Socio-technical transitions:
Towards a low carbon future

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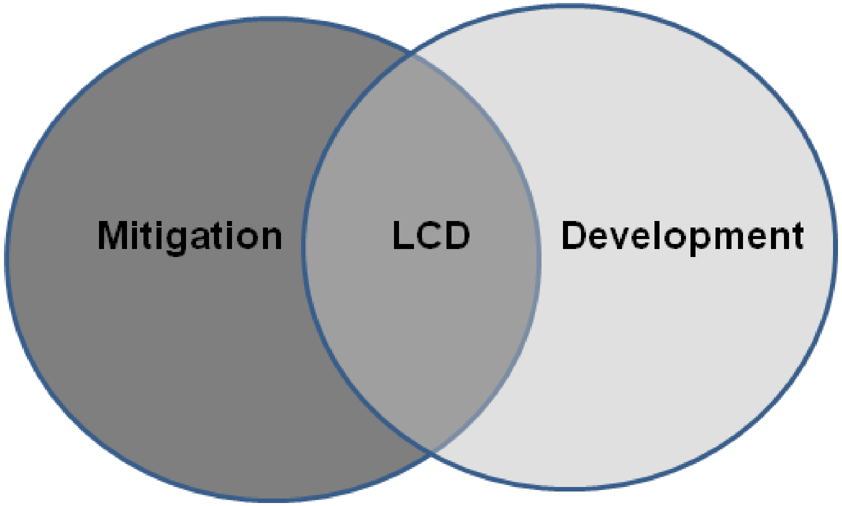
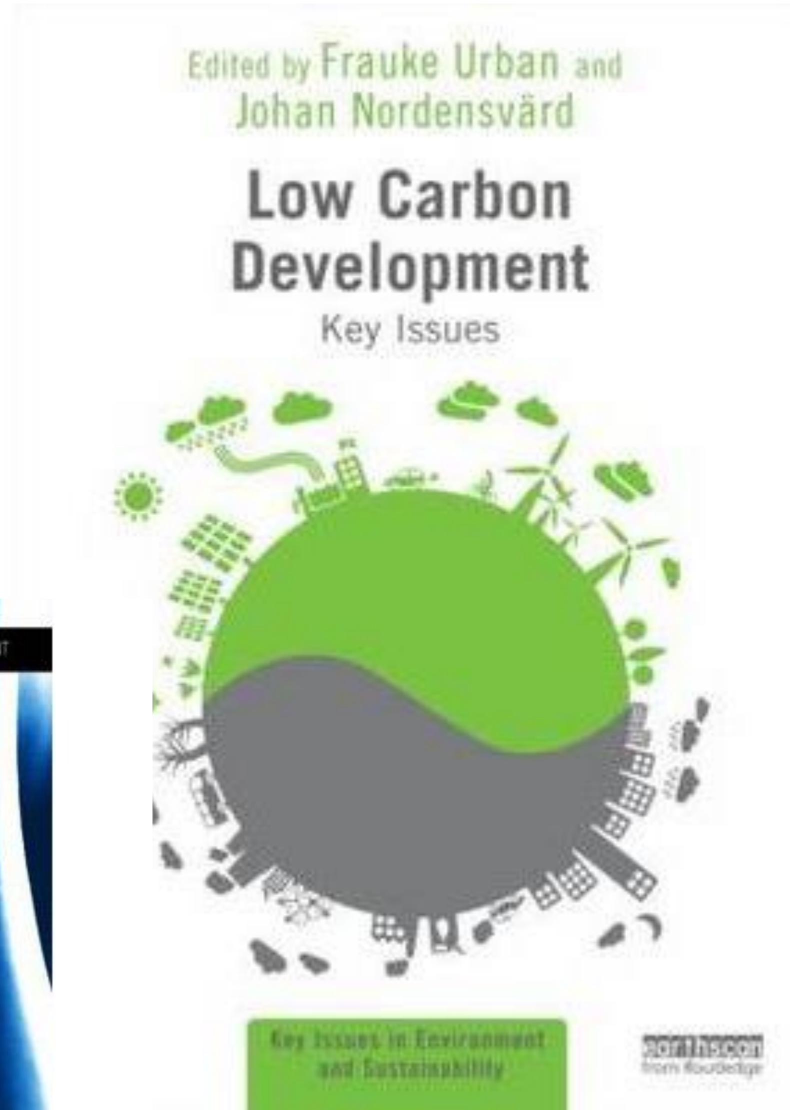
Low carbon development

