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COORDINATED CONTROL AND MANAGEMENT OF AGGREGATED DISTRIBUTED ENERGY RESOURCES FOR ENHANCED BUSINESS CASE VIABILITY

ABSTRACT

Distributed Energy Resources asset aligned to developments in real time asset Monitoring and Management solutions are opening up a new perspective on how future generation, distribution and supply businesses can be more effectively and economically coordinated.

INTRODUCTION

Recently, innovative technology development and more ambitious integration strategies have opened up the possibility of greater value from Distributed Energy Resources (DER) integrated within the power distribution system. The introduction and acceptance of three fundamental energy delivery components to the DER management paradigm accelerates these potential values. These fundamental components are (1) Integrated Demand Side Management programs (IDSM) as load resources with quantifiable reliability impact and economic value (2) responsive technology platforms that allow for the constant monitoring and assessment of DER impact upon the distribution grid including efficient balancing of the load and demand profiles (3) the capability to aggregate and activate coordinated DER assets for presentation and utilisation as single generation alternatives. Together, these innovations have substantially widened the possibilities associated with DER and enhanced the ROI available from its adoption.

1 DISTRIBUTED ENERGY RESOURCES - A NEW PERSPECTIVE

Technologies to coordinate diverse DER assets (including both supply and load resources) across a wide distribution area, allow for more effective management systems and a greater number of value-based outcomes. Not long ago, DER integration was employed for buffering the grid against the transient effects of distributed generation. The potential today for DER integration is to deliver "whole system" benefits and become the foundation for active management of distribution grids. In effect delivering operational and market efficiencies throughout the power generation, distribution and supply value chain.
In 2002, for example, CIGRE introduced a strategic objective that involved focusing internal activity on the "electrical system" as a whole, with a special emphasis on interconnected components. Among the components specified for attention were distributed energy resources, due in some measure to the growth of distributed generation across distribution grids. Beyond this however, environmental and political pressures were calling for changes to the structure and operations of transmission and distribution. This has now resulted in demand management technologies, renewable energy resources and energy storage functions becoming key drivers of the requirement for a more organic energy delivery system.

2 DIVERSITY OF DER ASSETS IS A KEY ENABLER

The potential for an enhanced business case relates to the ability to more tightly manage and coordinate a broad range of DER assets, to support the needs of the distribution network in real time. Widespread and diverse asset deployments call for effective methodologies that address technical, operational and commercial constraints. Such applications must allow distribution companies to integrate, operate and actively manage DER within a network of their responsibility. For example, opportunities that are driven by capacity, geographic location and ancillary service markets have the potential to be addressed more effectively, because diverse assets deliver diverse capabilities to the system – these capabilities can be optimized therefore when they are managed by an intelligent system and thereby coordinated to meet the requirements of that particular system. By the same token, undesirable impacts of DER activation are mitigated through the same system intelligence.

Treating integrated DER as a key component of an overall energy supply reintegration will also support objectives related to improvements in efficiency and reliability. Reintegration can drive the convergence of operational guidelines for the dispatch of demand management technologies, integrated renewables, distributed generation and energy storage. These assets can be dispatched individually or in a collaborative approach to extend their value to the overall system. Of equal importance are changes to distribution loading orders that are rapidly evolving to emphasize efficiency, load management and the use of renewables for base loading. Technical and operational coordination into a unified system helps to support these loading orders by using complementary DER components within the same system to secure efficient and economic delivery.

