How much energy demand in a net-zero emissions world?
Minutes of the first scenario workshop of the PAC project

Tuesday, July 9th, 2019, 10:00 – 16:00
European Environmental Bureau, Rue des Deux Eglises 12-14, 1000 Brussels

27 participants including speakers attending
>List of participants (EEB_detailed_list_registered_participants_9jul19.xls)

10:00 **Welcome and tour-de-table**

Participants present their work area and their expectations with regards the scenario workshop. A number of participants from NGOs federations mentioned the need to develop an own NGO vision to be shared with the renewables industry. Several participants expressed their wish to contribute to a "Paris compatible" modelling, in line with the European Commission's long-term strategic vision. The workshop was expected to develop an integrated view of the demand side and to deduct policy messages. Regarding the content, several participants highlighted their interest in the role of district heating and the impact of electric vehicles on energy infrastructure.

Introducing the PAC project

Jonathan Bonadio (EEB) welcomed the diversity of NGOs, renewable industry federations and think tanks in the room. He invited all participants to provide input for building a Paris compatible NGO scenario during the PAC project by challenging key parameters. On the question on how feedback will be collected, Jonathan Bonadio responded that the project in the first place will interact with stakeholders through workshops. The project will also launch a website at a later stage and project partners EEB and CAN Europe always would be happy to receive direct feedback.

>Presentation EEB (EEB_Introduction_PAC_project_9jul19.pdf)

10:45 **Primary and final energy demand – Introduction to key assumptions**

Dante Powell (ENTSO-E) firstly explained the modelling architecture used by ENTSO-E and ENTSOG to develop the Ten-Year Network Development Plan (TYNDP). He presented the differences between the top-down storylines ("Global Ambition", focussing on wind, solar, carbon-free gases and global emission trading; "Distributed Energy", focussing on prosumers and decentralised growth of renewables) versus the bottom-up storyline (National Trends):

- Data input for the bottom-up storyline is collected from national transmission system operators and from National Energy and Climate Plans (NECPs).
- Top-down storylines reach out to 2050 while the bottom-up storyline only looks until 2040.
- Top-down storylines modelling includes an ambition tool to apply a carbon budget approach that aims for the 1.5°C objective of the Paris Agreement.

The driving force for future emissions reductions in all modelling would be the carbon price assumed in the different storylines.

The carbon budget included for the first time in the two TYNDP top-down storylines comprises 48.5 Gt CO_{2eq} (2018-2100). The maximum emissions are allocated to European countries on a per capita basis. Dante Powell expanded on the assumptions regarding demand side response potential in the transport sector (electric vehicles), in the heating sector (heat pumps) and in industry. He also compared gas and electricity demands in the TYNDP storylines, visualising sector-related demand and electrification of sectors in different studies published by WindEurope and Eurelectric.

Q&A

In the following Q&A session, inclusion of non-energy sectors such as agriculture and non-CO_2 emissions were discussed. A few participants questioned the relatively low degree of electrification in 2050 in the TYNDP

storylines. The data base for energy demand in the transport sector was clarified. According to Dante Powell, sector coupling doesn't have a big impact on electrification. In the top-down storylines, it would increase electrification by 5 to 8 percentage points.

Regarding calculations, Dante Powell clarified that in top-down storylines, the relative figure regarding future developments creates the absolute figure used in the modelling architecture.

Dante Powell also mentioned that a collaboration with Eurelectric would be organized on future electricity demand.

>Presentation ENTSO-E (ENTSO-E_Powell_Introduction_to_key_assumptions_9jul19.pdf)

Energy demand – Deeper dive into sectors

11:30 **Industry sector**

Rannveig van Iterson (ECF) presented findings of the Industrial Transformation 2050 (IT50) research project that shows pathways towards a truly net-zero emissions heavy industry. The study mainly looked into the sectors of steel, cement and chemicals (plastic and ammonia). Together, these sectors are responsible for 500 Mt of CO_2 emissions (60% of emissions from intensive industries and 14% of EU greenhouse gas emissions). These are also the sectors where emissions are the most difficult to abate.

