Wind Energy Sector: Employment Opportunities & Requirements

Data from existing Markets as a Reference for Maine Industry Needs

Full Report
January 2010

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Introduction:

- This report was commissioned by Maine Composite Alliance (MCA) and Maine Wind Industry Initiative (MWII) to assess the employment opportunities as well as the personnel and training requirements for the Maine Wind Industry.
- The data used in this report was obtained from different US and European sources.
- While there are a number of analyses re. job creation in the wind industry, the data reviewed does only lead to estimates for Maine. Also, there is lack of data breaking down the number of jobs created by function.
- Due to the longer history of onshore wind installation, most data available relates to onshore wind. There is currently limited data available re. employment trends in the offshore wind industry.
- Technical development of especially wind turbine technology continues with the MW output per turbine increasing and the number of turbines installed therefore decreasing. This impacts employment.

Introduction (continued):

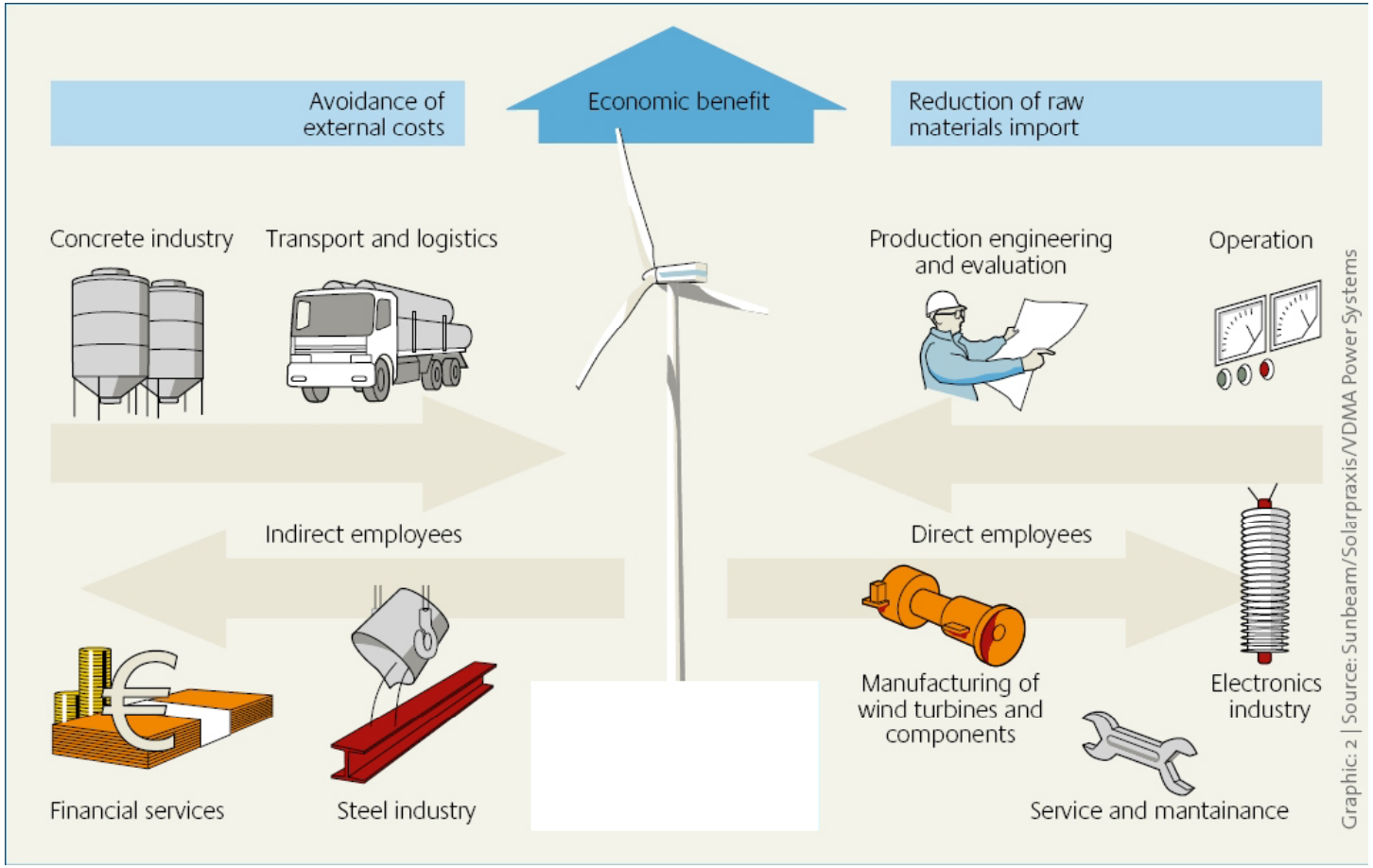
- The key data studied and referenced in this report is related to the following markets:
  - Germany: one of the world leaders in installation and manufacturing, with a large export share of industry output.
  - Spain: another world leader in installation and manufacturing
  - UK: a market with a small local industry but currently the largest offshore installations in the world.
  - Various US data from Federal and State Sources
- The domestic and international employment data helps to make assumptions for Maine's wind industry. However, caution is required because none of the data used contains information related to deep water offshore installations.
- This report does not cover the policy and legislative side (i.e. feed in tariffs and confirmed grid connection) impacting the wind energy market which significantly influences to the level of industry growth in these countries.

Content:

1) Type of Jobs in the Wind Industry
2) European Wind Industry Employment Trends
3) Jobs created per MW
4) Estimated Maine Wind Industry Employment Needs based on International Data
5) Estimated Maine Wind Industry Employment Needs based on NREL's JEDI Model
6) Key Personnel Training Schemes in the EU
7) Conclusions

1) Type of Jobs in the Wind Industry

The main factors in the Wind Power Supply Chain can be visualized as below:

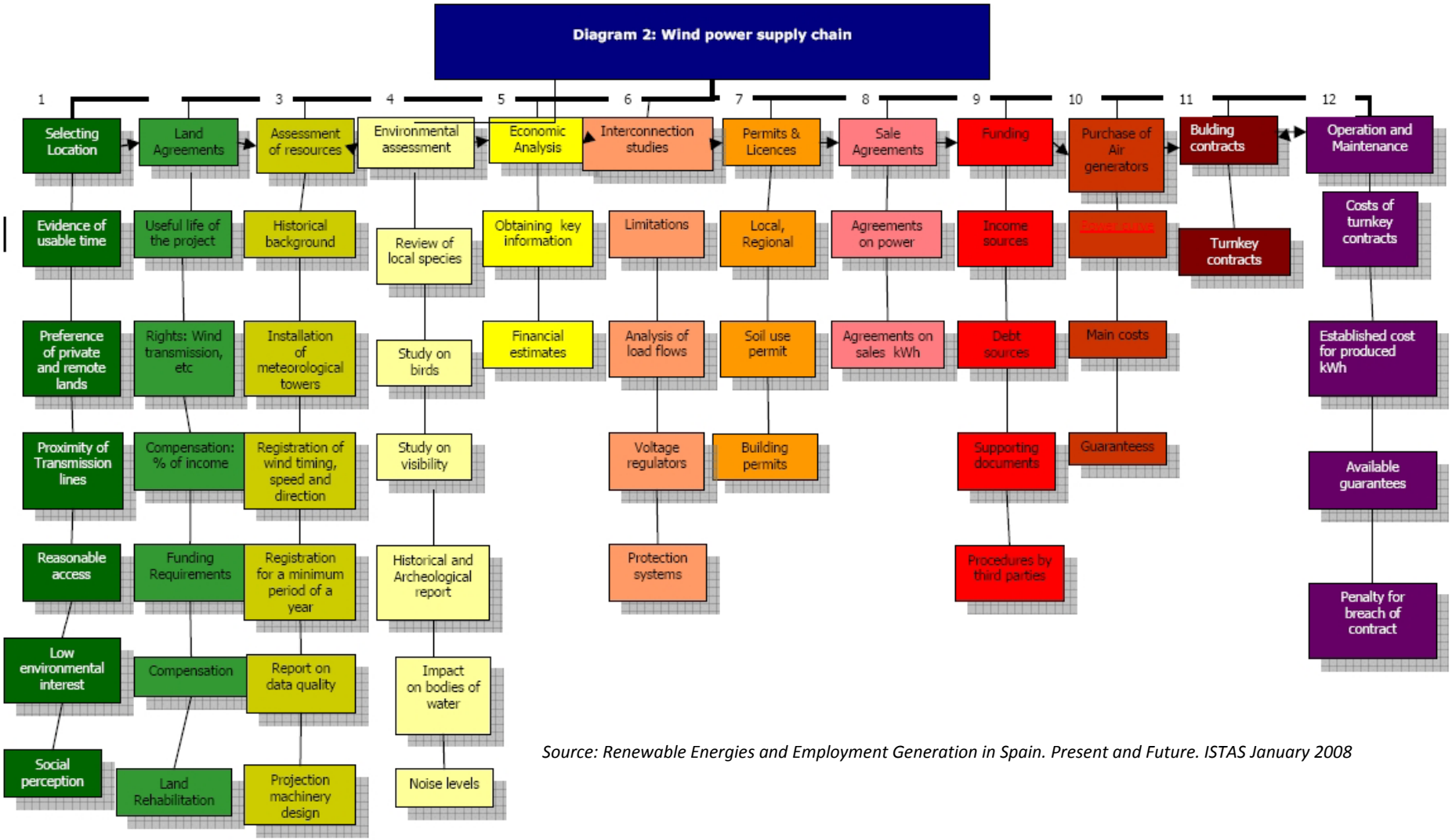


Source: The Wind Industry in Germany – Economic Report 2009 (VDMA and Bundesverband Wind Energie)

The majority of the data in this report refers to direct employees.

