

# Building a National Wind Turbine Industry: Experiences from China, India and South Korea



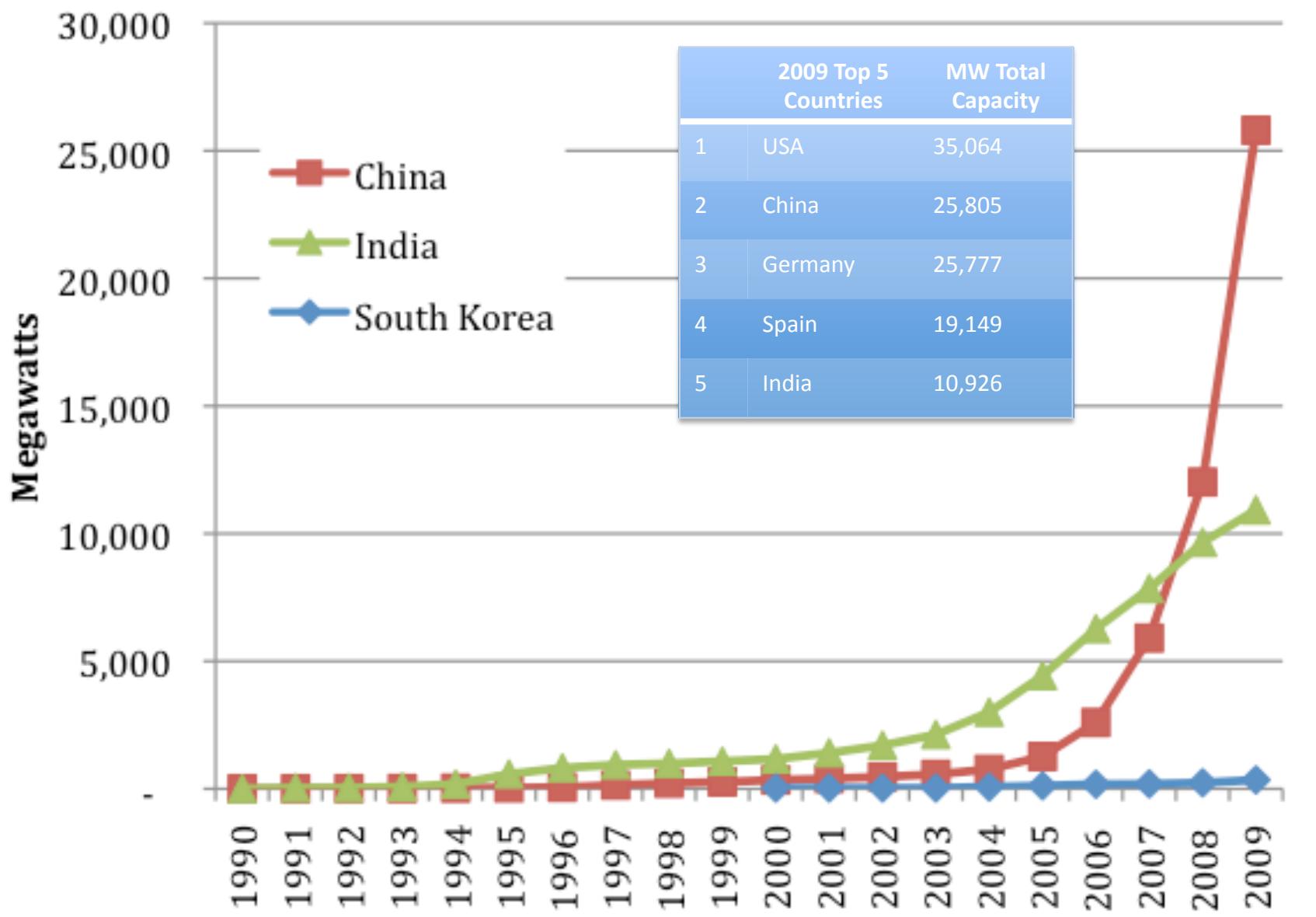
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Presented at UNFCCC Meetings in Tianjin  
October 7, 2010

