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Sun coupled innovative Heat pumps

D2.3 – Macro-market analysis, value chain and conceptual business model definition

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1 Summary

Heat Pump and solar appliances are the most socially accepted residential renewable energy-based energy systems. SunHorizon will demonstrate up to TRL 7 innovative, reliable, cost-effective coupling of solar and HP technologies. SunHorizon addresses three main research pillars that interact each other towards project objectives achievement, demonstration and replication: i) Optimized design, engineering and manufacturing of SunHorizon technologies, ii) Smart functional monitoring for H&C, iii) KPI driven management and demonstration. Five different combinations of heat pumps and solar appliances (technology packages) will be evaluated in the SunHorizon project. Four of the technology packages will be demonstrated at eight demo sites (single family houses, multi-level buildings, municipality owned buildings, sport facilities) in four different EU countries (Germany, Spain, Belgium and Latvia).

In this, Deliverable 2.3, *Macro-market analysis, value chain and conceptual business model definition*, a first business model related to the technology packages is developed for the technology packages installed at the demo sites. D2.3 is developed within Task 2.2, *Resource Mapping and Business Model case definition*. The purpose of D2.3 is to provide guidance to the demo sites about business model concepts and to be the starting point of Task 7.2, *A low carbon heating and cooling system affordable for everyone. Business (-ESCO) models, bankability and contractual arrangements: TRL 9 roadmap*. In Task 7.2 the market potential of the SunHorizon concept will be studied and business models will be developed that consider the integration of social and marketing aspects. Information from D2.2, *Mapping of solar resource and building demand for SunHorizon implementation*, is considered when developing the business model concepts.

The business model concepts in D2.3 are developed through a three-step approach that combines a PESTLE (political, economic, social, technological, environmental and legal) analysis, value chain mapping and development of the business model concepts.

The PESTLE analysis shows that different countries have different prerequisites (political agenda for renewables, financial support, permits) for the technology packages in SunHorizon to be successful. The PESTLE analysis of the demo site countries shows high potential for market uptake of the SunHorizon technology packages in Spain and Germany, medium potential in Belgium and low in Latvia. All the value chains reflect the values provided by the installation of the SunHorizon technology packages. At month 12 of the SunHorizon project (M12) the on-going value-adding activities at the demo sites focus on the technology and the technical equipment and, consequently, the values proposed are primarily reduced greenhouse gas emissions, primary energy savings and energy efficiency (and potentially cost savings). The business model concepts identify different customer segments (small-to-medium size residential owner, municipalities and building residents**)**, and identifies that the technology packages are successful in providing a clear value proposition to all segments. Through the business model concepts, thermal comfort and increased self-supply of energy are identified as additional values to those identified in the value chain mapping. These values provide a competitive edge for the SunHorizon technology packages compared to conventional technology and they can be exploited further when the value chains of the technology packages develop to encompass other aspects (like outbound logistics, sales, marketing and after-sales activities): something to be explored further in Task 7.2.

2 Introduction

This report presents the business model concepts that are developed for the technology packages (i.e. different combinations of technology and equipment from BoostHeat (BH), BDR Thermea (BDR), Fahrenheit AG (FAHR), TVP Solar SA (TVP), DualSun (DS), Ratiotherm Heizung + Solartechnik gmbh & Co. KG (RATIO) as outlined in Task 2.1, *High level requirements and specification of the technologies and Implementation Plans*) to be installed at the eight demo sites located in four different EU countries. Focus is on conceptualizing the business model that is likely to be successful in making the technology packages exploitable to the market. The business model concepts account for different customer segments and value propositions per technology package. Information from deliverable 2.2, *Mapping of solar resource and building demand for SunHorizon implementation*, has been taken into consideration when developing the business model concepts.

The concepts are developed through a three-step approach within the scope of Task 2.2, *Resource Mapping and Business Model case definition*. First, a macro-market analysis (PESTLE analysis) of the demo site countries is undertaken to identify important aspects to consider for the market uptake of the demonstrated SunHorizon technology packages implemented at the demo sites. Secondly, value chains are drafted for the demonstrated technology packages. The value chains encompass Heating & Cooling generation (hardware definition), Distribution (hardware definition) Connect & Control (hardware and software definition), Energy efficiency (compared to conventional heating & cooling alternative) and Customer management (IT solution, billing etc.). Then, for each technology package implemented at the demo sites, a business model concept is developed. Finally, the common denominators from the business models are identified and key points to consider going forward in the project are concluded upon.

The purpose of deliverable 2.3 is to provide guidance to the demo sites about business model concepts and it serves as a strategic guideline for developing business models taking the technological solutions to be demonstrated to the market in Task 7.2, *A low carbon heating and cooling system affordable for everyone. Business (-ESCO) models, bankability and contractual arrangements: TRL 9 roadmap.*

The report is structured into eight chapters, six annexes and one bibliography. Chapter One, provides a brief summary describing the content of the report. Chapter two, is an introduction to the report. Chapter three, describes the methodological framework used in the report and consists of three parts, Macro-market analysis (PESTLE), Value Chain and the business model canvas. Chapter four, describes how the methodological framework is applied in the report in the context of SunHorizon D2.3. Chapter five, provides a brief description, and visualization, of the technology packages to be demonstrated within SunHorizon. Chapter six presents the results from the PESTLE analysis and a summary of the important aspects from D2.2 to use as input when deriving the business models. Chapter 7 is divided into subchapters for each demo sites. Each subchapter contains a short description of the demo site, the results from the value chain mapping and the business model concept. Chapter eight, concludes the findings in the report based on the PESTLE analysis, the value chain analysis and the derived business models. The Annexes provide more information from the PESTLE analysis.

3 Framework

In chapter 3 the methodological framework used for developing the business model concepts for the technology packages implemented at the demo sites is presented.

3.1 Macro-market analysis (PESTLE)

To gain insight into the general and into the most immediate external influences that will impact SunHorizon' business activities, a PESTLE analysis is used to determine these key factors. PESTLE is a strategic analytical tool used to assess external factors affecting the spread of technologies or businesses in a region. The PESTLE analysis has evolved from PEST analysis, focused on intensifying forces of globalization and intensifying forces of competition in the marketplace, by adding another set of factors focusing on the increased importance and potential impact of environmental and legal factors on businesses.

The PESTLE analysis, performed by EXERGY Ltd, is developed by using the concept of Design Thinking (illustrated below). Design thinking offers a structured framework for understanding and pursuing innovation in ways that contribute to organic growth and add real value to end-users. The design thinking cycle involves observation to discover unmet needs within the context and constraints of a situation, framing the opportunity and scope of innovation, generating creative ideas, testing and refining solutions.

Below is a scheme of the method and approach that is taken in order to conduct the PESTLE analysis:

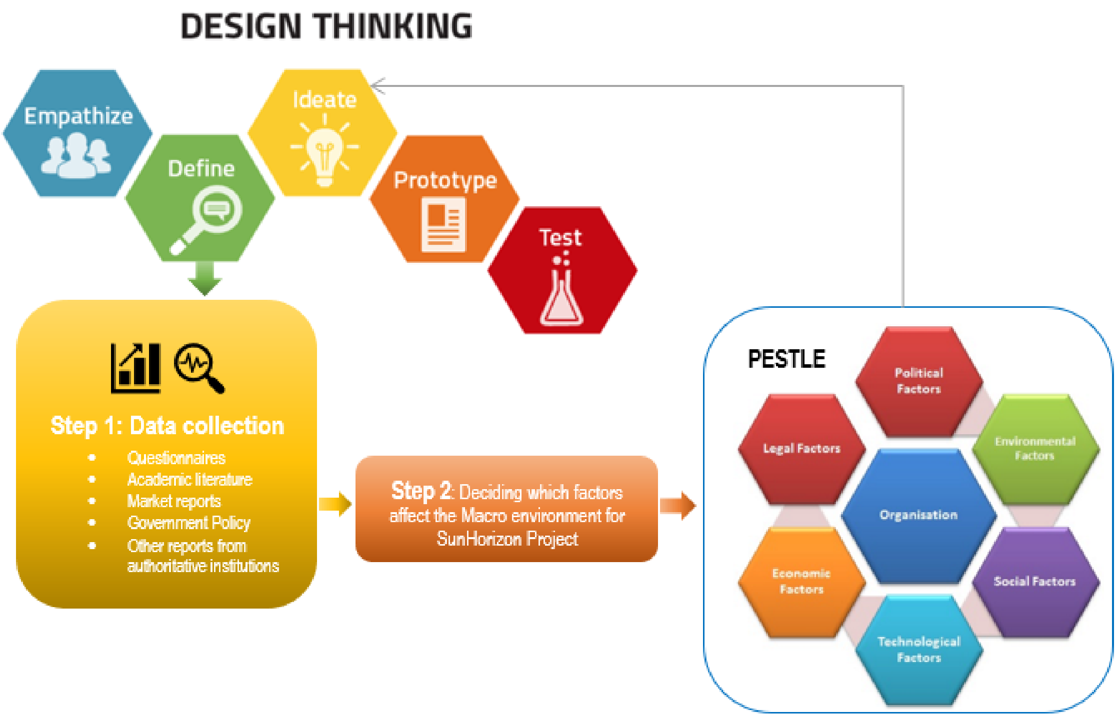


Figure 1: Illustration of the design thinking concept method

3.2 Value chain

A value chain describes the activities that a firm undertakes in order to add buyer value to a product. The concept of value chains in an activity-based point of view was first introduced by Michael E. Porter in 1985 and has since then been in extensive use for representing the logic of firm-level value creation (Porter, 1985), (Stabell & Fjeldstad, 1998). The value chain describes the full range of activities that are required to bring a product or service from conception, through the different phases of production, delivery to final consumers and final disposal after use (Kaplinsky & Morris, 2000). Value chains were initially developed from the perspective of a manufacturing company and the activities that are common in a manufacturing setting are often categorized and placed in a value chain according to Figure 2 below.

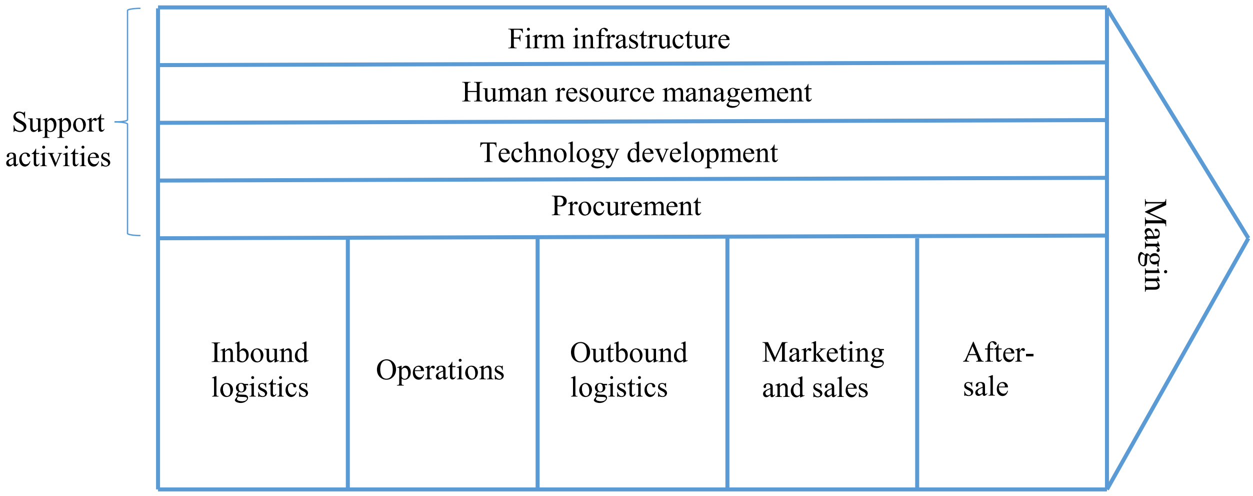


Figure 2 The generic value chain. Source: (Porter, 1995)

All the activities in the chain contribute to the value of the product or service and each activity is also related to a cost for the company. If the accumulated value, indicated by the amount that customers wants to pay for the product or service, is higher than the collective costs of performing the value adding activities, the company is profitable. The activities in the value chain are divided into two broad categories called *primary activities* and *support activities*. Primary activities are involved in the physical production of the product (for example manufacturing), whereas support activities are needed for the primary activities to be possible to perform (for example providing purchased inputs, technology, human resources or overall infrastructure) (Porter, 1994).

The primary activities are briefly described as (Porter, 1995):

- Inbound logistics: Activities associated with receiving, storing, and disseminating inputs to the product.
- Operations: Activities associated with transforming inputs into the final product form.
- Outbound logistics: Activities associated with collecting, storing, and physically distributing the product to buyers.
- Marketing and sales: Activities associated with providing a means by which buyers can purchase the product and inducing them to do so.
- Service: Activities associated with providing service to enhance or maintain the value of the product.

The supporting activities that facilitate the primary value creating activities are described as follows:

- Procurement: Purchasing of inputs used in the value chain.
- Technology development: Activities intended to improve products and processes.
- Human resource management: Activities such as recruiting, hiring, training of staff et cetera.
- Firm infrastructure: Infrastructure activities that support several parts of the company; general management, planning, finance, accounting and legal.

3.3 The business model canvas

Customers (value, relationships, and segments), resources (infrastructure, activities, partners, logistics) and the cost/income structure resulting from customer and resource choices are generic elements of business models (Groth & Nielsen, 2015; Osterwalder & Pigneur, 2010). There is no universal definition of what a business model is, however, Osterwalder and Pigneur (2010) formulated the following definition "A business model describes the rationale of how an organization creates, delivers and capture value". Business models are not to be confused with product market since business models describe how different pieces of a business fit together but do not account for choices made to meet competition (Magretta, 2002). Business models are also different from products, companies, industries, networks, technology, internal organization and value chains (Groth & Nielsen, 2015). It is known that business models develop over time, and some studies promote the idea that business model development is a tool for corporate renewal and that good business models secure long-term competitiveness and survival. Successful companies, it is argued, account for changing preconditions in the surrounding world through developing their business models (Johnson, Christensen, & Kagermann, 2008). There is no consensus on how business model development is realised. Some researchers advocate that business model development is the result of a systematic and structured process (Eurich, Weiblen, Breitenmoser, 2014). Others claim that it stems from trial and error (Sosna, Trevinyo-Rodríguez, & Velamuri, 2010; Blank and Dorf, 2012).

The business model canvas (Ostewalder & Pigneur, 2010) provides a framework composed of nine blocks and is widely used for understanding business models. It was developed jointly by academic researchers, government officials, professionals from different industries, analysts from different sectors and consultants interested in business modelling. Four of the blocks address the customer, outlining the customer segment, the channels used to reach the customers, customer relationships and the value proposition. Three of the blocks consider activities undertaken to deliver the value, the resources needed for value creation and the imperative partnerships for delivery of the product or service. The last two blocks outline the cost structure undertaken by the business and the income structure of the realised sales. The canvas is illustrated in Figure 3.

<table>
<tr><td rowspan="2">Key Partners
"Who can help you?"</td><td>Key activities
"How do you do it?"</td><td rowspan="2">Value Proposition
"What do you do?"
This is where the analysis starts.</td><td>Customer Relationship
"How do you interact?"</td><td rowspan="2">Customer segment
"Who do you help?"</td></tr>
<tr><td>Key Resources
"What do you need?"</td><td>Channels
"How do you reach them?"</td></tr>
<tr><td colspan="3">Cost structure
"What will it cost?"</td><td colspan="2">Revenue streams
"What will it cost?"</td></tr>
</table>

Figure 3: The business model canvas (Ostewalder & Pigneur, 2010)

4 Methodology

The methodological framework described above is applied to derive the business model concepts for the technology packages implemented at the demo sites. The business model concepts are based on the available knowledge in the project at this stage (M12) and while they serve as a guidance for the demo sites in their progression towards commercial, solar driven heat pump options, they will be further developed in later stages of the project (Task 7.2). A three-step approach is applied:

- A macro-market analysis (PESTLE analysis) of the demo site countries is performed to identify the important aspects to consider for the market uptake of the demonstrated SunHorizon technology packages in the demo site countries. Key opportunity areas are identified as well as potential barriers for each country in the analysis.
- Value chains are drafted for the technology packages implemented at the demo sites based on the available knowledge in the project at M12. The value chains encompass Heating & Cooling generation (hardware definition), Distribution (hardware definition) Connect & Control (hardware and software definition), Energy efficiency compared to conventional heating & cooling alternative) and Customer management (IT solution, billing etc.). The value chains for the technology packages focuses on the inbound logistics and operations since the technology packages are not mature and, on the market, yet. The common denominators for all technology packages implemented at the demo sites is structured into a generic value chain. For each demo site the generic value chain is altered by highlighting, or adding, the distinct value-adding activities or values to that specific site. Later steps of the value chain will be addressed in Task 7.2. The value chains were developed based on interviews conducted by audio link with the responsible part for each of the demo sites and the results have been validated by the interviewees. For demo site 1 and 2 a single value chain map was derived because the sites have the same responsible partner and the value-adding activities are very similar. This is also true for demo sites 6 and 7.
- The information found in the PESTLE analysis and through the value chain mapping, together with the important aspects from SunHorizon deliverable D2.2, *Mapping of solar resource and building demand for SunHorizon implementation*, are analysed and mapped in the business model canvas framework. A business model concept is drafted for each of the technology packages implemented at the demo sites in SunHorizon. Empirical data gathered during the project and identified exploitation possibilities will direct the development of business model concepts that can be taken to market, developing the designs of D2.3 further (the purpose of Task 7.2).

In sum, the methodology applied in D2.3 and the link to Task 7.2 is illustrated in Figure 4 below.

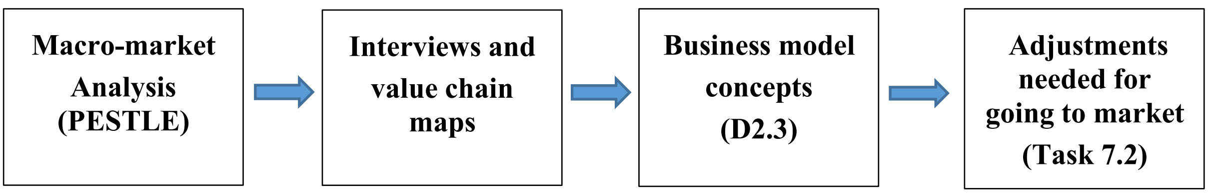


Figure 4: The methodology applied in D2.3 and the link to Task 7.2

5 Description of the technology packages

The five low emission heating and cooling technology packages to be installed at the SunHorizon demonstration sites are described in this chapter. The technology packages consist of different combinations of novel heating and cooling technologies, especially solar and heat pump-based technologies. The technology packages are described in more detail in D2.1, High level requirements and specification of demo sites (including implementation and risk plans).

5.1 Thermal energy storage included in all technology packages

At each demo site, a thermal energy storage will be installed to support optimized operation of the SunHorizon technology packages. A thermal energy storage can be used to store heat at times of, for example, solar thermal production surplus. The stored solar thermal energy can be discharged later, when the solar thermal production is lower than the demand in the building. The thermal energy storage used within the SunHorizon project is a storage tank with enhanced stratification. The enhanced stratification gives a higher quality of storage, in terms of temperature, and reduced thermal losses.

5.2 Technology package 1 (TP1)

Technology package 1 (TP1) is denoted as a *parallel solar-heat pump integration* concept and consists of solar thermal panels from TVP paired with a thermal compression heat pump (HP) from BH, using natural gas from the grid as fuel. The TVP technology will utilise solar heat to mainly supply a building with space heating and domestic hot water (DHW), the BH technology will be used as a back-up supply of heat whenever solar heat is not available. The end user obtains space heating and domestic hot water. The flowchart below shows a conceptual energy flow diagram for TP1.

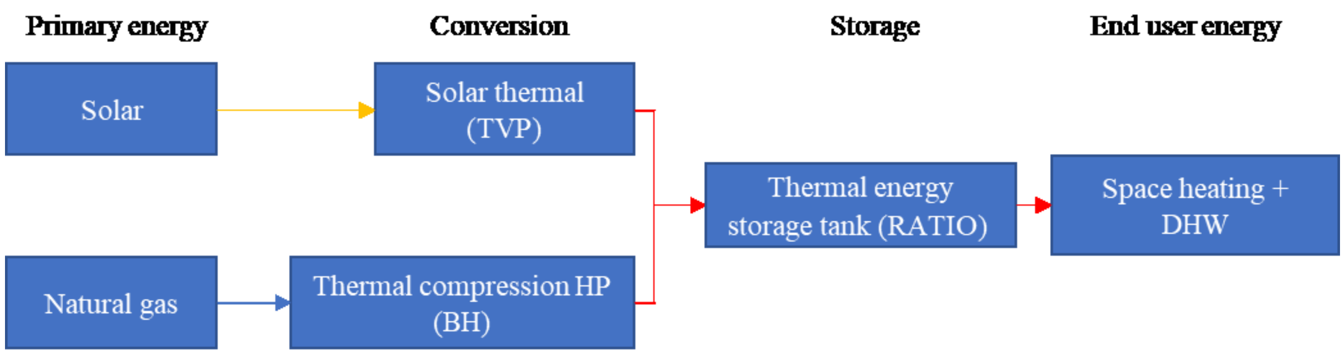


Figure 5: TP1 conceptual energy flow diagram. Yellow arrow equals solar energy, blue arrow equals natural gas and red arrow equals heat.

5.3 Technology package 2 (TP2)

Technology package 2 (TP2) is denoted as a *mixed solar-assisted/parallel solar-heat pump integration* concept and includes a natural gas-fuelled heat pump (BH) and hybrid solar PV-T panels from DS, which simultaneously produces electricity and hot water. Heat produced by the solar panels will be used to cover heat demand (both space heating and DHW) to as large extent as possible, BH covers the remaining heat demand. The electricity produced by the solar panels will be used to cover electricity demand from appliances within the building. The end user also obtains space heating and domestic hot water. The flowchart below shows a conceptual energy flow diagram for TP2.

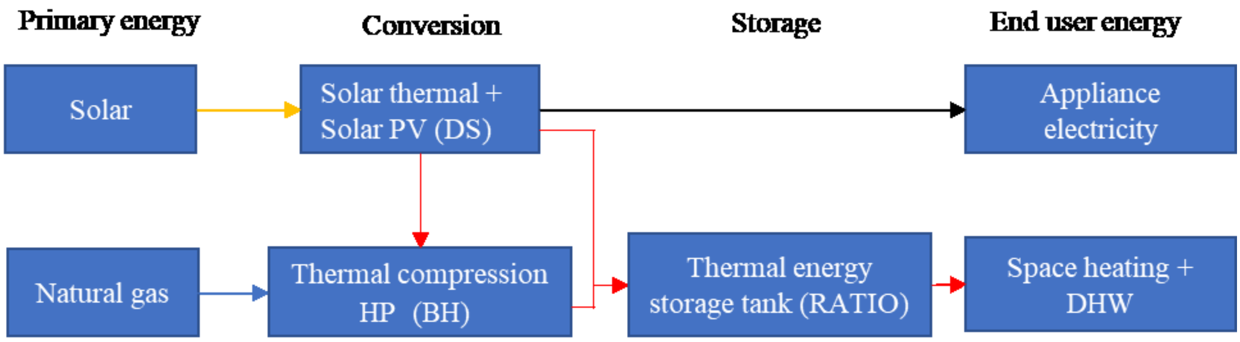


Figure 6: TP2 conceptual energy flow diagram. Yellow arrow equals solar energy, blue arrow equals natural gas, red arrow equals heat and black arrow equals electricity.

5.4 Technology package 3 (TP3)

Technology package 3 (TP3) is denoted as a *solar driven heat pump for cooling* concept and includes thermal solar panels (TVP) and a hybrid sorption/compression chiller from FAHR. The thermal solar panels shall cover space heating and DHW demand during the heating season. The chiller will provide cooling during the cooling season and is powered by electricity and thermal energy, which is provided by the thermal solar panels. The end user also obtains space heating and domestic hot water. The flowchart below shows a conceptual energy flow diagram for TP3.

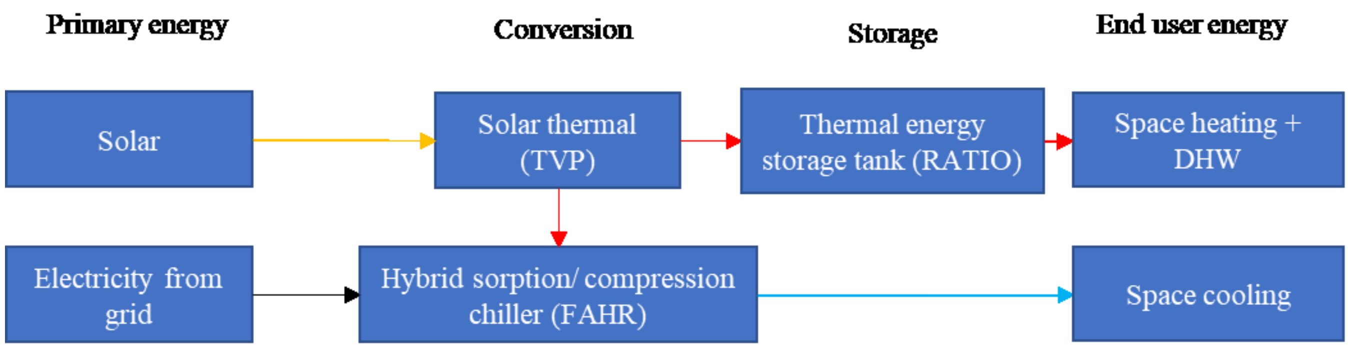


Figure 7: TP3 conceptual energy flow diagram. Yellow arrow equals solar energy, blue arrow equals natural gas, red arrow equals heat, black arrow equals electricity and light blue arrow equals cooling.

5.5 Technology package 4 (TP4)

Technology package 4 (TP4) has the same denoted as TP1, a *parallel solar-heat pump integration* concept, and consists of hybrid PV-T solar panels from DS and a reversible heat pump from BDR. The reversible heat pump is powered by electricity and can be used for both heating and cooling purposes. The thermal output from the solar panels shall cover part of the space heating and domestic hot water demand in the building and the electricity output shall be consumed by the reversible heat pump to provide heating or cooling. The flowchart below shows a conceptual energy flow diagram for TP4.

