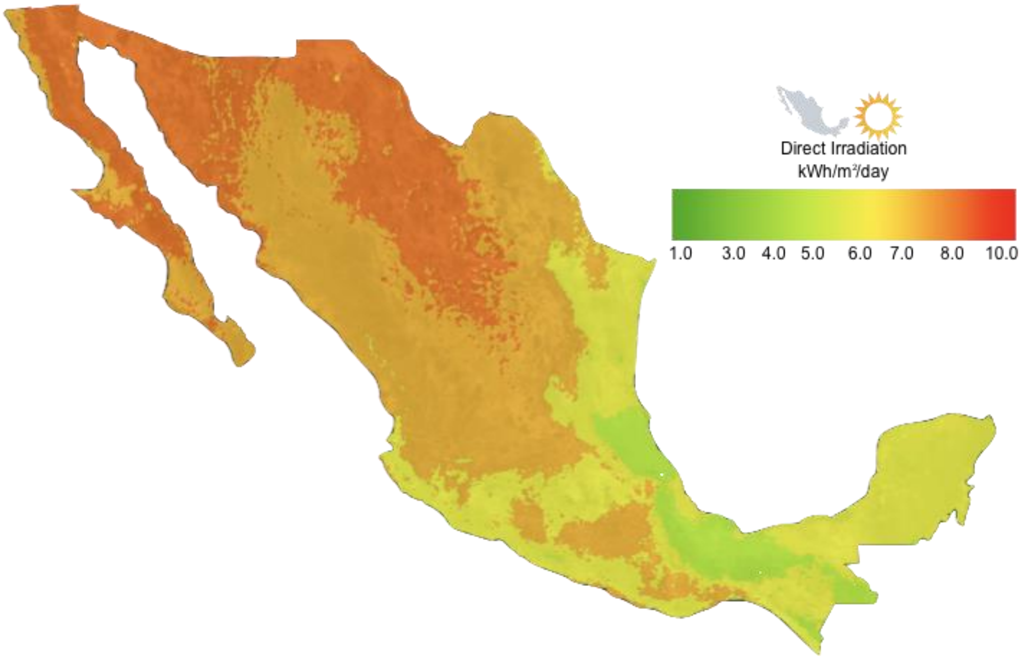

Figure 13: Solar insolation levels (kWh/m2/day) and location of the electricity generator states using PV technology in Mexico.

(Source: own depiction after: INERE. Inventario Nacional de Energías Renovables. Mexico, June 25, 2018.)

Since the publication of the First Interconnection Contract for Small Scale Solar Power Sources, as well as the entry into operation of the first large-scale photovoltaic power plant in 2011, the installed capacity and the generation of electric power from solar energy increased from 18.5 MW and 8.8 GWh in 2007 to 170.24 MW and 190.26 GWh in 2015, making it a record-breaking year for solar energy generation in Mexico (SENER 2016).

Mexico has 9 solar energy generation centrals distributed in several regions of the country – none of which are in a capital city (Figure 14) (SENER 2016). However, projections anticipate that an increase in installed capacity will occur. It will be divided in two periods: The first period between 2016 and 2018, with close to 3,546.6MW and the second one from 2020 to 2030 (SENER 2016).

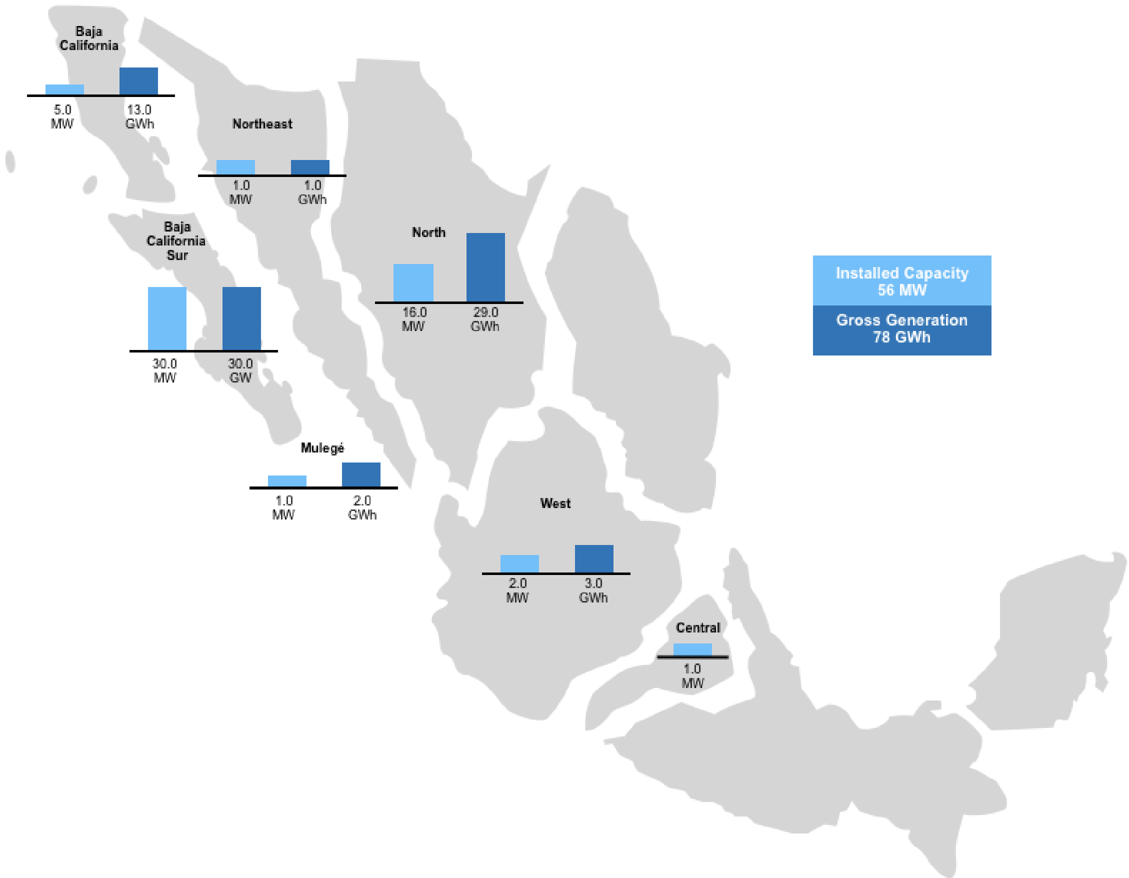

Figure 14: Capacity and generation of electricity with solar photovoltaic technologies by area of control. (Source: own depiction after: SENER. Prospectiva de Energías Renovables. Mexico City: Mexican Government, 2016. Sistema Europeo de Negociación de CO2. SENDECO2. - -, 2017.)

7.5. Mexico City's energetic consumption for groundwater pumping

Mexico City's annual electricity needs for groundwater pumping are of 299,595,632.33 kWh for its 528 public urban wells. The annual extraction of water corresponds to 559, 700, 928 m^3 of water for its 16 municipalities (SACMEX 2016). This means that for every m^3 of water extracted, 0.53kWh are needed. Currently, the electricity needs are covered by CFE with fossil-fuel based pumps. As previously mentioned, electricity in Mexico operates on a very high subsidy. However, only the domestic, agriculture, and services sectors receive such a subsidy (Table 7). It is important to consider that while the service sector consists of four concepts which are depicted in Table 7, and are namely 5, 5A, 6 and EA, the only one that is subsidized by the government is tariff number 6

(Undersecretary of Electricity 2014). This tariff corresponds to electricity for pumping potable and/ or wastewater.

Table 7: Non-industrial electricity tariffs.

(Source: own depiction after: Undersecretary of Electricity. Informe Pormenorizado del Desempeño y las Tendencias de la Industria Eléctrica. Mexico City: SENER, 2014.)

	Domestic
1*	For locations with a temperate climate, with a limit for high consumption of 250 kWh / month
1A*	For locations with a minimum average summer temperature of 25 ° C, with a limit for high consumption of 300 kWh / month
1B*	For locations with a minimum average summer temperature of 25 ° C, with a limit for high consumption of 400 kWh / month.
1C*	For locations with a minimum average summer temperature of 25 ° C, with a limit for high consumption of 850 kWh / month
1D*	For locations with a minimum average summer temperature of 25 ° C, with a limit for high consumption of 1000 kWh / month
1E*	For locations with a minimum average summer temperature of 25 ° C, with a limit for high consumption of 2000 kWh / month
1F*	For locations with a minimum average summer temperature of 25 ° C, with a limit for high consumption of 2500 kWh / month
DAC	High consumption domestic service
	Agriculture
9*	For pumping water for agricultural irrigation in low voltage
9CU*	Of stimulus for pumping water for agricultural irrigation with a single payment
9M*	For pumping water for medium voltage agricultural irrigation
9N*	Stimulus for pumping water for agricultural irrigation - Nighttime
	Services
5	For street lighting in suburban areas of Monterrey, Guadalajara and Mexico City
5A	For street lighting in the rest of the country
6*	For pumping potable or waste water
EA	Stimulus for the electric energy consumed in aquaculture facilities.
	*Tariffs with subsidies

In 2014, 6,251,390 USD were allotted by the Mexican government to subsidize electricity. Of this amount, 87.18 percent was destined to domestic users, 11.53 percent for agriculture, and only 1.29 percent for services (Undersecretary of Electricity 2014). Of this national total, 5.53 percent corresponds to Mexico City. In Mexico City there is no agriculture activities, thus, the subsidies only correspond to domestic and services, with 97 and 3 percent, respectively (Figure 15) (Undersecretary of Electricity 2014).

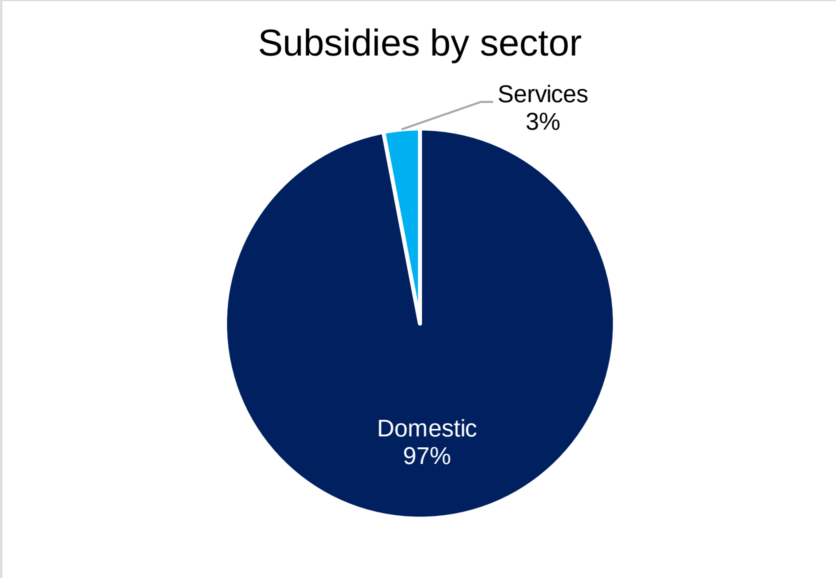

Figure 15: Electricity subsidies by sectors.

(Source: own depiction after: Undersecretary of Electricity. Informe Pormenorizado del Desempeño y las Tendencias de la Industria Eléctrica. Mexico City: SENER, 2014.)

While the tariff for pumping groundwater for domestic supply (tariff number 6) is highly subsidized; this subsidy tends to get reduced along the years, negatively impacting the finances of the operating agency. The implementation of the "Energy Reform" established the intention of reducing the subsidies of each sector with the long-term goal of phasing it out completely (IEA 2017). This is set to be achieved by making the institutions responsible of providing the service more efficient by reducing their losses. A reduction of the subsidies presents an opportunity to invest in renewable energy systems as an alternative to the increased expenditure in electricity (IEA 2017). Ultimately, to overcome these adversities, the project to build a photovoltaic system that guarantees the supply of electricity for the next 30 years in the CDMX will be evaluated in the following section.

7.6. PV array sizing for 528 public urban wells in Mexico

The installation of SPVWPS is unprecedented. The lack of information and experience at this scale, implies that while it is doable, it also comes with great risks. For these reasons and due to practical limitation, this study will focus on the expenditure and sizing of the photovoltaic array needed for this system. As mentioned before, the PV array is the biggest cost of the overall system, implying that almost 80 percent of the total investment has to be allotted towards it (Kalamkar and Sontake 2016). The PV array consists on a series of photovoltaic panels connected in parallel or in series. The scheming of the calculation to size the PV array was provided Natura Energy Mexico, which is one of the leading solar photovoltaic companies installing and operating PV arrays in Mexico. It must be considered that while the aim is for the system's capacity to generate the same amount of electricity than that of a conventional fossil-fuel pump, installing a system of such a scale entails that costs must be cut down as much as possible. Hence, this study does not consider the expenditure either on batteries nor on water storage tanks.

However, this research contemplates having the PV array system connected to the utility grid. This, in an attempt to reduce costs and space (Kalamkar and Sontake 2016). Making the system grid-connected and not fully dependent on the PV array, is a decision made under the assumption that during cloudy, rainy or extremely polluted days, the system could still depend (to a minimal extent) on fossil-fuel based electricity to ensure the supply of groundwater to the population. Also, if the system were to produce any excess electricity, it could be returned to the grid and sold to CFE, making the system more efficient and reducing the expenditure in electricity in the long run (Chaib, Achour and Kesraoui 2016).

The estimation of the PV array was calculated for each of the 528 public urban wells that are under operation in Mexico City's 16 municipalities. Wells that are privately owned or exclusively for industrial use are not considered for this study. Moreover, SACMEX provided the water flow, electricity consumption and type of well for this study (SACMEX 2016). Additionally, the depth of each well was not provided. However, according to one interview and several Mexican news websites, it has been determined that in average each well has a depth of 200-400 meters (Peña 2017). Next, the water flow per year (in cubic meters), the electric consumption (in Watt/hour) per year per well, the average insolation hours (5,6 hours/day), and the maximum power of every individual panel (315 watts) were considered to estimate the overall size of the array (Peña 2017). Figure 16 displays an example of the calculation of the PV array for one well was made. Moreover, it must be considered that the results may vary due to lack of information on some wells. The data provided by SACMEX includes wells that are in operation, but also those that are out of order, in rehabilitation, or SACMEX is considering replacing. However, these wells were also taken into the total calculation, even when they do not provide any data. For practical reasons, the detailed information on the municipalities can be found in Annex 1 and information on wells can be found in Annex 2**.**

Grid-connected Photovoltaic Array Sizing Calculation

Exchange rate 18.13 M.N./USD Date 28.Sep.17

Code	Municipality	Number of wells	Average Electricity consumption per well (kWh/y)
2	AZCAPOTZALCO	34	533,480

Electric consumption per well:	18,138,321.41	kWh/y
	18,138,321,409.60	Wh/y
Insolation	5.6	h/day
Dividing by 365 days	49,694,031.26	Wh/d
Dividing by 5.6 insolation hours per day	8,873,934.15	W
Insolation divided by temperature loss (0.88)	10,084,016.08	W
Temperature loss divided by general network factor (0.84).	12,004,781.05	W
Network factor divided by investment effect (0.96)	**12,504,980.26**	W
Investment effect divided by security factor (1%)	**12,379,930.46**	
Considering a maximum power per panel	315.00	W
Amount of modules	**39,302.00**	Units
Capacity of the PV system	**12,380,130.00**	Wp
	12,380.13	kWp
Price per watt	$ 2.80	USD/W
Estimated Sale Value	**$ 34,664,364.00**	**USD + VAT**

Total area if module size = 2.1m² 82534.2 m²

Figure 16: PV array sizing calculation.

(Source: own depiction. ***Note:*** *the number of modules displayed in this figure are estimated after the average electricity consumption per day for illustrative reasons. The real number can be found in the annexes and is not based on an average.)*

Table 8 displays that the PV system capacity for the 16 municipalities in Mexico City should be of 204,104,250 watt-peak to cover the daily electricity needs for water pumping. To do so, SACMEX would have to invest in the installation of 647,950 solar panels. Through this installation, the substitution of 100% of the use of fossil fuels would be ensured. These results are guaranteed when the system works at an efficiency of 100%. Meaning that during the average insolation hours in Mexico City (5.6 hours per day), the system would even be able to produce an electricity surplus – during optimal weather conditions. Moreover, considering that this study contemplates installing a grid-connected system by connecting the arrays to CFE's electricity grid, electricity from conventional sources (fossil-fuels) would only be required on rainy, cloudy, or very polluted days. Additionally, if there was to be an energetic surplus, it could be returned to the electricity grid. By returning the potential surplus, SACMEX's could, on the one hand, possibly compensate its expenditure on conventional electricity, and on the other hand, sell the electricity to CFE, suggesting the possibility of receiving revenue.

Moreover, SACMEX could potentially comply and profit from the clean energy certificates (CECs) implemented by the "Energy Reform". As it was previously mentioned, high consumption sectors are required to buy or produce a percentage of their electricity from renewable energies (IEA 2017). Not only could SACMEX be able to buy CECs to show its compliance with the law, it could turnover from them. For every extra megawatt-hour of clean energy that the PV array system produced, SACMEX would be entitled to a CEC, entailing additional revenue that could be used to pay the debt for the PV array faster or pay back the use of conventional electricity (if any was required) (IEA 2017).

Table 8: Photovoltaic array sizing and capacity per municipality.

(Source: Own depiction)

	Data input provided by SACMEX and Natura Energy Mexico						
Municipality	Number of wells	Electric energy consumption per well WH/y	Insolation 5.6 h/d	Each module provides up to 315W	Amount of modules	Estimated area if each module size is 2.1. **In m2**	Capacity of the PV system **Watt Peak**
Azcapotzalco	34	18,138,321,409.6	5.6	315	39,317	82,565.70	12,384,855
Coyoacán	84	46,590,134,606.4	5.6	315	99,540	209,034.00	31,355,100
Cuajimalpa de Morelos	2	800,810,000.0	5.6	315	1,737	3,647.70	547,155
Gustavo A. Madero	3	1,960,237,449.6	5.6	315	4,249	8,922.90	1,338,435
Iztacalco	9	5,565,841,000.0	5.6	315	12,065	25,336.50	3,800,475
Iztapalapa	78	46,402,209,313.6	5.6	315	100,579	211,215.90	31,682,385
Magdalena Contreras	6	3,709,128,000.0	5.6	315	8,040	16,884.00	2,532,600
Milpa Alta	21	13,105,294,513.6	5.6	315	28,407	59,654.70	8,948,205
Alvaro Obregón	37	12,507,735,700.0	5.6	315	27,115	56,941.50	8,541,225
Tláhuac	16	9,851,076,216.0	5.6	315	21,352	44,839.20	6,725,880
Tlalpan	89	48,821,869,041.6	5.6	315	105,828	222,238.80	33,335,820
Xochimilco	81	49,364,072,025.6	5.6	315	106,999	224,697.90	33,704,685
Benito Juárez	26	14,600,505,062.4	5.6	315	31,647	66,458.70	9,968,805
Cuauhtémoc	6	4,692,039,481.6	5.6	315	10,169	21,354.90	3,203,235
Miguel Hidalgo	29	19,305,709,000.0	5.6	315	41,845	87,874.50	13,181,175
Venustiano Carranza	7	4,180,649,512.0	5.6	315	9,061	19,028.10	2,854,215
TOTAL	528	299,595,632,332.0			647,950	1,360,695.00	204,104,250

7.7. Economic feasibility of the implementation of the installation of the PV array as an initial investment of SPVWPS

SACMEX consumes 299,595,632.33 kWh per year to operate the 528 public urban wells from which it extracts water. Such an intensive use of electricity implies an annual effective cost of 40,928,365.07 USD (in 2016, base year of this study), which entails an average cost of 0.14 USD per kwh (Table 9). This tariff is very cheap, but it is influenced by the fact that it receives a very high subsidy (Undersecretary of Electricity 2014). Therefore, the low tariff paid by SACMEX is one of the main disincentives for energy reconversion.

Table 9: Value of electricity 2016: base year.

(Source: Own depiction)

Municipality	Number of wells	Annual electricity needs for groundwater pumping kWH/y	Price of electricity in Mexico (USD)	Value of electricity (USD)
Azcapotzalco	34	18,138,321	$ 0.14	$ 2,477,912.76
Coyoacán	84	46,590,135	$ 0.14	$ 6,364,772.49
Cuajimalpa de Morelos	2	800,810	$ 0.14	$ 109,400.27
Gustavo A. Madero	3	1,960,237	$ 0.14	$ 267,792.00
Iztacalco	9	5,565,841	$ 0.14	$ 760,360.79
Iztapalapa	78	46,402,209	$ 0.14	$ 6,339,099.63
Magdalena Contreras	6	3,709,128	$ 0.14	$ 506,711.48
Milpa Alta	21	13,105,295	$ 0.14	$ 1,790,340.78
Alvaro Obregón	37	12,507,736	$ 0.14	$ 1,708,707.06
Tláhuac	16	9,851,076	$ 0.14	$ 1,345,775.44
Tlalpan	89	48,821,869	$ 0.14	$ 6,669,654.24
Xochimilco	81	49,364,072	$ 0.14	$ 6,743,725.69
Benito Juárez	26	14,600,505	$ 0.14	$ 1,994,604.52
Cuauhtémoc	6	4,692,039	$ 0.14	$ 640,989.00
Miguel Hidalgo	29	19,305,709	$ 0.14	$ 2,637,391.94
Venustiano Carranza	7	4,180,650	$ 0.14	$ 571,126.98
Total	528	299,595,632	$ 0.14	$ 40,928,365.07

As indicated above, the PV system capacity covers the annual energy requirements of SACMEX in its entirety and contemplates a 30-year duration scenario (2016-2045). In this scenario, the future benefits of the system are estimated for that period and according to the following methodology: the estimation of the benefits is based on the annual payment flows that SACMEX would pay to the CFE for the next 30 years (Annex 3). Since this study contemplates present and future scenarios, there are special considerations that must be envisaged when estimating the payment flows (*Table 10*):

Table 10: Assumptions of the cost-benefit analysis

(Source: Own depiction)

Annual rate growth rate	0.02%
Annual growth rate of consumption	0.0%
Discount rate (interest)	3.0%
Energy rate per KW (USD)	$0.14
Exchange rate USD / MEX	$18.30
Price per CO_2 ton USD	$3.55

The payment made to CFE in 2016 was projected with the relevant adjustments considering a growth rate based on the last decade. It was deduced that there will be no increases in water consumption but that rates will increase annually by 2 percent. The payments were evaluated at present value in order to aggregate them into a single magnitude and consequently make a comparison that determined the convenience of developing the project. Moreover, the calculation of the present value of the flow of future payments (30 years) was estimated discounting a rate of 3% per year (soft loan) (Annex 3). The present value added in the next 30 years -2016 to 2045- would be of 818,258,300 USD (Table 11). This amount represents the annual electricity costs that SACMEX would avoid if it decided to transform its source of electricity supply from fossil-fuel to solar photovoltaic. Therefore, the avoided costs of can be interpreted as future benefits for SACMEX.

Table 11: Annual savings in conventional energy in USD.

(Source: Own depiction)

Municipality	Total benefits of the PV array system. (Present Value: Total expenditure in conventional electricity per municipality in USD)
Azcapotzalco	$ 49,539,547
Coyoacán	$ 127,247,397
Cuajimalpa de Morelos	$ 2,187,180
Gustavo A. Madero	$ 5,353,818
Iztacalco	$ 15,201,475
Iztapalapa	$ 126,734,134
Magdalena Contreras	$ 10,130,404
Milpa Alta	$ 35,793,299
Alvaro Obregón	$ 34,161,241
Tláhuac	$ 26,905,348
Tlalpan	$ 133,342,730
Xochimilco	$ 134,823,600
Benito Juárez	$ 39,877,031
Cuauhtémoc	$ 12,814,941
Miguel Hidalgo	$ 52,727,927
Venustiano Carranza	$ 11,418,228
Total	**$ 818,258,300**

7.7.1. Cost of the PV array investment

The cost of the project was estimated under the following considerations: the photovoltaic array system is composed of 647,310 panels. This system has a generation capacity of 204,104,250 watt-peak and guarantees that it has the potential to produce the same amount of electricity as a fossil-fuel based system (Table 12). Next, it was also considered that the price per watt-peak is of 2.8 USD. This price includes the cost per photovoltaic unit, installation, and all costs associated to taxes. In addition, this study considered that the demand for electricity consumption would not increase during the next 30 years of useful life of the solar panels. Finally, the investment was contemplated to be made in the initial year: 2016 (year zero).

