Integrated solutions for electrification: three approaches from three countries

April 28, 2021
15h00 – 16h00

Leonardo ENERGY Webinar Channel
j.mp/leonardotube

5th Webinar of the Electrification Academy

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Leonardo ENERGY

"Decarbonisation is a team effort."

Christian van Maarschalkerweerd, Danish Energy Association

Laura Glover, Delta-EE

Stefan Liesner, 2G Energy

The path to a climate-neutral Europe in 2050 will be paved with a variety of solutions. Diverse conditions in European countries require holistic planning approaches tailored to local needs to progress towards a net-zero power system. In the fifth webinar of the Electrification Academy, three speakers share integrated approaches from their respective countries. These strategies seek synergies between solutions to meet the common challenge of integrating growing shares of variable renewable energy sources, boosting power system flexibility and lowering carbon emissions.

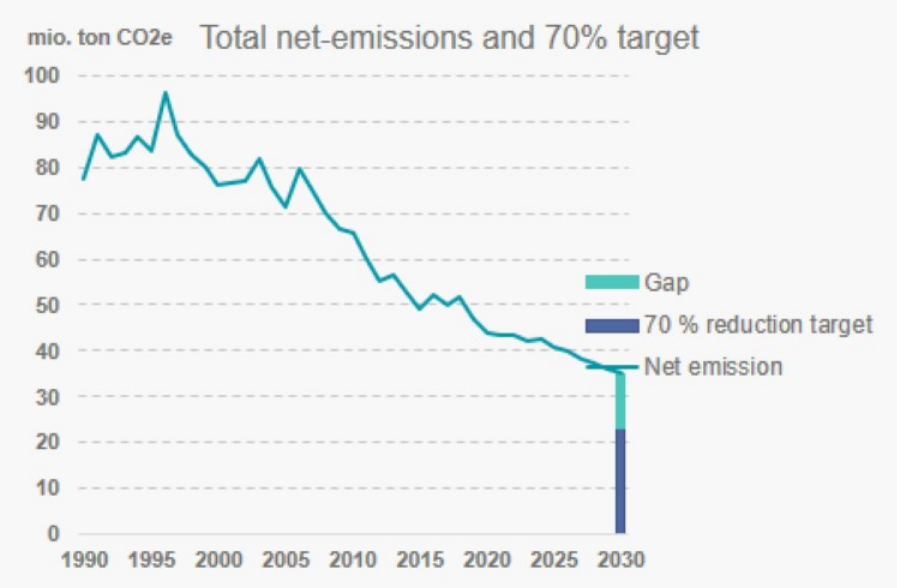
Integrated solutions for electrification: RE-integration and the role of district heating in Denmark

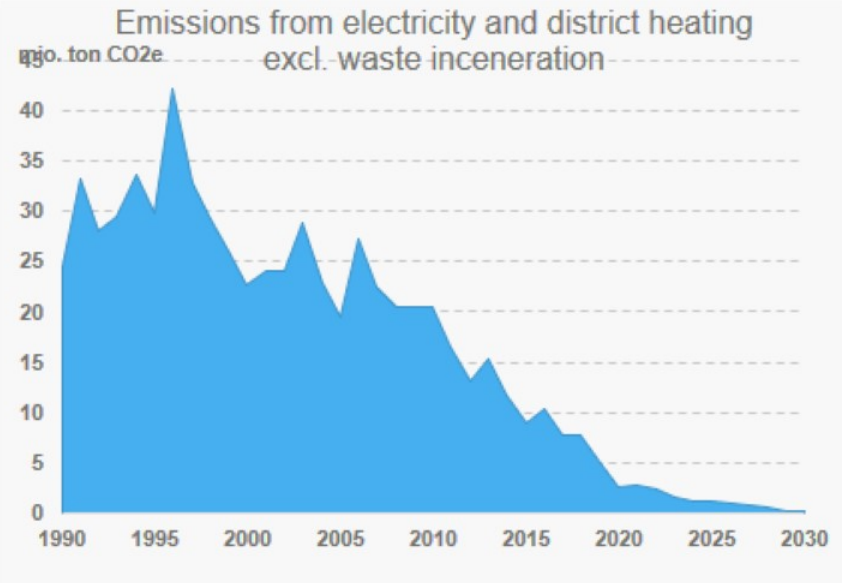
Fifth webinar of the Electrification Academy

Christian van Maarschalkerweerd - Dansk Energi

DANSK ENERGI

Green transition and reduction targets drives fundamental change of Danish energy system





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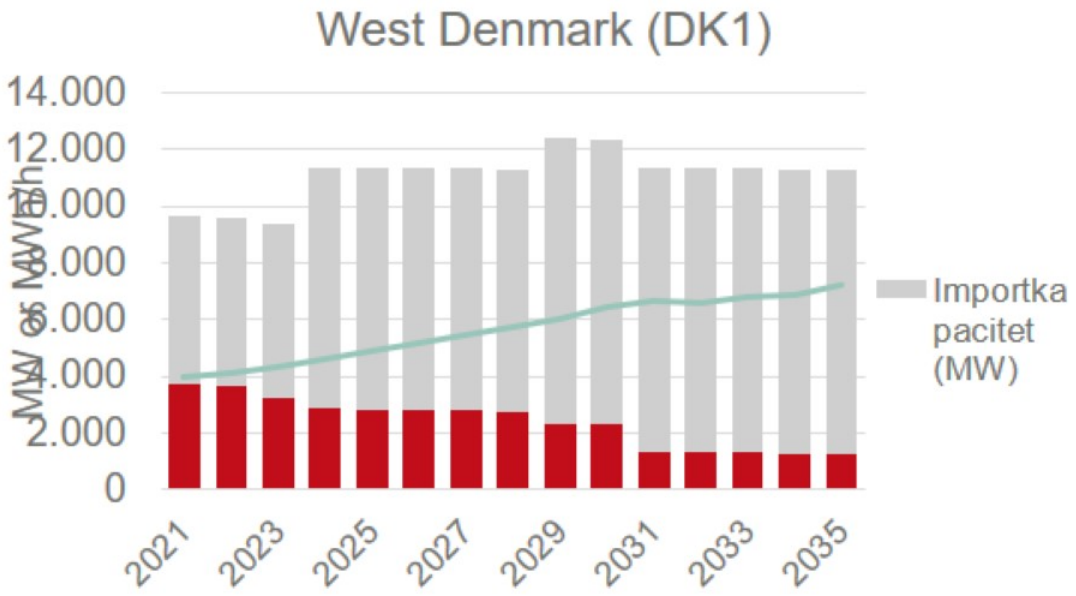
Balancing the green electricity system



