



HAL
open science

Employment Implication of Coal Phase-Out: Revealing Transition Risks through Downscaling

Thomas Le Gallic, Augustin Danneaux, Julien Lefèvre

► To cite this version:

Thomas Le Gallic, Augustin Danneaux, Julien Lefèvre. Employment Implication of Coal Phase-Out: Revealing Transition Risks through Downscaling. Sixteenth IAMC (Integrated Assessment Modeling Consortium) Annual Meeting 2023, Nov 2023, Venice, Italy. hal-04477762

HAL Id: hal-04477762

<https://hal.science/hal-04477762>

Submitted on 26 Feb 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Employment Implication of Coal Phase-Out: Revealing Transition Risks through Downscaling

Thomas Le Gallic^{1,2*}, Augustin Danneaux^{1,3}, Julien Lefèvre¹

¹ CIREN (International Research Center On the Environment and Development), AgroParisTech, CIRAD, CNRS, EHESS, Ecole des Ponts ParisTech, Université Paris-Saclay, Campus du Jardin Tropical, 45 bis, avenue de la Belle Gabrielle, 94736 Nogent-sur-Marne, France

² SMASH (Society of Applied Mathematics and Humanities), 75012 Paris, France

³ LISIS (Laboratory for Interdisciplinary studies of Science Innovation and Society), INRAE (Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement), 93160 Noisy-le-Grand, France

* Presenting author

Abstract

This study addresses the need to refine the assessment of employment impacts associated with coal phase-out in transition scenarios. We use a multi-sectoral macroeconomic Integrated Assessment Model enhanced by incorporating detailed data to improve productivity expectations in the coal sector. We also developed a sub-national economies dynamics module enabling the results to be scaled down, which provides qualitatively new information. The analysis quantifies job losses and their timing, highlighting regional disparities and vulnerability. The findings underscore the importance of integrating support policies for affected employees into carbon neutrality programs in order to enhance the feasibility and acceptance of transition pathways.

Introduction and background

A rapid and massive phase-out of fossil fuels will be required to meet the Paris Agreement's ambitious targets (IPCC, 2022). By 2050, most scenarios forecast a steady decline in the use of coal at a rate rarely seen in the past, and in some cases unprecedented (Vinichenko et al., 2021). Doubts arise regarding the feasibility of achieving such high rates due to political and social resistance fuelled by fears of significant impacts on employment (Ruppert Bulmer et al., 2021). Previous experiences in coal-mining regions have demonstrated such concerns (Isoaho and Markard, 2020; Kurz et al., 2010). This issue is therefore one of the well identified transition risks that merits closer economic analyses.

Some assessments of climate change mitigation scenarios by large-scale IAMs have sought to capture these impacts on employment, often highlighting the overall net benefits of a transition to a low-carbon energy system on employment at the regional or global level (Barker et al., 2016; Fragkos and Paroussos, 2018; Jacobson et al., 2019; Pai et al., 2021; Pollitt et al., 2015). However, it is not clear that the jobs created will be located in the same areas as those destroyed. In addition, the spatial resolution of the models dilutes effects that can be brutal at the scale of production basins. So when it comes to transition risk due to sectoral decline in the transition to carbon neutrality, space and location matter.

Only a small number of studies have looked at these transition risks and the vulnerability of producing regions in the context of long-term mitigation scenarios. The main exceptions are McDowall et al. (2023) who provide a mapping of regional vulnerability in Europe's energy transition focusing on high carbon sector, and Alves Dias et al. (2018) focusing on coal in Europe.

In this study, we develop an innovative method to explore transition risks at sub-national level associated with coal decline in global decarbonisation pathways. Our study improves upon existing assessments in two ways. Firstly, we

extend the geographical coverage to include major coal-producing regions, such as China and India, where coal transition challenges are especially prominent. Secondly, we develop a data-intensive approach to more accurately estimate the evolution of labour productivity in the coal sector, a crucial factor for such assessment.

Methods

In this study, we investigate climate change mitigation scenarios using an Integrated Assessment Model (IAM) and augment the overall analysis by incorporating a data science approach.

We use the hybrid Imaclim-R model (see description in Méjean et al., 2019; Waisman et al., 2012). This model's multi-sector structure and general equilibrium framework make it possible (1) to align technological choices in coal-using sectors, particularly the electricity sector, with the choices governing the evolution of coal supply (e.g. investments); (2) to take into account of the labour productivity trajectories adjustments in the coal sector in the macroeconomic dynamics (Figure 1).

