TESTING THE JAPANESE LISTED EQUITY MARKET ALIGNMENT WITH THE 2°C CLIMATE GOAL

ENERGY TECHNOLOGY DIVERSIFICATION ASSESSMENT RELATIVE TO THE IEA 2°C SCENARIO

In partnership with:

IGES
Institute for Global Environmental Strategies

RIEF

"Testing the Japanese listed equity market alignment with the 2°C climate goal – Energy technology diversification assessment relative to the IEA 2°C scenario"

A 2° Investing Initiative report, in partnership with IGES & RIEF
February 2018

Authors:
Hugues Chenet, Klaus Hagedorn, Michael Hayne [2° Investing Initiative]
Takako Wakiyama, Noriko Shimizu [IGES]

Acknowledgments:
The authors would like to thank Martha McPherson (2°ii) and Jakob Thomae (2°ii, CNAM and ADEME) for their precious help, as well as Pr. Yoshihiro Fujii (Research Institute for Environmental Finance) and Pr. Jusen Asuka (Tohoku University, Center for Northeast Asian Studies) whose reviews contributed to improve the report, and Mrs Michiyo Morisawa, (PRI Japan, CDP Japan) for her useful advices. The completion of this report could not have been possible without the support of the Institute for Global Environmental Strategies (IGES) and the Research Institute for Environmental Finance (RIEF).
The report also benefits from the results of the European H2020 project "SEI Metrics", which developed the model applied in the report.

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 and 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. 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.

The contents of this publication are the opinions of the authors and do not reflect the views of 2°ii, IGES and RIEF.

Front cover illustration: Copyright © Japan - Single Color by FreeVectorMaps.com

Copyright © 2018 2° Investing Initiative. All rights reserved.

SUMMARY OF THE REPORT

This report compares the energy and technology exposure of the Tokyo Stock Price Index (TOPIX) stock market index with the 2°C roadmap of the International Energy Agency (IEA). The analysis is based on a translation of this climate scenario into "2°C benchmarks" for investment portfolios, focusing on a 5-year window: 2016-2021. Such a 2°C benchmark for the TOPIX represents the relative amount of energy/technology which TOPIX companies should produce/use to achieve the 2°C target under the IEA 2°C scenario. If the TOPIX index, based on its current composition, follows this production and capacity benchmark, it would then be "2°C-aligned".

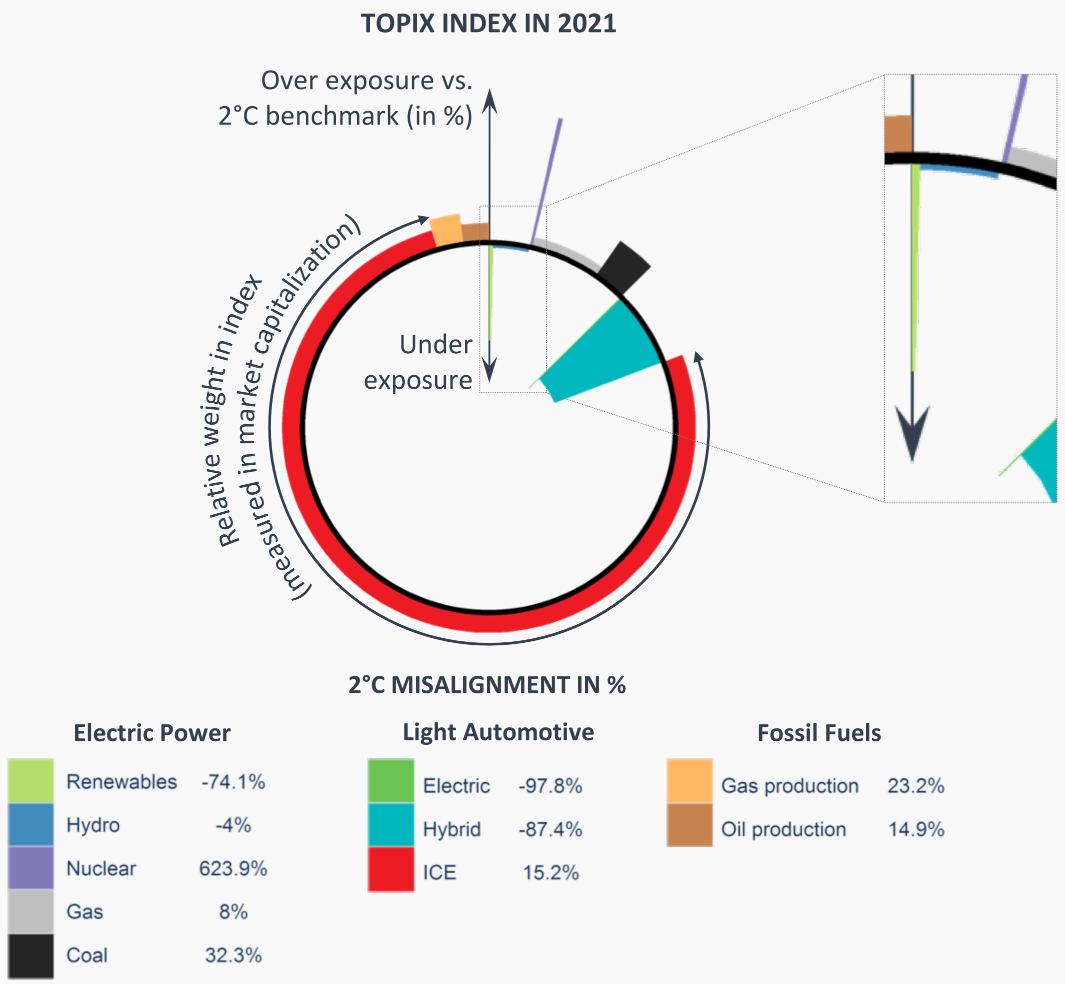
TOPIX was chosen for this analysis because it is the largest index in Japan, encompassing the popular 'Nikkei 225' stock market index. Therefore, the TOPIX index provides financial institutions with a relevant proxy of the investing universe in Japan. The assessment is performed on three main sectors that represent most of the full index exposure to climate change issues: Power production, Automobiles, and Fossil fuels. The output of the assessment is the discovery and explanation of an energy and technology gap. The gap quantifies the over and under exposure of those three TOPIX sectors to energy and technology under a 2°C trajectory.

The main results for the TOPIX analysis are the following (also see the figure on the next page):
Power: The TOPIX overweights nuclear, gas and coal capacity relative to its 2°C benchmark, while underweighting renewables capacity. The planned electric capacity of TOPIX companies is thus misaligned with the power capacity in the 2°C scenario.
Automobiles: The TOPIX underweights low-carbon technologies (hybrid, electric) and overweights high-carbon technologies (internal combustion engine (ICE) e.g. petrol / diesel car production) relative to the 2°C reference. The TOPIX is thus misaligned with the 2°C pathway for automobiles.
Fossil fuels: The TOPIX overweights oil and gas production relative to the 2°C scenario. It does not contain any coal production. The exposure is thus misaligned with the 2°C pathway for oil and gas production but is more climate-friendly than the 2°C scenario for coal production.

Since the above three sectors are among the most climate change concerned sectors (they typically account for most of the TOPIX carbon footprint), their misalignment with the average production and capacity required by the 2°C scenario means that the TOPIX index, as a whole, seems to be incompatible with a 2°C climate goal. As a consequence, financial institutions that invest in the Japanese economy through Japanese listed companies are not aligned with such goals, and contribute to orienting the global climate towards hazardous trends, leading to the overshooting of the 2°C threshold.

These results call for more informed investment strategies towards decarbonization and for better policy signals oriented at investors, so that the financial sector contributes effectively to the fight against climate change.

Figure. Estimated 2°C alignment of the 2016 TOPIX in 2021.



The alignment of the TOPIX with the IEA 2°C benchmark is represented by the exposure of each of the covered industries and technologies relative to the benchmark. The 2°C benchmark is symbolised by a black circle - any sectors which are fully aligned will sit directly on top of this circle. Each sector is represented by a coloured "circular bar". The height of the bar relative to the circle represents the level of misalignment in terms of under/over-exposure compared to the 2°C benchmark: the higher the bar is outside the black circle, the more the TOPIX is overexposed to this technology compared to the 2°C benchmark; the longer the bar is inside the black circle, the more the TOPIX is underexposed to this technology. This misalignment with the 2°C benchmark is expressed as a percentage. The width of the bars represents the relative weight of the technology in the TOPIX, measured in market capitalisation. While a perfect alignment can be considered as the target, it is important to notice that overexposure is a "climate positive" (i.e. relatively positive effect on climate change) feature for some technologies (e.g. renewables, electric cars) and a negative feature (i.e. relatively negative effect on climate change) for others (e.g. ICE, coal). Conversely, underexposure would be considered positive for oil but not for hybrid cars. The graph for the TOPIX shows that all the underexposures are for "green" technologies while overexposures are for "brown" ones. As a consequence, the TOPIX is not aligned with the 2°C benchmark and does not appear to contribute to a 2°C (or below) scenario.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

The Paris Agreement entered into force on 4 November 2016. The Agreement was made in 2015 at the 21st Conference of the Parties (COP 21) of the United Nations Framework Convention on Climate Change (UNFCCC), where Parties agreed on legally binding limits to global average temperature rises below 2°C above pre-industrial levels in a long-term goal (UNFCCC, 2015b; UNFCCC, 2016). More ambitiously, it also agreed to aim to limit the increase to 1.5°C, since this would significantly reduce the risks and impacts of climate change. To achieve the goal, global emissions are expected to peak as soon as possible, recognising that this will take longer for developing countries, and emitters to undertake rapid reductions thereafter in accordance with the best available science (UNFCCC, 2015b). The Agreement required the process of the ratcheting up ambition every five years to maintain momentum and ensure appropriate targets under the current climate regime. To reduce CO_2 emissions, all countries need to reduce energy demand and energy intensity.

Japan accepted the Paris Agreement on 8 November 2016, a few days after it entered into force. Japan set up a post-2020 GHG emissions mitigation target ([Intended] Nationally Determined Contribution ([I]NDC)), which proposes a 26% reduction in CO_2 from the 2013 level (UNFCCC, 2015a). The NDC specifies an intended 2030 electricity mix of: 20–22% from nuclear, 26% from coal, 3% from oil, 27% from natural gas, and 22–24% from renewables. The NDC states that '*Japan's INDC is consistent with the long-term emission pathways up to 2050 to achieve the 2 °C goal […], and with the goal the country upholds, namely, "the goal of achieving at least a 50% reduction of global GHG emissions by 2050, and as a part of this, the goal of developed countries reducing GHG emissions in aggregate by 80% or more by 2050"' (UNFCCC, 2015a)*.

1.2 Purpose of this paper

This paper proposes to test the alignment of the Japanese listed stock market with the internationally agreed climate goal. The Japanese stock market is represented by the Tokyo Stock Price Index (TOPIX), composed by a capital-weighted ensemble of about 2000 domestic large-sized companies listed on the Tokyo Stock Exchange First Section. The TOPIX index is the largest index in Japan, encompassing the popular 'Nikkei 225' stock market index. Therefore, the TOPIX index provides financial institutions with a relevant proxy of the equity investing universe in Japan. The assessment compares the energy and technology exposure in three high-emission sectors of the TOPIX index (hereafter 'TOPIX') with the 2°C roadmap of the International Energy Agency (IEA) [cf. section 2.1. methodology for details].

The analysis is based on a translation of this climate scenario into a "2°C benchmarks" for investment portfolios, focusing on a 5-year window: 2016-2021. Such a 2°C benchmark for the TOPIX represents the relative amount of energy/technology which TOPIX companies should produce/use to achieve the 2°C target under the IEA 2°C scenario. If the TOPIX index, based on its current composition, follows this production and capacity benchmark, it would then be "2°C-aligned". The output of the assessment is the identification of energy and technology gaps, some of these representing climate problems, and some solutions. The gap quantifies the over and under exposure to energy and technology under a 2°C trajectory.

An objective of the paper is for policy makers to understand how companies listed in the TOPIX are considering climate targets and how their business models today align with decarbonization trends in order to quantify the necessary steps to close the 2°C exposure gap. It will also help to determine if financial institutions can address the energy transition challenge by following 'simple' market behaviour, or conversely whether they will need to diverge from the average portfolio allocation in order to make a real contribution.

From an investor point of view, the analysis helps them characterise the areas of the Japanese stock market that are exposed to energy technology transition. The paper illustrates how far they need to put in place an 'active' asset management to be in line with Japanese and international climate targets, or if investing 'passively' in a mainstream index such as the TOPIX is consistent with the Japanese decarbonisation pathway.

More specifically, this assessment can inform investors and policymakers objectives through two complementary channels: contribution to energy transition, and risk management. Energy transition is now featured in most developed countries' official goals, and investors, either public or private, are expected to contribute to its financing. Some investors even have a clear mandate to contributing to public policy goals, including climate mitigation. Whilst applying the 2°C benchmark does not inform on the actual impact of investors' financial allocation in the real economy, it can be considered an initial approximation of such impact.

On the other hand, 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 such related risks. To date, the emphasis on risk assessment has been on developing alternative discounted cash flow models (e.g. 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 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) commonly used by investors. The 2°C benchmark can thus inform on potential idiosyncratic risk exposure to the high-carbon economy –which corresponds to sub-optimal diversification in the context of the transition to a low-carbon economy, as the transition is promoted by virtually all governments, including Japan.

