***FINANCIAL RISK FROM MITIGATING CLIMATE CHANGE:***

***AN INTEGRATED APPROACH***

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## Overview

Several generations of integrated assessment models (IAMs) have been examing how the economy and specifically the energy system need to change to mitigate climate change. Their results show that with increasingly ambitous targets, the low carbon transition requires more and more stringent policies for abrupt yet large scale change ever sooner (Rogelj et al. 2018). But these models do not account for the interaction of this transition with the financial sector. In 2015, the Governor of the Bank of England issued a stark warning that not only the impacts of climate change but also those of climate policies could have pronounced effects on financial and insurance industries. At the core of climate-related impacts, there is a dilemma: while climate policy seeks to avoid long-term physical damages from climate change, it may also negatively affect financial markets in the short-term as the valuation of fossil fuel-related financial assets falls. Such assets could become effectively 'stranded' by the transition to environmental sustainability. The financial risks arising from the transition and the stranding of fossil-fuel related assets have been termed 'transition risks'. Understanding the magnitude and incidence of such transition risks, and the extent to which the interconnectedness of the financial system can lead not only to a financial but also a real economy crisis is key to designing climate change mitigation policy that simultaneously mitigates these financial risks.

This paper is the first academic work to our knowledge that integrates a financial module into an IAM of the climate, the economy and the energy system and introduces transition risks. Hitherto, climate stress tests of the financial system (Battiston et al. 2017) have only been carried out in parallel to the integrated assessment literature, where the initial shock to fossil-fuel related assets was exogenous, and there was no feedback into the real economy. Here, we endogenise the shock using an IAM, translate it through the global network of financial ownership, and feed it back into the real-economy module of the IAM. Our contribution consists both in showing the feasibility of integrating detailed models of climate policy with network models of financial transition risks, and in generating plausible scenarios of the magnitude and distribution of financial shocks and their feedback into the real economy resulting initially from from decline in demand for oil and gas.

## Methods

We use the simulation-based integrated energy-economy-carbon-cycle-climate model E3ME-FTT-GENIE to generate baseline and climate policy scenarios with year-wise steps to 2050. Both scenarios have annual time series of oil and gas prices and demand. This model has already been used for the first real-economy integrated assessment of the impact of stranded fossil fuel assets (Mercure et al. 2018). We link the oil and gas price series to individual oil and gas companies’ upstream production and reserves portfolios and identify which production assets become unecomomic under the policy scenario using Rystad’s ucube database. We then impose a financial expectations scenario where via herding effects investors switch their expectations from the baseline to the policy scenario in a single year. This generates a loss in asset valuation from mark-to-market pricing that is the net present value of lost future cash-flows. We trace the realisation of this market risk via loss of equity to financial institutions and via ‘second round effects’ to their shareholders and ultimate beneficial owners using the global network of equity ownership from Bureau van Dijk’s Orbis database. We also calculate a realisation of credit risk impact on banks’ loan books using the equity/debt ratios of shocked shareholders. The financial impact is fed back into the macroeconomy via wealth loss impact on consumption and investment behavior, and credit tightening via investment behavior. It is possible to generate ‘third round’ effects with a renewed shock to the financial network as the impact from the real-economy feedbacks into the financiel system.

## Results

We find that fossil fuel companies are affected differentially, and so are shareholding financial institutions, both geographically and in terms of investor classes, by the policy scenario’s impact on cash flows and asset values. As a result, different regions (of which there are 66 in the E3ME model) feel different impacts from the transition risk realisation and in different sectors. Model runs are still ongoing at the time of writing this abstract and more detailed results will be presented at the conference.

## Conclusions

In this paper, we show the feasibility of depicting low-carbon transition risks for finance in an integrated assessment model, thus endogenizing both the causes and effects of these transition risks in a broader macroeconomic model. By modeling expectations as following baseline (or ‘current policy’) scenarios and then switching to a policy scenario, we can generate a shock to financial assets. We can calculate the magnitude and distribution of the shock by reliance on asset and firm level datasets for fossil fuel production and ownership. A better understanding of transition risks and their interaction with the real economy in various geographies and sectors will help craft policy that mitigates these risks alongside climate change.

## References

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