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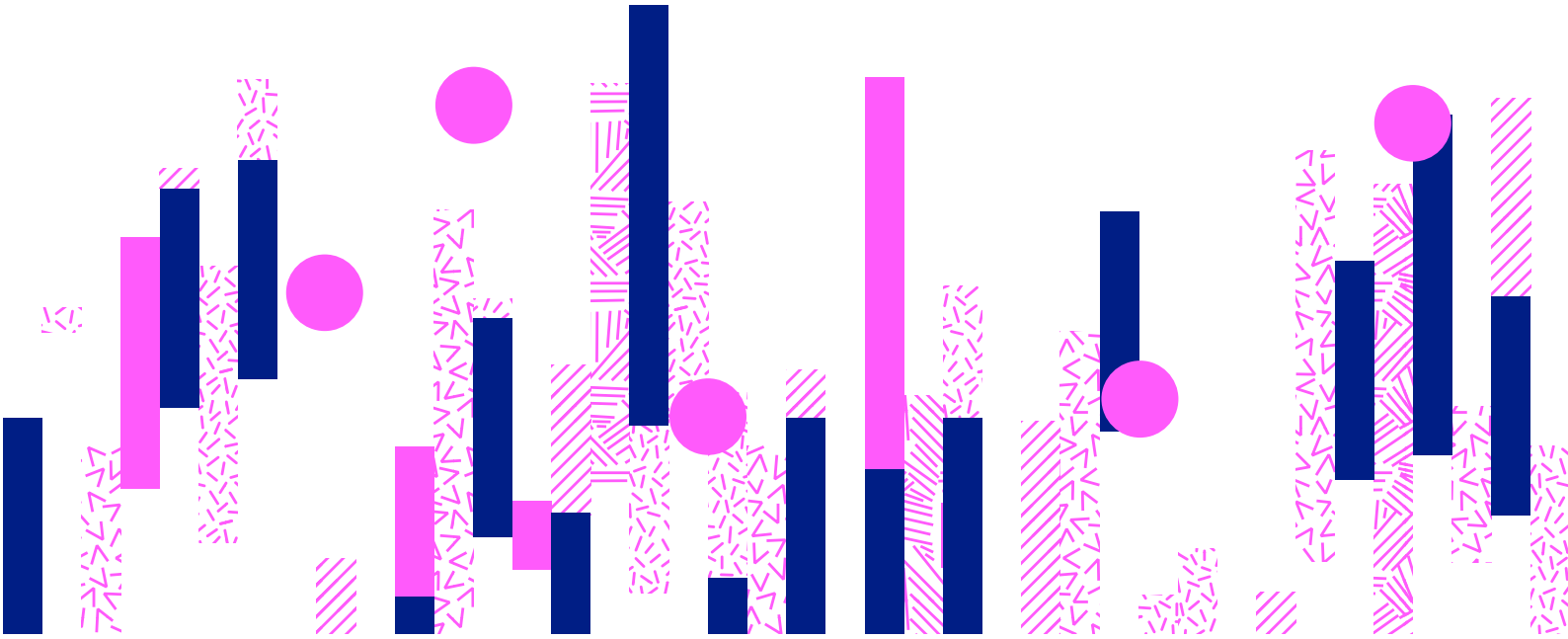
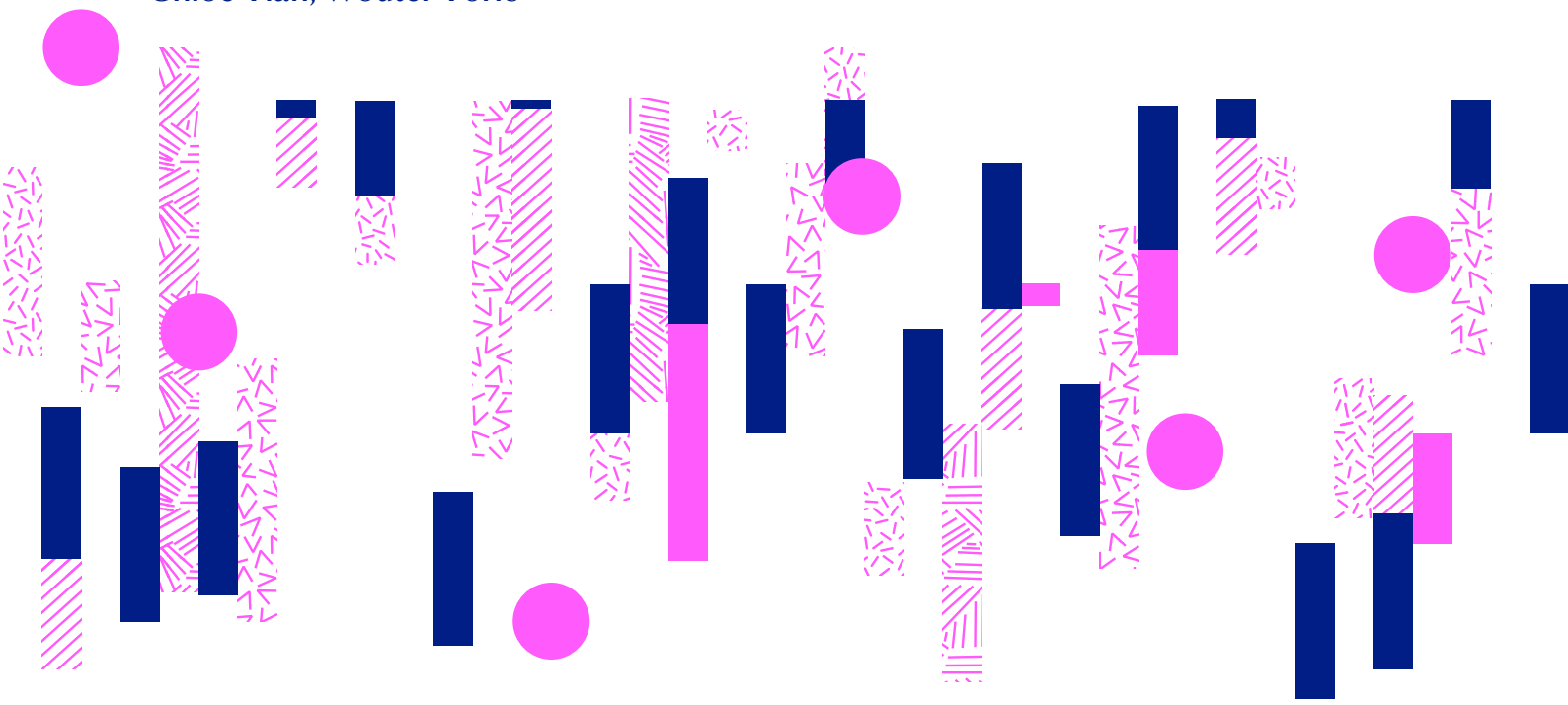


Determinants of EU Greentech investments: the role of financial market conditions

Gabrielle de Haan Montes, Salome Gvetadze, Felina Lottner, Henry Milander, Xianxing Pan, Chloe Tian, Wouter Torfs



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Executive Summary[1]

This paper investigates the role of financial market conditions on Greentech investment activity. By endorsing the Paris Agreement on climate change, the European Union has committed itself to a path of sustainable economic growth. Greentech innovation is a key element of Europe's environmental and net-zero strategies and innovative start-ups are key drivers of Greentech innovation. Breakthroughs in the sphere of Green technology can ensure the EU reaches its environmental targets in a cost-efficient manner, by lowering the marginal CO2 abatement costs and the marginal cost of pollution reduction. Greentech innovation can also help the EU to respond and adapt to the reality of an altered climate. Moreover, a vibrant European Greentech ecosystem can position the EU economy at the forefront of the global environmental agenda, as the expected increase in the demand for green products and services presents unprecedented growth prospects for the European Greentech sector.

To date, little is known about the factors that determine the framework conditions for a fast-growing Greentech sector. In particular the role of the financial market environment has been underexplored. Therefore, this report contributes to the understanding of how Greentech ecosystems develop by considering the impact of different aspects of a country's local financial market environment on the prevalence of Greentech investment deal activity.

The empirical analysis uses a European country-level panel dataset on investments in the early stage (VC) and later-stage (PE-growth) private equity market, sourced from the PitchBook database and models Greentech deal count in a given EU country as a function of a set of indicators that proxy national financial market conditions, categorised in three groups: access to finance conditions, the debt and the equity environment. The analysis furthermore controls for a number of indicators that proxy a country's general macro-environment and regulatory frameworks.

Our findings show that the occurrence of IPOs in a country incentivises Greentech investors and entrepreneurs and stimulates deal activity in earlier stages of the market. More precisely, we find that doubling the number of IPOs in a given country leads national Greentech deals to increase by 13%, two years later. This implies that, apart from providing a direct scale-up channel, stimulating the availability of scale-up financing provides strong incentive effects in earlier stages of the market. The existence of such second-round, bottom-up incentive effects indicates that policy makers should invest effort into ensuring the market provides sufficient scale-up opportunities, as the return to such policies is likely to exceed the benefits related to the direct, first-round effect. A number of recent European investment initiatives, such as the European Scale-up Action for Risk capital (ESCALAR), the European Tech Champions Initiative (ETCI) and EIF's IPO Initiative, aim to fill this policy void.

