Distribution Market Model

Response to AEMC Approach Paper

Please find the following responses to questions posed in the approach paper.

Question 2 Response

While Transmission and Distribution has similarities there are key differences.

- There should be no expectations on the Distributor to manage energy balance across the networks from energy source to energy consumer.
- Along with energy balance the requirement of frequency support and balance go hand in hand with energy balance and therefore there should be no expectation that a distributor should be required to management Network frequency. However a distributor may be in a position to offer energy and frequency support services as a purchased service.
- Technology is available and should be deployed in all Distribution businesses to deploy Distribution Management Systems (DMS) down to the LV Network Level. This technology will facilitate the required tools to manage a complex distribution network with a range of DER resources including;
    - Volt/Var management
    - Load management
        - Automatic network reconfiguration at HV level
        - Energy support where distribution level batteries installed
        - Constraint advice to the market
        - Demand Management Requests to DM providers
        - Load Shedding
    - Investment will be required to build these facilities and the field located equipment particularly for Volt/Var management

In summary the expectation of Distribution business to deploy more complex systems than the DMS mentioned above and any expectation that they could easily be connected and coordinated with Transmission EMS systems in real time with the required protective measures to ensure network stability is beyond what can be achieved or what should be targeted at this time for implementation by Distribution businesses.

With the DMS system capability mentioned above, provided Distribution businesses can see in near real time the usage at the customer level and can manage localized constraints through Constraint Advise to the market (AEMO and Consumers) and their response is also in near real time then the distribution network risks to mass DER takeup will not be of issue.

It should be noted that for a Constraint mechanism to work there is a requirement for a standard (communication & data formats) to be developed in this regard to allow the Distributor to receive customer data and send constraints to the market. A rule change needs to occur to impose on consumers that a home entry device meeting this standard is required to be deployed for all installations where a PV + Battery install occurs.

Question 4

AEMO's responsibility to understand the status of Distribution Energy Resources at the low voltage network level needs to established in the rules. This requirement is fundamental in being able to effectively managing the requirements of energy security.

In summary with visibility of LV customer DER resources (PV, Battery and other), AEMO will be able to model

- Solar resource across the NEM and by integration of cloud cover models will be able to predict/forecast the Solar generation resource in the NEM
- Battery Stored Capacity at any time in the NEM. This will assist in understanding the NEM stability risk at any point in time and allow AEMO to call on stored battery energy in regions as required to support the Network stability and energy balance.
- The NEM over the long term, understand how DER deployment is occurring and playing out, better value centralized generation and therefore better plan the future requirements of the NEM.

Question 5

The response to question 2 above indicates that there is a natural delineation of monitoring and control required between distributors, Transmission and AEMO.

For a distributor to manage its network, tools in the way of a more capable DMS needs to be deployed. At the same time however a Distributor and AEMO need to understand and have visibility at the consumer level. Therefore a mechanism needs to be established to require better visibility of DER at the consumer level (PV, Batteries & other) to allow the Distributor or AEMO to send to the consumer, constraint/support requests to manage issues of Voltage, frequency and Load constraints.

In summary if the right mechanisms and standards are put in place quickly with communications established to a home entry device (Home Energy Management System) then AEMO, Transmission and Distribution can continue to operate effectively in a manner similar to present areas of control.

Question 6

It is important that the consumer and market promotes competition and development in a least cost manner. With increased price signals and headroom in capacity within the networks the majority of the time (99%+) the market will regulate and operate without the need for constraint or security management.

There is however the need for AEMO, Transmission and Distribution to be able to take control of and apply constraint/support management as required to maintain the safety, stability and security of the electricity system or parts thereof from time to time.

Question 7

The commission need to consider the supporting standards as a priority and to do this must establish a robust road map otherwise the early design and application of standards will fall behind and the ability to manage the network safety, stability and security will be lost without a large expense to rework systems and consumer equipment.

The commission also needs to seriously consider the requirements with the interface to the consumer residence. In my view there is a strong need to apply a requirement on consumers where PV, Batteries and smart appliances are installed that a Home Entry Device be deployed to allow effective management within the home and allow coordinated communication to the retailer and AEMO/Distributor. Communication standards can be applied to device to ensure interaction with all parties and DERs and appliances.

