Leveraging Open-Source Tools to Advance Industry Capabilities:

OpenDSS

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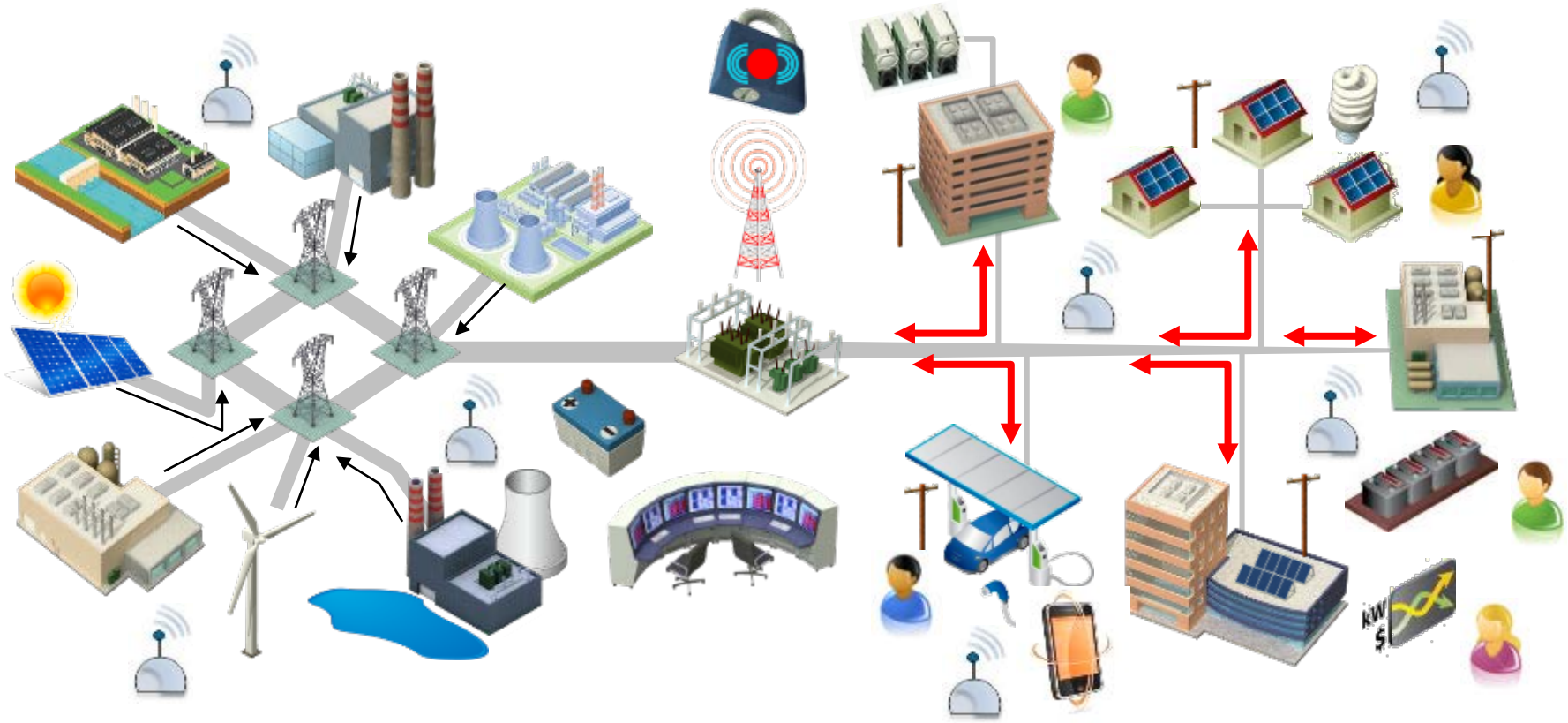
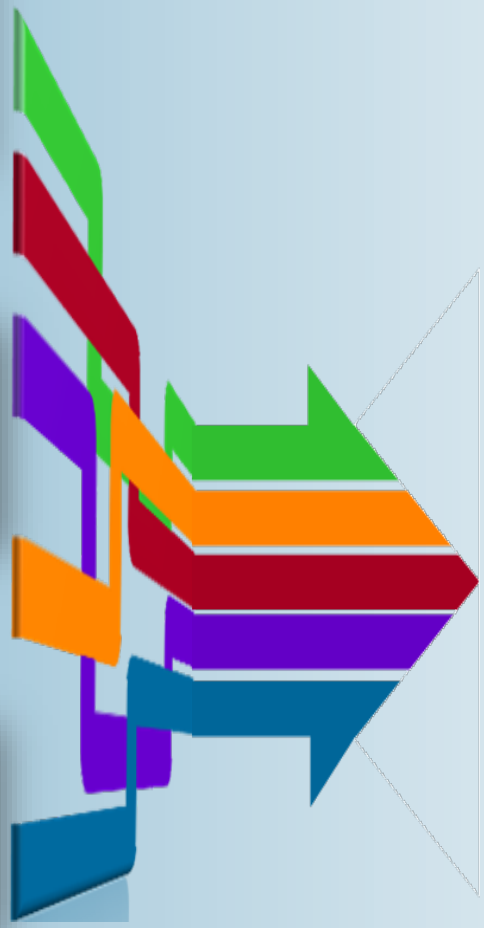
Landscape – The Future Integrated Grid



