Die Klima-Investitionslücke der G7 Staaten

Wie viel Geld in Kohle, Öl und Gas statt in die Energiewende fließt

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Studie im Auftrag von Greenpeace e.V.
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Vorwort

Liebe Leser:innen,

mit ihren historischen CO2-Emissionen tragen die G7-Staaten eine große Verantwortung für das Klima: Damit unumkehrbare Klimaschäden und der Klimakollaps verhindert werden können, müssen die sieben reichsten Demokratien jetzt dieser Verantwortung gerecht werden und sofort sämtliche Investitionen in klimaschädliche Infrastruktur für Kohle, Öl und Gas stoppen. Nur wenn sie ihre Kapitalflüsse und Investitionen sofort weg von fossilen Energien und hin in die ökologische Transformation lenken, können sie die Pariser Klimaziele noch erreichen.

Anlässlich des diesjährigen G7-Gipfels unter deutscher Ratspräsidentschaft hat Greenpeace das Institut New Economic Foundation (NEF) beauftragt, die sogenannte Klimainvestitionslücke der G7-Mitgliedstaaten zu untersuchen. **Das Ergebnis: Deutschland, Frankreich, Großbritannien, Italien, Japan, Kanada und die USA planen seit 2020 fast ebenso hohe öffentliche Investitionen in fossile Energien wie für den Ausbau von Sonnen- und Windkraft** (geplante Investitionen für fossile Energien: 211,7 Milliarden Euro; geplante Investitionen für klimafreundliche Energieprojekte: 265,7 Milliarden Euro). Für die Energiewende und den klimafreundlichen Umbau der Wirtschaft investieren die Staaten der G7 viel zu wenig – nämlich deutlich weniger als zehn Prozent des erforderlichen Gesamtinvestitionsvolumens, welches zur Einhaltung der 1,5-Grad-Grenze nötig wäre. In Italien, den USA, Kanada und Japan ist die Klimainvestitionslücke sogar noch deutlich größer als in den anderen Staaten.

Deutschland muss jährlich rund **118,9 Milliarden Euro** investieren, um den klimagerechten Umbau der Wirtschaft zu schaffen. Tatsächlich lagen die Gesamtinvestitionen in die ökologische Wende zwischen 2015 und 2020 aber nur bei rund **26,4 Milliarden Euro** jährlich, wovon 9,8 Milliarden Euro öffentliche Gelder waren. Zum Vergleich: zwischen 2015 und 2021 importierte Deutschland im Schnitt jedes Jahr fossile Energieträger im Wert von **87,9 Milliarden Euro** – 17,2 Prozent davon kamen aus Russland. Zur Einhaltung der kritischen 1,5-Grad-Grenze müsste Deutschland fast das zwölffache an öffentlichen und privaten Geldern für die grüne Transformation aufbringen, als im Schnitt seit 2020 investiert wurde. Klimaschädliche Investitionen in die Neuerschließung fossiler Energieträger und damit verbundene Infrastrukturinvestitionen müssen dagegen so schnell wie möglich auf null gesenkt werden.

Die vorliegende Analyse zeigt sehr deutlich, dass die größten demokratischen Wirtschaftsnationen ihrer immensen Verantwortung nicht gerecht werden. Sie müssen sofort die Klimainvestitionslücke schließen, um den Klimakollaps zu verhindern. Gleichzeitig müssen sie mit ihren finanziellen Mitteln und ihrem technologischen Know-How die weltweite Energiesystemwende einleiten.

Jonas Ott
Greenpeace-Experte für erneuerbare Energien

Hamburg, Juni 2022

Die zentralen Ergebnisse der Kurzexpertise:

- Kein G7-Staat plant derzeit mehr als zehn Prozent der Investitionen in die Energiewende und den klimafreundlichen Umbau der Wirtschaft, die zur Erreichung des 1,5 Grad-Ziels nötig wären. Frankreich, Italien, Japan und die USA planen derzeit sogar weniger als zwei Prozent der benötigten Gelder dafür ein.

- Die G7-Staaten planen insgesamt nahezu ebenso viel Geld für klimaschädliche fossile Energien (211,7 Milliarden Euro) ein wie für saubere Energielösungen (265,7 Milliarden Euro).

- Die bisherigen Gesamtinvestitionen in den klimafreundlichen Umbau der Wirtschaft (2015–2021) und die zukünftig vorgesehenen öffentlichen Investitionen (2020–heute) sind in allen G7-Staaten deutlich zu niedrig, um das 1,5 Grad-Ziel einzuhalten. Die Lücke zwischen den geplanten und den benötigten Investitionen in den Klimaschutz ist in Kanada, Japan und den USA am größten.

- Inlandsinvestitionen: In den Jahren 2015–2021 tätigten die USA, Großbritannien und insbesondere Kanada im Verhältnis zu ihrer Wirtschaftsleistung die höchsten Investitionen in fossile Energien im eigenen Land. Bei den USA und Kanada sind im Verhältnis zu ihrer Wirtschaftsleistung zusätzlich die inländischen Investitionen in fossile Energien deutlich höher als die öffentlichen eingeplanten Gelder und Ausgaben für saubere Energie.

- Seit 2020 haben Deutschland, Frankreich und Italien mehr Gelder in öffentliche Finanzierungen für erneuerbare Energien als in fossile Energien eingeplant. In absoluten Zahlen haben die USA, Großbritannien und Kanada in den vergangenen zwei Jahren die größten Investitionen in fossile Energien getätigt.

