NextGrid: Utility of the Future Study
Working Group 1: New Technology and Grid Integration
Meeting No. 5
February 28, 2018
1:00 – 5:00 pm

Working Group Leader: Dr. Mohammad Shahidehpour

Part I: DER and Grid Integration Issues, Demand Response, Energy Efficiency

Presentation 1: Michael Abba, Director, Smart Grid Integration & System Improvement, Ameren

- A broad definition of DER is any generation, storage, otherwise load management.
- DER including wind, solar, fossil fueled, storage of all types, energy, demand response are not all created equally and need to be integrated effectively into the grid with a focus on safety and to do no harm to the grid.
- Integration vs. Interconnection
    - Integration = is the broader, deeper meaning of connecting DER to the grid.
    - Interconnection- how to safely interconnect onto the grid, do not harm to the existing grid and cause no reliability detriments operating in static and dynamic states.
- Other Considerations of DER:
    - How do you calculate or recover cost of interconnection?
- Moving forward what are we thinking about?
    - Speed and the number of integration requests has increased dramatically. About 1000 DERS are connected in IL, mostly small scale and that number is expected to increase.
    - Expectations of developers will continue to increase and we need to evolve to meet those expectations.
- Management of the grid is changing with DER
    - Currently, utilities are passively managing and interconnecting with low penetration now and simple controls. There is no visibility to what DER are doing, no communication or control. Operate under IEEE standards.
    - Going forward, management is evolving to active management of resources. For example, on SB2814- smart inverters are installed and compensation will be provided. There is visibly and control into DERs. Inverters and control mechanisms are getting stronger, but we do not know how fast it will change.
- Drivers for DER are not necessarily technical, market and policy drivers allow more active integration of the DER.

- DERs are a third-party resource, can we count on DERs to do what they are supposed to do when they say they will do it? If DER doesn't act appropriately how will it impact the overall system? Reliability is key.
- Another consideration- one whole level of integration when system operating as full grid. Next level is microgrids - piecing parts off operating independent of grid – more complex. Balance load and fault currents.
- Need to understand the size of these systems coming onto the system. Size matters. There are different levels of integration complexity the bigger or smaller it is.
- DER integration and management is still evolving.

Presentation 2: Russell Young, SVP, Operations, SoCore Energy

- SoCore operates all over country, owned by Edison International.
- An overview of the Slide reviews specific examples of how fast things are moving and changing in the electric industry.
    - South Carolina nuclear plant – project canceled last year after spending huge amount of money – 2000 mw plant.
        - From a Utility planning perspective with nuclear – shows how fast things can happen.
- Can see how fast solar is being adopted across the country
- Slide shows how much you can integrate
    - Denmark – have 3k per load. Produced more than 3k through wind in one day in 2015. To do that, they tie into hydropower in Norway.
    - IL is smart with smart inverter initiative.
- Grid Code Slide – Denmark back in 1990. Denmark was comprised of large generating sites. 3k mw. They changed by introducing wind. Denmark implemented distributed energy super-fast.
- By studying the Cal ISO duck curve – during day, load goes way down, then huge ramp.
    - The opportunity is can integrate a lot of renewables. We are talking about 100%, not 3%.
- 85kwh battery – Tesla. That is like 3 houses. A normal house uses 30kwh per day. Really amazing how that can change as well and is happening fast.
- Fast charge network in The Netherlands is a good example of an amazingly fast roll out in a few months.

Presentation 3: Michael Munson, Attorney and Energy Consultant, BOMA

- BOMA is a trade association that has represented interests of Chicago office building industry since 1902. 100 BOMAS internationally. Chicago is the oldest.
- Estimate that BOMA Chicago load is 5% of ComEd's load at peak.
- Billing energy market goals
    - BOMA Supports competitive market principles because real estate market is competitive in Chicago.

