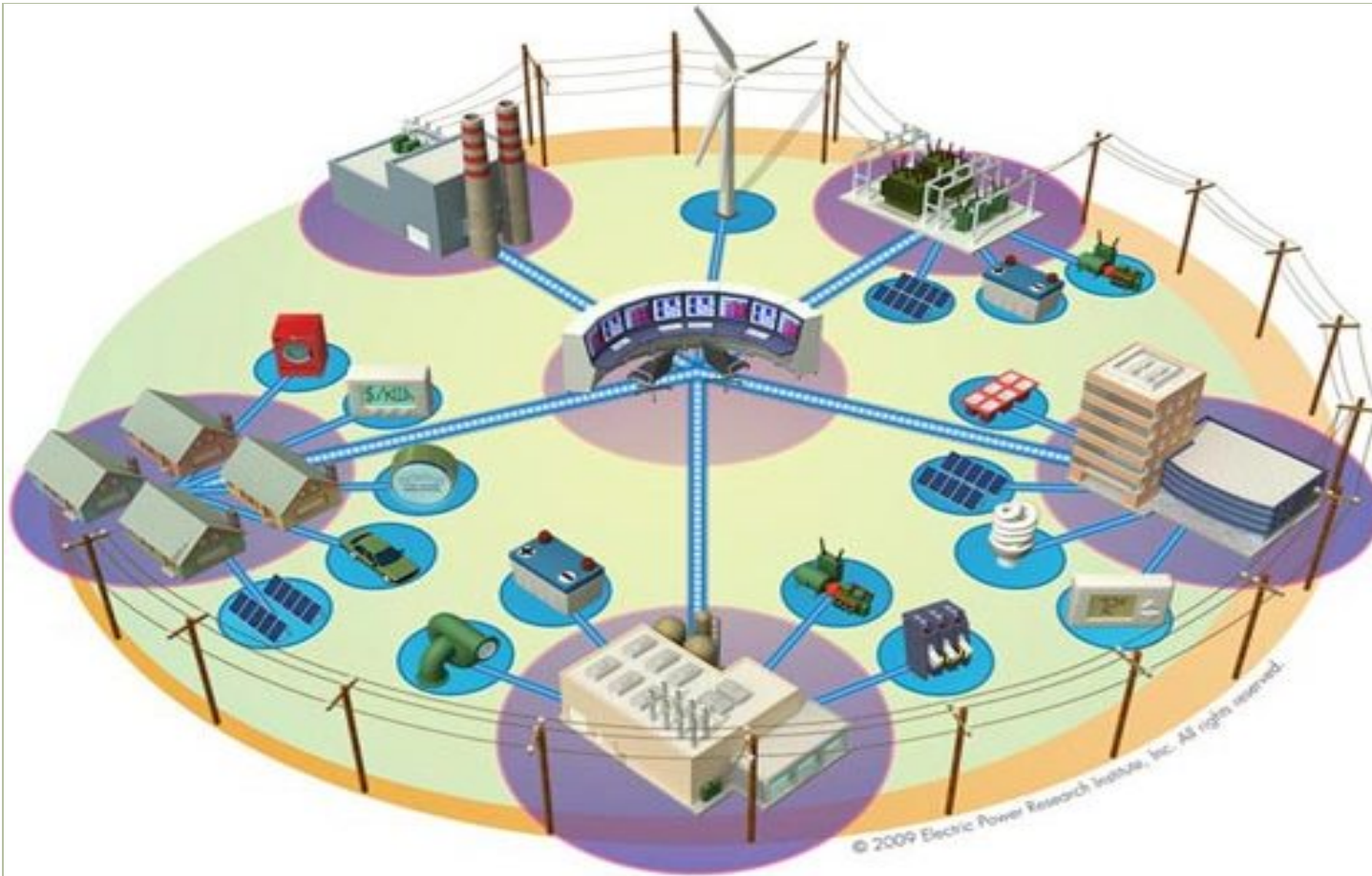


Smart Grid Energy Storage Demonstrations Overview



Ron Staubly – National Energy Technology Laboratory
DOE Smart Grid Demonstration Program



