



Delivering on climate targets

– Mistra Carbon Exit's programme conference 2023

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On 18-19 September 2023, the research programme Mistra Carbon Exit held its fifth programme conference. The purpose of the conference was to share research results from all parts of the programme, including assessments of, technical solutions, governance issues and policy instruments related to the supply chains of buildings, transport infrastructure and transports.

“We want to use this opportunity to present results, and also to discuss what research issues will be important in the next 4-8 years. We have set off plenty of time between sessions to allow for networking and discussion”, said the programme director Lars Zetterberg when introducing the conference.

Among the conference participants were 32 researchers from institutes and academia, 10 representatives from governmental agencies and institutions as well as 14 representatives from industry.

“We have gathered a broad representation from industry and policy makers, and from my perspective this is important if we want to transform the value chains successfully. Industry and politics coming together can make a difference”, said Peter Nygårds, chair of the Mistra Carbon Exit board when he opened the conference.

Presentations were given by PhD students within the programme, senior researchers and programme partners from industry and authorities. The conference consisted of four different sessions. Read more about them on the following pages.



In session - Thomas Sterner and Johannes Morfeldt .

Session 1: Today's policy landscape: Sweden, EU and the ETS

Chair – **Åsa Löfgren**, Göteborg University.

Victoria Wibeck, Linköping University, gave insights from the latest Swedish Climate Policy Council report. She emphasised the need to develop a climate policy action plan for 2030 – and to ensure that the action plan covers all sectors. There are many factors to consider where we can find both synergies and conflicts. For example, the difference between private and societal interests, current and future generations, and local and global actions taken by small or large actors.

“We need to develop a clearer, comprehensive narrative about Sweden’s climate transition”, she said and mentioned handling energy prices as an especially interesting challenge.

Victoria Wibeck gave the audience the following three takeaways:

- Four key areas for the climate transition: A more efficient use of energy and resources; Fossil-free electrification; Biomass from forestry and agriculture; Carbon capture and storage.
- The Climate Policy Council’s assessment report 2023 concluded that Swedish climate policy has lost steam – there is a need for a concrete plan for achieving the 2030 targets and provide conditions for zero emissions in 2045.
- It is important to take advantage of the momentum in the ongoing climate transition, utilise synergies and handle conflicts.

The next topic was EU’s climate policy with presentations by Milan Elkerbout, CEPS (Center for European Policy Studies) and Lars Zetterberg, IVL Swedish Environmental Research Institute.

Milan Elkerbout talked about the development of EU climate policy the last 5 years, starting with the Green Deal and giving details of EU’s recent climate package Fit for 55 (FF55). He also looked forward and highlighted some challenges waiting around the corner.

He shared three takeaways:

- Carbon Border Adjustment Mechanism (CBAM): Implementation sucks. The administrative burden is high.
- Response to US Inflation Reduction Act: Called Green Deal Industrial plan. EU has few available funds and must rely on member states to fund green techs. To allow for this, EU may loosen state aid rules. This may lead to fragmentation of green efforts in the EU.
- The new ETS2 (for transports, heating of buildings and smaller industries) will be stand-alone for now. Good that more emissions are capped. But there is a price ceiling of 45 EUR. When this is blown – more allowances will be issued.

Lars Zetterberg focused on the endgame of the Emissions Trading System (EU ETS) - what happens when the cap goes to zero and how can negative emissions be created?

His three takeaways are:

- Fit for 55 is remarkably ambitious given the impacts of the pandemic and Russia's war in Ukraine. FF55 will speed up the decarbonization of industry in the EU, mainly due to the fast reduction of the cap, phase-out of free allocation and introduction of CBAM
- Sooner or later there will be liquidity issues. The first action will be to merge EU ETS with ETS2.
- Endgame of ETS. What happens when the cap goes to zero in 2039 and no more allowances are distributed? Most likely that EU will allow limited use of credits representing negative emissions from for instance BECCS and DACCS.