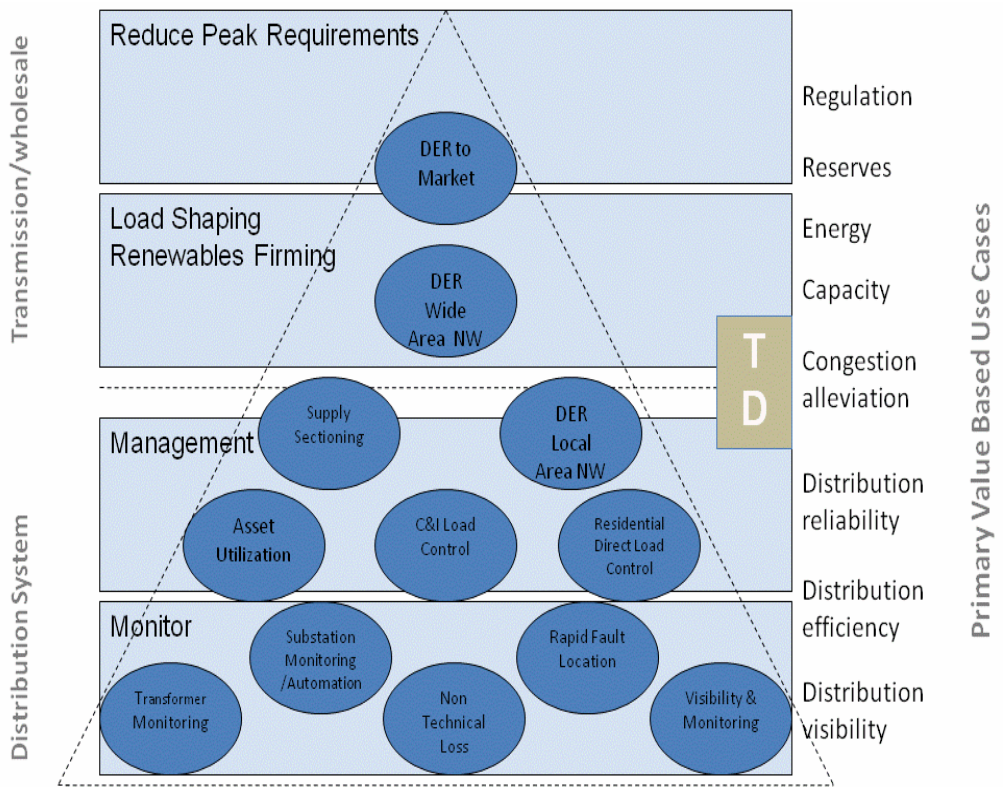

Figure 1: Technical, Operational and Economic Coordination into a Unified System

3 THE IMPACT OF DER UPON SYSTEM ECONOMICS

Coordination of diverse DER assets has the ability to improve overall system capitalization requirements, driving down the per kilowatt cost of capacity deployments. For example, battery storage creates tremendous value in terms of firming delivery of renewables to the market and delivering capacity at the time of greatest market need and therefore highest cost. To date, battery technology has been prohibitively expensive for widespread deployment. It is possible however, to unlock the potential of battery storage by deploying it within a broader DER system. Under this scenario, an enhanced business case, wherein more costly DER components (such as battery storage) are incorporated with lower cost DER (such as DR) into a controllable unified DER system can drive richer benefits.

By combining multiple DER assets into a unified system, the business case underpinning a range of applications, (which in isolation may often be seen as uneconomic), can become viable.

These include:

- Load management for peak load reduction
- Congestion alleviation during peak traffic periods
- Renewables status, diagnostics and performance visibility of the asset

Improvements in the capability of grid integrated devices and sensors to monitor local grid conditions are beginning to allow the network operator to assess and quantify the need for available DER assets in real time. The quality of the operator's assessment and decision methodology regarding the application of the DER assets can also be significantly improved. Utilization of responsive technology platforms to assess distribution network conditions and then "schedule" DER assets according to the particular objectives of the operator, further enhances the business case. For example, with the addition of a responsive technology platform that can coordinate sensory data into a comprehensive system perspective, additional use cases in support of operational efficiency in local distribution can be realised.

