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Foreign Direct Investments in Green Industries

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Motivation

- Increasing importance of outward FDI as means of technology acquisition in emerging countries;
- To what extent are we seeing catch-up/leadership change in green sectors? What are the determinants?
 - whether and how are FDI key determinants in technological catch up in green industries.

Green FDI: the existing literature

- Some studies on the location choice of multinationals assessing the impact of specific policy instruments, such as feed in tariffs and tax incentives, in attracting green FDI (Hanni et al. 2011; Wall et al. 2018);
 - In developing countries traditional factors such as institutional quality and macro conditions are more relevant than specific policy instruments (Keeley & Ikeda, 2017; Keeley & Matsumoto, 2018).
- Very limited empirical work on the impact of FDI:
 - R&D internalization has a positive effect on firms' innovation across energy sectors (Hurtado-Torres, 2018);
- On Chinese FDI:
 - Market-seeking and technology-seeking (particularly through acquisitions) are the main motivations behind green Chinese FDI (Curran et al., 2017);
 - Location choice of Chinese MNEs is explained by macro institutional conditions in host countries as well as some characteristics of the investors, such as age and experience (Pareja-Alcaraz, 2017; Lv & Spigarelli, 2015, 2016)
 - Convergence of policy incentives between China and the EU (Gippner & Torney, 2017)

Research questions

- 1. *What kind of firms are more likely to undertake FDI in green industries?***
 - What are the firm-level investors' characteristics? (e.g. patenting activity, R&D, size, productivity, openness, ownership);
 - Any significant differences among home countries of FDIs? Between enterprises from emerging markets and from advanced countries?
 - Any significant differences across entry modes (i.e. greenfield investments vs. M&As)?

- 2. *What is the impact of FDI in green industries on investors' performance?***
 - What is the effect on investors' efficiency? And on investors' innovative capacity?
 - Are there significant differences in terms of impact among EMNEs vs. AMNEs?
 - Are there significant difference across different FDI types?

Foreign Direct Investments: data sources

- **Greenfield investments:** fDi Markets (Financial Times Group), a deal-based database reporting all cross-border investments resulting in a wholly-owned subsidiary, covering all sectors and countries worldwide since 2003 and providing information about the activity undertaken with the deal;
- **Acquisitions** cross-border of a minimum 10 per cent share of the target, reported by Zephyr, a Bureau van Dijk database.

Table 1. Sector definitions (fDi Markets & NAICS)

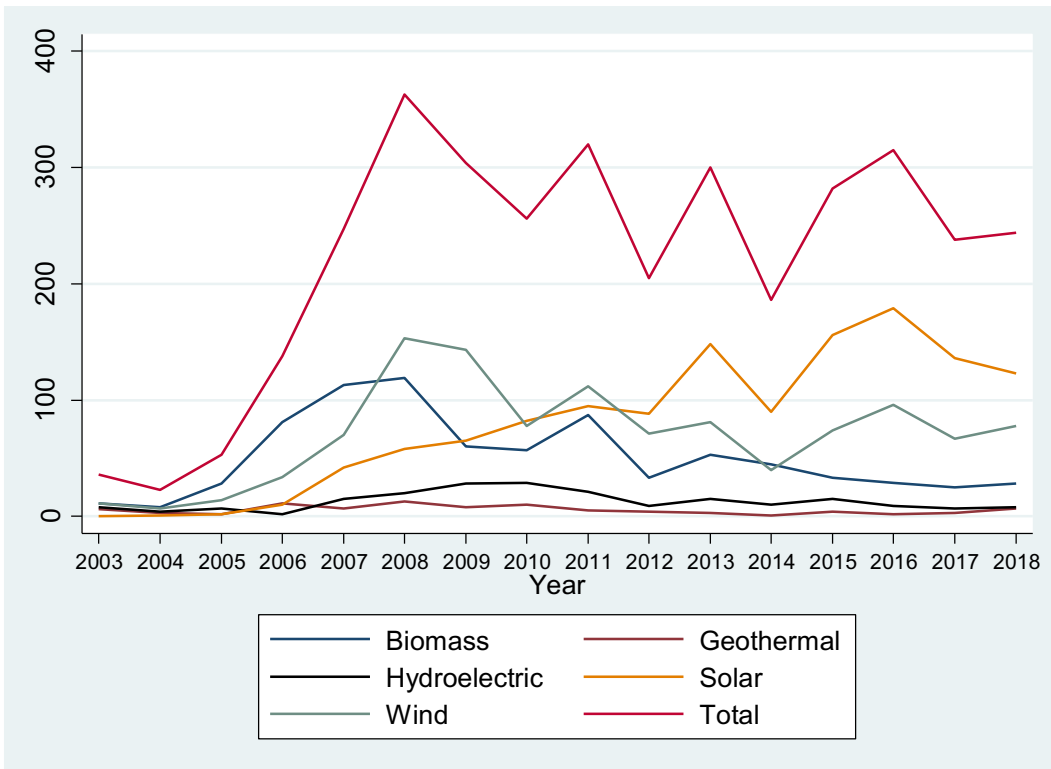
Sector	fDi Markets definition		NAICS 2017
	Industry Sector	Industry Subsector	
Solar	Alternative/Renewable energy**	Solar electric power*	221114
Wind	Alternative/Renewable energy	Wind electric power*	221115
Biomass	Alternative/Renewable energy	Biomass power*	221117
Hydroelectric	Alternative/Renewable energy	Hydroelectric power	221111
Geothermal	Alternative/Renewable energy	Geothermal electric power	221116

