DTE Energy

DTE Energy: Distributed Energy Resources Experience and Roadmap

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DTE Energy is an Integrated Energy Company

Strong, Stable and Growing Utilities

~80% of DTE Energy's 2011 Earnings

Detroit Edison

- Electric generation and distribution
- 2.1 million customers
- Fully regulated by Michigan Public Service Commission (MPSC)

MichCon

- Natural gas distribution
- 1.2 million customers
- Fully regulated by MPSC

Complementary Non-Utility Businesses

~20% of DTE Energy's 2011 Earnings

Gas Storage & Pipelines

Transport and store natural gas

Power & Industrial Projects

Own and operate energy related assets

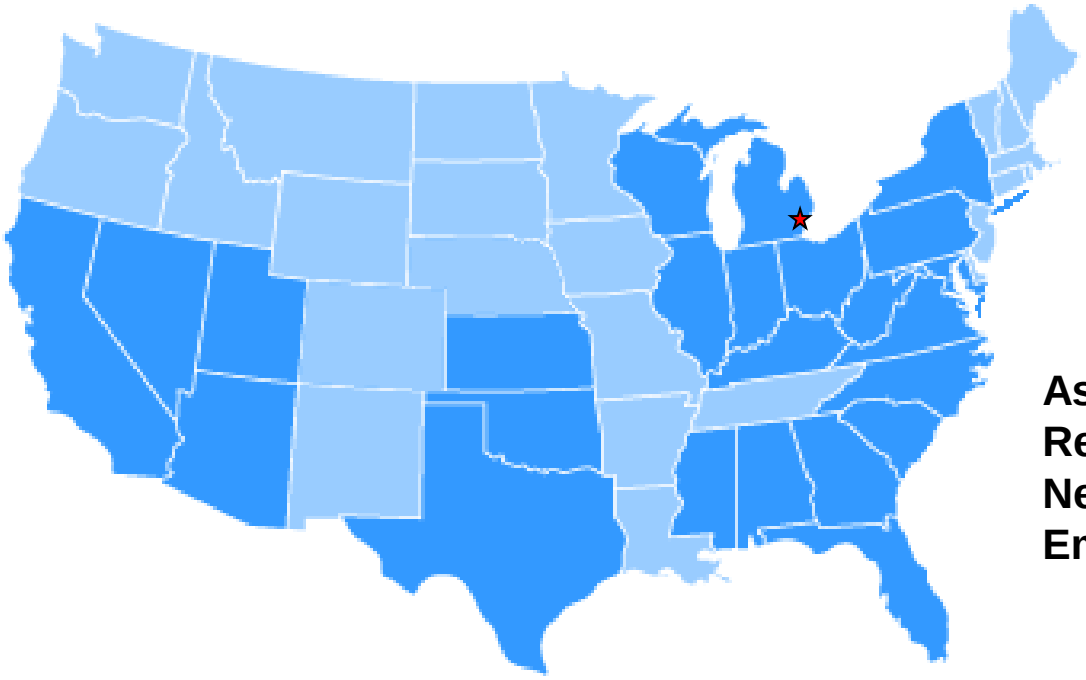
Energy Trading

Generate economic value and provide strategic benefits

Unconventional Gas Production

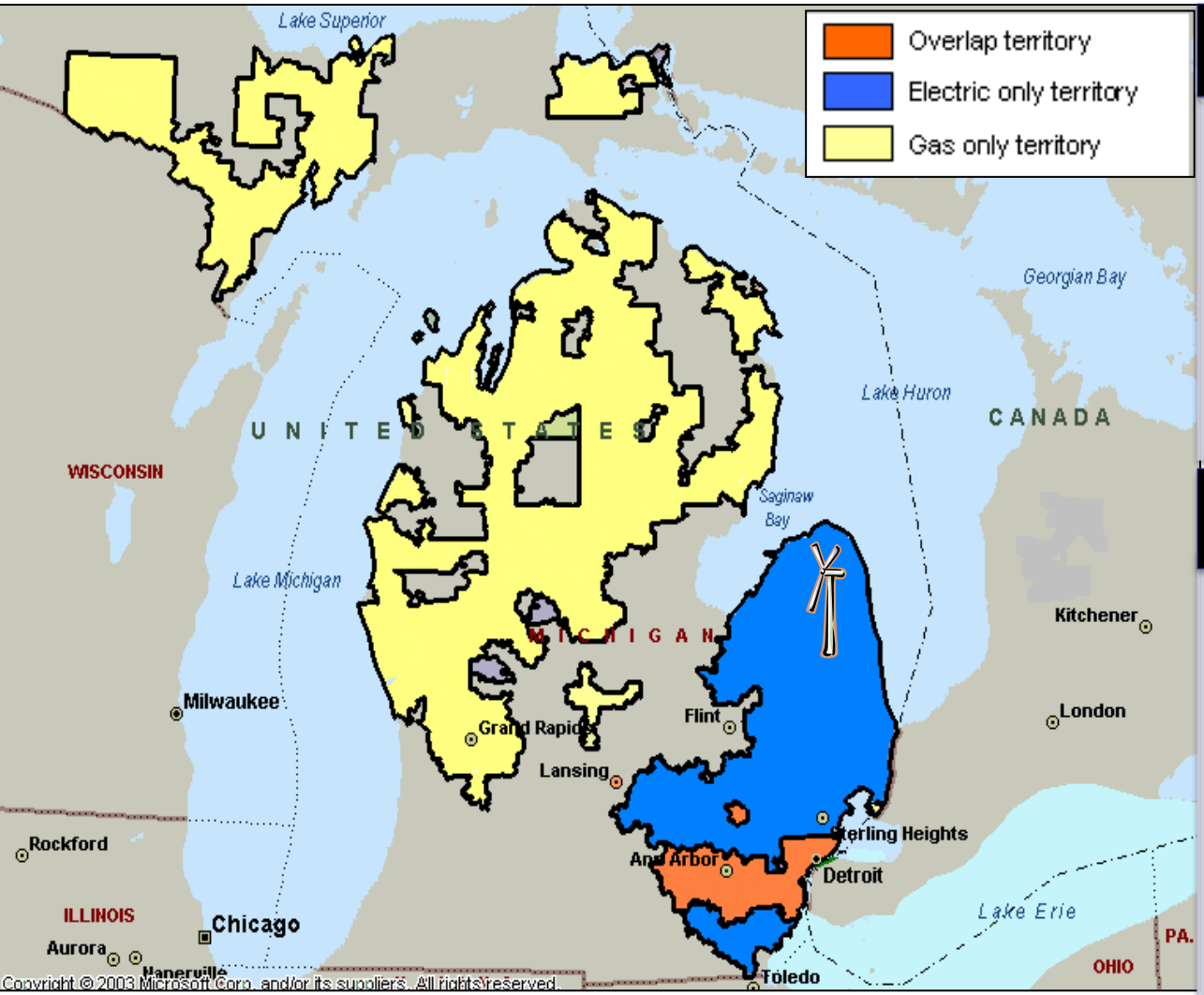
Production of shale natural gas and oil in Texas

