

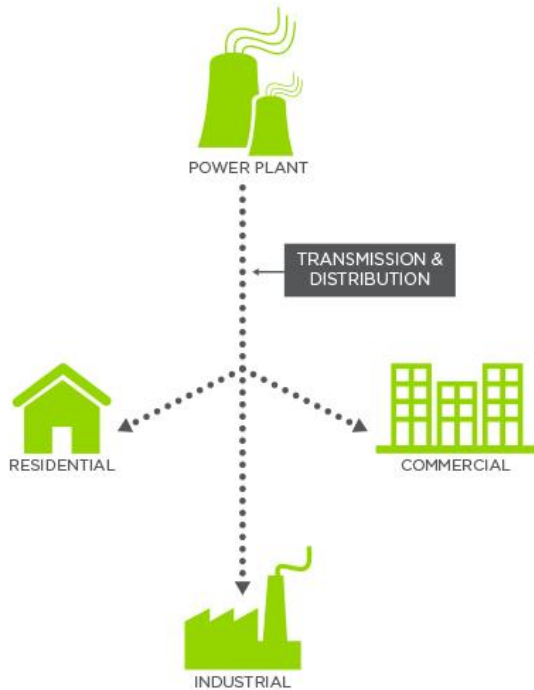


Markets of the Future

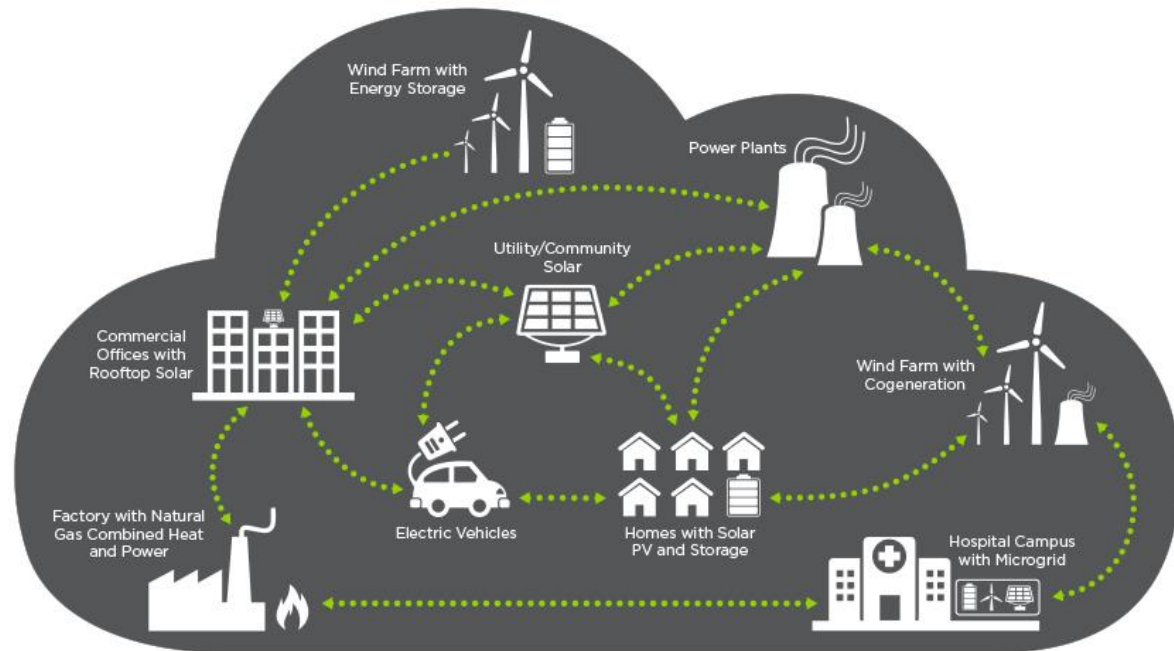
OMS Annual Meeting
October 25, 2018

The energy paradigm is evolving

TODAY: ONE-WAY POWER SYSTEM



EMERGING: THE ENERGY CLOUD



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Read more: <https://www.navigant.com/insights/energy/2018/energy-cloud-4>

Rapid industry change presents challenges and opportunities for creating value for consumers

Digitalization

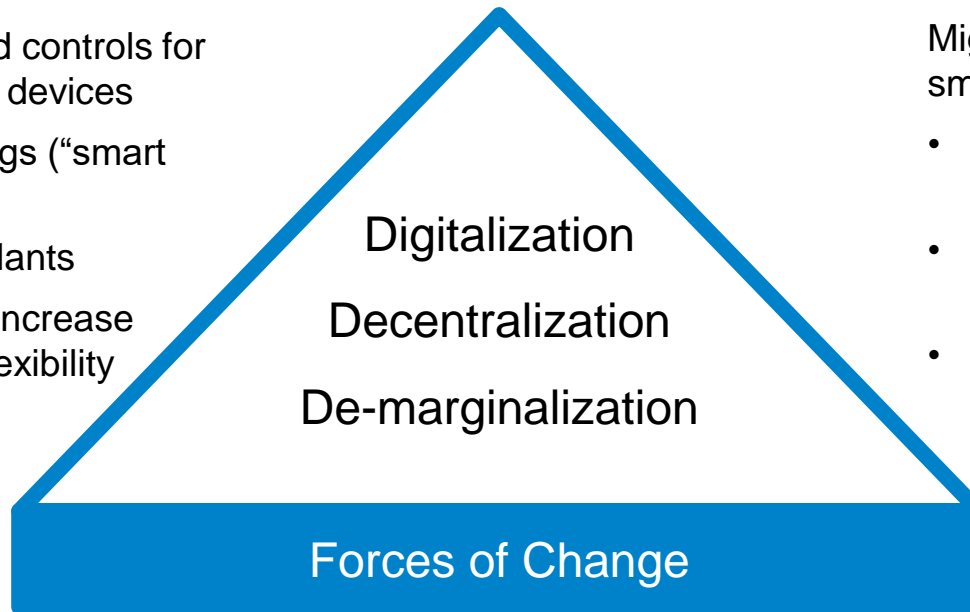
New classes of and controls for electric consuming devices

