Wind Energy R&D and Policy of Korean Government

2012. 10. 18.

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Wind Power Program Director

Knowledge Economy R&D Program

Contents

Vision for Offshore Wind Development

Climate Change Response | **New Growth Engine** | **Energy Security**

Vision: Top 3 Offshore Wind Power Country by 2020

Key Areas:
- Turbine/ Operation
- Site Development/ Construction
- Supply Chain

Policy Goals:
- **Market Creation**: RPS, projects in progress, 10 green projects, etc.
- **Buildup of Supply Capacities**: R&D, test-beds, certifications, etc.

Source: Kook-Hyun Im(MKE), Current Status & Policy Directions for Korean Wind Industry, 20 Sept. 2012, Korea-Europe Wind Plaza 2012

Market Creation

1 Compulsory System for Market Creation

RPS (Renewable Energy Portfolio Standard) introduced in 2012

- 13 Power Companies, which have generation capacity of over 500MW are obliged to produce a certain portion of their electricity from NRE
- Costs for Implementing RPS will be Added to Electricity Bill

Annual RPS Targets

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Rate(%)	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0

* Annual compulsory RE generation = Total generation(excl. RE) × Compulsory rate(%)

RPS Weight Factors for Eligible New and Renewable Energy Sources

Weight Factors	Eligible NRE Sources
0.25	IGCC, byproduct gas
0.5	Waste, landfill gas
1.0	Hydropower, onshore wind, bio-energy, RDF, waste gasification, tidal power
1.5	Lignin biomass generation, offshore wind (less than 5km from land)
2.0	Offshore wind (more than 5km), tidal power(without Seawall), fuel cell

Source: Kook-Hyun Im(MKE), Current Status & Policy Directions for Korean Wind Industry, 20 Sept. 2012, Korea-Europe Wind Plaza 2012

Market Creation

2 10 Green Projects

Large-scale deployment of NRE with 10 green projects

- **Green-School Project linked to RPS (Win-win Business Model between Utilities and School)**
  * (Utilities) Install PV rooftops at the school to meet RPS obligation, (School) Rent to be used for scholarships
- **Full-scale implementation from 2012 after pilot project in 2011**

10 Projects		Contents	
1	Green Post	2,746 Post Office Buildings and their Premises	PV, Solar-,Geo-thermal
2	Green Port	28 Logistics Complexes behind Harbors	PV, Offshore Wind
3	Green School	11,080 First &Secondary Schools and their Premises	PV, Solar-,Geo-thermal
4	Green Island	Islands with decentralized power supply system	Wind, Bio, Geothermal
5	Green Logistics	Large-scale Warehouses and their Premises	PV, Solar-,Geo-thermal
6	Green Industrial Complex	Industrial Complexes: National(40), general(347), Agro(396)	Fuel cell, Bio, Waste
7	Green Highway	Service Stations(167), Korea Highway Corp. Branches(360)	PV, Solar-, Geo-thermal
8	Green Army	Army Facilities and their Premises	Solar-,Geo-thermal, Bio
9	Green Factory	Factories and their Premises	PV, Fuel cell, Waste
10	Green Power	KEPCO, Power Companies and their Premises	PV, Wind, Bio

Source: Kook-Hyun Im(MKE), Current Status & Policy Directions for Korean Wind Industry, 20 Sept. 2012, Korea-Europe Wind Plaza 2012

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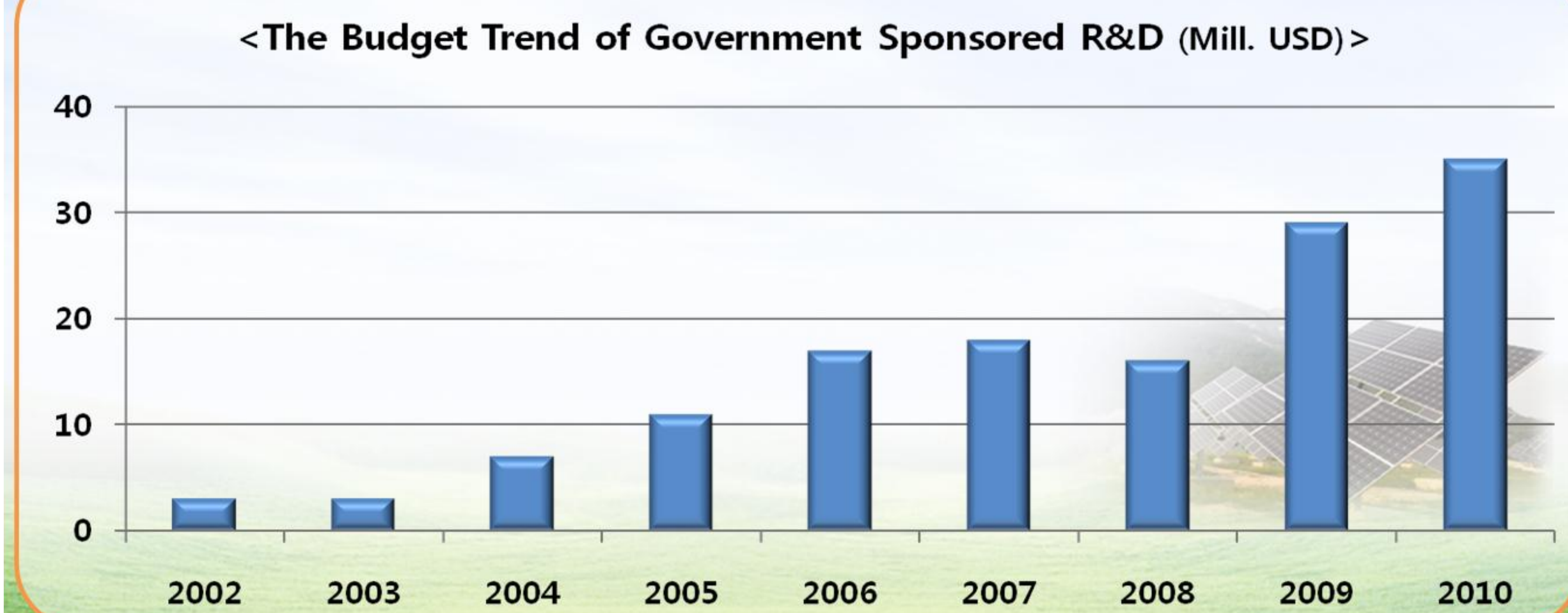
Buildup of Supply Capacities

1 R&D Support for Wind Technologies

Localization of core technologies and components

- Budget Rate(2010, %): Component(40), field test(35), system(16), etc.(9)



Source: Kook-Hyun Im(MKE), Current Status & Policy Directions for Korean Wind Industry, 20 Sept. 2012, Korea-Europe Wind Plaza 2012

Buildup of Supply Capacities

2 Infrastructure for Wind Industry Development

Test beds to commercialize developed technologies & products

- Facilitating the evaluation, certification, & demonstration of offshore wind system

Construction of a support harbor for offshore wind project

- Kusan selected as a support harbor for 2.5GW offshore wind project in the south-west sea
- Support harbor serves as a base of assemblies, logistics for large-scale wind power projects

<Load · Pile up>

<Assembly>

<Transportation>

<Construction>

<Function of Offshore Wind Harbor Complex>

Source: Kook-Hyun Im(MKE), Current Status & Policy Directions for Korean Wind Industry, 20 Sept. 2012, Korea-Europe Wind Plaza 2012

Buildup of Supply Capacities

3 Financial Support

Financial support for building offshore wind farms

- Reinforcement of financial assistance in the green industries through Korea Finance Corporation
- Support investments in renewable energy production facilities
  - Provide tax reduction by 50% for the imported facilities to produce NRE products

4 Business Friendly Environment

Establishment of a governmental cooperative system

- **Function:** To Investigate restrictions (i.e. environment regulation, civil complaints, etc.) on the offshore wind projects and suggest solutions for governmental level
- **Members:** Related government officials (i.e. Ministry of Knowledge, Ministry of Environment, Ministry of land, Transportation and Maritimes, etc.)

Source: Kook-Hyun Im(MKE), Current Status & Policy Directions for Korean Wind Industry, 20 Sept. 2012, Korea-Europe Wind Plaza 2012

I. Vision and Policy of Korean Government for Wind Energy

II. General Aspects of Process and Activities of Technology to Business

- **Resource Allocation for R&D**
- **Public and Private Sector's Role in R&D**
- **Influencing the Learning System : Public R&D and Deployment Polices**
- **Example : Technology Structural Change**