Table 12: Total PV capacity and estimated sale value.
(Source: Own depiction)

Municipality	# of Wells	Amount of modules	Capacity of the PV system **Watt Peak**	Estimated Sale Value (USD) + VAT
Azcapotzalco	34	39,317.00	12,384,855.00	$ 34,677,594.00
Coyoacán	84	99,540.00	31,355,100.00	$ 87,794,280.00
Cuajimalpa de Mo	2	1,737.00	547,155.00	$ 1,532,034.00
Gustavo A. Mader	3	4,249.00	1,338,435.00	$ 3,747,618.00
Iztacalco	9	12,065.00	3,800,475.00	$ 10,641,330.00
Iztapalapa	78	100,579.00	31,682,385.00	$ 88,710,678.00
Magdalena Contre	6	8,040.00	2,532,600.00	$ 7,091,280.00
Milpa Alta	21	28,407.00	8,948,205.00	$ 25,054,974.00
Álvaro Obregón	37	27,115.00	8,541,225.00	$ 23,915,430.00
Tláhuac	16	21,352.00	6,725,880.00	$ 18,832,464.00
Tlalpan	89	105,828.00	33,335,820.00	$ 93,340,296.00
Xochimilco	81	106,999.00	33,704,685.00	$ 94,373,118.00
Benito Juárez	26	31,647.00	9,968,805.00	$ 27,912,654.00
Cuauhtémoc	6	10,169.00	3,203,235.00	$ 8,969,058.00
Miguel Hidalgo	29	41,845.00	13,181,175.00	$ 36,907,290.00
Venustiano Carran	7	9,061.00	2,854,215.00	$ 7,991,802.00
TOTAL	528	647,950.00	204,104,250.00	$ 571,491,900.00

Considering the system capacity of 204,104,250 watt-peak, the PV array cost would be of 571,491,900 USD. Conclusively, the system could be financed to its entirety and its entirety would be paid in a time frame of 30 years – which is the approximate lifetime of the system. This positive outcome would allow to start the operations from year one. The comparison of the benefits of the project with the costs allows to evaluate the economic feasibility of it. Consequently, the project is possible because the future benefits are evaluated at present value (column 1 of Table 13), and the costs are to the year 2016 (column 2 of Table 13). Therefore, the information is comparable. Furthermore, if one compares the expenditure on conventional electricity versus the investment in the PV array system (Table 13), it can be concluded that not only is the investment feasible, but it also entails long-term savings.

Table 13: Present value: total expenditure in conventional electricity (30 years) vs investment in PV array system (USD).

(Source: Own depiction)

Municipality	Present Value: Total expenditure in conventional electricity per municipality	Investment in PV array USD
Azcapotzalco	$ 49,539,547	$ 34,677,594
Coyoacán	$ 127,247,397	$ 87,794,280
Cuajimalpa de Morelos	$ 2,187,180	$ 1,532,034
Gustavo A. Madero	$ 5,353,818	$ 3,747,618
Iztacalco	$ 15,201,475	$ 10,641,330
Iztapalapa	$ 126,734,134	$ 88,710,678
Magdalena Contreras	$ 10,130,404	$ 7,091,280
Milpa Alta	$ 35,793,299	$ 25,054,974
Alvaro Obregón	$ 34,161,241	$ 23,915,430
Tláhuac	$ 26,905,348	$ 18,832,464
Tlalpan	$ 133,342,730	$ 93,340,296
Xochimilco	$ 134,823,600	$ 94,373,118
Benito Juárez	$ 39,877,031	$ 27,912,654
Cuauhtémoc	$ 12,814,941	$ 8,969,058
Miguel Hidalgo	$ 52,727,927	$ 36,907,290
Venustiano Carranza	$ 11,418,228	$ 7,991,802
Total	**$ 818,258,300**	**$ 571,491,900**

7.7.2. Cost-benefit analysis of the potential PV array installation

Once the benefits and costs are at present value, the next step is to make a comparison of both magnitudes. The total benefits of the installation of the PV array system reach a magnitude of 818,258,300 USD. By discounting the cost of the system (571,491,900 USD) to the total benefits (818,258,300 USD) a net benefit of 246,766,400 USD is obtained (

Table 14). Ultimately, the positive value that the net benefits display is a clear indication that, from an economic point of view, this project is profitable, as shown in Annex 3. In addition, when evaluating the project by relating the net benefits (column 4) between the total cost of the project (column 3), the result indicates that this relationship reaches a value of 0.43. This value indicates that, for every dollar invested in this project, a benefit of 0.43 USD is obtained. Meaning that the debt acquired by the installation of this system can be paid with ease - since a soft loan of 3% was considered. Therefore, the figures below show that SACMEX must contemplate the possibility of investing in the PV array system for the 16 municipalities of Mexico City.

Table 14: Cost-benefit analysis of the installation of the PV array system. (Source: own depiction)

Municipality	Total benefits of the PV array system. (Present Value: Total expenditure in conventional electricity per municipality in USD)	Cost of the PV array system (Investment in PV array USD)	Net benefits (Savings USD)	DECISION
Azcapotzalco	$ 49,539,547	$ 34,677,594	$ 14,861,953	PROFITABLE
Coyoacán	$ 127,247,397	$ 87,794,280	$ 39,453,117	PROFITABLE
Cuajimalpa de Morelos	$ 2,187,180	$ 1,532,034	$ 655,146	PROFITABLE
Gustavo A. Madero	$ 5,353,818	$ 3,747,618	$ 1,606,200	PROFITABLE
Iztacalco	$ 15,201,475	$ 10,641,330	$ 4,560,145	PROFITABLE
Iztapalapa	$ 126,734,134	$ 88,710,678	$ 38,023,456	PROFITABLE
Magdalena Contreras	$ 10,130,404	$ 7,091,280	$ 3,039,124	PROFITABLE
Milpa Alta	$ 35,793,299	$ 25,054,974	$ 10,738,325	PROFITABLE
Alvaro Obregón	$ 34,161,241	$ 23,915,430	$ 10,245,811	PROFITABLE
Tláhuac	$ 26,905,348	$ 18,832,464	$ 8,072,884	PROFITABLE
Tlalpan	$ 133,342,730	$ 93,340,296	$ 40,002,434	PROFITABLE
Xochimilco	$ 134,823,600	$ 94,373,118	$ 40,450,482	PROFITABLE
Benito Juárez	$ 39,877,031	$ 27,912,654	$ 11,964,377	PROFITABLE
Cuauhtémoc	$ 12,814,941	$ 8,969,058	$ 3,845,883	PROFITABLE
Miguel Hidalgo	$ 52,727,927	$ 36,907,290	$ 15,820,637	PROFITABLE
Venustiano Carranza	$ 11,418,228	$ 7,991,802	$ 3,426,426	PROFITABLE
Total	**$ 818,258,300**	**$ 571,491,900**	**$ 246,766,400**	**PROFITABLE**

7.8. Reduction of CO_2 emissions with the initial installation of a PV array to pump groundwater in Mexico City

The installment of the PV array in the 16 municipalities that form Mexico City would entail an annual reduction of 137,215 tons equivalent of CO_2 (Table 15). This calculation was performed considering an emission factor of 0.458 which is recommended by the Ministry of Environment and Natural Resources (SEMARNAT[15]) when CFE is the electricity supplier – which is the case of SACMEX. Furthermore, to have a better understanding of the magnitude of the CO_2 reductions, decreasing annual emissions by 137,215 tons equivalent of CO_2 is equal to driving 26,655 average-size passenger vehicles for an entire year (EPA 2017).

[15] Secretaría de Medio Ambiente y Recursos Naturales – Ministry of Environment and Natural Resources

Table 15: CO2 emission reduction and monetary value of the reduction per year. (Source: own depiction of data analysed from: Sistema Europeo de Negociación de CO2. SENDECO2. - -, 2017. http://www.sendeco2.com/es/precios-co2 (accessed 09 15, 2017) and (SACMEX 2016).)

Municipality	Annual kWH/y substituted by the PV array	Annual reduction of CO2 tons equivalent
Azcapotzalco	18,138,321.41	8,307
Coyoacán	46,590,134.61	21,338
Cuajimalpa de Moré	800,810.00	367
Gustavo A. Madero	1,960,237.45	898
Iztacalco	5,565,841.00	2,549
Iztapalapa	46,402,209.31	21,252
Magdalena Contrer	3,709,128.00	1,699
Milpa Alta	13,105,294.51	6,002
Álvaro Obregón	12,507,735.70	5,729
Tláhuac	9,851,076.22	4,512
Tlalpan	48,821,869.04	22,360
Xochimilco	49,364,072.03	22,609
Benito Juárez	14,600,505.06	6,687
Cuauhtémoc	4,692,039.48	2,149
Miguel Hidalgo	19,305,709.00	8,842
Venustiano Carranz	4,180,649.51	1,915
TOTAL	299,595,632.33	137,215

In addition to the environmental benefit, there is also a monetary value of lowering the overall emissions that groundwater pumping operations by SACMEX. Savings add up to almost half a million dollars (487,716 USD) annually – considering an average price of 3.55 USD per ton in the international CO_2 market (Table 16). Furthermore, the effect is cumulative and increases within time. The net benefits estimated in the previous sections are amplified by the annual revenue obtained by the reduction of CO_2 emissions. A reduction in the overall emissions would further increase the economic profitability of the project. Half a million dollars of annual income could be applied to the amortization of the capital, which would allow to liquidate the funding in a shorter period of time – ceteris paribus means 2.56% of the total investment. On top of this, on the one hand, Mexico City would contribute to the compliance national laws such as the “Energy Reform” which aims at producing 35% of the country’s energy with renewable energies by 2024. Likewise, the “General Law for Climate Change”, whose goal is to reduce greenhouse gas emissions by 30% by 2020 by below business-as-usual levels (IEA 2017).

On the other hand, at an international level, being a non-Annex I party to the United Nations Framework Convention on Climate Change (UNFCCC), and in line with the Paris Agreement, Mexico would be closer to complying with the INDCs that it committed to: cutting back emissions in the electricity sector by 31% business-as-usual emissions (IEA 2017). This factor is crucial, since it is specifically intended towards the electricity sector, which is the main and biggest polluting sector in the country, accounting for almost 85 percent of the emissions in 2013 (Ramos Leal, Noyola Medrano and Tapia Silva 2010). Ultimately, the reduction of CO_2 emissions that a single public institution can achieve (SACMEX) through its energy conversion, suggests that the public policy alternatives of the CDMX government to meet its goal of becoming a sustainable city are potentially feasible.

Table 16: Financial benefits by the reduction of CO_2 emissions. (Source: own depiction)

Municipality	Annual revenue in USD by CO2 emissions reductions
Azcapotzalco	$ 29,527.65
Coyoacán	$ 75,844.79
Cuajimalpa de Morelos	$ 1,303.65
Gustavo A. Madero	$ 3,191.10
Iztacalco	$ 9,060.72
Iztapalapa	$ 75,538.86
Magdalena Contreras	$ 6,038.15
Milpa Alta	$ 21,334.31
Alvaro Obregón	$ 20,361.53
Tláhuac	$ 16,036.72
Tlalpan	$ 79,477.86
Xochimilco	$ 80,360.52
Benito Juárez	$ 23,768.38
Cuauhtémoc	$ 7,638.24
Miguel Hidalgo	$ 31,428.06
Venustiano Carranza	$ 6,805.74
Total	$ 487,716.28

8. Conclusions and discussion of results

The overall purpose of this investigation was to analyze the potential of installing several proper sized PV arrays in a megacity in the developing world as an alternative on the reliance of conventional electricity for pumping groundwater for domestic urban supply. Secondly, it aimed at taking Mexico City's 528 groundwater wells as a study case to determine the size and capacity of the system in order to assess if it is enough to cover the electricity needs for groundwater pumping. The third aim was to study if the investment in the system at such a large scale is financially realistic. Lastly, the fourth goal of this study was to explore the potential environmental benefits that the installation of a PV array system could generate.

By contemplating a 30-year duration scenario (2016-2045), this study found that the calculation of the PV array sizing displays that its installation is feasible from a capacity point of view. With an overall capacity of 204,104,250 watt-peak, the system would be able to cover the annual electricity needs of 299,595,632 kWh for the 528 public urban wells in Mexico City.

Furthermore, by calculating SACMEX's expenditure (at present value) on conventional energy in the next 30 years, it was revealed that 818,258,300 USD would potentially be spent annually only for pumping and distributing groundwater. Hence, if SACMEX considered investing in the installation of 647,950 panels, it would benefit from more than 800 million dollars in savings (over the 30-year period), and it would also profit from returning the potential daily surplus produced by the system to the electricity grid. By returning the potential surplus, SACMEX's could, on the one hand, possibly compensate its expenditure on conventional electricity, and on the other hand, sell the electricity to CFE, suggesting the possibility of receiving revenue. Moreover, SACMEX could potentially comply and profit from the clean energy certificates (CECs) implemented by the "Energy Reform". For every extra megawatt-hour of clean energy that the PV array system produced, SACMEX would be entitled to a CEC, entailing additional revenue that could be used to pay the debt for the PV array faster or pay back the use of conventional electricity (if any was required) (IEA 2017).

Next, from an economic point of view, with a system capacity of 204,104,250 watt-peak, the PV array cost would be of 571,491,900 USD. This study concludes that the investment is financially feasible considering that its net benefits of 247,330,880 USD over a time frame of 30 years, which is the approximate lifetime of the entire system. This means, that for every dollar invested, a net profit of almost 0.5 USD is obtained, adding up to the economic sustainability of the project. These net benefits would allow SACMEX to pay the investment in less time, and even to generate surpluses. In addition, with proven financial means, SACMEX could start to operate the system from year one. Ultimately, this investment would start to give back financial and environmental returns almost immediately.

Finally, from an environmental perspective, the installation of the PV arrays in the 16 municipalities that form Mexico City, would entail an annual reduction of 137,215 tons equivalent of CO_2. This reduction equals driving 26,655 average-size passenger vehicles for an entire year (EPA 2017). In addition to the environmental benefit, there is also a monetary value of lowering the overall emissions that groundwater pumping operations by SACMEX. Savings add up to almost half a million dollars (487,716 USD) every year and with prospective increases in its savings overtime. On top of this, on the one hand, Mexico City would contribute to the compliance national laws such as the “Energy Reform” which aims at producing 35% of the country’s energy with renewable energies by 2024. Likewise, the “General Law for Climate Change”, whose goal is to reduce greenhouse gas emissions by 30% by 2020 by below business-as-usual levels (IEA 2017). Ultimately, the reduction of CO_2 emissions that a single public institution can achieve (SACMEX) through its energy conversion, suggests that the public policy alternatives of the CDMX government to meet its goal of becoming a sustainable city are potentially feasible.

The results of this study indicate that from an economic and environmental perspective, Mexico City has the potential to start its energetic conversion from fossil-fuels to renewable energies in the pumping and supply part of the system. An initial bulky investment in PV arrays could allow SACMEX to generate enough electricity to cover the needs of each well, but it could also utilize its eventual revenues to invest in the remaining part of the SPVWPS system.

Moreover, the eventual elimination of electricity subsidies, should be one of the main drivers towards this transition. Also, this project would enhance compliance of national laws such as “Energy Reform” or the “General Law for Climate Change”. These laws state that Mexico as an upper-middle income country must reduce its greenhouse gas emissions by 30 percent by 2020 and 35 percent by 2024 below the business-as-usual levels (IEA 2017).

Finally, the constant decline in the cost of renewable energies like solar photovoltaic, should be an incentive for public and private entities. The IEA expects that market prices will drop 25 percent by 2021. Moreover, financing conditions for renewable energies are constantly improving, playing a key role in public and private investments. The global increase in energetic competition through public or private auctions If these trends are combined with supported by efficient policy making, technologic progress, research and development, and multilateral cooperation, the potential outcomes could be enhanced.

Bibliography

Baklanov, Alexander, Luisa T. Molina, and Michael Gauss. "Megacities, air quality and climate." *Atmospheric Environment* (ELSEVIER) 126 (February 2016): 235-49.

Chaib, Ahmed, Djalloul Achour, and Mohamed Kesraoui. "Control of a Solar PV/wind Hybrid Energy System." *Energy Procedia* (ELSEVIER) 95 (September 2016): 89-97.

Chandel, Rahul, S.S Chandel, and M. Nagaraju Naik. "Review of solar photovoltaic water pumping system technology for irrigation and community drinking water supplies." *Renewable and Sustainable Energy Reviews* (ELSEVIER) 49 (September 2015): 1084-1099.

ECOSOC. *Water, Megacities and Global Change.* Paris: United Nations Educational, Scientific and Cultural Organization, 2016.

EPA. *Environmental Protection Agency.* September 2017. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator (accessed July 23, 2018).

FAO. *Walking the Nexus Talk: Assessing the Water-Energy-Food Nexus in the Context of the Sustainable Energy for All Initiative.* Rome, 2014.

Farooqui, Tahueed A., Marguerite A. Renouf, and Steven J. Kenway. "A metabolism perspective on alternative urban water servicing options using water mass balance." *Water Research* (ELSEVIER) 106 (December 2016): 415-428.

Government of Mexico City. *Government of Mexico City.* 05 02, 2018. http://www.cdmx.gob.mx/gobierno/delegaciones (accessed 06 01, 2018).

Hernandez-Espiru, Antonio, et al. "The DRASTIC-Sg model: an extension to the DRASTIC approach for mapping groundwater vulnerability in aquifers subject to differential land subsidence, with application to Mexico City." *Hydrogeology Journal* 22, no. 6 (September 2014): 1469-1485.

IEA. *2016 Snapshot of Global Photovoltaic Markets.* PV Markets, Paris: International Energy Agency, 2016.

IEA. *Energy Policies Beyond IEA Countries: Mexico.* France: International Energy Agency, 2017.

IEA. *Technology Roadmap: Solar Photovoltaic Energy.* International Energy Agency, Paris: International Energy Agency, 2014.

IEA. *Water Energy Nexus.* Paris: OECD, 2016.

INEGI. *Instituto Nacional de Estadistica y Georgrafía.* 2015. http://cuentame.inegi.org.mx/monografias/informacion/df/poblacion/ (accessed August 29, 2017).

INERE. *Inventario Nacional de Energías Renovables.* Mexico, June 25, 2018.

Kalamkar, Vilas R., and Vimal Chand Sontake. "Solar photovoltaic water pumping system - A comprehensive review." *Renewable and Sustainable Energy Reviews* (ELSEVIER) 59 (June 2016): 1038 - 1067.

Lázaro, Lara. "La COP21 y el acuerdo de París: Una clase magistral en diplomacia en busca de mayor ambición." *Papeles de Europa* 29, no. 2 (April 2017): 54-68.

Morales-Novelo, Jorge A., and Lilia Rodriguez-Tapia. "Bacterial Pollution in River Waters and Gastrointestinal Diseases." *International Journal of Environmental Research and Public Health* (MDPI) 14, no. 5 (May 2017): 1-11.

Morales-Novelo, Jorge A., Daniel A. Revollo-Fernandez, and Lilia Rodriguez-Tapia. "Household's Perception of Water Quality and Willingness to Pay for Clean Water in Mexico City." *Economies* (MDPI) 5, no. 2 (April 2017): 1-15.

Moredia Valek , Adrián, Janez Susnik, and Stelios Grafakos. "Quantification of the urban water-energy nexus in México City, México, with an assessment of water-system related carbon emissions." *Science of the Total Environment* (ELSEVIER) 590-591 (July 2017): 258-268.

Mundo-Hernandez, Julia, Benito de Celis Alonso, Julia Hernandez-Alvarez, and Benito de Celis-Carrillo. "An overview of solar photovoltaic energy in Mexico and Germany." *Renewable and Sustainable Energy Reviews* (ELSEVIER) 31 (March 2014): 639-649.

Olli, Varis. "Megacities, Development and Water." *International Journal of Water Resources Development* 22, no. 2 (2006): 199-225.

Olsson, Gustaf. *Water and Energy: Threats and Opportunities.* London: IWA Publishing, 2012.

Peña, Francisco Javier Patiño, interview by Liliana Morales Rodriguez. *Water pumping from wells in Mexico City*Translated by Liliana Morales Rodriguez. N/A, (May 15, 2017).

Pérez-Denicia, Eduardo, Fabián Fernández-Luqueñob, Darnes Vilariño-Ayala, Luis Manuel Montaño-Zetina, and Luis Alfonso Maldonado-López. "Renewable energy sources for electricity generation in Mexico: A review." *Renewable and Sustainable Energy Review* (ELSEVIER) 78 (2017): 597-613.

Population Reference Bureau. "Statista." *Statista - The Statistics Portal.* August -, 2017. https://www.statista.com/statistics/270860/urbanization-by-continent/. (accessed September 06, 2017).

Ramos Leal, Jose Alfredo, C Noyola Medrano, and F.O Tapia Silva. "Aquifer vulnerability and groundwater quality in megacities: case of the Mexico Basin." *Environmental Earth Sciences* 61, no. 6 (September 2010): 1309-1320.

SACMEX. *Mexico City's Groundwater Well Database*. Mexico City: Sistema de Aguas de la Ciudad de México, 2017.

SENER. *Prospectiva de Energías Renovables.* Mexico City: Mexican Government, 2016.

Sistema Europeo de Negociación de CO2. *SENDECO2.* - -, 2017. http://www.sendeco2.com/es/precios-co2 (accessed 09 15, 2017).

Tortajada, Cecilia, and Enrique Castelán. "Water Management for a Megacity: Mexico City Metropolitan Area." *AMBIO: A Journal of the Human Environment* (Royal Swedish Academy of Sciences) 32, no. 2 (March 2003): 124-129.

UN DESA. "Projected Population Living in The Top Ten Megacities in 2030 (in Thousands)." *Statista - The Statistics Portal.* July -, 2014. www.statista.com/statistics/672502/top-ten-most-populous-megcities-worldwide/ (accessed September 06, 2017).

UNCED. *The Rio Declaration on Environment and Development.* Geneva: United Nations Conference on Environmental Development, 1992.

Undersecretary of Electricity. *Informe Pormenorizado del Desempeño y las Tendencias de la Industria Eléctrica.* Mexico City: SENER, 2014.

UNESCO. *Water, Megacities & Global Change.* Paris: United Nations Educational, Scientific, and Cultural Organization, 2016.

UNFCCC. *Paris Agreement.* Agreement, Paris: United Nations, 2015.

US Geological Survey. "Statista - The Statistics Portal." *Distribution of Earth's Global Water Resources.* 1993. www.statista.com/statistics/564724/distribution-of-earths-water-resources (accessed 10 2017, 02).

Wen, Hua, Lijin Zhong, Xiaotian Fu, and Simon Spooner. *Water Energy Nexus in Urban Water Source Selection: A Case Study from Qingdao.* Qingdao: World Resources Institute, 2017.

Wenzel, Friedmann, Fouad Bendimerad, and Ravi Sinha. "Megacities - megarisks." *Natural Hazards* (Kluwer Academic Publishers) 42, no. 3 (September 2007): 481-491.

World Bank. *Mexico seeks to adapt to climate change and mitigate its effects.* April 17, 2013. http://www.worldbank.org/en/results/2013/04/17/mexico-seeks-to-adapt-to-climate-change-and-mitigate-its-effects (accessed July 2018, 15).

World Bank. *Water and Climate Change: Understanding the Risks and Making Climate-Smart Investment Decisions.* World Bank, 2009.

WWAP. *The United Nations World Water Development Report 2014: Water and Energy.* Paris: UNESCO, 2014.

Zaini, Nur Hazirah, et al. "Lightning Surge Analysis on a Large Scale Grid-Connected Solar Photovoltaic System." *Energies* (MDPI) 10, no. 12 (December 2017): 2149.

List of Tables

List of Figures

List of Annexes

Annex 1: Calculation of the PV array and capacity per municipality

Municipality	Number of wells	Water flow (m3/y)	Electric energy consumption per well WH/y	Electric energy consumption per well per day (divided by 365). WH/d	Insolation 5.6 h/d	Insolation per day per well: WH/d / insolation 5.6 : in WATTS	Insolation divided by temperature loss (.88). Result in **WATTS**	Temperature loss divided by general network factor (.84). **Result in WATTS**	Network factor divided by investment effect (.96). Result in **Watts**	Investment effect divided by security factor (1%). **Result in Watts**	Each module provides up to 315W	Amount of modules	Estimated area if each module size is 2.1. **In m2**	Capacity of the PV system **Watt Peak**
Azcapotzalco	34	31,945,968.00	18,138,321,409.60	49,694,031.26	5.6	8,873,934.15	10,084,016.08	12,004,781.05	12,504,980.26	12,379,930.46	315.00	39,317.00	82,565.70	12,384,855.00
Coyoacán	84	64,245,139.20	46,590,134,606.40	125,815,492.07	5.6	22,467,052.16	25,530,741.09	30,393,739.39	31,660,145.20	31,343,543.74	315.00	99,540.00	209,034.00	31,355,100.00
Cuajimalpa de Morelo	2	1,072,224.00	800,810,000.00	2,194,000.00	5.6	391,785.71	445,211.04	530,013.14	552,097.02	546,576.05	315.00	1,737.00	3,647.70	547,155.00
Gustavo A. Madero	3	5,014,224.00	1,960,237,449.60	5,370,513.56	5.6	959,020.28	1,089,795.77	1,297,375.92	1,351,433.25	1,337,918.92	315.00	4,249.00	8,922.90	1,338,435.00
Iztacalco	9	9,145,440.00	5,565,841,000.00	15,248,879.45	5.6	2,723,014.19	3,094,334.30	3,683,731.31	3,837,220.12	3,798,847.92	315.00	12,065.00	25,336.50	3,800,475.00
Iztapalapa	78	143,110,368.00	46,402,209,313.60	127,129,340.59	5.6	22,701,667.96	25,797,349.96	30,711,130.90	31,990,761.35	31,670,853.74	315.00	100,579.00	211,215.90	31,682,385.00
Magdalena Contreras	6	2,144,448.00	3,709,128,000.00	10,161,994.52	5.6	1,814,641.88	2,062,093.04	2,454,872.67	2,557,159.03	2,531,587.44	315.00	8,040.00	16,884.00	2,532,600.00
Milpa Alta	21	25,733,376.00	13,105,294,513.60	35,904,916.48	5.6	6,411,592.23	7,285,900.26	8,673,690.78	9,035,094.57	8,944,743.62	315.00	28,407.00	59,654.70	8,948,205.00
Alvaro Obregón	37	16,903,296.00	12,507,735,700.00	34,267,769.04	5.6	6,119,244.47	6,953,686.90	8,278,198.69	8,623,123.64	8,536,892.40	315.00	27,115.00	56,941.50	8,541,225.00
Tláhuac	16	17,187,120.00	9,851,076,216.00	26,989,249.91	5.6	4,819,508.91	5,476,714.67	6,519,898.42	6,791,560.85	6,723,645.25	315.00	21,352.00	44,839.20	6,725,880.00
Tlalpan	89	96,279,408.00	48,821,869,041.60	133,758,545.32	5.6	23,885,454.52	27,142,561.96	32,312,573.76	33,658,931.00	33,322,341.69	315.00	105,828.00	222,238.80	33,335,820.00
Xochimilco	81	89,183,808.00	49,364,072,025.60	135,244,032.95	5.6	24,150,720.17	27,444,000.19	32,671,428.80	34,032,738.33	33,692,410.95	315.00	106,999.00	224,697.90	33,704,685.00
Benito Juárez	26	24,030,432.00	14,600,505,062.40	40,001,383.73	5.6	7,143,104.24	8,117,163.91	9,663,290.37	10,065,927.46	9,965,268.19	315.00	31,647.00	66,458.70	9,968,805.00
Cuauhtémoc	6	4,036,608.00	4,692,039,481.60	12,854,902.69	5.6	2,295,518.34	2,608,543.57	3,105,409.01	3,234,801.05	3,202,453.04	315.00	10,169.00	21,354.90	3,203,235.00
Miguel Hidalgo	29	25,474,780.80	19,305,709,000.00	52,892,353.42	5.6	9,445,063.11	10,733,026.26	12,777,412.22	13,309,804.39	13,176,706.35	315.00	41,845.00	87,874.50	13,181,175.00
Venustiano Carranza	7	4,194,288.00	4,180,649,512.00	11,453,834.28	5.6	2,045,327.55	2,324,235.85	2,766,947.44	2,882,236.92	2,853,414.55	315.00	9,061.00	19,028.10	2,854,215.00
TOTAL	528	559,700,928.00	299,595,632,332.00	818,981,239.27		146,246,649.87	166,189,374.85	197,844,493.87	206,088,014.45	204,027,134.30		647,950.00	1,360,695.00	204,104,250.00

Annex 2: Overview of 528 public urban wells in Mexico City.

