**Submission No 208**

# INQUIRY INTO FEASIBILITY OF UNDERGROUNDING THE TRANSMISSION INFRASTRUCTURE FOR RENEWABLE ENERGY PROJECTS

**Organisation:** 100 percent Renewable Energy Group, School of Engineering, College of Engineering, Computing & Cybernetics, Australian National University

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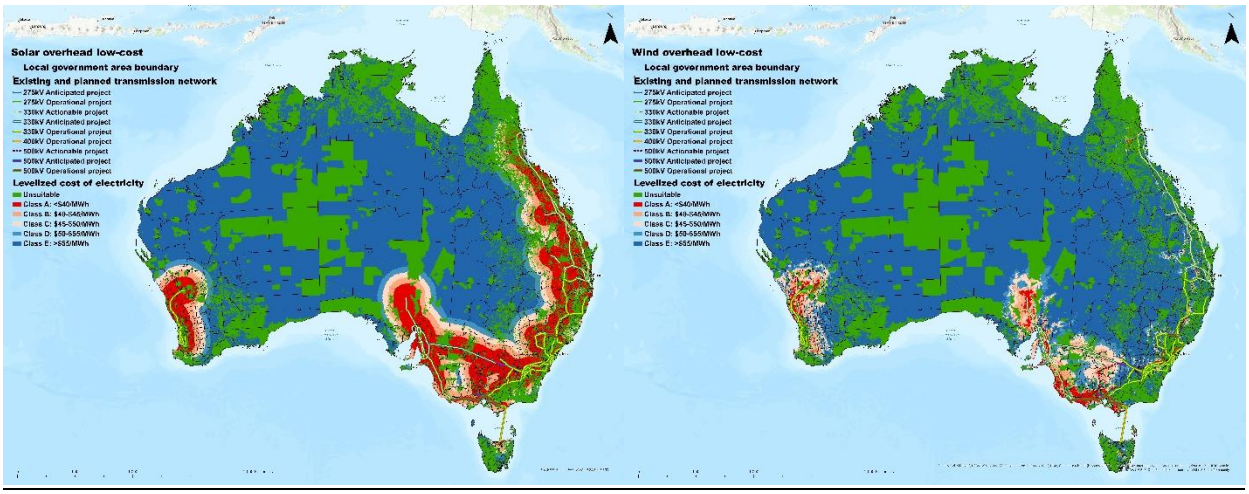
Australian National University

**To: The Standing Committee on State Development,**

**Subject: Utilizing Heat Maps for Maximum Use of Existing Transmission Infrastructure**

We are writing to share insights from a recent project conducted by our team. The project involves the development of high-resolution heat maps showing the optimal locations and potential of solar photovoltaics (PV) and wind energy across Australia. We are eager to share our findings and suggestions in the context of the feasibility study into the undergrounding of transmission infrastructure for renewable energy projects in New South Wales (NSW).

*Understanding the Heat Maps*




Our project created detailed, high-resolution heat maps of Australia that demonstrate the most prospective regions for solar PV and wind energy developments. We analysed each pixel (1km x 1km for solar and 250m x 250m for wind) based on a calculated indicative cost of electricity in AUD/MWh, which encompasses the cost of energy from a solar or wind farm, as well as the cost of an associated powerline connecting the renewable energy installation to the existing and planned high voltage transmission network.

The indicative costs were categorized from Class A to Class E, with Class A being the lowest (< $40/MWh) and Class E being the highest (> $55/MWh). Our calculations incorporated costs for wind, solar, and the low voltage powerline connection, but they did not include costs for environmental and geotechnical approvals, road upgrades, substations, payments to host farmers, or risk.

When developing these maps, we factored out unsuitable areas for renewable energy infrastructure, such as urban zones, protected lands, and native forests. These regions are marked green in the maps. The remaining areas are also color-coded to designate suitability, with red indicating highly suitable locations, yellow and blue for less suitable locations.

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*Using Heat Maps to Optimize Existing Transmission Infrastructure*

In the transition towards a decarbonized energy system, Australia will need to double, and then triple, its electricity production. Existing transmission infrastructure is often insufficient and originates from locations that no longer align with our renewable energy goals, such as coalfields.

We recognize the complexity of constructing new transmission lines into densely populated cities or through protected lands. In places like Sydney, where urban density is high, and the surrounding areas are populated by national parks, adding new infrastructure could be both technically challenging and environmentally detrimental.

This is where our heat maps prove invaluable. By identifying potential sites close to existing transmission lines, they allow maximum usage of the current infrastructure, thus facilitating the growth of our renewable energy capacity with minimal additional transmission construction. This approach is both cost-efficient and environmentally considerate.

For example, the area between Goulburn and Lithgow in NSW shows great potential for new clean energy sites, given its strong connection to transmission lines and a favourable mix of wind and solar resources.

*Leveraging Pumped Hydro Energy Storage (PHES) and the Heat Maps*

An integral part of maximizing the use of existing transmission is implementing storage solutions that allow renewable energy to be dispatched according to demand, rather than supply. By placing overnight storage for solar and wind energy on a major existing powerline, the full power capacity can be utilized 24/7.

Pumped Hydro Energy Storage (PHES) is an economical and proven method of storing and recovering energy. Locations near existing power lines, such as Lithgow, are excellent candidates for PHES installations. By using the off-peak excess of renewable electricity to pump water uphill and then releasing it to generate power during periods of low renewable generation and high demand, we can maintain a stable and consistent energy supply around the clock. It's worth noting that the cost of implementing PHES is likely significantly lower than the cost of undergrounding transmission.

Our team, with expertise in both PHES and the heat maps, is capable of modelling these scenarios in detail to provide an evidence-based strategy for renewable energy development in NSW.

We recently collaborated with the NSW Department of Planning and Environment on the "Optimal Site Selection Mapping for Large-Scale Solar and Wind Energy Development" project. In this project, we together developed a meticulous approach, incorporating a broad spectrum of factors to create an advanced site selection model. Our primary deliverable was a comprehensive set of maps for solar and wind, designed to delineate areas unsuitable for renewable energy development, alongside regions that

require additional assessment by stakeholders during project site selection. Furthermore, these maps assist users in pinpointing locations with minimum constraints and maximum opportunities at the earliest stage of a project's development. This tool is designed to aid the community and other stakeholders in understanding, both visually and conceptually, the regions that are most and least suitable for renewable energy development in NSW.

In conclusion, while exploring the potential of underground transmission infrastructure is important, we suggest the committee to also consider alternatives like maximizing the use of existing transmission and integrating storage solutions. Our heat maps offer an innovative, data-driven approach to identify potential sites that minimize environmental impact, costs, and infrastructural changes.

More information about the heat maps can be accessed here: https://re100.eng.anu.edu.au/heatmaps/.

A detailed summary of the identified solar and wind potential for all local government areas and all scenarios is available here: https://www.dropbox.com/s/ngr056mhls0vsxm/LGA_summary.xlsx?dl=0.

Our website also provides atlases of promising PHES sites in Australia and around the world: https://re100.eng.anu.edu.au/pumped_hydro_atlas/.

We look forward to the opportunity to collaborate further with the committee and local stakeholders on this matter.

Sincerely,

**100% Renewable Energy Group**
**School of Engineering, CECC**
**Australian National University**