NSERC SMART MICROGRID NETWORK
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Can a Smarter Grid Slow Down Climate Change While Accelerating Energy Independence?

A ***Smart*** but not ***Super*** Grid

Chris Marnay

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Recap

Speaker #1: Dr. John Macdonald – Day4 Energy (Founder and Chairman)
Title: Future of energy systems and unsustainability of status quo

- climate change situation is dire
- most renewable generation is intermittent/variable, esp. solar, wind,
- must start harvesting local renewable sources

Speaker # 2: Mr. Kip Morison – BC Hydro (Chief Technical Officer)
Title: Utility perspectives on issues confronting the energy industry

- electricity transmission and distribution is a technological laggard
- accommodating dispersed sources requires
  technological catch-up and progress
- ambitious goals in B.C. (and CA!)
- Smart Grid definition: *a power system which achieves reliability, safety, and efficiency through the use of widespread monitoring, communications, automation, and intelligent control.*
- technologies are coming to the rescue:
  batteries, PEVs, better grid operation, etc.

Speaker # 3: Dr. Hassan Farhangi – BC Institute of Technology (Director)
Title: Smart Grid and its role in achieving energy independence

- a word of caution about the limitations of emerging technologies
- there are other problems, in addition to climate change, esp. reliability
- "rich portfolio of innovative technologies" required,
  BCIT is helping deliver them

Speaker # 4: Dr. Reza Iravani – University of Toronto (Professor)
itle: Managing demand through a smarter distribution system

- local resources suggest local control
- perhaps we need a different kind of grid?
  dispersed control? new actors: *microgrids*
- smart microgrids can interact and cooperate semi-autonomously

Speaker # 5: Dr. Geza Joos – McGill University (Professor)
Title: Expanding production capacity thru renewable sources of energy

- imperative of GHG emission abatement drives everything
- beyond intermittency/variability,
  renewables would still keep power engineers awake at night
- help is on the way from new technologies, especially storage,
  (PEVs a mobile resource!)
- intelligent grid can be the enabler

Speaker # 6: Dr. David G Michelson – University of British Columbia (Professor)
Title: Role of ICT in transforming the existing grid into smart grid

- ICT can come to the rescue and manage zillions of dispersed devices
- we can build a "super grid"

