

The CPP and Reliability

**We are in a low-carbon transition:
Reliability is essential; ensuring
reliability at least cost is the
pivotal issue**

**The Clean Power Plan is the step in
the transition where we begin to
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**The question is:
Does this initial recognition of
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RAP

Energy solutions
for a changing world

Countering the Reliability Card

Webinar
February 12, 2015

Carl Linvill
Principal

February 12, 2015

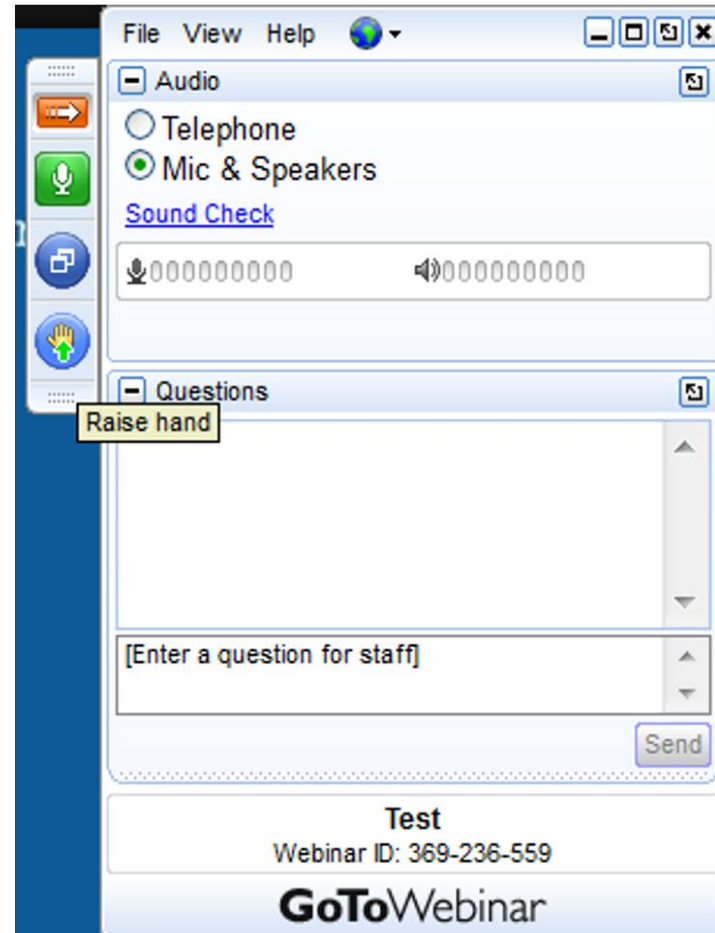
The Regulatory Assistance Project

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Housekeeping

Please send questions through the Questions pane.



Consumers Energy Senior Vice President David Mengebier on Reliability

- *"It's really an opportunity for the state of Michigan because we are going to change out our older plants and build the next generation of clean burning power plants while investing in renewable energy,".*
- *Mr. Mengebier also stated that it is not cost effective to retrofit some of the older plants. "And this is true not just for utilities in Michigan, but around the Midwest"*

Our Reliability Experts



Carl Linvill, Principal



Christopher James, Principal

Countering the Reliability Card

1. Reliability cards, hands, and examples
 - Reliability cards
 - Hands that counter reliability cards
 - Calling reliability bluffs, some examples
2. What are the CPP reliability concerns?
 - CPP reliability concerns
 - Is CPP compliance on a low carbon path?
3. Consultation with the experts: Are low carbon paths more aggressive than CPP compliance reliable?

A Summary of NERC's Definition

What is "Reliability"?

- ◆ "Keeping the lights on"
- ◆ NERC's definition of "reliability" consists of two fundamental concepts :
 - **Adequacy** is the ability of the electric system to supply the aggregate electric power and energy requirements of the electricity consumers at all times, taking into account scheduled and reasonably expected unscheduled outages of system components.
 - **Operating reliability (former known as "security")** is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system component
- ◆ Long-term adequacy measured by capacity margin or LOLE
- ◆ Operating reserves employed to insure short-term adequacy

Supply exceeds demand, tomorrow and in 2022

System is maintained in state to withstand loss of any element(s); no cascading outages

