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# Trends, investor types and drivers of renewable energy FDI

By

Polina Knutsson and Perla Ibarlucea Flores*

As foreign direct investment (FDI) can help mitigate the repercussions of climate change, understanding what factors attract energy FDI is important. A large share of energy FDI originated from outside the energy sector, and given that renewable power FDI also comes from outside the energy sector, it is worthwhile to examine if drivers behind this type of FDI differ from what encourages investment by firms operating within the energy sector. This paper demonstrates that renewable energy FDI has been increasing, while FDI in fossil fuels is potentially slowing down. Results of the empirical analysis show that both the broader investment conditions and the strength of climate policies are vital for ensuring the favourable environment for renewable energy FDI, but the extent to which these factors impact investment decisions varies depending on where the investors come from: greenfield investors from outside the energy sector seem less responsive to the climate mitigation policies of host countries, whereas their location choices are tightly linked to the broader investment conditions in the destination economies.

Authorised for release by Carmine Di Noia, Director, OECD Directorate for Financial and Enterprise Affairs.

*Keywords*: foreign direct investment, renewable energy, M&A, greenfield investment.

*JEL codes*: F21, F23, Q42.

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## Key findings

- Greenfield activity in renewable energy has been increasing since 2012. Among OECD countries, announced brand-new investment in renewable energy reached USD 82 billion in 2020, 21% of all greenfield projects announced in OECD countries. In 2021, total announced capital expenditure on renewable energy remained large, at USD 49 billion. Greenfield activity in fossil fuels has started showing some signs of a possible slowdown, although the mounting pressures on the supply of energy prompted by the Russia's war against Ukraine might reverse this trend.
- Cross-border M&A activity in renewable energy is outpaced by that of the fossil fuel sector. In 2021, renewables represented less than 1% of total cross-border M&A values, whereas fossil fuels stood at 3%. Yet, the number of deals in fossil fuels has been declining as well as total deal values, while deal making in renewables has remained relatively stable over time.
- Wind power is among the most popular sources of renewable energy FDI, accounting for more than half of total cross-border M&A deal values and around 40% of announced greenfield investment in the clean energy sector. Solar energy attracts close to 40% of greenfield investment value.
- FDI into renewable energy comes also from outside the energy sector. From 2012 to 2021, companies whose main activity lay outside energy production were responsible for about 70% of cross-border M&A deal values and 11% of announced greenfield investment in renewables.
- Both the strength of climate policies and the broader drivers of investment are essential to ensure a favourable environment for renewable energy FDI. However, firms from outside the energy sector seem to put less weight on the strength of energy policies when undertaking greenfield projects in renewable power but other factors appear to strongly influence their location choices.

Investment in renewable energy is critically important in addressing the risks of climate change. Foreign direct investment (FDI) can help accelerate the transition to a carbon-neutral economy by providing financial and technological resources needed to support green growth. As many countries are stepping up efforts to diversify their energy supply and strengthen energy independence in response to the mounting geopolitical tensions, mobilising foreign investment to achieve environmental policy goals might become especially challenging and, hence, understanding what factors encourage renewable energy FDI is particularly important.[1] Given that FDI into renewable power comes also from outside the energy sector, for instance, as investment by firms that decide to power their existing operations abroad with renewable energy, it is worthwhile to examine if drivers behind this type of FDI are different from the factors that instead attract firms born in the energy sector.[2]

[1] In this working paper, renewable energy is defined as the production of energy from naturally replenishing sources, i.e. solar, wind, geothermal, marine, biomass and hydroelectric energy. Fossil energy includes the generation of fuels, such as coal, oil and natural gas, and related extraction activities. Nuclear energy is not considered. To identify FDI into renewable and fossil energy, this paper uses sectoral classification available in the source data. Terms 'green', 'clean' and 'renewable' are used interchangeably in this paper.

[2] An acquiring company is considered as active in the energy sector if the sector of its ultimate parent is Energy and Power as defined by Refinitiv; otherwise, it is considered as operating outside the energy sector. Acquisitions of gasoline stations were excluded from the definition of the energy sector. In the fDi Markets database, company description was used to distinguish energy firms. Investors were considered as operating in energy production if the company descriptions contained energy-related key words or their derivatives (e.g. energy, petroleum, oil, renewable,

This working paper reviews recent FDI trends in renewable and fossil-fuel energy and then highlights the noteworthy contribution of companies from outside the energy sector to green FDI, trying to shed light on the possible drivers behind FDI in renewables, based on the sector of origin of foreign investors.

## FDI in renewable energy is gaining momentum

### *Brand new investment into renewable energy is booming*

Greenfield activity in renewable energy has been on the rise: announced capital investment and the number of greenfield projects in renewables have been on a steady increasing trend since 2012, exceeding greenfield activity in fossil fuels in most years (Figure 1). The growth in values was particularly pronounced in the past five years among OECD countries, with greenfield investment projects in renewable energy peaking at USD 82 billion in 2020; this amounted to 21% of all greenfield investment projects announced in OECD countries. Although the uncertainty surrounding the pandemic weighed on investors' sentiment, in 2021, total announced capital expenditure in renewable energy remained substantial, at USD 49 billion, while the number of projects nearly doubled compared to 2017 (from 154 to 313). Although the growth in renewable greenfield activity was less remarkable among selected non-OECD economies,[3] the overall trend was also positive. In 2021, projects in renewable energy targeting non-OECD economies accounted for as much as 27% of total announced greenfield investment into these countries – a noteworthy increase from the average of 5% observed between 2012 and 2020.[4]

