Cold climate WE issues; policy aspects

Jos Beurskens – EWEA advisor, TPWind
(Steering Committee, Chair WG2 (Wind Power Systems))

Winterwind 2008
Norrköping, 09-10 December 2008

Outline presentation

- EWEA & TPWind & EU
- Potential of WE in cold climate areas
- Research issues
- Potential impact on European research strategy

Annexes:

- State of the art deployment WE
- New RES Directive
- R&D priorities TPWind WG2 Wind Power Systems

WHAT IS THE EUROPEAN WIND ENERGY ASSOCIATION?

EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

EWEA is the **voice of the wind industry**, actively promoting the utilisation of wind power in Europe and worldwide.

Resources are focused on **lobbying, communication and policy activities**, and responding to enquiries from our member organisations.

More than 500 members from over 45 countries

EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

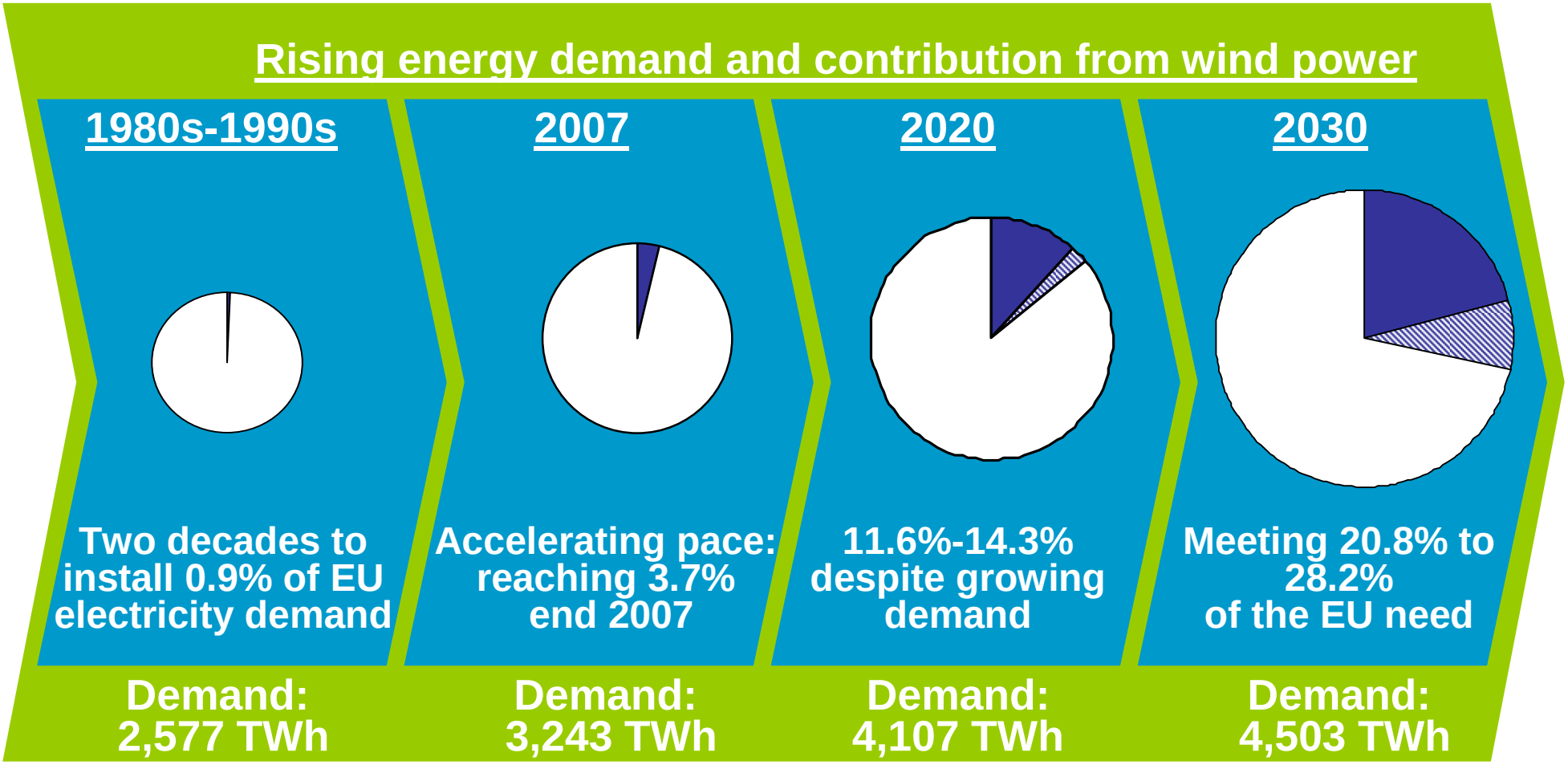
- Manufacturers covering 90% of the world wind power market
- Component suppliers
- Research institutes
- National wind and renewables associations
- Developers
- Electricity providers
- Finance and insurance companies
- Consultants
- Contractors

This combined strength makes EWEA the world's largest and most powerful wind energy network

EWEA targets

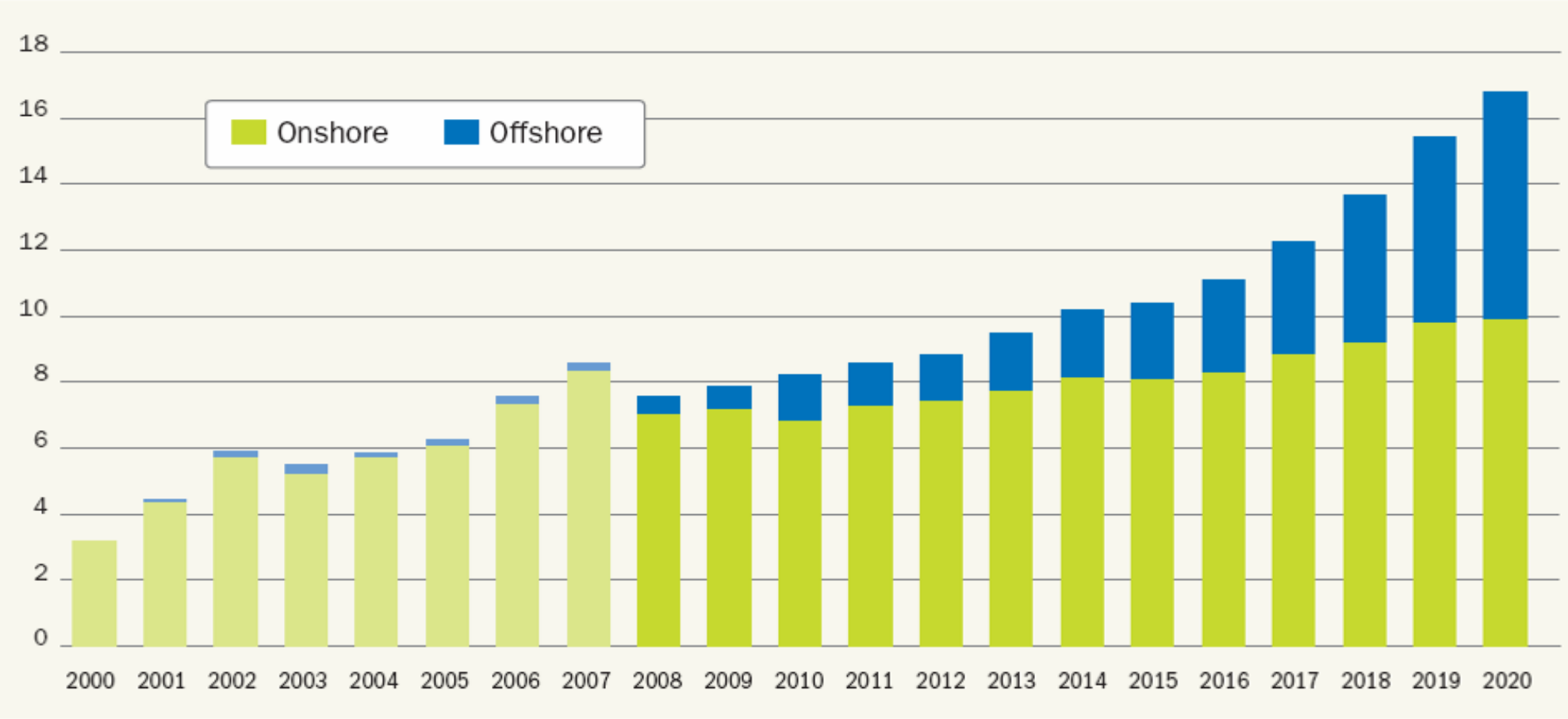
Wind energy expansion

Rising energy demand and contribution from wind power



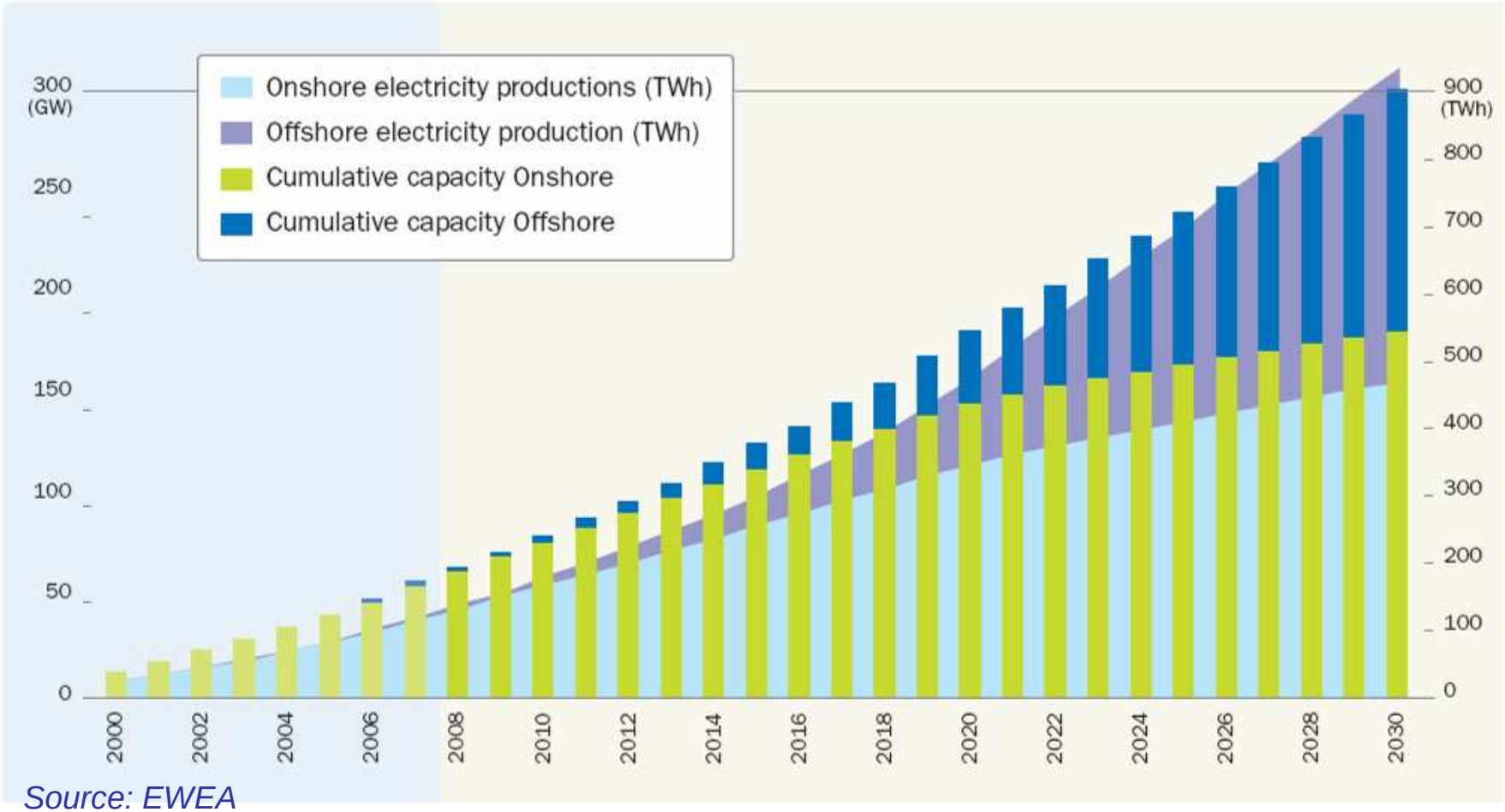
Source: EWEA

Wind energy annual installation 2000-2020 (in GW)