- Significant increase in electricity consumption
- Significant reduction of thermal capacity. Phase out of coal and gas, and reduced biomass usage
- Interconnectors are needed to maintain balance between supply and demand
- Flexible and price sensitive demand is also needed

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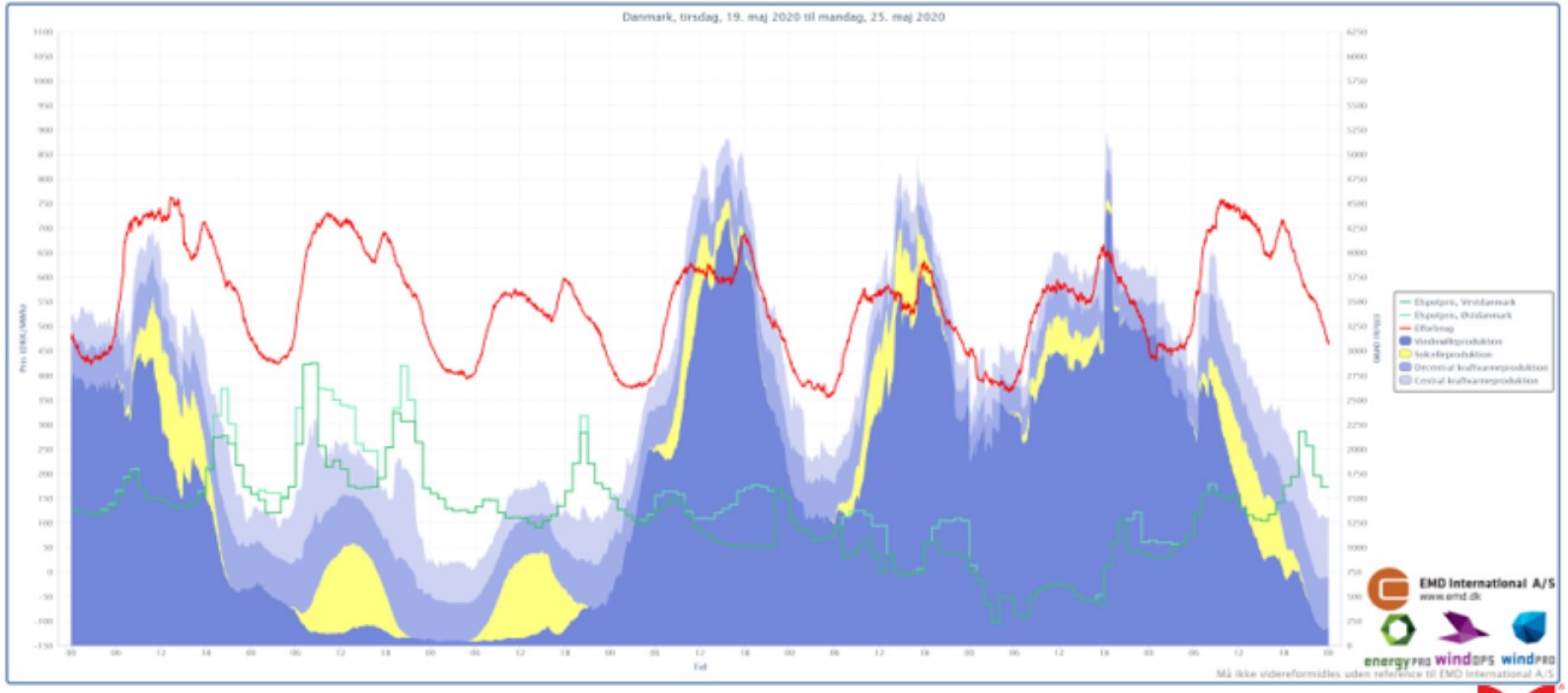
May 2020 – An example of production and demand



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District heating in Denmark

- 64% of Danish households are heated with district heating, and many areas with individual gas boilers are now being converted to district heating or heat pumps
- Historically the heat has primarily been produced on combined heat and power plants
- Now the production is converted to heat pumps and heat-only-boilers (electric and/or biomass)
- District heating companies are going from production to consumption of electricity
- Heat storage has always been an integrated part of the system to enable optimal operation of CHP plants day/night
- The economic value of heat storage is increasing -> investments in new storage capacity

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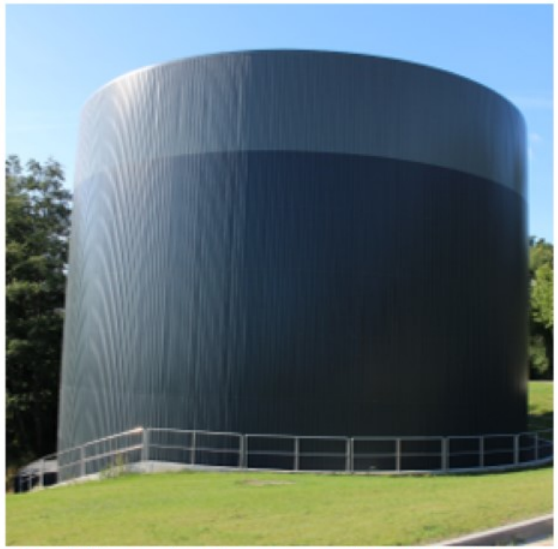
Storage in DH systems and buildings



