



Peer Review and Update Meeting 2014
U.S. Department of Energy
Energy Storage Systems Program (ESS)

**Overview of ARRA Smart Grid
Energy Storage Demonstrations**

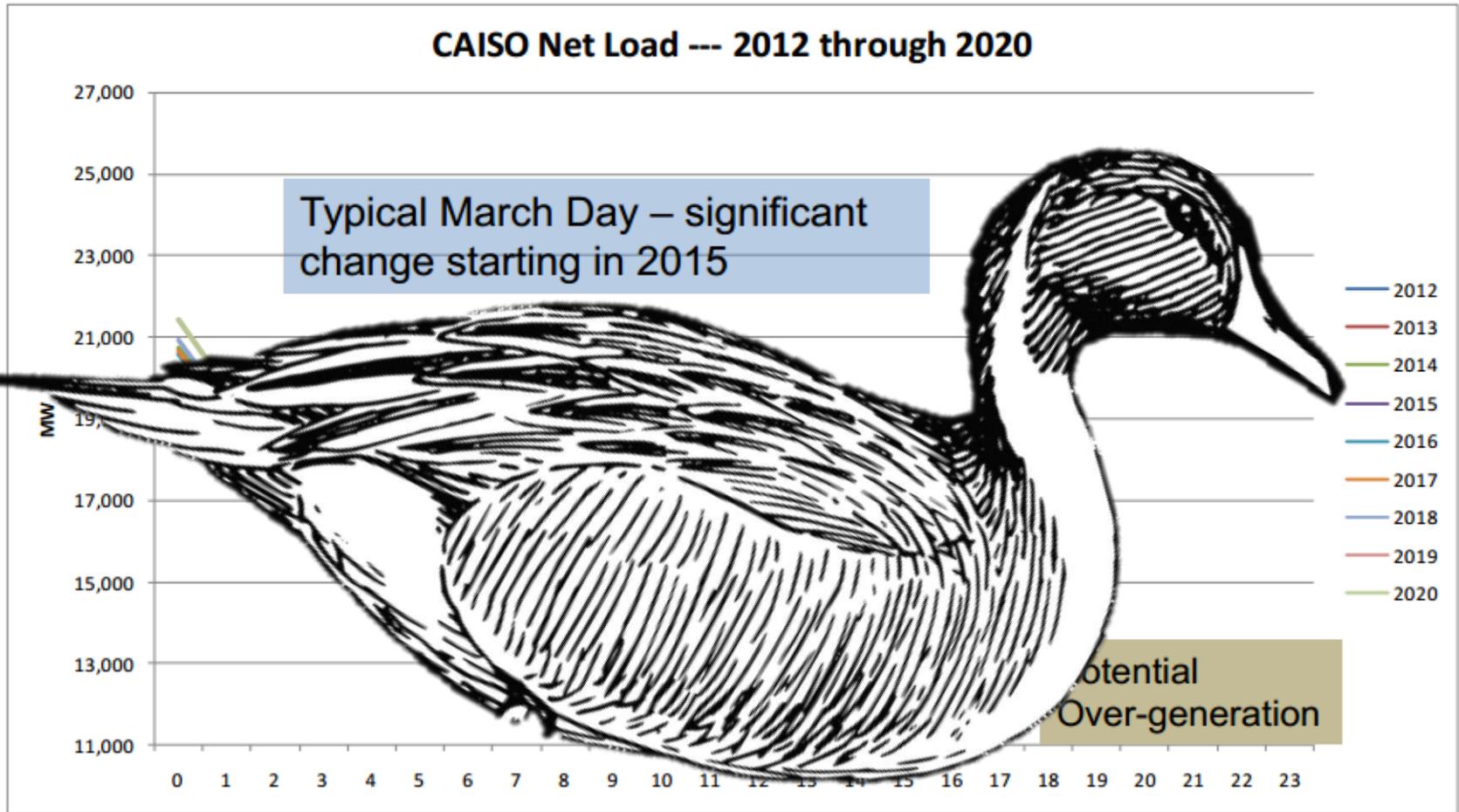
Ron Staubly – National Energy Technology Laboratory
September 17, 2014

