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Annual conference of Cambridge EPRG and, MIT CEEPR

Our world in 2050: Three factors determining how our future will look like

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Berlin, 2.7.2018

1 What can we learn from experience 90 years ago?

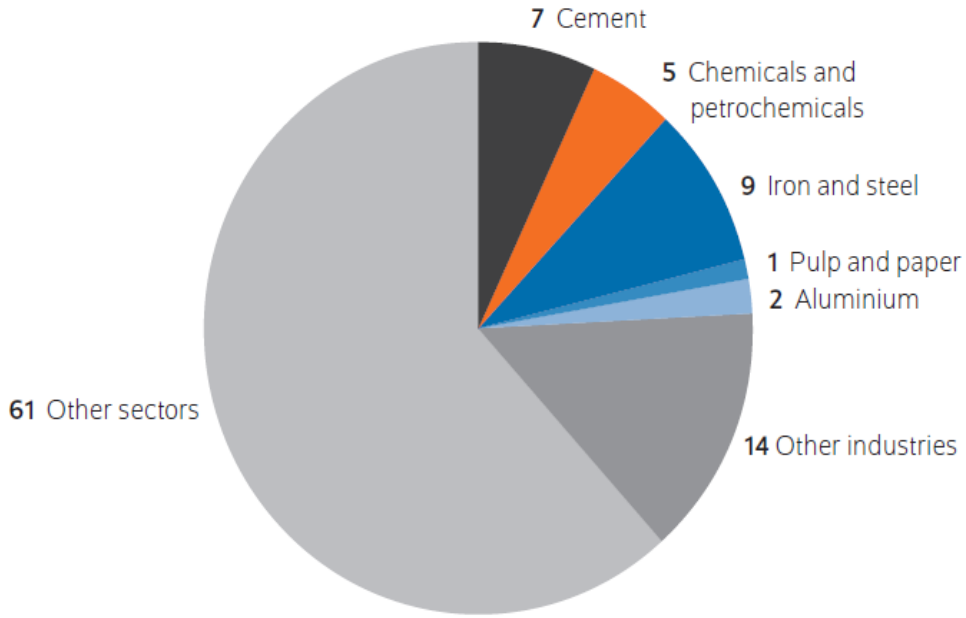
- If climate change triggers economic and social instability, then democratic structures are at risk and global tensions and wars are likely.
- Need to cooperate locally, nationally and internationally to
  - tackle climate change,
  - care for local jobs and local actors as foundation of democracies.
- History shows – transformation can be faster than you think.

Important determinants for our future:

