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Metric-Based Evaluation of Storage at Wind Interconnection Points

Presented by:

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Presented to:

CEC PIER Workshop:

What Is Needed to Accelerate Path to Market and Achieve California's 2020 Renewable Energy Goals

February 29, 2012

Presentation Outline

- Project Objectives
- Background Information
- Results for SCE and PG&E Substations
- Conclusions and Recommendations

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Project Objectives
(Under CEC Grant # PIR-07-010)

- **Identify At Least Two Priority Sites In California To Deploy Energy Storage Devices To Mitigate Wind Generator Critical Transmission And / Or Operational Issues.**
- **Use A Metrics-Based Tool To:**
  - **Quantify The Value Of Energy Storage Devices To Mitigate The Grid Challenges Of Wind Generation**
  - **Select Energy Storage Plant Type And Specify MW And Hours Of Storage Needed For Each Site.**

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The Wind Challenge and Industry Response

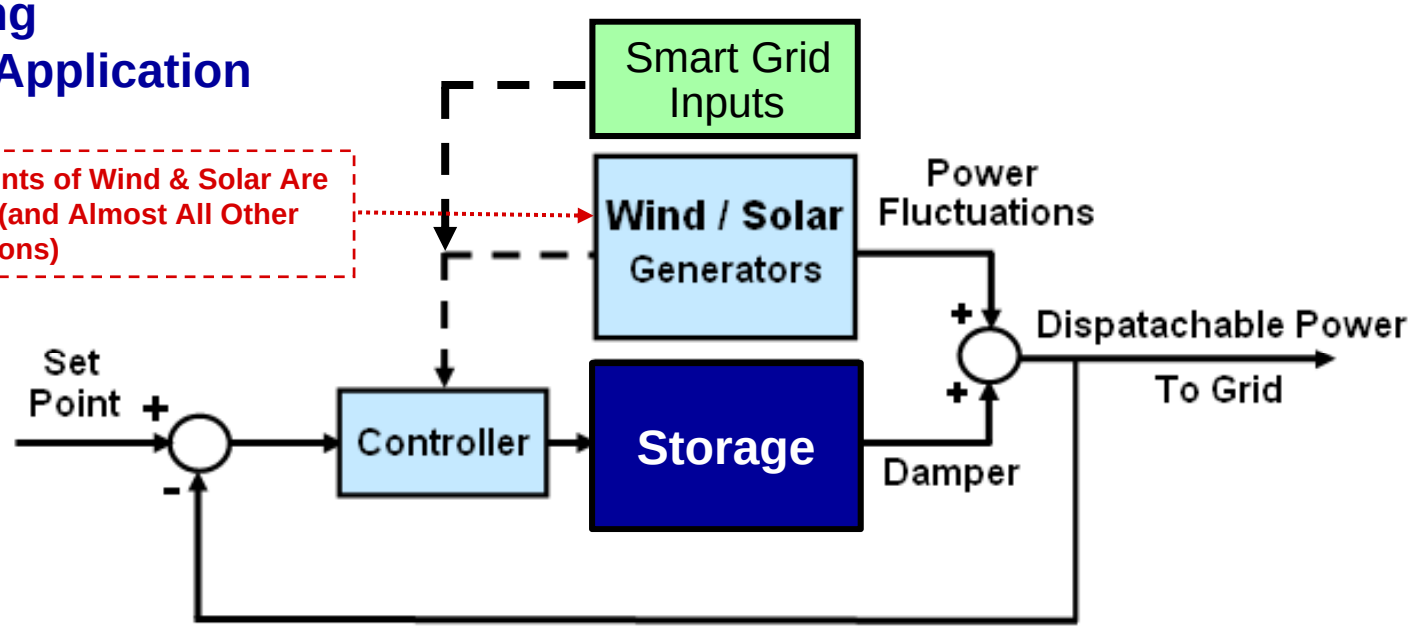
Challenge: **Wind/Renewable Fluctuating Power Output**

- **Produce power oscillations with high, unpredictable ramping problems**
- **Provide power when not needed (off-peak rather than on-peak time)**

Response: **Deploy Electric Energy Storage, sized and operated for:**

- **Frequency regulation**
- **Ramping**
- **Load leveling**
- **Smart Grid Application**

Extremely Large Amounts of Wind & Solar Are Expected In California (and Almost All Other US Electric Utility Regions)



