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Energy transformation in Germany
Progress, shortfalls and prospects

6th Roundtable of the Minister for Economy, Trade and Industry (METI) on Studying Energy Situations

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Disclaimer and preliminary remarks

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- **The views and opinions expressed in this presentation are partly based on results from research commissioned by the German Federal Ministry for the Environment, Nature Protection, Building and Reactor Safety (BMUB), the German Federal Ministry for Economic Affairs and Energy (BMWi), the German Federal Environment Agency (UBA), the European Commission (EC) and the European Environment Agency (EEA).**
- **The contents of this presentation does, however, not necessarily reflect any official position of Germany or the European Union.**

- **The English version of a more comprehensive statement with more background information and data is also available at:**
  www.oeko.de/fileadmin/oekodoc/Statement-for-the-6th-METI-roundtable.pdf

Energy Transformation in Germany
Important background

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- **The German energy transformation ("Energiewende") is a project of a policy-driven structural change of the energy system.**
  - it is a target-driven approach with short-term (at risk), medium-term and long-term targets that create a framework for policy design, policy evaluation and consistency of policies and strategies;
  - it is characterized in at least some fields by issues that will not occur for other countries (efforts and costs to buy down the learning curves of key technologies);
  - it needs to be seen in the framework of national energy & climate policy efforts, the liberalization of the electricity/gas markets as well as the a strong European framework (it is more than a German experiment).
- **Lessons learned**
  - it is a learning-by-doing process which needs to reflect the experiences from the implementation efforts as and the a changing environment (energy markets, technology portfolios, policy framework etc.)
  - setting clear & ambitious targets and starting early is important

Realizing what transforming the energy system is really about: managing structural change

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- **Energy transition: towards a low/zero carbon, risk minimized and renewables-based energy system**
  - the technologies are available (globally, w/o learning costs)
  - clean options are competitive and/or affordable on a LCOE basis
- **Managing structural change is the real key challenge**
  - changing characteristics of technologies: variable generation, more (but however not exclusively) distributed/decentralized
  - changing structures of costs: higher shares of fixed/capital costs
  - changing structures of players/market participants: much more diverse investors and operators with new/other (economic) appraisals, other financing approaches, sources or risk assessments
  - changing spatial structures: upgrading (distribution/transmission) grids
- **Lessons learned**
  - need for new market design (coordination & pay-back for investments), grid issues (neutrality, upgrades/investments) must be addressed early; new players, their market access and appraisals need to be reflected

Energy transformation in Germany
Deep dive #1: Market design

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- **The first phase of the energy transformation was characterized by administratively fixed feed-in tariffs, in 2014 the system was changed towards auctions which mark the second phase of the transformation**
  - huge role of FiTs for technology learning & non-technical infrastructures
  - major cost decreases for onshore/offshore wind, utility-scale solar PV
- **Is there a future without remuneration mechanisms?**
  - potentially for an interim phase (depending on wholesale market prices, crucial impact of CO2 price etc.): zero-bids observed in offshore wind auctions; green power purchase agreements for niche markets
  - on the medium- to long-run: current market design will not provide payback for any (!) investments in the system if prices will be increasingly formed on the basis of options with very low marginal costs
- **Lessons learned**
  - for the first phase (non-technical infrastructures etc.) robust remuneration mechanisms are needed
  - a new market design needs to be developed that reflects fundamentals and specifics of the future system (marginal costs, regionalization)

Energy transformation in Germany
Deep dive #2: Grid infrastructures

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- **Grid infrastructure is a key bottleneck for the energy transformation**
  - upgrade of transmission system faces significant delays (lead-times, public and political acceptances, changes in the regulatory framework)
  - upgrade of distribution systems (“smart grids”) still in an early phase
  - Loop-flows are a side issue
    - common & large-scale practice in Western Germany (FR-DE-CH)
    - partly technical and partly political problem in less well-connected Eastern Germany (DE-PL-CZ-DE), essentially solved by phase-shifters and AC link from Thuringia to Bavaria in 2017
- **Lessons learned**
  - early action is need on network upgrades (long lead-times, tensions between necessary changes in the regulatory framework and robustness of the regulatory framework need to be managed)
  - a heavily interconnected transmission system is a benefit (for integration of renewables) and a burden (export of high-carbon power)
  - regionalization as a challenge for a future-proofed market design