1) Type of Jobs in the Wind Industry

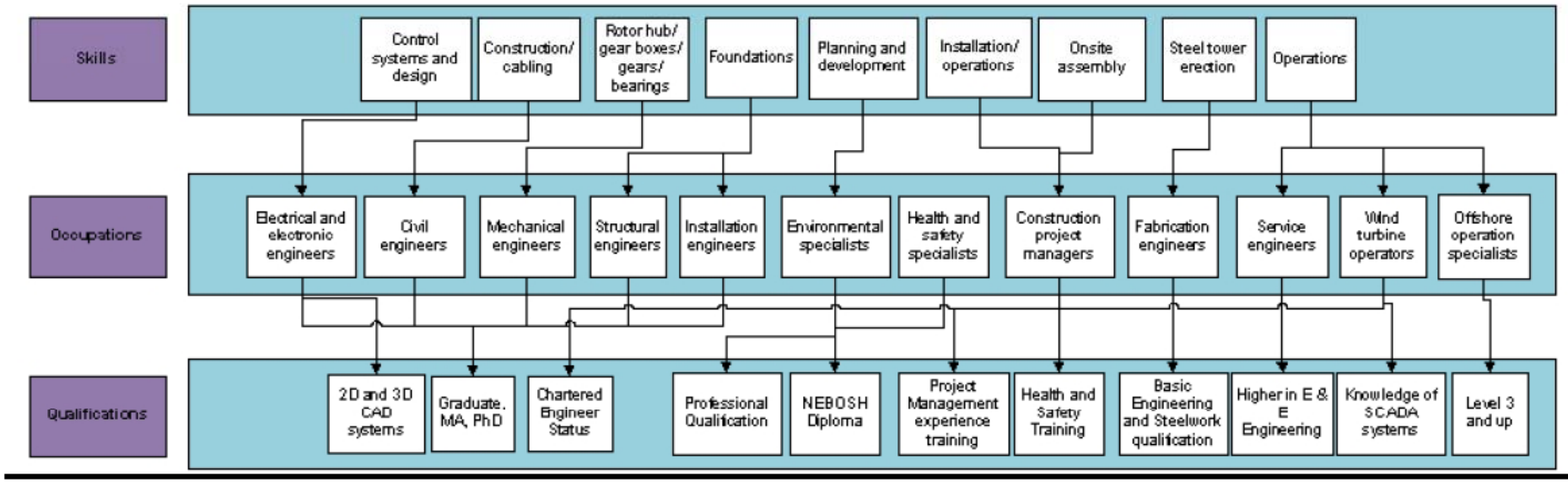
The process flow in the Wind Power Supply Chain:



Source: Renewable Energies and Employment Generation in Spain. Present and Future. ISTAS January 2008

1) Type of Positions (direct jobs) in the Wind Industry – Required Skill Sets

Figure 2-1 : Skills, Occupations and Qualifications within the WWT sector



Source: Skills and Employment in Wind, Wave and Tidal Sectors – Report to the British Wind Energy Association, October 2008 by SQWenergy

1) Type of Positions (direct jobs) in the Wind Industry – Turbine Manufacturing

- Turbine and component manufacturing provide the bulk of employment opportunities in the wind industry; 59% of total direct employment in the EU in 2008.
- Installation of wind farms account for 16% of direct EU wind energy jobs in 2008.
- Maintenance of wind farms account for 11% of direct EU wind energy jobs in 2008.
- Components and parts for wind turbines are manufactured by a large number of different companies. They tend to supply numerous industry and product segments.
- The specific skill needs in the wind energy sector are in the planning, installation and maintenance of wind farms.
- The typical employee profile at a US Wind Turbine Manufacturing site with 250 employees comprises 126 occupations – from mechanical engineers to janitors.

1) Type of Positions (direct jobs) in the Wind Industry – Installation Key Functions

a) DESIGN, PLANNING AND ASSEMBLY OF FACILITIES:

This is a professional group that overlaps all project teams in all major construction projects. The individuals involved share common technical and managerial skills.

- Project Engineer
- Wind Farm Project Designer
- Wind Farm Sales Manager
- Technical Director Wind Farms
- Head of Purchasing Department
- Project Assembly Manager
- Site Manager (Set up)
- Equipment Fitter Renewable Energy
- Logistic Manager

b) RUNNING OPERATIONS OF FACILITIES:

- Head of Maintenance Department
- Maintenance Technician (Turbine Technician, Blade Technician)
- Head of Technical Operation Department
- Technical Operation Engineer

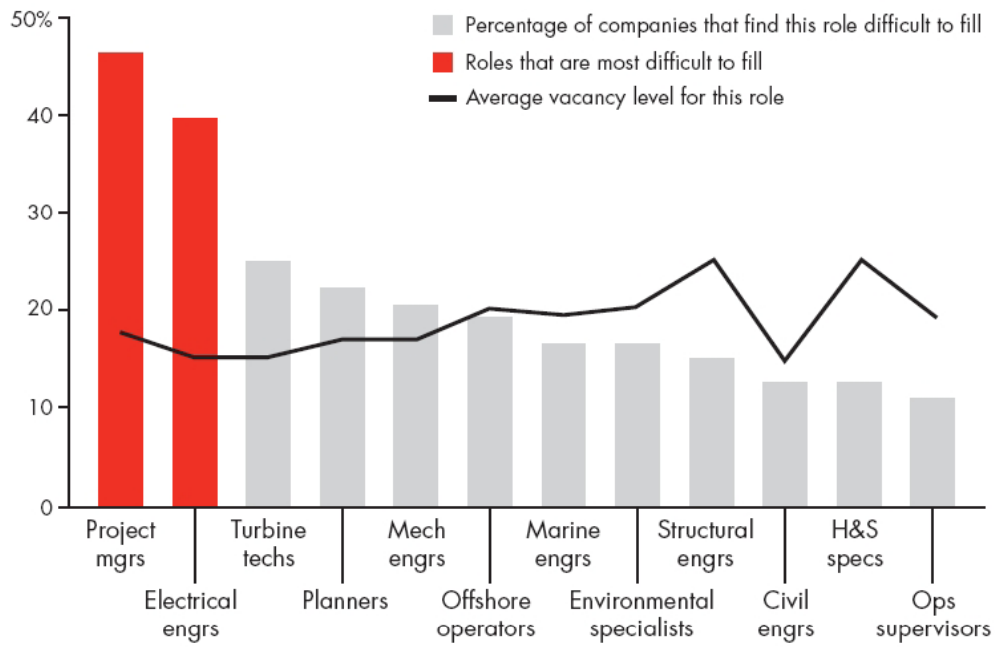
Only the positions in Group b) are permanent; the positions in group a are limited to the planning and installation phase.

1) Type of Positions (direct jobs) in the Wind Industry – Installation Specialist Roles

Below are key specialist roles that according to an industry survey in the UK are difficult to fill. A similar situation exists in the rest of Europe. Applies to both on- and offshore.

a. Project Managers
b. Electrical Engineers
c. Turbine Technicians
d. Planners
e. Mechanical Engineers
f. Offshore Operators
g. Marine Engineers
h. Environmental Specialists
i. Structural Engineers
j. Civil Engineers
k. Health & Safety Specialists
l. Operation Supervisors

Figure 6: Some specialist roles are particularly challenging to fill



Source: Industry survey

Source: 'A closer Look at Wind, Wave and Tidal Energy in the UK'. Bain & Company Report for the British Wind Energy Association 2008