III. Overview of Global Status for Wind Energy

IV. Status of Korean R&D Activities for Wind Energy

V. Implications and Strategic Directions

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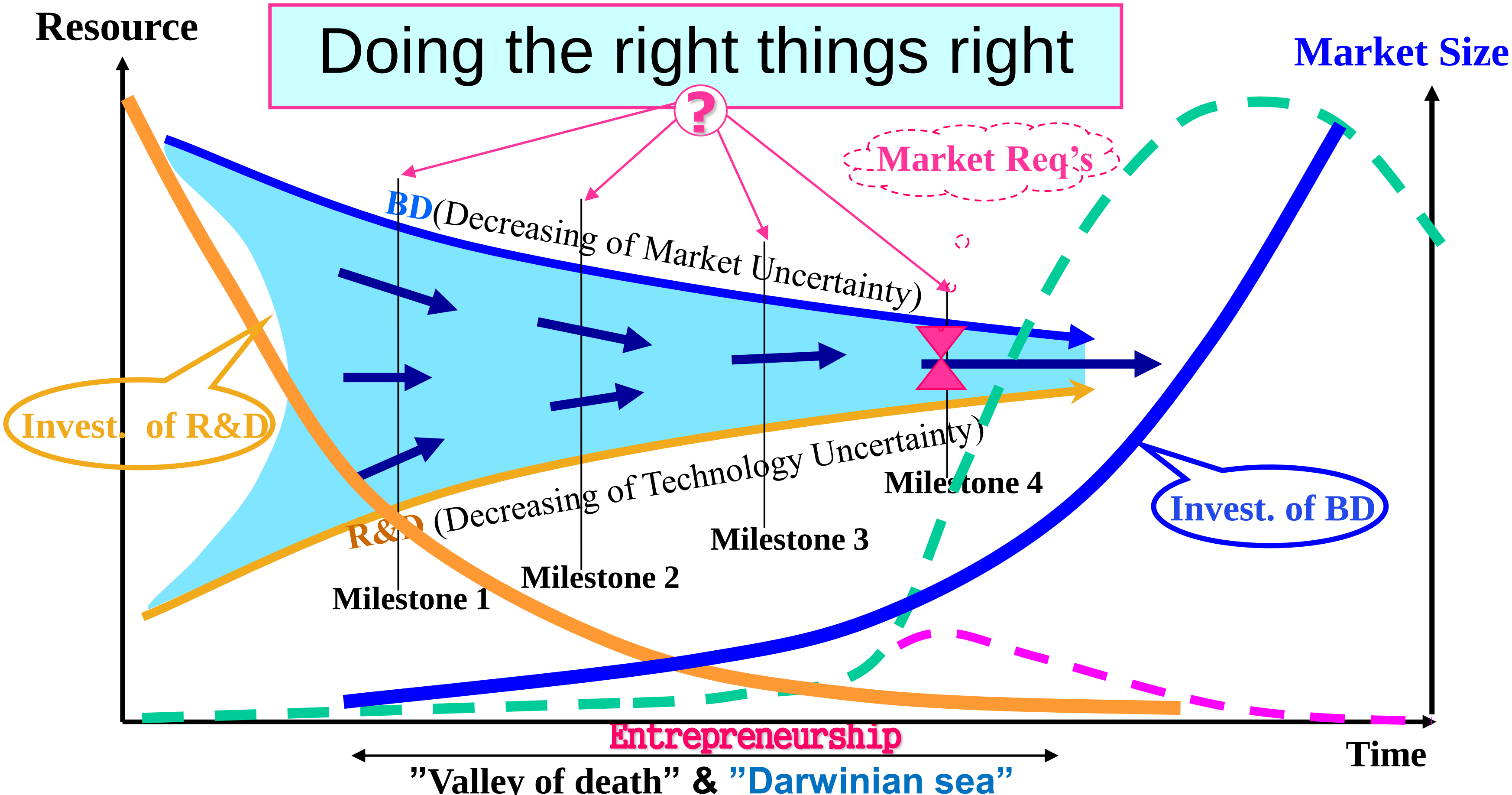
Resource Allocation for Technology to Business

Doing the right things right; Consider the effectiveness of the work.

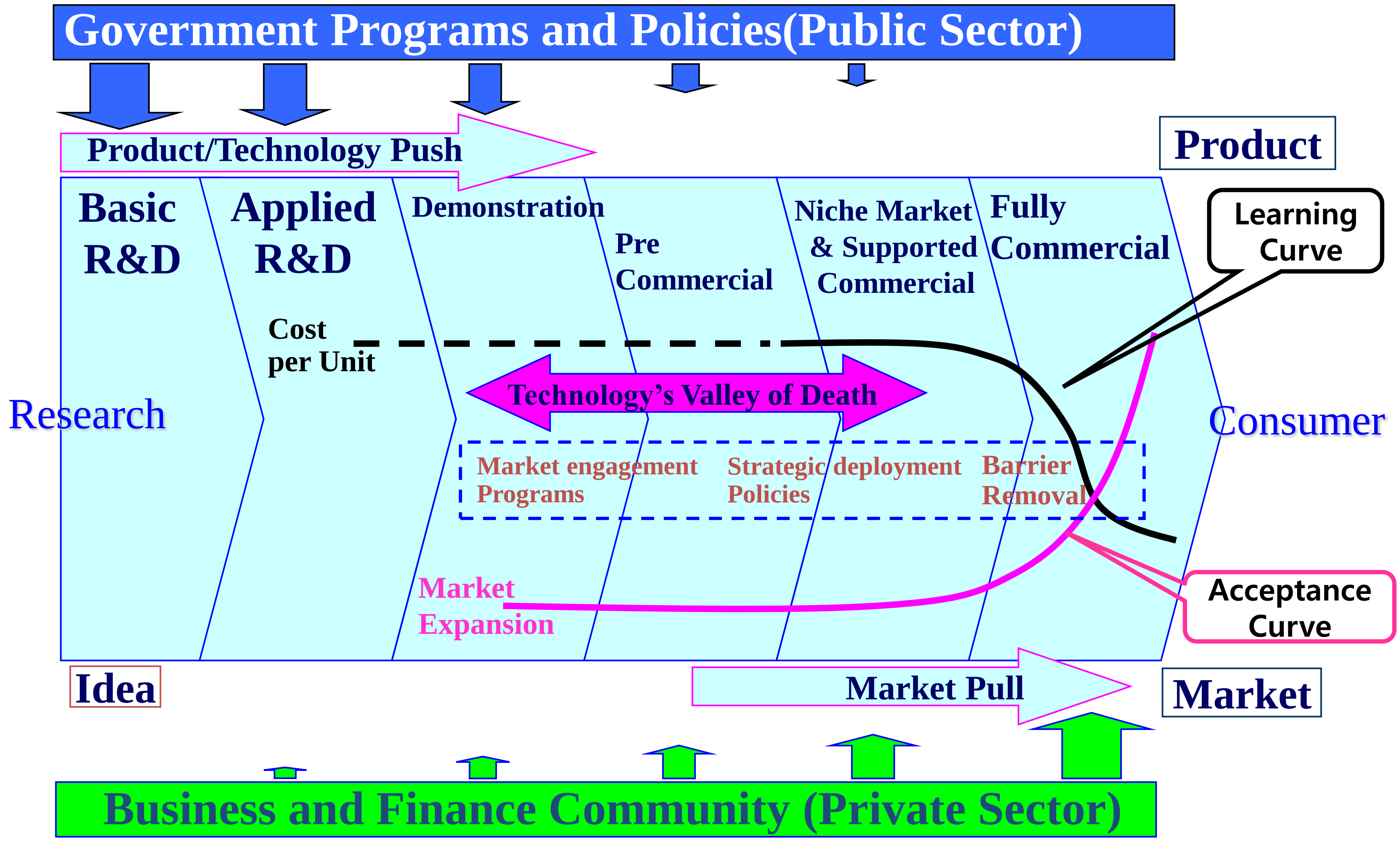
Possessing the right technology is only one side of coin.

Creating the right market is equally important.



Source: S.D, Oh, Materials of Private Company, 2004

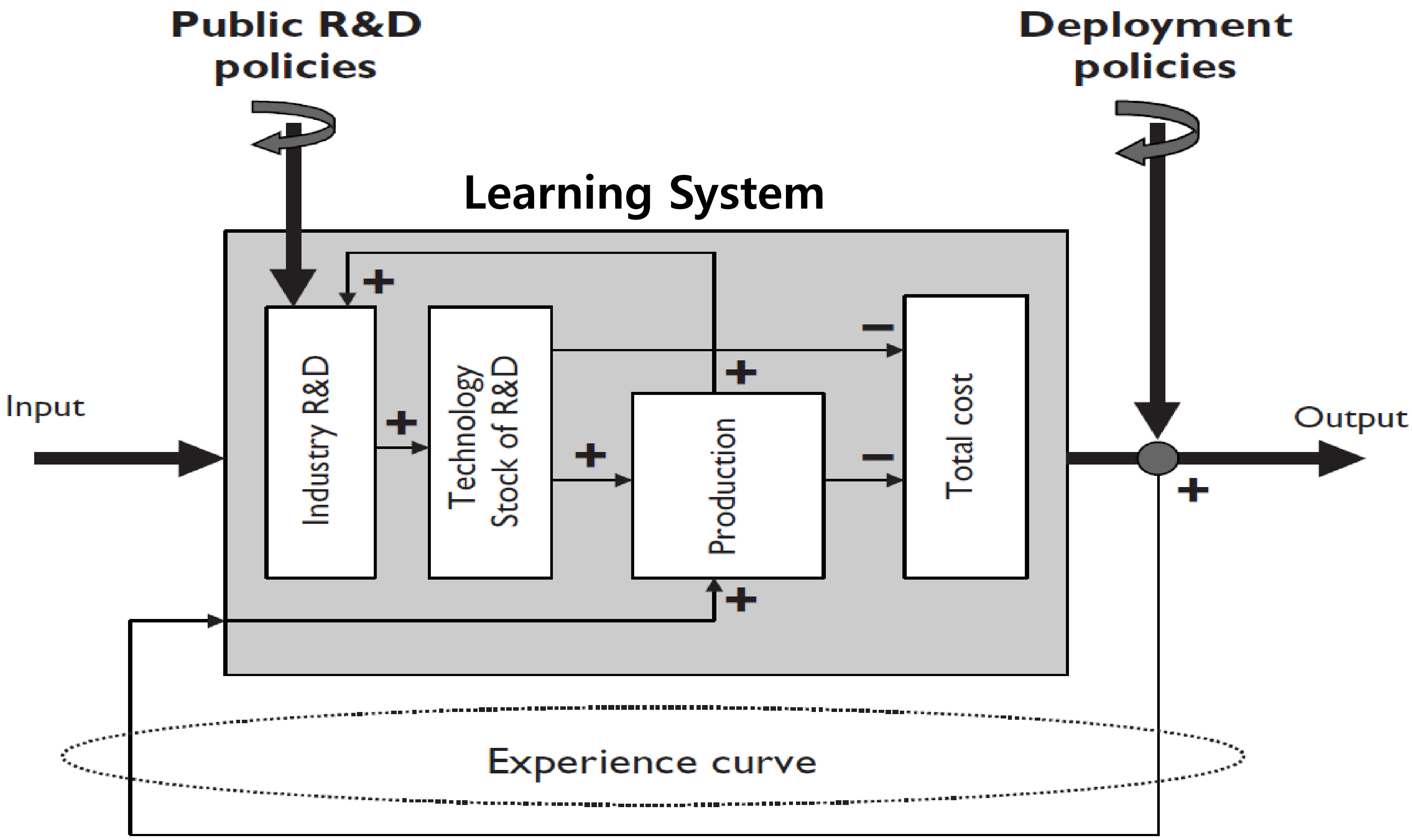
Public and Private Sector's Role in R&BD



Source: S.D, Oh, Knowledge and Innovation for Sustainable Growth, 2004, Modified in 2012

