

CODE2

**Cogeneration Observatory
and Dissemination Europe**



D5.1 Final Cogeneration Roadmap

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Leading CODE2 Partner: Jozef Stefan Institute



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Introduction and Summary

The CODE2 project¹

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 Czech Republic 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 experts².

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

Czech Republic is one of the leading cogeneration member states in the EU with a long cogeneration tradition, a rather broad awareness of cogeneration's advantages, growing CHP electricity generation, an incentive support framework for new small scale CHP investments and powerful domestic CHP manufacturers and project providers. Cogeneration fits well into the key national energy policy goals to increase energy efficiency and decrease greenhouse gases emissions especially by the necessary retrofit and replacement of existing old CHP plants in district heating systems by modern CHP units and a gradual switch from coal to natural gas and wood biomass. CHP electricity generation could increase by up to 30% over the 2010 level until 2030 and provide more than 25% of the final electricity demand becoming an important sustainable pillar of the electricity supply in the Czech Republic alongside nuclear energy and other renewable generation.

The CHP roadmap path would deliver 9 TWh/a of primary energy saving (PES) under the EED methodology until 2030. Considering the likely implementation path of such a roadmap up to 12 TWh/a PES and 6 Million tonnes of CO₂/a reductions are achievable in practice until 2030 which could contribute more than 35% of the national indicative energy saving target (13 TWh) till 2020 resulting in huge benefits for the national economy. Establishing a stable long term support framework for cogeneration and for the energy retrofit of district heating systems, along with the removal key barriers are prerequisite conditions for achieving these results. Conscientious implementation of the European Energy Efficiency Directive (EED) could significantly contribute to a significant future CHP role in sustainable energy supply for the Czech Republic and for the implementation of this roadmap.

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 October 2013 in Prague on the Cogeneration days 2013 and was later continued with several national expert consultations.

1. Where are we now? Background and situation of cogeneration in the Czech Republic

1.1 Current status: Summary of currently installed cogeneration in the Czech Republic

The Cogeneration capacity and energy production in the last years is relatively stable and reached 14% share in total gross electricity generation in 2010. 4,7 GWe of the installed CHP capacity³ produced 11 TWh of electricity and close to 34 TWh of heat in the year 2011.

The majority of electricity from CHP is produced in steam condensing extraction turbines and steam back-pressure turbines jointly 95%, internal combustion engines provide 3% and combined cycle gas turbines (CCGT) with heat regeneration provide 2%. The major fuel source (more than 75% share) is domestic coal with a growing share of RES (9%) and natural gas (7%) beside other fuels.

The installed capacity of high-efficiency cogeneration in the Czech Republic⁴ in the period 2008-2011 was less or more on the level of about 4,7 GW, but the electricity production from the high-efficiency cogeneration varied between 11 TWh and 12,2 TWh in this period. Close to 70% of this production is from public district heating plants and the rest is from industry and services. The share of cogenerated electricity in gross electricity production is around 14% (14,2% in 2010 and 12,8 in 2011).

The total CHP heat production increased from 35,4 TWh in 2008 to 37,7 TWh in 2010 and then decreased to 33,6 in 2011. More than 50% of the heat supply in the Czech Republic is provided by district heating systems. Around 70% of this heat is produced by CHP plants.

The majority of the electricity from CHP in 2010 was produced in steam condensing extraction turbines (59%, with installed capacity of 3,2 GW), followed by production in steam back-pressure turbines (36%, with installed capacity of 1,2 GW), combustion engines (3%, with installed capacity of 0,5 GW) and combined cycle gas turbines (CCGT) with heat regeneration (2%, with installed capacity of 0,2 GW).

Solid fossil fuels (brown and black coal) are the main fuels used for electricity production from cogeneration (2011) with more than 75% share in total fuel used by CHP plants, followed by renewable energy sources (mainly biogas and wood) with almost 8% share, 7,5% share of natural gas (growing in recent years, mainly in medium and small size units), 1,5% share of oil products and 8% share of other fuels.

The statistical data about the installed capacity, gross electricity and heat production from high-efficiency cogeneration in the Czech Republic⁵ in the period 2008-2011 are shown in the Table 1 and Figure 1.

³ Second Progress report on the cogeneration of electricity and heat in the Czech Republic according to Directive 2004/8/EC, June 2012.

⁴ Second Progress report on the cogeneration of electricity and heat in the Czech Republic according to Directive 2004/8/EC, June 2012.

⁵ Eurostat: Combined Heat and Power (CHP) data, 11 June 2013

Table 1 - National data on cogeneration in the Czech Republic 2008 – 2011

CHP	Installed electrical capacity [GWe]	Total heat supplied [TWh]	Total CHP electricity generated [TWh]	Total electricity generated [TWh]	Total % of gross electr. production
2008	4,82	35,45	11,88	83,52	14,22%
2009	4,76	33,31	11,05	82,25	13,43%
2010	4,79	37,69	12,24	85,91	14,25%
2011	4,66	33,64	11,18	87,41	12,79%

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

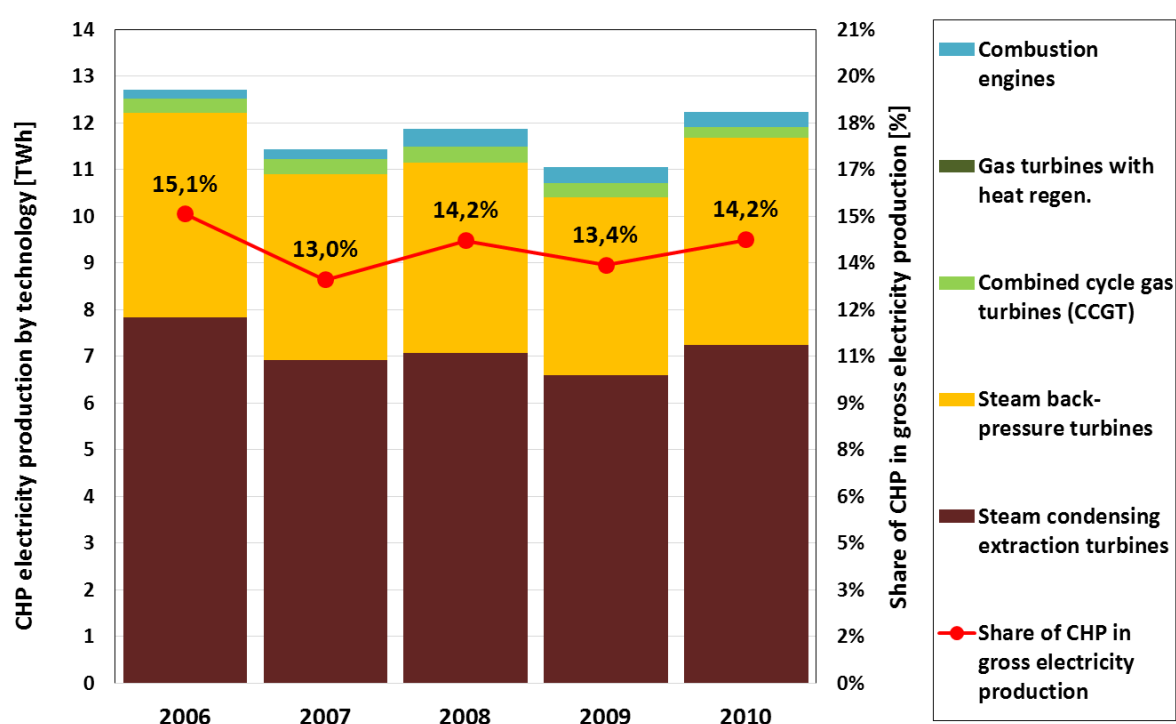


Figure 1: CHP electricity production by technology in the Czech Republic

The Czech Republic is the third largest EU net electricity exporter (after France and Germany) with about 17 TWh or 25% of gross consumption export in last period. Although close to 90% of 86 TWh gross electricity generation is generated from domestic coal and nuclear energy rapid development of decentralized electricity production happened in the last 20 and especially last 10 years with fast growth of RES generation (wind and PV).

