

CELSIUS Talk: Integration of heat, power and intermittent renewables

2017.10.04



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 314441.



A systemic view of power and District Energy systems



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» How we define „Power-to-(District)Heat (P2H)

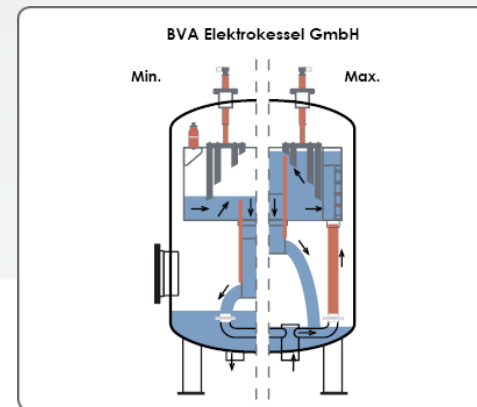
- industrial-scale, central transformation of electricity into heat
- embedded in a multivalent heat generation portfolio, optional usage of different fuels (renewable or fossil) and/or electricity
- preferably combined heat and power plants, efficiently transformation in heat and power

Electric flow heaters

50 kW to approx. 15 MW

Electrode boilers

> approx. 10 MW

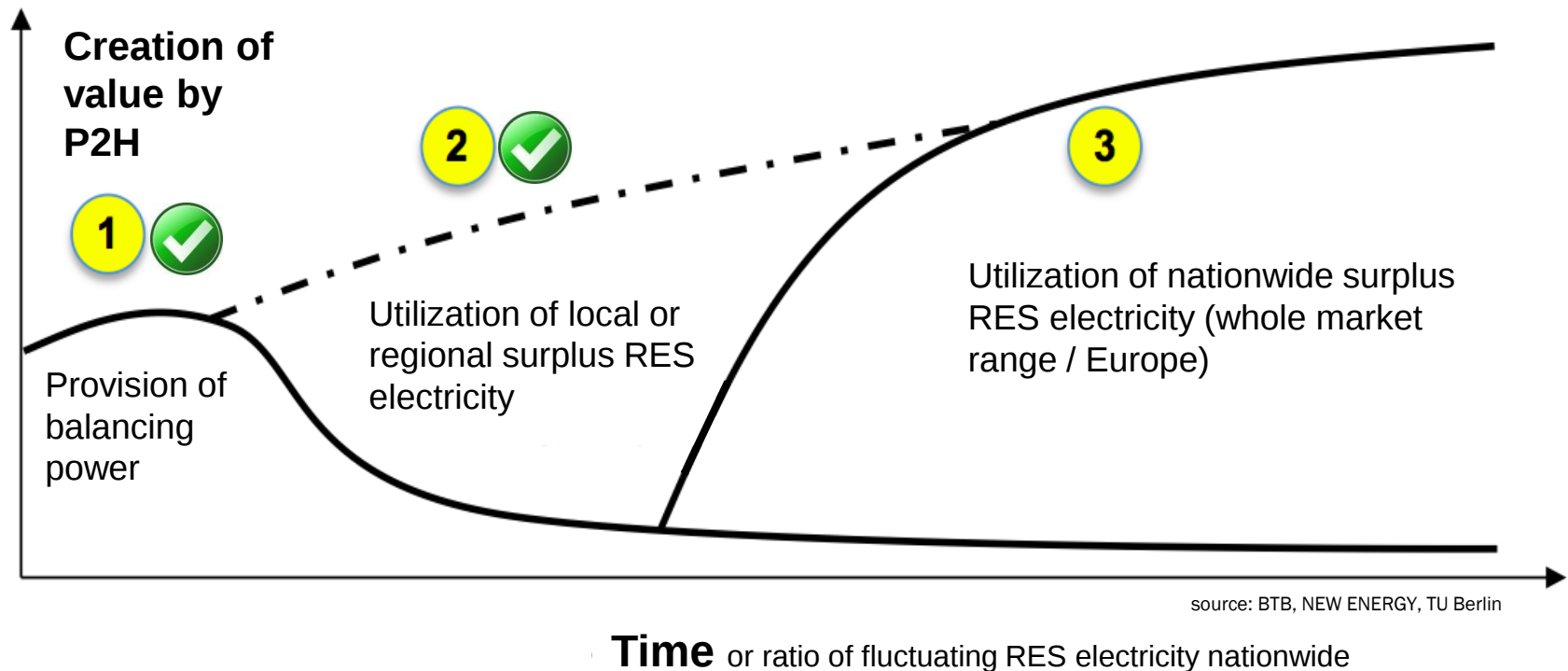


Municipal P2H-applications in Germany

Company	Electr. capacity	Year
Bioenergie Taufkirchen	6,4 MW	2016
BTB Berlin	6 MW	2015