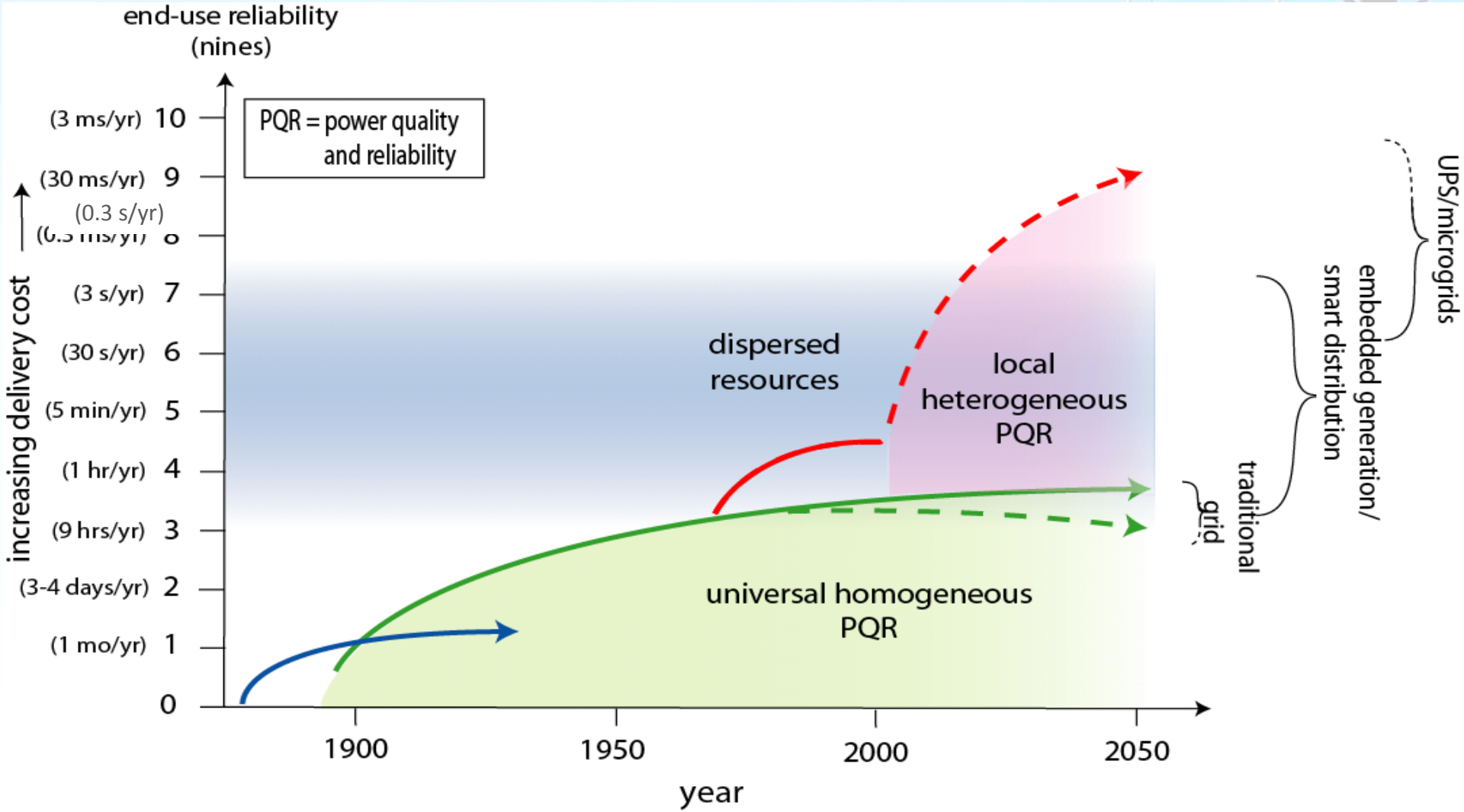
Discussant: Dr. Chris Marnay - Lawrence Berkley National Lab
(Staff Scientist)