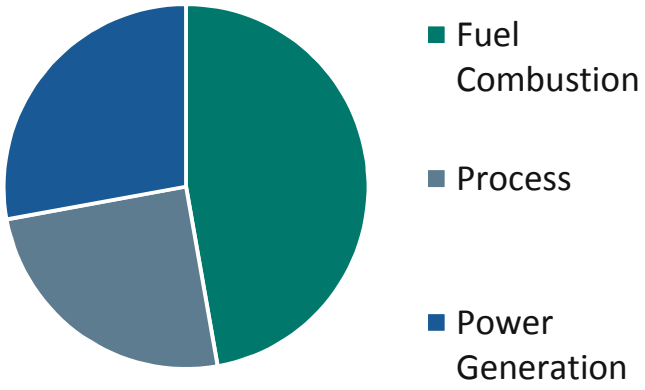
I. Resource and energy efficiency

4 Why are we interested in materials?

Percentage contribution of various basic materials to global CO2 emissions



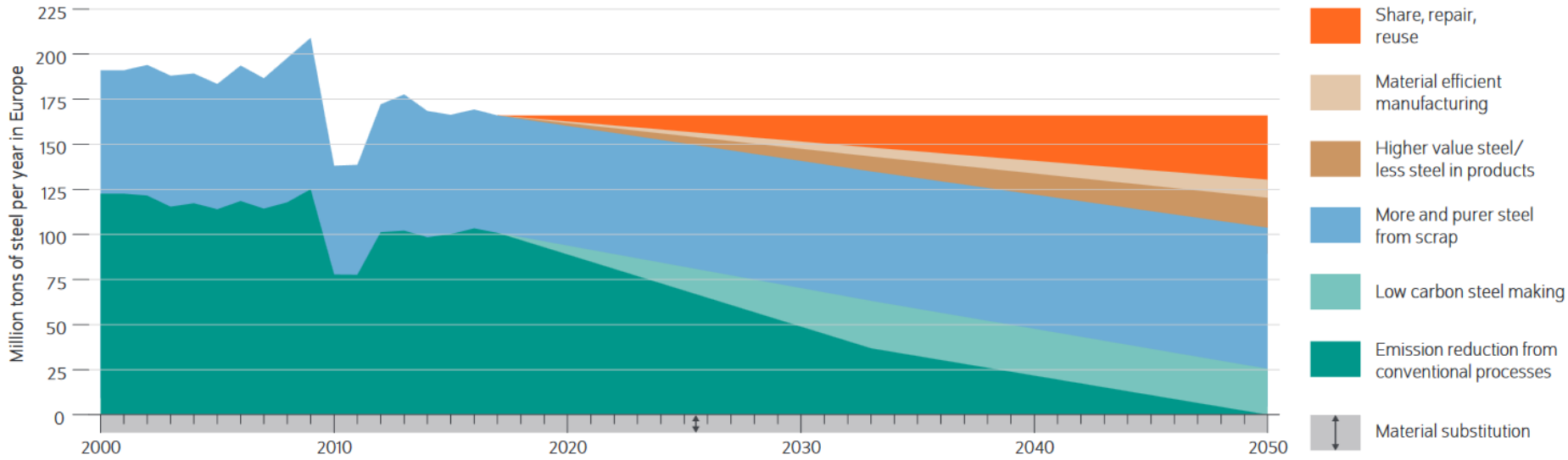
Sources of Emissions in Material Production



Source: Based on IEA ETP 2017

5 Portfolio of mitigation options necessary for shift to a low-carbon material sector

Steel in Europe



Difficult to envisage that RE supply sufficies for clean material production, unless portfolio of demand side measures for use of materials successfull.

Source: https://climatestrategies.org/publication/filling-gaps-in-the-policy-package-to-decarbonise-production-and-use-of-materials/

6 Filling gaps in the policy package to decarbonize Europe's materials sector

Source: https://climatestrategies.org/publication/filling-gaps-in-the-policy-package-to-decarbonise-production-and-use-of-materials/

7 Summary: Resource and energy efficiency

Challenge: Implementation of policy package

One decisive factor: National Climate Change Law, EU 2030 governance, to provide framework for policies in **all** sectors.