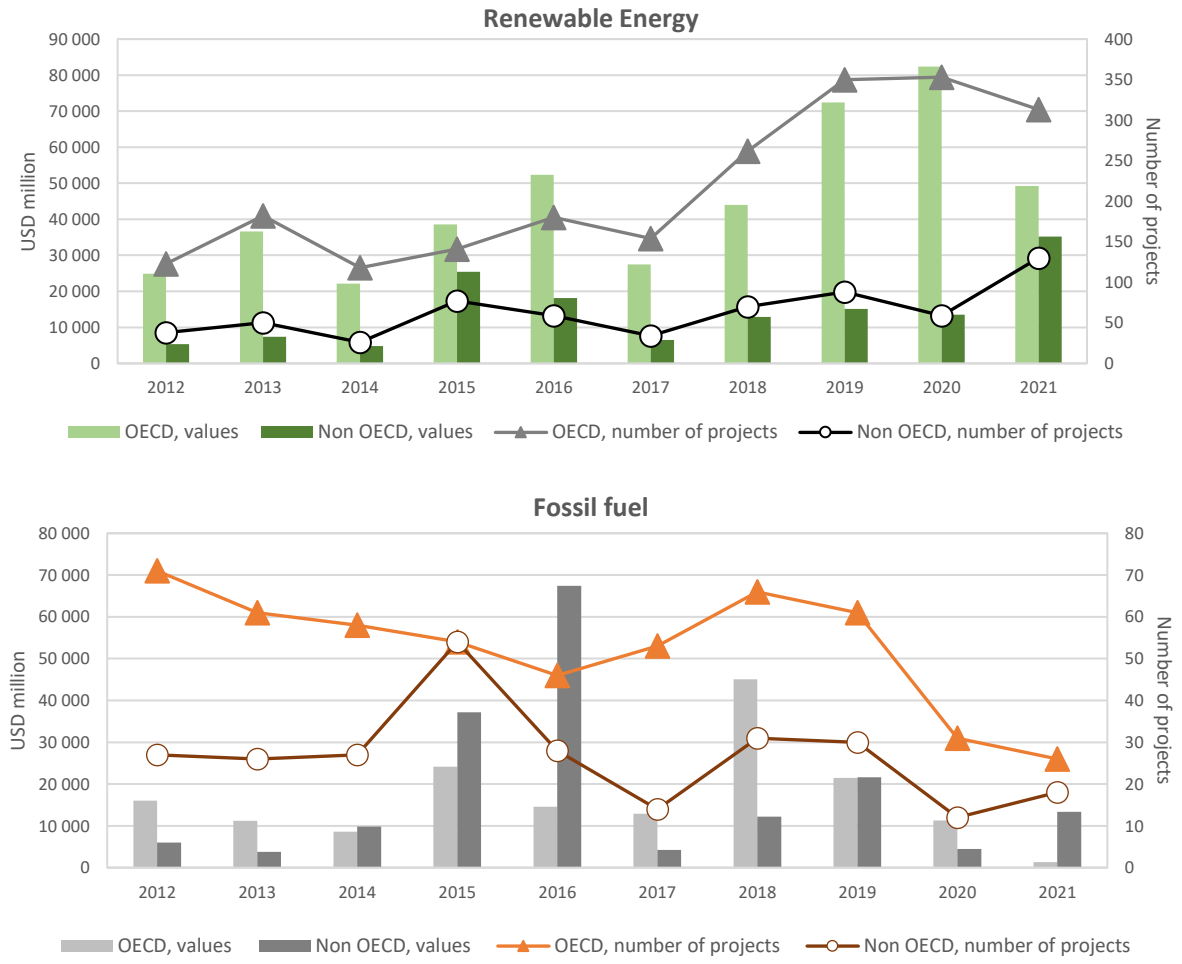
Greenfield activity in fossil fuels has started to decline in the recent years, although the mounting pressures on the supply of energy associated with the consequences of the Russia's war against Ukraine might reverse this trend (see Box 1). While the number of projects remained relatively low and varied little between 2012 and 2021, announced capital expenditure was on a declining trend in recent years – from 2018 in OECD economies and from 2016 in selected non-OECD countries. In 2021, the share of fossil fuel projects in total announced greenfield expenditure, i.e. including announced projects in all other sectors, was less than 1% in OECD countries and 10% in selected non-OECD economies.

solar, wind, geothermal, hydro, etc.). Extensive manual checks were performed to minimise the risk of inaccurate classification.

[3] These countries are Brazil, China, India, Indonesia, Kazakhstan, Malaysia, Peru, the Russian Federation, South Africa and Thailand.

[4] However, the large values observed in 2021 were mainly driven by a few sizable investment projects. For example, Enegix Energy, an Australian developer of renewable energy projects specialised in the construction and management of green hydrogen production facilities, announced its plan to open a large hydrogen production facility in Brazil worth USD 5.4 billion. Two Singaporean solar energy companies – Sunseap and Sun Cable – announced projects in Indonesia for a total capital investment of USD 4.5 billion.

## Figure 1. Trends in greenfield investment

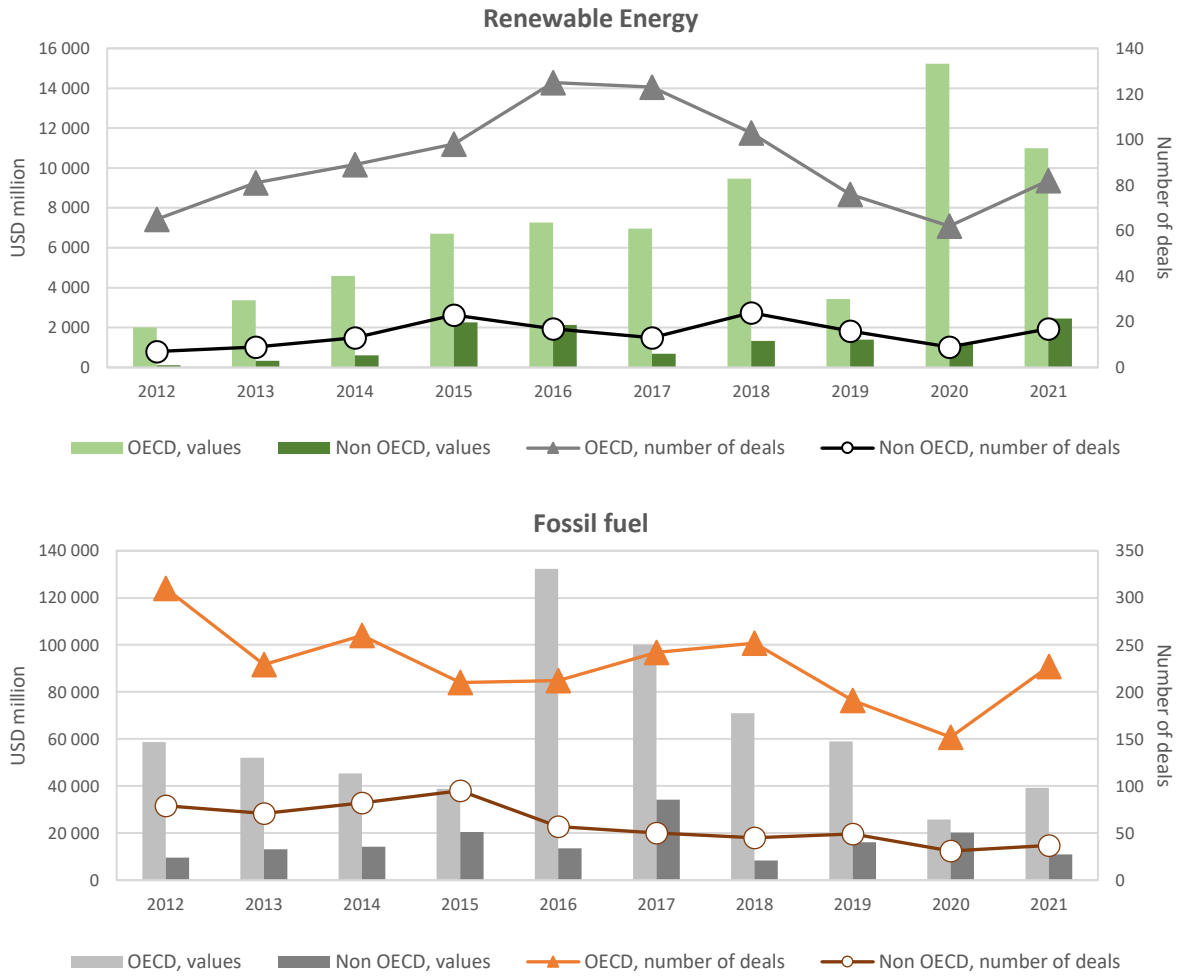



Source: Financial Times fDi Markets database, OECD calculations. Monetary values are in constant prices, deflated using the U.S. Producer Price Index for Energy.