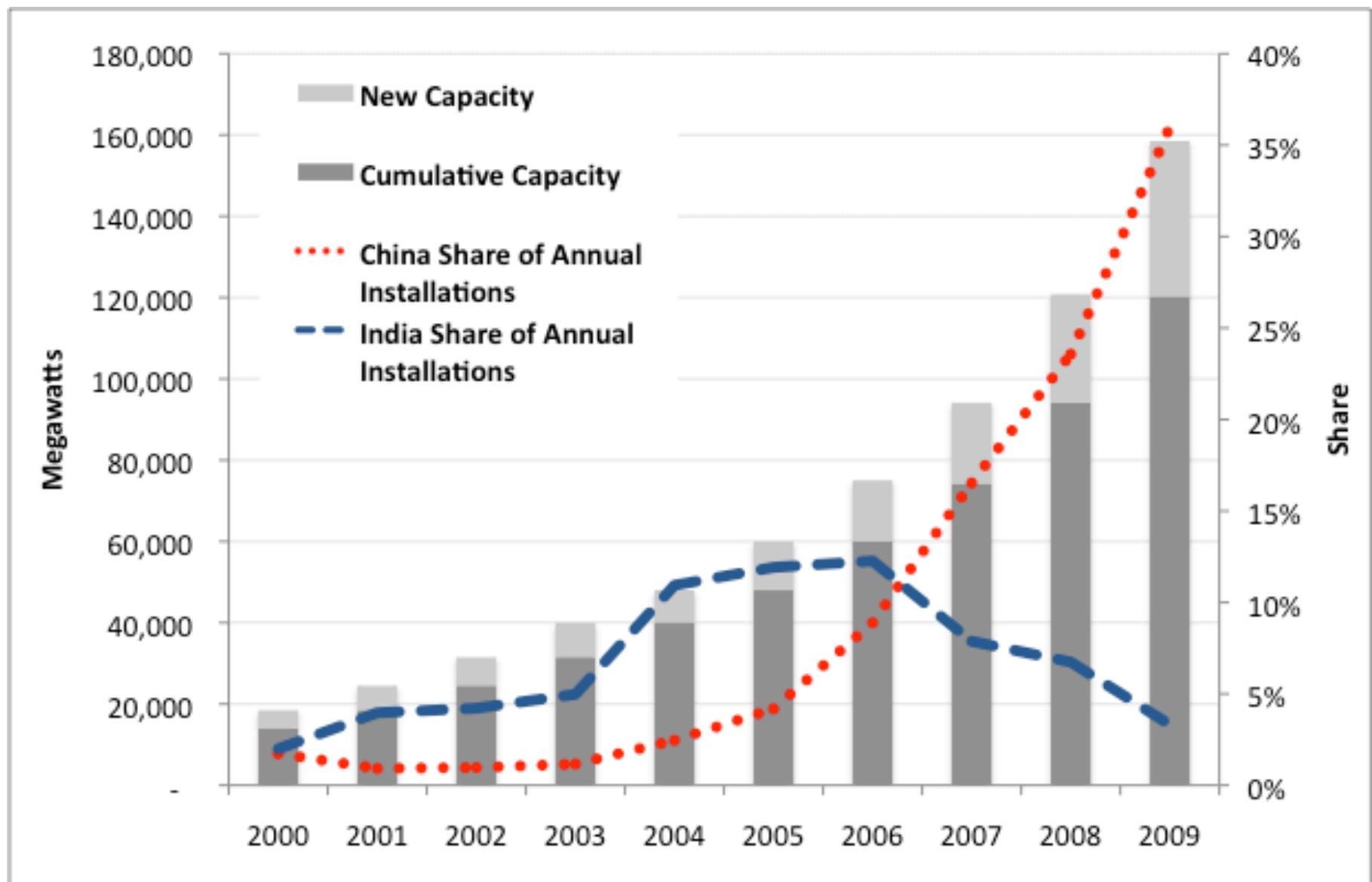
# Overview

- Wind power status in China, India and S. Korea in the global context
- Options for late entry into the wind industry: models of technology development
- Case studies of firm-level technology strategies from each country
- Cross-country comparison and implications
  - For other countries looking to enter the wind industry
  - For technological leapfrogging/technology catch-up in general

# Wind Power Development in China, India, and South Korea



# Share of China and India in Global Annual Wind Capacity



# Resource Context & Policy Support

## *Brief Overview*

	CHINA	INDIA	SOUTH KOREA
<b>Total capacity</b>	25.8 GW	10.9 GW	0.348 GW
<b>Onshore resources</b>	250 GW (up to 4000 GW)	45 GW (likely far underestimated)	18 GW
<b>Offshore resources</b>	200 GW (est)		31 GW (likely underestimated)
<b>Government tendering</b>	X		
<b>Feed-in tariffs</b>	X	X (State-level)	X
<b>Renewable portfolio standards</b>	X		
<b>Tax incentives</b>	X	X	X
<b>R&amp;D support</b>	X		X
<b>Technology standards</b>	X	X	

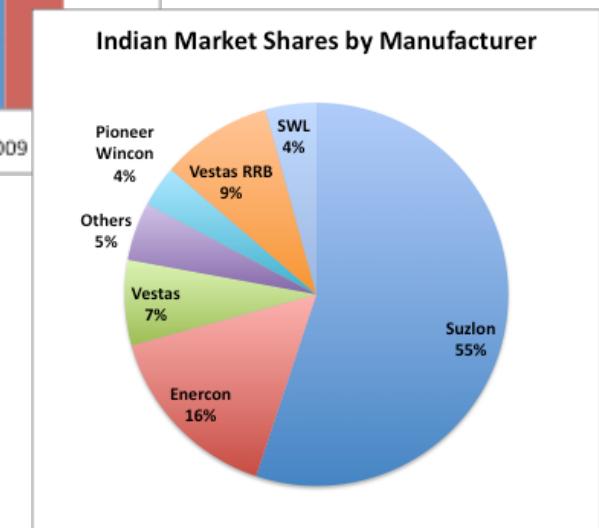
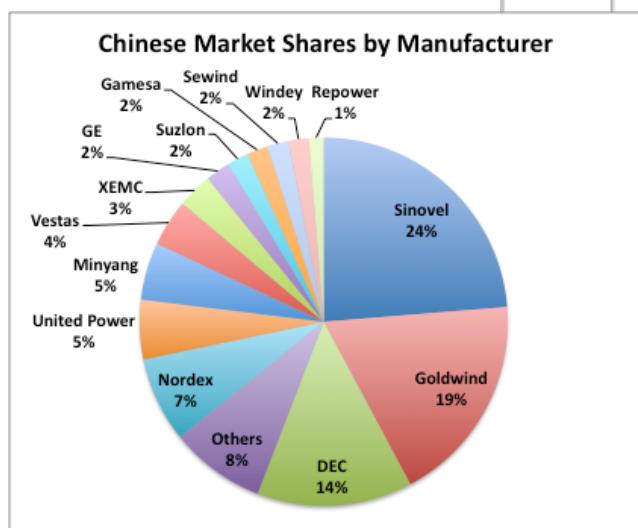
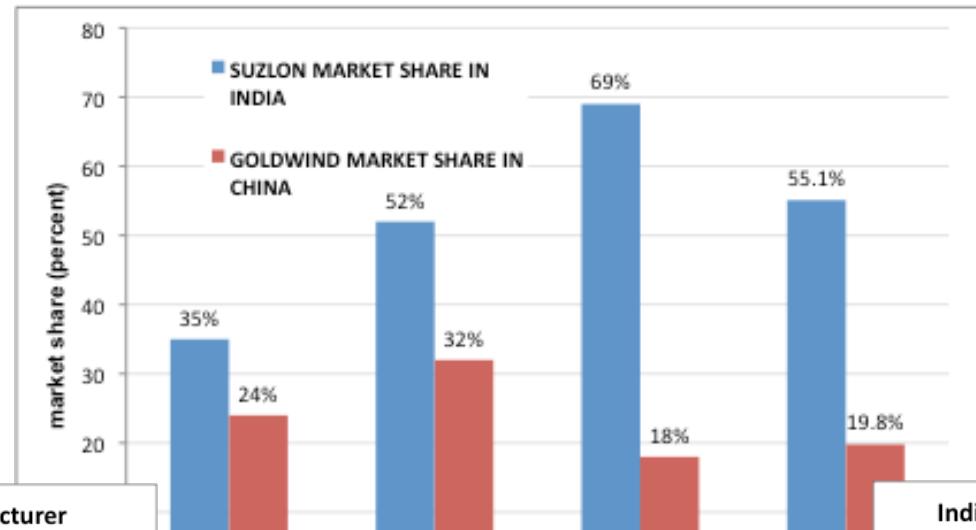
# Models of Technology Development