DOE Smart Grid Demonstration Program





My version of California's "duck curve"



The Program At a Glance



Recipient	Demo/Pilot Test Location	Storage Capacity	Storage Technology Provider	Storage Technology	Utility	Federal Funding	Total Project Value
AREA OF INTEREST 2.1 - Battery Storage for Utility Load Shifting							
Southern California Edison	Kern County, CA	8MW	LG Chem	Lithium-ion	Southern California Edison	\$24.9M	\$54.8M
Primus Power	Modesto, CA	25MW	Primus Power	Zinc-Halogen	Modesto Irrigation District	\$14.0M	\$46.7M
Duke Energy	Notrees Windfarm, TX	24MW	Xtreme Power	Advanced lead-acid	Duke Energy	\$21.8M	\$43.6M
AREA OF INTEREST 2.2 - Frequency Regulation Ancillary Services							
Hazle Spindle, LLC	Hazle Township, PA	20MW	Beacon Power	Flywheel	PJM/PPL	\$24.0M	\$48.1M
AREA OF INTEREST 2.3 - Distributed Energy Storage for Grid Support							
East Penn Manufacturing Co.	Lyon Station, PA	3MW	East Penn/Ecoult	Advanced lead-acid / ultracapacitor	PJM/PPL	\$2.5M	\$5.0M
Public Service of New Mexico	Albuquerque, NM	2.8MWh	East Penn/Ecoult	Advanced lead-acid / ultracapacitor	Public Service of New Mexico	\$2.5M	\$6.3M
The Detroit Edison Company	MI	1.5MW	Dow KoKam	Lithium-ion	Detroit Edison	\$4.9M	\$10.8M
City of Painesville	Painesville, OH	1MW	Ashlawn Energy	Vanadium redox	Painesville Municipal Power	\$4.2M	\$9.6M
Premium Power Corporation	Everett, MA Worcester, MA	2.5MW	Premium Power	Zinc-Bromide Vanadium Redox	National Grid	\$6.0M	\$12.5M
AREA OF INTEREST 2.4 - Compressed Air Energy Storage (CAES)							
New York State Electric & Gas	Reading, NY	150MW	N/A	CAES	NYSEG	\$29.5M	\$125.0M
Pacific Gas & Electric	TBD, CA	300MW	TBD	CAES	PG&E	\$25.0M	\$355.9M
AREA OF INTEREST 2.5 - Demonstration of Promising Energy Storage Technologies							
Seeo, Inc	Hayward, CA	<25kWh	Seeo	Lithium ion polymer electrolyte	NA	\$6.2M	\$12.3M
Aquion Energy	Pittsburgh, PA	> 10kWh	Aquion Energy	Sodium ion	NA	\$5.1M	\$10.3M
SustainX, Inc.	Seabrook, NH	1.5MW	SustainX	CAES	NA - Pilot Test @ SustainX	\$5.3M	\$10.7M
Amber Kinetics, Inc.	San Diego, CA	500kW	Amber Kinetics, Inc.	Flywheel	UCSD Microgrid	\$3.6M	\$10.0M
Raytheon Ktech	Turlock, CA	250kW	EnerVault	Fe/Cr redox-flow	Valley View Ranches Almond Farm	\$4.8M	\$9.5M



Breakdown by Storage Technology



Lithium Ion Batteries	Flow Batteries	Advanced LABs	Other	CAES	Flywheels
Detroit Edison (Kokam)	Ktech (Enervault)	East Penn	Aquion (Sodium-Ion)	NYSEG	Amber Kinetics
So Cal Edison/ (LG Chem)	Painesville (Ashlawn)	Public Service of NM (East Penn/Ecoult)		PG&E	Beacon Power
Seeo	Premium Power	Duke (Xtreme*)		SustainX	
	Primus Power				



