Impacts of New EU and Czech Environmental Legislation on Heat and Electricity Prices of Combined Heat and Power Sources in the Czech Republic

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Abstract

In my economic model I calculate the impact of the new EU ETS Directive, the Industrial Emissions Directive and the new air protection law on future heat and electricity prices for combined heat and power sources. I discover that there will be a significant increase in heat and electricity prices, especially because of the implementation of new so-called benchmark tools for allocating allowances. The main problem of large heat producers in this respect is loss of competitiveness on the heat market due to emerging stricter environmental legislation, which is not applied to competitors on the heat market (smaller heat sources). There is also lack of clarity about the modalities for allocating free allowances, and about the future development of the whole carbon market (the future European allowance price).

Keywords: district heating (DH), combined heat and power (CHP), benchmark, EU emissions trading scheme (EU ETS), industrial emissions directive (IED), uropean allowance (EUA), climate-energy package (Package), climate change committee (CCC), member state (MS).

1 New EU legislation

1.1 Emission trading

The Climate-Energy Package (Package) was adopted in June 2009. It consists of 4 parts. The main part is the Directive 2009/29/EC (source [1]) amending existing Directive 2003/87/EC (source [2]) establishing a scheme for greenhouse gas emission allowance trading within the EU — the so-called EU emission trading scheme (EU ETS). Directive 2003/87/EC was already amended in 2004 by Directive 2004/101/EC. The scope of the new Directive 2009/29/EC inter alia includes EU greenhouse gas targets to decrease GHG emissions by 20 % by 2020. The final text was adopted after long debates, and it contains many terms that need to be further defined by the relevant authorities. This task falls to the so-called "Climate Change Committee" (CCC), which was established by Directive 2003/87/EC. CCC acts as an implementing body for all EU ETS Directives (2003/87/EC, 2004/101/EC and 2009/29/EC).

The most important aspect of Directive 2009/29/EC for all installations in EU ETS concerns the new allocation tool — auctioning of allowances, which should serve as a universal approach for distributing European allowances (EUA) from 2013 onwards. Auctioning means that all EUAs will not be distributed to producers free of charge (as they are now) but producers will have to purchase them in open auctions. There are several exceptions to this rule.

- Free allocation will be given to sectors endangered by so-called "carbon leakage" — meaning sectors like steel or lime production, which could be moved to countries outside the EU because of higher costs. This rule is not applicable to DH sources.
- A transitional free allocation will be given for the modernization of electricity generation — fulfilling at least 1 of 3 criteria given by Directive 2009/29/EC, a Member State can ask for a partial free allocation of EUAs for electricity producers. The market value of free EUAs has to be used for retrofitting and upgrading the infrastructure and clean technologies.
- A free allocation will be given to district heating and also to high efficiency cogeneration, as defined by Directive 2004/8/EC on the promotion of cogeneration, for economically justifiable demand, in respect of the production of heating or cooling.

In December 2010, a Commission Decision on determining transitional Union-wide rules for the harmonised free allocation of emission allowances (source [3]) was adopted within the CCC body. This Decision introduces new rules for adjusting the allocation of free allowances in respect of heat delivered for private households. Unfortunately, it is still unclear how this new toll will be implemented, and for this reason I have tried to cover all possible outcomes of these EU processes.

1.2 Industrial Emission Directive (IED)

Industrial Emissions Directive 2010/75/EU (source [4]) was adopted after long negotiations in December 2010 as a recast previous Directive on Integrated Pollution Prevention and Control (so-called IPPC). This new Directive merges 6 Directives in the field of pollution control and in effect integrates environmental management. The purpose of Integrated Prevention is to focus on the impact of industrial installations on all aspects of the environment — including soil and ground water.

The directive introduces new ambitious emission limit values for combustion plants (as listed in Table 1). These new limits are evolved from Best Available Technology (BAT) levels for each technology.

Table 1: Emission limit values for combustion plants

	Fuel		Hard coal or lignite	Liquid fuels	Biomass	Gaseous fuels
Emission limit values in mg/Nm³	50–100 MW	SO₂	400	350	200	35
		NOₓ	300/450	450	300	100
		Dust	30			5
	101–300 MW	SO₂	250		200	35
		NOₓ	200		250	100
		Dust	25		20	5
	> 300 MW	SO₂	200			35
		NOₓ	200	150	200	100
		Dust	20			5

Member States can use various derogation tools from these Emission Limit values.

