



# Wind Energy Trends in Denmark

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SEAI and IEA Wind Task 26 seminar  
"The Cost and Value of Wind Energy"  
Dublin, May 26, 2014



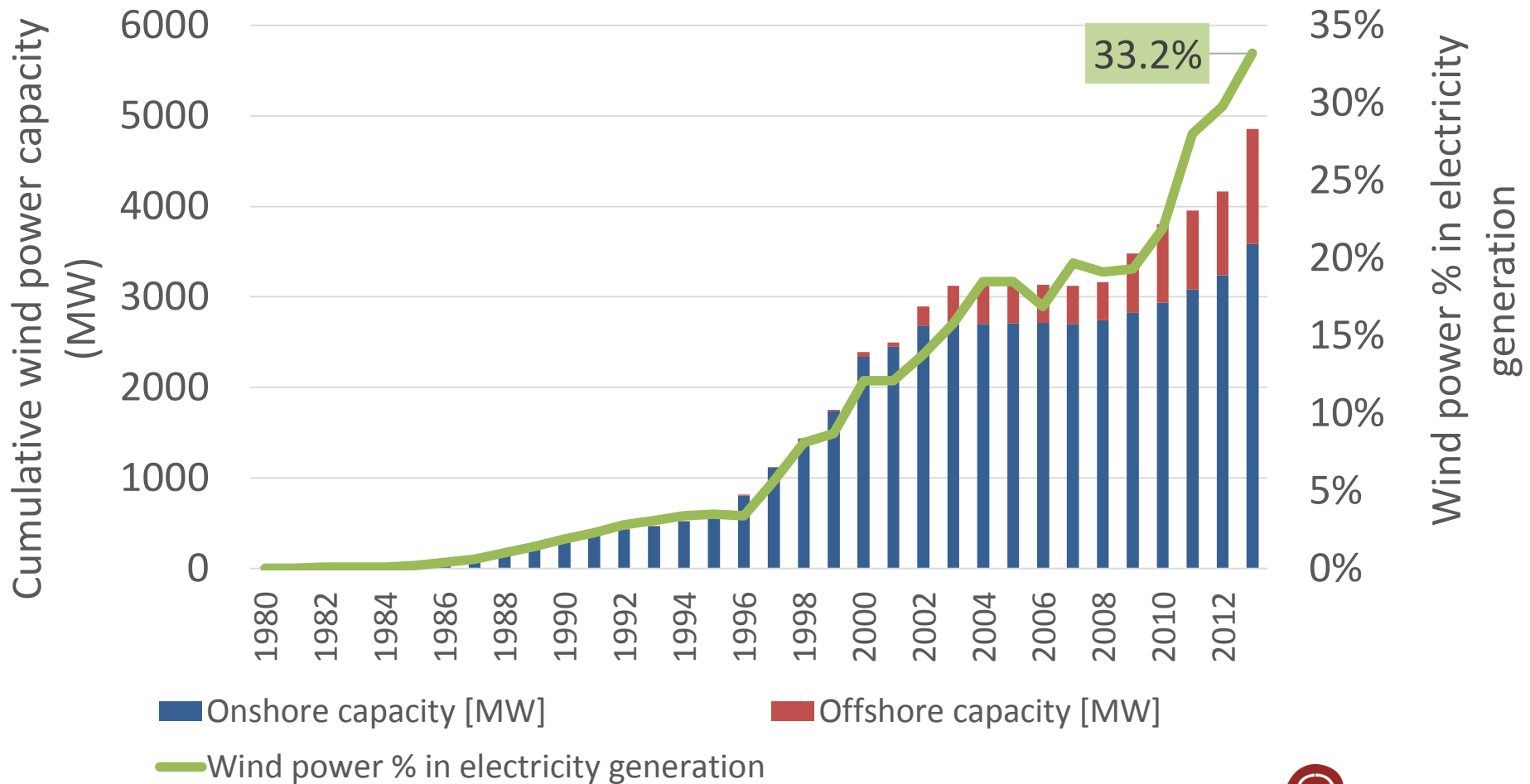
# On the menu



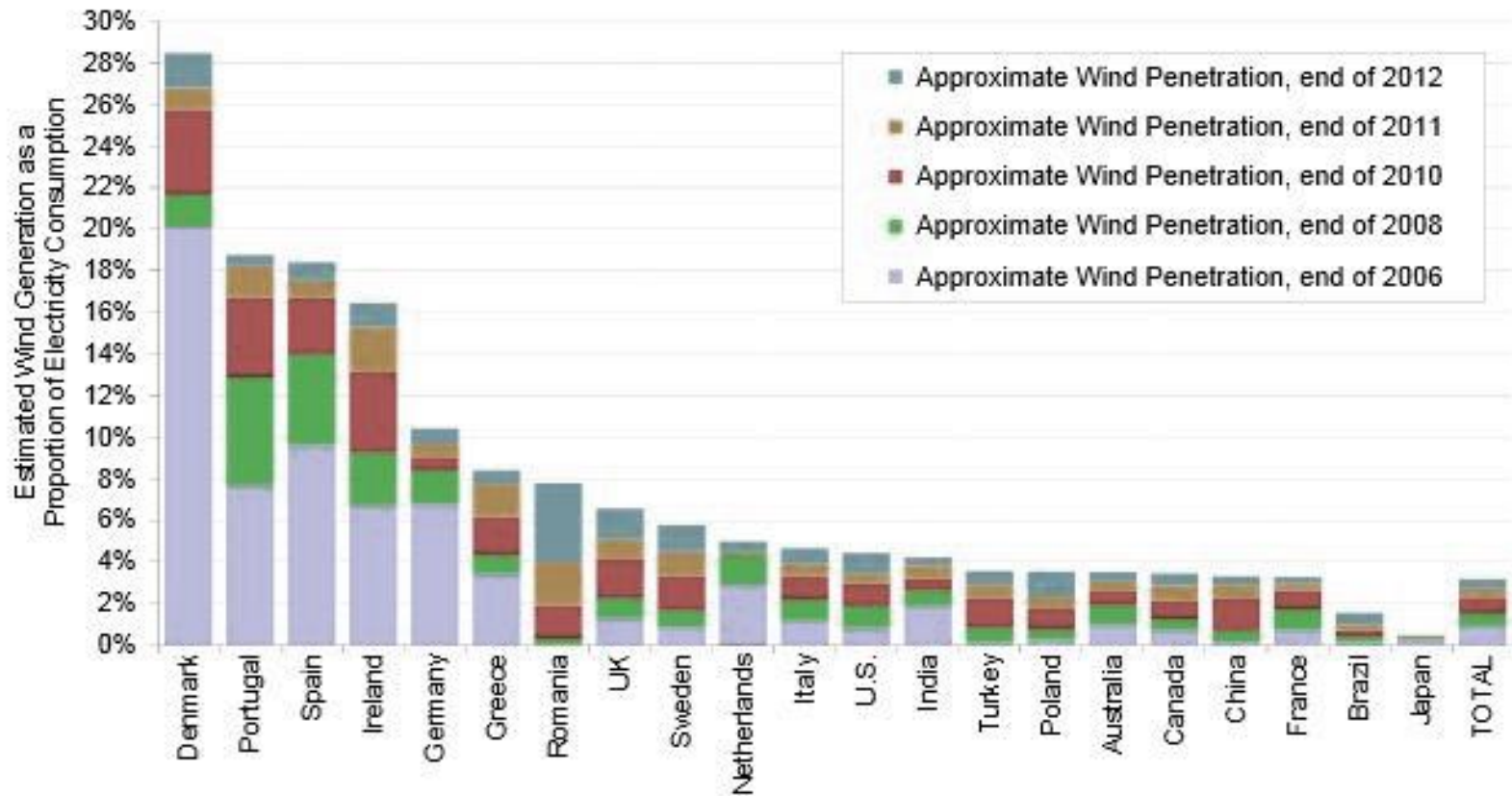
- The particularities of the Danish (wind power)
  - Early adoption and high penetration
  - TSO's involvement and cost sharing
  - Public access to data – and ownership
  - Repowering (\*)
- Wind energy project cost drivers
- Cost development over time in Denmark