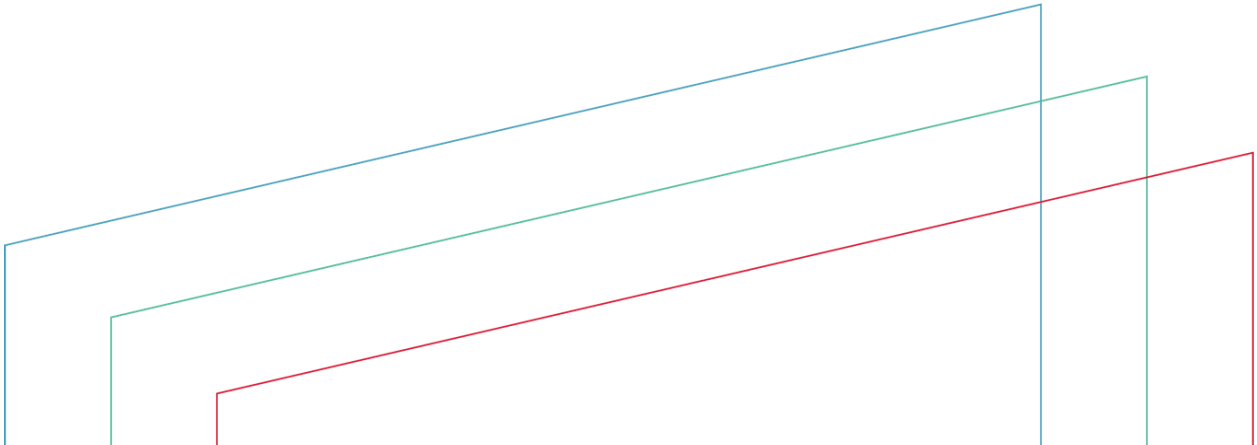
- Deutschland und Frankreich haben im Verhältnis zu ihrer Wirtschaftsleistung seit 2020 die größte Summe in saubere Energien investiert. Beide Länder müssten jedoch insgesamt rund 12 bzw. 22 Mal mehr in ein klimagerechtes Energiesystem investieren.

- Deutschland muss seine jährlichen Gesamtinvestition in die Energiewende im Verhältnis zu den vergangenen Jahren von 26,4 Milliarden auf mindestens 118,9 Milliarden Euro vervierfachen. Zum Vergleich: In den letzten Jahren hat Deutschland jährlich für durchschnittlich rund 88 Milliarden Euro fossile Energieträger aus dem Ausland bezogen.

THE CLIMATE INVESTMENT GAP OF G7 COUNTRIES

How G7 money is flowing into coal, oil, and gas instead of the energy transition

A report based on research commissioned by Greenpeace Germany



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CONTENTS

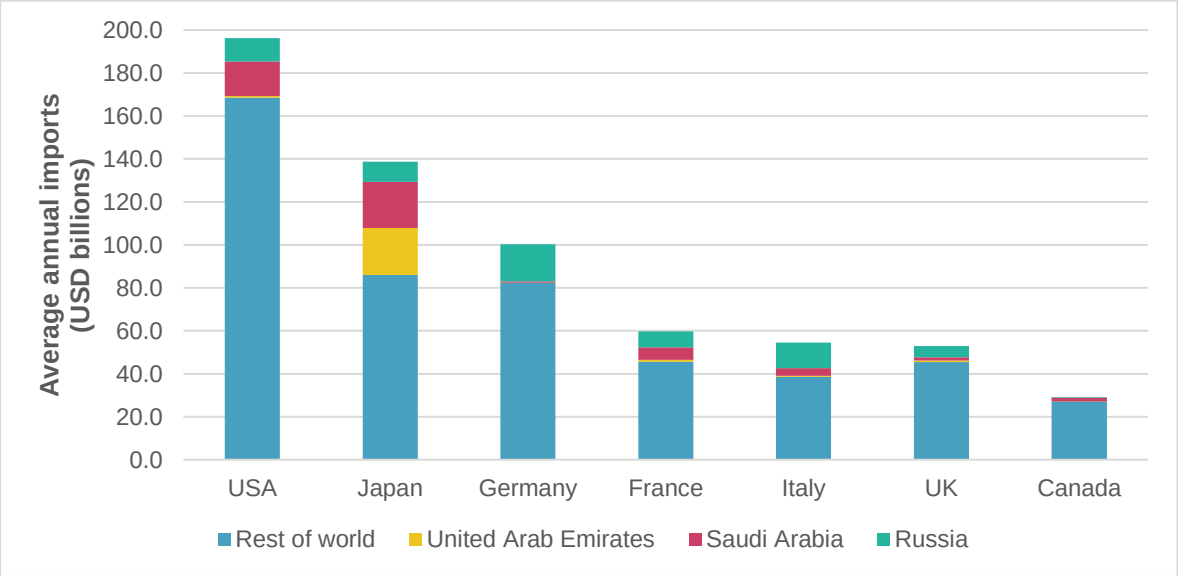
INTRODUCTION AND CONTEXT

In the coming decades, it will be crucial for the Group of 7 (G7) countries, which are among the largest and most powerful economies in the world, to make radical changes to their energy systems. This is required both to begin mitigating their substantial environmental impact and to collaborate with other countries in the global south on a level playing field, helping them to make a similar transition. An important first step in this transition will be to scale down investment and production in fossil-fuel-based energy systems over the coming years, while the ultimate aim of this process should be the phasing out entirely of these systems and a wholesale shift to renewable energy systems. While carbon-intensive expenditure directly impedes a just transition to renewable energy sources, international financial flows in fossil fuel sectors also contribute funding for devastating wars, such as the ongoing war following the Russian invasion of Ukraine. This nexus between the just transition, renewable energy sovereignty, and the funding of war adds further urgency to the task of scaling up investment in renewable energy systems.

This short paper presents the findings of research into the investment and expenditure of the G7 relating to fossil fuels and clean energy investments. We outline the current level of fossil-fuel dependence among these countries and the money flowing via fossil fuel towards catastrophic wars, before estimating the required level of investment to achieve a fully renewable energy system and net zero CO_2 emissions in each G7 country. We conclude by highlighting the large investment gap between what is required to avert climate breakdown and the current climate investment plans of each country.

FOSSIL FUEL INVESTMENT AND EXPENDITURE BY G7 COUNTRIES

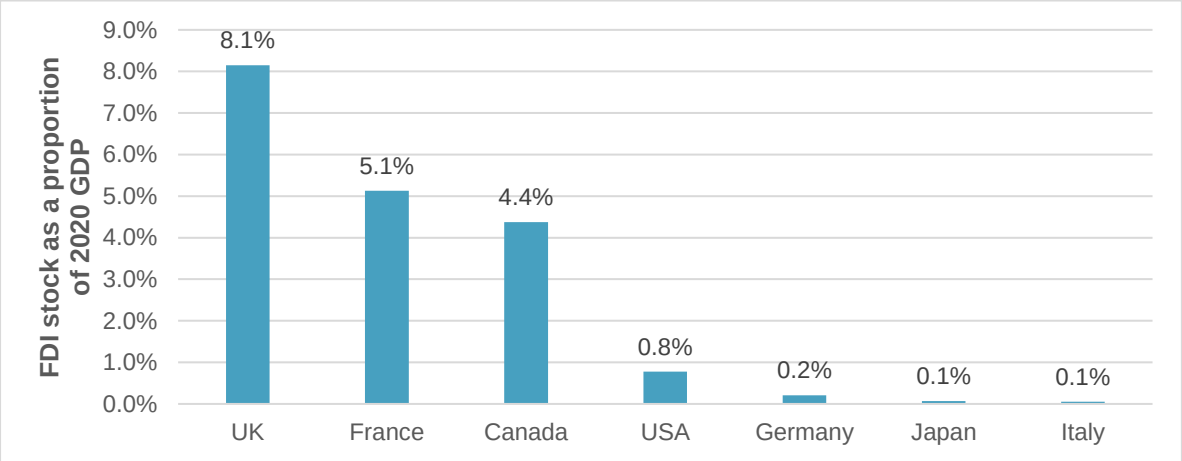
Figure 1: Average annual fossil fuel imports (2015–2021) of G7 countries by origin[1]



