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CIGRE US National Committee
2018 Grid of the Future Symposium

Visualizing the Grid of the Future

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SUMMARY

The Grid of the Future should not simply be resigned to functions and specifications. It is paramount to the successful buy-in of new technology that users – both the power utilities and the consuming public – have sufficient understanding of the advancements being made and believe them to be useful and productive. It is through art, designed specifically to grow the idea and acceptance of advanced grid solutions, that we believe the message can be best conveyed to, and most easily digested by, the greater public.

The growing complexity of power solutions is exceeding the limits of existing visual solutions. As such, we are constantly testing and iterating to find visual solutions to complex technical problems. The considerations are numerous, from switch functionality to communication protocols [1]. But, within the industry, the conversation is continuing to develop and is growing in complexity [2]. It is with this acknowledgement of growth that we explore the opportunities that lie within.

As a case study, we will examine the efforts to create intriguing visual artifacts that can serve a variety of functions, from story-telling elements to marketing campaigns or publicly facing stimuli. With modest intent, to simply improve engagement with internal corporate presentations, this effort blossomed into the development of an idea-selling, buy-in capturing graphical system.

Starting with a simple request, work begins with the creation of some loose ideas for new visual elements valuable for a strategy presentation. This request, for images/representations of switching hardware, led to a brief but thoughtful exploration into what characteristics of the hardware truly make it recognizable. This was not limited to the appearance of the device. Installation location (above/below ground), number of phases, type of access point (SCADA, serial, Wi-Fi, etc.), and other elements were all considered during the design process.

Once the initial work was complete, we began to look for opportunities to grow this foundational set of design assets. The next iteration worked to bring all the elements together

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to better evaluate the success (How understandable is the graphic? Does this image translate across language/culture?) of each graphic within, and among, the set. This resulted in a further refined set of assets and a new cohesive piece, now tailored to visually define an internal vision.

Lastly, we push the effort an additional step, taking the set of design elements, the presentations, and artwork created to date and then reworking them together into a more elaborate artwork. This new work represents the vision of the grid of the future, the skill available, and the commitment to improving our products – and our world.

We believe that this effort, and others like it, could be beneficial for public facing purposes. If these visual assets are valuable internally, why couldn't they be valuable for legislative or public use. Establishing design as a high-value skill, we could dedicate the necessary time to creating not only something useful, but something memorable, impactful, and beautiful. And why shouldn't something that is undoubtedly necessary, and functional, be beautiful?

KEYWORDS

Art, Design, Visual, Presentation, Cross cultural, Immediate Understanding

1. Build the foundation

The concept of visual media as the primary form of communication begins with a small exploration into grid-design language and hardware representation. Though this exploration is not at all exhaustive [3], we chose to begin with a subset of internal hardware to initiate the process. For our case, we began with two overhead switches, a pad-mounted switch, and several Web and IT technologies.

We believe we were able to capture the breadth of a simplified distribution grid at a very high level. From our software perspective, we put particular emphasis on how legacy devices could be retrofitted to communicate through more modern IT networks. Furthermore, we wanted to show what type of enterprise infrastructure would be needed to support this updated grid solution.

This small set of assets tells a short, but clear, story; a few new resources can provide new access points to manage the grid. But, as we look to the grid of the future, this simplicity begs many more challenging questions: What happens if the infrastructure isn't uniform? Will it scale? [4] So, we continue exploration to better answer some of these questions.

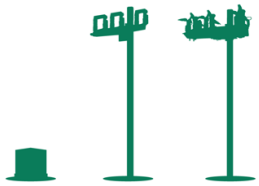

Fig. 01
Initial representations of pad-mounted enclosures, overhead sectionalizers and overhead fault interrupters

Fig. 02
Initial representation of possible data acquisition infrastructure

Fig. 03
Initial Grid of the Future concept

2. Examine and Improve

With the gained experience and feedback, we bring the elements together to better understand their visual relationships and how to advance their success as immediately recognizable visual elements. We additionally set out to explore opportunities to further simplify complex grid schemes and to tell the story of transitioning technologies within the industry.

Utilities and municipalities across the country are working on legislation [5] that is attempting to establish how the grid will advance with new technologies [6]. We understand this emerging pattern and take this opportunity to explore the visual storytelling component to this technological, legislative, and commercial problem.

We believe that presenting, and understanding, the historical transitions already surmounted can provide confidence moving into this new transition. As with many endeavors, taking inspiration from previous work, we examine the possibilities that lie ahead to move our visual system closer to a fully expressed solution.

