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CLIMATE

NOTES

Policies to Foster Green FDI: Best Practices for Emerging Market and Developing Economies

Florence Jaumotte, Jaden Kim, Samuel Pienknagura, and Gregor Schwerhoff

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Summary

IEA (2024) estimates that meeting COP28 goals requires a doubling of clean energy investment worldwide by 2030, including an additional $600 billion among emerging market and developing economies (EMDEs) excluding China. Moreover, investments in electric vehicles and new sources of energy, such as green hydrogen, are key ingredients in the green transition. Amid low fiscal space and financially constrained domestic investors, foreign direct investment (FDI) could play a key role in EMDEs' ability to close their renewable energy investment gap and finance green projects, more broadly. Combining econometric evidence with country case studies, this Staff Climate Note explores whether climate policies can help attract FDI in green projects and how other domestic policies and global factors affect these flows.

Econometric evidence shows that a larger number of climate policies are associated with higher FDI flows into renewable energy, especially in countries with solar power potential and low dependence on fossil fuels. Estimates suggest that closing the climate policy gap between the average EMDE and the average AE would triple the green FDI to GDP ratio in the average EMDE and would close 40 percent of the private renewable investment gap in EMDEs excluding China. Moreover, more action on the climate policy front can help EMDEs overcome the adverse impact of high financing costs on FDI flows into renewables. Green FDI into EVs and green hydrogen do not appear to respond to domestic climate policies. The lack of systematic evidence of a relationship between domestic climate policies and these flows could be related to their recent emergence.

Beyond domestic climate policies, countries can leverage favorable domestic fundamentals and global factors to boost specific types of green FDI. Countries with higher levels of trade and capital account openness and better institutional quality received larger green FDI flows. FDI related to electric vehicles (EVs) responds to global climate policies, highlighting the global nature of EV markets, and is facilitated by a country's prior car manufacturing experience. Yet geoeconomic fragmentation could limit countries' ability to leverage climate and structural policies to attract green FDI inflows. Econometric evidence shows that green FDI, both in renewable energy and EVs, is less likely between politically distant countries, a pattern that may be exacerbated in a context of geopolitical fragmentation.

To gain a better understanding of the nuanced relationship between domestic climate policies, country fundamentals, global factors, and green FDI, this note also provides a deeper look at country-specific experiences. Countries that attract FDI into the renewable sector have a large and diverse set of domestic climate policies for the electricity sector and adapt their energy policy framework to technological change. Key policies include those that secure a revenue stream for investors in the initial phases, such as power-purchase agreements/feed-in tariffs, renewables targets, and complementary investments. Countries that have successfully attracted FDI in EVs have relied on the development of national sectoral strategies, prior comparative advantage in the automobile sector, and bilateral alliances with large global players in the EV market. Finally, in the case of green hydrogen, comprehensive national hydrogen strategies that leverage international efforts to boost production, and good conditions for production of renewable energy, appear to be key drivers of FDI flows. Beyond domestic factors, global initiatives such as the Just Energy Transition Partnership and the EU strategy for green hydrogen are benefitting green FDI to EMDEs.

Introduction

Reducing emissions to net zero by 2050 will require substantial investment in low-carbon technologies (LCTs), including in emerging market and developing economies (EMDEs). The International Energy Agency estimates that, by the end of 2030, climate mitigation investment needs will increase to about $2 trillion per year in EMDEs—about 40 percent of global investment needs. This estimate implies that climate mitigation investments will have to climb to 12 percent of total investments in EMDEs by 2030—a significant increase from the present 3 percent (see IMF 2023a). At the same time, IEA (2024) estimates that, to meet the COP28 target, EMDEs excluding China will need to invest an additional $600 billion in clean energy by 2030.

The widespread decline in the cost of renewable energy provides opportunities for greater investment in renewable energy in EMDEs. IRENA (2023a) highlights that the levelized cost of energy (LCOE)[1] for wind, solar, and hydropower plants is lower than that of fossil fuel power plants, and it has been decreasing over time. Moreover, while there are considerable differences across regions in terms of LCOEs for renewables, EMDEs have now a cost that is similar, and in some cases lower, than those in Europe. This points to growing incentives to invest in renewable energy projects in EMDEs.

However, structural barriers faced by EMDEs have, so far, undermined technical improvements reducing the cost of renewable energy, resulting in relatively low investment per capita. Clean energy investment per capita among advanced economies (AEs) increased from around $400 in 2020 to more than $500 in 2022 (Figure 1, panel 1). In contrast, clean energy investment per capita among EMDEs has remained low (around $50) and stagnant since 2020, with the notable exception of China. Data from IEA (2024) suggests that, to reach net-zero targets, EMDEs would need to increase their per capita investment in clean energy to around $300 by 2030. Behind these patterns there are structural factors hampering EMDEs' ability to attract investments in renewable energy, including higher costs of capital. Renewable energy has a much more front-loaded investment profile than fossil fuel energy, thus requiring a larger initial investment and making it more sensitive to high financing cost. Survey data show that the financing costs for renewable energy are much higher in EMDEs (especially in Africa) compared to Western Europe (Figure 1, right panel). Higher financial costs in EMDEs are associated with, among other factors, higher country risks (Đukan and Kitzing 2023) and less developed banking sectors (Kempa, Moslener, and Schenker 2021).

Innovative financing instruments can help overcome the obstacles to renewable investment in EMDEs in the short term, but sustained improvements in the attraction of renewable energy investments will require tackling structural factors, such as deepening commitments on the climate policy front. Blended finance, including the enhanced use of Multilateral Development Banks' and donors' guarantees, is an innovative financing tool that, if designed well and used appropriately, can help attract private investment by providing a vehicle for public–private risk-sharing (IMF 2023a). In low-income countries, larger international public support is essential, given the steep challenges in attracting private climate finance. However, to achieve sustained attraction of investment in renewables, EMDEs will need to address the structural factors affecting private investments. One area specific to investments in renewables is climate policy. Strong climate policies and commitments to achieve climate objectives, such as legally enshrined national commitments to achieve net zero emissions by a given date, provide a strong signal to private investors (IMF 2023a).

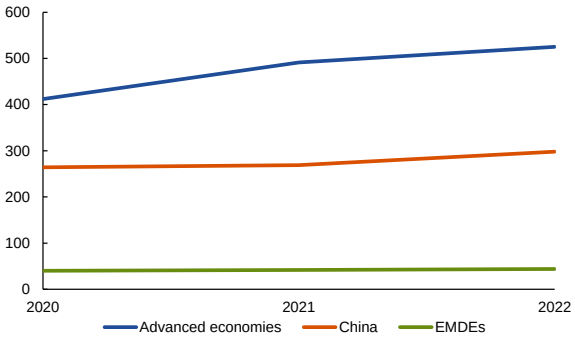
Beyond renewable energy, there has been a global push to increase the production of electric vehicles (EVs) and green hydrogen in recent years, a process that EMDEs want to participate in. Since 2015, the production of electric and hybrid vehicles has accelerated, as countries have introduced policies and provided incentives for the use of these vehicles. Similarly, demand for green hydrogen, which can be used to

[1] The LCOE of a project is the ratio between the present discounted value of all costs associated with a project (investments, operations and management expenses, and fuel expenses) and the present discounted value of energy generation revenue.

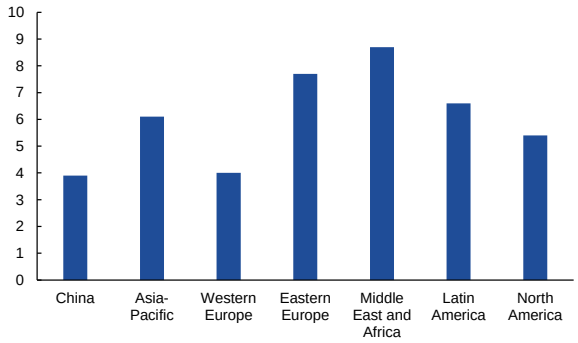
decarbonize the use of gas in industry, as well as air and maritime transportation, is expected to rise substantially even in scenarios where uptake of blue and green hydrogen loses momentum.[2] Amid these developments, EMDEs have made efforts to reap the benefits of these trends. For example, EMDEs with an abundance of critical upstream inputs in the production of EVs have pursued industrial policies aimed at developing capabilities in the production of more sophisticated downstream products in the EV value chain.

Figure 1. Financing of Renewable Energy for Different World Regions

1. Per-Capita Clean Energy Investment in Selected Regions, in US$ (2021)



2. Average Regional Cost of Capital for Utility-Scale Solar PV, in percent



Sources: IEA 2022 (panel 1); IRENA 2023b (panel 2).
Note: The right panel shows a simple average of the regional cost of capital for utility-scale solar PV, as reported by survey respondents. EMDEs = emerging market and developing economies; PV = photovoltaic.

This Staff Climate Note studies how the introduction of new climate policies, together with other domestic and global factors, can facilitate the financing and diffusion of low carbon technologies (LCTs) through FDI. This note builds on the work done by Hasna and others (2023) and zooms into the link between different types of FDI and climate policies in EMDEs by pursuing a multipronged approach. First, it extends the econometric strategy in Hasna and others (2023) and Pienknagura (2024) to identify systematic patterns in the data. More precisely, it (1) explores econometrically how the relationship between climate policies and green FDI[3] varies for the three major categories (renewable energy, FDI related to EVs, and green hydrogen) and (2) explores how other policy and structural factors affect green FDI. Second, the note highlights examples of EMDEs that have successfully attracted different types of green FDI flows and draws policy lessons from these examples. The note focuses on FDI for two reasons. Like trade, FDI is a vessel for technological diffusion.[4] In addition, FDI is a key source of private financing that can relax domestic financial constraints and can help to close the climate investment gap in EMDEs, at a time when tight fiscal space limits the scope for publicly funded climate investments.

