Polish Economic Institute

MAY 2022

WARSAW

ISBN 978-83-66698-60-4

The Emitting 7: the time and cost of climate neutrality

Citations:
Maj, M., Miniszewski, M. (2022), *The Emitting 7: the time and cost of climate neutrality*, Polish Economic Institute, Warsaw.

Warsaw, May 2022
Authors: Magdalena Maj, Maciej Miniszewski
Editing: Annabelle Chapman
Graphic design: Anna Olczak
Graphic collaboration: Tomasz Gałązka, Joanna Cisek
Text and graphic composition: Sławomir Jarząbek
Polish Economic Institute
Al. Jerozolimskie 87
02-001 Warsaw, Poland

ISBN 978-83-66698-60-4

Climate politics in a fragmented world

We are living in an era of unprecedented global warming. Global CO_2 emissions are at record highs and need to fall to keep the Paris Agreement targets within reach. We need to investigate whether climate and green finance policies are not too weak to meet the Paris targets and whether the EU's unprecedented efforts are enough.

The Russian invasion of Ukraine could mean tougher sanctions against the gas-and-oil giant and, ironically, help push the world towards a cleaner future. This is an opportunity to change course by showing that clean energy is crucial for national security. Further sanctions by Europe carry long-term potential for energy independence.

Short-term energy security could boost conventional sources of energy, such as nuclear power and solid fossil fuels.

Yet for coal, there is no long-term sustainable perspective. There are also claims that increasing the role of fossil fuels could push the target of limiting global warming to 1.5°C out of reach.

Regardless of the horrors of the Russian invasion of Ukraine and its effects on energy markets, Europe is likely to sustain its planned energy transition. The goal is to boost energy security by enhancing efforts to combat climate change.

A compromise is possible: a balanced approach where different starting points and transition pathways are taken into consideration.

Short-term actions related to the sanctions against Russia and strengthening energy security might be as important as the long-term clean transition strategy. Like during the Second World War, we need to be aware of the costs of overconsuming fossil fuels and using too much energy.

The 100 EU cities that have committed to slashing their emissions to zero by the end of the decade can serve as an example of the struggle against climate crisis. This can be scaled up through a global effort and support for the world's most vulnerable inhabitants.

We must remember that the world faces rising commodity and energy prices. Some say that we are back in the 1970s; we know that we do not want history to repeat itself. In Germany, the debate over whether there should be a speed limit on the country's famous motorways has been revived in light of the war.

The transition will not remedy the higher inflation in the short term. It will also require financial outlays by governments and societies. In the process of decarbonisation, we must take these aspects into account so that society does not become discouraged. At the same time, we must remember that the costs incurred will be lower than the opportunity cost of maintaining the *status quo*.

Europe should not bear the cost of combating climate change alone – it is the US, China and Russia's responsibility, too.

Piotr Arak

Director of the Polish Economic Institute

Table of contents

Key numbers

66%

of global carbon emissions were generated by the E7 in 2018. These seven economies account for half the global population and 72% of global GDP in 2019

USD 67 trillion

potential costs in 2020-2030 for the E7 of reaching the Paris Agreement target of 1.5°C

2056

the EU will meet its net-zero goal, 6 years after the official target

2060

the US will meet its net-zero goal, 10 years after the official target

2071

China will meet its net-zero goal, 11 years after the official target

10%

of the population is responsible for nearly 50% of global emissions

11-13.9%

of global GDP will be lost in 2050 if the temperature rises by 2-2.6°C (the most probable scenario), compared to a scenario without climate change, based on projections by the SwissRe Institute

Key messages

- **The Emitting 7 (E7)* account for almost 70% of global greenhouse gas emissions.** The main objective of the Paris Agreement is to keep the global temperature rise in the 21st century to 2°C above pre-industrial levels and to take steps to limit the temperature increase to 1.5°C. **The E7 will need to spend USD 67 trillion by 2030 to stay on the pathway to the 1.5°C target – 7.6% of global GDP in 2019 and 10.6% of the E7's GDP in 2019 per year.**

- **Achieving climate neutrality within the Paris Agreement framework requires even greater efforts by the main emitters than stated in their official documents.** The EU has pledged USD 625 billion in its programmes. Moreover, the European Commission calculated that general costs will reach USD 4.5 trillion. According to our study, the EU needs to increase investments in 2020-2030 to USD 7 trillion. Annually, **this translates into 4.5% of its 2019 GDP. Japan would need to invest almost 6% of 2019 GDP per year, the US 6.3%, Brazil 7.2%, India more than 19%, China nearly 22%, and Russia close to 27%.**

- **The current efforts are not enough. None of the E7 economies will achieve net-zero emissions by 2050 or their official targets.** The EU will achieve climate neutrality in 2056, followed by the US four years later and Brazil in 2061. China will overtake Japan and reach the target in 2071, 11 years after its target. Japan will have a significant delay and achieve neutrality in 2076 – 26 years after the declared date. India will achieve neutrality in 2085 and Russia a year later.

- **Rising temperatures are likely to reduce global wealth significantly, compared to growth levels without climate change.** According to Swiss Re, the size of the global economy will contract by 11-13.9%, compared to a world without climate change (0°C) if the temperature rises by 2-2.6°C. In the case of 3.2°C scenarios, the global economy will contract by 18.1%. Even achieving the Paris Agreement target well below 2°C will not prevent an economic slowdown. However, it will result in a much less negative

* The economies that emit the most GHG: China, the US, the EU, Brazil, India, Russia and Japan.

GDP impact of 4.2% relative to a world without climate change by 2050. **A lack of commitment to halting global warming will hit Southeast Asia and Latin America the most.** Economies in the northern hemisphere are the least vulnerable to the overall effects of climate change.

- **For green investments, the multiplier effects on GDP tend to be three times higher than for fossil fuels investments.** Green land use is as much as twelve times more beneficial for GDP than non-eco-friendly land use at the same time. **Green investments can help mitigate the negative effects of climate change.**

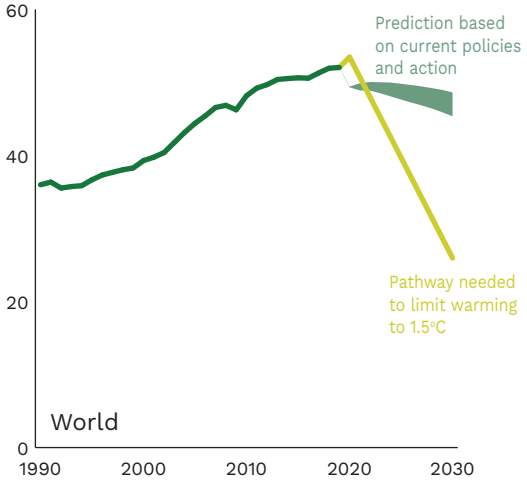
The climate neutrality trilemma in charts

Current climate actions and policies are not enough to prevent an increase in the average global temperature (Figure 1). The world will emit 45-50 $GtCO_2e$ in 2030, almost 90% more than in the modelled pathway to limit global warming.

A commitment to limiting global warming requires much more funding (Figure 2). The public and private sectors in the E7 economies are expected to mobilise nearly USD 70 trillion in the capital in 2020-2030.

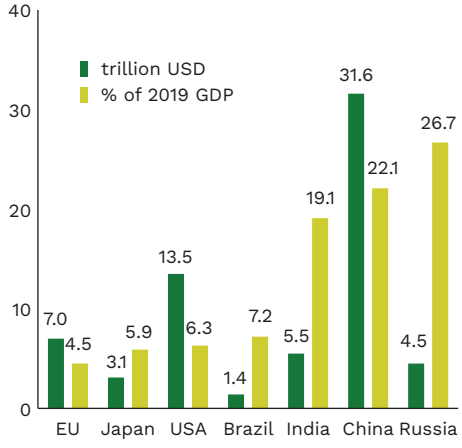
Withholding investments in the energy transition will result in a much greater economic downturn (Figure 3). A temperature increase of 2-2.6°C will decrease global GDP by 11-13.9%.

Figure 1. **The world is not on track to meet the 1.5°C goal**
Historical and predicted pathways of CO_2 emissions (in $GtCO_2e$)



Source: PEI based on Climate Action Tracker (2021).

