CODE2

Cogeneration Observatory and Dissemination Europe

D5.1 Final Cogeneration Roadmap

Member State: ***The Slovak Republic***

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Leading CODE2 Partner: ***Jozef Stefan Institute***

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Introduction and Summary

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 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 the Slovak Republic (SR) is written by CODE2 partner Jozef Stefan institute based on a range of studies and consultations (see Annex 7). It has been developed through a process of discussion and exchanges with experts[2].

Acknowledgement

Jozef Stefan Institute and the CODE2 team would like to thank all experts involved for their contributions to develop this roadmap, which has been valuable regardless of whether critical or affirmative. It has to be stressed that the statements and proposals in this paper do not necessarily reflect those of the consulted experts.

Summary

The Slovak Republic is one of the most developed cogeneration member states in the EU and with 25% CHP share in gross electricity generation on the 6th place in EU28. Long cogeneration tradition in district heating and industry, rather broad awareness on cogeneration advantages and incentive support framework enables further CHP development, especially with necessary retrofit and replacement of existing old CHP plants in district heating systems and industry by modern CHP units with partial switch to wood biomass. Sustainable CHP electricity generation is in line with the key national energy policy goals to increase energy efficiency and use of domestic primary energy sources, especially nuclear energy and biomass and would contribute to faster reduction of current high energy intensity and import dependency.

The CHP roadmap path would deliver up to 4 TWh/a of primary energy saving (PES) under the EED methodology till 2030. Considering the likely implementation path of such a roadmap up to 6 TWh/a PES and 3Million tonnes of CO_2 reductions are achievable in practice till 2030 and could contribute more 30 – 50% of the national indicative primary energy saving target (10 TWh) till 2020 and result in huge benefits for the national economy. Establishing stable long term support framework for cogeneration and incentives for the energy retrofit of district heating systems and increase of their competitiveness are prerequisite conditions beside the removal of some other barriers. Profound implementation of EED could significantly contribute to a proper future CHP role in the sustainable energy supply of SR and roadmap implementation. Resolving current natural gas supply problem from Ukraine is one of the critical issues of the EU policy to enable security of natural gas supply and future operation of CHP units.

[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 on the several CA-EED meetings and later on in 2014 with more experts phone conversation and mail exchanges of information.

1. Where are we now? Background and situation of cogeneration in Slovakia

1.1 Current status: Summary of currently installed cogeneration in Slovakia

Slovakia is facing slightly decreasing trends of CHP generation although still with high 14% share of total electricity generation (even 25% reported by Eurostat). Majority or more than 80% of the total 2,6 GWe installed capacity with around 4 TWh of electricity and 10 TWh of heat production was provided by steam turbines (including nuclear power plants) and more than 80% of total CHP generation is generated by plants supplying district heating systems.

Slovakia has a very high and prevailing more than 30% share of natural gas in CHP generation, followed by 27% share of coal, above 20% of nuclear energy and growing 4% share of RES. Only gas engines CHP units are facing positive recent trends in the period with significant heat demand decrease and current low electricity prices on the regional electricity market.

The Slovak Republic has very balanced primary energy consumption, with prevailing share of natural gas (27%), following by nuclear energy, oil, coal (all above 20%) and growing share of renewables (RES) (Figure 1) although it is facing rather high 64% import dependency[3]. More than half of the total 28 TWh electricity generation (8 GWe of installed capacity[4]) was in 2011 produced by nuclear energy, close to 20% by renewable sources and more than 20% by coal and natural gas, as shown in Figure 1, with growing share of RES generation in the year 2013 and small net import of electricity.

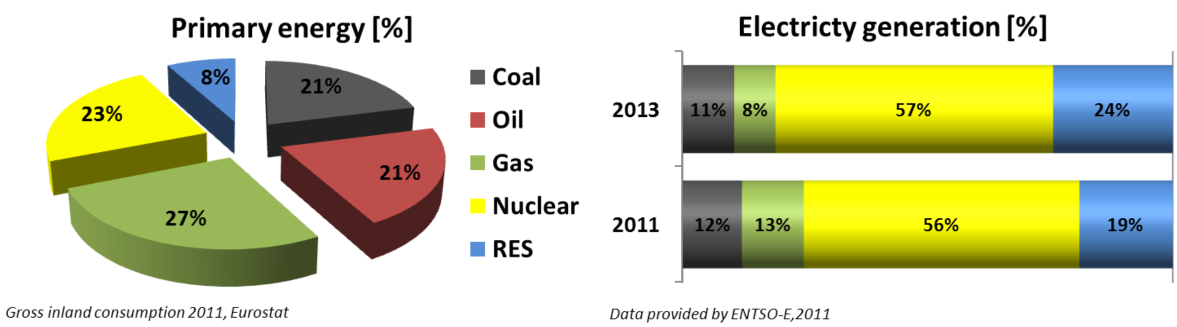

Figure 1: Structure of primary energy and electricity generation

Following Eurostat data share of cogeneration in total gross electricity production oscillates and reached high 24,5% share in 2011 (Table 1) with total 7 TWh of electricity and 7,3 TWh of heat generation.

National reported cogeneration statistics[5] considerably deviate[6] and the share of cogeneration has a slightly negative trend and reached lower 13,5% in the year 2010 with 3,8 TWh of total electricity

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[3] Entire import of oil and natural gas (majority from Russia) is key reason for higher than EU28 average import dependency (54% in 2011).

[4] EUROSTAT Energy, transport and environment indicators, pocketbooks, EU, 2013

[5] Ministry of economy of the Slovak republic: “Second” Report on progress towards increasing the share of high-efficiency cogeneration Article 6 paragraph 3 of Directive 2004/8/EC, Bratislava, 10 October 2011.

[6] Data based on the individual plants data and not using preselected electricity to heat ratio used for Eurostat reporting.

generation (Table 2, Figure 2). The installed capacity of high-efficiency cogeneration in the period 2008-2010 was around 2,6 GW, but the electricity production has decreased from 4,4 TWh to 3,8 TWh in this period, same as the total heat CHP production decreased from 13 TWh in 2008 to 11 TWh in 2010.

Table 1 – Eurostat data on cogeneration in the Slovak Republic 2008 – 2011

CHP	Installed electrical capacity [GW]	Total heat supplied [TWh]	Total electricity generated TWh]	Total % of gross electricity production**
2008	2,15	7,26	6,96	24,0%
2009	1,59	5,19	5,01	19,2%
2010	2,82	5,57	4,43	15,9%
2011	2,46	7,27	7,02	24,5%

Eurostat: Combined Heat and Power (CHP) data, 11 June 2013

Table 2 - National data on cogeneration in the Slovak Republic 2008 – 2010

CHP	Installed electrical capacity [GW]	Total heat supplied [TWh]	Total electricity generated TWh]	Total % of gross electricity production**
2008	2,645	12,86	4,37	15,1%
2009	2,547	11,80	3,89	14,9%
2010	2,609	11,00	3,80	13,8%

Source: Report on progress towards increasing the share of high-efficiency cogeneration Article 6 paragraph 3 of Directive 2004/8/EC, Bratislava, 10 October 2011

