

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

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Coal under Paris compliant pathways

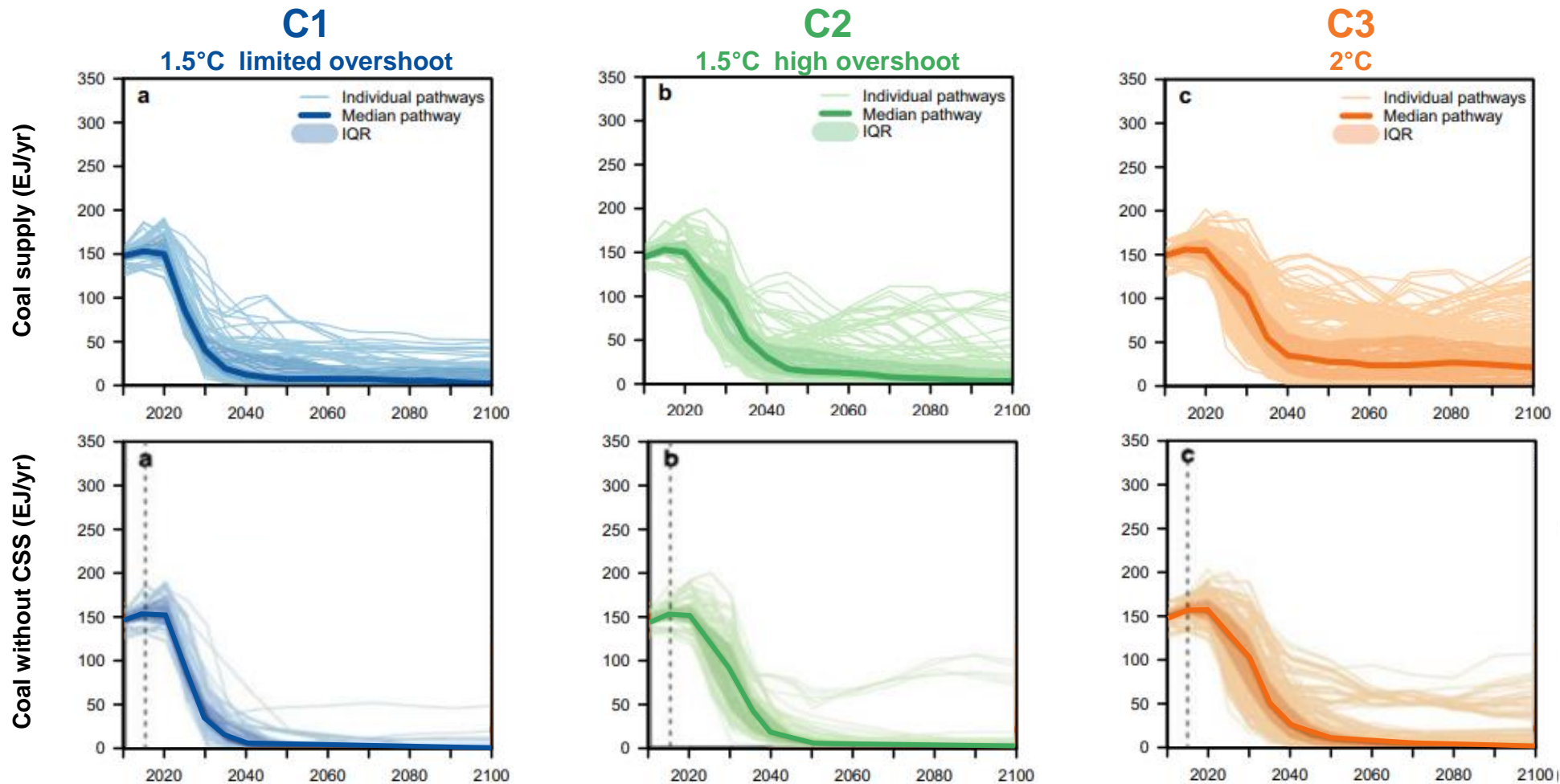


Figure 1: Coal pathways consistent with different climate mitigation objectives (from Achakulwisut et al, 2023)

