GWAC F2F – EnerNex, Knoxville, TN

Tuesday Oct. 3, 2023 - *Meeting Day 1*

Attendees

GWAC

GWAC Members

Chair – Ron Bernstein

Andy Bordine

Ron Ambrosio

Ron Cunningham

David Forfia

Lorenzo Kristov

Mark Ortiz

Farrokh Rahimi

Aaron Snyder

Leonard Tillman

GWAC Associates

Mark Paterson

Marc Costa

PNNL

Jaime Kolln

Ron Melton

Susie McGuire

Seemita Pal

GWAC Friends

Michele Pastore, EnerNex – Guest Speaker

David Wollman, NIST Liaison

Anthony James, S. Calif. Edison

GRIDWISE Architecture Council

Agenda Oct. 2023

Call to Order and roll call

GWAC Administrative Business

- Welcome

- Minutes

- Upcoming events

- Actions

- Speaker: **GWAC Associate nominees**

Future Activities

- GWAC Fall F2F – Knoxville

- Planning 2024 "TE" Conference

- Next Big Thing

Status Reports

- GWAC Projects Overview Chart review

- Working Party Status Updates
    - Grid Architecture White Paper
    - Grid Future State White Paper
    - Grid Arch for Regulators White Paper

- Liaison Reports

The group reassembled at the Knoxville EnerNex facility after the EPRI tour.

Ron Bernstein asked for a motion to approve the August meeting minutes. Ron Ambrosio gave the motion and Kay Aikin seconded the motion. The group gave a show of hands to approve the minutes with no objections.

Jaime Kolln reviewed the GWAC Conference slide.

Kay Aikin updated the group that she will not be attending the ISGT North America.

Ron A. noted that he will not be at Chicago AHR.

DistribuTech was suggested for a GWAC F2F, but Ron Melton noted that rooms and equipment at that event are quite expensive which makes it difficult for smaller events to co-locate.

Action: Add T&D Expo – May 2024 to the Conference list. (Done)

Ron Melton asked the group if they would like to attend a GWAC F2F in conjunction with a NARUC meeting. The response was positive. Kay Aikin expressed strong support.

Jaime suggested a GWAC F2F meeting at PNNL, and he would set up a van tour of Hanford site.

Ron Bernstein noted that Don Colliver would like to still talk at a future GWAC meeting. Due to unexpected circumstances, he was not able to present at this meeting.

Kay noted a current UN effort on high performance buildings. Kay is on a senior advisory committee on organizing a building coalition. They are looking at the potential that a high-performance building can have through an interaction with the grid. Both she and Marc Costa traveled to Ireland this past year in conjunction with this .

Marc Costa said that there might be a 2024 instance of this meeting in the US. He commented that at this time there are 36K native Americans without electric poles and wires to their homes.

David reminded us about the plight of the Griddy customers of ERCOT during the cold weather in 2023.

Kay said the balance of additional storage – the meta problem is what is the balance going to be.

Lorenzo said that if large numbers of people leave the grid that regulators will notice.

Aaron said we have to resize and rethink what we are doing.

Kay said the amount of infrastructure that we have to rework could be really costly if we don't plan carefully. We have to look at it almost circuit by circuit.

Ron C. said there is an issue for utilities have with variable resources. Operators have to protect the grid to keep it reliable. There is a physics and assessment balance that some are looking at.

Marc Costa said that for local government issue and regulators – permits don't need to be pulled by utilities.

Kay said that FERC 2222 could eventually be a huge problem.

Jaime said 2222 doesn't provide the ability to enforce.

Ron M. said that all recent PGE presentations noted a huge cost looming.

Farrokh commented on FERC 2222 and said an aggregator can only do what the market wants to do.

Marc Costa referred to the Grid Future States paper and asked if the money was there what would we build?

Ron B. noted impact near term issues such as the threat of wildfires. How will pay for the cost of mitigation and the cost of rebuilding infrastructure?

NIST - Dave Wollman Liaison Report

NIST published an update to the flagship 800-82 Operational Technology Security guidance (Release 3) last week. https://www.nist.gov/news-events/news/2023/09/nist-publishes-guide-operational-technology-ot-security

Presentation by Michele Pastore, Chief Business Strategy Officer, EnerNex

Michele gave a brief summary of the relationship of EnerNex and KEMA:

CESI: A Leading Global Player in Engineering, Testing, and Power Systems Consulting
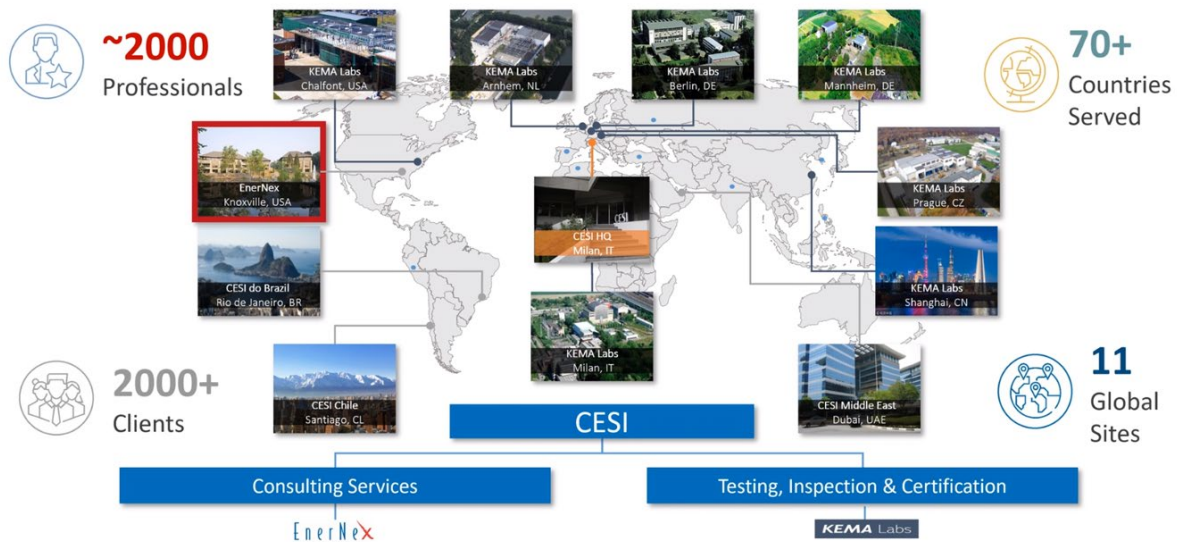
Unique capabilities to tackle complex power system changes

KEMA and EnerNex can solve a wide variety of issues that are challenging the electric sector

Through the combination of real-world testing and decades of engineering consulting expertise we help minimizing the risk on existing assets and new technologies
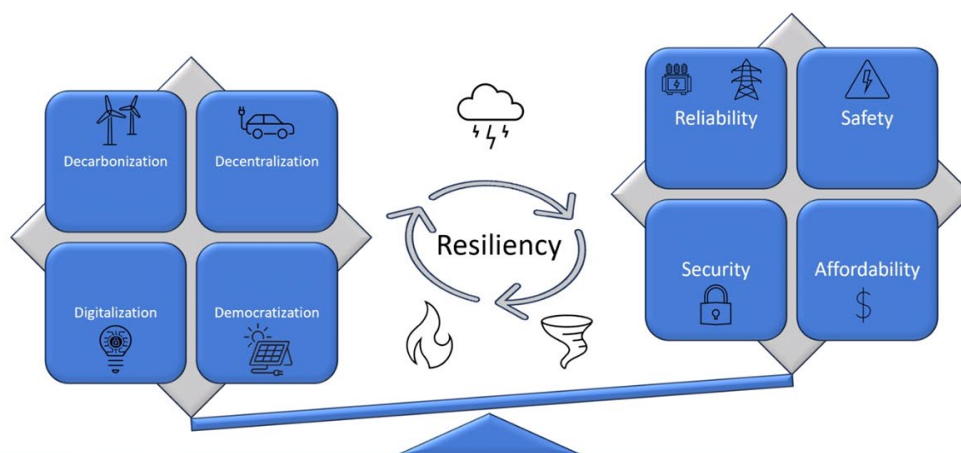
Decarb, Decentral, digitization and democratization – are the 4 D's, Michele asked the Council which

Is most important?

Decarbonization received the most votes from the group.

Michele asked participants to explain their thoughts behind their prioritizations.

David Forfia said if we are dependent on variable renewables, it becomes a perpetual challenge.

Kay said she and Lorenzo might argue that the end goal of all of it is democratization.

Lorenzo said that the customer end use energy need should be seen as the driver rather than here's the grid, and this is how does it maintain its dominance. In the future the grid doesn't need to own everything. He said he expects that it will take 10 to 20 years to decarbonize, and we will have to have power during the transition.

Kay said we should find a way to look holistically at all four at the same time.

Lorenzo said even the decisions are being decentralized, we need to consider who decides – the customer, the power supplier, the city? It's no longer top-down.

From chat:

> Digitalization is far more that telecom and getting all data out of the analog world to digital. It gets to the enabling the capability to relate/connect data into new ways of inferring/discovery of new insights and reduce the friction of linking apps/systems in modular ways to address customer needs/rqmt's faster satisfy the increasing speed in change

Kay said customers are purchasing based on need. She said with the UN group they are emphasizing the value of the power to the consumer. In Africa the needs are at a more basic level than say in the US or Europe.

Mark Paterson asked what is the governance?

Lorenzo asked how can we provide incentives for people to stay connected?

Kay noted there could be income-based rates.

Marc said education of local governments would be helpful. In line with that, localized studies could be beneficial. The grid must remain operational.

Lorenzo said that cost of the grid is going up and there are alternatives now. Most regulatory changes are having the effect of pushing people away from the grid.

Lorenzo shared a quote that you can't make a man understand something if his salary depends on him not understanding it.

