SEI response: Europe's 2040 climate target

With reference to the European Commission's proposal and the request for input from the Swedish Ministry of Climate and Enterprise under Remissärende: KN2024/00503.

Prepared by Carly Evaeus, Michael Lazarus, Aaron Maltais, Björn Nykvist, Martina Paulin, Tommaso Piseddu, Claudia Strambo, Timothy Suljada, Eileen Torres Morales, and Cleo Verkuijl on behalf of the Stockholm Environment Institute, 30 April 2024

Background to this response:

The Stockholm Environment Institute (SEI) *is an international non-profit research and policy organization that tackles environment and development challenges. Headquartered in Sweden, the institute has centres in Estonia, Thailand, Kenya, UK, US, and Colombia. We connect science and decision-making to develop solutions for a sustainable future for all. Stakeholder involvement is at the heart of our efforts to build capacity, strengthen institutions and equip partners for long-term change. Our knowledge and findings are accessible: as our own open access material, in leading academic journals, and repackaged for effective decision support.*

Key points:

1. Achieving a just transition requires coordinated efforts by both the EU and Member States in all policy sectors.
2. Just transition policy must go beyond financial compensation to include community-level public investment in infrastructure.
3. Market-based incentives in the Energy Performance of Buildings Directive provide a strong energy efficiency push, but the supply-side may not be ready
4. In relation to buildings, emissions cannot be the only scope in focus
5. The EU should set near- and long-term targets for eliminating fossil fuel production and couple these with its Just Transition framework.
6. The EU needs to have a climate-consistent and equitable strategy to source its remaining fossil fuel needs.
7. All target options proposed entail very strong emission reductions in the industrial sector, and in no case can investments and efforts on key technologies wait.

8. The EU should highlight the urgency of scaling up industrial carbon removals, while acknowledging that technical solutions alone are insufficient.
9. A just transition requires involving the public in discussions about the deployment of carbon removal techniques and their impacts.
10. Dietary change is necessary to achieve global and European sustainability ambitions, and investment in alternative proteins can support this aim.
11. Solutions to reduce emissions from animal agriculture should be supportive of broader One Health and animal welfare goals.
12. A just transition in the agricultural sector should consider the voices of marginalized groups and engage emerging sectors.

Response:

The EU communication on Europe's 2040 climate target demonstrates the EU's commitment to decarbonisation and just transition in the years leading up to 2050. The document covers many important issues of priority, but we recognize that certain issues are lacking. In this consultation response, we highlight certain weaknesses and strengths in the EU Communication, and suggest additional aspects that should be considered, based on the research conducted by our research institute, Stockholm Environment Institute (SEI), and our assessment of scientific knowledge in the research fields in which we work.

A just and fair transition for people and decarbonising transport and improving mobility (Prepared by Claudia Strambo, Michael Lazarus, Eileen Torres Morales)

Achieving a just transition requires coordinated efforts by both the EU and Member States in all policy sectors.

The EU Communication (p. 11) highlights the need for close collaboration and comprehensive Member State action and measures to support just transition in carbon-intensive regions. Collaboration is also crucial to address the negative impacts of decarbonization in other sectors, such as transport and housing. In Sweden, SEI research finds that about 40% of the population will likely struggle to cope with decarbonization policy in the transport and food sector, due to limited income, high dependence on cars, lack of access to public transport, and long distances to public services (Dawkins et al. 2023). To effectively target transition policy, planning by the EU and Member States must take into account the different needs and ability to cope with change within different segments of the population (Dawkins et al. 2023). EU mechanisms alone will not suffice to provide the required support to such a large share of the population. For example, the Social Climate Fund (SCF) regulation considers a total of EUR 65.000.000.000 to be distributed across EU Member States under a seven-year period starting in 2026. Sweden is assigned with 0,62% of the fund (around EUR 400,3 million), which if distributed equally across the seven years, corresponds to around SEK 667 million per year. As of February 2024 Sweden's population was 10.549.287 people (Statistics Sweden (SCB) 2024). If 40% of the Swedish population are considered "at risk" and require access to this support, around SEK 158 per person, per year, would be available. This amount might be insufficient to support the vulnerable population (Dawkins et al. 2023).