Source: EWEA

The sector's growth will be supported by offshore wind's take-off



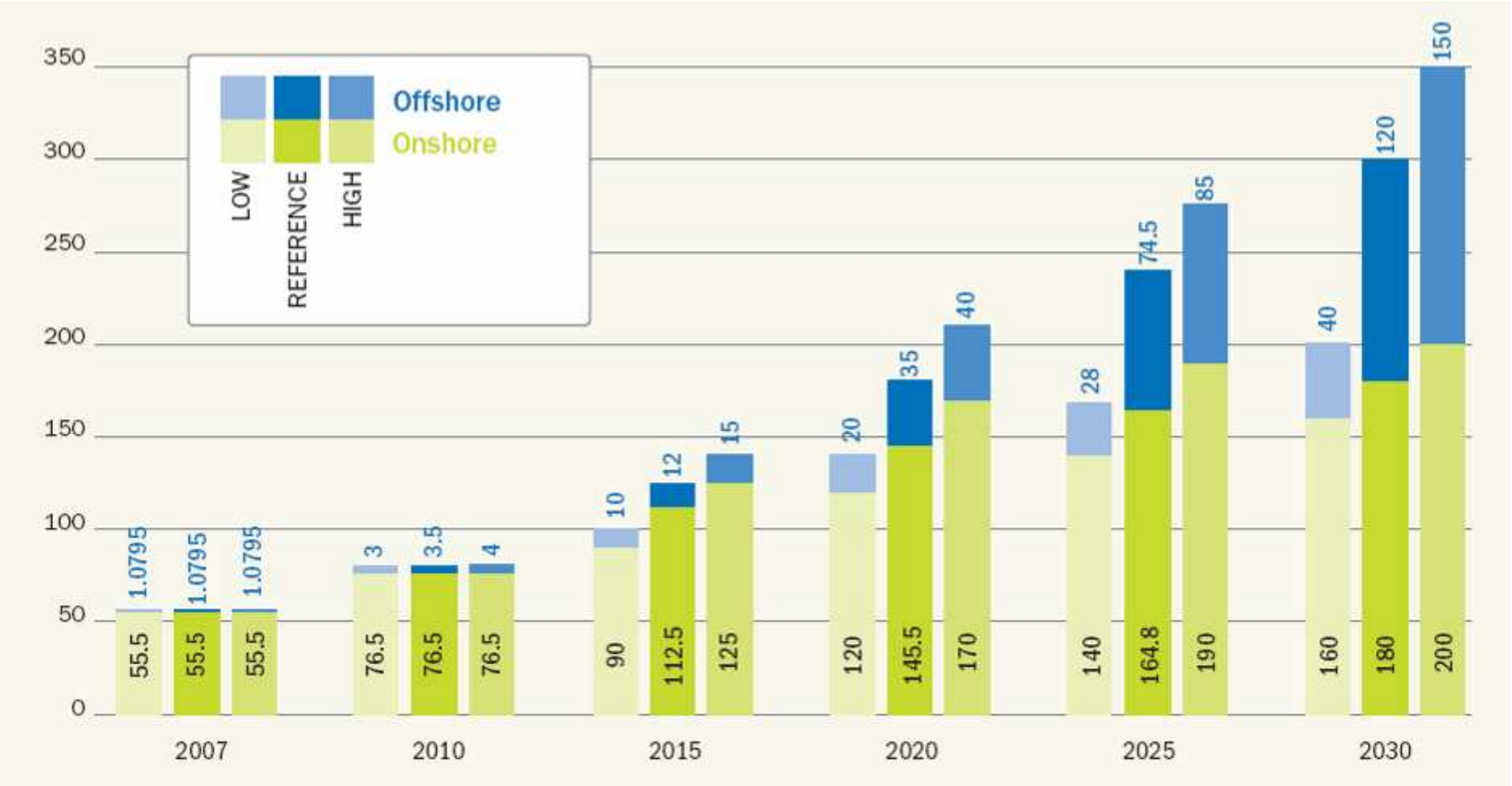
Source: EWEA

.. and contributing to new generating capacity

	2005-2010	2011-2020	2021-2030
Wind power's share of new capacity	39%	32%	46%
New generating capacity (GW)	117	368	404
New wind generating capacity (GW)	46	117	187

Source: EWEA Pure Power report

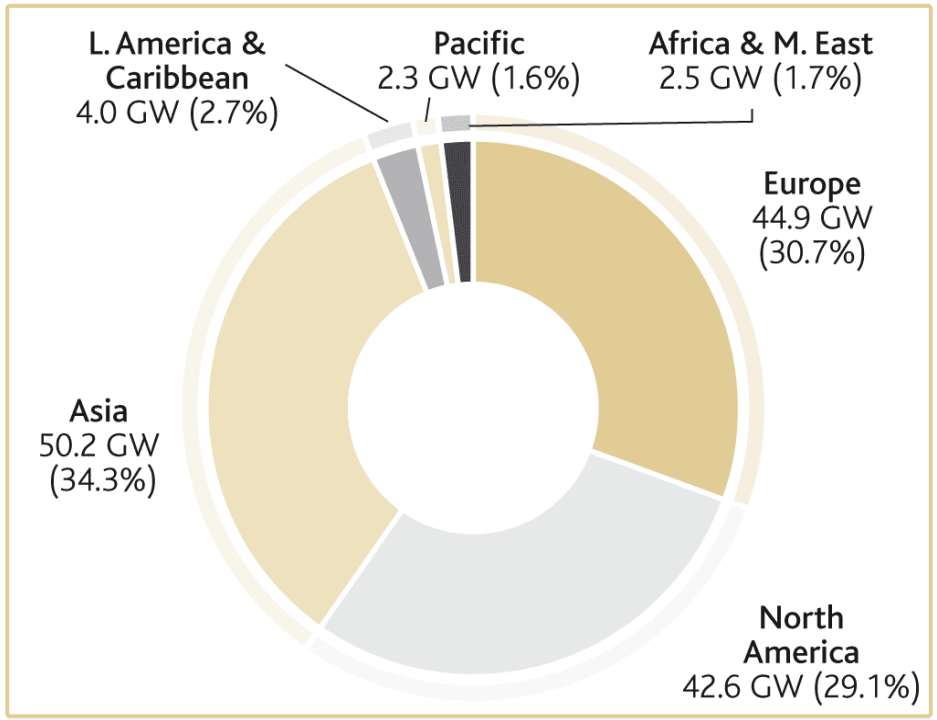
EWEA'S three wind power scenarios (in GW)



