„Evolution or Revolution”
The organization of the electricity system after 2040

Presentation for the IASS workshop
„The Organization of Electricity – a Multi-perspective Inquiry“

Uwe Leprich
Institute for Future Energy Systems (IZES)
Potsdam, January 8, 2015

Agenda

1 **Future technical developments**

2 Key drivers of past developments

3 The development of system roles

4 The transnational perspective in Europe

5 Prospects

Future technical developments: evolution!

izes gGmbH
Institut für ZukunftsEnergieSysteme

Renewable energies

- Wind on- and offshore power plants
- Photovoltaics

will continue to become even cheaper

Backups / Flexibilities

- Conventional power plants
- Cogeneration / CHP plants
- Demand-side applications

will continue to become more flexible

Networks

- High temperature conductors
- Controllable transformer stations
- Cable solutions

will contribute to more flexible network solutions

Electricity efficiency

- Motors
- Appliances
- ICT

will continue to become more efficient

Future technical developments: revolution?

izes gGmbH
Institut für ZukunftsEnergieSysteme

Renewable Energies

- Biocoal
- Wave power plants
- Energy harvesting

will play no mayor role in the foreseeable future

Storages

- Controllable batteries in electrical vehicles
- Power-to-methane
- Large hydraulic storages

will play no mayor role in the foreseeable future

Networks

- Microgrids
- Superconductors
- Wireless electricity transport

will play no mayor or no role in the foreseeable future

Joker

- Small CHP nuclear reactors
- Nuclear fusion reactors
- Algae

Nobody should bet on them!

Resume

- The technical developments in the electricity sector will at least in the next decades mainly be improvements of existing technologies and their combinations
- The flexibilities both on the supply and the demand side will significantly improve due to the rationale of the variable renewable energies; ICT will be the key to ensure this development
- Even an unexpected breakthrough of a new technology would not change the character of the new electricity system based on variable renewable energies and flexibilities

Agenda

1 Future technical developments

2 **Key drivers of past developments**

3 The development of system roles

4 The transnational perspective in Europe

5 Prospects

Key drivers of past developments: shocks/revolution!

izes gGmbH
Institut für ZukunftsEnergieSysteme

Oil price crises in the 70s

Tschernobyl / Fukushima

Global Warming

Liberalization of the electricity sector

Key drivers of past developments: evolution

izes gGmbH
Institut für ZukunftsEnergieSysteme

CO_2 reduction targets

Renewable targets

Energy efficiency standards

Closedown schedules for nuclear power plants

Resume

- The past developments in the electricity sector have been heavily influenced by external shocks.
- The political answer to these shocks have been targets, roadmaps and legal measures.
- The developments after the shocks have usually not been linear; sometimes the targets and measures have been given up.

Agenda

1 Future technical developments

2 Key drivers of past developments

3 **The development of system roles**

4 The transnational perspective in Europe

5 Prospects

The development of system roles: evolution!

izes gGmbH
Institut für ZukunftsEnergieSysteme

Generators

- face investment risks
- minimize OPEX
- improve flexibility of their assets

to maximize their market chances

TSOs

- enable/facilitate markets
- ensure cross-border trading
- strengthen the cooperation with the DSOs in order to guarantee security of supply

DSOs

- have more cost awareness through incentive regulation
- have decentralized plants as new network customers
- make their networks “smarter”

Suppliers/Retailers

- differentiate their products
- offer more services
- market renewable energies

The development of system roles: post-liberal revolution?

izes gGmbH
Institut für ZukunftsEnergieSysteme

Generation

- Wind Onshore, PV and non-industrial cogeneration is treated as public infrastructure and financed through charges

TSOs

- guarantee security of supply through own backup capacities

DSOs

- optimize their networks through direct access to customer appliances and decentralized plants

Suppliers/Retailers

- integrate their share of the variable renewable energies into their portfolios / “residual load approach”

Resume

- Liberalization is not the end of the story; the renewable paradigm might require new system roles which could differ from the market roles in the liberalization paradigm.
- The room for markets will shrink in the new electricity system; a major part of it will be infrastructure.
- Small and medium-sized public and private entities will dominate the system.