Methodology

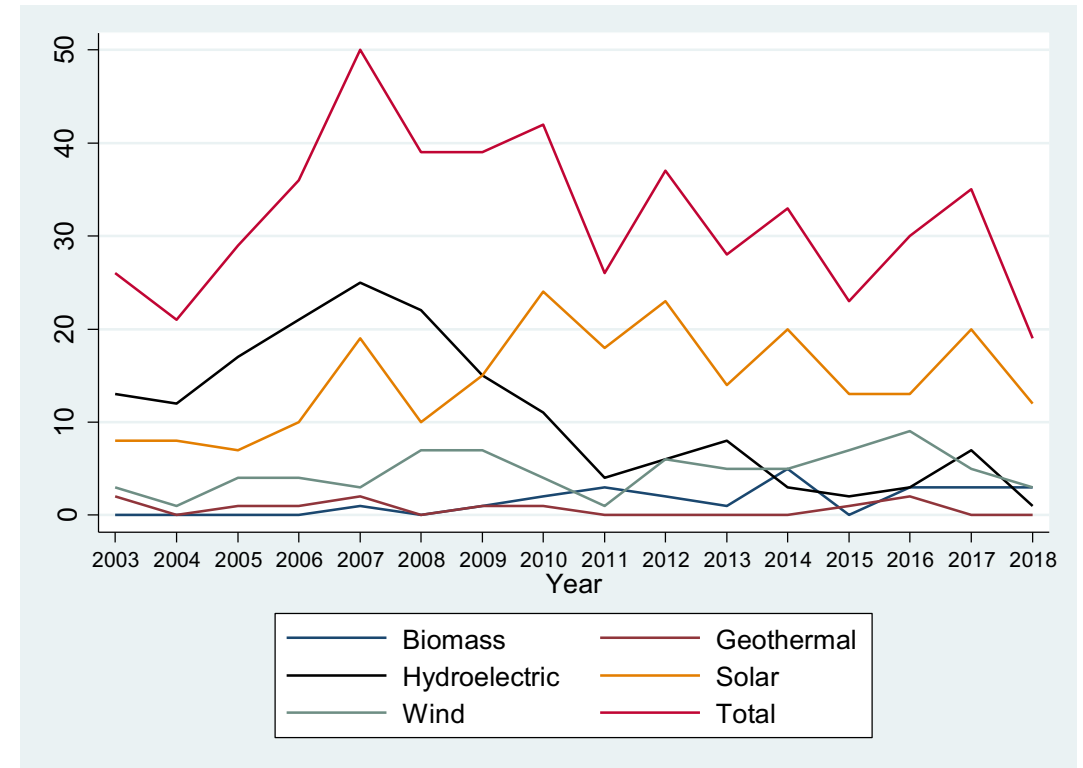
- Problem of self-selection because more productive and innovative firms are more likely to undertake foreign investments: the better performance of MNEs with respect to firms without foreign investments might be independent on their decision to undertake such investment:
 - **control sample** of companies without foreign subsidiaries, randomly selected from the same industries of the companies undertaking FDI;
- **Logit regression** to investigate firm-level characteristics that discriminate investors from non-investors;
- **Difference-in-Difference analysis** to estimate the causal effect of FDIs on investors' efficiency and innovative capacity;
- ***Output variables***: Productivity and Technological capability indicators (# and quality of patents);
- **Explanatory variables**: Size, Age, R&D, Tangible/Intangible assets, Ownership.

