IREC
Interstate Renewable Energy Council, Inc.

Shaping our future with clean energy

Interconnection and Deployment of Energy Storage in the US

Presentation to the MA Technical Standards Review Group

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March 17, 2016

IREC
Interstate Renewable Energy Council, Inc.

Shaping our future with clean energy

- 501(c)(3) non-profit working to improve consumer access to renewable energy since 1982
- Current projects include:
  - Net metering rules and interconnection standards
  - Grid Modernization
  - Shared renewable energy policies
  - Smart Grid, intersection of PEVs and renewables, and integration of storage
  - Workforce training and development for the renewables industry
- www.irecusa.org

What is Energy Storage?

"Commercially available technology that is capable of absorbing energy, storing it for a period of time, and thereafter dispatching the energy." Southern California Edison

What Can Energy Storage Do?

- Milliseconds to seconds: Provide ancillary grid balancing services
- Minutes to Hours: Provide intermittent generation smoothing from transient cloud events
- Hours: Provide localized or system level capacity benefits into evening hours
- Hours to Days: Provide on-site or micro-grid back-up services during grid outages

From SEPA

Potential services that DES Provides

Category 1 – Electric Supply

1. Electric Energy Time-shift (Arbitrage)
2. Electric Supply Capacity

Category 2 – Ancillary Services

3. Load Following
4. Area Regulation
5. Electric Supply Reserve Capacity
6. Voltage Support

Category 3 – Grid System

7. Transmission Support
8. Transmission Congestion Relief
9. Transmission & Distribution (T&D) Upgrade Deferral
10. Substation On-site Power

Category 4 – End User/Utility Customer

11. Time-of-use (TOU) Energy Cost Management
12. Demand Charge Management
13. Electric Service Reliability
14. Electric Service Power Quality

Category 5 – Renewables Integration

15. Renewables Energy Time-shift
16. Renewables Capacity Firming
17. Wind Grid Integration

Sandia National Laboratories

IREC

Stacking Effect

Key Near-Term Regulatory Considerations 1 to 3

1. Design rate structures that send DES customers appropriate economic signals
2. Open up markets for ancillary services and demand response
3. Ensure DES systems have a clear path to fair and efficient interconnection

Key Near-Term Regulatory Considerations 4 to 6

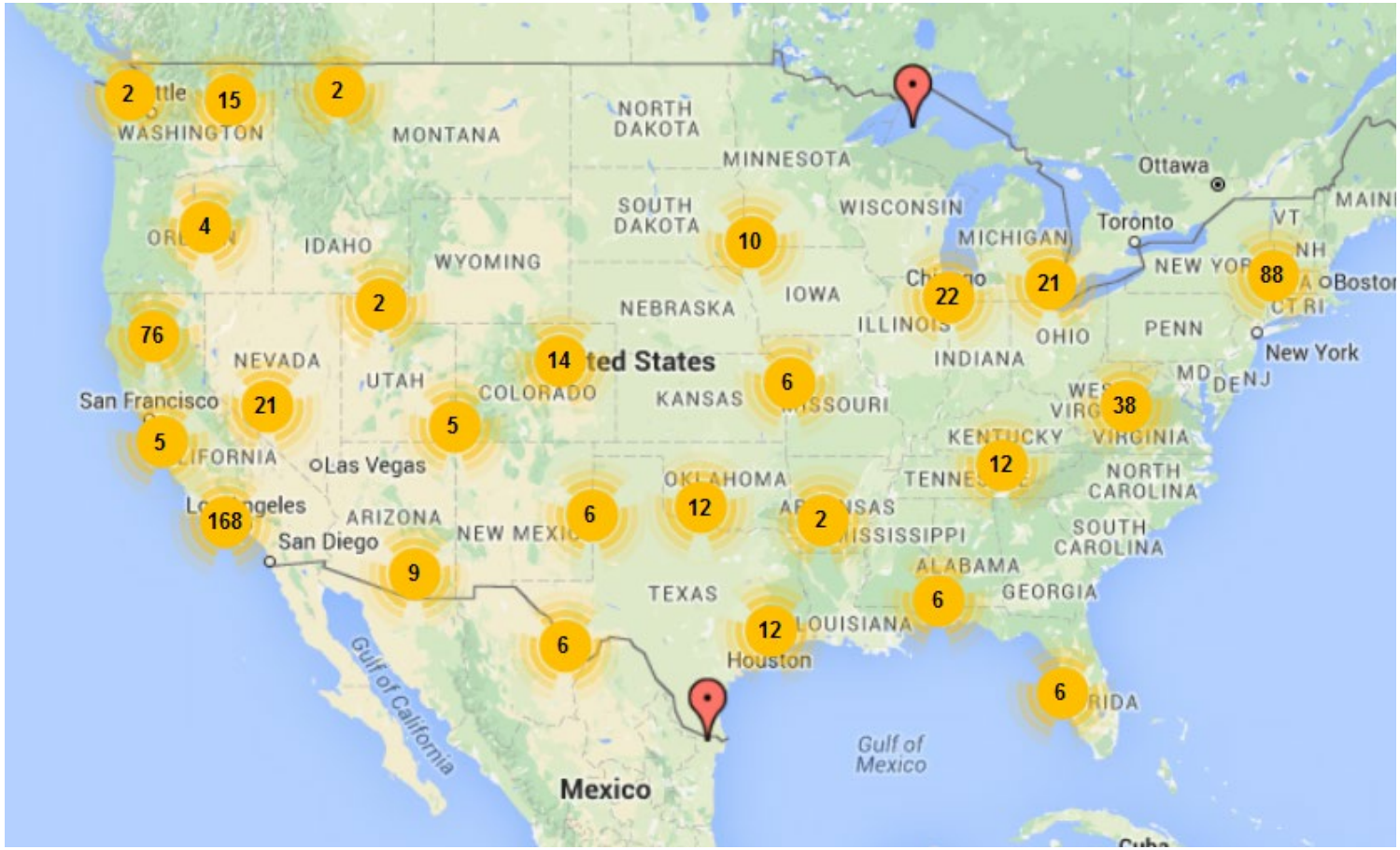
4. Address net energy metering opportunities for storage systems
5. Consider DES solutions in the context of broad distribution planning efforts
6. Ensure sufficient, but not duplicative, oversight of DES safety