## *Advantages and Risks*

- **Licensing:**
  - Advantages: obtaining a technology that has been field tested
  - Risks: often an older (smaller), outdated model; restrictions on IPR use (exports); others can license the same technology
- **Mergers & acquisitions (M&A):**
  - Advantages: obtain control over IPR
  - Risks: need sufficient financial resources; need ability to integrate new business knowledge into current business
- **Joint development:**
  - Advantages: no concerns about market competition; less concern about IPR (often design with multiple manufacturers)
  - Risks: Design firm has no manufacturing experience; manufacturers have no design experience

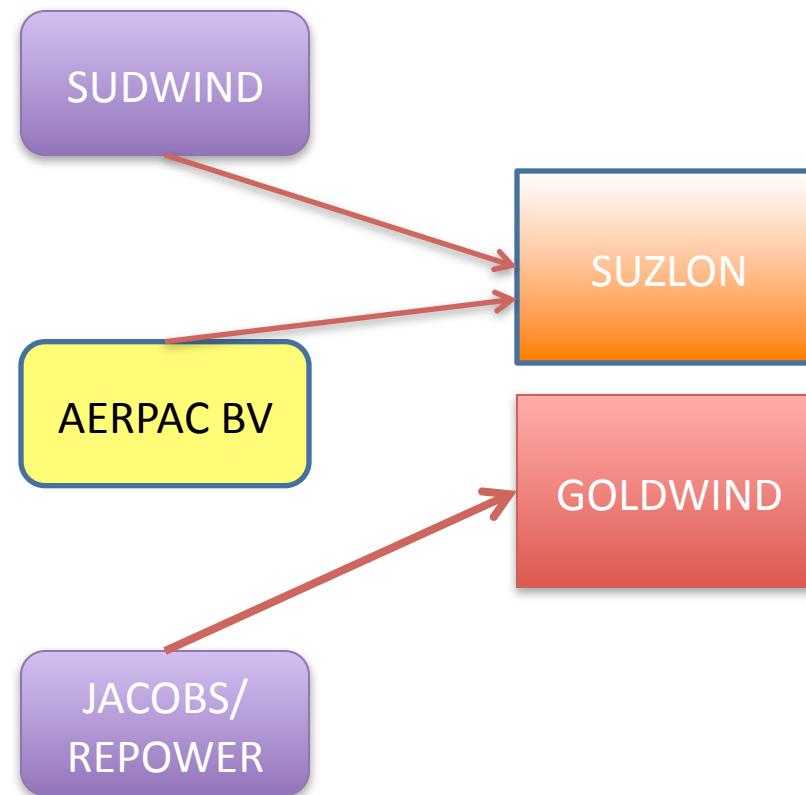
# Company Case Studies: *Suzlon (India) and Goldwind (China)*

- Both are leading manufacturers in their home country markets and have plans for further global expansions
- Both began manufacturing wind turbines around the same time (1990s)



# Early Years: Licensing Technology

- Both Suzlon and Goldwind began developing wind turbine technology with foreign licenses



Chinese Firm	Korean Firm	Indian Firm	German Firm	Danish Firm	US Firm
Brazilian Firm	Dutch Firm	Spanish Firm	Czech Firm	Argentinean Firm	Belgium Firm

