

June 16 – August 4, 1-2 pm EDT

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#3EWebinar



Intelligent Generation

Developing the Operating System for the Networked Clean Energy Grid

Environmental Defense Fund

July 9, 2015

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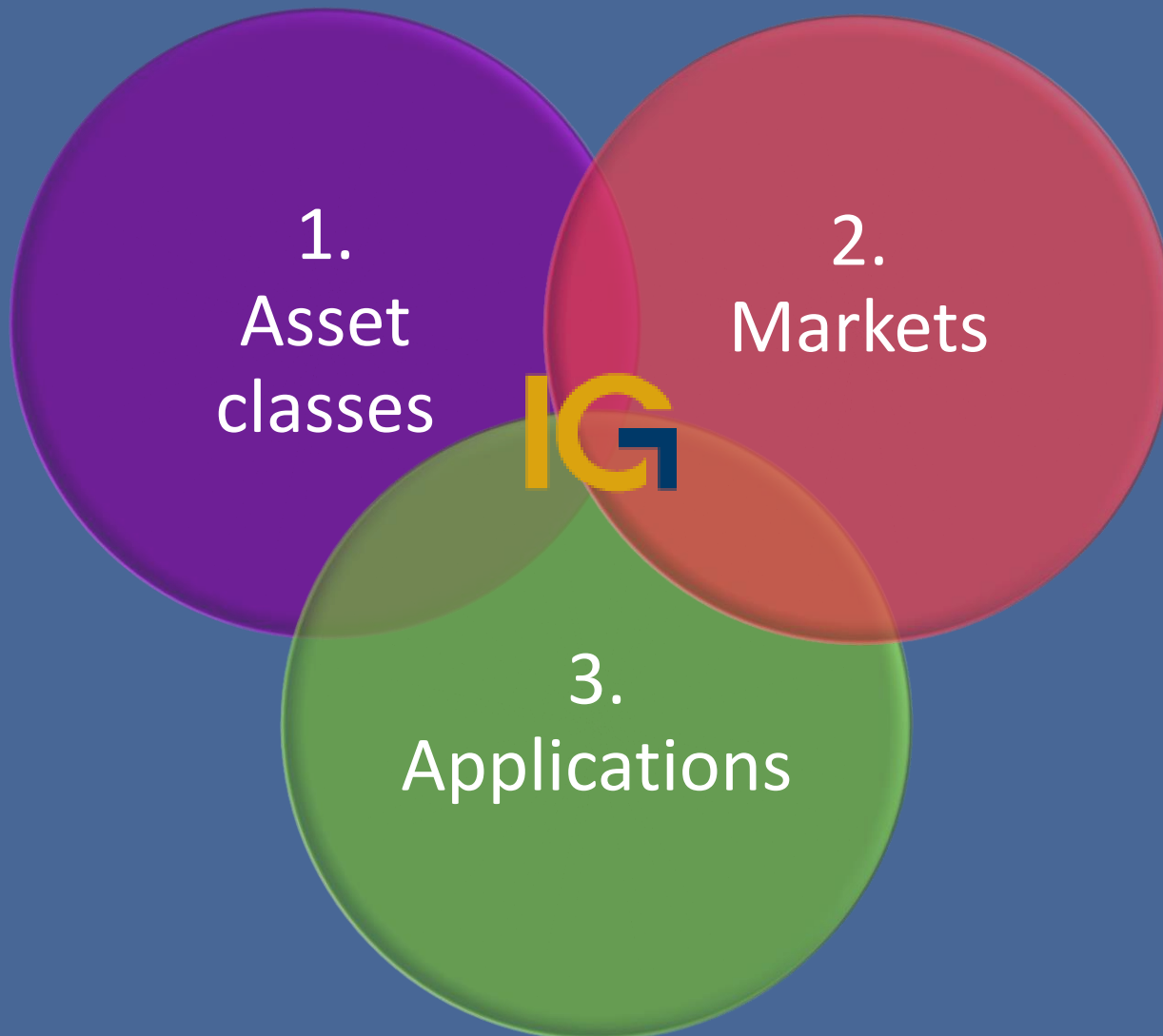