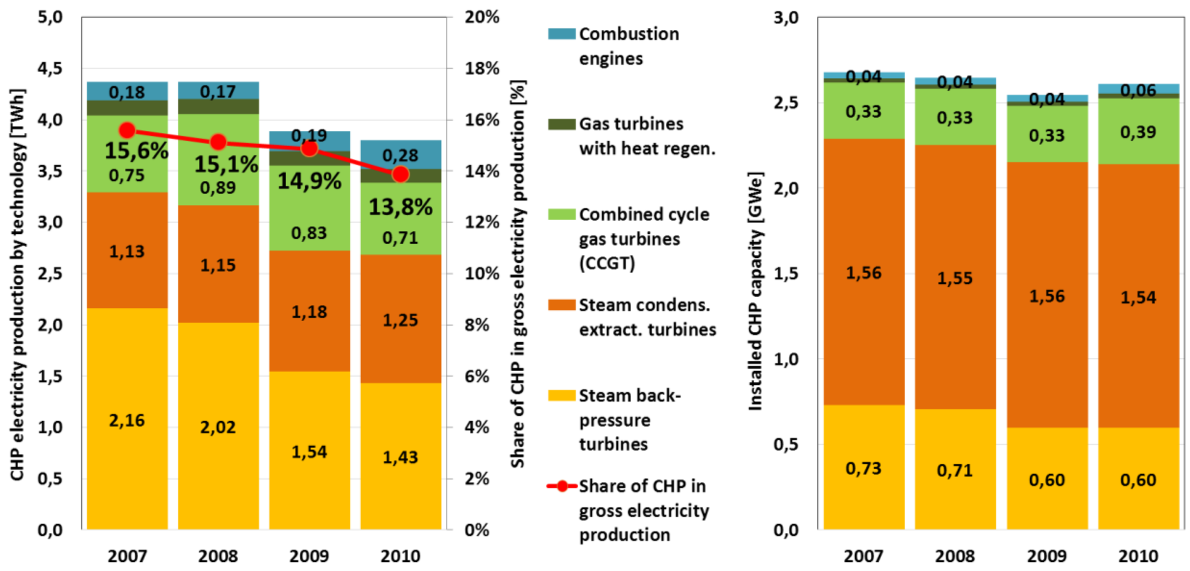


Figure 2: CHP electricity production and installed capacity by technology in Slovakia

The most of electricity from CHP in 2010 was produced in steam back pressure turbines (38%), followed by the production in steam condensing extraction turbines (33%), combined cycle gas turbines (19%), internal combustion engines (7%), and gas turbines with heat recovery (4%). The main fuel used in CHP was natural gas with 31% share, followed by coal (27%), nuclear energy (21%), liquid fuels (17%) and 4% share of biomass and biogas[7].

More than 80% of all CHP electricity and heat was produced by main activity producers (district heating plants and larger power plants – also nuclear) and the rest in industry and services.

1.2. Energy and Climate Strategy of the Slovak Republic

Increase of energy efficiency and use of domestic primary energy sources, especially nuclear energy and biomass are key energy and climate orientation of the Slovak Republic with goals to further reduce high energy intensity and import dependency.

The key objectives of energy policy, set in the document Energy policy of the Slovak Republic[8], are increasing efficiency in the power and end-use sectors, reducing energy intensity, reducing dependence on energy imports, expanding the use of nuclear power, increasing the share of renewables in the heat and electricity sectors and supporting the use of alternative fuels for transport. Following set objectives next priorities, relevant also for development of cogeneration, have been set:

1. Replacing the shut-down energy production installations so that this replacement will ensure the generation of such volume of energy which would primarily cover domestic demand on a cost-effective principle;
2. Adopting measures aimed at saving energy and increasing energy efficiency on the side of the consumption;
3. Decreasing the dependency of energy supplies from risk areas – diversification of energy sources as well as transport routes;
4. Using domestic primary energy sources for the electricity and heat generation on a cost-effective principle;
5. **Increasing the use of combined energy generation;**
6. Using the nuclear energy as diversified, cost-effective possibility of energy generation reasonably acceptable also for the perspective of the environment,
7. Ensuring nuclear safety in all operated nuclear installations;
8. Increasing the share of renewable energy sources in the generation of electricity and heat with the aim of creating adequate additional sources in order to cover domestic demand;

Due to still high energy intensity[9] and import dependency, the objective of the Energy security strategy [11] is to achieve competitive energy that would safeguard secure, reliable and efficient supply of all forms of energy at reasonable prices with respect to the protection of the consumer, protection of the environment, sustainable development, safety of supplies and technical safety.

Following the National Renewable Energy Action Plan [12] 14% share of RES of total energy consumption by 2020 will be achieved, especially by further increase of the use of biomass for

[7] Spreadsheet to facilitate the submission of specific data to support the evaluation of progress towards increasing the share of high-efficiency cogeneration in accordance with Article 6(3) and Article 10(2) of Directive 2004/8/EC,

[8] Energy policy of the Slovak Republic, Approved by resolution of the government of the Slovak Republic No. 29 from 11 January 2006 (update expected soon).

[9] 5th in EU28 in 2011, although decreased for more than 40% in the period from 2001 till 2011 [1]

electricity and heat generation as biomass represents a significant low-carbon energy resource for the Slovak Republic.

The total GHGs emissions have decreased extremely[10] (37%) between 1990 and 2011 because of the structure of economic activities, far more than 8% reduction commitment from the Kyoto protocol[11]. Support of the electricity production from renewable energy sources and nuclear power is the key energy policy measure to decrease GHG emissions and to reduce energy dependency. The energy strategy includes installation of 3 nuclear power plants: 2 nuclear power plants (Mochovce 3&4) next to Mochovce 1&2[12] and the new block in Bohunice.

1.3. Policy development in the Slovak Republic

Slovakia has established an efficient CHP support framework with premium payments set for different CHP technologies and used fuels as the key CHP support instrument, enabling economic environment for small and medium size CHP investments and operation.

Increase of electricity generation from nuclear power, renewable energy sources and in high efficient cogeneration (CHP) are key objectives of the Slovak energy strategy. In 2009 adopted Act on the Promotion of Renewable Sources of Energy and High-Efficiency Cogeneration, the government has set rules for supporting electricity produced from renewable energy sources and high-efficiency cogeneration (feed-in tariff), that started already in 2005.

The key instrument - feed-in tariff is based on the fixed basic electricity price set by the Regulatory Office for Network Industries for a certain type of CHP technology and used fuel (fossil or renewable)[13] as shown in Table 3. The premium payment is equal to the difference between the set fixed basic price and the price of electricity set yearly by the Regulatory Office for Network Industries for the electricity to cover losses of all regional distribution system operators.

The CHP support framework in Slovakia includes next elements:

- **Premium** is paid to all electricity produced (also for on-site direct consumption) by high-efficiency CHP plants with a total installed output of up to 10 MW and up to 125 MW or 200 MW, where the proportion of usable heat supplied to the industrial sector is no more than 40%[14]. Plants are eligible for payment for 15 years (from start of operation or reconstruction or modernization).
- **Purchase of electricity at a loss-making electricity price** by the electricity network operator to all of the electricity produced by high efficiency CHP units with a total installed output of up to 125 MW or up to 200 MW where the energy share for renewable energy sources in

[10] Assessment of climate change policies in the context of the European Semester, Country report: Slovakia, Ecological Institute - elecreon, June 2013

[11] Approximated EU GHG inventory: Proxy GHG estimates for 2012, Technical report No 14/2013, (http://www.eea.europa.eu/publications/approximated-eu-ghg-inventory-2012).

[12] Two units of 440 MWe net capacity are expected to be in operation in 2016 (Mochovce 3) and in 2017 (Mochovce 4).

[13] The fixed price of electricity produced by high-efficiency combined production ensure investment return in the 12 years period and remains at least at the level set for the year in which the plant was brought into operation or the year of reconstruction or modernisation of the plant.

[14] In the case of a higher proportion of usable heat supplied to the industrial sector it is possible to apply the supplement only to the amount of electricity which corresponds to a plant with a total installed output of up to 10 MW.

the fuel is higher than 20%. Units up to 1 MWe are eligible for the support throughout the plant lifetime whereas larger plants are eligible for 15 years (from the year of installation or modernization).