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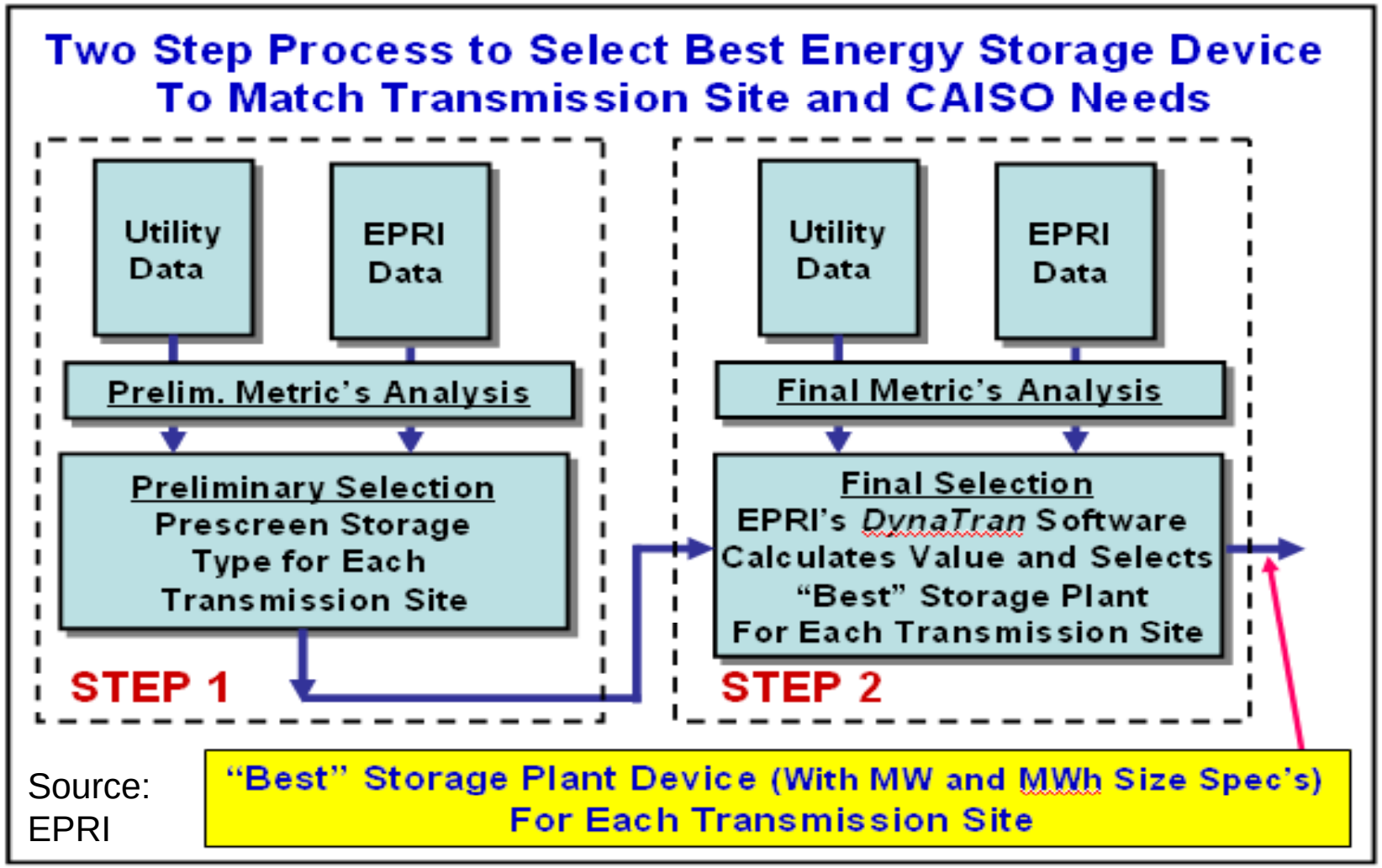
Two Step Process to Determine the Value of Energy Storage and To Select Best Storage Technology for a Particular Site