It is possible to go to net zero, though it will be difficult. It can be reached through combination of electrification, renewable energy, circular economy, CCS and CCU with the electricity price as the biggest driver. Large amounts of clean electricity (additional 450 to 750 TWh per year, i.e. doubling or tripling the current share) will be needed, in particular in the chemicals sector. According to Rannveig van Iterson fully exploiting the benefits of circular economy and only using a limited number of energy-intensive technologies such as synthetic fuels and CCU processes would lower the electricity demand. The cement sector is regarded as the most difficult to electrify (or through indirect electrification) meaning CCS would be needed to abate its process emissions. Ideally, the need for CCS however would be minimised. Biomass will also be needed for this sector, but should be prioritised as as feedstock for plastics. Van Iterson hinted at interdependencies between the electricity price and technologies to choose for achieving a net-zero industry: The more expensive electricity gets, the use of hydrogen and direct electrification of industry processes becomes less attractive and circular economy and/or carbon capture solutions are likely to be more cost efficient.

>Presentation ECF (ECF_Van_Iterson_Industry_Energy_Demand_9jul19.pdf)

Q&A

Several participants suggested to expand the scope to potential renewable heat demand, depending on the different temperature levels required in different industry sectors. Participants from the renewable energy industry highlighted the increasing demand of energy-intensive industries for directly accessing renewable electricity. The role of simplified PPAs therefore should be analysed.

Participants also asked for potential disruption of industry sectors such as cement for which it could be too costly to invest in decentralised small-scale CCS. Reducing and replacing cement demand could be beneficial in view of reducing emissions. Rannveig van Iterson explained that only 5 % wood substitution for cement was assumed in the study. Following conservative assumptions, only proven technologies were included in the IT50 research, but many of the technologies still need to be piloted and scaled to become commercial. This highlights the innovation challenge that is ahead of us if net-zero heavy industry is to be realised. In the discussion, participants stressed the need to define which technologies are needed by when and what this means for launching their market introduction.

12:00 **Buildings (tertiary & residential) sector**

Almut Bonhage (Coalition for Energy Savings) presented the Fraunhofer ISI study on energy savings scenarios 2050. Starting from a baseline that projects total EU28 final energy demand in 2050 is 1,086 Mtoe, the study

calculated a Removing Market Barriers scenario. This takes into account ongoing additional techno-economic savings with existing technologies which reduce the baseline demand by 51% by 2050. Two more scenarios vary with regard to the impact of future societal trends such as digitalization, new social and economic models (e.g. sharing economy, prosumers), industrial transformation and quality of life implications (air quality, noise, heat). In case these new trends unfold in an inefficient way, baseline demand would only decrease by 32% by 2050 while tapping the potentials of these new trends in an efficient way would even reduce demand by 67%.

In the buildings sector, the renovation rate is the most important factor impacting demand. Under the Removing Barriers Scenario, an annual renovation rate of 2.5% makes that all houses would be renovated in 2050. If used wisely, digitalisation can contribute prominently to decreasing energy demand of buildings. Almut Bonhage however warned against as big risks that an inefficient use of these solutions could also increase demand.

>Presentation Coalition for Energy Savings (CfES_Bonhage_Buildings_Sector_9jul19.pdf)

Q&A

One participant asked if decreasing consumption of appliances was duly taken into account. The Fraunhofer ISI study refers to IEA estimation on how connected appliances impact energy demand. The share of these appliances in electricity consumption is set to increase. The increase is also caused by the quantity of data processing.

Discussion touched upon the comparison of Fraunhofer ISI and PRIMES assumptions. The EU Long Term Strategic Vision provides for a new baseline considering PRIMES 2016 and the EU 2030 energy efficiency target, assuming a 1.8% annual renovation rate in the 1.5°C target compatible scenarios.