About Intelligent Generation

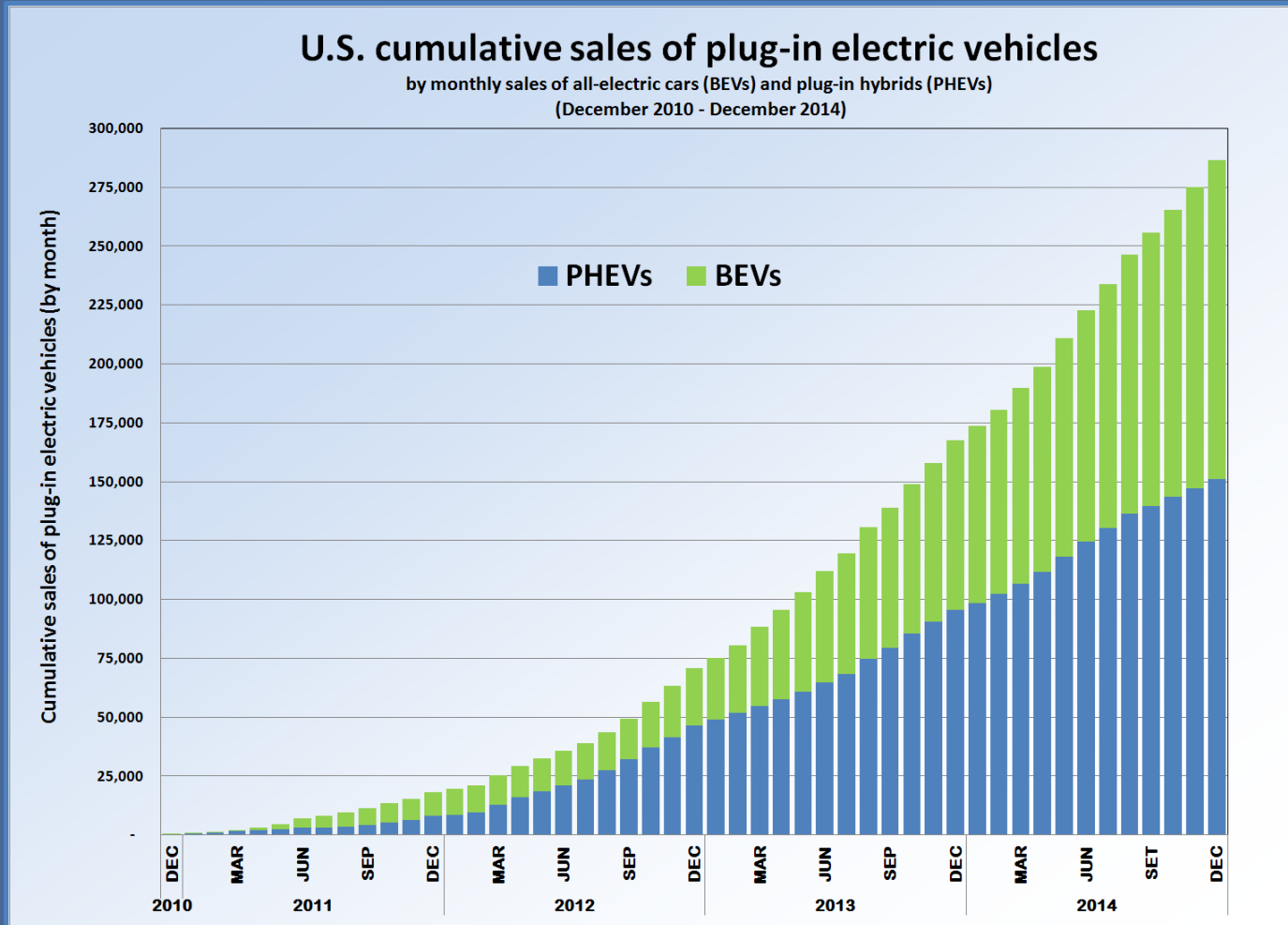
- We believe we can create a world of **sustainable abundance**, powered by **clean energy**
- IG empowers everyone to produce clean energy by maximizing their **market power** in an **intelligent** network
- Intelligent Generation provides the operating system for the **networked clean energy grid**