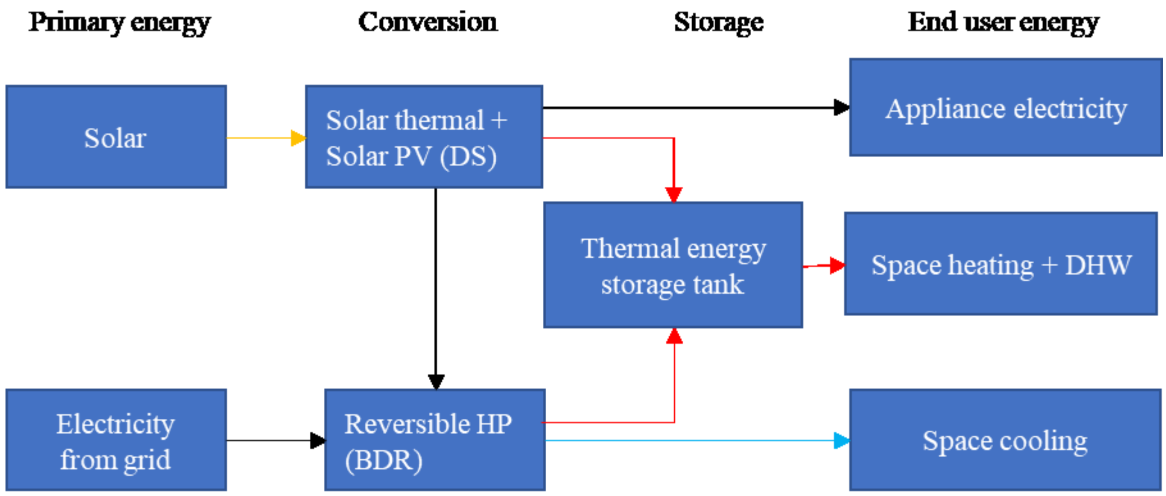


Figure 8: TP4 conceptual energy flow diagram. Yellow arrow equals solar energy, blue arrow equals natural gas, red arrow equals heat, black arrow equals electricity and light blue arrow equals cooling.

5.6 Technology package 5 (TP5)

Technology package 5 is (TP5) denoted as a *mixed solar-assisted/parallel solar-heat pump integration* concept. It includes thermal solar panels from TVP, a natural gas fuelled heat pump from BH and a sorption/compressor chiller from FAHR. Heat output from the solar panels will be used to cover the demand for space heating and domestic hot water, BH will be used to cover heat demand when the solar panels are not producing heat, and to power the FAHR chiller when there is a need for cooling. TP5 will not be installed at any SunHorizon demonstration site. The flowchart below shows a conceptual energy flow diagram for TP5.

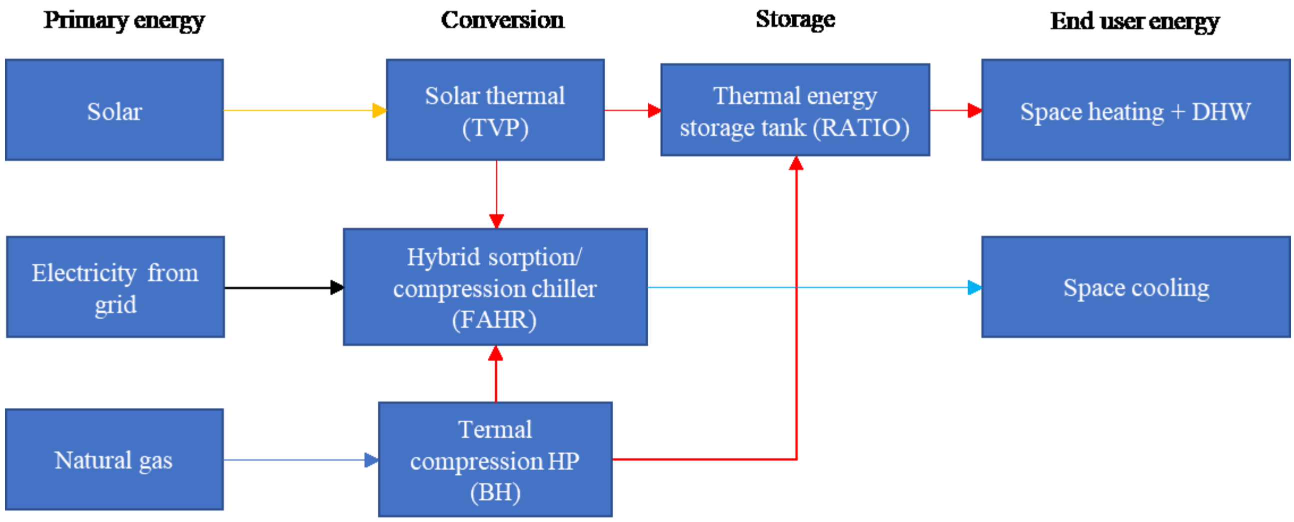


Figure 9: TP5 conceptual energy flow diagram. Yellow arrow equals solar energy, blue arrow equals natural gas, red arrow equals heat, black arrow equals electricity and light blue arrow equals cooling.

6 Results from the PESTLE analysis and input from D2.2

Chapter six provides the result of the PESTLE analysis and a summary of the important aspects from D2.2, Mapping of solar resource and building demand for SunHorizon implementation, to consider when developing the business model concepts in Chapter 7.

6.1 Market analysis

A PESTLE analysis is performed to identify important macro-market aspects that can affect the commercialization of the SunHorizon technology packages on the respective demo site countries. Comparisons are presented between the demo site countries, and with the rest of the EU countries, with regards to installed capacity of the SunHorizon technologies, heating and cooling demand and energy price and data.

6.1.1 Installed capacity of the SunHorizon technologies

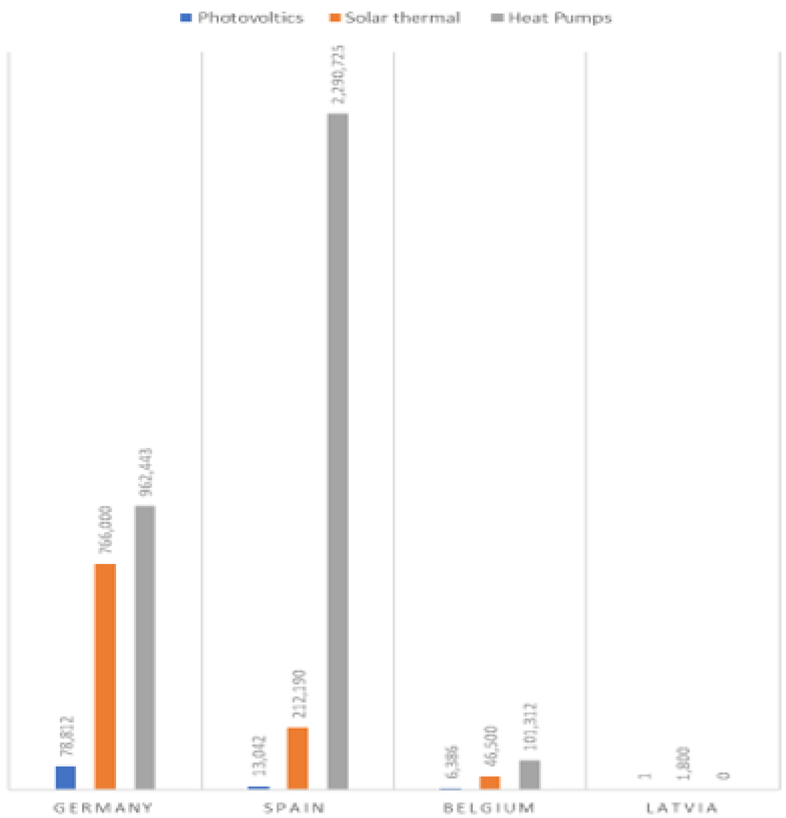


Figure 10: The installed capacity of the SunHorizon technologies, solar photovoltaics, solar thermal and heat pumps in the demo site countries (EurObserv'ER 2017).

Germany is the largest user of solar PV and solar thermal panels in the EU and is ranked the second highest user of heat pumps when compared to the demo countries. Spain is the largest user of heat pumps when compared in the demo site countries but is ranked third when compared to the rest of EU following Italy and Spain. Spain is the second largest user of solar thermal and solar PV compared with the demo sites, but is ranked fourth and fifth, respectively, in the rest of EU. Belgium has a lower installed capacity of both solar and heat pump technologies. Latvia has very low installed capacity of the SunHorizon technologies. More detailed analysis and comparison with the rest of the EU countries is available in Annex B.

6.1.2 Heating and cooling demand in the EU

Heating accounts for the largest part of the heating, cooling and DHW demand in the EU15. Germany and Belgium have a higher than average heating demand, whereas Spain has a higher than average cooling demand. The PESTLE analysis was unable to identify the demand of heating, cooling and DHW in Latvia.

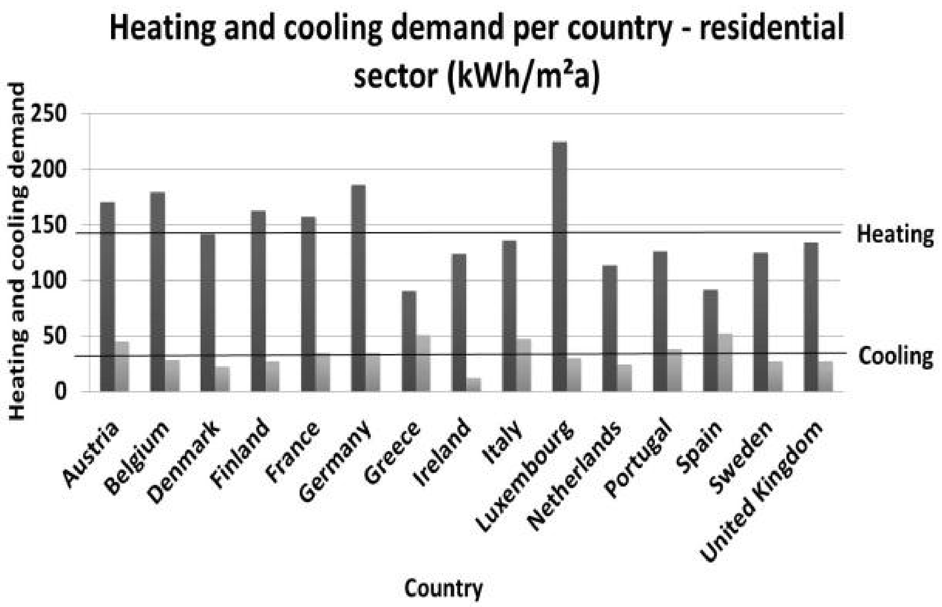


Figure 11: Heating and cooling demand per country (EU15) -residential sector [kWh/m²a] (Pezzutto, 2012)

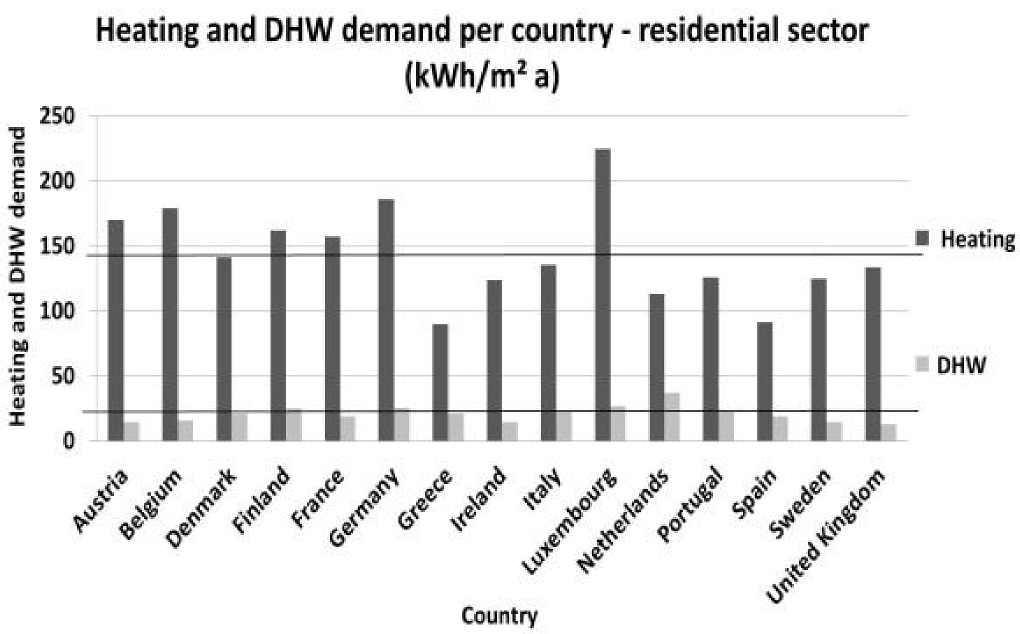


Figure 12: Heating and DHW demand per country – residential sector [kWh/m²a] (Pezzutto, 2012)

6.1.3 Key findings from energy data

The figures below display key energy data for the demo site countries that can affect the SunHorizon exploitation in the respective country. Many energy features show a large difference between the countries which entails that each country has different prerequisites on the energy market. As can be seen in Figure 13, the difference in electricity price between Latvia (15.8 cent/kWh) and Germany (30.5 cent/kWh) is almost the double. In the same figure it is visible that the increase in electricity price in Belgium has been 30% in the last 10 years whereas in Latvia the increase has been 58% during the same period. Belgium is the demo site country with the highest energy use (in Figure 14) and electricity consumption (Figure 15). Compared with the other demo site countries Latvia has the lowest percentage of fossil fuel consumption and Germany the highest (Figure 16). Figure 17 shows that Belgium has the highest dependency on importing energy and Latvia is the most energy self-supplied out of the demo site countries (however still at 45% net import). (Eurostat, 2018; World Bank, 2019)

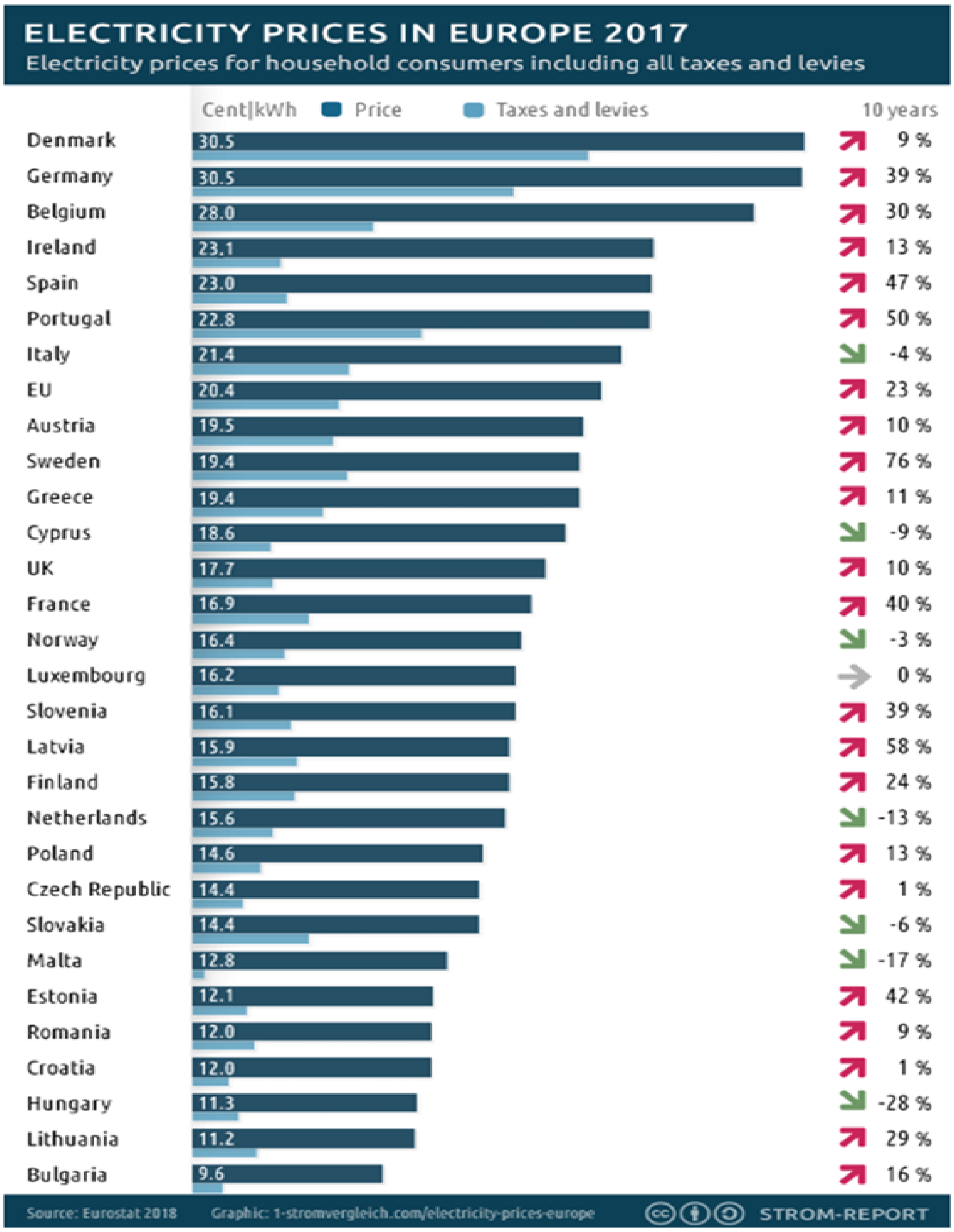


Figure 13: Electricity price and price trend for households, including all taxes and levies, in Europe 2017 (Eurostat, 2018)

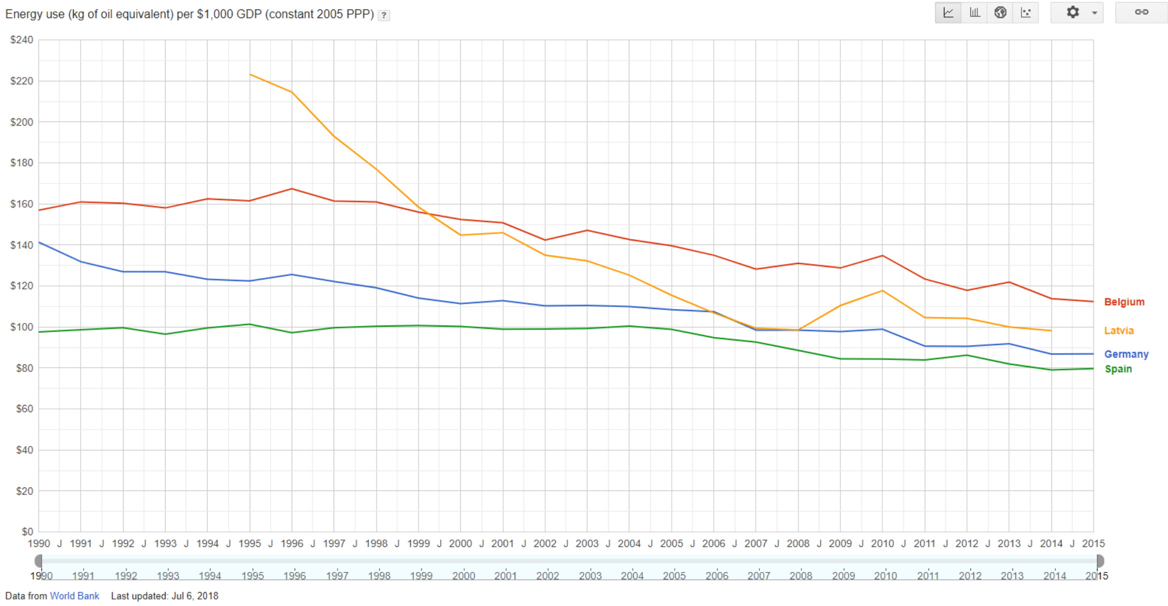


Figure 14: Energy use (kg oil equivalent) per $1000 GDP (World Bank, 2019)

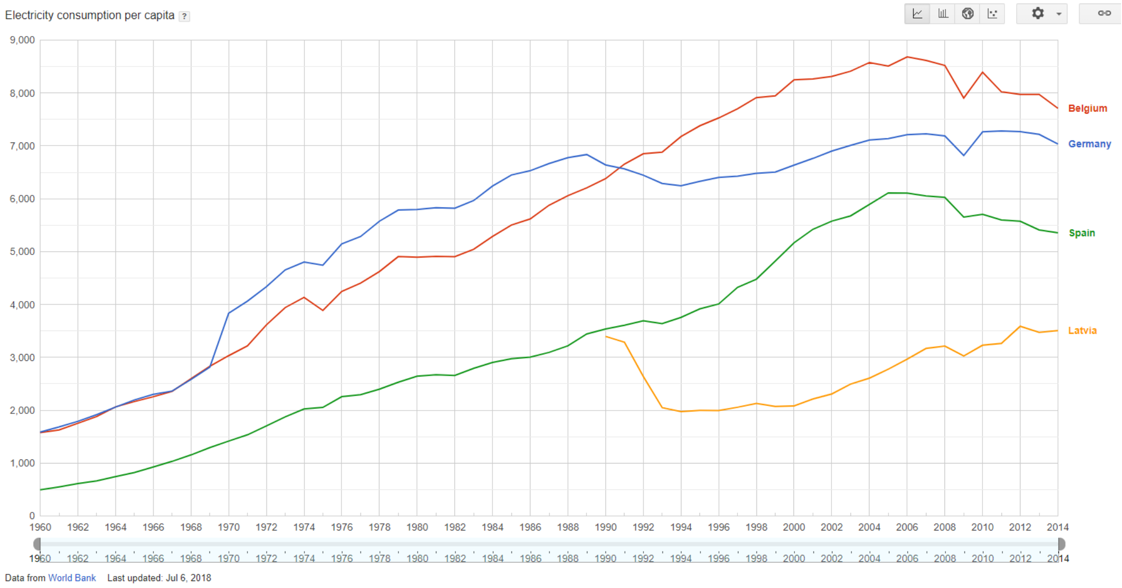


Figure 15: Electricity consumption for the demo site countries in kWh per capita (World Bank, 2019)

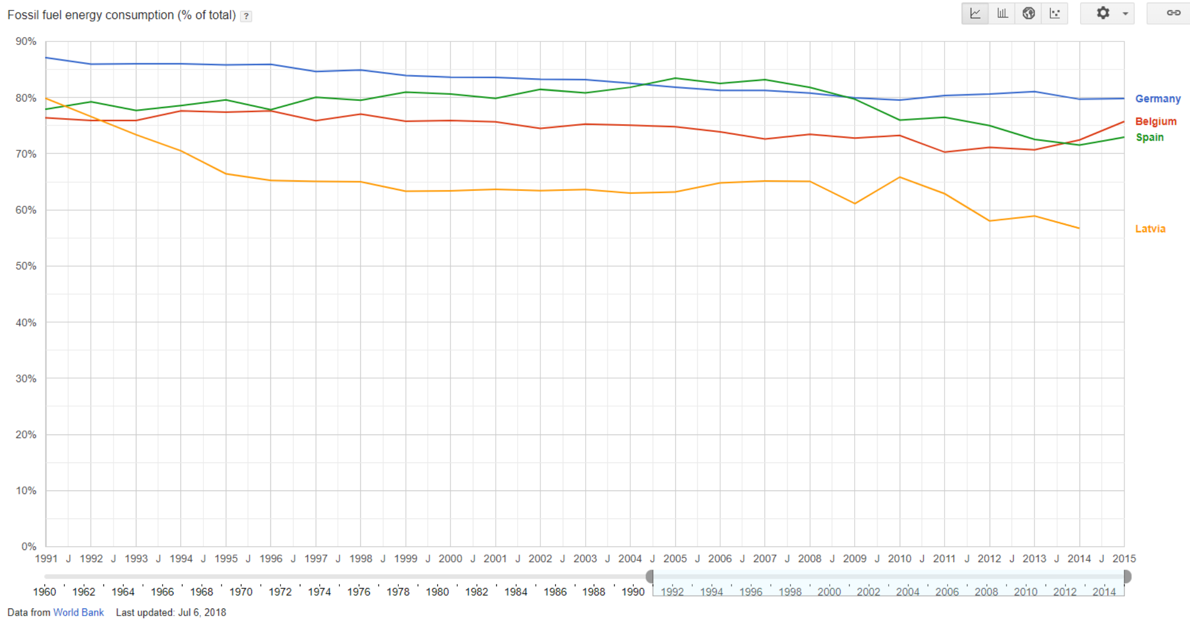


Figure 16: Fossil fuel energy consumption as % of total energy consumption (World Bank, 2019)

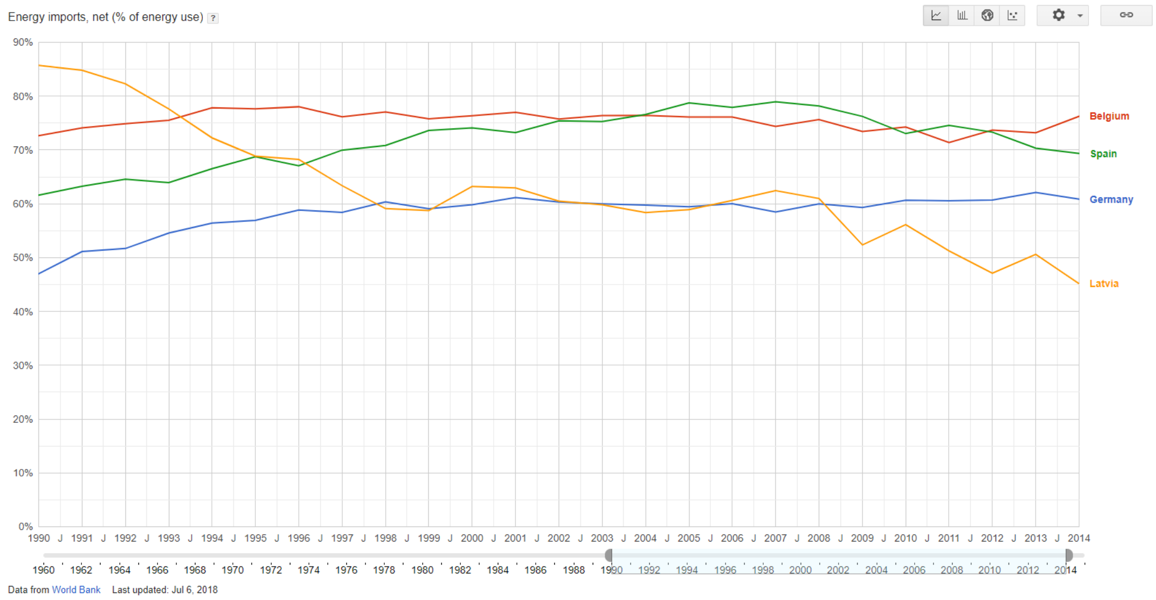


Figure 17: Net energy import as % of total energy use (World Bank, 2019)

6.2 Germany

6.2.1 PESTLE Results

From the PESTLE analysis on the German market, it can be concluded that Germany has an overall positive macro environment for the SunHorizon project. The main drivers are the government's climate goals, the available funding for renewable energy and energy efficiency measures and the high level of electricity costs in the country. The main barrier for the SunHorizon technology packages in Germany is the extensive installation of technologies based on solar energy, competing with the SunHorizon solutions. The full PESTLE analysis for Germany in available in Annex C.