Just transition policy must go beyond financial compensation to include community-level public investment in infrastructure.

While income is a determinant of households' capacity to cope with decarbonization policy, so is their access to low-carbon services and products. For instance, SEI research highlights demographic and geographic inequalities in the access to electric vehicle chargers in Sweden (Xylia and Joshi 2022). Another example is how long distances to public transportation stops and public services also make it harder for some population groups to cope with decarbonization policy in the transport sector (Dawkins et al. 2023). The low-carbon transition could also have negative health, social and psychological impacts (Claudia Strambo, Dawkins, and Suljada 2022).

The EU's Just Transition approach primarily focuses on financial compensation and structural adjustment (p.10-11). However, a just transition requires the recognition of a wider range of potential negative impacts on citizens' quality of life (Claudia Strambo, Dawkins, and Suljada 2022). Addressing these requires comprehensive adaptive support, which combines adaptive financial support and structural adjustment assistance with other strategies aiming at addressing non-financial impacts of the transition, such as community-level public investment in economic and non-economic infrastructure (Green and Gambhir 2020; Claudia Strambo, Dawkins, and Suljada 2022).

Moreover, financial compensation-only approaches face limitations with regard to supporting a just transition, as illustrated in the compensation measures implemented by various EU countries for households facing increased energy prices following Russia's war on Ukraine. In Sweden, the fuel tax reduction was not targeted to those most vulnerable, resulting in high-income urban households benefitting from reduced fuel expenditure, while the loss in government revenue could negatively impact welfare expenditure (C. Strambo and Xylia 2023). While the EU Communication mentions the need to phase out fossil fuel subsidies that "…do not address energy poverty or just transition" (p. 14), there is a risk that Member States take temporary measures justified on just transition grounds that not only work against decarbonization goals, but also fail to support the most vulnerable. Thus, there is a role for the EU to provide clear guidelines to member states to ensure that allowed subsidies are effectively targeted.

Energy efficiency and buildings (Prepared by Tommaso Piseddu)

Market-based incentives in the Energy Performance of Buildings Directive provide a strong energy efficiency push, but the supply-side may not be ready

The mobilization of private capital investments mentioned in the EU Communication will benefit from the recent final adoption of the Energy Performance of Buildings Directive (EPBD)[1]. The EPBD will provide the substantial market-based incentives to make green buildings and investment in deep energy retrofitting measures more attractive. Green premiums, even substantially larger than the energy savings, have already been observed on real estate markets and higher returns on investments will follow (Akhtyrska and Fuerst 2024; Kempf and Syz 2022).

[1] https://ec.europa.eu/commission/presscorner/detail/en/IP_24_1965

While the public sector may provide the example through green public procurement and be the driver towards a more energy efficient building stock, private capital investments are driven by attractive financial returns. As energy-efficient buildings become the norm on the market, the green premiums may decrease, removing or reducing the market-based incentives. Moreover, the amount of investments required at the EU level will probably result in supply constraints in meeting the goods and service demands. Such a shortage may result in, for instance, an increase in prices. The increased supply of green electricity from the public electricity grid will also have to compete with the increased demand, among others, from the electrification of the transport sector.

In relation to buildings, emissions cannot be the only scope in focus

Lastly, in the face of potential challenges in achieving the "last mile", determined by the potential lack of private investments, financial support from the public sector may be a solution to cope with reduced private capital flow. However, such possibilities may be difficult to justify when the investments are benchmarked against the sole goal of achieving a reduction in emissions. Retrofitting existing building stocks and the construction of green buildings are among the least cost-efficient investments when measured in life-cycle-cost over overall emissions impact (Piseddu and Vanhuyse 2023; Savvidou and Nykvist 2020). Other metrics should be introduced to guarantee that the funneling of public investments into more efficient building stocks can be justified in the eyes of the public. Social considerations such as the provision of housing for low-income households may be a relevant starting point.

