EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

Wind Energy The Facts

Prof. ARTHOUROS ZERVOS
PRESIDENT
European Wind Energy Association

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Bucharest, Romania

WIND ENERGY –THE FACTS

I. Technology

II. Grid Integration

III. The Economics of Wind Power

IV. Industry and Markets

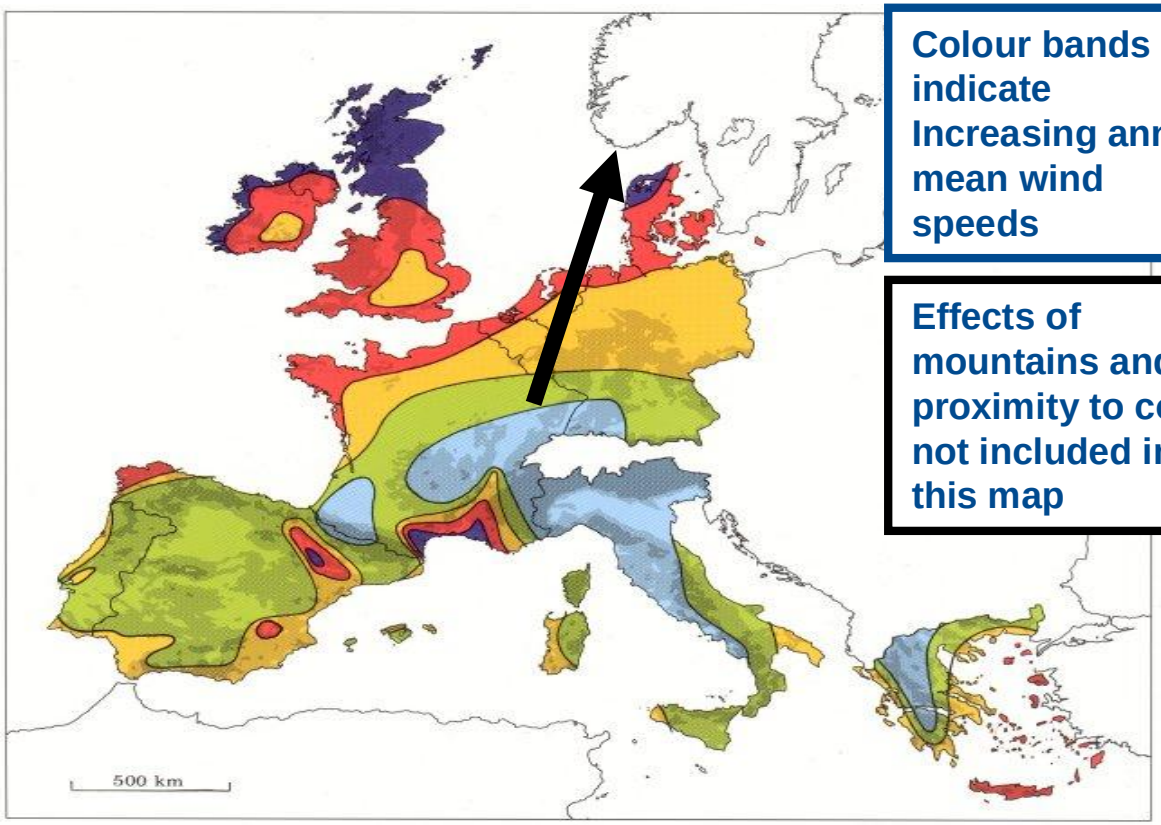
V. Environment

VI. Scenarios and Targets

I. TECHNOLOGY: Wind resource estimation 1/2

Wind maps are a good starting point

But at each site wind measurements and topography needs to be taken into account



Colour bands indicate Increasing annual mean wind speeds

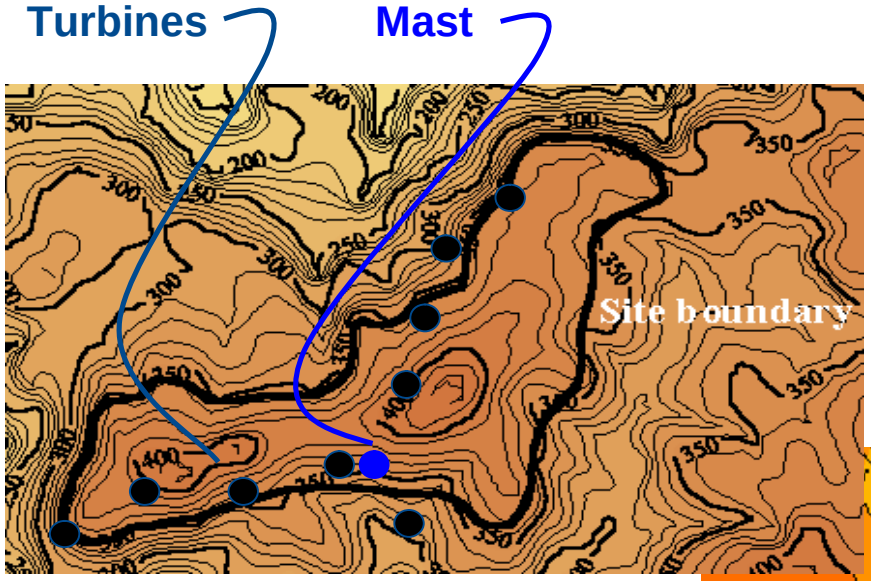
Effects of mountains and proximity to coast not included in this map

Wind resources[1] at 50 metres above ground level for five different topographic conditions

	Sheltered terrain[2]		Open plain[3]		At a sea coast[4]		Open sea[5]		Hills and ridges[6]	
	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}
	> 6.0	> 250	> 7.5	> 500	> 8.5	> 700	> 9.0	> 800	> 11.5	> 1800
	5.0-6.0	150-250	6.5-7.5	300-500	7.0-8.5	400-700	8.0-9.0	600-800	10.0-11.5	1200-1800
	4.5-5.0	100-150	5.5-6.5	200-300	6.0-7.0	250-400	7.0-8.0	400-600	8.5-10.0	700-1200
	3.5-4.5	50-100	4.5-5.5	100-200	5.0-6.0	150-250	5.5-7.0	200-400	7.0- 8.5	400- 700
	< 3.5	< 50	< 4.5	< 100	< 5.0	< 150	< 5.5	< 200	< 7.0	< 400

Onshore wind energy resource, as computed on a broad scale for the European Wind Atlas.