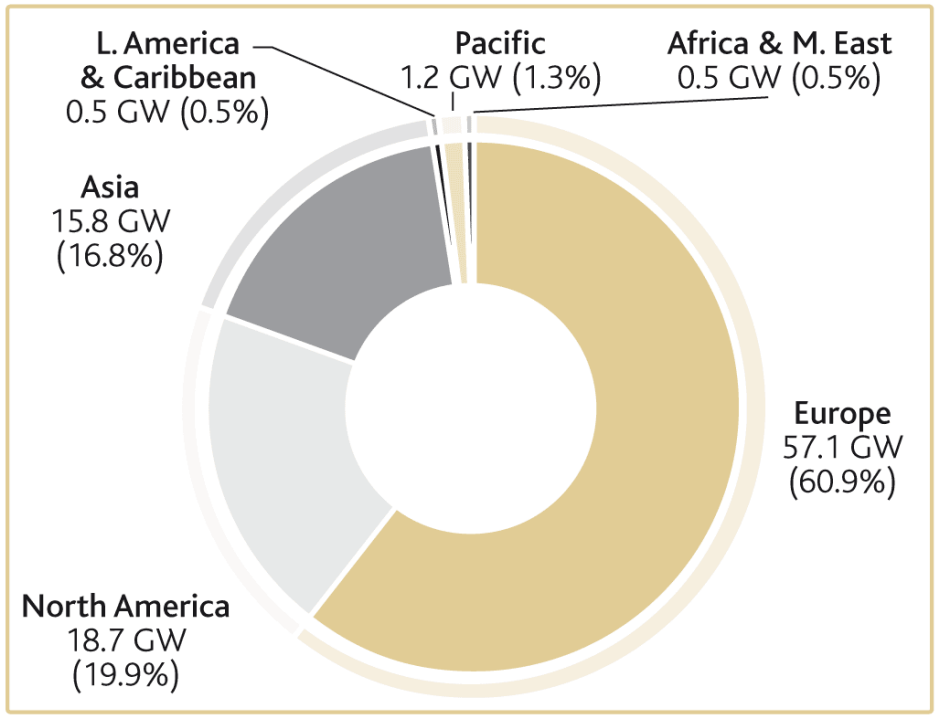
Source: EWEA Pure Power report

Global world market in the next five years

NEW INSTALLED CAPACITY 2008-2012

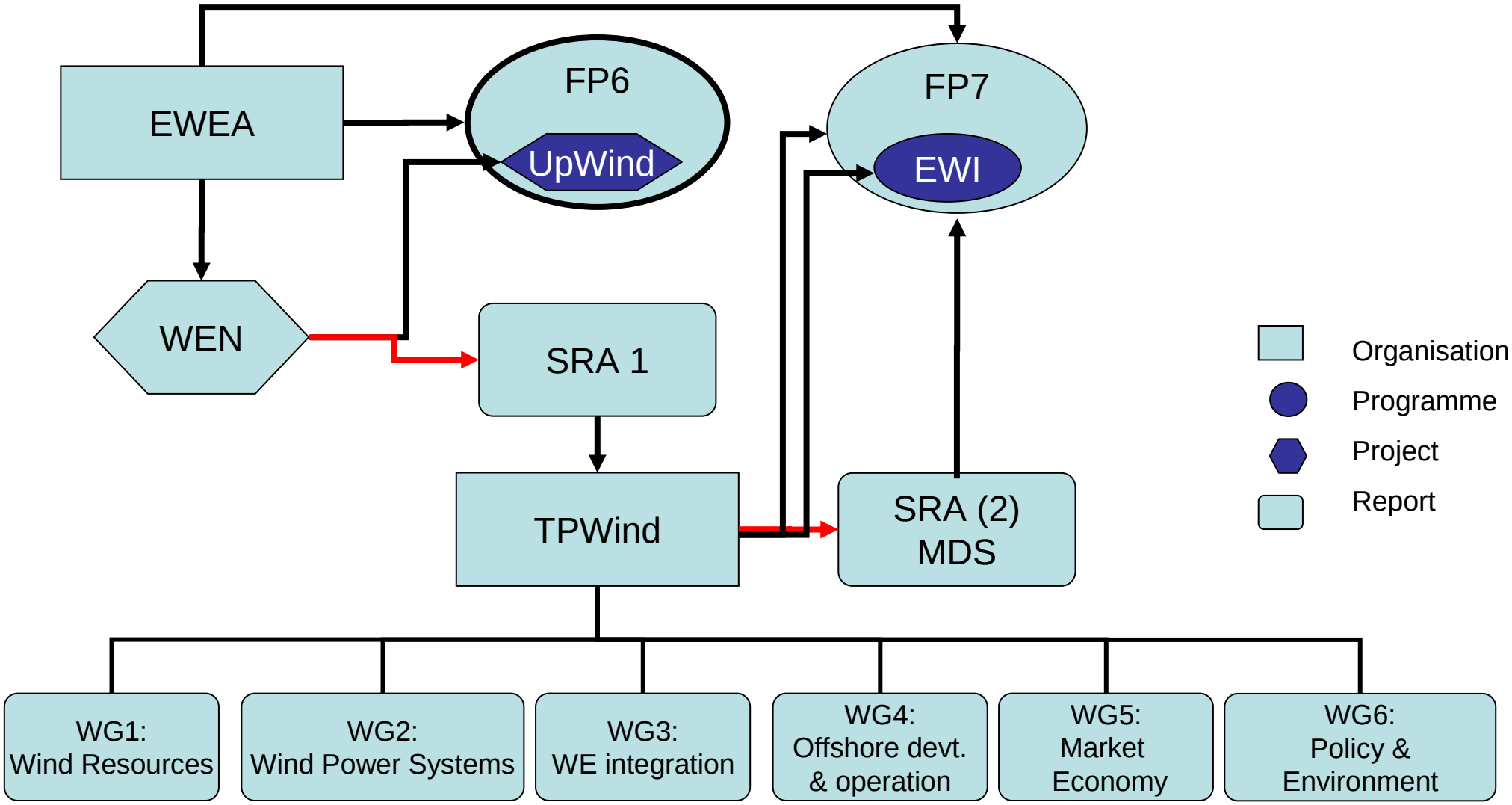


CUMULATIVE CAPACITY END 2007

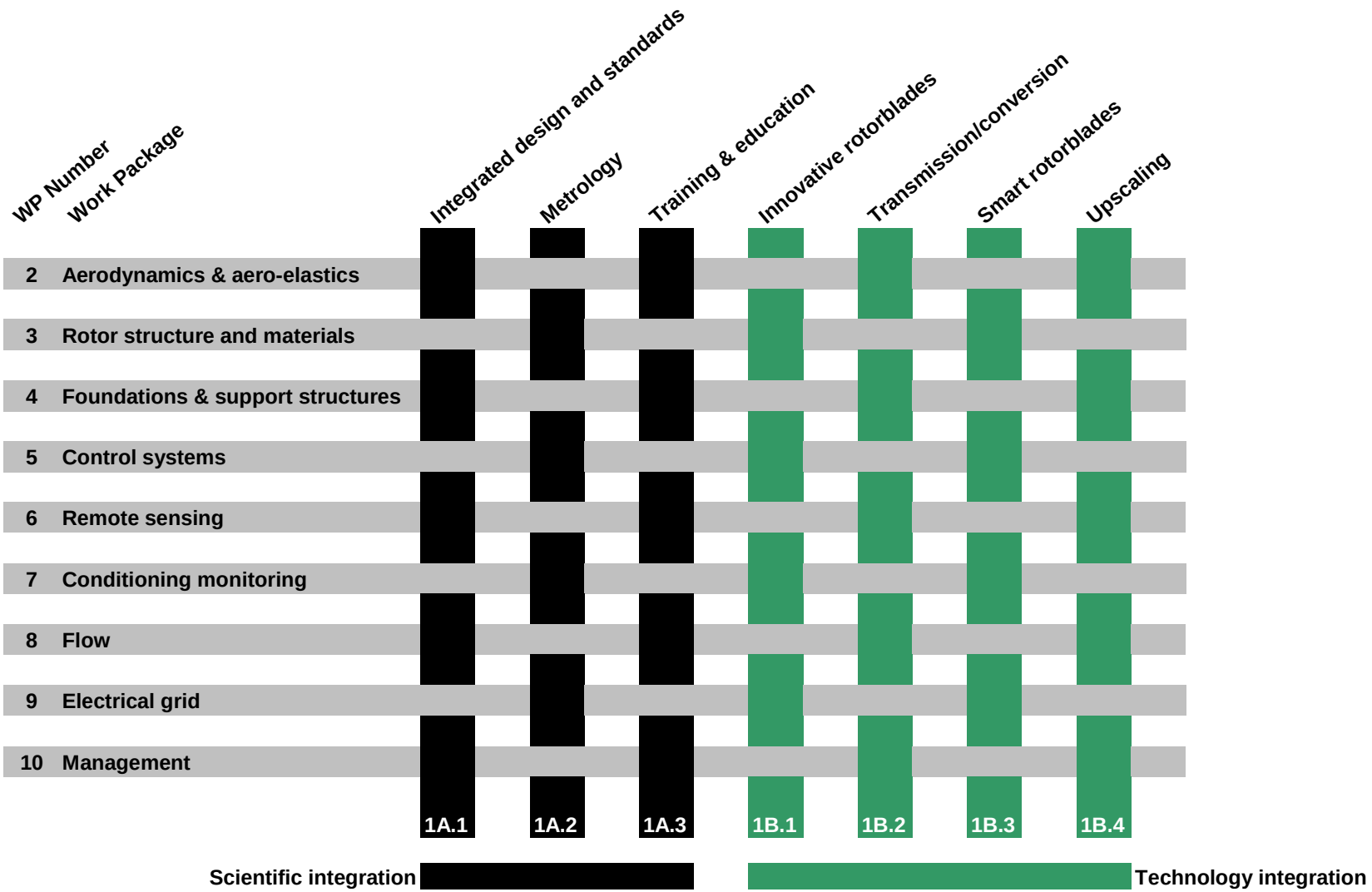


Source: Global Wind Energy Council

Relevant European policy framework



Integrated project ‘UpWind’

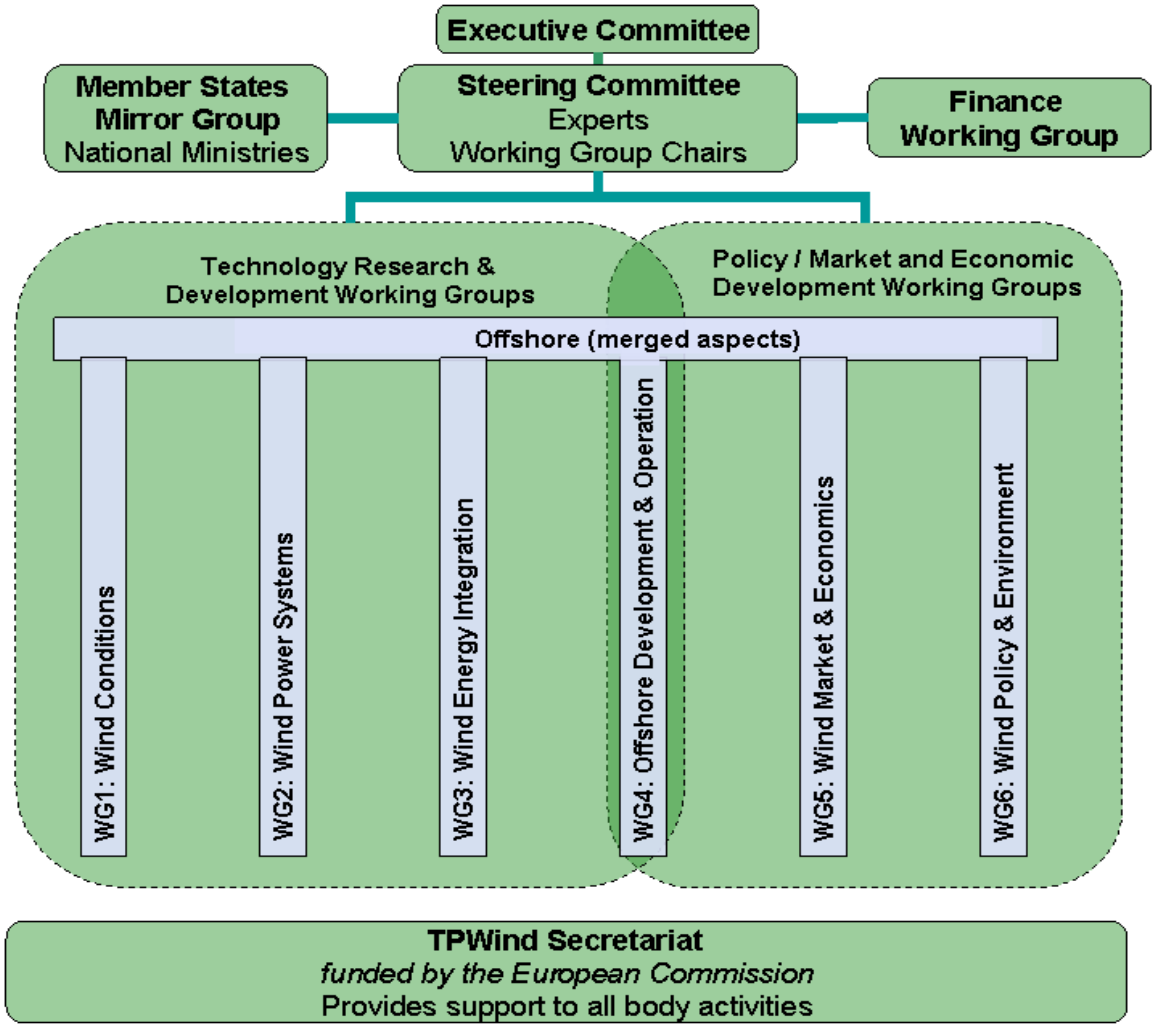


TPWind

Technology Platform Wind Energy

What is TPWind?