Fossil fuel phase out by (Prepared by Claudia Strambo, Michael Lazarus, Eileen Torres Morales, Björn Nykvist)

The EU should set near- and long-term targets for eliminating fossil fuel production and couple these with its Just Transition framework.

The EU's approach to transitioning away from fossil fuels, as presented in the EU Communication, is primarily demand-based. However, research shows that the almost exclusive focus of climate policy on the demand for fossil fuels and on the territorial emissions associated with their use has proven to be insufficient. The EU should adopt near- and long-term reduction targets in fossil fuel production to complement its climate mitigation strategy and reduce the risk of stranded assets. This can lower the costs of decarbonization, increase policy coherence and ensure that renewable energy displaces fossil fuel energy rather than supplementing it (SEI et al. 2023).

As a region with relatively low dependence on fossil fuel production and high capacity to transition, the EU has a responsibility to show leadership and set ambitious targets for phasing out fossil fuels in addition to addressing the demand side (SEI et al. 2020). While Denmark has established a legally binding date (2050) for ending oil and gas production (Tong et al. 2019) (Sanchez et al. 2023), no other European country has done similarly, nor has the EU or individual European country set an oil and gas production phase out target for 2040 or 2030. Doing so would send an important signal to other regions of the world.

In contrast, no EU country has set a schedule for phasing out coal production or linking production phase out with a just transition framework. Germany's Coal Phase-out Act sets a

date for ending coal-fired power generation (2038) but does not explicitly address production. By setting a coal production phase out trajectory – ceasing production no later than 2040 – and coupling it with its Just Transition framework, the EU can demonstrate leadership while minimizing impacts on coal-dependent communities.

The EU needs to have a climate-consistent and equitable strategy to source its remaining fossil fuel needs.
The EU Communication mentions the importance of partnerships with like-minded countries "to ensure its long-term energy security and predictability of supply throughout the energy transition". However, there is no explicit strategy as to where and how the EU will source its remaining fossil fuel needs. The EU's fossil fuel supply strategy has important implications for just transitions globally, and thus warrants further consideration in the text. Moreover, as a region with relatively low dependence on fossil fuel production and high capacity to transition, the EU has a responsibility to support countries with high dependence and low capacity to move away from fossil fuel production in a fair and managed way. This implies strong financial commitments, as well as further technology transfer and capacity building (SEI 2020).

Industry decarbonisation deal (Prepared by Aaron Maltais and Björn Nykvist)

All target options proposed entail very strong emission reductions in the industrial sector, and in no case can investments and efforts on key technologies wait.
The transition of the steel sector is illustrative of the need for the industrial sector to rapidly mobilise investments and efforts to decarbonise in order to meet climate mitigation goals. Research (Tong et al. 2019) shows that to meet net zero emissions by 2050 we need to avoid any further investments in fossil-based industry. When making large-scale investments in industry, fossil-fuel based equipment such as blast furnaces must be phased out in favour of low carbon technology such as hydrogen-based direct reduction (Vogl, Olsson, and Nykvist 2021). This is the strategy deployed by the Swedish steel industry leading this transition in Europe.[2] On page seven (p. 7), the EU Communication considers the "varying importance of novel technologies" across the three 2040 target options, including hydrogen production by electrolysis. This is not in line with research findings and pathways toward net zero by 2050, which rather indicate that a transition needs to start by 2030 at the latest for long-lived assets, and the corresponding scaling of hydrogen manufacturing equipment for hydrogen-based steel making is thus needed during the coming decade, not in 2041-2050, irrespective of the target level in the three proposed options (Olsson and Nykvist 2020; Vogl, Olsson, and Nykvist 2021).