Courtesy of R. Zavadil, UVIG, 2014 Tucson, AZ

Further Disaggregation of Reliability Issues

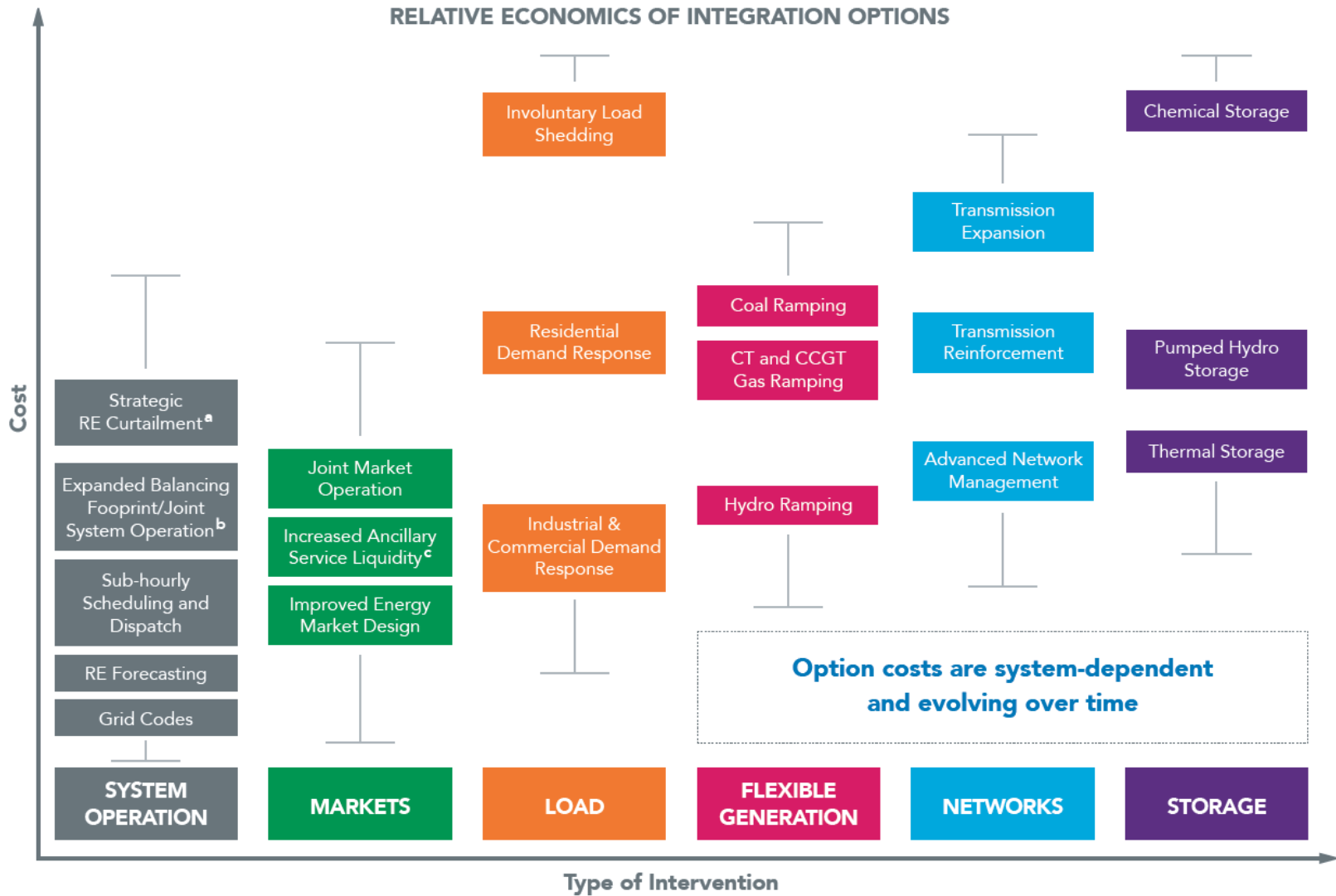
- Planning Reserve and Resource Adequacy
- Normal Operations and Load Balancing
- Disturbance Response

~ Courtesy of Brian Parsons

What Hands Can be Played?

The appropriate hand depends on the resources available, the flexibility of the electric system, and the operational practices that can feasibly be implemented, but the number and variety of hands to be played is large.

Flexibility in 21st Century Power Systems, NREL, EPRI, et al, May 2014



Example: Does Growth Require Generation?

- Load growth rapid through the early 1970's
- Large base load additions proposed to ensure reliability
- Reduced consumption ensured reliability with far less generation

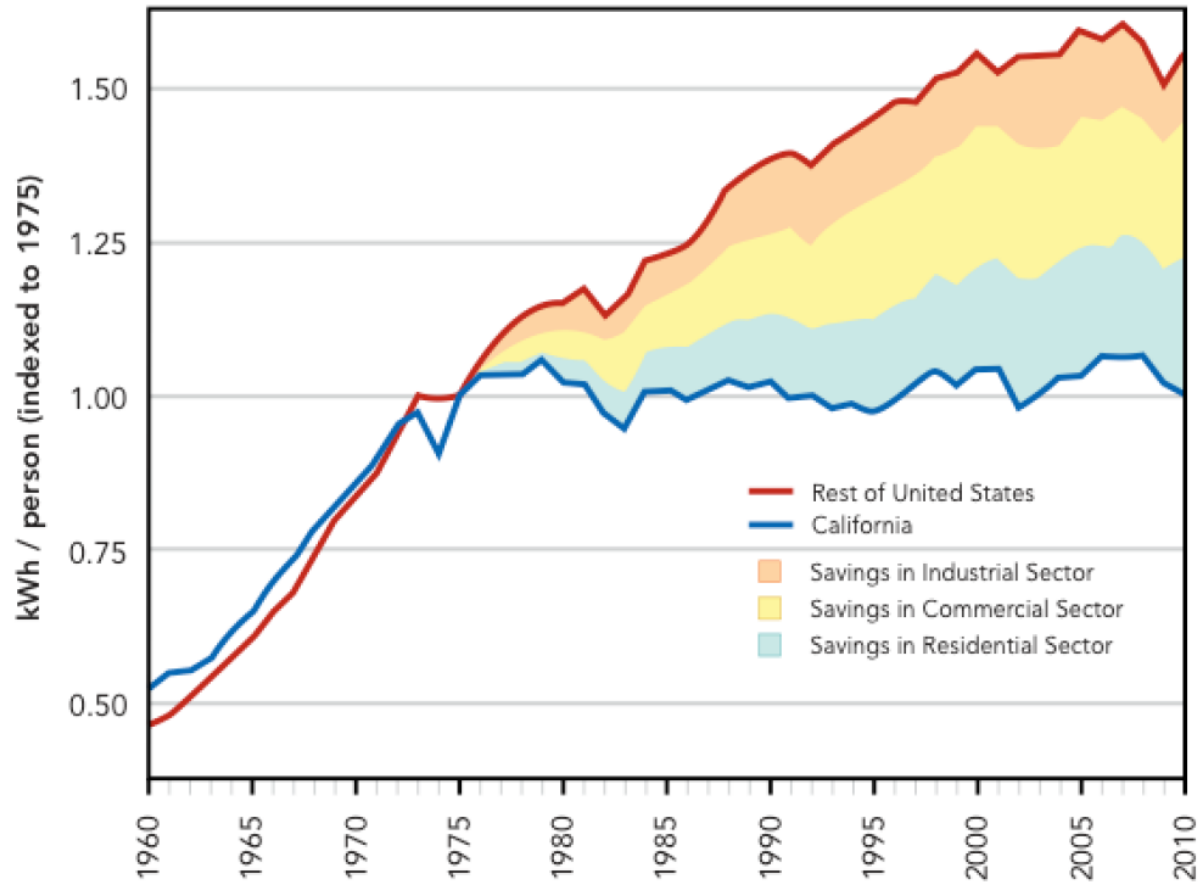
We Will Need 40 Nuclear Power Plants to Keep the Lights on in California ...