# THE PARTICULARITIES OF THE DANISH WIND POWER

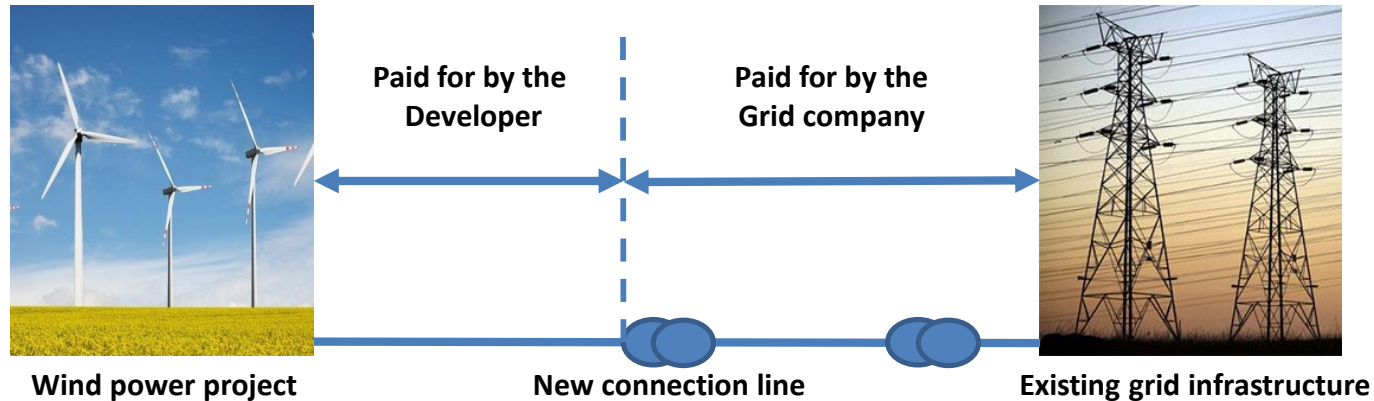
# The particularities of the Danish wind power: Early adoption & high penetration (1)