Influencing the Learning System : Public R&D and Deployment Policies

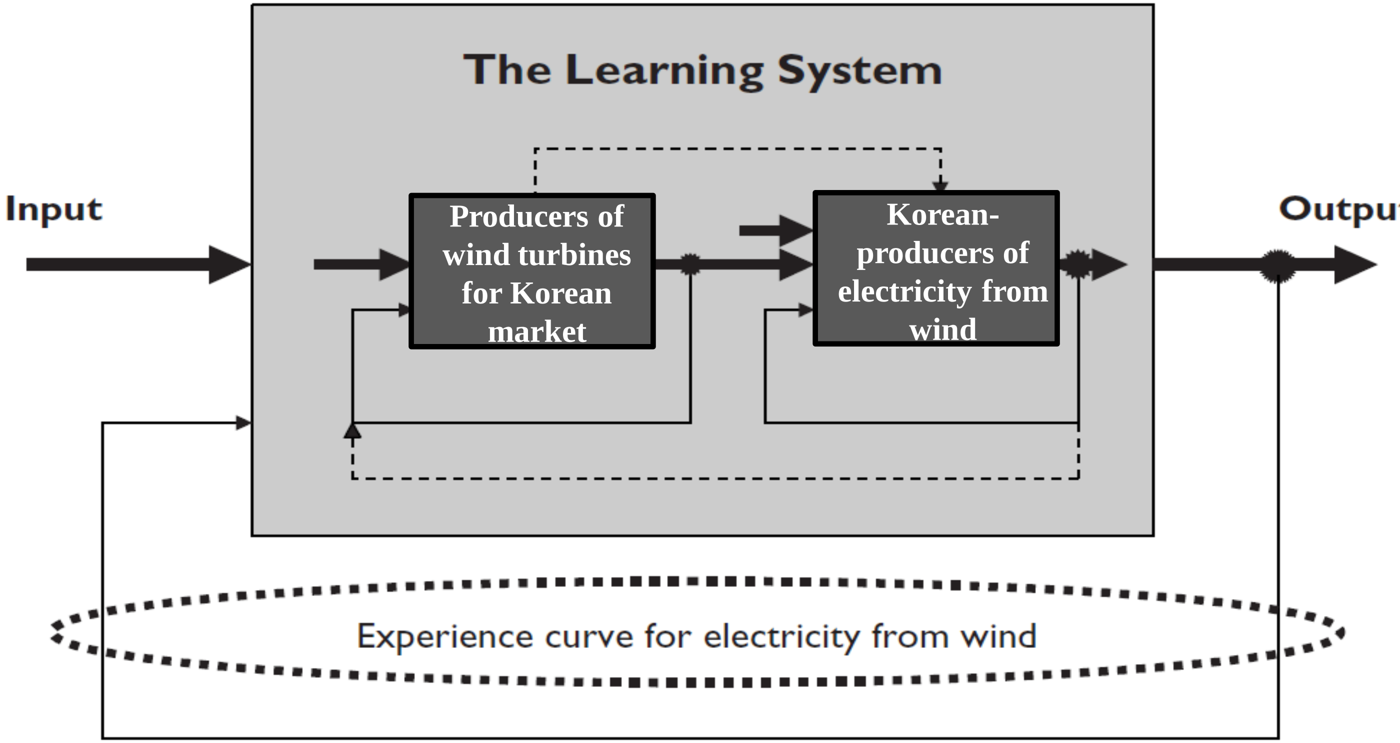
Learning by searching, Learning by Doing, **Learning by Using(Market)**



Source : OECD/IEA, Experience Curves for Energy Technology Policy, 2000

Learning System for Production of Electricity from Wind

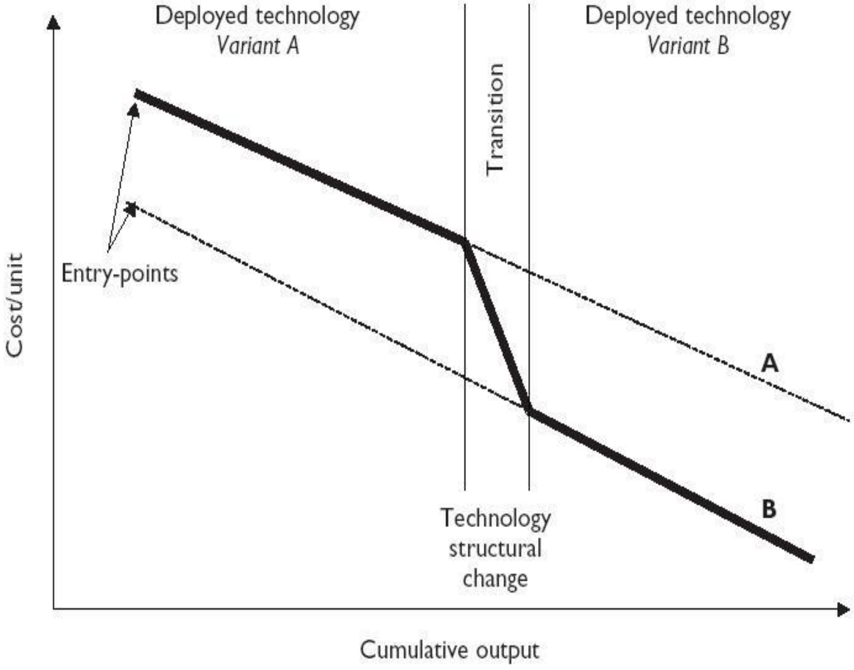
- The system contains two subsystems, one producing wind turbines and one producing electricity from wind using wind turbines.
- Solid lines represent information feed-forward from one subsystem to another and information feed-backward within a (sub)system.
- Dashed lines represent information feed forward or feed-backward between the two subsystems.

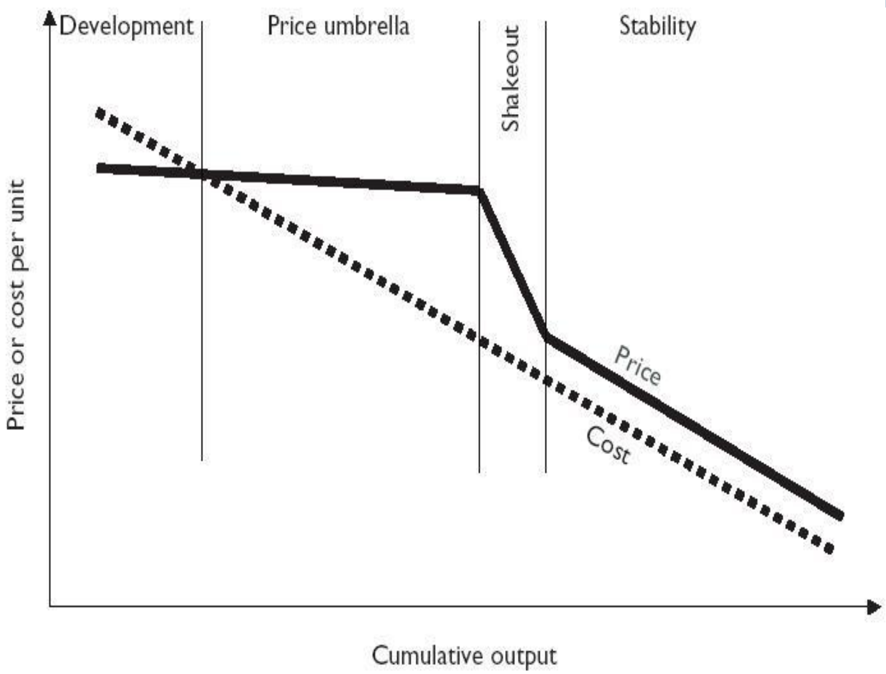


Source : OECD/IEA, Experience Curves for Energy Technology Policy, 2000

Inside learning System : Technology and Market Structural Changes

- Experience curves usually measure changes in prices, and there is a risk that the effect of technology structural changes and market structural changes are masked by changes in the market.
- For example, a wind turbine consists (amongst many other parts) of rotor blades and a gearbox. Both the efficiency of the wind capture of the rotor blades and the efficiency of the gearbox can increase by learning.





Source : OECD/IEA, Experience Curves for Energy Technology Policy, 2000

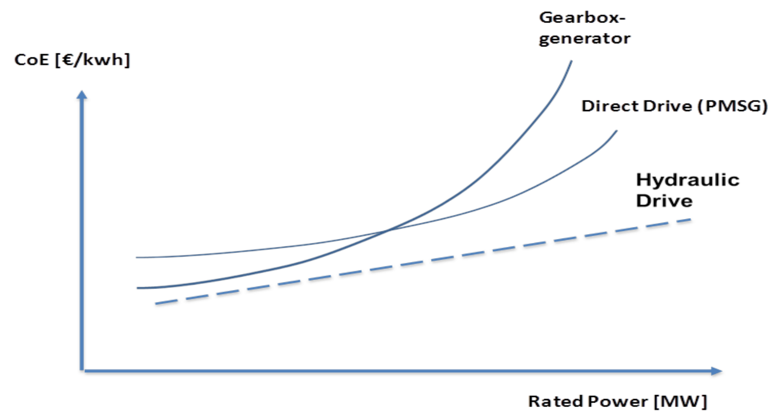
Example : Technology Structural Change

Evolution of large wind turbine technologies, 1980-2007

	Early 1980s	Early 1990s		Late 1990s		2000–2007		
Stall regulated	X			X				
Active stall			X					
Fixed speed	X	X	X					
Limited Variable Speed					X			
Gearbox	X	X	X	X	X	X		
Pitch regulated		X			X	X	X	X
Variable speed				X		X	X	X
Direct Drive		X			X		X	X
"Multibrid"							X	X

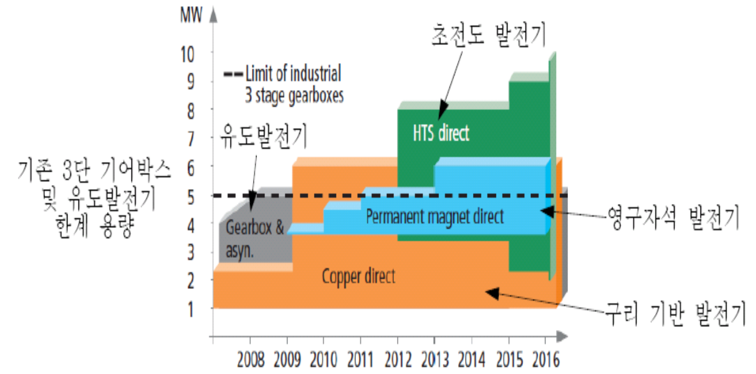
Source : Michelle Avis and Preben Maegaard, Worldwide Wind Turbine market and Manufacturing Trends, Jan. 2008

Cost of Energy Potential by Drivetrain



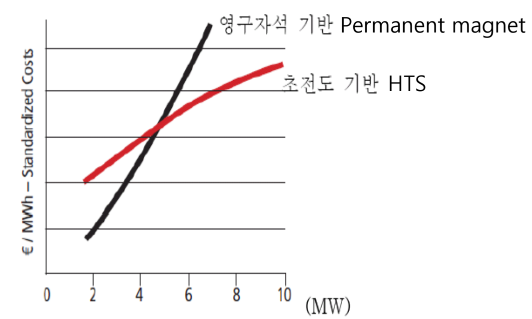
Source: BTM Consult - A Part of Navigant (internal files) - March 2012

풍력발전기 용량에 따른 4가지 발전기 기술의 한계



자료: Lesser, M. & Muller, J. (2009). Generating the Future of Offshore Wind Power. Renewable Energy World Conference and Exhibition, May 27. Cologne, Germany.