The structure of this paper is the following: The methodology used to analyse the alignment of TOPIX and 2°C climate goals is described in next section; This includes timeframe and sector coverage of this assessment. The result of the analysis is explained in section 3 focusing on electricity, automobile and fossil fuel production sectors. The limitation of the analysis is laid out in section 4. We finish with the conclusion and our recommendations.

2. APPROACH AND METHODOLOGY

This paper examines the gaps in energy and technology exposures between a theoretical ‘2°C portfolio’, our ‘2°C benchmark’, and the TOPIX index, which is made up of Japanese listed large companies. The analysis covers a period of five years (up to 2021 as of 2016), based on the 2°C roadmap of the International Energy Agency (IEA).

More information on the details of the underlying approach and methodology can be found in publications by 2°ii (2015), Thomä et al. (2015), 2°ii (2016), Thomä et al. (2018), and on the website of the SEI Metrics project, which developed the methodology.*

2.1 Timeframe

This 5-year timeframe comes with relatively accurate forecasts on what companies have planned to produce, develop and invest, but by definition may also fail to capture longer term trends in some industries. The 5-year time window chosen for the analysis has also to be seen from the perspective of decarbonisation scenarios. Indeed, most scenarios show slow decarbonisation rates in the near future, while increasing the decarbonisation effort over a 20 to 40-year timeframe. As a consequence, the 2°C scenario diverges slowly from the business-as-usual scenario, and being in line with 2°C in 2020 does not guarantee the subsequent alignment and ultimate achievement of the target. Focusing on a 5-year time window can appear to be biased towards a lower expected level of decarbonisation from assessed companies, but on the other hand it would be much less reliable to use longer windows within which companies’ plans are much less clear.

The data used in the analysis are up to date as of 30 Dec. 2016, unless otherwise specified.

2.2 Sector coverage

The presented framework defines the energy and technology exposure targets for the representative diversified equity portfolio for Japan. The results show what the benchmark would look like if the Japanese equity markets were 2°C aligned from an IEA perspective (i.e. the 450S scenario). The paper focuses on the Japanese listed equity market, represented by TOPIX. Thus, the model translates sectoral goals in terms of production of the investible equity universe in the Japanese market. It then applies a “fair share logic” that allocates future responsibility for production across all asset classes based on their current market share (i.e. it uses the IEA 450S production trendline for Japan on top of the listed equity universe starting point).

The future market share is calculated depending on whether the production exposure is set to decrease or increase within the analysed timeline (5 years) according to the macroeconomic trend to reach 2°C. If the production is meant to increase, the fair share is calculated based on the total market share of the product (e.g. installed capacity, etc.). This approach is called the ‘market fair share’. If the production is meant to decrease, the fair share is calculated based on the total market share of the specific fuel or technology (e.g. coal production, coal installed power capacity). This approach is called the ‘technology fair share’. This distinction was chosen since applying market fair share to declining technologies can yield negative results eventually (since the market share could be higher than the technology fair share) and because companies that have ‘lagged’ production increases in the past shouldn’t be assumed to do so in the future. In theory, the model could apply the technology fair share for both increasing and decreasing technologies, a modelling choice not made in the current iteration. The main reason for this decision is to avoid penalising front runners and rewarding laggards (as the required build out would be 0 for companies that own 0 MW to begin with).

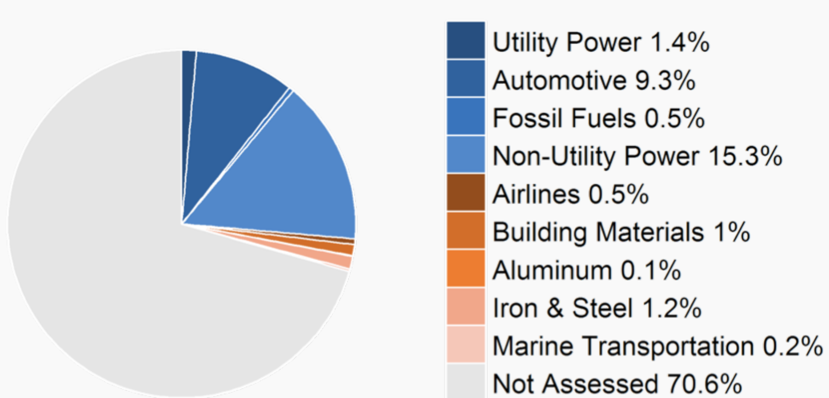
** This methodology was tested by more than 100 international investors and several international supervisors in the frame of the SEI Metrics project (http://seimetrics.org). This report was made independently from the SEI Metrics project.*

In terms of sectoral coverage, the assessment focuses on energy and technology for electric utilities, automobile transport and fossil fuel productions. Those primary sectors are represented in blue in Figure 1 as the share of all holdings in the TOPIX that can be assessed in this paper. Our approach is based on available production and capacity data, and we capture all asset ownership and production regardless of industry classification of the company. Therefore, we can monitor the production and ownership in electric power, oil, gas, coal and light automobiles of those three macro sectors listed above, but also what is produced by companies of other sectors (e.g. IT, Chemicals, Pharmaceuticals). This is especially relevant for electricity production, which is frequent in a number of industries that produce their own power for their facilities. We classify the electricity production from non-utility companies as "non-utility power".

The sector coverage (the blue area in Figure 1), represents only ~25% of TOPIX market capitalisation, but we estimate that it covers most of its carbon footprint (about 70-90%) and therefore represents the main part of the climate challenge we can study. The orange share (about 3% of TOPIX market capitalisation) relates to the sectors and/or technologies for which the methodology is under development and will be integrated in the future. The grey area is not part of our approach, either being considered a second order element in the climate challenge, or being impossible to address with such an approach at this stage, often because no technology benchmark/scenario or no appropriate databases exist.

Thus, this report does not address all sectors listed in the TOPIX but focuses on the most significant when talking about climate change targets. It is also important to note that sectors such as agriculture and forestry are indeed key in the climate change discussion, but there are very few listed companies for those sectors, which renders the agriculture issue difficult to address when analysing equity indices and portfolios.

Figure 1. Coverage of assessment (blue) and potential future coverage (orange) in market capitalisation of the companies listed in TOPIX as of 30 December 2016.

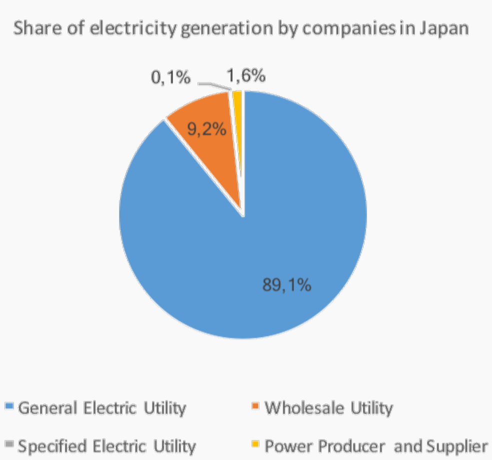


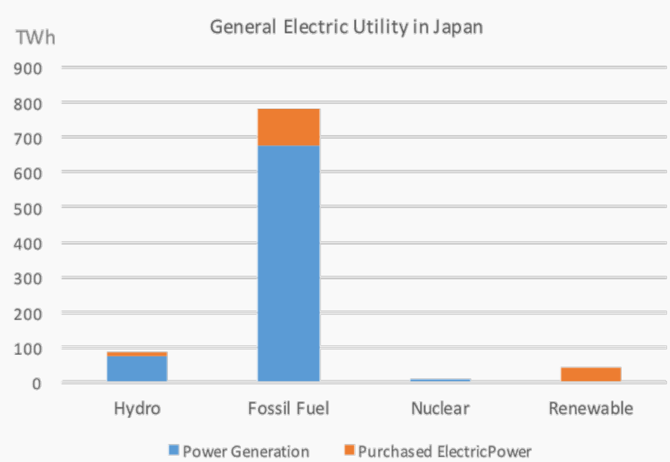
2.2.1. Electric utilities

The utility sector is one of the most important sectors when considering climate change. Electricity and heat account for roughly a quarter of global GHG emissions. The sector will face significant challenges in both climate problems and climate solutions, especially through the competition of power production from high-carbon fossil sources and from low-carbon renewable sources. TOPIX includes power utility companies (10 regional electricity companies, and Electric Power Development Co., Ltd. (J-Power)) and non-utility companies that do produce electricity. The ten regional electricity companies, together with J-Power, account for approximately 95% of electricity supply in Japan (Figure 2). The share of "non-utility power" companies in Fig. 1 is large as it is represented by market capitalization, whether electric production is significant or marginal in their activities.

The approach for the utility sector is to define a 2°C compatible capacity mix by fuel for the domestic capacity of utilities. For the power sector the scaling is done by the TOPIX proportional ownership of installed power capacity in Japan. Capacity additions / retirements as defined in the IEA 2°C roadmap are allocated to the TOPIX based either on the market share for technologies and fuels that see additions over the next 5 years (e.g. renewables), or technology share for technologies and fuels that that see retirements (e.g. coal power). The same logic is applied at company level. Thus, if a company owns 1% of the total power capacity in Japan today, 1% of total renewable required additions to meet the 2°C benchmark are allocated to the company, whatever the level of renewable capacity it owns today (even 0%). On the other hand, if the company owns 1% of coal power capacity in Japan, 1% of the required retirements are allocated to the company.

Figure 2. Electricity generation by companies and its energy mix. Source: Authors made from METI energy statistics as of March 2015. *[NB: General electric utility is made up of 10 regional electric power companies, and wholesale electric utility is through J-Power. Japan has two wholesale electric utilities, J-Power and Japan Atomic Power Company (JAPC), but JAPC, the owner of nuclear power plants, has not been active.]*





2.2.2 Automobile

The transport sector, encompassing shipping, rail, road and air traffic, accounts 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 automobile vehicles. The analysis in this paper focuses on passenger light duty vehicles, for which the IEA highlights three main pathways to reach the 2°C warming target via the 2 degree scenario (2DS) of IEA Energy Technology Perspectives 2015: fuel efficiency, alternative propulsion, and modal shift. Alternative propulsion is the only indicator where the IEA provides quantitative 2°C benchmarks until 2050. These 2°C benchmarks can be compared to production forecasts from WardsAuto to measure the energy technology exposure of the indices relative to the 2°C benchmark in the short term. The production benchmark is global, as automobile manufacturers operate internationally. Nevertheless, Japanese auto maker production pattern is quite different from the global one (see Figure 15). One of the advantages here 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. More than 9% of the TOPIX market capitalisation is held by automobile companies. Those highly capitalised car manufacturing companies therefore represent a very significant market capitalisation share of the sectors we analyse here. The auto sector is about 83% of our sampled sectors, putting aside non-utility power companies, cf. Figure 6.

2.2.3 Fossil fuel production

The oil, gas and coal production sectors are addressed together, given the common challenge these sectors face. It is worth remembering 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 level that would be fully aligned with the 2°C pathway promoted by the IEA (2015)?

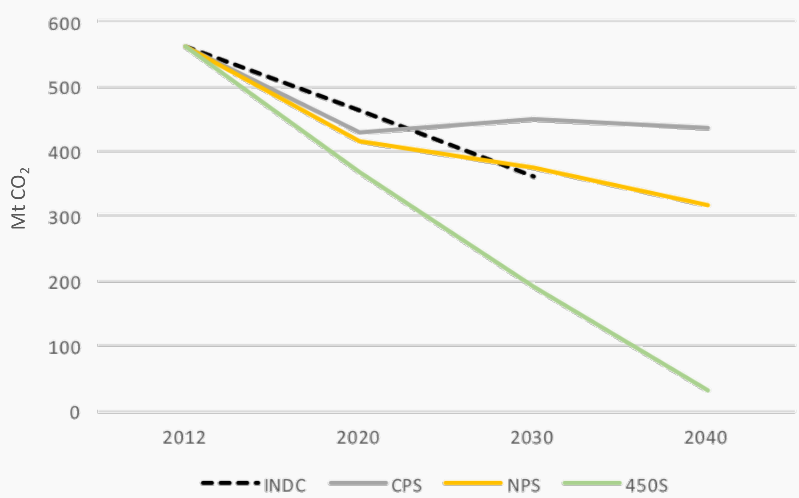
2°C compatibility for the fossil fuel sectors can be determined by defining targeted exposure levels to future potential production. This exposure can then be measured by estimating the total future potential production for all the listed equity stocks and the associated 2°C compatible production in the TOPIX, based on the share of the index in this full listed equity universe. Future potential production can be estimated using industry databases for the next 10 years, but the accuracy of the forecasts drops significantly after 5 years. This is even without a paradigm shift in the fossil fuel sector, as those forecasts offer a current snap shot of capital expenditure plans which are likely to change, i.e. new well get drilled, fields explored, etc.

2.3 2°C scenarios

The methodology uses the data from the International Energy Agency (IEA) World Energy Outlook 2015 (IEA 2015b) for the utility and fossil fuel production sector, and the Energy Technology Perspectives (ETP) 2015 roadmaps for the automobile sector (IEA 2015a).

