

CLEEN

Cluster for Energy and Environment



sgem

Smart Grids and Energy Markets

Demand Response, a Holistic Approach

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Demand Response, a holistic approach

- Today we will
 - Define Demand Response (DR)
 - Look at the drivers and opportunities
 - Discuss research on enabling Demand Response
 - Look at the state of DR validation within SGEM

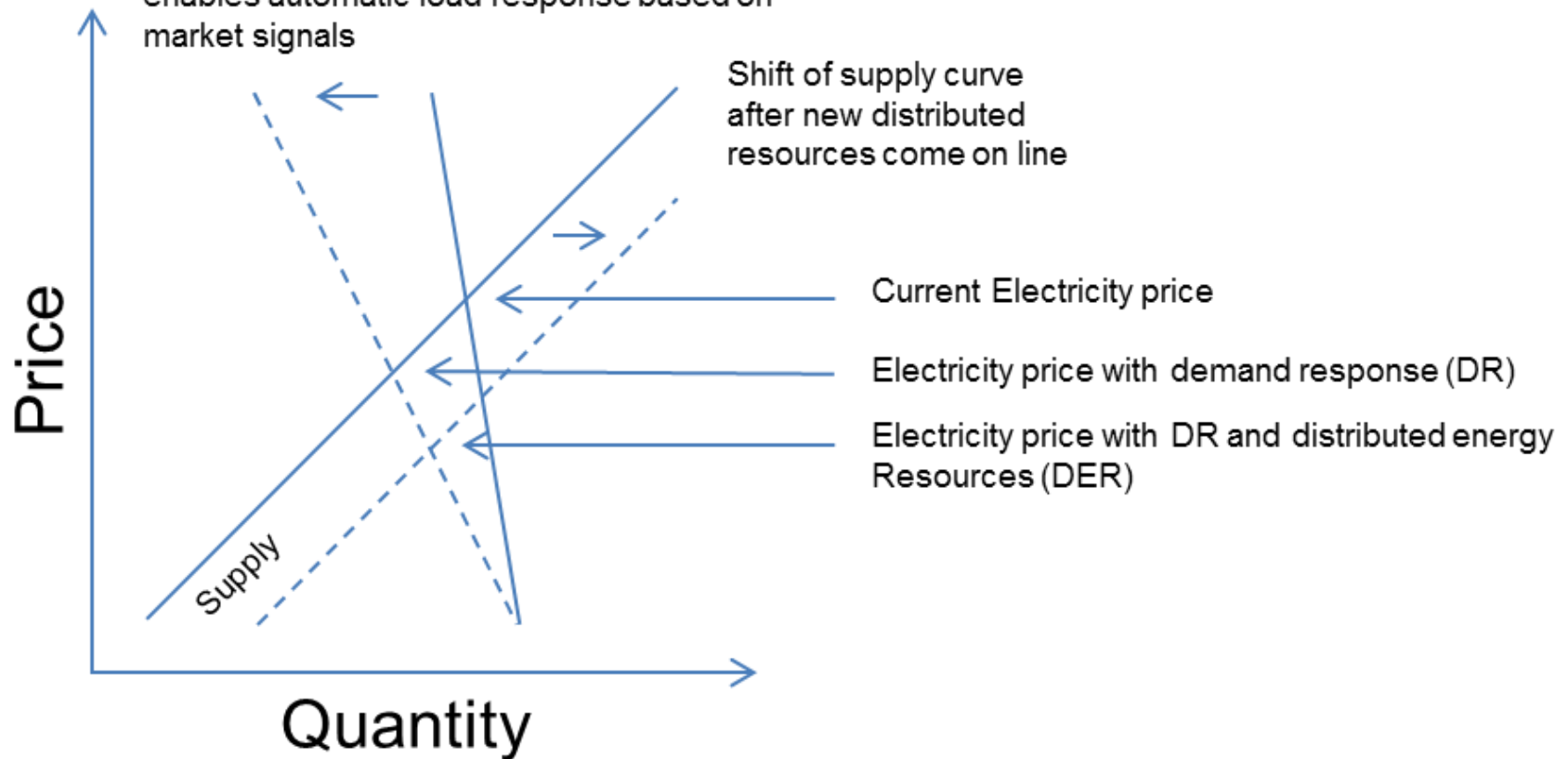
Demand Response, a holistic approach

- Demand Response is a complex issue
 - Many definitions
 - Many implications
 - Many effects
 - Involves many stakeholders
- Demand Response only works within a larger context
 - Market structures dictate means of aggregation
 - Market design specifies relevant roles in implementation
 - Market situation defines relevance of the concept