I. TECHNOLOGY: Wind resource estimation 2/2

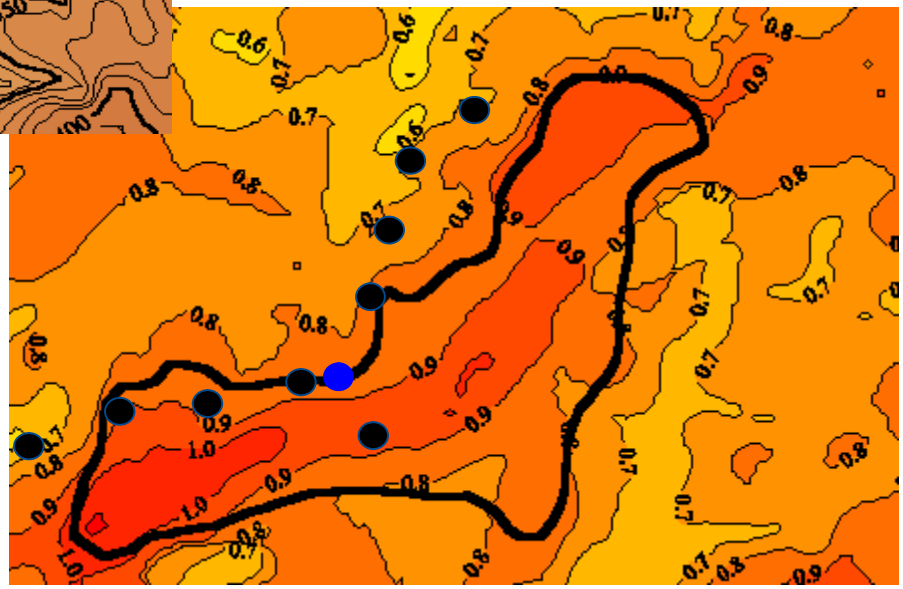


Computational flow modelling initiated from wind conditions at mast

Input - topography

Have predicted wind conditions at each turbine location

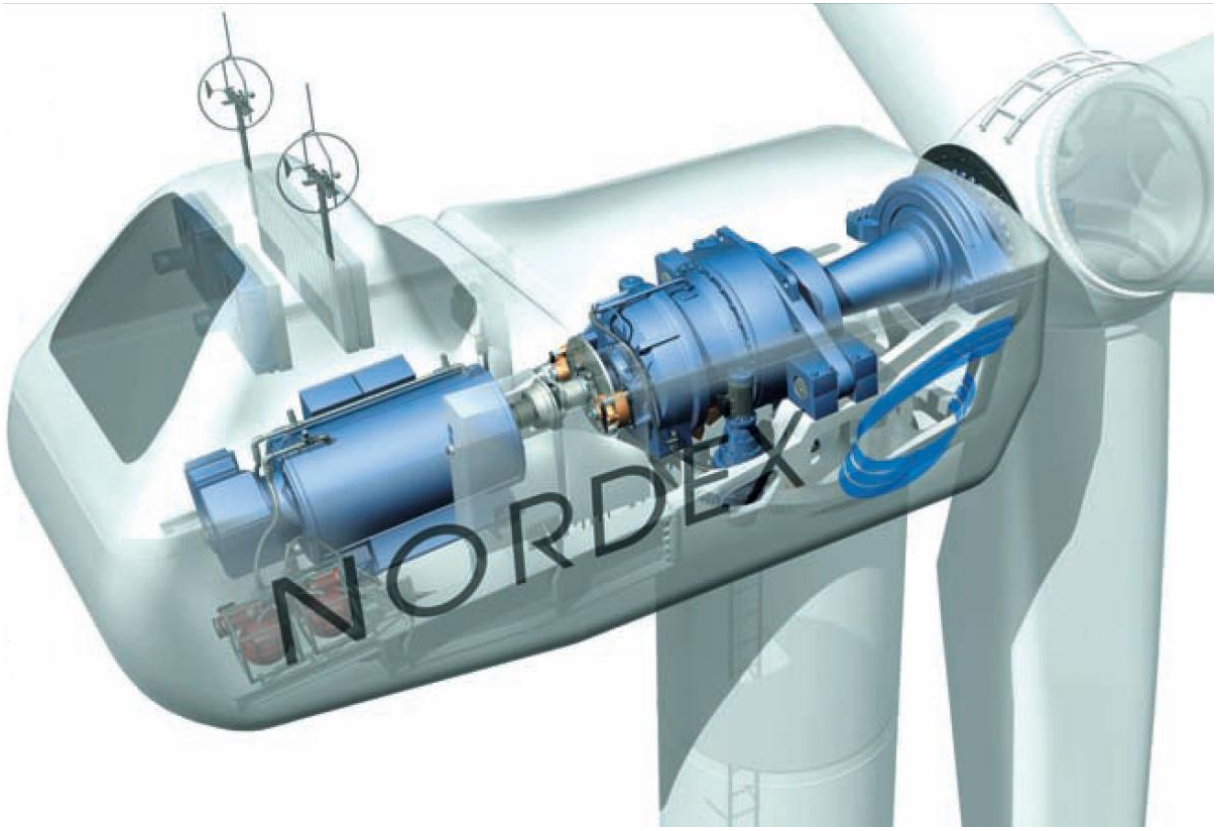
In this example annual mean wind speed varies by 30 % over site area



Output normalised wind speed

I. TECHNOLOGY: Wind turbine 1/2

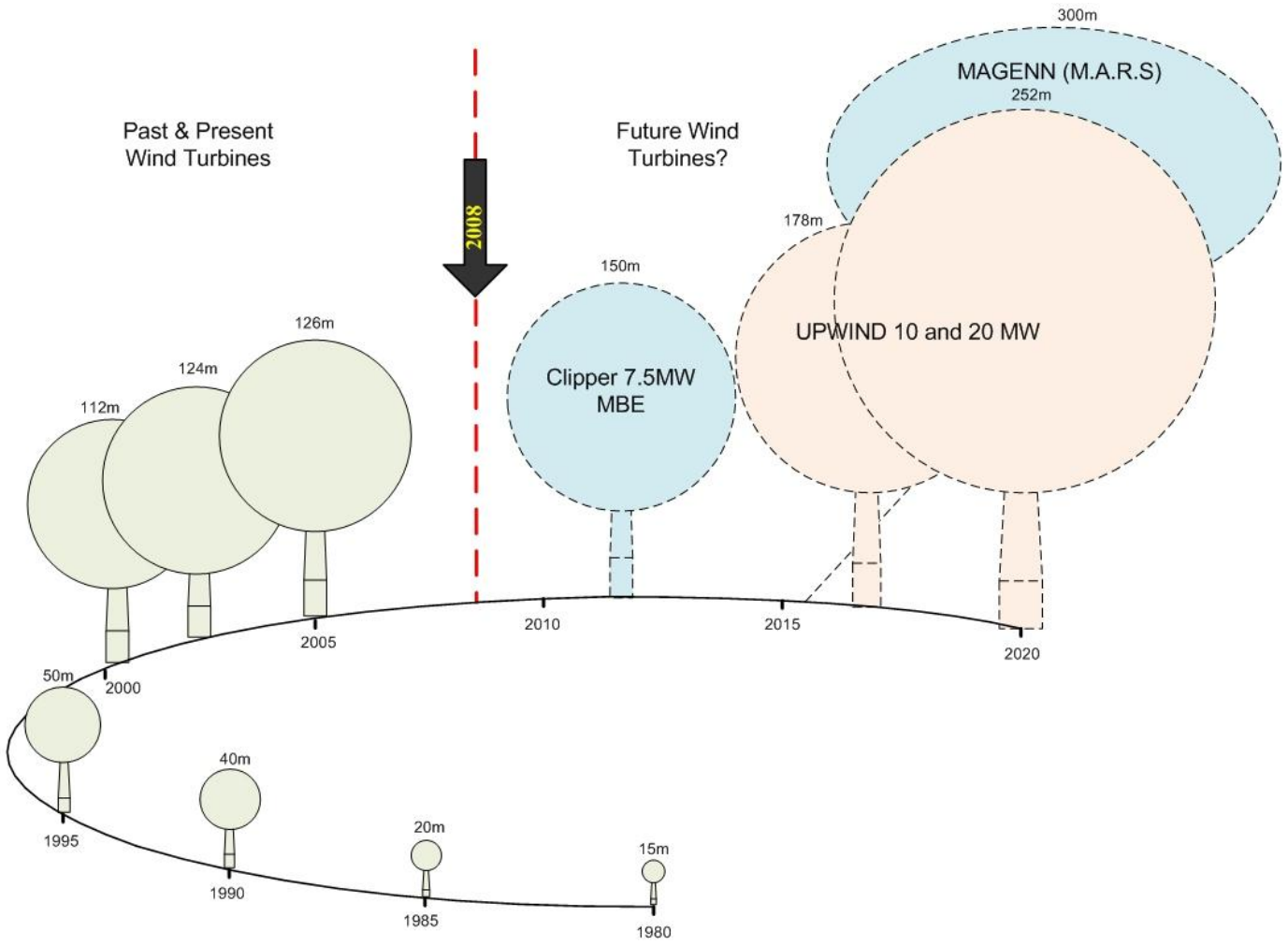
WIND TURBINE –WHAT'S INSIDE?



I. TECHNOLOGY: Wind turbine 2/2

WIND TURBINES

How big will they get?



II. GRID INTEGRATION 1/4

- Wind power fits well in power systems, the need for additional 'integration efforts' depend on:
  - Wind power penetration
  - Flexibility of the power system in question:
    - Generation (up and down regulation capability)
    - Demand management and storage
    - Interconnection (available capacity)
    - Power market characteristics (e.g. for balancing services): time, geographical area.

- Flexibility varies widely in EU. Integration efforts (e.g. moving to more flexibility) can be implemented by suitable market design (rules, incentives).

