

What if the Energy Grid Were Designed Like the Internet?

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Ok, so I stole some of this from:

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The LolCal logo, featuring the word "LolCal" in a stylized, cursive blue font. It is centered within a white rectangular area that has a dark blue header and footer. The header and footer contain horizontal gradient bars.

What if the Energy Grid Where Designed Like the Internet?

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Many of these ideas have been
around for quite a while.

Oversimplified comparison

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Grid

- Semi-Global Synchronization and coordination of changes
- (Mostly) one-way from generation to consumption
- (Very) Sparse topology
- Little or no buffering
- High reliability, low resilience to cascading failures

Internet

- Very loose coordination of changes
 - ▣ Some would argue none at all
- Multi-way flows
- Tree topology at edge, mesh in middle
- Both short term buffering (packet switching) and long term buffering (CDNs)
- Good resilience to both localized and wide-spread failures of infrastructure
 - ▣ except for obvious security issues

Idea 1: What if there were batteries at every substation?

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Note: High capacity storage at generation locations already happening

- Cover short to medium term outages
- Store excess power generated downstream at consumers
- De-synchronize energy flow from upstream – everything goes through the battery controllers
- Except where little to no extra space, use cheap storage:
 - ▣ Flow batteries
 - ▣ Recycled Lithium Ion since efficiency not paramount

Idea 2: Improve the topology with peering links

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Add new or upgraded transmission lines that interconnect mid- and sub-stations rather than just downstream generation → consumption

- Improves resilience to link failure
- Allows multi-way flows if batteries decouple storage/flow at connection points
- May give more economic/financial/regulatory influence to regional or local entities. (like ISPs ?)

Idea 3: Decouple Administrative Control

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Account for energy at every "switching" point (generation, mi- and sub-station level). Allow consumer control of where energy comes from

- Analogous to Path-oriented routing/forwarding
 - ▣ Main difference is that electrons are fungible but data packets are not
- Grid operators control aggregation and switching in their administrative domain, but not between domains
- Overload (equivalent to congestion) is controlled by applying capacity limits on each "path segment".
 - ▣ Failures require (and get bypassed by) consumers choosing different energy "paths"