Grid Issues

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Why are microgrids so different?

Plain vanilla grid

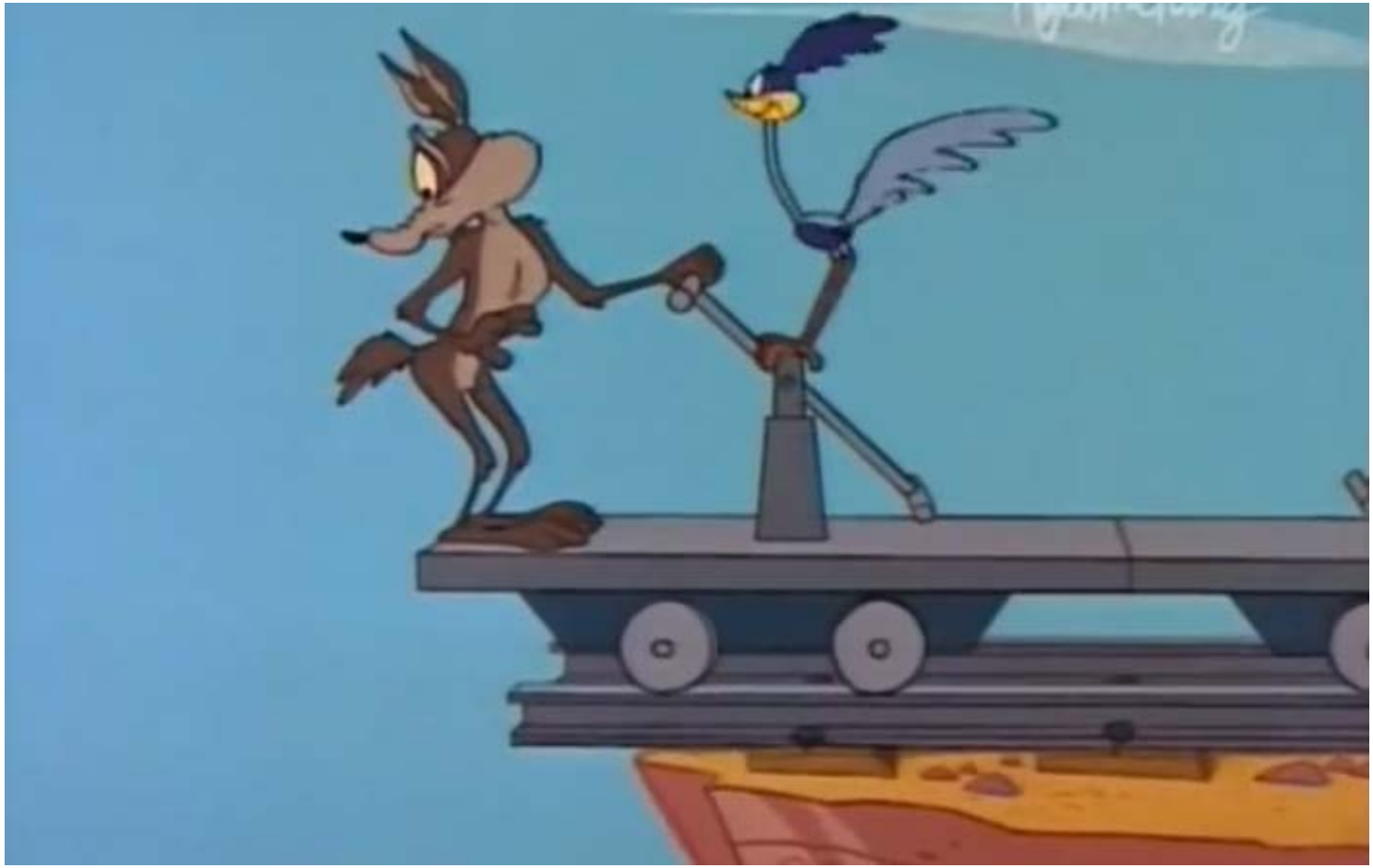
Microgrid

No matter what, conservation of energy is unescapable!

What are the challenges?

- When connected to the grid
  - Maximize the commercial and environmental value microgrid (generation) assets
  - Different modes of operation → dispatched (or not) by the main grid, virtual power plant
  - Optimization problem primarily
- When islanded from the grid
  - No longer have the electrical support of the main grid → limited capacity and inertia, finite energy
    - Things will swing…
  - Restore service as quickly as possible
  - Keep the lights on for as many consumers as possible
  - Control problem primarily

What not to do? Keep on doing the same old things!

