Looking back on a successful conference

It was a great pleasure to host the 41st IAEE International Conference in Groningen. We can look back at a successful conference with many great speakers and visitors. About 650 delegates from all over the world spoke on a wide variety of subjects within the energy economics field. The central theme of the conference, Transforming Energy Markets, has been discussed in 7 plenary sessions, 6 round tables and 91 concurrent sessions. In addition we offered 3 poster sessions, 3 master classes, 1 doctoral seminar, 2 technical excursions.
Assessment of Potential Attack Vectors, Threats and Risks of Increasingly Renewable, Decentralised, Cross-Sectoral and Participatory Future Energy Systems

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41st IAEE International Conference
1. Energy Transition: Overall Objective Clear?

2. “Tomorrow” (e.g. 2030)
   - Green? / Independent? / Ethical?

3. “Day after Tomorrow” (e.g. 2050, beyond)
   - Overview: Attack Vectors, Threats, Risks of Future Energy Systems
   - Selected Examples
     - Primary fuel & raw material shortages
     - Governance & acceptance failures

4. Case Study: Austria
   - Techno-economic & socio-economic analysis
   - Resilience cycles for different attack/threat scenarios

5. Mitigation Strategies, Concluding Remarks
Energy Transition: Overall Objective Clear?

Energy Transition („Energiewende“)

Today's Energy System

„Today“


„Tomorrow“

Repowering of Future Energy Systems Possible?

„Day after Tomorrow“

Risks Threats Attacks...

18/06/2018
"Tomorrow" – Green?

Electric vehicles’ climate impact in different energy mixes

Source: VUB University Brussels (2017)
Global Battery Markets: Supply Chain Reliability?

Albemarle (2016): Global Lithium Market Outlook
Example: Cobalt from Congo

At present, more than 50% of global cobalt is mined in Congo...

Facts:
• Child Labor (up to 12 hours/day)
• 1-2 $/day
• Health-damaging
• ...

Ethical Question!

www.faz.de (AP)
• Attacks (terroristic, cyber, ...) of vulnerable energy systems as a result of myopic cost reduction goals
• Weather extrems (storms, floodings, droughts/heat waves, defreezing permafrost, ...) resulting in shortages of electricity generation
• Primary fuel shortages, notably gas (lack of alternatives as a result of an earlier phase out of coal/lignite): Permafrost; European access to the global LNG/shale gas market (willingness to pay)
• Raw material shortages from global supply hot spots (e.g. protests of local population, environmental damages, exploitation of local workers)
• Governance failures: frequently changing governments and disruptive politics („Trump“) causing uncertainties for investors
• Acceptance failures: society not willing to support energy transition any more (e.g. blackouts, too costly, land use, externalities, ...)
Eastern Gas Corridors to Europe

Global Gas Trade

Source: BP (2016)
World Lithium Reserves by Country in 2017

Source: US Geological Survey [ID 268790]
@ Governance Failures

- Frequently changing governments, disruptive politics (national, global) and weak regulatory frameworks causing uncertainties for investors
- Myopic political decisions as a result of several reasons: election tactics, changing competences in energy decision making (European Commission versus Member States)
- Effectless policy instruments trying to push energy transition
- Standed cost of energy technologies
- Misjudgement of lead times for implementation of new policies
- Changing and/or setting unrealistic policy targets
- ....
Acceptance Failures

• Frequent blackouts
• Energy transition too costly for (parts of) end-users
• Exernalities too high (e.g. land use, etc.)
• Increasing unemployment due to re-allocation of jobs
• Accidents: self-driving electric vehicles, fires (battery factories, wind turbines, ...)
• Cyber attacks of smart meters of organised gangs of burglars
• Ethical questions in terms of „fair trade“ standards for access to raw materials
• ....
Case Study: Austria

Scenarios:
Structure & Components of the Austrian Energy System in 2030, 2050, 2100

Techno-Economic Analysis:
• Implementation of Risk Assessment Methodology
• Definition of KPIs

Socio-Economic Analysis:
• Risk - Prosumers/ Stakeholders/Policy Makers
• Participatory/Ethical Questions
• Empirical data bases

Description of Selected Attack Scenarios:
Interdependences, Contradictory Goals, Resilience Strategies

Definition of Detailed Research Questions (incl. Stakeholder Associations and Policy Makers)

Relevance of Possible Attack Vectors, Threats & Risks for the Austrian Energy System
@ Techno-Economic Analysis

@ KPIs (selected examples):
• Market Concentration Factor (e.g. Herfindahl-Hirschman Index (HHI)) of supply countries for raw materials
• Corruption Perception Index (CPI) of supply countries
• Social Standards / Ethics-Index in supply countries (Child-Labor, ...)
• Sustainability Index of key energy components (e.g. Life-Cycle-Analysis, Recycling Factors, ...)
• Security of Supply Factor of energy system
• ....

@ Empirical data bases:
Cost-resource curves of global raw materials
• Theoretical-, technical-, economical-, socially-acceptable potentials
• Cost & learning effects over time
@ Screening the Public Opinion on Acceptance, Risk Appraisal & Sustainability of Energy Transition (Interviews/Questionnaires/Focus Groups)

• Social Acceptance / Acceptance Limits
• Dynamics & Role of Opinion Leaders
• Risk Appraisal
• Willingness to Participate/Pay/Adapt for... e.g. Green?, Independent?, Ethical?
• ...

@ Risk Appraisal of Stakeholders & Policy Maker (Interviews/Questionnaires)

• Expectations/measures to establish confidence and to trigger investments
• Expectations/measures to monitor energy transition
• Measures and contingency plans in case of challenges/disruptions
• ....
@ Resilience Cycles

1. Risk Identification / Risk Minimization

2. Risk Prevention / Reduction of Vulnerability

3. Reaction / Mitigation of negative Events

4. Adaption / Learning / Update of Contingency Plans
Mitigation Strategies, Concluding Remarks

Energy Transition („Energiewende“)


Ultimate Questions:
• Cost, Cost allocation, Benefits
• Internalisation of externalities
• Willingness to pay
• Willingness to clear markets
• ...

Price Signals!