European Transmission System Operators and their Association ENTSO-E: International cooperation, market and network integration

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1. Introduction: ENTSO-E
2. Network codes
3. The 2012 Ten-Year Network Development Plan
4. Conclusion

Introduction: TSOs’ and ENTSO-E's significant role for European energy and climate change objectives

Key activities set out in Regulation 714/2009 (on cross-border electricity trade, part of the 3rd IEM Package)

• Deliver **network codes** binding to all network users (through ‘Comitology’)
• Deliver **network plans** European / regional view of system needs (“**TYNDP**”)
• Deliver crucial aspects of **market integration** (“market coupling”)
• **R&D Plan** (including the just approved E-Highways 2050 study)

Recent important work products:

• **1st Network Code on Requirements for Generators**
  delivered for ACER Opinion 14 July – prerequisite for the future system with much more RES
• **TYNDP 2012** incl. major improvements in methods, data

**41 TSOs** from **34 countries**;
**530 million people**; **910 GW gen.**; **300 000 km transm.**
Interconnection, cooperation ⇒ reliability ↑, costs ↓, through trading, shared reserves ⇒ Need for strong common rules
Huge flows all over Europe

Current and future challenges: a fast changing energy mix

Thousands of small units

Wind share of demand: 2010 = 5.3% → 2020 = 23% → 2030 = 36%
More fluctuating RES, more distributed gen., more pan-European markets, planning + operational coordination

Change is at the core of transmission planning

2012
320 GW RES
538 GW peak load
3300 TWh demand

Share of total RES in net gen. capac. 1/2020, scen. EU2020

However scale and speed of change in recent years is unprecedented

2012 - 2014 TYNDP
2020 – TYNDP 2012
536 GW RES
567 GW peak load
3600 TWh demand

eHIGHWAY 2050 study:
- strong consortium,
- 3 years
- 80-95% reduction in greenhouse gases; higher reduction for electricity

2030 visions
- 2014 TYNDP

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Many TSO and ENTSO-E efforts necessary for a European system fit for the future – incl. joint planning, network codes

- Build and maintain transmission network for bulk power flows – today’s focus
- Reinforce transmission network for connection of new generation
- Design market mechanisms for trading at all time horizons
- Continuous evolution of operational and coordination measures
- Generators should be able to provide ancillary services – NC RfG

EU-wide Network Code Requirements for Generators

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Network codes: common codes for an integrated market
TYNDP 2012: A stronger grid to answer major challenges, jointly planned by all TSOs within ENTSO-E

- Security of Supply: 21,900 km
- Internal Energy Market: 18,200 km
- Renewable Energy Sources Integration: 44,700 km
- Peak load growth: +1.7% per year
- Grid length: +1.3% per year with RES triggering 80% of assets growth

Europe-wide 52,300 km:
2020 Europe - 100 bottlenecks in the transmission system

RES is triggering 80% of assets growth
2020 Europe – 17% increase in infrastructure

By end 2016

2017 and beyond
### 2020 Europe - About €100 billion in investments

- €100 billion investment on grids...
- ≈ 1.5-2 €/MWh in Europe over the 10-year period,
- ≈ 2% of the bulk power prices,
- ≈ less than 1% of the total end-users’ electricity bill

<table>
<thead>
<tr>
<th>Country</th>
<th>Investment (billion €)</th>
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<tbody>
<tr>
<td>Austria</td>
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<tr>
<td>Belgium</td>
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**Total ENTSOE perimeter**: 104
Status in 2020 and further issues

Three major issues after 2020:

- Integration of offshore wind generation in the North Seas
- Connection of solar generation in Northern Africa to the European continent
- Interconnection with Eastern countries
Integration of electricity networks can be done either through:

- **AC** (alternating current), or
- **DC** (direct current) connection.

**Both alternatives are currently important** within ENTSO-E and with neighbors:

- **Existing DC lines** within the Continental European system and between the different synchronous areas **within ENTSO-E** (Nordic, UK, Ireland, Baltic)
- **Baltic countries** – more DC connections firmly planned in BEMIP and TYNDP; EU financed study on possible synchronous (AC) connection ongoing
- **Maghreb** – AC connection through Strait of Gibraltar; visions for further connections around the Mediterranean, although 2 synchronous tests failed
- **Turkey** – ongoing synchronous (AC) trial operation with Continental Europe, and Turkish plans for near-term DC connections with neighbors to the South and East
- **Ukraine/Moldova** – beginning EU financed study on synchronous (AC) connection

**TYNDP and network codes provide an even clearer integration framework!**
Conclusions

1. **TYNDP 2012** - 17% increase in grid needed by 2020 ≈ 52300 km

2. Europe-wide grid planning for the urgent 10-year needs, and for 2030 and 2050, is important but only one part: Network codes are also needed urgently, and so is the market integration (described in NCs)

3. Integration of electricity networks = integration of markets;
   Both AC and DC integrations support wider electricity markets integration

4. The new methodologies based on the 3rd IEM Package – TYNDP, NCs – provide a solid framework and foundation for further studies and further integration
Thousands of possible situations and overall social economic welfare assessed via *regional* market studies

- 5% of generating costs saved by new interconnection
- Direct connection for 125 GW RES
- - 170 Mt/y CO₂ emissions savings