영구자석 및 초전도 기반 발전기의 발전비용 비교



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- **Market and Industry Trend by Technology**
- **Turbine Size : 1.5 MW to 2.5 MW Products Key to Competitiveness**
- **Trends in Hub Height and Rotor Scaling**
- **Change of Focus Area and Procurement Approach**
- **Overview Technical Challenges**

IV. Status of Korean R&D Activities for Wind Energy

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Market and Industry Trend by Technology

FIGURE 18. WIND POWER CAPACITY, TOP 10 COUNTRIES, 2011

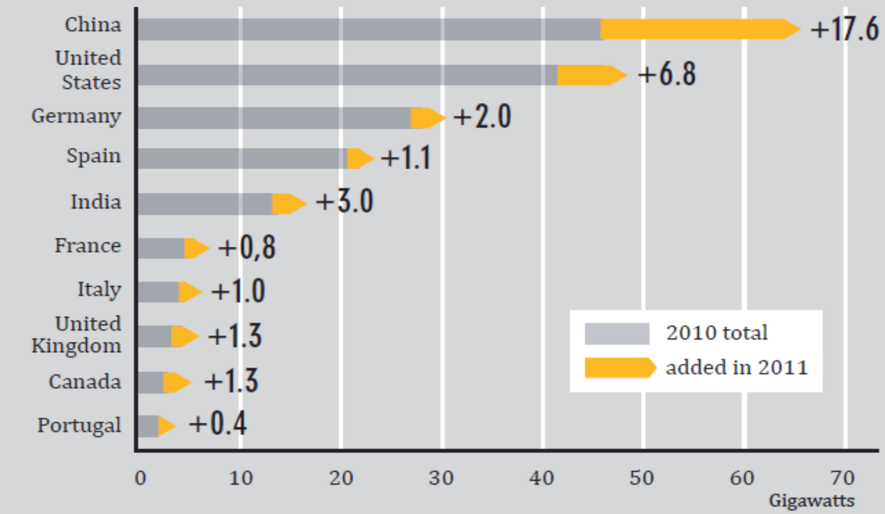
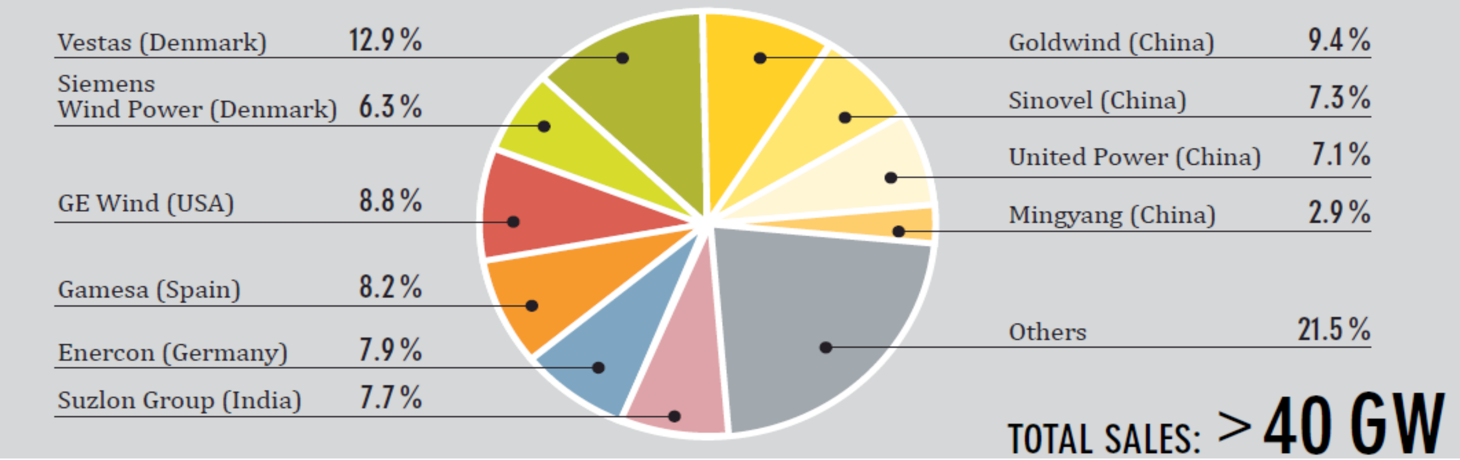


FIGURE 19. MARKET SHARES OF TOP 10 WIND TURBINE MANUFACTURERS, 2011



Source : RENEWABLES 2012 GLOBAL STATUS REPORT

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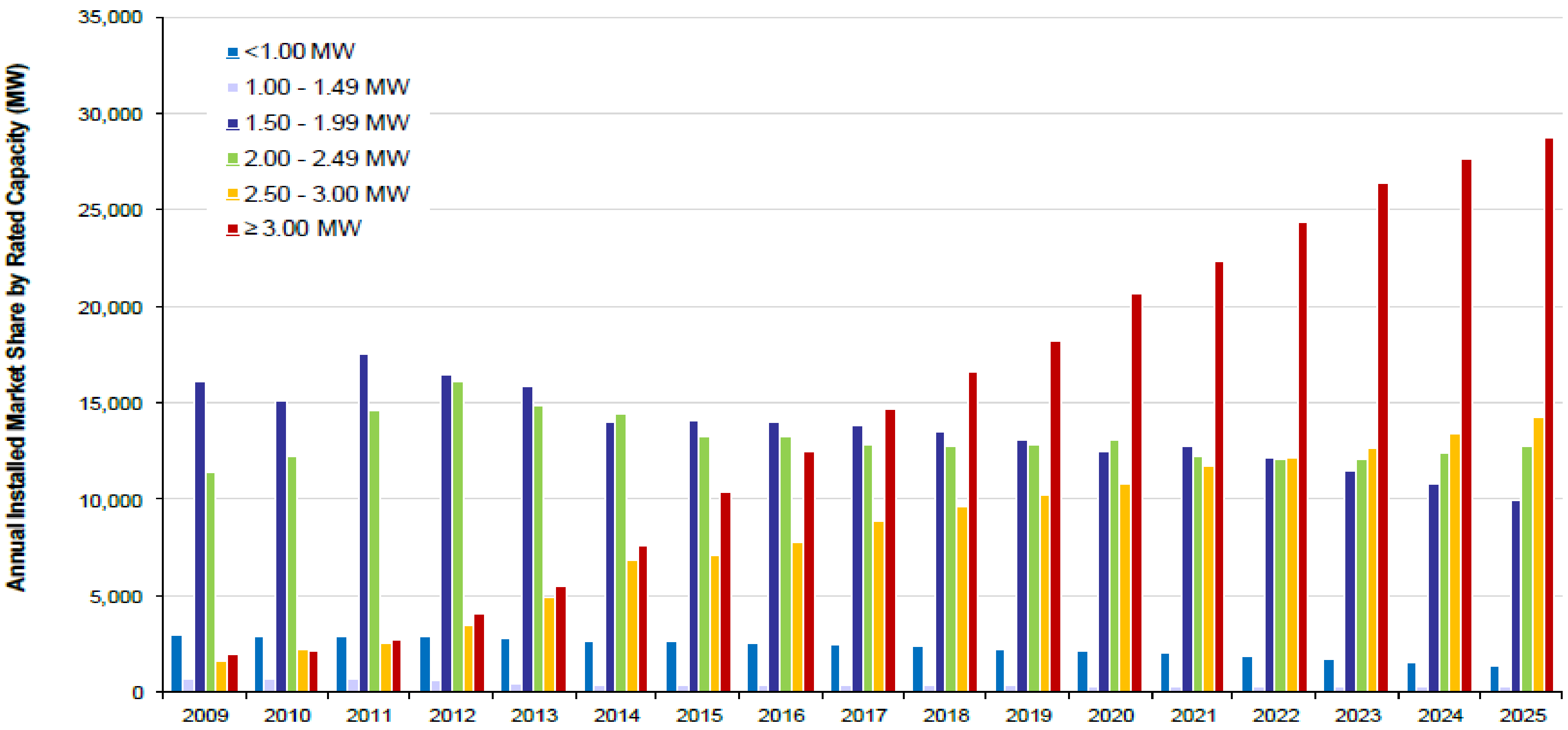
Turbine Size : 1.5 MW to 2.5 MW Products Key to Competitiveness

The global wind turbine industry's scaling up in terms of turbine size will likely continue as underscored by new product launches from leading turbine manufacturers, while new asian competitors enter the space targeting the segment of turbines between 1 MW and 2 MW.

