The case for a global energy grid based on 100% renewable energy

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Researchers envisage a global sustainable energy grid, and are building a prototype for an innovative technology that could make this happen. Credit: University of Birmingham

Researchers at the Birmingham Energy Institute are working with the C-EPRI Electric Power Engineering Ltd (C-EPRI), to build an industrial-scale prototype of a next-generation HVDC technology that could pave the way for a global electricity grid, based on renewable energy.

A team led by Professor Xiao-Ping Zhang, Director of Smart Grid, at the University of Birmingham, will be using innovations developed at Birmingham, that improve the reliability and efficiency of high-voltage, direct current (HVDC) power transmission systems, which are used for the bulk transmission of electrical power.

The researchers recently published an economic analysis demonstrating that coupling HVDC transmission with 100% renewable energy generation can deliver significant cost-savings (a minimum of 20%) when the world's continents are joined together by a global energy supply grid.

Their vision for the global grid involves connecting renewable energy supply from 14 regions in the world, which span all continents and all time zones.

The regions comprise: the European Union, North Africa and the Middle East, Eastern Russia, Western Russia, Central, South, East and South East Asia, Oceania, Western, Eastern and North-eastern North America, and South America.

Professor Zhang commented: "The prototype based on our theoretical model is now under development and our research aims to increase the availability of renewable energy—by improving the efficiency and reliability of transmission to reduce costs for householders and businesses. It's important that we can use renewable energy to provide a vital safety mechanism for controlling frequency dips in national power grids. Our vision for a global energy grid could revolutionize the way we use renewables."

The comprehensive analysis involved data capture for both renewable energy supply and global electricity demand.

Renewable energy supply was calculated using historical meteorological (weather) data showing the potential for wind and solar power generation over a seven year period (2011–2017), and estimates of hydro-electric power generation from the International Energy Association.

The researchers then calculated transmission costs over land and sea, potential power losses during transmission, and the operational and management costs of an HVDC-based global grid.

A more regional perspective, provided in a previous paper, shows that adopting this approach would result in the regional cost of electricity dropping by 31%, 10%, and 10% for Europe, North-East Asia and North America respectively.

Professor Zhang has championed the concept of a global energy grid, and has developed several technologies to overcome the practical challenges involved in the transition to renewable energies.

His innovations include prize-winning technologies to improve efficiency and eliminate commutation failure in long distance HVDC power transmission and ways of stabilizing local grids that receive renewable energy.

Professor Xiao-Ping Zhang has a portfolio of patents on related technologies, which are available to view on the IN-PART website.

More information: Cong Wu et al, Global Electricity Interconnection With 100% Renewable Energy Generation, *IEEE Access* (2021). DOI: 10.1109/ACCESS.2021.3104167

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