The text on industrial policy sets out ambitious aims for green industrial transitions and for the EU's competitiveness, and it highlights many of the key challenges and objectives the EU must focus on to realise these aims. However, there are no new proposals for an EU policy agenda that would address weaknesses in its current approach to green industrial policy, particularly in the context of efforts by other major economies like China and the United States. Concerns that have been raised include insufficient EU-level funding supporting innovation and especially deployment of new low-carbon technologies and processes in

[2] https://www.industrytransition.org/green-steel-tracker/

energy intensive sectors (e.g. given that the EU ETS may not mobilise sufficient willingness to invest for some key energy intensive industrial sectors (Vogl, Åhman, and Nilsson 2021)), insufficient EU level coordination of industrial policy and financing, risks of weakening the level playing field within the EU as member countries ramp up national industrial policy measures, and risks that competitive strategies focused heavily on geopolitical concerns and control over green energy value chains could slow the pace and efficiency of industrial decarbonisation both in the EU and at the global level (Veugelers, Tagliapietra, and Trasi 2024).

More emphasis should be placed on how the EU can address some of the challenges it faces in responding to other major economies industrial policies in a coordinated way that takes advantage of the EU's strengths and leadership in industry decarbonisation and that promotes globally inclusive green industrial transitions. The EU Communication's text on 'a global level playing field' focuses less on addressing the global challenge of climate change in an inclusive way and more on measures to protect EU competitiveness. The EU also has an opportunity to ensure that its industrial policy and trade measures do not raise barriers to inclusive green industrial transitions for emerging and developing economies.

Carbon removals (Prepared by Martina Paulin and Eileen Torres Morales)

The EU should highlight the urgency of scaling up industrial carbon removals, while acknowledging that technical solutions alone are insufficient.

The EU Communication effectively highlights the need for urgent action in conjunction with increasingly effective climate policies to achieve the climate neutrality target by 2050 (p. 4). It describes option 3 as essential for alignment with the European Climate Law, which will require extensive deployment of low-carbon technologies to establish a definitive transition away from fossil fuels (p. 7). Pages 17-18 rightly emphasize the importance of early deployment of industrial carbon removal techniques (e.g. BioCCS, DACCS, CCUS, CCU), while acknowledging that these should complement, not replace, land-based carbon removal techniques. With regards to industrial carbon removals (p. 17-18), the EU Communication stresses the need for development of complete economic value chains, increased innovation, and both public and private investment. Given the ambition of the 2040 Target, the EU should highlight the urgency of scaling up industrial carbon removals to meet climate targets, as per option 3, while acknowledging that technical solutions alone are insufficient, as per the IPCC's Sixth Assessment Report (AR6). The scaling up of carbon removal techniques should reflect EU Member States local conditions, acknowledging that not all techniques may be viable for every Member State.

To successfully scale up carbon removal techniques, a comprehensive appraisal is needed. This includes assessing potential environmental impacts of carbon removal techniques (e.g. biodiversity and habitat degradation), exploring the trade-offs between different business models (e.g. industrial carbon storage vs. using timber in construction for long-term carbon storage), establishing best practices (e.g. developing certification systems and monitoring, reporting, and verification standards, such as the EU's Carbon Removal Certification framework and QU.A.L.ITY), exploring optimal carbon removals portfolios including industrial and land-based solutions, and developing an integrated approach to land use planning and optimization in Europe that considers the cumulative effects on food production, biodiversity, and carbon removal. The development of optimal carbon removals portfolios and an integrated approach to land use planning should consider factors such as concurrent land use and management techniques (e.g. forestry and agricultural practices), local industrial activities, and land

availability. In addition to a technoeconomic evaluation of carbon removal techniques, early-stage and continued stakeholder engagement is imperative to uphold legitimacy, credibility, and transparency in the scaling up of carbon removal methods (Gerger Swartling et al. 2023).

A just transition requires involving the public in discussions about the deployment of carbon removal techniques and their impacts.
The EU Communication recognizes the need for a just transition to climate neutrality, highlighting concerns among citizens and industry actors about the risks and costs of this transition (p. 4). It also details technical and economic aspects that should be addressed for scaling up industrial carbon removals (p. 17-18). However, it does not address the need to consider public perspectives related to carbon removal techniques, which are critical for their acceptance and long-term scalability. Scaling up carbon removal techniques will require a comprehensive evaluation of factors that could influence their social acceptance at the economic, political, and community levels (e.g. inclusivity in the decision-making process, 'naturalness' of carbon capture techniques), to prevent social conflict (Nielsen, Stavrianakis, and Morrison 2022; Vega Araujo et al. 2024).