In 1972 the RAND Corporation found:

Electricity use in California has been doubling every 8 to 10 years, and every 8 to 10 years the electric utilities in the state have had to build as much new generating capacity as they have built in all their previous history. The growth of demand for electricity is expected to slow down only slightly in the future. California's electric utilities predict that by 1991 electricity consumption in California will be almost four times greater than in 1970. Meeting this demand means that the utilities will require 72,000 megawatts¹ of new generating capacity, or about 60 new power plants throughout the state.² The utilities predict [1] that as many as 19 of these plants will burn fossil fuels and more than 40 more may be fueled by nuclear energy.³

Reality: Demand Declined, Nuclear Power Plants are Retiring and the Lights Are On

Commissioner Hochschild Presentation, 2014



Example: How Much Wind Can be Accommodated?

In some places in the west in the early 2000's wind capacity limits less than 10% were asserted to ensure reliability. For example, in Nevada a 50 MW limit on a 2,000 MW system was asserted.

Table 2. U.S. wind power rankings: the top 20 states

Installed Capacity (MW)				Percentage of In-State Generation	
Annual (2013)		Cumulative (end of 2013)		Actual (2013)*	
California	269	Texas	12,354	Iowa	27.4%
Kansas	254	California	5,829	South Dakota	26.0%
Michigan	175	Iowa	5,177	Kansas	19.4%
Texas	141	Illinois	3,568	Idaho	16.2%
New York	84	Oregon	3,153	Minnesota	15.7%
Nebraska	75	Oklahoma	3,134	North Dakota	15.6%
Iowa	45	Minnesota	2,987	Oklahoma	14.8%
Colorado	32	Kansas	2,967	Colorado	13.8%
Ohio	3	Washington	2,808	Oregon	12.4%
Massachusetts	3	Colorado	2,332	Wyoming	8.4%
Alaska	3	New York	1,722	Texas	8.3%
North Dakota	2	North Dakota	1,681	Maine	7.4%
Indiana	1	Indiana	1,544	California	6.6%
Puerto Rico	1	Wyoming	1,410	Washington	6.2%
		Pennsylvania	1,340	New Mexico	6.1%
		Michigan	1,163	Montana	6.0%
		Idaho	973	Hawaii	5.1%
		South Dakota	783	Nebraska	4.8%
		New Mexico	778	Illinois	4.7%
		Montana	645	Vermont	3.4%
<i>Rest of U.S.</i>	0	<i>Rest of U.S.</i>	4,762	<i>Rest of U.S.</i>	0.8%
TOTAL	1,087	TOTAL	61,110	TOTAL	4.1%

* Based on 2013 wind and total generation by state from EIA's *Electric Power Monthly*.

Source: AWEA project database, EIA

There are More Examples ...

- DG penetration cannot exceed 15% on any circuit
- 1 MW of gas generation will be required for every 1 MW of coal generation retired
- An RPS of 10%, 15%, ... (fill in the blank) will cause reliability problems

Reliability is Vital, Reliability Limits do Exist and Are Location-specific, But ...

- An assertion has not always manifested itself as a problem
- It has proven tempting in the past to play the reliability card without considering the full palette of options
- Proven technology and operations practices offer many options

What Reliability Issues are Being Asserted Relative to the Clean Power Plan?

FERC boiled down the issues they wished to hear about into three categories:

1. Does the CPP impose operational issues?
2. Does the CPP affect infrastructure investment?
3. Does the CPP cause market issues?

Let's Take a Step Back: What is the Question?

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Where is the CPP on the Low Carbon trajectory? Compare CPP targets ...

Table 4.4. Regional RE Generation Targets

Region	Regional RE Generation Targets
Alaska	10%
East Central	16%
Hawaii	10%
North Central	15%
Northeast	25%
South Central	20%
Southeast	10%
West	21%

Taken from: Technical Support Document (TSD) for Carbon Pollution Guidelines for Existing Power Plants: Emission Guidelines for Greenhouse Gas Emissions from Existing Stationary Sources: Electric Utility Generating Units
Docket ID No. EPA-HQ-OAR-2013-0602
GHG Abatement Measures
U.S. EPA, Office of Air and Radiation, June 2014st

TABLE 4.2. Effective RE Levels Derived from RPS Requirements

RPS States	Primary Target	Target Year	2020 Effective RE Levels	Exclusions
AZ	15%	2025	10%	
CA	33%	2020	33%	
CO	30%	2020	30%	Secondary RPS requirement
CT	23%	2020	23%	Class 3 includes non-RE
DC	20%	2023	20%	
DE	25%	2027	19%	
HI	40%	2030	25%	
IL	25%	2025	16%	Secondary RPS requirement
KS	20%	2020	20%	
MA	33%	2030	22%	
MD	20%	2022	18%	
ME	40%	2017	40%	
MI	10%	2015	10%	
MN	30%	2020	30%	Secondary RPS requirement
MO	15%	2021	10%	
MT	15%	2015	15%	
NC	13%	2021	10%	Secondary RPS requirement

To existing RPS targets ...
 (for the complete table of the CPP state specific targets and existing state targets see the EPA document)