Question 8

In general I agree with the analysis provided.

Question 9

While the opportunities put forward are solutions and can be implemented the impact verses cost varies substantially and I view solutions that are standards based and can be added to existing hardware both in AEMO EMS, the Distribution DMS and Customer Interface is the best solution for safety and security of the electricity system.

It might appear extreme that I suggest a customer entry point via a Home entry device but if metering functionality is provided in this device, efficiency can be gained in in the communications interface and the processing capability that is already provided in smart meters. Therefore the impact of mandating a device as part of a PV + Battery installation will not be significant as a separate control device would have also been required for PV, Battery and appliances.

The communication interface to the meter data provider and retailer will still allow price market signals and my proposal does not push against the need for market competition and using pricing signals to manage load. This will actually ensure the energy flows through the network will remain within the networks capability for the majority of the time but in the end a mechanism for security, stability and safety needs to be implemented where AEMO, Transmission and Distribution know they have the capability of managing the rare instances where the market pricing cannot cater for extreme or unforeseen events.

Question 10

The Regulator should require all distributors to implement a sophisticated DMS system down to the LV level where Volt/Var algorithms and load constraint analysis can be run in real time to identify distribution network constrains apply network adjustments where available through control of distribution devices or if this is not sufficient send a constraint requirement to the Market.

The Regulator & Standards Australia need to set up Standards and make them mandatory for the movement of data and control across communication networks between Distributors, AEMO and Customers

AEMO needs to enhance its Systems to understand in near real time DER at the LV level in order to better plan the NEM, and manage stability and security.

The regulator needs to rule where consumers install Batteries that a home entry device meeting new data and control standards be installed.

In relation to grid technical issues these should remain the domain of the network owner to analyse and provide the lowest cost solutions. The Regulator needs to understand the need and risk and fund network providers accordingly when issues are identified and funding requested. Risk should be shifted to the Regulator if funding is not provided to an appropriate level to manage the technical issue in an appropriate time frame.

Closing Remark and Solution Attachment

I would like to emphasise that I consider that market forces alone will not manage the increased complexity of DERs connected to the grid and with the emergence of smart appliances the ability to coordinate at a household level will become quite complex without a single view at the household level.

It is people's nature that consumers will want systems to set and forget and comfort will override price in extreme conditions.

This leads to the requirement that AEMO, Transmission and Distribution require a mechanism to manage constraints, security and stability. Device level independent control at the network level will not provide this and consumers will demand more than this agricultural methodology. However Systems based enhancements with robust standards and regulation down to a Home Entry Device can provide the management of constraints, security and stability.

Attached also is a presentation in regards to this approach.

Managing
Distributed Energy Resources
- A Team Solution -

8th Jan 2017

Managing a Distribution Network in an era of Customer Distributed Energy Resources

- All players in the Electrical Energy Sector face a range of challenges as the uptake of Prosumer based Distributed Energy Resources occur.

- For interoperability and two way energy flow to occur freely across a large prosumer base, the Distribution Networks need to ensure that energy flows occurring within the network are within the limits of the network design and code requirements.

- As a society we also demand that Network Distributors manage costs and not invest in large capital programs based on short term or irregular peak demands.

- The following slides present a simple method of achieving these goals through the adaption of new technologies in the Distribution Utility and in the home.

- Note, this proposal is a direct action proposal, Distributor to Home. There are other opportunities that are tariff based that may also be feasible

The Challenge

- It must be understood that for any model to work the first step is for every utility to be able to understand the network constraints in real time.
  - All utilities are at different phases of implementing SCADA/DMS systems
  - There are many SCADA/DMS products and offerings that are utilised across utilities
  - The range of real-time data from the field varies enormously across utilities
    - Smart Meters, Substation monitoring, Feeder devices, Voltage control etc.
  - Regulation and capability varies vastly across utilities

- The second challenge is for energy prosumers to be able to react to these constraints in real time.
  - Households are only beginning to understand the energy revolution journey
  - The systems to integrate and manage household energy is still developing
  - The availability and range of products in this market will be huge
  - Will prosumers pick the right product?
  - Retrofitting houses with a home management system will provide challenges

- With the challenges on both sides will the two ever meet to create a truly integrated energy delivery system?

