



Key Takeaways for Plenary 2 – Climate Neutral Pathways, scenarios and storylines: Useful lessons learned and strategies for the European Green Deal

Session Objectives

To be consistent with the Paris climate target, Europe is discussing to become climate neutral by mid-century. Much more debated than the goal is the means to get there. Carbon dioxide removal from the atmosphere will be necessary to offset unavoidable emissions, but to what extent will this be possible and which are the best options? The objective of this session is to outline different strategies for carbon neutral pathways and analyse their preconditions and impacts.

The main part of this session comprises four presentations showing potential pathways and different possibilities/opportunities towards climate neutrality. In the following discussion, similarities and differences of pathway results were discussed. In this context, most importantly, attempts were made not only to identify robust findings and no regret mitigation options across several analyses, but also to understand the driving factors for differences in modelling results (model-design/type related, input-data related, etc.). These kinds of discussions among modelling teams is very important to be able to come up with robust and consolidated synthesis of modelling results across modelling teams and thus actually support policy makers.

Session Organization

Pao-Yu Oei (TU Berlin) chairs and moderates the session. After introducing the session and the corresponding interactive web-tools to enable pools and comments (like Slido) he presents the results from the questionnaire (sent to all participants upon registration). Afterwards, the four presentations on recent pathway model runs are scheduled. Finally, the moderators leads the discussion with the audience, while also reviewing and incorporating the Slido inputs into the discussion. Special focus is also put in the discussion to elaborate on how to integrate the pathway results in the EU Green Deal initiative.

Summary of Survey and Presentations

Responses to the Survey

- Majority expects large-scale hydrogen application across Europe not before year 2040
- The same is true for carbon capture in the *energy* sector on large-scale across Europe. Some responses expect it beyond 2050 or even never
- Carbon capture in the *industry* sector is seen different: majority expect it in 2050 or afterwards. CO₂ capture cost are more challenging/expensive in the industry sector; less responses say it will never come
- Majority expect carbon dioxide removal technologies to be applied on large-scale across Europe in 2050 or never



- The question: “How many new nuclear reactors will be built by 2050?” is answered as follows: a few say “no one”; majority votes for 5 or 5-10; a minority expects a renaissance on nuclear
- The three most important aspects for climate neutrality are: renewables, change of behaviour, storage improvements (chosen among nine different options for selection)

Presentations

Alessia De Vita (E3M): "Modeling carbon neutral pathways for EU Green deal and climate neutrality"

Main points: Overview of contribution of PRIMES based modeling in European and national studies in recent year. Elaboration on options for decarbonisation - no regret options versus disruptive changes. PRIMES modeling to explore contrasted strategies show that climate-neutrality is feasible. Elaboration on challenges on demand side modeling in the different sectors (incl. circular economy). Challenges in industry sector in terms of process heat&emissions (limits of electrification). Challenges about huge investments. Conclusions: climate neutrality feasible, technology/infrastructure cost estimations uncertain, no regret options are clear, disruptive changes also needed, uncertainty about not mature technologies by 2030, big question on how to incentivize investments by individuals and firms

Karlo Hainsch (TU Berlin): "Quantitative Scenarios for Low Carbon Futures of the pan-European Energy System"

Main points: Presentation of the 3-dimensional openENTRANCE storyline topology with 4 storylines (3x 1.5°C target, 1x 2.0°C target): societal commitment, techno-friendly, directed transition, gradual development. Model setup and specifications of the open source energy system model GeneSys-MOD. Presentation of selected highlights on quantitative results of the 4 openENTRANCE scenarios derived from GeneSys-MOD. Several scenarios show significant reduction of primary energy demand. Discussion of different technology trade-offs in the different scenarios. Comparison of several scenarios until 2050 in terms of energy demand reductions, electricity generation, CO₂ emissions, installed power capacities, hydrogen production. Hydrogen production capacities change at different points in time in the future in the different scenarios. Conclusions: scenario results show need to accelerate climate-neutrality measure implementation. No one of the scenarios is “favorable”, several show different nuances of possible ways to go ahead. Transparency and openness of scientific research are a necessity.

Jessica Strefler (PIK): "The path to climate neutrality – residual sector emissions and CDR"

Main points: Presentation of pathways to carbon neutrality from the Navigate project. Elaboration on remaining residual emissions, negative emission technologies. Distribution of emissions – mitigation versus offsetting. Potential and policies for carbon dioxide removal – ETS (Emission Trading Scheme), competitive bidding, etc. Elaboration on electrification in the industry sector – current share 19%; exploitation of achievable electrification potential industry very high (excluding feedstock). Climate neutrality - how to distribute ETS versus ESR (Effort Sharing Regulations). From -40% target in 2030 -> -55% in 2030: doubling CO₂ prices in current split (for -60% even higher prices). Conclusions: Sufficient carbon price crucial to leverage potential of ETS and avoid overburdening of ESR sectors – additional policies can significantly reduce CO₂ price in ESR.

Jörg Mühlenhoff (CAN Europe): "Civil society's Paris Agreement Compatible (PAC) scenario for net zero emissions by 2040"

Main points: Presentation of Paris Agreement Compatible (PAC) scenarios. Civil society developed scenario (participatory bottom-up approach of more than 150 members and experts). Starting point 1.5°C IPCC and UNEP Emission Gap report. Scrutinise studies and models. Scenarios meet energy demand in several sectors. Then matched with supply. Checking several targets. Iterative approach with Öko-Institute model (hourly basis, no grid model). Main objective: checking

feasibility of net zero emissions by 2040. It is feasible! Results of pathways quite similar to the others presented in this session (e.g. incl. effects like electrification in industry sector also confirmed). Residential sector needs deep-renovation. Agricultural/transport sector – phase out of fossils very fast. Hydrogen an option rather beyond 2040. Electrification doubles until 2050. Finally, elaboration on several flexibility options.

Session Outcomes (incl. Comments from the Audience) and Lessons Learned

- Climate neutrality pathway modelling (PRIMES, GENeSYS-MOD, NAVIGATE) and a Civil Society Scenario show similar trends and confirm feasibility to decarbonize Europe by 2050.
- Key insights: consensus on no-regret options (bio-fuels are sensitive in this context (land-use) notably in terms of transport sector), but also need for disruptions and technology breakthroughs is expected
- Strong electrification of the energy system (dependent on availability (and when) of hydrogen and carbon capture and storage technologies)
- In terms of effectiveness and efficiency of carbon pricing, split between ETS and ESR is crucial
- Better understanding consumer behaviour and behavioural changes is important in residential and tertiary sector (in industry it rather is technologies only; in transport more research on modal split necessary)
- Main topics to improve models and thus better support policy making: more focus on behavioural and life style changes, socio-economic drivers in general, transport/ agricultural sector, circular and sharing economy, link/interface to climate modelling
- Key discussion points: open source models/data, forum to coordinate pathway assumptions, results and methods appreciated

Consolidated final conclusion: Developing a comprehensive understanding of similarities and differences of modelling results of different modelling teams not only is important for serving policy making, but also for identifying existing research gaps and future research needs (see above) which will benefit from the increasingly visible development towards open source modelling and thus bring closer together the different modelling teams.

Video-Link of P2

<https://www.youtube.com/watch?v=A2sLEbOgJXM>



