Natural gas in the Energiewende

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Based on joint research with Christian von Hirschhausen, Claudia Kemfert, Clemens Gerbaulet, Casimir Lorenz et al.

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Structure of this talk

1. What is the German Energiewende?
    1. Mandatory RES targets
    2. Nuclear phase-out
    3. Economy-wide climate targets to 2030/2050
2. Sector 1: Electricity
3. Sector 2: Transportation
4. Sector 3: Industry
5. Conclusions and outlook

1 „Energiewende“ in Germany: Strong role for renewables

	Reduction of nuclear energy	Share of Renewable Energy		Reduction GHG-Emissions	Reduction of Energy Demand			
		Gross final energy	Electricity Production		Primary Energy	Domestic Heat	Final Energy Transport	Electricity Demand
2015 2017 2019	-47% -56% -60%							
2020		18%	35%	-40%	-20%	-20%	-10%	-10%
2021 2022 2025	-80% -100%		40-45%					
2030 2035		30%	50% 55-60%	-55%				
2040		45%	65%	-70%				
2050		60%	80%	-80% bis 95%	-50%	-80%	-40%	-25%
Base year	2010	-	-	1990	2008	2008	2005	2008

No explicit and clear role for natural gas

Source: German government (2010, 2011, 2013)

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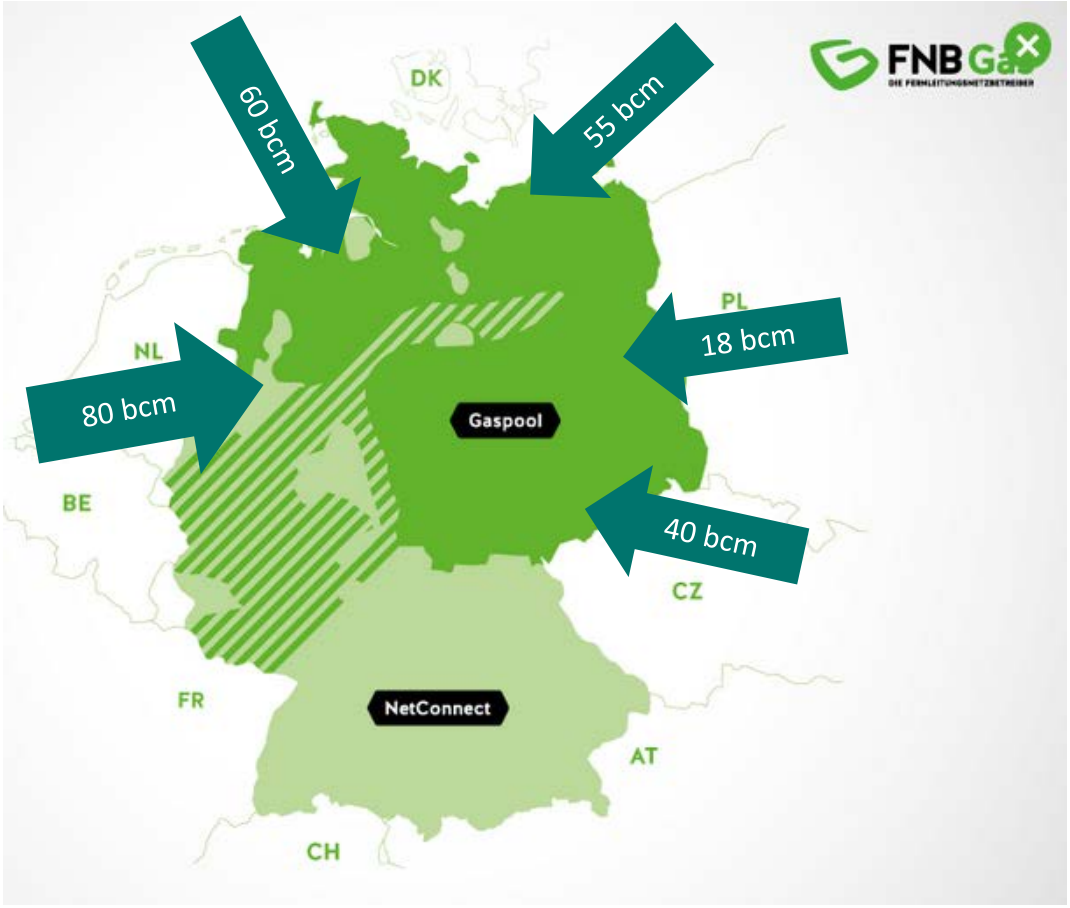
1 The next step: An economy-wide “climate protection plan” to 2050

Table: Emissions and emissions targets by sector, in Mio. t CO_2 equiv.

Sector	1990	2014	2030	2030 (reduction to 1990)
Energy	466	358	175 – 183	62 – 61 %
Buildings	209	119	70 – 72	67 – 66 %
Transport	163	160	95 – 98	42 – 40 %
Industry	283	181	140 – 143	51 – 49 %
Agriculture	88	72	58 – 61	34 – 31 %
Others	39	12	5	87 %
Sum	1248	902	543 – 562	56 – 55 %

1 Germany (and Europe) have a very comfortable supply situation

What to do with all the natural gas?



2 Natural gas use in Germany today

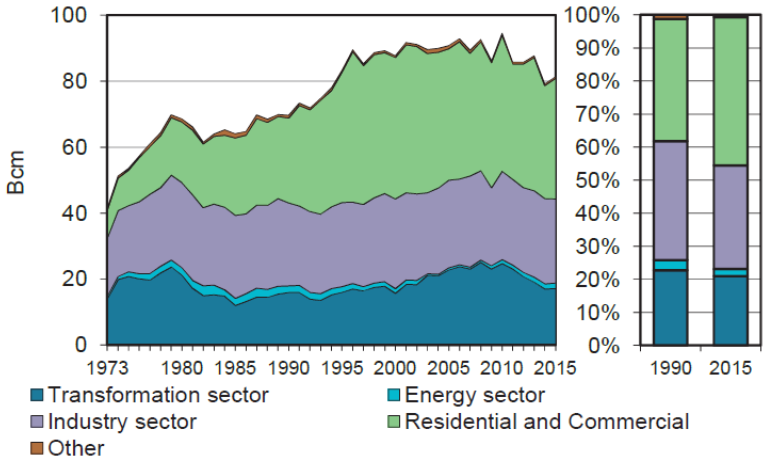
Power sector

Germany:

- 14% of installed capacity (~ 30 GW), of which ~ ⅓ are 10 years old less
- ~10% of electricity generation