Ron M. compared Lorenzo's thought with the pesky laws of physics.

With a few words describe what you think is missing today to enable a fully decentralized power system

Mark Paterson agreed and said there are thousands of people who are paid to maintain the status quo. No one wants to stick their neck out. We have to convince them that inaction will be worse than taking a risk and moving forward. It is possible for things to break or even catastrophically break with inaction. Internationally there are people who you could say are running around like chickens to get to decarbonization.

Marc Costa said he's seen some lawsuits in the regulatory space. There are some bunk studies in the record. We are dealing with deep pocket market actors and maybe we need to up our game. He noted inspiration from someone he met at a master class who had been a hostage negotiator. He said there are effective strategies for getting people to come around to another side in their thinking.

Ron A. said the GWAC early leaders used the U.S. constitutional convention at the beginning of GWAC to grab attention. They had dealt with industry players for a year prior to that. The grid interoperability meetings were a vehicle to formation of the GWAC. He asked if we want the message to be to all parts of the industry and said we need to boil it down to an "easily consumed" message. There is a marketing aspect to this strategy, and we need to promote the thinking over time.

Jaime said we can be one of various stakeholders in the grid. Our GWAC influence can be enhanced if three of us attend targeted conferences and then if we have some people in the audience that can help in messaging. We need to leverage our relationships and have SMEs to help us in strategic places such as specific conferences.

Marc Costa mentioned a DOE effort to help local and state governments:
https://www.energy.gov/scep/office-state-and-community-energy-programs

It is from the new Office of State and Community Energy Programs (SCEP). It is being put together from the ground up. There is a lot of interest in grid modernization and this office has many opportunities. He added that he is an advisor to the initiative.

Mark Ortiz said that the GWAC Interoperability Framework pointed to specific standards which he found to be really helpful. Now we have different domains and behind the meter assets and distributed apps including FAST DERMS – he talked to his company's leadership as to how to transition. It's hard for people to visualize.

Jaime said that he is primarily engaged in transportation – the big picture can get a little messy – like spaghetti. Today it's more about managing relationships.

Ron C. said with utilities and stakeholders' things are "going to break." We have to remember our audience. If we can bring models or simulations to the table – we have to prove the validity and robustness of the model. We can't just throw out assumptions. OR we need real world transmission distribution failures of things we said were going to happen.

Mark Paterson said we should ask what we are trying to change and who are we trying to connect with in a multi-pronged way. We need a holistic strategy. He liked the idea of the constitutional convention because it was representative of a revolution. He said thinking about those billions of dollars that are now being invested, we need to try to create a new strategy for the industry. We have to identify the small percent of people who will be the catalyst of change and concentrate efforts there.

Ron Melton noted some related observations about game theory that might be helpful.

Liaison Reports

Ron B. noted that IEEE Latin America is coming up in a few weeks.

He suggested that since the IEEE North America conference in 2024 conference will be held in Seattle, it might be a good place for a GWAC F2F. Seemita Pal will be the meeting chair.

Ron Melton noted that there are some work groups in IEEE such as one on vehicle technology that he hadn't been aware of. Aaron Snyder added a few more to the list that Ron had.

Ron Melton mentioned an upcoming SEPA modeling CIM group to be held in Austin, TX.

Ron B. - ASHRAE: Ron noted a new activity about developing a CTA policy document. He also said that the DOD is looking to create a document in this area. It would be implemented by USACE. Ron is working on a high-level document in this area. If someone is interested in these efforts, please contact him for more details.

Jaime reminded everyone that tomorrow Chris Irwin will give a presentation to GWAC from 8:30am to 9:45am Eastern time.

Jaime mentioned that the work group mission and vision refresh will reconvene again soon.

Kay asked Mark P. about Australia. Kay sees Australia as being quicker to respond to problems than the US and said she would like to hear more about how Australia responds to problems with grid modernization.

Lorenzo said that Grid Architecture may cause people to think of as having an architect behind it and he asked the group to consider that as we decentralize, where would this architect be?

Marc Costa asked Mark Paterson about the paper that he had sent out recently.

GWAC F2F – EnerNex, Knoxville, TN

Wednesday, Oct. 4, 2023 - *Meeting Day 2*

Attendees

GWAC Members

Chair – Ron Bernstein

Kay Aikin

Andy Bordine

Ron Cunningham

David Forfia

Lorenzo Kristov

Mark Ortiz

Farrokh Rahimi

Aaron Snyder

Leonard Tillman

Ahlmahz Negash

GWAC Associates

Mark Costa

Mark Paterson

GWAC Friends

Melanie Johnson, USACE, Guest speaker

Christopher Irwin, US DOE, Guest Speaker

Anthony James, S. Calf. Edison

David Wollman, NIST

PNNL

Jaime Kolln, PNNL

Ron Melton, PNNL

Susie McGuire, PNNL

Seemita Pal, PNNL

Jaime Kolln noted that after Melanie Johnson's talk this morning the GWAC will discuss the next GWAC Conference.

Ron Bernstein opened the meeting and introduced guest speaker Christopher Irwin, US DOE.

Chris Irwin started his presentation looking at the pace of change in the grid industry. Chris said that his career with the DOE began during the Economic Recovery Act, and he pointed out that many changes have taken place in the grid industry since then.

He said that we are now in the time of decarbonization and electrification. We're on a path to electrify everything. He asked the group to think about the reliability and resilience that is needed and noted and to consider that there is no such thing as centralized reliability and resilience. Those lie at the edge of the grid.

Having the money to invest to influence these changes through companies and government; things like connected communities is a great opportunity to fund some of the ideas that GWAC has come up with and that is exciting. We were born with the interoperability mission as GWAC. The EE-RE program strategy involves how to treat the grid edge for all it is trying to serve. From an architectural perspective if you don't have the design that can harness the capabilities you won't be ready. These are not easy or user-friendly tools necessarily; through disciplined analysis with regulatory in mind – those will sustain us. There is far more collaboration these days. There is no obvious way to solve the problem. Chris is the DOE point person for all things EV to grid and buildings and then on to grid integration. He added that he is also the point person for data ecosystems and microgrids.

Chris noted that the U.S. doesn't have an energy data policy, but we are in the process of creating one.

Jaime Kolln asked about the NERC.

Chris replied that with NERC, for the bulk power systems in industry, they need information, and they need detailed DER models of everything that is connected to the grid. Their level of surveillance is untenable. We need to make sure that NERC, ISOs, and similar groups get the information products that allow them to serve their mission to society. He noted a dilemma between what they want and what they need which may not be in balance.

Jaime – said he is looking for hierarchical node data.

Chris replied that the DOE Office of Electricity is charged with holistically serving everything; solar, DER, and EV. Chris's team is trying to infuse that perspective. There is tremendous financial potential but, in DER aggregation, there is a tipping point. There is a topology in where the service is delivered. It is a challenge.

Chris said that he would like DER to be the future of the system and be about 30 to 40% of the capacity of the system. For example, a massive VPP with 50 utilities – with tens of megawatts to the bulk system they have an obligation to feed information to the bulk system.

Lorenzo stated that he is looking at layered architecture. It's a principal to make the high DER future better. But when we talk about it in the grid industry, we hit a wall. He asked about the state of play to open minds to the concept of layered architecture. Lorenzo asked for information about getting more

traction to this concept. He suggested that if all the needs come from the architecture, the whole thing could be significantly more manageable.

Chris observed that people fear blindness. They fear losing control of the system when looking at a layered approach – it becomes opaque with the layers. He mentioned Jim Ogle's work at PNNL saying Jim's team looks at information that is not available to them. He has asked the group, as you move through the chain, what products are available to help them see what is being delivered to them to help the system?

Marc Costa commented that Chris's comment about DER being 30 to 40% of capacity was interesting. He's thought about some possible legislation and asked Chris, "from your view what perspective is needed and what near term deployments in the next year or two?"

Jaime asked what we can do to expose these challenges and topics? What opportunities are there to put our work in front of some of these DOE agencies to move these ideas?

Chris said you have to be able to hear what these people are saying – what they fear and what they think they need. If they have a vision of virtual power plants or DER, you have to assure them that you agree but then insert the fine-grained understanding that we are discussing. You have to translate into their frame of mind. Connected communities is a 50 to 60 million FOA. He suggested getting them to clarify their mind set and then reassure them of their great idea.

Jaime said we want our voices to be heard. He asked Chris what he thinks are the best places to get access.

Chris said that I2X is a DOE Wind and Solar Technology Office strategy – they are moving on transmission and distribution. The DOE Grid Edge strategy will be moving out in the next couple of months.

Ron Bernstein asked if there were any potential guest speakers that we could invite to GWAC monthly meetings, that would get the discussion going?

Chris suggested Jennifer Downing who is the architect of the virtual power plant as a potential good candidate for GWAC. She is very strategic.

Mark Paterson noted the scale of challenge and level of change needed. He asked if we have a coherent theory of change at the society and industry level? In the absence of a rudimentary theory of change…how do we catalyze a deeper engagement with the topic? He said that in Australia we might try asking a question but get crickets. How does this group deal with the scale of change in a limited time? How can GWAC be more intentional in leading discussions on a multi-front level?

Chris said the theory of change is a good observation. The magnitude of the change is uncomfortable. It bends their Roman Chariot level of thinking. He likes to remind people that they have experienced this level of change already in society – such as the proliferation of restaurants and fast food. Food went to a centralized model, and it has evolved. You need to find something that they understand better that went to fully centralized and then how it evolved. If you can take something they understand well and then compare it to that it helps to bring understanding.

Andy Bordine asked about IIJA funding, is there anything around the DOE that lists who has been awarded funding?

Chris replied that grant programs for utilities are administered by the DOE's Grid Deployment Office.

David Wollman asked Chris about the outage data initiative (ODIN) and Chris said that it is being led by ORNL and the DOE Office of Electricity. (https://odin.ornl.gov/)

Chris asked Ron Bernstein about big data topics that his segment is coming to.

