Levelised Costs of Renewable Energy: What if costs continue to drop?

Recent developments and policy implications up to 2015

Summary of the joint IRENA and IEA-RETD workshop, 26 October 2012, Bonn, Germany

Rationale

Equipment and project costs for many renewable technologies are falling, some rapidly. This will require policy makers and other stakeholders to adjust quickly to this rapidly changing environment. The International Renewable Energy Agency's (IRENA) Innovation and Technology Centre (IITC) and the International Energy Agency's Renewable Energy Technology Deployment Implementing Agreement (IEA-RETD) jointly organised the workshop *Levelised Costs of Renewable Energy: What if costs continue to drop?* in order to lead a discussion on the consequences of the trend of declining costs of renewable energies and the future implications of these developments. In the workshop, where industry representatives, scientists, academics and policy makers came together, recent work on the costs of renewable energy by IRENA and IEA-RETD was presented, while invited experts gave their perspectives on a range of issues and contributed to stimulating the discussion.

Objectives

The workshop aimed to:

(1) Update participants with the latest information on the costs of renewable energy technologies and system integration costs, while also offering a venue where they could critically challenge this information,

(2) Raise awareness about the true state of costs and address potential misperceptions on renewable energy technologies, as well as facilitating a dialogue on the implications for policy makers and other stakeholders (utilities, TDOs, investors, financers) of continued cost reductions for renewables up to 2015, and

(3) Prioritise actions needed in the next three to five years to ensure policy developments anticipate developments in renewable energy markets. The goal was to ensure policy makers and other stakeholders are aware of the need to avoid letting policy drift and locking-in expensive solutions, as well as the need for a shift in policy focus.

Main messages

1. Cost reductions and performance improvements mean renewables are increasingly competitive

The costs of many renewable energy technologies have dropped, some significantly, in recent years due to a virtuous circle of high learning rates and increased deployment. Workshop participants were presented recent work by IRENA and IEA-RETD that looks at the latest cost data and trends in detail. For instance, the cost of solar photovoltaic (PV) modules have fallen by around 60% in the past two years. Chinese-made crystalline silicon modules were selling for around USD 0.75/W in September 2012 in Europe[1], with a dramatic impact on the levelised cost of electricity (LCOE) of PV.

Wind turbine prices are decreasing after a period of high prices, while higher hub heights are increasing yields, meaning the LCOE of wind is reducing. Depending on the location, onshore wind may be the most cost-effective generation option available, with typical costs of USD 0.06 to USD 0.09/kWh[2] (Figure 1). Critically, if the wind turbine market follows the PV market, cost reductions could be rapid, because Chinese wind turbines are half the price of western models and there is around 15 GW of spare manufacturing capacity in China.

Concentrating solar power (CSP) is being deployed at scale, although the industry is facing challenging times with the economic downturn, and costs are reducing. Solar towers are emerging as a particularly important generation option, as they are likely to have higher cost reduction potentials and can integrate low-cost thermal energy storage, allowing electricity generation when the sun isn't shining. Solar towers could therefore emerge as an important resource in order to integrate high levels of variable renewable energies at lower cost. The LCOE of CSP in areas with excellent solar resources may be in the range USD 0.14 to USD 0.18/kWh, while cost reductions are likely.

[1] See www.sologico.com for their PV price index data.
[2] Assuming a 10% cost of capital.

