OGC Energy & Utilities Summit, June 28, 2017

Harnessing the Power of Geospatial Information for Smart Energy Communities and Utilities

Executive Summary:

The Energy Summit held in St. John's Newfoundland engaged experts in the energy and geomatics fields, to explore Enterprise, Information, and Computation viewpoints for geospatial standards in service of utility and broader market requirements. The Summit covered opportunities and challenges associated with energy use data exchange, evidence-based decision making, through to sophisticated utility scenarios and customer applications for demand management and clean energy integration. Expert speakers shared examples of OGC Standards in practice, identified opportunities/gaps, made recommendations, and engaged in discussion, captured below.

The Summit was framed using the Reference Model of Open Distributed Processing (RM-ODP) Viewpoints (Enterprise, Information, Computation, Engineering, Technology – focusing primarily on the first three viewpoints). Thus, the summary of the presentations and discussion follow a logical flow from the high-level context (trends, drivers, requirements), to the information requirements across various scenarios, to the computation methods used. The input collected for this report will inform the OGC Energy & Utilities DWG as it develops scenarios, interoperability pilots, and documentation (e.g. Engineering Reports) for advancing OGC standards to better serve the energy & utilities domain.

Below you will find:

Participants at the OGC Energy & Utilities Summit,
June 28, 2017 in St. John's, Newfoundland

Summary of Presentations

Scott Simmons, OGC (www.opengeospatial.org):

See Presentation (link): **Introduction of OGC and Energy and Utilities Domain Area**

Scott provided a background about OGC, efforts to advance Standards e.g. CityGML Energy ADE Modules (combining time series, energy system, building construction/materials and occupancy attributes; for demand and power generation capacity/resources assessment and pre-certification), InfraGML (infrastructure knowledge is needed to extend the standard for civil engineering aspects of infrastructure, energy distribution and other utilities, to correctly describe requirements / interoperability); PipelineML (encoding prototype); etc, and outlined where OGC standards are being used for improving oil spill response (Standards and Operational Procedures to respond to events; building a Common Operating Picture), with bindings across domain(s); in partnership with International Association of Oil and Gas Producers IOGP, who manage CRS (coordinate reference systems) using OGC/ISO TC 211 standards, for this sector. A Best Practice was published by OGC.

Bruce Cameron, QUEST (www.questcanada.org):

See Presentation (hyperlink): **Atlantic Canada Energy Data Roadmap Project - Overview**

Bruce introduced the Energy Data Roadmap project led by QUEST and partners (see slides). For context, Bruce alluded to data deluge (e.g. AMI; more frequent / diverse) for program accountability, whether for meeting efficiency or climate change objectives; and of scarcity (lack of availability) for various external applications, e.g. community energy profiles and the use of data to drive innovation.

But who manages the data, to give meaning to the data / how people can shift – the more granularity in the data the more you can base decisions. In privacy terms, it is acceptable when there is a one-to-one relationship (e.g. utility to customer) where data may be voluntarily exchanged. Where it gets complicated is when outside actors (outside the provider-customer relationship) wants access to the data – e.g. to provide efficiency services; improve building performance, install clean energy, research on building energy profiles, and for communities to monitor performance and reduce carbon. At what level do you need the data for what purpose? In geospatial terms – you need a fair amount of data in order to make meaningful analysis and questions, bringing us into core questions of privacy.

This project will look at what is going on now (a baseline of how things are working in the Atlantic Provinces) and close energy and GHG emissions data gaps. Most energy data is modeled on macro-economic basis or large scale facilities that report emissions, the rest of the world is derived from import/export model, not adequate anymore for planning. The roadmap project will provide recommendations for data exchange and for policy, and to remove barriers for data to be used. It will look for data types/sources, ease of access, privacy, and how other jurisdictions share it under what protocols, to share data without revealing personal information (even though public is sharing data all the time through web applications and search engines). We need to be rigorous because energy use data is not available at a click, and methods need to be developed to satisfy regulatory, privacy, innovation and commercial interests … the project sets up a framework, details actions, taking into account technical barriers and opportunities. We listen to people / like in this room / to understand technically what to do, and to make policy recommendations and provide feedback to utilities. Geospatial is one of the areas where there is a lot of innovation possibilities, as will be described throughout today's program, and which will be informative to the project.

Bruce spoke about the need for electronic data - how data is used by utilities, efficiency programmers, customers, and community service providers.

- Utilities to:
  - Manage systems including billing, reliability and remote connects
- Efficiency Programmers to:
  - Design and implement programs as well as report on outcomes and demonstrate achievements
- Customers and Building Owners to:
  - Review & manage/reduce (manual or automated) energy use
  - Share with others who review & manage energy use for customers
- Actors outside a utility customer relationship:
  - Governments to model performance and monitor trends
  - Researchers to discover relationships and trends
  - Communities for energy planning (Smart Energy Communities)
  - Commercial entities (e.g. marketers)

Project objectives are to undertake an analysis of: Energy and greenhouse gas emissions, Consumption methodologies, and Techniques, including for the cross-provincial attribution of energy consumption, within Atlantic Canada. This project initiates a process to close energy and GHG emissions data gaps in Atlantic Canada. The roadmap will provide recommendations on how to improve the availability, identification, and accuracy of the measurement of GHG emissions; toward public policy development, program, design, research advances, and new technology and business opportunities in Atlantic Canada.

Project outcomes include identifying: sources of energy consumption and GHG emissions data, ease of access, new technology and policy changes, and identifying protocols / best practices for how energy use data is exchanged. Furthermore, to evaluate the benefits, opportunities and barriers to more open availability of energy consumption data. Finally, to describe methods to overcome barriers, develop the opportunities, and achieve benefits. Bruce finished with the need to engage with geospatial community for informing best practices [for energy use data exchange, integration, and visualization]. Results of this Summit will be used to help inform the Energy Data Roadmap led by QUEST and partners.

Details of the project can be found here:
http://www.questcanada.org/hub/research/DataRoadmap

John Simmins, EPRI (www.epri.com):

See Presentation (hyperlink): **Sharing of Utility Data for Smart Cities**

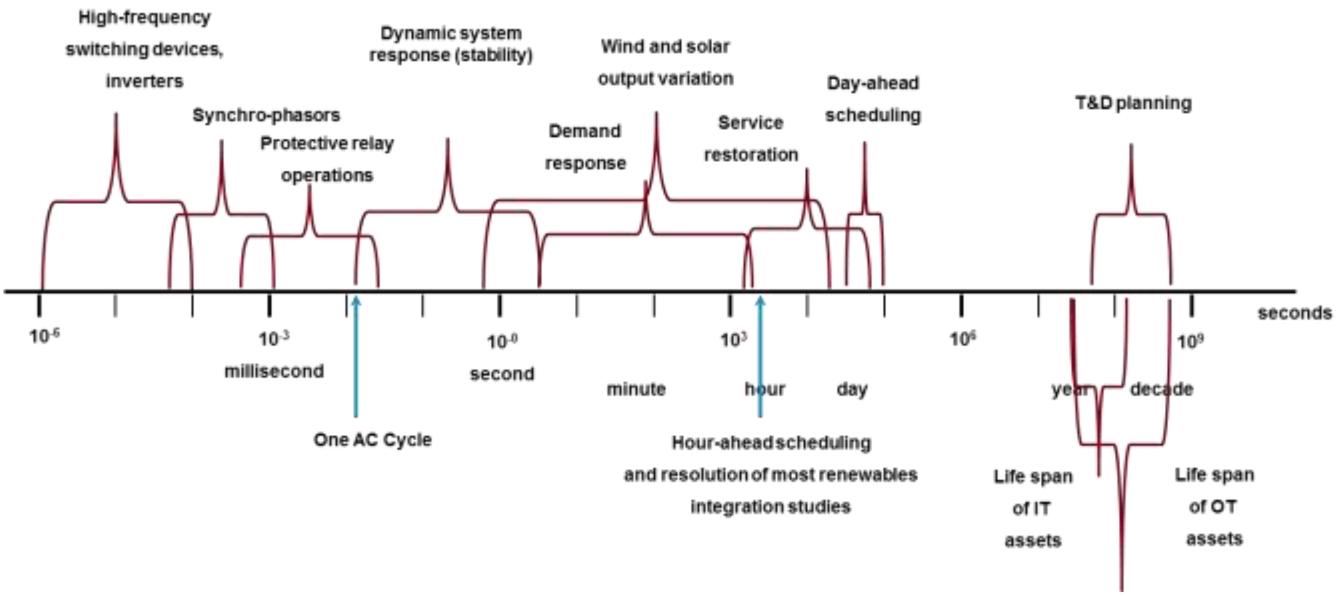
EPRI is a 501C3 with a goal to enable the transformation of power systems to be more flexible, resilient and connected to provide society with safe, reliable, affordable, and environmentally responsible electricity. Standards and GIS – so many possible engineering applications, but not many utilities were using GIS that way (8-9 years ago)… while focus is often on Smart Meters, Telecommunications,… **first we need to fix our GIS data**.

The world is becoming more connected and more complex, at increasing speed. **Network model management is important to utilities** – it's assets, how they are connected, how they are used; matched with asset management plans. Pat Brown will speak more about the importance of network model management later. Distribution Management Systems can fail if they don't have a network model. There is some overlap of EPRI and OGC so work could be supported to improve network model creation and management.

What is a Smart City / Smart Grid? It is whatever you need it to be. Whatever you are trying to do, with data, communication, integration of systems – that's 'smart city'.

Smart Grid/Cities = lots of data and sensors. There is interest in non-intrusive load management – using meter data for a variety of value streams. The number of units providing data in the next decade will increase rapidly.

John shared a temporal spectrum of data intervals from Operational vs Information technology:



Source: John Simmins, EPRI, Presentation at OGC Energy & Utilities Summit, June 28, 2017

There are impacts across this temporal spectrum, where decisions at one end affect the other end. Would be good to consider OT/etc in Standards. Utility's passive assets can be used to hang IoT and telecommunication services for smart city applications. Semi-active assets can be leveraged to facilitate non-utility Smart Cities applications – communications e.g. mesh network for metering, tower network, control systems, safety systems, large fiber / backhaul capabilities, can be leveraged. Active assets - that can actively participate in Smart Cities (e.g. meters as a platform) A key concept, is where smart phones stopped being a phone and started being a platform - meters could be a platform where users can use all sorts of applications, leveraged to do smart building and smart cities activities. iPad for building energy management; sensors in meters can be used for earthquake detection; etc.

Green Button and Orange Button can provide data useful for GIS (from energy demand profiles to aggregated solar yields). In DER – location is critical… EV network tracking… where/when (+attributes) has to be communicated between utility and customer.

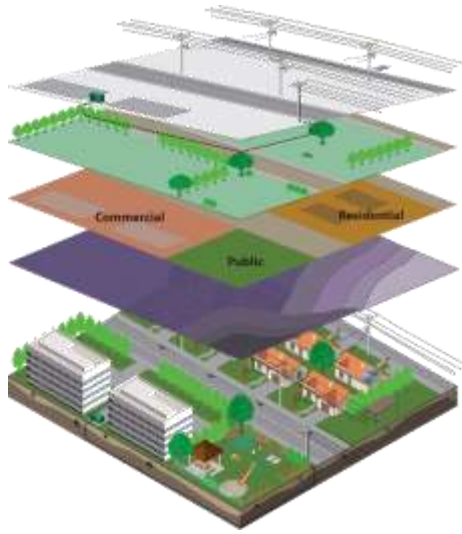
EPRI scoped out GIS / geospatial data integration requirements (internal and external):

Internal GIS Integrations: GIS for Network Analysis for planning and engineering; construction, operation, and repair; Home automation and demand response (AMI MDMS, and CMS); Distribution Automation (DMS); Schedule and Dispatch (WMS), Service Restoration (OMS), Work Orders / Maintenance (CMMS), etc. "Everything is somewhere at some point."

External GIS Integrations:

- Outgoing: Asset location for sensor siting; or for coordinated construction, operation and repair; Network model for coordinated operations; emergency preparedness and response

- Incoming: Weather data, soil data (moisture), vegetation data (where the trees are), land use data, building data (e.g. BIM), brought into GIS for analysis -
- New / Emerging… e.g. Sensors / IoT for ADR, integrated demand profiles / capacity assessments, etc.



