Last man standing:
Gas to save the day on sector-coupling and getting ‘green’ along the way

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Agenda:

- Gas Advocacy in ‘last man standing’ fashion: the next level
- Counter coal industry attack: well-to-grid emissions
- ‘All-electric’ sector-coupling: substantial incremental power demand
- Short position renewable power – load hour limitations
- Gas to cover short position: massive expansion
- Gas to tackle intermittency:
  - Too little: ‘Kalte Dunkelflaute’ requires residual load
  - Too much: Surplus production - curtail & export at negative prices?
- ‘Store’ surplus renewable power? Gas can green!

Gas advocacy in ‘last man standing’ fashion

The next level: besides rational arguments, use popularity concerns

Source: Zukunft ERDGAS, Jahresbericht 2016, page 18

Counter coal industry attack: well-to-grid emissions

Gas supremacy prevails by far also by 'well-to-grid' standards

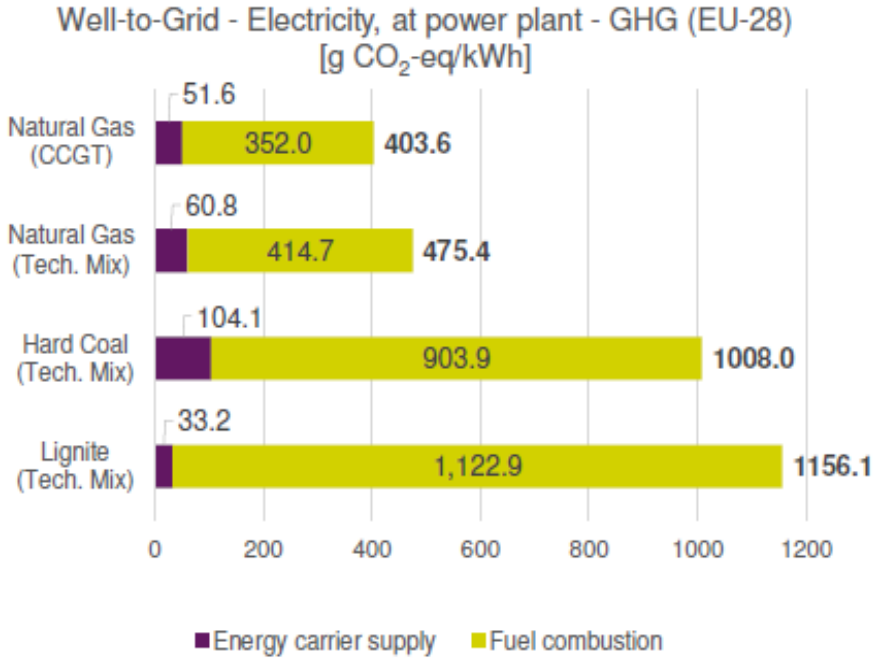


Figure 7-8: Well-to-Electricity – GHG Emissions: Electricity Production Comparison for different Energy Carriers [33]