DTE Energy Holdings Map



Assets:	$26 billion
Revenue:	$8.8 billion
Net Income:	$720 million
Employees:	9,895

DTE Energy – Electric & Gas Regulated Businesses



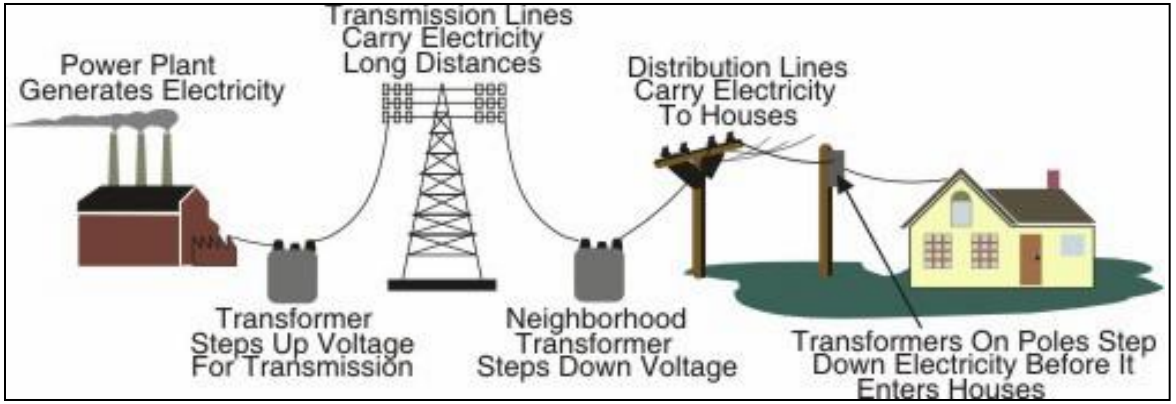
Detroit Edison

- Tenth largest US electric utility
- 7,600 square mile service
- 2.1 million customers
- $4.9 billion in revenue
- Gen Capacity: 11,084 MW
- Annual Sales: 50,000 GWH

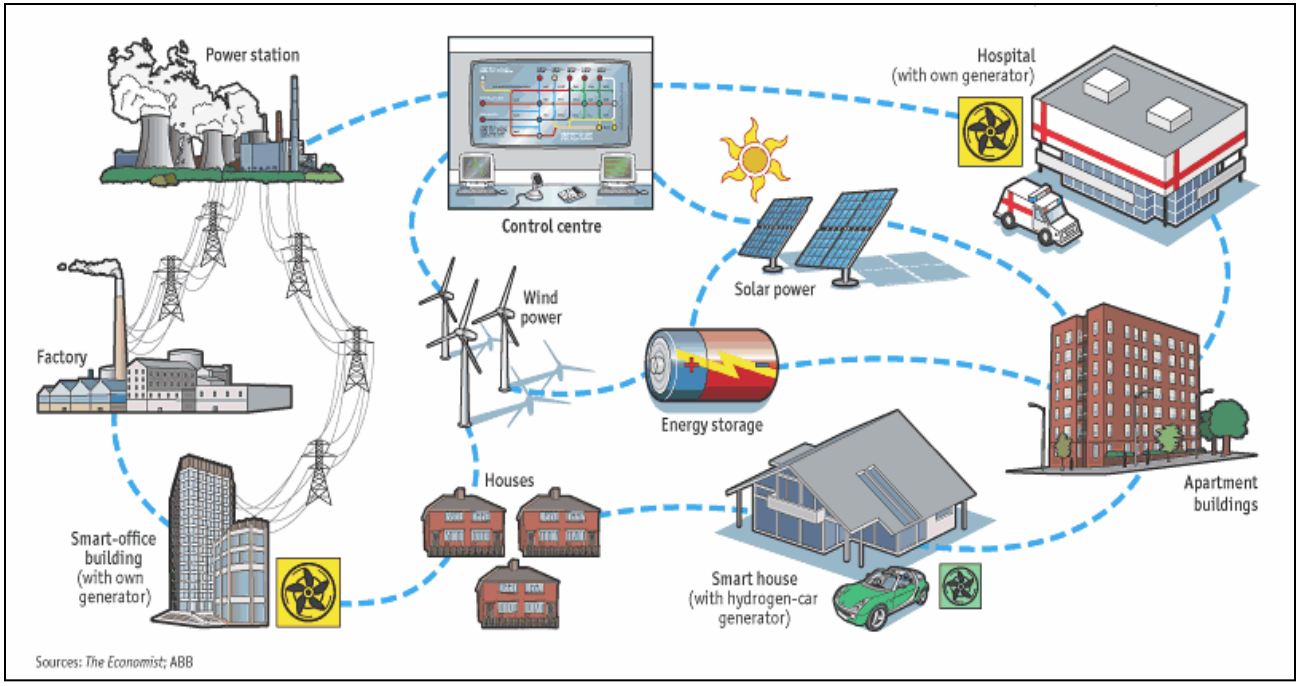
Michcon

- Eleventh largest US natural gas utility
- 14,700 square mile service territory throughout Michigan
- 1.2 million customers
- 679 bcf of gas sales
- $1.8 billion in revenue