Dallas Burtraw, Resources for the Future (RFF), gave updates on important federal actions that has had an impact on climate policy in the US. Among those are the bipartisan infrastructure law, the IRA (Inflation Reduction Act) that is part of the Build Back Better framework, the Clean Air Regulation and the proposed guidelines Justice for 40 which means that 40 per cent of actions taken shall go to areas to the country's disadvantaged areas.

"A significant amount of clean energy projects has been announced since the IRA. This is important progress that gives us a political opportunity to make long-term goals possible, for example, for solar, wind and storage demand and the reduction of emissions", he said.

But there are also things to watch for, such as how siting and permitting are handled on a federal, state and local level and subsidies and regulations for emissions, taxation and farming.

Dallas Burtraw contributed three takeaways:

- Climate policy in the US relies primarily on substantial subsidies under the Inflation Reduction Act and other policies. Regulation also plays an important role. Pricing is relevant in 13 states.
- Subsidies for clean energy are rapidly decarbonizing the electricity sector but it is still not on track to achieve the US commitment for 2030. As in Europe, siting and permitting present obstacles to new investment in clean energy.
- Subsidies for clean energy reduce the carbon price by half, which would be sufficient to achieve the US commitment by 2030.

Presentations from this session:

Victoria Wibeck: Insights from the latest report from the Swedish Climate Policy Council

Milan Elkerbout and Lars Zetterberg: Appraisal for the FF55 climate package but difficult issues around the corner

Dallas Burtraw: Climate policy development in the US

Session 2: Greening the vehicle supply chain – Industrial decarbonization in Northern Sweden

Chair – **Filip Johnsson**, Chalmers University of Technology.

Filip introduced this session talking about the benefits of a supply chain perspective. This perspective gives many advantages, he concluded.

Among them are the cost and value distribution, and the possibility to target scope 1 (direct emissions) as well as scope 2 and 3 (indirect emissions), the changing of targets and attitudes and the possibility of securing the supply of resources.

Filip Johnsson shared four takeaways from the supply chain perspective:

- Cost and value creation of mitigation measures along the supply chain – from large cost increases to small price increases.
- Emission targets in the entire supply chain promote sector cooperation and sector coupling. Flexibility measures in the electricity system are an essential sector coupling.
- A supply chain perspective will prepare for consumption-based emission targets.
- A supply chain perspective will be beneficial for planning for increased supply security.



Filip Johnsson.

Lisa Göransson, Chalmers University of Technology, discussed the opportunities and challenges in the Swedish electricity system. In a recent study, three possible scenarios were analyzed: One cost-optimal, one with at least 9 GW nuclear power and one with at least 22 GW offshore wind power.

“The demand for electricity can be met in all three cases”, she said.

However, this requires a combination of measures to remove barriers and increase flexibility to meet different types of variations. Investments in storage – batteries, hydrogen and heat storage - will be needed in all three cases but in varying degrees depending on location and energy type.

Lisa Göransson’s three takeaways are:

- Three possible Swedish electricity systems in 2045 have been investigated, one with focus on onshore wind power and import, one with 9 GW of nuclear power and one with 22 GW of offshore wind power.
- There is a varying electricity price in all three cases as a consequence of extensive wind power generation in northern Europe.
- The electricity demand can be met every hour in all three cases and there are many options for flexibility in the Swedish electricity system.

Alla Toktarova, Chalmers University of Technology, presented on the topic of industrial flexibility as part of the solution. Today, the production of steel, ammonia, cement, and plastics stands for 70 per cent of the EU’s industrial CO₂ emissions. Electrification and increased flexibility from the industry are likely to play an important role in lowering those emissions.

“Flexibility in time, in CO₂ use and in location are three options to achieve change”, she said.

Her takeaways are:

- Flexibility in the industry is likely to play an important role in energy system transition.
- The availability of low-cost electricity generation is the determining parameter for the geographical location of electrified industries with high operational flexibility and high hydrogen intensity.
- Industrial flexibility options provide the lowest cost for basic materials production but at the cost of the lowest capacity utilization rate, i.e., overcapacity.