In the period 2012-21, the top investors of greenfield investment into renewable power came from France, Germany, Italy and Spain (41% of total greenfield investment in renewables).[5] The top recipients of renewable energy FDI were Australia, Chile, the United States and the United Kingdom (accounting for 46% of all announced greenfield investment projects in renewable energies in 2012-21). For fossil fuels, in the same period, over half (53%) of announced capital expenditure originated in China, Japan, the Netherlands and the United States, whereas most new FDI in fossil fuels went to Canada, Kazakhstan, the United Kingdom and the United States (42%), possibly reflecting the availability of natural resources in these countries.

[5] These are the countries where the parent companies were located. The fDi Markets database reports only the immediate investor country per greenfield project (i.e. it is not possible to know who owns the immediate parent, and hence, the ultimate investing economy).

## Figure 2. Trends in cross-border M&A




Note: Total value of cross-border M&A deals is based on the deals with disclosed deal values.
Source: Refinitiv M&A Deal Analytics database, OECD calculations. Monetary values are in constant prices, deflated using the US Producer Price Index for Energy.

Cross-border M&A activity in the renewable power sector is substantially more contained than in fossil fuels (Figure 2). In 2021, fossil energy accounted for 3% of total cross-border completed M&A deal values, whereas clean energy represented less than 1%. However, the number of deals in fossil fuels has been falling and total deal values have been shrinking since 2016, at least in OECD economies, where the total value of foreign M&A in fossil fuels peaked at USD 132 billion.[6,7] In contrast, deal making in renewables remained quite stable over time, both in terms of values and the number of transactions. As with greenfield

[6] The large values observed in fossil fuel energy in 2016, for OECD countries, comes mainly from two large-sized deals: the merger between Columbia Pipeline Group Inc. (United States) and TransCanada Corp. (Canada) in natural gas transmission (USD 13 billion), and the acquisition of BG Group PLC, a British multinational oil and gas company, by Royal Dutch Shell PLC (Netherlands), a record deal since 2012 (USD 54 billion).

[7] It is also worth noting that many fossil-fuel M&As are undertaken by private firms and, hence, the deal values might be undisclosed (The Economist, accessed on 24 May 2022); this might underestimate the total deal value of M&A in fossil fuels.

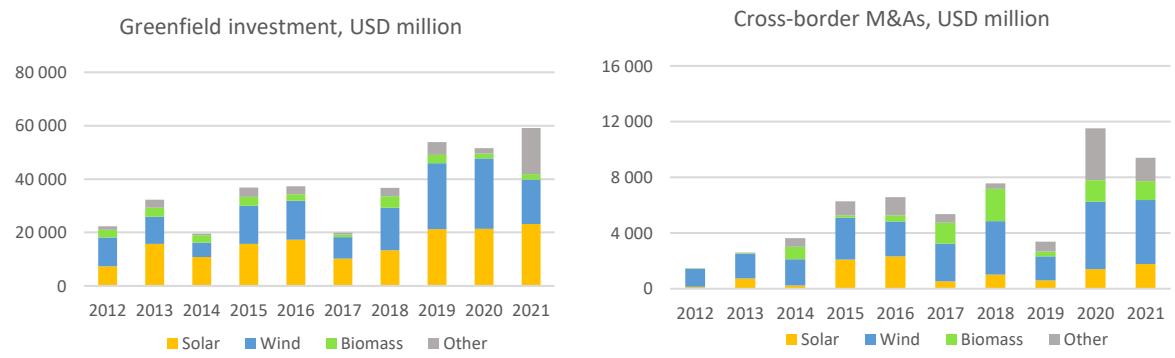
investment, 2020 was the record year for cross-border M&A in renewables for a total deal value of USD 16 billion between OECD and non-OECD economies.[8]

Nearly half of the total cross-border M&A activity into renewable energy came from investors located in Canada, Japan, France and the United States.[9] Canada and the United States were also among the top ultimate acquirers in the fossil fuel sector, along with the other important investors, such as the Netherlands and China, all of which represented close to 40% of total cross-border M&A value in fossil power. The top destinations targeted by foreign investors in clean energy were Portugal, Spain, the United Kingdom and the United States, accounting for half of total deal values. In contrast, Canada, the Russian Federation, the United Kingdom and the United States were among the top destinations for cross-border M&As in fossil fuels (59% of total value in fossil fuel M&A).

### *Wind and solar are the most popular sources of clean energy*

In terms of sources of renewable energy, wind and solar power were driving the trend into renewable greenfield investment (Figure 3). The share of both sources of clean energy varied around 40% of announced greenfield investment in renewable energy. Wind energy dominated in the renewable M&A activity, on average representing more than a half of total deal values in the clean energy sector. A large portion of deals was undertaken in solar and biomass energy (on average, 19% and 13%, respectively).

**Figure 3. FDI in renewables by energy source**




Note: The figures include both OECD and selected non-OECD countries. Other sectors include geothermal, hydroelectric and marine power. The investment projects that did not specify the source of renewable energy are excluded. Value of cross-border M&A deals is based on the deals with disclosed values. Monetary values are in constant prices, deflated using the US Producer Price Index for Energy.
Source: FT fDi Markets database and Refinitiv M&A Deal Analytics database, OECD calculations.

[8] The three largest deals explaining part of the hike in 2020 values included: the merger between Eneco (Netherlands) and Mitsubishi Corp (Japan) with a reported deal value of USD 4.4 billion; the acquisition of EDP Energias de Portugal SA (Portugal) by a French Financial Investor Group with a reported deal value of USD 2.4 billion; and, the acquisition of ACS-Solar Photovoltaic Assets (Spain) by Galp Energia SGPS SA (Portugal) with a reported deal value of USD 2.4 billion.

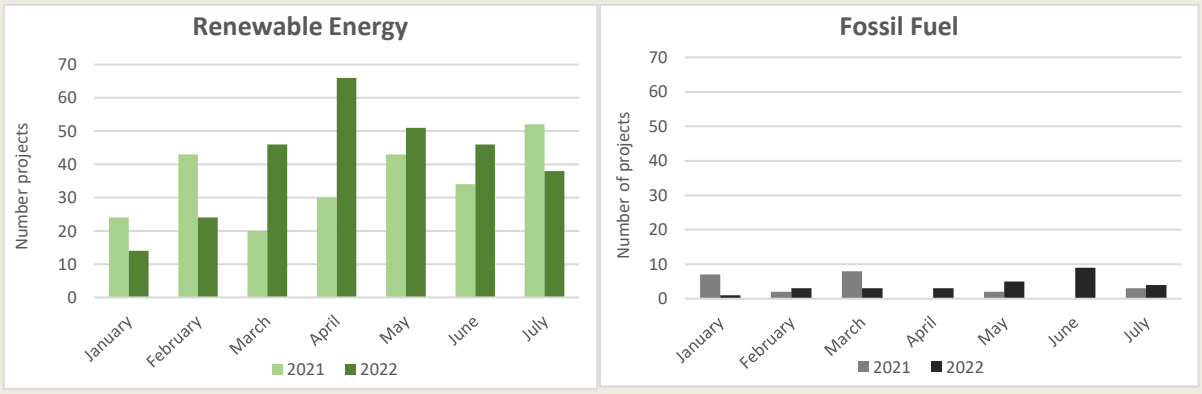
[9] These were the countries where the ultimate investors resided. Refinitiv M&A Deal Analytics database reports cross-border deals investor's origin based on the ultimate investor.

