Risk assessment of the low-carbon transition of Austria's steel and electricity sectors [1]

Gabriel Bachner[a*], Brigitte Wolkinger[a], Jakob Mayer[a], Andres Türk[a], Karl W. Steininger[a,b]

[a]Wegener Center for Climate and Global Change, University of Graz, Austria;
[b]Department of Economics, University of Graz, Austria;
*Corresponding author: +43(0)316 380 8454, gabriel.bachner@uni-graz.at

HIGHLIGHTS

- *Barriers for transition are at least as important as possible negative consequences.*
- *What stakeholders refer to as "barriers" in fact can be traced back to perceived consequential risks.*
- *Macroeconomic costs of a low carbon transition of the steel and electricity sector are moderate.*
- *Using quantitative and qualitative methods in a complementary way allows to pinpoint robust conclusions.*
- *Stakeholders might overestimate risks, when neglecting (compensating) macroeconomic feedback effects.*

OVERARCHING RESEARCH QUESTION

"What are feasible transition pathways towards the deep decarbonization of the iron and steel as well as electricity sector in Austria?"

RESEARCH STRATEGY

- ***Implementation risks*** **analyzed by using qualitative methods**
- ***Consequential risks*** **analyzed by using quantitative methods**

QUANTITATIVE METHODS

We use the WEGDYN model [2], a **global multi-regional multi-sectoral computable general equilibrium (CGE) model**, which is able to assess the economy-wide and indirect effects of economic (e.g. sectoral) system interventions such as policies or technological changes. CGE models are thus well suited to identify and quantify unintended implications, or consequential risks, of such interventions.

The modelled **scenarios** involve
(i) an **early** (2020) or **late** (2035) start of a linear phase-out of process-emission-intensive iron and steel production (i.e. blast furnaces) switching to process-emission-free production distinguishing two techno-economic specifications (**"high-costs"** and **"low-costs"**; based on [2]), and
(ii) almost complete and simultaneous decarbonization of Austria's electricity supply by 2050 (**renewables share of 98% compared to 80%** in the baseline; based on [3]).

METHODS INTEGRATION

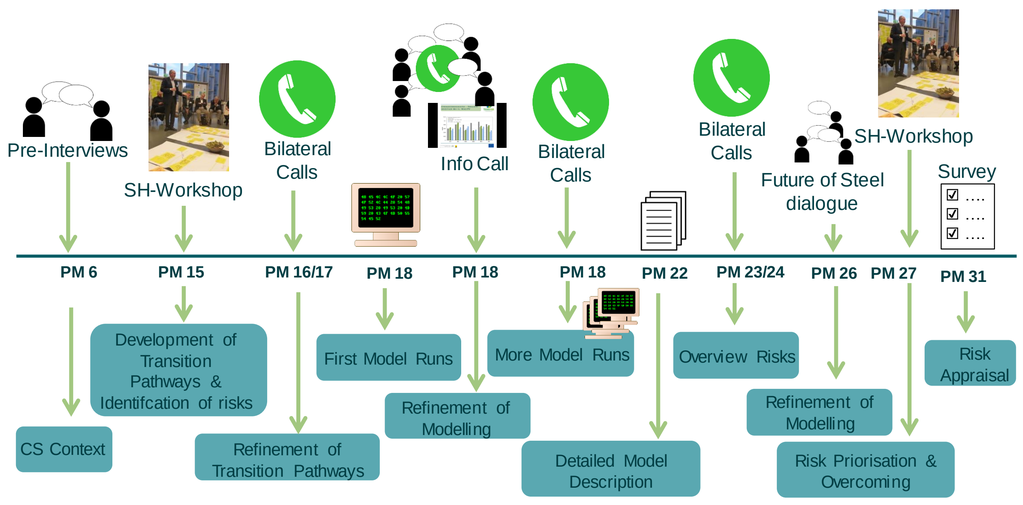

Figure: Overview of stakeholder and modelling integration. (PM=project month).

QUALITATIVE METHODS

Aim	Method	Scope*	Stakeholders involved
Learning about the contextual factors	Semi-structured pre-interviews	8	Generalists
Getting a common picture of the current state	Card surveying and group summary (WS 1)	32(8)	WS1 participants (6 generalists, 7 energy sector, 6 industry, 5 science/politics/admin)
Visioning a desired future	Group work (WS 1)	32(8)	WS1 participants (old system and frontrunners)
Designing transition pathways and milestones to reach the desired future	Group work (WS 1)	32(8)	WS1 participants (old system and frontrunners)
Leaning about opportunities and risks along the transition pathways	Circulating groups and silent feedback (WS1)	32(8)	WS1 participants (old system and frontrunners)
Providing workshop results and getting feedback	Info-call and E-Mail communication	15 (6)	WS1 participants (old system and frontrunners)
Fine tuning of transition pathways	Bilateral calls	5	Focus sector stakeholders
Exchange of ideas	Dialogue 'Future of Steel' initiated by NGO	5(3)	NGOs, Steel companies, research team
Gathering risks and uncertainties within the pathways	Pre-workshop interviews	10	WS1 participants (old system and frontrunners)
Discussing modelling results and pathway assumptions	Presentation (WS 2)	36(12)	WS2 participants (mostly from WS 1)
Risk prioritization by cluster	World Café (WS 2) (switching members)	36(12)	WS2 participants (mostly from WS 1)
Developing measures to minimize or overcome risks	World Café (WS 2)	36(12)	WS2 participants + new participants from policy and administration
Risk valuation (by different criteria)	Survey	11	WS2 participants + new participants from policy and administration

Table: Overview of qualitative methods in stakeholder dialogue. (*in brackets: number of scientists from project team).

