What energy mix in a net-zero emissions world?
Minutes of the second scenario workshop of the PAC project

Wednesday, 9 October 2019, 10:00 – 17:15
Domus Medica Europaea, Rue de l'Industrie 24, 1040 Brussels

34 participants including speakers attending

10:00 **Introduction. Why infrastructure and scenarios matter.**

The introductory session explains the relevance of energy scenarios for EU energy infrastructure planning. According to Jörg Mühlenhoff (CAN Europe), the classical approach of EU institutions defines energy infrastructure needs mainly from the perspective of security of supply and enhancing cross-border trade. Emission reductions and the preparation for energy transition are barely integrated in infrastructure policies.

He explains that while regulators warn against potentially stranded assets of fossil gas infrastructure, the Trans-European Networks for Energy (TEN-E) Regulation does neither relate to the Paris Agreement nor to the Clean Energy Package yet. Environmental NGOs criticise that funding fossil gas projects by attributing them the Projects of Common Interest (PCI) stamp leads to continued fossil gas consumptions, thus undermines the EU's own climate and energy targets.

>Presentation CAN Europe/EEB (PAC_scenario_workshop_9oct19.pdf)

10:30 **Building a common scenario: our approach – your feedback.**

Participants are invited to present their expectations with regard to the workshop and scenario building. Jörg Mühlenhoff (CAN Europe) explains that the challenge of the PAC project is to align infrastructure planning with the 1.5°C Paris Agreement target by developing a new common scenario that will be Paris compatible. He gives an overview of previous and upcoming opportunities for stakeholders to feed into the common scenario building.

The purpose of the scenario workshop is to present and discuss the most important assumptions for the potential energy mix. Key parameters are to be fed into the Ten Year Network Development Plan (TYNDP) modelling process of the European Network of Transmission System Operators for Electricity (ENTSO-E). The scenario developed now with stakeholders under the PAC project ideally would become part of the storylines that will be modelled under the TYNDP 2022. Participants' questions relate to the scope of the TYNDP and infrastructure costs.

10:45 **Deeper dive into the generation side**

Dante Powell (ENTSO-E) explains how grid operators model the future energy mix being based on demand side assumptions and a decarbonisation target. The "ambition tool" in the modelling process reflects a carbon budget that would be in line with the Paris Agreement 1.5°C target. ENTSOs' modellers define the boundary conditions for the development of different technologies. While the cost assumptions of the TYNDP are mostly based on the PRIMES model (June 2018), costs of some technologies are modified (solar PV and solar battery systems). Dante Powell invited participants to contribute to the consultation on the TYNDP 2020 Draft Scenario Report which will start on 12 November 2019.

>Presentation ENTSO-E (ENTSO-E_Powell_Scenario_Building_Generation_Side_9oct19.pdf)

Participants raise questions concerning the TYNDP model's capability to analyse whether it is better to build renewables or to build grids and how renewable capacities are distributed. Regarding one participant's question on the integration of the distribution level, Dante Powell explains that the TYNDP model builds on the net transmission capacities between national or regional nodes but does not consider flows within the distribution level.

11:30 **Building our scenario: Phasing out fossil fuels and nuclear**
Phasing out lignite and hard coal

The first part of presenting CAN Europe's and EEB's assumptions for the common scenario building focuses on fossil fuels and nuclear power. Jörg Mühlenhoff lays out the key assumptions for phasing out **coal** that are based on a country-specific analysis, backed by recent studies and market forecasts from research and member organisations. After 2030, only very few capacities of under 10 GW still would be connected to the grid to serve as capacity reserve.

Joanna Flisowska (CAN Europe) as senior coal policy coordinator considers the phase-out schedule as realistic and balanced. Given the poor economic performance of old coal fired power plants under rising carbon prices even more ambitious scenarios could be argued. Dante Powell suggests to consider the need for must-run capacities and reactive power as well as the influence of national capacity mechanisms on the phase-out schedule for coal capacities.