Ensuring climate-neutral food production and strengthening the bioeconomy sectors (Prepared by Cleo Verkuijl)

Dietary change is necessary to achieve global and European sustainability ambitions, and investment in alternative proteins can support this aim.
The EU Communication rightly acknowledges the important role of the farming sector in achieving climate goals, including the need to address emissions from animal agriculture, which represent 81-86% of EU agricultural emissions when including emissions related to feed (European Commission et al. 2020). The EU Communication also acknowledges that: "A whole-of-food-sector approach is also the best way to give farmers perspective to solid and fair earnings from their produce" (p.21). We agree that it is important to emphasise a holistic food systems approach to reducing emissions from the food system: this could be strengthened in the EU Communication.

Indeed, reductions in animal protein consumption and production in regions where such consumption is currently high (including the EU) can significantly reduce agricultural emissions, support other environmental goals such as reduced land use, deforestation, and biodiversity loss, and support a range of public health goals including reduced non-communicable diseases (Verkuijl, Dutkiewicz, et al. 2024; European Commission 2020). The EU should therefore emphasise measures to steer dietary choices towards reduced levels of intake that will promote its citizens' health, as well as contributing to the region's ability to achieve multiple sustainability goals.

However, consumers' dietary choices are mentioned last in a list of interventions that can support a whole-of-food sector approach. By contrast, among potential interventions to address emissions from agriculture, the EU Communication mentions in a footnote: "Mitigation technologies such as selective breeding, optimised feed efficiency and improved manure management can reduce methane emissions from livestock" (p. 21). We suggest giving dietary shift stronger emphasis in the EU Communication and including interventions that can help support dietary shift, rather than only specifically identifying technological solutions to reducing methane emissions from farmed animals.

Relatedly, it is surprising that targets and/or investment in **alternative proteins** receive no mention in the draft climate plan, given significant promise for reduced environmental, health, and animal welfare concerns, as highlighted in a recent UN Environment Programme Report, which several SEI researchers contributed to (United Nations Environment Programme 2023). Alternative proteins also create an opportunity for EU innovation and leadership in a new sector. We would therefore encourage explicit consideration of the promise of alternative protein in the EU Communication, including through increased R&D investment.

Solutions to reduce emissions from animal agriculture should be supportive of broader One Health and animal welfare goals.

A One Health approach recognizes the interlinkages between human, animal, and environmental health and underscores the imperative of considering these elements together to achieve better public health outcomes (Mettenleiter et al. 2023). Research by SEI and others shows that commonly proposed and implemented interventions to reduce emissions from farmed animals may sometimes conflict with an One Health approach. For instance, shifting from beef to chicken farming or intensifying farming practices run the risk of increasing risks of anti-microbial resistance or zoonotic disease emergence, or weakening animal health through increased stress (Verkuijl, Smit, et al. 2024; Hayek 2022).

In addition, according to the UN's One Health High Level Expert Panel, a foundational principle of ensuring effective, fair, equitable and sustainable One Health actions is "adopt[ing] solutions that recognize the importance of animal welfare and the integrity of the whole ecosystem" (Mettenleiter et al. 2023). Of course, the EU has also made its own commitments to uphold high animal welfare standards. It is therefore also concerning that a growing body of research highlights that climate change interventions intended to reduce emissions from farmed animals can be harmful for animal welfare (Verkuijl, Smit, et al. 2024; Shields and Orme-Evans 2015). This includes interventions highlighted in the draft climate plan such as selective breeding and feed changes. Given strong public support for animal welfare in the EU, it is important to ensure that climate action does not undermine this goal.

Against this backdrop, we encourage explicit acknowledgement of the need to safeguard One Health goals and animal welfare in the EU Communication. We also suggest the EU Commission commits to stronger collaboration between relevant departments to minimize trade-offs and maximise synergies in these areas, including through use of impact assessments that cover a broader range of considerations than only greenhouse gas emissions reductions.

A just transition in the agricultural sector should consider the voices of marginalized groups and engage emerging sectors.