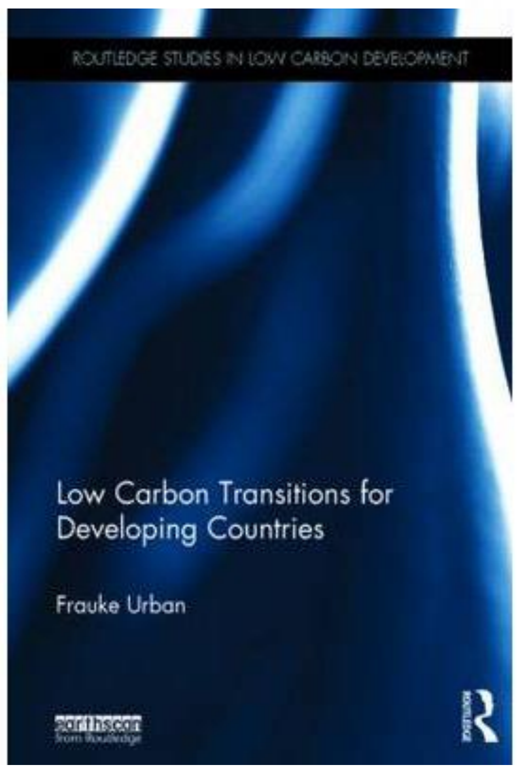
- Defined as a development model that is based on climate-friendly low carbon energy and follows principles of sustainable development, makes a contribution to avoiding dangerous climate change and adopts patterns of low carbon consumption and production (Urban and Nordensvard, 2013)
- Requires switching from fossil fuels to low carbon energy, promoting low carbon technology innovation and business models, protecting and promoting natural carbon sinks such as forests and wetlands, and formulating policies that promote low carbon practices and behaviours (DfID, 2009; Urban et al, 2011).
- Less focus on economic growth and exploiting finite natural resources, more focus on fair and equitable human development within the limits of our planet (Urban and Nordensvard, 2013).





Source: Urban and Nordensvard, 2013

LCD: Low Carbon Development



Social technical regimes

- Socio-technical regimes are “stable and ordered configurations of technologies, actors and rules that represent the basis for social and economic practices” and includes “a complex web of technologies, producer companies, consumers and markets, regulations, infrastructures and cultural values” (Berkhout etal.,2010: 263).
- Energy systems are based on “socio-technical configurations where technologies, institutional arrangements (for example, regulation, norms), social practices and actor constellations (such as user–producer relations and interactions, intermediary organisations, public authorities, etc.) mutually depend on and co-evolve with each other” (Rohracher and Späth,2014: 1417)
- Lock-in creates “persistent market and policy failures that can inhibit the diffusion of carbon-saving technologies despite their apparent environmental and economic advantages” (Unruh,2000: 817).

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The stuttering energy transition in Germany: Wind energy policy and feed-in tariff lock-in

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HIGHLIGHTS

- Feed-in tariff favours specific wind innovation, rather than energy transition.
- Wind energy incorporated into a slightly modified socio-technical regime.
- The outdated grid infrastructure is a bottleneck for the wind energy sector.

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ABSTRACT

This article aims to examine whether the formulation of specific low carbon policy such as the feed-in tariff for wind energy in Germany can partly be a barrier to a comprehensive energy transition (Energiewende). Despite their short and medium-term success, these policies could create a long-term lock-in if they are formulated in a way that leads to a stagnation of systems innovation. The research finds that while the share of wind energy has increased rapidly over time, the feed-in-tariff and other low carbon policies and incentives have not been sufficient to achieve a socio-technical regime transition in Germany yet. We suggest that the German feed-in-tariff has incorporated wind energy (a niche-innovation) and wind energy actors (pathway newcomers) into a slightly modified socio-technical regime that is rather similar to the earlier 'fossil fuel dominant' socio-technical regime.