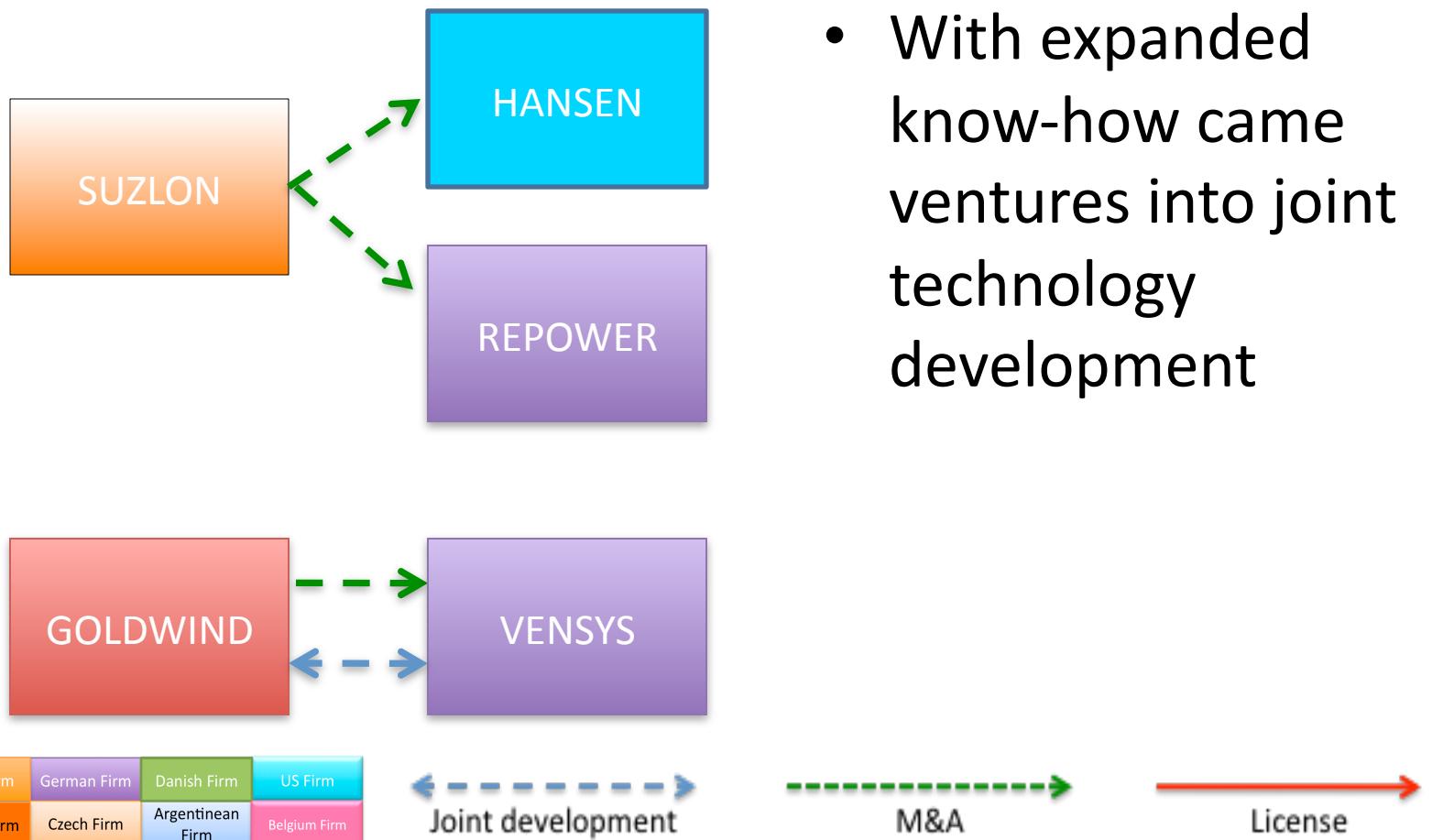
Joint development

M&A

License

# Later Years: Firm Acquisition & Joint Development

- As they became more successful they reached out to additional foreign partners, and acquired majority control of foreign companies



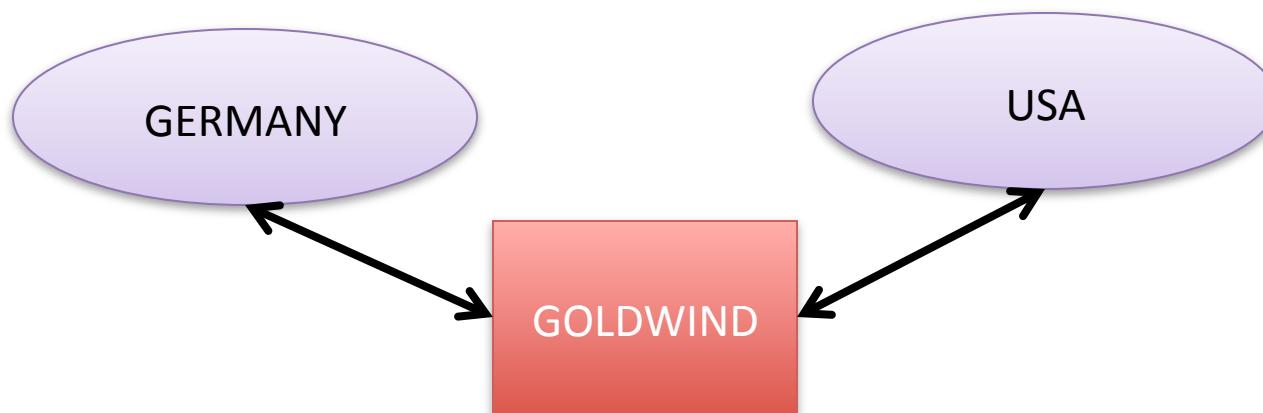
# Global Learning Networks

- Suzlon has an extensive global presence, allowing for an extensive global network for R&D, manufacturing and development experience



