ENTSO-E position on Sector Coupling through Power to Gas and Sector Integration – October 2019

Sector coupling and sector integration have recently gained significance in political discussions. This has translated into numerous studies, scientific papers and political statements being presented by European and national research institutes and policy makers.
To contribute to the debate on the decarbonisation of the economy, this document explains the perspective of ENTSO-E towards sector integration as a whole, focusing in particular on the sector coupling of power to gas.

1. Definition

There is an ongoing debate regarding the exact definition of sector coupling and sector integration. Although there is no clear accepted definition available, ENTSO-E's current understanding refers to the conclusion of the EC at the 31st Madrid Forum Oct. 2018[1]. Sector coupling is defined by the EC as closely linking the electricity and gas sectors, both in terms of their markets and infrastructure. Therefore, sector coupling is equivalent to power to gas. Sector integration is understood by the EC to mean the usage of final energy (i.e. electricity or gas) in the end use, which includes, for example, the transport or heating sector. Both require 'hardware' and an adequate legal and regulatory framework. This paper addresses both aspects.

2. Key Messages

The Paris Agreement requires the decarbonisation of the European economy well in advance of 2050. A decarbonisation of the electricity system cannot achieve this alone: the rate of electrification of end-consumption may have reached up to 65% by then[2]. The remaining gap will have to be realised by substituting fossil fuels for carbon-free primary sources, mainly wind and sun. The interlinking of the various energy sectors will help cost-efficient solutions to be found while maintaining a high level of security of supply and providing more flexibility for the electricity system. This requires technical coordination and a supporting regulatory framework. Therefore, ENTSO-E recommends addressing the following points amongst other activities in an upcoming legislative initiative:

- **One energy system view:** A view of all sectors in the European economy must be applied in order to ensure an affordable, effective and efficient transition.
- **Global energy system and cost efficiency**: A cost efficient energy system has to be targeted, considering the energy efficiencies of different conversion technologies and their costs. Electricity from renewable energy sources (RES) should be directly consumed where feasible, due to the higher efficiencies of available technologies in the electric system. Multiple energy conversions should be avoided as they create losses.

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[1] https://ec.europa.eu/info/sites/info/files/31st_mf_conclusions_final.pdf

[2] EURELECTRIC, 2018, 'Decarbonisation pathways', https://cdn.eurelectric.org/media/3558/decarbonisation-pathways-all-slideslinks-29112018-h-4484BB0C.pdf
European Commission, 'IN-DEPTH ANALYSIS IN SUPPORT OF THE COMMISSION COMMUNICATION COM(2018) 773', 2018, https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf
Wind Europe, 'Wind Energy and the Electrification of Europe's Energy System'. https://windeurope.org/wp-content/uploads/files/about-wind/reports/WindEurope-breaking-new-ground.pdf

RES energy that cannot be integrated into the power system should be used in other energy sectors through sector coupling.

- **Operational patterns of power to gas technologies:** Power to gas technologies should help to decarbonise the economy and provide flexibility to the electric system. Thus, their operational patterns shall take operation of the electricity system into account to reach effective decarbonisation while ensuring security of the interconnected European transmission network. It must be ensured that the facilities are operated simultaneously when there is surplus zero CO2-emitting production in the electricity system.
- **Location of power to gas facilities:** The decarbonised economy will make the transmission and storage of energy even more important than it is today. It is therefore crucial to choose the most appropriate locations in terms of geography and voltage levels. In particular, such an approach would optimise the capacity of the existing grid structures.
- **Ownership of power to gas facilities:** Power to gas assets could be market driven private production facilities or, as infrastructure, a public good in the regulated environment owned by system operators. Especially in the start-up phase, the regulated environment can help to develop the sector coupling technologies.
- **Open access to power to gas infrastructure:** As is common practice today in electricity infrastructure, power to gas infrastructure in a regulated environment must be based on non-discriminatory open access of the capacity of the facilities to market actors.
- **Definition of 'green' products:** The certification of green products should consider emissions of CO2 along their entire production process, including externalities. Products derived from sector coupling should only be defined as green when the electricity used comes from a system without increasing its total CO2 emissions.
- **Technology diversity and neutrality:** For a successful transition, different technologies have to be applied to manage different challenges (e.g. energy transmission, short-term and long-term storage). This includes technologies such as power to H2, power to CH4, power to heat and power to liquids, as well as other technologies providing flexibility such as electro-mobility or batteries. These individual technologies are not directly interchangeable with each other due to the different kinds of flexibilities they provide. For example, hydrogen can be transported over a long distance, but heat cannot; batteries provide day/night shift whereas gas provides long-term storage. A neutral approach ensures that diverse solutions are considered and accordingly facilitates the transition.
- **Innovation and large-scale power to gas pilot plants:** In the next few decades, a substantial amount of installed capacities of power to gas facilities will be necessary. To initiate the upscaling process and to demonstrate their system supporting capabilities, large scale pilot projects should be built now.