- **Balancing of deviations** for CHP units up to 4 MWe (1 MWe where appropriate)
- **Preferential connection and access to the electricity network** for all electricity produced in high efficiency CHP units up to 5 MWe (for units above 5 MWe only in proportion to the useful heat) if enabled by technical conditions.
- **Excise tax exemption for** electricity produced by high-efficiency CHP if supplied directly to the end consumer or consumed by the producer.
- **Investment subsidies** from Structural funds (2007 – 2013, planned also in the period 2014 - 2020) for CHP in different operational programmes (industry[15], district heating, Bratislava region, biogas, etc.).

[15] Main support provided by Operational Programme Competitiveness and economic growth, measure 2.1: Increasing energy efficiency on supply side and demand side and introducing advanced technology in energy sector where eligible projects are high-efficiency CHP units with installed capacity up to 10 MWe.

Table 3 - Feed-in tariffs for electricity produced from high-efficiency cogeneration for the period 2010-2015

Technologies	Fuels	Fixed purchase prices €/MWh			
		2010	2013	2014	2015
CCGT with heat		81,87	83,06	74,75	74,75
Gas turbine with heat recovery		75,59	80,99	72,89	72,89
Internal combustion engine	Natural gas	85,89	91,70	82,53	82,53
	Oil&oil products	85,89	87,66	78,89	78,89
	Mixture of air and methane	73,94	75,52	74,39	74,39
	Specially processed waste	149	149,00	120,69	99,89
	Thermal cracking of waste and its products	-	140,00	113,40	98,40
Steam back pressure turbine or steam condensing extraction turbine	Natural gas	83,65	81,71	80,97	80,97
	Oil&oil products	83,65	87,73	78,96	78,96
	Lignite	88,72	89,30	80,37	80,37
	HARD COAL (INSTALLED OUTPUT OF CHP SOURCE ≤ 50mwe)	82,15	83,16	74,84	74,84
	HARD COAL (INSTALLED OUTPUT OF CHP SOURCE> 50mwe)	78,87	79,81	71,83	71,60
	Waste incineration	80,00	80,00	77,60	77,60
	Gas produced by thermochemical gasification of waste in gasifier generator	114,74	114,71	103,24	89,05
	Gas from steel production	-	-	80,02	80,02
Organic rankine cycles		123,24	123,24	118,31	98,31

Electricity produced from renewable energy sources

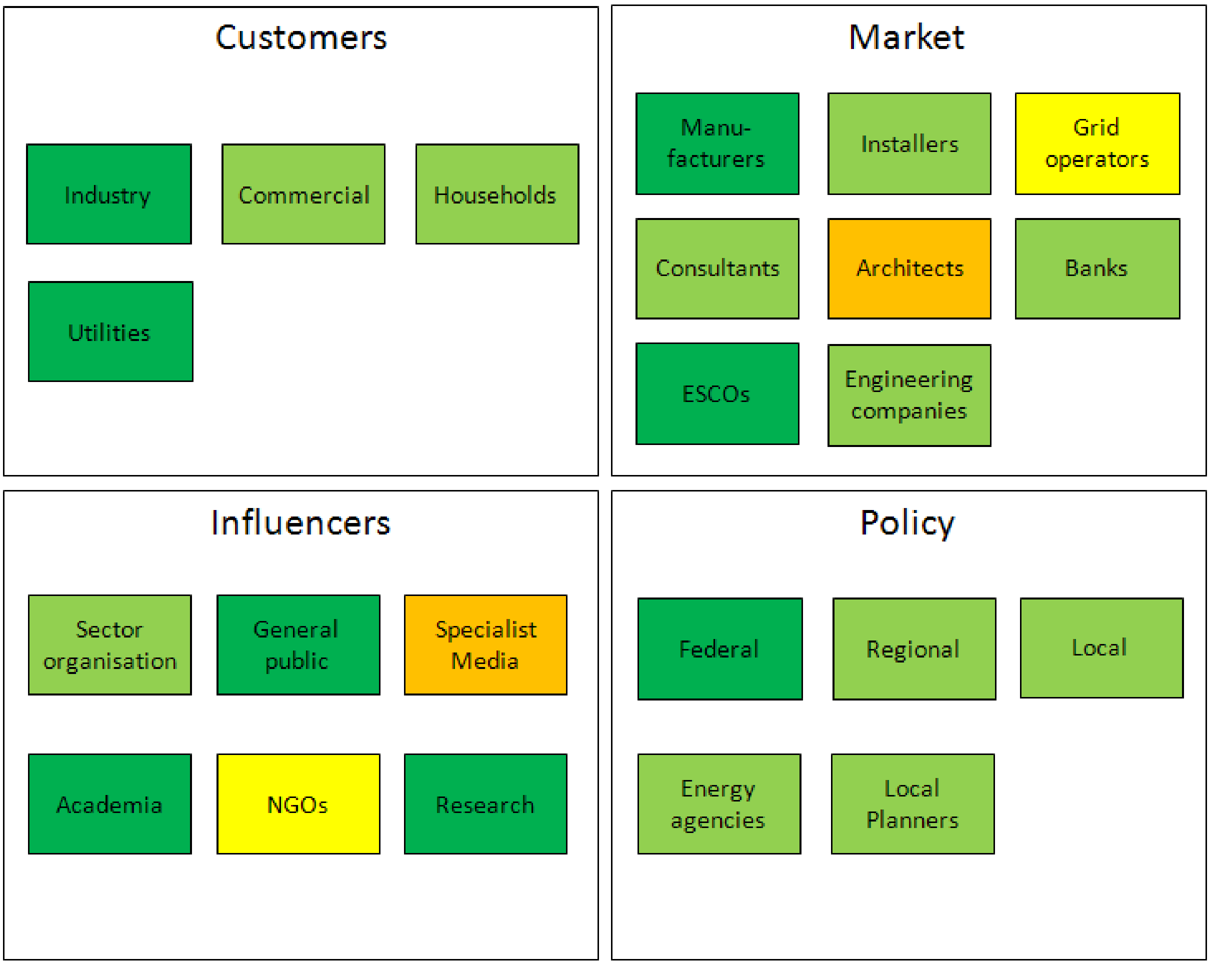
	Fuels	Fixed purchase prices €/MWh			
CHP	Specifically grown biomass	113,10	112,24	92,09	92,09
	Other (waste, straw..) biomass	125,98	122,64	100,63	96,90

Source: [7] [8] [9] [10]

1.4. Exchange of information and awareness in the Slovak Republic

Traditional use of CHP in industry and district heating and rather high heating prices are key drivers for general high CHP awareness in Slovakia, where interested investors are looking for economic CHP heating solutions. High level awareness of energy service providers and financial institutions is good support to the well-developed domestic CHP technology and project providers, where very good position of cogeneration in research and education programme is a very important pillar for the successful CHP development.

A good awareness of the benefits of cogeneration, among the different socio-economic 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 goes hand in hand with well-informed customers. Awareness among professional and influencers that inform and advise the other groups support policy makers to create and provide effective frameworks for a functioning market. For the purpose of this analysis the actors on the CHP market, were classified into four social-economic groups, shown in Figure 3. 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 Annex 1.



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

Figure 3: Assessment of four groups of the socio-economic actors' awareness of cogeneration in the Slovak Republic

Customers

Rather high heating prices and long tradition of cogeneration in Slovakia is an important fact for high awareness of CHP in all sectors where investors are driven by good CHP projects economics (short payback time) and good practice exchange.

Market players

District heating and industry are the key sector for cogeneration, well supported by domestic manufacturers (linked also to the providers from the Czech Republic), good technology providers and energy companies supported by banks which are well acquainted with financing of energy efficiency measures by several successful demonstration projects.

Influencers

Except District heating association in Slovakia there is no other stronger CHP association or more involved NGOs. Strong research and proper positioned cogeneration learning in education programme is a very important pillar for high educated technical staff and awareness in engineering area with important influence also on high general awareness on cogeneration in Slovakia.