Operating Model Dimensions



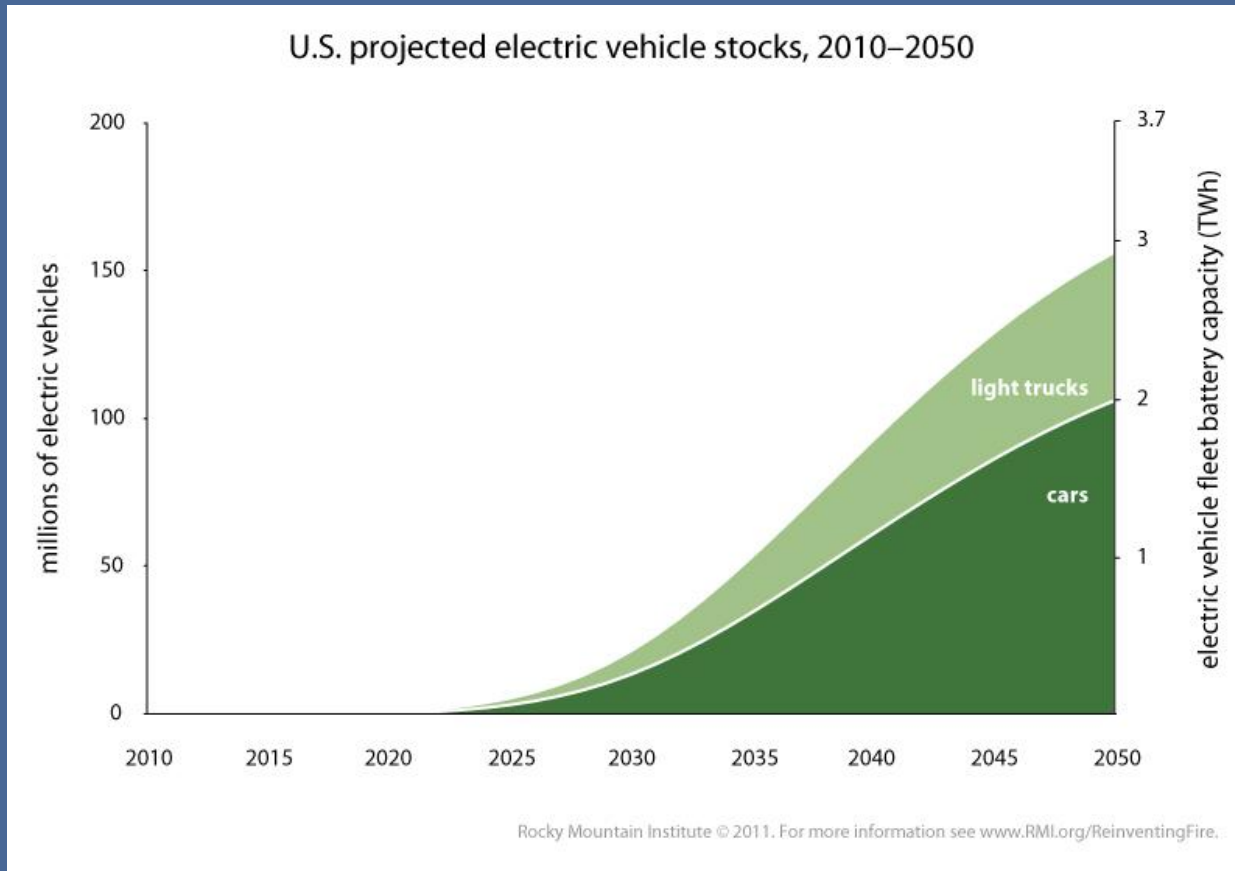
Asset Class



Jeff Cobb (2014-09-09). "Americans Buy Their 250,000th Plug-In Car". *HybridCars.com*.