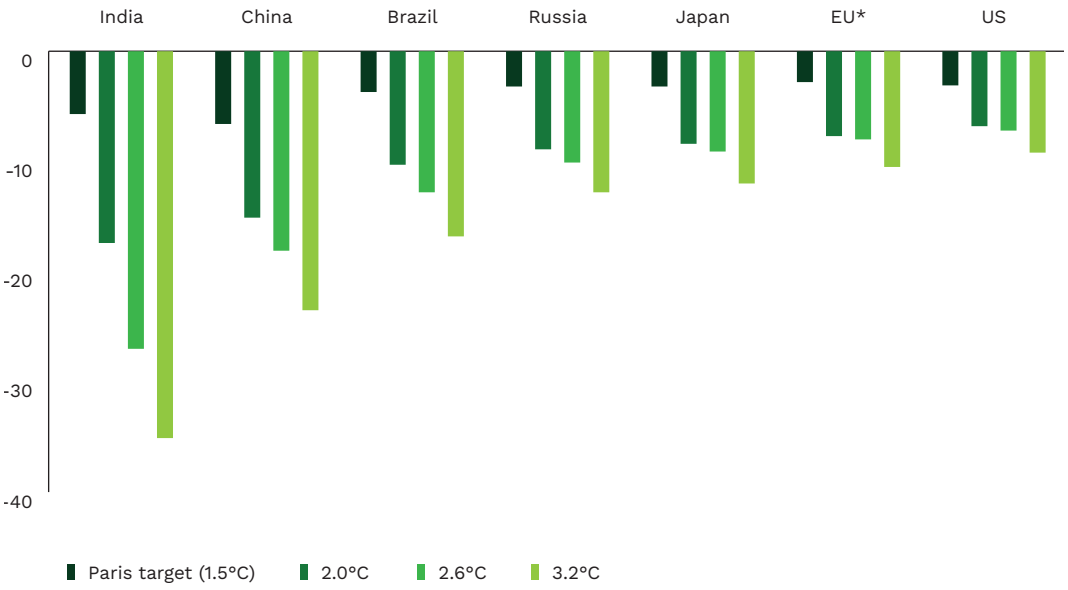
Figure 2. **China needs to spend 5 times more than the EU to meet the 1.5°C goal**
Total financial outlay (in trillion USD) by 2030, average annual investment (in % of 2020 GDP)



Source: PEI calculations based on European Commission (2020a); Climate Action Tracker (2021).

Figure 3. Global warming will hit the poor the hardest

Simulation of the economic loss due to rising temperatures before 2050, compared to a world without climate change (0°C) (in %GDP)



* The values for the EU are the average of the data available for 16 EU countries.

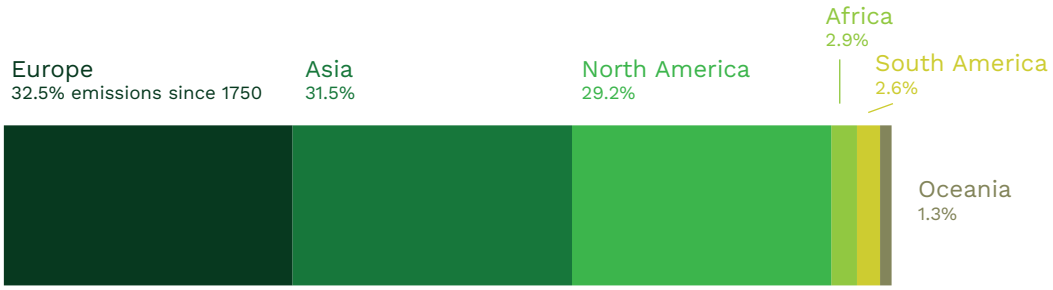
Source: PEI based on Guo et al. (2021).

Introduction

The Emitting Seven and global emissions

The Industrial Revolution led to the rapid economic development of the Western world. Nonetheless, the unprecedented growth in GDP has translated into a disproportionally higher increase in the level of greenhouse gases. As a result, all the continents must face the consequences of global warming (Mulvaney, 2021).

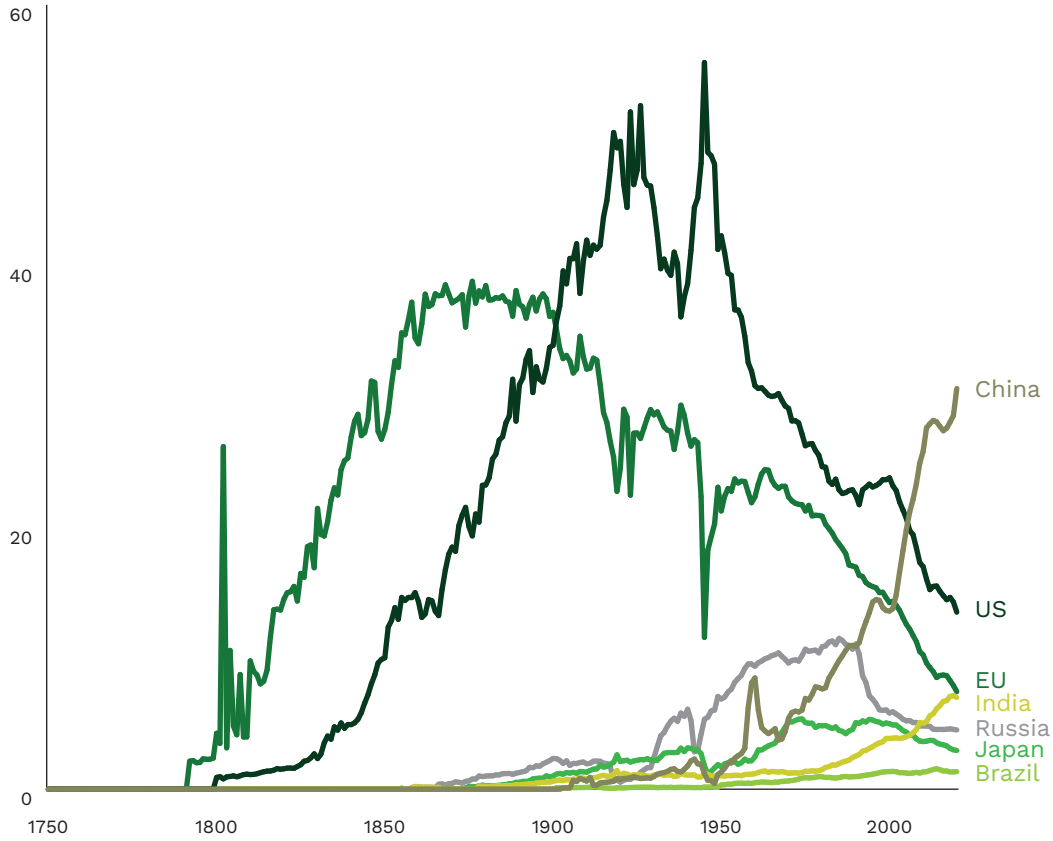
Figure 4. Europe has emitted the most CO_2 since 1750
Cumulative CO_2 emissions (1750-2019) (in %)



Source: PEI based on Mulvaney (2021).

Europe, Asia and North America are almost equally responsible for 90% of CO_2 emissions since 1750 (Figure 4). In the 20th century, the US that was the main emitter, followed by the EU. **In the current century, China overtook the US as the world's biggest greenhouse gases producer (in 2006), accounting for 30.1% of global emissions in 2020** (Figure 5).

Figure 5. China has been emitting more than the US since the 2000s
CO_2 emissions (1750-2020) (% of global emissions)



Source: PEI calculations based on Ritchie and Roser (2020).

In addition to China, the current leaders are the US (13.1%), the EU (7.8%), India (7.4%), Russia (5.5%), Japan (2.6%) and Brazil (2.3%). These seven economies are responsible for 30.1 billion tonnes of eCO_2 emitted in 2018, 66% of global emissions. **In the paper, this group of countries is referred to as the Emitting 7, or E7** (Figure 6).

Historical data on CO_2 emissions helps illustrate developmental differences and changes in climate attitudes between regions. **In the 19th and 20th centuries, the EU and the US emitted the most carbon dioxide,** as a result of their rapid industrial development within the former dominant economic paradigm. Currently, Western countries have recognised the challenge of rising emissions and called on the international community to take urgent action to combat climate change and its impact by setting emission-reduction targets (Roser, 2020).

Figure 6. The E7 is responsible for almost 70% of global GHG emissions
Global emissions in 2018 (in billion tonnes CO_2e and %)

Source: PEI calculations based on World Bank (2022).