Results show that climate policies are associated with higher green FDI inflows in renewable energy, especially in countries with solar energy potential and low fossil fuel dependence, but no statistical association was found with higher FDI in EVs and green hydrogen. Consistent with the work done by Hasna and others (2023), econometric evidence shows that an increase in the number of climate policies is associated with higher green FDI inflows as a share of gross domestic product (GDP) in the average country, without significant adverse impacts on nongreen FDI inflows. Estimates suggest that closing the climate policy

[2] https://www.mckinsey.com/industries/oil-and-gas/our-insights/global-energy-perspective-2023-hydrogen-outlook.
[3] Data are from the fDi Markets database, which covers new cross-border projects and expansions of existing projects. Given its nature, it can differ from official FDI numbers. However, Aiyar, Malacrino, and Presbitero (2023) show a strong correlation between gross FDI flows and aggregate FDI from the fDi Markets Database. Green FDI is built using project tags in the fDi Markets Database. It ranges from renewable energy and EVs to carbon capture and green hydrogen (see the online Annex).
[4] In general, FDI can facilitate technological diffusion through affiliate–parent company interactions (Arnold and Javorcik 2009) and through direct and indirect linkages between affiliates and local firms (Javorcik 2004). Foreign-owned firms in emerging markets also exhibit lower carbon intensity than domestic firms in high emissions sectors (Borga and others 2023) and use less energy than local firms (Brucal, Javorcik, and Love 2019).

gap between the average EMDE and the average AE would triple the green FDI to GDP ratio in the average EMDE and would help close 40 percent of the private renewable investment gap in EMDEs excluding China. A breakdown of green FDI into the three major categories shows that, in EMDEs, there is an economically and statistically significant positive association between the number of active climate policies in a country and FDI inflows in renewable energies. The relationship between climate policies and FDI in renewables is larger in countries with more solar energy potential (as defined in ESMAP 2020), and with lower fossil fuel dependence (as captured by fossil production and net exports). In contrast, the association between climate policies and FDI flows in EVs and green hydrogen is economically and statistically negligible, mostly because of the recent and rapid development of these technologies.

More action on the climate policy front can help EMDEs alleviate the adverse impact that high financial costs have on green FDI inflows. Factors like shallow financial markets and sovereign risk result in relatively high borrowing costs in EMDEs, which this note shows can hamper green FDI inflows. The note also finds a relatively smaller impact of financing costs on green FDI compared to that of climate policies, suggesting that decisive action on the climate policy front can help EMDEs partly offset the adverse impact of relatively high financing costs.

Structural factors, such as openness to trade and capital, governance, and education, do not explain within-country FDI dynamics but do explain cross-country differences in green FDI inflows among EMDEs. Results from econometric analysis do not point to a strong relationship between improvements in key country structural characteristics and higher inflows of green FDI. This may be because of the slow-moving nature of these variables and the fact that the period of analysis misses most of the big improvements experienced by EMDEs in many of these variables (which mostly occurred in the 1990s). However, cross-country differences in openness (as measured by an index of capital account and trade openness), quality of institutions (as measured by an index of rule of law), education (as measured by an index of human capital), and solar power potential, are associated with cross-country differences in green FDI inflows.

Yet geoeconomic fragmentation could limit countries' ability to leverage climate and structural policies to attract green FDI inflows. Econometric evidence shows that green FDI, both in renewable energy and EVs, is less likely between politically distant countries, a pattern that may accentuate in coming years and could undermine countries' ability to attract green FDI inflows from a diverse set of countries by pursuing robust climate and structural policies. Indeed, Gopinath and others (2024) point to deeper trade and FDI fragmentation along geopolitical lines since 2022.

Evidence from individual country experiences shows that attracting FDI inflows in renewable energy requires a broad range of climate policies, including the removal of obstacles to renewable energy, complementary public investments, and, crucially, ensuring a reliable revenue stream to investors. Countries that were very successful at attracting FDI in renewable energy have a long track record of continuously improving legislation in the electricity sector. The steady introduction of new legislation has allowed the energy sector in these countries to adapt to technological progress and has proven critical to provide the right incentives for investment in renewable energy and to build reliable infrastructure. Moreover, these countries do not rely on a narrow set of instruments. Rather, they display a wide set of instruments that have been introduced gradually as the conditions of the sector have improved. The instruments include policies to affect relative prices, barrier removal to make renewable investments possible, policies to ensure revenues over longer periods, and others. Policies to ensure revenues are highly country-specific and can take the form of feed-in tariffs, auction programs, or ensuring wider market access.

Countries attracting FDI inflows in EVs and green hydrogen have relied on ambitious national sectoral strategies and on favorable initial conditions. EMDEs receiving large FDI inflows in EVs and green hydrogen have recently passed national strategic plans (industrial policies) to develop the sector and boost production. In the case of EVs, national strategic plans include incentives for investments into electric vehicle production and

policies to encourage domestic adoption. For both types of investments, initial conditions play an important role. Prior comparative advantage in the automobile sector appears to be an important factor leading to higher FDI in EVs. For green hydrogen, a high potential to generate renewable energy is common across successful countries.

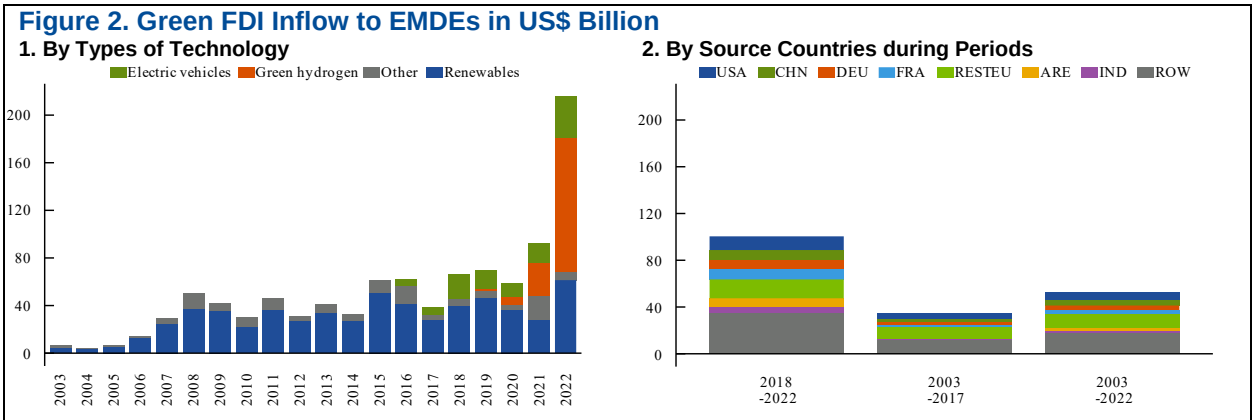
Global factors have interacted with domestic policies to shape green FDI flows into EMDEs. Beyond domestic efforts, many recent green FDI success stories are linked to major policy initiatives from AEs. In the case of renewable energy, the International Partnership Group is investing large amounts in countries entering the Just Energy Transition Partnership (for example, Vietnam). In the case of green hydrogen, many EMDEs, especially those with the right natural conditions, have benefited from strategic alliances with the European Union (EU), which has been promoting investment in the sector. Finally, in the case of EVs, synchronized policy movements among AEs to boost the production and adoption of EVs, and bilateral agreements between countries, have allowed EMDEs with a comparative advantage in the sector to increase their FDI inflows. The importance of these global initiatives has resulted in a "sudden take-off" dynamic of green FDI in many EMDEs, whereby green FDI inflows into EMDEs surge in the aftermath of big international initiatives.

The rest of this note is organized as follows. First, it presents green FDI and climate policy patterns among EMDEs. Then, it discusses econometric results assessing the link between climate policies and other country-specific factors and green FDI inflows. The next section draws policy lessons from a selected group of EMDEs that have successfully attracted FDI in the three main categories of green FDI (renewables, green hydrogen, and EVs). Then, it discusses the role of international factors in shaping FDI inflows into EMDEs. The last section concludes.

Green FDI and Climate Policies in Emerging Market and Developing Economies (EMDEs): Stylized Facts

Foreign direct investment in activities related to low carbon technologies (green FDI) has accelerated in recent years. Global green FDI accelerated since 2016 and tripled as a share of global GDP between 2014 and 2022 (see Hasna and others 2023). The rising trend in green FDI is also evident when looking at US$ FDI inflows—they increased from close to $40 billion in 2014 to $80 billion in 2019 and surpassed $200 billion in 2022.

Figure 2. Green FDI Inflow to EMDEs in US$ Billion



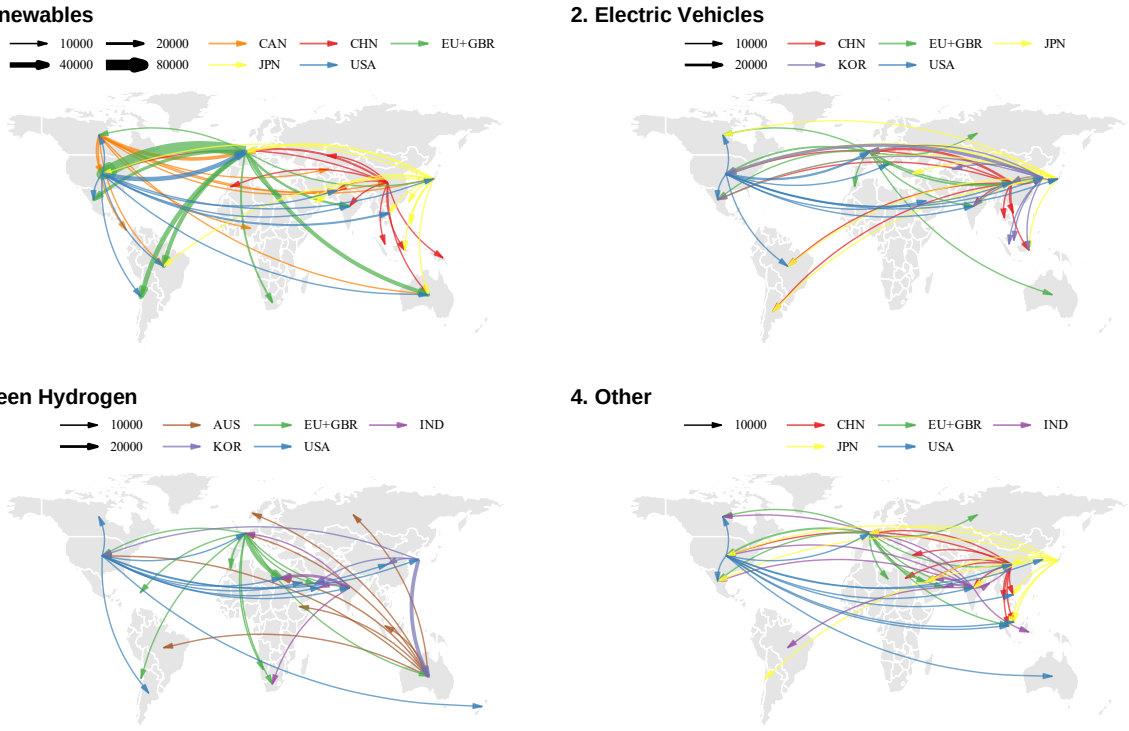
Source: Financial Times fDi Markets database.
Note: The database records project announcements and deletes entries that did not materialize after some years, thus data for recent years might be overstated. Data labels in the figure use International Organization for Standardization (ISO) country codes. FDI = foreign direct investment; EMDEs = emerging market and developing economies.

