



Research partnership – 2° Investing Initiative *2°C scenario analysis for corporate lending portfolios*

Background.

A number of banks are currently exploring opportunities to develop 2°C scenario analysis for its corporate lending and asset management portfolio. The 2° Investing Initiative (2°ii) has piloted a model that assesses the exposure of both equity and credit portfolios to transition technologies across key sectors (energy, power, transport, cement, and steel) and the alignment of that exposure with 2°C roadmaps, as defined by the International Energy Agency.

The model on listed equity and corporate bonds portfolios developed by 2°ii and funded by the European Commission and the Swiss government among others, has been piloted on over 2,000 financial portfolios, representing over \$10 trillion in assets under management, across over 800 financial institutions around the world. 2°ii is currently piloting an expansion of the model to lending portfolios with European and international banks.

Research partnership.

The proposed research partnership involves developing the infrastructure to expand the existing 2°C scenario tools for listed equity and corporate bonds to corporate credit portfolios, including the following outputs:

1. **Matching software to match economic assets with unlisted financial assets.** Matching non-listed, non-uniquely identified financial instruments with economic intelligence databases (i.e. asset databases on power plants, automobile plants, oil & gas fields, etc.) in corporate lending portfolios. This will enable participating banks to overcome the data challenge for large lending portfolios associated with non-listed counterparties and other counterparties for which climate-related data is not readily available in a homogenous and low-cost way. The output will be tested in partnerships with participating banks on their lending portfolios, with the underlying matching software and calibration for matching instruments made publicly available at the end of the project.
2. **Road-testing the 2°C scenario analysis applied to over 2,000 equity and corporate bonds funds to non-listed financial instruments/portfolios.** Expanding the existing open-source software and IT-infrastructure of 2°ii available for public use in order to allow for efficient, independent, and high-volume assessment of lending portfolios across portfolios, with the ultimate objective of facilitating the opportunity for participating banks to initiate in-house 2°C scenario analysis in the future independent of the technical support of 2°ii. In addition to the technical development, 2°ii will conduct a confidential pilot application on the listed equity (where relevant and desired), corporate bonds, and corporate credit portfolios of participating banks, including preparatory meetings, in-house analysis by a 2°ii analyst, and a preparation of a short explanatory report on the pilot results and how they can be interpreted and used by participating banks in the future.

All results of the analysis will be kept confidential. The learnings of the road-test will be published in a public-facing report, co-branded (if desired) with the participating banks, containing the methodological lessons, accounting rules, and other key findings (anonymized).

3. **Expanding the scenario analysis toolbox for banks.** This element will include developing 'complementary tools' that can allow banks to move from exposure analysis contained in the 2°C scenario analysis model to credit risk models, etc. through additional inputs, notably transition scenarios tailored to financial analysis and other potential tools in the credit risk toolbox.



Estimated project costs & timeline.

2°ii is seeking support for the research partnership as part of either a membership or a grant agreement. The total project budget of the research partnership is EUR 120,000, with targeted contributions from participating banks of EUR 10,000-30,000. As a research grant, this cost is tax-deductible (2°ii is a non-profit network, including registered as a 501c3 entity in the United States). The following types of contribution can be considered:

- Tier 1: EUR 10,000. Participation in the portfolio analysis pilot and joint findings. No branding of public-facing outputs
- Tier 2: EUR 20,000. Same as Tier 1 + branding of public-facing output
- Tier 3: EUR 30,000. Same as Tier 1 + plus membership in the 2° Investing Initiative network, with inputs into the broader research programme, opportunities for bespoke co-branding of research outputs, etc.

The final outputs associated with the research partnership will be an open-source software tailored to lending portfolios for 2°C scenario analysis including associated matching software and calibration, a confidential pilot analysis results, and a public paper on technical questions around 2°C scenario analysis for banks, as well as related potential inputs into credit risk models (e.g. financial analysis scenarios). The results will help inform both the science-based targets work of the 2° Investing Initiative as well as the ISO 14097 working group on scenario analysis and target-setting by banks, of which 2°ii is one of the two chairs. All results associated with bank data directly will be kept fully confidential and preserved on the banks' server.

ABOUT 2° INVESTING INITIATIVE

The 2° Investing Initiative is the leading global think tank on developing climate metrics in financial markets.

