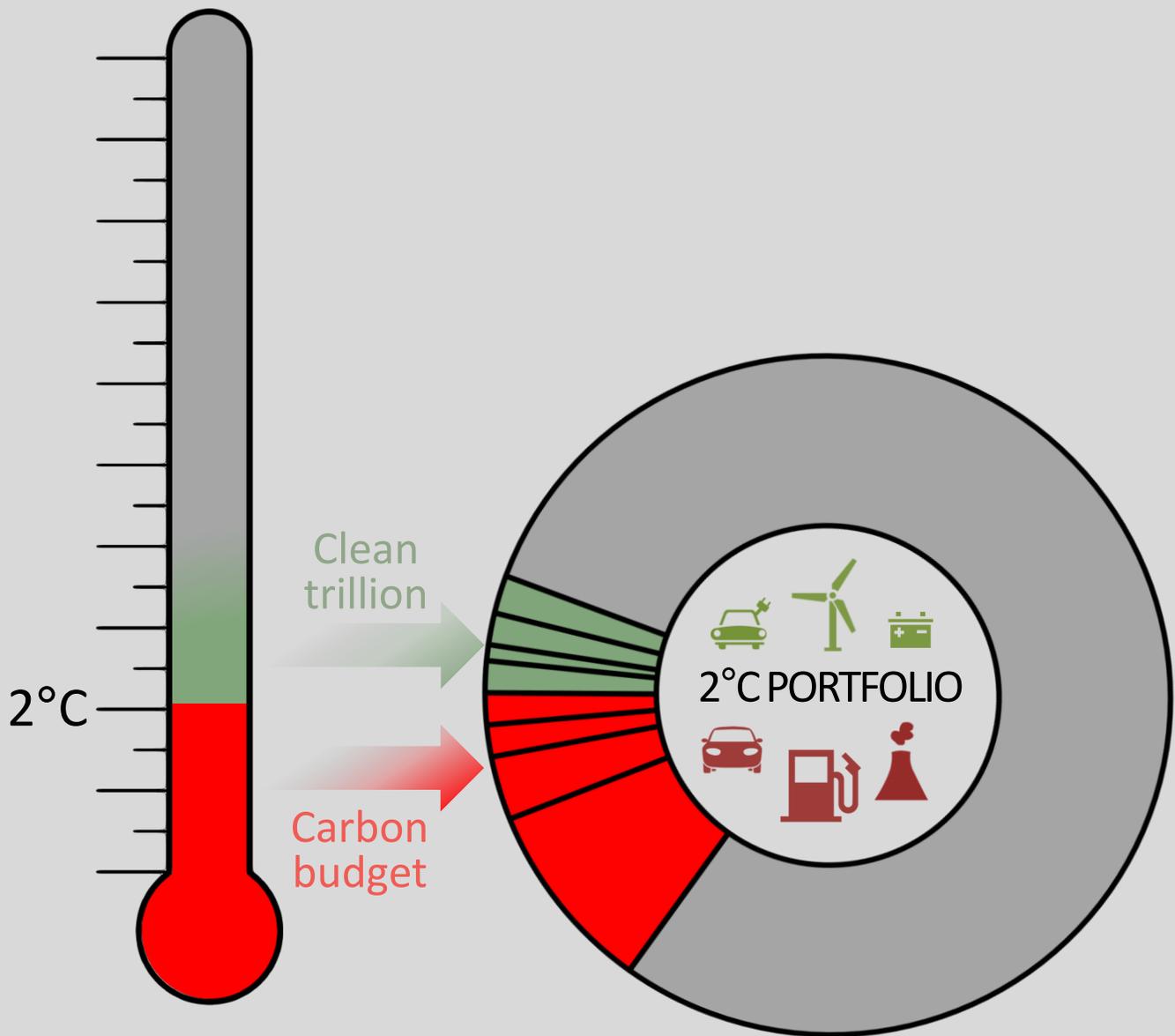


ASSESSING THE ALIGNMENT OF PORTFOLIOS WITH CLIMATE GOALS

CLIMATE SCENARIOS TRANSLATED INTO A 2°C BENCHMARK



WORKING PAPER - OCTOBER 2015

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ADEME



Agence de l'Environnement et de la Maîtrise de l'Énergie



ABOUT 2° INVESTING INITIATIVE

The 2° Investing Initiative [2°ii] is a multi-stakeholder think tank working to align the financial sector with the 2°C climate goal and long-term investment needs. Our research work seeks to align investment processes of financial institutions with climate goals; develop the metrics and tools to measure the climate friendliness of financial institutions; and mobilize regulatory and policy incentives to shift capital to energy transition financing. The association was founded in 2012 and has offices in Paris, London, and New York City.

ABOUT SEI METRICS PROJECT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649982. This report was published in the context of the H2020 "Sustainable Energy investment Metrics" project. The project aims to develop a climate performance framework and associated investment products that measure the exposure of financial portfolios to the 2°C economy. The metrics, benchmarks, and tools will enable investors to align their portfolio with decarbonization roadmaps. The project runs from March 2015 to March 2018 and mobilizes over €2.5m in funding. Consortium members in the project include the 2° Investing Initiative, CIRED, WWF Germany, Kepler-Cheuvreux, Climate Bonds Initiative, Frankfurt School of Finance & Management, CDP, WWF European Policy Office and the University of Zurich.

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TABLE OF CONTENTS

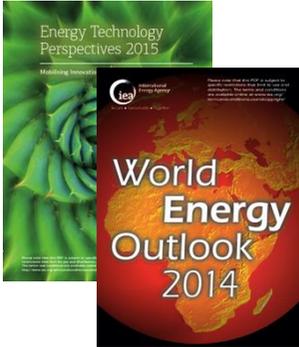
EXECUTIVE SUMMARY	4
1. INTRODUCTION	9
2. DEFINING THE 2°C PORTFOLIO	11
2.1 Overview	11
2.2 Current practices	12
2.3 The 2°C Portfolio framework	13
<i>Focus: 2 °C scenarios</i>	15
<i>Focus: Defining 2 °C Alignment at company level</i>	16
2.5 Data sources	17
2.4 Caveats	18
3. THE 2°C BENCHMARK	19
3.1 Overview	19
3.2 Electric utilities	20
<i>Focus: Energy and technologies in the utility sector</i>	22
<i>Focus: The future of the utility sector</i>	22
3.3 Automotive sector	23
<i>Focus: Fuel efficiency</i>	25
<i>Focus: Heavy duty vehicles</i>	25
3.4 Fossil fuel sectors	26
<i>Focus: Carbon capture and storage</i>	29
<i>Focus: Biofuels</i>	29
4. CONCLUSION	30
4.1 Implications for investors	30
4.2 Investability of a 2°C portfolio	31
4.3 Implications for climate friendliness and impact	32
4.4 Implications for data providers	32
4.5 Implications for policy makers	33
4.6 Next steps for the project	33
BIBLIOGRAPHY	34
ABOUT SEI METRICS CONSORTIUM	35

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HOW DO WE TRANSLATE 2°C SCENARIOS INTO A 2°C BENCHMARK?

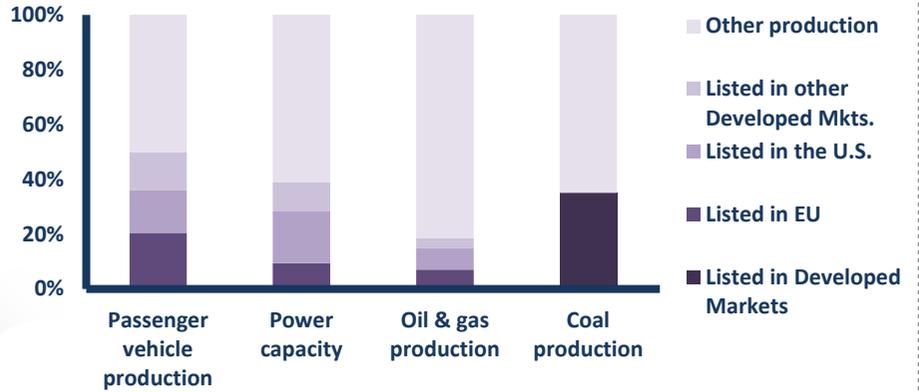
2°C Energy technology roadmaps

Technology deployment objectives

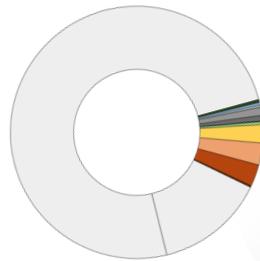


Relative role of stock exchanges

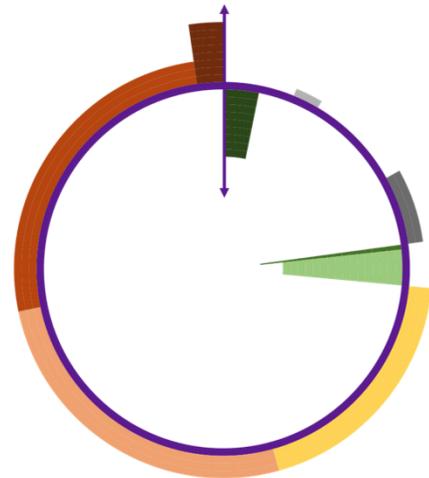
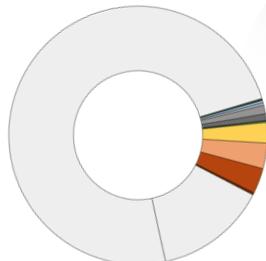
Role of listed companies in delivering energy and transport



TARGET:
the 2°C portfolio
Technology exposure in 2020 aligned with the IEA 2°C scenario



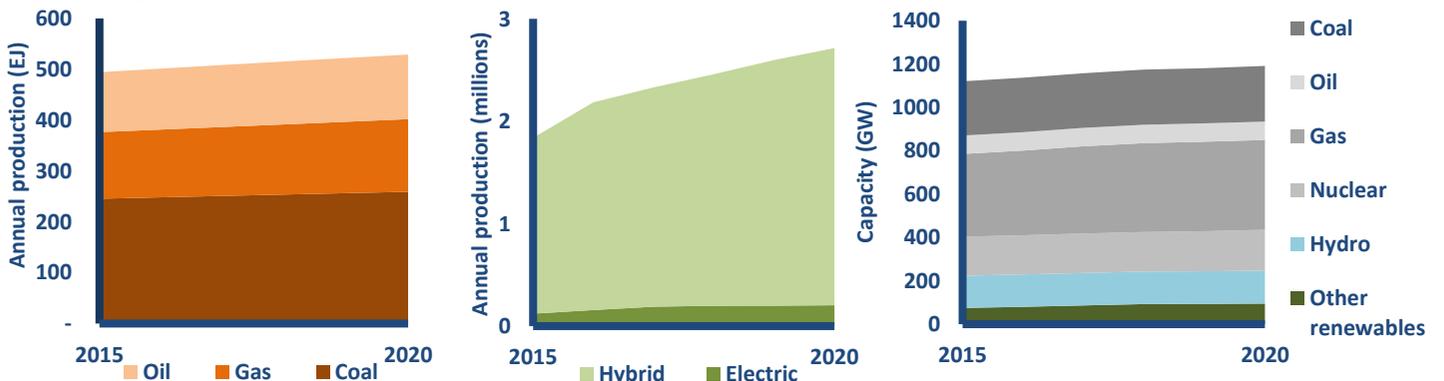
PERFORMANCE:
Actual portfolio
Technology exposure of portfolio components in 2020 based on forecasts



OUTPUT:
Exposure gap analysis
Over and under exposure of the portfolio vs. target

Portfolios production forecast

Technology deployment and production forecasts for constituents, based on industry-specific databases



EXECUTIVE SUMMARY

KEY OBJECTIVES



PROVIDE A 2°C BENCHMARK The primary objective of the project is to provide 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.



PROVIDE RELEVANT PERFORMANCE METRICS FOR COMPANIES AND INVESTORS In performing this translation, the framework generates a set of key, sector-specific performance metrics that measure the exposure of a given portfolio to the energy and technologies that represent climate problems and solutions. These performance metrics allow for the first time portfolio-level benchmarking of climate policy alignment. They act as benchmarks for both asset managers and companies on how their business model today aligns with decarbonization trends and quantify the necessary steps to close the 2°C exposure gap.



INFORM POLICY MAKERS The benchmarks and measurement of alignment can be disclosed by investors to help policy makers better identify key private sector investment gaps, allowing them to better target public investments and tax incentives.

KEY DRIVERS OF ADOPTION



INVESTORS PLEDGES ON PORTFOLIO DECARBONIZATION

“The Portfolio Decarbonization Coalition (PDC) is a multi-stakeholder initiative that will drive GHG emissions reductions on the ground by mobilizing a critical mass of institutional investors committed to gradually decarbonizing their portfolios (...) Portfolio decarbonization can be achieved by withdrawing capital from particularly carbon-intensive companies, projects and technologies in each sector and by re-investing that capital into particularly carbon-efficient companies, projects, and technologies of the same sector. It can also be achieved through targeted engagement by investors with portfolio companies. (...) the second goal is to assemble a coalition of investors who in aggregate will commit to decarbonizing at least USD 100bn in institutional investment across asset classes.”

Portfolio Decarbonization Coalition, launched in September 2014



MANDATORY INVESTOR DISCLOSURE

Institutional investors shall “disclose in their annual report, and make available to their beneficiaries, (...) their exposure to climate-related risks, including the GHG emissions associated with assets owned, their contribution to the international climate targets and the energy and ecological transition. That contribution will be assessed with regards to indicative targets taking into account the nature of their activities (...) set by the implementation decree.”

Article 173 of the French Law on the Energy Transition for Green Growth, applicable from 2016 onwards



INTERNATIOANL POLICY INITIATIVES

“Risks to financial stability will be minimised if the transition begins early and follows a predictable path, thereby helping the market anticipate the transition to a 2 degree world (...) We are considering recommending to the G20 summit that more be done to develop consistent, comparable, reliable and clear disclosure around the carbon intensity of different assets. (...) Companies would disclose not only what they are emitting today, but how they plan their transition to the net-zero world of the future.”

Mark Carney, Governor of the Bank of England, Chairman of the Financial Stability Board, 29 September 2015

KEY ELEMENTS OF THE METHODOLOGY



ROADMAP TRANSLATION The framework starts with the quantitative targets set in the 2°C energy technology roadmaps of the International Energy Agency (World Energy Outlook and Energy Technology Perspectives). These targets are ‘adapted’ to stock markets to reflect the role of listed companies in the deployment of technologies and the production of energy in different geographies.



ENERGY TECHNOLOGY EXPOSURE Using granular (plant by plant, car production by model and country), forward-looking (capacity addition plans, production forecast, etc.) data from industry-specific databases, the authors assess the future exposure of listed companies to energy technologies.



GAP ANALYSIS The exposure of a given equity portfolio to various energy and technologies is compared to the exposure of the 2°C benchmark, generating indicators of over- and under-exposure to these key technologies and energy production.

KEY FINDINGS



WHAT DOES A 2°C PORTFOLIO LOOK LIKE? The report defines allocation targets for a European, US, and Developed Markets 2°C portfolio and compares these to the STOXX 600, S&P 500, and MSCI World respectively. Based on the limited number of technologies and indicators covered in this first version of the model, the market-capitalization weighted indices under-weight renewable power generation by 19-36% and electric car production by 66-96%. They over-weight coal fired power generation by 7-16%, oil & gas production by 12-14% and coal production by 0-31%. Our anecdotal evidence regarding exposure to R&D expenditure further suggests that a 2°C portfolio involves a dramatic increase in exposure to breakthrough zero carbon technologies and that this increase is generally unachievable in large companies alone.



HOW CAN INVESTORS ALIGN THEIR PORTFOLIO? Investors have several options to reach 2°C benchmarks. Options include reweighting the portfolio using key performance indicators as constraints, engaging with large companies to influence capital and R&D expenditure or asset impairment strategies, extending their universe to clean tech pure players, or directly ‘offsetting’ their under exposure to clean technologies in the infrastructure, private equity, and venture capital buckets of their portfolio.



HOW DOES IT PERFORM? The illustrative optimized 2°C equities portfolio over-perform their benchmark over the past 3 years, with a tracking error of 0.29-0.97. This performance is likely related to the recent underperformance of the energy sector and does not predict future performance.

KEY CAVEATS



EXPOSURE VS. IMPACT ON THE GROUND. The reallocation of an investment portfolio doesn’t necessarily lead to changes in capital allocation on the ground. Some decarbonization strategies are more impactful than others. The next step of the project will involve exploring the most impactful avenues.

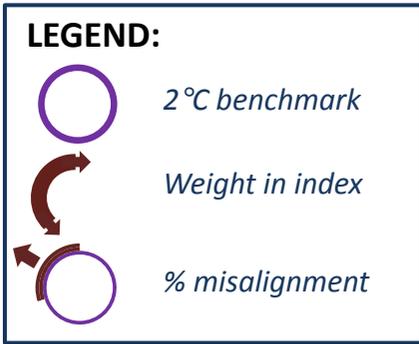


THINK BEYOND IEA SCENARIOS. The objective of the project is to develop a proof of concept on a ‘translation software’, not to prescribe the IEA vision or any other vision of a 2°C future. The next step will involve translating other scenarios, notably based on different assumptions regarding the deployment of renewables and carbon capture and sequestration (CCS).

