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The Spatial Outcome of Modular Production: Organization of the Wind Industry in Brazil

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Current Market and Industry Dynamics

- Challenging market conditions in former core markets
- Changes in the competitive environment in international markets
- Coexistence of different types of value chains
- Pressure to reduce costs and increase efficiency in Wind turbine manufacturing
- Manufacturers adapt their supply chain and vertical integration leading to a modularization of value chains
- Specific market requirements in growing markets

Market Conditions – Changing Market Structures

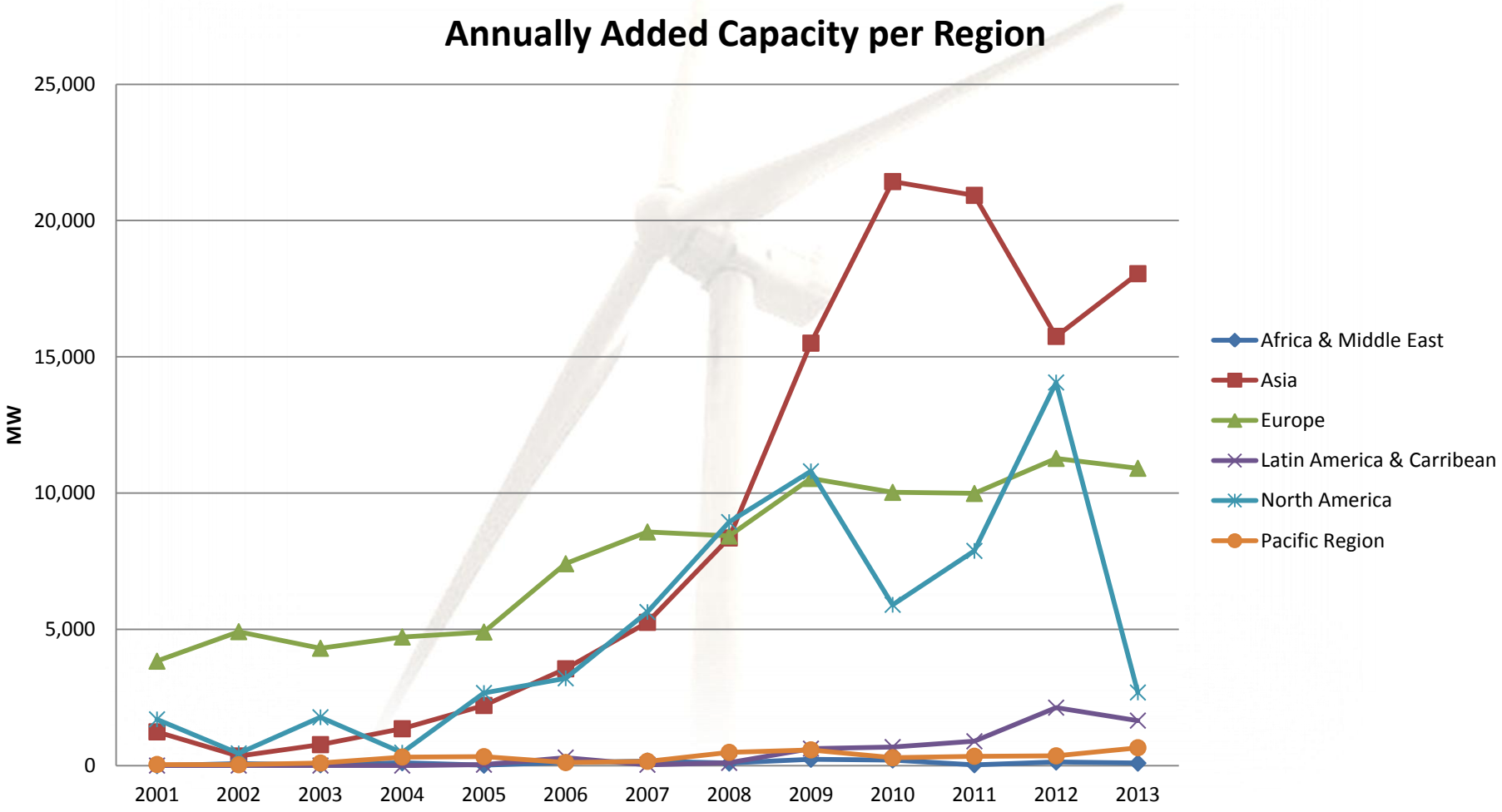

Figure 1: Annually Added Capacity per Region (based on data by GWEC and further national data)