- "Transitional national plans" for large combustion plants with individual emission limits until 30 June 2020,
- Exception for district heating plants (installations up to 200 MW thermal output) until 31 December 2022,
- Limited life time derogation for sources in operation no more than 17 500 operating hours, starting from 1 January 2016 and ending no later than 31 December 2023.

In my economic model I use the exception for district heating plants.

2 New Czech legislation

Air protection law

In the Czech Republic there is a new proposal on the government's agenda for a complex amendment to Act no. 86/2002 Coll., on air protection. This proposal includes a new version of pollution fees for all sources (as listed in Table 2 — comparison between current fees and proposed fees) with a vast increase by about 10 times until 2022. There is huge opposition from industry stakeholders to these new fees because in the context of IED (with strict emission limits on BAT levels) there is no additional economic incentive for producers to aim for even lower emission levels. The definition of BAT itself means that there is no technological possibility (or at least only a very narrow possibility) to go further. Consequently, pollution fees will only become a new pollution tax.

Table 2: Pollution fees — current and proposed in CZK per ton

Pollutant	Dust	SOₓ	NOₓ	VOC
Current	3 000	1 000	800	2 000
2012–2016	4 200	1 350	1 100	2 700
2017	6 300	2 100	1 700	4 200
2018	8 400	2 800	2 200	5 600
2019	10 500	3 500	2 800	7 000
2020	12 600	4 200	3 300	8 400
2021	14 700	4 900	3 900	9 800
2022 and further	29 400	9 800	7 800	19 600

3 Future of heat prices in the Czech Republic after 2012

In the respect of emission trading, I have focused on the third exception (free allocation of allowances for district heating), which is crucial for my economic model. According to the text of Directive 2009/29/EC, there should be a free allocation for heat producers. The rules of this free allocation are presented in the Decision (source [4], as mentioned above), but the detailed modalities have to be discussed within the CCC bodies. The benchmark value, which is the ratio between GHG emissions and heat production, was set at levels for a natural gas source with 90 % heat production efficiency — this leads to 62.3 allowances per TJ of heat delivered to consumers. There has been significant opposition to this proposal, mainly from new MSs, which are strongly dependent on coal-fired DH systems. Old MSs were neutral or in favour of this proposal, because their heat systems mainly use natural gas as fuel (see Figure 1).

Fortunately because of organized pressure from the new MSs, the Commission has proposed a new tool to improve free allocation for DH systems in respect of heat delivered to private households (see description below).
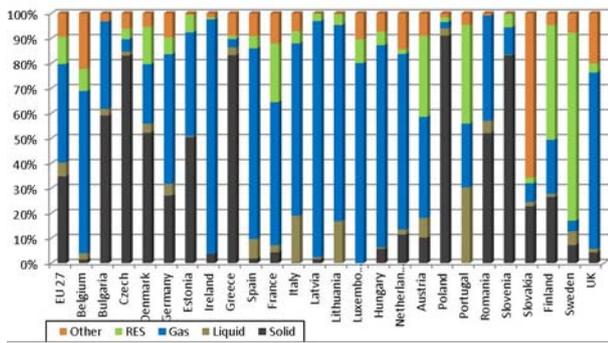
Fig. 1: Heat production fuel mix in the EU in 2008 (source [5])

In terms of IED, it is necessary to implement all possible derogation tools for local sources. The new emission limits were correctly set at BAT levels. Regulators however should bear in mind local circumstances — local fuel sources, the huge improvement in air quality within last 2 decades, and the energy security of the Czech Republic (the "cleanest" natural gas is imported via a 4 500 km long transit gas-pipeline from the Yamburg gas fields).

In terms of new pollution fees, the national authority should take into account that going below BAT is not economically and technically possible, and therefore pollution fees will become a "tax". There is no necessity to introduce a new "pollution tax". IED forms a sufficiently deep and demanding framework for cleaner production of energy.

4 Description of the economic model

I have created an economic model for calculating the implementation of the new EU and Czech environmental legislation and its influence on future heat prices. I used the following approach:

- The model calculates the influence caused by Emission trading, IED and pollution fees.
- The model can be applied only to installations which fall into IED (thermal input 50 MW or higher); smaller sources will not suffer from all new EU and Czech legislation.
- The model assumes combined heat and power generation.
- Certain inputs were set by expert estimation (e.g. efficiency of coal boilers, grid losses, etc.)
- A basic presumption is that heat and electricity production for the period 2013–2027 will be the same (or without significant changes) as average production during the period 2005–2008, which is the basic period for historical data according to Decision to Directive 2009/29/EC (source [4]).

