The SC3 Project: Country Specific System Cost Modelling
NEA support for countries interested in calculating their system costs and optimising their electricity system

Why? Motivation

Electricity systems and electricity markets are changing very quickly and decision makers need to evaluate carefully what is the optimum generation mix. Some considerations include:

(1) Strong carbon constraint following commitments under the Paris Agreement
(2) Large-scale deployment of renewable energies, most of them variable (wind, solar PV)
(3) Variability requires innovative system analysis as traditional system optimisation no longer applies
(4) Technological and behavioural changes (storage, demand-side management, increasing interconnections)
(5) Increasing value of flexibility, reliability and dispatchability especially if technologies are low carbon (nuclear, hydro).

Policy-makers need to understand the new contexts in order to propose suitable policies. Rapidly changing electricity systems can confront policymakers with questions that are difficult to answer without the help of integrated energy system modelling.

What NEA Offers

It is NEA's role is to assist decision-makers in developing a coherent view of the costs and contributions of nuclear energy in a low-carbon electricity context. The strategic decisions related to the choice of technologies, potentially including new nuclear build or prolonging the license of existing nuclear units, etc. depends crucially on a clear perception of the needs and constraints of the power sector, as an integrated system, in the coming decades.

In 2012, NEA pioneered an innovative programme on the study of system costs and the impact of changes in the configuration of electricity systems on their costs and reliability. Several other organizations, including IEA, have since recognized the importance of system costs when assessing the contributions and impact of various generation technologies to the overall electricity system.

NEA system cost modelling allows determining least cost generation mix and optimal share of nuclear energy in function of different CO2 emission reduction, renewable generation targets and a combination of greenfield and existing brownfield generation mixes. NEA work systematically integrates electricity system modelling with clearly formulated policy objectives and instruments for energy policy-making to attain these objectives.

In cooperation with the Department of Mechanical Engineering of the University of Leuven (Belgium), the NEA is making its modelling capabilities available to interested member countries. While the methodology is general, results will depend strongly on the specific situation of each individual member country.

What Questions Can SC3 Answer

The presence of a significant share of intermittent resources in the system and the need for new sources of flexibility make the analysis of the electricity system significantly more complex and require the use of advanced modelling tools. Assessing the cost and performance of electricity system as well as the impact and effectiveness of policy measures in the short- and in the long-run also requires knowledge and data about a number of country-specific conditions: the endowment of hydroelectric resources, interconnections with neighbouring countries, the development of storage capacity and demand side response, as well as the generation profile of Variable Renewable Energy (VRE) and its correlation with demand.

Policymakers are in this context confronted with a number of questions that are difficult to answer without the help of integrated energy system modelling. The most important questions usually are:

- What is the cost of attaining different VRE and carbon targets, either individually or jointly?
- What is the impact of these targets on different technologies, in particular nuclear, and the overall mix? What will be the load factor for nuclear power and other dispatchable plants?
- To which extent does both the market value generated by a MW of VRE and its contribution to covering demand (capacity credit) decline as the share of VRE in the electricity mix increases?
- What will be the role of storage as well as voluntary and involuntary demand response?
- What is the level and volatility of electricity prices, including hours with zero or negative prices?
- What will be the key inflections points, and the resulting capacity mixes, that define the trajectories running from the current situation to new equilibria?

What Is Needed from the Member Country

SC3 results are very much country-dependent and they will ultimately be driven by the conditions translated into country-specific data, as well as by the VRE and CO2 constraints. Member countries participants in the SC3 modelling effort thus must take ownership of the process and designate responsive interlocutors that can fully appreciate the nuances of the exercise in order to develop policy-relevant results.

Typical required data include:

- Country-specific costs and performance of different technologies including load factors for VRE with their daily and annual variations;
- The hourly load curve for electricity demand;
- The amount of flexibility resources available including hydroelectric capacity, the demand-side potential and the available interconnections with neighbouring countries;
- Specifying whether one assumes the complete long-term configuration of the system (greenfield) or a shorter-term optimisation given the existing capacity mix (brownfield);
- Indication of different policy measures to be used in terms of VRE and carbon constraints; different options are possible but require different model runs.

Timelines and Deliverables

Depending on the complexity of the project, the timeline may be:

- Preparatory Phase: Interactive process (NEA – Member country) of data assembly and formulation of the constraints - three months
- Modelling Phase: two months
- Analysis Phase: Interactive process of evaluation of modelling results and development of policy relevant recommendations; Elaboration of summary report – three months

Member states would be expected to provide voluntary contributions to the NEA in support of the project.

The ultimate deliverable will be a detailed report summarizing the modelling effort and providing in-depth analysis of the results, including policy recommendations.