Market Conditions – Changing Market Structures

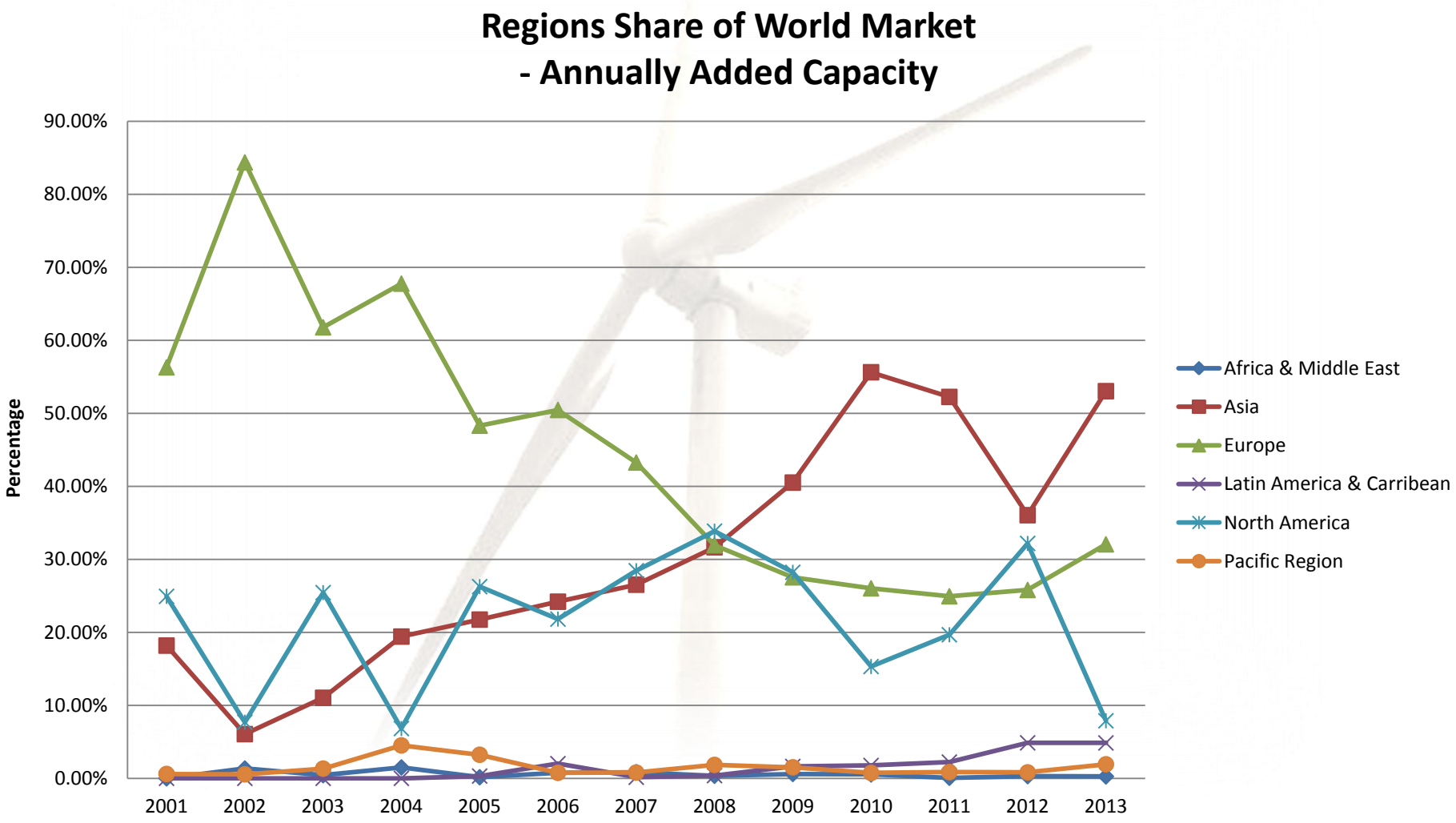

Figure 2: Regions Share of World Market by Annually Added Capacity (based on data by GWEC and further national data)

