



The role of renewable gas after adoption of the CEP GREEN HYDROGEN

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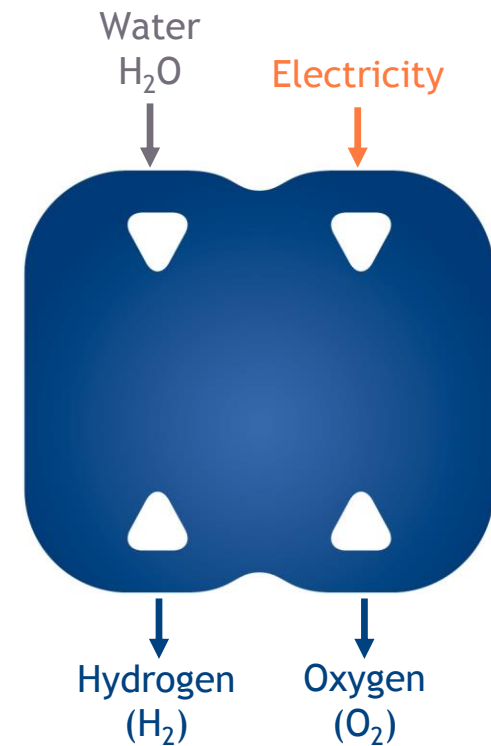


Investors



Green hydrogen in a “nutshell”

- + **Green hydrogen (H_2)** is produced via electrolysis in an electrochemical reaction that splits water or steam (H_2O) into hydrogen (H_2) and oxygen (O_2) using renewable electricity
- + It is a **100% emissions free** process
- + H_2 can be blended with natural gas directly or used to produce **synthetic natural gas** using CO_2



Analysis of Clean Energy Package regarding renewable gas

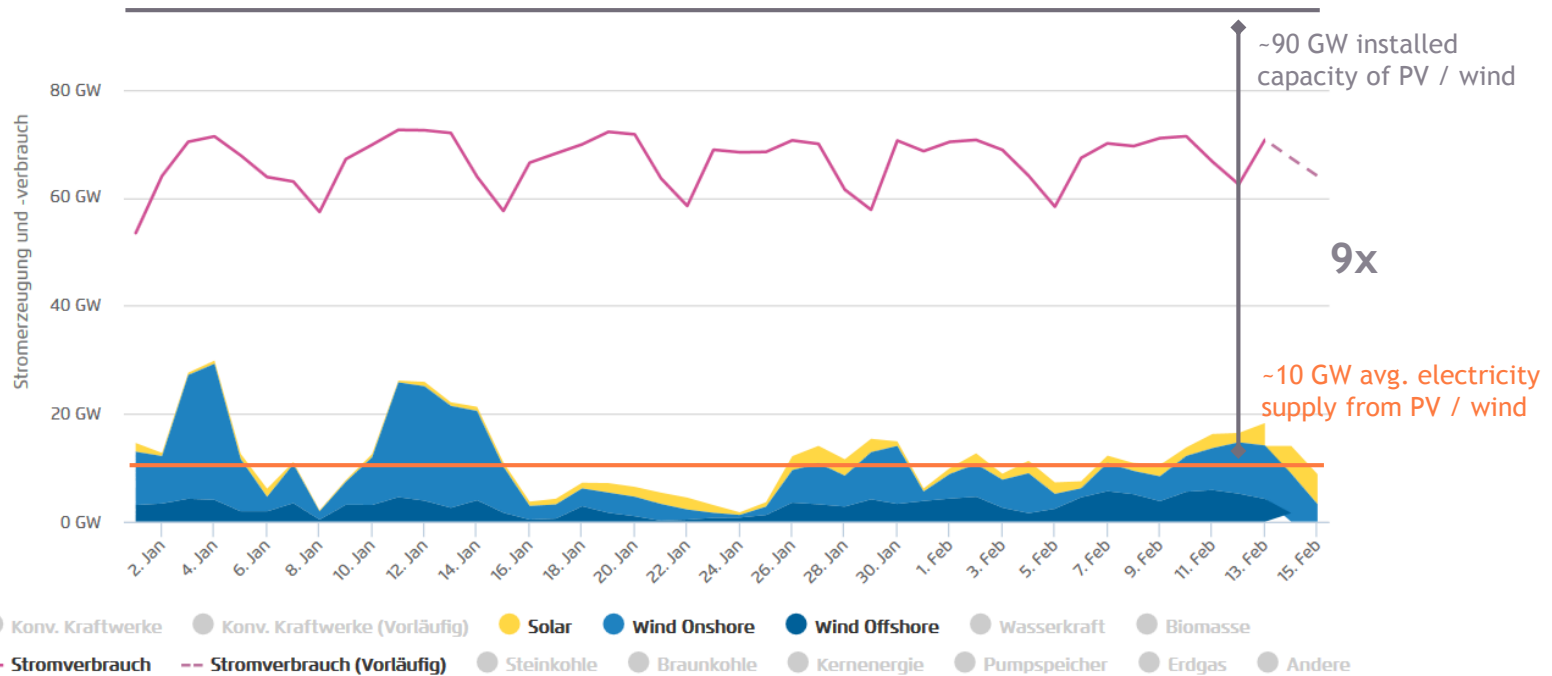
Renewable Energy Directive (RED)

