CODE2

Cogeneration Observatory and Dissemination Europe

D5.1 - Final Cogeneration Roadmap
Member State: Luxembourg

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Leading CODE 2 Partner: COGEN Vlaanderen

Luxembourg is part of the non-pilot Member States of the North-Western Europe CODE2 Region.

The CODE2 Region 'North-Western Europe' comprises the following Member States: Belgium, Ireland, Luxembourg, Netherlands and United Kingdom

Co-funded by the Intelligent Energy Europe
Programme of the European Union

The CODE2 project[1]

This roadmap has been developed in the frame of the CODE2 project, which is co-funded by the European Commission (Intelligent Energy Europe – IEE) and will launch and structure an important market consultation for developing 27 National Cogeneration Roadmaps and one European Cogeneration Roadmap. These roadmaps are built on the experience of the previous CODE project (www.code-project.eu) and in close interaction with the policy-makers, industry and civil society through research and workshops.

The input of all experts has informed these roadmaps. The content of the roadmaps, and opinions of the roadmaps presented reflect the conclusions of the CODE2 project only.

The project aims to provide a better understanding of key markets, policy interactions around cogeneration and acceleration of cogeneration penetration into industry. By adding a bio-energy CHP and micro-CHP analysis to the Member State projections for cogeneration to 2020, the project consortium is proposing a concrete route to realise Europe's cogeneration potential.

Draft roadmap methodology

This roadmap for CHP in Luxembourg is written by CODE2 partner COGEN Vlaanderen based on a range of studies and consultations. It has been developed through a process of discussion and exchanges with experts.[2]

[1] For more details and other outcomes of the CODE2 project see: http://www.code2-project.eu/.

[2] First discussions with policy authorities and experts took place in May 2014.

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1 Executive Summary

Several actions are considered necessary to fill in the CHP potential. First, the disadvantage for CHP should be eliminate, which the government experience as result of the switch of emissions from foreign power plants the local heat customers, which fall under the national emission accounting system. Secondly, the integration of the Luxembourg gas market with other gas national markets should decrease the gas price and improve the economics of CHP. Further, an assessment of the high-efficiency CHP and efficient district heating potential should performed as stated in the Energy Efficiency Directive. Based on this potential, ambitious targets for high efficiency CHP should be defined. To achieve those targets, the benefits of CHP should be rewarded with operational support. The CHP stakeholders should form a CHP coalition. A partnership of the government and the industry should increase the awareness of the benefits of CHP plants. At last, the government should keep stimulating and developing heat networks. Without any action, the amount of electricity generated by CHP will shrink drastically from 380 GWh in 2013 to 130 GWh in 2030. A conservative growth scenario, which could be possible if the operational support for CHP is restored to its former situation, result in 630 GWh in 2030. An optimistic growth scenario, which could be the case if all actions are executed, results in a total electricity production of 2570 GW in 2030.

2 Where are we now?: Background and situation of cogeneration in Luxembourg

2.1 Current status: Summary of currently installed cogeneration in Luxembourg

Luxembourg has 133 CHP plants, mainly with a capacity between 150 kWe and 1,5 MWe. After a decade of constant growth, the number of plants stagnates since 2012. Several district heating grids are fed by heat from a CHP plants.

According to Eurostat data[3], as shown in Table 1, approximately 11,9% of all generated electricity in 2008 was produced by high efficiency CHP installations.

Table 1: Eurostat data for CHP in Luxembourg

Year	Installed capacity electricity (MW)	Total cogenerated electricity generated (MWh)	Total heat supplied (MWh)	Total electricity generated (MWh)	Total share on electricity
2008	-	420.000	667.000	3.530.000	11,9%

Luxembourg has known a slow but constant growth of CHP capacity in the last decade but between 2012 and 2013 remained the same. In 2013, the total installed fossil CHP capacity was 116 MWe, which corresponds with 16,9% of the total installed electrical capacity (exclusive pump plants). Because of the

[3] Combined Heat and Power (CHP) in the EU, Turkey, and Norway - 2008 Data. EU: Environment and Energy, 2010.

support system, most CHP plants are smaller than 1500 kWe. An overview of the statistics of the fossil fired CHP plants in 2013 can be found in Table 2.[4] There are also 26 biogas plants with a total electrical capacity of 8 MWe[5]. According our calculations[6], about half of the capacity could be considered as high-efficiency CHP.

Table 2: 2013 CHP statistics of Luxembourg

	Number of installations	Installed capacity (MWe)	Produced electricity (MWh)
Industrial plants (above 1500 kWe)	3	29,2	62.715
Small plants (150 kWe – 1500 kWe)	86	83,816	290.212
Micro plants (1 kWe - 150 kWe)	43	0,919	2.674
Autoproduction	1	2,56	3.298
Total	**133**	**116,495**	**358.898**

Luxembourg has a very high demand of energy, and strongly depends on imports. Half of the consumed electricity is imported from Germany and to a lesser extent from Belgium. The pump station of Vianden (1 096 MWe) can cover a large share of the peak demand in Luxembourg. Its capacity is 60% larger than the total non-pumping capacity (689 MWe). As a result, CHP plants produce only 6% of the total amount of consumed electricity.

The city of Luxembourg has seven heat networks each equipped with one or more cogeneration units that provide heat to public buildings and some households. There are plans to extend the heat networks but it is uncertain that CHP plants will deliver the heat in the future because they are no longer profitable.

2.2 Energy and Climate Strategy Luxembourg of Luxembourg

Luxembourg needs to reduce his CO_2-emission with 20% in 2020 by 2005 levels and provide 11% of the final energy consumption by renewable energy sources.

In 2007, the European Council decided to set ambitious climate and energy targets for 2020. Those targets, also known as the '20-20-20' targets, are to reduce greenhouse gas emissions by 20% compared to 1990, increase the share of renewable energy to 20% and improve energy efficiency by 20%.[7] Those EU targets are translated to national targets.

In 2009, under the Renewable Energy Directive[8], Luxembourg has taken on a binding target to provide 11% of the final energy consumption in 2020 by renewable energy sources.

[4] Source: http://www.ilr.public.lu/electricite/statistiques/

[5] Source: http://www.environnement.public.lu/dechets/statistiques_indicateurs/index.html

[6] According the CEN Workshop Agreement CWA 45547:2004

[7] The 2020 climate and energy package (http://ec.europa.eu/clima/policies/package/index_en.htm)

[8] Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources

The EU Effort Sharing Decision (406/2009/EC) establishes binding annual greenhouse gas (GHG) emission targets for EU Member States for the period 2013–2020. These targets concern emissions from most sectors not included in the EU Emissions Trading System (EU ETS), such as transport (except aviation), buildings, agriculture and waste. The target for Luxembourg is a 20% emission reduction in 2020 by 2005 levels[9].

In 2011, Luxembourg had a total final energy consumption of 49.522 GWh, which corresponds with a primary energy consumption of 52.770 GWh. Luxembourg's provisional final energy target for 2020 under Article 3(1) of the Energy Efficiency Directive (EED) is 49.292 GWh or a primary energy consumption of 52.111 GWh.[10] Far more than half of this energy is used for transportation, mainly used by the transit traffic and tanking tourism[11].

2.3 Policy development in Luxembourg

Enterprises and local authorities receive investment support for high efficiency CHP. The feed-in tariffs for fossil CHP plants, which were applicable since two decades, abolishes from July 2014. Renewable electricity production receives feed-in support since 2008 and new regulation is underway which will increase the tariffs. An additional amount is given for the economical valuable heat produced during the generation of renewable electricity.