Market Conditions – Changing Market Structures

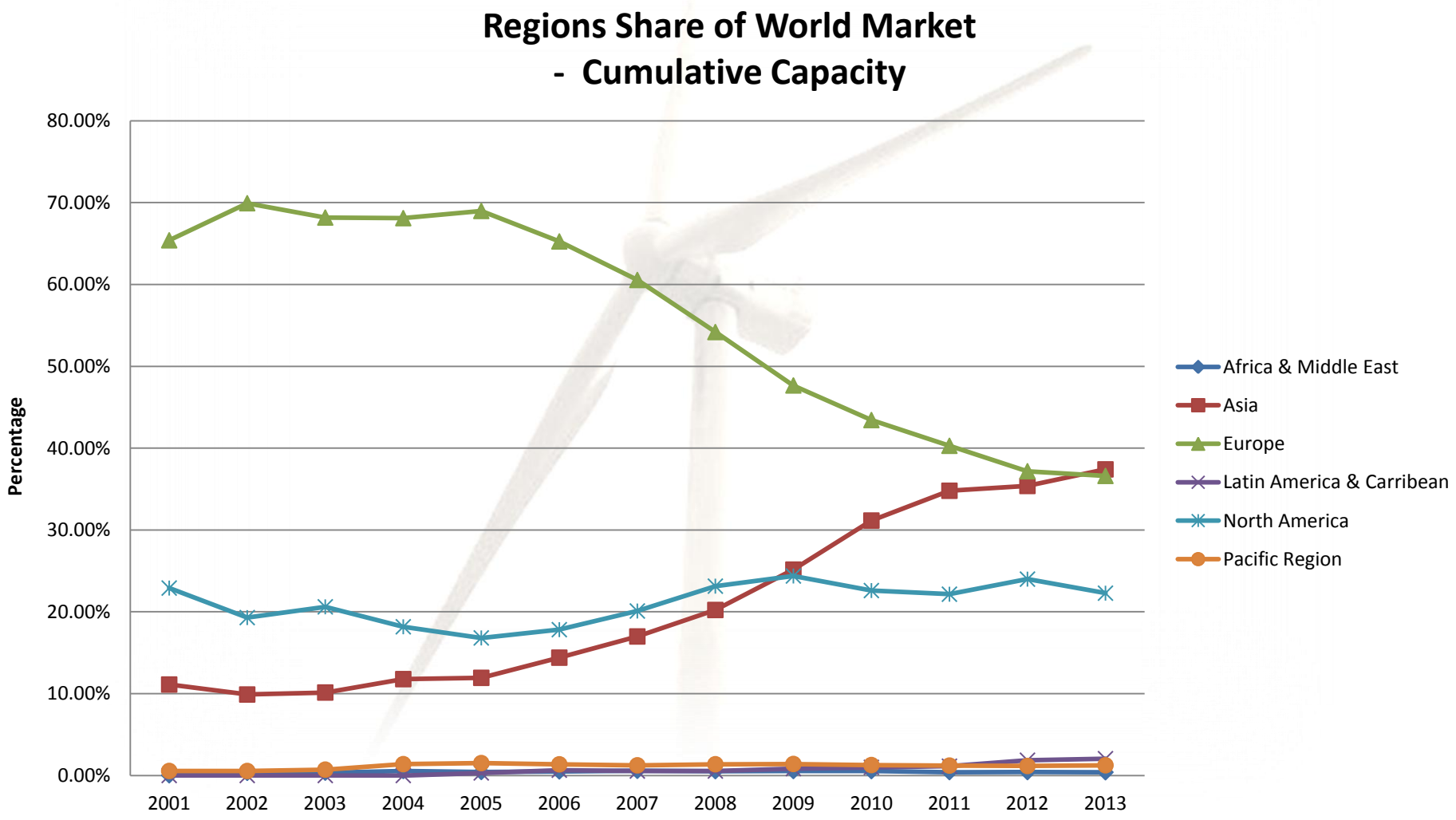

Figure 3: Regions Share of World Market by Cumulative Capacity (based on data by GWEC and further national data)

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Market Conditions – Changing Industry Structure

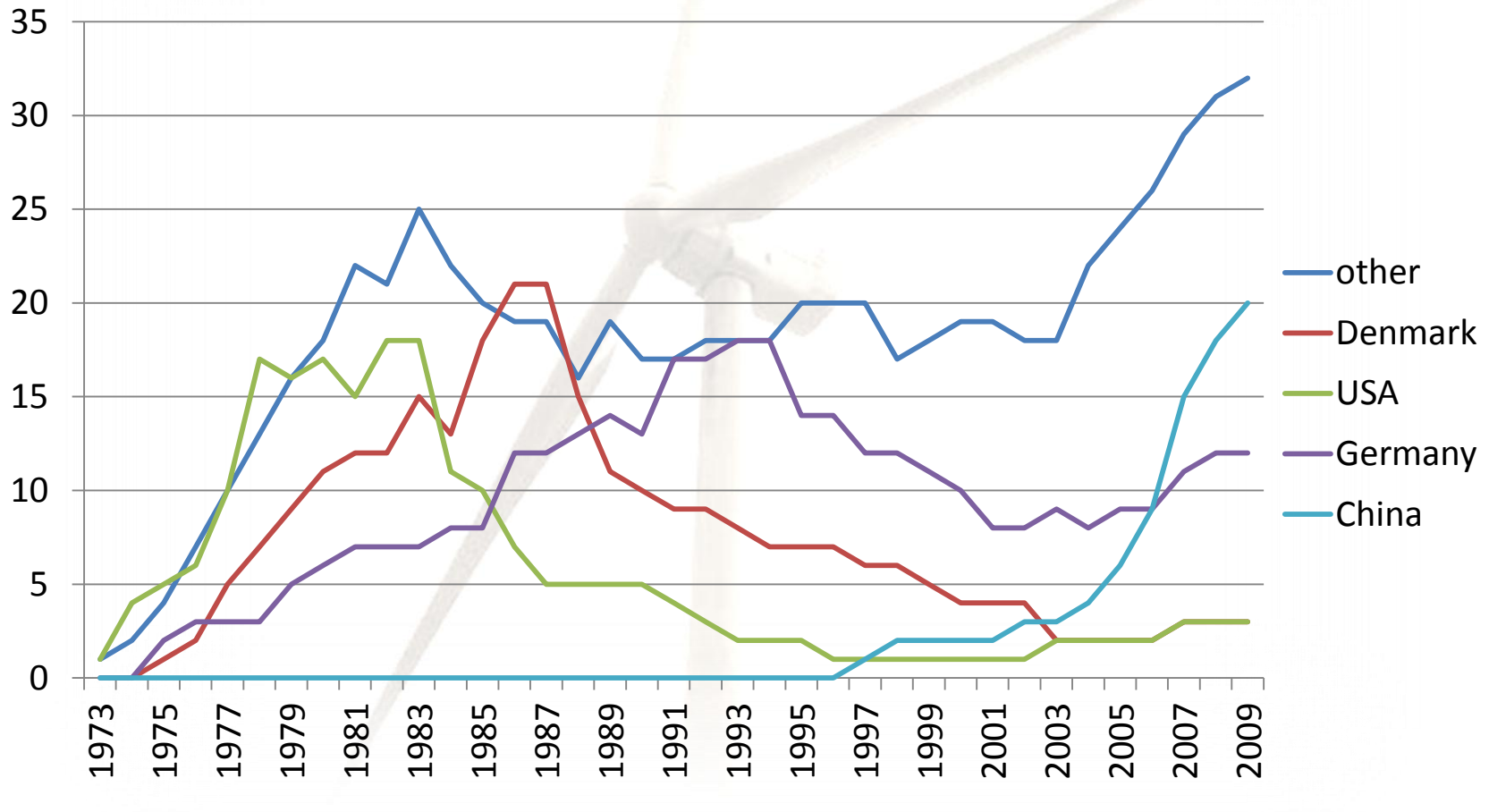

Figure 4: Number of Wind Turbine Generator Manufacturers per Country (Menzel and Kammer 2011, 9)