The IEA WEO (IEA 2015b) provides three scenarios. The 2°C scenario is called the 450 scenario (450S) because it aims for a pathway that limits atmospheric CO_2 concentrations to 450 parts per million (ppm). The New Policies Scenario (NPS) is the baseline scenario taking existing policy commitments into account, and, lastly, there is the Current Policy Scenario (CPS). The 2°C scenario of the ETP is called the 2°C scenario (2DS), which aims for a pathway consistent with a 50% chance of limiting average global temperature increase to 2°C. 2DS is broadly consistent with the WEO 450 scenario through 2035. In the IEA report, there are data on 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 split out by fuel (passenger light duty vehicles). The indicators in the analysis are thus prescribed by the mainstream scenarios. According to IEA WEO, power generation-related CO_2 emissions will be roughly 15% lower in the 450S than the CPS in 2020, and 90% lower in 2050 (Fig. 3).The Japanese INDC curve is similar to the NPS scenario of the WEO.

Figure 3. Power generation related GHG emissions for Japan, for 4 scenarios. *Source: Authors made from IEA (2015b); UNFCCC (2015a). [NB: There is no INDC target of 2020, thus the 2020 data of INDC uses linear interpolation from 2012 to 2030.]*



In the comparison of renewable energy, while renewable electricity generation is expected to increase to 35% in 2030 and 50% in 2040 of the total share of power generation in a 2°C scenario (450S), other scenarios (CPS, NPS, INDC) show an increase of only 22-24% in 2030. The gap is increasingly observable after 2020 (Figure 4). In the IEA 2°C (450S) scenario for Japan, coal power capacity dramatically drops after 2020. On the other hand, thermal coal power capacity stays stable or even increases until 2020 in NPS and CPS respectively (Figure 5). This widens the gaps between 450S and NPS/CPS.

As quoted from a recent 2°ii report (2°ii, 2017), the IEA WEO and ETP provide roadmaps covering about 20 technologies, with different geographic focuses. They include both the GHG emissions and related production characteristics (e.g. passenger-km, MWh, km, EJ) for each technology, but do not cover sectors such as agriculture and forestry. The IEA 2°C scenario is the most complete energy technology worldwide scenario available and considered by many market players as a mainstream reference, as the IEA is OECD body. However, it also garners a number of criticisms. It appears that IEA somehow missed the growth trend of renewable electric capacity since 2000, just as it missed the recent shale gas upheaval that revolutionised the energy equation in the US.

Figure 4. Renewable Power generation and capacity For JAPAN from 2012 to 2040. *Source: Authors, made from IEA (2015b); UNFCCC (2015a). [NB: There is no INDC target of 2020, so the 2020 data of INDC uses linear interpolation from 2012 to 2030.]*

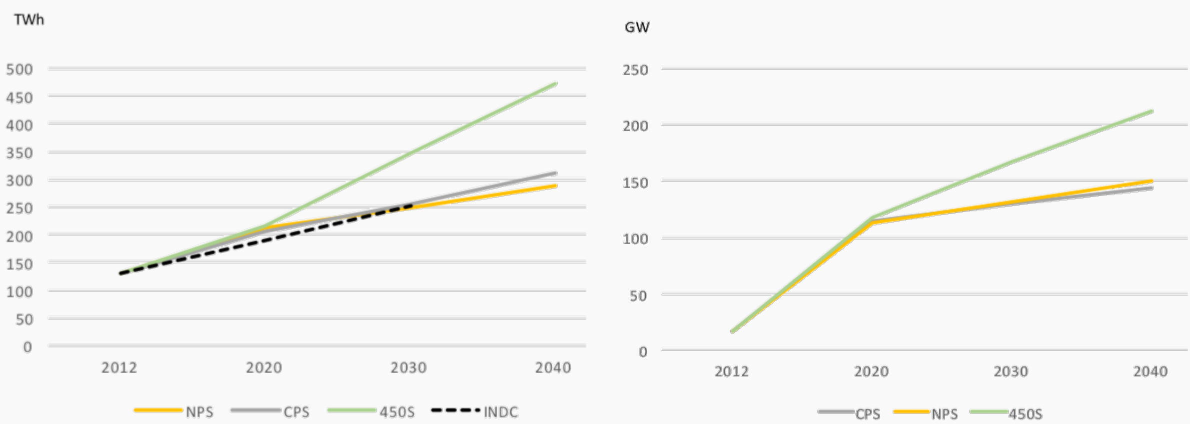
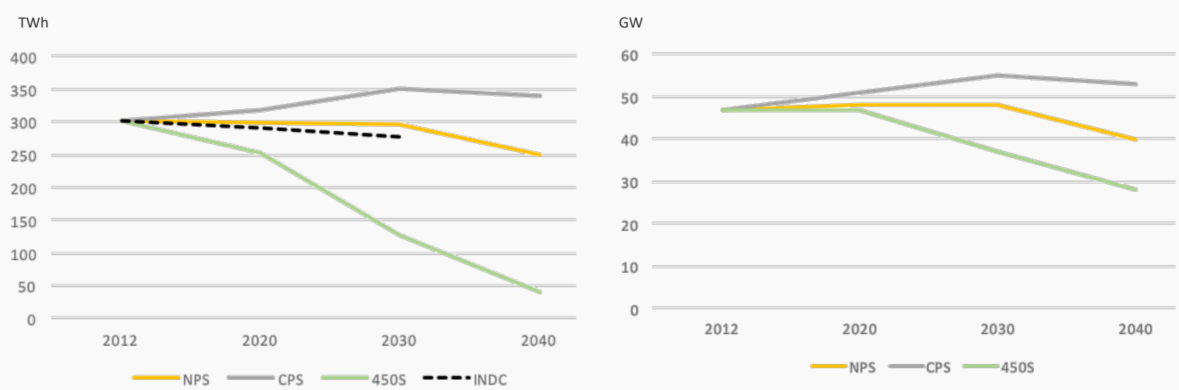


Figure 5. Coal Power generation and capacity from 2012 to 2040 for JAPAN. *Source: IEA (2015b); UNFCCC (2015a). [NB: There is no INDC target of 2020, so the 2020 data of INDC uses linear interpolation from 2012 to 2030.]*



The other major criticism comes from the substantial reliance of the scenario on nuclear power and CCS, which are themselves strongly dependent on political preference and technological development.

It should be emphasised that relying substantially on CCS allows forecasting of global negative emissions, typically after 2070, which automatically reduces emission reduction ambition before then. If CCS is not deployed at the level forecasted, this would have serious consequences on the capacity to limit global warming to +2°C. Other organisations are working on producing similar types of technological roadmaps, especially for the energy sector (e.g. Greenpeace, 2015). Currently, no such global economic / energy scenario is currently available for the +1.5°C target. However, the IPCC is preparing a +1.5°C Special Report for September 2018 (IPCC, 2016) and prominent modelling providers are also likely to adjust their models in the near future (e.g. IEA).

2.4. Construction of the '2°C benchmark'

The '2°C benchmark' is a production and capacity benchmark, constructed using industry databases* that track current company equity stakes in physical assets.

The total portion which is owned by TOPIX is calculated based on the relative ownership of each company's total equity. The 2°C benchmark up to 2021 is calculated by scaling the IEA 2°C scenario to the size of the index in 2016. According to allocation rules, power plant capacity is allocated based on the basis of equity share in the plant where multiple owners exist.

Where data are available, production and capacity indicators are allocated to owners of subsidiaries. For power capacity, GlobalData's internal list of plant owners and subsidiaries were utilized, with 100% of capacity allocated from subsidiary to parent. Based on these data, the 2°C benchmark is built with specific energy/technology mix for TOPIX based on the current ownership of capacity/production of the TOPIX relative to the total listed market.

[Please refer to the SEI Metrics methodology paper available online for further details (2°ii, 2016).]

** The analysis relies on the following data sources: GlobalData (Power plant data, including plants classified as active, announced, financed, partially active, permitting, temporarily shut down, under construction, under rehabilitation & modernisation, and Oil and Gas production data and forecast until 2016-2021), WardsAuto (light passenger duty vehicle, including BAU production forecasts 2016-2021), Bloomberg (financial data and coal production data). The financial data for the index and companies through Bloomberg is current as of 30 December 2016.*

3. RESULTS

3.1 Overview – TOPIX relative to a 2°C benchmark

For this report, we tested the alignment of the TOPIX with the IEA 2°C benchmark. Figure 6 below shows the estimated over and under-exposure of the TOPIX to fuels and technologies relative to the IEA 2°C benchmark in 2021. The black circle line indicates the 2°C benchmark. The different gaps between the 2°C benchmark and TOPIX are represented inside or outside this circle. A fuel/technology standing outside the 2°C circle line is considered over-represented in the index compared to the IEA 2°C benchmark; TOPIX is then over-exposed to that fuel or technology. Conversely, a fuel or technology lying inside the 2°C circle line shows less capacity or production from TOPIX than the IEA 2°C benchmark.

The contribution of each technology in the chart is shown as the 'fair share' of the TOPIX index. The model uses a simple 'fair share' assumption which maps the trends of the IEA 2°C scenario to companies and financial portfolios and indices. It applies the production market share in 2016 to the 2°C benchmark in 2021.

The relative coverage weight of each of the three macro sectors (Electric power, Light Duty Automobile, Fossil Fuels) on the circle chart of Figure 6 (i.e. the width of each "slice") is the market capitalisation of the TOPIX companies active in those sectors.

The preponderance of the automobile sector in terms of weight (83%) in the chart results from the high market capitalisation of Japanese car makers in the equity market relative to energy related companies (as of 30 December 2016). The respective width of each technology inside each of the three macro sectors is determined by the share of capacity/production* in 2016 at national level.

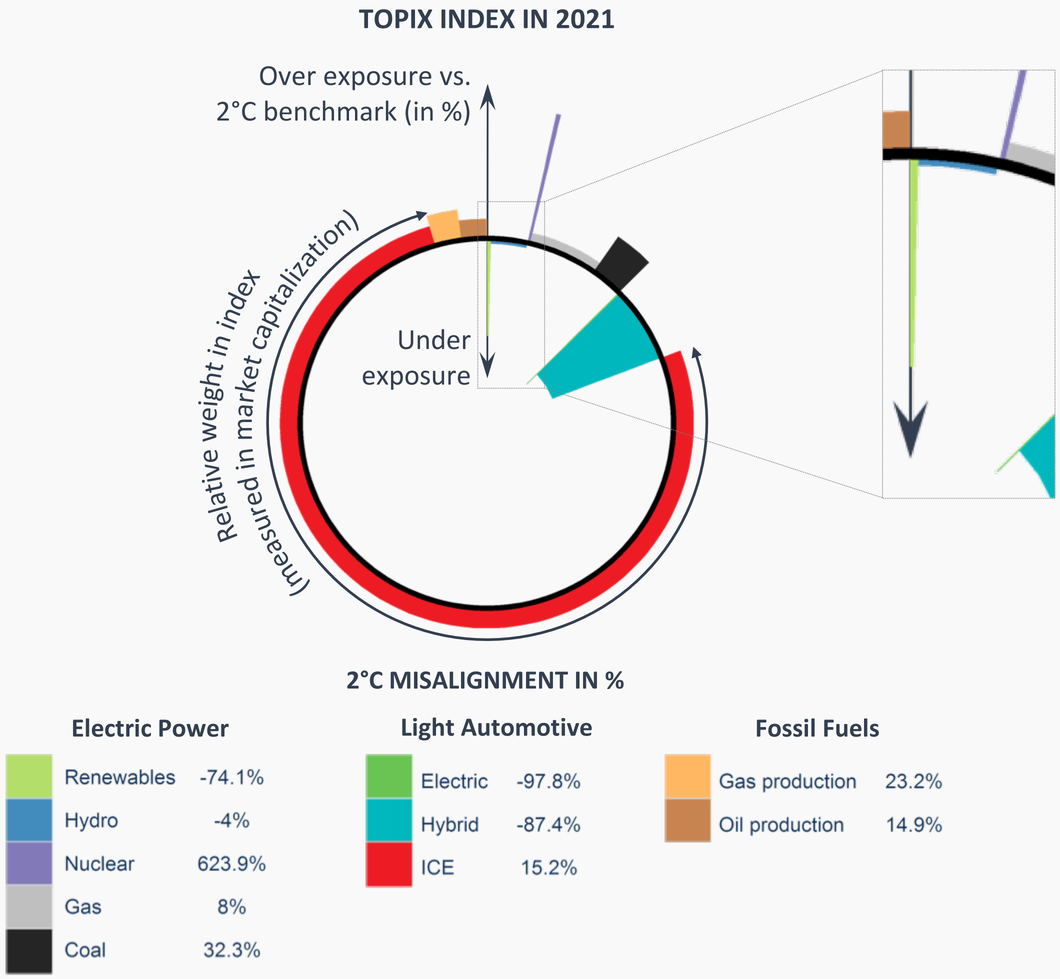
Figure 6 shows that, in the case of power sector, the green bar representing renewables is inside the 2°C benchmark circle: this under-exposure of TOPIX to renewables indicates a lack of capacity in 2021 compared to the IEA 2°C trajectory. On the other hand, the capacity of nuclear (purple bar), natural gas (grey bar) and coal (black bar) is beyond the 2°C benchmark. It indicates that TOPIX overweights nuclear, gas and coal capacity in 2021 compared to the IEA 2°C target. TOPIX is thus misaligned with the 2°C benchmark for the power sector in 2021.