2) European Wind Industry Employment Trends - # of Direct Jobs

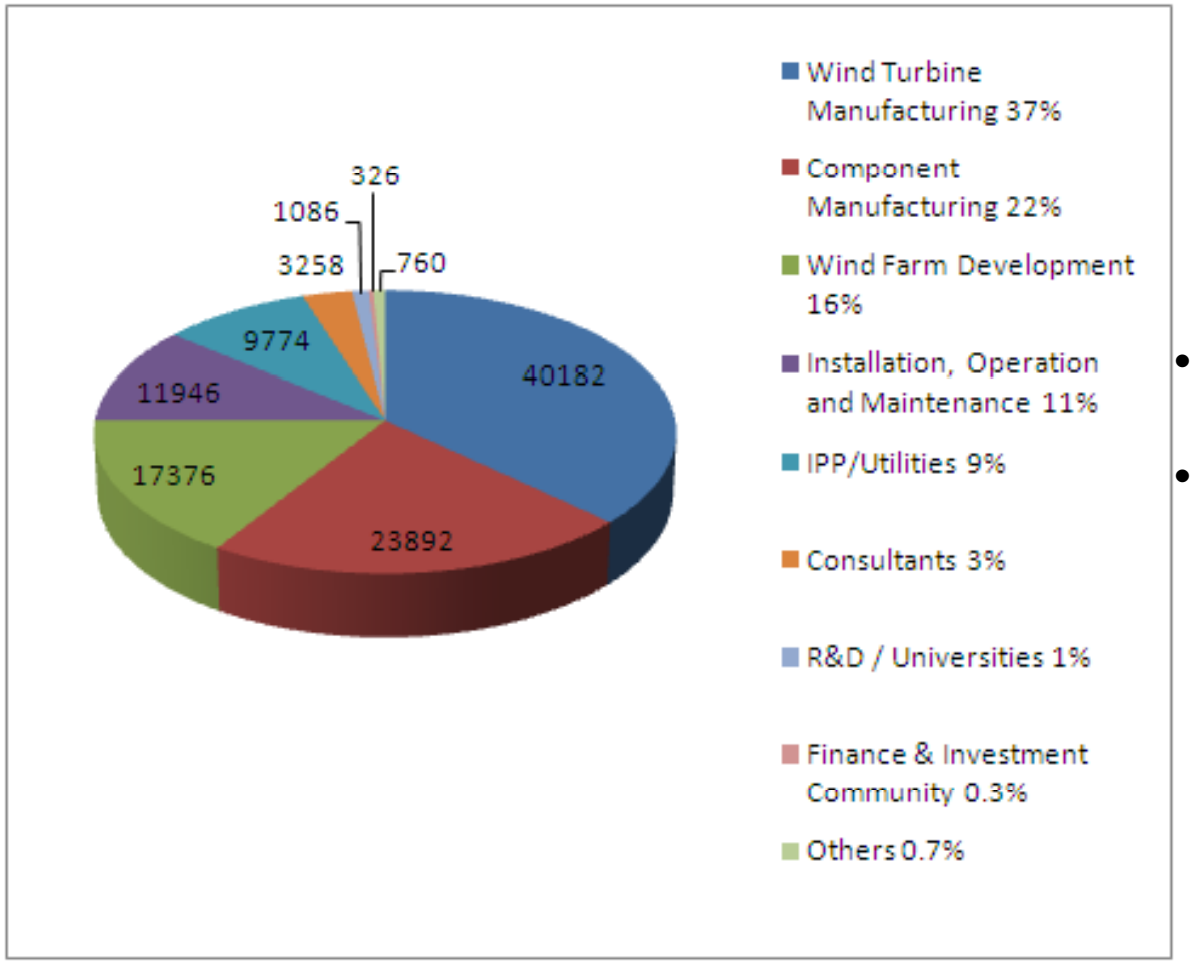
No. of direct jobs in the wind industry (in 2007)

Country	No. of direct jobs
Austria	700
Belgium	2,000
Bulgaria	100
Czech Republic	100
Denmark	23,500
Finland	800
France	7,000
Germany	38,000
Greece	1,800
Hungary	100
Ireland	1,500
Italy	2,500
Netherlands	2,000
Poland	800
Portugal	800
Spain	20,500
Sweden	2,000
United Kingdom	4,000
Rest of EU	400
TOTAL	**108,600**

SOURCE: Estimates based on EWEA survey; ADEME, 2008; AEE, 2008a; DWIA, 2008; Federal Ministry of the Environment in Germany, BMU 2008.

- 75% of European direct wind jobs are in the pioneer countries of Germany, Denmark and Spain.
- There is an acute project manager shortage because this position requires the skill combination of wind energy expertise, familiarity with the local market and negotiation and organization skills.
- It is not reasonable to link this data to installed MW in these countries as the European industry contains sales and therefore employment impact from a large % of exports; especially in Germany and Denmark.

Direct Employment by Wind Energy Segment in Europe (2007)

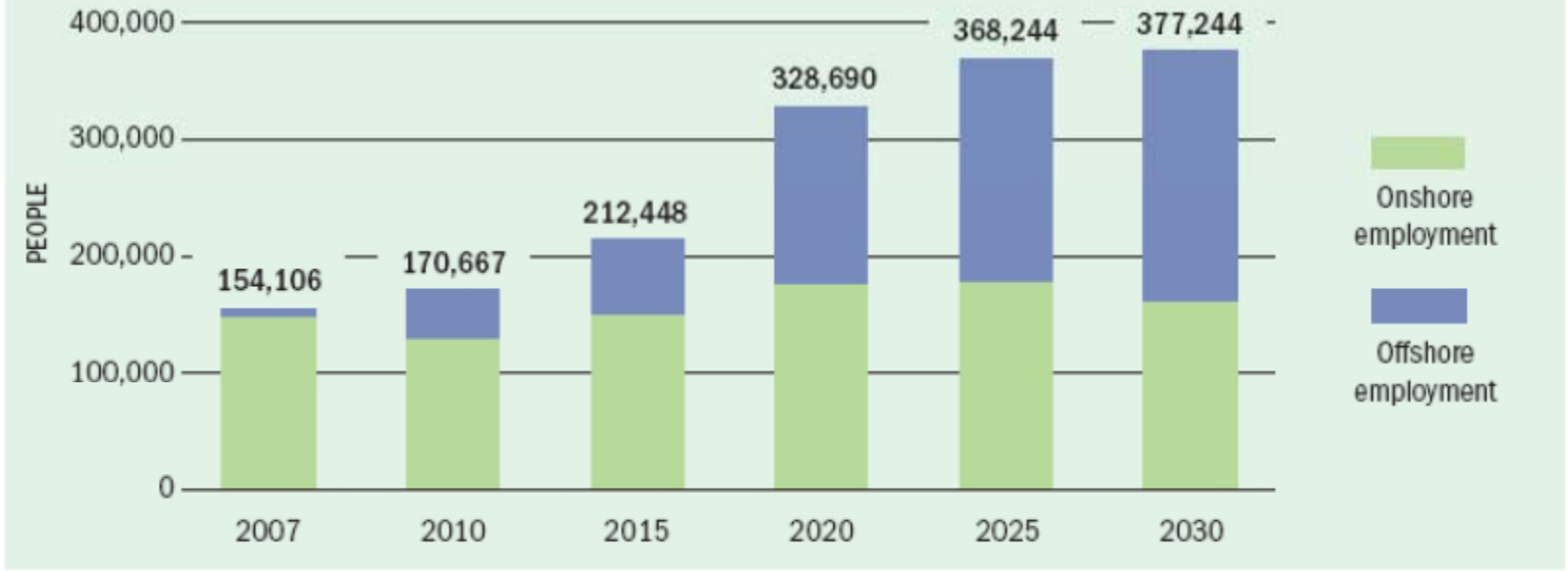


- Total Direct Employment in Europe: 108,600 jobs
- Total Indirect Employment in Europe: 42,716 jobs

Data Source: EWEA Survey 2008 / VDMA

Wind Industry Total Employment Prognosis Europe 2007 - 2030

FIGURE 02: Wind energy sector employment (EU 2007-2030)