EPA Clean Power Plan

Phase I - Preliminary Technical Report

WECC Staff

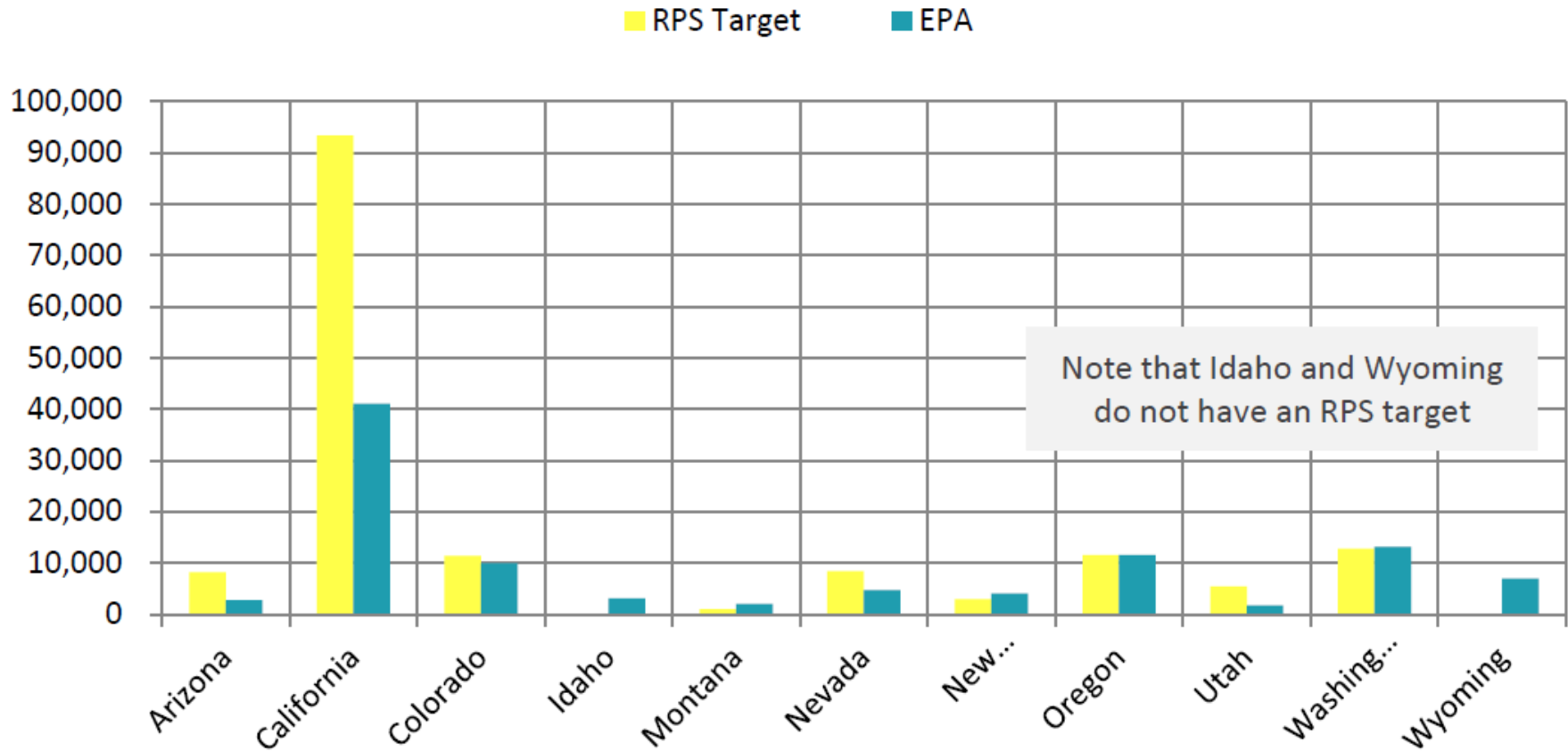
September 19, 2014



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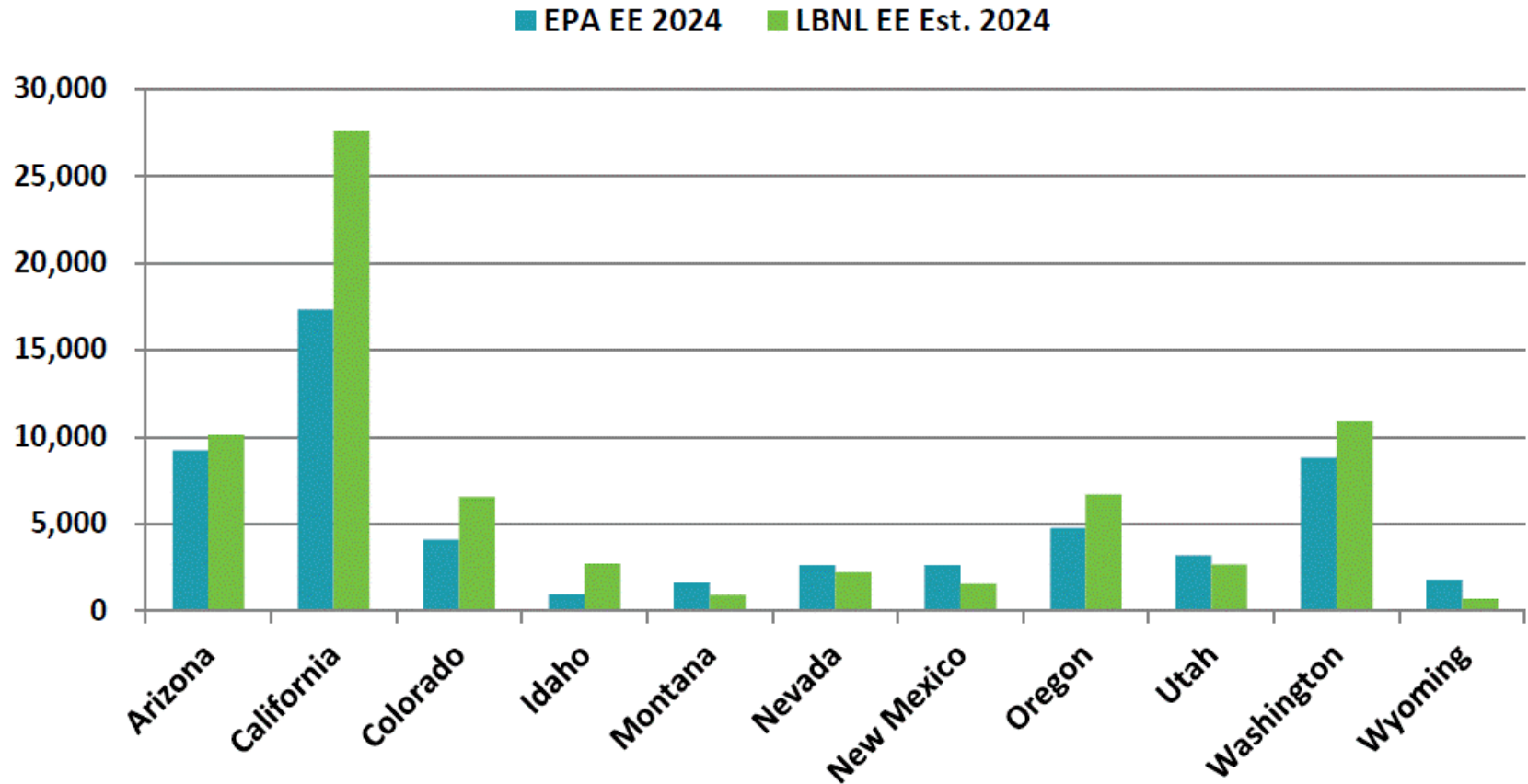
Salt Lake City, Utah 84103-1114