1.2. Energy and Climate Strategy of the Czech Republic

The objective of the revised State energy concept (SEC) in 2012 gives a priority in electricity supply to the increase of nuclear power generation (from 16% to about 35% by 2040) and economically viable RES and natural gas power generation (balancing energy and cogeneration) to gradually replace current predominant role of domestic coal.

Maximising energy efficiency and the reduction of pollutant and GHG emissions are one of the key energy policy goals for the Czech Republic with ambitious targets to reduce total aggregate CO₂ emissions by 25 % by the year 2020 compared to the year 2000.

The basic priorities of energy policy of the Czech Republic⁶ are independence and safety of energy supply and sustainable development. Two main goals of the energy policy are the maximising of energy efficiency and environmental friendliness (minimising greenhouse gasses and other harmful emissions, etc.).

The revision of the State energy concept (SEC) in 2012 defines the main energy policy as being to reduce GHG emissions based on the increase of nuclear power generation from currently 16% to about 35% by 2040⁷, to decrease the use of coal (only CHP-mode new coal-fuelled energy sources will be permitted) and the gradual elimination of the support for renewable energy.

The target of the environmental policy in the Czech Republic for the first commitment period of the Kyoto protocol (2008-2012) has been an 8% reduction in GHG emissions compared to 1990. The total GHGs emissions have meanwhile decreased extremely (23.4%) mostly as a consequence of economic transformation. The last data⁸ about the change in GHG emissions for the Czech Republic for 2012 shows -35% decrease compared to 1990⁹.

The National Programme to Abate Climate Change Impacts in the Czech Republic¹⁰ sets these additional targets after the end of the first commitment period of the Protocol:

- reduce CO₂ emissions per capita till 2020 by 30 % compared to the 2000,
- reduce total aggregate CO₂ emissions to 2020 by 25 % compared to 2000,
- continue in the commenced trend to 2030.

The main measures in the energy field to achieve the goals of the energy and environmental policies are focused on the improvement of energy efficiency, increasing utilization of renewable energy sources and secondary energy sources where some of main targets of Czech Republic are¹¹:

- higher utilization of renewable and secondary energy sources,
- higher usage of energy saving potential¹²,

⁶ State energy policy of the Czech Republic, Prague 2004.

⁷ Another 2.000 MWe is planned in Temelin and heat supply to the district heating systems is foreseen for the future.

⁸ 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>).

⁹ Total GHG emissions were decreased for 5.8 Mt CO₂eq or -4.4% compared to 2011. Beside negative economic growth (GDP fell by -1.3 %), RES grew by 11 % and nuclear energy generation was increased by 7 % compared to 2011.

¹⁰ Ministry of the environment of the Czech Republic: The National Programme to Abate the Climate Change Impacts in the Czech Republic, 2004.

¹¹ Ministry of industry and trade of Czech Republic (Responses of the Czech Republic to the SLT of IEA Questionnaire): Periodic review of the Czech energy policy, Prague, September 2009.

¹² Act. No. 180/2005 Coll. on promotion of energy production from renewable energy sources and amending certain acts.

- fulfil national goal in electricity production from renewable sources in gross electricity consumption (8% in 2010), (minimally 15% in 2030) etc.,
- minimize CO₂ emissions and local pollutants, mainly in very large combustion sources.

1.3. Policy development in the Czech Republic

Green premiums, set yearly for different CHP size categories and operation hours classes is the key CHP support instrument in the Czech Republic. The Green Premiums enable an economic environment for CHP investments and operation. Special extra rates (bonuses) are paid for CHP electricity generation from renewable energy.

The development of energy policy depends and follows the development of economic policy in the Czech Republic. The energy policy is focusing on preferring renewable energy sources and the promotion of combined heat and electricity production. The support for cogeneration in the Czech Republic is published in the State Energy Concept (SEC) and the State environmental policy (SEF).

Support for high efficiency cogeneration has a long tradition in the Czech Republic, from 1 January 2013 the governing regulation is Act no 165/2012 Sb. on Promoted Energy Sources. The current support scheme for electricity from cogeneration (a universal scheme, not targeted to specific sectors) is in the form of green premiums ("green bonus") which are organised as follows:

- **Four categories according to the installed electric capacity** (up to 200 kWe, from 200 kWe to 1 MWe, from 1 MWe to 5 MWe and over 5 MWe)
- **For categories up to 5MWe each Category is split into three operating hours classes** (3000, 4400 and 8400 hours per year,) For units above 5MWe the hours classes do not exist.
- **The premium level is differentiated according to the Primary Energy Savings (PES)** with minimum support for plants which have PES below and up to 15% savings and higher support for sources above 5MWe and PES greater than 15%.
- **Special extra rates** (bonus additional to the basic rate of green bonus) are used for support of CHP electricity generation from renewable sources (solid biomass - also gasification and co-firing, biogas, mine or drained gas, etc.).
- **Support is applicable also to modernized old CHP plants** with proved improved performance.

The premium levels are set yearly by the Energy regulatory office (ERU) based on the market conditions (reflecting the actual electricity and natural gas prices). The system operates as a form of price regulation conducted by the ERU where a price decision is applied to the whole market and not as a support mechanism subject to direct state aid¹³. Overall the support for cogeneration represents only 5% of the overall financial resources for the total support which is jointly provided for renewables and CHP but contributes 48% of the total supported electricity generation.

The ERU have established a CHP project team - a team of experts and stakeholders to design a system of support for cogeneration in the Czech Republic, which is a good practice example of

¹³ As the level of the support is setting for next calendar year, stable long-term investment conditions for investors are not provided.

cooperation of different CHP market actors with the common goal of developing and maintaining a financially reasonable, sustainable and predictable CHP support environment¹⁴.

Table 2: Green premiums for fossil CHP units in the year 2014

Type of supported source (generating plant)	Installed capacity of plant [kW]		Operating hours [hr/yr]	Green premiums [CZK/MWh]
	from	to (inclusive)		
a	d	e	j	m
Combined heat and power generation except plants claiming aid under (1) and/or (2.1) hereof and except municipal waste firing	0	200	3 000	1 610
	0	200	4 400	1 150
	0	200	8 400	220
	200	1 000	3 000	1 150
	200	1 000	4 400	750
	200	1 000	8 400	140
	1 000	5 000	3 000	800
	1 000	5 000	4 400	470
	1 000	5 000	8 400	45
Combined heat and power generation simultaneously claiming aid under (1) and/or (2.1) hereof and municipal waste firing	0	5 000	8 400	45

Type of supported source (generating plant)	Installed capacity of plant [kW]		PES [%]		Energy generation efficiency [%]		Green premiums [CZK/MWh]
	from	to (inclusive)	from	to (inclusive)	from	to (inclusive)	
a	d	e	f	g	h	i	m
Combined heat and power generation plant	5 000	-	10	15	-	-	45
	5 000	-	15	-	-	45	60
	5 000	-	15	-	45	75	140
	5 000	-	15	-	75	-	200
New or modernised combined heat and power generation plant	5 000	-	15	-	45	-	200

