Site specific cost modelling for reducing the cost of energy

Wind Energy Update – Offshore Developer Supply Chain Forum

25 March 2013

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BVGassociates

Presentation overview

What will I be talking about?

Contents

- Why are BVG Associates qualified to talk about cost modelling?
- The Crown Estate cost reduction pathways
- Relative costs in building the UK portfolio
- Timing and cost reduction
- Some salient points

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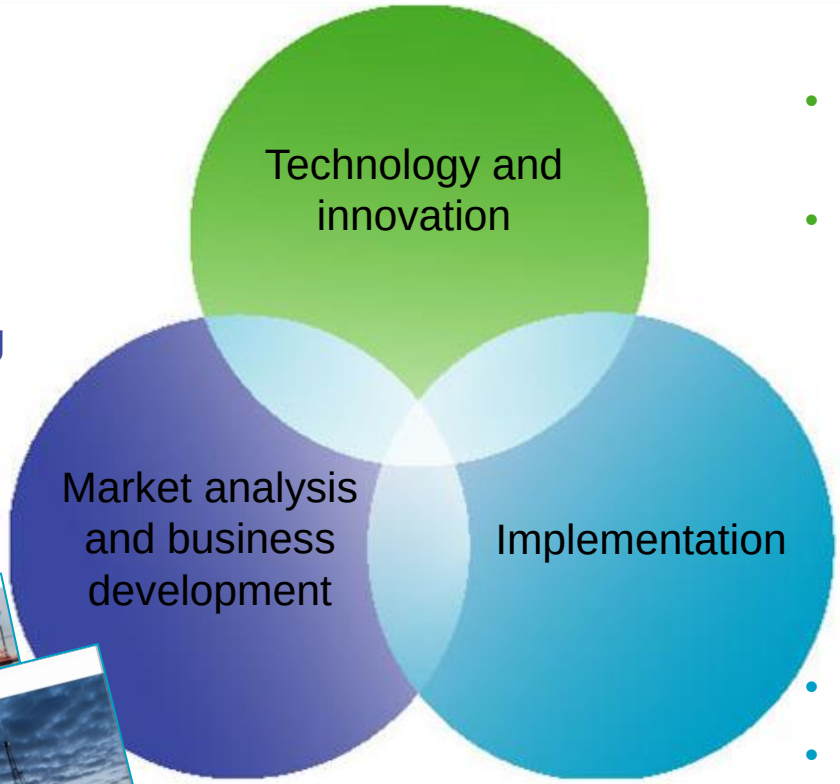
Three work spheres

BVG baubles

- Supply chain development
- Economic impact assessment
- Support to industrialisation
- Market forecasting



- Support to investment in technology
- R&D programme management
- Design and engineering services

- FIT project development
- SCADA & condition monitoring
- O&M technical support

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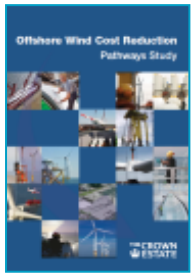
Cost reduction pathways study

Overview

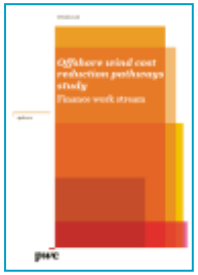
Context

- 2011 UK Government Energy white paper:
  - Central scenario 13GW by 2020
  - Support available for 18GW if cost of energy reduced – target £100/MWh
- The Crown Estate cost reduction pathways study established to evidence what industry thinks could be done

- Published summer 2012
- Cost reduction pathways = supply chain + technology + finance