- Lack of demand side policies

-> Tension on energy/resource markets

- Inconsistent picture for supply side

-> Public R&D focused policy

-> Investment limbo

- Successfull demand side policies

-> Opportunities for local business

- Clarity on vision for supply side

-> Puplic & private driven innovation

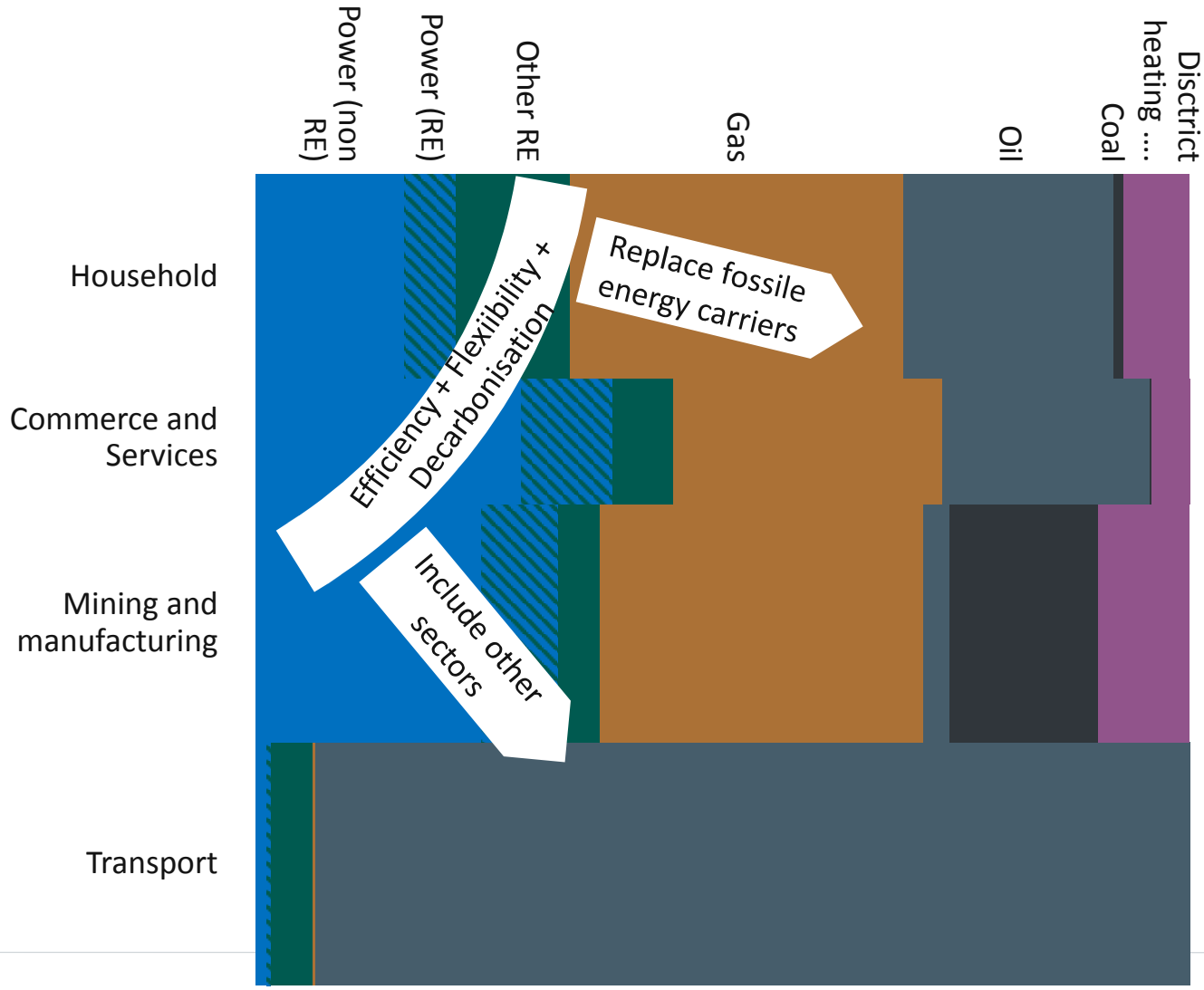
-> Investment

Important determinants for our future:

II. System integration

8 Moving beyond today's electricity demand: Flexibility and efficiency for reliable, affordable, and climate friendly energy services

Size of areas proportional to primary input by energy carrier and sector



Based on AG Energiebilanzen (2016)

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9 Unlocking demand side flexibilty

- To replace conventional generation and meet extra needs
- Large potentials from e-mobilty, electric heating, industry

- Unlocking potentials requires
  - Tailored proposal & credibility to engage consumers
  - Clear interface to distribution/transmission system

- Two scenarios:
  - Flexibility portfolio managed in centralised systems
  - Customers offer flexibilty responding to local prices

10 Summary: System integration

Challenge: Create incentives for households and regional business to unlock flexibility potential

One decisive factor: Local prices

- Cloud-based flexibility control

-> concentration of actors and data
-> accelerated if used for re-dispatch
-> lack of regional anchoring/jobs
-> difficult to align with cyber security

- Tendency towards autarky
  - Households seek privacy
  - Physical linking of RE and Flex