Additional tariff I to basic tariff of green premium for electricity from CHP

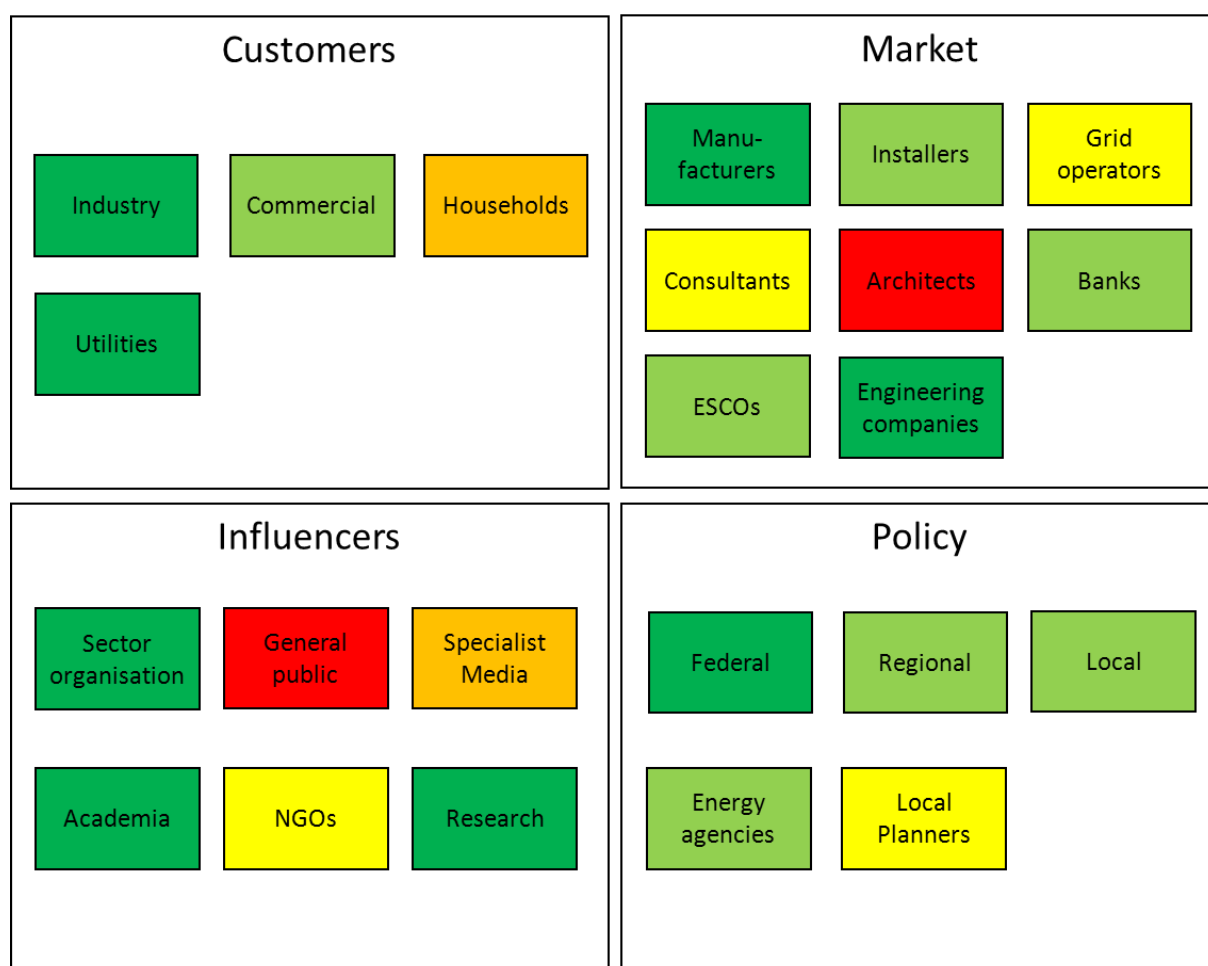
Type of supported source (generating plant)	Date of operation start		Installed capacity of plant [kW]		Biomass type and usage	Green premium [CZK/MWh]
	From	Till	From	To		
Generating plant which fire biomass	1.1.2013	31.12.2013	0	5000	O	100
	1.1.2014	31.12.2014	0	5000	O	455
Generating plant which fire (separately) gas from solid biomass gasification	1.1.2013	31.12.2013	0	2500	O	455
	1.1.2014	31.12.2014	0	2500	O	755
Generating plant which fire biogas in biogas station	1.1.2013	31.12.2013	0	2500	AF	455
New generating plant which fire biogas in biogas station	1.1.2014	31.12.2014	0	550	AF	900
Generating plant which fire mining gas or drained gas	1.1.2013	31.12.2014	0	5000	-	455
Electricity produced by firing of municipal waste or co-firing of municipal waste with different energy sources	-	31.12.2014	0	5000	-	155
Generating plant which fire (separately) natural gas	-	31.12.2014	0	5000	-	455

¹⁴ Current support level is appropriate for optimal and maximum efficient CHP project only.

1.4. Exchange of information and awareness in the Czech Republic

A long CHP tradition in industry and district heating and a well developed CHP market with domestic manufacturers and technology providers are key drivers for a reasonably high level of CHP awareness in Czech Republic. A proper awareness of other market links like supportive energy policy, a positive attitude of financial institutions, ESCOs, energy companies, sector organisations and research, are very much key drivers for the stable volume of CHP investments.

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 2. 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 2: Assessment of four groups of the socio-economic actors' awareness of cogeneration in Czech Republic

Customers

There is an active and growing CHP market especially in services sectors, industry and district heating CHP applications, with an associated reasonable level of CHP awareness by customers in all sectors, which is driven mainly by market players and good practice exchange.

Market players

There is a well-developed manufacturers, technology providers and energy companies sector which are key CHP market driven players. The practically based CHP awareness of financial institutions and installers beside other actors is crucial for fluid CHP investment market in Czech Republic which is facing strong competition from other heat supply technologies (heat pumps, wood biomass, etc.), especially in services and households.

Influencers

Several sector organisations (**Association for the District Heating of the Czech Republic** and **COGEN CZECH**) are very active and complementary in CHP promotion between different market players. Renewable energy sources is a key focus of most of the NGOs which seem often to have a rather negative attitude to cogeneration support mainly due to government stop of the PV and other RES electricity generation support. Good CHP research support exists in the Czech Republic and the inclusion of CHP in education programs is an important factor for the quality level of CHP development

Policy makers

Cogeneration awareness is reasonably high among the relevant policy makers as it is well positioned in Czech national energy policy resulting in one of the most attractive and active CHP support frameworks in EU. The future position of CHP strongly depends on how the EED is implemented (foreseen till the end of 2014), especially in the analysis of the heating and cooling potential. Future development of nuclear energy will have an important influence on CHP investments. Energy agencies know CHP sufficiently well however they are more oriented to RES solutions.

1.5. The economics of CHP in the Czech Republic

The current CHP support framework enables a reasonable profitability for micro CHP units in services and CHP units up to 5 MWe on natural gas across the economy. By contrast the economic conditions for larger coal and RES CHP units are modest or 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.

An economic analysis is made on four CHP cases, which are standardized within the CODE2 project to compare the economic situation of CHP between the Member States. The cases are:

- a **50 kWe internal combustion engine (ICE)** installed in a hotel
- a **1 MWe internal combustion engine installed (ICE)** in an industrial plant
- 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.

Results for Czech Republic¹⁵ CHP economic indicators, shown in Figure 3 show, that only micro CHP unit in hotel achieves appropriate profitability level (IRR 7%), whereas all other CHP cases are facing zero or negative IRR, below typical investors' profitability expectations.

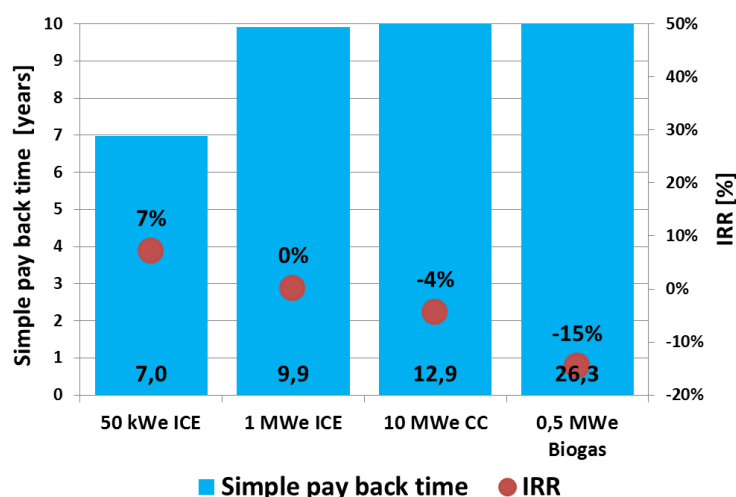


Figure 3: Economic calculations of for reference CHP plants in Czech Republic

In spite of prevailing negative economic indicators for standard CHP cases, current market conditions show more optimistic and “normal” market situation, especially for micro CHP units in services and other CHP units on natural gas up to 5 MWe in all sectors. This proves that only optimal and very

¹⁵ The details of this economic analysis can be found in Annex 4: Assumptions used in the economics of CHP.


efficiently implemented CHP projects are economically viable within established support framework, which is important challenge for the investors.