- I have calculated the simple influence on the energy price (1 GJ of energy produced) for the whole Czech Republic based on fuel source in two scenarios. The real impact on energy prices has to take into account the fuel mix used for energy generation in real CHP sources.

4.1 CO_2 emission factors

I have used CO_2 emission factors from the Ministry of Industry and Trade web site (as listed in Table 3).

Table 3: CO_2 emission factors

Fuel	Emission factor	
	t CO_2/MWh of fuel calorific value	t CO_2/GJ of fuel calorific value
Brown Coal	0.360	0.100
Hard Coal	0.330	0.092
Liquid Fuels	0.260	0.072
Natural Gas	0.200	0.056
Biomass	0.000	0.000

4.2 Main indicators

I have determined the values of the main indicators through expert estimations (see Table 4).

Table 4: Main Indicators

Indicator	Value in %
Coal Boiler Efficiency	85
Gas Boiler Efficiency	90
Fuel Oil Boiler Efficiency	87
Heat Production Efficiency	95
Grid Losses	13

There are several presumptions in these figures.

- The efficiencies of Boilers are true for ideal operating circumstances (installed capacity, high base load etc.)
- The Heat Production Efficiency is true for modern technology, but it can vary greatly across the district heating (DH) sector.
- Grid Losses are true for hot-water grids; there will be a higher figure for steam grids (approx. 5 % higher)

All these presumptions are made in respect of the objectivity of the model outcomes. There are significant differences among installations in the DH sector, so there are no "correct values" in this respect.

4.3 Benchmarks

According to the text of Decision to Directive 2009/29/EC, the allocation of free allowances will be determined by so-called "benchmarks". A benchmark is a fixed ratio between GHG emissions and a unit of production (in the case of the district heating sector, 1 GJ of heat). Benchmarks will be used for free EUA allocation, as follows:

- In 2013 there will be a free EUA allocation of 80 % of the benchmark value, with a linear decrease to 30 % in 2020.
- In 2027 there should be no free EUA allocation.

The benchmark value was set within Decision [4] on 10 % of the best installations using as a fuel natural gas with 90 % boiler efficiency. The final value of the so-called heat benchmark is 62.3 kg CO_2/GJ of produced heat.

4.4 Free allocation for heat to private households

Free allocation for heat delivered to private households is a new tool introduced by Decision [4] — the so-called household rule. This tool provides for an increase in the free allocation for DH systems according to their emissions related to the production of heat exported to private households from 1 January 2005 to 31 December 2008. This means that the free allocation for heat for private households will be adjusted by the difference between historical emissions related to heat for households and the allocation according to the benchmark. However, this application of historical emissions is lowered each year, starting from 90 % in 2014. Heat for other customers will be allocated only according to the benchmark (as described above). Detailed rules of this tool have not yet been approved, and there are still many modalities to be developed. There are about four possible interpretations of the household rule.

4.5 Derogation for electricity producers

Free allocation in respect of production of electricity is enabled by the text of Directive 2009/29/EC. This allocation is possible mainly for new MSs. The CCC body adopted the Decision on the relevant part of Directive 2009/29/EC in November 2010 (source [6]). Unfortunately, this Decision was very short and narrow, and left a major part of this allocation tool unclear. In recent months, the Commission tried to adopt a Communication on implementing measures of this free allocation, with very restrictive conditions and requirements for producers. This situation can be seen as an almost clear attempt to breach the subsidiarity rules of the EU, because the modalities of this allocation tool should be on the shoulders of the CCC bodies. Fortunately, there was opposition to this Communication even within the Commission itself. Derogation rules and their applicability for electricity producers have therefore not yet been finalized.

4.6 IED implementation

Implementation of IED will involve significant investment in the technology of existing sources in terms of lowering emissions of pollutants (especially NO_x and SO_x). In my model, I assume that the derogation rule for DH systems will be used.

Concerning the fulfillment of emission limits given by IED, sources should invest in the following technology:

- Lignite/Hard coal source — $deSO_x$, $deNO_x$ technology, dust is managed at emission limits in current technology systems (could be managed by minor adjustment of the system)
  Total investments: CZK 2 bln three years before emission limits are applied (e.g. in 2019 in order to meet emission limits in 2023).
- Liquid fuel source — $deSO_x$, $deNO_x$ technology, dust/solid residues is covered by quality management of the fuel that is used (high quality heating oil)
  Total investments: CZK 1.5 bln three years before emission limits are applied.
- Gaseous fuel source — $DeNO_x$ technology, dust/solid residues and SO_x is not applicable, covered by quality management of the fuel that is used (mainly natural gas)
  Total investments: 0.75 bln CZK three years before emission limits are applied.