The recent surge in green FDI inflows has been driven by the emergence of investments in electric vehicles and green hydrogen, while FDI investments into renewable energy have remained relatively stable. Investments into renewable energy reached a high level in 2008 and has stayed at around that level

since (Figure 2, panel 1). The composition of this investment shifted from hydropower and biomass toward solar and wind; but this shift in composition did not affect the amount. In 2016, investments into electric vehicles emerged and have become an important part of green FDI inflows into EMDEs. Similarly, investments into green hydrogen started in 2019 and reached very high levels by 2022. Apart from these three technologies, there were no other major types of green FDI. The source countries have become more diversified in recent years, with China, the United Arab Emirates, and India becoming important investors (Figure 2, panel 2).

Green FDI for renewable energy and green hydrogen is directed at a broad range of countries, while FDI for electric vehicles is transferred mainly between advanced economies. Figure 3 highlights a few important patterns of global FDI flows. Renewable energy has accounted for the largest flows over the past 20 years, a reflection that this technology has been available for a much longer time than the other types of green FDI. FDI in renewable energy originates mostly in advanced economies and China and is directed at large emerging markets, including Brazil, Chile, and South Africa. The pattern for green hydrogen is similar but at lower volumes and with the US and Europe as dominant sources. Noteworthy are Europe's investments in Egypt, Chile, and Morocco and the US investments in Argentina, Egypt, and India. For electric vehicles, most investments are between the US, Europe, and East Asia (China, Japan, and Korea). In addition, the East Asian countries are investing in both Southeast Asia and South America, and the US is investing in Brazil, Mexico, and India. One notable recent development is the big investment that China has made in EVs in Hungary.

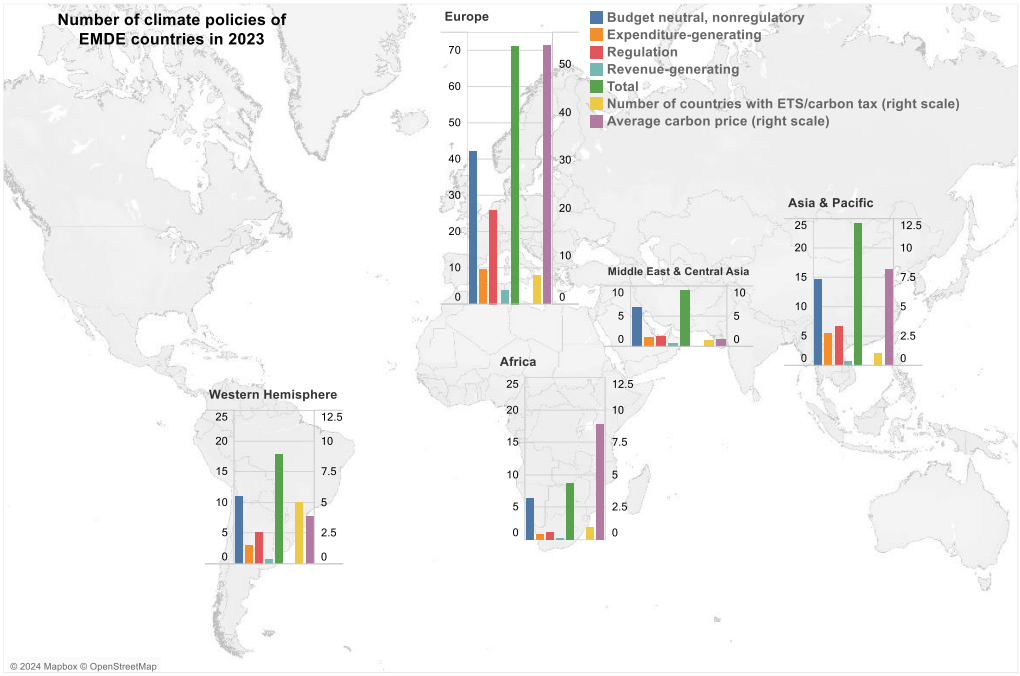
Figure 3. Green FDI Flows by Technology



Source: Financial Times fDi Markets database.
Note: Chart shows total green FDI between 2003 and 2023 for the largest five source countries and the ten largest destinations in each category. Data labels in the figure use International Organization for Standardization (ISO) country codes. FDI = foreign direct investment. The boundaries, colors, denominations, and any other information shown on the maps do not imply, on the part of the International Monetary Fund, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

There is substantial heterogeneity across regions both on the number of active policies and in the types of instruments used. European EMDEs have, on average, a much larger set of active climate policies relative to the average EMDE in other regions (Figure 4). Part of this reflects their membership in the European Union. In contrast, EMDEs in Africa, the Middle East, and Central Asia display a relatively low number of active climate policies. This may reflect political economy constraints arising from the perceived economic cost of climate policies (Dabla-Norris and others, 2023). Nonbinding policies, such as industry and firm-level self-imposed targets or national medium-term strategies, account for the lion's share of total policies in most regions. Among binding policies, regulations and expenditure measures are the most used. One caveat to the picture emerging from Figure 4 is that policy counts do not reflect the size and coverage of policies. This may be an important consideration in countries pursuing broad-based carbon taxes. For example, while revenue measures account for a relatively small share of total policies in the average EMDE in the Western Hemisphere, Argentina, Chile, Colombia, Mexico, and Uruguay have recently introduced carbon taxes and so have a handful of EMDEs in Africa, Asia, and Europe. In the case of EU EMDEs, they are part of the EU-ETS system.

Figure 4. Average Number of Climate Policies per Country among EMDEs: Cross-Regional Differences



Sources: Climate Policies Database; World Bank Carbon Pricing Dashboard; and IMF staff calculations.
Note: Policies can target multiple sectors; thus, the average number of policies per country does not necessarily add up to the sum of individual categories. EMDEs = emerging market and developing economies. Regions follow the IMF's regional groupings. The boundaries, colors, denominations, and any other information shown on the maps do not imply, on the part of the International Monetary Fund, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

The Relationship between Climate Policies and Green FDI in Emerging Market and Developing Economies (EMDEs)

To study systematically the link between climate policies and green FDI among EMDEs, this note follows a panel regression approach. The sample consists of over 100 EMDEs during 2003–22. As in Gu and Hale (2023) and Pienknagura (2024), the analysis follows two approaches. The first is a panel approach to estimate the relationship between climate policies and green FDI as a share of GDP. The second follows the trade literature and estimates a gravity model that exploits both destination-country information and source-

country information. The latter allows to better study the relationship between climate policies and the level of FDI flows, as well as the role of bilateral variables, such as the geopolitical alignment between two countries (Aiyar and others 2023).

Compared to past studies, the analysis focuses exclusively on EMDEs and is extended to distinguish between different types of green FDI flows. It focuses on renewable energy flows, green FDI associated with electric vehicles and green hydrogen, and the three leading types of green FDI. Data on green FDI flows are constructed using the Financial Times fDi Markets Database, which records new cross-border investment plans from multiple media and business sources. The data are an imperfect proxy for overall FDI, since they capture only investment projects included in the fDi Markets database, but they offer unique information that makes it possible to identify green FDI.

Econometric Evidence

More action on the climate policy front by EMDEs is associated with larger green FDI inflows, without significant adverse effects on total FDI. Figure 5, panel 1, shows the impact of climate policies on greenfield FDI inflows (green and nongreen) as a share of GDP for a sample of advanced economies and EMDEs and for a sample including only EMDEs. The analysis uses FDI as a share of GDP as its dependent variable to facilitate comparison with previous work. An increase in the number of climate policies is found to yield higher green FDI inflows as a share of GDP in the average country, without significant adverse impacts on nongreen FDI inflows. These patterns also hold in the average EMDE country, where the relationship between climate policies and green FDI inflows is stronger.[5] The estimates point to an economically significant impact on climate policies—closing the climate policy gap between the average EMDE and the average AE would triple the green FDI- to-GDP ratio in the average EMDE and would help close between 30 and 50 percent of the private renewable investment gap in EMDEs.[6] Note that while climate policies in EMDEs are negatively associated with FDI inflows in nongreen projects, the effect is statistically insignificant. This pattern may reflect the fact that nongreen FDI includes both carbon-intensive projects (such as those associated with fossil fuels), which are likely hampered by climate policies, and activities that complement green projects, thus benefiting from more stringent climate policies (for example, those providing inputs to green projects or those reliant on the output of green projects). This does not preclude FDI inflows into some sectors from being adversely affected by climate policies, as climate policies can lower investment by a typical oil and gas firm (Bogmans, Pescatori, and Prifti, 2023); it just points to a lack of aggregate effects. Results are consistent with those of Gu and Hale (2023), who found no significant relationship between climate policy stringency and overall FDI flows. More broadly, the factors underpinning green and nongreen FDI appear to be different—the former responds mostly to climate policies and financing costs, while the latter is more closely associated with growth prospects and the recipient's level of development (see online Annex 3).