The G7 countries are major importers of fossil fuel products. Their fossil fuel imports as a share of GDP vary, with the USA (0.9% of GDP) importing relatively less than countries like Italy (2.9%), Japan (2.8%), and Germany (2.6%). Unlike the other G7 countries, Canada is a major net exporter of fossil fuels,[2] and the USA has moved towards becoming a net exporter

of oil and gas in recent years.[3, 4] Several countries import a large share of their fossil fuels from regimes that are perpetrating major ongoing conflicts. Italy (21.9% of all its fossil fuel imports), Germany (17.2%), and France (12.5%) rely more heavily on fossil fuel imports from Russia, whereas Japan sources a significant proportion of its fossil fuel imports from Saudi Arabia (15.5%) and the United Arab Emirates (15.7%). In this way, the continued reliance of G7 economies on fossil fuels has a direct implication for the funding of governments that have instigated wars in Ukraine and Yemen.[5]

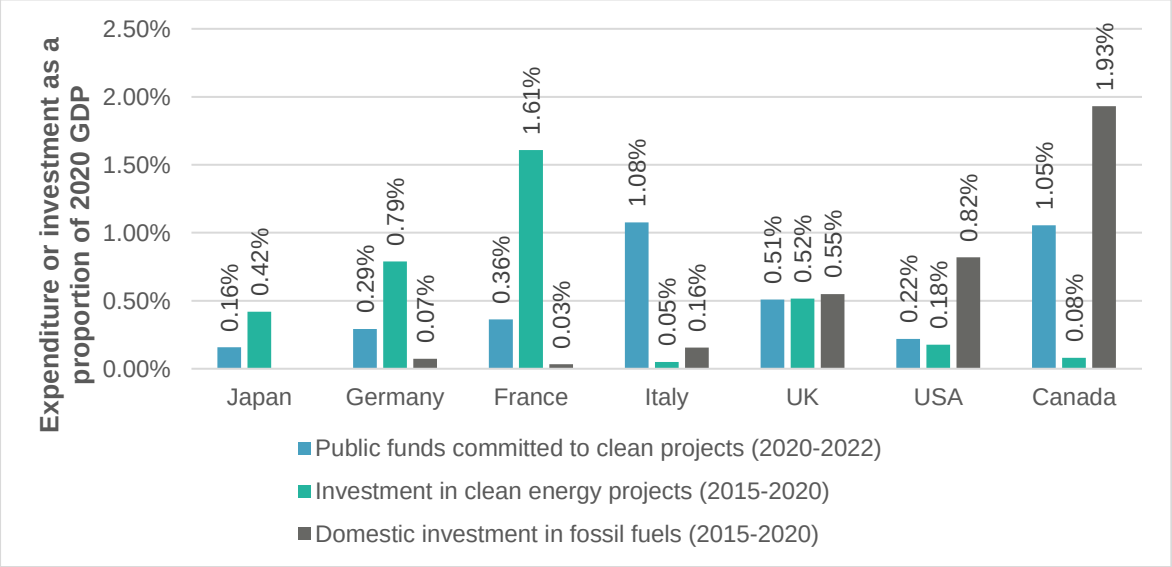
Figure 2: Average annual FDI stock of G7 countries in fossil fuel activities (2015–2020)[6]



The G7 economies also have a major stake in fossil fuel sectors via foreign direct investment (FDI), which occurs when private investors based in G7 countries own a stake in fossil fuel enterprises abroad.[7] Fossil fuels FDI from the UK, France, and Canada is significant in comparison with their GDP levels. The largest stocks of fossil fuel FDI among the G7 are those of the UK ($220.6bn), the USA ($162.3bn), France ($133.5bn), and Canada ($71.9bn), while the other three countries have far less FDI in fossil fuel sectors.

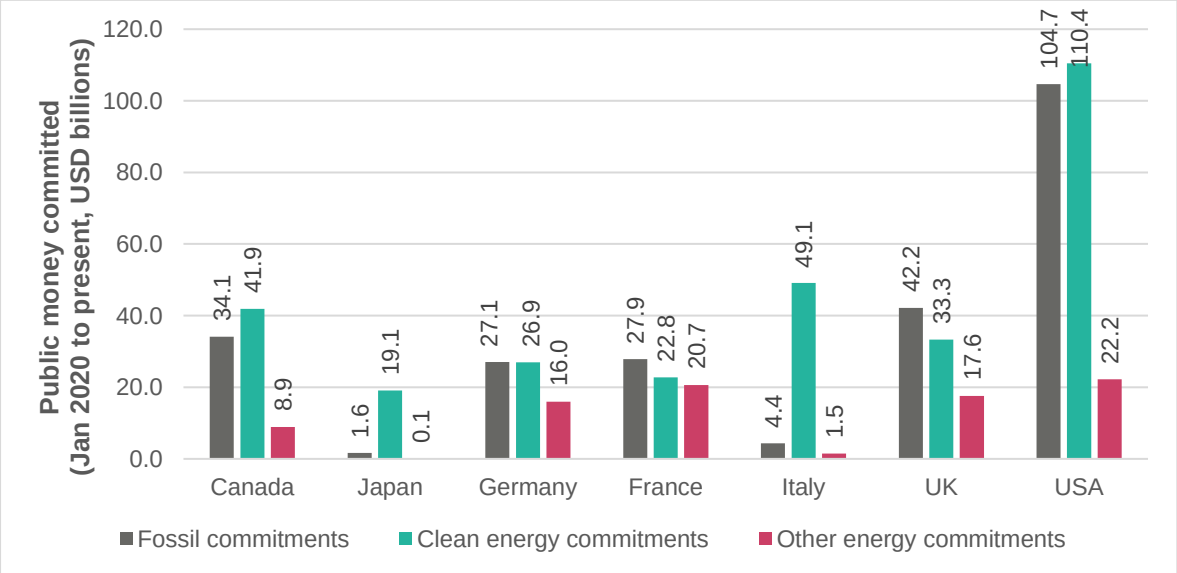
Domestically, the level of investment in fossil fuel sectors varies among the group (Figure 3). In recent years this investment has been higher in the UK (0.55% of GDP), the USA (0.82%), and especially Canada (1.93%), despite clear scientific advice that fossil fuel production needs to be reduced to contain global temperature rises to 1.5°C.[8] In the USA and Canada, domestic investment in fossil fuels has far outstripped overall investment in clean energy generation (private and public combined)[9] in recent years, while in the UK fossil fuel investments were also higher relative to GDP. On the other hand, in France and Germany, the investment in clean energy generation was higher than in other G7 economies during this period and investment in fossil fuels was relatively low.