At the same time, developing economies may refer to the principle outlined in the UN Declaration on the Right to Development of the human right to "full sovereignty over all their natural wealth and resources development" (UN GAOR, 1986). This may be interpreted as the right to follow the development path of, for example, the EU and the US, which for decades built prosperity without giving the environmental costs much consideration. Despite their potential legitimacy, these claims are detrimental since, in the long run, climate change affects the long-term growth potential of every country. Therefore, **a mechanism encouraging a just transition away from a carbon-based economy and towards one based on sustainable development must be established, so that climate-resilient economies are built** (Figure 6).

Global emission inequalities

Since 1990, emissions among E7 have risen by 42% overall, with the highest reductions observed in Russia and the EU (-22%). The substantial decrease in Russian GHG emissions can be attributed to the economic downturn, which led to a considerable drop in primary energy production and demand for energy. This means that the period of lower emissions only lasted from 1990 to 1998. Since then, emissions in Russia have gradually increased. The EU is the only economy that has continuously reduced emissions since 1990 (Table 1).

Table 1. India still lacks a plan for reducing GHG by 2030
Summary of national efforts to reduce GHG emissions

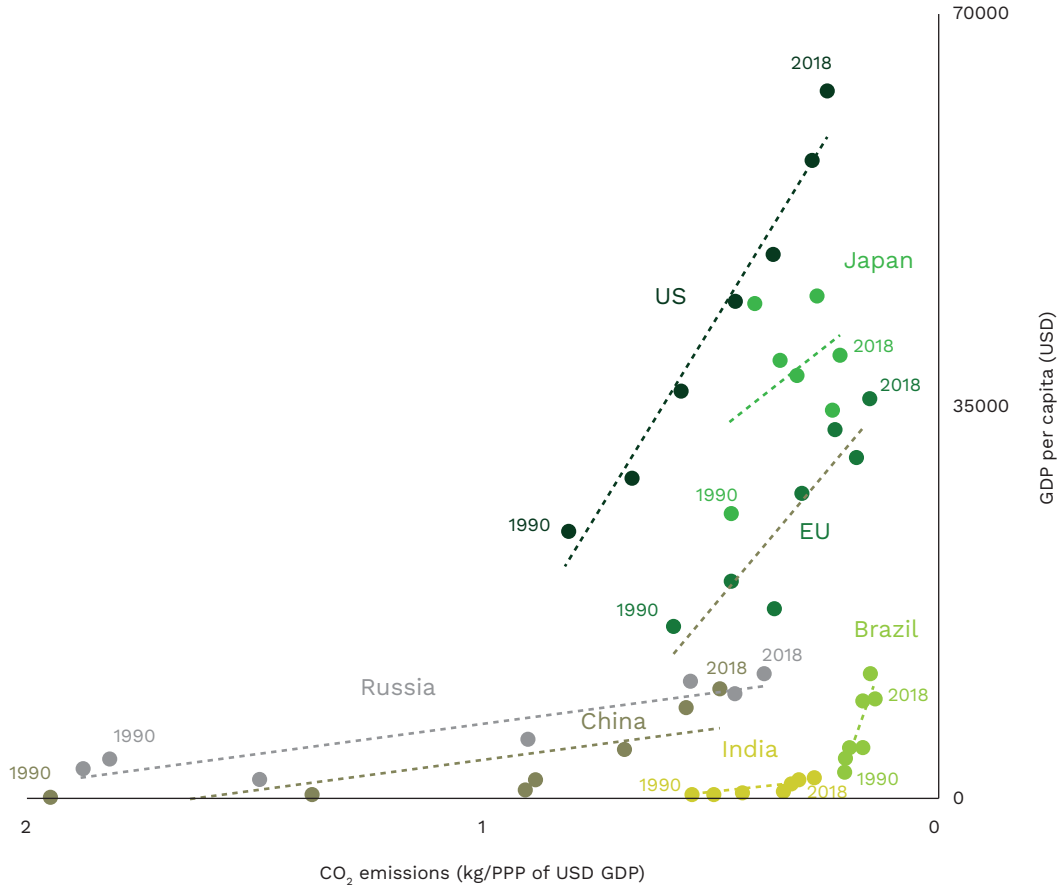
Country	Global share of GHG emissions, 2018 (%)	Declared year for achieving climate neutrality	Emission reduction target 2030 in relation to baseline year (%)	Change in GHG emissions in 1990-2018 (%)
China	30.1	2060	65 since 2005 (CO_2 per unit of GDP)	+283
US	13.1	2050	50-52 since 2005 (GHG)	+1
EU	7.8	2050	55 since 1990 (GHG)	-22
India	7.4	2070	-	+175
Russia	5.5	2060	70 since 1990 (GHG)	-22
Japan	2.6	2050	46 since 2013 (GHG)	+0
Brazil	2.3	2050	43 since 2005 (GHG)	+74

Source: PEI based on Rhodium Group (2021); Climate Watch Data (2021); World Bank Data (2022).

The EU, which was among the first to adopt climate targets, is ahead of the other E7 economies in the green transition process. For similar levels of GDP per capita, the EU has emitted less CO_2 per unit of GDP than the US

and Japan, even if the latter is catching up at higher GDP per capita levels. China, Russia, Brazil and India boost levels of wealth with lower CO_2 emissions than in the EU before 1990. This suggests that stricter environmental rules in some regions may have had positive environmental spillover abroad. Moreover, these countries started theirs green transition at lower GDP per capita levels than the US, the EU, and Japan (Henderson et al., 2020; Amiot, Bovino, 2021).

Figure 7. The US and China produce more CO_2 per GDP than the EU
CO_2 emissions (in kg/PPP of USD GDP) per GDP per capita in 1990-2018 (in USD)

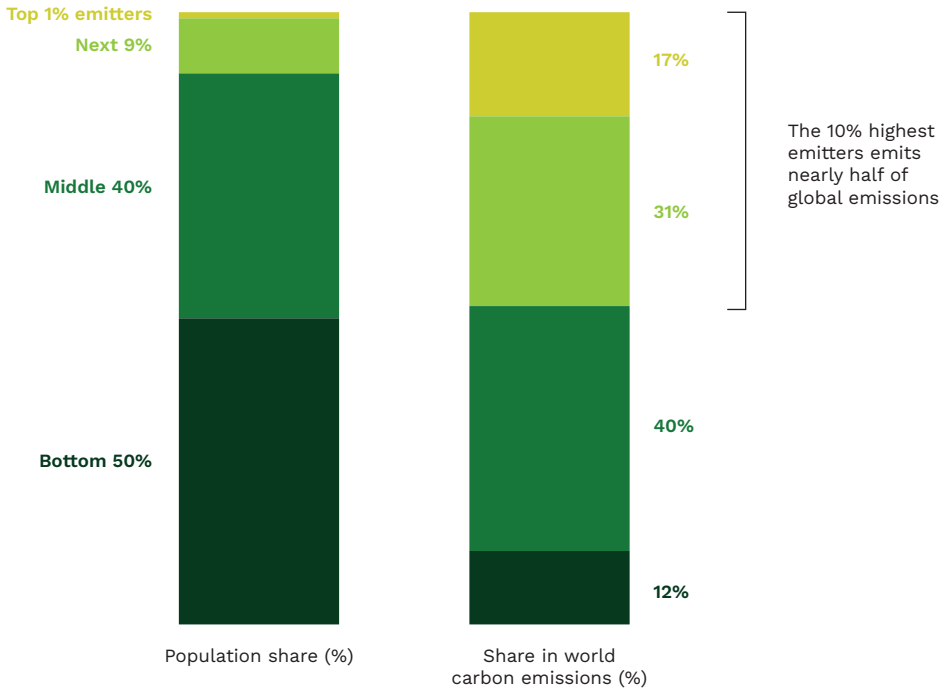


Source: PEI calculations based on World Bank Data (2022a; 2022b).

The world's most carbon-intensive economies (China and India) may feel aggrieved that the EU and the US developed at a time of higher emissions, whereas they now face higher expectations. Global carbon emissions are

inequal – not only for China, Russia, India, and Brazil in the E7, but also in the world as a whole. **The top 10% of the population is responsible for nearly 50% of global emissions. The bottom 50% of the population emits just 12% of the world's carbon dioxide** (Figure 8).

Figure 8. Global carbon emissions are unequal
Population share (in %) vs. share in world carbon emissions in 2019 (in %)



Source: PEI based on Chancel (2021).