Figure 18: Opportunity area's for SunHorizon technology packages in Germany

6.2.2 PESTLE Results: Political, Legislative & Economic factors

Germany has strong energy policies and a renewable energy target to progress from 18% in 2020 to 30% in 2030 (gross final energy consumption) (European Commission, 2019). There are several funding initiatives described below to increase energy efficiency in the building sector, both by self-producing energy and switching to more efficient heating systems based on electricity or renewable energy. There is also a push from the government to increase sectoral coupling, the interconnection of the consuming sector, such as buildings, with the power producing sector. The landlord-to-tenant electricity act can provide funding to landlord-to-tenant models involving generation of electricity through solar PV on the roof of residential buildings supplying electricity to tenants without passing through the grid. The funding is provided through the Renewable energy sources act (EEG). The EEG is the central incentive scheme fostering the growth of renewable electricity generation using a feed-in tariff. The government subsidy for solar heating modernization of a home is usually 3,600 euros (lowest 2,000 euros). To drive energy efficiency in the building sector the Energy savings ordinance (EnEV) sets minimum requirements for the energy performance in new buildings and buildings undergoing major renovations. The requirements do not explicitly ban fossil fuel heating systems, but in practice it would be nearly impossible to meet the requirements with an oil or gas boiler. Alternative heating systems are necessary to meet the requirements and both heat pumps and solar thermal are suitable options. If a house that accommodates more than three residential units is retrofitted, then up to 100 m^2 of collector area can be subsidized with 200 euros/m^2 through innovation funding. Solar heating systems are currently not subsidized by the state in new buildings. Available funding for improving energy efficiency in buildings is available through the Energy Efficiency Incentive Programme focusing on ventilation systems and heating packages. Towards the heating sector, under the Energy Efficiency Strategy for Buildings, funding measures are available for developing fourth-generation heating networks. Funding for *Heating Network Systems 4.0* is scheduled to continue until the end of 2020 but is expected to be extended to drive the goal of an almost climate-neutral building stock by 2050. Germany has the second highest electricity price for households in the EU, after Denmark. In the last ten years the electricity price has increased by 39% (Eurostat, 2018).

6.2.3 PESTLE Results: Technological, Social & Environmental factors

The largest source of renewable energy in Germany is wind power, followed by solar energy. Germany has the largest installed base of solar photovoltaic (PV) in the EU with 43 GW in 2017 (more than double the installed capacity of second placeholder Italy) and is EU leader in installed capacity of solar thermal. The large installed base of solar energy indicates a maturity on the market for such technologies and a high level of social acceptance. Heat pump installations have increased in recent years due to government subsidies and stricter energy savings requirements and Germany has the fifth most installation of heat pumps in the EU (EurObserv'ER, 2017). Although having a large installed base of the technologies included in the SunHorizon technology packages preliminarily indicates a high social acceptance and awareness of the technologies, these aspects will be studied in detail in D7.1*, SunHorizon Technologies social and market acceptance.*

Germany's climate is characterized by a central European climate with a flat to hilly landscape. Solar irradiation maps of Germany show that the highest potential for solar technology is in the southern regions and the least potential is in the north-western regions (Solargis, 2019).

6.2.4 Input from D2.2: Mapping of solar resource and building demand for SunHorizon implementation

Countries with high level of solar resource potential, high values of H&C demand, and high energy costs are those where the installation of SunHorizon technologies is more promising. Other suitable countries are those characterized by high values of H&C demand and where there are positive market conditions. It is possible that sometimes the market conditions play a more important role than solar irradiation.

The solar resource measured as global irradiation (kWh/m^2), calculated on annual basis and optimum angle, can estimate potential energy production in terms of electricity and/or heat production for the solar technology in SunHorizon. The highest values in Europe are at 2200 kWh/m^2 and are found in the southern part of Europe and the lowest values at 1000 kWh/m^2 are found in the northern parts of Europe. Germany is categorized to have medium availability of solar resource at 1251 kWh/m^2 (PVGIS © European Communities, 2001 – 2019).

Looking at energy demand as energy input to the H&C system at the final customer, measured as kWh/m^2/y, can provide information about in which countries there is a demand for more energy efficient H&C solutions. For EU countries the heating demand account for most of the H&C demand in the residential and tertiary sector. Compared to other EU countries Germany is considered to have a high heating demand and medium cooling demand, with the cooling demand only making up about 2% of the total energy required for H&C (Heat Roadmap Europe, 2017).

Since SunHorizon offers a H&C system it is important to know how this demand is met in the countries today, thus which energy source is the main competition. In Germany most of the heating demand (84%) in the residential and tertiary sector is produced in boilers using oil (29%), gas (44%) and biomass (11%) (Heat Roadmap Europe, 2017). By weighing together the energy price (from electricity, natural gas, district heating and fuel oil) and comparing to other EU countries Germany is found to have medium energy costs (Eurostat, 2019). A key aspect for the financial viability of renewable energy and energy efficiency installations that can help drive the market towards these solutions is the presence of support mechanisms. Even though Germany has strong energy policies overall, the support mechanisms specifically directed towards solar energy in H&C applications is low (Council of European Energy Regulators, 2018).

6.3 Spain

6.3.1 PESTLE Results

The PESTLE analysis shows that Spain has an overall positive macro environment for the SunHorizon technology packages. The main drivers are the governments climate goals and the available funding for renewable energy and energy efficiency measures. The main barrier in Spain is the high installation costs compared to the well-established conventional technologies such as gas and electric boilers. The full PESTLE analysis for Spain in available in Annex D.

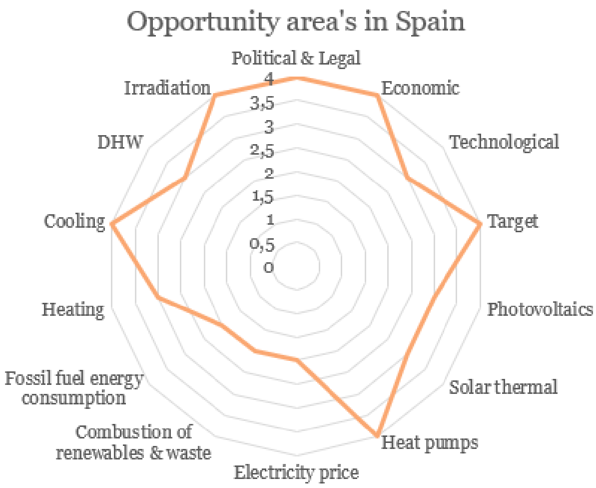


Figure 19: Opportunity area's for SunHorizon technology packages in Spain

6.3.2 PESTLE Results: Political, Legislative & Economic factors

The Spanish government has an ambitious renewable energy target, to increase the share of renewable energy from 20% in 2020 to 42% in 2030 (gross final energy consumption) (European Commission, 2019), showing a political support for the transition of the country's energy system towards renewable energy. In comparison, in 2018 the share of renewable energy was 16%. The technical Building Code (CTE, codigo tecnico de la edifcacion) from 2006 sets out an obligation on all new buildings, and buildings undergoing major refurbishments to cover part of the DHW with solar thermal energy. The contribution varies between 30-70%. Some municipalities, such as Barcelona and Madrid, had similar but stricter demands even before the CTE and more municipalities have joined. Municipality solar obligations, together with the CTE, have proven a big driver for the solar thermal market and is estimated to have motivated 80% of installations. This stimulated the market and has led to installations also outside the solar obligation regulation. Other than solar obligations, public financial schemes are available for renewable energy and energy efficiency measures. Spain recently received a support package from the European Investment Bank of EUR 450m to enable finance of solar and onshore wind projects. Today gas and electrical boilers are well established on the Spanish market and the major economic factor for investing in a SunHorizon technology package, or other similar technology, is the high investment cost in comparison to conventional technology. Spain has the fifth highest electricity price in the EU and the price trend has been a 47% increase in the last 10 years (Eurostat, 2018).

6.3.3 PESTLE Results: Technological, Social & Environmental factors

The largest source of renewable energy in Spain is wind power, followed by hydro and in third place solar energy. Spain has the fifth largest installed base of solar photovoltaic (PV) in the EU, around 12% of the installed capacity in Germany, and the fourth largest installed capacity of solar thermal. Heat pumps are common in Spain, likely due to the cooling demand arising during summer, and Spain has the third largest installed base in the EU (EurObserv'ER, 2017). This indicates that the technology included in the SunHorizon technology packages is known in Spain which should make commercialization easier from a social acceptance perspective but could also indicate a competitive market. The increase of renewable energy until 2030 is expected to mainly be due to an increase in wind power and solar PV, but also solar thermal.

Spain is located in the south-western part of Europe and characterized by a large, flat dissected plateau surrounded by rugged hills and the Pyrenees to the north. The temperate climate provides clear and hot summers inland and more moderate and cloudy summers along the coast. Winters are cloudy and cold inland and partly cloudy and cool also along the coast. Solar irradiation maps of Spain show high levels of irradiation, the highest potential of the four demo site countries (Solargis, 2019).

6.3.4 Input from D2.2: Mapping of solar resource and building demand for SunHorizon implementation

Spain is categorized to have high availability of solar resource at 1948 kWh/m^2, measured as global irradiation (PVGIS © European Communities, 2001 – 2019). Compared to other EU countries Spain is considered to have low heating demand and high cooling demand when measuring energy input to the H&C system at the final customer in kWh/m^2/y. The cooling demand makes up about 13% of the total energy required for H&C. In Spain most of the heating demand (84%) in the residential and tertiary sector is produced in boilers using oil (27%), gas (38%) and biomass (19%) (Heat Roadmap Europe, 2017). By weighing together the energy price (from electricity, natural gas, district heating and fuel oil) and comparing to other EU countries Spain is found to have high energy costs (Eurostat, 2019). Even though Spain has high goals for increasing the amount of renewable energy the overall support mechanisms for solar energy in H&C applications is absent (Council of European Energy Regulators, 2018).

6.4 Belgium

6.4.1 PESTLE Results

Belgium has an overall decent macro environment for the SunHorizon project. There is some political support, but very scarce availability of financial support. The full PESTLE analysis for Belgium in available in Annex E.

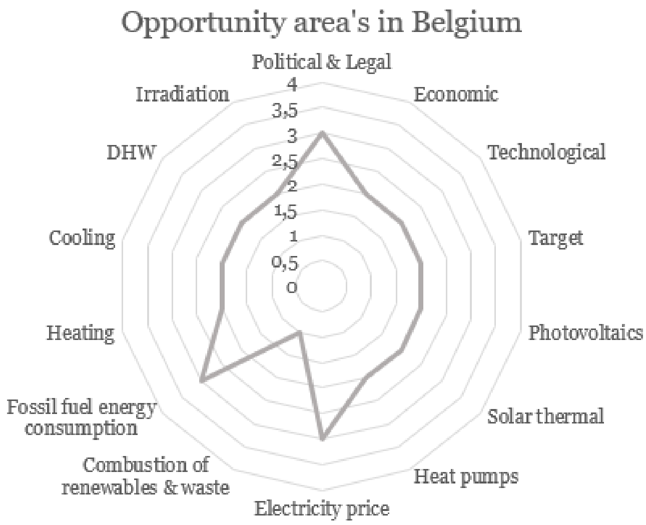


Figure 20: Opportunity area's for SunHorizon technology packages in Belgium

6.4.2 PESTLE Results: Political, Legislative & Economic factors

The overall target for renewable energy in Belgium is 13% to 2020 with an increase to 18.3% in 2030 (gross final energy consumption) (European Commission, 2019), a lower increase of target than in Germany and Spain. Belgium has some differences in political initiatives and targets regarding energy depending on region (Wallonia, Flanders and the Brussels area) and this should be considered when initiating a project. For example, in Wallonia the Energy Performance for Buildings legislation obliges certain new buildings as well as existing buildings with a floor area greater than 1000 m² to install thermal solar collectors or other installations equivalent to the energy saving of thermal solar collectors. Electricity from renewable sources is promoted throughout Belgium mainly through a quota system based on certificates trade, called green certificates. There is some political support for the use of solar and coupled technologies within this target, but economic support is general to all renewable technologies. The electricity price for households including taxes and levies have increased 30% in the last 10 years. Belgium has the third highest electricity price in the EU and both the highest electricity and energy usage per capita compared to the other four demo sites countries (Eurostat, 2018).

6.4.3 PESTLE Results: Technological, Social & Environmental factors

Belgium has the sixth largest installed base of solar photovoltaic (PV) in the EU, which is less than 10% of the installed capacity in Germany, and the ninth largest installed capacity of solar thermal. The amount of heat pump installation is very limited (EurObserv'ER, 2017). This indicates that the technology present in SunHorizon is not very common or known in Belgium.

Belgium is a low-lying country, with a broad coastal plain extending in a south easterly direction from the North Sea and rising gradually into the Ardennes hills. Belgium has a temperate, maritime climate predominantly influenced by air masses from the Atlantic. Winters are damp and cool with frequent fogs; summers are rather mild. Solar irradiation maps of Belgium show lower levels of irradiation than other areas in Europe but still there is potential for solar technologies (Solargis, 2019).

6.4.4 Input from D2.2: Mapping of solar resource and building demand for SunHorizon implementation

Belgium is categorized to have low availability of solar resource at 1238 kWh/m^2, measured as global irradiation (PVGIS © European Communities, 2001 – 2019). Compared to other EU countries Belgium is categorized to have high heating demand and medium cooling demand when measuring energy input to the H&C system at the final customer in kWh/m^2/y. The cooling demand only making up about 2% of the total energy required for H&C. In Belgium the majority of heating demand (84%) in the residential and tertiary sector is produced in boilers using oil (34%) and gas (50%) (Heat Roadmap Europe, 2017). By weighing together the energy price (from electricity, natural gas, district heating and fuel oil) and comparing to other EU countries Belgium is found to have medium energy costs (Eurostat, 2019). The overall support mechanisms for solar energy in H&C applications in Belgium is high (Council of European Energy Regulators, 2018).

6.5 Latvia

6.5.1 PESTLE Results

The PESTLE analysis shows that Latvia has an overall poor macro environment for the SunHorizon technology packages. The financial support is low or absent, however in the government plans for 2020 to 2030 some implementation of funding is present, but currently there is no clear indication as to what this will include. The full PESTLE analysis for Latvia in available in Annex F.

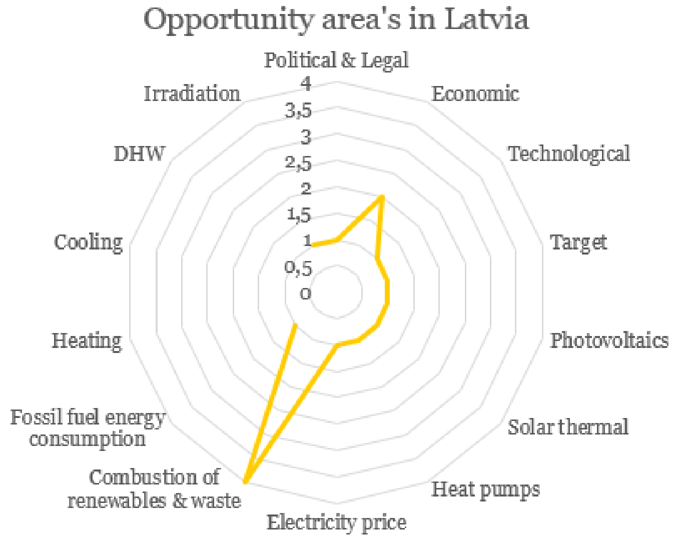


Figure 21: Opportunity area's for SunHorizon technology packages in Latvia. Some values are missing due to lack of available market information.

6.5.2 PESTLE Results: Political, Legislative & Economic factors

Latvia has a renewable energy target of 40% to 2020 with an increase to 45% to 2030 (gross final energy consumption) (European Commission, 2019). The measures and policies for fulfilling the increase of renewable energy can be summarised into three lines of action. The first being development of legislation to stimulate the increase without direct financial support. Secondly, a review of tax rates to promote renewable energy and make it more competitive to fossil fuel. Thirdly, attract funding through cross border cooperation and renewable energy technology project.

A policy in place today related to the building sector is that owners of new buildings or buildings undergoing major refurbishment are obliged to consider using renewable energy sourced heating and cooling system. Since 2014 Latvia has applied net-metering for small grid connections where the user is both producing and consuming electricity. The user only pays for the net-energy, i.e. the difference between electricity obtained and fed-in to the grid. Approval from the responsible grid operator is necessary before electricity is delivered to the grid. There is basically no other financial support available today for solar technology or heat pumps as of current but there are some indications that funding may be implemented between 2020 and 2030.

Latvia has the 18th highest electricity price in the EU and the lowest electricity consumption per capita of the demo site countries. The electricity price for households have increased 58% in the last 10 years (Eurostat, 2018).

6.5.3 PESTLE Results: Technological, Social & Environmental factors

The largest source of renewable energy in Latvia is by far hydro power, followed by solid biofuels. Solar PV in Latvia is basically non-existent, in the EU only Estonia has less installed capacity, and the same is true for solar thermal where Latvia has the least installed base in the EU. Heat pumps are very uncommon (EurObserv'ER, 2017). This indicated that the technology included in the SunHorizon technology packages is unfamiliar in Latvia which could make commercialization more difficult from a social acceptance perspective

Latvia is characterized by typical European continental climate with warm, dry summers and cold winters. Solar irradiation maps of Latvia show low levels of irradiation, with some potential in the coastal regions (Solargis, 2019).

6.5.4 Input from D2.2: Mapping of solar resource and building demand for SunHorizon implementation

Latvia is categorized to have low availability of solar resource at 1175 kWh/m^2, measured as global irradiation (PVGIS © European Communities, 2001 – 2019). Looking at energy demand as energy input to the H&C system at the final customer, measured as kWh/m^2/y, Latvia is considered to have high heating demand and low cooling demand when compared to other EU countries. The cooling demand is essentially non-existent. In Latvia the majority of the heating demand (89%) in the residential and tertiary sector is produced in boilers using biomass (42%) and gas (14%) and through district heating (33%) (Heat Roadmap Europe, 2017). By weighing together the energy price (from electricity, natural gas, district heating and fuel oil) and comparing to other EU countries Latvia is found to have low energy costs (Eurostat). The overall support mechanisms for solar energy in H&C applications in Latvia is absent (Council of European Energy Regulators, 2018).

7 Business model concepts for the technology packages implemented at the demo sites

In this chapter information from the value chains, PESTLE analysis and deliverable 2.2 are condensed into business model concepts for each technology package implemented at the demo sites.

7.1 The identified generic value chain in SunHorizon

In the *planning and design* step, energy consultants are important actors who add value. In combination with the hardware providers who define the best solution (the technology package providers in SunHorizon) and the software providers who define efficient controls, the technology packages can be planned and designed. For the technical installations, permits, policy on energy efficiency investments and subsidies of such investments are important factors. When a municipal actor is involved, time and resources must be accounted for to meet public procurement demands.

The actual supply of components is made by both hardware and software providers. The *supply of components* is based on the definitions made in the planning and design stage. Another activity of importance is the contracting to undertake installations. The value added in the *installation stage* comes from labour efforts to install, inspect and calibrate the necessary components and software. Added value in *operation* stems from metering (basis for invoicing, monitoring and efficient service and maintenance).

Analysing the customer value that the four steps add to the customer, compared to conventional heating and cooling alternatives, the common denominator is lower GHG emissions, primary energy savings and energy efficiency, potentially resulting in cost savings. The identified values reflect the purpose of the SunHorizon project itself.

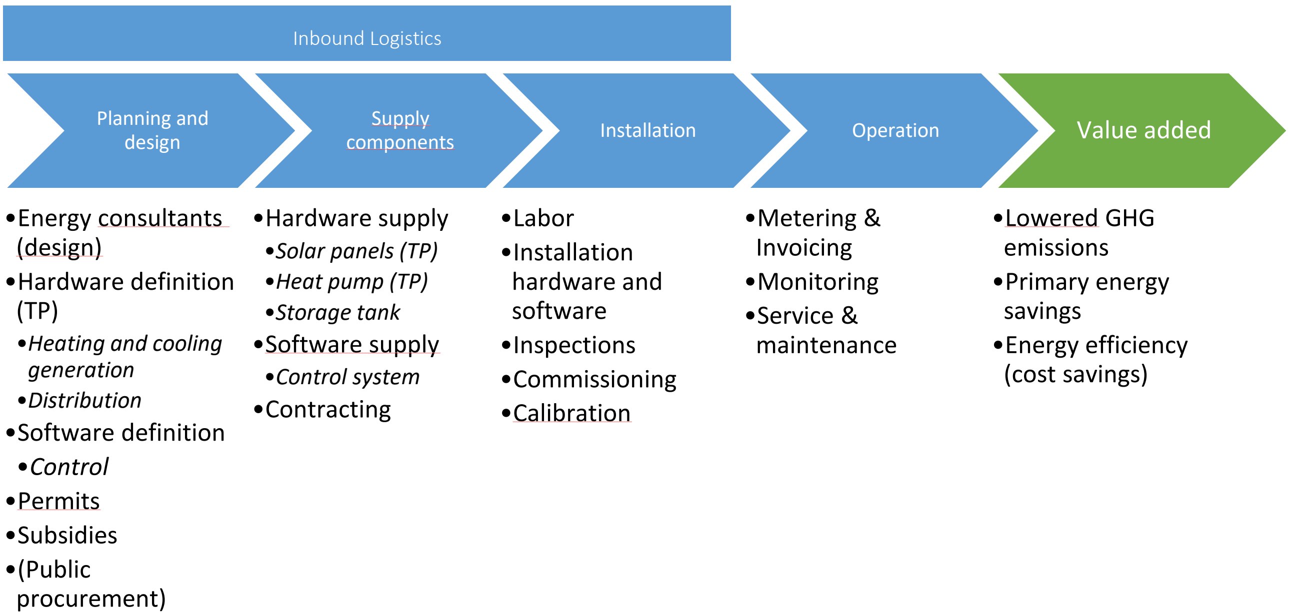


Figure 22: Generic value chain for all SunHorizon technology packages at all demonstration sites

7.2 Demosite 1 & Demosite 2: Berlin and Nurnberg

7.2.1 Description of DS1

At the Berlin demonstrator, TP1 will be installed and demonstrated. DS1 is a small residential building with two apartments, located in Berlin, Germany. The buildings space heating and DHW demand is currently met by two natural gas fuelled boilers and a solar thermal panel coupled together with a thermal energy storage tank. One of the main differences between TP1 and the current heating installation is that the two separate heating systems (one for each apartment in the building) will be replaced by a single, central heating system. The solar thermal panel installed in TP1 will be used to cover as much of the space heating and DHW demand as possible and the natural gas fuelled heat pump will cover the additional demand. DS1 is owned by a private building owner and managed in SunHorizon by BH. In M12, the technical installation had not been fully planned and designed. Therefore, the size of the new heating system is not known.

7.2.2 Description of DS2

At the Nürnberg demo site, TP2 will be installed and demonstrated. DS2 is a residential, multi-family building with four apartments, constructed in 1906. The building is connected to a natural gas grid and two of the flats have individual gas boilers for space heating and domestic hot water heating. One flat is heated by a wood stove and one flat is currently heated by a back-up oil boiler. The electricity generated by the hybrid solar panels in TP2 will be used to cover appliance electricity demand within the building and the heat generated will be used to cover space heating demand to as large extent as possible. The remaining heat demand will be covered by the natural gas-fuelled heat pump. Heat from the hybrid solar panels, through the thermal energy storage, will be used to raise the evaporator temperature of the heat pump, thus increasing the efficiency of the heat pump. DS2 is owned by a private building owner and managed in SunHorizon by BH. In M12, the technical installation had not been fully planned and designed therefore the size of the new heating system is not known.

7.2.3 Value chain for DS1 & DS2

BH, as responsible for the two demo sites in Germany, has been the primary point of data collection to produce the value chain of TP1 and TP2 installed at DS1 and DS2 respectively. Given the generic value chain from section 7.1, the most important value adding activities for these sites are highlighted in the value chain in Figure 23 below.

To small residential building owners, subsidies are especially important for the project to be viable, which are present on the German market. Distinct value-adding activities for these sites are added to the list and highlighted. Distinct to Germany is the installer, acting as a caretaker for the building, and the chimneysweep, necessary for inspections. The main values derived from the installation of the technology packages are increased energy efficiency, primary energy savings and lower emissions of GHG.

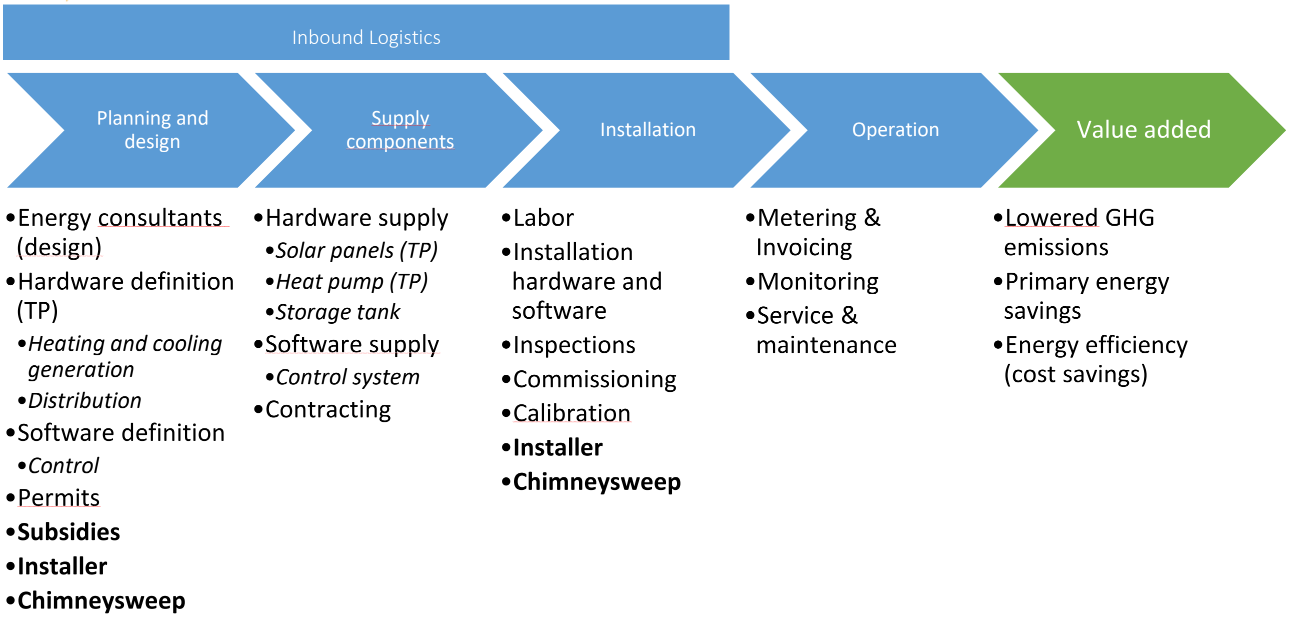


Figure 23: Value chain overview labelling important actors, activities and external factors relevant to demo sites 1 and 2

7.2.4 Business model concept for DS1 and DS2

7.2.4.1 Value proposition

The natural gas fuelled heat pump and solar system will replace a conventional natural gas boiler. This enables a more efficient use of natural gas resulting in reduced cost and gas dependency. The solar thermal panels will cover as much of the heat demand as possible thus reducing the need for natural gas even further compared to the conventional technology. The service DHW and heating is the same as before but now with **increased energy efficiency** leading to potential cost savings. The hybrid solar panel at demo site 2 will provide electricity to building appliances, which replaces part of the electricity purchased from the grid, resulting in **reduced cost of electricity**. Lowering energy cost for building owners in Germany could be desirable since Germany is categorized to have medium energy costs compared to other EU countries and especially looking at electricity price. Germany has the second highest electricity price for households in the EU, only Denmark has higher. In the last ten years the electricity price has increased by 39%. **The green value** of installing renewable energy sources and reducing fossil fuel consumption could be an important value depending on the customer. The control system that is to be installed will both provide value through **improved thermal comfort** in the building and the possibility to apply predicative maintenance on equipment can help drive maintenance cost down.