[1] *The paper is a result of the 2021-2022 LSE-EIF Capstone Project, in cooperation with the EIB Institute. It benefited significantly from the invaluable input of Carmen Alonso, Prof. Stephen Jenkins, Helmut Kraemer-Eis, Barry McGrath and Lyubomira Trendafilova. All remaining errors are our own.*

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1 | The EU Greentech Ecosystem

By endorsing the Paris Agreement on climate change, the European Union has committed itself to follow a path of sustainable economic growth. Innovations in the field of environmental sustainability, commonly referred to as Greentech, are a key element of Europe's environmental and net-zero strategy. Innovative breakthroughs in the sphere of Green technology lower the marginal cost of pollution reduction and can ensure the EU reaches its environmental targets in a cost-efficient manner. Moreover, they can help EU firms to respond and adapt to the reality of an altered climate.

Start-ups and other young, innovative enterprises are key drivers of Greentech innovation. Despite their importance in driving green innovation, small firms typically struggle to access external financing, in particular equity products. According to the ECB's SME Access to Finance (SAFE) survey, 11% of SMEs in Europe considered equity a viable financing option, while only 1% have actually used it (ECB, 2022). This could potentially be a significant hurdle for the growth of the EU VC/PE ecosystem. This holds true also for Greentech investments. Despite the fact that in Europe 70 to 80% of PE Mid Market funds and VC funds already incorporate environmental and climate considerations into their investment decisions, the Cleantech Group found that EU Greentech ventures attract only 6.9% of global Greentech growth and scale-up capital (compared to 54% for North America), possibly indicating a lack of key support mechanisms required for SMEs to successfully complete their product development cycle, from investments in R&D expenditures to product commercialisation (Besnainou and Chatburn, 2021).

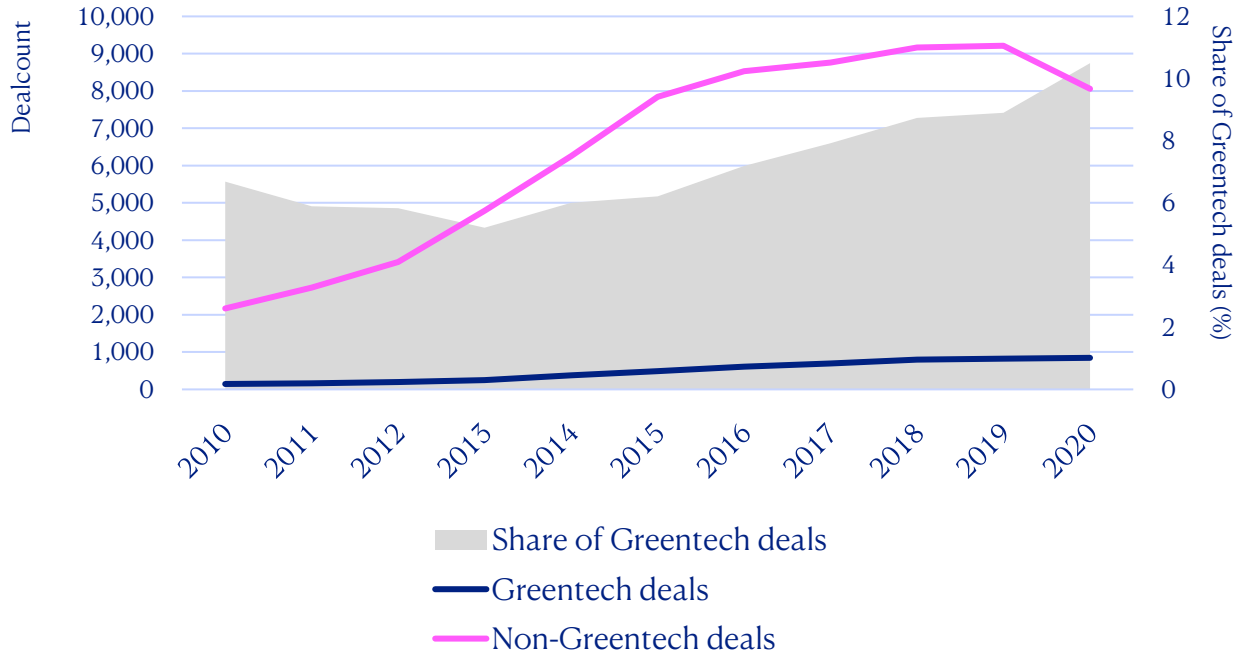
To date, little is known about the factors that determine the framework conditions for a thriving Greentech investment ecosystem. In particular the role of the financial market environment has been underexplored. Therefore, this report contributes to the literature on the determinants of Greentech investment activity by focusing on the impact of financial market conditions on Greentech deal count. The different financial market proxies are categorised into three groups: the debt environment, the equity environment and general access to finance indicators.

We measure Greentech investment activity by counting the annual, country-level early-stage (e.g., accelerators, venture capital (VC)) and growth private equity (PE) deals, aggregated from deal-level microdata that are sourced from the PitchBook database. We choose deal count, rather than deal volumes, because almost a third of deals in the PitchBook database do not report on exact financing volumes. Our final sample consists of 5,391 early-stage financing deals (PE+VC) in companies that were headquartered in one of the 27 EU member states, covering all

investments that were classified by PitchBook under the verticals 'Cleantech', 'Climate tech' and 'Agtech'.[2]

Statistics derived from the resulting sample show that Greentech investment activity has increased significantly in recent years (Figure 1), in particular from 2013 onwards. Growth in the Greentech deal activity outpaced the aggregate PE+VC market, indicating the increase is not attributable to a mere scale effect.

Figure 1: Evolution of Greentech deals and their share in the overall market



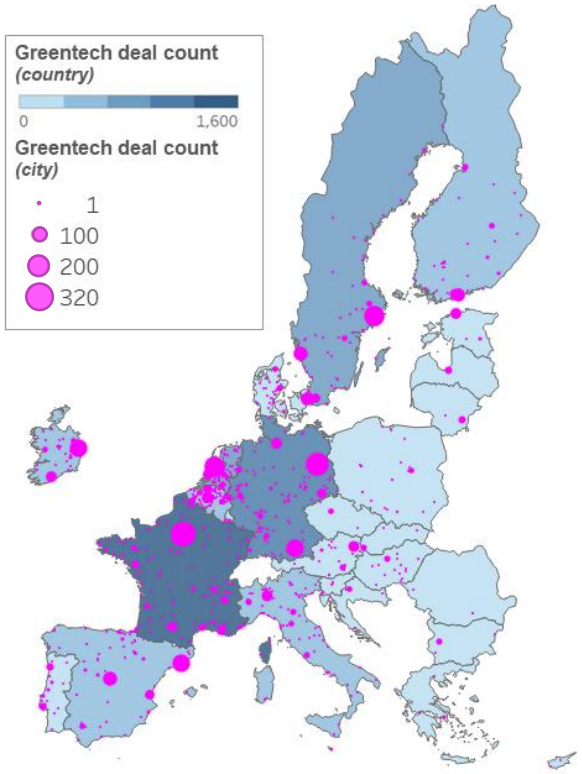
Source: PitchBook, authors' calculations

The European Greentech deals that serve as the basis for this analysis are mostly concentrated in Centre and Northern Europe (Figure 2). France and Germany – followed by the Netherlands, Sweden and Spain – emerge as Greentech leaders in terms of total deal counts between 2010 and 2020. The distribution of Greentech investment activity around Europe's most important capital hubs is in accordance with the findings of earlier EIF papers, which studied the geographic distribution of European aggregate VC financing (Kraemer-Eis et al., 2016). Eastern European and Italian Greentech markets appear to lag the rest of Europe, both in absolute and relative terms (Figure 2).

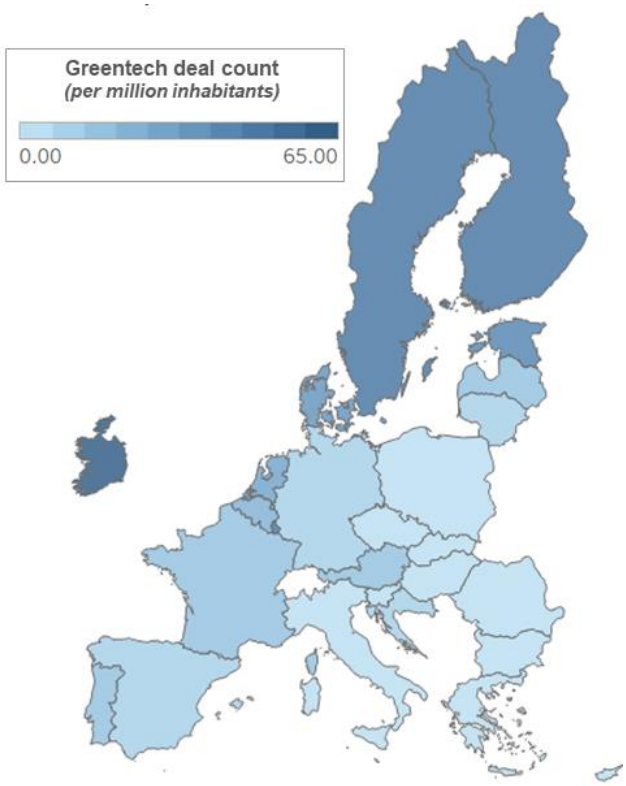
[2] *Verticals are used by PitchBook to classify "companies focusing on a shared niche or specialized market spanning multiple industries" (PitchBook website). For the purpose of this report, the term 'Greentech' will be used as an overarching term to refer to all three verticals, especially since many of the deals in the dataset are tagged with more than one of the above-mentioned verticals and the distinction is often not clear-cut. See Annex I for a detailed description on the PitchBook database and the sample selection process.*

Figure 2: Greentech deals recorded in the PitchBook database (EU-27)

a) Greentech deals (2010–2020), absolute count



b) Greentech deals (2010–2020), per million inhabitants



Source: PitchBook

The concentration of Greentech deal activity around major urban hubs is likely to be rooted in the presence of knowledge spillovers and labour market scale effects, which lead to agglomeration externalities that cause industries to concentrate in specific regions (Torfs, 2015; Crisanti et al., 2021). Such effects are particularly relevant for companies focussing on Greentech, whose R&D cycles and production processes are characterised by a high degree of knowledge intensity and require a highly educated labour force with a specific, technical skill set. In this context, Turkina and Oreshkin (2021) document the importance of inventor-networks on the emergence of smart cleantech innovations in urban areas, which indicates knowledge spillovers are indeed a likely driver of the clustering pattern illustrated in Figure 2.

