2°C PORTFOLIO ASSESSMENT DOCUMENTATION

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1. Background

The following provides documentation on the 2°C portfolio assessment developed by the 2° Investing Initiative in the context of the Sustainable Energy Investing Metrics project, funded by the European Commission and involving WWF Germany, WWF European Policy Office, CDP, Climate Bonds Initiative, University of Zurich, Frankfurt School of Finance, Cired, and Kepler-Cheuvreux.

The objective of the assessment framework is to measure the alignment of financial portfolios with 2°C decarbonisation pathways. Specifically, the framework quantifies a financial portfolio's exposure to a 2°C benchmark in relation to a series of climate-related technologies. The result is thus a misalignment indicator that measures the extent to which current and planned assets, production profiles, investments, and GHG emissions are aligned with a 2°C trajectory.

The model involves a number of key features and distinguishing characteristics that are briefly summarized below:

- The model does not pre-define macroeconomic trends or shocks, but rather creates a 'translation software' that maps forecasted macroeconomic trends and shocks to financial portfolios. It thus doesn't rely on developing these economic trends themselves and can be used to test any macroeconomic assumption.

- The model assesses the 2°C alignment of financial portfolios with a 5-year time horizon / forecast period. The time horizon is limited to the time horizon of capital expenditure planning for which data can be tracked at a meaningful level. More long-term assessments are planned as the model gets extended to risk-related indicators, requiring a set of additional assumptions.

- The model assesses the 'technology exposure' of portfolios across a range of climate-relevant business segments and sectors. At this stage, it covers fossil fuels, power, and transport (light-passenger duty vehicles, airplanes). Indicators are considered either in 'aggregate exposure' terms or 'trajectory terms' (i.e. investments, asset additions / retirements, changes in production profiles).

- The model sources, where possible, forward-looking asset-level data for key technologies in order to provide for geography-specific assessments for specific business segments. It thus bypasses wherever possible backward-looking, corporate level reporting, although such reporting can be used for validating forward-looking parameters (e.g. GHG emissions).

- The model develops financial market specific, science-based benchmarks that compare portfolio performance not just to existing market benchmarks, but benchmarks associated with decarbonisation pathways.

- The model focuses on assessing specific asset classes, with the assessment at this stage limited to credit instruments (in particular corporate bonds) and equity (in particular listed equity, although it can be applied to private equity).

- Given its emphasis on technologies and climate, the analysis is limited to those parts of the portfolio with direct exposure to the relevant technologies. It thus only covers around 20-30% of the average portfolio in terms of AUM, although around 70-80% of the portfolio's GHG impacts.

2. Scenarios

2.1 Overview of scenarios

As outlined above, the benchmark applied in the model relies on a translation of an energy-technology scenarios into benchmarks for financial portfolios. The model by itself does not prescribe specific energy-technology scenarios, but allows for a range of scenarios to be used as benchmarks. The choice of which is used can critically influence the results of the assessment and thus an assessment can be made against both individual scenarios or all available scenarios to show a range of possible decarbonisation pathways.

2°C assessment frameworks require scenarios that comment on the trajectory of production, assets, and investment in the real economy. The granularity of the scenario will then determine the granularity of the assessment. Thus, scenarios that provide data points by region allow for assessment at regional level.

A range of organizations have developed energy-technology scenarios that can be used as inputs. Notable examples include the International Energy Agency 450 Scenario and 2D scenario, as well as Greenpeace and IRENEA. These scenarios provide for a 50% probability of achieving the global policy objective of limiting global warming to 2°C above pre-industrial levels. The scenarios are global with a time horizon of 2040 (450 Scenario) and 2050 (ETP) respectively. The 450 scenario covers electric power and fossil fuels, with the 2D scenario providing for more detail on other sectors (e.g. transport, cement, etc.). Both scenarios are thus used in the assessment as the 'default' scenarios in the assessment, with alternative scenarios being integrated into the assessment tool (e.g. Greenpeace, Cired, etc.).

Scenarios differ in the following elements:

- Scenarios will reflect different levels of ambition regarding the decarbonisation of the economy;
- Scenarios will involve different speeds around which decarbonisation takes place, with some assuming a more accelerated, linear, and short-term adjustments and others assuming more long-term disruption;
- Scenarios have different coverage in terms of geographies assessed, both in terms of absolute coverage and the resolution of geographic specificities;
- Scenarios reflect different progress in certain technologies (e.g. nuclear, carbon capture and storage, etc.);
- Scenarios provide for different time horizons, with some scenarios as short as 5 years and others calculating decarbonisation pathways over several decades.

2.2 Overview of scenario indicators used in the model

2.2.1 Overview

The indicators extracted from the scenarios to inform the model at this stage are either asset indicators (e.g. installed capacity) or production indicators. In theory, indicators could also be extended to investment indicators, although the lack of annually updated, technology-specific, global investment roadmaps create a barrier to using these as benchmarks. In addition, investment figures are associated with higher levels of uncertainty given the uncertainty both around the technology pathway itself and the costs associated with different technology deployments within these pathways.