Problems go beyond climate change

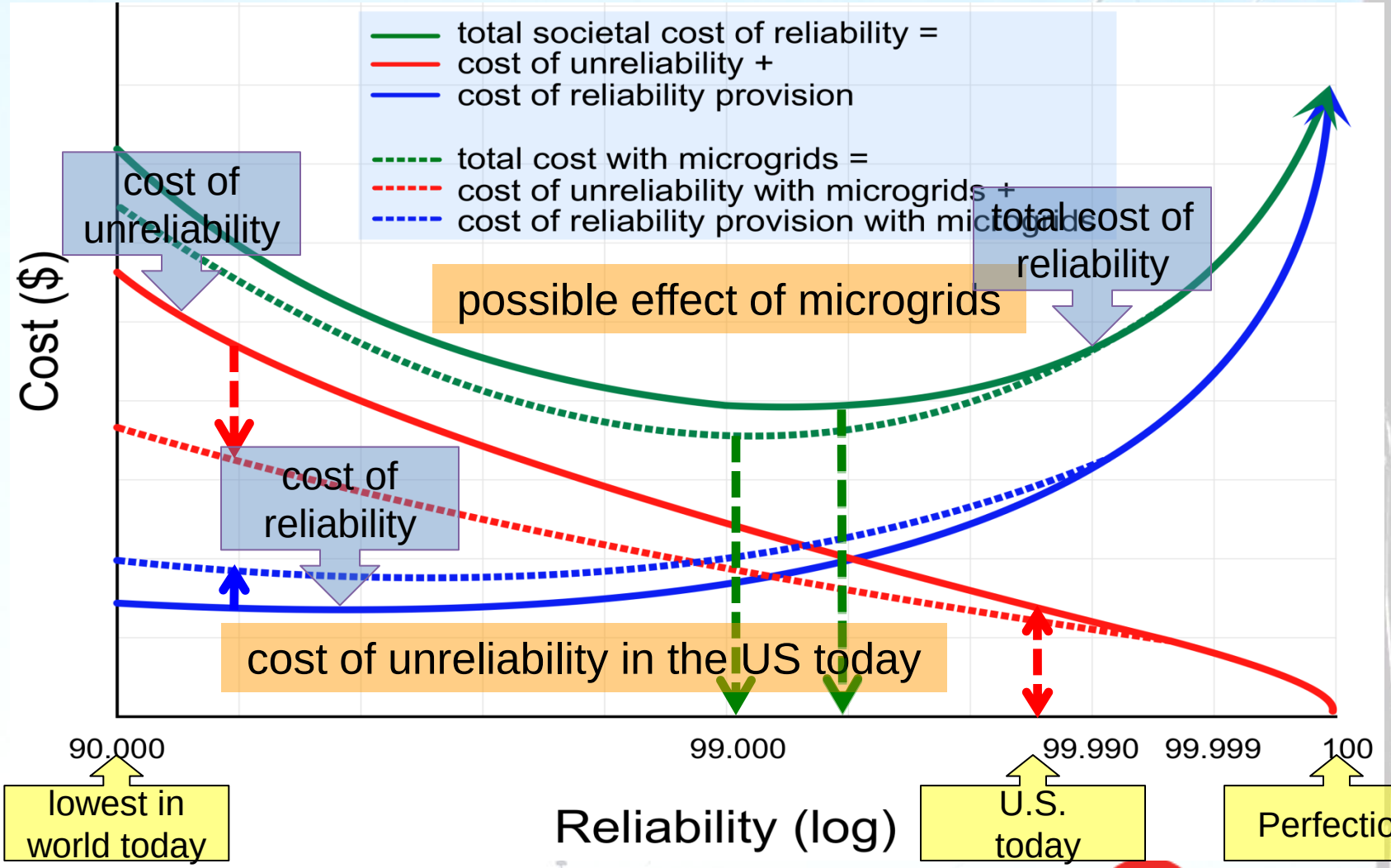
- conflicting policy objectives
  - generation competition (equipment stress, volatile markets)
  - connection of intermittent renewables
- load growth (transportation electrification, heating, …)
- environmental constraints (carbon, water, etc.)
- centralized generation heat loss
- infrastructure interdependency, cyber security
- reliability is costly for a fundamentally insecure system
- restricted expansion of centralized system
- DC sources and sinks, heterogeneous power quality
- plug-in electric vehicles a potential game changer
- grid paradigm vs. internet paradigm

Dispersed Vision

(distributed control & heterogeneous service)