Market Share of Top 10 Producers

1996	Market Share
Vestas (DK)	17,6%
Enercon (DE)	11,8%
Micon (DK)	10,4%
Bonus (DK)	9,1%
Nordtank (DK)	8,5%
Tacke (DE)	6,4%
Gamesa (ES)	6,1%
Nordex (DE)	2,9%
NEPC (IN)	2,8%
WindWorld (DK)	2,2%
Europ. Manuf.	**75,00%**

Market Share of Wind Turbine Producers (based on Data by BTM, MAKE and Bloomberg)

* Suzlon in 2006 without Repower; Suzlon Group in 2013 includes Repower/Senvion

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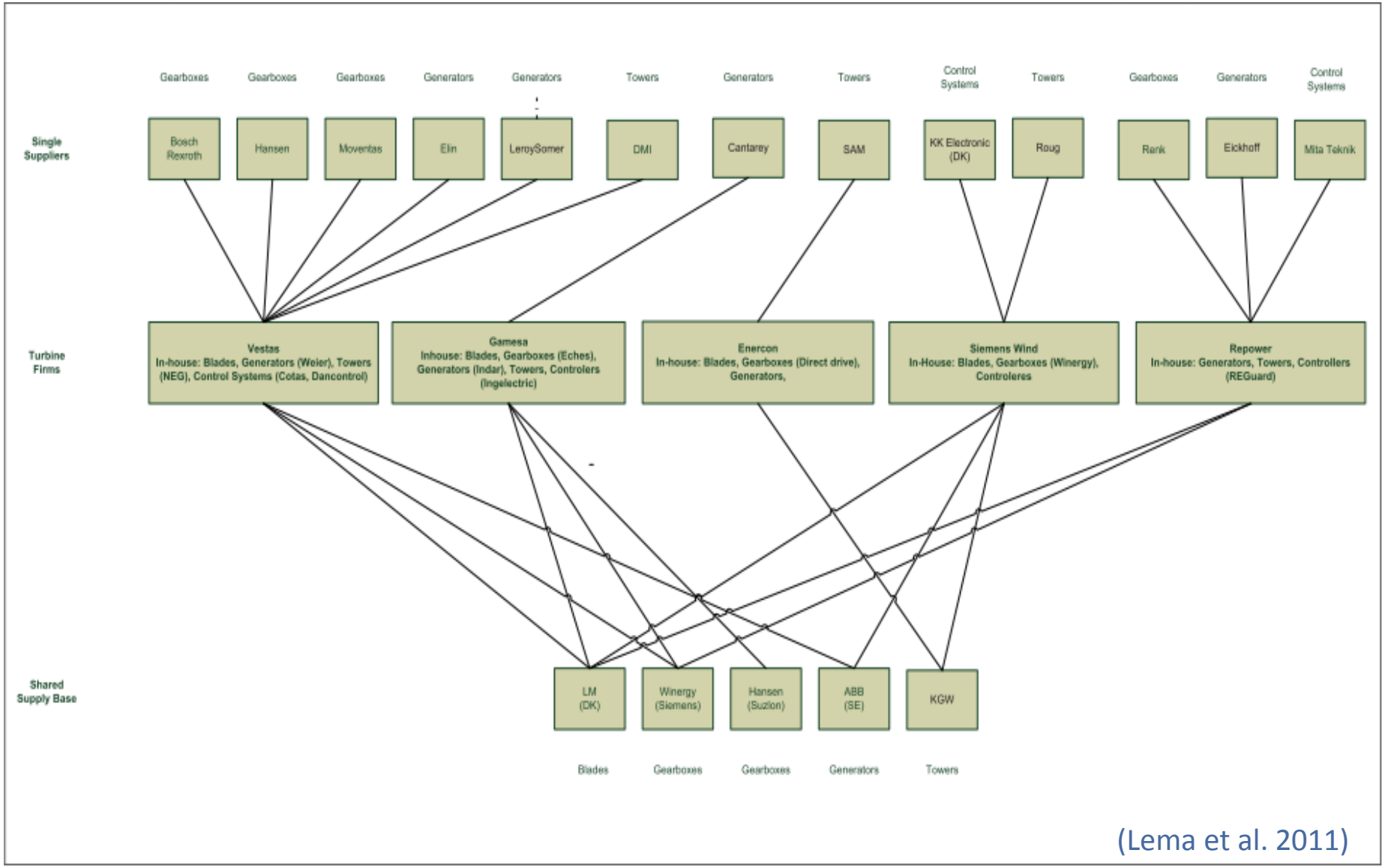
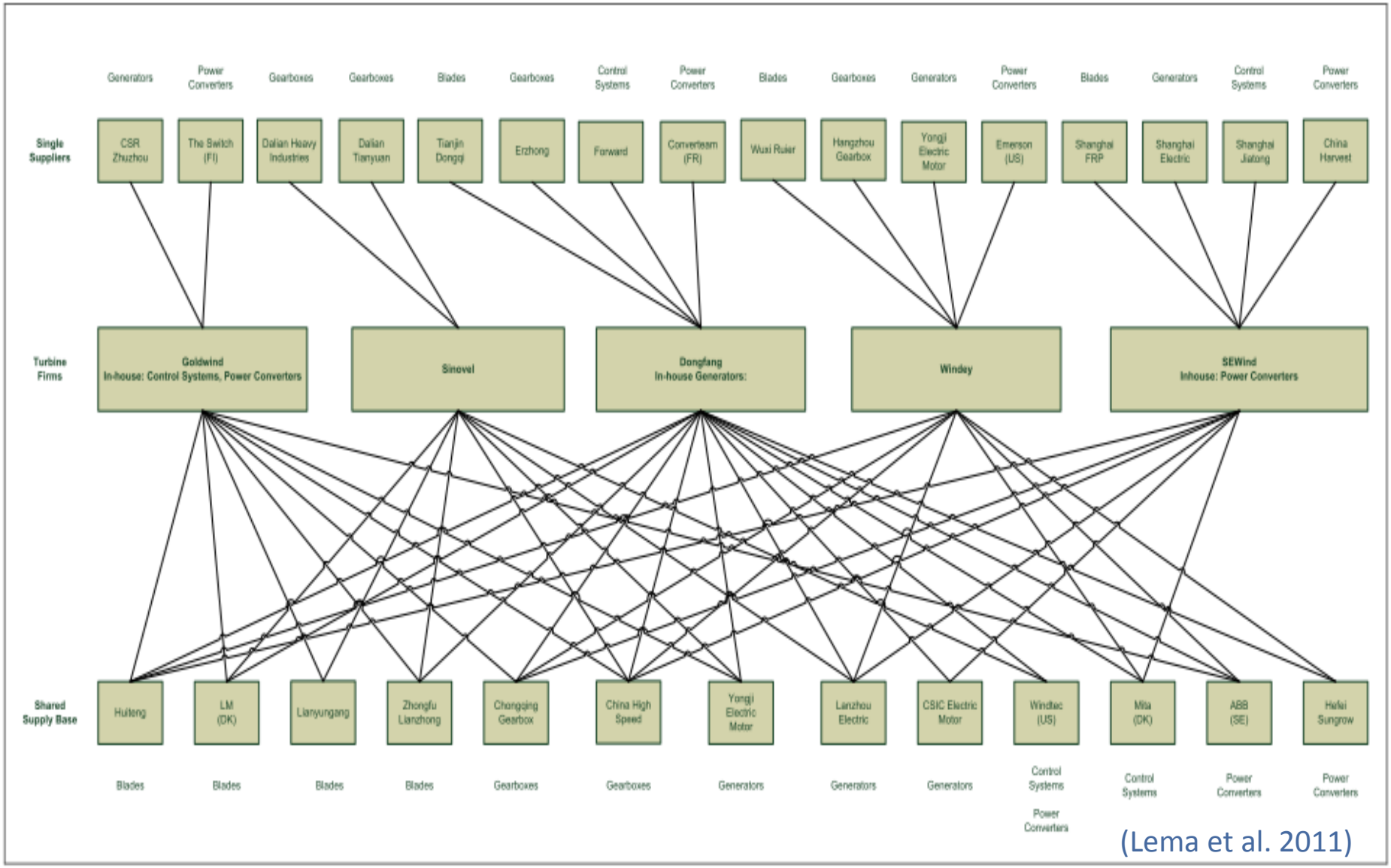
Value Chains of European Manufacturers