Enterprises receive investment support for high efficiency cogeneration. The eligible costs are limited to the extra investment costs necessary to achieve a high efficiency cogeneration installation. For small, medium-size and big business the support is respectively 65%, 55% and 45% of the eligible costs.[12]

Local authorities receive financial support for investments in CHP and district heating systems. If the heat production is based on renewable sources the support amounts to 33% of the investment costs and 20% of the investment cost in case of fossil fuels.[13]

The Grand Ducal regulation of 30 May 1994[14] remunerated electricity injected into the network by gas CHP plants up to 1,5 MWe. From 1 July 2014, this feed-in tariff is abolished for new fossil CHP plants[15]. The reason is that a large share of electricity is imported with as result that additional electricity production by CHP plants in Luxembourg would increase the national emissions with the risk of missing several climate and energy targets. Therefore, the government considers operational support for CHP as counter-productive and focuses mainly on renewable energy sources. Existing fossil fuel plants can still receive financial support for a period of 20 years after they first injected electricity to the grid.

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[9] Source: http://ec.europa.eu/clima/policies/effort/index_en.htm

[10] Luxembourg's first annual monitoring report for 2013 under Article 24(1) of the EED (Ministry of Economic Affairs and Foreign Trade - Directorate-General for Energy, 2013)

[11] Energy Efficiency Policies and Measures in Luxembourg (Fraunhofer Institute for Systems and Innovation Research, 2012)

[12] Loi du 18 février 2010 relative à un régime d'aides à la protection de l'environnement et à l'utilisation rationnelle des ressources naturelles

[13] Source: http://particuliers.myenergy.lu/fr/subvention/communes

[14] Règlement grand-ducal modifié du 30 mai 1994 concernant la production d'énergie électrique basée sur la cogénération.

[15] Règlement grand-ducal du 26 décembre 2012 relatif à la production d'électricité basée sur la cogénération à haut rendement.

Electricity generation based on renewable energy sources receives feed-in support for electricity injected to the grid based on the regulation of 8 February 2008[16]. On top of the financial support for electricity injected into the grid, 30€/MWh support is given for each unit economically valuable heat if the CHP plant satisfies the necessary conditions. A new regulation is under development that will replace the regulation of 8 February 2008. The feed-in tariffs for power plants on renewable energy sources, with the first injecting electricity from 1 January 2014, are higher than the tariffs of 2008, as shown in Table 3. The new feed-in tariffs are applicable for 15 years.

Table 3: Feed-in tariff for power plants with renewable sources which start injecting electricity in 2014

Fuel		Tariff 2008 (€/MWh)	Tariff 2014 (€/MWh)
Biogas	Up to 150 kWe	150	192
	Between 150 kWe and 300 kWe	140	181
	Between 300 kWe and 500 kWe	130	171
	Between 500 kWe and 2500 kWe	120	153
Gas from a wastewater treatment plant		65	120
Biomass	Up to 1 MWe	145	163
	Between 1 MWe and 5 MWe	125	143
Wood waste	Up to 1 MWe	130	138
	Between 1 MWe and 5 MWe	110	118

2.4 Exchange of information and awareness in Luxembourg

After two decades of support of fossil CHP, the government abolished the support for fossil CHP and increased meanwhile the tariffs of renewable CHP. There is sufficient CHP knowledge available in Luxembourg but since the removal of the fossil CHP support, the CHP market collapsed and most of those market players are not interested anymore in CHP or are focusing their CHP related activities to neighbouring countries. The debate about CHP in Luxembourg is almost non-existent.

Good awareness about the benefits of cogeneration, among the different actors, is one of the basic conditions to create an active CHP market. This is necessary to achieve the full potential of CHP. Good awareness corresponds with well-informed customers, enough qualified market players, policy makers that provide the correct framework for a functioning market and influencers that inform and advise the other groups. The actors on the CHP market, classified into four social-economic groups, are show in Figure 1. The level of awareness was assessed for each of the actors and rated 1-5, (1 poor and 5 Active market), as shown below. The detailed comments on each group are described in **Error! Reference source not found.**.

[16] Règlement grand-ducal du 8 février 2008 relatif à la production d'électricité basée sur les sources d'énergie renouvelables

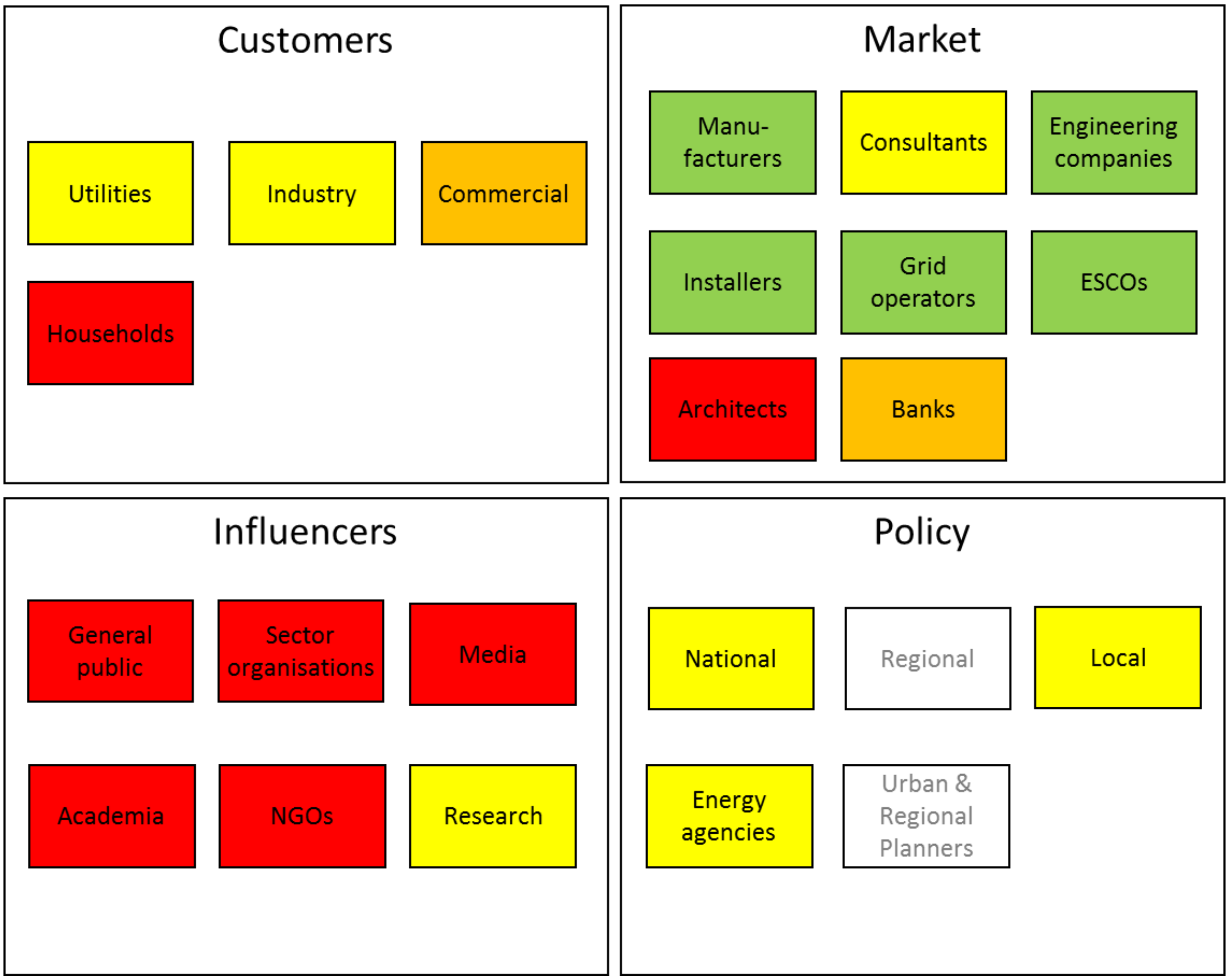


Figure 1: Level of awareness among key actors under the four socio-economic groups

1	Poor
2	Low
3	Early awareness
4	Interest
5	Active market

Customers

The penetration of CHP in the industry is rather limited, mainly because of the industry is dominated by the steel and iron industry, which is not suited for CHP. However, only a minor share of the companies which a suitable for CHP plant actually have a one. This is mainly the result of the government policy to focus the financial support on installation below 1,5 MWe. A major share of the CHP plants can be found in two applications. First, there are CHP plants connected to several district heating grids, providing heat to mainly public buildings. Secondly, there are CHP plants fed by biogas from anaerobic digestion. Those are operated by cooperation's of farmers, which provide the necessary input for those installations. The interest for CHP by commercial premises is rather limited and mainly located in services that have a large hot water demand like hotels and swimming pools.

