GMP SMART POWER

# Future Grid Vision

GMP PLUG 'N GO

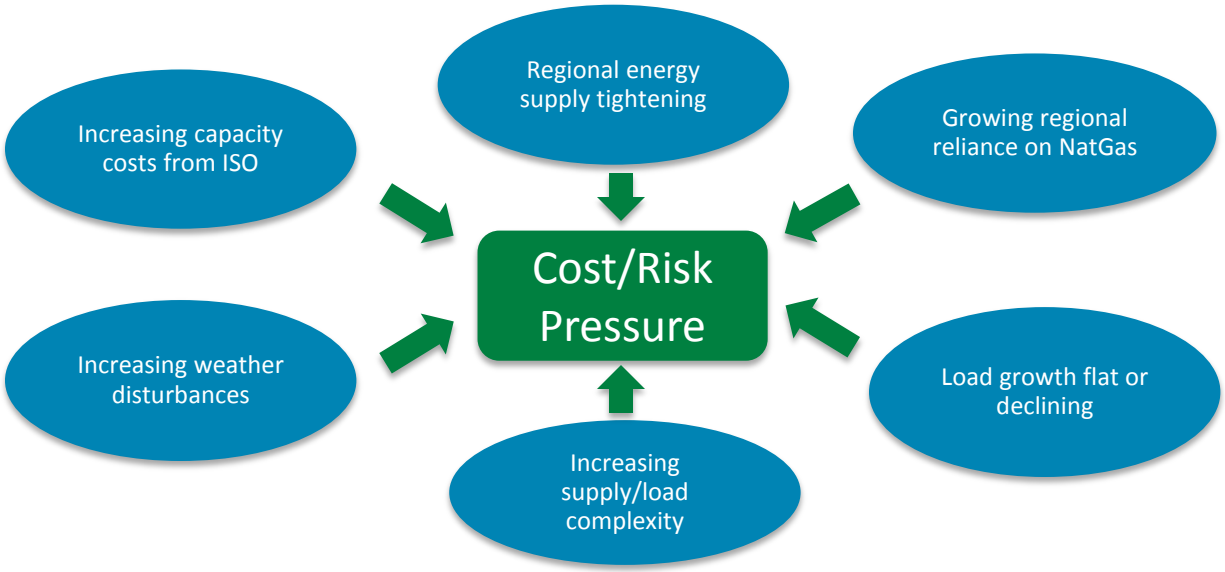
GMP SOLAR POWER

## February 24th, 2015

GMP RENEWABLE POWER

GMP WIND POWER

# Current GMP Challenges/Opportunities




*Technology creates an opportunity for us to embrace progress and transition to another business model*

So what do we do?

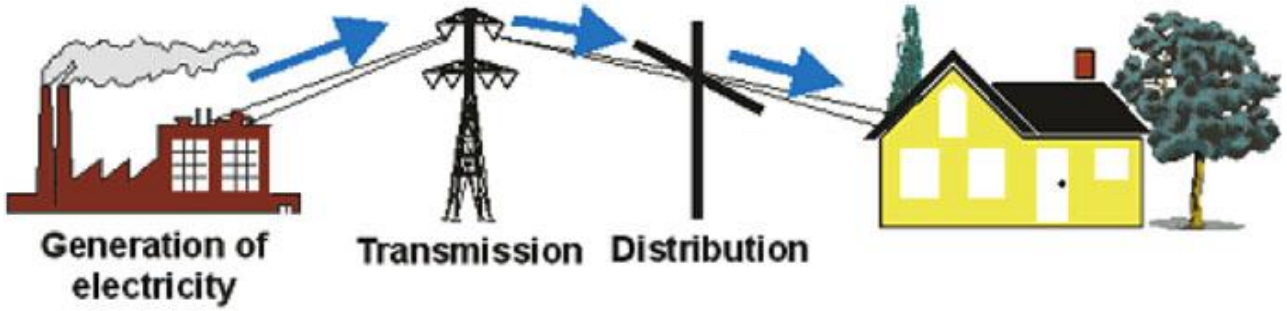
*<u>Three Strategic Imperatives</u>:*

*1) Change the distribution grid model*

*2) Engage customer value*

*3) Increase reliance on local resources*

# Today




Today:

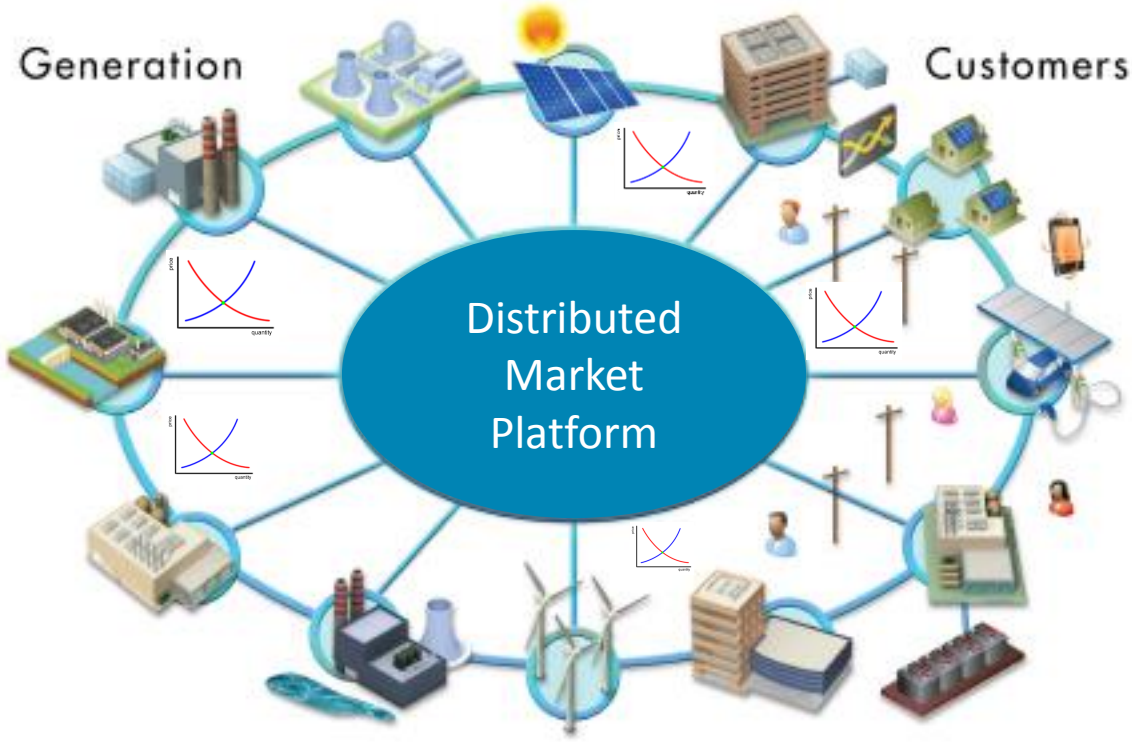
- Supply goes from one direction over long distances, leading to losses and immense infrastructure requirements
- Supply built to accommodate demand => Inefficient asset utilization

***When a customer turns on a kW of load, the bulk grid must supply that additional kW – which could result in nearly 2 kW being turned up to meet the need due to inefficiencies and losses***

# Tomorrow

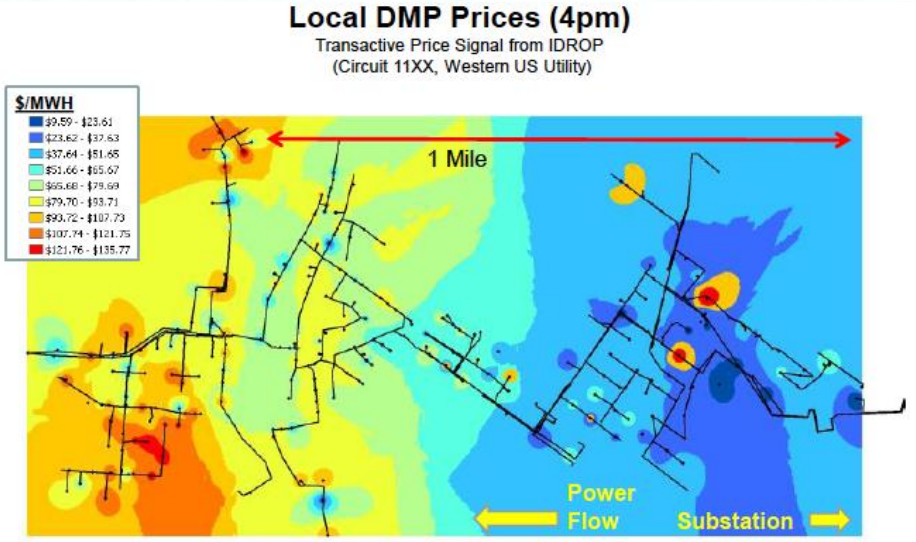
*Guiding Philosophy: Shift the locus of control from the bulk power grid to the near customer distribution grid and subject as much as possible to market forces.*

- Create a market platform leveraging distributed marginal pricing
- Exploit and create value from energy supply and demand assets behind customer meter
- Leverage advanced software and controls to automate grid observation and response functions for greater resilience and efficiency
- New network investment dictated by market forces rather than utility command and control



# Future State: Grid Market Platform

- Distributed marginal pricing provides market for participants
- Multiple energy system products (energy, ancillary services, etc.) priced on a temporal and locational basis.
- ***Technology works on behalf of customers!***




- Value creation through engagement of customer technology and third party developers, app providers and others
- Economic efficiency improvements through matching of supply and demand

What is a Platform Business Model?

