Assessing the Development of Combined Heat and Power Generation in the EU

ETSAP Workshop, 9 November 2011

Loreta Stankeviciute, Anna Krook Riekkola
Joint Research Centre
IPTS - Institute for Prospective Technological Studies
http://ipts.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/

Problematique

I. **Energy efficiency is a cost efficient method of enhancing security of supply and reducing GHG emissions**

II. **Increasing the deployment of CHP should produce energy savings**

- CHP plants can convert up to 90% of their fuel into useful energy.
- Conventional power plants currently operate with an average of 40% electric efficiency (UK example)

III. **Europe can at least double it's CHP potential up to 2020 (MS national reports)**

IV. **The deployment of CHP will be influenced by EU climate and energy policies (*e.g.* strong CO2 emission reductions, renewable target, support policies,..)**

Objective

I. Quantification of technical and economic potentials in EU-27 up to 2030 on a sectoral level

- Technical potential – maximum possible penetration of CHP technologies;
- Economic potential – a share of technical potential influenced by economic considerations.

II. Main economic criteria considered:

- Existing policies and measures on renewable energy and energy efficiency;
- EU-ETS, renewable, biofuels targets to 2020;
- CO2 emission reduction target in line with *European Road Map to 2050*.

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Methodology

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- **TIMES-EU model covers EU27 + Iceland, Norway and Switzerland**
- **Planning horizon in the study: up to 2030**
- **End-use energy service demands are from GEM-E3**
- **The prices of fossil fuels are from PRIMES Baseline scenario**
- **Heat demand** in residential sector is based on projection of the number of dwellings and its allocation by category and on the projection of the heat demand per dwelling and by category. Industrial and agricultural demands follow the sectoral production evolution.
- **Heat is supplied** either by individual heating devices or by district heating. Additionally, in industry and commercial sectors auto-production CHPs can contribute

Methodology continuation

TIMES-EU energy-economic model of European energy system is used to derive CHP potentials from three scenarios:

Baseline scenario

Main assumptions

- existing support mechanisms to renewable energy and CHP,
- CO2 emissions reduction in ETS system,
- and energy efficiency measures.

ETSREN scenario

Main assumptions

- as in Baseline scenario,
- plus Renewable (20% in primary energy consumption) and Biofuels targets (10% of transport fuel is from renewable source) in 2020

CO2REN scenario

Main assumptions

- as in Baseline and ETSREN scenarios except ETS,
- rather overall economy CO2 emissions reduction target is assumed (25% reduction in 2020, and 40% in 2030)

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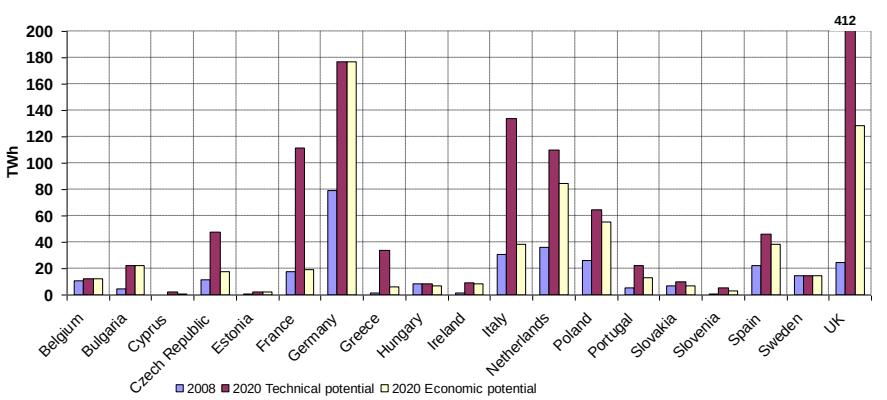
Overview of cogeneration potentials from MS national reports

- **Under CHP Directive, MS should report their cogeneration potentials up to 2020 (only 19 countries have reported at the time of the study)**
- **The level of detail and approaches in considering sectors and sizes/technologies/energy sources of CHP units varies among national reports**



Comparison with TIMES-EU Baseline potentials

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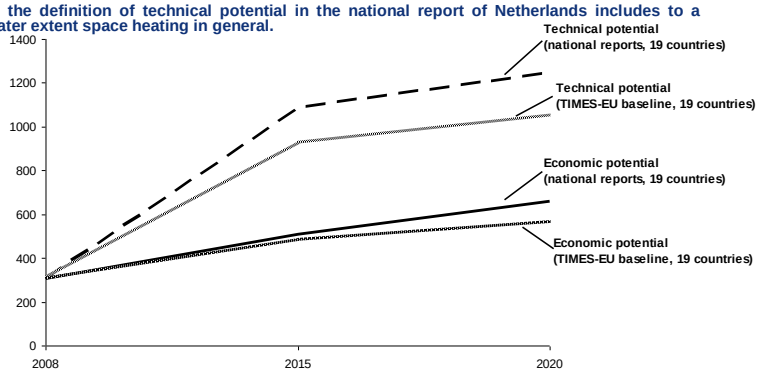
Technical and economic potentials are found to be lower in Baseline scenario than in national reports (by 15.5% and by 14.7% respectively in 2020)

Even though lower, they are triple for technical and almost double for economic potentials from the year 2008

Multiple reasons:

- **Types of national models, assumptions about heat demand, different economic criteria;**
- ***e.g.* UK national report defines technical potential as the electricity demand instead of the heat demand;**
- ***e.g.* the definition of technical potential in the national report of Netherlands includes to a greater extent space heating in general.**

Comparison of economic and technical potential for CHP electricity output from national reports with the results of Baseline, in TWh