Key takeaways

Coal labour will decrease
even in high emissions
scenarios

Jharkhand and Shanxi are
highly vulnerable to the
transition

Many coal workers may not
find new employment

Need to design effective
Just Transition policies

Lessons from historical transitions

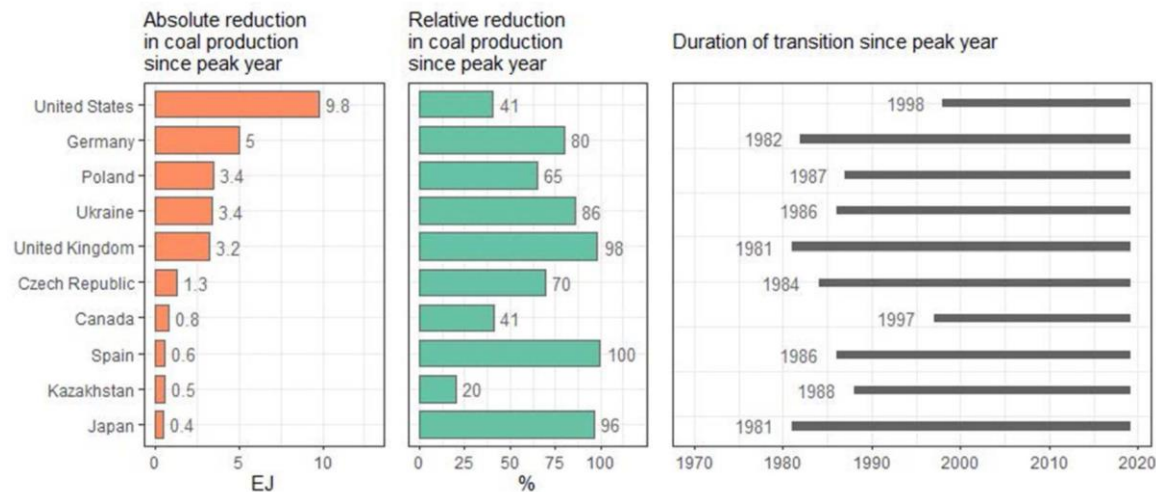
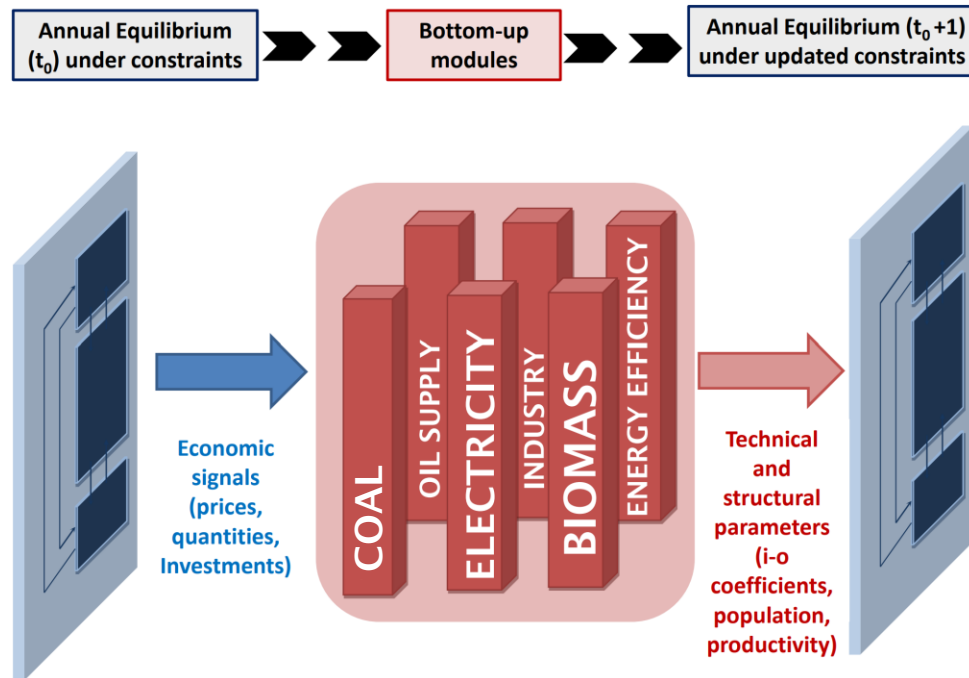


Figure 2: Coal transition indicators in the ten countries that have seen the largest absolute decline in coal production. (from Diluiso et al, 2021)

- Multiple example of coal production and consumption phase-outs
- Inconsistent with the speed required for 1.5°C (Vinichenko et al, 2021)
- Local economic reliance hinders transition (Diluiso et al, 2021)
- Localised regional impacts (Caldecott et al, 2017)
- Generate unemployment (Caldecott et al, 2017)
- Affect workers' and regions' identity (Oei et al, 2020)

The IMACLIM-R model



Model strength

Hybrid architecture

Coal sector representation

Unemployment representation

Necessary improvements

Coal investments driver

Spatial disaggregation

Labour employability representation

Figure 3: IMACLIM-R modular architecture (from Bibas et al, 2015)