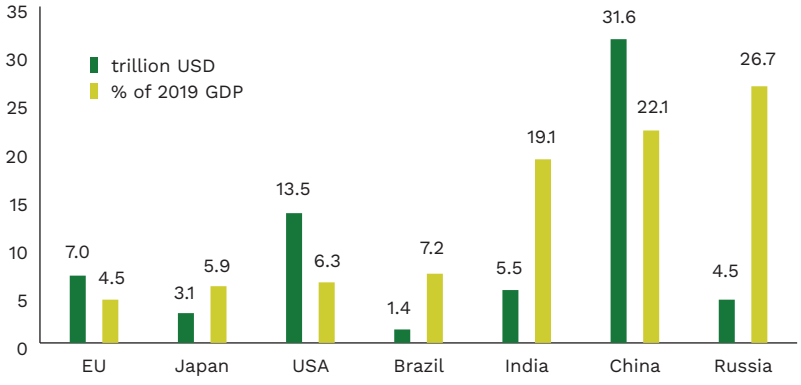
The cost of climate neutrality

Investments needed to meet the Paris Agreement target

The Emitting Seven will need to spend nearly USD 70 trillion by 2030 to stay on track to meet the 1.5°C goal[1]. While the EU needs to increase its financial effort in 2020-2030 to USD 7 trillion (4.5% of its 2019 GDP per year), Japan would need to invest 3.1 trillion USD (5.9% of its 2019 GDP), the US nearly USD 13.5 trillion (6.3% of its 2019 GDP), Brazil USD 1.4 trillion (7.2% of its 2019 GDP), India USD 5.5 trillion (19.1% of its 2019 GDP), China USD 31.6 trillion (22.1% of its 2019 GDP), and Russia USD 4.5 trillion (26.7% of its 2019 GDP) (Figure 9).

Figure 9. China needs to spend 5 times more than the EU to meet the 1.5°C target

Total financial outlay (in trillion USD), average annual investment (in % of 2019 GDP)



Source: PEI calculations based on European Commission (2020a); Climate Action Tracker (2021).

[1] The central objective of the Paris Agreement is its long-term temperature target, which involves limiting the increase in the average global temperature to "well below 2°C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (UN, 2015).

As a percentage of GDP, regions that produce fossil fuel and developing countries would spend more than others on physical assets for energy and land-use systems. According to McKinsey Global Institute (2022), Russia and CIS (Commonwealth of Independent States) need to invest the most in relation to GDP (21%). Spending in India would amount to more than 10%. In the EU, the US and Japan, investments would cost 6.5%, 6.4% and 4.2% respectively. These results are consistent with our calculations. The biggest difference concerns China, which, according to McKinsey, will only have to spend around 4.2% of GDP. However, this difference may stem from the fact that the study is limited to physical assets, whereas our analysis is holistic.

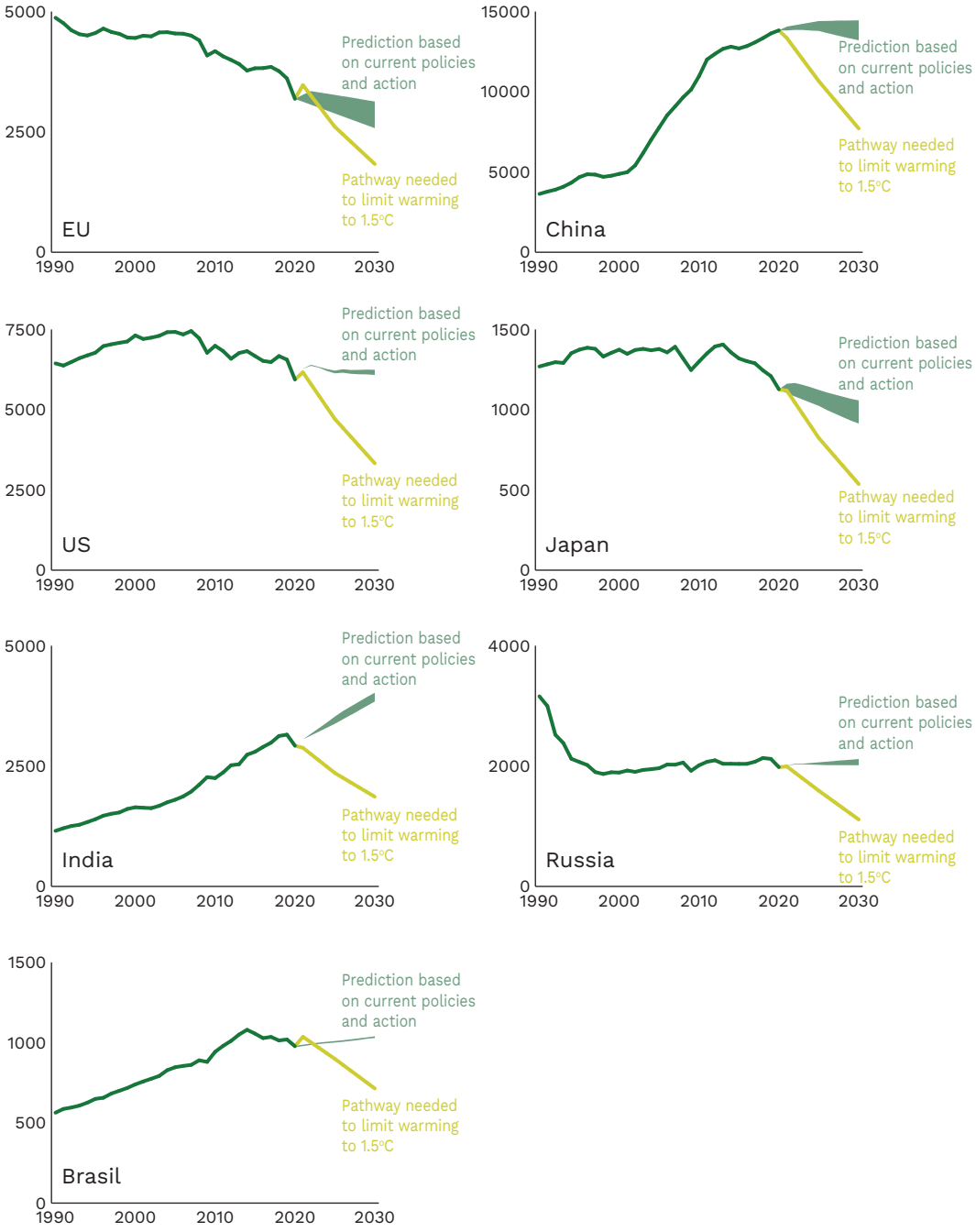
Box 1. How did we calculate the investment costs?

In our calculations, we estimated the GHG abatement cost based on the European Commission's (2020a) calculation, which estimated the total cost of a 55% reduction in emissions by 2030 at USD 4.5 trillion. Based on this value, we calculated the average abatement cost, which is approximately USD 5200 per tonne of CO_2e. This is slightly higher than indicated in the literature (Gillingham, Stock, 2018; Gillingham, 2019). However, the EC's more holistic approach might be more appropriate for these kinds of estimates than a purely academic approach, focused mainly on selected technologies. We used the calculated abatement cost to estimate other countries' total reduction costs.

Although the EC's emission-reduction plan is ambitious, it is still not enough to put the EU on track to achieve the Paris Agreement target of 1.5°C, according to Climate Action Tracker (2021). Using the results of the abatement needed from the Climate Action Tracker model MAGICC6, we calculated the financial effort the E7 economies need to make. To assess the climate impact of all the targets proposed by countries and thereby the consistency with the Paris Agreement, Climate Action Tracker (2021) derives a global emissions pathway to 2100, which is used as an input in a carbon cycle/climate model (MAGICC6). "It is run multiple times to obtain a probability distribution of global mean temperature and the corresponding central median estimate and corresponding exceedance probabilities. The detailed methodology of the climate model is outlined in Meinshausen et al. (2009, 2011) and with updated parameters from Rogelj et al. (2012)" (Climate Action Tracker, 2021).