2015 Energy Storage Summary

	2015	2014	Change
Total Deployments (MW)	221	65	Up 243%
Total Deployments (MWh)	161	86	Up 88%
Front-of-Meter Deployments (MW)	187	58	Up 223%
Behind-the-Meter Deployments (MW)	35	6.9	Up 405%
Utility-Scale System Price ($/kWh)	$700-$1,200	$800-$1,300	Down 8% to 13%
Utility-Scale Pipeline (MW)	6,638	3,630	Up 83%
Number of Markets With Policy Developments	20 State Markets, 4 Regional Markets, and Federal	10 State Markets, 1 Regional Market, and Federal	13 Additional Markets
Cumulative Five-Year Forecast (MW)	4,030 (2016-2020)	2,294 (2015-2019)	Up 76%

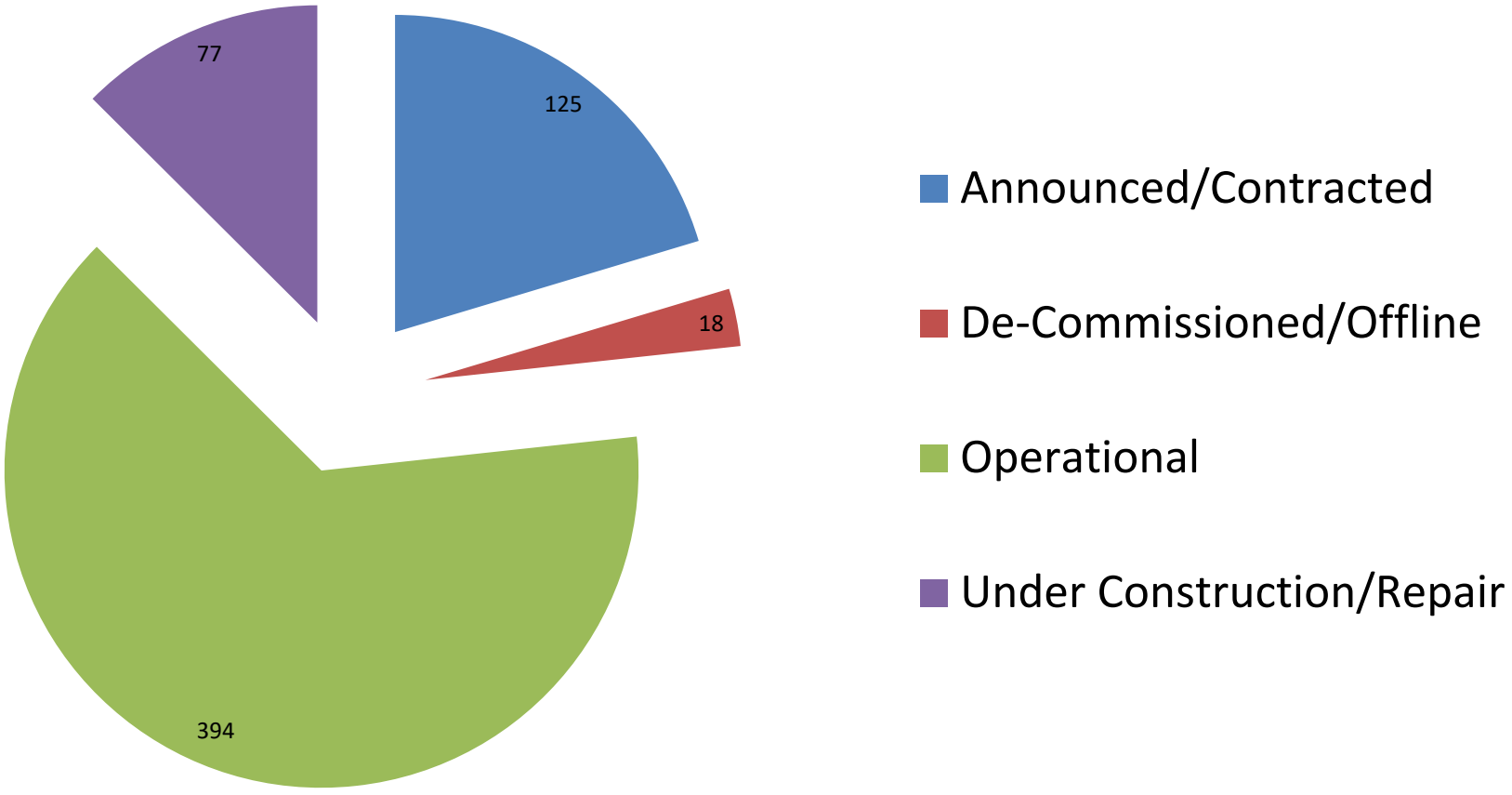
GTM Research/ESA U.S. Energy Storage Monitor 2015: Year in Review

Storage Projects in the U.S.