Market players

There are different important CHP market players in Luxembourg, such as Energolux and Dalkia, which have experience in managing whole CHP projects including engineering, installation, exploitation and maintenance. Similar, an energy service company (ESCO) like LuxEnergy sells heat by operating CHP in combination with district heating networks. We can conclude the necessary knowledge is available in Luxembourg but since the removal of the CHP support, the CHP market collapsed and most of those market players are not interested anymore in the Luxembourg CHP market. The market player who are still active in CHP are focusing their activities to neighbouring countries, such as Germany and Belgium, which still give financial support. Grid operators are aware of CHP as CHP provides additional capacity during periods of grid stress. Architects have little experience with actual CHP installations, since CHPs are often implemented in combination with heat networks.

Influencers

There is no CHP sector organisation in Luxembourg and the promotion of and discussion about CHP is almost non-existent. However, knowledge of CHP is available at the public research centre Henri Tudor, who also develops the map for Luxembourg.

Policy makers

The national government started to promote fossil CHP in 1994 with a straightforward support system. Last years, the government changed its focus to renewable energy, both electricity and heat, whether or not combined. Recently, the government decided to phase out the support for fossil CHP plants. Although, the city of Luxembourg used heat from centralised cogeneration plants for public buildings for several years, this will be decrease as result of the change at national policy level. The national energy agency MyEnergy is aware of cogeneration but does little to promote it.

2.5 The economics of CHP in Luxembourg

Luxembourg has high gas prices and low electricity prices, which is unattractive for natural gas fired power plants, CHP included. Nevertheless, micro-CHP is attractive due to high investment relatively high electricity prices for small companies. Biogas CHP is also attractive as result of the interesting feed-in tariffs for electricity and heat in combination with the investment support.

A cogeneration plant is a large investment and its feasibility is most of the time measured by its financial parameters, such as internal rate of return (IRR), return on investment (ROI) or payback period. An important factor is the capital cost of the cogeneration unit and its maintenance compared to a standard boiler. The most significant parameter however, is the spark spread. This is the theoretical gross margin of a gas-fired CHP from selling a unit of electricity, having bought the fuel required to produce this unit of electricity. As result of the current gas market structure, Luxembourg has high gas prices for the gas imports from Germany or Belgium. On the other hand, the large import of electricity with low wholesale prices from Germany, combined with the large electrical storage capacity, cause low electricity prices in Luxembourg. Together, this result is a negative spark spread that makes gas fired power plants such as most CHP financially unattractive. The support systems described in Chapter 2.3 should improve the business case for CHP installations.

An economic analysis is made on five standard CHP cases:

- a 50 kWe internal combustion engine (ICE) installed in a hotel
- a 1 MWe internal combustion engine installed (ICE) in an industrial plant
- a 1 MWe ICE CHP producing district heat and power in a public utility
- a 10 MWe combined cycle (CC) CHP producing district heat and power in a public utility
- a 500 kWe biogas engine cogeneration placed at a farm, where the heat is sold to a client.

The details of this economic analysis can be found in Annex 4: Assumptions used in the economics of CHP. The results are shown in **Error! Reference source not found.**. The calculations are performed for new installations commissioned from 1 July 2014. From this date, gas CHP plants receive no financial support anymore in the form of a feed-in tariff.

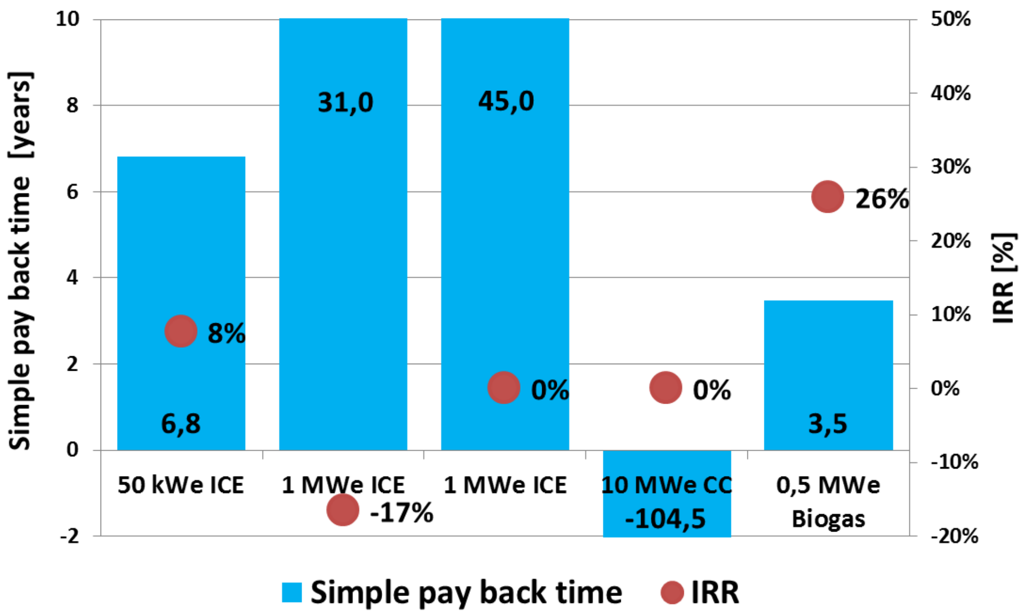


Figure 2: Economic calculations of four standard CHP plants

The economic analysis shows that the case with the 50 kWe fossil fuel ICE CHP installed in a hotel is profitable to a certain extent. This is mainly the result of large investment support for CHP installation in small companies and the ‘relatively’ high electricity prices they are avoiding by producing their own electricity. The case assumes that all the produced electricity is consumed on-site, which improve the economic feasibility of the installation. The case of the 1 MWe ICE in the industry is not profitable because of lower investment support and a low price of electricity from the grid. This is even more the case for fossil CHP plants in district heating schemes injecting electricity to the grid. Those plants have to sell their electricity at wholesale prices, which are currently too low to run gas power plants profitably. CHP plants running on biogas from anaerobic digestion are profitable due to financial support based on a feed-in-tariff for electricity injected to the grid in combination with additional support for the production of economically valuable heat.

An overview of the economic situation of cogeneration in the main market segments is given in **Error! Not a valid bookmark self-reference.**. The profitability of fossil CHP plants is largely dependent on the size of the company where the CHP is installed, the profile of the heat demand, the price of electricity purchased form the grid and the amount of electricity generated by the CHP which is consumed on-site. Bio-CHP plants are profitable due to a sufficient financial support.

Table 4: CHP economics matrix

Luxembourg	**Micro** up to 50kW		**Small & Medium** up to 10 MW		**Large** more than 10 MW		
	NG	**RES**	**NG**	**RES**	**NG**	**Coal**	**RES**
SME/Industry							
District heating/cooling							
Services							
Households							

Legend:

(green)	**"normal"**	Cogeneration Investment has **good economic benefits**, return on investment acceptable for the investors, **interest for new investment exists**; there are no significant economic barriers for the implementation.
(yellow)	**"modest"**	Cogeneration Investment has **modest/limited economic benefits** and return on investment, **limited interest for new investments**.
(red)	**"poor"**	Cogeneration Investment has **poor or negative return on investment or is not possible due to other limitations**, **no interest/possibilities for new investments**.
(hatched)		Inapplicable, the technology is not used in this market segment.
NG		**Natural Gas** or appropriate fossil fuel
RES		**Renewable energy sources** (wood biomass, biogas, etc.)