- **Official EU Technology Platform**
- **Launched in 2006 by Commissioner Piebalgs**
- **Secretariat supported by EC**
- **25 Steering committee members**
- **17 Member States**



EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

SRA & MDS documents represent:

- The vision for the wind energy sector
- Research priorities at short/medium/long term
- Market / Policy recommendations
- Human Resources
- Research Financing

TPWind Research action plan

EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

Thematic priority to achieve the global vision	WIND CONDITIONS											
Priority topics to achieve the 2030 vision	Siting in complex terrain and forested areas		Wakes		Offshore		Extreme wind speeds		Wind profiles at greater heights		Short-term Forecasting	
Implementation of priority topics: research priorities	Ashervein II	1	Data analysis	2	Design conditions for offshore sites	1	Data analysis	1	Data Analysis	1	Data Analysis	1
	New measurement techniques	1	Advanced Models	6	Improvement of meteorological models	1	Advanced models	3	Advanced Models	4	New Measurement Techniques	1
	Standards	3			Dedicated offshore short-term forecasting models	3	Extreme Wind Atlas	5	New Measurement Techniques	6	Advanced Models	6
	Advanced models	6			Fully integrated wind-wave-current interaction models	3						
					Basic knowledge of marine atmosphere	3						
					Standard models for resource assessment	4						
					Ground-based remote sensing techniques	6						
					Satellite-based remote sensing techniques	6						

Thematic priority to achieve the global vision	WIND TURBINE TECHNOLOGY								
Priority topics to achieve the 2030 vision	Wind turbine as a flow device	Wind turbine as a mechanical structure / materials	Wind turbine as an electricity plant	Wind turbine as a controlled system	Operation and Maintenance, Condition Monitoring, Installation	Concepts and Integration	New concepts	Standards	R&D facilities
Implementation of priority topics: research priorities	Final strategy under development								

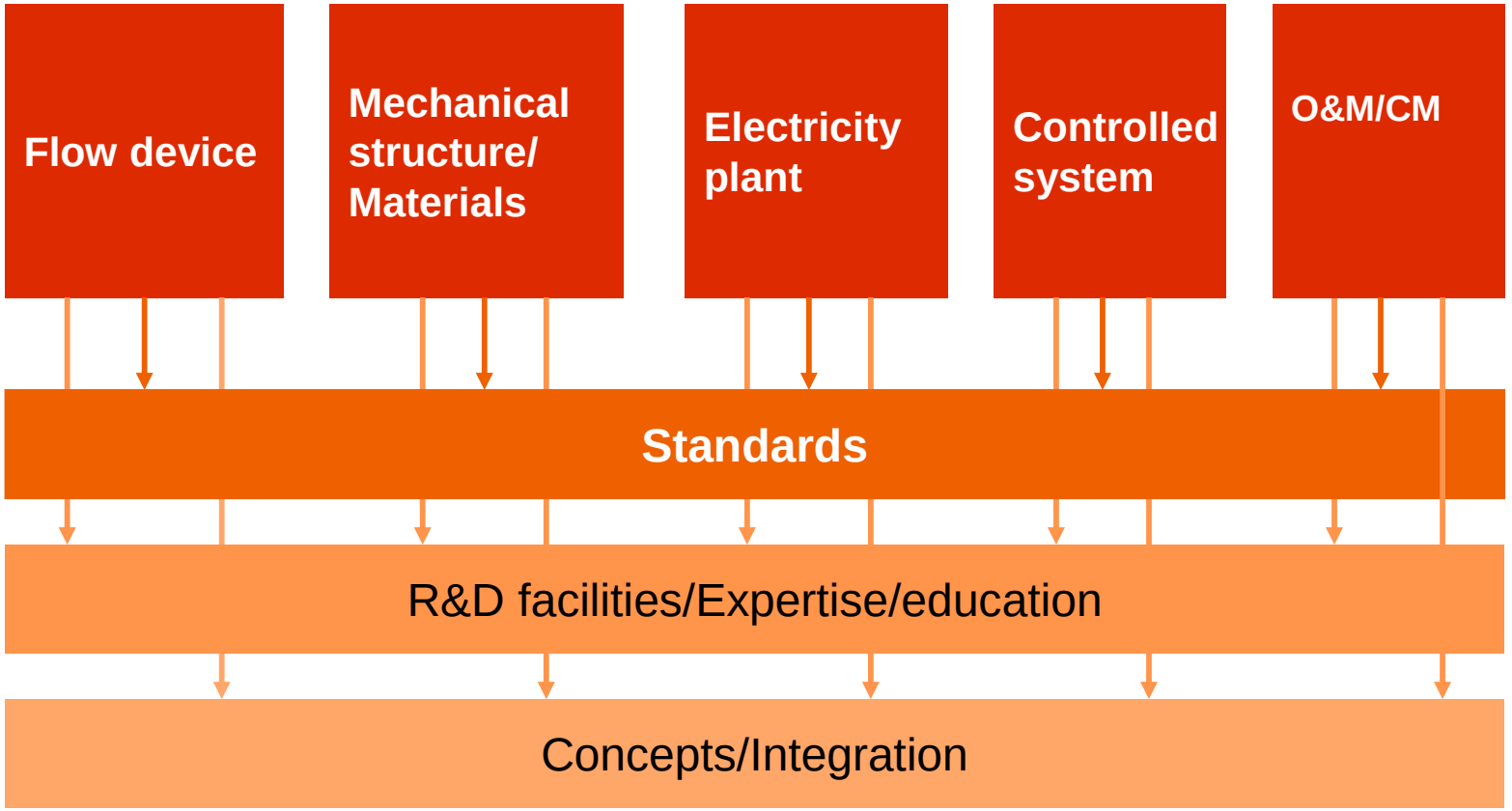
Thematic priority to achieve the global vision	WIND ENERGY INTEGRATION							
Priority topics to achieve the 2030 vision	Wind power plant capabilities		Grid planning and operation		Energy and power management		Energy markets	
Implementation of priority topics: research priorities	Grid code requirements	2	Improved operation, interoperability	2	Long term planning	4	Market modelling	1
	Means of verification	2	Models, simulation tools	2	System Operation	6	Market rules	3
	Opportunities for meeting requirements	4	Accelerated extension and reinforcement	3			Market access	6
			Transmission studies for offshore	5				

Thematic priority to achieve the global vision	OFFSHORE DEPLOYMENT AND OPERATION			
Priority topics to achieve the 2030 vision	Market deployment actions		Research actions	
Implementation of priority topics: research priorities	Installation, Assembly, Decommissioning	1	Environment	5
	Environment	1	Electrical infrastructure	5
	Safety	6	Safety	6
	Education	6	Substructure	6
	Substructure	6	Installation, Assembly, Decommissioning	6
	Electrical infrastructure	6	Turbines	6
	Turbines	6	Operation and Maintenance	6
	Operation and Maintenance	6		

Legend	
1	Short term
2	Short and medium term
3	Medium term
4	Medium and long term
5	Long term
6	Short to including long term

TPWind Research action plan

Consider a wind turbine system as a:



Example TPWind WG 2

Flow device

With the **increasing size** and **complexity** of wind turbines the need develops for:

- A full understanding of the aerodynamic phenomena, including external conditions.
- Significant improvement of the corresponding design and analysis tools.

Example TPWind WG 2

O&M
CM

- Improving reliability by improving wind farm management, reliability of wind turbine components, and improve standardisation.
- Minimising O&M by cost applying **preventive maintenance strategies** and tools developed on the basis of low cost and **extremely reliable condition monitoring methods**.

Example TPWind WG 2

Concepts Integration

- Fully integrated methods (Design methods should include all sub design routines such as those for blades, power electronic stems, mechanical transmission, support structures, transport and installation loads, etc. After having been developed they need thorough verification and have to be introduced into the standard design and certification processes.)
- **New concepts** will arise from innovations in materials and components and from the needs of the offshore project operators/owners. (Given the huge challenges on the present and medium term market, caused by the gap between demand and supply, improving present wind turbine concepts has to be addressed first and **should not suffer from conceiving 'disruptive' technologies)**.

Deployment phases of Technology Platforms:

- **Establishment and getting TPWind started (2006 – 2007)**
- **Definition of a Strategic Research Agenda (2007 – 2008) Actually the second version. SRA is an ongoing process.**
- **Implementation phase (2008 – 2009 and beyond)**

  Framework Programme, other sources of European funding, national research programmes, industry funding and third-party private finance…

The European Wind Initiative is a strong opportunity for the implementation phase

Cold climate issues

The geographical potential

Majority of cold climate wind turbine sites are located in open and forested terrain with average wind speeds of > 7m/s and altitudes > 71 m.
The total potential is 10 times more than for easily accessible offshore sites.

Ref: Vindkompaniet; Potential study

Potential of WE in cold climates

Where is the load?
113 million people in only 28 countries (*)

(*)

- Sweden, Finland, Norway, Iceland
- Other European mountainous areas (Pyrenees, France, Austria, Switzerland, Liechtenstein, Italy, Germany. Slovenia, Romania, Slovakia, Ukraine, Hungary, Serbia & Montenegro, Scotland
- North America (Canada, USA)
- Asia (Himalaya's in China, India, Nepal, Bhutan)

Excluding South America and non Himalayan parts of China!!

Research issues

Basically similar approach as for offshore and complex terrain issues.

It is just a particular case of taking into account:
* extreme external conditions
* its consequences for technology development.

Research issues; comparison with offshore approach

Reference: Offshore WE

What makes offshore WE different from on-land applications?

- Cost breakdown (foundation and grid connection dominant)
- External conditions (waves, salt conditions, turbulence, extreme winds, water currents, (sea) bottom morphology)
- Support structures
- Assembly, transport and installation
- Commissioning
- Operation and maintenance/access
- Grid integration
- Ecology & safety

Requires dedicated concepts

Research issues

What makes cold climate WE different from main stream applications?

- External conditions (probability of icing, extreme low temperatures)
- Impact on mechanical loading and performance
- Transport and assembly, because of poor access
- Operation and maintenance/access
- Safety

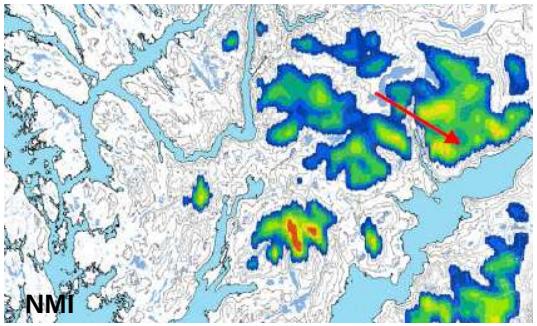
Requires dedicated or adopted concepts?

Research issues

Priorities (1)

(taken from Boreas, Swedish WE conference, IEA docs, personal communications)

- Conditions for icing (super cooling, sublimation)
- Icing probability mapping of areas wind high wind resource (‘iso icing days/annum’ contours)
- Cold climate resistant measuring instruments and associated power supply units (performance, resource assessment, ice detection, loads, heating system control



Priorities (2)

(taken from Boreas, Swedish WE conference, IEA docs, Personal communications)

- Impact on loading (aerodynamically and mechanical/aerodynamically induced loads, scale effects; PSCCAD-ADAMS-SIMULINK)

Turbine 3
- Ice prevention in operation

Turbine 2
- Ice prevention system fault

- Safety (Detection methods)

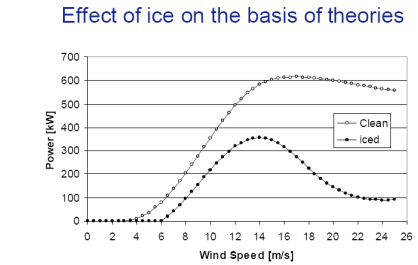
VTT

Research issues

Priorities (3)

(taken from Boreas, Swedish WE conference, IEA docs, Personal communications)

- Impact on performance (PSCCAD-ADAMS-SIMULINK)



Esa Peltona

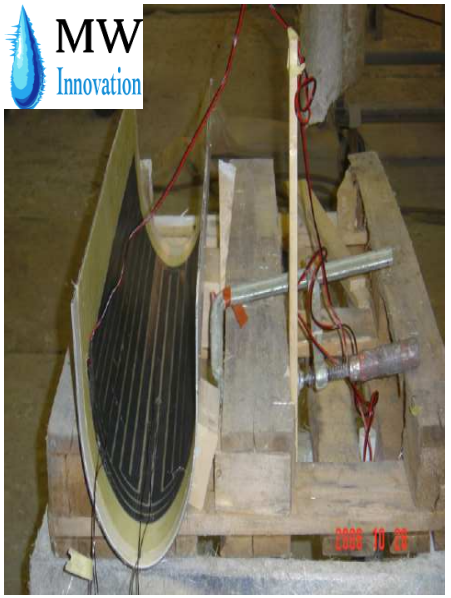
- Transport and assembly, because of poor access
- Operation and maintenance/access