The positive relationship between climate policies and green FDI is robust to endogeneity and reverse causality concerns. One caveat to a causal interpretation of the estimates in Figure 5 is that estimates may reflect reverse causality (where countries implement climate policies in anticipation of higher green FDI) or the omission of variables affecting both climate policies and green FDI. To tackle these concerns, online Annex 3 presents results for two exercises. The first follows an instrumental variable approach where domestic climate policies are instrumented by a variable capturing the intensity of climate policies in nearby countries. Results from this exercise are consistent with baseline results, thus alleviating endogeneity concerns. A second exercise

[5] One caveat of our climate policy count is that it does not consider the intensity of policies. However, the positive association between climate policies and green FDI is robust to the use of the proxies that quantify policy stringency. Moreover, similar patterns emerge when using FDI levels as the dependent variable. See online Annex for details.

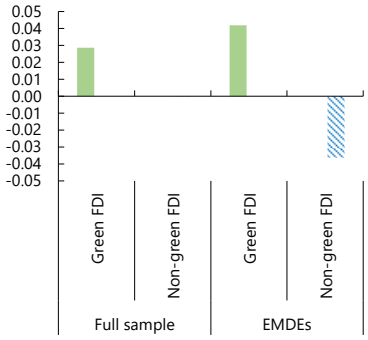
[6] EMDEs excluding China need to boost their investment in renewables by US$600 billion by 2030 (IEA, 2024). Under the current composition of climate investment (about 50 percent comes from private investors), the increase in green FDI in the counterfactual exercise would close 50 percent of the private renewable investment gap in EMDEs excluding China. IMF (2023) argues that the private sector's share of climate investment in EMDEs should jump to over 80 percent, in which case, the counterfactual exercise would result in 30 percent of the private renewable investment gap being closed.

assesses the extent to which domestic climate policies are shaped by past green FDI flows, with no evidence of this being the case. Taken together, the two results suggest that the baseline results are not simply capturing a spurious or reverse relationship between climate policies and green FDI among EMDEs.

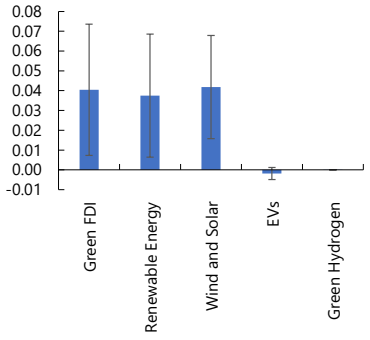
A finer look across types of green FDI flows points to a positive and statistically significant relationship between investments in renewable energy and climate policies; the relationship is not statistically significant for other types of FDI. To further assess the link between climate policies and green FDI, Figure 5, panel 2, shows the estimated relationship between climate policies and the main subcategories of green FDI identified in Figure 2. Results show a strong relationship between climate policies and renewable energy FDI flows (overall and in solar and wind). This is consistent with the results by Knutsson and Ibarlucea Flores (2022), who, using the OECD's environmental policy stringency index, found a strong association between environmental policies and renewable energy FDI inflows. In contrast, FDI in EVs and in green hydrogen projects display no clear relationship with climate policies. This may reflect the recent emergence of these flows (Figure 2), making it challenging to capture a statistical relationship through historical data.

Figure 5. Climate Policies and Green FDI

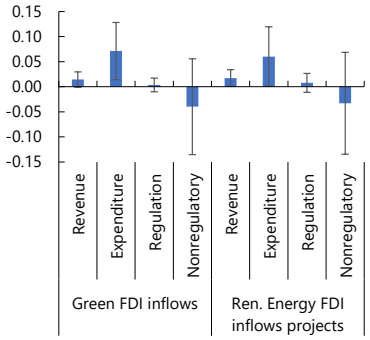
1. Impact of Climate Policies on Aggregate FDI Flows, Percent of GDP



2. Climate Policies and Green FDI Subcategories in EMDEs, Percent of GDP



3. Impact of Climate Policies on FDI in EMDEs by Policy Instrument, Percent Increase in Bilateral Flows



Sources: Financial Times fDi Markets; Climate Policies Database; and World Development Indicators.
Note: Panel 1 shows panel regression results quantifying the impact of a one-standard-deviation change in log climate policies on each FDI measure. Solid bars are significant at the 10-percent level; patterned bars are not significant. Panel 2 shows similar regressions but for each green FDI subcategory. Error bands are 90-percent confidence intervals. Panel 3 assesses the relationship between different policy instruments and green FDI. Additional details can be found in the online Annex. EMDEs = emerging market and developing economies; EVs = electric vehicles; FDI = foreign direct investment; Ren. = renewable.

Expenditure measures, such as subsidies, are associated with larger green and renewable energy FDI inflows, and so are revenue measures. Following Hasna and others (2023), Figure 5, panel 3, shows the results of an augmented gravity specification that, in addition to controlling for the total number of climate policies, includes the share of each policy type (revenue, expenditure, or regulation) in the total. This allows to control for destination-country, source-country, and country-pair characteristics that could affect FDI flows. For example, geographic, cultural, and political proximity are some of the attributes associated with FDI flows, and the gravity framework makes it possible to take these factors into account. Results in Figure 5, panel 3, show that, in line with findings for a sample of AEs and EMDEs, revenue and expenditure measures have a positive and significant effect on both overall green FDI inflows and renewable energy inflows into EMDEs. Other policies, including nonbinding neutral policies, have a nonsignificant impact. This points to the importance of more binding and specific policies in the design of climate policies when pursuing higher green FDI inflows.

Enabling Factors and Additional Factors Shaping Green FDI Flows

Structural factors, such as governance, human capital, and external sector openness, do not systematically explain green FDI dynamics within countries, but they are related to cross-country differences in green FDI. The baseline specification used in panel regressions is expanded to study the role of structural variables (namely, the structural reform components described in Budina and others (2023), and an

index of human capital). Evidence suggests that these variables are not significant drivers of within-country green FDI dynamics in EMDEs from a statistical point of view. This may partly reflect the fact that these are typically slow-moving variables, and the econometric analysis, which starts in 2003, misses the period of big reforms in EMDEs, which was around the 1990s. To further study the potential role that these variables may play in explaining cross-country differences in green FDI flows, Figure 6, panel 1, presents results of regressions of the fixed effects from the baseline regressions (which roughly capture the average green FDI as a share of GDP that each country receives) on the structural variables described in the previous section. Results point to external sector openness (to trade and capital flows), rule of law and human capital, as important variables explaining differences in FDI flows across EMDEs.[7] The overall less robust evidence of the impact of structural reforms on green FDI further underscores potential differences in the drivers of green and non-green FDI inflows, as Budina and others (2023) show that improvements on the structural reforms front typically increase net FDI inflows, which mostly comprise non-green FDI.

Relatedly, higher costs of capital can hamper green FDI inflows, but decisive action on the climate policy front can help EMDEs alleviate the adverse impacts of relatively high financing costs. As discussed, EMDEs typically face higher financing costs compared to AEs, which can be another manifestation of structural policy gaps, and can reduce green FDI inflows (Eyraud, Clements, and Wane 2013; Desbordes and Wei 2017). Indeed, econometric evidence shows that higher financing costs are associated with lower green FDI inflows as a share of GDP (see online Annex 3).[8] However, the impact of higher climate policies on green FDI appears to be quantitatively more important compared to the impact of reducing financing costs—a one-standard-deviation improvement in climate policies has an impact on green FDI inflows as a share of GDP that is almost six times as large as a one-standard-deviation reduction in real deposit rates.

Geopolitical fragmentation could pose risks to green FDI inflows into EMDEs, potentially attenuating the effect of country-specific policies on green FDI inflows. Domestic factors (climate policies, structural reforms) and global factors (policy action by large economies) are not the only forces shaping international trade and capital movements. New geopolitical alliances are being forged and will likely affect the patterns of investment documented earlier. For example, Aiyar and others (2023) show that bilateral FDI flows are more likely and larger in value between countries that are politically aligned. Figure 6, panel 2 shows results of an econometric exercise that expands the work of Aiyar and others (2023) and assesses the extent to which political alignment affects green FDI flows. Results show that green FDI flows are more sensitive to political alignment than nongreen flows (Figure 6, panel 2).[9] This, in turn, suggests that an extreme case of geopolitical fragmentation could hamper the diffusion of LCTs to EMDEs and limit countries' ability to attract green FDI inflows from a diverse set of countries by pursuing robust climate and structural policies. Indeed, Gopinath and others (2024) provide evidence of trade and FDI fragmentation along geopolitical lines since 2022.

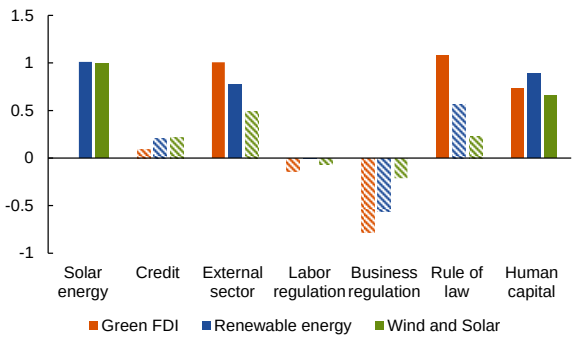
The relationship between climate policies and FDI in renewable energy is stronger in EMDEs that are commodity importers and that have more generation potential. So far, the analysis has focused on studying the impact that climate policies have on the average EMDE. Yet several factors may amplify the catalytic effect of climate policies. Two factors that are critical in the interplay between climate policies and green investment are, on the one hand, endowments of fossil fuels (most prominently oil) and, on the other hand, the potential that a country has to produce renewable energy. For example, climate policies aimed at decarbonization introduced by fossil fuel producers/exporters may be less credible than those introduced by fossil fuel importers, as investors anticipate the difficult trade-offs faced by these countries.[10] In contrast, good geographic conditions,

[7] Each structural subcomponent is positively and significantly correlated with overall green FDI's fixed effects. However, due to correlation among structural subcomponents, each coefficient in the regressions in Figure 7 can lose statistical significance.
[8] We use ex-post real deposit rates to proxy financial costs given their broad availability for countries in our sample. They are typically highly correlated with lending rates and with sovereign spreads (Li, Magud, and Werner, 2023)..
[9] Results hold for flows related to renewable energy and those related to EVs. The recent emergence of green hydrogen limits the ability to conduct bilateral estimations for that flow.
[10] For a discussion of the challenges associated with the energy transition faced by oil-rich Latin American countries, see https://blogs.iadb.org/sostenibilidad/en/are-latin-americas-fossil-fuels-at-risk-of-becoming-stranded-assets-this-decade/.