Figure 3: Investment of G7 countries in fossil fuels,[10] investment in clean energy projects,[11] and public funds committed to clean projects[12] (all figures shown per annum and as a proportion of 2020 GDP)[13]



Since the beginning of 2020, the governments of the UK, France, and Germany have committed more public funds to fossil-intensive spending[14] than they have in support of clean energy.[15] On the other hand, Japan and Italy have committed very little in public funds to support fossil-intensive activities in the same period. Relative to their economic size, Italy and Canada have directed the most new public spending to clean energy interventions since January 2020 (Figure 3), with these funds exceeding 1% of GDP for both countries. Canada (2.1% of GDP), the UK (1.6%), and France (1.1%) have committed the most public funding to fossil fuel-based activities in the past two and a half years relative to their economic size.

Figure 4: Public funds committed to clean, fossil-intensive, and other energy projects since 2020 by G7 countries[16]



In light of this data on imports, investment, and public expenditure, it is clear that G7 countries continue to fund the fossil fuel sector despite its central role in exacerbating the climate crisis. There are some signs from clean energy investment of a shift in favour of

renewables occurring in France and Germany, though public funds are still being committed to fossil-intensive policies in these countries.

REQUIRED INVESTMENT FOR TRANSITION AND PLANNED INVESTMENT

It is vital for G7 countries to begin a rapid transition from fossil fuels to a fully renewable energy system and a decarbonised economy to limit global temperature rises to 1.5°C. This can be achieved through a rapid scaling up of investment across the economy; a growing evidence base has developed to indicate the scale of investment required. We have modelled the capital investment required to transition to a 100% renewable energy system[17] and to achieve net zero CO_2 emissions by 2050 at the latest in each G7 country, drawing on the best available evidence (Table 1). While absolute precision is impossible, the extensive research and modelling in the underlying sources give us a good idea of the scale of investment that will be required and a firm foundation on which to draw conclusions about the investment gap.

Table 1. Estimated investment required by G7 countries for net zero across the whole economy with a fully renewable energy system

Country	Investment required for transition (USD billions)	Sources
Germany	3,666.1	Sufficiency2035 scenario from Fraunhofer Institute for Solar Energy (2020): *Paths to a Climate-Neutral Energy System*[18] Achieves net zero by 2035
France	5,911.7	Main scenario from Institut Rousseau report (2022): *2% pour 2 degrés,*[19] adjusted using M0 100% renewables costing from RTE (2022)[20] Achieves net zero by 2050
Italy	4,366.6	Modelling based on cost estimates by *Economia e Sostenibilità* (2020)[21] and the cost of transition to 100% renewables by 2040 from the Institute for Sustainable Futures, University of Technology Sydney[22] Achieves net zero by 2050
United Kingdom	2,001.5	Capital expenditure in the Tailwinds scenario from the UK Climate Change Committee's Sixth Carbon Budget model,[23] modelled for 100% renewables using underlying data Achieves net zero by 2042
United States of America	39,510.0	E+ RE+ scenario from Princeton University (2021): *Net Zero America: Potential Pathways, Infrastructure, and Impacts,* [24] based on the present value of investment required Achieves net zero by 2050
Canada	1,108.6	Modelling of abatement costs of achieving net zero CO_2 emissions by 2050 relative to the government's 2021 reference case, drawing on the methodology used by Queen's University, Kingston, Ontario[25] Achieves net zero by 2050
Japan	10,022.0	Main scenario from McKinsey (2021): *How Japan could reach carbon neutrality by 2050,*[26] modelled for 100% renewable generation Achieves net zero by 2050

These capital investment estimates would be offset to some extent by the reduction in operational costs that would arise from the use of more efficient clean technology.[27] In the model scenario that we have adopted for the UK, for example, there is estimated to be a saving of $708.5bn in total on operational costs, yielding a net cost of $1,293.0bn to achieve net zero with fully renewable energy. Our research into the required total investment also revealed that there is a limited amount of evidence available in Canada at present[28] and a lack of modelling of scenarios that do not rely heavily on carbon capture and storage in the USA.

We have reviewed the planned investment of each G7 country based on government strategies and proposals (Table 2). There remains a large gap for each country between the level of investment in transition they are currently anticipating and the required amount to make a rapid transition.

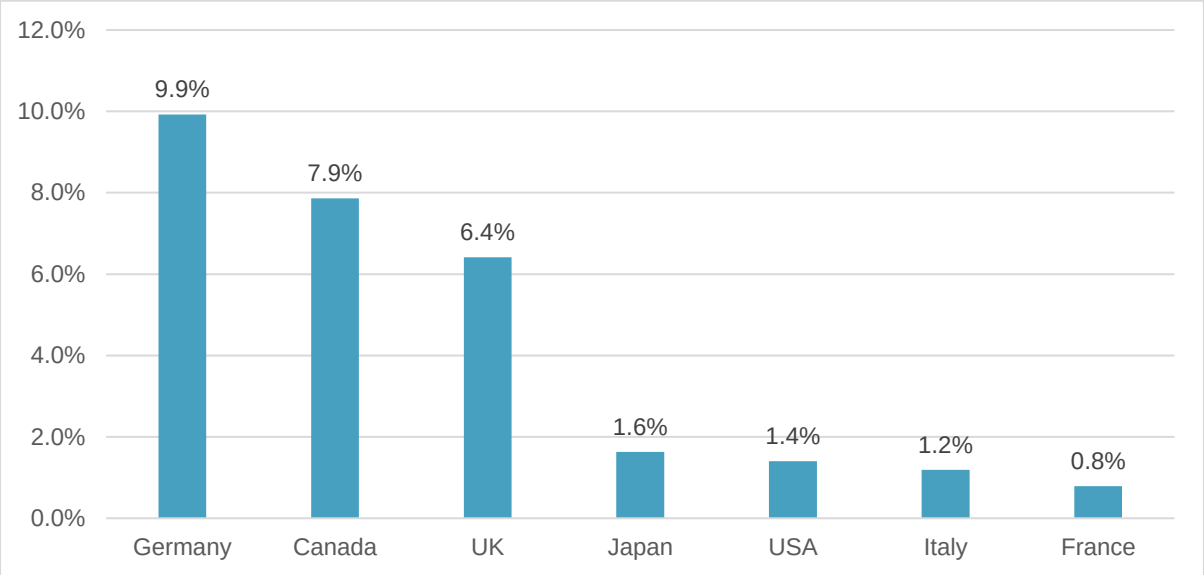
Table 2. Principal climate investments planned by the governments of G7 countries

