Environmental impacts of wind power (onshore & offshore)

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One of 4 1.3MW turbines, Westmill Cooperative Windfarm, near Oxford, UK: a typical setting

http://www.westmill.coop

- The impacts considered are from installed wind turbines on windfarms
- Manufacture is not considered here, which relates to standard industrial practice for engineering structures
- ‘Wind Energy The Facts ’analyses and quantifies environmental factors by formal mechanisms of Life Cycle Assessment (LCA:ISO 14040-44 etc) and External Costs; essential for governmental policy

Planning and operation

- Environmental factors are of major importance
- Impacts are both positive and negative
- Aim to reduce the -ve, increase the +ve
- Both the public and the site staff appreciate good environmental practice
- Much environmental knowledge is gained from Windfarm Environmental Impact Assessment, EIA, *e.g. bird behaviour, public perception, noise reduction, sympathetic design*

Classes of impact in general

- Chemical *e.g. air and water pollution, climate-change emissions*
- Physical *e.g. noise, collision, radar, TV*
- Biological *e.g. infertility*
- Ecological *e.g. flora, fauna, agriculture*
- Psychological *e.g. visual effects on humans*

Impacts are

- Positive (+) i.e. benefits, and so welcome by all

  e.g. generate electricity,

  abate emissions from substituted fossil fuels, provide jobs

- Negative (-) and so unwanted

  e.g. associated acoustic noise

- Neutral (o) and so unnoticed

  e.g. foundations

Area of impact

- GLOBAL, *international*

  e.g. climate change

- REGIONAL, *governmental*

  e.g. employment, investment,
  bird population, radar

- LOCAL, *community , site specific*

  e.g. noise, visual impact, sunshine flicker

	Global	Regional	Local
chemical			
physical			
ecological			
psychological/ emotional (human only)			

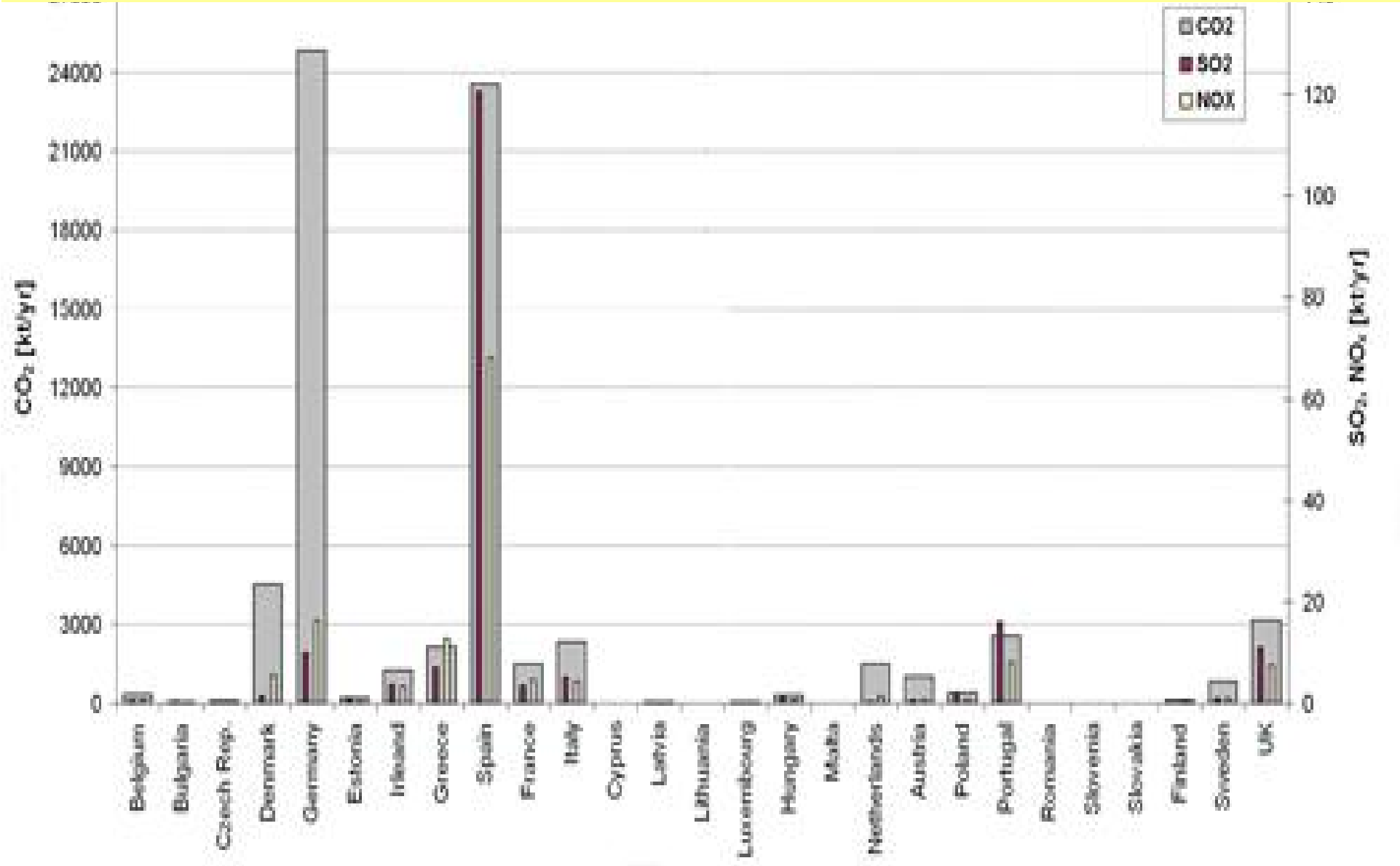
Chemical impacts: CO_2 abatement from reduced electricity generation from fossil fuels