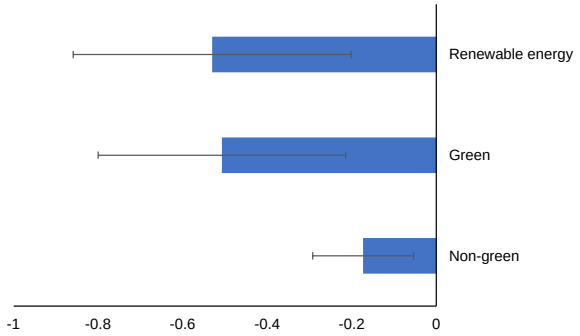
such as solar and wind potential foster FDI in renewable energy (Figure 6, panel 1) and can amplify the impact of climate policies. Figure 7 explores empirically how these country characteristics affect the relationship between climate policies and green FDI. First, Figure 7, panel 1, shows that while the relationship between climate policies and green FDI is positive and statistically significant in both oil producers (exporting) and nonproducers (importers), the relationship is weaker in the former relative to the latter. Figure 7, panel 2, shows that higher solar energy potential, as defined in the World Bank's 2020 Energy Sector Management Assistance Program (ESMAP), is associated with a stronger relationship between climate policies and solar and wind FDI.

Figure 6. Green FDI Inflow to EMDEs in US$ Billion

1. Structural Factors and Green FDI



2. Political Distance and Green FDI



Sources: Financial Times fDi Markets; ESMAP (2020); Climate Policy Database; World Development Indicators; Budina and others (2023); and CEPII's BACI database.
Note: Panel 1 shows coefficients of a regression of the fixed effects derived from the exercise in Figure 5 on structural factors. For renewable energy and solar and wind, regressions also control for solar energy potential. To ease comparison, all right-hand-side variables are normalized to lie between 0 and 1. Solid bars are significant at the 90 percent level. Panel 2 shows coefficients of gravity regressions that control for political distance among other country-level and bilateral variables. Bars represent the coefficient for geopolitical distance. See online Annex 3 for more details. FDI = foreign direct investment.

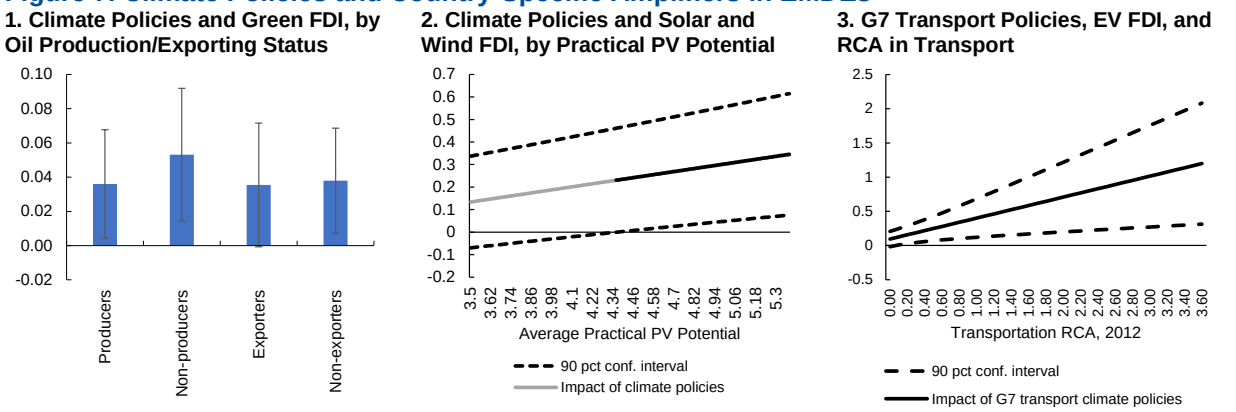
FDI in EVs responds to movements in the climate policy sphere by large countries, and competitiveness in the automobile sector amplifies the role of global policies. As discussed, EV FDI does not appear to be linked to domestic climate policies. Such disconnect reflects the global nature of EV production and the preponderance of key consumption markets, namely China, the US, and the EU. This is a key distinction with renewable energy, which is mostly a local/regional good, thus more sensitive to local policies. To explore the role played by global policies in affecting EV FDI, the baseline specification is modified to include the sum of climate policies pursued by G7 countries and China targeting the transport sector. These include policies like emission standards or subsidies aimed at attracting EV production plants. Global climate transport policies have a positive effect on EV FDI flows (Figure 7, panel 3). However, country characteristics matter—flows to countries that had a comparative advantage in the production of cars and car parts prior to the boom in EVs have responded more strongly to the rise in climate policies in the transport sector. This could reflect, for example, a link between past experience in the auto industry in the destination country and the availability of technical expertise and inputs needed in EV manufacturing.

Evaluating Policy Performance: Evidence from Top Green FDI Recipients

The econometric analysis is useful for studying average patterns but masks the nuanced interplay between climate policy strategies and country-specific factors, calling for a detailed analysis of country strategies to attract green FDI. As documented, there are several forces that shape green FDI flows and how they relate to climate policies. First, country-specific factors can accentuate climate policy's ability to attract green investment. Then, there are differences in the policy mix that each country pursues—incentives versus taxes, sectors targeted, and complementary policies—and how this affects FDI flows. Finally, each type of green FDI flow appears to respond to different factors, including the exact time at which they rose in prominence. All

this suggests that there is value in taking a deep dive into country-specific experiences in attracting green FDI flows among EMDEs, as they can provide broad lessons for other countries.

Figure 7. Climate Policies and Country-Specific Amplifiers in EMDEs



Sources: Financial Times fDi Markets; ESMAP (2020); Climate Policies Database; World Development Indicators; and CEPII's BACI database.

Note: Panel 1 quantifies the impact of a one-standard-deviation change in log climate policies on green FDI, by oil production and export status. Panel 2 quantifies the impact of a 1-percent change in log climate policies on solar and wind FDI, allowing the coefficient for policies to vary with a country's solar energy potential. The gray portion of the line is not statistically significant at the 90 percent level; the black portion indicates statistical significance. Panel 3 quantifies the impact of a 1-percent change in log climate policies by G7 countries and China in the transport sector on EV FDI, allowing the coefficient for policies to vary with the country's revealed comparative advantage in transport at the beginning of the analysis. See online Annexes for details. EV = electric vehicles; FDI = foreign direct investment; G7 = Group of Seven; PV = photovoltaic; RCA= revealed comparative advantage.

This section draws policy lessons from selected countries that have successfully attracted FDI in renewable energy, EVs, and green hydrogen. For renewable energy, it focuses on the experiences of Chile, Uruguay, and Vietnam (see the online Annex for a discussion of country selection). Chile started introducing climate policies in the mid-2000s and is a top recipient of FDI to renewable energy (investments exceeded $1 billion for the first time in 2008 and have been high since then). Uruguay was an early adopter of climate policies and has seen considerable FDI for renewable energy since 2010 and a sharp increase in renewable energy production from 2013 onward. Vietnam has received green FDI inflows exceeding $1 billion annually since 2015, especially for solar and wind energy. Mexico and Nigeria are also included in the discussion to highlight less successful cases. Mexico was a success story until recently, attracting more than $800 million in FDI for renewable energy annually between 2008 and 2020. However, reversals in policies have since led to a strong decline in renewable energy FDI. Nigeria also passed numerous policies but was unable to attract significant sustained renewable energy FDI because of an unconducive business environment and other structural weaknesses. In the case of green hydrogen, the note draws on the experience of Chile, Egypt, and Morocco, which have received substantial FDI announcements in green hydrogen. Finally, for EVs, the note discusses the cases of Hungary, Indonesia, Mexico, and Thailand. Since 2016, Hungary has been receiving considerable amounts of green FDI announcements ($10 billion in 2022), almost all into the construction of EVs and vehicle batteries. Mexico and Thailand saw a surge in FDI announcements for electric vehicles around the time they passed major legislation on electric vehicles—the former received announcements for $10.4 billion over 2021–22; the latter received close to $1 billion in the 2000–22 period. Finally, Indonesia received $18 billion of FDI announcements for EVs and batteries since 2019.

The rest of this section is organized as follows. For each FDI flow, it summarizes the key policy lessons drawn from individual country experiences, also shown in Table 1 (details about individual countries are in boxes 1-3). Then, it discusses the role of international factors in shaping green FDI.

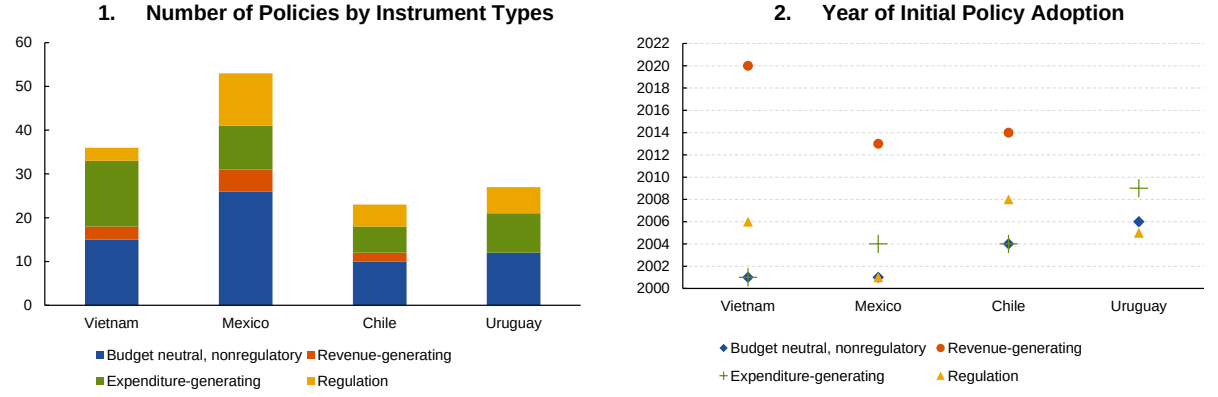
Renewable Energy: A Comprehensive Domestic Policy Portfolio

Beyond solar and wind potential, successful attraction of FDI into renewable energy is based on developing and continuously modernizing the electricity sector's policy framework. Countries that have attracted large FDI inflows into renewable energy implemented a large portfolio of domestic policies in the

electricity sector for the past 10–15 years (Table 1, Box 1). Between 2015 and 2022, Vietnam passed 12 climate policy laws in the sector "electricity and heat" and Chile 11. Leading countries in the attraction of FDI in renewable energy have very diversified policy portfolios in terms of policy types (Figure 8, panel 1). All policy types (revenue-generating, expenditure-generating, regulations, and nonbinding) were used by all four countries in the electricity sector.