To document the potential existence of regional technological specialisation patterns, we decompose the Greentech space into eight thematic subcategories (Table 1). The first two categories capture deals related to clean energy generation and energy management, respectively, while the third and fourth categories include deals related to electric vehicles (EV) and alternative clean mobility technologies. Categories five, six and seven entail deals related to agriculture, environmental management, as well as clean industry and production (with the eighth category created as a catch-all, containing mostly Greentech services, such as

environmental consulting). Deals are assigned to a category based on keywords extracted from the deal description.[3]

Patterns of technological specialisation vary within the EU (Figure 3). Clean energy generation (32.1% between 2010–2020), as well as innovations in the area of energy efficiency, storage and infrastructure constitute the largest part of Greentech activity across the EU (27.6%) and deals in these categories are prevalent across all EU-27 countries, with a large fraction of deals based in large hubs such as Paris, Berlin, Stockholm, and Amsterdam.

Table 1: A decomposition of the Greentech space in eight categories

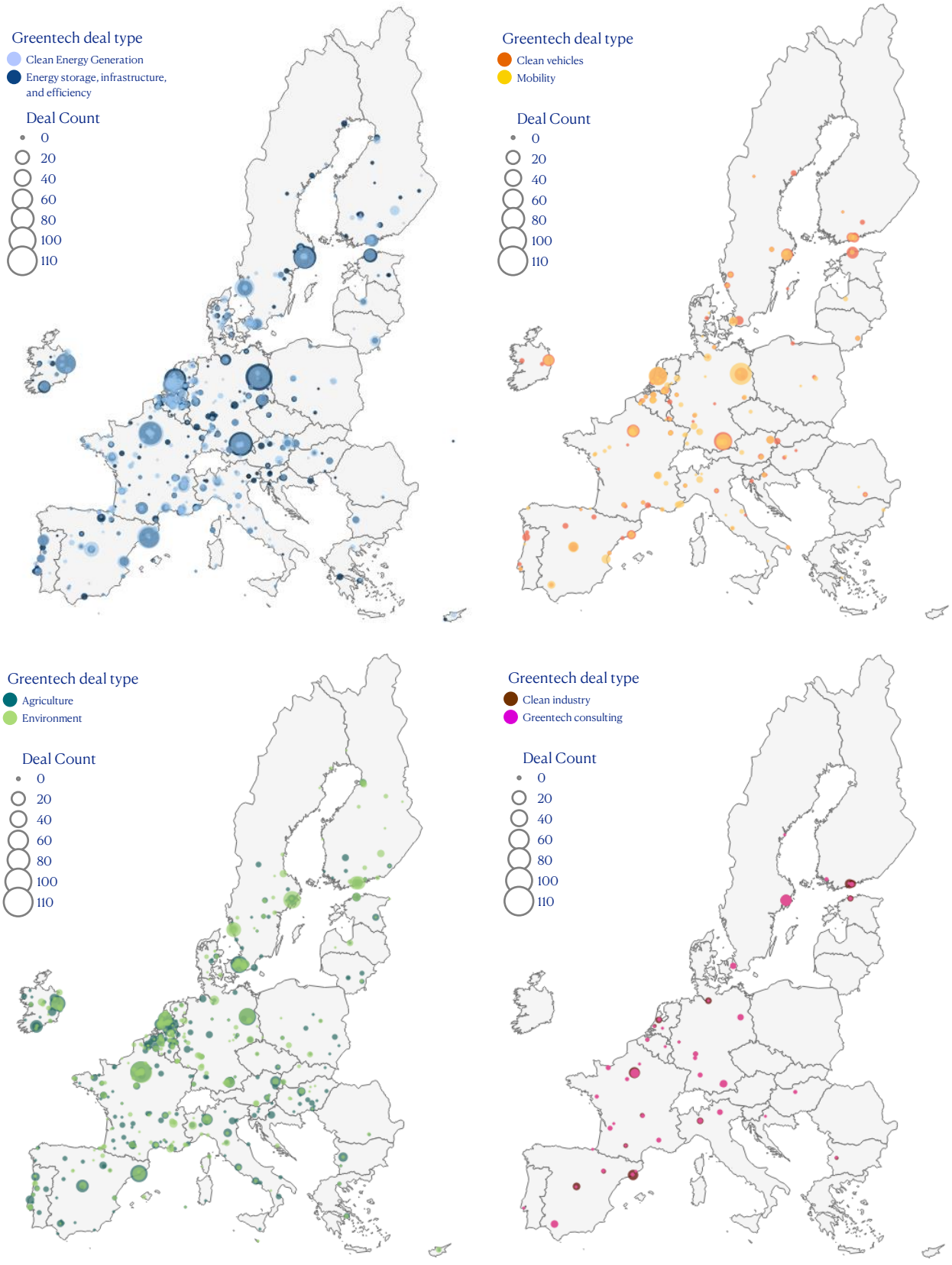
Renewable power generation  Solar, wind, geothermal, marine (hydro, wave, ocean), biomass, renewable fuels, waste-to-energy, fuel cells	*Energy Storage, Infrastructure, Efficiency*  Energy storage, energy management and efficiency, grid technology and semi-conductors, fuel efficiency, construction, heating and lighting	*Clean vehicles*  Electric and hydro cars, EV infrastructure, electrification of freight transport (road, rail & maritime)	*Mobility*  Car sharing, urban mobility solutions, public transportation, fleet management, sustainable logistics
Agriculture  Agtech innovation, food systems, crop efficiency, agricultural chemicals, meat alternatives	*Environment*  Water, waste & recycling, land use and forestry, air quality, carbon capture	*Industry*  Chemical, mining, materials, clean production and manufacturing	*Other*  Energy and environmental consulting, other Cleantech services / product

The two largest sectors within clean energy generation in the EU, namely solar and wind, exhibit similar patterns of concentration around major hubs, with an apparent lack of activity in Eastern Europe. Furthermore, even though some European regions arguably have better topographical and climatic conditions for certain types of energy generation, we do not find evidence that such regions focus disproportionally on the developments of these technologies.

Investments in the area of electric vehicles (7%) and mobility (8.6%) are heavily concentrated in metropolitan areas. Interestingly, while Paris emerges as the clear leader in terms of the total number of Greentech deals, it lags other major capital regions in the area of mobility, as it only records 14 deals in this field between 2010–2020, a relatively limited amount compared to cities such as Berlin (57), Amsterdam (39) or Munich (25).

[3] *The keywords are made available by PitchBook through a dedicated field which is based the deal description. For a complete list of applied keywords and a further discussion of the classification strategy, see Annex 3.*

Figure 3: Greentech deals in the EU27 (2010-2020) by technology thematic



By contrast, deal types in the field of agricultural innovation (19.2%) and environment (19.8%) are more dispersed and occur more frequently outside the large urban hubs, which is in line with the nature of these Greentech fields. Countries like the Netherlands, which is well-known for being at the forefront of global innovation in food and agriculture (OECD, 2015), as well as Ireland and Italy, perform strongly in this sector relative to other Greentech domains. Deal count in clean industry and production remains marginal, perhaps because large deals in the manufacturing sectors are primarily financed through sources outside of VC and early-stage growth PE (e.g., Hall & Lerner, 2010).

The remainder of this report presents the results of an empirical analysis that seeks to identify the factors that play a role in the development of a Greentech ecosystem in European countries, focussing in particular on the impact of the local financial environment. We model Greentech deal count in a given EU country as a function of a select set of indicators that proxy financial market conditions (access to finance conditions, the debt and equity environment). The following section provides an overview of the existing literature on determinants of investments in Greentech companies, which serves as the basis for the selection of explanatory variables, section 3 | presents the results and section 4 | concludes.

2 | Determinants of Greentech investments

The development of Greentech ecosystems differs markedly among European countries. The literature review presented in this section aims to identify the factors that explain such discrepancies. As such, it informs the selection of indicators that will be used in the empirical analysis. The financial market conditions are grouped into three different classes, where we distinguish between access to finance perception, debt-market and equity-market indicators. While the analysis' central focus is the role of the financial environment, we also control for other country characteristics, like general macroeconomic conditions, innovative capacity and regulatory framework. Table 2, at the end of this chapter, provides a comprehensive list of all indicators that are contained in our empirical model and includes a list of data sources.