- Internet of Things (“smart homes”)
- Virtual power plants
- Opportunity to increase demand-side flexibility

Decentralization

Migration from large stations to smaller distributed resources

- DER (storage, solar, EVs, DR)
- Loss of visibility and predictability
- Closer coordination needed between distribution and transmission operators

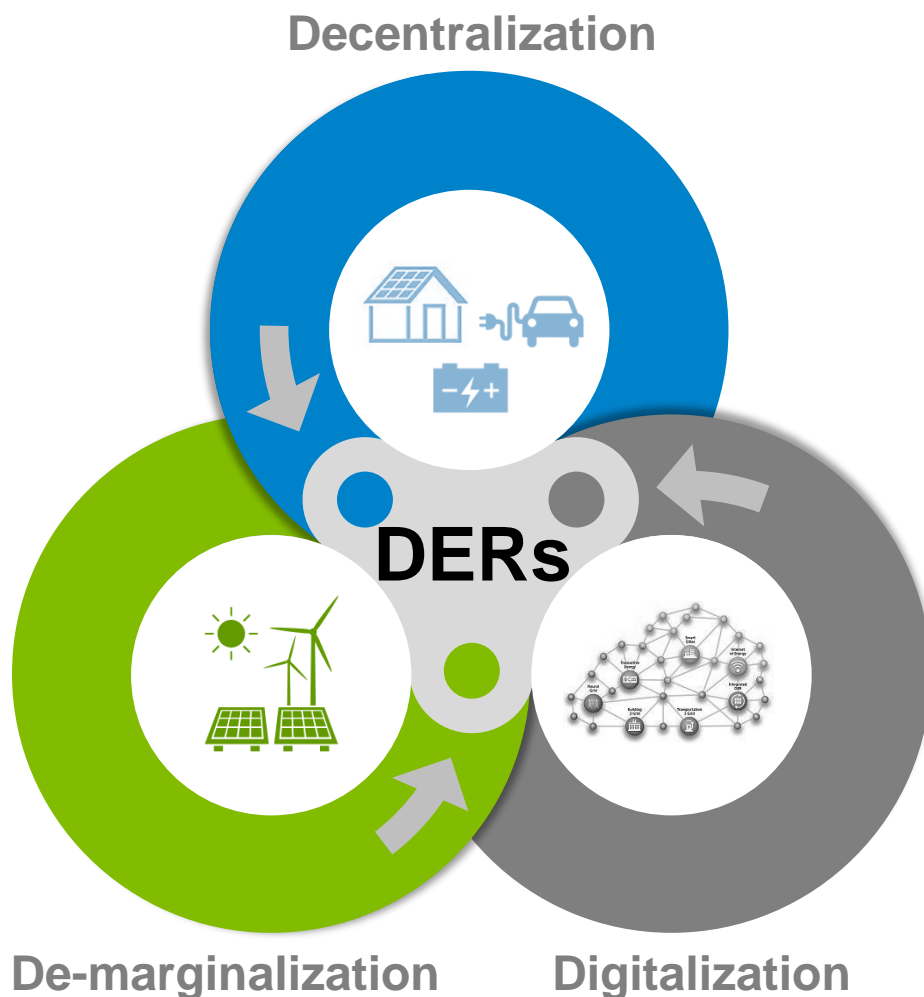


De-marginalization (low / no marginal costs)

Substantial growth of renewables and non-price sensitive DERs

- Reduced flexibility and potential shortages of currently free ancillaries (e.g., voltage, frequency)

Distributed Energy Resources (DERs) contribute to all three overlapping trends



Decentralization:

- DERs tend to be small and widely dispersed across individual distribution systems and the MISO region

De-marginalization:

- DERs often have zero or low marginal operating cost

Digitalization:

- Much of the potential value of digitalization comes from the ability to optimize consumer level usage

Unmatched complexity presents an increasing challenge and opportunity

MISO Approach

- Define integration approach in collaboration with stakeholders
- Coordinate governance and policy changes at federal and state level
- Identify visibility, situational awareness and communication needs across footprint
- Enhance market participation model and innovate market system computational capabilities



Potential changes needed:

- New situational awareness tools
- Forecasting methods
- Communications systems/platform
- Advanced computing capabilities
- New market products/services
- Market system requirements
- Interconnection coordination