Source: Thinkstep Natural Gas GHG Intensity Report, page 91

All-electric' sector-coupling: substantial incremental power demand

Germany: from ~600 to 1,300 TWh

Provided all efficiency measures are implemented

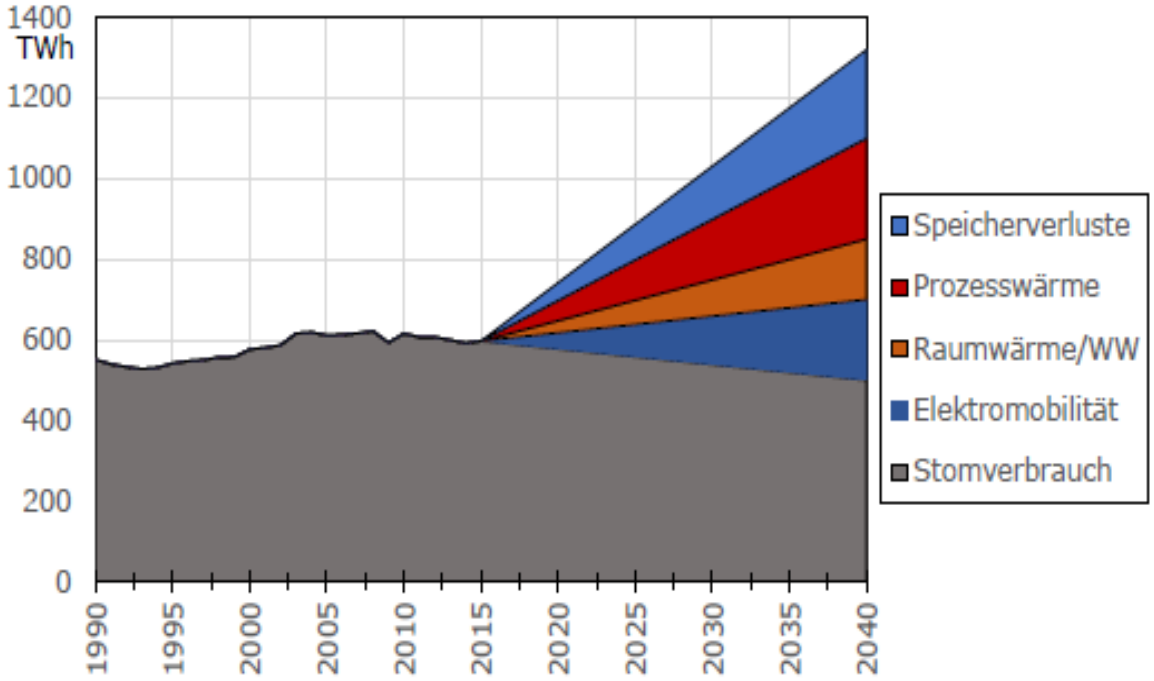


Bild 14 Entwicklung des Strombedarfs für eine klimaneutrale Energieversorgung mit Effizienzmaßnahmen

Source: : Quaschning, Sektorkopplung, page 29

Example German passenger cars only
15 million e-cars (1/3rd of total): 54.45 TWh

Average driving distance: 20,913 Pkm

Consumption BEV 150/300: 0.625 MJ/km = 174 Wh/km

1 million e-cars: 3.6 TWh

Tabelle II-7: Eigenschaften neu zugelassener Pkw-mittel – Entwicklung von 2010 bis 2050

	2010	2020	2030	2040	2050
Energieverbrauch in MJ/km					
ICEV-B	2,57	1,84	1,50	1,13	1,08
ICEV-D	2,35	1,80	1,48	1,17	1,08
PHEV	2,37 / 0,80	1,71 / 0,68	1,59 / 0,64	1,13 / 0,56	1,07 / 0,52
REEV	2,78 / 0,80	2,00 / 0,67	1,90 / 0,63	1,41 / 0,55	1,33 / 0,51
BEV 150	0,80	0,67	0,62	0,54	0,50
BEV 300	0,89	0,73	0,63	0,55	0,51
ICEV-CH_4	2,57	1,84	1,50	1,13	1,08
ICEV-H_2	1,43	1,19	1,13	0,92	0,80

Source: : UBA/Öko Institut Verkehr 2016, page 94

Short position renewable power: 840 TWh

Load factor limitations solar and wind

Renewables output 2040: only 460 of 1,300 TWh

Tabelle 12 Entwicklung der regenerativen Stromerzeugung bis 2040 bei dauerhaftem Einhalten der EEG-Zielkorridore aus dem EEG 2014 [EEG14]