Kajsa-Stina Benulic, Linköping University, introduced the conference to an upcoming report that analyzes which policy changes can deliver the needed solutions for the expansion in Northern Sweden. The report is based on interviews with municipalities, public organizations, manufacturers and sourcing companies.

Work is still in progress so the conclusions will follow later.

Thomas Sterner, University of Gothenburg, has studied EU citizens' preferences for climate change. Are they ready to let their country take the lead by cutting emissions more than other countries – and how is that related to if they believe other countries would react, follow a good example or do nothing? Or would other countries increase their emissions as a result?

“Those who think that other countries would certainly follow are more inclined to go ahead, those who think there will be no reaction would not like to be forerunners”, he said.

The results clearly show that the cost is very important. Support for being a forerunner declines as the cost increases.

Thomas Sterner gave the conference two main takeaways:

- Sweden must adjust its carbon exit to EU strategy Fit for 55
- We should focus more on combinations of Supply and demand side policies à la Bard Harstad. Colombia, Nigeria and Ecuador have all recently introduced policies reducing oil production and/or subsidies to the sector.

Presentations from this session:

Filip Johnsson: The benefits of a supply chain perspective

Lisa Göransson: Possible Swedish Electricity Systems 2045

Alla Toktarova: Industrial flexibility is part of the solution

Thomas Sterner: Leading by example? EU citizens' preferences for climate leadership



Coffee break.

Session 3: Buildings and infrastructure (breakout session)

Chair – **Johan Rootzén**, IVL Swedish Environmental Research Institute.

Åsa Hult, IVL Swedish Environmental Research Institute, and **Ida Karlsson**, Chalmers University of Technology have both focused on the climate transition in Skellefteå in Northern Sweden, a municipality that is expanding rapidly and at the same time is investing in climate change.

Åsa Hult has made a case study based on building departments in Skellefteå and a series of interviews about examples such as Site East and Sara Culture Center.

Her main conclusions are:

- Cutting-edge projects at Skellefteå Municipality are part of a broad climate transition in most, but not all, departments.
- Cutting-edge projects have the potential to push for climate change by influencing beliefs and norms.
- Our study shows that learning takes place through recruiting so-called “bridging agents” that create a “sharing culture”, a strategy that has not received sufficient attention in previous research.

Ida Karlsson has studied infrastructure projects in Skellefteå – what are the obstacles to accelerating the climate transition in the construction sector?

She offers three takeaways:

- There is a large difference between the potential and actual implementation of carbon emissions reduction in construction.
- To support the transition, we have developed a climate action menu detailing key mitigation measures within the project domain of influence.
- It is deemed useful as a baseline level and a checklist across project stages. It will now be tested, refined and integrated into tools and handbooks to support broad dissemination.

Aaron Qiyu Liu, Chalmers University of Technology, has studied how missing data can be handled when conducting material flow analyses to estimate embodied carbon from the construction of buildings and transport infrastructures.

Statistical data are often incomplete, but methods to impute or predict missing data are required to conduct a national-level analysis. Aaron Qiyu Liu has shown that supervised machine learning can be applied and that such methods perform relatively well.

Aaron's takeaways are:

- Machine learning and big data methods can be used to improve estimations of embodied carbons in buildings and infrastructures.
- Municipalities and private road owners have a large role to play in reducing embodied carbons in Swedish transport infrastructure.
- More focus should be put on improving the maintenance procedures of roads as new construction contributes to a small share of embodied carbon.

Anna Kadefors has studied how procurement can be used to drive towards climate and sustainability targets. What are the requirements and criteria, regulations and guidelines, bonuses and penalties that are being used and how do they affect purchasers and contractors?

Three takeaways from the presentation:

- Carbon reduction in construction projects is highly facilitated by collaborative project delivery models that enable knowledge integration between project parties.
- Client functions are complex. There is a need for better collaboration between top management, purchasing functions, environmental specialists and project managers.
- In the project-based construction sector, relationships are temporary and decision-making is decentralised. Thus, long-term development is best driven by collaborative efforts at the industry level.