Successful countries in the renewable energy FDI space sequence policies, from expenditure-generating policies and nonregulatory budget-neutral policies, to regulation and finally revenue-generating policy. Countries went through a sequence of declaring targets, setting up institutions (for monitoring and enforcing climate policy), removing barriers (for example for the use of renewable energy), offering incentives, and setting regulations. Such a pattern of policy sequencing has been observed for climate policy more generally (Pahle and others 2018; Linsenmeier, Mohommad, and Schwerhoff 2022). Figure 8, panel 2, shows that policy types tend to be introduced in roughly in the same order. Expenditure-generating policies such as subsidies and feed-in tariffs, and budget-neutral, nonregulatory policies such as strategic planning and target setting are the first to be implemented. Countries then move to regulation and take the step to revenue-generating policy (like carbon pricing) only after a while. Vietnam, for example, started in 2001 with a broad "decree" that included strategic planning (budget-neutral, nonregulatory) as well as fiscal and financial incentives (expenditure-generating). In 2006, it introduced energy-efficiency laws, which are classified as regulation. In 2020, it introduced a law establishing a mandate to design an ETS, which is expected to start by 2025. Some of the four countries have carbon prices; however, the carbon price is either very low (about $5 in Chile and $3.3 in Mexico) or covers only a small part of emissions (5 percent in Uruguay), so that it is not likely to have influenced green FDI much yet.[11]

Figure 8. Policy Instrument Types among Renewable Energy Leaders



Sources: Climate Policy Database and IMF staff calculations.
Note: The classification into policy types follows the Climate Policy Database. The chart reflects all policies recorded in the Climate Policy Database.

Creating a domestic market for renewables appears as a key common feature of policy frameworks, while the exact policy is highly country-specific. Production of renewable energy is largely for domestic consumption purposes, albeit recently it is also being used to produce green hydrogen. Therefore, power purchase agreements, or feed-in tariffs, where the government commits to buy the electricity at a fixed rate for some time, were key in developing a domestic market for renewable energy and to reassure investors about the possibility of selling the energy. These agreements typically came with a subsidy element that helped overcome any initial cost disadvantage. In Chile, connecting ideal locations for solar and wind energy with industrial

[11] https://carbonpricingdashboard.worldbank.org/. No revenue-generating policies are shown for Uruguay does not show any revenue-generating policies, because the carbon price, introduced in 2022, is not yet captured in the database.

Table 1. Key Factors for Successful Attraction of Green FDI—Takeaways from Case Studies

	Domestic climate policies				Other domestic factors	International context
	Overall/other	**Expenditure measures**	**Regulation**	**Revenue measures**		
Renewable Energy	• Robust and predictable policy framework. • Policy sequencing, from expenditure to revenue measures	• Support for the development of technologies • Support for market creation, including subsidies for solar rooftops, feed-in-tariffs and power purchase agreements • Investment in complementary infrastructure, for example electricity grid extension and energy storage	• Removal of obstacles for renewable energy use, for example allowing solar energy sale to the grid • Limits/bans on fossil fuel use in electricity generation • Targets for the share of renewables in the electricity mix	• Carbon taxes or ETS for fossil fuels in electricity generation	• Trade and financial openness; low country risk • Renewable energy potential	• International partnerships (JETP)
Green Hydrogen	• Comprehensive national strategy • Export support through alliances with countries with growing demand • Reinforcing international coordination to secure financing	• Investment in storage capacity • R&D for hydrogen production, storage technologies • Investment in cost reductions along the supply chain	• Regulatory framework for the development of a national hydrogen market and for regional industrial integration • Streamline permitting process for the development of projects		• Availability of renewable energy	• Advanced economy initiatives to buy green hydrogen
Electric Vehicles	• Comprehensive national strategy that allows covering several policy areas simultaneously	• Incentives for EV production and for EV domestic adoption	• Minimum shares for EVs to provide clear signals to market participants		• Existing vehicle production potential • Market size or access	• Partnerships with large EV producers • Benefits from supranational policies (EU)

centers and the capital was also key to ensure a market for renewables. Box 1 discusses in greater detail the policies put in place in selected countries.

Success in attracting FDI into renewable energy is contingent on maintaining an attractive policy framework and giving clear policy signals. Mexico's experience is a prime example of the importance of a consistent policy framework. While Mexico passed new climate policies in recent years,[12] the cancellation in 2019 of the auction system, which had been decisive for attracting renewable energy FDI in previous years and the renewed support to the fossil fuel sector, contributed to the strong decline in renewable energy FDI in recent years and a plateauing in the share of solar and wind energy since 2020.[13] Moreover, a large number of climate policies do not guarantee large FDI inflows for renewable energy**.** Nigeria stood out for passing 12 climate policies between 2007 and 2019 and a further five since then. Policies include a law on feed-in tariffs for renewable energy in 2016 that also specified procedures for renewable energy auctions. However, the country received very little FDI for renewable energy. The exceptions are two FDI announcements worth $5 billion in 2014 and $1.2 billion in 2016. At the same time, the share of solar energy in the electricity mix remains below 0.15 percent, suggesting some of the FDI announcements did not materialize. The lack of success in attracting green FDI despite a large climate policy portfolio in the electricity sector has been attributed to "policy uncertainty and weak financing mechanisms" (Isah and others 2023) and to structural factors such as "structural gaps, policy discordance, unconducive investment climate, questionable commitment of stakeholders to transit to renewable energy and inability to attract robust private investments" (Nwozor and others 2021).

Green Hydrogen and EVs: Decisive Green Industrial Policy

The attraction of FDI for green hydrogen and electric vehicles, two nascent forms of green FDI, was facilitated by pre-existing conditions. Countries that received substantial FDI for these technologies presented favorable investment conditions. Chile and Morocco, for example, have great potential for renewable energy and hence for the production of green hydrogen. Indonesia, Hungary, Mexico, and Thailand were already producing cars, and hence had the infrastructure for the production of EVs in place. In addition, Chile, Indonesia, Hungary, Mexico, Morocco and Thailand are investment-grade countries and thus able to absorb FDI with relatively low risk for investors.

In addition, countries implemented decisive government action to attract green hydrogen FDI and coordinated policy with the EU. As discussed in the previous section, attracting FDI for renewable energy was associated with a large and diversified portfolio of climate policies that were introduced gradually. Renewable energy's long track record and dramatic technological improvements meant that adjustments to policy frameworks were necessary. In contrast, electric vehicles and green hydrogen appeared only very recently and there was no time to unfold policy gradually. Countries that received large FDI inflow announcements (Chile, Egypt, and Morocco) passed some form of "national strategy" for green hydrogen in 2020 or 2021. These can be considered a form of industrial policy and include cost reductions along the supply chain, plans for regional industrial integration, the creation of industrial clusters, a national storage plan, reinforcing international coordination to ensure financing, the development of a national hydrogen market, the creation of national research and development capacity, and support for the export of hydrogen.[14] All three countries received several billions in investment in green hydrogen from European Union and UK investors, which might have communicated to potential producers that a comprehensive policy framework would be helpful to secure investments. The single, comprehensive policy and immediate inflow of substantial investment stands in contrast to the much more gradual and co-evolutionary development of policies and investments in renewable energy. Investments

[12] Several of these policies set targets for renewables: one sets up a registry for greenhouse gases and one organizes a trial phase for an ETS. Thus, while the number of policies can be useful for country comparisons, at the country-level quality matters.

[13] Uruguay has also reached a plateau in the share of renewable energy in electricity production but at a high level of 90 percent.

[14] https://www.mem.gov.ma/Pages/actualite.aspx?act=278.

in green hydrogen seem to involve a high degree of coordination between private and public actors in investing and receiving countries. Each country's case is discussed in greater detail in Box 2.

For EV production, successful countries also developed national strategies, with the exception of Hungary, which relied on a diplomacy-based approach. Between 2019 and 2021, Indonesia, Thailand, and Mexico passed a "national strategy" for EVs (see Box 3). These included incentives for investments into EV production and also policies to encourage domestic adoption, which complement production incentives by creating a domestic market. Around the passing of the strategies, countries started receiving substantial FDI for EV production. Hungary is an interesting variant of the strategy. As an EU member, it is subject to 21 laws on decarbonizing road transportation passed between 2000 and 2022, including the ban on the sale of combustion engine vehicles by 2035, which likely created favorable investment conditions for electric vehicles. While Hungary did not pass any national legislation for the production or purchase of electric vehicles, it does offer subsidies and tax breaks for EV production.[15] The subsidies seem to be offered as part of agreements with manufacturers.[16] Importantly, Hungary engaged in intense bilateral diplomacy with the Chinese government to attract FDI for EV.[17]

International Context for Policy Success

Large green FDI flows have coincided with recent major multi-country efforts to promote climate mitigation. Prior to 2018, green FDI flows followed conventional wisdom that "good policy attracts investment." While policies remain important, recently green FDI has been strongly linked to climate policy coordination efforts by large groups of countries. Such coordination aims at matching demand and supply and achieving scale effects by ramping up demand simultaneously. The country groups involved are the EU for investing in green hydrogen, countries contributing to the 2022 climate conference, International Partners Group (IPG) working on Just Energy Transition Partnerships (JETP) and the EU in their domestic decarbonization efforts. The Green Climate Fund, a fund for climate finance within the framework of the United Nations Framework Convention on Climate Change, has not been central despite a mandate to involve private investors, partly because the principles of the Global Partnership for Effective Development Co-operation are difficult to reconcile with private interests (Kalinowski 2024).