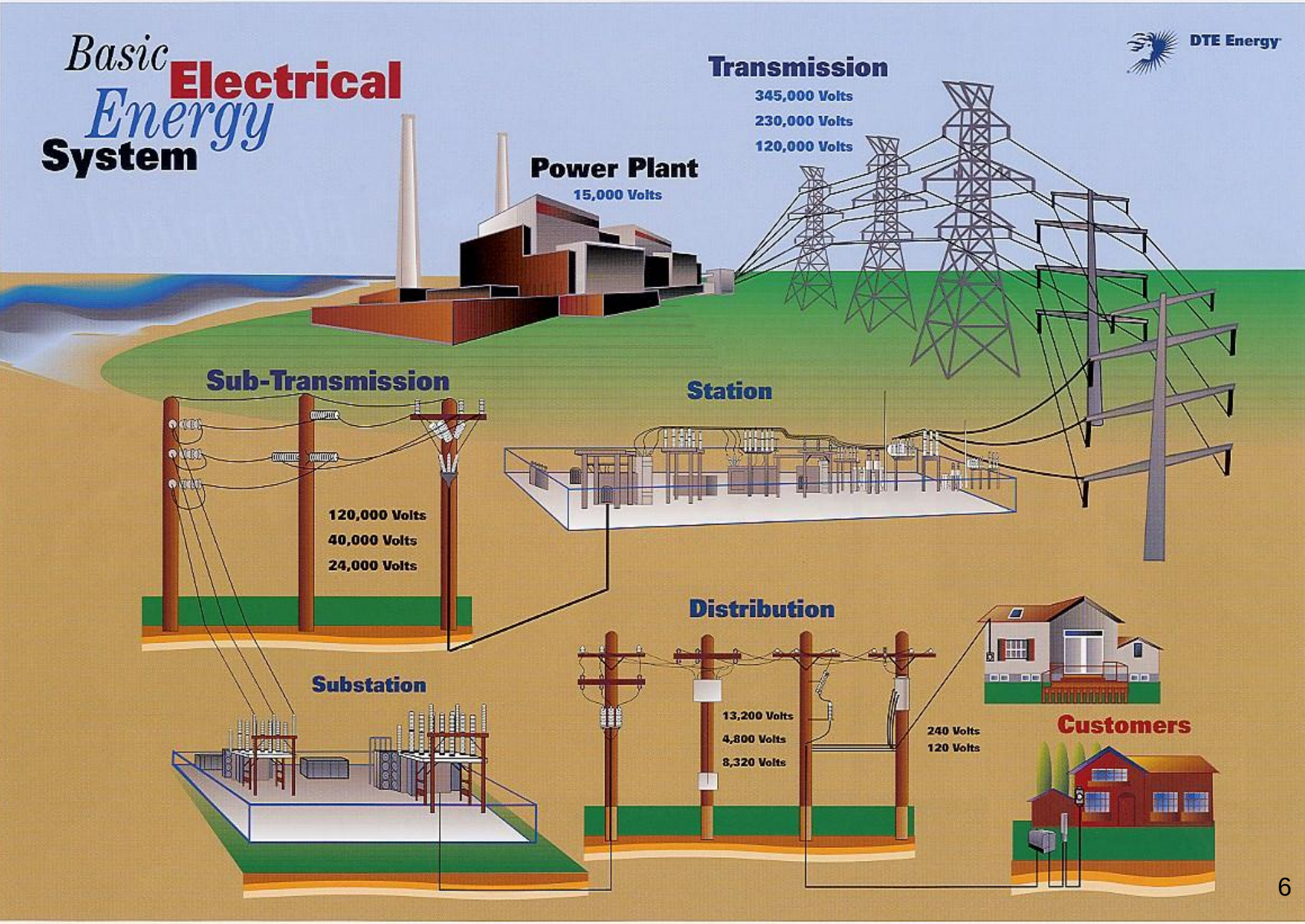
The Evolution of the Electric Utility System



One way power flow, limited renewable resources and simple interaction with load



Two way power flow, multiple distributed resources and stakeholders


Basic Electrical Energy System
DTE Energy
Transmission
345,000 Volts
230,000 Volts
120,000 Volts
Power Plant
15,000 Volts
Sub-Transmission
120,000 Volts
40,000 Volts
24,000 Volts
Station
Distribution
13,200 Volts
4,800 Volts
8,320 Volts
240 Volts
120 Volts
Substation
Customers

Disruptive technologies alter the playing field

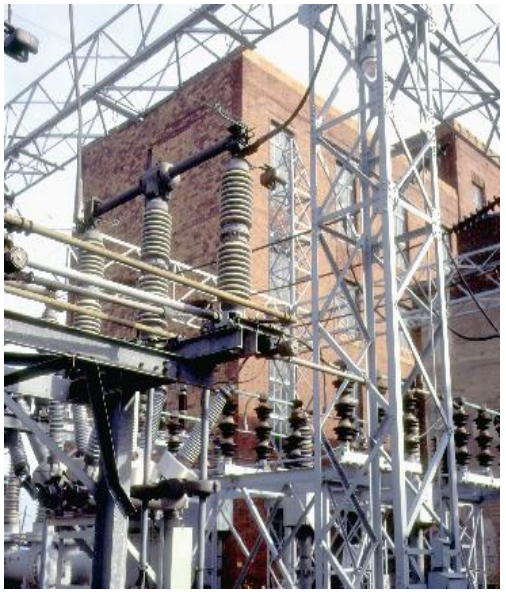
Disruptive Technologies bring to market a fundamentally different value proposition than previously available (based on a different set of product attributes), leading to the emergence of new products, the re-definition of an industry's value network, and a shake- up in its competitive structure