Ron said as a buildings guy, the lowest level of equipment to grid demand response, and to provide information at the energy level of the building to help manage energy efficiency in the building. They need data from both outside and inside the building. They need data to control responses. They need to make new and efficient strategies. It's more than the system you are controlling. There is not a good a repository for a campus of information and there are inconsistencies in interoperability. It's a challenge to get information.

Chris noted that there is an appetite for contextualizing other people's data and knowing how to scale is helpful.

Ron Bernstein stressed that with USACE there is need to have a common nomenclature – in fact it is a DOD research project that he is working on. They are creating a strategy and recommendation for them. Without a standards or certifications, there is not real way to stress the importance of having a naming convention.

Chris added that he's been working on something similar…there are two common reference frames for data that many things have – spatial and temporal. One geospatial that he and EPRI have been playing with is H3GL. Google and UBER are using one. It has multiple layered hexagons with data across multiple platforms at multiple set resolutions. If you can think about a common reference for a data frame, as you move from Hex 10 to Hex 8 – if you have things that can move up the scale.

DOD also has some data but it's sensitive. A spatial devolution upwards – with a time dimension.

Marc Costa and Jaime Kolln both mentioned some of the work the PNNL had done. Some of it is not for public release.

Ron Bernstein said if you can find out where to find things are inside a building it's helpful. Such as sensors and equipment …then maybe the next step is adding cyber security at a level defined by the environment.

Chris said It would be nice with NERC if we could prove what level data they would need by these coordinates – to provide what information they need. Something with provable outcomes. It would be great if we could respect privacy and practice good hygiene. If we could help them see they level that they need and not beyond.

Lorenzo asked about energy equity.

Chris said that equity should be considered. He said Argonne has looked at something like energy per capita. He cautioned that it's easy to just do lip service to equity and noted that unfortunately at this time we don't have a good formula to ensure that energy equity will be implemented with our current schemes.

Ron Bernstein introduced Melanie Johnson, USACE

"Army Microgrid Implementation and Criteria Development"

Melanie described the specifics of the microgrid implementation including constraints as to how to use it where and when they want. It is a work in progress.

Melanie noted that for some installations there is not much data available. The microgrids themselves are not uniform. Some have privatized their distribution systems and that seems to determine what information is available.

She included hydrogen and fuel cells in the list of DERs (also renewables, hydro, more).

Jaime Kolln thanked Melanie for her presentation and asked about posting her video and a copy of the slides. She will let us know if she has any concerns.

Action: Ron Bernstein will follow up with Melanie Johnson about posting the presentation to the GWAC website.

Kay Aikin and Lorenzo Kristov had some questions and comments on microgrids.

Aaron Snyder noted that asking open ended questions at the beginning of work with a client can be really beneficial because you don't pigeonhole the conversation at the start.

Marc Costa noted that with some technologies people have to know it's available and what it's for. For example, people didn't ask for say the I-Pod because it didn't exist but once it was available people realized how much they needed it.

Anthony James said that there is a need for metadata for measurements and buildings; there are insights for demand response.

Jaime Kolln introduced PNNL's Seemita Pal for her presentation:

"Overview of Grid-Transportation Sector Coupling"

She said that similar to Mark Paterson's ideas we need to know where we are and where we are going.
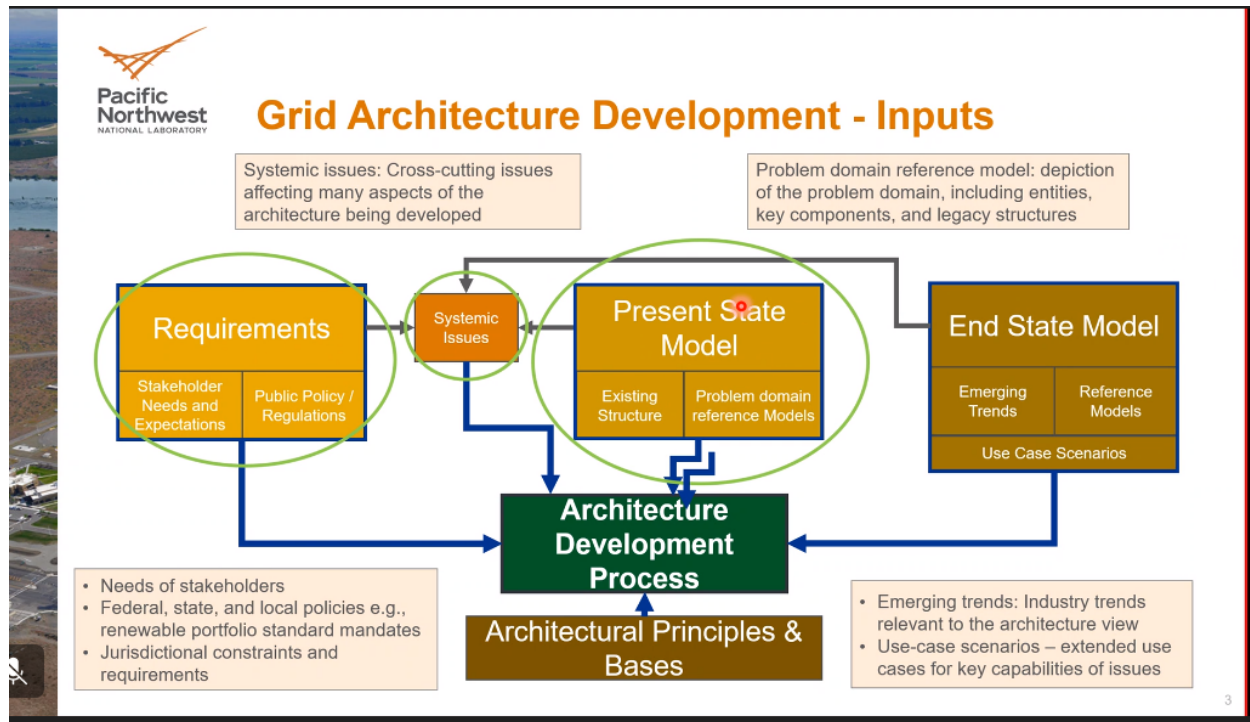
The current state with fossil fuels is a reliable system.

- Developed for over a century.
- Mature, may slow the transition.
- Fossil can provide lessons learned for electric vehicles.
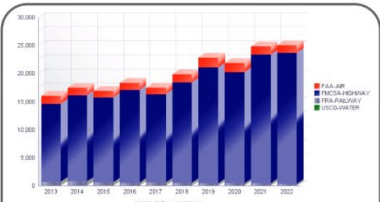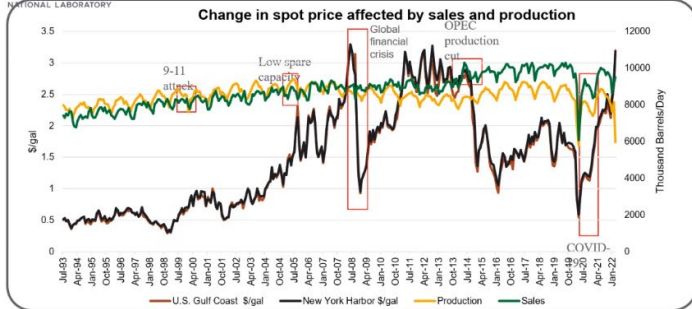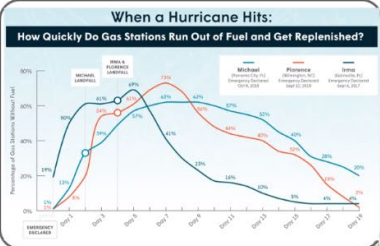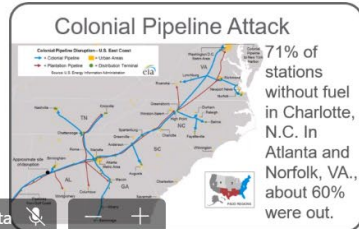
Seemita's presentation looked closely at nationwide events and how they affect the supply chain.

Her team is looking at what an event such as a hurricane would do in a situation with more EV vehicles needing to charge at the same time.

They also looked at the US oil reserves to cover fuel needed in a major event.

She compared the fossil fuel system to the electricity supply chain.

Threats and Vulnerabilities

Threats	Vulnerabilities	Examples	Likelihood	ICE / EV / Both
Hazards	Infrastructure vulnerability to extreme weather events or natural disasters	Tornados, Hurricanes, Flood, Earthquake, cyclone	L/M/H (dependent on the region and time of the year)	Both
Geopolitical Instability	Dependence of economy on imports or exports energy	Oil Embargo, terrorism events like 9/11 attack, OPEC regulations, Ukraine's war	L (can be sustained over a period)	ICE
Cybersecurity threats	Cybersecurity vulnerability	Cybersecurity attack	L	Both (More for EV)
International threat to supply chain	Tanker security vulnerability	Vessel seizure	L/M	ICE
Threats to transportation and storage	Physical vulnerability of transportation and storage infrastructure	Failures or other incidents leading to leaks, spills or fire	M/H	ICE
Pandemic / lack of training programs	Workforce vulnerability	Shortage of tanker truck drivers, experienced personnel for inspecting and repairing tanker trucks etc., electric linemen	L/M	Both
Panic buying/ consumption	Demand surge or capacity limitation	Shortage of supply or limiting capacity of transmission/ distribution	L	Both
Other reasons leading to electric outage	System limitations		L/M	Both (More for EV)
Physical attack	Physical security vulnerability		L (but increasing)	Both

Seemita explained how the group evaluated impacts from these scenarios.