        - In essence in new energy market buildings are becoming more sophisticated – automated systems. By optimizing operation flexibility to the grid the buildings can become efficient assets.
- Some of guiding principles to address in NextGrid:
    - Open and transparent process
        - Look to competitive market for solutions
        - The question is: what is the problem, rather than what's the new shiny gadget.
            - All utility technology deployment should have cost benefit analysis of some sort for the benefit of consumers.
    - Cost benefit approach
        - New tech deployment - What is the baseline and what has already been deployed? What is on utility agenda? What is in the queue?
    - A Fascinating fact about Il is the success of the competitive market.
        - According to Phil O'Connor, competitive gas and electric has resulted in 41.3 billion in savings.
        - How can we capitalize on more competitive benefits for consumers and all stakeholders? Or are we going to re-monopolize some functions?
- Demand Response
    - The slide represents the supply curve effect. Supply quantity increases during high cost periods.
    - demand response is a shift. Demand Response benefits the whole market.
- Distributed Generation
    - May buildings downtown are ideal for solar because of new tech breakthroughs allowing for solar placement inside windows, glass, etc. -- shouldn't be narrowly defined and definition should include batteries.
    - Drivers and benefits
        - Lots of reasons customers want to install –one being lower carbon emissions.
    - Barriers
        - Ability to have information. For example, it would be easier if we had standardized process to interconnect distributed generation. It is a challenge to distinguish DR and EE. Demand is responding to market.

Presentation 4: Dr. Ralph Muehleisen, Principal Building Scientist and Buildings Program Lead, Argonne National Laboratory

- When thinking about EE, DR and Grid Integration Argonne questions how do we value? How do we integrate?
- A common tend is the blurring of EE and DR.
    - There is a lot of energy use from commercial and residential customers. Building engineers have incentives to make buildings more efficient. Cost of operations, real estate more valuable in short term for rental and longer-term life cycle cost.

EE is not cheap, whether new building and integrating it, or retrofitting of large building.
    - When we can integrate these buildings and components that provide EE, those grid services and value to grid operators is what is going to help pay for EE, whether building owners or energy service companies who are working in bulk, and aggregating benefits of DERs.
- Argonne EE technology is more efficient. For grid services, much of work has been understanding advanced building countries and how we can make them interactive. Adaptive scheduling to make use of thermal and electric storage in building. Do a load shift while maintaining comfort for occupant
- EV –to EVs and all services come through a building.
- When we look at Argonne for DR – smart buildings are a place for DR. But there is more to DR. If we look at DR and dispatchable DR – large or small scale, how can we provide services beside peak load shaving, like volt var control and frequency control?
- Large part is understanding markets
    - Markets are not necessarily designed to integrate DR, DERs, etc. Market may be designed. Even if not designed, how different groups bidding in can be thinking of DR as a value within their bids.
    - When it comes to wind and solar generation, how does that integrate along with DER and DR?
- Big role in smart grid, EV integration lab. Worldwide network – standards for EVs on the grid – charging, communication, and even the plug for EV.
    - Looking at stochastic modeling – wind and solar for short term – long term markets.
    - Start looking at microgrids and how they integrate into the grid as a DER
    - Future weather and climate change. How much more frequent are storms, how much more intense, most likely outages, and how will it impact generation and assets on the grid?
- Battery research - Lithium magnesium -- twice as dense in energy storage
    - How do we process and bring those into market?
    - Develop standards for testing
    - How do you recycle at end of life?
    - How do you integrate into the grid?
    - All of battery integration except for new high-power semi-conductors. But control and system level design of batteries is a big area
- For example:
    - You put storage with a wind turbine for small wind farm. If you start looking at stochastic modeling, you know it won't be generating. By collects statistics about variability helps us learn how to value a battery in a given location.
    - Adding a battery reduces net present value -- reduces by 13-14%. Lower overall cost.
- We need to think about our work and how it will help

Presentation 5: Dr. Thomas Brisbin, CEO, Willdan Group

- Willdan energy services portfolio
- Topics to review include: EE, DER integration, clean energy, smart cities, microgrids
    - EE is changing. It is more on demand reduction
        - Buying local capacity reduction. Providing EE in form of power purchase agreement. 18.5 mw to SDGE. This is a change
        - For example, worked on the Brooklyn Queens demand management area project. They Requested 50 mw reduction. Delivered 35 of 37 they got.
    - Distributed Generation- heavily involved in building generation facilities. Becoming more integrated when we have distributed energy. Helping load pocket.
        - Charging station deployment around the country
            - Electrification of transportation is the single most additive component. Spent many years reducing it.
        - IIT – integrating battery and solar.
    - Analytics – PECO, PGE. Using analytics. Foundational load forecasting analytics. How do we know what is going on all over? Will show us how. Next step is how DERs come in at nodal level.
    - Network – for 15 years we have been doing EE across network. No reason why we can't do it anywhere to reduce amount of demand. Now we can target it. Where we place DERs can be predicted and impact on grid can be predicted in real time.
    - Microgrids overview:
        - Want to increase resiliency and reliability
        - Economic value
        - IIT campus
        - MA Clean Energy Project – microgrid
            - Redo all microgrid applications – recently selected
- Regulators of CO2 in CA. microgrid there. Reduce carbon footprint. In Turkey, looking at this.
- Concluding statement – smart city vision. Big transformation in utilities. Customers are changing and so are utilities. Keep capabilities. Transportation side, big data side, and how to process this data.