Source: John Simmins, EPRI, Presentation at OGC Energy & Utilities Summit, June 28, 2017

Suggestion made to advance interoperability pilots with Utilities (internal) first, and external second. Could be with research/commercial partners or OGC members.

He emphasised that utilities must:

- Create and maintain accurate and complete network models that include GIS as a major component. And to pull all sorts of data into that.
- Invest in reliable, resilient, flexible, and secure network architectures and computing technologies to accommodate increasing volumes, varieties, and velocities of data from a broad range of sensing devices.
- Implement data analytics to create new insights and information while creating relevant policies and practices for data security and privacy.
- Increase engagement among utilities, cities, regulators, and other key stakeholders to educate about the importance of infrastructure investments and reflect this in utility and city plans.

Discussion

Q: By network model, what do you mean?

A: It’s not only assets, and how they’ are connected, but also how they are being used, and asset history, etc. Is it OT or IT? GIS can provide 85% of info needed for network model, for planning / for SCADA. Utilities sometimes have multiple models, to keep track of different aspects of the network, rather than centralized in a GIS. It grew in organically in siloes, completely unaware where data could be leveraged.

Comment: Love the time graph graphic (above). We have standards for temporal things – but you have a very different operational and maintenance frequency for infrastructure – we don't often think of things that way. Would be good to inform the InfraML group/standards.

Q. Utilities don't like going outside of their environment. Are they pulling data for weather, forecasting, etc. using OGC standards web services.

A. A lot do, but a lot are not aware they can do this. So we need to do education.

Q. Working on Green Button and Orange Button, is GIS part of that, are they adding this kind of information. What about Regulators / level of privacy

A. It should be. So that it's not just everyone implementing small scale systems ad hoc, but within a known topology and capacity constraints. This information is lacking – we need to try to map this stuff out.

Q. We often don't look at outgoing, just ingoing data requirements. Interoperability can solve it – but are external cases more complicated, holding development back?

A. That's an issue. But take for example: Moving Objects / EV – Vehicle 2 Grid. We don't even know where rooftop PV and batteries are, but now we want to provide grid support to moving batteries/EVs? Standardize and communication protocols are needed. That's the kind of data we will need to leverage.

Victoria Gunderson, US Department of Commerce:

See Presentation (hyperlink): **Global Trends in Smart Grid Deployment for Smart Cities**

This presentation echoed a number of things from previous presentations. US Department of Commerce is not who you think as being involved in energy policy… but we facilitate deployment of US technology in global marketplace – including advanced grid technologies. We have the same issues – what does deployment and policy framework look like to bring technologies forward. To support these goals, the Department focuses efforts such as NAFTA, informing US government positions, we help negotiated privacy policy for data exchange with EU, and other mechanisms to help open up markets for U.S. Business.

Big trends: shift to emerging economies (renewable capacity), focus on clean energy and Grid management – demand and new generation (renewables), emphasis on efficiency, and shift to urban centers with high concentration of people, mobile phones, etc.

Globally, trends/opportunities in some countries are more around Transmission and Distribution; some countries more around the Smart Grid ICT (equipping with sensors); and some countries it is Storage, as an example.

A Smart City and a Smart Grid can be anything – We need to move beyond nomenclature and get to the logistics.

Smart Cities and Smart Grid have similar challenges, including for information sharing across their own siloes, and how to capture the greatest value of the data. Many industries play a role.

← Information Communications →

Smart City: Transportation, Energy, Buildings, Water, Economic Development, Farming, EMR

Smart Grid: Generation, Operations, Transmission, Distribution, Sales, Consumption

(See slides for figure)

3 Key Questions for Smart Cities / business serving this market:

1. **Did Decisions/Behaviours Change as Result of SC initiative**? How is it changing how people do business, policy; Buyer or decision maker changes as a function of a smart grid/cities initiative – cities may have budgetary or regulatory control for initiatives, where funding is available, where regulatory controls or policies force/enable verticals to cooperate and break down sector stove pipes.
2. **Can one asset serve multiple value streams to reduce costs, multiple customers/use cases?** E.g. poles/wires – hang things on static assets. What's the implication to the company when using the asset for multiple things? Leverage one time cost, use for multiple uses to make it more economical. Lease physical assets to reduce capital costs.
3. **What am I fundamentally selling?** The value is not the commodity or hardware, it is how you use it and what problem you are solving, for example, to increase reliability, reduce peaks, or for resource integration, etc   Need to identify ways to leverage insights gained from data integrated securely and via interoperable devices. (Secure – macro/system level, and at individual level data).

Shout out to Green Button. SGIP. Good example of what can be done / a type of interoperability.

Recommendations:

- Solve utility pain-points
- Aim to increase system efficiency and clean energy integration
- Improve understanding of technology applications for utilities, policy makers, and regulators
- Optimize assets / cost to consumers or rate-base
- Interoperability Pilots should focus on reducing costs, support multiple use cases / value streams. For example: Peak demand reduction, Volt/Var control, Resource Integration, Outage Management / Forecasting, etc. (see slides).

Discussion:

It is nice to see this all coming together at this Summit. All the presentations are excellent. Will they be posted? A: Yes, on the portal and public wiki page.

Q: What's the Canadian skinny? A/Comments: Energy is a Provincial Jurisdiction; they deal more directly with cities; whereas it is primarily federal investment in smart cities/grid, infrastructure, reducing GHG emissions. Industry is engaged e.g. CABA studying economic opportunities from smart solutions through investment in buildings/infrastructure. Also, Infrastructure Canada will have an open call for Smart Cities work this Fall.

Comment: We see an economic development standpoint – interest in an efficient system from a budgetary standpoint, and to redirect capital resources. From a perception standpoint - people want to hear about the array of things being done (a marketing /PR thing that cities are capitalizing on). Using combination of phone data / IoT to tailor consumer experience.

Comment: From a city perspective Tourism/Transport is big driver in communities. For, Electric utilities – to be more efficient is a driver, manage system in a way that opens up capital.

Comment: There's a lot of interesting pilots, but not a lot of full roll-out. Cities and utilities will try things, but there are challenges in full roll-out.

Comment: Cities are investing in smart technologies because they are in a global race for talent and skills… I like the idea of leveraging multiple value streams (for more than one use case) – from a geospatial perspective we struggle with all kinds of business cases and ROI context : for Open Data, for 3D, for SDI in the wider sense. You need to prove your investment to get a lot out of it, for an ROI study or practical implementation, is a challenge – but it would give the industry quite a boost to get this right (develop solid ROI / value propositions).

Comment: It's not the city that's doing the multiple value chains – it's the companies getting the pilots out in each vertical. Top Down has not been as successful... Each vertical can be approached individually – easier to identify ROI . But when an asset is used for multiple purposes, how does a city/utility rate-base that; how does it guarantee the asset's availability at any given time for each purpose; How to piecemeal an expenditure across multiple regulated industries / value streams.

Comment: With DER – PV on roof / distribution utility has capacity constraints; transmission company wants power support, ISO wants it for frequency support, etc. Many value streams. Dozens of reports on impacts of DER on the grid are available from the EPRI website.

Comment (Bruce Cameron): If you are talking about building a business case, who is it to? If you are a regulated sector, you build it within that framework. As a utility, it is to a regulator. The cool stuff doesn't get you far – Regulator is going to be looking at the world as it is today. If you are making a case to the law makers, you have some power/broader business case to be made, where the cool factor may have some influence, so that they can make rules / legal changes for regulatory bodies to take into consideration these new things. Even if energy policy is at state or provincial level, its often the national government that might have dollars to invest to make things happen. It's important to know who is listening to a business case to make a decision.

Q (Mark Reichardt): Presentations are quite intriguing. With respect to megatrends, one of the things I've observed looking at renewable resources – is the stress on the grid, especially with more solar and local storage; the impact on the distribution network; are you witnessing a greater interest in DER on the Grid, where most of these grids are built for centralized generation. Is that one of the major trends – the integration of DER on the grid, informing policies for cities to participate/invest, utilities to generate revenue, the impact on the distribution network? Are you noticing a technology trend?

A (Vickie Gunderson): Short answer is yes. See German and California models / policies, so successfully now at saturation point. Utilities don't see assets as things they need to take on, they are looking at how to entice consumers to take on those technologies, so they don't have to build new substations/wires… This conversation is happening often. This goes back to GIS, I need to know what my system looks like, map it to effectively use resources – this is a fairly sophisticated conversation taking place in various locations, especially in some US States.

Comment (Vivian Sultan): On the issue of regulators holding us back – in 2015, first time utilities have to incorporate DER in the grid, they made a plan with a timeframe. They want to keep costs down but they are willing to enable more clean energy, storage, DR, initiatives. Utilities are trying DER – it's not an easy thing – it's a paradigm shift. It moves a lot of technology, people, and energy. Utilities are asking for the change, but the expense is their biggest question.

Comment (Bruce Cameron): If the law makers have given authority to utilities to innovate and carry out policy objectives. If the utilities are working in a supportive policy environment. Unless that has been triggered, both the utilities and regulators are constrained. There needs to be broad policy support.

Bruce Cameron, QUEST: See Presentation (hyperlink): Critical Issues for Energy Data

Critical issues include: Needing energy data in electronic form (whereas many utilities still use paper or manual data conversion processes); needing standards / security around all fuels' data / around a platform that can communicate that information. Energy utilities have lots of information intervals to collect – whether electric, or oil (in more discreet chunks); does industry want to invest in sensor technology? How do we manage these resources efficiently? Heating oil and diesel still an important source of heat in North America, Natural Gas is a significant source, and other Renewable Technologies entering the market in significant volume.

Data conversation begins with conversation on **privacy** – and it's value – but how to de-identify data and protect privacy of individuals, consider commercial competitive issues, and still create useful information products? To adopt common standards in Atlantic Canada, in North America and globally, we need to connect in with what is happening in the utility space and in the standards space. For example: Green Button is an opportunity for customers to consent to the encryption of their energy use data for use in 3rd party applications. It has become a de-facto standard – some utilities are finding it is a great platform to use for internal utility communication of data; and to the external world (customers and 3rd parties).

We want to be able to enable something that goes beyond the 1:1 relationship (utility-customer). How we do it, also brings into question, **who manages the data** – who has the legal basis – what are the regulatory requirements, etc. with how energy data is collected, exchanged and used. And, what is the incentive? Why would a utility spend time/money on doing larger things – there needs to be an incentive to the system, to do what they are legally able to do. How do utilities exchange data (protocols) – then how do we integrate the data in useful ways.

There are issues around connecting data and granularity – for example, you may want to run 3 or 4 databases (one for each utility) enabled by Green Button, for customers to look at or to voluntarily share e.g. applications that may integrate other data, to give advice / assist decisions. Or, some kind of unified energy profile – does data reside at their source or does one entity or utility have jurisdiction to combine them. When you start to develop geospatial analysis, to affect building level decisions to policy decisions, if you want the level of granularity at a building level, you need to integrate the energy data at a building level. At a community level, do you need to preserve the address/geo reference, and/or strip identifiers? An important question for geospatial is how much detail at what scale is appropriate and who gets to use it.

What is the value proposition and legal framework required? Can energy data exchange and geospatial needs be achieved through existing legal framework or do regulators need a/to mandate? There is a need to combine multiple energy data sources for true energy profiles – a need to integrate data at the building level, as well as for neighborhood scale profiles (historical and forecast). Do you need to preserve address and/or personal data, in order to manipulate and present/visualize? Is the utility the right place for integrating data, or another government body, or non-government body? All important questions this project seeks input to address.

Discussion/Comments:

- Envisage Energy SDI – interoperability between data siloes, integrating on the fly for variety of applications, could help solve some of these issues – including privacy.
- There are technological solutions, with de-identification, security, - but while there may be a technical solutions, are the players trusting – are the leaders prepared to enable things to happen. Look at both technical feasibility and connect it with appropriate policy/legal structure, to meet public trust and confidence.
- Utilities only keep meter data for so long, and eventually purge because it costs money to keep data around. Required for certain # of years. Are not allowed to sell their data. They are Energy utilities – legacy systems, not like retail sector.
- Federal legal framework – recent Privacy legislation around customer information – can't be shared without written authorization. Applies to commercial corporations, but Crowne Corporations fall under Provincial laws. Utilities are Private or Public / Crowne Corp –

depends on Province. So it is a mixture across Canada – so this needs to be sorted out and lined up appropriately, We need to look at the opportunities for energy data end-use for improving efficiency (at building level, and system-wide), combining with other data sets for commercial applications, etc. in some way benefiting the rate base / customer.

