ENERGY TRANSITION AND INVESTMENT SCENARIOS FOR MEXICO

Alejandra Salazar, University of Zurich, alejandra2.salazar@bf.uzh.ch; Jae Edmonds, Joint Global Change Research Institute and Pacific Northwest National Laboratory, jae@pnnl.gov; Stefano Battiston, University of Zurich and University Ca’ Foscari of Venice, stefano.battiston@bf.uzh.ch; Matthew Zwerling, University of Maryland, mzwerlin@umd.edu

# Overview

Economic actors face at least two types of climate-related risks: physical and transition risks. The physical risks are those resulting from climatic events such as lower agricultural production and wildfires. Transition risks are business and financial-related risks resulting from policies and actions towards a low-carbon economy, such as unexpected implementation of policies to lower emissions, or technological developments affecting the competitiveness of carbon intensive industries, or change in consumer preferences.

Several financial actors and academic works suggest that markets can be underestimating financial risks related to climate change (Stroebel and Wurgler 2021; Condon 2022; Hong et al. 2019; Campiglio et al. 2023; Krueger et al. 2020). Mispricing the risks presents by one hand a hazard for financial stability (Battiston et al. 2017), but on the other hand can cause lower investments in mitigation and adaptation through inefficient allocation of capital (Condon 2022; Thomä and Chenet 2017).

In order to evaluate the extent of the transition risks it is important to assess the extent to which the transformation of the economy, principally in the energy sectors, would have to take place to achieve the climate goals. In line with this, it is important to evaluate how the capital would need to be allocated for the economy transformation of a country. However, transition scenarios are frequently made at aggregate region levels or for the bigger emitters, and detailed scenarios for smaller economies or developing countries are scarcer.

In the case of Mexico, a handful of works have assessed transition scenarios (e.g. Octaviano et al. 2016, Solano-Rodríguez et al. 2018). However, most of them have not focused on the issue of transition risks and capital allocation by scenario, and the ones that consider capital investments, usually evaluate the costs of the Nationally Determined Contributions (NDC). Buira et al. (2021) propose a transition scenario for Mexico (DDP: deep decarbonization pathway) aligned to Paris Agreement and compare it against a scenario modeling Mexico’s NDC commitments. They calculate the capital investments required between 2020 and 2050 in generation capacity of the power sector. They contrast this amount to the announced planned investments for upstream and downstream activities in the oil and gas state-owned company, but do not make a comparison of capital reallocation from current policies.

**Methods**

The methodology consists of a comparative assessment of emissions' mitigation scenarios helpful to assess transition risks, using an integrated assessment model. Integrated models consider the main processes in the energy production and demand as well as some of their implied tradeoffs, such as use of land. In this methodology the integrated assessment model GCAM was used, since it is an open-source model that has Mexico disaggregated. Key assumptions for Mexico are compared with other sources to ensure that they closely reflect the conditions of the country, and in case, they are updated.

The mitigation pathways are explored with three transition scenarios and a current policies scenario that acts as a reference to compare the three transition scenarios against. These scenarios are mainly based on the scenarios proposed by the Network for Greening the Financial System (NGFS), a group of central banks and financial supervisors, designed to assess climate-related financial risks. In the first scenario, all the world cooperates and starts to decrease emissions immediately in 2020 with a goal of limiting the increase in the global average temperature to well below 2˚C by the end of the century; in the second scenario all the world is still cooperating towards a goal of well below 2˚C, but delays the start of climate policies until 2030; and in the third scenario, Mexico does not cooperate with climate policies while the rest of the world is aiming to limit global warming to 1.5°C by the end of the century. This last scenario is based in the net-zero scenario from the NGFS, but Mexico follows the current policies scenario. This scenario is helpful to assess the implications for a non-cooperating country in a world that is transitioning. The delayed transition scenario (scenario 2) is helpful to assess the implications of a sudden transition compared to one made more orderly (scenario 1).

The main variables of interest in these scenarios are the implied carbon tax, changes in fuels in primary energy, the transition in energy technologies by industries, and the investment required in the energy supply for this transition. These variables are frequently used to characterize transition risks in previous works (Dunz et al. 2021; Roncoroni et al. 2021; Vermeulen et al. 2021). However, they can be contrasted with other tradeoffs such as land use, water use, and carbon leakages when carbon tariffs are not implemented.

# Results

The transition scenarios confirm the results of previous works about the feasibility of limiting climate warming to well below 2˚C through a gradual replacement of fossil fuels, primarily with renewable energies. GCAM (Calvin et al. 2019) considers an important deployment of negative emission technologies (i.e. biomass) in Mexico to compensate for the sectors that are difficult to transform, and this would have to be more suddenly and starkly implemented in a delayed scenario. Companies working with biofuels, for example, could suddenly see their market share increase. The results also confirm previous findings about the need to expand electrification and reduce emissions in transportation. These results, however, show a higher relevance of electrifying road freight transportation than passenger transportation.