Power System that is Highly Flexible, Resilient and Connected and Optimizes Energy Resources

Integrating New Technologies and Advanced Resources

- *Grid-edge control*
- *Automation*
- *PV*
- *Storage*
- *Advanced metering*
- *Demand response*
- *Customer choice*
- *Adv Communications*



Distribution Operations and Planning

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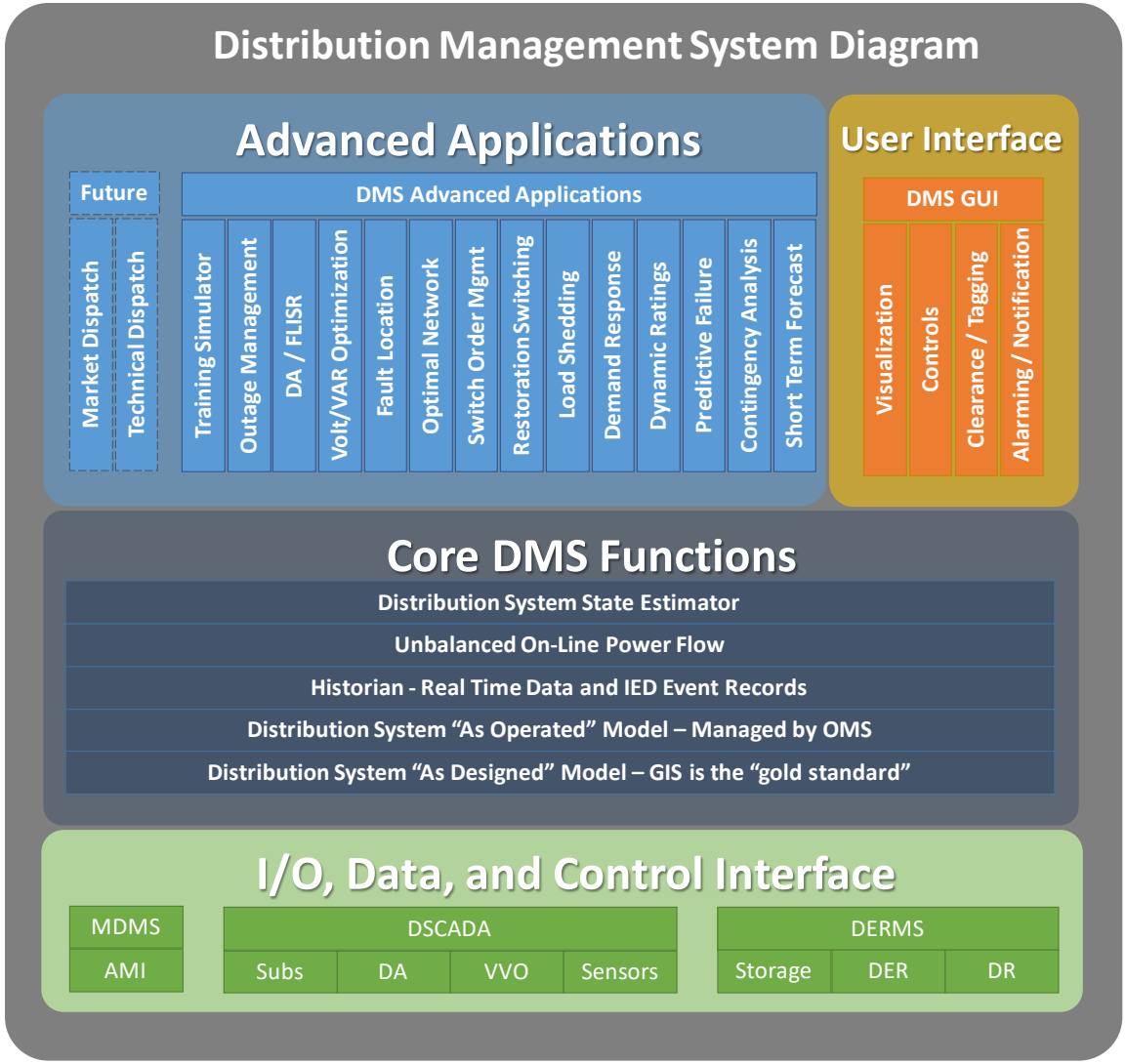
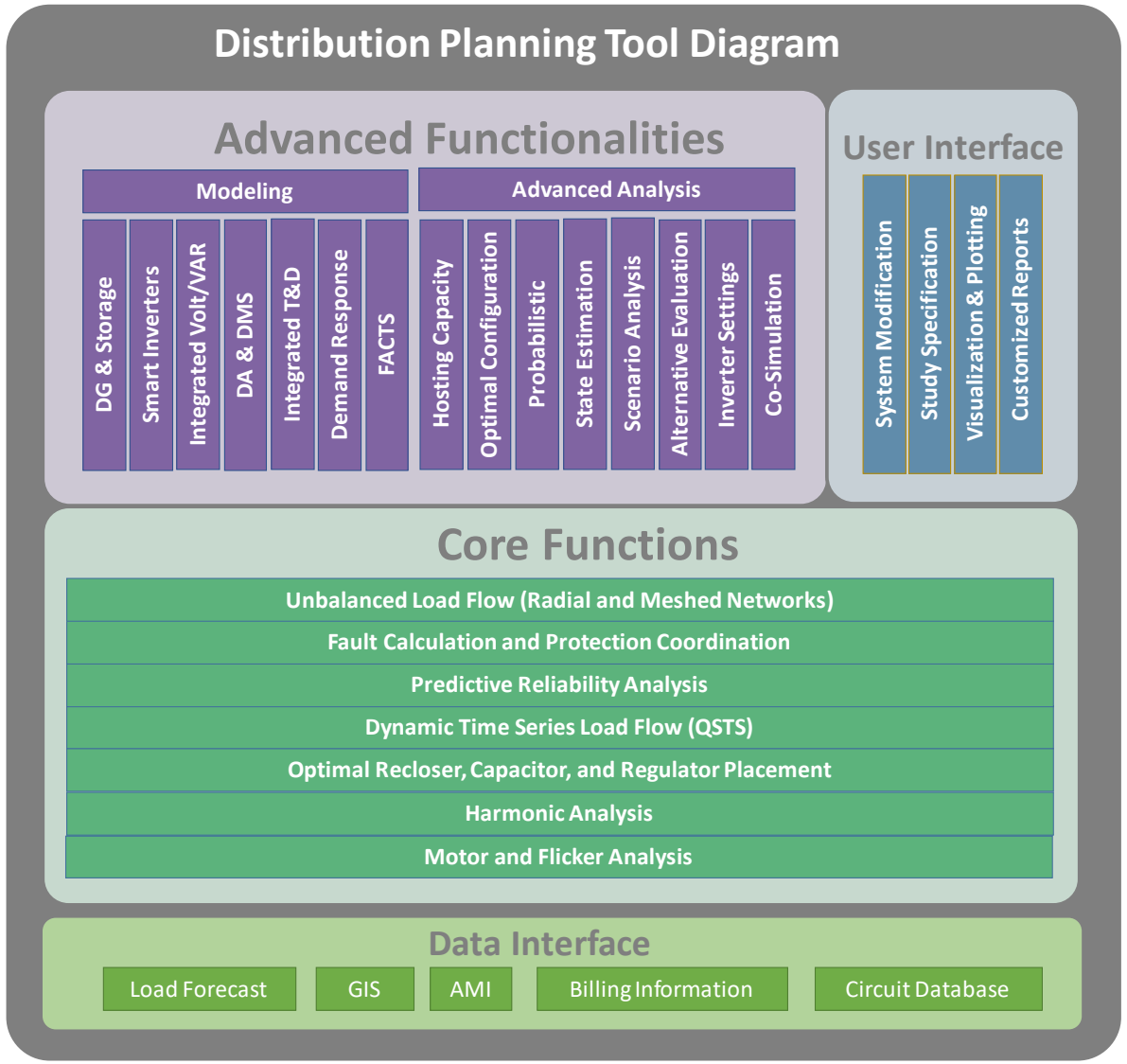
Advanced Distribution Operations

