Dispelling the Myths: Renewables in the Grid – References for Infographics

Dear Reader,

Around the world, renewable electricity generation by solar and wind is increasing at exponential rates, with shares approaching 50% or more in some countries. New ways to manage energy generation, transmission, distribution, and storage are being established, as well as how to best manage the integration of new renewable electricity with traditional, centralized energy sources, such as coal, gas and nuclear power plants.

Yet, commonly claimed short comings regarding renewable energies and especially their successful integration in to the grid often make it hard when discussing the urgent need for an energy transformation based on the renewables.

For this, the International Solar Energy Society has developed a series of infographics to clarify some commonly claimed shortcomings about renewable energy - we hope you find this document helpful when discussing renewable energy with your friends, family, or colleagues.

In this document, we have collected all references used to create the infographics and the information they contain. The references are grouped for each of the "myths" they dispel. Please note, any graphics not specified differently are ISES property.

Myth 1: "Wind and solar will never replace baseload generation, the constant electricity production typically provided by coal, nuclear and large hydro power plants"

Fact: Wind and solar already provide periods of 100% renewable electricity coverage in countries such as Denmark, Germany, and in parts of Australia. In the future the importance of baseload will decrease as grids transform to having primarily variable generation supported by flexible and on-demand sources, such as energy storage. Strengthened interconnections, smart grid technologies, and load management strategies enable greater efficiency and better control, while providing flexible, reliable, and economical renewable based power systems.

- **References:**

Diesendorf, M., Elliston, B., 2018. The feasibility of 100% renewable electricity systems: A response to critics, Renewable and Sustainable Energy Reviews. 93, 318-330.

REN21, 2017. *Renewables 2017 Global Status Report,* Paris: REN21 Secretariat.

Myth 2: "Wind and Solar are too intermittent for reliable grid operations and cannot be predicted"

Fact: Wind and solar forecast predictions are increasing in accuracy, in time periods from minutes to several days. These forecasts provide grid operators with information about what the power output of renewable power plants will be to a high degree of certainty. This information then allows the operators to anticipate how to best control fluctuating loads with other flexible power sources to match energy supply to its demand. It also promotes demand side management, which are initiatives and technologies that encourage consumers to optimize their energy use.

- **References:**

California Independent System Operator, 2018. *Supply and renewables.* [Online]
Available at: http://www.caiso.com/todaysoutlook/pages/supply.aspx
[Accessed 15 September 2018].

Kariniotakis, G., 2017. Renewable Energy Forcasting: From Models to Applications, Woodhead Publishing, Cambridge.

Qamar Raza, M., Nadarajah, M., Ekanayake, C., 2016. On recent advances in PV output power forcast. Solar Energy Journal. 136, 125-144

Myth 3: "Expensive storage is required to further increase reliability and renewable energy use in the electricity grid"

Fact: A minimum of storage in the form of batteries, hydrogen, and pumped hydroelectric will certainly support increased renewable energy and help prevent costly energy waste. However, increased grid flexibility and management, interconnections between regional grids, and dispatchable power sources, like on-site combined heat and power (CHP), allow for greater renewable energy integration even without storage while increasing power supply reliability.

- **References:**

Elliston, B., Diesendorf, M., MacGill, I., 2013. Least cost 100% renewable electricity scenarios in Australian National Electricity Market. Energy Policy. 108, 259-279

Elliston, B., Riesz, J., MacGill, I., 2016. What cost for more renewables? The incremental cost of renewable generation – An Australian National Electricity Market case study. Solar Energy Journal. 95, 127-139.

The storage necessity myth: how to choreograph high-renewable electricity systems. 2014. [Film] Directed by Amory Lovins. Colorado, USA: Rocky Mountain Institute .

Zerrahn, A., Schill W., Kemfert, C., 2018. On the economics of electrical storage for variable renewable energy sources. Solar Energy Journal. 108, 259-279

Myth 4: "High quantities of wind and solar energy will destabilize the grid and cause blackouts"

Fact: Knowledge is power. The key is to install and manage smart systems that allow a smooth integration and control of variable electricity sources. This way grid operators can ensure that sufficient electricity is supplied at all times, resulting in a more resilient grid. For example, the average blackout duration was cut in half in Germany after the integration of 40% renewable electricity.

- **References:**

Blumsack, S., Fernandez, A., 2012. Ready or not, here comes smart grid!. Energy. 37, 61-68.

John, J. S., 2017. *The Rising Tide of Evidence Against Blaming Wind and Solar for Grid Instabilitity.* [Online] Available at: https://www.greentechmedia.com/articles/read/the-rising-tide-of-evidence-against-blaming-wind-and-solar-for-grid-instabi [Accessed 2 October 2018].

RenewEconomy, 2016. *The myth of renewables threatening grid stability.* [Online] Available at: https://reneweconomy.com.au/the-myth-of-renewables-threatening-grid-stability-17082/ [Accessed 15th September 2018].