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	A123	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	TBD	TBD	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	Sacramento, CA Everett, MA Worcester, MA	2.5MW	Premium Power	Zinc-Bromide	Sacramento Municipal Utility District & National Grid	\$6.0M	\$12.5M
AREA OF INTEREST 2.4 - Compressed Air Energy Storage (CAES)							
New York State Electric & Gas	Reading, NY	150MW	TBD	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.	TBD	500kW	Amber Kinetics, Inc.	Flywheel	TBD	\$3.6M	\$10.0M
Raytheon Ktech	Turlock, CA	250kW	EnerVault	Fe/Cr redox-flow	NA	\$4.8M	\$9.5M

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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/ (A123)	Painesville (Ashlawn)	Public Service of NM (East Penn/Ecoult)		PG&E	Beacon Power
Seeo	Premium Power	Duke (Xtreme*)		SustainX	
	Primus Power				

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Breakdown by Primary Storage Application to be Demonstrated



Capacity/ Arbitrage	Renewable Firming/ Shifting	Grid Support/ Distributed Storage	Frequency Regulation	NA/TBD
NYSEG	Duke	Detroit Edison	Amber Kinetics	Aquion
PG&E	Ktech	Painesville	Beacon Power	Seeo
	Primus Power	Premium Power	East Penn	SustainX
	Public Service of NM			
	So Cal Edison			

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Duke Energy Business Systems Notrees Wind Storage Demonstration Project



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Wind Firming EnergyFarm™ Primus Power



2012: EnergyCell



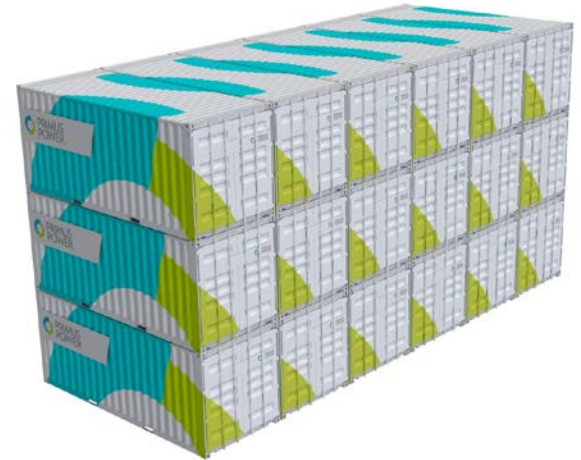
20 kW
80 kWh

2013: EnergyPod™



250 kW
1,000 kWh

2014: shipments start



MegaWatt
Deployments



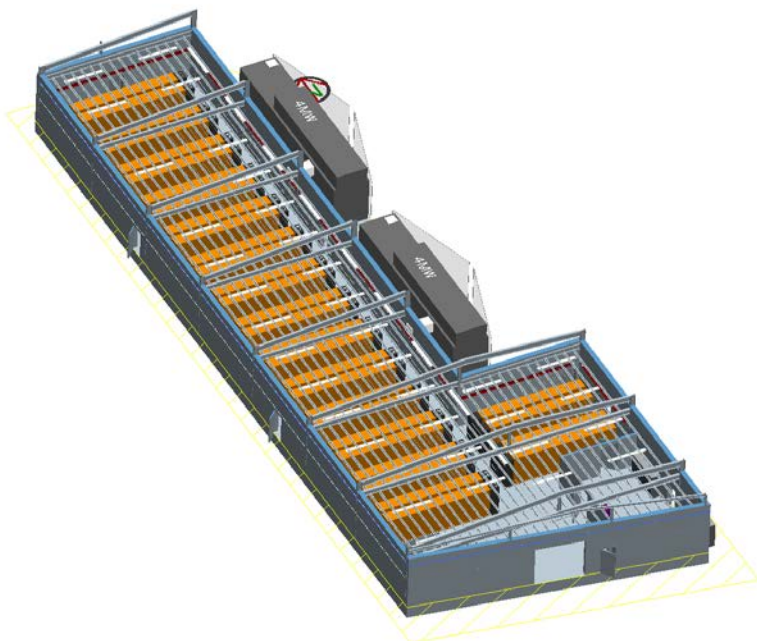
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Tehachapi Wind Energy Storage Project