Asset Class

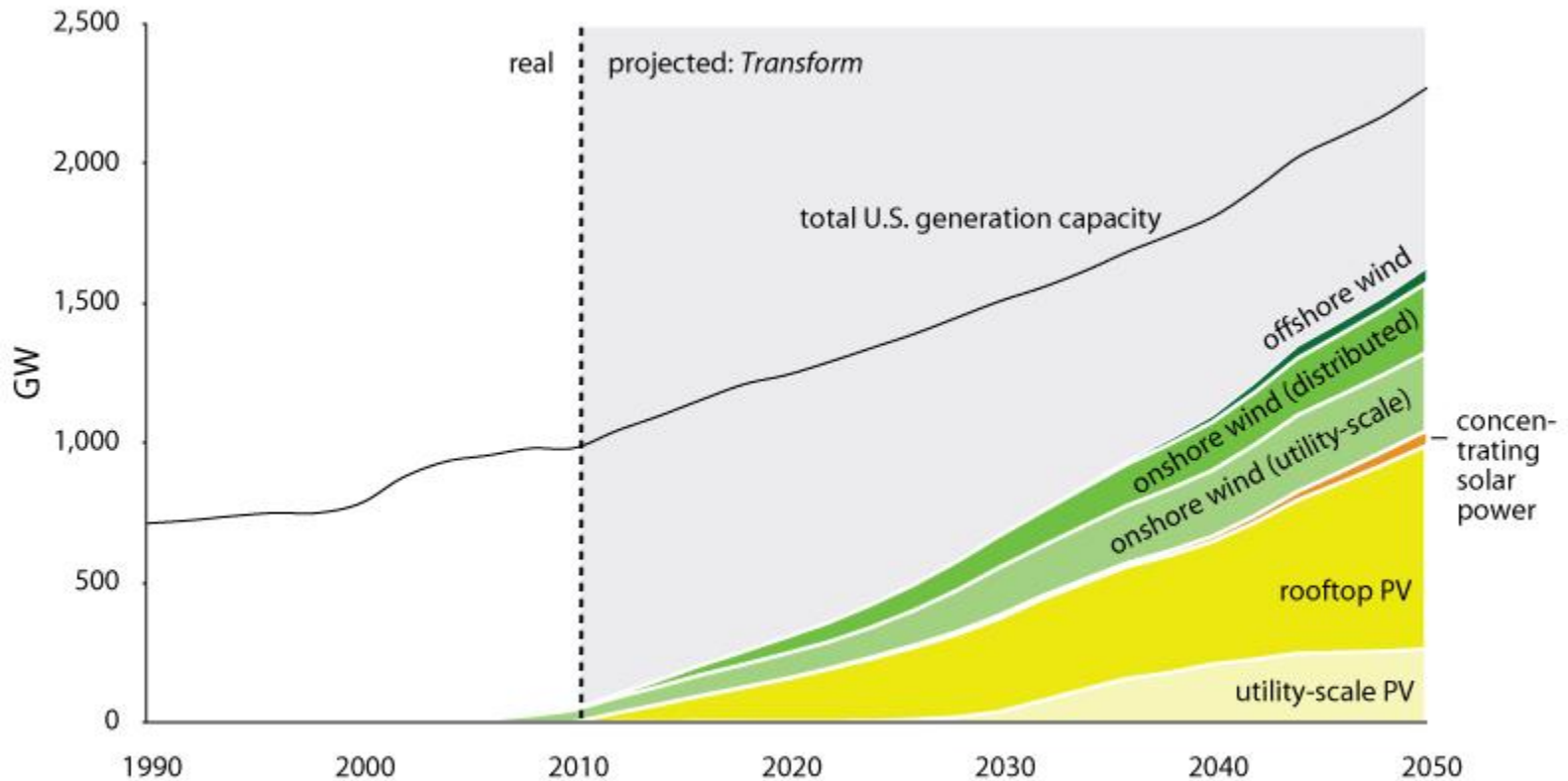
Annual peak demand last year was **800 GW** (.8 TW)