Policy makers

Cogeneration awareness is on a rather high level as it is well positioned in the national energy policy which results in incentive support framework and very balanced mix of electricity supply with important role of cogeneration. Future development of district heating systems will be crucial for the future CHP development where successful implementation of EED (foreseen till the end of the year) should have important influence, especially on the analysis of heating and cooling priorities for district heating. The future development of nuclear energy and electricity market price trends will have an important influence on CHP investments.

1.5. The economics of CHP in the Slovak Republic

Current size - uniform CHP support framework enables required profitability for small and medium scale CHP (up to 10 MWe) whereas economic conditions for micro and large scale CHP units are not adequate for new investments.

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. The support systems described in Chapter 1.3 should improve the business case for CHP installations.

Assessment of current market conditions for new CHP investments proves live CHP market in Slovakia (Table 4). Proper support framework and market conditions triggered incentive conditions and established normal market for small and medium size CHP units (up to 10 MWe) for fossil and renewable CHP applications in all sectors (especially on natural and bio gas).

Same level of support for CHP units is not assuring requested profitability for micro CHP units (except some larger units in services and industry) whereas current energy market condition with low electricity prices have stopped the investments in larger CHP units.

Table 4: Market economic situation of CHP in major user groups

Slovak Republic	**Micro**		**Small & Medium**		**Large**		
	up to 50kW		*up to 10 MW*		*more than 10 MW*		
	NG	**RES**	**NG**	**RES**	**NG**	**Coal**[16]	**RES**
Industry	[yellow]	[red]	[green]	[green]	[red]	[yellow]	[yellow]
District heating	[grey]	[grey]	[green]	[green]	[red]	[yellow]	[yellow]
Services	[yellow]	[red]	[green]	[green]	[grey]	[grey]	[grey]
Households	[red]	[red]	[grey]	[grey]	[grey]	[grey]	[grey]

Legend:

[green] **"normal"** CHP Investment has **good economic benefits**, return on investment acceptable (8-10%) for the investors, **interest for new investment exists**; there are no significant economic barriers for the implementation.

[yellow] **"modest"** CHP Investment has **modest/limited economic benefits** and return on investment (5-7%), **limited interest for new investments**.

[red] **"poor"** CHP Investment has **poor or negative return on investment or is not possible due to other limitations, no interest/possibilities for new investments**.

[grey] **Not applicable** for the sector

NG **Natural Gas** or appropriate fossil fuel

RES **Renewable energy sources** (wood biomass, biogas, etc.)

[16] Market potential for larger coal and RES CHP is only within the reconstruction of existing units (no potential for new units.)

1.6. Barriers to CHP in the Slovak Republic

Low competitiveness of district heating systems compared to other heating options is the most important barrier for the future development of the largest CHP sector in Slovakia. Current unfavourable energy market conditions that recently stop connection of new CHP units need fast update of the support scheme regulation to establish long-term stable and predictable conditions for new investments. Recent reduced natural gas supply from Ukraine is a huge threat that needs urgent EU policy response.

In the Second CHP progress report presented to the EC, the Slovak government has indicated next obstacles for CHP production:

- administrative procedures,
- regulation and price setting for electricity and heat,
- weak monitoring of CHP operation
- Technical obstacles:
    - reduced heat demand due to energy efficiency in buildings
    - increased use of renewable energy sources technologies (heat pumps, solar collectors),
    - decrease of operation efficiency of large CHP plants due of increased demand for ancillary services caused by dispersed electricity generation from RES

the Slovak Republic is one of the advanced EU member states where current policy and regulatory framework enables the CHP development in different sectors. Based on recent market assessment and expert opinion we have identified three major still existing barriers for faster and stable CHP development, listed in a descending order of importance:

Barrier 1: Weak competitiveness of DH systems compared to other heat supply options

Low competitiveness of district heating systems is one of the key barriers for the future development of the largest CHP sector in Slovakia as current systems are often not competitive to new alternative heat supply options in buildings (especially heat pumps, solar collectors and biomass boilers).

How to reduce operation cost by increase of systems energy efficiency in obsolete systems and trigger energy retrofit (also by fuel switch to RES and natural gas by CHP units) is a crucial development challenge.

Current high heat prices for the consumer also result of not optimal heat price regulation, enable short return of investments to the alternative heating options and extensive disconnections which cause additional decrease of heat demand (beside decrease due to energy efficiency measures in buildings[17] and industry) and non-optimal operation of the existing CHP units and request systematic update of regulation.

[17] Ministry of economy estimated that energy retrofit has already been implemented on more than 50% of the buildings and should be completed in the period 2030 - 2040.

Additional ETS costs and higher air quality request for larger production units (IED) are decreasing competitiveness of DHC compared to individual heat supply options, not burdened by these costs and distort competition on the heat supply market.

Barrier 2: Unfavourable energy market conditions have negative effect also on CHP support scheme operation

Several CHP investments in recent years prove effectiveness of the existing CHP support scheme and increased CHP and RES electricity generation. As CHP support is linked to the yearly set price of electricity to cover grid losses by the Regulatory Office for Network Industries, drop of the electricity market prices below the regulatory set price and the volume of CHP and RES electricity exceeded the volume necessary to cover grid losses, connection of new units to the grid by regional distribution system operators was almost stopped in the year 2014.

Recent reduced natural gas supply from Ukraine could become a serious problem (this winter or long term) and needs a fast common EU solution to avoid serious problems with the natural gas supply that would seriously hurt the CHP operation.

Barrier 3: Complex administrative procedures need to be simplified

The legal framework for cogeneration is still rather complex and time consuming requesting certification procedure[18] (cogeneration has no advantage in comparison to other investment projects) and issuing a permit for business activity in the electricity and heat supply[19] (CHP unit up to 1 MWe should only notify such an activity to the Regulatory Office for Network Industries) beside complexity of administrative procedures for the preparation of the investment (ownership of real estate, approval of the respective authorities, etc.).

2. What is possible? Cogeneration potential and market opportunities in Slovakia

Evident economical CHP potential exist in Slovakia which should be re-assessed within EED prescribed comprehensive assessment till the end of 2015. 0,5 GW or 2,6 TWh of additional CHP generation was earmarked as an additional economic CHP potential till the year 2020 in the National potential study from 2008 with a growing role of the bio and micro CHP potential proved by the recent CODE2 analysis.

Following the latest National energy efficiency action plan [13] [20], new comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling will be prepared in due time till the end of 2015 and in the meantime the results of the

[18] Each investment project for electricity supply above 1 MWe) or above 10 MW for heat supply should be certified by the Ministry of Economy of the Slovak Republic that is in accordance to the long-term energy policy concept.

[19] Permit is issued by the Regulatory Office for Network Industries with request of employed professionally competent person who meets the prescribed qualification requirements (for units above 1 MWe)

[20] NEAP 2014, issued on 30th April 2014.

Analysis of the National Potential for High-Efficiency Cogeneration in the Slovak Republic from 2008[21] is the most relevant source on the cogeneration market potential.

Additional technical CHP potential till 2020 was estimated on more than 15 TWh of electricity or close to 10 GWe expressed in electrical capacity. Only 5% of the total estimated technical potential (0,5 GW or 2,6 TWh) was earmarked as an additional economic CHP potential till the year 2020 (Figure 4). To enable the CHP growth, 1,9 GWe of new investments was foreseen as reconstruction and refurbishment of existing mainly big old coal and natural gas CHP units with gradual switch to wood biomass (also co - firing with coal) and only 0,5 GWe of new CHP units, mainly industrial and small scale applications on natural gas.