(Lema et al. 2011)

Value Chains of Chinese Manufacturers



(Lema et al. 2011)

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Indicators for Value Chain Modularization

- Multiple Sourcing
  - Usually several suppliers per component (optimally about two to "reduce uncertainty due to lower monitoring costs" (Zademach et al. 2006: 190)
- Vertical disintegration
  - Outsourcing of formerly integrated suppliers (Sturgeon 2002)
- Product modularity
  - Using interchangeable modules in different platforms without almost no adjustments
  - Prerequisites:
    - emergence of standards or de facto standards or
    - technological progress which enables to break up formerly complex information to be transformed into codes (STURGEON 2002: 467)

Global Top Ten 2013 – Product Modularization, Vertical Integration and outsourcing

Rank	Manufacturer	Origin	Market Share	Product Modularization	Vertical integration	outsourcing
1	Vestas	DK	13,2%	2012		2012*
2	Goldwind	CN	10,3%	?		2012**
3	Enercon	DE	10,1%	?		-
4	Siemens	DE	8,0%	2012		-
5	Suzlon Group****	IN	6,3%	?		2011***
6	GE	US	4,9%	x		-
7	Gamesa	ES	4,6%	x		-
8	United Power	CN	3,9%	?		?
9	MingYang	CN	3,7%	?		?
10	Nordex	DE	3,4%	2010-2011		-

mainly external supply | in-house and external supply | mainly in-house supply

x - yes, year of introduction not known (x) - planned or in progress ? - unknown

* - Sold tower factory in Varde (DK)