The coal labour nexus

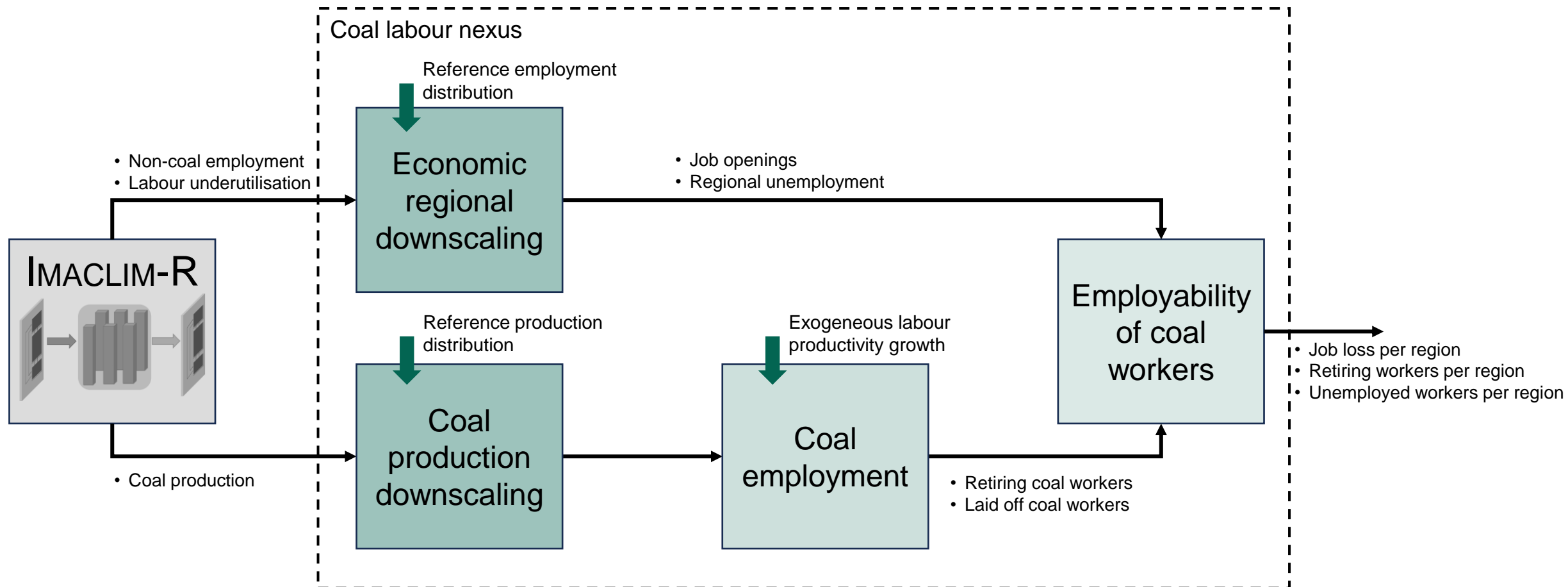


Figure 4: Modelling approach of the coal labour nexus

Global transition scenarios

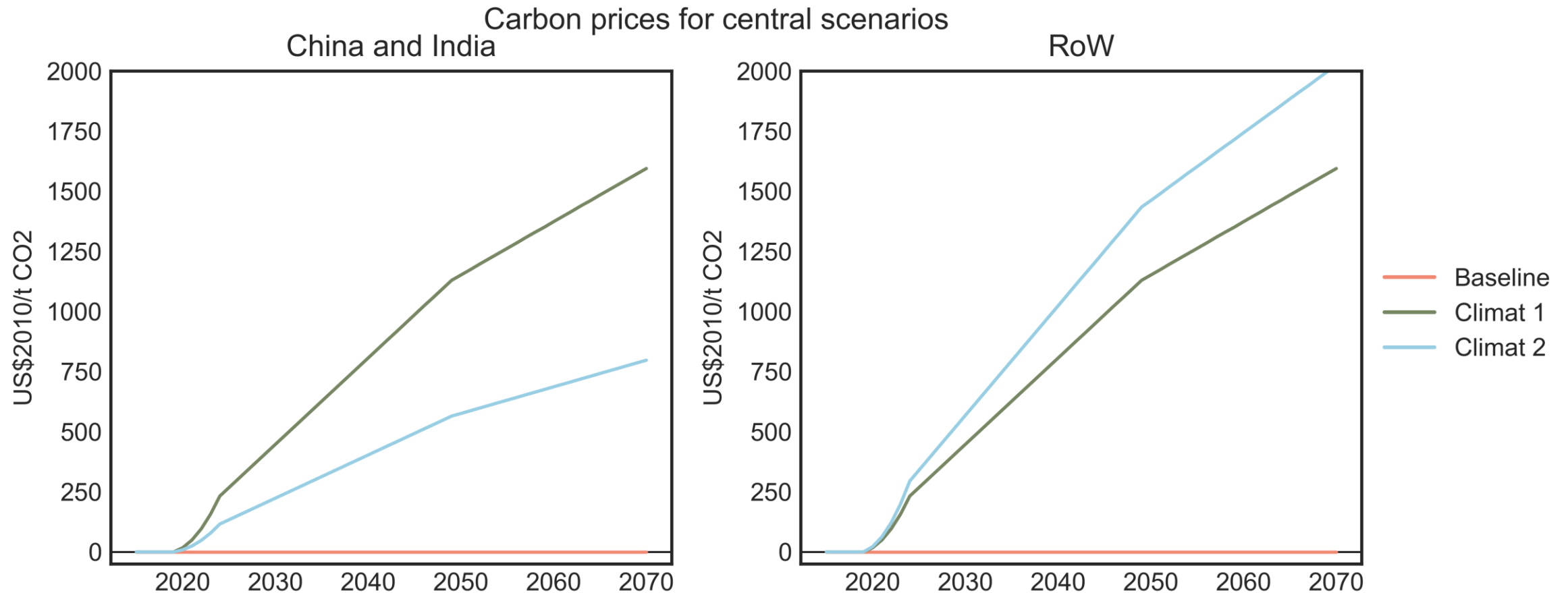


Figure 5: Carbon price in the central scenarios. All scenarios are based on SSP2 and are differentiated on the basis of carbon prices

Coal pathways

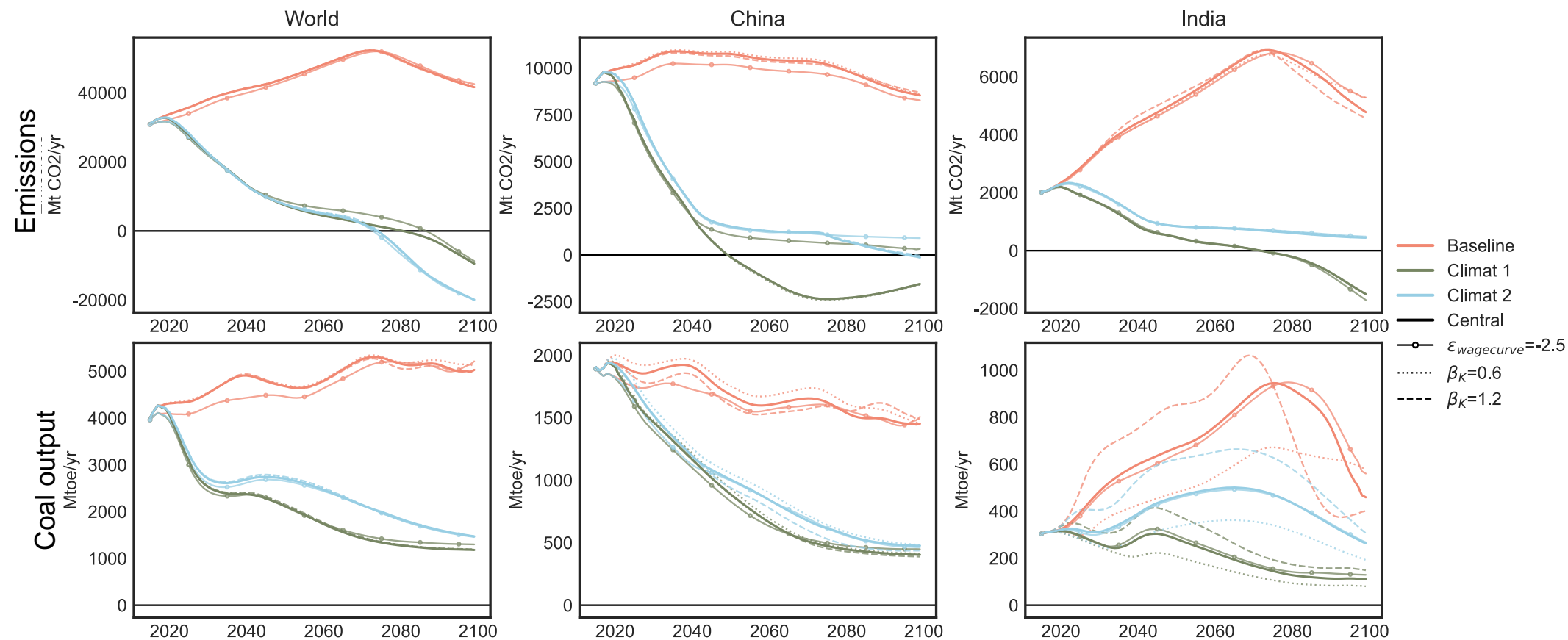


Figure 6: Main indicators for analysed scenarios.