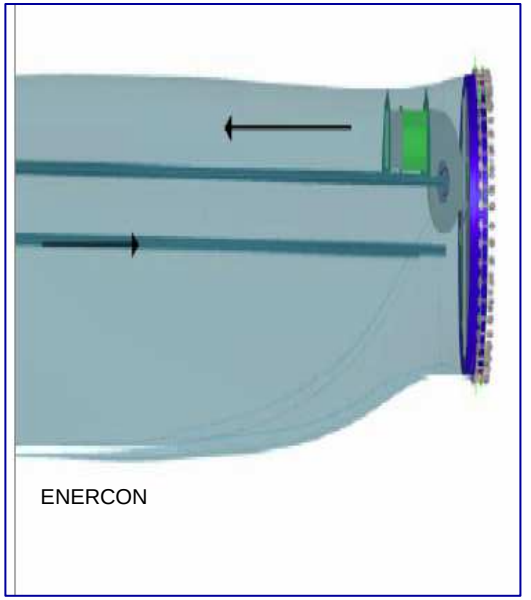
Priorities (4)

(taken from Boreas, Swedish WE conference, IEA docs, Personal communications)

Dedicated cold weather wind turbine concepts

- Avoiding icing by heating blades (e.g. carbon fibre heating foils, warm air)
- Heating (energy) demand (Turbice)
- Monitoring during operation
- Materials (nano structured surfaces)
- Control systems (parameter identification)





Conclusions

- Market potential in cold climate areas is significant
- Numerous problems still unsolved
- Cold climate research issues need to be included in European research agendas

Research issues; comparison with offshore approach

Questions

- Are the research issues correct?
- Which are the research priorities?
- How to include the industry's position?
- Procedure to include them in the SRA (3)?

Acknowledgements

Göran Ronsten (WindREN AB)

Filippo Gagliardi (TPWind)

Sharon Wokke (EWEA office)

EWEA

TPWind

All participants of the Swedish WE Conference 2008 (!)

THANK YOU VERY MUCH FOR YOUR ATTENTION

For more information, visit www.ewea.org

THE EUROPEAN
WIND
ENERGY
ASSOCIATION

RENEWABLE ENERGY
HOUSE
63-65 RUE D'ARLON
B-1040 BRUSSELS

T: +32 2 546 1940
F: +32 2 546 1944
E: ewea@ewea.org

European Wind Energy Conference EWEC

EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

ewec 2009 MARSEILLE
Europe's premier wind energy event

Come to next years EWEC in Marseille (16 - 19 March 2009) and be part of the international wind energy debate!

- **Over 80% of the 9,000 m2 of the exhibition space has already been sold. It will be the largest EWEC exhibition ever!**
- **Over 6,000 key players will attend from all sectors of the industry: manufacturers, component suppliers, developers, operators, utilities, consultants and financiers**

ewec 2010 WARSAW
Europe's premier wind energy event

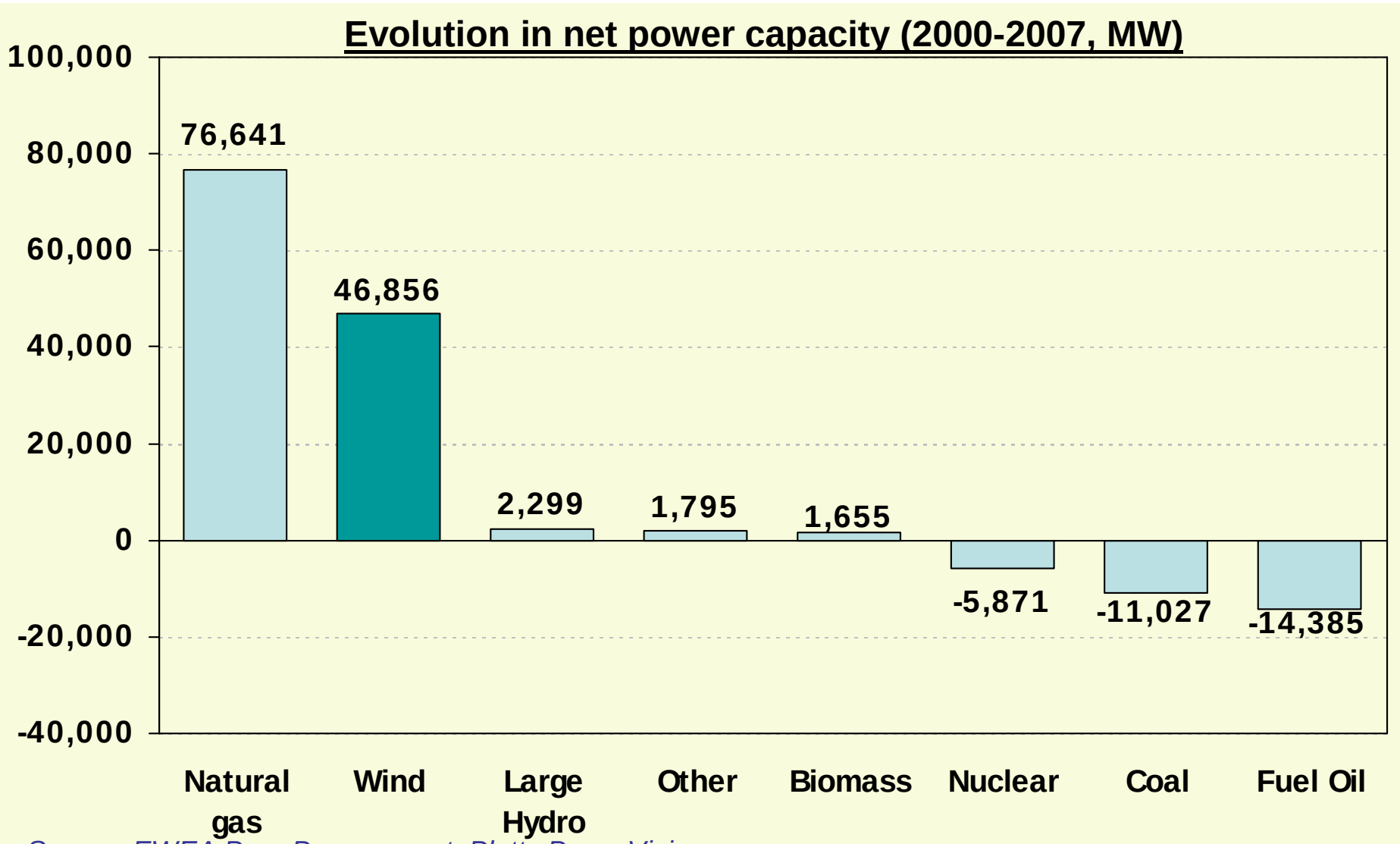
The EWEC 2010 will take place in Warsaw, Poland (20 – 23 April 2010).

Book your stand now!

More information: www.ewec.info

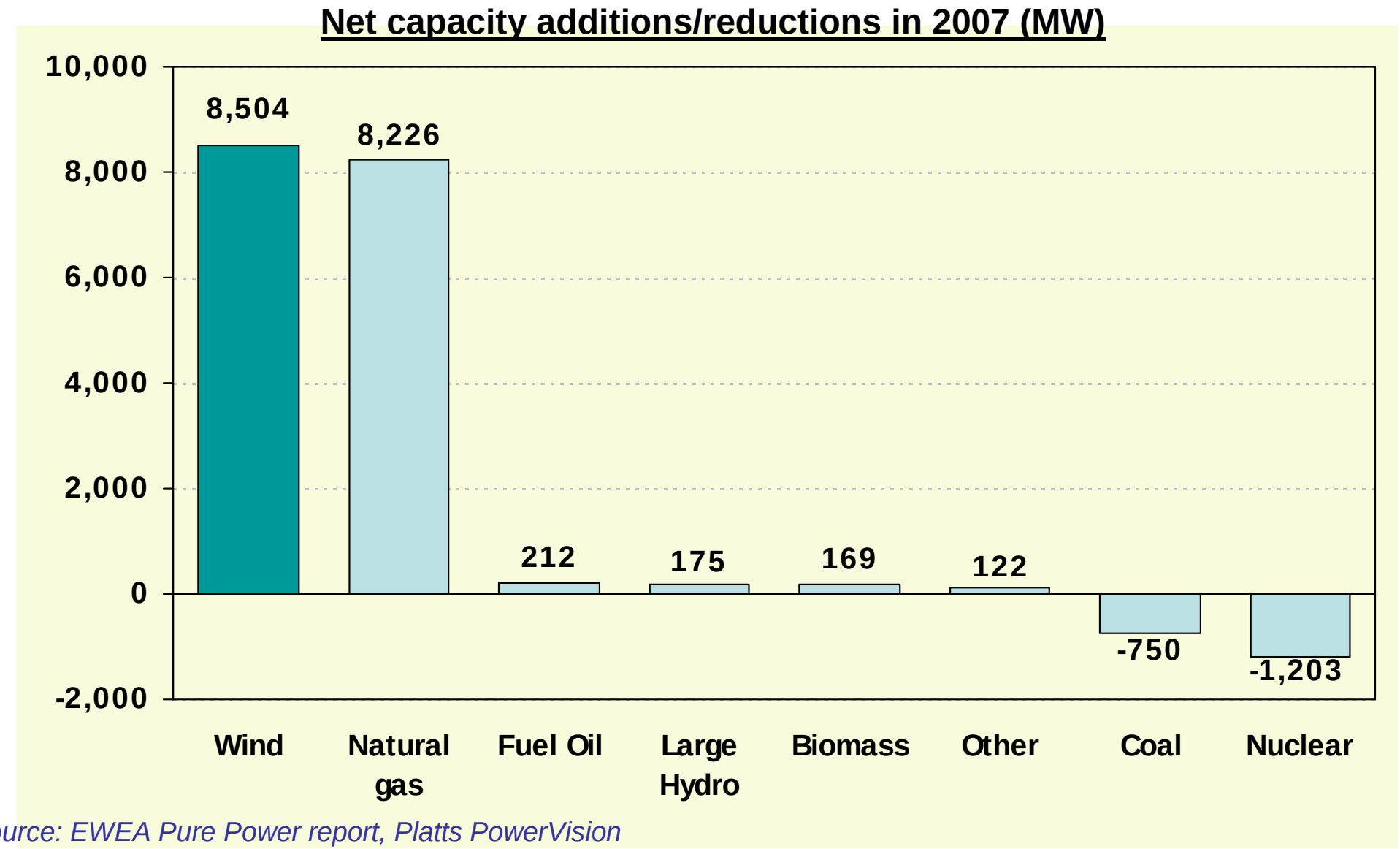
State of the art deployment wind energy

Wind has become a major player ….