- **The future system will consist of renewable power generation and flexibility options (generation, demand flexibility, storage)**
  - base load and medium load options will disappear over time, the demand for residual load (load minus production of variable generation, “residual peak load”) will be covered as we cover peak load today: flexible, clean and low capital cost generation options
  - in a first phase (next two decades) flexible, clean and low-capital cost generation options compete with demand flexibility (sector integration) and infrastructure upgrades, on the longer-term the broad range of storage options and sector integration will play important roles
- **Lessons learned**
  - reflecting different phases and not mixing it is crucial
  - creating a level playing field is important (market design)
  - creating a sustainable economic basis for all (!) future-proof options in the system that can trigger coordination based on price signals and pay-back for the necessary investments is crucial
  - carbon constraints need to be reflected in the mechanisms

Energy transformation in Germany
Deep dive #4: Meeting climate targets

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- **German energy and climate policy is target driven**
  - nuclear phase-out is clearly on track
  - mixed outcomes for the 2005 and 2008/2012 greenhouse gas emission reduction targets
  - 40% for 2020 is at serious risk (partly as a result of high-carbon electricity exports, partly due to a lack of progress with regard to transport)
  - this triggered major efforts on improving the regulatory framework (Climate Action Plan 2050, increasing interest in Climate Action Act)
- **Lessons learned**
  - clear and ambitious targets for different time horizons are necessary but not sufficient
  - accountable strategies are urgently needed (a) paving the way for the clean options, b) designing the exit game for the non-sustainable assets, c) triggering the necessary infrastructure adjustments with sufficient lead times, c) making innovation work in time
  - implementation mechanisms need to flexible and will need regular adaptations to a changing environment

Energy transformation in Germany
Deep dive #5: Transport sector

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- **The transport sector transformation in Germany faces major delays**
  - almost no contribution to GHG emission reductions since 1990 (-27%)
  - no accountable strategies for transport sector yet, Diesel strategy failed
  - lacking triggers for market penetration by transformative technologies
  - a key field for action in the next few years
  - electric car sales grew, however, substantially in 2017
- **Lessons learned**
  - passenger and freight, local and long-distance transport need different strategies and are much more consumer-driven
  - key infrastructure decisions need to be made, this puts limits on the potential of “technology-neutral” approaches
  - electrification will be the likely the key strategy for the coming years, the additional electricity demand is manageable, early decarbonization of the power sector will be crucial
  - novel (zero-carbon) fuels need to be considered carefully, are more long-term & innovation issues but require early international activities

Energy transformation in Germany on its way
The current status at a glance

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- **Paving the way – for energy efficiency, clean generation & flexibility options (renewables & complementary flexibility)**
  - innovation, level playing field & roll-out for renewables (☺) , energy efficiency (😐), clean heating (😐) and zero-emission transport (☹)
  - sustainable economic basis (enabling coordination & investments) (😐)
- **Designing the exit-game – for the non-sustainable capital stocks**
  - phase-out for nuclear power (☺) and coal (☹) in the electricity sector
  - phase-out of outdated heating systems (😐), changing modal split in transportation (😐) and phase-out high-emitting vehicles (☹)
  - consistent carbon pricing (☹)
- **Triggering the necessary infrastructure adjustments with sufficient lead-times for electricity (☹), heat** (😐) **and gas** (😐)
- **Making the necessary innovation work in time**
  - an extremely broad range of innovation in the pipeline (☺)
  - attribution of innovation to the different phases of the energy transformation (😐)

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Thank you very much

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