Germany and wind energy

- Germany is currently Europe's largest wind energy market and the world's third largest wind energy market, after China and the United States(US)(GWEC, 2014).
- Germany had an installed capacity of more than 35 GW in early 2014. This accounted for about 30% of the European installed wind capacity (GWEC,2014; IEA,2014).
- The German government has targets in place for a share of 35% renewable energy among the final electricity consumption by 2020, 50% by 2030 and 80% by 2050, of which wind plays an important role (BMU,2012, 2011).
- Still its target for a comprehensive energy transition has not been reached (and might not be reached in the short term either).

Table 2
National wind policies and the feed-in-tariff in Germany.
Source: DEA (2014), BMU (2012), Lema et al. (2014).

Germany	• Renewable Energy Law EEG • Renewable energy to make up 35% of final electricity consumption by 2020, mainly from wind and solar (in 2011 almost 20% had already been achieved). • German feed-in tariff: 1. Onshore wind energy: 8.93 EUR ct/kWh for the first 5 years+0.48 EUR ct/kWh bonus=9.41 EUR ct/kWh for first 5 years, then 4.87 ct/kWh. 2. Offshore wind energy: 3. Model 1: 15 ct/kWh for the first 12 years, then 3.5 ct/kWh 4. Model 2: or alternatively 19 ct/kWh for the first 8 years.

Argument

- German feed-in-tariff has incorporated wind energy (a niche-innovation) and wind energy actors (pathway newcomers) into a slightly modified socio-technical regime that is rather similar to the earlier 'fossil fuel dominant' socio-technical regime – instead of a complete energy transition. The focus has been on increasing capacity which is favouring costly and risky off-shore projects.
- Current German wind energy policy has created two financial dilemmas:
- First, it has pushed up energy costs for consumers through the feed-in-tariff which is funded by increases in consumer electricity prices, second it has lowered energy costs for energy-intensive industries through feed-in-tariff exemptions.
- The financing model 1 for offshore wind energy can in fact yield double the financial incentives over a 15 or 20 year period with turbines of the same size and the same kW/h output than onshore, while for financing model 2 the difference is about 50% compared to onshore (DEA2014; BMU 2012). The investment costs for off shore are currently twice as ex pensive as for onshore, which again offsets some of the additional gains from the higher feed-in-tariff incentives.