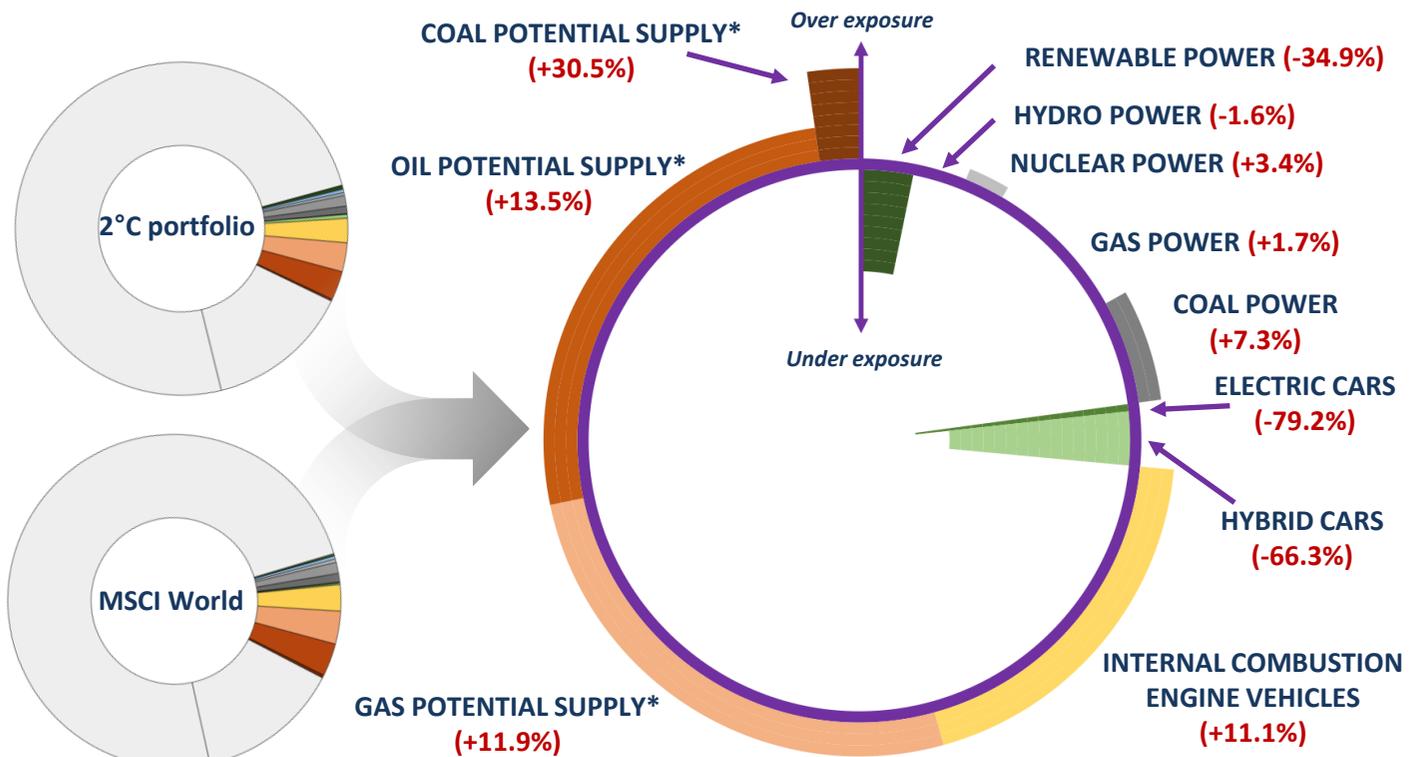


BEWARE OF PICKING WINNERS. The translation of a 2°C roadmap into a target portfolio inherently prescribes exposure to certain categories of technologies (technology exposure targets) and certain burden sharing between sectors’ and geographies’ carbon budget. This challenge exists as well for the carbon allocation of the carbon budget more generally. The only way to achieve different outcomes is to benchmark a portfolio against different roadmaps with different visions of the 2°C decarbonisation pathway.

THE DEVELOPED MARKETS EQUITY UNIVERSE: 2°C BENCHMARK AND MSCI WORLD



The portfolio shows the relative under- and over exposure of the index to the 2°C exposure target for the index’s geographic boundary. The width of the bars approximate the market capitalization share in the part of the portfolio assessed (Figure on left). The distance from the purple circle (the 2°C benchmark) shows the degree of over and under exposure. The misalignment is calculated using a 5 year time horizon (until 2020). The utility and automobile sector misalignment was defined using 5 year production and capacity forecasts. The oil, gas, and coal misalignment was assessed by using the difference between potential future supply in the 4-5°C and the 2°C scenario, and extrapolating this result on the company’s activities until 2020.



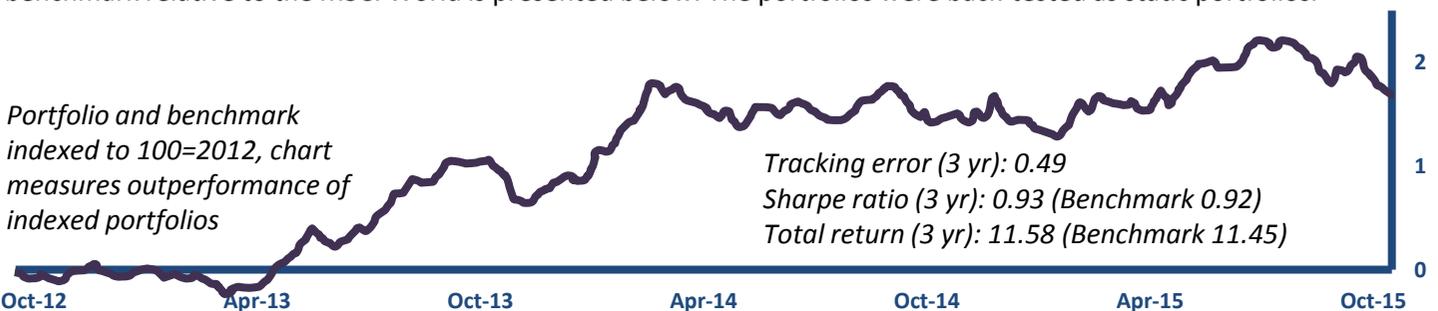
* Based on industry average estimates.

SOURCE: 2°I, BASED ON IEA, GLOBALDATA, AND WARDAUTO

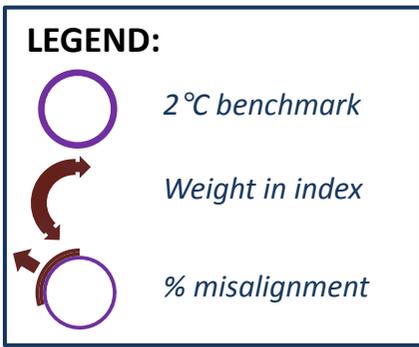
BACK TESTING THE 2°C DEVELOPED MARKETS PORTFOLIO

Comparing 2°C portfolio with market benchmark (based on Bloomberg Portfolio Analytics)

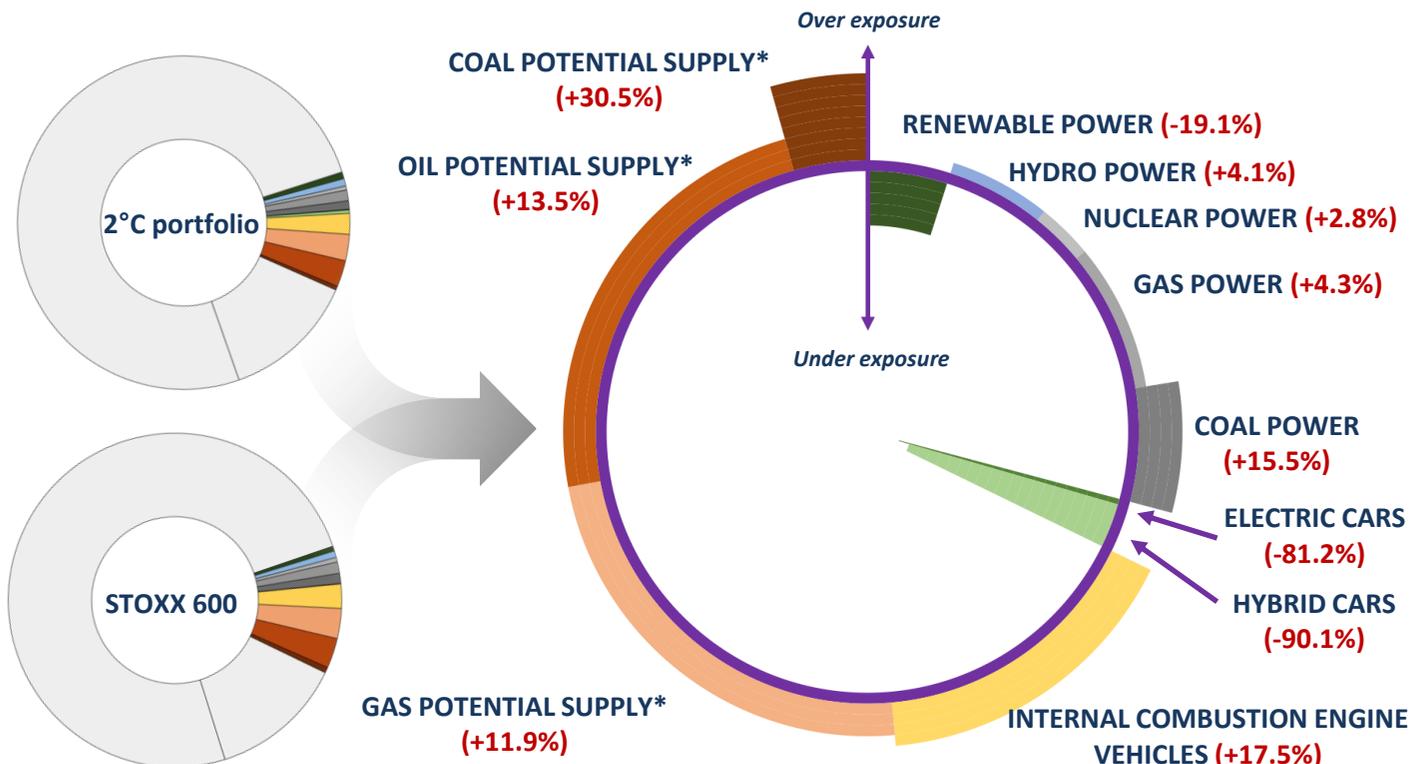
The MSCI World was re-weighted to align the portfolio with the 2°C technology exposure targets. The realignment was limited to the energy and technologies covered in this paper and did not consider potential misalignment to technologies not yet covered. The realignment in the utility and automobile sector relied on aligning the relative energy and technology ratios without managing total production levels. In the case of automobile, this alignment was only possible for electric vehicles, with a gap remaining for hybrid. The financial performance (total return) of the 2°C benchmark relative to the MSCI World is presented below. The portfolios were back-tested as static portfolios.



THE EUROPEAN EQUITY UNIVERSE: 2°C BENCHMARK AND STOXX 600



The portfolio shows the relative under- and over exposure of the index to the 2°C exposure target for the index's geographic boundary. The width of the bars approximate the market capitalization share in the part of the portfolio assessed (Figure on left). The distance from the purple circle (the 2°C benchmark) shows the degree of over and under exposure. The misalignment is calculated using a 5 year time horizon (until 2020). The utility and automobile sector misalignment was defined using 5 year production and capacity forecasts. The oil, gas, and coal misalignment was assessed by using the difference between potential future supply in the 4-5°C and the 2°C scenario, and extrapolating this result on the company's activities until 2020.



* Based on industry average estimates.

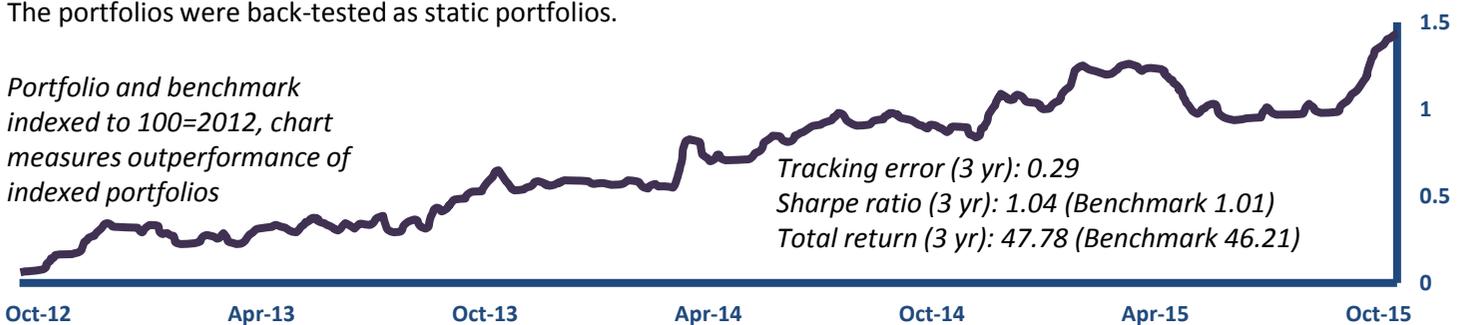
SOURCE: 2°II, BASED ON IEA, GLOBALDATA, AND WARDAUTO

BACK TESTING THE 2°C EUROPEAN PORTFOLIO

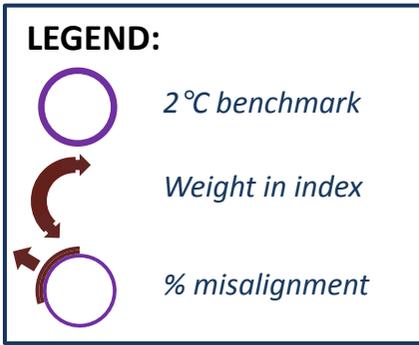
Comparing 2°C portfolio with market benchmark (based on Bloomberg Portfolio Analytics)

The STOXX 600 could not be aligned as a 2°C portfolio based on its current universe. A realigned portfolio still under weights exposure to electric vehicles by about 40% and hybrid vehicles by about 80%. The back-tested portfolio *thus remains misaligned*. The results are presented below. As for the other indices, the realignment was limited to the energy and technologies covered in this paper and did not consider potential misalignment to technologies not yet covered. The financial performance (total return) of the 2°C benchmark relative to the STOXX600 is presented below. The portfolios were back-tested as static portfolios.

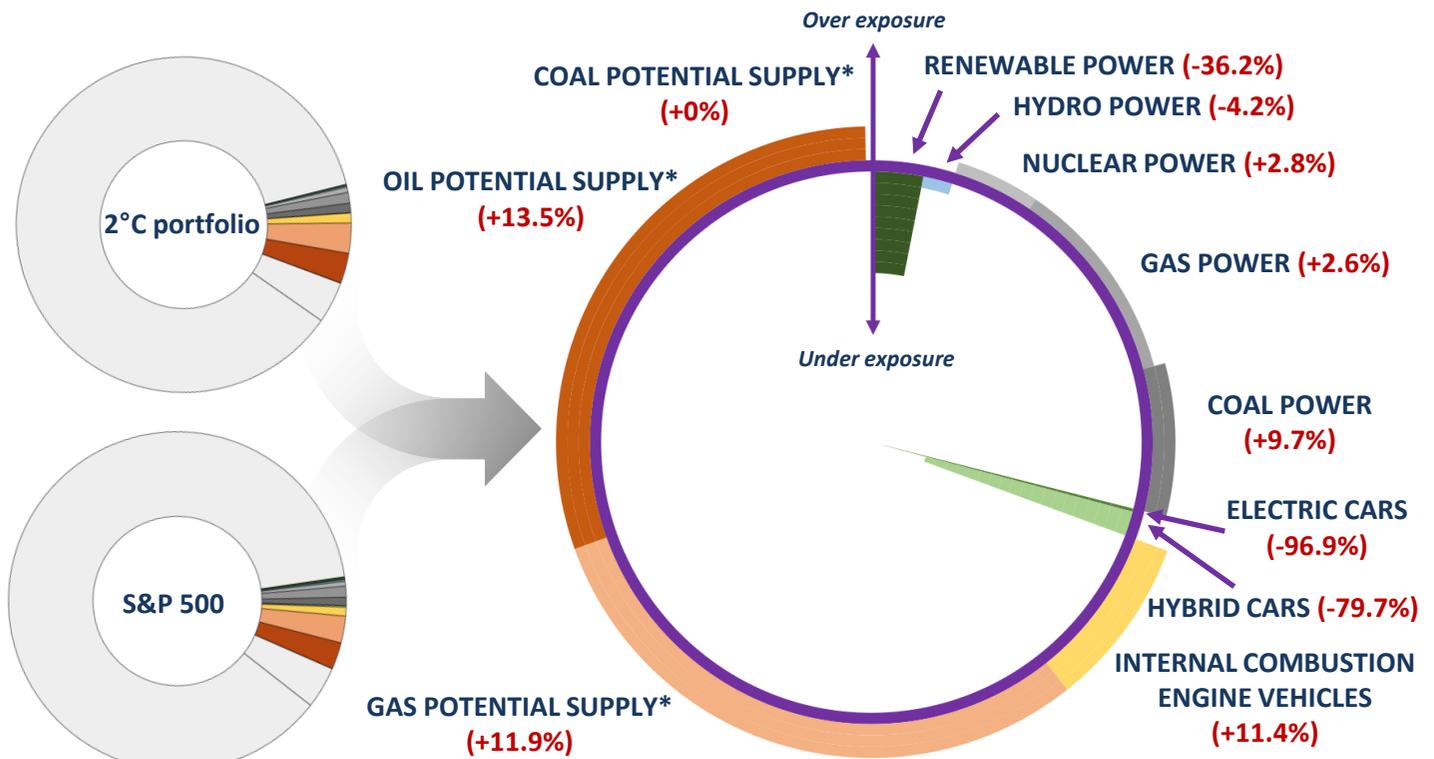
Portfolio and benchmark indexed to 100=2012, chart measures outperformance of indexed portfolios



THE US EQUITY UNIVERSE: 2°C BENCHMARK AND S&P 500



The portfolio shows the relative under- and over exposure of the index to the 2°C exposure target for the index’s geographic boundary. The width of the bars approximate the market capitalization share in the part of the portfolio assessed (Figure on left). The distance from the purple circle (the 2°C benchmark) shows the degree of over and under exposure. The misalignment is calculated using a 5 year time horizon (until 2020). The utility and automobile sector misalignment was defined using 5 year production and capacity forecasts. The oil, gas, and coal misalignment was assessed by using the difference between potential future supply in the 4-5°C and the 2°C scenario, and extrapolating this result on the company’s activities until 2020.



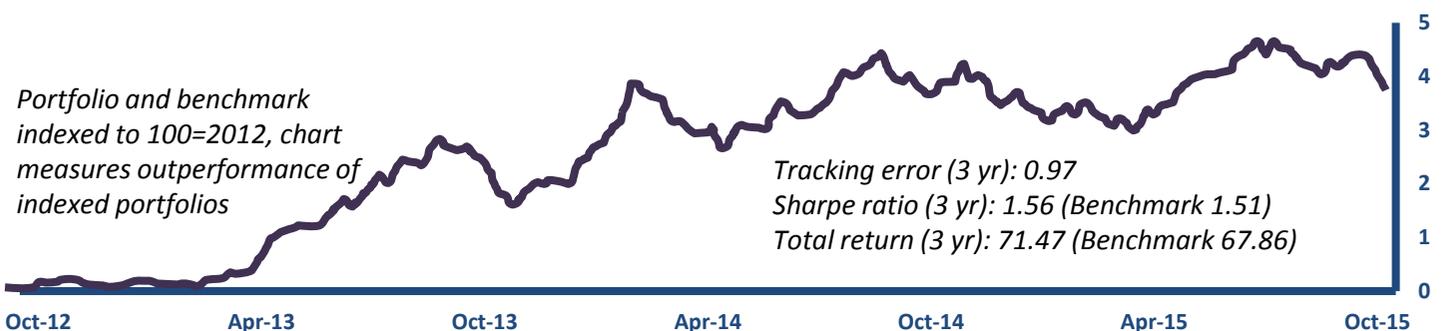
* Based on industry average estimates.