2.2.2 Regions & Time horizon

Data for the scenario pathways are extracted with a 25-year time horizon. For the 2°C portfolio assessment, the actual assessment is limited to a 5 year time period (see p. 11). Scenario data is extracted for the regions provided by the scenario provider and then aggregated into five regions: Global, OECD, Non-OECD, USA, and Europe. Further detail is possible and can be applied to the model.

2.2.3 Completing missing data

Data points from publicly available scenarios usually are presented in 5 year intervals. Missing data is interpolated using a linear function. A function with more degrees of freedom could be applied as an alternative modelling decision to 'smooth-out' the transition between data points.

2.2.4 Electric Power

The extracted data from the scenarios for electric power is installed capacity and CO2 emissions by fuel/technology. The different fuel categories are coal, gas, oil, nuclear, hydropower (large and small-scale), and renewables. Renewables is an aggregated category involving solar PV, CSP, wind power, biofuels, and geothermal. The aggregation decision is a function of reducing the complexity of the results while still maintaining resolution on hydropower given its different level of societal acceptance in some countries. Annex 1 shows how different fuels are mapped to these categories, although scenarios don't usually provide this granularity.

2.2.5 Automobile

The extracted data from the scenarios for automobile at this stage is limited to light passenger duty vehicle data by drivetrain. It distinguishes three categories: electric vehicle (which include extended range electric vehicles), hybrid (which includes plug in and conventional hybrids), and internal combustion engine (which includes diesel, gasoline/petrol, compressed natural gas, and liquefied petroleum gas vehicles). While fuel cell and other types of drivetrain data is also extracted, the current marginal production does not allow for a meaningful assessment. In addition, where available, fuel efficiency estimates are also extracted that can be integrated into the assessment.

2.2.6 Oil & gas

The extracted data from the scenarios for oil & gas are production profiles by region.

2.2.7 Coal production

The extracted data from the scenarios for coal is global coal production.

2.2.8 Other sectors

At this stage, the model does not extract data for other sectors.

2.3 Application of economic scenarios to asset classes

2.3.1 Overview

The basic framework of the model is an application of economic scenarios to asset classes. This requires a translation of these scenarios for each specific asset classes. This translation is based on defining the market portfolio for the financial portfolio being assessed, which encompasses the investable universe for that portfolio manager (e.g. US listed equities, etc.). At this stage, this investable universe is only constrained by the asset class and the region in which the investor is invested in and does not provide for further constraints (e.g. large cap, investment grade, etc.).

2.3.2 Listed Equity

The model takes as the basis the capacity mix and absolute exposure in the asset level databases (see p. 7) for the market portfolio related to the portfolio under assessment. This is calculated in terms of the relative weight / absolute exposure of the market portfolio to each indicator in the model (e.g. fuel mix for power, oil production, etc.). The economy level build-out and decline rates are then applied to that starting point to define the 2°C benchmark for private equity portfolios in 2020.

2.3.3 Private equity

The model takes as the basis the non-listed capacity in the asset level databases (see p. 7) to calculate the starting point for private equity exposure. The economy level build-out and decline rates are then applied to that starting point to define the 2°C benchmark for private equity portfolios in 2020.

2.3.4 Corporate bonds

The benchmark for corporate bonds as an asset class is more difficult to identify since both listed and non-listed entities issue corporate bonds. At this stage, the benchmark thus simply reflects the company benchmark. More precise iterations will seek to model the corporate bonds universe exposure.

2.3.5 Sovereign bonds

The model currently does not cover an assessment of sovereign bonds. For a discussion of options around assessing the climate friendliness and 2°C alignment of sovereign bonds, see Beyond Ratings / 2° Investing Initiative (2016) "Sovereign bonds and the transition to a low-carbon economy: Measurement options for investors".

2.3.6 Real estate

The model currently does not cover an assessment of real estate. Analysis on this is under development in partnership with the Climate Bonds Initiative as part of the Sustainable Energy Investing metrics project.

2.3.7 Infrastructure

The model takes as the basis the 'utility-scale' in the asset level databases (see p. 7) to calculate the starting point for the infrastructure exposure for the market in which the investor is invested in, in terms of the relative weight / exposure of the asset class to each indicator in the model (e.g. fuel mix for power, oil production, etc.). The economy level build-out and decline rates are then applied to that starting point to define the 2°C benchmark for private equity portfolios in 2020.

2.3.8 Household loans

The model currently does not cover an assessment of household loans. Analysis is planned for 2017.

2.3.9 Other asset classes

At this stage, the model does not integrate other asset classes.

3. Data

3.1 Overview

In addition to the scenario data (see p. 4), the model relies on three additional data inputs for the analysis. These are transition data on entities exposure to assets / production / investments, portfolio data on which the model is applied, and financial data.