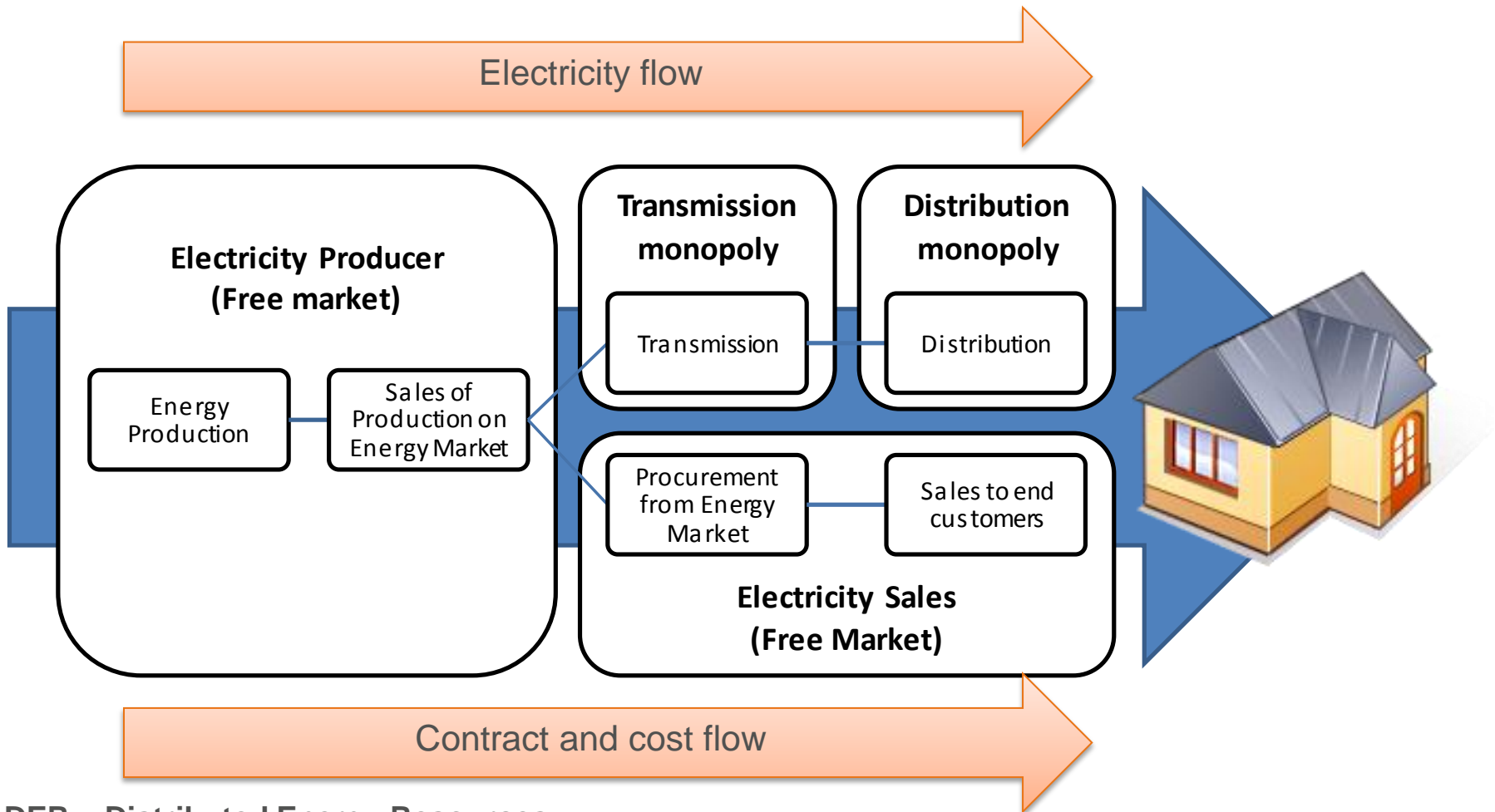
Demand Response in Economic Sense

Shift of demand curve slope, ie. Demand Becomes more elastic when new technology enables automatic load response based on market signals