For the Automobile sector, the relative weight (in production) of electric and hybrid vehicles in TOPIX is small compared to internal combustion engine (ICE) vehicles. The expected capacity from TOPIX for hybrid and electric engines is far below the 2°C benchmark, whereas the capacity of ICE is above. It means that the companies listed in TOPIX underweights low-carbon technologies (hybrid, electric) and overweights high-carbon technologies (internal combustion engine, e.g. petrol and/or diesel car production). The TOPIX exposure is thus misaligned with the 2°C benchmark.

Fossil fuel production in TOPIX also shows an over-capacity in 2021 compared with the 2°C benchmark. While Japan produces very little coal, it produces and manufactures a relatively large amount of oil products and gas products. As such, TOPIX overweights oil and gas production relative to the 2°C benchmark. The index exposure is thus misaligned with the 2°C benchmark for oil and gas production, but outperforms the 2°C benchmark for coal in 2021 as it can be considered as null.

** Power: capacity share; Auto: production share; Fossil fuels: production share in terms of energy content (first brought to the same Unit Joule/gigajoule to be able to compare them).*

Figure 6. Estimated 2°C alignment of the TOPIX in 2021.



The alignment of the TOPIX with the IEA 2°C benchmark is represented by the exposure of each of the covered industries and technologies relative to the benchmark. The 2°C benchmark is symbolised by a black circle - any sectors which are fully aligned will sit directly on top of this circle. Each sector is represented by a coloured "circular bar". The height of the bar relative to the circle represents the level of misalignment in terms of under/over-exposure compared to the 2°C benchmark: the higher the bar is outside the black circle, the more the TOPIX is overexposed to this technology compared to the 2°C benchmark; the longer the bar is inside the black circle, the more the TOPIX is underexposed to this technology. This misalignment with the 2°C benchmark is expressed as a percentage. The width of the bars represents the relative weight of the technology in the TOPIX, measured in market capitalisation. While a perfect alignment can be considered as the target, it is important to notice that overexposure is a "climate positive" (i.e. relatively positive effect on climate change) feature for some technologies (e.g. renewables, electric cars) and a negative feature (i.e. relatively negative effect on climate change) for others (e.g. ICE, coal). Conversely, underexposure would be considered positive for oil but not for hybrid cars. The graph for the TOPIX shows that all the underexposures are for "green" technologies while overexposures are for "brown" ones. As a consequence, the TOPIX is not aligned with the 2°C benchmark and does not appear to contribute to a 2°C (or below) scenario. [NOTA: The assessment is based on third-party data, including Bloomberg, WardsAuto/AutoForecast Solutions, GlobalData (for power, oil and gas). 2°ii is not responsible for any errors associated with externally sourced data.

3.2 Electric power

3.2.1. Fuel mix analysis for electric power

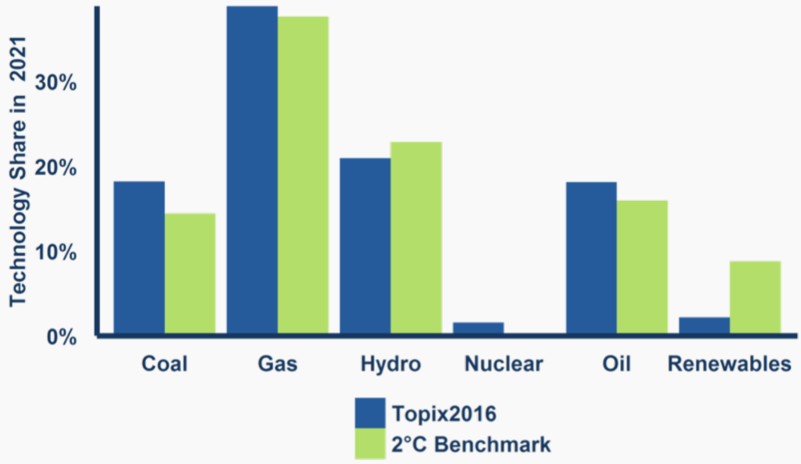
This section looks at the details of fuel mix in the electric power sector. As described in section 2, the assessment for power sector focuses on existing and planned capacity by fuel type (e.g. coal, renewables, etc.) on the basis of the GlobalData database. The TOPIX results for 2021 reflect the estimated share by fuel in power capacity owned by the index in 2021 (based on current index constituents). The 2°C benchmark for 2021 is the relative share each fuel 'should' have in TOPIX in 2021 to be aligned with the IEA 2°C pathway. The estimated share of each fuel in total power capacity in 2021 is shown in Figure 7 (this is calculated based on bottom-up analysis of the evolution of power plant ownership until 2021). The result indicates that TOPIX has a lower share of renewables and hydro, and a higher share of all other technologies relative to the 2°C benchmark in 2021.

It is important to note that oil makes up a significant share of electric power sources in Japan (18.3% in 2012 (METI, 2016a)), while more globally it is usually only a back-up for gas or coal power plants. Figure 7 shows the 2021 expected share and 2°C benchmark for oil, but oil as a source of electric power is not analysed in details in the report, for the same reason. The share of oil-fired power is decreasing, but significantly increased in 2011 and 2012 to meet electricity demand following the Fukushima catastrophe and subsequent shutdown of nuclear plants.*

While the share of oil in the electricity mix started to decrease from 2014, the further decrease or stabilisation of this use of oil in the future will depend on the energy policy choices that will be put in place by the government, either promoting a quick restart of nuclear power or supporting the development of alternative renewable sources. However, a great deal of effort is required to restart existing nuclear power plants in Japan, because each plant has to pass the new safety assessment by the government of Japan and there has to be a consensus with the local people who are living around the nuclear power plants. Therefore, it is difficult to predict the number of nuclear power plants that would be operational in 2021.

** Cf. Japan electricity generation by type of fuel: http://www.iea.org/stats/WebGraphs/JAPAN2.pdf*

Figure 7. Estimated fuel share in 2021 electric power capacity for the TOPIX index and 2°C benchmark. *Source: 2dii, based on GlobalData and IEA.*



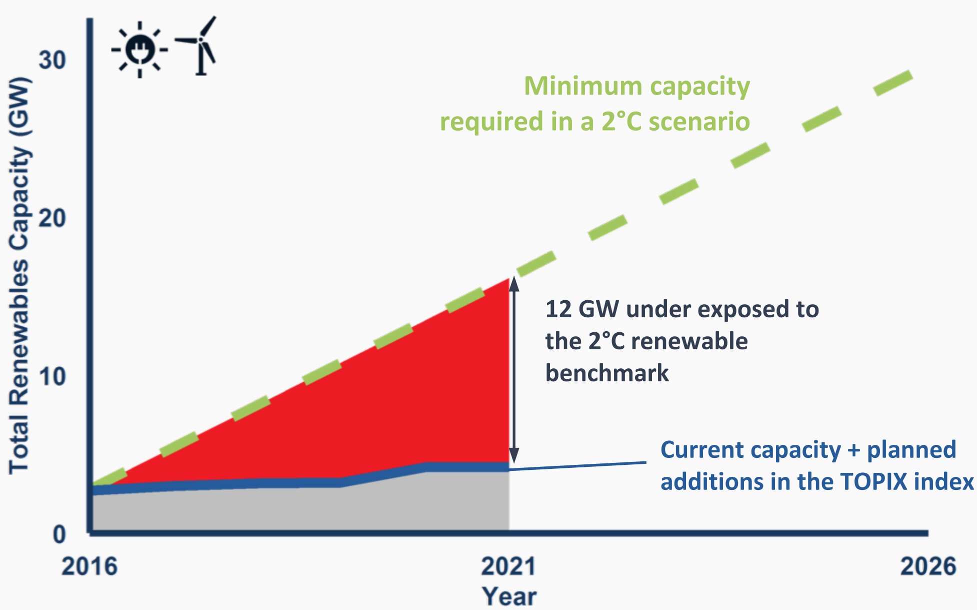
Figures 8 & 9 show the evolution of electric power capacity for renewables and coal.* The 2°C benchmark (green dotted line) in 2021 represents the market average starting point scaled to the power plant exposure of TOPIX, and then adds or retires capacity based on a 2°C trajectory. The 2°C starting point is calculated based on the current listed power capacity in the Japanese stock market as identified by GlobalData. The results (Figure 8) suggest that TOPIX has roughly the same renewable power exposure as the market average in 2016, but that it is not forecast to be able to increase production at rate to maintain 2°C alignment in 2021. This can be seen in the almost steady existing and planned capacity (utility power and non-utility power companies listed in TOPIX) represented in the grey area.

Compared with Japanese NDC targets, as shown in Figure 4, the total installed capacity in ~2020 is expected to be similar for each of the scenarios: 450S, CPS and NPS and IND. Whilst an additional 12 GW to the current planned installed capacity is required in 2021 (red area) to align with the 2°C trajectory, it should be noted that capacity additions that are not yet disclosed might further increase the renewable capacity, and that most renewables are not generated from regional electricity companies but purchased from other companies.

The planned installed capacity of coal power generation of TOPIX companies reveals that it has roughly the same exposure to coal power capacity as the market average in 2016, which remains stable until 2019 despite the fact that it needs to decrease for 2°C compliance (Figure 10). Furthermore, construction plans for new coal power plants announced by electricity power companies show a strong increase in coal capacity from a number of projects starting in 2019, which goes directly against the 2°C trajectory, leading to significant overexposure by 2021. Given uncertainty of data, retirements of existing plants were not estimated. Actual retirements may materialise in the next five years.

** The analysis is limited to downstream power capacity of utility and non-utility companies (excluding petroleum) and does not address upstream supply chain activities, CO_2 intensity, smart grid, carbon capture and storage, and energy storage. It also doesn't address demand responses. Each of these will be developed at the next stage of the project. It should be noted that the build out of hydro capacity is aligned based on the total capacity in 2016, but the share of hydro in the total power capacity mix decreases due to the relatively large build out of coal capacity. The total power capacity trajectory is thus misaligned with the IEA targets as well.*

Figure 8. The evolution of the TOPIX renewable capacity versus the 2°C benchmark.



Section 3.2.3 provides further details on the potential coal power retirements at company level. Resulting from our analysis, coal thermal power plants in TOPIX companies widen the gaps with 2°C trajectory by 8.6 GW (area). If Japan could stick to the NDC target, the gap between TOPIX and the 2°C benchmark would not widen as the production level is planned to slightly decrease from the 2016 level (Figure 5).

3.2.2 Electric power investment landscape of individual companies

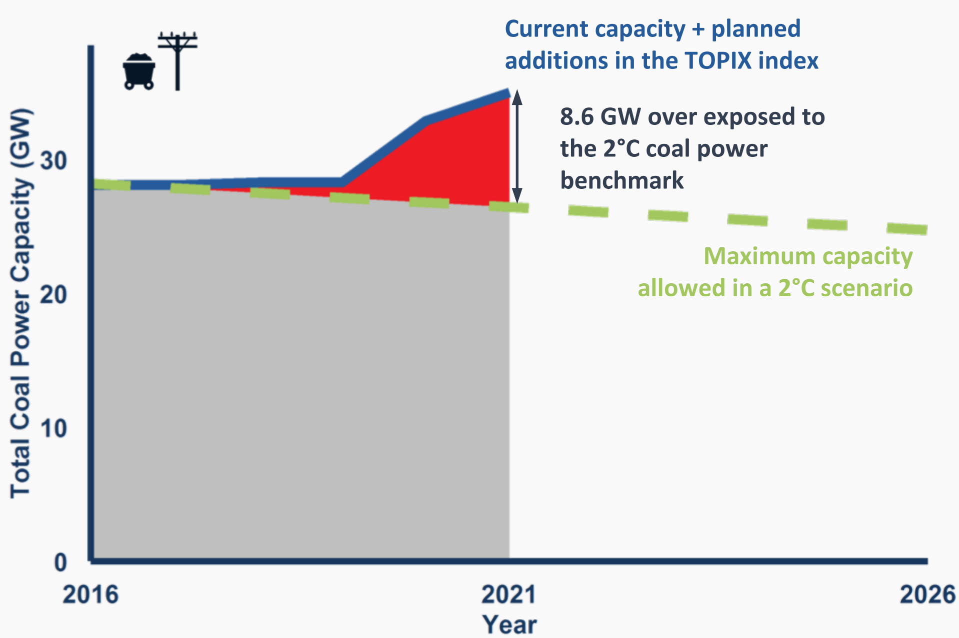
The previous section focused on the overall profile of the power sector in TOPIX and the current forecast until 2021. The structure of Japanese electricity mix was changed after Fukushima Daiichi nuclear power plant accident happened in March 2011. While almost all nuclear power plants halted their operations, electricity supply by gas-fired plants and oil-fired plants increased by 38% and 86% from 2010 respectively, to compensate for the lack of electricity supply from nuclear power plants (METI 2015a).

As a result, although the CO_2 intensity of electricity in Japan from 1996 to 2002 was about 0.35–0.38 $kgCO_2/kWh$, it increased to 0.57 $kgCO_2/kWh$ in 2012, which marked the highest within 20 years (Wakiyama and Kuriyama, 2015). On the other hand, as a mid-term target for electricity power generation, electricity companies (of which there are 35 companies that cover 99% of electricity sales in Japan) made a joint announcement on 17 July 2015, stating that they would set a 0.37$kgCO_2/kWh$ intensity target for the whole electricity sector in 2030, as a voluntary action plan in response to emission intensity targets by the government under the NDC.

