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Rethinking the concept of value in national assets and infrastructure.

Engineering Asset Management at Hydro-Quebec

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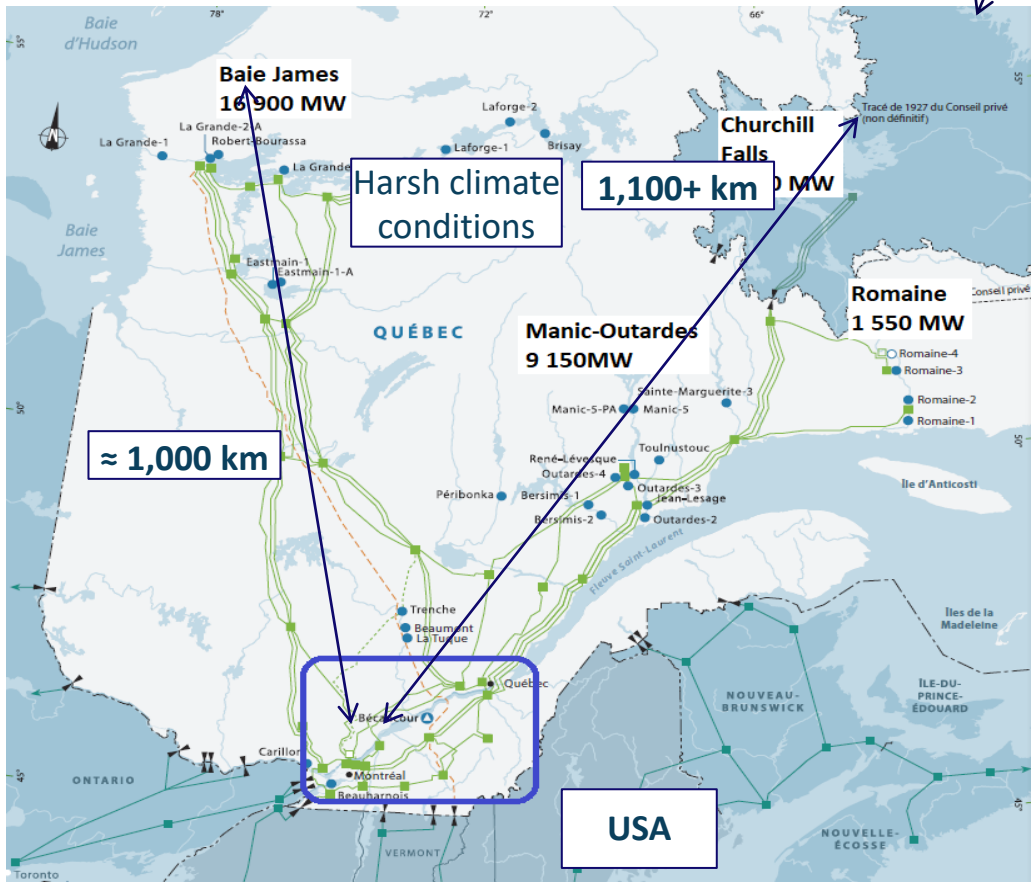
Hydro-Quebec in numbers

HQ is only N-A electrical utility with a major research institute (IREQ) (500+ people)



https://www.hydroquebec.com/about/
https://www.hydroquebec.com/sustainable-development/

- **Total number of employees: 19,477**
- **Total number of customers: 4,357,000**

Generation capacity

- **62** Hydroelectric power plants; **>350** Hydroelectric generators
- **37,243 MW** installed generation power

Transmission grid

- Over **34,802 km transmission lines 49 kV to 765 kV** (almost 12,000 km 735 kV transmission lines)
- **534** Transmission substations
- **15 Strategic inter-connexions** with neighbor grids for exports (Canada, NE USA)

Distribution grid

- **118,500+ km MV** < 25 kV & **120,000+ km LT** distribution grid
- **≈ 3,000+** Distribution substations
- **≈ 680,000+** Arial transformers

Main generation units are in North and **main consumption centers** are in the Southern part of Quebec, Ontario, NE USA **(1,000+ km) –** huge technological and scientific challenges to reliably operate the whole system