Energieversorgung Offenbach	10 MW	2014
Energie und Wasser Potsdam	20 MW	2015
ENRO Ludwigsfelde	15 MW	2014
FHW Neukölln, Berlin	10 MW	2015
Heizkraftwerke Mainz	5 MW	2013
Kraftwerk Dessau	5 MW	2015
Mainova, Frankfurt/Main	8 MW	2015
N-ERGIE, Nürnberg	50 MW	2015
Stadtwerke Amberg	1,5 MW	2015/2016
Stadtwerke Augsburg	10 MW	2015
Stadtwerke Bielefeld	20 MW	2016
Stadtwerke Detmold	5 MW	2015
Stadtwerke Flensburg	30 MW	2012
Stadtwerke Forst	0,55 MW	2014
Stadtwerke Greifswald	5 MW	planned
Stadtwerke Jena	4 MW	2016
Stadtwerke Kiel	30 MW	2015
Stadtwerke Lemgo	5 MW	2012
Stadtwerke Lübeck	4,5 MW	2016
Stadtwerke München	10 MW	2013
Stadtwerke Münster	22 MW	2016
Stadtwerke Neumünster	20 MW	2016
Stadtwerke Schwerin	15 MW	2013
Stadtwerke Tübingen	5 MW	2013
Techn. Werke Ludwigshafen	10 MW	2015
VVS Saarbrücken	10 MW	2012
Sum	342,95 MW	



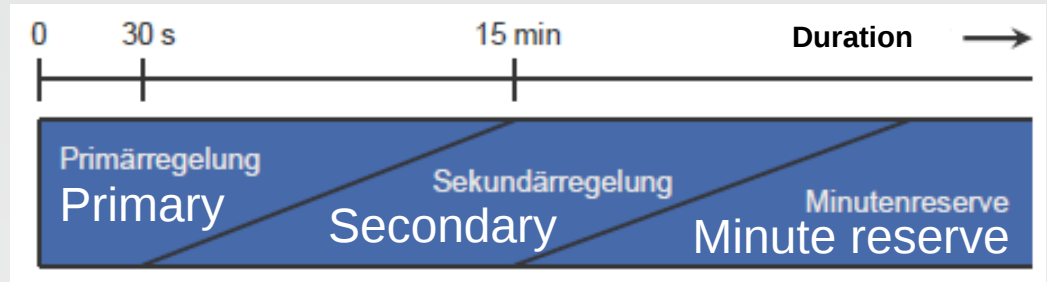
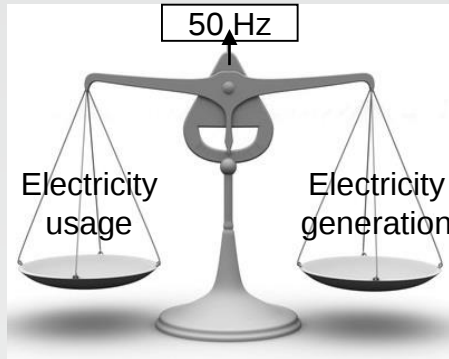
Source: AGFW