- What is the social benefit (value proposition of using energy data)? Who Benefits and who Pays? E.g. rate-base, tax base, or mandate in a regulatory construct? We need a clear idea of the benefits to help make the case to governments to take action
- Green Button standard is becoming more widely adopted, enables a great 1:1 consent tool.
- After a regulatory process, utility in Illinois could share electricity data with the 15 by 15 rule – no parcel should have less than 15 customers and no customer shall exceed 15% of consumption in that parcel. ON Energy Conservation committee looking at this – what is the right granularity for sharing.
- Some utilities in Canada – e.g. ON, BC, energy utilities have been sharing with municipalities – NDA agreements govern data granularity and use, coming from Public mandate / policy, regulatory consideration
- Data that preserve location information has value – you can link information. Energy and Efficiency programs generate lots of data that could ultimately provide lots of value for investment decisions.
- Question for Researchers – at what level is it needed? At neighborhood level? At block or building level?
- If you have homogeneous neighborhoods you can extrapolate neighborhood energy consumption, but communities in transition, mixed use, are not as homogeneous.
- EPRI worked on an outage data standard – for utilities to communicate outage data uniformly. We called it the Red Button. What would be the path to getting that adopted in Canada? This came out of Hurricane Sandy, Must not forget For security uses – EMR
- One level is depersonalized data – and another for emergency personnel, at a parcel level.

The next set of presentations focus on Information and Computation Viewpoints, including Use Case Scenarios and data requirements

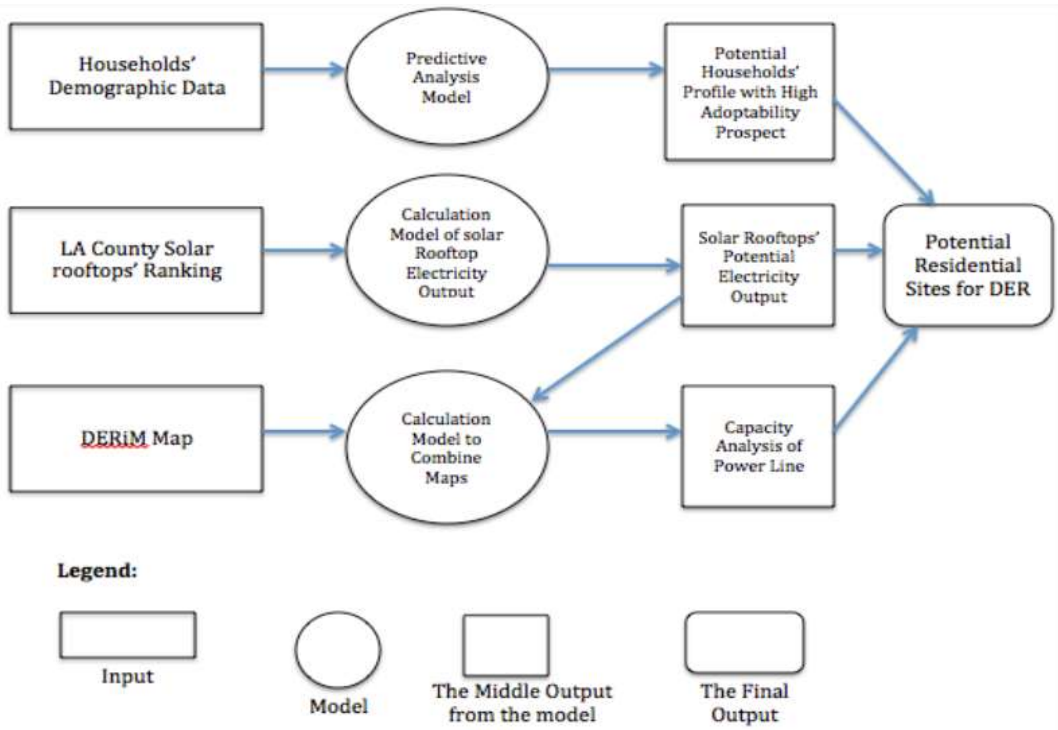
Vivian Sultan, California State University, LA:

See Presentation (hyperlink): **Prediction of consumer participation in solar programs using GIS and deep learning**

We do **energy informatics** – two streams: on energy efficiency (consumer side), and renewable energy supply (integration of resources into the grid, and advancement of the smart grid). `Within the context of smart grid there are many use cases. This presentation focuses on solar adoption in residential sector. PV is increasingly cost-competitive. Our studies try to **pinpoint most likely customers to invest in renewable energy technology**. We combined information about income, household ownership, education level, financial, and other factors…. This research was to come up with a model to predict solar adoption considering all those factors, with data analytics and GIS, in a utility context – for integrated capacity analysis. It is helpful for utilities because of the impact of solar generation on the grid, circuit capacity constraints, and to prioritize infrastructure work.

ArcMap Model Builder was used. We combined customer data with expenditures on energy, parcel and building data, grid constraints, electricity outputs, etc. This involves many thousands of records.

A GIS model to optimize DER's placement:



Source: Vivian Sultan, California State University, LA, presentation at Energy Summit, June 28, 2017

We used Microsoft Azure machine learning tools, identified 98 independent variables. We used Logistic Regression to find most significant factors. This included: Parcel age, total area suitable for solar roof top, household value/size, income, utility provider, county (for this study area – it will be different depending where it is). We came up with an algorithm / formula, considering these factors, to know if a household is likely to adopt solar. We tested it with data (Azure Microsoft Machine Learning). Achieved overall success rate of 79.4% to predict customer likelihood to adopt solar PV.

The prediction is based on block level data / not utility data. It would be strengthened with utility data. One of the data sources: LA County Solar Map and Green Planning Tool http://solarmap.lacounty.gov/ which includes total roof area suitable for solar, potential system size, annual output, and cost savings. We used ArcGIS to get average customer expenditures on energy – but it's not by household.

We did the **integrated Capacity Analysis** in ArcMap. We did hotspot analysis to determine where the electric circuits with either high or low capacity constraints values cluster spatially. This analysis shows which electric circuits need to be upgraded/prioritized for infrastructure work, and which circuits with adequate hosting capacity appropriate for rooftop solar adoption. . Knowing where solar adoption is most likely to occur can definitely impact energy planning,

Real data can help:

- Integrated Capacity Analysis - to find where & how much can be generated and calculate capacity constraints by circuit line and find locations that may allow for rooftop solar adoption.
- To prioritize new installs, Utility needs to know "where" for DER (planning and operations)
- Similarly, Utility needs to know where utility assets need to be upgraded (e.g. circuits / substations, meters, lines)
- Policy would be informed by this.

Discussion:

Q – pragmatic – targeting infrastructure / DER. Can you use this simulation (for different scenarios) to inform policy development?

A: it's really the job of the utility to make the necessary upgrades. They need to know the problem areas. In terms of policy, the only thing we can do is share the data – with customers etc. Some utilities in the US have maps online, with capacity analysis…

Comment: Solar uptake in the world largely influenced by policy/regulation/prices for selling into the grid.

Comment: This analysis would get into what specifically needs to get upgraded, and you can put a dollar amount to that – i.e. determine cost of upgrading the network, and to prioritize.

Q: How transferable / applicable is the method: A: this could be applied in any area if you have the data. The outcome of your analysis will be different – first, what are the significant factors might be different for you. We can reach a general model - but you may not have the same outcome we have today. It can be improved with more accurate data (below block level).

Prof. Thierry Ranchin, Director, Centre Observation, Impacts, Energy-MINES ParisTech: GEO VENER

See Presentation (hyperlink): **GEO VENER: Geospatial data, resources and community portal for renewable energies**

We focus on evaluation of renewable energy resources, and assessment of energy use, yesterday, today and tomorrow, for integrating renewables. This is in order to help utilities to do what will help their networks / for future development of networks.

GEOSS – Group on Earth Observation started to work on Global Earth Observation System of Systems in 2005 – to support decision making with Earth Observation Data across Societal Benefit Areas. We are handling the Energy and Mineral Resource Management SBA since 2005. Many types of data, and it's transmission around the world. Since 1980s we are working on solar energy.

GeoVENER (Vision for Energy) = Earth Observation data for products and service for energy management, end to end energy production systems (utility planning. generation, transmission, distribution), and for energy policy development (for all countries). For details of the initiative see: http://www.earthobservations.org/activity.php?id=121#

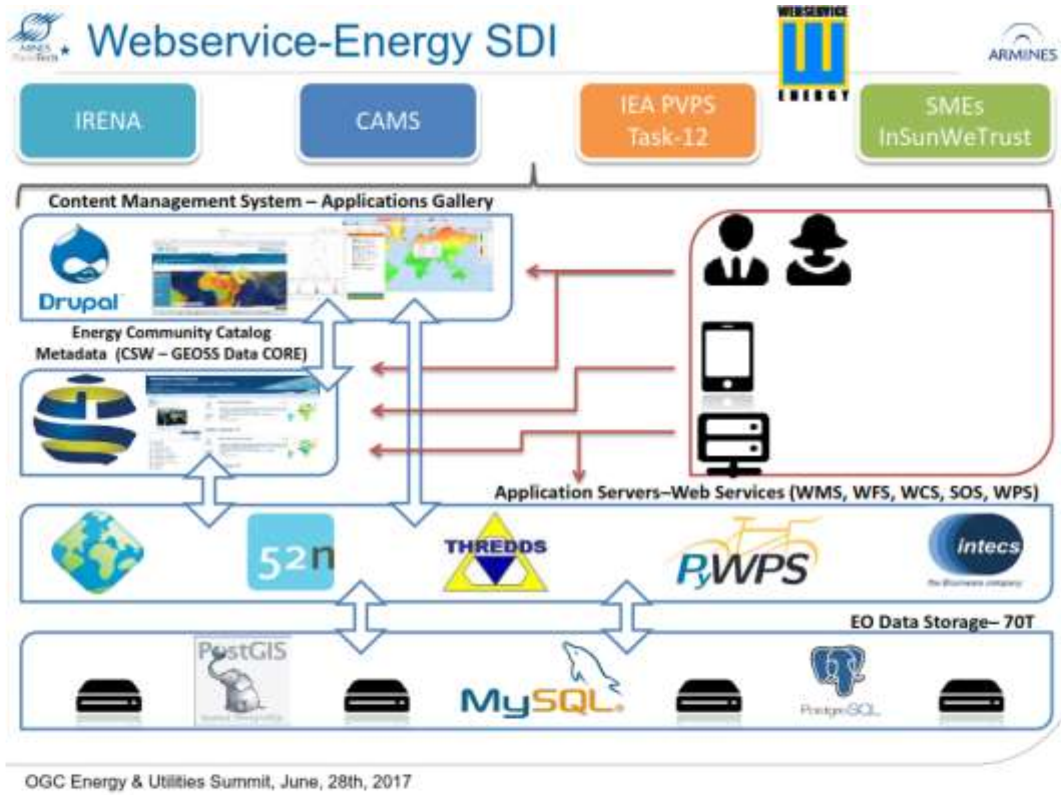
Some GeoVENER activities supported under EU H2020 programme, include for wind resources, and for Copernicus Atmosphere Monitoring Service (CAMS) to Solar radiation service; and Climate Change Service (C3S) for energy (through ECEM project). Also looking to develop services for seasonal forecasts.

We developed/contribute a **Web service Energy SD**I http://www.webservice-energy.org The platform hosts data and a collection of Web Services (including OGC WMS, WFS, WPS) offering data and applications in Renewable Energy and Environment.

What is Web service Energy SDI? It combines data storage, application server, and web services, a community portal dedicated to energy, with a catalogue and content management system with a set of aggregation galleries – serving multiple users. You will see later the IRENA Global Atlas, the catalogue of this Atlas is managed by our Web service energy SDI. We persuaded IRENA to adopt OGC Standards and the GEOSS common infrastructure – in order to have something Interoperable and standardized.

We **implemented OGC Standards:** WMS (layers), WFS (attributes), WCS (maps), WPS (executables), SOS (in-situ), CSW (catalogue) – this ensures interoperability, scalability, reusability on the web. In effect, it allows to share energy resource data in a manner that is useful for analysis and decision-making.

