The Economics Of New Renewables (without the hot air)

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New renewables (NRs: wind; solar; modern biomass and bio- fuels; tidal, wave and ocean energy) are widely claimed to be clean, indigenous and sustainable sources of energy. Therefore, they are favoured by many governments and the public as a whole. However, their present contribution to global energy consumption is still limited, about 3% in 2013 (IEA, 2015), and still only 7% of global electricity production, since their economics are not yet favourable. In most instances, they need to be supported by state subsidies and regulations, or by increased energy bills for final customers. In several countries this has raised further concerns about increasing fuel poverty where final customers bear the bulk of costs of renewable energy subsidies.

In most instances, they suffer from high investment costs and, as a result of the intermittent and diffused nature of wind, solar, and tidal, relatively low- utilisation factors. Incorporating new renewables into power grids poses challenges due to dispatching problems and potential needs for transmission extensions, grid reinforcements or investments in energy storage (Khatib, 2016). Already there is grave concern that existing base-load plants are being closed, even relatively recent ones, and new proposals are being withdrawn.

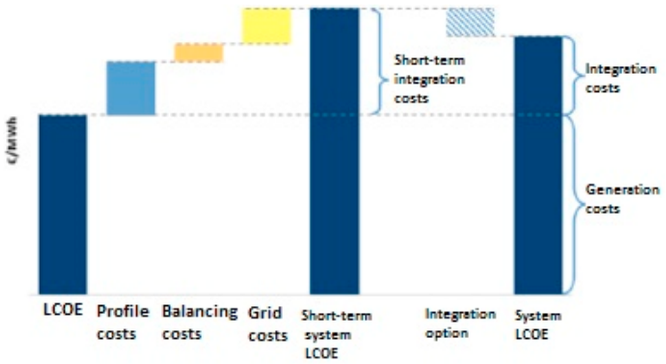
The economics of NRs are often wrongly measured by their levelised cost of electricity "LCOE", as well as "grid parity", sometimes also by the price paid to independent power producers (IPPs). Although these criteria are relevant to established dispatchable technologies firing fossil fuels, nuclear and also large hydro, these do not necessarily apply to NRs. Electrical energy (in kWhs) is not homogenous. A kWh generated by dispatchable technologies is more valuable to system security and economics than a similar kWh generated by wind energy, mostly late at night. Also a kWh of solar facilities which is usually generated at day peaks improve system economics much more than intermittent wind energy, which most of the time has to compete with dispatchable facilities, leading to over generation and under-utilization of base units. Also, sometimes, to the curtailment of the wind source or its export at cheap prices (even negative prices) to neighbouring grids

The renewable energy program in most countries consists of a myriad of implicit and explicit subsidies, and overlapping local and governmental programs. It includes mandates, feed-in tariffs, exemption from taxes, production tax credits, free land and free interconnection to the grid and other tempting devices. This combination of approaches makes it virtually impossible to figure out the amount of the subsidy by adding up the constituent parts. Usually the amounts are high, which completely distorts the true economics of NRs.

The true value of new renewables is the "system cost" which is the cost to the electricity system (and the national economy) after introducing the renewables compared with the cost if these technologies had been absent. System cost is approximately equal to LCOE plus integration costs (profile costs, balancing costs and grid costs). System cost involves the significant cost of transmission and other grid costs which are significant in case of renewables (Hirth 2016); also any governmental or final consumer subsidies.

System cost is defined by adding the three components of integration costs to standard LCOE that reflect generation costs (see Figure). Such integration costs, which are not easy to calculate, vary from one system to another depending on the extent of penetration of NRs, location and the composition of the dispatchable plant in the generation system (such as the availability of rapid ramping up or down units). Before investment decisions are made they need to be computed separately for any national grid in order to compute the true market value of NRs. Therefore, the system costs of NRs can be significantly higher than their LCOE as demonstrated in the figure. The true cost of NRs to the power system is quite different from the LCOE or grid parity. They differ from one system to another and need to be studied and roughly evaluated, before subsidies, prior to investment decisions.

Two criteria improve the true system cost of renewables. The first is "carbon pricing". If this cost, which is often not regulated, is added at an elevated level



System Costs for NRs. (Adapted from Hirth 2016)

then it will significantly improve the system value of the NRs. The other is the "discount rate" utilized in evaluating the cost of the renewables. This can be low since the risks, including regulatory risks, are not high in contrast to nuclear or coal production. The sun will surely rise and the wind will ultimately blow, although sometimes in the wrong period of the day. Also NRs will not suffer from the volatility of fossil fuel prices. However, the discount rate, or the weighted average cost of capital (WACC), can be high in developing economies due to capital shortages.

The future of NRs will be significantly improved by the development of energy storage. Other than well-established pumped storage schemes, the prospect of large storage has hitherto been limited, and there is controversy over how far and fast battery storage can assist. Also the economics of concentrated solar plant (CSP) are not well established yet; it may take some time for this to happen.

Recently there was significant reduction in the price of NRs. Recent contracts for large PV, in favourable sites, were less than 6 cents/kWh and still falling (in rare cases to less than 3 cents). The prices quoted by independent power producers (IPPs) in windy sites both in North and South America are as low as 4.25cents/ kWh, sometimes even less. As pointed out above, the actual system costs are usually significantly higher, sometimes even four times higher (energycollective, 2016). Nonetheless, these are significant developments that are likely to make renewables more competitive and lead to their increased market share in power production. However, as market share increases, the negative impact of NRs on system operation will increase creating more challenges for system integration, dispatching and controlling the system cost of NRs. Renewables are must dispatch electricity, and this can only be at the expense of other base load generation, mainly nuclear and large base load coal firing plants. Correspondingly, the need for solid interconnections and meshing. Most important is the rational evaluation of the true cost of the NRs to the power system (and the national economy). Hitherto there has been a great deal of exaggeration of the performance and speed of expansion that NRs have and will make to global and national electricity supply, with all too many proposed schemes being approved for subsidies which are poorly located. There needs to be much closer discrimination in favour of technically sound schemes, many of them reliant on optimal location.

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