2.6 Barriers to CHP in Luxembourg

The most important barrier for CHP is the result of the EU emission counting system. Since a large share of electricity is currently imported, an increase in electricity generated in Luxembourg CHP plants would increase the national emissions with the risk of missing several climate and energy targets. Hence, the government considers support for CHP as counter-productive and abolish the operational support for fossil-fired CHP plants. Another important barrier for CHP is the very low spark spread. At last, inadequate communication about CHP leads to lack of awareness of the benefits of CHP at different stakeholders of CHP.

There are different barriers that hamper achieving the full potential of CHP in Luxembourg. The barriers are listed according to priority. Different CHP experts identified the first barrier as the main barrier for CHP in Luxembourg.

Barrier 1: Since a large share of electricity is currently imported, an increase in electricity generated in Luxembourg CHP plants would increase the national emissions with the risk of missing several climate and energy targets. Hence, the policy level considers support for CHP as counter-productive.

Luxembourg imports half of its consumed electricity from electricity plants in Germany and Belgium. The carbon emissions of those power plants are allocated to the respectively countries. If Luxembourg decides to support further development of cogeneration based on fossil energy sources, it will leads to an increase in CO_2-emission in Luxembourg's carbon balance. This means that Luxembourg will either have to buy emission rights to compensate for the extra emissions from cogeneration installations on its territory, or reduce the national emissions in other sectors, the cost of this operation being added to the present costs of supporting cogeneration.

This accounting system is considered the biggest barrier to the national development of high-efficiency cogeneration based on fossil energy sources, mainly due to the decisions adopted by the European Parliament and the Council on reducing greenhouse gas emissions. Luxembourg therefore has to reduce its CO_2-emissions (outside ETS) by 20% compared with 2005 and has only very limited recourse to flexible mechanisms. This is why Luxembourg will find it more and more difficult to support the development of cogeneration.[17]

Barrier 2: High gas prices in combination with a low electricity prices result in a very low spark spread, which have a negative impact on the economic case of CHP plants.

Luxembourg has to pay high prices for the gas it imports from Belgium or Germany, which is the result of the current gas market structure. On the other hand, Luxembourg have has low electricity prices as a result of the high import of low-priced electricity from Germany in combination with a relatively large electrical storage potential in the pump station of Vianden. Together, this results in a small or negative spark spread. Recently, the gas transmission system operators Creos Luxembourg en Fluxys Belgium announced that they will join the Belgium en Luxembourg gas market together in 2015, provided that their respective regulatory authorities approve it[18]. This could have a major effect on the gas prices in Luxembourg.

[17] Report on progress towards increasing the share of high-efficiency cogeneration in accordance with Article 6(3) and Article 10(2) of Directive 2004/8/EC (Ministry of Economic Affairs and Foreign Trade - Directorate-General for Energy, 2012)

[18] Creos Luxembourg and Fluxys Belgium heading for an integrated Belgium-Luxembourg gas market. (Fluxys, 2014)

Barrier 3: The abolition of operational support for new CHP installations prevents the wider deployment of CHP.

As result of the changed view on CHP at policy level, as described in Barrier 1, the operational support for new fossil CHP installations is abolished. As shown in the economics study, without this financial support, fossil CHP plants are not profitable anymore in Luxembourg. As a result, investors lost interest in CHP. This is a major barrier for the wider deployment of CHP in Luxembourg.

Barrier 4: Inadequate communication about CHP leads to lack of awareness of the benefits of CHP at different stakeholders of CHP.

Partly as a result of the policy view on cogeneration discussed in barrier 1, the benefits of cogeneration, like energy efficiency, real CO2-emission reduction and employment, are not recognized. The inadequate communication about CHP in Luxembourg results in lack of awareness of the benefits of CHP at different socio-economical groups as shown in Chapter 2.4. Another example of this inadequate communication is the lack of background information about CHP from a reliable source in Luxembourg.

3 What is possible? Cogeneration potential and market opportunities in Luxembourg

The official Luxembourg cogeneration potential study reported 2008 to the EU commission estimates that 2.340 GWh of electricity could generated by fossil CHP in 2020. An additional 230 GWh of electricity could be produced by biomass CHP if appropriate subsidies where available. The fossil fired potential will be mainly situated in the industry and district heating.

The final report on the research into the potential of high-efficiency CHP plants in Luxembourg[19] was published in 2008 to meet Article 6 of EU Directive 2004/8/EC. The national CHP potential was estimated for four potential areas based on an economic analysis of the cost-effectiveness based on an average increase in the cost of fuels until 2020. The results can be found in Table 5.

Table 5: Summary of areas of potential

Total areas of potential	Useful energy		Proportion of total potential	
	Heat (GWh)	Power (GWh)	Heat (%)	Power (%)
District heating CHP plants	1.051	1.037	41	44
Property-related CHP plants	0	0	0	0
Industrial CHP plants	1.539	1.302	59	56
Biomass CHP	0	0	0	0
Total	2.590	2.339	100	100

The district heating CHP potential is mainly located in the two municipalities Luxembourg and Esch-Alzette. To increase the cost-effectiveness of district heating cogeneration, the property-related CHP solutions are disregarded in the areas suitable for district heating cogeneration. An analysis of large properties in the remaining areas leads to the recognition that no property-related cogeneration potential is to be identified from a national economic viewpoint.

Out of a total heat requirement of 8.515 GWh a theoretical heat output of approximately 2.540 GWh can potentially be covered by CHP plants. This potential increases to approximately 3.226 GWh in 2020 due to rise in the final energy demand in the industrial sector. The economic potential involves a heat requirement of 1.539 GWh.

Table 6: Economic potential for industrial CHP plants

Plant capacity	Quantity	Installed capacity		Generation	
		Heat (MW)	Power (MW)	Heat (GWh)	Power (GWh)
Unit-type CHP (<1 MW)	0	0	0	0	0
Small CHP (1-10 MW)	14	56	48	328	281
Medium-sized CHP (10-50 MW)	6	127	98	787	604
Large CHP (>50 MW)	1	60	60	423	417
Total	21	244	205	1.539	1.302

[19] Final report on the research into the potential of high-efficiency CHP plants in Luxembourg (Fraunhofer Institute for Systems and Innovation Research, 2008)

The report indicates that the biomass CHPs costs are above the power generation costs of the separate reference technologies, thus leaving no economic potential. An analysis of the structural potential, which could be exploited with appropriate subsidies, reveals a heat requirement of 454 GWh/a, which could be covered by CHP plants. The corresponding power generation then reaches approximately 232 GWh/a by 2020.

The potential of high-quality CHP may be small with respect to Luxembourg high energy consumption. This is because industries, which are well suited for primary energy savings by CHP, represent only a minor share of the energy consumption in the industry. In 2010, the steel and iron industry, with his electric arc furnaces, is responsible for 66% of the industrial energy consumption. The chemical (4%), the pulp and paper (1%) and the food (1%) industry, where CHP is popular, represent only a minor share of the total primary energy consumption[20].

Micro-CHP

The CODE2 micro-CHP potential analysis expects a potential for 6.000 household micro-CHP units, with an electrical capacity of 1 kWe, in the Luxembourg in 2030. This will deliver 35 GWh/year primary energy saving. The potential for micro-CHP in collective housing systems and SMEs is estimated 700 units with an 150 GWh/year primary energy saving. More information can be found in Annex 2: Micro CHP potential assessment.

Bio-energy CHP

The objectives of the Luxembourg Action Plan for Renewable Energy[21] as well as in the LUXRES study[22] have clearly illustrated the enormous potential in the biogas sector. The action plan for renewable energy estimates the installed electrical CHP capacity in 2020 at 56 MWe with an electricity production of 318 GWh.