From DOE Global Energy Storage Database

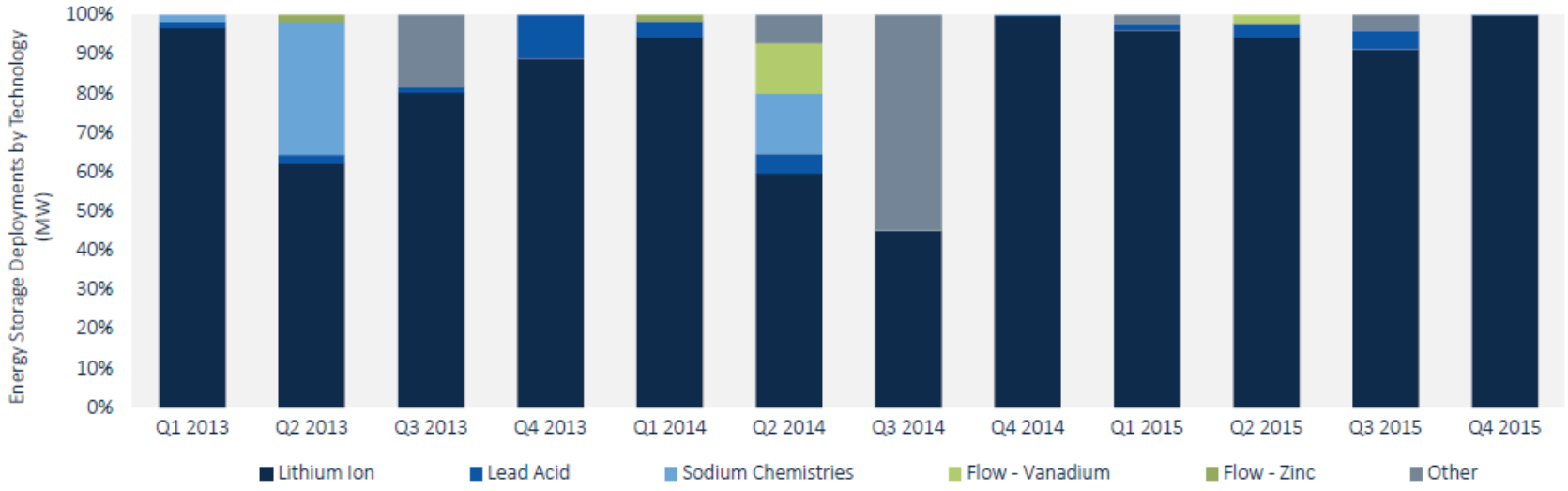
Storage Projects in the U.S.:
Status of Projects



Data from DOE Global Energy Storage Database

Storage Technology Market Share

Lithium-Ion Technologies Made Up 96% of 2015 Deployments (MW)

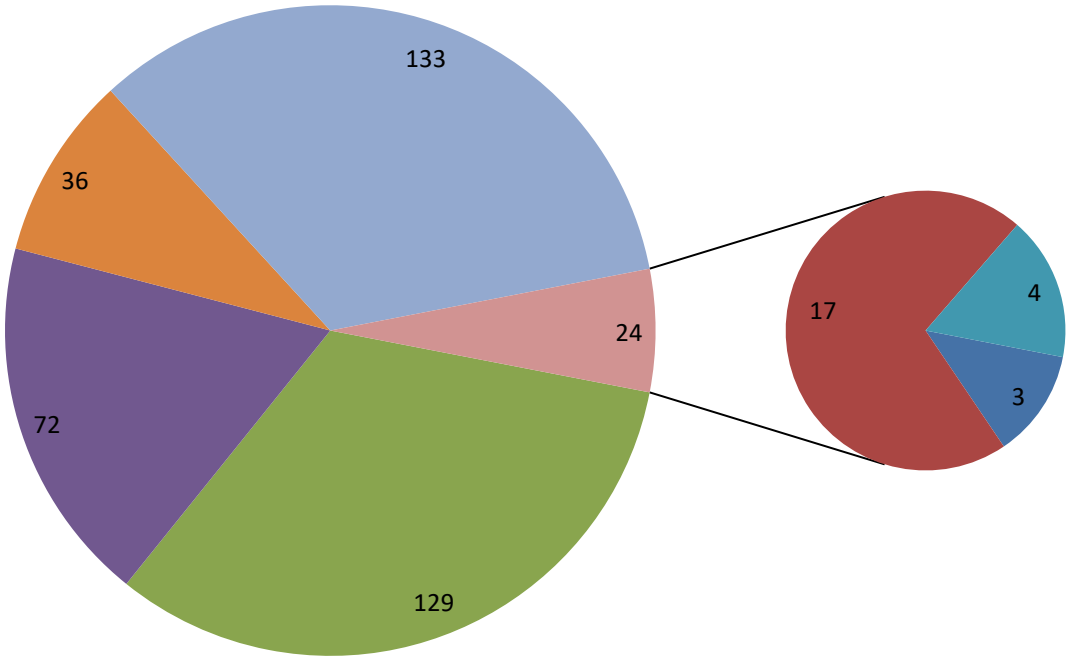


- In 2015, lithium-ion systems made up 96% of the total MW deployed, compared to 72% in 2014. Some of this difference can be attributed to a few large demonstration projects in 2014.