We host WPS and Metadata for radiation services, do computation for high resolution sub assessment. The main client, Companies, can access solar irradiance. We are working with them to understand their information needs, in order to provide them what they need. Another example, WPS on the fly computation for high-resolution sub-roof business potential assessment –looks at factors for installation of solar. Historical Irradiance must be pre-computed. Here is an application using the service to enable property owners assess and install rooftop solar http://www.Insunwetrust.solar



Source: Thierry Ranchin, Director, Centre Observation, Impacts, Energy - MINES ParisTech, Presentation at OGC Energy & Utilities Summit, June 28, 2017

Future work can be done with partnership of OGC as part of Next GEOSS – combine EO data sources, new ways pf processing them, through integration of computing intensive workflows and high computing cloud platform. We need something that goes faster, to compute maps in 10 km cells, 10,000 cells at a time, and something closer to real-time rendering to show impact of daily movement of sun on rooftop, for being able to produce solar energy. Here is the link for the project http://Nextgeoss.eu

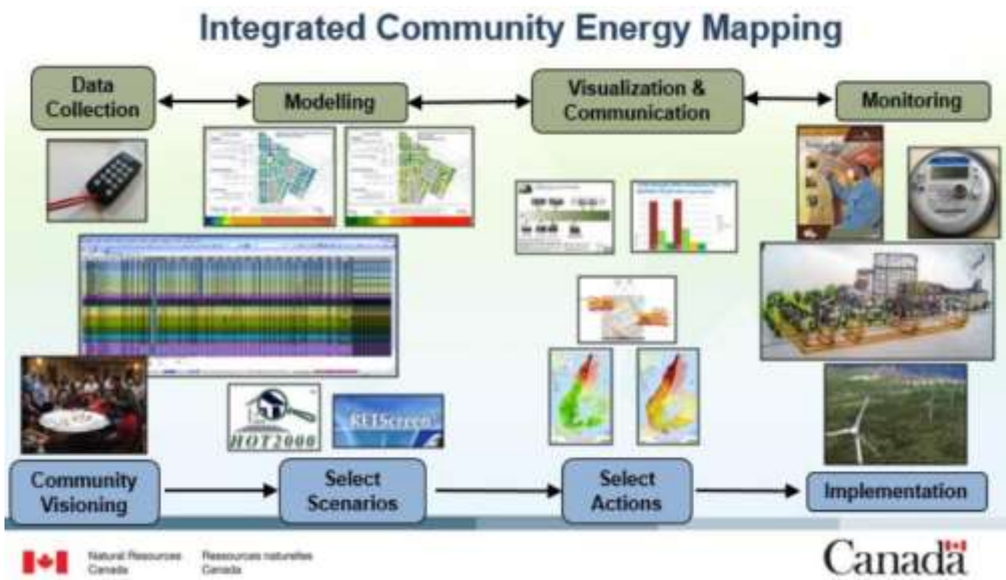
Comment: great example of implementation of OGC standards for SDI to meet user needs.

Jessica Webster, CanmetENERGY, Natural Resources Canada

See Presentation (hyperlink): **CanmetENERGY Data Issues, Promising Practices and Key Methods from CanmetENERGY Integrated Community Energy Mapping Research**

CanmetENERGY is a division of Natural Resources Canada, a different division than the conference sponsor. This presentation shares key methods, data issues, promising practices, selected outputs of **Integrated Community Energy Mapping (ICEM)** research done between 2006 and 2012. The research responded to community energy planning and mapping needs.

ICEM is a technical modelling process that is interlinked with a community's planning process. Modelling is done for housing and building energy use and renewable energy technologies and data is linked in GIS to enable integrated scenario modelling for whole neighbourhoods or municipalities. Output helps to prioritize actions and leads to implementation of measures at a local, community, or utility scale. Communication products, which may be maps but may also be bar or line graphs, can be tailored for decision makers. If measured data is also available, it can be used to monitor the outcomes of recommended changes.



Source: Jessica Webster, CanmetENERGY,, Presentation at OGC Energy & Utilities Summit, June 28, 2017

Key methods in ICEM, illustrated using examples from the SCEC3 model and TaNDM projects in British Columbia, include:

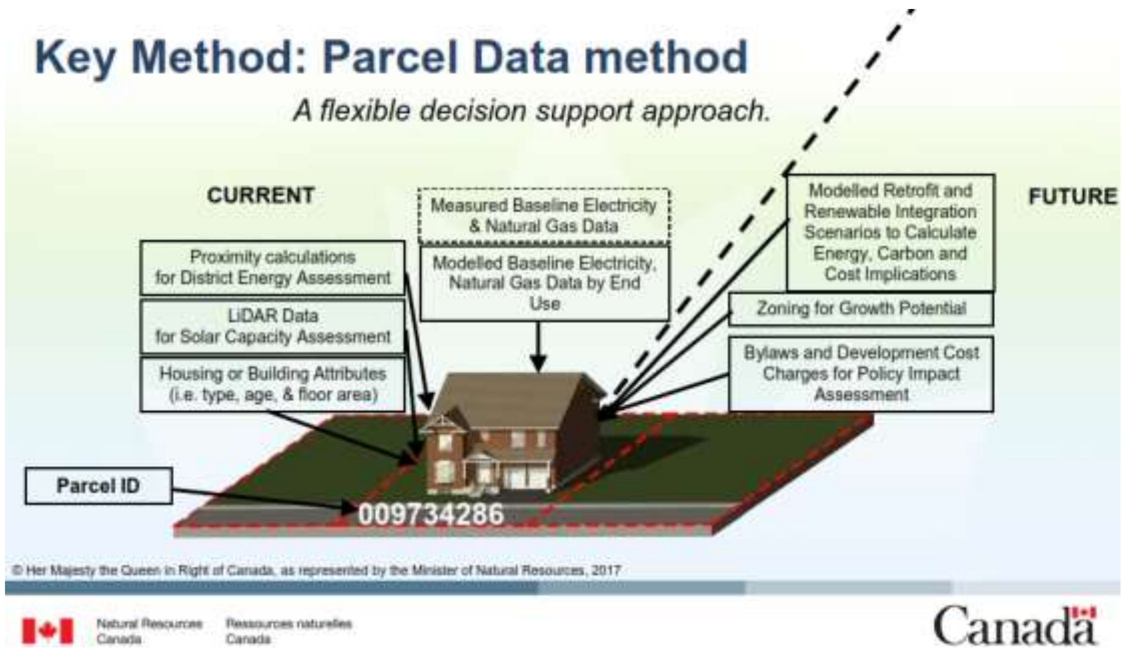
Requirements gathering workshops – Trust is the foundation for data exchange and integration. Build a collaborative process, use consensus and identify use cases. Today we've heard there are myriad of use cases – you may want to contain the scope to a few clearly identified scenarios with data requirements.

Standard building categories – A central challenge is that organizations maintain and use different building categories. For example utilities may only associate residential, commercial or industrial rate classes to each customer account while over 400 codes are used by assessors to describe building type or category. Create a "cross-walk", aligning them from a general to a detailed level; you can then collapse and expand the categories as necessary.

Standard building information report – In the TaNDM project, BC Assessment produced a standard report – describing the energy-related attributes of all buildings in BC (otherwise maintained for property assessment purposes). Attributes were vetted for applicability for housing and building energy modelling, availability across the province and over time; attributes deemed to be personal information were screened out. Attributes include PID, building type, floor area, and other attributes types.

Modelled housing and building archetypes – Housing and energy modeling (using archetypes) allows analysis of energy, GHG and costs in future scenarios relating to efficiency, renewable integration, fuel switching etc. CanmetENERGY has two cloud-based computing platforms for modelling energy in houses and commercial buildings – HTAP and BTAP. Phylroy Lopez will present later on the BTAP platform.

Parcel data method – Building attributes, modeled and measured energy data (as well as other potential data such as solar capacity) should be linked to the parcel, not the building. There are many cases in the built environment where buildings sit on multiple parcels, or there are multiple units or mixed use buildings. These are "many-to-many" relationships. This can inform efficiency or renewable capacity assessments at different levels of geography. The TaNDM method – linking building attributes and measured energy data to the parcel and aggregating by building category to a level of geography – has the potential to improve energy and emission inventories for building stock.



Source: Jessica Webster, CanmetENERGY, Presentation at OGC Energy & Utilities Summit, June 28, 2017

ICEM for ON communities and other projects **found that data needs to be linked at lowest level of geography to be useful, re-useable, and to be able to be aggregated to other appropriate levels for public consumption.**

Aggregate measured energy use by building category to privacy threshold and level of geography - Utility data aggregation by postal code causes errors in energy inventories. Integrating the data at a parcel level and aggregate by building category to a privacy threshold and level of geography makes the results meaningful from an energy modeling and planning perspective, while protecting privacy. To be determined what level of geography/scale of representation the data needs be appropriate in certain area. For example, in BC neighbourhoods were found to be inconsistent/unavailable as geographic boundaries so census tracts were used instead.

Echoing comments made earlier, utilities are not fully leveraging standards. However, linking building and housing attribute data to customer accounts in the utility's own GIS has huge potential value for demand side management program and capital planning. This is also a way to address privacy concerns – if building archetype and energy data is integrated by utilities, it can then be aggregated for reporting out.

An example is BC's Community Energy and Emissions Inventory (CCEI). The most detailed in Canada. These are created at the city scale. Although it has not been official implemented, the TaNDM method improved the structure and level of geography of the CEEI inventory reports for buildings, showing for pilot communities that measured energy data could be reported by building sub-category (i.e. small office) at the census tract scale. Another example is

Spatial Community Energy Carbon and Cost Characterization (SCEC^3) model for Prince George, BC. Using the ICEM method, it's possible to show the huge gap to net zero energy in Prince George under various growth scenarios that include extensive retrofits and uptake of clean energy technologies.

A research paper was developed based on review of three energy mapping projects entitled "Data Issues and Promising Practices for Integrated Community Energy Mapping" http://www.nrcan.gc.ca/energy/offices-labs/canmet/publications/19118. More detail on the recommendations made in this presentation can be found in the report.

Summary of Recommendations: Identify use cases and gather data requirements; develop cross walk table of building categories, integrate building attribute, measured and modelled energy use data at the parcel scale and aggregate by building category to level of geography and privacy threshold.

Pat Brown, EPRI – Network Model Management

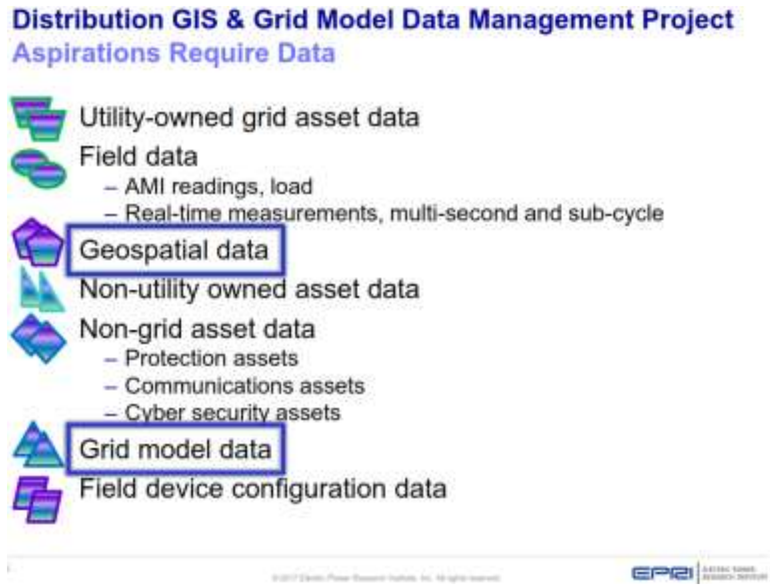
See Presentation: **Network Model Management, internal / external data dependencies**

There is interest in the distribution domain for high quality GIS data.

Drivers – the distribution world undergoing major changes. Grid was built on premise of bulk generation, transmitted high voltage, converted to low voltage, to customer. Radial out to load. Dealt with in a bulk market. Distribution is now going toward new equipment/technology, new players (DER) – not your grandfather's grid.

Utilities need to be proactive players to leverage the benefits of DER. To accurately identify, isolate and restore outages. Manage assets, Benefit Volt/VAR control, Optimize efficiency of the grid itself. To reduce costs.