II. GRID INTEGRATION 2/4

THE MAIN CHALLENGES

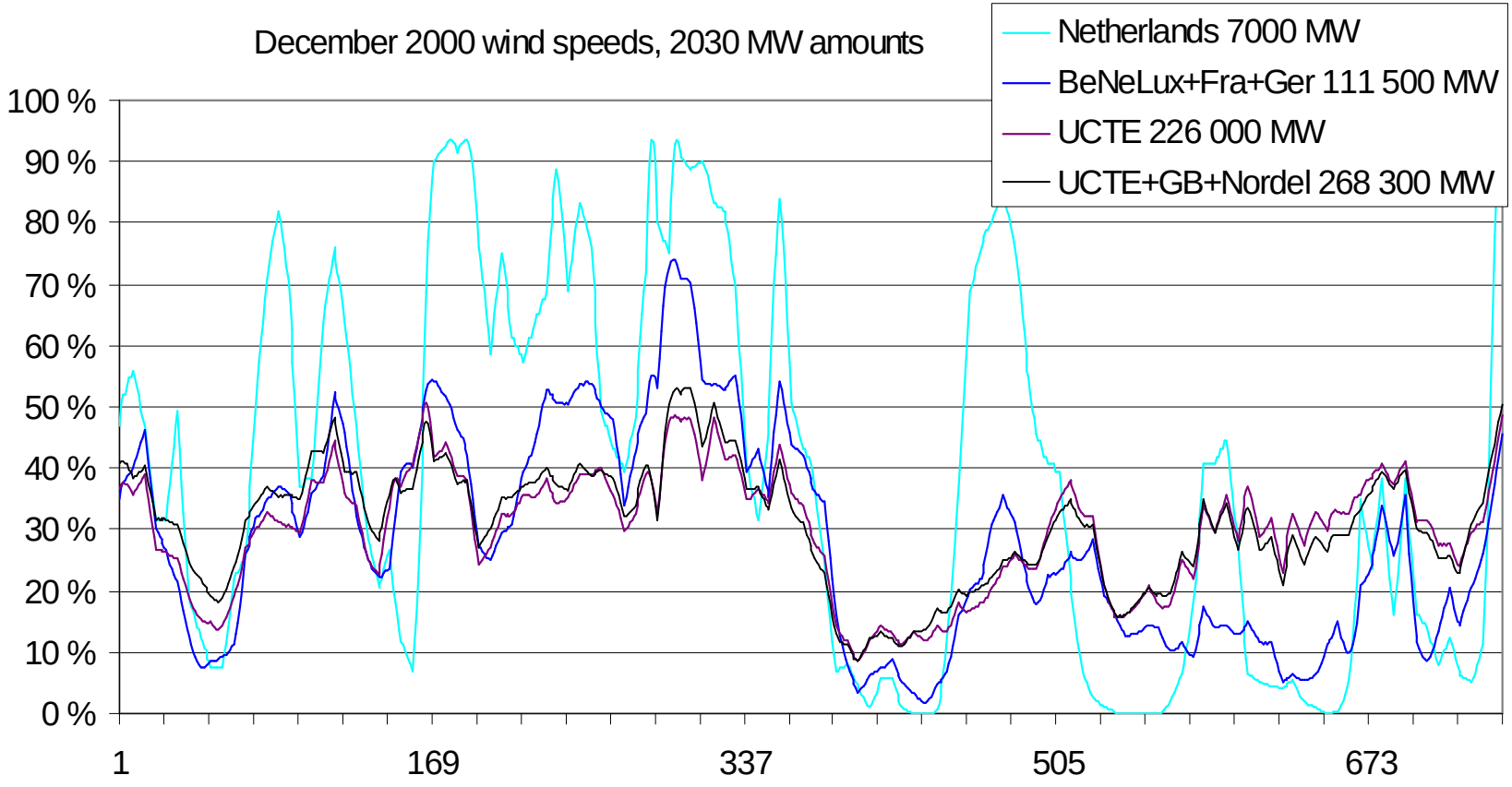
- Increased power flows as wind power capacity increases
- Distance of wind power from load centres

ISSUES

- European grid is weak on interconnections
- Often weak distribution grids
- Interconnection projects face long lead times (10 years) due to planning obstacles.
- Cost allocation : example approach = Infrastructure planning law in Germany (offshore grids for wind power to be built by TSO ṡ.

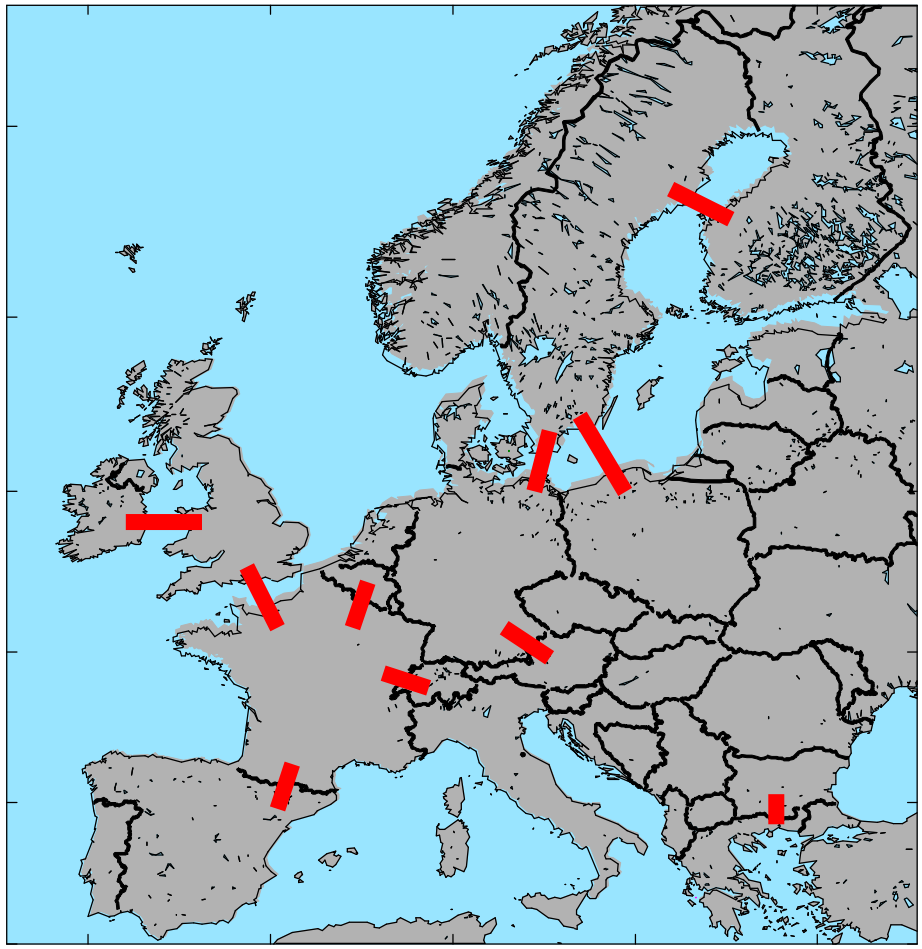
II. GRID INTEGRATION 3/4

The need for interconnection: spatial smoothing effect



II. GRID INTEGRATION 4/4

- Large amounts of wind power (2020, 2030 scenarios) will increase congestions in interconnectors
- Strong adequate interconnectors will allow for a 27 GW firm generating capacity for 2020 (200 GW scenario).



III. ECONOMICS OF WIND: Costs 1/2

- Investment costs
- O&M costs
- Electricity production
- Average wind speed
- Turbine lifetime
- Discount rate

Cost structure of a typical 2 MW wind turbine installed in Europe (€2006)

	INVESTMENT (€1,000/MW)	SHARE OF TOTAL COST %
Turbine (ex works)	928	75.6
Grid connection	109	8.9
Foundation	80	6.5
Land rent	48	3.9
Electric installation	18	1.5
Consultancy	15	1.2
Financial costs	15	1.2
Road construction	11	0.9
Control systems	4	0.3
TOTAL	**1,227**	**100**

Source: EWEA 2009 report "The Economics of Wind Energy"

