# COMPETITIVENESS IS NOT JUST ABOUT REDUCING TECHNOLOGY COSTS

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Funny how the same product can taste a lot better, or worse, depending on the location: an Italian ice cream provides delicious relief on a mercilessly hot and humid afternoon in New York, but is not so refreshing on a wet morning in Brussels. A dram of whisky is best in front of a roaring fire on an icy night in Scotland. It is not so clever at lunchtime on a summer's day in Sydney.

It is similar in energy. A generation choice that is attractive in one part of the world may not be nearly so tasty in another. Gas-fired generation might head up the menu in one country, it could be hydro-electric in another, or nuclear, or coal, or geothermal, or wind, or solar.

However, we have reported over the last year that wind and solar are climbing up that menu in a growing number of places, even without artificial additives (subsidies). The sharp reductions in technology costs since 2008, particularly in PV but also in wind, mean that in specific developing country locations, and on rooftops in many jurisdictions with high electricity prices, renewable options are now cost-effective choices compared to the available fossil fuel alternatives.

It is also the case that renewables could make even faster progress if there was not such a big gap between what they cost in some places and what they cost in others.

Earlier this month, in a presentation to investors, Joao Manso Neto, chief executive of EDP Renovaveis, the Portuguese company that is one of the biggest owners of renewable power projects globally, said that onshore wind is now the second cheapest generation technology in terms of levelised costs per MWh. He put it well ahead of coal, nuclear and combined-cycle gas turbines in terms of cost-competitiveness, and behind only the best hydro-electric projects.

Bloomberg New Energy Finance's own levelised cost of electricity model is a little more cautious, giving onshore wind an average worldwide LCOE of $82 per MWh, $91 for coal-fired power , $82 for CCGT, $70 for large hydro and $149 for crystalline silicon PV.

What is more striking, however, is how much levelised costs vary for the same technology as you go around the world. Our LCOE model shows the levelised cost of electricity per MWh for onshore wind varying between a low of $37, all the way to $187; and the equivalent for crystalline silicon PV varying between a low of $82, all the way to $329.

Now, some of this is inevitable – to do with resource availability. In places blessed with strong breezes most of the year, such as close to shore, in mountains or on extensive plains, capacity factors are likely to be high (30% upwards), while in mixed-geography inland locations they are likely to be closer to 20%. Deserts near the Equator offer high capacity factors for solar, fields in damp, cloudy, high-latitude locations in the Northern Hemisphere do not. In biomass, projects with a ready local supply of woodchips, straw or waste will often have an advantage over those that have to import pellets across the ocean.

However there is more to it than that. Also in the mix are stubborn issues relating to capital costs, and others to the costs of generation in the operating phase.

### Capital costs

Take these five onshore wind projects around the world that have recently reached important milestones. On 6 March, developer Greenko Group said it had completed a 15MW project in Mangalore, India, for $18m ($1.2m per MW). On 24 March, the 300MW Lake Turkana wind project in Kenya finally clinched financing to cover its estimated $854m capital cost ($2.8m per MW).

On 22 April, the World Bank's International Finance Corporation said it would provide debt for a 50MW project in Pakistan costing $132m (or $2.6m per MW). On 1 May, chocolate maker Mars said it would partner with Sumitomo Corporation of America on a 200MW wind project at Mesquite Creek, Texas, costing $345m (or $1.7m per MW). On 16 May, the Scottish government gave the go-ahead for a project by Iberdrola's UK subsidiary for a 51MW project at Ewe Hill, costing $109m (or $2.1m per MW).

Or take these five PV projects recently in the news. On 10 March, Yondenko Corporation said it would build a 12.5MW plant in western Japan for $30m ($2.4m per MW). On 9 April, Dubai-based Adenium Energy Capital said it was financing a 10MW project in Jordan at a cost of $26m ($2.6m per MW).

On 29 April, Northland Power closed the financing on five 11.8MW projects in Ontario at a cost of $219m ($3.7m per MW). On 19 May, Rwanda awarded a contract to a 10MW solar project at Kayonza, costing $20m (or $2m per MW). On 20 May, Enel Green Power started building two PV parks in Chile, costing $180m for 100MW (or $1.8m per MW).

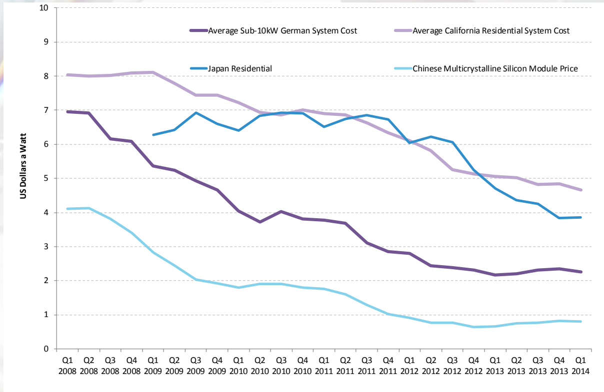
### Behind the differences

What explains the large differences between these cost figures for individual projects? Well, there could be significant differences to do with terrain or distance from the grid. This would not just affect the comparison between projects in different countries but also between those in the same country, such as between a wind project in Inner Mongolia and one in Hunan.