Methodology in numbers: technology work stream

4 Dimensional cost model: Time, types of wind farm site, turbine sizes, industry scenarios

6 Industry day-long workshops (in UK, DK, DE)

20 Deep interviews (4 hours +)

125 Industry individuals directly involved

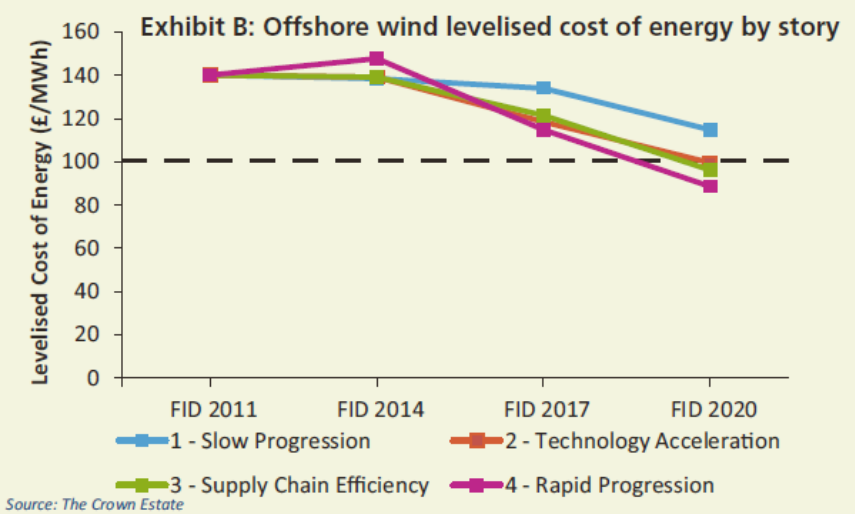
232 Pages – available for download from our website

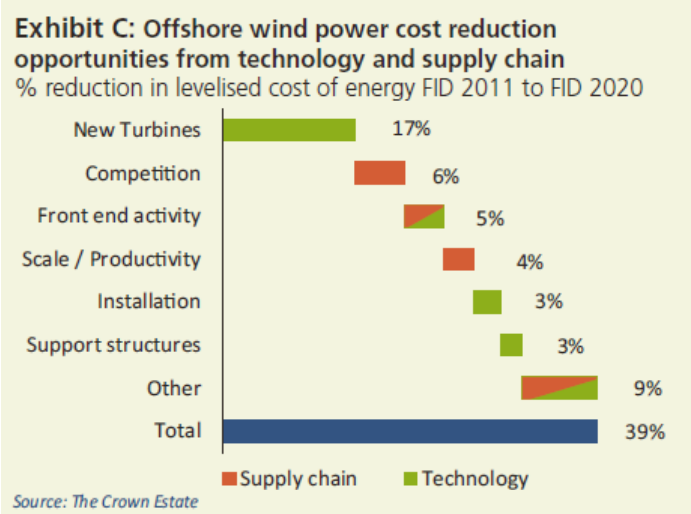
Cost reduction pathways study

Overview

Results

- Industry can meet target LCOE





- But industry needs:
  - Confidence in the market…
  - Reliability in timelines…
  - Facilitation of new technology introduction
  - To access new finance
  - To work together for best practice, standardisation and risk management

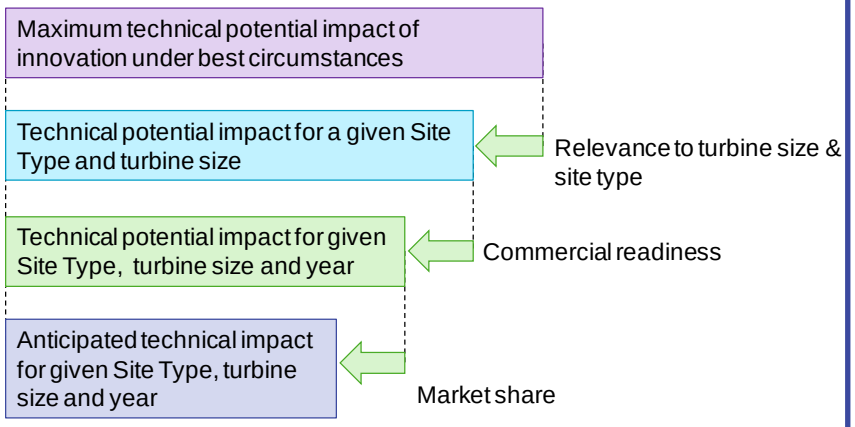
Methodology

For each independent innovation (60+ covered)