Status of Demonstration Projects



Completed/Ended	Operational	Still in Development/ Construction
Aquion	Beacon Power	Amber Kinetics
NYSEG*	Detroit Edison	PG&E
Public Service of New Mexico	Duke Energy	Painesville†
Seeo	East Penn	Premium Power
	Ktech/Enervault	Primus Power
	SoCal Edison	
	SustainX	

* The NYSEG project was discontinued after Phase 1 feasibility study

† The City of Painesville project is on hold

DOE Smart Grid Demonstration Program



COMPLETED – Aquion Energy Sodium Ion Battery for Grid Level Application



Supporters



BRIGHT CAPITAL



DoE high voltage demonstration at Aquion



DOE Smart Grid Demonstration Program



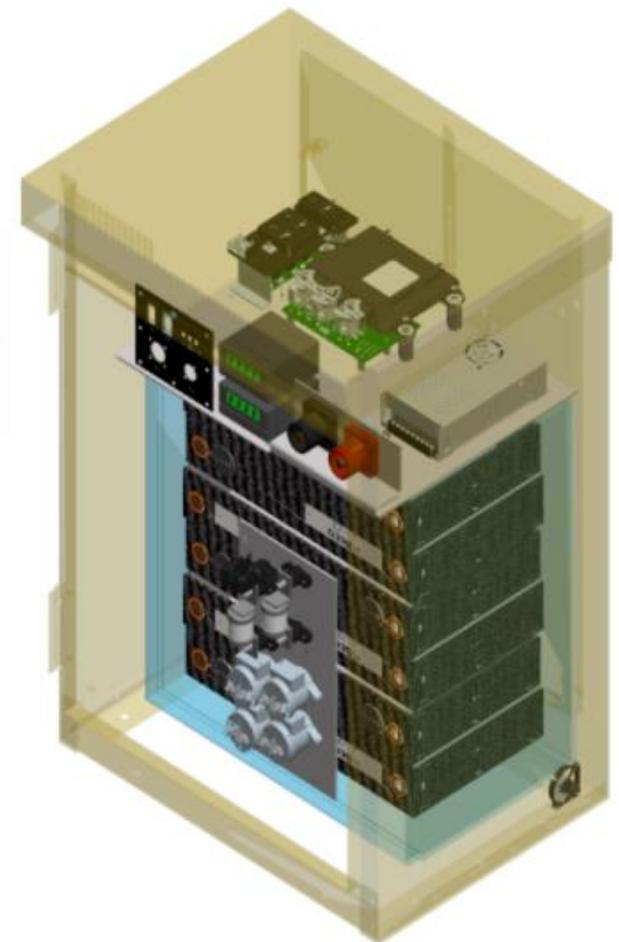
COMPLETED – PNM Resources Prosperity Energy Storage Project