Time trends (2003-2018)

Greenfield investments

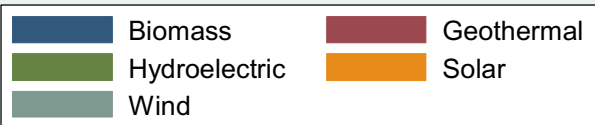
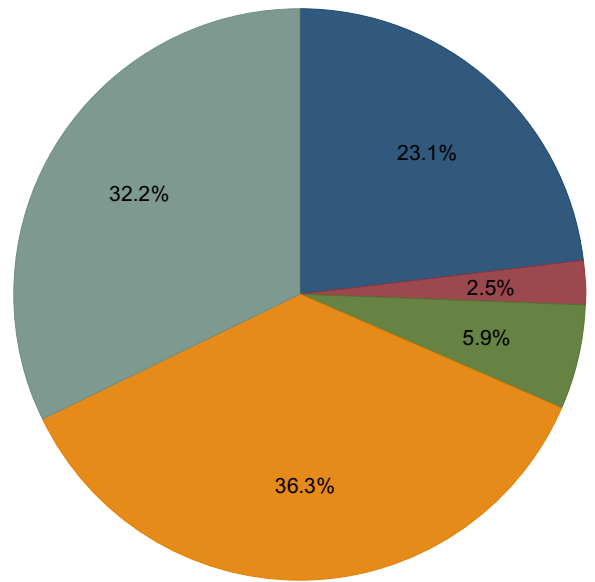


Acquisitions

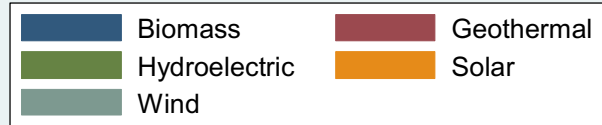
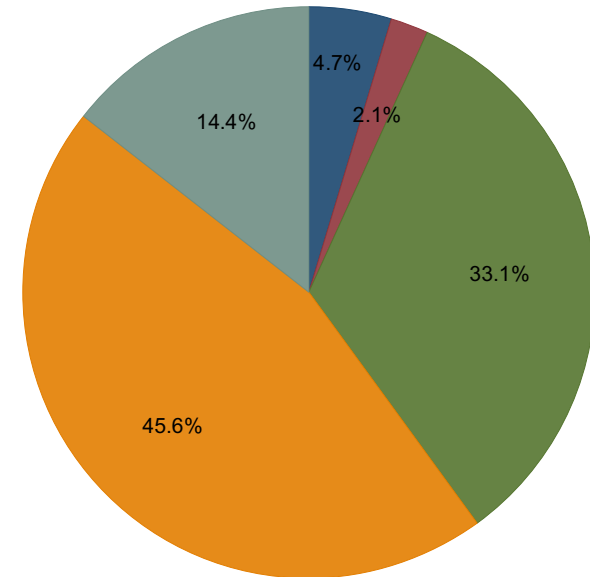


