Do Carbon Offsets Offset Carbon?

Raphael Calel, Georgetown University
Jonathan Colmer, University of Virginia
Antoine Dechezleprêtre, OECD
Matthieu Glachant, MINES ParisTech


United Nations Framework Convention on Climate Change
Third Session, Conference of the Parties

The Kyoto Protocol (1997)

- **It set binding emission reduction targets for 37 industrialized countries and economies in transition**
  - **An average 5 per cent emission reduction compared to 1990 levels over the five year period 2008–2012**
- **These countries could meet part of their targets by implementing emission-reduction project in developing countries**

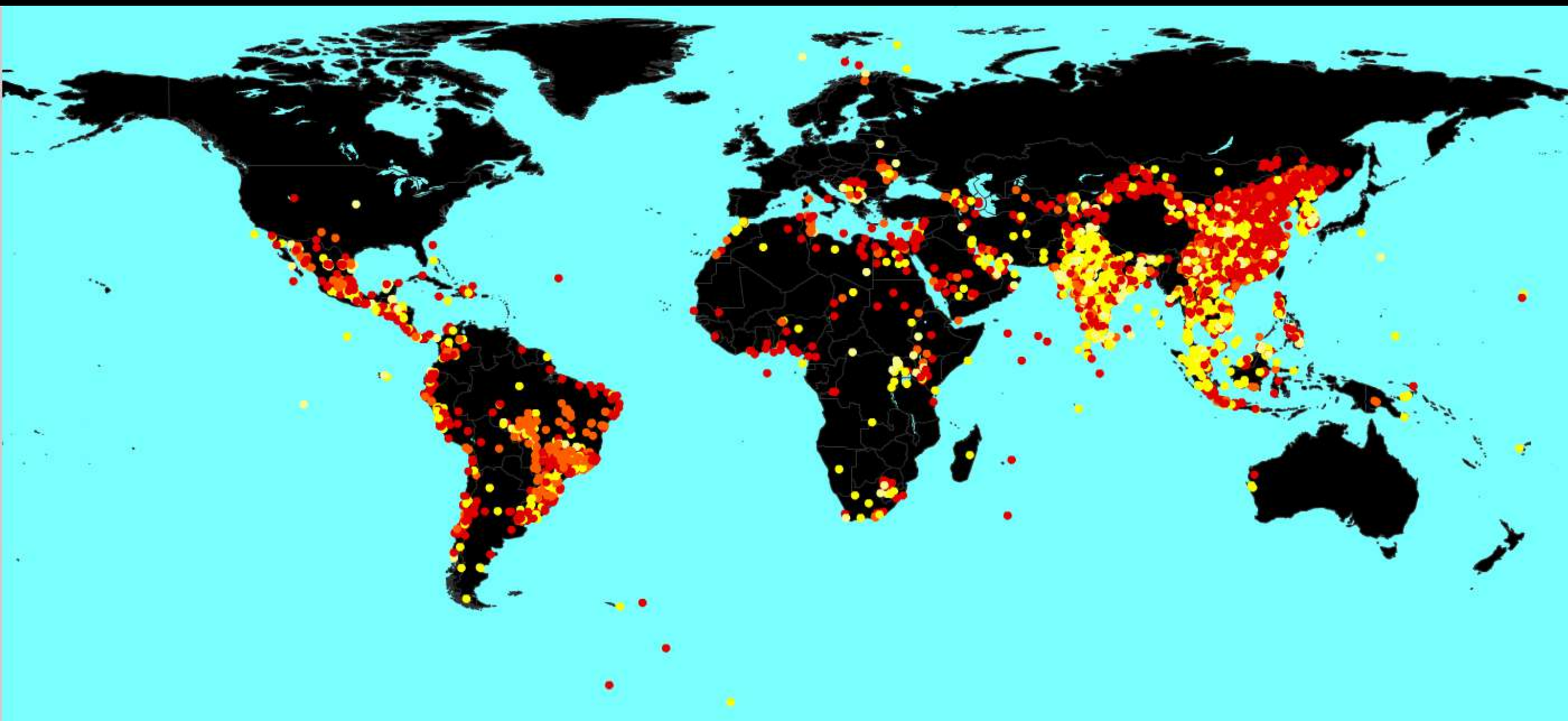
The Clean Development Mechanism

- **The main carbon offset mechanism established under the Protocol**
- **A CDM project must be located in a developing country**
- **Must provide emission reductions that are additional to what would otherwise have occurred.**
- **Emissions credits used by regulated entities located in countries with targets to meet their obligations**

The Importance of the CDM

- **A contribution of $90 billion to renewable energy investments in developing countries**
  - **13% of their total RE investments**
- **By 2030, 11.8 billion carbon offsets (roughly equivalent to US + EU emissions in 2019)**

Clean Development Mechanism (CDM)



- = CDM project, Large scale, one location
- = CDM project, Large scale, several locations
- = CDM project, Small scale, one location
- = CDM project, Small scale, several locations

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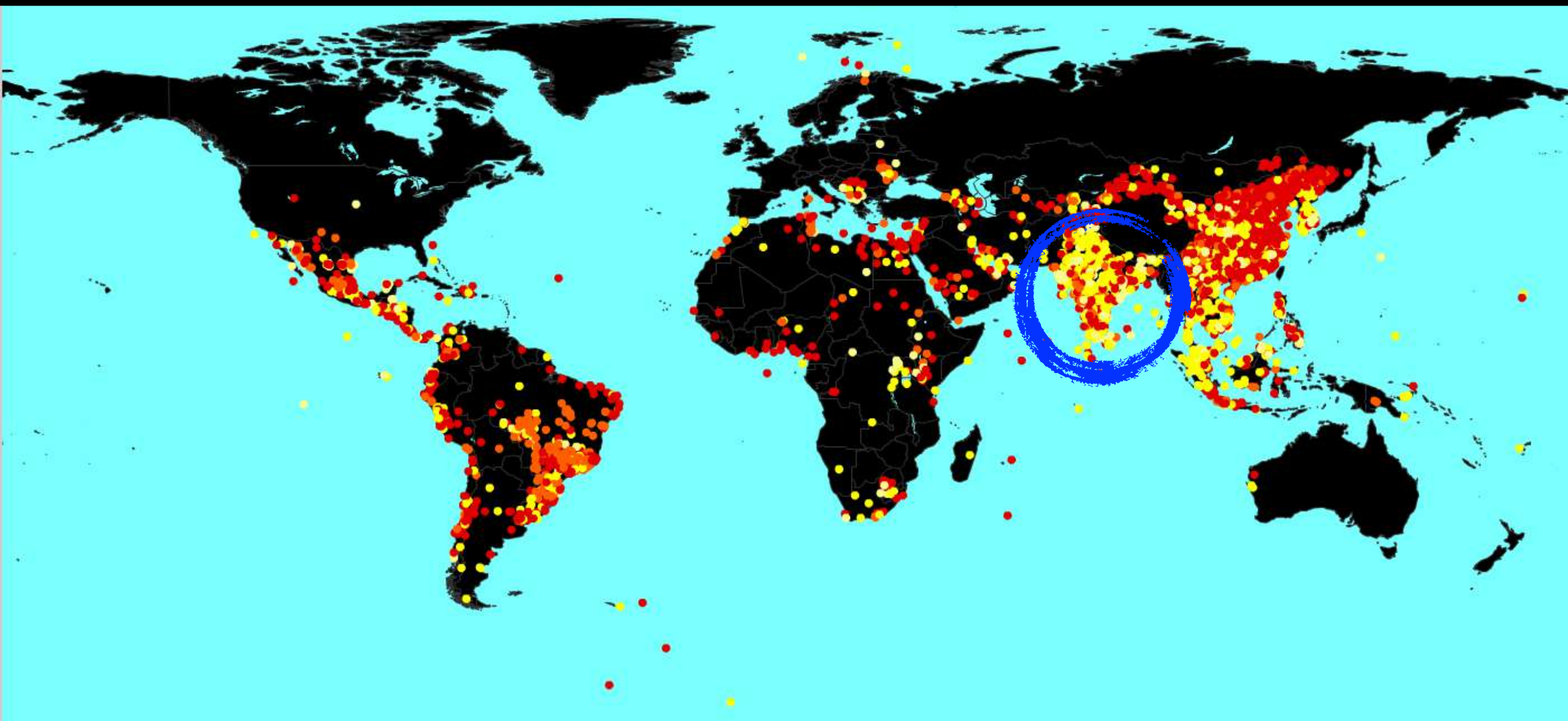

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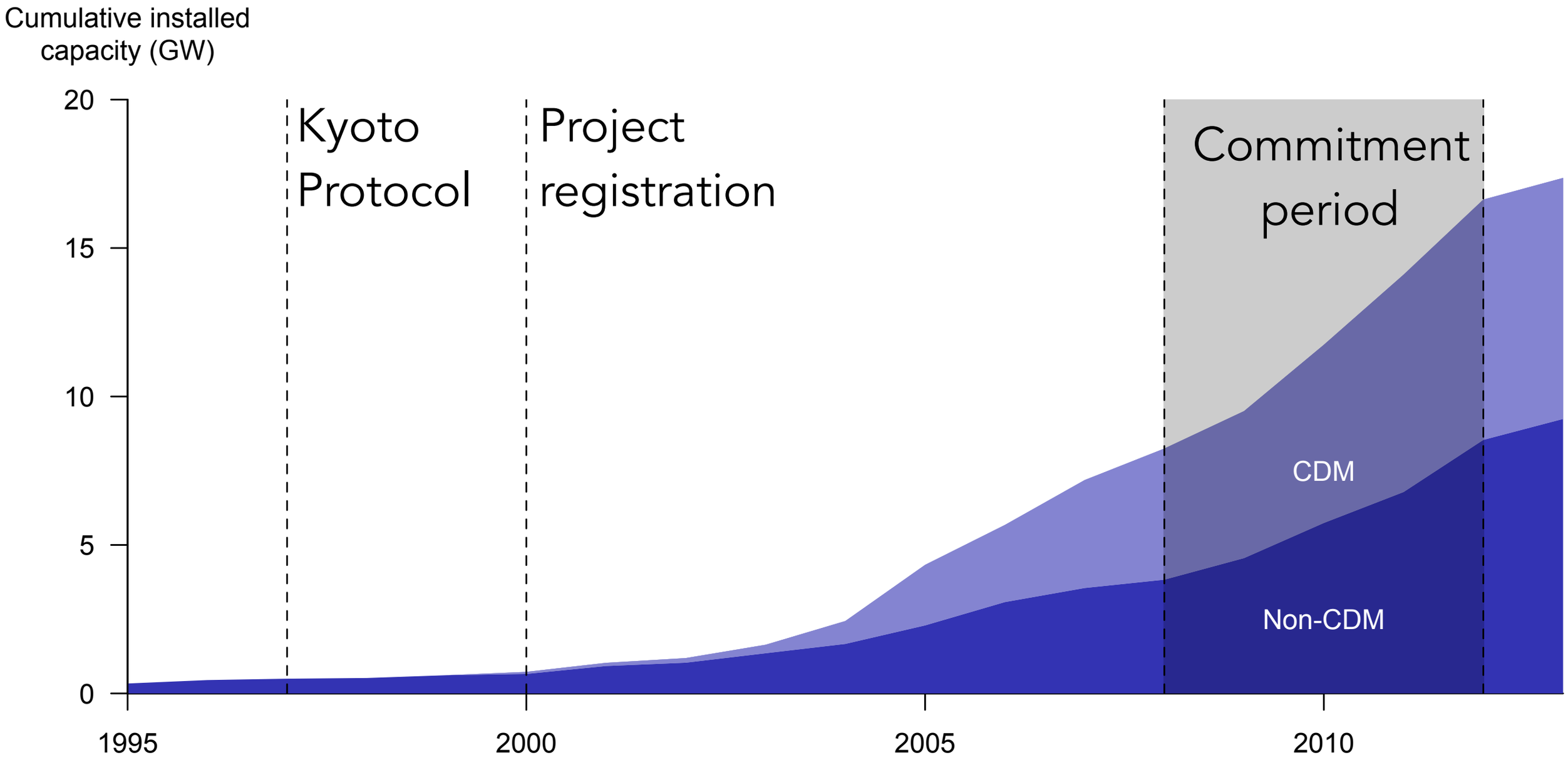
Offsets in Indian Wind Power



Marginal vs. Infra-Marginal

Let $V(s, x)$ be the private value of a project with characteristics x, and a subsidy rate of s.