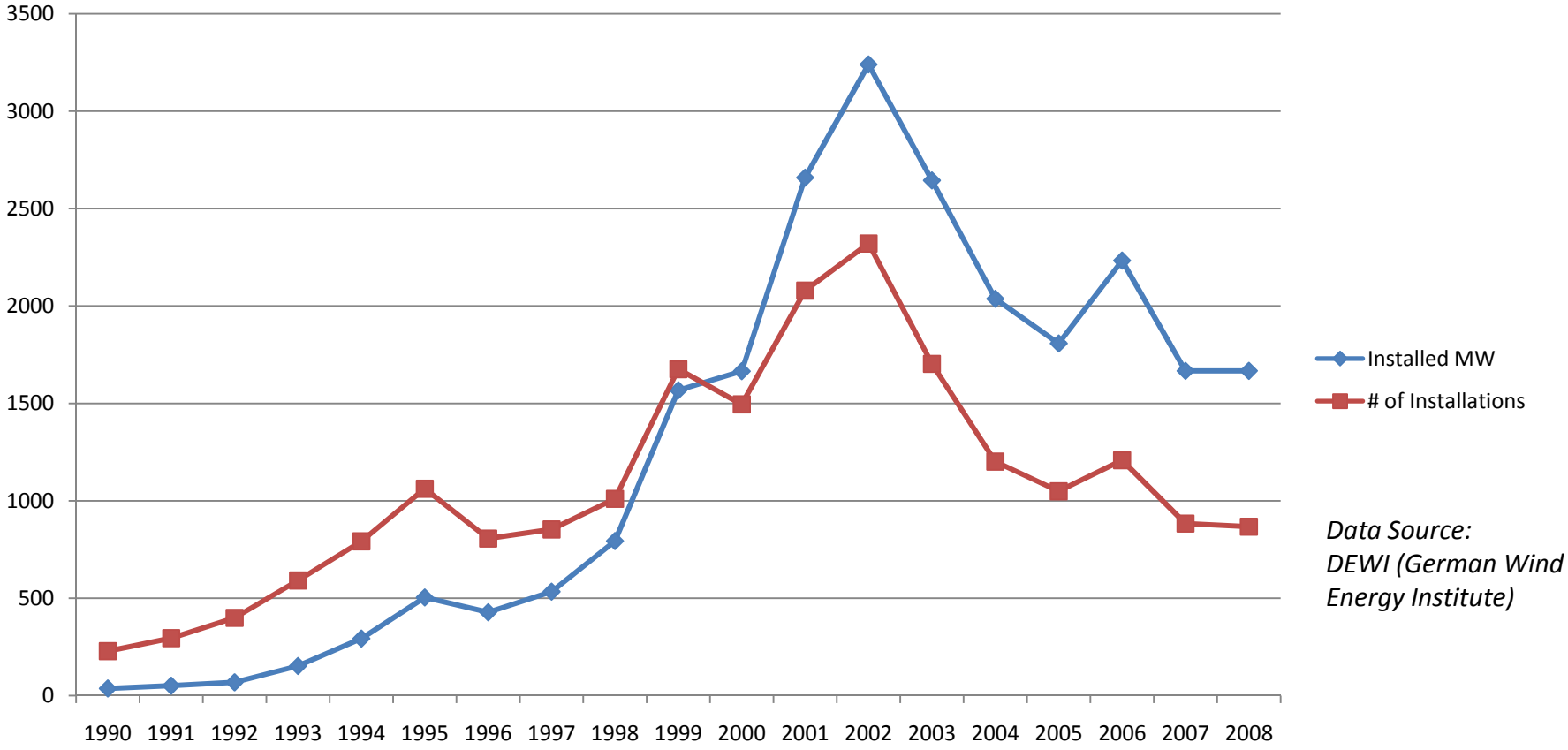
Source: EWEA

2) European Wind Industry Employment Trends – Example Germany

- Wind Energy has been installed in Germany since 1990
- The German Wind Energy Industry comprises:
  - Turbine Manufacturers
  - Component Manufacturers (Tower, Blades, Gear Boxes, Lubricants etc.)
  - Installation and Construction Companies
  - Grid Integration Companies
  - Grid Integration Component Manufacturers (Generators, Transformers, Converters)
  - Maintenance and Monitoring Services
  - Personnel Training
  - Consulting, Project Management and R&D Services
- Total # of Wind Energy related companies in Germany: ca. 3,500
- Between 2003 and 2008 the Export Share of the German Wind Industry grew from 58% of total industry turn over to 87%. (2.1 to 6.9 Billion € / US$ 3 to 10 Billion at $1.46 per €)
- The German domestic Market has declined by 25% between 2006 to 2008 in terms of installed MW.
- Offshore Wind will be positively impacting the number of direct and indirect employees.

Wind Energy Installations in Germany 1990 – 2008

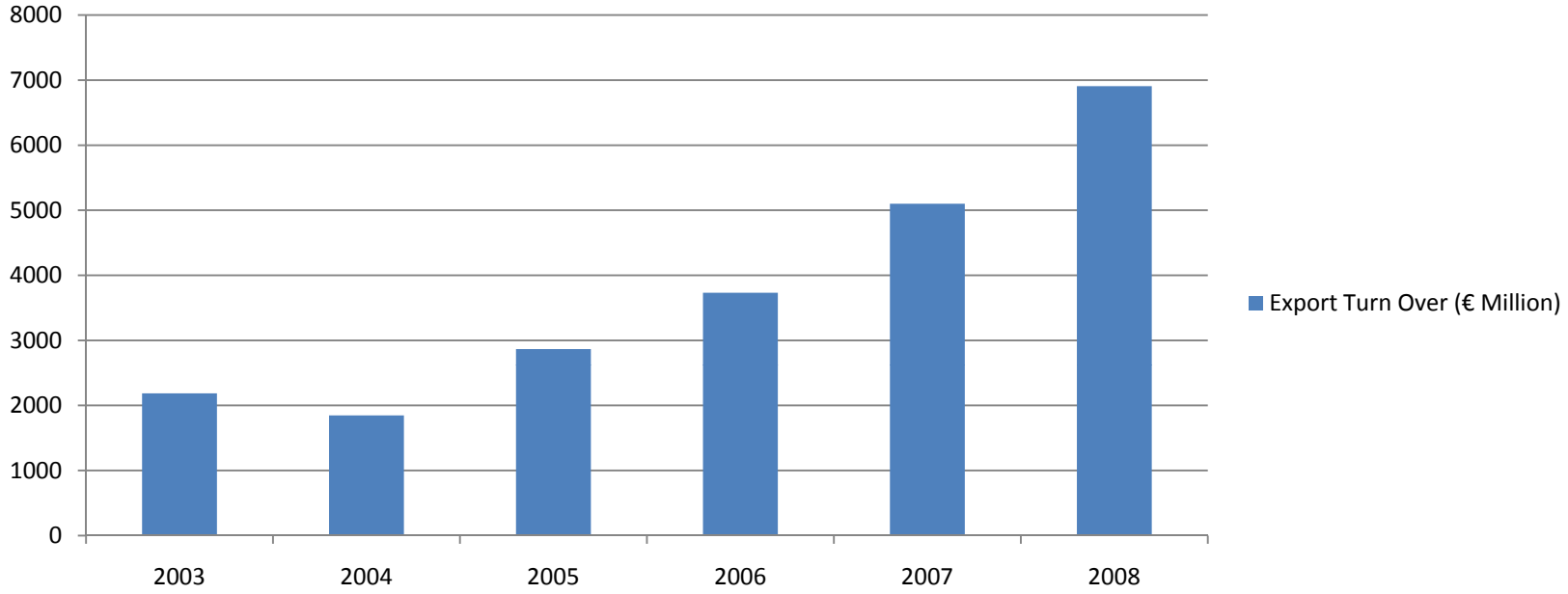
Annual Installations – Not Cumulative



Data Source: DEWI (German Wind Energy Institute)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Installed MW	37	51	68	152	293	504	428	534	793	1,568	1,665	2,659	3,240	2,645	2,037	1,808	2,233	1,667	1,667
# of Installations	228	295	399	591	792	1,062	806	853	1,010	1,676	1,495	2,079	2,321	1,703	1,201	1,049	1,208	883	867

Export Turnover & Share of German Wind Industry 2003 - 2008

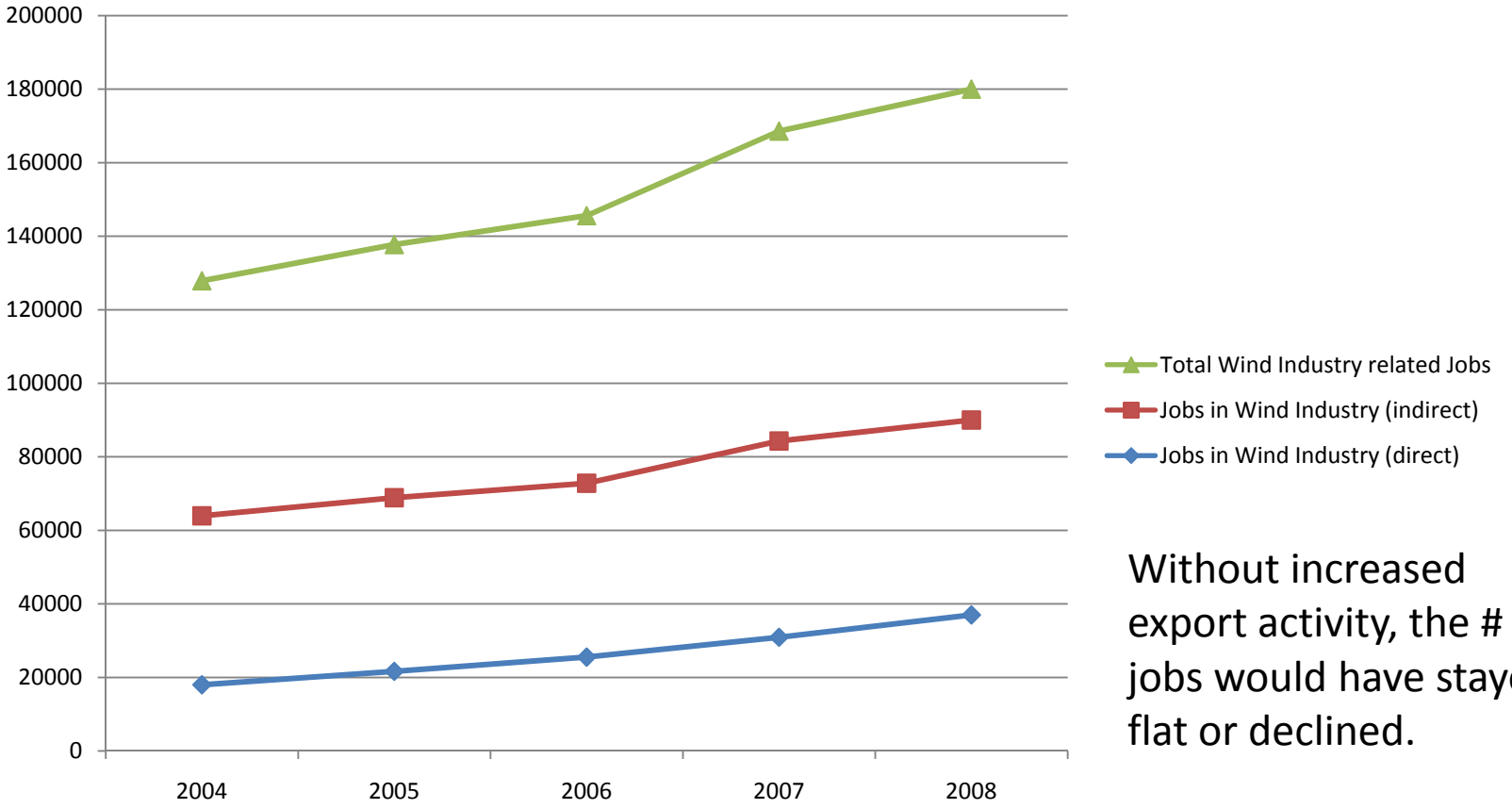


	2003	2004	2005	2006	2007	2008
Export Turn Over (€ Million)	2,187	1,847	2,867	3,733	5,100	6,907
Export Share in %	58%	59%	71%	74%	83%	87%

Data Source: DEWI (German Wind Energy Institute ; VDMA (German Engineering Federation)

The saturation in the domestic market has stimulated the growth of German exports. Note the export share of 87% in 2008!