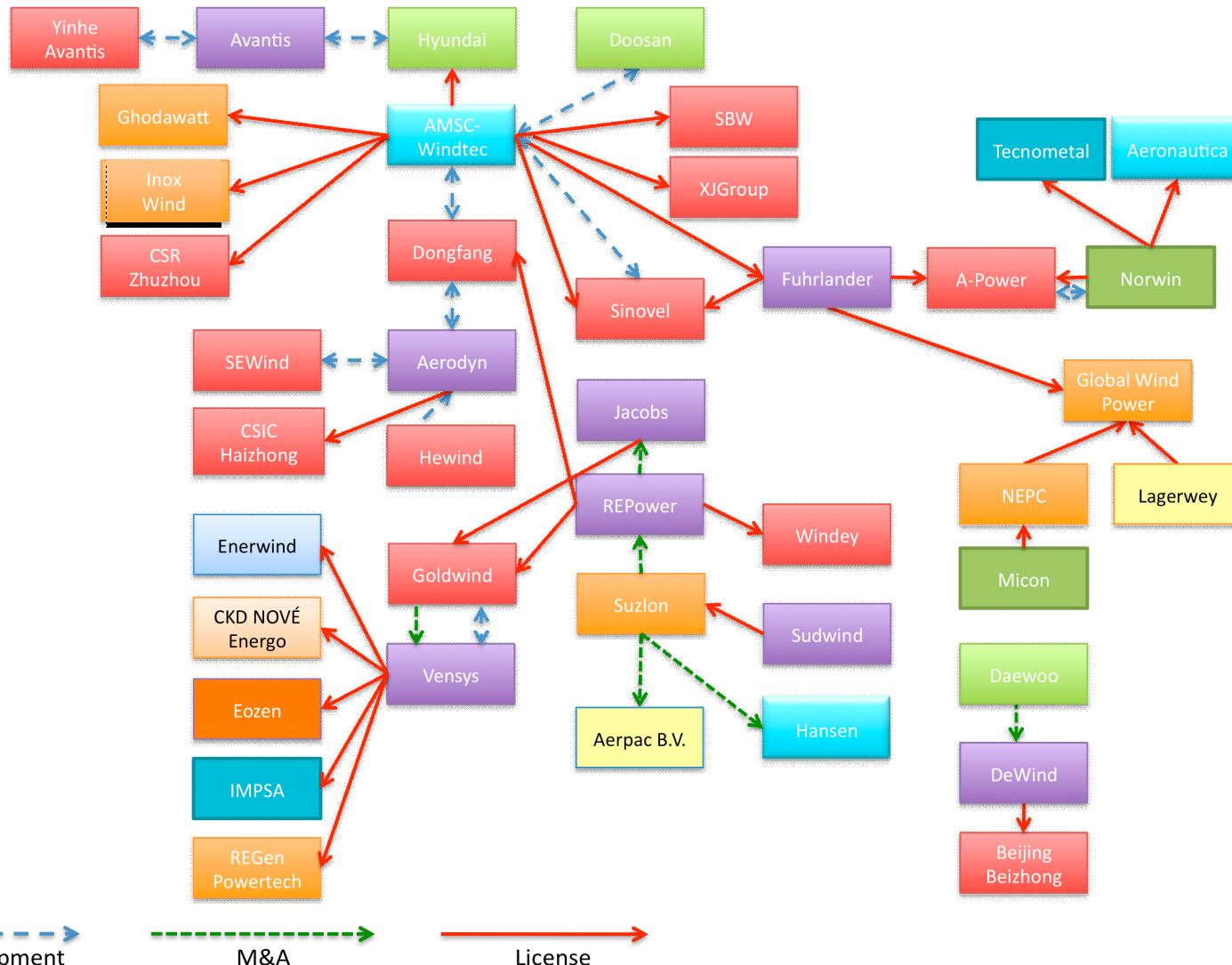
# Global Learning Networks

- Goldwind's global presence is more limited, but it has plans to continue its R&D, manufacturing and project development overseas