How can a truly integrated energy delivery system emerge

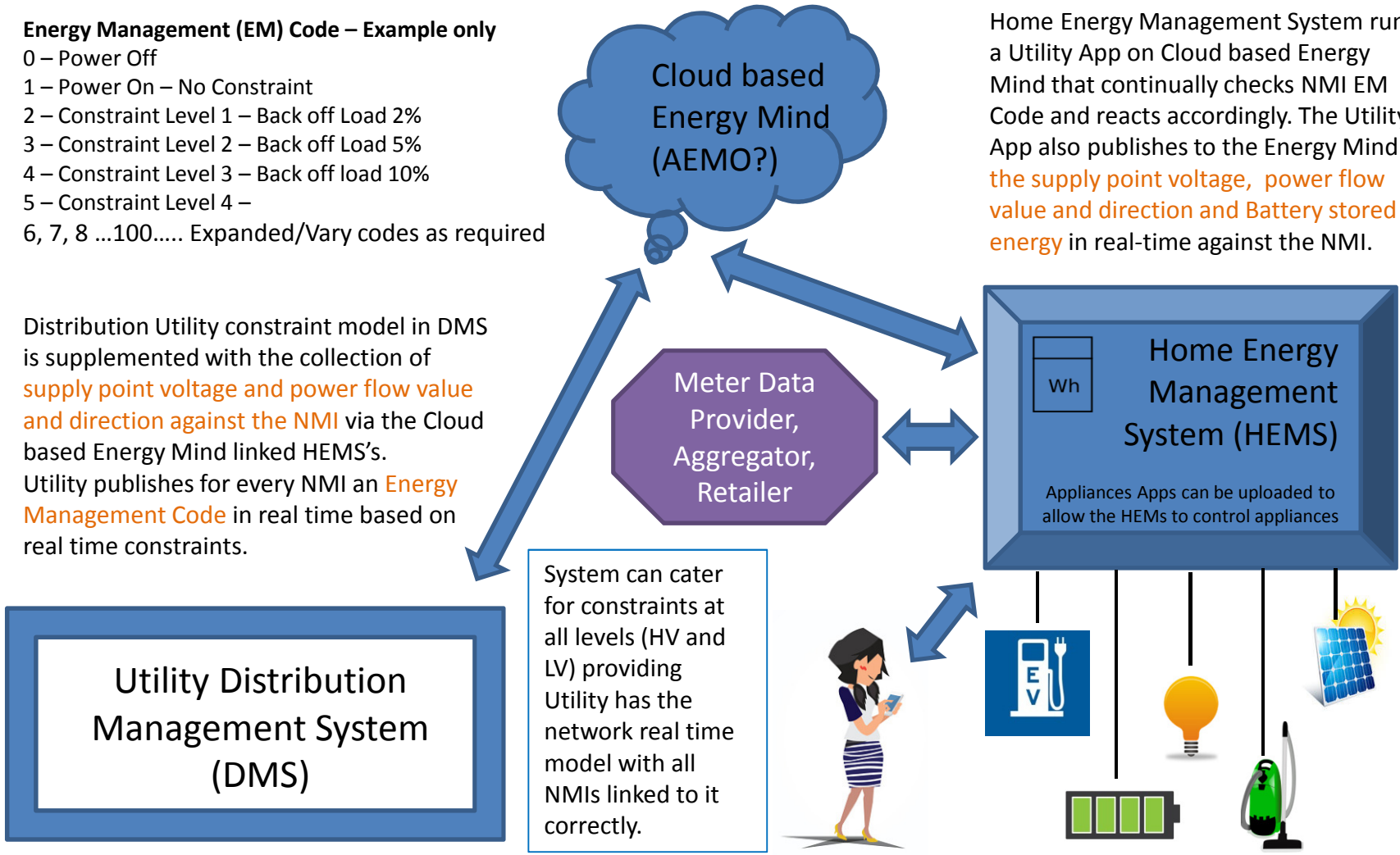
For this or any model to work it is required that

