Basic features of ENTSOG network and market tool

The basic features of the ENTSOG network and market tool, as currently used for developing the TYNDP, are described in this section.

The tool used by ENTSOG to perform the TYNDP assessment is the ENTSOG NeMo Tool. It is both a network and market simulation tool. The tool reflects the physical characteristics of the gas infrastructure relevant from the Union-wide TYNDP perspective.

ENTSOG feeds the tool with specific datasets for the TYNDP and Seasonal Outlooks. Experience gained in running these exercises is used in order to continuously improve the tool. ENTSOG provides a detailed up-to-date description of the tool as part of each TYNDP edition.

Role of the simulation tool in the TYNDP

The simulation tool is used in the TYNDP in order to **verify the feasibility** of different flow situations, handle the **supply adequacy outlook,** assess the **resilience of the system**, identify the **infrastructure gaps and assess projects**. This requires that the assessment is performed against a reasonably contrasted range of demand and supply situations, considering also the impact of infrastructure-related or supply-related disruption situations on security of supply.

The tool subsequently calculates related outputs, including the indicators defined as part of the CBA methodology in force, by running different **simulation cases**. A simulation case is a combination of specific situations in regard to demand, supply, prices and various other parameters. The tool outputs form the input for the subsequent monetisation task. The TYNDP assessment results from performing the simulation cases for different level of development of the gas infrastructure.

To ensure an accurate assessment of the system the simulation cases cover a whole year situation as well as specific high demand situations (design case peak day and 1-in-20 years the 2-week high demand case).

Representation of the gas infrastructure

The tool builds on a **topology of the gas infrastructure** developed and regularly updated by ENTSOG. This topology is used as a basis for the NeMo tool, as well as for the ENTSOG Transparency Platform, the Transmission Capacity Map and the System Development Map. It covers the gas infrastructure in the EU: cross-border capacities between countries, intra-country capacities between balancing zones, and meaningful intra-balancing zone constraints. LNG terminals including LNG tanks, underground gas storages, and their connection to the gas grid as well as connection to the production infrastructure are reflected as well. It also covers the gas infrastructure in countries adjacent to the EU inasmuch as the

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infrastructure in these countries contributes to imports to or exports from the EU. This refers both to the existing and planned infrastructure.

In the NeMo tool, the basic block of the topology is the balancing **Zone**, at which level demand and supply shall be balanced. The zones are connected through **Arcs** representing the capacity of the interconnection point(s) between the connected zones[1]. Underground storages, LNG terminals, internal bottlenecks where relevant (i.e. reflecting a meaningful clustering capacity aspect) or interconnectors with specific regime are represented by zones with no attached demand. Zones with or without demand attached are more generally referred to as **Nodes**. Supply sources are attached to supply nodes. Extra-EU supplies are connected through import arcs. Indigenous production is connected to the concerned balancing zone through an arc reflecting the production infrastructure.

The TYNDP[2] subsequently represents the following existing and planned gas infrastructure:

- For the transmission infrastructure
  - transmission capacities, including complex interconnections between more than two TSOs
  - internal bottlenecks, where relevant (i.e. clustering of capacities)
  - transit capacities
- For the underground storage infrastructure
  - the working gas volume
  - the withdrawal and injection capacities
  - the withdrawal and injection curves which define their ability to withdraw or inject gas depending on the filling level
- For the LNG terminals infrastructure
  - regasification capacities both along the year and during high demand situations
  - the tank volumes characteristics including a flexibility factor defining the share of the tank volume expected to be available during high demand situations
- For the indigenous production infrastructure
  - Expected production, by type of production (conventional, unconventional, biomethane…)

[1] After application of the "lesser-of-rule"

[2] The TYNDP 2017 topology consists of more than 400 arcs. The corresponding capacities are publicly available as part of TYNDP 2017 Annex D: http://www.entsog.eu/public/uploads/files/publications/TYNDP/2016/entsog_tyndp_2017_Annex_D_Capacities.xlsx

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Inputs to the tool

In order to run the different simulations cases, and calculate the different outputs, the tool uses the following inputs:

- Gas demand
- Supply potentials and supply prices curves
- Existing infrastructure information, where the Transparency Platform is used as one of the basis to collect the information
- Planned infrastructure information including capacity increments, expected commissioning date and status of the planned infrastructure (such as FID, Advanced, PCI, Non-FID)
- Route disruption cases information and applicability

The inputs are stored and made available to the simulation tool through ENTSOG Professional Data Warehouse System (PDWS).

The simulation tool

The NeMo tool is a network flow optimisation algorithm.

The tool has the primary objective of deriving flows on each arc that allow balancing supply and demand for every node, using the available system capacities. The objective function is the minimisation of the supply costs at European level. The tool derives the marginal price per node as the part of the optimisation. Demand curtailment is used as a virtual last resource supply.

The tool outputs (supply flows, marginal prices, disrupted demand…) are used to derive specific results for the different simulation cases, such as:

- EU-level results in terms of supply costs
- country-level results in terms of resilience of the system (demand curtailment or remaining flexibility), dependence on specific supply sources or ability to diversify to different supply sources, marginal price

The simulation tool results together with additional costs inputs (such as fuel prices, CO2 prices and value of loss of load) allow to derive monetised results as part of the TYNDP assessment.

More information on ENTSOG network and market tool can be found in Annex F of TYNDP 2017[3].

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http://www.entsog.eu/public/uploads/files/publications/TYNDP/2016/entsog_tyndp_2017_annex_F_method_web.pdf

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