3.2 Asset data

3.2.1 Overview

The 'transition data' in the model relies, wherever possible, on bottom-up, physical asset level data. These physical asset level databases are sourced sector-specific. For each sector / technology, they, can be sourced from a range of different data providers. The following summarizes the data points sourced in each of these databases.

3.2.2 Electric power

The power data relies on current and planned installed power capacity by fuel. Current installed capacity only considers active capacity. The model also tracks planned capacity that falls into one of the following categories: "Announced", "Financed", "Partially Active", "Permitting", "Temporarily Shutdown", "Under Construction", "Under Rehabilitation & Modernization". The data is currently sourced from GlobalData. Platts WEPP is one potential alternative.

The fuels identified in the database are categorized into the category "coal", "gas", "hydropower", "oil", "nuclear", and "renewables". See Annex 1 for a categorization of different fuels

Dual-fuel power plants are categorized according to the primary fuel. The data does not have a self-contained time horizon, but covers roughly a 5 year time horizon at a meaningful level, after which the number of projects in the pipeline drops significantly.

3.2.3 Auto

The automobile data at this stage focuses on passenger light-duty vehicles. Data can be sourced from a number of different data providers, with the current iteration of the model relying on WardsAuto Forecast Solutions. The data provides current and future production with an eight-year time horizon. The forecasting is done through monitoring of current and future production plant capacity, vehicle part shipments from suppliers, and vehicle model producing life cycles to give monthly estimated production at the model and plant level.

The model currently presents the results using four categories: Internal combustion engine (including petrol, diesel, LPG and CNG vehicles), hybrid vehicles (including plug-in hybrid), fuel cell, and electric vehicles. The results usually omit fuel cell vehicles in the presentation, given the marginal to non-existent pipeline of production of cars powered by fuel cells. Additional data that is tracked by the data provider can be found in Annex 1.

3.2.4 Oil & gas

The oil & gas data at this stage focuses on upstream oil & gas production. Alternative assessments extending to production associated with cost curves (see Leaton et al. 2015), types of oil plays (e.g. tar sands, deepwater, etc.) could be envisioned, but are currently not considered, given that they are not explicitly represented in the scenarios.

While there are also a number of data providers for oil & gas production GlobalData's platform is currently used. The platform covers upstream, midstream and downstream production. However only upstream is currently assessed in the model. The production data is gathered at the field level and is aggregated to the global parent owner via individual equity stakes in each field by GlobalData. The production includes a baseline forecast and an estimated high and range production forecast. Only the baseline scenario is used for the assessment. In addition, commodity price data is extracted to inform the additional modelling features.

GlobalData's upstream analytics includes details on global fields including forecasts for capital and operating expenditures, cash flows, and production scenarios by field at company level. Additional data that is tracked by the data provider can be found in Annex 1.

3.2.5 Coal

The coal production data at this stage sources company-level reporting provided on Bloomberg and is limited to coal production as reported in 2015. This is obtained through the Bloomberg data field FS377 - Mining - Total Coal Mined Production (MINING_COAL_PRODUCTION_ACTUAL). In addition, commodity price data is extracted to inform the additional modelling features.

3.2.6 Other sectors

The model at this stage does not integrate other sectors.

3.3 Portfolio data

The portfolio data required for the analysis is the list of unique security ID for each help share along with the total quantity held. Currently ISINs are used as the primary ID, but other IDs such as CUSIP and SEDOL can also be used.

Alternatively, to benchmark a fund, the weight of each security in the fund, and the date the weights were calculated can also be used, although the ultimate portfolio ownership assumption then depends on the assumption around the size of the portfolio. This information allows for a reverse-engineering around the information related to number of shares in the portfolio.