- Advanced Applications
  - Volt/var optimization
  - Fault location, isolation, and restoration (FLISR)
  - Unbalanced power flow with distributed controls
  - Optimal network management
  - Contingency analysis
  - Operator training
  - Predictive failure
- Enabling
  - Effective integration of distributed resources, automation and control, and improved situational awareness
  - Enhanced system operation and automation technologies, processes, and work rules that incorporate new technologies and resource alternatives to improve safety, efficiency, and reliability
  - Integration and coordination of DSP and ISO processes and priorities

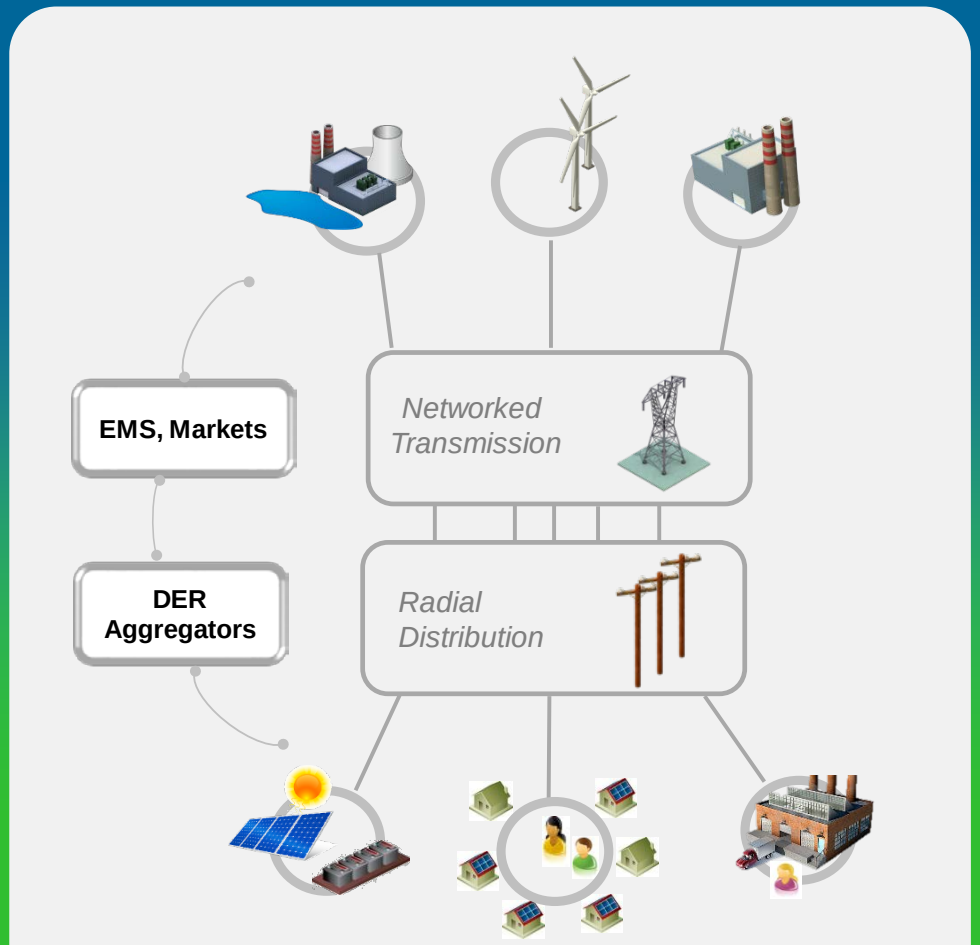


Advanced Distribution Planning