Traditional storage day/night

Large scale/seasonal storage

Thermal capacity in buildings

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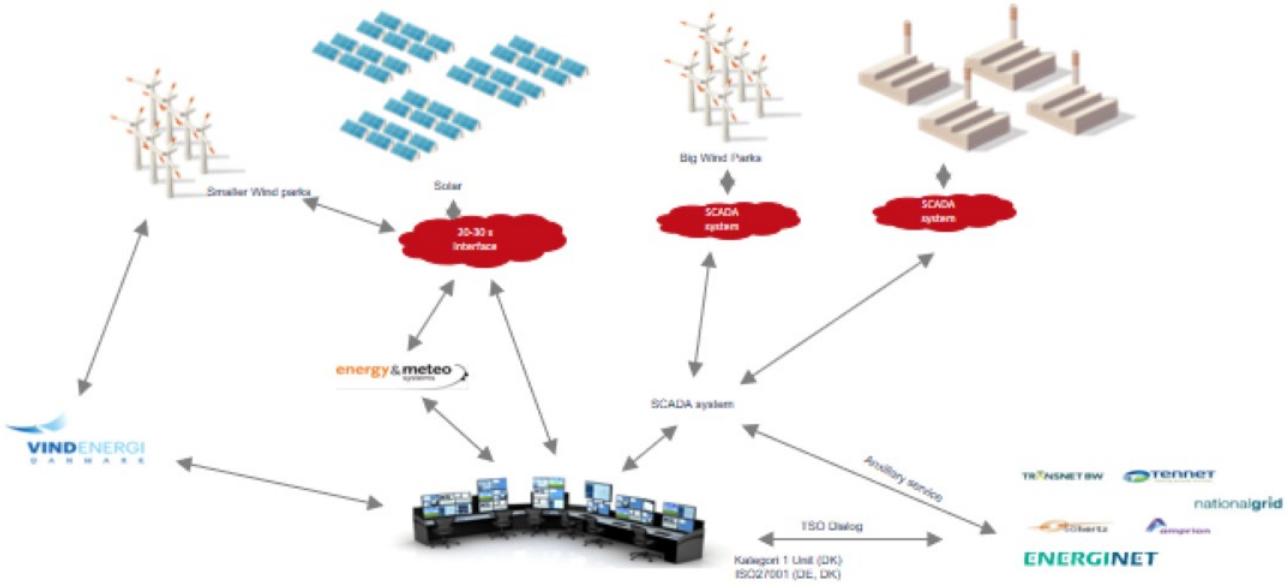
The role of aggregators increases with increased complexity



Larger players can handle complexity and a variety of products, while smaller district heating companies can benefit from cooperation with an aggregator.

In both cases there are significant economic benefits from participating in markets for anxillary services.

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Regulatory framework

- Electricity tax for heating purposes reduced to EU minimum charge (both for individual households and DH companies)
- Subsidy for converting from gasboiler to heat pump or district heating
- District heating projects need to demonstrate that they are cheaper than individual heat pumps in order to be approved by municipality
- Price signals from electricity side – spot price, anxillary service and special regulation
- Distribution/transmission tarifs and connection charges reflecting true costs. Distribution tarifs differentiated in time and reduced connection charges, if load can be reduced
- Today there are many small consumer owned or municipal DH companies. Is consolidation and more commercial ownership of production units needed to harvest full flexibility potential?

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4D HEAT

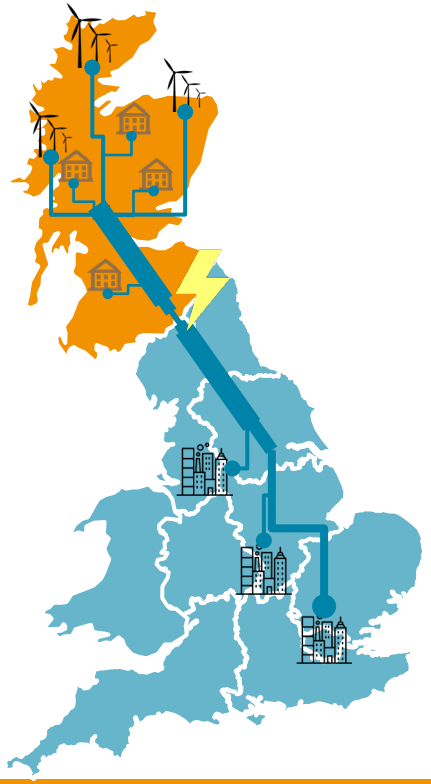
USING DOMESTIC HEAT TO ADDRESS WIND CONSTRAINTS

28th April 2021

CONTACT: laura.glover@delta-ee.com

4D Heat

Maximum volume of wind energy (MWh) that could avoid being constrained by controlling electric residential heating



Key considerations

- Need to do this without costing the ESO, DSO or end-consumer more
- Only considering **off-gas grid** electric heating in Scotland

Method:

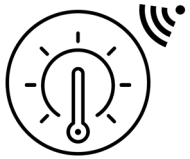
- Technical and techno-economic modelling + qualitative research
- Use storage heaters, hot water tanks and heat pumps

Outputs:

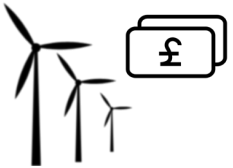
- How much of a difference can we make
- CBA
- Route to market

Scenarios

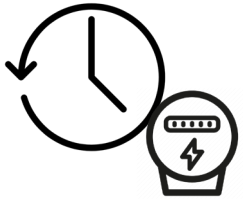
Smart controls, explicit wind incentivisation, dynamic tariffs