The Strategic Dialogue on the Future of EU Agriculture is an important step in recognizing the need for just transition planning and support in the agricultural sector, similar to the energy sector.

Our work has highlighted a number of elements that can support such efforts in the animal agriculture space, including: phasing down or repurposing harmful policies, programmes, and fiscal support (a recent study found that over 80% of the EU Common Agricultural Policy

supports emissions-intensive animal products (Kortleve et al. 2024); increasing support for alternatives and ensuring they safeguard social equity, human health and animal welfare; ensuring inclusive and participatory planning processes; providing support to stakeholders to help offset the impacts of a transition; and addressing historical injustices in the sector (Verkuijl et al. 2023).

Cultural traditions around food production and rural livelihoods run deep and extend beyond those immediately employed or involved in the sector, with important differences between rural and urban communities. A Just Transition approach can help identify solutions that meet producer needs as well as those of consumers. Given the diversity of workers in the sector, it also is particularly important that a just transition should ensure the meaningful participation and political empowerment of marginalized groups. These include workers and communities of colour, migrant and female workers, smallholder farmers, and informal and seasonal workers (Verkuijl et al. 2022). A just transition planning process could also proactively involve the alternative proteins sector to help ensure this industry scales up in a way that is social benefits are maximised.

The maritime sector (Prepared by Björn Nykvist)

According to the newly adopted Maritime fuel directive 2009/16/EC, marine shipping only must reduce emissions by 31% 2040. This means that no matter if option (1,2, or 3) is chosen as the 2040 goal, this lags behind. It is thus unclear if choosing a more stringent option implies that other regulations, such as the marine fuel directive, need to be reconsidered, evaluating if more action intervention and revised targets are needed. This illustrates a general problem with the proposed text, that there is limited recognition of how choosing one option over the other has implications on other EU legislation.

References

Akhtyrska, Yana, and Franz Fuerst. 2024. "The Effectiveness of Climate Change Regulations in the Commercial Real Estate Market." *Energy Policy* 185 (February): 113916. https://doi.org/10.1016/j.enpol.2023.113916.

Dawkins, Elena, Claudia Strambo, Maria Xylia, Rok Grah, Jindan Gong, Katarina Axelsson, and Aaron Maltais. 2023. "Who Is Most at Risk of Losing out from Low-Carbon Transition in the Food and Transport Sectors in Sweden? Equity Considerations from a Consumption Perspective." *Energy Research & Social Science* 95: 102881. https://doi.org/10.1016/j.erss.2022.102881.

European Commission, Jean-Louis Peyraud, and Michael MacLeod. 2020. "Study on Future of EU Livestock: How to Contribute to a Sustainable Agricultural Sector? Final Report." European Commission. https://data.europa.eu/doi/10.2762/810306.

Gerger Swartling, Åsa, Karin André, Mathilda Englund, Katy Harris, Carlo Aall, Western Norway Research Institute, Linda Petutschnig, et al. 2023. "Towards Improved Adaptation Action in Europe: Policy Recommendations from the UNCHAIN Project." Stockholm Environment Institute. https://doi.org/10.51414/sei2023.035.

Green, Fergus, and Ajay Gambhir. 2020. "Transitional Assistance Policies for Just, Equitable and Smooth Low-Carbon Transitions: Who, What and How?" *Climate Policy* 0 (0): 1–20. https://doi.org/10.1080/14693062.2019.1657379.

Hayek, Matthew N. 2022. "The Infectious Disease Trap of Animal Agriculture." *Science Advances* 8 (44): eadd6681. https://doi.org/10.1126/sciadv.add6681.

Kempf, Constantin, and Juerg Syz. 2022. "Why Pay for Sustainable Housing? Decomposing the Green Premium of the Residential Property Market in the Canton of Zurich, Switzerland." *SN Business & Economics* 2 (11): 170. https://doi.org/10.1007/s43546-022-00346-8.