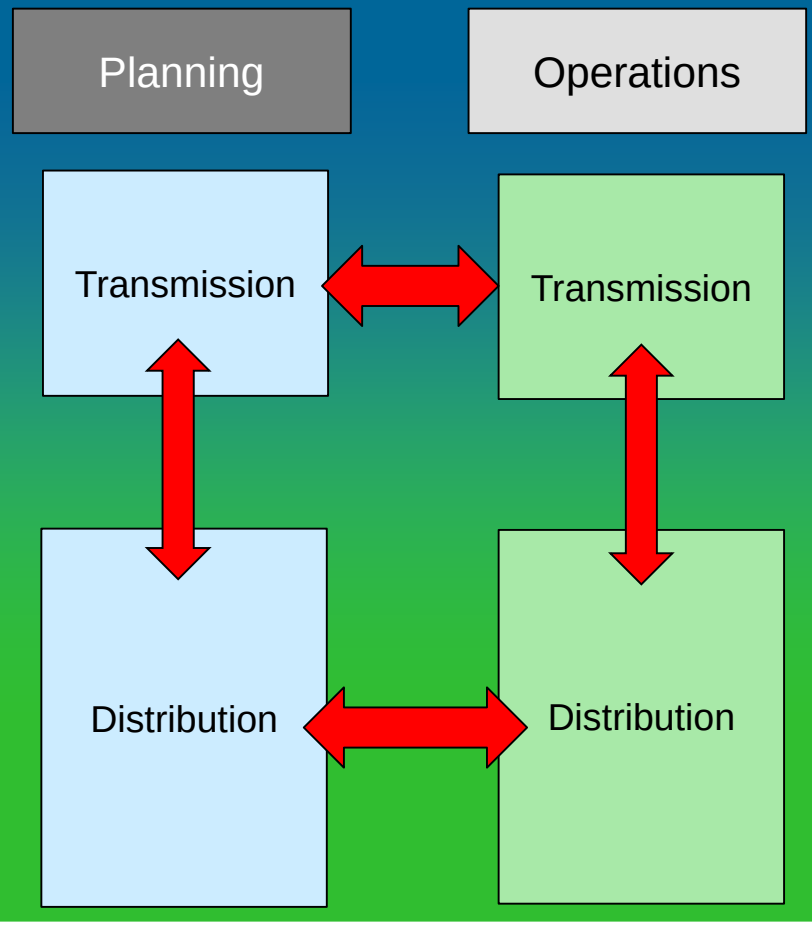
- Advanced Capabilities
  - Probabilistic planning
  - Load and DER forecasting
  - DER/customer choice modeling
  - Hosting capacity assessment
  - DER Interconnection screening
  - Non-wires solution assessments
  - DA/DMS simulation
  - Automated scenario/mitigation analysis
- Enabling
  - Effective integration of distributed resources, new automation and control, and facilitation of new domain interactions
  - Informed system design and investment decisions that consider new technologies and resource alternatives
  - Safe, reliable, and efficient system designs given rapidly changing system conditions and uncertainty
  - Efficient and timely planning assessments and decisions