** - Sold tower manufacturer Tellhow Wind Power

*** - Sold Gearbox manufacturer Hansen to ZF

**** - Suzlon Group (including Senvion) - Data without Senvion

Market Share based on data by MAKE Consulting

Global Top Ten 2013 – Vertical Integration by Component

Rank	Manufacturer	Blades		Gearboxes		Generator		Tower	
		In-house	extern	In-house	extern	In-house	extern	In-house	extern
1	Vestas (DK)	x	x	-	x	x	x	x 2008: 20%	x 2008: 80%
2	Goldwind (CN)	-	x	direct drive		x	?	-	x
3	Enercon (DE)	x	?	directdrive		x	?	x	?
4	Siemens (DE)	x	-	-	x (Subsidiary)	-	x (Subsidiary)	-	x
5	Suzlon Energy (IN)(without Senvion)	x	-	?	x	x	x	x	x
6	GE Wind (US)	-	x	-	x (Subsidiary)	?	?	?	?
7	Gamesa (ES)	2007: 85% 2010: 72% 2013: 50% projected: 35%	2007: 15% 2010: 28% 2013: 50%	2007: > 50% 2010: 65% projected: 47%	2007: < 50% 2010: 35% projected: 53%	2007: > 50% 2010: 88% * projected: 69%	2007: < 50% 2010: 12% ** projected: 31%	2007: >50%***	2007: <50%
8	United Power (CN)	x	?	x	?	x	?	-	x
9	MingYang (CN)	x	?	-	x	-	x	-	x
10	Nordex	2010: 26,3 % 2011: 27,8 % 2012: 28,3%	x	-	x	-	x	-	x

* - Including Susidiary Cantarrey ** - Without Subsidiary Cantarrey *** - Including Windar (Gamesa with 32% Stake in Windar) ? - unknown, if additional in-house/ external supply

Modularization and knowledge

- Development and transfer of tacit knowledge benefit from – especially – spatial proximity (Malmberg and Maskell 1997)
- codified knowledge enables a transfer on a broader (e.g. national or inter-national) scale (Malmberg and Maskell 1997)
- Codified knowledge thus gives rise to new organizational forms of cooperation between
  - manufacturers and suppliers
  - different location sites of these actors
- It thus enables changes in the spatiality of production, especially in emerging markets

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Wind Industry in Brazil – Overview

- Market Conditions/ Environment
  - Political incentives
  - Favorable wind conditions

    → result in a growth market of the wind energy industry
  - Demand
  - Local content requirements[1]
  - Lack of a second-tier supplier base[2]

  →led to the emergence of an ever more broadened manufacturing base of wind turbines and its components.

[1] To be applicable for loans from the Banco Nacional de Desenvolvimento Economico e Social (BNDES), companies must source 60 % of components locally. From January 2013 on they will have to be producing or assembling at least three of the four main wind turbine components - towers, blades, nacelles and hubs - in Brazil

[2] Alfonso Faubel (Alstom, senior vice president) in http://www.windpowermonthly.com/article/1184025/bndes-approves-alstom-local-sourcing on 28 of May 2013 (30.01.2014)