Scenario results: CHP production output

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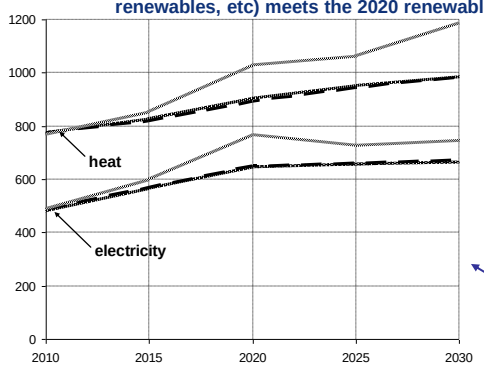
The energy wide emission reduction target in CO2REN scenario strongly increases the CHP output;

- **50% more TWh in 2020 compared to 2008 (Eurostat);**
- **15% more TWh in 2020 compared to the results of Baseline and ETSREN;**
- **besides the increase in CHP electricity output, an increase in electricity produced by wind (167TWh or 10%) and noticeable decreases in electricity produced from coal (207TWh or 48%) and gas (357TWh or 12%) also take place.**

The similarities between Baseline and ETSREN scenarios tend to indicate that that the continuation of existing policies present in both scenarios (EU-ETS, feed-in tariffs for renewables, etc) meets the 2020 renewable target with no or little additional effortenergy



Resulting share of CHP in total electricity generation in EU-27, in %

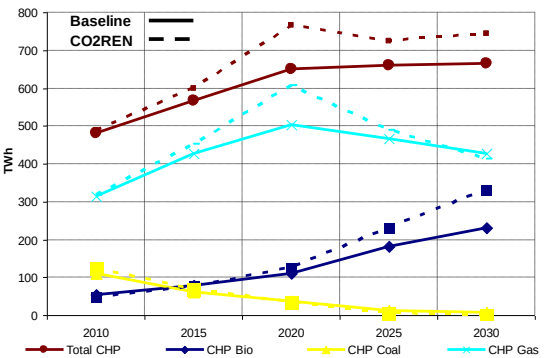
	2010	2015	2020	2025	2030
Baseline	14.8	17.0	19.0	18.9	18.5
ETSREN	14.9	17.0	19.0	18.9	18.6
CO2REN	14.7	17.8	22.4	20.8	20.8

Impact of policy scenarios on the amount of electricity and heat generated by CHP in EU-27, TWh

Scenario results: Fuel input into CHP

- **Gas is a dominating fuel input until 2020 in all scenarios**
- **After 2020, the increasing intensity of climate policy starts to replace gas input by biomass**

Electricity supplied by CHP and by fuel in EU-27 in Baseline and CO2REN scenarios, in TWh



Scenario results: CHP in heat markets

Strong CO2 emission reduction in CO2REN scenario increases even more DH expansion ;

- **most noticeable increases in DH levels occur in countries like Germany, Poland, Italy, France and Czech republic;**
- **DH constitutes therefore one of the cost-effective measures to reduce CO2 emissions.**

CHP penetration into DH also follows an upward trend, the opposite is seen for IH for the cheaper technological options available.

	2010		2020		2030	
	DH	IH	DH	IH	DH	IH
Baseline	550	850	604	1034	649	1182
ETSREN	549	848	603	1034	648	1182
CO2REN	563	853	672	1033	778	1180

District heat (DH) and industrial heat (IH) demands, in TWh

Resulting share of CHP district heating (DH) and industrial heat (IH) in EU-27, in %

	2010		2020		2030	
	DH	IH	DH	IH	DH	IH
Baseline	74%	35%	83%	26%	87%	20%
ETSREN	74%	35%	82%	26%	87%	20%
CO2REN	72%	33%	84%	27%	89%	20%

Scenario results: impact on primary energy consumption

On aggregate level the total primary energy consumption reduction in CO2REN scenario as compared to Baseline is rather marginal;

However, the primary energy consumption by fuel diverges significantly;

- **Decrease in fossil fuel consumption;**
- **Increase in renewable energy.**

Increasing use of biomass in CHP and it's raising share in primary energy consumption indicates that CHP contribution to the fuel changes might be important

Primary energy consumption in CO2REN scenario as compared to Baseline scenario, in %

	2020	2025	2030
Solids	-13.6%	-26.3%	-14.7%
Oil	-3.9%	-4.5%	-7.4%
Natural gas	0.0%	-3.6%	-11.6%
Biomass	20.7%	28.5%	29.1%
Rest of renewables	5.2%	7.1%	11.7%
Total	-0.6%	-0.7%	-1.7%

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Conclusion

- **This modelling exercise covering all EU-27 countries confirms the aggregated European potential reported in MS national reports of almost doubling (43%) the current levels of CHP electricity output in 2020**
- **Strong CO2 emission reductions lead to an even higher employment of CHP in 2020 (53% more than the current electricity production levels)**
- **These increases are more important for countries that posses large thermal electricity generation parks (*e.g* Poland, Germany)**
- **Strong CO2 emission reduction induce DH expansion with an increasing penetration of CHP to produce DH**
- **Strong CO2 emission reduction highly influences fuel distribution in primary energy consumption**
- **Similar results obtained in Baseline and ETSREN scenarios indicates that the the continuation of existing policies and measures meets the renewable target with no or little additional effort**

Improvements in the future

Sensitivity analysis should be performed to better understand the dynamics behind the decisions of the model:

- on primary energy prices
- on biomass costs, availabilities

Techno-economic parameters should be reviewed

Levelised-cost methodology should be established

THANK YOU

loreta.stankeviciute@ec.europa.eu