It is interesting to look at the relative fuel mix of the TOPIX utility companies, which correspond to all listed utilities in the Japan market. These contribute 90% of the electric power capacity in the index. The remaining 10% percent is the electric power capacity owned by 88 non-utility sector companies within the TOPIX (e.g. IT, oil and gas producers, cement, etc.).

The wheel chart (Figure 10) allows for an identification of the market leaders and laggards by technology. The right side of the graph shows the estimated 2021 fuel mix of each utility company listed in the 2016 TOPIX.

Figure 9. The evolution of the TOPIX ownership of coal capacity versus the 2°C benchmark.



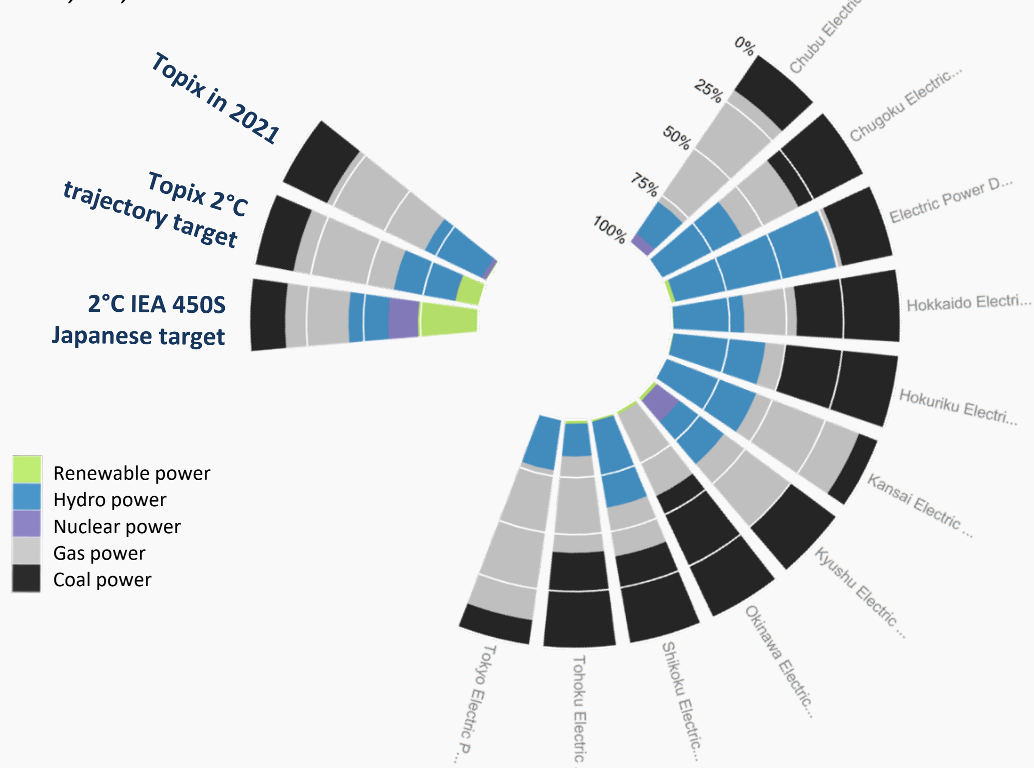
The three other bars on the left side of the graph represent respectively: the TOPIX index mix in 2021 as a whole; the 2°C target for the listed market (virtually equivalent to TOPIX) – that is the figure the TOPIX can be compared with if it is expected to provide its "fair share" of the effort; and the 2°C target for the whole Japanese economy (including listed and non-listed companies), which comes from the IEA 2°C scenario. It illustrates that the power companies of the TOPIX are not aligned with a 2°C trajectory, even though the "fair share" of the TOPIX is less ambitious than the expected contribution of the whole Japanese economy, which should reach a 25% renewable mix to be consistent with the 2°C goal. This means that a significant part of the renewable energy production is expected to come from non-listed entities (including households).

The results at this stage only show the status quo and not the relative evolution of the capacity mix by utility. They also do not inform about the total capacity of each utility. It means that this chart only lists active or pipeline capacity. For instance, Kansai Electric Power Co is indicated with no nuclear capacity in 2021 in the chart, because as of 30 December 2016 its nuclear capacity was temporarily shut down (shown as "inactive" in our data source), whereas some of its reactors now have an approval to be restarted in the future.

Concerning renewables, the listed utilities in the TOPIX have a lower relative renewable capacity in 2021 than the non-utilities within the TOPIX and thus the overall technology share in Figure 10 differs from the full index technology share shown in Figure 7.

The relatively modest difference between the TOPIX and the 2°C benchmark for coal and gas sources of power can be explained almost fully by understanding that by ~2020 NPS and 450S are quite similar: the gap between the two scenarios materializes seriously after 2020 (Fig. 3,4,5,11).

Figure 10. Estimated fuel mix of listed utilities in the TOPIX in 2021.
Source: 2dii, IEA, GlobalData.



3.2.3 Information at company level

The energy mix profile in the power sector as shown above is likely to evolve over time as companies may build out more renewables by 2021 than is currently captured by the data, potentially eventually aligning with the 2°C trajectory. This is largely a result of projects that are either not yet planned or long-term projects that are yet to move from the planning stage into implementation. Furthermore, a significant amount of renewable power currently under development and captured in the database could eventually be sold to companies within the index in the coming years, increasing the index's renewable exposure.

Crucially, investors that pursue a climate-related engagement strategy can influence this process. We highlight hereafter the potential engagement strategies and activities for coal and renewable power additions.

Figure 12 breaks down the required coal power capacity retirement of companies within TOPIX needed by 2021 (dark red) and 2026 (light red) to do their 'fair share' under a 2°C transition on a company level. As the 2°C pathway requires current coal power capacity to be reduced, any additional gigawatt (GW) of capacity installed must be offset by the retirement of equivalent coal capacity. This capacity is also included in Figure 12 as planned additions (black). The percentage figures show the relative size of the required retirement of coal capacity to each company's current 2016 capacity from all fuel sources by 2026.

For instance, for the Tohoku electric company to meet the 2°C pathway, 0.4GW of the existing coal power plants are required to be retired by 2021, in addition to the planned addition of coal plants of 0.7 GW, and 0.4GW being retired by 2026 (Figure 12). This represents a retirement of 8% of the company's total 2016 capacity. It should be noted that other non-power utilities can also have coal-fired power capacity that contributes to the total coal capacity in the TOPIX. This is aggregated under 'All Non-Utilities' capacity. The most significant contributor to this capacity are the oil and gas company TonenGeneral Sekiyu KK (classified in the "Exploration & Production" sector by ICB subsector classification) as well as Mitsubishi Corporation (classified in the "Industrial Suppliers" sector by ICB subsector classification). Although their coal power capacity in the total capacity is small, it is required for all non-utilities to reduce 22% of their total power capacity from 2016 by 2025 through coal retirement.

Figure 11. Comparison of scenarios in energy mix. *Source: IEA (2015b).*

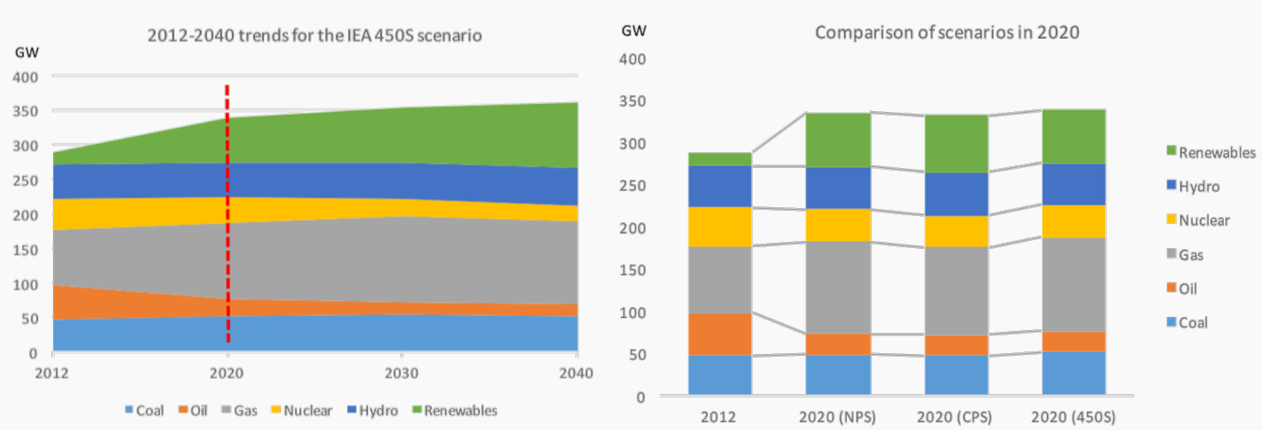


Figure 13 breaks down the planned additions of the individual companies in the TOPIX listed as power utilities, as well as the total renewable additions from these utilities. The blue indicator shows the current progress of the required renewable power capacity addition by 2021 for each segment to do their 'fair share' under a 2°C transition. It should be noted that there can be renewable additions coming from entities that are not power utilities listed in the TOPIX; this would reduce the required additions at portfolio level.

Figure 13 illustrates that there is little planned renewable capacity from TOPIX listed utilities in the next five years. In the case of TEPCO (Tokyo Electric Power Co), the figure indicates that while there is no planned addition of renewable power from 2016 to 2021, an additional 4073 MW of renewable energy needs to be installed by 2021. TEPCO can also purchase the additional 4073 MW capacity by 2021 to be aligned with the 2°C target. Current Japanese renewable-generated electricity is notably generated from individual households or small firms, which is sold to regional electricity power companies through a feed-in-tariff system, which is not reflected here.

Figure 12. Coal power capacity retirements required by the TOPIX utilities for a 2°C pathway.

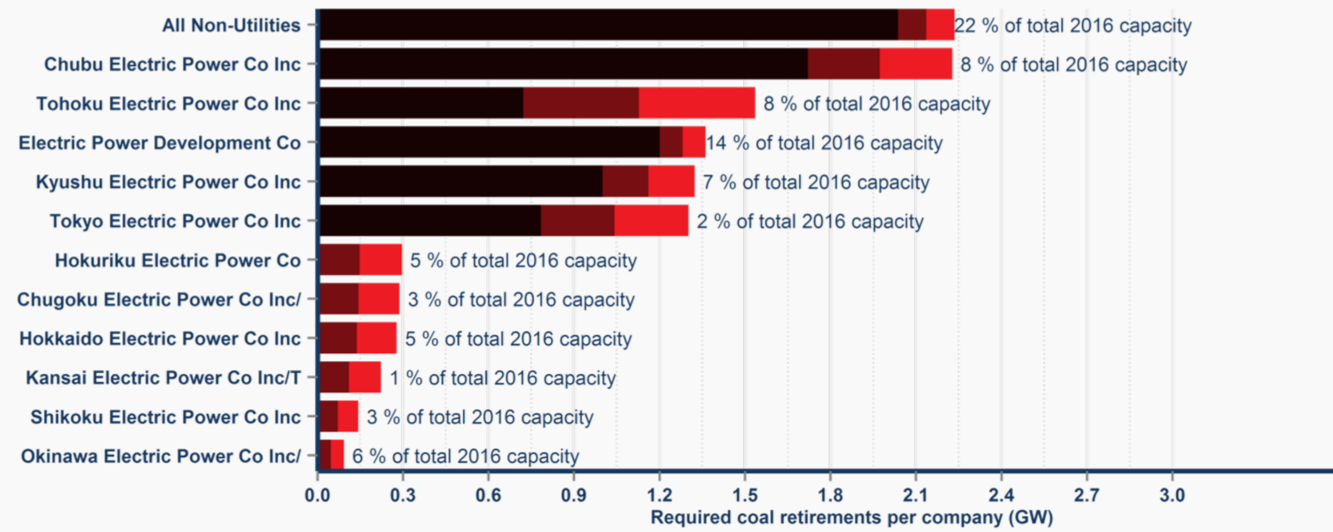
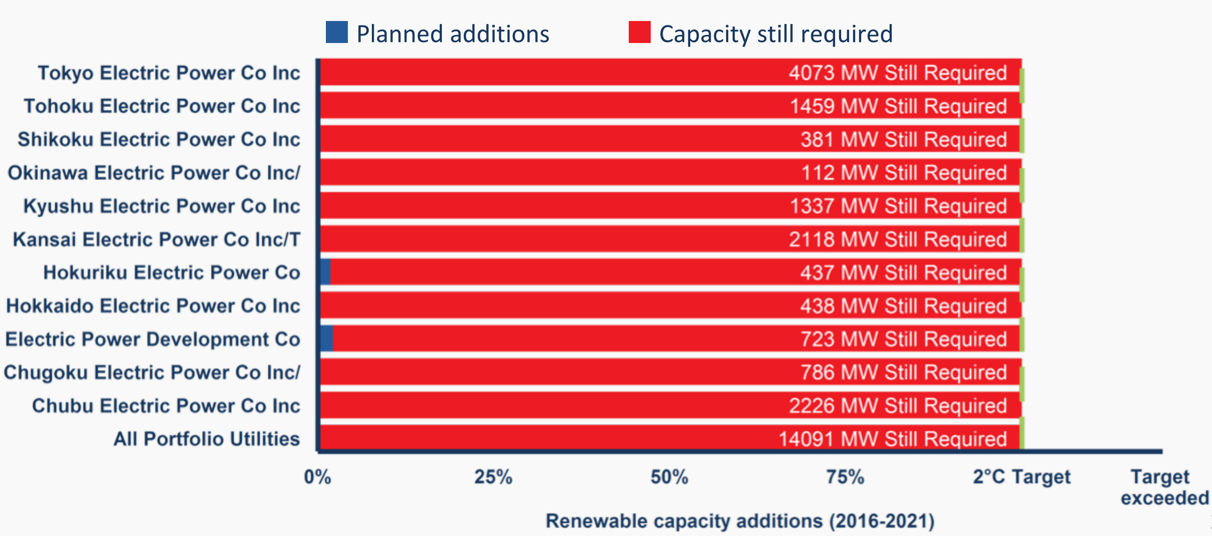