Smart Controls



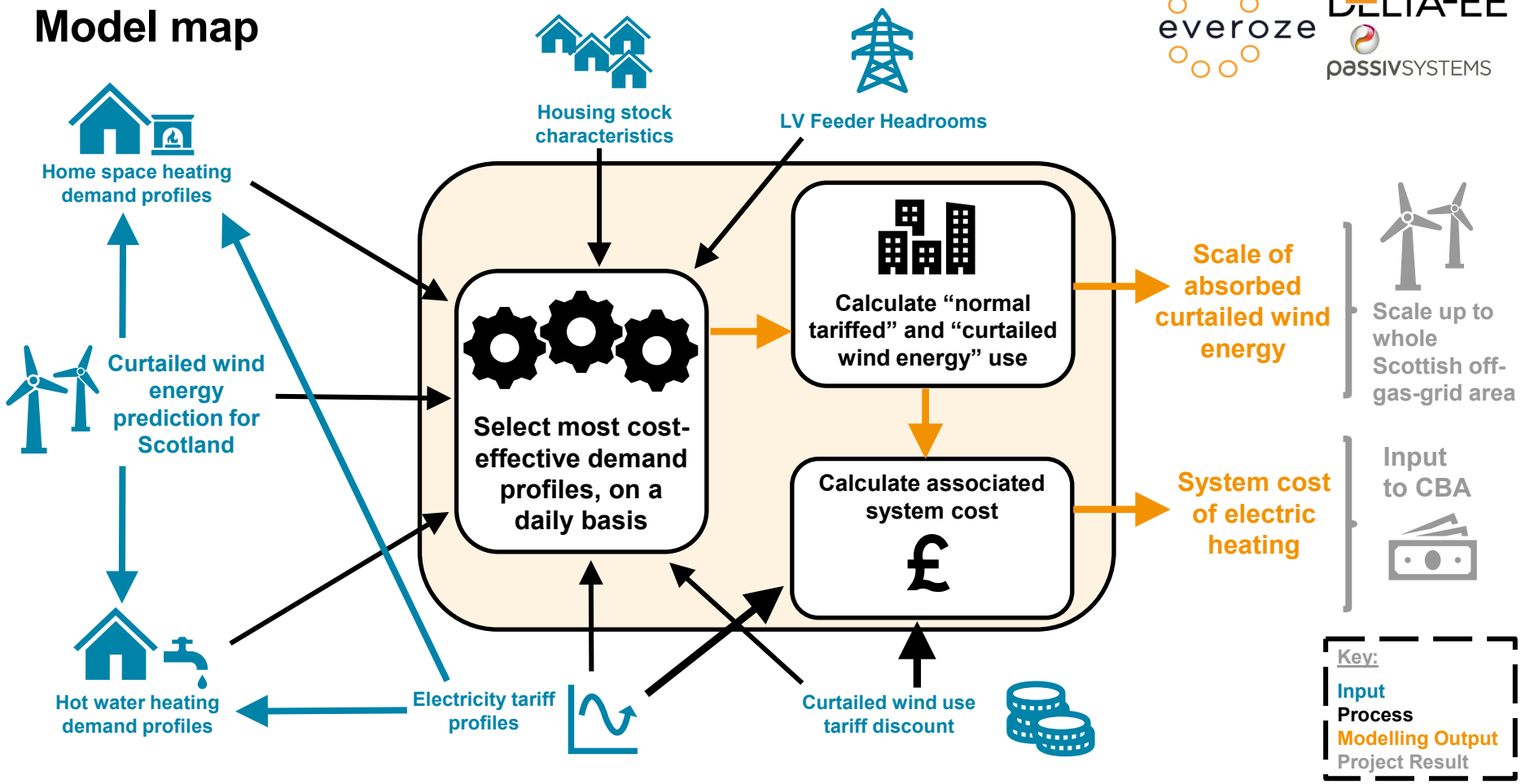
Direct financial incentives



Dynamic time of use tariffs

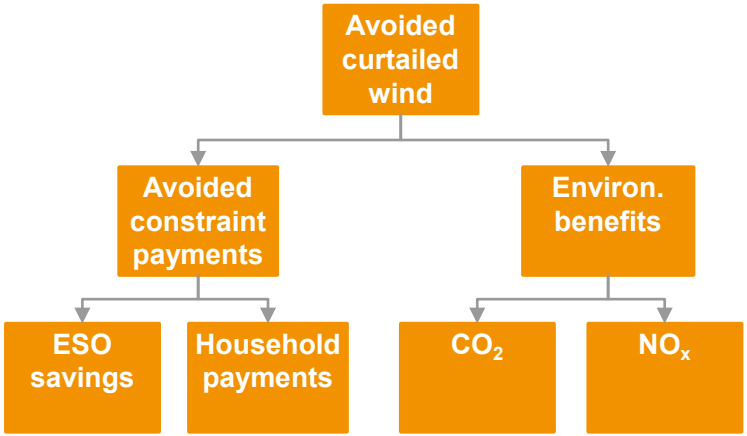
2020 **2030**

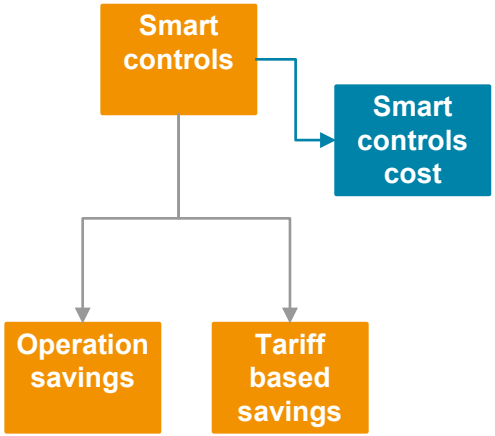
Model map


Housing stock characteristics
LV Feeder Headrooms
Home space heating demand profiles
Curtailed wind energy prediction for Scotland
Hot water heating demand profiles
Electricity tariff profiles
Curtailed wind use tariff discount
Select most cost-effective demand profiles, on a daily basis
Calculate "normal tariffed" and "curtailed wind energy" use
Calculate associated system cost
£
Scale of absorbed curtailed wind energy
Scale up to whole Scottish off-gas-grid area
System cost of electric heating
Input to CBA
Key:
Input
Process
Modelling Output
Project Result