## Box 1. A glimpse at FDI trends in 2022

The Russia's war against Ukraine has brought deep uncertainties around energy supply and the role of fossil fuel in addressing the energy crisis. Although the turmoil on the energy markets will continue affecting FDI activity to the end of the year and beyond, available monthly data for 2022 show developments similar to the decade-long trends.

From January to July 2022, greenfield activity in renewable energy continued to grow, with more investment projects announced than in the same period in 2021 (285 compared to 246, Figure 4). In contrast, the number of projects in fossil fuels remained relatively low.

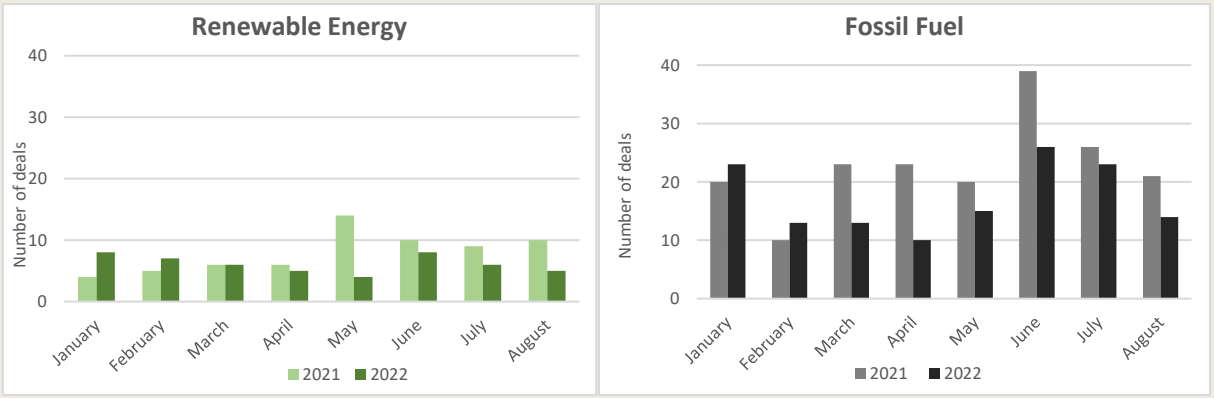
### Figure 4. Number of greenfield projects




Note: aggregated trends for OECD and selected non-OECD countries.
Source: FT fDi Markets database and Refinitiv M&A Deal Analytics database, OECD calculations.

Cross-border M&A activity in renewable power was rather stable, albeit low, from January to August of 2022 (Figure 5). The number of deals in fossil fuel continued to decline with 137 deals completed between January and August of 2022 compared to 182 in the same period of 2021.

### Figure 5. Number of cross-border M&A



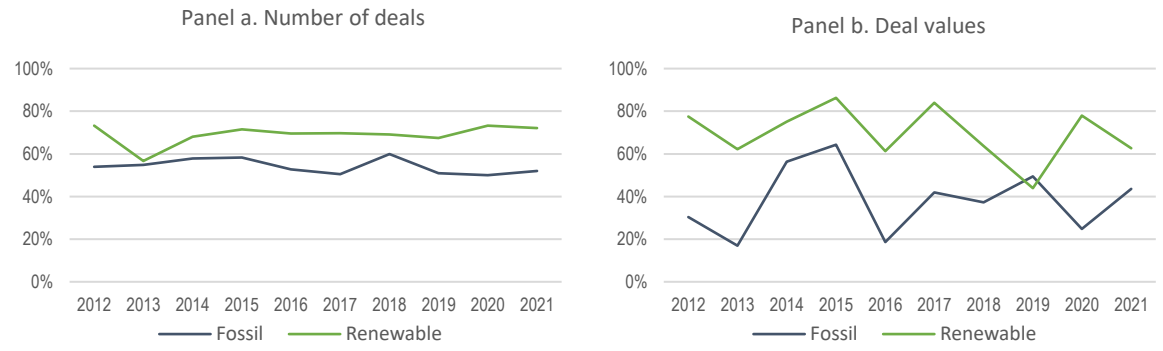

Note: aggregated trends for OECD and selected non-OECD countries.
Source: Refinitiv M&A Deal Analytics database, OECD calculations.

## Renewable energy FDI comes also from outside the energy sector

A large share of energy FDI originates from outside the energy sector. Over the last decade, companies whose main activity lay outside energy production were responsible for about 70% of the number of cross-border M&A in renewables (Figure 6, panel a). In value terms, their contribution to cross-border M&A activity in renewable energy was also remarkable (Figure 6, panel b).

Transactions targeting energy companies come from companies in the financial sector, most likely holdings, but businesses from other sectors are also active in energy M&A. For instance, in 2018, gold mining company Kinross Gold Corporation from Canada acquired two hydropower plants in Brazil to secure long-term power for its mines.[10] Also in 2018, furniture retailer IKEA Portugal, a unit of a Dutch-registered group Ingka Holding, expanded the group's portfolio of renewables by purchasing a wind farm in Portugal with a capacity to power 30 IKEA stores, to reduce the group's carbon footprint.[11]

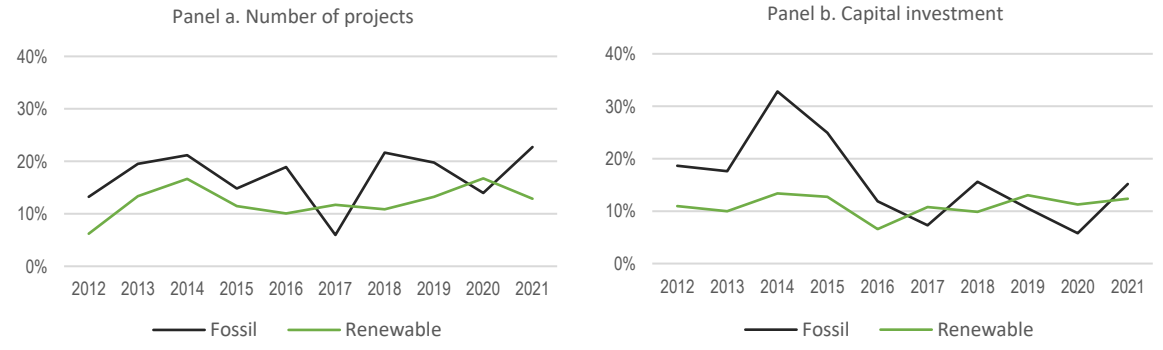
### Figure 6. Share of non-energy investors undertaking cross-border M&A in the energy sector




Source: Refinitiv M&A Deal Analytics database.

The story is slightly different for greenfield investment into energy, which comes mainly from the energy sector, presumably because setting up a new energy facility from scratch might be very costly for non-energy companies as compared to purchasing access to power supply or acquiring an established facility.

### Figure 7. Share of non-energy firms undertaking greenfield investment in the energy sector




[10] Kinross acquires power plants in Brazil (accessed on 31.05.2022).