- Abatement of fossil CO_2 is the most significant impact (+ve, benefit) because of Climate Change and national reduction targets
- World wind capacity now ~140 GW, abating ~170 Mt CO_2 /y (~ 60Mt coal/y)
- Carbon trading is *'internalising this externality'*

Other chemical impacts

- +ve : abated SO_2 , NO_x, wastes, ash and other chemicals, especially if coal plant is marginalised
- +ve: abated cooling water if thermal plant marginalised
- +ve: abated extraction, transportation, logistics and fuel of fossil fuels
- +ve: abated ill-health from pollution

Avoided emissions from wind power in the EU in 2007: *Wind Energy The Facts, part 5 ch 5*



Physical impacts: acoustic noise outside the turbine

- -ve, annoying to everyone and a sign of inefficiency *(so < 40 dBA outside nearest house)*
- Mechanical noise, e.g. from gearboxes, is now largely eliminated
- Blade-generated noise is intrinsic, but decreased by accurate angle of attack and efficient blade profiles
- Pulsation of blade noise by tower-passing and wind shear is intrinsic

Physical impact: visibility

- Turbine rotors need to be high and in open country, so always potentially visible
- Reduce near-zone visibility by careful siting
- Choose colours, finishes etc to reduce visibility
- Few large turbines better than many small (cheaper, more spaced ~5 diameters, slower rotation)

Middelgrunden windfarm, off Copenhagen: artistic design inspiration

Physical impacts: electromagnetic radiation, predominantly line-of-sight interaction

- TV (easily solved with local boost transmitter not in line-of-sight)
- Microwave (avoid line-of-site turbines)
- Radar (may be a real difficulty for air traffic controllers; special software removes signals)

Ecological harmony is basic for sustainability; wind power is an aspect of ecology.