4.7 Future CO_2 price

There is lack of clarity in respect of the future CO_2 price (future price of the EU allowance). According to various EC studies, and according to the opinion of the Ministry of Environment of the Czech Republic, the future price of EUA will be in range of EUR 20–30. However I have also used the "opinion" of the carbon market itself, which estimates the future EUA price at around EUR 16 (this is the average price for buying EUA with delivery 2013–2015).

4.8 Scenarios

I have constructed two possible implementation scenarios of the described environmental legislation. Each of these scenarios has two carbon price values (as the carbon price is the most important parameter).

Scenario 1 — Strictest implementation

Emission trading — no household rule, no derogation for electricity producers, just free allocation according to the benchmark.

IED — without any derogation for district heating, full application from 1 January 2016.

Air protection — highest pollution fees with no applicable fixation at lower levels (current proposal for a complex amendment to Act no. 86/2002 Coll., on air protection).

Scenario 2 — Pragmatic implementation

Emission trading — household rule (most probable interpretation, 60 % of heat is delivered to households), derogation for electricity producers (most probable application with benchmark according to the proposal for the national plan by the Ministry of Environment proposal (source [7])).

IED — with a derogation for district heating, full application from 1 January 2023.

Air protection — pollution fees fixed at 2012–2016 levels (meaning an increase of about 40 % of current fees).

5 Model outcomes

The following tables show the outcomes from my economic model. The listed figures reflect the impact on energy prices after the implementation of benchmarks on heat.

Table 5: Impact on energy prices based on fuels used for Scenario 1 and EUA price EUR 16

	Year	Fuel			
		Lignite	Hard Coal	Liquid	Natural Gas
Impact on energy prices in CZK per 1 GJ	2012	0.47	0.47	0.18	0.18
	2013	42.32	37.81	24.56	13.62
	2014	47.34	42.83	28.78	16.65
	2015	49.07	44.55	30.52	18.42
	2016	50.50	45.99	32.11	20.03
	2017	52.25	47.73	33.79	21.72
	2018	53.93	49.41	35.40	23.36
	2019	55.57	51.05	36.98	24.96
	2020	57.14	52.62	38.49	26.49
	2021	58.15	53.64	39.43	27.44
	2022	59.85	55.33	40.58	28.60
	2023	60.67	56.16	41.41	29.45
	2024	61.47	56.95	42.21	30.26
	2025	62.23	57.71	42.99	31.04
	2026	62.96	58.44	43.72	31.79
	2027	63.66	59.14	44.43	32.50

Table 6: Impact on energy prices based on fuels used for Scenario 1 and EUA price EUR 30

	Year	Fuel			
		Lignite	Hard Coal	Liquid	Natural Gas
Impact on energy prices in CZK per 1 GJ	2012	0.47	0.47	0.18	0.18
	2013	64.59	57.53	37.31	20.70
	2014	70.61	63.55	42.55	24.75
	2015	73.30	66.24	45.27	27.51
	2016	75.68	68.62	47.80	30.08
	2017	78.33	71.27	50.40	32.71
	2018	80.89	73.83	52.90	35.25
	2019	83.38	76.32	55.33	37.71
	2020	85.78	78.72	57.67	40.08
	2021	87.29	80.23	59.12	41.55
	2022	89.46	82.41	60.76	43.21
	2023	90.76	83.70	62.06	44.53
	2024	92.00	84.94	63.31	45.80
	2025	93.19	86.13	64.52	47.02
	2026	94.33	87.27	65.67	48.18
	2027	95.43	88.37	66.78	49.30

Table 7: Impact on energy prices based on fuels used for Scenario 2 and EUA price EUR 16

	Year	Fuel			
		Lignite	Hard Coal	Liquid	Natural Gas
Impact on energy prices in CZK per 1 GJ	2012	0.47	0.47	0.18	0.18
	2013	14.74	12.04	4.52	−1.16
	2014	21.69	18.64	10.16	3.67
	2015	28.09	24.72	15.39	7.79
	2016	33.95	30.31	20.24	11.21
	2017	39.29	35.43	24.39	14.58
	2018	44.15	40.09	27.74	17.89
	2019	48.10	43.59	31.04	21.15
	2020	53.65	49.13	35.99	25.21
	2021	57.78	53.27	39.32	27.33
	2022	58.64	54.12	40.19	28.21
	2023	59.23	54.72	40.92	28.96
	2024	60.03	55.51	41.73	29.77
	2025	60.79	56.27	42.50	30.55
	2026	61.52	57.01	43.23	31.30
	2027	62.22	57.71	43.94	32.01