Two main scenarios are investigated: a baseline and 2°C scenarios. We also explored alternative mitigation scenarios to assess the significance of the pathway concerning employment issues, and to measure any path dependency similar to that observed for infrastructure, but the results are not presented in this abstract.

A data science-based approach is being used for enhancing the coal nexus within the Imaclim-R framework. This is based on the exploitation of databases at facility level (Global Energy Monitor, 2023; Jasansky et al., 2022). An additional downscaling module has also been produced, which enables the economic results to be scaled down and thus provide qualitatively new information.

In order to draw lessons for decision-making from the results, we have supplemented our analysis with a review of current and past support policies for employees in the coal sector.

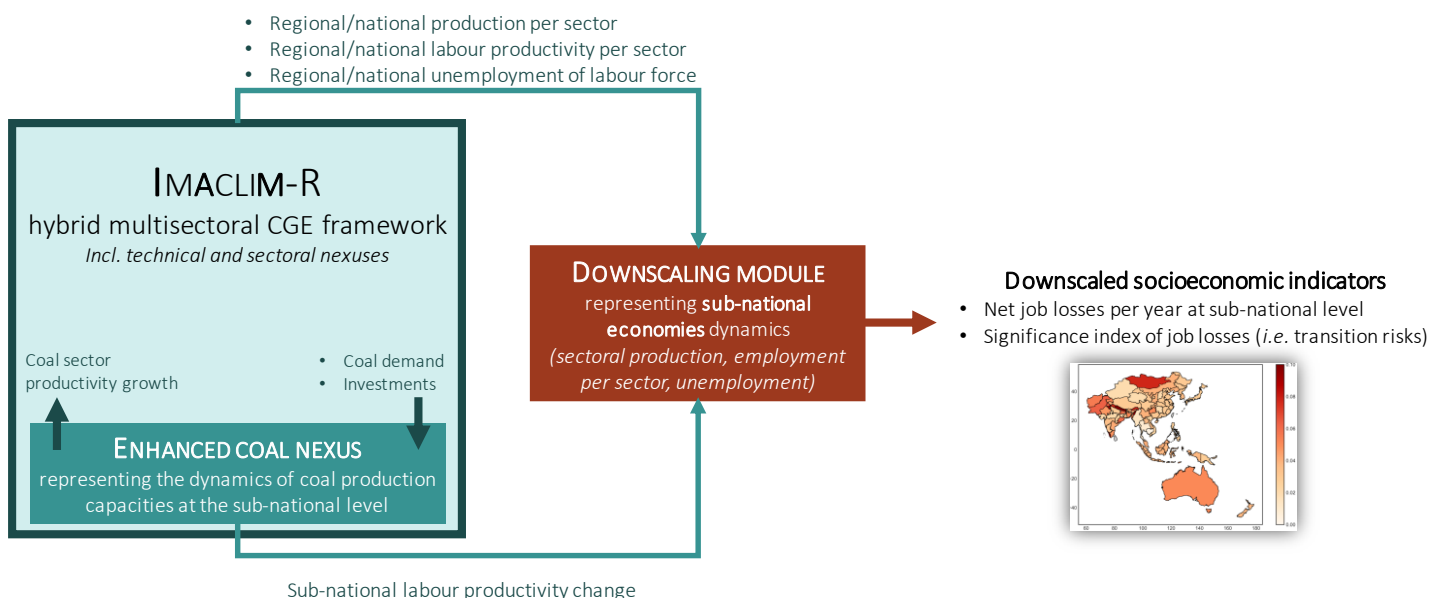


Figure 1. Overview of the innovative approach

Results

The analysis quantifies job losses and their timing in order to understand the impact on regional economies (see an extract of results in Figure 2 and 3). Figure 2 provides a better view of the stringency of job losses in certain regions, as in the Shanxi region in China. It also highlights that production regions are unequally vulnerable to job destruction, because the characteristics of production are different. Employment intensity levels differ greatly according to the nature of the mines (surface or underground), or the levels of intensity of mechanisation (differences in cumulative investment in equipment).

The analysis also highlights the fact that the additional job losses in the coal sector caused by the transition to carbon neutrality are less than the losses linked to the increase in productivity. Interestingly, even in transition scenarios, job losses are not occurring at unprecedented rates, unlike the decline in physical output highlighted by (Vinichenko et al., 2021). Indeed, past gains in labour productivity at certain periods in coal-producing regions have led to very high rates of job destruction, for example in the United States or China in recent decades.