The scenario 3 shows that highly emitting technologies such as coal-based electricity could disappear even without an internal policy limiting emissions, exemplifying a case of transition risk derived from technological change. This scenario, however, highlights potential tradeoffs. If the rest of the world does not consider carbon tariffs for agricultural products, the carbon leakage could be important, and Mexico could benefit economically from it but at the expense of loss of forests and higher water stress, and therefore of its biodiversity.

The main result for capital is that the energy transition under these scenarios would require in the first term a reallocation of the investments in energy supply and in the second term an expansion of it. Although a slight expansion of the investment could be needed for the transition before 2050, the reallocation of investments shows to be more relevant. By the second half of the century the investment in fossil extraction would be replaced by investment in electricity generation, transmission, and distribution.

**Conclusions**

This work offers a comparative assessment of three scenarios of carbon mitigation that can cause transition risks in Mexico. They show the importance that policymakers and regulators consider efficient capital allocation. Additionally, a non-cooperative scenario highlights the presence of transition risks even without internal climate policies.

If financial risks are actually underestimated, they can have several sources such as low credibility to transition scenarios given confusing signals of climate policies from governments, or the rigidities for the transition. However, the investment amount required for the transition could be less of a concern when compared to the amounts required by the current policies scenarios.

# References

Battiston, S., Mandel, A., Monasterolo, I., Schütze, F. and Visentin, G., 2017. A climate stress-test of the financial system. Nature Climate Change, 7(4), pp.283-288.

Banacloche, Santacruz, et al. "Assessment of the sustainability of Mexico green investments in the road to Paris." Energy Policy 141 (2020): 111458.

Buira, Daniel, et al. "A whole-economy deep decarbonization pathway for Mexico." Energy Strategy Reviews 33 (2021): 100578.

Campiglio, E., Daumas, L., Monnin, P., and von Jagow, A. (2023). Climate‐related risks in financial assets. Journal of Economic Surveys, 37(3), 950-992.

Calvin, K., Patel, P., Clarke, L., Asrar, G., Bond-Lamberty, B., Cui, R.Y., Di Vittorio, A., Dorheim, K., Edmonds, J., Hartin, C. and Hejazi, M., 2019. GCAM v5. 1: representing the linkages between energy, water, land, climate, and economic systems. Geoscientific Model Development, 12(2), pp.677-698.

Condon, M. (2022). Market myopia's climate bubble. Utah L. Rev., 63.

Dunz, N., Naqvi, A. and Monasterolo, I., 2021. Climate sentiments, transition risk, and financial stability in a stock-flow consistent model. Journal of Financial Stability, 54, p.100872.

Elizondo, A., Pérez-Cirera, V., Strapasson, A., Fernández, J.C. and Cruz-Cano, D., 2017. Mexico’s low carbon futures: An integrated assessment for energy planning and climate change mitigation by 2050. Futures, 93, pp.14-26.

Hong, H., Li, F. W., and Xu, J. (2019). Climate risks and market efficiency. Journal of econometrics, 208(1), 265-281.

Krueger, P., Sautner, Z., and Starks, L. T. (2020). The importance of climate risks for institutional investors. The Review of Financial Studies, 33(3), 1067-1111

McCollum, D.L., Zhou, W., Bertram, C., De Boer, H.S., Bosetti, V., Busch, S., Després, J., Drouet, L., Emmerling, J., Fay, M. and Fricko, O., 2018. Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals. Nature Energy, 3(7), pp.589-599.

Octaviano, C., Paltsev, S. and Gurgel, A.C., 2016. Climate change policy in Brazil and Mexico: Results from the MIT EPPA model. Energy Economics, 56, pp.600-614.

Roncoroni, A., Battiston, S., Escobar-Farfán, L.O. and Martinez-Jaramillo, S., 2021. Climate risk and financial stability in the network of banks and investment funds. Journal of Financial Stability, 54, p.100870.

Solano-Rodríguez, B., Pizarro-Alonso, A., Vaillancourt, K. and Martin-del-Campo, C., 2018. Mexico’s transition to a net-zero emissions energy system: Near term implications of long term stringent climate targets. Limiting Global Warming to Well Below 2 C: Energy System Modelling and Policy Development, pp.315-331.

Stroebel, J., and Wurgler, J. (2021). What do you think about climate finance?. Journal of Financial Economics, 142(2), 487-498.

Thomä, J., and Chenet, H. (2017). Transition risks and market failure: a theoretical discourse on why financial models and economic agents may misprice risk related to the transition to a low-carbon economy. Journal of Sustainable Finance and Investment, 7(1), 82-98.

Vermeulen, R., Schets, E., Lohuis, M., Kölbl, B., Jansen, D.J. and Heeringa, W., 2021. The heat is on: A framework for measuring financial stress under disruptive energy transition scenarios. Ecological Economics, 190, p.107205.