



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

Symposium ID 4120, Organized by Dr. Hassan Farhangi, PI NSMG-Net
American Association for the Advancement of Science
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Agenda

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 sources of power are intermittent/variable, 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.
- 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 helping deliver them

Speaker # 4: Dr. Reza Iravani – University of Toronto (Professor)
Title: 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 & 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 keep power engineers awake at night
- help is on the way from new technologies, especially storage
- 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



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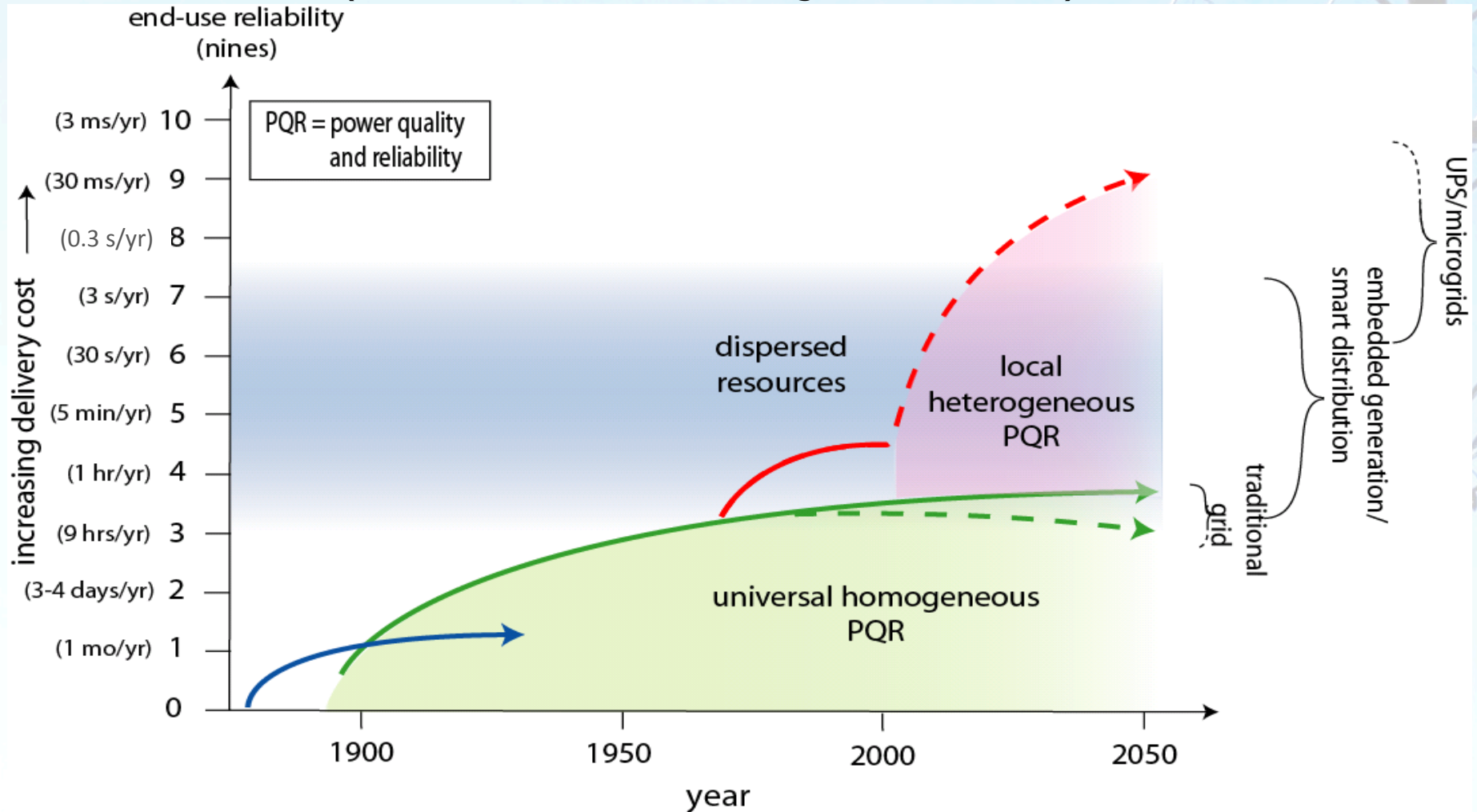
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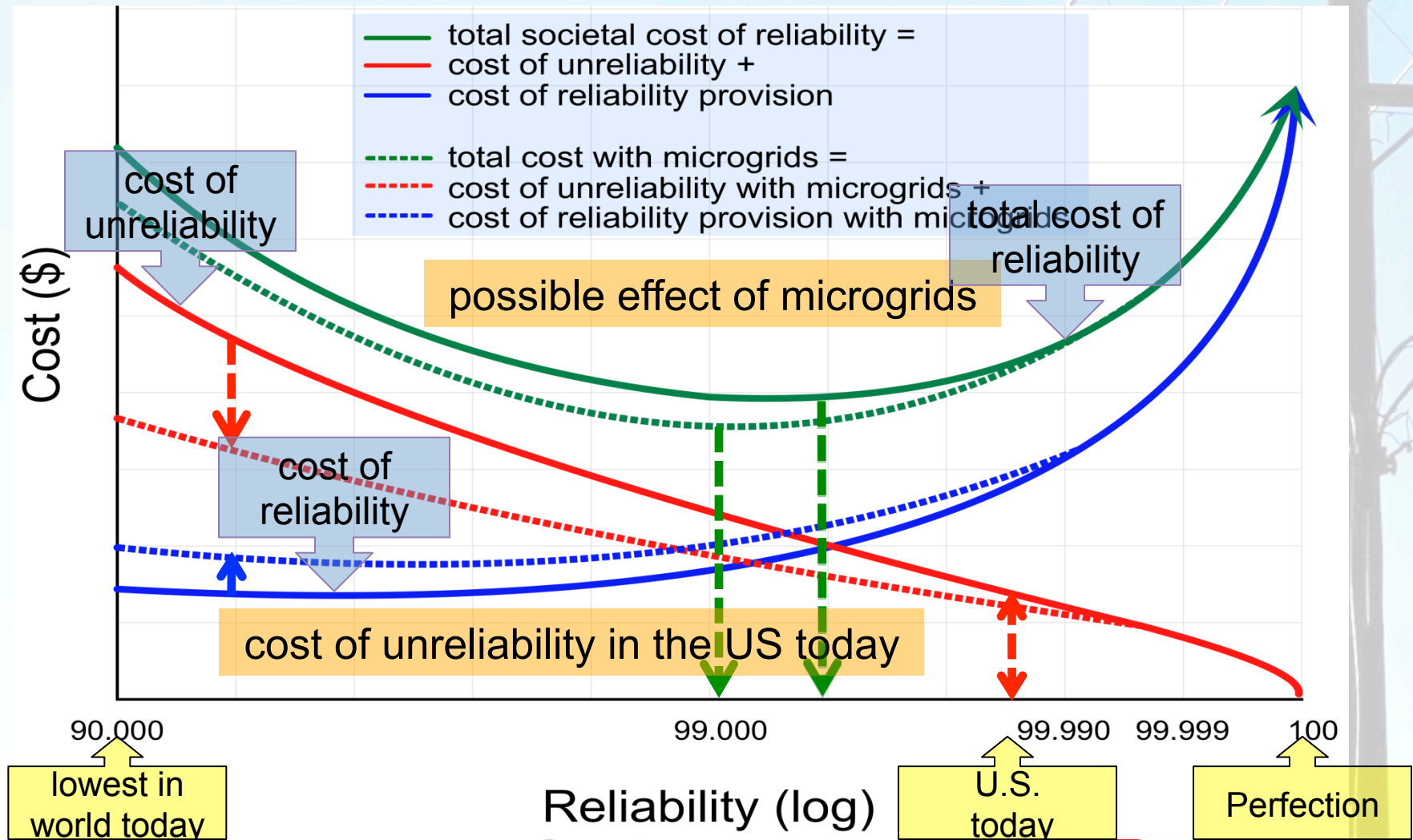
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Dispersed Vision