These include:

- Load management for enhanced asset utilization
- Congestion alleviation via load balancing peak traffic periods
- Renewables firming and integration
- Frequency control
- Voltage stability
- Reactive power and voltage control
- Transient monitoring and ride through capability

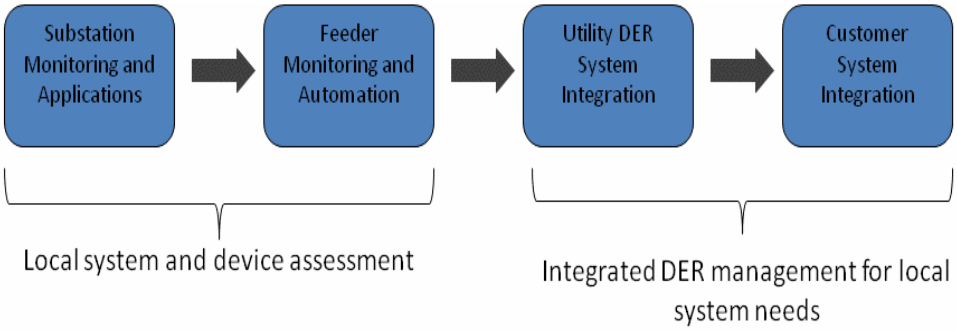

Figure 2: Integrated DER in Support of Local System Network Requirements

4 DER MARKET DYNAMIC

A key component of the evolving Smart Grid paradigm is the involvement of controllable loads and distributed resources that allow active management of distribution operations. Coordination of these integrated assets can also lead to increased value through higher capacity utilization. Large scale networking and aggregation can also make integrated DER appear as sizable, central generation facilities to system operators.

This visualization, supported by granular management and control of underlying assets, allows integrated DER to present improvements in capacity, energy availability and services to the wholesale market. When these distributed resources are not required to meet local needs and are in "standby" mode, the door is opened for these combined DER assets to be leveraged into various market opportunities. Response to market signals and utilization of DER on a potentially level playing field with centralized generation assets, can provide a lucrative revenue stream for the utility (or other asset owner) to support the business case for DER deployment. Thus, coordination of assets and capabilities means that the unified DER system can act in a distributed fashion to meet the needs of the local distribution system or appear as centralized generation to meet the needs of the transmission system.

The ability to mediate between these two primary uses in near real time significantly enhances the business case for DER. In fact, there are many use case scenarios wherein both the local distribution system and the transmission/wholesale system benefit from the same control or activation scenario. This technology thereby allows distribution companies to act at the same time in both the demand and generation dynamic, essentially reintegrating the supply chain based on a much more efficient level of asset and investment utilization.