Agenda

1 Future technical developments

2 Key drivers of past developments

3 The development of system roles

4 **The transnational perspective in Europe**

5 Prospects

The transnational perspective: evolution?

izes gGmbH
Institut für ZukunftsEnergieSysteme

Technical Options

- Norway as a European battery
- Northsea as Europe‘s green Power House
- Mediterranean Solar Region

The European Union

- as infrastructure provider
- as facilitator of large cooperation projects between countries in and outside the EU

?

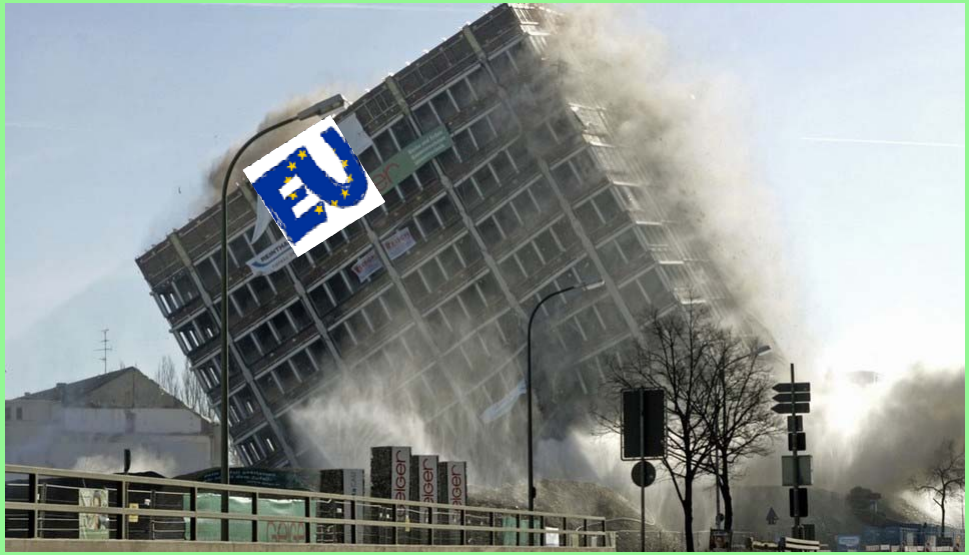
National Governments

- willing to cooperate regionally in terms of security of supply and renewable remuneration schemes

The People

- willing to accept a mix of centralized and decentralized options
- not heading for autonomy or even autarky

The transnational perspective: revolution??



Resume

- The perspective of transnational cooperation in the electricity sectors in Europe will be tied to the existence and the perspective of the European Union itself
- If the EU continues to exist there could be a tendency for a closer regional cooperation

Prospects

- A linear development to a sustainable electricity system might be not be very likely; external shocks might be necessary to overcome path dependencies
- Variable renewable energies (VRES) will dominate the system sooner or later
- A broad range of backup capabilities for the VRES will be determined both politically and by market forces
- The future electricity system based on VRES will more be seen as an infrastructure for the industrial society than a system characterized by commodity markets

Thank you very much for your attention!

Institut für ZukunftsEnergieSysteme (IZES)

Altenkesselerstr. 17, Gebäude A1

66115 Saarbrücken

Tel. 0681 – 9762 840

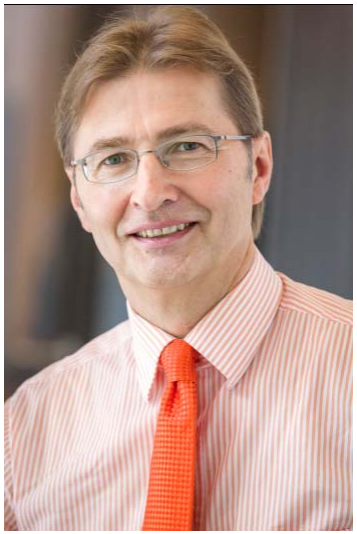
Fax 0681 – 9762 850

email: leprich@izes.de

Homepage www.izes.de

Uwe Leprich

izes gGmbH
Institut für ZukunftsEnergieSysteme



- Professor at the business school of the University of Applied Sciences in Saarbruecken since 1995
- At the same time scientific head of the Institute for Future Energy Systems (IZES), a university based research institute focussing on renewable energies, energy efficiency and decentralised power generation
- Author and co-author of several books and articles liberalised electricity markets, feed-in law regulations and instruments for promoting renewable energies in the heat market.
- Chairman of the Energiebeirat of the state of Rheinland-Pfalz
- Alternate member of the Administrative Board of ACER (Agency for the cooperation of Energy Regulators)