# The particularities of the Danish wind power: Early adoption & high penetration (2)

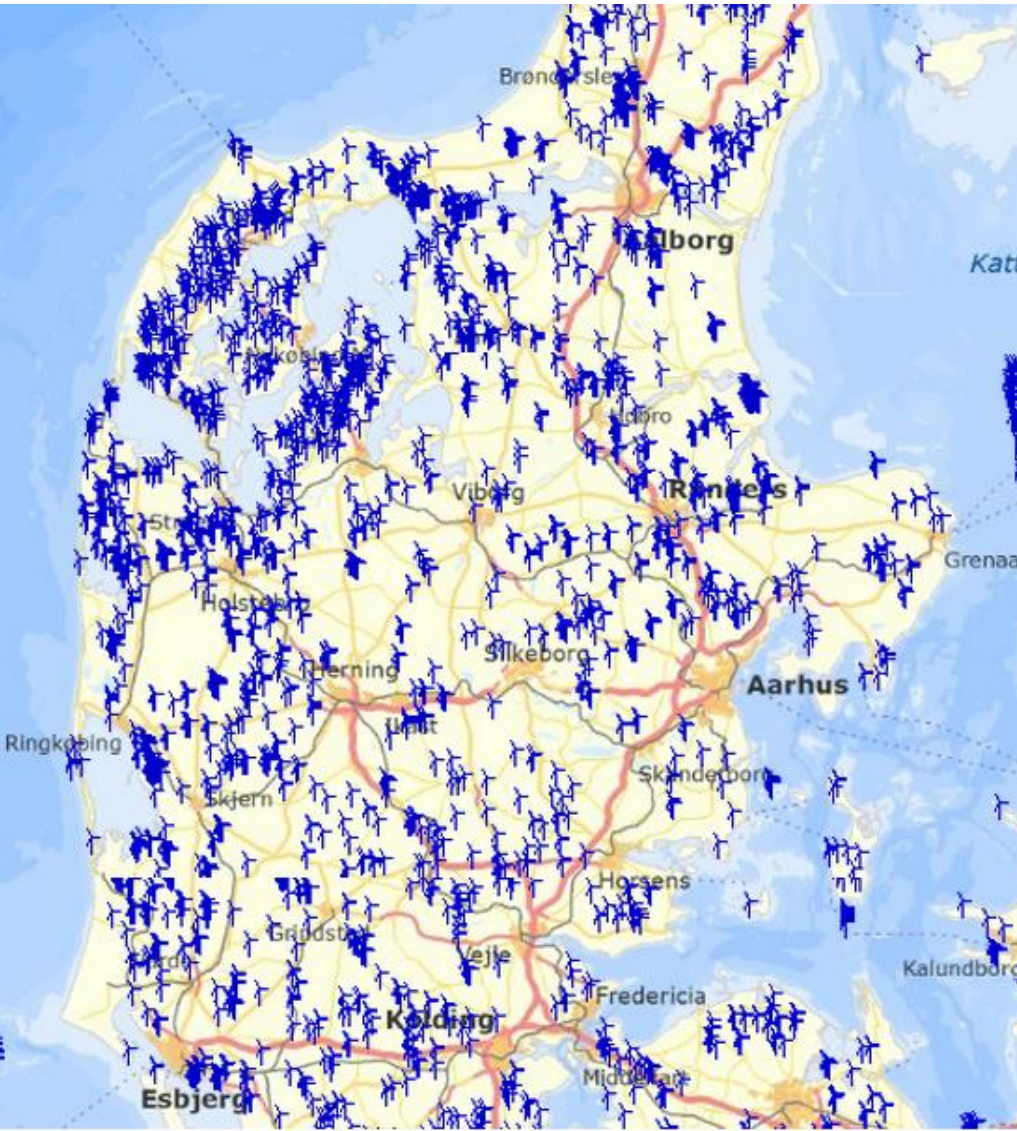


# The particularities of the Danish wind power: TSO's involvement and cost sharing



- The developer only pays for the connection from the turbine to the coupling point
  - Transformers, substations, grid extension – cost socialized (covered by the grid company/-ies)
- Also for offshore projects
  - Exploratory studies (geophysical, geotechnical, metocean and environmental assessment) carried out by the TSO
- Impact on overall project risk and costs

# The particularities of the Danish wind power: public access to data – and ownership



- Individual turbine-level data starting 1978 reported and published
- A regulation stipulating local residents' 'right of purchase' of 20% of the wind power project shares at **cost price**
  - Audited share purchase offers (incl. cost data) are publicly available
  - Contributes to high acceptance rate and availability of sites across the country (terrible noise vs 'the sound of money being made')