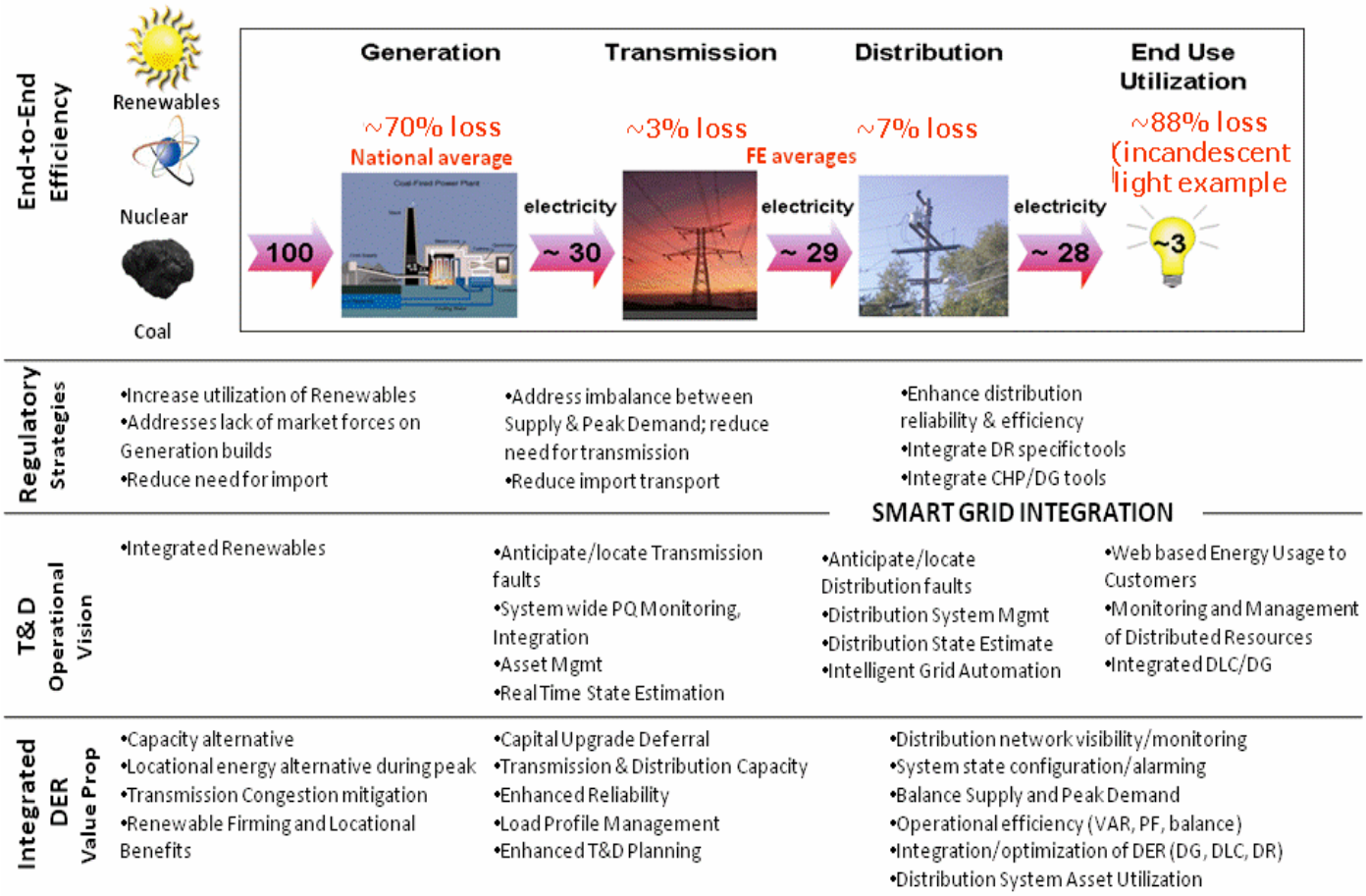

Figure 3: Overall Energy Delivery Enhancements from Integrated DER

5 IMPACT OF DER ON THE REGULATORY PERSPECTIVE

To date Regulation of the Power delivery sector has been driven by static and isolated perspectives from generation, distribution and supply. The limited capability of the network and related management systems results in these inter related segments of the value chain, being operated as separate assets often with conflicting objectives.

The arrival of DER solutions and the far reaching operational and economic benefits that can result, is now pointing to the need for an adjustment in the present approach. If the possibilities of DER are to be fully realized, the relationship between network operation and integration of diverse assets and resources must become symbiotic. The drivers behind network operation and the generation market must be closely aligned if we are to incentivise the most efficient and effective system wide solutions. The new horizon of DER can offer the real time integration and operation of new assets and capabilities upon which this new approach to the market as a whole can be based.

CONCLUSION

Enhancement of use case scenarios and the application of integrated DER to therefore meet future service requirements of the grid can lead to an enhanced and more flexible ROI across the power delivery value chain. Moreover, in a “reintegration” scenario, services can be made available to meet a wider range of needs on a more frequent basis, and the investment in integrated DER is further enhanced and justified. Over time, this will lead to a smarter approach to dealing with the growing number of constraints that challenge efficiency, economy and reliability in energy delivery.