In 2009, bio-energy had a share of 20% in the CHP fuel consumption, resulted in 140 GWh produced heat. According the CODE2 bio-energy CHP potential analysis, the projected heat demand from bio-energy CHP in 2020 and 2030 results in respectively 200 and 230 GWh. More information can be found in Annex 3: Bio-CHP potential assessment.

[20] Energy Efficiency Policies and Measures in Luxembourg (Fraunhofer Institute for Systems and Innovation Research, 2012)

[21] Luxembourg action plan for renewable energy (Ministry of Economic Affairs and Foreign Trade - Directorate-General for Energy, 2010)

[22] Bestimmung der Potenziale und Ausarbeitung von Strategien zur verstärkten Nutzung von erneuer-baren Energien in Luxemburg (Fraunhofer Institute for Systems and Innovation Research, 2007)

4 How do we arrive there? The Roadmap

4.1 Overcoming existing barriers and creating a framework for action in Luxembourg

Several actions are considered necessary to fill in the CHP potential. First, the disadvantage for CHP should be eliminate, which the government experience as result of the switch of emissions from foreign power plants the local heat customers, which fall under the national emission accounting system. Secondly, the integration of the Luxembourg gas market with other gas national markets should decrease the gas price and improve the economics of CHP. Further, an assessment of the high-efficiency CHP and efficient district heating potential should performed as stated in the Energy Efficiency Directive. Based on this potential, ambitious targets for high efficiency CHP should be defined. To achieve those targets, the benefits of CHP should be rewarded with operational support. The CHP stakeholders should form a CHP coalition. A partnership of the government and the industry should increase the awareness of the benefits of CHP plants. At last, the government should keep stimulating and developing heat networks.

Action 1: Eliminate the disadvantage for CHP, which the government experience as result of the switch of emissions from foreign power plants the local heat customers, which fall under the national emission accounting system.

As discussed in barrier 1, in the design of the EU emission counting system, one does not take into account the specific requirements of cogeneration plants. Electricity production by cogeneration plants often switch CO_2-emissions from foreign power plants to local heat consumers, which fall under the national emission targets of Luxembourg. The national government, which is only responsible for the national emission targets, therefore recognize fossil CHP as a technique that increases emissions instead of lowering them. Therefore, we must insist to apply an exception in the EU emission counting system for CHP, so CHP will no longer have a disadvantage with respect to other alternatives.

Action 2: The integration of the Luxembourg gas market with other national gas markets should decrease the gas price and improve the economics of CHP.

As discussed in barrier 2, Luxembourg suffers from high gas prices relative to surrounding countries. Therefore, we welcome the initiative of both gas transmission system operators Creos Luxembourg en Fluxys Belgium to integrate the national gas markets. Merging the Belgian and Luxembourg gas markets will strengthen security of supply in Luxembourg and improve market functioning. The rules between the two countries will be harmonised, facilitating the task of suppliers active in both countries. This cooperation project is fully in line with the spirit of European Directive 2009/73/EC, i.e. to get the Member States to evolve towards creating a barrier-free single market with competitively priced gas and enhanced security of supply.

Action 3: Perform an assessment of the high-efficiency CHP and efficient district heating potential.

The Energy Efficiency Directive (EED) Article 14 paragraph 1 states that "*by 31 December 2015, Member States shall carry out and notify to the Commission a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling, [..]"*. A thorough analysis of the potential of high-efficiency CHP (taking into account "*External benefits such as environmental and health benefits", EED Annex IX, part 1)* allows for defendable yet ambitious targets for primary energy savings through high efficiency CHP.

Action 4: Set ambitious targets for high efficiency CHP.

At the moment, Luxembourg has no targets for high efficiency CHP. Targets are useful, however, for both policy makers and market players. Article 3 of the European Energy Efficiency Directive (EED) states that each Member State has to set indicative energy efficiency targets. As cogeneration forms an important part of the EED, a vision should be formed on how cogeneration will contribute to energy efficiency targets of the Luxembourg. The above mentioned assessment of the CHP potential can act as a guideline. This energy efficiency target should be based on primary energy use.

Action 5: The benefits of cogeneration should be rewarded with operational support.

The use of CHP has several benefits for the society, such as primary energy savings, lower CO_2-emissions, reduced reliance on imported energy, reduced investment in energy system infrastructure, enhanced electricity network stability through reduction in congestion and 'peak-shaving', beneficial use of local and surplus energy resources (particularly through the use of waste, biomass, and geothermal resources in district heating/cooling systems) and employment. Those benefits are not rewarded in the market. The operation of CHP plants should again get financial support from the government, with sufficient funding to meet the ambitious target defined in Action 4. This complies with Article 14.2 of the EED which states that "*Member States shall **adopt policies** which **encourage** the due taking into account at local and regional levels of the potential of using efficient heating and cooling systems, in particular those using **high-efficiency cogeneration**. [..]*"

Action 6: The CHP stakeholders should form a CHP coalition.

The different CHP stakeholders should form a coalition, which has the objective contribute to the development of high efficiency CHP in Luxembourg. This coalition could form a platform, which can provide a meeting place for all the stakeholders to discuss CHP related topics in Luxembourg. Those topics could be specific and practical problems or a long-term vision on CHP in Luxembourg. The discussions in the platform should be targeted; it should lead to clear positions on the topics of discussion and could result in recommendation to the government. Furthermore, the coalition should provide information to interested parties.

Action 7: Increase the awareness of the benefits of CHP installations.

As discussed in barrier 4, several actors miss the necessary awareness about the benefits of CHP. In order to overcome this, targeted information campaigns on cogeneration and its advantages for consumers, the environment and the national economy should be launched in a partnership between the government and the industry. This new campaign would comply with Article 17.4 of the EED that states "*Member States shall, with the participation of stakeholders, including local and regional authorities, promote suitable information, awareness-raising and training initiatives to inform citizens of the benefits and practicalities of taking energy efficiency improvement measures.*"

Action 8: Keep stimulating and developing heat networks.

Luxembourg has already invested a lot in heat networks and should continue to do so in the future. This action complies with the obligation of Article 14 of the EED to take appropriate measures so that an efficient infrastructure for district heating and cooling will be developed.

4.2 Possible paths to growth in Luxembourg

With the proposed roadmap, the CHP electricity production could amount to 2.570 GWh in 2030, as compared to 380 GWh in 2013. With the restoration of the financial support system alone, CHP could produce 630 GWh electricity in 2030. The business as usual scenario predicts a decline to 130 GWh electricity production by CHP.

As discussed in Chapter 1.1, the Luxembourg CHP market has known a steady growth during several years, mainly in the segment of the 150 to 1500 kWe plants. In 2013, the total installed CHP capacity, including renewable CHP, was about 120 MWe which produced 380 GWh of electricity.

As discussed in Chapter 2.3, no operational support is given anymore to new fossil fired CHP plants. For existing fossil fired CHP plants the operational support will phase out; they can still receive support during 20 years after their first electricity injection to the grid. As majority of the CHP plants under the support system are installed before 2010, we believe the electricity generated by CHP, within the category below 1500 kWe, will shrink drastically. Within the category of industrial installations, above 1500 kWe, it is likely there will still be CHP plants left, as they didn't receive support before. For the renewable CHP plants, a yearly 0,5% increase is assumed based on historical data. This results in 130 GWh of electricity produced by CHP in 2030, as shown in Figure 3.

The scenario estimated by the EU energy trends baseline[23], as shown in Figure 3, result in 630 GWh electricity produced by CHP in 2030. This is a conservative growth scenario that could be possible if the operational support for CHP is restored to its former situation.

The final report on the research into the potential of high-efficiency CHP plants in Luxembourg, as discussed in Chapter 3, estimates that 2.340 GWh of electricity which could generated by fossil CHP in 2020. An additional 230 GWh of electricity could be produced by biomass CHP if appropriate subsidies where available. Together, if we assume that the heat demand in Luxembourg will decrease with 0,2%[23], this result in a total electricity production of 2.570 GWh in 2030. This could be the result of an optimistic growth scenario, if all actions in the previous chapter are executed.