Presentations from this session:

Åsa Hult: From experimentation to transformation

Ida Karlsson: Project-level mitigation measures in infrastructure projects

Aaron Qiyu Liu: Application of machine learning methods for embodied carbon estimation

Anna Kadefors: Challenges in procurement and learning



A panel discussion concluded this breakout session.

Session 4: A resource-efficient electrification of the transport system (breakout session)

Chair – **Daniel Johansson**, Chalmers University of Technology

Johannes Morfeldt, Chalmers University of Technology, presented a scenario analysis on how measures can reduce the demand for raw materials for lithium-ion batteries.

Vehicle technology transport system options and traveling behavior can make it possible to reduce material demands for batteries. Johannes Morfeldt has studied different scenarios based on stated policy and baseline assumptions but also on possible improvements by reduced travel demand, improved charging infrastructure, new battery chemistries and increased energy efficiency.

Takeaways from the presentation:

- Increased energy efficiency in cars, reduced travel demand and improved charging infrastructure that allows for shorter battery range or reduced vehicle demand can together with new battery chemistries and recycling, achieve material demands below the equal per capita share of the global reserve for nickel, cobalt and lithium.
- Individual measures, except new battery chemistries, achieve similar results in isolation - with moderate impact on material demand.
- New battery chemistries may have a high impact on reducing nickel and cobalt demand, but lithium demand could remain high unless the industry moves towards non-lithium batteries.

Rei Palm, Volvo Cars, presented the company's ambition to become a climate-neutral company by 2040. But how to get there? It will demand several solutions in different phases – concept, engineering and industrialisation. Two focus areas for emission reduction are materials production and refining and the use phase.

Three takeaways from the presentation:

- LCA is a good tool to build knowledge of the current state, which is crucial when deciding on the allocation of resources and focusing on reducing the environmental impact.
- Targets and requirements derived from metrics based on a life cycle perspective are necessary to drive improvement. They should be followed up by doing forecasts and estimation calculations as the project progress.
- Reducing emissions in materials production and refining holds the biggest potential for BEVs, but energy efficiency is also very important, also from a range and cost perspective.

Frances Sprei, Chalmers University of Technology, made a presentation focusing on the development of parking and charging infrastructure.

Sweden has almost 5 million passenger cars. They stand still around 95 per cent of the time, so parking spaces are important. But for electric vehicles the charging possibilities are linked to the parking situation. When do the owners charge the car – and why? Because they have a charging plan for their trip. because they routinely charge the car when they have the opportunity, for example when they return home, or when the state of charge of the battery become low, and charge in a way similar to have mane fill their fuel tank?

Three takeaways from the presentation:

There is a close relationship between parking demand and car ownership and usage.
There is no contradiction between reduced parking and electrification - we need both!
Charging behavior is influenced by mental models and will affect demand and planning of charging infrastructure.

Presentations from this session:

Johannes Morfeldt: Measures to reduce the demand for raw materials for lithium-ion batteries: A scenario analysis

Rei Palm: Electrification and resource use - Carbon footprint of Volvo C40

Recharge and decarbonisation initiatives

Frances Sprei: Parking policies and charging infrastructure

Following the two breakout sessions, the conference participants met in the plenary room to get a summary of the sessions by the chairs.

Before the conference was closed, **Sverker Jagers**, Göteborg University, gave the talk - "Getting everyone onboard – social/policy acceptability".



Frances Sprei in the foreground

About Mistra Carbon Exit

Mistra Carbon Exit is a research programme that identifies and analyzes the technical, economic and political opportunities and challenges for Sweden to reach the target of net zero greenhouse gas emissions by 2045. We will identify pathways and policies for how Sweden and Swedish companies can become frontrunners in transforming society and industries, providing low carbon products and services while at the same time dressing market risks. This will make Sweden an important international example for other countries to follow.

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