Other includes flywheel and unreported energy storage technologies

GTM Research/ESA U.S. Energy Storage Monitor 2015: Year in Review

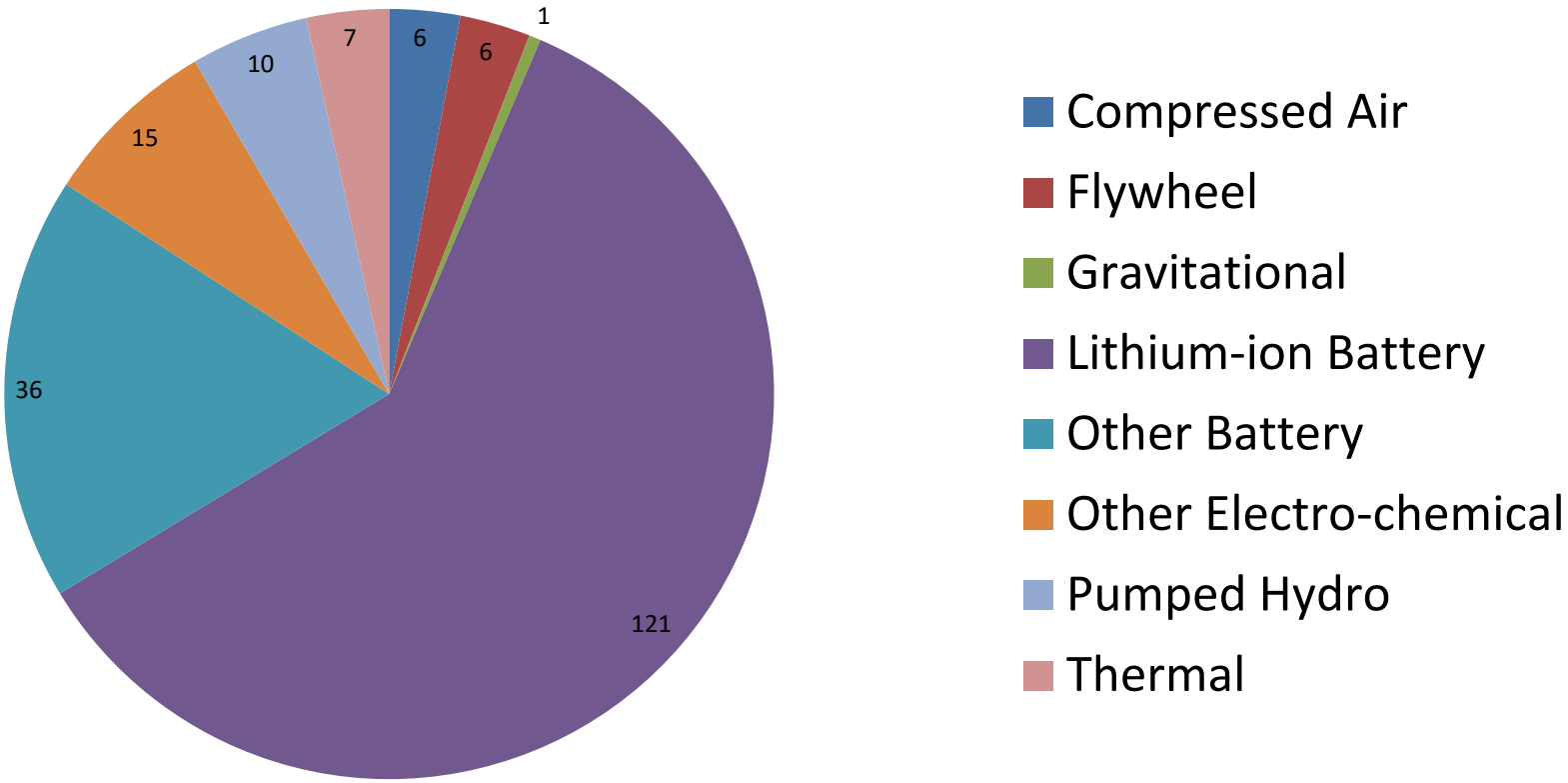
Storage Projects in the U.S.:
Types of Operational Projects



- Compressed Air
- Flywheel
- Lithium-ion Battery
- Other Battery
- Other Electro-chemical
- Pumped Hydro
- Thermal

Data from DOE Global Energy Storage Database

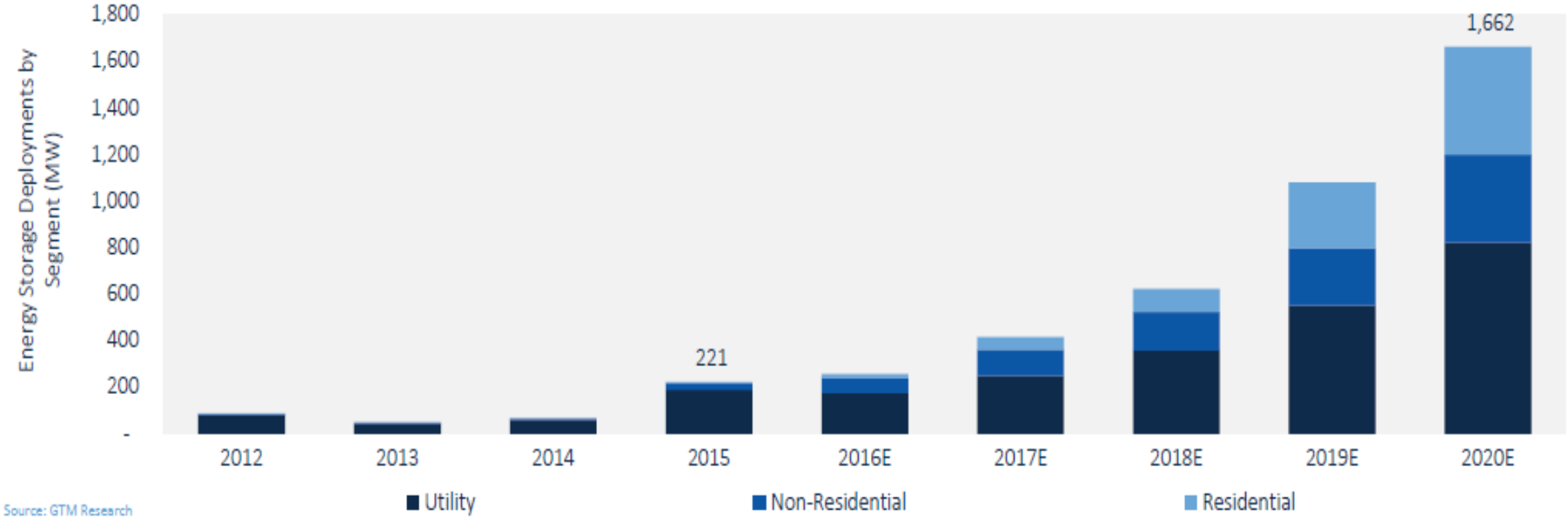
Storage Projects in the U.S.:
Types of Projects Pending