Figure 13. Renewable capacity additions by listed utilities within the index compared to the 2°C benchmark. *Source: 2dii, GlobalData*



3.3 Automobiles

The Japanese NDC targeted the reduction of national CO_2 emissions from the transportation sector from 225MtCO_2 in 2013 to 163MtCO_2 in 2030. A decrease in population, as well as a technology and fuel switch from internal combustion engine (ICE) to hybrid cars and to electricity vehicles (EV) are both expected to contribute to the reduction of CO_2 emissions (METI 2014; METI 2016b). The government strategies for automobile production are targeted to increase the share of next generation automobile technology such as EV and plug-in hybrid cars in both the overseas and domestic markets. The targets in terms of automobile technologies in new auto sales* in 2020 and 2030 is estimated as 80-50% for ICE in 2020 and 50-30% in 2030, and 15-20% for EV/Plug in hybrid cars in 2020 and 20-30% in 2030 (Figure 14).

The assessment for automobiles in this report focuses on passenger light-duty vehicle production by propulsion technology, based on WardsAuto data. We consider here that the light-duty vehicles category also includes vans, pick-up trucks and SUVs (vehicle classifications vary between countries). Among the eight automobile manufacturing companies that are listed in the TOPIX, one of them produces only ICE cars (Isuzu Motors Ltd).

Japanese car production has a singular profile, clearly leading the market in terms of share of hybrid vehicles produced, having the smallest share of ICE vehicles among main car producers. But Japan is lagging behind China and US companies for electric vehicles, both in proportional and absolute figures (Figure 15).

* Sales (in Japan) is not the same indicator as production by Japanese companies (production and sales worldwide).

Figure 14. Government targets for shares of automobile technologies in new auto sales to 2030. *Source: Authors, made from METI (2014); Ibuki (2016).*

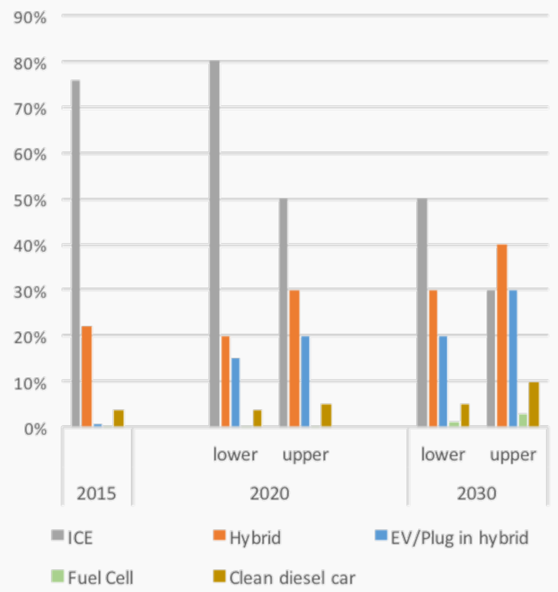


Figure 15. Automobile technology share in 2016 for a selection of countries.

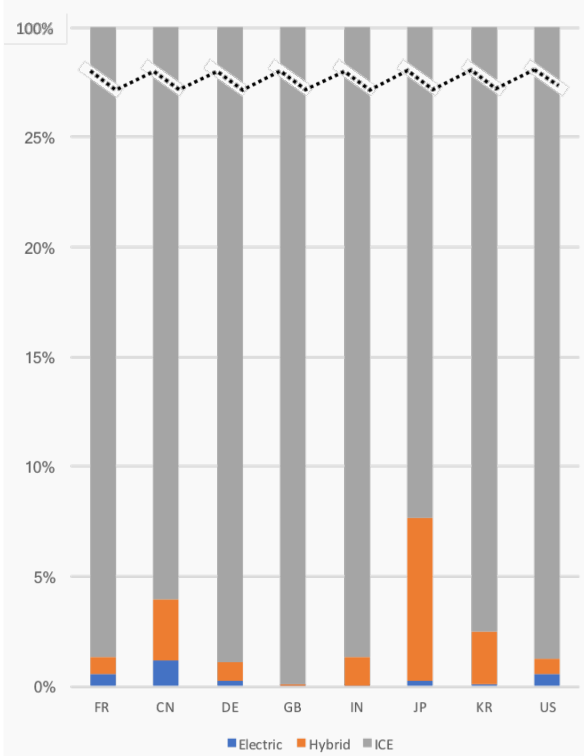
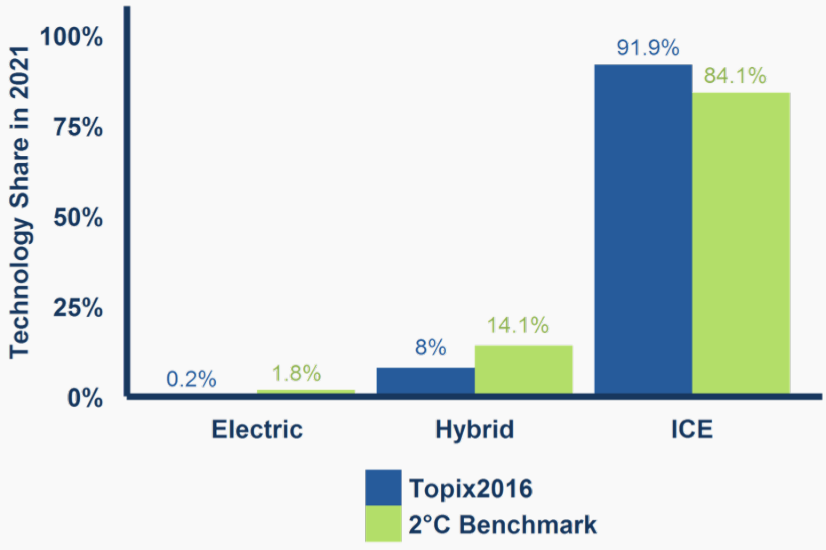


Figure 16 shows the share of automobile production by technology for TOPIX and the 2°C global benchmark in 2021. The results* suggest the index is over exposed to ICE and under exposed to both electric and hybrid cars relative to the 2°C benchmark. In contrast to the power sector, which is strongly anchored at the regional level due to the inherent limits of transporting power across continents, the automobile sector is largely global. Therefore, we consider a global benchmark for car producers in our cross-sector analysis (cf. Figure 6): Japanese car makers are monitored on their production worldwide, with a unique global target for motorization mix (Figure 16).

** The analysis at this stage is limited to sustainable propulsion technologies diversification and does not address upstream technology providers used in cars. Due to data quality, fuel efficiency data was not assessed. Missing as well in the analysis is a review of other potential technologies (e.g. fuel cells, hydrogen) in terms of R&D and scaling activities. The database captures deployment of these technologies, limited however they may be. The model also does not address heavy duty vehicles to date. Each of these aspects will be investigated in further detail at the next stage.*

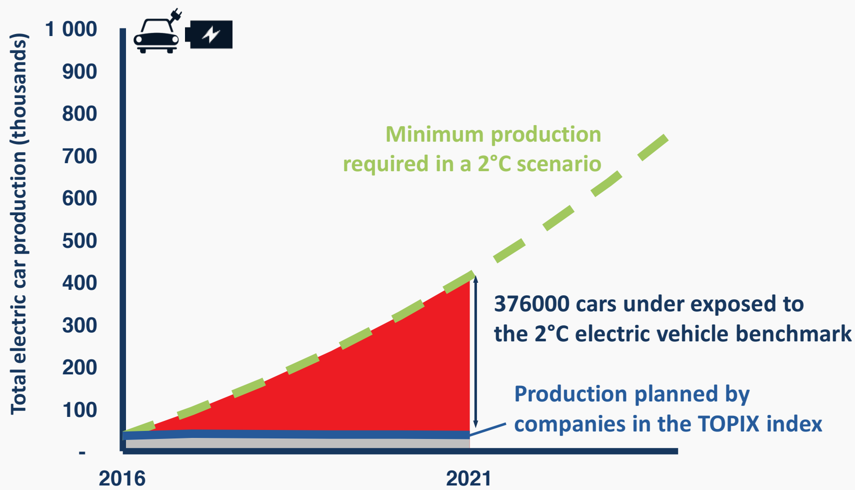
Figure 16. Estimated relative share of cars produced in 2021 for TOPIX and the 2°C benchmark.



The three area charts below show how these percentages translate into production ownership for each automobile technology by the index (Figure 17-19). In the case of electric cars, TOPIX soon exhibits a gap in production increase relative to the 2°C benchmark resulting in under exposure by 2021. Figure 17 indicates that an additional 376 000 electric cars are needed to be produced by the seven industries listed in TOPIX by 2021 to align with the 2°C scenario.

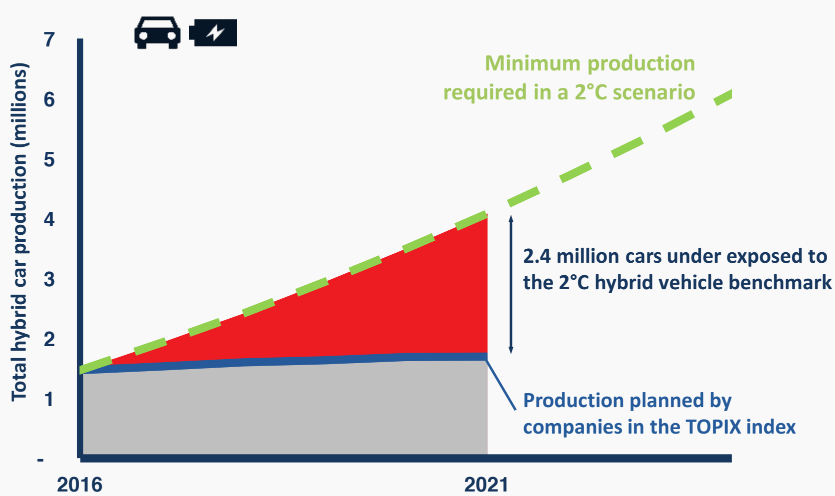
In the production of hybrid cars, the index is not forecast to be able to increase production at the rate needed to maintain 2°C alignment in 2021. To align with the 2°C target, more hybrid cars should replace ICE, as expected production is short by 2.4 million cars by 2021.

Figure 17. The evolution of TOPIX electric car production versus the 2°C benchmark.



Source: 2dii, based on WardsAuto/ AutoForecast Solutions and IEA

Figure 18. The evolution of TOPIX hybrid car production versus the 2°C benchmark.



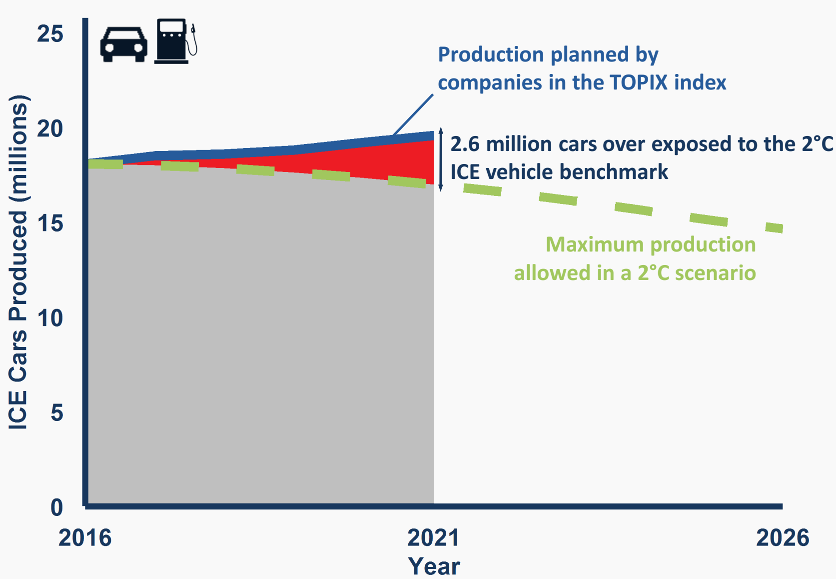
Source: 2ii, based on WardsAuto/ AutoForecast Solutions and IEA

Based on our analysis, in 2021, ICE cars are still expected to dominate the production of automobile cars of TOPIX companies. As shown in Figure 19, TOPIX ICE production is expected to increase, whilst it should actually decrease to be on a 2°C pathway. This results in an overexposure of the TOPIX for ICE vehicles by 2021, with 2.6 million ICE cars over-produced in the comparison with the 2°C benchmark.