Exhibit 3-3: Global Annual Megawatts Installed by Rated Turbine Capacity: 2009–2025



Source: IHS Emerging Energy Research

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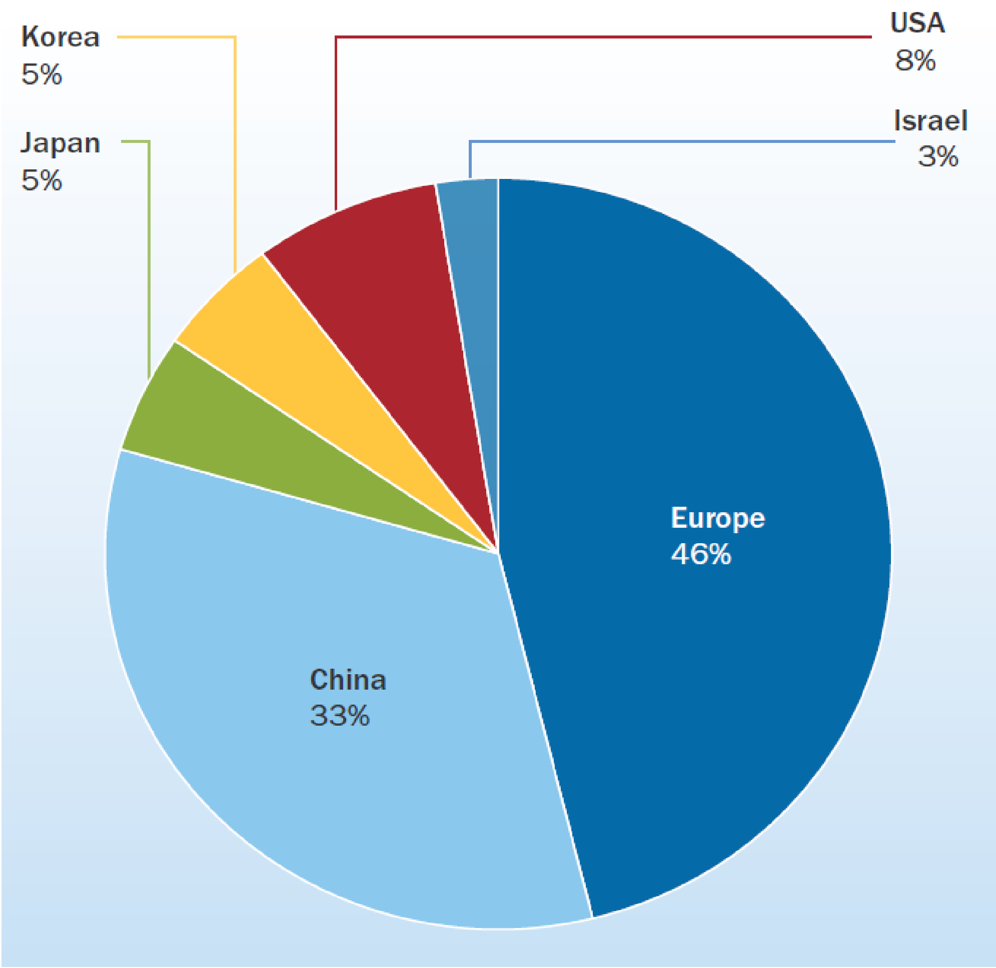
Origin of Companies and Announcing New Offshore Wind Turbine Models



- Almost half of the companies, announcing new models are based in Europe.
- China is a second largest with 33%, then the US (8%), Japan, South Korea and Israel follow.
- This activity across the globe is creating a highly competitive environment.

Source: EWEA, The European offshore wind industry key 2011 trends and statistics, January 2012

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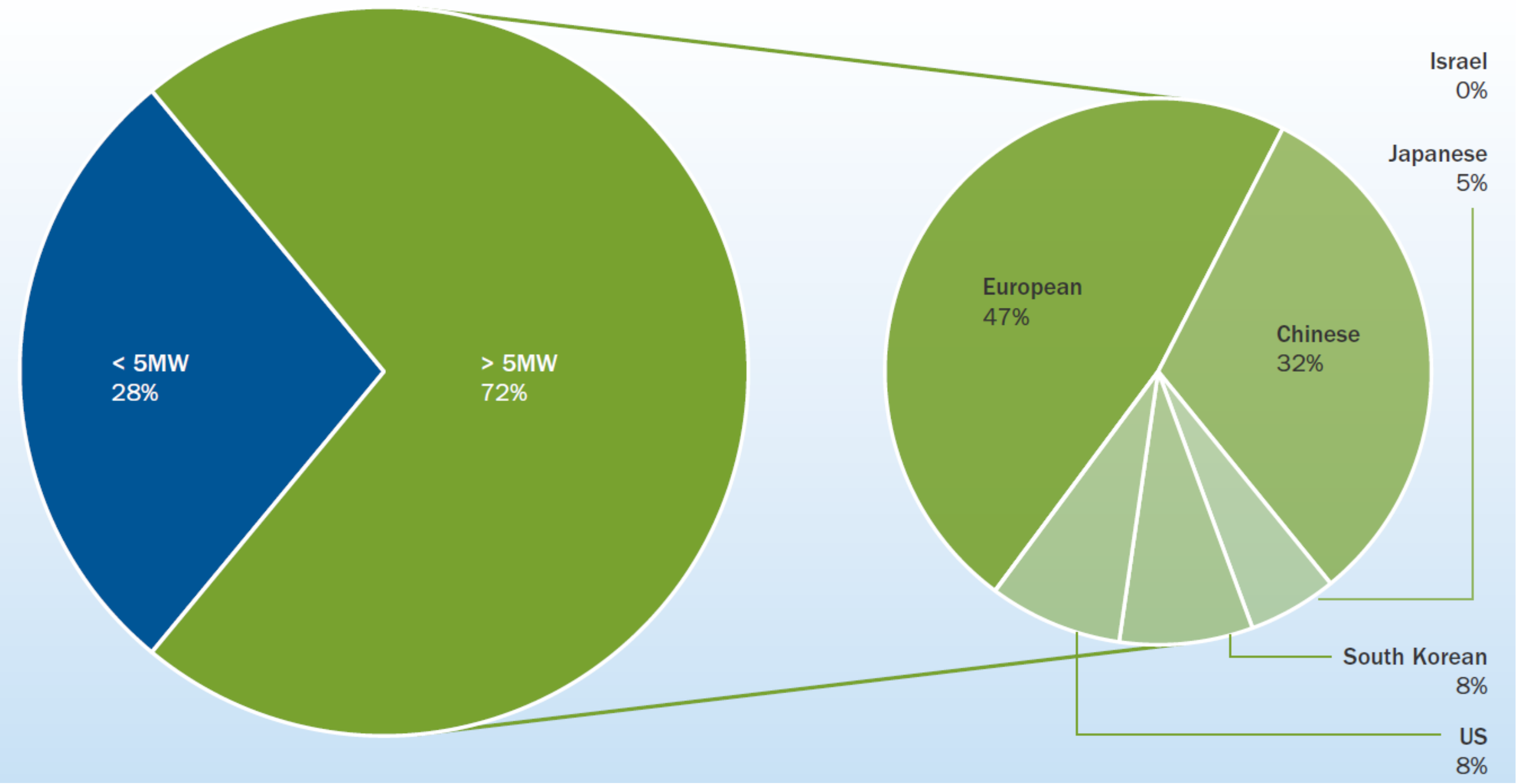
Offshore Wind Turbine Announcements by Size and Origin

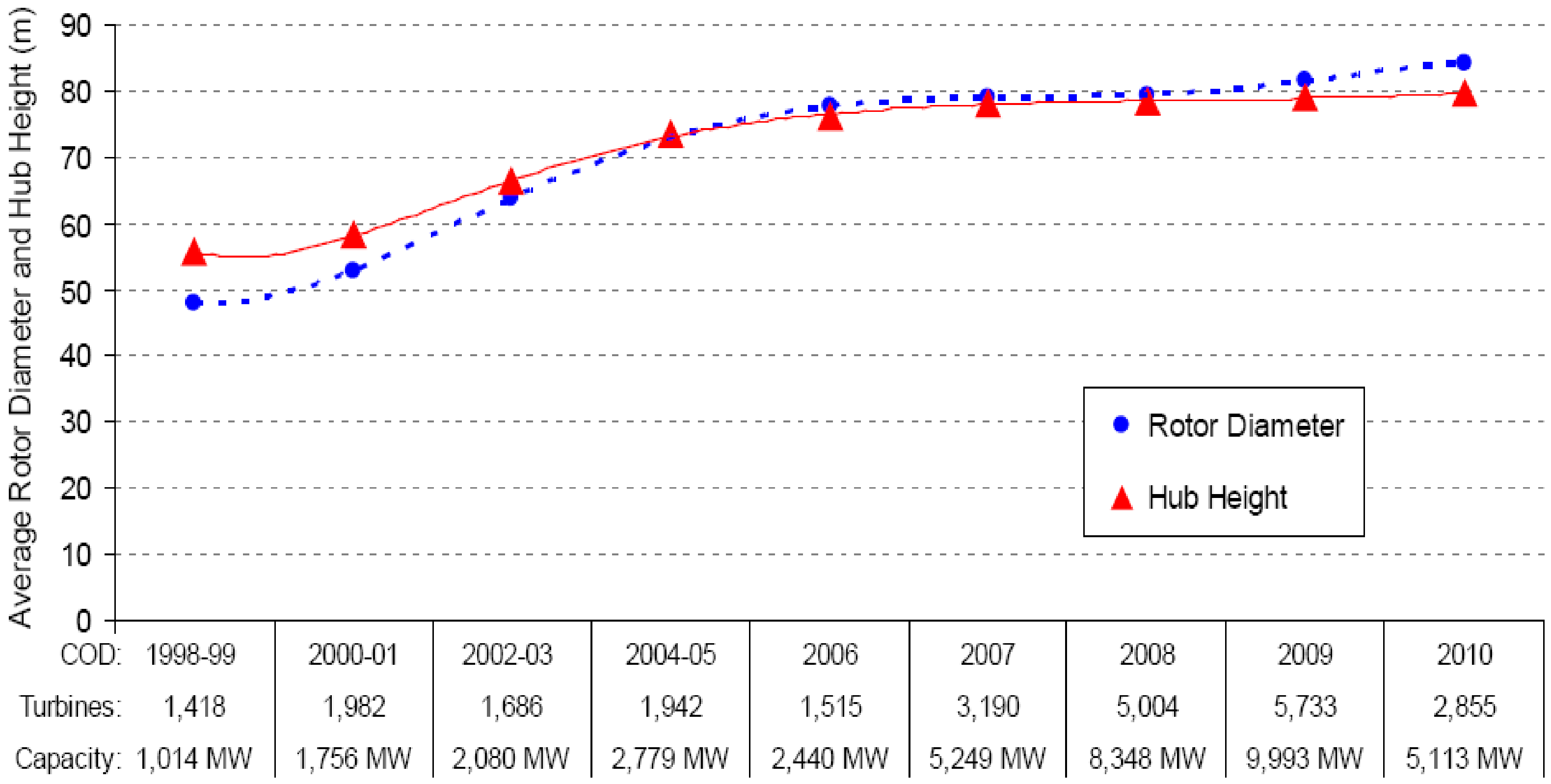
- The new models announced are mostly large machines with a rated capacity above 5 MW.
- Taking into account the models announced over the last two years, only 28% are less than 5MW, the rest (72%) consists of bigger machines.