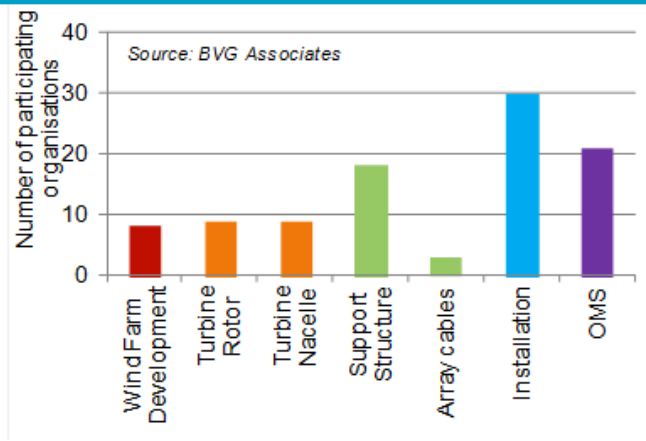
Maximum potential impact of innovation

Innovation	Wind Farm Development	Wind Turbine Rotor	Wind Turbine Nacelle	Support Structure	Array Electrical	Installation	Operation and planned maintenance	Unplanned service	Other OPEX	Increase in Gross AEP	Relative decrease in other turbine losses	Relative decrease in WF aerodynamic array losses	Relative decrease in WF electrical array losses	Relative decrease in WF unavailability
Introduction of DC power take-off (incl impact of DC array cables)			4.0%		10.0%	0.5%		5.0%		1.2%			10.0%	1.0%

Impact of innovation in real world



Thorough peer review (4 stages)

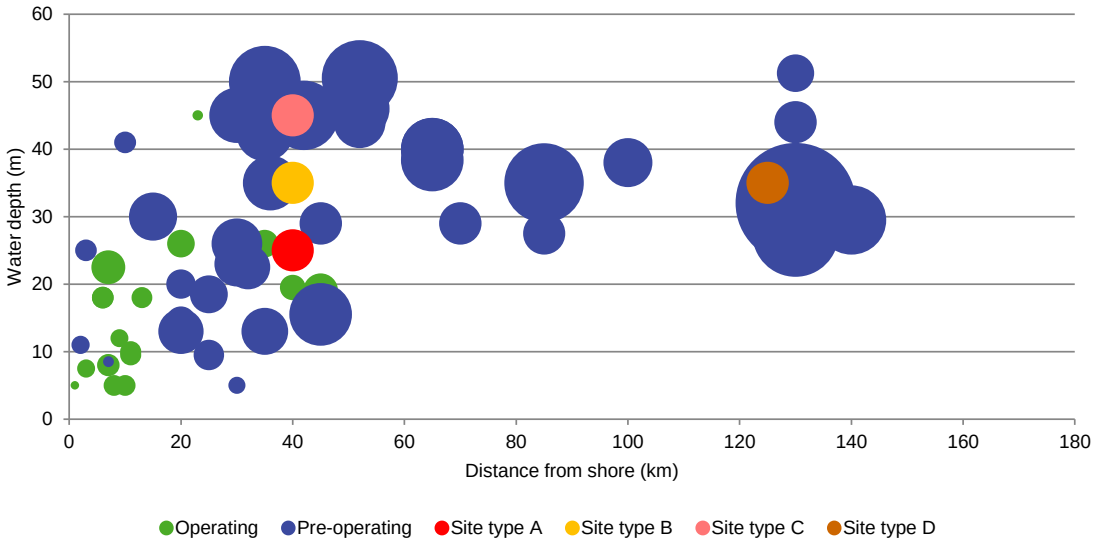


Methodology

Robust cost model and industry-supported baselines

Baselines

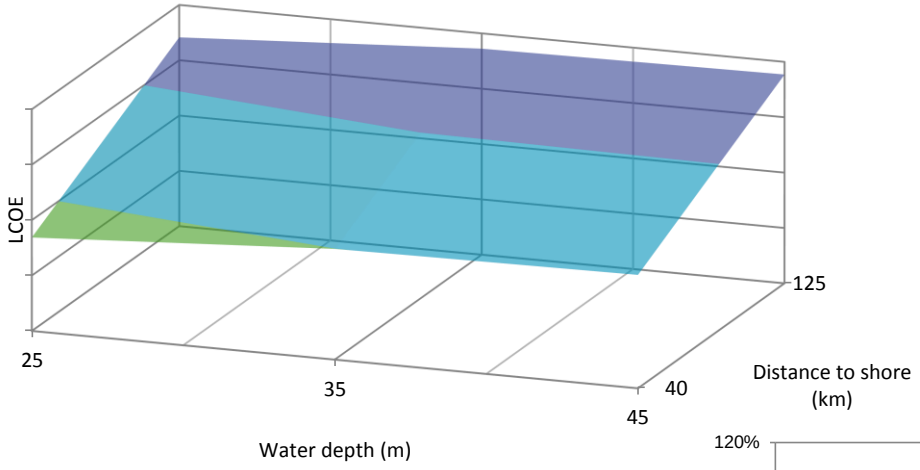
Turbine MW-Class	Nominal range of power rating (MW)	Typical range of rotor diameter (m)	Diameter modelled (m)	Example current and future turbines
4MW	3 to 5	up to 145	120	AREVA M5000-116 and 135, REpower 5M and 6M, Siemens SWT 3.6-107 and 120, Vestas V112-3.0
6MW	5 to 7	145 to 162	147	Alstom Haliade 150-6MW, Siemens SWT-6.0-154
8MW	7 to 9	162 to 180	169	MPSE Sea Angel, Samsung S7.0-171 Vestas V164-8.0MW