Renewable Generation



Source: WECC Preliminary Report

Energy Efficiency



Source: WECC Preliminary Report

And how does this compare with what RE levels can be attained without imposing significant reliability problems?

*** See Clean Keeps the Lights On for a more complete description and citations to the following studies:**
<http://www.raonline.org/document/download/id/7175>

Clean Energy Portfolios Beyond CPP Requirements Have Been Found to be Reliable (Partial List)

Public and Investor-Owned Companies	Agencies
Electric Reliability Council of Texas (ERCOT)	U.S. Department of Energy (U.S. DOE)
PJM	International Energy Agency (IEA)
Research Institutions	Consultants
Lawrence Berkeley National Laboratory (LBNL)	The Brattle Group
National Renewable Energy Laboratory (NREL)	GE Energy Solutions
Pacific Northwest National Laboratory (PNNL)	KEMA
Massachusetts Institute of Technology (MIT)	Energy and Environmental Economics (E3)
Imperial College London	

PJM study of 30% variable energy

- PJM Commissioned the study
- GE Energy Consulting, et al performed it
- 2% RE in 2011 and 14% RE by 2026 was policy at the time
- Study examined up to 30% penetration

The Envelope, Please ...

“The study findings indicated that the PJM system, with adequate transmission expansion and additional regulating reserves, will not have any significant issues operating with up to 30% of its energy provided by wind and solar generation.”

ERCOT Study

- Commissioned by Texas Clean Energy Coalition
- 2032 Scenarios by Brattle Group
- More than 12,000 MW of wind today
- Wind expansions 4 to 46,000 MW
- Solar expansion 6 to 13,000 MW
- Gas expansions 50 to 65,000 MW
- Coal fleet flat to 80% reduction

The Envelope, Please ...

“Our models found no technical difficulties accommodating much higher levels of variable wind and solar energy, while fully preserving reliability.”

Western Wind and Solar Integration Study

- Commissioned by NREL
- Performed NREL and GE Energy Solutions
- Examines 35% penetration

The Envelope, Please ...

“The technical analysis performed in this study shows that it is feasible for the WestConnect region to accommodate 30% wind and 5% solar energy penetration. This requires key changes to current practice, including substantial balancing area cooperation, sub-hourly scheduling, and access to under-utilized transmission.”

And There Are More ...

- [MRITS study](#) of 40% RE in MN
- NREL
 - [Low Carbon Grid Study](#) (CA & West)
 - [Renewable Energy Futures Study](#)
- Roadmap 2050 for the EU
- Eastern Wind Integration and Transmission Study
- Beyond 33% study by E3 for CPUC
- [Natural Gas Infrastructure Implications of Increased Demand](#) by DOE Feb. 2015
- Debra Lew's presentations on [Reliability](#) for WIRAB

Conclusions

1. Reliability is a legitimate issue
2. Hands are often available to counter the reliability card
3. CPP is an initial recognition of carbon cost and in many states the CPP is on a path toward a state specified RE goal
4. CPP targets are modest compared with viable RE penetration futures

Wrap Up

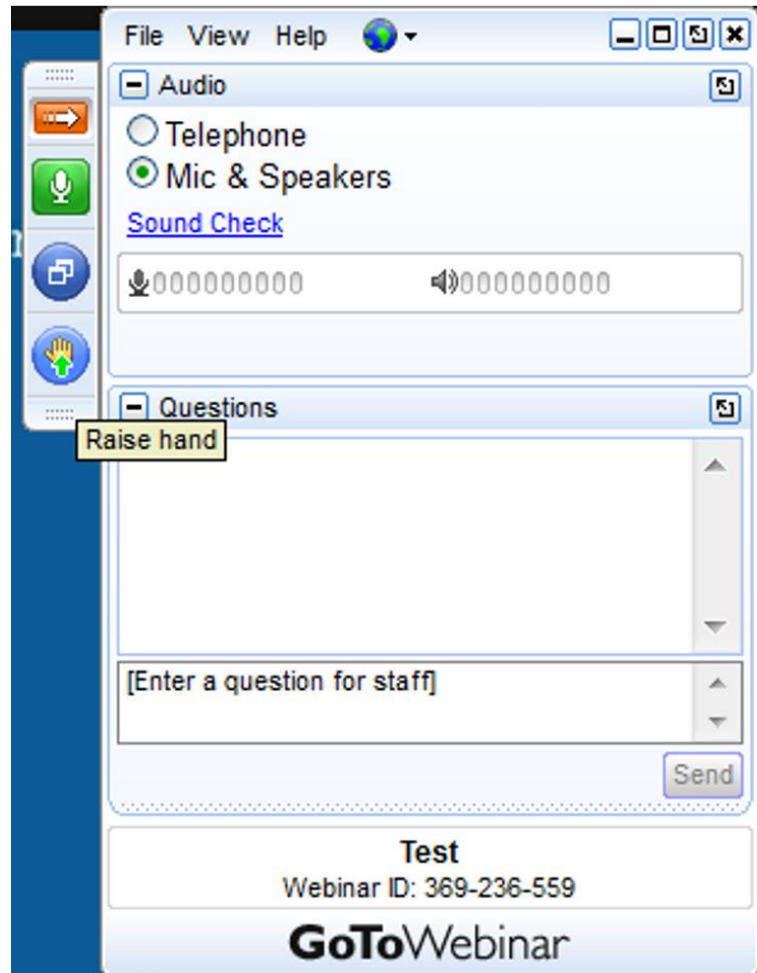
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About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power sector. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