2.1 | Access to finance and finance conditions

Access to Finance

The literature on Greentech financing recognises that Greentech SMEs face a range of obstacles accessing external capital. Owen et al. (2020) explain that this is mainly due to the market failure that exists in the early stage Greentech financing market driven by information asymmetry and the undervaluation of the social and environmental benefits that these firms bring to society. In this context, Ghisetti et al. (2017) argue that Greentech SMEs are more likely to be constrained financially – and have less access to formal financing – compared to large and more established firms. Greentech SMEs face additional barriers to access finance simply due to higher demand but lower supply of financing, which Lee et al. (2015) find to be the case utilising the UK Small Business Survey. Similarly, in a firm-level study of businesses in the UK, Cowling and Liu (2021) show that, while firms engaging with green technology have a higher demand for external capital, traditional providers of finance such as bank are unable to meet this demand, thus forcing Greentech firms to seek capital from alternative and non-traditional actors, including nonbank financial institutions and government.

To proxy access to finance, we employ the ECB's SAFE survey and select three variables that measure SMEs' perception of their own external financing environment: *(i) the percentage of firms who are not willing to apply for bank loans due to fear of possible rejection, (ii) the percentage of firms not willing to apply for credit lines and (ii) the number of firms who do not experience obstacles in accessing financing.*

Debt-financing environment

Ang et al. (2017) stress the importance of well-developed traditional debt-channels and show that the inability of banking systems to provide adequate long-term debt financing for capital-intensive infrastructure projects restricts the positive effects of carbon prices on investments in renewable energy. In addition, a range of studies have examined the relationship between the health of the broader financial system, including the volume of domestic credit provided to private sector or the ratio of non-performing loans, and economic growth. Levine (2005), for example, points out that "better developed financial systems ease external financing constraints facing firms", while Tölö & Virén (2021) argue that a high rate of non-performing loans, e.g., after the 2008 financial crisis, substantially depressed bank lending activity. Such measures (e.g., percentage of firms using certain financing types like bank loans) also could give an indication of the extent to which the existing financial infrastructure adequately caters to SMEs (Gvetadze et al., 2018).

To accommodate these findings, we include the *percentage of firms using credit lines and bank loans* (SAFE Survey) as well as *domestic credit to the private sector* (as a share of GDP) as proxies for the availability of debt-financing. In addition, we use *non-performing bank loans* (as a share of total gross loans) to measure the health of the financing infrastructure. Following Eyraud et al. (2013)

and Bonini and Alkan (2012), we add an interest rate variable to the specification, as we control for *long term interest rates* as a proxy for the cost of debt. The net impact on Greentech investments is ambiguous as it depends on whether debt and equity financing are considered as complements or substitutes for Greentech start-ups. Hence, a priori, the expected sign of the coefficient on our interest rate variable is ambivalent, as it depends on which of the two forces prevails.

Equity-financing environment

Colombo and Grilli (2007) argue that equity investors, such as business angels, VCs, and PEs, are the most suitable external capital suppliers for Greentech SMEs. Bonini and Alkan (2012) find that innovative SMEs benefit from an active VC and PE industry precisely because traditional financing options, including debt, are not accessible to small and unproven innovative firms. By supporting companies in the early stages of their technological development, VCs are crucial in bridging the 'valley of death' faced by innovative firms that are no longer eligible for public research funding, but do not yet dispose of the technical or commercial maturity to access funds supplied by institutional investors (Gaddy et al., 2017). VCs and PEs help SMEs to innovate more and to develop faster (Keuschnigg, 2004) over medium- to long-term investment horizons, which comes to the benefit of economic growth and innovation (Cusmano, 2015).

An early study by Randjelovic et al. (2003) finds that the absence of good investor-investee networks, poor business forecasts, and informational asymmetries constitute the main obstacles to accessing capital. In a more recent study on global Greentech VC, Cumming et al. (2016) find that Greentech firms tend to be more capital-intensive, exhibit higher technological risks, and lack a clear exist strategy compared to firms in other sectors. Finally, others point to long time horizons and intensive research and development periods (Ghosh & Nanda, 2010; Mazzucato & Semieniuk, 2018; Lehner et al., 2018), in part due to the path dependency of energy markets (Ghosh & Nanda, 2010; Polzin, 2017), as key challenges. All these studies point towards the importance of a well-developed VC&PE market for the development of the Greentech sector.

The exit environment also emerges from the literature as an important determinant of VC investment activity, with initial public offerings (IPOs) being among the most desirable options "to liquidate a fund" for many entrepreneurs (Jeng & Wells 2000). Black and Gilson (1998) and Jeng and Wells (2000) were among the first researchers to study the effect of IPOs on VC investment activity, with the latter finding "that IPOs are the most important determinant of venture capital investment". However, they point to the importance of differentiating between early and later-stage financing, arguing that while the IPO environment is a significant determinant of early-stage funding, it is almost irrelevant for variation in later financing. Furthermore, Félix et al. (2013) suggest mergers and acquisitions are becoming increasingly important exit mechanisms, in particular in the European context.

To investigate the impact of the equity environment on Greentech deals, we add three equity-based proxies to the empirical specification. First, we include a general measure of the overall VC/PE environment (includes early-stage financing, including accelerators, and incubators) as *total deal count recorded by PitchBook* (within relevant deal types and excluding Greentech deals).

We expect a positive association between the degree of development of a country's overall VC/PE environment and Greentech deals.

Finally, we include the *IPO count,* as reported by PitchBook, which serves as a proxy for perceived opportunities in the general start-up environment (Jeng & Wells, 2000), acknowledging that a high number of IPOs is likely to incentivise entrepreneurial activity. In addition, in accordance with Gomes Santana Félix et al. (2013), we also included *the number of M&A deals*. This transmission channel is governed by the perception of opportunity. That is, upon observing the market provides sufficient opportunities to successfully valorise an investment in a start-up, new entrepreneurs are incentivised to start a company. Given this transmission mechanism, it is reasonable to assume the existence of a significant time lag between the observed exit opportunities and the actual investments in Greentech companies. Therefore, we lag the vector containing the equity financing indicators with one additional year. The implied assumption is that through our theorised transmission mechanism, the impact of observed exit opportunities and related opportunities in the market takes at least two years to materialise.

2.2 | Macro factors and regulatory environment

A significant portion of the literature studies how *policy interventions* create incentives for Greentech financing (Bürer & Wüstenhagen, 2009; Cumming et al., 2016; Eyraud et al., 2013; Polzin et al., 2015). These policies include both green regulations (e.g., carbon taxes) as well as government spending and subsidies (e.g., tax rebates, feed-in tariffs, fossil fuel subsidies).

Ang et al. (2017) find that policies such as feed-in tariffs, renewable energy certificates, carbon-pricing mechanisms and energy tax rates have a positive effect on mobilising capital towards renewable energy solutions. In addition, Polzin (2017) suggests that VC investors view demand-generating policies that support consumption of Greentech products favourably. Conversely, other authors have identified a lack of clear policies encouraging investments in climate change solutions as a deterring factor for Cleantech investments (Junginger et al., 2019; Pfeifer & Sullivan, 2008).

Related, the price of non-renewable energy source also emerges from the literature as an important determining factor of Greentech financing. Cumming et al. (2016) show that "oil prices have a curvilinear effect on [C]leantech VC deals". Focussing not only on VC financing, but also on a broader category of green investments, Eyraud et al. (2013) document that the international price of oil has a positive and significant effect on green investment volumes, an effect that is found to materialise with a lag. Consistent with these findings, Ang et al. (2017) report on a negative relationship between support measures for fossil fuels and investment in renewable energy across OECD countries.

Various studies (Cumming et al., 2016; Eyraud et al., 2013; Grilli et al., 2019) point to the *general formal institutional framework* as an important explanatory factor for cross-country variation in investment activity. Arguably, regulatory and government quality, lower levels of corruption, a cultural adherence to the rule of law, and higher political stability create an environment in which entrepreneurs are more willing and able to innovate. When these conditions are met, investors face less risk and uncertainty and entrepreneurial activity is incentivised. Generally, these institutional factors are captured by different cross-country indices of good governance and regulatory quality. Conversely, the lack of a clear, stable, and homogenous policy environment constitutes the single most prohibiting factor to the development of Greentech investing ecosystem (Campiglio et al., 2017; Ghosh & Nanda, 2010; Hafner et al., 2019; Polzin, 2017; Polzin et al., 2015). Others identify overly complex policy environments (Rio et al., 2012) as equally harmful obstacles to Greentech financing. Boute et al. (2012) add that the absence of proper governance around accountability and enforcement of policies could also prove to be a barrier.

Another strand of research focuses on the influence of a country's *innovative capacity*. For example, Schertler (2003) argues that the degree to which a country supports and embeds innovation into its systems is a meaningful predictor of the volume of VC activity. They proxy innovation capacity by measuring regional or national patenting activity or the volume of spending on research and development (R&D). In a similar vein, Eyraud et al. (2013) and Gantenbein et al. (2019) find that human capital positively affects investment activity.

Finally, the *general macroeconomic environment* is also attributed a role in explaining variation in investment activity (Grilli et al., 2019). For example, larger economies typically host more investments. In addition, larger populations can facilitate the development of ideas beyond a pure scale effect and may increase demands for energy consumption and pollution control, which could create a more conducive environment for Greentech investment activity.