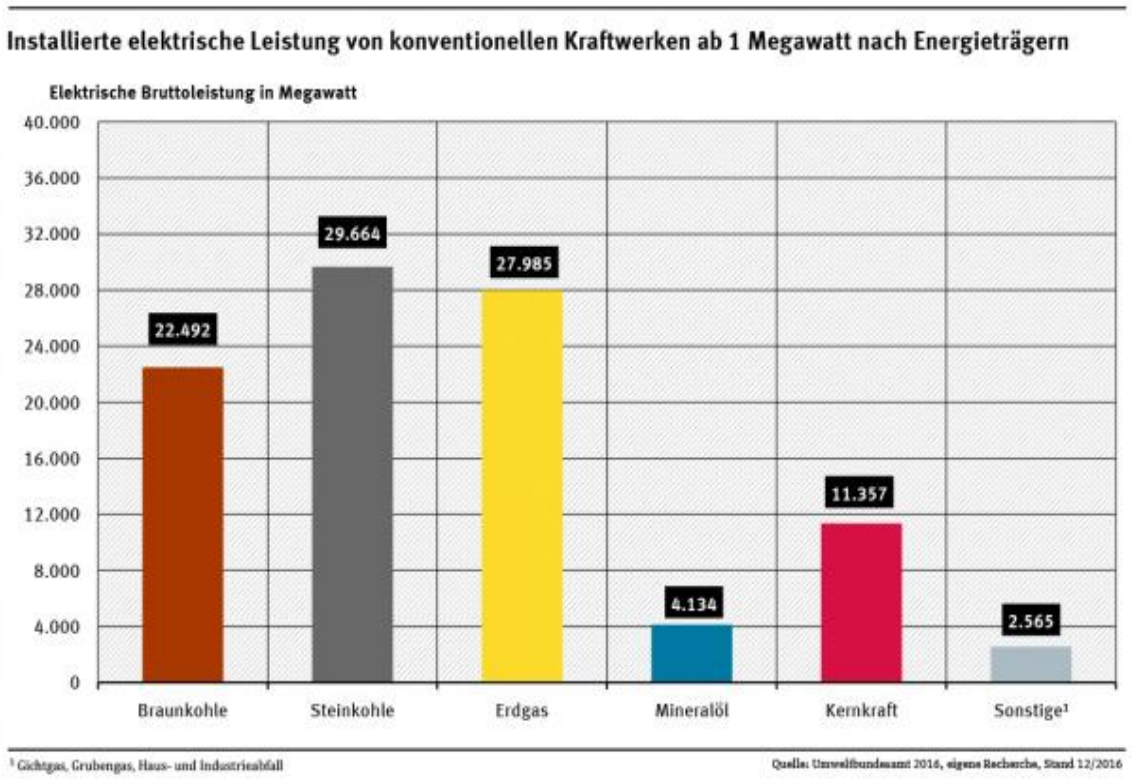
Erzeugung	Jährlicher Ausbau in GW	Installierte Leistung 2040 in GW	Volllaststunden in h/a	Strom-erzeugung 2040 in TWh [2]
Photovoltaik	2,5 (brutto)	50	950	48
Windkraft onshore	2,5 (netto)	104	2500	260
Windkraft offshore [1]	0,85 (netto)	24	4500	108
Biomasse	0,1 (brutto)	3	5500	17
Wasserkraft [1]	0,05 (netto)	7	3800	27
Summe	6	187		460 (35 %)

[1] Ausbauziele für Wind-Offshore: 6,5 GW bis 2020 und 15 GW bis 2030, keine Ziele für die Wasserkraft
[2] durchschnittliche Anlagenlebensdauer 20 Jahre