7.2.4.2 Customer segment, relationship and channels

The customer segment is a **private building owner of small to medium residential buildings**. A **close relationship** with the customer is necessary for the project to progress according to plan and to ensure a satisfied customer after finalized project. During the planning and installation phase this is achieved through **ongoing dialogue** and after commissioning the value delivered by the installed system could benefit from a display showcasing the savings to customers. Since most customers in this segment lack the competence of operating and maintaining an installation and ensuring optimal performance there is a possibility for the contractor to offer operation and maintenance contract that could be beneficial for the customer. Potentially something to explore further in Task 7.2.

7.2.4.3 Key resources, activities, and partners

The technology packages 1 and 2 (as described in chapter 5) and personnel that can operate the equipment and manage the project are required resources. For a contractor, the focus is mainly on coordination and management of different subcontractors who perform the actual value-adding activities and product management competence within the organisation is therefore necessary. Some building owners can experience unacceptance from the residents of the building, and this could cause delays in the project if residents are reluctant to let contractors into the building or in the worst case stop the project. It is therefore important for the contractor to develop information material that the building owner can directly supply to its end-customers, the residents of the building. The information should highlight the customer value of the installation. **Dissemination of knowledge** can lower the threshold for the building owner to make an investment decision if its customers are on-board with the project. For the project to progress smoothly **necessary permits and inspections** should be performed at the correct point in time in the project. The customer is not likely to have the knowledge needed to carry out applications for all necessary permits and this responsibility should lie with the contractor. For example, involve a local chimney sweep to provide necessary permits for the installation and inspections after commissioning the gas fuelled heat pump and reporting on the fulfilment of heating installation standards according to the German energy saving ordinance EnEV,(Energieeinsparverordnung). Another key activity is **applying for subsidies and grants** that are relevant to the SunHorizon technologies. The application process can be complicated for the customer to undertake without assistance and the contractor can again provide value to the customer by performing this task. Since the demo cases are already subsidized through the SunHorizon project no further subsidies will be granted to the installation but going forward to commercial stage financial support can be applicable.

To a contractor the subcontractors performing the design and buildings works and the **suppliers of technical equipment** are key partners to the project. In Germany another key partner is identified as **the installer**. The installer has a caretaker function of the building and is responsible for all the technical installations. The installer will be the contractor's main source of information about the building. Early involvement and inclusion in all phases of the project can be very beneficial. To receive the necessary permits for the installation **a local chimneysweep** must be involved in the project already in the planning stage. The chimneysweep returns just before commissioning of the system to perform inspections and issue permits.

7.2.4.4 Cost structure and revenue streams

The technical installation had not been fully planned and designed in the project at this stage (M12), so the size of the new heating equipment was not known. The cost efficiency of the SunHorizon technology packages is the subject of forthcoming research and investigation within the project itself. The details of how fixed assets and their maintenance will drive cost are not know at M12 of the project and will be developed further in Task 7.2

7.2.4.5 Business model canvas

Both in Berlin and Nürnberg the building owner is in the segment of small residential and as such it is not likely that the necessary resources to manage permits, grants, subsidies and the installation are available. Time and competences are best spent by a turnkey contractor. Turnkey contracts to small residential owners are key to commercialize the SunHorizon technology packages in this segment.

The business model concept for demo site 1 and 2 is designed for a turnkey contractor's perspective servicing small-to-medium residential building owners.

<table>
<tr><th>Key Partners</th><th>Key activities</th><th>Value Proposition</th><th>Customer Relationship</th><th>Customer segment</th></tr>
<tr><td rowspan="3">Subcontractors
Suppliers of technical equipment (TP1 &TP2)
Installer (caretaker)
Chimneysweep</td><td>Apply for financial support (subsidies)
Inspections & permits
Dissemination of knowledge</td><td rowspan="3">Heating, DHW and electricity (DS2)
Energy savings (Cost savings)
The green value
Thermal comfort</td><td>Close contact
Possibility to extend with operation and maintenance contract</td><td rowspan="3">Small-to-medium residential building owners</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td>Installed equipment and control system (TP1 & TP2)
Personnel (project management)</td><td>Dialogue
Visualization tool</td></tr>
<tr><td colspan="3">Cost structure</td><td colspan="2">Revenue streams</td></tr>
<tr><td colspan="3">To be developed within Task 7.2</td><td colspan="2">To be developed within Task 7.2</td></tr>
</table>

Figure 24: The business model canvas for demo site 1 and 2

7.3 Demosite 3: Sant Cugat del Vallés

7.3.1 Description of DS3

At the Sant Cugat del Vallés demo site, TP3 will be installed and demonstrated. The solar thermal will supply as much of space heating and DHW demand as possible and the hybrid chiller will provide space cooling. DS3 is a tertiary civic centre constructed in 2006 and located in Sant Cugat del Vallés, in the north west of Spain. Currently the heating and cooling needs in the building are met by a reversible heat pump and several variable refrigerant flow air condition units. All the current heating and cooling technologies at the demo site are powered by electricity. Heating and cooling provided by the large central reversible heat pump is distributed through a hydronic system while the smaller VRV system distributes heating and cooling through a refrigerant-based distribution system. DS3 is owned by the municipality in Sant Cugat del Vallés, whom is also the responsible partner for the demo site. In these types of projects, the municipality values having a single responsible contractor through the entire value chain and will therefore assign an Energy Performance Contract (EPC). The contract will cover from the design stage, through to installation, commissioning and 10 years of operation and maintenance of the system. In this case the energy service company also includes all the works that will be made in the municipality buildings concerning energy, i.e. much more than the scope of the SunHorizon project. In M12, the technical installation had not been fully planned and designed therefore the size of the new heating system is not known.

7.3.2 Value chain for DS3

AJSCV (Ajuntament de Sant Cugat del Vallès), i.e. the municipality of Sant Cugat del Vallès, the building owner of DS3, has been the primary point of data collection to produce the value chain of the technology installed at DS3. Given the generic value chain from section 7.1, the most important value adding activities for this site is highlighted in the value chain below. To a municipality the public procurement process is especially important for the project. Distinct value-adding activities for the site are added to the list and highlighted. Distinct to DS3 is that the municipality in-house energy management team will be involved during the operations phase together with the contractor to perform the value adding activities. The main values derived from the installation of the technology package is the increased energy efficiency, primary energy savings and lower emissions of GHG. The value of green is especially important to municipalities where the government has set targets to increase the amount of renewable energy.

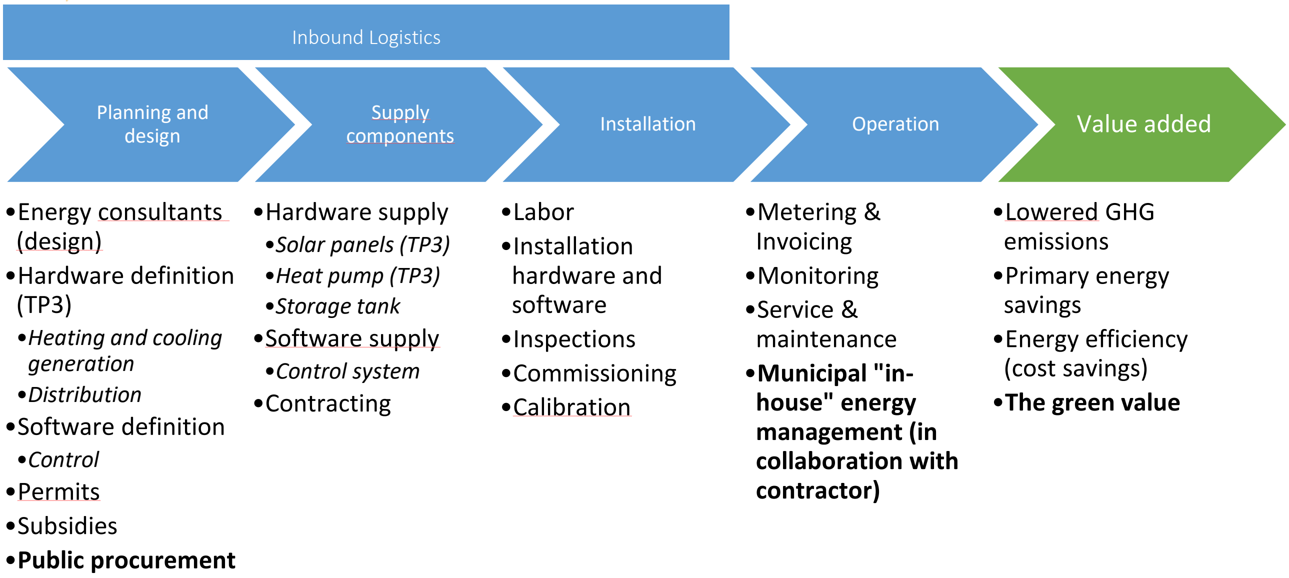


Figure 25: Value chain overview labelling important actors, activities and external factors relevant to demo site 3

7.3.3 Business model concept for DS3

7.3.3.1 Value proposition

With the ambitious target of increasing renewable energy in Spain from 20% in 2020 to 42% by 2030 it is important that municipalities lead by example. **The green value** achieved by the municipality can create a goodwill and motivation among citizens if communicated. It is also important for the municipality that the installed solution is reliable and will lead to cost savings, which is something that SunHorizon demo sites hope to show. The system will make the building more **energy efficient** through a smart control system of the coupled technologies. Through the installation of hybrid solar panels, the building will produce part of the heating and electricity demand in-house, thus reducing the amount of energy purchased externally. Both these factors will presumably lead to **decreased energy costs**. Through the installation of renewable energy sources such as solar thermal and solar PV the share of the building's energy residing from renewable energy will increase since the idea is for all self-produced energy to be consumed within the building for heating, hot water and electricity. By producing a share of the energy demand within the building there is less economic risk from fluctuating electricity prices on the market. Reducing the electricity purchased from the grid should be very desirable in Spain since Spain has the fifth highest electricity price in the EU and the price trend has been a 47% increase in the last 10 years. The overall energy cost in Spain is high when comparing to other EU countries and solutions such as the SunHorizon technology packages should be a sought-after solution if it can prove financially viable.

7.3.3.2 Customer segment, relationship and channels

The customer segment is **municipally owned buildings.** The municipality has expressed the importance of having a single contractor managing the entire value chain, from planning and design through to operation and maintenance, to ensure proper functioning and performance of installation. When outsourcing the entire value chain, it can be difficult for the building owner after the contract has ended to manage the system because they do not possess the knowledge. The municipality has a building management team that will be involved throughout the project to ensure in-house competence is achieved. This involvement from the customer side with the contractor will mean that **a close relationship** and **dialogue** should take place often for the customer to be able to achieve this level of knowledge of the system.

7.3.3.3 Key resources, activities and partners

For the contractor to be successful it is important that the operational energy performance is according to expectation. Above all this requires two key resources. The first being that **technology package 3** is correctly dimensioned and properly integrated in the energy control management system. The second is **competent personnel** that can manage the project to ensure proper installation and competence on how to carry out the operation and maintenance of the system to maintain energy performance throughout the length of the contract. Since comprehensive contracts are more economically complex, extensive and stretches over a long period of time, it is of high importance to formulate a good contract. Since the contractor is responsible for the entire value chain their key activities during planning and installation phase is to **manage the project** to ensure adequate quality and that energy performance measures are achieved. In order to avoid delay to the project an important aspect is to ensure all **permits and inspections** are performed at the right time. After commissioning the role moves into operation and monitoring of equipment and system. **Energy performance monitoring** becomes very important during the operation phase and through SunHorizon a one-year monitoring is planned for the last year of the project to enable a thorough evaluation of the technical performance and an improved chance to ensure the quality of the installations. An evaluation and monitoring period should be considered for installations also outside the scope of SunHorizon. To an overall responsible contractor, the subcontractors are key partners to maintain for a successful result. Examples of subcontractors are plumbers, electricians, building works. Of special importance to achieve expected performance are the companies delivering the technical equipment in the technology package and the control system for coupling and managing the building energy.

7.3.3.4 Cost structure and revenue streams

For the technical solutions and for this comprehensive contracting form (EPC) to be replicated extensively in other cases, it should be important to furtherly evaluate the energy performance that is obtained, and the final impact made on energy supply costs. This could be used to assess the economic feasibility and reliability of the contracting form applied for performing the installations. It should be highly important for the replicability among further building owners if results of increasingly reliable solution choices or contracting models can be displayed. The details of how fixed assets and their maintenance will drive cost and the format of the EPC are not known at M12 of the project and will be developed further in Task 7.2

7.3.3.5 Business model canvas

The municipality in Sant Cugat del Vallés has previous experience from the use of an Energy Performance Contract (EPC) and is of the understanding that it improves the possibility to invest in buildings and that better quality is achieved. With different contractors it would also be necessary to be very detailed in the responsibilities of each contractor since no one has the overall responsibility. Should a problem, such as operational problems, arise when the responsibility is unclear the dispute can be both time consuming and costly. This would demand more of the municipality who might not have the technological competence with these types of installations or a project management department that could manage such a project. Many governments in the EU are encouraging this type of solution to promote energy efficient buildings but the contracting type is still immature in many countries. EPC could be a viable way for commercialization of similar installations in municipality owned buildings.

The business model concept for demo site 3 is designed for an Energy Performance Contractors perspective servicing municipalities.

<table>
<tr><td rowspan="2">Key Partners
Subcontractors
Suppliers of technical equipment</td><td>Key activities
Contract award
Inspections & permits
Apply for subsidies
Project management
Energy Performance monitoring- smart control</td><td rowspan="2">Value Proposition
DHW, space heating/cooling, electricity
Value of green
Energy savings (Cost savings)
Increased self-supply of energy
Increased thermal comfort</td><td>Customer Relationship
Close relationship
Long term</td><td rowspan="2">Customer segment
Municipalities</td></tr>
<tr><td>Key Resources
Installed equipment and control system
Personnel (project management)</td><td>Channels
Dialogue
Meetings (during installation)</td></tr>
<tr><td colspan="3">Cost structure
To be developed within Task 7.2</td><td colspan="2">Revenue streams
To be developed within Task 7.2</td></tr>
</table>

Figure 26: The business model canvas for demo site 3

7.4 Demosite 4: Madrid

7.4.1 Description of DS4

At the Madrid demo site, TP4 will be installed and demonstrated. DS4 is a multi-family residential building with nine apartments split over four floors located in Madrid, Spain, built in 1946. The current H&C system consists of a gas boiler per apartment supplying DHW and space heating and air/air split for cooling. The envelope and the mechanical ventilation in the building are currently being retrofitted. One of the main differences to the current heating installation is that the two separate heating systems (one for each apartment in the building) will be replaced by a single, central heating system. The thermal output from the hybrid solar panels installed in TP4 will help cover the heating demand in the building, the electricity produced will power the reversible heat pump or else supply electricity to appliances in the building. The reversible HP will supply additional demand of DHW, space heating and cooling. As in the other technology packages a thermal energy storage will be installed. DS4 is owned by Empresa Municipal de la Vivienda y Suelo de Madrid (EMVS). EMVS is also the responsible part for the demo site in the SunHorizon project. As owner and manager, EMVS will lead the maintenance and operation of the technical solutions of the demo site building in the long run, either in-house or with contractor assigned. In this project EMVS will coordinate the activities and assign separate contracts to the different parts of the value chain, e.g. design works, contractor for building works (most likely will subcontract works such as plumbers and electricians but could also be in-house), a project manager for overall responsibility, a technical maintenance contractor in the operation phase. In M12, the technical installation had not been fully planned and designed therefore the size of the new heating system is not known.

7.4.2 Value chain for DS4

Empresa Municipal de la Vivienda y Suelo de Madrid (EMVS), as the building owner at DS4, has been the primary point of data collection to produce the value chain of TP4 installed at DS4. Given the generic value chain from section 7.1, the most important value adding activities for the site are highlighted in the value chain below. To municipalities the public procurement process is especially important for the project and since the municipality is looking to have different contractors involved at different stages in the project, contracting is important. The main value derived from the installation of the technology packages is the increased energy efficiency and primary energy savings and lower emissions of GHG. The value of green is especially important to municipalities where the government has set targets to increase the amount of renewable energy.

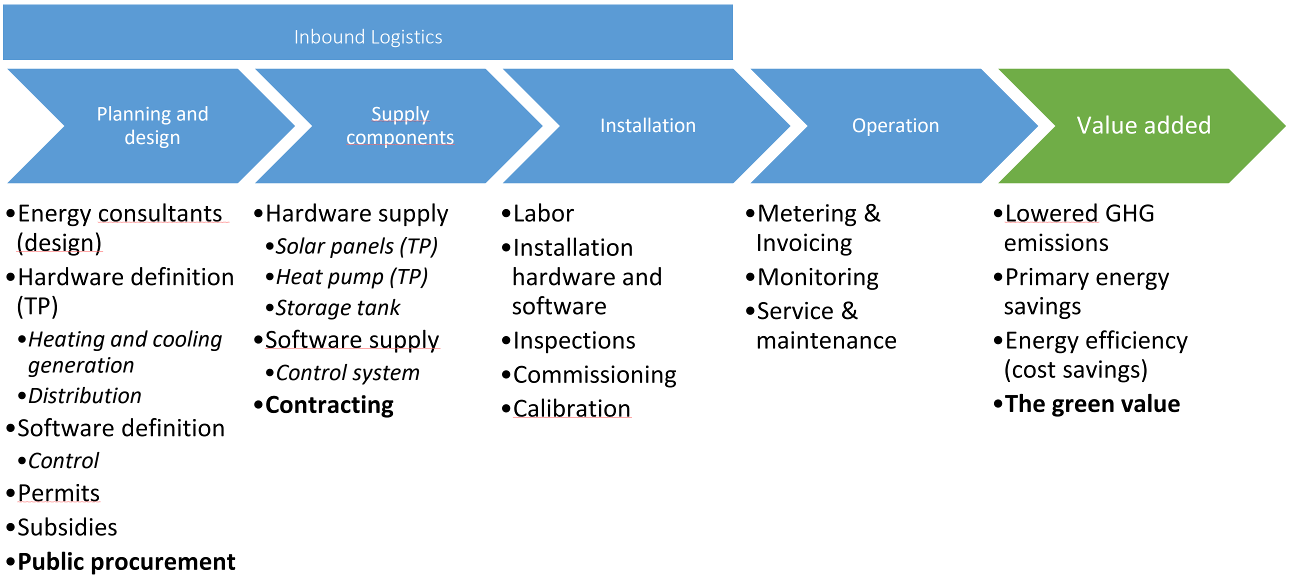


Figure 27: Value chain overview labelling important actors, activities and external factors relevant to demo site 4

7.4.3 Business model concept for DS4

7.4.3.1 Value proposition

To the residents of the building the delivered services will remain the same, heating, cooling and DHW. However, **improved thermal comfort** should by achieved due to the renewal of the H&C system and an updated control system. Having solar thermal and solar PV installed in the building and thus reducing the fossil fuel consumption provides **a green value** but depending on customer the green value can be appreciated differently. Reduced cost of purchasing external fuels and increased energy efficiency is likely to lead to cost savings, however if these cost savings reach the end customer depends on the cost and income structure by the municipality and will be examined further in Task 7.2. Cost savings are therefore a potential value for the customers in this business case.

7.4.3.2 Customer segment, relationship and channels

Customer segment is the **residents of the building**. DS4 is a special case since it is a social housing and additional cost of green value or increased thermal comfort is not likely to be transferred to the end user but in other similar cases this could be considered. For the installation of the system in DS4 the residents are affected rather limited and only necessary information will be provided by the municipality. In other cases, keeping the residents (the customers) involved can be key to a successful installation and **continuous information** should be supplied to maintain a **close relationship**. It is also possible to engage the customers further with access to a showcasing display of the systems performance. Through such a channel, customers could also provide useful input regarding thermal comfort in the buildings. Customers could also be incentivised to shift their habits to help maximize the self-supply of the system. Potentially something to explore further in Task 7.2.

7.4.3.3 Key resources, activities, and partners

Technology package 4 (as described in Chapter 5) and personnel that can operate the equipment are required resources. The municipality has the option to contract a project manager with overall responsibility of the project, but this competence could also be provided in-house if the municipality has **personnel with project management experience**.

A key activity is to **apply for permits** necessary to perform building works and implement the technical solution, such as municipal license and tax payment. After installation is completed, it is necessary to register the installation in the proper public organism for legalization. For permits and registrations, external technical companies contracted by the building owner conduct several inspections to verify the correct assembly and operation of the systems. The municipality will decide on the technical requirements of the system and initiate a **public procurement** procedure where key partners are contracted in the different stages of the project. It is necessary for the municipality to be present throughout the project to give access to the building and provide information to contractors. Depending on how the end-customer, the residents of the building, are affected by the installation, it is also necessary to supply them with continuous information on progress and upcoming activities.

7.4.3.4 Cost structure and revenue streams

It is not clear today if any of the potential cost savings for the system will be forwarded to the residents or if there will be an additional cost of the green value or increased thermal comfort. However, it is not likely in this case since it is a social housing where the residents are already living at a cost subsidised by the municipality. These aspects should however be considered in other similar cases where the municipality, or other large building owners, have rental agreements with customers. The design and dimensioning of the technical solution is still under development, same with details of fixed assets and their maintenance cost, and more detailed economic aspects of the solution will be developed further in Task 7.2.

7.4.3.5 Business model canvas

For municipalities, or other larger building owners, where the technical competence, finance and a project management department, is available it is possible to perform and manage the project in-house. Compared to having an EPC, the building owner will in this case see the entire advantage from potential energy savings directly. This could also enable a close relationship between the building owner and the residents of the building.

The business model concept for demo site 4 is designed for a municipality, or other larger building owners, servicing the residents of the building.

Key Partners	**Key activities**	**Value Proposition**	**Customer Relationship**	**Customer segment**
Subcontractors Suppliers of technical equipment (TP4)	Public procurement Inspections & permits	Space heating/ cooling, DHW, electricity Thermal comfort The green value Possibility to transfer cost savings	Two-way communication can be beneficial	Residents of the building
	Key Resources		**Channels**	
	Installed equipment and control system (TP4) Personnel (technical, project management)		Information material Visualization tool	
Cost structure			**Revenue streams**	
To be developed within Task 7.2			To be developed within Task 7.2	

Figure 28: The business model canvas for demo site 4

7.5 Demosite 5: San Lorenzo de Hortóns

7.5.1 Description of DS5

At the San Lorenzo de Hortóns demonstrator, TP4 will be installed and demonstrated. DS5 is a small residential building with three floors located in San Lorenzo de Hortóns, Spain, and constructed in 2004. The existing heating system of the building comprises a hybrid heat pump supplying DHW and space heating, with an oil boiler as complementing energy supply for space heating. A control system, which will be updated within SunHorizon, currently alternates the heat supply between the electricity powered heat pump and the oil boiler, depending on the variable costs. The thermal output from the hybrid solar panel installed as a part of TP4 will supply DHW, for which a reversible heat pump will provide the complementing energy supply. The electrical output will power the new reversible heat pump, which will generate heating, cooling and DHW. The oil boiler will remain on site after the installations due to customer requirement, but the intention is to not use the oil boiler under normal circumstances. DS5 is owned by a private building owner and managed in SunHorizon by BDR. At the time of submitting this report (M12), the technical installation had not been fully planned and designed, and thus the size of the new heating system is not known.

7.5.2 Value chain for DS5

BDR, as responsible for DS5, has been the primary point of data collection to produce the value chain of TP4 installed at DS5. Given the generic value chain from section 7.13.2, the most important value adding activities for this site is highlighted in the value chain below. To small residential building owners, subsidies and energy consultants are especially important for the project to be viable. Subsidies by driving installation costs down and energy consultant by supplying competence about the installation that many customers in this segment lack. Distinct value-adding activities for this site is added to the list and highlighted. Distinct to DS5 is that a visualization tool will be provided where the customer can view the operation of the system and thus increase the competence. The main value derived from the installation of the technology packages is the increased energy efficiency, primary energy savings and lower emissions of GHG.

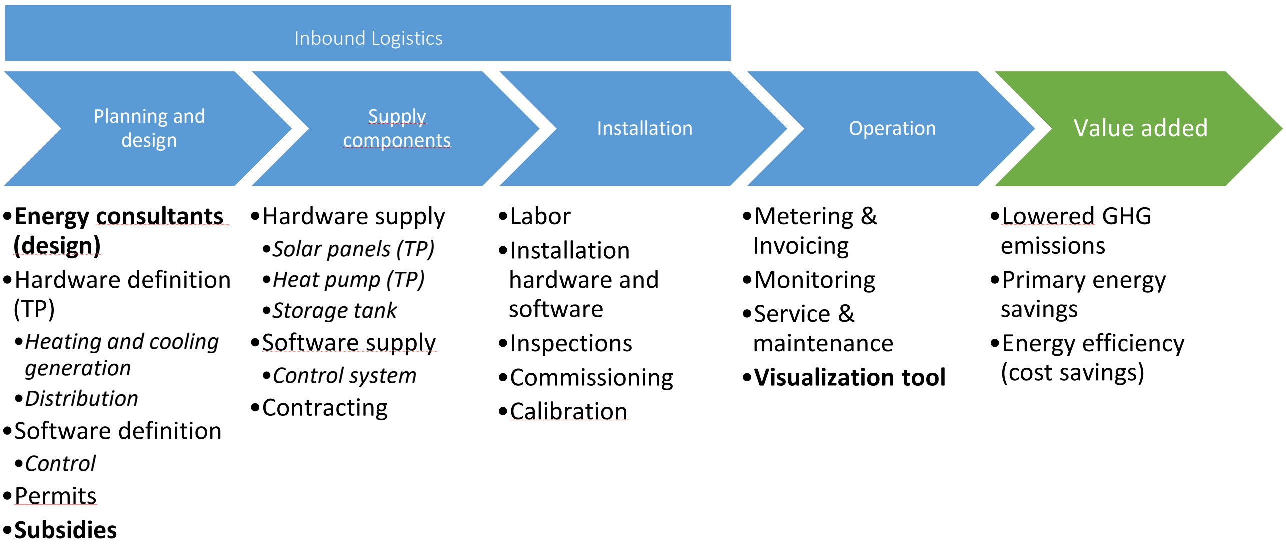


Figure 29: Value chain overview labelling important actors, activities and external factors relevant to demo site 5

7.5.3 Business model concept for DS5

7.5.3.1 Value proposition

For a private building owner, **the green value** of renewable energy and the interest in reducing energy usage is often not enough to trigger a project and an investment such as the SunHorizon technology package. It will require a clear value proposition that makes it simple for the building owner to make the right decision. The prestige that could potentially come with installing renewable energy could of course be one factor, but **cost savings** that result from energy savings will probably be the main driver. While the service delivered from the system will be the same as before, heating, cooling and DHW, the cost of producing these products will probably decrease due to a more **energy efficient** system and increased self-supply. The energy cost in Spain is categorized to be high compared to other EU countries and it is probably desirable for private residents to become more self-sufficient on energy to avoid these costs. Especially looking at electricity price where Spain has the fifth highest cost per kWh for households in the EU and the increase has been 47% in the last 10 years. By having solar PV supplying much of the electricity to the heat pump the electricity bill is expected to decrease. By replacing previously installed H&C systems based on fossil fuels the dependency of fossil fuel supply and cost thereof will be removed.