Forecasts are based on current production plans estimated by WardsAuto to 2021. Thus, some companies that lag in the short-term may be leaders in the long-term, but these plans are not reflected in the estimations used for this paper. For example, Toyota lags over the next five years in electric vehicle production, but has a long-term 2050 zero-carbon vehicle commitment. It should be noted that none of the large capitalization companies worldwide meet the 2°C benchmark.

On the other hand, energy efficiency is one of the most important factors impacting the gap between car production and the 2°C target. Japan has improved the energy efficiency of automobiles through a top-runner programme. The top-runner programme sets out energy efficiency standards which aim to produce the world's most energy efficient products (METI 2015b). The Japanese government established a new fuel consumption standard for the production of passenger cars in 2011, with the target year of 2020. If the target is achieved, fuel consumption for passenger cars can be improved by 19.5% from 2015 levels by 2020 (MLIT, 2011). If this is achieved, energy consumption and GHG emissions for conventional passenger cars such as ICE and hybrid cars would be reduced in comparison with the estimates stated in this report.

Figure 19. The evolution of TOPIX ICE car production versus the 2°C benchmark.

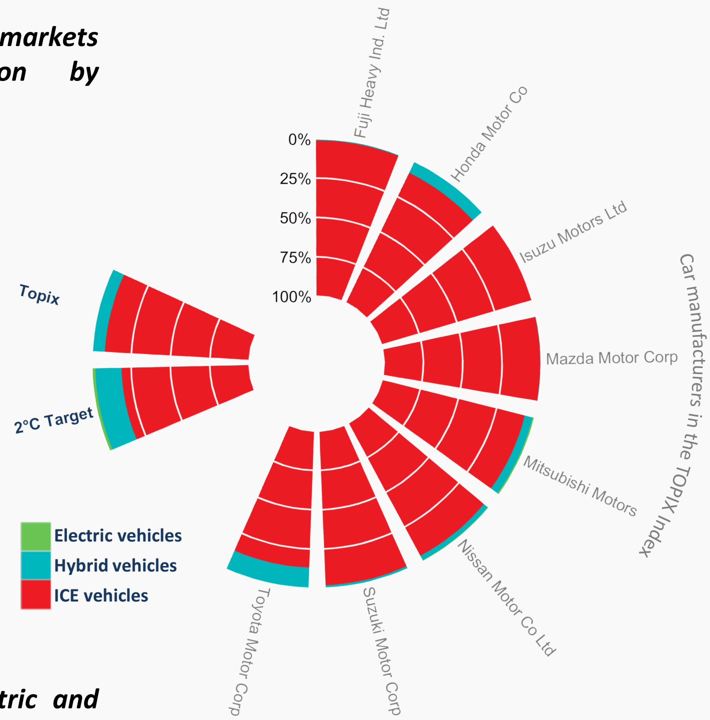


Source: 2dii, based on WardsAuto/ AutoForecast Solutions and IEA

Automobile investment landscape

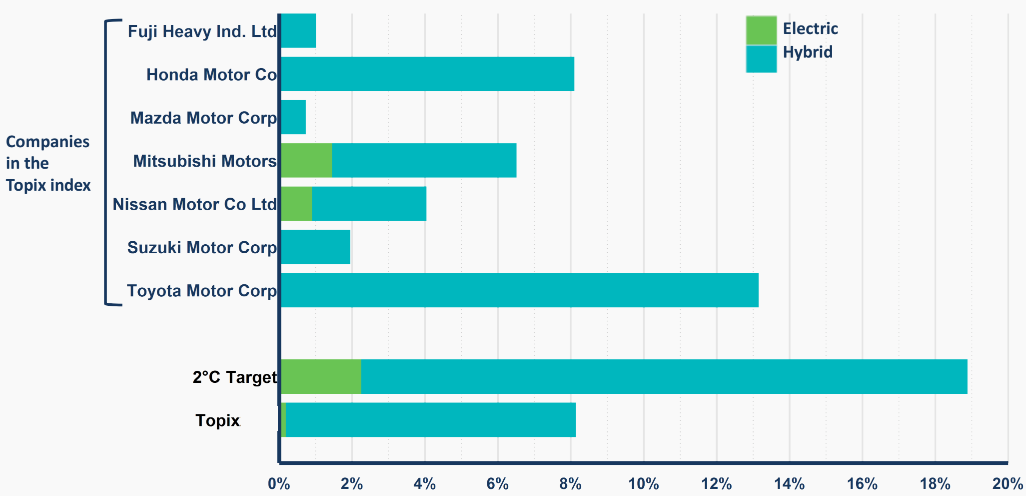
This section sees the alignment of production of automobiles in individual companies with the 2°C benchmark. Figures 20 & 21 show the relative share of electric and hybrid vehicles out of total vehicle production by car manufacturer. The charts allow for an identification of the market leaders and laggards by technology. The charts thus allow an investor to identify those companies contributing to the overall 2°C alignment of the index, as well as identifying the market leaders and laggards more generally. The figures indicate that while the share of hybrid cars out of total production at Toyota will align with the share of 2°C target (about 14% of the total production) in 2021, the level for electric cars is much lower than the 2°C benchmark. On the other hand, Nissan and Mitsubishi have a larger share of electric cars than other companies and the share is closer to the 2°C benchmark, but the share of hybrid cars is much lower than that indicated in 2°C target (Fig. 20 and 21).

Figure 20. Estimated Japanese markets automobile producers' production by technology in 2021.



Source: 2ii, WardsAuto/AutoForecast Solutions

Figure 21. Estimated share of electric and hybrid vehicle production in total production in 2021.



3.4. Fossil fuels production

Japanese domestic production of fossil fuels is very small, but the country has a much higher dependency on fossil fuels (primary energy supply of crude oil, oil product, coal and natural gas/ total primary energy supply) than most other countries, reaching 94.6% (Figure 22). Japan has a very low energy self-sufficiency for fossil fuel production; in fact, 99.7% and 99.3% of crude oil and steam coal supply are imported as of 2014 (Figure 23).

There are 18 fossil fuels production companies listed in TOPIX (among which only three are classified as fossil fuel sector companies based on their ICB subsector classification). We define a total production target for the TOPIX based on the size of the index (measured in percentage share of production in the developed markets stock market). Figure 24 shows the estimated exposure of TOPIX to oil and gas production in 2021, with the 2°C benchmark normalised to 100.

The TOPIX is over exposed relative to the market average production for oil and gas in 2016, and is expected to increase dramatically over the next five years. There is no coal production from TOPIX companies, and thus the index is aligned to a 2°C benchmark by default. Given the long-term time horizon at stake for the fossil fuels sector and the fact that the direction of trends for some technologies will change after 2020, the fossil fuel figures (Fig. 25,26) extend to 2040 to show the more long-term trends that the portfolio may be exposed to.

As there is no coal production in the TOPIX in 2016, there is also no forecast production by 2021 under this methodology.

Figure 22. Fossil fuel dependency by countries (%). *Source: METI (2016a).*

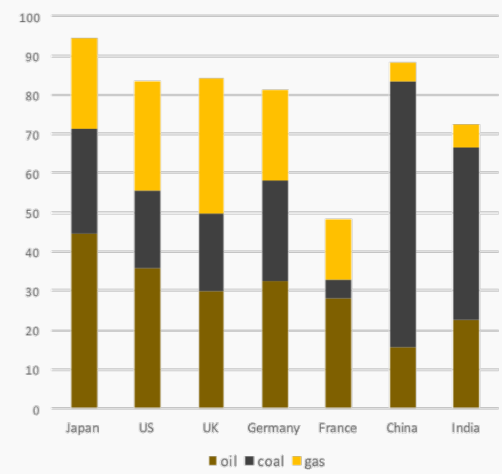


Figure 23. Domestic production of fossil fuels. *Source: Authors from METI (2016a).*

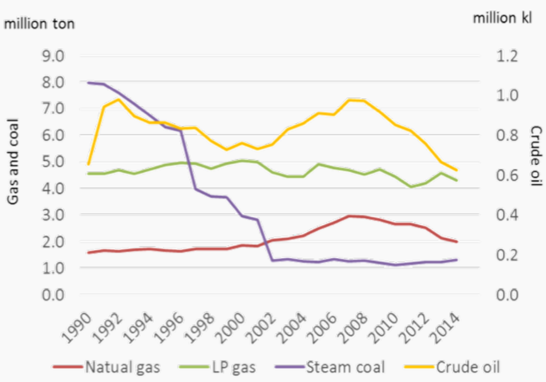
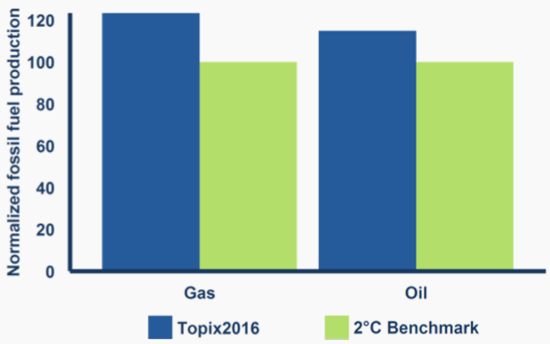


Figure 24. Estimated relative exposure to fossil fuel production in 2021 normalised to 100 (2°C benchmark = 100). *Source: 2°ii, based on Bloomberg and IEA****.***

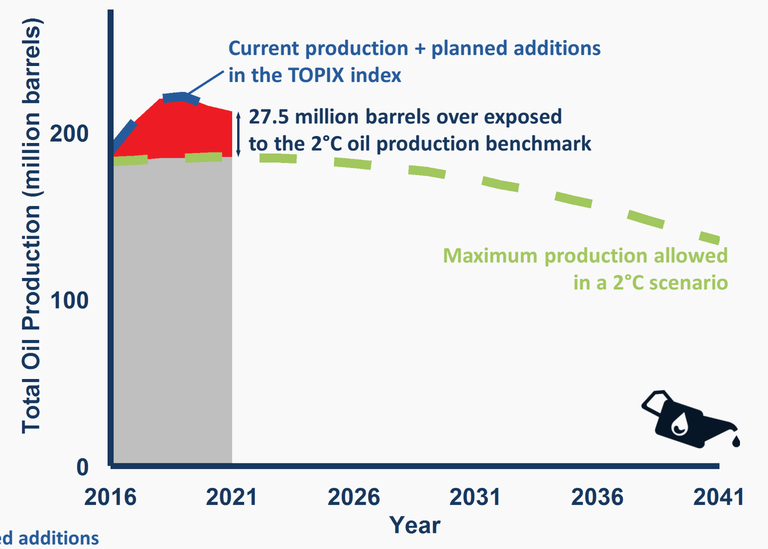


The levels of oil and gas production are shown in Figure 25 & 26 as the results for oil & gas based on GlobalData estimates of the fields production profiles over the next five years. The curve itself increases sharply in the short-term and then decreases again by 2021. This trend may be a function of the time horizon of the data, and the low current oil price inhibiting production increases beyond three years.

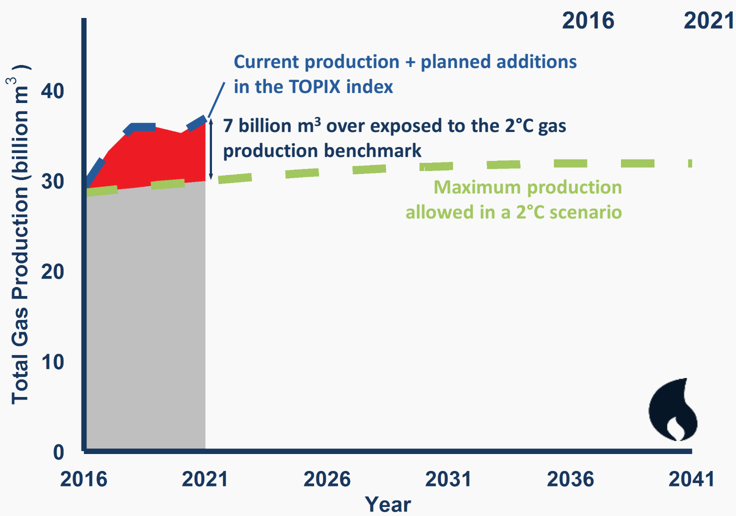
Although Japan relies almost entirely on imparts for crude oil, Japan produced 3.8 million barrels of domestic crude oil in 2014 (METI, 2016a). Most of the domestic and imported crude oil is refined and distilled, and processed as oil products, but the analysis only covers oil production. The oil types we analyse here are conventional oil, unconventional oil, heavy oil and oil sands, which are coming from oil fields worldwide that are directly or indirectly owned or operated by companies listed in the TOPIX. To ensure the alignment of Japanese oil production of TOPIX companies with the 2°C scenario, 27.5 million barrels should be reduced from planned production in 2021 to track the 2°C target trajectory (Figure 25).

According to the IEA, contrary to other fossil fuels, gas production is expected to grow smoothly until 2040 while still being compatible with the 2°C objective, which makes gas a "transition fuel" for many analysts. Our analysis shows that the production of gas by TOPIX companies is planned to increase as well from 2016 to 2021, but in excess of 7 billion m^3 compared with the maximum production allowed in a 2°C scenario (Figure 26).