DATA INPUT						CALCULATION														
Code	Municipality	Well #	Use	Water flow (m3/y)	Electric energy consumption per well (kWh/y)	Electric energy consumption per well (Wh/y)	Electric energy consumption per well per day (Wh/d)	Insolation (h/d)	Insolation per day per well (Wh/d)	Insolation divided by temperature loss (0.88) (W)	Temperature loss divided by general network factor (0.84). (W)	Network factor divided by investment effect (0.96) (W)	Investment effect divided by security factor (1%)	Maximum power per panel (W)	Amount of modules	Total area if module size = 2.1m² (m²)	Capacity of the PV system (Wp)	Capacity of the PV system (kWp)	Price per watt (USD/W)	Estimated Sale Value (USD + VAT)
002	Azcapotzalco	1	Public Urban	1,576,800.00	853,729.00	853,729,000.00	2,338,983.56	5.6	417,675.64	474,631.40	565,037.39	588,580.61	582,694.80	315	1850	3885	582,750.00	582.75	$ 2.80	$ 1,631,700.00
002	Azcapotzalco	2	Public Urban	1,545,264.00	749,298.51	749,298,513.60	2,052,872.64	5.6	366,584.40	416,573.18	495,920.45	516,583.81	511,417.97	315	1624	3410.4	511,560.00	511.56	$ 2.80	$ 1,432,368.00
002	Azcapotzalco	3	Public Urban	FO		-	-	5.6	-	-	-	-	-	315	0	0	-	0	$ 2.80	$ -
002	Azcapotzalco	4	Public Urban	FO		-	-	5.6	-	-	-	-	-	315	0	0	-	0	$ 2.80	$ -
002	Azcapotzalco	5	Public Urban	1,829,088.00	840,470.00	840,470,000.00	2,302,657.53	5.6	411,188.85	467,260.05	556,261.97	579,439.55	573,645.15	315	1822	3826.2	573,930.00	573.93	$ 2.80	$ 1,607,004.00
002	Azcapotzalco	6	Public Urban	1,766,016.00	726,190.00	726,190,000.00	1,989,561.64	5.6	355,278.86	403,725.98	480,626.17	500,652.26	495,645.74	315	1574	3305.4	495,810.00	495.81	$ 2.80	$ 1,388,268.00
002	Azcapotzalco	7	Public Urban	662,256.00	321,127.93	321,127,934.40	879,802.56	5.6	157,107.60	178,531.36	212,537.34	221,393.06	219,179.13	315	696	1461.6	219,240.00	219.24	$ 2.80	$ 613,872.00
002	Azcapotzalco	8	Public Urban	1,608,336.00	1,591,720.00	1,591,720,000.00	4,360,876.71	5.6	778,727.98	884,918.16	1,053,474.00	1,097,368.75	1,086,395.07	315	3449	7242.9	1,086,435.00	1086.435	$ 2.80	$ 3,042,018.00
002	Azcapotzalco	9	Public Urban	2,018,304.00	13,329.00	13,329,000.00	36,517.81	5.6	6,521.04	7,410.27	8,821.75	9,189.32	9,097.43	315	29	60.9	9,135.00	9.135	$ 2.80	$ 25,578.00
002	Azcapotzalco	10	Public Urban	1,040,688.00	516,950.00	516,950,000.00	1,416,301.37	5.6	252,910.96	287,398.82	342,141.45	356,397.34	352,833.37	315	1121	2354.1	353,115.00	353.115	$ 2.80	$ 988,722.00
002	Azcapotzalco	11	Public Urban	1,860,624.00	280,570.00	280,570,000.00	768,684.93	5.6	137,265.17	155,983.14	185,694.22	193,431.48	191,497.16	315	608	1276.8	191,520.00	191.52	$ 2.80	$ 536,256.00
002	Azcapotzalco	12	Public Urban	851,472.00	401,140.00	401,140,000.00	1,099,013.70	5.6	196,252.45	223,014.14	265,493.03	276,555.24	273,789.68	315	870	1827	274,050.00	274.05	$ 2.80	$ 767,340.00
002	Azcapotzalco	13	Public Urban	378,432.00	387,710.00	387,710,000.00	1,062,219.18	5.6	189,682.00	215,547.72	256,604.43	267,296.28	264,623.32	315	841	1766.1	264,915.00	264.915	$ 2.80	$ 741,762.00
002	Azcapotzalco	14	Public Urban	1,261,440.00	661,485.00	661,485,000.00	1,812,287.67	5.6	323,622.80	367,753.18	437,801.40	456,043.13	451,482.70	315	1434	3011.4	451,710.00	451.71	$ 2.80	$ 1,264,788.00
002	Azcapotzalco	15	Public Urban	1,040,688.00	230,610.00	230,610,000.00	631,808.22	5.6	112,822.90	128,207.84	152,628.38	158,987.89	157,398.01	315	500	1050	157,500.00	157.5	$ 2.80	$ 441,000.00
002	Azcapotzalco	16	Public Urban	473,040.00	760,000.00	760,000,000.00	2,082,191.78	5.6	371,819.96	422,522.68	503,003.19	523,961.66	518,722.04	315	1647	3458.7	518,805.00	518.805	$ 2.80	$ 1,452,654.00
002	Azcapotzalco	17	Public Urban	1,702,944.00	894,438.00	894,438,000.00	2,450,515.07	5.6	437,591.98	497,263.61	591,980.49	616,646.34	610,479.88	315	1939	4071.9	610,785.00	610.785	$ 2.80	$ 1,710,198.00
002	Azcapotzalco	18	Public Urban	662,256.00	10,940.00	10,940,000.00	29,972.60	5.6	5,352.25	6,082.10	7,240.60	7,542.29	7,466.87	315	24	50.4	7,560.00	7.56	$ 2.80	$ 21,168.00
002	Azcapotzalco	19	Public Urban	1,135,296.00	679,108.00	679,108,000.00	1,860,569.86	5.6	332,244.62	377,550.70	449,465.12	468,192.84	463,510.91	315	1472	3091.2	463,680.00	463.68	$ 2.80	$ 1,298,304.00
002	Azcapotzalco	20	Public Urban	1,545,264.00	749,298.51	749,298,513.60	2,052,872.64	5.6	366,584.40	416,573.18	495,920.45	516,583.81	511,417.97	315	1624	3410.4	511,560.00	511.56	$ 2.80	$ 1,432,368.00
002	Azcapotzalco	21	Public Urban	1,040,688.00	395,990.00	395,990,000.00	1,084,904.11	5.6	193,732.88	220,151.00	262,084.52	273,004.71	270,274.66	315	859	1803.9	270,585.00	270.585	$ 2.80	$ 757,638.00
002	Azcapotzalco	22	Public Urban	FO	273,675.00	273,675,000.00	749,794.52	5.6	133,891.88	152,149.86	181,130.79	188,677.90	186,791.13	315	593	1245.3	186,795.00	186.795	$ 2.80	$ 523,026.00
002	Azcapotzalco	23	Public Urban	1,766,016.00	655,060.00	655,060,000.00	1,794,684.93	5.6	320,479.45	364,181.20	433,549.04	451,613.59	447,097.45	315	1420	2982	447,300.00	447.3	$ 2.80	$ 1,252,440.00
002	Azcapotzalco	24	Public Urban	788,400.00	685,088.00	685,088,000.00	1,876,953.42	5.6	335,170.25	380,875.29	453,422.96	472,315.59	467,592.43	315	1485	3118.5	467,775.00	467.775	$ 2.80	$ 1,309,770.00
002	Azcapotzalco	25	Public Urban	FO	604,290.00	604,290,000.00	1,655,589.04	5.6	295,640.90	335,955.57	399,947.11	416,611.57	412,445.45	315	1310	2751	412,650.00	412.65	$ 2.80	$ 1,155,420.00
002	Azcapotzalco	26	Public Urban	1,545,264.00	749,298.51	749,298,513.60	2,052,872.64	5.6	366,584.40	416,573.18	495,920.45	516,583.81	511,417.97	315	1624	3410.4	511,560.00	511.56	$ 2.80	$ 1,432,368.00
002	Azcapotzalco	27	Public Urban	FO	704,129.00	704,129,000.00	1,929,120.55	5.6	344,485.81	391,461.15	466,025.18	485,442.89	480,588.47	315	1526	3204.6	480,690.00	480.69	$ 2.80	$ 1,345,932.00
002	Azcapotzalco	28	Public Urban	725,328.00	967,590.00	967,590,000.00	2,650,931.51	5.6	473,380.63	537,932.53	640,395.87	667,079.03	660,408.24	315	2097	4403.7	660,555.00	660.555	$ 2.80	$ 1,849,554.00
002	Azcapotzalco	29	Public Urban	1,072,224.00	513,240.00	513,240,000.00	1,406,136.99	5.6	251,095.89	285,336.24	339,686.00	353,839.58	350,301.19	315	1113	2337.3	350,595.00	350.595	$ 2.80	$ 981,666.00
002	Azcapotzalco	30	Public Urban	1,387,584.00	439,570.00	439,570,000.00	1,204,301.37	5.6	215,053.82	244,379.34	290,927.78	303,049.77	300,019.27	315	953	2001.3	300,195.00	300.195	$ 2.80	$ 840,546.00
002	Azcapotzalco	31	Public Urban	662,256.00	321,127.93	321,127,934.40	879,802.56	5.6	157,107.60	178,531.36	212,537.34	221,393.06	219,179.13	315	696	1461.6	219,240.00	219.24	$ 2.80	$ 613,872.00
002	Azcapotzalco	32	Public Urban	FO	433,590.00	433,590,000.00	1,187,917.81	5.6	212,128.18	241,054.75	286,969.94	298,927.02	295,937.75	315	940	1974	296,100.00	296.1	$ 2.80	$ 829,080.00
002	Azcapotzalco	33	Public Urban	FO	7,349.00	7,349,000.00	20,134.25	5.6	3,595.40	4,085.68	4,863.91	5,066.57	5,015.91	315	16	33.6	5,040.00	5.04	$ 2.80	$ 14,112.00
002	Azcapotzalco	34	Public Urban	FO	720,210.00	720,210,000.00	1,973,178.08	5.6	352,353.23	400,401.40	476,668.33	496,529.51	491,564.21	315	1561	3278.1	491,715.00	491.715	$ 2.80	$ 1,376,802.00
003	Coyoacán	1	Public Urban	RE	RE			5.6	0.00	-	-	-	-	315	0	0	0	0	$ 2.80	$ -
003	Coyoacán	2	Public Urban	1040688.00	667480.00	667,480,000.00	-	5.6	0.00	-	-	-	-	315	0	0	0	0	$ 2.80	$ -
003	Coyoacán	3	Public Urban	409968.00	236130.00	236,130,000.00	646,931.51	5.6	115523.48	131,276.69	156,281.77	162,793.51	161,165.57	315	512	1075.2	161280	161.28	$ 2.80	$ 451,584.00
003	Coyoacán	4	Public Urban	788400.00	16460.00	16,460,000.00	45,095.89	5.6	8052.84	9,150.95	10,893.99	11,347.91	11,234.43	315	36	75.6	11340	11.34	$ 2.80	$ 31,752.00
003	Coyoacán	5	Public Urban	RE	656570.00	656,570,000.00	1,798,821.92	5.6	321218.20	365,020.68	434,548.43	452,654.61	448,128.07	315	1423	2988.3	448245	448.245	$ 2.80	$ 1,255,086.00
003	Coyoacán	6	Public Urban	1261440.00	665810.00	665,810,000.00	1,824,136.99	5.6	325738.75	370,157.67	440,663.89	459,024.89	454,434.64	315	1443	3030.3	454545	454.545	$ 2.80	$ 1,272,726.00
003	Coyoacán	7	Public Urban	1292976.00	675600.00	675,600,000.00	1,850,958.90	5.6	330528.38	375,600.43	447,143.37	465,774.34	461,116.60	315	1464	3074.4	461160	461.16	$ 2.80	$ 1,291,248.00
003	Coyoacán	8	Public Urban	851472.00	859249.00	859,249,000.00	2,354,106.85	5.6	420376.22	477,700.25	568,690.78	592,386.23	586,462.36	315	1862	3910.2	586530	586.53	$ 2.80	$ 1,642,284.00
003	Coyoacán	9	Public Urban	883008.00	430680.00	430,680,000.00	1,179,945.21	5.6	210704.50	239,436.93	285,043.97	296,920.80	293,951.59	315	934	1961.4	294210	294.21	$ 2.80	$ 823,788.00
003	Coyoacán	10	Public Urban	662256.00	731710.00	731,710,000.00	2,004,684.93	5.6	357979.45	406,794.83	484,279.56	504,457.88	499,413.30	315	1586	3330.6	499590	499.59	$ 2.80	$ 1,398,852.00
003	Coyoacán	11	Public Urban	977616.00	660580.00	660,580,000.00	1,809,808.22	5.6	323180.04	367,250.04	437,202.43	455,419.20	450,865.01	315	1432	3007.2	451080	451.08	$ 2.80	$ 1,263,024.00
003	Coyoacán	12	Public Urban	RH	1582330.00	1,582,330,000.00	4,335,150.68	5.6	774,134.05	879,697.79	1,047,259.27	1,090,895.07	1,079,986.12	315	3429	7200.9	1080135	1080.135	$ 2.80	$ 3,024,378.00
003	Coyoacán	13	Public Urban	567648.00	401510.00	401,510,000.00	1,100,027.40	5.6	196,433.46	223,219.85	265,737.91	276,810.32	274,042.22	315	870	1827	274050	274.05	$ 2.80	$ 767,340.00
003	Coyoacán	14	Public Urban	567648.00	524740.00	524,740,000.00	1,437,643.84	5.6	256,722.11	291,729.67	347,297.23	361,767.95	358,150.27	315	1137	2387.7	358155	358.155	$ 2.80	$ 1,002,834.00
003	Coyoacán	15	Public Urban	851472.00	978840.00	978,840,000.00	2,681,753.42	5.6	478,884.54	544,186.98	647,841.64	674,835.04	668,086.69	315	2121	4454.1	668115	668.115	$ 2.80	$ 1,870,722.00
003	Coyoacán	16	Public Urban	RE	396450.00	396,450,000.00	1,086,164.38	5.6	193,957.93	220,406.73	262,388.97	273,321.84	270,588.62	315	860	1806	270900	270.9	$ 2.80	$ 758,520.00
003	Coyoacán	17	Public Urban	RE	RE		-	5.6	-	-	-	-	-	315	0	0	0	0	$ 2.80	$ -
003	Coyoacán	18	Public Urban	756864.00	19690.00	19,690,000.00	53,945.21	5.6	9,633.07	10,946.67	13,031.75	13,574.74	13,439.00	315	43	90.3	13545	13.545	$ 2.80	$ 37,926.00
003	Coyoacán	19	Public Urban	220752.00	4939.00	4,939,000.00	13,531.51	5.6	2,416.34	2,745.84	3,268.86	3,405.06	3,371.01	315	11	23.1	3465	3.465	$ 2.80	$ 9,702.00
003	Coyoacán	20	Public Urban	2932848.00	522470.00	522,470,000.00	1,431,424.66	5.6	255,611.55	290,467.67	345,794.84	360,202.96	356,600.93	315	1133	2379.3	356895	356.895	$ 2.80	$ 999,306.00
003	Coyoacán	21	Public Urban	693792.00	653380.00	653,380,000.00	1,790,082.19	5.6	319,657.53	363,247.20	432,437.14	450,455.35	445,950.80	315	1416	2973.6	446040	446.04	$ 2.80	$ 1,248,912.00
003	Coyoacán	22	Public Urban	69379.20	677428.00	677,428,000.00	1,855,967.12	5.6	331,422.70	376,616.71	448,353.22	467,034.60	462,364.26	315	1468	3082.8	462420	462.42	$ 2.80	$ 1,294,776.00
003	Coyoacán	23	Public Urban	FO	FO		-	5.6	-	-	-	-	-	315	0	0	0	0	$ 2.80	$ -
003	Coyoacán	24	Public Urban	1103760.00	668400.00	668,400,000.00	1,831,232.88	5.6	327,005.87	371,597.58	442,378.07	460,810.49	456,202.39	315	1449	3042.9	456435	456.435	$ 2.80	$ 1,278,018.00
003	Coyoacán	25	Public Urban	662256.00	852049.00	852,049,000.00	2,334,380.82	5.6	416,853.72	473,697.41	563,925.48	587,422.38	581,548.16	315	1847	3878.7	581805	581.805	$ 2.80	$ 1,629,054.00
003	Coyoacán	26	Public Urban	883008.00	669710.00	669,710,000.00	1,834,821.92	5.6	327,646.77	372,325.88	443,245.09	461,713.64	457,096.50	315	1452	3049.2	457380	457.38	$ 2.80	$ 1,280,664.00
003	Coyoacán	27	Public Urban	662256.00	609810.00	609,810,000.00	1,670,712.33	5.6	298,341.49	339,024.42	403,600.50	420,417.18	416,213.01	315	1322	2776.2	416430	416.43	$ 2.80	$ 1,166,004.00
003	Coyoacán	28	Public Urban	1009152.00	765520.00	765,520,000.00	2,097,315.07	5.6	374,520.55	425,591.53	506,656.59	527,767.28	522,489.60	315	1659	3483.9	522585	522.585	$ 2.80	$ 1,463,238.00
003	Coyoacán	29	Public Urban	725328.00	793014.00	793,014,000.00	2,172,641.10	5.6	387,971.62	440,876.85	524,853.39	546,722.28	541,255.06	315	1719	3609.9	541485	541.485	$ 2.80	$ 1,516,158.00
003	Coyoacán	30	Public Urban	2049840.00	1597240.00	1,597,240,000.00	4,376,000.00	5.6	781,428.57	887,987.01	1,057,127.40	1,101,174.37	1,090,162.63	315	3461	7268.1	1090215	1090.215	$ 2.80	$ 3,052,602.00
003	Coyoacán	31	Public Urban	1292976.00	690608.00	690,608,000.00	1,892,076.71	5.6	337,870.84	383,944.14	457,076.35	476,121.20	471,359.99	315	1497	3143.7	471555	471.555	$ 2.80	$ 1,320,354.00
003	Coyoacán	32	Public Urban	630720.00	516490.00	516,490,000.00	1,415,041.10	5.6	252,685.91	287,143.08	341,837.00	356,080.21	352,519.41	315	1120	2352	352800	352.8	$ 2.80	$ 987,840.00
003	Coyoacán	33	Public Urban	725328.00	280110.00	280,110,000.00	767,424.66	5.6	137,040.12	155,727.41	185,389.77	193,114.34	191,183.20	315	607	1274.7	191205	191.205	$ 2.80	$ 535,374.00
003	Coyoacán	34	Public Urban	1040688.00	228930.00	228,930,000.00	627,205.48	5.6	112,000.98	127,273.84	151,516.48	157,829.66	156,251.37	315	497	1043.7	156555	156.555	$ 2.80	$ 438,354.00
003	Coyoacán	35	Public Urban	1292976.00	718530.00	718,530,000.00	1,968,575.34	5.6	351,531.31	399,467.40	475,556.43	495,371.28	490,417.57	315	1557	3269.7	490455	490.455	$ 2.80	$ 1,373,274.00
003	Coyoacán	36	Public Urban	346896.00	518760.00	518,760,000.00	1,421,260.27	5.6	253,796.48	288,405.09	343,339.39	357,645.20	354,068.75	315	1125	2362.5	354375	354.375	$ 2.80	$ 992,250.00
003	Coyoacán	37	Public Urban	31536.00	11894.00	11,894,000.00	32,586.30	5.6	5,818.98	6,612.48	7,872.00	8,200.00	8,118.00	315	26	54.6	8190	8.19	$ 2.80	$ 22,932.00

