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Energy Storage Devices:
Smart Grid Applications for Grid Reliability

Presented to the

Electrical Storage Business

and Policy Drivers

Jan 24-25, 2010

Hyatt Regency - Houston TX

Western Grid Development

Ziad Alaywan

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AGENDA

1. Application of Energy Storage Device as a wireless solution
2. Technology selection criteria
3. Site selection criteria
4. Current paradigm on wire-only solutions
5. Proposed wireless solution to replace the traditional “wire” solutions
6. Description of WGD projects
7. Cost comparison
8. Regulatory challenges

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Project Feasibility

Energy Storage Device (ESD)

Can ESD solve a reliability problem and thus be considered a transmission asset and able to recover costs through a transmission rate?

Why Now?

1. ESD has been used at several locations to solve reliability or defer T&D projects.
2. Rate Recovery mechanism is in place.
3. Technology is mature.
4. Political and regulatory environments are favorable.
5. Consistent with state and federal energy policies.
6. Cost is justified.

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Application of the ESD

- Locations where reliability violations exist during super summer peak hours under normal conditions.
- Situations where facilities are under N-1 conditions and where the upgrades are costly and require years in lead time.
- Highest loads occur on just a few days per year, for 4-6 hours.

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Large Scale Battery

(Not Vehicle)

Energy Storage Battery (ESD)

- Store already generated (off peak) energy and released the stored energy (on peak)
  - New design
  - 300 MW installation Worldwide
  - Stores Green Energy and Emission Free
  - Smaller in size (25kW modules) and scalable
  - Very quick response (less than 0.16 sec)
  - Six to eight hours for discharge

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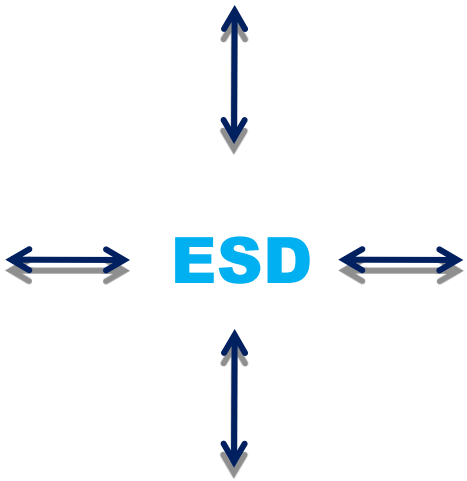
Drivers

Economics



Greenhouse Gas Goals (AB 32) ⟷ **ESD** ⟷ **Reliability**

Renewable Development

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WGD Technology Selection Criteria

Vendor provides technology with:

- Large scale implementation (to 34 MW)
- Small footprint requirement (1500 sq. ft/ MW)
- Zero emissions
- Fast response (100% capacity in 10 sec., immediate synchronization to grid)
- Solid financial backing
- Over three years track record

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Project Locations

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Improvement Over T&D

- Public Utilities Commission in Texas approved a 5 MW ESD battery as a transmission alternative.
- AEP used ESD in Charleston, WV, when there was not sufficient time to add a transformer; realized additional benefits:
  - Reduced existing transformer temperature
  - Increased load factor
  - Helped shape peak

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WGD Business Case

- ESD is an ideal solution when capital costs to upgrade the transmission system are high and load growth is relatively low.
- Avoid miles of costly reconductoring and over-engineering.

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Projects Cost Comparison

	Transmission Upgrade (20 miles reconductoring)	ESD Battery Alternative
Project Cost	$ 40 million	$36 million
NPV Revenue Requirement	$ 80 million[1]	$55 million[2]

1. Assumes 50/50 debt/Equity, ROE = 10.75%, debt rate = 7.25%, pre-Tax WACC=12.5%, Inflation 2.25%, project life =41 yrs, G&A=4%
2. Assumes 50/50 debt/Equity, ROE = 11.90%, debt rate = 8.50%, pre-Tax WACC= 14.2%, Inflation 2.25%, project life = 41 yrs., G&A=2%

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WGD Proposed Projects

- Comprehensive reliability and economic analysis were conducted as part of the project submit ions. The analysis concluded:
  - ESD can resolve existing or projected reliability violations
  - The total cost to ratepayers is less than the proposed alternative
  - Benefit-to-cost ratio between 1.67 to 2.11
  - WGD would not receive any payment above the transmission rate
- ESD solution solves the reliability problem.
- Provides a lower cost solution to ratepayers.