7.5.3.2 Customer segment, relationship and channels

The customer segment is a **small residential private building owner**. As a contractor wanting to replicate as many similar systems as possible it is important to maintain **a close relationship** with the building owner throughout the project to ensure satisfaction. **Ongoing dialogue** and information should take place often during the project to ensure that the building owner knows when to provide information and when subcontractors will be present in the building. The value of the installed system would benefit from a display showcasing the savings to customers. After the project has ended and the commissioned system has been handed over to the building owner it is likely that the building owner will not have enough knowledge on how to operate the system to optimal performance. There is a possibility now for the contractor to offer operation and maintenance contracts to the building owner, to add more value to the customer by optimizing performance of the system also in the long term. Potentially something to explore further in Task 7.2.

7.5.3.3 Key resources, activities, and partners

The main resources for a contractor are represented by competent **project managers** and the installed equipment, TP4. For the project to be ready in time it is necessary for the contractor to ensure **permits and inspections** are carried out according to local legislation. The customer is not likely to have the knowledge needed to carry out applications for all necessary permits and this responsibility should lie with the contractor. Another key activity is **applying for subsidies** that are relevant for the SunHorizon technologies. The application processes can be complicated for the customer to undertake without assistance and the contractor can again provide value to the customer by performing this task. The contractor can have some of the competence needed in the project for design, site and installation works in-house, but would most likely subcontract all or parts of the works through local suppliers. Key partners are all **subcontractors** and the supplier of the technical equipment included in TP4.

7.5.3.4 Cost structure and revenue streams

The technical installation had not been fully planned and designed in the project at this stage (M12), so the size of the new heating equipment was not known. The cost efficiency of the SunHorizon technology packages is the subject of forthcoming research and investigation within the project itself. The details of how fixed assets and their maintenance will drive cost are not know at M12 of the project and will be developed further in Task 7.2.

7.5.3.5 Business model canvas

A private building owner is not likely to have the necessary resources to manage permits, grants, subsidies and the installation. Time and competence are best provided by a turnkey contractor and by using contracts that are easy to understand, offering an upfront cost and managing the project from start till after commissioning, it will be easier for private building owners to invest. Providing turnkey contracts to small residential owners will be key to drive commercialization of the SunHorizon technology packages in this segment.

The business model concept for demo site 5 is designed from a turnkey contractor's perspective servicing small residential building owners.

Key Partners	Key activities	Value Proposition	Customer Relationship	Customer segment
Subcontractors Suppliers of technical installation (TP4)	Apply for financial support (subsidies) Inspections & permits Manage project	Heating, cooling, DHW, electricity Energy savings (Cost savings) Increased self-supply of energy	Close contact during project Possibility to extend with operation and maintenance contract	Small residential building owners
	Key Resources Installed equipment and control system (TP4) Personnel (Project management)		**Channels** Dialogue Visualization tool	
Cost structure To be developed within Task 7.2			**Revenue streams** To be developed within Task 7.2	

Figure 30: The business model canvas for demo site 5

7.6 Demosite 6 & Demosite 7: Verviers

7.6.1 Description of DS6: Verviers (sport centre)

At the Vervier sport center demonstrator, TP1 will be installed and demonstrated. DS6 is a tertiary sport centre located in Verviers, Belgium, built in 2006. The current heating demand for DHW is met by natural gas boilers. The solar thermal panels installed in TP1 will supply as much of the hot water demand as possible and the additional demand will be met by the HP. DS6 is owned and managed by the municipality through the city-owned non-profit organisation Synergis and the responsible partner in SunHorizon is GRE-Liége, a public organization directly financed by the Minister of Economy working as an incubator for large project in the Liege region in Belgium. In M12, the technical installation had not been fully planned and designed therefore the size of the new heating system is not known.

7.6.2 Description of DS7: Verviers (swimming pool)

At the Verviers swimming pool demonstrator, TP2 will be installed and demonstrated. DS7 is a tertiary swimming pool located in Verviers, Belgium, built in 1963. The current heating demand for space heating and DHW is met by natural gas boilers. The thermal output of the hybrid solar panels installed in TP2 will supply as much of the heating demand as possible and assist with evaporation of the HP, that will supply the additional heating demand. The electricity generated by the hybrid solar panel will cover part of appliance electricity. DS7 is owned and managed by the municipality through the city-owned non-profit organisation Synergis and the responsible partner in SunHorizon is GRE-Liége, a public organization directly financed by the Minister of Economy working as an incubator for large project in the Liege region in Belgium. In M12, the technical installation had not been fully planned and designed, therefore the size of the new heating system is not known.

7.6.3 Value chain for DS6 & DS7

GRE-Liége, as responsible for the two demo sites in Belgium, has been the primary point of data collection to produce the value chain of TP1 and 2 installed at DS6 and DS7. Given the generic value chain from section 7.1, the most important value adding activities for these sites are highlighted in the value chain below. To municipalities the public procurement process is especially important for the project. The main value derived from the installation of the technology packages is the increased energy efficiency and primary energy savings and lower emissions of GHG. The value of green is especially important to municipalities where the government has set targets to increase the amount of renewable energy.

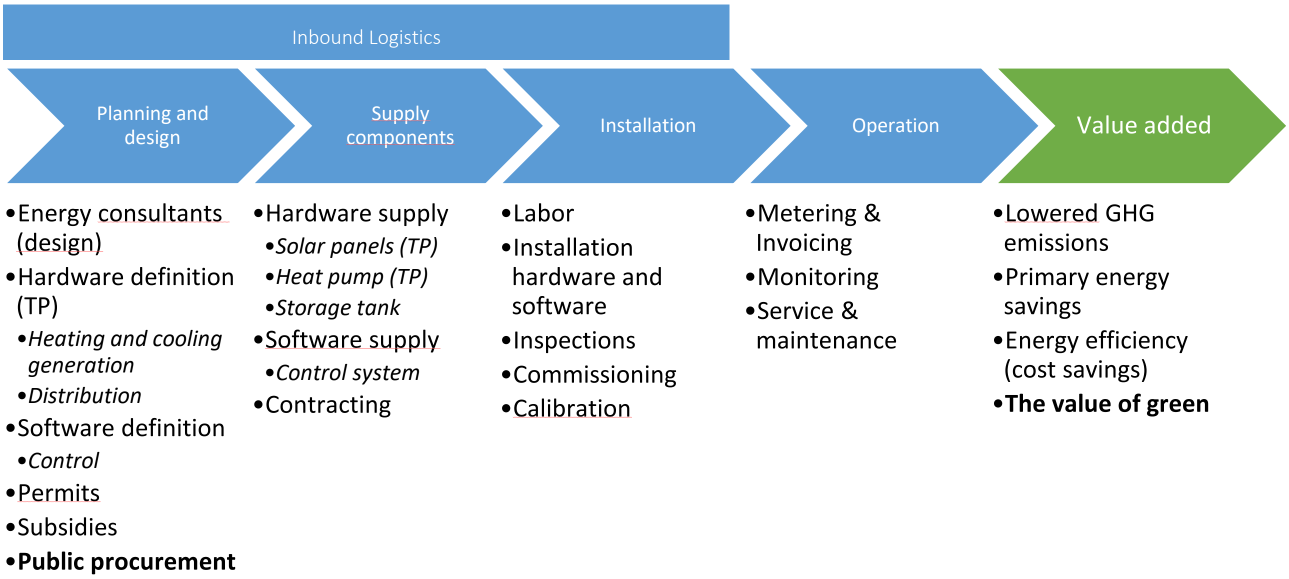


Figure 31: Value chain overview labelling important actors, activities and external factors relevant to demo site 6 and 7

7.6.4 Business model concept for DS6 and DS7

7.6.4.1 Value proposition

Belgium aims at increasing its share of renewables from 13% in 2020 to 18.3% in 2030 with some differences in target between the different regions (Wallonia, Flanders and the Brussels area). It is important that the government through the municipalities take lead to drive the transition and help visualise the possibilities with the technologies and normalize such installations. **The value of green** is therefore especially important to this customer segment. Installing solar and heat pumps at sport centres and swimming pools where many residents will encounter the installations would be a good way to display the technologies and improve social acceptance of the technologies. This could be particularly important in countries where the technology is not readily present. As was concluded in the PESTLE analysis the SunHorizon technology is not as established in Belgium as it is in other countries in the EU. The installation also has the potential of **increasing the number of visitors** through a sustainability profile and possibly extra attention to the facility. The services provided, DHW and electricity, will still be the same but part of the demand will be met by locally produced renewable energy sources. The system will make the building more **energy efficient** through a smart control system of the coupled technologies and reducing the use of a gas boiler by installing a heat pump with higher efficiency.

7.6.4.2 Customer segment, relationship and channels

The customer segment is **municipally owned tertiary buildings**. The concept should be applicable to other municipality owned buildings, or similar buildings owned by a large property owner. The communication channel will be based on a **close relationship** with the customer in the format of **ongoing dialogue**. This is especially important during the installation phase, because it will sometimes be necessary to adapt the on-going business at the sport centre to accommodate the installation of the system. The facility owner will likely want to prepare some information material and close of some areas during times when installation is ongoing to reduce a negative effect on its customers.

7.6.4.3 Key resources, activities, and partners

The technology packages 1 and 2 (as described in Chapter 5) and personnel that can operate the equipment are required resources. Ensuring key activities are carried out correctly and managing the key partners will require that the contractor has **competent personnel**, especially in project management. For the project to finish on time and budget it is necessary to **apply for permits, inspections and available subsidies** at the right phase in the project. Within the scope of SunHorizon a one-year performance evaluation will be performed to adjust the system, learn more about how it can be improved and bring the technologies closer to a commercial stage. Having such an adjustment period is likely to be a good idea also in future installations to ensure optimal performance, especially when the facility owner is lacking resources, time or knowledge, about how to operate the system in-house. Having a contractor that offers to take on also the operation and maintenance phase of the system could be very important to achieve expected energy performance and a key activity would then be **energy performance monitoring**. To a contractor, all the **key partners** will be subcontractors, including the suppliers of the technical installation.

7.6.4.4 Cost structure and revenue streams

For the technical solutions to be replicated extensively in other cases, it is important to furtherly evaluate the energy performance that is obtained, and the final impact made on energy supply costs. This could be used to assess the economic feasibility and reliability of the contracting form applied for performing the installations. It should be highly important for the replicability among further building owners if results of increasingly reliable solution choices or contracting models can be displayed. In Belgium the different regions have some difference in political initiatives but in general there is political support for the use of solar and coupled technologies, but economic support is general to all renewable technologies. The details of how fixed assets and their maintenance will drive cost and the format of the EPC are not know at M12 of the project and will be developed further in Task 7.2.

7.6.4.5 Business model canvas

In DS6 and DS7 the transition of the ownership and management of the equipment from the contractor to the municipality is expected to take place during the initial stage of operation. However, depending on the building owner's knowledge of the technology and about the optimization and maintenance of the system, it could be more commercially viable to have a different business set-up. In cases where the municipality might not have the resources or competence to be project manager of a technical installation of such complexity a more viable way of bringing the technology to a commercial stage could be through an Energy performance contractor (EPC). EPC is often advocated in Belgian energy politics as a beneficial contracting form, especially for high-energy consuming sites. The Ministry of Energy has through an agency (RenoWatt) initiated certain aid for municipalities to launch EPC projects, which could be a key to add the necessary know-how for the municipalities. The market for EPC is still immature and not many contractors in Belgium are making them yet, why more still must be done to implement and develop the concept.

The business model concept for demo site 6 and 7 is designed for an Energy Performance Contractors perspective servicing municipalities.

Key Partners	Key activities	Value Proposition	Customer Relationship	Customer segment
Subcontractors Suppliers of technical equipment (TP1 &TP2)	Contract award Inspections & permits Apply for subsidies Energy performance monitoring- smart control	DHW, and electricity (DS7) The value of green Energy savings (cost savings) Potentially increased number of visitors	Long term contract Close relationship	Municipalities
	Key Resources Installed equipment and control system (TP1 & TP2) Personnel (project management)		**Channels** Dialogue	
Cost structure To be developed within Task 7.2			**Revenue streams** To be developed within Task 7.2	

Figure 32: The business model canvas for demo site 6 and 7

7.7 Demosite 8: Riga

7.7.1 Description of DS8

At the Riga demonstrator, TP2 will be installed and demonstrated. DS8 consists of two two-storey single houses located in Riga, Latvia. The current heating system consists of natural gas boilers for DHW and space heating. The thermal output from the solar hybrid panel in TP2 is planned to cover heat demand and to assist with evaporation of the HP. The electricity production from the hybrid solar panel will be used in the building appliances. DS8 is owned by a private building owner and managed in SunHorizon by Riga Technical University (RTU). In M12, the technical installation had not been fully planned and designed therefore the size of the new heating system is not known.

7.7.2 Value chain for DS8

Riga Technical University (RTU), as responsible for the site in Latvia, has been the primary point of data collection to produce the value chain of TP2 installed at DS8. Given the generic value chain from section 7.1, the most important value adding activities for the sites are highlighted in the value chain below. In Latvia the permit process for the installation is especially important for the project to be viable. Distinct value-adding activities for the site are added to the list and highlighted. Distinct to Latvia is applying for several required approvals, grid connection approval (distribution system operator), micro-production approval (Ministry of Energy) and approval of gas connection diagram. The main value derived from the installation of the technology packages is the increased energy efficiency and primary energy savings and lower emissions of GHG.

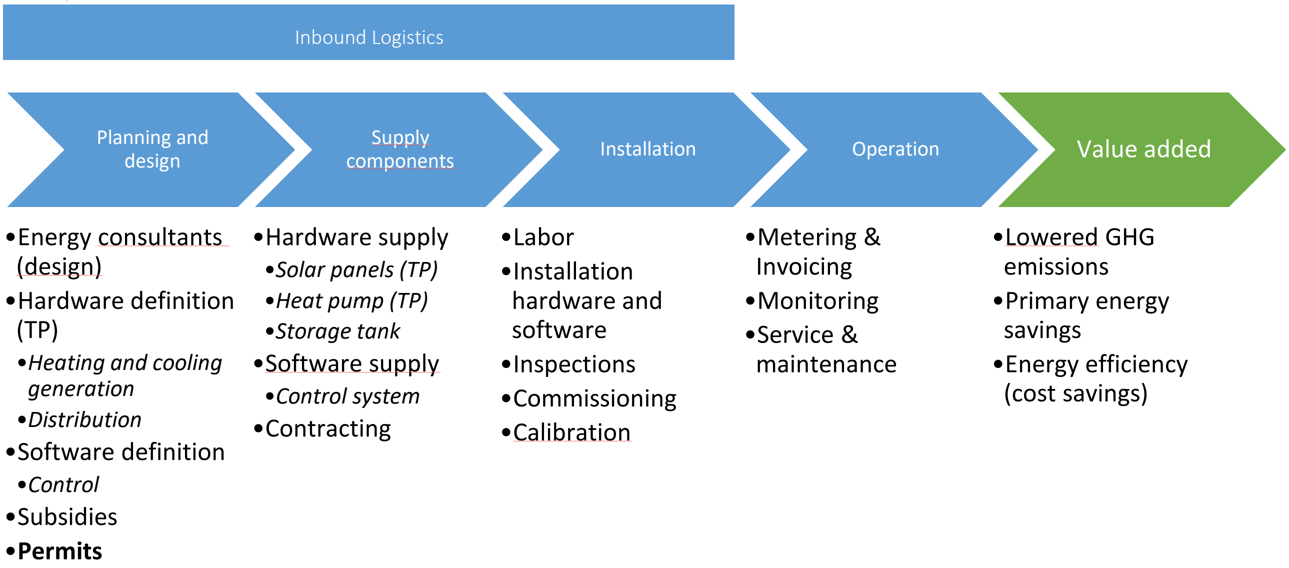


Figure 33: Value chain overview labelling important actors, activities and external factors relevant to demo site 8

7.7.3 Business model concept for DS8

7.7.3.1 Value proposition

The services provided through the installation will be the same, space heating, DHW and electricity, but produced in a more **energy efficient** way through the control system and the replacement of a conventional gas boiler with a heat pump. The heat demand will partly be covered by solar thermal, thus reducing the amount of natural gas required even more compared to conventional technology. The electricity output from the hybrid solar system will cover part of the building appliances thus reducing the electricity bill. The **energy savings** are likely to lead to cost savings, something that will be subject for analysis through the SunHorizon project. The updated H&C system managed by an advanced control system will improve the experienced **thermal comfort** in the buildings. Even though Latvia is categorized to have a low overall energy cost and the lowest electricity consumption per capita of the demo site countries, the electricity price for households has increased 58% in the last 10 years which could mean that the citizens in Latvia still experience their electricity price to be high. For some customers **the value of green** arising from the installation of renewable energy and contributing to Latvia's renewable energy target, to increase from 40% to 45% between 2020 and 2030, can be a value. However, to most customers it is considered a risky investment and Latvia barely has any installed base of solar technologies and heat pumps are very uncommon.

7.7.3.2 Customer segment, relationship and channels

Customer segment is a **private building owner of small residential buildings**. For a contractor wanting to replicate the solution in more buildings in this customer segment it is very important that the customer is content with the installation. Above all this requires two things, that a **close relationship** is established with the customer e.g. with **continuous updates** of the progress of the project and upcoming activities, and secondly that the system performs as anticipated. The continuous flow of information could be especially important to customers in countries such as Latvia where the technology is unfamiliar. After installation the value of the installed system could benefit from a display showcasing the savings to the customer. Since most customers in this segment lack the competence of operating and maintaining an installation and ensuring optimal performance there is a possibility for the contractor to offer operation and maintenance contract that could be beneficial for the customer. Extending the relationship between the contractor and the customer through operation and maintenance contracts is a potential method to improve the relationship and keep the customer. Potentially something to explore further in Task 7.2.

7.7.3.3 Key resources, activities, and partners

Technology packages 2 (as described in chapter 5) and personnel that can operate the equipment and manage the project are required resources. For the project to progress smoothly **necessary permits and inspections** should be performed at the right point in the project. In Latvia this includes for example, micro-generation approval from the Ministry of Economics, permit from the distribution system operator to allow connection of solar panels to the external electricity grid and for installations in Riga city, approval for installation of local gas-based heating equipment is required from the Heat Supply Committee of Riga City Council Housing and Environment Department. The customer is not likely to have the knowledge needed to carry out applications for all necessary permits and this responsibility should lie with the contractor. Another key activity to make the solution commercial in Latvia is to develop information material to build incentive among building owners in Latvia. Information about why, and especially how, to install technologies included in the SunHorizon technology packages is very hard to find and **dissemination of knowledge** can lower the threshold for the building owner to make an investment decision. The economic feasibility of such an installation is of vast importance. Especially since the gas grid is in proximity of the buildings, a regular gas boiler system is a relatively cheap and easy system choice for many building owners. To a contractor all the **subcontractors** will be key partners and especially important are the suppliers of the technical equipment included in TP2.

7.7.3.4 Cost structure and revenue streams

The technical solutions are under development, meaning that the specific technical capacities and dimensioning of the solar energy and heat pump system are not settled yet. Any theoretical impact on energy efficiency of the buildings could thus not yet be calculated. The details of how fixed assets and their maintenance will drive cost are not known at M12 of the project and will be developed further in Task 7.2

7.7.3.5 Business model canvas

In Riga the building owner is in the segment of small residential and as such it is not likely that the necessary resources to manage permits, grants, subsidies and the installation are available. Managing separate contracts for each phase of the project demands a high level of knowledge from the building owner, both in terms of the technical aspects and in detailed requirements setting. This is probably too demanding for most small-house owners, and the availability of total package contractors with simplified contracts and business models is probably vital for the spread of these solutions. A turnkey contractor will likely be the most viable solution for this technology to be made available to the customer segment in demo case 8.

The business model concept for demo site 8 is designed from a turnkey contractor’s perspective servicing small residential building owners.

<table>
<tr>
<td rowspan="2">Key Partners
Subcontractors
Suppliers of technical equipment (TP2)</td>
<td>Key activities
Apply for financial support (subsidies)
Inspections & permits
Dissemination of knowledge</td>
<td rowspan="2">Value Proposition
Space heating, DHW, electricity
Increased self-supply of energy
Energy savings (cost savings)
The green value
Thermal comfort</td>
<td>Customer Relationship
Close contact
Possibility to extend with operation and maintenance</td>
<td rowspan="2">Customer segment
Small residential</td>
</tr>
<tr>
<td>Key Resources
Installed equipment and control system (TP2)
Personnel (project management)</td>
<td>Channels
Dialogue
Continuous information
Visualization tool</td>
</tr>
<tr>
<td colspan="3">Cost structure
To be developed within Task 7.2</td>
<td colspan="2">Revenue streams
To be developed within Task 7.2</td>
</tr>
</table>

Figure 34: The business model canvas for demo site 8

8 Conclusion

The conclusion section is divided into four-parts to first reflect the three-step approach used to develop the business model concepts: PESTLE analysis, Value chains and Business model, and a fourth section providing a general conclusion.

8.1 Conclusions based on the PESTLE analysis

Considering the macro-economic factors of the PESTLE, **it is concluded that overall, Spain and Germany have high potential for the SunHorizon solutions Belgium has medium potential and Latvia has low potential.** Figure 35 provides an overview of the opportunities for the SunHorizon technology packages in the demo site countries.

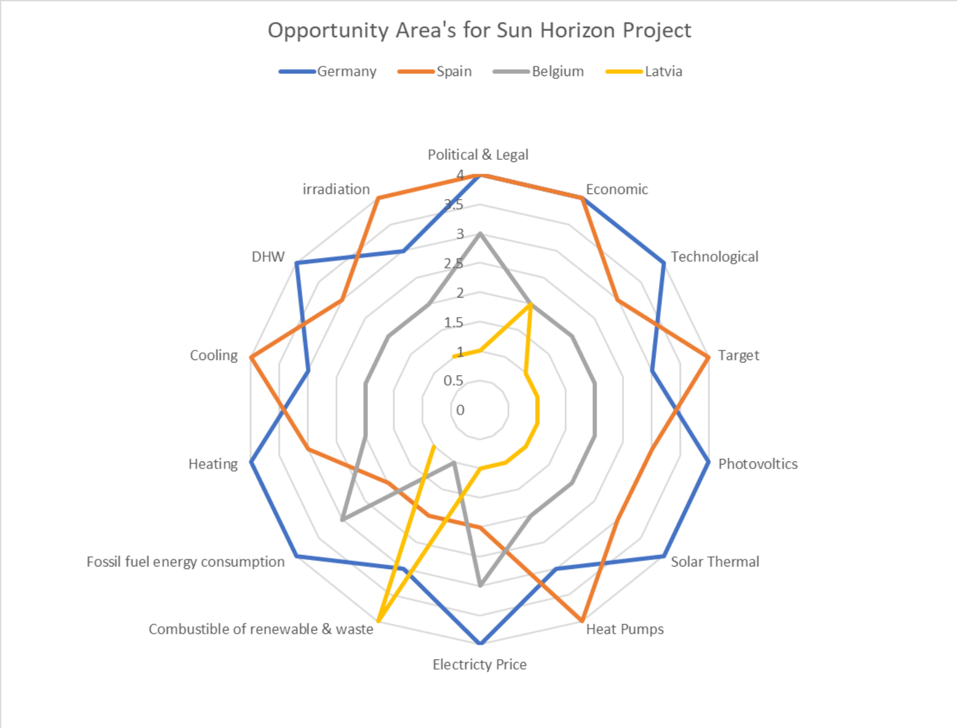


Figure 35: Opportunity areas for the SunHorizon project in Germany, Spain, Belgium and Latvia

Different countries have different prerequisites (political agenda for renewables, financial support, permits) for the technology packages in SunHorizon to be successful. The political agenda regarding renewable energy targets is very important to solar energy solutions. Both Germany and Spain foresee a large uptake of renewable energy (which includes solar energy) until 2030. In both Belgium and Latvia, the targeted increase of renewable energy is approximately 5% to 2030.

The availability of financial support schemes for renewables differs between the countries. Subsidies for installation of renewable energy, for increasing the energy efficiency of buildings or targeted support to H&C systems can be present. In Germany, Spain and Belgium the financial incentives for H&C systems exist, it is not the case in Latvia.

The SunHorizon project brings innovative technology to the H&C systems. New technologies can face barriers with regards to permits and inspections. This is exemplified in Latvia, where neither solar energy or heat pump are common technologies, making the permit activities very complex (several processes are included rather than one, standardized). As the technology matures the process is likely to be simplified and the hurdle of complex permits will be lowered.

Within the EU**, the cost of energy supply** to the conventional H&C technologies varies between the countries. More expensive supply of energy to the conventional technologies could motivate the installation of new technology, such as in Spain (there is a motivation to become less dependent on natural gas), and low cost of conventional alternatives could make innovative technologies seem risky, such as in Latvia. **The electricity price is especially important to consider for the technology packages** including solar PV or electricity powered HP. There is a great variety in cost for both electricity and other energy sources in the EU. In Germany for example, where the electricity price is among the highest in Europe, the cost of electricity could motivate new technology including the generation of electricity. Finally, the geographical locations of the installation impact both the supply to, and demand of, the technology packages. **The availability of solar irradiation affects the profitability** of the solar panels and the climate determines the demand of heating and cooling in the buildings.

In the temporal impact matrix below, a list of key factors is made on the vertical axis and along the horizontal axis time periods are denoted appropriate to the industry. For each factor a positive or negative score is indicated for the future between 1 to 4 years. The scale for these scores is approximate, figures range from +5 for major positive effect to -5 for major negative effect. This score may also be weighted by likelihood of occurrence. A more detailed summary is available in Annex A.