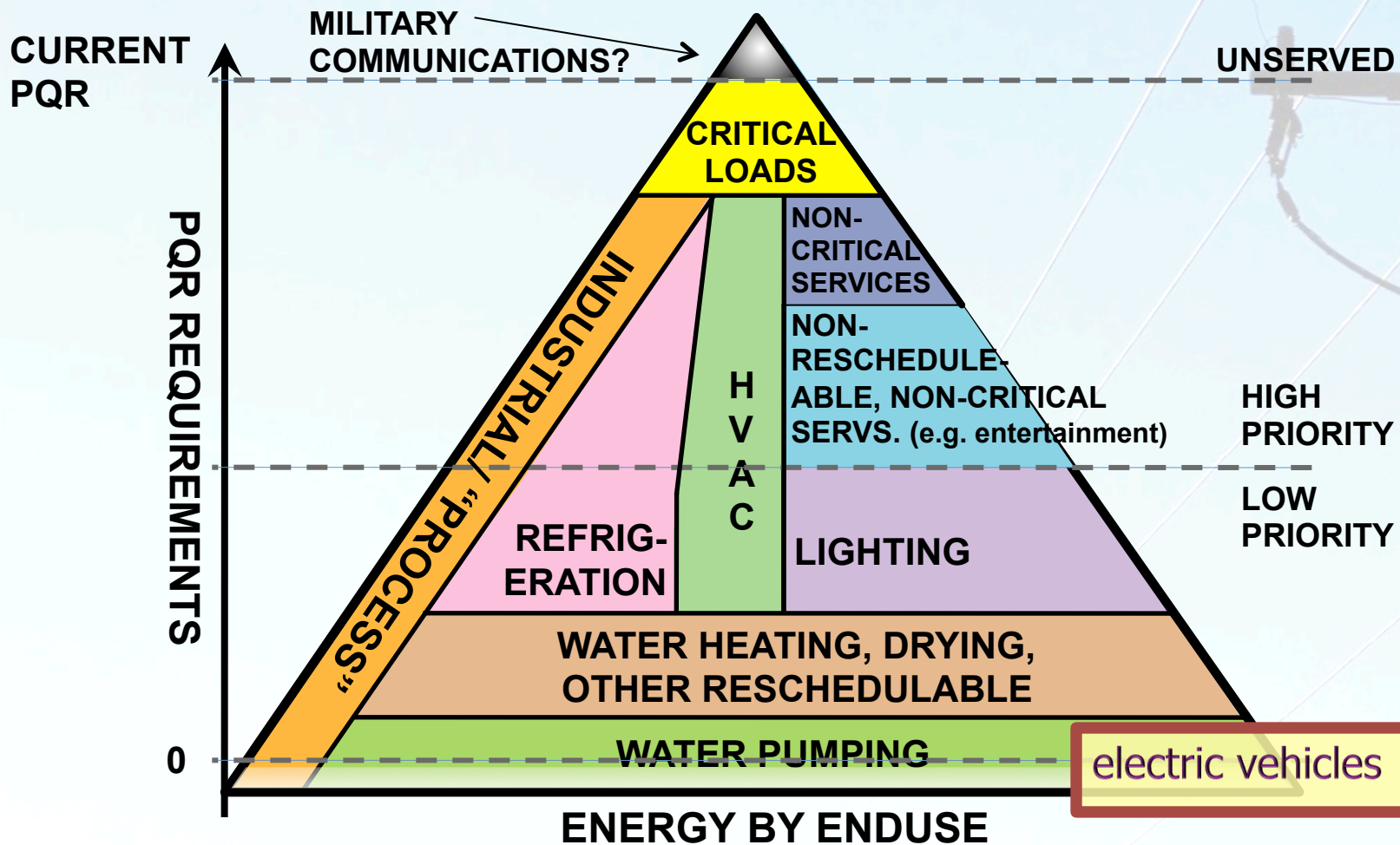
(distributed control & heterogeneous service)



Choosing Universal Service Quality



Loads Disaggregated by PQR Requirements



Conclusion

- climate change a chronic problem for power sector
- electricity distribution overdue for technological overhaul
- dealing with dispersed resources implies dispersed control
- there are other problems
- locally controlled microgrids with renewables, etc.
 - can buffer the macrogrid from problems
 - can also provide locally heterogeneous service to loads
- if all this is all done locally:
 - what kind of macrogrid do we need?
 - can it be one that serves other goals?
 - will complexity deliver high PQR?
 - where should the intelligence lie?
 - should it be **super**, or merely **smart**?
 - how much are we prepared to pay for it?



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THANK YOU

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