- **Leading research.** We are currently leading three, EU-funded projects (Total budget: EUR 6 million) designed to develop both publicly available and IP-rights free 2°C scenario tools for financial portfolios (*SEI metrics*), as well as risk management tools (*ET Risk*), and target-setting (INVECAT). The project involves over 20 research partners, including universities (Frankfurt School of Finance, University of Zurich), financial industry (S&P Market Intelligence, Kepler-Cheuvreux), consultants (The CO-Firm), and NGOs (Climate Bonds Initiative, CDP, WWF, etc.), and international organisations (UNEP-Fi, UNFCCC).
- **Global partnerships with the financial industry.** We have partnered with over 200 financial institutions on scenario analysis for equity and / or corporate bonds portfolios, three financial supervisory authorities, and two governments on supporting 2°C scenario analysis among financial institutions.
- **Scenario analysis initiatives.** 2°ii is also leading a range of research projects on providing the 'inputs' into financial institutions 2°C scenario analyses. 2°ii is a founding partner of the Asset Data Initiative (ADI) and the Science-Based Targets (SBT) working group on financial institutions. 2°ii also participated in the FSB TCFD scenario working group. 2°ii has contributed to the International Energy Agency World Energy Investment Outlook (2014), the IEA Investment report (2016), and the IEA Energy Efficiency Market Report (*forthcoming, 2017*). 2°ii Director Stan Dupre is also co-chairing the ISO 14097 working group on setting science-based targets together with the UNFCCC Secretariat, as well as participating as a member to the EC High Level Expert Group on Sustainable Finance (HLEG).
- **Independent research.** The 2° Investing Initiative has a multi-stakeholder and independent governance framework designed to ensure the intellectual integrity of its work and its independence. Thanks to its non-advocacy position and technical emphasis, it enjoys the trust and confidence of central banks, insurance companies, banks, and pension funds.

Contact. Jakob Thomä (Director) – Jakob@2dii.org – Schönhauser Allee 188, 10119 Berlin-DE – +447500398801

ANNEX 1: TECHNOLOGY EXPOSURE SOFTWARE

2° Investing Initiative will provide technical support to each participating bank in applying 2°C scenario analysis. The key challenge we identify in this context is that there is a climate data gap that many banks face in identifying the energy technology exposure of the companies in their lending portfolios, given the lack of (standardized) reporting, in particular for non-listed companies.

Lacking this information, analysis has to be default sector-level, which may miss the critical questions of transition pathways that these companies are on. A utility can be 100% renewable or 100% coal and the 2°C scenario analysis for either is likely to be fundamentally different. A combination of sector & energy technology exposure analysis can thus reveal more detailed information about the lending portfolio, either as use directly in terms of 2°C scenario analysis of the kind that the UK pension fund TPT and French insurance company AXA were recognized for in the French climate disclosure awards, or serve as inputs for traditional bank models. Sector level exposures thus have to be complemented with sub-sector technology estimates.

2°ii has built a software that calculates this sector and technology exposure information for corporate bonds and listed equity portfolios and compares these exposures to benchmarks in the 2°C scenarios from the International Energy Agency or related organizations. The model builds on access to global, economic intelligence databases of infrastructure assets (e.g. coal fields, oil & gas plays, power plants, car factories, airplanes, ships, cement factories, steel plants) covering >90% of global assets for most sectors.¹ These assets are then mapped to their owners and the parent companies of these owners, and ultimately to financial assets to calculate exposures.

The model is technology based, but includes data around associated GHG emissions factors, allowing for both a technology and GHG emissions assessment. For the majority of sectors, it covers, in particular energy, power, and transport, it integrates forward-looking data, allowing for a comparison with the scenario trend. Since it doesn't rely on traditional reporting channels (e.g. annual reports), it can calculate exposures across a wide universe of listed and non-listed companies, as well as other actors (e.g. municipalities). It can also identify exposures for non-utility companies (e.g. oil & gas).