***What is needed*:**

- Cost recovery from transmission access charge with possible upside incentives.

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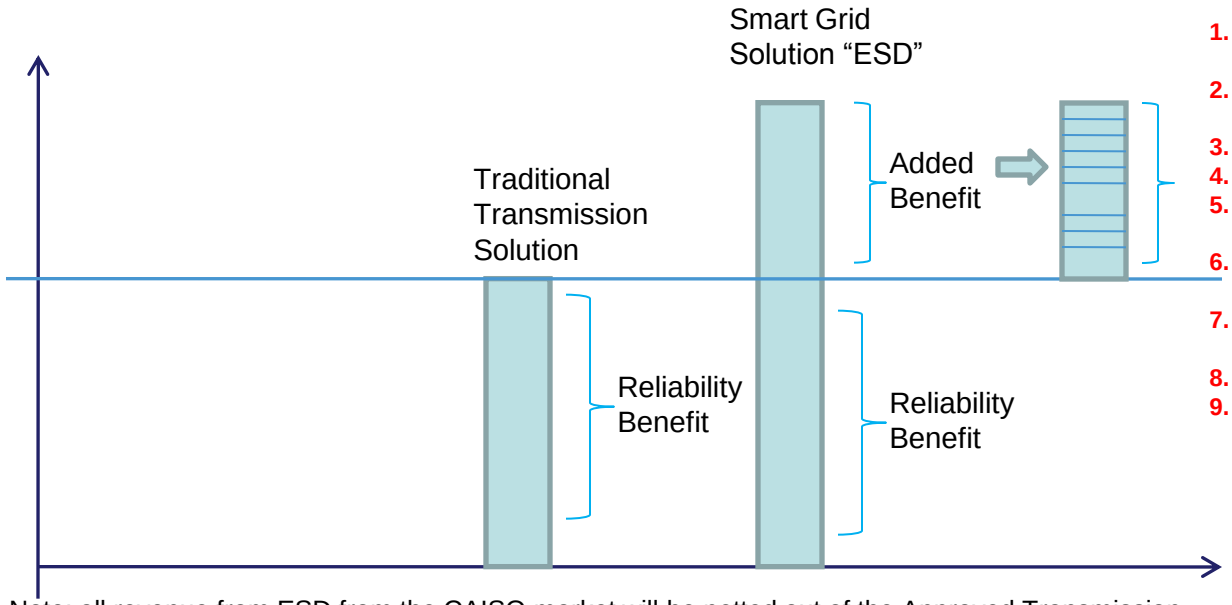
Summary of Benefits to the Electric Grid



1. **Delay or remove proposed transmission projects**
2. **Provide stored energy for the peak hours**
3. **Reduce transmission congestion**
4. **Reduce marginal losses revenue**
5. **Reduced overall system production cost**
6. **Enhance resource adequacy (capacity)**
7. **Provide ancillary services (spin, regulations)**
8. **Emissions reduction**
9. **Renewable firming**

Note: all revenue from ESD from the CAISO market will be netted out of the Approved Transmission Rate.

ESD will be scheduled into the CAISO market as price takers and will operate based on a reliability schedule by the scheduling coordinators.

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Initial Quantifiable Benefits

1. Delay or remove proposed transmission or “wire” projects.
2. Provide stored energy for the peak hours.
3. Reduce transmission congestion.
4. Reduce marginal losses revenue.
5. Reduce overall system production cost.
6. Enhance resource adequacy (capacity).
7. Provide ancillary services (spin, regulations).
8. Emissions reduction.
9. Renewable firming.

WGD only used #1 to justify the proposed WGD projects.

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Regulatory Challenges

1. FERC policies have not fully been integrated in an effective manner.
2. CAISO has challenged whether non-utility entity such as WGD could compete?

Questions:

How are the consumers protected if no competition in transmission is allowed?

How would FERC and the local PUC justify transmission rates as being “just and reasonable”?

Although, what ratepayers pay for transmission is small in comparison to the overall utility bill, transmission is one of the biggest drivers in obtaining economic energy!