- + **Stricter criteria for bioenergy** in heating & cooling, electricity and transport
- + Increasing renewable share in transport sector (2030: 6,8%/9%). Gap needs to be filled by **advanced biofuels** and **renewable fuels of non-biological origin**
- + Increase renewable share in heating and cooling sector (1% /2% per year)
- + Long-term **power purchase agreements** accepted for the supply of electricity to electrolysers (Draft Report)

Energy Efficiency Directive (EED)

- + **Lowering primary energy factor (PEF)** for electricity from 2.5 to 2.0
 - W/o any technological progress, 25% increase in efficiency
 - PEF of electricity worse in winter time. Suggestion: Calculate a variable PEF for electricity accounting for relevant geographical and seasonal factors

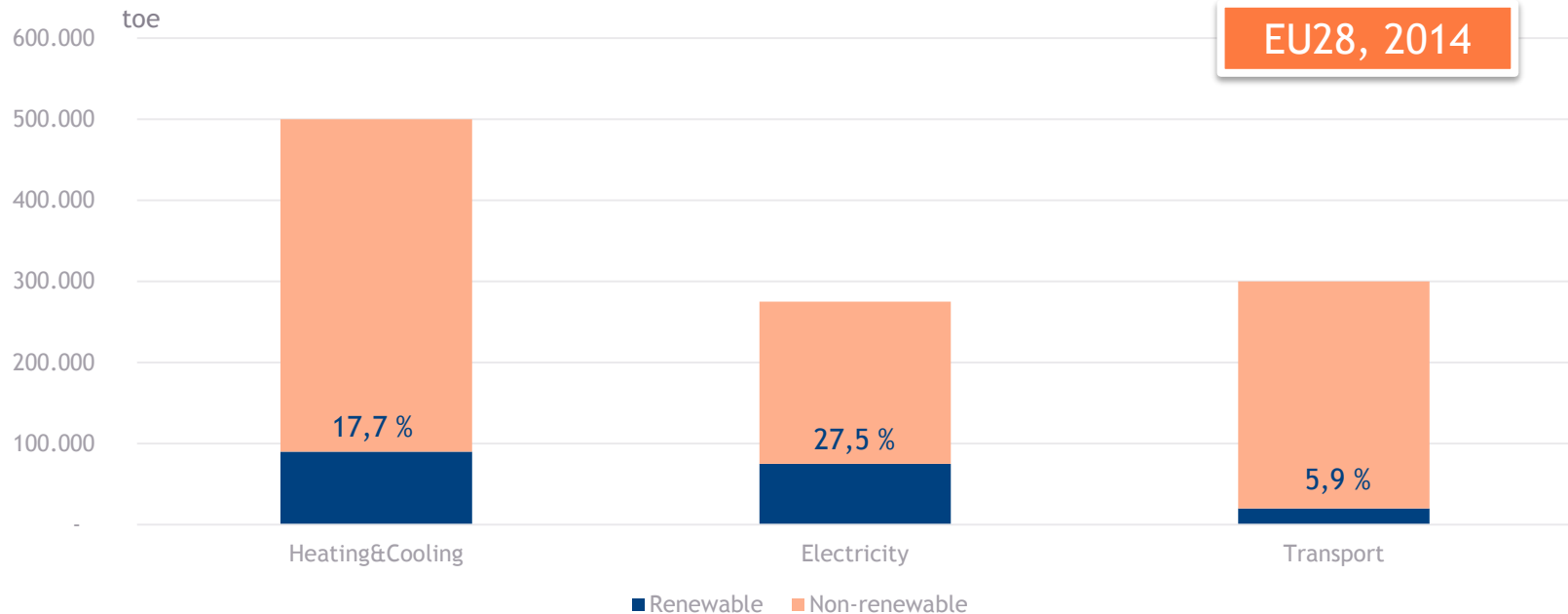
An all-electric world requires large overcapacities