Aspirations require data – that is well managed. Data may be at low or high granularity (gets less and less visible) as you move down this list:



Source: Pat Brown, EPRI, Presentation at OGC Energy & Utilities Summit, June 28, 2017

Geospatial data and Grid model data are two foundational data sets.
Grid Model / Network model data underpins many future applications that will be deployed for DER / optimize distribution grid. Almost always, we look to GIS to extract or create a grid model from.

Applications to support safe, reliable and affordable operation of the grid, are used in:

- Planning the grid – grid extension, replacement, protection systems design, optimizing third party engagement (DER providers);
- Operating the grid - for outage detection/restoration, plan/schedule maintenance, situational awareness , efficiency optimization.

It's more than WATTs (or real power) - That doesn't tell the whole story. It's voltage, frequency, 'reactive power'. Behavior and response over time (ramping, power quality). These things need to be looked at all along the length of a feeder (not just head or tail end). How fast can particular resources be ramped up – as solar takes off, what happens at the distribution level, this type of information is needed by utilities. Applications to do all of this, are almost always powerflow simulations / network analysis functions of an entire grid at a moment of time, and they need high quality network models.

I define **high quality network model data** as: data that represents a view of the electrical grid, including equipment, its electrical behavior and its connectivity, as well as its operating state at a moment in a time, that is sufficient to provide a starting point for network analysis. So that a network analysis function can run.   But it is hard to manage. Grid Model data is big (variety and volume), from many sources, over many temporal spans. You need to have a physical description and starting state that is cohesive, with a temporal aspect.

To make capital investment, you need to do 'what if scenarios' – to determine what needs to be done, upgraded, changed etc., why, when, and where. This type of information output can be derived from analysis using high quality network model data.

From a network model perspective **GIS data is a challenge**, because most distribution utilities have issues with consistency and completeness in their GIS data. Most GIS Databases were not initially populated for network connectivity – but for some other purpose. Lots of changes in the distribution system – lots of new applications. We need to ensure a good data – good model data management.

Current state: on the transmission side, most utilities maintain separate network models for well-established silos of network cases. But data comes from various sources - so one data source might be used for several network cases, and often needs to be duplicated. Data flows often need manual conversion, with slow or inconsistent outputs. Utilities often have no overarching data management strategy. There is interest to solve this problem –an architecture vision to manage data enterprise wide.

We have started to look at distribution domain –we are looking to define architecture for Distribution grid model data management. In addition, we aim to promote industry understanding of grid model data management and vendor product support for it, provide participating utilities with actionable strategies for **improving GIS data and grid model data derived from it, and advance the data exchange standards.**

Move industry in direction of grid model data well managed, products support what they need to support. … Data exchange standards to underpin the ability to gather source data one time and construct cases for network analysis and shared with applications across domains inside a utility.

Key points: Network model is crucial. GIS model is crucial. Exchange standards are crucial if we are to cope with increasing penetration of DER in the distribution world.

Discussion:

Q. Could we advance some draft standard / something that deals with model management.

A. At the end of this project – interesting work by OGC that could help us in describing engineering details – poles, conductors, assets and how they're connected. Some of that work OGC sponsored at underground conference back in March. We need to see if there are ways to leverage OGC standards to be part of the solution to the questions of leveraging GIS data and turn it into Network model data.

Comment: George Percivall, in the room. Report being written up – data models (summary), including EPRI models, CIM, and how do we bring relationship between those data models – use cases discover of spatial assets underground, modeling of assets related to each other – that's more of what you are referring to – for outages detection/recovery, etc. Data model will evolve for underground. There's also the aspect of the dynamizer function within OGC context - model prediction into static models (like CityGML). These are relevant for you.

What was done in recent Underground utility work – we cast wide net to find out what people needed. We focused on data modeling – hard to do from interoperability perspective – important to know how you can connect models. We need to do practical experimentation – we have discovered there are a number of models but no idea how they relate. Everything is pointing at a pilot that George is planning for later this year.

Pat Brown: Standard that seems to hold significant promise – CityGML Utility Network ADE – for organizing networks.

Participants looked forward to work together in a pilot activity. EPRI and OGC have projects aligned in that area.

John Simmins, EPRI – CIM for DER + DR (DERMS)

See Presentation (hyperlink): **CIM for DER**

CIM = Common Information Model – 3 standards that IEC developed – IEC 61968 61970 62325. The combination of these standards cover modeling of infrastructure, messages that are exchanged by the applications, and the market (for buying and selling power).

The area presented today – 61968 – part 3 – Network Operations: DER Enterprise Integration – Communication with Inverters. EPRI defined functions for smart inverters, data models, communication protocols. ICE 61850 – 90-7 came out of this. Multiple versions –up into 40 functions now. This includes managing Volt/Var locally. "Common Functions for Smart Inverters, Version 3".

To dispatch and manage DER at enterprise level, you need a whole new set of standards / situation. We are now working on the enterprise functionality. This includes data from:

- MDMS - Meted Data Management System,
- OMS - Outage Management Systems
- GIS – Geographic Information Systems
- DMS - Distribution Management Systems
- DERMS – Distributed Energy Resource Management System – which is a set of functionality that can reside in many places - it's just functionality for managing DER.

First we identified use cases, functions needed in smart inverters, identified data models, and OpenDERMS / Standard protocols. We also have an Open Source DR, and an open source application for DSS – Distribution Simulation Software.

Use cases we identified, most likely a utility would want (there are many others):

CIM/DER (load balancing) – availability/quality checking DER for distribution level balancing. These 6 scenarios were identified previously by EPRI:

- DER Group Creation
- DER Group Status Monitoring
- DER Group Capabilities Discovery
- Real Power Dispatch
- Reactive Power Dispatch
- DER Forecasting

Original use cases

- DER Group creation maintenance
- DER Group forecast
- DER Group dispatch (real, reactive power)
- DER Group status

Updating test script (Adding 3 use cases)

- DER Group Voltage regulation (ramp/curve)
- DER Group Capability discovery
- DER Group connect/disconnect

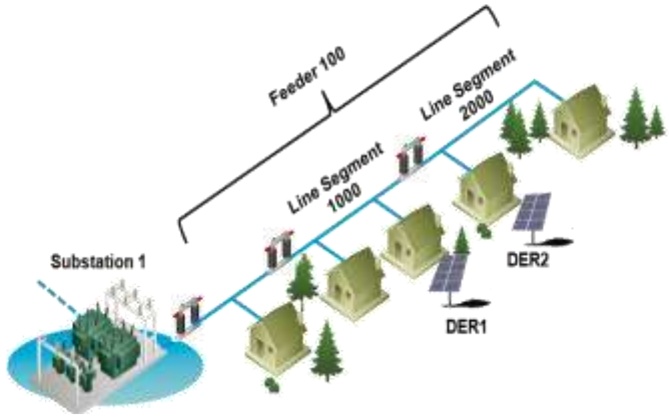
Testing event: October 10 – 12, 2017

Identified data requirements, modeling in CIM and MultiSpeak, Createf messages, then we built the functionality in OpenDERMS and tested it. See: Enterprise Integration Functions for Distributed Energy Resources: Phase 1: EPRI, Palo Alto, CA: 2013. 3002001249

We did (previously) **interoperability testing** at an NREL hosted simulation initiative. We took the messages we created and tested them in 18 projects. We took a look at these ideas (DER scenarios listed above) – for further details see NREL website. We were looking at DER and DR in the same environment to control meter conditions, in a similar way that we would use voltage regulators/capacitors. We combined a few groups of DER and DR devices, different voltage scenarios and var support, for transmission use cases.

Yes – you can use DR and DER to support grid operations. OpenADR standard was meant for market participation – no functionality for grid support. We wrote that in. There were no CIM messages between DMS and OpenADR for the purpose of grid operations. We wrote those as well. We said 'shed load' not because of market condition, but because of a peak event.

See: DER Enterprise Integration: Interoperability Workshop Results. EPRI, Palo Alto, CA: 2014 3002003035.



Source: John Simmins ,EPRI, Presentation at OGC Energy & Utilities Summit, June 28, 2017

The concept of a DER Group – How do you want to group DER – there are many ways: Substation, Circuit/Bus, Feeder, Feeder Segment, Island/Microgrid, Device, by Lat/Long Rectangle etc. We decided, we don't care what a group is – a group is whatever you need to address your situation. Any DER resource could be in any group(s), or just one. The job of the DERMS is to know how to dispatch, the DMS doesn't have to deal with it at an individual DER level – DMS needs WATTS from line segments at specific times. DERMS does the analysis/dispatch, DERMS can have other DERMS underneath them i.e. a horizontal and vertical expandable 'DERMS' – each DERMS can speak to DERMS, doesn't care what the other DERMS does beneath it. We crafted CIM messages to reflect this. DER to CIM is in OpenDERMS. Assets to DERMS could be any info standard (it varies by place/technology). This architecture allows significant functionality. As an aside, Blockchain could be perfect architecture for trading energy.

In the CIM world – Compliance is an issue We are removing barriers – EPRI will develop open source stuff to allow a testing and certification community to flourish. A workshop is planned where developers will come in to test against…. If there is interest – **CIM messages don't have a heavy geospatial component. In my opinion, it needs that**. If we can do something with OGC inspired on this, please let me know.

Discussion:

Q. If Location element standardized – how would that help?

A. DER is now Dots on a schematic. Utilities use it for thematic representation of grid to manage. They don't have a geography. However, for some use cases, you don't only want to dispatch by circuit or feeder, there is a geographic way to look at it. EPRI, we are looking at concept of ad hoc microgrid, distributed intelligence, smart regulators/inverters, etc., sophisticated computers, to address problems like loss of power, or power quality, etc. The grid has to be made self-aware. This (geography) is where it all starts.

Q. Are there DER specs for GIS integration.

A, A CIM message is associated with that. Whether or not it's sufficient is debatable, should be looked at in more detail given value streams identified.

Dr. Jacinto Estima, IRENA Global Atlas

See Presentation (hyperlink): **IRENA: Global Atlas for Renewable Energy**

IRENA Global Atlas – started in the Clean Energy Ministerial, working group for solar and wind, handed over to IRENA for coordination. Developed in collaboration with leading institutes, including NREL, Mines Paris-Tech, and others.

IRENA Global Atlas facilitates access to renewable resource data, analysis, and methods in order to accelerate the initiative and development of a broader range of renewable energy projects particularly in developing countries. This is in line with SDG goals – providing resource data for all. The **global atlas is an SDI that relies heavily on OGC Standards**. The initiative can be used in phases on lifecycle – from prospecting, site selection, feasibility analysis, design and development, financing, construction and operation stages. Better resource data **reduces risk** over the life of projects.

There are **many users** – from policy makers/governments, to modellers, business developers, educators, etc. As an international agency – we are not producers of data – this initiative is a web platform for access – data is produced by many institutes around the world, by countries themselves (partnership with 65 countries), has over 2000 data sets available.

"In terms of architecture – we rely on OGC standards – The feature, map, processing, catalogue specifications. We have map servers (GeoServer) and connect with ArcGIS and MapServer. Many applications can access.

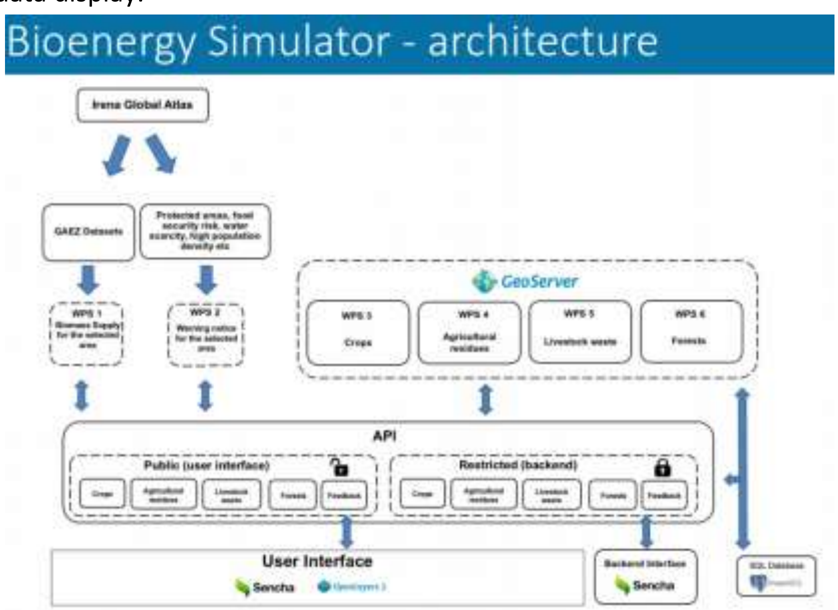
The GIS interface / web client, includes data layers, visualization, query and analytical tools, in one platform. We have a list of action tools available in the Atlas to do more advanced analysis – e.g. time-series, dealing with complexity to help decision making. **Good for suitability analysis** for prospecting good sites for renewable energy deployment- using factors such as Renewable energy resource intensity, distance to grid, population density, topography, land cover, protected areas, etc. Suitability index can be outputted as potentials in numbers, to calculate technical potential of PV (solar) given the right siting conditions.