Transportation

- 0.2% of passenger cars run on natural gas

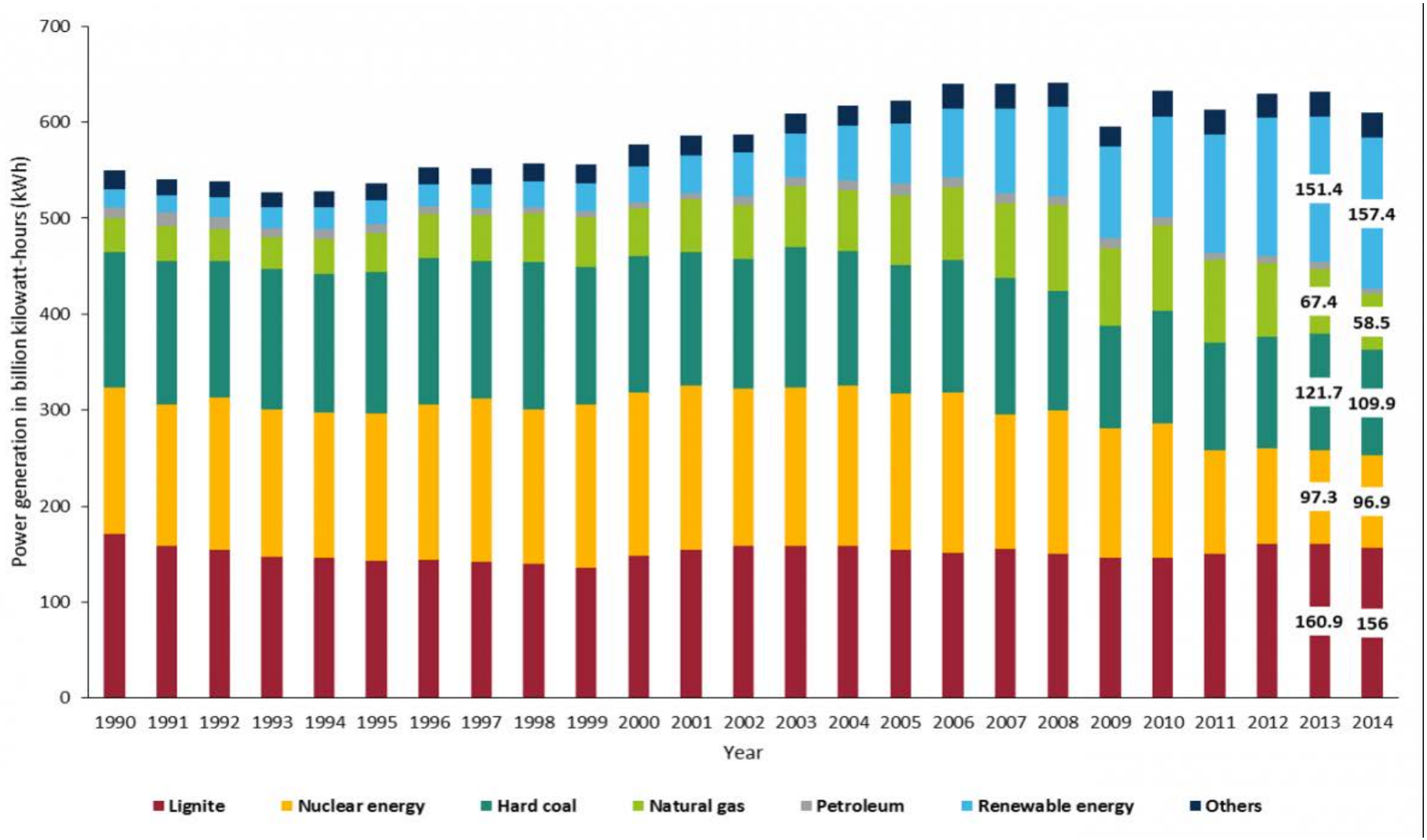


Heat

- Households:
  - Existing building stock : 50% market share of natural gas, new-built 40%

Industry: large role as fuel and feedstock

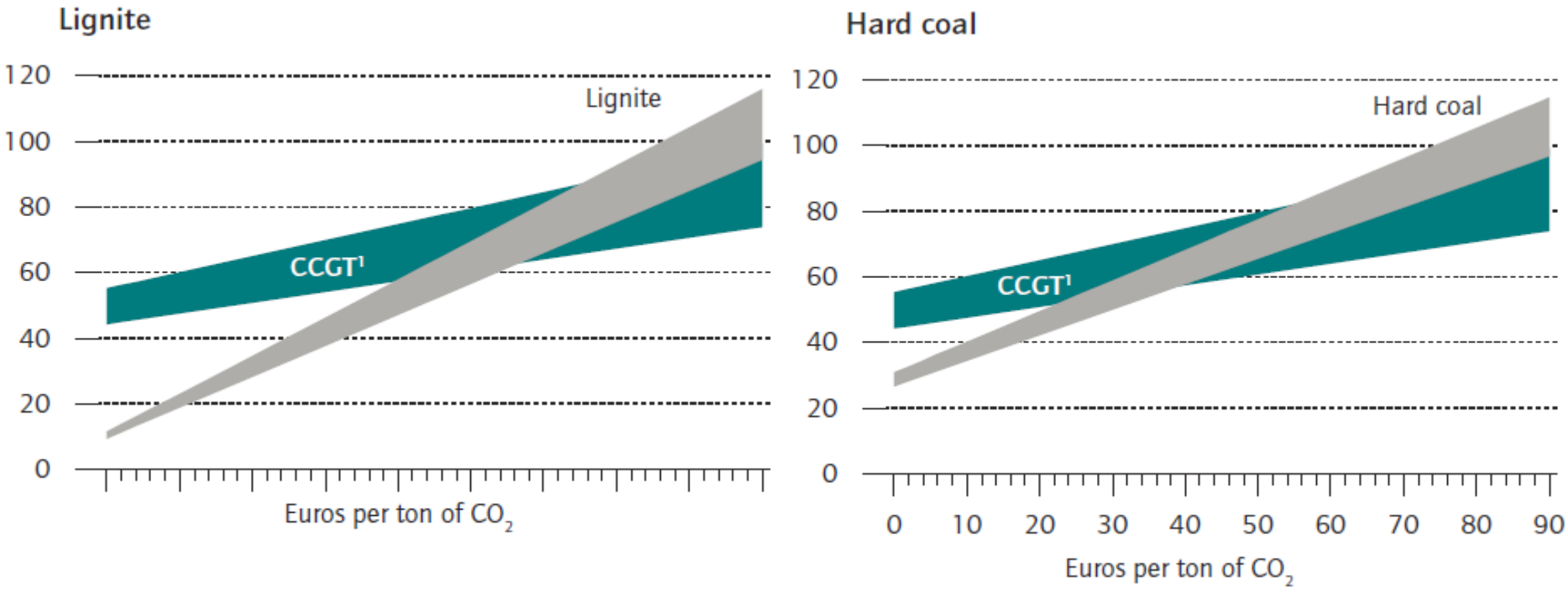
Only 10% natural gas but more than 50% coal in the electricity mix



Source: Clean Energy Wire, based on AGEB, 2014.