Employment Effect of the German Wind Industry 2004 - 2008

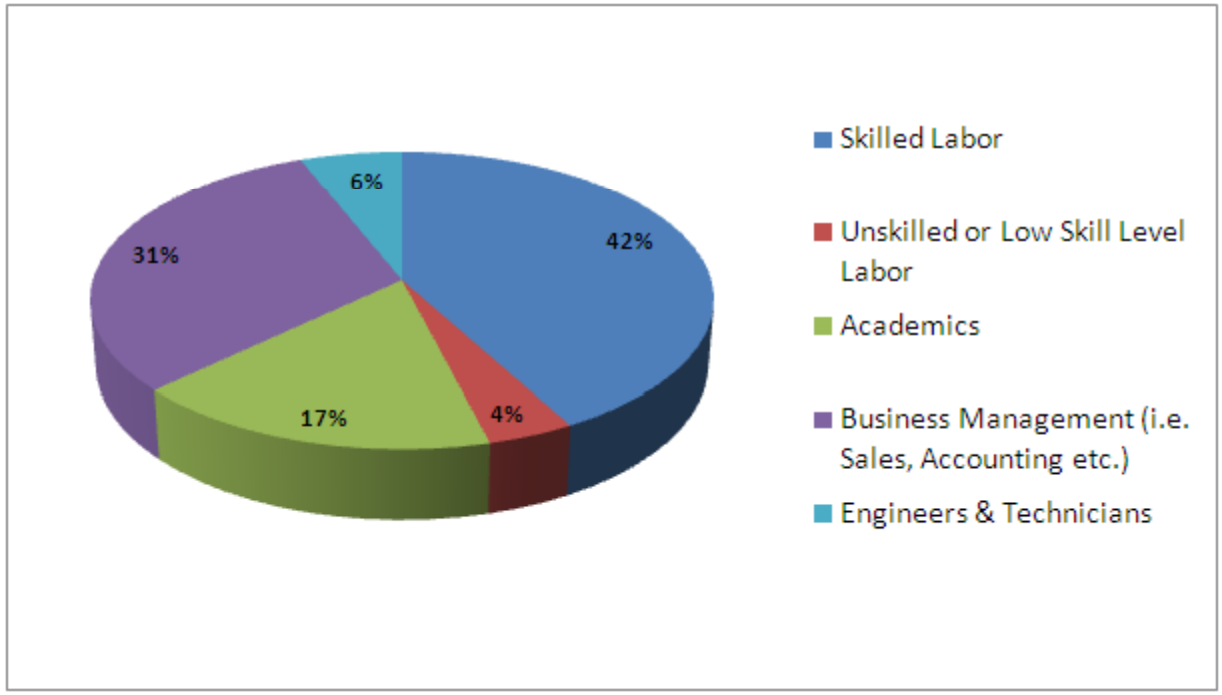


Without increased export activity, the # of jobs would have stayed flat or declined.

	2004	2005	2006	2007	2008
Jobs in Wind Industry (direct)	17,979	21,643	25,518	30,903	37,000
Jobs in Wind Industry (indirect)	45,965	47,229	47,282	53,397	53,000
Total Wind Industry related Jobs	63,944	68,872	72,800	84,300	90,000

Data Source:
DEWI (German Wind Energy Institute)

Qualification Levels in the German Wind Industry (2007)



Data Source: WiLa Bonn (Research Institute)

Skilled labor in a German context refers to employees with a minimum of 3 years apprenticeship/vocational training and certificate.

3) Jobs created per MW - Data

Jobs created per MW Onshore

Report	Year of Data	Country	Jobs per MW	Comment
Bain and Company	2008	UK	4	UK based jobs
BWEA	2008	UK	1.58	Uk based jobs
US DoE	2008	US	0.2	permanent O&M jobs only at ME Mars Hill
NREL	2009	US	4-6	during construction period
NREL	2009	US	0.3 - 0.6	permanent positions

Jobs created per MW Offshore

Report	Year of Data	Country	Jobs per MW	Comment
Bain and Company	2008	UK	5.3	UK based jobs
BWEA	2008	UK	1.2	Uk based jobs

Jobs created per MW combined Off and Onshore

Report	Year of Data	Country	Jobs per MW	Comment
EWEA	2008	EU	15.1	exclude installation, O&M
ISTAS	2008	Spain	2.52	Estimate for 2010; excluding installation and O&M
GWEC	2008	Worldwide	22.5	Scenario for 2020 with 24 GW global installation
GWEC	2008	Worldwide	15.8	Scenario for 2020 with 82 GW global installation
GWEC	2008	Worldwide	15.4	Scenario for 2020 with 143 GW global installation
GWEC	2008	Worldwide	16.5	Data for 2007 with 19.8 GW global installation
GWEC	2008	Worldwide	21.5	Data for 2008 with 18 GW global installation
GWEC	2008	Worldwide	23.2	Scenario for 2009 with 18 GW global installation
GWEC	2008	Worldwide	23.1	Scenario for 2010 with 18.3 GW global installation
GWEC	2008	Worldwide	22.9	Scenario for 2015 with 20.8 GW global installation
BWEA	2008	UK	1.5	Actual Number

EWEA= European Wind Energy Association; BWEA = British Wind Energy Association, NREL = National Renewable Energy Laboratory; ISTA = Instituto Sindical de Trabajo Ambiente y Salud; GWEC = Global Wind Energy Council

3) Jobs created per MW - Comments

- The most commonly used parameter to measure the impact on employment is jobs/MW.
- The international data available is inconsistent as it relates to segmenting the type of jobs created, i.e.
  - manufacturing jobs
  - installation jobs
  - O&M jobs
- The UK data tracks only domestically created jobs and that share is very low due the lack of an established wind industry in the UK.
- The German, Danish, Spanish data does not specify jobs/MW installed because of the large export share in those countries.
- Available US data is limited; it focuses on either total job creation or the number of turbine technicians required. Unlike the EU data there seems to be no data re. the the requirement of project managers and engineers for the industry.
- US data assumes at this point in time an average requirement of 10-20 wind technicians required per 100 MW[*1] or 1 wind technician per 12 turbines [*2] or 1 technician per 10 turbines [*3] for O&M .
- US and international data show that long term jobs are only created in O&M and through export.

**1: Data from Texas State Technical College *2: Center of Excellence California: Wind Energy Industry California: A community college perspective on wind turbine technicians. September 2009. *3: Kalamazoo Valley Community College*

3) Jobs created per MW – Comments (continued)

- It is not visible if and to what extend the job creation data takes into consideration downtime and maintenance time/requirements of wind turbines.

MAL-FUNCTIONS OF COMPONENTS

The reported downtimes are caused by both regular maintenance and unforeseen malfunctions. The following evaluations refer only to the latter, which concerned half mechanical and half electrical components. (Fig. 2).

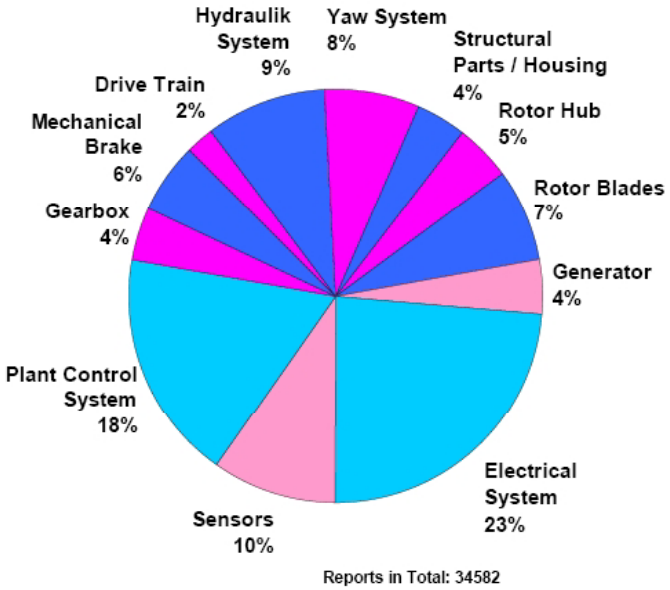


Fig. 2. Share of main components of total number of failures

Source: Reliability of Wind Turbines – Experiences of 15 years with 1,500 WTs. ISET, Germany 2006