The public maps include the recent global solar map. www.irena.org/globalatlas. We have also the global wind map, and advanced wind analysis tools – to show for some locations (where we have data) what are the wind resources. We also have maps for marine energy, bioenergy, tidal currents, geothermal map (heat flow), we have regional and country level maps.

We recently launched a **new map gallery** – users can search for maps and tools – using an interface, searching according to your location and preferences.

Source: Dr. Jacinto Estima, IRENA, Presentation at OGC Energy & Utilities Summit, June 28, 2017

Our **BioEnergy simulator** relies on OGC standards. Given a feedstock, combined with an area, with a process (selection of crops, definition of use, technology) we can understand how much energy can be produced. This simulator is a complex example – the possible combinations are endless. The architecture involves a lot of processing services, map services, and feature services, for data display.



Source: Dr. Jacinto Estima, IRENA, Presentation at OGC Energy & Utilities Summit, June 28, 2017

We also have a **mobile application** to access the renewable resource maps.

Discussion:

Lionel Menard: I was part of the core developer of the project, under leadership of IRENA. I'd like to expand on it: Global Atlas has a relationship with GEOSS – using OGC standards. A lot of things developed here with the knowledge gained from GEOSS AIP. Thanks to OGC for enabling the pilots and helping along the way, many things were achieved. New applications can be built on top of the interoperable infrastructure.

Q. Do you use time tag specifications - ?

A. Not in WMS. We use WFS to provide temporal functions for data.

Global Atlas provides 20 years of time-series through WPS – implemented within web GIS client.

Q. Is the data presented in the application also available as coverage.

A. Yes, it is presented as WCS. You can access the GIS interface you can right click for download – if yes, it is using the WCS. If not, due to data sharing agreements.

Comment: Assuming that is for being able to use it for analysis, determine proximity to loads / viable resource integrations? A. Precisely/Exactly. Yes, if you can download it, you can use it in analysis.

Q. Data is provided by various countries?

A. Yes various countries and institutes provide data…, data/services hosted by IRENA. The focus is on mostly developing countries to help them make the transition. We also have North American data from NREL, and worldwide data sets which cover NA too.

Phylroy Lopez, Natural Resources Canada

This presentation focuses on **data driven building models** developed by CanmetENERGY – specifically the Commercial Buildings Archetype Project. Our group does research around the built environment, particularly housing and buildings. We look at innovative technologies and how they can be incorporated into them that reduces cost, maintenance and most importantly energy and GHG emissions.

What is the incremental cost to the designer/developer to make these more efficient buildings? With more stringent codes, can public bear the cost? What are the code changes that will get us there in the most cost-effective manner? How do we design our buildings to be more efficient? This research project creates a set of archetypes that are representative of new construction across Canada to perform detailed scenario analysis to help answer the questions above.

These **Building Energy Models** contain details of HVAC, lighting envelope, schedules and provide information on how these building consume energy. Because they are hourly simulations, these models show peak and annual energy consumption, and divided by end uses such as lighting, heat, electricity and gas. **This information helps designer develop better buildings, policy makers develop better energy codes and standards, and researchers test the impact of innovative technologies in the Canadian building marker.**

Archetype development – is time consuming, human error prone, inconsistent interpretation of data, not built for mass simulation. Developing a single model can cost thousands of dollars. Consultants and governments produce siloed models, with little reuse, and which is cost and time prohibitive. To reduce the effort and to be as accurate as possible, the project attempts to automate the development process, while taking advantage of modern compute capabilities**.**

There is very little information on commercial building stock in Canada, in particular new construction. For this reason, we are using the National Energy Code for Buildings (NECB) as our main data source. The NECB represents bare minimum for energy design and construction.

We have collaborated with National Renewable Energy Laboratory (NREL) to develop the Building Technology Assessment Platform (BTAP) To support commercial buildings with **open source technology.** This aligns with US Department of Energy (USDOE), NREL and NRCan efficiency goals.

The steps to develop: For every building type: we define a geometry, identify what spaces in the building are used for. The database then automatically defines, envelope attributes, HVAC/systems, and schedules using the NECB developed databases, creating a new representative baseline for currently 70 locations in Canada. This also deals with different fuel types, based on which Province you are.

Simulation runtimes are much faster than has been possible even 5 years ago. The thousands of models are run in a scalable cloud computing service like the Amazon Cloud. Thousands of simulations are completed in hours, not weeks or months using traditional methods.

Source code and simulation results are available on GitHub. The more frequent intervals required, the more data is produced. Github is the most appropriate place for the data currently, and can be pulled into other databases quite easily. However housing it in a responsive database like MongoDB would allow better interoperability with other organizations and client applications.

With respect to geospatial – we need to incorporate statistical data. We are focusing on building codes, but we **need more data to feed in** more accurately what is going on in the Country.

16 Archetypes created, more could be added. Leveraged NRCan's knowledge of NECB, simulation, and software development. Develop automated ECMs to apply to buildings. 200 ECMs developed through crowdsourcing, but costing these ECMs has not been conducted nor the application to the Canadian market.

Next steps, consulting with users, utilities, industry – what are the possible technologies, more vintage data of building stock, and refining for schools, small officers. We will create consistent data structure with minimum requirements to do soft modeling. With utilities and other partners, also using data sources Stats Can, IEE, CaGBC, as starting points. There is an interest in data soft modeling. We'd like to incorporate these data driven decisions into the NECB to drive energy code development.

What data we need: space load, occupancy, and vintage data: geometry, envelope information, past upgrades to the building, heating fuels/ dominant systems, how efficient is the equipment being used, what are the utility bills. Data collection will be a challenge. Cleaning and normalizing will be key. Lots of gaps would still exist nationally. We will find a way to fill the gaps.

People can test and post issues on the issue tracker on GitHub. We are looking to improve the quality of these models. https://github.com/NREL/openstudio-standards/tree/nrcan

An analysis was done in Ontario – specific neighborhoods needed targeted improvements – they were looking for what kind of upgrades where possible – using building archetypes and geographic information, socio-economic analysis, to determine neighborhoods most likely to take advantage of programs / for higher penetration rates.

Other NRCan tools are listed here: http://www.nrcan.gc.ca/energy/software-tools/7417

Discussion:

Q. What is the potential benefits to utilities, so that they provide data / get engaged?

A. Utilities are interested in determining impacts of their incentive programs. A lot of times they are not sure what to target, or what savings they can achieve, and what kind of incentives they could do to get over the barriers to technology adoption to reduce consumption or mitigate peaks. A more targeted model to show specific upgrades to buildings in a sub-hourly way is useful to utilities.

Comment: A previous OGC Testbed experimented with BIM and OGC Web Services interoperability to link building models with energy analysis – EnergyPlus was used. The use case was am architectural design study "how does a new window design affect energy consumption?" only one building. Results of the AECOO Testbed-1:
http://www.opengeospatial.org/projects/initiatives/aecoo-1

Comment: At the building level a lot of the integration needs to happen – a lot of this is pointing to the future for energy use data and exchange. …

Comment: If we want utilities to buy into it – we need to show them how it helps them stay in business, as well as provide safe, reliable, affordable energy. For them to be informed, we need to be able to send the results of this summit and interoperability efforts. How data can be brought together and how it can be used. It's an information piece. Utilities need internal interoperability, to improve regulation reporting by 2018 & beyond.

Comment: As we develop the Energy Data Roadmap further – this information has been useful – we can come back to the group in a few months' time. How can we build on protection and protocols. Anybody who feels they can contribute further to the project – contact Eddie Oldfield (QUEST) or Bruce Cameron.

Comment: By solving these needs with OGC standards, enables the consistent, repeatable, scalable reproduction in time/cost effective manner.

Comment: Many similarities between electric, gas/oil, underground utility networks. Need crosspollination between DWGs / SWGs, ensure coordinated standards development – use common scenarios.

Comment: Sensor integration – Future Cities Pilot / testbed – capitalize on knowledge and experience that exists, and demonstrate how that can work for utilities. See the YouTube video describing the Future Cities Pilot: https://www.youtube.com/watch?v=aSQFIPwf2oM

Comment: Perhaps we need a Discussion paper to inform utility space

Common: Common interoperability requirements across multiple value streams.

Eddie Oldfield, Spatial Quest

Due to constraints in time, the co-chair ceded his time for other presenters and for valuable discussion time. Key remarks he would have made are summarized here.

Many use cases identified throughout the day. Collectively, we have identified use cases corresponding to **advancing Smart Energy Communities and Utility Distribution Networks**. Rather than dive into use case scenarios, or sophisticated modeling, **I will touch on energy SDI architecture.** In addition to the OGC Reference Architecture, one can envision an energy SDI / OGC Standards-based architecture suitable to meet requirements in the energy & utilities domain, with cross-cutting functionality applicable to smart cities, smart pipes and wires, and smart buildings.

Considering privacy was one of the core issues identified – it will be important to document how privacy is protected at data source, as part of data/feature services, web services, and in the application tier, as part of scenarios requiring different levels of granularity in data. As well, it will be important to **consider possible architectures** – for enterprise wide (utility) applications, to a distributed architecture (where distributed data custodians erect WMS/preprocess data) supporting multiple applications, to a centralized services architecture, to a hybrid of public/private services compliant with OGC standards.

As an analogy/example:

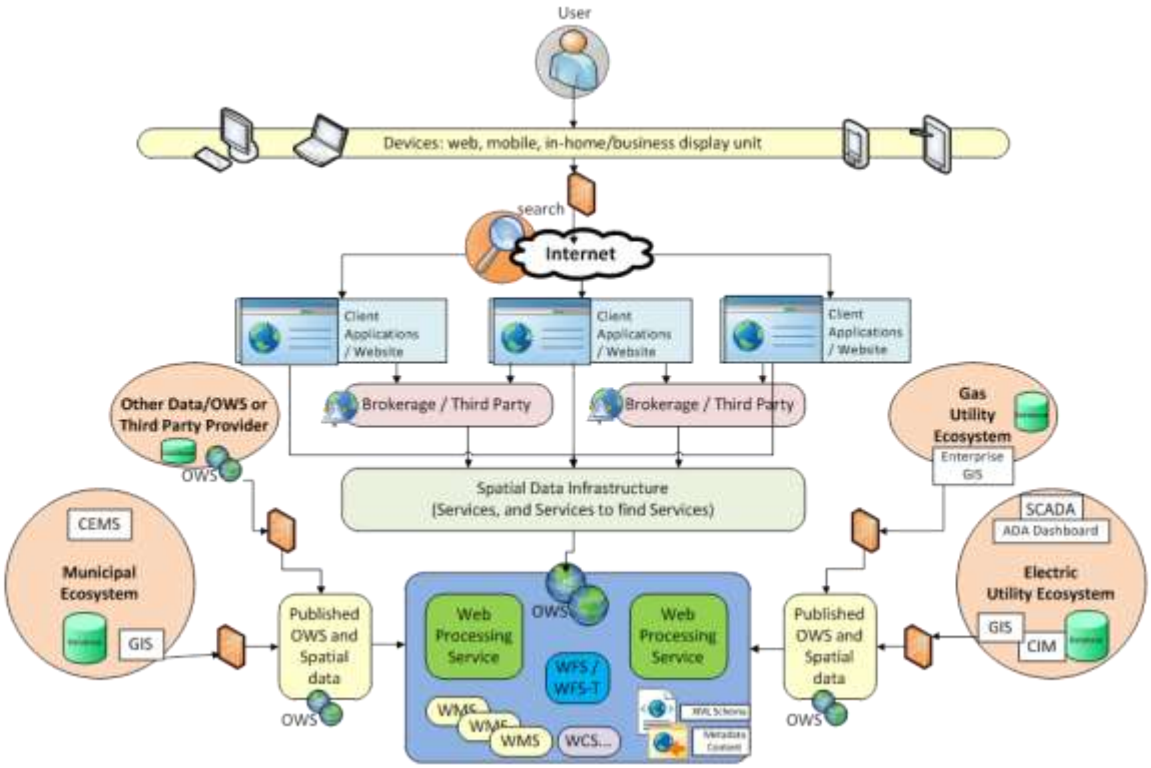
In 2007, I coordinated a pandemic simulation, with a similar set of challenges: protecting privacy of health data, while making useful information products for the health care sector, the emergency management / operations centre, and 3rd party consumers / public. It was accomplished by developing a 'Health SDI', which was supplemented by a Health XML Schema, Relational and Hierarchical Schema, implementations of OGC SLD, WMS, WFS, WPS, GML, and related services in the data tier and the application tier.