Three main market barriers hampering an uptake in building renovation have been identified, namely:

- The current structure of ownership
- The presence of co-ownership in many buildings
- The “critical mass” of projects, there are many small-scale projects

12:30 **Transport sector**

Thomas Earl (Transport & Environment, T&E) presented T&E’s report: How to decarbonise European transport by 2050. The presentation highlighted the urgency of tackling emissions in the transport sector which is the biggest and still growing emitter, including international aviation and shipping. T&E’s own transportation roadmap model describes a pathway towards net-zero emissions in the transport sector by 2050 based on a carbon budget of 45 Gt CO_{2eq}. Although cars are the most important energy consumers in the transport sector, all sectors will have to be reduced to zero. T&E assumes a strong modal shift backed by demand reduction policies such as road charging and parking policies. Electric drives are key to reducing the land transport sector energy demand, with additional but limited demand for the rather inefficient energy carriers as hydrogen. Hydrogen and synthetic fuels will play an important role in shipping and aviation respectively. However, such an uptake of electrification in the transport sector would require a substantial amount of clean electricity, comparable with the current electricity demand. For heavy duty vehicles, truck manufacturers say that hydrogen is not considered cost-effective until late 21st century. Crop based biofuels have been discarded due to land-use concerns and sustainable advanced biofuels play a limited role as there is limited supply of organic waste feedstock for biofuels and competing uses. Long haul road freight would also be electrified with batteries, electric highways, or hydrogen; CNG trucks have no climate benefit and are not cost-competitive. In aviation, strong policies are needed to reduce demand while strongly ramping up synthetic fuel demand by 2050. The analysis showed that despite a very rapid transition to zero emissions, the transport sector would only just keep below a 2-degree carbon budget.

>Presentation T&E (T_E_Earl_2050_Decarbonisation_Vision_Transport_9jul19.pdf)

Q&A

In the following debate, participants looked at elements that could influence adequately aviation's energy demand. A number of participants questioned the sharp increase of market shares reaching 100% electric vehicles sales in 2035. Thomas Earl was optimistic with regard to doubts about the availability of lithium and other raw materials (esp. cobalt, as new chemistries use less and less) for battery production. Answering to a question on a potential shift from trucks to rail, Thomas Earl asserted that rail freight could double compared to today's levels by 2050, but was reluctant to suggest this could be increased too much more, hinting at rather difficult access to rail infrastructure in particular below 300 km of distance.

Building a narrative and numbers on energy demand

14:00 **Three sector-wise parallel working groups**

Jörg Mühlenhoff (CAN Europe) introduced the guiding questions of the three working groups. Participants were asked to develop answers and presented key findings afterwards in plenary.

Industry sector

What are the most relevant assumptions that should be considered in your sector by order of importance?

- Without CO_2 pricing natural gas is so cheap that there is no incentive to change existing structures.
- Electrification
- Replacement of CO_2 intensive materials (bone of contention: biomass use and allocation)
- Efficient use of materials
- Energy efficiency
- Future industrial plants will be built in such a way that a maximum of flexible electricity consumption will be possible
- CCS is limited and not possible at every location, it should be used as little as possible
- Low technology readiness level of key technologies and new processes
- New flexible and fast actors will enter the sector, putting pressure on old players to change their structure
- Renewable energies are built in such a way that the fluctuating generation is optimally balanced. In places with a low energy yield, good revenues can be achieved if production can take place at times when the renewable energy supply is generally low.
- The optimization of each sub sector should follow the principle: First Sufficiency, second efficiency, third renewables.
- Assumptions concerning the policy field (internalisation of externalities, circular economy)

What would be the assumptions that appear less plausible to you (red lines)?

- Border control of CO_2 footprints and taxation will not help (impossible to control CO_2 emissions of products)
- Easy CCS (CCS technologies will always remain problematic)
- No Business as usual (Scenarios should not expect everything going on as before)

What could be the most important game changers in your sector?

- Market pull (of technologies)
- Change in size of industry plants (small, specialised, geographically flexible)
- ETS (could force a lot of fast innovation)
- A global synthetic fuel market (the development could be disruptive when the first global player starts to build a big plant)

Buildings (tertiary & residential) sector

What are the most relevant assumptions that should be considered in your sector by order of importance?