3) Jobs created per MW – Comments (continued)

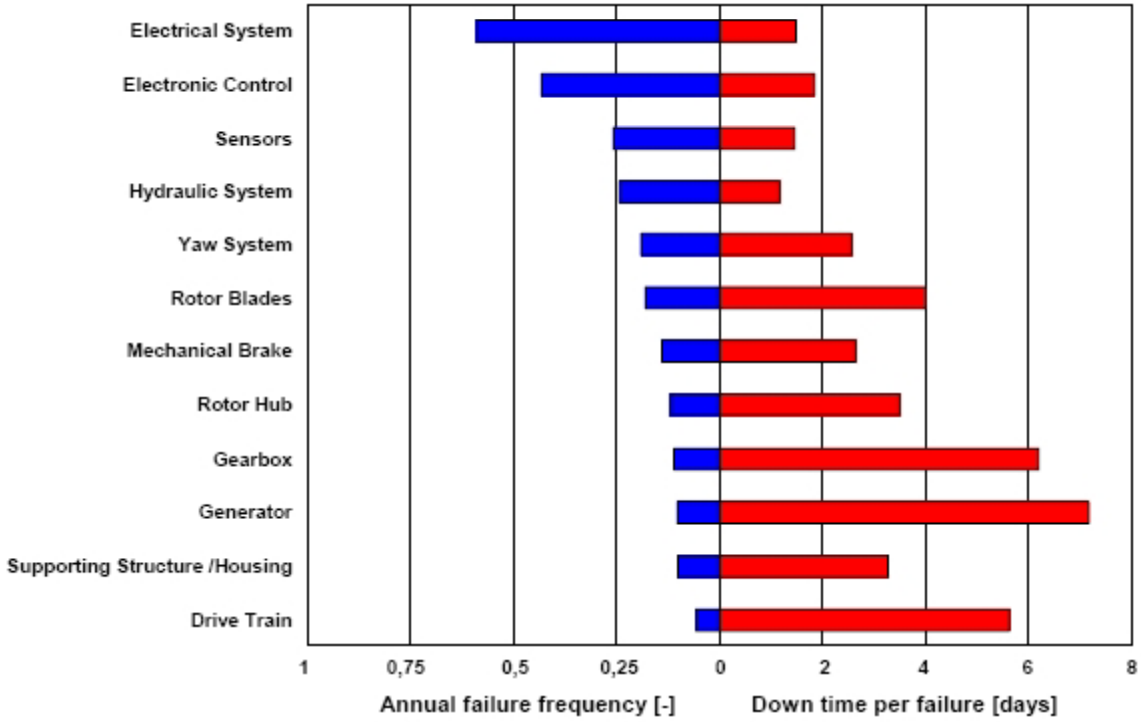


Fig. 3. Failure Frequency and downtimes of components

Source: Reliability of Wind Turbines – Experiences of 15 years with 1,500 WTs. ISET, Germany 2006

Since deepwater offshore farms like planned for Maine do not exist right now, no corresponding failure rate and the impact on O&M capacity is available. Also, European data on offshore turbine failure rate is still limited. The availability of remote monitoring technology and facilities will be vital for Maine's offshore developments – an opportunity also for the technology sector.

4) Maine Wind Industry Employment Needs based on National and International Data

Scenario per State Government Target:
- 2,000 MW for Onshore by 2015
- 2,700 MW for Onshore by 2020
- 300 MW for Offshore by 2020

Maine Currently installed Wind Turbines - Onshore

Location	MW Capacity	Units
Presque Isle	0.6	1
Stetson Wind	57	38
Patriot	4.5	3
Mars Hill	42	28
GM Allen	0.05	1
Beaulieu	0.05	1
Kibbey Mountain	66	22
TOTAL	**170.2**	**94**

4) Maine Wind Industry Employment Needs – Required Turbine Technicians (permanent)

Scenario 1: 5 MW Turbines and 1 Technician per 10 Turbines

Location	MW Capacity	Individual Turbine MW Capacity	# of Turbines	Required # of WT Techs
Onshore	2,700	5	540	54
Offshore	300	5	60	6
TOTAL	**3,000**		**600**	**60**

Scenario 2: 6 MW Turbines and 1 Technician per 10 Turbines

Location	MW Capacity	Individual Turbine MW Capacity	# of Turbines	Required # of WT Techs
Onshore	2,700	6	450	45
Offshore	300	6	50	5
TOTAL	**3,000**		**500**	**50**

Scenario 3: 6 MW Turbines and 1 Technician per 10 Turbines onshore / 5 Turbines offsh.

Location	MW Capacity	Individual Turbine MW Capacity	# of Turbines	Required # of WT Techs
Onshore	2,700	6	450	45
Offshore	300	6	50	10
TOTAL	**3,000**		**500**	**55**

Photo: Siemens

Photo: Keenpress Publishing/Stese Brimberg & Cotton Coulson

4) Maine Wind Industry Employment Needs – Estimated Job Creation – Reference Data

Base Data for Maine Assumptions

Report	Year of Data	Country	Jobs per MW	Comment
NREL (onshore)	2009	US	4-6	during construction period
NREL (onshore)	2009	US	0.3 - 0.6	permanent positions
Bain (offshore)	2008	UK	5.3	assuming limited supply chain in ME as in UK Model
BWEA (on & off)	2008	UK	1.5	assuming limited supply chain in ME as in UK Model
EWEA (on & off)	2008	EU	15.1	Manufacturing only; assumes full supply chain in ME

Reference for construction per year: Germany

Onshore # of Wind Turbine Installations: around 850 per year in 2007 – 2009
average of 1,579 per year in 2000 – 2006

Offshore # of Wind Turbine Installation Plans: 2,500 turbines (40 wind farms) by 2030

= 125 turbines installed per year
Generation target is close to 25,000 MW

4) Maine Wind Industry Employment Needs – Estimated Job Creation – Scenarios

Scenario 1:

assumes that Maine would have the full supply chain locally, including turbine production

Estimated # of Annual Jobs to reach installation targets for 2020

Location	# of 5MW Turbines installed	Total annually installed MW	Construction Jobs	Total Supply Chain Jobs	Factor used per MW
Onshore	200	1,000	5,000		5
Offshore	25	125	663		5.3
Total	**225**	**1,125**	**5,663**	**16,988**	15.1

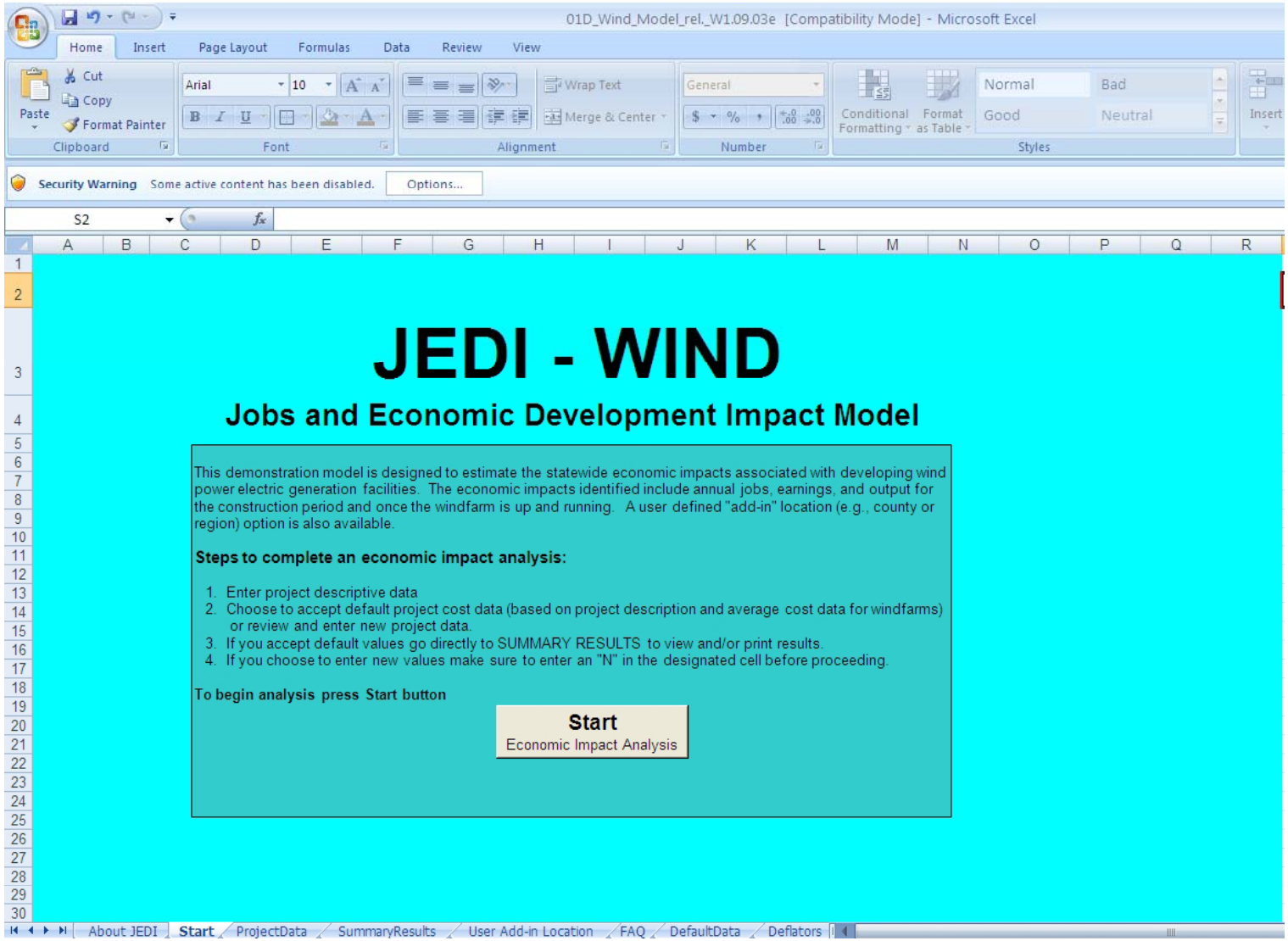
Scenario 2:

assumes that Maine has only limited local supply chain and no local turbine manufacturing