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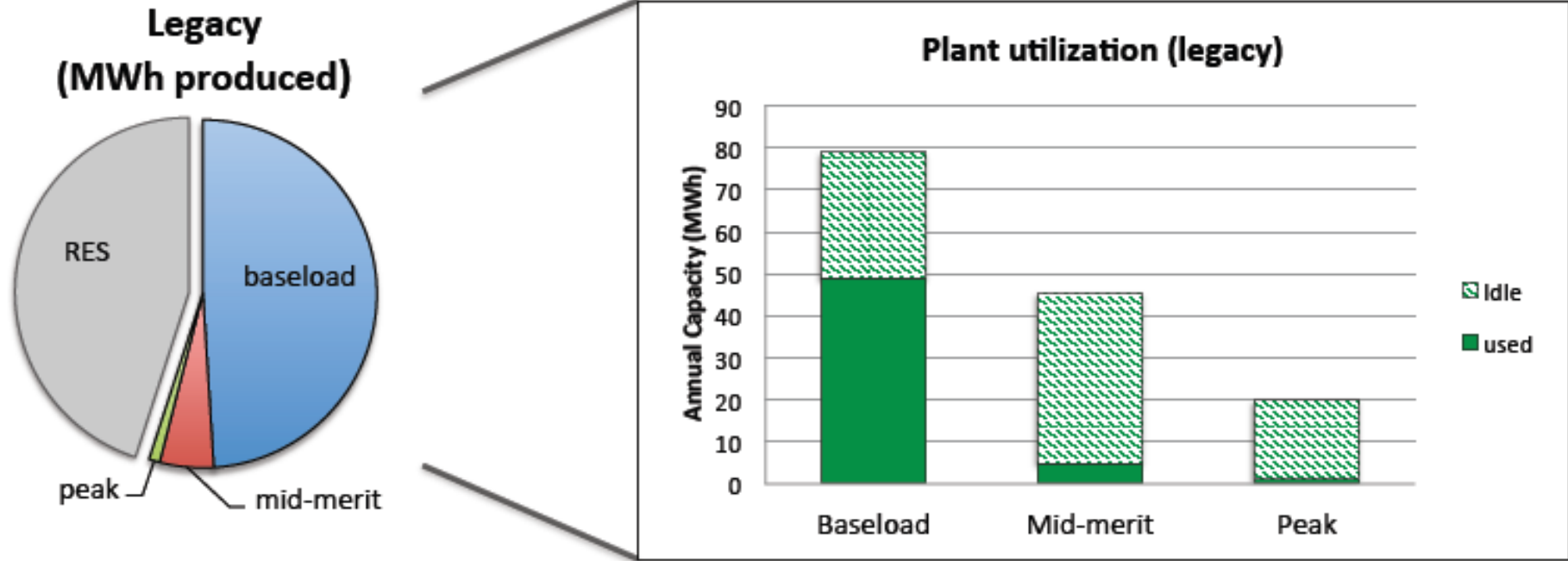
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Extra Slides

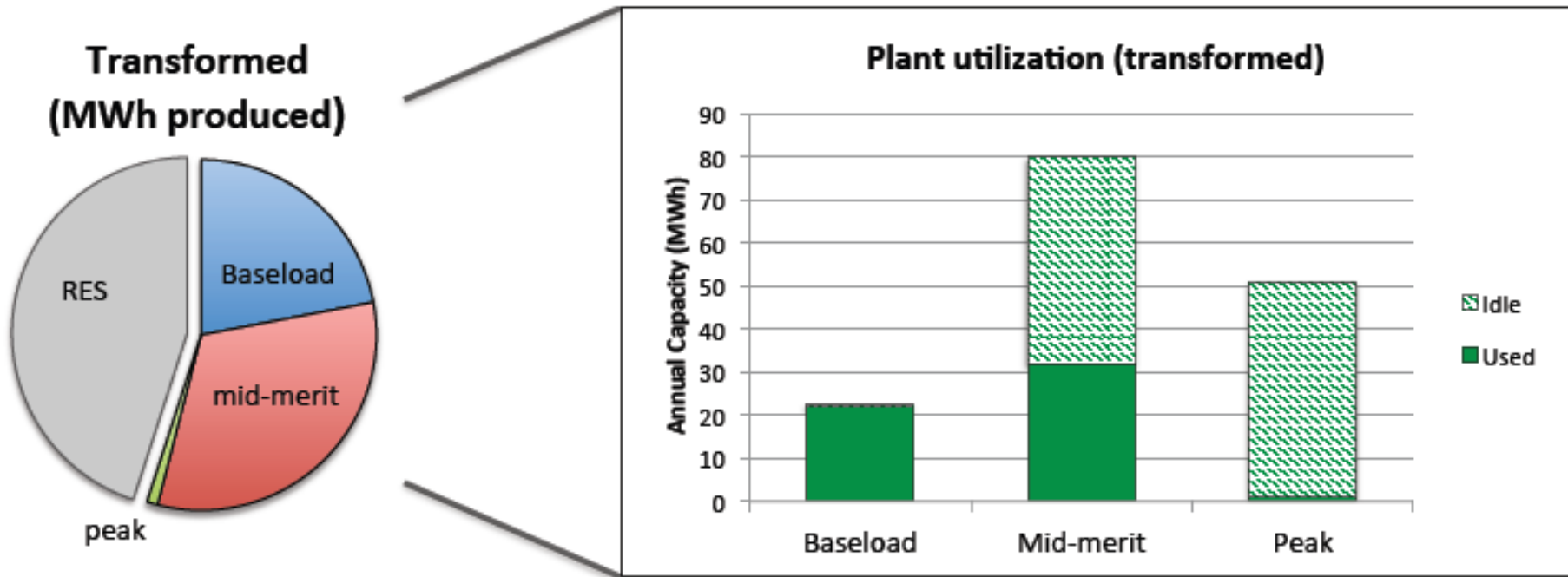
“How much?” depends on “what kind?”



