INDUSTRY PERSPECTIVE

Dutch renewables R&D seeks paradigm shift

Gail Rajgor

Committed to strengthening its position in the global renewable energy industry, the Netherlands offers world-class R&D facilities and incentive programmes. Here, Gail Rajgor looks at some of the R&D work being done and some of the key players.

Thanks to the Netherland's 2013 Energy Agreement for Sustainable growth, the Dutch Government is firmly committed to supporting R&D work to ensure the country meets its short and long term targets for renewables and carbon dioxide emission reductions. In the short term that includes a goal for renewables to supply 16% of the country's electricity supply by 2023, while in the longer it wants energy supply to be carbon neutral by 2050 and fully affordable. The longer term goal was recently reinforced with the publication of a new ''energy agenda'' early in December.

To meet its renewables goal, the Government has placed emphasis on boosting use of wind power (10.5 GW of new capacity by 2023, 6 GW of that onshore by 2020) and solar PV (the Energy Agreement sets an indicative target for 5% of the country's energy supply, which would require around 6 GW). The Government's commitment has been clearly demonstrated with the country's flagship five-year offshore wind tender programme, which aims for 4.5 GW of new capacity to be operating by 2023 (taking the country's cumulative operating capacity to 6 GW). Already under this programme, Dong Energy has secured 700 MW of capacity (in the first tender round announced in mid-2016) and a consortium including Shell has won a further 700 MW (second tender round with the winner announced in December 2016). A key aim of the programme is for offshore wind costs to fall 40% by 2020 (compared to 2014 prices). The longer term Energy Agenda will see large-scale offshore wind further supported beyond 2023.

The 1.4 GW awarded so far under the current programme is all in the Borssele Wind Farm Zone (BWFZ) in the Dutch North Sea. When Dong won the first tender, it did so at a then record price for offshore wind – €72.70/MWh (excluding transmission costs). The Shell consortium bid even lower – €54.50/MWh – to win the second tender. Whether such a low price is possible for the next round of projects planned in the Hollandse Kust Wind farm Zone remains to be seen – the location and seabed conditions are not as favourable as those in the BWFZ. What is clear, for both the short and long term, is that continuous innovation is critical.

R&D drive

The Netherlands has strengthened its position in offshore wind R&D with strategic public–private partnerships and world-class facilities, such as the Top Consortium for Knowledge and Innovation Offshore Wind (TKI Wind op Zee), the Energy Research Centre of the Netherlands (ECN) and Delft University of Technology – one of the world's leading specialists in sustainable energy. WMC (Knowledge Centre Wind turbine Materials and Constructions), TU/e, RUG, Deltares, NIOZ, IMARES, Marin and NLR are other leading Dutch enablers and catalysts for manufacturers, project developers, owners, operators, investors, governments and NGOs.

TKI Wind op Zee is a public private partnership specifically initiated by the Dutch Government to facilitate innovations that will help achieve the 40% cost reduction for offshore wind. A study, *Cost reduction options for offshore wind in the Netherlands FID 2010-2020*, published in October 2015 by TKI Wind op Zee, suggested the 40% cost reduction target could well be exceeded, with a reduction of at least 46% possible (Figure 1).

These conclusions were recently supported in another Dutch research project – the five-year FLOW (Far and Large Offshore Wind energy) programme. The final results of FLOW were presented in June, indicating that ''a well-coordinated approach between industry, knowledge institutes and government can achieve 40% cost reduction in ten years in the offshore wind sector. In about ten to fifteen years, offshore wind should be able to manage without subsidies.''

The increase in rated power of wind turbines, improvements in blade design and manufacturing and the application of extra

E-mail address: gail.rajgor@lineone.net.