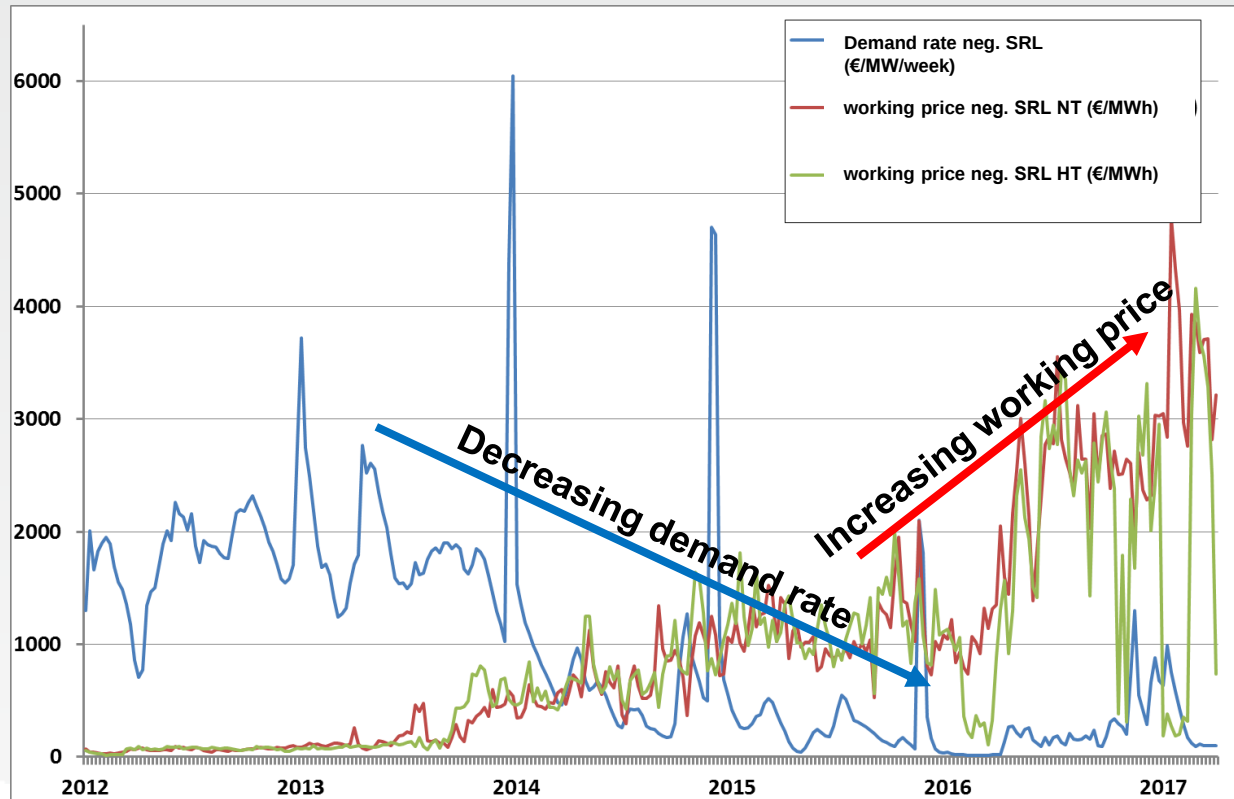
» Power-to-(District)Heat has different utilization options regarding the German Energy transition (Energiewende)

- Provision of balancing power
- Utilization of local or regional surplus RES electricity (grid bottlenecks)
- Utilization of nationwide surplus RES electricity (whole market range / Europe)

1



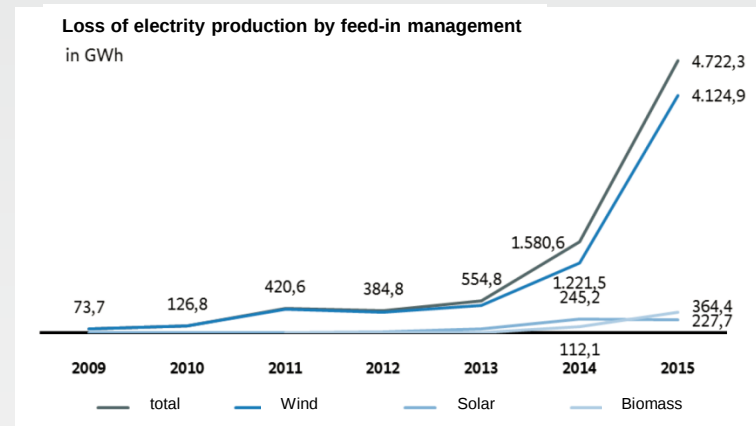
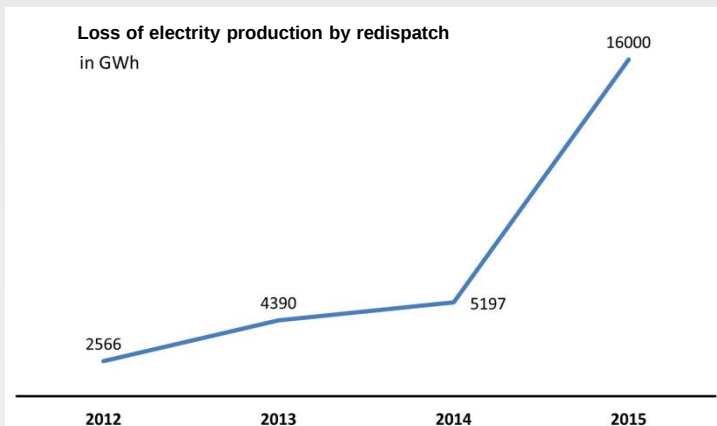
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2

Increase of bottlenecks

- Measures for stabilizing reliability and safety of the electricity system are increasing
 - Redispatch (§ 13.1 EnWG)
 - Feed-in management (§ 14 EEG i. V. m. § 13 Abs. 2 EnWG)