2 Reasons for strong coal and low natural gas: Very low CO_2 price

CO_2 switch price to natural gas far from current CO_2 price levels



Depending on the efficiency level of the power plant considered, the switch CO_2 price starts at around 40 euros per ton for lignite; for hard coal, the corresponding number is around 20 euros per t CO_2.

Source: Oei et al. (2014)

2 Coal exit policies now largely accepted

EU power utility boss: 'Coal is finished, the hard question now is gas'

By Frédéric Simon | EURACTIV.com

4. Okt. 2017 (updated: 7. Nov. 2017)

EURACTIV website, retrieved February 22, 2018
(https://www.euractiv.com/section/electricity/interview/eu-power-utility-boss-coal-is-finished-the-hard-question-now-is-gas/)

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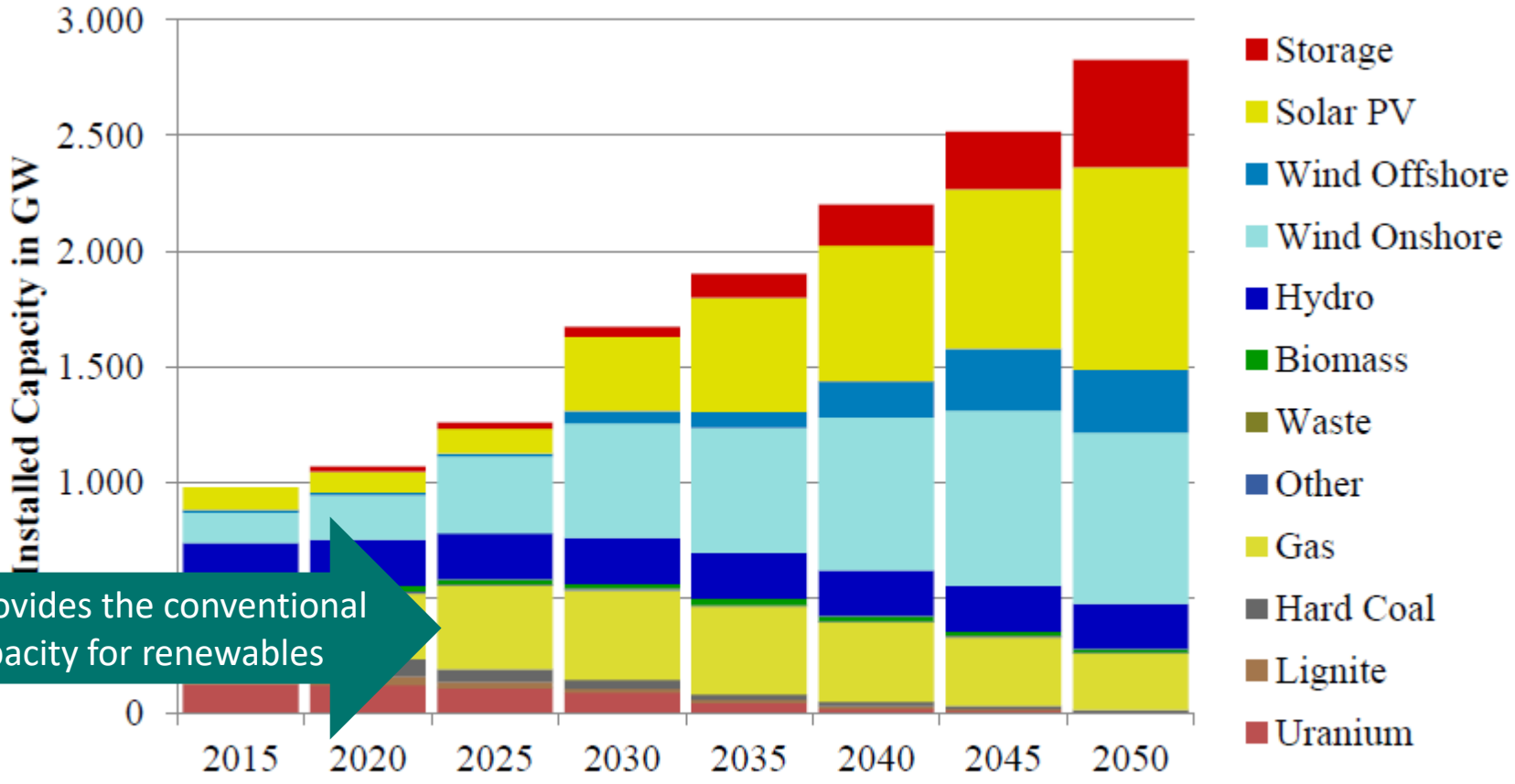
2 Natural gas in the European power sector 2015-2050

Results with the nodal hourly electricity model ELMOD



Natural gas provides the conventional back-up capacity for renewables

Figure 12: Installed electricity generation and storage capacities in Europe 2015–2050

Source: Gerbaulet and Lorenz (2017)

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2 Electricity generation in Europe 2015-2050