Source: EPRI

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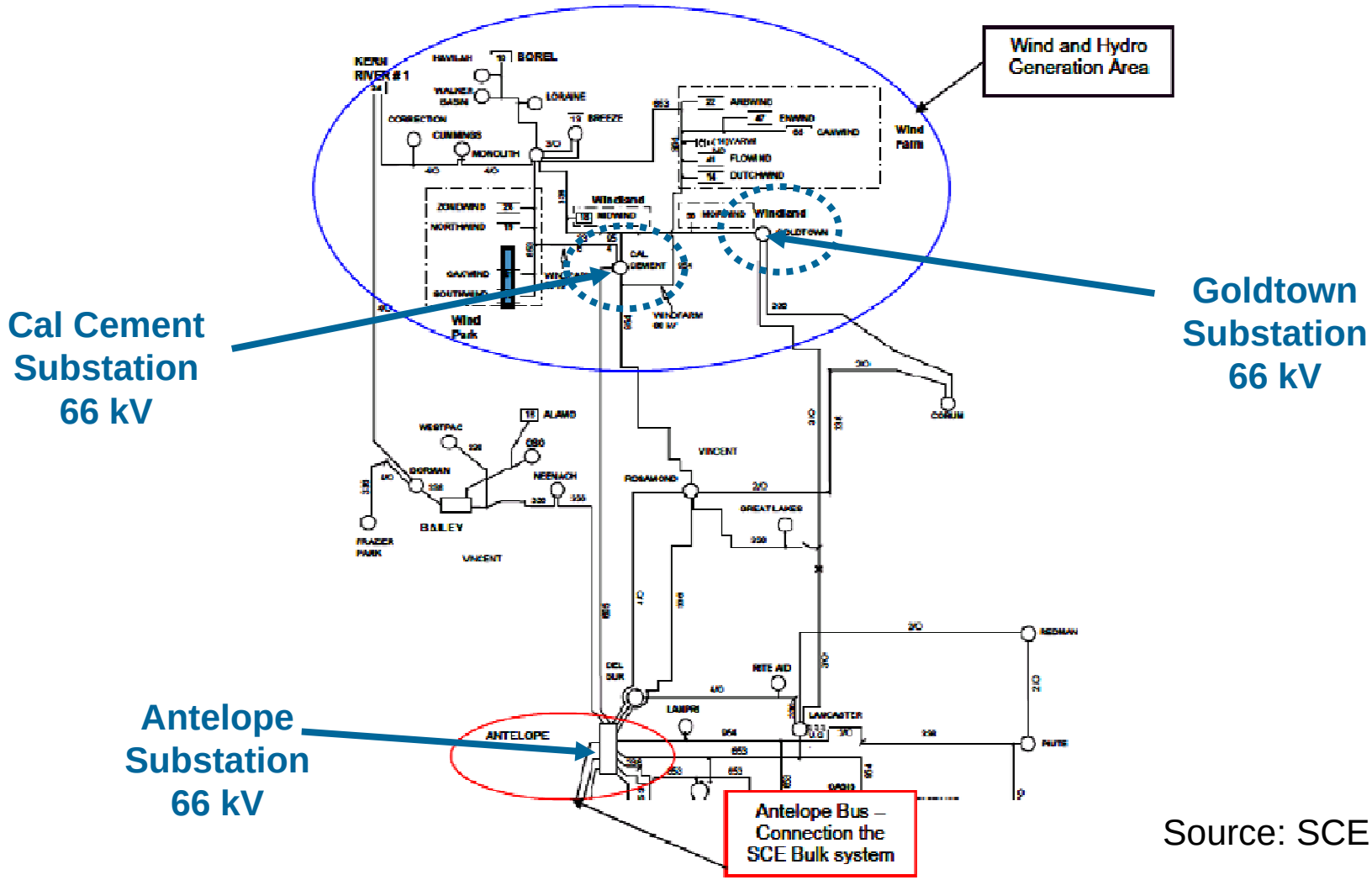
SCE Antelope-Bailey 66 kV System One Line Diagram Showing SCE Cal Cement and SCE Goldtown Substation Sites Needing Energy Storage Plants To Resolve Transmission Curtailment Due To Wind Generators