Wind Industry in Brazil – Market per State

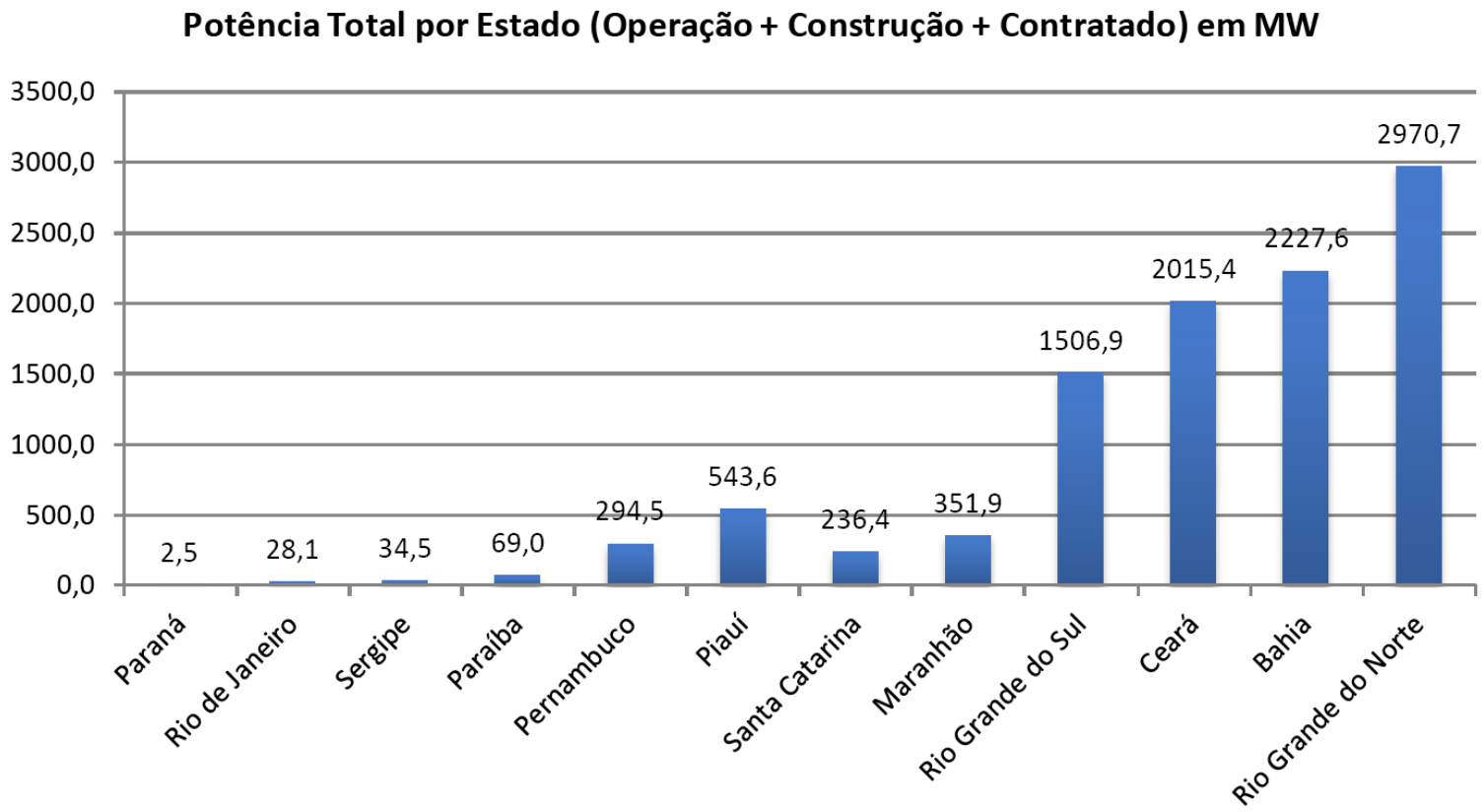
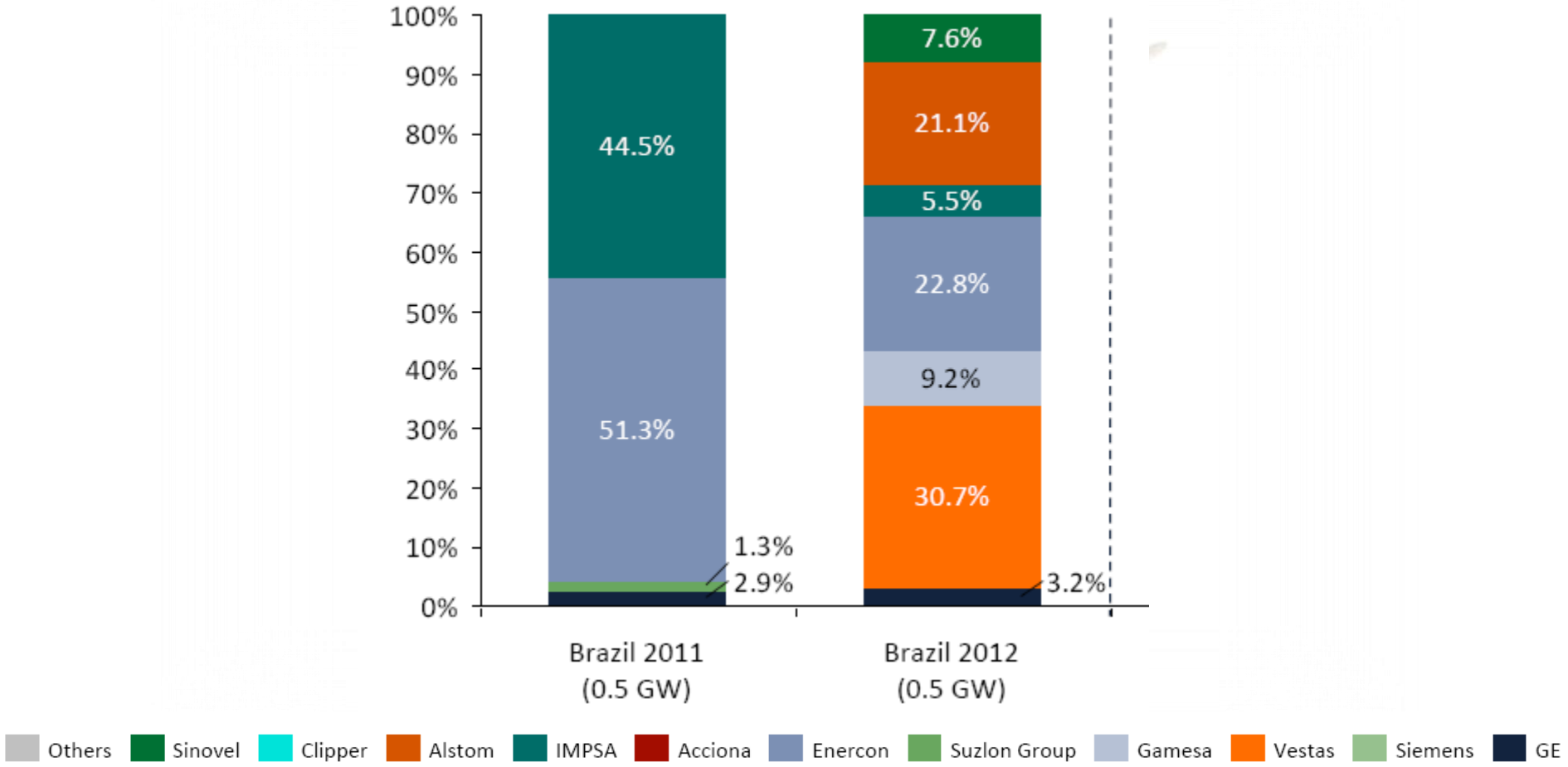