The very modest situation is typical for larger coal and RES plants, whereas conditions for larger natural gas CHP units are poor.


Table 3: Market economic situation of CHP in major user groups

Czech Republic	Micro		Small & Medium		Large		
	up to 50kW		up to 10 MW ¹⁶		more than 10 MW		
	NG	RES	NG	RES	NG	Coal ¹⁷	RES
Industry							
District heating							
Services							
Households							

Legend:

 **"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.

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

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

 **Not applicable** for the sector

NG **Natural Gas** or appropriate fossil fuel

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

1.6. Barriers to CHP in the Czech Republic

An unreliable long term perspective of the support framework for CHP is the key risk and barrier for new CHP investment in the Czech Republic, in spite of current favourable conditions for CHP projects. Weak support for the increase of competitiveness of existing district heating systems is a threat for the future development of these systems where majority of existing CHP plants are located.

¹⁶ Assessment relevant for CHP units up to 5 MWe only.

¹⁷ Market potential for larger coal and RES CHP is only within the reconstruction of existing units (no potential for new units.)

In the second CHP progress report (2012) presented to the EC [1] the Czech government has indicated planned measures for the removal of three important barriers to CHP:

- a) **Lengthy authorization processes** for energy facilities – amendment of the Building act.
- b) **Reserved connection capacities** for not implemented RES project – option of cancellation introduced in new act on promoted energy sources
- c) **Negative influence of additional ETS costs** for CHP units above 20 MW input power – new carbon tax introduced to non-ETS sector.

Beside these the following additional general barriers have been identified:

- Unclear long-term prospects in the area of state aid;
- A complex legal framework;
- Complex and time-consuming administrative procedures;
- The influences of other legislation;
- The availability of connection to the grid (financial, time-related);
- The updating of the grid in order that electricity generated by way of cogeneration may be supplied;
- Unfavourable conditions for reserve supplies of electricity from the grid;
- Delayed submission of reports on cogeneration.

Although several listed barriers have been successfully mitigated and the Czech Republic is one of the newer EU member states where current policy and regulatory framework is positive and adequate for CHP investments, based on recent market assessment and expert opinion we have identified three still existing barriers for faster and stable CHP development, listed in descending order of importance:

Barrier 1: Unreliable long term support framework for CHP poses risks for investors

Although the current CHP support scheme is one of the most attractive in Europe, the long term perspective is unclear linked to the uncertainty in future energy policy, where future role of nuclear energy and security of natural gas supply are the most actual influencing issues. The question of state aid compatibility with present support scheme and any modifications is increasing the risks for potential CHP investors, especially for the more economically exposed SMEs. The notification process to the European commission of the support for electricity and heat produced from RES and cogeneration started already in January 2013 and has not been completed at the time of writing. (the case has been split and positive decision was issued on June 2014 for RES electricity support only¹⁸).

Barrier 2: Weak support for the increased competitiveness of District Heating systems compared to other heat supply options hampers the growth of CHP and district heating.

Increasing the energy efficiency of existing old district heating systems (DH) is a key challenge for the future development these systems in the open competition between all heat supply options in buildings. For district heating based CHP and the associated heat networks to prosper requires a well-structured proportionate support scheme to enable energy retrofit of the inefficient old heat

¹⁸ State aid SA.35177 (2014/NN) – Czech Republic – Promotion of electricity production from renewable energy sources.

network and its further expansion. The share of current cohesion funds investment by the Czech regions for measures enabling exploitation of the large energy savings potential in the energy supply system is not proportionate to the opportunity and the large majority of investment is allocated to other end use energy efficiency measures¹⁹.

Additional ETS costs and higher air quality requirements for larger production units (IED²⁰) are eroding the competitiveness of District Heating compared to individual heat supply options, resulting in a need for additional investment to modernise and upgrade the larger plants and network systems through this transition period in legislation.

Barrier 3: A Complex legal framework around CHP and around CHP grid connection adds cost and risk to CHP projects which translate in to a barrier to additional investment.

The legal framework around CHP is still complex and time consuming in administrative hours. Procedures such as authorisation are bureaucratic and extensive and the involvement of and absence of co-ordination between several competent authorities still creates a substantial barrier for investors.

Extensive documentation and requests for additional equipment investments around the connections point (more than necessary) should be eliminated and simplified to decrease time and additional investment costs of the grid connection. These latter points especially burden investment profitability of smaller CHP units and SME installation.

2. What is possible? Cogeneration potential and market opportunities in the Czech Republic

The evident economical CHP potential which exist in the Czech Republic should be re-assessed within Energy Efficiency Directive prescribed comprehensive assessment. 2,8 GW or 5,6 TWh of additional CHP generation was earmarked as additional economic CHP potential up to the year 2020 in the National potential study from 2006, and this should be reconfirmed. Additionally the growing role for bio and micro CHP potential proved by recent CODE2 analysis highlights additional opportunities.

Following latest Czech National energy efficiency action plan²¹, a 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 Analysis of the National Potential for High-Efficiency Cogeneration in the Czech Republic from 2006²² is the most relevant source on cogeneration market potential.

¹⁹ Potential savings in energy generation and distribution could be more balanced assessed in NEAP where more than 75% of savings are coming from end use measures.

²⁰ Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).

²¹ Issued on 30th April 2014.

²² Report on the Results of the Analysis of National Potential of Combined Electricity and Heat Generation in the Czech Republic Pursuant to Directive 2004/8/EC, January 2006.

The additional technical CHP potential out to 2020 was estimated (2006) at more than 36 TWh of electricity or 30 GWe expressed in electrical capacity. Only 9% of total estimated technical potential (2,8 GW or 5,6 TWh) was earmarked as additional economic CHP potential till the year 2020. To achieve 2,8 GWe increase of CHP capacity, 2,3 GWe of new investments was foreseen as refurbishment of existing large and aging coal CHP units with a gradual switch to natural gas and wood biomass (also co - firing with coal) and 2,2 GWe of new CHP units, mainly industrial and small scale units on natural gas and liquid fuels.