DOE Smart Grid Demonstration Program



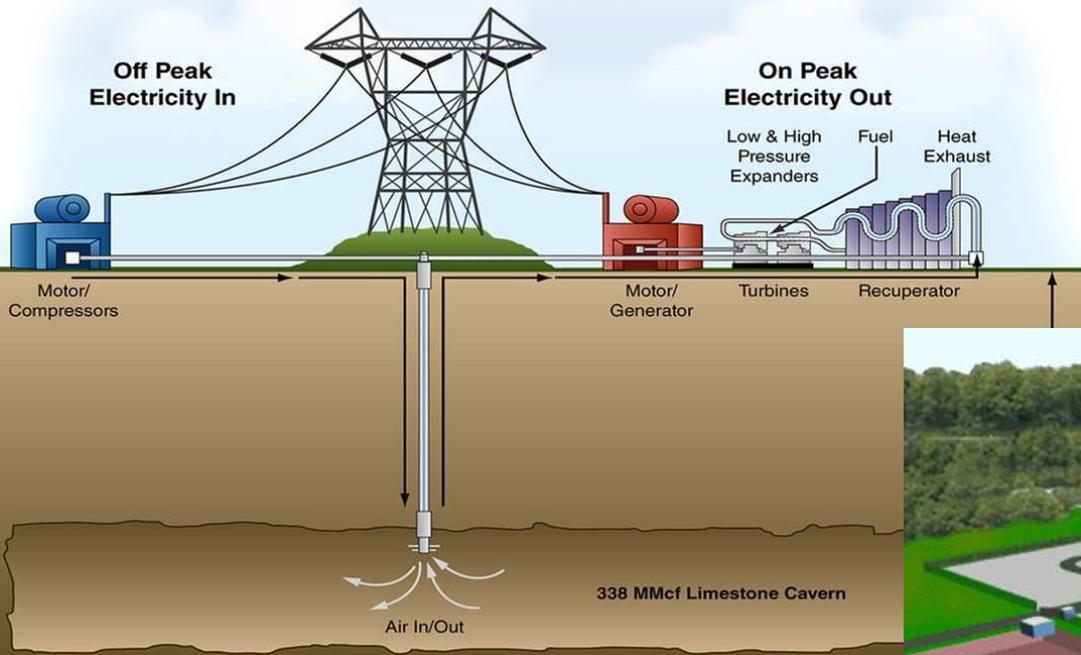
COMPLETED – Seeo Solid-State Batteries for Grid-Scale Energy Storage



DOE Smart Grid Demonstration Program



COMPLETED - New York State Electric and Gas Seneca Compressed Air Energy Storage Project



WorleyParsons
resources & energy



DOE Smart Grid Demonstration Program



OPERATIONAL – East Penn Manufacturing Ancillary Services Using UltraBattery Technology



EAST PENN manufacturing co., inc.