YaleEnvironment360, 2017. *The Energy Secretary Is Wrong: The Grid Is Ready for Renewables.* [Online] Available at: https://e360.yale.edu/features/forget-the-naysayers-the-grid-is-increasingly-ready-for-renewable-energy [Accessed 15 September 2018].

Myth 5: "For every PV or wind power plant, an equal capacity of fossil fuel generated electricity must be running in the background, negating most of the carbon emissions benefit"

Fact: Renewable energy and storage systems combined with other modern grid-management tools can reduce the number of operating fossil fuel power plants that must be run in the background, known as "spinning reserves". This reduces net grid carbon emissions. The need for additional fossil-based power plants that can raise their output to replace renewable sources when the wind drops or clouds pass overhead will be minimal as the grid becomes more flexible and "smarter". Several grids, for example in Tasmania, Uruguay and Costa Rica, already operate for periods of hours to days on 100% renewable

electricity with no additional fossil fuel power plants running in the background, only requiring a small spinning reserve for any power generation, regardless of its source.

- **References:**

International Energy Agency, 2017. *Getting Wind and Sun onto the Grid - A Manual for Policy Makers,* Paris: International Energy Agency.

export.gov, 2018. *Uruguay - Renewable Energy Equipment.* [Online]
Available at: https://www.export.gov/article?id=Uruguay-Renewable-Energy-Equipment
[Accessed 3 October 2018].

Hanley, S., 2018. *Costa Rica: 1st Country to Achieve Independence From Fossil Fuels.* [Online] Available at: https://cleantechnica.com/2018/05/13/costa-rica-1st-country-to-achieve-independence-from-fossil-fuels/ [Accessed 3rd October 2018].

Parkinson, G., 2018. *Look, no batteries! How "flexible" solar can help the grid, without storage.* [Online] Available at: https://reneweconomy.com.au/look-no-batteries-how-flexible-solar-can-help-the-grid-without-storage-14061/ [Accessed 4th October 2018].

Global-Roam, 2018. *Live Supply & Demand Widget, sponsored by RenewEconomy.* [Online]
Available at: www.nem-watch.info/widgets/reneweconomy/ [Accessed 3rd December 2018].

Electricity Supply Industry Expert Panel, 2011. *Technical Parameters of the Tasmanian Electricity Supply System,* Hobart: State of Tasmania.

Nelson, J., Kasina, S. & Stevens, J., 2018. *Investigating the Economic Value of Flexible Solar Power Plant Operation,* San Francisco: Energy and Environmental Economics, Inc.

Myth 6: "The duck curve, which shows a late afternoon load spike as large amounts of solar energy go offline coincidentally during the evening peak electricity demand, will be very difficult and expensive to solve"

Fact: Increased demand side management coupled with short-term balancing and electrical storage (possibly making use of electric vehicles adjusting their charging practices) can solve this problem without causing instability in the grid. This is already being explored by some grid operators by promoting "Time-of-day" pricing that encourages greater electricity use during the off-peak early-morning, mid-afternoon, and night-time hours.

- **References:**

Roberts, D., 2018. *Solar power's greatest challenge was discoverd 10 years ago. It looks like a duck..* [Online] Available at: https://www.vox.com/2018/5/9/17336330/duck-curve-solar-energy-supply-demand-problem-caiso-nrel [Accessed 11 October 2018].

Myth 7: "Excess renewable energy generation will be wasted, causing retail electricity prices to increase"

Fact: There are many ways to utilize excess generation to provide additional benefits, including power-to-heat, (e.g. heat pump operation for district heating), pumped hydro storage, and hydrogen or synthetic fuel production. Not only does this create other valuable products, but they can also increase grid stability. In regions with interconnections, excess renewable energy can be exported to supply low emission electricity in adjoining territories, also increasing revenue.

- **References:**

Turner, J., Sustainable Hydrogen Production. 2004. Science. 305, 972-974.

Bueno, C., Carta, J., 2006. Wind powered pumped hydro storage systems, a means of increasing the penetration of renewable energy in the Canary Islands. Renewable & Sustainable Energy Reviews. 10, 312-340.

Lund, H., Moller, B., Mathiesen, B., Dyrelund, A., 2010. The role of district heating in future renewable energy systems. Energy. 35, 1381-1390.

Myth 8: "Transmitting renewable energy across the electric grid over long distances is highly inefficient and costly"

Fact: Renewable energy generation can be very local in nature. Solar PV systems, in particular rooftop solar, are located close to consumers, effectively reducing transmission grid requirements. For long-distance power transmission from large PV and wind plants in optimum resource regions, new high voltage direct current (HVDC) transmission lines are efficient and allow for electricity exchange over whole continents, increasing grid stability and renewable energy use.

- **References:**

Larson, A., 2018. *Benefits of High-Voltage Direct Current Transmission Systems.* [Online] Available at: https://www.powermag.com/benefits-of-high-voltage-direct-current-transmission-systems/ [Accessed 3rd December 2018

Barnard, M., 2018. *Future of electricity transmission is HVDC.* [Online] Available at: https://medium.com/predict/future-of-electricity-transmission-is-hvdc-9800a545cd18 [Accessed 2 December 2018].