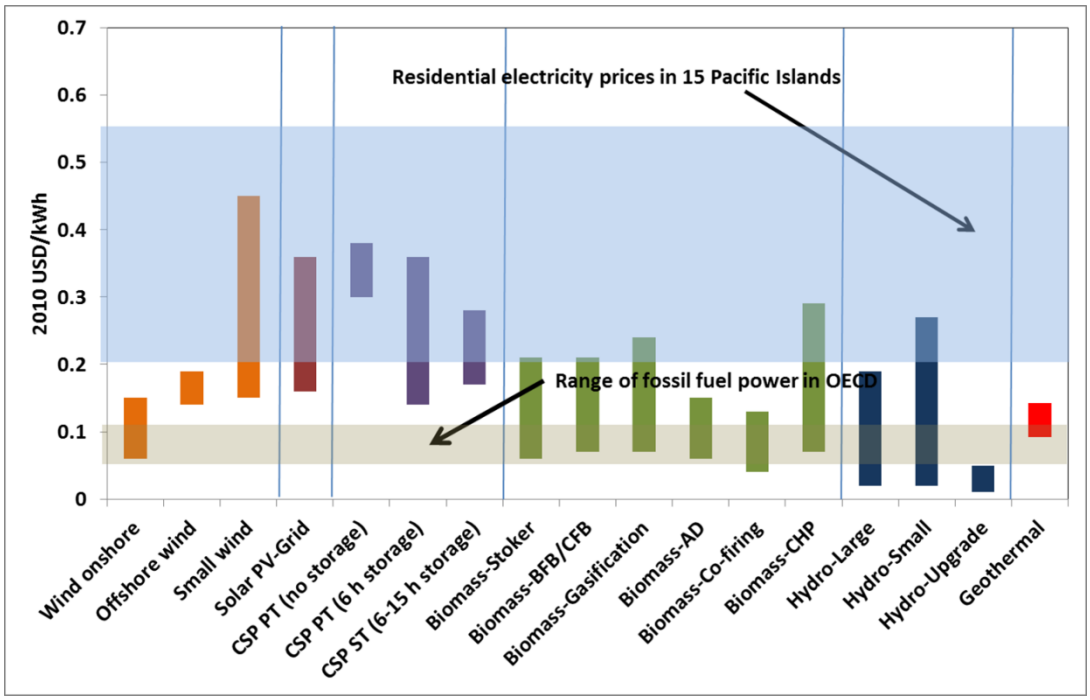

Figure 1: The typical levelised cost of renewable power generation technologies

Note: Assumes the cost of capital is 10%. The bands reflect ranges of typical investment costs (excluding transmission and distribution) and capacity factors. PT = parabolic trough, ST = solar tower, BFB/CFB = bubbling fluidised bed/circulating fluidised bed, AD = anaerobic digester, CHP = combined heat and power.
Source: IRENA

Hydropower is the largest source of renewable electricity generation today, contributing 16% of global electricity needs and often provides the lowest cost electricity of any source. Geothermal is also a mature technology capable of meeting base load electricity needs and can be very competitive where high quality, well defined resources exist. Biomass for electricity generation involves a range of technologies from combustion to gasification, with various solutions at different stages of maturity. Where industrial, agricultural or forestry residues are available onsite electricity can be generated at low cost.

The importance of hydropower, biomass, geothermal and CSP with thermal energy storage is likely to grow over time, as their ability to dispatch will make them critical to facilitating the high penetration of variable sources such as wind and solar.

Comparing costs or prices of energy technologies is not as straightforward as it may seem. Levelised costs of energy for renewables are typically compared with existing technologies that often benefit from direct and/or indirect government interventions (e.g. subsidies, tax measures) and which exclude any external costs (e.g. environmental damage). Any comparison of the costs and benefits of renewable technologies and conventional power generation technologies needs to take these issues into account if a fair comparison is to be made.

In summary, more and more renewable energy technologies are becoming competitive in more and more energy markets, depending on regulatory and market regimes, and the natural resource potential. If renewables were able to compete with other technologies on a level playing field, the number of economically viable projects would increase significantly.

2. Many misperceptions on the real costs of renewable energy still exist

Many of the workshop speakers highlighted that there are still many misperceptions about the cost and performance of renewables and that costs are generally lower, sometimes significantly so, than is often thought. It will, therefore, remain important for policy makers and other stakeholders to keep addressing these misperceptions, as wrong perceptions on the costs figures of renewables may hinder the full potential of renewable energy deployment.

3. Emerging challenges and opportunities: support policies for renewables will have to shift their focus to the system level

The accelerated deployment of renewables, performance improvements and cost reductions represent the beginnings of a renewable revolution. This raises a critical issue, in that the transition to a high share of renewables in power generation will increasingly pose new challenges for policy-makers. This point, and the path dependent nature of the current investment in long-lived renewable energy assets were highlighted by various workshop speakers and participants. Decisions taken now will shape the electricity system for decades into the future. This means that as renewable energy technologies share of the system increases, the policy focus will need to move away from technology specific support packages, to ones that are designed to minimise the overall electricity system costs with higher levels of renewables. Renewable energy technologies need to work more closely together to unlock synergies and ensure there is sufficient flexibility in the system to integrate, at least cost, high levels of variable renewables. This may mean that a focus on more 'costly' renewable technologies and supporting infrastructure will yield lower system costs over time, a point missed by a static analysis.

Critically, the integration of high levels of variable renewables requires a coherent, long-term strategy to minimise the overall costs of a transition to a truly sustainable energy sector. The workshop participants agreed that sooner, rather than later, the policy focus will need to shift from a technology specific approach to an electricity systems approach that ensures sufficient investment in grids, inter-connections, short-term (seconds and minutes) and longer-term (hours and days) system flexibility, and demand response. Workshop speakers and participants discussed analysis that shows that the incremental system costs of higher levels of renewables are likely to be modest and may be barely different from what could be expected in a business-as-usual scenario in the long-term, with proper planning and foresight. This will involve higher investments in the short-to medium-term, but yield reduced costs of delivered energy in the medium- to long-term. It was also noted by participants that these incremental investments aren't as large as is often implied as large investments will need to be made in the aging electricity infrastructure in OECD counties within the next one to three decades.

An important aspect raised by workshop participants of the shift in focus towards integrated systems was the contribution of demand-side technologies (and management). One workshop session was devoted to the synergies between the electrification of transport and higher renewable penetration. When large numbers of electric vehicle batteries are plugged into the grid, they will offer some additional system flexibility, but even modest levels of electric vehicles can provide real benefits in terms of emergency flexibility to avoid system stresses (e.g. the loss of inter-connectors). The main advantage of electric vehicles based on modelling, was the ability to reduce curtailment by sending electricity at times of high wind and solar insulation to vehicles. The modelling suggests the opportunities for vehicles providing electricity to the grid are more limited.