Figure 10. The EU is the closest to the 1.5°C pathway

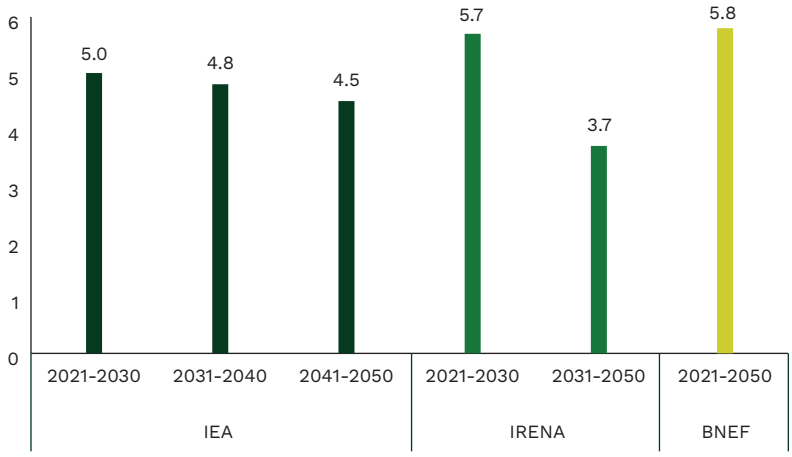
Historical and predicted CO_2 emissions pathways (in $MtCO_2e$)



Source: PEI based on Climate Action Tracker (2021).

Climate Action Tracker (2021) shows that no country has developed a pathway for meeting the targets in the Paris Agreement. The investment costs calculated by us are therefore higher than those stated by officials so far. To reach the 1.5°C target, China should reduce its annual emissions by 6115.1 $MtCO_2e$ (-44%) from 2020 to 2030, the US by 2611.5 $MtCO_2e$ (-44%), Japan by 590.5 (-52%), India by 1060.3 (-36%), Russia by 870.1 (-44%), the EU by 1353.1 (-42%), and Brazil by 263.2 (-27%). For E7 countries combined, the total reduction is around 13,000 Mt CO_2, which is 43% of the E7's emissions in 2020, based on the model.

Figure 11. Reaching Paris Agreement target will be expensive
Average annual global investment requirements (in USD trillion)



Source: PEI based on BNEF (2021); IEA (2021a); IRENA (2021); Lenaerts (2021).

Based on our calculations, the Emitting Seven should invest USD 67 trillion by 2030, which is higher than the amount forecast by international institutions. Global energy investments in 2016-2020 stand at around USD 2 trillion per year (2.5% of global GDP). According to the IEA (International Energy Agency), this will have to be increased to USD 5 trillion (4.5% of GDP) by 2030 and stay there until at least 2050 to reach net-zero emissions (IEA, 2021). The International Renewable Energy Agency (IRENA, 2021) frontloads the necessary investments for the current decade, resulting in investments of USD 5.7 trillion per year until 2030. According to BNEF (Bloomberg New Energy Finance), the average investment requirements will have to be between USD 3.1-5.8 trillion per year until 2050. BNEF analysts believe that governments and companies will need to invest at least USD 92 trillion by 2050 to cut emissions fast enough and prevent the most detrimental impact of

climate change (BNEF, 2021). The values indicated are for the energy sector. McKinsey Global Institute calculated that, in a net-zero scenario, global investment in physical assets in energy and land-use would need to amount to around USD 9.2 trillion per year until 2050 (McKinsey Global Institute, 2022). In our study, we calculated the investment costs needed to meet the Paris Agreement's 1.5°C target with reference to the sectors used by the European Commission (2020a): energy, industry, transport and residential.

Green public spending plans

For the current decade, the EU has committed more resources as a percentage of its GDP to fighting climate change than the US, with green public spending amounting to about 3.9% of 2019 GDP. A minimum of 30% of the combined EU budget and COVID-19 recovery fund (Next Generation EU) has been earmarked to fight climate change (Amiot, Bovino, 2021). **This is 12% of what the amount it needs to invest to implement the Fit For 55 package (European Commission, 2020a), and just 9% of that needed to be on the 1.5°C pathway** (Figure 9). These are the more significant means underpinning the EU Green Deal (its roadmap to carbon neutrality), which was meant to generate USD 1.1 trillion in green spending from the public and private sector over the next decade, in early 2020 (European Commission, 2020b).

In the US, two separate federal plans with large amounts of green allocations have been proposed: the House of Representative's Invest in America Act and the Senate's Bipartisan Infrastructure Deal. On average, close to 50% of these plans is green, representing 1.4% of 2019 GDP (Amiot, Bovino, 2021). **The amount is less than 5% of that needed to meet the 1.5°C pathway** (Figure 9).

Table 2. The EU has committed more resources to fighting climate change than the US
Plan, public spending in USD and % of 2019 GDP

Region	Plan	Total amount	Green Public spending	Period
US	Invest in American Act	USD 760 billion	USD 352 billion, 1.6% of 2019 GDP (46% of total amount)	5 years
US	Bipartisan Infrastructure Deal	USD 550 billion	USD 286 billion, 1.3% of 2019 GDP (52% of total amount)	8 years
EU	The Multiannual Financial Framework and Next Generation EU Fund	USD 2.05 trillion	USD 625.34 billion, 3.9% of 2019 GDP (30% of total amount)	7 years

Source: PEI based on Amiot, Bovino (2021).

The other E7 economies have not presented long-term financial frameworks for transition spending. From general announcements, it turns out that making Xi Jinping's pledge a reality will require new technologies and cost about 2% of China's cumulative GDP for 2020-2050 (Wu, 2020). Union Environment Minister Yadav stresses that India had reached its previous climate targets without the financing promised by developed countries. According to the Indian Ministry of Finance's calculations, the cost of meeting the net-zero targets is estimated at USD 2.5 trillion (Ghosal, 2021).

Economic impact of climate neutrality

Economic loss due to rising temperatures

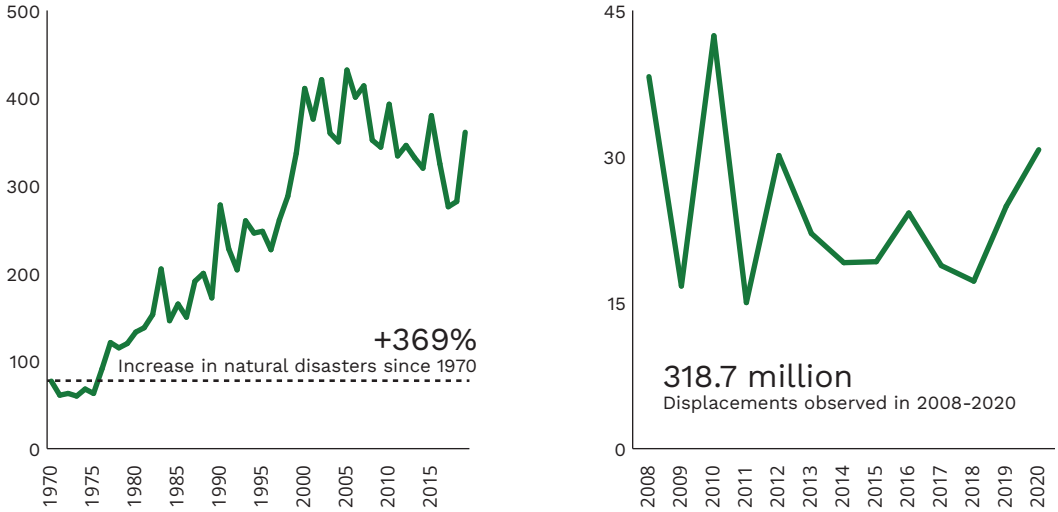
Even if climate change is limited to the level stipulated in the Paris Agreement, global GDP growth will be 4.2% lower in 2050, compared to a world without climate change. This fall will triple to 11.0-13.9% if the temperature rise is 2-2.6°C (the temperature rise deemed most likely by SwissRe, based on current policies), and 18.1% if the temperature rise is 3.2°C. The economy will also be affected by additional factors, in the form of natural disasters and uncontrolled migration (Guo et al., 2021).

In one of the worst-case scenarios, in 2070, as much as 19% of land area may be uninhabitable due to average annual temperatures above 29°C. According to the Climate Risk Index, in 2000-2019, the region most affected by the weather was South Asia (Germanwatch, 2021). The current rise in temperatures resulting from climate change could force up to 3.5 billion people to migrate (about 30% of the world's population, according to the projections for 2070). According to statistics published by the Internal Displacement Monitoring Centre, since 2008, over 318 million people around the world have been forcibly displaced by floods, windstorms, earthquakes or drought – including 30.7 million in 2020 alone (IDMC, 2021).