Source: Arthur D. Little

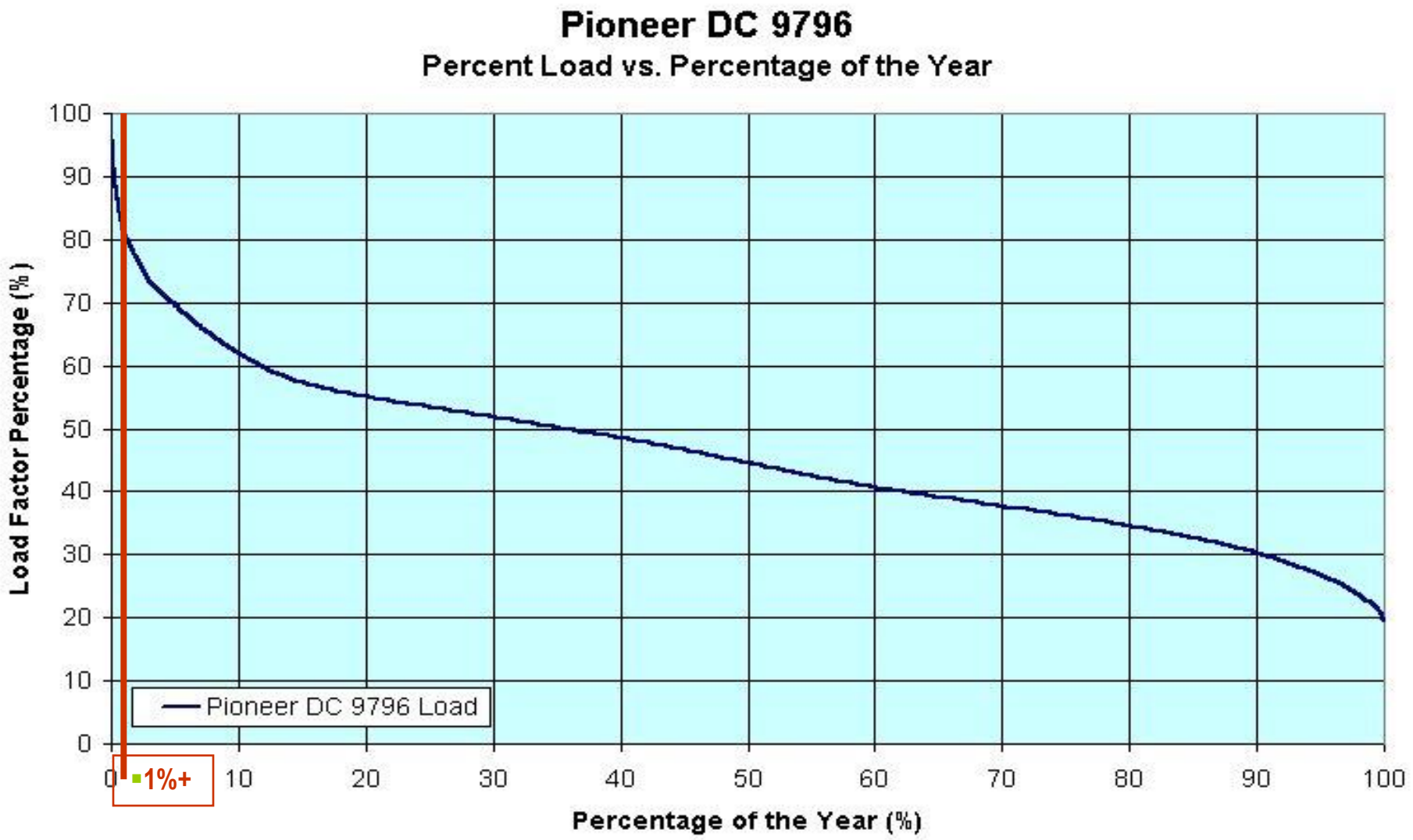
- **Internet**
- **Personal computer**
- **Cellular technologies**
- **Apple iPhone & iPad**
- **Plug-in Electric Vehicles**

Distributed Generation strengthens and supplements the electric grid

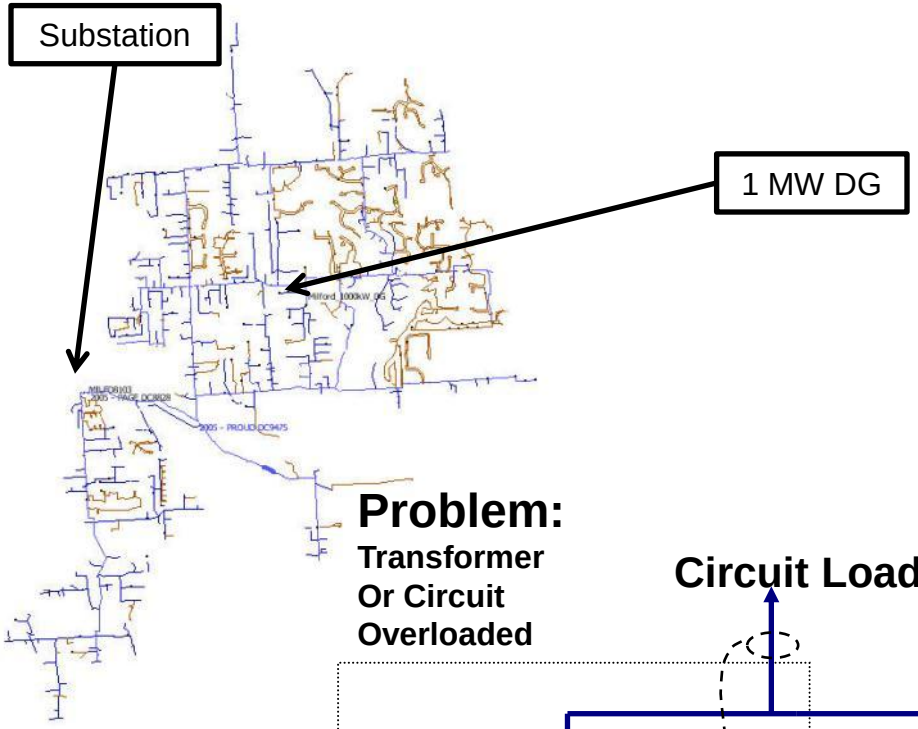
- Deferred T&D expenditures
  - Allows for a delay in T&D projects until demand warrants
- Interim T&D solutions
  - Provides a temporary solution when projects are delayed due to NIMBY
- Emergency Capacity
  - Provides a “JIT” solution for localized outage or overload situations
- Maintenance
  - Allows power continuity when conducting routine maintenance



Asset Utilization Opportunity



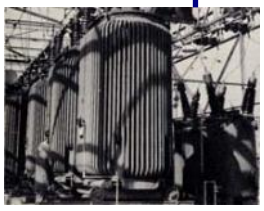
Local capacity need (Peak Shaving Application)



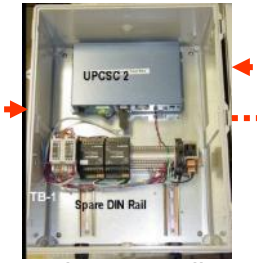
Problem:
Transformer Or Circuit Overloaded

Circuit Load

Solution:
Line Support Using Distributed Energy Resource(s)