Source: Rocky Mountain Institute

Asset Class

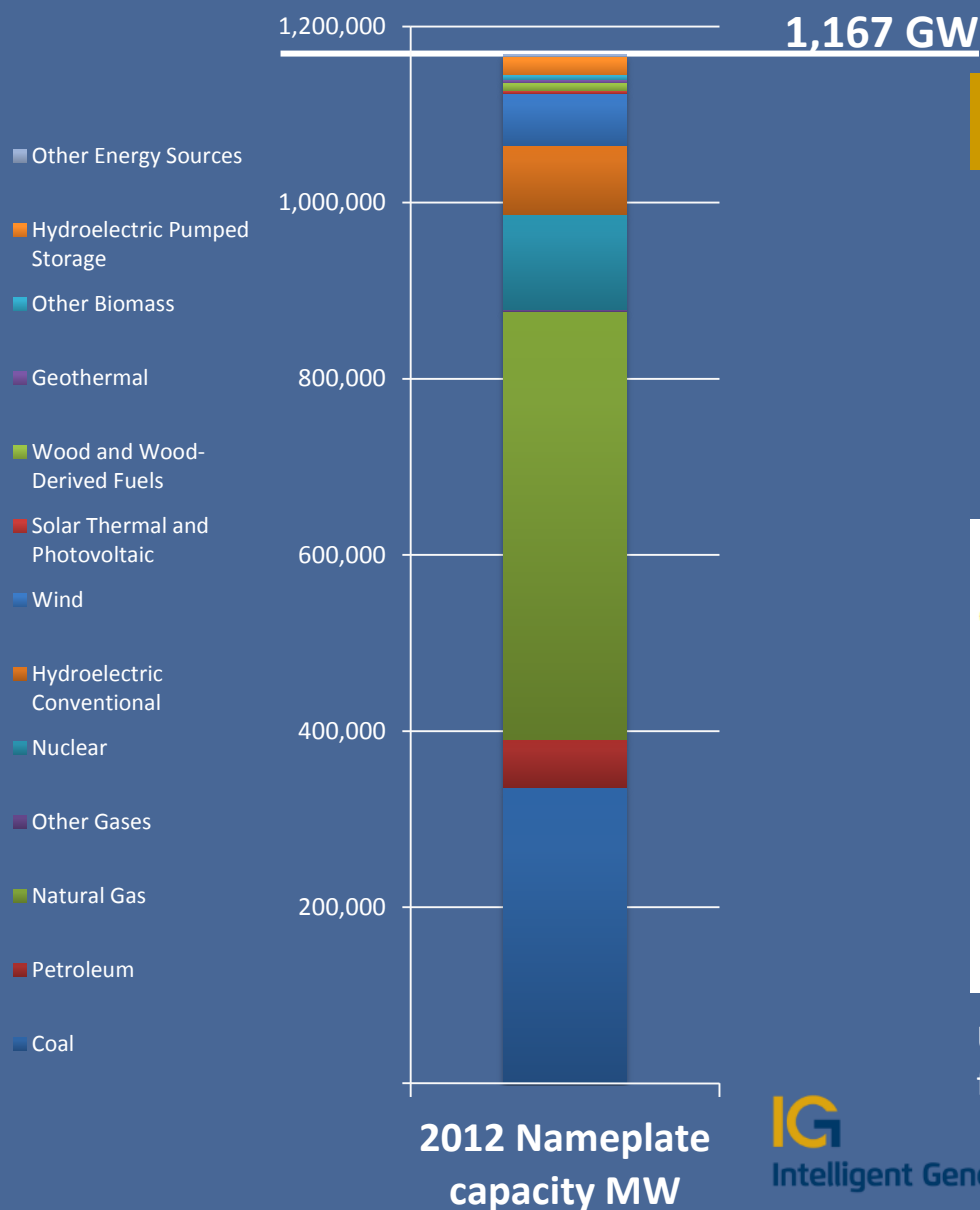
U.S. installed wind and solar power capacities and projections, 1990–2050



Rocky Mountain Institute © 2011. For more information see www.RMI.org/ReinventingFire.

Source: Rocky Mountain Institute

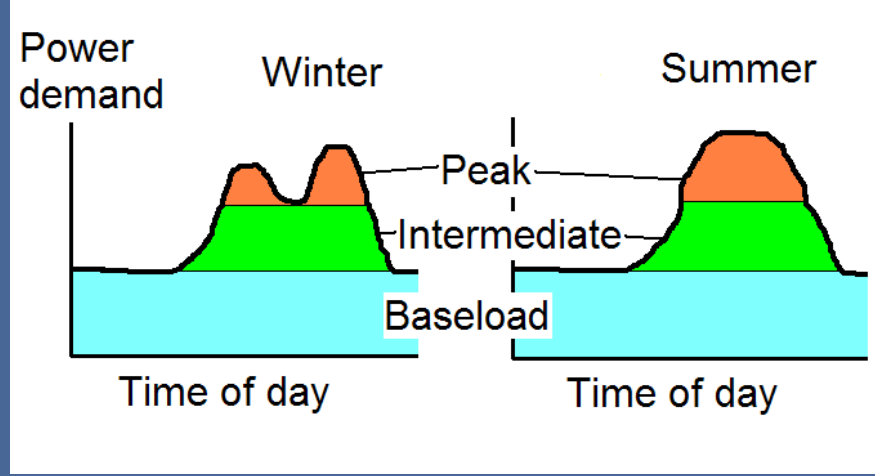
Energy storage needed to address inefficiencies