CBA overview

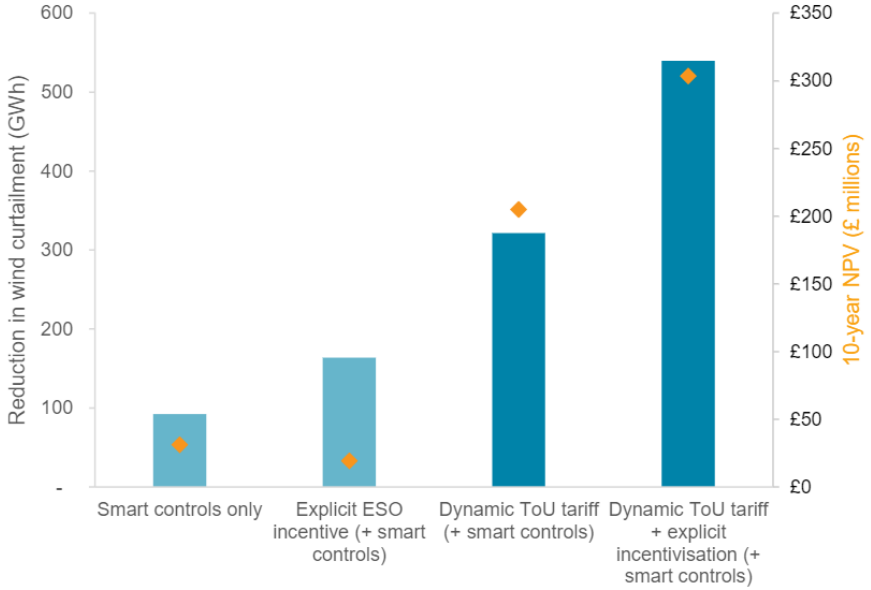
CBA components



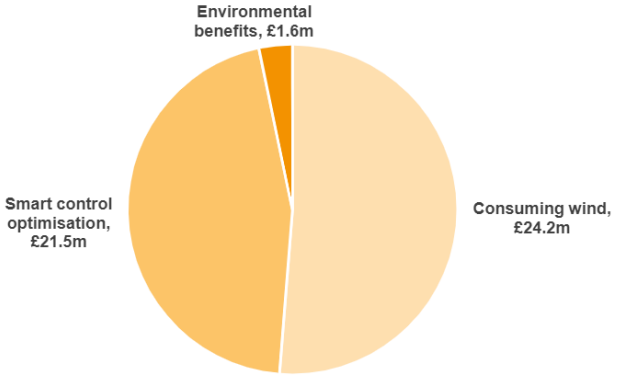


Main findings – modelling for 2030 scenarios

Reduction in wind curtailment (bars) and 10-year NPV (diamonds) in 2030 in response to different mechanisms investigated



Breakdown of system wide benefits per annum for combined scenario, 2030



Conclusions

Smart electric heating can deliver value and reduce wind curtailment

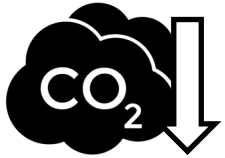
2020: 17%

2030: 9%

£24m/yr

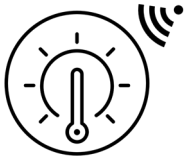
2030 wind curtailment = 3x greater than all off-gas grid electric heating demand

2030: 213 Gt

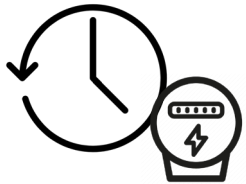


Improved customer comfort ensured

Smart controls are the key mechanisms to access all values



Smart controls



Time of Use tariffs

Explicit wind consumption incentivisation payments

Putting the theory into practice

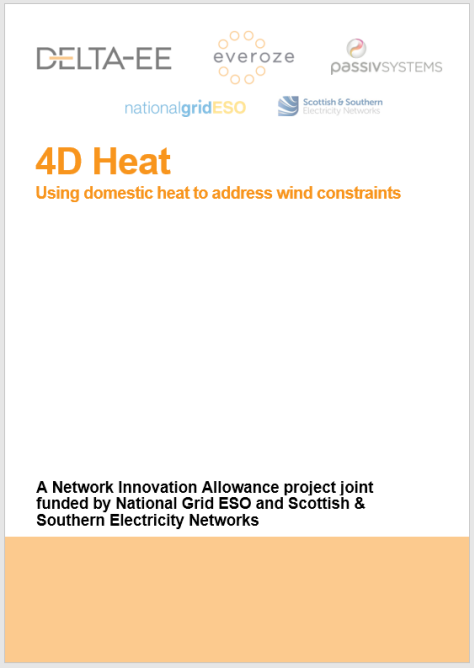
EnergyCloud Ireland

Ireland faces similar renewable curtailment issues to the UK, with over €50 million of renewable energy wasted in 2019 alone. A consortium from across the sector aim to change this.

- EnergyCloud aims to capture some of this surplus renewable energy and redistribute it to citizens on the island of Ireland who are living in fuel poverty.
- Houses included in the scheme will be fitted with a small heating control device that will activate the immersion to come on and use the free power to heat water.
- An initial trial of 50 homes has just kicked off.

https://www.energycloud.org/about/

Further information

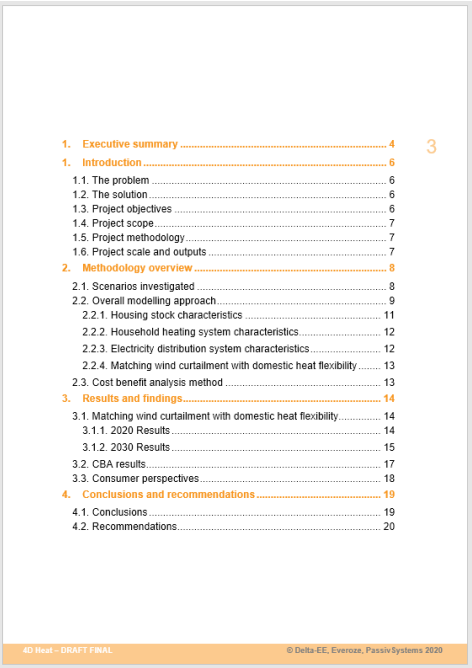

DELTA-EE everoze passivSYSTEMS

nationalgridESO Scottish & Southern Electricity Networks

4D Heat

Using domestic heat to address wind constraints

A Network Innovation Allowance project joint funded by National Grid ESO and Scottish & Southern Electricity Networks