8 MW x 4 Hr
Battery Energy Storage System
(BESS)

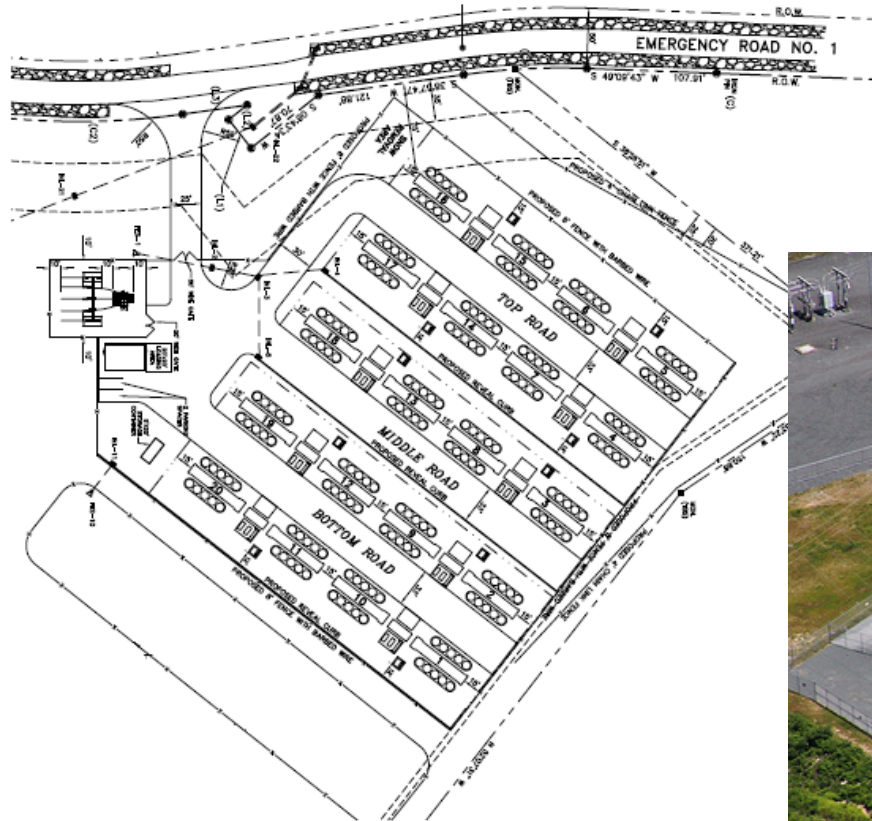


33-01
33-02
33-03
33-04

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Hazle Spindle - 20 MW Flywheel Plant



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Ancillary Services Using the UltraBattery Technology



EAST PENN manufacturing co., inc.



Project in operations as of July 25, 2012

Providing up to 3MW of Ancillary Services to PJM

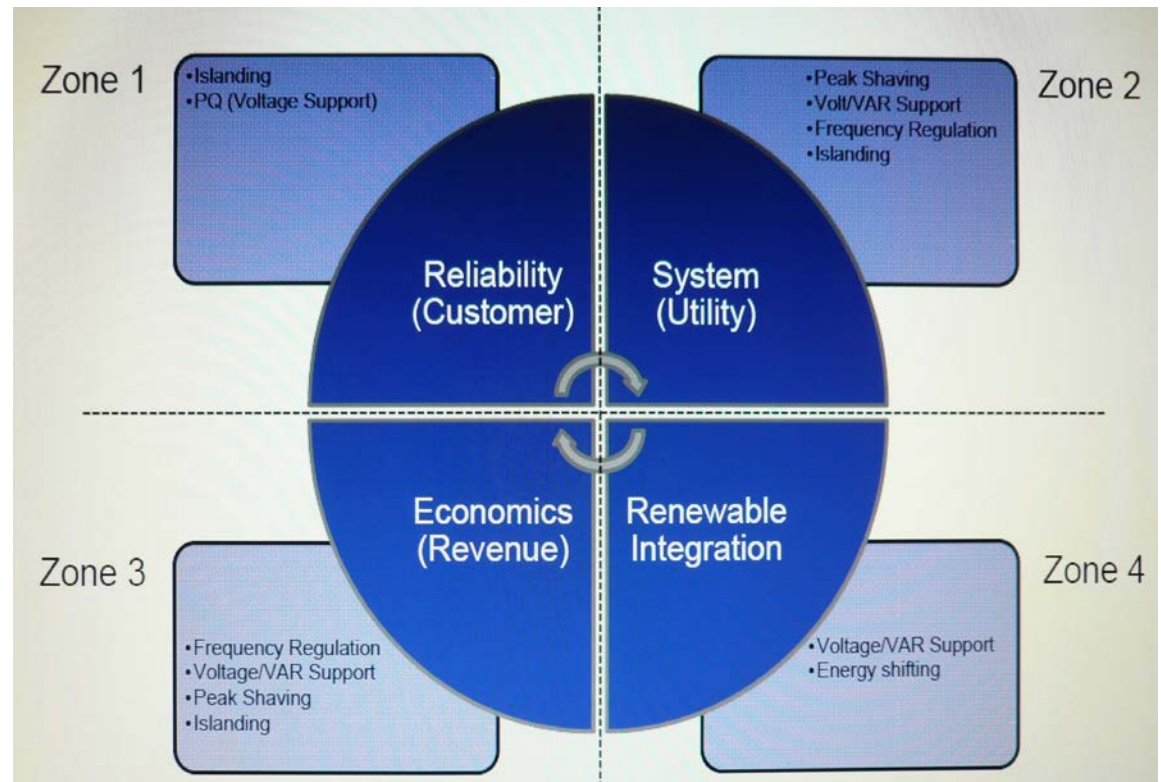
Data collection, monitoring and evaluation for next 30 months