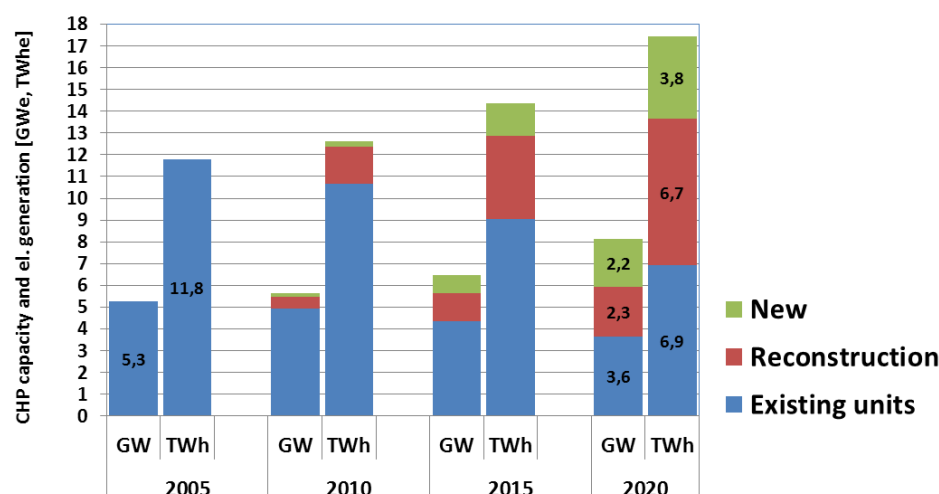


Figure 4: Cogeneration expansion - economic potential in the period 2005 - 2020

It is now a challenge to produce such an increase in CHP capacity under the current difficult and changed market conditions. Recent trends of stable investments in small scale CHP units (app. 20 MWe new installed capacity per year) proves the market potential in services, households and industry, especially in case of faster economic crisis recovery in EU. These small units are at the capacity which can provide energy cost advantages for SMEs and their important increase of competitiveness. At present the refurbishment and repowering of existing large CHP units in district heating systems is driven by increased environmental restrictions and gradual decrease of domestic coal exploitation and the need to increase the efficiency and competitiveness of older plants. This represents an opportunity to upgrade the plants and also address the new plant design the changes foreseen for the electricity market as decarbonisation out to 2030 creates a demand for more flexibility in electricity supply units and favours smaller generating capacities than was historically the case. Current support from cohesion funds is appreciated but not sufficient to enable retrofit of all heating infrastructure needed for further CHP operation and development.

Bio energy

Currently there is around an 8% share of renewable fuels used in CHP generation, more than 60% of that is wood biomass. This could be increased in the future, especially with co-combustion of wood biomass with coal in larger CHP units and the technological development of biomass gasification in smaller CHP applications.

An analysis of Bio CHP potential for the Czech Republic was carried out within CODE2 project, based on published bio –energy forecasts and member states own reporting with a “score cards analysis”.

The analysis suggests that the potential for bio CHP growth up to the 20% of CHP generation exists to 2030 (see annex 3) which is in line with the revision of the State energy concept [9] where an almost 60% increase of wood biomass is foreseen in 2030 compared to the 2010 consumption.

Micro CHP

The CODE2 micro CHP potential analysis estimated that the market potential for micro CHP units in the Czech Republic is around 700 units per year (16 MWe) in the year 2020 (300 units of ± 1 kWe in households and 400 units of ± 40 kWe in services) which in terms of total capacity fits to the current trends (20 MWe of small scale CHP units per year) although the current market conditions are still not enabling the smallest CHP investments in single family houses to take place (see Annex 2).

3. How do we arrive there? The Roadmap

Following the current ambitious energy policy goals and orientations the Czech Republic can remain one of the leading European cogeneration countries with further growth of CHP generation and global export of CHP technology. Cogeneration can significantly contribute to the key energy policy priorities namely the maximising of energy efficiency and environmental friendliness (minimising greenhouse gasses emissions) and can complement the development of nuclear energy generation and the use of RES for heating (heat pumps).

3.1. Overcoming existing barriers and creating a framework for action in the Czech Republic

Establishing a long term stable and predictable legal incentive framework for cogeneration is a key priority necessary for the future CHP development in the Czech Republic. Intensifying the support instruments for increasing the 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 used as an important tool for putting CHP policy in place and to push for an increase of the efficiency in heat supply where simplification of administrative procedures and grid connection is one of the important issues.

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

The existing support scheme is one of the best in the EU with careful annual setting of the level of the support offered (CHP project has to be optimally built and operate with maximum efficiency in the locations with reasonable heat demand to achieve the requested profitability) with a necessary yearly adaptation to the actual market conditions (gas and electricity prices) and incentives for the CHP support of grid operation (peak operation units). The key current weak point is the lack of a long term perspective on how this support mechanism may evolve or be modified which is crucial for the investors. The Czech Ministry and DG Competition should speed up and intensify the communication to quickly complete the notification procedure and resolve the question of state aid compatibility. Based on that and on the set energy policy goals the Czech Government should prepare a long term CHP support framework for further development of modern cogeneration applications in Czech Republic under the EED article 14.

Within Energy regulatory office (ERU) established CHP project team of experts and stakeholders should continue with operation and be deeply involved in this process.

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

The majority of current CHP generation is traditionally linked to the district heating (DH) systems which present a very important infrastructure resource for the efficient and environmentally friendly heat supply today and also in the future. This network is of increasing importance for the flexibility of fuel use which it can introduce to heat supply allowing different fuel options and fuel switching in situations where security of supply may be a concern. Enforcing the support instruments to increase the grid efficiency and around the necessary plant environmental retrofit (IED requests) are crucial to enable future competitiveness and economic operation of DH systems. Special emphasis should also be placed on small local heating networks with old heat only boilers where CHP units could easily be introduced and ease fulfilment of IED requirements by boiler replacement.

The Ministry of Industry and Trade should allocate proper and balanced finance resources for the implementation of measures to increase the efficiency in energy supply compared to the measures directed at the demand side. Linking Energy policy and industry policy in this respect is an advantage. This can be in continuation of already established schemes of investment subsidies and other financial instruments for increasing efficiency of heat supply systems in the next financial perspective (2014 – 2020) by Operational Programme Entrepreneurship and Innovations for Competitiveness 2014-2020²³ and foreseen also in NEAP 2014²⁴.

Article 3 of the EED requires that energy targets be expressed eventually in primary energy savings (PES) terms where the member state can gain substantial improvements through CHP. Article 14 and 15 EED clearly encourage energy savings measures along the supply chain and Article 7 allows the use of CHP in meeting the energy efficiency improvements necessary in end use.

Action 3: Fast and quality implementation of EED – especially 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 district heating and cooling (DHC) options. The CBA for market potential could contribute to better awareness of the cogeneration opportunities in all sectors and the potential contribution to the national strategic climate energy goals with the approval of necessary additional adequate measures for the cogeneration support.

The EED implementation is also an ideal tool to bring other benefits for increase efficiency in heat supply:

- **Clear priorities in heat supply** (Article 14 (4)) – new comprehensive approach as basis for the shaping of local legislative rules and practice on municipality level to enforce local energy planning and new sustainable investments in the heat supply.
- **Assessment of energy efficiency potential in gas and electricity infrastructure** (Article 15 (2)): as cogeneration has positive influence on better infrastructure utilisation, decrease of losses and load balancing, assessment should better position the role and contribution of cogeneration units to the energy efficiency in gas and electricity grids.

²³ Priority Axis 3 "Effective management of energy, energy infrastructure development and renewable energy sources, support the introduction of new technologies in areas of energy waste and secondary raw materials".

²⁴ Measure 2.24 - Increasing the efficiency of heat supply systems.

- **Improving access to electricity networks and priority of dispatch for cogeneration** (Article 15 (5)) – introduction of improvements and new simple procedures, especially for small scale cogeneration units and SMEs).
- **Enable conditions for introduction of system services from cogeneration** (Article 15 (6)) - demand response, balancing, etc.

Action 4: Simplification of the administrative procedures and grid connection

Further efforts of all involved authorities (Ministries, Network operators, Regulator, etc.) should be made to remove the administrative barriers around efficient and fast CHP project implementation and grid connection, following also requirements from EED (Article 15)

Special emphasis should be put on micro CHP potential following the provisions from the article 14 and 15 (5) of the EED: simple notification “install and inform”, net metering, etc. where more opened approach should be introduced in the Energy law for units up to 10 kWe.

3.2. A possible path to further growth of CHP in the Czech Republic

CHP could contribute more than 25% of final electricity demand and become the sustainable pillar of electricity supply in the Czech Republic through establishing a long term stable and incentive legal framework for cogeneration and district heating systems proposed in CHP road map implementation. By necessary replacement of ¼ of existing CHP capacities by 2,3 GWe of modern CHP plants and 40% implementation of economic potential or 0,9 GWe of new CHP units current CHP electricity generation could be increased for 30% to 16 TWh till the year 2030.