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We can then, in principle, rank projects from most to least valuable, for a given subsidy rate $s = 0$.

$$V(0, x_1) \geq V(0, x_2) \geq R \geq V(0, x_3) \geq V(0, x_4) \geq V(0, x_5)$$

R is the reservation rate.

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Given minimal regularity conditions on V, the ranking is invariant to the subsidy, so that for $s > 0$, we have:

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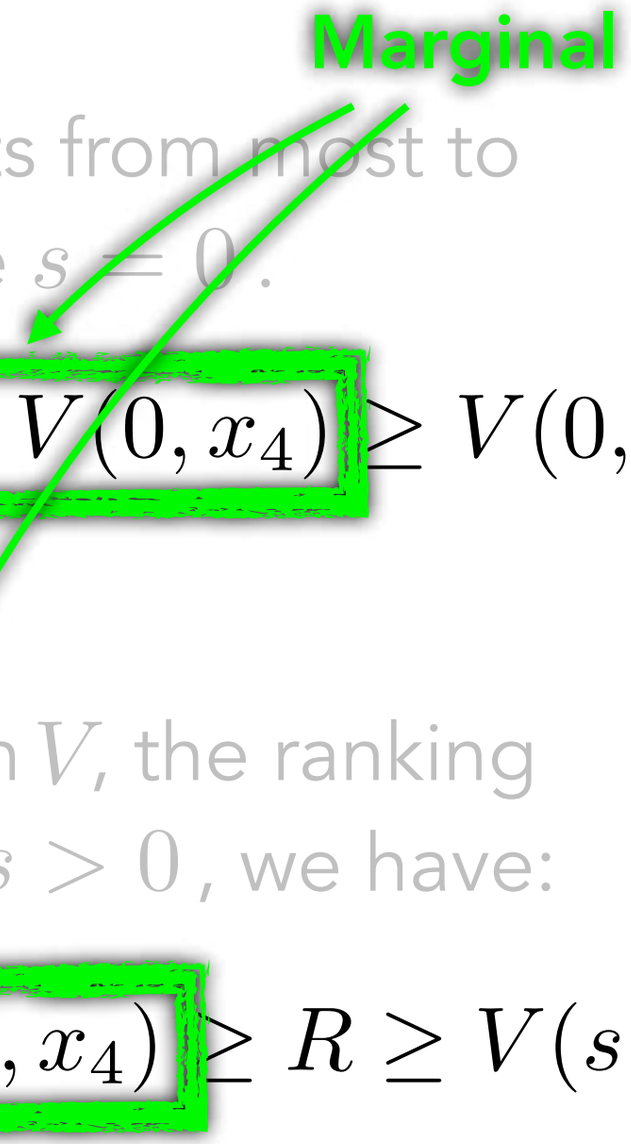

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Infra-marginal

Marginal

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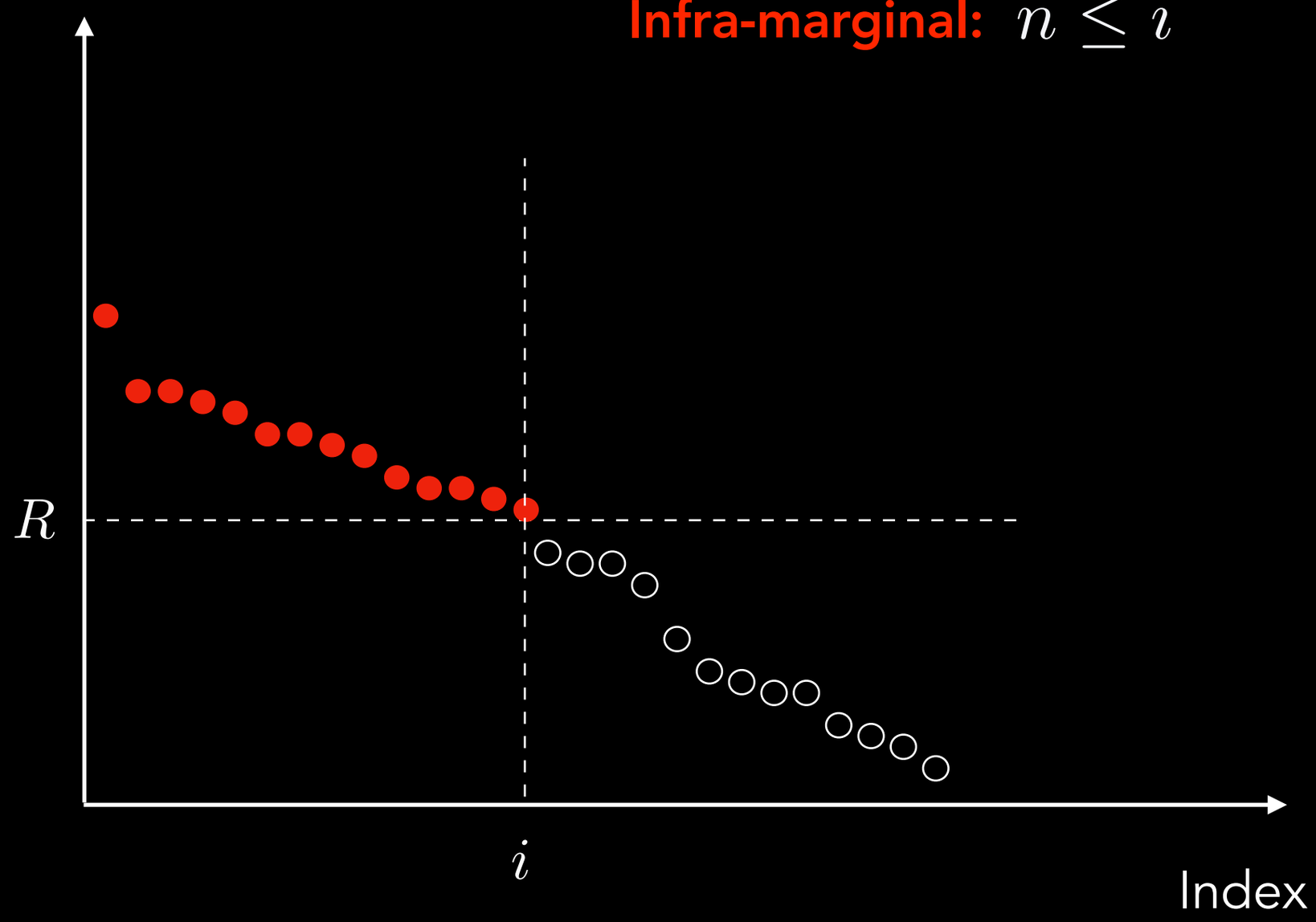
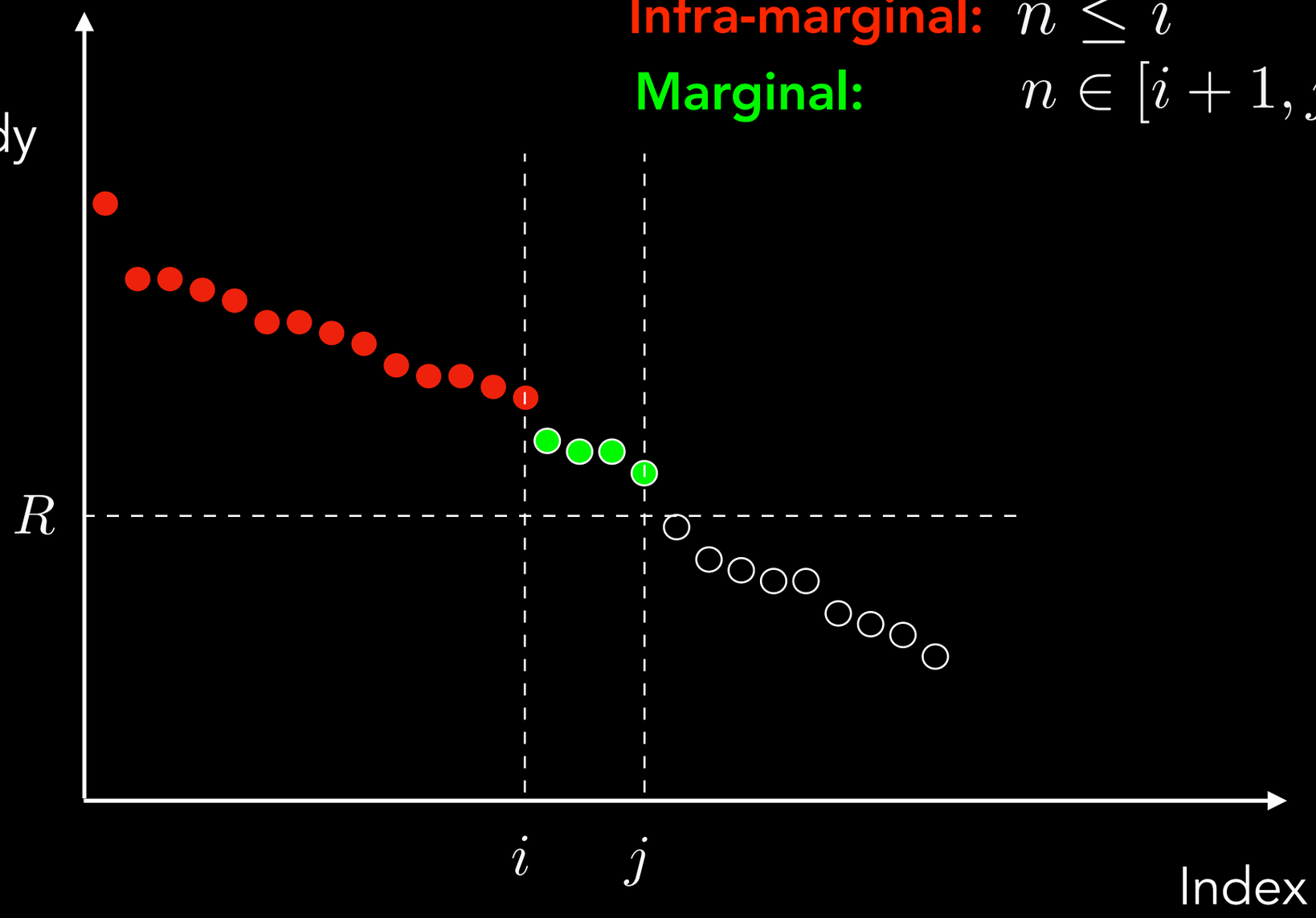


Marginal vs. Infra-Marginal

Infra-marginal: $n \leq i$

Marginal: $n \in [i+1, j]$



MARGINAL VS. INFRA-MARGINAL

If V is monotonic in some subset of of characteristics, $\tilde{x} \subset x$, then we can infer that project n is infra-marginal if a project m exists such that:

(1) m did not receive a subsidy $\implies m \leq i$

(2) $\tilde{x}_m$ is inferior to $\tilde{x}_n$, and $\implies n \leq m$

(3) $x_m = x_n$ for all characteristics not in $\tilde{x}$.