In line with the findings of the literature on macro and regulatory determinants of Greentech activity, we include multiple country-level control variables that could affect Greentech deal activity. First, we control for *GDP* and *population* to account for several general sources of omitted variables bias, such as, most importantly general scale effects. Second, following the example of the literature (e.g., Grilli et al., 2019; Cumming et al., 2016; Eyraud et al., 2013), we also control for the quality of the formal institutional environment using the World Bank's (WB) Worldwide Governance Indicators (WGIs). However, time and cross-country variation in some of these indicators tends to be small and the six different sub-indicators are highly correlated. We therefore select those three measures with the highest degree of time variation. We control for the quality of a country's legal environment using the sub-indicator *Regulatory Quality*, which "captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development" (Kauffman et al., 2011). We also employ the *Rule of Law* index, which "captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence" (Kauffman et al., 2011). The third control variable sourced from the World Bank index collection is the *Government Effectiveness* index, which "captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from

political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (Kauffman et al., 2011). Thirdly, we use *Environmental Tax Revenue* from Eurostat as a proxy for the environmental focus of the national regulatory framework. To avoid that this variable picks up the general tax burden effect, we also add *Total Tax Revenue* to the specification. Furthermore, since environmental tax revenue mostly derives from taxes on carbon-intensive energy, this measure is closely related to the importance of fossil fuels in a country's energy mix. To distinguish between the impact of the regulatory framework and the impact of the relative importance of fossil fuel in a country's energy mix, we therefore also add the *Share of Final Energy Consumption derived from Renewable Energy Sources* as a control variable. Finally, we include three proxies that measure a country's innovative capacity, namely *Patent Applications* to the European Patent Office, *R&D Spending* and *Tertiary Education Rate (%)*.

Table 2: Overview of outcome, explanatory and control variables

		Variable Name	Definition	Source
Outcome Variable		Greentech Deal Count	Greentech deal count	PitchBook
Macro and regulatory indicators		GDP	Gross Domestic Product	Eurostat
		Population	Total population head count	Eurostat
		Regulatory Quality	Regulation quality estimate	World Bank
		Government Effectiveness	Government effectiveness estimate	World Bank
		Rule of Law	Rule of law estimate	World Bank
		Patent Applications	Patent applications to European Patent Office	Eurostat
		R&D Expenditures	R&D spending	World Bank
		Tertiary Education	Tertiary education rate (%)	World Bank
		Environmental Tax	Environmentally related tax revenues	Eurostat
		Total Tax Revenue	Total amount of tax revenue received by all combined governments	Eurostat
		Renewable Share	Share of energy in total final energy consumption derived from renewable sources	Eurostat
Financial Environment indicators	Equity	VC&PE Deal Count	Overall VC/PE environment — VC/PE deal count excluding Greentech deals	PitchBook
		M&A Deal Count	M&A deal count	PitchBook
		IPO Deal Count	IPO deal count	PitchBook
	AtF[4]	SME unwilling apply for Loan	SMEs that did not apply for bank loans because of possible rejections (%)	ECB SAFE
		SME unwilling apply for CL	SMEs that did not apply for credit lines because of possible rejections (%)	ECB SAFE
		SME no finance obstacles	SMEs that see no financing obstacles (%)	ECB SAFE
		LTIR	Long-term interest rates (%)	ECB
	Debt	SMEs using Bank Loans	SMEs that used bank loans in the past 6 months (%)	ECB SAFE
		SMEs using Credit Lines	SMEs that used credit lines in the past 6 months (%)	ECB SAFE
		Share non-perf Bank Loans	Bank non-performing loans (% of total gross bank loans)	World Bank
		Dom Credit to Private Sector	Domestic credit to private sector	World Bank

[4] *AtF = Access to Finance*

3 | Empirical analysis

For the dependent variable, we use the count of early stage Greentech deals per year and country (2010–2020, EU-27), aggregated from deal-level microdata and sourced from PitchBook.[5] A more detailed description of those data was provided in Chapter 1 |. To accommodate the count nature of our dependent variable, we fit the data using a Poisson model.[6]

The empirical specification controls for common time effects by adding year dummies (θ_t), while country dummies (α_i) control for country-invariant time effects, with t denoting the year and i the country. $Macro_{it}$ is a vector containing all macro- and regulatory determinants discussed in section 2.2 |, while AtF_{it} $Debt_{it}$ and $Equity_{it}$ are the three vectors containing the financial environment indicators (see section 2.1 |). All indicators enter the specification in logs, apart from indicators in the form of a ratio, which enter the model without further transformation.

To account for the time dynamics governing the modelled relationship, the explanatory variables are lagged by one year. In addition, lagging the explanatory variables potentially mitigates the presence of endogeneity issues. Dictated by our theorized transmission mechanisms as well as by the outcome of our empirical tests, the equity proxies were lagged by one additional year, the reason for which is elaborated upon in section 2.2. This results in the following empirical specification that will be taken to the data:

$$Greentech\ Deal\ Count_{it} = e^{\beta' x_{it}} + u_{it}$$

$$\beta' x_{it} = \alpha_i + \beta_M Macro_{it-1} + \beta_A AtF_{it-1} + \beta_D Debt_{it-1} + \beta_E Equity_{it-2} + \theta_t,$$

where u_{it} is an error term for which it is assumed that $E(u_{it}|x_{it}) = 0$. The empirical analysis gradually introduces the respective vectors of control variables, starting with the macro factors, followed by a stepwise introduction of the access to finance, debt and VC&PE environment indicators, respectively. The fifth model introduces all control variables simultaneously. The empirical results of all model specifications are reported in Table 3.

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[5] Greentech investment volumes would arguably provide a richer picture of actual investment activity, but we opted for deal counts as a proxy because information on investment volumes was missing in the PitchBook database for a substantial number of Greentech deals. Since the pattern of missing investment volumes is unlikely to be random, solely basing the analysis on that subsample would lead to misleading results.

[6] Alternative, the model could be estimated using a negative binomial estimator, which would be more appropriate in a situation where the Poisson assumption of equality between mean and variance is violated, a situation referred to as overdispersion. Formal tests suggest this is not the case for our data. Estimation using the negative binomial estimator returns identical coefficients, confirming overdispersion is not a cause of concern. See Allison & Waterman (2002), Guimaraes (2008), Allison (2012) and Blackburn (2015) for an elaborate discussion on the use of Poisson and negative binomial estimators and their implementation into common software packages.

Table 3: Main regression results

Greentech Deal Count (Poisson)	(1)	(2)	(3)	(4)	(5)
$ln(GDP)_{t-1}$	-0.996	-0.363	-0.912	-1.019	-0.406
	(-1.53)	*(-0.32)*	*(-1.39)*	*(-1.67)*	*(-0.37)*
$ln(Population)_{t-1}$	-1.528	-3.34	-1.775	-1.428	-4.435
	(-0.41)	*(-0.91)*	*(-0.50)*	*(-0.46)*	*(-1.29)*
$ln(Regulatory\ Quality)_{t-1}$	-0.500**	-0.489**	-0.505**	-0.463*	-0.524**
	(-2.24)	*(-2.47)*	*(-2.23)*	*(-1.90)*	*(-2.21)*
$ln(Rule\ of\ Law)_{t-1}$	0.195	0.143	0.185	0.192	0.16
	(-0.91	*(0.58)*	*(0.79)*	*(0.83)*	*(0.66)*
$ln(Government\ Effectiveness)_{t-1}$	-0.0957	-0.094	-0.0862	-0.09	-0.0666
	(-0.36)	*(-0.29)*	*(-0.31)*	*(-0.35)*	*(-0.22)*
$ln(Environmental\ Tax\ Revenues)_{t-1}$	-1.720***	-1.887***	-1.738***	-1.405***	-1.716***
	(-3.95)	*(-3.82)*	*(-4.14)*	*(-3.09)*	*(-3.10)*
$ln(Total\ Tax\ Revenue)_{t-1}$	0.372	0.793	0.365	0.371	0.759
	(0.38	*(1.09)*	*(0.37)*	*(0.38)*	*(1.01)*
$ln(Renewable\ Share)_{t-1}$	-0.00132	-0.0161	-0.00439	-0.00334	-0.0159
	(-0.07)	(-0.82)	*(-0.20)*	*(-0.21)*	(-0.78)
$ln(R\&D\ Expenditure)_{t-1}$	0.307	0.141	0.287	0.392	0.273
	-0.65)	*(0.32)*	*(0.62)*	*(0.9)*	*(0.59)*
$ln(Patent\ Applications)_{t-1}$	0.235	0.306	0.254	0.19	0.248
	-0.95)	*(1.04)*	*(1.03)*	*(0.79)*	*(0.88)*
$Tertiary\ Education\ Rate_{t-1}$	-0.00371	-0.0228	-0.00231	-0.0171	-0.0264
	(-0.19)	*(-1.06)*	*(-0.11)*	*(-0.94)*	*(-1.02)*
$\%\ of\ SMEs\ unwilling\ to\ apply\ for\ Bank\ Loans_{t-1}$			-0.0948		-2.108
			(-0.06)		*(-1.24)*
$\%\ of\ SMEs\ unwilling\ to\ apply\ for\ Credit\ Lines_{t-1}$			0.865		1.017
			(0.55)		*(0.63)*
$\%\ of\ SMEs\ with\ No\ Financing\ Obstacles_{t-1}$			-0.132		-0.27
			(-0.31)		*(-0.79)*
$Long\ Term\ Interest\ Rate_{t-1}$		-0.0297			-0.0164
		(-0.48)			*(-0.26)*
$Share\ of\ Non-Performing\ Bank\ Loans_{t-1}$		0.0161			0.0156
		(0.91)			*(0.89)*
$ln(Domestic\ Credits\ to\ Private\ Sector)_{t-1}$		0.252			0.444
		(0.44)			*(0.97)*
$\%\ of\ SMEs\ that\ used\ Bank\ Loans_{t-1}$		1.415			1.358
		(1.59)			*(1.52)*
$\%\ of\ SMEs\ that\ used\ Credit\ Lines_{t-1}$		0.11			0.0196
		(0.29)			*(0.05)*
$ln(IPO\ Deal\ Count)_{t-2}$				0.0933*	0.123***
				(1.72)	*(2.58)*
$ln(M\&A\ Deal\ Count)_{t-2}$				0.0599	0.118
				(0.38)	*(0.85)*
$ln(VC/PE\ Deal\ Count)_{t-2}$				0.189	0.223
				(1.38)	*(1.45)*