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Thank You!

If you have any questions, please contact:

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Additional Information

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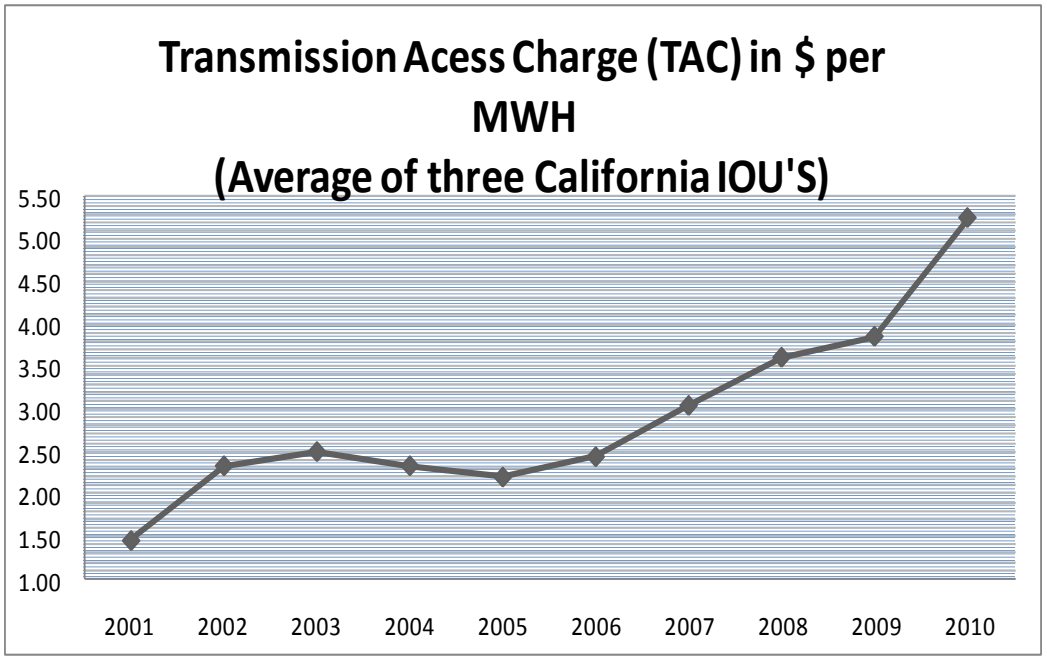
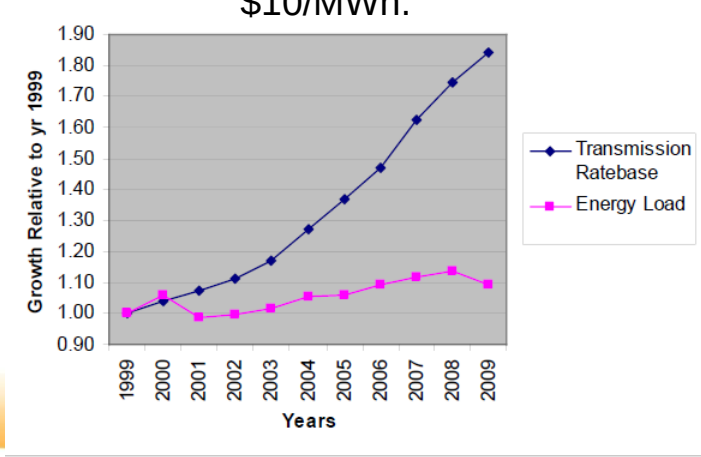
Transmission Rate



- Between 1999 - 2009 the California IOUs' combined transmission rate base has grown by 84% while during the same period, energy loads have only grown by 9%.
- This increase in transmission rate base has more than doubled the TAC that CAISO ratepayers and other users of the grid pay ($5.25/MWh).
- Assuming that an additional $10 billion in new transmission rate base is added by year 2020, the TAC can easily reach an astonishing $10/MWh.

This increase is particularly troubling when compared with the rate of energy consumption with CAISO. As illustrated in the graph below, tracking transmission rate base against energy load, the former has grown substantially when compared to the latter.