Source: EWEA Pure Power report, Platts PowerVision

… and was even Nr. 1 last year

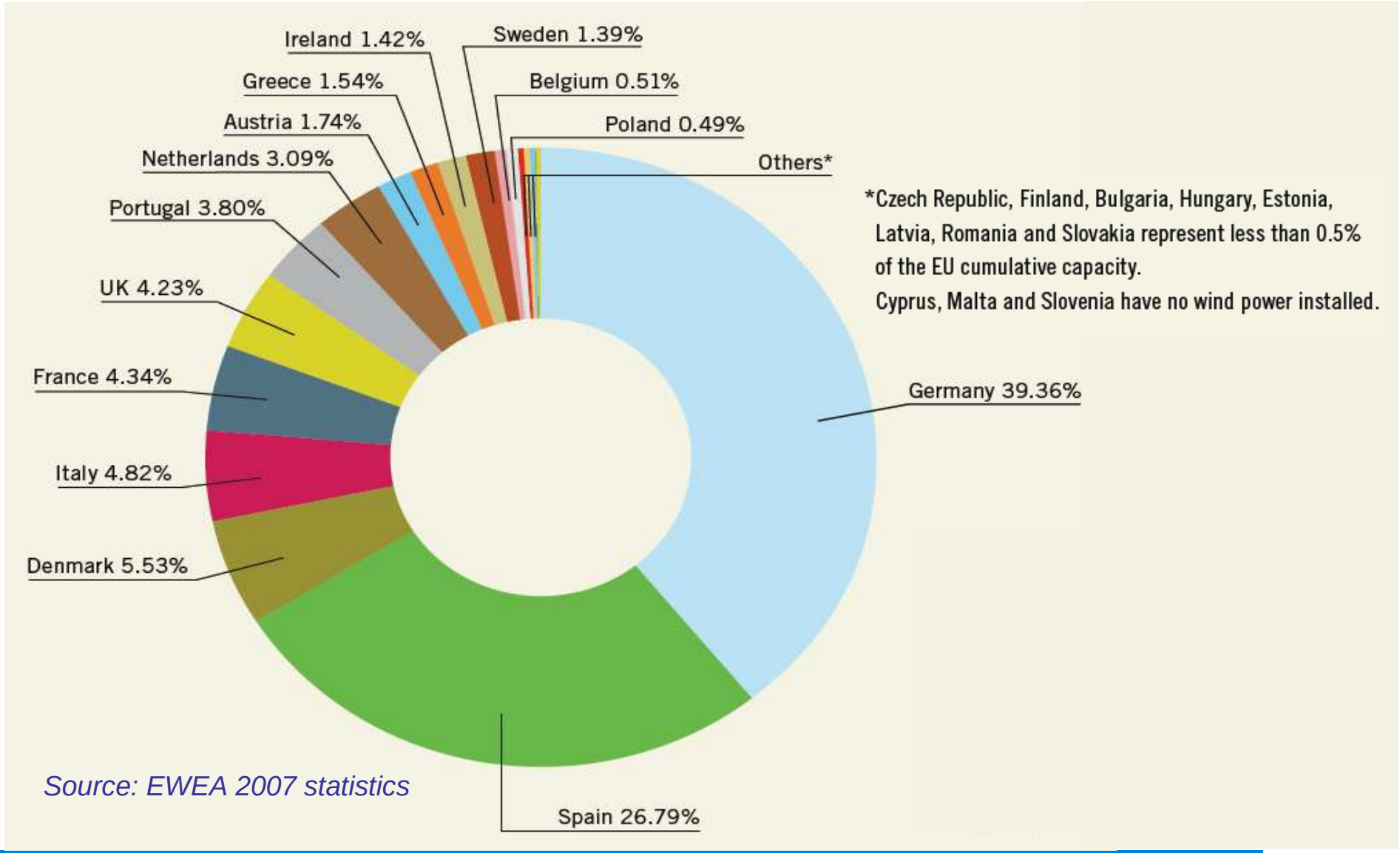


Source: EWEA Pure Power report, Platts PowerVision

Cumulative installed capacity EU-27, share per member state 2007

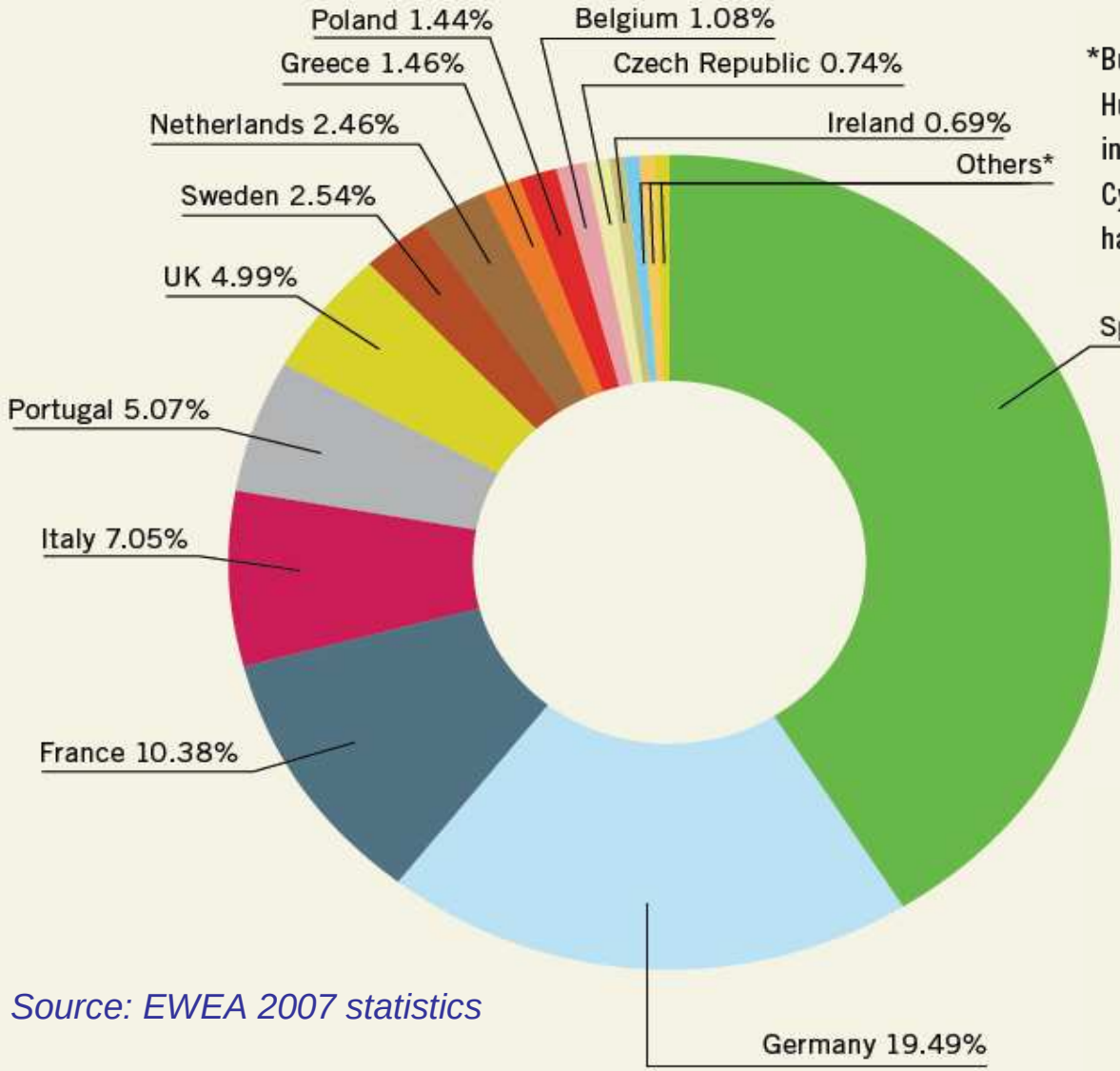
Source: EWEA 2007 statistics

Cumulative installed capacity EU-27, share per member state 2007



Source: EWEA 2007 statistics

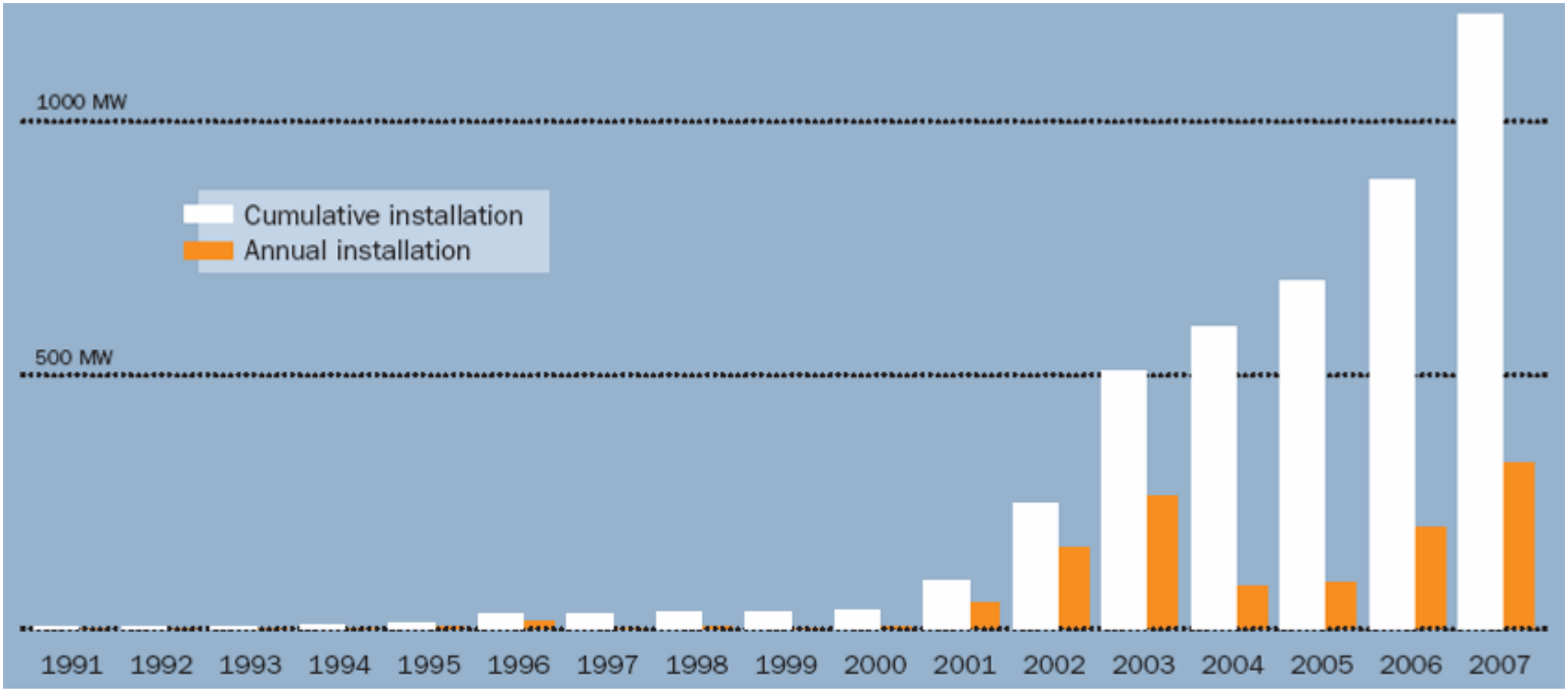
Cumulative installed capacity EU-27, share per member state 2007



*Bulgaria, Estonia, Finland, Austria, Lithuania, Romania, Hungary and Denmark represent less than 0.5% of the new installed capacity.
Cyprus, Latvia, Luxembourg, Malta, Slovakia and Slovenia had no new wind power installations in 2007.