Q&A Moderator: Steve Johanns, CEO, Veriown Energy

- Microgrid, future grid, NextGrid– we have been thinking about our future grid for some time. Is there something different now than in the past?
    - Technology keeps getting better, cost of technology, solar and batteries is getting lower. Customer expectations are changing– want faster response and more info, along with environmental considerations/where we get energy from and how we use it. Value in making changes and third parties/markets see value. Have capability due to technology to move there faster.
- Fill us in on innovation and tech – seeing any tipping points?

    - Major breakthroughs are on the horizon in energy storage, lithium ions for EVs- the density is going up, cost going down. Some major Science discoveries– new tools to fundamental scientists – change safety and reliability. University breakthroughs – use different chemistry.
    - Transactive energy –comes down to change of market and change of how utilities work – what their service role is. They become market operators – maintain viability.
    - Second new tech breakthrough is computation power, better understanding how to connect/ disconnect. Ongoing development of algorithms. How systems interact and react.
- From building perspective, we have cost effective energy and low-cost energy today. One question, renewables and DER, increase cost. From BOMA perspective, why is this important?
    - Cost of energy for buildings is one of largest expense of building. Taxes, energy, labor. Anything to reduce is beneficial.
- Positives and negatives – EVs on the grid.
    - From the customer side, hospitals and campuses want EV storage. Utilities want to know effect of it. Have ability to model it.
    - Advanced modeling technique – different markets where DERs are common. Have a couple different perspectives. How does the consumer gain access for EVs, what are leading indicators to be adopted, charging stations, clustering of EVs, neighbors doing it, etc. Forecasting penetration of those assets. What time they will draw power and how you control it. How to make more transaction. Tiers of service from utility? About how load shape impacts feeder or subsection of feeder. Upgrade transformer? How do you project forward? EVs will be biggest driver. As EE flattens load growth, EVs.
- Fast charging is the big problem on distribution grid. Charging EVs is hard enough. Becomes even harder to integrate.
- 85% charging done at home. Especially here in IL. Have negative prices every week. Tech to dispatch and re-dispatch. Seems like benefit to utility and grid.
- If there is tremendous new load of EV going on grid. Utilities must be banging on door to put solar panels up to offload the grid. Balance of huge loads from EV, how do we get more innovative on distributive load? Are you seeing that activity? Policies?
    - We are seeing this all-around the country. Look at PGE heat lamps identifying solar. What is so different about solar is that you can put in anywhere. Ikea in Schaumberg has mw on roof.
    - With wind, you have siting issues and looking for wind in transmission. Solar can put anywhere. Cost has come down – becoming cheapest source of energy
- Solar panel, battery, LED in box can do it for 200 dollars. That is what is a revolution. Cost driver at pico level. Idea of transactive energy. Lot of talk about battery chemistry, solar panels, but most transformative is transaction energy, big data, block chain, transactive things happening.

- See the markets and industry going to that level. How fast and what level, don't know. But future where customer, EV driver, solar owner, knows what markets there are for that tech, what cost and value is, and knows that at tip of fingers. We see a future where we have a device, know what can sell it for, buy it for, etc. That model has to take into account how to get energy to me.
- The revolution is in better control in the transactive energy part. Ability – two-way communication and systems to be controlled by the grid, or for loads and generators to exchange information for what load is going to be. Control issue. Information flow issue. This is the change, and important part of ICC's role in helping understand and facilitate. Needs to be fair for consumers, generators, and utilities. Role for utility in market forces to work with direct transactive energy in some form.
- Policy perspective, easy fix. Allow those to compete as same level as generation. Be compensated at right price for benefits they can provide their neighbors. A lot of efficiency in market and energy use instead of one-way electricity.
- Voltage control – volt var functionalities. Whole market for vars.