- Utilities becoming smarter
  - Utilities need to adopt enhanced DMS systems that provide real time visibility down to the LV network level
  - That utilities have a view of household use in real time
  - That utilities understand network constraints down to the LV network level in real time.
  - That constrain signals be made available to the home in real time.
- Households embrace a home energy management system that will
  - Manage the energy generation, storage and usage needs of the home
  - Be able to react to utility network constraints
  - Provide a least cost energy solution for the household
  - Be able to down load and assimilate new appliance Apps
  - Be connected to the internet for pricing and constrain signals
- A data exchange interoperability mechanism is established.
  - A vendor/utility independent mind that connects utilities and HEMs

How might Society Manage Distributed Energy Resources and Associated Load Constraints in the Future

Energy Management (EM) Code – Example only
0 – Power Off
1 – Power On – No Constraint
2 – Constraint Level 1 – Back off Load 2%
3 – Constraint Level 2 – Back off Load 5%
4 – Constraint Level 3 – Back off load 10%
5 – Constraint Level 4 –
6, 7, 8 …100….. Expanded/Vary codes as required

Distribution Utility constraint model in DMS is supplemented with the collection of supply point voltage and power flow value and direction against the NMI via the Cloud based Energy Mind linked HEMS's.
Utility publishes for every NMI an Energy Management Code in real time based on real time constraints.



System can cater for constraints at all levels (HV and LV) providing Utility has the network real time model with all NMIs linked to it correctly.

Home Energy Management System runs a Utility App on Cloud based Energy Mind that continually checks NMI EM Code and reacts accordingly. The Utility App also publishes to the Energy Mind the supply point voltage, power flow value and direction and Battery stored energy in real-time against the NMI.

8/01/2017

Discussion

The solution purpose is to create an environment in which utilities and households can co exist by creating a flexible and dynamic network.

The solution needs to be

- Least cost
  - Assumes Utility has DMS with Constrains Model in real-time
  - Assumes residence has a Home Energy Management System connected to the Internet.
  - Assumes that the HEMS can act as the supply point metering infrastructure to reduce duplication of equipment.
- Flexible & Dynamic
  - Needs to work in real-time which is achievable using the cloud as a data exchange tool.
  - It is anticipated that for 99+% of the time no constraints are likely to be deployed by Distribution Utility due to the largely robust nature and excess capacity within the distribution networks.
- Endorsed by Governments & Regulation
  - Simple requirement that Utilities deploy a DMS system to LV level with Constraints Model – Regulator ensures funding to deploy (most utilities have a DMS so this will be an enhancement).
  - Requirement that a Residence with PV, Battery or EV deploy a Home Energy Management System with Internet connectivity that runs an application that responds to network constraints (Government support through subsidy for HEMS's).
  - the standard for HEMS requires the response to Constraint Codes and publishes data to be defined
  - Regulation allows HEMS's to include the supply point metering infrastructure provided the supply point metering capability meets the metering code. This will ensure there is reduced duplication with the HEMS located in the meter board reducing install costs.

Energy Mind

- There is an opportunity that AEMO could be the owner and manager of the 'Energy Mind'.
  - This would provide consumer protection against privacy concerns
  - Provide the security demanded by Distributors, Retailers and home owners
  - Provide AEMO and Distributors a method of load shedding control at more discreet level than total blackouts – retain priority load segments – that is Traffic lights, transport, life support customers etc.

- The ability for AEMO to also understand and model the stored energy capacity in the Australian Network in real time would also provide a forward indication of energy capacity and management requirements and also enhance generator bidding modelling as disruptive technologies are network connected.

- If AEMO do not wish to be involved then individual DNSPs can still interface with the HEMS to provide the constraint management required at the Distribution level.

HEMS Requirements

- The HEMS should be an integrated product that manages the following
  - Provide Residential Customer Metering to Class 2 for remote down loading including a buffer of energy data.
  - Energy generation, storage and usage needs of the home at the lowest price
  - Battery App uploaded to allow battery management
  - Inverter App uploaded to allow PV Inverter Management
  - Provide Control over network Distributor Energy Flows, Voltage and Power Factor.
  - Provide data to 'Energy Mind' & Accept Energy Management codes from 'Energy Mind' and act appropriately
  - Provide remote household control to Customer
  - Provide a communications interfaces with
    - Meter Data provider
    - Customer
    - 'Energy Mind'
    - In house Appliances (via Apps that are in supplied with Appliance and uploaded)
    - data to be encrypted and secure as appropriate to the connection
  - Set up interfaces using Apps type methodology for all connections and appliances