Source: SCE and EPRI

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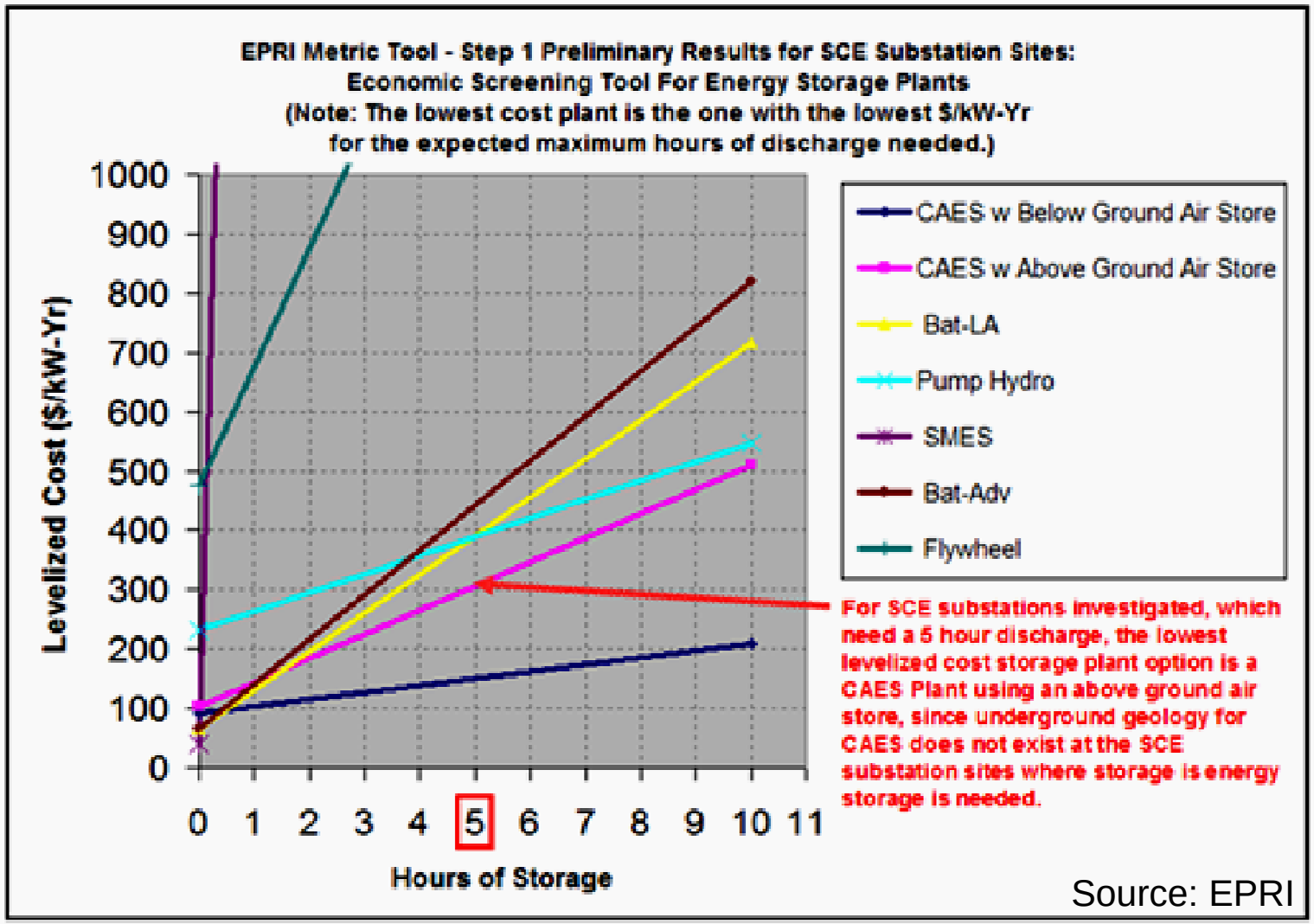
EPRI Metric Tool Results Indicate The SCE Storage Plant Should Have 5 Hours Of Maximum Discharge Capability And Be A CAES Plant Using An Above Ground Air Storage System



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SCE Energy Storage Recommendations

- Two Storage Plants Needed to Total 110 MW – 5 Hour
  - Cal Cement Substation: 70 MW – 5 Hour
  - Goldtown Substation: 40 MW – 5 Hours

- Type of Storage Plant
  - Compressed Air Energy Storage Plants Using Above Ground Air Storage Systems
  - See Next Slide For Preliminary Plant Layout