Impacts

System Scale of Delivery Issue

Safety Concern

Ecological Concern

Price Impact

Response and Restoration Cost

Negative Impact on Billing

Negative Impact on Production/Generation

Negative Impact on Transmission/Storage

Negative Impact on Customer Service

Destroys Goodwill towards Organization

Cybersecurity Issues

Immediate Economic Damage

- 12 impact criteria relevant for both ICE vehicles and EVs

- Each criteria has 4 levels of impact (0-3)

- Total impact is cumulative of impact levels on all criteria

- Examples:
  - 0: None; 1: Local gas/charging station affected; 2: Gas/charging stations in a region affected; 3: Gas/charging stations affected over the US.
  - 0: None; 1: local ecological damage such as localized fire or spill, repairable; 2: permanent local ecological damage; 3: widespread temporary or permanent damage to one or more ecosystems

Use Case Based Assessment

In 2008, hurricane *Ike* produced a damaging, destructive and deadly storm surge across the upper Texas and southwest Louisiana coasts and is one of the costliest natural disasters in the US and likelihood is low.

- 27k miles of wire down
- 52 oil platforms destroyed and 38 damaged
- $132 M in damages to transportation system
- At least half million gallons of crude oil spilled into the Gulf of Mexico and the marshes, bayous and bays of Louisiana and Texas

Criterion	Hurricane Ike (ICE)	Hurricane Ike (EV)
System Scale of delivery issues	3	2
Safety Concern	0	0
Ecological Concern	3	1
Price Impact	3	2
Response and restoration Cost	3	3
Negative Impact on sales/billing	3	3
Negative impact on production	3	3
Negative impact on transportation/transmission level	3	3
Negative impact on customer service	0	0
Immediate economic damage	1	2
Destroys goodwill towards organization	0	0
Cybersecurity compromise	0	0
TOTAL	**22**	**19**

Fossil Fuel Supply Chain Resiliency Discussion

- Energy storage
- Mature and agile fuel delivery system
- Standardization of fuel grades and dispensers
- Mix of centralized and decentralized operations
- Allows different business models

Accelerated EV Adoption – Is the Grid Ready?

- **Policy:** Federal Government goal is to make half of all new vehicles sold in the U.S. in 2030 zero-emissions vehicles, and to build a convenient and equitable network of 500,000 chargers

- **Auto industry:** EV model availability and sales share have increased significantly

- **Customer interest:** Survey by Consumer Reports finds that 7 in 10 American adults with valid driver's license are interested in getting a plug-in EV in the future

- **Funding:** President Biden signed the IIJA, which contains $7.5 billion in new funding for EV charging stations

- https://www.transportation.gov/rural/ev
- https://www.acs.org/content/acs/en/pressroom/newsreleases/2022/august/super-fast-electric-car-charging-with-tailor-made-touch.html
- https://advocacy.consumerreports.org/press_release/new-consumer-reports-survey-finds-most-drivers-are-interested-in-electric-vehicles/
- https://www.iea.org/reports/global-ev-outlook-2022/trends-in-electric-light-duty-vehicles

https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Apr/IRENA_Report_GET_2018.pdf
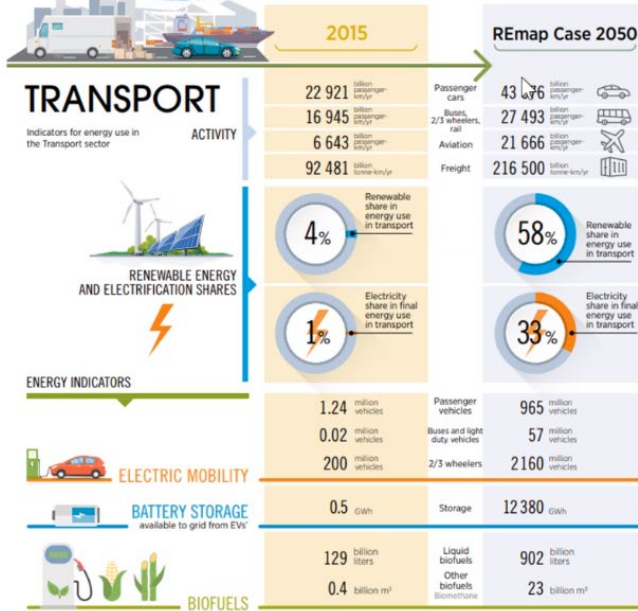
Accelerated EV Adoption – Is the Grid Ready?

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- https://www.transportation.gov/rural/ev
- https://www.acs.org/content/acs/en/pressroom/newsreleases/2022/august/super-fast-electric-car-charging-with-tailor-made-touch.html
- https://advocacy.consumerreports.org/press_release/new-consumer-reports-survey-finds-most-drivers-are-interested-in-electric-vehicles/
- https://www.iea.org/reports/global-ev-outlook-2022/trends-in-electric-light-duty-vehicles

Jaime noted the MAX plug of TESLA will become the standard for all EVs.

Industry Structure of Grid-Transportation Converged Networks
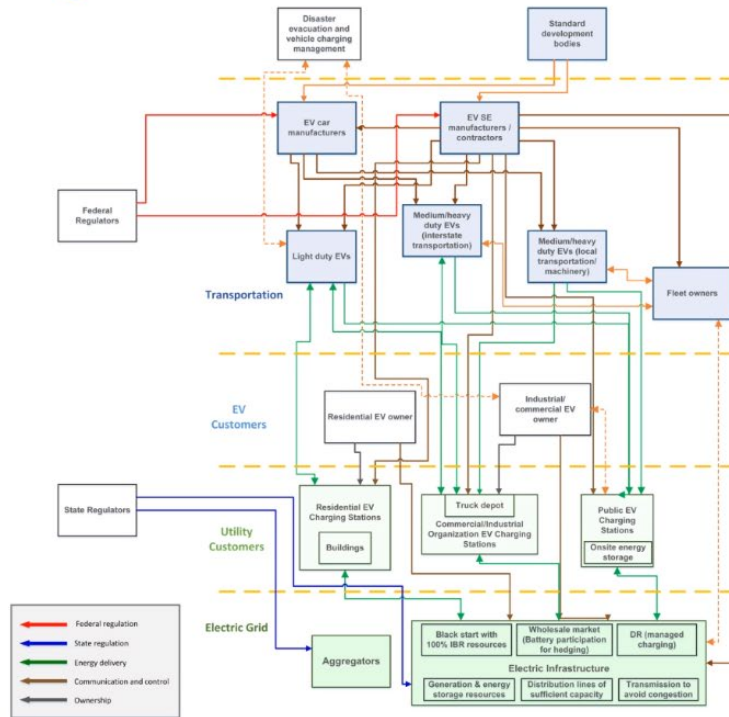
GWAC 2024 Conference Discussion

Jaime Kolln recounted the discussion that he and Ron Melton had at RE+ in September with their representatives, Leslie, and Rory at RE+. Their group will take care of GWAC Conference registrations on their conference website. The GWAC Conference will be an independent registration; people will be able to attend only the GWAC meeting. RE+ registration will not be needed to attend the GWAC Conference.

The RE+ conference will be held on Tuesday, and Wednesday and GWAC will be Wednesday and Thursday.

GWAC will have its own website landing page.

Ron B. suggested Grid Innovation Summit as a new name for the TESC meeting.

Kay suggested "future idea" but also liked Ron B's suggestion.

Ron C. said that SEPA used to hold "innovation summits," so that could create some confusion.

Ron B. said that's not a bad thing.

Ron C. suggested future states as a subtopic.

Kay had several suggestions and emailed them to Jaime. One subtopic suggestion is Bridge to the Future.

Ron B. liked the topic; "impacts of electrification."

Jaime suggested that GWAC also present a Grid Architecture Tutorial.

Mark Ortiz suggested a topic related to a residential home issue with multiple standards and highlight the top 10 problems, tools, and methods to address them.

Ron B. said the list of standards in that sector has been problematic for NIST.

Ron M. suggested we use the term workshop instead of conference. He suggested that GWAC create the panels and discussion topics. Kay agreed with that suggestion.

Ron B. suggested structured panels with invited guests.

Seemita suggested thinking of the audience and the message first.

Aaron Schneider said that since the council wants to craft what is next how about getting a group of people ages 18 to 28 and ask them questions about how they see the future, how they expect to be moving around and living – they have different values and lifestyles and should be involved in future planning.

Marc gave an example of a meeting that he recently arranged. Have someone can start the panel with a summary on their experience and give a summary and then move forward.

Ron B. said the tutorial could be a good lead in with a panel to follow.

Andy B. suggested that in line with Mark Paterson's example, let's define what the workshop/conference will be, what people can gain from it and who is the target audience? We need to make people believe that if they are innovators that this conference is for them.

Kay said we are providing future market analysis with the goal that people will know where their place is in the future.

Marc said that what attracts him to the GWAC s that he doesn't think there the level of experience of the members that he can team with and gain knowledge from.

Ron M. said the keynote should layout what the workshop will be about, what is coming.

Marc said adjectives he thinks of about GWAC are altruistic, informed,

Ron B. said we don't need 3,000 unengaged people; we want 200 people with a true interest. And they do like what Aaron said they can tell us what they need. A broad group of engaged stakeholders.

Ron A. said we want the community to come in and validate that we are going the right direction. He said we could use polling tools, spatial chat, and electronic facilitation tools to support their engagement and capture their feedback.

Ron M. urged us to get the conference name decided on.

Ron noted that we will need an organizing committee and it doesn't have to be council members.

Mark Paterson volunteered to be on the organizing committee if the meetings could be at or after 1:00pm PST.

The 2024 Conference dates will be Sept. 9 – 12, 2024, GWAC members should hold the dates.

Mark P. asked everyone to think about what is unique about GWAC. It's future-oriented and multi-disciplined. It has navigational intelligence.

Marc noted RE+ will be in Anaheim, down the street from Disney. We could borrow the term imagineering.

GWAC Conference Committee: Mark Ortiz, Marc Costa, Aaron Synder, David Forfia. Farrokh Rahimi will work with the next person to be technical chair.