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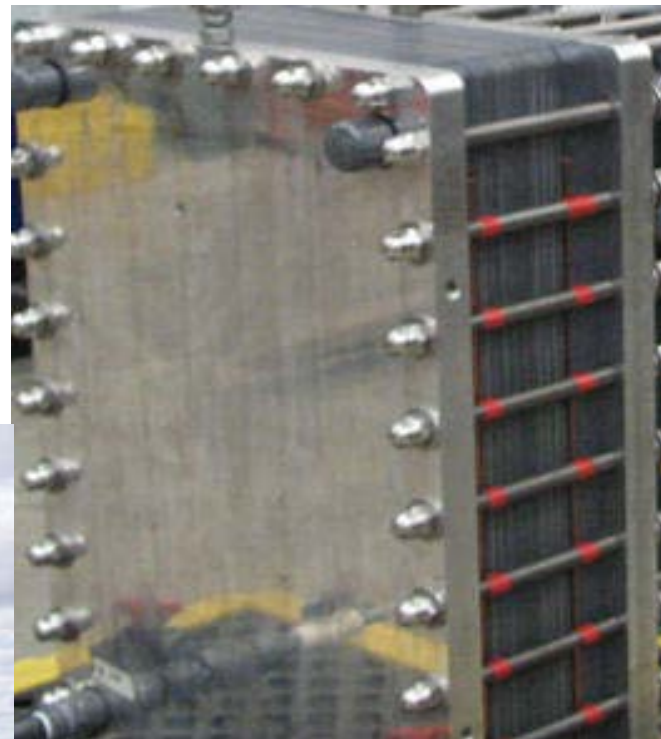
Detroit Edison's Advanced Implementation of Community Energy Storage Systems for Grid Support



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Painesville Municipal Electric Power Vanadium Redox Battery Demonstration Project



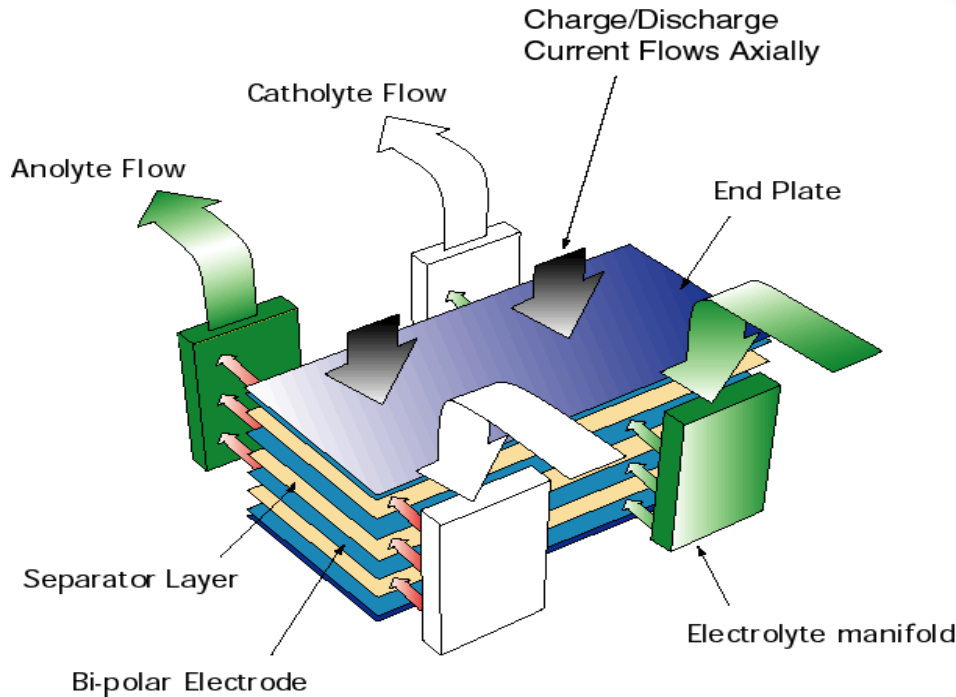
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Distributed Energy Storage System Demonstration