» Increase of costs

- Redispatch (§ 13.1 EnWG)
 - Cost estimation 2015: **411,9 Mio. Euro**
- Feed-in management (§ 14 EEG i. V. m. § 13 Abs. 2 EnWG)
 - Cost estimation 2015: **478 Mio. Euro**

» Two measures for avoiding cost rise

- „use-instead-shut down“-measure
- experimental clause for future application of power-to-(district)heat

2 So called „use-instead-shut down“-measure

Contractual agreement between grid operator and CHP-operator

- **Reduction of CHP feed-in** and **simultaneous provision of electricity** for maintaining heat supply
- Only valid within the **northern region of Germany**
- CHP **larger than 500 kWel**

Additional framework

- **Subsequent measure** to „ordinary“ redispatch measure
- Grid operator **pays an adequate reward** for reduction of CHP feed-in and pays costs für the electricity provided
- **Investment for electric heat generator ist payed by grid operator**
- **Minimum duration is five years**

Economic potential stays unclear

- What is an **adequate reward**?
- Can there be **parallel option** for economic operation? (e.g. balancing power market)
- How to consider electricity in **primary energy factor**?

2

R&D program (SINTEG) „Digital Agenda for the Energy Transition“

- Subsidies for model regions, that develop and demonstrate solutions of climate friendly, efficient and secure energy supply with high RES ratios
- Program duration of 4 years
- Total amount of subsidies of 200 Mio. €

Projects, including Power-to-(District)Heat

- **NEW 4.0:** Energy transition in northern Germany
- **WindNODE:** Intelligent energy in north-eastern Germany

Projects aim at

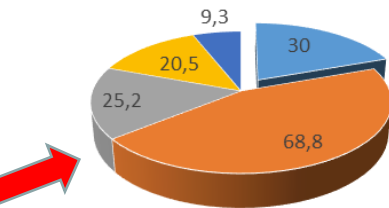
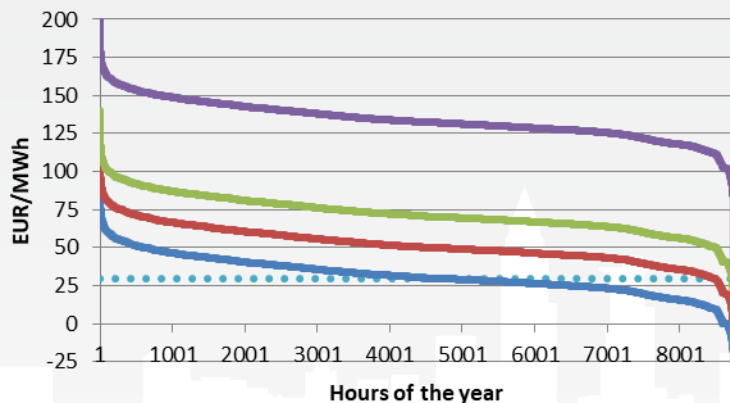
- Real **sector coupling** between electricity and heat market
- Investigating **stabilizing operation** of Power-to-(District)Heat onto electricity grid
- Investigating effects of **less regulatory electricity price components**

3

Increasing nationwide surplus RES electricity (2040/50)

- Efficient utilization by sector coupling (e.g. heat market or transportation)
- Challenging transformation of the regulatory framework

- Electricity used in Power-to-(District)Heat-applications is very expensive due to regulatory price components
- A successful sector coupling of electricity and market regulatory framework needs to be adapted



- Electricity market price
- EEG reallocation charge
- electricity grid fee
- electricity tax
- further components (CHP, § 19, concession levy)

Feasible heat price	30 €/MWh	e.g. gas boiler
Electricity market price	varying	approx. 4.100 h economic operation
Add. grid fees	25,20 €/MWh	approx. 300 h economic operation
Add. electricity tax	20,50 €/MWh	approx. 40 h economic operation
Add. EEG reallocation fee	68,80 €/MWh	approx. 1 h economic operation

- » **Power-to-(District)Heat is currently a successful instrument for integrating RES into the electricity grid (balancing power market)**
 - Profits were interesting in the years 2012-2014
 - Profits have decreased due to low prices on balancing power market

- » **Power-to-(District)Heat can be operated to stabilize electricity grid**
 - Two instruments have been developed
 - Voluntary contractual agreement combined with CHP
 - R&D projects regarding digitalization within the energy transition (SINTEG)
 - Success, development and results of both instruments are open

- » **Power-to-(District)Heat is able to successfully connect electricity and heat market**
 - Based on SINTEG results the regulatory framework needs to be adapted