Following the trends of recent years CHP electricity generation at the level of around 12 TWh_e we can expect only minimum growth in the future with results far from the assessed economic potential and economic opportunities under a business as usual approach

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 CHP growth is evident in district heating systems, process industry, SMEs and services (for various technologies and growing share of renewable energy), although before the implementation of comprehensive assessment of actual potential due under the EED we can reasonably take part of the economic potential assessment from 2006 as a target CHP path to growth till the year 2030:

- **Reconstruction of 25% of existing old CHP capacity** largely situated in district heating systems and industry (**1,2 GWe**) – which is necessary due to the lifetime expiration and new environmental restrictions – **by new CHP capacity of 2,3 GWe and 6,7 TWh_e of electricity generation,**
- **40% implementation of new CHP plants economic potential mainly in industry, services and smaller DH systems – 0,9 GWe and 2,6 TWh_e of electricity generation,**

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

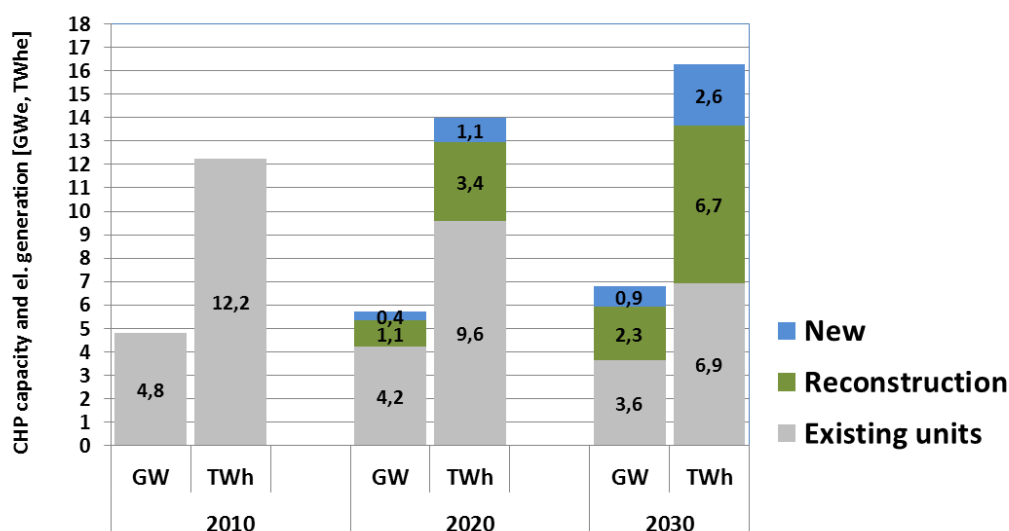


Figure 5: Target path to CHP growth till the year 2030

- **CHP electricity generation:** an increase for 4 TWh_e to 16 TWh or more than 30% of current 12 TWh_e generation, with the largest contribution of existing reconstructed CHP plants in district heating systems, partial switched to renewables and natural gas (6,7 TWh_e generation in reconstructed units as supplement for 5,3 TWh_e generation in old replaced CHP plants).
- **Share of cogeneration electricity in final energy demand:** the share of CHP electricity generation in final energy demand could be increased from 21% to 26% by 2030 and establish this energy efficiency technique as an important pillar for sustainable electricity generation in Czech Republic beside nuclear and other renewable generation.

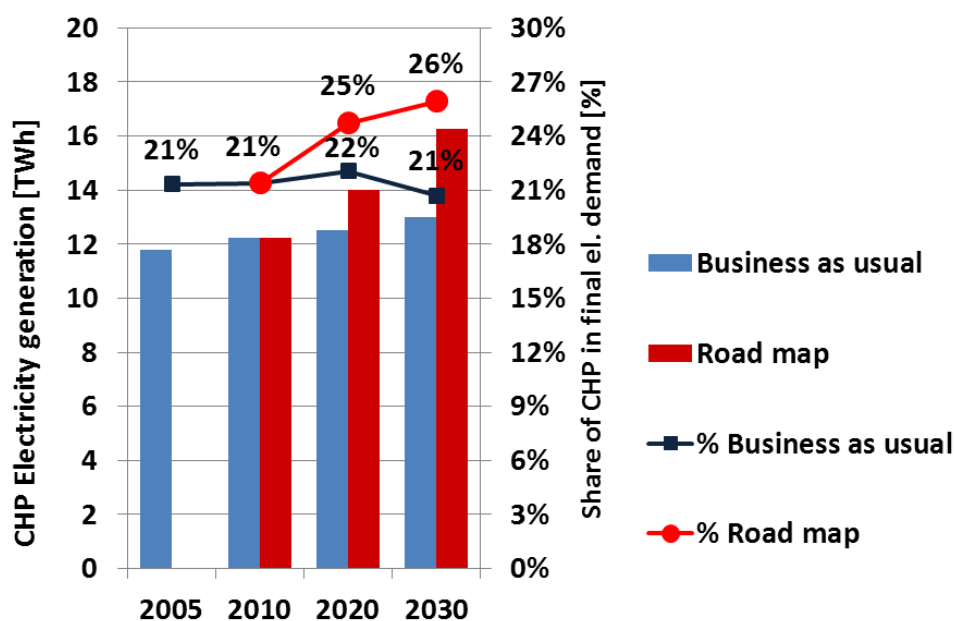


Figure 6: CHP Roadmap Electricity indicators

3.2. Saving of primary energy and CO₂ emissions by the CHP roadmap

The Potential CHP primary energy savings could contribute more than 35% of the indicative national target of energy savings till the year 2020 and reduce CO₂ emissions for up to 6 million tons of CO₂ till the year 2030.

Within CODE2 project two approaches for assessment of primary energy savings (PES) and CO₂ emissions savings are used to demonstrate advantages and contribution of CHP technology to the reduction of energy use and CO₂ emissions:

1. **Methodology prescribed by EED** (according to Annexes I and II) ²⁵
2. **Substitution method** – new developed method for assessment of actual achieved savings ²⁶

New CHP generation proposed by Road map would contribute **9 TWh of PES (32 PJ)** calculated by the EED methodology or **up to 12 TWh of PES (43 PJ)** calculated by substitution method as shown in Table 4. Especially reconstructed CHP plants which are replacing existing low efficient coal 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 substitution method are for 1/3 larger than assessed savings by 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.

Assessed CHP PES potential (12 TWh till 2030, 5 TWh till 2020) is very close to 13,3 TWh of the set indicative national target of final energy savings in the year 2020²⁷ which mean that implementation of CHP roadmap can contribute more than 35% to the national goals of energy savings or even more with faster CHP road map implementation toward the year 2030.

By using same approach potential real achievable CO₂ savings by substitution method are 6 miot of CO₂, much higher than 2 miot of CO₂ savings by EED methodology²⁸. By increasing the share of renewable energy and faster transition to natural gas potential CO₂ savings would be even higher.

²⁵ **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.

²⁶ **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.

²⁷ Set in NEEAP 3 - Národní akční plán energetické účinnosti ČR, april 2014, page 7.

²⁸ CHP plants using renewable energy are not achieving CO₂ savings by EED methodology (compared to separate renewable generation), but in reality they are replacing current coal generation.

Table 4: Saving of primary energy and CO₂ by the CHP roadmap till 2030

	Substitution method		EED method	
	Business as usual	Road map	Business as usual	Road map
PE saving	2 TWh/a	12 TWh/a	2 TWh/a	9 TWh/a
CO₂ saving	1 Mio t/a	6 Mio t/a	0,4 Mio t/a	2 Mio t/a
- per kWh_{el}*²⁹	1,55 kg/kWh _{el}	1,56 kg/kWh _{el}		

²⁹ 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.