$\div 2.5$

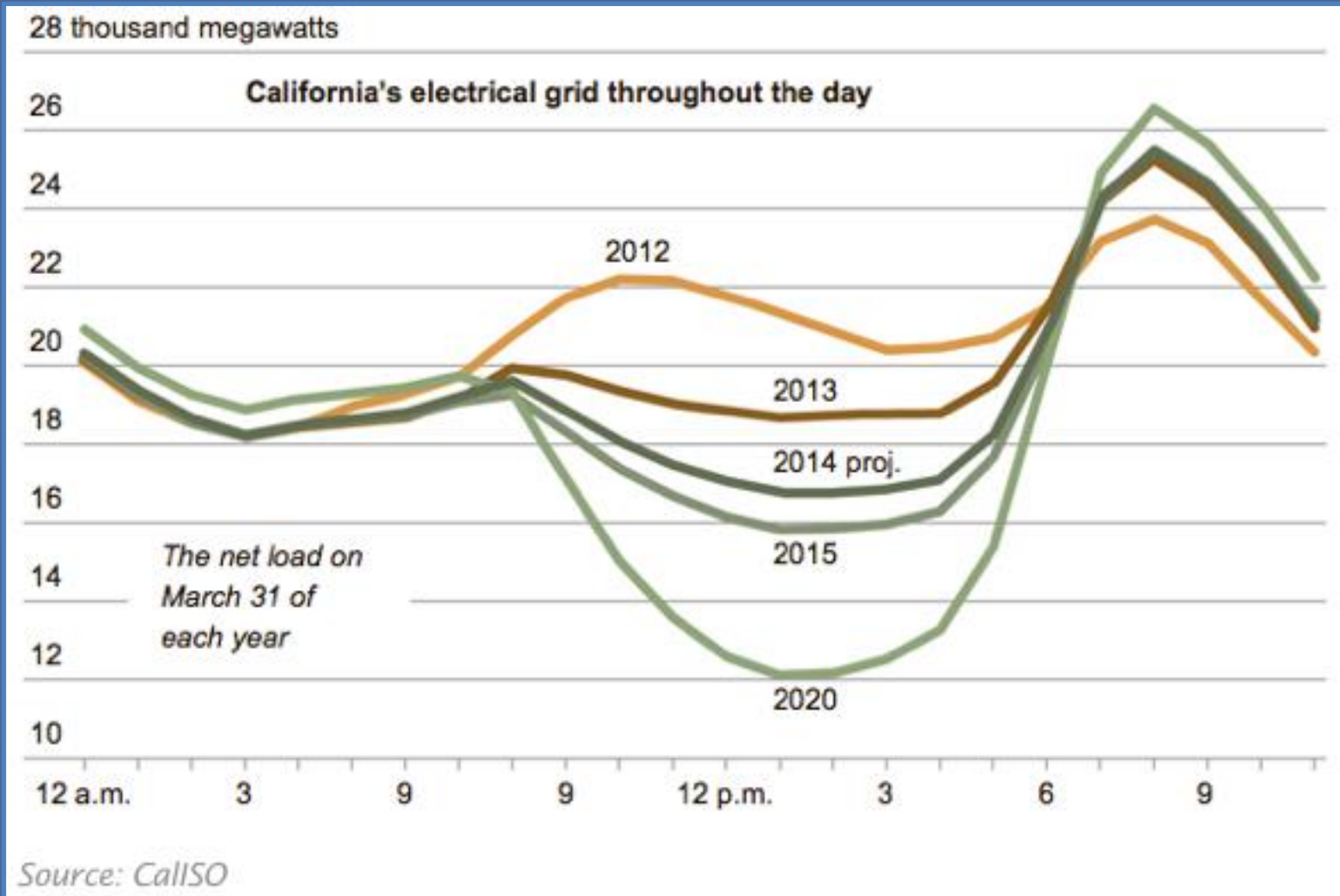
467 GW demand

If electricity were an efficient supply chain, it would have 150% excess capacity!