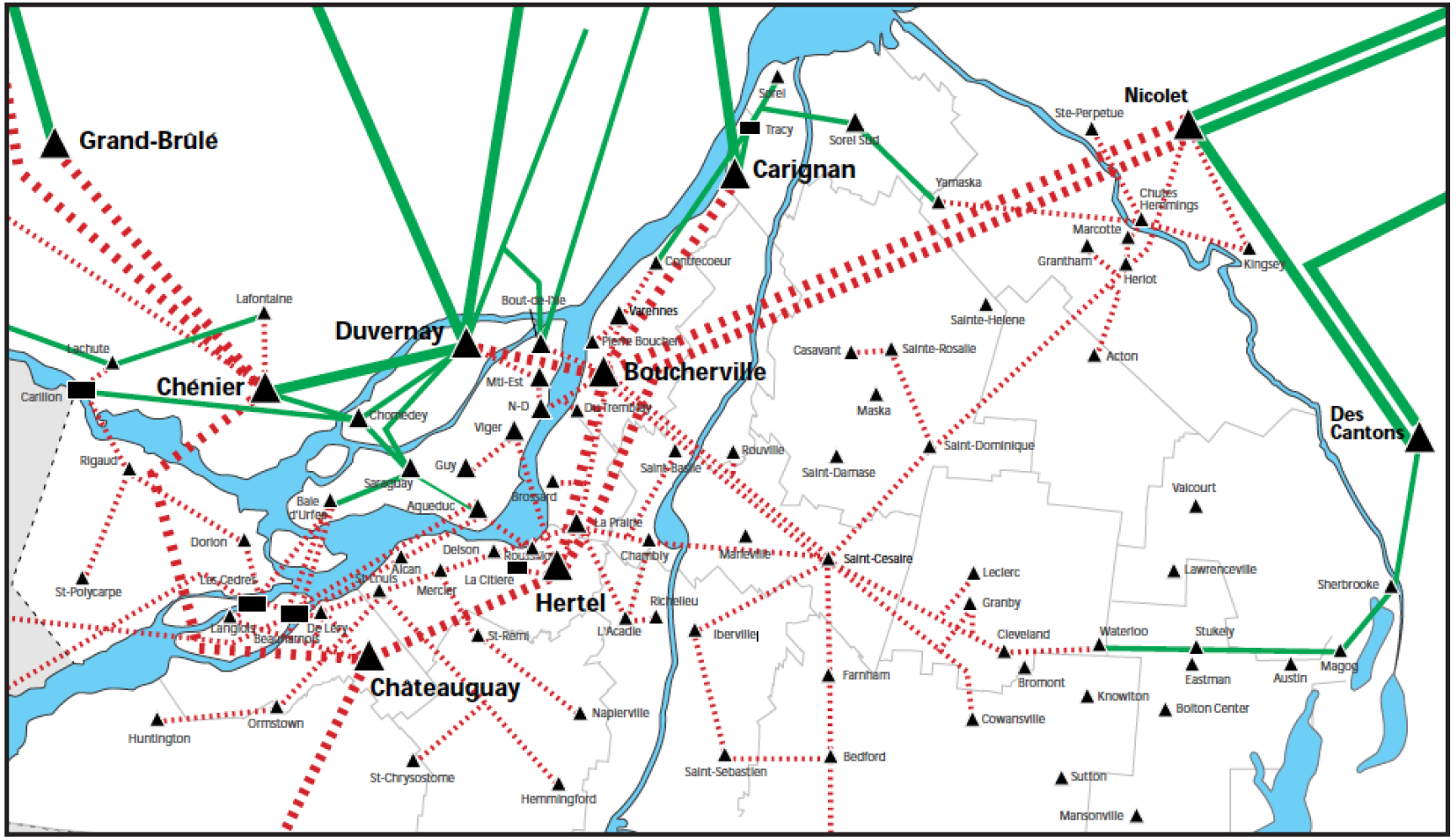


Still from "Rushing Roulette" (1965). Directed by R. McKimson

The solutions

- Active grid management
  - Essential to leverage available resources in an integrated manner
    - Generation assets ⟶ dispatchable and non-dispatchable (through forecasting)
    - Network ⟶ topology changes
    - Energy storage systems ⟶ different types for different
    - Consumers ⟶ priority, equity, safety
  - Adjudicate competing objectives
    - Cost
    - Technical performance
    - Regulatory compliance
  - Acknowledge the impact of uncertainty