*t-statistic in parentheses. * p<=0.1, ** p<=0.05, *** p<=0.01. The dependent variable is the number of Greentech deals of country i in year t. All models are estimated including a full set of year dummies, based on 156 observations (see Annex 4 for an overview on the estimation sample). Robust z-statistics in parentheses.*

All indicators that measure the development of a country's equity ecosystem were estimated to have a positive impact on Greentech deal activity, however, only the *IPO deal count* emerged as statistically significant. The results show that a doubling of the number of IPOs in a country leads to a 12.3% increase in the number of Greentech deals two year later. The other exit proxy (*M&A Deal Count*), while not statistically significant at conventional significance levels, emerges with a coefficient of similar magnitude, showing that a doubling of M&A deals leads to an 11.8% increase in Greentech deals.

None of the access to finance proxies and debt-environment indicators are estimated to have a significant impact on Greentech investments, neither in the combined specifications, nor in the specification that controls for the access to finance vector individually. Two of the access to finance proxies relate to bank instruments, which are arguably less important for innovative companies focussing on Greentech innovation. In addition, all three access to finance indicators are survey-based perception indicators, derived from the ECB SAFE survey. While informative in their own right, they might not be able to capture the transmission channels that are most relevant for the specific type of Greentech start-ups that form the subject of this study. None of the indicators related to the debt-financing environment appear to have a significant impact on Greentech deal activity either. This confirms that bank-based financing products are typically less important for Greentech start-ups.

Of the included macro and regulatory control variables, only two coefficients are estimated to be statistically significant (*Environmental Tax Revenues* and *Regulatory Quality*). However, on both counts, the sign on the estimated coefficients runs counter our prior intuition. In particular the negative impact of *Environmental Tax Revenues*, our proxy for the development of a country's body of environmental laws comes as a surprise. The estimated effect is robust to different specifications. Because the model also controls for total tax revenue and share of renewables in the energy mix, the negative impact cannot be explained by a general tax-burden effect that stiffens innovation incentives, nor can it be explained by a scale effect where countries with a high reliance on fossil fuels (and hence, substantial collection of environmental tax revenues) might have a lower Greentech deal count. Deeper investigation uncovering the exact drivers behind this negative effect must be left for future research.

Regulatory quality was also estimated to have a negative impact on Greentech investment activity. This indicator, sourced from the Worldwide Governance Indicators Project (Kauffmann et al., 2010) is a survey-based measure which proxies "the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development" and is an index that combines 12 different assessments and surveys. Therefore, uncovering the underlying mechanism behind the uncovered effect is difficult. However, its likely relationship with our variables of interest included in the financial conditions vectors motivates its inclusion in the empirical specification.

The interpretation of the above results should proceed with caution. First, while the PitchBook database is one of the most comprehensive investment databases available, the coverage is necessarily limited by the methodology underlying the data collection, which relies on web-crawling techniques and manual desk research. While sample selection is therefore likely, we do not believe the extent of this would lead to a degree of misrepresentation of the true population

that would threaten the validity of our main conclusions. Further analyses could explore the impact of potential selection bias present in the PitchBook investment database by replicating the framework presented in this paper using different data sources. Second, due to incomplete reporting of deal value, Greentech investment activity is proxied by deal count. Including deal volumes as a dependent variable would certainly enrich the analysis and would provide a more detailed picture on the exact magnitude of the effect, in terms of Euro value. However, it would also imply a significant sample selection effect, as the resulting sample would likely be highly skewed towards larger deals. We leave the exploration of the impact on deal value as a venue for future research.

4 Policy implications and discussion

The European efforts to decarbonise its economy and develop a global technological leadership position in the sphere of Greentech innovation imply an increasingly important role for the mobilisation of investments towards highly innovative start-up and growth ventures. Since 2006, the EIB Group has been involved actively in supporting growth of the EU green investments. For example, the Group's climate and infrastructure funds have channelled over EUR 1bn to funds that focus on green infrastructure projects and climate and environment start-ups. Currently, the EIF manages several other initiatives that aim to stimulate investments in EU Greentech companies. For example, the InvestEU SME Window, through its Climate and Environment products, contains a EUR 900m pocket to increase access to equity finance for innovative SMEs that develop or adopt Greentech solutions, while the EIF's RCR mandate provides EUR 300m annually, on average, over the period EUR 2022-2027, to European funds investing in Greentech companies. This amount was recently increased by approximately EUR 300m per annum through the Commission's REPowerEU plan.

While targeted Greentech finance support is an essential element of the EU Green Deal, this report stresses the importance of a well-developed PE/VC ecosystem as a framework condition for a thriving Greentech sector, as it uncovered an interesting relationship between exit opportunities in the general market and Greentech deal activity. In accordance with previous studies on the relationship between IPOs and venture capital investments (e.g., Black and Gilson, 1998; Jeng and Wells, 2000), our analysis showed that a flourishing exit environment incentivises Greentech investors and entrepreneurs and stimulates deal activity in the Greentech market. More precisely, we found that a doubling of IPOs in a given country leads national Greentech deals to increase by 13%, two years later. This implies that, in addition to providing direct scale-up opportunities for high-growth companies, the availability of exit opportunities in the form of IPOs are associated with strong incentives for VC/PE investors and Greentech entrepreneurs, as it spurs deal activity in the earlier stage market segments.

The existence of such second-round, bottom-up incentive effects indicate that policy makers should invest effort into ensuring the market provides sufficient scale-up opportunities, as failing to do so could have significant consequences for the development of Greentech ecosystems, as perceived lack of opportunity might encourage successful ventures to leave the region and raise funding elsewhere. However, descriptive evidence suggests that scale-up opportunities in Greentech financing remains lacking in the EU. As deal size grows, Greentech entrepreneurs rely increasingly on international investors to complete funding rounds (Table 4). Recent evidence of EIF's VC/PE surveys among European fund managers confirmed the existence of a scale-up gap, as respondents indicated one of the main challenges they faced by investing at the scale-up stage, there were too few other funds active in the space, inhibiting them to achieve the necessary scale (Botsari et al., 2021).

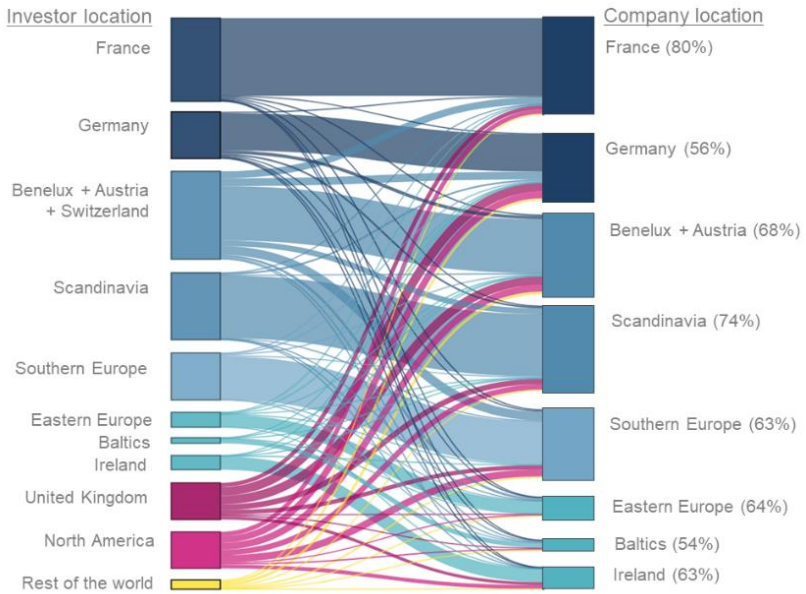
Table 4: Cross-border and extra-EU investors in Greentech ventures, by deal size

Deals by investment size (million USD)	*Deals by investment size (as % of total deals)*	*Deals with cross-border investors (%) (intra- and extra-EU)*	*Deals with cross-border investors (%) (extra-EU only)*
Total	100	34.6	19.8
0 – 0.5	40.1	37.9	21.9
0.5 – 1	10.8	14.3	7.4
1 – 2	13.4	19.2	8.8
2 – 5	15.6	30.2	13.1
5 – 10	7.4	36.7	23.0
10 – 20	6.3	40.1	23.4
20 – 50	3.0	46.3	31.3
50 – 100	1.2	56.3	43.8
100 – 500	1.0	63.0	51.9
500 +	0.3	57.1	42.9

Source: PitchBook

A recent report by the European Commission suggests this issue might be rooted in a general malfunctioning of the European VC industry, symptomized by, for example, the prevalence of small VC fund sizes (Ambrosio et al., 2021; Kraemer-Eis et al., 2021; Quas et al., 2022). This hypothesis is corroborated by Duruflé et al. (2018), who find that between 2005-2015, Europe hosted only 10% of the world's funds larger than USD 250 million, compared to 28% that are hosted in the USA.