3.4 Financial data

The model extracts a number of indicators from Bloomberg in order to inform the model's financial asset allocation rules (p. 10) and the model calculation rules (p. 11). Specifically the model requires extracting the following data fields for each security: ID_ISIN (alternatively ID_SEDOL1, ID_CUSIP), SECURITY_NAME, COUNTRY_ISO, EQY_FUND_TICKER, TICKER_AND_EXCH_CODE, ICB_SUBSECTOR_NAME, ADR_ADR_PER_SH, EQY_SH_OUT, EQY_FLOAT, PX_LAST. In addition to this the total number shares need to be taken over all share classes this is done through the Bloomberg Excel API, by using the following command:

```
{=SUM(BDH(BDS( "RDSA LN Equity","MULTIPLE_SHARE_INFO","Endcol=1","array=true")&" EQUITY","EQY_SH_OUT", "30/12/2015", "30/12/2015"))}.
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Here Royal Dutch Shell is used as an example, for the last trading day of 2015.

To access the global listed market that owner production in the selected technologies requires access to a significant number of securities. For this reason, the financial data is update periodically and is currently valid as of 30.06.16.

3.5 Modelled data

In addition to the primary data sourced from asset level databases, financial databases, company reporting, and energy technology scenarios, the model also integrates 'modelled data points' that inform the final assessment. These data points are sourced from economic databases or modelled as part of separate analysis. Modelled data is not part of the basic 2°C alignment analysis, but may inform some of the additional elements computed in the context of the model application. The use of these data points thus depends on the scope of the analysis and the extent to which all the potential features of the model are applied. Specifically, at this stage the model relies on modelled GHG emissions data applied to assets, done in partnership with EY and involving open-source carbon factors applied to asset level data, investment estimates derived from capital expenditure data available in asset-level databases or through third party sources, revenue estimates based on economic costs and prices. Annex 2 (p.20) provides an overview of these databases.

While the application by the 2° Investing Initiative of the assessment tool involves the selection of a particular set of modelled data sources, these could of course be replaced by data points of similar quality and scope or expanded upon to include additional data points.

3.6 Consolidation rules

Datasets for production and ownership of assets can report this data at different levels along the ownership tree. In most instances the data provider aggregates production from all subsidiaries to a global parent owner, and does this based of the equity share principle. However, this is not always the case.

For the power sector the data is aggregated to the subsidiary level, ownership of physical assets is attributed to a subsidiary based on their respective equity stake in each physical plant. This ownership is then aggregated to the parent of the subsidiary as identified by the data provider, in this case, GlobalData, depending on if the subsidiary is private or publicly listed. For private subsidiaries, 100% of assets ownership attributed to the subsidiary is roll up to the parent company. For publicly listed subsidiaries, the ownership of physical assets is allocated over both the floating and non-floating portion of the company's total equity. The non-floating portion of the equity is attributed to the parent company, and the floating portion to the respective stock exchange.

For the Automotive sector the production values are aggregated to brand of automotive producer, as well as up to the ultimate global brand owner. In the case of joint ventures, which are most prevalent in the Chinese market, the production from these manufactures is distributed to the joint venture's owners by their respective equity share. This data for joint venture equity share is obtained through Bureau van Dijk's database, Orbis.

Using industry databases allocation of ownership and classification of companies listing status can create a time lag for the allocation of capital to the correct current owner. For this reason, linking the industry database to a 3rd party platform, such as Orbis, could increase the accuracy of the analysis. The accuracy of industry databases reporting on equity shares and listing status is currently being investigated by the University of Zurich.

4. Financial asset allocation rules

4.1 Overview

In order to assess financial portfolios, the real economic activity identified in the asset level or other databases (p. 7) needs to be matched to financial assets. This requires financial asset allocation rules, which may be different for different asset classes. The following briefly summarizes the allocation rules chosen by the assessment framework.

4.2 Private and listed equity

The model relies on the 'equity ownership' approach to allocate production to individual stocks. The relative ownership in a portfolio is thus calculated based on ownership of shares / # of outstanding shares. This uses standard financial accounting practices modelled after the practices developed as part of financed emissions methodologies.[1]