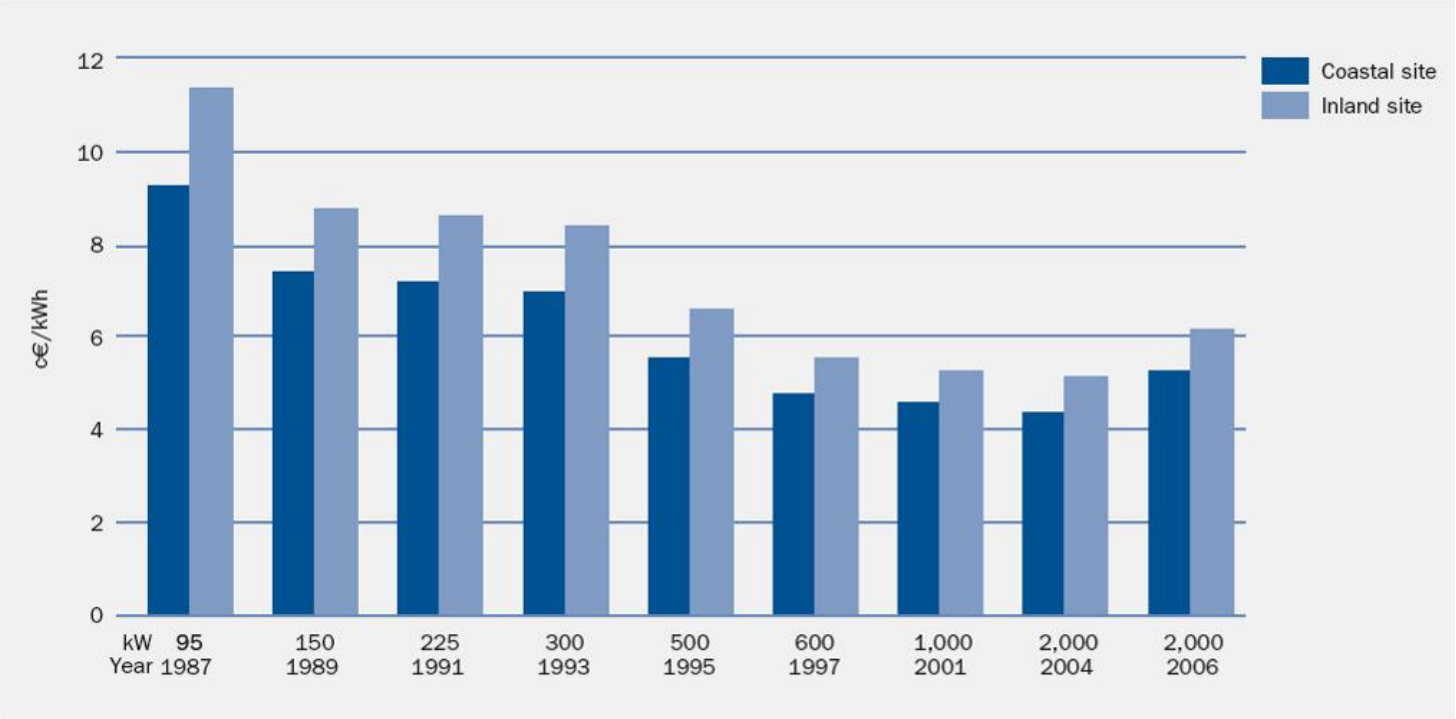
- Wind energy: 75% of costs paid upfront
- Conventional power: less capital intensive – uncertain fuel and carbon costs

III. ECONOMICS OF WIND: Costs 2/2

Production costs are decreasing

- Trend towards larger turbines
- Trend towards improved cost-effectiveness
- Costs have gone down by more than 40%

Total wind energy costs per unit of electricity produced, by turbine size (c €/kWh, constant €^{2006} prices), and assuming a 7.5% discount rate



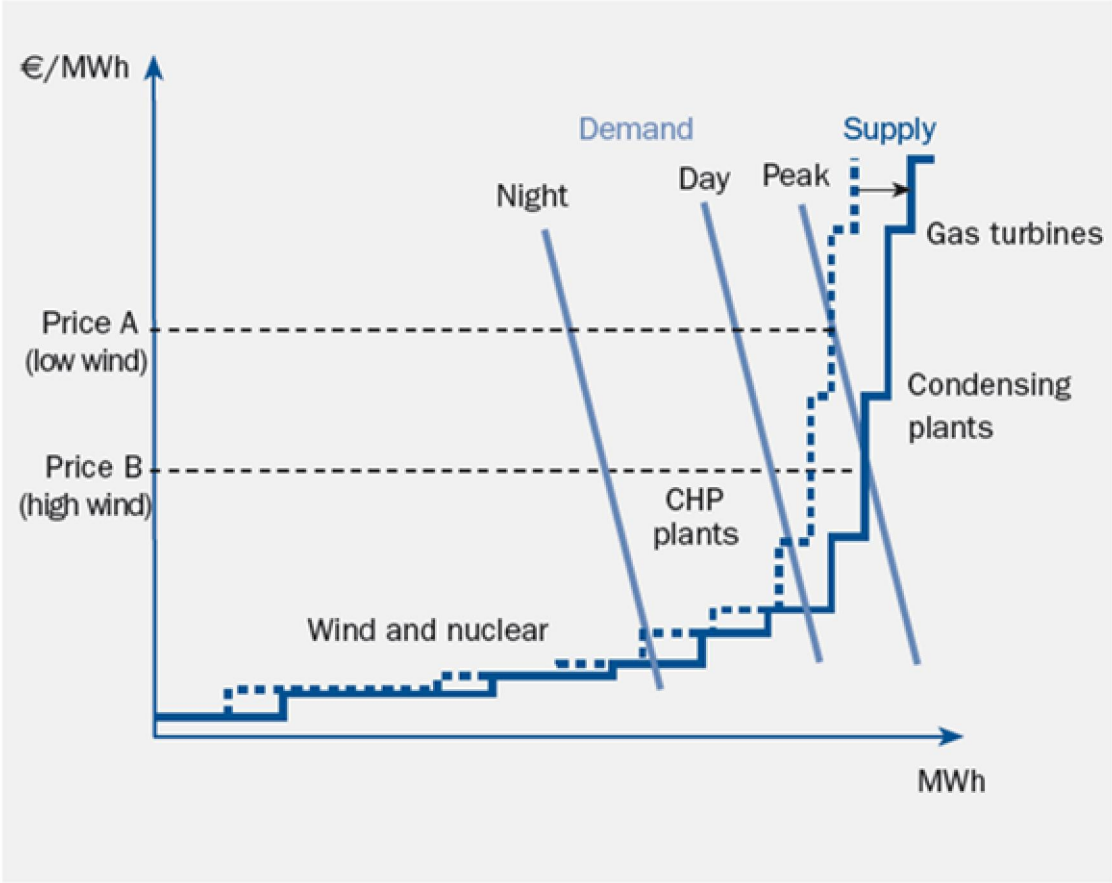
Source: EWEA 2009 report "The Economics of Wind Energy"

III. ECONOMICS OF WIND: Electricity price

Wind energy reduces power price - merit - order effect

- Impact of wind power depends on time of the day
- High demand and high wind impact the spot power price significantly
- Lower power spot price is beneficial to all consumers

How wind power influences the power spot price at different times of day



Source: EWEA 2009 report "The Economics of Wind Energy"

WIND ENERGY IN EU-27 - 2008 FACTS (I)