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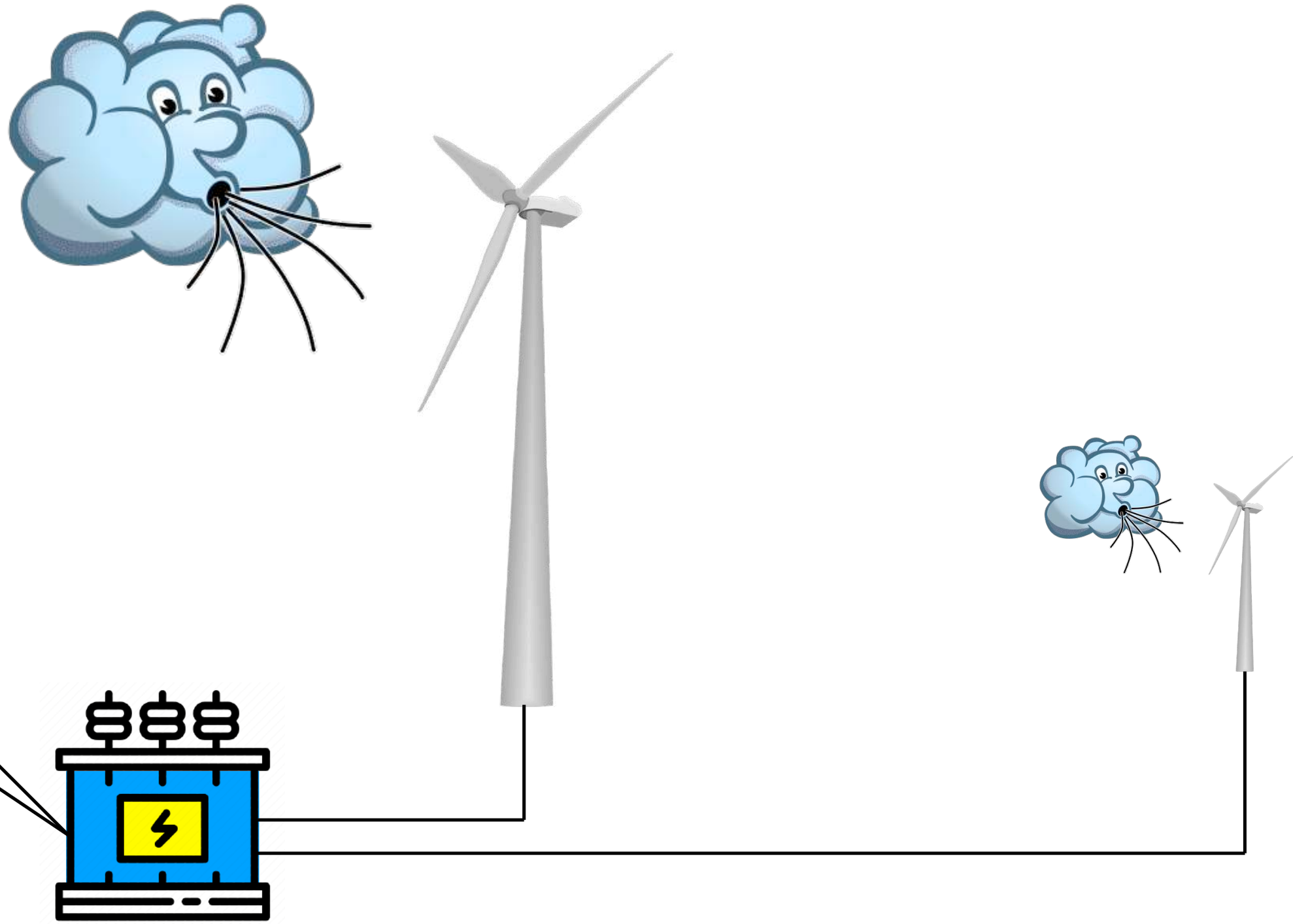
$$\implies n \leq i$$

n is a **blatantly infra-marginal project (BLIMP)** by virtue of the existence of an inferior unsubsidized project m.

Wind Farm Economics



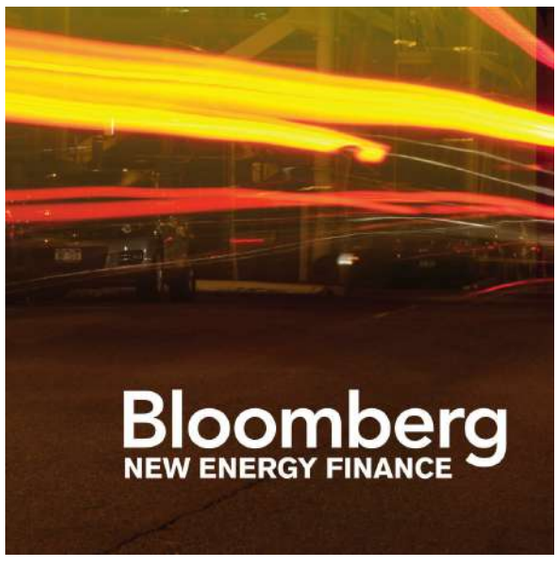
An operational definition of a BLIMP

A CDM wind power project is a BLIMP if there exists at least one non-CDM wind power project built in the same state and year

- **with a larger capacity, and**
- **built in a windier location, and**
- **built closer to a connection point**

Sufficient, but not necessary conditions for infra-marginality

Geo-locate Wind Farms



United Nations Framework
Convention on Climate Change

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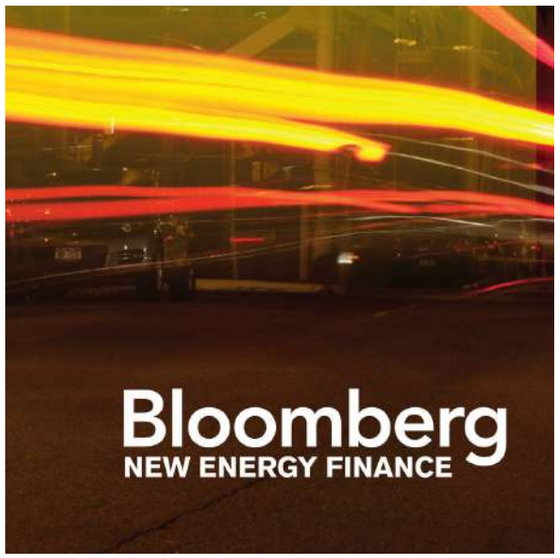

United Nations Framework Convention on Climate Change

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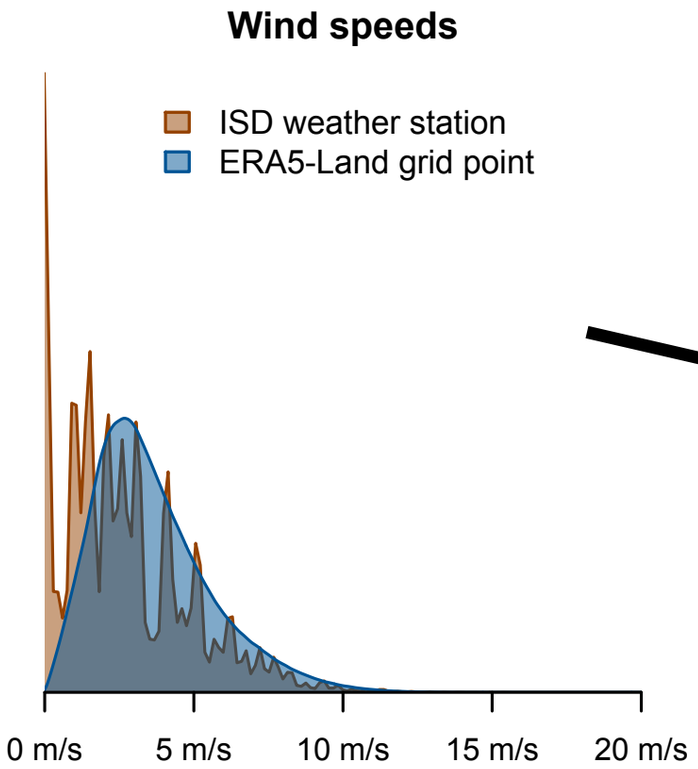
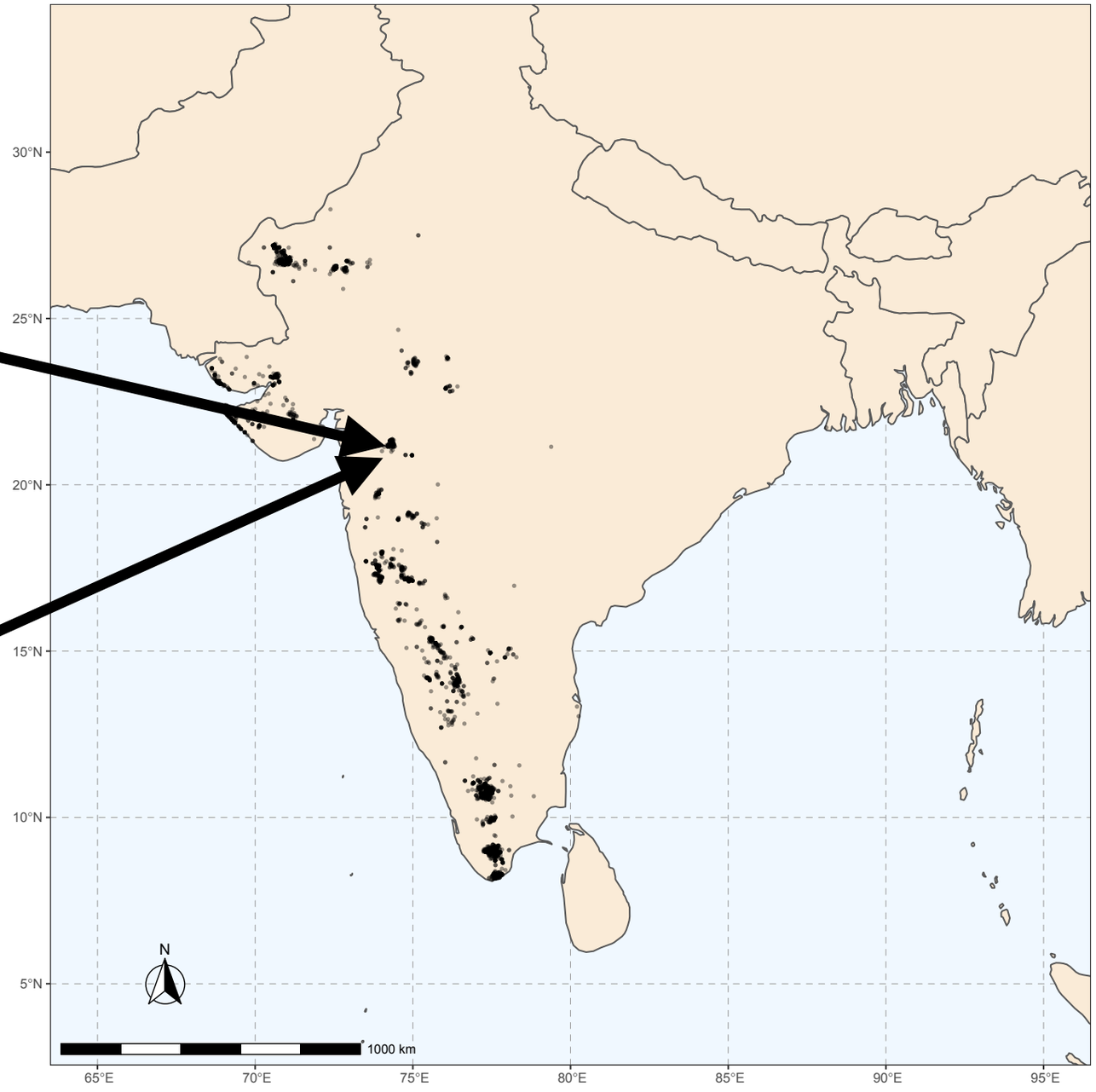
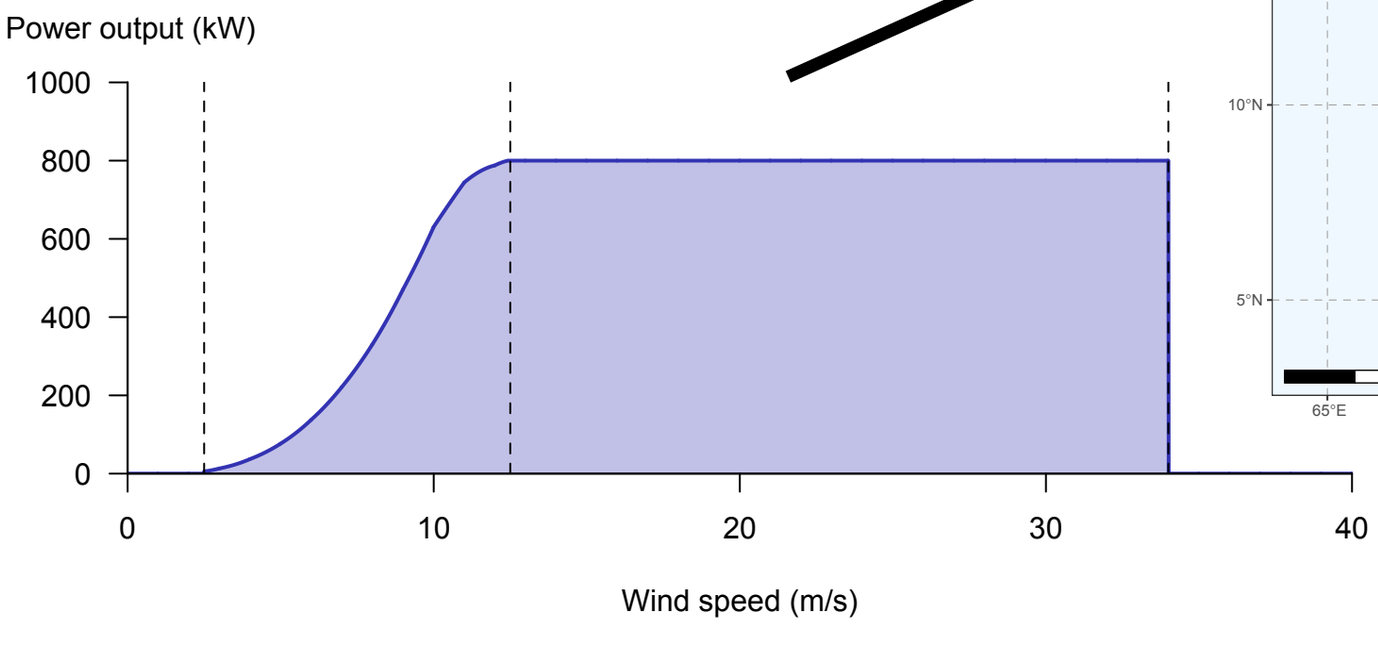
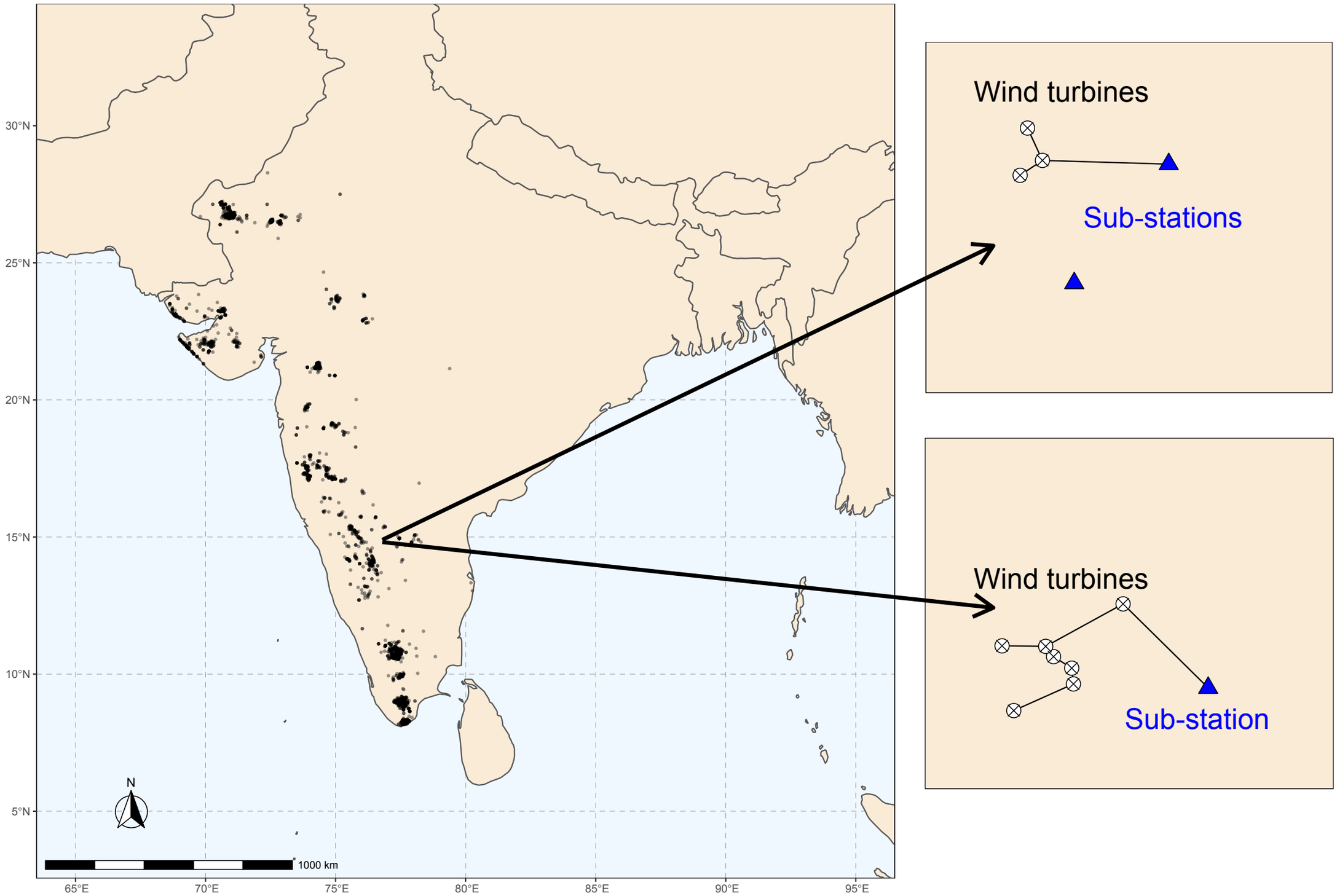
Estimate Capacity Factors