	Macro Indicator	**Positive or negative indicator Between 1-4 years**
Political & Legal	Policy & regulation to promote the use of Solar power, and Heat pumps, as well as push for coupled technologies: *Germany* *Spain* *Belgium* *Latvia – No clear policy or regulation for the above*	 +5 +5 +5 +1
Economic	Incentivises for the use of Solar power, and Heat pumps, as well as push for coupled technologies: *Germany* *Spain* *Belgium – some incentives but not specific to solar or heat pumps* *Latvia – No clear indication of incentives yet*	 +5 +5 +2 +1
Technological	Technological competition between other renewable sources when compared with Solar power or heat pumps: *Germany – Low competition* *Spain – Low competition* *Belgium – Medium Competition* *Latvia – High competition*	 +5 +5 +2 +1

Socio-cultural & Environmental	The use of renewable energy for the reduction of GHG's *All countries*	+5

8.2 Conclusions based on the Value chain analysis

The value chains for the technology packages implemented are similar and reflect the value added by the technical installations themselves. The values from the technical installations are the values foreseen in the SunHorizon project. However, there is a possibility to create additional values as the value chains mature.

Analysing the customer value that the inbound logistics and operation add to the customer, compared to conventional heating alternatives, **the common denominator is lower GHG emissions, primary energy savings and energy efficiency which leads to cost savings. The identified values reflect the purpose of the SunHorizon project itself.** In the inbound logistics and operation, the energy consultants with the competence to implement and operate the system as well as the technical equipment itself are crucial for value creation. The software supply through the control system is especially important during the initial stages of commercialization to achieve expected performance by operating and monitoring the H&C system. New technology such as the SunHorizon technology packages often have a lower margin than mature technology and optimizing the system is crucial for the system to become financially viable. However, the development of digital solutions by energy service companies depends on the social acceptance of such solutions in society. The culture of embracing new innovations and digital offerings differ between countries.

As the SunHorizon project progresses more steps will be added to the value chain and these additional steps could result in additional values to the customer. The logistics of getting the installation to site, format of offering (e.g. leasing, service agreement, one-off payment) and the possibility of after sales are examples of steps that could provide additional customer values. A visualisation tool displaying the savings and operation of the system to the customer (as in DS5) is one option for engaging the customer and empowering him/her to be an active energy citizen.

8.3 Conclusions based on the Business model analysis

The SunHorizon technology packages provide an innovative way of increasing the efficiency of buildings H&C system through innovative control strategies for coupling heat pumps and solar energy production units. A challenge when bringing new technology to the market it to understand what new value the technology delivers to the customer compared to the existing system. The value proposition (value proposed to the customer) is at the core of every business model. **The value proposition to customers through the installation of a SunHorizon technology package are naturally the same as the values created in the value chain: lower GHG emissions, primary energy savings and energy efficiency, potentially resulting in cost savings.** However, from the business model analysis other values, such as thermal comfort and reduced dependency on external fuel supply due to increased self-supply and more efficient H&C system are detected. These values can, jointly, provide a competitive edge for the SunHorizon technology packages compared to conventional technology. The added value of **increased thermal comfort** is mentioned for demo sites with multi-apartment buildings moving from a decentralized to a centralized H&C system. The values of **increased self-supply** and reduced dependence on external fuels (fossil fuels) appears in discussion with DS3, DS5 and DS8. Increased self-supply is a result of the installation of any of the TPs and hence provided to all demo sites. The value of increased self-supply to the customers will be explored further in Task 7.2. A value that is especially important to municipalities is **the value of green** as a means of achieving the governmental renewable energy targets and contribute to stimulating the market for such actors and technologies.

It is concluded that different customer segments are analysed (small-to-medium size residential owner, municipalities and building residents**), nevertheless, the technology packages are successful in providing a clear value proposition to all.** The relationship with the customer is identified to be the same for all demo sites, regardless of customer segment. The innovative technology in SunHorizon requires a close dialogue with the customer to ensure that expectations and performance matches. The close relationship throughout the project creates the possibility for a long-term relationship where the customer becomes loyal to the contractor.

The key resources and key partners reflect the added values in the value chain: e.g. technology equipment and competence to install it are important features. Again, this reflects that at M12 of the project the demo sites are occupied with planning and design of the systems**. Key activities for all demo sites include inspections and permits required at different phases in the project.** The complexity, guidance and information to perform this activity varies between countries. For example, in Latvia many administratively heavy permits are required, and information is scarce. Applying for available financial support is an especially important activity for small-to-medium sized private building owners where subsidies can be a key driver. As **financial support is identified as a key driver for the implementation of renewable energy** and energy efficient measures for the private sector this instrument can be useful to governments with ambitious target. With the EU goal to establish energy citizens, aware and effective in their use of energy, the level of knowledge amongst citizens need to increase. This is reflected in the business model canvases as dissemination of knowledge in DS1, DS2, DS8 and visualization of system performance in DS4, DS5 and DS8.

The most frequent technology package is TP2, occurring in three of the demo sites. TP2 is the only technology package that generates both heat and electricity in combination with a natural gas HP, therefore likely to result in the lowest electricity costs. The other TPs generating electricity also have a HP installed powered by electricity. The higher frequency pf TP2 installations can imply that customers want to reduce the amount of electricity purchased from the grid. TP5 is the most complex technology package with two different heat pumps (natural gas and electricity) in combination with thermal solar panels. TP5 will not be installed in any of the demo sites but demonstrated virtually in a modelling exercise that will be presented in D2.5, *SunHorizon TPs and demo site conceptual design and simulations*.

At the time of submitting this report (M12), the technical solutions are still under development and therefore the cost structure cannot be anticipated. Identified in the value chain analysis, the focus at this stage of the project is on technology itself and little thought is given to how the revenue streams will be formulated (except for DS3 where Energy Performance Contracting is expected). The cost structure and revenue streams will be developed in Task 7.2.

8.4 General conclusion

Through the macro-market analysis (PESTLE) it is concluded that countries have different prerequisites (political agenda for renewables, financial support, permits) for the technology packages in SunHorizon to be successful. By summarizing the opportunities for the demo sites countries, it is identified that Spain and Germany have high potential for the SunHorizon solutions, Belgium has medium potential and Latvia has low potential. The value chains for the technology packages implemented at the demo sites share the common denominators lower GHG emissions, primary energy savings and energy efficiency as the resultant values arising from the value-adding activities. These values appear again, along with the value of green, increased thermal comfort and increased self-supply, in the business model canvas as the value proposition offered to the identified customer segments (small-to-medium size residential owner, municipalities and building residents) in SunHorizon compared to the conventional solution. At the time of submitting this report (M12), the technical solutions are still under development and therefore the cost structure cannot be anticipated. The cost structure and revenue streams in the business model canvas will be developed in Task 7.2.

A. ANNEX PESTLE: Summary

The table below summaries the key findings and recommendations proposed for the exploitation of the SunHorizon project.

Best Opportunity	Key Findings
Spain – High	-Renewable energy target increase of 22% between 2020 to 2030. -Positive Government support and promotion of the use of more Solar energy and coupled technologies. -There is currently a large installed capacity of heat pumps. - EUR 450m finance package issued by the European Investment Bank, which will fund Spanish solar and onshore wind. -Good demand for cooling, DHW and heating. - Currently low use of renewable energy sources, compared to other demo sites. - Good levels irradiation.
Recommendation	The country already has a large installed capacity of heat pumps, this could be a good market for coupling with Solar panels. Potentially a lot of growth over the next 10 years for both technologies. Presumably this will be a highly competitive market for the producers of Solar panels and Heat pumps, the best strategy to use would be cost leadership, where prices would be lower than other suppliers, or a specific innovation that is not readily available in the market.
Germany – High	-Renewable energy target increase of 12% between 2020 to 2030. -Positive government support for the use of Solar energy and coupled technologies. -Although Germany has the largest installed capacity of Solar energy in Europe, there's still potential for further development in the new government plans for 2020-2030. Additional 4GW capacity on top of the current 52GW capacity of Solar. -Currently high electricity prices, which would act as driver for households to create own energy. -Good levels of irradiation. -High demand for heating, DHW and cooling.
Recommendation	Germany is the largest user solar panels and currently rooftop space is limited, there could be opportunity for commercial use for retails units / offices etc. There is a very positive environment for Sun Horizon technology, but there will be a steady increase in the uptake of the technology over the next 10 years. Also, a very competitive environment, so cost leadership should be used, lowering prices to meet competition, or a specific innovation that it not readily available in the market.
Belgium - Medium	-Renewable energy target increase of 5.3% between 2020 to 2030. Therefore, not major deployment of renewable technologies.

	-Some Political support for the use of Solar and coupled technologies in areas of Belgium projected in the new plan for 2020- 2030. -Little economic support, and is general to all renewable technologies, nothing specific for solar or heat pumps. - Low installed capacity of solar and heat pumps. -Less demand for Heating, cooling and DHW when compared with the other demo sites, this could be that Belgium is smaller country compared to Spain and Germany. - Poor levels of irradiation when compared to Spain and Germany.
Recommendation	Wait until better finance mechanisms are being offered to support the technologies, then there would be potential of growth.
Latvia – Low	-Renewable energy target increase of 5% between 2020 to 2030. This is because Latvia are currently using 40% renewable energy in their energy mix, which is generally derived from hydro power and solid biofuels. -Little support from government policy to support the use of solar or coupled technologies. - Potential use of heat pumps. - Currently poor economic support or incentives for the use of solar or coupled technologies or other renewable sources. However, in the new draft plan, speculation over some incentives to be offered, but unknown at this time. -Electricity prices ae already low compared to the other demo sites. - Low levels of irradiation, not the best for solar power. -No data was available for the demand of heating, cooling or DHW. Presumably this is a northern country and would experience cooler climates compared to the other demo sites. Therefore, would require more heating and DHW.
Recommendation	Area of very low opportunity and growth currently.
Other considerations & further development areas	For the Sun Horizon project, there are other opportunities within Europe for the exploitation of the project. These can be considered as countries with high irradiation levels, positive government support and funding, and areas with currently high targets for renewables and low current installed capacity. Without further research into these markets' information cannot be provided.

B. ANNEX PESTLE: Installed capacity of the SunHorizon technologies in the EU

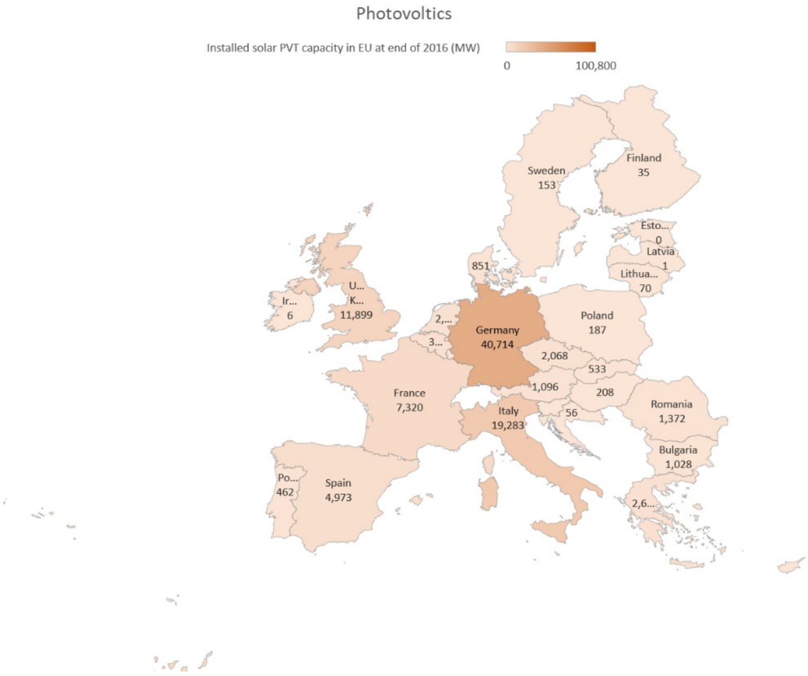


Figure 36 Photovoltaics- Installed solar PV capacity in EU at end of 2016 [MW] (EurObserv'ER 2017)

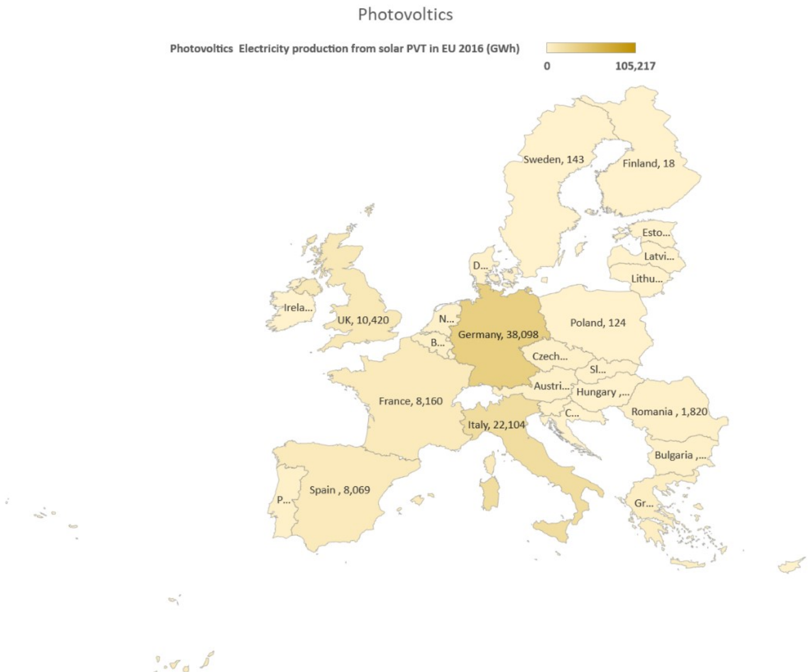


Figure 37 Photovoltaics- Electricity production from solar PV in EU 2016 [GWh] (EurObserv'ER 2017)

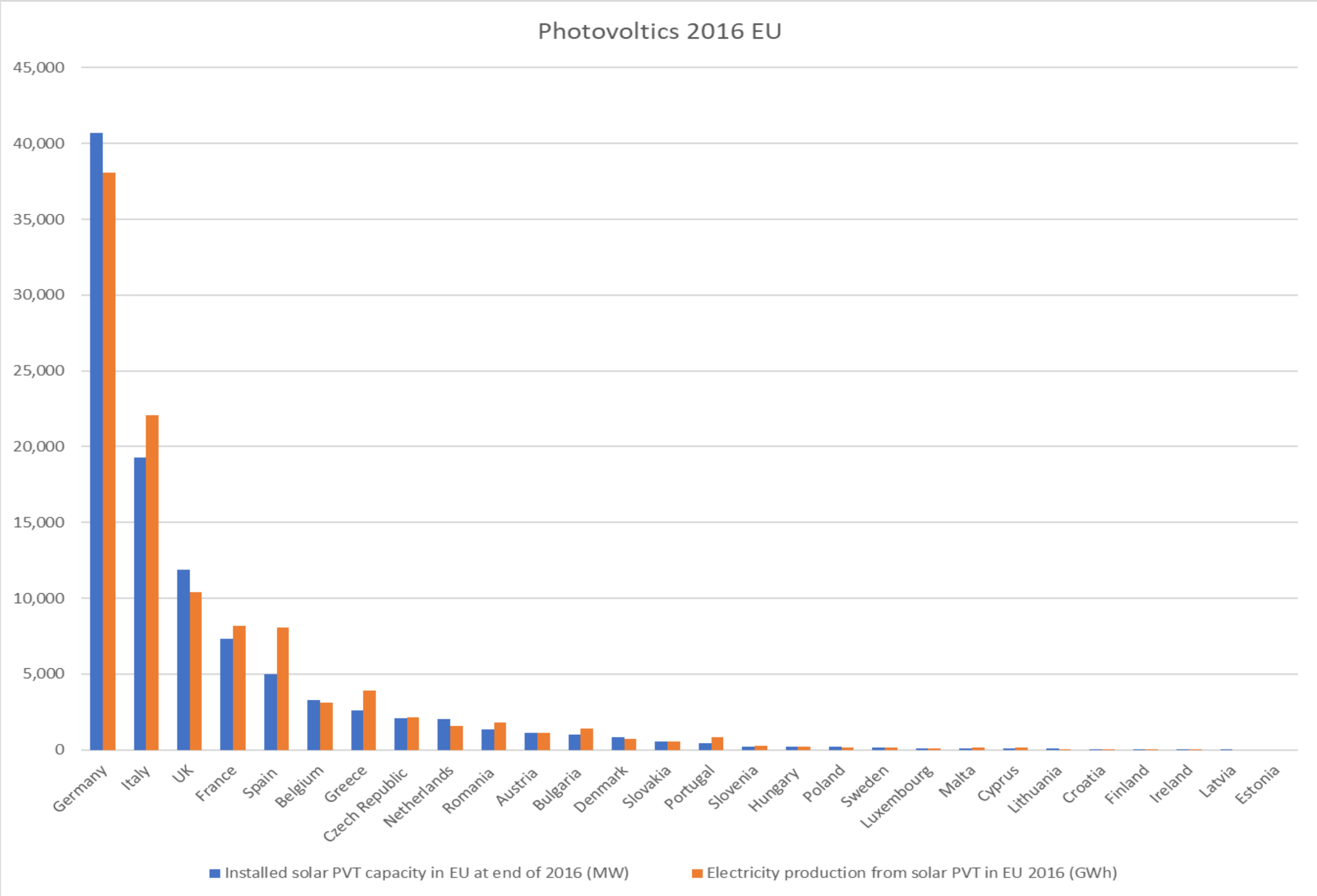


Figure 38 - Total Photovoltaics, installed capacity and electricity 2016 EU (EurObserv'ER 2017)

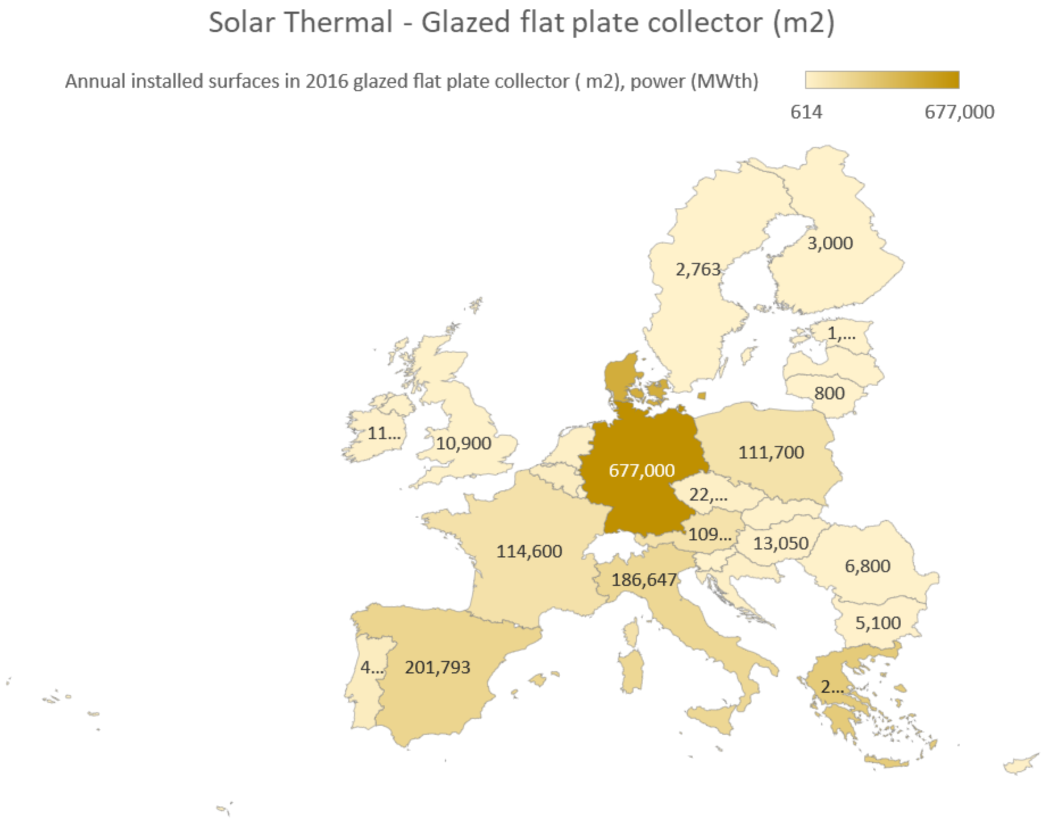


Figure 39 Solar Thermal EU Installed capacity for Glazed flat plate collector [m^2] (EurObserv'ER 2017)

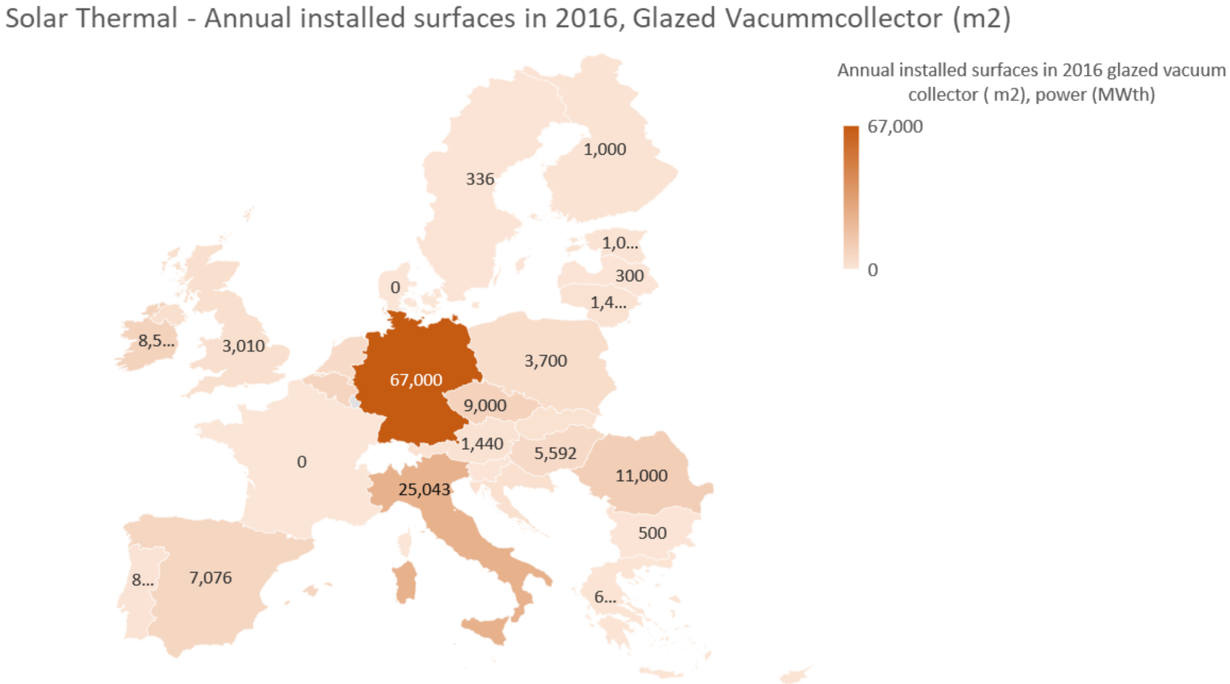


Figure 40 Solar Thermal - Glazed Vacuum collector 2016 [m^2] (EurObserv'ER 2017)

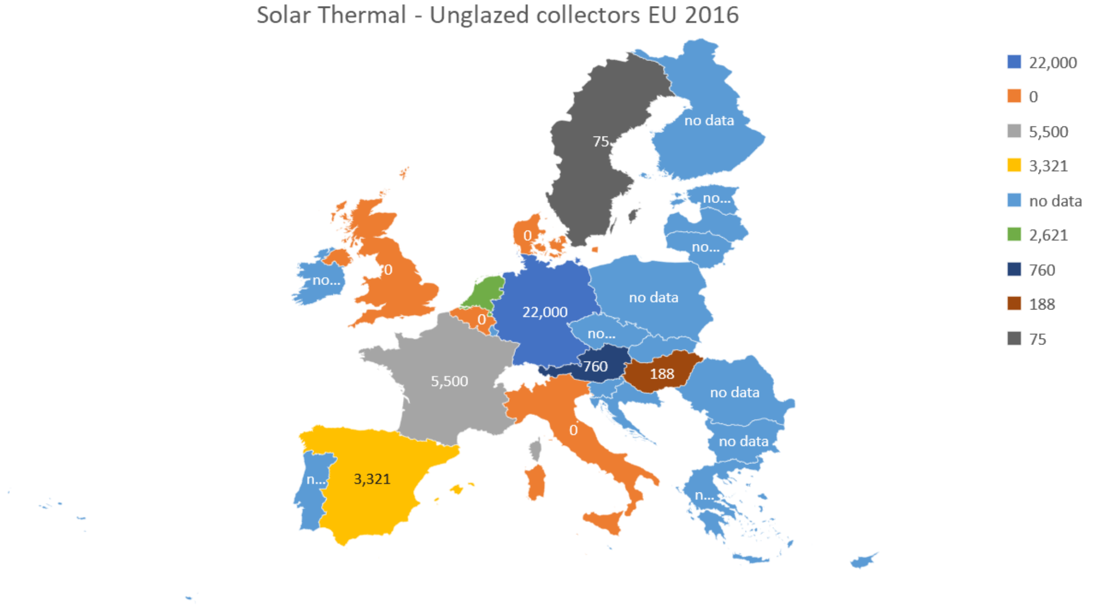


Figure 41 Solar Thermal Unglazed collectors 2016 [m^2] (EurObserv'ER 2017)