Coal employment pathway

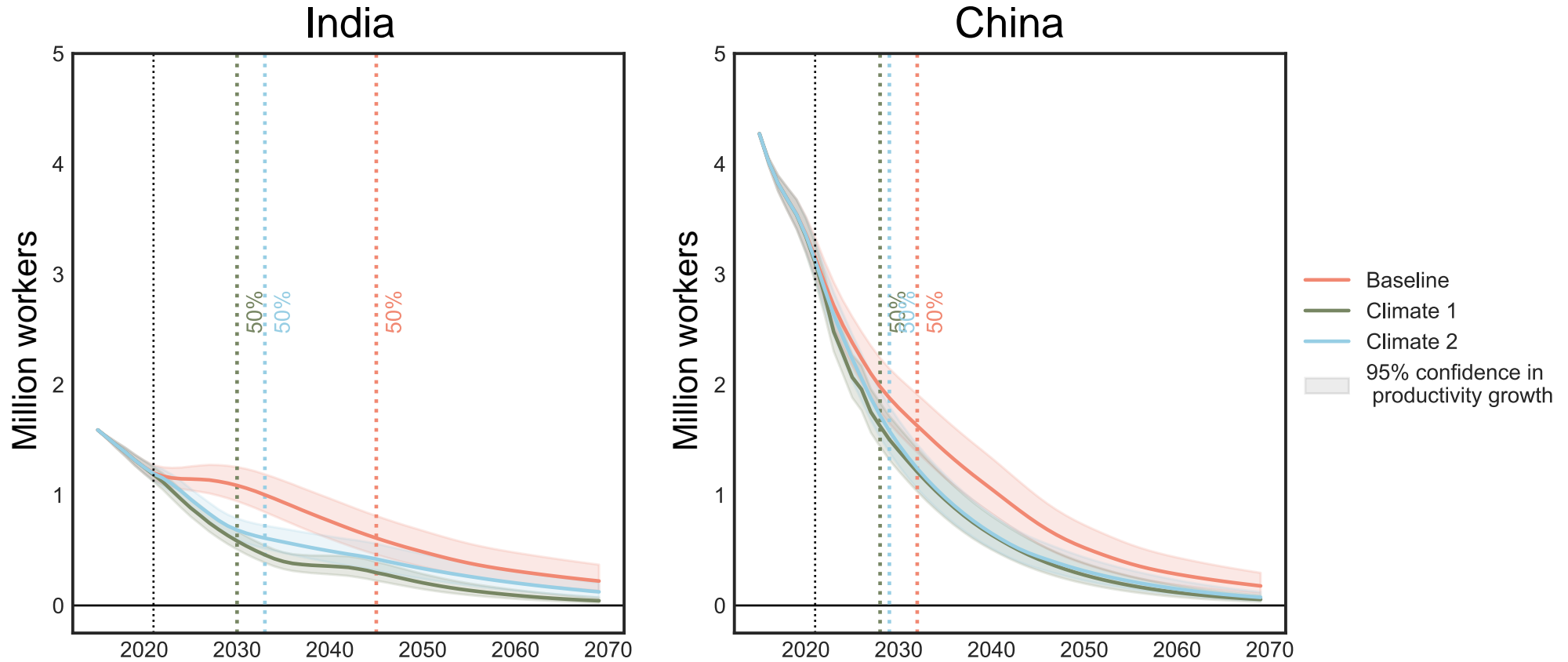


Figure 7: Coal employment for the analysed scenarios. Central estimates assume a constant 5.8% annual increase of the labour productivity of the coal sector. This corresponds to the calculated trend between 2004 and 2021 in China.