Results with the nodal hourly electricity model ELMOD

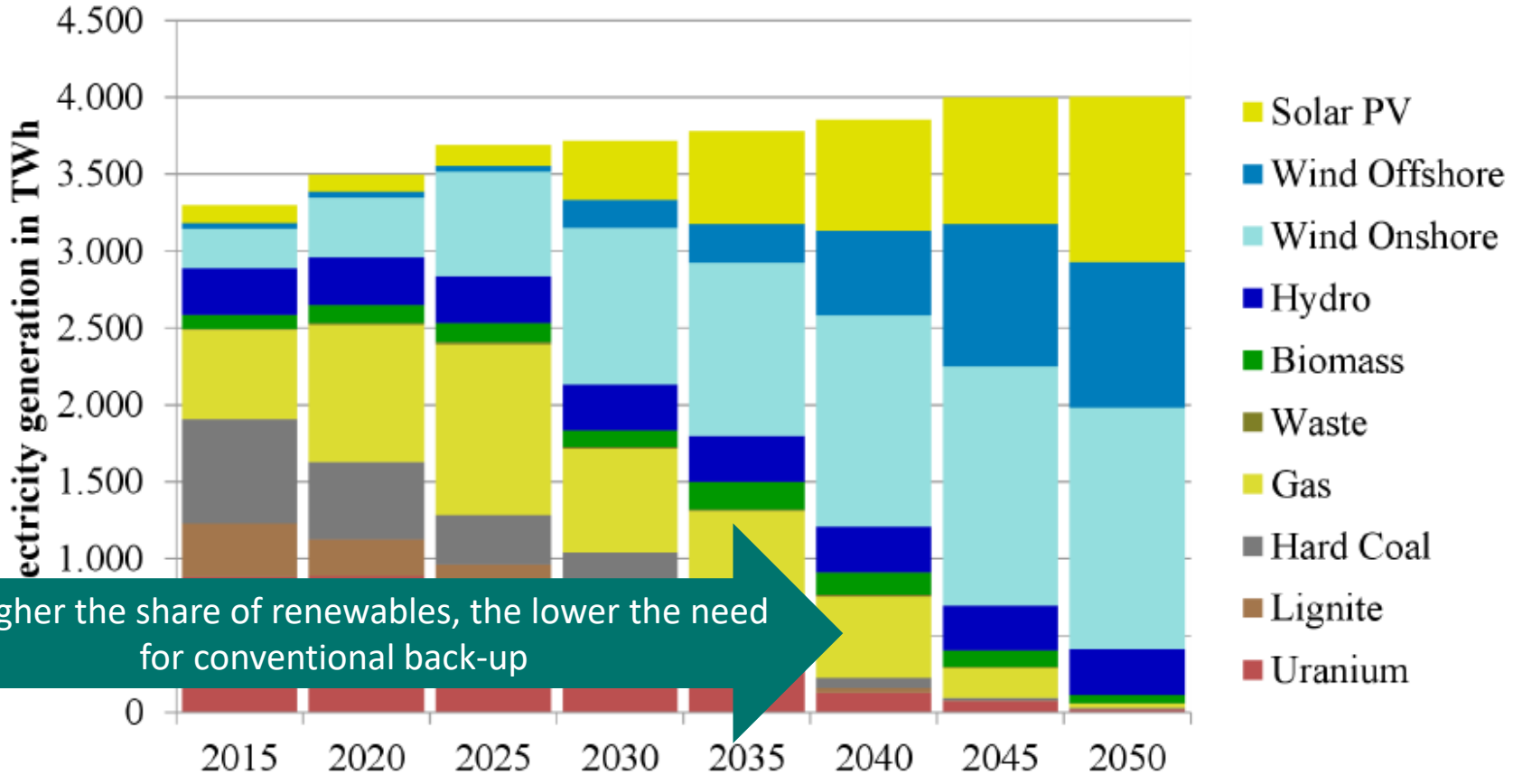


Figure 13: Electricity generation 2015–2050

Source: Gerbaulet and Lorenz (2017)

2 Early decarbonization of the power mix phases natural gas out earlier

- ELMOD results 2050 by decarbonization target of the power

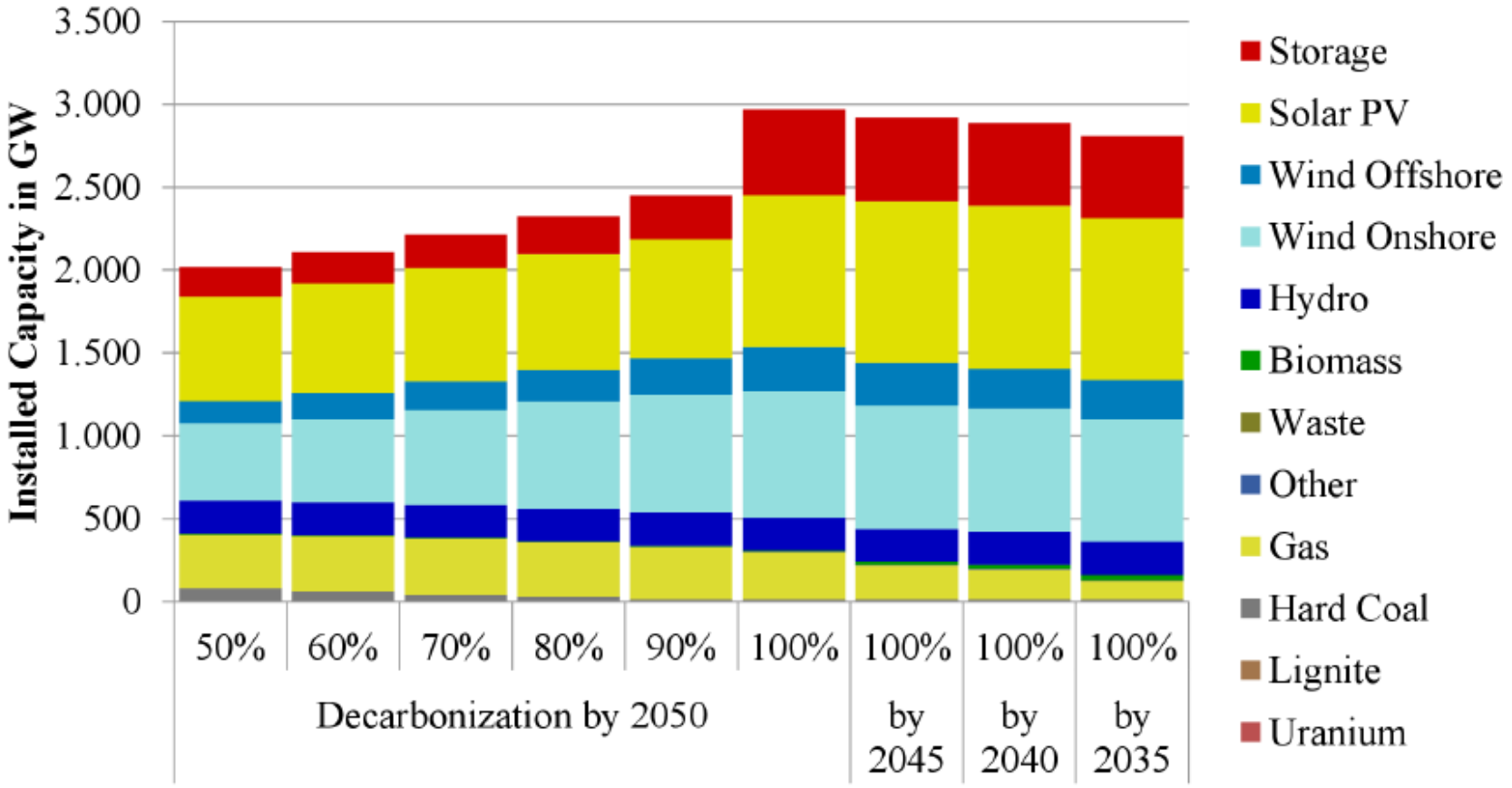


Figure 23: Installed capacity 2050 subject to the decarbonization target

Source: Gerbaulet and Lorenz (2017)

