Ontario Power Generation Case Study

The Impact of Climate Change on a Redevelopment Scenario

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Context

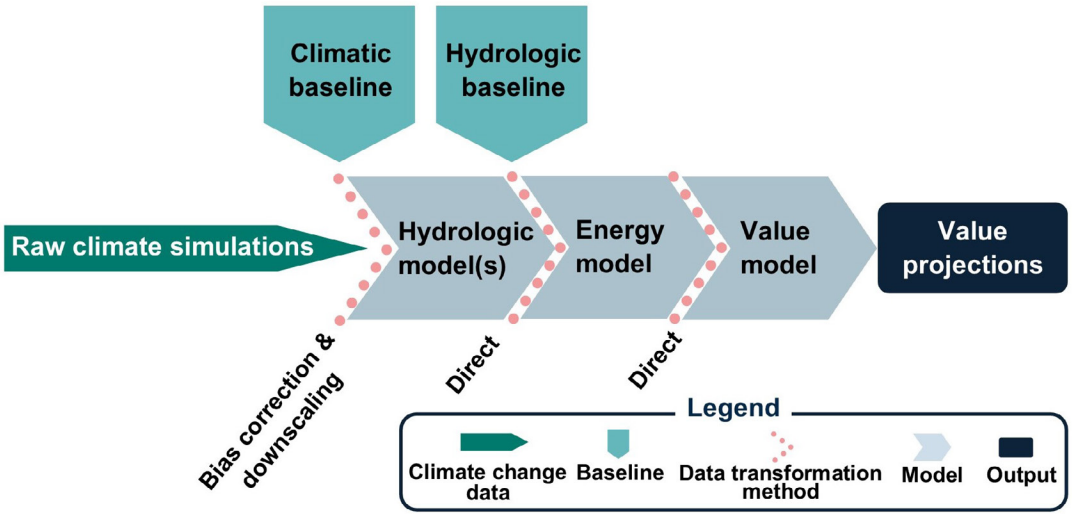
Business cases for the construction or redevelopment of generating stations need to reflect revenues and costs over the long lifespans of hydropower assets. This case study involved a nearly end-to-end assessment of potential changes in streamflow and energy production caused by climate change and the impact these could have on the current costs of a hypothetical project.

Objective

Develop an understanding of the impacts of climate change on the energy production of an individual station and their relative influence on the valuation of station redevelopment.

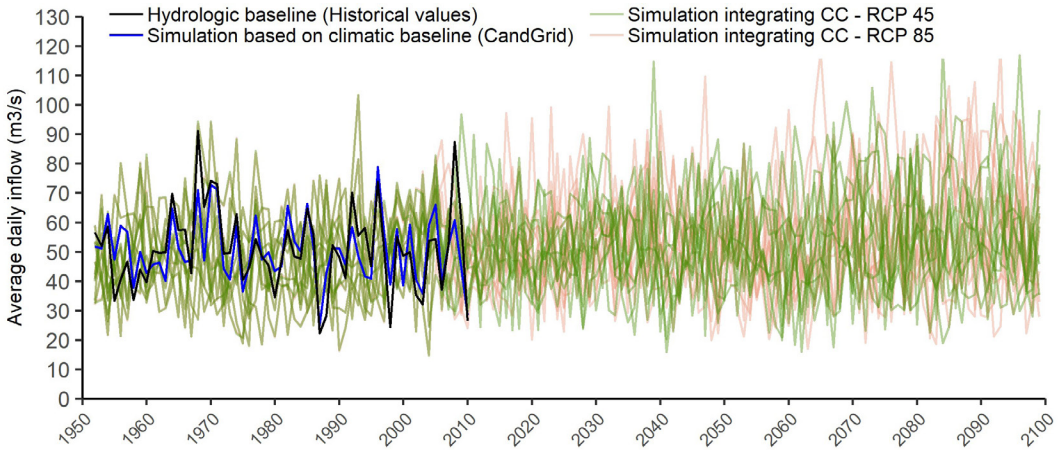
Approach

To better isolate the impacts of climate change from other influences, such as changes in reservoir management, OPG decided to implement the full modelling chain and climatic baseline. Downscaled and bias-corrected GCM scenarios for temperature and precipitation were provided by Ouranos and used to simulate daily flow and energy production from the generating station. A financial model was used to determine the relative impact that climate-driven flow changes could have on station valuation. Operational or physical adaptations were not considered.



Results

- Several iterations of the hydrologic model were used to enhance consistency with historical data and simulation based on a climatic baseline, resulting in a well-performing modelling chain with an inflow bias of less than 1% compared to historical values. This was achieved by calibrating the hydrologic model over a longer historical period of 62 years and by using the same base-gridded precipitation product used as reference for climate-data bias correction.
- Mean annual flow was not found to be affected much at this site as a result of climate change (i.e. few significant trends), but there is greater year-to-year variability in flow, as well as more frequent high- and low-flow years, although they are of similar magnitude to historical records (Figure). Flow changes had a corresponding impact on energy production.
- The asset valuation was sensitive to many factors unrelated to climate, including investment cost and discount rate. Some of these financial factors were found to affect projected asset value more than the anticipated variations in energy production due to climate change. It should be noted that physical or operational adaptation measures were not considered as part of this case study and would impact project costs and energy production.
- A sensitivity analysis on energy-production values revealed that the valuation was more sensitive to lower energy production than it was to higher energy production.



Lessons learned

- Several models are involved in the modelling chain that produced the final outcome. It was helpful to put all the pieces together, using acceptable-quality models, and then perform a sensitivity analysis on the whole chain to identify which models most influenced the final results. This enabled us to better focus our efforts and refine the few models that had the biggest impact on the final outcome.
- Consistency proved to be very important. It was absolutely necessary to recalibrate our hydrologic model using the same gridded precipitation product used as reference for the GCM bias-correction method, as the original hydrologic model was calibrated with different datasets. The shared baseline removed some significant initial biases.

Reference

This case study was developped as part of the Guidebook: Fournier, E., Lamy, A., Pineault, K., Braschi, L., Kornelsen, K., Hannart, A., Chartier, I., Tarel, G., Minville, M. et Merleau, J. (2020). Valuation of Hydropower Assets and Climate Change Physical Impacts A Guidebook to Integrate Climate Data in Energy Production for Value Modelling, Ouranos, Montréal, 208 pages.