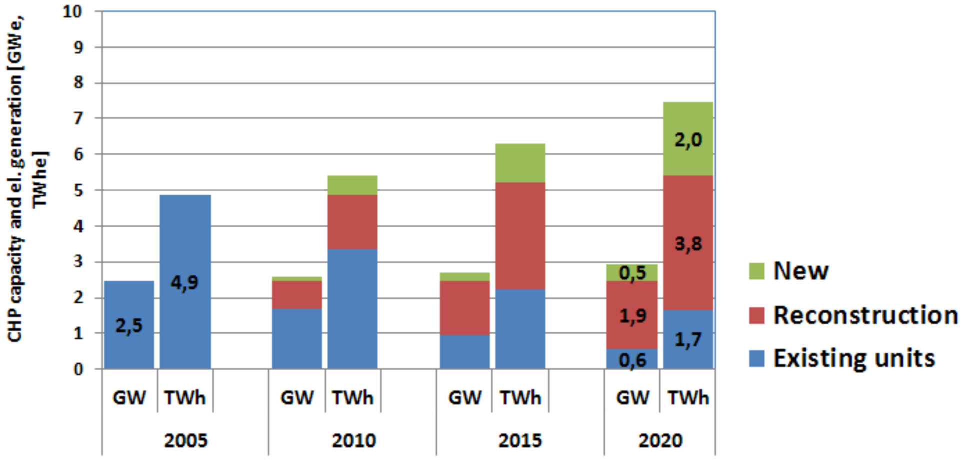


Figure 4: Cogeneration expansion - economic potential in the period 2005 - 2020

Current and expected energy market and economic conditions till the year 2020 seems inadequate for implementation of such a volume of investments, especially a huge refurbishment of existing larger CHP units in district heating systems although driven by increased environmental restrictions and gradual decrease of domestic coal exploitation and need of efficiency and competitiveness increase of expired old units. Recent boom of the new CHP investment (prevailing small and medium size CHP units) which slowed down in 2014 proves the market potential in services, households and industry, especially in case of faster economic crisis recovery in EU.

Bio energy

Currently more than 4% share of RES in CHP generation (60% of that wood biomass, rest biogas) could be increased in the future, especially with co-combustion of wood biomass with coal in larger CHP units and technology development of biomass gasification in smaller CHP applications.

The analysis on Bio CHP potential carried out within CODE2 project, based on the “score cards analysis”, proves the huge potential for bio CHP growth to over 25% share of CHP generation till the year 2030 (see Annex 3) as Slovakia has very good preconditions for the utilisation of wood biomass[22]which is in line with the energy policy orientation to the use of domestic energy resources and RES, especially wood biomass.

[21] Analysis of the national potential for high-efficiency cogeneration, Slovak innovation and energy agency.

[22] Appropriate support mechanisms, high share of district heating heat supply, biomass availability and high awareness result of efficient promotion of Biomass association.

Micro CHP

The CODE2 micro CHP potential analysis estimated the market potential for micro CHP units on around 500 units per year in the year 2020 of that 400 units of ±40 kWe in services (16 MWe total) and 120 units of ±1 kWe in households. At least the households CHP development is very uncertain due to high current technology costs although in case of the expected decrease of investment costs, the sales of micro CHP units in 2030 could exceed 10.000 units per year due to the extensive natural gas network in Slovakia (more than 90% of all inhabitants have access to the gas network). For more details see Annex 2.

3. How do we arrive there? The Roadmap

Following current ambitious energy policy goals and orientations the Slovak Republic can remain one of the leading European cogeneration countries with further growth of CHP generation with special emphasis on the use of renewable energy sources. Cogeneration can significantly contribute to the key energy policy priorities: increase of energy efficiency and use of domestic energy resources can complement the development of the nuclear energy generation and use of RES for heating (heat pumps).

3.1. Overcoming existing barriers and creating a framework for action in Slovakia

Establishing a long term stable and predictable incentive legal framework for cogeneration is the key priority necessary for the future CHP development in Slovakia. Intensifying the support instruments for increasing efficiency and competitiveness of district heating systems is crucial for their future economic operation and preserving the majority of current CHP generation. EED implementation should be an important tool and push in the increase of the efficiency in heat supply where simplification of administrative procedures and grid connection is one of the important issues beside EU policy action for mitigation of the natural gas supply risk.

Action 1: Establishing a long term stable, incentive and predictable legal framework for cogeneration

Removing existing regulation problems of setting and adaptation of the price of the electricity to cover grid losses with the current electricity market price is the key issue for prosecution of current successful support scheme and to enable new grid connections.

Regular evaluation and proper yearly tuning of the level of support (following the technology and the energy market prices development) is crucial precondition for the economically sustainable operation and long term stable operation, which is crucial for the investors. Special emphasis should be on the instruments that will enable modernisation of existing old CHP units in industry. Good cooperation between Ministry of Economy and Regulatory Office for Network Industries is of key importance where considering the state aid compatibility is an important aspect.

Further development of DSM and cogeneration access to the system services as foreseen in the latest NEAP 2014[23] is an important instrument for increasing competiveness of CHP plants in current very difficult market conditions.

Action 2: Intensify the support for increasing the competitiveness of the District heating systems

Majority of current CHP generation is traditionally linked to the district heating (DH) systems which present a very important infrastructure for the efficient and environmentally friendly heat supply today and also in the future. Enforcing the support instruments for the increase of the heat grid efficiency, optimisation due to decreased heat demand and necessary plant environmental retrofit (IED requests) are crucial for enabling future competitiveness and economic operation of DH systems. A special emphasis should be also on small district heating systems with heat only boilers or use of coal which could be replaced by CHP units on wood biomass or natural gas and use of other RES (solar, geothermal, etc.)

Ministry of Economy should continue with investment subsidies and other financial instruments for increasing efficiency of heat supply systems in the next financial perspective (2014 – 2020) that are planned to start in 2016 [13] [24].

Update of current heat price regulation in district heating systems is necessary to enable more flexibility and optimal balancing of final heat prices and assure competitive price level compared to other heating alternatives to stop disconnection of final consumers. An on-going change of the Heating law, which will stop disconnection for larger heat consumers (>100 kWe) if they cause a decrease of the system efficiency, is a much appreciated step toward more efficient operation of DH systems.

Action 3: Fast and quality implementation of EED – especially a comprehensive assessment and cost benefit analysis (CBA) for efficiency in heating and cooling

New assessment of heating and cooling potential should bring new information of the real technical potential and advantages of cogeneration and DHC options. CBA for market potential could contribute to better awareness of the cogeneration opportunities in all sectors and a potential contribution to the national strategic climate energy goals with an approval of necessary additional adequate measures for the cogeneration support.

EED implementation should bring also other benefits for the increase of efficiency in heat supply:

- **Clear priorities in heat supply** – new comprehensive approach as basis for the shaping of local legislative rules and practice on the municipality level to enforce local energy planning and new sustainable investments in the heat supply integrated in other sectors (use of waste heat, etc.).
- **Assessment of energy efficiency potential in the gas and electricity infrastructure:** as cogeneration has positive influence on better infrastructure utilisation, decrease of losses

[23] Measures to promote demand-side response (DSM) based on the Regulatory Office for Network Industries issued Methodological Guideline from 01.12.2013.

[24] 37 million of EU funds are foreseen especially for reconstruction and modernisation of existing heat network and CHP units with up to 20 MWe capacity.

and load balancing, assessment should better position the role and contribution of cogeneration units to the energy efficiency in gas and electricity grids.

- **Improving access to electricity networks and priority of dispatch for cogeneration** – introduction of improvements and new issues, especially for small scale cogeneration units:
- **Enable conditions for introduction of system services from cogeneration** (demand response, balancing, etc.).