Estimated # of Annual Jobs to reach installation targets for 2020

Location	# of 5MW Turbines installed	Total annually installed MW	Construction Jobs	Total Supply Chain Jobs	Factor used per MW
Onshore	200	1,000	2,000		2
Offshore	25	125	663		5.3
Total	**225**	**1,125**	**2,663**	**1,688**	1.5

5) Maine Wind Industry Employment Needs – Estimated Job Creation – NREL JEDI



5) Maine Wind Industry Employment Needs – Estimated Job Creation – NREL JEDI

Sample calculation for annual onshore installation of 1,000 MW with limited local share:

Wind Farm - Project Data Summary based on model default values

Project Location	**MAINE**
Year of Construction	**2012**
Total Project Size - Nameplate Capacity (MW)	**1000**
Number of Projects (included in total)	**3**
Turbine Size (KW)	**5000**
Number of Turbines	**200**
Installed Project Cost ($/KW)	**$1,945**
Annual Direct O&M Cost ($/KW)	**$18.69**
Money Value (Dollar Year)	**2008**
Installed Project Cost	**$1,945,189,476**
Local Spending	**$334,386,163**
Total Annual Operational Expenses	**$328,784,848**
Direct Operating and Maintenance Costs	**$18,686,351**
Local Spending	**$4,973,699**
Other Annual Costs	**$310,098,497**
Local Spending	**$17,542,000**
Debt and Equity Payments	**$0**
Property Taxes	**$14,542,000**
Land Lease	**$3,000,000**

Note:
Awaiting input from Maine Industry Partners with some actual investment numbers to qualify this NREL tool.

# of created jobs is not far off from Scenario 2 assumption based on International data which assumes 5,200 Jobs for a 200 turbine / 1,000 MW project.

Local Economic Impacts - Summary Results

	Jobs
During construction period	
Project Development and Onsite Labor Impacts	519
Construction and Interconnection Labor	436
Construction Related Services	83
Turbine and Supply Chain Impacts	3,515
Induced Impacts	1,104
Total Impacts	**5,139**

5) Maine Wind Industry Employment Needs – Estimated Job Creation – NREL JEDI

Detailed Wind Farm Project Data Costs	MAINE	
Construction Costs	**Cost**	**Local Share**
Equipment Costs		
Turbines	$884,394,938	0%
Blades	$207,048,982	0%
Towers	$229,232,802	0%
Transportation	$158,244,579	0%
Equipment Subtotal	$1,478,921,300	
Balance of Plant		
Materials		
Construction (concrete rebar, equip, roads and site prep)	$213,704,131	90%
Transformer	$24,174,368	0%
Electrical (drop cable, wire,)	$25,481,417	100%
HV line extension	$46,546,048	70%
Materials Subtotal	$309,905,963	
Labor		
Foundation	$5,875,273	95%
Erection	$6,654,581	75%
Electrical	$9,697,728	70%
Management/supervision	$5,032,169	0%
Misc.	$73,942,694	50%
Labor Subtotal	$101,202,445	
Development/Other Costs		
HV Sub/Interconnection		
Materials	$14,687,068	90%
Labor	$4,498,938	10%
Engineering	$19,985,423	0%
Legal Services	$10,892,056	100%
Land Easements	$0	100%
Site Certificate	$5,096,283	100%
Other Subtotal	$55,159,767	
Balance of Plant Total	$466,268,175	
Total Project Costs	$1,945,189,476	

Note: Awaiting input from Maine Industry Partners with some actual investment numbers to qualify this NREL tool.

6) Personnel Training Schemes in the EU for Turbine Technicians

Windskill is an EU initiative to streamline training and qualifications standards across the various countries. This is important because of the cross border nature of wind farm development in Europe. Goal is that an EU certified technician can work in every EU market.

6) Personnel Training Schemes in the EU for Turbine Technicians

Windskill Training Programme

The following Windskill Training Modules designed to implement the Windskill Standard were endorsed at Project Meeting 9 in March 2009. A range of pilot training sessions will be conducted in the partner regions between March and June 2009. Contact national contacts for dates and venues.

EQP-Ref.	Module	EQF-Level	Pilot areas
3.3	WT installation	3	
6.1	Inspection and maintenance of electrical systems	3	DE, UK
		4	
6.2	Inspection and maintenance of mechanical and hydraulic systems	3	DE, UK
		3	
6.3	Inspection and maintenance of safety-relevant apparatus	4	DE
6.4	Inspection of rotorblades	3	DE, NL
	Repair of rotor blades	3	
6.5	Trouble shooting	3	DK
		4	
6.6	Fire-fighting	3	DE, NL, UK
6.7	Rescue from heights	3	
7.1	Offshore communication	3	NL
7.9	Maritime Training	3	NL
	Offshore Environment	3	NL
	Offshore access and sea survival	3	UK, NL, DK
support	Technical English	2	FR
support	Environmental awareness and protection	2	FR
support	General health and safety	1	FR
support	Wind energy systems	3	NL

WINDSKILL
Intelligent Energy Europe
European Wind Energy Skills Network

The work to design the individual training modules is currently ongoing, involving the various partners and advisors to the Windskill project.

The program also receives Technical and material support from the industry.

6) Personnel Training Schemes in the EU for Turbine Technicians

WT installation

The programme aims to train technicians involved during mechanical and electric installation of onshore wind plants. Learners will be trained in the following activities: installation of tower, nacelle, hub and blades and assembling of components inside the turbine. A general background knowledge concerning electrical and mechanical issues and basic and technical English are needed.

IMPORTANT NOTE:
The training scheme has to be understood in the context of the existing general European education and vocational training structure which is quite different from the US.
See next slide.

6) Personnel Training Schemes in the EU for Turbine Technicians – EU General Training

The Windskill Training Scheme is based on the general education and training system as found in most EU Member Countries:

1. School education in basic 2 or 3 tier school system, depending on country, up to 10th grade (4 grades elementary school and 6 grades high school; no middle school like in the US)
2. For students planning to get a university degree: an additional 2 or 3 years (depending on country) pre-university education (comparable to US college)
3. For students planning to start vocational training: apprenticeship in the so-called 'dual system' of training at a company, complemented by vocational school. This training for a specific profession or trade is provided by a company who pays the apprentice some wages and the corresponding vocational college. The program normally takes 3 years, with 12-14 hours per week of school training and the rest training on the job in the company. After passing practical and theoretical exams the apprentice receives the base certification for the trade, e.g. certified and licensed electrician, mechanic etc.
4. Most EU Wind Turbine training schemes such as BZEE in Germany have as requirements for applicants: certificate in an electrical or mechanical profession and several years professional experience. They do not accept students right out of school.

6) Personnel Training Schemes in the EU for Turbine Technicians

Inspection and maintenance of electrical systems

The module is designed to provide maintenance staff with the knowledge, skills and competences required to anticipate risks in the maintenance of electro-technical WT components and functions. This involves compliance with H&S regulations and Law.The module focusses on training standardised theoretical and practical knowledge skills, procedures, safety directives, electrical maintenance instructions and documentation requirements.

The module focusses on training standardised theoretical and practical knowledge skills, procedures, safety directives, electrical maintenance instructions and documentation requirements. The module is designed to provide maintenance staff with the knowledge, skills and competences required to anticipate risks in the maintenance of electro-technical WT components and functions and conduct maintenance operations in a professional manner. This involves compliance with H&S regulations and teamwork in carrying out self-supervised maintenance operations.

6) Personnel Training Schemes in the EU for Turbine Technicians

Inspection and maintenance of mechanical systems

Learners will develop, through a practical approach, a working knowledge of the operating principles and maintenance requirements of the mechanical components of wind turbines in excess of 1mw.

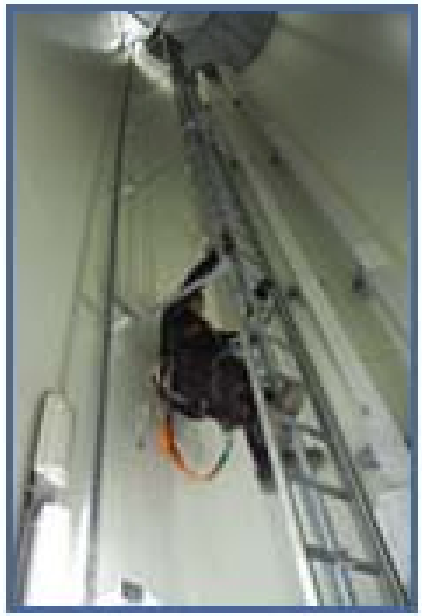
Inspection and maintenance of hydraulic systems

Learners will develop, through a practical approach, a working knowledge of the operating principles and maintenance requirements of the hydraulic components of wind turbines in excess of 1mw.

