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## Using energy network science (ENS) to connect resilience with the larger story of systemic health and development

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### Abstract

An electricity generation planning framework incorporating adaptation to hydroclimatic change is presented. The planning framework internalizes risks and opportunities associated with alternative hydro-climate scenarios to identify a long-term systems configuration robust to uncertainty. The implications of a robust response to hydro-climatic change are demonstrated for the electricity system in British Columbia (BC), Canada. Adaptation strategy is crucial in this region, mainly due to the large contribution of hydropower resources to regional electricity supply. Analysis of results from basin-scale hydrologic models driven with downscaled global climate data suggest that shifts in regional streamflow characteristics by the year 2050 are likely to increase BC's annual hydropower potential by more than 10 %. These effects combined with an estimated decrease in electricity demand by 2 % due to warmer temperatures, could provide an additional 11 TWh of annual energy. Uncertainties in these projected climate impacts indicate technology configurations offering significant long-term operational flexibility will be needed to ensure system reliability. Results from the regional long-term electricity generation model incorporating adaptive capacity show the significant shifts required in the non-hydro capacity mix to ensure system robustness cause an increase in cumulative operating costs of between 1 and 7 %. Analysis of technology configurations involving high-penetrations of wind generation highlights interactions between flexibility requirements occurring over multiple temporal scales.

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**KEYWORDS** Family resilience; family processes; family adaptation. Resilience – the capacity to withstand and rebound from disruptive life challenges – has become an important concept in developmental science and in the field of mental health over recent decades. It involves dynamic processes, fostering positive adaptation in the context of significant adversity (Masten & Garmezy, 1990). Resilience is not a fixed trait, but a dynamic process that can be fostered through supportive relationships, coping strategies, and a sense of purpose and meaning. Resilience is especially important in the context of significant adversity, such as the death of a child (which upends normative generational expectations). In our experience (Walsh & McGoldrick, 2013)