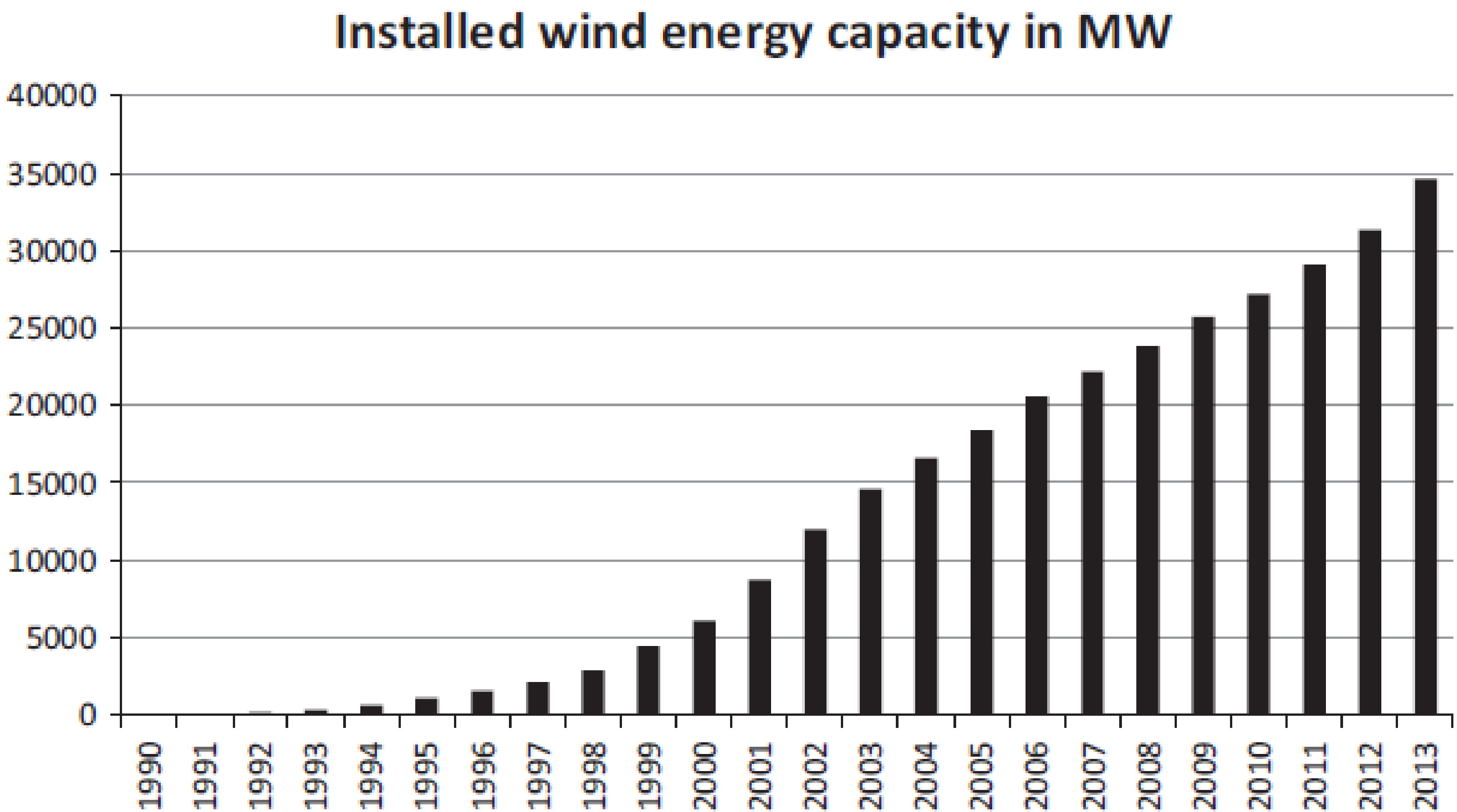
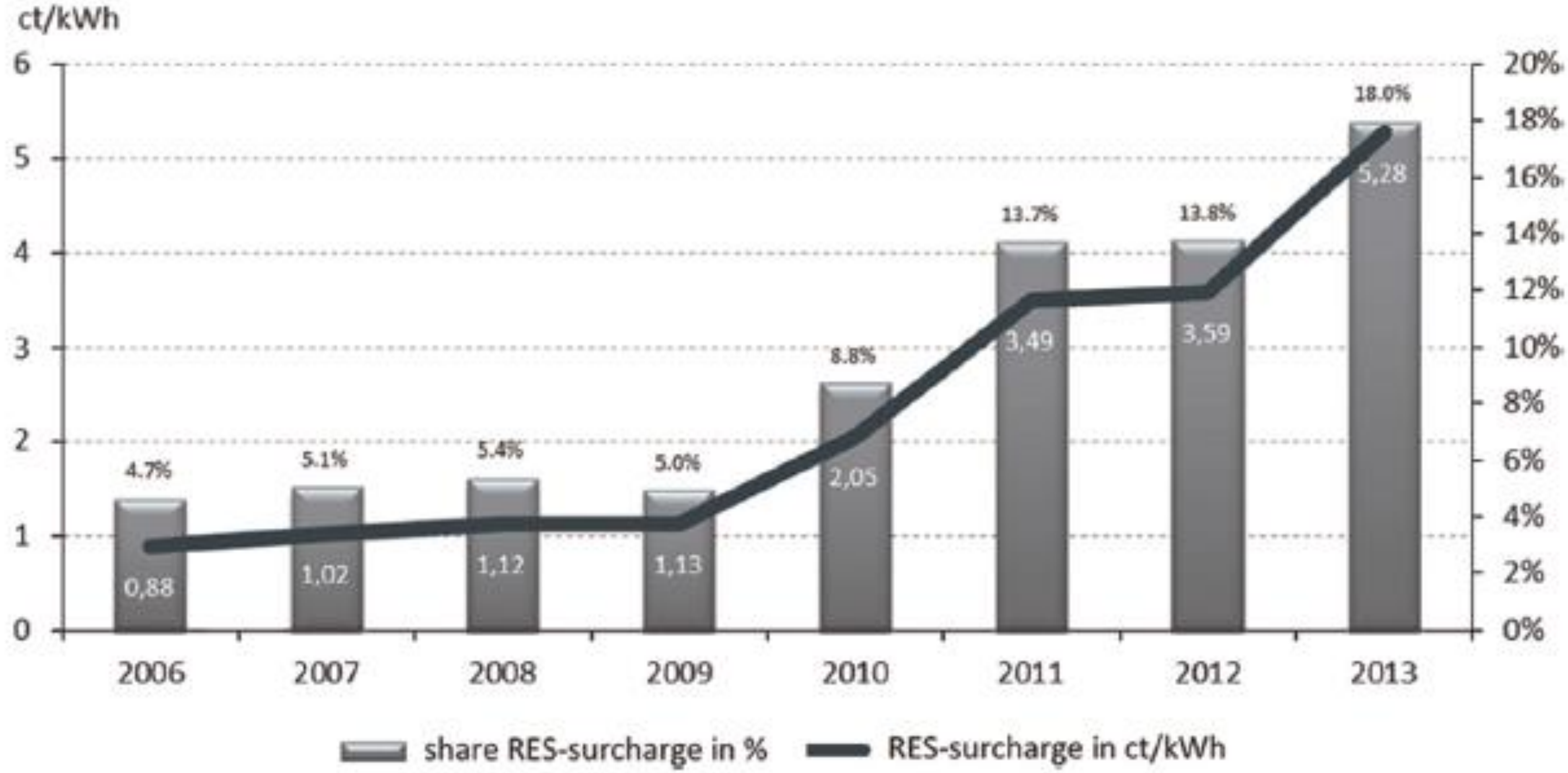