Kortleve, Anniek J., José M. Mogollón, Helen Harwatt, and Paul Behrens. 2024. "Over 80% of the European Union's Common Agricultural Policy Supports Emissions-Intensive Animal Products." *Nature Food* 5 (4): 288–92. https://doi.org/10.1038/s43016-024-00949-4.

Mettenleiter, Thomas C., Wanda Markotter, Dominique F. Charron, Wiku B. Adisasmito, Salama Almuhairi, Casey Barton Behravesh, Pépé Bilivogui, et al. 2023. "The One Health High-Level Expert Panel (OHHLEP)." *One Health Outlook* 5 (1): 18. https://doi.org/10.1186/s42522-023-00085-2.

Nielsen, Jacob A. E., Kostas Stavrianakis, and Zoe Morrison. 2022. "Community Acceptance and Social Impacts of Carbon Capture, Utilization and Storage Projects: A Systematic Meta-Narrative Literature Review." *PLOS ONE* 17 (8): e0272409. https://doi.org/10.1371/journal.pone.0272409.

Olsson, Olle, and Björn Nykvist. 2020. "Bigger Is Sometimes Better: Demonstrating Hydrogen Steelmaking at Scale," July. https://www.sei.org/publications/bigger-is-sometimes-better-demonstrating-hydrogen-steelmaking-at-scale/.

Piseddu, Tommaso, and Fedra Vanhuyse. 2023. "Cost Efficiency of Municipal Green Bonds' Measures: A Marginal Abatement Cost Curves Approach." *Studies in Economics and Finance* ahead-of-print (ahead-of-print). https://doi.org/10.1108/SEF-06-2023-0294.

Sanchez, Felipe, Nykvist Björn, Olsson Olle, and Linus Linde. 2023. "Lessons from Oil and Gas Transitions in the North Sea." Stockholm Environment Institute. https://doi.org/10.51414/sei2023.041.

Savvidou, Georgia, and Björn Nykvist. 2020. "Heat Demand in the Swedish Residential Building Stock - Pathways on Demand Reduction Potential Based on Socio-Technical Analysis." *Energy Policy* 144 (September): 111679. https://doi.org/10.1016/j.enpol.2020.111679.

SEI, Climate Analytics, E3G, IISD, and UNEP. 2023. "The Production Gap: Phasing down or Phasing up? Top Fossil Fuel Producers Plan Even More Extraction despite Climate Promises." Stockholm Environment Institute, Climate Analytics, E3G, International