Shift of supply curve after new distributed resources come on line

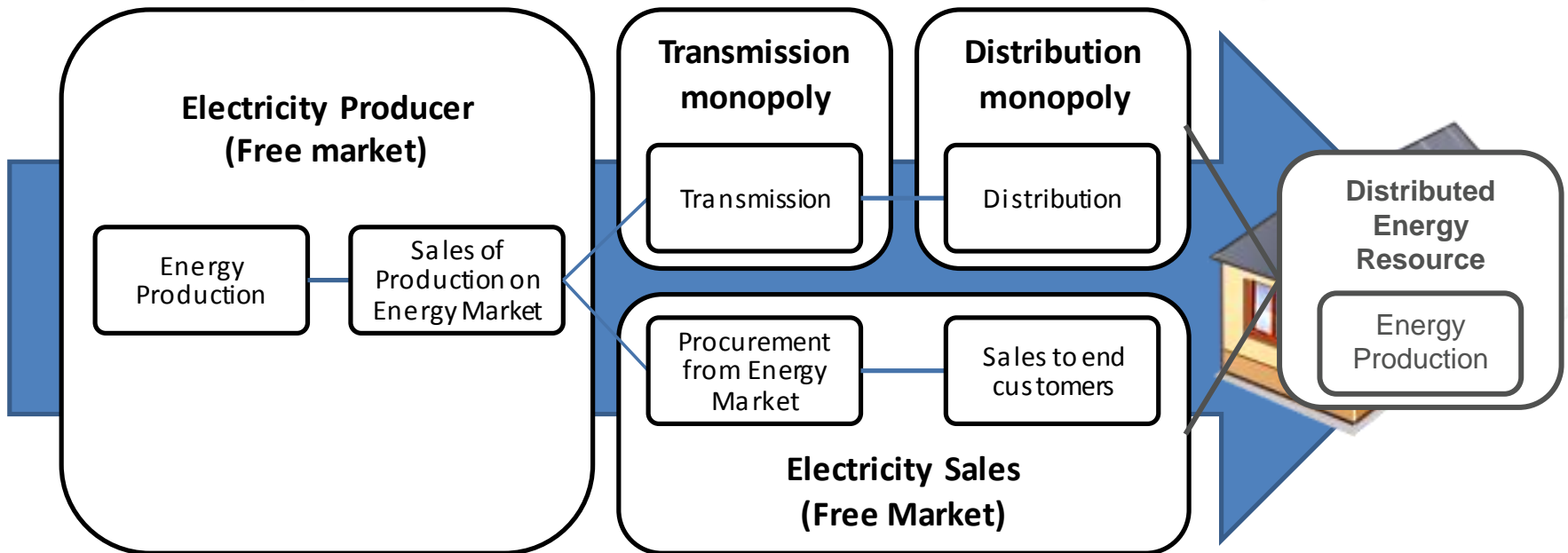


The Retail Energy Market without DER



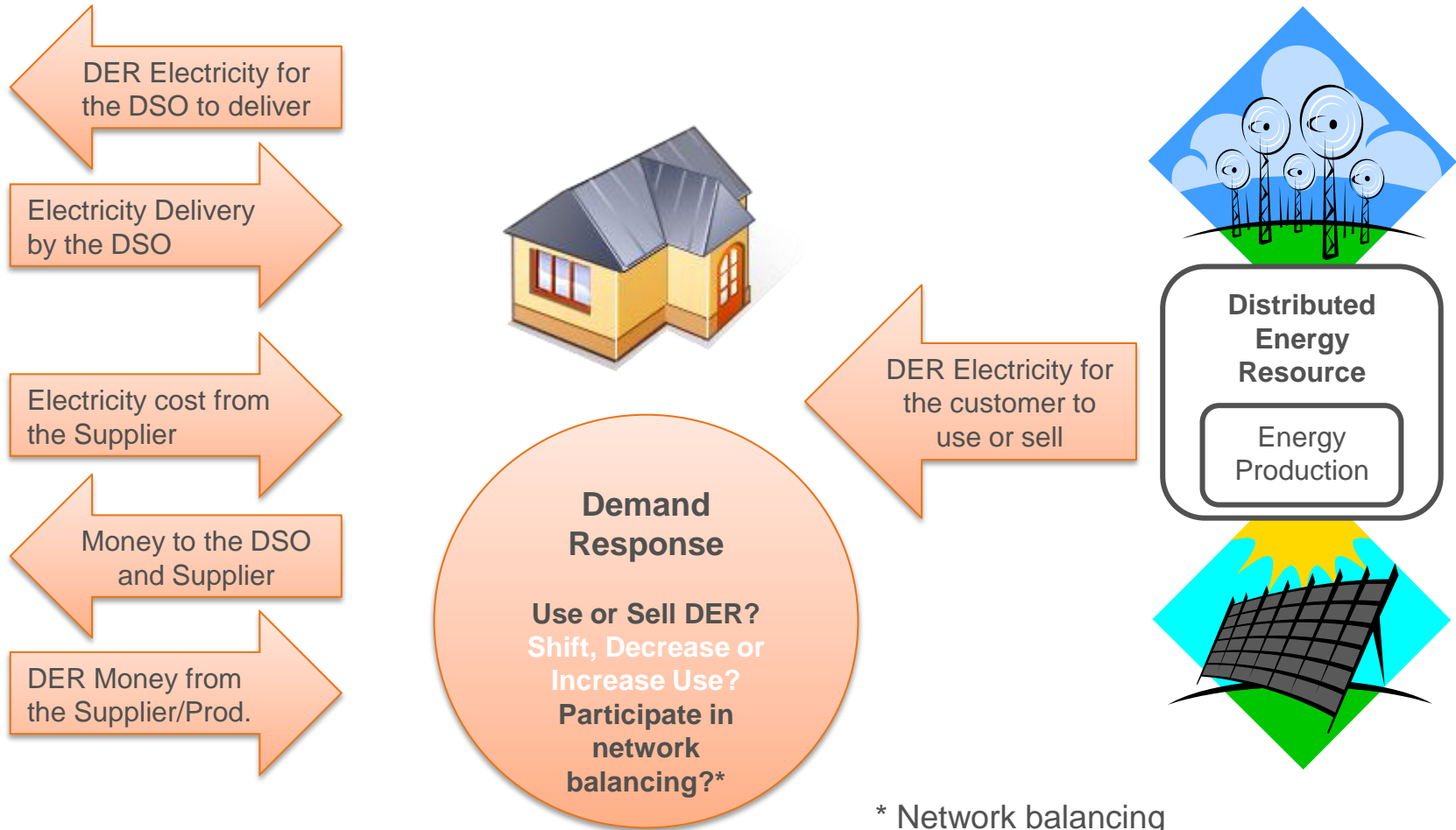
DER = Distributed Energy Resources

The Retail Energy Market with DER



DER = Distributed Energy Resources

Demand Response in the Retail Energy Market



DER = Distributed Energy Resources

* Network balancing flows left out for clarity

Major Driving Trends for Demand Response

Demand by Production

Production must equal demand at all times

Marginal cost of renewable production is zero

Limiting production brings no fuel savings

Demand Response maximizes production

From direct sums to aggregates

Market Processes based on dissecting total volumes

Smart Grids enable building processes on information of discrete site measurements

Availability of site specific information enables

Demand Response Scope

Derivative Market

- Allocation for meeting long term forecast

Day-ahead Market

- Allocation for meeting short term forecast

Intraday Market

- Execution to meet hourly/quarterly target

Regulating power Market

- Bid of available allocation
- Execution of winning bid response volumes

Automated Disturbance Response

- Allocation of reserve with availability compensation
- Automated control execution within trading time unit
- Compensating volume within trading time unit by opposite control

Demand Response Execution Options

Deferred use

- Shift of consumption in time (main generic idea)

Time optimized energy savings

- Execute energy saving measures at times of most market effect
- Flexible in resulting effect like temperature, light, end product volume

Time optimized use of local energy resources

- Switch to local production at times of most market effect
- Leveraging from lessened distribution cost allocation

Use of storage

- Intermediate products, sawdust, components, pumped water
- Electricity Storage Units

Demand Response

- Demand Response is
 - Dynamic Loads and Dynamic Generation
 - Planned, but responsive
- Demand Response involves
 - The Distribution Network
 - The Energy Supplier
 - The Generator (producer)
 - The Energy Markets (on many levels)
 - The End Customer
- Demand Response enables
 - Optimum use of grid capacity
 - Optimum use of generation capacity
 - Better quality of delivery
 - Lower cost of supply