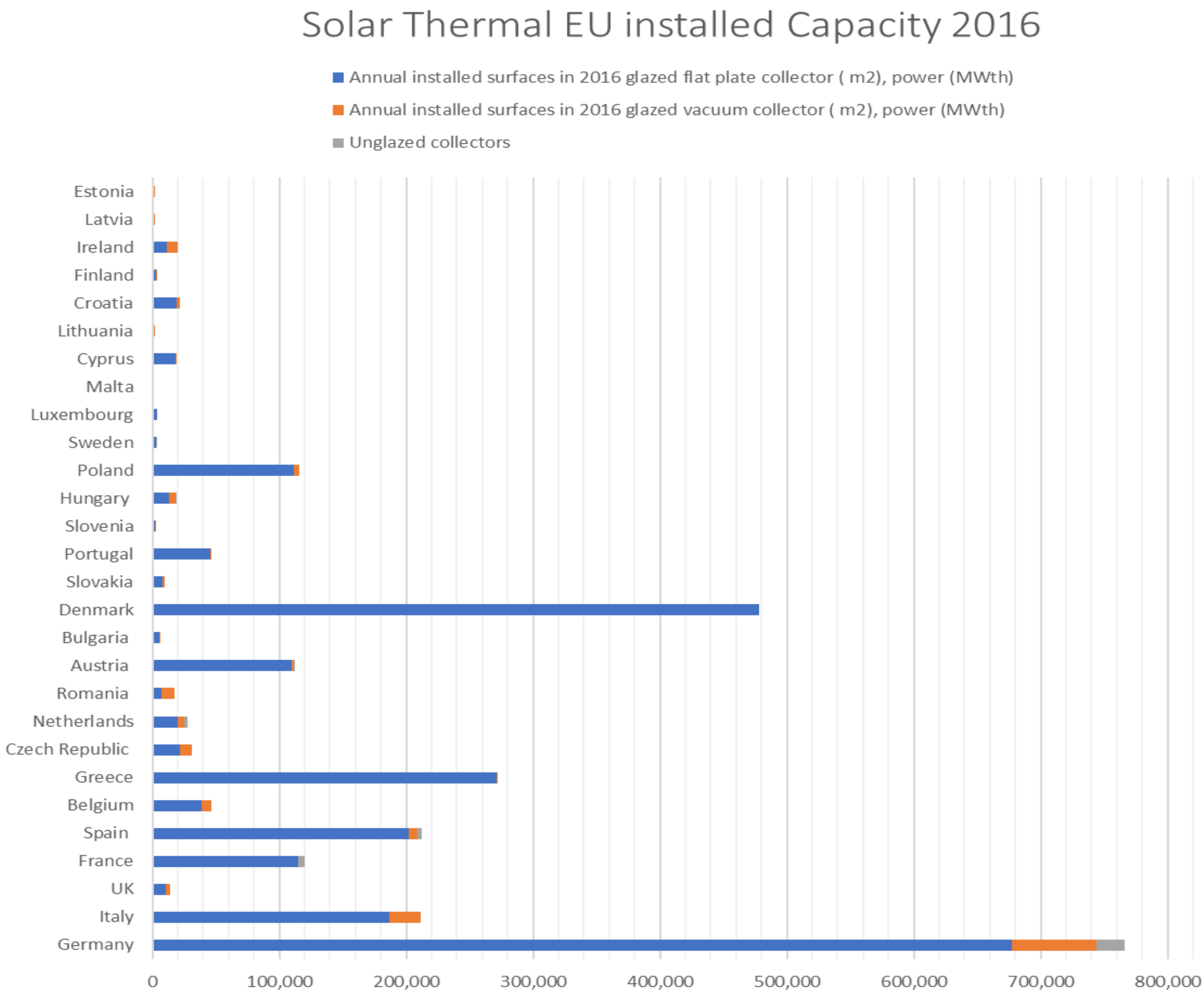


Figure 42- Solar Thermal EU installed capacity 2016 (EurObserv'ER 2017)

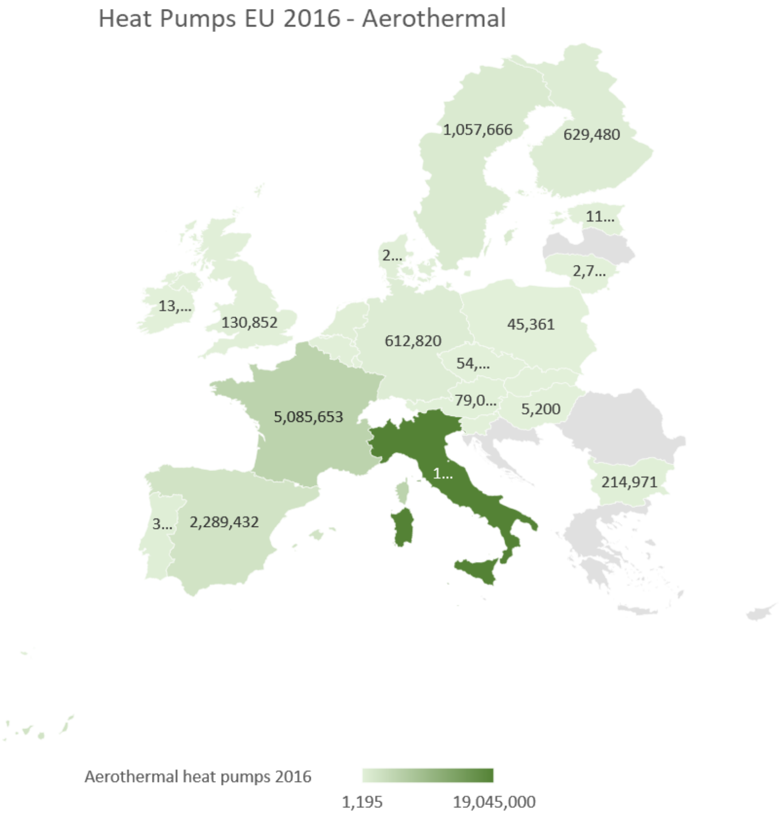


Figure 43 Aerothermal Heat Pumps EU 2016 (EurObserv'ER 2017)

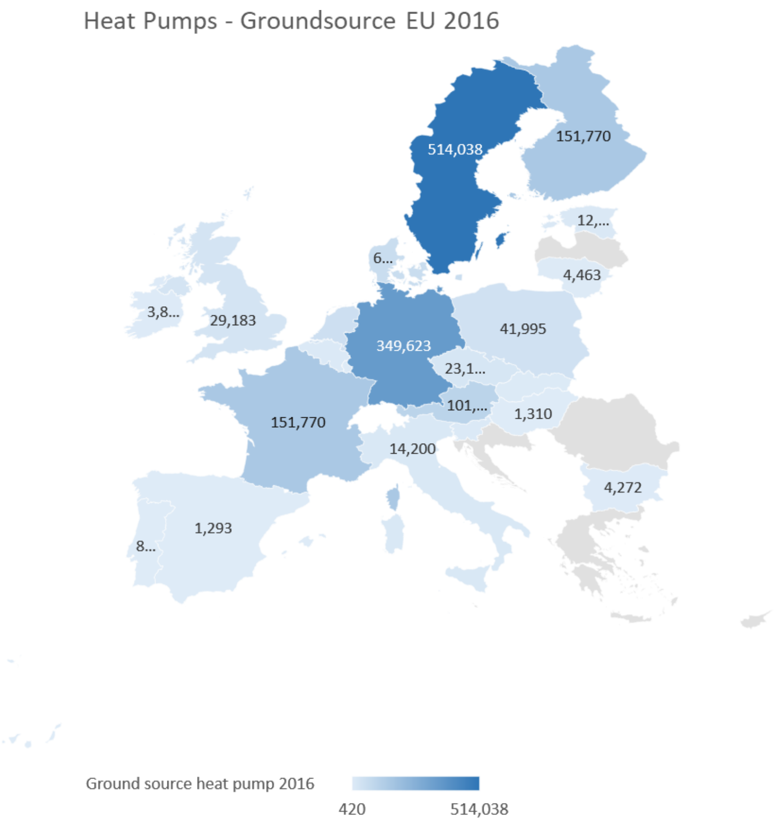


Figure 44 Ground Source Heat Pump EU 2016 (EurObserv'ER 2017)

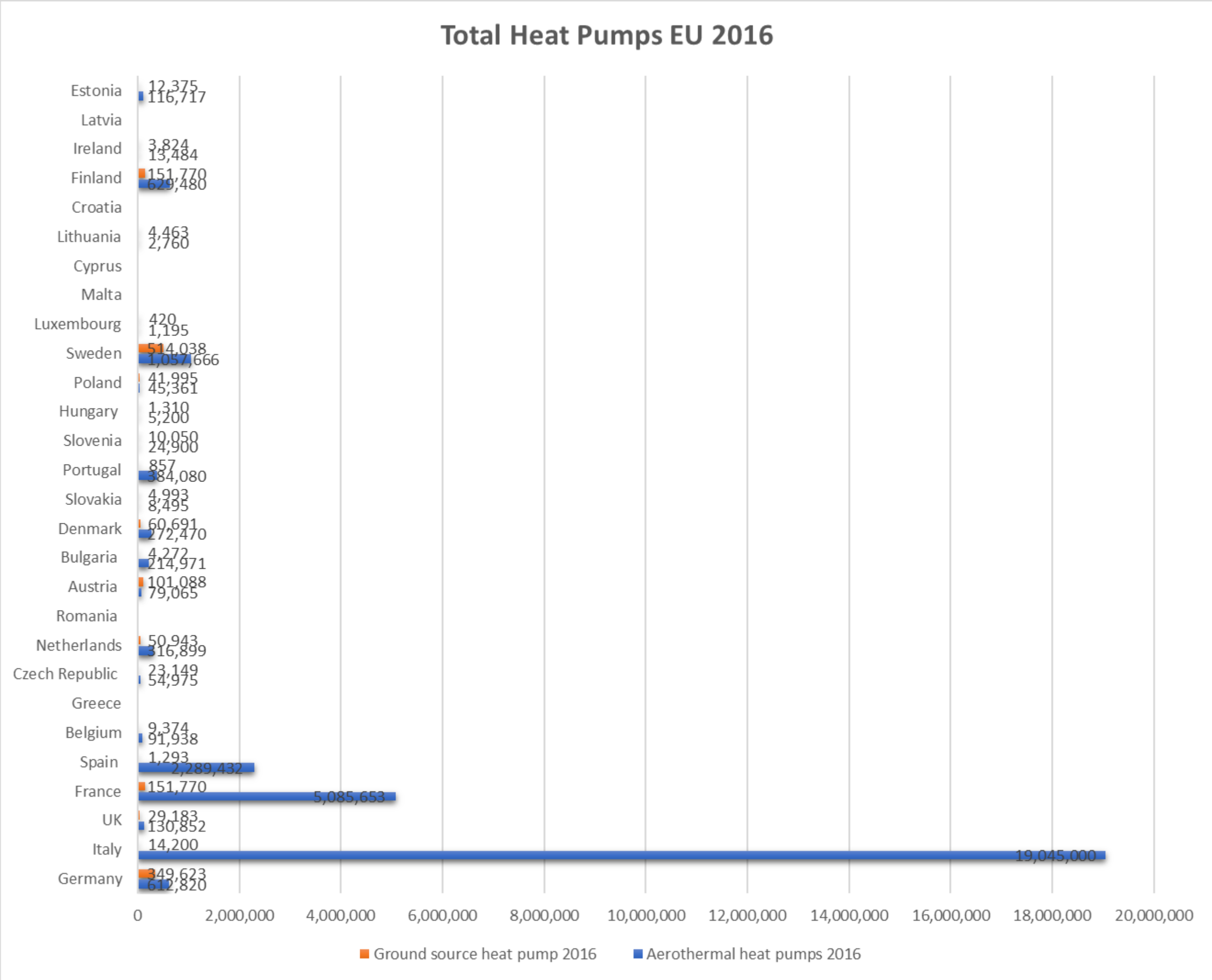


Figure 45 Total Heat Pumps EU 2016 (EurObserv'ER 2017)

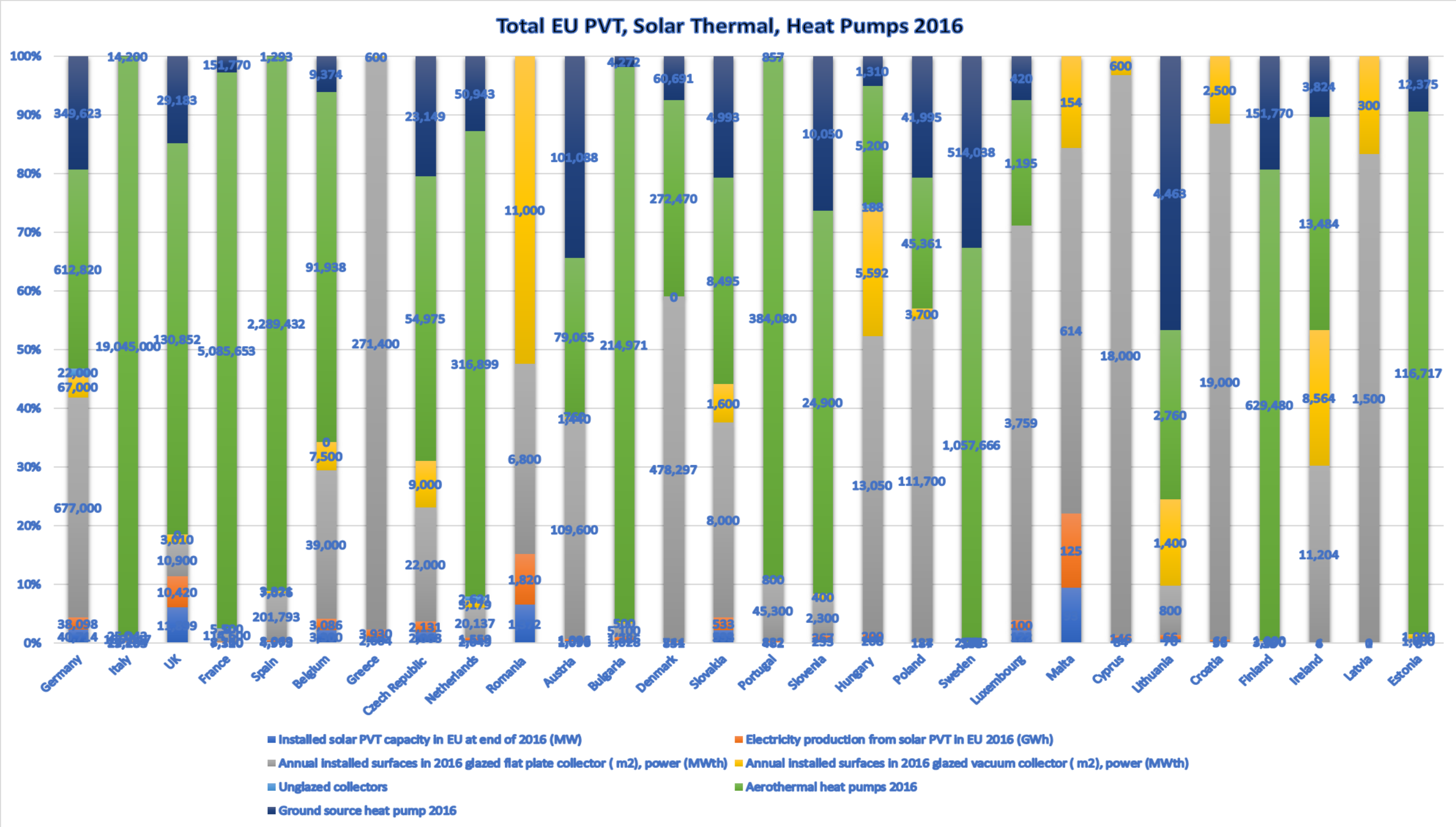


Figure 46: Total installed capacity of photovolatics, solar thermal and heat pumps in the EU (EurObserv'ER 2017)

C. ANNEX Germany PESTLE analysis

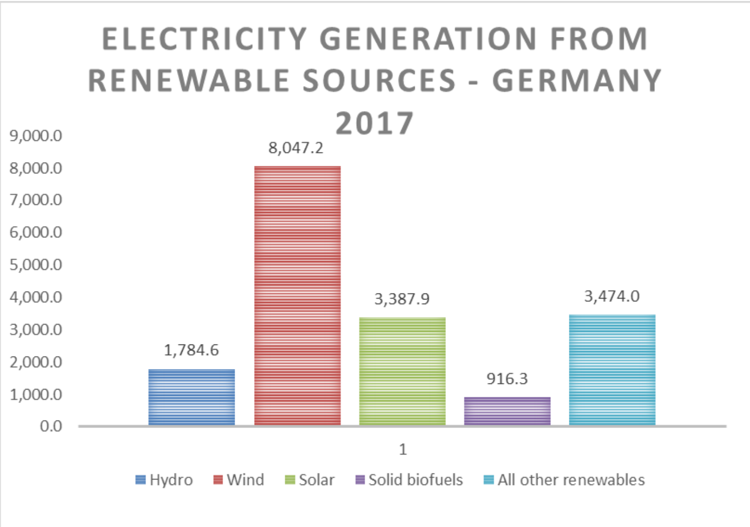
Indicative Trajectory					Target 2020	Target 2030
2011-2012	2013-2014	2015-2016	2017-2018			
8.2%	9.5%	11.3%	13.7%		18.0%	30%

The indicative trajectory for the total share of renewables in gross final energy consumption follows a linear increase from 18 % in 2020 to 30 % in 2030. This corresponds to an annual increase of 1.2 percentage points:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
19.2%	20.4%	21.6%	22.8%	24.0%	25.2%	26.4%	27.6%	28.8%	30.0%

*The indicative trajectory is based on the Energy Concept; it is provisional in nature and may differ in the final NECP.

Germany is one of the largest EU countries with a population of 82.7 million people. This highly industrialised country can be characterised by a central European climate and a flat to hilly landscape. Germany has strong energy policies, its current share of renewables in the energy mix has developed its wind power, biomass and solar energy sectors.



The below PESTLE analysis has been outlined in order of importance and where there are similarities in areas, they have been grouped together in sections.

Political & Legislative

2020 – 2030:

According to the Renewable Energy Sources Act 2017, special calls for tender will be published from 2019 onwards as an additional effort towards achievement of the climate goals. In total, an additional 4 GW of capacity will be tendered out by 2021 for solar and onshore wind respectively. Depending on the specific nature of the projects, they will come online as early as 2020 or in the years following. The capacities tendered will not count towards the current 52 GW ceiling for PV systems. The special tendering procedures form part of the 'Omnibus Energy Act' (Federal Government bill dated 5 November 2018).

Sectoral coupling for electricity, heating and transport

The Federal Government plans to press ahead with sectoral coupling, or in other words the efficient use of electricity from renewable energies, in order to decarbonise the heating and transport sectors yet further. As a result of sectoral coupling, electricity from renewables will therefore also play an increasingly important role in the buildings, transport and industry sectors. The framework conditions for sectoral coupling should therefore be improved in these sectors with a view to creating a level playing field for the various fuel technologies.

Landlord-to-Tenant Electricity Act

The Landlord-to-Tenant Electricity Act enshrined eligibility for the funding of landlord-to-tenant models in the Renewable Energy Sources Act 2017. Landlord-to-tenant models involve the generation of electricity using photovoltaic panels on the roof of a residential building and the supply of this electricity to end consumers (in particular tenants) in the same building or in residential buildings and ancillary installations in the immediate geographical vicinity, without transit through a grid. The landlord-to-tenant electricity supplement is funded through the surcharge under the Renewable Energy Sources Act. Using the wording drafted by the Federal Government, in late November 2018 the German Bundestag furthermore adopted an amendment to §5(1)(10) of the Corporation Tax Act within the framework of debates on a draft bill on tax incentives for the construction of rental housing. This amendment to the Corporation Tax Act ensures that rental incomes earned by housing cooperatives and associations will continue to be exempt from tax even if the cooperative or association operates a landlord-to-tenant photovoltaic system.

2010-2020:

Energy Saving Ordinance (EnEV)

On the efficiency field, the Energy Saving Ordinance (EnEV) sets minimum requirements for efficient energy use in new buildings and for large-scale renovations of existing buildings.

On 1 January 2016, new rules on constructing new buildings entered into force. New buildings in Germany must now meet a maximum primary energy requirement that is 25% lower than the previous threshold. It does not explicitly ban fossil fuel heating systems, but in practice it would be nearly impossible to meet the new requirements with an oil or gas boiler. This means that people will have to find alternative ways of heating their homes and heat pumps are a way to achieve this result.

RES-H building obligations (Quota)2019 – solar thermal

New buildings: The quota (§ 3 par. 1 EEWärmeG) is fulfilled if the share is at least 15% (§ 5 par. 1 EEWärmeG). In case of buildings with 2 flats, PV installations should have 0.04 m² collector surface per m² floor space. For buildings with more than 2 flats the ratio is 0.03 m² collector surface per m² floor space (Annex I. 1. A) EEWärmeG).

Renovation: The quota (§ 3 par. 2 EEWärmeG) is fulfilled if the share of renewable energy is at least 15% (§ 5a par. 2 EEWärmeG).

Heat pumps:

New buildings: The quota (§ 3 par. 1 EEWärmeG) is fulfilled if the share is at least 50% (§ 5 par. 4 EEWärmeG)

The quota (§ 3 par. 1-2 EEWärmeG) for new buildings and renovation is fulfilled if the following requirements are met:

Heat is produced with an operating factor of at least 3.5 for air/water and air/air heat pumps (for all others the factor is at least 4.0) EEWärmeG. In case the hot water production of the building is produced by heat pumps or other technologies using renewable energy sources, different operating factors apply: air/water and air/air heat pumps 3.3 (for all others the factor is at least 3.8) EEWärmeG).

Heat pumps must be equipped with heat and electricity meters EEWärmeG.

If the heat pump is powered by fossil fuels, the quota is only fulfilled if the operating factor is at least 1.2 EEWärmeG.

Heat pumps must be certified either with the label “Euroblume”, ”Blauer Engel” or “European Quality Label for Heat Pumps” (Version1.3) or be in accordance with general European norms and regulations comparable to the aforementioned labels. EEWärmeG.

Renovation: The quota (§ 3 par. 2 EEWärmeG) is fulfilled if the share of renewable energy is at least 15% (§ 5a par. 2 EEWärmeG).

Economic

2020 – 2030:

Increase in the consumption of self-generated electricity and landlord-to-tenant models in the electricity sector

Consumption of self-generated renewable electricity makes a significant contribution to Germany’s power supply. An estimated 4 TWh a year is estimated to be generated from renewable energies and consumed by the same party. The recast Renewable Energy Directive gave a boost to the consumption of self-generated renewable electricity throughout the EU. At the same time, however, it is important to ensure that the consumption of self-generated electricity contributes in an appropriate way to the financing of the energy transition. Germany has developed a balanced concept with this in mind: consumers of self-generated electricity benefit from exemptions and caps in relation to various taxes, levies and fees. (Government has not announced what these various taxes and levies and fees are.)

Heating Network Systems 4.0

Fourth-generation heating networks can easily be powered using renewable energies, and they open up additional options for flexibility within the electricity market. The funding arrangements for the ‘Heating Network Systems 4.0’ model project represent the first ever use of system-based funding (i.e. funding whole systems rather than individual technologies and components) in the heating infrastructure sector. The systems developed within the framework of this project are remarkable for their very low temperature (20-95 °C) and very high share of renewable energies and waste heat; they often feature large seasonal heat reservoirs as a key component. Incentivisation of the market launch of fourth-generation heating networks for commercial-scale technical use represents a huge leap forwards in terms of the heating transition, since Heating Network Systems 4.0 represent tangible progress towards the goals of an almost climate-neutral building stock by 2050 and greater integration of renewable energies into the heating sector, and can offer increased flexibility to the electricity sector on a cost-effective and energy-efficient basis. The funding measure is currently scheduled to run until 31 December 2020 but is expected to continue beyond that date. The programme also contributes to implementation of the Energy Efficiency Strategy for Buildings.

Energy Efficiency Incentive Programme

Funding under the Market Incentive Programme has been boosted through the introduction of the Energy Efficiency Incentive Programme. Three areas of investment are covered: (1) the installation of ventilation systems (ventilation package) in combination with renovation measures involving the building shell with a view to avoiding structural damage (including mould), (2) the replacement of inefficient heating installations with efficient heating installations (heating package), (3) the market launch of stationary fuel cell heating systems in new and existing buildings. Funding for stationary fuel cell heating systems with an electrical output of 0.25-5.0 kW is available in the form of a subsidy under the KfW programme ‘Energy-Efficient Construction and Renovation – Fuel Cell Subsidy’.

The Renewable Energy Sources Act (EEG) is the central incentive scheme fostering the growth of renewable electricity generation using a feed-in tariff.

Funding programme for heating optimisation

The aim of the programme is to incentivise the replacement of inefficient heating and hot water circulation pumps with high-efficiency pumps, and the optimisation of existing heating systems by means of hydraulic balancing. The programme also serves as a gateway to more comprehensive energy efficiency measures in buildings.

Funding initiative 'Solar Construction/Energy-Efficient City'

This funding initiative is led by the Federal Ministry of Economic Affairs and Energy and the Federal Ministry of Education and Research, and promotes the energy transition in urban buildings. The focus is on building new multi-storey housing or renovating existing building stock of this type, and on large-scale flagship projects at district level which incorporate a systems-based approach. The project was launched in mid-2017 and has a total funding volume of EUR 120 million.

Transformation of the financing system and contributions to revenue:

The future model for financing an energy supply based on renewables, including the necessary infrastructure, needs to ensure that all energy-consuming sectors make an appropriate contribution to financing it. This will create more sustainable revenue potential for renewable electricity generation, improve the competitive conditions for renewable electricity and facilitate a market-driven breakthrough renewable electricity into other sectors (sector coupling). (Source- German Climate Action Plan 2050).

2010 – 2020:

- The government subsidy for solar heating modernization of a home is usually 3,600 euros, but at least 2,000 euros.
- Renovators who opt for a solar system exclusively for the provision of hot water, now receive at least 500, a maximum of 2,000 euros. The expansion of an existing "solar heating system" with up to 2,000 euros is also funded. To do this, the existing heating system must have a collector area of four to at most 40 square meters and have already been in use for two years.
- If a house is retrofitted, which accommodates more than three residential units, then up to 100 square meters of collector area will be subsidized with 200 euros per square meter through the so-called innovation funding.
- Solar heating systems are currently not subsidized by the state in new buildings.
- With a solar thermal system, you can use the renewable heat of the sun and benefit from attractive subsidies of up to 20,000 euros per project. In the case of an income-related grant, the grant amount may be higher.

Technology

New solar installations are among the most affordable renewables technologies. At the end of 2017, the number of PV installations stood at 1.6 million. These produced around 43 gigawatts of electricity, making PV the second largest source of renewable electricity, followed by onshore wind energy.

Heat pump sales hit a record 78,000 in Germany in 2017, according to figures from the industry association Bundesverband Wärmepumpe (BWP).

According to the latest BWP report, government subsidies for heat pumps and the stricter energy saving requirements saw sales rise by 17% compared to 2016 – itself a record year.

Air-to-air heat pumps witnessed the largest increase with sales of 55,000 units, an increase of 20% compared to the previous year. Sales of monobloc units increased by 24% to 31,000 units. Split units sales growth was slightly smaller at 16%. Ground-source and groundwater heat pump sales increased by 11% to 23,000 devices.

Air-source heat pumps accounted for the majority of heat pump sales at around 71%. In total, around 800,000 heating heat pumps are now installed in Germany.

• Lack of suitable objects/sites: e.g. photovoltaic energy cooperatives have difficulties to identify

suitable rooftop areas while the few left are often not available due to competition

Photovoltaic plants from 750 kW: 600 MW a year. The overall goal for photovoltaics is an expansion corridor of 2 500 MW a year; the Omnibus Energy Act provides for special calls for tender covering an additional 4 GW over the period 2019-2021.

Socio- Cultural & Environmental

Opponents of renewable energy development complain about e.g. noise, shading, changing landscapes or conservation conflicts.

Scarcity of resources. Especially small communities lack staff capacity to collect sufficient data (energy demand, amount of existing buildings and new construction areas or the location of energy producers) which is a requirement for proper planning. Larger communities need to face the challenge to collect big amount of data to ensure a solid basis.