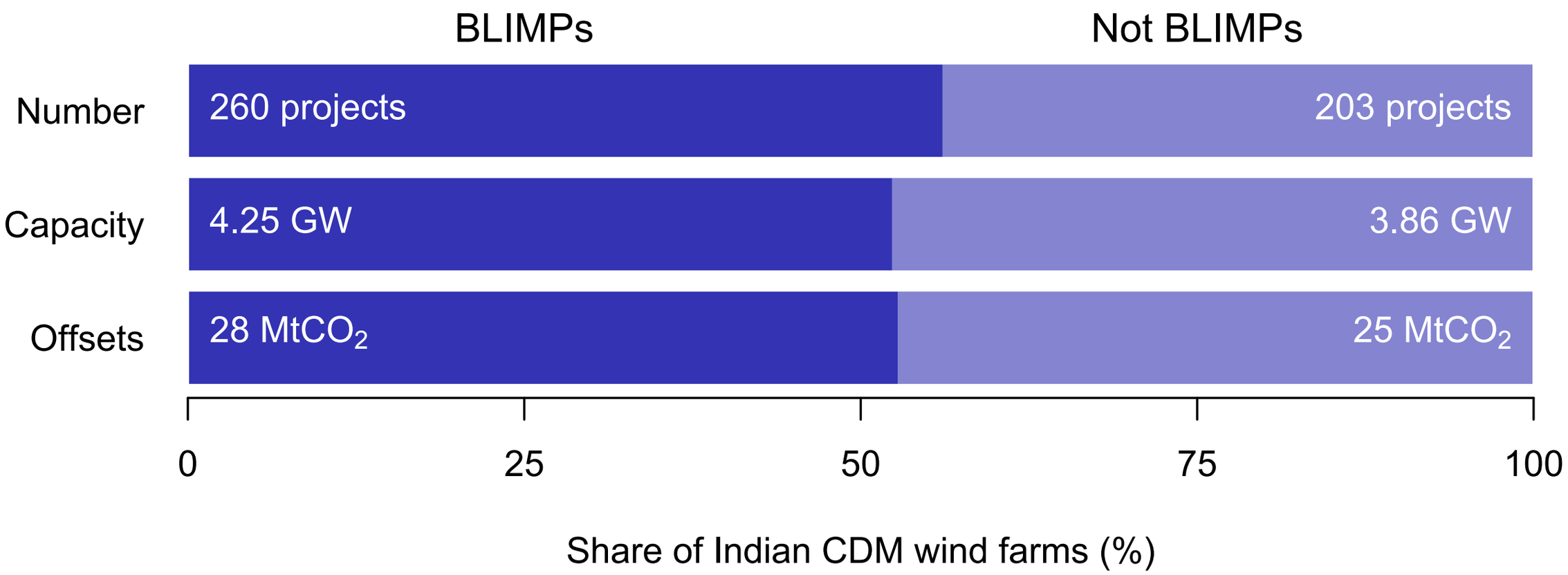




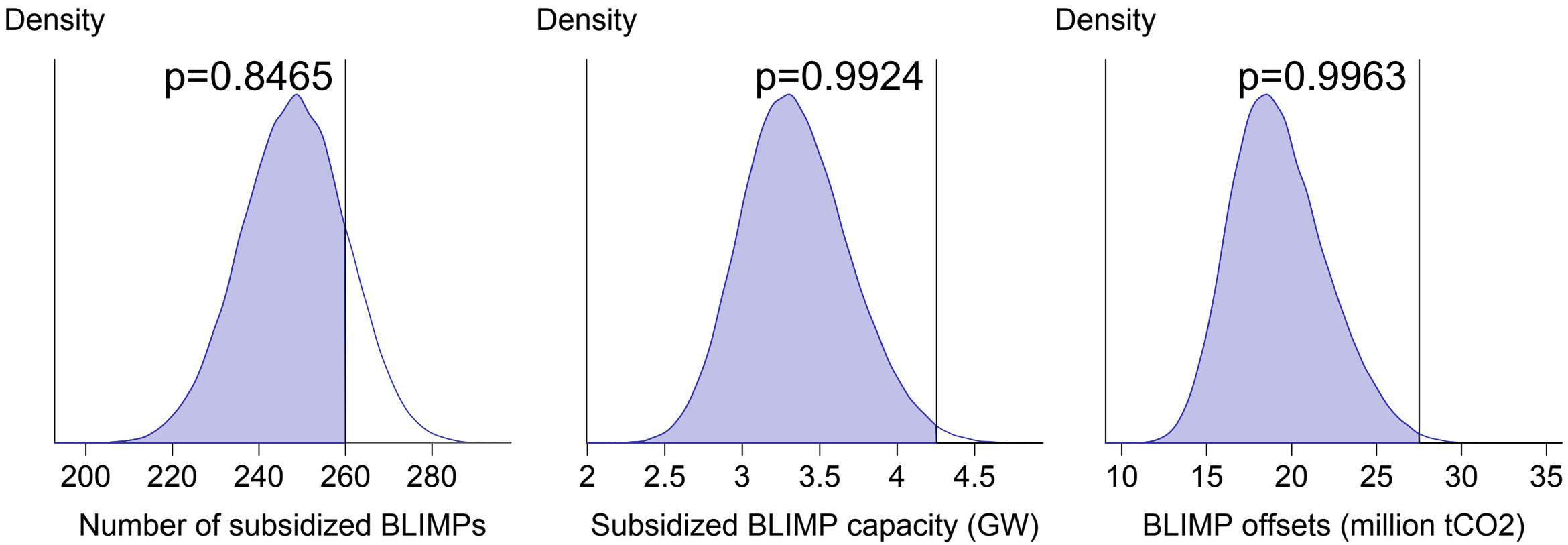
Estimate Grid-Connection Cost



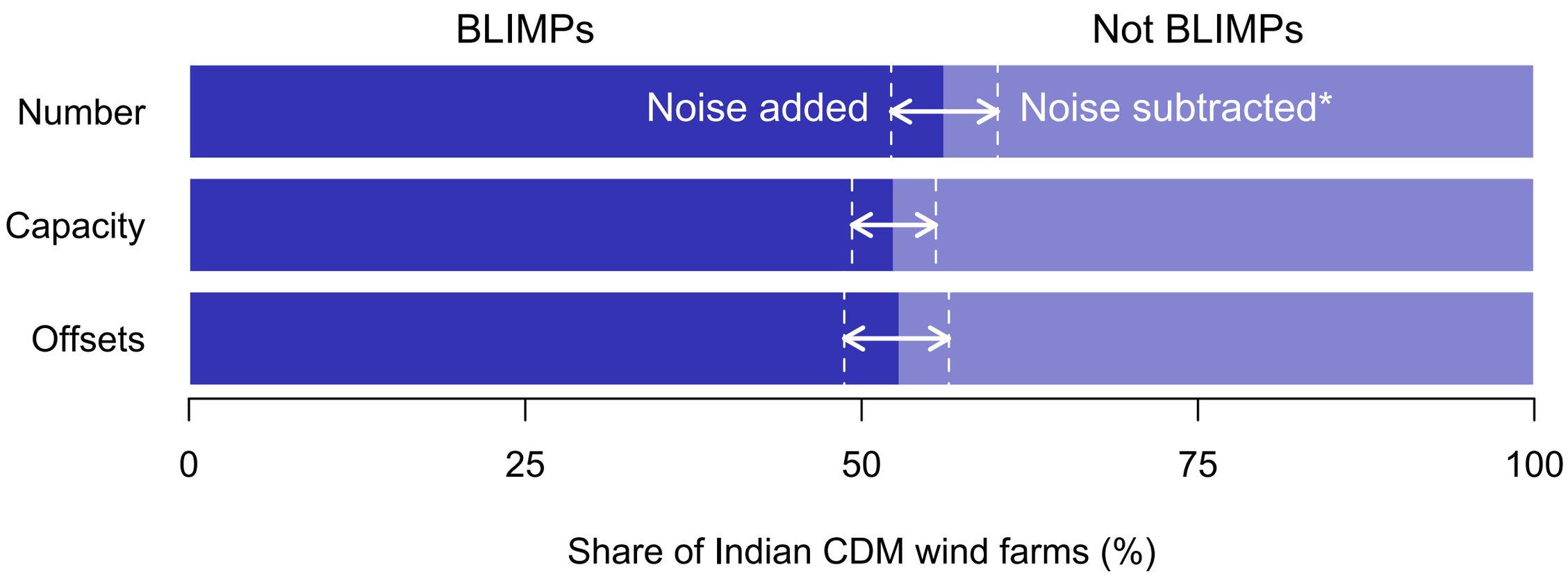
RESULTS


BLIMPs
Not BLIMPs
Number
260 projects
203 projects
Capacity
4.25 GW
3.86 GW
Offsets
28 MtCO2
25 MtCO2
0
25
50
75
100
Share of Indian CDM wind farms (%)