# Models of Wind Power Technology Transfer

*China, India, Korea... and beyond*



## Legend

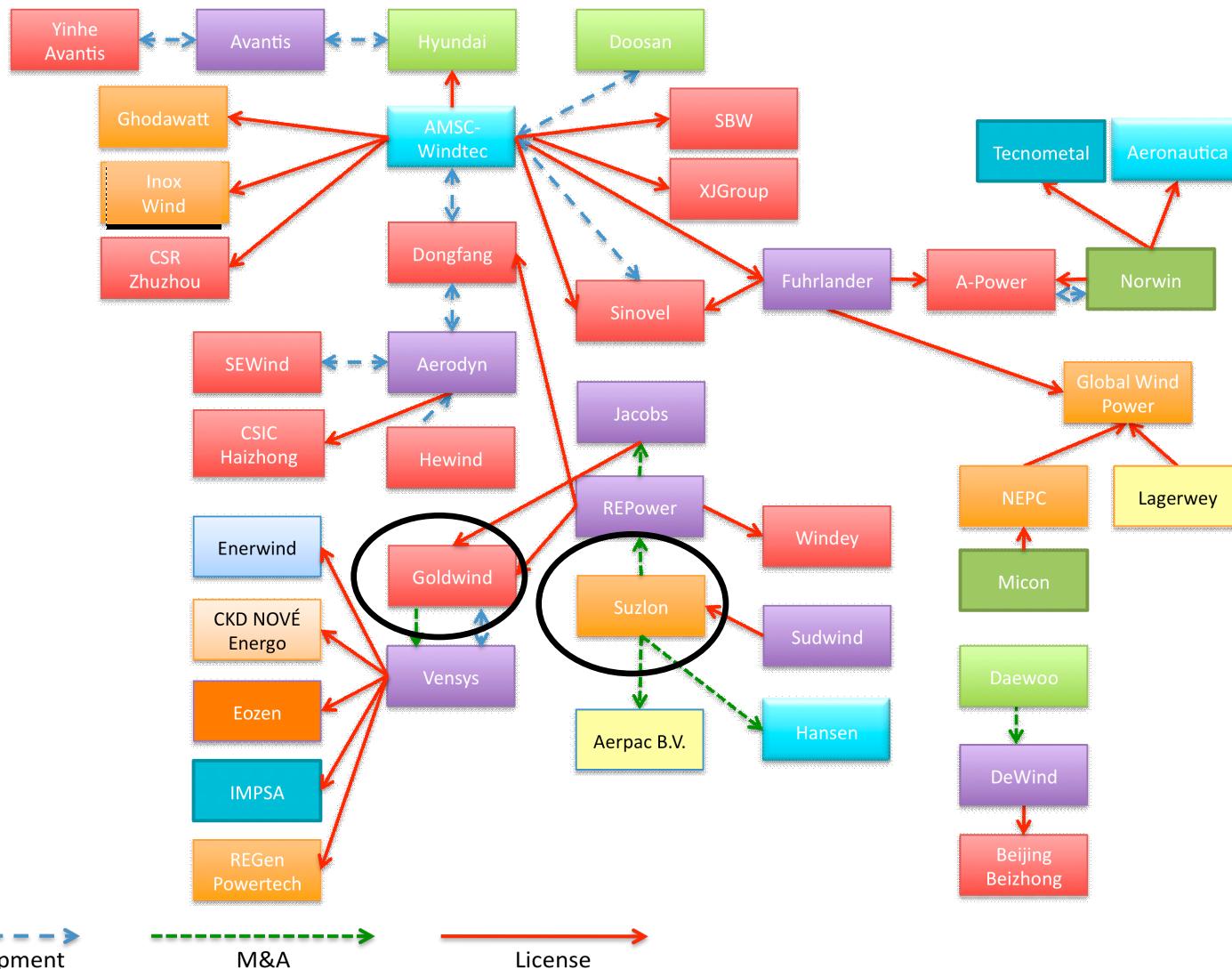
Joint development  
 M&A  
 License

Chinese Firm	Korean Firm	Indian Firm	German Firm	Danish Firm	US Firm
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Lewis, 2010 (forthcoming)

# Models of Wind Power Technology Transfer

## *Suzlon & Goldwind*



### Legend

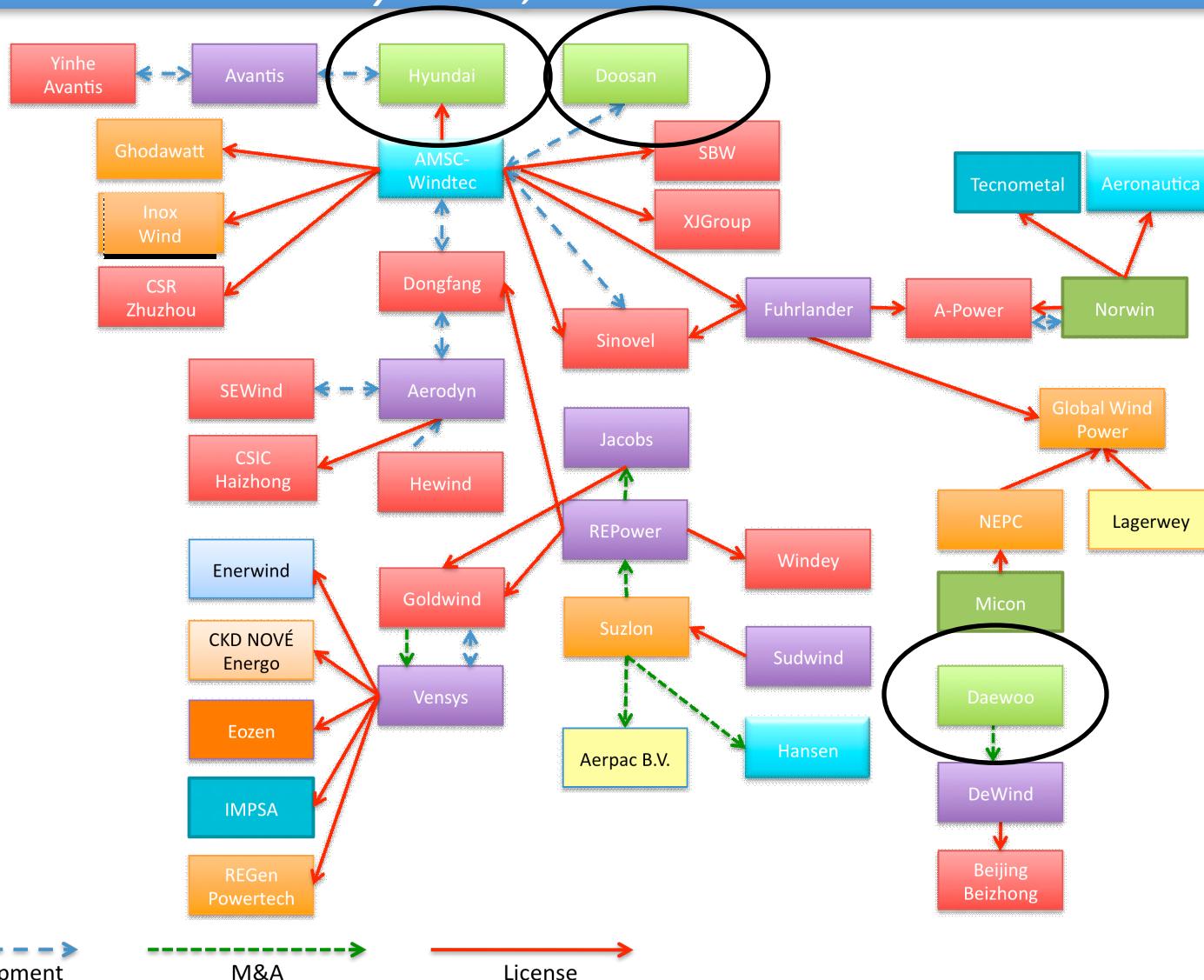
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# Models of Wind Power Technology Transfer