Over 200 investors have signed up to test the model to date, in addition to the application by two European central banks. The model has thus been tested on over \$10 trillion in assets under management to date. In terms of application in this project, participating banks can benefit from the existing infrastructure developed for listed equity and corporate bonds portfolios, in terms of R software (available online at www.sei-metrics.org) to apply it to banks' lending portfolios. A number of adjustments and additions are suggested/required however for application and the ability to easily use the software independently, as well as in order to generate the capacity to scale the software

1. **Mapping energy technology assets to lending portfolios.** Mapping energy technology assets to listed equity and corporate bonds portfolios are more straight forward, given the use of established and accepted identifiers by investors that can be linked (e.g. ISINs, SEDOLs). For lending portfolios, this type of analysis can be more complex since many banks use their own internal identifiers and the use of a larger universe of identifiers (e.g. LEIs) is not yet established as a standard, although this may change with new regulation in the European Union² and other jurisdictions.

¹ 2° Investing Initiative (2016) "Asset-Level Databases". NB: This estimate is limited to utility- or enterprise-scale assets and thus does not consider for example residential solar PV assets in the sample.

² Notably Anacredit.

To overcome this challenge for lending portfolios, a matching software is required that manually matches the company name in the lending portfolio (as a text-string) and the company name (as a text-string) in the database associated with energy technology assets. This can be done using open-source text matching software like Trill. It requires some manual validation however given the need to use matching algorithms. This approach has been tested successfully to date on cross-referencing databases across different energy technologies (e.g. the ownership of oil & gas companies of oil & gas fields and renewable power plants).

2. **Analysing credit assets & definition of allocation rules.** Another challenge to analysing credit portfolios is determining allocation rules. Traditional climate accounting in financial markets has largely been constrained to listed equity portfolios, where the accounting standards have relied on the ownership approach (allocating GHG emissions based on the ownership share in the company). This approach is not easily translated to credit since the ownership principle does not exist and the potential volatility in outstanding debt can create misleading results (e.g. the debt in the oil & gas sector has increased by >50% for some companies in the past 2-3 years). Similarly, there are challenges to normalizing exposures over sales given similar potential volatility in revenues. One response to this is weighting exposures by portfolio weight, which is the metric recommended by the TCFD and currently applied by 2[°]ii in its corporate bonds portfolio work. Fine-tuning these methodological issues into the model, as well as providing for a flexible framework that allows each bank to source the metrics they are interested in requires some adaptation of the existing infrastructure.
3. **Creating a safe and independent user interface.** In our experience, data confidentiality and security issues are much more prominent for banks than for most institutional investors that will in some cases even make their holdings portfolio data public. Moreover, the servicing of the analysis can be more labour intensive in the case of banks portfolios given their relative size. Currently, 2[°]ii runs the analysis itself for investor portfolios. In order to reduce the cost, ensure scalability, and allow for the independent application of the model and data, 2[°]ii proposes building a software user interface that allows banks to run the analysis independently and determine the metrics they consider most relevant. This process enables the application of the analysis without the need to provide 2[°]ii access to underlying data.

Other potential application & scope:

The final objective of the technology exposure software is to provide banks with an independent and publicly available tool that allows them to do a sector- and technology-exposure based 2[°]C scenario analysis. The results of the analysis can operate as a stand-alone result for 2[°]C scenario analysis and/or potentially be integrated into banks traditional risk models for further analysis. One key advantage of a basic technology exposure analysis is that for a number of sectors – power, fossil fuels – it builds on regional benchmarks. This regional benchmarking can at least for certain technologies allow for comparability across different banks operating in different regions. It doesn't blindly preference banks whose exposures are to regions with higher renewable power penetration but contextualizes the alignment of the energy technology exposures with each regional benchmark and indeed regional portfolios.

While this proposal focuses exclusively on transition risk, the model infrastructure can potentially also be mobilized on the physical risk side. The asset data mobilized for this software is for many sectors (e.g. power, steel, cement, oil & gas) at geolocational level (longitude / latitude) and can thus be layered over physical risk shape files (maps) to identify direct assets exposure to various physical risks (storms, flooding, drought, etc.). While not explicitly in scope for the transition risk analysis, 2[°]ii would offer to discuss a potential use of the analysis for physical risk scenario analysis.