Results


Density
p=0.8465
200
220
240
260
280
Number of subsidized BLIMPs
Density
p=0.9924
2
2.5
3
3.5
4
4.5
Subsidized BLIMP capacity (GW)
Density
p=0.9963
10
15
20
25
30
35
BLIMP offsets (million tCO2)

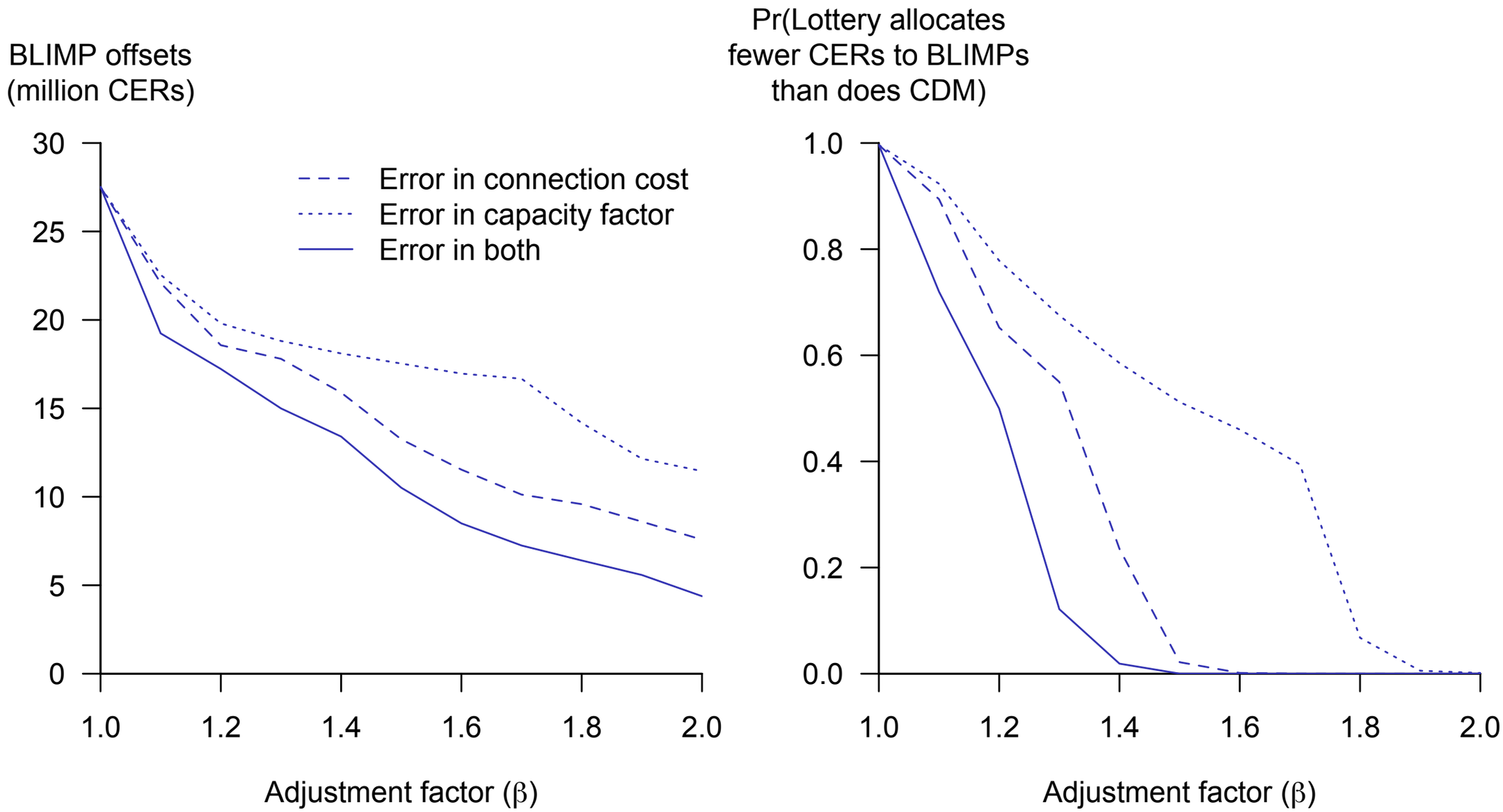
Measurement Error



Measurement Error

	BLIMP fraction (in percent)	BLIMP capacity (in GW)	BLIMP offsets (in million tCO_2)
Main result	56	4.254	27.513
	(0.8465)	(0.9924)	(0.9963)
Measurement errors			
(1) Connect within States	57	4.351	27.836
	(0.8956)	(0.9957)	(0.9970)
(2) Connect to Power stations	52	4.750	30.602
	(0.7215)	(0.9997)	(0.9999)
(3) Connect to Cities of >100,000	56	4.186	25.884
	(0.9563)	(0.9999)	(0.9999)
(4) Connect to Cities with power	52	4.098	25.531
	(0.8820)	(0.9988)	(0.9988)
(5) Suzlon benchmark turbine	56	4.230	27.329
	(0.8013)	(0.9916)	(0.9959)
(6) Standard air density	56	4.254	27.513
	(0.8452)	(0.9924)	(0.9963)
(7) Adjustment factor $\beta = 1.2$	36	2.752	17.228
	(0.0001)	(0.1032)	(0.4996)

Measurement Error



Omitted Variables

	BLIMP fraction (in percent)	BLIMP capacity (in GW)	BLIMP offsets (in million tCO_2)
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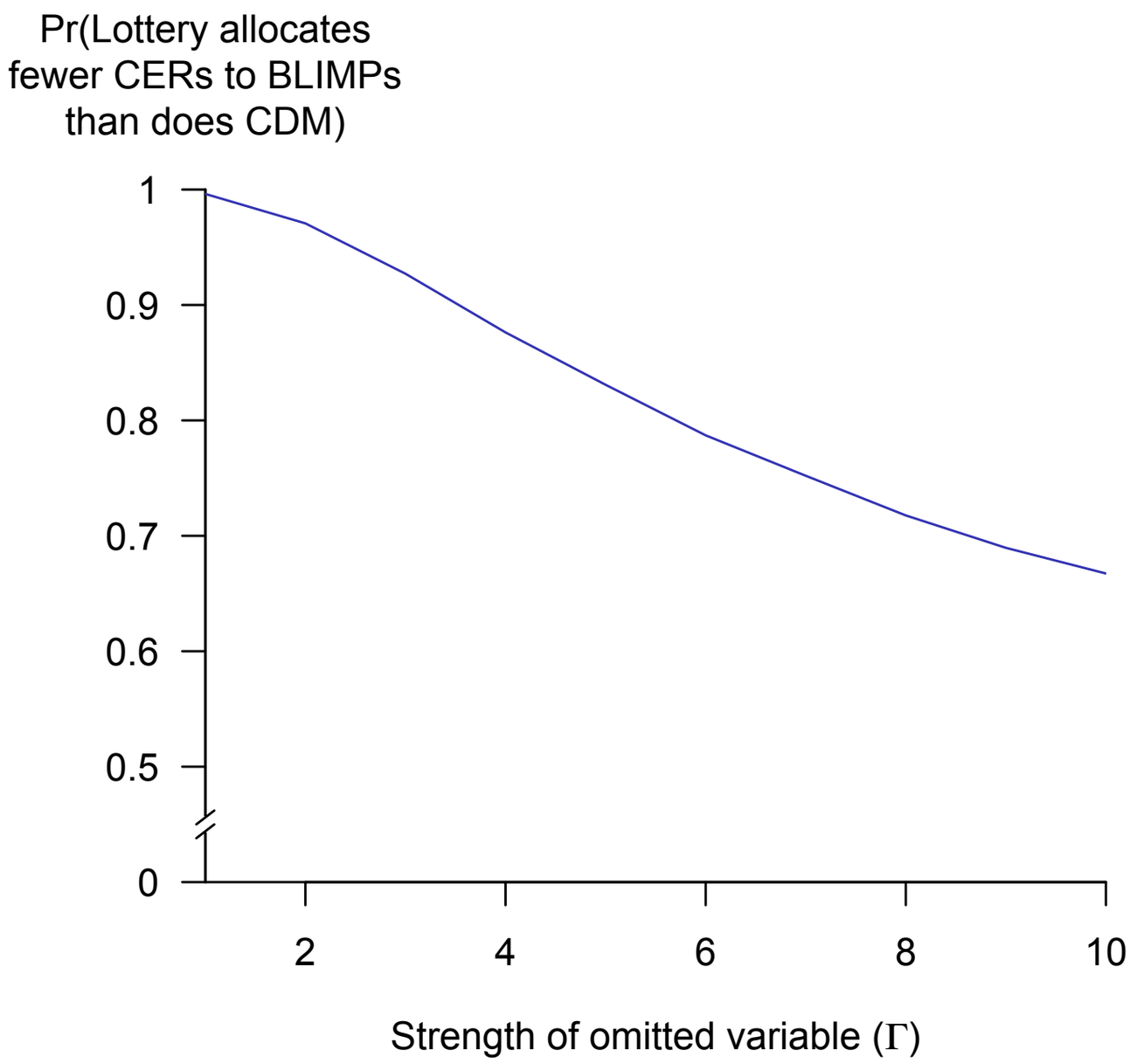
Omitted variables			
(8) Match manufacturer	30	1.907	9.950
	(0.0619)	(0.6701)	(0.6490)
(9) Match number of sites	39	2.776	15.389
	(0.1043)	(0.8845)	(0.8413)
(10) With 5MW threshold	45	3.267	19.208
	(0.5134)	(0.9012)	(0.8794)
(11) Within District-year	33	2.521	13.665
	(0.1785)	(0.9243)	(0.8561)
(12) Within Village-year	14	0.897	4.797
	(0.0016)	(0.8169)	(0.7849)
(13) CDM developers only	36	2.932	17.964
	(0.5889)	(0.7145)	(0.7556)

Omitted Variables



Misspecification Tests

	BLIMP fraction (in percent)	BLIMP capacity (in GW)	BLIMP offsets (in million tCO_2)
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Mis-specification tests			
(14) Match connection distance	25	1.419	8.746
	(0.0001)	(0.7585)	(0.8636)
(15) Match capacity factor	25	1.353	7.483
	(0.0001)	(0.7316)	(0.8313)
(16) Match capacity	10	0.441	2.327
	(0.0018)	(0.8378)	(0.8794)

Incomplete Data

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Incomplete data			
(17) With unconfirmed projects	43	4.642	28.760
	(0.3238)	(0.7258)	(0.9536)