SOURCE: 2°II, BASED ON IEA, GLOBALDATA, AND WARDAUTO

BACK TESTING THE 2°C US PORTFOLIO

Comparing 2°C portfolio with market benchmark (based on Bloomberg Portfolio Analytics)

The S&P 500 was re-weighted to align the portfolio with the 2°C technology exposure targets. The realignment was limited to the energy and technologies covered in this paper and did not consider potential misalignment to technologies not yet covered. The realignment in the utility and automobile sector relied on aligning the relative energy and technology ratios without managing total production levels. In the case of automobile, this alignment was only possible for electric vehicles, with a gap remaining for hybrid. The financial performance (total return) of the 2°C benchmark relative to the S&P 500 is presented below. The portfolios were back-tested as static portfolios.



1. INTRODUCTION

Overview. This paper introduces a framework for assessing the alignment of an investment portfolio with the 2°C climate goal. The assessment consists of comparing the energy and technology exposure of a portfolio with the 2°C roadmap of the International Energy Agency (IEA). In other words, this paper translates the climate goals and related scenarios into a '2°C benchmark' for investors: the 2°C portfolio. A 2°C portfolio is the 'normal' diversified portfolio of an average investor in a 2°C world. The framework enables the assessment of an investment portfolio vis-à-vis a 2°C benchmark. The output of the assessment is a 'energy and technology exposure gap'. This gap quantifies the over and under-exposure to energy and technologies under a 2°C trajectory.

Objective. The assessment can inform investor and policy makers objectives through two complementary channels:

- *Risk management:* The transition to a low-carbon economy may lead to disruptive changes that give rise to financial risk. Some long-term investors believe that the market misprices the related risks. To date, the emphasis in risk assessment has been on developing alternative discounted cash flow models (HSBC 2012) and to some extent on top-down models at strategic asset allocation level (Mercer 2015). The 2°C benchmark is an indicator measuring the exposure to energy and technologies, acting as an extension of traditional country and sector diversification criteria, as espoused by modern portfolio theory (Markowitz 1952, Tobin 1958, Sharpe 1964). The benchmark can thus inform on potential idiosyncratic risk exposure to the high carbon economy – sub-optimal diversification in the context of the transition to a low-carbon economy.
- *Contribution to the energy transition.* Some investors' mandates involve contributing to public policy goals, including climate mitigation (2° Investing Initiative / UNEP-Fi / WRI 2015). While applying the 2°C benchmark does not inform on the actual *impact* of investors portfolio allocation in the real economy, it can be considered a first approximation of such impact.

Use of the 2°C benchmark. In practice, this paper suggests that the framework can be applied as follows:

- Inform shareholder engagement activities, with a focus on the capital and R&D expenditure on energy and technologies;
- Define priorities for investments in small caps, private equity and venture capital, where investments at individual level can make a difference;
- Create a new 'norm' for public investors, and new performance criteria for fiscal policy makers in order to mobilize a critical mass of assets under management and ultimately impact the cost of capital for companies;
- Help long-term investors define 'goal posts' for energy technology exposure.

FIG 1.1: FROM CLIMATE GOALS TO INVESTOR PORTFOLIOS AND BACK (SOURCE: 2°II)



From current metrics to 2°C portfolios. This framework builds on years of experience developing, testing, and studying climate related metrics such as the portfolio carbon footprint (CO₂/\$ of capitalization), exposure to green and brown categories (% of sales or capitalization), and climate scoring (2° Investing Initiative 2013; 2° Investing Initiative 2014; 2° Investing Initiative / UNEP-Fi / WRI 2015). It recognizes and utilizes the strengths of each of these approaches and minimizes each of their weaknesses in the following ways:

- Existing metrics measure performance relative to market benchmarks. They lack a meaningful 2°C benchmark. The report does not necessarily endorse alternative metrics; all of the indicators used in this report are provided by industry and ESG data providers and are used by market actors. The role here is to contextualize what the paper identifies as the most relevant criteria from a 2°C economy perspective and develop benchmarks for these criteria.
- Existing metrics help communicate on a single figure and thus focus either on the problem (e.g. carbon footprint) or the solutions (e.g. green share). Without context, including exposure to “green”, “brown”, and business that is neither “green” or “brown”, these metrics do not provide a complete picture.
- Most approaches for equities rely on proprietary models and methodologies, preventing standardization around voluntary and mandatory disclosure, and the associated introduction of policy incentives. The approach developed here is open source. Unlike in the bonds space (e.g. Climate Bonds Initiative), open source hasn’t been a part of equity methodologies. The methodology will be made publicly available, and free-of-charge support actions are planned for policy makers, index and data providers, asset managers, and asset owners.

Equally, the 2°C portfolio framework is designed as a complement to other approaches rather than a replacement (cf. p. 12). It builds on existing metrics and links these to 2°C exposure targets. It can help inform portfolio construction that can be communicated through a portfolio carbon footprint for example. It’s scope is limited to energy technology roadmaps and thus does not cover a number of key industries requiring alternative approaches (e.g. real estate, etc.). Moreover, due to its quantitative focus, the framework doesn’t capture ‘qualitative’ impacts such as lobbying practices of companies, influence on suppliers and clients, etc.

Scope. This paper introduces the concept of 2°C portfolio and tests it for a subset of investor portfolios:

- *Asset classes:* The paper focuses exclusively on the assessment of equity portfolios. The framework will be further developed for other asset classes, notably bonds, in 2016.
- *Geographies:* The paper covers US, European, and Developed Markets equity portfolios. An Emerging Market report will be published in 2016.
- *Industries:* The report provides specific quantitative benchmarks for key energy and energy technologies, including oil & gas, coal mining, power, and automotive. The next version will then be extended to other sectors referenced in the IEA roadmaps: cement, steel, shipping, and air transport.
- *Scenarios:* The current framework is based on the IEA 2°C roadmaps. Future developments will involve changes in assumptions, notably regarding the role of CCS and nuclear, and the use of other scenarios (cf. p. 15).
- *Current data:* The paper provides a framework that can be applied by investors using the current landscape of data. All analysis presented in this working paper is already offered as a free service in the short-term can be replicated by standard ESG data providers as part of commercial services in a few months with limited cost.

The framework is a work in progress. It presents different options, which will be explored in further detail and extended in the next months. The results are not definitive. The aim is to pave the way for a new avenue, leading to new questions asked by investors (through platforms like CDP), new reporting frameworks for companies, and new criteria for financial and fiscal policy makers. Its focus on diversification is designed to challenge and respond to broader questions of fiduciary duty.

Outline of the paper. The paper is organized as follows. Section II reviews existing practices and defines the general framework. Section III applies this framework for the utility, automobile, and fossil fuel sector (e.g. oil & gas, coal). Section IV then provides some concluding remarks and an outlook for next steps.

2. DEFINING THE 2°C PORTFOLIO

2.1 OVERVIEW

Definition. The objective of the framework is to allow investors and policy makers to assess the alignment of an equity portfolio with the decarbonization pathways, specifically those associated with the 2°C climate goal. The 2°C portfolio is defined as *the representative, diversified equity portfolio in a market aligned with a consistent 2°C decarbonization pathway*. This concept can be explained best by splitting it into its constituent parts:

- **Representative diversified.** The framework defines what the representative diversified equity portfolio looks like in terms of energy and technology exposure targets. While different exposure can in sum be 2°C compatible, of interest here is the representative exposure. The framework thus acts as a market benchmark. This 2°C exposure is compared to the current market benchmarks (S&P 500, STOXX 600, and MSCI World) as proof of concept. The results show what the benchmark *would* look like if the equity markets were 2°C aligned.
- **Equity portfolio in a market.** The framework presented here focuses on equity markets. Thus the model does not apply ‘economy’ benchmarks as targets, but translates them to equity markets based on the breakdown of production by markets and a ‘fair share’ logic that allocates future responsibility for production across asset classes. The next steps of the project will generalize the concept to other asset classes.
- **Aligned.** Alignment is defined as *the compatibility of projected future production of the companies in the portfolio with energy and technology trends in the 2°C scenario*.
- **Consistent 2°C decarbonization pathway.** Benchmarks for alignment are derived from detailed energy systems models that account for all sectors and the interdependencies between them (c.f. p. 15). Models optimize the energy system and associated technologies across sectors, regions, and time to meet the constraint laid out by the 2°C carbon budget (Fig. 2.1).

FIG. 2.1: THE 2°C FRAMEWORK (SOURCE: 2° II)

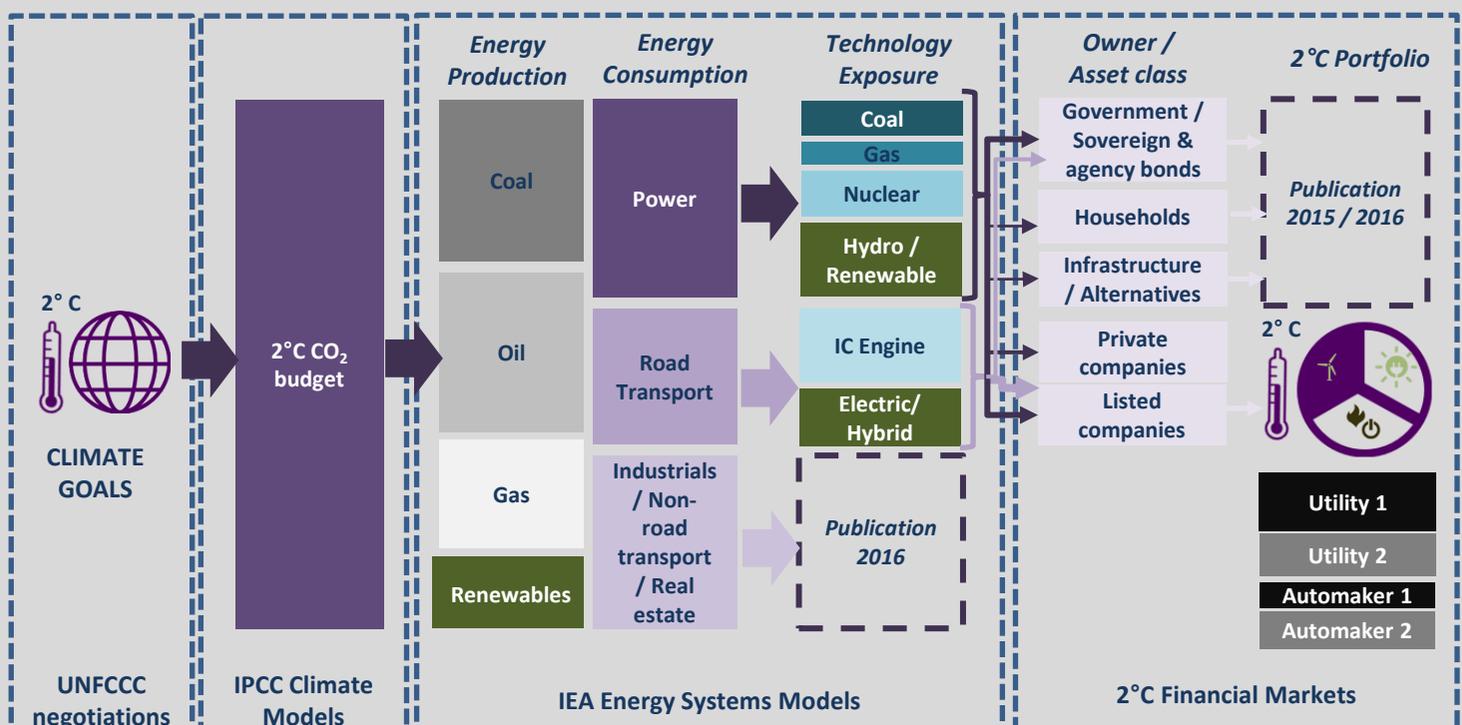


FIG.2.2: SHARE OF GREEN IN MSCI ACWI AND LOW CARBON TARGET INDEX (SOURCE: MSCI 2015)

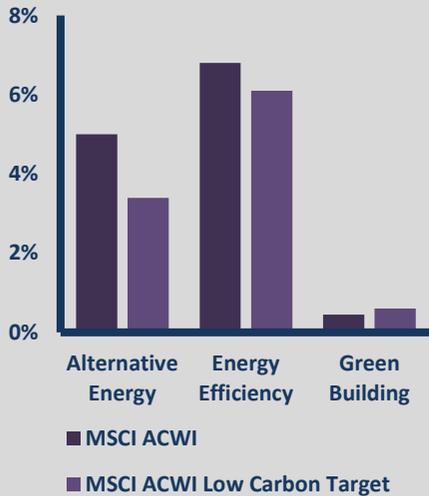


FIG. 2.3: TECHNOLOGY WEIGHTS IN LOW-CARBON INDEX VERSUS 2°C TARGET (SOURCE: 2°II, BASED ON GLOBALDATA)

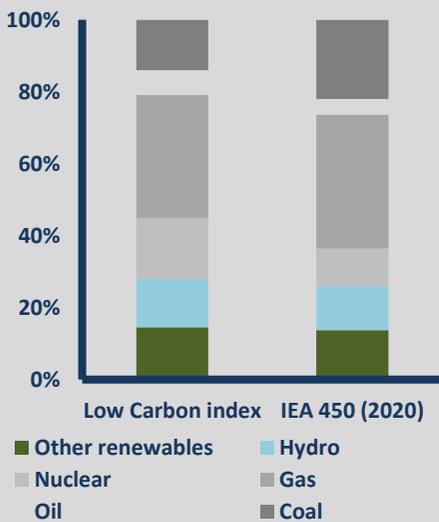
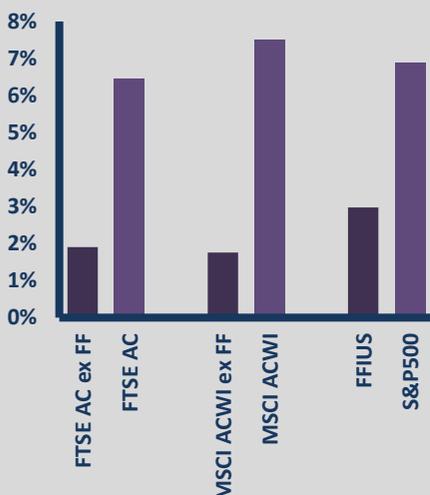


FIG.2.4: WEIGHT OF ENERGY SECTOR IN FOSSIL FUEL FREE INDICES (SOURCE: 2°II, BASED ON INDEX FACTSHEETS 2015)



2.2. CURRENT PRACTICES

Types of climate related indices. Current climate-related portfolio assessment frameworks emphasize either climate solutions or climate problems. They are already applied in financial market indices advertised as ‘climate friendly’ and/or contributing to reducing carbon risk exposure.

The three most prominent types are pure play indices (e.g. cleantech indices), ‘divest’ indices (e.g. ex-coal, ex fossil fuel), and carbon tilted indices:

- **Carbon tilted indices** use the carbon footprint (generally Scopes 1 and 2) of the company to adjust exposure, with some indices now also integrating fossil fuel reserves as well. Carbon-tilted indices do not directly address the exposure to green (Fig. 2.2). The indices do however lower the exposure to high-carbon sectors more generally. One of the low carbon indices reviewed for this paper, for example, has a slightly higher exposure to oil & gas production, but significantly reduced exposure to coal production (over 80% for coal in 2014). At the same time, their utility exposure seems largely 2°C aligned (Fig. 2.3).
- **Ex fossil fuel indices** are the most ambitious in terms of reducing exposure to fossil fuel technologies (oil & gas, coal). They struggle to get mainstream traction given their significant sector adjustment (Fig. 2.4) and don’t address ‘green’ exposure.
- **Pure play sustainability indices** are the most ambitious from a ‘green’ exposure perspective, but do not represent diversified portfolios.

Towards a 2°C assessment. None of the existing products are benchmarked to decarbonization pathways. The framework developed here has several differences:

- The framework defines exposure targets to both **climate solutions and climate problems**. Existing approaches are generally limited to one aspect.
- The assessment focuses on aggregate portfolio-level **energy and technology exposure**. This does not imply that individual companies are 2°C compatible or not, the subject of “science-based target setting” at company level (cf p. 16).
- The framework is **not by default less or more climate friendly** than existing indices. Fossil fuel free indices, for example, will likely be more ambitious from an energy exposure perspective and less ambitious from a green technology perspective.

2.3 THE 2°C PORTFOLIO FRAMEWORK

Step 1: Define the decarbonisation pathway

The International Energy Agency (IEA) publishes an annual *World Energy Outlook* (WEO) and *Energy Technology Perspectives* (ETP), the most prominent forecasts on energy technology trends (cf. sidebar). This report will use these as the basis of the analysis although the exercise can be done with other roadmaps (cf. p. 15). The IEA presents in their roadmaps both production profiles (measured in MWh generated, etc.) and decarbonisation profiles (emissions generated and avoided due to a technology).

Step 2: Define the relevant geography

The IEA regions do not always match the geographical boundaries relevant to investors (e.g. stock markets, corporate production boundaries). For example, the countries covered by the MSCI World are not classified as one region by the IEA, the closest equivalent being the OECD region, and a similar problem exists for the STOXX 600 (Fig. 2.5). In general the approach taken here is to align geographies as closely as possible and report on gaps.

Step 3: Define the forecast period and benchmark year

A 2°C portfolio can hypothetically take any forecast period as the benchmark within the constraints of available scenarios (e.g. IEA WEO 2040, IEA ETP 2050). Short-term forecast periods will naturally have less uncertainty, but by definition they also may fail to capture long-term trends in some industries. Another issue is that most scenarios show slow decarbonisation at first while increasing in speed over the 20-40 year timeframe. Thus the 2°C scenario only diverges marginally until 2020 from the BAU scenario. Two options are possible:

- Define a common forecast period across sectors;
- Align the forecast periods in line with the ability to forecast data in each sector (Fig 2.6).