# WIND ENERGY PROJECT COST DRIVERS

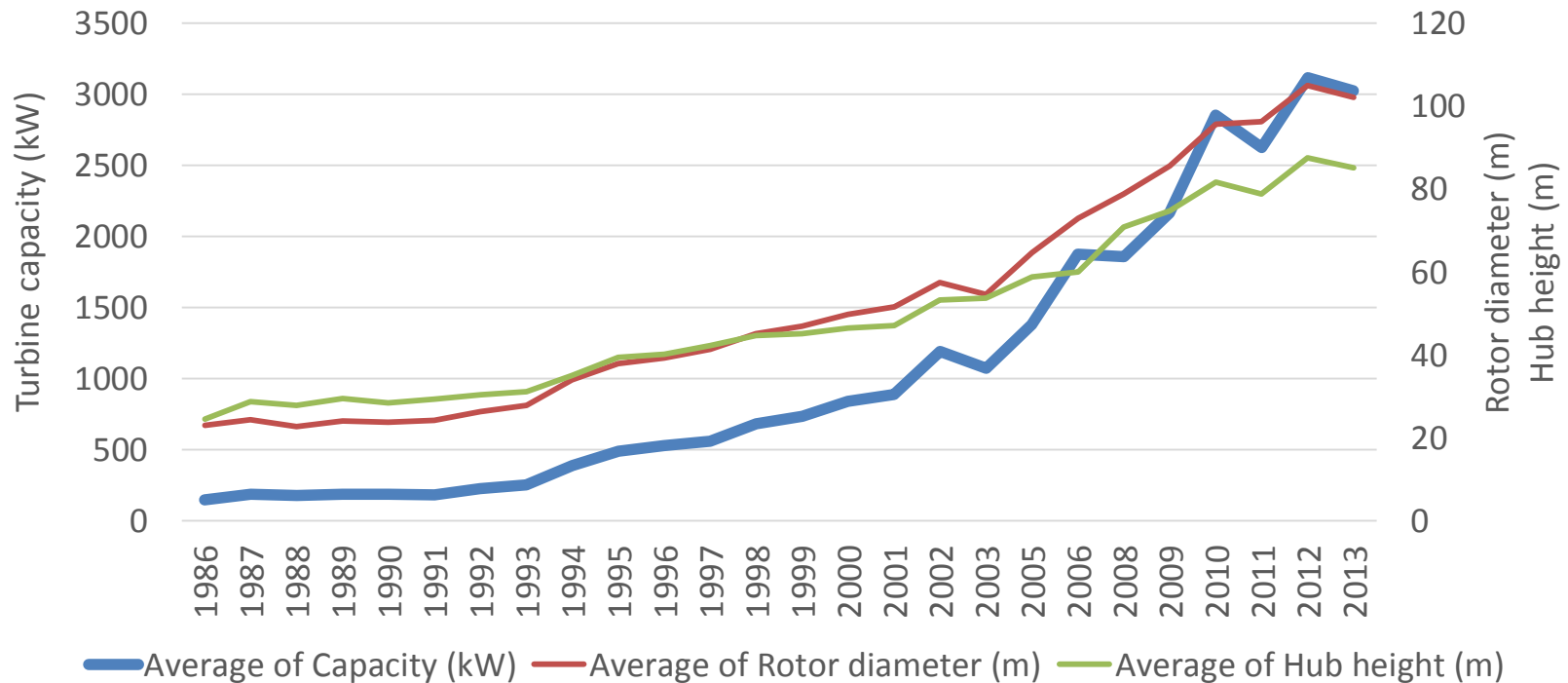


# Wind energy project cost drivers: key factors

- Materials, components, labour
  - Especially significant in the period leading up to 2008
- Supply-demand dynamics, competitive landscape
  - Over-supply in the early 2000s, bottle-necks leading up to 2008
- O&M costs
  - Increase in turbine size / production, among other things, decreases per-kWh O&M costs
  - More mature technology, higher capacity factors, lower administration and other costs per MW

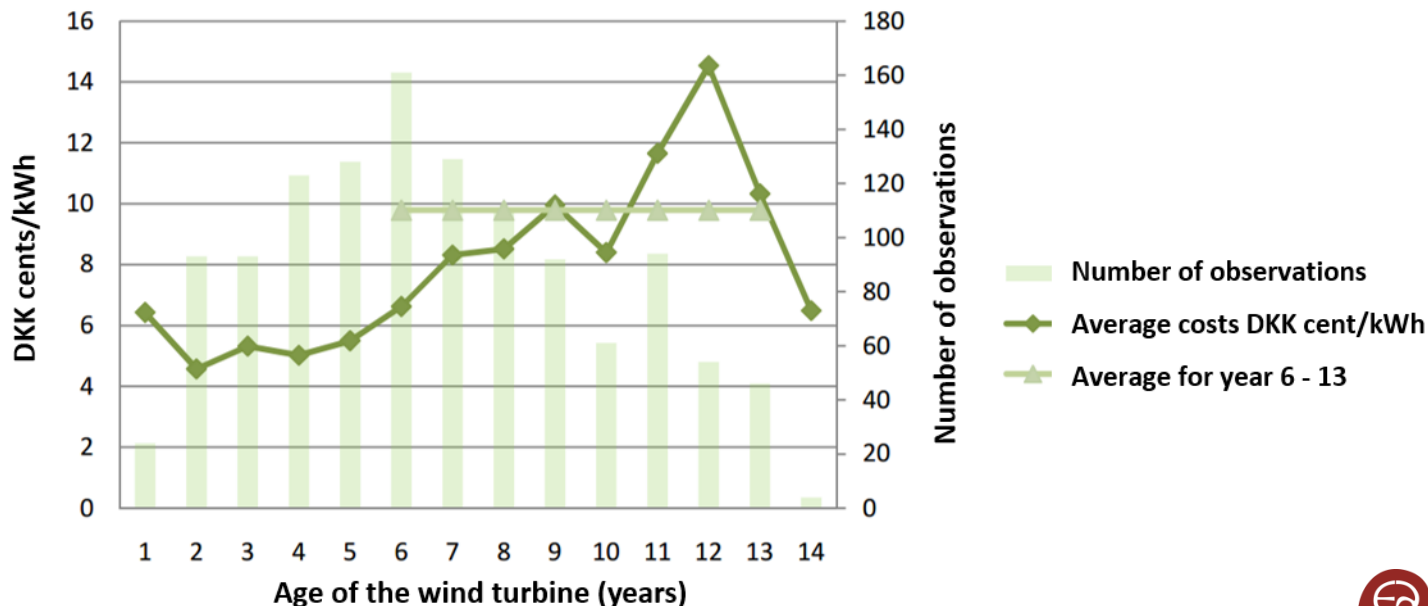
# Wind energy project cost drivers: size

- Continuous turbine size increase over the past 20 years
- In 2012 and 2013 in Denmark, the newly-installed turbines were predominantly 3 MW