Allowing for Mistakes

	BLIMP fraction (in percent)	BLIMP capacity (in GW)	BLIMP offsets (in million tCO_2)
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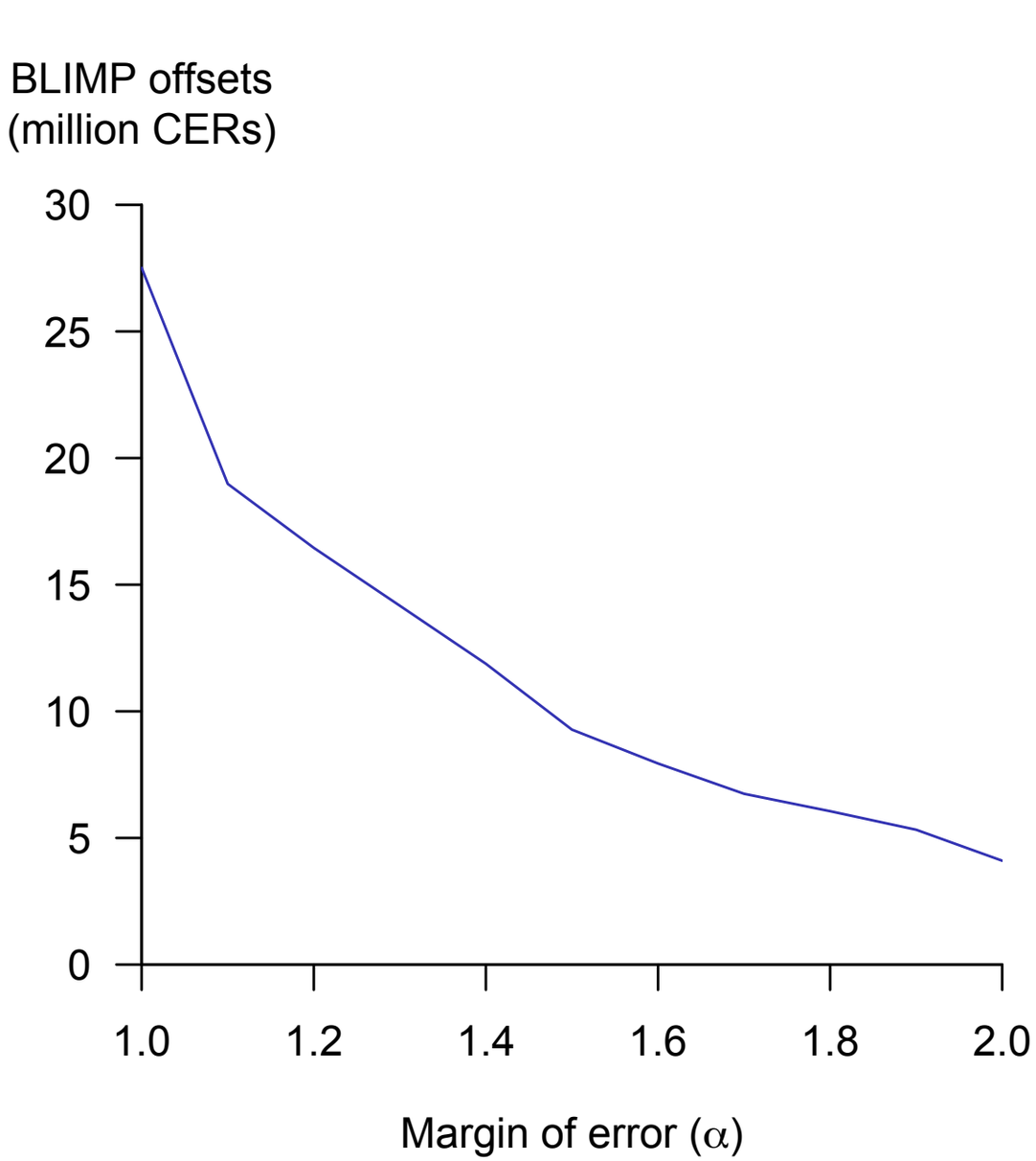
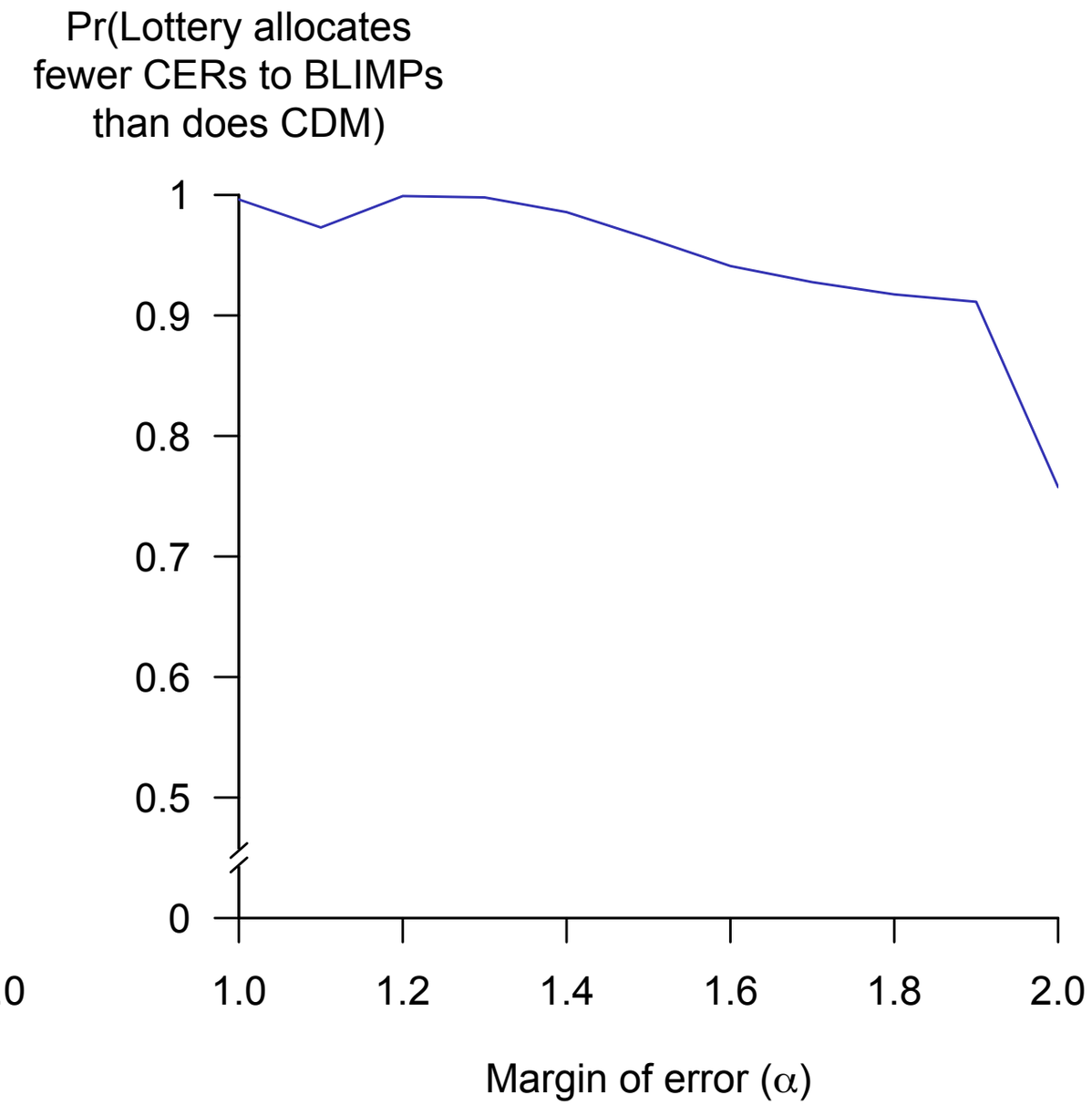
Allowing for mistakes			
(18) Margin of error $\alpha = 1.2$	32	2.572	16.456
	(0.8848)	(0.9835)	(0.9991)
(19) Two inferior projects	33	2.664	15.565
	(0.2630)	(0.8619)	(0.8568)

Allowing for Mistakes





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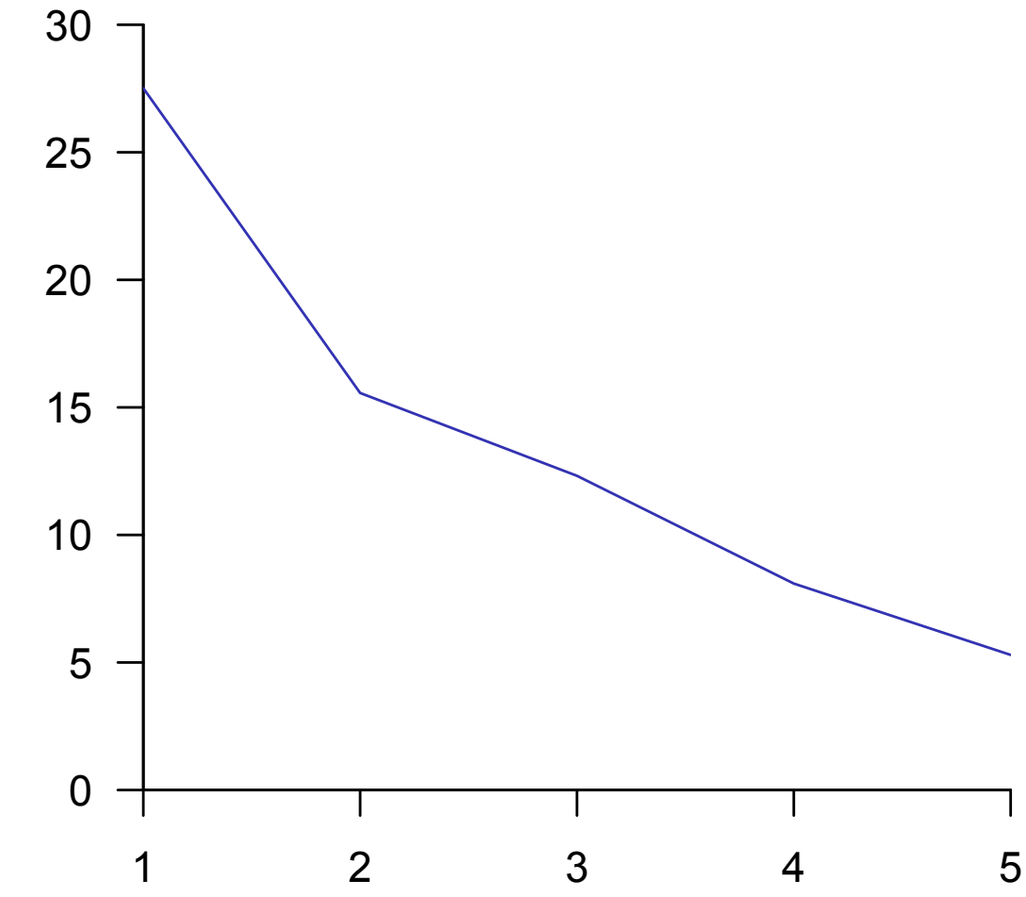