Data from DOE Global Energy Storage Database

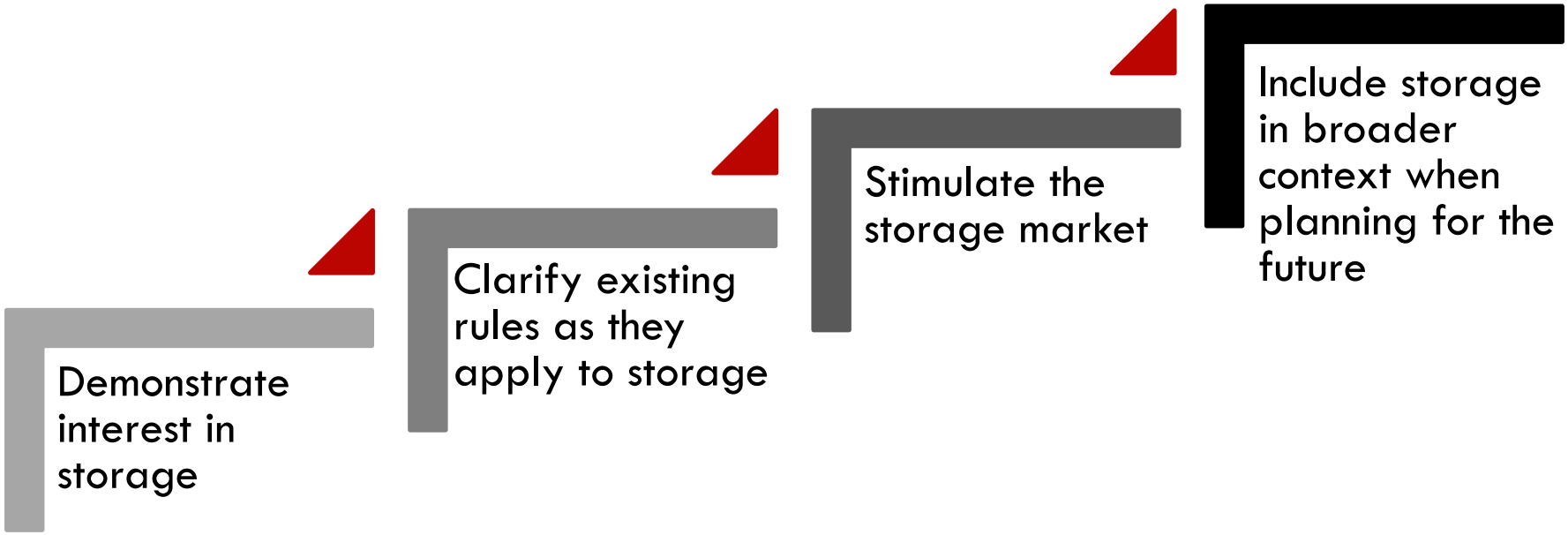
The “Third Wave” of Growth

Dropping cost of smaller batteries will drive a “third wave” of storage growth



GTM Research/ESA U.S. Energy Storage Monitor 2015: Year in Review

What are States Doing?



State Actions:
Demonstrate Interest in Storage

State	Activity
AZ	Workshops on energy storage in 2014, investigating energy innovation
CO	Commission required storage investigation; approved two demonstration projects with battery storage in March 2016
IA	Utilities Board initiated inquiry on distributed generation, including storage; implementation plans for utility pilot projects due in March 2016
MN	Published white paper on utility-managed, on-site energy storage
NJ	Energy Storage Working Group provides input on incentives development
NM	Renewable Energy Storage Task Force held storage meetings and developed recommendations to the legislature
NV	Initiated proceeding to investigate battery storage technology
NY	Battery and Energy Storage Technology Consortium advances storage issues
OR	Commission and Department of Energy hosted storage workshops and sought comments on demonstration projects
CT, MA, NY, NJ	Funding for microgrids able to disconnect from the grid in emergency

State Actions:
Clarify Existing Rules

State	Activity
HI	Commission required utilities to modify interconnection tariffs to clarify that distributed generation facilities with battery back-ups must obtain an interconnection review by the utility.
CA	Commission is addressing storage integration in state's interconnection proceeding. Commission extended fee exemptions to some storage paired with net metering facilities and is developing methodology to determine billing credits for net energy metered systems paired with storage devices.
NJ	Board of Public Utilities requested comments on interconnecting storage systems with renewable generating facilities.