Data was integrated at a postal code level, normalized, aggregated / masked for low counts, and categorized into a risk index, using the combination of OGC WPS, WFS, WMS, SLD, etc. operating on distributed data (using the Health XML schema). This method allowed for accurate visualization of local patterns in data, while protecting privacy of individuals. The architecture ensured data stayed closest to source, and that multiple processes could be run on the fly / that multiple value streams could be supported (from epidemiology, to emergency response / common operating picture, to field personnel / triage, to public education).

While we solved part of the challenge – achieving interoperability and protecting privacy while making useful information products for multiple value streams; we have yet to solve the non-engineering aspects of market readiness and policy, to support wider adoption.

The energy sector is moving quicker / more proactively down the path of Big Data analytics, decision-support for Smart Cities/Smart Grid, enterprise-wide information architecture, and standardized approaches to data integration etc. An energy SDI will necessarily require various actors – from utilities and governments, to application developers – to refer to a common architecture and build services within that architecture.

Mapping of energy and emissions data for non-utility uses is still largely based on manual and GIS assisted methods, and is a time consuming and costly process, prone to data inconsistencies, where data is even made available. Informed by our more recent work in the energy domain with QUEST, below is an illustration of architecture at a high level – not proscriptive – that shows a user, through various applications, requesting services from an Energy SDI, with OGC Web services implemented internally/externally (as may be) across different 'ecosystems' – electricity, gas, government, ICT applications, etc. This architecture / Spatial Data Infrastructure would enable repeatable/scalable geospatial web services, to support multiple value streams.

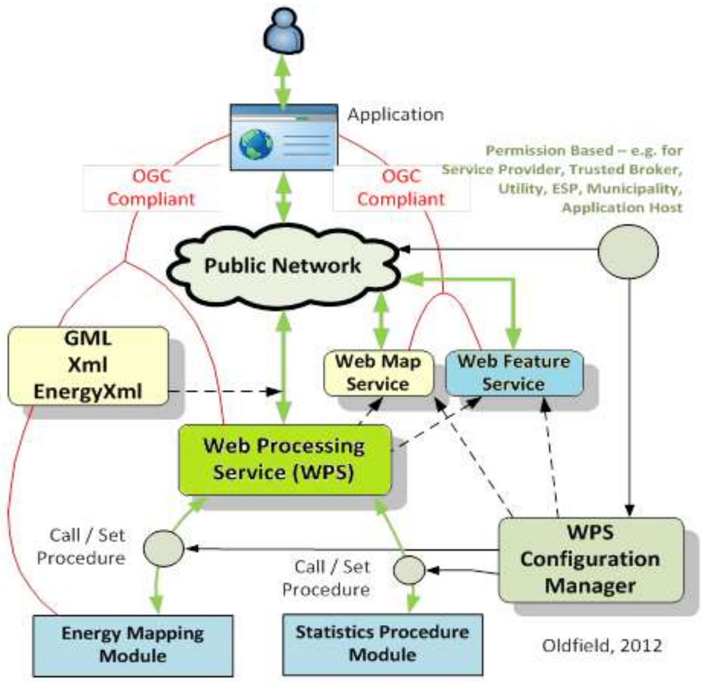


Source: Eddie Oldfield, Spatial Quest, Presentation at OGC Energy & Utilities Summit, June 28, 2017

OGC Web services may reside at data source, or externally (e.g. government/public body; at a service broker; or in a 3rd party application). End-use Applications may call those services directly, or as provided by a catalogue, discovery portal, or service broker. An Energy SDI is more likely a combination of these distributed web map and processing services, governed by a legal mandate/framework, Non-Disclosure Agreements, Service Level Agreements, License Agreements, etc.. In the end, you want an architecture that helps **minimize exposure to risk**, for the end user, service host, data provider/custodian, and data owner(s), **while providing the best value** / a value stream that benefits everyone that is part of it.

I recommend testing OGC Web Services for internal and external integrations of geospatial data in GIS, where the internal integrations support utility use cases as well as provide model data for future internal and external services / external integrations. To support a broader energy SDI architecture, I recommend development of an energy XML schema, a relational schema/semantic network, and hierarchical schema (hosted in WFS), as well as extension to WPS standard specific to geo-statistical queries within the scenarios requiring sophisticated calculation across several large data types/sets. I recommend integrating energy utility and demand profiles in various ways – including as map images (WMS) and 3D City Models (e.g. CityGML). This is only scratching the surface, but it gives us an idea of what needs to be thought out with respect to an energy-focused web services architecture.

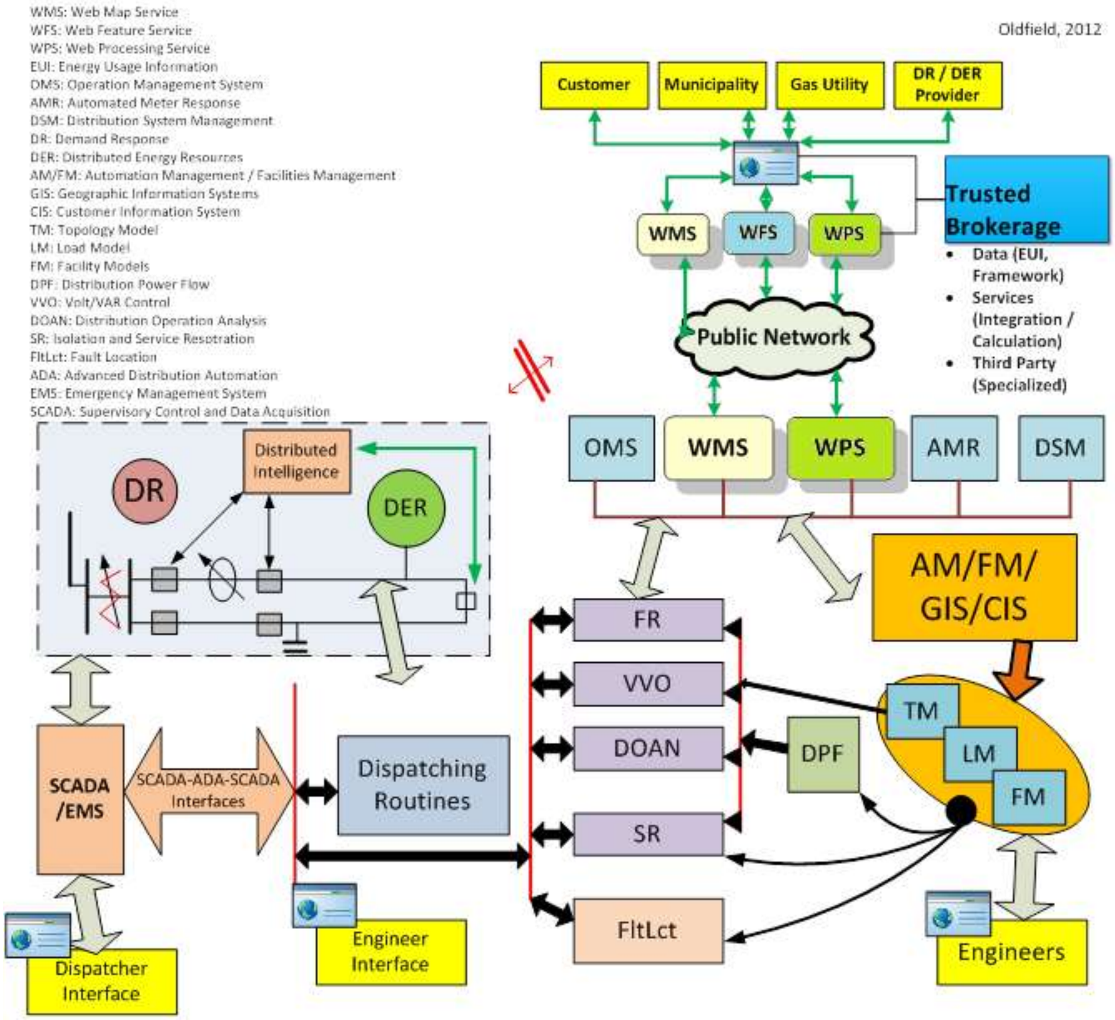
Consider, as illustrated below, a user may call several OGC web services (e.g. WMS, WFS, WPS) to produce an on-the-fly representation of energy demand and renewable resource potential at various scales. These types of requests, especially if the results are not pre-processed/cached, may require significant computing resources on distributed data. Thus, an Energy SDI would likely require significant computing resources to support multiple concurrent use cases.



Source: Eddie Oldfield, Spatial Quest, Presentation at OGC Energy & Utilities Summit, June 28, 2017

The architecture decisions that are made will affect downstream costs, data availability, privacy protection, value streams supported or not supported, and the burden on computing power / time for handling concurrent requests to multiple services at a time.

Below is a high level overview of the relationship (information flows and Hard Firewalls) from a Utility's Grid / DER (on the left); SCADA; Dispatching Routines/Applications; Various Management Systems; through to a utility's GIS, and External services (on the right). It is meant to show some of the areas where a utility may leverage web map services, to improve network models in GIS, and how it may consume or publish web map services to a public network (without interfering with internal systems/OT). It is a snapshot for provoking further thought.



Source: Eddie Oldfield, Spatial Quest, Presentation at OGC Energy & Utilities Summit, June 28, 2017

Following the presentations, Co-Chairs provided a brief recap of the day, and summarized action items.

End of Session

- 2:30 p.m. local time.

Key Drivers Identified:

- Energy Cost (reduction/management)
- Energy Demand and Peak Demand Reduction
- Climate Change and CO2 (reduction/management)
- Acceleration of clean energy tech deployment / cost reduction
- Infrastructure Renewal/Avoidance