Audience

- ***What are Energy Solutions?***
  - We have discussed integration of DERs and microgrids, and how to provide utilities with visibility and control of resources to operate system more efficiently. The utility is responsible to run system in cost effective and secure way. Do you think that enforcing or regulating tech developers to provide tech with management system which provides utility with some visibility and access to those resources, will improve the way that utilities operate own system?
  - The more visibility we have, the more direction we can provide to the DER. Need ability to send signals and adjust as necessary.
  - Standards are necessary. From producer, they want to know standards so that they have same ability to compete and enter into market – can interact with the grid and my utility will acknowledge it. Develop smart standards. API interface, but also standard information. Role for regulators is to help decide which standards should be making use of. Standards take a long time because of consensus needed.
- Talked about transactional model for energy for DER. For net metering, the excess you don't use goes onto grid, it is used and then utility has process to compensate for use. Why is that not a method to value excess generation through DG?
  - There is an interesting case study where one neighbor has solar power, and the other is on the grid. This case study showed value exchange between the two. Solar had excess and getting benefit from person on the grid.
  - In simplest form, net metering is transactional model of some sort.. Next few steps of net metering is – working toward a more robust model.
  - Net metering as currently practiced – captures what you need. Captures what is leaving. How you are doing metering, per second basis? Time synchronization? Concept of net metering is sufficient, but implementation on many buildings is not necessarily at stage where it can meet all those services.

    - Net metering is one of barriers. Should they get energy price? Or utility? To extent you displace distribution, should be compensated. Rider 12 allows resellers to sell power and energy only within buildings. Beneficial to utility as well to allow consumers to control their own destiny and capture value they put on the grid.
    - Another question – Amazon paid 1 billion for company that makes doorbells and video cameras. Getting into the house – gateway to the home. Amazon and Ring. They have ideas about the next grid. What are your thoughts?
    - Value of transactive energy for buildings is there are all kinds of other services. Is the idea of utilities providing as a transaction unit, something to be considered?
    - Follow-up comment. Struggle with thinking about blockchain, market where 70% load is already transactive. Ability to purchase energy at hourly price, not sure which neighbor would buy from another neighbor at a price higher than market to where value of blockchain is providing value to customers. When you have market to transact in real time price and buy from 70 diff suppliers, missing the value on blockchain.
- When we put smart devices in, where do you see innovation happening?
    - Innovations are just price for us. Cost coming down so much that making, community solar in MN, but price is innovation driving adoption.
    - Variability in hourly pricing is significant in PJM. Energy isn't the only commodity or service that is transactive. Lots of markets – capacity, transmission services. It isn't going to necessarily be done by utilities but by third party providers that serve the utility. They know what to do with the data, but data should be sent to market so that other people can provide solutions instead of just monopoly.
    - Platforms for trading and changing neighbor to neighbor or neighbor to utility. If you have platform, call it Uber, how you transact on platform, depends on how liquid market can be.
        - Blockchain is very hot buzzword. But it is a way to record transaction and mechanism for settling. Not a mechanism for price discovery or who is making offers to whom.
        - To say that customers will not buy electricity from their neighbor at a price higher than market price is to assume we live in land of rational economist consumers.
        - Manage devices across network. Data collection aggregation. Dispatch of control effectively. One application, not multi- not perfect. Stacking of multiple applications – for home or building, not science fiction. Contracted to build home community. Homes operate as microgrid of homes that transact with each other and then transact onto grid. Enabling home owners to transact their air conditioning on wholesale market – how valuable is that? Time will tell. Claim a couple bucks a year. Ability of homeowners to make price decisions themselves. Those things exist. I agree with him. Market is deregulated to sufficient point where disruption is happening.

        - I encourage you to pay attention to the developing world, India, Nigeria, Ethiopia. These markets are large and have a transactive nature.
    - We know what to do with AMI data. Look at the Denmark slide. The average price of electricity in Denmark is a high cost of energy – 33 cents per kwh. Why integrate wind, when expensive? Now wind is cheaper. Basically, way we integrate is good transmission highs to Germany, Sweden, Norway. If you think in US – states are like countries. Can integrate a lot of renewables. Transmission access and sell to others, store in batteries.