Demand Response

- Technology Enabled Market Dynamism
- Service Enabled Implementation
- Customer Enabled Energy Efficiency
- Smart Devices and Smart Infrastructure are prerequisites

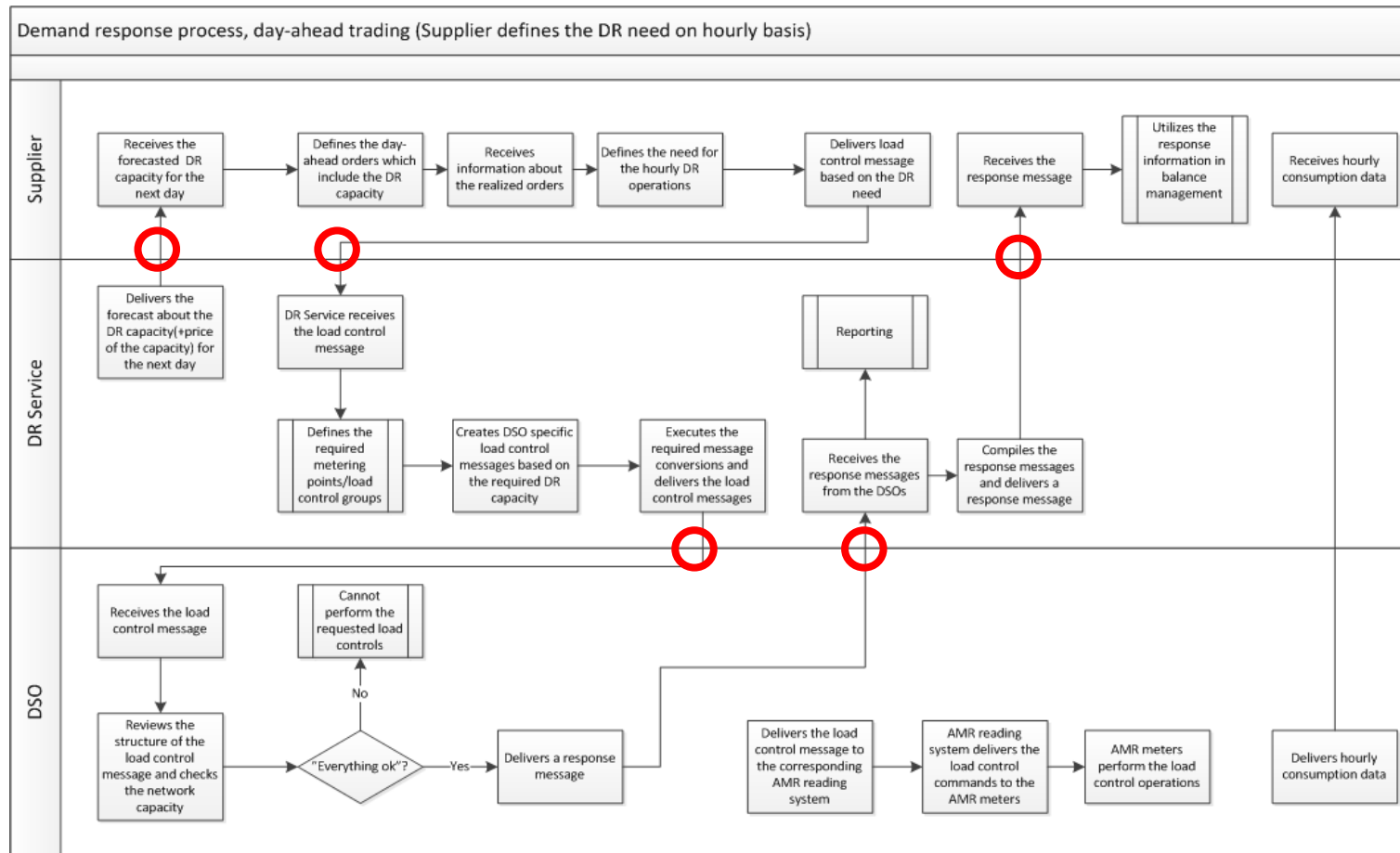
Demand Response Technology Endpoints


- Smart Meter
 - Leverage installed base
 - Create intelligent DR Service Coupling
 - Discover flows
 - Discover conflicts