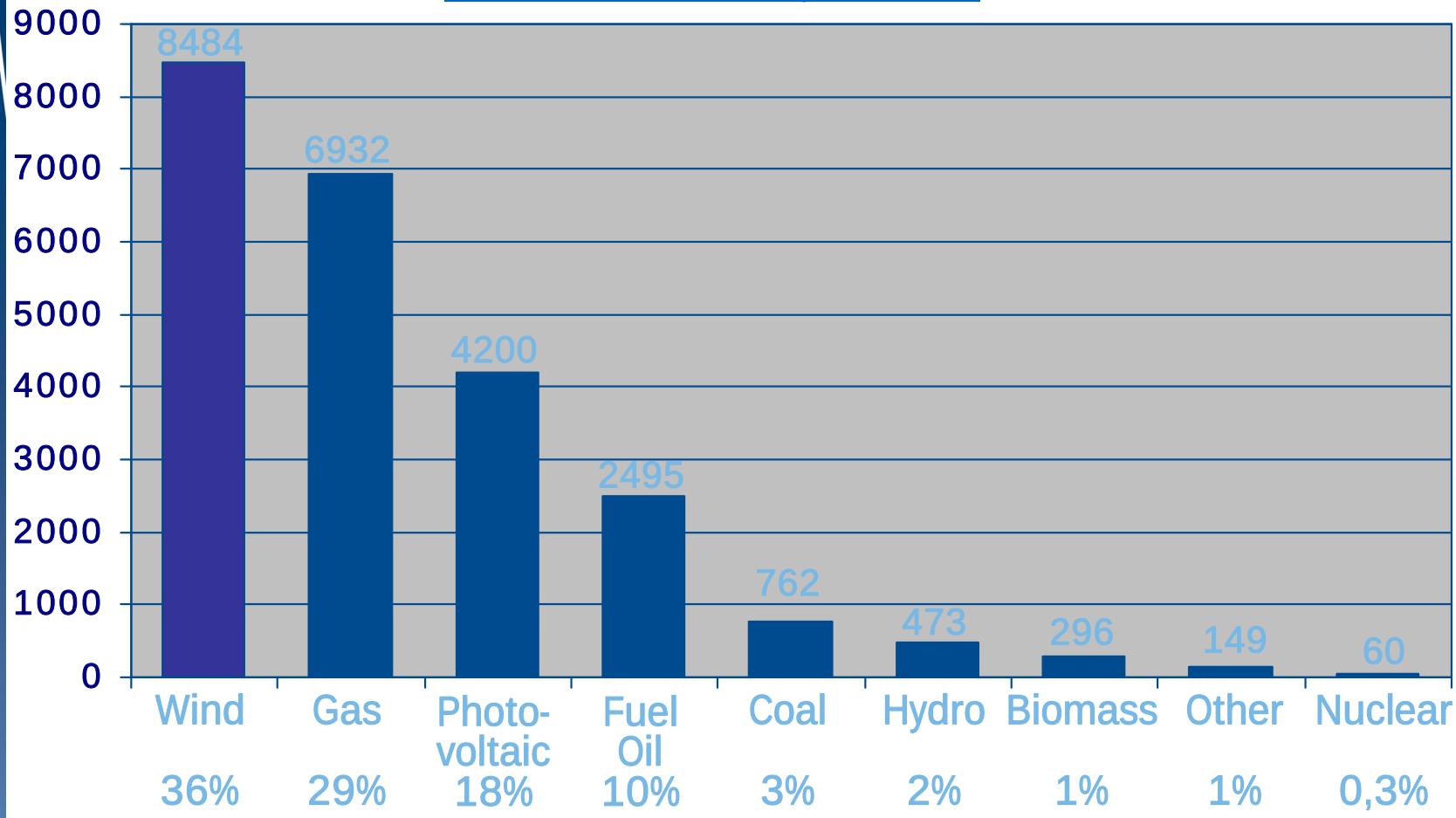
- 65 GW installed capacity, incl. 1.47 GW offshore
- Annual installations of 8.5 GW, incl. 0.35 GW offshore
- Electricity production of 142 TWh
- Meeting 4.2% of total EU electricity demand
- Providing power equivalent to the needs of 35 million average EU households

WIND ENERGY IN EU-27 –2008 FACTS (II)

- Avoiding 108 Mt of CO2 –equivalent to taking more than 50 million cars off the road (20% of the EU car fleet) and equal to 31% of the EU-15 ś Kyoto obligation
- Annual avoided fuel cost of €5.4 billion
- Annual avoided CO2 costs of approximately €2.4 billion
- Annual investments in wind turbines of €11 billion

WIND LEADS THE EU POWER SECTOR

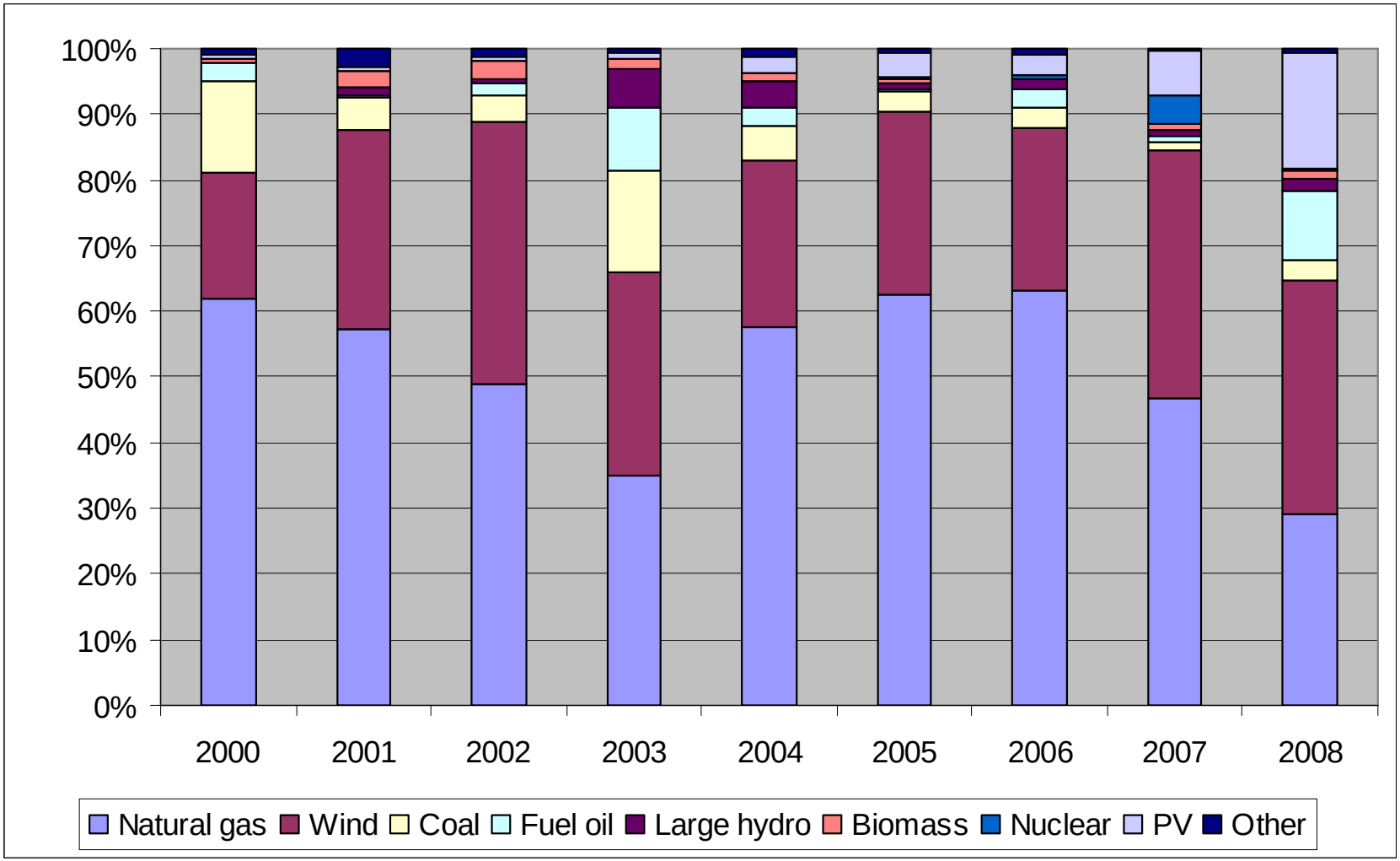
NEW POWER CAPACITY INSTALLED IN 2008
Total installed: 23,851 MW