Multilateral Initiatives for Green Hydrogen

The EU facilitated green hydrogen FDI to EMDEs through strategic initiatives and engagement with potential recipient country governments. In July 2020, the EU passed an "EU Hydrogen Strategy," consisting of 20 key actions.[18] Actions 18-19 are devoted to cooperation processes with potential trade partners for green hydrogen in Africa and Eastern Europe. In 2022, this was followed up with a specific initiative to cooperate with Chile on green hydrogen with the objective to "boost investment opportunities in the field of green hydrogen." [19] The initiative covers activities such as "fostering business cooperation," which explains why this initiative is reflected in private FDI. The 2020 initiative targeting (North) African countries was followed by green hydrogen FDI in 2022 in Morocco and Egypt. The 2022 initiative with Chile was followed by FDI to Chile in 2023. A big part of all green hydrogen FDI to EMDEs has happened under these EU initiatives (while strategies in the US and China target mostly domestic investment), showing the key role of investing governments' efforts in spurring the establishment of policy frameworks in recipient countries to align the interest of investing and receiving countries.

[15] https://cepa.org/article/xi-and-china-electric-cars-drive-into-hungary/.
[16] https://www.france24.com/en/europe/20240509-china-clean-car-manufacturers-find-european-foothold-hungary-ev-orban-xi-jinping.
[17] https://www.politico.eu/article/hungary-pm-viktor-oran-china-ties-ev-clean-car-investments-tensions-eu/.
[18] https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen/key-actions-eu-hydrogen-strategy_en.
[19] https://www.eeas.europa.eu/delegations/chile/developing-chiles-green-hydrogen-potential-fast-forward-carbon-neutrality_en?s=192.

Box 1. Climate Policies in Top Recipients of FDI in Renewable Energy

Chile showcases the link between climate policies, FDI for renewables, and increases in the share of renewable energy in electricity production. Chile's success in attracting FDI in renewable energy followed the systematic introduction of climate policies in the electricity sector since 2004, including FITs in 2004 and 2012 and a carbon tax in 2014. The integration of markets in ideal locations for solar and wind energy in the north with industrial centers and the capital in the south was key to improve efficiency (Gonzales, Ito, and Reguant 2023) and increase solar energy generation (Figure B1, panel 1). The coal power phase-out announcement in 2021 provided additional security for investors in renewables. In addition, a mature electricity market, a sound policy framework (openness to trade and FDI and a legal framework for investment), and one of the best solar potentials globally (Figure B1, panel 2) have helped to attract FDI.

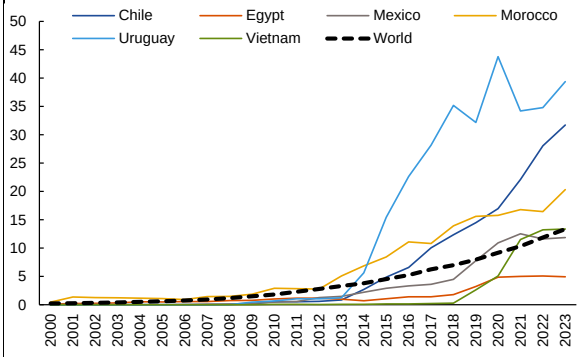
Uruguay was an early adopter of renewable energy and attracted steady inflows of FDI. It passed laws on renewable energy in 2009, including support for solar and wind energy. This was followed by additional policies, including a carbon tax in 2022. Power purchase agreements, where the government pays electricity at a given price, were key for the rapid development of wind energy (Corrêa, Uriona-Maldonado, and Vaz 2022). Other policies included a law on research and development and training for solar energy, a decree on wind power auctions, and a law giving wind power priority in dispatching energy. These policies were accompanied by high levels of green FDI and a sharp increase in renewable energy production since 2013.

Mexico, an early adopter of climate policies among EMDEs, has seen recent reversals. It enacted pollution control policies in the 1990s and since 2001 has been consistently introducing policies that reduced solar and wind energy costs. Major policies include the 2014 carbon tax and the energy transition law of 2015. Since then, it passed policies with application to electricity and heat every year and policies to improve the regulation of the electricity sector. The success depended strongly on a law for power auctions (where the government bought renewable energy from the lowest bidder), which was introduced in 2016 and cancelled in 2019. Progress stalled in recent years and the government's financial support for domestic fossil fuel production increased (IMF 2023b). As priorities shifted, green FDI inflows dropped since 2020 and solar and wind energy production stagnated.

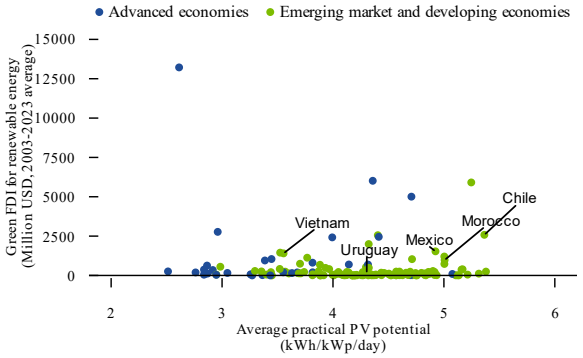
Vietnam's success has been bolstered by international initiatives. A tax relief for renewable energy was passed in 2013 and FITs in 2017, with the latter considered key for the solar boom (Do and others 2020). An ETS pilot is expected to start by 2025 (IMF 2023c). The LCOE for solar PV is below the FITs for capital costs of up to 10 percent (IEA 2021). The year 2015 was a turning point for green FDI in Vietnam—since then, inflows have been consistently high and in 2022 Vietnam received investments of $13.6 billion for wind energy. This coincided with an agreement on a Just Energy Transition Partnership between the International Partners Group and Vietnam, development partners organize funding and Vietnam commits to reducing coal use and building renewable energy capacity.

Figure 1.1. Key Outcomes in Renewable Energy

1. Share of Solar and Wind in the Electricity Mix



2. Green FDI in Renewable Energy versus PV Potential



Sources: Financial Times fDi Markets Database; Ember; World Bank; and IMF staff calculations.
Note: FDI = foreign direct investment; PV = photovoltaic.

Other green hydrogen FDI occurred in the context of government negotiations at COP27, further highlighting the role of multilateral government coordination. A substantial part of green hydrogen FDI to EMDEs happened in the immediate context of COP27 in Egypt. By far the largest beneficiary was Egypt, but Djibouti also received an investment of $2.3 billion in 2022. The only major green hydrogen FDI to an EMDE without EU involvement or climate conference context is an investment from Malaysia to India, which was done by Malaysia's state-owned energy company Petronas. Taking together all these FDI flows, we can conclude that policy alone might not suffice to attract green hydrogen FDI, even if it is a comprehensive "national strategy." The government might have to link into international coordination efforts to coordinate supply and demand and provide additional reinsurance to private investors.

Just Energy Transition Partnership

Increased FDI in renewable energy in Vietnam coincided with an agreement on a JETP. In December 2022, the IPG, consisting of European and North American countries, and Japan, agreed on a JETP with Vietnam.[20] The IPG and Vietnam agreed on financing $15.8 billion for renewable energy, without specifying the type of investment. In this context, Vietnam made a range of commitments, regarding limiting greenhouse gas emissions from electricity generation and the use of coal, as well as ambitious renewable energy targets. Also, for 2022, the fDi Markets database recorded a $13-billion investment in wind energy in Vietnam from the United States. Limited transmission grid capacity and policy uncertainty have been key barriers for the development of renewable energy in Vietnam (Do and others 2021). The JETP might have increased investor confidence in more infrastructure investments and a stronger commitment to renewable energy. Further JETP agreements have been reached with South Africa in 2021, Indonesia in 2022, and Senegal in 2023. In these countries, no major inflow of FDI into renewable energy has been observed yet, but it might still be coming.

Supranational Policy

Hungary benefited from a very persistent climate policy for road transportation in the EU. Hungary is exceptional in that the country was able to attract significant FDI EV production without a national policy basis. This was explained to some extent by a bilateral diplomatic effort with the Chinese government. The importance of diplomatic initiatives is reflected in the fact that some of Hungary's neighbors with large car manufacturing industries, like Slovak Republic and Romania, have been much less successful in attracting FDI for EVs. In addition, EV FDI into Hungary has been bolstered by EU policies for heavy- and light-duty vehicles between 1999 and 2022, including a ban on combustion engine vehicles by 2035. These laws apply in all member states, including Hungary. They set gradually higher emissions and efficiency standards for cars, which helped create a market for low-emission vehicles and provided investment security. Two of Hungary's neighbors, Austria and Slovak Republic also received FDI for EVs in recent years, albeit amounts were significantly smaller compared to Hungary's. This points to a complementarity: For Hungary, the good fundamentals of the EU law and targeted diplomacy reinforced each other.

Conclusion

Attracting different types of green FDI requires a policy approach suitable for each technology. Econometric evidence and case studies show the nuanced relationship between climate policies, country characteristics, and green FDI. These relationships will depend crucially on the type of green FDI.

The link between domestic climate policies and FDI is most clearly seen for renewable energy, where the steady development of comprehensive policy frameworks is associated with higher FDI inflows. Econometric evidence shows that a larger number of climate policies is associated with higher

[20] https://ec.europa.eu/commission/presscorner/detail/en/statement_23_6243.

FDI inflows in renewable energies, pointing to the importance of the gradual development of a policy framework that is up to date with technological progress, as highlighted in the case studies. In EMDEs, the enhancement of the policy framework entails the adoption of multiple instruments which are typically introduced in the order of difficulty, starting with government expenses (like subsidies), then regulation, and finally government revenues (like carbon taxes). Some policies are critical to remove barriers to renewable energy use, but the key policies for obtaining FDI in renewable energy are those that ensure a reliable revenue stream to investors. This can take the form of feed-in tariffs, auctions, or even connecting regional markets with different price levels. While countries need a large and diverse set of policies, their sheer number is not sufficient, as shown by the experience of countries with structural weaknesses that implemented many policies but received little FDI inflow. Moreover, the experience of some countries shows that if the policy focus is diverted, FDI inflows in renewable energies could stall.