Once the forecast period is chosen, it is necessary to align *current* production by company with the *future year benchmark*. This can be done in several ways:

- Estimate the future production profile using today's indicators. The ability to develop meaningful long-term forecasts depends on the sector (Fig. 2.6). Here we use short-term benchmarks (2020) for utilities and automotive and longer-term for fossil fuels (2040).
- Utilise future production profiles directly as benchmarks for today as a second-best option.

IEA SCENARIOS: SUMMARY

World Energy Outlook (WEO): The 2°C Scenario in the WEO is called the 450 Scenario because it solves for a pathway that limits atmospheric CO₂ concentrations to 450 ppm. The WEO also includes a New Policies Scenario (NPS) — the IEA baseline scenario taking existing policy commitments into account — and a Current Policies Scenario (CPS).

Energy Technology Perspectives (ETP): The 2°C Scenario of the ETP is called the 2°C Scenario (2DS), which solves for a pathway consistent with an 80% chance of limiting average global temperature increase to 2°C. 2DS is broadly consistent with the WEO 450 Scenario through 2035. The ETP also develops a 4°C Scenario (4DS) and a 6°C Scenario (6DS) largely consistent with the NPS and CPS respectively.

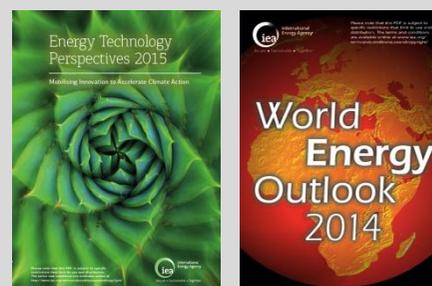


FIG 2.5: SHARE OF INDEX GEOGRAPHY IN IEA GEOGRAPHY (SOURCE: 2°II, BASED ON EIA DATA)



FIG 2.6: ILLUSTRATIVE TIME HORIZON OF INDUSTRY DATABASES (SOURCE: 2°II)

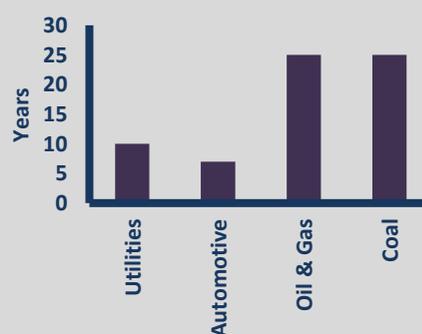


FIG. 2.7: OWNERSHIP OF GLOBAL POWER GENERATION ASSETS IN 2012
(SOURCE: IEA 2015)

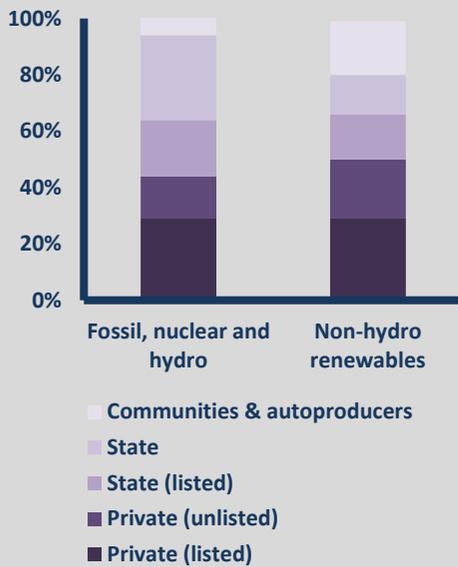


FIG. 2.8: ILLUSTRATION OF 2°C PORTFOLIO APPROACH (SOURCE: 2°II)



Step 4: Assign "fair share" exposure to market and sector

The companies listed in stock markets do not cover all production for all goods and services. Some production, and thus exposure to technologies, may be associated with households, non-listed companies, or public sector companies (cf. Fig. 2.7 for power generation).

The energy transition may also shift technology exposure across sectors. This is already visible insofar as oil & gas companies like Total are moving into the utility space and IT companies are developing products for the automobile industry. The speed with which such changes may occur is uncertain, but it can be expected that shorter term time horizons will be less sensitive to this phenomenon.

The solution to these problems involves defining the "fair share" of technology exposure by sector for listed equity markets and then forecasting any expected changes. Here the simplest approach is assuming that these shares stay constant over projection periods, although alternative assumptions can naturally be applied.

Step 5: Test for sector-level compatibility

Importantly, at portfolio scale some sectors are able to achieve 2° compatibility through best in class reweighting whereas other sectors will require sector-level reweighting. The optimal reweighting strategy follows a two-pronged approach:

- For sectors where intrasector reweighting is possible, reweight using security-level approach (screening worst performers, tilting best performers);
- For sectors requiring sector-level reweighting, define minimum shift to achieve compatibility through chosen rule (screening, tilting) and reweight sector accordingly.

Step 6: Reweight to align portfolio

The goal of this framework is to define benchmarks compatible with feasible decarbonization scenarios while leaving actual calculation rules open to its users. Thus, while the report will create benchmarks to inform index calculation rules and portfolio assessment, it will stop at laying out options for these calculation rules.

Figure 2.8 summarizes the key steps of the framework

FOCUS: 2°C SCENARIOS

The roadmaps from the International Energy Agency currently serve as the market standard for forecasts on energy and technology trends. At the same time, they are not the only roadmaps in the market. There are hundreds of different roadmaps estimating a 2°C compatible trajectory for energy and technologies. These roadmaps can be distinguished as follows:

- Assumptions around the carbon budget:** There is no consensus around the exact carbon budget associated with a 2°C compatible trajectory, with a range of different climate models providing different results (IPCC 2015). Even within scenarios, the 2°C compatibility is usually defined as a % probability. By extension, scenarios can differ according to the underlying assumption associated with the carbon budget and the implications for example for ‘burnable reserves’ (Fig. 2.9).
- Assumptions around the fair share by geography:** Scenarios can differ according to their geographic scope. Even when scenarios do have the same scope, they can differ with regard to the assumptions around how the carbon budget is allocated by geography, an important issue from both a practical and ethical standpoint.
- Assumptions around the fair share by technology:** Scenarios also differ in their underlying assumptions regarding different technologies, including technology curves, costs, and political acceptance (e.g. nuclear, CCS).

Challenges to the IEA roadmap. Although the IEA operates as the market standard, it faces a number of critiques:

- IEA projections missed both the shale gas revolution and the trend in renewable electric capacity growth over the past 15 years (Fig. 2.11). In 2000, the IEA WEO published projections of global installed capacity for wind turbines of 32,500 MW for 2010. This capacity had been connected to the grid by early 2003, only two-and-a-half years later. In 2014, the annual global wind market was at 39,000 MW increasing the total cumulative capacity to around 370,000 MW; around ten times more than the IEA’s assumption a decade earlier. The renewable trend was foreseen by other scenarios, notably the Greenpeace Energy (R)evolution Scenario. Greenpeace currently forecasts significantly higher renewable energy deployment until 2040 compared to IEA (Fig. 2.10).
- Moving forward, another key challenge to the scenarios are related to what are seen as optimistic trends around both nuclear and CCS deployment. Altering the assumption on CCS significantly alters the relative deployment of gas and coal-fired power generation for example (cf. p. 29).

Old scenarios. Beyond the differences between scenarios, scenarios can also evolve quite dramatically over time as seen in the scenarios of the IEA. As outlined above, while older scenarios can provide a measure of the extent to which the economy is on track, they also suffer from outdated assumptions around technology evolution, costs, and policies.

FIG. 2.9: PERCENT OF LISTED RESERVES FITTING DIFFERENT CARBON BUDGETS AND PROBABILITIES (SOURCE: IEA 2015)

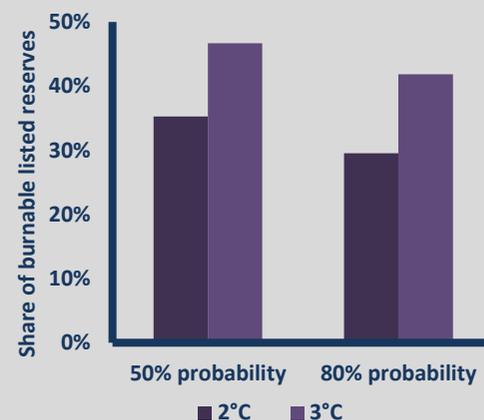
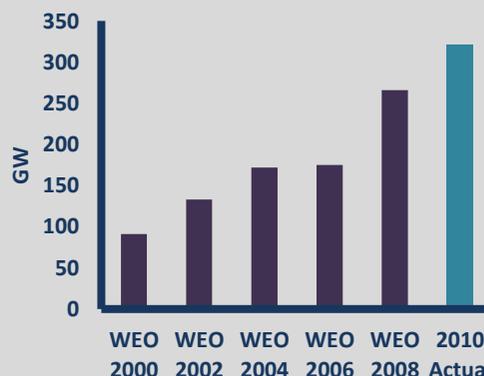


FIG. 2.10: SHARE OF RENEWABLES IN GLOBAL ELECTRIC CAPACITY IN IEA AND GREENPEACE SCENARIO (SOURCE: 2°II, BASED ON IEA 2014 AND GREENPEACE 2015)



FIG. 2.11 IEA FORECAST FOR 2010 “OTHER RENEWABLES” ELECTRIC CAPACITY (SOURCE: 2°II, BASED ON IEA WEO 2000, 2002, 2004, 2006, 2008)



FOCUS: DEFINING ALIGNMENT AT COMPANY LEVEL

Science Based Targets. A similar concept to 2°C alignment at portfolio level is the alignment of individual companies. Measuring such alignment at company level is the subject of the Science Based Targets (SBT) Initiative, jointly led by CDP, WWF, WRI, and the UN Global Compact. The initiative recognizes 7 methods companies can use to set SBTs, all based on one of three types of carbon metrics (absolute GHG, GHG/value added, or GHG/physical production), typically for Scope 1 (direct) and Scope 2 (purchased energy). Such physical carbon intensities can be used to screen companies within sectors for alignment with climate scenarios (Exane 2015).

SBT for portfolio alignment? One question is whether SBT methods could be generalized to set sector exposure targets at portfolio level. This generalization would solve a core underlying problem of the SBT methods, namely the choice between “convergence” of all companies to a performance target (rewarding leaders or lower-carbon market positioning) or “compression” of all companies following the same trajectory (rewarding laggards).

Advantages of “portfolio SBT”. The key advantage of using SBT relates to the ability to achieve goals using different approaches. A carbon metrics indicator is less prescriptive than an energy and technology indicator. It allows for a diversity of approaches to achieve the 2°C goal. A common unit allows for a system of equivalence, creating comparability between activities and production in different units (Fig. 2.12).

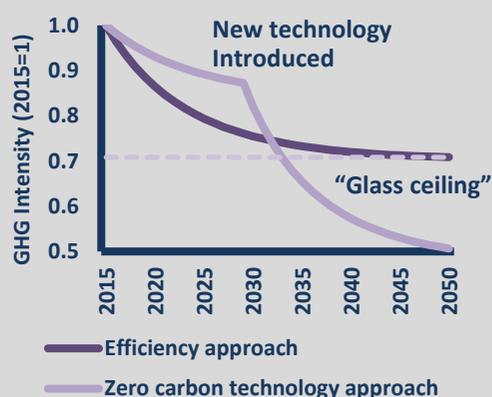
Shortcomings of “portfolio SBT”. SBT would have to integrate a number of additional components to operate at portfolio level, notably asset class specific benchmarks and the introduction of portfolio weighting. Beyond, SBT based on carbon metrics suffer from the uncertainty around data, geography, and coverage. In this vein, SBT introduced a base line year (2010 in most cases) that creates discrimination, similar to that observed in the grandfathering bias of the EU-ETS (Kepler-Chevreur 2015). Another shortcoming is that corporate decarbonization targets do not necessarily align with actions – companies can miss targets (Exane 2015). Finally, long-term decarbonization targets require a shift to zero carbon technologies. Annual GHG emissions reduction may hide these trends as efficiency gains for example hit an eventual glass ceiling (Fig 2.13).

Comparing “portfolio SBT” and 2°C portfolio. The flipside of equivalence is the ability to treat multiple technology constraints within the framework. For example, the technology exposure method used here can define reweighting rules for automotive companies using both fuel economy and electric vehicles, which are masked together in a single carbon metric (CO₂/pkm) using carbon intensities. At the same time, the portfolio assessment framework developed here faces barriers when applied at company level. Not all companies will look the same vis-à-vis a certain scenario and energy and technology targets can resemble a ‘central planning’ or ‘picking winners’ logic. Of course, this element is built into the roadmaps themselves and can be addressed by using a diverse set of portfolios. Indeed, once exposure targets are defined for a portfolio, SBT can be used to inform stock selection under the constraint of the overall exposure target.

FIG. 2.12: SUMMARY PROS/CONS OF CARBON INTENSITY VS. TECHNOLOGY EXPOSURE TARGETS (SOURCE: 2°II)

	PROS	CONS
PORTFOLIO-AVERAGED CARBON INTENSITIES	<ul style="list-style-type: none"> System of equivalence across sectors, allowing deviations from scenarios 	<ul style="list-style-type: none"> Not easy to capture green technologies Equivalence can mask true technology exposure Currently not built by asset class
TECHNOLOGY EXPOSURE	<ul style="list-style-type: none"> Track ‘brown’ and ‘green’ technologies separately Separate multiple constraints in reweighting rules 	<ul style="list-style-type: none"> No ‘system of equivalence’ across sectors Potentially greater concerns about ‘central planning’ based on scenario assumptions if applied at company level

FIG. 2.13: ILLUSTRATIVE ZERO CARBON TECHNOLOGIES AND THE GLASS CEILING (SOURCE: 2°II)



2.4 DATA SOURCES

The analysis in this working paper relies primarily on industry databases. This type of data has a number of advantages over reported data from companies:

- *Comparability:* Given the common production units and avoiding the need for estimation models, data is comparable across companies and geographies.
- *Forward-looking:* Industry databases include planned capacity additions and / or production forecasts that allow for a comparison of the IEA 2020 2°C target with companies business models (Fig. 2.14 & Fig. 2.15).
- *Geography-specific:* Industry databases inform on the geography of production. This allows for a comparison with regional benchmarks for the utility sector for example (Fig. 2.16)

Despite their advantages, there may be gaps in this data as well and issues with the coverage of forward-looking data. They are currently not available as a one-stop option and need to be treated to match with companies. Financial and ESG data providers are currently addressing these challenges. The authors expect industry databases to inform the services of ESG and financial database providers within the next year.

The authors estimate that the cost of this data for data providers is roughly EUR 50 000 – EUR 100 000. Costs may however be lower depending on license arrangement. Economies of scale will imply lower costs for investors.

FIG. 2.14: WARDAUTO ACCUMULATED ELECTRIC VEHICLE STOCK FORECAST VERSUS IEA 2DS
(SOURCE: 2°II, BASED ON IEA ETP 2015 AND WARDAUTO)

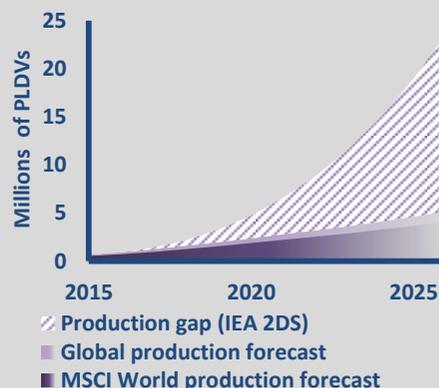


FIG. 2.15: GLOBALDATA MSCI WORLD OTHER RENEWABLE POWER CAPACITY FORECAST VERSUS 2°C TRAJECTORY
(SOURCE: 2°II, BASED ON IEA ETP 2015 AND GLOBALDATA)

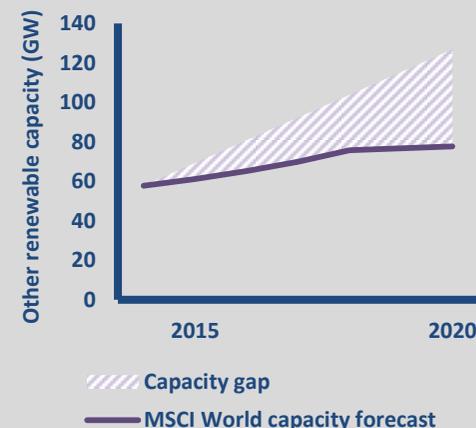


FIG. 2.16: DEFINING GEOGRAPHY SPECIFIC BENCHMARKS USING INDUSTRY DATABASES
(SOURCE: 2°II)