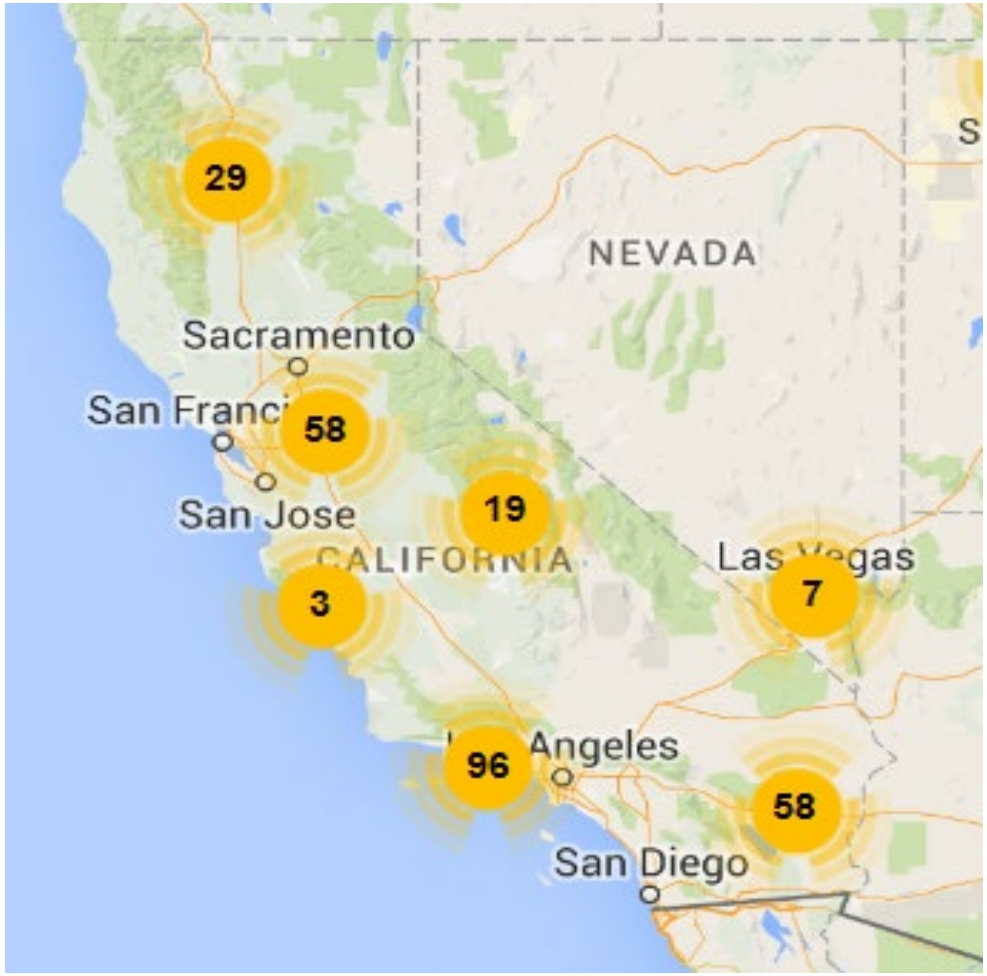
State Actions:
Stimulate the Storage Market

State	Activity
CA	Self-Generator Incentive Program provides incentives to advanced energy storage systems; AB 2514 calls for 1.3 GW energy storage by 2020 from the three largest investor-owned utilities.
OR	House Bill 2193 requires utilities to invest in at least one energy storage system of at least 5 MWh. Regulators will put out procurement guidelines by January 2017 and utilities will have to submit proposals the following year.
NJ	Renewable Electric Storage Incentive Competitive Solicitation prioritizes projects that are “public and critical.”
NY	Performance-Based Incentives for Existing Facilities Program offers incentives for energy storage systems; Demand Management Program covers part of cost for battery storage projects that are operational by June 1, 2016 and achieve target peak demand reduction.
MA	Energy Storage Initiative will advance energy storage segment of clean energy industry with research, market support, policy. Energy Storage for Renewables and Grid Support provides funding for programs to further energy storage activities.

State Actions:
Include Storage in Planning

State	Activity
CA	Utilities must develop “distribution resources plans” that identify optimal locations for distributed resources, including storage.
HI	Several grid modernization dockets require utilities to submit plans for a modern grid, and each touches on the role of energy storage.
MA	Utilities submitted Grid Modernization Plans in 2015. They are required to demonstrate how they will integrate distributed resources, including storage, and they do this to varying degrees. Several proposed pilot programs incorporate storage.
MN	Opened grid modernization proceeding, focus on distribution planning.
NH	Opened proceeding investigating grid modernization.
NY	Reforming the Energy Vision addresses integration and leveraging of the technical potential of energy storage

California Energy Storage Projects



From DOE Global Energy Storage Database

The California Energy Storage Mandate

- Decision 13-10-040, October 2013
- Adopted a procurement target of 1,325 MW of energy storage
- Utilities may own no more than ½ of the storage assets they procure
- Creates three different "classes" of storage: Transmission, Distribution, and Customer-sited
- Have to be shown to be cost-effective
- Each project must achieve at least one of these goals:
  - Grid optimization,
  - Renewables integration, or
  - GHG reduction

The Energy Storage Targets

Proposed Energy Storage Procurement Targets (in MW)[22]

Storage Grid Domain Point of Interconnection	2014	2016	2018	2020	Total
Southern California Edison					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal SCE	**90**	**120**	**160**	**210**	**580**
Pacific Gas and Electric					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal PG&E	**90**	**120**	**160**	**210**	**580**
San Diego Gas & Electric					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
Subtotal SDG&E	**20**	**30**	**45**	**70**	**165**
Total - all 3 utilities	**200**	**270**	**365**	**490**	**1,325**

The Initial Procurement Plans

SCE

- 16.3 MW, relying on existing projects and those already under the local capacity RFO

SDG&E

- Already had significant development underway and thus had already met the target
- But proposed to procure an additional 16 MW toward future targets

PG&E

- Sought 78 MW but the Commission modified to 80.5 MW due to an ineligible biogas project
- Announced 75 MW in selected offers, included flywheels, Lithium Ion & zinc air batteries

All the IOUs weighted their proposals more heavily towards transmission level projects.