RESULTS

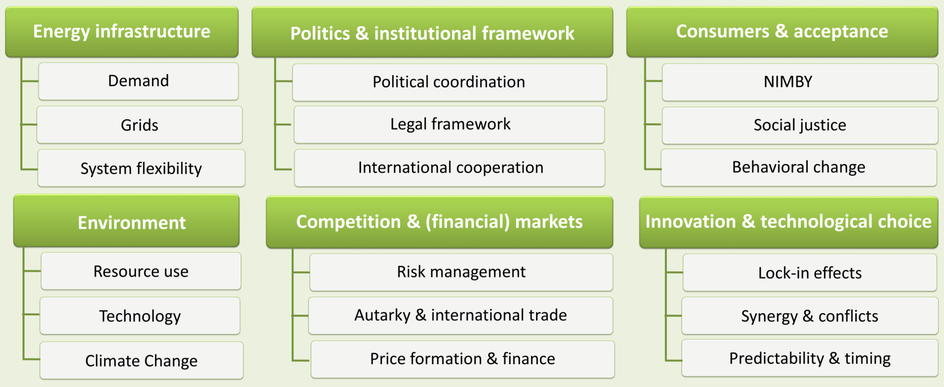

Figure: Clusters of explored risks during stakeholder interaction.

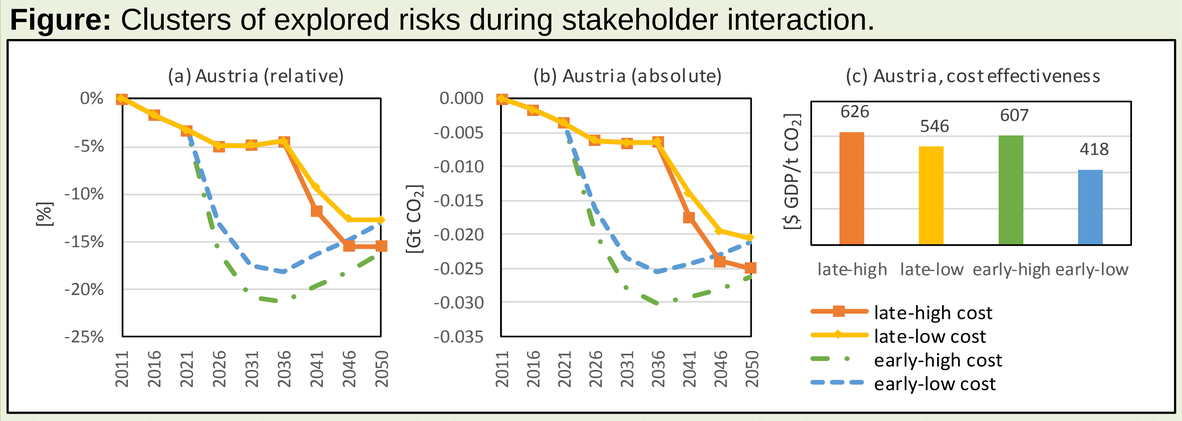

Figure: Changes in CO2 emissions (a-b) and cost effectiveness (c) by an EU-wide transition to climate neutral electricity and iron and steel production (all changes relative to Baseline).

CONCLUSION

Implementation risks

- Lack of reliable, transparent and well specified national long-term policy framework.
- Substantial fraction of what stakeholders refer to as implementation risks (e.g. fear of job losses/competitive disadvantages) can be traced back to perceived consequential risks.

Consequential risks

- Levels of gross domestic product and welfare (i.e. consumption possibilities) are consistently lower in all investigated deep decarbonization scenarios.
- Losses range in between -0.02% and -0.07%-points for growth rates of GDP and welfare, thus expected costs are moderate.
- Quantitative results do not account for non-market co-benefits such as health effects from less local air pollution or avoided climate change impacts.
- Early action dominates macroeconomic cost effectiveness of emission reduction (GDP loss per ton of CO_2 saved).
- Increase in electricity demand (due to electrification of iron and steel production) is about halve of what stakeholders anticipate (~15TWh instead of +33TWh).

Methodological insight & recommendations

- Co-production is very useful for increasing scientific and social relevance.
- There is strong demand by stakeholders for neutral fora to discuss transition issues.
- Extending the group of stakeholders to other sectors is suggested.
- Broader analysis of implementation risks through integration of further disciplines (e.g. political science) and complementary approaches (e.g. agent-based models).

REFERENCES

[1] Bachner, G., Wolkinger, B., Mayer, J., Tuerk, A., Karl W. Steininger. 2018. Risk assessment of the low-carbon transition of Austria's steel and electricity sectors. *Environmental Innovation and Societal Transitions*. In Press. https://doi.org/10.1016/j.eist.2018.12.005.

[2] Mayer, J., Bachner, G., Steininger, K.W. 2019. Macroeconomic implications of switching to process-emission-free iron and steel production in Europe. *Journal of Cleaner Production*. 210:1517-1533. https://doi.org/10.1016/j.jclepro.2018.11.118.

[3] Bachner, G., Mayer, J., Steininger, K.W., 2018. *The carbon bubble and investment risk – getting capital costs "right" in Europe's electricity sector transition* (TRANSrisk Deliverable to the European Commission No. D6.4). University of Graz, Graz.