Regional exposure and vulnerability

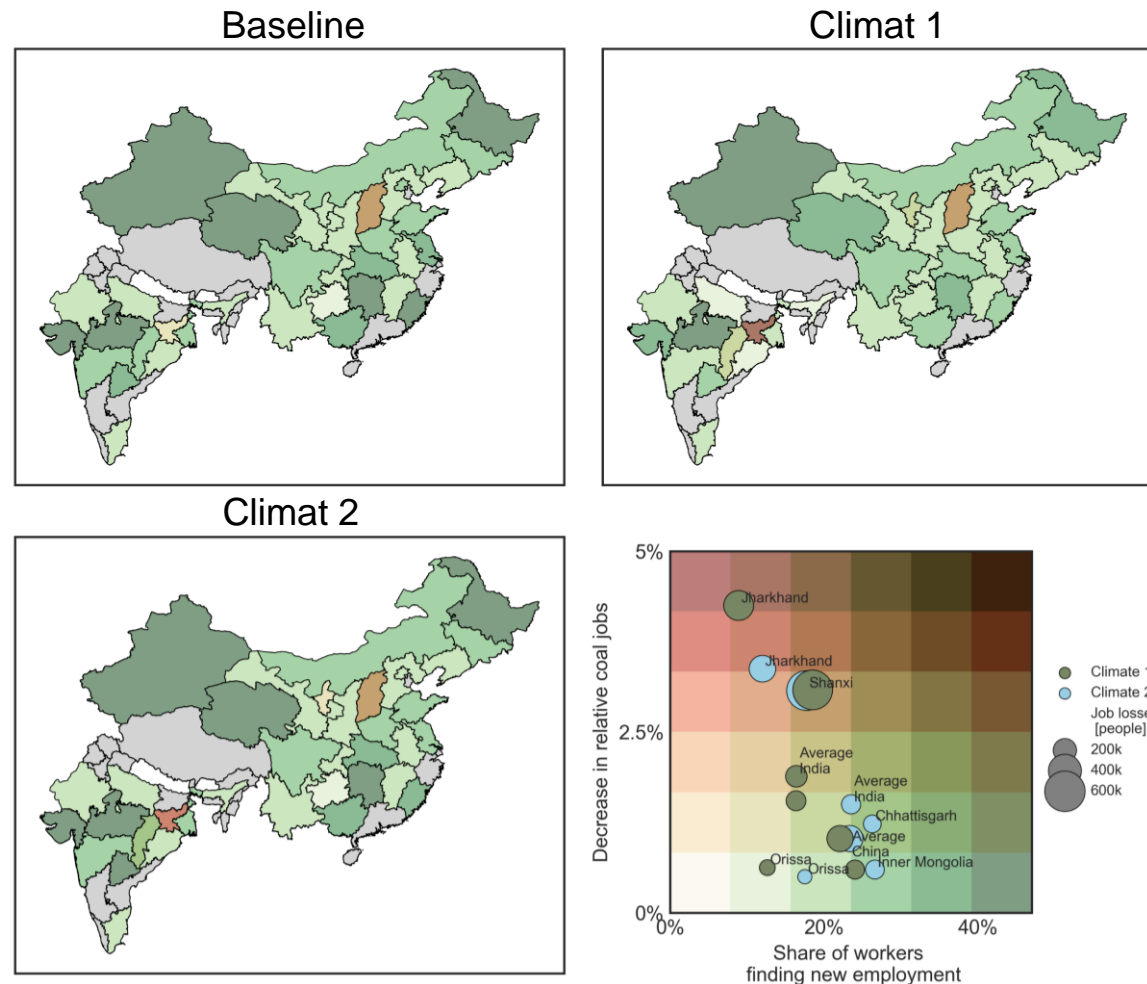


Figure 9: Exposure and vulnerability of regions to coal transition between 2020 and 2035. Exposure, in red on the y-axis refers to the amount of job destruction relative to the regional labour force. Vulnerability in green on the x-axis refers to the share of laid-off coal workers who do not find a new job.

Mobility of laid-off coal workers

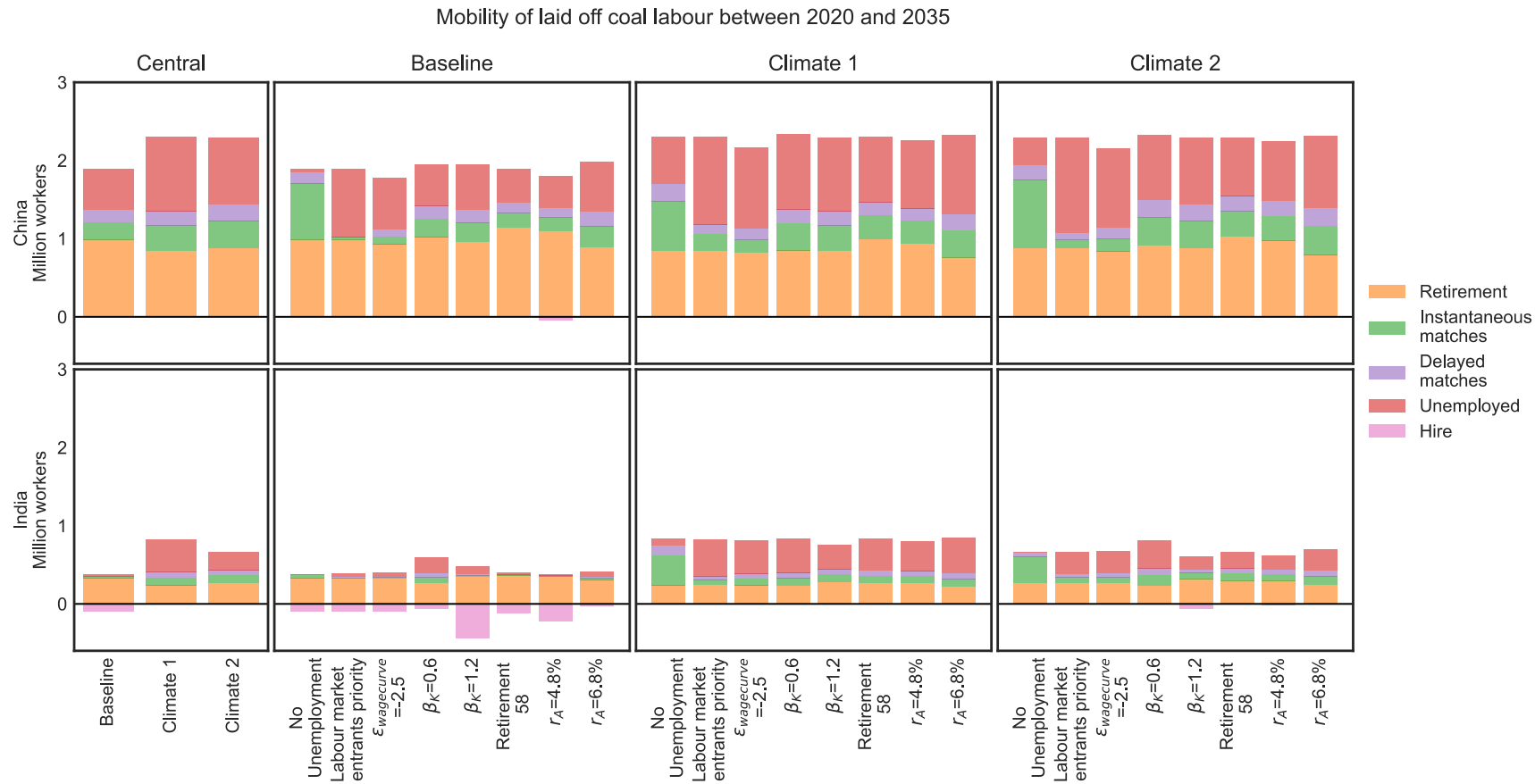


Figure 10: Mobility of laid-off workers between 2020 and 2035. Central scenarios refer to those depending on default parameters. Other scenarios are sensitivity analysis. Indirect matches refer to those happening within a year of the worker losing their job.