[11] IKEA Portugal acquires Pisco Wind Farm (accessed on 31.05.2022).

Source: fDi Markets database.

Yet, the contribution of other sectors to greenfield activity in renewables is also noteworthy (Figure 7). Non-energy companies account for around 11% of the overall announced capital expenditure in renewables (which includes also projects from companies in the energy sector). The share of projects has been climbing up from 6% in 2012 reaching 17% in 2020 and 13% in 2021, as businesses are increasingly embracing green goals and demanding increased renewable energy capacity.

For instance, in April 2021, Amazon, a US-based technology company, announced its intent to launch nine projects in wind and solar energy to power its operations in North America and Europe.[12] In October 2021, German logistics company DHL revealed its plan to develop a solar energy project to support its operations in Dubai.[13] Investment into fossil-fuel assets by companies outside the energy sector seems to be dwindling, at least in terms of capital expenditure.

## The drivers of FDI vary across investors

What factors can boost foreign investment in green growth? Previous research has shown that beyond the general determinants of FDI (such as market size, growth potential, regulatory restrictions to market access), climate policies can play a critical role in the attraction of green investment (Ang, Röttgers and Burli, 2017[1]; Criscuolo et al., 2014[2]; Röttgers and Anderson, 2018[3]). But is the strength of climate policies important for all foreign investors, irrespective of their sector of origin? In what follows, this working paper investigates how the number of FDI projects in renewable energy is linked to a subset of climate mitigation policies and the broader investment drivers in host economies and how the importance of these factors differs across various types of investors.[14] See Box 2 for a broader discussion on the interplay between FDI, decarbonisation and policy.

### Box 2. FDI and climate change mitigation

FDI can help address the risks of climate change by directly financing low carbon energy infrastructure, which is the focus of this working paper, but there are other mechanisms through which foreign investment can influence the green transition. For instance, foreign investors can have an impact on decarbonisation through the energy- and emission-intensity of their operations as well as through their contribution to the development of low-carbon technologies.

Ensuring that foreign investment has a positive impact on countries' carbon footprint and sustainable development in general is important and may require policy interventions. The FDI Qualities Policy Toolkit (OECD, 2022[4]) discusses the design of policies to help countries maximise the potential benefits from FDI and minimise possible negative effects. The Policy Toolkit complements the OECD Policy Framework for Investment (PFI) (OECD, 2015[5]) by focusing on international investment and providing governments with detailed guidance on how to enhance its impact. In its cluster on

[12] Amazon invests in nine new renewable enrgy projects (accessed on 31.05.2022).

[13] DHL to develop a solar project (accessed on 31.05.2022).

[14] This working paper focuses on a subset of climate mitigation policies that could be meaningfully quantified for an empirical analysis and that have been found to drive investment into clean energy, availability of timely data also guided the choice of variables. The study by Ang, Röttgers and Burli (2017[1]) analyses the relevance of a broader set of policy variables to investment in renewable energy. The FDI Qualities Policy Toolkit gives an extensive overview of various other policies that can contribute to decarbonisation (OECD, 2022[4]).

decarbonisation, the Policy Toolkit provides an overview of the policy choices that can enhance the impacts of FDI on decarbonisation by reducing the emissions associated with foreign investment and enhancing the potential of FDI spillovers that advance decarbonisation of domestic businesses. By providing broad policy directions for strengthening the positive effects of FDI, the Policy Toolkit offers a flexible approach that can be tailored to a country's economic context and policy priorities.

### *The importance of climate policies*

The empirical approach uses data on cross-border M&A and greenfield investment into 48 countries between 2012 and 2019.[15] The estimation is performed separately for energy and non-energy investors to compare how they respond to the various determinants of FDI. To investigate the impact of climate mitigation policies on FDI into renewables, the analysis takes into account several factors that have been found to drive investment into clean energy. Feed-in tariffs (FITs) are an instrument designed to incentivise investment in low-carbon technologies by offering long-term contracts to renewable energy producers guaranteeing a fixed price for the generated power. Explicit carbon prices are a mechanism that puts a price on greenhouse gas (GHG) emissions generated during production or use of goods. Government spending for research, development and demonstration (RD&D) in renewable energy (as a share of GDP) represents the extent of countries' support for the development of renewable technologies. Finally, fossil-fuel support measures include financial incentives for producers of fossil fuel as a share of GDP. Box 3 provides a brief overview of some challenges with implementing climate mitigation policies.

Furthermore, the analysis incorporates also variables that contribute to explain FDI flows from countries of origin to host countries. These factors include the distance between the two countries, their market size, the membership of both countries to the same regional trade agreement, as well as whether the two countries share a land border and whether they have a common official language. The analysis also includes explicit barriers to FDI, as measured by the FDI Regulatory Restrictiveness Index (RRI), to capture the impact of policy obstacles to foreign investment. Global economic trends and industry effects are also taken into account.[16]

The findings confirm the importance of climate mitigation policies for FDI in renewable energy (Table 1, Columns 1 and 2).[17] The results show that FITs are positively associated with the number of FDI projects in renewable power, suggesting that these targeted investment incentives contribute to encouraging green investment. An increase of FITs by 1 USD/kWh could boost the total number of greenfield projects by 4% and the number of M&A in by 9% (Figure 8).[18] A possible explanation why the estimated effect is

[15] Data for climate policies are only available until 2019. Table A 1 in the annex describes all variables and their sources.

[16] The key objective of the analysis is to estimate the effects of country-specific policy measures, which however vary little over time; therefore, country fixed effects are not included into the empirical specification. By accounting for known determinants of foreign investment, this estimation approach produces good estimates of the correlation between FDI and the variables of interest, but this correlation cannot be interpreted as reflecting a causal relationship.

[17] Table A 2 in the annex details the estimation results.

[18] The reported estimates show how the number of FDI projects is predicted to respond if a given variable changes from its average level observed in the sample by one unit in the direction of a more climate-friendly policy or a more open investment environment in case of FDI RRI, while other variables included in the model are fixed at their mean values. The predicted changes are estimated only for the statistically significant policy variables. The predicted effects assume that the impact of a given change would apply equally across countries, but in reality, the predicted results are likely to differ across countries. Among others, the cost of implementing various measures to achieve a given simulated change would vary considerably among the countries depending on the existing policy landscape (Box 3 discusses some challenges with implementing climate policies). The magnitudes of the predicted changes do not

substantially larger for M&A than for greenfield investment is that businesses in locations with higher FITs might have already benefitted from the generosity of these policies and, hence, are more attractive to M&A investors than companies in places where these measures are less abundant. In contrast, it would take time for greenfield investors to benefit from the climate policies as these investors often establish their operations from scratch.

