

Multi-energy expansion under uncertainty of the Australian energy system: integrated electricity-gas generation-transmission planning with consideration for low carbon transport

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Recent events such as the loss of a main interconnector between Victoria and South Australia have highlighted how an expansion of the Australian electrical transmission system might be beneficial in both economic and reliability terms. This is also to be seen in the light of the need for decarbonising the electrical sector and the consequent increasing volume of renewable energy sources such as wind and solar, which are bringing about new operational challenges and new opportunities for various technologies in Australia. In particular, gas fired power plants are seen more and more as a relatively clean generation source to balance a system with increasing variable clean energy generation. This potentially calls for an expansion in the gas fired generation plant fleet, and in turn for the gas transmission network. There is therefore a clear opportunity for coordinating and integrating the expansion plan for both the electrical and gas transmission networks as well as new gas generation resources. At the same time, and as a further point, decarbonisation of the whole energy system, and not only electricity, calls for consideration for low carbon transport too, which might be for instance delivered through electric or hydrogen-based vehicles or a combination thereof. This would further impact on both the electrical and gas development plan, thus leading to a truly “multi-energy system” expansion problem. Moreover, given the level of uncertainty in long term planning of such a complex multi-energy system, relevant for instance to energy prices; volume, type and location of new renewable installation; new energy technologies themselves (including for transport); etc.; such a problem needs to be tackled considering an appropriate formulation that takes into account possible futures that might realise.

The aim of this project, first of its kind, is thus to develop a multi-energy system expansion plan under uncertainty for low carbon electricity-gas-transport sectors considering both electrical and gas transmission networks as well as generation fleet and possible options for decarbonising transport. The project will be founded on the long experience of and existing tools developed by the supervisors in the area of multi-energy system modelling, and will explore the use of different types of optimization and risk analysis techniques to deal with long term uncertainty and risk. The project outcomes are intended to inform strategic development of all energy sectors and in particular of the electrical and gas transmission systems, and provide insights into future low carbon transport options.