Boosting FDI in renewable energy can have the additional benefit of helping attract green hydrogen projects. The successful attraction of FDI flows in green hydrogen projects is closely related to decisive national strategies to develop the sector and to renewable energy potential. Thus, countries that strengthen their renewable energy capacity, through investments in the sector, the gradual adoption of climate policies, and credible commitments, are better placed to attract FDI in green hydrogen.

EMDEs, especially those with national strategic plans and past specialization in the sector, have benefited from a push by AEs to accelerate the production and sales of electric vehicles. EV FDI to EMDEs increased substantially since 2015. This notable uptick coincided with growing demand for EVs in AEs and policy action aimed at boosting production. However, not all EMDEs have benefited from these patterns. Econometric findings and case studies show that the largest recipients appear to be countries that already had a comparative advantage in the automobile sector and those that actively sought to attract investment in the sector establishing a strategic sectoral strategy involving subsidies or through bilateral diplomatic efforts.

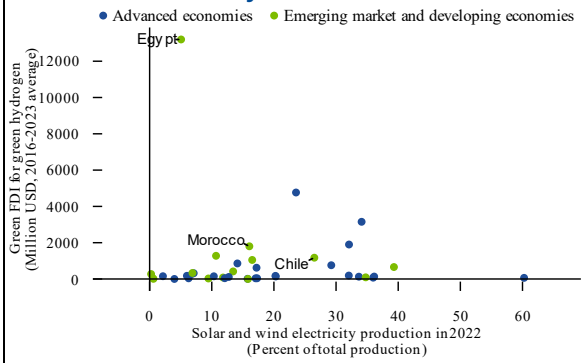
Green FDI flows to EMDEs are also shaped by international initiatives by AEs. Green FDI success stories are linked to major policy initiatives from AEs. For example, the International Partnership Group is investing large amounts in some of the countries entering the Just Energy Transition Partnership (for example, Vietnam). EMDEs, especially those with the right natural conditions, have benefited from strategic alliances with the EU, which has been promoting investment in green hydrogen. The importance of these global initiatives has resulted in a “sudden take-off” dynamic of green FDI in many EMDEs, whereby green FDI inflows into EMDEs surge in the aftermath of big international initiatives.

Structural factors do not seem to affect green FDI dynamics, but they explain cross-country differences in levels. Structural reforms and slow-moving variables such as human capital do not systematically relate to green FDI dynamics. However, external sector openness (to trade and capital flows), rule of law, human capital, and solar energy potential explain cross-country differences in green FDI levels. The latter complements the findings by Cai and others (2024), who stress the role played by structural reforms targeting external sector openness and governance to attract official climate finance.

Box 2. Successful Attraction of Green Hydrogen FDI: Top FDI Recipients

Ambitious strategic goals helped Morocco position itself as a producer of green hydrogen and become a large recipient of green FDI announcements. In 2015, Morocco adopted an ambitious target of reaching 52 percent renewable energy by 2030. More climate policies in the electricity sector followed, including a decree to create a training institute, a national greenhouse gas inventory system, and a support program for green startups. The country received FDI for renewable energy regularly between 2014 and 2018 and the share of renewable energy increased and stayed well above the global average. The 2021 National Roadmap for Green Hydrogen opened the door to substantial FDI inflows for green hydrogen. Building on the country's high share of renewable energy, green hydrogen has been the driving force behind Morocco's green FDI announcements, including the extraordinary amount in 2022 of $11.5 billion. These investments have originated in Italy and Luxembourg, reflecting the strategic partnership between the EU and Morocco for green hydrogen production and trade (Plank and others 2023).

Figure 2.1. FDI in Green Hydrogen and Solar and Wind Electricity Production



Source: Financial Times fDi Markets database; World bank; and IMF staff calculations.
Note: FDI = foreign direct investment.

Chile has obtained major FDI investment announcements into green hydrogen, preceded by substantial FDI for solar and wind energy. As discussed, Chile developed a strong portfolio of climate policies in the electricity sector and drew substantial FDI for renewable energy, from a diversified group of investors, including Spain (24 percent), the UK (18 percent), and Ireland (12 percent). The country's advantageous conditions for both solar and wind power make it a prime candidate to produce green hydrogen. The national green hydrogen strategy of 2020 aims at exploiting this objective systematically. Action areas of the strategy are promoting domestic and export market standards, safety, and piloting, social and local development, and capacity building and innovation (Government of Chile 2020). Chile does not yet produce green hydrogen at industrial scale, but is attracting significant investment to the sector (Bartlett 2022). An investment of $5 billion into 64 industrial projects is expected for green hydrogen (France 24 2024). The simultaneous transition to renewable energy and green hydrogen production for export is consistent with research that finds that the two developments are highly complementary, as excess solar and wind energy production can be used to produce green hydrogen (Figure 2.1). Green hydrogen could even allow the country to reach 100 percent renewables without the use of batteries (Ferrada and others 2023; Jorquera-Copier and others 2024).

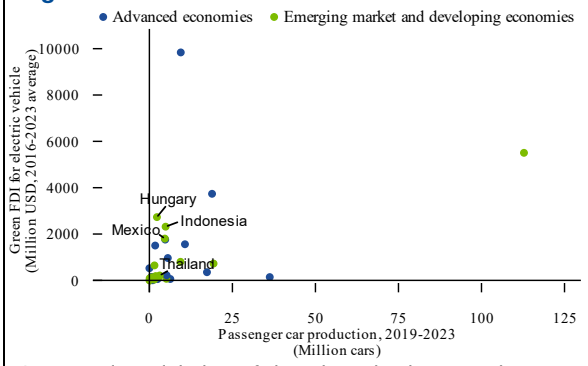
Leveraging its green hydrogen policy and hosting the 2022 climate conference, Egypt has attracted an extraordinary amount of FDI announcements from a very diverse set of investors. Egypt also adopted a single law for green hydrogen production and subsequently received substantial investment announcements. Two features stand out for Egypt. First, Egypt received announcements for the extraordinary amount of $92 billion for green hydrogen. Second, these investments originate from a very diverse range of partner countries: five EU countries, the US, Australia, two Middle Eastern neighbors, and India. It appears that Egypt was extremely successful in leveraging its host country status for the 2022 United Nations Climate Change Conference (COP27).[21] At the same time, Egypt has a share of only 5 percent of solar and wind energy in electricity production so far and this share stayed stagnant between 2020 and 2023. Egypt received exceptional FDI announcements, despite having a much lower share of renewable energy in its electricity mix than other countries. But the materialization of some of these investments may require stepping up quickly renewable energy production.

[21] https://www.reuters.com/world/middle-east/egypt-signs-framework-deals-bid-launch-hydrogen-industry-2022-11-15/.

Box 3. FDI in EV Production: Selected Country Experiences

Hungary has been exceptionally successful in attracting FDI announcements for the construction of EVs in the last five years. Hungary has been receiving considerable amounts of green FDI for the construction of EVs and vehicle batteries since 2016. China contributed $8 billion, mostly for EVs, Korea contributed $6.1 billion and Germany $5.6 billion. Hungary was already an important car manufacturer (Figure 3.1), so its FDI inflows are in line with the econometric result that existing automobile manufacturers are more likely to receive FDI for EVs. Its success has been described as a result of the government's active engagement with China, which has also raised concerns about increasing dependence on Chinese investments. As discussed in the main text, Hungary has also benefited from EU policies on transportation and benefits from the EU market access. The Financial Times projects that, by 2031, Hungary will be in second place for electric vehicle production, behind Germany.

Figure 3.1. FDI in EVs and Car Production



Source: Financial Times fDi Markets database; Ember; International Organization of Motor Vehicle Manufacturers; and IMF staff calculations.
Note: FDI = foreign direct investment.

A vibrant automobile industry and government support helped Indonesia attract considerable FDI for EVs. Indonesia is a top producer of passenger vehicles among EMDEs. To benefit from a global surge in FDI flows in EVs, Indonesia's "downstreaming" strategy (aimed at reducing exports of raw materials in favor of exporting higher value-added products) hinges, inter alia, on fiscal incentives and nontariff measures. This helped boost exports of refined nickel and FDI into the e-battery/EV value chain. Indonesia passed the "Presidential Regulation 55/2019 on electric vehicles" in 2019, which specifies domestic content rules and provides fiscal and financial incentives for investment in EV production (Baker McKenzie 2019). This was followed by policies to enhance domestic adoption of EVs, most importantly subsidies for purchases. While coming with fiscal costs and potential unintended effects both at home and abroad (misallocation, rent-seeking, and cross-border spillovers from nontariff measures), the authorities' strategy[22] has propped FDI for EVs. Since 2019, Indonesia received $18 billion of FDI announcements for EVs and batteries. These come from a diversified set of East Asian trading partners.

Mexico and Thailand saw a surge in FDI announcements for electric vehicles around the time they passed major legislation on electric vehicles. In 2021, Mexico introduced a "National Strategy for Electric Mobility Vision 2030," on the footsteps of $1.3 billion in FDI announcements for EVs between 2016 and 2019. It includes measures to increase the domestic adoption of EVs, like tax breaks for charging stations, and subsidies for production available to domestic and international investors.[23] Mexico received FDI announcements for $10.4 billion over 2021–22. The US manufacturers, who produce in Mexico for the US market, contributed $6.9 billion during 2016–22 to the total. A similar pattern occurred in Thailand. In 2020, Thailand introduced the "National EV Roadmap." The roadmap is a three-step plan with increasing ambition, including policies to support local adoption and subsidies to investors for electric vehicle production in Thailand.[24] Between 2020 and 2022, the country received $907 million in FDI announcements for electric vehicles, up from the $467 million between 2016 and 2019. In Thailand's case, China is the main contributor with $707 million.

[22] See IMF's 2023b Indonesia Article IV for details.
[23] https://sanchezdevanny.com/en/trending/reports-and-legal-articles/national-electric-mobility-strategy.
[24] https://paultan.org/2021/05/18/thailand-reveals-its-ev-roadmap-three-phase-plan-into-2030-30-of-local-production-to-be-evs-by-then/.

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