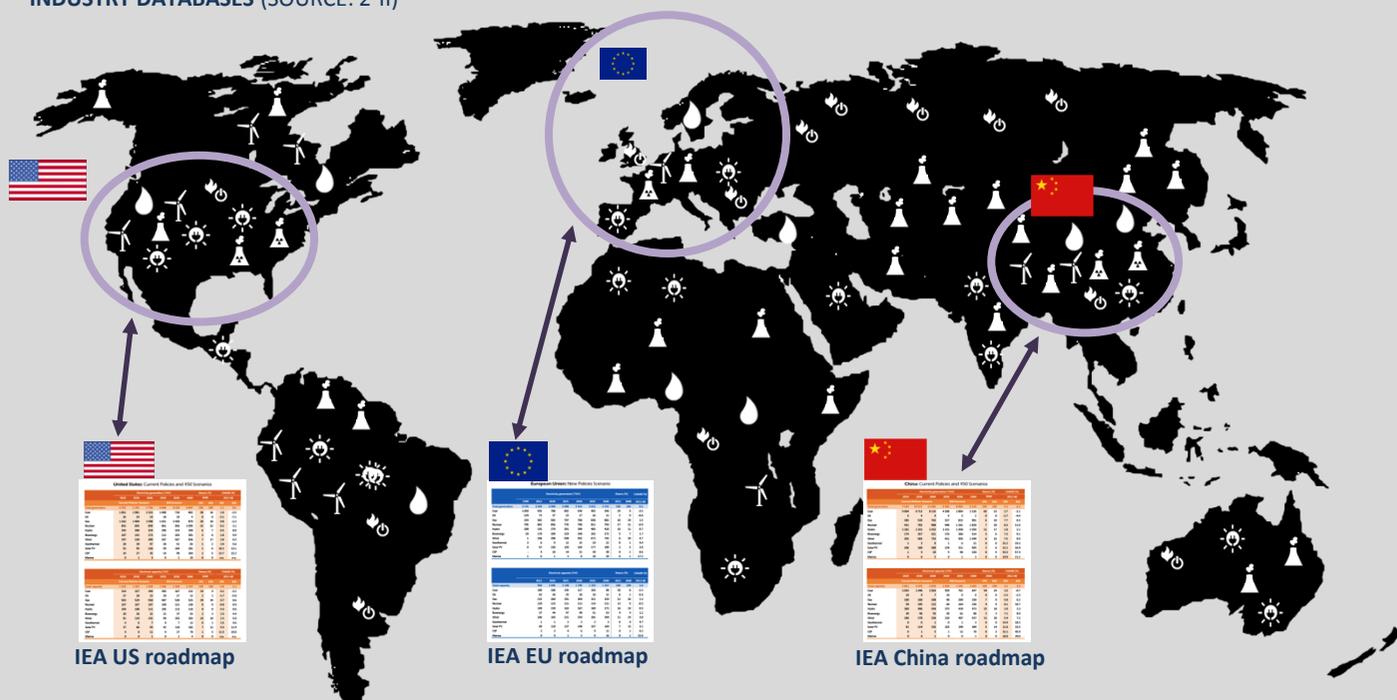
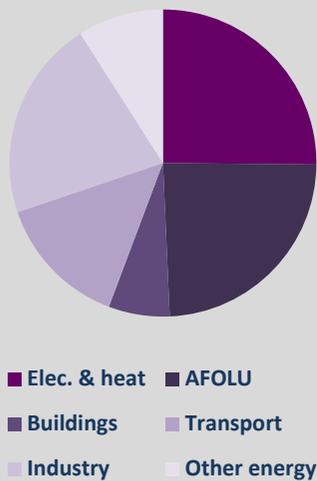


FIG. 2.17: BREAKDOWN OF GHG EMISSIONS BY SECTOR IN 2010
(SOURCE: IPCC 2014)*



*AFOLU = Agriculture, Forestry and Other. Land Use

FIG 2.18: SHARE OF IEA ETP RELATED SECTORS IN MSCI WORLD (SOURCE: 2°II, BASED ON MSCI WORLD AND IEA ETP 2015)

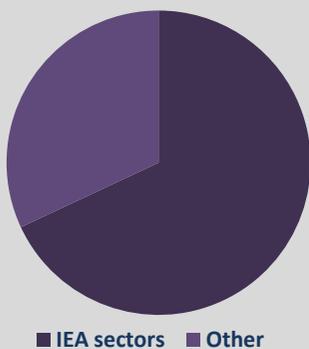
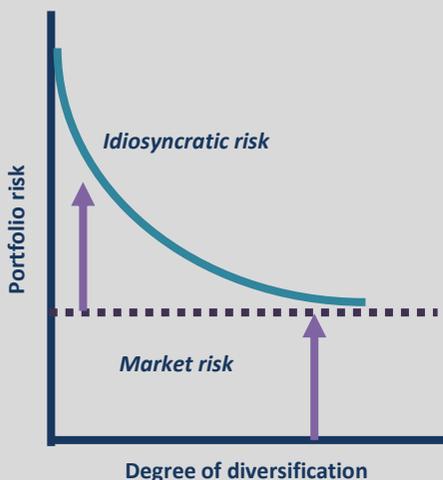


FIG 2.19: ILLUSTRATIVE MODEL CONNECTING DIVERSIFICATION AND IDIOSYNCRATIC RISK (SOURCE: 2°II)



2.5 CAVEATS

The following briefly highlights the main caveats to the framework:

Exposure. The framework only focuses on assessing whether the *exposure* a portfolio is aligned with a 2°C decarbonization pathway. It *does not* inform on the portfolio’s contribution to financing this transition.

Coverage. The framework is limited to the energy technologies and fuels covered in the IEA 450 scenarios as well as automotive transport. While they account for the majority of GHG emissions, this approach creates gaps requiring alternative approaches (Fig. 2.17 & Fig. 2.18).

Data. Information needed to estimate production profiles by energy technology requires relatively granular, company level data on these energy technologies. To date, this data does not always exist in financial or ESG databases and sometimes gaps may even extend to industry databases. As a result, the method needs to account both for the optimal translation possible and what is feasible given current data constraints.

Gaps in the scenario. The IEA scenarios differ significantly with regard to their relative granularity. The framework can thus only be as good as the source information allows it to be (cf. p. 15).

Estimates. A final caveat identified in the development of the method are the assumptions that are necessary to develop the production profile forecasts of companies (e.g. pipeline capacity, company announcements, construction of new factories, plants, etc.). While some of these assumptions may be challenged (e.g. production forecasts) and indeed may change dramatically, they are equal to any standard industry estimates and thus appear as a meaningful tool at this stage.

Distinction from current practice. The proposed approach extends the sector diversification logic core to modern portfolio theory to energy technologies. In terms of climate, it treats the carbon footprint, traditionally the key metric in the sector, not as a portfolio management tool, but rather an ultimate target that is achieved through investing decisions informed by energy technology indicators.

The logic of energy technology exposure is an extension of the modern portfolio theory, which focuses on managing broad industry exposure (Fig. 2.19). It extends this logic to energy technologies, whose relative weight is the discriminating factor in decarbonization roadmaps of different ambitions.

3. THE 2°C BENCHMARK

3.1 OVERVIEW

Focus on core sectors: electric utilities, automobile, oil & gas, and coal mining. This working paper focus on energy and technologies for electric utilities, automobile transport, oil & gas, and coal mining. The following sections will discuss each of these in turn, with the discussion on oil & gas and coal combined given the shared challenges for these sectors.

The analysis will define exposure targets for the core technologies reviewed by the IEA for each of these sectors. These are oil and gas production for the oil & gas sector (measured in mboe / day and bcm respectively), coal production (mtce), electric capacity by fuel (Gigawatt), and cars produced by fuel (passenger light duty vehicles). The indicators in the analysis are thus prescribed by the mainstream scenarios. Beyond the ‘headline’ indicators where exposure targets can be defined, the report also reviews other key indicators referenced in the scenarios. At this stage, these indicators are only briefly referenced. They will be more fully developed in the final version of the report. Notable examples include energy storage, carbon capture and storage, and fuel efficiency.

Coverage of analysis. The analysis on a 2°C portfolio covers roughly 50-80% of Scope 1+2+3 CO₂ emissions of the MSCI World, STOXX 600, and S&P 500 (Fig. 3.1). Notably, these estimates do not take into account issues around double counting. The exercise of doing a carbon footprint of these indices already helps to identify a number of stylized facts. The first is that the over-whelming majority of GHG emissions are concentrated in two transition sectors – oil & gas and utilities. Currently, the weight of the sectors under review fluctuates between 10-15%. Over the past couple of years, these weights approached 20%, in particular in the context of a larger oil & gas sector enjoying significantly higher oil & gas prices. The largest sector by weight is the oil & gas sector.

At this stage, the analysis is entirely sector specific, focusing only on the companies that are actually classified in the sectors under review. The exception in this framework relates to RWE, which is classified as a utility, but given its prominence in coal mining, is also reviewed as a coal mining company. The limit to companies in the key sectors implies that some production is missing from the analysis (e.g. power capacity from oil & gas companies, industry, etc.). While the ‘missing production’ is unlikely to be significant enough to skew the overall picture, it is an important piece of the element. The final analysis will thus extend to look at exposure to all key technologies.

FIG 3.1: COVERAGE OF 2°C PORTFOLIO BY GHG EMISSIONS AND WEIGHT* (SOURCE: 2°II, BASED ON TRUCOST AND SOUTH POLE GROUP DATA)

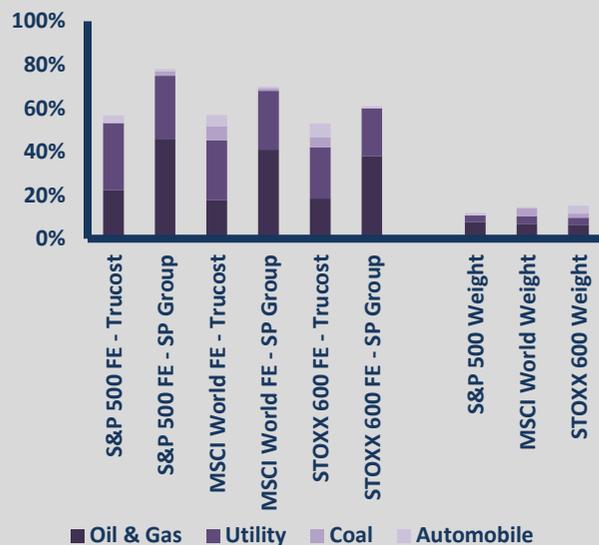


FIG 3.2: SUMMARY OF TECHNOLOGY COVERAGE (SOURCE: 2°II)

Sector	Forecast period	Indicative Target	Alternative Targets?
Power	2020	Elec. Capacity by Fuel	Elec. Generation by fuel; Fuel efficiency
Automotive	2020	Alternative Propulsion (EV, hybrid)	Average fuel economy, MPG-eq. including alt propulsion
Oil & Gas	2040	Future potential production	Future potential supply above \$x/BBL
Coal	2040	Future potential production	Future potential supply above \$x/Mtoe

* Differences in results largely relate to Scope 3 estimates.

FIG. 3.3: POWER GENERATION RELATED GHG EMISSIONS BY SCENARIO (SOURCE: IEA 2014)

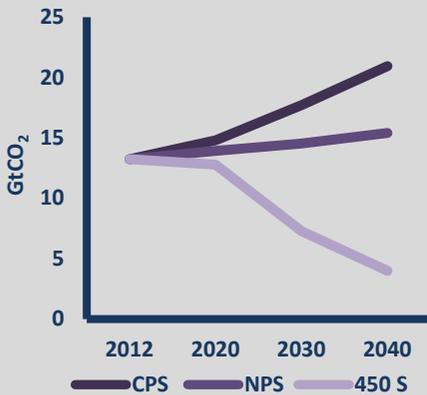


FIG. 3.4: NON-HYDRO RENEWABLE ELECTRIC CAPACITY BY SCENARIO (SOURCE: 2°II, BASED ON IEA 2014 AND GREENPEACE 2015)

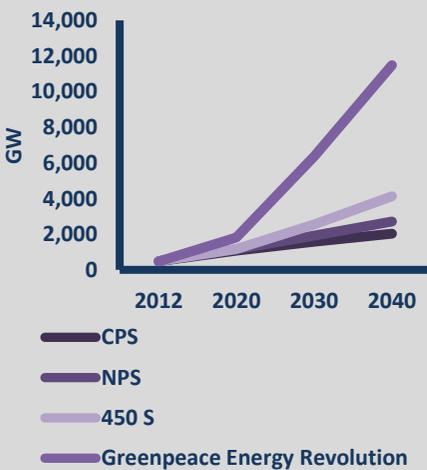
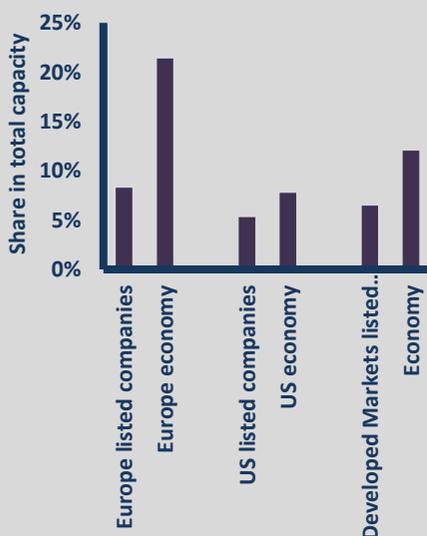


FIG. 3.5: ESTIMATED SHARE OF RENEWABLES IN STOCK MARKET AND ECONOMY ELECTRIC CAPACITY (SOURCE: 2°II, BASED ON IEA 2014 AND GLOBALDATA)



3.2 ELECTRIC UTILITIES

Overview. The utility sector is one of the most important sectors in the index. Electricity and heat account for roughly a quarter of global GHG emissions. The sector will face significant change in its role in both climate problems and climate solutions:

- Power generation related CO₂ emissions are roughly 80% lower in the 450 Scenario relative to CPS (Fig. 3.3).
- Non-hydro renewable electricity generation grows by a factor of 8 between 2012 and 2040 (Fig. 3.4).

The charts also reflect the larger question of time horizons. Until 2020, the scenarios exhibit only marginal differences, with big divergences only starting after 2020.

Approach. The focus is on electric capacity by technology as the core indicator in the sector, given the potential volatility around electricity generation data and data gaps. GlobalData plans to add generation to their database this year, potentially allowing for an extension of the approach in 2016. At this stage, it does not address potential emissions differences within technologies, heat generation, and storage (cf. p.22).

The approach for the utility sector is to define a 2°C compatible capacity mix by fuel for the domestic capacity of utilities. Non-domestic capacity, accounting for anywhere between 0% to 30%, was excluded at this stage for simplicity's sake. This data will be added in the final framework.

The current capacity mix of the listed equity universe forms the starting point. Changes in capacity under the IEA scenarios are then allocated to this starting point using a dual approach:

- *Retirements* targets are calculated by allocating the IEA retirement share to the utility based on the utility's ownership share of that technology (fair share technology approach)
- *Additions* targets are calculated by allocating the IEA additions share based on the utility's share in the overall mix (fair share market approach).

The dual approach is necessary in order not to reward laggards with lower additions targets and 'punish' companies that already have a lower high carbon capacity exposure. This is particularly relevant as stock markets have notoriously lagged the economy's renewable mix (Fig. 3.5). The relatively strict rules can be softened in application of course, especially given the fact that the fair share assumption for listed equity utility renewable plans is unlikely to be correct based on history (Fig. 3.5)

The analysis presented here applies the framework discussed above on the basis of plant level data using GlobalData. This database provides country level forecasts of planned retirements and company level forecasts of planned capacity additions:

- Pipeline data can be used for gas, hydropower, and renewables to assess capacity deployment;
- Retirement forecasts for coal and oil at company level do not exist. The country level retirement forecast thus needs to be applied pro rata (done here). Alternatively, the analysis can be limited to just using pipeline additions to estimate the future exposure. While this is undoubtedly a sub-optimal solution, using country-level forecasted retirements from GlobalData for the index utilities only changes the results by about +/- 1%. This suggests that the lack of a forecast on retirements doesn't materially change results.

Results. Figures 3.6 show the results for each listed equity universe and a major stock index in the universe. The first bar graph shows the current mix and the second bar graph shows the forecasted mix for 2020. The third bar graph then show what the mix of the listed utilities would look like if they followed a 2°C (450 Scenario) trajectory. The numbers are calculated at this stage using only utility sector capacity and may change slightly when expanding to non-utility electric capacity.

Application. The following hypothetical calculation rules can be applied to achieve the exposure targets:

- *Optimal re-weighting:* This approach calculates how utilities can be re-weighted so that their capacity mix aligns, as close as possible, with the 2°C benchmark, while keeping total capacity constant and minimizing sector divergence.
- *Screening non-green:* The top ten worst performers in terms of renewable capacity excluding hydro as percent of total capacity weights are halved, and the removed weight is shared evenly over the remaining components. This approximates the first result, but uses a simpler calculation rule.

Challenges / Alternatives. It should be noted that the results always assume that listed utilities will in a 2°C scenario deploy renewables at scale. This assumption can be challenged as some forecasts see a permanent decline for utility-scale power generation in favour of renewable deployment by households, small non-listed utilities, and non-utility companies (Roland Berger 2015; Carbon Tracker Initiative 2015, cf. next page). Capacity is allocated to subsidiaries and subsidiaries to owners using the ownership principle. This will be reviewed in the next iteration of the model.