Agora Energiewende; Stand: 15.02.2017, 14:10

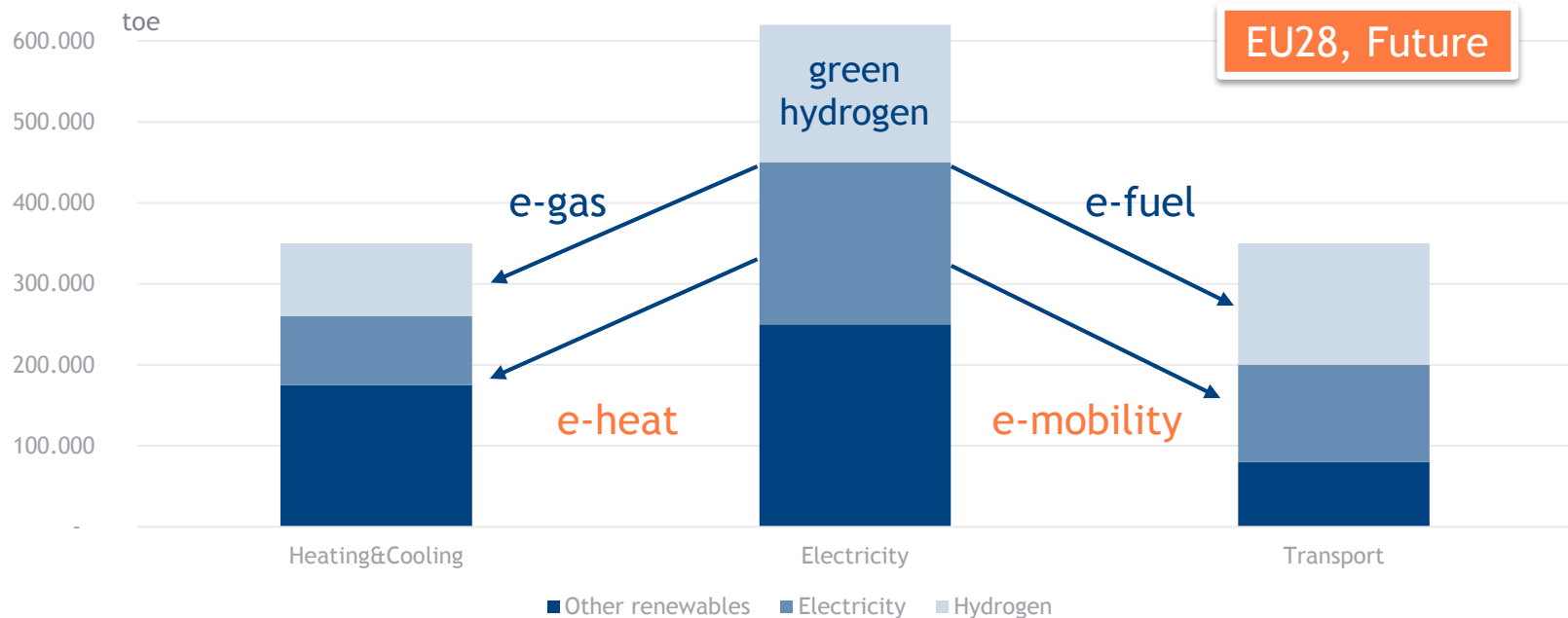
- + Very low share of RES during winter time
- + A major electrification of heating & transport requires significant overcapacities
- + Every additional kWh in winter time is a burden for the power system

We are lacking renewable solutions for oil and gas



- + 2014 total RES share: 17% → 2030 RES target: 27%
- + Limited solutions for oil and gas. Solar and wind power are competitive with fossils, but electrical sector makes up only 25% of overall energy sector
- + An “all electric” energy system seems unlikely

A future scenario with green hydrogen



- + Hydrogen connects the power sector with the heating & cooling and the transport sectors (→ sector integration)
- + Hydrogen promises a better integration of and more renewables in all sectors

Conclusion

- + Fossil gas and oil need to show renewable options otherwise they will be shut-out
- + CEP will increase RES targets and impose stricter criteria for biofuels and biogas
- + An all-electric scenario seems not feasible, but fossil oil and gas will be shut out unless they can show large-scale renewable options for the future
- + Hydrogen is the perfect match for natural gas and biogas / bio- methane
- + Green hydrogen is ready now!



GREEN HYDROGEN NOW

E N E R G Y
E V E R Y W H E R E

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ONTRAS study: „all-electric“ vs. „green-gas“ till 2050¹

- + Detailed comparison of an „all-electric“ vs. „green-gas“ scenario till 2050 for East Germany (ONTRAS grid) - ca. 18% of the German energy market
- + Including private households, commercial, industry and transport
- + Cumulative costs and CO₂ reductions:

		All-electric	Green-gas
CO ₂ reduction till 2050	%	-91	-94
Costs till 2050	bn €	219.4	217.5

- + Key advantages:
 - Possibility of seasonal storage
 - Reduction of re-dispatch
 - Reduction of electricity grid expansion (on TSO and DSO level)
 - Reduction of stranded assets in the gas sector

¹Endbericht zur Kurzstudie der nymoen|strategieberatung: „PtG-Potenziale im ONTRAS-Netzgebiet“ (2017)