Note: Preliminary figures for solar photovoltaic installations

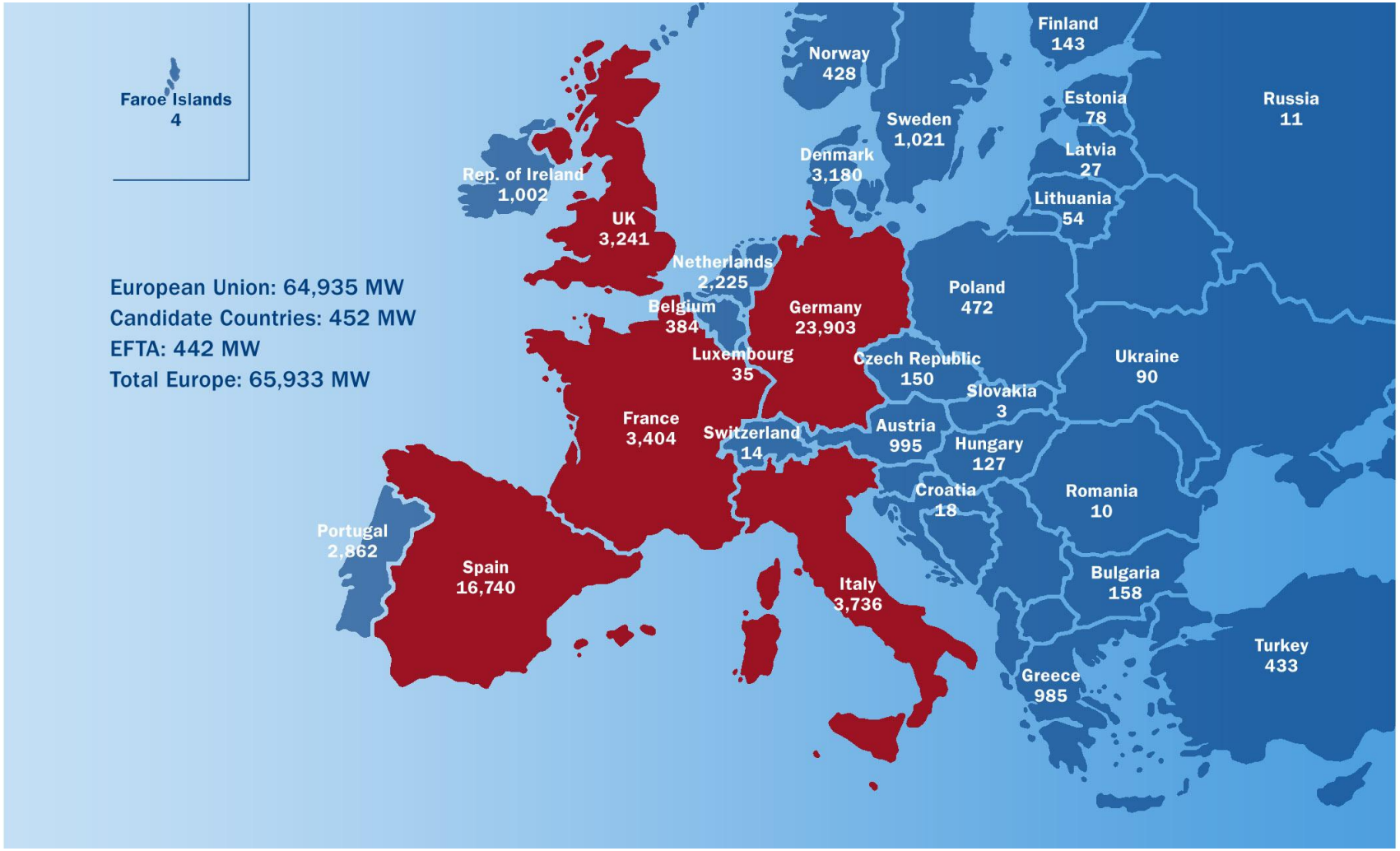
Source: EWEA, EPIA and Platts PowerVision

NEW CAPACITY INSTALLED BY ENERGY SOURCE IN EU (2000-2008)



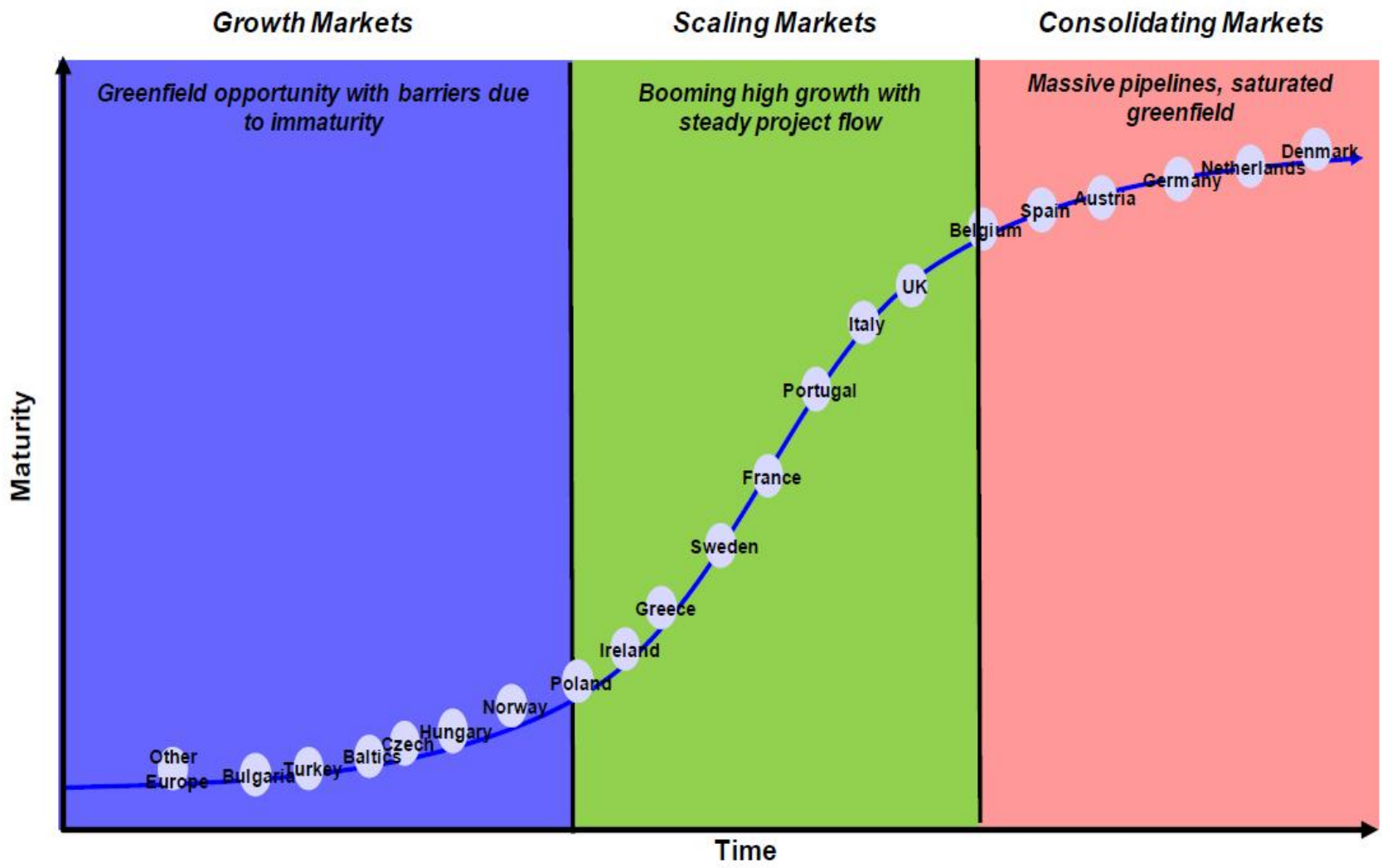
Source: Platts PowerVision 2008

EU TOP 5 WIND ENERGY CAPACITY



Source: EWEA Wind Map 2008

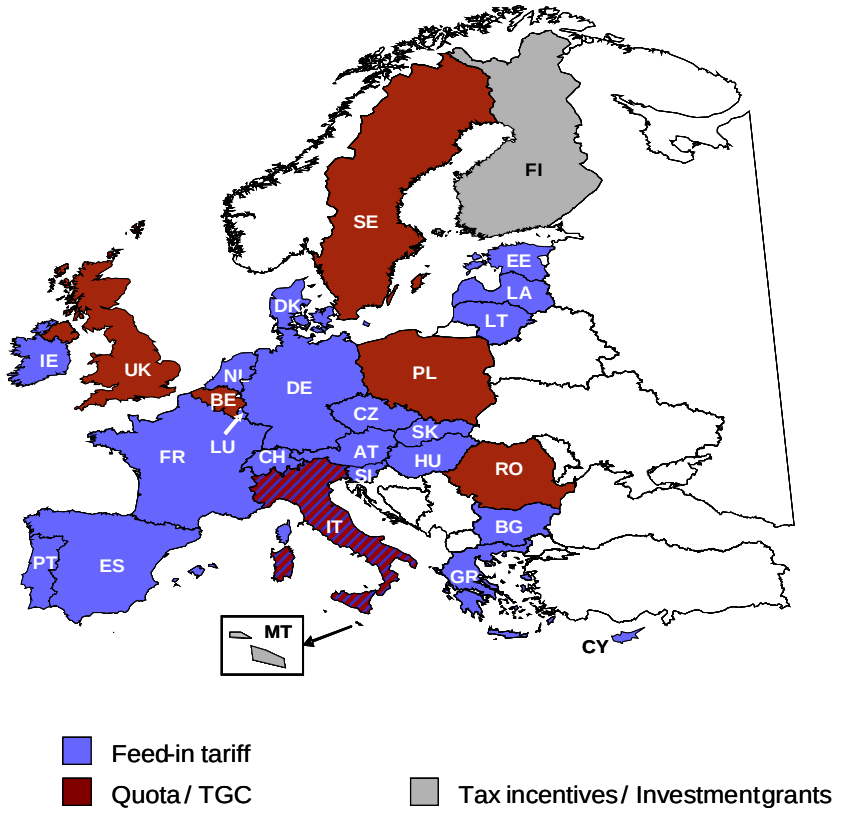
ONSHORE MARKETS ARE DEVELOPING AT THREE SPEEDS



Source: Emerging Energy Research

IV. INDUSTRY AND MARKETS: Support schemes for RES-E 1/2

- **National support schemes**
  - Each Member State can choose its own support scheme
  - Strong tendency towards:
    - Feed-in tariffs
    - Quota obligations with tradable green certificates