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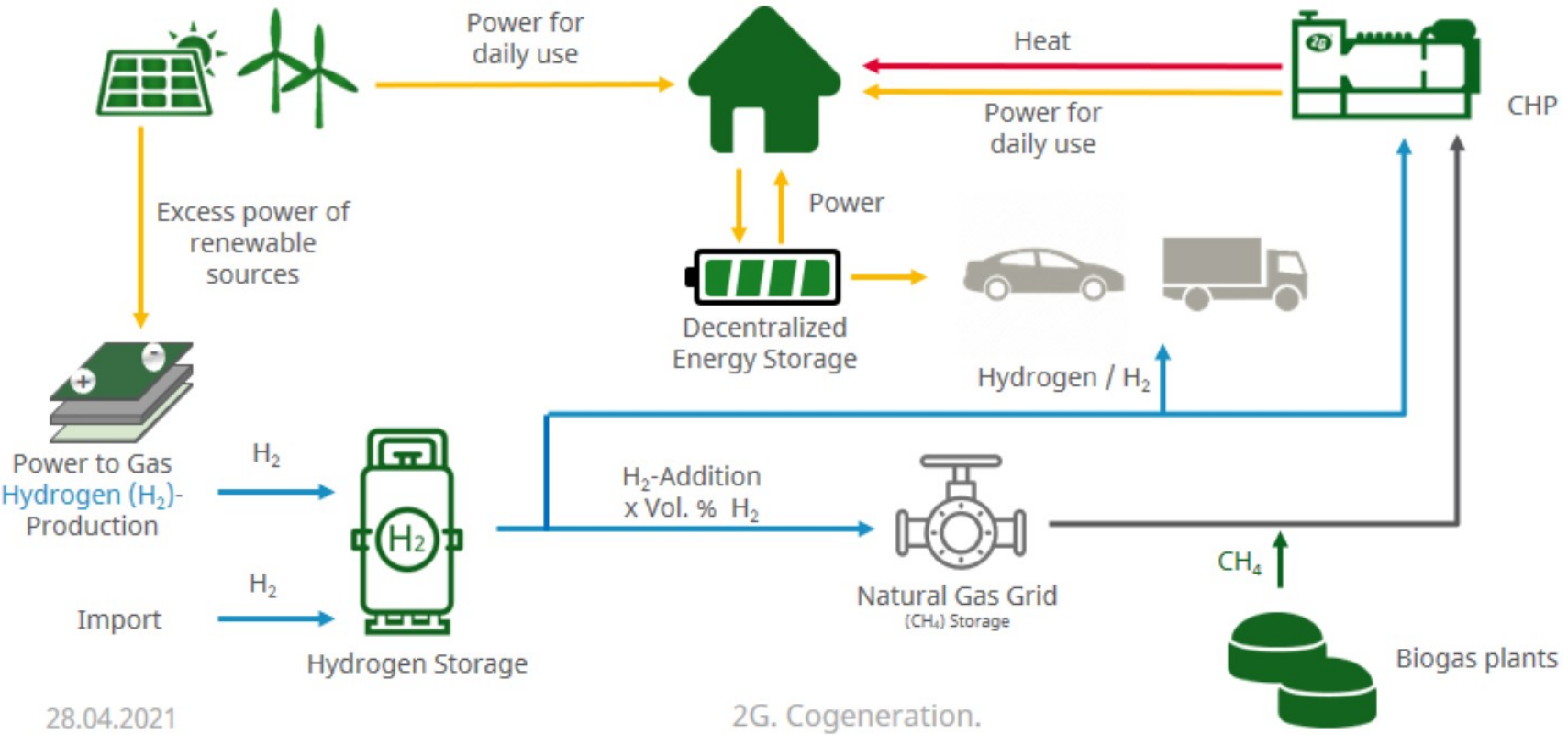
Hydrogen CHP - The Enabler

Stefan Liesner, Head of Public Affairs and Public Relations, 2G Energy AG

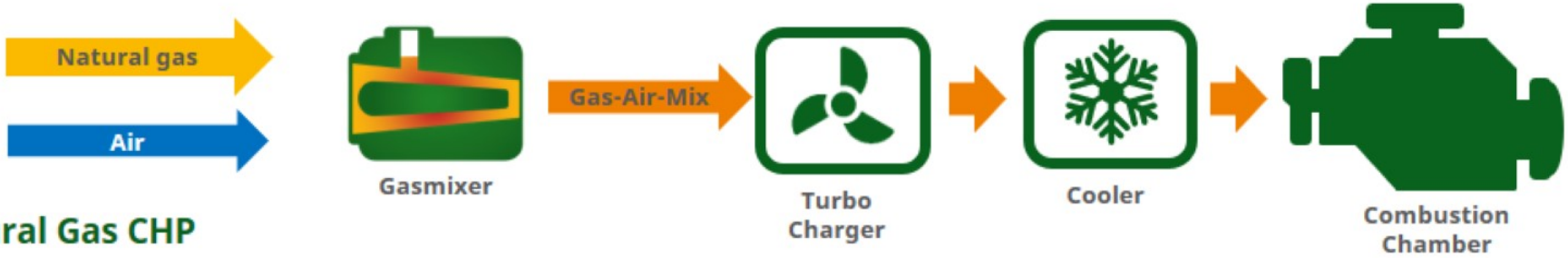
2G. Cogeneration.

28.04.2021

Sectoral Coupling.