Table 8: Impact on energy prices based on fuels used for Scenario 2 and EUA price EUR 30

	Year	Fuel			
		Lignite	Hard Coal	Liquid	Natural Gas
Impact on energy prices in CZK per 1 GJ	2012	0.47	0.47	0.18	0.18
	2013	22.76	18.55	6.97	−1.92
	2014	33.62	28.86	15.77	5.63
	2015	43.62	38.37	23.95	12.07
	2016	52.78	47.10	31.52	17.41
	2017	61.13	55.09	38.01	22.67
	2018	68.72	62.38	43.25	27.85
	2019	74.90	67.84	48.40	32.95
	2020	82.29	75.23	55.18	38.81
	2021	86.92	79.86	59.01	41.44
	2022	88.26	81.20	60.37	42.81
	2023	89.32	82.26	61.57	44.04
	2024	90.56	83.50	62.82	45.31
	2025	91.75	84.69	64.03	46.53
	2026	92.89	85.84	65.18	47.70
	2027	93.99	86.93	66.29	48.81

All listed figures are in CZK and per 1 GJ of energy supply — in the case of heat, the impact on price for customers for 1 GJ of heat; in the case of electricity, the impact on the price of 1 GJ of electricity supply to the electricity grid. The major difference between the two scenarios is in the first years, where Scenario 1 models a severe price increase. Scenario 2 offers much more flexibility for producers through a gradual increase in energy prices.
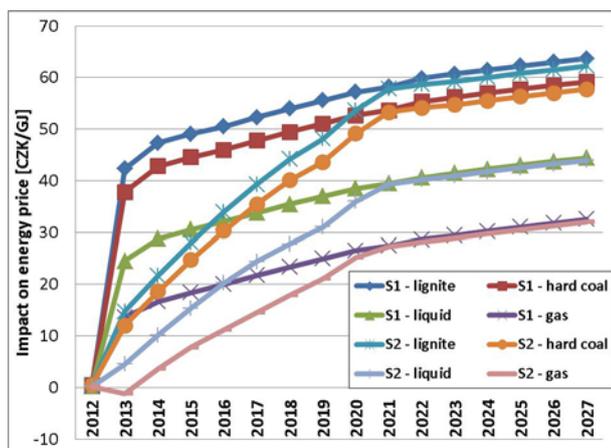

Fig. 2: Impact on energy prices in different scenarios for future EUA price EUR 16

6 Summary

As has been presented in the figures above future energy prices from CHP sources under EU ETS and IED will be heavily influenced mainly by the implementation of Directive 2009/29/EC, which introduces a new tool for allocating free allowances. So-called benchmarks will be used for all EU ETS installations in the district heating sector. Estimating the future EU allowance price is also very problematic. The European Commission guesses an EUA price of around EUR 30, while the carbon market itself guesses around EUR 16 (average price of EUA with delivery after 2013). There are still many unclear modalities concerning free allocation of allowances after 2013. Implementation of IED (new emission limits) and new pollutant fees will not have major impacts on the energy prices themselves, but could be seen as a reason for a fuel switch or closure.

As is described by my model, there are several ways by which the ultimate target in terms of lowering emissions could be attained. However, the chosen path to the target could mean "price shocks" in the event of strict application or a gradual price increase in the event of a pragmatic approach.

Implementation of the new environmental legislation will lead to an increase in the energy prices of CHP sources. In the case of heat prices, there will be no direct impact on costs or revenues for these companies because of the heat price structure (regulated by the Energy Regulatory Office). The most severe impact in this respect is the loss of competitiveness of heat producers in EU ETS. Customers in the Czech Republic do not care much about the environmental background of heat production — their main concern is about the total price of heating. The main competitors on the heat market (local heat sources below EU ETS thresholds) are in a much better position in this respect. They are not influenced by EU ETS, IED, pollution fees or an ecological tax (in the case of local boiler houses).

The new environmental legislation is shown to distort competition on the heat market. A new "carbon tax" for sources outside EU ETS needs to be established as soon as possible to take this issue into account. In the case of electricity prices, implementing the environmental legislation will involve a loss of profit for producers (especially for producers from coal sources).

Acknowledgement

References

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