## *Hyundai, Doosan & Daewoo*



### Legend

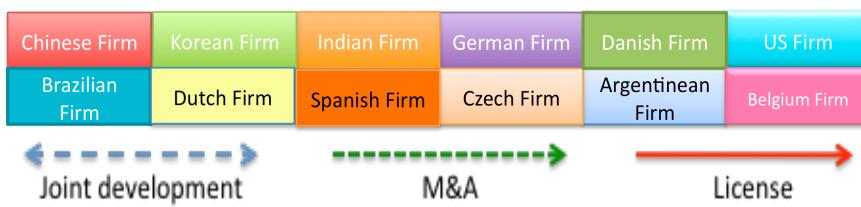
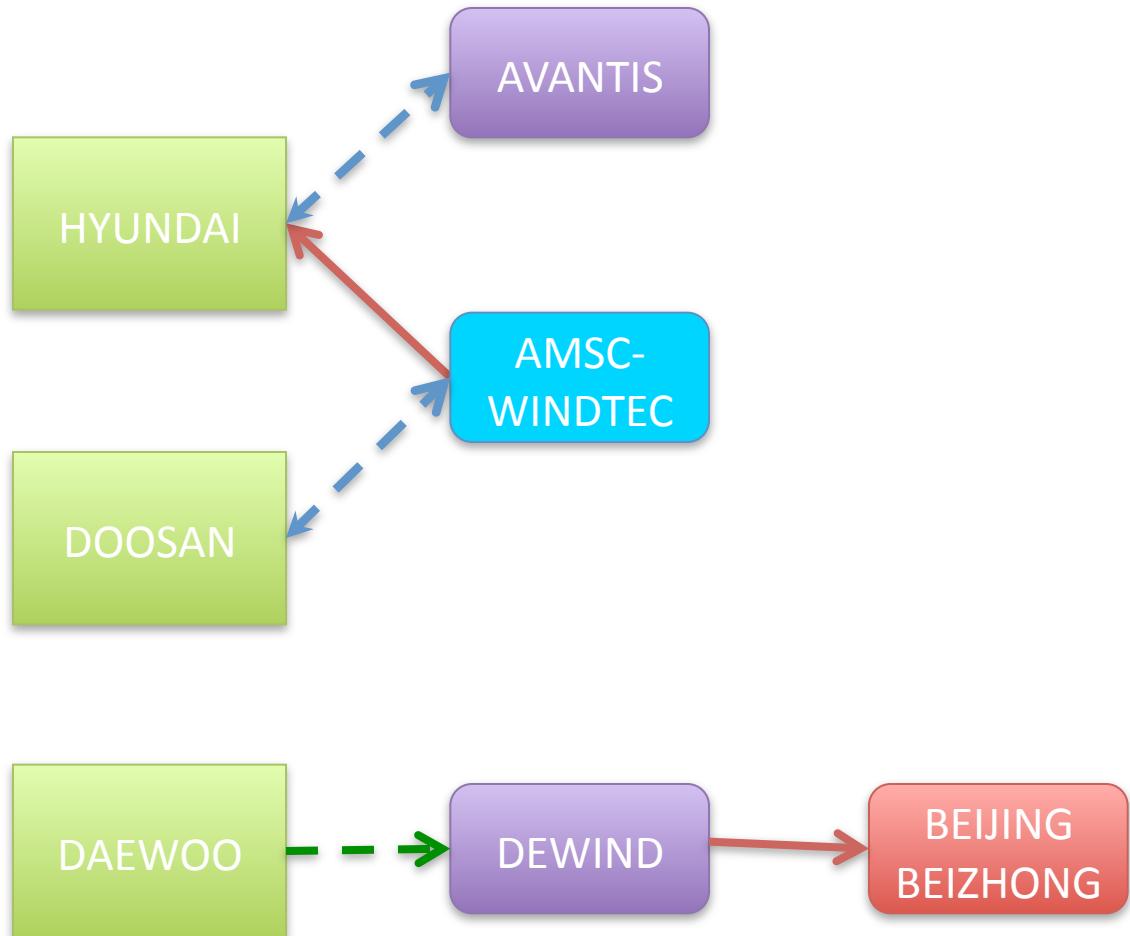
Joint development  
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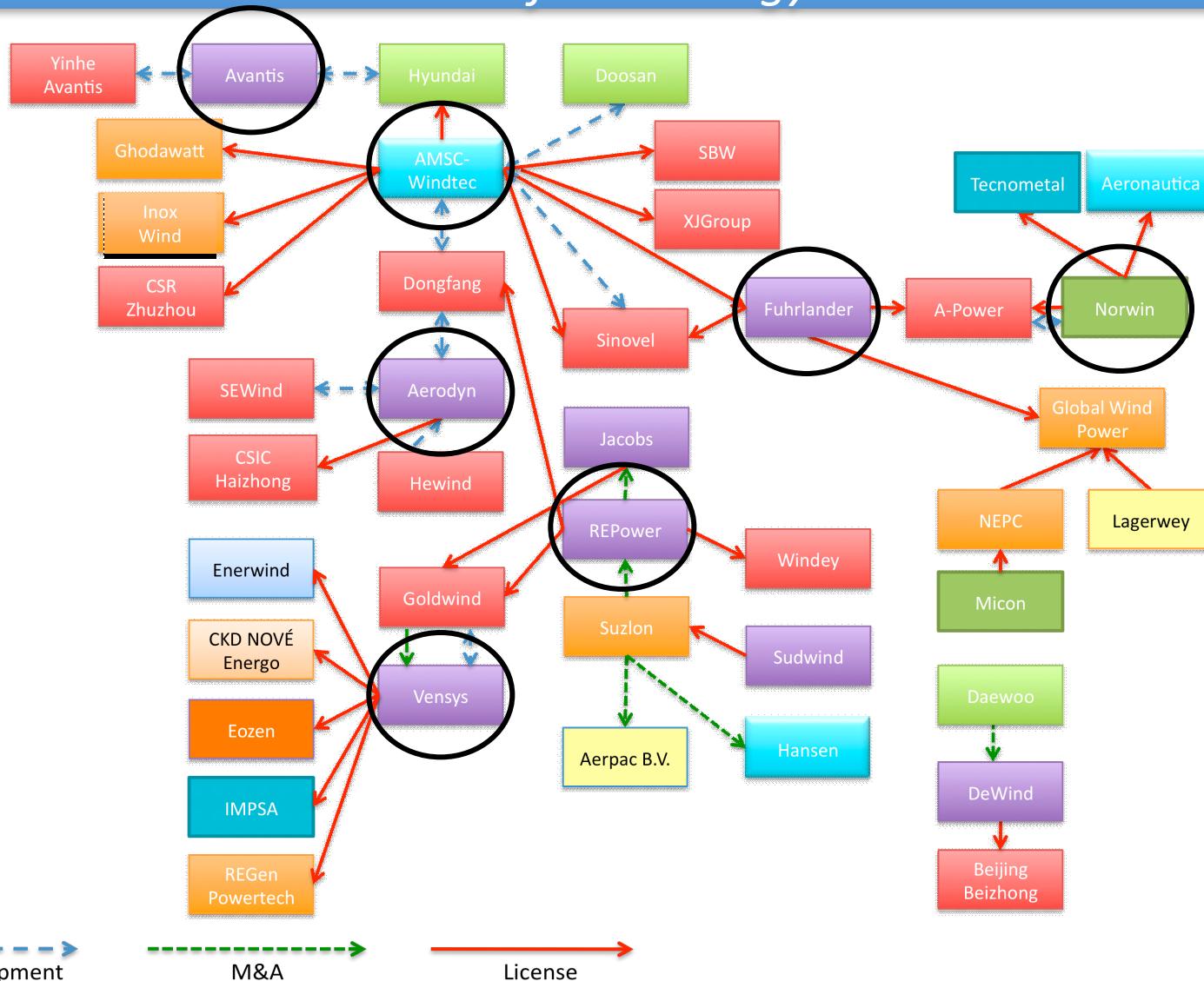
# Korean Firm Wind Technology Development