Part II: DER Valuation Concept and Technology

Presentation 1: Dr. Richard Tabors, President, Tabors Caramanis Rudkevich

- Headed the Utility of the Future project at MIT. Looked at the Integration question and Valuation question for DERS.
- Valuation and technology
    - Clear that DERs have huge set of values—enviro, economic to owners, but when look at DERs they have ways of making money, whether consumer side, selling into wholesale market, or subsidies that are helping things along. Focus only on value DER brings to distribution system per se, and the grid. Distribution wires business – what DER can do.
    - Bottom line, positive or negative value of any assets we look at, to distribution network, is combo of three functions
        - What product or service is delivering or being consumed from network
        - Where product being delivered and consumed
        - When product being delivered and consumed
- After two and a half years of bright people and grad students at MIT working on future of grid project, at economic end, came down to those three things
    - What DER does, where it does it in sense of location of distribution system precisely, and when it does it – when delivers what products are. Three products that DER provides to the system as a whole – specific to distribution – real power, kwh, reactive power, and has ability to provide reserves. Basically, all DER technologies can provide these three services.
    - What are tradeoffs for being able to provide them. For most DERs, if you want to provide reactive power, you end up having to give up some real power one way. Can't produce 100% real and 100% reactive. Tradeoffs. Concept of reserves – if I want to sell reserves 3 hours from now. Can't sell energy contract that goes through same 3-hour period. Energy more valuable, or block, can't double sell. Becomes critical to think through what am I getting under these circumstances?
    - Where -- location of DER on the system
    - In one sense, anywhere is good – enviro benefits. Other hand, network perspective and kwh, go back to concept of constraint in the system, have to be able to have DER energy available downstream of that constraint. DER available upstream is no value if constraint on the system. Key parts to think about. Distribution system is inherently system than transmission systems. Distribution

system can calculate locational prices, but can also get locational value. Value is only there under circumstances that effectively DER is able to provide what is required, when, and where required. DER in constrained situation provides value only on downstream buses. Different from transmission.

- No inherent value in the grid when kwh or kilo-vars are provided to individual consumers or owners and sold to wholesale market. Value is in the sale. Not explicitly or implicitly to the network itself. Only value to grid is when there is a need for those services. From perspective of distribution wire company, what's valuable in this? There are times when constrains and kwhs provided by DERs, reduces cost behind constraint. Key to it is, only when there is constraint that the value exists to the distribution entity. Only when need in time and space and whatever product is that is has value to distribution utility itself. Doesn't mean no value in other ways. But specific value to distribution utility.

- From economic perspective, when done, how do you measure that value. Answer – where, what, when delivered – three valuation pieces. Basic mantra working on this topic.

Presentation 2: Curt Volkman, President, New Energy Advisors

- Discussion is about the necessary steps that need to be taken to fully realize value of DER, once DER value components are determined.
- Definition of DER is much broader than inverter based DER. Definition includes EE, Demand response, EVs, storage and would add -- combined heat and power (CHP) and bundles or portfolios of DER as microgrids.
- Solar – IN IL, under the Adjustable block program (ABP) solar installations is less than 2mw. The Proposed Block volume targets are 666 mw of new solar connected to distribution system in IL.
  - If the IPA plan is executed cleanly, go from few thousand, to 50-60 mw of distributed solar.
- An increase of solar as well as EE programs will result in stress on the interconnection process and will require new and a vast number of distribution connected resources.
- To determine the value of DER, grid services need to be defined.
- NY – utilities are compensating using their own marginal cost of service studies as basis for locational value component. There are many ways to value the locational benefit – tie to specific projects. Capacity, reliability, voltage, wide range of projects
- To give an example of how we think about DER proliferation in IL – a ComEd customer, can participate in Nest rush hour rewards. When there is system wide peak anticipated, if participate, goes up a few degrees next day. This is a Demand response mechanism to address systemwide capacity concern. Same tech could be applied. If live on a feed that is capacity constrained, could figure out how many in program, that load decrease could be applied at local level.
- What we need to do to deploy and take advantage of DER tech.
  - Changes to distribution planning