In light of the central role of electrification and thus the electrical system, electricity TSOs have a central role when developing future integrated systems. The increasingly coupled energy system as a strong enabler of the decarbonisation efforts of other sectors requires coherent infrastructure planning on a national, regional and European scale. ENTSO-E and TSOs will, in their planning processes, take into account the new energy system components and technologies and the necessary interplay between the different operational levels, and will interact with all stakeholders.

3. Rationale and Context

To address climate change and achieve the objectives of the Paris Agreement, the European energy system is undergoing an unprecedented transition. One of the key elements in this transition is the increase of energy production from variable RES. Wind turbines and photovoltaic panels are among the electricity production technologies with by far the highest utilisation potential across Europe. As a consequence, the electricity system plays a pivotal role in the energy transition process. However, some end uses cannot be electrified due to technical reasons or cost-efficiency and thus require different energy carriers. A perspective on the total energy system including heating, transportation and industry is therefore necessary to deliver reliable and affordable solutions for successfully decarbonising the energy systems.

Local differences between energy generation and energy demand result in a need for energy transmission, either directly as electricity or as another transportable form of energy. Sector integration technologies are mostly placed near the customers, thus the transport of energy is necessary. Power to gas facilities, however, can be optimally placed in the system to make use of existing transport networks. Time differences between variable electricity generation from RES and variable energy demand require high system flexibility. Most of the technologies can provide short-term flexibility on an hourly or daily basis. However, only some technologies, such as hydro storage, power to gas or power to heat, are able to provide long-term flexibility. To overcome critical situations such as cold and dark doldrums (assuming lack of wind and solar irradiation, especially in the cold winter months) it is necessary to introduce a backup system. Such a system requires a high level of capacity to provide energy supply for weeks without using fossil fuels. The requirements of flexibility can only be provided by diverse technologies and all actors in the energy field. This is why they all are important for the target of a fully decarbonised European economy.

Facing the continuously increasing installed capacity of variable RES, a significant scale-up of decarbonised flexibility and storage facilities must be achieved. To ensure the necessary technologies and innovation at a sufficient scale are available by the end of the next decade, the upscaling process or deployment must begin immediately. In addition, pilot plants should also be tested on future operational patterns so that the technology is fit for purpose. To accelerate the development of sector coupling infrastructure, especially in its early stages, TSOs could – under certain conditions and regulatory oversight – own, develop and/ or manage those power to gas facilities.

To minimise the overall costs for grid infrastructure and to ensure the secure and reliable operation of the entire system, TSOs should take the lead in developing technical requirements for new sector coupling equipment.

To avoid 'greenwashing', ENTSO-E recommends the introduction of a clear definition of the term 'green' in a consistent manner across all energy sectors. The term 'green' shall be used only in cases of solutions when it is guaranteed that a product provided by sector coupling technologies does not increase overall greenhouse gas emissions, as reducing greenhouse gas emissions in one sector alone might have a negative effect on other sectors. Accordingly, sector coupling technologies should be operated without increasing CO2 emissions in the system. Otherwise, conventional power plants could use fossil fuels (i.e. natural, hence 'not green' gas) to feed the system with electric power, which would ultimately increase the CO2 emissions. This means that the definition of 'green' must ensure that electricity from RES is used that otherwise would have been curtailed or other non-CO2 emitting energy sources are used, bearing in mind that electricity from dispatchable power plants will have a very high value in the future.

A successful and economic efficient energy transition towards an affordable, sustainable and competitive energy transmission system featuring the highest possible flexibility and security of supply cannot be achieved by using a single energy source. An electricity system with high production from RES offers unique opportunities to not only decarbonise the electric system but also all other sectors. In addition to the energy system, a balanced mix of energy resources and various technologies is required to achieve a decarbonised European economy. Sector coupling and sector integration are therefore highly relevant for ENTSO-E because they introduce access to economic, efficient cross-sectoral flexibility.