ENTSO-E

41 TSOs from 34 countries

532 million citizens served

828 GW generation

305 Thousand Km of transmission lines

Ten-Year Network Development Plans
Network Codes
R&D plans
Adequacy forecasts
Tools for Market Integration
Less CO$_2$, more electricity, smarter grids

Energy will be more based on electricity

- More renewables
- Stronger grid
- DSR
- Energy storage

Internal electricity market

Pioneering role of Europe
Energy policies and power system implications for TSOs

Integration of RES, new demand wave and grid users

System security and adequacy

Facilitate pan-European markets with a strong infrastructure backbone

Challenges

System Stability, Resource Variability, Uncertainty, New connections, Changed power flows
Crucial work of ENTSO-E

Rule adaptations (Network codes) - Interaction - Technologies and system solutions (TYNDP) - R&D

Challenges & gaps

Smart transmission system towards 2050 decarbonisation
Challenges induced by generation today

Backup: Renewable generation in Germany for two weeks from 5 May 2014
European Energy vision requires a paradigm shift: Installed generation capacity scenarios for EU

**Challenges induced by generation in the future**
Challenges induced by demand: today

A quantitative assessment

Consumption hourly load curves on 16.01.2013 CET

ENTSO-E

120 GW

170 GW

300 360 420 480 540

0 2 4 6 8 10 12 14 16 18 20 22 h
Demand patterns in the future: changes, opportunities

Flexibility and DSR are crucial parts of secure electricity supply (2050 simulations)
Flexibility Improvements – competing solutions

- Increased pan-European interconnections
- Improved transmission/distribution grid capacity in the different control zones
- Operation of CHP and biomass plants according to electricity demand
- Improved flexibility of fossil-fired power plants
- Avoiding generation peaks from wind and PV or using them for heating
- Energy storage

- Thursday from 10 AM to 1 PM, electricity demand is covered almost completely by wind and solar power
- Starting from 1 PM, power generation from both wind and solar goes down, by 5 PM about 30 GW of supplementary power plant capacity is required
Energy storage development challenge

Maintaining or increasing the security of supply – additional storage required

TYNDP 2014 includes large scale storage facilities connected at transmission level

- Pumped Hydro Storage (PHS)
- Compressed Air Energy Storage (CAES)
TYNDP 2014 – base for the PCI 2015 list include 9 storage projects

- NDPs: Projects of national relevance
- Regional reports: Projects of regional relevance
- TYNDP report: Projects of pan-European relevance
- PCIs: Projects of Common Interest (defined in 2013 Infrastructure Regulation)

TYNDP 2014 package

120 projects of pan-European relevance

- Incorporating 22 third party projects

- 17 PCI projects assessed:
  - 8 transmission projects
  - 9 storage projects
PCI 2013 storage projects
Storage a needed alternative: what, how, who?

Rational for storage

• Restructuring of generation and demand side
• Slow development and difficulty in establishing interconnectors
• Balancing the power system in short time scale (few hours and even minutes)
• Spinning reserves on traditional power plants are expected to decline in the future years

Time horizons for storage for delivery back to the grid

• Yearly basis
• Daily basis – fast reacting storage (e.g., batteries and ancillary services)

Regulatory framework

• Who should own and operate the storage facilities
• Business models
Storage a component of R&D Roadmaps and Implementation Plans

From TSOs R&D Roadmap

To TSOs and DSOs R&D Roadmap and Joint actions

To TSOs and integration DSOs and energy storage
Towards a more integrated energy system

EC framework: R&D within an Integrated Roadmap
TSOs: work for an integrated energy system

- Heating and Cooling
- Transport sector
- Smart Grid deployment
- Use of Gas including power to gas technologies
- Storage
Thank you for your attention!
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Network codes into force will strengthen consumers

Internal electricity market

3 Connection Network Codes
- set requirements for
  - Generators
  - Demand-side
  - HVDC connections

3 Market Network Codes
- set market rules for
  - Day ahead/intraday & Capacity calculation
  - Long-term timeframes
  - System balancing

4 Operational Network Codes
- set common rules for
  - Assessing adequacy
  - Planning outages
  - System security
  - Emergency situations
Market coupling: Consumers enjoy purchasing electricity across Europe

- The NWE price coupling project went live in Feb 2014
- Full coupling SWE-NWE in 2014
- Market is supported with a strengthening transmission backbone
Main concerns

- RES integration
- Market integration
- Security of supply

Bottlenecks

Marginal cost difference

Projects

Target capacities

Adequacy

What to expect from the TYNDP 2014

...a comprehensive document suite that includes

- Ten-Year Network Development Plan
- Scenario Outlook and Adequacy Report
- 6 Regional Investment Plans
### TSO R&I Clusters
- Grid architecture
- Power technologies
- Network operations
- Market designs
- Asset management

### DSO R&I Clusters
- Integration of smart customers
- Integration of DER and new uses
- Network operations
- Network planning and asset management
- Market design
Purpose of EC contract

- provide the EEGI team and EC with consolidated stakeholder views for the research and technology development needs and market uptake measures for end to end pan European electricity grids and energy storage including interaction with other energy networks
- facilitate a technological base to open up for the "active customer"
- 1.5 million € for a 2 year contract