Sector distribution

Greenfield investments

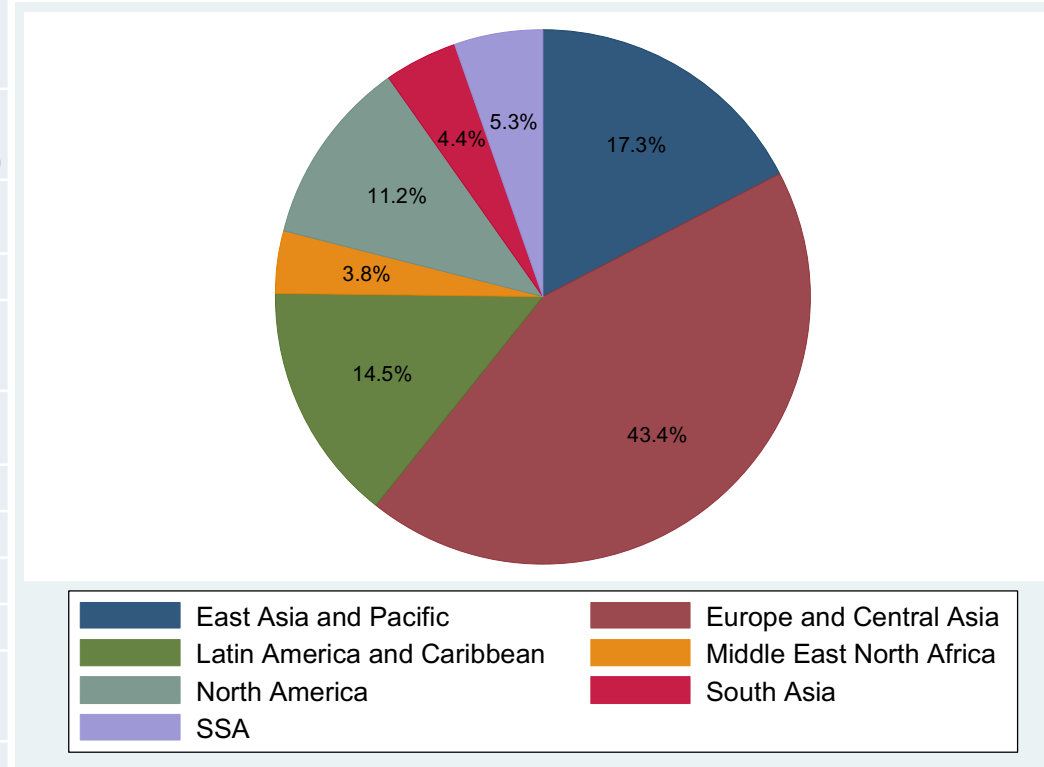


Acquisitions



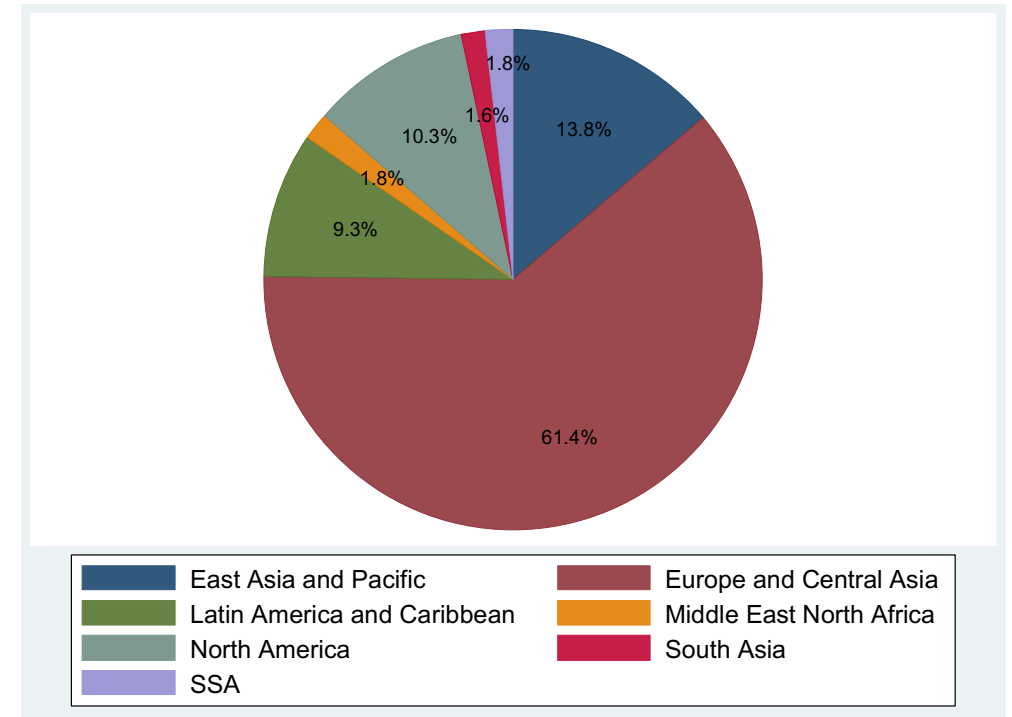
Spatial distribution: greenfield investments

Greenfield (# FDI and %)						
Destination	Biomass	Geothermal	Hydro	Solar	Wind	Total
High Income*	442 (54.6)	33 (37.1)	43 (20.8)	699 (54.8)	742 (65.7)	1,959 (55.8)
Low and Middle Income	368 (45.3)	56 (62.9)	164 (79.2)	576 (45.2)	387 (34.3)	1551 (44.2)
East Asia & Pacific**	185 (22.8)	21 (23.6)	36 (17.4)	264 (20.7)	103 (9.1)	609 (17.3)
Europe and Central Asia	363 (44.8)	39 (43.8)	83 (40.1)	439 (34.4)	599 (53.1)	1,523 (43.4)
Latin America and Caribbean	97 (12.0)	11 (12.4)	54 (26.1)	192 (15.1)	154 (13.6)	508 (14.5)
Middle East North Africa	11 (1.4)	2 (2.2)	3 (1.4)	82 (6.4)	35 (3.1)	133 (3.8)
North America	89 (11.0)	4 (4.5)	4 (1.9)	129 (10.1)	169 (15.0)	395 (11.2)
South Asia	29 (3.6)	2 (2.2)	12 (5.8)	74 (5.8)	37 (3.3)	154 (4.4)
SSA	36 (4.4)	10 (11.2)	15 (7.2)	95 (7.4)	32 (2.8)	188 (5.3)
Total	810 (100)	89 (100)	207 (100)	1,275 (100)	1,129 (100)	3,510 (100)
Top 3 Destinations (# FDI)	UK (77); USA (76); Brazil (43)	Indonesia (8); China, Germany (6 each)	Serbia (14); Bosnia, Brazil, Laos (13 each)	USA (103); Japan (80); Spain (69)	UK (135); USA (131); France (69)	USA (317); UK (278); France (126)