Illustration case: If portfolio owns 1% of one listed utility's total equity who in turn owned 50GW of installed power capacity in Europe, the portfolio would be allocated 500 MW of this capacity. If from the total 50GW, the utility owns 7GW of renewable power capacity, the portfolio would be allocated 70 MW of renewable power. If the listed utility plans to build out 1GW by 2020 then the portfolio will be allocated a total of 10MW of renewable capacity by 2020.

4.3 Bonds and other credit instruments (except for sovereign bonds)

There are three options to allocating economic activity to corporate bonds:

- The 'portfolio weight approach' weights each bond's exposure to a certain company based on the weight the bond has in the portfolio (e.g. 1% weight in the portfolio will lead to an allocation of 1% of the company).
- The 'equity + debt ownership approach' weights each bond's exposure to a certain company based on the share of the bond in total outstanding equity and debt, thus treating debt and equity equally in allocation.
- The 'financing approach' seeks to quantify each bond's exposure to a certain company based on the estimated financing the bon provides to the company's specific expenditures. This approach thus seeks to map expenditures directly with a bond, which, given data limitations, doesn't, requires a significant set of assumptions.

The model application at this stage can be done using either the first or the second approach, with no complete methodology that exists that would accompany the third approach.

4.4 Sovereign bonds

The model currently does not directly integrate assessments for sovereign bonds. For further information around allocation rules, see Beyond Ratings / 2° Investing Initiative (2016) "Sovereign bonds and the transition to a low-carbon economy: Measurement options for investors".

4.5 Real estate and infrastructure

The allocation of real estate to financial securities replicates the private and listed equity allocation rules in terms of the relative ownership of

4.6 Other asset classes

At this stage, the model does not integrate assessments for other asset classes.

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[1] 2°ii 2013 'From financed emissions to long-term investing metrics. State-of-the-art review of GHG emissions accounting for the financial sector'

5. Model assumptions

5.1 Overview

The 2°C portfolio assessment developed by the 2° Investing Initiative in the context of the Sustainable Energy Investing Metrics (SEIM),[2] Energy Transition Risk & Opportunity (ET Risk),[3] and Tragedy of the Horizons[4] projects. The following sections summarize the key modelling assumptions and calculation rules for each type of assessment performed as part of the 2°C portfolio test.

5.2 Principles around applying macroeconomic trends and shocks to financial portfolios and companies

The core modelling challenge associated with each type of assessment is mapping macroeconomic trends and shocks to financial portfolios and companies. The models developed here are thus different insofar as their key role is to map the exposure to and impact of economic trends to financial portfolios.

The model uses a simple 'fair share' assumption to map these trends to companies and financial portfolios. This fair share assumption stipulates that economic impacts are mapped to financial portfolios and underlying companies based on the market share these portfolios and companies have in the technology or market that affected by this impact.

The future market share is calculated depending on whether the production exposure is set to decrease or increase in the next 25 years according to the macroeconomic trend. If the production is meant to increase, the fair share is calculated based on the total market share of the product (e.g. installed capacity, etc.). This approach is called the 'market fair share'. If the production is meant to decrease, the fair share is calculated based on the total market share of the specific fuel / technology (e.g. coal production, coal installed power capacity). This approach is called the 'technology fair share'. This distinction was chosen since applying market fair share to declining technologies can yield negative results eventually (since the market share could be higher than the technology fair share) and because portfolios that have 'lagged' production increases in the past shouldn't be assumed to do so in the future. In theory, the model could apply the technology fair share for both increasing and decreasing technologies, a modelling choice not made in the current iteration.

The use of the fair share approach could be contested since it ignores important market realities that will dictate how each individual company performs under different macro scenarios. Alternative approaches involve bottom-up assessments of each individual company. While this is technically feasible, it is much more expensive and technically complex. An alternative option for oil and gas companies is to use cost curves to map impacts to low-cost and high-cost producers. The challenge with this approach is both the quality of the data and the logic of assuming costs are the primary drivers. Nevertheless, such a cost curve approach is likely to be more accurate than a simple fair share