003	Coyoacán	38	Public Urban	220752.00	893978.00	893,978,000.00	2,449,254.79	5.6	437,366.93	497,007.87	591,676.04	616,329.21	610,165.91	315	1938	4069.8	610470	610.47	$	2.80	$ 1,709,316.00
003	Coyoacán	39	Public Urban	1135296.00	273680.00	273,680,000.00	749,808.22	5.6	133,894.32	152,152.64	181,134.10	188,681.35	186,794.54	315	593	1245.3	186795	186.795	$	2.80	$ 523,026.00
003	Coyoacán	40	Public Urban	FO	FO		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
003	Coyoacán	41	Public Urban	1702944.00	582650.00	582,650,000.00	1,596,301.37	5.6	285,053.82	323,924.79	385,624.75	401,692.45	397,675.52	315	1263	2652.3	397845	397.845	$	2.80	$ 1,113,966.00
003	Coyoacán	42	Public Urban	1292976.00	780584.00	780,584,000.00	2,138,586.30	5.6	381,890.41	433,966.38	516,626.64	538,152.75	532,771.22	315	1692	3553.2	532980	532.98	$	2.80	$ 1,492,344.00
003	Coyoacán	43	Public Urban	1229904.00	753590.00	753,590,000.00	2,064,630.14	5.6	368,683.95	418,959.04	498,760.76	519,542.46	514,347.03	315	1633	3429.3	514395	514.395	$	2.80	$ 1,440,306.00
003	Coyoacán	44	Public Urban	819936.00	397586.97	397,586,966.40	1,089,279.36	5.6	194,514.17	221,038.83	263,141.47	274,105.69	271,364.64	315	862	1810.2	271530	271.53	$	2.80	$ 760,284.00
003	Coyoacán	45	Public Urban	1324512.00	642255.87	642,255,868.80	1,759,605.12	5.6	314,215.20	357,062.73	425,074.68	442,786.12	438,358.26	315	1392	2923.2	438480	438.48	$	2.80	$ 1,227,744.00
003	Coyoacán	46	Public Urban	819936.00	445090.00	445,090,000.00	1,219,424.66	5.6	217,754.40	247,448.19	294,581.17	306,855.39	303,786.83	315	965	2026.5	303975	303.975	$	2.80	$ 851,130.00
003	Coyoacán	47	Public Urban	1702944.00	595580.00	595,580,000.00	1,631,726.03	5.6	291,379.65	331,113.24	394,182.42	410,606.69	406,500.62	315	1291	2711.1	406665	406.665	$	2.80	$ 1,138,662.00
003	Coyoacán	48	Public Urban	1419120.00	717560.00	717,560,000.00	1,965,917.81	5.6	351,056.75	398,928.13	474,914.44	494,702.54	489,755.51	315	1555	3265.5	489825	489.825	$	2.80	$ 1,371,510.00
003	Coyoacán	49	Public Urban	FO	394750.00	394,750,000.00	1,081,506.85	5.6	193,126.22	219,461.62	261,263.83	272,149.82	269,428.32	315	856	1797.6	269640	269.64	$	2.80	$ 754,992.00
003	Coyoacán	50	Public Urban	409968.00	709649.00	709,649,000.00	1,944,243.84	5.6	347,186.40	394,530.00	469,678.57	489,248.51	484,356.03	315	1538	3229.8	484470	484.47	$	2.80	$ 1,356,516.00
003	Coyoacán	51	Public Urban	946080.00	684628.00	684,628,000.00	1,875,693.15	5.6	334,945.21	380,619.55	453,118.51	471,998.45	467,278.47	315	1484	3116.4	467460	467.46	$	2.80	$ 1,308,888.00
003	Coyoacán	52	Public Urban	1419120.00	679830.00	679,830,000.00	1,862,547.95	5.6	332,597.85	377,952.10	449,942.98	468,690.60	464,003.69	315	1474	3095.4	464310	464.31	$	2.80	$ 1,300,068.00
003	Coyoacán	53	Public Urban	914544.00	899958.00	899,958,000.00	2,465,638.36	5.6	440,292.56	500,332.46	595,633.88	620,451.96	614,247.44	315	1950	4095	614250	614.25	$	2.80	$ 1,719,900.00
003	Coyoacán	54	Public Urban	756864.00	973110.00	973,110,000.00	2,666,054.79	5.6	476,081.21	541,001.38	644,049.26	670,884.65	664,175.80	315	2109	4428.9	664335	664.335	$	2.80	$ 1,860,138.00
003	Coyoacán	55	Public Urban	693792.00	406660.00	406,660,000.00	1,114,136.99	5.6	198,953.03	226,082.99	269,146.42	280,360.85	277,557.25	315	882	1852.2	277830	277.83	$	2.80	$ 777,924.00
003	Coyoacán	56	Public Urban	725328.00	393230.00	393,230,000.00	1,077,342.47	5.6	192,382.58	218,616.57	260,257.82	271,101.90	268,390.88	315	853	1791.3	268695	268.695	$	2.80	$ 752,346.00
003	Coyoacán	57	Public Urban	RE	RE		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
003	Coyoacán	58	Public Urban	504576.00	244668.90	244,668,902.40	670,325.76	5.6	119,701.03	136,023.90	161,933.21	168,680.43	166,993.62	315	531	1115.1	167265	167.265	$	2.80	$ 468,342.00
003	Coyoacán	59	Public Urban	RE	RE		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
003	Coyoacán	60	Public Urban	RE	RE		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
003	Coyoacán	61	Public Urban	RE	RE		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
003	Coyoacán	62	Public Urban	RE	850839.00	850,839,000.00	2,331,065.75	5.6	416,261.74	473,024.71	563,124.65	586,588.18	580,722.30	315	1844	3872.4	580860	580.86	$	2.80	$ 1,626,408.00
003	Coyoacán	63	Public Urban	RE	RE		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
003	Coyoacán	64	Public Urban	977616.00	725730.00	725,730,000.00	1,988,301.37	5.6	355,053.82	403,470.25	480,321.72	500,335.13	495,331.77	315	1573	3303.3	495495	495.495	$	2.80	$ 1,387,386.00
003	Coyoacán	65	Public Urban	1734480.00	1591260.00	1,591,260,000.00	4,359,616.44	5.6	778,502.94	884,662.43	1,053,169.56	1,097,051.62	1,086,081.10	315	3448	7240.8	1086120	1086.12	$	2.80	$ 3,041,136.00
003	Coyoacán	66	Public Urban	RE	758320.00	758,320,000.00	2,077,589.04	5.6	370,998.04	421,588.69	501,891.29	522,803.43	517,575.39	315	1644	3452.4	517860	517.86	$	2.80	$ 1,450,008.00
003	Coyoacán	67	Public Urban	RE	785814.00	785,814,000.00	2,152,915.07	5.6	384,449.12	436,874.00	520,088.09	541,758.43	536,340.85	315	1703	3576.3	536445	536.445	$	2.80	$ 1,502,046.00
003	Coyoacán	68	Public Urban	1671408.00	771500.00	771,500,000.00	2,113,698.63	5.6	377,446.18	428,916.12	510,614.43	531,890.03	526,571.13	315	1672	3511.2	526680	526.68	$	2.80	$ 1,474,704.00
003	Coyoacán	69	Public Urban	1356048.00	399460.00	399,460,000.00	1,094,410.96	5.6	195,430.53	222,080.15	264,381.13	275,397.01	272,643.04	315	866	1818.6	272790	272.79	$	2.80	$ 763,812.00
003	Coyoacán	70	Public Urban	1135296.00	828580.00	828,580,000.00	2,270,082.19	5.6	405,371.82	460,649.80	548,392.61	571,242.31	565,529.88	315	1796	3771.6	565740	565.74	$	2.80	$ 1,584,072.00
003	Coyoacán	71	Public Urban	220752.00	965910.00	965,910,000.00	2,646,328.77	5.6	472,558.71	536,998.53	639,283.97	665,920.80	659,261.59	315	2093	4395.3	659295	659.295	$	2.80	$ 1,846,026.00
003	Coyoacán	72	Public Urban	157680.00	511560.00	511,560,000.00	1,401,534.25	5.6	250,273.97	284,402.24	338,574.10	352,681.35	349,154.54	315	1109	2328.9	349335	349.335	$	2.80	$ 978,138.00
003	Coyoacán	73	Public Urban	1923696.00	386030.00	386,030,000.00	1,057,616.44	5.6	188,860.08	214,613.73	255,492.53	266,138.05	263,476.67	315	837	1757.7	263655	263.655	$	2.80	$ 738,234.00
003	Coyoacán	74	Public Urban	1608336.00	660280.00	660,280,000.00	1,808,986.30	5.6	323,033.27	367,083.26	437,003.88	455,212.38	450,660.25	315	1431	3005.1	450765	450.765	$	2.80	$ 1,262,142.00
003	Coyoacán	75	Public Urban	946080.00	863979.00	863,979,000.00	2,367,065.75	5.6	422,690.31	480,329.90	571,821.31	595,647.20	589,690.73	315	1873	3933.3	589995	589.995	$	2.80	$ 1,651,986.00
003	Coyoacán	76	Public Urban	473040.00	405240.00	405,240,000.00	1,110,246.58	5.6	198,258.32	225,293.54	268,206.60	279,381.87	276,588.05	315	879	1845.9	276885	276.885	$	2.80	$ 775,278.00
003	Coyoacán	77	Public Urban	1198368.00	238860.00	238,860,000.00	654,410.96	5.6	116,859.10	132,794.43	158,088.61	164,675.63	163,028.88	315	518	1087.8	163170	163.17	$	2.80	$ 456,876.00
003	Coyoacán	78	Public Urban	630720.00	305836.13	305,836,128.00	837,907.20	5.6	149,626.29	170,029.87	202,416.51	210,850.53	208,742.03	315	663	1392.3	208845	208.845	$	2.80	$ 584,766.00
003	Coyoacán	79	Public Urban	1009152.00	654300.00	654,300,000.00	1,792,602.74	5.6	320,107.63	363,758.67	433,046.04	451,089.62	446,578.73	315	1418	2977.8	446670	446.67	$	2.80	$ 1,250,676.00
003	Coyoacán	80	Public Urban	1198368.00	673698.00	673,698,000.00	1,845,747.95	5.6	329,597.85	374,543.01	445,884.53	464,463.06	459,818.43	315	1460	3066	459900	459.9	$	2.80	$ 1,287,720.00
003	Coyoacán	81	Public Urban	473040.00	693239.00	693,239,000.00	1,899,284.93	5.6	339,158.02	385,406.84	458,817.67	477,935.08	473,155.72	315	1503	3156.3	473445	473.445	$	2.80	$ 1,325,646.00
003	Coyoacán	82	Public Urban	1419120.00	714830.00	714,830,000.00	1,958,438.36	5.6	349,721.14	397,410.38	473,107.60	492,820.41	487,892.21	315	1549	3252.9	487935	487.935	$	2.80	$ 1,366,218.00
003	Coyoacán	83	Public Urban	693792.00	336419.74	336,419,740.80	921,697.92	5.6	164,588.91	187,032.86	222,658.16	231,935.59	229,616.23	315	729	1530.9	229635	229.635	$	2.80	$ 642,978.00
003	Coyoacán	84	Public Urban	94608.00	716300.00	716,300,000.00	1,962,465.75	5.6	350,440.31	398,227.63	474,080.51	493,833.86	488,895.53	315	1553	3261.3	489195	489.195	$	2.80	$ 1,369,746.00
004	uajimalpa de Morelos	1	Public Urban	788400	407,120.00	407,120,000.00	1,115,397.26	5.6	199,178.08	226,338.73	269,450.87	280,677.99	277,871.21	315	883	1854.3	278145	278.145	$	2.80	$ 778,806.00
004	uajimalpa de Morelos	2	Public Urban	283824	393,690.00	393,690,000.00	1,078,602.74	5.6	192,607.63	218,872.31	260,562.27	271,419.03	268,704.84	315	854	1793.4	269010	269.01	$	2.80	$ 753,228.00
005	Gustavo A. Madero	1	Public Urban	1892160	672,158.00	672,158,000.00	1,841,528.77	5.6	328,844.42	373,686.84	444,865.29	463,401.34	458,767.33	315	1457	3059.7	458955	458.955	$	2.80	$ 1,285,074.00
005	Gustavo A. Madero	2	Public Urban	1892160	691,699.00	691,699,000.00	1,895,065.75	5.6	338,404.60	384,550.68	457,798.43	476,873.36	472,104.63	315	1499	3147.9	472185	472.185	$	2.80	$ 1,322,118.00
005	Gustavo A. Madero	3	Public Urban	1229904	596,380.45	596,380,449.60	1,633,919.04	5.6	291,771.26	331,558.25	394,712.20	411,158.54	407,046.95	315	1293	2715.3	407295	407.295	$	2.80	$ 1,140,426.00
006	Iztacalco	1	Public Urban	RH	764,870.00	764,870,000.00	2,095,534.25	5.6	374,202.54	425,230.16	506,226.39	527,319.15	522,045.96	315	1658	3481.8	522270	522.27	$	2.80	$ 1,462,356.00
006	Iztacalco	2	Public Urban	1135296	898,328.00	898,328,000.00	2,461,172.60	5.6	439,495.11	499,426.26	594,555.07	619,328.20	613,134.92	315	1947	4088.7	613305	613.305	$	2.80	$ 1,717,254.00
006	Iztacalco	3	Public Urban	2333664	517,410.00	517,410,000.00	1,417,561.64	5.6	253,136.01	287,654.55	342,445.90	356,714.48	353,147.33	315	1122	2356.2	353430	353.43	$	2.80	$ 989,604.00
006	Iztacalco	4	Public Urban	94608	238,270.00	238,270,000.00	652,794.52	5.6	116,570.45	132,466.42	157,698.12	164,268.87	162,626.19	315	517	1085.7	162855	162.855	$	2.80	$ 455,994.00
006	Iztacalco	5	Public Urban	2207520	403,650.00	403,650,000.00	1,105,890.41	5.6	197,480.43	224,409.58	267,154.26	278,285.69	275,502.83	315	875	1837.5	275625	275.625	$	2.80	$ 771,750.00
006	Iztacalco	6	Public Urban	FO	976,980.00	976,980,000.00	2,676,657.53	5.6	477,974.56	543,152.91	646,610.61	673,552.71	666,817.19	315	2117	4445.7	666855	666.855	$	2.80	$ 1,867,194.00
006	Iztacalco	7	Public Urban	1198368	677,740.00	677,740,000.00	1,856,821.92	5.6	331,575.34	376,790.16	448,559.72	467,249.70	462,577.21	315	1469	3084.9	462735	462.735	$	2.80	$ 1,295,658.00
006	Iztacalco	8	Public Urban	441504	686,768.00	686,768,000.00	1,881,556.16	5.6	335,992.17	381,809.29	454,534.87	473,473.82	468,739.08	315	1489	3126.9	469035	469.035	$	2.80	$ 1,313,298.00
006	Iztacalco	9	Public Urban	1734480	401,825.00	401,825,000.00	1,100,890.41	5.6	196,587.57	223,394.97	265,946.39	277,027.49	274,257.22	315	871	1829.1	274365	274.365	$	2.80	$ 768,222.00
007	Iztapalapa	1	Public Urban	1576800	658,150	658,150,000.00	1,803,150.68	5.6	321,991.19	365,899.08	435,594.15	453,743.90	449,206.46	315	1427	2996.7	449505	449.505	$	2.80	$ 1,258,614.00
007	Iztapalapa	2	Public Urban	946080	791,864	791,864,000.00	2,169,490.41	5.6	387,409.00	440,237.50	524,092.26	545,929.44	540,470.15	315	1716	3603.6	540540	540.54	$	2.80	$ 1,513,512.00
007	Iztapalapa	3	Public Urban	2049840	798,884	798,884,000.00	2,188,723.29	5.6	390,843.44	444,140.28	528,738.43	550,769.19	545,261.50	315	1731	3635.1	545265	545.265	$	2.80	$ 1,526,742.00
007	Iztapalapa	4	Public Urban	1892160	902,098	902,098,000.00	2,471,501.37	5.6	441,339.53	501,522.19	597,050.23	621,927.32	615,708.05	315	1955	4105.5	615825	615.825	$	2.80	$ 1,724,310.00
007	Iztapalapa	5	Public Urban	0	13,789	13,789,000.00	37,778.08	5.6	6,746.09	7,666.01	9,126.20	9,506.46	9,411.39	315	30	63	9450	9.45	$	2.80	$ 26,460.00
007	Iztapalapa	6	Public Urban	1576800	237,000	237,000,000.00	649,315.07	5.6	115,949.12	131,760.36	156,857.57	163,393.31	161,759.37	315	514	1079.4	161910	161.91	$	2.80	$ 453,348.00
007	Iztapalapa	7	Public Urban	1734480	684,978	684,978,000.00	1,876,652.05	5.6	335,116.44	380,814.13	453,350.16	472,239.75	467,517.35	315	1485	3118.5	467775	467.775	$	2.80	$ 1,309,770.00
007	Iztapalapa	8	Public Urban	409968	198,793.48	198,793,483.20	544,639.68	5.6	97,257.09	110,519.42	131,570.73	137,052.85	135,682.32	315	431	905.1	135765	135.765	$	2.80	$ 380,142.00
007	Iztapalapa	9	Public Urban	1892160	520,900	520,900,000.00	1,427,123.29	5.6	254,843.44	289,594.82	344,755.74	359,120.56	355,529.36	315	1129	2370.9	355635	355.635	$	2.80	$ 995,778.00
007	Iztapalapa	10	Public Urban	3153600	669,620	669,620,000.00	1,834,575.34	5.6	327,602.74	372,275.84	443,185.52	461,651.59	457,035.07	315	1451	3047.1	457065	457.065	$	2.80	$ 1,279,782.00
007	Iztapalapa	11	Public Urban	2049840	733,850	733,850,000.00	2,010,547.95	5.6	359,026.42	407,984.57	485,695.91	505,933.24	500,873.91	315	1591	3341.1	501165	501.165	$	2.80	$ 1,403,262.00
007	Iztapalapa	12	Public Urban	599184	290,544.32	290,544,321.60	796,011.84	5.6	142,144.97	161,528.38	192,295.69	200,308.01	198,304.93	315	630	1323	198450	198.45	$	2.80	$ 555,660.00
007	Iztapalapa	13	Public Urban	1576800	16,219	16,219,000.00	44,435.62	5.6	7,934.93	9,016.97	10,734.49	11,181.76	11,069.94	315	36	75.6	11340	11.34	$	2.80	$ 31,752.00
007	Iztapalapa	14	Public Urban	1576800	968,050	968,050,000.00	2,652,191.78	5.6	473,605.68	538,188.27	640,700.32	667,396.16	660,722.20	315	2098	4405.8	660870	660.87	$	2.80	$ 1,850,436.00

007	Iztapalapa	15	Public Urban	1261440	513,700	513,700,000.00	1,407,397.26	5.6	251,320.94	285,591.98	339,990.45	354,156.72	350,615.15	315	1114	2339.4	350910	350.91	$	2.80	$ 982,548.00
007	Iztapalapa	16	Public Urban	1261440	284,960	284,960,000.00	780,712.33	5.6	139,412.92	158,423.77	188,599.72	196,458.05	194,493.47	315	618	1297.8	194670	194.67	$	2.80	$ 545,076.00
007	Iztapalapa	17	Public Urban	1892160	406,030	406,030,000.00	1,112,410.96	5.6	198,644.81	225,732.74	268,729.46	279,926.52	277,127.25	315	880	1848	277200	277.2	$	2.80	$ 776,160.00
007	Iztapalapa	18	Public Urban	1892160	393,085	393,085,000.00	1,076,945.21	5.6	192,311.64	218,535.96	260,161.86	271,001.93	268,291.91	315	852	1789.2	268380	268.38	$	2.80	$ 751,464.00
007	Iztapalapa	19	Public Urban	1576800	667,850	667,850,000.00	1,829,726.03	5.6	326,736.79	371,291.81	442,014.06	460,431.31	455,827.00	315	1448	3040.8	456120	456.12	$	2.80	$ 1,277,136.00
007	Iztapalapa	20	Public Urban	1513728	17,830	17,830,000.00	48,849.32	5.6	8,723.09	9,912.60	11,800.72	12,292.42	12,169.49	315	39	81.9	12285	12.285	$	2.80	$ 34,398.00
007	Iztapalapa	21	Public Urban	1829088	403,380	403,380,000.00	1,105,150.68	5.6	197,348.34	224,259.47	266,975.56	278,099.55	275,318.55	315	875	1837.5	275625	275.625	$	2.80	$ 771,750.00
007	Iztapalapa	22	Public Urban	1986768	677,970	677,970,000.00	1,857,452.05	5.6	331,687.87	376,918.03	448,711.94	467,408.27	462,734.19	315	1469	3084.9	462735	462.735	$	2.80	$ 1,295,658.00
007	Iztapalapa	23	Public Urban	1892160	862,119	862,119,000.00	2,361,969.86	5.6	421,780.33	479,295.83	570,590.28	594,364.87	588,421.22	315	1869	3924.9	588735	588.735	$	2.80	$ 1,648,458.00
007	Iztapalapa	24	Public Urban	1576800	523,130	523,130,000.00	1,433,232.88	5.6	255,934.44	290,834.59	346,231.66	360,657.98	357,051.40	315	1134	2381.4	357210	357.21	$	2.80	$ 1,000,188.00
007	Iztapalapa	25	Public Urban	1892160	593,930	593,930,000.00	1,627,205.48	5.6	290,572.41	330,195.92	393,090.38	409,469.14	405,374.45	315	1287	2702.7	405405	405.405	$	2.80	$ 1,135,134.00
007	Iztapalapa	26	Public Urban	2270592	771,890	771,890,000.00	2,114,767.12	5.6	377,636.99	429,132.94	510,872.55	532,158.90	526,837.31	315	1673	3513.3	526995	526.995	$	2.80	$ 1,475,586.00
007	Iztapalapa	27	Public Urban	2207520	691,998	691,998,000.00	1,895,884.93	5.6	338,550.88	384,714.91	457,996.32	477,079.50	472,308.71	315	1500	3150	472500	472.5	$	2.80	$ 1,323,000.00
007	Iztapalapa	28	Public Urban	2207520	711,539	711,539,000.00	1,949,421.92	5.6	348,111.06	395,580.75	470,929.46	490,551.52	485,646.01	315	1542	3238.2	485730	485.73	$	2.80	$ 1,360,044.00
007	Iztapalapa	29	Public Urban	2207520	732,880	732,880,000.00	2,007,890.41	5.6	358,551.86	407,445.29	485,053.92	505,264.50	500,211.86	315	1588	3334.8	500220	500.22	$	2.80	$ 1,400,616.00
007	Iztapalapa	30	Public Urban	1892160	1,599,380	1,599,380,000.00	4,381,863.01	5.6	782,475.54	889,176.75	1,058,543.75	1,102,649.74	1,091,623.24	315	3466	7278.6	1091790	1091.79	$	2.80	$ 3,057,012.00
007	Iztapalapa	31	Public Urban	1702944	447,230	447,230,000.00	1,225,287.67	5.6	218,801.37	248,637.92	295,997.52	308,330.75	305,247.45	315	970	2037	305550	305.55	$	2.80	$ 855,540.00
007	Iztapalapa	32	Public Urban	1702944	20,989	20,989,000.00	57,504.11	5.6	10,268.59	11,668.85	13,891.49	14,470.30	14,325.60	315	46	96.6	14490	14.49	$	2.80	$ 40,572.00
007	Iztapalapa	33	Public Urban	1892160	524,610	524,610,000.00	1,437,287.67	5.6	256,658.51	291,657.40	347,211.19	361,678.32	358,061.54	315	1137	2387.7	358155	358.155	$	2.80	$ 1,002,834.00
007	Iztapalapa	34	Public Urban	2207520	902,098	902,098,000.00	2,471,501.37	5.6	441,339.53	501,522.19	597,050.23	621,927.32	615,708.05	315	1955	4105.5	615825	615.825	$	2.80	$ 1,724,310.00
007	Iztapalapa	35	Public Urban	2270592	1,101,010.06	1,101,010,060.80	3,016,465.92	5.6	538,654.63	612,107.53	728,699.44	759,061.92	751,471.30	315	2386	5010.6	751590	751.59	$	2.80	$ 2,104,452.00
007	Iztapalapa	36	Public Urban	3153600	408,800	408,800,000.00	1,120,000.00	5.6	200,000.00	227,272.73	270,562.77	281,836.22	279,017.86	315	886	1860.6	279090	279.09	$	2.80	$ 781,452.00
007	Iztapalapa	37	Public Urban	3153600	971,180	971,180,000.00	2,660,767.12	5.6	475,136.99	539,928.39	642,771.90	669,554.06	662,858.52	315	2105	4420.5	663075	663.075	$	2.80	$ 1,856,610.00
007	Iztapalapa	38	Public Urban	1892160	395,370	395,370,000.00	1,083,205.48	5.6	193,429.55	219,806.31	261,674.17	272,577.27	269,851.49	315	857	1799.7	269955	269.955	$	2.80	$ 755,874.00
007	Iztapalapa	39	Public Urban	3153600	1,592,180	1,592,180,000.00	4,362,136.99	5.6	778,953.03	885,173.90	1,053,778.45	1,097,685.89	1,086,709.03	315	3450	7245	1086750	1086.75	$	2.80	$ 3,042,900.00
007	Iztapalapa	40	Public Urban	1892160	281,030	281,030,000.00	769,945.21	5.6	137,490.22	156,238.88	185,998.67	193,748.61	191,811.13	315	609	1278.9	191835	191.835	$	2.80	$ 537,138.00
007	Iztapalapa	41	Public Urban	1797552	18,600	18,600,000.00	50,958.90	5.6	9,099.80	10,340.69	12,310.34	12,823.27	12,695.04	315	41	86.1	12915	12.915	$	2.80	$ 36,162.00
007	Iztapalapa	42	Public Urban	1639872	861,389	861,389,000.00	2,359,969.86	5.6	421,423.19	478,889.99	570,107.13	593,861.59	587,922.98	315	1867	3920.7	588105	588.105	$	2.80	$ 1,646,694.00
007	Iztapalapa	43	Public Urban	1576800	662,065	662,065,000.00	1,813,876.71	5.6	323,906.56	368,075.63	438,185.28	456,443.00	451,878.57	315	1435	3013.5	452025	452.025	$	2.80	$ 1,265,670.00
007	Iztapalapa	44	Public Urban	1419120	975,250	975,250,000.00	2,671,917.81	5.6	477,128.18	542,191.11	645,465.61	672,360.01	665,636.41	315	2114	4439.4	665910	665.91	$	2.80	$ 1,864,548.00
007	Iztapalapa	45	Public Urban	1892160	767,660	767,660,000.00	2,103,178.08	5.6	375,567.51	426,781.27	508,072.94	529,242.64	523,950.22	315	1664	3494.4	524160	524.16	$	2.80	$ 1,467,648.00
007	Iztapalapa	46	Public Urban	1923696	590,520	590,520,000.00	1,617,863.01	5.6	288,904.11	328,300.12	390,833.48	407,118.21	403,047.03	315	1280	2688	403200	403.2	$	2.80	$ 1,128,960.00
007	Iztapalapa	47	Public Urban	2459808	705,809	705,809,000.00	1,933,723.29	5.6	345,307.73	392,395.15	467,137.08	486,601.13	481,735.11	315	1530	3213	481950	481.95	$	2.80	$ 1,349,460.00
007	Iztapalapa	48	Public Urban	946080	458,754.19	458,754,192.00	1,256,860.80	5.6	224,439.43	255,044.81	303,624.77	316,275.80	313,113.04	315	995	2089.5	313425	313.425	$	2.80	$ 877,590.00
007	Iztapalapa	49	Public Urban	1576800	663,950	663,950,000.00	1,819,041.10	5.6	324,828.77	369,123.60	439,432.86	457,742.56	453,165.13	315	1439	3021.9	453285	453.285	$	2.80	$ 1,269,198.00
007	Iztapalapa	50	Public Urban	2333664	704,519	704,519,000.00	1,930,189.04	5.6	344,676.61	391,677.97	466,283.30	485,711.77	480,854.65	315	1527	3206.7	481005	481.005	$	2.80	$ 1,346,814.00
007	Iztapalapa	51	Public Urban	1892160	726,110	726,110,000.00	1,989,342.47	5.6	355,239.73	403,681.51	480,573.22	500,597.11	495,591.14	315	1574	3305.4	495810	495.81	$	2.80	$ 1,388,268.00
007	Iztapalapa	52	Public Urban	1892160	727,580	727,580,000.00	1,993,369.86	5.6	355,958.90	404,498.75	481,546.14	501,610.56	496,594.45	315	1577	3311.7	496755	496.755	$	2.80	$ 1,390,914.00
007	Iztapalapa	53	Public Urban	788400	597,720	597,720,000.00	1,637,589.04	5.6	292,426.61	332,302.97	395,598.78	412,082.06	407,961.24	315	1296	2721.6	408240	408.24	$	2.80	$ 1,143,072.00
007	Iztapalapa	54	Public Urban	473040	726,900	726,900,000.00	1,991,506.85	5.6	355,626.22	404,120.71	481,096.08	501,141.75	496,130.33	315	1576	3309.6	496440	496.44	$	2.80	$ 1,390,032.00
007	Iztapalapa	55	Public Urban	1892160	611,950	611,950,000.00	1,676,575.34	5.6	299,388.45	340,214.15	405,016.85	421,892.55	417,673.62	315	1326	2784.6	417690	417.69	$	2.80	$ 1,169,532.00
007	Iztapalapa	56	Public Urban	1261440	842,150	842,150,000.00	2,307,260.27	5.6	412,010.76	468,194.05	557,373.87	580,597.78	574,791.80	315	1825	3832.5	574875	574.875	$	2.80	$ 1,609,650.00
007	Iztapalapa	57	Public Urban	1576800	593,930	593,930,000.00	1,627,205.48	5.6	290,572.41	330,195.92	393,090.38	409,469.14	405,374.45	315	1287	2702.7	405405	405.405	$	2.80	$ 1,135,134.00
007	Iztapalapa	58	Public Urban	2207520	846,880	846,880,000.00	2,320,219.18	5.6	414,324.85	470,823.70	560,504.40	583,858.75	578,020.16	315	1835	3853.5	578025	578.025	$	2.80	$ 1,618,470.00
007	Iztapalapa	59	Public Urban	819936	614,680	614,680,000.00	1,684,054.79	5.6	300,724.07	341,731.90	406,823.69	423,774.68	419,536.93	315	1332	2797.2	419580	419.58	$	2.80	$ 1,174,824.00
007	Iztapalapa	60	Public Urban	23967360	726,110	726,110,000.00	1,989,342.47	5.6	355,239.73	403,681.51	480,573.22	500,597.11	495,591.14	315	1574	3305.4	495810	495.81	$	2.80	$ 1,388,268.00
007	Iztapalapa	61	Public Urban	1261440	611,672.26	611,672,256.00	1,675,814.40	5.6	299,252.57	340,059.74	404,833.02	421,701.07	417,484.06	315	1326	2784.6	417690	417.69	$	2.80	$ 1,169,532.00
007	Iztapalapa	62	Public Urban	1892160	600,950	600,950,000.00	1,646,438.36	5.6	294,006.85	334,098.69	397,736.54	414,308.89	410,165.81	315	1303	2736.3	410445	410.445	$	2.80	$ 1,149,246.00
007	Iztapalapa	63	Public Urban		388,790	388,790,000.00	1,065,178.08	5.6	190,210.37	216,148.15	257,319.23	268,040.86	265,360.45	315	843	1770.3	265545	265.545	$	2.80	$ 743,526.00
007	Iztapalapa	64	Public Urban		662,880	662,880,000.00	1,816,109.59	5.6	324,305.28	368,528.73	438,724.68	457,004.88	452,434.83	315	1437	3017.7	452655	452.655	$	2.80	$ 1,267,434.00
007	Iztapalapa	65	Public Urban		654,760	654,760,000.00	1,793,863.01	5.6	320,332.68	364,014.41	433,350.49	451,406.76	446,892.69	315	1419	2979.9	446985	446.985	$	2.80	$ 1,251,558.00
007	Iztapalapa	66	Public Urban	1829088	846,529	846,529,000.00	2,319,257.53	5.6	414,153.13	470,628.56	560,272.09	583,616.76	577,780.60	315	1835	3853.5	578025	578.025	$	2.80	$ 1,618,470.00
007	Iztapalapa	67	Public Urban	1892160	647,860	647,860,000.00	1,774,958.90	5.6	316,956.95	360,178.35	428,783.75	446,649.74	442,183.24	315	1404	2948.4	442260	442.26	$	2.80	$ 1,238,328.00
007	Iztapalapa	68	Public Urban	946080	960,390	960,390,000.00	2,631,205.48	5.6	469,858.12	533,929.68	635,630.58	662,115.18	655,494.03	315	2081	4370.1	655515	655.515	$	2.80	$ 1,835,442.00
007	Iztapalapa	69	Public Urban	1324512	506,040	506,040,000.00	1,386,410.96	5.6	247,573.39	281,333.39	334,920.71	348,875.73	345,386.98	315	1097	2303.7	345555	345.555	$	2.80	$ 967,554.00
007	Iztapalapa	70	Public Urban	S/D	223,410	223,410,000.00	612,082.19	5.6	109,300.39	124,204.99	147,863.08	154,024.05	152,483.80	315	485	1018.5	152775	152.775	$	2.80	$ 427,770.00
007	Iztapalapa	71	Public Urban	1040688	597,090	597,090,000.00	1,635,863.01	5.6	292,118.40	331,952.72	395,181.81	411,647.72	407,531.24	315	1294	2717.4	407610	407.61	$	2.80	$ 1,141,308.00
007	Iztapalapa	72	Public Urban	977616	380,510	380,510,000.00	1,042,493.15	5.6	186,159.49	211,544.88	251,839.14	262,332.44	259,709.11	315	825	1732.5	259875	259.875	$	2.80	$ 727,650.00
007	Iztapalapa	73	Public Urban	567648	395,160	395,160,000.00	1,082,630.14	5.6	193,326.81	219,689.56	261,535.19	272,432.49	269,708.16	315	857	1799.7	269955	269.955	$	2.80	$ 755,874.00
007	Iztapalapa	74	Public Urban		S/D		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
007	Iztapalapa	75	Public Urban		-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
007	Iztapalapa	76	Public Urban	1261440	795,154	795,154,000.00	2,178,504.11	5.6	389,018.59	442,066.58	526,269.74	548,197.64	542,715.67	315	1723	3618.3	542745	542.745	$	2.80	$ 1,519,686.00
007	Iztapalapa	77	Public Urban	2365200	727,580	727,580,000.00	1,993,369.86	5.6	355,958.90	404,498.75	481,546.14	501,610.56	496,594.45	315	1577	3311.7	496755	496.755	$	2.80	$ 1,390,914.00
007	Iztapalapa	78	Public Urban		-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
008	Magdalena Contreras	1	Public Urban	peración de nivel	391,700.00	391,700,000.00	1,073,150.68	5.6	191,634.05	217,765.97	259,245.20	270,047.08	267,346.61	315	849	1782.9	267435	267.435	$	2.80	$ 748,818.00
008	Magdalena Contreras	2	Public Urban	315360	708,349.00	708,349,000.00	1,940,682.19	5.6	346,550.39	393,807.26	468,818.17	488,352.26	483,468.74	315	1535	3223.5	483525	483.525	$	2.80	$ 1,353,870.00
008	Magdalena Contreras	3	Public Urban	63072	665,880.00	665,880,000.00	1,824,328.77	5.6	325,772.99	370,196.58	440,710.22	459,073.15	454,482.41	315	1443	3030.3	454545	454.545	$	2.80	$ 1,272,726.00
008	Magdalena Contreras	4	Public Urban	693792	858,929.00	858,929,000.00	2,353,230.14	5.6	420,219.67	477,522.35	568,478.99	592,165.61	586,243.96	315	1862	3910.2	586530	586.53	$	2.80	$ 1,642,284.00
008	Magdalena Contreras	5	Public Urban	630720	240,580.00	240,580,000.00	659,123.29	5.6	117,700.59	133,750.67	159,226.98	165,861.44	164,202.83	315	522	1096.2	164430	164.43	$	2.80	$ 460,404.00
008	Magdalena Contreras	6	Public Urban	441504	843,690.00	843,690,000.00	2,311,479.45	5.6	412,764.19	469,050.21	558,393.11	581,659.49	575,842.90	315	1829	3840.9	576135	576.135	$	2.80	$ 1,613,178.00
009	Milpa Alta	1	Public Urban	-	601,615.00	601,615,000.00	1,648,260.27	5.6	294,332.19	334,468.40	398,176.67	414,767.36	410,619.69	315	1304	2738.4	410760	410.76	$	2.80	$ 1,150,128.00
009	Milpa Alta	2	Public Urban	-	1,595,150.00	1,595,150,000.00	4,370,273.97	5.6	780,406.07	886,825.08	1,055,744.14	1,099,733.48	1,088,736.14	315	3457	7259.7	1088955	1088.955	$	2.80	$ 3,049,074.00
009	Milpa Alta	3	Public Urban	-	773,180.00	773,180,000.00	2,118,301.37	5.6	378,268.10	429,850.12	511,726.33	533,048.26	527,717.78	315	1676	3519.6	527940	527.94	$	2.80	$ 1,478,232.00
009	Milpa Alta	4	Public Urban	1545264	856,639.00	856,639,000.00	2,346,956.16	5.6	419,099.32	476,249.22	566,963.36	590,586.83	584,680.96	315	1857	3899.7	584955	584.955	$	2.80	$ 1,637,874.00
009	Milpa Alta	5	Public Urban	1671408	658,470.00	658,470,000.00	1,804,027.40	5.6	322,147.75	366,076.99	435,805.94	453,964.52	449,424.87	315	1427	2996.7	449505	449.505	$	2.80	$ 1,258,614.00