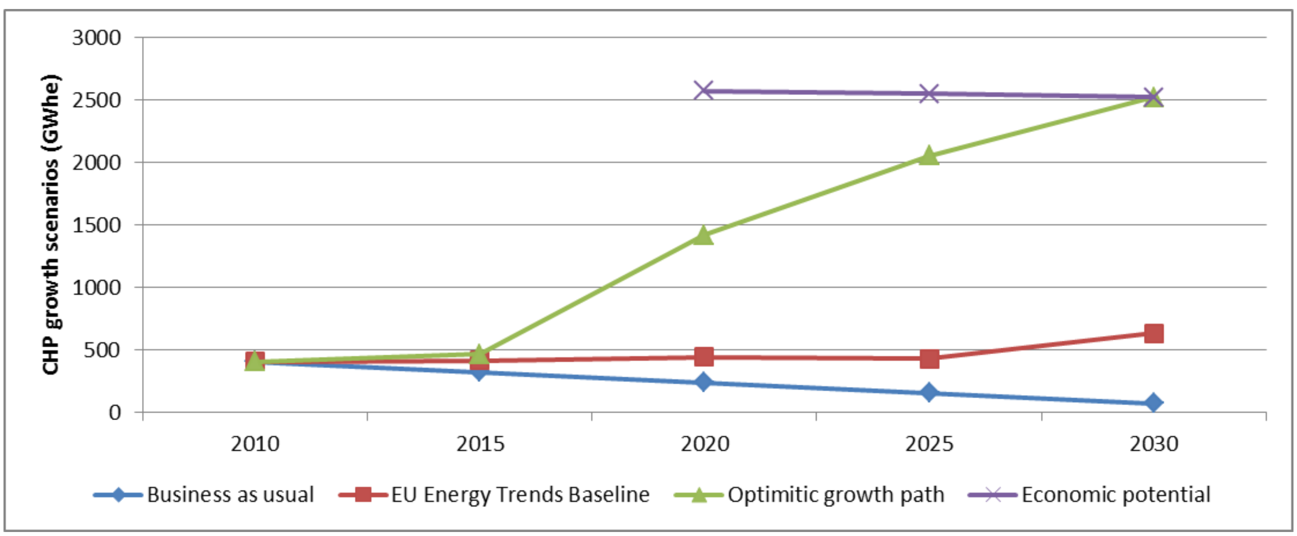


Figure 3: CHP growth scenarios to 2030

[23] EU Energy, Transport and GHG emissions trends to 2050 reference scenario 2013 (European commission, 2014)

4.3 Saving of primary energy and CO2 emissions by the CHP roadmap of Luxembourg

Primary energy saving (PES) and of CO_2 emissions saving projections resulting from increased use of CHP require assumptions about not just what types of fuel and technology are displaced, but also their operation on the market. Within CODE2 two approaches are developed. These represent two different analytic considerations which are summarised here and more fully explored in Annexe 6.

1) **Methodology according to Annexe s I and II of the EED**. This method is used at a member state level today for national reporting to the European Commission and at project level for determining if a specific CHP plant is highly efficient. In the methodology, the efficiency of each cogeneration unit is derived by comparing its actual operating performance data with the best available technology for separate production of heat and electricity on the same fuel in the market in the year of construction of the cogeneration unit using harmonized reference values which are determined by fuel type and year of construction.

2) **Substitution method**. This method has been developed within the project and estimates the amounts of electricity, heat and fuel which are actually replaced by additional new CHP based on a projection of the supply base changes in the member state supply over the period are calculated. The situation in 2030 is compared to the current status. With this method PES for Finland through implementing the roadmap for CHP is estimated at xx TWh per year and yy CO_2 savings are estimated to be between X and Y Million tons per year in 2030. The actual saving is particularly dependent on the efficiency increase through upgrading both current power plant and CHP technology efficiencies. The final share of bio energy in additional CHP has a major impact on the CO2 savings which can be anticipated. The CO_2 reduction achieved is due to both higher energy efficiency and fuel switching towards low carbon (natural gas) or non-carbon (bio energy) fuel, but CHP development and fuel switching are anticipated to be an integrated process driven by policy objectives.

Table 7: Economic potential for industrial CHP plants

		Substitution method		EED method	
		low case	**high case**	**low case**	**high case**
PE saving	TWh/a	4,5	4,5	2,8	2,8
CO2 saving	Mio t/a	1,8	1,8	0,3	0,3
- per kWh el*	kg/kWh el	0,93	0,93	0,16	0,16

* This value represents the CO2 reduction of the power generation. It includes the avoided CO2 emissions from fuel savings for separate heat generation in boilers; it must not be confused with the considerably lower CO2 emissions of the substituted condensation electricity or with even lower emissions of compared power production according to the BAT approach in accordance with the EU CHP directive reference values.

ANNEXES

1. Stakeholder group awareness assessment

1	Poor	
2	Low	
3	Early awareness	
4	Interest	
5	Active market	

Group	Comments
Customers	
Industry	The penetration of CHP in the industry is rather limited, mainly because of the industry is dominated by the steel and iron industry, which not suited for CHP. However, only a minor share of the companies which a suitable for CHP plant actually have a one. This is mainly the result of the government policy to focus the financial support on installation below 1,5 MWe. An important customer group are cooperation's of farmers which operate several CHP plants which are fed from biogas from anaerobic digestion.
Utilities	There are CHP plants connected to the district heating grids in the city of Luxembourg operated by LuxEnergy and providing heat to mainly public buildings and some households.
Commercial	The interest for CHP by commercial premises is rather limited and mainly located in services that have a large hot water demand like hotels and swimming pools.
Households	The awareness of CHP is poor.
Market and supply chain	

Manufacturers	There are different important CHP market players in Luxembourg, such as Energolux and Dalkia, which have experience in managing whole CHP projects including engineering, installation, exploitation and maintenance. We can conclude the necessary knowledge is available in Luxembourg but since the removal of the CHP support, the CHP market collapsed and none of those market players are still interested in the Luxembourg CHP market. The market player who are still active in with CHP are focusing the activities to neighbouring countries, such as Germany and Belgium, which still give financial support for CHP.
Installers	
Consultants	
Engineering companies	
Grid operators	Grid operators are aware of CHP as CHP provides additional capacity during periods of grid stress.
Architects	Architects have little experience with actual CHP installations, since CHPs are often implemented in combination with heat networks.
Banks	
ESCOs	LuxEnergie sells heat to by operating CHP in combination with district heating networks.
Policy	
National	The national government started to promote fossil CHP in 1994, with a financial support system for CHP installation up to 1,5 MWe. Last years the government changed its focus to renewable energy, both electricity and heat, whether or not combined. Recently, the government decided to phase out the support for fossil CHP plants.
Regional	/
Local	Although, the city of Luxembourg[24] used heat from centralised cogeneration plants for public buildings for several years, this will be decrease as result of the change at national policy level.
Urban & Regional planners	/

[24] Source: http://www.vdl.lu/Citoyens+et+r%C3%A9sidents/Energies_+Eaux+et+Canalisation/Centrales.html

Energy agencies	The national energy agency MyEnergy is aware of cogeneration but does little to promote it.
Influencers	
Sector organisations	There is no CHP sector organisation in Luxembourg.
General public	The awareness of CHP is poor.
Media	
Academia	
Research	Knowledge of CHP is available at the public research centre Henri Tudor, which also develops the map for Luxembourg.
NGOs	

2. Micro-CHP potential assessment

Country statistics

Population: 500 000 (2010)
Number of households: 210 000 (2010)
GDP per capita: € 68 100 (2010)
Primary energy use: 4 300 ktoe/year (2010)
GHG-emissions: 12 Mton $CO_{2,eq}$/year (2010)