Phasing out fossil oil in transport

Jonathan Bonadio (EEB) gives an introduction to the scenario building on **fossil oil**. Based on modelling done by Transport & Environment (T&E), fossil fuels would be completely phased out in transport to match the net zero target. The proposed assumptions focus on electrification of transport. Due to low efficiencies and high renewable electricity demand, liquefied fuels based on synthetic methane and renewable hydrogen should only play a limited role, except in those sectors that are most difficult to decarbonise, such as aviation and partly in heavy freight and shipping.

Thomas Earl (T&E) as commenting external expert underlines the high costs of synthetic methane, hydrogen and liquefied synthetic fuels, compared to electrification, even when including additional infrastructure costs for electrified highways. The high level of electrification is questioned by one participant, predicting problems with grid size, infrastructures and management. Against this backdrop, the participant argued that the use of renewable gases in freight and passenger cars would make sense to ease electricity grids. Participants also ask to be transparent with regard to feedstocks used for biofuels production.

Phasing out fossil gas

As CAN Europe and EEB have not yet prepared detailed assumptions on the quantities of biogas, biomethane, hydrogen and synthetic methane, the phase-out schedule for **fossil gas** is not yet outlined with robust figures. Jörg Mühlenhoff (CAN Europe) explains the key assumptions and policy demands (fossil gas phase-out by 2035).

In his comment as external expert, Dries Acke (ECF) stresses that even gas industry studies project that only roughly a tenth of current fossil gas use will remain as demand for gaseous energy carriers in buildings. Higher infrastructure costs offset the alleged cost advantages of hydrogen and synthetic methane produced with renewable electricity. Given the limited availability of these renewable gases, they should be used in those sectors where there is no alternative for decarbonisation, like heavy industry, planes and ships. He questions the need to maintain gas distribution grids just for supplying gas to hybrid heat pumps during a few winter weeks at times of cold spells. Participants discuss the range of potentials of renewable gases.

>Presentation ECF (ECF_Acke_Future_Role_of_Gas_9oct19.pdf)

12:15 **Phasing out nuclear**

Jörg Mühlenhoff presents the key assumptions on trends in the **nuclear power** industry. According to these, only a few far advanced projects of new nuclear reactors would be completed. Due to high investment costs and competition of renewables, the replacement of existing nuclear capacities is considered as being not very realistic in literature. In the draft scenario, CAN Europe refers to the retirement schedule of the operators' own World Nuclear Association and limits lifetime to 40 years in case no other framework is set. By 2040, almost the entire European fleet would be decommissioned.

As most of European nuclear capacities are operated in France, Yves Marignac from the French NégaWatt network of energy analysts provides an overview of current challenges of the French and European nuclear industry. The NégaWatt scenario foresees an even quicker phase-out of nuclear power in France before 2040. Speakers and participants agree that the future of nuclear is highly influenced by political decisions that are difficult to anticipate.

14:00 **Building our scenario: Reaching 100 % renewables**
Assumptions on variables renewables in the energy mix (solar, wind, ocean)

Jörg Mühlenhoff introduces the key assumptions on growing renewable capacities and related pathways for installed capacities. Figures for the scenario building on solar PV and onshore wind are basically taken over from the model run by Lappeenranta Technical University (LUT) together with the Energy Watch Group (EWG).

Solar PV

The installed **solar PV** capacity of 122 GW in the countries covered by the TYNDP in 2018 would be doubled in the early 2020es. Following LUT/EWG's ambitious assumptions, capacities would increase to 1500 GW in 2030 already. Other EU scenarios are much more conservative and expect only a restricted and delayed increase of capacities.

Onshore wind

Installed capacities of **onshore wind** rise from 170 GW in 2018 to 240 GW in the early 2020es. Like in the case of solar PV, the ramping around 2020 would have to be adjusted to more up to date market forecasts and national policies. Figures from LUT/EWG are however not that far away from other scenarios that are published.

Offshore wind

While the LUT/EWG model does not expect further uptake of **offshore wind** on the middle and long-run, Jörg Mühlenhoff suggests that CAN Europe and EEB scenario building includes most recent market analysis from BVG Associates on offshore wind potentials that predicts a total capacity of 64 to 86 GW in 2030.