[2] The EU Horizons 2020 the Sustainable Energy Investing Metrics (SEIM) project is currently in the process of providing a framework for investors and policy makers to translate high-level climate policy goals (e.g. limiting global warming to 2°C) into a benchmark that can inform portfolio allocation targets. The consortium is led by 2°ii and consists of CIRED, WWF Germany, KeplerCheuvreux, Climate Bonds Initiative, Frankfurt School of Finance & Management, CDP, WWF European Policy Office and the University of Zurich. (Grant number: 649982)

[3] The EU Horizons 2020 Energy Transition Risk (ET Risk) project is currently in the process of providing standardized tools for assessing carbon risk by translating the economic risk indicators around capital misallocation in the economy into financial risk indicators for financial market actors. The consortium is led by 2°ii and consists of University of Oxford, Kepler Cheuvreux, Carbon Tracker Initiative, Institute for Climate Economics (I4CE), The CO-Firm and Standard & Poor´s.

[4] 2°ii & The Generation Foundation have formed a partnership with a project entitled 'Tragedy of the Horizons' to explore and address the notion of the 'tragedy of the horizon', describing the potential suboptimal allocation of capital for the long-term due to the inability of the finance sector to capture long-term risks with short-term risk-assessment frameworks.

assumption and can be applied to scale with given datasets where they include production cost information. It would however be limited to fossil fuel companies in its application.

5.3 Defining the 2°C market benchmark

The model involves three types of assessments.

- An 'absolute' 2°C alignment assessment, based on the absolute weight of the technology in a portfolio relative to what would be expected under a 2°C transition for that portfolio's market;

- A 'relative' 2°C alignment assessment based on the exposure of technologies relative to each other in the portfolio; and

- A 'trend' 2°C alignment assessment that ignores the starting point exposure and only measures increase / decline rates.

Each of these assessments requires a benchmark against which misalignment can be tested. The key distinction for each of these approaches then relates to how the market benchmark's starting point is defined. The benchmark consists of two elements, namely the current point-in-time starting point and the increase / decrease of the exposure over a 5-year time horizon. The 2°C benchmark is then calculated for the market portfolio and scaled to the size of the portfolio being assessed.

The starting point is calculated in three different ways:

- For the 'absolute' 2°C alignment test, the starting point calculates the total exposure of the market portfolio (i.e. investable universe) to each technology and scales it on the basis of the size of the portfolio being assessed relative to the market portfolio. The model currently applies the absolute alignment test for fossil fuels, for which a relative 2°C alignment test is difficult given the lack of 'green' technologies to build ratios with in the fossil fuel sector.

  Example: If the market portfolio contains 100 GW of renewable power and the portfolio being assessed is 1% of the size of the market portfolio, the starting point to which the increases / decreases are applied using the fair share principle is 1 GW.

- For the 'relative' 2°C alignment test, the starting point is calculated based on the relative weight of different technologies in the market portfolio within one sector. The model currently applies the 'relative' 2°C alignment test for electric power and automobile.

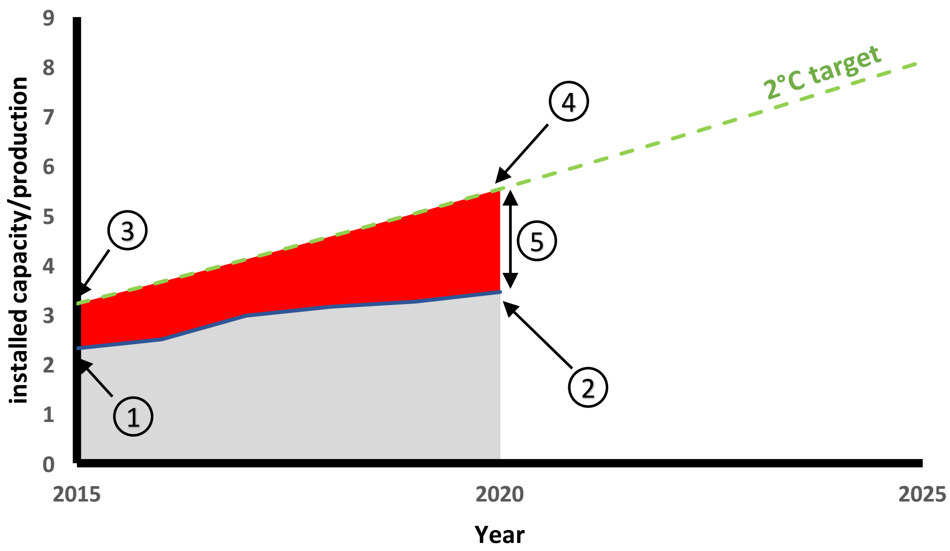
  Example: If the market portfolio's power mix at the starting point of the assessment includes 20% renewable power, the 20% share is applied to the total power exposure in the portfolio being assessed, independent of what the absolute exposure may be.

- For the 'trend' 2°C alignment test, the starting point of the portfolio being assessed is used as the basis and only the increase / decrease based on the fair share principle is applied.

  Example: If the portfolio has only 1% renewable power rather than 20% as in the market portfolio, the starting point is 1% for the benchmark, but the increase rate is applied based on the total share in electric power in the market.

5.4 2°C alignment test – Technology exposure

The 2°C alignment test – Technology exposure assessment involves the modelling steps outlined below, supported visually by the associated figure applied as an example to calculating the 2°C alignment test – technology exposure to renewable power. The example used here applies the 'relative' assessment, could however be adapted for the other two types of tests.