- A multi-sided business model that connects various types of producers with various types of consumers.
- Contrasted against the traditional one sided model which takes inputs from suppliers, adds value to create a product and then sells to customers.
- Users of a platform can improve the platform's functionality and value

# Why does a distribution market platform benefit the customer?

- Cost reduction through exploitation of customer owned virtual energy services
- Customers use technology to engage with grid and each other creating network effects and adding value to the platform
- Third party developers create apps to engage customers
- Greater resiliency by virtue of asset growth and control near the customer

Application

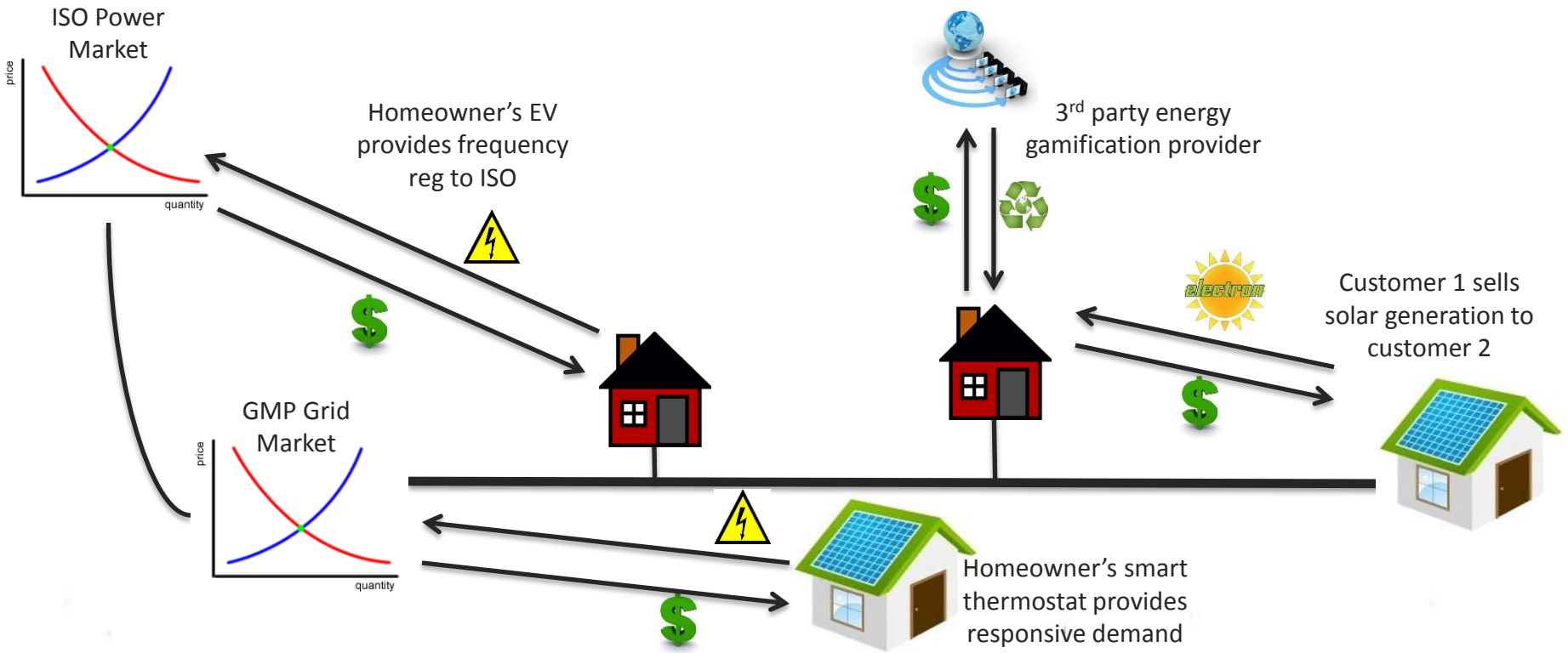
This…

vs. this…

Platform

# Grid Future State: Grid Market Platform Examples

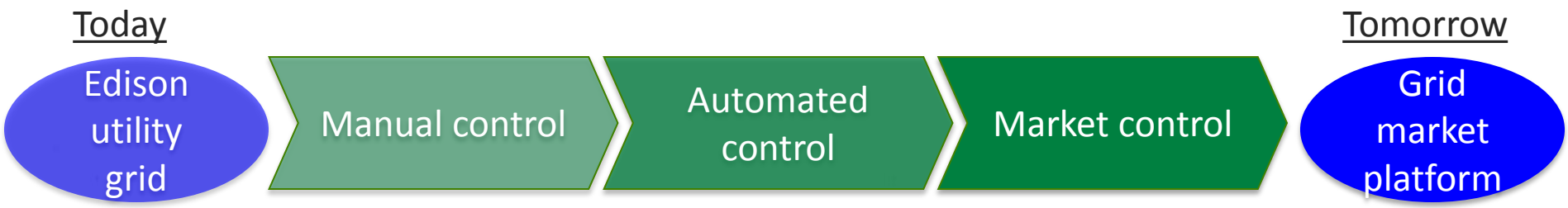