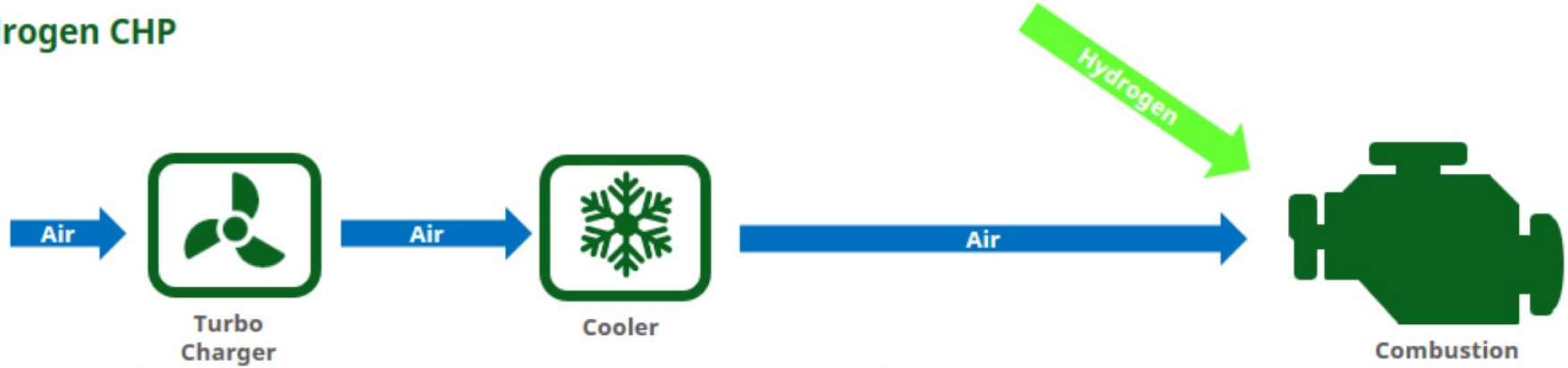


Comparison: Natural Gas CHP vs. Hydrogen CHP

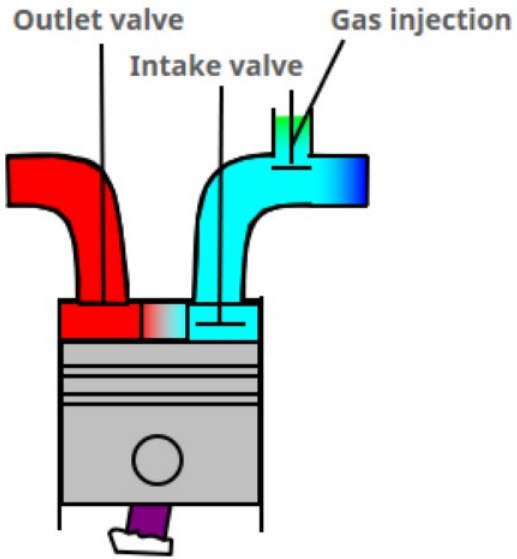


Natural Gas CHP

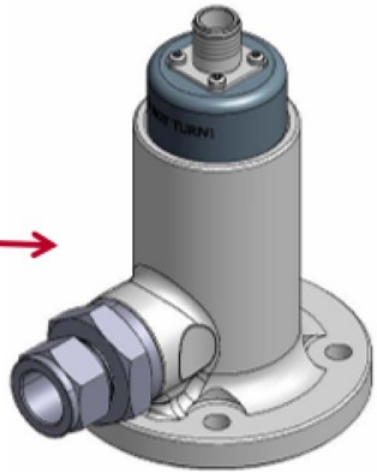
Hydrogen CHP



Mixture with Port Injection



Port Injection:
Mixture just before the combustion chamber

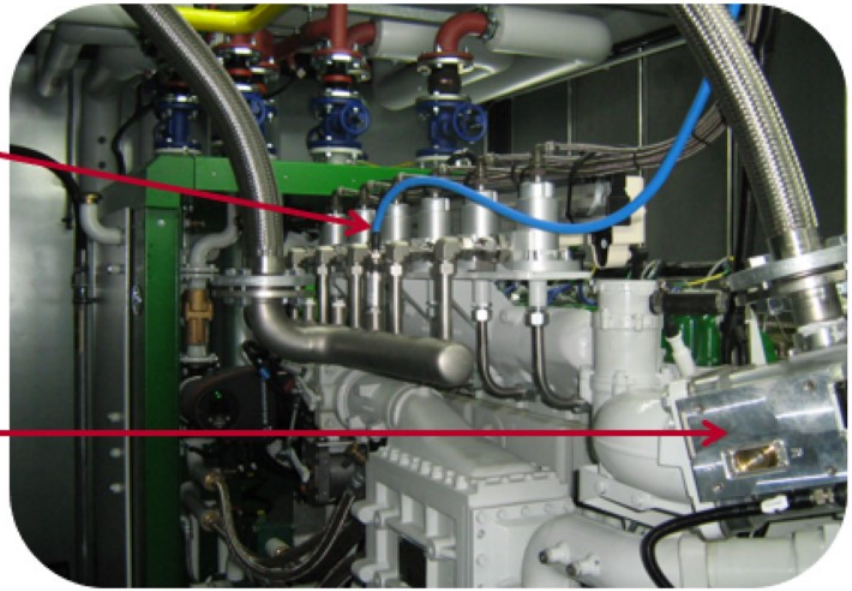


Gas injection valve

Combination of Hydrogen / Natural Gas Operation

Gas injection for hydrogen operation

Regular gas mixer



Switch between hydrogen / natural gas (biogas) operation enables covering peak demand

Today Natural Gas - Tomorrow Hydrogen.

Natural Gas

Hydrogen

References.