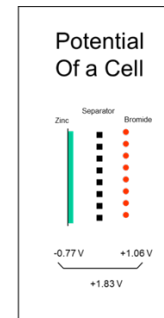
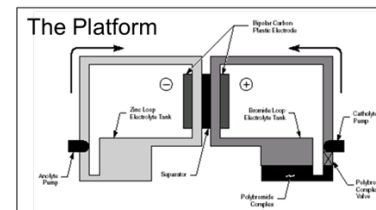


Premium Power



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

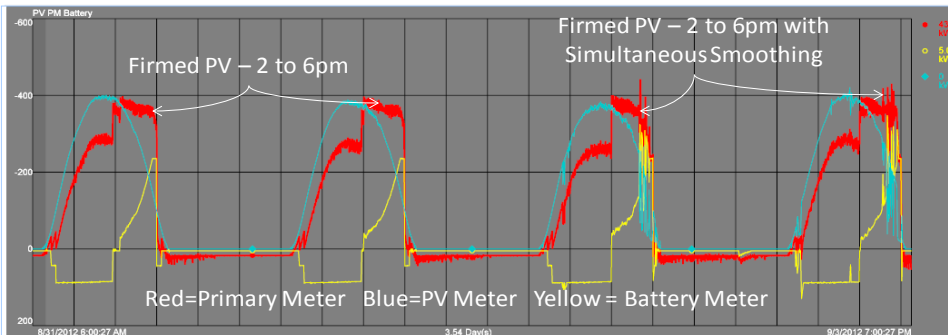
The Reaction



DOE Smart Grid Demonstration Program



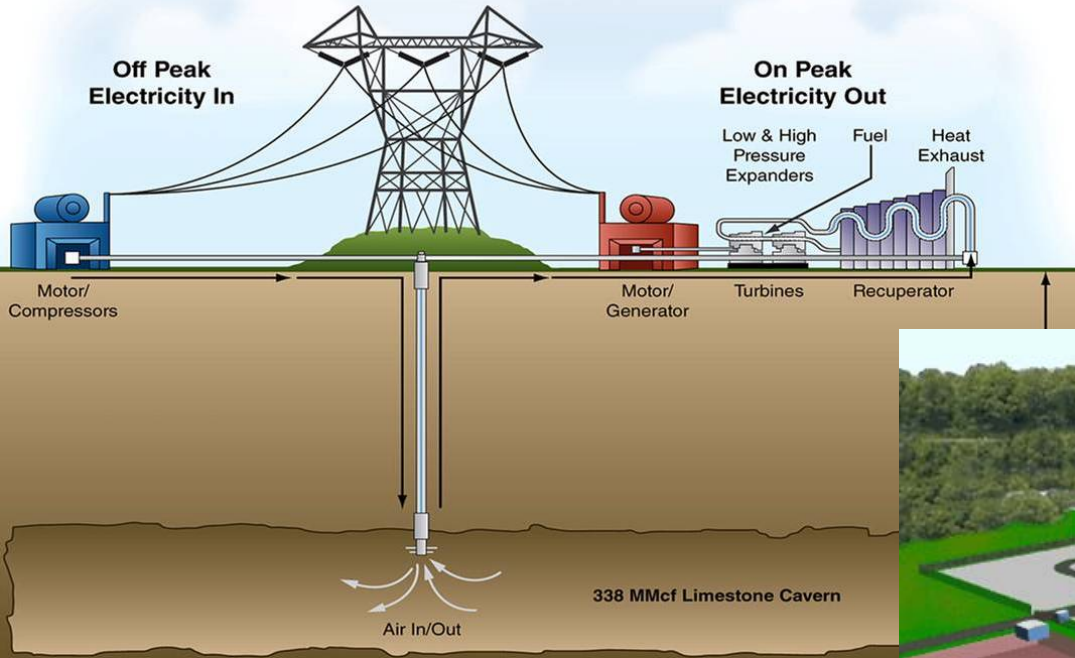
Public Service Co. of New Mexico Prosperity Energy Storage Project