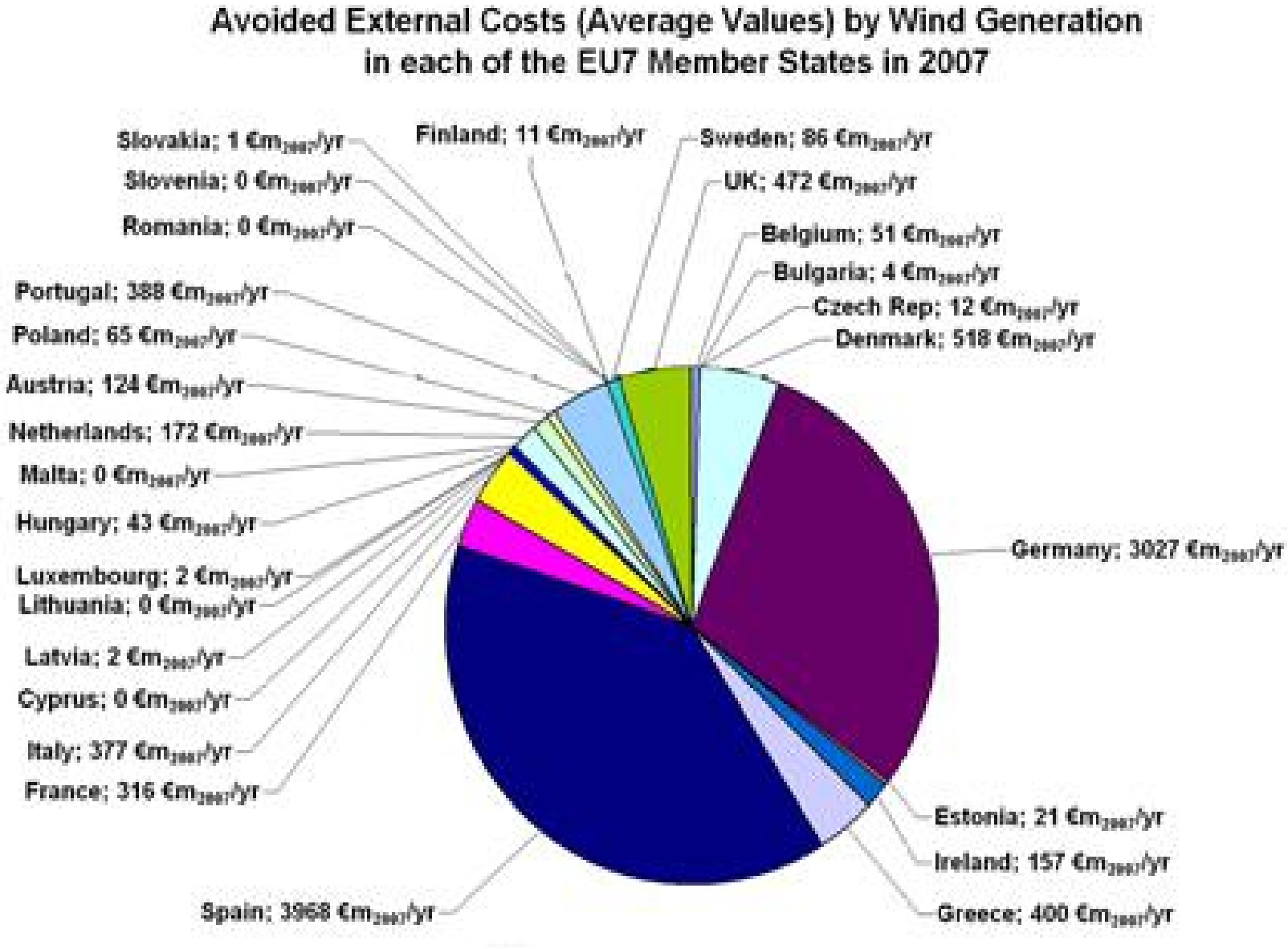
Ecological impact

- -ve Bird and bat strike (but does it effect species population?)
- -ve Disruption at installation
- -ve No trees
- +ve Windfarm is secure open-space for natural species and agriculture
- +ve Ecocompensation *(e.g. ponds, low vegetation for fauna & flora, marine fish breeding)*
- Decommissioning & removal are easy; wind turbines are temporary structures (< 25 y)

Psychological/emotional impact

- Emotional factors are real and require sympathy
- Each person is different
- Understanding, co-operation, ‘ownership ’and time make these impacts more positive
- Only humans notice visual impact, which may be positive, but is often negative
- ‘Landscape ’, ‘countryside ’, ‘industrial ’are complex terms, with different meaning to different people