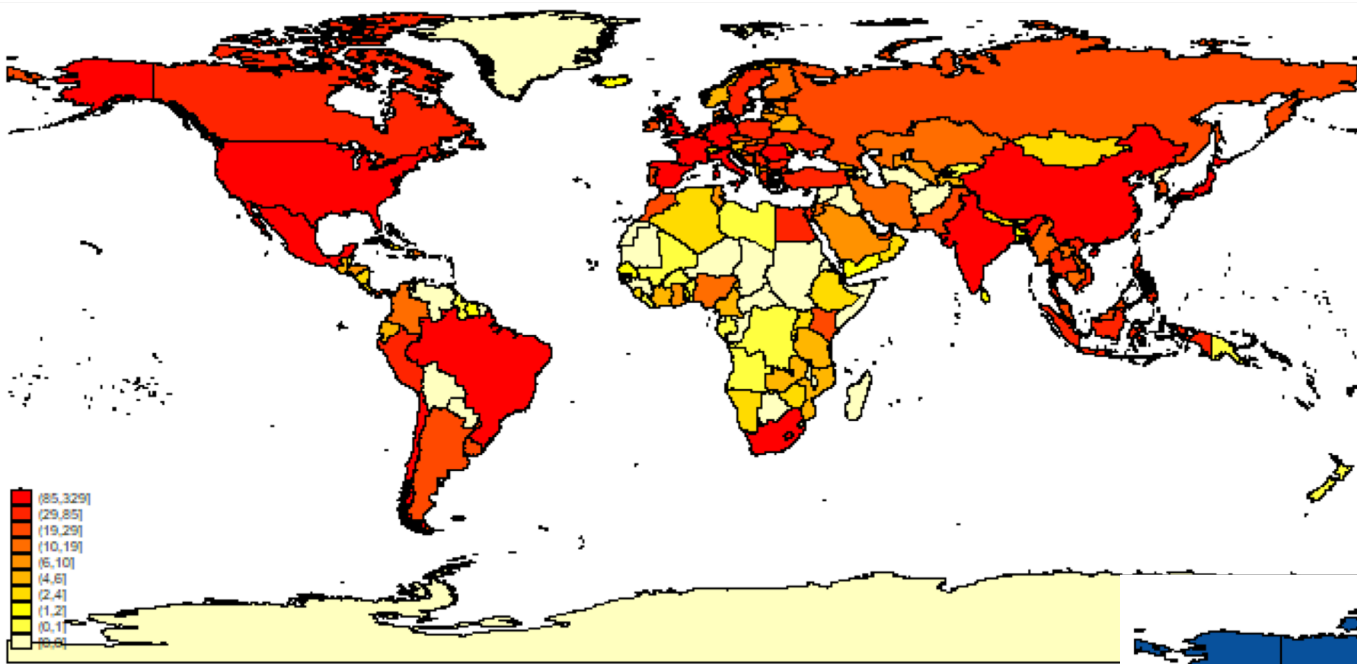
Spatial distribution: acquisitions

CBA (# FDI and %)						
Destination	Biomass	Geothermal	Hydro	Solar	Wind	Total
High Income*	21 (87.5)	3 (27.3)	113 (66.5)	174 (74.4)	64 (86.5)	375 (73.1)
Low and Middle Income	3 (12.5)	8 (72.7)	57 (33.5)	60 (25.6)	10 (13.5)	138 (26.9)
East Asia & Pacific**	4 (16.7)	7 (63.6)	26 (15.3)	27 (11.5)	7 (9.5)	71 (13.8)
Europe and Central Asia	18 (75.0)	3 (27.3)	82 (48.2)	156 (66.7)	56 (75.7)	315 (61.4)
Latin America and Caribbean	1 (4.2)	0 (0.0)	22 (12.9)	20 (8.5)	5 (6.8)	48 (9.3)
Middle East North Africa	0 (0.0)	1 (9.1)	5 (2.9)	2 (0.8)	1 (1.3)	9 (1.7)
North America	1 (4.2)	0 (0.0)	29 (17.1)	20 (8.5)	3 (4.0)	53 (10.3)
South Asia	0 (0.0)	0 (0.0)	3 (1.8)	3 (1.3)	2 (2.7)	8 (1.6)
SSA	0 (0.0)	0 (0.0)	3 (1.8)	6 (2.6)	0 (0.0)	9 (1.7)
Total	24 (100)	11 (100)	170 (100)	234 (100)	74 (100)	513 (100)
Top 3 Destinations (# FDI)	Portugal (4); Sweden (3); Various (2)	China (7); Various (1)	US (23); China, UK, Italy (9 each)	Italy (24); UK (19); Spain (17)	Germany (12); Poland (7); UK (6)	Italy (39); UK, USA (36 each)