First, the model assesses the exposure to renewable power at the starting point of the assessment, with the portfolio representing the blue line ① and then measures the planned increased exposure based on bottom-up asset level databases ②. The 2°C benchmark (the green line) is then calculated by scaling the relative exposures to the portfolio size. Thus, if the total portfolio ownership of electric power is 16 GW and the weight of renewable power in the market portfolio in 2015 is 20%, the starting point is 3.2 GW (20% of 16 GW) ③. (*NB: As an illustrative example for the absolute assessment, if the portfolio was 3.2% of the market portfolio and the renewable power ownership by the market portfolio was 100 GW, then the starting point would be 3.2 GW).* The slope of the green line continuing from that starting point is then based on the fair share 'market principle' ④. The difference between the green line and the blue line in 2020 informs the 2°C alignment test ⑤. This difference can be expressed in economic units (e.g. GW) or percentage terms. The economic units are helpful to inform on some type of 'real' impact whereas the percentage terms help create comparability across financial portfolios of different sizes. The results can be calculated at aggregate portfolio level and for regional exposures within the portfolio.

5.5 2°C alignment test – Forward-looking carbon footprint

This test applies the results calculated in economic units and translates them into GHG emissions indicators using the forward-looking GHG emissions factors developed by the 2° Investing Initiative in partnership with EY.

5.6 2°C alignment test – Investment gap analysis

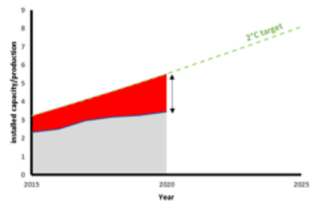
This test applies the results calculated in economic units and translates them into investment gap / over-investment figures using investment factors sourced from asset-level and economic databases.

5.7 2°C alignment test – Revenue gap analysis

The model applies the results calculated in economic units and translates them into revenue impact figures using revenue factors sourced from asset-level data and economic databases.

	Fossil Fuels			Automotive			Power					
	Gas Production	Oil Production	Coal Production	Electric Vehicles	Hybrid Vehicles	ICE Vehicles	Renewable Capacity	Hydro Capacity	Nuclear Capacity	Oil Capacity	Gas Capacity	Coal Capacity
Global	-17.7%	-15.8%	-61.9%	-72.5%	-70.3%	7.2%	88.4%	-78.6%	-59.4%	-94.4%	-9.2%	21.1%
OECD	20.7%	22.1%	-34.5%				86.2%	-71.5%	-65.2%	-93.7%	-12.4%	59.6%
Non-OECD	-96.2%	-95.6%	-100%		**No regional benchmark for automotive sector**		3.8%	-20.5%	-100%	75%	43.1%	-22%
U.S.	-39.5%	-26.3%	-100%				99.3%	-22.4%	-71.1%	-89.3%	-19.5%	50.2%
EU28	-63.1%	-62.4%	-64.1%				-28.1%	-16%	-13.6%	32.2%	38.4%	-11.1%

European Renewable Power Alignment



Caveats and further research

The following briefly summarizes some of the main caveats

- Power plant capacity is allocated based on the basis of equity share in the plant where multiple owners exist. Where data is available, production and capacity indicators were allocated to owners of subsidiaries based on the equity share principle. For power capacity, GlobalData's internal list of plant owners and subsidiaries were utilized, with 100% of capacity allocated from subsidiary to parent. For the automotive data there a number of joint ventures, particularly between OECD and Chinese firms. The production capacity is divided by the equity share. Oil and Gas production is allocated based on equity stake at field level, and is aggregated to parent companies by GlobalData, and coal production is taken from company reporting.
- The planned renewable capacity additions captured in the GlobalData database decrease starting in 2019. There are thus likely to be a number of projects that utilities *will* plan over the time horizon that are not yet captured in the database. The results thus under-state renewable exposure. Moreover, around 10% of the current data is currently not allocated to an owner / developer.

- Retirements are currently not forecasted for coal, given data constraints. Thus, 2020 estimates of coal power capacity may be overestimated to the extent that such capacity will be retired by then.

- Another challenge relates to the fair share assumption for renewables. Listed utilities currently have a lower share of renewable capacity than the total market. This can be interpreted to be a historical fluke (i.e. listed utilities are late-comers) or as some form of listed utility bias that will remain even in a 2°C economy. The model applied here assumes the first. Alternatively, the model could be developed assuming the second, where the 2°C equity benchmark is calculated by applying the 'fair share technology' approach to all technologies. Both options will be reviewed in further detail in the next iterations of the model. At this stage, the 'fair market share' was chosen given that there is no scientific basis to assume listed utilities should be less involved in building out renewables, where indeed some listed utilities exceed their 'fair market share' approach. Moreover, the fair market share approach shows more accurately potential misalignment with broader market trends, which would impact market share overall.

6. A list of the ISINs from the tested portfolio that have been captured by the modeling and allocated production values based on the aforementioned databases, can be provided upon request. 2ii cannot does not guarantee that all applicable ISINs within the test portfolio have been matched to their associated production values, or that all subsidiaries have been mated to parent companies.

Annex 1 –Data

6.1 Power data through GlobaLData