009	Milpa Alta	6	Public Urban	1387584	971,500.00	971,500,000.00	2,661,643.84	5.6	475,293.54	540,106.30	642,983.69	669,774.67	663,076.93	315	2106	4422.6	663390	663.39	$	2.80	$ 1,857,492.00
009	Milpa Alta	7	Public Urban	2491344	517,650.00	517,650,000.00	1,418,219.18	5.6	253,253.42	287,787.98	342,604.74	356,879.94	353,311.14	315	1122	2356.2	353430	353.43	$	2.80	$ 989,604.00
009	Milpa Alta	8	Public Urban	1545264	749,298.51	749,298,513.60	2,052,872.64	5.6	366,584.40	416,573.18	495,920.45	516,583.81	511,417.97	315	1624	3410.4	511560	511.56	$	2.80	$ 1,432,368.00
009	Milpa Alta	9	Public Urban	2049840	609,200.00	609,200,000.00	1,669,041.10	5.6	298,043.05	338,685.29	403,196.77	419,996.64	415,796.67	315	1320	2772	415800	415.8	$	2.80	$ 1,164,240.00
009	Milpa Alta	10	Public Urban	-	521,880.00	521,880,000.00	1,429,808.22	5.6	255,322.90	290,139.65	345,404.35	359,796.20	356,198.24	315	1131	2375.1	356265	356.265	$	2.80	$ 997,542.00
009	Milpa Alta	11	Public Urban	2018304	595,470.00	595,470,000.00	1,631,424.66	5.6	291,325.83	331,052.08	394,109.62	410,530.86	406,425.55	315	1291	2711.1	406665	406.665	$	2.80	$ 1,138,662.00
009	Milpa Alta	12	Public Urban	1671408	436,480.00	436,480,000.00	1,195,835.62	5.6	213,542.07	242,661.45	288,882.68	300,919.45	297,910.26	315	946	1986.6	297990	297.99	$	2.80	$ 834,372.00
009	Milpa Alta	13	Public Urban	567648	10,739.00	10,739,000.00	29,421.92	5.6	5,253.91	5,970.36	7,107.57	7,403.72	7,329.68	315	24	50.4	7560	7.56	$	2.80	$ 21,168.00
009	Milpa Alta	14	Public Urban	1261440	514,860.00	514,860,000.00	1,410,575.34	5.6	251,888.45	286,236.88	340,758.19	354,956.45	351,406.88	315	1116	2343.6	351540	351.54	$	2.80	$ 984,312.00
009	Milpa Alta	15	Public Urban	1734480	892,753.00	892,753,000.00	2,445,898.63	5.6	436,767.61	496,326.83	590,865.28	615,484.66	609,329.82	315	1935	4063.5	609525	609.525	$	2.80	$ 1,706,670.00
009	Milpa Alta	16	Public Urban	1229904	279,480.00	279,480,000.00	765,698.63	5.6	136,731.90	155,377.16	184,972.81	192,680.01	190,753.21	315	606	1272.6	190890	190.89	$	2.80	$ 534,492.00
009	Milpa Alta	17	Public Urban	819936	400,550.00	400,550,000.00	1,097,397.26	5.6	195,963.80	222,686.13	265,102.54	276,148.48	273,386.99	315	868	1822.8	273420	273.42	$	2.80	$ 765,576.00
009	Milpa Alta	18	Public Urban	1892160	387,620.00	387,620,000.00	1,061,972.60	5.6	189,637.96	215,497.69	256,544.87	267,234.24	264,561.89	315	840	1764	264600	264.6	$	2.80	$ 740,880.00
009	Milpa Alta	19	Public Urban	1356048	662,370.00	662,370,000.00	1,814,712.33	5.6	324,055.77	368,245.20	438,387.14	456,653.27	452,086.74	315	1436	3015.6	452340	452.34	$	2.80	$ 1,266,552.00
009	Milpa Alta	20	Public Urban	914544	397,900.00	397,900,000.00	1,090,136.99	5.6	194,667.32	221,212.86	263,348.65	274,321.51	271,578.29	315	863	1812.3	271845	271.845	$	2.80	$ 761,166.00
009	Milpa Alta	21	Public Urban	1576800	672,490.00	672,490,000.00	1,842,438.36	5.6	329,006.85	373,871.42	445,085.02	463,630.23	458,993.93	315	1458	3061.8	459270	459.27	$	2.80	$ 1,285,956.00
010	Alvaro Obregón	1	Public Urban	RN		-															
010	Alvaro Obregón	2	Public Urban	1198368	395,070	395,070,000.00	1,082,383.56	5.6	193,282.78	219,639.52	261,475.62	272,370.44	269,646.73	315	857	1799.7	269955	269.955	$	2.80	$ 755,874.00
010	Alvaro Obregón	3	Public Urban	1608336	382,140	382,140,000.00	1,046,958.90	5.6	186,956.95	212,451.08	252,917.95	263,456.20	260,821.63	315	829	1740.9	261135	261.135	$	2.80	$ 731,178.00
010	Alvaro Obregón	4	Public Urban	977616	474,046.00	474,046,000.00	1,298,756.16	5.6	231,920.74	263,546.30	313,745.59	326,818.33	323,550.14	315	1028	2158.8	323820	323.82	$	2.80	$ 906,696.00
010	Alvaro Obregón	5	Public Urban	567648	226,040	226,040,000.00	619,287.67	5.6	110,587.08	125,667.14	149,603.74	155,837.23	154,278.86	315	490	1029	154350	154.35	$	2.80	$ 432,180.00
010	Alvaro Obregón	6	Public Urban	599184	290,544.00	290,544,000.00	796,010.96	5.6	142,144.81	161,528.20	192,295.47	200,307.79	198,304.71	315	630	1323	198450	198.45	$	2.80	$ 555,660.00
010	Alvaro Obregón	7	Public Urban	C			-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	8	Public Urban	FE			-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	9	Public Urban	1166832	565,796.00	565,796,000.00	1,550,126.03	5.6	276,808.22	314,554.79	374,469.99	390,072.91	386,172.18	315	1226	2574.6	386190	386.19	$	2.80	$ 1,081,332.00
010	Alvaro Obregón	10	Public Urban	1419120	851,159	851,159,000.00	2,331,942.47	5.6	416,418.30	473,202.61	563,336.44	586,808.79	580,940.71	315	1845	3874.5	581175	581.175	$	2.80	$ 1,627,290.00
010	Alvaro Obregón	11	Public Urban	RN	512,170	512,170,000.00	1,403,205.48	5.6	250,572.41	284,741.37	338,977.82	353,101.90	349,570.88	315	1110	2331	349650	349.65	$	2.80	$ 979,020.00
010	Alvaro Obregón	12	Public Urban	31536	900,188	900,188,000.00	2,466,268.49	5.6	440,405.09	500,460.33	595,786.10	620,610.52	614,404.42	315	1951	4097.1	614565	614.565	$	2.80	$ 1,720,782.00
010	Alvaro Obregón	13	Public Urban	RN	767,950	767,950,000.00	2,103,972.60	5.6	375,709.39	426,942.49	508,264.87	529,442.57	524,148.15	315	1664	3494.4	524160	524.16	$	2.80	$ 1,467,648.00
010	Alvaro Obregón	14	Public Urban	819936	407,890	407,890,000.00	1,117,506.85	5.6	199,554.79	226,766.81	269,960.49	281,208.84	278,396.76	315	884	1856.4	278460	278.46	$	2.80	$ 779,688.00
010	Alvaro Obregón	15	Public Urban	1135296	966,020	966,020,000.00	2,646,630.14	5.6	472,612.52	537,059.69	639,356.77	665,996.64	659,336.67	315	2094	4397.4	659610	659.61	$	2.80	$ 1,846,908.00
010	Alvaro Obregón	16	Public Urban	RE	589,990	589,990,000.00	1,616,410.96	5.6	288,644.81	328,005.47	390,482.70	406,752.82	402,685.29	315	1279	2685.9	402885	402.885	$	2.80	$ 1,128,078.00
010	Alvaro Obregón	17	Public Urban	RN	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	18	Public Urban	PR	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	19	Public Urban	C	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	20	Public Urban	283824	137,626.26	137,626,260.00	377,058.25	5.6	67,331.83	76,513.44	91,087.43	94,882.74	93,933.91	315	299	627.9	94185	94.185	$	2.80	$ 263,718.00
010	Alvaro Obregón	21	Public Urban	2207520	1,070,426.45	1,070,426,450.00	2,932,675.21	5.6	523,692.00	595,104.55	708,457.79	737,976.87	730,597.10	315	2320	4872	730800	730.8	$	2.80	$ 2,046,240.00
010	Alvaro Obregón	22	Public Urban	RH	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	23	Public Urban	RN	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	24	Public Urban	RH	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	25	Public Urban	346896	168,209.87	168,209,870.00	460,848.96	5.6	82,294.46	93,516.43	111,329.08	115,967.79	114,808.12	315	365	766.5	114975	114.975	$	2.80	$ 321,930.00
010	Alvaro Obregón	26	Public Urban	473040	229,377.10	229,377,100.00	628,430.41	5.6	112,219.72	127,522.40	151,812.39	158,137.90	156,556.52	315	498	1045.8	156870	156.87	$	2.80	$ 439,236.00
010	Alvaro Obregón	27	Public Urban	1387584	672,839.48	672,839,480.00	1,843,395.84	5.6	329,177.83	374,065.71	445,316.33	463,871.17	459,232.46	315	1458	3061.8	459270	459.27	$	2.80	$ 1,285,956.00
010	Alvaro Obregón	28	Public Urban	MC	597,010	597,010,000.00	1,635,643.84	5.6	292,079.26	331,908.25	395,128.86	411,592.57	407,476.64	315	1294	2717.4	407610	407.61	$	2.80	$ 1,141,308.00
010	Alvaro Obregón	29	Public Urban	977616	474,046.00	474,046,000.00	1,298,756.16	5.6	231,920.74	263,546.30	313,745.59	326,818.33	323,550.14	315	1028	2158.8	323820	323.82	$	2.80	$ 906,696.00
010	Alvaro Obregón	30	Public Urban	504576	244,668.90	244,668,900.00	670,325.75	5.6	119,701.03	136,023.89	161,933.21	168,680.43	166,993.62	315	531	1115.1	167265	167.265	$	2.80	$ 468,342.00
010	Alvaro Obregón	31	Public Urban	1198368	581,088.64	581,088,640.00	1,592,023.67	5.6	284,289.94	323,056.75	384,591.37	400,616.01	396,609.85	315	1260	2646	396900	396.9	$	2.80	$ 1,111,320.00
010	Alvaro Obregón	32	Public Urban		716,620	716,620,000.00	1,963,342.47	5.6	350,596.87	398,405.53	474,292.30	494,054.48	489,113.94	315	1553	3261.3	489195	489.195	$	2.80	$ 1,369,746.00
010	Alvaro Obregón	33	Public Urban		-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	34	Public Urban		-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	35	Public Urban		286,820	286,820,000.00	785,808.22	5.6	140,322.90	159,457.84	189,830.76	197,740.37	195,762.97	315	622	1306.2	195930	195.93	$	2.80	$ 548,604.00
010	Alvaro Obregón	36	Public Urban		-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
010	Alvaro Obregón	37	Public Urban		-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
011	Tláhuac	1	Public Urban	1229904	510,630.00	510,630,000.00	1,398,986.30	5.6	249,818.98	283,885.21	337,958.58	352,040.19	348,519.79	315	1107	2324.7	348705	348.705	$	2.80	$ 976,374.00
011	Tláhuac	2	Public Urban	1229904	793,404.00	793,404,000.00	2,173,709.59	5.6	388,162.43	441,093.67	525,111.51	546,991.15	541,521.24	315	1720	3612	541800	541.8	$	2.80	$ 1,517,040.00
011	Tláhuac	3	Public Urban	1261440	602,180.00	602,180,000.00	1,649,808.22	5.6	294,608.61	334,782.51	398,550.61	415,156.88	411,005.32	315	1305	2740.5	411075	411.075	$	2.80	$ 1,151,010.00
011	Tláhuac	4	Public Urban	819936	766,410.00	766,410,000.00	2,099,753.42	5.6	374,955.97	426,086.33	507,245.63	528,380.86	523,097.05	315	1661	3488.1	523215	523.215	$	2.80	$ 1,465,002.00
011	Tláhuac	5	Public Urban	-	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
011	Tláhuac	6	Public Urban	1608336	841,400.00	841,400,000.00	2,305,205.48	5.6	411,643.84	467,777.09	556,877.48	580,080.71	574,279.90	315	1824	3830.4	574560	574.56	$	2.80	$ 1,608,768.00
011	Tláhuac	7	Public Urban	851472	412,878.77	412,878,772.80	1,131,174.72	5.6	201,995.49	229,540.32	273,262.29	284,648.22	281,801.74	315	895	1879.5	281925	281.925	$	2.80	$ 789,390.00
011	Tláhuac	8	Public Urban	1261440	964,480.00	964,480,000.00	2,642,410.96	5.6	471,859.10	536,203.52	638,337.53	664,934.92	658,285.57	315	2090	4389	658350	658.35	$	2.80	$ 1,843,380.00
011	Tláhuac	9	Public Urban	1261440	611,672.26	611,672,256.00	1,675,814.40	5.6	299,252.57	340,059.74	404,833.02	421,701.07	417,484.06	315	1326	2784.6	417690	417.69	$	2.80	$ 1,169,532.00
011	Tláhuac	10	Public Urban	1261440	706,059.00	706,059,000.00	1,934,408.22	5.6	345,430.04	392,534.14	467,302.54	486,773.48	481,905.75	315	1530	3213	481950	481.95	$	2.80	$ 1,349,460.00
011	Tláhuac	11	Public Urban	1261440	729,120.00	729,120,000.00	1,997,589.04	5.6	356,712.33	405,354.92	482,565.38	502,672.27	497,645.55	315	1580	3318	497700	497.7	$	2.80	$ 1,393,560.00
011	Tláhuac	12	Public Urban	-	443,500.00	443,500,000.00	1,215,068.49	5.6	216,976.52	246,564.22	293,528.84	305,759.21	302,701.61	315	961	2018.1	302715	302.715	$	2.80	$ 847,602.00
011	Tláhuac	13	Public Urban	1261440	611,672.26	611,672,256.00	1,675,814.40	5.6	299,252.57	340,059.74	404,833.02	421,701.07	417,484.06	315	1326	2784.6	417690	417.69	$	2.80	$ 1,169,532.00
011	Tláhuac	14	Public Urban	1261440	588,450.00	588,450,000.00	1,612,191.78	5.6	287,891.39	327,149.31	389,463.46	405,691.10	401,634.19	315	1276	2679.6	401940	401.94	$	2.80	$ 1,125,432.00
011	Tláhuac	15	Public Urban	788400	382,295.16	382,295,160.00	1,047,384.00	5.6	187,032.86	212,537.34	253,020.64	263,563.17	260,927.54	315	829	1740.9	261135	261.135	$	2.80	$ 731,178.00
011	Tláhuac	16	Public Urban	1829088	886,924.77	886,924,771.20	2,429,930.88	5.6	433,916.23	493,086.62	587,007.88	611,466.55	605,351.88	315	1922	4036.2	605430	605.43	$	2.80	$ 1,695,204.00
012	Tlalpan	1	Public Urban	1135296	550,505.03	550,505,030.40	1,508,232.96	5.6	269,327.31	306,053.77	364,349.72	379,530.96	375,735.65	315	1193	2505.3	375795	375.795	$	2.80	$ 1,052,226.00
012	Tlalpan	2	Public Urban	946080	458,754.19	458,754,192.00	1,256,860.80	5.6	224,439.43	255,044.81	303,624.77	316,275.80	313,113.04	315	995	2089.5	313425	313.425	$	2.80	$ 877,590.00
012	Tlalpan	3	Public Urban	630720	1,595,710.00	1,595,710,000.00	4,371,808.22	5.6	780,680.04	887,136.41	1,056,114.77	1,100,119.55	1,089,118.36	315	3458	7261.8	1089270	1089.27	$	2.80	$ 3,049,956.00
012	Tlalpan	4	Public Urban	1261440	520,940.00	520,940,000.00	1,427,232.88	5.6	254,863.01	289,617.06	344,782.22	359,148.14	355,556.66	315	1129	2370.9	355635	355.635	$	2.80	$ 995,778.00
012	Tlalpan	5	Public Urban	1072224	519,921.42	519,921,417.60	1,424,442.24	5.6	254,364.69	289,050.78	344,108.07	358,445.91	354,861.45	315	1127	2366.7	355005	355.005	$	2.80	$ 994,014.00
012	Tlalpan	6	Public Urban	1576800	439,990.00	439,990,000.00	1,205,452.05	5.6	215,259.30	244,612.84	291,205.76	303,339.33	300,305.94	315	954	2003.4	300510	300.51	$	2.80	$ 841,428.00