Source: EWEA, The European offshore wind industry key 2011 trends and statistics, January 2012

Trends in Hub Height and Rotor Scaling

- Average rotor diameters have increased at a more rapid pace
- These trends in hub height and rotor scaling are one of several factors impacting the project-level capacity factors



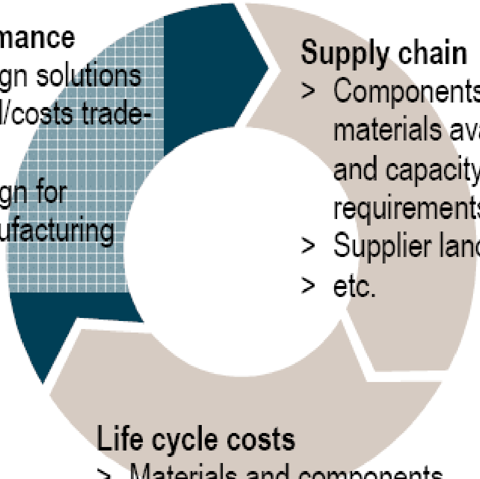
Source: Berkeley Lab

Source : U.S. DOE,2010 Wind Technologies Market Report, June 2011

Change of Focus Area and Procurement Approach

- Focus Area : Performance => Supply Chain, Life Cycle Costs
- Procurement Approach : Price based => Strategic Partnership for Win-Win

COMPLEX TECHNOLOGY TRADE-OFFS



Performance
- > Design solutions
- > Yield/costs trade-offs
- > Design for manufacturing
- > etc.

Supply chain
- > Components and materials availability and capacity requirements
- > Supplier landscape
- > etc.

Life cycle costs
- > Materials and components manufacturing costs
- > Assembly costs
- > Deployment costs
- > Operation and maintenance
- > etc.

Additional reqvired future focus

Main focus today

EXAMPLE CASE: COMPOSITES

> **Performance and technical challenges**
- Development of design solutions using CFRP low weight and high stiffness, e.g. longer blades enabling more efficient energy harvesting
- Operating life constraints and environmental damage, e.g., lightning strike
- Design for manufacturing – complex manufacturing processes and tolerances

> **Supply chain**
- Suppliers landscape – three companies, Toray, Tohotenax and Mitsubishi Rayon, account for >75% of the market
- Most of the capacity today focused on high margins industries as aerospace – secondary players focus on wing (e.g. Zoltek)
- In 2015, material requirements for wind turbines would account for 25,000 tons, ~2,5 times the volume of material required for new aircraft programs[1)]

> **Life cycle costs**
- Material costs – high costs of CFRP, ~350 USD/kg for aerospace high-grade materials. Lower-grade materials still far from 12 USD/kg target for wing industry
- Manufacturing costs – expensive and complex processes
- Maintenance – new methods and processes for inspection and repairs

Source : Roland Berger Strategy Consultants, Wind Energy Manufacturers' Challenge, Hamburg 2009

Levels of Vertical Integration of Main Manufacturers of WT

- An important trend in the wind turbine manufacturing business is vertical integration that is taking place mainly in mature companies on the wind energy market.

	Blades	Gearbox	Generator	Castings & Forgings	Tower	Overall
Goldwind	○	○	○	○	○	Very Low
Repower	◔	○	○	○	○	Very Low
Acciona	◔	○	○	○	○	Very Low
Clipper	○	●	○	○	○	Low
Nordex	◑	○	○	○	◑	Low
GE	○	◑	◑	○	○	Low
Dongfang***	◕	○	◑	◑	○	Moderate
Vestas	◕	○	◔	◑	◑	Moderate
Siemens	◕	●	◑	○	○	Moderate
Gamesa	◕	◑	◑	◑	◑	High
Mitsubishi	●	◕	◕	○	◑	High
Suzlon	◕	◔	◕	●	◑	High
Enercon	◕	n/a*	◕	○	◕	Very High
Sinovel**	○	●	◑	◕	●	Very High

○ =100% outsourced
◔ =Some internal production, mostly outsourced
◑ =equally internally and externally sourced
◕ =internal, but may 2nd source in some cases
● =100% internal. May sell on merchant basis

Notes : * uses gearless design
** including parent DHI DCW
*** including parent Dongfang Electric Corp. and subsidiaries

Source : Anais Poncin etc, SCOR Supply Chain Benchmark, European Wind Turbine Manufacturers

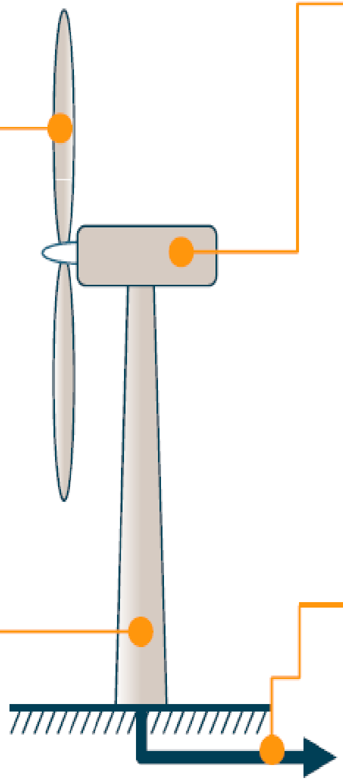
Overview Technical Challenges

- Focus on reliability, costs and yields

BLADES AND ROTOR

> **Focus**
- Larger sizes for more efficient energy harvesting
- Capability to sustain higher loads
- Quality (e.g. cracks, delamination, ...)
- Costs for transport and handling
- Manufacturing costs
- Operational lifetime
- Low weight and high stiffness of structures

> **Challenges**
- Introduction of new materials (e.g. CFRP)
- Manufacturing constraints
- Endurance to environmental damage (e.g. weather, lighting)



DRIVE TRAIN AND GENERATOR

> **Focus**
- Reliability and efficiency (e.g. gearbox accounts for ~40% of wind turbine failures)
- Operational lifetime
- Service and maintenance
- Installation costs

> **Challenges**
- Lighter and more compact housings (e.g. integration of drive train and generator)
- Simplification and new design solutions for drive trains (e.g. reduction of bearings and roller parts)
- Integration of new generator technologies (e.g. superconductor generators)

TOWER AND FOUNDATION

> **Focus**
- Lighter and leaner structures
- Material, handling and installation costs
- Installation and costs of foundations, specially offshore

> **Challenges**
- New foundations design, construction techniques and materials, specially for Offshore

GRID CONNECTION & INTEGRATION

> **Focus**
- Adaptation to grid requirements (e.g. stability, voltage fluctuations)
- Integration costs (e.g. due to intermittency)

> **Challenges**
- Industrial customization and modularization of wind turbines
- New integration technologies

Source : Roland Berger Strategy Consultants, Wind Energy Manufacturers' Challenge, Hamburg 2009

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IV. Status of Korean R&D Activities for Wind Energy

- **Results of R&D Activities**
- **Time to Market from R&D Activities**
- **Current status of domestic manufacturers**
- **Supply chains of domestic manufacturers**

V. Implications and Strategic Directions

Results of R&D Activities

Status and Results of R&D

- ~3MW Class : Support for developing systems and components excluding carbon fiber blades, forgings/castings and the related offshore items.
- 5MW Class : Ongoing R&D Projects for developing system including main components such as blades, main shaft, gear box, generator and tower.

Status and Results during Current 3 Years

- Onshore : Vertical axis of small WT, hybrid system, drive train, main bearing, controller, blade and inspection technology of blade and optimal design of near shore wind farm.
- Offshore : Dynamic simulation technology of a floating system, substructure of a shallow sea and floating, yaw system, grid connections for offshore and the related projects of the West South 2.5GW demonstration wind farm.

Supply Plan of Multi-MW Machines

	DSME	DOOSAN	SAMSUNG	UNISON	HYUNDAI	HYOSUNG	DMS	STX
Capacity (MW)	(7)	3(7)	7	(5)	5.5	5	(6)	(7)

<Supply Plan of Machine for Demonstration Wind Farm(~14) >

Time to Market from R&D Activities

- Possessing the right technology is only one side of coin, the right market is equally important.
- Need to a high strategic agility for “time to market”

Year (share, %)		2006	2007	2008	2009	2010
World Market (MW)	0.75~	2.4	1.3	0.5	1.1	0.2
	0.75 ~ 1.5	31.0	29.8	13.1	12.0	8.3
	1.5 ~ 2.5	62.2	63.7	80.4	81.9	83.1
	2.5~	4.3	5.3	6.0	5.1	8.4
Korea, R&D Milestone (MW)	0.75	'01 Start				
	1.5	'05.12 Start				
	2	'04.4 Start				
	3					Field Test, ’12.4 Finished
	5					’13.8

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Current Status of Domestic Manufacturers

Manufacturer	Capacity	Type	Remarks
UNISON	750kW 2MW 3MW	Gearless PMSG Geared PMSG Gearless PMSG	Developed & Certified, On Sale Developed & Certified, On Sale Under development
HYOSUNG	750kW, 2MW 5MW	Geared DFIG Geared PMSG	Developed & Certified, On Sale Under development (2013)
DOOSAN	3MW	Geared PMSG	Developed & Certified, On Sale (TC-1, TC-2 Certified, TC-3 Under development)
SAMSUNG	2.5MW 7.0MW	Geared PMSG Geared PMSG	Garrad Hassan Technical Tie-up, On Sale Under development (2013)
HYUNDAI-Rotem	2MW	Gearless PMSG	Developed (2012)
DMS	2MW	Gearless PMSG	Under development (Cooperation with German Design Company)
HYUNDAI	1.65kW, 2MW 2.5MW 5.5MW	Geared DFIG Gearless PMSG Geared PMSG	Windtec Licensing Production, On Sale Under development (2013)
STX	2MW	Gearless PMSG	Harakosan M&A
DSME	2MW 7MW	Geared PMSG Geared PMSG	Dewind M&A Under development (2013)
HANJIN	1.5MW 2MW	Geared DFIG Geared DFIG	Developed & Certified, On Sale Demonstrating(Jeju Gimnyeong site)