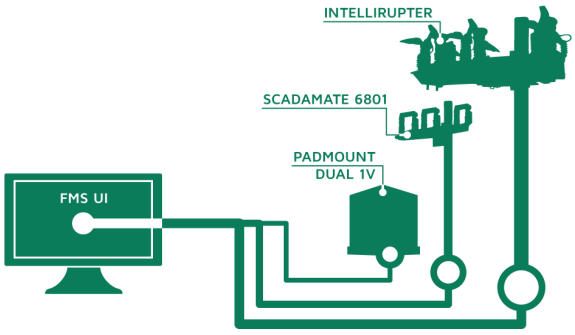

Fig. 04
Simplified Grid of the Future concept

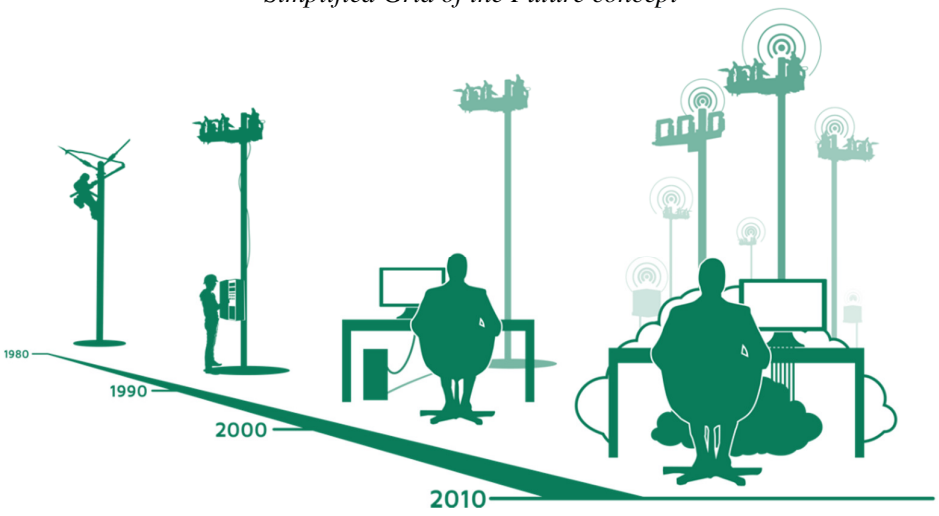

Fig. 05
Grid evolution / timeline graphic

Fig. 06
Enhanced Grid of the Future concept

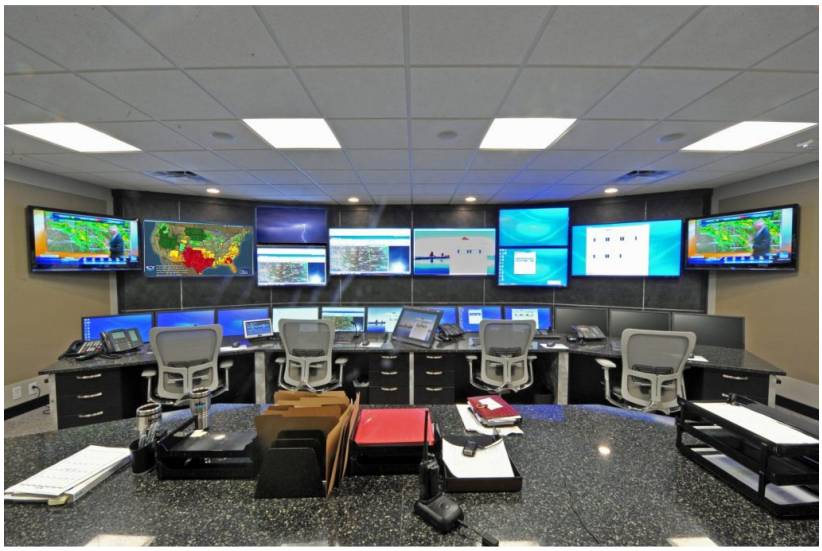

Fig. 07
Source: Jay Stanley & Associates [7]
Typical operations center
reference image

3. Refine and Polish

Once satisfied with the refined set of visual elements, we push into a full work of art intended to wow and facilitate conversation about the opportunities fostered by the grid of the future. Here is where we push the visual display past the literal and into the metaphorical by touching on scale, variety, safety, and environmental concerns.

We bring these pieces together to portray our vision of how we view the integration of new technology with old infrastructure and growing customer needs: cohesively, in a system where the scale of need is matched by a variety of hardware and supporting software and personnel that is distributed throughout the community.

But, we see areas for improvement, not just in our visual model, but in existing grid solutions. And, we hope to use this exercise to act as a visual reference point, similar to a smart grid glossary [8]. Acting as a menu, of sorts, customers, engineers, and politicians could utilize a visual system to frame technological and legislative conversations.