Transformer

Circuit Load Current



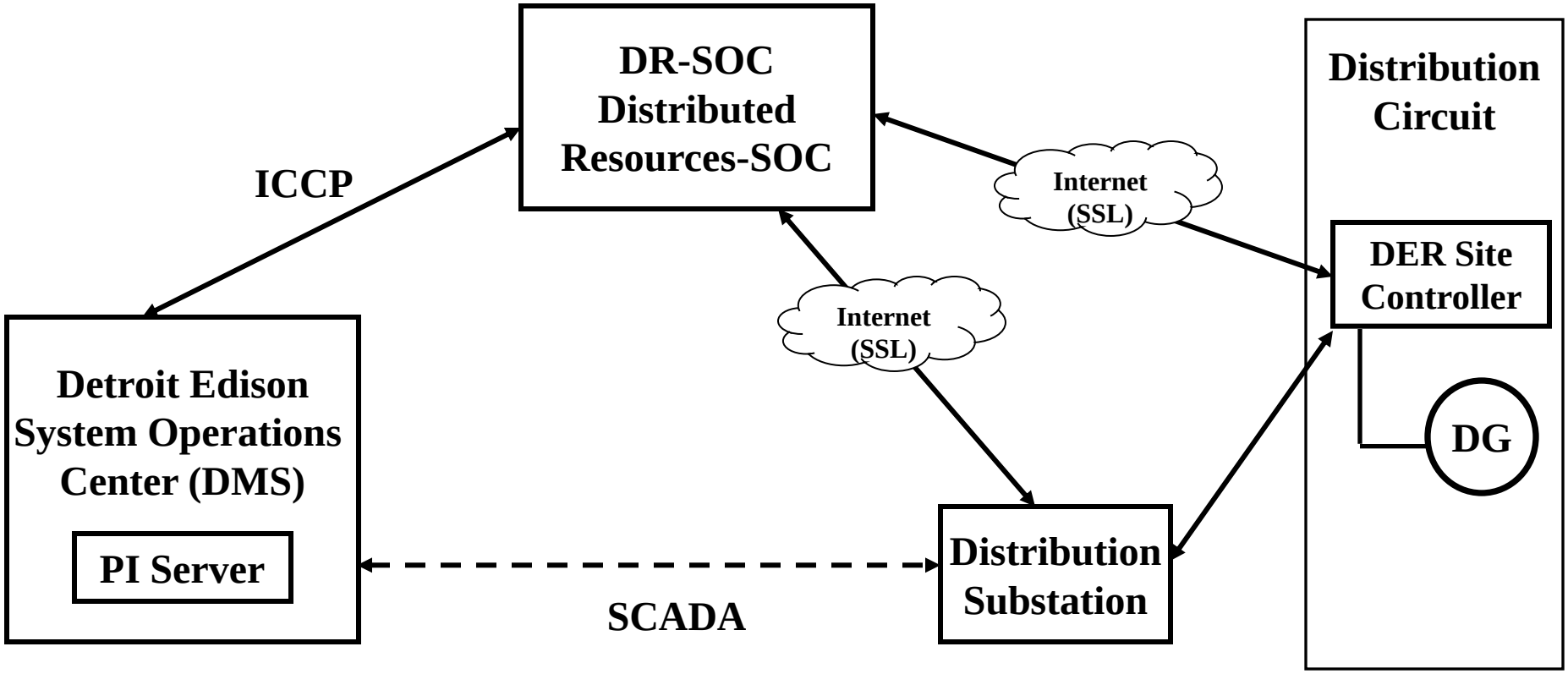
Site Controller

Generator Data

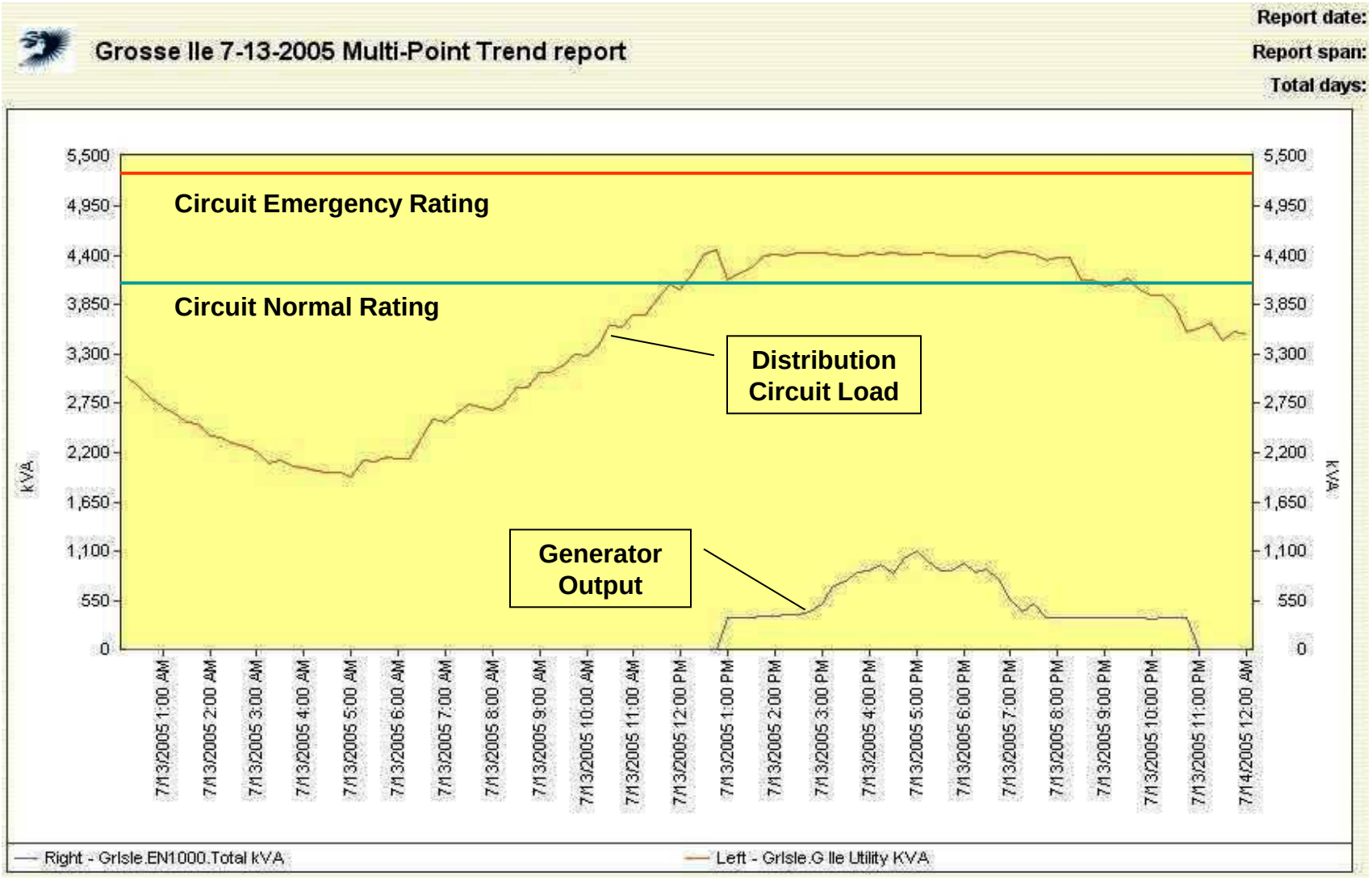
Control Data:
•Start/Stop
•Output Level


Distributed Energy Resource

DG Communication Architecture



Automatic Load Following



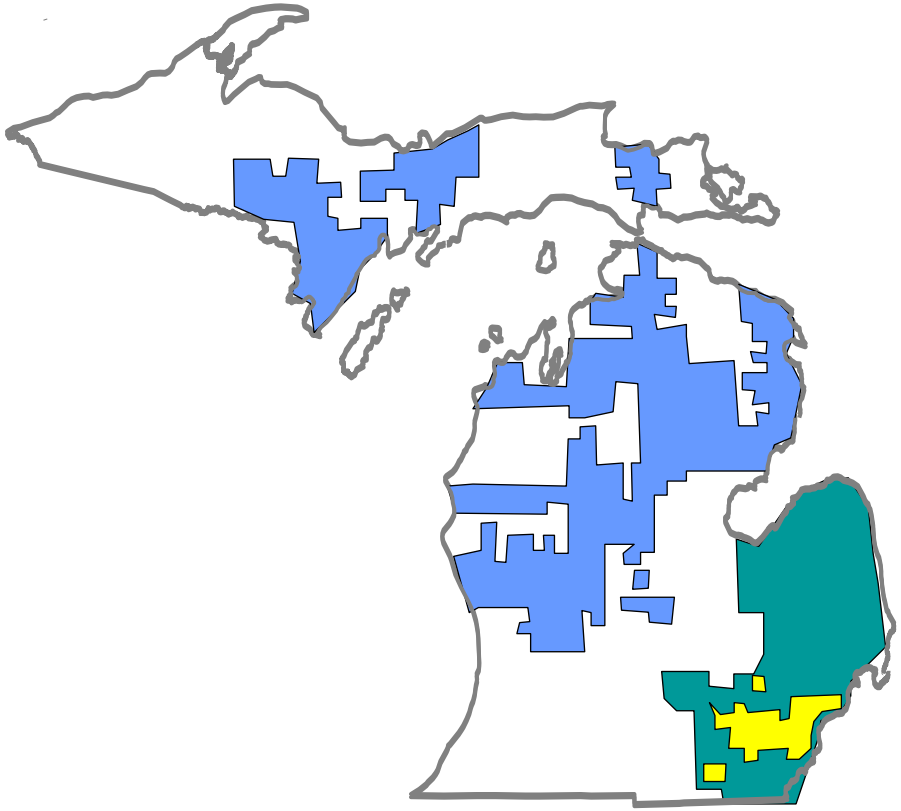
DER – DG Solutions Projects

DOE DER Integration - Phase 3

Project in three parts

1. System study to determine the benefits of customer DER penetration limits on distribution
2. Intentional islanding at the system level and circuit level