        - Forecasting and ID of grid needs and solutions is a closed process – utility planning engineers get that info.
        - Identify Third party needs
        - Need collaboration and coordinated planning of distribution planning functions and EE planning.
    - Key forecasting process challenges include:
        - Uncommon for DER to be included in load forecast.
        - Uncertainty about DER deployment not factored in.
        - ID systems ability today without upgrades – hosting capacity analysis.
        - Insight from hosting capacity should help develop interconnection
        - Locational value analysis should place DER where true value is delivered to system from deploying DER, location on the system should not just accommodate DER.
        - Explicit consideration of non-wires alternatives. Nest thermostat at local level, storage deployment to address capacity constraint. Third party owned and operated usually. Consideration of non-utility alternatives.
        - Need to develop ability to acquire these resources – pricing programs and procurements as ways to assets. Emerging capabilities that are important to develop as market matures and customers adopt these resources.

Presentation 3: Susan Satter, Public Utilities Counsel, Attorney General's Office, Illinois

- Discussion represents residential consumers perspective.
- When considering DERs, what is the value? What do people get out of a service or product or investment? Does it make sense to buy it?
    - Electricity is an input, we use it to do things, solar panels are not put on the roof as a decoration, they are used to charge our cell phones.
    - Look at differences from business approach to purchasing DER and residential consumer.
        - IIT – invested in a microgrid. Why did IIT adopt a microgrid? IIT was losing 500k annually from outages. Huge amount of money – unusual response. As a research institution and large university, they quantified the loss and looked-for solutions. IIT has the option to purchase power on the on a market, or we produce their own. IIT invested 14 million dollars in there campus to control their own destiny. The investment includes various generation, distribution upgrades, etc. 14 million dollars and simple payback in 5 years.
        - IIT used Cost benefit analysis to determine if they should invest in DERS.
        - Commercial enterprises also look carefully at cost benefit analysis to determine if investing in DER will save money.

        - For example, Walmart to reduce energy cost uses storage as a bridge for backup generation. If sufficient storage is available will bring in diesel generation and become their own microgrid.
        - User will value things – day to day experience, and dollars and cents.
    - Residential:
        - Large growth in residential and more distributed solar
        - As of 2016, ComEd identified 824 solar facilities. 9k kw of demand. Ameren identified 741 installations. And 5.9k kw of demand. Bottom line- not a lot
        - CA has the most solar and large sense of kwh charge. Blended charge – energy and delivery. 15.2 cents. Compared to IL 9.3 cents. Il is a low-cost energy state.
        - NJ has a lot of solar, MA, NY, these states have high price and relatively low solar resource.
        - IL solar resources varies a lot across the state. The southern part of IL has potential for more solar resources thus more solar production.
        - If customer usage does not match generation then you have to worry about what to do with excess, net metering, market, etc. complicated for consumer. While commercial side has ability to make these sophisticated economic decisions, it is complicated for consumers and policymakers need to be aware of the complexity.

Presentation 4: Kristin Munsch, Deputy Director, CUB

- Suggestions for NextGrid process:
    - There are multiple POVs and perspectives to consider when valuing DER – from who's perspective? Utilities? Customers, municipalities, group, commercial, individual? Values are not the same for everyone.
    - Policy objectives include lowering bills and managing energy. Customers want improved services, reliability and some environmental goals. Larger industrial customers have economic and workforce development goals. Also, environmental justice goals – how is this impacting different communities in different ways.
- Valuation framework for calculating value to the grid must have few key elements to all stakeholders
    - Frameworks should have simplicity, transparency, be comprehensive, captures values overtime, quality of information, asymmetry of information and framework needs to reflect policy objectives and values.
- Questions for future
    - What technology do we want to consider?
        - Need to narrow down down DER to grapple with some of these technologies in more fundamental way
    - What are deployment scenarios short and long term for them?
    - What info is necessary to assess how tech performs and how it is used in the field?

    - Distribution system planning – what info we need to capture to assess.
        - What info is necessary to facilitate a tech's adoption and who has information?
    - How does tech impact utility, individual customer, groups of customers?
    - How are impacts realized? Change to business model, etc.
    - What do those impacts mean for customers, utilities, and regulators?
        - If there's value, what is value, how is compensated, how is compensation recovered, when should it be recovered, etc.?
- Challenges
    - not all DER framework is the same. While we want a framework that has comprehensive elements – every perspective we take on it, not every DER will have same impact.