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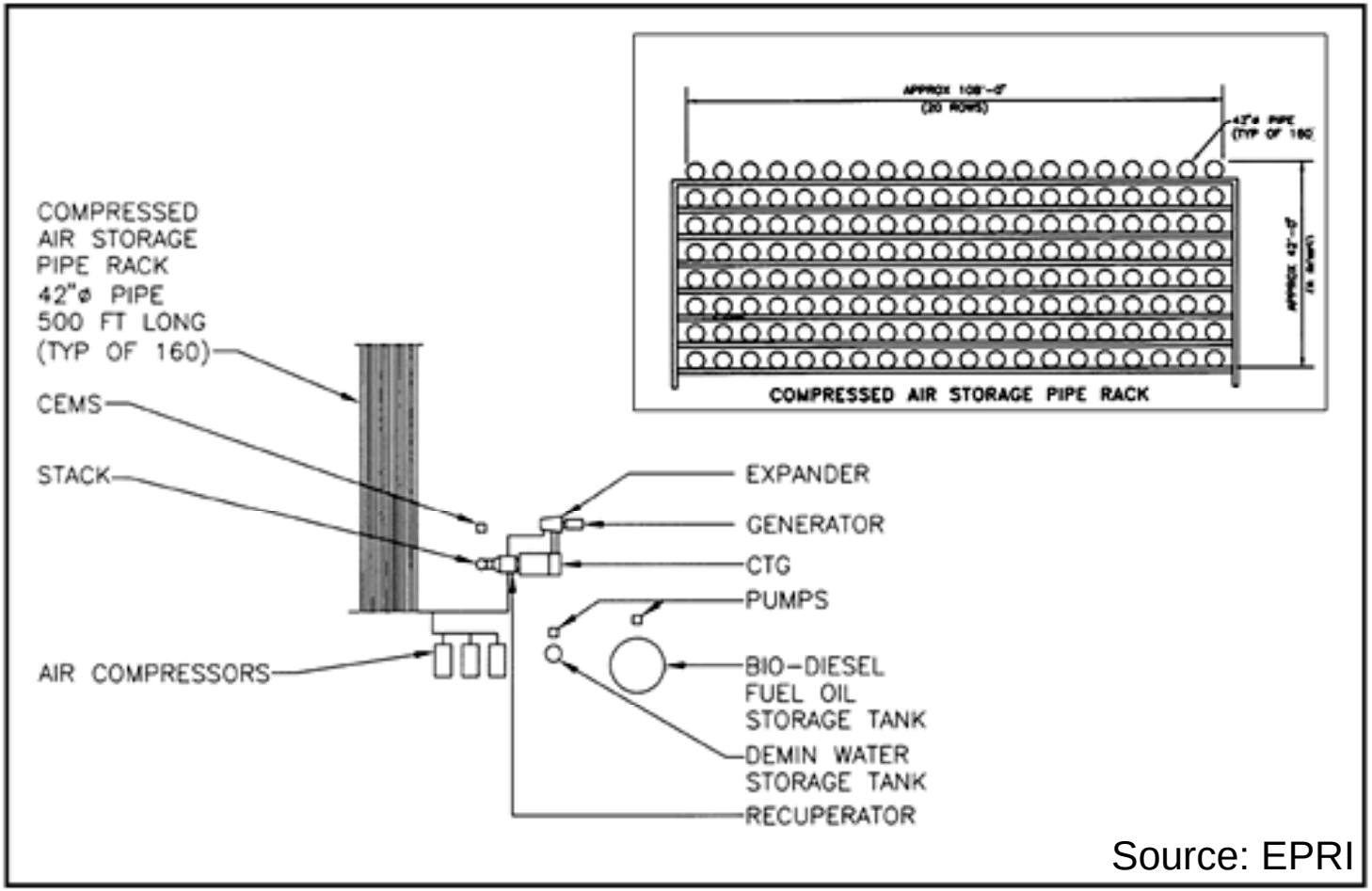
SCE Advanced CAES Plant Device Schematic Layout Plant, Using Above Ground Air Storage System



Source: EPRI

Note: The schematic shown is for a 50MW-4Hr Plant, which can be scaled for the 70 MW-5Hr and 40MW-5Hr Plants Needed.

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PG&E Transmission Sites Likely to Benefit from Energy Storage Plants

Source: EPRI

Site	Line(s)	Voltages (kV)	Load / Power Flow Characteristics	Available Land	Nearby Wind Farms (Capacity)	Issues created by wind
Midway	Located on California Oregon Intertie. Major transmission ties to Fresno, Bakersfield, and Southern California	500/2	Networked Bulk Transmission	Yes, may require expansion of existing fence	Tehachapi (750 MW, expanding to 4200 MW by 2012)	Generation/Load Leveling, Ramping
Tesla	Located on California Oregon Intertie. Major transmission ties to SF Bay Area.	500/2	Networked Bulk Transmission	Yes, may require expansion of existing fence	Altamont (500 MW)	Generation/Load Leveling, Ramping,