### Table 1. The effects of climate policies and investment environment on FDI in renewable energy

| | | Greenfield | Cross-border M&A | Greenfield | Greenfield | Cross-border M&A | Cross-border M&A |
|---|---|---|---|---|---|---|---|
| | | All | All | Energy | Non-Energy | Energy | Non-Energy |
| Climate policies | FIT | + | + | + | | | + |
| | Carbon price | + | + | + | - | + | + |
| | RD&D/GDP | | | | + | + | |
| | FFS/GDP | - | | - | | - | + |
| Other determinants | FDI RRI | - | - | - | | - | - |
| | GDP destination | + | + | + | + | + | + |
| | GDP origin | + | + | + | + | + | + |
| | Distance | | - | | - | - | - |
| | Common border | + | + | + | | + | |
| | Common language | + | + | + | + | + | + |
| | RTA | + | + | + | + | + | + |
| Number of observations | | 18 994 | 13 022 | 14 872 | 4 122 | 5 081 | 7 941 |

Note: '+' indicates that the corresponding variable has a statistically significant positive effect on a given type of FDI,''-' stands for a statistically significant negative effect, empty cells represent statistically insignificant effects. The first two columns refer to the results obtained for all projects. Columns 3-6 report the results from the analysis by subsamples: "Energy" refers to investment originating from the energy sector, "Non-energy" denotes projects where the investing firms has main operations outside the energy sector.
Source: Based on fDi Markets database and Refinitiv M&A Deal Analytics database.

Explicit carbon prices are also positively associated with the number of FDI projects, indicating that high costs of GHGs emitted during production or use of goods might accelerate the shift towards investment in low-carbon infrastructure. Increasing the level of carbon prices by 1 USD/tCO2e could increase the number of greenfield projects and M&A deals by almost 1% (Figure 8).

RD&D spending in renewable technologies as a share of GDP appears less relevant, which can partially reflect that RD&D expenditures typically target early-stage development of technologies, but not the deployment of infrastructure. Moreover, this finding might be attributed to the historically low levels of public RD&D expenditures across many countries relative to public support through targeted investment incentives (Ang, Röttgers and Burli, 2017[1]).[19] Higher support for production of fossil fuel is negatively associated with the announced number of greenfield projects in clean energy, indicating that public support

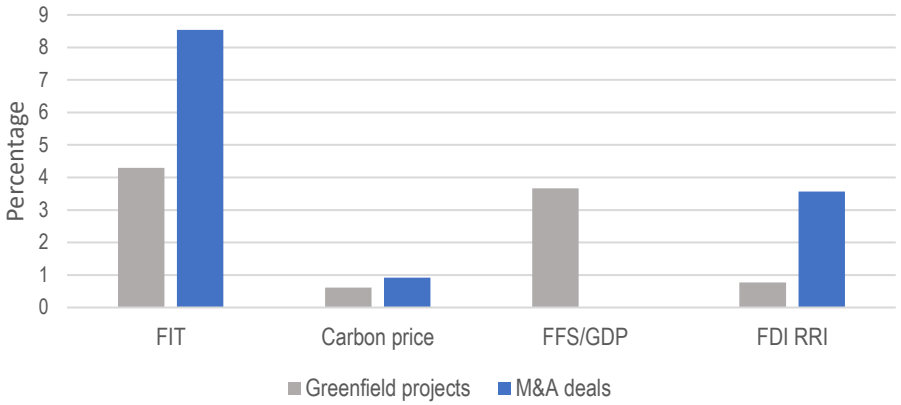
inform about the relative effectiveness of the policies, because the units used to measured different policies are not directly comparable.

[19] RD&D spending data have many missing values. Excluding this variable from the analysis increases the number of observations, while the estimated effects for the other variables remain unchanged.

for fossil fuel can discourage greenfield investment into renewable power.[20] This result provides empirical evidence in support of the notion that phasing out support for fossil fuel production is important for incentivising investment into renewable energy. Reducing the share of fossil fuel support in GDP by 0.01 percentage points could raise the number of greenfield projects in renewable energy by 4% (Figure 8).[21]

The results also confirm that other factors play an important role in mobilising FDI into renewable power. Countries with higher explicit barriers to foreign investment, as measured by the FDI Regulatory Restrictiveness Index receive fewer FDI projects in renewable energy, which highlights that regulatory obstacles to FDI might slow down the green transition. This finding is consistent with the fact that statutory restrictions on FDI might limit market reach or increase transaction costs for foreign investors, tilting their location choice towards places with fewer regulatory hurdles. The results show that a modest change in regulatory barriers to FDI, as measured by a reduction of 0.01 points in the FDI RRI, could lead to a 1% increase in the number of greenfield projects and a 4% rise in the number of M&A (Figure 8). The greater responsiveness of M&A to the reduction in the score might be picking up the deterring effect of screening mechanisms for acquisitions.

### Figure 8. Estimated change in the number of FDI projects in renewable energy




Note: Estimated impact of a unit change in a given variable relative to the sample average, where the unit changes are as follows: an increase of 1 USD/kWh for FITs, an increase of 1 USD/tCO2e for carbon prices, a decrease of 0.01 percentage points for the share of fossil fuel support in GDP and a decrease of 0.01 in the FDI RRI score.
Source: Based on fDi Markets database and Refinitiv M&A Deal Analytics database.

More FDI projects into renewables go to larger markets, picking up the greater demand of larger economies for clean energy. Foreign firms from larger countries undertake more cross-border projects in renewable energy, possibly because larger and richer economies might have more financial and technological resources to reach the competitive edge and the development and deployment of clean technologies. The

[20] These results show no effect of fossil fuel support on cross-border M&A. However, as explained further in the section, the link shows up in the estimation results performed by subsamples.

[21] Previous research has also found that renewable energy certificates (tradable documents certifying that a certain amount of energy was produced and delivered to the electricity grid from a renewable source) can serve as a powerful incentive for green investment (Ang, Röttgers and Burli, 2017[1]). However, available data sources on the target share of generated electricity under renewable energy certificates (RECs) cover the period only until 2011. A binary variable constructed on the basis of the IEA/IRENA Renewable Energy Policies and Measures database to indicate if RECs are present in a given country did not produce statistically significant results, probably because the variable has much lower variation over time and across countries than the coverage of the policy.

number of cross-border M&A decreases with distance to the destination country. Besides reflecting transportation costs, distance captures informational and organisational costs; hence, a strong effect of distance on FDI underscores the relevance of these costs to foreign investors. However, the effect of distance is insignificant for greenfield investors. A possible explanation behind this result is that greenfield investment into renewable energy, which often involves setting up low-carbon infrastructure from scratch, might be more drawn to the suitability of landscape and, hence, ready to bear the distance-related costs; whereas investors seeking to acquire low-carbon facilities might weigh transportation costs more, because if these costs are too high, they might search for another less distant acquisition target.

### Box 3. Climate mitigation policies can be challenging to implement

Implementation of climate mitigation policies can be challenging and can come with important drawbacks (OECD, 2022[4]). For instance, although feed-in-tariffs are often found to be effective in attracting investment in green power, designing the incentive can be challenging, as the tariff schedule needs to take into account possible changes in technology costs and to ensure that investors have clarity on how these changes will affect the incentive. Renewable energy certificates reduce the initial disadvantage of renewable energy producers vis-à-vis the fossil-fuel sector, but can come with high administrative costs and may require other types of support such as capacity building for firms to be able to engage in certificate trading. Domestic carbon pricing schemes, while encouraging investment in cleaner technologies, can weaken the competitiveness of local firms (both foreign and domestic) as they increase costs of carbon-intensive production. The potential challenges of these and other climate mitigation policies are extensively discussed in the FDI Qualities Policy Toolkit (OECD, 2022[4]).