References

- Achakulwisut, P., Erickson, P., Guivarch, C., Schaeffer, R., Brutschin, E., Pye, S., 2023. Global fossil fuel reduction pathways under different climate mitigation strategies and ambitions. *Nat Commun* 14, 5425. <https://doi.org/10.1038/s41467-023-41105-z>
- Bibas, R., Cassen, C., Crassous, R., Guivarch, C., Hamdi-Cherif, M., Hourcade, J.-C., Leblanc, F., Mejean, A., O Broin, E., Rozenberg, J., Sassi, O., Vogt-Schilb, A. and Waisman, H. (2015), '*Impact Assessment of CLIMate policies with IMACLIM-R 1.1. Model documentation version 1.1.*'.
- Caldecott, B., Sartor, O., Spencer, T., 2017. *Lessons from previous coal transitions*, 'Coal Transitions: Research and Dialogue on the Future of Coal' Project. IDDI and Climate Strategies.
- Diluiso, F., Walk, P., Manych, N., Cerutti, N., Chipiga, V., Workman, A., Ayas, C., Cui, R.Y., Cui, D., Song, K., Banisch, L.A., Moretti, N., Callaghan, M.W., Clarke, L., Creutzig, F., Hilaire, J., Jotzo, F., Kalkuhl, M., Lamb, W.F., Löschel, A., Müller-Hansen, F., Nemet, G.F., Oei, P.-Y., Sovacool, B.K., Steckel, J.C., Thomas, S., Wiseman, J., Minx, J.C., 2021. Coal transitions—part 1: a systematic map and review of case study learnings from regional, national, and local coal phase-out experiences. *Environ. Res. Lett.* 16, 113003. <https://doi.org/10.1088/1748-9326/ac1b58>
- Oei, P.-Y., Brauers, H., Herpich, P., 2020. Lessons from Germany's hard coal mining phase-out: policies and transition from 1950 to 2018. *Climate Policy* 20, 963–979. <https://doi.org/10.1080/14693062.2019.1688636>

Additional indicators

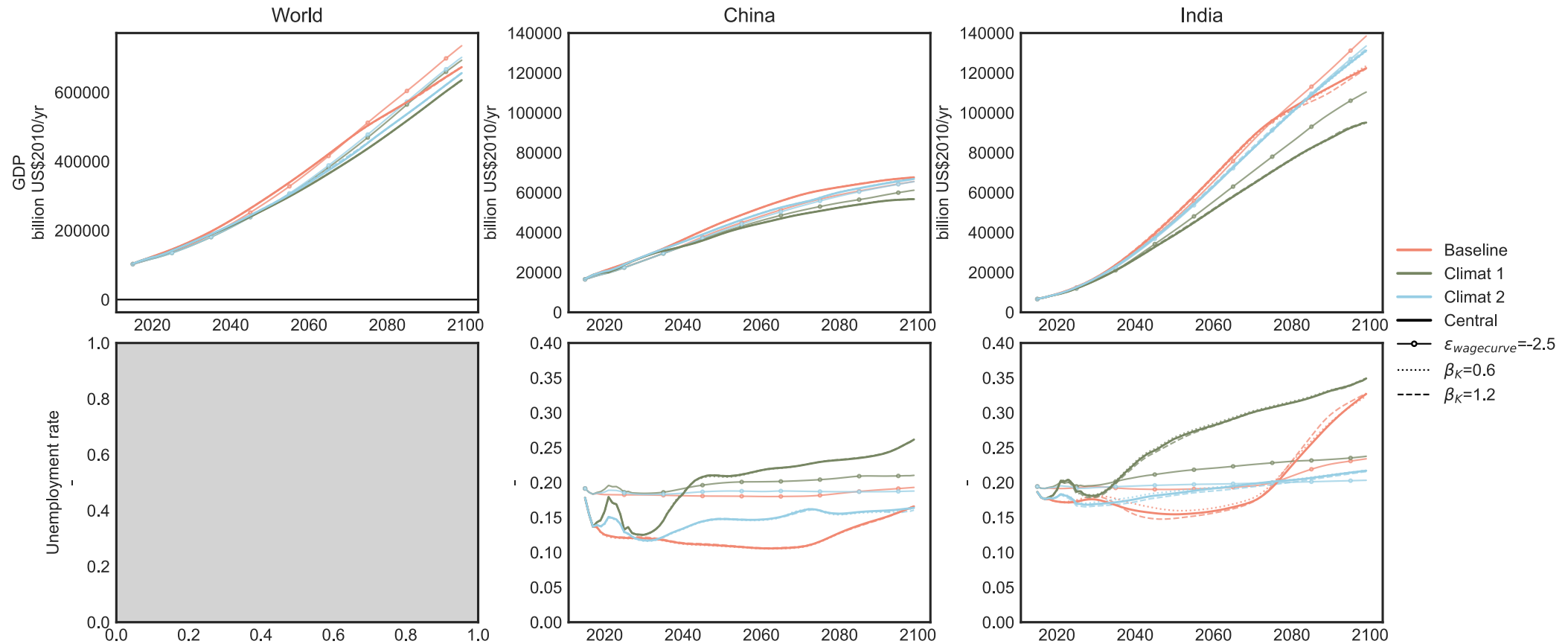


Figure A.1: Secondary indicators for analysed scenarios.