2 Natural gas would benefit from the availability of CCS

ELMOD results assuming CCS available

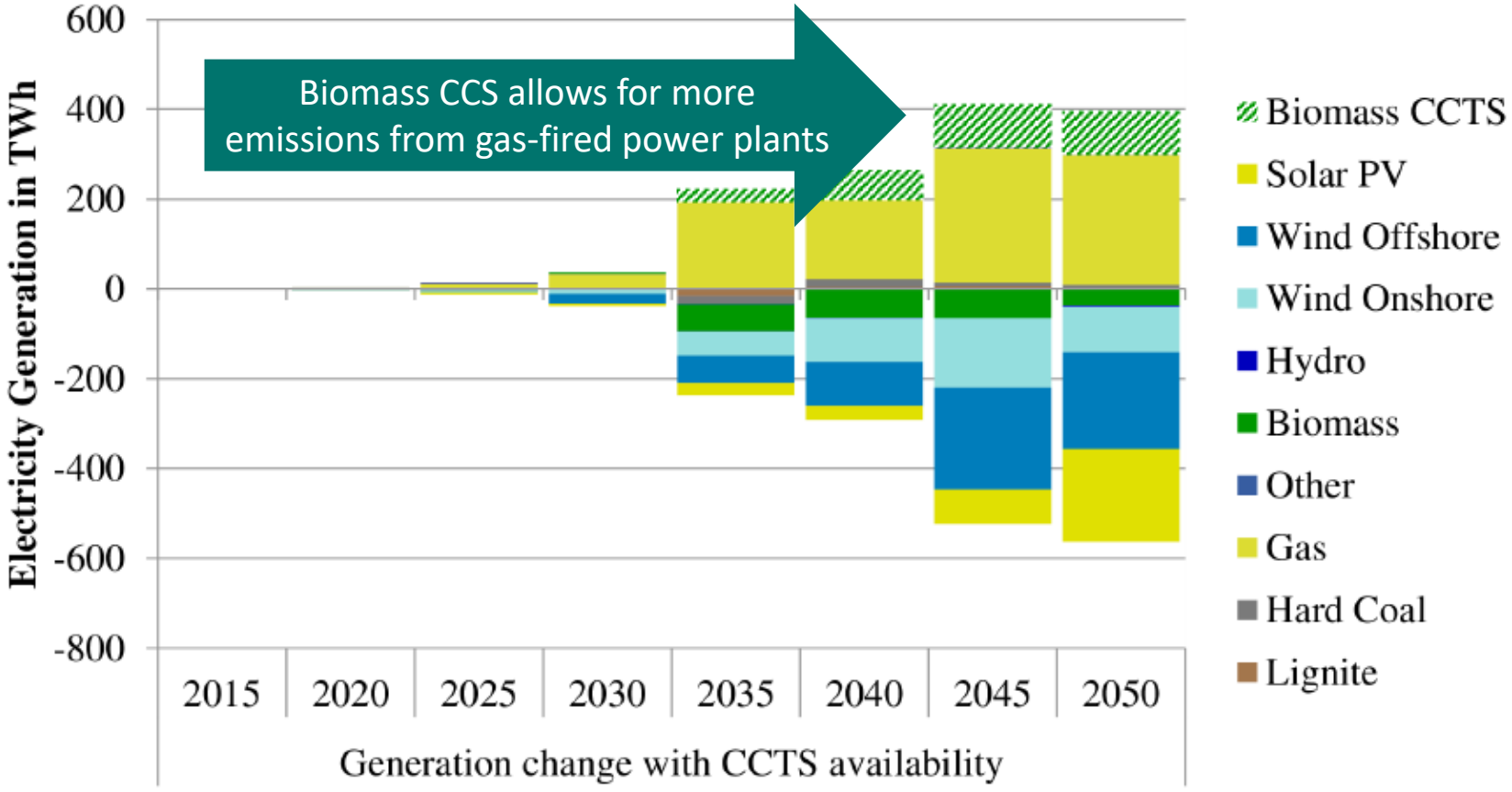


Figure 21: Difference in electricity generation with CCTS available

Source: Gerbaulet and Lorenz (2017)

3 „Niche use“? : Small-scale LNG

- Small barges (river and coastal)
- Trucks (long-distance and local use)

Advantage:
lower emissions

Requires development
of infrastructure

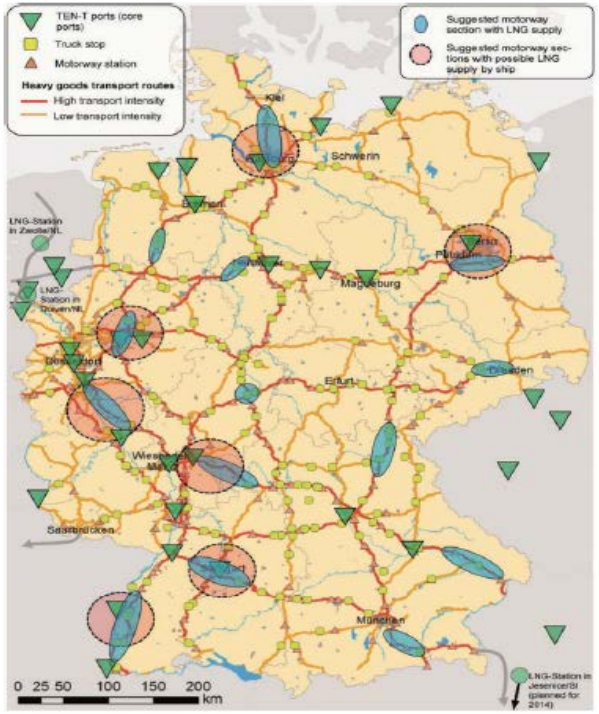


Figure 4: Plan for initial LNG filling station network with 14 stations in the blue areas