Figure 4: Cross-border Greentech investment flows in the EU



Source: PitchBook

Another potential cause of the scale-up gap is rooted in the lack of integration of the European capital market in general, and VC market in particular, as geo-political fragmentation and regulatory heterogeneity lead to hurdles for international capital flows, inhibiting the growth of funds to a scale observed in the US and China (Quas et al., 2022). Our data suggests this issue is indeed prevalent in the market for Greentech investments, where financing flows tend to flow primarily within a country's own borders. This implies smaller countries might not be able to

provide the right environment for Greentech start-ups to develop throughout their product life cycle. Indeed, we find that countries in Eastern Europe in particular exhibit consistently low Greentech deal counts.

This suggests an important role for policy intervention at the EU-level, as EU policymakers can support the development of a European Greentech ecosystem by bridging the scale-up gap through the use of innovative financing instruments. A number of existing initiatives have already been put in place to support the general European scale-up space. For example, the European Scale-up Action for Risk capital (ESCALAR) is a new investment approach launched in 2020 by the EC in cooperation with the EIF in the context of the EC's new SME strategy. It supports VC and growth financing for high-growth enterprises, specifically aimed at increasing investment capacity of European VC/PE funds, providing funds with up to EUR 300m of financing. In addition, the European Tech Champions Initiative (ETCI) is a pan-European investment program that aims to support tech-focused scale-ups. As suggested by Ambrosio et al. (2021) and Quas et al. (2022), a pan-European fund-of-fund approach is particularly well-suited to stimulate the flow of cross-border investments as it allows for larger ticket sizes. In this context, ETCI strives to foster late-stage growth of Europe's high-tech companies, by mobilising private investment alongside public commitments. Finally, the EIF's IPO Initiative, a new initiative launched under InvestEU, seeks to strengthen the EU's public market ecosystem by providing support to investment funds that target pre-IPO and/or public equity market investments in European SMEs and Mid-Caps.

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Annexes

Annex 1: Detailed data and sample description

The data that served as the basis for the analyses was sourced from the PitchBook database. PitchBook is a Seattle-based SaaS company specialising in VC, PE and M&A financial data from both public and private markets, with data covering "over 3.3 million companies, 1.6 million deals, 384,000 investors, and 75,000 funds" (PitchBook n.d.). Three PitchBook datasets were extracted, comprising the totality of PitchBook's data for approximately 11,200 unique investors across 91 countries and 36,000 deals across 11,000 unique companies located in 29 countries (EU27, China, and the US), approximately 80% of which are categorised by PitchBook to be within the 'Cleantech', 'Climate tech', and/or 'Agtech' vertical. The other 20% were added to the sample using the keyword-based strategy described below.

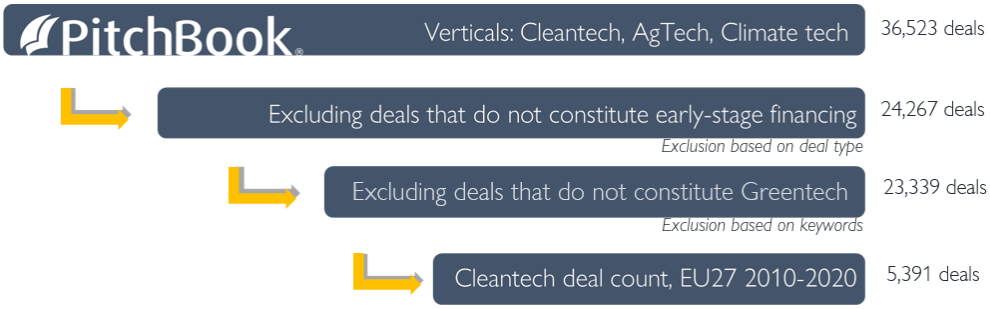
Table A.1: Greentech PitchBook Verticals

Vertical	Definition	Examples
Cleantech	Companies that "develop technologies that reduce the environmental impact of human activities or reduce the amount of natural resources consumed through such activities"	Companies developing cleaner production technologies, waste- & water management
Climate tech	Companies developing "technologies to help mitigate or adapt to the effects of climate change"	Renewable energy generation, transport electrification
Agtech	Companies developing "software and hardware systems that automate and promote environmentally conscious farming"	Sensors to monitor soil, air and animal health; aqua- & hydroponics; smart irrigation systems

Exclusion criteria

Our initial dataset contains 36,523 deals, narrowed down further to 23,339 deals of interest (including all years and USA/China), and 5,391 deals when examining only EU-27 countries between 2010 and 2020.

Figure A.1: Sample selection procedure



While the dataset contains deals at all stages of the financing process, the analysis focusses primarily on Venture Capital (all rounds) and Growth Private Equity deals (this excludes M&A, IPOs, and buyouts, et alia). It is mostly concerned with explaining the VC and growth equity ecosystem, therefore it treats these deals, investors, and receiving firms distinctly from those accessing other financial channels.

Table A.2: Deal classification and deal type

Deal Classification	*Deal Type*	*Percentage of Observations*
VC/Growth PE	Early-Stage VC, Later Stage VC, Seed Round, PE Growth/Expansion, Accelerator/Incubator, Angel (individual), Product Crowdfunding, Equity Crowdfunding, Convertible Debt, Restart-Later VC, Restart-Early VC, Restart-Angel	63%
Non-VC/Growth PE	Grant, Debt-General and PPP, M&A, Secondary Transaction – Private and Open Market, IPO, Buyout/LBO, PIPE, Corporate, Bankruptcy, Capitalisation, Public investment 2nd offering, reverse merger, debt refinancing, joint venture, mezzanine, undetermined, debt repayment, merger of equals, bridge, debt conversion, corporate asset purchase, investor buyout by management, platform creation, dividend recapitalisation, share repurchase, leveraged recapitalisation, equity for service, corporate asset purchase, restart – corporate, sale-lease back facility, spin-off, venture leasing	37%

Furthermore, we exclude deals with companies that are clearly not operating in the Greentech space, but are nevertheless categorised as such. Furthermore, there are a substantial number of companies in the dataset that are either not assigned verticals (3.7%) or are tagged with different (non-Greentech) verticals (17.8%), but nevertheless clearly classify as Greentech.

Table A.3: Included deals by deal type

Deal Type	*Frequency*	*Percentage*
Accelerator/Incubator	1,705	31.6
Early Stage VC	1,340	24.9
Later Stage VC	850	15.8
Seed Round	537	10.0
Angel (individual)	372	6.9
PE Growth/Expansion	267	5.0
Equity Crowdfunding	169	3.1
Product Crowdfunding	146	2.7
Convertible Debt	4	0.07
Restart – Later VC	1	0.02

Our sample was selected by including all deals that are tagged with the **verticals** 'Cleantech', 'Agtech' or 'Climate tech'. In addition, we include all deals that are not assigned one of these verticals, but include one of the following **keywords** in their description: wind, solar, photovoltaic, wave, hydraulic turbines, geothermal, clean energy, sustainable energy, renewable energy, renewable technology, alternative energy, energy consumption, energy management, energy efficiency, energy storage, fuel cell, decarbonizing, green hydrogen, electric car, electric vehicle, electric scooter, e-mobility, sustainable mobility, alternative to meat, alternative protein, hydroponics, meat alternative, real meat, bioethanol, renewable fuel, biofuel, wood pellet, sustainable materials, eco-friendly, environmentally friendly, environmental impact, circular, renewable, biolighting, food waste, recycling, recycled, waste management, water management, energy, power storage, heat storage, smart home , fuel efficiency, hybrid, lithium, battery, batteries, fuel cell, hydrogen, batteries, biodiesel, ethanol, sustainable, LED, biodegradable, plant based, zero waste, zero-waste, power generation, sustainability, biomass, heat.

Finally, all remaining deals are dropped, as well as any deals that contain the keywords "oil exploration" or "crude oil refining".