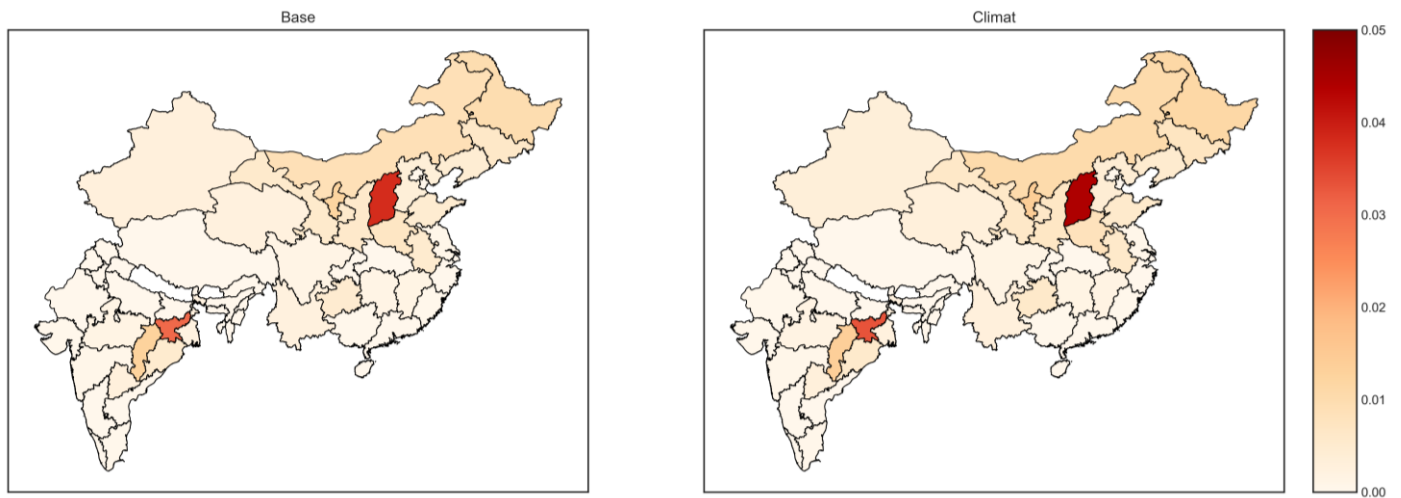


Figure 2 : Job destruction between 2020 and 2050 as a share of 2015 labor force in India and China (baseline on the left, 2°C on the right side).

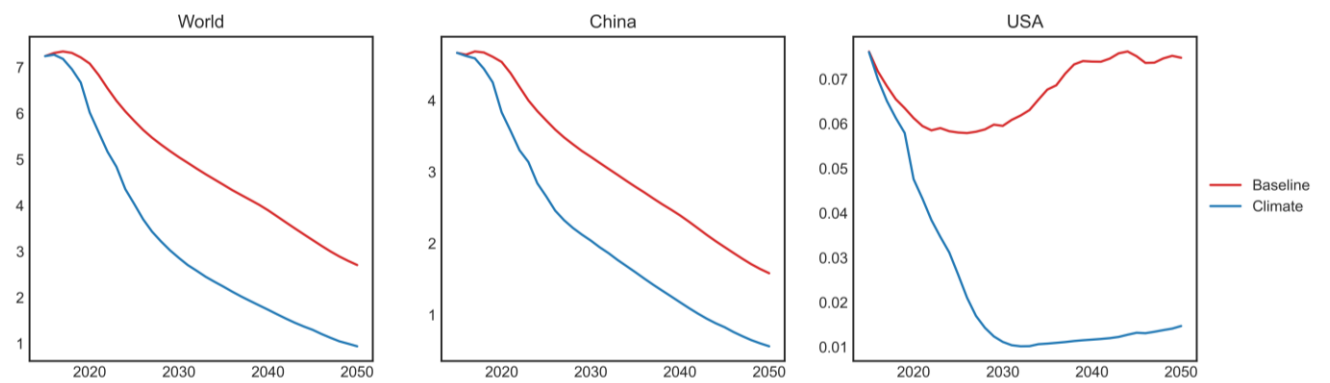


Figure 3. Evolution of job in the coal sector at the Global level, in China and in the USA between 2020 and 2050 (in million full-time equivalent).

Discussion and perspectives

The perspective of significant job destruction in the coal sector in some regions shows the importance of fully integrating support policies for employees into the programmes implemented to achieve carbon neutrality. Experience has shown the extent to which these policies need to be anticipated, as they can only produce effects in the medium term.

For that reason, we need to supplement our mitigation pathway assessment work with more detailed analyses of the impact on employment. Our study paves the way by allowing to better measure the impact and risks, and thus to plan and size up the policies needed to support people leaving the labour market. To take this a step further, we intend to make a version of the ex post module available so that it can be used with scenarios produced by other IAMs.