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New York State Electric and Gas (NYSEG) Seneca Compressed Air Energy Storage Project



WorleyParsons
resources & energy

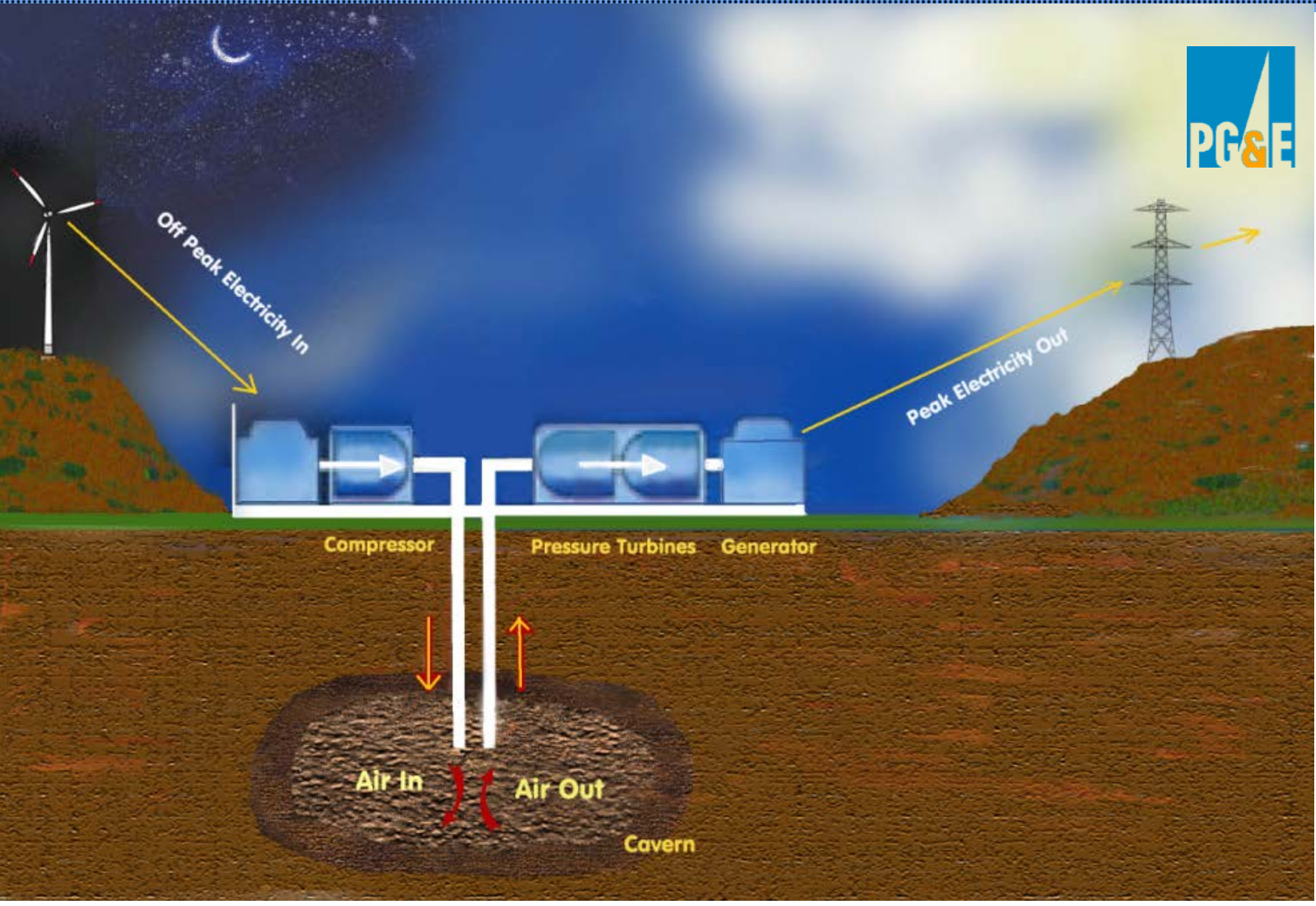


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Compressed Air Energy Storage (CAES) In California



Pacific Gas and Electric Company



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Flywheel Energy Storage Demonstration



amber_kinetics



SIEMENS



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Demonstration of Sodium Ion Battery for Grid Level Application