***Directed technology interacts with market and third party providers on behalf of the customer!***




THIS IS NOT EASY TO CREATE!

# Implementation

- National focus on major state policy revisions
  - New York
  - California
  - Massachusetts
- GMP Philosophy:  Prove out the system and let policy and regulation follow



# Our First Foray: Rutland Microgrid

Goal: Full integration of renewable generation, battery storage, distribution telemetry and customer devices on a single circuit.

**Controls and software to enable:**

- Frequency Regulation
- Solar ramp smoothing
- Peak management
- Islanding

nrg SM

Spirae wave™

Spring/Summer 2015 Manual Operation → Fall 2015 Automated Operation → Winter 2015/16 Analysis → 2016 Additional Circuits → ??? Dense Nodal Pricing

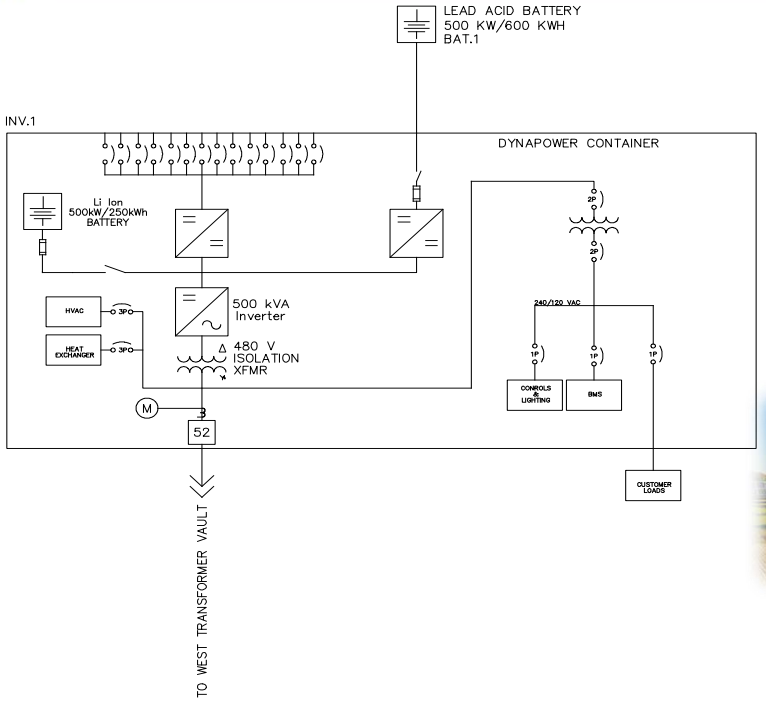
# Pilot Circuit – East Rutland




Stafford Hill

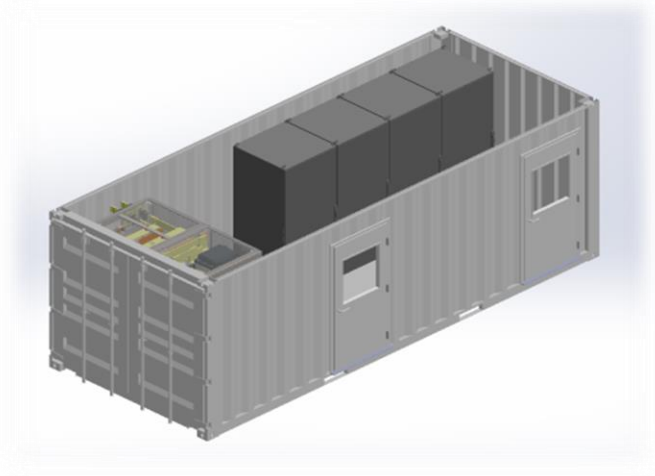
- ~4 MW peak load
- 2.5 MW solar
- 1 MW solar
- 150 kW solar
- 4 MW battery storage
- 200 controllable water heaters