Source: Peters-von Rosenstiel 2014, p.22

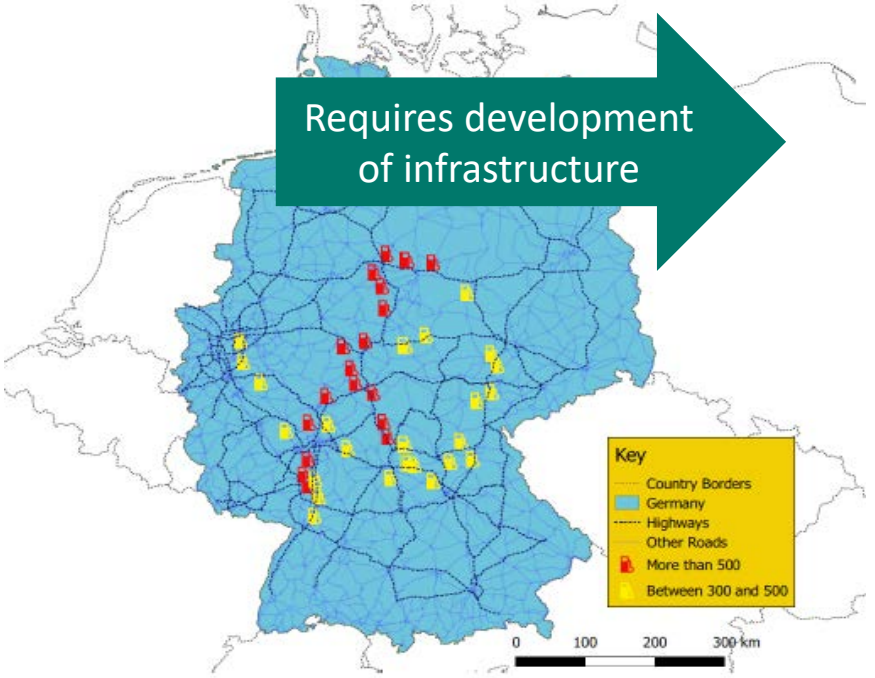


Figure 14: Location of most frequented filling stations

Source: K.B. Hainsch (2016) „A complementarity approach of analyzing the impact of simultaneous routing and refueling in a congested network”. TU Berlin.

Natural gas use in industry

Industry

- A sector yet to be better understood by (energy) economists
- Natural gas is used for
  - **Process heat**

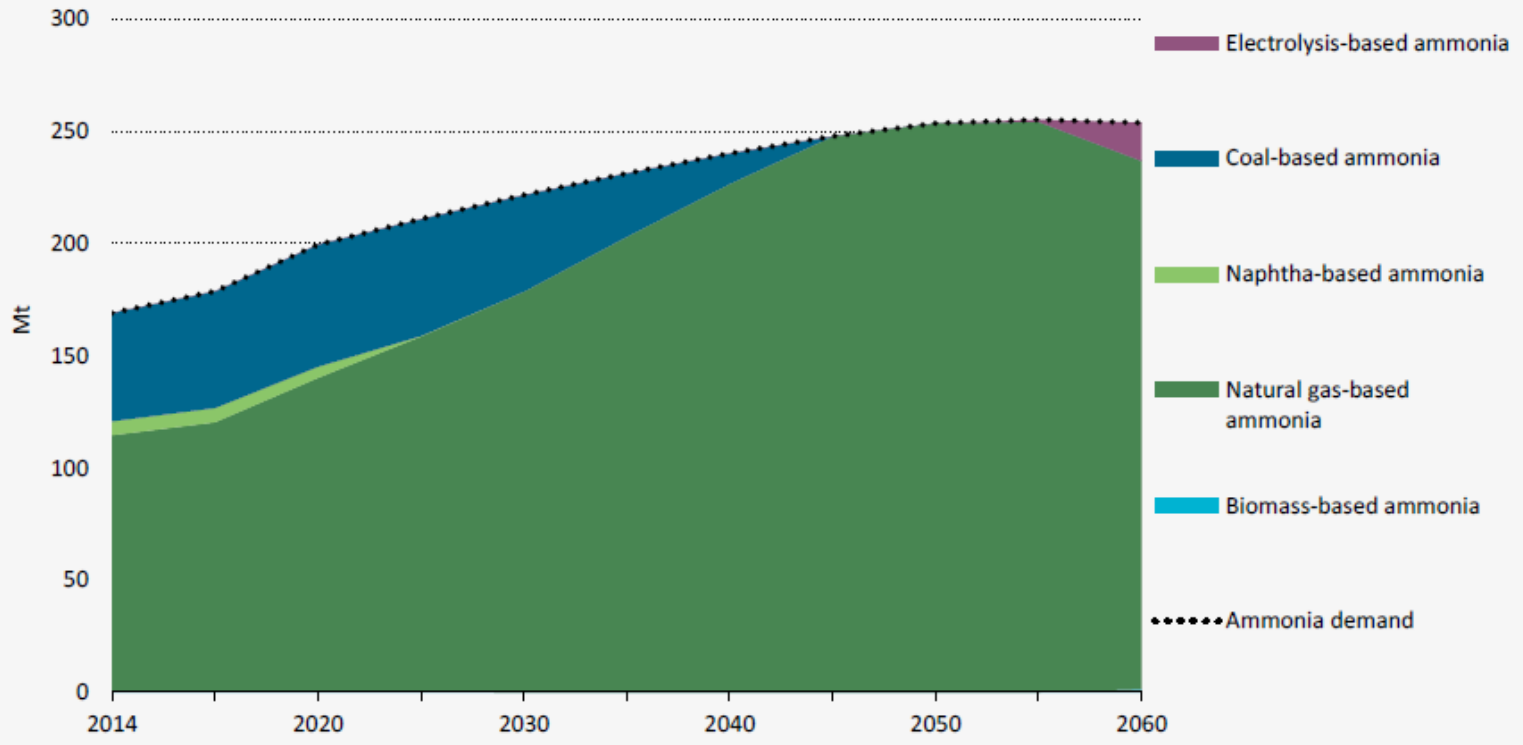
Natural gas can potentially keep its role (in combination with CCS?) and partially maybe even replace coal