Household systems (±1 kWe)
Boiler replacement technology

Present market (2013)
Boiler stock: 71 000 units
Boiler sales: 5 400 units/year

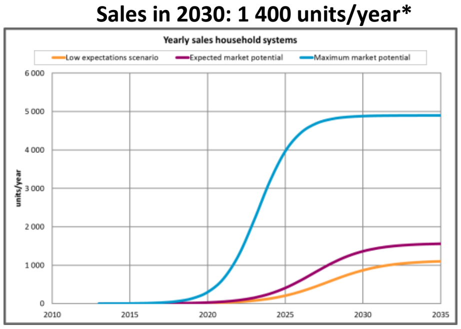
Potential estimation

Indicator	Score
Market alternatives	0
Global CBA	3
Legislation/support	1
Awareness	0
Purchasing power	3
Total	**7 out of 12**

Expected final market share: 29% of boiler sales in Household sector

Yearly sales

Sales in 2020: 30 units/year*
Sales in 2030: 1 400 units/year*



Stock

Stock in 2020: 60 units*
Stock in 2030: 6 000 units*
Stock in 2040: 15 400 units*

Potential savings in 2030

Primary energy savings:
0 PJ/year*
3 ktoe/year*
GHG-emissions reduction:
0 Mton $CO_{2,eq}$/year*

SME & Collective systems (±40 kWe)
Boiler add-on technology

Present market (2013)
Boiler stock: 5 400 units
Boiler sales: 400 units/year

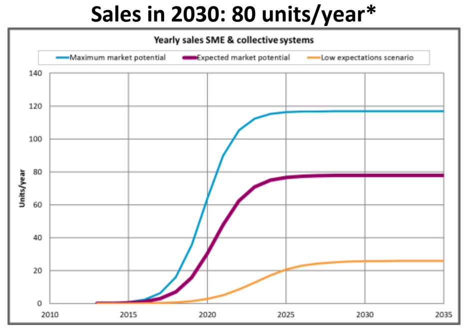
Potential estimation

Indicator	Score
Market alternatives	0
Global CBA	4
Legislation/support	2
Awareness	0
Total	**6 out of 9**

Expected final market share: 18% of boiler sales in SME & Coll. sector

Yearly sales

Sales in 2020: 30 units/year*
Sales in 2030: 80 units/year*



Stock

Stock in 2020: 170 units*
Stock in 2030: 700 units*
Stock in 2040: 800 units*

Potential savings in 2030

Primary energy savings:
1 PJ/year*
13 ktoe/year*
GHG-emissions reduction:
0 Mton $CO_{2,eq}$/year*

*Corresponding to the expected potential scenario.

The score card is used to assess the relative position of an EU country based on current regulations, markets and economics. The score itself functions as input to the implementation model to 2030.

±1 kWe systems (Households)

Boiler replacement technology

Scorecard

Indicator	*Score*
Market alternatives	0
Global CBA	3
Legislation/support	1
Awareness	0
Purchasing power	3
Total	**7 out of 12**

Market alternatives

The NG grid is well developed

Global CBA

SPOT: ***6 years***

Legislation/support

Current incentives on micro CHP
Feed-in Tariff (if full load hours > 2500)
Current incentives on other technologies
Good investment support for RES
Current regulation in favour of micro CHP ***Basic***
Current legislation in favour of other technologies ***Yes***

Awareness

Are stakeholders aware of the microCHP technologies
Low or no awareness of micro-CHP for households because no incentives to invest in micro-CHP. No investment support for households and the rule that you need more than 2500 full load hours to receive a Feed-in Tariff.

Purchasing power

GDP: ***€ 68 100 per year***

±40 kWe systems (SME & Collective systems)

Boiler add-on technology

Scorecard

Indicator	*Score*
Market alternatives	0
Global CBA	4
Legislation/support	2
Awareness	0
Total	**6 out of 9**

Market alternatives

The NG grid is well developed

Global CBA

SPOT: ***4 years***

Legislation/support

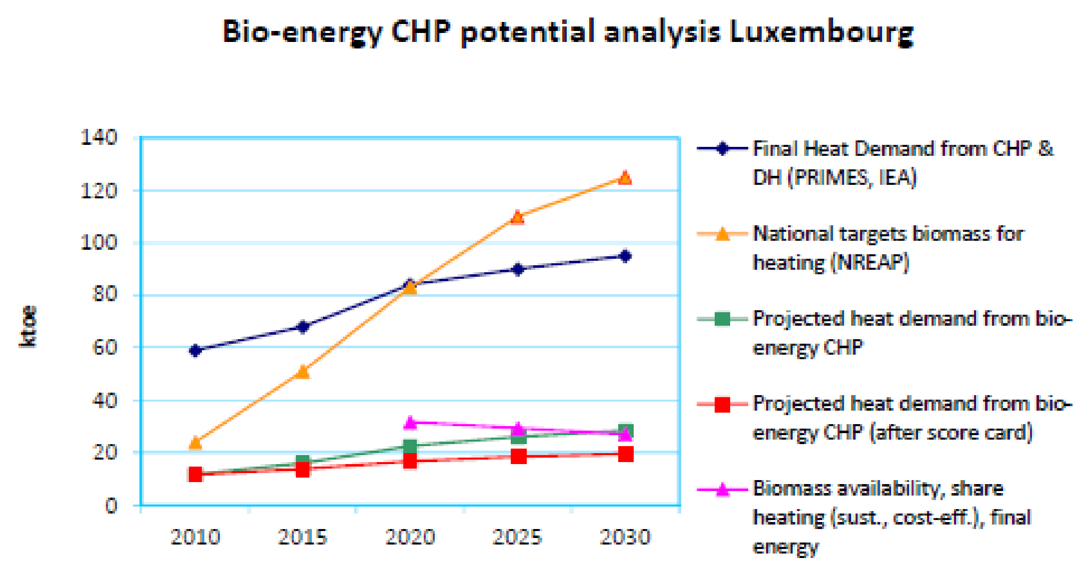
Current incentives on micro CHP
Feed-in Tariff (if full load hours > 2500)
Investment support for communes and companies
Support for DH connection
Current incentives on other technologies
Good Investment support for RES
Current regulation in favour of micro CHP ***Basic***
Current legislation in favour of other technologies ***Yes***

Awareness

Are stakeholders aware of the microCHP technologies
There are collective systems but no micro-CHP

3. Bio-CHP potential assessment

Figures (projections)	2010	2020	2030
Final heat demand from CHP and DH (PRIMES, IEA), ktoe	59	84	95
(Projected) heat demand from bio-energy CHP and DH (after score card), ktoe	12	17	20
Bio-energy penetration rate in CHP markets (2009: EEA, Eurostat)	20,0% (2009)	20,0%	20,6%
Biomass availability, share heating (sust., cost-eff.), final energy (Biom. Futures), ktoe		32	27



Framework Assessment (Score card)	Score	Short analysis
Legislative environment	+ 2 (of 3)	Good (future) DH grid access in Luxembourg (ville); Good support for DH and CHP
Suitability of heat market for switch to bio-energy CHP	+ 2 (of 3)	Good (future) DH grid access in Luxembourg (ville); No large industries
Share of Citizens served by DH	o 1 (of 3)	Good (future) DH infrastructure in the capital (7 DH grids with CHP)
National supply chain for biomass for energy	o 1 (of 3)	Big biomass potential but still too expensive in comparison with fossil fuel

Awareness for DH and CHP	o 1 (of 3)	Good awareness around DH; no independent sources of information on cogeneration

The national bio-CHP potential analysis is based on figures from the PRIMES database, Eurostat, the National Renewable Energy Action Plan (NREAP), and the project Biomass Futures. The analysis has been discussed and, where necessary, refined in consultations with national energy experts (see Annex for the detailed bio-CHP potential analysis).