Reliable, but costly & unstable, with investment based on:

- Single-product capacity mechanisms
- Inflated targets for generation adequacy
- No significant role for demand-side participation
- Flawed energy market implementation

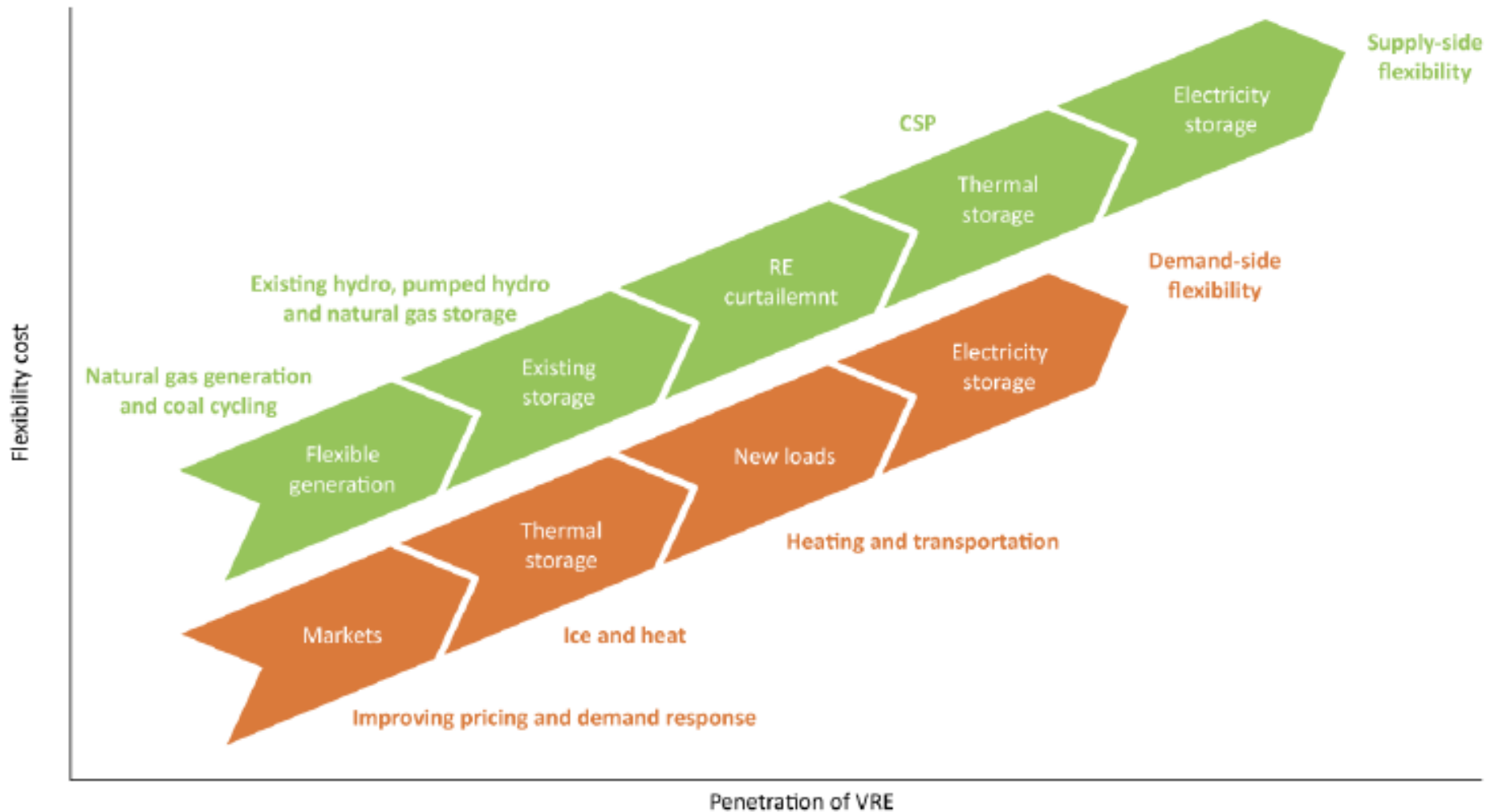
“How much?” depends on “what kind?”



Reliable, low-cost & stable, with investment based on:

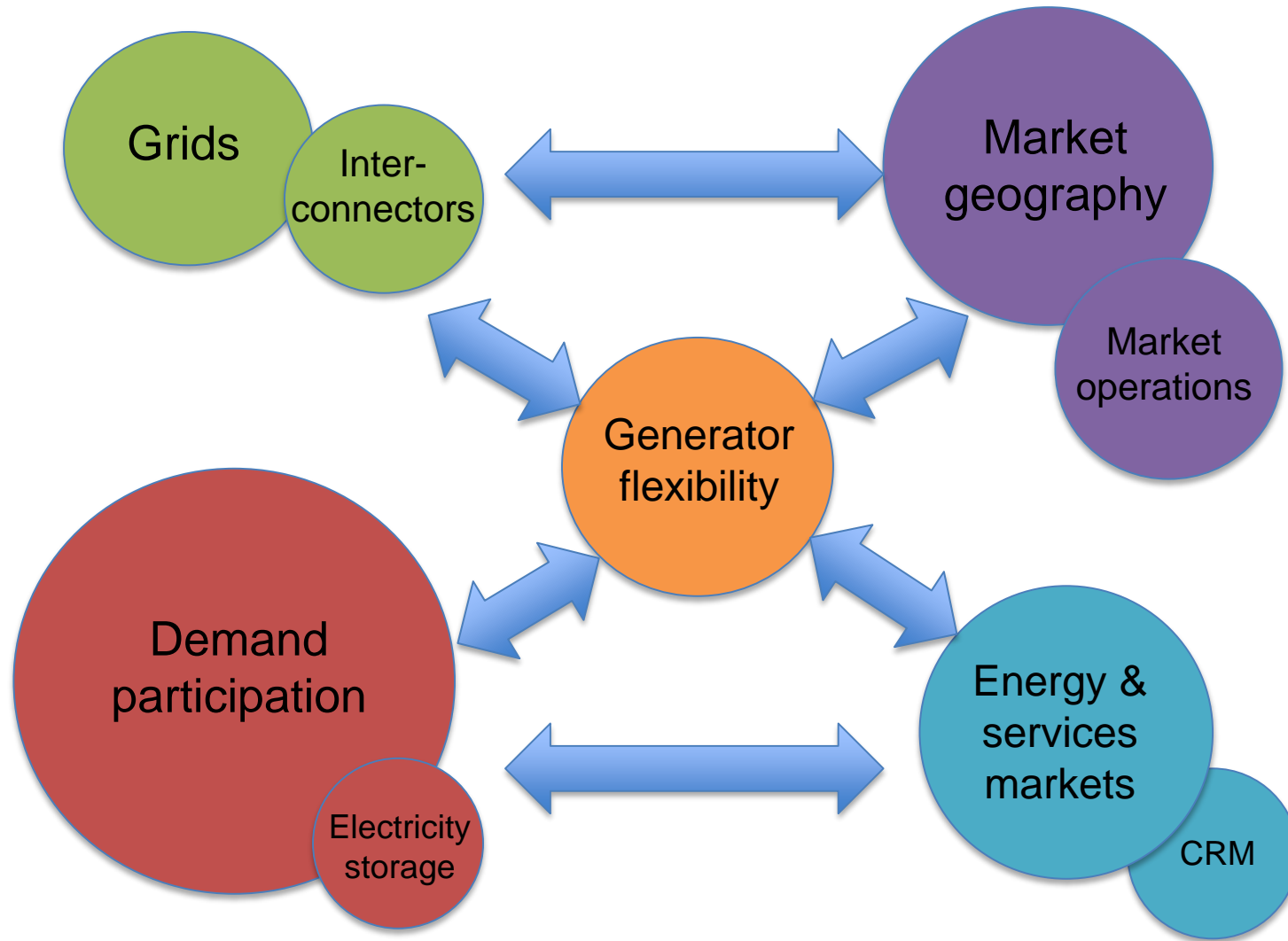
- Improved functioning of energy & balancing markets
- Transparent/objective/independent/regional RA assessment
- If desired, a simple multi-product CRM as a safety net
- Full demand-side participation in all markets

Flexible Generation is Just One Piece of the Puzzle

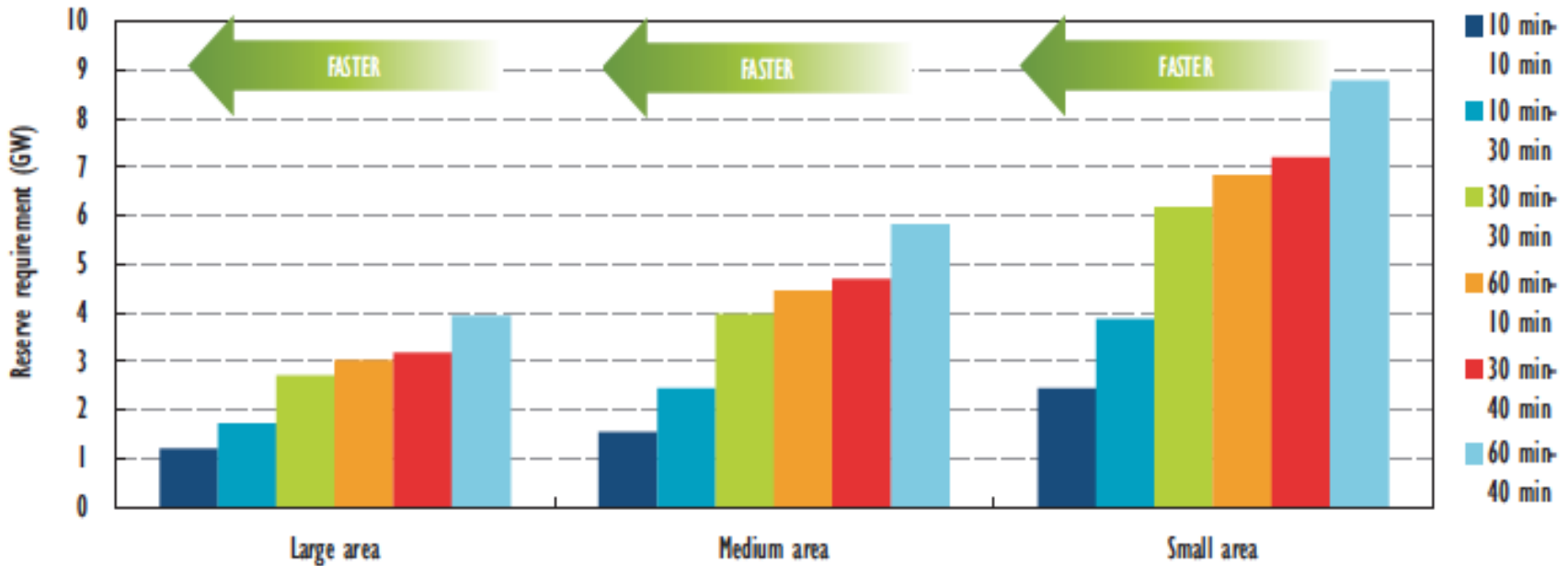


Penetration of VRE
 Source: IEA Energy Technology Perspectives 2014

Components can be complementary



Larger balancing areas, “faster” markets



Source: National Renewable Energy Laboratory (U.S.), 2013

Balance control authority over larger geographic footprints:

- Reduces variability of demand
- Reduces the impact of individual generator events
- Increases real-time access to balancing resources
- Among other benefits, reduced reserves requirements

WWSIS Phase 3 Draft Results ...

- System-wide transient stability can be maintained with high levels of wind and solar if local issues are addressed with traditional transmission system reinforcements. Then an 80% reduction in coal plant commitment results in acceptable transient stability performance.
- Further reinforcements, such as synchronous condenser conversions, help a 90% reduction in coal plant commitment result in acceptable transient stability performance.

N. Miller, GE, WWSIS₃, CREPC/SPSC, San Diego Oct 2014