3. Fuel cell inverter development and testing to IEEE 1547.1

Virtual Power Plant – Dispatchable Customer Generation (DCG) Program



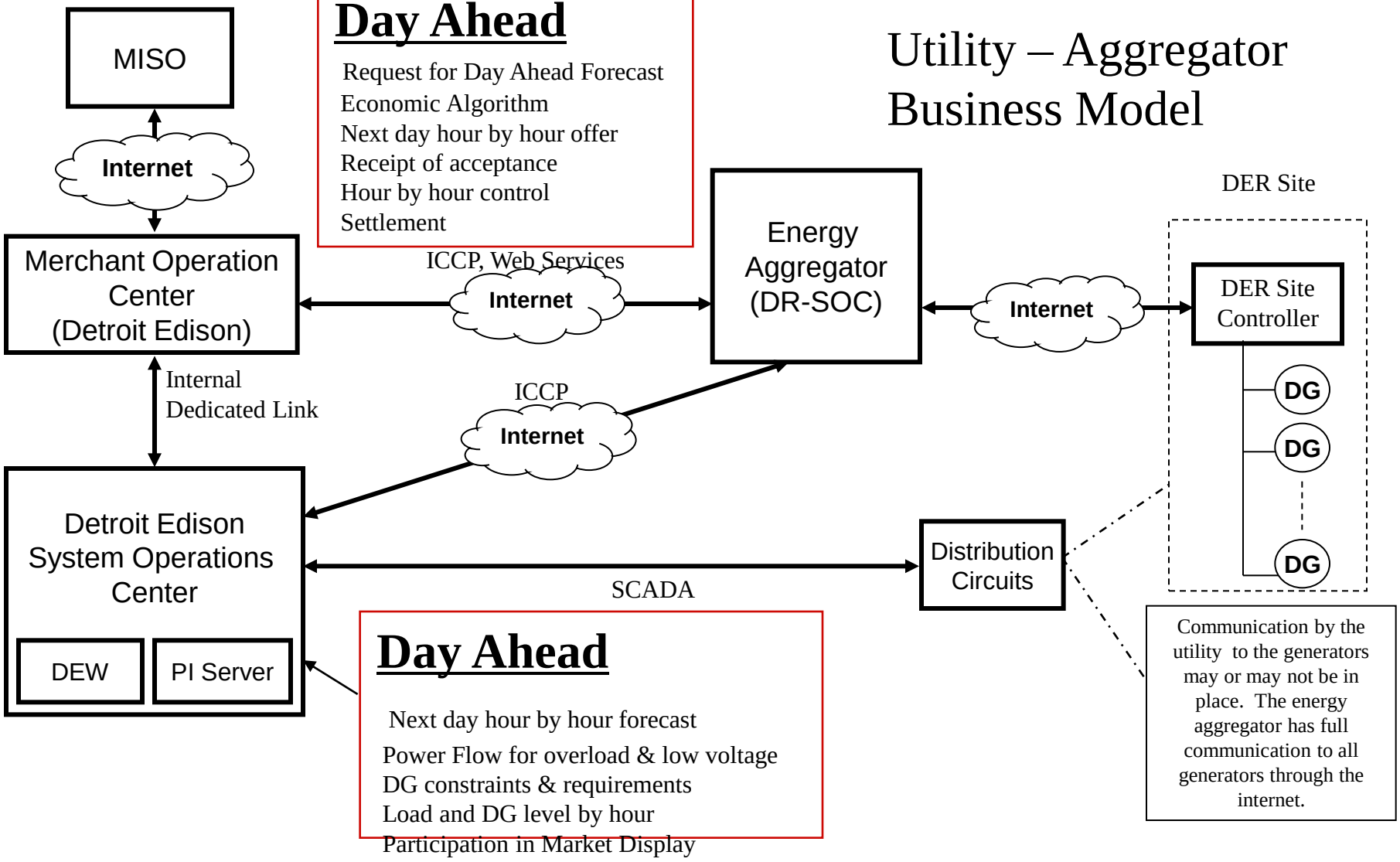
Utility Service Territory

Detroit Edison **MichCon**

Overlap

- Create a 300 MW Virtual Power Plant over the next 10 years using customer generation
- Approximately 200 customers
- 20 MW in 2009
- 30 MW/year beginning in 2010
- Low cost peaking plant
- Provide maintenance, fuel cost, paralleling switchgear and monitoring
- Being reviewed again in 2012