Edison's Local Capacity Requirement RFO

- Driven primarily by closure of San Onofre Nuclear Generating Station
- Needed capacity in two sub-areas of their system
- CPUC required Edison to get at least 50 MW of energy storage
- Ended up signing contracts for **FIVE** times that amount = 250 MW
- Includes:
  - AES – 100 MW in-front-of-meter battery system
  - Stem – 85 MW behind-the-meter
  - 50 MW of "hybrid electric buildings"
  - 25.6 MW Ice Energy's AC load shifting (no discharge to grid)

California's Demand Response Auction Mechanisms (DRAM)

- Experimental program to deploy Demand Response
- Utilities each had a minimum target - 10 MW for PG&E and SCE, 2 MW for SDG&E, at least 20% from the residential sector.
- Each chose exceed their minimum, **for a total of 40+ MW** contracted.
- Some of the winning bids came from companies aggregating behind-the-meter batteries, as well as companies aggregating EV chargers
- Winners will respond to day-ahead market signals from CAISO and meet Resource Adequacy requirements

Other CA Initiatives

- Clarified rules for systems co-located with a NEM system (metering, interconnection costs)
- Self Generation Incentive Program (SGIP… no not that SGIP)
- CAISO/CPUC/CEC Energy Storage Roadmap
- CAISO's market for aggregated DERs
- The Distributed Resources Planning Proceeding, and the Integrated Distributed Energy Resources Proceeding

Storage and Interconnection

The CPUC determined that appropriate interconnection policies are one of the major barriers toward the deployment of storage. (R. 10-12-007 Energy Storage Phase 2 Interim Staff Report – January 13, 2014.)

Interconnection - Scope of Issues

- FERC SGIP Update:
  - Added energy storage to definition of generator
  - Clarified method for determining system capacity
- California: many fits and starts, finally a staff report in 2014, nearing a Decision
- Other states: added FERC definition, not much other action yet.
  - Have seen some tension as utilities have contested whether energy storage is eligible to interconnect under existing rules in some states

Is it Load or is it Generation?

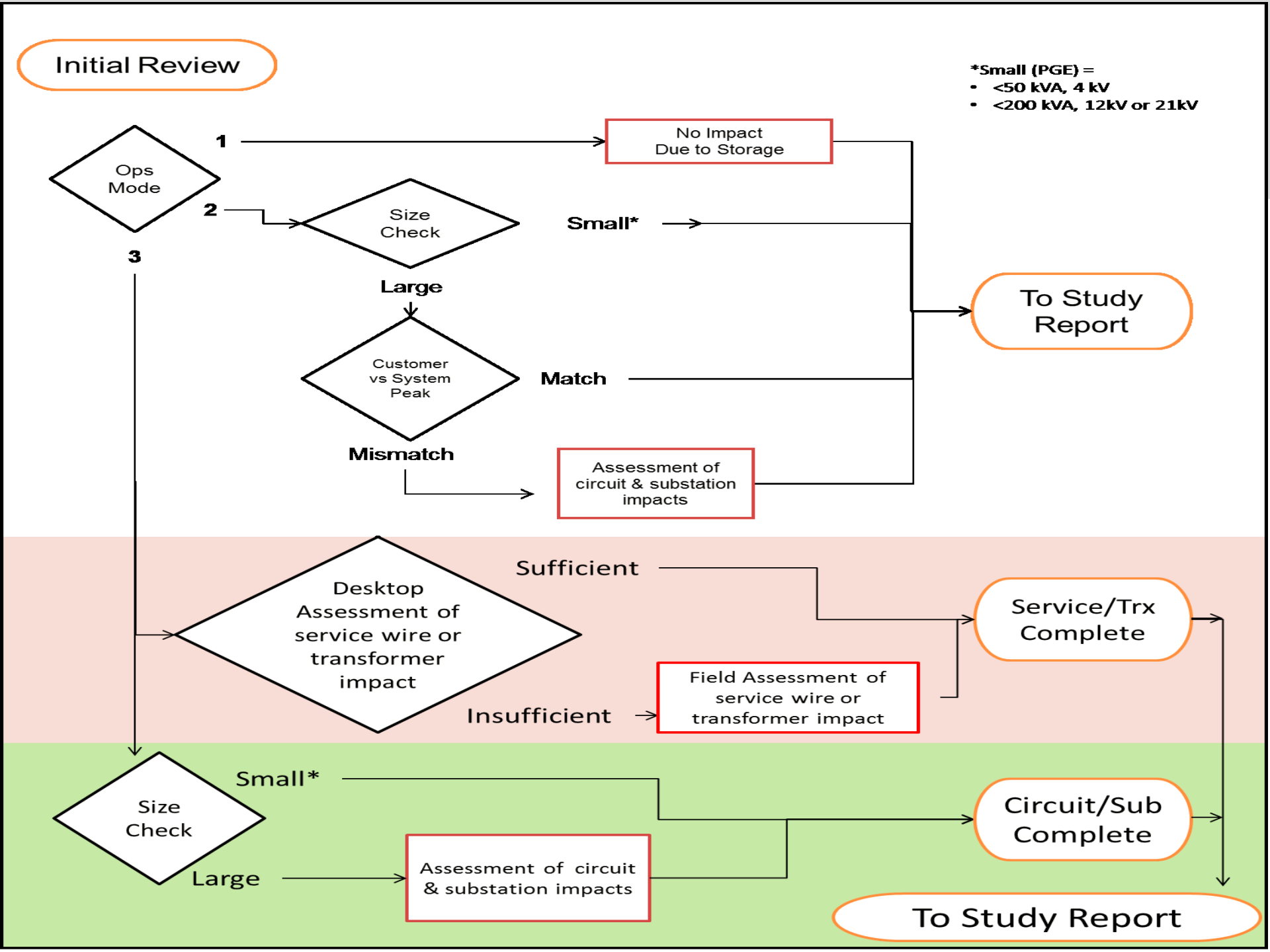
- Question: is the interconnection process the appropriate place to review charging impacts?
- Existing rules in most states address review, and cost allocation, for new load customers
- Traditional principles of “cost-causer” are inapplicable
- Should energy storage customers be treated differently from other new load?