Site specific cost modelling

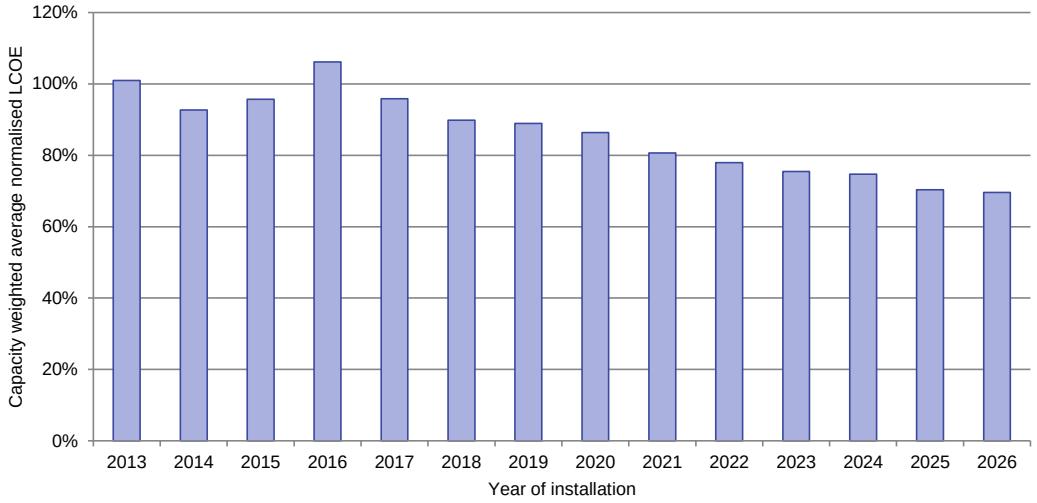
Combining predicted LCOE with UK site conditions

Interpolate to find LCOE



- Assumes LCOE exists on plane through points defined by site types
- Site specific LCOE calculated by interpolation of known results

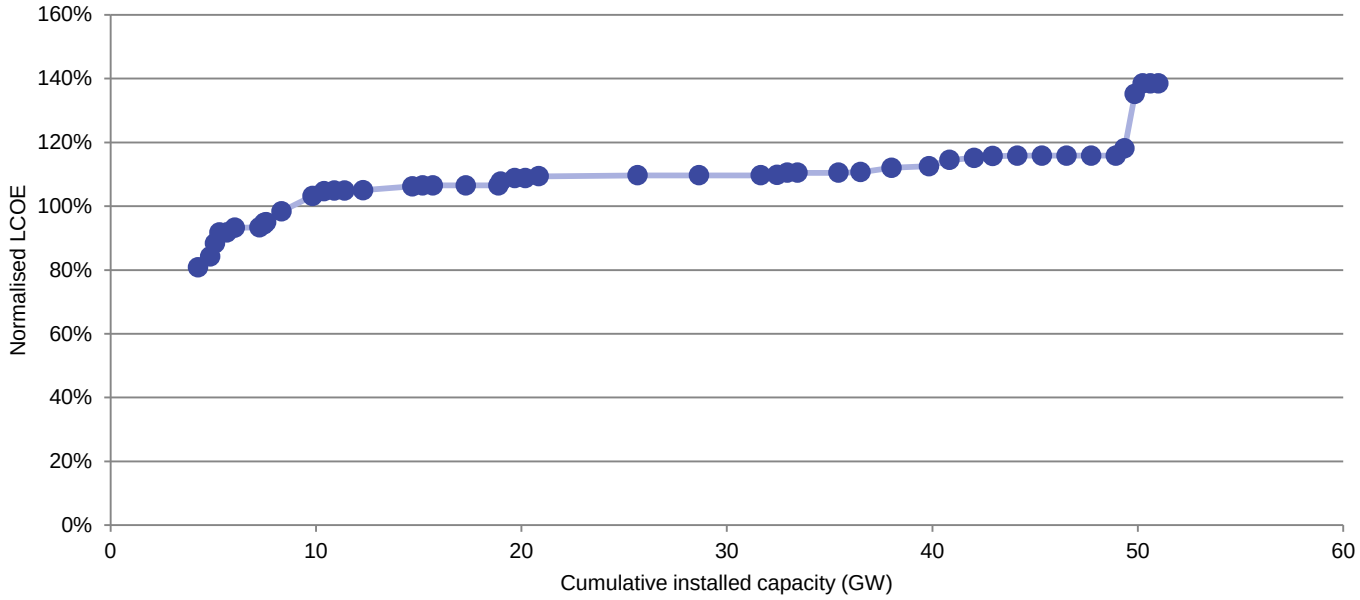
- Cost of energy only starts falling post 2016/2017
- Innovation selected now is not installed for a few years
- Early innovation and increasing site complexity are balancing