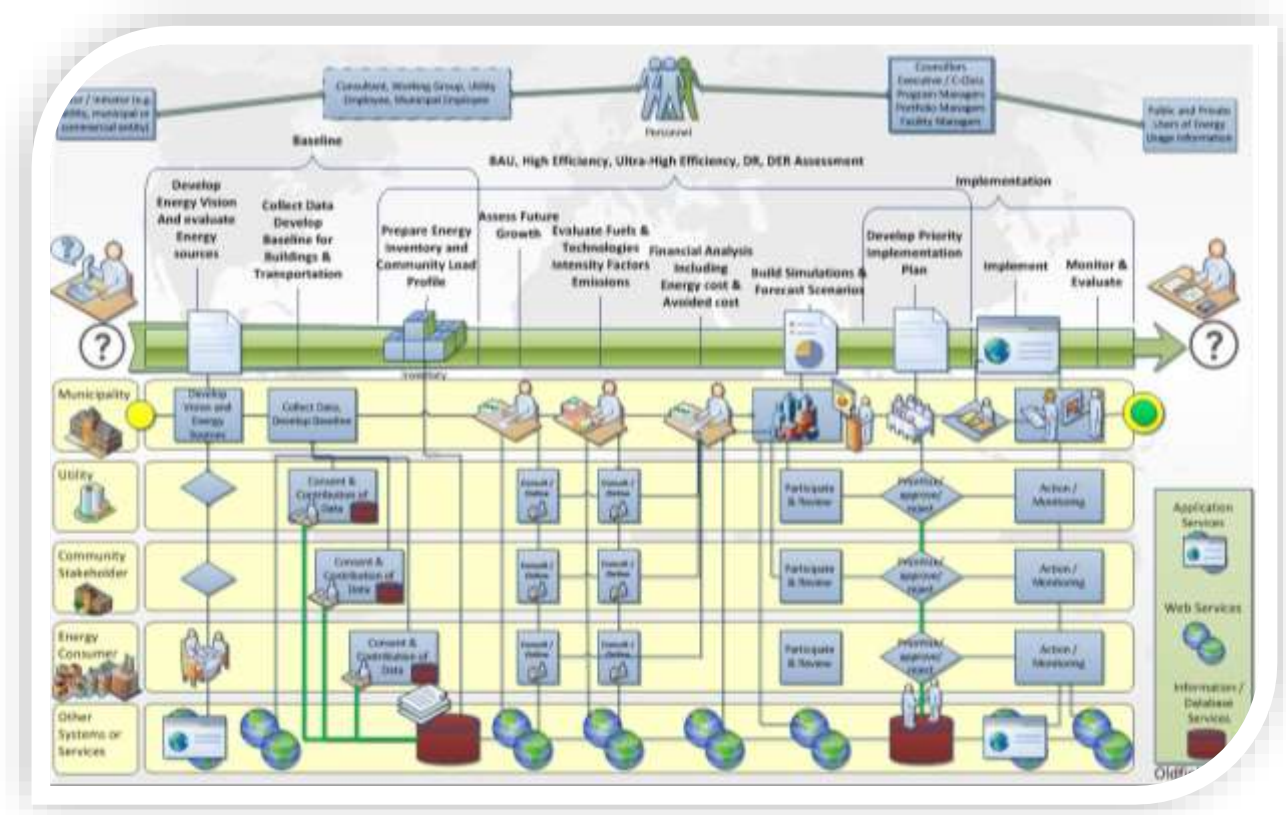
Needs for energy information, fell into three common buckets:

- To Inform Policy
- To improve Customer Choice
- For Utility Planning / Programs

Scenarios:

Participants agreed there is a need to demonstrate ROI for multiple value streams – e.g. through a coordinated effort to test/develop interoperable solutions and inform best practices or standards for energy use data exchange, integration, and visualization. Scenarios should focus on achieving key requirements / providing the greatest impact across value streams. **The following scenarios were identified throughout the day – some may overlap:**

- Suggested that it may build trust and prove business case/value proposition by approaching scenario interoperability testing in **2 phases. Phase 1** – Internal interop pilot to satisfy utilities and regulators. **Phase 2** – supporting external web map services / 3rd party applications.
- **Demonstrate WMS on Utility side, on Broker Side, on customer side – i.e. Internal and External integrations.**
- **Demonstrate methods for de-identification,** processing, normalization and aggregation of energy demand (across all fuel/building types) for geographic representation – to a scale or geography and privacy threshold that protects privacy / prevents re-identification. Provide users (utility and customers) a tool for measuring impact of investment decisions.
- **Integrate Building attribute and energy modeling data at parcel level** – combining various data/models/standards, to support multiple use cases from an individual building to wider area analysis [for energy efficiency, renewable resource integration, and to support functions in the Smart Grid and Smart City initiatives].
- **Community Energy Planning** – Calculate Baseline and Forecast Energy Use and GHG emissions, At neighborhood scale, for supporting a municipality or utility target investments in efficiency and clean energy integration.



Source: Eddie Oldfield, Spatial Quest, Presentation at OGC Energy & Utilities Summit, June 28, 2017

- **Improve accuracy of models** (backcast/historical and forecast scenarios), using OGC core standards (WMS, WFS, WPS, etc) and statistical methods, on distributed data sources/types
- Demonstrate how the CityGML or IndoorGML standards can handle necessary energy related attributes for building modelling, such as space type, mechanical systems, insulation levels etc.
- **Integrate Green Button (energy use data)** – To obtain authentication and do integrations of customer energy use data across fuel types / and at various scales. This data can be used to create more accurate models of consumption (even when aggregated) to help determine what efficiency improvements and DR/DER programs are suitable/available to a geographic location and energy consumption profile. To model what-if scenarios / impacts of technologies and policy decisions on the metered building stock. To determine impact of efficiency measures.
- **Power generation capacity/resources assessment** and pre-certification (demonstrated with with CityGML Energy ADE)
- **Renewable Resource Assessments** as WPS and WCS, to **integrate with demand profiles** for optimal siting / integration
- To improve CIM/DER (load balancing) – availability/quality checking DER for distribution level balancing and power quality. Several scenarios identified by EPRI. The question is how can **OGC standards improve interoperability of DERMS and GIS?**

- **Build high quality GIS model of network**, for Network Model Management – distribution topology for enterprise-wide/lifecycle applications; integration of DER; integration of IoT; for Asset Management Planning to automation/ADR.
- **Develop architecture vision to manage data enterprise wide** - EPRI is working to define architecture for Distribution grid model data management, in order to provide participating utilities with actionable strategies for improving GIS data and grid model data derived from it, and advance the data exchange standards.
- **Integration of all fuels data**, for improved supply management (and demand management)
- **Provide more data for Integrated Capacity Assessment** … to enable DER analysis / site selection
- **AR for Inspection, Surveying** – for Energy Infrastructure
- **Oil & Gas pipeline** – unique requirements (but some common data requirements with electric distribution networks)
- **Oil Spill Response** (already done)
- **Red Button** – for Emergency Management & Response (EPRI did this / in the US)
- **Probabilistic forecasting using WXXM and CIM** – weather data elements for probabilistic forecasting (outage preparation & response/recovery).
- **BIM – OGC** (testbed, already done see Results of the AECOO Testbed-1: http://www.opengeospatial.org/projects/initiatives/aecoo-1)
- **Define conceptual architecture of Energy SDI.**

  Editor's note: While scenarios may be specifically tailored to user needs in one area (e.g. determine solar rooftop feasibility for a home), the interoperability achieved for one use case may support multiple value streams / use cases – which need to be documented.

  An Energy SDI may facilitate integration of data on land use, building types, energy demand profiles (based on metered, modeled, or remote sensed data), renewable energy resource availability, capacity constraint assessments, etc, which can be leveraged to serve all three key needs (policy, customer choice, utility programs). Hence, Spatial Data Infrastructure's promise to the energy sector is to improve efficiencies through a "build once use many" philosophy. Much like we use all use the same infrastructure (roads) to get to many places, using many modes of transport.

  Over the next three months the OGC E&U DWG will work to refine the scenarios identified, aligning geospatial data requirements and interoperability standards to identify most suitable scenarios for interoperability pilots/demonstration with greatest potential impact. We need to focus on the interoperability requirements that satisfy the greatest need or broadest set of scenarios identified above, to maximize investment. We also seek to integrate knowledge from other DWGs/ SWGs/TestBeds.

Data Requirements (in use / relevant to scenarios identified):

Data types identified during the presentations and discussion, include:
(These can be matched to scenarios as they are refined)

- Utility assets, their connectivity, their uses (for utility focused cases)
- Energy use data (metered, modeled), at various scales / aggregations
- Buildings data / Typology (consistent building archetypes)
- Relational schema – e.g. linking building types, categories, attribute codes, customer classes
- Hierarchical schema – e.g. from building/parcel (meter), to neighborhood scales, to geopolitical boundary (e.g. municipalities), to distribution network topology.
- Energy resource data / Renewable energy resource intensity (several data types)
- Distance to grid
- Earth Observation data
- Stats/Demographic data
- Sensor data (IoT; SensorThings API)
- Land use/coverage/topography
- Parcel/area boundaries
- Population density
- Protected areas
- Indicators / Factors surrounding adoption of technologies – determined through analysis by area
  Others data related needs:
- Best practice NDAs and SLAs for geospatial data exchange and privacy protection
- QA/QC of data sources

Data Sources:

- Federal/Provincial/State Governments – Open Data / Geospatial Portals
- Utilities (public/Crowne, or private)
- Green Button
- Statistics Agencies
- Tax Authorities
- Building Owners
- Municipalities
- IoT / Sensors
- EO data providers
- Global Atlas (e.g. IRENA), Web Service providers, Brokerages, or Energy SDI

Standards identified (in use / relevant to scenarios identified):

Participants identified OGC WMS, WFS, WCS, SOS, WPS, CSW, SensorThings API, CityGML Utility ADE, as relevant to the scenarios identified. Each of these standards provides functional elements to support various use case scenarios.

In addition, participants identified IEC CIM/DERMS; other IEC standards, + Multispeak, and Green Button. It was recommended to advance geospatial standards and interoperability to support CIM/DERMS, Network Model Management and integrated Capacity Constraint analysis.

Participants expressed a need for standard / architecture for integrating underground utilities – e.g. using standards for landInfra / InfraML and/or proposed PipelineML.

While no specific gaps were identified in the existing standards, many scenarios identified at the Summit required integration of geospatial data using *new* combination of standards / data / methods.

Gaps: need to do better integration of energy data for demand profiles; noted challenges to that, include privacy, legal framework, exchange protocols, data standards / inconsistencies, risk perception, lack of understanding of ROI, utilities not fully leveraging standards – to consume or push out data.

It was agreed that interoperability pilots can provide valuable contribution to informing the sector. Interoperability pilots may help to identify/fill gaps, contribute to new standards or extensions to standards in a way to support energy sector requirements.

Issues identified include:

- Breadth of Audience – challenge to serve all needs. Must focus ROI / Value Proposition, in part, based on the audience. E.g Need to improve utility understanding of technology impact/ROI; or to inform policy makers, or to educate communities or building owners of efficiency potential.
- Diverse requirements / data standards, for different applications.
- Policy / legal framework must enable energy data collection, exchange, integration, visualization, in privacy compliant ways.
- Maintaining Privacy / identifying appropriate aggregation techniques and exchange protocols
- Multiple value streams may be supported by an asset, this can be difficult to divide the cost/benefit across program areas/departments/organizations.
- Utilities not fully leveraging GeoData / Interoperable WMS. Need to demonstrate value / solve pain-points.
- Need to leverage Open Standards (more) to enable utilities do 'Smart Grid' including DER/DR.
- Need to leverage Open Standards to create and maintain high quality network models
- Need to improve ability to integrate demand profiles with renewable resource assessments

Recommended Actions for the OGC Energy & Utilities DWG:

- Communicate outcomes of the Summit (this report)
- Develop Scenarios (prior to next TC), to inform interoperability pilots - This report lists key scenarios identified. The OGC E&U DWG participants should endeavor to refine the scenarios – and to facilitate interoperability projects, Scenarios may be refined by identifying Key Actors, Use Case Triggers/Conditions, Data Requirements, Model, Messages – for GIS; workflow iteration/procedures.
- Develop table aligning use cases, data requirements and relevant standards – then boil down / select a few scenarios that represent the best scope / solve the most important interoperability challenges with OGC standards

- Consider launching Call for Sponsors / Participants to support pilots – request to TC?
- Advance Interoperability Pilots, publish outcomes
- Engage PipelineML (John Tisdale), LandInfraML (Hans-Christoph), SmartCities DWG (John and Carsten) to cross-pollinate
- Engage members in regular sessions (a schedule is established and will be sent via list serve)
- Consider developing discussion Paper to inform utility sector, and/or regulators, government.
- Feed outcomes from the QUEST Energy Data Roadmap back to the OGC E&U DWG
- Define conceptual architecture of Energy SDI, define data preparation and privacy steps.

Attendance:

- Stan Tillman, Intergraph
- Gordon Plunkett, ESRI Canada
- David Katz, SGIP member
- Thierry Ranchin, Mines Paris-Tech
- Yanmei Wu, NRCan
- Mark Cumby, Hatch, Energy Sector Atlantic
- Maggie Smith, GeoScience Australia
- Vickie Gunderson, US Chamber of Commerce
- Jessica Webster, CanmetENERGY, Natural Resources Canada
- Phylroy Lopez, Natural Resources Canada
- Scott Simmons, OGC
- Trevor Taylor, OGC
- Glen, Trimble
- Michael Smith, Harris Corporation
- Vivian Sultan, University of California
- Perry Peterson, Pyxis
- Carsten Roensdorf, Ordnance Survey
- Paul Moris – Retired Energy Policy maker
- Brad Ashley – SilvaCom, Alberta
- Someone from Hitachi
- John Simmins, EPRI
- Samantha Peverill, QUEST NB
- Eddie Oldfield, QUEST/OGC