Ocean energy

Jörg Mühlenhoff stresses that CAN Europe's and EEB's scenario building strives to integrate also potentials of **marine, tidal and wave energies** that are mostly left out by energy scenarios. Because of time restrictions, these variable renewable energy sources however would not be covered in detail during this workshop.

Q&A

Thure Traber (Energy Watch Group) explains how their model results interrelate. He sees the steep curves of installed solar capacities as the answer to fast emission mitigation needs in view of the Paris Agreement 1.5°C target. In geographical terms, the LUT/EWG model runs a worldwide assessment of renewable potentials in almost 50 km2 granularity to calculate the optimal renewable energy roll-out within big countries or clustered regions consisting of smaller countries. These countries or regions are each modelled as energetic islands where the aim is cost minimisation for hitting the zero emission target with renewable energies. Under 100% renewable energy provision the overall electrification level across the electricity, heat, transport and desalination sectors reaches up to 90%.

>Presentation EWG (EWG_Traber_Energy_Scenarios_Net_Zero_Emissions_9oct19.pdf)

Questions relate to cost assumptions, capacity factors, space restrictions and to additional electricity flows that will mainly come from exporting countries in Scandinavia and from the British Isles if the European transmission grid would be strengthened. Grid reinforcement in Central Europe would support these exports but the clustered regions would also be able to guarantee security of supply on the base of current electricity

interconnections in case of delays. In addition, the LUT/EWG model simulation finds that wide-spread decentralised self-consumption of solar PV electricity plays out to ease the grids.

14:45 **Assumptions on dispatchable renewables in the energy mix (hydropower, biomass, geothermal)**
Hydropower

Jonathan Bonadio explains that CAN Europe and EEB decided not to take over assumptions of the LUT/EWG model on hydropower potentials. Besides refurbishment for increasing efficiency or pump storage capacity of existing dams, no more new hydropower capacity would be added in Europe in order to respect environmental constraints. Discussions of participants and speakers turn around potential upgrading of pumped hydro and hydropower plants that are not considered as being economically viable in the future.

One participant also asks to consider the impact of climate change on hydropower potentials. Another participant warns that the position towards hydropower could appear like NGOs reject almost every source of power generation which might undermine credibility in public perception.

Biomass

The key assumptions are based on the EEB's Burnable Carbon paper that sums up available biomass potentials under strict sustainability criteria. Jonathan Bonadio highlights the differences with the LUT/EWG model: Given the recycling targets, waste incineration would be phased out in CAN Europe's and EEB's scenario building. It expects a decrease in food waste generation by 30% by 2025. Biomass use would be limited mostly to residues and organic waste, with very limited use of energy crops with the exemption of plants such as clover from crop rotation for biogas. Use of biomass should be tied to combined heat and power (CHP) plants, meaning a phase-out of electricity-only plants. Regarding wood energy, the potential is limited to a 70% removal of forest residues from harvesting sites. Stricter limits apply to poor soils and peatlands. Forest areas left outside of harvesting operations increase by 5%.

A number of participants ask for more detailed assumptions on the different forestry residues in order to avoid using feedstocks that are not beneficial from a climate perspective. Some participants say that in the case of biofuels, the scenario building should clarify whether the projections up to 2030 rather reflect EU legislation or what is desirable and ambitious from the point of view of environmental NGOs. Some participants also warn against displacement effects of biomass that is not sustainably sourced, e.g. palm oil and soy. Thure Traber stresses that prices for biomass need to be reflected as an important driver of model results. Dante Powell explains that the TYNDP modelling does not establish a merit order for different biomasses according to their carbon footprint. He sees only a very limited amount of biomass use for electricity.

Geothermal and solar thermal energy

While CAN Europe and EEB strive to integrate a detailed picture of geothermal energy's contributions to different sectors, this energy source is not covered in the scenario workshop because of time constraints. CAN Europe and EEB have not yet completed assumptions and key parameters for geothermal energy at the moment of organising the scenario workshop. The same applies to solar thermal energy.