-> Failure to reach scale and efficiency

- Price based flexibility control

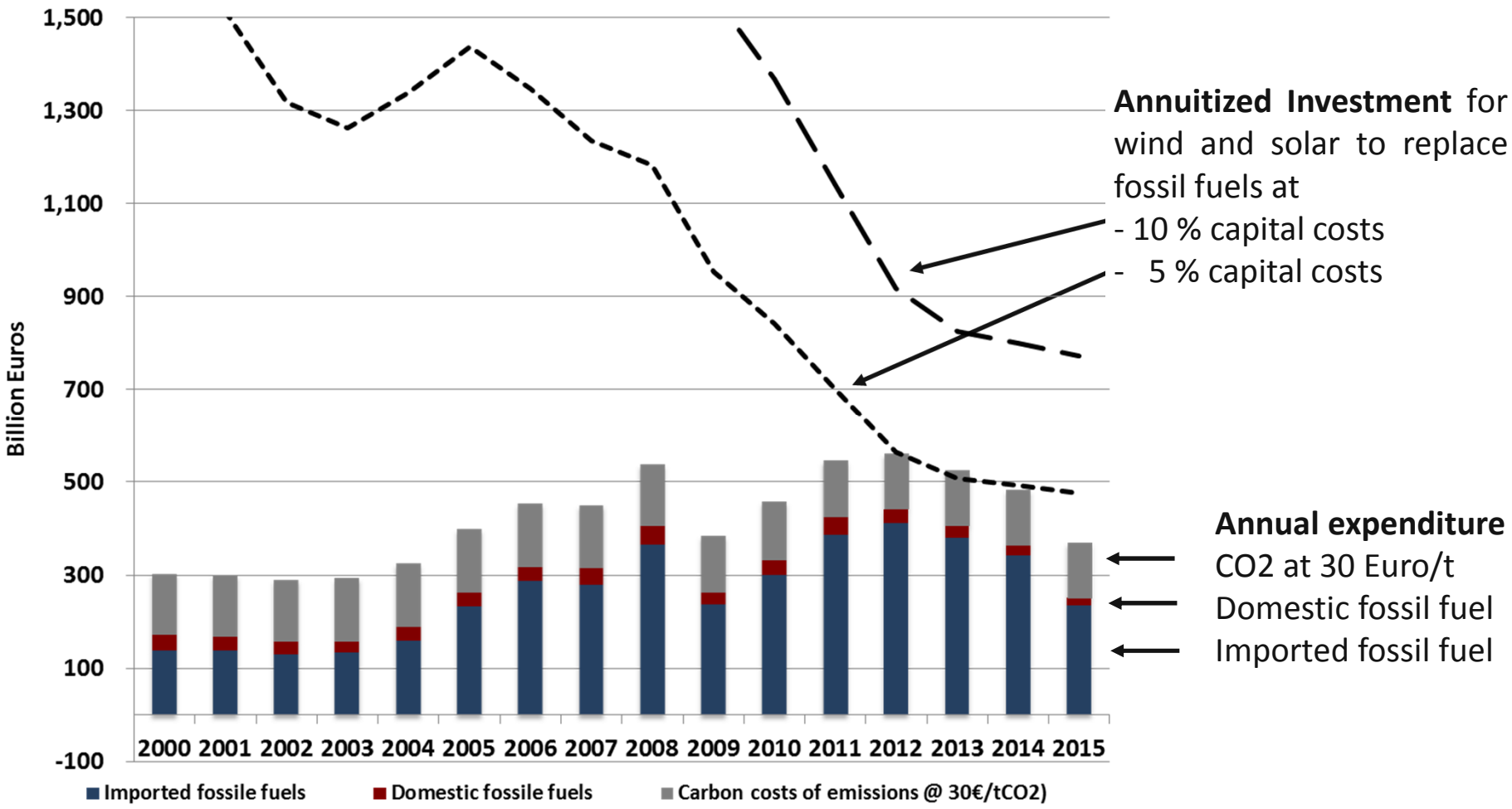
-> standardised protocolls address cyber security and privacy risks
-> value for system fully remunerated
-> easy market entry for local actors
-> tailored solutions unlock potentials

Important determinants for our future:

III. Financing

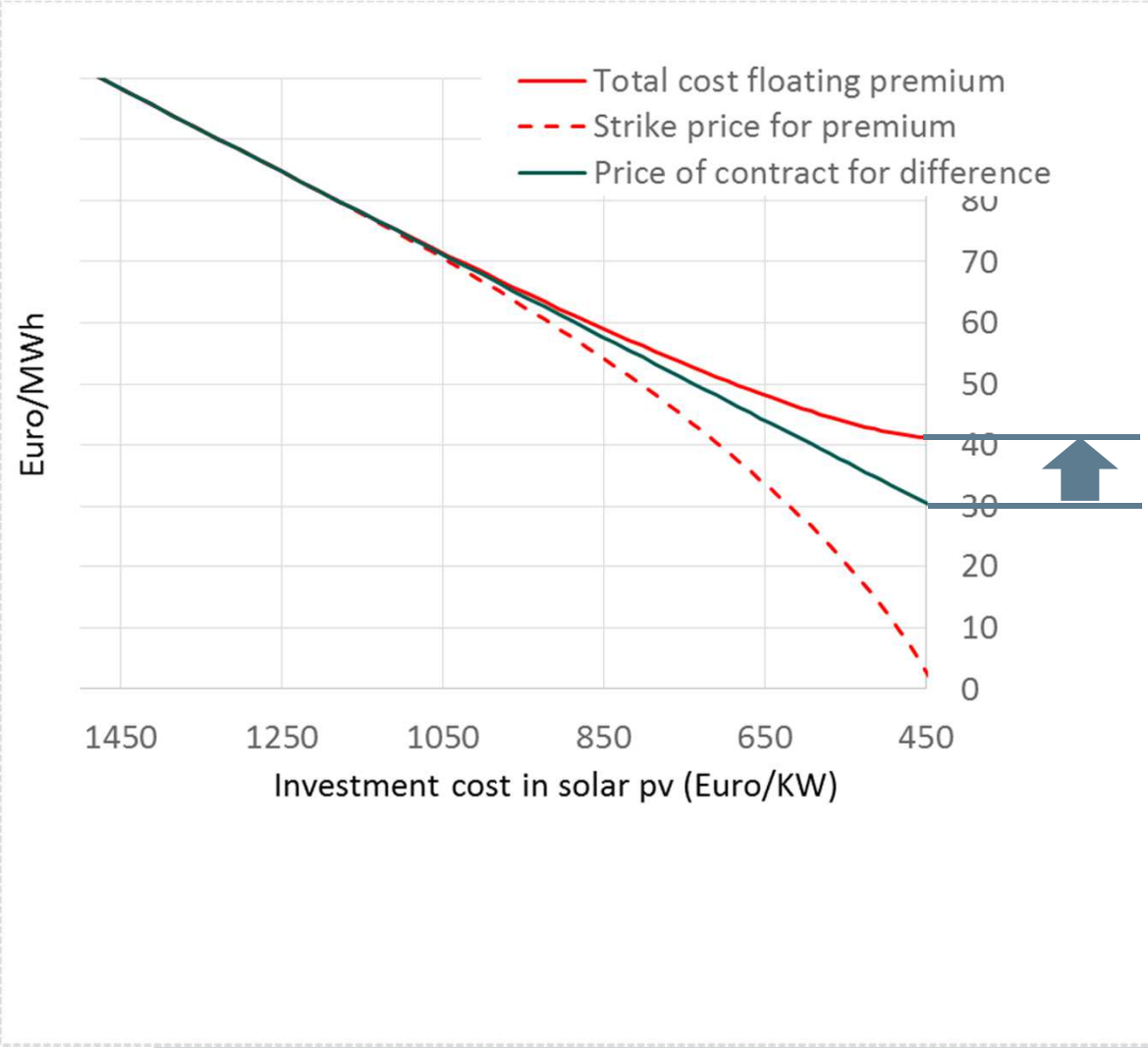
11 Financing costs important for viability of wind and solar