Next steps

1. Improve the availability of real project cost data in the public domain to improve the efficiency of renewable support policies

It was stressed at the workshop that the lack of comparable, verified data on the costs and performance of real renewable energy projects is a major barrier to the accelerated uptake of renewables. The lack of a systematic collection system for renewable energy project cost and performance data increases the risk that policy-making is based on inaccurate, old or inappropriate data.

Given the challenge of having up-to-date cost data in a fast moving industry like PV, workshop participants recommended to investigate opportunities to develop an online database where data could be shared. The participants emphasised the importance of involving the private sector, especially the utilities, in the gathering of data, but also in policy development and decision making.

The workshop participants emphasised the importance of IRENA's and IEA-RETD's efforts to improve the data collection, streamline methodologies, work on assumption transparency, analysis and publish of up to date data on renewable energy costs in order to facilitate robust, efficient policy-making. They encouraged both organisations to continue their work in this vital area.

2. Encourage policy makers to think in systems and not in technologies and remain focussed on cost reductions

The higher levels of penetration of renewables in the electricity sector that is being driven by strong cost reductions and deployment policies will require a shift in the policy landscape. One of the most important outcomes of the workshop was the consensus that the transition which is currently taking place, will require a policy shift from support for individual technologies (and static LCOEs), towards a support framework that is focused on renewables working together at a system level in order to minimize total system costs. This will require complementary policies to address grid strengthening and upgrades, inter-connection, electricity market flexibility, energy storage and demand response. This shift in policy focus will need to happen sooner, rather than later, in many countries if the risk of individual technology support mechanisms locking in sub-optimal overall electricity systems is to be avoided.

Workshop participants saw specific examples of where the modelled costs of electricity systems with high shares of renewables result in very little difference in overall system cost in the medium- to long-term compared to business-as-usual scenarios. However, further work will be required to analyse the numerous detailed studies that have looked at this issue in order to extract the common components of successful strategies to the integration of higher shares of variable renewables.

The idea that the integration of higher shares of renewable energy will lead to higher system costs is seen by many studies to be a myth. A transition towards an energy system with high shares of renewable energy will, however, require a different look on how the energy system and markets operate, and on how they can effectively be supported by public policies. Workshop speakers pointed out that a shift towards systems with high shares of intermittent renewables will require leadership from policy makers and politicians in order to define long-term and to adjust support mechanisms to deliver on those goals, even if this requires higher initial investments. Without a long-term perspective, an effective and efficient transition will be unlikely to materialise. Fortunately, many countries have already embarked on this process and they will provide valuable lessons for others that follow.

3. Address the new challenges - especially regarding flexible integration and flexible demand reduction - in a creative and systematic way

With this new phase in renewable energy deployment decision makers will have to find adequate answers to new challenges. Most of these challenges will be in the area of electricity system flexibility and how much of this comes from the demand side. The good news is that many solutions seem to exist. However, market participants and policy makers are not always aware of the full potential of the solutions available, as they are not yet used to thinking about these issues and have limited experience in dealing with them and technical solutions have not been deployed at the scale required for the transition.

Several workshop speakers presented effective and efficient new examples, such as pilot schemes of demand response in the household sector and in data centres, or the usage of heat storage. More creative thinking in this line, where we think beyond electricity, to the entire energy system, and involve all economic sectors where possible, will be needed in the very near future if costs are to be minimised. Workshop speakers were confident about the existence of a large untapped potential of creative solutions, that will enable the cost-effective integration of high shares of renewables.

Conclusions

The transition towards energy systems with high shares of renewables will require a shift in policy focus and a new way of thinking about many problems in the energy system. This shift in thinking about the costs of individual technologies (simple LCOE) towards thinking in terms of the overall cost of the energy systems will be critical to minimising the cost of a transition to a sustainable energy future. It was stressed at the workshop that the prospects for further deployment of renewables are good, well designed support policies have spurred deployment and, as a result, impressive cost reductions for some technologies in recent years. The huge potential of innovative solutions on the demand-side and in grid flexibility to address new challenges was also highlighted. It was argued that, even more than before, it will be important that the different stakeholders, in particular the policy makers, utilities and manufactures, work together in this transformational change. The government is seen as the facilitator and needs to bring together the different stakeholders and share their long-term vision of the future with them, so as to ensure the policy framework is there and industry, utilities and others understand their role in the investments needed for a sustainable energy system. What will be increasingly important, as initial investment costs rise to reap the benefits of lower system costs in the future, is the role governments and other stakeholders have in conveying this message to society, as public support, and indeed participation, is necessary for the changes needed to make a sustainable energy future happen.

FURTHER INFORMATION

Workshop

The workshop agenda, participants list and speaker presentations can be found at www.irena.org ("Events Archive") or at www.iea-retd.org ("Events")

Recent cost work of IRENA and IEA-RETD

The IRENA Renewable Energy Cost Analysis Papers can be found at http://www.irena.org/publications
For information on the RE-COST 1 Study of IEA-RETD please visit http://iea-retd.org/re-cost-1