012	Tlalpan	7	Public Urban	9460800	519,940.00	519,940,000.00	1,424,493.15	5.6	254,373.78	289,061.11	344,120.37	358,458.72	354,874.13	315	1127	2366.7	355005	355.005	$ 2.80	$ 994,014.00
012	Tlalpan	8	Public Urban	1229904	596,380.45	596,380,449.60	1,633,919.04	5.6	291,771.26	331,558.25	394,712.20	411,158.54	407,046.95	315	1293	2715.3	407295	407.295	$ 2.80	$ 1,140,426.00
012	Tlalpan	9	Public Urban	1072224	519,921.42	519,921,417.60	1,424,442.24	5.6	254,364.69	289,050.78	344,108.07	358,445.91	354,861.45	315	1127	2366.7	355005	355.005	$ 2.80	$ 994,014.00
012	Tlalpan	10	Public Urban	599184	688,808.00	688,808,000.00	1,887,145.21	5.6	336,990.22	382,943.43	455,885.03	474,880.24	470,131.44	315	1493	3135.3	470295	470.295	$ 2.80	$ 1,316,826.00
012	Tlalpan	11	Public Urban	1324512	703,669.00	703,669,000.00	1,927,860.27	5.6	344,260.76	391,205.41	465,720.73	485,125.76	480,274.50	315	1525	3202.5	480375	480.375	$ 2.80	$ 1,345,050.00
012	Tlalpan	12	Public Urban	946080	724,760.00	724,760,000.00	1,985,643.84	5.6	354,579.26	402,930.97	479,679.73	499,666.39	494,669.72	315	1571	3299.1	494865	494.865	$ 2.80	$ 1,385,622.00
012	Tlalpan	13	Public Urban	946080	409,860.00	409,860,000.00	1,122,904.11	5.6	200,518.59	227,862.04	271,264.33	282,567.01	279,741.34	315	889	1866.9	280035	280.035	$ 2.80	$ 784,098.00
012	Tlalpan	14	Public Urban	378432	14,249.00	14,249,000.00	39,038.36	5.6	6,971.14	7,921.74	9,430.65	9,823.59	9,725.36	315	31	65.1	9765	9.765	$ 2.80	$ 27,342.00
012	Tlalpan	15	Public Urban	473040	600,030.00	600,030,000.00	1,643,917.81	5.6	293,556.75	333,587.22	397,127.64	413,674.62	409,537.88	315	1301	2732.1	409815	409.815	$ 2.80	$ 1,147,482.00
012	Tlalpan	16	Public Urban	2239056	844,460.00	844,460,000.00	2,313,589.04	5.6	413,140.90	469,478.30	558,902.73	582,190.35	576,368.44	315	1830	3843	576450	576.45	$ 2.80	$ 1,614,060.00
012	Tlalpan	17	Public Urban	1482192	680,050.00	680,050,000.00	1,863,150.68	5.6	332,705.48	378,074.41	450,088.58	468,842.27	464,153.85	315	1474	3095.4	464310	464.31	$ 2.80	$ 1,300,068.00
012	Tlalpan	18	Public Urban	630720	863,699.00	863,699,000.00	2,366,298.63	5.6	422,553.33	480,174.24	571,635.99	595,454.16	589,499.62	315	1872	3931.2	589680	589.68	$ 2.80	$ 1,651,104.00
012	Tlalpan	19	Public Urban	1292976	660,760.00	660,760,000.00	1,810,301.37	5.6	323,268.10	367,350.12	437,321.57	455,543.30	450,987.87	315	1432	3007.2	451080	451.08	$ 2.80	$ 1,263,024.00
012	Tlalpan	20	Public Urban	1387584	391,130.00	391,130,000.00	1,071,589.04	5.6	191,355.19	217,449.07	258,867.95	269,654.11	266,957.57	315	848	1780.8	267120	267.12	$ 2.80	$ 747,936.00
012	Tlalpan	21	Public Urban	346896	168,209.87	168,209,870.40	460,848.96	5.6	82,294.46	93,516.43	111,329.08	115,967.79	114,808.12	315	365	766.5	114975	114.975	$ 2.80	$ 321,930.00
012	Tlalpan	22	Public Urban	1356048	730,740.00	730,740,000.00	2,002,027.40	5.6	357,504.89	406,255.56	483,637.57	503,789.14	498,751.24	315	1584	3326.4	498960	498.96	$ 2.80	$ 1,397,088.00
012	Tlalpan	23	Public Urban	2175984	286,090.00	286,090,000.00	783,808.22	5.6	139,965.75	159,051.99	189,347.61	197,237.09	195,264.72	315	620	1302	195300	195.3	$ 2.80	$ 546,840.00
012	Tlalpan	24	Public Urban	1324512	642,255.87	642,255,868.80	1,759,605.12	5.6	314,215.20	357,062.73	425,074.68	442,786.12	438,358.26	315	1392	2923.2	438480	438.48	$ 2.80	$ 1,227,744.00
012	Tlalpan	25	Public Urban	946080	708,119.00	708,119,000.00	1,940,052.05	5.6	346,437.87	393,679.39	468,665.95	488,193.69	483,311.76	315	1535	3223.5	483525	483.525	$ 2.80	$ 1,353,870.00
012	Tlalpan	26	Public Urban	946080	458,754.19	458,754,192.00	1,256,860.80	5.6	224,439.43	255,044.81	303,624.77	316,275.80	313,113.04	315	995	2089.5	313425	313.425	$ 2.80	$ 877,590.00
012	Tlalpan	27	Public Urban	1892160	666,690.00	666,690,000.00	1,826,547.95	5.6	326,169.28	370,646.90	441,246.31	459,631.58	455,035.26	315	1445	3034.5	455175	455.175	$ 2.80	$ 1,274,490.00
012	Tlalpan	28	Public Urban	1261440	393,480.00	393,480,000.00	1,078,027.40	5.6	192,504.89	218,755.56	260,423.29	271,274.26	268,561.51	315	853	1791.3	268695	268.695	$ 2.80	$ 752,346.00
012	Tlalpan	29	Public Urban	FO	380,050.00	380,050,000.00	1,041,232.88	5.6	185,934.44	211,289.14	251,534.69	262,015.30	259,395.15	315	824	1730.4	259560	259.56	$ 2.80	$ 726,768.00
012	Tlalpan	30	Public Urban	SD	388,330.00	388,330,000.00	1,063,917.81	5.6	189,985.32	215,892.41	257,014.78	267,723.73	265,046.49	315	842	1768.2	265230	265.23	$ 2.80	$ 742,644.00
012	Tlalpan	31	Public Urban	1892160	18,849.00	18,849,000.00	51,641.10	5.6	9,221.62	10,479.12	12,475.14	12,994.94	12,864.99	315	41	86.1	12915	12.915	$ 2.80	$ 36,162.00
012	Tlalpan	32	Public Urban	2207520	661,965.00	661,965,000.00	1,813,602.74	5.6	323,857.63	368,020.04	438,119.09	456,374.05	451,810.31	315	1435	3013.5	452025	452.025	$ 2.80	$ 1,265,670.00
012	Tlalpan	33	Public Urban	946080	846,069.00	846,069,000.00	2,317,997.26	5.6	413,928.08	470,372.82	559,967.64	583,299.63	577,466.63	315	1834	3851.4	577710	577.71	$ 2.80	$ 1,617,588.00
012	Tlalpan	34	Public Urban	819936	647,400.00	647,400,000.00	1,773,698.63	5.6	316,731.90	359,922.61	428,479.30	446,332.60	441,869.28	315	1403	2946.3	441945	441.945	$ 2.80	$ 1,237,446.00
012	Tlalpan	35	Public Urban	2522880	959,930.00	959,930,000.00	2,629,945.21	5.6	469,633.07	533,673.95	635,326.13	661,798.05	655,180.07	315	2080	4368	655200	655.2	$ 2.80	$ 1,834,560.00
012	Tlalpan	36	Public Urban	1892160	5,669.00	5,669,000.00	15,531.51	5.6	2,773.48	3,151.69	3,752.01	3,908.34	3,869.26	315	13	27.3	4095	4.095	$ 2.80	$ 11,466.00
012	Tlalpan	37	Public Urban	1009152	509,290.00	509,290,000.00	1,395,315.07	5.6	249,163.41	283,140.23	337,071.71	351,116.36	347,605.20	315	1104	2318.4	347760	347.76	$ 2.80	$ 973,728.00
012	Tlalpan	38	Public Urban	1261440	886,778.00	886,778,000.00	2,429,528.77	5.6	433,844.42	493,005.03	586,910.74	611,365.36	605,251.71	315	1922	4036.2	605430	605.43	$ 2.80	$ 1,695,204.00
012	Tlalpan	39	Public Urban	788400	272,910.00	272,910,000.00	747,698.63	5.6	133,517.61	151,724.56	180,624.48	188,150.50	186,268.99	315	592	1243.2	186480	186.48	$ 2.80	$ 522,144.00
012	Tlalpan	40	Public Urban	946080	696,469.00	696,469,000.00	1,908,134.25	5.6	340,738.26	387,202.57	460,955.44	480,161.91	475,360.29	315	1510	3171	475650	475.65	$ 2.80	$ 1,331,820.00
012	Tlalpan	41	Public Urban	946080	845,990.00	845,990,000.00	2,317,780.82	5.6	413,889.43	470,328.90	559,915.36	583,245.16	577,412.71	315	1834	3851.4	577710	577.71	$ 2.80	$ 1,617,588.00
012	Tlalpan	42	Public Urban	2207520	615,790.00	615,790,000.00	1,687,095.89	5.6	301,267.12	342,349.00	407,558.34	424,539.94	420,294.54	315	1335	2803.5	420525	420.525	$ 2.80	$ 1,177,470.00
012	Tlalpan	43	Public Urban	473040	973,790.00	973,790,000.00	2,667,917.81	5.6	476,413.89	541,379.43	644,499.32	671,353.45	664,639.92	315	2110	4431	664650	664.65	$ 2.80	$ 1,861,020.00
012	Tlalpan	44	Public Urban	977616	832,810.00	832,810,000.00	2,281,671.23	5.6	407,441.29	463,001.47	551,192.22	574,158.57	568,416.98	315	1805	3790.5	568575	568.575	$ 2.80	$ 1,592,010.00
012	Tlalpan	45	Public Urban	630720	731,410.00	731,410,000.00	2,003,863.01	5.6	357,832.68	406,628.05	484,081.01	504,251.05	499,208.54	315	1585	3328.5	499275	499.275	$ 2.80	$ 1,397,970.00
012	Tlalpan	46	Public Urban	1103760	1,597,440.00	1,597,440,000.00	4,376,547.95	5.6	781,526.42	888,098.20	1,057,259.77	1,101,312.26	1,090,299.13	315	3462	7270.2	1090530	1090.53	$ 2.80	$ 3,053,484.00
012	Tlalpan	47	Public Urban	1576800	9,260.00	9,260,000.00	25,369.86	5.6	4,530.33	5,148.11	6,128.70	6,384.06	6,320.22	315	21	44.1	6615	6.615	$ 2.80	$ 18,522.00
012	Tlalpan	48	Public Urban	851472	412,878.77	412,878,772.80	1,131,174.72	5.6	201,995.49	229,540.32	273,262.29	284,648.22	281,801.74	315	895	1879.5	281925	281.925	$ 2.80	$ 789,390.00
012	Tlalpan	49	Public Urban	378432	665,030.00	665,030,000.00	1,822,000.00	5.6	325,357.14	369,724.03	440,147.65	458,487.14	453,902.26	315	1441	3026.1	453915	453.915	$ 2.80	$ 1,270,962.00
012	Tlalpan	50	Public Urban	441504	214,085.29	214,085,289.60	586,535.04	5.6	104,738.40	119,020.91	141,691.56	147,595.37	146,119.42	315	464	974.4	146160	146.16	$ 2.80	$ 409,248.00
012	Tlalpan	51	Public Urban	1860624	396,930.00	396,930,000.00	1,087,479.45	5.6	194,192.76	220,673.59	262,706.65	273,652.77	270,916.24	315	861	1808.1	271215	271.215	$ 2.80	$ 759,402.00
012	Tlalpan	52	Public Urban	693792	611,490.00	611,490,000.00	1,675,315.07	5.6	299,163.41	339,958.41	404,712.40	421,575.42	417,359.66	315	1325	2782.5	417375	417.375	$ 2.80	$ 1,168,650.00
012	Tlalpan	53	Public Urban	1198368	769,970.00	769,970,000.00	2,109,506.85	5.6	376,697.65	428,065.51	509,601.80	530,835.21	525,526.86	315	1669	3504.9	525735	525.735	$ 2.80	$ 1,472,058.00
012	Tlalpan	54	Public Urban	1103760	535,213.22	535,213,224.00	1,466,337.60	5.6	261,846.00	297,552.27	354,228.90	368,988.43	365,298.55	315	1160	2436	365400	365.4	$ 2.80	$ 1,023,120.00
012	Tlalpan	55	Public Urban	693792	336,419.74	336,419,740.80	921,697.92	5.6	164,588.91	187,032.86	222,658.16	231,935.59	229,616.23	315	729	1530.9	229635	229.635	$ 2.80	$ 642,978.00
012	Tlalpan	56	Public Urban	1009152	671,680.00	671,680,000.00	1,840,219.18	5.6	328,610.57	373,421.10	444,548.93	463,071.80	458,441.08	315	1456	3057.6	458640	458.64	$ 2.80	$ 1,284,192.00
012	Tlalpan	57	Public Urban	1576800	381,820.00	381,820,000.00	1,046,082.19	5.6	186,800.39	212,273.17	252,706.16	263,235.58	260,603.22	315	828	1738.8	260820	260.82	$ 2.80	$ 730,296.00
012	Tlalpan	58	Public Urban	851472	235,030.00	235,030,000.00	643,917.81	5.6	114,985.32	130,665.14	155,553.74	162,035.14	160,414.79	315	510	1071	160650	160.65	$ 2.80	$ 449,820.00
012	Tlalpan	59	Public Urban	1072224	505,580.00	505,580,000.00	1,385,150.68	5.6	247,348.34	281,077.66	334,616.26	348,558.60	345,073.01	315	1096	2301.6	345240	345.24	$ 2.80	$ 966,672.00
012	Tlalpan	60	Public Urban	819936	596,630.00	596,630,000.00	1,634,602.74	5.6	291,893.35	331,696.98	394,877.36	411,330.59	407,217.28	315	1293	2715.3	407295	407.295	$ 2.80	$ 1,140,426.00
012	Tlalpan	61	Public Urban	315360	234,600.00	234,600,000.00	642,739.73	5.6	114,774.95	130,426.08	155,269.14	161,738.69	160,121.30	315	509	1068.9	160335	160.335	$ 2.80	$ 448,938.00
012	Tlalpan	62	Public Urban	756864	445,790.00	445,790,000.00	1,221,342.47	5.6	218,096.87	247,837.35	295,044.47	307,337.98	304,264.61	315	966	2028.6	304290	304.29	$ 2.80	$ 852,012.00
012	Tlalpan	63	Public Urban	473040	284,560.00	284,560,000.00	779,616.44	5.6	139,217.22	158,201.39	188,334.99	196,182.28	194,220.45	315	617	1295.7	194355	194.355	$ 2.80	$ 544,194.00
012	Tlalpan	64	Public Urban	1986768	20,049.00	20,049,000.00	54,928.77	5.6	9,808.71	11,146.26	13,269.36	13,822.25	13,684.02	315	44	92.4	13860	13.86	$ 2.80	$ 38,808.00
012	Tlalpan	65	Public Urban	1040688	524,170.00	524,170,000.00	1,436,082.19	5.6	256,443.25	291,412.78	346,919.98	361,374.98	357,761.23	315	1136	2385.6	357840	357.84	$ 2.80	$ 1,001,952.00
012	Tlalpan	66	Public Urban	409968	902,158.00	902,158,000.00	2,471,665.75	5.6	441,368.88	501,555.55	597,089.94	621,968.69	615,749.00	315	1955	4105.5	615825	615.825	$ 2.80	$ 1,724,310.00
012	Tlalpan	67	Public Urban	473040	17,319.00	17,319,000.00	47,449.32	5.6	8,473.09	9,628.51	11,462.52	11,940.12	11,820.72	315	38	79.8	11970	11.97	$ 2.80	$ 33,516.00
012	Tlalpan	68	Public Urban	693792	288,790.00	288,790,000.00	791,205.48	5.6	141,286.69	160,553.06	191,134.60	199,098.54	197,107.55	315	626	1314.6	197190	197.19	$ 2.80	$ 552,132.00
012	Tlalpan	69	Public Urban	883008	689,078.00	689,078,000.00	1,887,884.93	5.6	337,122.31	383,093.53	456,063.73	475,066.39	470,315.72	315	1494	3137.4	470610	470.61	$ 2.80	$ 1,317,708.00
012	Tlalpan	70	Public Urban	315360	665,950.00	665,950,000.00	1,824,520.55	5.6	325,807.24	370,235.50	440,756.55	459,121.40	454,530.19	315	1443	3030.3	454545	454.545	$ 2.80	$ 1,272,726.00
012	Tlalpan	71	Public Urban	1608336	404,060.00	404,060,000.00	1,107,013.70	5.6	197,681.02	224,637.52	267,425.62	278,568.35	275,782.67	315	876	1839.6	275940	275.94	$ 2.80	$ 772,632.00
012	Tlalpan	72	Public Urban	315360	443,560.00	443,560,000.00	1,215,232.88	5.6	217,005.87	246,597.58	293,568.55	305,800.57	302,742.57	315	962	2020.2	303030	303.03	$ 2.80	$ 848,484.00
012	Tlalpan	73	Public Urban	315360	401,410.00	401,410,000.00	1,099,753.42	5.6	196,384.54	223,164.25	265,671.73	276,741.38	273,973.97	315	870	1827	274050	274.05	$ 2.80	$ 767,340.00
012	Tlalpan	74	Public Urban	315360	674,780.00	674,780,000.00	1,848,712.33	5.6	330,127.20	375,144.55	446,600.65	465,209.01	460,556.92	315	1463	3072.3	460845	460.845	$ 2.80	$ 1,290,366.00
012	Tlalpan	75	Public Urban	315360	1,591,640.00	1,591,640,000.00	4,360,657.53	5.6	778,688.85	884,873.69	1,053,421.06	1,097,313.60	1,086,340.47	315	3449	7242.9	1086435	1086.435	$ 2.80	$ 3,042,018.00
012	Tlalpan	76	Public Urban	662256	724,140.00	724,140,000.00	1,983,945.21	5.6	354,275.93	402,586.28	479,269.39	499,238.94	494,246.55	315	1570	3297	494550	494.55	$ 2.80	$ 1,384,740.00
012	Tlalpan	77	Public Urban	1135296	768,700.00	768,700,000.00	2,106,027.40	5.6	376,076.32	427,359.46	508,761.26	529,959.64	524,660.05	315	1666	3498.6	524790	524.79	$ 2.80	$ 1,469,412.00
012	Tlalpan	78	Public Urban	1166832	439,990.00	439,990,000.00	1,205,452.05	5.6	215,259.30	244,612.84	291,205.76	303,339.33	300,305.94	315	954	2003.4	300510	300.51	$ 2.80	$ 841,428.00
012	Tlalpan	79	Public Urban	630720	729,940.00	729,940,000.00	1,999,835.62	5.6	357,113.50	405,810.80	483,108.09	503,237.60	498,205.22	315	1582	3322.2	498330	498.33	$ 2.80	$ 1,395,324.00
012	Tlalpan	80	Public Urban	2838240	1,376,262.58	1,376,262,576.00	3,770,582.40	5.6	673,318.29	765,134.42	910,874.30	948,827.40	939,339.13	315	2983	6264.3	939645	939.645	$ 2.80	$ 2,631,006.00
012	Tlalpan	81	Public Urban	0	0.00	-	-	5.6	-	-	-	-	-	315	0	0	0	0	$ 2.80	$ -