15:15 **Assumptions on non-fossil gases in the energy mix**

Jörg Mühlenhoff briefly introduced the key assumptions that stem from CAN Europe's upcoming position on the role of different gases. The CAN Europe/EEB scenario building has not yet developed detailed figures on the quantities of different non-fossil gases. Assuming that potentials are limited, the allocation of non-fossil gases to balancing the energy system, for long-term storage and sectors that are most difficult to decarbonise is considered as an overarching priority.

>Presentation ICCT (ICCT_Baldino_Potential_Renewable_Gas_9oct19.pdf)

Chelsea Baldino (ICCT) gives an overview of her research on the financial incentives needed to mobilise the different potentials of non-fossil gases in different sectors. At lower levels of incentives, mainly waste conversion is viable. Only high level incentives allow to tap the potentials of wider technological options.

Against the backdrop of low efficiencies and high costs, she does not see renewable gases playing a large role in a trajectory to 2050. Participants' questions refer to the inclusion of different biomass potentials into the ICCT's assessment. One participant criticises that the deep changes that are needed in the agricultural sector as a part of its ecological transition, and their impact on biomass potentials, do not seem to be reflected sufficiently in the current analysis.

Building our scenario: How to guarantee security of supply and flexibility?
16:00 **Assumptions on demand side response and flexibility options**

In his introduction to the role of flexibility in an energy system that will be dominated by renewable energy, Holger Loew (RGI) identifies four systemic aspects that constitute a new energy market value: Digitisation allows for automated control, fast communication, better forecasts and peer-to-peer business models. At all voltage levels, flexibility makes its important contribution, optimising the energy supply system. Particularly at the lowest voltage level, high level of economic advantage can be achieved. The time value adds another dimension with the relevance of different reaction times of power plants, consumers and storage. Finally, market related aspects will influence flexibility, depending on new products and multiple business cases, e.g. to optimise self-consumption.

>Presentation RGI (RGI_Loew_Demand_Side_Response_Flexibility_Options_9oct19.pdf)

The discussion amongst participants revealed that one main challenge will be to trigger the right instruments at the right time and place. It became evident that the current market design is not yet enabling flexibility options. Decentralised provision of flexibility services might become more effective than wholesale market solutions, could help to reduce the need of non-electric energy careers (gas), provided there is an incentive such as regional prices or dynamic network tariffs. The costs for developing such complex and diverse infrastructure as a "smart city" will have to be put into comparison with established infrastructure solutions.

16:30 **Identifying gaps and priorities**

The **role of different gases** and the allocation of **sustainable biomass potentials** are identified as priorities by many participants. CAN Europe and EEB offer to host informal working groups with those stakeholders who are interested in substantiating the assumptions. Jörg Mühlenhoff and Jonathan Bonadio encourage participants to look together into details of the key parameters.

Besides the role of different gases and biomass, the following priority questions merit further consideration according to feedback given by participants:

- To what extent could 2050 scenarios that have been presented at the scenario workshop be even anticipated to reach their 2050 level ten years earlier for a net zero emissions Europe in 2040?
- Is a progressive or quick total phase-out of nuclear power in Europe more realistic?
- What are the most up to date and realistic cost assumptions on variable renewable energies?
- Can solutions on the distribution grid level be integrated into modelling?

On remaining gaps in the PAC project's scenario building, participants mention the following issues:

- Consistency should be ensured when it comes to implementing those topics that have been discussed in the scenario workshop into the methodology for modelling.
- The heating and cooling sector has not been covered appropriately, in particular with regard to indirect assumptions on high electrification.
- It would be worth to substantiate whether electrification is really the most cost-efficient way for energy transition.

Wrap-up, next steps

Jonathan Bonadio and Jörg Mühlenhoff inform participants about the opportunity to join the consultation on the TYNDP 2020 Draft Scenario Report in November 2019. They announce the next potential scenario workshop in December 2019 in Brussels.