The following summarizes the matching of data for fuels used for power production to categories for GlobalData:

Coal	**Gas**	**Hydro**	**Nuclear**	**Oil**	**Renewables**
Anthracite	Blast Furnace Gas	Hydropower	Nuclear	Asphalt	Agricultural By-Product
Anthracite, Bituminous	City Gas			Automotive Diesel Oil	Animal Waste
Asphaltite	Coal Bed Methane Gas			Automotive Gas Oil	Bagasse
Bituminous	Coal Mine Gas			Bitumen	Bio-Waste
Bituminous, Subbituminous	Coal Mine Methane			Bunker Oil	Industrial Waste
Black Coal	Coal Seam Gas			Corex Gas	LandFill Gas
Brown Coal	Coal Seam Methane Gas			Crude Oil	Landfill-Gas
Coal	Coalbed Methane			Diesel	Municipal Solid Waste
Coal, Lignite	Coke Gas			Diesel Oil	Sewage Gas
Hard Coal	Coke Oven Gas			Distillate Fuel Oil	Waste Water
Lignite	Compressed Natural Gas			Distillate Oil	Wood By-Product
Low Sulphur Coal	Flare Gas			Distilled Fuel Oil	(blank):
Middling Coal	Flue Gas			Fuel Oil	**Biopower**
Peat	Fuel Gas			Fuel Oil, Diesel	Biopower
Pet Coke	Fuel Oil			Furnace Oil	**Geothermal**
Petroleum Coke	Gas			Gas Oil	Geothermal
Pulverized coal	Gas Oil			Heating Oil	**Ocean**
Pulverized Lignite	Industrial Gas			Heavy Crude Oil	Ocean Thermal
Raw Lignite	Industrial Waste Gas			Heavy Fuel Oil	Tidal
Refined Coal	Liquefied Natural Gas			Heavy Fuel Oil, Diesel	Wave
Soft Coal	Liquefied Natural Gas, Natural Gas			Heavy Furnace Oil	**Solar**
Sponge Coke	Liquefied Petroleum Gas			Heavy Oil	Solar CPV
Subbituminous	Liquified Natural Gas			High Speed Diesel	Solar CSP
Sub-Bituminous/Bituminous	Liquified Petroleum Gas			High Speed Furnace Oil	Solar PV
Syngas	Liquified Propane Gas			High Sulphur Fuel Oil	**Wind**
Waste Coal	Methane			Jet Fuel	Wind
	Methane Gas			Kerosene	

	Naptha			Light Crude Oil
	Natural Gas			Light Diesel Fuel Oil
	Natural Gas, Diesel			Light Diesel Oil
	Natural Gas, Furnace Oil			Light Distillate Oil
	Natural Gas, Petroleum Gas			Light Fuel Oil
	Natural Gas, Propane			Light Oil
	Natural Gas,Diesel			Liquefied Fuel Oil
	Natural Gas,Oil			Liquified Fuel Oil
	Natural Gas/Diesel			Low Pour Fuel Oil
	Off-Gas			Low Sulfur Distillate Fuel Oil
	Other Gas			Low Sulfur Heavy Fuel Oil
	Permeate Gas			Low Sulphur Fuel Oil
	Petroleum Gas			Low Sulphur Heavy Fuel Oil
	Propane			Low Sulphur Heavy Stock
	Refinery Gas			Low Sulphur Heavy Stock Fuel Oil
	Regasified Liquefied Natural Gas			Low Sulphur Heavy Stock Oil
	Residual Gas			LowæSulphuræFurnace Oil
	Syngas			Low-sulfur Kerosene
	Waste Coal Mine Gas			Marine Diesel Fuel Oil
	Waste Gas			Marine Diesel Oil
				Marine Fuel Oil
				Mazout
				Naphtha
				Naptha
				Oil
				Oil Shale
				Oil, Coal
				Orimulsion
				Pet Coke
				Residual Fuel Oil
				Residual Furnace Oil
				Residual Oil
				Syngas
				Ultra-low Sulfur Kerosene
				Waste Oil

The data fields retrieved from the database are listed below. The fields in **bold** are currently being used within the analysis. **Technology, Power Plant Name, Subsidiary Asset Name,** Fuel, Primary Fuel Secondary Fuel, Region, **Country**, State Or Province, County, City or Town, Total Capacity (MW), **Active Capacity (MW), Pipeline Capacity (MW),** Discontinued Capacity (MW), Type of Plant, **Owner, Owner Stake(%)**, Ownership Year, Operator, Developer, EPC Constructor, Power Purchaser, **Capex USD**, Efficiency, Latitude, Longitude, CCS/CCUS Technology, Annual Output, Capacity Factor, CO2 Emissions (Tonnes per annum), NOx Emissions (Tonnes per annum), SOx Emissions (Tonnes per annum), NOx Control System, NOx Control System Manufacturer, SOx Control System, SOx Control System Manufacturer, **Status, Year Online.**

6.2 Automotive data through WardsAuto Forecast Solutions

The data platform includes, but is not limited to, the following fields with the fields in **bold** currently being used within the analysis: **monthly production volume**, vehicle manufacturer, **brand owner**, brand, vehicle platform, vehicle program, state of production, end date of production, nameplate, vehicle segment, vehicle assembly plant, plant country, **powertrain type**, **primary fuel type**, number of cylinders, aspiration, displacement, max voltage and transmission type. Oil & Gas data through GlobalData.

The data platform includes, but is not limited to, the following fields with the fields in **bold** currently being used within the analysis: **Annual Production**, Field Name, Region**, Country**, Constituent Entity, Field Terrain, Field Status, Resource Type, Basin, **Participants,** Operator, Associated Block, Associated License, Reserve Status, 1p Reserves (boe), 2p Reserves (boe), 3p Reserves (boe), Recoverable Reserves (boe), Remaining Reserves (boe), Primary Trap Type, Gravity, Sulphur Content, Hydrogen Sulfide Content, Formation, Formation Rock Type, Facility Type, Calorific Value, County, Remaining NPV, IRR %, Capital Expenditure per (boe), Gas Oil Ratio, Payback years, Operating Expenditure (per boe), NPV (per boe), Remaining break even oil price (per bbl), Remaining break even gas price (per mcf), Full cycle break even oil price (per bbl), Full cycle break even gas price (per mcf), Total Capital Expenditure, Full Cycle NPV, Recovery Factor, Carbon Dioxide.

7. Annex 2 – Modelled data

Type of data point	Source	Use
Future emissions	2°ii / EY	
Oil and gas prices	International Energy Agency	