Country	Planned climate investment (USD billions)	Sources
Germany	363.9	Planned investment includes the industrial transformation announced up to 2026, sustainable investments planned, and the green stimulus for transport.
France	46.5	Planned investment includes the France Relance recovery plan and green investment in the France 2030 Investment Plan.
Italy	52.1	We have included missions 2 and 3 from the National Recovery Plan, deducting money already spent.
United Kingdom	128.4	Planned investment includes the expected private investment and public investment from the Ten Point Plan.
United States of America	555.0	A provisional figure based on the total value of the climate investment proposed under the revised version of the Build Back Better Act, which has not yet passed into law
Canada	87.1	This includes the emissions reduction plan for 2030, the Zero Emission Transition Fund, the Net Zero Accelerator Fund, and new public transit investments.
Japan	163.5	The Ministry of Economy, Trade and Industry provides the data for the green growth strategy in Japan to reach net zero.

CONCLUSION AND INVESTMENT GAPS

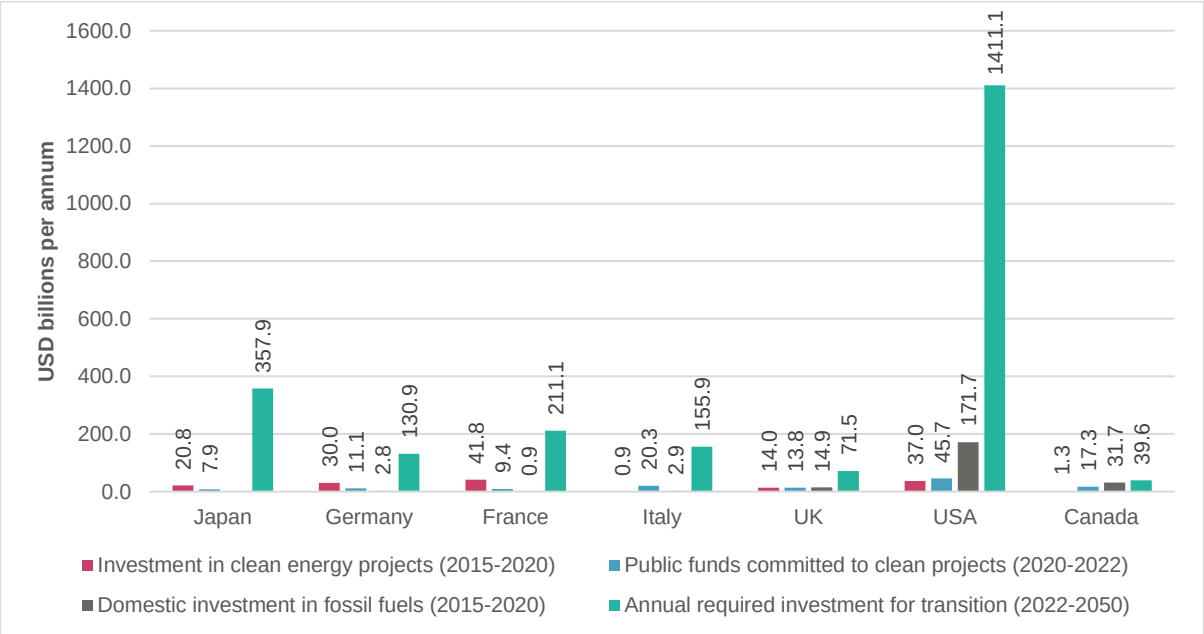
A comparison between the total amount of investment required for the transition between now and 2050, and the investment currently planned by the G7, illustrates a vast investment gap that will need to be closed without delay (Figure 5). While the scale of the investments mobilised by many G7 countries in recent years may be large relative to anything that came before, we find that none of the countries has yet planned investments that cover more than 10% of the required spending until 2050. The planned investments of Japan, the USA, Italy, and France are particularly small relative to the scale of the challenge faced by those countries.

Figure 5: Currently planned climate investments as a proportion of the total required investment (until 2050) for a just transition by country



Much more ambitious intervention will be needed to mobilise investment of a scale that is commensurate with the need to rapidly decarbonise the world's largest economies. A first step is to stop moving in the wrong direction by redirecting investable funds out of fossil fuel production and by not allocating public funds to support fossil-intensive activities wherever possible (while ensuring a just transition).

Figure 6: Recent investment into clean energy, public funds committed to clean energy projects, investment in fossil fuels, and required investment for a just transition to a fully renewable energy system (all figures expressed as averages per annum)[29]



This redirection of finances carries a triple benefit, helping to mitigate further environmental breakdown, building capacity for a more energy-efficient economy, and limiting the revenues of governments that are waging catastrophic wars. In particular, in G7 countries where fossil fuels account for a larger amount of annual investment (Figure 6), the potential improvement from redirecting funds is greater. The USA, omitted from Figure 6 for clarity, faces the largest

investment gap by far, with a need to invest over $1.4tn per annum in decarbonisation, in contrast with a planned (but unconfirmed) public investment package of $555bn and existing annual investment in clean energy of $222bn.

Focus on: Germany

Modelling by the Fraunhofer Institute for Solar Energy (2020)[30] found that the total investment required to reduce Germany's energy-related CO_2 emissions to zero by 2035 is $3.67 trillion (between 2020 and 2050).[31] We estimate that this is 10 times the investment currently planned ($363.9bn) under the industrial transformation announced up to 2026, sustainable investments, and the green stimulus for transport.