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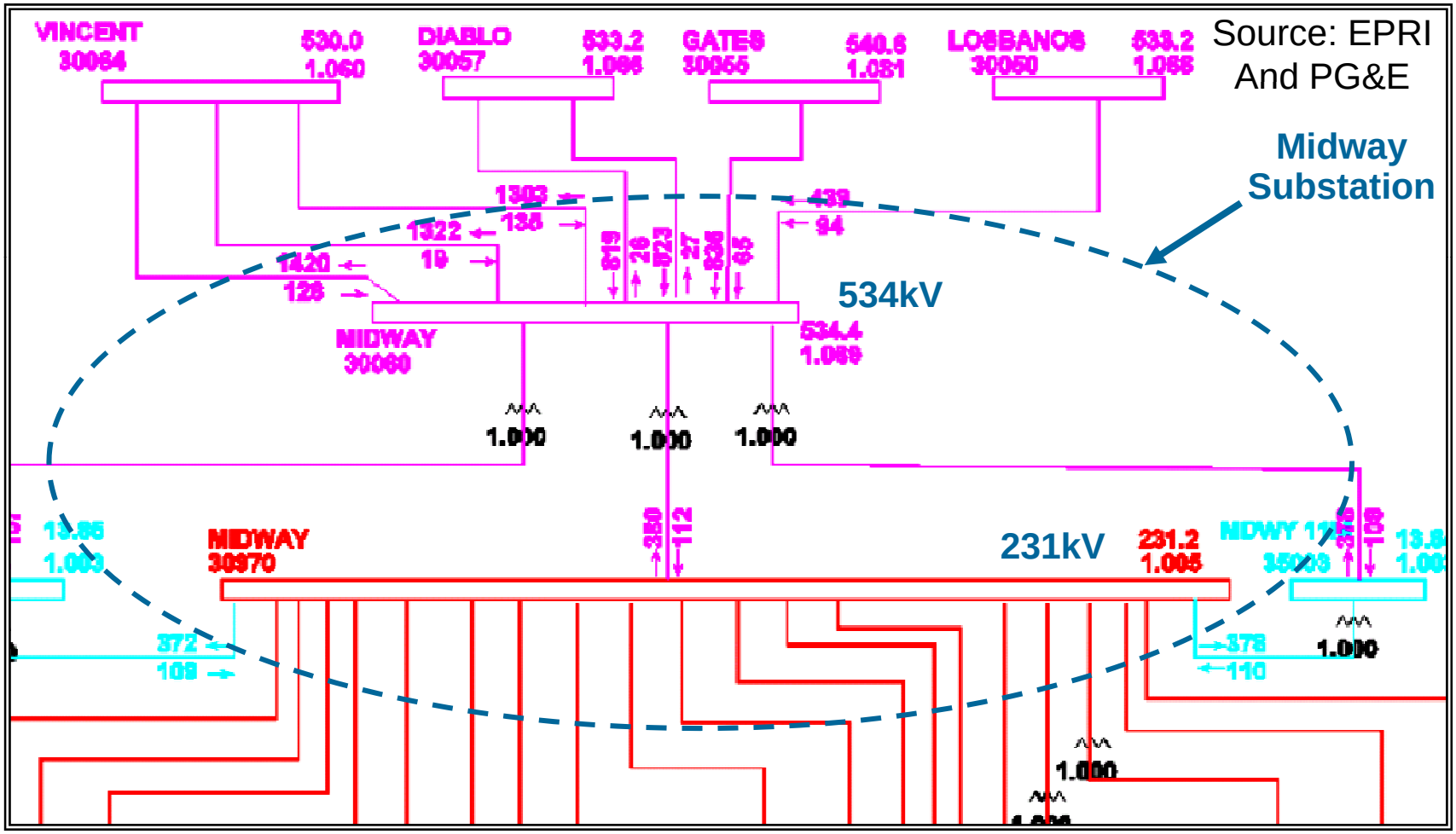
PG&E Midway Substation:
Estimated Power Flow for Year 2014, Summer Peak