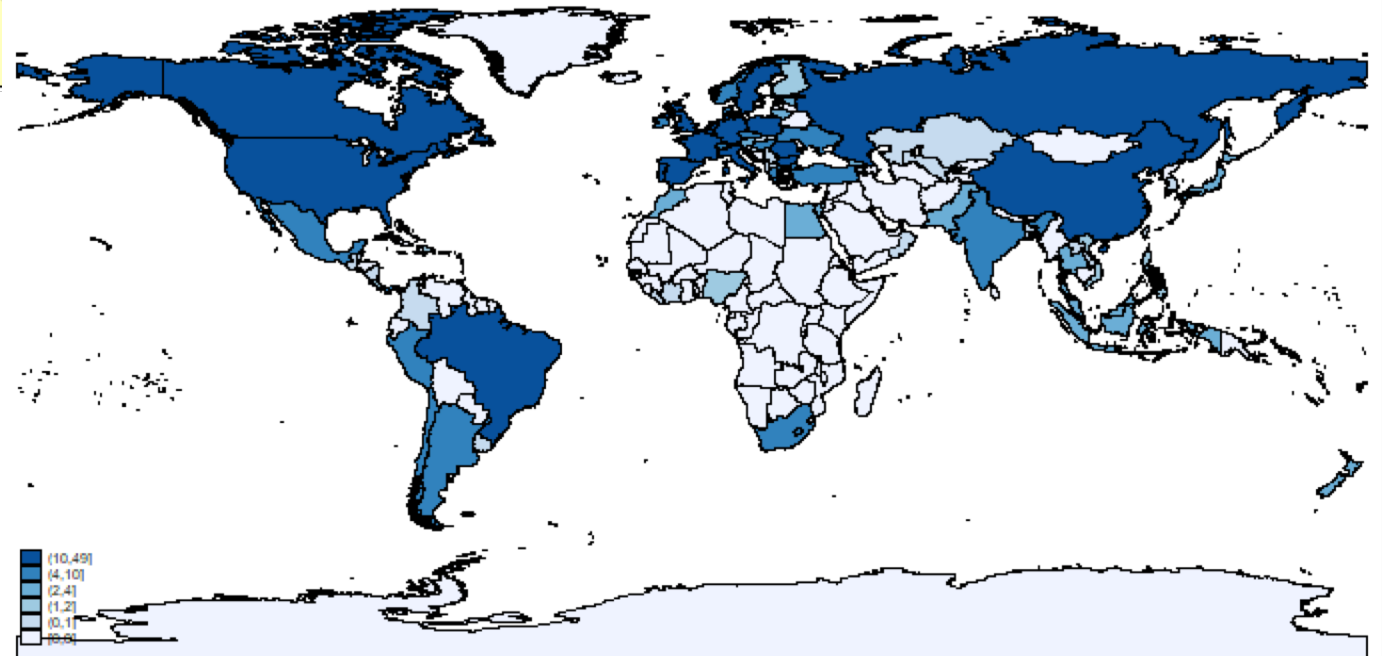


Host countries

Greenfield Investments



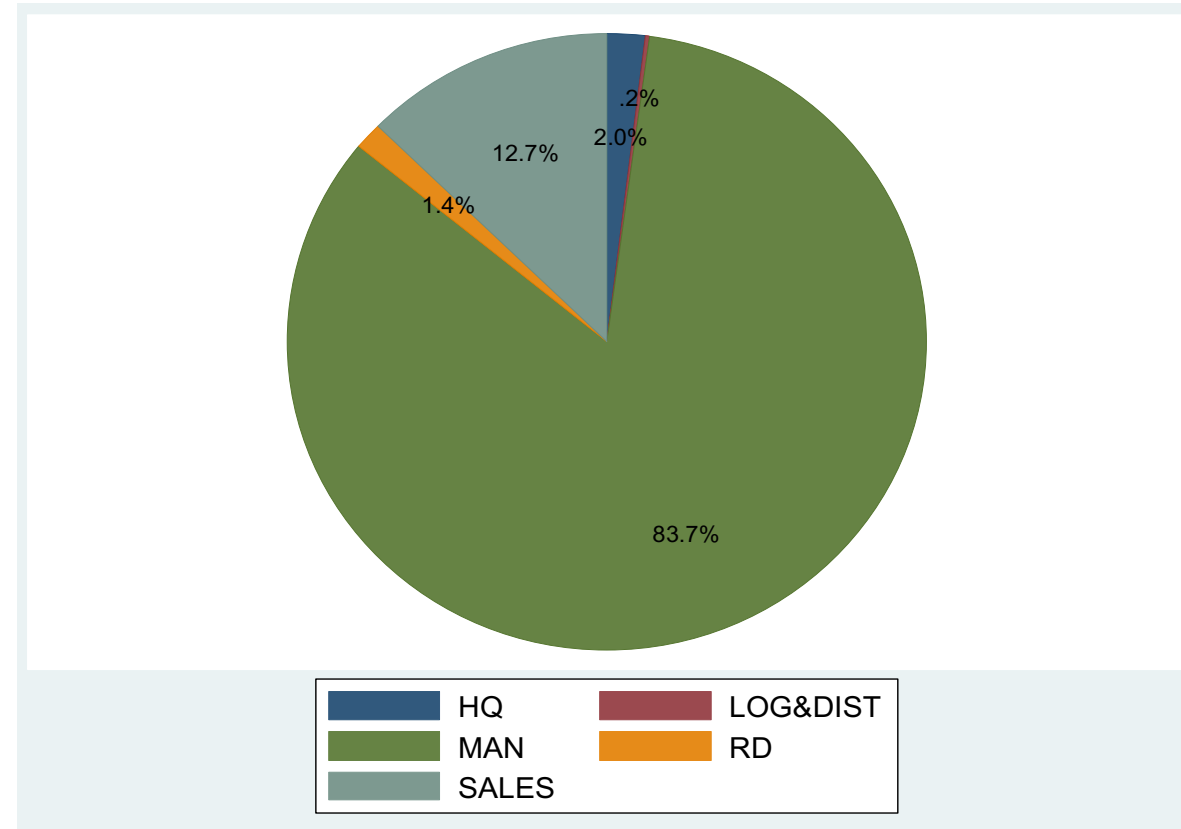
Acquisitions



Greenfield investments: activities

Value Chain distribution (# FDI and %, by sector)

Value Chain Stage*	Solar	Wind	Biomass	Hydro	Geothermal	Total
MAN	1,049 (82.3)	950 (84.1)	692 (85.4)	170 (82.1)	78 (87.6)	2,939 (83.7)
SALES	177 (13.9)	146 (12.9)	80 (9.9)	32 (15.5)	10 (11.2)	445 (12.7)
HQ	37 (2.9)	19 (1.7)	13 (1.6)	0 (0.0)	0 (0.0)	69 (2.0)
RD	11 (0.9)	14 (1.2)	21 (2.6)	3 (1.4)	1 (1.1)	50 (1.4)
LOG&DIST	1 (0.1)	0 (0.0)	4 (0.5)	2 (1.0)	0 (0.0)	7 (0.2)
Total	1,275 (100)	1,129 (100)	810 (100)	207 (100)	89 (100)	3,510 (100)



Home countries

Greenfield investments

Source Country	#	Percent
Germany	458	13.05
Spain	402	11.45
United States	382	10.88
France	258	7.35
Italy	251	7.15
United Kingdom	181	5.16
China	169	4.81
Canada	157	4.47
Japan	115	3.28
Ireland	75	2.14
Netherlands	73	2.08
Norway	67	1.91
Austria	66	1.88
South Korea	66	1.88
Denmark	61	1.74
Portugal	61	1.74
Belgium	54	1.54
Sweden	45	1.28
Switzerland	43	1.23
Singapore	38	1.08
Thailand	38	1.08
Czech Republic	36	1.03
Australia	35	1
India	35	1
Finland	34	0.97
ROW	310	8.82