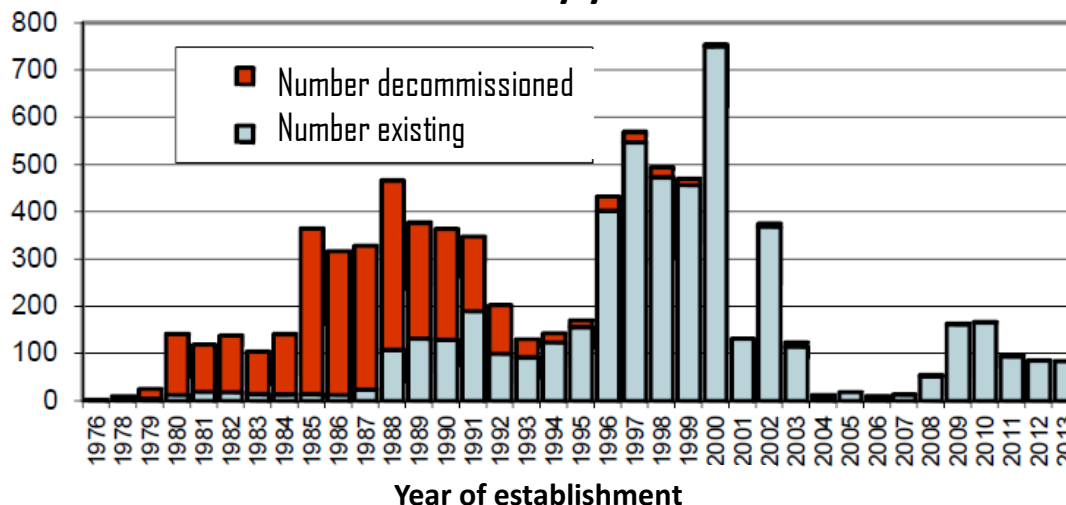
# Wind energy project cost drivers: O&M costs

- For projects 1996-2008 the average lifetime O&M costs (average for years 6-13) estimated at ca.14.5 EUR/MWh (2012 prices)
- For new projects as of 2010, indications of 12.3 EUR/MWh (2012 prices)
  - Significant reductions in O&M costs over time