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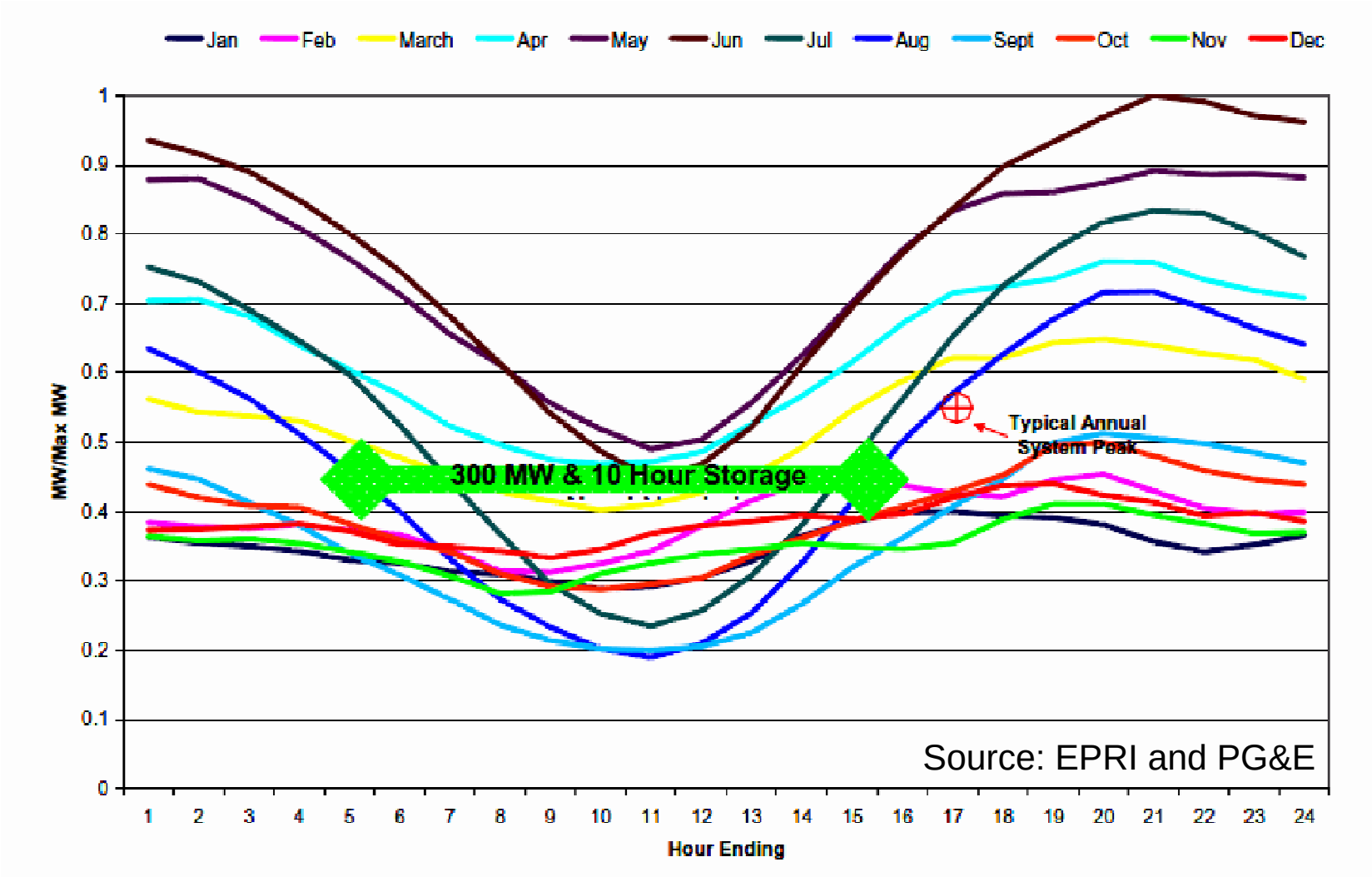
Average Tehachapi Monthly Wind Plant Production As A Ratio Of Actual MW Output To Maximum MW Output