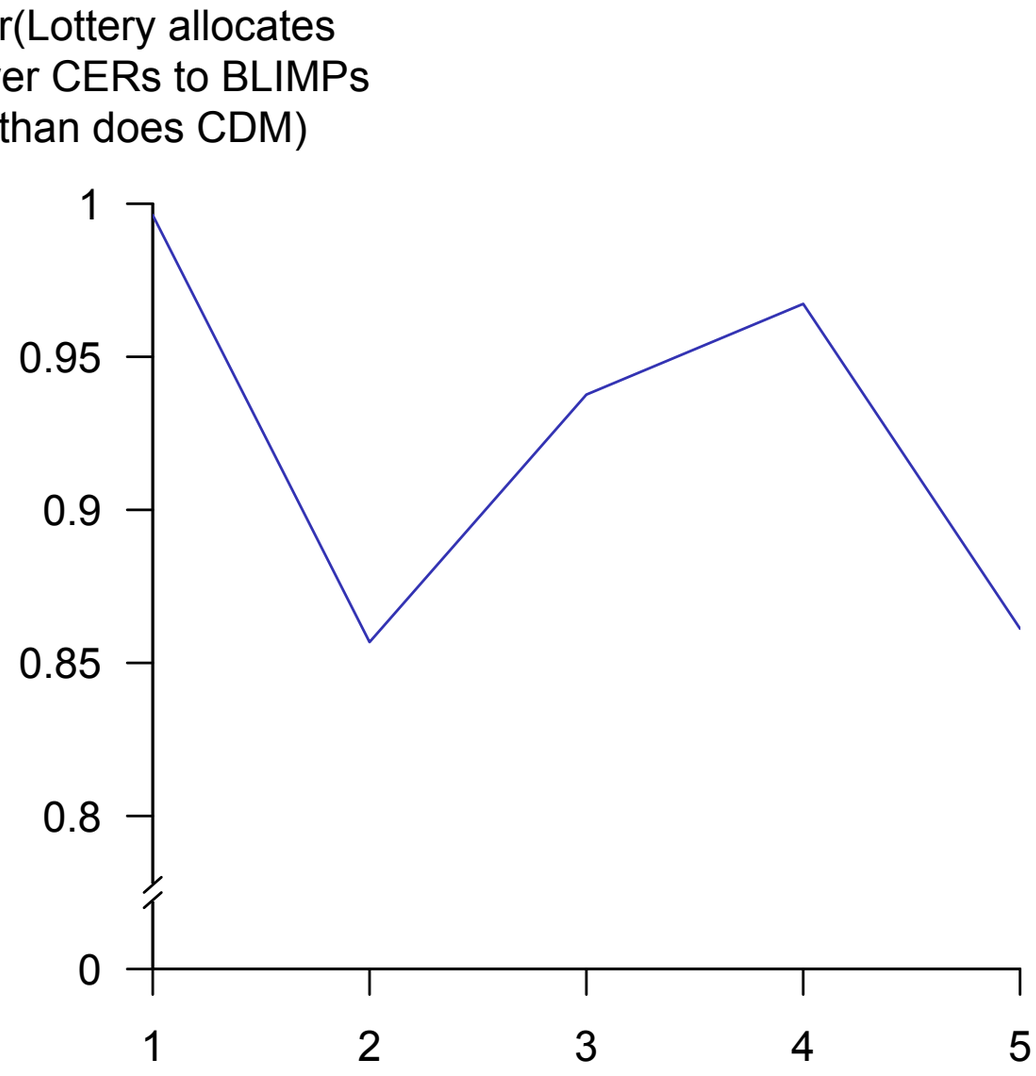

Financial Spillovers

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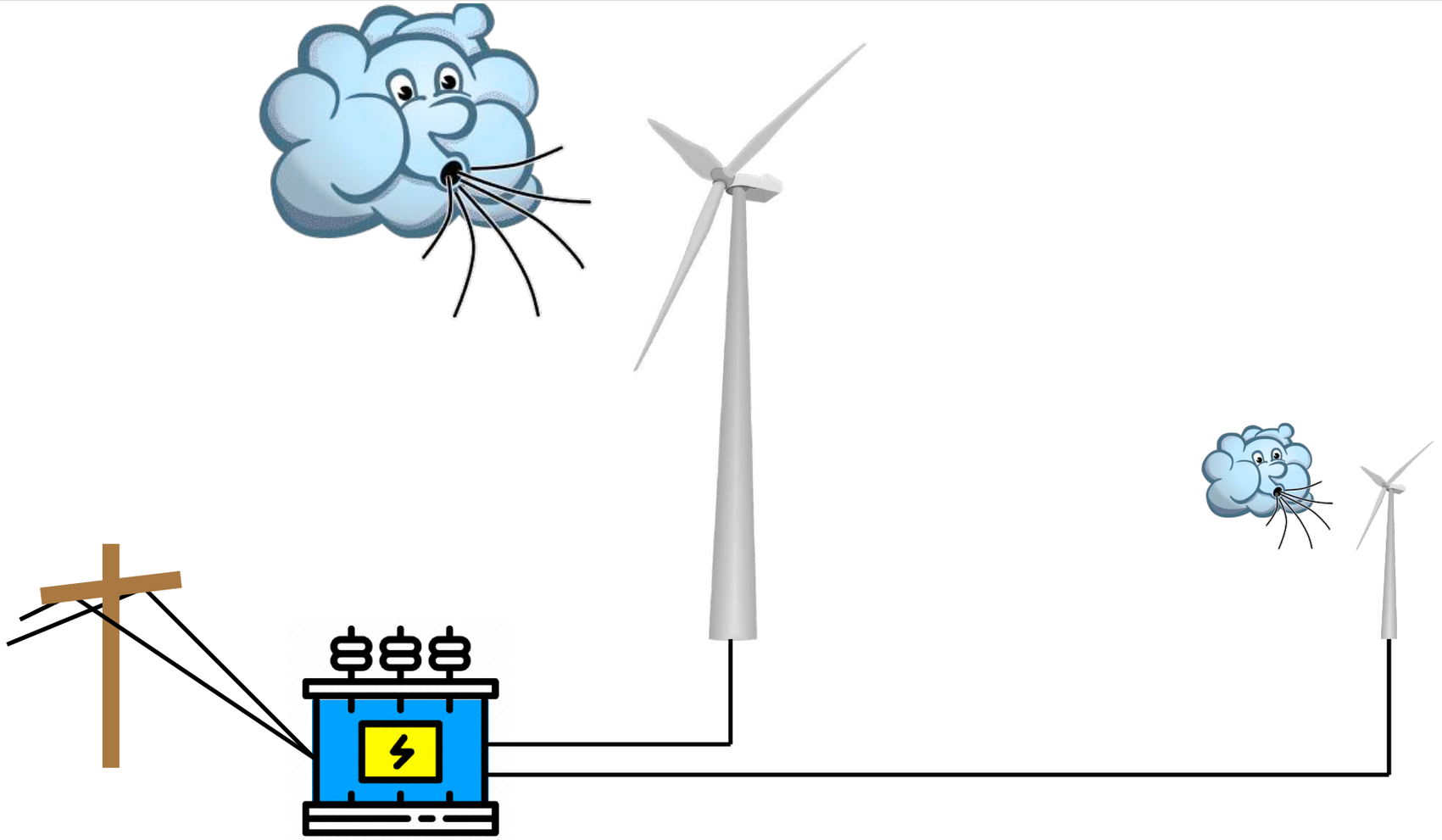
Financial spillovers			
(20) No non-CDM projects from developers with prior CDM support	47	3.665	23.735
	(0.7474)	(0.9596)	(0.9763)



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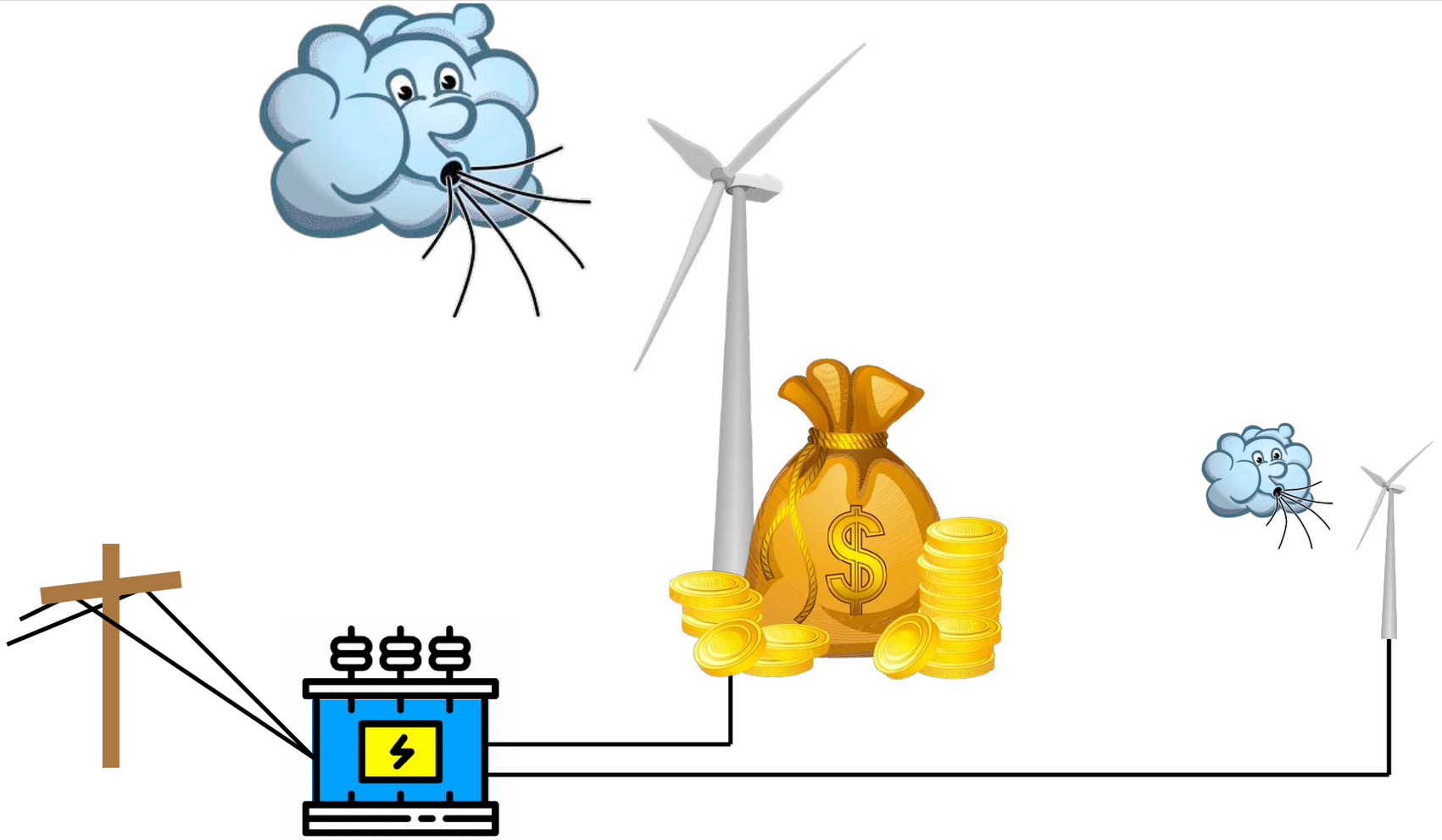

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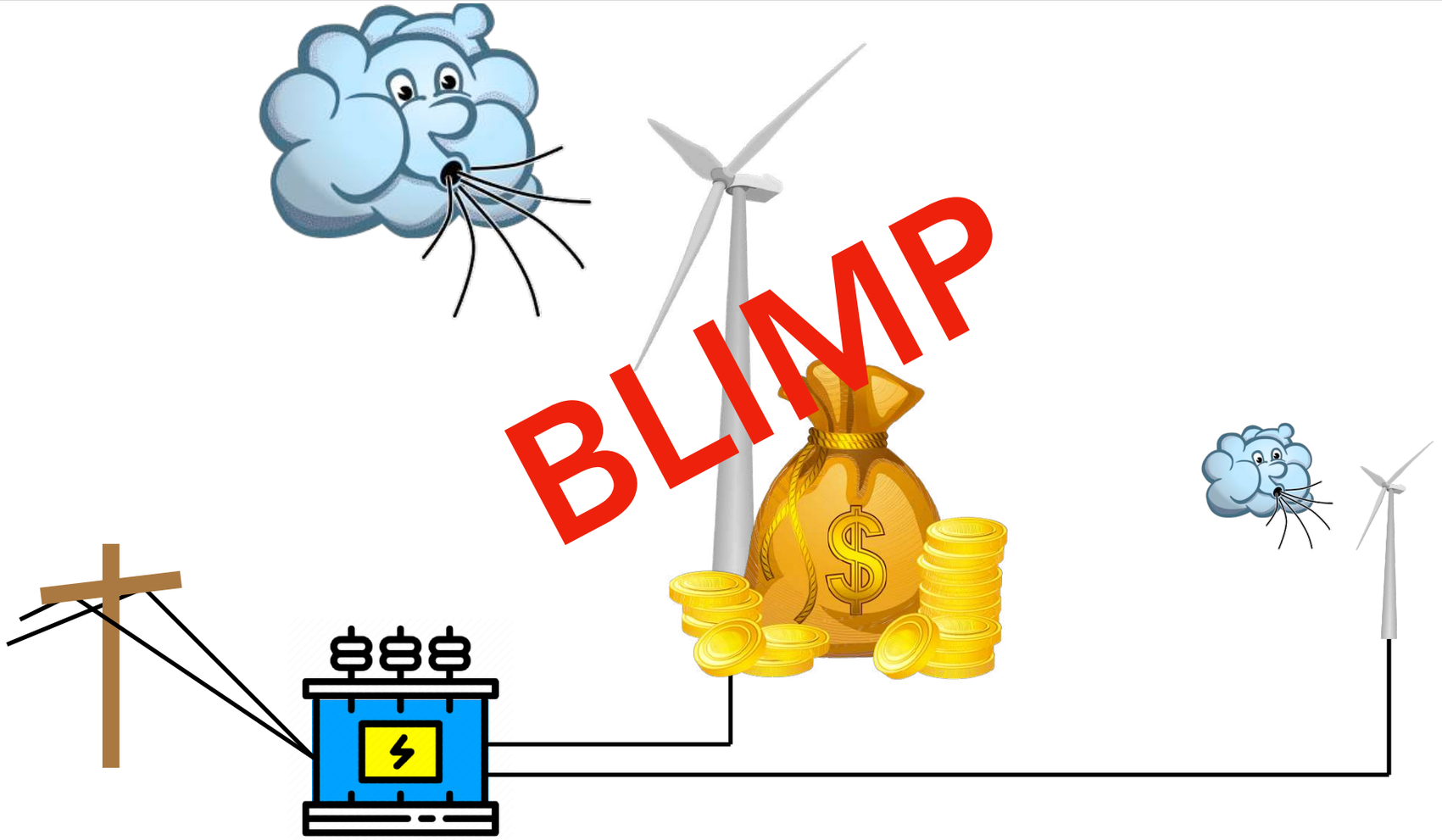