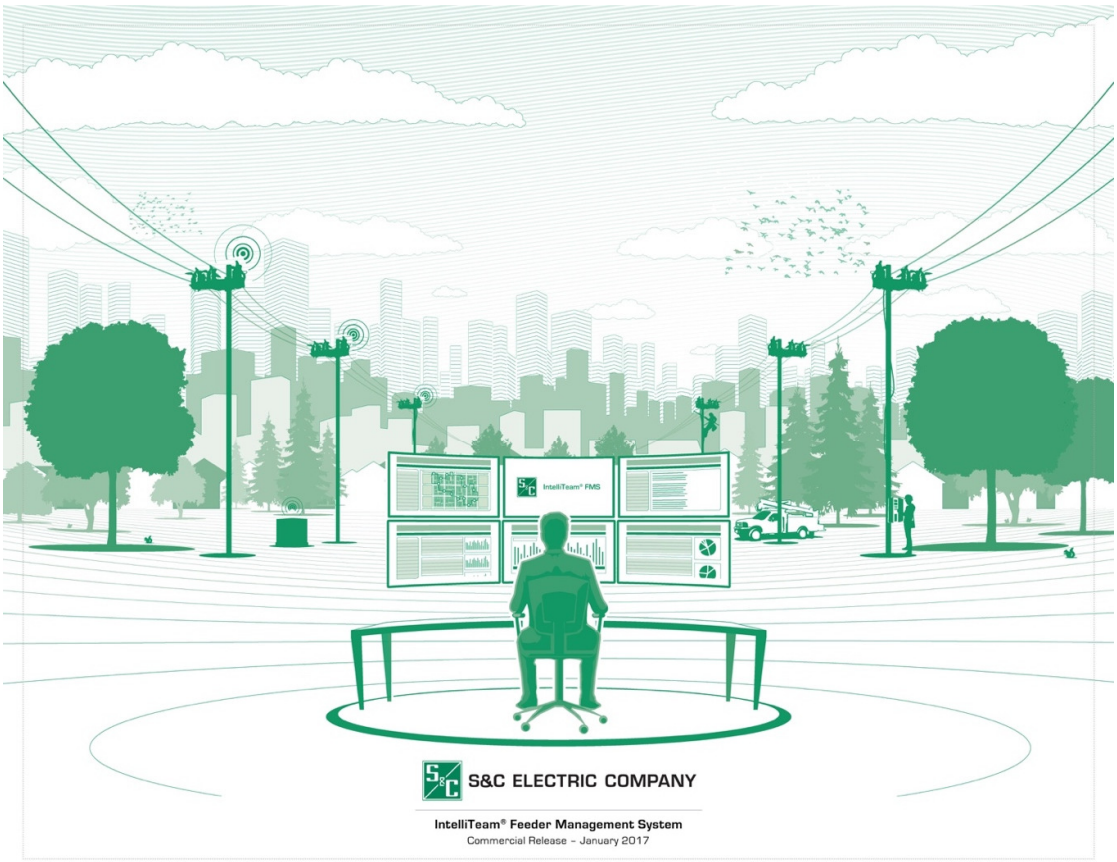

Fig. 08
Present Grid of the Future Concept

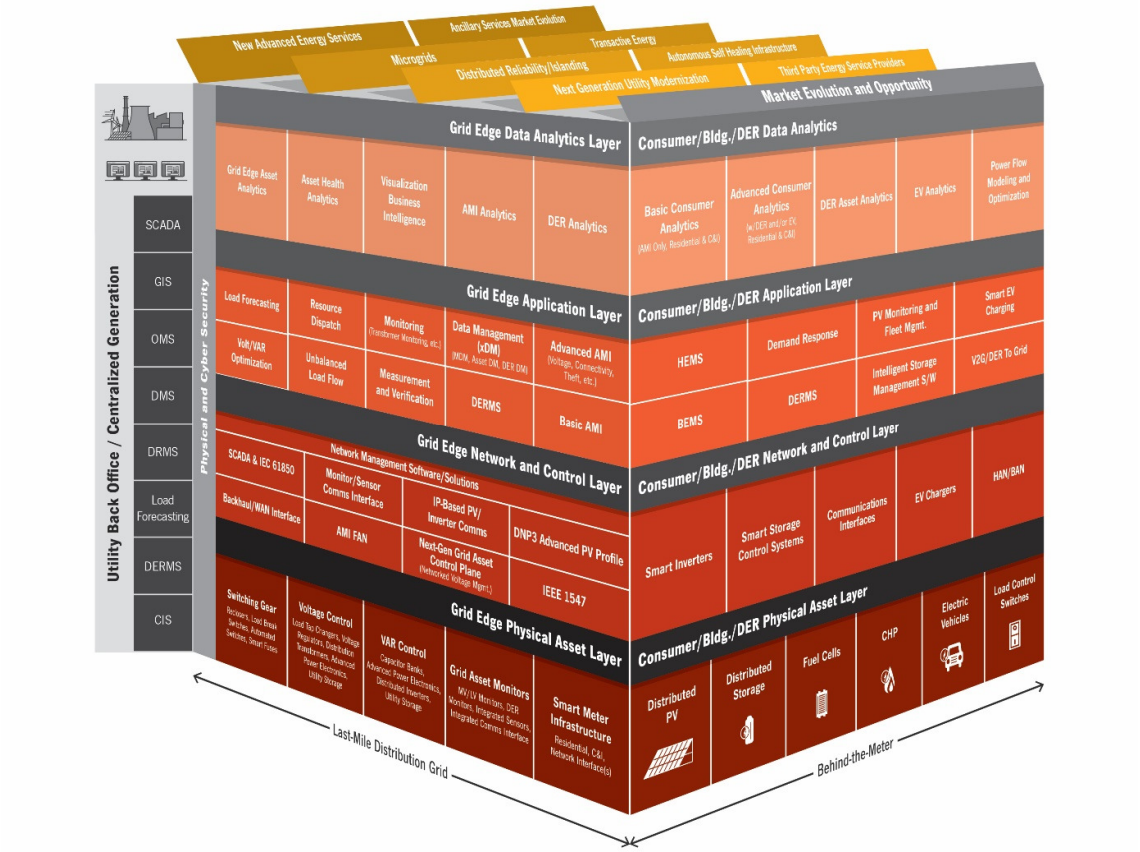

Fig. 09
Source: GTM Research [9]
Smart-grid complexity info-graphic reference image

4. Continuing Effort

Never completely satisfied, we continue the process. By analyzing new challenges, we consciously look for opportunities to use, add to, and advocate for the future use of these resources. For example, our current presentation does not depict generation or the prevalence of renewable sources around our communities. Because this is not a component of our present hardware offering, it was not of high enough value to include for our internal purposes. But, now that the effort has progressed, we look forward to including this consideration in future iterations of the visual system.

Besides additional hardware, there are several additional layers of communication and IT infrastructure that could be added to present a more detailed representation of the grid of the future. These could include database and server technologies, IT security considerations, and access points for utilities and customers. However, bringing additional consideration into the system requires balancing the desired level of understanding with minimum detail.

This is where the need for the system emerges. Creating one design to initiate conversation is achievable. Creating a single design that is representative of the variance among utilities is less so. As such, a system of interchangeable components could be valuable in efforts to present and demonstrate why a particular approach is best suited for a specific installation. But, there is considerable work remaining to bridge the gap from a good start to the full picture

BIBLIOGRAPHY