4. Assumptions used in the economics of CHP

Sector		Heating in services (hotel, swimming pool, …)	Industry and service process heat and heating supply	District heating	District heating	Bio gas CHP (agriculture)
		50 kWe ICE	1 MWe ICE	1 MWe ICE	10 MWe CC	0,5 MWe Biogas
Technology		**ICE**	**ICE**	**ICE**	**CC**	**ICE**
Power	**MW_{El}**	**0,05**	**1**	**1**	**10**	**0,5**
Efficiency-el.	Eff_{EL}	34%	40%	40%	35%	38%
Efficiency-th.	Eff_{H}	56%	50%	50%	50%	37%
Efficiency-sum.	Eff_{SUM}	90%	90%	90%	85%	75%
Operation	**h/a**	**4.000**	**6.500**	**6.500**	**6.500**	**7.000**
Fuel	MWh	588	16.250	16.250	185.714	9.211
Electricty	MWh	200	6.500	6.500	65.000	3.500
Heat	MWh	329	8.125	8.125	92.857	3.408
Investment	**EUR**	**130.000**	**850.000**	**850.000**	**14.400.000**	**3.700.000**
	€/kWel	2.600	850	850	1.440	7.400
O&M costs	% of Inv.	5%	13%	13%	6%	5%
	€/MWhe	32,5	17,0	17,0	13,3	52,9
Price of fuel	€/MWh	57	57	57	57	0
Value of electrcity	€/MWh	118	73	73	73	0
Other market revenues	€/MWh					
Value of heat	€/MWh	70	70	70	70	70
Support						
Electricity	€/MWh					128
Heat	€/MWh					**18**
Other support or benefits	€/a					
Investment support	€	84.500	382.500	170.000	2.880.000	1.739.000
Costs & revenues						
Fuel	€/a	-33.553	-918.450	-918.450	-10.496.571	0
Electricty	€/a	23.540	477.100	477.100	4.771.000	0
Heat	€/a	23.197	566.944	566.944	6.479.365	239.983
Support	€/a	0	0	0	0	509.517
Other market revenues	€/a	0	0	0	0	0
O&M costs	€/a	-6.500	-110.500	-110.500	-864.000	-185.000
TOTAL	**€/a**	**6.684**	**15.094**	**15.094**	**-110.206**	**564.500**
SPB	**years**	**6,8**	**31,0**	**45,0**	**-104,5**	**3,5**
IRR	**%**	**8%**	**-17%**	**#GETAL!**	**#GETAL!**	**26%**

5. Methodologies used to calculate the saving of primary energy and CO2 emissions under the roadmap

Substitution method

This method has been developed in the CODE2 project. In doing this, two other approaches have been considered: 1) the "replacement mix method[25]" from the Munich FfE institute, which however cannot be used directly for a long term comparison as needed in CODE2; 2) a method used to calculate the CO2 saving resulting from a voluntary commitment of the German industry for CO2 reduction[26], however this method has been considered as too simple. Therefor the following more differentiated approach has been developed:

Based on an estimate of the increase in cogeneration electricity the thereby caused decrease of CO_2 emissions and primary energy consumption is estimated. In this approach, an attempt is made to determine the actual quantities saved compared to the base year (e.g. 2010). Hence it refers to the actual saving of fuels for the production of the amounts substituted by modern CHP plants

a) of electricity and heat in the replaced or retrofitted old CHP plants

b) of electricity in power plants

c) of heat in boilers.

The savings result from a combination of three effects:

- CHP effect

- Technology effect (improved CHP technologies)

- Fuel switching (eg lower carbon content of natural gas compared to coal, CO2 neutrality of bioenergy)

The results show the savings actually induced by the expansion of CHP compared to the situation in the base year.

This approach differs fundamentally from the methods for checking the high-efficiency according to the CHP Directive or in accordance with ANNEX II of the EED (Directive 2012/27/EU on energy efficiency), in which a comparison between CHP and the best available Technology (BAT) of separate production of electricity and heat produced is carried out strictly on a same-fuel basis.

This procedure is considered to be inappropriate to deliver an estimate of the actual fuel saving quantities by CHP over a longer period, which is considered relevant value, representing meaningful the contribution of CHP to the long-term objectives of the EU to reduce CO2 emissions and primary energy consumption. The BAT approach of the CHP Directive have been developed to verify the high efficiency of individual plants, but not to determine actual saved CO2 emissions and primary energy quantities by CHP expansion.

In fact, the CHP expansion is closely associated with a replacement of old by new cogeneration technologies and a change in the structure of fuel away from coal to natural gas and bio-energy. These three developments,

[25] 10. FfE Forschungsstelle für Energiewirtschaft e.V., Energiezukunft 2050; http://www.ffe.de/die-themen/erzeugung-und-markt/257

[26] The calculation has been made by the VIK Verband der Industriellen Energie- und Kraftwirtschaft e.V., 2010, Unpublished.

- replacement of separate generation by cogeneration

- replacement of old by new cogeneration technologies

- replacement of carbon-rich towards carbon intensive fuels,

can be usefully seen only as an integrated process.

To account for the uncertainties in particular with regard to fuel shares and technology development, a window of possible developments with an upper value and a lower value of emission reduction and savings has been determined. The different levels of results are due to assumptions about key parameters such as current share of electricity from cogeneration, which is replaced by electricity from new or retrofitted units, fuel shares in the replaced CHP plants, power plants and boilers as well as in the new CHP plants.

The results have been calculated based on the following input values: growth of CHP power production, share of current old CHP to be replaced by new installations and retrofitting, fuel efficiency and electric efficiency of new CHP and replaced CHP for different fuels, electric efficiency of replaced power from conventional power plants for different fuels, heat efficiency of replaced heat from boilers, corresponding fuel shares.

EED method

The Primary Energy Savings methodology of the EED is used at a country level for national reporting to the Commission, and at project level for determining if CHP is highly efficient. In the methodology, each cogeneration unit is compared with the best technology for separate production of heat and electricity on the same fuel on the market in the year of construction of the cogeneration unit and the harmonized reference values are determined by fuel type and year of construction.

The underlying principle is that, knowing that regularly new investments have to be made in new energy production units, it is necessary to compare CHP with the centralized production installation which could be built using the same fuel rather than assuming a displacement of a different fuel or introduction of a new fuel. It is a logical approach when looking at the decision making process of investors or a member state government. By investing in or supporting CHP, a certain electricity generating capacity will be produced by CHP and NOT by centralized production based on the same fuel (= principle of 'avoided production').

For the timeframe of the roadmap (between 2010 and 2030), and especially in countries where there is no overcapacity, it is relevant to compare installing a certain capacity (at national level) of CHP compared to installing new capacity with another technology (power plant + gas boiler). Older installations being replaced with state-of-the-art technology.is a typical reinvestment decision. New CHP-plant (or combination of smaller installations) would not necessarily lead to less production in older production installations, but would rather preempt investments in e.g. new CCGT investments.

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7. Contacts

Project partners

The project consortium exists of the following partners that have a solid expertise on cogeneration:

- COGEN Europe, the European Association for the promotion of cogeneration, is the project coordinator (Belgium) – contact: fiona.riddoch@cogeneurope.eu
- Hellenic Association for the Cogeneration of Heat and Power (HACHP) (Greece) – contact: hfa@heatflux.eu
- Jožef Stefan Institute (Slovenia) – contact: stane.merse@ijs.si
- Federazione d' associazioni scientifiche e tecniche (FAST) (Italy) – contact: giorgio.tagliabue@gmail.com
- COGEN Vlaanderen (Belgium) – contact: joni.rossi@cogenvlaanderen.be
- Energy Matters (Netherlands) – contact: Arjen.deJong@energymatters.nl
- Berlin Energy Agency (Germany) – contact: hermann@berliner-e-agentur.de
- KWK kommt (Germany) – contact: adi.golbach@kwkkommt.de