FIG. 3.6: FUEL MIX OF INDICES VERSUS 2°C BENCHMARK (SOURCE: 2°II, BASED ON IEA 2014 AND GLOBALDATA)

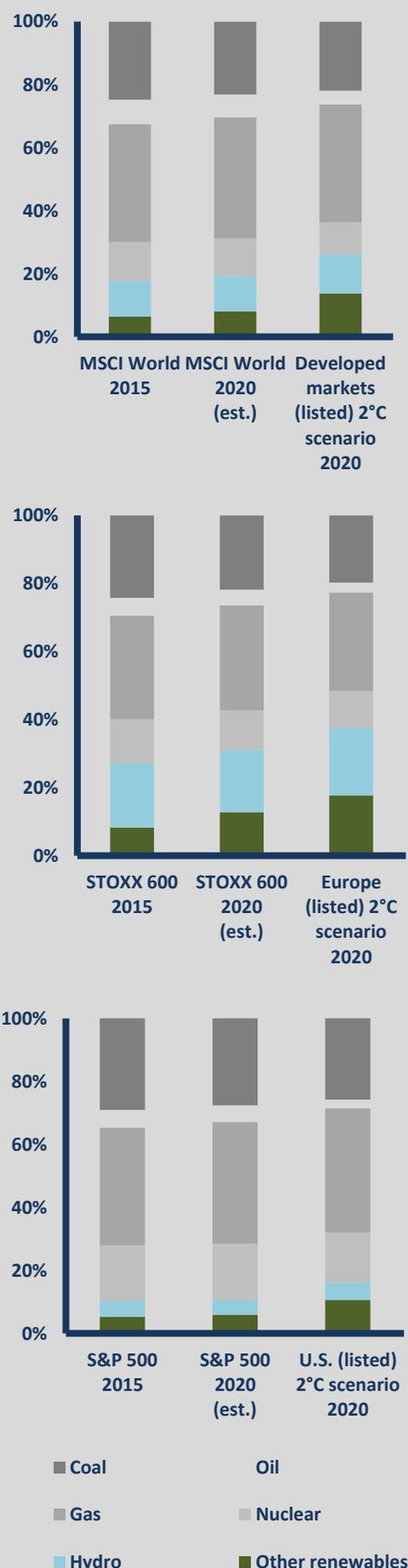


FIG 3.7: SHARE OF HEAT GENERATION IN FINAL ENERGY DEMAND (SOURCE: IEA ETP 2015)

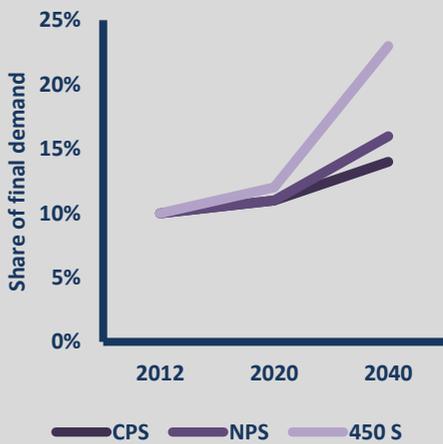


FIG 3.8: ENERGY STORAGE DEPLOYMENT BY REGION AND SCENARIO (SOURCE: IEA ETP 2015)

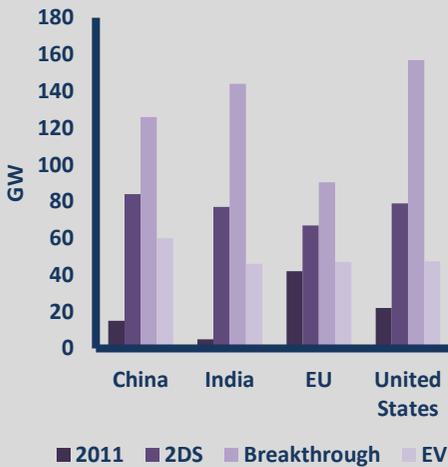
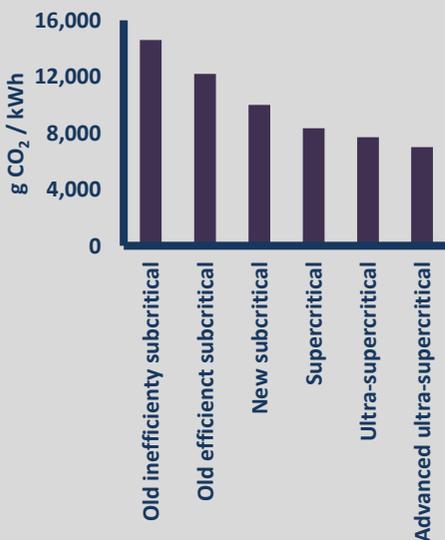


FIG 3.9: RELATIVE EFFICIENCY OF DIFFERENT TYPES OF COAL-FIRED POWER PLANTS (SOURCE: OXFORD UNIVERSITY STRANDED ASSETS PROGRAMME 2015)



FOCUS: ENERGY AND TECHNOLOGIES IN THE UTILITY SECTOR NOT COVERED AT THIS STAGE

The following briefly reviews the key energy and technology issues **not covered** in the framework at this stage. In principle CCS could equally well be explored here.

Heat. Heat accounts for roughly 14% of power generation (e.g. electricity and heat). The IEA estimates that the share of renewable heat in final demand will increase from 10% to 12% by 2020 and to 23% by 2040 in the 450 Scenario (Fig. 3.7). Given the relative prominence of power relative to heat, this working paper will focus on power.

System management. The intermittent nature of solar PV and wind power generation requires new technologies around system management. This includes primarily the deployment of energy storage and the design of so-called smart grids (including advanced metering and distribution automation). The IEA estimates 180 million smart meter estimations in Europe by 2020. Energy storage in turn is set to reach 60-80 GW in key regions, roughly the equivalent of the total French nuclear power capacity (Fig. 3.8). Whereas smart grid technologies are likely to be developed by a range of companies across sectors, energy storage will be a key ingredient for the survival of the utility power model and the scaling up of intermittent renewable power.

Efficiency. At this stage, this framework focuses exclusively on the relative exposure to different energy technology fuels for power generation (e.g. coal, gas, oil, renewable, hydropower, and nuclear). At a later stage, this can be complemented, data permitting, with an assessment of the relative GHG intensity within different technologies. This is key, as old inefficient coal-fired power plants can be 100% as CO₂ intensive as the newest generation of coal-fired power plants (Fig. 3.9). At this stage, the data granularity does not allow for a meaningful assessment of these differences. The issue of relative power plant efficiency will be returned to in the next version of the framework.

FOCUS: THE FUTURE OF THE UTILITY SECTOR

The rise of renewable power generation has threatened the traditional business model of large electric utility companies. Listed utilities have lagged in renewable deployment and struggle to adapt to small scale capacity. European utilities in particular have lost significant value in the past couple of years. At the same time, growing deployment of commercial scale solar PV suggests listed utilities may make a come back (UBS 2015). This framework assumes that technically listed utilities have no barrier to contributing their market share in renewable capacity deployment. Naturally, this assumption can be challenged. Indeed, an alternative 2°C compatible model treats utilities more like oil & gas or coal companies, with an emphasis on a declining sector and exposure to renewables through other asset classes (e.g. solar asset-backed bonds, etc.)

3.3 AUTOMOTIVE

Overview The transport sector, encompassing shipping, rail, road, and air traffic account for over a fifth of global GHG emissions. Within transport, road transport contributes the greatest share, accounting for over 70% of total annual transport emissions. The two key sectors within road transport are light- and heavy-duty automotive vehicles. The analysis in this working paper will focus on passenger light duty vehicles, with heavy duty vehicles added to the final framework. To reach the 2°C warming target via the 2DS, the IEA highlights the following technologies for light duty vehicles:

- *Fuel efficiency:* The IEA has calculated that fuel economy from light passenger vehicles must double between 2005 and 2030 to meet the 2DS scenario. Increases in efficiency of 30% and 20% are required from heavy vehicles and two-wheeled vehicles. This is the main short term driver of decarbonisation, but issues arise in its long term potential to deliver full decarbonization. There are also measurement challenges (lack of developing market data, real world vs. rating issues, cf. p. 25).
- *Alternative propulsion:* Perhaps the most important driver of decarbonisation for road transport in the scenario is the switch to alternative fuels, notably electric vehicles, hybrid, biofuels, and alternative ‘breakthrough technologies’ (e.g. fuel cells, hydrogen, etc.) (Fig. 3.11). This will be the core part of the framework here.
- *Modal shift:* The IEA highlights the increase of car-sharing services, public transport (Fig. 3.12), and rail for long-distance travel as part of a modal shift. One potential way to capture the aggregate effect of this modal switch on the existing industry is through total car sales. This indicator is particularly relevant from the perspective of total sector exposure, which will be further explored in the final framework paper through exposure to alternative transport company equity and green transport infrastructure in fixed income.

Approach. Alternative propulsion is the only indicator where the IEA provides quantitative benchmarks until 2050 (Fig. 3.11). These benchmarks can be compared to production forecasts from WardsAuto to measure the energy technology exposure of the benchmark indices relative to the 2°C benchmark in the short term. The production benchmark for all three indices is global as automobile manufacturers operate internationally. One of the advantages of this sector is that all auto production is concentrated in the same sector and almost all production is listed, which allows for a one-to-one translation of IEA targets to the automobile sector.

FIG. 3.10: ROAD TRANSPORT OIL CONSUMPTION BY SCENARIO
(SOURCE: WEO 2014)

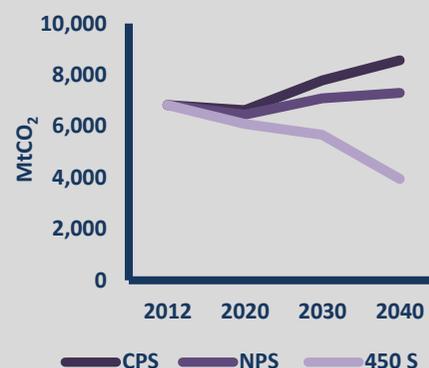


FIG 3.11: ESTIMATED PASSENGER VEHICLE MARKET SHARE BY PROPULSION TECHNOLOGY (SOURCE: IEA 2015)

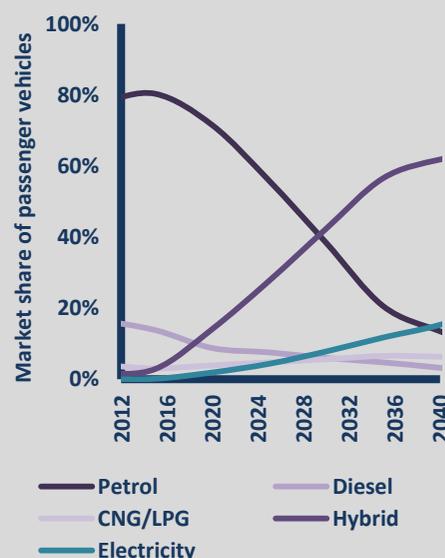


FIG 3.12: FUEL ECONOMY BY PASSENGER (SOURCE: USA DEPARTMENT OF TRANSPORTATION 2011)

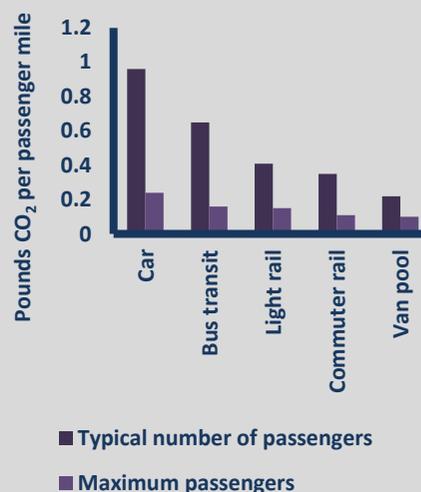


FIG. 3.13: ESTIMATED SHARE OF ELECTRIC VEHICLES IN 2020 FOR IEA 2DS AND INDICES (SOURCE: 2°II, BASED ON WARDAUTO AND IEA 2DS)

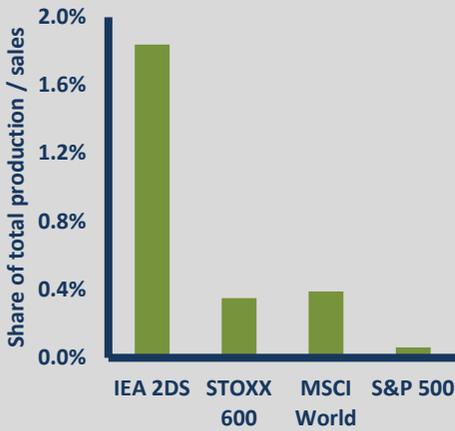
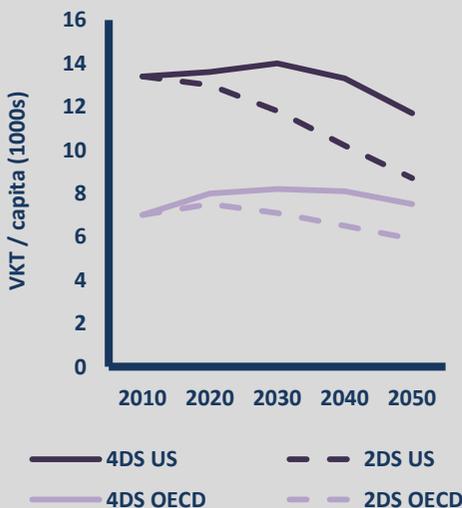


FIG. 3.14: ESTIMATED SHARE OF HYBRID VEHICLES IN 2020 FOR IEA 2DS AND INDICES (SOURCE: 2°II, BASED ON WARDAUTO AND IEA 2DS)



FIG. 3.15: ESTIMATED VEHICLE KILOMETER TRAVELLED (VKT) PER CAPITA IN LIGHT DUTY VEHICLES BY REGION AND SCENARIO (SOURCE: FULTON 2013, BASED ON IEA DATA)



Results. The analysis presented here compares IEA targets for sales to WardsAuto production forecasts. There are two challenges to this approach:

- The framework compares global production (WardsAuto) with sales targets (IEA). This can naturally introduce minor biases.
- The analysis uses industry forecasts from WardsAuto, a global automobile data provider. The granularity is down to the drive-train level for every plant in the developed market. The production forecast figures are based on a range of industry indicators and are updated. Short-term estimations are likely to be quite accurate and thus an appropriate estimation of planned company production mix. In addition back testing can be carried out to test the historical accuracy of forecasts and included through sensitivity analysis.

Fig. 3.13 shows the IEA 2°C target share for electric vehicle sales in 2020 versus the expected share by index and Fig. 3.14 does the same for hybrid vehicle share. Production of subsidiaries is allocated based on ownership shares. The results suggest that indices are significantly misaligned with the IEA targets. Indeed, Tesla is the only company that meets (indeed exceeds) the electric vehicle target in the universe under review and Toyota the only company that meets the hybrid target. This suggests that it is currently impossible to align the automotive sector exposure with the 2°C trajectory without extending to small caps and private equity.

Application. Given the inability to align the index with forecasts based on the current universe, second-best calculation rules need to be developed, associated with a reporting on the gap. These can for example include:

- Selecting the best performers in terms of fuel efficiency, share of hybrid car sales and share of electric car sales and distributing the sector weight in line with the original relative weights of the company;
- Screening the bottom 30% in terms of electric vehicle share and re-weighting the remaining companies to approximate an electric vehicle target (e.g. 1.8%).

Challenges. There are two key challenges to this approach. At this stage, the analysis excludes heavy duty vehicles and fuel efficiency, elements that will be added to the framework at a later stage (cf. next page). Moreover, it does not address the issue of overall production levels, which may be misaligned given modal shift away from light-duty transport in the 2°C scenario – shifts that can be quite significant (Fig. 3.15). These shifts may suggest a re-weighting of the sector, an issue that will also be returned to in the final framework.

FOCUS: FUEL EFFICIENCY

Diesel and petrol vehicles will continue to dominate global production over the next five years, thus fuel efficiency and fuel switching will be important in the short-term. However, car manufacturers only control exposure to biofuels to a limited degree, and there is still debate over the use of traditional biofuels. The potential for 2°C compatibility of advanced biofuels will be reviewed in the final framework (cf. p. 29).

As outlined above, the IEA also emphasizes fuel efficiency, which is intrinsically linked to carbon emissions, in their scenarios. However, as currently highlighted by the Volkswagen scandal, standardized emissions and fuel efficiency tests are fundamentally flawed and require a significant overhaul:

- Many standardized testing results for vehicle efficiency differ significantly from the actual on-road performance. Results show that this gap has grown from 8% for 2001 year model vehicles to 40% for 2014 models (ICCT 2015). The gap has grown each year as manufacturers design for tests rather than actual road performance.
- The results of these tests are not necessarily consistent across geographies for the similar model vehicle (Fig. 3.16).
- The gap is of a similar magnitude as the range of average emissions between manufactures (Fig. 3.17).
- Vehicle fuel efficiency data is a poor proxy for climate impact as the ultimate impact depends on other factors, including the number of passengers, use of the car, etc. Fuel efficiency indicators should thus ideally be compared at a more granular level (e.g. family vans with family vans, etc.).

FOCUS: HEAVY DUTY VEHICLES

Heavy duty vehicles (HDV) are the other side of the coin for road transport, and include buses, trucks, etc. These vehicles account for around 5% of global road transport vehicle production (Fig. 3.18), but roughly 50% of GHG emissions in the road transport sector due to their higher use and mass.

This reflects a disconnect between the size of the market and its impact. Given its prominence from an impact perspective, HDV's will be covered in the final framework. The bias from ignoring this technology at this stage only affects a small portion of companies.

FIG. 3.16: DIFFERENCES IN TEST RESULTS (SOURCE: 2°ii, BASED ON EPA AND EUROPEAN ENVIRONMENT AGENCY)

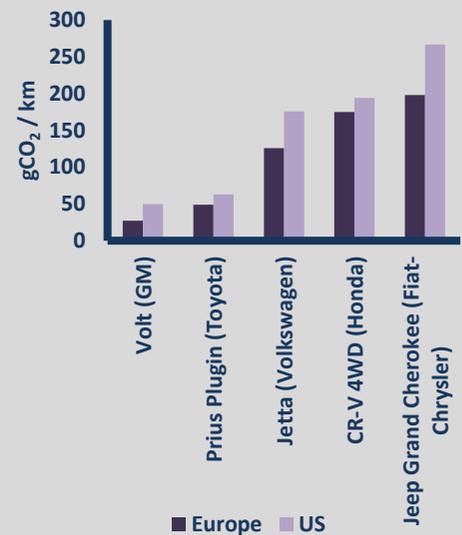


FIG. 3.17: AVERAGE FUEL EFFICIENCY AND RANGE IN INDICES (SOURCE: IEA 2015)



FIG. 3.18: SHARE OF NON-CAR VEHICLES IN GLOBAL PRODUCTION IN Q2 2015 (SOURCE: OICA 2015)

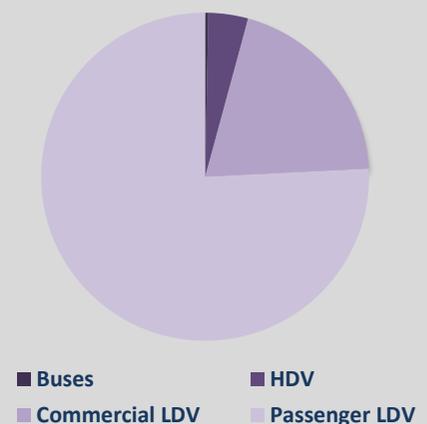


FIG. 3.19: OIL PRODUCTION RELATED CO₂ EMISSIONS BY SCENARIO*
(SOURCE: IEA WEO 2014)

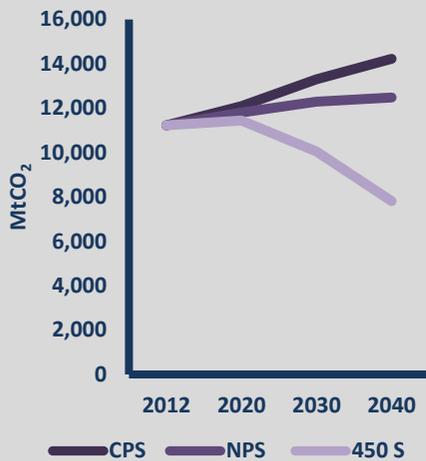


FIG. 3.20: GAS PRODUCTION RELATED CO₂ EMISSIONS BY SCENARIO*
(Source: IEA WEO 2014)

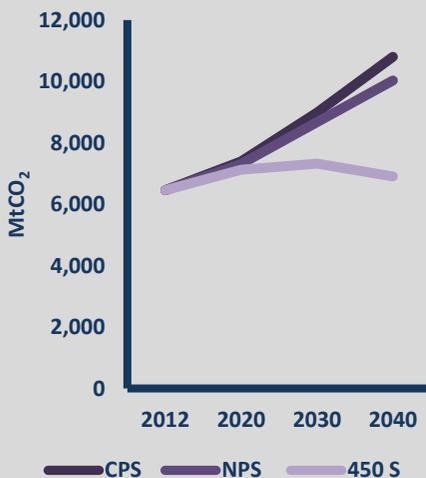
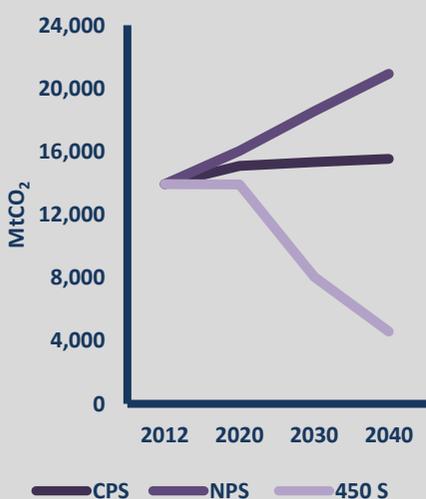


FIG. 3.21: COAL PRODUCTION RELATED CO₂ EMISSIONS BY SCENARIO* (Source: IEA WEO 2014)



* CO₂ emissions include all emissions in the economy that can be traced to coal, gas, and oil production.