Site specific cost modelling

Natural variation in site costs due to conditions

Merit order

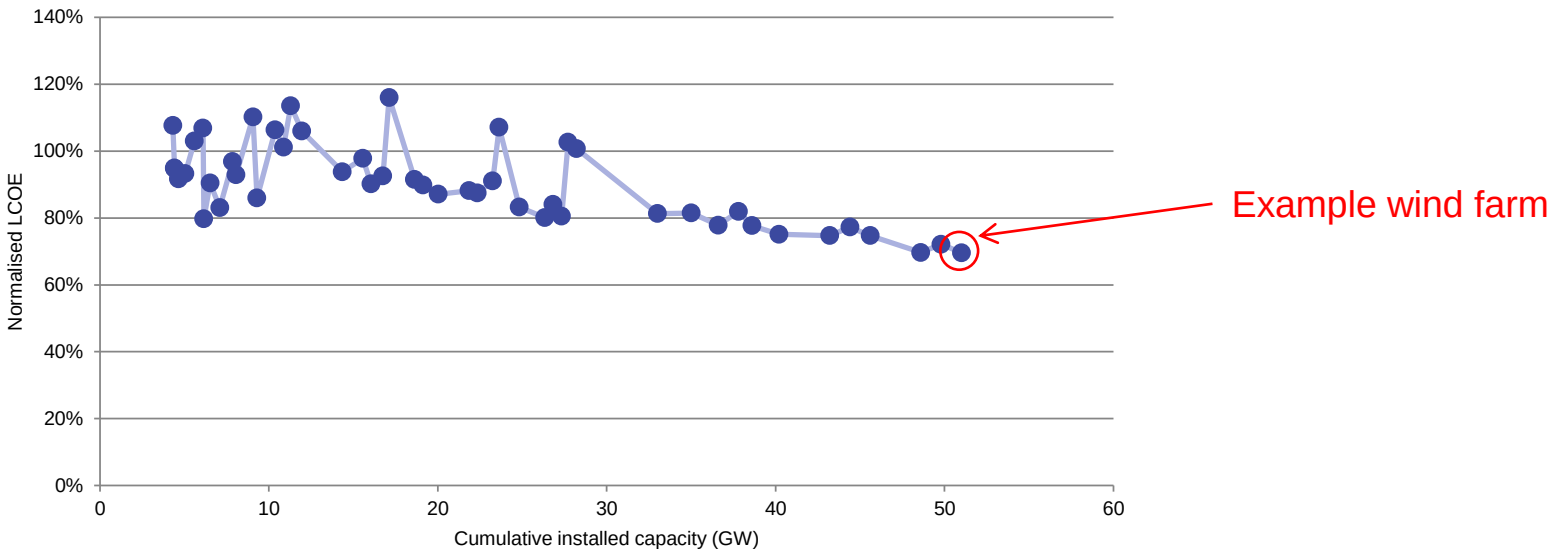


- Assumes all sites are built using today's technology
- Large variation in LCOE as a result of natural differences in site conditions