Target head count: Jaime said that the number 200 was suggested as the registration target.

Jaime and Ron said there is an MOU needed that someone would need to sign.

The general consensus among the group was that there would not be technical papers for this meeting.

Jaime suggested a **poster session** for students that would couple with a discount to encourage them.

Jaime said the **tutorial** could be combined with RE+ technical sessions the day before.

Seemita noted the step change and systems thinking and said we need to ensure we get decision makers to the conference.

Jaime said there weren't a lot of utilities at RE+ this year.

Marc said some local/regional CAISOs would be there.

Jaime noted that Transactive Energy and Interoperability were written for regulators, utilities, and integrators.

The GWAC conference will be a 2-day conference. If we have a tutorial that would be day 3.

Mark P. said the plenary should set up as a lead in to workshop discussions.

Jaime confirmed that attendees can register a la carte for the GWAC Workshop.

Jaime Kolln Introduced Mark Paterson, Energy Catalyst, the title of his presentation is: "Power Systems Architecture; Critical enabler of reliable, flexible and cost-efficient future power systems."

Power Systems Architecture

*Critical enabler of **reliable, flexible & cost-efficient** future power systems*

Mark Paterson gave a diagram of research he worked on with Paul DeMartini at the Pacific Power Institute.

Mark has been working with power administrators in Indonesia which is a country with roughly the population of the United States but spread across 10,000 islands.

As we move from the built power system we are working with a theory of change.

For example, If you are trying to move from fossil to say 50% renewable and then on to 0% fossil.

- Assess where do you have a good understanding?
- Where are you trying to go?
    - If you are catching an Uber – what do you need to know?

    We are good at restating problems,

    We need more convergent thinking

Mark took a minute to review the built system as it is and commented that many people are paid well to continue in the status quo.

He explained the GW Scale power system and showed a slide to explain. He said that many people don't have the lenses to really see the power system as it is now.

The group began some discussion about the name of the next GWAC conference. They discussed what are the fundamental underpinnings of the GWAC

Mark noted that often decisions are made emotionally. He's noted some gaping holes in what we know and cautioned to "fasten your seat belts" for the next slide noting that we need to condition people to be receptive to new information that may not agree with what they have been told.

Mark explained how Australia's power systems are changing. He showed slides regarding his Architectural tool kit.

He described it as transformational change rather than bolt on add-ons. He said broad brush strokes are needed, building back from the middle.

Cross cutting issues are also needed. Structural issues are baked into legacy systems and make it impossible to scale them to what we are trying to do. To overcome resistance to change reassure your client that you are here to help; to save funds; to get to what is scalable.

Bulk power, transmission and distribution systems, and the rapidly expanding fleet of distributed will need to function for more dynamically and holistically to enable secure, cost-efficient, and flexible operation of the end-to-end future power system.

Mark noted there overall there is an anti-story to be followed by the solution. The main game is not the toolkit, it is the societal reimagining.

Impact Strategy is multi-pronged, multi-stakeholder and multi-time horizon. It focuses on strategic points of leverage.

It advances the creation of an expanding community of practice.
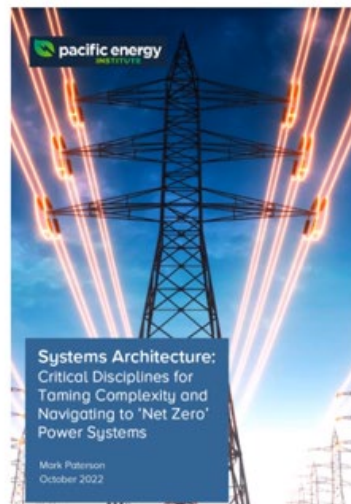
Mark noted 3 relevant publications by Pacific Energy.

- Survive, Thrive or Decline, Pacific Energy Institute: https://pacificenergyinstitute.org/wp-content/uploads/2022/10/2022-09-PEI-Survive-Thrive-or-Decline-Organisational-Transformation-in-the-Power-Sector.pdf
- Systems Architecture: Critical Disciplines for Taming Complexity and Navigating to "Net Zero" Power Systems: https://pacificenergyinstitute.org/wp-content/uploads/2022/11/2022-10-PEI-Systems-Architecture-Critical-Disciplines-for-Taming-Complexity-and-Navigating-to-NZE-Grids.pdf Also from Pacific Energy Institute.
- Power Systems Architecture, Strategen: https://www.strategen.com/power-systems-architecture

Mark invited GWAC to join him on a future power system glossary and noted the need is real because the existing ones are very outdated.

Mark addressed Anthony's chat question:

Look at 10 systemic issues in the report he mentioned. They are the heart of what can be addressed with the arch toolkit.

Mark noted the disciplined focus needed and how central it is to everything that follows.

Aaron compared US to AU and noted that in AU there is only a national vision. In the US we have states to deal with instead of one national authority

Lorenzo Kristov asked where energy justice fits into this discussion?

Ron Ambrosio suggested that the Council consider *energy equity* in future planning.

Agenda: GWAC Meeting

+ About Energy Catalyst

+ An illustration of sharing the transformational role of Grid Architecture with Indonesian government and electric utility stakeholders / ASEAN members

+ The need to be super clear about what Grid Architecture / Power Systems Architecture is and does (i.e. techno-centric vs enabler of systemic change)

+ The need for a GWAC Impact Strategy

+ Some example 'Marketing' Artefacts
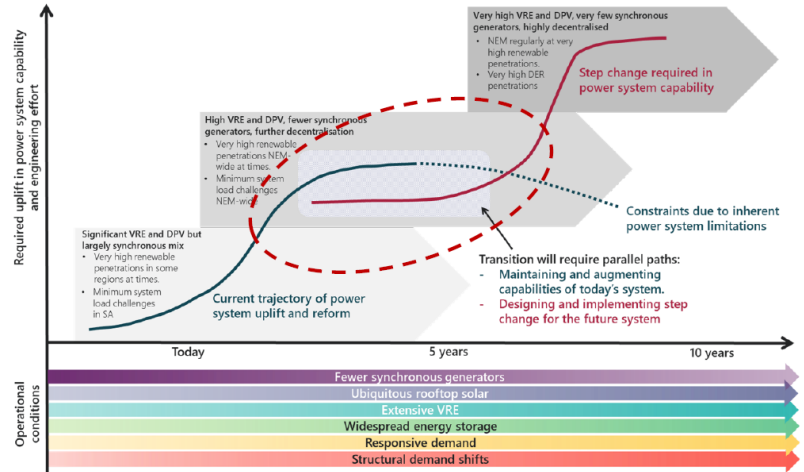
Energy Catalyst

01 Navigate:
Strategic Futures & Transition Roadmapping

02 Validate:
Whole-system Structural Analysis: Cyber-physical-transactional

03 Accelerate:
Multi-stakeholder Collaboration Processes & Ecosystems

Very high VRE and DPV, very few synchronous generators, highly decentralised
- NEM regularly at very high renewable penetrations.
- Very high DER penetrations

Step change required in power system capability

High VRE and DPV, fewer synchronous generators, further decentralisation
- Very high renewable penetrations NEM-wide at times.
- Minimum system load challenges NEM-wide

Constraints due to inherent power system limitations

Significant VRE and DPV but largely synchronous mix
- Very high renewable penetrations in some regions at times.
- Minimum system load challenges in SA

Current trajectory of power system uplift and reform

Transition will require parallel paths:
- Maintaining and augmenting capabilities of today's system.
- Designing and implementing step change for the future system

Required uplift in power system capability and engineering effort

Operational conditions

Today | 5 years | 10 years

Fewer synchronous generators
Ubiquitous rooftop solar
Extensive VRE
Widespread energy storage
Responsive demand
Structural demand shifts

Energy Catalyst supports energy sector leaders in navigating transformative step changes toward a decarbonised future

The 'original' grid as a platform for decentralised innovation

1936

Imbil was the first town in the Mary Valley to 'light up' with electricity in 1936

Gomersalls installed a power plant at their butcher's shop with sufficient power to supply all of the businesses and homes of Imbil. This included street lights which were provided by the council on poles which the Gomersalls installed.

Main power was initiated by the Queensland Dairying Organisation in 1944 and in 1947 the lights were 'switched on' the Campfire Ball and Rodeo by from a switch on the Imbil Public Halls verandah at 8pm at night.

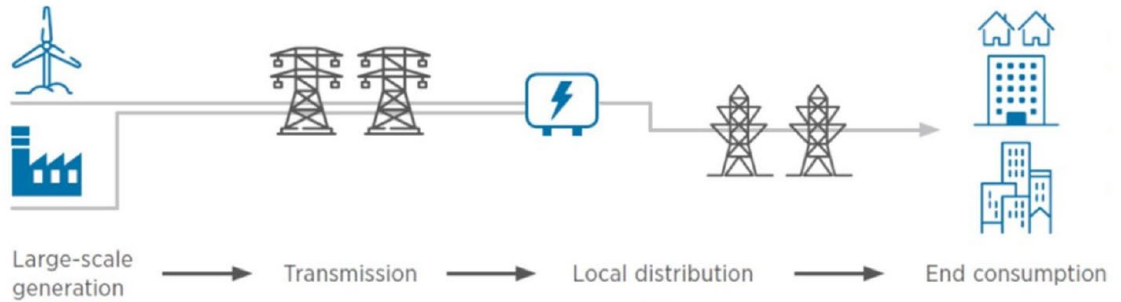Brooloo was the last township in the Mary Valley to be connected in 1953.