Action 4: Simplification of administrative procedures and greed connection

Further efforts of all involved authorities (ministries, network operators, regulator, etc.) should be still focused on the removing of administrative barriers necessary for efficient and fast CHP project implementation and grid connection. Certification and issuing business permits should be simplified (omitted where possible) and issued in shortened time to enable faster investment implementation.

A special emphasis should be on the larger CHP units where procedures are the most extensive and time consuming. For micro CHP units the provisions from the article 15 of the EED: simple notification "install and inform" should be followed by upgrades with other instruments like net metering, tax incentives, etc. to enable development also of small scale units[25] as the existing support scheme is not size sensitive (same support for all size units).

3.2. Possible paths to the growth in the Slovak Republic

CHP could also in the future contribute around 15% of final electricity demand and become the sustainable pillar of electricity supply in Slovakia by the proposed CHP road map implementation. By the necessary replacement of 45% of existing CHP capacities by 1,1 GWe of modern CHP plants and 60% implementation of economic potential or 0,3 GWe of new CHP units, the current CHP electricity generation could be increased for 60% from the current 4 TWh to more than 6 TWh till the year 2030.

In spite of recent negative trends of high efficiency CHP electricity generation around 4 TWh_e (7 TWh by Eurostat) we can still expect a moderate economic growth in the future and increase of CHP generation for about 2,3 TWhe by the assessed economic potential and economic opportunities.

With the proposed **CHP road map** implementation we can strengthen the CHP development and significantly contribute to the EU energy climate targets. The economic potential for the CHP growth is evident although before the implementation of comprehensive assessment of the actual potential we can reasonably take only part - 60% of the economic potential assessment from 2008 as the target CHP path to the growth till the year 2030:

- **Reconstruction of 45% of existing old CHP capacity** (**1,1 GWe**) – which is necessary due to the lifetime expiration and new environmental restrictions – **and increase of electricity generation for 1,1 TWh_e,**
- **0,3 GW_e of new CHP plants installation and 1,2 TWh_e additional electricity generation**,

[25] Especially in services and later with expected price drop of technologies also in smaller applications.

as shown in Figure 5 and the following energy and environmental indicators for the roadmap impact assessment.

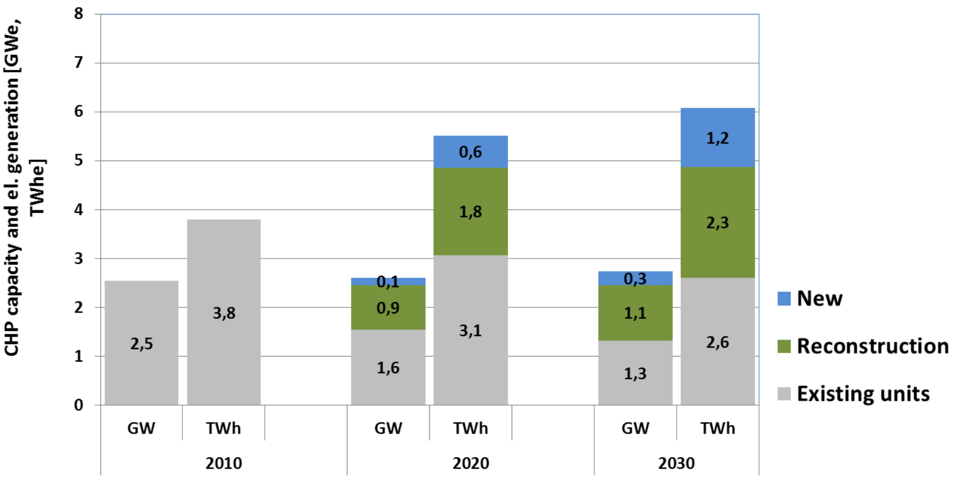


Figure 5: Target path to the CHP growth till the year 2030

- **CHP electricity generation: increase for 2,3 TWh$_e$ or for 60% compared to the current high efficiency electricity generation in the year 2010**, with the balanced contribution of existing reconstructed CHP plants in district heating systems and the new installed CHP capacity.
- **Share of cogeneration electricity in final energy demand:** the **share of CHP electricity generation in final energy demand could be at least slightly increased from 14% to 16% till 2030** and establish an important stable generation pillar for the sustainable and complementary electricity supply in the Slovak Republic beside nuclear and other renewable generation.

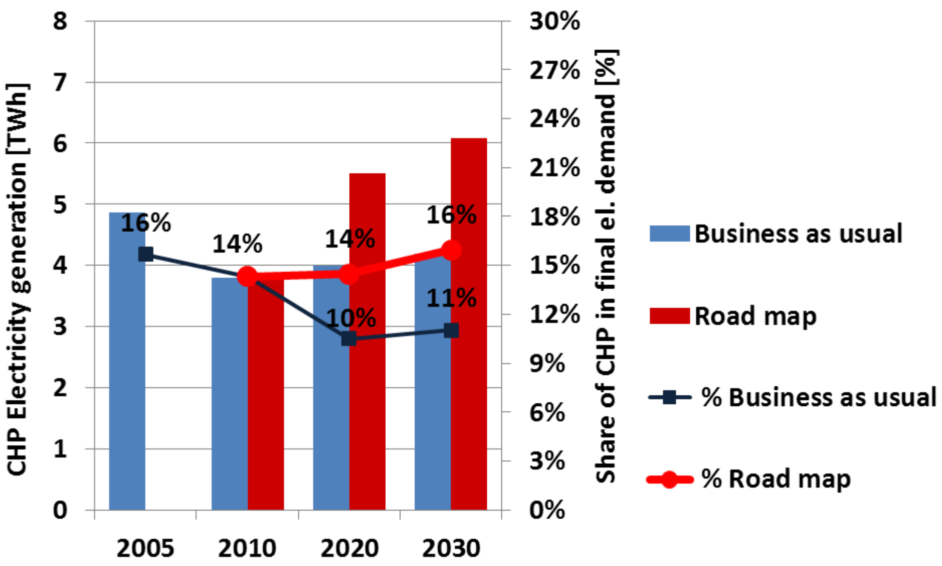


Figure 6: CHP Roadmap Electricity indicators

Future development of cogeneration could be even greater as we consider the proposed roadmap economic potential rather conservative, especially in faster economic growth circumstances till the year 2030.

3.2. Saving of primary energy and CO_2 emissions by the CHP roadmap of Slovakia

Potential CHP primary energy savings could contribute 30 – 45% of the indicative national target of primary energy savings till the year 2020 and reduce CO_2 emissions for up to 2,3 million tons of CO_2 till the year 2030.

Within CODE2 project two approaches for assessment of primary energy savings (PES) and CO_2 emissions savings are used to demonstrate advantages and contribution of CHP technology to the reduction of energy use and CO_2 emissions:

1. **Methodology prescribed by EED** (according to Annexes I and II) [26]
2. **Substitution method –** new developed method for assessment of actual achieved savings[27]

New CHP generation proposed by the Road map would contribute **2,5 TWh PES** calculated by the EED methodology or **up to 5,3 TWh of PES (19 PJ)** calculated by the substitution method as shown in Table 5. Especially reconstructed CHP plants which are replacing the existing old steam turbine on coal and natural gas plants contribute the majority of the potential PES which is important from the perspective of national goals till the year 2020 and 2030. Real potential savings by the substitution method are for almost 60% larger than assessed savings by the EED methodology where comparison to the best available alternative technology for separate electricity and heat generation do not reflect the actual savings in the country.

The assessed PES potential of CHP (3,0 to 4,8 TWh till 2020) is 30 - 45% of the 10,4 TWh set indicative national target of primary energy savings in the year 2020 in NEAP 2014[28] [13] which means that implementation of the CHP roadmap can contribute a significant part or even increase the foreseen national goals for the year 2020 and additionally contributes to the new goals for the year 2030.