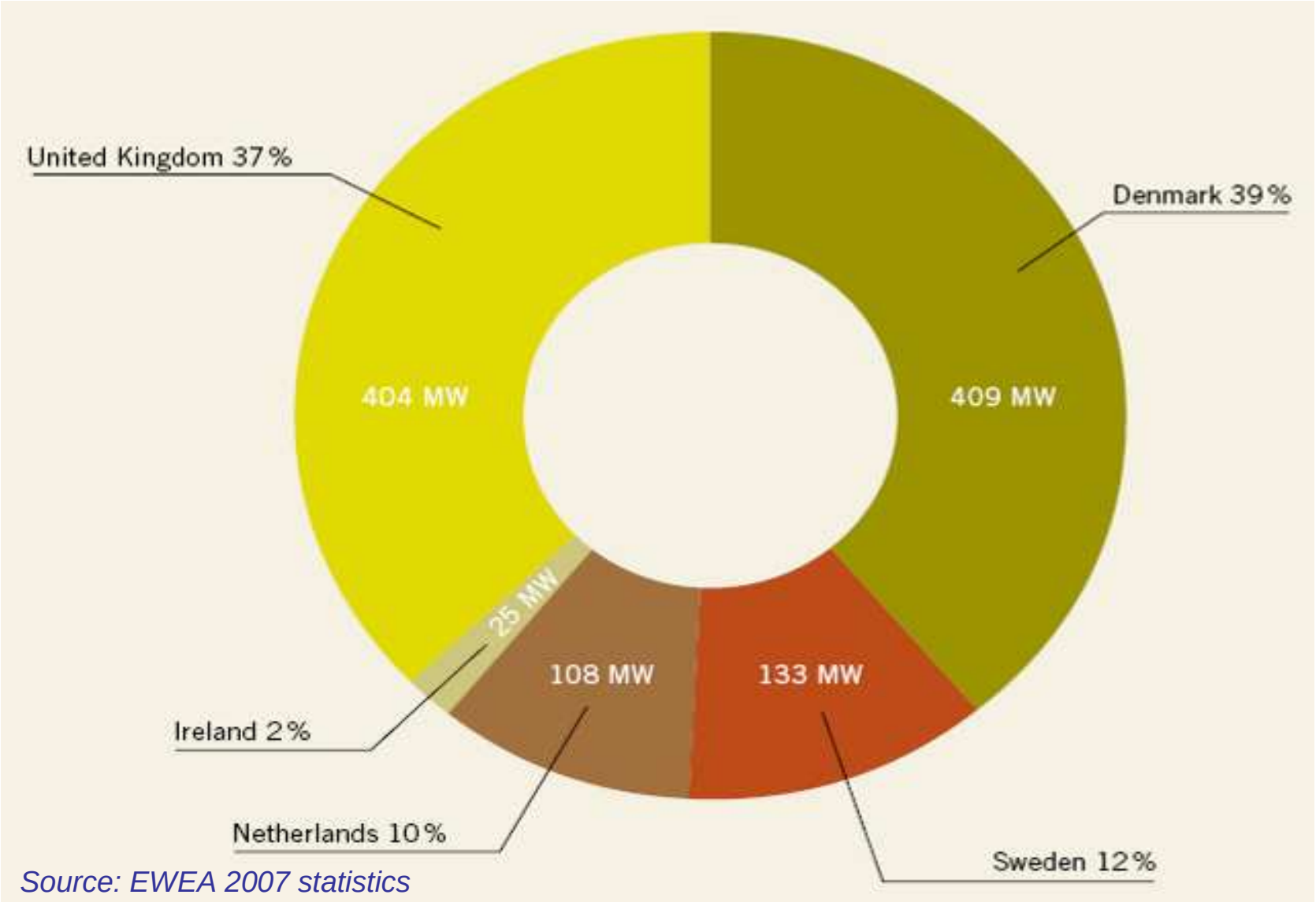
Source: EWEA 2007 statistics

Offshore market development in Europe



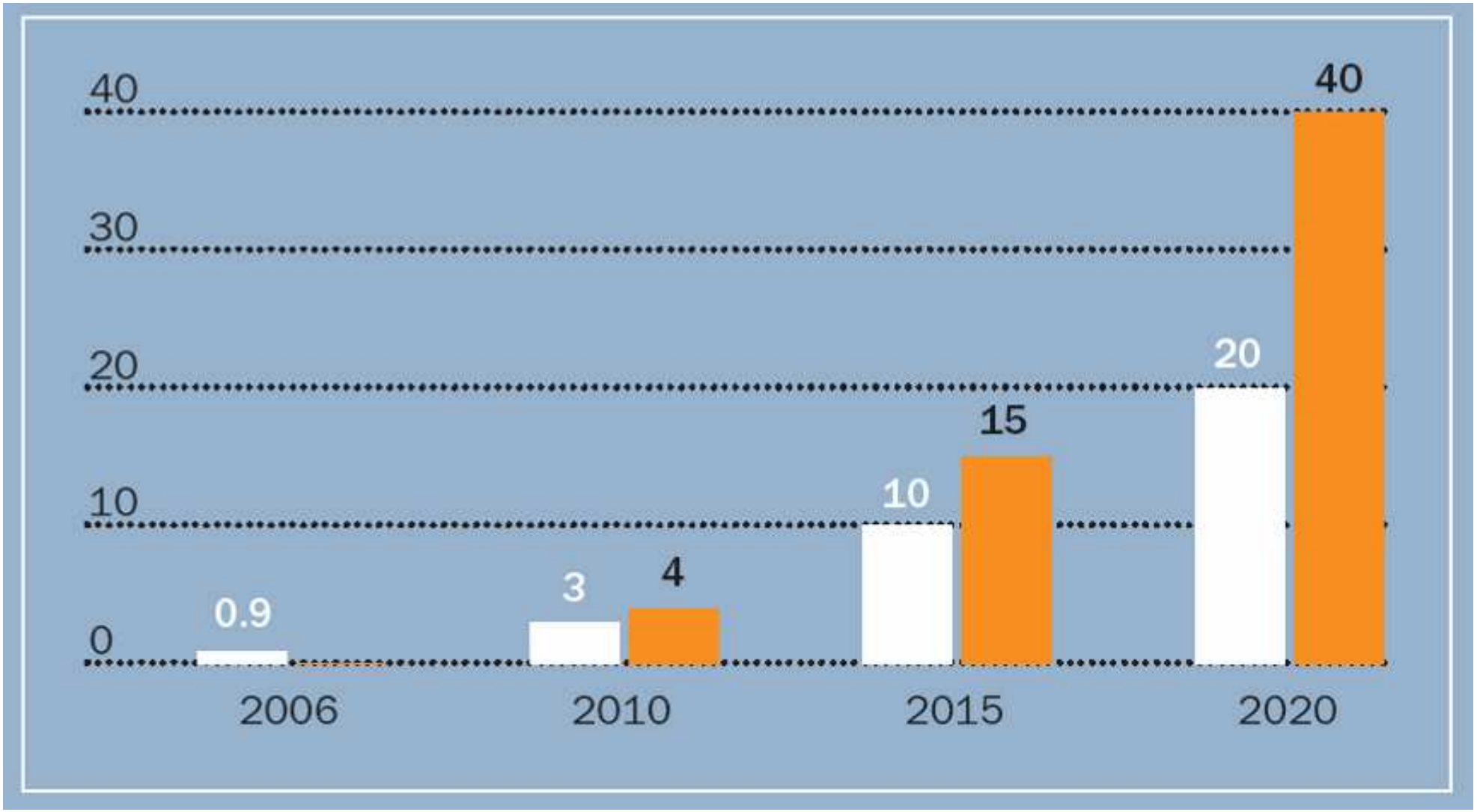
Source: EWEA 2007 report - Delivering Offshore Wind Power in Europe

Total offshore wind power installed at the end of 2007



Source: EWEA 2007 statistics

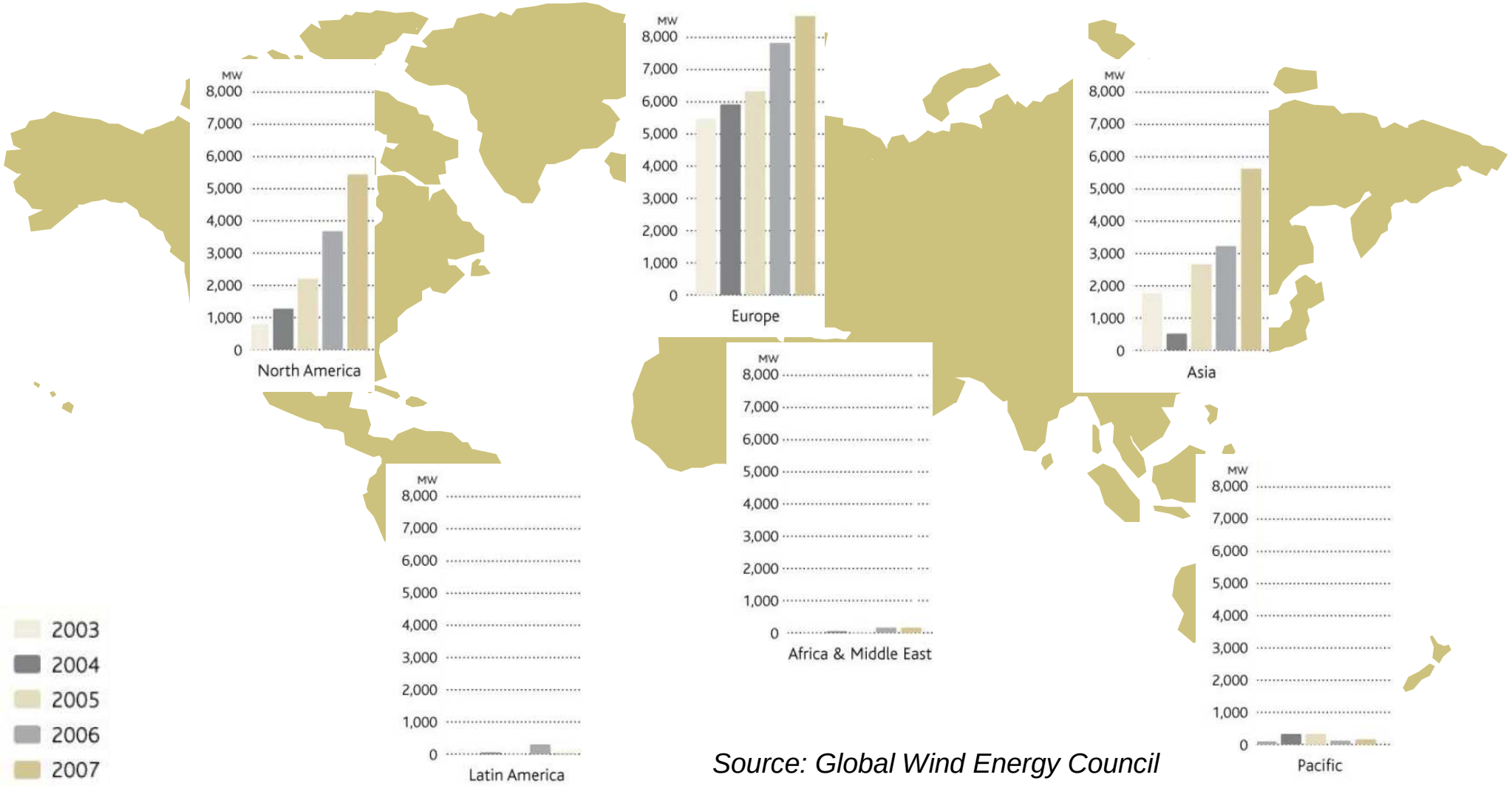
Offshore wind development 2006–2020 (Cumulative, GW)



Source: EWEA 2007 report - Delivering Offshore Wind Power in Europe

Europe maintained its position at the forefront of the global scene

Annual installed capacity by region (2003-2007, MW)