The California Approach

- Joint Motion pending before Commission
- Clarifies how load from energy storage will be reviewed under Rule 21
- Allocates costs for upgrades attributable to both load and generation by prioritizing the load impacts
- More efficient to review both load and generation together, but costs will be allocated without discriminating against customers.
- Load rules will be used to assess upgrade costs from bona fide load (not positive incremental load)

The California Approach

- All energy storage systems will be reviewed
  - Even though not enforced with traditional load
- Defines review based on size and op modes
  - Non Grid Charging – charges from onsite generator
    - Cursory Review only (i.e. notice to utility)
  - Peak Shaving – no increase to host's peak load
    - Load review to determine impacts to primary conductor and substation transformer. Same time as Fast Track. No additional cost.
  - Unrestricted Charging
    - Load review for impacts to circuit and service facilities.
    - Fast Track timelines for smaller, simpler systems
    - 60 Biz Days for larger or more complex systems


Initial Review
*Small (PGE) =
• <50 kVA, 4 kV
• <200 kVA, 12kV or 21kV
Ops Mode
1
No Impact Due to Storage
2
Size Check
Small*
3
Large
Customer vs System Peak
Match
Mismatch
Assessment of circuit & substation impacts
To Study Report
Sufficient
Desktop Assessment of service wire or transformer impact
Service/Trx Complete
Insufficient
Field Assessment of service wire or transformer impact
Small*
Size Check
Large
Assessment of circuit & substation impacts
Circuit/Sub Complete
To Study Report

Streamlining Behind the Meter Storage

- In addition, there are ongoing efforts to:
  - Create an interconnection guide for energy storage
  - Create a modified application and agreement to define charging behavior
  - Potentially define a process for making changes to the “inadvertent export” rules for advanced inverter functionality (Solar City)
  - Create a special review process for a Bosch AC/DC “converter-based” storage system that is “physically incapable of back feeding power”
  - List of other issues still to consider

PJM Ancillary Services Market

- Some Interconnection Considerations
  - Demand Response resources = no interconnection agreement (from PJM)
  - If it wants to sell generation into the PJM market, however, it must have a FERC jurisdictional interconnection agreement
  - “for a battery to participate as generator in PJM markets or ancillary services, a battery must proceed through PJM’s interconnection process and enter into a WMPA or ISA with PJM.”

Communications Protocols

- Modular Energy Storage Architecture (MESA) is an open, non-proprietary set of specifications and standards developed by an industry consortium of electric utilities and technology suppliers. Through standardization, MESA accelerates interoperability, scalability, safety, quality, availability, and affordability in energy storage components and systems.
- The creation of UL standards for energy storage
- Integrating storage with smart solar inverters and other critical power electronics equipment.

For More Information

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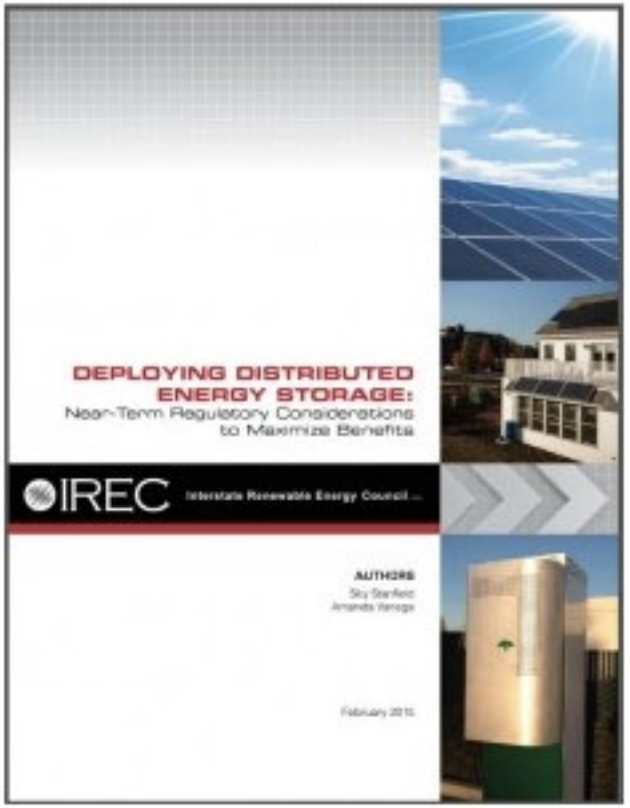

Report Link: http://www.irecusa.org/deploying-distributed-energy-storage/

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