At this stage, the software and project scope as described herein focuses on corporate lending portfolios. While the software does not extend to sovereigns, the macro scenario parameters can be used for further analysis on sovereigns. In addition, sovereigns can hypothetically be assessed in terms of the ownership of companies that own energy technology assets. Expanding the scope to sovereigns however for the software is likely to increase the project costs. Moreover, the analysis does not extend to the real estate sector, given the still prevalent paucity of data in this sector. 2°ii is open to exploring an adjustment of the scope however to consider real estate assets. 2°ii has worked with the Climate Bonds Initiative on developing science-based benchmarks for real estate assets across dozens of cities and geographies that can inform this project.

Output: An R-based software and interface provided to all participating banks that calculates the technology/efficiency exposure for credit portfolios. The software can be used by the participating banks to match their portfolio information with 2°ii asset level data across 8 sectors (covering >90% of global assets for most sectors) and calculate associated exposures, as well as benchmark these exposures to the scenarios provided in Deliverable #1. The software will be provided as downloadable file and USB-stick and will include an associated open-source R script underpinning the software, methodology documentation, user guide, and model briefing report.

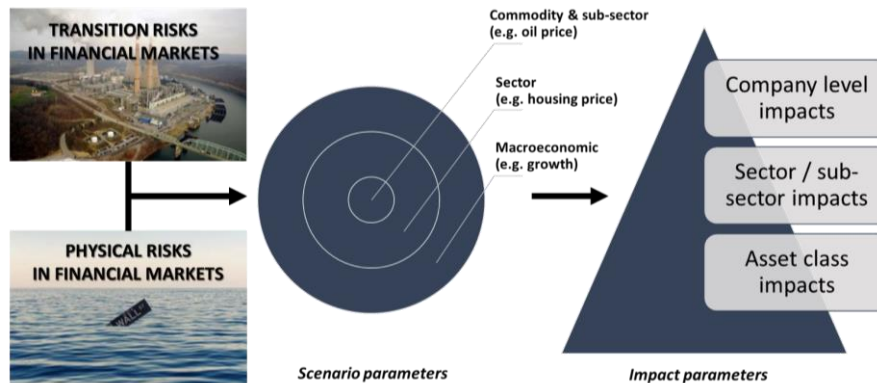
The output can also be used to develop target portfolio allocation in terms of energy technology exposure by region/geography and sector.

ANNEX 2: SCENARIO PARAMETERS

The first step of the project will be to prepare the scenario inputs for analysis. There are two types of inputs that can be prepared for scenario analysis, each operating at three different levels (see image below):

1. **Scenario parameters** relate to assumptions about macroeconomic trends (GDP, employment, etc.), as well as sectoral and sub-sectoral impacts. In banks stress-tests, these indicators, with a few exceptions (housing prices, oil prices) generally operate at the macroeconomic level.³
2. **Impact parameters** are pre-modelled impacts on financial risk and/or return that can directly be applied to financial portfolios. These can operate at asset class, sectoral, or financial security level. In traditional stress-tests, they are generally limited to asset class level.

Figure 1 Scenario & impact parameters for transition risks



From a transition risk perspective, indicators at sector or sub-sector / security level are likely to be the most material for the analysis. Nevertheless, a comprehensive suite of inputs is relevant to ensure a comprehensive analysis of transition risks. The work involves collecting a set of scenario parameters for each of the levels defined above based on a series of third-party sources and existing 2^oii data. This exercise will involve limited modelling, but rather rely on best available existing literature

Table 1 Types of scenario indicators and their sources

Type of indicator	Indicators	Sources
Scenario & Sector & sub-sector	Macro GDP & employment effects, enriched, where possible, with sectoral economic impacts	Cired, CISL, ⁴ OECD, IRENA, ⁵ Mercer ⁶
	Technology mix and production/capacity assumptions for power, oil & gas, coal mining, and automobile sector	IEA, ET Risk, Cired, Greenpeace, IPCC
Asset class & sectoral & impacts	CO2 intensity and production/capacity assumptions for the cement, steel, aviation, and shipping sector	IEA, ET Risk
	Market price assumptions	
	Policy pathways	
Asset class & sectoral & impacts	Asset class impacts	<i>Out of scope since the analysis is limited to credit portfolios</i>
	Sectoral impacts for credit portfolios (e.g. risk of downgrade, etc.)	Moody's, S&P*, Mercer, CO-Firm,

³ 2^oii (2017) "Right Direction, Wrong Equipment".