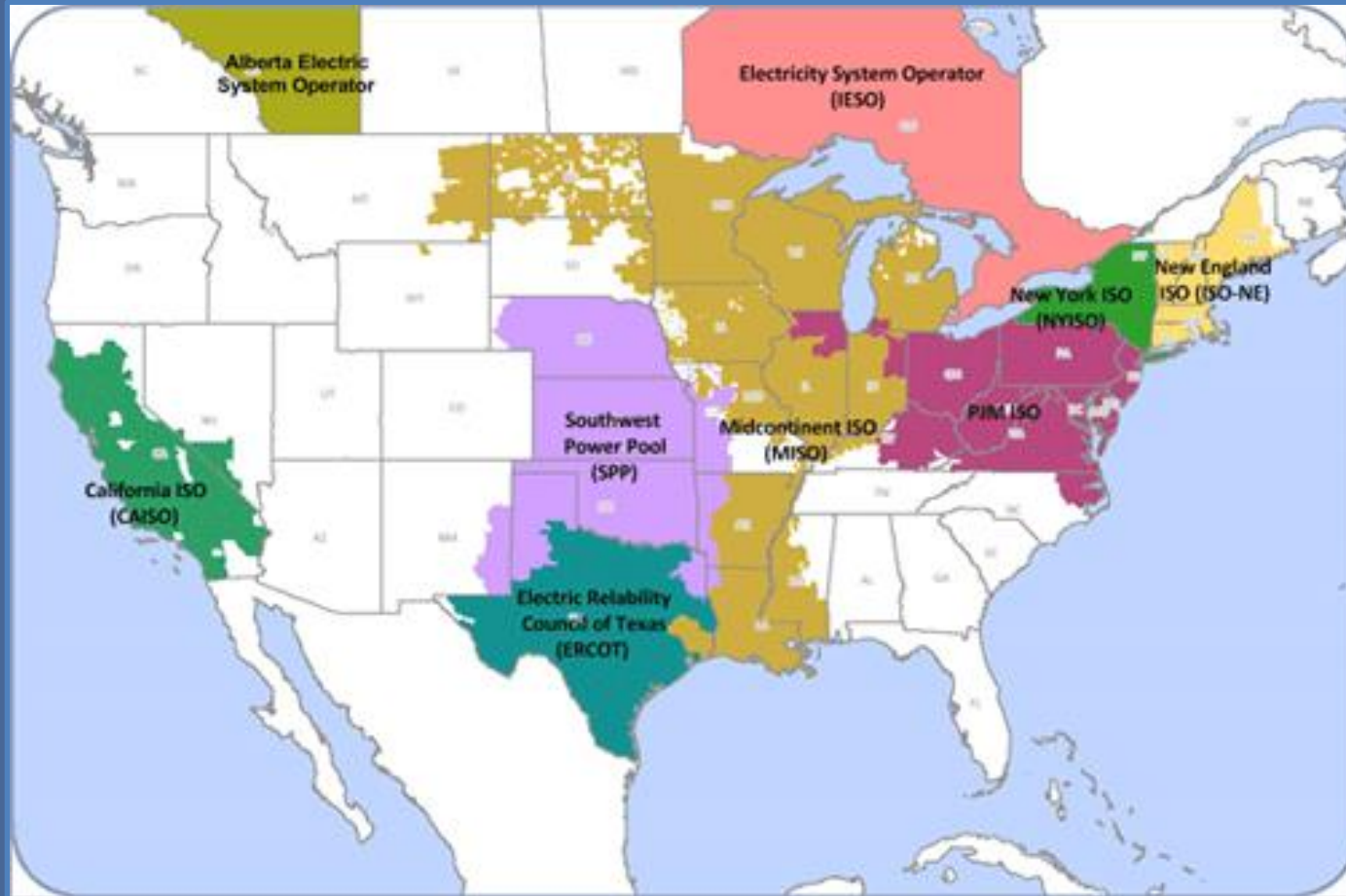


US Annual electrical consumption 4,095 B.kWh = flat average demand of 467 GW

The Duck Curve



Markets



Source: FERC

A Complex Overlay

- Federal (FERC) vs. state (PUC)
- De-regulated (wires and meters, merchant power, IPP) vs. vertically integrated
- IOU vs. muni vs.co-op
- Utility-sided vs. behind the meter