Island of Montréal: c. 9-10 Jan. 1998



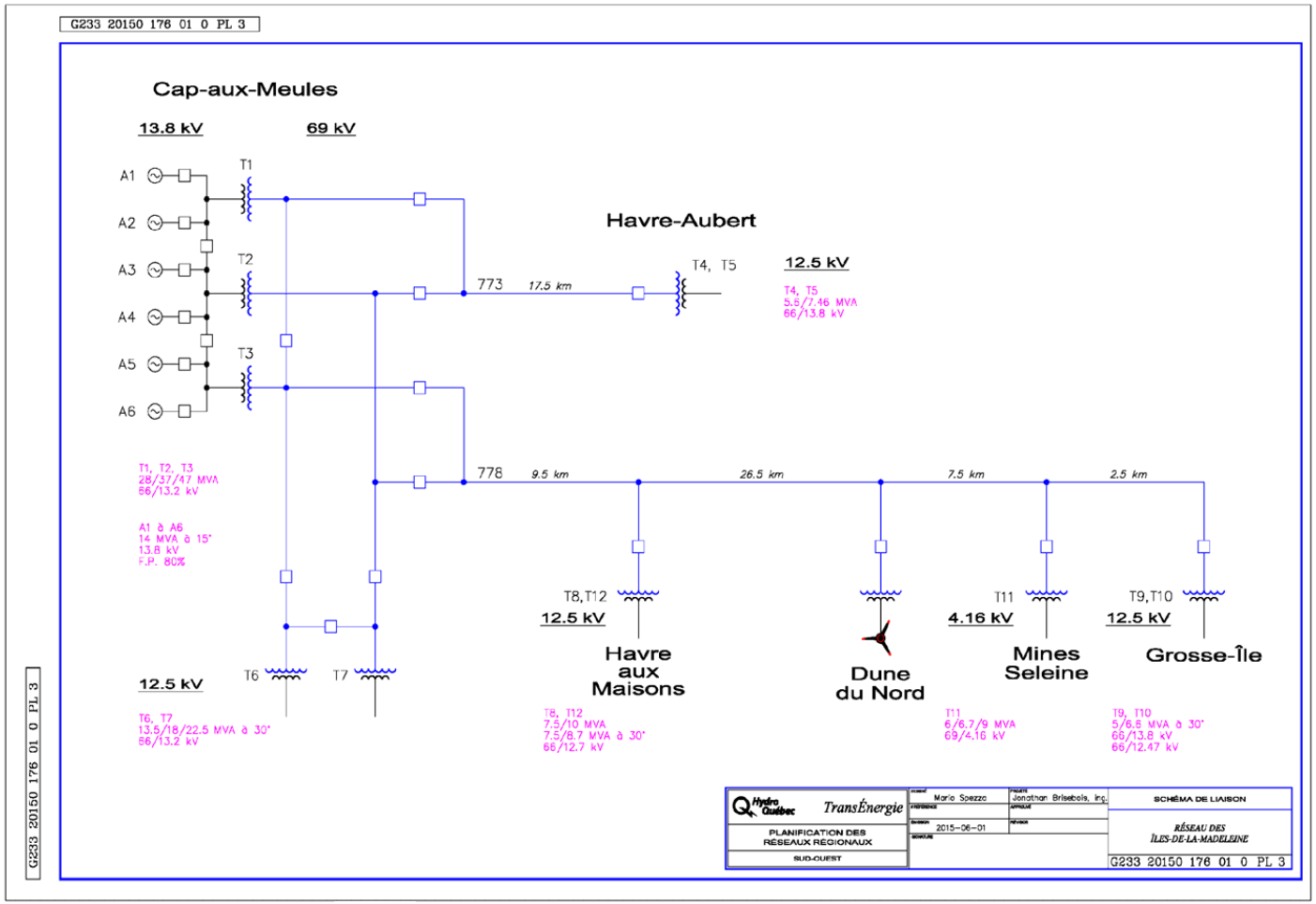
Source: Hydro-Québec TransÉnergie (2004)

The solutions

- Adaptable controls
  - Transitioning from grid-connected to islanded operation (and vice-versa)

    - Can't rely anymore on the grid's inertia and capacity
    - Traditional control loops for frequency and voltage control don't work
    - We need:
      - Prompt islanding detection
      - Fast adaptation of control behaviours
      - ***An anchor*** → an asset with enough capacity and available energy to maintain frequency and voltage references
- Microgrid design
  - Selection and sizing of assets
  - Validation of control and microgrid management philosphies

Magdalen Islands: wind power



Source: Hydro-Québec TransÉnergie (2015)