Presentation 5: Dr. Shay Bahramird, Director, Distribution System Planning, Smart Grid and Innovation, ComEd

- Discussion is about different types of DER provide different values and the utility distribution perspective. Conceptually how that value can be calculated and compensated.
- Standards – define DER as resources on grid. Type of resources they provide, inverter, synchro-generator. Definition is broader than that. Includes all of things DER
- DER has positive and negative value depending on type and where on grid. Benefit and positive value perspective – real and reactive power to areas where there is a forecast that demand is going to be more than existing capacity of network. If any reliability or voltage issue on system if type of DER is right and connected to right part of distribution system, there will be a positive value. The impact of negative value distributed energy resources depending on size, location, and type – need to be mitigated in order to impact any other customers within that distribution feeder.
- When talking about value of DER – positive and negative side need a framework that recognizes both sides.
    - Recognize that integration of DER into grid can benefit the distribution grid, consumer, transmission, wholesale, society, etc.
    - Policy conversations need to recognize and compensate those benefits. Mainly focusing on distribution system– determining DER rebate on FEJA – focusing on determining what services DERs can or should provide to distribution grid and determining those services and compensating accordingly.
    - In developing DER compensation framework – need to have in mind that we must ensure that customers interests are protected while also ensuring that owner of DERs receive fair compensation of value of asset. Valuation methodology must promote covered DER investment. Accurately reflects net grid value. Value of compensation methodology need a transparent market. Information readily available to participant to effectively help investors and customers to make smart choices
    - There are 5500 distribution feeders in ComEd. Value of DER varies between feeders and also where in feeder they are connected. Reason is that places we

need capacity to meet peak demand – capacity needed – goes back to– when and where and what – what type of DER can provide that. What type, what time, and where on feeder. Identifying from traditional grid investment – how much will take. How much it costs, how much is value. How we come up with projects in distribution system
    - Combination of solar and storage provides different value. DR and Solar. Each one of those – combo is value that has to be recognized accordingly and valued.
- Thinking and developing mechanism to compensate DER is a complex process and not all DER are able to provide real reactive power. Need Engineering analysis to establish a true value reflective of deferral of costs.
    - Focusing on distribution grid. Value of DER to grid only.
    - Location. Calculating value at nodal basis
    - Comparing DER from traditional investment.
    - Considering temporal effect
        - Time series analysis. Calculating hourly value.
    - Implementation of various levels of granularity. About aggregation. Need to be compensated for value they provide
- Extended to all DER – compensate real value to grid to avoid over and under compensation. Max savings for all customers.

Q&A Moderator: Dr. Mohammad Shahidehpour

- Do you agree that in order to help determine value of DER, that utility should be more open with planning process?
    - Yes. Guidelines can be found on the ICC website. Investments in grid are based on capacity relief or reliability, they are based on guidelines that are public. Any investment in grid goes into rate case. Ahead of time transparency, and after the fact, how each one of those projects worked. Stochastic modeling, heat maps are types of data and information historically we have not done for developers and residential customer but we are working on it and trying to help people think about where to put solar.
    - In NY, say here is where we need help on distribution grid. Let us help you fix those issues. Helps with where to put DER.
    - Historically we have asked others to help through distribution system planning. If cannot get project done by May 1, then ask for Demand Response and compensate people when they help.
    - Black box clarification. There are state mandated design standards for capacity and reliability, which is transparent. Less transparent is load forecasting assumptions that goes into project. DER growth and adoption in service territory. Directly impacts loads that impacts capital expenses. Project identification transparency. When get to rate case, it is too late. Contentious. Hard to have open dialogue and common understanding in rate case environment. Identification of grid needs should be agnostic. Leave it up to developers to decide the need. Identify nature of need and let developers and customers design solutions. Not utilities dictating only solutions.