012	Tlalpan	82	Public Urban	0	977,560.00	977,560,000.00	2,678,246.58	5.6	478,258.32	543,475.36	646,994.48	673,952.58	667,213.05	315	2119	4449.9	667485	667.485	$	2.80	$ 1,868,958.00
012	Tlalpan	83	Public Urban	567648	523,210.00	523,210,000.00	1,433,452.05	5.6	255,973.58	290,879.07	346,284.61	360,713.13	357,106.00	315	1134	2381.4	357210	357.21	$	2.80	$ 1,000,188.00
012	Tlalpan	84	Public Urban	883008	614,260.00	614,260,000.00	1,682,904.11	5.6	300,518.59	341,498.40	406,545.71	423,485.12	419,250.27	315	1331	2795.1	419265	419.265	$	2.80	$ 1,173,942.00
012	Tlalpan	85	Public Urban	2207520	509,060.00	509,060,000.00	1,394,684.93	5.6	249,050.88	283,012.36	336,919.48	350,957.79	347,448.22	315	1104	2318.4	347760	347.76	$	2.80	$ 973,728.00
012	Tlalpan	86	Public Urban	0	0.00	-	-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
012	Tlalpan	87	Public Urban	-	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
012	Tlalpan	88	Public Urban	-	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
012	Tlalpan	89	Public Urban	883008	-		-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
013	Xochimilco	1	Public Urban	1292976	659,050.00	659,050,000.00	1,805,616.44	5.6	322,431.51	366,399.44	436,189.81	454,364.38	449,820.74	315	1429	3000.9	450135	450.135	$	2.80	$ 1,260,378.00
013	Xochimilco	2	Public Urban	2144448	971,580.00	971,580,000.00	2,661,863.01	5.6	475,332.68	540,150.77	643,036.64	669,829.83	663,131.53	315	2106	4422.6	663390	663.39	$	2.80	$ 1,857,492.00
013	Xochimilco	3	Public Urban	1261440	674,070.00	674,070,000.00	1,846,767.12	5.6	329,779.84	374,749.82	446,130.74	464,719.52	460,072.33	315	1461	3068.1	460215	460.215	$	2.80	$ 1,288,602.00
013	Xochimilco	4	Public Urban	567648	517,230.00	517,230,000.00	1,417,068.49	5.6	253,047.95	287,554.48	342,326.77	356,590.38	353,024.48	315	1121	2354.1	353115	353.115	$	2.80	$ 988,722.00
013	Xochimilco	5	Public Urban	504576	608,280.00	608,280,000.00	1,666,520.55	5.6	297,592.95	338,173.81	402,587.87	419,362.37	415,168.74	315	1318	2767.8	415170	415.17	$	2.80	$ 1,162,476.00
013	Xochimilco	6	Public Urban	1261440	830,800.00	830,800,000.00	2,276,164.38	5.6	406,457.93	461,884.01	549,861.91	572,772.83	567,045.10	315	1801	3782.1	567315	567.315	$	2.80	$ 1,588,482.00
013	Xochimilco	7	Public Urban	1671408	594,050.00	594,050,000.00	1,627,534.25	5.6	290,631.12	330,262.63	393,169.80	409,551.87	405,456.36	315	1288	2704.8	405720	405.72	$	2.80	$ 1,136,016.00
013	Xochimilco	8	Public Urban	1576800	791,484.00	791,484,000.00	2,168,449.32	5.6	387,223.09	440,026.24	523,840.76	545,667.46	540,210.79	315	1715	3601.5	540225	540.225	$	2.80	$ 1,512,630.00
013	Xochimilco	9	Public Urban	1986768	837,260.00	837,260,000.00	2,293,863.01	5.6	409,618.40	465,475.45	554,137.44	577,226.50	571,454.23	315	1815	3811.5	571725	571.725	$	2.80	$ 1,600,830.00
013	Xochimilco	10	Public Urban	1103760	681,878.00	681,878,000.00	1,868,158.90	5.6	333,599.80	379,090.69	451,298.44	470,102.54	465,401.51	315	1478	3103.8	465570	465.57	$	2.80	$ 1,303,596.00
013	Xochimilco	11	Public Urban	2333664	700,919.00	700,919,000.00	1,920,326.03	5.6	342,915.36	389,676.55	463,900.65	483,229.85	478,397.55	315	1519	3189.9	478485	478.485	$	2.80	$ 1,339,758.00
013	Xochimilco	12	Public Urban	-	-	-	-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
013	Xochimilco	13	Public Urban	1419120	688,131.29	688,131,288.00	1,885,291.20	5.6	336,659.14	382,567.21	455,437.15	474,413.70	469,669.56	315	1492	3133.2	469980	469.98	$	2.80	$ 1,315,944.00
013	Xochimilco	14	Public Urban	-	675,918.00	675,918,000.00	1,851,830.14	5.6	330,683.95	375,777.22	447,353.83	465,993.58	461,333.64	315	1465	3076.5	461475	461.475	$	2.80	$ 1,292,130.00
013	Xochimilco	15	Public Urban	977616	510,030.00	510,030,000.00	1,397,342.47	5.6	249,525.44	283,551.64	337,561.47	351,626.53	348,110.27	315	1106	2322.6	348390	348.39	$	2.80	$ 975,492.00
013	Xochimilco	16	Public Urban	1324512	642,255.87	642,255,868.80	1,759,605.12	5.6	314,215.20	357,062.73	425,074.68	442,786.12	438,358.26	315	1392	2923.2	438480	438.48	$	2.80	$ 1,227,744.00
013	Xochimilco	17	Public Urban	1072224	1,588,510.00	1,588,510,000.00	4,352,082.19	5.6	777,157.53	883,133.56	1,051,349.48	1,095,155.71	1,084,204.15	315	3442	7228.2	1084230	1084.23	$	2.80	$ 3,035,844.00
013	Xochimilco	18	Public Urban	1103760	436,360.00	436,360,000.00	1,195,506.85	5.6	213,483.37	242,594.73	288,803.25	300,836.72	297,828.36	315	946	1986.6	297990	297.99	$	2.80	$ 834,372.00
013	Xochimilco	19	Public Urban	1702944	10,119.00	10,119,000.00	27,723.29	5.6	4,950.59	5,625.67	6,697.22	6,976.27	6,906.51	315	22	46.2	6930	6.93	$	2.80	$ 19,404.00
013	Xochimilco	20	Public Urban	1292976	513,740.00	513,740,000.00	1,407,506.85	5.6	251,340.51	285,614.21	340,016.92	354,184.29	350,642.45	315	1114	2339.4	350910	350.91	$	2.80	$ 982,548.00
013	Xochimilco	21	Public Urban	1482192	277,360.00	277,360,000.00	759,890.41	5.6	135,694.72	154,198.54	183,569.69	191,218.43	189,306.24	315	601	1262.1	189315	189.315	$	2.80	$ 530,082.00
013	Xochimilco	22	Public Urban	1292976	397,930.00	397,930,000.00	1,090,219.18	5.6	194,682.00	221,229.54	263,368.50	274,342.19	271,598.77	315	863	1812.3	271845	271.845	$	2.80	$ 761,166.00
013	Xochimilco	23	Public Urban	1198368	384,500.00	384,500,000.00	1,053,424.66	5.6	188,111.55	213,763.12	254,479.91	265,083.23	262,432.40	315	834	1751.4	262710	262.71	$	2.80	$ 735,588.00
013	Xochimilco	24	Public Urban	977616	658,750.00	658,750,000.00	1,804,794.52	5.6	322,284.74	366,232.65	435,991.26	454,157.56	449,615.98	315	1428	2998.8	449820	449.82	$	2.80	$ 1,259,496.00
013	Xochimilco	25	Public Urban	977616	227,400.00	227,400,000.00	623,013.70	5.6	111,252.45	126,423.23	150,503.85	156,774.84	155,207.10	315	493	1035.3	155295	155.295	$	2.80	$ 434,826.00
013	Xochimilco	26	Public Urban	1513728	7,730.00	7,730,000.00	21,178.08	5.6	3,781.80	4,297.50	5,116.07	5,329.24	5,275.95	315	17	35.7	5355	5.355	$	2.80	$ 14,994.00
013	Xochimilco	27	Public Urban	1986768	392,945.00	392,945,000.00	1,076,561.64	5.6	192,243.15	218,458.13	260,069.20	270,905.41	268,196.36	315	852	1789.2	268380	268.38	$	2.80	$ 751,464.00
013	Xochimilco	28	Public Urban	1576800	666,870.00	666,870,000.00	1,827,041.10	5.6	326,257.34	370,746.98	441,365.45	459,755.67	455,158.12	315	1445	3034.5	455175	455.175	$	2.80	$ 1,274,490.00
013	Xochimilco	29	Public Urban	914544	891,228.00	891,228,000.00	2,441,720.55	5.6	436,021.53	495,479.01	589,855.96	614,433.29	608,288.96	315	1932	4057.2	608580	608.58	$	2.80	$ 1,704,024.00
013	Xochimilco	30	Public Urban	693792	850,519.00	850,519,000.00	2,330,189.04	5.6	416,105.19	472,846.80	562,912.86	586,367.56	580,503.89	315	1843	3870.3	580545	580.545	$	2.80	$ 1,625,526.00
013	Xochimilco	31	Public Urban	725328	651,850.00	651,850,000.00	1,785,890.41	5.6	318,909.00	362,396.59	431,424.52	449,400.54	444,906.53	315	1413	2967.3	445095	445.095	$	2.80	$ 1,246,266.00
013	Xochimilco	32	Public Urban	1450656	964,380.00	964,380,000.00	2,642,136.99	5.6	471,810.18	536,147.93	638,271.34	664,865.98	658,217.32	315	2090	4389	658350	658.35	$	2.80	$ 1,843,380.00
013	Xochimilco	33	Public Urban	-	647,870.00	647,870,000.00	1,774,986.30	5.6	316,961.84	360,183.91	428,790.37	446,656.63	442,190.07	315	1404	2948.4	442260	442.26	$	2.80	$ 1,238,328.00
013	Xochimilco	34	Public Urban	1166832	601,080.00	601,080,000.00	1,646,794.52	5.6	294,070.45	334,170.97	397,822.58	414,398.52	410,254.53	315	1303	2736.3	410445	410.445	$	2.80	$ 1,149,246.00
013	Xochimilco	35	Public Urban	1292976	782,804.00	782,804,000.00	2,144,668.49	5.6	382,976.52	435,200.59	518,095.94	539,683.27	534,286.44	315	1697	3563.7	534555	534.555	$	2.80	$ 1,496,754.00
013	Xochimilco	36	Public Urban	-	695,459.00	695,459,000.00	1,905,367.12	5.6	340,244.13	386,641.06	460,286.97	479,465.60	474,670.94	315	1507	3164.7	474705	474.705	$	2.80	$ 1,329,174.00
013	Xochimilco	37	Public Urban	-	507,050.00	507,050,000.00	1,389,178.08	5.6	248,067.51	281,894.90	335,589.17	349,572.05	346,076.33	315	1099	2307.9	346185	346.185	$	2.80	$ 969,318.00
013	Xochimilco	38	Public Urban	-	430,380.00	430,380,000.00	1,179,123.29	5.6	210,557.73	239,270.15	284,845.41	296,713.97	293,746.83	315	933	1959.3	293895	293.895	$	2.80	$ 822,906.00
013	Xochimilco	39	Public Urban	-		-	-	5.6	-	-	-	-	-	315	0	0	0	0	$	2.80	$ -
013	Xochimilco	40	Public Urban	3342816	4,139.00	4,139,000.00	11,339.73	5.6	2,024.95	2,301.08	2,739.38	2,853.52	2,824.99	315	9	18.9	2835	2.835	$	2.80	$ 7,938.00
013	Xochimilco	41	Public Urban	1009152	507,760.00	507,760,000.00	1,391,123.29	5.6	248,414.87	282,289.63	336,059.08	350,061.54	346,560.93	315	1101	2312.1	346815	346.815	$	2.80	$ 971,082.00
013	Xochimilco	42	Public Urban	1324512	885,248.00	885,248,000.00	2,425,336.99	5.6	433,095.89	492,154.42	585,898.12	610,310.54	604,207.44	315	1919	4029.9	604485	604.485	$	2.80	$ 1,692,558.00
013	Xochimilco	43	Public Urban	-	661,890.00	661,890,000.00	1,813,397.26	5.6	323,820.94	367,978.34	438,069.45	456,322.35	451,759.12	315	1435	3013.5	452025	452.025	$	2.80	$ 1,265,670.00
013	Xochimilco	44	Public Urban	2270592	586,850.00	586,850,000.00	1,607,808.22	5.6	287,108.61	326,259.78	388,404.51	404,588.03	400,542.15	315	1272	2671.2	400680	400.68	$	2.80	$ 1,121,904.00
013	Xochimilco	45	Public Urban	2270592	784,284.00	784,284,000.00	2,148,723.29	5.6	383,700.59	436,023.39	519,075.47	540,703.61	535,296.58	315	1700	3570	535500	535.5	$	2.80	$ 1,499,400.00
013	Xochimilco	46	Public Urban	1892160	756,790.00	756,790,000.00	2,073,397.26	5.6	370,249.51	420,738.08	500,878.67	521,748.61	516,531.13	315	1640	3444	516600	516.6	$	2.80	$ 1,446,480.00
013	Xochimilco	47	Public Urban	1166832	831,280.00	831,280,000.00	2,277,479.45	5.6	406,692.76	462,150.86	550,179.60	573,103.75	567,372.71	315	1802	3784.2	567630	567.63	$	2.80	$ 1,589,364.00
013	Xochimilco	48	Public Urban	-	755,810.00	755,810,000.00	2,070,712.33	5.6	369,770.06	420,193.25	500,230.06	521,072.98	515,862.25	315	1638	3439.8	515970	515.97	$	2.80	$ 1,444,716.00
013	Xochimilco	49	Public Urban	2649024	675,898.00	675,898,000.00	1,851,775.34	5.6	330,674.17	375,766.10	447,340.60	465,979.79	461,319.99	315	1465	3076.5	461475	461.475	$	2.80	$ 1,292,130.00
013	Xochimilco	50	Public Urban	473040	694,939.00	694,939,000.00	1,903,942.47	5.6	339,989.73	386,351.96	459,942.81	479,107.09	474,316.02	315	1506	3162.6	474390	474.39	$	2.80	$ 1,328,292.00
013	Xochimilco	51	Public Urban	2964384	716,030.00	716,030,000.00	1,961,726.03	5.6	350,308.22	398,077.52	473,901.81	493,647.72	488,711.24	315	1552	3259.2	488880	488.88	$	2.80	$ 1,368,864.00
013	Xochimilco	52	Public Urban	914544	717,000.00	717,000,000.00	1,964,383.56	5.6	350,782.78	398,616.79	474,543.80	494,316.46	489,373.30	315	1554	3263.4	489510	489.51	$	2.80	$ 1,370,628.00
013	Xochimilco	53	Public Urban	2112912	1,582,530.00	1,582,530,000.00	4,335,698.63	5.6	774,231.90	879,808.98	1,047,391.64	1,091,032.96	1,080,122.63	315	3429	7200.9	1080135	1080.135	$	2.80	$ 3,024,378.00
013	Xochimilco	54	Public Urban	1356048	271,380.00	271,380,000.00	743,506.85	5.6	132,769.08	150,873.95	179,611.85	187,095.68	185,224.72	315	589	1236.9	185535	185.535	$	2.80	$ 519,498.00
013	Xochimilco	55	Public Urban	1103760	642,255.87	642,255,868.80	1,759,605.12	5.6	314,215.20	357,062.73	425,074.68	442,786.12	438,358.26	315	1392	2923.2	438480	438.48	$	2.80	$ 1,227,744.00
013	Xochimilco	56	Public Urban	1040688	391,950.00	391,950,000.00	1,073,835.62	5.6	191,756.36	217,904.95	259,410.66	270,219.44	267,517.24	315	850	1785	267750	267.75	$	2.80	$ 749,700.00
013	Xochimilco	57	Public Urban	2049840	378,520.00	378,520,000.00	1,037,041.10	5.6	185,185.91	210,438.53	250,522.06	260,960.48	258,350.88	315	821	1724.1	258615	258.615	$	2.80	$ 724,122.00
013	Xochimilco	58	Public Urban	2649024	652,770.00	652,770,000.00	1,788,410.96	5.6	319,359.10	362,908.07	432,033.41	450,034.81	445,534.46	315	1415	2971.5	445725	445.725	$	2.80	$ 1,248,030.00
013	Xochimilco	59	Public Urban	1229904	221,420.00	221,420,000.00	606,630.14	5.6	108,326.81	123,098.65	146,546.01	152,652.09	151,125.57	315	480	1008	151200	151.2	$	2.80	$ 423,360.00
013	Xochimilco	60	Public Urban	788400	1,750.00	1,750,000.00	4,794.52	5.6	856.16	972.91	1,158.23	1,206.49	1,194.43	315	4	8.4	1260	1.26	$	2.80	$ 3,528.00
013	Xochimilco	61	Public Urban	788400	386,965.00	386,965,000.00	1,060,178.08	5.6	189,317.51	215,133.54	256,111.36	266,782.66	264,114.84	315	839	1761.9	264285	264.285	$	2.80	$ 739,998.00
013	Xochimilco	62	Public Urban	599184	834,380.00	834,380,000.00	2,285,972.60	5.6	408,209.39	463,874.31	552,231.32	575,240.96	569,488.55	315	1808	3796.8	569520	569.52	$	2.80	$ 1,594,656.00
013	Xochimilco	63	Public Urban	1639872	679,498.00	679,498,000.00	1,861,638.36	5.6	332,435.42	377,767.52	449,723.24	468,461.71	463,777.09	315	1473	3093.3	463995	463.995	$	2.80	$ 1,299,186.00
013	Xochimilco	64	Public Urban	977616	699,039.00	699,039,000.00	1,915,175.34	5.6	341,995.60	388,631.36	462,656.38	481,933.73	477,114.39	315	1515	3181.5	477225	477.225	$	2.80	$ 1,336,230.00
013	Xochimilco	65	Public Urban	-	720,630.00	720,630,000.00	1,974,328.77	5.6	352,558.71	400,634.90	476,946.30	496,819.07	491,850.88	315	1562	3280.2	492030	492.03	$	2.80	$ 1,377,684.00
013	Xochimilco	66	Public Urban	-	722,100.00	722,100,000.00	1,978,356.16	5.6	353,277.89	401,452.14	477,919.22	497,832.52	492,854.19	315	1565	3286.5	492975	492.975	$	2.80	$ 1,380,330.00
013	Xochimilco	67	Public Urban	1040688	857,719.00	857,719,000.00	2,349,915.07	5.6	419,627.69	476,849.65	567,678.15	591,331.41	585,418.10	315	1859	3903.9	585585	585.585	$	2.80	$ 1,639,638.00

013	Xochimilco	68	Public Urban	1797552	231,520.00	231,520,000.00	634,301.37	5.6	113,268.10	128,713.75	153,230.66	159,615.27	158,019.12	315	502	1054.2	158130	158.13	$ 2.80	$ 442,764.00
013	Xochimilco	69	Public Urban	1103760	12,350.00	12,350,000.00	33,835.62	5.6	6,042.07	6,865.99	8,173.80	8,514.38	8,429.23	315	27	56.7	8505	8.505	$ 2.80	$ 23,814.00
013	Xochimilco	70	Public Urban	-	759,390.00	759,390,000.00	2,080,520.55	5.6	371,521.53	422,183.55	502,599.47	523,541.11	518,305.70	315	1646	3456.6	518490	518.49	$ 2.80	$ 1,451,772.00
013	Xochimilco	71	Public Urban	-	-	-	-	5.6	-	-	-	-	-	315	0	0	0	0	$ 2.80	$ -
013	Xochimilco	72	Public Urban	-	978,520.00	978,520,000.00	2,680,876.71	5.6	478,727.98	544,009.07	647,629.85	674,614.43	667,868.28	315	2121	4454.1	668115	668.115	$ 2.80	$ 1,870,722.00
013	Xochimilco	73	Public Urban	599184	686,518.00	686,518,000.00	1,880,871.23	5.6	335,869.86	381,670.30	454,369.40	473,301.46	468,568.45	315	1488	3124.8	468720	468.72	$ 2.80	$ 1,312,416.00
013	Xochimilco	74	Public Urban	-	524,670.00	524,670,000.00	1,437,452.05	5.6	256,687.87	291,690.76	347,250.90	361,719.69	358,102.49	315	1137	2387.7	358155	358.155	$ 2.80	$ 1,002,834.00
013	Xochimilco	75	Public Urban	-	404,920.00	404,920,000.00	1,109,369.86	5.6	198,101.76	225,115.64	267,994.81	279,161.26	276,369.64	315	878	1843.8	276570	276.57	$ 2.80	$ 774,396.00
013	Xochimilco	76	Public Urban	1608336	1,588,130.00	1,588,130,000.00	4,351,041.10	5.6	776,971.62	882,922.30	1,051,097.98	1,094,893.73	1,083,944.79	315	3442	7228.2	1084230	1084.23	$ 2.80	$ 3,035,844.00
013	Xochimilco	77	Public Urban	1229904	722,980.00	722,980,000.00	1,980,767.12	5.6	353,708.41	401,941.38	478,501.64	498,439.21	493,454.82	315	1567	3290.7	493605	493.605	$ 2.80	$ 1,382,094.00
013	Xochimilco	78	Public Urban	SD	584,870.00	584,870,000.00	1,602,383.56	5.6	286,139.92	325,159.00	387,094.05	403,222.97	399,190.74	315	1268	2662.8	399420	399.42	$ 2.80	$ 1,118,376.00
013	Xochimilco	79	Public Urban	1450656	718,520.00	718,520,000.00	1,968,547.95	5.6	351,526.42	399,461.84	475,549.81	495,364.38	490,410.74	315	1557	3269.7	490455	490.455	$ 2.80	$ 1,373,274.00
013	Xochimilco	80	Public Urban	1419120	717,050.00	717,050,000.00	1,964,520.55	5.6	350,807.24	398,644.59	474,576.89	494,350.93	489,407.42	315	1554	3263.4	489510	489.51	$ 2.80	$ 1,370,628.00
013	Xochimilco	81	Public Urban	473040	846,039.00	846,039,000.00	2,317,915.07	5.6	413,913.41	470,356.14	559,947.79	583,278.95	577,446.16	315	1834	3851.4	577710	577.71	$ 2.80	$ 1,617,588.00
014	Benito Juárez	1	Public Urban	409968	674,018.00	674,018,000.00	1,846,624.66	5.6	329,754.40	374,720.91	446,096.32	464,683.67	460,036.83	315	1461	3068.1	460215	460.215	$ 2.80	$ 1,288,602.00
014	Benito Juárez	2	Public Urban	1040688	509,225.00	509,225,000.00	1,395,136.99	5.6	249,131.60	283,104.10	337,028.69	351,071.55	347,560.83	315	1104	2318.4	347760	347.76	$ 2.80	$ 973,728.00
014	Benito Juárez	3	Public Urban	851472	5,259.00	5,259,000.00	14,408.22	5.6	2,572.90	2,923.75	3,480.65	3,625.68	3,589.42	315	12	25.2	3780	3.78	$ 2.80	$ 10,584.00
014	Benito Juárez	4	Public Urban	1513728	887,368.00	887,368,000.00	2,431,145.21	5.6	434,133.07	493,333.04	587,301.23	611,772.12	605,654.40	315	1923	4038.3	605745	605.745	$ 2.80	$ 1,696,086.00
014	Benito Juárez	5	Public Urban	851472	656,890.00	656,890,000.00	1,799,698.63	5.6	321,374.76	365,198.59	434,760.22	452,875.23	448,346.48	315	1424	2990.4	448560	448.56	$ 2.80	$ 1,255,968.00
014	Benito Juárez	6	Public Urban	1450656	959,000.00	959,000,000.00	2,627,397.26	5.6	469,178.08	533,156.91	634,710.61	661,156.88	654,545.32	315	2078	4363.8	654570	654.57	$ 2.80	$ 1,832,796.00
014	Benito Juárez	7	Public Urban	1419120	706,379.00	706,379,000.00	1,935,284.93	5.6	345,586.59	392,712.04	467,514.33	486,994.10	482,124.16	315	1531	3215.1	482265	482.265	$ 2.80	$ 1,350,342.00
014	Benito Juárez	8	Public Urban	441504	603,720.00	603,720,000.00	1,654,027.40	5.6	295,362.04	335,638.68	399,569.85	416,218.60	412,056.41	315	1309	2748.9	412335	412.335	$ 2.80	$ 1,154,538.00
014	Benito Juárez	9	Public Urban	157680	76,459.03	76,459,032.00	209,476.80	5.6	37,406.57	42,507.47	50,604.13	52,712.63	52,185.51	315	166	348.6	52290	52.29	$ 2.80	$ 146,412.00
014	Benito Juárez	10	Public Urban	788400	681,038.00	681,038,000.00	1,865,857.53	5.6	333,188.85	378,623.69	450,742.49	469,523.42	464,828.19	315	1476	3099.6	464940	464.94	$ 2.80	$ 1,301,832.00
014	Benito Juárez	11	Public Urban	FO	394,960.00	394,960,000.00	1,082,082.19	5.6	193,228.96	219,578.37	261,402.82	272,294.60	269,571.66	315	856	1797.6	269640	269.64	$ 2.80	$ 754,992.00
014	Benito Juárez	12	Public Urban	977616	516,400.00	516,400,000.00	1,414,794.52	5.6	252,641.88	287,093.04	341,777.43	356,018.16	352,457.98	315	1119	2349.9	352485	352.485	$ 2.80	$ 986,958.00
014	Benito Juárez	13	Public Urban	1292976	894,388.00	894,388,000.00	2,450,378.08	5.6	437,567.51	497,235.81	591,947.40	616,611.87	610,445.75	315	1938	4069.8	610470	610.47	$ 2.80	$ 1,709,316.00
014	Benito Juárez	14	Public Urban	504576	402,090.00	402,090,000.00	1,101,616.44	5.6	196,717.22	223,542.30	266,121.78	277,210.19	274,438.09	315	872	1831.2	274680	274.68	$ 2.80	$ 769,104.00
014	Benito Juárez	15	Public Urban	1860624	233,060.00	233,060,000.00	638,520.55	5.6	114,021.53	129,569.92	154,249.90	160,676.98	159,070.21	315	505	1060.5	159075	159.075	$ 2.80	$ 445,410.00
014	Benito Juárez	16	Public Urban	1040688	688,058.00	688,058,000.00	1,885,090.41	5.6	336,623.29	382,526.46	455,388.65	474,363.17	469,619.54	315	1491	3131.1	469665	469.665	$ 2.80	$ 1,315,062.00
014	Benito Juárez	17	Public Urban	1860624	505,150.00	505,150,000.00	1,383,972.60	5.6	247,137.96	280,838.60	334,331.66	348,262.15	344,779.53	315	1095	2299.5	344925	344.925	$ 2.80	$ 965,790.00
014	Benito Juárez	18	Public Urban	1292976	674,030.00	674,030,000.00	1,846,657.53	5.6	329,760.27	374,727.58	446,104.27	464,691.94	460,045.03	315	1461	3068.1	460215	460.215	$ 2.80	$ 1,288,602.00
014	Benito Juárez	19	Public Urban	1482192	858,179.00	858,179,000.00	2,351,175.34	5.6	419,852.74	477,105.39	567,982.60	591,648.54	585,732.06	315	1860	3906	585900	585.9	$ 2.80	$ 1,640,520.00
014	Benito Juárez	20	Public Urban	1766016	663,910.00	663,910,000.00	1,818,931.51	5.6	324,809.20	369,101.36	439,406.38	457,714.98	453,137.83	315	1439	3021.9	453285	453.285	$ 2.80	$ 1,269,198.00
014	Benito Juárez	21	Public Urban	1135296	550,505.03	550,505,030.40	1,508,232.96	5.6	269,327.31	306,053.77	364,349.72	379,530.96	375,735.65	315	1193	2505.3	375795	375.795	$ 2.80	$ 1,052,226.00
014	Benito Juárez	22	Public Urban	946080	389,160.00	389,160,000.00	1,066,191.78	5.6	190,391.39	216,353.85	257,564.11	268,295.95	265,612.99	315	844	1772.4	265860	265.86	$ 2.80	$ 744,408.00
014	Benito Juárez	23	Public Urban	63072	13,890.00	13,890,000.00	38,054.79	5.6	6,795.50	7,722.16	9,193.05	9,576.09	9,480.33	315	31	65.1	9765	9.765	$ 2.80	$ 27,342.00
014	Benito Juárez	24	Public Urban	FO	18,079.00	18,079,000.00	49,531.51	5.6	8,844.91	10,051.04	11,965.52	12,464.08	12,339.44	315	40	84	12600	12.6	$ 2.80	$ 35,280.00
014	Benito Juárez	25	Public Urban	883008	443,820.00	443,820,000.00	1,215,945.21	5.6	217,133.07	246,742.13	293,740.63	305,979.82	302,920.02	315	962	2020.2	303030	303.03	$ 2.80	$ 848,484.00
014	Benito Juárez	26	Public Urban	FO	1,595,470.00	1,595,470,000.00	4,371,150.68	5.6	780,562.62	887,002.98	1,055,955.93	1,099,954.09	1,088,954.55	315	3457	7259.7	1088955	1088.955	$ 2.80	$ 3,049,074.00
015	Cuauhtémoc	1	Public Urban	FO	1,582,650.00	1,582,650,000.00	4,336,027.40	5.6	774,290.61	879,875.69	1,047,471.06	1,091,115.69	1,080,204.53	315	3430	7203	1080450	1080.45	$ 2.80	$ 3,025,260.00
015	Cuauhtémoc	2	Public Urban	1639872	431,000.00	431,000,000.00	1,180,821.92	5.6	210,861.06	239,614.84	285,255.76	297,141.42	294,170.00	315	934	1961.4	294210	294.21	$ 2.80	$ 823,788.00
015	Cuauhtémoc	3	Public Urban	FO	729,440.00	729,440,000.00	1,998,465.75	5.6	356,868.88	405,532.82	482,777.17	502,892.89	497,863.96	315	1581	3320.1	498015	498.015	$ 2.80	$ 1,394,442.00
015	Cuauhtémoc	4	Public Urban	1009152	753,910.00	753,910,000.00	2,065,506.85	5.6	368,840.51	419,136.94	498,972.55	519,763.07	514,565.44	315	1634	3431.4	514710	514.71	$ 2.80	$ 1,441,188.00
015	Cuauhtémoc	5	Public Urban	1387584	672,839.48	672,839,481.60	1,843,395.84	5.6	329,177.83	374,065.71	445,316.33	463,871.17	459,232.46	315	1458	3061.8	459270	459.27	$ 2.80	$ 1,285,956.00
015	Cuauhtémoc	6	Public Urban	FO	522,200.00	522,200,000.00	1,430,684.93	5.6	255,479.45	290,317.56	345,616.14	360,016.81	356,416.65	315	1132	2377.2	356580	356.58	$ 2.80	$ 998,424.00
016	Miguel Hidalgo	1	Public Urban	1702944	842,940.00	842,940,000.00	2,309,424.66	5.6	412,397.26	468,633.25	557,896.73	581,142.42	575,331.00	315	1827	3836.7	575505	575.505	$ 2.80	$ 1,611,414.00
016	Miguel Hidalgo	2	Public Urban	473040	693,559.00	693,559,000.00	1,900,161.64	5.6	339,314.58	385,584.75	459,029.46	478,155.69	473,374.13	315	1503	3156.3	473445	473.445	$ 2.80	$ 1,325,646.00
016	Miguel Hidalgo	3	Public Urban	1229904	645,970.00	645,970,000.00	1,769,780.82	5.6	316,032.29	359,127.60	427,532.86	445,346.73	440,893.26	315	1400	2940	441000	441	$ 2.80	$ 1,234,800.00
016	Miguel Hidalgo	4	Public Urban	1387584	6,870.00	6,870,000.00	18,821.92	5.6	3,361.06	3,819.38	4,546.88	4,736.34	4,688.97	315	15	31.5	4725	4.725	$ 2.80	$ 13,230.00
016	Miguel Hidalgo	5	Public Urban	1072224	392,420.00	392,420,000.00	1,075,123.29	5.6	191,986.30	218,166.25	259,721.73	270,543.47	267,838.03	315	851	1787.1	268065	268.065	$ 2.80	$ 750,582.00
016	Miguel Hidalgo	6	Public Urban	1356048	667,010.00	667,010,000.00	1,827,424.66	5.6	326,325.83	370,824.91	441,458.11	459,852.19	455,253.67	315	1446	3036.6	455490	455.49	$ 2.80	$ 1,275,372.00
016	Miguel Hidalgo	7	Public Urban	504576	715,150.00	715,150,000.00	1,959,315.07	5.6	349,877.69	397,588.29	473,319.39	493,041.03	488,110.62	315	1550	3255	488250	488.25	$ 2.80	$ 1,367,100.00
016	Miguel Hidalgo	8	Public Urban	662256	652,990.00	652,990,000.00	1,789,013.70	5.6	319,466.73	363,030.38	432,179.02	450,186.48	445,684.61	315	1415	2971.5	445725	445.725	$ 2.80	$ 1,248,030.00
016	Miguel Hidalgo	9	Public Urban	630720	610,740.00	610,740,000.00	1,673,260.27	5.6	298,796.48	339,541.45	404,216.01	421,058.35	416,847.76	315	1324	2780.4	417060	417.06	$ 2.80	$ 1,167,768.00
016	Miguel Hidalgo	10	Public Urban	FO	835,920.00	835,920,000.00	2,290,191.78	5.6	408,962.82	464,730.48	553,250.57	576,302.67	570,539.65	315	1812	3805.2	570780	570.78	$ 2.80	$ 1,598,184.00
016	Miguel Hidalgo	11	Public Urban	1166832	399,440.00	399,440,000.00	1,094,356.16	5.6	195,420.74	222,069.03	264,367.89	275,383.22	272,629.39	315	866	1818.6	272790	272.79	$ 2.80	$ 763,812.00
016	Miguel Hidalgo	12	Public Urban	1229904	787,924.00	787,924,000.00	2,158,695.89	5.6	385,481.41	438,047.06	521,484.59	543,213.11	537,780.98	315	1708	3586.8	538020	538.02	$ 2.80	$ 1,506,456.00
016	Miguel Hidalgo	13	Public Urban	630720	700,579.00	700,579,000.00	1,919,394.52	5.6	342,749.02	389,487.52	463,675.62	482,995.44	478,165.49	315	1518	3187.8	478170	478.17	$ 2.80	$ 1,338,876.00
016	Miguel Hidalgo	14	Public Urban	946080	722,170.00	722,170,000.00	1,978,547.95	5.6	353,312.13	401,491.06	477,965.55	497,880.78	492,901.97	315	1565	3286.5	492975	492.975	$ 2.80	$ 1,380,330.00
016	Miguel Hidalgo	15	Public Urban	725328	723,640.00	723,640,000.00	1,982,575.34	5.6	354,031.31	402,308.31	478,938.46	498,894.23	493,905.29	315	1568	3292.8	493920	493.92	$ 2.80	$ 1,382,976.00
016	Miguel Hidalgo	16	Public Urban	788400	1,589,670.00	1,589,670,000.00	4,355,260.27	5.6	777,725.05	883,778.46	1,052,117.22	1,095,955.44	1,084,995.88	315	3445	7234.5	1085175	1085.175	$ 2.80	$ 3,038,490.00
016	Miguel Hidalgo	17	Public Urban	220752	438,020.00	438,020,000.00	1,200,054.79	5.6	214,295.50	243,517.61	289,901.92	301,981.17	298,961.35	315	950	1995	299250	299.25	$ 2.80	$ 837,900.00
016	Miguel Hidalgo	18	Public Urban	1009152	12,279.00	12,279,000.00	33,641.10	5.6	6,007.34	6,826.52	8,126.81	8,465.43	8,380.77	315	27	56.7	8505	8.505	$ 2.80	$ 23,814.00
016	Miguel Hidalgo	19	Public Urban	88300.8	596,700.00	596,700,000.00	1,634,794.52	5.6	291,927.59	331,735.90	394,923.69	411,378.85	407,265.06	315	1293	2715.3	407295	407.295	$ 2.80	$ 1,140,426.00
016	Miguel Hidalgo	20	Public Urban	1009152	281,020.00	281,020,000.00	769,917.81	5.6	137,485.32	156,233.32	185,992.05	193,741.72	191,804.30	315	609	1278.9	191835	191.835	$ 2.80	$ 537,138.00
016	Miguel Hidalgo	21	Public Urban	FO	727,970.00	727,970,000.00	1,994,438.36	5.6	356,149.71	404,715.58	481,804.26	501,879.43	496,860.64	315	1578	3313.8	497070	497.07	$ 2.80	$ 1,391,796.00
016	Miguel Hidalgo	22	Public Urban	977616	780,904.00	780,904,000.00	2,139,463.01	5.6	382,046.97	434,144.28	516,838.43	538,373.36	532,989.63	315	1693	3555.3	533295	533.295	$ 2.80	$ 1,493,226.00
016	Miguel Hidalgo	23	Public Urban	1040688	660,010.00	660,010,000.00	1,808,246.58	5.6	322,901.17	366,933.15	436,825.18	455,026.23	450,475.97	315	1431	3005.1	450765	450.765	$ 2.80	$ 1,262,142.00
016	Miguel Hidalgo	24	Public Urban	1608336	973,040.00	973,040,000.00	2,665,863.01	5.6	476,046.97	540,962.46	644,002.93	670,836.39	664,128.02	315	2109	4428.9	664335	664.335	$ 2.80	$ 1,860,138.00
016	Miguel Hidalgo	25	Public Urban	1513728	519,190.00	519,190,000.00	1,422,438.36	5.6	254,006.85	288,644.15	343,623.98	357,941.65	354,362.23	315	1125	2362.5	354375	354.375	$ 2.80	$ 992,250.00
016	Miguel Hidalgo	26	Public Urban	1229904	828,900.00	828,900,000.00	2,270,958.90	5.6	405,528.38	460,827.70	548,604.40	571,462.92	565,748.29	315	1797	3773.7	566055	566.055	$ 2.80	$ 1,584,954.00
016	Miguel Hidalgo	27	Public Urban	FO	973,570.00	973,570,000.00	2,667,315.07	5.6	476,306.26	541,257.12	644,353.71	671,201.78	664,489.76	315	2110	4431	664650	664.65	$ 2.80	$ 1,861,020.00
016	Miguel Hidalgo	28	Public Urban	567648	732,170.00	732,170,000.00	2,005,945.21	5.6	358,204.50	407,050.57	484,584.01	504,775.01	499,727.26	315	1587	3332.7	499905	499.905	$ 2.80	$ 1,399,734.00
016	Miguel Hidalgo	29	Public Urban	1702944	794,944.00	794,944,000.00	2,177,928.77	5.6	388,915.85	441,949.83	526,130.75	548,052.87	542,572.34	315	1723	3618.3	542745	542.745	$ 2.80	$ 1,519,686.00

