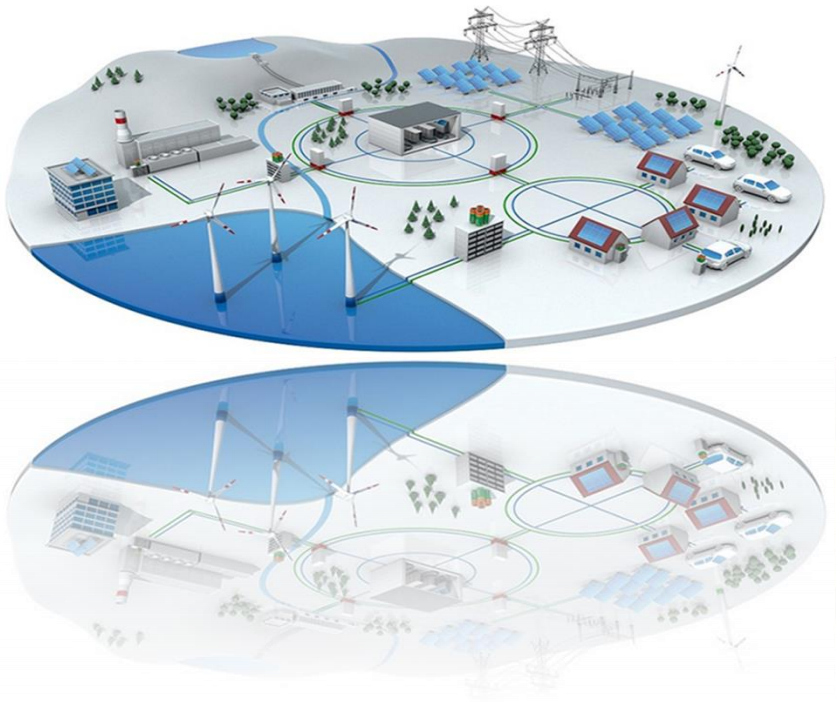
Smart Grid -
Myths and Realities



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What was the original promise of the Smart Grid?

The concept of the Smart Grid was:

- The exploitation of the implementation of
- Significantly improved communications technology
- To monitor, control, and optimize, grid assets':
  - Operation (including fault location, isolation and service restoration)
  - Growth, maintenance, and renewal,

And to facilitate new paradigms of customer engagement, such as

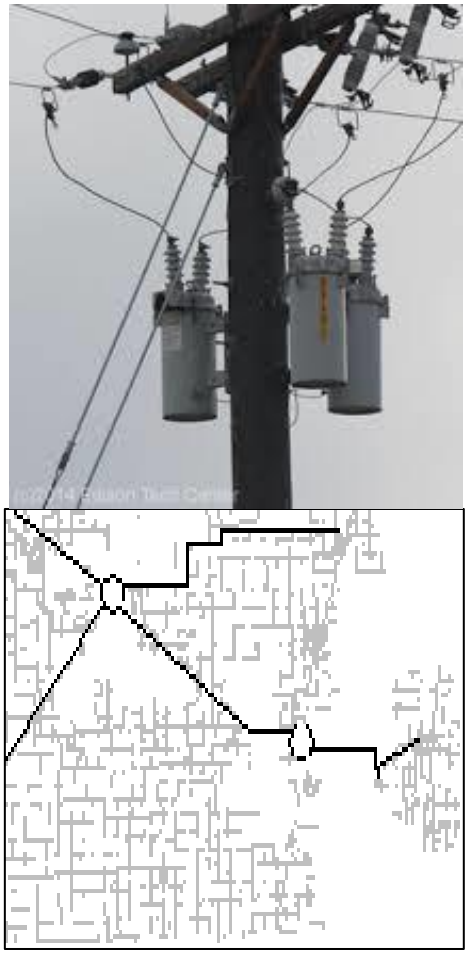
- Time of use pricing (including pricing of both use and generation),
- Distributed demand response, generation, and storage, e.g., via
  - PV solar, wind, combined heat and power, electric vehicles, appliances
- Enhanced outage communication

To obtain greater grid reliability, safety, efficiency, and sustainability.

Business cases for smart grid investment usually referred to all of these, but often in phases of deployment that were expected to take many years

Myth or reality: Does Smart Grid improve reliability?

- Reality: The biggest impact of Smart Grid on reliability is extensive deployment of switching for fault location, isolation, and service restoration (FLISR*)
- Question: Didn't we have FLISR before the Smart Grid, i.e., we just needed to deploy enough 'dumb' reclosers with enough backfeed?
- Question: A centralized DMS** making all the switching decisions should be closer to optimal than our existing elaborate schemes on dumb reclosers, and/or operator SCADA control. Right?
- Question: Culturally, are we really prepared to let the centralized DMS make all those decisions all the time? And ripple throughout?
- Reality: Switching does nothing to avoid the outage (tree falls on a line). It only reduces the number of customers affected and maybe the duration of restoration.
- Myth? (or just not here yet?): The visionaries said Smart Grid would allow us to sense a fault before it occurs – at least sometimes. Are we doing that today?



* Or FDIR for fault detection, isolation and restoration

** Distribution Management System – monitoring and control of all distribution equipment

If Smart Grid does nothing but put smart switches on aging/failing lines, poles, and equipment, are we just pushing the rock down the road?

Myth or reality: Is Smart Grid good for everybody?