6) Personnel Training Schemes in the EU for Turbine Technicians

Inspection and maintenance of safety-relevant apparatus

A training programme designed to qualify persons to carry out mandatory inspections of safety-relevant equipment in a wind turbine installation. The successful participant is equipped to carry out inspections of safety-relevant equipment on a wind turbine, assess the safety standard of all items and document the assessment using a prescribed format.



6) Personnel Training Schemes in the EU for Turbine Technicians

Inspection of rotorblades

The module focusses on standardised knowledge and skills (theoretical and practical), procedures, safety instructions, rotorblade inspections and documentation requirements related to rotorblade maintenance. The successful trainee gains an overview of rotorblade designs and fittings and is able to assess and inspection of rotorblades and delegate repair work.

Repair of rotor blades

The module focusses on standardised knowledge and skills (theoretical and practical), procedures, safety instructions, rotorblade repair specifications and documentation requirements related to rotorblade maintenance. The required materials and tools are treated in respect of their functions, use and safety precautions

Trouble shooting

This training programme aims to train technicians in applying systematic trouble shooting- and repair techniques in a safely manner.

Fire-fighting

This module comprises training of standardised basic theoretical and practical knowledge, procedures, safety regulations, preventative fire protection measures and behaviour in the event of fire on a wind turbine

6) Personnel Training Schemes in the EU for Turbine Technicians

Working at heights and rescue

This module comprises training in procedures for working at heights and standardised rescue techniques including first-aid instruction. The module includes handling of the equipment needed, its function and how to harness and use it in a safe and reliable manner. This training is a pre-requisite and the basis for all work on wind energy turbines.




Access

Training in accessing offshore wind energy installations is treated in three modules:

- Offshore transfer
- Offshore communication and
- Offshore environment




6) Personnel Training Schemes in the EU for Turbine Technicians

Sea survival

The aim of the training is to give all persons intending to work on offshore wind energy generators the essential knowledge and skills of marine survival techniques to maximise their chances of survival in the event of a marine casualty.




Technical English

This training module deals with:

- Communication and social skills
- Ability to read, understand, write and speak in English
- Key technical expressions of wind energy

The output of this traning module is knowledge, skills and competences in English in the specific framework of wind turbine maintenance activities.


Environmental awareness and protection

This transversal module deals with:
- Global environmental awareness (global warming, resources depletion)
- General interest of wind energy
- Local environment awareness and impact of wind energy,
- Good environmental behaviour

6) Personnel Training Schemes in the EU for Turbine Technicians

General health and safety

This training module deals with:
- Environmental regulation and laws,
- Cleanliness issues, importance of a clean workplace,
- Training on environmental and weather influences and risk (access and assess the data, appropriate reaction in case of emergency) and job-specific environmental conditions.

The existing programs in most EU countries require prior completed vocational training as mechanical or electrical engineer before being accepted.

Wind energy systems

This module provides the learner with a general overview of the most common wind energy systems. Basics wind turbine design features, components and control systems will be discussed. Additionally a review of the potential, resources and costs of wind energy will be given.

6) Personnel Training Schemes in the EU – Promoting Project Managers and Engineers

The European Academy of Wind Energy

The EAWE is a co-operation on wind energy R&D of research institutes and universities in seven countries:
Germany, Denmark, Greece, Netherlands, Spain, UK and recently Norway. The Academy is founded to formulate and execute joint R&D projects and to coordinate high quality scientific research and education on wind energy on a European level. The members include 29 entities, representing 7 EU countries and more than 80% of the long-term research activity in the field of Wind Energy.

The activities of the EAWE are split into:

- integration activities, through PhD exchanges, exchange of scientists, exploitation of existing research infrastructures,
- activities to spread excellence, through development of international training courses, dissemination of knowledge, support to SMEs, standardization,
- long-term research activities (see below).

The following thematic areas (and topics) are identified as first priority long-term RTD issues for EAWE's joint program of activities:

- Long-term Wind Forecast
- Wind Turbine External Conditions
- Wind Turbine Technology
- System Integration
- Integration into Energy Economy

6) Personnel Training Schemes in the EU – Promoting Project Managers and Engineers

Integration activities

PhD-Exchange

In training better young European scientists, the Network of Excellence will contribute to bridge the gap it has with the Unites States and Japan in terms of density of researchers per inhabitant thus consenting businesses to hire personnel trained in high and new technologies.

Exchange of scientists

Short term exchange of scientist among the network's participants in order to promote integration of R&D, contribute to education of PhDs and preparation of dissemination activities.

Exploitation of existing research infrastructures

with a view of shared or complementary use, in particular for large, full scale, laboratories (WT test-stations, blade-testing rigs, wind tunnel facilities, atmospheric and sea-state field measurement systems etc.)

6) Personnel Training Schemes in the EU – Promoting Project Managers and Engineers

Long-Term research activity

Long-term Wind Forecast

- Wind resources,
- Micro-siting in complex terrain,
- Annual energy yield,
- Design wind conditions (turbulence, shear, gusts, extreme winds) offshore, onshore and in complex terrain
  Wind Turbine External Conditions
- Characteristics of wind regime and waves
- Atmospheric flow and turbulence
- Interaction of boundary layer and large wind farms
- Prediction of exceptional events

Wind Turbine Technology

- Aerodynamics, aero elasticity and aero acoustics,
- Electrical generators, power electronics and control
- Loads, safety and reliability
- Materials and composite structures, fracture mechanisms
- Material characterization and Life Cycle Analysis
- New wind turbine concepts

System Integration

- Grid connection and power quality issues
- Short-term power prediction
- Wind farm and cluster management and control
- Condition monitoring, Maintenance on Demand
- New storage, transmission and power compensation systems

Integration into Energy Economy

- Integration of wind power into power plant scheduling and electricity trading
- Profile-based power output, Virtual power plants
- Trans-national and –continental supply structures
- Control of distributed energy systems

6) Personnel Training Schemes in the EU – Promoting Project Managers and Engineers

Major Project Examples:

RAVE
RESEARCH AT ALPHA VENTUS
Eine Forschungsinitiative des Bundesumweltministeriums

The RAVE research initiative runs simultaneously with the con-struction and operation of the "alpha ventus" test site to attain broad based experience and knowledge for future offshore wind parks.

RAVE is sponsored by the German Federal Ministry for the Environment, Nature Conservation and Reactor Safety (BMU) following a resolution by the German Federal Parliament and is coordinated by Fraunhofer IWES. It combines the scientific activities of the plant manufacturers and a multitude of research institutions. In total the BMU has allocated 50 million Euro for the research and further development of wind energy utilization at sea.

UpWind
Finding design solutions for very large wind turbines

UpWind is a European project funded under the EU's Sixth Framework Progamme (FP6). The project looks towards the wind power of tomorrow, more precisely towards the design of very large wind turbines (8-10MW), both onshore and offshore.

The wind turbines of the future necessitate the re-evaluation of the turbine itself for its re-conception to cope with future challenges. The aim of the project is to develop the accurate, verified tools and component concepts the industry needs to design and manufacture this new type of turbine.

UpWind focuses on design tools for the complete range of turbine components. It addresses the aerodynamic, aero-elastic, structural and material design of rotors. Critical analysis of drive train components will be carried out in the search for breakthrough solutions.

The UpWind consortium, composed of 40 partners, brings together the most advanced European specialists of the wind industry. The findings of the project will be disseminated through a series of workshops.

7) Conclusions

- Without establishing a full supply chain that includes turbine and tower manufacturing, the employment opportunities in Maine will be limited. Full advantage of the wind energy opportunity can only be taken if the full supply chain or at least the key factors (i.e. turbine manufacturing) have a local presence in Maine.
- In order to secure long term job stability and growth, the supply chain in Maine would need to focus on developing out of state and international business. Germany's data clearly shows the impact of exports on employment. Without out of state and international export markets the employment opportunities in Maine created by Wind will be limited.
- Clear estimates about the number of jobs created / number of personnel required need a lot deeper analyses than MIC can provide as well as the input from project managers and developers in the offshore industry. This includes estimations re. the need of O&M turbine mechanics for deep water offshore.
- Turbine manufacturers need to be included in Maine's training programs for technicians as the technical specs can vary a lot by manufacturer. Example: Siemens turbines with gear boxes, Enercon turbines without gear boxes.
- Project managers are in short supply worldwide; there is an opportunity for Maine to develop and train a pool of project managers for the offshore industry who can also work on international assignments.
- The European example shows a clear need re. collaboration in training and certification as well as research and development. In both areas Maine should look for domestic as well as international partners to become a center of excellence.

Disclaimer:

This workforce solution was funded by a grant awarded under Workforce Innovation in Regional Economic Development (WIRED) as implemented by the U.S. Department of Labor's Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, expressed or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy or the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership.

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