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Cost Recovery (1)

We proposed a transmission rate recovery mechanism:

- The CAISO will evaluate the merit of the proposed ESD as a transmission alternative.
- Once the project is approved by the CAISO, the project would recover all costs (including development cost, O&M, capital costs, taxes, engineering, etc ...), plus
- Request 13.5% fixed ROE for 20 years, in addition to requesting:
  - 1.5% added benefit for applying a Smart Grid technology and a Renewable Integration benefit.
  - Recommend filing with FERC requesting treatment of ESD as a transmission alternative for a specific project(s) and through CAISO planning process.

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Proposal Project Steps

Step 1 - Screen several sites.

Step 2 - Select locations on the Grid where reliability is an issue (traditional transmission projects may be extensive in terms of cost, environmental impact and timeframe).

Step 3 - Perform reliability analysis to ensure and verify which reliability standards are violated.

Step 4 - Evaluate utility proposed alternatives, if any.

Step 5 - Verify the battery operating characteristics at the selected sites in step 3. Ensure that the Energy Storage (ES) solution resolves the reliability concern and is consistent with CAISO's requirements in meeting all reliability requirements.

Step 6 - Calculate the minimum amount of battery storage that needs to be installed to resolve the immediate reliability problem.

Step 7 - Calculate the amount of battery storage that is needed to be installed to resolve the immediate reliability problem and cover for load growth of 20 years.

Step 8 - Design a methodology to quantify additional economic benefit to the ES alternative.

Step 9 - Prepare an economic valuation model of ES solution.

Step 10 - Prepare cash flow models for each of the ES & utility options:

- Estimate NPV and IRR over expected asset life (20 years).
- Identify benefits to cost ratio to the ratepayers.
- Compare ES alternative to the traditional approach (utility option), and
- Perform a benefit cost analysis for two alternatives for each proposed site.

Step 11 - Compare alternatives

Step 12 - Summarize results and recommend next steps based on the results of the financial analysis.

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WGD PATH

- On November 20, 2009, Western Grid Development LLC, filed a petition for declaratory order requests a Commission finding that its proposed energy storage device projects are wholesale transmission facilities, as well as Commission approval of certain incentive rate treatments for the Projects.

- The proposed WGD were also filed with CAISO in November 2009. The filing targeted eight locations on the CAISO Grid. Western Grid demonstrated that the Projects will facilitate reliability on the CAISO system by (1) mitigating normal transmission overload; (2) addressing transmission line trips; (3) responding to transmission lines taken off for maintenance; and/or (4) reacting to voltage dips on transmission line segments on the CAISO system.

- FERC issued this order on 1/20/2010, "W*e find that, based on the circumstances and characteristics of the Projects, the Projects are wholesale transmission facilities. We also grant the requested incentives, with the exception of the abandoned plant incentive, conditioned on, among other things, the California Independent System Operator Corporation's (CAISO) approval of the Projects in its transmission planning process. We note that our findings herein apply only to the specific Projects already identified by Western Grid to1 the CAISO in the CAISO's transmission planning process as of the date Western Grid submitted its Petition for our consideration".*

- CAISO rejected all WGD projects mainly due to the fact that WGD is not a utility and the local utility has the Right of First Refusal (ROFR).

- In December of 2010, WGD filed Complaint 206 with FERC.

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Conclusion

1. Technological improvements have been tremendous.
2. The Electric Grid and the ratepayers can benefit from these wireless solutions.

What is needed:

1. Introducing competition will allow innovative solutions to be implemented.
2. The RTO must encourage competition and not stiffen it.
3. The RTO must conduct a truly open, non-discriminatory process and choice.
4. Local utilities should NOT have a “Monopoly” on new technologies such as ESD.
5. The most reliable and economic alternatives should be chosen regardless of the sponsor.
6. Ratepayers deserve to have reliability projects judged on total cost and not on who is behind the project.