# Key Building Block: Solar+Battery




Stafford Hill Solar+Battery

- 2.5MW Fixed Solar on Landfill Cap
- 2MW/1MWH Lithium Ion Batteries
- 2MW/2.4MWH Lead Acid Batteries
- 4 – 500KW Multiport Inverters



**GMP System Expansion Strategy**

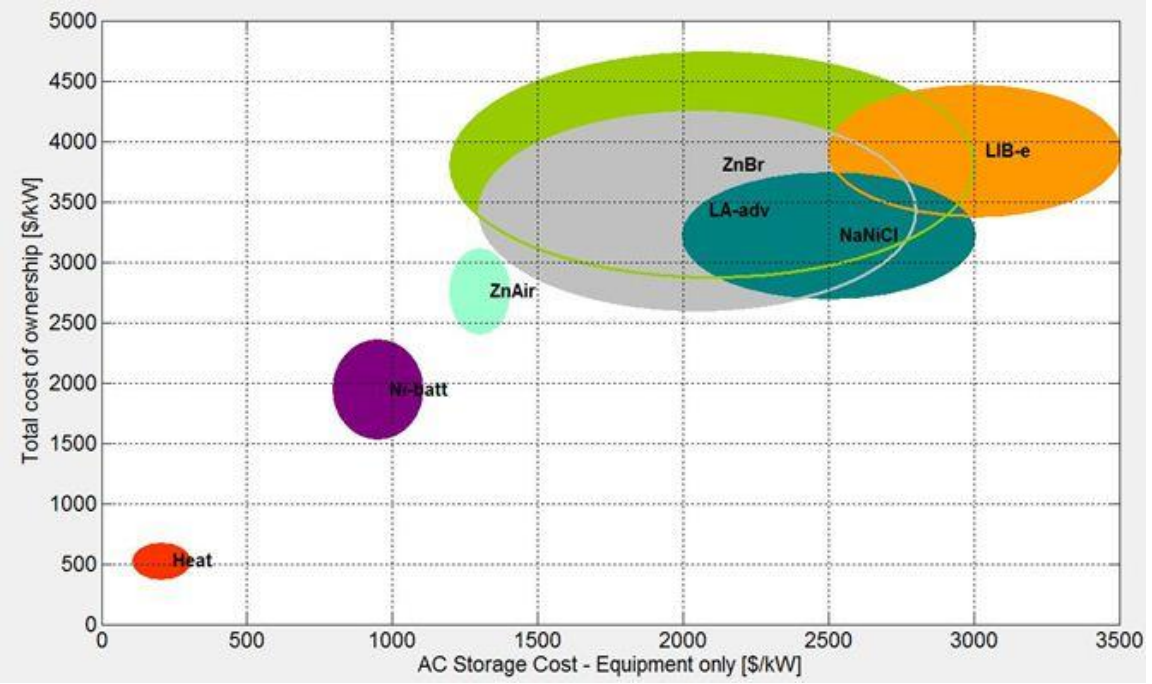
- Modularize storage solution for cost reduction
- Installation on most susceptible feeders to provide outage ride through during major storms
- Assets can produce other value streams during non-storm time (voltage regulation, on-off peak arbitrage, asset investment delay)

# Value of Customer Engagement

*Enormous untapped capacity potential exists on the customer side of the meter.*

- Commercial and residential hot water heating
- Commercial and residential building envelope
- Commercial ice chilling
- Residential ceramic brick heat storage systems
- Electric Vehicle battery

Electric Thermal Storage is the least cost form of energy storage




*Example: Residential Hot Water Heating*

- ~ 100,000 electric hot water heaters in state
- Assumed net peak demand of 2 kW
- 20% control penetration could yield 40 MW
- Worth approximately $4M/year in demand savings alone
- Does NOT count savings from frequency reg, intermittent renewable integration, etc.

# Regulatory/Policy 2.0 (My Opinion)

1) Change the fundamental utility capital model

- Return on capital invested does not create efficiency or innovation
- Move to capped revenue model or some other true performance based model

2) Turn grid into platform business

- Transparent dense nodal pricing encourages third party innovation
- Value of distributed resources becomes market based
- Utility receives cut of third party revenue

# Thank You

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