Illustration excludes system costs



DIW Berlin Calculations based on BP Statistical Review of World Energy; Energy Statistics for the EU-28; Bundesverband Solarwirtschaft e. V.; IEA; European Wind Energy Association; Bundesamt für Wirtschaft und Ausfuhrkontrolle, first published in Energy Journal (2016)

12 If nothing changes all will change



Floating Premium: As technology costs decline optionality kicks in, floating premium offers less hedging, financing costs increase, total cost increase.

Without long-term hedging 30% cost increase from

- Project revenue risk (1)
- Liability in LT Contracts (2)

Matches overall assessment (3)

(1) Diacore review (2) Standard & Poor's (2017): Key Credit Factors For The Regulated Utilities Industry,
(2) Baringa (2013) PPAs for independent RE generators (3) Aurora Energy Research (2018), May & Neuhoff (2017) Financing power.

13 Summary: Financing

Challenge: Allow simple hedging to facilitate low-cost finance

One decisive factor: Shift to contracts for difference

- Concentration of actors

-> lack of local engagement and support
-> insufficient capacity to realize projects

- Increase of cost to consumer (example Germany 2030 projection)*
  Floating market premium: 0,8 billion
  Fixed market premium: 2,7 billion
  CO2 price only: 3,4 billion.

-> Industry/HH less supportive for RE
-> Speed of transition declines

- Multiple actors compete

-> improves projects/technologies
-> realisation of deployment targets

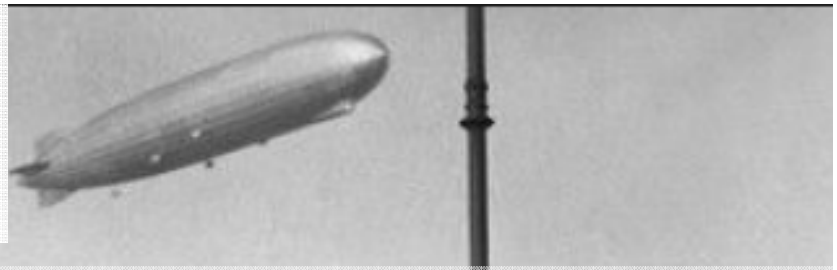
- Consumers fully benefit from cost RE reductions

-> accelerate electrification
-> accelerate speed of transition

* Source: DIW Berlin, Weekly Report 28/2018

What do we need for our world in 2050?

- Rapid reduction of emissions
- Functioning communities



What is important to make this happen?

- Governance for eficiency policies
- Local prices for system integration
- Remuneration for simple financíng