By using the same approach, potential real achievable CO_2 savings by the substitution method are 2,3 Mt of CO_2, much higher than 0,7 Mt CO_2 savings by the EED methodology[29] as shown in Table 5. By increasing the share of renewable energy and faster transition to the natural gas potential CO_2 savings would be even higher.

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[26] **EED 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.

[27] **Substitution 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 in the country.

[28] Assessed NEAP 2014 PES of planed measures in district heating and CHP are 0,7 TWh.

[29] CHP plants using renewable energy are not achieving CO_2 savings by EED methodology (compared to separate renewable generation), but in reality they are replacing current coal generation.

Table 5: Saving of primary energy and CO2 by the Slovakia CHP roadmap till 2030

	Substitution method		EED method	
	Business as usual	**Road map**	**Business as usual**	**Road map**
PE saving	2,5 TWh/a	**5,3 TWh/a**	1,4 TWh/a	**3,3 TWh/a**
CO_2 saving	1 Mt/a	**2,3 Mt/a**	0,3 Mt/a	**0,7 Mt/a**
- per kWh_{el}*[30]	0,87 kg/kWh_{el}	**0,99 kg/kWh_{el}**		

[30] This value represents the CO_2 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.

Annex 1: Stakeholder group awareness assessment

Users	
Industry	CHP is well known with a long tradition especially in pulp, refinery and other process industry with a huge potential for modernisation of the old steam technology by the introduction of new CHP technologies.
Utilities	The cogeneration is a traditional technology in larger district heating systems Actual significant decrease of heat demand due to efficiency measures in buildings and industry, difficult reconstruction of big systems (several small system have been completely renovated) and customers disconnections (high regulated heat prices compared to other heating options) have a big negative impact on the efficiency and future operation of CHP plants.
SMEs	SMEs are getting slowly more aware of CHP technology, especially of gas engines, where an efficient CHP solution with short payback time should be competitive to the other potential investments in companies (other technology and efficiency investments).
Households	Due to high heating prices people are aware of different alternative heating options where cogeneration is one of the potential technology for a competitive heat supply source for multifamily buildings, although sometimes inappropriate competition to district heating. Awareness of cogeneration is growing and facing a very strong competition with other heating options.
Market and supply chain	
Manufacturers/ Technology providers	In Slovakia there are 2 companies manufacturing gas engines (NG, biogas) and several CHP project suppliers with long tradition and good links with CHP industry.
Installation companies	Cogeneration is well known by installation companies with proper number and education of CHP installers.
Grid operators	Negative attitude happened in 2014 with an almost complete stop of permits for connection to the grid, but traditionally awareness of the grid operators on cogeneration is on the proper level.
Consultants	Consultants are in principle acquainted with CHP, but usually not the actors that propose cogeneration solutions to the investors. Usually Investors have a more active role based on the attractive payback of the project.
Architects	Architects are less acquainted with cogeneration.
Banks, leasing	Several demonstration projects have a very positive effect on banks and other financial institutions which are well acquainted with the cogeneration technology and support environment and are active in the CHP project financing.
ESCOs	Well-developed ESCOs market with about 30 companies focused mainly on energy delivery contracts in central heating where the CHP installation is one of the important service beside the fuel switch (RES, etc.).

Policy	
Policy makers on different levels	Cogeneration awareness is traditionally on a rather high level as it is well positioned in the national energy policy which results in several support instruments – subsidies and a premium scheme for CHP.
Energy agencies	Energy agencies know CHP but are not very active in the promotion.
Planners	CHP is in principle known, but the CHP market is the key driver for new investments.
Influencers	
Sector organisations	District heating association in Slovakia professional association of largest manufacturers of heat from cogeneration and heat distributors (established in 1998 and also Euro Heat and Power – member) with the goal to increase the awareness and to mitigate risks for successful operation and development of district heating systems, is the only larger CHP sector organisation in Slovakia (Activities of COGEN SNS – association for promotion of small scale CHP stopped recently).
General public	General public awareness about cogeneration in the Slovak republic is rather good, in general people know well the CHP technology.
Media	No special attitude to CHP in media for the general public. There are not many articles or aimed promotion.
Academic area/ Research	Good research support, CHP part of the programmes on faculties. Good cooperation established with industry and University (special subject of industrial engines, etc.)
NGOs	Not very active in the CHP sector.

1.

Legend:

(dark green)	Active CHP market	(orange)	Low CHP awareness
(light green)	Interest in CHP	(red)	Poor CHP awareness
(yellow)	Early CHP awareness		

Annex 2: Micro CHP potential assessment

micro-CHP potential summary Slovakia

Country statistics

Population: 5 400 000 (2010)
Number of households: 2 700 000 (2010)
GDP per capita: € 18 400 (2010)
Primary energy use: 11 600 ktoe/year (2010)
GHG-emissions: 46 Mton $CO_{2,eq}$/year (2010)

Household systems (±1 kWe)

Boiler replacement technology

Present market (2013)

Boiler stock: 375 000 units
Boiler sales: 56 000 units/year

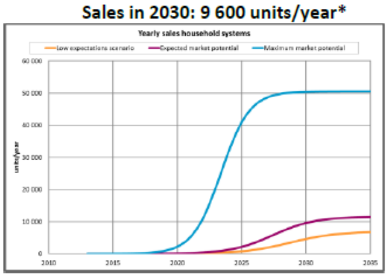
Potential estimation

Indicator	Score
Market alternatives	0
Global CBA	3
Legislation/support	1
Awareness	0
Purchasing power	1
Total	**5 out of 12**

Expected final market share: 21% of boiler sales in Household sector

Yearly sales

Sales in 2020: 120 units/year*
Sales in 2030: 9 600 units/year*



Stock

Stock in 2020: 260 units*
Stock in 2030: 38 000 units*
Stock in 2040: 113 000 units*

Potential savings in 2030

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

SME & Collective systems (±40 kWe)

Boiler add-on technology

Present market (2013)

Boiler stock: 52 000 units
Boiler sales: 7 800 units/year

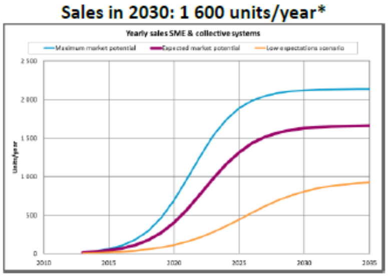
Potential estimation

Indicator	Score
Market alternatives	0
Global CBA	4
Legislation/support	2
Awareness	1
Total	**5 out of 9**

Expected final market share: 15% of boiler sales in SME & Coll. sector

Yearly sales

Sales in 2020: 400 units/year*
Sales in 2030: 1 600 units/year*



Stock

Stock in 2020: 2 500 units*
Stock in 2030: 13 000 units*
Stock in 2040: 17 000 units*

Potential savings in 2030

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

*Corresponding to the expected potential scenario.

micro-CHP score card
Argumentation

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	1
Total	**5 out of 12**

Market alternatives

*There is **strong competition of other heating technologies in households**: extensive district heating systems in towns, geothermal energy and heat pumps, wood biomass (cheap heating source), **extensive natural gas network** (more than 94% of all inhabitants of Slovakia have access to distribution network).*

Global CBA

*SPOT: **5 years***

Legislation/support

***Current incentives on micro CHP are not yet sufficient** for the economic project implementation in households*

Awareness

*Due to the too high investment costs and not sufficient support for the economic implementation, **current awareness of micro CHP technologies for households is still very low** or poor on all levels.*

Purchasing power

*GDP: **€ 18 400 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	1
Total	**7 out of 9**

Market alternatives

*There is **very strong competition of other heating technologies in services**: extensive district heating systems in towns, geothermal energy, heat pumps and extensive natural gas network in the country.*