- Later, larger entrants relying primarily on joint development and M&A for advanced technology, but still licensing



# Models of Wind Power Technology Transfer

## *Common Sources of Technology IPR & Know-How*



### Legend

Joint development  
 M&A  
 License

Chinese Firm	Korean Firm	Indian Firm	German Firm	Danish Firm	US Firm
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Lewis, 2010 (forthcoming)

# Cross-Country Comparisons

- **China**
  - Strong policy support (especially for Chinese companies)
  - Large domestic potential
  - Lots of manufacturers; limited competition
  - Rely on licensing for technology development; M&A for larger firms; joint development for more experienced firms
  - Limited global learning networks/RD&D activities
- **India**
  - Unstable policy support
  - Future expansion in domestic market uncertain
  - First developing country industry mover, but limited domestic competition
  - Leading manufacturer already a global player, with expansive global operations and networks
- **South Korea**
  - Limited domestic policy support, but evolving
  - Limited potential for domestic expansion, some opportunities offshore
  - Late-mover, but leapfrogging directly to most advanced technologies
  - Building on domestic industrial base and multinational companies; have the capacity for M&As and joint development

# Implications for Leapfrogging

- Substantial technical advances are possible in relatively short amounts of time
  - It took China, India and S. Korea less than 10 years to go from no experience to complete wind turbine systems
  - Existing industrial base helps; may not be applicable for LDCs
- Licensing is a relatively inexpensive way to acquire knowledge, but future potential is limited
  - Structure of license should include “know-how,” but often does not
  - Beneficial also to transferring firm, particularly if not active in that market
  - Comes with market restrictions which limit expansion
  - Licenses frequently come from the same companies
- Tapping into global learning/innovation networks can be highly valuable
  - Suzlon’s network of strategically positioned global subsidiaries contribute to its base of industry knowledge and technical capacity
  - Goldwind recognizes this value as well and is expanding intl. activities
  - Korea’s new entrants looking globally for their technology partnerships; looking to export markets outside Korea and positioned to compete with global industry leaders

# Policy Implications

- Technology transfers are occurring via commercial channels, but still are opportunities for technology improvement
  - Improve technical capacity in wind turbine design through independent research and testing centers
  - Knowledge transfer also important in O&M of projects
  - Can build upon international experience
- Local content requirements will not necessarily result in tech transfer; coordinated learning clusters/ innovation networks may be more valuable
  - Examples: Low Carbon Development Zones (Tianjin, Baoding)
  - Large wind bases with multiple projects and factories
  - May be valuable to include foreign firms in these networks

# Implications for Intl. Climate Regime

- Payments for licensing IPR for commercially-available tech not necessarily a barrier to technology transfer
  - Royalty payments for wind licenses are typically small proportion of total capital investment
- Government can facilitate tech transfers within the private sector (via procurements, aggregating demand)
  - Commercial technology can be acquired through private sector transfers
  - But with advanced/pre-commercial technology, leaders are not willing to give up IPR to competitors
- Are opportunities for collaborative R&D on pre-commercial technologies
  - Less competition and concerns about IPR during the pre-commercial stage, role for government support

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