Mathematical formula boosts renewable energy efficiency

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Mr Banerjee says Albany's windfarm in the Great Southern, is an example of a renewable power producer at the end of a congested feeder. Credit: Stefan L

A mathmatical framework for rating transmission lines aims to help relieve power grid congestion to make more efficient use of renewable energy.

The framework has been devised by Curtin PhD student Binayak

Banerjee who says current grids are designed for the simple task of taking power from a big energy producer at one end, to consumers at the other.

His research aims to better manage the grid by reducing congestion when power is input from multiple renewable energy sources like wind and solar farms.

Mr Banerjee says Albany's windfarm in the Great Southern, is an example of a renewable power producer at the end of a congested feeder.

"Congestion occurs when the networks capacity isn't big enough to transport energy from generation to loads and so the power from wind and solar farms is not fully utilised," he says.

"One option when you don't have enough capacity is you can build a bigger network which is time consuming and expensive and may not be economically viable as renewable sources produce high output only intermittently.

"That's where I propose this idea of a Dynamic Line Rating [DLR] where we can overload the network for a really short period of time to absorb that extra generation you get from wind or solar farms."

DLR is more accurate than existing methods because it uses real time operating conditions like temperature, load intermittent effects and sag to capture real time variations.

This is compared to the existing rating where transmission lines' capacity are assessed using estimations that include worst case weather conditions which rarely occur. It means networks are often underutilised.

Risky framework promises huge capacity

Mr Banerjee says using a DLR framework is risky because increasing line flows beyond the rating can damage the network.

But the benefit is almost infinite capacity if the network is supported by dynamic infrastructure; a 'smart grid' capable of being managed in real time, he says.

The DLR framework was tested at Curtin University's Electrical and Computer Engineering Department using simulations and mathematical modelling around congestion following power outages.

Mr Banerjee says scientists have been researching DLRs for decades but the technology for implementing them has not been available until now.

"That's why we wanted to assess how we can use a smart grid infrastructure to implement DLR in a more co-ordinated fashion," he says.

Other benefits are lower electricity prices and potential for more renewable power generation.

The flow-on effect is to reduce uncertainty about the renewable energy supply.

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