DOE Smart Grid Demonstration Program



OPERATIONAL - Duke Energy Notrees Wind Storage Demonstration Project



DOE Smart Grid Demonstration Program



OPERATIONAL - Detroit Edison Advanced Community Energy Storage for Grid Support



DOE Smart Grid Demonstration Program



OPERATIONAL - Hazle Spindle LLC Beacon Power 20 MW Flywheel Plant



DOE Smart Grid Demonstration Program



OPERATIONAL - Southern California Edison Tehachapi Wind Energy Storage Project



LG Chem

DOE Smart Grid Demonstration Program



OPERATIONAL – SustainX MW-Scale Isothermal CAES System



DOE Smart Grid Demonstration Program



DEVELOPMENT – Raytheon Ktech Redox Flow Battery Demonstration



Raytheon Ktech

EnerVault
Safe, Reliable, Cost-Effective Energy Storage



DOE Smart Grid Demonstration Program



DEVELOPMENT – Amber Kinetics Flywheel Energy Storage Demonstration



AMBER_KINETICS

BERKELEY
ENERGY
SCIENCES
CORP

SIEMENS



SDGE

A Sempra Energy utility™



DOE Smart Grid Demonstration Program

DEVELOPMENT - Primus Power Wind Firming EnergyFarm™



2012 - 13: EnergyCell

2013 - 14: EnergyPod™

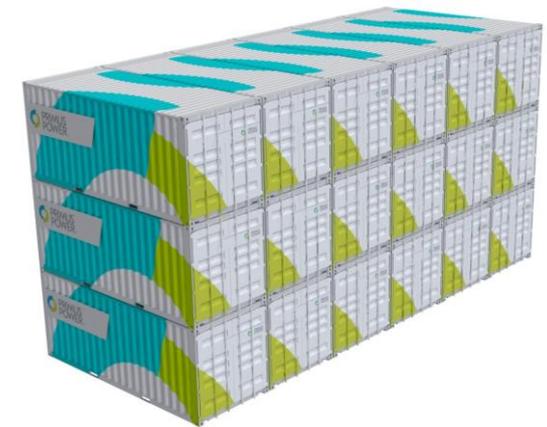
2014 - 15: production starts



20 kW
80 kWh



250 kW
1,000 kWh



MegaWatt
Deployments

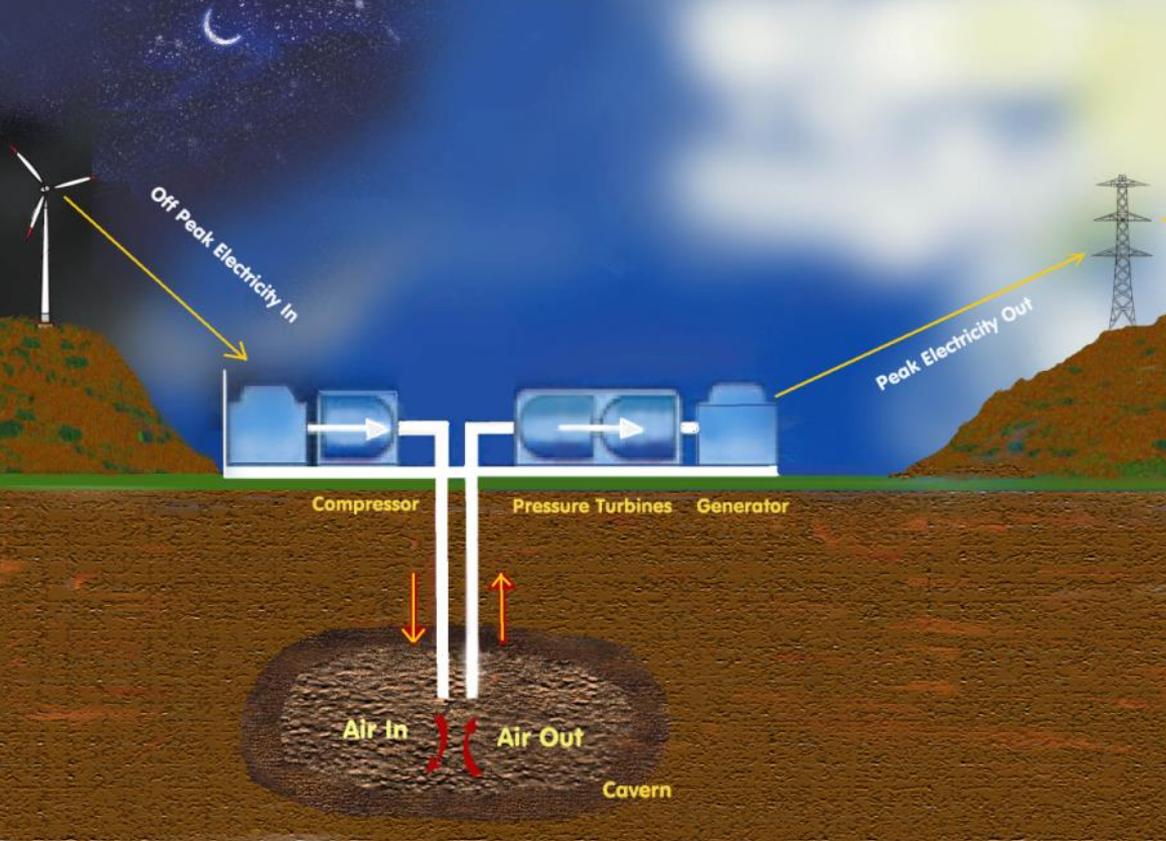


DOE Smart Grid Demonstration Program



DEVELOPMENT – PG&E

Compressed Air Energy Storage In California



Pacific Gas and Electric Company[®]