3.4 FOSSIL FUEL SECTORS

Overview. This paper presents the approach for the oil & gas sector and the coal mining sector in one section, given the common challenge these sectors face. As a whole these energy sectors have received the most attention from investors and NGOs in terms of their exposure and trajectory. The work of the Carbon Tracker Initiative (CTI) and the “Divest” movement have created momentum around re-evaluating the exposure to these sectors.

It bears reminding that the objective here is not to define what the most climate friendly approach is for this sector. The question here is what is the exposure that would be aligned with the 2°C pathway.

The sector faces a number of unique challenges that are worth highlighting briefly:

- Unlike for automobile or the utility sector, there is currently no ‘green’ technology that can fully offset high carbon activities. The only exceptions are potential partial offsets through CCS, which is not yet developed (cf. p. 29), and biofuels, which are currently primarily deployed by non- oil & gas companies, although there is some R&D in this space (cf. p. 29).
- All three sectors see significant decline relative to the CPS and NPS, with gas being the only energy that grows, albeit marginally, in the 450 scenario. All these numbers rely however on relative significant deployment of carbon capture and storage.

By extension, one of the challenges for this sector is that all companies likely have some part of their business that is 2°C incompatible, insofar as the specific oil resources for example will not be burned in a 2°C pathway. This makes it very challenging for investors to identify 2°C compatible companies.

Approach. 2°C compatibility for the fossil fuel sectors can be determined by defining targeted exposure levels to future potential production. This exposure can be measured by estimating the total future potential production until 2040 for the listed equity universe and the associated 2 °C compatible production in the portfolio based on the share of the portfolio in the listed equity universe. Future potential production can be estimated using industry databases (cf. discussion next page). A CTI analysis of business level forecasts suggests that potential production plans range between the CPS roadmap and what can be labeled a NPS+ forecast (i.e. between NPS and CPS). These forecasts can thus form the general industry benchmark for future potential supply when industry databases are missing. Industry databases would allow for more precise results.

There are a number of challenges for these sectors:

Listed equity bias: A significant share of fossil fuel reserves are owned by the public sector. National oil companies (e.g. companies with >50% public ownership) own 71% of oil and gas reserves worldwide (IEA 2014). The IEA doesn't provide forecasts using this categorization however, but by OPEC / non-OPEC production. Non-OPEC production thus serves as the closest proxy for private production, although the trends by scenario don't diverge significantly for the two. CTI has also developed this analysis using industry databases (Fig. 3.22)

Geography bias: While ownership of potential supply is largely global and random vis-à-vis the location where companies are listed (Fig. 3.23), local demand profiles for gas and coal will impact potential future supply in regions differently. This is because these markets are not fully internationally integrated. For example, changes in coal demand in India and China potentially impact imported coal first, before affecting national coal companies. These trends are likely to be less material for oil, given that markets here are largely integrated.

While the framework at this stage is limited to global benchmarks, industry-level databases allow for defining listed market specific regional benchmarks and mapping these effects to companies based on the geography of their exposure.

Time horizon: The IEA projects oil, gas, and coal production trends out to 2040 in the World Energy Outlook. This time horizon can be linked to the ability to forecast company's potential supply using industry databases. This time horizon is significantly longer than the time horizons that were used as benchmarks for the utility and automotive sectors. The framework presented here will use the time horizon that fits the sector i.e. out to 2040. The analysis can also however use more short-term data or bring long-term trends forward by applying them to a five year time horizon.

Databases: Proper analysis requires industry level databases, in particular around future potential supply. ESG databases are limited to current production and reserves data. While production data is a helpful indicator to track over time and to compare companies, it does not inform on future production. Developed reserves data is only a poor proxy for future production, at least for oil. This is because at least half of future production in 2040 relies on non-developed reserves (Fig. 3.24).

At the same time, the Carbon Tracker Initiative suggests that future production under various scenarios depends on the cost curves of production, data that depends on the evolution of reserves into resources and production and is not correlated with current reserves data (2°ii / UNEP-Fi / GHG Protocol 2015).

FIG. 3.22: BREAKDOWN OF TOTAL POTENTIAL OIL PRODUCTION (SOURCE: RYSTAD ENERGY, CTI/ETA ANALYSIS 2014)



FIG. 3.23: COMPANY OIL PRODUCTION VERSUS COUNTRY PRODUCTION LEVELS (SOURCE: 2°ii, BASED ON BLOOMBERG AND US EIA DATA)

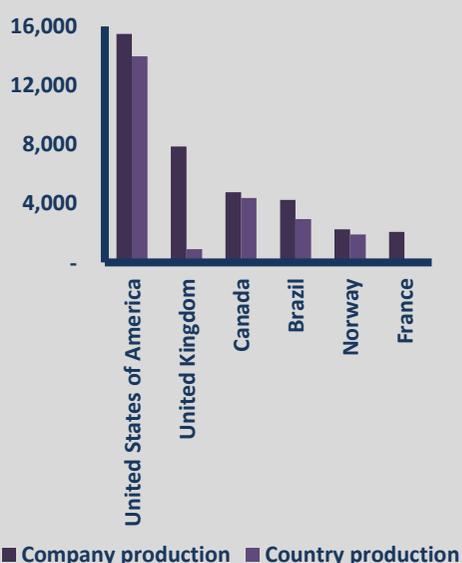


FIG. 3.24: BREAKDOWN OF FUTURE PRODUCTION IN NPS BY STAGE OF DEVELOPMENT (SOURCE: IEA WEO 2014)

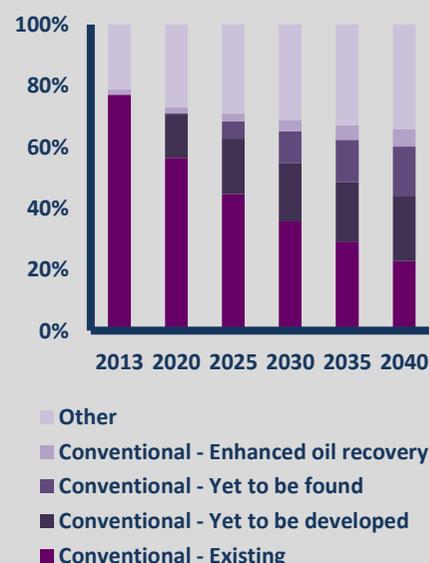


FIG. 3.25: ESTIMATED PRODUCTION DIFFERENCE BETWEEN NPS+ AND 450 SCENARIO BY ENERGY (SOURCE: 2°II, BASED ON IEA 2014)

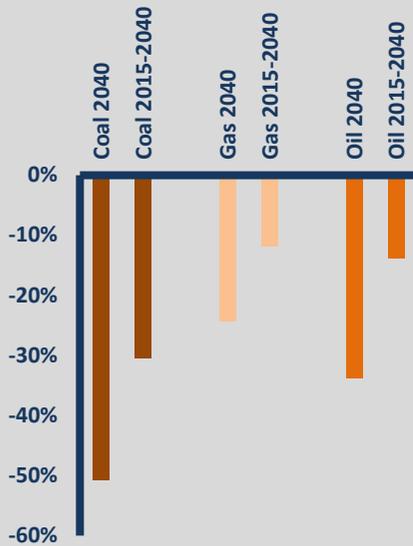
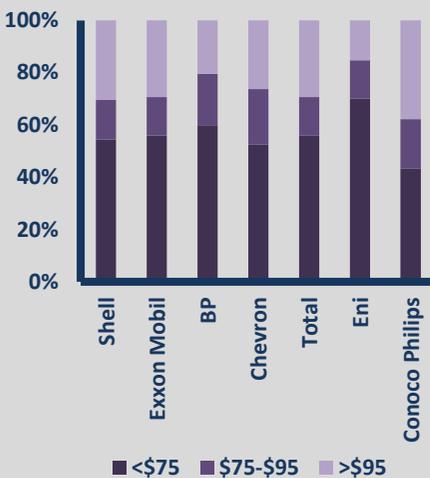


FIG. 3.26: POTENTIAL OIL SUPPLY BY COMPANY AND COST 2014-2050 (SOURCE: CTI 2014)



2°C POTENTIAL OIL SUPPLY

One way to define 2°C compatible targets is by setting growth / decline targets over 5 year time horizons across a listed universe. This can be done for example by taking current production levels and applying IEA 2°C growth rates to these production levels. Exposure / intensity targets can then be defined using a fair share approach, where the targeted production volumes depend on the % ownership in the universe.

Results. Fig. 3.25 shows the differences for total production by energy between NPS+ (~5°C scenario) and 450 (2°C scenario). For oil, this difference is 13.9% in terms of total production, with significantly lower levels in 2040. This implies that reducing the exposure to oil producing companies by 13.5% leads to an exposure to potential future production that is 2°C compatible. The equivalent logic applies for gas and coal. The 2040 target matches the IEA WEO roadmaps and industry databases. Shorter and longer time horizons would obviously have a significant impact on the results.

The benchmark for reducing this exposure can be the existing market-capitalization weighted index. A more granular analysis requires defining the actual share of the sector in the total listed equity universe, which can, in particular for the French and UK stock market, diverge significantly (2°ii 2014). The framework presents the results using a NPS+ assumption as the baseline. A more climate friendly assumption regarding current production trajectory (e.g. NPS) would only yield marginally different results, given the close proximity of the NPS and CPS.

The adjustment in exposure is not a comment on market capitalization. They reflect the appropriate exposure to future production. One key difference between the two is alternative valuation assumptions would also consider implications of different prices under different scenarios. While this is modeled by the IEA, it does not inform the analysis here (see also Kepler-Chevreur 2014).

Application. Analysis of future production requires industry databases:

- CTI breaks down production based on carbon cost curves (Fig. 3.26). These cost curves can then be used to define the 2°C incompatible potential supply by company over a fixed time period and re-weighting the exposure by that %. CTI will publish updated results in November for a sample of companies using this type of analysis
- The alternative approach is to look at growth rate assumptions of potential supply and compare these to IEA assumptions, assuming a pro-rata allocation of future production growth independent of cost curves. This is easier from an analytical perspective, but less precise. This growth would likely have to be adjusted based on rolling 5-year time horizons (cf. box on side).

Challenges. The framework at this stage does not respond to oil & gas service providers and other companies in this sector. These companies classified as “Energy” or “Oil & Gas” companies can be kept either neutral (e.g. no re-weighting), re-weighted in line with the oil & gas production & exploration companies’ adjustments, or adjusted based on carbon footprint data.

FOCUS: CARBON CAPTURE AND STORAGE

Overview. The IEA’s 2DS assumes that by 2050 about 6 billion tons of CO₂ are captured and stored per year with two thirds of the projected capacity needed in non-OECD countries. This includes CCS needs across all sectors, but most notably for power generation and also industrial processes. The IEA projects deployment for CCS to take off rapidly after 2025. In the IEA scenarios, CCS is crucial to allow for continued higher levels of fossil fuel consumption. Ekins & McGlade (2015) demonstrate the implications for stranded assets if CCS does not materialize (Fig. 3.27). No CCS requires an additional 15% of global gas and coal capacity to come offline by 2040 in the 450 Scenario (Fig. 3.28).

Next steps. CCS is currently only viable in a few regions/areas where the cost structure, the policy framework, and commercial opportunities align. The IEA underlines that much needed cost reductions for CCS will not be achieved by R&D alone, but that commercial experience is needed through deployment in order to allow for “learning by doing”. At this stage, anecdotal evidence suggests a significant R&D and deployment gap in CCS relative to the 2°C scenario. In addition, the technology is highly controversial given unresolved questions about feasibility and storage. The next version of the framework will explore this potential gap and discuss implications for looking at CCS-free scenarios.

FOCUS: BIOENERGY AND BIOFUELS

Bioenergy constitutes a core part of the climate solutions package. They play a particular prominent role as a source of electric power and in transport, as well as in industry.

In transport, bioenergy takes the form of biofuels, notably as inputs into petrol, diesel, and jet fuel. Biofuels are set to account for roughly 15-18% of road transport fuel consumption and a growing share of aviation fuel in the NPS, with ethanol accounting for the largest share. The key issue for growth identified by the IEA is opportunity for new technologies around biofuels, notably cellulosic ethanol and alga-based advanced biofuels. This is in particular a response to the growing concern of biofuels impacting food security. The exposure to biofuel production is particularly relevant on the production side as downstream consumers (e.g. road vehicles, etc.) usually respond homogenously to policy standards. The exception may be in the context of assessing companies like Boeing and Airbus and their work on building 100% biofuel compatible planes. There is public industry data on biofuel capacity (Fig. 3.29), but it is not comprehensive and doesn’t cover next generation fuels.

FIG 3.27: STRANDED RESERVES UNDER CCS AND NO CCS ASSUMPTION
(SOURCE: EKINS & MCGLADE 2015)

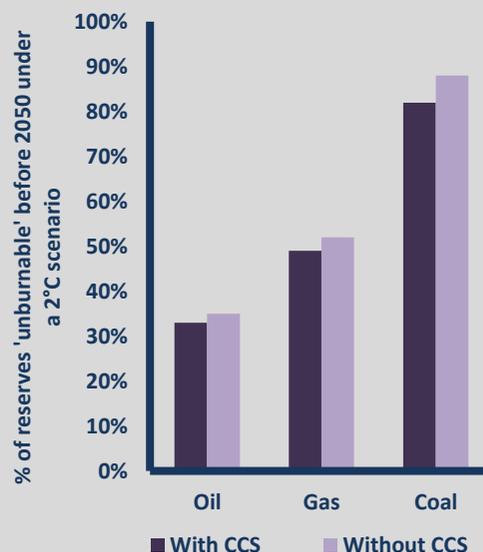


FIG. 3.28: ESTIMATED GLOBAL GAS AND COAL UTILITY CAPACITY UNDER CCS AND NO CCS ASSUMPTION
(SOURCE: 2°II, BASED ON IEA 2014 DATA)

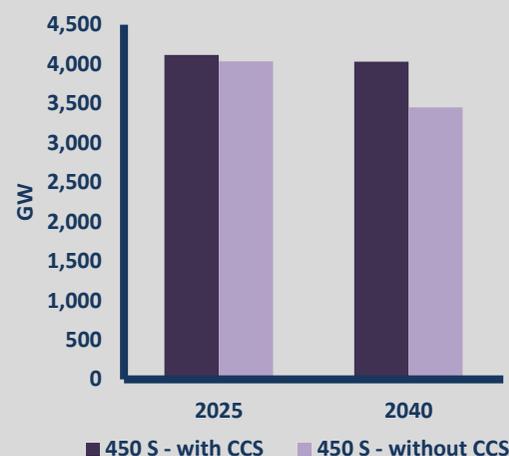


FIG 3.29. CURRENT AND PLANNED US BIOFUEL CAPACITY (SOURCE: 2°II, BASED ON BIOFUELS DATA)



4. IMPLICATIONS AND NEXT STEPS

4.1 IMPLICATIONS FOR INVESTORS

Aligning portfolios with decarbonization trends. With the introduction of this method, investors can for the first time test the alignment of an investment portfolio with various decarbonization scenarios. The results demonstrated that the most significant misalignment lay in the space of emerging and green technologies.

Indeed, the results suggest actual alignment at sector level is impossible for some sectors in the indices due to the absence of relevant technologies in the market (e.g. electric vehicles). This will likely apply even more so for other sectors and technologies explored in the next phase of the project (e.g. carbon capture and storage, R&D in zero carbon cement). An investor can potentially overcome this underexposure either by expanding the universe in the listed equity space or by gaining exposure to other asset classes (e.g. private equity / venture capital, alternatives), where the relative exposure to these technologies is potentially higher (Fig. 4.1).

How to use the 2°C assessment framework – Basic. For investors with no previous experience in responding to the issue of climate change in asset allocation and investment decisions, the 2° C assessment framework can be applied as a basic test in complementarity, for example, with a carbon footprint. This basic application involves:

- 1. Assessment.** Assessing the alignment of the listed equity portfolio with the 2°C climate goal using the free alignment check offered to investors as part of the SEI metrics consortium project (cf. p. 33).
- 2. Back-testing.** Back-testing alternative portfolio construction and potentially stress-testing these portfolios to a range of future energy and technology trends (e.g. using TIPS model (Mercer 2015)).
- 3. Action.** Identifying areas of action based on the investment belief about future scenarios.

How to use the 2°C assessment framework - Advanced. For investors with more experience, the assessment framework can directly be fine-tuned starting with the investment belief (Fig. 4.2). Thus, instead of starting with the IEA 2°C roadmap, investors can define the energy and technology roadmap (existing or new) that aligns with their investment beliefs. The investor can then compare the investment belief to the portfolio’s trajectory and future exposure using the free check of the SEI metrics consortium.