Source: Global Wind Energy Council

New RES Directive

Draft EU Renewables Directive 2008

- 20% more energy efficiency
- 20% share of renewable energy
- Reduction of 20% in greenhouse gas emissions

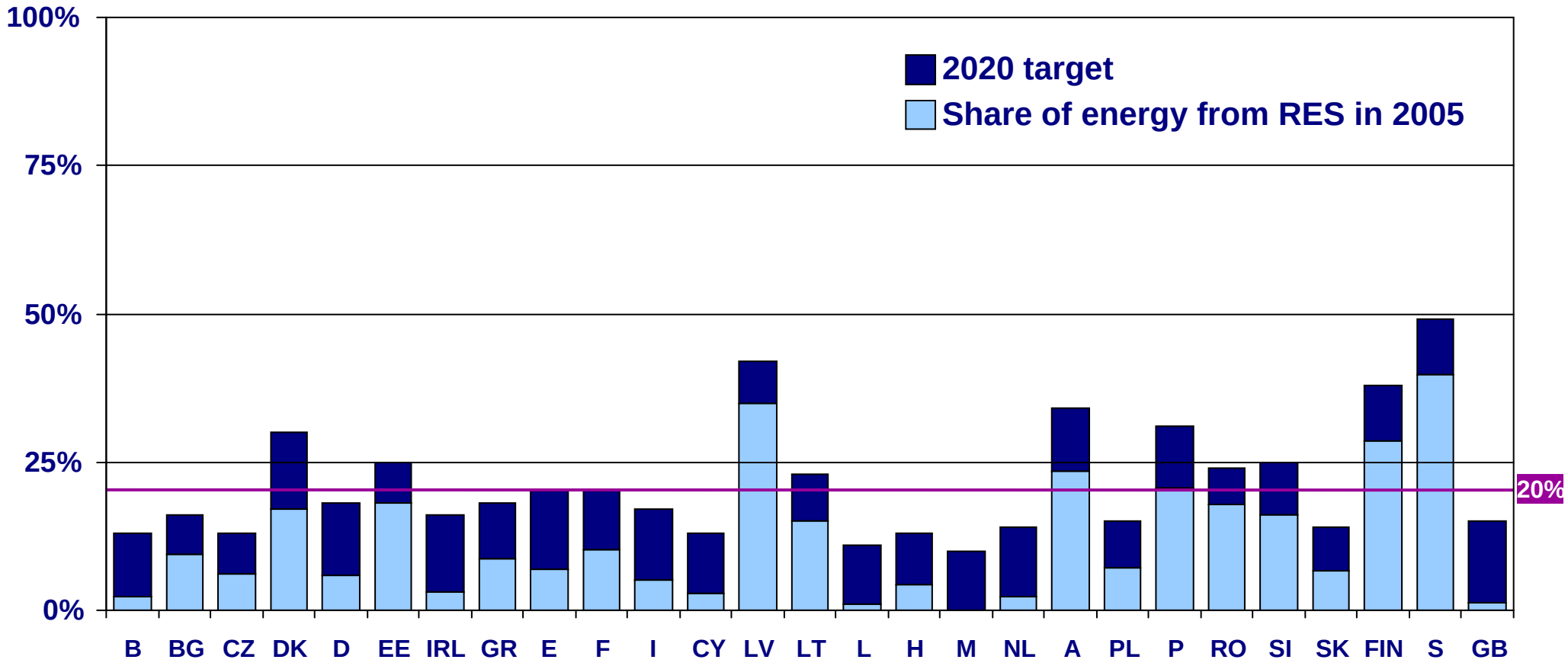
Draft EU Renewables Directive; a good start

Setting an EU target of a 20% share of renewable energy in 2020, compared to the share of 8.5% today

- **Differentiated binding national targets**
- **National action plans by March 2010**
- **Flexibility for target fulfilment**
  - **Choice in mix & support system**
  - **GO's**
- **Indicative trajectory in the run-up to 2020**
- **Streamlining authorisation procedures**
- **Potential priority grid access for renewables**

EU 2020 Renewable Energy Targets

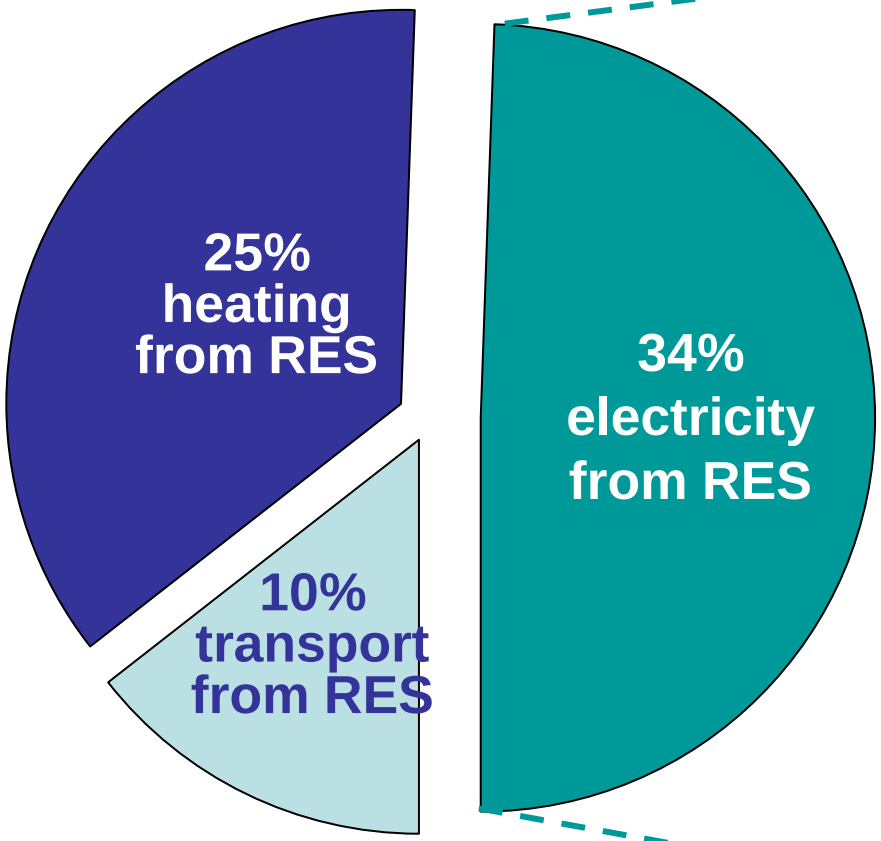
National overall targets for the share of energy from RES in final consumption of energy in 2020



Source: European Commission draft proposal for a Directive on the promotion of the use of energy from renewable sources

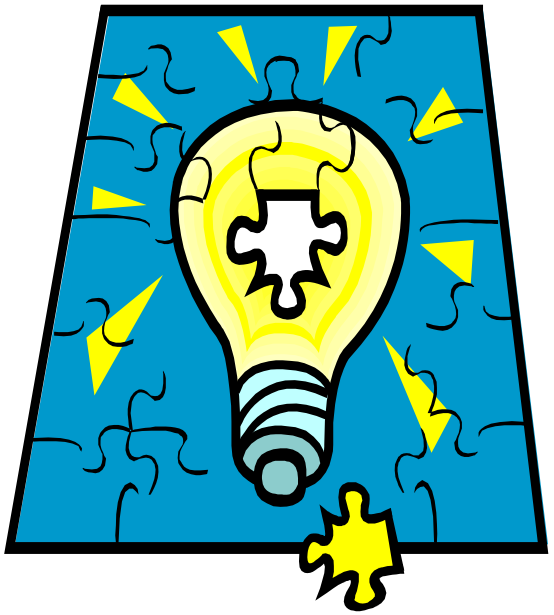
How much renewable electricity? How much power?

20% Renewable Energy by 2020 (EC methodology)



- Excluding hydro, increase in the share of renewable electricity from 5% to approx. 25% in 15 years, depending on power demand
- For wind, increase from 3.5% (56 GW) to 11-14% (180 GW) in 2020, depending on 2020 demand
  - Implies average 9.5 GW increase per year
  - 2007 market: 8.5 GW

Wind's energy contribution to the 20% target



	➡ Today	➡ 2020
•RES	➡ 8.5%	➡ 20%
• Electricity	➡ 15%	➡ 34%
•Wind energy	➡ 3%	➡ 12-14%
Of which offshore	➡ 0%	➡ 1.8-4.5%

Wind energy will be the biggest contributor to the massive increase in clean energy production

R&D priorities

TPWind WG 2

Wind Power Systems

Flow device

With the **increasing size** and **complexity** of wind turbines the need develops for:

- A full understanding of the aerodynamic phenomena, including external conditions.
- Significant improvement of the corresponding design and analysis tools.

Mechanical structure/ materials

- Uncertainties need to be substantially decreased to provide manufacturers with appropriate **specifications for designing and manufacturing**.
- Continued **characterisation** of both existing and new materials to reduce design safety factors and reduce cost.
- Less uncertainties in materials characterisation also requires improved **measuring and evaluation methods**
- **New materials** for many components such as blades and towers.
- Improvement of condition monitoring and system control by **incorporating sensors into the materials**.
- **Recycling** of materials so that the quality of the materials are maintained at **original levels**.

Electricity plant

- Improved **high voltage power electronics** to increase efficiency and decrease costs.
- Improved power converters to **maximise system efficiency, controllability and power quality**.
- **Light weighted, low speed and low maintenance generators, possibly including high temperature super conductors** (LT).

Controlled system

- Development of **sensors** to realise multi parameter and adaptive control strategies, leading to optimised operation.
- **Continuous control** based on critical parameters, charactersing efficiency, capacity factor, safety, power quality, structural and electric stability, while external conditions and turbine properties may vary.

(Implementing these strategies would guarantee low O&M cost during the specified life time.)

O&M
CM

- Improving reliability by improving wind farm management, reliability of wind turbine components, and improve standardisation.
- Minimising O&M by cost applying **preventive maintenance strategies** and tools developed on the basis of low cost and **extremely reliable condition monitoring methods**.

Concepts Integration

- Fully integrated methods (Design methods should include all sub design routines such as those for blades, power electronic stems, mechanical transmission, support structures, transport and installation loads, etc. After having been developed they need thorough verification and have to be introduced into the standard design and certification processes.)
- **New concepts** will arise from innovations in materials and components and from the needs of the offshore project operators/owners. (Given the huge challenges on the present and medium term market, caused by the gap between demand and supply, improving present wind turbine concepts has to be addressed first and **should not suffer from conceiving 'disruptive' technologies)**.

Standards

- Standardisation is the **final stage of a development trajectory**; it freezes the state of the art knowledge.
- In order to avoid that standards become a barrier to technical innovation, the standards need to be subject to a **stepwise updating process**.
- All earlier mentioned aspects of technology development will form inputs for the standardisation process.

R&D Facilities

- Joint efforts to realise facilities and to make them accessible to the international R&D community and the wind turbine and component manufacturers. (As wind turbines form large structures most of the research infrastructure needs to be large and costly as well. This particularly applies to wind tunnels, blade fatigue testing facilities, drive train testing, wind turbine test stations and facilities to evaluate wind farm control).
- Need **operational verification** (demonstration) of new risk full concepts such as **new installation and transport concepts**.
- Full scale **(comparative) testing of wind turbines under extreme climatological conditions** provides extra security for financiers planning large investments. A joint operated test site at extreme site would meet the need for such a facility.