There is an additional boost to the number of FDI projects in renewable energy if countries share a common land border and an official language. As these two factors capture various commonalities between countries (including historical and cultural ties), their importance for FDI in renewable power seems to indicate that shared background reduces transaction costs for cross-border green investment. When two countries are members of a regional trade agreement (RTA), they tend to receive more FDI projects from each other. Beyond highlighting the general importance of trade for a favourable environment for cross-border investment, this result might be picking the impact of environmental clauses in RTAs, which might stimulate additional green investment flows between the countries.

### *Non-energy parents are led by other factors*

Interestingly, the importance of investment conditions and climate policies differs depending on the sector where greenfield investors come from, suggesting that different motives might be driving the two types of investors (Table 1, Columns 3 and 4). Overall, greenfield investors from outside the energy sector seem less responsive to the climate mitigation policies of host countries. More specifically, generosity of FITs or stricter carbon prices appear to have no effect on this type of investors.[22] Fossil fuel support does not appear to have any deterring effect on greenfield FDI either. These findings are consistent with the fact that some non-energy firms undertake greenfield projects in renewable energy to power their core activities abroad and, as they have already established these core operations in a given country, they are less

[22] The negative of carbon prices sign is not robust, i.e. its statistical significance disappears when other variables are included in the specification. Overall, the absence of a positive significant effect of carbon prices on greenfield investment from outside the energy sector might indicate that some of these investors are already emitting very low amount of GHG. Hence, explicit carbon prices are not the major driver behind their investment into renewable power (perhaps the projects are motivated by a corporate strategy to contribute to the net-zero transition). Furthermore, the low variation of carbon prices over time but also across EU countries might be contributing to this result.

affected by local climate policies. Interestingly, the results show that the number of greenfield projects by non-energy investors is positively associated with spending on RD&D. This result might be picking up the better preparedness of countries with higher RD&D in renewables for continued deployment of infrastructure, which could be of particular importance to investors that do not operate in the energy sector.

Furthermore, the impact of other determinants on greenfield FDI seems to depend on the sector where the foreign investor is active. For instance, restrictions to FDI have no effect on greenfield investors from outside the energy sector, whereas they have strong deterring effect on FDI originating in the energy sector. This result might be driven by the fact that non-energy firms often invest in renewable infrastructure where they already have established their operations, and where they have already incurred the sunk cost of entry. Distance appears to deter greenfield investors from outside the energy sector, while it has no effect on investors from the energy sector. This finding is consistent with the idea that in the long term suitability of landscape might outweigh transportation costs for energy firms seeking to expand their operations while maximising return on investment, whereas high transportation costs might be seen as more imminent obstacle for businesses that invest in renewables to supply power for their core operations.

For M&A investment, the difference in drivers is less distinct (Table 1, Columns 5 and 6). Climate mitigation measures matter for all acquiring firms, irrespective of their sectoral origin. This finding is in line with the idea that companies that might have already benefitted from the climate policies might be more attractive targets for foreign investors than businesses in a location where such policies were weaker. Moreover, this result might be partially related to the fact that many M&A originating from outside the energy sector are undertaken by financial firms seeking to maximise return on investment so that these investors take the strength of climate policies into account. Yet, M&A originating from the energy sector seem less influenced by FITs. The substantial share of deals in wind energy in renewable M&A (30%) might be among the reasons explaining this result, because FITs for wind power have been traditionally less generous than for solar energy. The positive association between the support for fossil fuel and the number of M&A undertaken by firms from outside the energy sector might be picking up the diversification strategy of investing firms. This positive effect detected for non-energy acquirers sheds some light on why fossil fuel support was found to have no impact in the results reported for all cross-border M&A.

### *Concluding remarks*

Recently, FDI in renewable energy has been on a rising trend, while FDI activity in fossil fuels has started showing some signs of a possible slowdown. Although the changing geopolitical context might have implications for the development of these trends, the findings presented in this working paper suggest that renewable FDI is gaining momentum, including thanks to investment by companies outside the energy sector.

The results show that while both the broader investment conditions and the strength of climate policies are essential for ensuring the favourable environment for FDI in renewable energy, the degree to which these drivers influence investment decisions depends on where the investors come from. In particular, firms from outside the energy sector seem to put less weight on the climate policies when undertaking greenfield projects in renewable power, consistent with the notion that non-energy companies invest into renewable energy in places where they have already established their core operations and, hence, their investment decisions are less affected by local climate policies. At the same time, the results show that greenfield investors form outside the energy sector are more responsive to costs associated with longer distance to the investment site than are energy firms, whereas energy firms put more weight on restrictions to FDI than their non-energy counterparts. Dissimilarity of the underlying motives behind investment projects, the extent of sunk costs incurred and the investment horizon might contribute to these differences between the investor types.

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# Annex

## Data

In this working paper, M&A refers to completed cross-border M&A deals from Refinitiv M&A Deal Analytics database. Greenfield projects include both announced and open investment projects as reported in the Financial Times fDi Markets database. Monetary values are reported in constant prices, deflated using the US Producer Price Index for Energy (2021 = 100).

M&A and greenfield data were collected for 48 countries: Australia, Austria, Belgium, Brazil, Canada, Chile, the People's Republic of China, Colombia, Costa Rica, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Latvia, Lithuania, Luxembourg, Malaysia, Mexico, the Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Russian Federation, the Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, the United Kingdom, the United States. Data were collected for 2012-21.

### *Econometric analysis*

The determinants of FDI are estimated using the gravity model, which tends to have a strong explanatory power in the context of cross-border investment and trade flows. The analysis is performed using a count model to estimate the number of FDI projects to a given energy sector of a given country, as this model is well suited for the underlying data. More specifically, a known issue in the econometric analysis of cross-border M&A, is the prevalence of M&A with undisclosed deal values. This feature of the data would increase the number of missing values in the analysis based on investment values. The imputation of zero investment flows required by the gravity framework would further aggravate this problem in the models where dependent variable is the total value of investment. In contrast, count models exploit the number of M&A instead of their values, and, hence are unaffected by the undisclosed deal values. Furthermore, count models tend to have a good fit to data on foreign M&A (Blonigen and Piger, 2014[6]; Herger, Kotsogiannis and McCorriston, 2016[7]; Hijzen, Görg and Manchin, 2008[8]).

The estimation is performed using a negative binomial regression, as this model is well suited for over-dispersed data (i.e. when the sample variance is far greater than the sample mean). The following model is estimated:

$$n_{ijklt} = \beta_o + \beta_1 X_{jlt} + \beta_2 Y_{kt} + \beta_3 Z_{lt} + \beta_4 G_{klt} + \theta_i + \tau_t + \varepsilon^s_{oct}$$

where $n_{ijklt}$ stands for the number of FDI projects undertaken by foreign investors coming from industry *i* in country *k* with the investment project taking place in industry *j* in country *l* in year *t*. $X_{jlt}$ denotes regulatory barriers in the destination country, as measured by the FDI Regulatory Restrictiveness index. $Y_{kt}$ and $Z_{lt}$ stand for market size of the origin and destination economies, measured by their GDP. $G_{klt}$ is a vector of bilateral variables: the distance between the two economies; binary indicators for whether the two countries share a land border, an official language and belong to the same RTA. Sector and time fixed effects $\theta_i$ and $\tau_t$ are included to account for sector-specific factors and economic trends.