⁴ CISL (2015) "Unhedgeable Risk: How Climate Change Sentiments Impact Investment"

⁵ IRENA (2016) "Renewable Energy Benefits: Measuring the Economics"

⁶ Mercer (2015) "Investing in a Time of Climate Change"

Scenario – Macro indicators. 2ⁱⁱ will prepare a database of GDP impacts under various transition scenarios that can be integrated into risk models, including both a ‘smooth’ and ‘disruptive’ transition. This will build on the data points already collected for research provided to the European Systemic Risk Board.⁷

Scenario – Sector and sub-sector indicators. The sector and sub-sector indicators developed for this project will draw from the H2020-funded *Energy Transition risk scenarios*, jointly developed with the CO-Firm and a consortium involving Kepler-Cheuvreux, S&P Market Intelligence, Carbon Tracker Initiative, I4CE, and the University of Oxford. The table below summarizes the key indicators developed in this project (for two scenarios).

Sector	Type	Indicator	Main Sources
Cross-sector	Market Pricing	Crude oil price (USD/bbl)	IEA ETP
		Natural gas price (USD/MBtu)	IEA ETP
		Coal prices (USD/ton)	IEA ETP
		Electricity prices (2015 EUR/MWh)	IEA WEO, Third-party source
	Policies costs and incentives	Carbon prices (2015 USD / T-Coeq)	IEA WEO
Power Utilities	Production & Technology	Electricity generation (TWh)	IEA ETP, EC Trends 2050
		Electricity capacity (GW)	IEA ETP, EC Trends 2050
	Market Pricing	Levelised costs of electricity (€/MWh)	NREL
	Policies costs and incentives	Subsidies (€/Mwh)	NREL
		Effective carbon rates (\$/tCO ₂)	IEA WEO
Automotive	Production & technology	Sales by drivetrain (%)	IEA
		Carbon fibre (USD/pound)	NREL
	Market Pricing	Battery costs (USD/kWh)	Third-party source, BNEF
		Fuel efficiency standards (%)	ICCT
Policy costs and incentives	Effective carbon rates(EUR/tCO ₂)	OECD, Third-party source	
Steel	Production & technology	Crude Steel production (Mt)	IEA ETP, EC
		Share of primary/secondary steel(%)	IEA ETP, EC
		Energy Intensity (GJ / t crude steel)	IEA ETP
		Carbon Intensity (t CO ₂ / t crude steel)	IEA ETP
	Market Pricing	Crude Steel Price (USD / ton)	Third-party source
		Raw Materials Prices (USD / ton)	Third-party source
	Policy costs and incentives	Allowances of free CO ₂ allowances(% of total CO ₂ direct emissions)	Third-party source
Cement	Production & technology	Cement production (Mt)	IEA ETP, EC Trends 2050
		Clinker to cement ratio (%)	IEA ETP
		Energy intensity for clinker production (GJ / t clinker)	IEA ETP
		Share of alternative fuel use (%)	IEA ETP
		CCS deployment (%)	IEA ETP
		CO ₂ Intensity (t CO ₂ / t cement)	IEA ETP
	Market Pricing	Secondary Fuels (USD/ton)	Third-party source
	Policy costs and incentives	Allowances of free CO ₂ allowances(% of total direct emissions)	IEA ETP and Third-party source
Aviation	Production & technology	Demand (passenger-km)	IEA ETP and Third-party source
		Fuel efficiency (g fuel burned /revenue passenger-km)	ICCT
		Biofuel penetration (%)	ICAO IEA ETP and Third-party source
	Market pricing	Jet fuel prices (USD / gallon)	IEA ETP
	Policy costs and incentives	Carbon credit mandates (USD/tCO ₂)	ICCT, ENVI
Shipping	Production & technology	Fuel efficiency standards (kg/km)	ICCT
		Shipping Transport Demand (G ton km / year)	IMO
		Fuel efficiency (kJ/tonne-km)	Third-party source
	Market Pricing	Alternative fuels penetration (%)	Third-party source
		Marine Fuel prices (fraction to 2010 HFO price) and (USD/GJ)	Third-party source
		Policies costs and incentives	Efficiency Design Regulations
		Emission/Fuel standard	Rightship

⁷ 2ii (2017) “Wrong Equipment, Right Direction”.