Job creation within PVT and heat pump sector.

Reduction on CO2 emissions and greenhouse gases.

Concluding Remarks

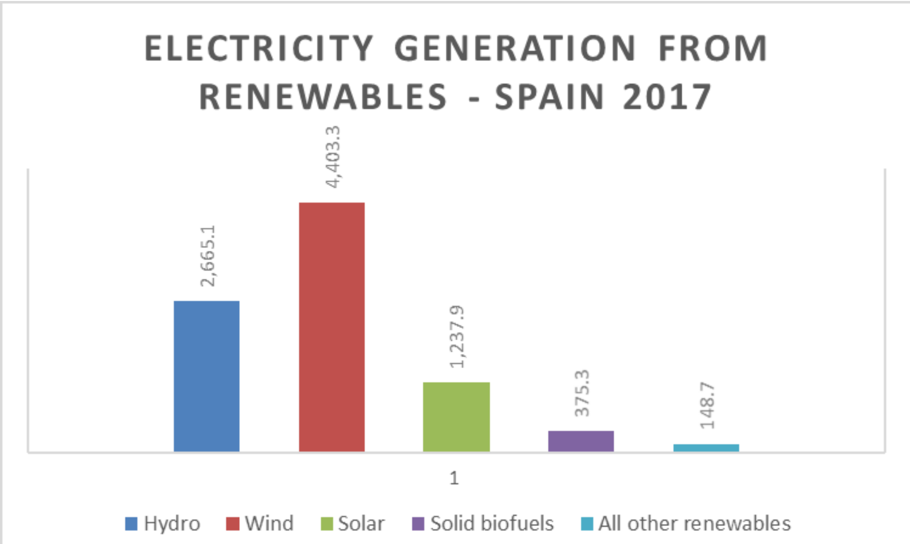
Between now and 2030 Germany are on projected trajectory for a 1.2% increase in renewable energy year on year.

Germany uses wind as the highest segment of their renewable energy mix, followed by solar powered energy generation.

Over all a positive macro environment for the Sun Horizon project. The main drivers being the climate goals and government plans, including additional 4GW capacity for solar, 52GW ceiling for PV systems. A push for Sectoral coupling is also being made in government plans. Positive support in the form of incentives and building obligations.

The main barrier for Germany is that they are already large users’ solar energy, making it a competitive environment for Sun Horizon project. There is lack of space availability on roof tops, but the government is still driving forward solar energy and with increased capacity, good market for heat pumps to be used with already installed solar panels as a method of coupling technology.

Indicative Trajectory					Target 2020	Target 2030
2011-2012	2013-2014	2015-2016	2017-2018			
11.0%	12.1%	13.8%	16.0%		20.0%	42%



Spain is in south-western Europe, bordering Portugal and France. Spain's landscape can be characterised by a large, flat to dissected plateau surrounded by rugged hills and the Pyrenees to the north. The temperate climate provides clear and hot summers inland and more moderate and cloudy summers along the coast. Winters are cloudy and cold inland and partly cloudy and cool along the coast. Spain has a population of 44.3 million. The share of renewables was 16% in 2018 produced primarily by biomass, hydropower and wind power.

The below PESTLE analysis has been outlined in order of importance and where there are similarities in areas, they have been grouped together in sections.

Political and Legislative

The Spanish Cabinet has approved a royal decree, which introduces a package of urgent measures to boost the country's energy transition. It includes the already announced elimination of the "sun tax".

CTE, Codigo Tecnico de la Edificacion

The Spanish government adopted a new Technical Building Code (CTE, Codigo Tecnico de la Edificacion) in March 2006 which includes an obligation (since September 2006) to cover part of the domestic hot water (DHW) demand with solar thermal energy. This obligation applies to all new buildings and to those undergoing major refurbishments.

The required solar contribution varies between 30 and 70 % depending on three main factors:

- Domestic hot water demand of the building (litres/day)
- Climate zone
- Conventional fuel to be replaced (only for refurbishments)

Some exceptions are defined in the law, mainly in the case of buildings that either satisfy their DHW demand by other renewables or by cogeneration or for shaded buildings.

It is important to point out that the municipal solar obligations, approved in the last few years in dozens of Spanish municipalities, including Barcelona in 2000 and Madrid in 2003, remained in force as long as they were stronger than the national obligation included in the CTE.

Solar obligations became a driver in the Spanish solar thermal market since estimates show that over 80 % of installations were motivated by CTE or municipal ordinances. Solar obligations are introduced at the local level for buildings, pools and industrial use up to 60 °C.

The penetration of solar-thermal in Barcelona increased by a factor of 20 since the adoption of the obligations. Other than solar obligations, public financial schemes are available for energy efficiency measures.

RES-H building obligations

(Minimal solar contribution of warm sanitary water – Contribución solar minima de agua caliente sanitaria)

All new buildings or buildings undergoing major renovation in which there is demand for warm sanitary water / air conditioning of a covered swimming pool must satisfy some of this demand through solar thermal installations (CTE, HE 4). The contribution varies between 30 and 70% of the total warm sanitary water demand of the building, depending on the demand level, the geographic position and the main heating source.

The City of Barcelona has been the pioneer for Solar Regulations in Europe. The first Solar Ordinance came into force in 2000 and required that a certain share of the domestic hot water demand be supplied by solar thermal, in new buildings and those undergoing major refurbishment. The implementation led to a significant increase in the use of solar thermal, thereby even stimulating the market for buildings not covered by the ordinance. The regulation was popular with decision makers and received widespread public support. Therefore, the number of buildings targeted increased and procedures, architectural integration as well as quality requirements improved thanks to the revision approved in 2006.

As a part of the Solar Thermal Action Plan, developed within the K4RES-H project coordinated by ESTIF, the Barcelona Energy Agency published an analysis of the lessons learned during the implementations of the Barcelona solar regulation. Inspired by the positive experience of Barcelona, dozens of municipalities under administration of different political colours approved solar obligations all over Spain.

Economic

The major economic factor is the high up-front installation costs compared to well established conventional technologies like gas and electric boilers. The more complex process and associated costs of integrating solar thermal systems into existing housing; and the competition with heat pumps for heating and cooling services, and with solar photovoltaics panels for rooftop space. Spain's new commitment to renewable sources was also outlined by a recent EUR 450m finance package issued by the European Investment Bank, which will fund Spanish solar and onshore wind projects.

Technological

Spain's technology targets outlined below:

Parque de generación del Escenario Objetivo (MW)				
Año	2015	2020	2025	2030
Eólica	22.925	27.968	40.258	50.258
Solar fotovoltaica	4.854	8.409	23.404	36.882
Solar termoeléctrica	2.300	2.303	4.803	7.303
Hidráulica	14.104	14.109	14.359	14.609
Bombeo Mixto	2.687	2.687	2.687	2.687
Bombeo Puro	3.337	3.337	4.212	6.837
Biogás	223	235	235	235
Geotérmica	0	0	15	30
Energías del mar	0	0	25	50
Biomasa	677	877	1.077	1.677
Carbón	11.311	10.524	4.532	0 – 1.300
Ciclo combinado	27.531	27.146	27.146	27.146
Cogeneración carbón	44	44	0	0
Cogeneración gas	4.055	4.001	3.373	3.000
Cogeneración productos petrolíferos	585	570	400	230
Fuel/Gas	2.790	2.790	2.441	2.093
Cogeneración renovable	535	491	491	491
Cogeneración con residuos	30	28	28	24
Residuos sólidos urbanos	234	234	234	234
Nuclear	7.399	7.399	7.399	3.181
Total	105.621	113.151	137.117	156.965

* Los datos de 2020, 2025 y 2030 son estimaciones del Escenario Objetivo del PNIEC.

The table shows all the technologies that are projected for use between 2020 to 2030, there is a large capacity for Solar PVT compared to solar thermal, although the uptake will be competing with other renewable technologies on the market.

Socio Cultural & Environmental

Job creation, reduction of CO2 levels, Spain is already is a high user of Solar PVT and society are already confident with this technology. The use of heat pumps is not well established yet, some information of coupled technologies should be made available to the public.

Concluding Remarks

Spain has a projected trajectory of 22.2 % from 2020 until 2030. Within the renewable energy mix, they are largest users of Wind, hydro and then solar. Their regulations support the use of Solar energy, and this has been a projected in their technology targets until 2030. Spain's new commitment to renewable sources was also outlined by a recent EUR 450m finance package issued by the European Investment Bank, which will fund Spanish solar and onshore wind projects.

The main barrier is the high -front installation costs compared with well-established conventional technologies like gas and electric boilers.

Indicative Trajectory				Target 2020	Target 2030
2011-2012	2013-2014	2015-2016	2017-2018		
4.4%	5.4%	7.1%	9.2%	13.0%	18.3%

As part of dimension decarbonisation, Belgium has set a contribution in terms of the proportion of renewable energy it uses. The EU target is 32 % by 2030. Based on the measures outlined in the entity specific plans, Belgium will generate 18.3 % of its gross final energy consumption from renewable energy sources (RES) by that date.

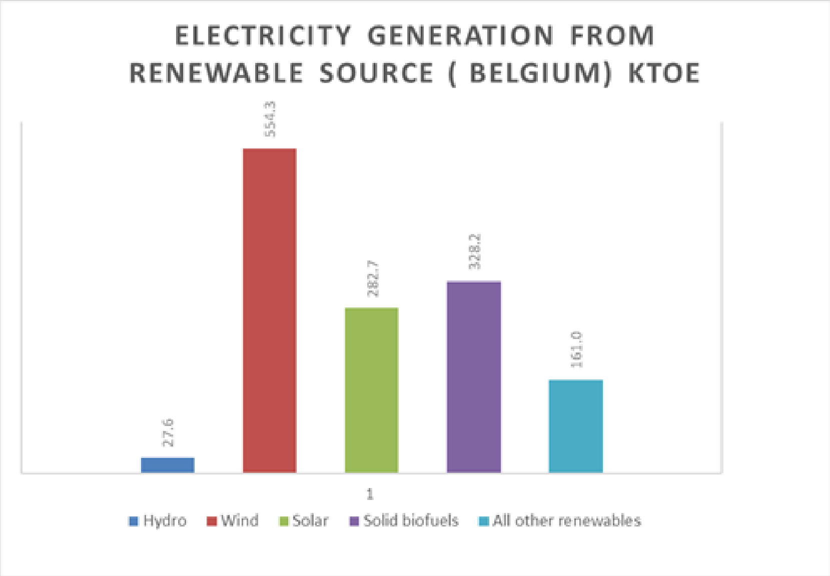
Renewable energy production in 2030:

By entity	RES production (Mtoe)	Final energy consumption (Mtoe)	Proportion of RES in final consumption (%)
Belgium	6.0	32.9	18.3
Brussels-Capital Region	0.1	1.6	4.8
Wallonia (*)	2.3	10.1	22.7
Flanders	2.4	21.2	11.2
Federal	1.3		

Belgium generally is a low-lying country, with a broad coastal plain extending in a south easterly direction from the North Sea and the Netherlands and rising gradually into the Ardennes hills and forests of the southeast, where a maximum elevation of 2,277 feet (694 metres) is reached at Botrange.

Belgium has a temperate, maritime climate predominantly influenced by air masses from the Atlantic. Rapid and frequent alternation of different air masses separated by fronts gives Belgium considerable variability in weather. Frontal conditions moving from the west produce heavy and frequent rainfall, averaging 30 to 40 inches (750 to 1,000 mm) a year. Winters are damp and cool with frequent fogs; summers are rather mild. The annual mean temperature is around 50 °F (10 °C). Brussels, which is roughly in the middle of the country, has a mean minimum temperature of just below 32 °F (0 °C) in January and a mean maximum of about 71 °F (22 °C) in July.

The Current renewable energy mix



Data: Eurostat 2017

The below PESTLE analysis has been outlined in order of importance and where there are similarities in areas, they have been grouped together in sections.

Political & Legislative

Current:

Wallonia

As far as the RES-H building obligation is concerned, the Energy Performance for Buildings legislation obliges certain new buildings as well as existing buildings with a floor area greater than 1000 m² to install thermal solar collectors or any other installation allowing an energy saving at least equivalent to thermal solar collectors.

- Loi du 29 avril 1999 Law of 29 April 1999 on the Organisation of the Electricity Market.
- Royal Decree of 16 July 2002 on the Introduction of Mechanisms Promoting Renewable Electricity Generation.
- Decree of the Walloon Government of 30 November 2006 on Support for Renewable Energy and Combined Heat and Power Generation.
- Decree of the Walloon Government of 30 March 2006 on Public Service Obligations in the Electricity Sector.

Brussels

- Decree of 17 December 2015 of the Brussels-Capital Government regarding the promotion of green electricity.
- Decree of 2 April 2009 of the Brussels-Capital region regarding the promotion of energy efficiency and energy production through renewable energy sources.
- Ordinance of 19 July 2001 on the organisation of the electricity market in the Brussels-Capital region.

Flanders

- Energy Decree, Law Establishing General Conditions for Energy Policy – Energy Law of 8 May 2009.
- Energy Regulation – (Regulation of the Flemish Government on General Conditions for Energy Policy – Energy Regulation of 19 November 2010).
- Decree on BF for GC and CHPC - (Ministerial Decree updating the current banding factor for green certificates and combined heat and power certificates)

- A decision has been taken to make maximum use of green heat capacity for the different heating technologies. It is nearly always more cost-effective from an economic point of view to obtain a given contribution to generation from green heat than from green electricity or green transport.

- For heat pumps, the system cost (impact on network load, higher investment and support costs than other sources of green heat) is higher than for other options (renewables). However, not everyone will opt for a heat pump when investing in a replacement system or as part of a renovation. To encourage a wider uptake of heat pumps, their cost-effectiveness in dwellings must be improved by reducing heating demand and integrating heat pumps into the electricity market and power grid.

- District heating contributes to more efficient heat production and provides the infrastructure required to facilitate conversion to renewable energy sources (e.g. geothermal energy).

Proposed targets 2020 – 2030

The energy efficiency dimension follows the model proposed by the European Commission. It therefore focuses mainly on the implementation of the revised Energy Efficiency Directive (Directive 2012/27/EU). In this context, various possible scenarios have been developed. The potential savings by 2030 have also been estimated in order to set Belgium's target, which will contribute to the EU target of 32.5 % by 2030 (Article 3). A significant contribution to Belgium's target will have to come from the implementation of Article 7. Depending on the chosen scenario, Belgium's energy efficiency policy may be developed further. The necessary strategic choices and decisions will be made according to the target set by Belgium. Particular attention will be paid to the following strategic measures: energy policy agreements (EPAs); the development of modernisation strategies; the exemplary role of the state authorities; further policy development around energy service companies (ESCOs)

Economic

Current

In Belgium, electricity from renewable sources is promoted mainly through a quota system based on certificates trade. In general, renewable energy is devolved competence. As far as the national promotion of heating and cooling is concerned, companies are eligible for a tax deduction on investment costs.

Proposed 2020 – 2030

National objectives related to other aspects of the internal energy market such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met.

Wallonia

Current

In the Walloon region, the generation of electricity through renewable energy plants is promoted through the federal system of green certificates as well as through regional support schemes such as investment assistance for companies or for public bodies and net-metering. The generation of heat through renewable energy plants is promoted through a system of energy subsidies, the granting of a zero-percent interest loan as well as through investment assistance for companies.

In the Walloon region, access of electricity from renewable energy sources is regulated by the Walloon grid code and by the regional electricity market decree. Electricity from renewable energy sources is given priority in both connection to and use of the grid.

Several policies aim at promoting the development, installation and usage of RES-installations, including training programmes for RES-installers; research, development and dissemination (RD&D) programmes; a building obligation for the use of renewable heating and a support scheme for the development of the RES-H infrastructure. Moreover, the Walloon government has developed a programme ensuring the exemplary role of public authorities.

2020 - 2030

National objectives related to other aspects of the internal energy market such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met.

Wallonia

In the Walloon region, the generation of electricity through renewable energy plants is promoted through the federal system of green certificates as well as through regional support schemes such as investment assistance for companies or for public bodies and net-metering.

Technological

Proposed Technologies for 2020-2030:

Flemish Region *– residential buildings (specifics only highlighted in this region)*

heating installation comprising:

- a condensing boiler, or
- a (micro-)cogeneration system, or
- a heating system based on a renewable energy source (heat pump, etc.), or
- decentralised heating appliances with a total maximum output of 15 W/m2, or
- connection to efficient district heating, and
- operation in accordance with EU, Belgian and Flemish regulations.

Green heat (in GWh)	2016	2020	2030
Solar	167	246	442
Heat pumps	308	610	1 300
Geothermal	0	164	594
Household biomass	3 949	3 850	1 950
Other biomass	3 387	4 327	5 401
Total	**7 811**	**9 197**	**9 687**

- According to the solar map, a potential 57 GWe has been calculated for the 'ideal' category, defined as sites with incident solar radiation of more than 1 000 kWh/m²/year. The potential of the 'usable' category, with incident solar radiation of between 800 and 1 000 kWh/m²/year, is 15 GWe.

Walloon Region

- The majority of renewable energy production will come from wind energy, followed by photovoltaics (PV). This will be followed by solid biomass cogeneration, biogas cogeneration and hydro power. Geothermal electricity will be used for demonstration purposes.

Renewable heat – WAM	2030
Biomass – heat only	7 281
Biomass – cogeneration	4 645
Solar thermal	181
Heat pump	1 875
Geothermal	251
Total – WAM	14 233

Social & Environmental

- Human life, health, and well-being is protected from adverse impacts of climate change irrespective of gender, age, or membership of a social group;
- Economy is able to adapt to climate change and use the opportunities it provides;
- Knowledge and information for the development and implementation of climate change adaptation policy is ensured based on the latest scientific argumentation.

Concluding Remarks

Belgium's overall projected trajectory is 5.3% up from 2020 until 2030, within this target each region has their own target. The research into Belgium PESTLE analysis has been difficult as the country has been divided into regions, and each region has their own targets and regulations.

As an overview Belgium's renewable energy mix is largely Wind, followed by solid biomass and then solar.

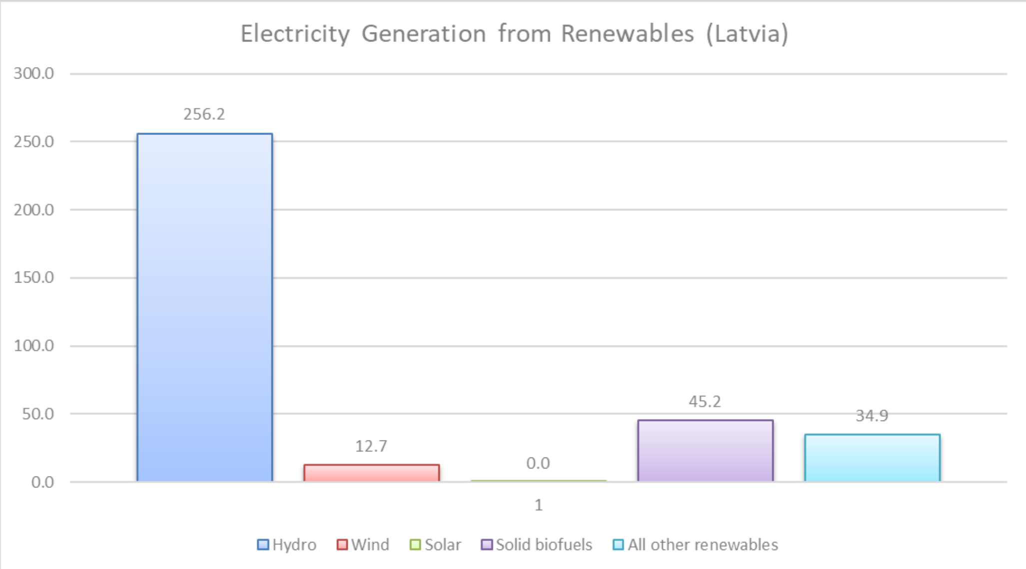
Positive government support and targets for 442GWh of Solar and 594GWh heat pumps projected by 2030.

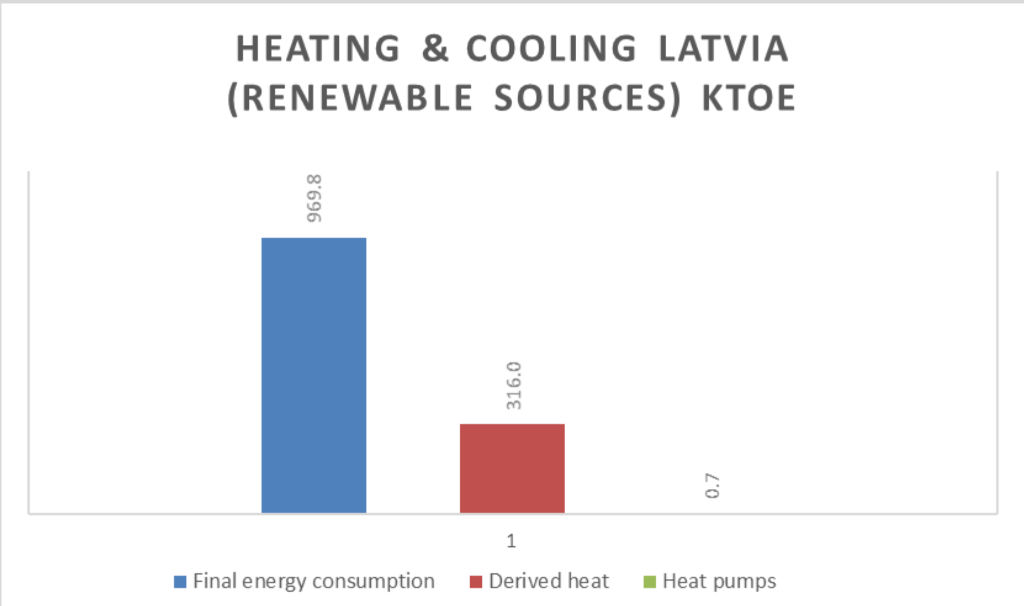
The main barrier is that the projected renewable energy target for Belgium is lower that of other demo sites.

F. ANNEX Latvia PESTLE analysis

Indicative Trajectory					
2011-2012	2013-2014	2015-2016	2017-2018	Target 2020	Target 2030
34.1%	34.8%	35.9%	37.4%	40.0%	45%

Latvia’s current renewable energy mix:





Data: Eurostat

The below PESTLE analysis has been outlined in order of importance and where there are similarities in areas, they have been grouped together in sections.

Political & Legislative

Summary of policies

Building obligation. The Law on the Energy Performance of Buildings obliges owners of new or renovated buildings to consider using RES heating and cooling systems.

SIA Salaspils siltums project for the use of solar energy in district heating by producing 12 GWh of heat annually and completely covering the consumption of heat during summer with the solar energy.

The measured and policies for fulfilling the renewable energy contribution have the following lines of action:

1) Development of legislative provisions to promote the implementation of RE technologies without direct financial support;

2) Review of tax rates to promote the ability of RES to compete with fossil energy sources;

3) Attraction of funding, including through cross-border cooperation and RE technology projects;

4) Promotion of own consumption of energy.

Economic

Feed in tariff

In the Republic of Latvia, renewable electricity generation is stimulated through a complex support system based on a feed-in tariff, which is on hold until 01.01.2020. According to Latvian Government, new RES-E support scheme should be elaborated until end of 2018. On 1 January 2014, net-metering was introduced.

Net Metering

Net-metering applies to clients who are producers of electricity, which are at the same time connected to the electricity grid through a connection smaller than or equal to 3*16A. Clients have to apply for an offer from the responsible grid operator for injecting electricity to the grid. For small-scale clients, energy costs apply to the net electricity consumption only, defined as the difference between electricity obtained from and fed-in to the grid. Furthermore, clients are required to pay a grid-use charge (§ 30 par. 1, 2, 3, 4 Electricity Market Law).

Net-metering applies to all technologies connected to the electricity grid through a small-scale connection (≤3*16A). Generally, all RES-E technologies are eligible, however, in practice the net-metering applies mainly to photovoltaic installations.

There is no direct financial compensation for the injected electricity, but the financial equivalent of the injected kW is deducted from the overall electricity bill. If an installation feeds more electricity into the grid than it has taken from the grid during a billing period, this amount is transferred to the next billing period (§ 30 par. 1 Electricity Market Law)

Since EU ETS in Latvia covers less than 20 % of the total GHG emissions in Latvia, only a small amount of funding is available from financing mechanisms established within the EU ETS, such as EAAI and Modernisation Fund. Moreover, as one of the small EU Member States, Latvia receives considerably small amounts of EU funds, which will decrease for the 2021–2027 period of the MFF compared to the programming period until 2020.

The measures and policies planned in order to reach the optional national objective — Latvia's contribution to the energy efficiency target of the EU — and the mandatory national energy efficiency objective, have the following major lines of action:

1) Implementation of the support programmes of EU funds — continuing the existing programmes and starting the implementation of new support programmes in order to promote and financially support the

implementation of energy efficiency measures in multiapartment buildings, national and municipal buildings and industrial production, as well as creation of support mechanisms for private houses and cooling;

2) Review of tax rates in order to promote reduction of energy consumption and change of habits of inhabitants and economic operators with the aim of improving energy efficiency and ensuring energy savings;

3) Review and enhancement of construction standards considering the requirements of Directive 2010/31/EC and the need to ensure that renovated buildings consume the least amount of energy possible and new buildings are constructed as nearly zero-energy consumption buildings;

Technological

Planned technologies for Latvia from 2020-2030:

Apart from building insulation, parties can implement the following energy efficiency measures in any of the final consumption sectors:

- Installation of heating regulators and meters in apartments and informing consumers about heating regulation;
- Installation of solar collectors for heating premises and water;
- Installation of heat pumps;
- Installation of more energy efficient boilers;
- Installation of heat recovery systems;
- Replacement of electrical appliances (refrigerators, electric stoves, etc.);
- Replacement of light fittings;
- Introduction of automatic lighting control systems;
- Replacement of electric motors, pumps, and other devices;
- Implementation of the energy management system (ISO 50001);

Socio-Cultural & Environmental

- Human life, health, and well-being is protected from adverse impacts of climate change irrespective of gender, age, or membership of a social group;
- Economy can adapt to climate change and use the opportunities it provides;
- Infrastructure and buildings are climate resilient and planned in the light of possible climate change risks;
- Natural and cultural values of Latvia are preserved by limiting any adverse impacts of climate change;
- Knowledge and information for the development and implementation of climate change adaptation policy is ensured based on the latest scientific argumentation.

Concluding Remarks

Latvia's projected trajectory for renewable energy generation is 5% up from 2020 until 2030, the main renewable energy mix largely uses Hydro power, followed by solid biofuels and then wind, there is little or no usage of Solar power. In the projected trajectory parties can implement several types of energy efficiency measures which includes the usage of solar power and heat pumps. The economic support currently is little or none at all, however the government plans for 2020 to 2030 some implementation of funding, but there is no clear indication as to what this will include at present.

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