

# Towards Grid Decarbonization: Medium and Long Duration Energy Storage:

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# Global Climate Change is Real!



California, +104 deg,  
Record Heat, Sep. 2022  
4, 000 MW of Storage  
Deployed to avert Outages



Florida  
Hurricane Ian, Sep. 2022  
Damage: \$65 Billion  
2.3 Million without Power

Floods and Droughts,  
but also  
Sea Level Rise, Coastal Erosion,  
Reduced Crop Yield, Wild Fires,  
and Health Impacts

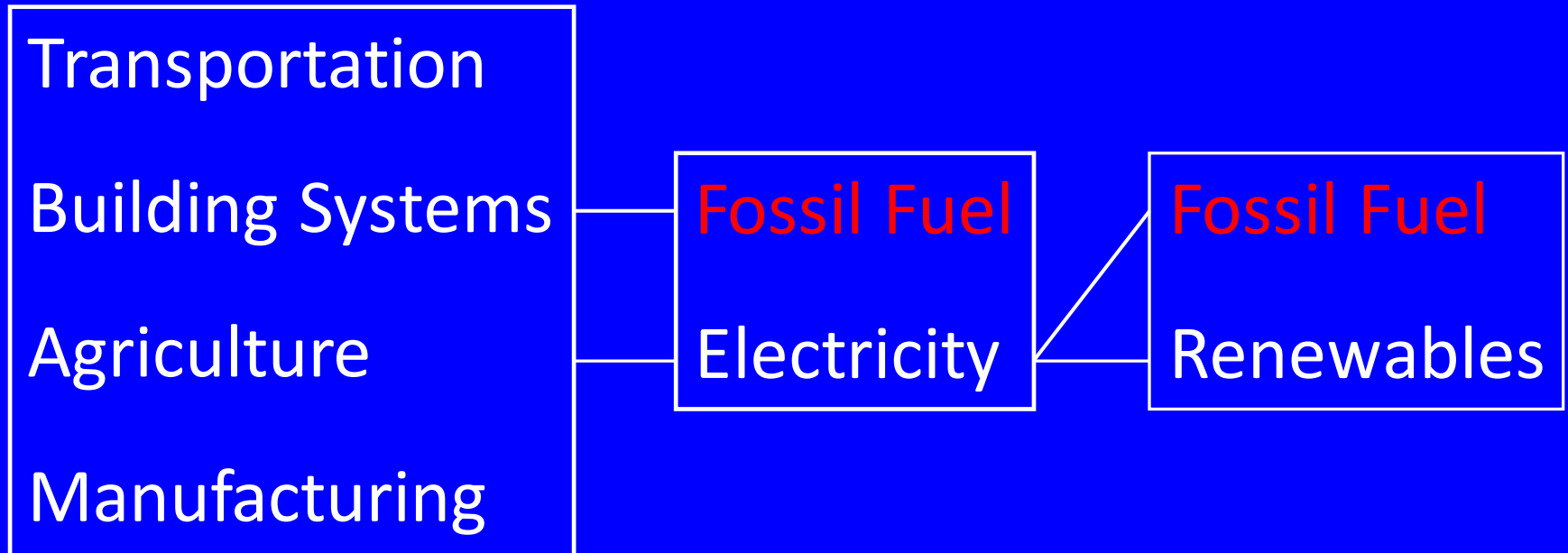
Global Warming has Emerged  
as a Paramount Issue - World Wide!

Burning Coal, Oil, Natural Gas:  
for our Electric Grid, Transportation,  
and Industry  
has increased CO<sub>2</sub>  
to twice the Highest Levels  
In 800,000 Years!