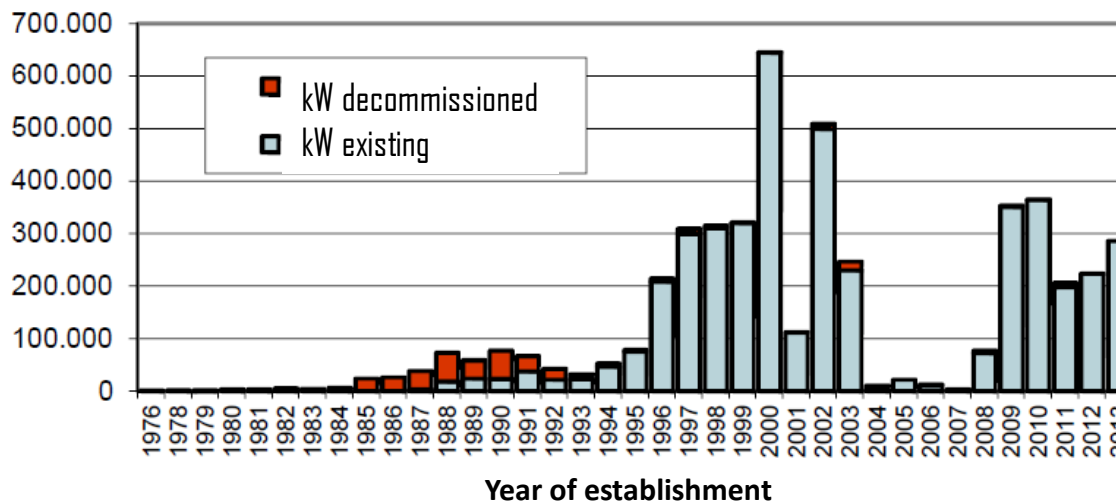


# Wind energy project cost drivers: Repowering as a new cost category

Number of turbines by year of establishment



Total capacity (kW) by year of establishment



# Wind energy project cost drivers:

## Repowering as a new cost category (2)

- Introduction of Scrappage Certificates
  - To continue deployment of wind resource
  - To facilitate decommissioning of old and poorly sited turbines
- Turbines of 450 kW or less can be replaced with new and more efficient wind turbines at an additional subsidy
  - Scrappage certificate -> additional subsidy for the newly installed capacity
  - Several subsidy regimes depending on the time period:
    - 0.02 EUR / kWh for 12 000 FLH of double the decommissioned capacity (upper limit of market price + subsidy at EUR 0.05 / kWh)
    - 0.01 EUR / kWh for 12 000 FLH of double the decommissioned capacity (fixed)
- Total pool of decommissioned capacity: 175 MW
- Scheme in force: 2005 – 2012
- An example from 2013 project proposal Nørhede-Hjortmose (22 \* 3.3 MW): compensation of 0.5 M EUR per turbine