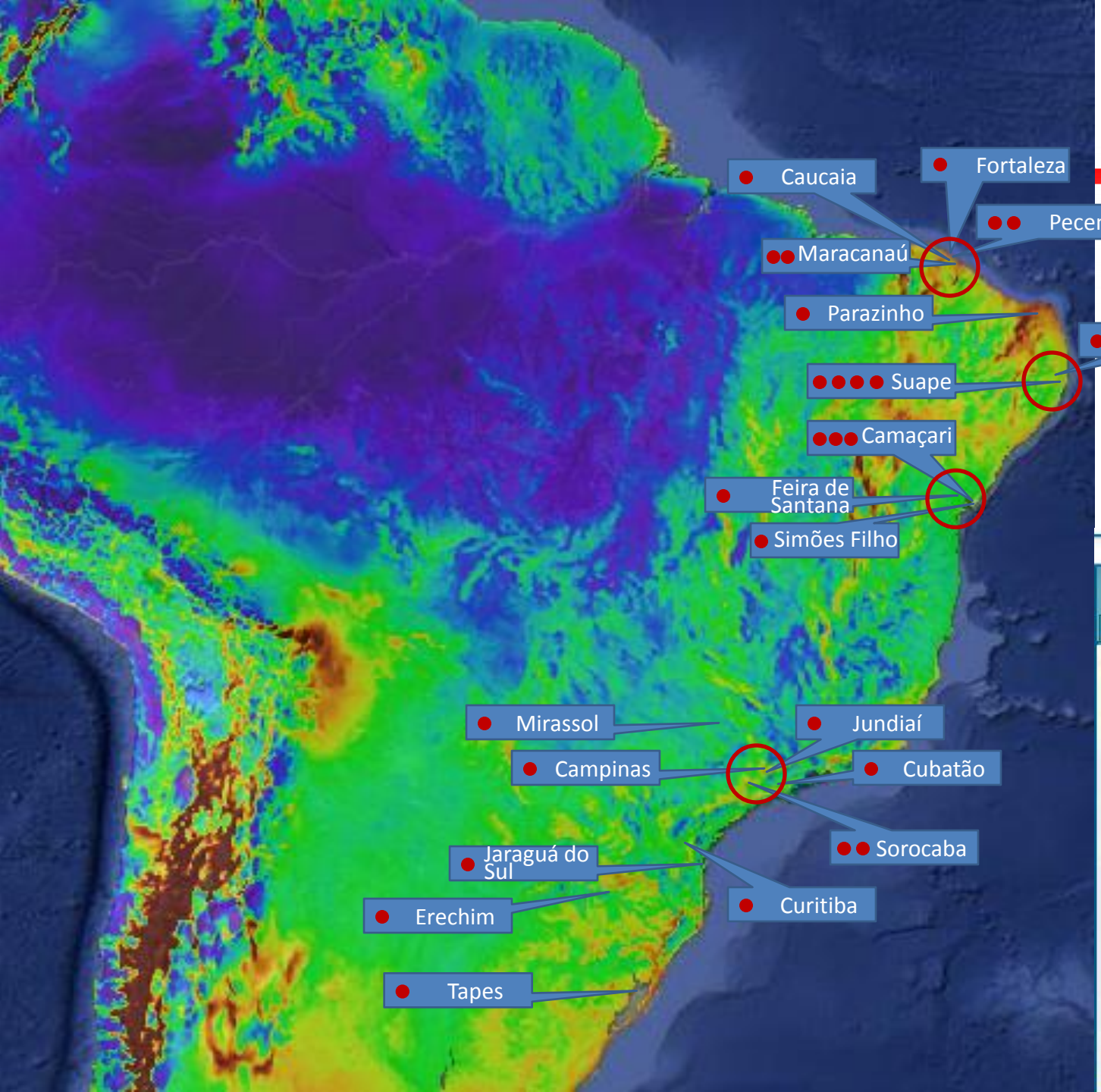
Gráfico 4- Potência Total por Estado (Fonte: ABEEólica)

Source: ABEEólica (2013) http://www.portalabeeolica.org.br/pdf/Boletim-Dados-ABEEolica-Novembro-2013-Publico.pdf

Wind Industry in Brazil – Market Share Year-End 2011 and 2012



Source: MAKE Consulting 2013: Global Wind Turbine OEM 2012 Market Share 2013_03



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3TIER's Global Wind Dataset 5km
onshore wind speed at 80m
height units in m/s

- 3.0 m/s
- 3.6 m/s
- 4.2 m/s
- 4.8 m/s
- 5.4 m/s
- 6.0 m/s
- 6.6 m/s
- 7.2 m/s
- 7.8 m/s
- 8.4 m/s
- 9.0 m/s

Google Satellite Map

Research Questions and Design

- Investigate the relations between
  - manufacturers and suppliers in Brazil
  - manufacturers and their HQ
  - (global) suppliers and their HQ
- Investigate the Modularity of value chains per component and company in Brazil
- Investigate the drivers for the location decisions of
  - manufacturers
  - suppliers

Thank you for your attention!