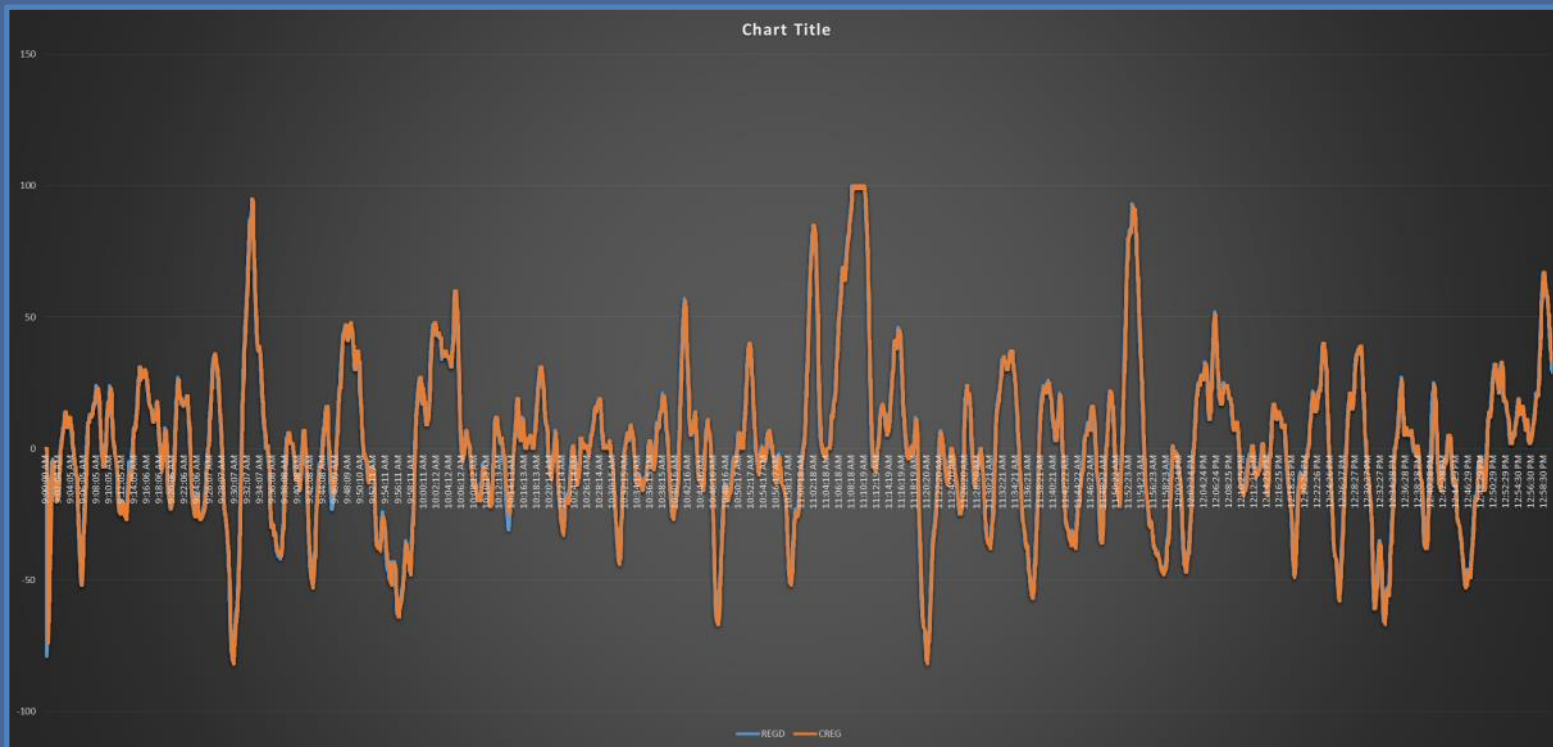
Application

Relevant grid services to consider

Grid Domain	Type of Avoided Cost	Grid Services Possible with Storage
Generation	Fixed	Resource Adequacy (Capacity)
		Resource Adequacy (Flexibility)
	Variable	Energy (Time-shifting / Arbitrage)
		Frequency Regulation*
		Spinning Reserve*
		Non-spinning Reserve*
Transmission	Fixed	Upgrade Deferral / Avoidance (Capacity)
	Variable	Energy Loss Reduction
		Voltage Support
Distribution	Fixed	Upgrade Deferral / Avoidance (Capacity)
	Variable	Energy Loss Reduction
		Voltage Control / Power Quality

Source: EPRI

Example: Frequency Regulation



- Blue is PJM regulation signal, gold is IG tracking it.
- **96% performance score** (40% is PJM minimum)
- Average hourly clearing price: \$40/MW-hour

IG's Genesis of the Operating System

Problem:

Energy Storage without intelligent application is non-economic



IG's solution:

Intelligently leverage energy storage to **optimize economics.**



Frequency regulation, capacity reduction and ITC




Frequency regulation during vehicle off hours (\$8,000/yr./vehicle)



Network solution extends battery life

Intelligent Solar with Storage Benefits

IG Intelligent Solar delivers benefits stack:

<u>Item</u>	<u>Benefit</u>	<u>Conventional Solar</u>	
<u>Energy</u>	<u>Save on Electricity Bill</u>	✓	✓
<u>Capacity Power</u>	<u>Save on Electricity Bill</u>		✓
<u>Demand Power</u>	<u>Save on Electricity Bill</u>		✓
<u>Fast Response Frequency Regulation</u>	<u>Earn Power Market Revenues</u>		✓
<u>Battery</u>	<u>Protect with Back-up Power</u>		✓

Bottom Line Results

Earn back 15-20% of annual energy costs, depending on battery size.

Save 10-20% off the power-related charges on electricity bills.

Protect critical operations with battery backup at no extra cost.

IG Platform for Multiple Storage Applications



Grid Balancing

IG Solar

IG Reserve

IG Fleet

IG Grid



Summary

- Solar + storage, EVs are emerging markets today
- Impact on the grid within 10 years will be seismic
- Market will drive management, control and monetization of the distributed clean energy grid
- IG poised to be platform leader for networking these distributed assets along dimensions of:
 1. Asset class
 2. Market
 3. Application

Thank You!

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