- Reality: Many of the benefits of Smart Grid are best suited for well-heeled, tech-savvy, suburban customers in detached homes with lots of appliances. So…, questions:
- Are Time of Use Pricing and Smart Meter features really that beneficial to low-use customers in small apartments or mobile homes without central HVAC, washer/dryers, large TV's, computers, or pool/hot tub pumps?
- Do all segments of the population understand Smart Grid technology enough to use it effectively – and not to unreasonably fear it?
- Or is it just that regulators could not politically afford to propose anything but a completely egalitarian solution, with a one-size-fits-all approach?
- Hadn't most utilities already skimmed the cream of demand response benefits with more selective application of simpler technologies?

For many Smart Grid technologies, the benefits could be optimized by applying them more selectively to customers, if 'society' would allow it

Myth or reality: Is an 'optimized' grid always better?

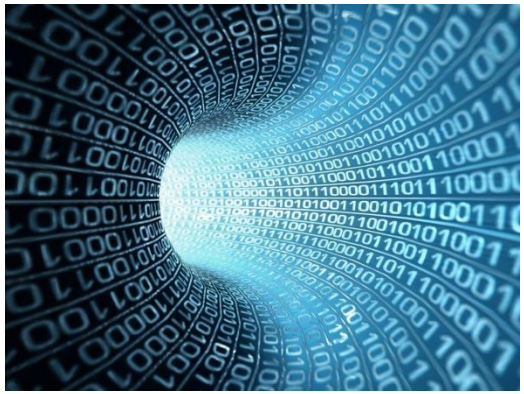
- Reality: With Smart Grid and a centralized DMS, we could increase grid efficiency significantly:
  - Reduce voltage to the minimum needed at all points
  - Reduce unused capacity by having many ties to many feeders for FLISR (not just dual feed and 50% utilization)
  - Reduce power-robbing VARs continuously as load changes
- Question: But is an 'optimal' solution always 'robust'?
  - Sometimes it helps to have a buffer or reserve
  - Running on the 'knife's edge' increases risk of any failure
  - Even 'n-2' is not so secure if failures are not independent
- Question: How does this relate to resilience?
  - In a storm, multiple hits on the same line prevent partial restoration via backfeed for some sections
  - As cyber/physical security concerns mount, is a Smart Grid pushing us in the wrong direction?
- Question: Didn't we have these options before SG?
  - Cap banks and switches could be programmed in schemes

Achieving Smart Grid efficiency benefits will often entail running a higher risk of failure, and less resilience to storms, hacking, and terrorism

Myth or reality: Will 'big data' analytics make the full benefits possible?

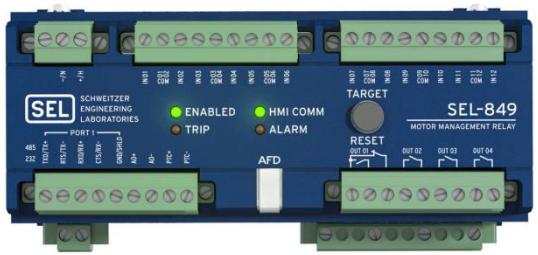
A new myth? Many are saying that 'big data' analytics is the key to achieving the Smart Grid's promised benefits

- Reality: Poor data quality can compromise its usefulness:
  - Switching schemes fail if signals can't get through
  - False outages undermine smart meters' touted ability to obviate the need for customers to call in outages (although AMI can still be useful for power confirmation)
  - Inaccurate customer device connectivity causes wrong FLISR
- Question: Is 'machine learning' real, or really 'voodoo statistics'?
  - Does no causal model mean no real insight, just correlation?



Still, the reality is that smart meters and relays can tell us a lot:

- Question: Haven't we had smart relays for years before Smart Grid? Have we really exploited them for fault distance, type, etc.?
- Reality: The data alone are often not enough, unless you establish a baseline and a threshold for failure.
- Old partial discharge complaint: "Predicts 9 of the last 3 fails"



Analyzing data to find valid predictive relationships can be a real benefit, but not unless you do the work to exploit it, with baselines and thresholds

Myth or reality: When will 'the future' be here?

Myth or reality: Aren't many predicted features of a Smart Grid world still not here, or nascent at best?

- Vehicle-to-grid – Not even close to commercial – limited pilots at best, because cycles degrade battery
- Smart appliances ("Internet of Things") – Protocol still not standardized, but apps do seem to be maturing (ZigBee, Nest)
- Micro-grids – Still mostly grid-tied, but there is a nascent trend toward more campus grids, combined heat and power, islanding in emergency, etc.
- DMS – Is there anybody whose DMS can handle all this now?

Question: if the future comes, will we like it?

- Question: Will 'big data' become obtrusive, with the utility knowing which appliances I am using and when?
- Question: If cell phones are all offering flat rate plans, why are we so keen to charge 'by the drink'?
- Sound familiar? "I don't want to think about it. I just want to watch the game."

The Smart Grid-enabled future is being accelerated by early adopters and regulatory pressure. Yet, the 'dumb grid' still has a lot going for it

Observations and Key Questions

Observations

- The Smart Grid has grown from a set of ideas about technical possibilities to plans, pilots, and even implementations
- In the process, the industry has learned some valuable lessons about what works well and what is still an unproven concept
- Sometimes the main impediment to successful exploitation of technology is reluctance to change the culture
- To reap the real benefits, utilities will need to do the nitty-gritty work of making new technology work, in other words:

"Get real"

Key Questions

- Has your company reaped the benefits of its Smart Grid investment?
- If not, when do you expect that it will?
- What would have to happen for the investment to pay off?
- What can you do make that happen?

Questions?

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Myths can be powerful – when they are transformed into practical reality through 'smart' implementation