Figure 25. Estimated ownership of the TOPIX oil production versus 2°C benchmark. *[NB: The analysis at this stage does not address downstream companies (e.g. pipeline, etc.), which will be explored in further detail in the next stage of the model.]*



Source: 2ii, based on GlobalData and IEA



Source: 2ii, based on GlobalData and IEA

Figure 26. Estimated ownership of the TOPIX gas production versus 2°C benchmark. *[NB: The analysis at this stage does not address downstream companies (e.g. pipeline, etc.), which will be explored in further detail in the next stage of the model.]*

4. LIMITATION OF THE ANALYSIS

It is important to highlight what this paper does and does not do. The paper is designed to show the alignment of the TOPIX with the 2°C decarbonisation trajectory as defined by the 2°C scenarios of the International Energy Agency, but is not a comment on financial performance. It shows the deviation of the TOPIX from what can be labelled as an optimally diversified energy/technology portfolio, under the 2°C pathway as defined by the International Energy Agency. Thus, while the assessment can be used as a risk management tool — helping to identify the possible discrepancies between a specific energy/technology portfolio and some long-term market moves that could be initiated from climate policies globally — it does not speak to financial performance directly. Moreover, the paper does not cover all the changes in energy and technologies relevant from a 2°C scenario. Especially, it is important to note that the IEA 2°C scenarios do not comprehensively take into account the possible improvements of energy efficiency, being limited to best available technologies. At this stage, the paper's underlying methodology* provides a 2°C assessment for a limited number of technologies and companies.

A wide range of technologies across sectors that will need to be scaled as part of the 2°C transition (as defined by the IEA) are still missing from the analysis (e.g. energy efficiency indicators, carbon capture and storage, biofuels, etc.). While the technologies and energy fuels assessed here account for a large share of CO_2eq emissions, there are obviously gaps. By extension, alignment based on the technologies reviewed in this report does not ensure 2°C alignment across all technologies. One notable example includes alignment on R&D investments in zero carbon technologies. The SEI Metrics project,* which produced the core methodology used in our analysis, will seek to eventually cover a significantly broader range of technologies as part of its assessment framework.

Similarly, this paper does not address climate mitigation potential from all sectors. As outlined in section 2, while focusing on the most relevant sectors in terms of GHG emissions, the majority of index components in terms of market capitalisation are not assessed.

It is important to notice that there is significant climate mitigation potential in the non-assessed part of the TOPIX, notably in GHG intensive sectors such as agriculture, or food & beverages. Here, alternative climate metrics and action are needed. The paper also does not provide specific financial portfolio reallocation or engagement recommendations. While this paper shows the relative leaders and laggards in terms of the technology and energy fuel exposure, it does not suggest any specific action. Investors seeking to be more climate-friendly can focus on cross-sector reallocation, engagement, or even reallocation towards leaders in terms of new renewable capacity deployment, without managing overall exposure. At this stage, in particular with a view towards the highest 'climate impact', the paper does not provide specific reallocation recommendations.

** This paper used a methodology developed in the frame of the SEI metrics project. The SEI Metrics consortium consists of 9 organisations, including the 2° Investing Initiative, CIRED, CDP, WWF European Policy Office, WWF Germany, Frankfurt School of Finance & Management, University of Zurich, Kepler-Cheuvreux, and the Climate Bonds Initiative. The SEI Metrics project aims to develop a climate performance framework and associated investment products that measure the exposure of financial portfolios to the 2°C economy. http://seimetrics.org*

5. CONCLUSIONS AND RECOMMENDATIONS

This paper indicates that to achieve the 2°C target, taking TOPIX as a good proxy of the Japanese (listed) economy, Japan needs to engage in a significant shift to decarbonise its economy, in each of the power, automobile and fuel sectors. The Japanese government set up a 26% reduction target by 2030 under the UNFCCC international agreement.

In the electricity sector, electric companies announced a voluntary mitigation target, but large-centralised electric companies have plans to add more fossil fuel plants to meet the electricity demand, whereas the 2°C roadmap imposes a sharp cut. In addition, although renewable energy has rapidly increased since a feed-in-tariff was introduced in 2012, TOPIX companies only had a 1.3% renewable capacity in 2016 while the Japanese economy had a 4.4% (2014) renewable capacity (METI 2017). Even though our analysis shows that in some technologies there will not be a big gap between the TOPIX portfolio and the 2°C scenario (450S) over the next five years, the gap will widen after 2020 for the following two decades. Thus, to fill in this gap, actions should be taken now, in order for Japan to take off on a low-carbon pathway in 2020 onwards.

Our assessment for automobiles focuses on passenger light-duty vehicle production by propulsion technology. Concerning electric and hybrid cars, TOPIX exhibits a significant gap in production increase relative to the 2°C benchmark to 2021. Reciprocally, ICE production is expected to increase smoothly until 2021 even though the 2°C benchmark requires a continuous decrease starting now. The Japanese car manufacturing industry is quite well equipped in terms of low-carbon technologies, and a company like Toyota is leading the market in hybrid vehicles worldwide, but all Japanese car companies should have even more ambitious 5-year plans than Toyota now has on hybrid, for Japan to be 2°C aligned. The same applies to Mitsubishi and Nissan for electric car production, which needs to grow sharply on a 2°C trajectory.

In case of domestic production of fossil fuels, Japanese dependency on fossil fuels is higher than most other countries. While coal production from Japanese listed companies is negligible, thus 2°C compatible, the constituent companies of TOPIX have plans to rapidly increase the production of gas and petroleum products towards 2021. Gas is considered as a transition fuel by the IEA 2°C scenario, and as such its production is expected to increase in the next five years, but the extent of overproduction compared to the 2°C benchmark makes the TOPIX overexposed to gas. Comparatively, the planned additions for oil production are clearly misdirected, as oil production must fall sharply over the next decades to be 2°C aligned.

Investors interested in responding to this paper can take a range of actions by setting exposure targets for portfolio managers, informing investment decisions, informing engagement, and informing strategic asset allocation. To do this, investors can define technology exposure targets as part of investment mandates for portfolio managers, either directly aligned with 2°C, or operating as 'goalposts', defining the maximum deviation from these targets, keeping in mind that high-emission companies will be the most affected by energy policies such as carbon pricing which the government is currently discussing. Portfolio managers can use information contained in this paper to directly inform investment decisions that create a more climate-friendly or 2°C aligned portfolio. Investors can use this information to engage with companies on their capital allocation decisions over the next five years and beyond. Some key technologies may not be developed in listed equity markets or may transition from listed to other markets (e.g. some renewable power). In particular when adding R&D to the assessment, investors will eventually be able to use the information contained in this report to inform cross-asset allocation decisions.

BIBLIOGRAPHY

2° Investing Initiative (2015) “Assessing the alignment of portfolios with climate goals – Climate scenarios translated into a 2°C benchmark”

2° Investing Initiative (2016) “Aligning financial markets with climate goals: sector & technology methodology”, Sustainable Energy Investment Metrics project http://seimetrics.org/publications/sei-metrics-sector-technology-methodology-draft/

2° Investing Initiative (2017) “Finance sector alignment with international climate goals – Reviewing options and obstacles”, Green-Win project

Greenpeace (2015) “Energy (R)evolution”

HSBC (2012) “Coal and Carbon”

Ibuki, H. (2016) “Structural Change and Its Correspondence of Automobile Industry (Japanese)”, Japan Foreign Trade Council,Inc. http://www.jftc.or.jp/shoshaeye/pdf/201603/201603_07.pdf

IEA (2012) “Energy Technology Perspectives”

IEA (2014a) “World Energy Outlook”

IEA (2014b) “World Energy Investment Outlook”

IEA (2015a) “Energy Technology Perspectives”

IEA (2015b) “World Energy Outlook”

IPCC (2016) “Global Warming of 1.5°C”, http://www.ipcc.ch/report/sr15/

Markowitz, H. M. (1952) “Portfolio Selection”, Journal of Finance, 7 (1), 77-91

Mercer (2015) “Investing in a time of climate change”

METI (2014) “Automobile Industry Strategy 2014 (Japanese)” http://www.meti.go.jp/press/2014/11/20141117003/20141117003-A.pdf

METI (2015a) “Energy White Paper 2015. (Japanese)” http://www.enecho.meti.go.jp/about/whitepaper/2015pdf/whitepaper2015pdf_2_1.pdf.

METI (2015b) “Top Runner Program. Developing the World’s Best Energy Efficient Appliances. (Japanese)” http://www.enecho.meti.go.jp/category/saving_and_new/saving/data/toprunner2015e.pdf.

METI (2016a) “Energy White Paper (Japanese)” http://www.enecho.meti.go.jp/about/whitepaper/2016html/

METI (2016b) “EV · PHV Roadmap Study Report (Japanese)” http://www.meti.go.jp/press/2015/03/ 20160323002/20160323002-3.pdf

METI (2017) “Guidebook on FIT FY 2017“ http://www.enecho.meti.go.jp/category/saving_and_new/saiene/data/kaitori/2017_fit.pdf

METI energy statistics. n.d. “Electricity Survey Statistics. (Japanese).” *Ministry of Economy, Trade and Industry (METI)*. http://www.enecho.meti.go.jp/statistics/electric_power/ep002/

MLIT (2011) “Final Report on Energy Research Committee: Energy Conservation Standards Subcommittee/Transport Policy Council: Land Transportation Subcommittee and Automobile Fuel Efficiency Standard Subcommittee (Japanese)”, Ministry of Land, Infrastructure, Transport and Tourism. http://www.mlit.go.jp/common/001129238.pdf

Sharpe, W. F. (1964) “Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk”, Journal of Finance, 19 (3), 425-442

Thomä, J., S. Dupré, A. Gorius, M. Coeslier, D. Guyatt (2015) “Optimal Diversification and the Energy Transition: Exploring Fossil Fuel Exposure Beyond Divestment”, Journal for Environmental Investing, Vol 6

Thomä, J., S. Dupré, M. Hayne (2018) "A Taxonomy of Climate Accounting Principles for Financial Portfolios”, Sustainability, vol. 10(2), 1-18

Tobin, J. (1958) “Liquidity Preferences as Behavior Towards Risk”, Review of Economic Studies, 25 (2), 65-86

TOPIX composition on Japan Exchange Group / Tokyo Stock Exchange, http://www.jpx.co.jp/english/markets/indices/topix/

UN (2016), C.N.735.2016.TREATIESGXXVII.7.d (Depositary Notification), https://treaties.un.org/doc/Publication/CN/2016/CN.735.2016-Eng.pdf

UNFCCC (2015a) “The Paris Agreement”, http://unfccc.int/paris_agreement/items/9485.php

UNFCCC (2015b) “Submission of Japan’s Intended Nationally Determined Contribution (INDC)“, http://www4.unfccc.int/submissions/INDC/Published%20Documents/Japan/1/20150717_Japan%27s%20INDC.pdf

Wakiyama, T. & A. Kuriyama (2015) “Can japan improve on its INDC-based target for CO_2 intensity in the electricity sector? Estimation of renewable electricity and nuclear power in 2030”, IGES/OCN Work. Paper

ABOUT 2° INVESTING INITIATIVE

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

2° Investing Initiative's research is provided free of charge and 2°ii does not seek any direct or indirect financial compensation for its research.

CONTACT:

France: 97 rue La Fayette, 75010 Paris
USA: 205 E 42nd Street, 10017 New York
UK: 40 Bermondsey St., SE1 3UD London
Germany: Am Kupfergraben 6A, 10117 Berlin

Tel: +33 1 4281 1997 • +1 516 418 3156
Email: contact@2degrees-investing.org
Website: www.2degrees-investing.org

ABOUT RIEF (Research Institute for Environmental Finance)

RIEF has been established in 2014, succeeding the Finance GreenWatch (FGW), which was also a non-profit organization concerning environmental & sustainable finance in Japan, started in 2011. A role of RIEF is to enlighten people and organizations in Japan on environmental and sustainable finance issues, and to make them move towards more sustainable societies. RIEF provides various related information, both global and domestic, academic and pragmatic, through RIEF's website and other activities. One of the most influential initiative of RIEF is the selection and presentation of an Annual Sustainable Finance Award for Japanese financial market participants.

CONTACT:

Nihon Press Centre, 2-2-1 Uchisaiwaicho,
Chiyoda-ku, Tokyo, 102-0011 Japan
Tel: +81-30-6206-6639
Email: info@rief-jp.org
Website: http://rief-jp.org

ABOUT IGES (Institute for Global Environmental Strategies)

IGES aims to achieve a new paradigm for civilisation and conduct innovative policy development and strategic research for environmental measures, reflecting the results of research into political decisions for realising sustainable development both in the Asia-Pacific region and globally. IGES will promote research cooperation with international organisations, governments, local governments, research institutions, business sectors, non-governmental organisations (NGO) and citizens. As well as conducting research, the Institute will share its research results and also host international conferences and study workshops.

CONTACT:

2108-11, Kamiyamaguchi, Hayama, Kanagawa,
240-0115, Japan
Tel: +81-46-855-3700
Fax: +81-46-855-3709
Email: iges@iges.or.jp
Website: http://www.iges.or.jp/en/index.html