[1] R. Thompson "The Grid Edge: How Will Utilities, Vendors and Energy Service Providers Adapt?" (Greentech Media, 7 October, 2013) www.greentechmedia.com/articles/read/the-grid-edge-how-will-utilities-vendors-regulators-and-energy-service-prov#gs.gNMFlqU

[2] GTM Creative Strategies "How Utilities Can Align 20-Year Resource Plans With Distributed Solar, EVs and More" (Grid Optimization – Greentech Media, 13 July, 2018) www.greentechmedia.com/articles/read/how-utilities-can-align-20-year-resource-plans-with-distributed-solar-evs-a#gs.NFUIKwM

[3] J. Pyper "Policy Transformations at the Grid Edge" (State Bulletin - Greentech Media, 20 July, 2018) www.greentechmedia.com/squared/read/policy-transformations-at-the-grid-edge#gs.FvaZinw

[4] E. Foehringer Merchant "Will Natural Disasters Boost the Case for Grid Defection" (Off Grid/Energy Access – Greentech Media, 19 July, 2018) www.greentechmedia.com/articles/read/can-disasters-make-grid-defection-mainstream#gs.QMUVpC8

[5] E. Foehringer Merchant "A Look at 3 Projects Accelerating the Energy Transition" (The Lead – Greentech Media, 10 July, 2018) www.greentechmedia.com/squared/read/a-look-at-three-projects-accelerating-the-energy-transition#gs.PPDMR=o

[6] Press Release "North Carolina Utilities Commission Orders Revenue Reduction for Duke Energy Carolinas" (North Carolina Utilities Commission, 22 June, 2018) http://www.ncuc.commerce.state.nc.us/DECPress%20ReleaseFinal.pdf

[7] Jay Stanley & Associates "Electric Utility Operations Center" Jaystanley.com www.jaystanley.com/wp-content/uploads/electric-utility-operations-center-1024x681.jpg

[8] National Institutes of Standards and Technology "The Smart Grid: An Introduction." (U.S. Department of Energy, 2008, Pages 41-43)

[9] GTM Research "The Grid Edge: How Will Utilities, Vendors and Energy Service Providers Adapt?" greentechmedia.com, Greentech Media, 7 Oct 2013 www.greentechmedia.com/content/images/articles/Grid-Edge-Taxonomy-01.jpg