    - From customer perspective, value of DER will change where and when. Customer perspective has to understand when making own calculation and make clear to them value may change.
    - How do we go from here is the value of time, place, how does that value then translate into a consumer incentive? Would there be a contract between utility and developer? Then sell to ultimate consumer? Want to hear mechanics.
    - Need a Probability requirement when setting up DER framework. There must be probability .8. Contract and agreement and penalty when you don't perform. From perspective of wholesale level, the economics take care of it. Retail and distribution, economics doesn't take care of it. Big issue between two systems.
- How does retail market for solar for IL programs take advantage of grid valuation?
    - There is more work to do on retail solar. Look at the Central Hudson Gas & Electric example – distribution grid needs. Identified a substation that would have capacity constraints down road. Cost of that. 5 million dollars. There is some value there. Translated to 5 million to a targeted deployment (know which customers connected) direct marketed to customers. Let me come into house, install two smart thermostats per month, 85 dollars paid. Let us put your temperature up one degree per day on peak days, etc. Determined a value that was appealing to customers based on avoided cost of capital investment. Communicated simple way. Local distribution value. Like the simplicity. How we get there with smart inverters and solar is unknown.
    - Utilize resources we have today. We have DR tech. Smart meters. In terms of where we are today versus future. Good example of using what we have to address the problems. In terms of drive toward solar, concerned it has nothing to do with utilities need and understanding of where the grid is constrained. Marketers are just selling, and not convinced.
    - The train has left the station on solar and other tech that is DER. Utility has been in taker mode and not in leader mode. One way is value constraint. Most of headache has to do with how much will I get, where will it come, etc. Negative nature on distribution utilities. Too much solar. California is not a case of encouraging more frequently. Not discouraging either. Recognizing fact that distribution system has to operate without having control of all the nobs. Shift from reactive to proactive opportunity to utilize in most cost-effective way.
- Utilities are moving toward transparency in providing the data solar developers want identifying constraints to the gird. How do we send appropriate price signals has been in discussion? Evident to participants in the market. Legislation is in place that has a vision of how we get there. Do we get there on day one? No. Locational value evident to retail customers based on where that system will be located on the grid and based on system conditions it attaches to at time it attaches to. We do need time to transition from where we are today, to one with more detail.
    - Load forecasting today – impacts of EE from legislation. Implications of DER. We are taking into account. What we don't do, from a load forecasting perspective, we do it in aggregate. Not at circuit level. When she is doing distribution, plan taking aggregated load forecasted. We are going to integrate solar into load

forecasting, but can't say what circuit will appear on it. Right now, uniform pricing.

- Sounded like panel reached consensus on agreement that there are appropriate price signals that measure how DERs can benefit the grid. Considering actual behavior, time, location, and delivering benefits being identified. How we get there is the question?
    - Need a Market that sends the right signals.
    - DER will reduce costs or could. From consumer point of view, can we expect that regulated price of electricity will also come down? One concern, is discussion about whether utilities have enough to invest in, enough return, etc. EE used to be a flow through, now subject of rate base and get a return. We want to see reduction in usage and expansion of DER. Utility will invest less, produce less profit for its parent, because the utility and its services will shrink and prices should follow. Express itself in some way to distribution level incentives or additional payments. If you do have this change, then the costs will follow.
    - Customer value in a lot of ways and will grow -- not shrink. Grid price, the panel was talking about, ought to send price signal.
    - If that is true, cost will go down?
    - How is value recognized by consumers. Separate question from contracting for other services. What does the world look like when we see impacts? Somewhat agree.
    - Effectively, customers at retail level pay a rate that is denominated into kwh. If you reduce kwh and don't reduce cost in terms of wires, or shift evaluation system, so valuing as customer something other than raw kwh, math doesn't work to say we will reduce the cost. Have to do something with rate structure to make all of this work so other attributes of the service are included in the value.
    - Agree as long as don't overcomplicate.
- Question that says we want to shrink the grid, might have arguable standing place in static position today. If you said 30 years from now, want no carbon in supply of electricity, want EVs, and BOMA will electrify buildings. How will you get power to Sears power and everything in loop without more wires? If you look longer term at the future, will we modify?
- Look at relationship between demand and investment. If transportation moves to the grid, then relationship between demand and investment should hold. If transportation moves in other direction, it is fair that costs will follow reduction in demand.
- Not really, we keep talking about marginal benefit and avoiding conversation of the cost of complexity. We keep forgetting the Average cost of complexity and marginal benefit. Talking about spectrum or framework, must consider marginal benefit not forgetting average complexity.
- Cost benefit analysis. Then look at that. Complexity should be considered in cost benefit analysis.
- How can NextGrid embrace and incorporate CUB's framework?
    - Having framework that sets up value of DER. Establish principles of how to have that conversation is important.

- Take questions and parcel them out to different working groups. Environmental, market, data, questions run through all. Let us all think through it and what it means for each point of view.