Trade-offs of heterogeneous climate price

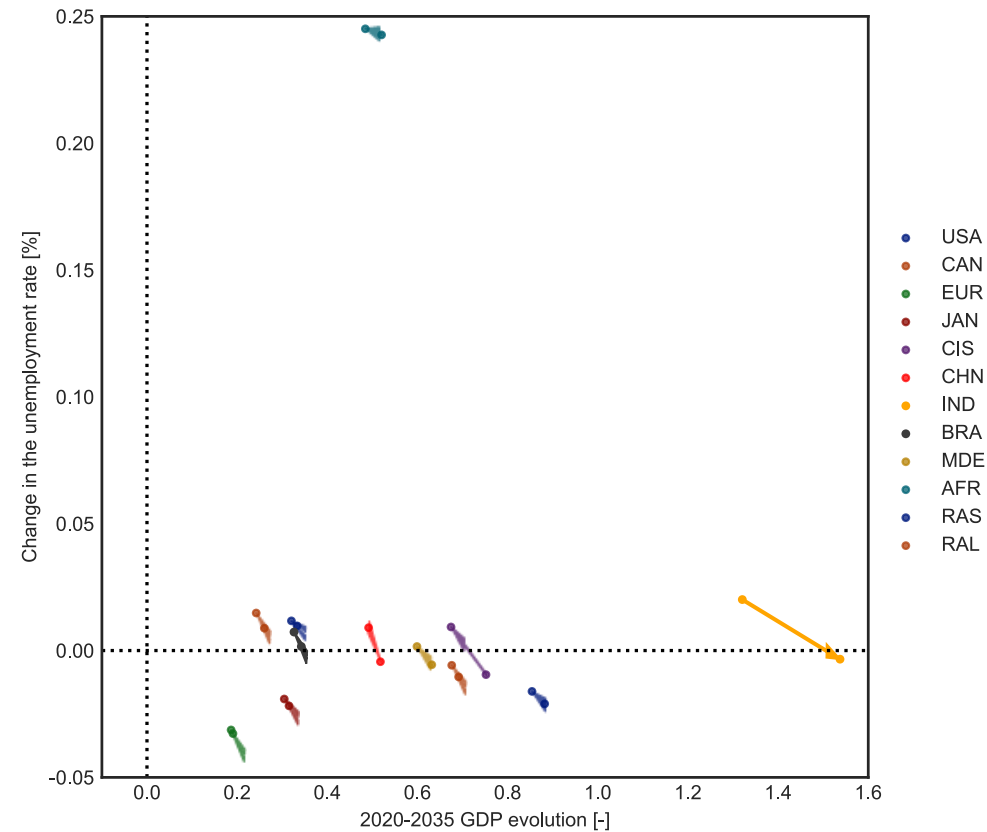


Figure A.2: Evolution of GDP (in purchase power parity) and labour under-utilisation across model regions between the two climate scenarios. Arrows point from Climate 1 to Climate 2 scenario

Trade-offs of heterogeneous climate price

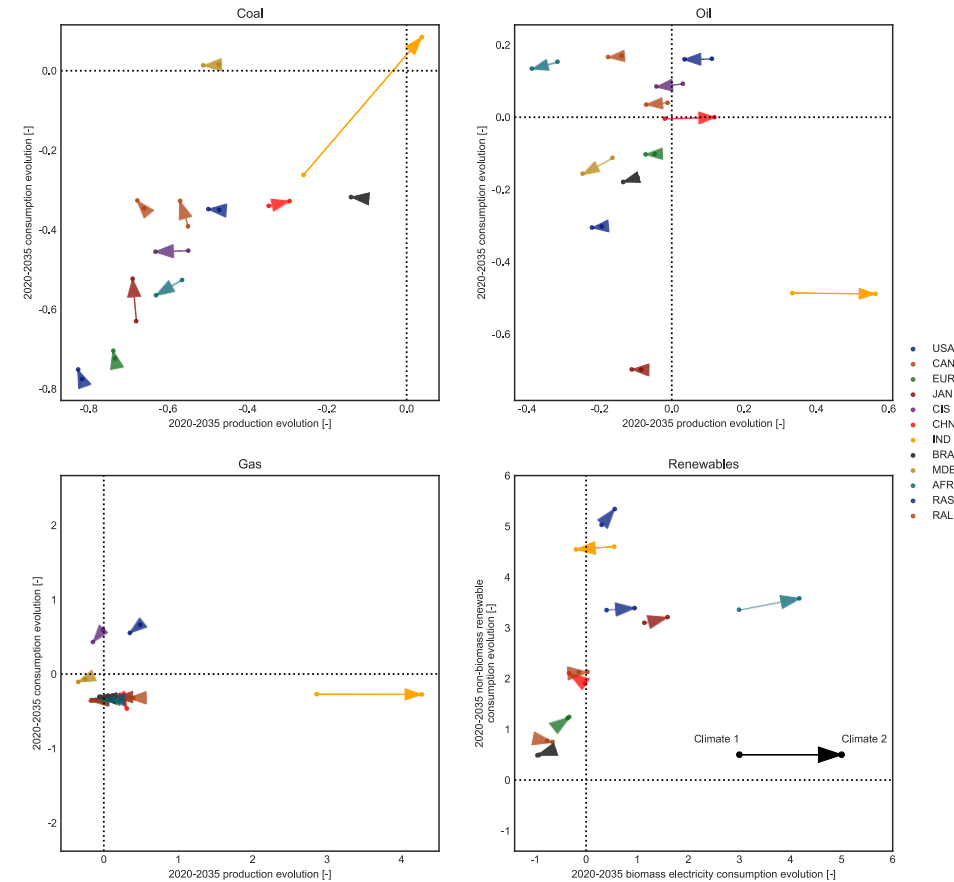


Figure A.3: Evolution of energy demand and supply across model regions between the two climate scenarios. Arrows point from Climate 1 to Climate 2 scenario.