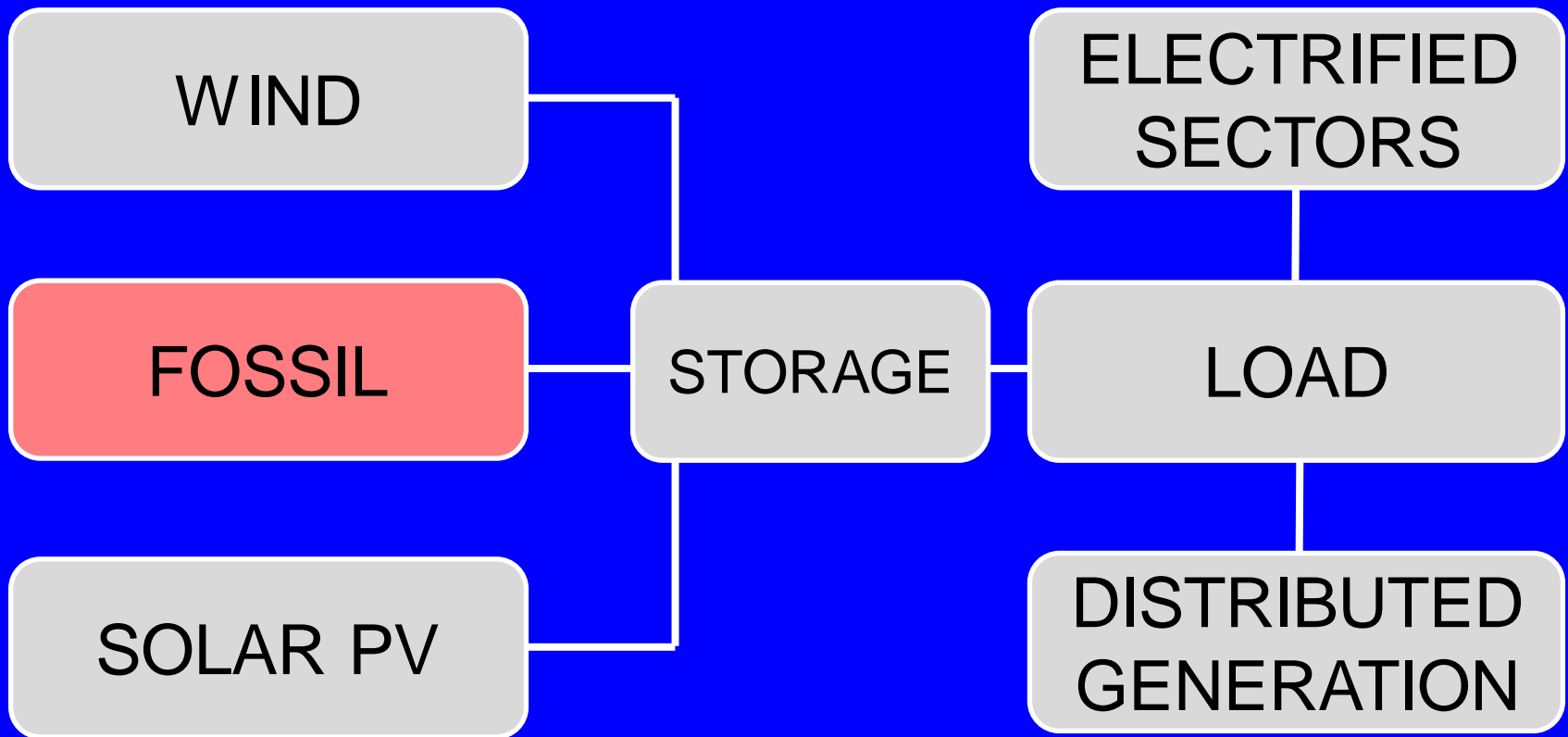
We must Decarbonize,  
we must change  
to Renewable Energy!

And we have to do it soon!

# Sector Coupling!



# Generation has become Variable - and so has the Load!



Storage is needed for reliable Resource Adequacy

Renewable Energy  
requires  
Energy Storage



# Storage of Various Durations will be Needed: Short, Medium, and Long

15 min – 4 hrs: smoothing renewables. Li-ion

4 – 12 hrs: day/night PV storage. Flow Batteries

12h – 3 days: bad weather backup. Thermal/Gravity

We will need some 1200-2300 GWh  
of Energy Storage!