Annex 1: Stakeholder group awareness assessment

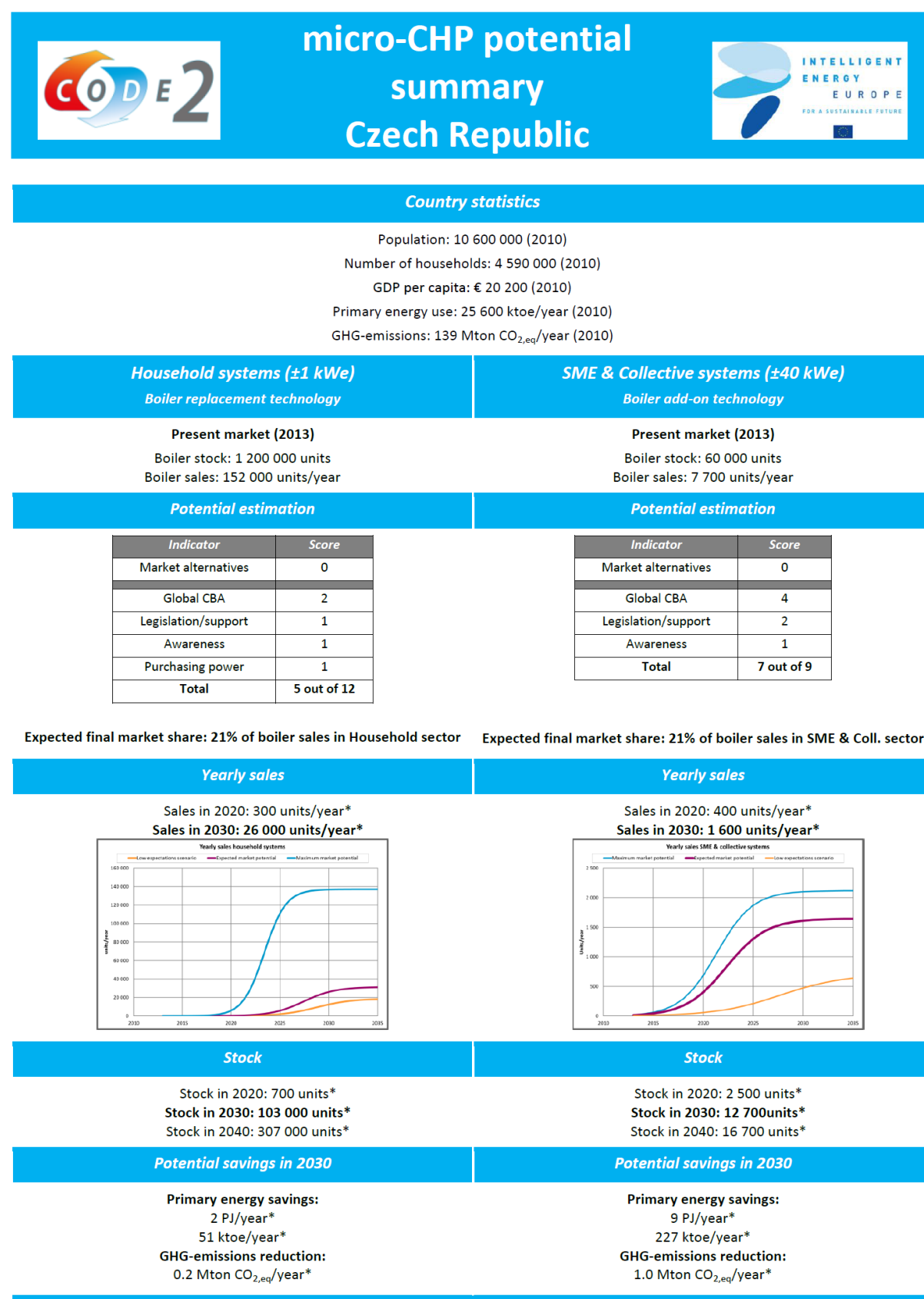
Users	
Industry	CHP is well known and normal standard solution in industry, traditionally from old steam units and new modern gas CHP units nowadays. Requested very short payback period (1-3 years) is key restriction for faster development.
Utilities	The cogeneration is usual technology in bigger plants supplying heat to industry and larger district heating systems. There are still some smaller district heating systems without cogeneration although several new CHP units, especially gas engines, have been installed in last decade. Actual decrease of heat demand and reduction of heat losses are key challenges for utilities when considering feasibility of new CHP plants.
SMEs	SMEs are getting more and more aware of CHP technology, especially of gas engines, where efficient CHP solution with short payback time should be competitive to the other potential investments in companies (other technology and efficiency investments).
Households	Cogeneration technology is far less known than more competitive and popular heat pump solutions in households. Due to proper CHP support of 30-50 kWe CHP units, gas engines are getting competitive heat supply source for multifamily buildings, although sometimes inappropriate competition to district heating. Awareness of cogeneration is growing and facing very strong competition with other heating options.
Market and supply chain	
Manufacturers/ Technology providers	Czech Republic has very mature market of CHP technologies with several domestic CHP manufactures and strong competition with other domestic and foreign technology providers.
Installation companies	Cogeneration is well known by installation companies with proper number of CHP installers for the CHP market in Czech Republic. Installation companies often prefer heat pumps, boilers and other more simple heating technologies.
Grid operators	Negative effects of recent PV boom caused negative attitude also to other decentralised sources (CHP treated the same as PV) but in general the level of cogeneration awareness among grid operators has risen and smart grid concept discussion has already started.
Consultants	Consultants are in principle acquainted with CHP, but often focussed on other technologies.
Architects	Architects are not thinking about cogeneration; still not well know the technology and new buildings are usually designed without CHP.
Banks, leasing	The financial sector is well acquainted with cogeneration technology and support environment and is active in the CHP project financing. Financial institutions are interested in new technology investments although unstable investment conditions (policy risk) and sometimes low profitability are key

	barriers for financing CHP projects in comparison with other perspective investments.
ESCOs	In spite of mature ESCO market, CHP installation is not usual measure in EPC. Several big energy companies (CEZ, RWE, EON, etc.) are active in investments and financing of CHP projects in different sectors.
Policy	
Policy makers on different levels	Cogeneration awareness is on rather high level as it is well positioned in the national energy policy which result in one of the most attractive and CHP active support framework in EU. Future position on CHP strongly depend on the way of EED implementation (foreseen till the end of the year), especially on the analysis of heating and cooling potential.
Energy agencies	Energy agencies know CHP although they are more oriented to RES solutions.
Planners	CHP is in principle known, but the CHP market is key driver for new investments.
Influencers	
Sector organisations	Several sector organisations are very active in the area of cogeneration, especially Association for the District Heating of the Czech Republic (www.tscr.cz), established in 1991 with the purpose to promote in the Czech Republic the development of district heating systems and CHP and COGEN CZECH (www.cogen.cz) Cogeneration association, with linking especially CHP manufacturers and small CHP operators, and all other actors interested in proper CHP support and favourable legislative and economic conditions for the development and promotion of CHP.
General public	General public awareness about cogeneration in Czech republic is low (in general people don't know about CHP or even not want to know). People who work with energy are very familiar with cogeneration.
Media	No special attitude to CHP in media for the general public.
Academic area/ Research	Good research support, CHP part of the programs on faculties.
NGOs	Prefer renewables, several against current CHP support (stopped for RES).