Communication Architecture
Aggregating for Day Ahead – DOE OE funded



Intentional Islanding

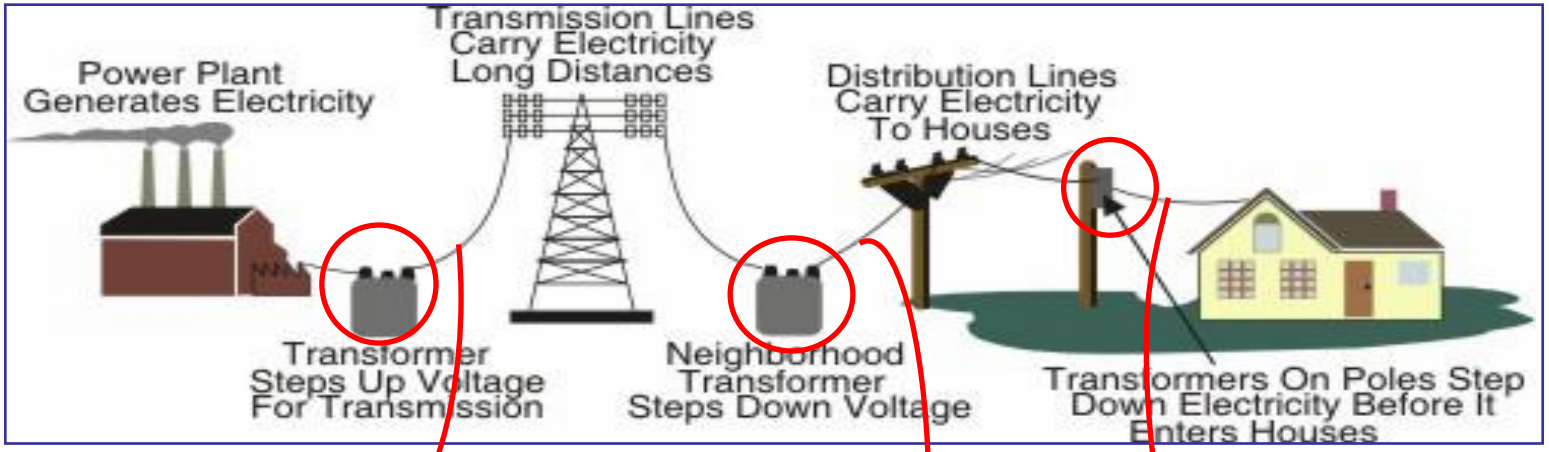
Rural substation with automatic islanding for reliability

Inverter and Fuel Cell System

An inverter system was design, tested and operated in parallel to the grid for over one year.

Electric Utility Energy Storage Applications

DTE Energy



Large Central Storage

100's of MW

Or

In conjunction with Wind Farm Firming

Substation or Circuit Level Storage

1 - 2 MW

Storage Close to Customer

25-50 kW

Ludington pumped storage facility stores renewable energy

DTE Energy

- Began operation in 1973
- 27 billion gallon water reservoir
- Currently produces enough energy to power 1.4 million homes
- $800 million upgrade underway
- Will increase generating capacity from 1,872 MW to 2,172 MW
- Stores renewable energy produced at off-peak hours

PV and Battery Storage Integration

Location

- Monroe County Community College
- 23 miles Southwest of Detroit

System

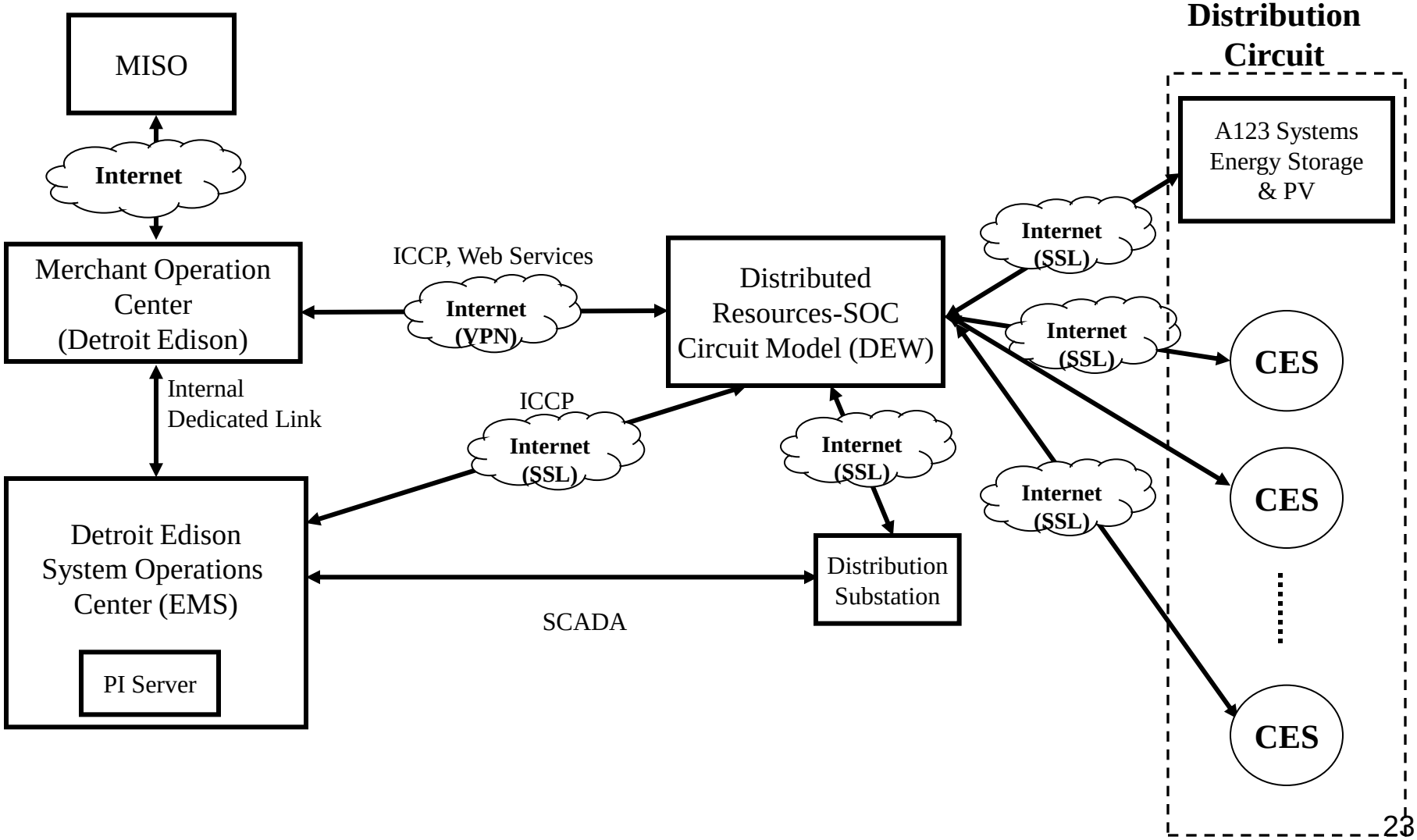
- 500kW PV
- 500kW – 30min (250kWh) Storage
- Dynamic 4-Quadrant PCS / Grid Interface
- Installation / Operation Sept 2012
- 20 Community Energy Storage Systems – Distributed
- Two will be used EV batteries