Climate change tends to have a larger negative impact on developing countries with lower per capita incomes. In the 3.2°C temperature increase scenario, China would lose a quarter (23.5%) of its GDP before 2050, and India more than a third (35.1%). As a result of its relative wealth, lower growth rates and cooler climate, the EU would face a less severe drop in GDP (10.5%). Even within Europe, the impact will vary between countries, with Denmark and Finland less exposed (4% and 6% respectively) than France and Greece (13%). The US would lose less than 10% of its GDP (Guo et al., 2021).

Figure 12. The number of recorded natural disasters is increasing, 320 million people have been displaced since 2008

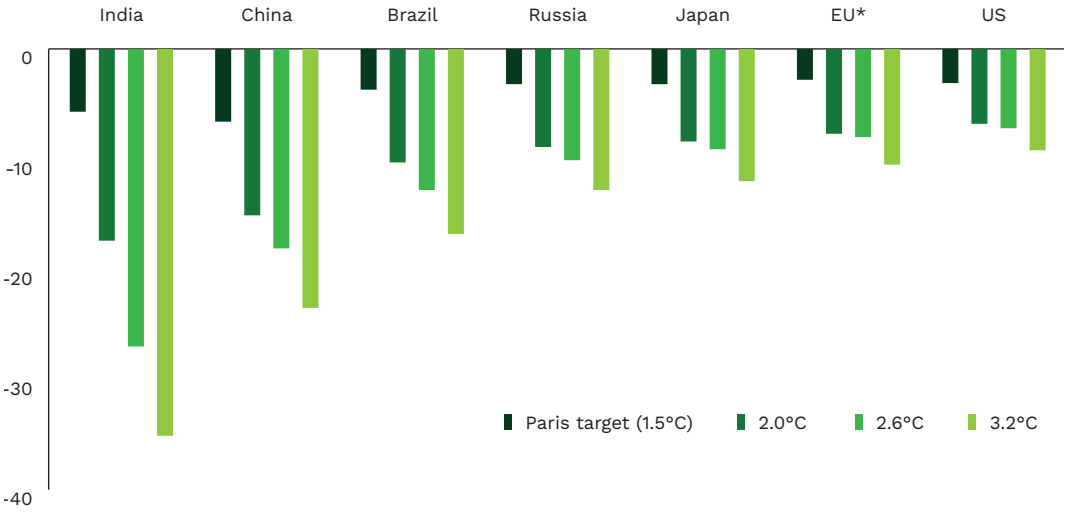
Global reported natural disaster events in 1970-2019, and displacements in 2008-2020



Source: PEI based on EMDAT (2020) and IDMC (2021).

Figure 13. Global warming will hit the poor the hardest before 2050

Simulation of economic loss caused by rising temperatures, compared to a world without climate change (0°C) (in % of GDP)



* The values for the EU are the average of the data available for 16 EU countries.

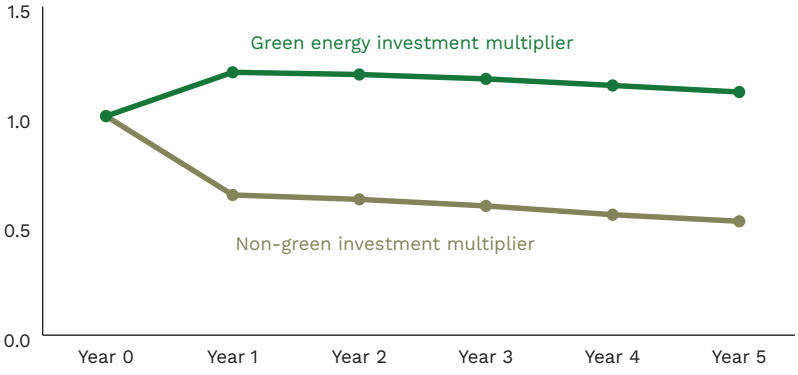
Source: PEI based on Guo et al. (2021).

Only a few existing studies point to a negative correlation between emission reductions and economic growth (Keyßer, Lenzen, 2021). The European Commission has shown that the relation between climate and energy policies and real GDP is projected "to be relatively small and can range from slightly positive to slightly negative, depending on the modelling approach used and the options considered for policy action. The policy and modelling options vary from model to model but convey a consistent message: the type of policy put in place to achieve greater reductions in GHG emissions is an important driver of the overall impact on GDP. The effects on the overall economy are smallest when policies are applied that put a price on the externality that the policy is intended to address and reduce distortionary taxes in other areas, such as labour taxation" (European Commission, 2018).

Economic gains from green investments in GDP

The costs of the green transition should be treated as an investment, rather than a one-off expense. Every dollar spent on carbon-neutral or carbon-sink activities generates over a dollar's worth of economic activity. This positive multiplier effect persists for at least four years and the impact on economic activity is 2-7 times larger than that associated with environmentally-detrimental measures. The results indicate that "building back better" – a strategy aimed at reducing the risk to countries and communities in the wake of future disasters and shocks, following the COVID-19 pandemic – does not require sacrificing GDP growth, even in the short term (Van de Schootbrugge, 2021).

Figure 14. Investment in green infrastructure has a greater rate of return
Estimated multiplier effects



* The multiplier effect refers to the proportional increase or decrease in final income that results from an injection of spending.

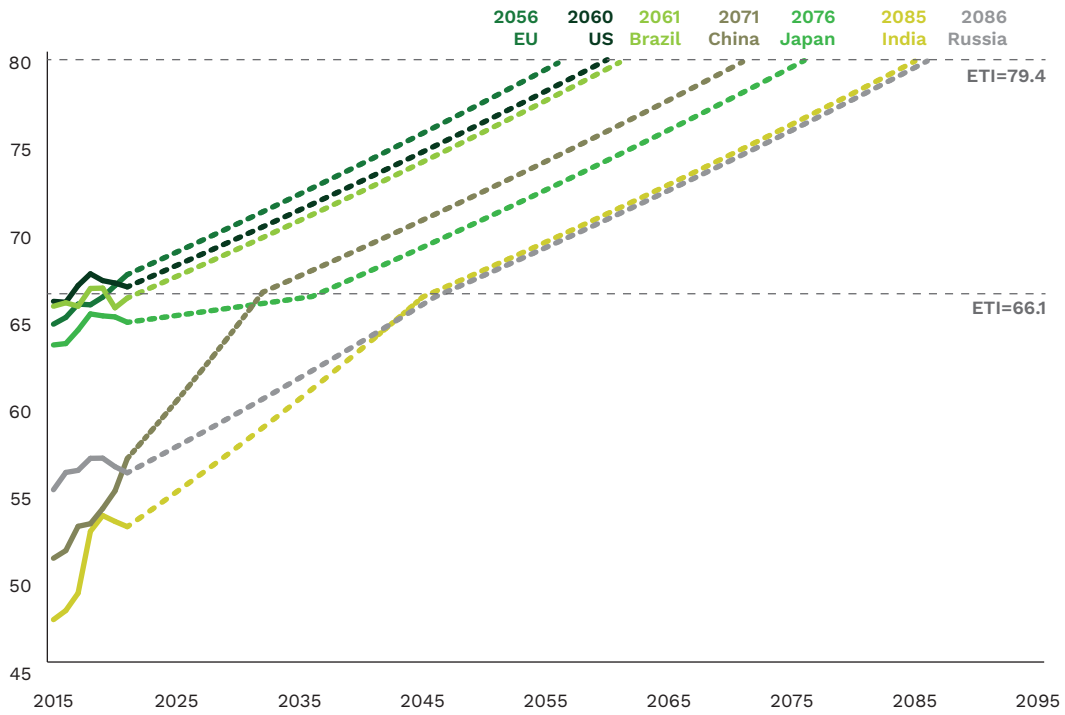
Source: PEI based on Ferris (2021).

In a study conducted with International Monetary Fund, the IEA analysed investments in clean energy (end-use, energy infrastructure, electricity generation and low-emission fuels) needed by 2030 to stay on the net-zero pathway. They conclude that annual global energy investments should triple from the current level, to USD 5 trillion. This adds 0.4 percentage points per year to GDP growth, resulting in a GDP that is 4% higher in 2030 than it would be with the current investment path. The surge in private and government spending will create millions of jobs in the clean energy sector, including in energy-efficiency improvement, as well as in engineering, manufacturing and construction (Batini et al., 2021; IEA, 2021a).