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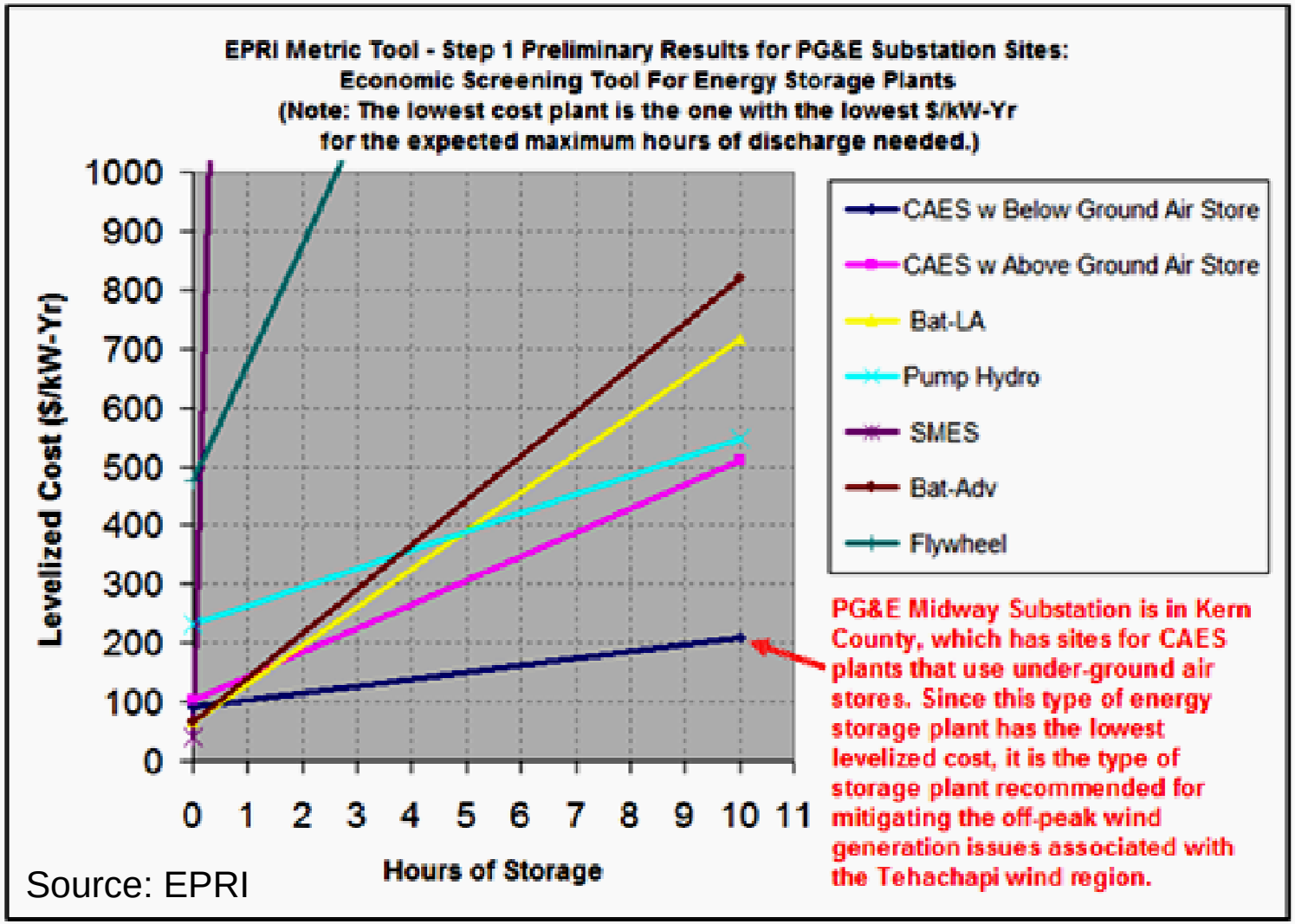
EPRI Metric Tool: Results Indicate The Storage Plant Type And Capacity Of The Storage Plant Needed At The PG&E Midway Substation Is A CAES Plant Using A Below Ground Air Store



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PG&E Energy Storage Recommendations

- One Storage Plant Needed: 300 MW – 10 Hour
  - At, or Near, Midway Substation

- Type of Storage Plant
  - Compressed Air Energy Storage Plants Using Below Ground Air Storage Systems
  - Preliminary CAES Plant Schematic Design Included In Final Report of this CEC-PIER project.

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Conclusions and Recommendations
(Part 1 of 2)

- **SCE Conclusions**
  - Cal Cement Substation Site: 70 MW – 5 hour Advanced Compressed Air Energy Storage (CAES) Plant. This plant is recommended to be built at this substation (using an aboveground air storage system) to mitigate transmission bottlenecks caused by the current and the expected increase of wind power flowing through this substation.
  - Goldtown Substation: 40 MW – 5 hour CAES plant. This plant is recommended to be built at this substation (using an aboveground air storage system) to mitigate transmission bottlenecks caused by the current and the expected increase of wind power flowing through this substation.

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Conclusions and Recommendations
(Part 2 of 2)

- **PG&E Conclusions**
  - PG&E Midway Substation Site: 300 MW – 10 hour CAES Plant. This plant is recommended to be built near this substation (using an underground air storage system) and should be connected to the high voltage California grid. Note: It has been determined by working with PG&E staff familiar with their natural gas storage facilities and potential CAES underground air storage media, there are potential sites for CAES plant that can connect into the Midway Substation. This type of plant will assist the CAISO to keep the California grid stable during rapid ramp-up, ramp-down and frequency/area control error regulation time periods.
  - As part of this project's Technology Transfer activities, EPRI assisted PG&E to submit and win a proposal (for $25M) from the DOE American Recovery & Reinvestment Act of 2009 (ARRA), to build a 300MW-10Hr Adv. CAES plant near the PG&E Midway substation. The final design, costing and geological assessment work for this plant is ongoing, which is Phase 1 of the ARRA project. If all permits and PG&E management approvals take place, this plant will be build and operational in the 2017-2019 time frame (which is Phase 2 of this ARRA project).

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Questions & Answer Session

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