- Home Energy Management System (HEMS)
 - Enable extended connectivity to market
 - Leverage Smart Capabilities
 - Discover flows
 - Discover conflicts

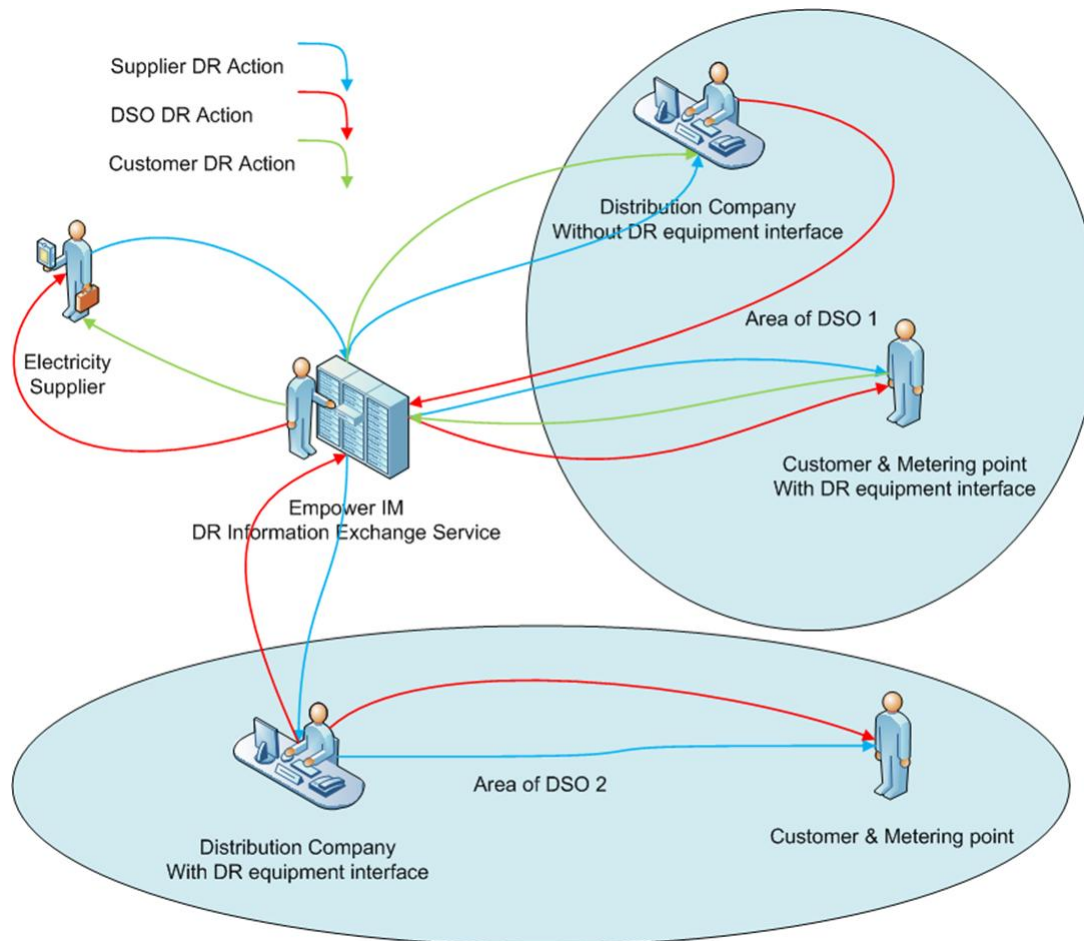


DR Information Exchange Example



 New Business Information Message

Enabling DR with Information Exchange



Demand Response Interaction Environment

- SGEM task 4.5.2
- combine the information flows of active customer enabling technologies
- create an interactive environment for presenting and executing active customer actions
- study how to present the active customer with product and contract structures developed under SGEM.
- This new environment will allow us to study how actual people will interact with the smart environment by presenting them with an interface to what could be the future interface towards smart grids and energy markets.

Demand Response Control Environment

- SGEM task 4.5.3
- Build a holistic environment of diverse smart energy solutions
- Build a platform for creating new knowledge about demand response processes in environments that closely model future market environments.
- Include different kinds of electricity consumers and producers
- Include novel storage technology
- Integrate these to suppliers to understand the systemic nature of demand response in a distributed environment.