Time to climate neutrality

According to our estimates, with the current levels of engagement, none of the E7 economies will achieve net-zero emissions before their official targets. The EU will be the fastest to achieve neutrality, in 2056, while the US will maintain a similar pace, with the final year 2060. Japan will be overtaken by China and will not achieve neutrality until 2076, 26 years after its target. China will make the transition by 2071. Neutrality will be achieved the most slowly in India and Russia. They will become climate neutral in 2085 and 2086, respectively (Figure 15).

Figure 15. The EU will achieve climate neutrality in 2056
Estimated time to achieve climate neutrality, based on ETI



Source: PEI calculations based on ETI.

Based on the Energy Transition Index (ETI) by the WEF (World Economic Forum), it is possible to calculate how long it will take to decarbonisation in the case of countries that have not announced a target date, or to verify current strategies aimed at achieving climate neutrality. Achieving climate neutrality is a challenge of varying degrees for individual countries, which is reflected in the ETI. By combining the ETI data and the target date for achieving climate neutrality of countries that have announced a date, it is possible to calculate how long it will take other countries to decarbonise (Box 2).

Box 2. How did we calculate time to climate neutrality?

We made two assumptions in our calculations:

a) **a threshold for achieving climate neutrality (ETI=79.4).**
We determined the value of the zero-carbon economy indicator based on the arithmetic average of the ETI in European countries that aim to decarbonise before 2050 (Austria in 2040, Finland in 2035, and Sweden in 2045). We forecast an indicator based on natural dynamics and the average growth rate from 2012-2020;

b) **a threshold for changing the rate of the energy transition (ETI=66.1).**
According to the literature (Dębkowska et al., 2021), removing "the final few percent of fossil fuels from the energy mix is the most difficult". Based on the ETI value in recent years, we can distinguish between two groups of E7 economies with different transition speeds and starting points. We assumed that the average ETI in 2020 for the US, the EU and Japan (66.1) is the threshold for reaching the transition dynamics of the most developed economies (the EU and the US average). The faster pace of transition at a further stage of development may occur despite declining technology costs, through investments with lower returns, impediments due to additional legislative processes, and social perception (Lind, 2016).

Developed countries are clearly at a better starting point. The developed economies (the US, the EU and Japan) aside, Brazil had the highest score. Russia also had a high score in 2015, but its low level of engagement on climate issues and the slow rate of growth in the index mean that it will be overtaken by both China and India, when it comes to achieving climate neutrality. China will also overtake Japan, which will lose its current lead by not being active enough in the transition domain (Figure 15). China is investing heavily in new renewable energy technologies and is allocating greater resources than the EU or the US – but the scale of its economy requires much greater efforts. However, this approach could backfire with a vengeance because of the particular impact of global warming on developing and poor economies ("The Economist", 2021).

Conclusions

Climate change, and war in Ukraine is one of the fundamental issues facing the world today. It is a particular challenge because it requires international cooperation schemes, in addition to domestic efforts. Furthermore, without the necessary solutions and compromises, economies could face economic collapse. On top of that, the irreversible environmental changes will increase global inequality and wreak havoc on people's livelihoods and communities. **In this report, we have created a new term, the E7, which encompasses the world's seven most emitting economies: China, the US, the EU, India, Russia, and Brazil.** Together, they are responsible for nearly 70% of global CO_2 emissions and have a huge responsibility when it comes to implementing climate solutions and creating a path that other countries can follow. At the same time, these economies are very diverse – from the rich and developed the US, the EU and Japan, to the huge economies of China and Russia, and the developing economies of India and Brazil.

Among these economies, China is showing considerable interest in developing green technologies and decarbonisation. At the same time, **only the EU and the US have made precise, long-term plans with anticipated climate investments.** However, the planned spending will do little to put the world on the pathway set out in the Paris Agreement. EU funding only covers about 9% of the investment needed in this region to limit temperature increases to 1.5°C; in the US, it only covers 5% of the goal. Annually, it amounts to 4.5% of its 2019 GDP.

In this report, we calculated the size of public and private investment needed in the E7 economies to achieve the Paris Agreement pathway. **They would need to mobilise nearly USD 70 trillion between 2020 and 2030.** For the EU, it means investments USD 2.5 trillion higher than stated in the Fit for 55 regulation, USD 4.5 trillion. For the other economies, the 1.5°C target in the Paris Agreement would mean the investment of USD 13.5 trillion for the US (6.3% of its 2019 GDP), USD 3.1 trillion for Japan (5.9% of its 2019 GDP), USD 1.4 trillion for Brazil (7.2% of its 2019 GDP), USD 5.5 trillion for India (19.1% of its 2019 GDP), USD 31.6 trillion for China (22.1% of its 2019 GDP), and USD 4.5 trillion for Russia (26.7% of its 2019 GDP).

Even such large investments will not allow the countries to avoid the economic downturn triggered by climate change. According to SwissRe (2021), the Paris Agreement pathway of a temperature increase of 1.5°C implies a 4% decline in global GDP by 2050, compared to a world without an increase in the temperature. Failure to respond to climate change and a higher temperature rise of 3.2°C would multiply the economic losses to 18% of GDP. In comparison, the major crises of recent times (the financial crisis in 2009 and the pandemic in 2020) led to GDP declines of 1.7% and 3.6%, respectively. Moreover, it should be remembered that green investments may partially offset these losses by improving macroeconomic indicators and ensuring a just transition by creating alternative jobs.

According to our calculations, the E7 economies' current commitment will not enable any of them to achieve climate neutrality within the timeframe set by them. The EU will make the transition in 2056 at the earliest, followed by the US and China in 2060 and 2071, respectively.

The report illustrates how much more action is needed to prevent the worst-case scenarios relating to global warming. Analysis of the data on emissions shows that the US and the EU have greater responsibility, but there has been a recent increase in China's contribution to global warming. At the same time, there are different sensitivities to the consequences of climate change around the world. Countries in South Asia are the most vulnerable.

We should expect concrete action plans in all the E7 economies, along the lines of those in the US and the EU. Declarations about achieving climate neutrality are a step in the right direction, but as we has shown in this report, they should be followed by much greater investments. This may not be feasible without the cooperation and support of the world's poorer regions.

Bibliography

Amiot, M., Bovino, B.A. (2021), *Economic Research: Green Spending Or Carbon Taxes (Or Both): How To Reach Climate Targets, And Grow Too, By 2030?*, S&P Global Ratings, https://www.spglobal.com/ratings/en/research/articles/211104-economic-research-green-spending-or-carbon-taxes-or-both-how-to-reach-climate-targets-and-grow-too-by-2-12175385 [accessed: 07.02.2022].

Batini, N., di Serio, M., Fragetta, M., Melina, G., Waldron, A. (2021), *Building Back Better: How Big Are Green Spending Multipliers?*, International Monetary Fund, Working Paper, No. 087, https://www.imf.org/en/Publications/WP/Issues/2021/03/19/Building-Back-Better-How-Big-Are-Green-Spending-Multipliers-50264 [accessed: 07.02.2022].

BNEF (2021), *New Energy Outlook 2021*, Bloomberg NEF, https://about.bnef.com/new-energy-outlook/ [accessed: 07.02.2022].

Chancel, L. (2021), *Global carbon inequality, 1990-2019*, WID, World Inequality Lab, Working Paper, No. 21, https://wid.world/wp-content/uploads/2021/10/Chancel2021CarbonInequality2210-1837.pdf [accessed: 07.02.2022].

Climate Action Tracker (2021), *Climate Analytics*, http://climateactiontracker.org/, https://1p5ndc-pathways.climateanalytics.org/countries/ [accessed: 07.02.2022].

Climate Watch Data (2021), *NDC Enhancement Tracker*, https://www.climatewatchdata.org [accessed: 07.02.2022].

Dębkowska, K., Juszczak, A., Maj, M., Szymańska, A. (2021), *Foresight energetyczny Unii Europejskiej*, Szpor, A. (współpr.), Polski Instytut Ekonomiczny, Warszawa.

EMDAT (2020), *OFDA/CRED International Disaster Database*, Université catholique de Louvain, Brussels.

European Commission (2018), *In-depth analysis in support on the COM(2018) 773: A Clean Planet for all – A European strategic long term vision for a prosperous, modern, competitive and climate neutral economy*.

European Commission (2020a), *State of the Union: Questions & Answers on the 2030 Climate Target Plan*, https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_1598 [accessed: 07.02.2022].

European Commission (2020b), *European Green Deal Investment Plan COM/2020/21 final*, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0021&from=EN [accessed: 07.02.2022].