- Policy (setting clear renovation rate to incentivise investments)
- Costs (cost of heating and technologies, prefinancing schemes, there are sufficient solutions to overachieve current targets)

- Consumers' needs and digitalisation (digitalisation of the building stock, development of smart solutions, boosting digitalisation by enabling access to sufficient funding, recognising prosumers' role and impact on the transition)
- Interlinkages with other sectors (e.g. transport sector: smart charging infrastructure in the building)

What would be the assumptions that appear less plausible to you (red lines)?
- Infrastructure by itself won't make us reach targets, the market conditions matter.
- Behavioural change alone will not deliver, it's difficult to activate and systems need to be foolproof.
- Using "green gas" in individual heating systems is neither realistic nor desirable from an efficiency perspective.
- Replacing the (fossil fuel) heating system without prior insulation is not desirable.

What could be the most important game changers in your sector?
- Sector integration, sector coupling (energy + transport + digital buildings + electric mobility)
- Prosumers' role
- Energy efficiency first principle applied in policies and funding decisions
- Net-zero investment decisions

Can you give us quantitative assumptions on the buildings sector?
- Final energy consumption of the EU buildings and residential sector can be reduced by 63% by 2050 latest, 2040 is realistic
- Final energy consumption of the EU tertiary sector can be reduced by 47% by 2050 latest, 2040 is realistic
- Implementation of energy efficiency potential in buildings would decrease current fossil gas consumption by 80% (source: Energy Union Choice, 2016).

Transport sector

What are the most relevant assumptions that should be considered in your sector by order of importance?
What would be the assumptions that appear less plausible to you (red lines)?
What could be the most important game changers in your sector?

The first three questions have been answered following the logic presented below. The question on figures has been answered through three sub-questions on specific parameters.

	Enabling Framework	**Behaviour**	**Energy mix**	**Infrastructure/ technology**
Assumptions	Incentives and disincentives such as taxation should be put in place	There should be raising awareness and behavioral change, e.g. for less individual transport and more car sharing All drivers should contribute to grid balancing	A 100% renewable electricity mix should be the final aim (esp. for hydrogen production) EV and EV batteries should eventually be built with low-carbon impact	Charging infrastructure (EV and hydrogen) should be deployed The grid should be ready for DSM More public transport would be needed

Red lines	Carbon fuel transport should be banned from cities after 2030 Car-free zones and labels should be harmonized across Europe	There should be no assumptions that people will actually fly less in the future	The "no biofuel" option didn't seem realistic => it has been eliminated The "no blue hydrogen" option has been considered	Vehicle-to-grid technology should not be considered before a certain point in time (2025) EV charging should be done in priority with RES-E
Game changers	MS should declare state of climate emergency Energy taxation on aviation should be implemented Rail infrastructure costs should be harmonized to improve rail freight	The transition to net zero transport will not be possible without a deep behavioral change, and a switch from individual to shared and public transport	/	Electrified highways Virtual power plants Charging infrastructure Hydrogen airplanes Vehicle to grid Improvement of EV autonomy

Can you give us quantitative assumptions on the transport sector?

- *When should the last car with Internal Combustion Engine be sold?*
  Answers ranged from 2025 to 2030, with an average of 2028.

- *What would be the overall electricity demand of transport by 2050 compared with today's overall electricity consumption?*
  Answers were quite homogenous, with an average of 29%. However, this figure was disregarded due to the inconsistency of the figure presented in the TEN-E study (~100%).

- *When should the transport sector reach net-zero emission?*
  Answers were quite homogenous, ranging from 2040 to 2050 with an average in 2043.

15:45 **Wrap-up, conclusion, next steps**

Jörg Mühlenhoff (CAN Europe) thanked all participants for their constructive feedback in this collaborative research exercise. He invited participants to join the upcoming scenario workshop dedicated to the generation side and future energy mixes which is scheduled for the beginning of October 2019.

The expertise provided by participants will be used as a very valuable guidance for EEB's and CAN Europe's own scenario building. Participants will be updated on the next steps with regard to this Paris compatible scenario that should reflect views and positions of the civil society's stakeholders in the room.

Regarding the official consultation process on the TYNDP 2020 scenarios, CAN Europe and EEB offered to coordinate potential submissions and to inform participants in time about the scope and formalities of the process.

ENDS