Powering California Forward

CPUC Thought Leaders Series

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## California, Outlier or Leader?

<table>
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<tr>
<th>Category</th>
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<td>Renewables Standard</td>
<td>Highest in US, 33% by 2020</td>
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<td>Greenhouse Gas Cap</td>
<td>1990 levels by 2020</td>
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<td>Electric Car Mandate</td>
<td>15% of sales by 2025</td>
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<td>Energy Efficiency</td>
<td>Gets first priority in resource planning</td>
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<td>Decoupling</td>
<td>Utility profits not tied to sales volume</td>
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<td>Smart Grid</td>
<td>One of the earliest &amp; largest adopters of AMI</td>
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<td>Solar Rooftops</td>
<td>Goal set for 1 million by 2016</td>
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<td>Nuclear</td>
<td>New plants prohibited by state law</td>
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CO₂ Emissions for Delivered Electricity

Source: U.S. and CA averages, U.S. Environmental Protection Agency.

Source: The Climate Registry, a third party verification of greenhouse gas emissions data.
Energy Efficiency: Ingrained in the PG&E Culture

- Legislation enacted in 1974 to “reduce wasteful, inefficient … consumption of energy.”
- Decoupling of natural gas sales in 1978; electric sales in 1982
- Shareholder incentive adopted in 1993
- Significant growth in funding for energy efficiency programs
PG&E is using Smart Grid technologies to provide customers with benefits today.

**Engaged Consumers**
- Online Information
- Home Energy Reports

**Smart Markets**
- Customer Energy Management
- Automated Demand Response

**Smart Utility**
- Outage and Load Management
- Advanced Automation

Diagram:
- Substation A
- Substation B
- Outage
- 1 2 3 4 5 6
PG&E is a Leader in Retail Solar PV

One-fourth of customer solar installations in the U.S. are in PG&E's service territory

Source: Annual survey by the Solar Electric Power Association for 2012 (2013 results available June 2014).
Customer PV has Grown Significantly

Cumulative Customer-Side PV Capacity*

* Capacity is CEC AC and includes all NEM and non-NEM customer-side PV capacity. Some previous versions of this chart include only NEM capacity, so totals were, on average, 5% lower than above.
California Utility Scale Renewables Increasing Dramatically

Figure 3: Renewable Resource Mix, Actual and Forecasted by Year\textsuperscript{11,12}

11. Figure is not risk-adjusted and forecast does not assume re-contracting of contracts whose terms expire prior to 2020.
California is Rich in Renewable Resources

Solar

Wind

Biomass

Geothermal

Source: NREL
Renewable generation is no longer a technical challenge, but an economic and operational challenge.
PG&E’s Portfolio Costs are Rising

- Energy Crisis Costs (DWR)
- Procurement Costs (ERRA)
- Citygate Gas Price

($000's)

$0

$500

$1,000

$1,500

$2,000

$2,500

$3,000

$3,500

$4,000

$4,500

$5,000

$5,500

$/MMbtu

$0

$1

$2

$3

$4

$5

$6

$7

$8

$9

$10


PG&E's Portfolio Costs are Rising as indicated by the following:

- Energy Crisis Costs (DWR)
- Procurement Costs (ERRA)
- Citygate Gas Price

The chart illustrates the changes in costs over the years, with a notable increase in the latter years.
PG&E’s Electric Rate History

Data as of May 1, 2014
Beyond 33% RPS, Integration is Increasingly Challenging and Costly

PG&E and other large California utilities studied challenges and solutions to implementing a higher RPS

Over-generation emerges as a problem above 33%

- Grid cannot absorb all energy generated
- Over-generation is very high on some days
- Flexible fossil generation helps mitigate daily swings

Without additional solutions, grid operator must curtail solar to maintain reliability

Example Day in April under 33%, 40% and 50% RPS

Source: Energy + Environmental Economics
What Does the Future Hold?

More renewables?

More demand response?

More storage?

More EVs?

More energy efficiency?

Will electricity replace natural gas usage?
Achieving CA’s 2050 GHG Goal

Source: Energy + Environmental Economics
Integration Solutions Will Be Critical to Success

Increased regional coordination
• Make best use of latent flexibility in current system

Renewable resource diversity
• Reduces over-generation and need for flexible resources

Flexible loads
• Shifting loads from one time period to another, sometimes on short notice

Flexible generation
• Need generation that is fast ramping, starts quickly, and has minimum generation flexibility

Energy storage
• Deep-draw (diurnal) storage is important