Community Energy Storage (CES)

- Proof of concept of an aggregated CES; demonstrating the following capabilities:
  - Voltage/VAR Support
  - Circuit load leveling
  - Islanding during outages – Backup power
  - Frequency Regulation - AGC
- Demonstrate secondary-use EV batteries
- Identify gaps, areas of improvement, and provide suggestions on how CES devices and control algorithms can be standardized
- Provide a functional and economic analysis for using the CES system in electric utility applications.

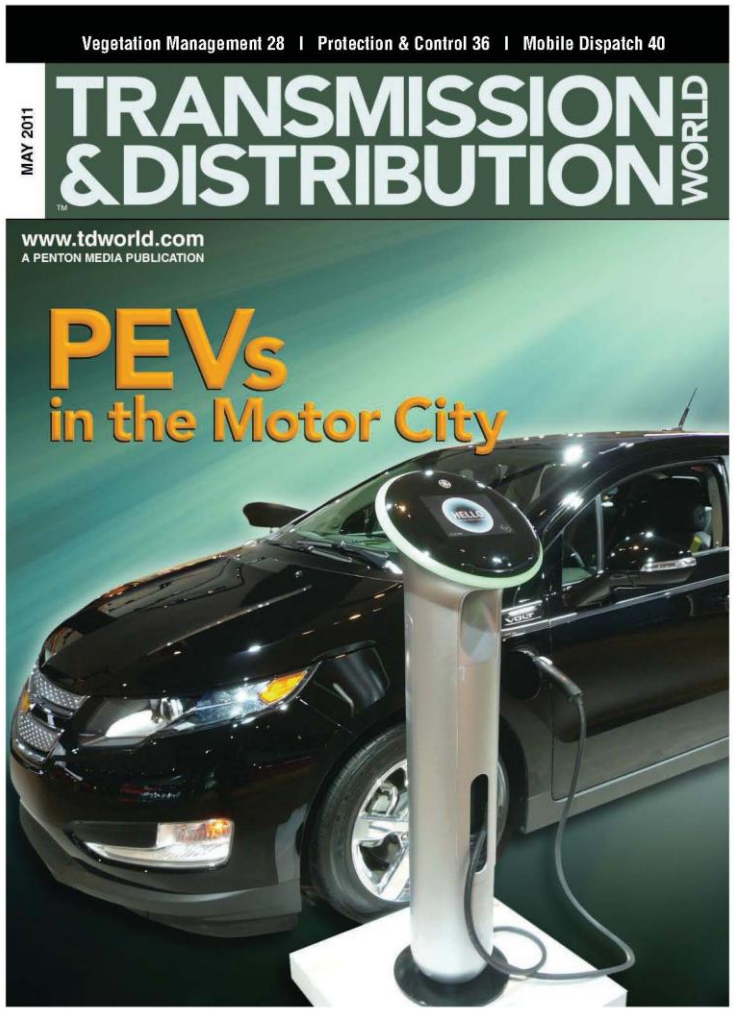
Key Parameters	Value
Power	25 kW
Energy	50 kWh
Voltage	240 / 120V AC
Battery - PHEV	Li-Ion
Round trip efficiency	> 85%

CES Communication Architecture



Solar Energy & Hydrogen Technology

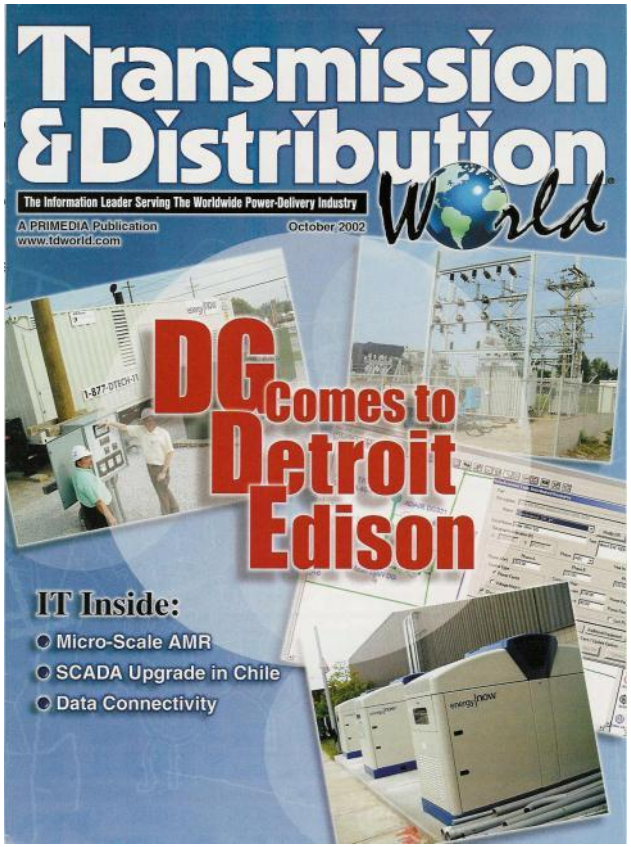
Plug-in Electric Vehicles



- DTE Energy has a long history working with the automotive industry
- PEVs are environmentally friendly
- The grid is ready today … but early planning is important for the future
- Vehicle to grid support
- Intelligent charging is the key

Summary

- Need support of senior level people
- Need internal champion
- Use new technology projects to engage employees
- For DER to be sustainable it needs to be a cost effective solution to a problem
- The solution can be on either side of the meter
- The use of Distributed Energy Resources will evolve



Thank you!