Site specific cost modelling

Impact of cost reduction

Cost modelling results

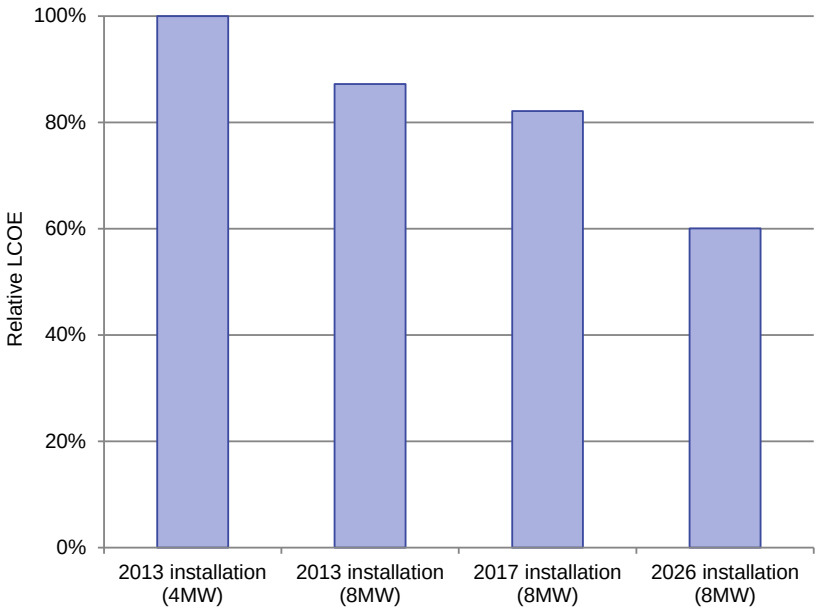


- Large variation in LCOE persists in early installations as challenges of site conditions outweigh cost reduction
- General trend of cost reduction lessening variation in later projects
- Challenge is which sites should be invested in, site specific cost modelling is necessary

Site specific cost modelling

Much of the cost reduction comes from larger turbine

Example cost reduction



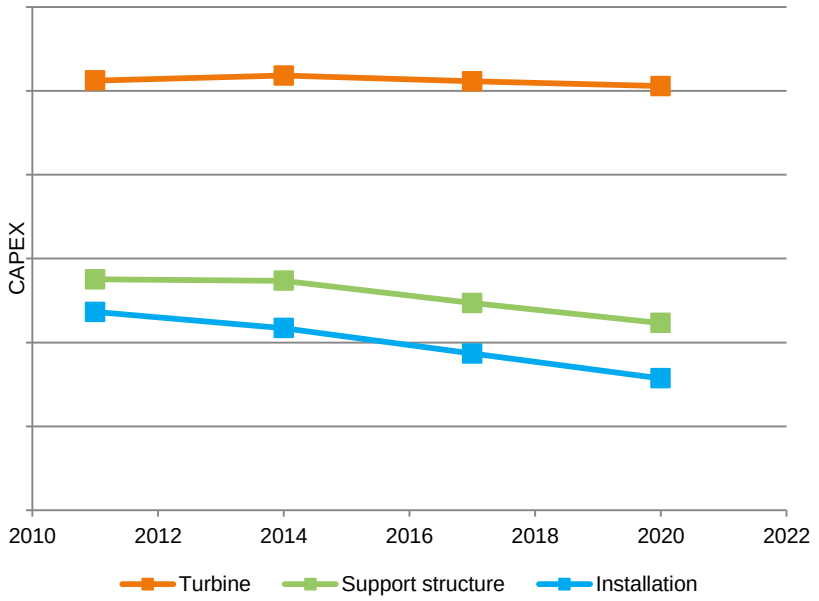
- Large proportion of the cost reduction comes from using larger turbines
- Later cost reduction coming from a realisation of combined innovations into the market
- Picture is complicated due to technology selection and timing

Site specific cost modelling

Need to compare technology with future costs

Technology choices

- Example technology choices affecting cost
  - Turbine size
  - Foundation type
  - Cable voltage
  - Installation vessels and methods
  - Operations, maintenance and service strategy
- Other site specific design optimisations
  - Electrical design
  - Site layout
  - Substation design



Conclusions

- Cost reduction analysis suitable for industry level stories
- Site specific costs are dependent on many variables, requiring more detailed analysis
- Significant variation on site specific cost of energy due to challenges of site conditions
- Timing of site development important for overall cost of energy

Thank you

Wind Energy Update: Developers Supply Chain Forum

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20 March 2013

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Site specific cost modelling

Build the easy sites first!

Industry build “scenarios