  - **Feedstock in (petro-) chemicals and ammonia production**

Natural gas can hardly be replaced

4 Industry: ammonia production strongly relying on natural gas feedstock

Figure 4.13. Global ammonia production by process technology in the B2DS



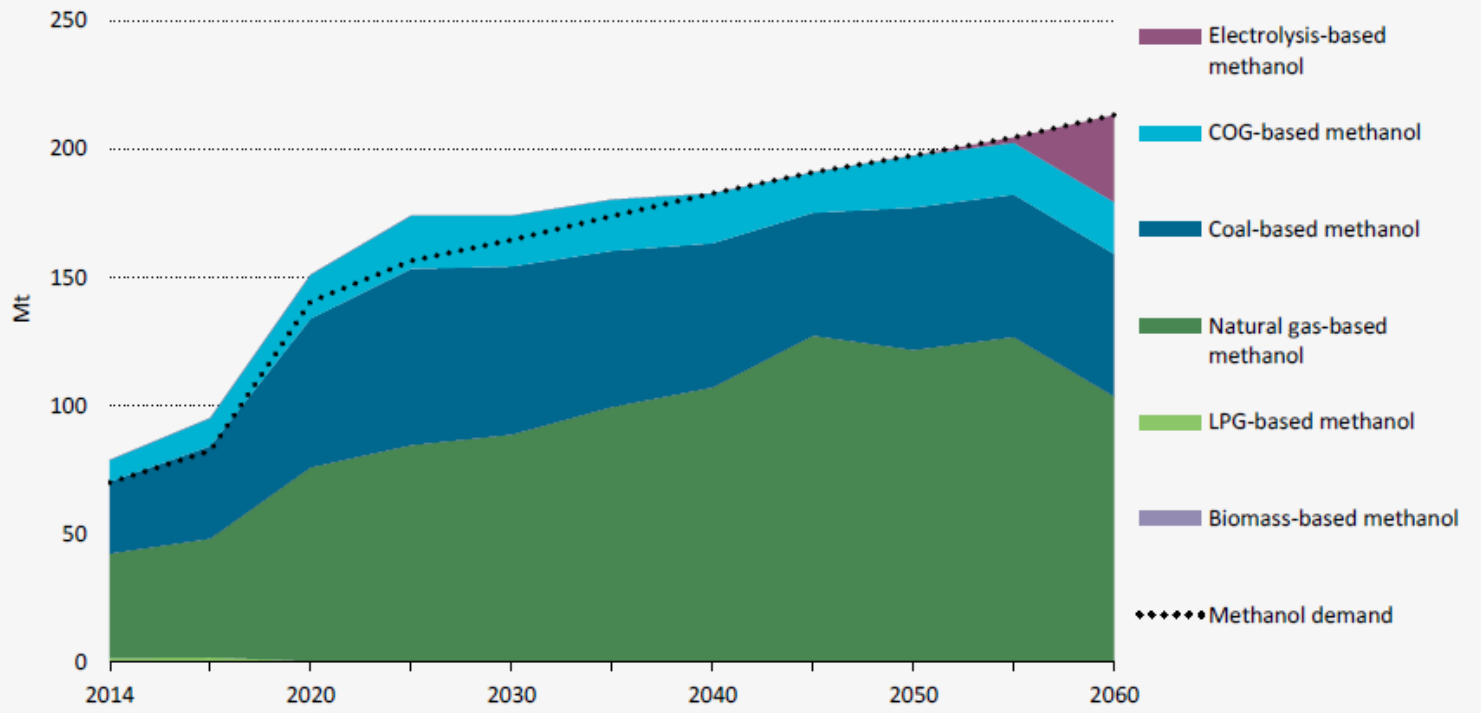
Key point *Natural gas-based ammonia is the primary process route in the B2DS.*

Source: IEA (2017): Energy Technology Perspectives: Catalysing Energy Technology Transformations. Paris: OECD / IEA. p. 182.

Note: B2DS is the „deep decarbonization scenario“ („Beyond 2 degrees“) which aims at 1.75°C temperature increase by 2100). It assumes early deployment of low-carbon technologies.

4 Industry: Methanol production strongly relying on natural gas feedstock

Figure 4.15. Global methanol production by process technology in the B2DS

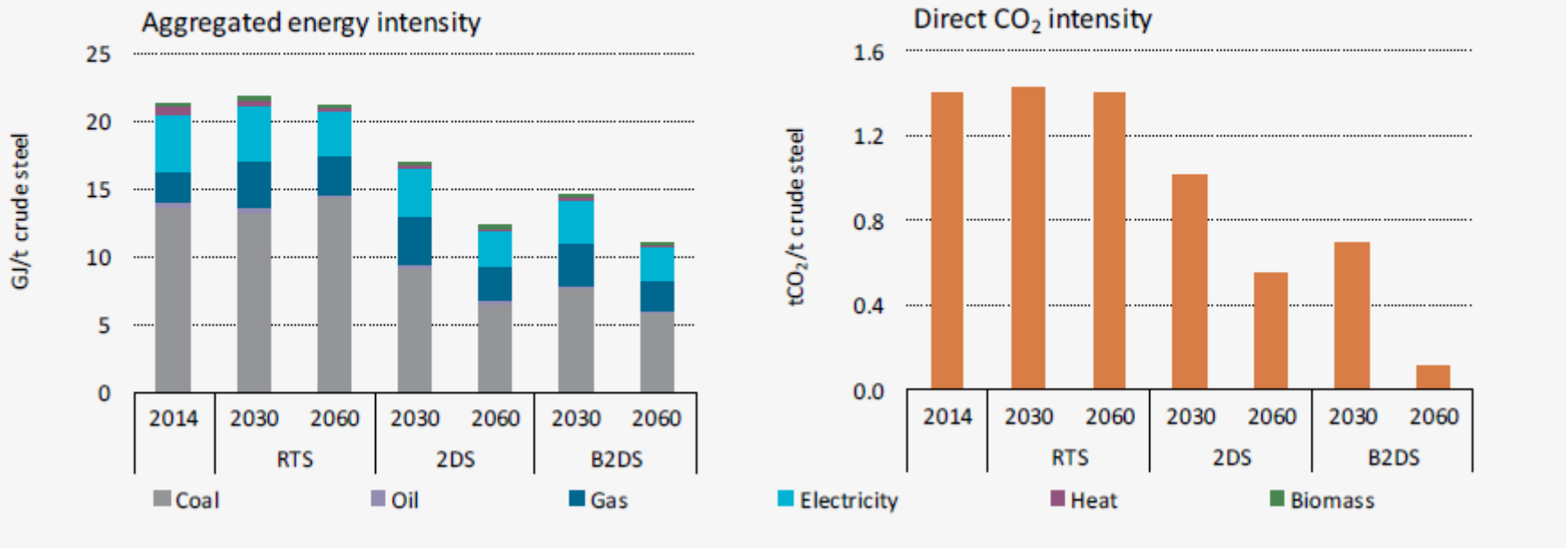


Key point *About half of global methanol production by 2060 in the B2DS comes from natural gas. Surplus production is due to methanol used as feedstock in the methanol-to-olefins process.*

Source: IEA (2017): Energy Technology Perspectives: Catalysing Energy Technology Transformations. Paris: OECD / IEA. p. 184.