IV. INDUSTRY AND MARKETS: Support schemes for RES-E 2/2

1. Feed-in tariffs (FIT)

- Renewable electricity can be fed into the grid at a guaranteed tariff for a determined period of time

2. Quota obligation with tradable green certificates (TGC)

- Additional revenue above market price from selling TGCs

3. Tender procedures

- In a bidding round projects with the lowest generation costs can obtain financial support

4. Incentives

- Tax incentives or investment grants

IV. INDUSTRY AND MARKETS: Employment 1/2

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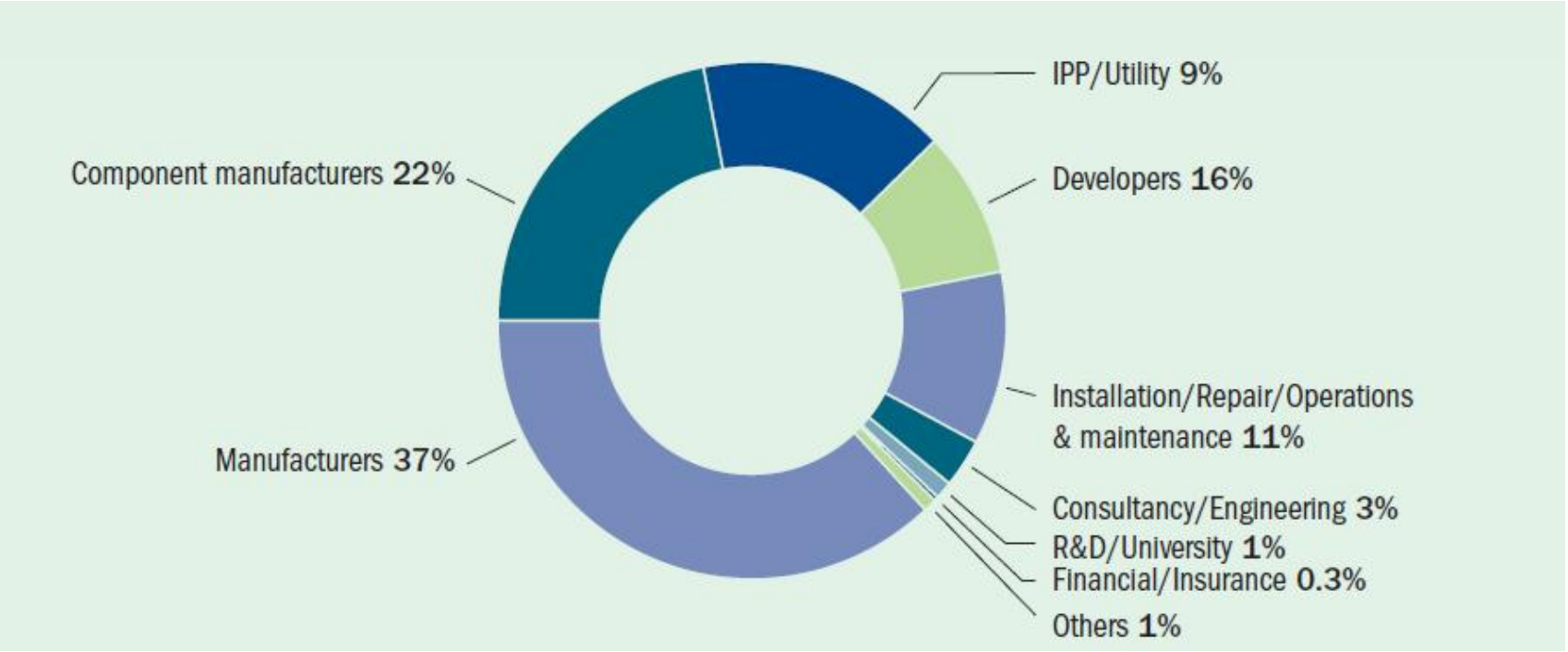
What is the current employment situation?

- The EU wind energy sector directly employed approximately **108,600 people** in 2007
- Including indirect jobs, the sector employed **154,000 people**
- Direct employment has increased by **60,237 (125%)** since 2002
- On average, the wind energy sector in Europe has created **33 new jobs every day, seven days a week over the past five years**
- Wind turbine and component manufacturers are responsible for the 59% of direct wind energy employment

IV. INDUSTRY AND MARKETS: Employment 2/2

Employment breakdown across sectors

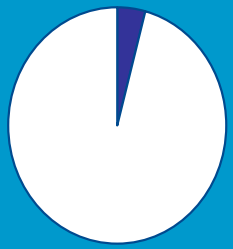
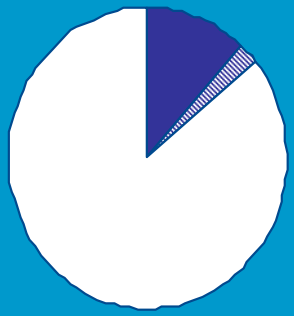
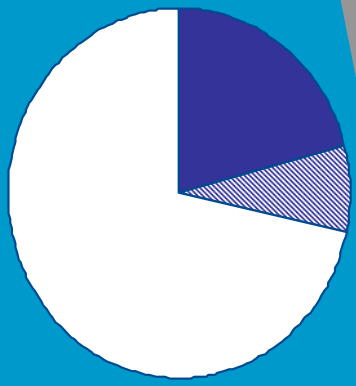


V. ENVIRONMENT

- Global environmental benefits
  - Wind energy is a clean energy source
- Local environmental impacts
  - Are site-specific, vary among the different species and should be put in context
  - Can be avoided/minimised: the role of environmental assessments, mitigation and compensation measures
- Conclusions and recommendations
  - Achieving the 20% RES target while respecting biodiversity