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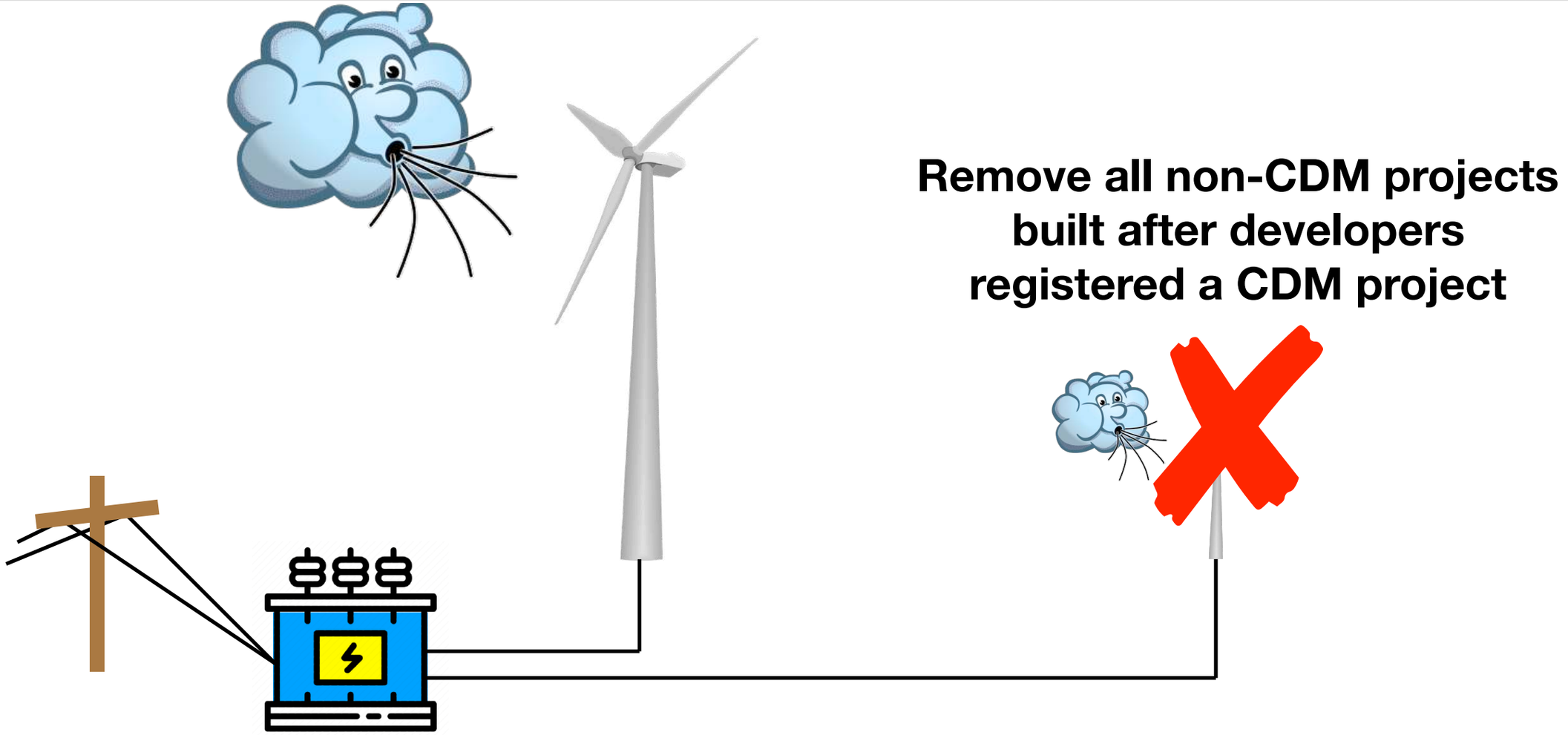

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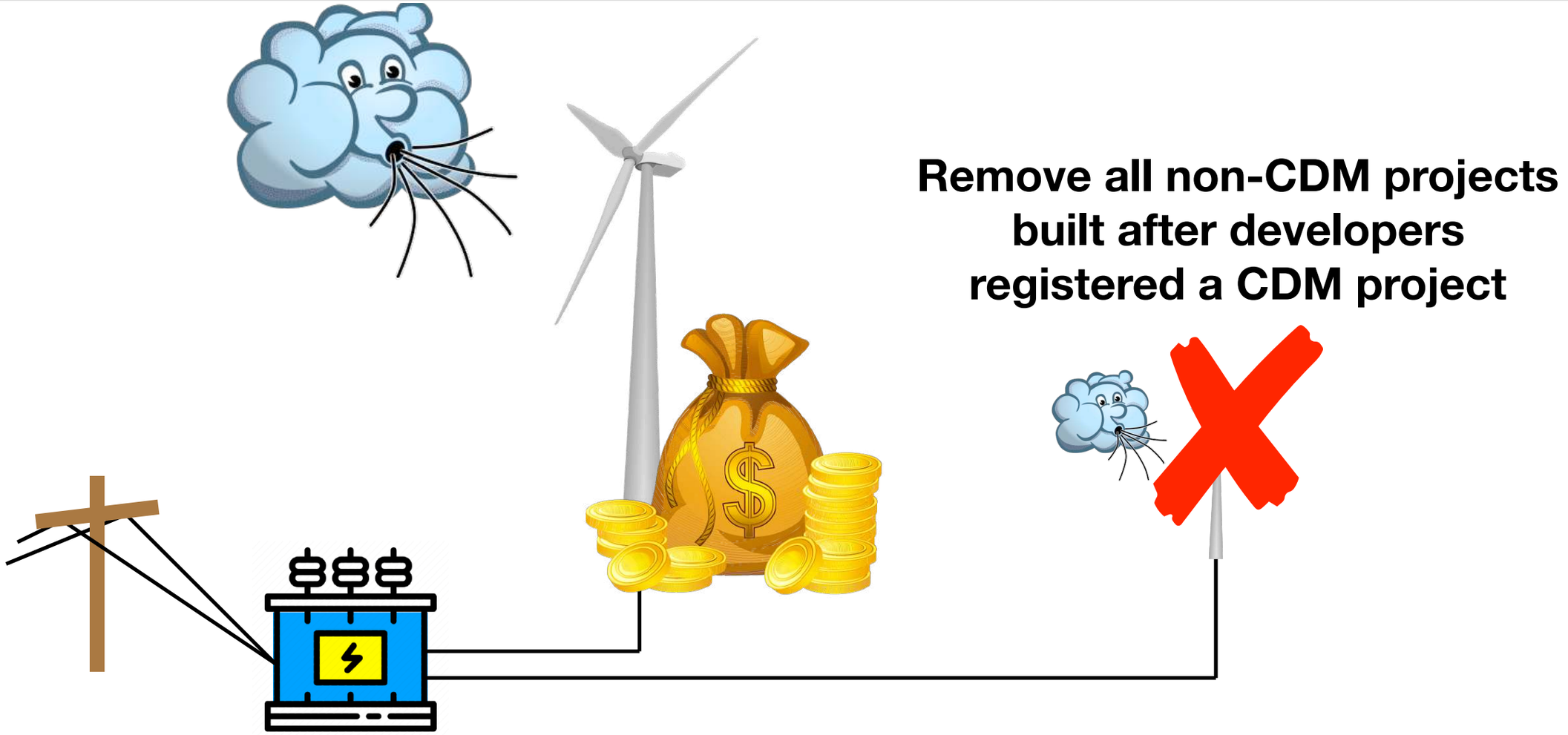

A Lower Bound

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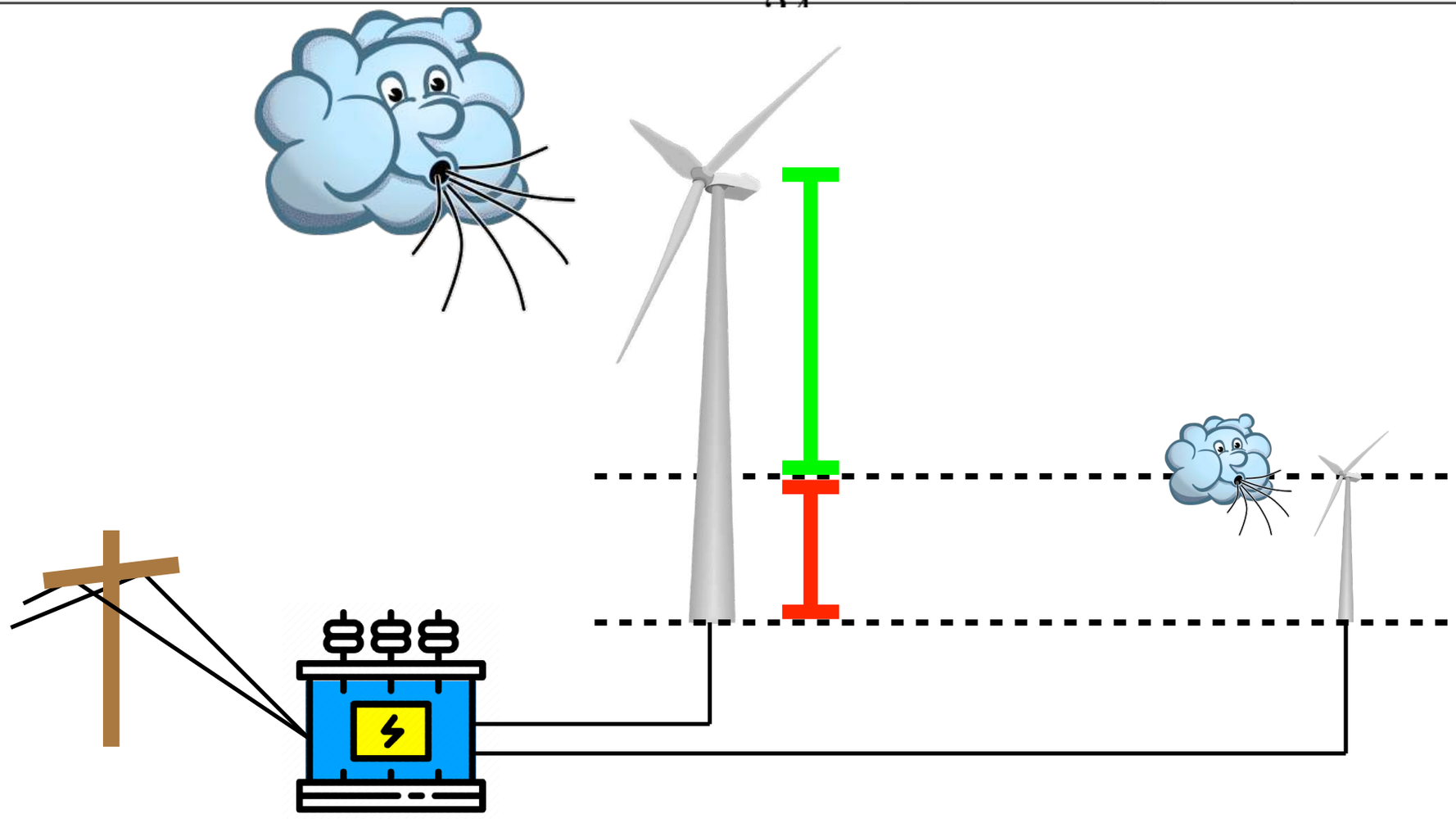
Partial infra-marginality			
(21) Next biggest project bound	56	1.912	8.891
	(0.8465)	(0.6604)	(0.3619)



Do Carbon Offsets Offset Carbon?

- Too often, it seems they don't.
- Applied to the CDM as a whole, our estimates imply global carbon emissions might be 6.1 billion tonnes *higher than* without the CDM.
- To get carbon neutrality, need to postulate that every offset to a non-BLIMP offset at least 2.1 tonnes.

WHY IS THIS HAPPENING?

- **Local politics** (Bayer et al., 2014)
- **High application cost** (Chadwick, 2006)
- **Fraud** (Consulate Mumbai Diplomatic Cable, 2008; Point Carbon, 2010)
- **Verifier conflicts of interest** (Frunza, 2013)
- **Executive Board conflicts of interest** (Transparency International, 2011)

- COP26 has just agreed to allow transition of up to 3.1 billion carbon offsets from CDM to the next Commitment Period.