017	Venustiano Carranza	1	Public Urban	1387584	672,839.48	672,839,481.60	1,843,395.84	5.6	329,177.83	374,065.71	445,316.33	463,871.17	459,232.46	315	1458	3061.8	459270	459.27	$ 2.80	$ 1,285,956.00
017	Venustiano Carranza	2	Public Urban	1135296	550,505.03	550,505,030.40	1,508,232.96	5.6	269,327.31	306,053.77	364,349.72	379,530.96	375,735.65	315	1193	2505.3	375795	375.795	$ 2.80	$ 1,052,226.00
017	Venustiano Carranza	3	Public Urban	851472	520,340.00	520,340,000.00	1,425,589.04	5.6	254,569.47	289,283.49	344,385.11	358,734.49	355,147.14	315	1128	2368.8	355320	355.32	$ 2.80	$ 994,896.00
017	Venustiano Carranza	4	Public Urban	819936	607,660.00	607,660,000.00	1,664,821.92	5.6	297,289.63	337,829.12	402,177.53	418,934.92	414,745.58	315	1317	2765.7	414855	414.855	$ 2.80	$ 1,161,594.00
017	Venustiano Carranza	5	ublico Urbano	FO	726,650.00	726,650,000.00	1,990,821.92	5.6	355,503.91	403,981.72	480,930.62	500,969.40	495,959.70	315	1575	3307.5	496125	496.125	$ 2.80	$ 1,389,150.00
017	Venustiano Carranza	6	ublico Urbano	FO	662,625.00	662,625,000.00	1,815,410.96	5.6	324,180.53	368,386.96	438,555.91	456,829.07	452,260.78	315	1436	3015.6	452340	452.34	$ 2.80	$ 1,266,552.00
017	Venustiano Carranza	7	ublico Urbano	FO	440,030.00	440,030,000.00	1,205,561.64	5.6	215,278.86	244,635.07	291,232.23	303,366.91	300,333.24	315	954	2003.4	300510	300.51	$ 2.80	$ 841,428.00

Annex 3: Present value of electricity 2016 - 2045

Year	**Annual electricity needs for groundwater pumping kWH/y**	**Price of electricity in Mexico (USD)**	**Value of electricity (USD)**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Period				**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Discount factor				**0.970873786**	**0.942595909**	**0.915141659**	**0.888487048**	**0.862608784**	**0.837484257**	**0.813091511**	**0.789409234**	**0.766416732**	**0.744093915**
Azcapotzalco	18,138,321	$ 0.14	$ 2,477,912.76	$ 2,453,855.36	$ 2,382,383.84	$ 2,312,994.02	$ 2,245,625.26	$ 2,180,218.70	$ 2,116,717.19	$ 2,055,065.23	$ 1,995,208.96	$ 1,937,096.08	$ 1,880,675.80
Coyoacán	46,590,135	$ 0.14	$ 6,364,772.49	$ 6,302,978.58	$ 6,119,396.68	$ 5,941,161.82	$ 5,768,118.28	$ 5,600,114.83	$ 5,437,004.69	$ 5,278,645.33	$ 5,124,898.38	$ 4,975,629.49	$ 4,830,708.25
Cuajimalpa de Morelos	800,810	$ 0.14	$ 109,400.27	$ 108,338.13	$ 105,182.65	$ 102,119.08	$ 99,144.74	$ 96,257.03	$ 93,453.43	$ 90,731.48	$ 88,088.82	$ 85,523.12	$ 83,032.16
Gustavo A. Madero	1,960,237	$ 0.14	$ 267,792.00	$ 265,192.08	$ 257,468.04	$ 249,968.97	$ 242,688.32	$ 235,619.73	$ 228,757.02	$ 222,094.19	$ 215,625.43	$ 209,345.08	$ 203,247.65
Iztacalco	5,565,841	$ 0.14	$ 760,360.79	$ 752,978.65	$ 731,047.23	$ 709,754.59	$ 689,082.13	$ 669,011.78	$ 649,526.00	$ 630,607.76	$ 612,240.55	$ 594,408.30	$ 577,095.44
Iztapalapa	46,402,209	$ 0.14	$ 6,339,099.63	$ 6,277,554.98	$ 6,094,713.57	$ 5,917,197.64	$ 5,744,852.08	$ 5,577,526.29	$ 5,415,074.07	$ 5,257,353.46	$ 5,104,226.66	$ 4,955,559.87	$ 4,811,223.17
Magdalena Contreras	3,709,128	$ 0.14	$ 506,711.48	$ 501,791.95	$ 487,176.65	$ 472,987.04	$ 459,210.71	$ 445,835.65	$ 432,850.14	$ 420,242.86	$ 408,002.77	$ 396,119.20	$ 384,581.74
Milpa Alta	13,105,295	$ 0.14	$ 1,790,340.78	$ 1,772,958.83	$ 1,721,319.25	$ 1,671,183.74	$ 1,622,508.49	$ 1,575,250.96	$ 1,529,369.86	$ 1,484,825.11	$ 1,441,577.78	$ 1,399,590.07	$ 1,358,825.31
Alvaro Obregón	12,507,736	$ 0.14	$ 1,708,707.06	$ 1,692,117.67	$ 1,642,832.69	$ 1,594,983.20	$ 1,548,527.38	$ 1,503,424.64	$ 1,459,635.57	$ 1,417,121.91	$ 1,375,846.52	$ 1,335,773.32	$ 1,296,867.30
Tláhuac	9,851,076	$ 0.14	$ 1,345,775.44	$ 1,332,709.66	$ 1,293,892.87	$ 1,256,206.67	$ 1,219,618.13	$ 1,184,095.27	$ 1,149,607.06	$ 1,116,123.36	$ 1,083,614.91	$ 1,052,053.31	$ 1,021,410.98
Tlalpan	48,821,869	$ 0.14	$ 6,669,654.24	$ 6,604,900.32	$ 6,412,524.58	$ 6,225,752.02	$ 6,044,419.44	$ 5,868,368.38	$ 5,697,445.03	$ 5,531,500.03	$ 5,370,388.38	$ 5,213,969.30	$ 5,062,106.12
Xochimilco	49,364,072	$ 0.14	$ 6,743,725.69	$ 6,678,252.62	$ 6,483,740.41	$ 6,294,893.60	$ 6,111,547.19	$ 5,933,540.96	$ 5,760,719.38	$ 5,592,931.43	$ 5,430,030.52	$ 5,271,874.29	$ 5,118,324.55
Benito Juárez	14,600,505	$ 0.14	$ 1,994,604.52	$ 1,975,239.42	$ 1,917,708.18	$ 1,861,852.60	$ 1,807,623.88	$ 1,754,974.65	$ 1,703,858.88	$ 1,654,231.92	$ 1,606,050.41	$ 1,559,272.24	$ 1,513,856.55
Cuauhtémoc	4,692,039	$ 0.14	$ 640,989.00	$ 634,765.81	$ 616,277.48	$ 598,327.65	$ 580,900.63	$ 563,981.20	$ 547,554.56	$ 531,606.37	$ 516,122.69	$ 501,089.99	$ 486,495.13
Miguel Hidalgo	19,305,709	$ 0.14	$ 2,637,391.94	$ 2,611,786.19	$ 2,535,714.75	$ 2,461,858.98	$ 2,390,154.35	$ 2,320,538.20	$ 2,252,949.71	$ 2,187,329.82	$ 2,123,621.18	$ 2,061,768.14	$ 2,001,716.64
Venustiano Carranza	4,180,650	$ 0.14	$ 571,126.98	$ 565,582.06	$ 549,108.80	$ 533,115.34	$ 517,587.71	$ 502,512.34	$ 487,876.05	$ 473,666.07	$ 459,869.97	$ 446,475.70	$ 433,471.55
Total	299,595,632	$ 0.14	$ 40,928,365.07	$ 40,531,002.30	$ 39,350,487.67	$ 38,204,356.97	$ 37,091,608.70	$ 36,011,270.59	$ 34,962,398.63	$ 33,944,076.34	$ 32,955,413.92	$ 31,995,547.50	$ 31,063,638.35

Prices in USD

2026	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
0.722421277	**0.70137988**	**0.68095134**	**0.661117806**	**0.641861947**	**0.623166939**	**0.605016446**	**0.587394608**	**0.570286027**	**0.553675754**	**0.537549276**	**0.521892501**	**0.506691748**	**0.491933736**
$ 1,825,898.84	$ 1,772,717.32	$ 1,721,084.78	$ 1,670,956.09	$ 1,622,287.47	$ 1,575,036.38	$ 1,529,161.53	$ 1,484,622.85	$ 1,441,381.40	$ 1,399,399.42	$ 1,358,640.21	$ 1,319,068.17	$ 1,280,648.71	$ 1,243,348.26
$ 4,690,008.01	$ 4,553,405.83	$ 4,420,782.36	$ 4,292,021.71	$ 4,167,011.37	$ 4,045,642.11	$ 3,927,807.87	$ 3,813,405.70	$ 3,702,335.63	$ 3,594,500.61	$ 3,489,806.42	$ 3,388,161.57	$ 3,289,477.25	$ 3,193,667.24
$ 80,613.75	$ 78,265.77	$ 75,986.19	$ 73,773.00	$ 71,624.27	$ 69,538.13	$ 67,512.74	$ 65,546.35	$ 63,637.24	$ 61,783.72	$ 59,984.20	$ 58,237.09	$ 56,540.86	$ 54,894.04
$ 197,327.81	$ 191,580.40	$ 186,000.39	$ 180,582.90	$ 175,323.21	$ 170,216.70	$ 165,258.94	$ 160,445.57	$ 155,772.40	$ 151,235.34	$ 146,830.42	$ 142,553.81	$ 138,401.76	$ 134,370.64
$ 560,286.83	$ 543,967.80	$ 528,124.07	$ 512,741.82	$ 497,807.59	$ 483,308.34	$ 469,231.40	$ 455,564.47	$ 442,295.60	$ 429,413.20	$ 416,906.02	$ 404,763.13	$ 392,973.91	$ 381,528.07
$ 4,671,090.46	$ 4,535,039.28	$ 4,402,950.76	$ 4,274,709.47	$ 4,150,203.37	$ 4,029,323.66	$ 3,911,964.72	$ 3,798,024.00	$ 3,687,401.94	$ 3,580,001.89	$ 3,475,729.99	$ 3,374,495.13	$ 3,276,208.87	$ 3,180,785.31
$ 373,380.33	$ 362,505.18	$ 351,946.78	$ 341,695.90	$ 331,743.59	$ 322,081.16	$ 312,700.15	$ 303,592.38	$ 294,749.88	$ 286,164.94	$ 277,830.03	$ 269,737.90	$ 261,881.45	$ 254,253.84
$ 1,319,247.88	$ 1,280,823.18	$ 1,243,517.65	$ 1,207,298.69	$ 1,172,134.65	$ 1,137,994.81	$ 1,104,849.33	$ 1,072,669.25	$ 1,041,426.46	$ 1,011,093.65	$ 981,644.32	$ 953,052.74	$ 925,293.92	$ 898,343.61
$ 1,259,094.46	$ 1,222,421.81	$ 1,186,817.29	$ 1,152,249.80	$ 1,118,689.12	$ 1,086,105.95	$ 1,054,471.79	$ 1,023,759.02	$ 993,940.80	$ 964,991.07	$ 936,884.53	$ 909,596.63	$ 883,103.52	$ 857,382.06
$ 991,661.15	$ 962,777.81	$ 934,735.74	$ 907,510.43	$ 881,078.09	$ 855,415.62	$ 830,500.60	$ 806,311.26	$ 782,826.47	$ 760,025.70	$ 737,889.03	$ 716,397.11	$ 695,531.18	$ 675,272.99
$ 4,914,666.13	$ 4,771,520.52	$ 4,632,544.19	$ 4,497,615.72	$ 4,366,617.20	$ 4,239,434.18	$ 4,115,955.51	$ 3,996,073.31	$ 3,879,682.83	$ 3,766,682.36	$ 3,656,973.16	$ 3,550,459.38	$ 3,447,047.94	$ 3,346,648.49
$ 4,969,247.14	$ 4,824,511.78	$ 4,683,992.02	$ 4,547,565.07	$ 4,415,111.72	$ 4,286,516.23	$ 4,161,666.25	$ 4,040,452.67	$ 3,922,769.58	$ 3,808,514.15	$ 3,697,586.56	$ 3,589,889.86	$ 3,485,329.96	$ 3,383,815.50
$ 1,469,763.64	$ 1,426,954.99	$ 1,385,393.19	$ 1,345,041.93	$ 1,305,865.95	$ 1,267,831.02	$ 1,230,903.91	$ 1,195,052.34	$ 1,160,244.99	$ 1,126,451.44	$ 1,093,642.18	$ 1,061,788.52	$ 1,030,862.64	$ 1,000,837.52
$ 472,325.37	$ 458,568.32	$ 445,211.96	$ 432,244.63	$ 419,654.98	$ 407,432.02	$ 395,565.06	$ 384,043.75	$ 372,858.01	$ 361,998.07	$ 351,454.44	$ 341,217.90	$ 331,279.51	$ 321,630.60
$ 1,943,414.21	$ 1,886,809.92	$ 1,831,854.29	$ 1,778,499.31	$ 1,726,698.36	$ 1,676,406.17	$ 1,627,578.81	$ 1,580,173.60	$ 1,534,149.13	$ 1,489,465.17	$ 1,446,082.69	$ 1,403,963.78	$ 1,363,071.63	$ 1,323,370.51
$ 420,846.17	$ 408,588.51	$ 396,687.88	$ 385,133.86	$ 373,916.37	$ 363,025.60	$ 352,452.04	$ 342,186.45	$ 332,219.85	$ 322,543.55	$ 313,149.07	$ 304,028.23	$ 295,173.04	$ 286,575.76
$ 30,158,872.18	$ 29,280,458.43	$ 28,427,629.54	$ 27,599,640.33	$ 26,795,767.31	$ 26,015,308.07	$ 25,257,580.65	$ 24,521,922.96	$ 23,807,692.20	$ 23,114,264.27	$ 22,441,033.27	$ 21,787,410.94	$ 21,152,826.16	$ 20,536,724.42

2040	2041	2042	2043	2044	2045	TOTAL
25	26	27	28	29	30	
0.477605569	0.463694727	0.450189056	0.437076753	0.424346362	0.41198676	
$ 1,207,134.23	$ 1,171,974.98	$ 1,137,839.79	$ 1,104,698.83	$ 1,072,523.13	$ 1,041,284.59	$ 49,539,547.41
$ 3,100,647.80	$ 3,010,337.67	$ 2,922,657.93	$ 2,837,531.98	$ 2,754,885.41	$ 2,674,646.03	$ 127,247,396.84
$ 53,295.18	$ 51,742.90	$ 50,235.82	$ 48,772.64	$ 47,352.08	$ 45,972.89	$ 2,187,179.51
$ 130,456.93	$ 126,657.21	$ 122,968.17	$ 119,386.57	$ 115,909.29	$ 112,533.29	$ 5,353,818.24
$ 370,415.60	$ 359,626.80	$ 349,152.23	$ 338,982.75	$ 329,109.46	$ 319,523.75	$ 15,201,475.26
$ 3,088,141.07	$ 2,998,195.22	$ 2,910,869.14	$ 2,826,086.55	$ 2,743,773.35	$ 2,663,857.62	$ 126,734,133.58
$ 246,848.39	$ 239,658.63	$ 232,678.28	$ 225,901.24	$ 219,321.59	$ 212,933.59	$ 10,130,403.93
$ 872,178.26	$ 846,775.01	$ 822,111.66	$ 798,166.66	$ 774,919.09	$ 752,348.63	$ 35,793,298.85
$ 832,409.77	$ 808,164.82	$ 784,626.04	$ 761,772.86	$ 739,585.30	$ 718,043.98	$ 34,161,240.82
$ 655,604.84	$ 636,509.56	$ 617,970.44	$ 599,971.30	$ 582,496.41	$ 565,530.50	$ 26,905,348.42
$ 3,249,173.29	$ 3,154,537.18	$ 3,062,657.45	$ 2,973,453.84	$ 2,886,848.39	$ 2,802,765.42	$ 133,342,730.10
$ 3,285,257.76	$ 3,189,570.65	$ 3,096,670.53	$ 3,006,476.24	$ 2,918,908.97	$ 2,833,892.21	$ 134,823,599.79
$ 971,686.91	$ 943,385.35	$ 915,908.11	$ 889,231.17	$ 863,331.23	$ 838,185.66	$ 39,877,031.42
$ 312,262.71	$ 303,167.68	$ 294,337.56	$ 285,764.62	$ 277,441.38	$ 269,360.56	$ 12,814,940.65
$ 1,284,825.74	$ 1,247,403.63	$ 1,211,071.49	$ 1,175,797.56	$ 1,141,551.03	$ 1,108,301.97	$ 52,727,926.95
$ 278,228.90	$ 270,125.14	$ 262,257.42	$ 254,618.85	$ 247,202.77	$ 240,002.69	$ 11,418,227.74
$ 19,938,567.40	$ 19,357,832.43	$ 18,794,012.07	$ 18,246,613.66	$ 17,715,158.89	$ 17,199,183.39	$ 818,258,299.52