References

- Alves Dias, P., Miranda Barbosa, E., Peteves, E., Vázquez Hernández, C., Gonzalez Aparicio, I., Kanellopoulos, K., Kapetaki, Z., Nijs, W., Shortall, R., Mandras, G., Czako, V., Trombetti, M., Telsnig, T., Medarac, H., Lacal Arántegui, R., Tzimas, E., 2018. EU coal regions: opportunities and challenges ahead. Publications Office of the European Union, LU.
- Barker, T., Alexandri, E., Mercure, J.-F., Ogawa, Y., Pollitt, H., 2016. GDP and employment effects of policies to close the 2020 emissions gap. *Climate Policy* 16, 393–414. <https://doi.org/10.1080/14693062.2014.1003774>
- Fragkos, P., Paroussos, L., 2018. Employment creation in EU related to renewables expansion. *Applied Energy* 230, 935–945. <https://doi.org/10.1016/j.apenergy.2018.09.032>
- Global Energy Monitor, 2023. Global Coal Mine Tracker, April 2023 release.
- IPCC, 2022. Summary for Policymakers, in: Shukla, P.R., Skea, J., Slade, R., Al Khourdajie, A., van Diemen, R., McCollum, D., Pathak, M., Some, S., Vyas, P., Fradera, R., Belkacemi, M., Hasija, A., Lisboa, G., Luz, S., Malley, J. (Eds.), *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY, USA.
- Isoaho, K., Markard, J., 2020. The Politics of Technology Decline: Discursive Struggles over Coal Phase-Out in the UK. *Review of Policy Research* 37, 342–368. <https://doi.org/10.1111/ropr.12370>
- Jacobson, M.Z., Delucchi, M.A., Cameron, M.A., Coughlin, S.J., Hay, C.A., Manogaran, I.P., Shu, Y., von Krauland, A.-K., 2019. Impacts of Green New Deal Energy Plans on Grid Stability, Costs, Jobs, Health, and Climate in 143 Countries. *One Earth* 1, 449–463. <https://doi.org/10.1016/j.oneear.2019.12.003>
- Jasansky, S., Lieber, M., Giljum, S., Maus, V., 2022. Open database on global coal and metal mine production. <https://doi.org/10.5281/zenodo.7369478>
- Kurz, T., Augoustinos, M., Crabb, S., 2010. Contesting the ‘national interest’ and maintaining ‘our lifestyle’: A discursive analysis of political rhetoric around climate change. *British Journal of Social Psychology* 49, 601–625. <https://doi.org/10.1348/014466609X481173>
- McDowall, W., Reinauer, T., Fragkos, P., Miedzinski, M., Cronin, J., 2023. Mapping regional vulnerability in Europe’s energy transition: development and application of an indicator to assess declining employment in four carbon-intensive industries. *Climatic Change* 176, 7. <https://doi.org/10.1007/s10584-022-03478-w>
- Méjean, A., Guivarch, C., Lefèvre, J., Hamdi-Cherif, M., 2019. The transition in energy demand sectors to limit global warming to 1.5 °C. *Energy Efficiency* 12, 441–462. <https://doi.org/10.1007/s12053-018-9682-0>
- Pai, S., Emmerling, J., Drouet, L., Zerriffi, H., Jewell, J., 2021. Meeting well-below 2°C target would increase energy sector jobs globally. *One Earth* 4, 1026–1036. <https://doi.org/10.1016/j.oneear.2021.06.005>
- Pollitt, H., Alexandri, E., Chewpreecha, U., Klaassen, G., 2015. Macroeconomic analysis of the employment impacts of future EU climate policies. *Climate Policy* 15, 604–625. <https://doi.org/10.1080/14693062.2014.953907>
- Ruppert Bulmer, E., Pela, K., Eberhard-Ruiz, A., Montoya, J., 2021. Global Perspective on Coal Jobs and Managing Labor Transition out of Coal: Key Issues and Policy Responses. World Bank. <https://doi.org/10.1596/37118>
- Vinichenko, V., Cherp, A., Jewell, J., 2021. Historical precedents and feasibility of rapid coal and gas decline required for the 1.5°C target. *One Earth* 4, 1477–1490. <https://doi.org/10.1016/j.oneear.2021.09.012>
- Waisman, H., Guivarch, C., Grazi, F., Hourcade, J.C., 2012. The Imaclim-R model: infrastructures, technical inertia and the costs of low carbon futures under imperfect foresight. *Climatic Change* 114, 101–120. <https://doi.org/10.1007/s10584-011-0387-z>