Fig. 2. Installed wind energy capacity in Germany, in MW. Data from IEA, 2014.

Vested interests

- The government gives exemption from the feed-in-tariff to energy intensive industries, such as the car industry and other large manufacturing industries, which has meant a rise of costs from 1 billion to 5 billion Euros by 2014.
- Industries that use large electricity quantities are only paying 0.05ct/kWh for the feed-in-tariff (virtually an exemption) compared to the 6.17ct/ kWh for private households (IWR, 2014).
- The quota for industries to receive this reduction in electricity prices has sunken from an electricity consumption of 10 to 1 GWh (IWR, 2014).
- The EFI reports that by 2014, one fifth of Germany‘ s average energy costs are due to the feed-in- tariffs. This has led to a critical public discussion about the legitimation of the EEG and the feed-in-tariff (EFI, 2014:2).



ct/kWh
6
5
4
3
2
1
0
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
4.7%
5.1%
5.4%
5.0%
8.8%
13.7%
13.8%
18.0%
0,88
1,02
1,12
1,13
2,05
3,49
3,59
5,28
2006
2007
2008
2009
2010
2011
2012
2013
share RES-surcharge in %
RES-surcharge in ct/kWh

Table 3
Lock-in and path dependency.

Lock-in and path dependency of an incomplete energy transition	
Feed-in-tariff favouring up-scaling and offshore	Innovation and investments in large turbines and projects at the expense of investments in grids and other innovation (e.g. low wind speed turbines, smaller turbines, systems integration with electric vehicles etc)
Aging, under-performing grid	Lacking grid expansion for onshore and offshore, lacking grid integration for offshore
Full potential for energy transition not achieved	Offshore wind energy growth restricted by grid bottlenecks, North–South long-distance transport of electricity restricted by grid bottlenecks, innovation and investments in other core technology and deployment areas neglected due to focus on up-scaling and offshore

Conclusion

- Lock-in and path dependency of an incomplete energy transition
- Feed-in-tariff favouring up-scaling and offshore innovation and investments in large turbines and projects at the expense of investments in grids and other innovation (e.g. low wind speed turbines, smaller turbines, systems integration with electric vehicles etc)
- Aging, underperforming grid / lacking grid expansion
- Offshore wind energy growth restricted by grid bottlenecks, North–South long-distance transport of electricity restricted by grid bottle necks, innovation and investments in other core technology and deployment are neglected due to focus on up-scaling and offshore