Mark said that as a point of reference this is the first town in Australia to have power in 1936.
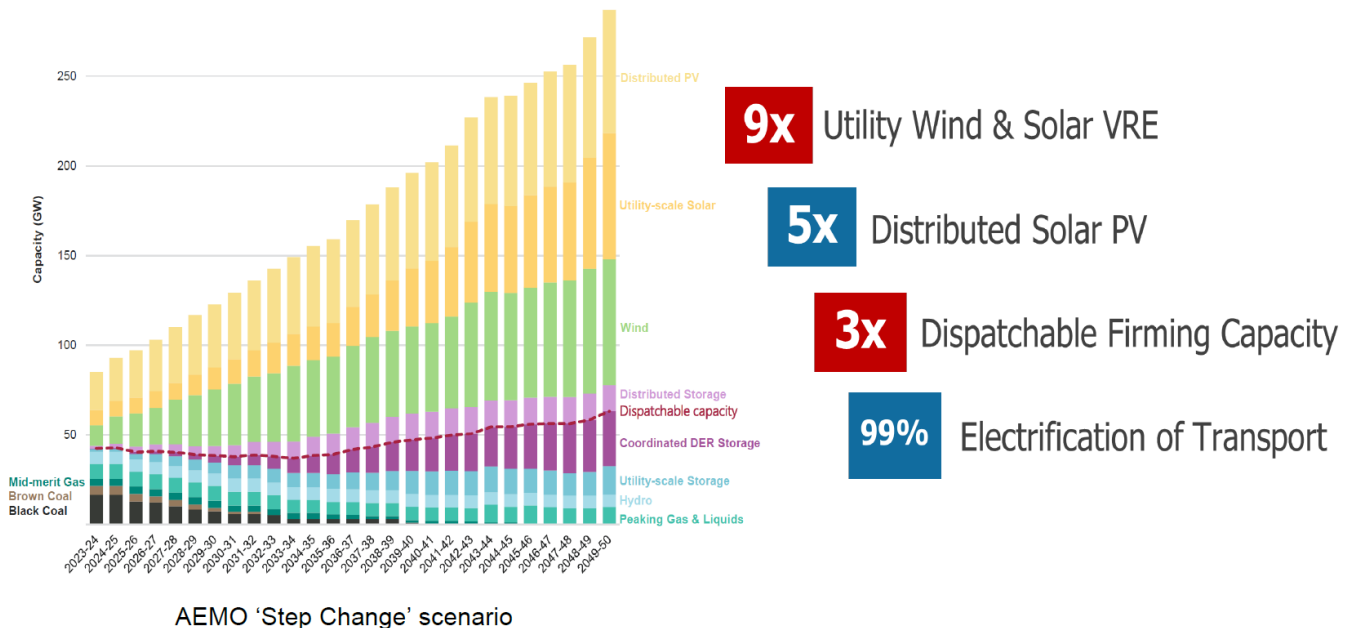
Across Indonesia's ~10,000 inhabited islands...

+ Supports transition design of complex power systems from **100% fossil fuel >> 50% renewables >> Net Zero Emissions** over time.

+ Enables detailed understanding of the relationships between the **cyber-physical-transactional systems** built into each power system.

+ Provides a **grid transformation toolkit and methodology** that can be applied across many different power system and community types (e.g. Java, Sulawesi, Flores, Sumatra)

Using the Network of Structures model to map Australia's 'As Built' grid architecture

Large-scale generation → Transmission → Local distribution → End consumption

Australia's power systems are changing dramatically

AEMO 'Step Change' scenario

9x Utility Wind & Solar VRE

5x Distributed Solar PV

3x Dispatchable Firming Capacity

99% Electrification of Transport

The power system that is fast emerging…

~0% to ≥100% Load Served

~0% to ≥100% Locally-supplied

Large-scale renewables

Baseload/backup

Local storage

Local generation

A power system that requires an entirely new level of
dynamic, whole-system inter-dependence
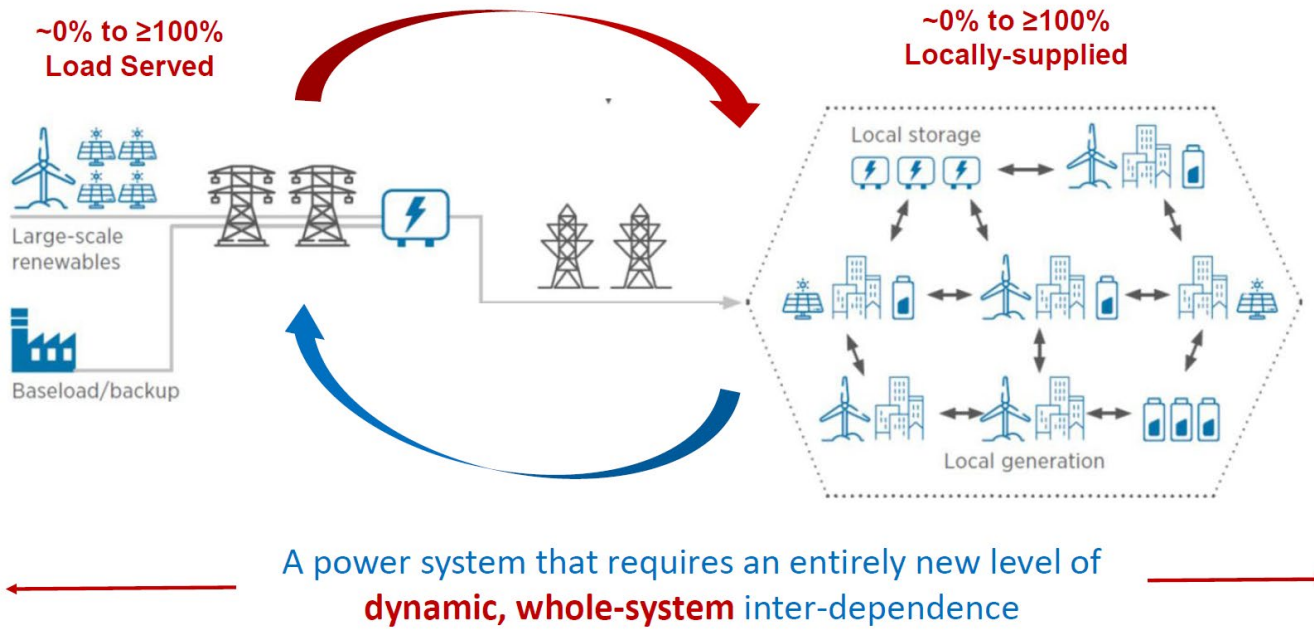
Ron M. took note and Kay A. agreed – what is the cost of inaction.

Paterson white board

Melton, Ronald B
To ● McGuire, Susan G (PNNL); ● Kolln, Jaime T

Principle #1

* "Follow the money"

↳ How many $-billions of _{economic} value will be destroyed by continued inaction?

Principle #2

* What is going to catastrophically break if we continue trying to extrapolate the past solutions into the future?

n?

EXHIBIT A: Decarbonising power systems are becoming increasingly volatile but still require instantaneous balancing of demand and supply
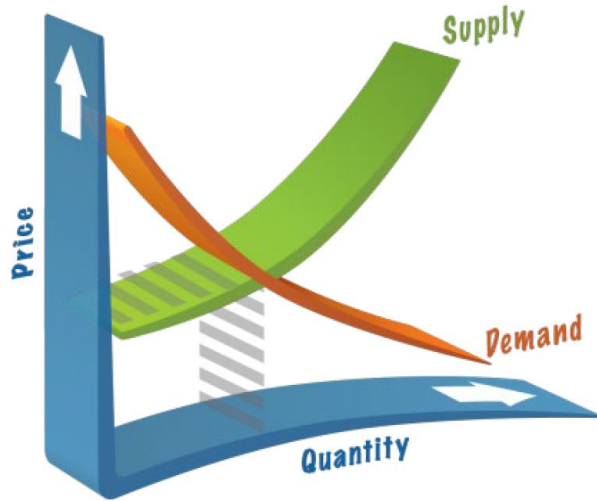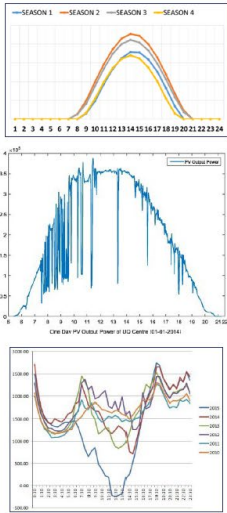
Customer demand and variable generation must still be kept 'in balance' every microsecond of the year as the dispatchable generation fleet is withdrawn

EXHIBIT B: New structures become essential for the Operational Coordination of tens of millions of diverse and dynamic participating energy resources
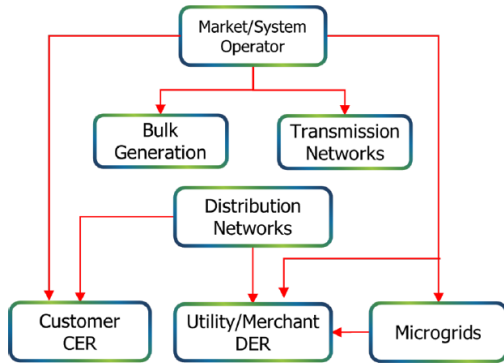
20th Century Grid Evolved
Increasing scalability, operational coordination and latency cascading issues
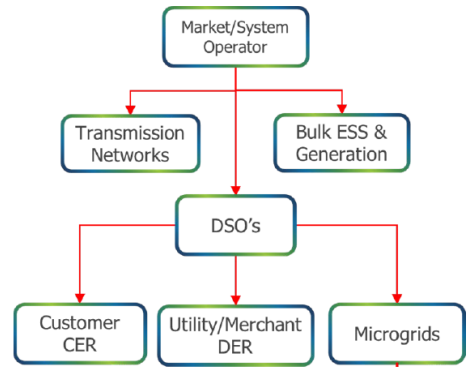
21st Century Grid Transformed
Secure, scalable, resilient, flexible, cost-effective and human-centred

Over time, a complex range of new Operational Coordination relationships have evolved as an entirely new class of LV-connected energy resources have emerged at massive scale

How can we transition from 100% fossil fuel to Net Zero Emissions?