DOE Smart Grid Demonstration Program

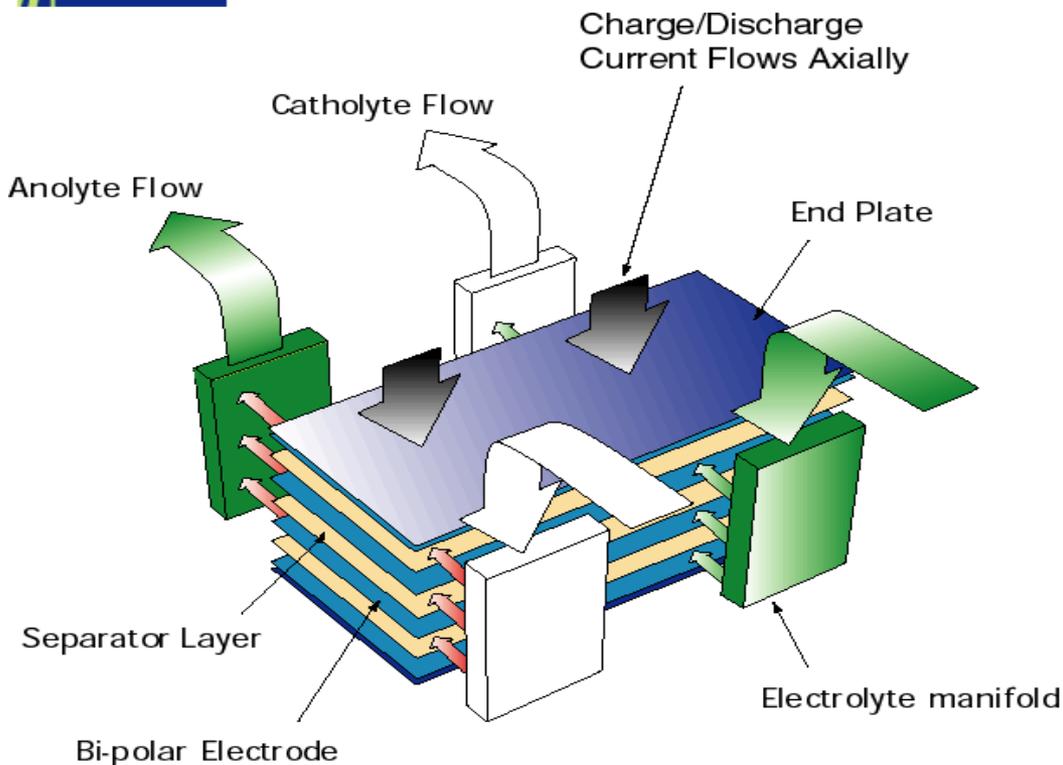


DEVELOPMENT – Premium Power Distributed Energy Storage System Demonstration

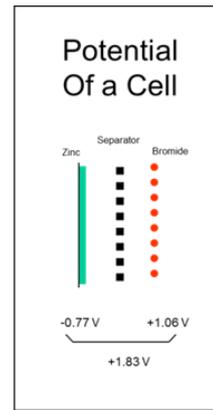
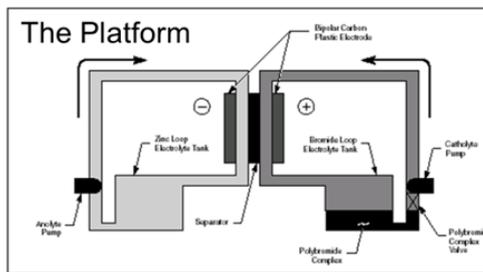


Premium Power

nationalgrid



	Charge	Discharge	The Reaction
Anode	$Zn^{++} + 2e^- \rightarrow Zn$	$Zn \rightarrow Zn^{++} + 2e^-$	
Cathode	$2 Br^- \rightarrow Br_2 + 2e^-$	$Br_2 \rightarrow 2e^- + 2Br$	



DOE Smart Grid Demonstration Program



ON HOLD - Painesville Municipal Electric Power Vanadium Redox Battery Demonstration Project



DOE Smart Grid Demonstration Program

For Further Information



- Visit SmartGrid.Gov for more information on the SGDP energy storage demonstration projects
 - Build Metrics for installed equipment are posted as they are deployed
 - Technology Performance Reports (TPRs) will be published on the site as they become available.