On an annual basis between 2022 and 2050, the required investment for transition in Germany works out at $130.9bn each year. The German government has committed $11.1bn per year in public funds to clean projects since January 2020,[32] while the average investment in clean energy generation (private and public) in Germany between 2015 and 2020 was $30.0bn per year.[33] These figures suggest that a significant investment gap remains that will need to be closed if Germany is to achieve a just transition compatible with global temperature increases being limited to 1.5°C. The required annual investment to reduce Germany's energy-related CO_2 emissions to zero is 11.7 times the amount of public funding committed to clean projects each year since 2020, or 4.4 times the total amount invested in clean energy generation in the German economy each year (2015-2020).

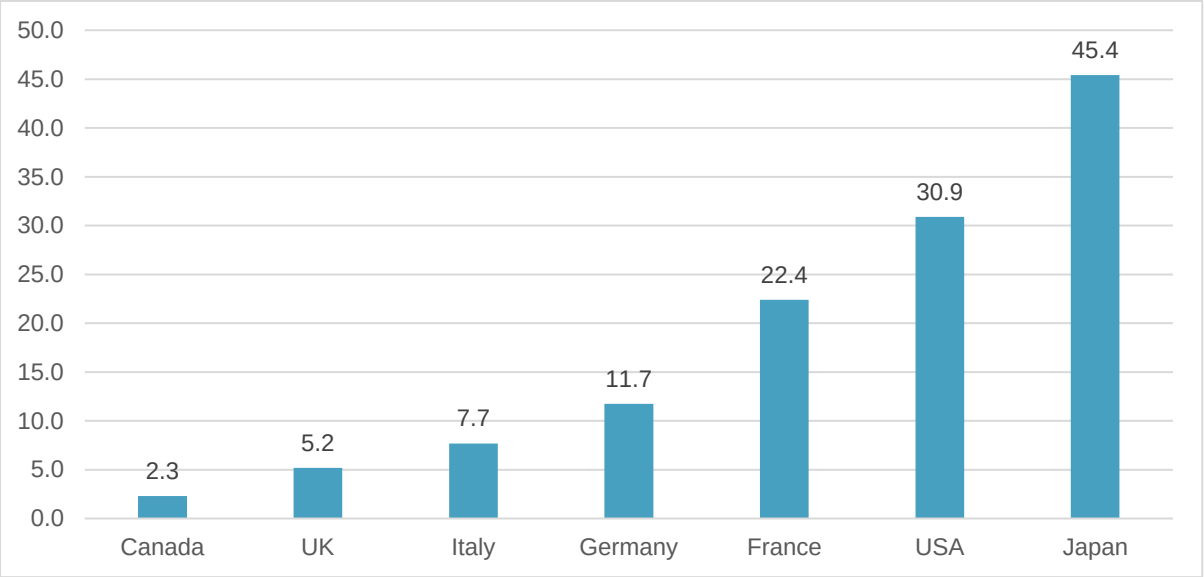
There is some scope for redirecting existing fossil fuel investments into the investment needed for emissions reduction. Private investment in fossil fuels in Germany averaged $2.8bn per annum between 2015 and 2021.[34] The German government has committed $27.1bn in public funds to support fossil-intensive activities since January 2020, including bailouts for airlines and support for the automotive industry and coal power generation, among other expenditures.[35] Using regulation and public spending to reduce these financial flows into fossil fuels would help to mitigate further environmental breakdown and speed the transition to a more energy-efficient economy.

Germany imported $100.2bn per year in fossil fuels between 2015 and 2021, with 17.2% of this total coming from Russia.[36] In this way, Germany's existing expenditure on fossil fuels may also be providing funding for the devastating ongoing war following the Russian invasion of Ukraine, adding further impetus to increase the pace of decarbonisation in the German economy.

A comparison of the estimated investment required for transition with the actual investment occurring in recent years in related sectors gives some illustration of the investment gap that remains. We estimate that for the G7 countries, the investment each year between now and 2050 is many times higher than the public funding committed to clean projects per year since 2020 (Figure 7). For the USA, the largest of the G7 economies, **the required investment each year until 2050 for transition is 31 times the amount of public funds committed**

between January 2020 and May 2022. The ratio of annual investment required for transition (2022-2050) to public funds committed per annum to clean projects (since 2020) is estimated at **45 times for Japan, 22 times for France, 12 times for Germany, 5 times for the UK and 2 times for Canada**.

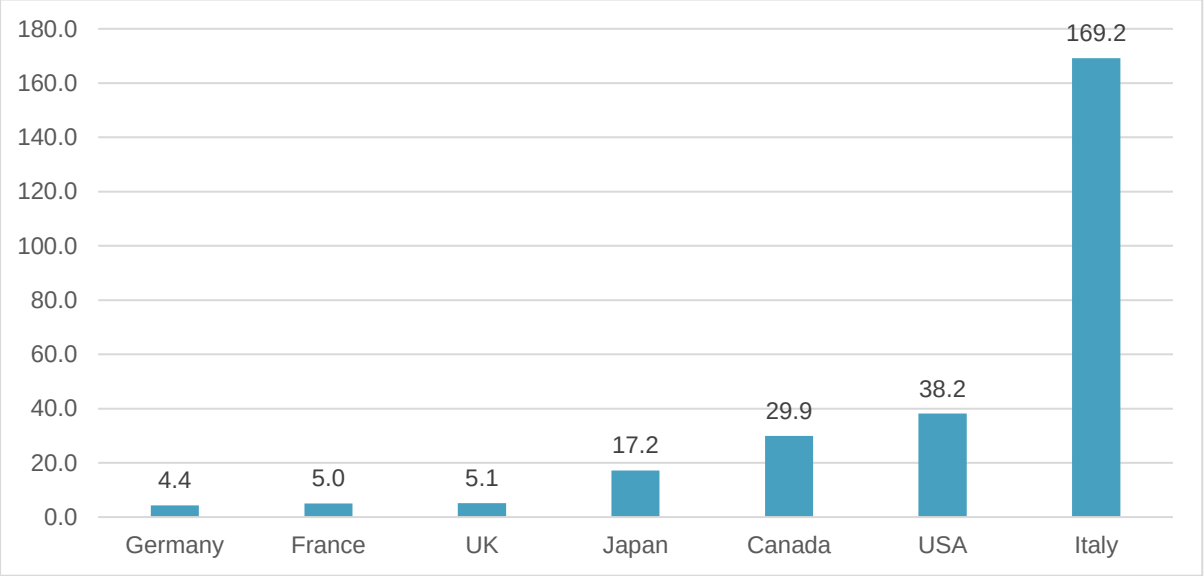
Figure 7: Ratio of required annual investment for transition (2022-2050) and annual public funds committed to clean projects (2020-2022) for the G7 countries[37]



Public funding is just one component of the total investment that will be needed for transition: private investment in transition will also need to increase. A comparison of the estimated annual investment required for transition across all economic sectors (2022-2050), with the actual annual investment that has occurred in clean energy generation in recent years (2015 to 2020) in the G7 countries, can give us some indication of the investment gap from a private sector perspective (Figure 8). It should be noted that private investment between now and 2050 will need to extend beyond just power generation to other sectors if a just transition is to be achieved, meaning that this comparison is just one illustration of the scale of the investment gap.