We have done well with Short Duration  
Energy Storage and Li-ion Technology

Frequency Regulation  
Smoothing Renewables  
Demand Charge Reduction  
Substation Upgrade Deferral

We have created Evaluation  
and Planning Tools (e.g. Quest),  
Developed viable Business Models

# Medium Duration Storage

4 – 12 hours

V Flow Batteries, Zn, Fe, Na-ion  
the next Wave!



400 MWh / 100MW

Dalian, China.

Vanadium Flow Bat.

Sep. 29, 2022

# Long Duration Storage

12h – 3 days

Mechanical, Thermal, Chemical  
Energy Storage

Long Duration Energy Storage  
is essential for the Development  
of a Decarbonized, Reliable Grid

but it will require

New Technology, New Business Cases  
and New Regulatory Frameworks!

And a lot of Funding  
for Research, Development,  
and Deployment!!

# Current CEC Long Duration Projects – Grants Awarded

MW/MWh	Technology	Vendor	Expected Completion
400kW / 10hr X2	Vanadium Redox Flow Battery	Invinity Energy Systems	2023, 2024
400kW / 10hr X2	Zinc Hybrid Cathode Battery	EOS	2023, 2024
400kW / 10hr	Flywheel	Kinetic ES Corporation	2024

200kW / 10hr 50kW / 10hr	Aquifer Pumped Hydro	N/A	2024 2023
50kW / 10hr X2	Vanadium Redox Flow Battery	Invinity Energy Systems	2023
50kW / 10hr	Flywheel	Kinetic Energy Storage Corp.	2024

MW/MWh	Technology	Vendor	Expected Completion
10kW / 100hr X2	Iron Air	Form Energy	2023
10kW / 100hr X2	Zinc Air	E-Zinc	2023
10kW / 100hr	Thermal Storage	Antora Energy	2024

## Grants in Development, Not Awarded yet

6MW / 10hr	Vanadium Redox Flow Battery	Invinity Energy Systems	2023
6MW / 10hr 8MW / 10hr	Zinc Hybrid Cathode Battery	EOS	2023 2023
5MW/100hr	Iron Air	Form Energy	2025



## DOE /Sandia Support for CEC Projects through joint MOU

- Technical review of proposals
- Analysis of operational data
- Expertise on Fire / Safety issues
- Support of system commissioning

**NYSERDA**  
**LONG DURATION ENERGY STORAGE**  
**TECHNOLOGY & PRODUCT DEVELOPMENT**  
PROGRAM OPPORTUNITY NOTICE (PON) 5179

Up to \$17 Million Available / 50% Cost Share

Product Development  
Demonstration Projects  
Federal Costshare Projects

**DOE /Sandia Support for NYSERDA**  
**Projects through joint MOU**

# Infrastructure Investment and Jobs Act (IIJA) of 2021. DOE Funding

IIJA Clean Energy Programs	IIJA Funding
<b>Resilience – Utilities</b> section 40101	\$5B
<b>Resilience – States &amp; Tribes</b> section 40103(b)	\$5B
<b>Resilience – Remote Areas</b> section 40103(c)	\$1B
<b>Grid Modernization</b> section 40107	\$3B
<b>Advanced Manufacturing</b> section 40209	\$750MM
<b>Clean Energy Projects on Mine Lands</b> section 40342	\$500MM
<b>Storage Demonstrations</b> section 41001(a)	\$355MM    OE
<b>Long-Duration Storage Demonstrations</b> section 41001(b)	\$150MM    OE
<b>TOTAL</b>	<b>\$15.755B</b>

## **OE \$355 million**

- ***Validation:*** “Demo Projects” for first-of-a-kind LDES utility scale demonstrations.
- ***Piloting:*** “Pilot Grants” to lower the barriers to storage deployments.

## **OE \$150 million**

- ***Demonstration:*** “Demo Initiative” for innovative early-stage long duration technologies.
- ***Resilience:*** “Joint Program” for storage demonstrations on DOE/ DOD facilities.

We need much more Energy Storage!  
And we need it bigger, and safer,  
less expensive, and longer in duration.  
And we need to apply it in equitable ways.  
If we don't do this, we are in very deep Trouble.