Ferris, N. (2021), *Why investing in green growth is the best economic path forward*, Sustainable Finance, Energy Monitor, https://www.energymonitor.ai/finance/sustainable-finance/the-economic-case-for-green-growth-is-now-indisputable [accessed: 07.02.2022].

Germanwatch (2021), *Global Climate Risk Index 2021*, Germanwatch e.V., Bonn, https://reliefweb.int/sites/reliefweb.int/files/resources/Global%20Climate%20Risk%20Index%202021_1_0.pdf [accessed: 07.02.2022].

Ghosal, A. (2021), *Net Zero Goals Aren't the Solution to Climate Change, Says India Ahead of COP26*, TIME, https://time.com/6111115/net-zero-cop26-india/ [accessed: 07.02.2022].

Gillingham, K., Stock, J.H. (2018), *The Cost of Reducing Greenhouse Gas Emissions*, NBER, "Journal of Economic Perspectives", https://scholar.harvard.edu/files/stock/files/gillingham_stock_cost_080218_posted.pdf [accessed: 07.02.2022].

Gillingham, K. (2019), *Carbon Calculus. For deep greenhouse gas emission reductions, a long-term perspective on costs is essential*, "Finance & Development", No. 56(4), https://www.imf.org/external/pubs/ft/fandd/2019/12/the-true-cost-of-reducing-greenhouse-gas-emissions-gillingham.htm [accessed: 07.02.2022].

Guo, J., Kubli, D., Saner, P. (2021), *The economics of climate change: no action not an option*, Swiss Re Institute, https://www.swissre.com/dam/jcr:e73ee7c3-7f83-4c17-a2b8-8ef23a8d3312/swiss-re-institute-expertise-publication-economics-of-climate-change.pdf [accessed: 07.02.2022].

Henderson, K., Pinner, D., Smeets, B., Tryggestad, C., Vargas, D. (2020), *Climate math: What a 1.5-degree pathway would take. Decarbonizing global business at scale is achievable, but the math is daunting*, "McKinsey Quarterly", https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability/our%20insights/climate%20math%20what%20a%201%20point%205%20degree%20pathway%20would%20take/climate-math-what-a-1-point-5-degree-pathway-would-take-final.pdf [accessed: 07.02.2022].

ICAP (2021), *Allowance Price Explorer*, https://icapcarbonaction.com/en/ets-prices [accessed: 07.02.2022].

IDMC (2021), *Global Internal Displacement Database*, https://www.internal-displacement.org/database [accessed: 07.02.2022].

IEA (2021), *Net Zero by 2050. A Roadmap for the Global Energy Sector*, International Energy Agency, https://www.iea.org/reports/net-zero-by-2050 [accessed: 07.02.2022].

IEA (2021a), *World Energy Investment 2021*, International Energy Agency, https://iea.blob.core.windows.net/assets/5e6b3821-bb8f-4df4-a88b-e891cd8251e3/WorldEnergyInvestment2021.pdf [accessed: 07.02.2022].

IRENA (2021), *World Energy Transitions Outlook: 1.5°C Pathway*, International Renewable Energy Agency, Abu Dhabi, https://www.irena.org/publications/2021/Jun/World-Energy-Transitions-Outlook [accessed: 07.02.2022].

Keyßer, L.T., Lenzen, M. (2021), *1.5 °C degrowth scenarios suggest the need for new mitigation pathways*, "Nature Communications", No. 12(2676), https://www.nature.com/articles/s41467-021-22884-9 [accessed: 07.02.2022].

Lenaerts, K., Tagliapietra, S., Wolff, G.B. (2021), *How much investment do we need to reach net zero?*, Bruegel, https://www.bruegel.org/2021/08/how-much-investment-do-we-need-to-reach-net-zero/?fbclid=IwAR12KCgZTGVuRlaSjl5qTA-CkywraJXdZx3ZuUZP_oxgoPvtNS3p8pnIG6g [accessed: 07.02.2022].

Lind, C. (2016), *Times They Are a-Changin': The Renewable Energy Transition Is Happening, But Major Challenges Are Slowing It Down*, https://www.ge.com/news/reports/times-changin-renewable-energy-transition-happening-major-challenges-slowing [accessed: 07.02.2022].

McKinsey Global Institute (2022), *The net-zero transition: What it would cost, what it could bring*, https://www.mckinsey.com/business-functions/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring [accessed: 07.02.2022].

Meinshausen, M., Meinshausen, N., Hare, W., Raper, S.C.B., Frieler, K., Knutti, R., Frame, D.J., Allen, M.R. (2009), *Greenhouse-gas emission targets for limiting global warming to 2°C*, "Nature, No. 458.

Meinshausen, M., Raper, S.C.B., Wigley, T M.L. (2011), *Emulating coupled atmosphere-ocean and carbon cycle models with a simpler model, MAGICC6: Part I – Model Description and Calibration*, "Atmospheric Chemistry and Physics", No. 11.

Mulvaney, K. (2021), *The world is still falling short of meeting its climate goals*, "National Geographic", Environment, https://www.nationalgeographic.com/environment/article/the-world-is-still-falling-short-of-meeting-its-climate-goals [accessed: 07.02.2022].

Pollitt, H., Lewney, R., Kiss-Dobronyi, B., Lin, X. (2021), *Modelling the economic effects of COVID-19 and possible green recovery plans: a post-Keynesian approach*, Climate Policy, https://www.tandfonline.com/doi/full/10.1080/14693062.2021.1965525/ [accessed: 07.02.2022].

Rhodium Group (2021), *China's Greenhouse Gas Emissions Exceeded the Developed World for the First Time in 2019*, https://rhg.com/research/chinas-emissions-surpass-developed-countries/ [accessed: 07.02.2022].

Ritchie, H., Roser, M. (2020), *CO_2 and Greenhouse Gas Emissions, Our World in Data*, https://ourworldindata.org/CO2-and-other-greenhouse-gas-emissions [accessed: 07.02.2022].

Rogelj, J., Meinshausen, M., Knutti, R. (2012), *Global warming under old and new scenarios using IPCC climate sensitivity range estimates*, Nature Clim Change (2), 248-253, https://doi.org/10.1038/nclimate1385.

SwissRe (2021), *The economics of climate change: no action not an option*, SwissRe Institute, https://www.swissre.com/dam/jcr:e73ee7c3-7f83-4c17-a2b8-8ef23a8d3312/swiss-re-institute-expertise-publication-economics-of-climate-change.pdf [accessed: 07.02.2022].

"The Economist" (2021), *COP26 ends with a pact that is neither a triumph nor a trainwreck*, https://www.economist.com/international/2021/11/13/cop26-ends-with-a-pact-that-is-neither-a-triumph-nor-a-trainwreck [accessed: 07.02.2022].

UN (2015), *Paris Agreement*, https://unfccc.int/sites/default/files/english_paris_agreement.pdf [accessed: 07.02.2022].

UN GAOR (1986), *Declaration on the Right to Development*, United Nations Global Health&Human Rights, General Assembly Resolution, No. 41/128.

World Bank Data (2022), *Total greenhouse gas emissions*, https://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE [accessed: 07.02.2022].

World Bank Data (2022a), *GDP per capita (current US$)*, World Bank national accounts data, and OECD National Accounts data files, https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?end=2020&locations=EU-CN-US-JP-IN-RU-IR&start=2020 [accessed: 07.02.2022].

World Bank Data (2022b), *CO_2 emissions*, https://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD.KD [accesed: 07.02.2022].

Wu, W. (2020), *Climate change: China's goal to be carbon neutral by 2060 will cost US$15 trillion, report says*, SCMP, https://www.scmp.com/news/china/diplomacy/article/3106509/climate-change-chinas-goal-be-carbon-neutral-2060-will-cost [accessed: 07.02.2022].

Van de Schootbrugge, S. (2021), *How Valuable Is 'Green' Investment?*, ESG & CLIMATE CHANGE, Macro Hive, https://macrohive.com/deep-dives/how-valuable-is-green-investment/ [accessed: 07.02.2022].

List of figures, tables and boxes

LIST OF FIGURES

LIST OS TABLES

LIST OF BOXES

The Polish Economic Institute

The Polish Economic Institute is a public economic think tank dating back to 1928. Its research primarily spans macroeconomics, energy and climate, foreign trade, economic foresight, the digital economy and behavioural economics. The Institute provides reports, analyses and recommendations for key areas of the economy and social life in Poland, taking into account the international situation.

Polish
Economic
Institute