This gap is highest in Italy (required annual investment for transition is **169 times** the amount that was invested in clean energy generation between 2015 and 2020), primarily due to the relatively low amount of investment in clean energy generation occurring in recent years (Figure 6). The gap is relatively larger in the USA (where required investment is **38 times** what was recently invested in clean energy generation), Canada (**30 times**) and Japan (**17 times**). The gap in the UK (**5 times**), France (**5 times**) and Germany (**4 times**) is smaller than in other G7 countries but still significant.

Figure 8: Ratio of required annual investment for transition (2022-2050) and annual public and private investment in clean energy generation projects (2015-2020) for the G7 countries[38]



As the elected leaders of G7 countries convene during the upcoming 48th summit, they have the opportunity to play a crucial role in the global response to climate change. While the scale of the investment gap may appear daunting, the largest and most powerful countries have the financial means, the technology, and the historical obligation to scale up their ambitions and begin a meaningful transition to a more sustainable economic system.

ENDNOTES

[1] We have used Harmonized System commodity code 27 (fossil fuels) on the Comtrade database to retrieve data on imports. United Nations. (2022). *UN Comtrade Database.* Retrieved from https://comtrade.un.org/data/

[2] See p15, p29, and pp60-69 of International Energy Agency. (2021). *Key World Energy Statistics 2021.* Retrieved from https://iea.blob.core.windows.net/assets/52f66a88-0b63-4ad2-94a5-29d36e864b82/KeyWorldEnergyStatistics2021.pdf

[3] Energy Information Administration. (2022a). Oil and petroleum products explained: oil imports and exports. Retrieved from https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php

[4] Energy Information Administration. (2022b). Natural gas explained: natural gas imports and exports. Retrieved from https://www.eia.gov/energyexplained/natural-gas/imports-and-exports.php

[5] For evidence of the human rights violations linked to the Saudi Arabian and UAE-led coalition in Yemen from the UN Group of Eminent International and Regional Experts on Yemen, see pp 4–5, pp 7–8 and p 17 of Human Rights Council. (2019). *Situation of human rights in Yemen, including violations and abuses since September 2014*. Retrieved from https://www.ohchr.org/Documents/HRBodies/HRCouncil/GEE-Yemen/A-HRC-45-CRP.7-en.pdf

[6] France, Germany, Italy (averaged from 2015 to 2020) and the UK (averaged from 2015 to 2017 due to lack of more recent data) we used Eurostat data for net FDI (assets minus liabilities) stock in the following sectors: 1) extraction of crude petroleum and natural gas and mining support service activities; 2) manufacture of coke and refined petroleum products. For Canada, data is from Statistics Canada for the following sectors: 1) oil and gas extraction; 2) petroleum and coal products manufacturing and 3) support activities for mining, and oil and gas extraction, averaged between 2016 and 2021. For the USA, BEA data on FDI for petroleum activities and coal mining activities were used, averaged between 2014 and 2019. For Japan, we used OECD FDI data for 2015–2020.

[7] FDI reflects the lasting interest of an investor from one economy in a business in another economy. This interest formally exists when 10% or more of the voting power is owned by a direct investor in the board of directors. Eurostat. (2022). *Foreign Direct Investments.* Retrieved from https://ec.europa.eu/eurostat/web/economic-globalisation/globalisation-in-business-statistics/foreign-direct-investments

[8] IPCC. (2014). *Climate Change 2014: Synthesis Report.* Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri, and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

[9] Data on investment in clean energy projects comes from the BNEF database, reported via Climatescope. This covers private and public sectors (though is expected to be largely private) and includes the following assets solar, biomass, geothermal, wave, tidal, wind (>1 MW), hydropower (between 1MW and 50MW) and biofuel projects (>1 million litre capacity per year). Ajadi, T., Cuming, V., Boyle, R., Strahan, D., Kimmel, M., Logan, M., & McCrone, A. (2020). *Global trends in renewable energy investment 2020*. Retrieved from https://www.fs-unep-centre.org/wp-content/uploads/2020/06/GTR_2020.pdf

[10] Eurostat provides data for Italy, France, Germany and the UK from 2015 to 2020 in five activities: 1) mining of coal and lignite, 2) extraction of crude petroleum and natural gas, 3) support activities for petroleum and natural gas extraction, 4) manufacture of coke and refined petroleum products, and 5) manufacture of gas and distribution of gaseous fuels through mains. The data has some missing data points for specific years. For the USA, the BEA has data on total investment in private non-residential fixed assets, which includes investment in infrastructure, equipment, and intellectual property products. This report includes data from 2014 to 2019 in three activities: 1) oil and gas extraction, 2)

petroleum and coal products, and 3) pipeline transportation. For Canada, Statistics Canada provides data on the stock of fixed non-residential capital, which includes non-residential building, engineering construction, machinery and equipment cost, and intellectual property products. This report uses data from 2016 to 2020 in four activities: 1) conventional oil and gas extraction, 2) non-conventional oil extraction, 3) support activities for mining and oil and gas extraction, and 4) petroleum and coal products manufacturing. Note: Data for domestic fossil fuel investment in Japan was not available.

[11] Data on investment in clean energy (averaged between 2015 and 2020). Climatescope, (2022). *Climatescope 2021 | Geography comparison.* Retrieved from https://global-climatescope.org/tools/geography-comparison/

[12] Data for public funds committed to clean energy includes energy efficiency improvements, such as retrofit, smart grid technology, investment in active transport, public transport and electric vehicles, renewable energy generation from solar, wind, hydropower, rain, tides, geothermal, green hydrogen (and hydrogen from mixed but predominantly clean sources) and biofuels, biomass and biogas with a proven minimum negative impact on the environment (sometimes referred to as “advanced” or “second” or “third-generation”). International Institute for Sustainable Development. (2022). *Energy Policy Tracker*. Retrieved from https://www.energypolicytracker.org/

[13] These different metrics have been kept separate as there is potential for limited overlap between sources, for example, some public investments in renewables generation may be covered by both the Energy Policy Tracker and Climatescope in 2020 or 2021.