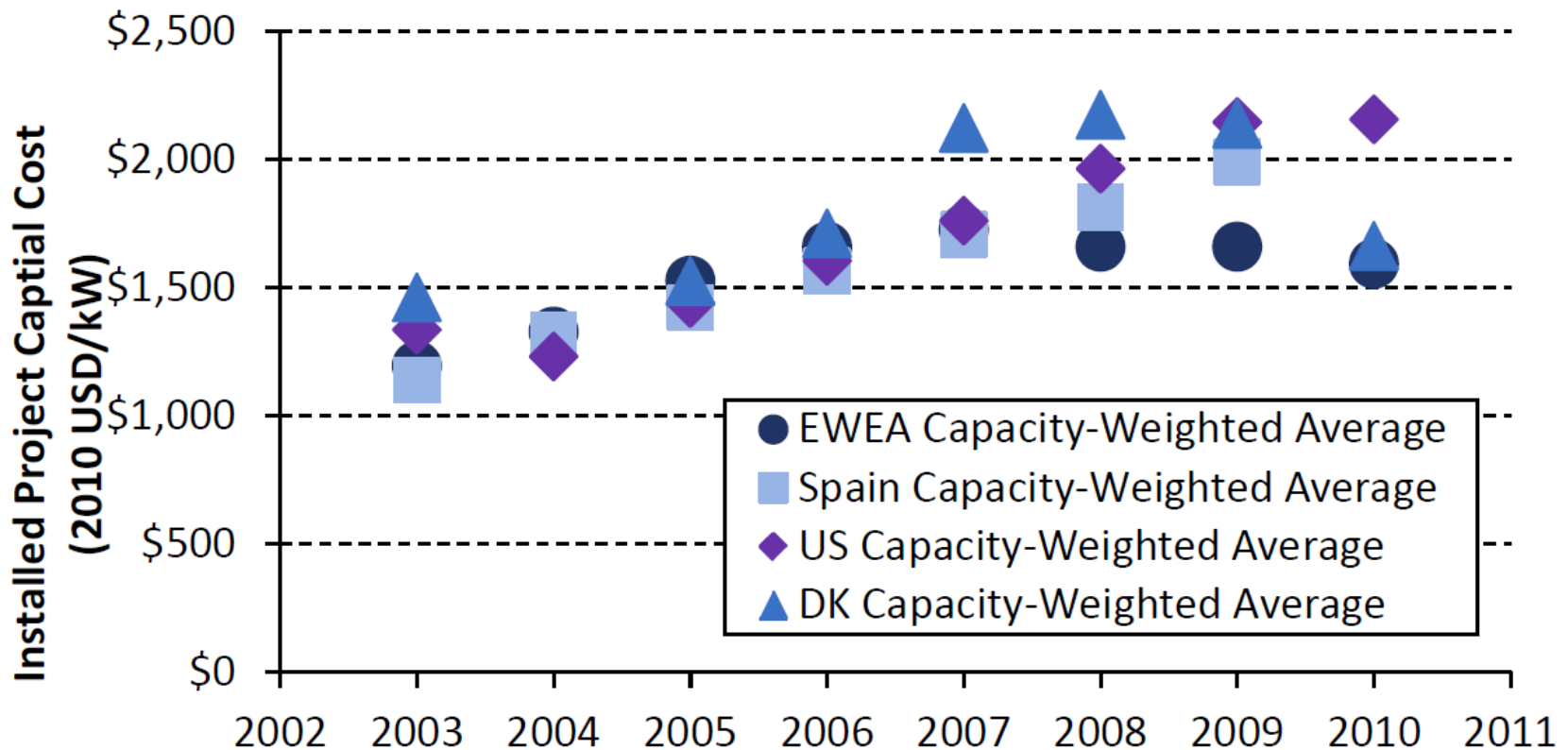
# COST DEVELOPMENT OVER TIME

# Cost development over time in Denmark (onshore)

Cost of turnkey onshore wind power projects in Denmark 1981 - 2012

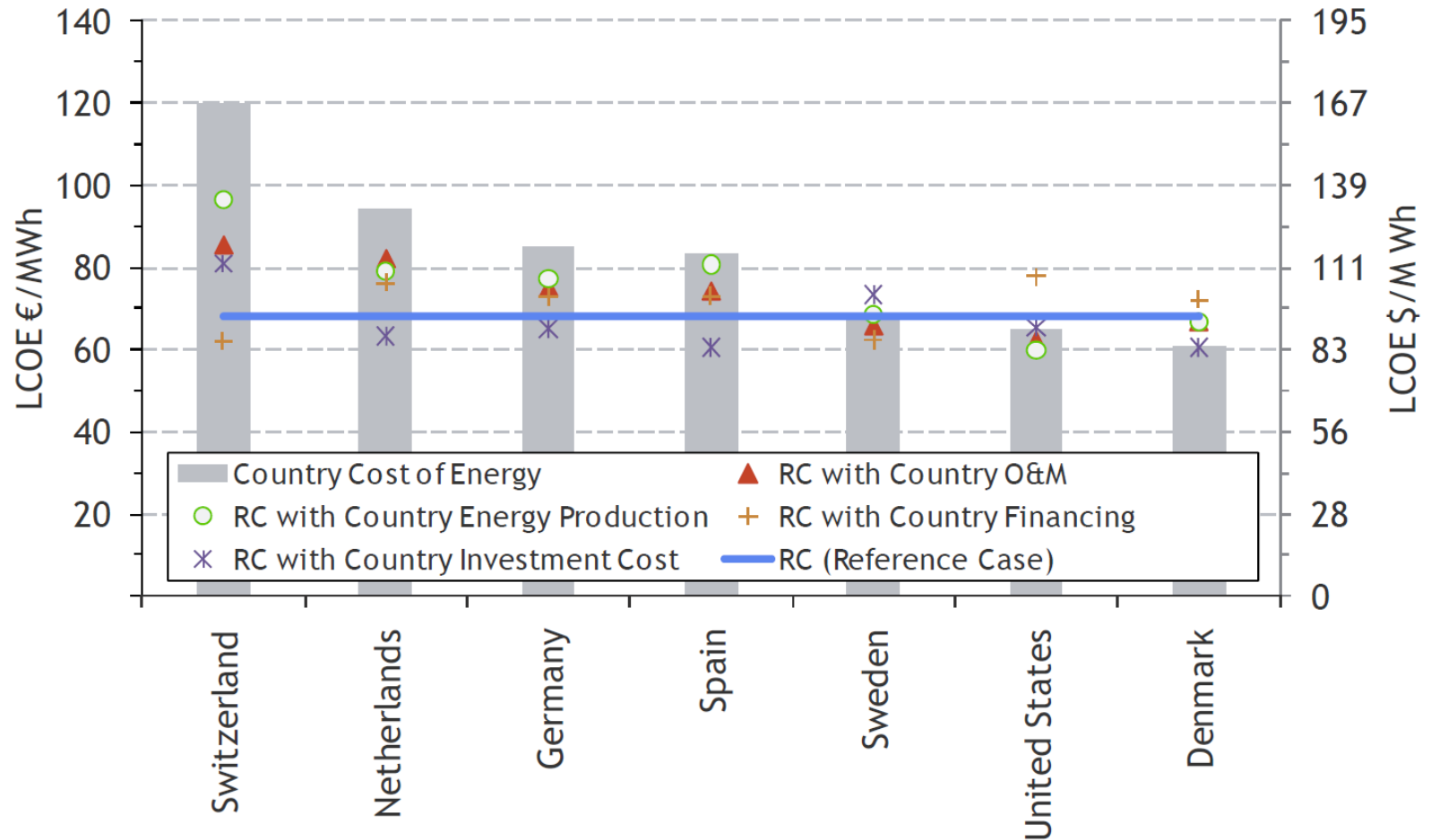


# Cost development over time in Denmark (vis-à-vis other countries): capital cost 2003-2009





# Cost development over time in Denmark (vis-à-vis other countries): LCOE 2008





# Thank you

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