TOTAL Hydrogen Service Station / Berlin (Germany)
agenitor 306 H_2 with 2G hydrogen technology

Stadtwerke Haßfurt / Haßfurt (Germany)
agenitor 406 H_2 with 2G hydrogen technology

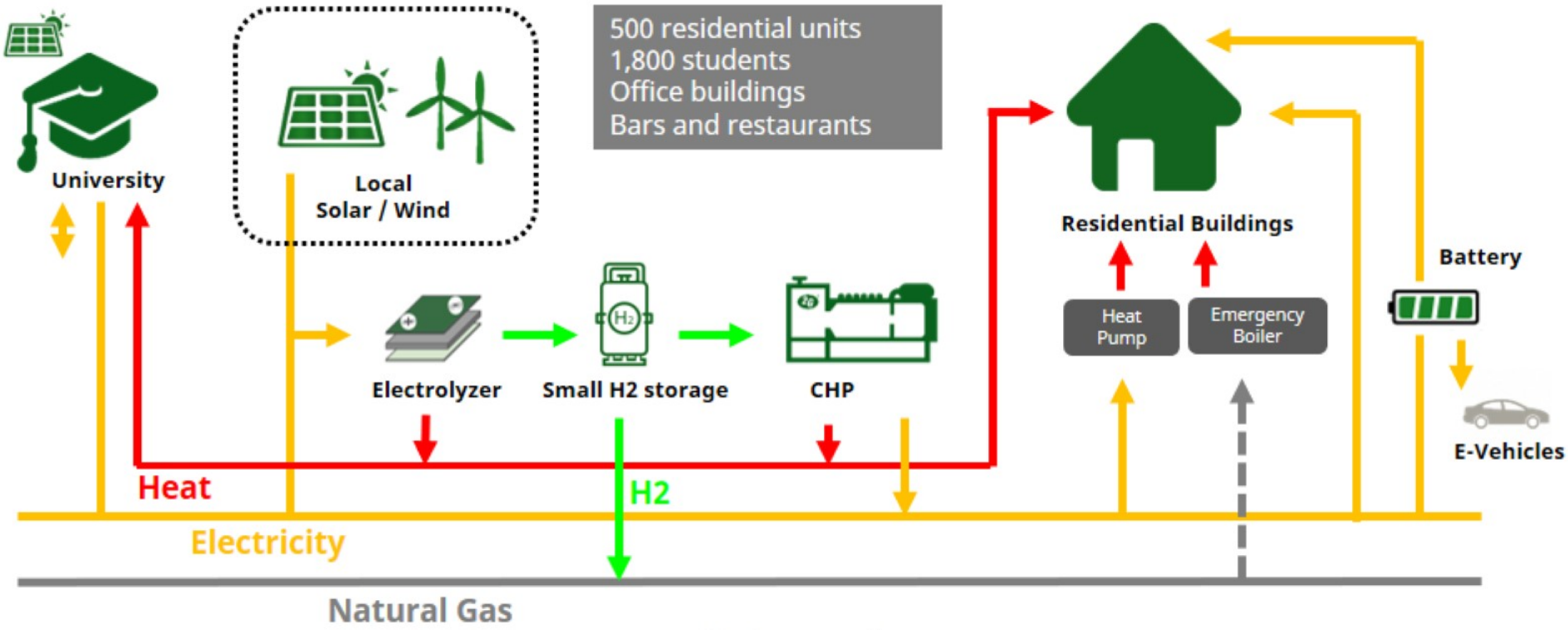
Siemens (Dubai)
agenitor 412 H_2 with 2G hydrogen technology

APEX / Rostock (Germany)
agenitor 404c H_2 with 2G hydrogen technology

Climate Neutral Quarter Esslingen (Germany)
agenitor 406 H_2 with 2G hydrogen technology

Oakney Airport (UK)
agenitor 404c with H_2 with 2G hydrogen technology

Case Study: City of Esslingen (Germany)



2G Hydrogen Portfolio.

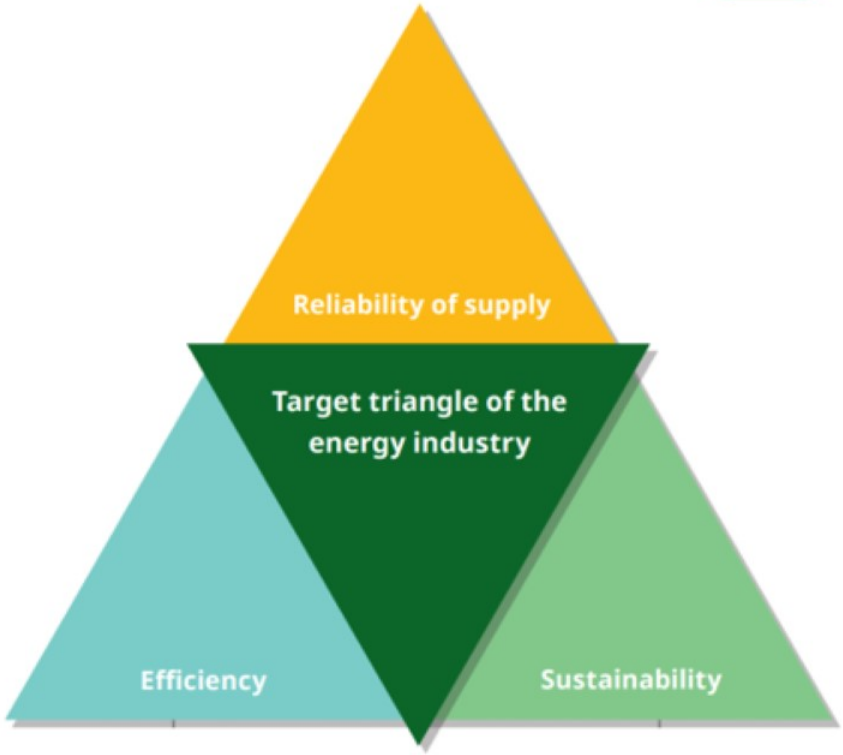
Type	Output		Efficiency Rate		
	Electrical	Thermal	Electrical	Thermal	Total
agenitor 404c H_2	115 kW	129 kW	37.7 %	42.3 %	80.0 %
agenitor 406 H_2	170 kW	183 kW	39.0 %	41.9 %	80.9 %
agenitor 408 H_2	240 kW	250 kW	40.2 %	41.9 %	82.1 %
agenitor 412 H_2	360 kW	371 kW	40.5 %	41.7 %	82.2 %

Summary – CHP systems are....

1. ...part of the renewable energy storage solution in order to re-electrify the wind and solar energy stored in the gas system in a highly efficient manner

2. ...the natural partner technology for PV systems due to the complementary mode of operation

3. ...system-relevant and can cover the residual load highly efficient as required



Questions?

Questions in the Q&A pod

Address your question to one or more speakers

Be concise & precise

Vote questions up