Acquisitions

Source Country	#	Percent
USA	59	11.5
Germany	46	8.97
UK	38	7.41
Italy	29	5.65
Canada	28	5.46
Spain	28	5.46
Netherlands	27	5.26
Switzerland	22	4.29
Denmark	22	4.29
Hong Kong	18	3.51
Norway	18	3.51
Czech Republic	14	2.73
Luxemburg	14	2.73
Singapore	12	2.34
Bermuda	11	2.14
Australia	9	1.75
China	9	1.75
Malaysia	9	1.75
New Zealand	9	1.75
France	8	1.56
Austria	6	1.17
Belgium	6	1.17
Chile	5	0.97
Ireland	5	0.97
Israel	5	0.97
India	5	0.97
Japan	5	0.97
ROW	46	9

Top 5 investors (# of deals): greenfield investments

Top investors (greenfield FDI)			
Sector	Investor Name (Origin)*	# FDI	Top Destination Countries by # deals
Biomass	Abengoa Bioenergy (ES)	11	USA (7)
Biomass	Archer Daniels Midland (US)	9	Brazil (6)
Biomass	Cargill (US)	9	France, Germany (2 each)
Biomass	Neste Oil (FI)	8	Netherlands, Singapore (3 each)
Biomass	Virdia - HCL CleanTech (IL)	8	USA (8)
Geothermal	Enex (IS)	7	Germany (6)
Geothermal	Enex China (IS)	4	China (4)
Geothermal	Ormat Technologies (IL)	4	Kenya (3)
Geothermal	Chint Solar (CN)	3	Spain (3)
Geothermal	KS Orka (CN)	3	Hungary, Indonesia, Serbia (1 each)
Hydroelectric	Centrais Eletricas Brasileira (Eletrobras)	9	Peru (8)
Hydroelectric	Enersis (ES)	6	Chile (5)
Hydroelectric	China Huadian Corporation (CN)	5	Cambodia, Cayman Is., Cyprus, Malaysia, Singapore
Hydroelectric	Platinum Power (MA)	5	Cote d'Ivoire (3)
Hydroelectric	Statkraft (NO)	5	Turkey (3)
Solar	Enel Green Power (IT)	34	Greece (16)
Solar	Canadian Solar Inc (CA)	33	Japan (13)
Solar	SunEdison (USA)	30	Canada (8)
Solar	OPDE (ES)	26	Italy (12)
Solar	SkyPower (CA)	23	Uzbekistan (6)
Wind	Iberdrola (ES)	30	Mexico (10)
Wind	Enel Green Power (IT)	27	Morocco (6)
Wind	Iberdrola Renovables (ES)	25	France, USA (8 each)
Wind	Mainstream Renewable Power (IR)	21	South Africa (9)
Wind	ACCIONA Energia (ES)	20	USA (5)

Top 3 investors (# of deals): acquisitions

Top investors (CBA FDI)			
Sector	Investor Name (Origin)**	# FDI	Top Destination Countries by # deals
Biomass	BAYWA RE RENEWABLE ENERGY GMBH (DE)	6	Australia (2)
Biomass	CHINA TIANYING INC. (CN)	2	Portugal (2)
Biomass	EBIOS ENERDZHI AD	2	Italy, Portugal (1 each))
Biomass	SOLOR BIOENERGI HOLDING AS (NO)	2	Sweden (2)
Geotherma	CHINA RESOURCES POWER HOLDINGS CO., LTD (HK)	8	China (7)
Geotherma	VOLTALIA SA (FR)	2	Morocco, Portugal (1 each)
Geotherma	COGENPOWER PLC (UK)	1	Italy (1)
Hydroelect	ASHMORE ENERGY INTERNATIONAL LTD (US)	7	Argentina, Brazil, Chile, Dominican R., Cayman Is., Peru, El Salvador
Hydroelect	ENEL INVESTMENT HOLDING BV (NL)	7	Romania (2)
Hydroelect	ENERGO-PRO AS (CZ)	7	Bulgaria (3)
Solar	ENEL SPA (IT)	11	Romania, Russia (2 each)
Solar	BKW FMB ENERGIE AG (CH)	6	Italy (5)
Solar	MEIYA POWER CO., LTD (BM)	6	China (6)
Solar	SONNEDIX POWER HOLDINGS LTD (UK)	6	Spain (3)
Wind	DONG ENERGY A/S (DK)	9	UK (4)
Wind	INTERNATIONAL POWER PLC (UK)	6	Germany (3)
Wind	EDP RENOVAVEIS SA (ES)	4	Brazil, France, Italy, Romania (1 each)

Questions?

Suggestions?

Thank you

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