[14] This covers projects supporting fossil fuel production or consumption (eg fossil fuel power generation, bailouts of airlines and car companies, or construction of highways) as determined by the IISD Energy Policy Tracker.

[15] This covers projects supporting clean energy (eg renewable power generation) and low-carbon activities (eg active travel and public transport, retrofit) as determined by the IISD Energy Policy Tracker.

[16] International Institute for Sustainable Development. (2022). *Energy Policy Tracker*. Retrieved from https://www.energypolicytracker.org/. ‘Other energy commitments’ in the IISD Energy Policy Tracker refers to energy generation from sources that are neither clean nor fossil fuels (eg nuclear, incineration, certain forms of biomass and hydrogen) or policies that support both fossil fuels and clean energy simultaneously.

[17] The cost estimates were adjusted wherever the data allowed the removal of power generation from nuclear sources, biomass other than residual supplies, and gas with carbon capture and storage.

[18] Sterchele, P., Brandes, J., Heilig, J., Wrede, D., Kost, C.,... & Henning, H. M. (2020). *Paths to a Climate-neutral Energy System*. Tech. rep. Freiburg, Germany: Fraunhofer Institute for Solar Energy Systems ISE. Retrieved from https://www.ise.fraunhofer.de/en/publications/studies/paths-to-a-climate-neutral-energy-system.html

[19] Dufrêne, N., Kerlero de Rosbo, G., & Nicol, C. (2022). *2% pour 2 degrés: Les investissements publics et privés nécessaires pour atteindre la neutralité carbone de la France en 2050.* [2% for 2 degrees: The public and private investment necessary to achieve carbon neutrality in France by 2050]. Retrieved from https://institut-rousseau.fr/wp-content/uploads/2022/03/rapport-neutralite-carbone-institut-rousseau.pdf

[20] RTE. (2022). *Futurs Énergétiques 2050.* [Energy futures 2050]. Figure 11.37. Retrieved from https://assets.rte-france.com/prod/public/2022-02/BP50_Principaux%20re%CC%81sultats_fev2022_Chap11_analyse%20economique.pdf

[21] Noera, M., Grazia Variato, A. M., Agnelli, G., Camisana, E., Di Stefano, A., … & Vite, C. (2020). *Il Green Deal conviene. Benefici per economia e lavoro in Italia al 2030.* Retrieved from https://www.italiaclima.org/wp-content/uploads/2020/10/Il-Green-Deal-conviene-Italian-Climate-Network.pdf; English translation: https://assesta.it/new-site/wp-content/uploads/2021/04/The-Green-Deal-is-Advantageous-ICN-ESta-2021-1.pdf

[22] Teske, S., Morris, T., & Nagrath, K. (2020). *100% renewable energy: An Energy [R]evolution for ITALY.* Report prepared by ISF for Greenpeace Italy, June 2020. Retrieved from https://www.uts.edu.au/sites/default/files/article/downloads/100-Percent-Renewable-Energy-Italy-report.pdf

[23] Climate Change Committee. (2021). *The 6th Carbon Budget Dataset.* Retrieved from https://www.theccc.org.uk/publication/sixth-carbon-budget/#supporting-information-charts-and-data

[24] Larson, E., Greig, C., Jenkins, J., Mayfield, E., Pascale, A., … & Swan, A. (2021). *Net-Zero America: Potential pathways, infrastructure, and impacts, Final report*. Princeton, NJ: Princeton University. Retrieved from https://netzeroamerica.princeton.edu/

[25] Martin, S. & Riordan, R. (2020). *Capital mobilization plan for a Canadian low-carbon economy.* Retrieved from https://smith.queensu.ca/centres/isf/pdfs/ISF-CapitalMobilizationPlan.pdf

[26] Kuwabara, T., Mohr, D., Sauer, B., & Yamada, Y. (2021). *How Japan could reach carbon neutrality by 2050 and why it must start now.* Retrieved from https://www.mckinsey.com/business-functions/sustainability/our-insights/how-japan-could-reach-carbon-neutrality-by-2050

[27] Examples of this reduction in operating costs include the lower maintenance costs of electrified transport relative to combustion engines and the reduced heating costs of buildings that are better insulated.

[28] For this reason, the estimates of total required investment for transition in Canada are necessarily less precise than for the other G7 countries and should be interpreted with caution.

[29] For sources for this chart see endnotes 10, 11, and 12, and Table 1.

[30] Sterchele, P., Brandes, J., Heilig, J., Wrede, D., Kost, C.,... & Henning, H. M. (2020). *Paths to a Climate-neutral Energy System*. Tech. rep. Freiburg, Germany: Fraunhofer Institute for Solar Energy Systems ISE. Retrieved from https://www.ise.fraunhofer.de/en/publications/studies/paths-to-a-climate-neutral-energy-system.html

[31] Applying the average exchange rate for 2020 calendar year to the original cost estimate of €3,330bn.

[32] International Institute for Sustainable Development. (2022). *Energy Policy Tracker*. Retrieved from https://www.energypolicytracker.org/

[33] Data on investment in clean energy (averaged between 2015 and 2020). Climatescope, (2022). *Climatescope 2021 | Geography comparison.* Retrieved from https://global-climatescope.org/tools/geography-comparison/

[34] Eurostat provides data for investment from 2015 to 2020 in five activities: 1) mining of coal and lignite, 2) extraction of crude petroleum and natural gas, 3) support activities for petroleum and natural gas extraction, 4) manufacture of coke and refined petroleum products, and 5) manufacture of gas and distribution of gaseous fuels through mains. The data has some missing data points for specific years.

[35] International Institute for Sustainable Development. (2022). *Energy Policy Tracker*. Retrieved from https://www.energypolicytracker.org/

[36] We have used Harmonized System commodity code 27 (fossil fuels) on the Comtrade database to retrieve data on imports. United Nations. (2022). *UN Comtrade Database.* Retrieved from https://comtrade.un.org/data/

[37] For sources for this chart see endnote 12 and Table 1.

[38] For sources for this chart see endnotes 11 and Table 1.