However, that cannot be more than part of the explanation. Bloomberg New Energy Finance's LCOE work also shows big differences between the capital costs of wind and solar in different countries. For China, we have figures of $1.3m per MW for construction, equipment and development in onshore wind, and $1.6m per MW for utility-scale PV without tracking; for the US, there are big variations by state, but for California, we have $1.8m per MW for wind and $1.7m for PV; for Australia, we have $2m per MW for wind, and $1.7m for solar; for the UK, we have $2.1m for onshore wind and $1.8m for PV. (Please note that just because solar has lower capital costs per MW in three of those countries does not mean it also has lower levelised costs per MWh than wind – the advantage is more than offset by solar's lower capacity factor.)

In small-scale PV, our *Q2 2014 Global PV Market Outlook*, published earlier this month, includes comparative figures on costs in three major markets. German industry association BSW-Solar pegs the cost of a rooftop system below 10kW at $2.3 per Watt, while California Solar Initiative and METI data show California and Japanese costs at $4.7/W and $3.9/W respectively.

**Japanese rooftop system cost is at $3.9/W, according to METI**




Source: Bloomberg New Energy Finance

So what might the other explanations be for these differences? And are they avoidable – in other words, should policy-makers and investors take a close look, and try to address them?

Let's start with the costs of buying the equipment and constructing the site. There may be local taxes on the purchase of wind and solar technology, even if they can be reclaimed gradually as revenue comes in for electricity generated. There may be limits on turbine size decreed by planning authorities, reducing the economies of scale that can be enjoyed by choosing a multi-MW machine with a high tower. An example is Sweden, where projects have taken place with 120-metre towers and 110-metre rotor diameters, whereas in the UK, projects have generally been limited to 70 to 90-metre towers and 90 to 100-metre rotors.

There is the question of ease of access to the most competitive technology. If wind turbines have to be shipped from afar, that is bound to add to capital costs. A PV project in China is going to have a good chance of buying its technology more cheaply than one in a country that has slapped tariffs on imported Chinese solar products, or one that stipulates high local content for any project receiving a subsidy.

There is the partially unavoidable issue of scale. A country that is big enough to have space for large wind or solar projects might boast a lower capital cost per MW than one where only small projects are possible, because of economies of scale on infrastructure grid links and use of cranes.

There may be non-hardware cost factors, including differences in land charges between crowded countries and sparsely populated ones, and in local regulations covering the hours that construction work can take place, and in the length of the planning process generally. Countries with a byzantine planning process are likely to be places where the development phase is long and costly. Development may also be protracted if financing is hard to obtain – an extreme example being the Lake Turkana project in Kenya, where the nine-year development phase up to financial close is understood to have cost $32m.

There may be the cost of finance itself. Perceived political or policy risk, exchange rate volatility, a shortage of well-capitalised and experienced local lenders and access to development bank lending are all reasons why the interest rate paid over the term of a loan can vary greatly between countries. Our latest Research Note on the topic (*European asset finance for wind and solar - spring coming?*) shows once again a gap of more than 200 basis points between the all-in cost of finance for an onshore wind farm in Germany, particularly when the KfW refinancing facility is used, and that in a country with perceived higher risks, such as Italy. The contrast is even starker when developing countries are included in the comparison.

Over 15 years, one, two, three or more percentage points of differential in debt interest can mean many dollars per MWh of differential in levelised costs. Governments and political parties that think they are being sensitive to voter concerns when they indulge in anti-renewables rhetoric are actually part of the problem, because the resulting uncertainty merely pushes up financing costs and therefore the bills that consumers will have to face.

### Costs in the operating phase

Several issues can get in the way of cost-competitive wind and solar generation. One is curtailment – if a country's grid is not able to cope with high levels of wind or solar power output, then that capacity will sometimes be turned off, pulling down capacity factors and pushing up levelised costs per MWh actually produced. Another may be operation and maintenance practices. These have been benefiting from greater use of diagnostic tools and the experience that comes with a few more years of operating history. However, the lack of access to spare parts is an issue in many countries.

There may be one final differentiator between countries when it comes to the costs of renewable power generation, and that is the profitability of projects. This is a slippery one, because projects often change hands and it may be difficult to tell who is making a fat return and who is not. It is also a controversial one, because many developers and equity investors will insist that subsidies such as feed-in tariffs and green certificates are only just generous enough to enable them to proceed with projects. Nevertheless, there are big differences in the revenues available to projects in major markets – our analysis shows for instance that they vary between the local currency equivalents of EUR 34 per MWh in Brazil, all the way to EUR 215 per MWh in Japan.

### Squeezing costs

I have been careful in this article to air possible explanations for the stubborn contrast in costs between wind and solar projects in different countries, rather than to leap to conclusions. The issue, as it relates to one important market, will be debated in June at an executive lunch Bloomberg New Energy Finance is holding on Friday 13 June in London, with the theme "Renewable energy in the UK: getting costs down and maintaining competitiveness" (anyone interested in more information on the event, please email David Foster on dfoster31@bloomberg.net).

This debate is likely to become more and more topical, as policy-makers search for ways to squeeze unnecessary cost out of the system. One response we are seeing increasingly in Germany and the Netherlands is for the authorities to adjust the tariffs paid to projects during the operating phase, depending on site-specific wind conditions.

Ice cream and whisky have proved versatile in many markets, helped by skilful marketing and by tricks such as adding a lump of ice to a glass of Scotch. To maximise their geographic appeal in a similar way, wind and solar will have not just to get average technology costs, but to eliminate a myriad of variations that exist between what projects cost in one place and what they cost in another.

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