Source: : Quaschning, Sektorkopplung, page 29

Gas to cover ~840 TWh short position
Massive expansion of gas capacity required

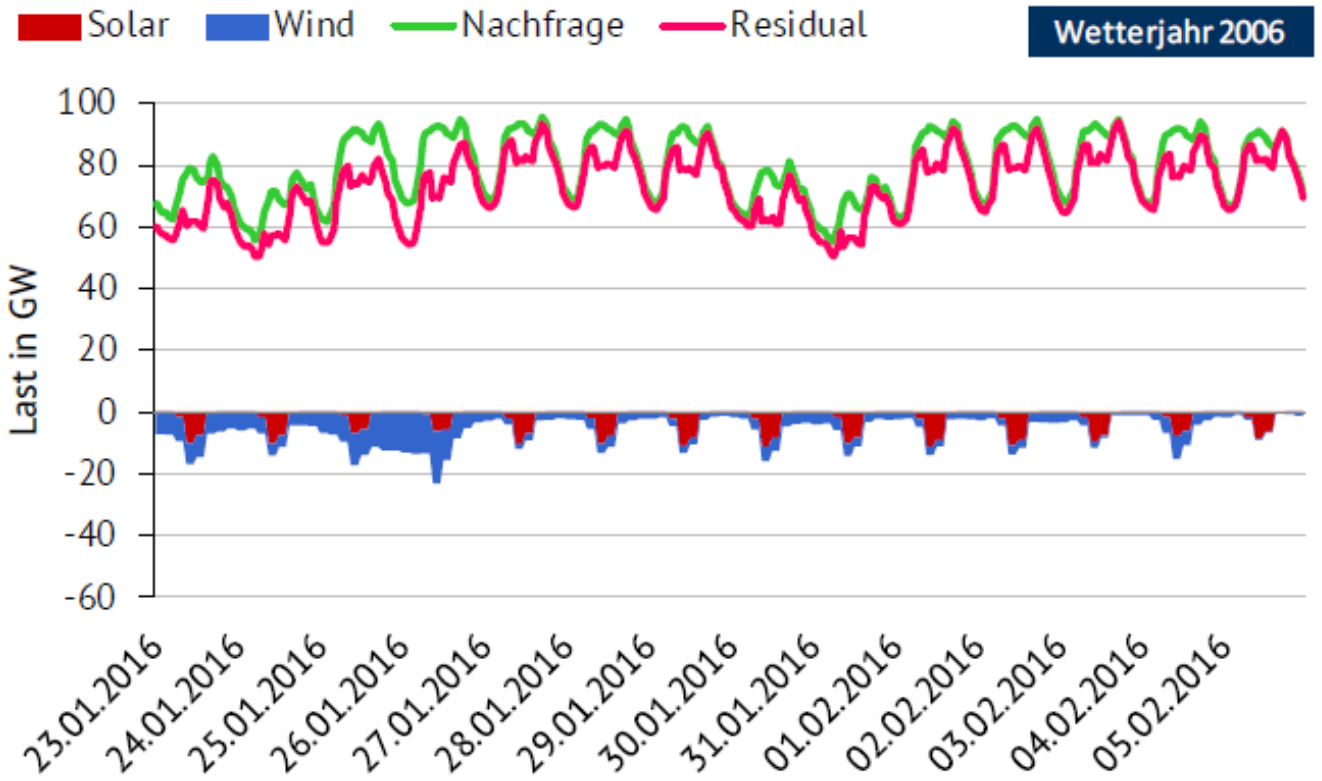
Higher load factor lignite/coal will increase CO2 emissions (memo: ~10 GW nuclear gone in 2020/21)



Source: https://www.umweltbundesamt.de/daten/energiebereitstellung-verbrauch/konventionelle-kraftwerke-erneuerbare-energien#textpart-1

Gas to tackle intermittency (1): Too little!
'Kalte Dunkelflaute'

'Residual Load' necessary for complete wind & solar capacities
Substantial gas capacity required to provide 'residual load'

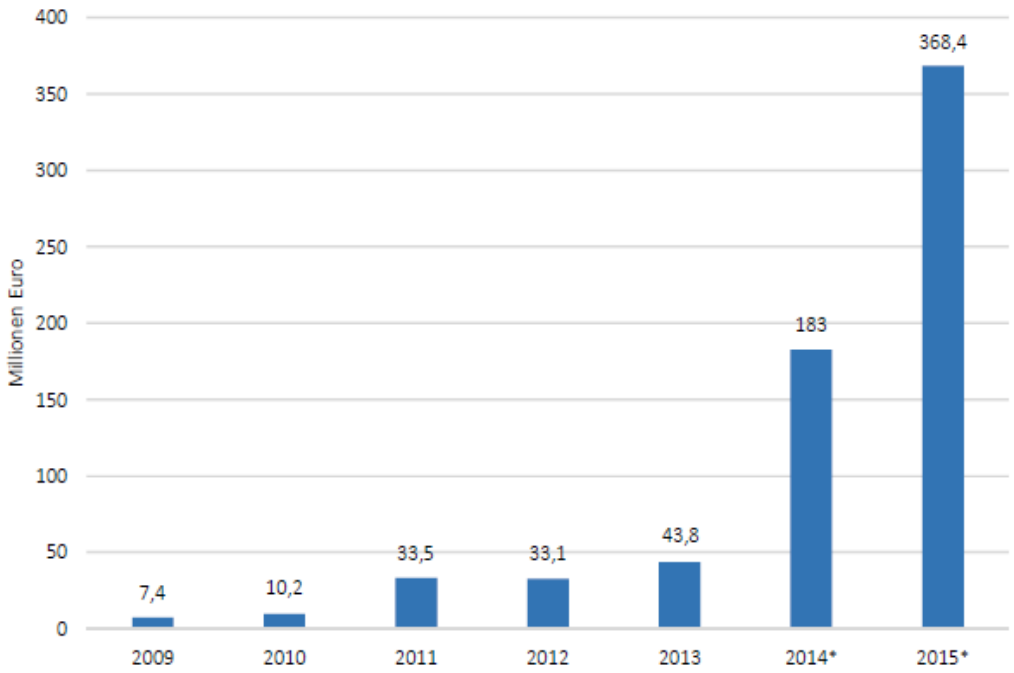


Source: Greenpeace/Energy Brainpool, 'Kalte Dunkelflaute', page 5

Gas to tackle intermittency (2): Too much! Surplus production – curtail or export?