Net Zero Emissions???

100% Fossil Fuel Based

??? ?? ?? ? ? PRESENT-FORWARD

To put it another way...

3. How do we get there?
Consider 'future-back' design

2050

2040

2030

2023

2. Where are you going?
Target future system

1. Where are you now?
'As built' power system
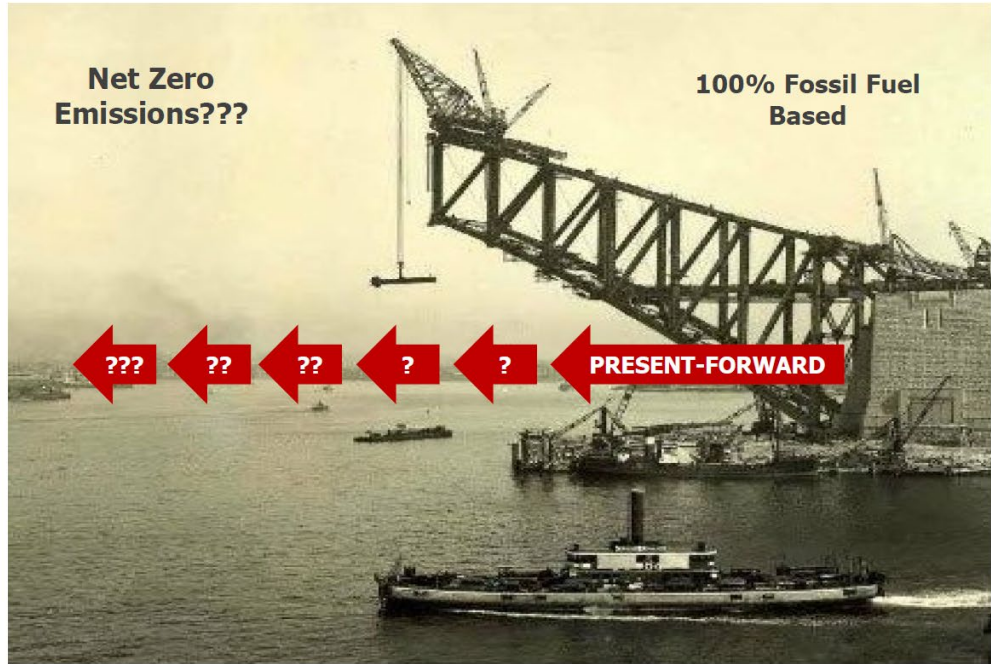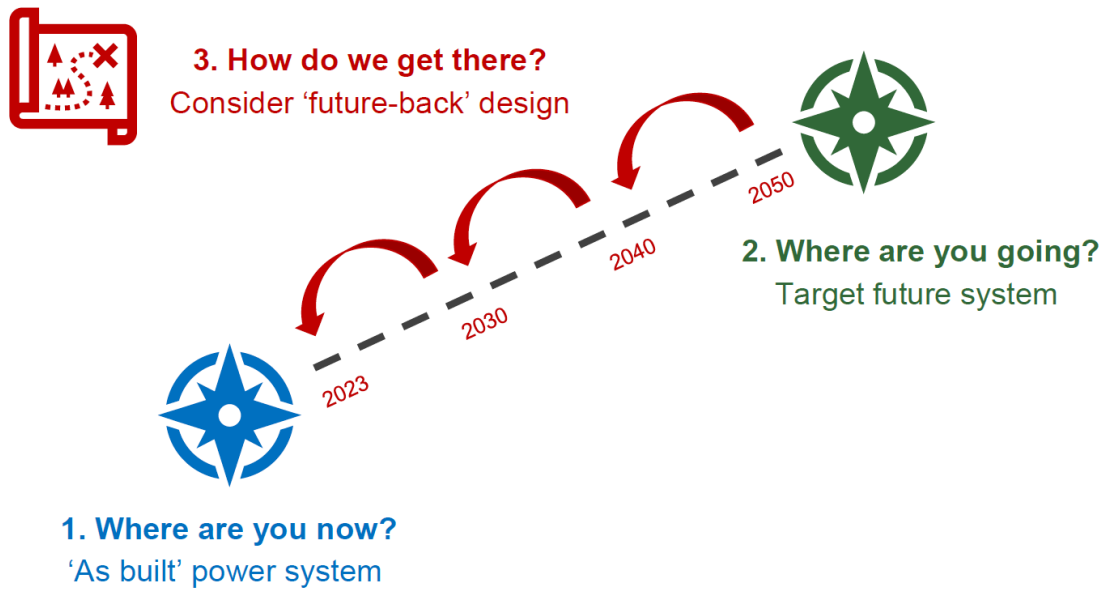
Some friendly reflections…

+ **The world needs the innovative insights of GWAC** (to help guide intelligent / holistic grid transformation)

+ **Systems Architecture-based tools are mission-critical for grid transformation** (i.e. they are the 'master key', critical 'connective tissue' and require a massive uplift in systems capabilities)

Some friendly reflections… (Cont')

+ **Advanced models of Operational Coordination are a, perhaps *the* central issue** (for enabling an increasingly volatile, tidal and 'hundreds >> hundreds-of-millions' resources grid)

   Bulk power, transmission and distribution systems – and the rapidly expanding fleet of distributed resources – will need to function far more <u>dynamically and holistically</u> to enable secure, cost-efficient and flexible operation of the end-to-end future power system.

+ **However, the power sector is both radically change resistant and largely ignorant of the need** ('the fish takes the water for granted')

+ **GWAC needs an Impact Strategy & Execution Plan if it wishes to effect significant change** (which it absolutely can)

Some friendly reflections... (Cont')

+ **An Impact Strategy is multi-pronged, multi-stakeholder and multi-time horizon** (i.e. it includes but transcends any individual publication, workshop, conference, etc)

+ **It focuses on strategic points of leverage** (i.e. critical few rather than trivial many)

+ **It also advances the creation of an expanding community of practice** (and 'evangelists')

+ **It may include leading the formation of an international expert community** (especially Australia and UK Energy Systems Catapult)

Mark suggested some publications:

Short / Accessible White Papers & Videos
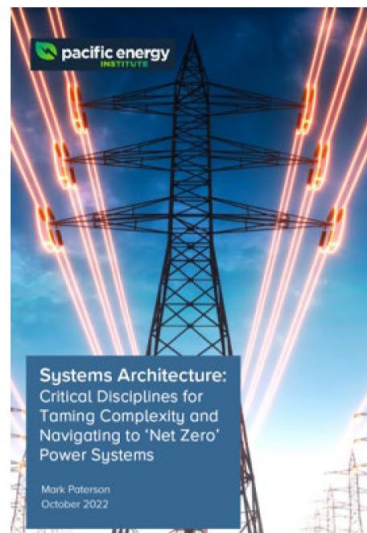
Own / Shape the Language
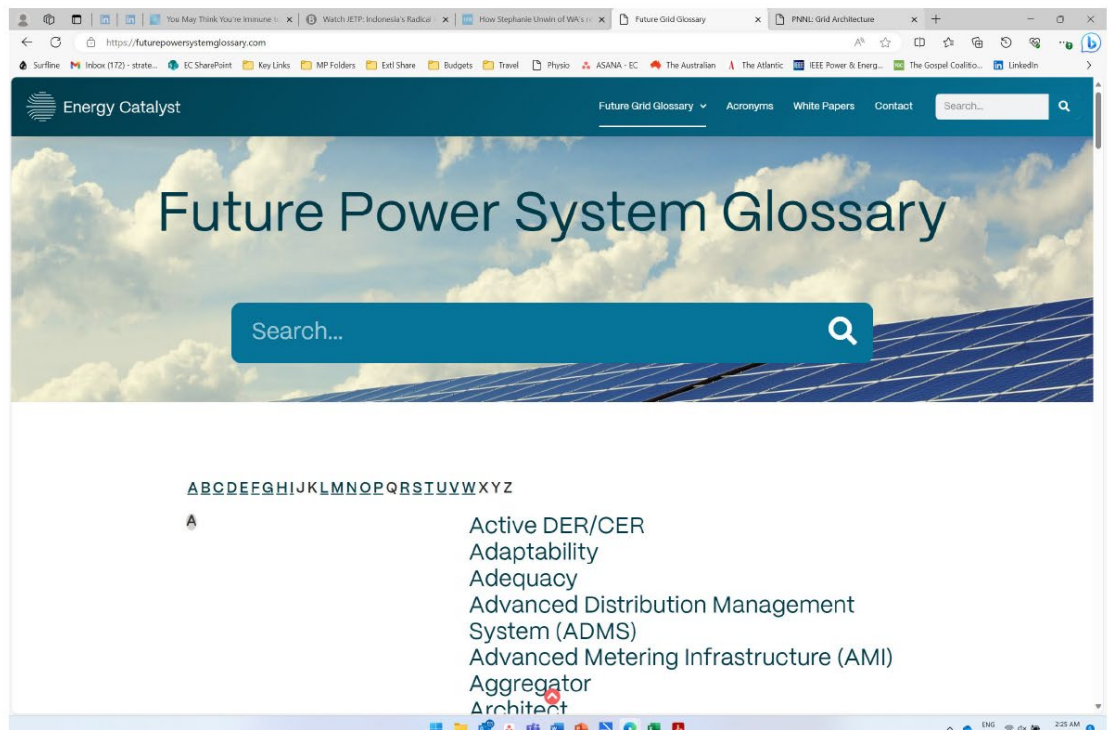
Please contact Mark Paterson: mpaterson@energycatalyst.au

GWAC F2F – EnerNex, Knoxville, TN

Thursday, Oct. 5, 2023 - *Meeting Day 3*

GWAC Members

Chair - Ron Bernstein

Kay Aikin

Ron Ambrosio

Andy Bordine

Ron Cunningham

David Forfia

Lorenzo Kristov

Mark Ortiz

Farrokh Rahimi

Aaron Snyder

Leonard Tillman

GWAC Associates

Marc Costa

Mark Paterson

Friends of GWAC

Anthony James

Michele Pastore, EnerNex

David Wollman, NIST

PNNL

Jaime Kolln

Ron Melton

Seemita Pal

Susie McGuire

The group discussed moving the December GWAC online meeting up a week due to the holidays and a motion to do so was approved.