Legend:

	Active CHP market		Low CHP awareness
	Interest in CHP		Poor CHP awareness
	Early CHP awareness		

Annex 2: Micro CHP potential assessment



*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		±40 kWe systems (SME & Collective systems) Boiler add-on technology	
Scorecard		Scorecard	
Indicator	Score	Indicator	Score
Market alternatives	0	Market alternatives	0
Global CBA	2	Global CBA	4
Legislation/support	1	Legislation/support	2
Awareness	1	Awareness	1
Purchasing power	1	Total	7 out of 9
Total	5 out of 12		
Market alternatives		Market alternatives	
There is strong competition of other heating technologies in households: extensive district heating systems in towns, heat pumps (low electricity prices), wood biomass (cheap heating source).		There is strong competition of other heating technologies in services: extensive district heating systems in towns, heat pumps (low electricity prices).	
Global CBA		Global CBA	
SPOT: 9 years		SPOT: 3 years	
Legislation/support		Legislation/support	
Current incentives on microchip: not yet sufficient for the economic project implementation		Current support offer moderate incentives for this size CHP project implementation in service sector triggering several investments in recent years	
Awareness		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. Manufacturers are not yet active in the market.		With proper support, strong domestic equipment producer and several number of successful CHP projects awareness in services is growing and is on moderate level.	
Purchasing power			
GDP: € 20 200 per year			

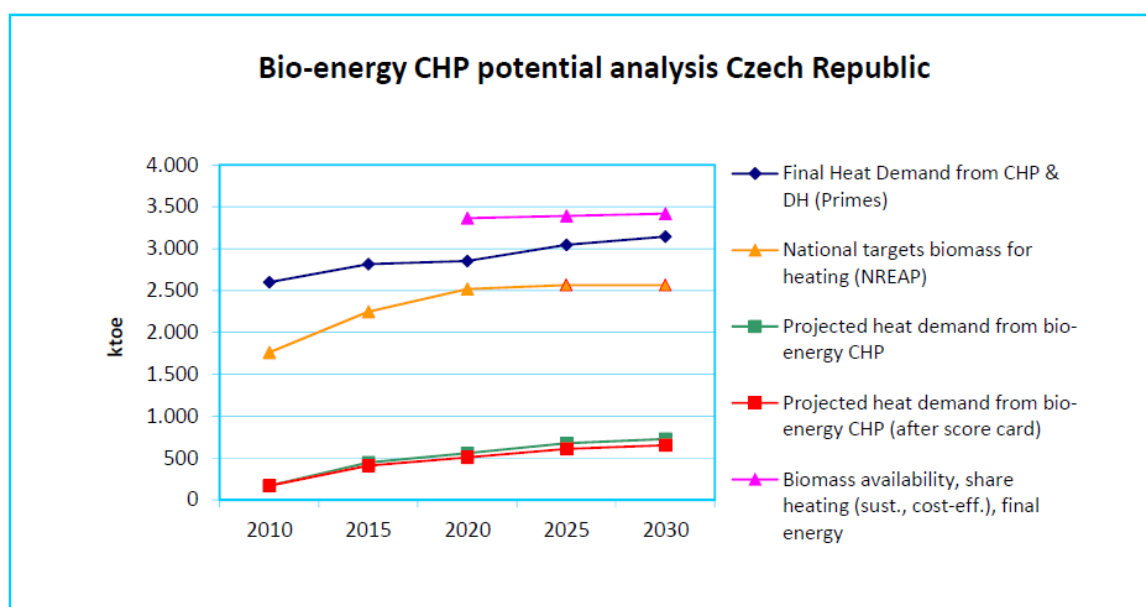
Annex 3: Bio CHP potential assessment



Bio-energy CHP potential analysis Czech Republic



Figures (projections)	2010	2020	2030
Final heat demand from CHP and DH (PRIMES, IEA), ktoe	2.600	2.853	3.145
(Projected) heat demand from bio-energy CHP and DH (after score card), ktoe	168	507	652
Bio-energy penetration rate in CHP markets (2009: EEA, Eurostat)	6,4% (2009)	17,8%	20,7%
Biomass availability, share heating (sust., cost-eff.), final energy (Biom. Futures), ktoe		3.362	3.416



Framework Assessment (Score card)	Score	Short analysis
Legislative environment	++ 3 (of 3)	Support scheme for CHP and heat from RES: 2 schemes of operational support: feed-in prices and green bonuses
Suitability of heat market for switch to bio-energy CHP	+ 2 (of 3)	Support for eco-energy in industry (efficient energy generation)
Share of Citizens served by DH	+ 2 (of 3)	The share of citizens served by DH is about 38%
National supply chain for biomass for energy	++ 3 (of 3)	Available biomass potential Wooded country with 63% of land covered by forest
Awareness for DH and CHP	++ 3 (of 3)	<ul style="list-style-type: none"> Biomass association, NGO for sustainable development Public campaign, workshops and conferences

Annex 4: Assumptions used in the economics of CHP

Sector		Heating in services and multifamily houses	Industry and service process heat and heating supply	District heating	Bio gas CHP (agriculture, waste, industrial wastewater or sewage treatment)
		50 kWe ICE	1 MWe ICE	10 MWe CC	0,5 MWe Biogas
Technology		ICE	ICE	CC	ICE
Power	MW _E	0,05	1	10	0,5
Efficiency-el.	Eff _{EL}	34%	40%	46%	38%
Efficiency-th.	Eff _H	56%	45%	42%	37%
Efficiency-sum.	Eff _{SUM}	90%	85%	88%	75%
Operation	h/a	4.400	4.400	7.500	7.500
Fuel	MWh	647	11.000	163.043	9.868
Electricity	MWh	220	4.400	75.000	3.750
Heat	MWh	362	4.950	68.478	3.651
Investment	EUR	93.000	1.100.000	10.000.000	1.900.000
	€/kWe _I	1.860	1.100	1.000	3.800
O&M costs	% of Inv.	5%	5,2%	4,5%	6%
	€/MWh	19,6	13,0	6,0	30,4
Price of fuel	€/MWh	52	37	35	25
Value of electricity	€/MWh	89	43	35	35
Other market revenues	€/MWh				
Value of heat	€/MWh	52	39	37	31
Support					
Electricity	€/MWh _{EI}	58,36	43,82	23,82	49,82
Other support or benefits	€/a				
Investment subsidy	€				
Costs & revenues					
Fuel	€/a	-33.551	-403.333	-5.736.715	-246.711
Electricity	€/a	19.556	187.407	2.638.889	131.944
Heat	€/a	18.789	191.053	2.536.232	114.104
Support	€/a	12.840	192.800	1.786.364	186.818
Other market revenues	€/a	0	0	0	0
O&M costs	€/a	-4.319	-57.037	-450.000	-114.000
TOTAL	€/a	13.315	110.890	774.769	72.156
SPB	years	7,0	9,9	12,9	26,3
IRR	%	7%	0%	-4%	-15%

Annex 5: Assumptions used in the market extrapolation

Installed capacity (GWe)	2010	2020	2030	2030-2010
Existing units	4,79	4,22	3,64	-1,15
Reconstruction		1,14	2,28	2,28
New		0,35	0,88	0,9
Total CHP	4,8	5,7	6,8	2,01
Economic potential		0,9	2,0	
existing + reconstruction		62%	56%	
New		38%	44%	
Total new CHP investment		1,5	3,2	
Electricity generation [TWh]	2010	2020	2030	2030-2010
Existing units	12,24	9,58	6,93	-5,31
Reconstruction		3,36	6,72	6,72
New		1,05	2,63	2,6
Total CHP	12,24	13,99	16,27	4,03
Economic potential		1,75	4,03	
of that biomass		15%	0,63	
existing + reconstruction		40%	35%	
New		60%	65%	

Annex 6: 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"³⁰ 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 reduction³¹, 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 CO₂ 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, CO₂ neutrality of bioenergy)

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

³¹ The calculation has been made by the VIK Verband der Industriellen Energie- und Kraftwirtschaft e.V., 2010, Unpublished.

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 has 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,

- replacement of separate generation by cogeneration
- replacement of old by new cogeneration technologies
- 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 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 pre-empt investments in e.g. new CCGT investments.

Annex 7: Sources

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- [2] *Source: Report evaluating the progress towards increasing the share of high-efficiency cogeneration in the total*
- [3] *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)*
- [4] *The energy regulatory office's Price Decision No. 4/2013 of 27 November 2013, laying down aid for promoted energy sources, (<http://www.eru.cz/en/cr>)*
- [5] *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>)*
- [6] *Act no 165/2012 Sb. on promoted energy sources (165 ZÁKON ze dne 31. ledna 2012 o podporovaných zdrojích energie a o změně některých zákonů) (<http://aplikace.mvcr.cz/sbirka-zakonu/SearchResult.aspx?q=2012&typeLaw=zakon&what=Rok&stranka=14>)*
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