Curtailment & export at negative prices exponentially increased

ABBILDUNG 12: KOSTEN DES EINSPEISEMANAGEMENTS

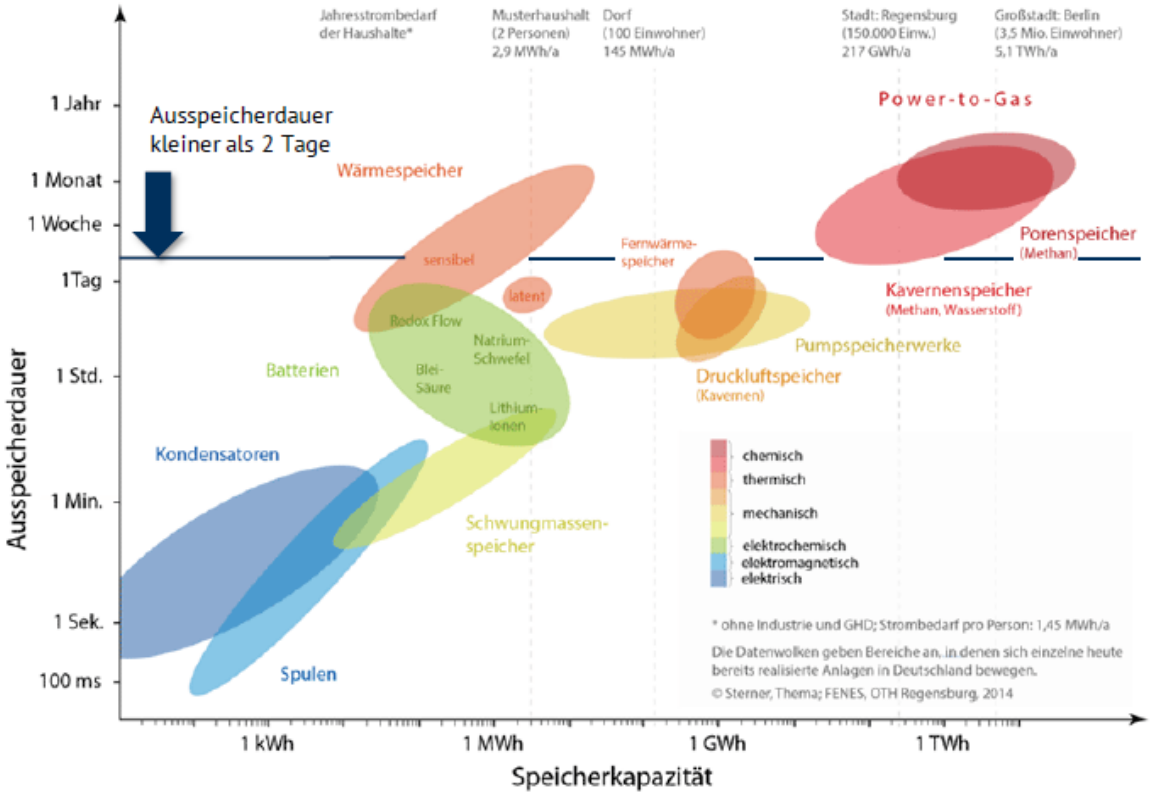


Quelle: Bundesnetzagentur, 2016, 15f.

Source: DICE Report, page 32

‘Store’ surplus renewable power? Gas can green!

P2G only technology for long-term storage of renewable power



Source: Greenpeace/Energy Brainpool: Minimum Power Flexibility, page 2

For further reading soon to come:

‘Energiewende: From Champion to ‘Fossil of the Day’

Without natural gas to save the day, ‘all-electric sector-coupling’ will ensure further fossil of the day awards

(www.gasvaluechain.com)

Thank you very much for your attention!