Choosing Universal Service Quality



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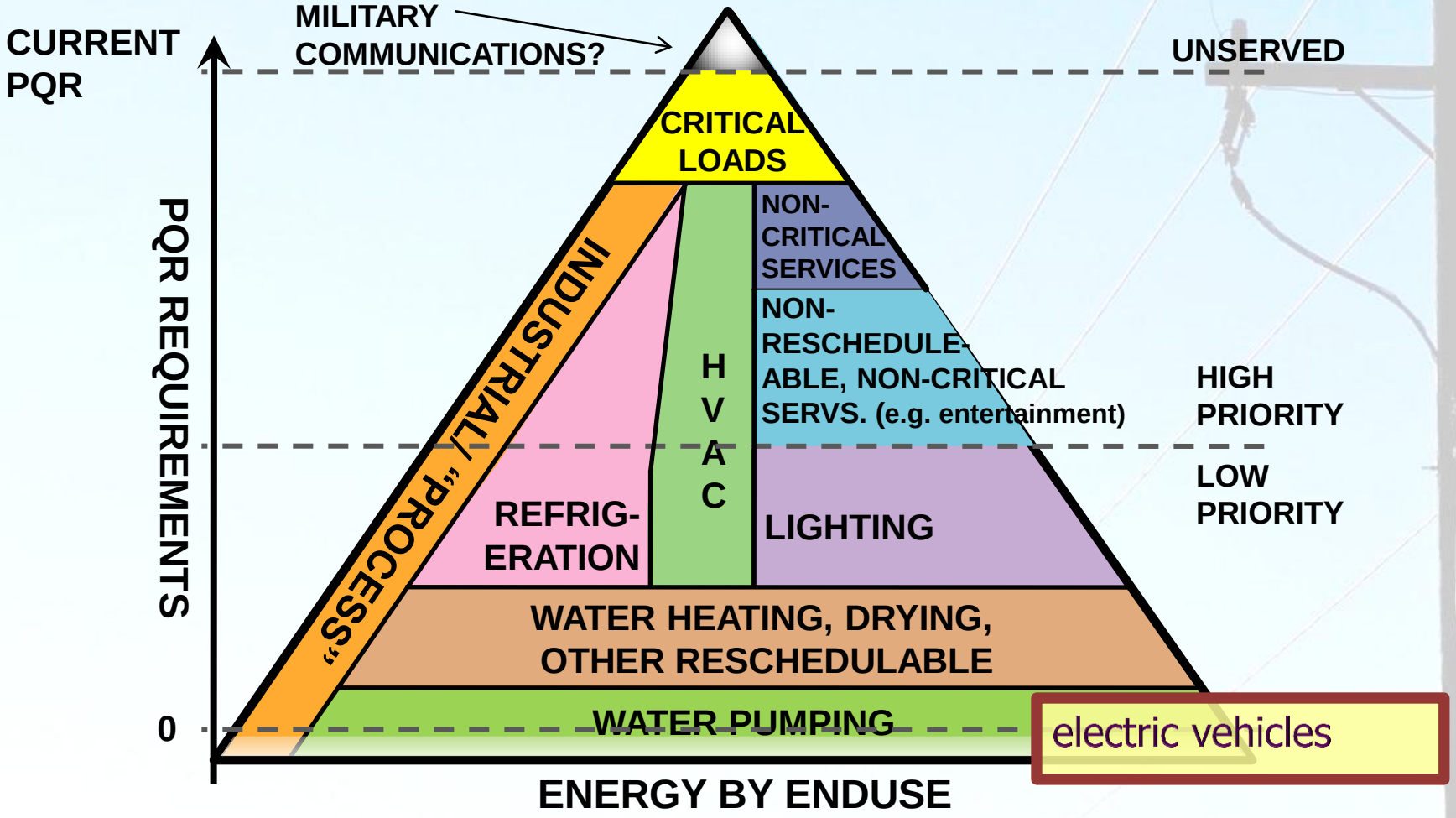
Loads Disaggregated by PQR Requirements



Conclusion 1

- climate change is a chronic problem for the power sector
- electricity distribution overdue for technological overhaul
- dealing with dispersed resources implies dispersed control
- there are other technical problems related to jointly
  - decarbonizing electricity supply
  - meeting growing loads (e.g. PEVs)
  - providing high PQR to loads that demand it
- locally controlled microgrids with renewables, etc.
  - can buffer the macrogrid from problems
  - provide other grid services
- can also
  - function as an island
  - provide locally heterogeneous service to loads

Conclusion 2

If we can deploy microgrids that provide satisfactory grid and customer services locally:

what kind of macrogrid do we need?
can it be one that serves other pressing goals?
will complexity deliver high PQR?
where should grid intelligence lie?
should it be ***super***, merely ***smart,*** or ***stupid***?
how much are we prepared to pay for it?

THANK YOU

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