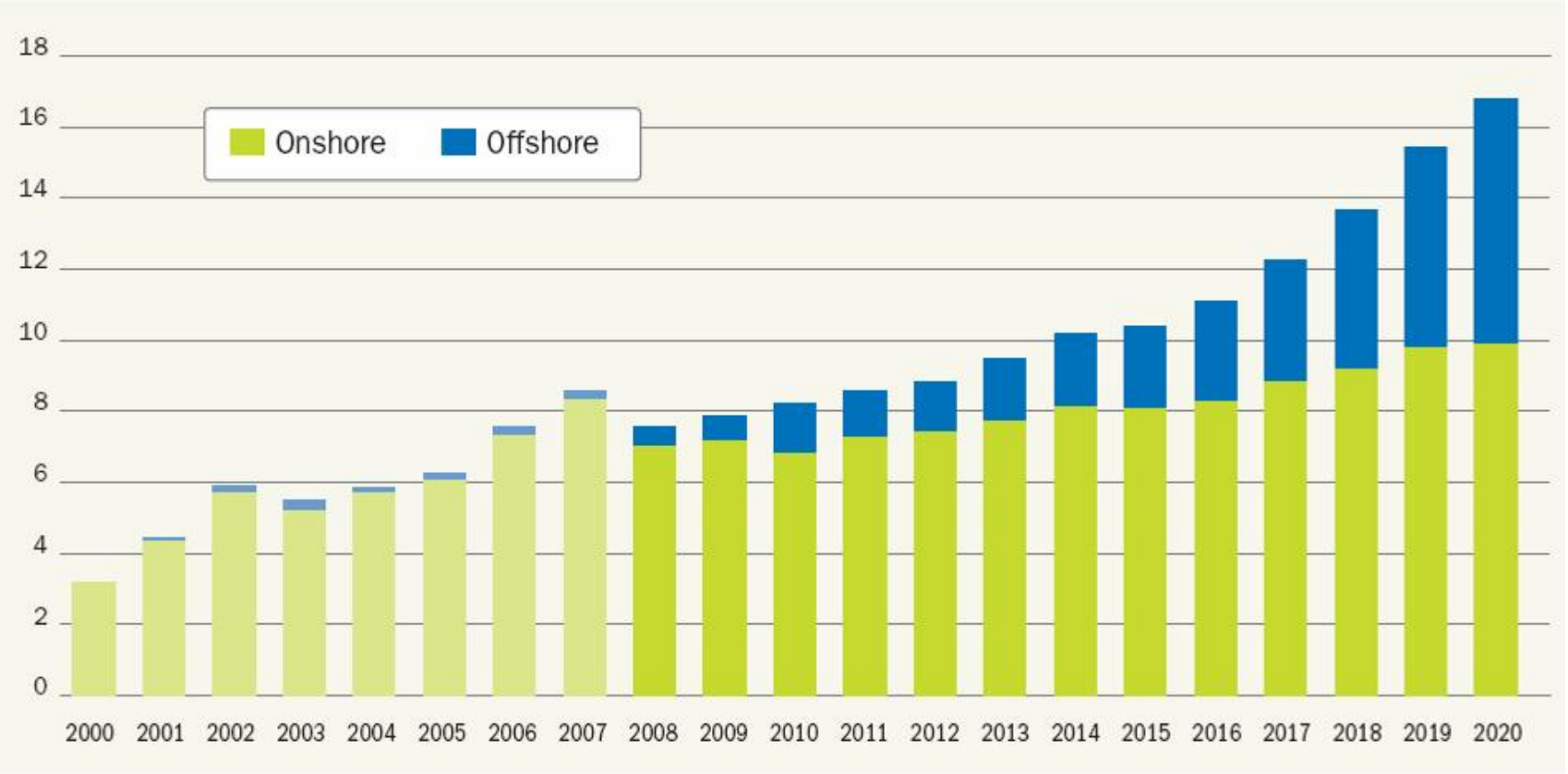
WIND ENERGY EXPANSION

Rising energy demand and contribution from wind power

1980s-1990s	2008	2020	2030
			
Two decades to install 0.9% of EU electricity demand	Accelerating pace: reaching 4.2% end 2008	11.6%-14.3% despite growing demand	Meeting between 20.8% & 28.2% of the EU need
Demand: 2,577 TWh	Demand: 3,380 TWh	Demand: 4,107 TWh	Demand: 4,503 TWh

Source: EWEA

EU 27 - WIND ENERGY ANNUAL INSTALLATION 2000-2020 (GW)



Source: EWEA

HOW MUCH RES-E?
HOW MUCH WIND POWER?

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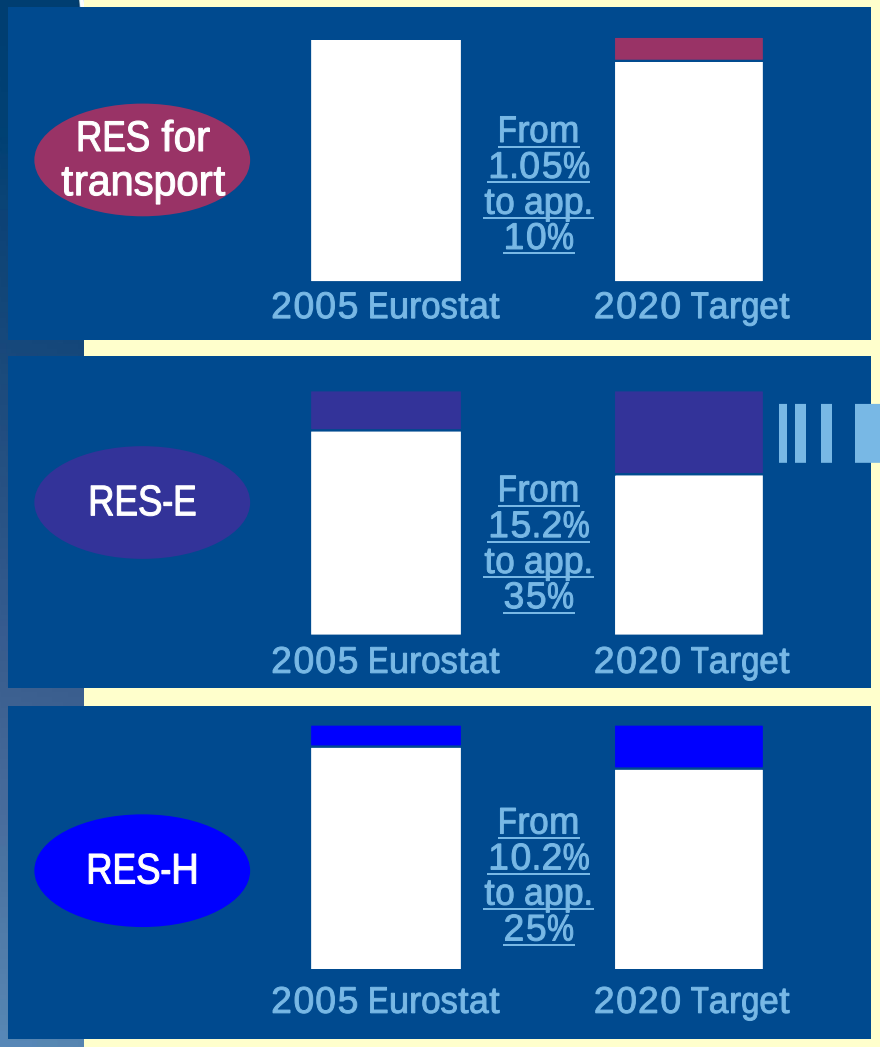
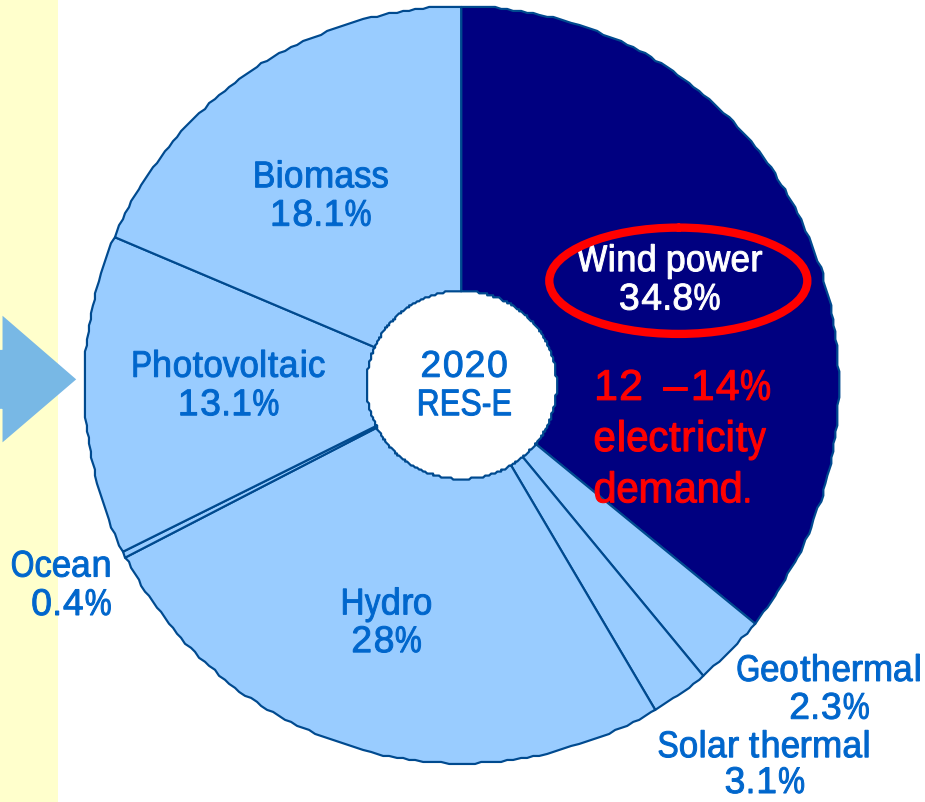
How to reach the 20% target





Source: EREC Renewable Energy Technology Roadmap –20% by 2020, November 2008 and Eurostat, EC 2007 communication

New EWEA Target for the European Union

- 230,000 MW in 2020
- (including 40,000 MW offshore)
- 600 TWh per year by 2020
- 14 – 18 % of EU Electricity Demand

EUROPEAN WIND ENERGY EVENTS

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EUROPEAN
OFFSHORE WIND 2009
Conference & Exhibition
14 - 16 September, Stockholm, Sweden

- Come to this year ś offshore wind event in Stockholm (14 - 16 September 2009)
- Over 80% of the exhibition space has already been sold.
- 2000 participants expected
- More information: www.eow2009.info

ewec 2010
WARSAW
Europe's premier wind energy event

- EWEAs annual event will take place in Warsaw, Poland (20 –23 April 2010).
- More information: www.ewec2010.info

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- www.windfacts.eu

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

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Thank you very much for your attention

www.ewea.org

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