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Supply Chains of Domestic Manufacturers

- Level of the vertical integration is lower than foreign leading manufacturer
- Almost of companies produce generator in house, tower and castings are localized
- Importing a gearbox from overseas, because of the entry barrier and the risk of capital intensive investment.
- High localization of a blades

In-house / Outsource	BLADES	GEARBOX	CONTROL	GENERATOR	CASTINGS	TOWER
UNISON	China/ Domestic	Germany	Domestic	Unison	China/ Domestic	Unison
DOOSAN Doosan Heavy Industries & Construction	KM	DOOSAN MOTROL / Wicov	DOOSAN / 국외	The Switch ABB	CASCO	DONGKUK S&C Win&P
HYUNDAI HEAVY INDUSTRIES CO.,LTD.	HYUNDAI / Dom./ Over.	Oversea	Oversea	HYUNDAI	Oversea	Domestic/ Oversea
HYOSUNG	DEC/ KM	HYOSUNG	HYOSUNG / kk electronic	HYOSUNG	CASCO SHW	HYOSUNG / SANGWON E&S

Source : Survey from Manufacturers, 2012, 6

V. Implications and Strategic Directions

- Different Approach According to the Level of Technology Maturity
- Important Issues are “Time to Market” and “Market Creation”
- Different Strategy in Evolving Value Network
- Directions of R&D Approaches

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Different Approach According to the Level of Technology Maturity

- **The Role of R&D focus on providing the core competency to the wind industry and market.**
  - Need to establish different strategies and portfolios for R&D according to the level of maturity in technology and markets

	FUEL CELL	WIND POWER
TRL	Demonstration	(Pre-)commercial
R&D Strategy	- Technical innovation, - Localization of system and components	Time to market
R&D Approach	- Establish the supply chains - Maintain a strategic and portfolio agility	- First, entry in market, - Second, buildup the supply chains
Conditions	High level uncertainty of technology and market	Comparably Low level uncertainty of technology and market
Priority Target	Efficiency	Availability
Electricity Generation	Dispatchable	Intermittent

- Medium Seize(1MW~2MW) in pooled interdependent status, Small WT(~100kW) and Multi Megawatt(3M~) in reciprocal interdependent status, according to the level of technology and market uncertainty

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Important Issues are “Time to Market” and “Market Creation”

- **Possessing the right technology is only one side of coin, the right market is equally important.**

  ⇒ **Need to high strategic agility for “Time to Market” and Market Creation**

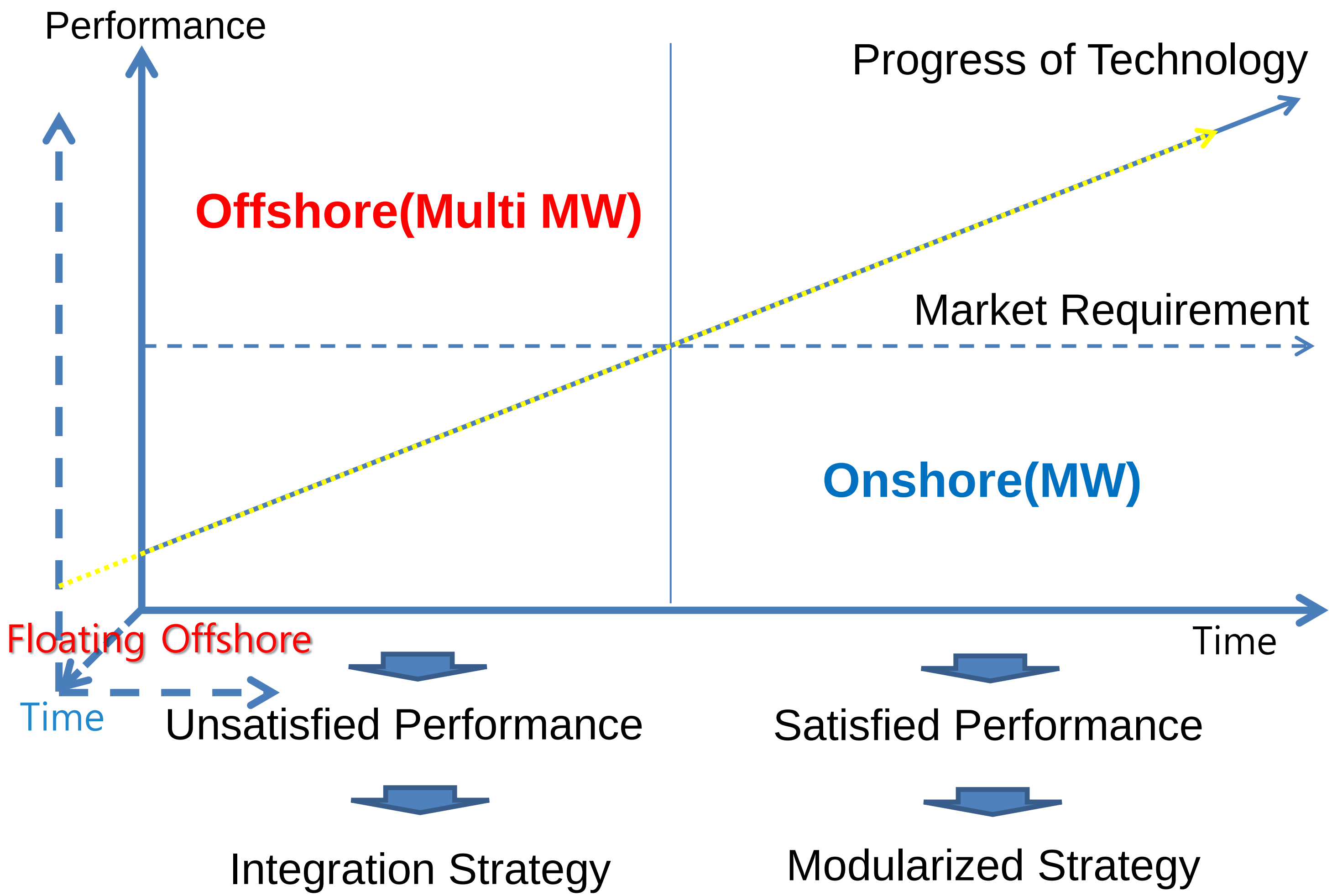
- **Domestic market is a crucial factor to develop the competitive position in the wind energy market, because “learning by using” is the most important thing.**
  - Offshore Wind Turbine : West south offshore wind farm.
  - Onshore Wind Turbine : Green Project(Island, Port, Power), Smart Grid and Micro Grid Project, Deployment Program for Regional Energy, etc.
  - Small WT : Deployment Program for Regional Energy

  ⇒ **Maintain a portfolio agility for integrated complex technology and projects**

- **Strategic approach of the integration with R&BD policy(R&D, Field test for reliability and yields in a long term, deployment program for creating a market).**
  - Need to overcome problems as follows for market access ;
    - **Immaturity of prototype and having no chance of a serial production**
    - **Lack of knowledge and skills for inspection, preventive and predictive maintenance**
    - **Quality and reliability of small WT model is not enough for a deployment program**

Different Strategy in Evolving Value Network

- Strategies should differ from an evolving value proposition and chains.



Source : Clayton M. Christensen , etc., The Innovator's Solution(2003), Seeing What's Next(2004)

Directions of R&D Approaches

Different approaches from onshore, offshore and over 7MW class

- **Onshore Wind(틈새 채우기) : Buildup the supply chains**
  - Motivate the localizations : Increasing a portfolio for components, medium and small enterprises
  - Focus to develop the technology of system and wind farm to reduce COE
  - Small WT : Develop the standard Model and increasing cost competiveness
  - Public acceptance : Focus to develop the integrated and complex technology to increasing public acceptance that is, field test and demonstration project to oriented target.
- **Offshore(multi MW) Wind(틈새 찾기) : Focus on time to market**
  - Focus to develop the components which is early adapted on system at the beginning
  - Focus to develop the technology for enabling the west south offshore wind farm which is related to grid connections, HVDC, substation, substructure and jack-up system, etc.
  - Develop the components which is adapted on system in the long term
- **Above 7MW class(밑그림 그리기) : Feasibility study on searching for the concept of dominant design and technology configurations**
  - Support to basic and advanced research on simulations, pilot component and system

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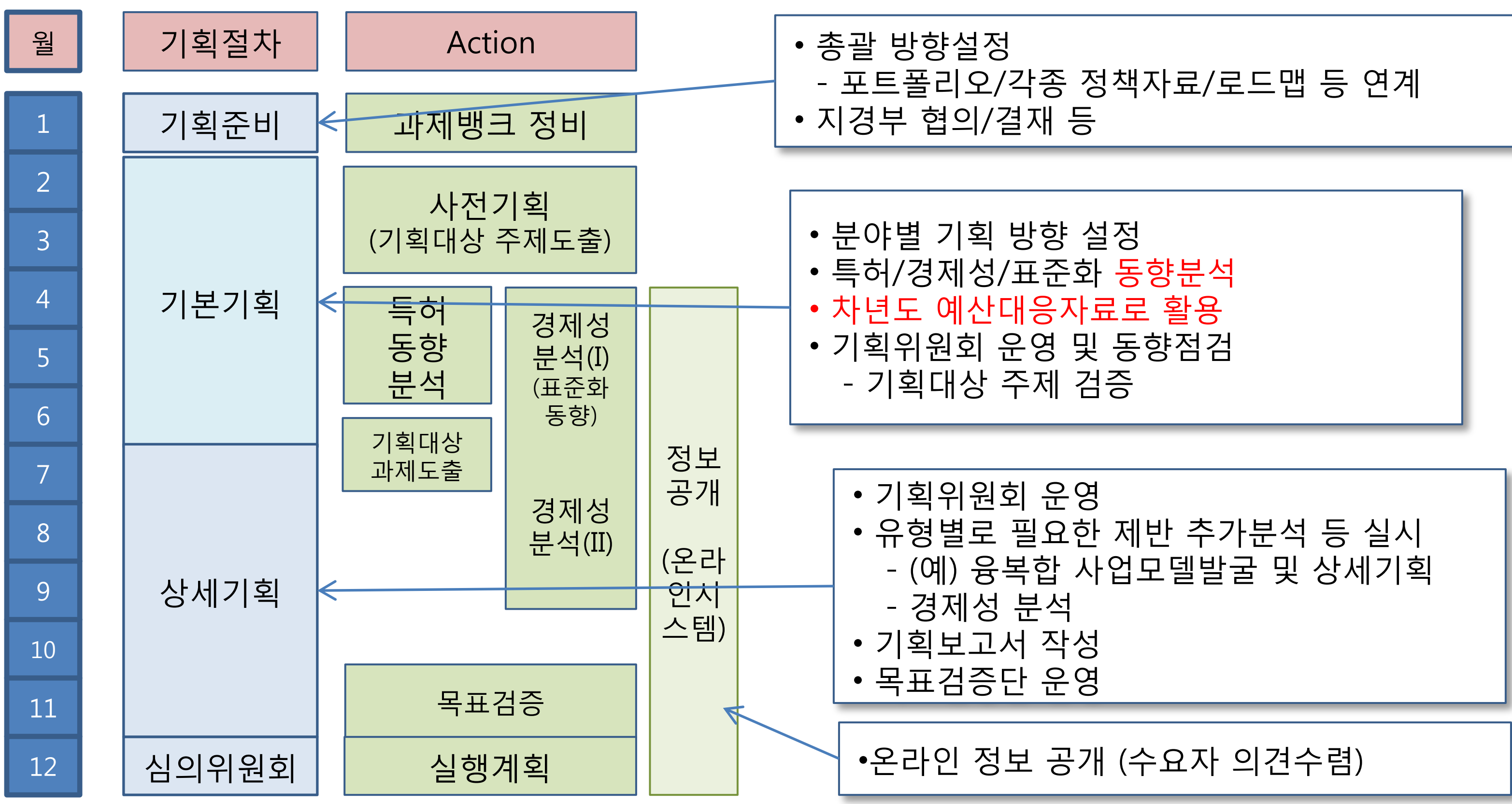
Appendix 1 : 기획 일정 조정(안)