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WGD – SUMMARY OF PROPOSED PROJECTS

Table A1 - Capital Cost Comparison				
Proj. #	Site	WGD Capital Cost	Local Utility Capital Cost	Savings by Selecting WGD Project
1	Placer	$ 43,500,000	$ 60,000,000	$ 16,500,000
2	Coppermine	$ 41,835,698	$ 40,000,000	$ (1,835,698)
3	Guernsey	$ 18,666,154	$ 15,000,000	$ (3,666,154)
4	Weedpatch	$ 15,816,169	$ 12,000,000	$ (3,816,169)
5	Stockton A	$ 52,869,572	$ 50,000,000	$ (2,869,572)
6	Madison _Vaca	$ 18,903,389	$ 14,000,000	$ (4,903,389)
7	Tulucay	$ 37,500,000	$ 40,000,000	$ 2,500,000
8	Potrero	$ 30,000,000	$ 29,000,000	$ (1,000,000)
	Total	$ 259,090,981	$ 260,000,000	$ 909,019

Table A-2 Comparison of the NPV of the Total Project Cost				
Proj. #	Site	NPV of the WGD Project's Yearly Revenue Rqmt	NPV of the Local Utility Project's Revenue Rqmt	Yearly Savings by Selecting WGD Project
1	Placer	$ 70,435,568	$ 116,373,032	$ 45,937,465
2	Coppermine	$ 54,262,957	$ 77,582,022	$ 23,319,064
3	Guernsey	$ 35,565,710	$ 29,093,258	$ (6,472,452)
4	Weedpatch	$ 19,821,580	$ 23,274,606	$ 3,453,026
5	Stockton A	$ 65,940,369	$ 96,977,527	$ 31,037,158
6	Madison _Vaca	$ 30,603,925	$ 27,153,708	$ (3,450,217)
7	Tulucay	$ 60,720,317	$ 77,582,022	$ 16,861,705
8	Potrero	$ 48,576,254	$ 56,246,966	$ 7,670,712
	Total	$ 385,926,680	$ 504,283,140	$ 118,356,460

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WGD – SUMMARY OF PROPOSED PROJECTS

Table A-3 Comparison of the NPV of the Total Net Project Cost

Proj. #	Site	NPV of the WGD Project's Yearly Revenue Rqmt	NPV of the Local Utility Project's Revenue Rqmt	Additional Benefits from Regulation Up and Resource Adequacy	Yearly Savings by Selecting WGD Project
1	Placer	$ 70,435,568	$ 116,373,032	$ 4,569,463	$ 50,506,927
2	Coppermine	$ 54,262,957	$ 77,582,022	$ 7,090,546	$ 30,409,610
3	Guernsey	$ 35,565,710	$ 29,093,258	$ 2,521,083	$ (3,951,369)
4	Weedpatch	$ 19,821,580	$ 23,274,606	$ 2,836,218	$ 6,289,244
5	Stockton A	$ 65,940,369	$ 96,977,527	$ 8,666,222	$ 39,703,380
6	Madison Vaca	$ 30,603,925	$ 27,153,708	$ 3,466,489	$ 16,272
7	Tulucay	$ 60,720,317	$ 77,582,022	$ 3,939,192	$ 20,800,897
8	Potrero	$ 48,576,254	$ 56,246,966	$ 3,151,354	$ 10,822,066
	Total	$ 385,926,680	$ 504,283,140	$ 36,240,566	$ 154,597,026

Table A4 - Comparison of the Net Cost to Ratepayers on an Annual Levelized Basis

Proj. #	Site	Levelized Annual Cost of WGD Project to Rate Payers	Levelized Annual Cost of the Local Utility Project to Rate Payers	Additional Benefits from Regulation Up and Resource Adequacy	Yearly Savings by Selecting WGD Project
1	Placer	$ 7,759,751	$ 11,106,174	$ 2,284,731	$ 5,631,155
2	Coppermine	$ 5,978,045	$ 7,404,116	$ 3,545,273	$ 4,971,344
3	Guernsey	$ 3,918,206	$ 2,776,544	$ 1,260,541	$ 118,879
4	Weedpatch	$ 2,183,705	$ 2,221,235	$ 1,418,109	$ 1,455,639
5	Stockton A	$ 7,264,523	$ 9,255,145	$ 4,333,111	$ 6,323,733
6	Madison Vaca	$ 3,371,575	$ 2,591,441	$ 1,733,244	$ 953,110
7	Tulucay	$ 6,689,440	$ 7,404,116	$ 1,969,596	$ 2,684,272
8	Potrero	$ 5,351,552	$ 5,367,984	$ 1,575,677	$ 1,592,109
	Total	$ 42,516,798	$ 48,126,755	$ 18,120,283	$ 23,730,240

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