Institute for Sustainable Development and United Nations Environment Programme. https://productiongap.org/wp-content/uploads/2023/11/PGR2023_web.pdf.
SEI, IISD. 2020. "The Production Gap Report: 2020 Special Report." https://productiongap.org/wp-content/uploads/2020/12/PGR2020_FullRprt_web.pdf.
SEI, IISD, ODI, E3G, and UNEP. 2020. "The Production Gap Report: 2020 Special Report," December. http://productiongap.org/2020report.
Shields, Sara, and Geoffrey Orme-Evans. 2015. "The Impacts of Climate Change Mitigation Strategies on Animal Welfare." *Animals : An Open Access Journal from MDPI* 5 (2): 361–94. https://doi.org/10.3390/ani5020361.
Statistics Sweden (SCB). 2024. "Population Statistics." Statistikmyndigheten SCB. February 2024. https://www.scb.se/be0101-en.
Strambo, C., and M. Xylia. 2023. "Lessons from Sweden's Energy Crisis: Shaping Equitable Low-Carbon Policies." SEI. March 8, 2023. https://www.sei.org/perspectives/sweden-energy-policies/.
Strambo, Claudia, Elena Dawkins, and Timothy Suljada. 2022. "The Impact of the EU Emissions Trading System on Households: How Can the Social Climate Fund Support a Just Transition?" Stockholm Environment Institute. https://doi.org/10.51414/sei2022.024.
Tong, Dan, Qiang Zhang, Yixuan Zheng, Ken Caldeira, Christine Shearer, Chaopeng Hong, Yue Qin, and Steven J. Davis. 2019. "Committed Emissions from Existing Energy Infrastructure Jeopardize 1.5 °C Climate Target." *Nature* 572 (7769): 373–77. https://doi.org/10.1038/s41586-019-1364-3.
Vega Araujo, Jose, Miquel Munoz Cabre, Yismary Ramirez, and Reinaldo Lerma. 2024. "Enabling Factors of Social Acceptance of Wind Energy Projects in La Guajira," January.
Verkuijl, Cleo, Jan Dutkiewicz, Laura Scherer, Paul Behrens, Michael Lazarus, Maria José Hötzel, Rebecca Nordquist, and Matthew Hayek. 2024. "FAO's 1.5 °C Roadmap for Food Systems Falls Short." *Nature Food* 5 (4): 264–66. https://doi.org/10.1038/s43016-024-00950-x.
Verkuijl, Cleo, Jessie Smit, Jonathan M. H. Green, Rebecca E. Nordquist, Jeff Sebo, Matthew Hayek, and Maria José Hötzel. 2024. "Climate Change, Public Health, and Animal Welfare: Towards a One Health Approach to Reducing Animal Agriculture's Climate Footprint." *Frontiers in Animal Science* 5 (March). https://doi.org/10.3389/fanim.2024.1281450.
Verkuijl, Cleo, Claudia Strambo, Robin Hocquet, Ruth Butterfield, Ploy Achakulwisut, Michael Boyland, José Antonio Vega Araújo, et al. 2022. "A Just Transition in the Meat Sector: Why, Who, and How?" Stockholm Environment Institute. https://www.sei.org/publications/just-transition-meat-sector/.
Verkuijl, Cleo, Claudia Strambo, Robin Hocquet, Ruth Butterfield, Ploy Achakulwisut, Michael Boyland, José Antonio Vega Araújo, et al. 2023. "A Just Transition in Animal Agriculture Is Necessary for More Effective and Equitable One Health Outcomes." *CABI One Health*. https://doi.org/10.1079/cabionehealth.2023.0021.
Veugelers, Reinhilde, Simone Tagliapietra, and Cecilia Trasi. 2024. "Green Industrial Policy in Europe: Past, Present, and Prospects." *Journal of Industry, Competition and Trade* 24 (1): 1–22. https://doi.org/10.1007/s10842-024-00418-5.
Vogl, Valentin, Max Åhman, and Lars J. Nilsson. 2021. "The Making of Green Steel in the EU: A Policy Evaluation for the Early Commercialization Phase." *Climate Policy*, January. https://www.tandfonline.com/doi/abs/10.1080/14693062.2020.1803040.
Vogl, Valentin, Olle Olsson, and Björn Nykvist. 2021. "Phasing out the Blast Furnace to Meet Global Climate Targets." *Joule* 5 (10): 2646–62. https://doi.org/10.1016/j.joule.2021.09.007.
Xylia, Maria, and Somya Joshi. 2022. "A Three-Dimensional View of Charging Infrastructure Equity." Policy paper. Stockholm: Stockholm Environment Institute. https://doi.org/10.51414/sei2022.020.

Annex A. Background and disclosure of interests

This response includes contributions from the following employees of the Stockholm Environment Institute (SEI):

Carly Evaeus, Fellow, SEI Headquarters

Michael Lazarus, Senior Scientist, SEI US

Aaron Maltais, Senior Research Fellow, SEI Headquarters

Björn Nykvist, Team Lead, Energy and Industry Transitions, SEI Headquarters

Martina Paulin, Research Fellow, SEI Headquarters

Tommaso Piseddu, Research Associate, SEI Headquarters

Claudia Strambo, Research Fellow, SEI Headquarters

Timothy Suljada, Head of Resources, Rights and Development Division, SEI Headquarters

Eileen Torres Morales, Research Associate, SEI Headquarters

Cleo Verkuijl, Scientist, SEI US

As part of our work, over the past several years, SEI has actively engaged with European-based organizations and activities seeking to promote a green industrial transition. This includes SEI's role as:

- Secretariat of the Leadership Group for Industry Transition (LeadIT)
- Member of the Think Sustainable Europe, a pan-European network of sustainability think tanks
- Lead author in the Production Gap Report series