Coal labour productivity

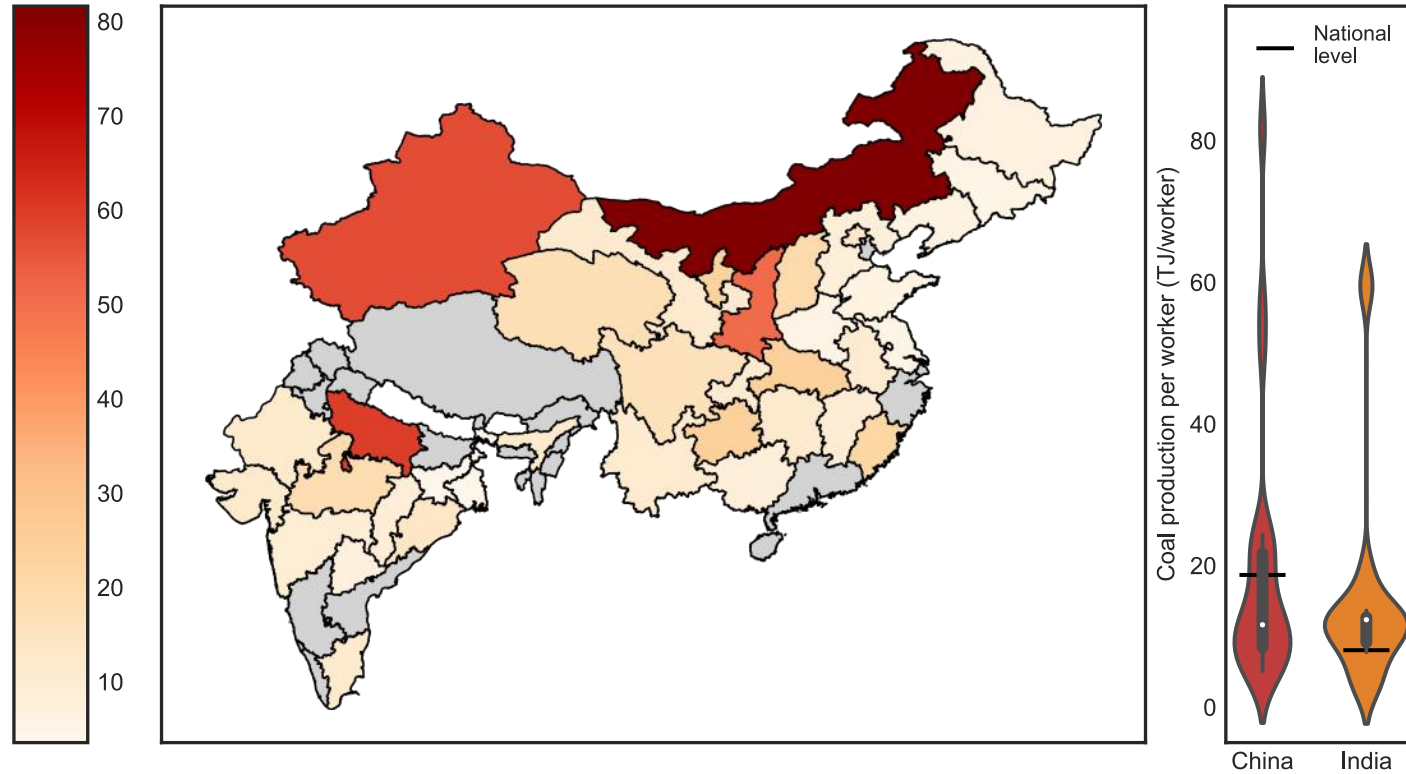


Figure A.4: Map of coal labour productivity (in TJ/workers) across subnational regions of China and India.

Labour productivity growth calibration

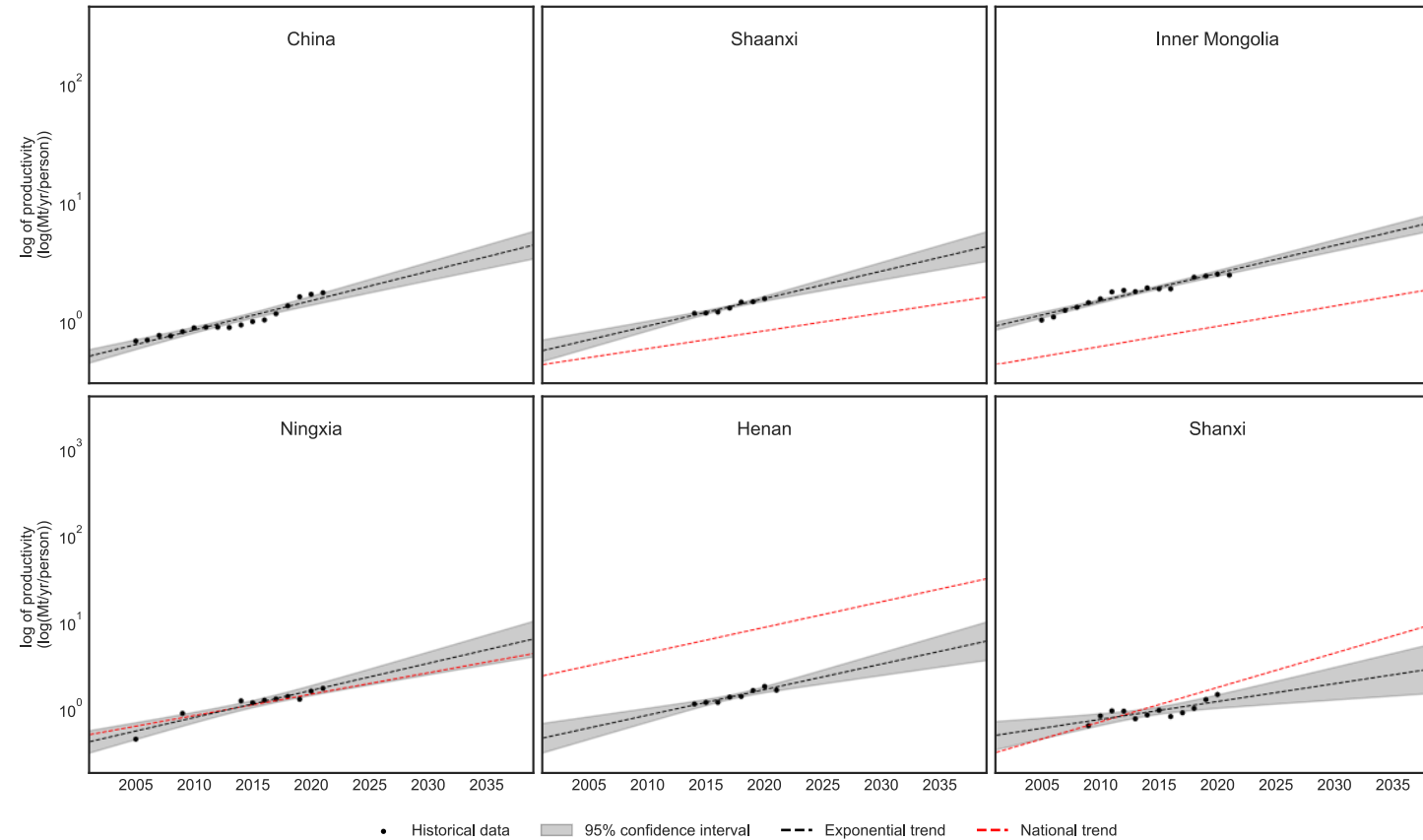


Figure A.5: Linear regression of the log of coal labour productivity with respect to time in China at the national level and in selected province. Productivity is constructed from production and employment data from yearly provincial yearbooks by NBSC (2016, 2022)