Asset Management at Hydro-Quebec

- Hydro-Quebec as a part of critical national infrastructures possesses the significant asset portfolio. Its assets are aging or become obsolete (e.g. IT, communication assets) requiring large scale replacements or refurbishment
- HQ also faces an increasingly complex operating and business environment (market evolution, performance requirements, changing regulatory framework, new technologies, pandemic, climate change & extreme weather events, etc.). This complexity and uncertainties have to be managed
- Asset management is considered an efficient approach able to provide a strong scientific and technical basis for a rigorous decision-making (combined with risk and resilience management)
- HQ is not certified ISO 55k, but follows its prescriptions/concept as far as possible
- HQ and NSERC also co-finance an university research chair in AM (UQTR) – R&D and innovation are considered quite important part of the overall AM undertaking
- The strength of HQ's AM (basically managed at the level of its main divisions) is in a multidisciplinary and holistic approach, collaboration and a long-term vision of the organization (HQ's divisions at all levels of organization, IREQ, universities, industry peers, participation at various conferences, regulatory and standardization bodies, ISEAM, IAM, CIGRE, IEEE, IEC, etc.)
- HQ's experience and approach might be of interest for other organizations

Some future challenges in AM (list non exhaustive)

Based on HQ's experience, there some challenges in efficiently apply AM

- ❑Integrate new technologies, materials, scientific knowledge, AI, "smart things" with existing ones
- ❑Align all the functions of an organization (engineering and non-engineering)
- ❑Enhance methods and tools for:
  - Life Cycle Cost modeling and decision making support
  - Diagnostic and prognostic
  - Data acquisition and treatment
- ❑Develop new modeling and optimization methods capable to grasp the complex operational and business environment, deep uncertainties as well as emergent and systemic risks associated with it
- ❑Understand, model and characterize:
  - Impact of climate change on assets and AM
  - Cyber security issue and its impact on AM (particularly relevant with the introduction of edge technologies)
  - Impact of human and organizational performance on the AM efficiency

Some our publications related to AM

- Komljenovic, D., Abdul-Nour, G., and Boudreau, J.F. (2019), Risk-informed decision-making in asset management as a complex adaptive system of systems. *International Journal of Strategic Engineering Asset Management (IJSEAM)*, Vol. 3, No. 3; 198-238
  DOI: 10.1504/IJSEAM.2019.10030326
- Komljenovic, D., (2019), *Asset Management and its importance for electrical power utilities*, Tutorial, CIGRE Canada, Montreal, September 2019
  https://www.researchgate.net/publication/335966870_TUTORIAL_Asset_Management_and_its_importance_for_electrical_power_utilities
- Abdul-Nour, G., Gauthier, F., Komljenovic, D., Vaillancourt, R., Côté, A., (2019), *Development of a resilience management framework adapted to complex assets systems: Hydro-Québec Research Chair on Asset Management*, World Congress on Resilience, Reliability and Asset Management (WCRRAM), Singapore, July 2019
- Komljenovic, D., Messaoudi, D., Larivière, P., Caron, S. and Chahine, R., (2019), *Risk-Informed Decision-Making in Asset Management of Electrical Utilities*, CIGRE Canada, Montreal, September 2019 (CIGRE Paper 138)
  https://cigre.ca/papers/2019/CIGRE-138.pdf
- Blancke, O., Tahan, A., Komljenovic, D., Amyot, N., Hudon, C., (2018), A holistic Multi-Failure Prognosis Approach for Complex Equipment, *Reliability Engineering and System Safety*, 180: 136-151
  DOI: 10.1016/j.ress.2018.07.006
- Komljenovic, D., Gaha, M., Abdul-Nour, G., Langheit, C., Bourgeois, M. (2016), Risks of Extreme and Rare Events in Asset Management, *Safety Science*, 88 : 129–145
  DOI: 10.1016/j.ssci.2016.05.004
  https://www.researchgate.net/publication/303316134_Risks_of_Extreme_and_Rare_Events_in_Asset_Management
- Komljenovic, D., Abdul-Nour, G. and Popovic, N. (2015), An approach for strategic planning and asset management in the mining industry in the context of business and operational complexity, *Int. J. Mining and Mineral Engineering*, Vol. 6, No. 4: 338–360
  DOI: 10.1504/IJMME.2015.073047
  https://www.researchgate.net/publication/283464241_An_Approach_for_Strategic_Planning_and_Asset_Management_in_Mining_Industry_in_the_Context_of_Business_and_Operational_Complexity
- https://www.researchgate.net/profile/Dragan_Komljenovic/research?ev=prf_act