FIG. 4.1: ENERGY AND ENVIRONMENT IN VENTURE CAPITAL IN EUROPE (SOURCE: EUROPEAN COMMISSION 2014)

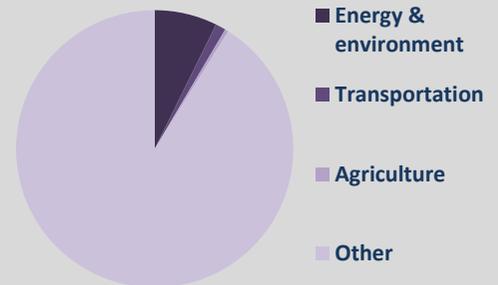
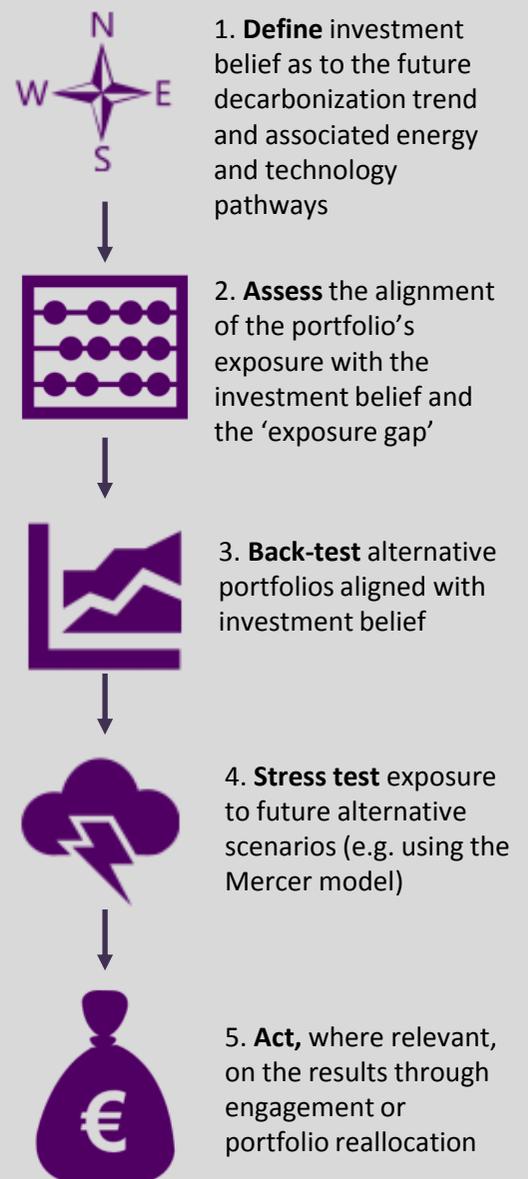


FIG. 4.2: ILLUSTRATIVE MODEL OF APPLYING THE 2°C MODEL (SOURCE: 2°II)



4.2 INVESTABILITY OF A 2°C PORTFOLIO

Back-testing method. To test the investability of 2°C portfolios, illustrative 2°C portfolios were constructed by re-weighting each index. At this stage, the framework does not comment on the optimal reallocation strategy, from either a climate or financial perspective. The re-weighting choice should thus be seen as a simple model and not prescriptive in terms of application.

The portfolios were re-weighted as follows:

- STOXX 600.** Indexed utilities were ranked by the percentage of renewable capacity in their overall mix. The worst performers were sequentially screened until the portfolio reaches the 2°C renewable capacity mix target. The weight from the screen components was scaled evenly over the remaining sector components to maintain constant sector exposure. The oil, gas and coal sectors, including non-producing companies (e.g. oil & gas service providers), were reduced by the average between the oil and gas misalignment. Given that alignment for automobile was impossible, the best-in class for hybrid share and electric vehicle share in production were selected and scaled to keep sector exposure neutral.
- S&P 500.** The same process was applied as with the STOXX 600 above, but with changes to the automotive sector. Tesla Motors was used to replace the manufacturer with the lowest share of electric vehicle production, with its portion of the sector weight increased until the portfolio achieved the 2°C electric vehicle production share target.
- MSCI World.** The 2°C electric vehicle production share was achieved by sequentially screening out the worst class performers with the highest internal combustion engine production mix until electric vehicle production reached its targeted share. The removed weight was scaled evenly to each remaining component within the sector. The remaining weight for the other sectors were calculated by the same method as outlined in the STOXX 600 portfolio above.

Results. The results for the illustrative portfolios are predictably the most pronounced for the S&P 500, the only index that saw a new company replace an existing one, significantly increasing the tracking error (Fig. 4.3). In terms of overall return, all reweighted portfolios outperformed the benchmark, albeit only marginally. Interestingly, the relative outperformance within sectors varied significantly across indices, even being negative in the case of energy for the S&P 500 and the STOXX 600 (Fig. 4.4). These results are illustrative using a very simple re-weighting rule and should not be seen as a general comment.

FIG. 4.3: TRACKING ERROR OF RE-WEIGHTED PORTFOLIO VERSUS BENCHMARK (SOURCE: 2°II, BASED ON BLOOMBERG PORTFOLIO ANALYTICS)

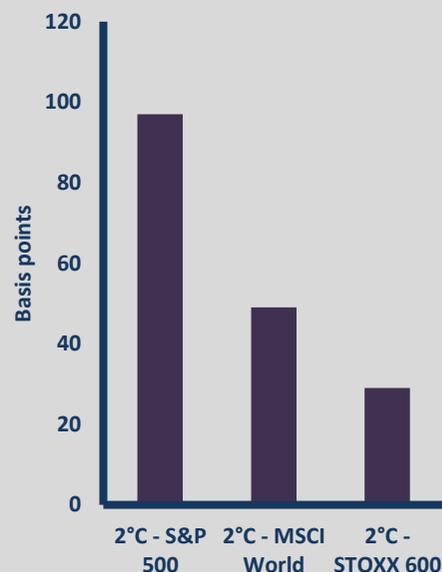


FIG. 4.4: RELATIVE OUTPERFORMANCE BY SECTOR OF REWEIGHTED PORTFOLIOS VERSUS BENCHMARK (SOURCE: 2°II, BASED ON BLOOMBERG PORTFOLIO ANALYTICS)

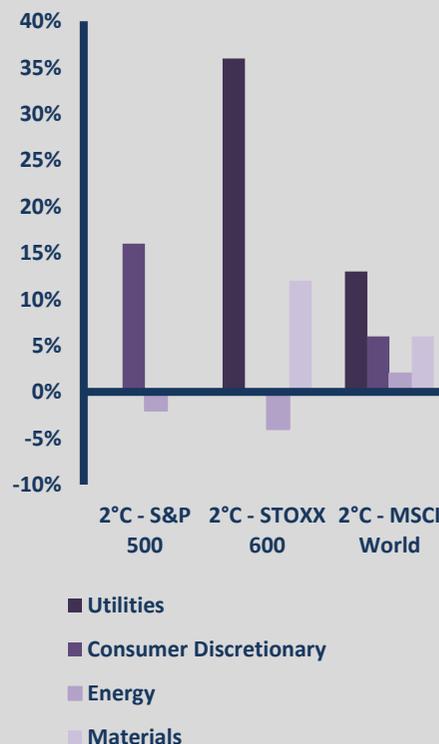
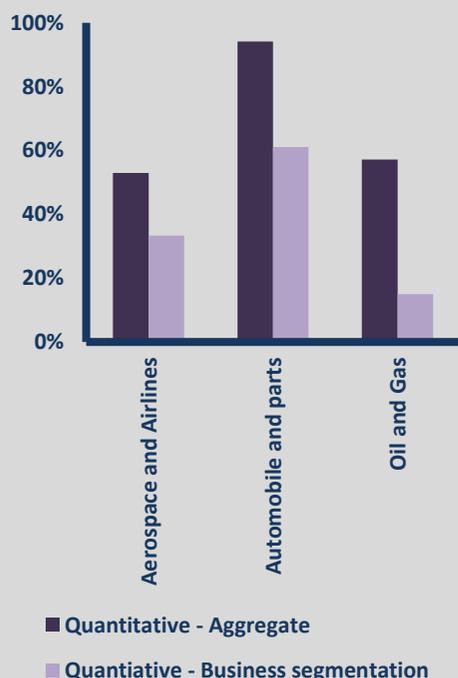


FIG. 4.5: NET R&D EXPENDITURE BY TYPE (SOURCE: EDF ANNUAL REPORT 2009)



FIG 4.6: QUANTITATIVE REPORTING ON R&D ACTIVITIES IN AGGREGATE AND BY BUSINESS SEGMENTATION IN ANNUAL REPORTS (SOURCE: 2°II, BASED ON ANNUAL REPORTS)



4.3 IMPLICATIONS FOR CLIMATE FRIENDLINESS AND IMPACT

A piece of the puzzle. The framework provides a piece in the puzzle in the larger conversation around the financial sector and climate change. This applies both from a risk perspective and ‘climate performance’ perspective. It complements existing practices, research, and tools behind both objectives.

Implications in terms of climate impact. The framework proposed here is not a climate friendly benchmark and thus doesn’t link to a climate impact logic directly (2° Investing Initiative / UNEP-FI / WRI (2015)). Its direct impact when linked to portfolio reallocation is low due to liquidity; indirectly however, it can help guide investors to impact in the real economy:

Engagement: Quantitative technology exposure targets can help inform engagement at company level by providing quantitative benchmarks. It can also help inform on the main engagement needs in terms of largest exposure gaps.

Signaling to companies: Portfolio reallocation can change relative asset prices, which in turn can send a signal to companies. The nature of the model allows for this signal to be directly linked to key indicators companies in the sector measure (e.g. electric capacity, car sales, etc.).

Signaling to policy makers: Where 2°C compatibility is impossible, an exposure gap can send a strong signal to policy makers around the need for further action to drive the transition to a low-carbon economy.

4.4 IMPLICATIONS FOR DATA PROVIDERS

By design, the method introduced in this paper relies on existing data available in financial and industry databases and is thus broadly replicable by any standard ESG or financial data provider. The work done to date, however, suggests a number of data gaps that will become more important in the next steps of the project.

R&D. Decarbonization in climate-relevant sectors often relies on technology that requires additional R&D investment, in both public and private spheres. It is currently impossible for investors to measure their exposure to such expenditures, as relatively few annual reports report R&D expenditures by technology (counterexamples can be found; Fig. 4.5 & Fig. 4.6).

The project’s next steps will explore the exact prevalence of such reporting and explore options around improving data availability, including the update of voluntary surveys (e.g. CDP questionnaire) and strategies around engaging on disclosure. It will also test the limits of this reporting.

Capital expenditure. Similarly, data on capital expenditures is not always available at desired levels, a crucial data point for assessing company level alignment with 2°C (CTI 2015). Such data are generally only available via expensive industry databases. Accessing the range of databases is currently relative expensive without the economies of scale provided by a one-stop shop data provider. Although out of scope for now, the industry databases will also be more challenging in the industrial sectors.

A proper 2°C compatibility assessment requires data granularity that only industry databases can provide. Where it didn't already exist, ESG data providers are now integrating this data into their services, creating potential new one-stop shops. The total cost of raw data necessary to implement the framework are estimated at ~\$50,000-\$75,000/year for the sectors covered here. These costs are relatively high where investors seek to have granular data by security (versus the high level assessment offered for free by the SEI metrics consortium) and as long as this data is not integrated into mainstream ESG and / or financial databases. Economies of scale from data providers would however likely reduce these costs significantly.

4.5 IMPLICATIONS FOR POLICY MAKERS

The framework presented here demonstrates that it is possible to measure the 2°C alignment of investment portfolios and financial markets more broadly – at the very least for the most significant sectors reviewed here. The framework can thus inform both mandatory (e.g. French ET Law) and voluntary disclosure requirements (e.g. proposed Climate Disclosure Task Force(Carney 2015)), allowing policy makers to set indicative targets, monitor progress, and, crucially, identify gaps and priorities for public support. Future developments of the method make it important for any policy development to remain flexible enough to incorporate new developments.

Data gaps from corporate disclosure are another important consideration for policy makers. A 'disclosure ceiling' may exist for certain types of business-sensitive information critical to assessing alignment to the energy transition (notably R&D and for some sectors capital expenditure by technology type). Options may exist for regulatory and supervisory authorities to collect and analyze confidential data from investors and issuers, with public-private partnerships developed with data providers and credit rating agencies to extend coverage to non regulated markets. Work done over the coming months will help define the extent of the 'disclosure ceiling' problem and recommendations will be made for the role of mandatory and voluntary disclosure.

4.6 NEXT STEPS FOR THE PROJECT

Free 2°C alignment check. The consortium offers a free 2°C alignment check for investors at portfolio level until the end of 2016. The offer will provide aggregate results on the 2°C exposure gap (cf. charts on p. 6-8), the potential to close that gap in the existing universe of companies in the portfolio, as well as a back-test of alternative strategies.

The framework will be road-tested in the coming months and lead to the design of 2°C compatible financial products (indexes, funds, etc.) and '2°C alignment check' for existing funds and indices. The research output constitutes an 'additional layer' of portfolio analysis and optimization (alignment with 2°C goals) that can be combined with other indicators for sector not covered by the model (e.g. green and brown activities, carbon intensity of companies, etc.) (2° Investing Initiative / UNEP-FI / WRI (2015).

Next steps. The initial research output presented is the first step in a multi-year project connecting climate scenarios and financial portfolios. Over the next year several elements will be improved or added:

- *New scenarios:* Alternative scenarios will be explored as benchmark, including scenarios developed by the SEI metrics consortium.
- *New sectors and asset classes:* While the four sectors used here are the four most critical to the transition to the low carbon economy, several others are important and will be included in the coming months, notably air transport, marine shipping, and cement. The framework will also be expanded to cover other asset classes, notably fixed income (corporate and sovereign bonds), as well as infrastructure finance.
- *R&D:* The project will place particular emphasis on measuring and responding to what anecdotal evidence suggests is a significant gap in breakthrough technologies and innovation, developing specific solutions for investors on this topic.

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SEI METRICS CONSORTIUM

The SEI metrics consortium is a EU funded group of organizations developing metrics, benchmarks, and tools to help financial institutions measure the alignment of their portfolios with the 2°C roadmap and associated decarbonization pathways. The project involves leading organizations on climate and finance, including the 2° Investing Initiative, the Climate Bonds Initiative, CDP, Kepler-Cheuvreux, WWF Germany, WWF European Policy Office, CIRED, Frankfurt School of Finance & Management and the University of Zurich.

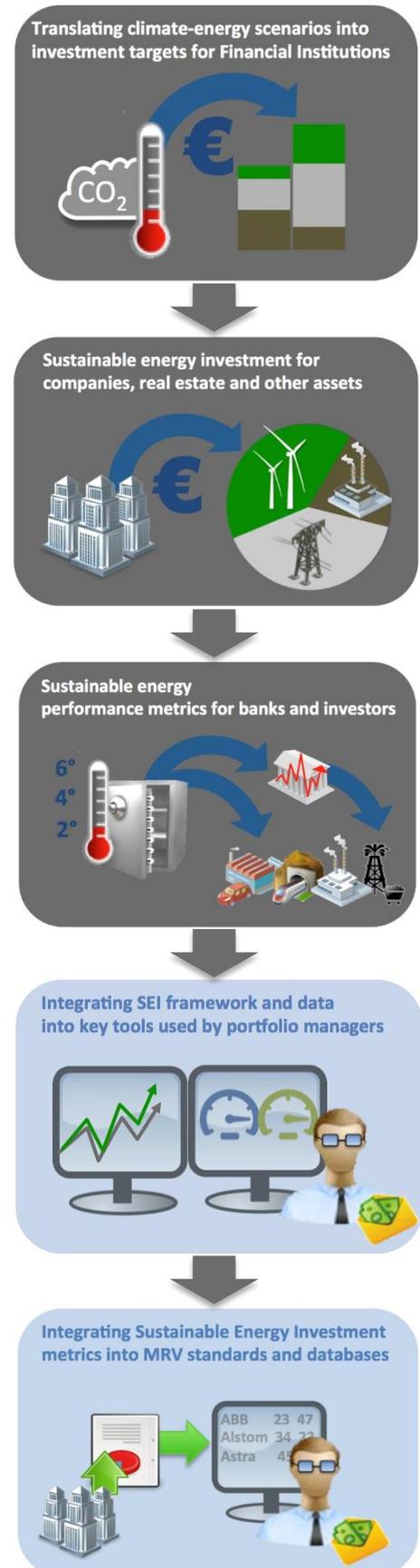
The project involves the following key outputs (Fig. on right):

- Translating energy and technology roadmaps into investment and financing roadmaps for investors;
- Developing a 2°C assessment framework for equity, bond, and alternative portfolios as well as lending books of banks;
- Partnering with index and data providers to develop 2°C indices and portfolio optimization tools;
- Engaging data providers and companies on improving reporting and accounting standards around 2°C metrics, including updating company questionnaires (e.g. CDP, etc.);
- Engaging policy makers on accounting and disclosure standards and requirements for 2°C disclosure in financial markets.

The project aims to achieve these goals by working with the entire ecosystem of the climate-finance nexus, from reporting companies and ESG data providers to financial data and index providers, investors, and asset managers and asset owners.

The project started in March 2015 and will continue through February 2018. The project has received EUR 2.5 million funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649982.

Get involved! In addition to the core members, a broad consortium of members, sponsors, and supporters including asset owners, asset managers, government agencies, research organizations, academic institutions, and financial data and index providers. Please get in touch if you would like to be involved in the project by emailing info@2degrees-investing.org.





The 2° Investing Initiative (2°ii) is a non-profit company set-up to produce research on pathways for aligning the financial sector with climate goals. Its research is provided free of charge and 2°ii does not seek any direct or indirect financial compensation for its research. 2°ii is not an investment adviser, and makes no representation regarding the advisability of investing in any particular company or investment fund or other vehicle. A decision to invest in any such investment fund or other entity should not be made in reliance on any of the statements set forth in this publication. The information & analysis contained in this research report does not constitute an offer to sell securities or the solicitation of an offer to buy, or recommendation for investment, in any securities within the United States or any other jurisdiction. The information is not intended as financial advice. The research report provides general information only. The information and opinions constitute a judgment as at the date indicated and are subject to change without notice. The information may therefore not be accurate or current. No representation or warranty, express or implied, is made by 2°ii as to their accuracy, completeness or correctness. 2°ii does not warrant that the information is up to date.

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The SEI metrics consortium consists of nine organizations, including the 2° Investing Initiative, CIRED (SMASH), CDP, WWF European Policy Office, WWF Germany, Frankfurt School of Finance & Management, University of Zurich, Kepler-Cheuvreux, and the Climate Bonds Initiative. Their involvement in this project does not constitute an endorsement of the messages in this working paper.



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