Annex 2: Overview of Greentech deals in the EU 27 (2010-2020)

Country	Absolute deal count	Deal counts per million inhabitants	% of total EU Greentech deals	Greentech deals as a % of VC/PE deals	Total investment volume (million USD)[7]
Austria	129	14.8	2.4	8.7	91.7
Belgium	286	25.2	5.3	8	708.8
Bulgaria	25	3.5	0.5	6.5	20.1
Croatia	30	7.3	0.6	11.5	33.5
Cyprus	7	6	0.1	3.6	2.1
Czechia	15	1.4	0.3	2.6	16.4
Denmark	203	35.3	3.8	7.5	3,050.1
Estonia	56	42.3	1	6.9	25.4
Finland	279	50.8	5.2	9.5	509.6
France	1,191	17.9	22.1	7.7	4,667.9
Germany	724	8.8	13.4	7	4,344.4
Greece	24	2.2	0.4	7.1	17.8
Hungary	59	6	1.1	6.1	65.9
Ireland	297	62.1	5.5	7.3	1,271
Italy	260	4.3	4.8	6.3	913.8
Latvia	26	13.5	0.5	7.3	26.6
Lithuania	34	11.9	0.6	8.7	56.5
Luxembourg	28	46.9	0.5	8.5	105.4
Malta	2	4.5	0	1.6	0.4
Netherlands	547	32	10	11.3	1,808.2
Poland	56	1.5	1	3.1	48.3
Portugal	136	13.2	1	9.2	43.1
Romania	8	0.4	0.1	2.1	6.4
Slovakia	22	4	0.4	10.8	28.4
Slovenia	12	5.8	0.2	6.5	19.1
Spain	433	9.3	8	5.4	831.6
Sweden	502	50.1	9.3	8.5	2,323.5
Total	**5,391**	**12.1**	**100**	**7.6**	**21,036.1**

[7] *Aggregated investment volumes are calculated only for those deals for which deal size was available. About 32% of observations have missing deal sizes. As a result, cumulative investment volumes reported here are a lower bound for the true value.*

Annex 3: Greentech taxonomy

Table B.1 gives an overview of the keywords we used to build our Greentech taxonomy (mainly using PitchBook's 'keywords' column, but also primary industry groups, codes and verticals where relevant). Keywords in italics were added after initial round of classification was complete, and only added if the deal did not already have any category assigned.

Table B.1: Keywords for Greentech taxonomy

Category	Sub-category	Keywords
Clean energy generation	Solar energy	"solar" (keywords and description) "photovoltaic" (keywords and description)
	Wind energy	"wind" (keywords and description)
	Geothermal energy	"geothermal"
	Nuclear energy	"nuclear" "neutron"
	Thermal energy	"thermal power" "waste heat" "heat electricity"
	Hydro energy	"hydro" "hydro-electric" "hydroelectric" "hydropower" "ocean" "wave" "tidal"
	Fuel cells	"fuel cell"
	Biofuel	"biofuel" "bio-oil" "biodiesel" "bioethanol" "renewable fuel" "sustainable fuel" "alternative fuel" (keywords and description) "synthetic fuel" "cellulose based ethanol" "biogas" "wood pellet" (description)
	Hydrogen	"hydrogen"
	Other energy (only if no other CEG category)	Deals with primary industry code "Alternative Energy Equipment" "alternative energy" "generator" "green energy" "energy production" "renewable energy" "electricity generation" "gasification" "green electricity" "green power"

Category	Sub-category	Keywords
		"anaerobic digestion" "energy harvesting" "biomass" "power plant" *Deals with primary industry group "Energy Equipment"* *Deals with primary industry code "Energy Production"*
Energy storage, infrastructure and efficiency	Energy storage	"energy storage" "power storage" "compressed air" "air compressor" "fly wheel" "storage system"
	Battery	"battery" (keywords and description) "batteries" (keywords and description)
	Energy management	"energy management" "energy analytics" "energy saving" "energy mapping" "energy modelling" "energy data" "grid" "energy conversion" "smart power" "microgrids" "energy efficiency" "electricity consumption" "energy optimization" "energy consumption" "distributed energy" "smart home" "power consumption" "utility data" "smart meter" "voltage control" "energy efficient" "energy measuring"
	Fuel efficiency	"fuel efficiency" "fuel consumption" "fuel management" "emission control" "fuel distribution" "exhaust" "nox"
	Construction	"construction" "building" Deals with vertical "Construction Technology" Deals with primary industry code "Construction and Engineering" "renovation" "environmentally-friendly building"

Category	Sub-category	Keywords
		"heating installation" "heating device" "cooling" "refrigeration" "water heating" "heating solutions" "heat exchanger" "heat pump" "heating service" "green roof" *Deals with primary industry group "Construction (Non-Wood)", "Buildings and Property"* *Deals with primary industry code "Building Products"*
	Lighting	"sustainable lighting" "led lighting" "light-emitting diode" "led bulbs" "led lamps" "smart led" *"lighting" (description)*
	Other	*Deals with primary industry group "Energy Services", "Other Energy"*
Electric vehicles		"ev charging" "electric charging" "smart charging" "electric vehicle charging" "electric vehicle" (keywords and description) "electric transportation" "electric car" "electric motor" (keywords and description) "cleantech engine" "eco-friendly automobile" "electric boat" "electricity management" "electric engine" "e-vehicles" "e-truck" *Deals with primary industry group "Transportation"*
Mobility		"carsharing" "ridesharing" "e-scooter" "bike sharing" "fleet management" "electric scooter" "bikes" "electric cycle" "mobility" "mass transit" "transportation technology" "public transportation"

Category	Sub-category	Keywords
		"sustainable logistics" *Deals with Primary Industry Code "Logistics, "Rail", "Other Transportation"*
Agriculture	Agriculture (general)	Deals with vertical "AgTech" Deals with primary industry group "Agriculture" Deals with primary industry code "Food Products" "agriculture" "agricultural" "soil" "livestock" "food" *"hydroponic"* *Deals with primary industry code "Agricultural Chemicals"* *Deals with primary industry code "Beverages"*
	Meat and dairy alternatives	"sustainable meat" "meat alternative" "soy-based meat" "cell-cultured meat" "sustainable food" "protein" "vegan" "dairy-free"
Environment	Waste and recycling	"waste management" "waste collection" "waste disposal" "waste monitoring" "waste reduction" "waste elimination" "waste treatment" "recycling" "waste garments" *"recyc"* (description) *"waste"* (description)
	Water	"water conservation" "water treatment" "water purification" "water management" "water filtration" "water usage" "water generation" "drinking water" "water equality" "water supply" "water data" "water clean" "toxic-free water" "groundwater" "water meter" "oil spill"

Category	Sub-category	Keywords
		"water station" "water contamination" "water purifier" "water pollution" "water filter" "water risk" "water consumption" "water produc" "water monitoring" "water sustainability" "water testing" "desalination" *"water" (description)* *Deals with primary industry code "Water Utilities"*
	Forest	Deals with primary industry group "Forestry" Deals with primary industry code "Forestry/Development/Harvesting" "reforestation" "forest"
	Land use	"land use" "land-use" "remote sensing" "environmental engineering" "environmental sensing" "environment protection" "weather forecasting" "satellite imagery" "weather" "climate forecast" "environmental solutions" "geospatial" "environmental monitoring"
	Carbon capture	"carbon capture" "carbon sequestration" "carbon dioxide converter" "carbon dioxide capturing" "carbon offset" "carbon credit" "carbon removal"
	Air	*"air"* *"air pollution"* (description)
Clean industry	Mining	Deals with primary industry group "Metals, Minerals and Mining" "mining" "metals"
	Chemicals	Deals with primary industry "Industrial Chemicals" Deals with primary industry "Specialty Chemicals" "green chemistry" "green chemicals" "chemical

Category	Sub-category	Keywords
		Deals with primary industry group "Chemicals and Gases"
	Materials	"biodegradable" "sustainable material" "packaging" "plastic-free" "materials" *Deals with primary industry group "Other Materials", "Textiles", "Containers and Packaging"*
	Clothing	Deals with primary industry code "Clothing" Deals with primary industry code "Footwear" Deals with primary industry group "Apparel and Accessories" *"textile" (description)*
Energy consulting		"energy consulting" "energy reporting" "consulting" "environmental services" "sustainable investing" "environmental consulting" "esg" *"consult"* (description) *Deals with primary industry code "Consulting Services (B2B), "Financial Services"*

This approach comes with limitations. For example, deals may have keywords matching more than one category, and some key words (e.g., 'energy management') are broad and do not allow to dissect additional sub-categories. Finally, we measure technological specialisation through early-stage deal counts, which inevitably does not capture financing through other deal types or innovation at public research institutes.

Annex 4: Estimation sample by EU country

Country	#Observations
Austria	7
Belgium	7
Bulgaria	0*
Croatia	6
Cyprus	7
Czech Republic	7
Denmark	8
Estonia	0*
Finland	7
France	8
Germany	8
Greece	8
Hungary	6
Ireland	7
Italy	8
Latvia	4
Lithuania	7
Luxembourg	6
Malta	0*
Netherlands	8
Poland	8
Portugal	5
Romania	0*
Slovak Republic	4
Slovenia	4
Spain	8
Sweden	8

**Countries that dropped from the sample that served as the basis for the empirical analysis had a missing value for at least one of the included explanatory variables for each of the sample years. While they were not part of the empirical analysis, we assumed that our conclusions are generalisable to all EU-27 countries.*

Annex 5: Acronyms

Benelux	Belgium, Netherlands, Luxembourg
BNEF	Bloomberg New Energy Finance
CEG	Clean energy generation
EC	European Commission
EIF	European Investment Fund
EU27	European Union
EUR	Euro
EV	Electric vehicle
FE	Fixed effects
FiT	Feed-in tariff
GDP	Gross domestic product
IPO	Initial public offering
M&A	Mergers and acquisitions
OECD	Organisation for Economic Cooperation and Development
PE	Private equity
PV	Photovoltaic
R&D	Research and development
RECs	Renewable Energy Certificates
SAFE	Survey on the Access to Finance of Enterprises
SME	Small- and medium-sized enterprise
TOR	Terms of Reference
UK	United Kingdom
USA	United States of America
USD	United States Dollar
VC	Venture capital
VCs	Venture capitalists
WB	World Bank
WGI	Worldwide Governance Indicators

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