Predictive margins are reported to describe the estimated increase in the number of cross-border investment projects associated with in a given change in the variables of interest. These effects are obtained from the fitted model, where the variable of interest changes from its sample average by one unit

in the direction of more climate-friendly policy or more open investment environment in case of FDI RRI, while other variables included in the model are fixed at their mean values.

## Tables

### Table A 1. Definition of variables and data sources

| Variable | Description | Units | Source | Sample coverage |
|---|---|---|---|---|
| GDP, destination (log) | Gross Domestic Product in the destination country, in logarithm | Ln(Nominal USD millions) | IMF, UN Stats and World Bank | 48 countries, 2012-21 |
| GDP, origin (log) | Gross Domestic Product in the country of origin, in logarithm | Ln(Nominal USD millions) | IMF, UN Stats and World Bank | 48 countries, 2012-21 |
| Common border | Contiguity | Dummy equal to 1 if countries are contiguous bilateral | The CEPII Gravity Database | 48 countries, 2012-21 |
| Distance (log) | Distance between most populated cities, in logarithm | Ln(Kilometers) | The CEPII Gravity Database | 48 countries, 2012-21 |
| Common language | Common official or primary language | Dummy equal to 1 if countries share common official or primary | The CEPII Gravity Database | 48 countries, 2012-21 |
| RTA | Regional Trade Agreement | Dummy equal to1 if the countries have a RTA | The CEPII Gravity Database | 48 countries, 2012-21 |
| FDI RRI | The OECD FDI Regulatory Restrictiveness Index measures statutory restrictions to foreign direct investment | The index take values between 0 and 1, with 1 being the most restrictive | The OECD FDI Regulatory Restrictiveness Database | 48 countries, 2012-21 |
| FIT | Feed-in tariff by energy type, weighted with the duration of power purchasing agreements | USD/kWh | OECD dataset on Renewable Energy Policies | No data available for Colombia, Costa Rica, Kazakhstan, Malaysia, Peru and Thailand. For USA 2019 is not covered. 2012-19 |
| Explicit Carbon Prices | Carbon taxes and emission trading schemes relevant for the electricity sector. Weights are applied if several relevant price exist in a given year. | USD/tCO2e | Carbon Pricing Dashboard, World Bank | 48 countries, 2012-21 |
| RD&D/GDP | Public RD&D budget in renewables by energy type as a share of GDP | Share (%) | Public RD&D Budget, IEA Energy Technology RD&D Statistics (database) | No data available for Chile, China, Colombia, Costa Rica, Indonesia, India, Iceland, Israel, Kazakhstan, Latvia, Malaysia, Peru, Russian Federation, Slovenia, Thailand, South Africa, 2012-21 |
| FFS/GDP | Fossil fuel support for power generation as a share of GDP | Share (%) | The OECD Fossil Fuel Support Inventory Indicators database | No data available for Costa Rica, Kazakhstan, Malaysia, Peru and Thailand. 2012-20 |
| Renewable Energy Certificate (REC) | Existence of RECs | Dummy equal to 1 if a country imposes mandatory renewable-power generation shares on power producers in a form of obligations or voluntary goals | IEA/IRENA | 48 countries, 2012-21 |

Note: 'Sample coverage' describes to what extent a given source covers the original sample of 48 destinations countries from 2012 to 2021.

## Table A 2. The effects of climate policies and investment environment on FDI in renewable energy

| | GI | MA | GI | GI | MA | MA |
|---|---|---|---|---|---|---|
| | All | All | Energy | Non-Energy | Energy | Non-Energy |
| FIT | 0.042* | 0.082*** | 0.057** | -0.025 | 0.065 | 0.087** |
| | (0.022) | (0.030) | (0.024) | (0.050) | (0.050) | (0.036) |
| Explicit Carbon Price | 0.006*** | 0.009*** | 0.009*** | -0.009* | 0.005** | 0.011*** |
| | (0.002) | (0.002) | (0.002) | (0.005) | (0.003) | (0.002) |
| RD&D/GDP | 6.695 | 9.071 | 3.129 | 33.948** | 18.563* | 4.960 |
| | (5.637) | (7.857) | (6.162) | (14.393) | (10.458) | (10.410) |
| FFS/GDP | -3.738*** | 0.396 | -4.510*** | 0.291 | -2.874** | 1.285*** |
| | (0.437) | (0.433) | (0.582) | (0.712) | (1.322) | (0.497) |
| GDP destination | 0.917*** | 1.132*** | 0.937*** | 0.865*** | 0.881*** | 1.257*** |
| | (0.048) | (0.060) | (0.047) | (0.103) | (0.078) | (0.082) |
| GDP origin | 0.404*** | 0.310*** | 0.396*** | 0.468*** | 0.297*** | 0.293*** |
| | (0.037) | (0.043) | (0.040) | (0.085) | (0.071) | (0.053) |
| Distance | 0.044 | -0.407*** | 0.077 | -0.184* | -0.331*** | -0.427*** |
| | (0.057) | (0.049) | (0.064) | (0.097) | (0.069) | (0.063) |
| Common border | 0.525* | 0.394** | 0.489** | 0.320 | 0.744*** | 0.221 |
| | (0.297) | (0.175) | (0.245) | (0.822) | (0.258) | (0.229) |
| Common language | 1.270*** | 1.134*** | 1.459*** | 0.506* | 1.430*** | 0.933*** |
| | (0.128) | (0.151) | (0.137) | (0.278) | (0.225) | (0.194) |
| RTA | 0.657*** | 0.540*** | 0.618*** | 0.726*** | 0.473** | 0.551*** |
| | (0.111) | (0.143) | (0.126) | (0.244) | (0.215) | (0.181) |
| FDI RRI | -4.502*** | -3.409*** | -5.084*** | -1.385 | -2.277* | -3.844*** |
| | (0.526) | (0.780) | (0.577) | (1.031) | (1.166) | (1.012) |
| Constant | -18.181*** | -21.041*** | -20.062*** | -20.102*** | -17.185*** | -21.523*** |
| | (1.071) | (1.370) | (1.101) | (2.357) | (1.856) | (1.801) |
| Observations | 18 994 | 13 022 | 14 872 | 4 122 | 5 081 | 7 941 |
| Sector FE | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Pseudo R-squared | 0.0802 | 0.128 | 0.0748 | 0.0978 | 0.142 | 0.125 |

Note: The table reports estimated coefficients from the negative binomial regressions. The dependent variable is a number of FDI projects; the type of FDI is reported in the column name. The second row indicates whether all projects were included in the analysis ("All"), or the analysis was run on subsamples: "Energy" refers to investment originating from the energy sector, "Non-energy" denotes projects where the investing firms has main operations outside the energy sector. Robust standard errors are reported in the parentheses. ***, ** and * denote statistical significance at 1%, 5% and 10% levels respectively.
Source: Based on FT fDi Markets database and Refinitiv M&A Deal Analytics database.