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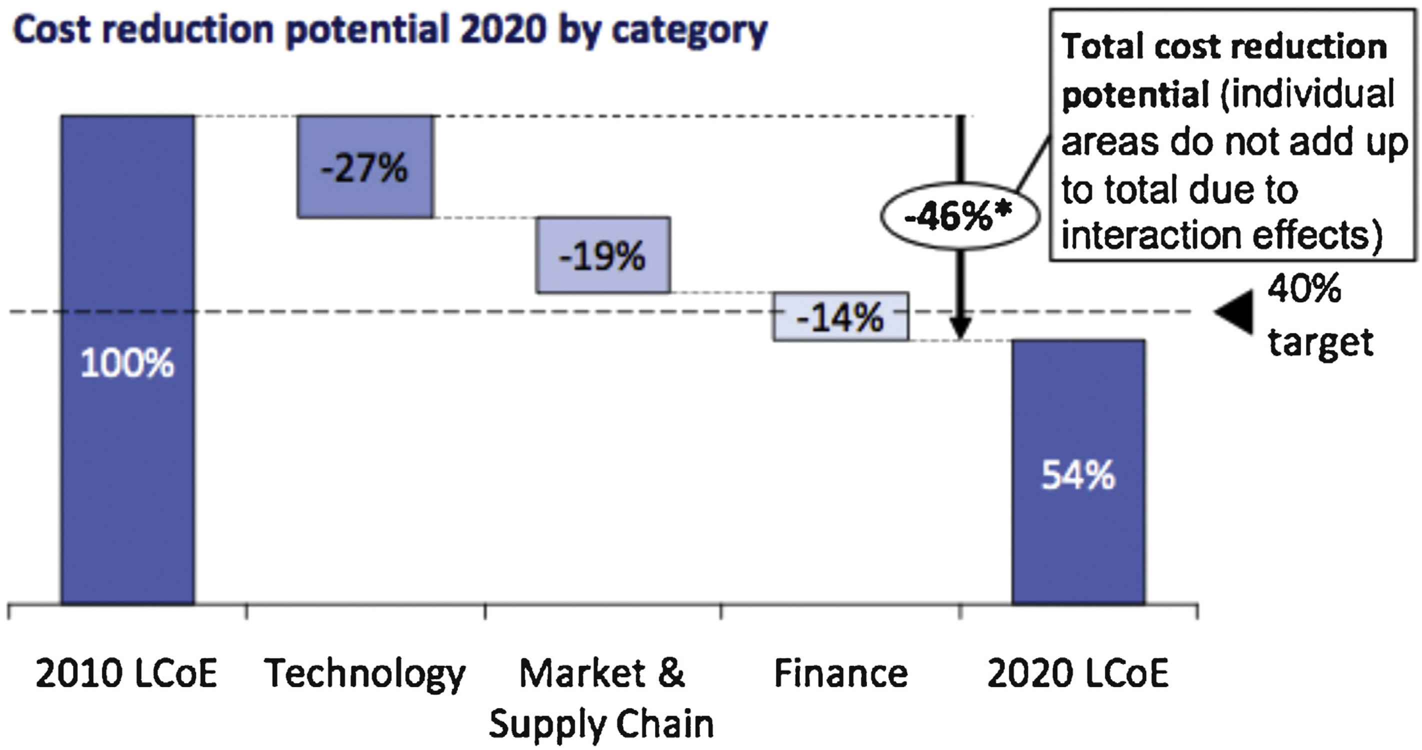

FIGURE 1
Offshore wind costs could fall by 46% with the right support and innovation, according to the TKI Wind Op Zee report, *Cost reduction options for offshore wind in the Netherlands FID 2010-2020*.

large (XL) monopiles have the largest impact on cost reduction, according to both the TKI Wind op Zee study and the results of FLOW. Overall, a move to the use of 8 MW turbines could contribute a cost reduction of up to 7%, says the TKI report, while innovations for blade tip speed, blade aerodynamics, improvements in blade manufacturing, design standards and materials could contribute 3.6% in savings. A further 2.7% saving could be achieved via innovations in blade pitch control and inflow wind measurements. See Figure 2 for cost saving breakdown.

The conclusions of the FLOW project are even more optimistic. ''The increasing size of turbines on the international market, presently reaching 8 MW, and even more importantly, larger rotors, up to 80 metres in length, is responsible for up to roughly 10% of the cost decrease over five years. The foundation and the design of a wind farm can also contribute substantially, up to roughly 5%.''

With all this in mind, Dutch R&D organisations have upped their game further. In August 2016, for example, ECN announced it is working with WMC, TRES4 B.V. and GE Global Research on a new TKI Wind op Zee funded R&D project called VaStBlade. This aims to enable more accurate designs of wind turbine blades by improved modelling and validation of torsional flexibility (the twisting of the blade). With turbines increasing in size, turbine blades have typically got longer and more flexible. ''In the past, only the deformations of the blade in and out of the rotor plane were taken into account in aeroelastic analyses. However, as the length of the blades increase, the torsional deformation becomes more and more important for an optimal power production, load reductions and the avoidance of aeroelastic instabilities like flutter,'' says ECN. ''The added value of more accurate blade torsion calculations increases significantly for larger and thus more flexible blades. The cost of energy is reduced by less use of blade material because of reduced loads and an increased yield of energy due to an optimal aeroelastic blade design with respect to power production.''

Current design tools have insufficient accuracy for the design of even larger, flexible blades. ''Recent investigations in an EU project showed large variations up to 17% in calculated torsional stiffness by using state-of-the-art tools,'' notes ECN. ''The VaStBlades project will deliver datasets with unique validation data, an improved structural blade model, validated aeroelastic and structural tools and a 10 MW wind turbine blade design.'' The project runs through to March 2019. The measurements will be made in 2017 followed by the validation process. Meanwhile the design of the 10 MW wind turbine blade is scheduled for 2018.

Other TKI Wind-op-Zee initiatives include:

- MIMIC (Micromechanics-based modelling and condition monitoring of wind turbine rotor blade composites)
- C-TOWER (Design and prototype of composite tower for offshore wind turbines) – two year programme which started October 2015. Project partners are Wind2020, Jules Dock Composites, Knowledge Centre WMC.
- S4VAWT (Semi-Submersible Support Structure for floating Vertical Axis Wind Turbine) – project partners are GustoMSC, ECN, Knowledge Centre WMC, and MARIN.

Meantime, another key Dutch wind R&D programme is INNWIND, a national research programme funded through SenterNovem, and executed by a consortium consisting of ECN, WMC and TU Delft. The project focuses on several research topics covering Concepts and Components, Aerodynamics, Materials, Integrated Design Software, and Guidelines.