Integrated Transmission and Distribution Operations and Planning



Integrated Approach to Planning and Operations

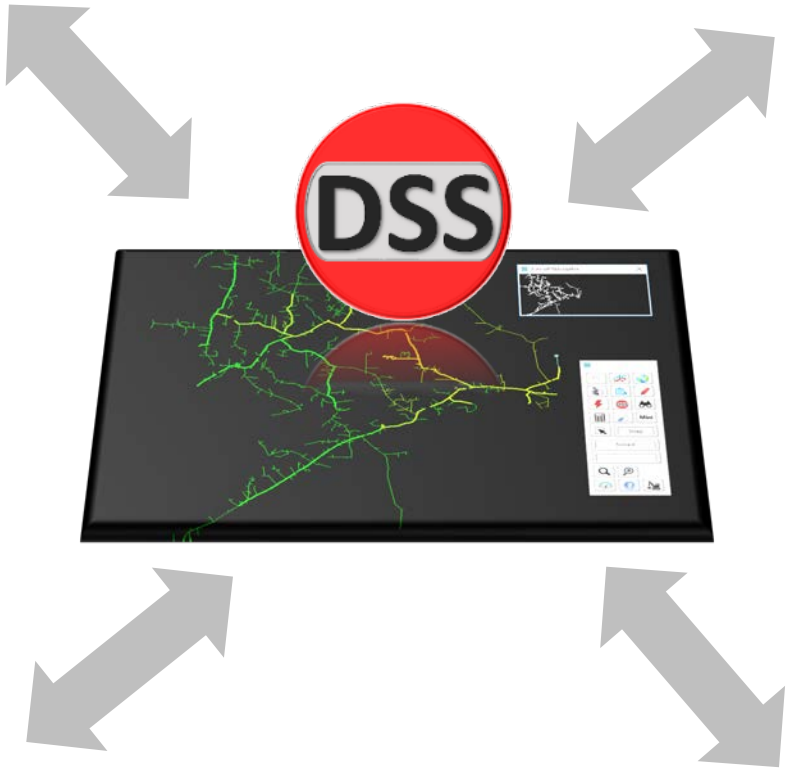


- Control Center RT-Ops
- Modeling & Sim. Methods
- Load/DER Forecasts & Models
- DSO/TSO Interaction
- Risk-Based Planning
- Protection and Coordination
- DER Integration

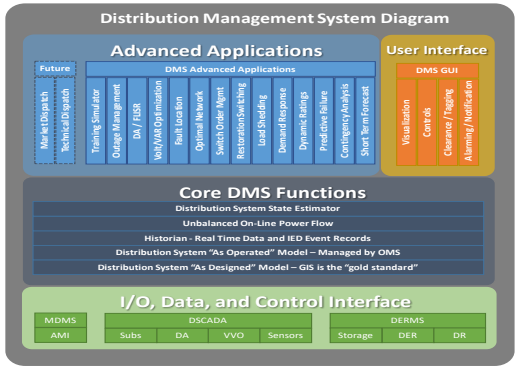
Advanced Distribution System Analysis Platform

Open-Source Distribution System Simulator (OpenDSS)

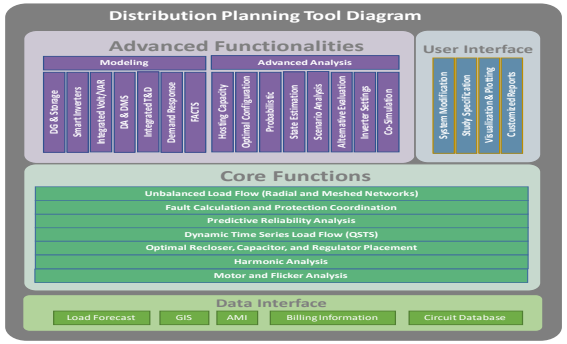
New Technologies



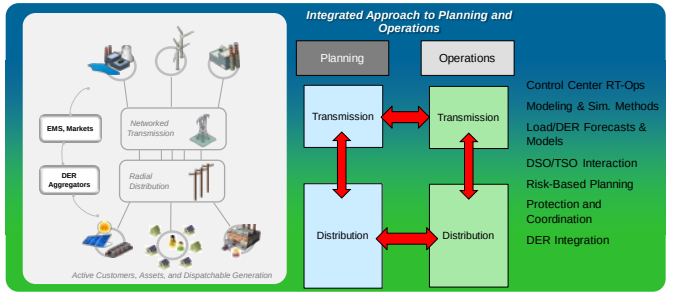
Operations



Planning



Integrated Transmission and Distribution Analysis



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OpenDSS – Brief Overview

- Open source of EPRI's Distribution System Simulator
  - Originally developed in 1997 for DG interconnection and planning
  - Open-sourced in 2008
- Designed from the beginning to capture
  - Time-specific impacts and
  - Location-specific impacts
- Unique application capabilities
  - Operations and planning
  - Integration into other simulation toolsets/environments
  - Co-simulation (power and communications)

Core Solution Capability
Full, unbalanced 3P power flow
Quasi-Static time-series analysis (QSTS)
Linear and non-linear analysis
Arbitrary n-phase circuit analysis
Harmonics analysis
Stray voltage/current analysis
Fault analysis
DER Models
Smart inverters (Phase I, II, and III functions)
Storage models with controllers
PV system models
Wind system models
Demand response
Microgrid modeling
DER Short-circuit models
Advanced Control Systems
Coordinated and integrated volt/var control
DERMS control
Full regulation control for LTC's, line regs, cap banks
High-Performance Computing Capabilities
Parallel processing
Multithreading circuit processing
Multi-core management
Misc
Both radial feeders and meshed networks
Transmission systems
Real-Time Simulation