Global CBA

*SPOT: **3 years***

Legislation/support

Current support offer moderate incentives for implementation of micro CHP project in service sector

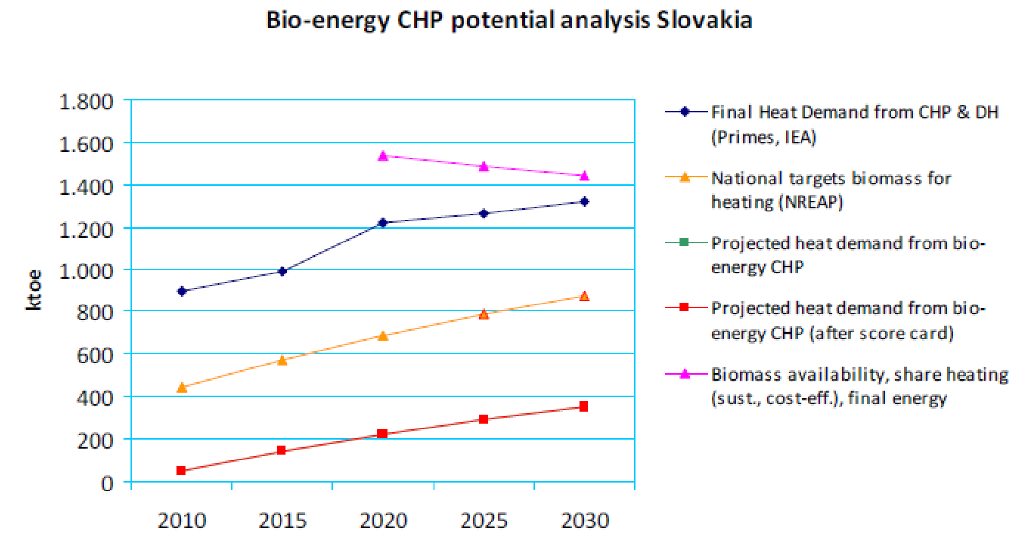
Awareness

*Due to lack of good CHP practice examples, **awareness of CHP is still on the very low level**.*

Annex 3: Bio CHP potential assessment

Bio-energy CHP potential analysis Slovakia

Figures (projections)	2010	2020	2030
Final heat demand from CHP and DH (PRIMES, IEA), ktoe	896	1.221	1.321
(Projected) heat demand from bio-energy CHP and DH (after score card), ktoe	50	223	354
Bio-energy penetration rate in CHP markets (2009: EEA, Eurostat)	5,6% (2009)	18,3%	26,8%
Biomass availability, share heating (sust., cost-eff.), final energy (Biom. Futures), ktoe		1.531	1.439



Framework Assessment (Score card)	Score	Short analysis
Legislative environment	++ 3 (of 3)	Support price for CHP electricity, agricultural biogas plants; High share of district heat; Preferential connection of CHP to network
Suitability of heat market for switch to bio-energy CHP	++ 3 (of 3)	Increase share of heat from RES from mostly biomass and biogas; High increase of electricity production from wood biomass and biogas
Share of Citizens served by DH	++ 3 (of 3)	41% citizen served by DH; 44% share of heat from DH systems in total heat
National supply chain for biomass for energy	++ 3 (of 3)	Support of the production of wood biomass for energy; Support of the processing of fuel wood biomass; Support for the establishment of energy crops
Awareness for DH and CHP	++ 3 (of 3)	Biomass association; Public campaign, workshops, and conferences

Annex 4: Assumptions used in the economics of CHP

Detailed economic analysis of four standard CHP cases was implemented in all pilot roadmaps and optionally in non-pilot roadmaps.

As requested detailed economic data for economic analysis of four standard CHP cases were not available or are not sufficiently reliable for making objective conclusions about the CHP profitability and comparison of economics with other member states, detailed calculation table is not included in this report.

Annex 5: Assumptions used in the market extrapolation

Roadmap scenario

Installed capacity (GWe)	2010	2020	2030	*2030-2010*
Existing units	2,46	1,55	1,33	-1,1
Reconstruction		0,91	1,14	1,1
New		0,15	0,28	0,3
Total CHP	**2,5**	**2,6**	**2,7**	**0,3**
Economic potential		**0,1**	**0,3**	
existing + reconstruction		381%	202%	
New		100%	100%	
Total new CHP investment		**1,1**	**1,4**	

Electricity generation [TWh]	2010	2020	2030	*2030-2010*
Existing units	3,80	3,06	2,61	-1,18
Reconstruction		1,80	2,25	2,25
New		0,65	1,22	1,2
Total CHP	**3,8**	**5,5**	**6,1**	**2,28**
Economic potential		**1,71**	**2,28**	
of that biomass		**16%**	**0,36**	
existing + reconstruction		62%	47%	
New		38%	53%	

Annex 6: Methodologies used to calculate the saving of primary energy and CO_2 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[31]" 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 CO_2 saving resulting from a voluntary commitment of the German industry for CO_2 reduction[32], 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 (e.g. lower carbon content of natural gas compared to coal, CO_2 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 the 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 a relevant value, representing meaningful contribution of CHP to the long-term objectives of the EU to reduce CO_2 emissions and primary energy consumption. The BAT approach of the CHP Directive has been developed to verify the high efficiency of individual plants, but not to determine actual saved CO_2 emissions and primary energy quantities by CHP expansion.

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

- replacement of separate generation by cogeneration,

- replacement of old cogeneration technologies by new ones,

- replacement of carbon-rich by low-carbon 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

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

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

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 an installation of a certain capacity (at the national level) of CHP compared to the installation of a new capacity with another technology (power plant + gas boiler). To replace older installations with state-of-the-art technology is a typical reinvestment decision. A new CHP-plant (or combination of smaller installations) would not necessarily lead to less production in older production installations, but would rather pre-empt investments in e.g. new CCGT investments.

Annex 7: Sources

[1] EUROSTAT Energy, transport and environment indicators, pocketbooks, EU, 2013

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[3] Eurostat: Combined Heat and Power (CHP) data, 11 June 2013

[4] Energy policy of the Slovak Republic, Approved by resolution of the government of the Slovak Republic No. 29 from 11 January 2006.

*[5] Ecologic Institute-eclareon, Assessment of climate change policies in the context of the European semester-Country report: Czech Republic, June 2013 (*http://ec.europa.eu/clima/policies/g-gas/progress/docs/cz_2013_en.pdf*)*

[6] ACT of 19 June 2009 on the promotion of renewable energy sources and high-efficiency cogeneration and on amendments to certain acts

[7] Slavomir Cifra: Cogeneration potential of the Slovak Republic, Slovak Innovation and Energy Agency

[8] Výnos Úradu pre reguláciu sieťových odvetví z 9. septembra 2009 –č. 7/2009, ktorým sa mení a dopĺňa výnos Úradu pre reguláciu sieťových odvetví z 28. júla 2008 č. 2/2008, ktorým sa ustanovuje regulácia cien v elektroenergetike zneni neskoršich predpisov.

[9] 221. VYHLÁŠKA. Úradu pre reguláciu sieťových odvetví z 11. júla 2013, ktorou sa ustanovuje cenova regulacia v elektroenergetike

[10] 189. VYHLÁŠKA. Úradu pre reguláciu sieťových odvetví z 23. júna 2014, ktorou sa mení a dopĺňa vyhláška Úradu pre reguláciu sieťových odvetví č. 221/2013 Z., ktorou sa ustanovuje cenova regulacia v elektroenergetike

[11] Draft Energy Security Strategy of the Slovak Republic, October 2008.

[12] National Renewable Energy Action Plan, October 2010.

[13] Akč ný plá n energetičkej efektí vnosti ná roký 2014-2016 s vý hľádom do roku 2020, July 2014.