Action: The December GWAC meeting will move to the 13th of December. (done)

Jaime Kolln proposed two new white paper topics to the group.

GWAC Future Work Products Discussion

Applying Grid Architecture Concepts to Bridge Back from the Future Grid

in concert with current work and building on the previous GridWise Architecture Council work products, this document attempts to provide a roadmap for operators, planners, developers, integrators, and policy makers as guidance to develop interoperable systems that will architect the grid of the future as described in the future states. This paper will include discussions of motivating participation of customer owned assets and opportunities for avoided costs by working toward a long-term vision rather than only short-term needs. This document will be completed in FY24.

Grid Architecture Concept Model for Interconnection, Electrification, and Decarbonization

Analyze various visions of the electrification of fossil fuel-based systems and identify areas where GWAC concepts could provide architectural value to bridge and coordinate between customer and grid objectives. Electrification will introduce dependencies such as those seen in the transportation sector due to electrification. Grid Architecture will be used to describe the touchpoints (for example through sector coupling) that will require collaboration. GMLC reference cases will be included. The majority of this activity will take place in FY24 and be completed FY25. .

Ron M. said he liked the idea. Jaime said that ideally, he would like to see these be completed before the conference although they may not be done before the conference agenda is complete. Ron M. said you would want to have the abstracts to refer to as you select conference agenda topics and also as you form question sets for the panels. Kay reinforced this point.

Lorenzo asked which future for the future grid would the paper refer to and to what time frame?

Jaime said his thought would be to find commonalities in the likely future states from the Future States white paper.

Ron A. asked if we could synthesize something reasonable?

Ron B. asked about different decision factors and when to pivot from one technology to another? What is common to all of them?

Ron A. said we should pick a point in time and work back. He asked about multiple end points and different points internationally.

Lorenzo said we'd select commonalities and then prioritize steps. Lorenzo said we might exam the pathway for the different choices.

Ron A. said we could put a stake in the ground regarding the different opinions and then work backwards.

Ron M. said we need to help everyone to understand the *characteristics* of the future and to identify the gaps.

Ron A. said as we work backwards, we will identify the gaps.

Jaime said we will find answers looking in both directions.

Kay said that it will be important to point out the impact of inaction as a threat.

Marc said it might be possible to introduce a selective application of the toolkit that Mark Paterson mentioned in his talk.

Marc suggested having a "lay of the land and discussion."

Ron M. suggested a high-definition focus, without exact specifics include the expected characteristics.

Marc said while we can't predict the future, we can call out some indicators to watch for. He suggested that climate change is a parallel problem to communicate.

Ron A. asked what stake in the ground do we think will be the end point?

Marc said that Trajectory – mapping the direction – is another aspect to consider.

Jaime said we can say we need distributed architecture, and we need equity – commonalities will be a guide.

Jaime said the first paper should definitely get perspective from a variety of authors.

The second one will be a focused example. It's a supporting document to the first paper.

Ron said the first one is foundational and the second one is more descriptive.

Ron C. said that the second paper should use the word "concepts" as plural, "concepts." You have to understand and then step back from the details to address a broad model that can be understood by various stakeholders.

Marc said his first impression of the concept model paper is favorable. But looking at nationwide change, does it address the long-range question? The concept model is trying to create an artifact and terms that everyone understands. He feels both must be in sync with terms and concepts.

Jaime suggested that the work groups should try to work with partners that they have never worked with before so that they understand not only what their role is but how it fits into the bigger picture and how they interrelate.

Marc said he's surprised at the lack of communication regarding car charging.

Kay said no one has a completely holistic view and asked the group to consider how all the pieces and parts must come together nothing that Seemita's talk earlier touched on this point.

Volunteers for papers

Marc Costa for the first paper

Jaime and Ron C for the second paper

Conference goal – to have the conference meeting before 12/30/2023

<u>GWAC Call for Candidates</u>

Jaime noted that the GWAC Call for Candidates would be open soon and will be due in December.

Dave Wollman agreed to participate again on the Selection Committee.

GWAC F2F – Spring 2024

Jaime asked for location suggestions.

Susie suggested that an inexpensive meeting room could be procured using an office space service which have nice meeting rooms available in various metropolitan areas for a daily rental fee, which are cancellable, and have no required food or lodging purchases.

Ron B. noted we could have a council meeting at RE+ on the Friday after the conference.

The group agreed that the meeting would follow a simple format with no guest speakers. The agenda would all be about GWAC business.

It was suggested that RE+ might have meeting space available.

Ron Bernstein said his home would be available and it's only an hour and a half away.

Marc also said the Energy Coalition might have space available and it would be easy to access by train.

Jaime said that Chris offered to do some kind of recognition past administrators and chairs for the 20th anniversary. This might work out well since it's more just the Council.

Marc C. asked about understanding the change theory agnostic. Does it have a home on these papers.

Moving Forward – GWAC Action Planning

Moving Forward
- Conference meeting 2 before EOCY
- Call For Candidates: Please let Jaime know if you would like to continue as a Council Member
  - Call is open for all to apply!
  - Applications due by December 15th
  - 2 council members, DOE Sponsor, Admin, friend of the Council – January meeting
  - Chair vote is also in February?
- Schedule F2F meetings
  - April 16 -18 2024
    - DC, PNNL, NEMA, San Diego, NRECA, OATI, Schneider
    - 20th Anniversary
  - September 13
    - Casa Bernstein, RE+?, Energy Coalition,
- Author meetings
  - Grid architecture "Roadmap"
    - Costa, Ambrosio, Forfia, Kay, Aaron, Lorenzo, Farrokh, Jaime
  - Example concept model – EV/DER Facility
    - Ron C, Farrokh, Jaime, Mark O, Forfia, Aaron Snyder, Leonard, Seemita, Paul DeMartini
- Strategic outreach plan – for discussion at the next GWAC meeting

The group talked about possible meeting times for work groups for the new white papers. He anticipates scheduling the first meeting for the first paper by Nov. 2, and then waiting a week or two to begin the meetings regarding the 2nd paper.

Ron C. suggested we get the objectives of the paper defined up front, so we have a path and an abstract as a starting point.

Marc C. suggested getting them on the GWAC work product matrix so we can track the progress.

Ron B. reiterated that the scope will feed into the conference, and the first objective is to get an abstract developed.

Roundtable

Ron B. asked people to share what they have been working on.

Aaron Snyder has been working with the International Bank on Grid Architecture and lessons learned in the developing world.

 Seemita Pal gave a brief summary of her recent trip to Vietnam for the Wires project.

Ron B. asked about leadership positions that GWAC members and associates serve on.

Ron Melton said he's been working on Distribution Transformation, which he took over from Jeff Taft.

Mark Ortiz recently gave a presentation to PGE which he might be able to share He will talk with Ron B. about it.

Lorenzo serves on a TD Coordination work group with 15 different companies. They look at distributed resources participating in the RTO market. It's an effort he's been supporting for some time. He will put something together for GWAC that can be shared.

Lorenzo also worked with a solar coalition building case group. Lorenzo said it's groundbreaking work that includes energy justice.

Ron C. has been working with SEPA on TE foundations ontology which builds on a TE concepts model that was put out late last year. We linked it in with TE foundational artifacts.

Ron B. asked him if there are defined terms and data points related to human and machine readable. He is using classic semantic modeling. They will establish meta classes and will do the substantiation with information gleaned from artifacts about what they think Transactive Energy is.

Marc C. noted that many terms can be found on the back end of documents that he works with. They would be a ready resource.

Ron C. said some of the SEPA work groups are also looking at this overlap.

Kay noted the United Nations Action Coalition that she is on along with Marc Costa. Much of the focus is on the building environment and Kay has related various ties to the Connected Communities work. Most of the research will be done at CMU, Penn State and Trinity Universities. She said the goal is to develop a framework for developing countries to try to get to where the US and EU are.

Marc Costa is working on an equitable building standard. They are planning a smart energy market. It's a one-year project and they will develop an ordinate language.

He is also working with a prosumer group in LA. They have worked with CTA 45 for residential. They are teaming with Vermont and other groups. They will look at parallel pathways, how to address communities and what services can these homes provide because they are on the same circuit.

Mark Ortiz is very really interested in finding an opportunity to collaborate with an institution on developing a white paper to explain the electric grid to a general audience with about a fifth-grade level of understanding.

Ron A. is working with universities through IEEE and is helping the University of South Florida to restart their student chapter. The group just restarted last month so it's just getting started again.

Marc C. was interested in what Ron A. is doing and said once it's going, he would like to be involved.

Ron B. also has done some work with students and could send some information to Ron A. It has to do with larger school campuses.

Ron B. has been working on an ASHRAE Standard - S229P. They are working on a public review of the first version. He also is working with Melanie Johnson on a USACE paper on interoperability. Ron B. noted programs and data sets that he works with are often incompatible so there is a real need.

From the chat:

- Ron B: ASHRAE specifying building automation out for final review; will be released before ASHRAE meeting in Jan-Feb timeframe; does have a section on legacy system operation focusing on cybersecurity; another effort is focusing on development of cybersecurity management overlay (Bacnet secure connect is known but that needs a security overlay); developing Division 25 called integrated automation and it would be good if it included B2G

Adjourn

Ron Bernstein thanked everyone who joined the meetings both in-person and online. He asked for a motion to adjourn. Ron Ambrosio gave the motion and Kay Aikin seconded the motion. There were no objections and the meeting was adjourned.