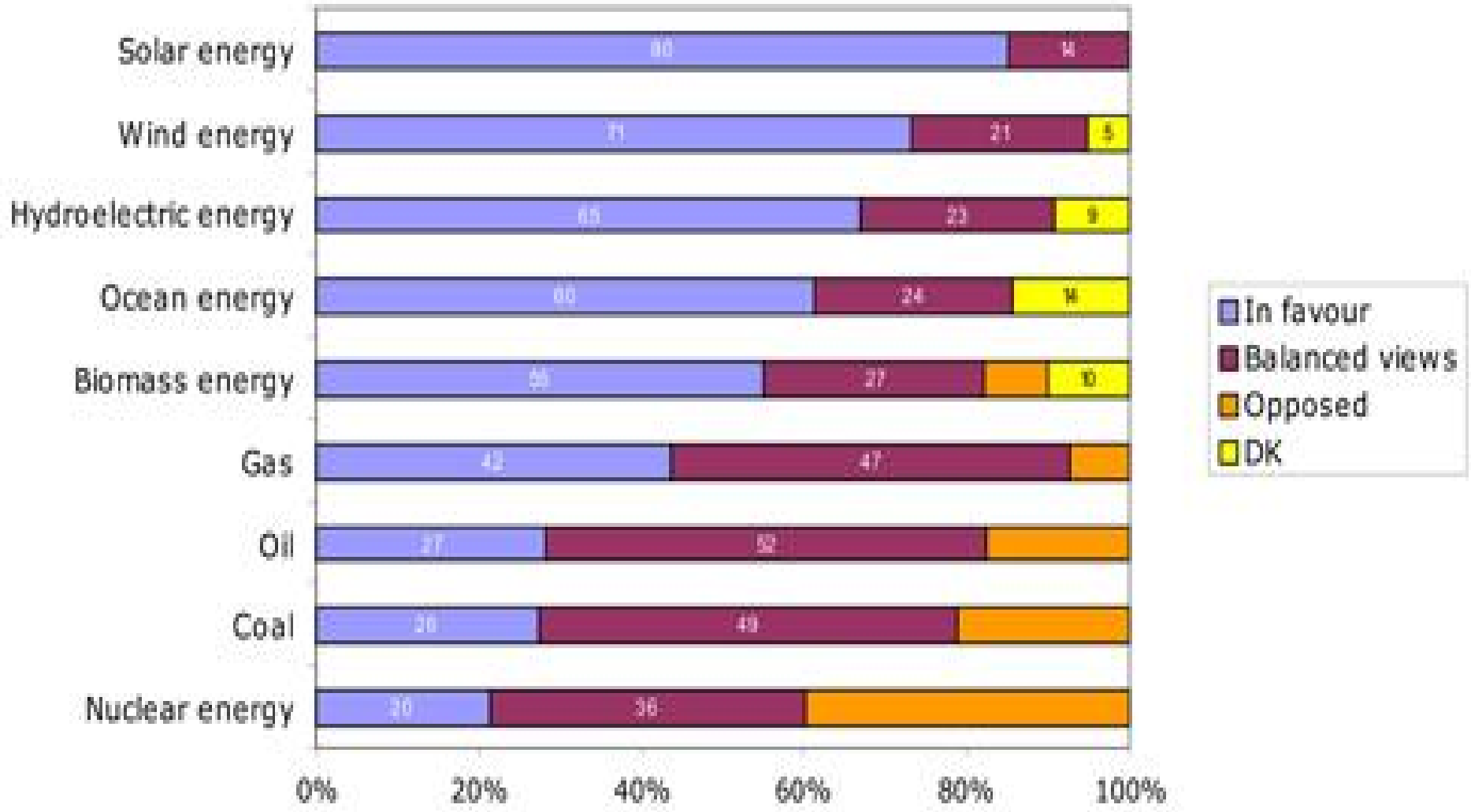
Analysis of impacts by evaluating avoided external costs: *Wind Energy The Facts, Part 5, chapter 5*



Social attitudes about EU energy sources: vital importance of public acceptance of policy

(but anti anything ĩn my back yard)

Special EB 262 (EC, 2007) from Wind Energy The Facts, EWEA 2009



	Global	Regional	Local
chemical	+ no CO_2	+ no SO_2, no NO_x	+ No smoke etc + No cooling water + No fuel transport
physical		+ no radioactivity + no wastes - radar - microwave comm	+ open access + grid reinforcing - power variability - acoustic noise - TV - marine collision
ecological	+ climate change abatement -rare species? + sustainability	-bird population? + fish breeding + eco-compensation	+ agriculture OK - bird & bat strike + eco-compensation
psychol-ogical/ emotional (human only)		+ energy security	- visual impact - sunshine flicker o visual impact