○ 기획 과정을 기본기획과 상세기획으로 나누고, **사전기획을 강화**함으로써 기획 품질 제고

- KETEP의 In-house 기획기능 강화하여 정책연계성 강화

○ **과제뱅크 재정의** 및 개편을 통한 기획과제 모집단 구축

○ **단계별 타당성 검토 및 정보공개**를 통해 기획과정의 공정성 확보



Appendix 2 : 기획 프로세스 개선 방향

목표	기술확보				성과창출				
유형	**미래기술** (원천기술확보)	**전략응용** (응용기술확보)	**부품소재** (중소기업육성)	…	**상용화** (원별)	**B/M** (융복합)	**글로벌전문기술** (특수목적)	**복지형**	…
기획 방향	* 경쟁기획/방향제시 - 연도별 target 등을 제시하고 구체적인 방법, 목표치는 사업자가 제안 * 실패용인, 도전적 R&D 등 * 과제별 특허/경제성 평가 생략				* 구체적인 모델 및 상세기획 실시 -비용분석, 경제성분석, 표준화 분석 등 필요 분석 실시 * 결과의 사업화 담보 * 상용화 계획 제시				
정책 방향	* 민간이 독자적으로 추진 어려우나 필요성이 인정되는 분야 - 핵심기술, Risk share, 인프라, 실증기반 등				* 민간기업 중심으로 사업모델을 상용화로 연계하는데 정부가 지원해야 하는 부분				

과제유형(기존)	목적	핵심원천 기술확보	핵심응용 기술확보	상용화	시장애로기술단기확보
	분류명	미래기술	전략응용	상용화	단기핵심
기획유형(예시)		미래기술	전략응용	상용화	단기핵심
			비즈니스모델형		
		부품소재(중소기업)		복지형R&D	
			글로벌스타 (중소기업)		
			에너지안전		

Appendix 3 : 단•장기 R&D 추진 방향

그린 에너지 전략 로드맵 풍력분야 전략품목

기간	전략품목 명	필요성/중요성	목표
단기 2015년	육상풍력시스템	·시장 주도 모델인 2-3MW급 풍력발전시스템(Class I, II)개발을 통해 국내 풍력시장 활성화 및 수출시장 확보	선진사 대비 capital & O&M cost 90%, AEP 100%
	해상풍력시스템	·해상 풍력은 3MW급(Class I, II) 기술을 기반으로 5-10MW급 시스템 개발에 대한 기술확보 주력	선진사 대비 capital & O&M cost 90%, AEP 100%
	부품경쟁력고도화	·블레이드, 발전기, 증속기등 주요핵심부품 독자기술력 확보를 통한 가격경쟁력 강화	선진사대비 가격경쟁력 95%
	해상풍력단지 운영기술	·해상풍력단지 설계, 시공, 운영을 위한 종합엔지니어링 기술 확보	선진사 대비 capital & O&M cost 90 ~ 95%, 독자기술 100%
	국제인증시스템 구축	·해외시장개척의 기반마련, 국부 및 기술유출 방지를 위한 풍력선도국형 인증시스템 구축	해외인증기관 기술력 대비 100%
장기 2030년	부유식 해상풍력	·pilot부유식 풍력발전기의 실증연구를 통하여 안전성 및 제반기술을 검증하고 부유식 해상풍력 시범단지 개발을 통한 미래시장 선점	풍력 선도국 기술력대비 100%

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참고자료 3 : 에너지 부품•소재•장비 마스터플랜

최종 목표

- 에너지 기기 및 시스템에 적용되는 부품·소재에 대해 기술개발에서 시스템(수요처) 적용단계까지 종합 지원방안 수립

  - 태양광, LED 등 자립화가 미약한 핵심장비의 국산화 전략 수립 병행

추진 전략

[전략1] 부품·소재가 최종적으로 적용될 에너지시스템에 대한 구체적이고 명확한 Targeting을 통해 R&D Supply chain 모델을 제시

- 마스터플랜을 통해「소재개발(원천기술) → 제조공정 개발/부품화 및 용도별 특성 부여 → 시스템적용 실증」까지의 R&D 연결고리를 제시

참고자료 3 : 에너지 부품•소재•장비 마스터플랜

추진 전략

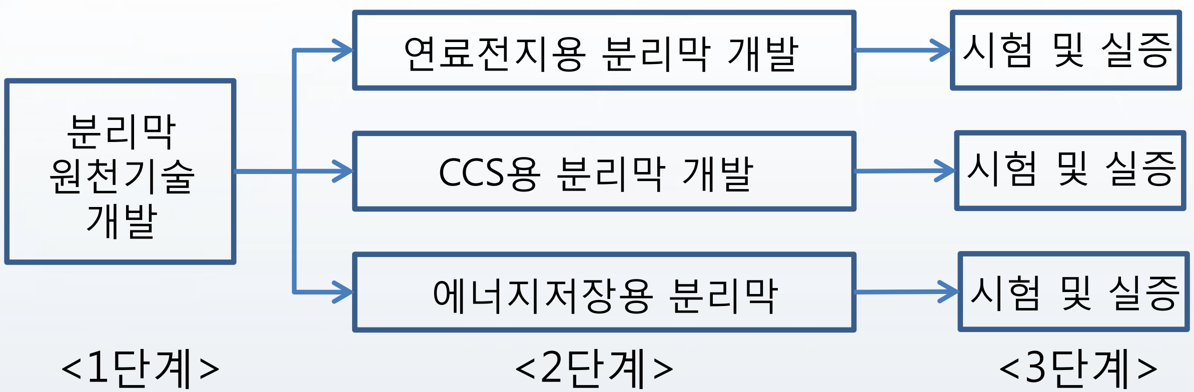
[전략2] 소재부품 관련기업이 대부분 중소기업인 것을 감안하여 시스템 제작 대기업과 소재부품 생산 중소기업간 협력 방안을 제시

- R&D 단계별 부품소재 기업과 시스템 기업과의 협력방안 제시

[전략3] 그린에너지 및 온실가스전략로드맵에 제시된 부품·소재·장비를 기반으로 관련기술을 재배열하고, 누락된 부분은 보완

[전략4] 수요와 시장분석을 통해 도출된 공통 핵심 부품소재에 대해서는 연관 기술군간 공동 컨소시엄 구성·지원

* (1단계) 기술의 융·복합을 통해 부가가치 창출 효과 극대화
* (2단계) 개별 적용처별 요구되는 기능 최적화 연구
* (3단계) 시스템 적용 시험 및 실증



참고자료 3 : 에너지 부품•소재•장비 마스터플랜

대상기술의 선정

- 그린에너지 및 온실가스 전략 로드맵 분야 중 상대적으로 부품.소재.장비 분야 기술개발 필요성이 높은 분야를 추진

- 기업별 생산제품(소재·부품·장비), 국내외 납품처, 시장점유율, 기술수준, 국내외 시장규모 및 전망 등 산업 및 기업현황 조사

- 국내 기업경쟁력, 시스템 기여도 분석 등을 통한 핵심 부품.소재.장비 아이템 도출

  * (대상기술 안) 태양광, 풍력, 연료전지, 에너지저장, CCS·청정화력발전, 원자력, 조명, 전동기·유체기기, 가전·정보화기기 등

작성 방향

- 원별.기술별 핵심 부품.소재.장비기술을 설정하고 원천기술에서 실증까지 종합적인 R&D 방법론 제시

- 부품·소재·장비를 포괄하는 종합적 R&D 전략 도출

기술분야	부품.소재	R&D 전략(예시)
풍력	블레이드	섬유강화소재 → 블레이드설계 및 제작 → 실증
태양광	박막소재/장비	박막태양전지용 소재 및 공정기술 개발 → 박막태양전지 장비 개발 → 실증 및 성능평가

참고자료 3 : 에너지 부품•소재•장비 마스터플랜

마스터 플랜 구성[안]

① 에너지 부품·소재·장비에 대한 종합적인 R&D 전략 제시

풍력 분야	2013	2015	2017	2020
블레이드	섬유강화소재개발	블레이드 개발		실증
베어링	고강도소재개발	베어링 개발	발전기(10MW) 적용	

② 대기업 중소기업간 상생전략 제시

- (예시) 블레이드는 A사, B사에서 개발하고, 풍력시스템업체인 C사, D사에 공급하여 해외 시장 공동 진출

③ 스타 중소중견기업 육성 아이템 제시

- (예시)풍력발전용 블레이드와 금속 고강도소재 분야가 스타기업 육성분야