Supporters



DoE high voltage demonstration at Aquion

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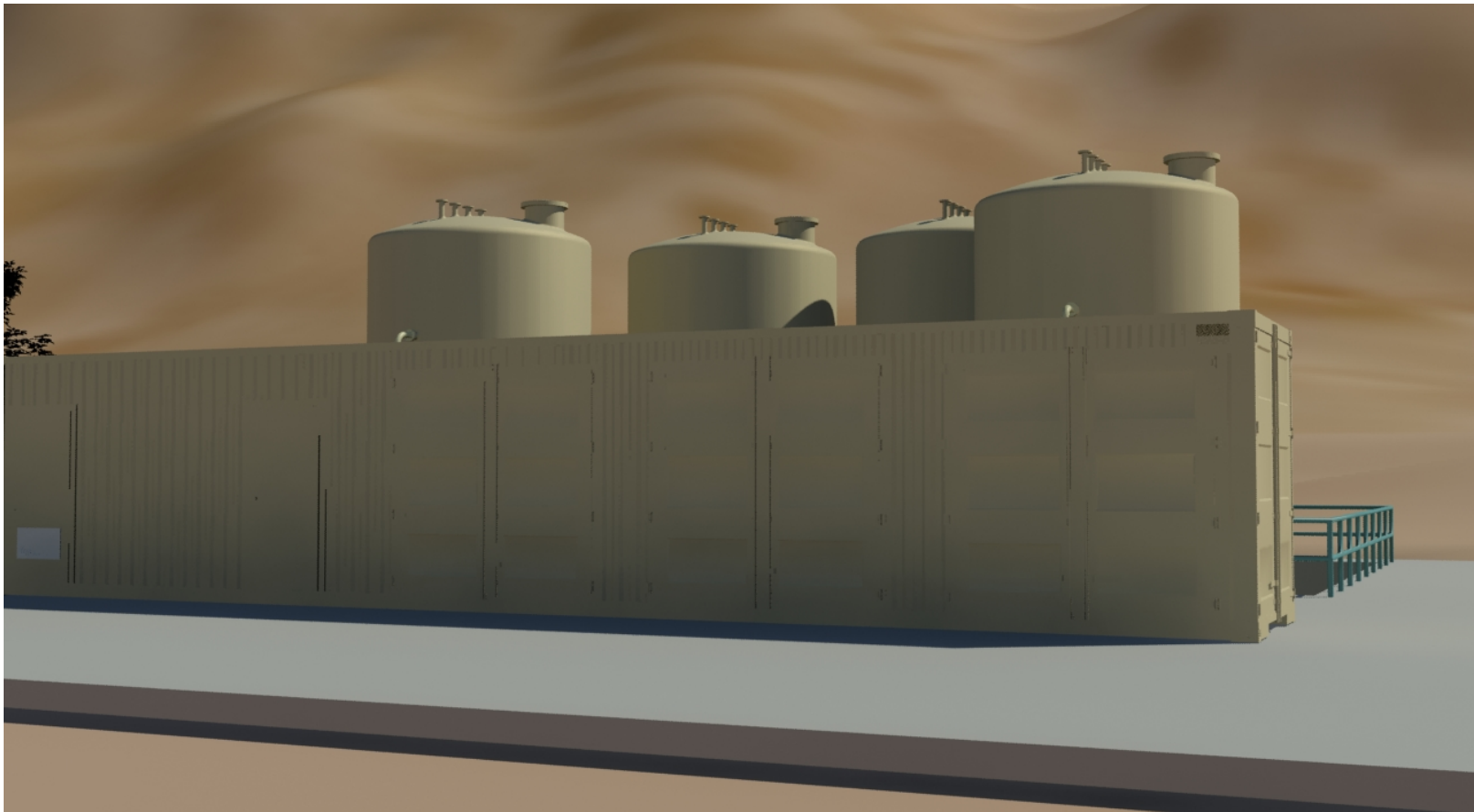


Redox Flow Battery Demonstration



Raytheon Ktech

EnerVault
Safe, Reliable, Cost-Effective Energy Storage



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Solid-State Batteries for Grid-Scale Energy Storage – Seeo, Inc.



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SustainX SMARTER ENERGY STORAGE MW-Scale Isothermal CAES System



General Catalyst
Partners



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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. NYSEG and PNM TPRs will be posted soon.
- Other information is available on the ARRA FederalReporting.Gov website