4 Industry: steel production continues to rely on natural gas

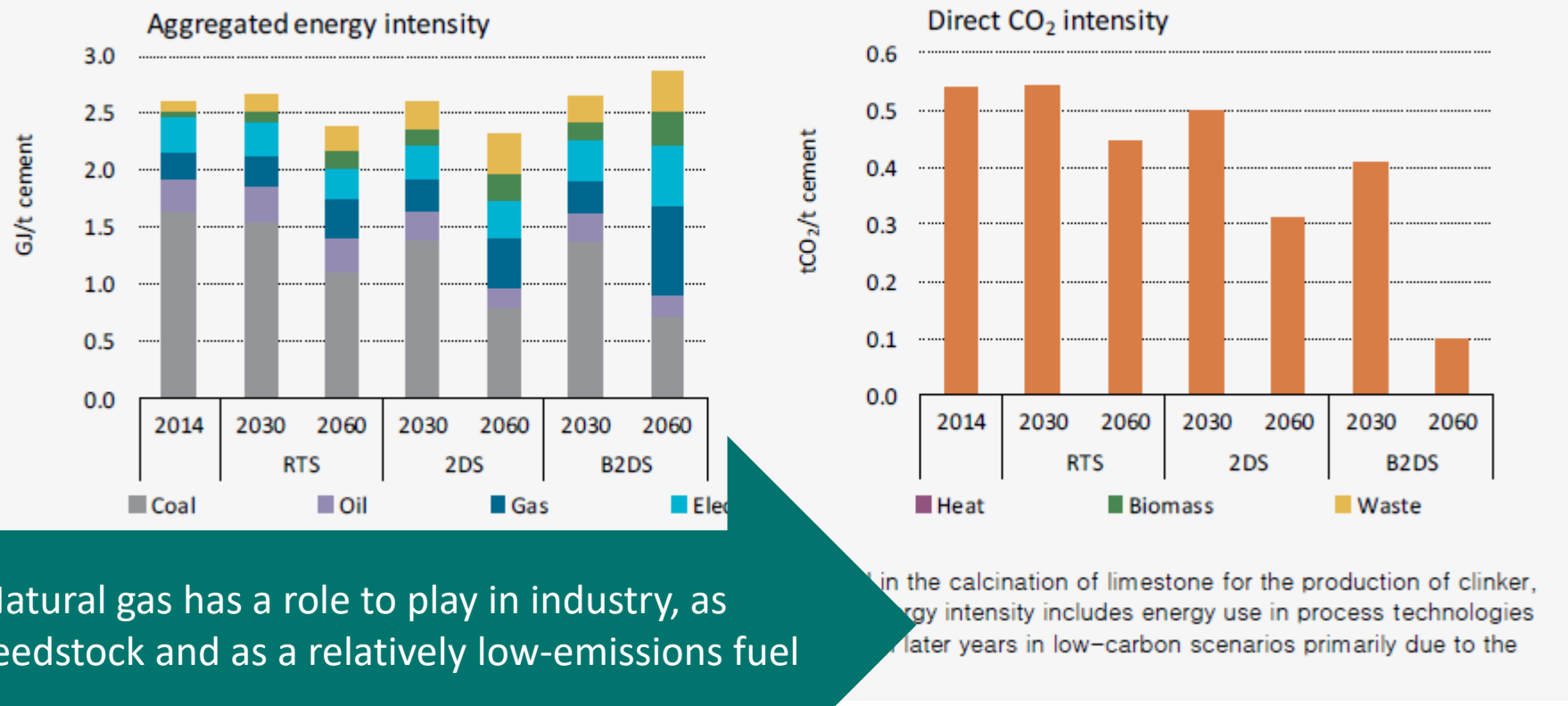
Figure 4.16. Global energy intensity and direct CO_2 emissions of crude steel production by scenario



Source: IEA (2017): Energy Technology Perspectives: Catalysing Energy Technology Transformations. Paris: OECD / IEA. p. 186.

4 Industry: cement production to use more natural gas (with CCS) in climate scenarios

Figure 4.21. Energy intensity and direct CO_2 emissions intensity of global cement production by scenario



Natural gas has a role to play in industry, as feedstock and as a relatively low-emissions fuel

Source: IEA (2017): Energy Technology Perspectives: Catalyzing Energy Technology Transformations. Paris: OECD / IEA. p. 192.

5 Gas exit plans? Beyond the academic debates

- National gas exit strategies emerge in parallel to coal exit efforts
- Focused on the energy sector: power generation, building heating

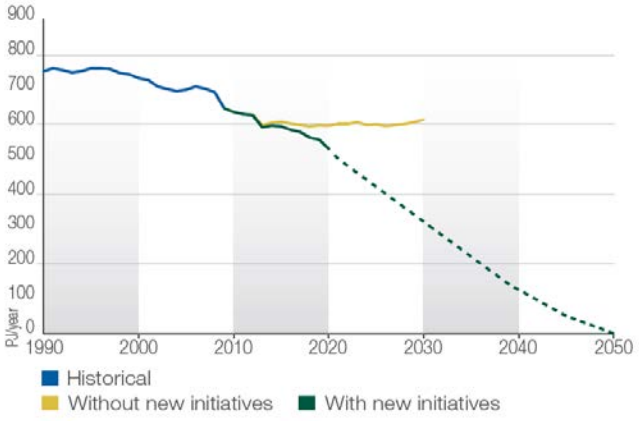


Figure 0.3 Consumption of coal, oil and natural gas 1990-2050. Source: Danish Energy Agency

Danish *Energy Strategy 2050* (2011): 100% renewables in the energy mix by 2050

But while there is widespread agreement that heating must be decarbonised in order to meet the UK's 2050 carbon targets, the recently published clean growth strategy contains few details on how this should be implemented.

5 Conclusions and outlook I

- Main elements of the Energiewende may be EU and global energy transition as well (at different paces)
  - Strong role of renewables
  - Phase-out of coal
  - Phase-out of nuclear
- Power sector: strong competition with fast deployment of renewables and/or storage → not even a need for gas bridge
- Longevity of niche applications such as natural gas in transportation is questionable
- Focus on industry as long-term consumer

→ CCS is needed

5 Conclusions and outlook II

- Natural gas use in the building sector is likely to be completely phased out because there are low-cost decarbonization options

Modeling and regulation economics to understand perspectives of (natural) gas

- Natural gas use in the power sector is more and more decreasing on economic grounds (strong growth of renewables and storage, cheap coal, low CO_2 prices)
- Natural gas use in transportation is not competitive (yet?) in most applications
- Natural gas use in industry is likely to remain and even grow if CCS is deployed
- Future use of pipeline network: natural gas or “green gas” (from P-2-G)?

Natural gas … greener than you think?

Vielen Dank für Ihre Aufmerksamkeit.

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