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PRIMUS POWER

CEC COMMITTEE WORKSHOP

July 13, 2010

Tammie Candelario

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Wind Firming EnergyFarm



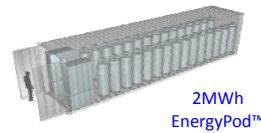
1. Scope
2. Value proposition
3. System description
4. Timing/deliverables
5. Funding
6. Expected outcomes
7. Challenges
8. Do differently?

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Scope

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- Development, integration, and field deployment of zinc flow battery storage system
 - ✓ Cell and system development in 2010 – 2011
 - ✓ Field demo at PG&E Modular Generation Test Facility early 2012
 - ✓ 25 MW/ 75 MWh installation at Modesto Irrigation District late 2012
- \$46.7M in total project funding
- Primary application: wind firming
- Lower cost, smaller footprint solution
- Local sourcing and manufacturing



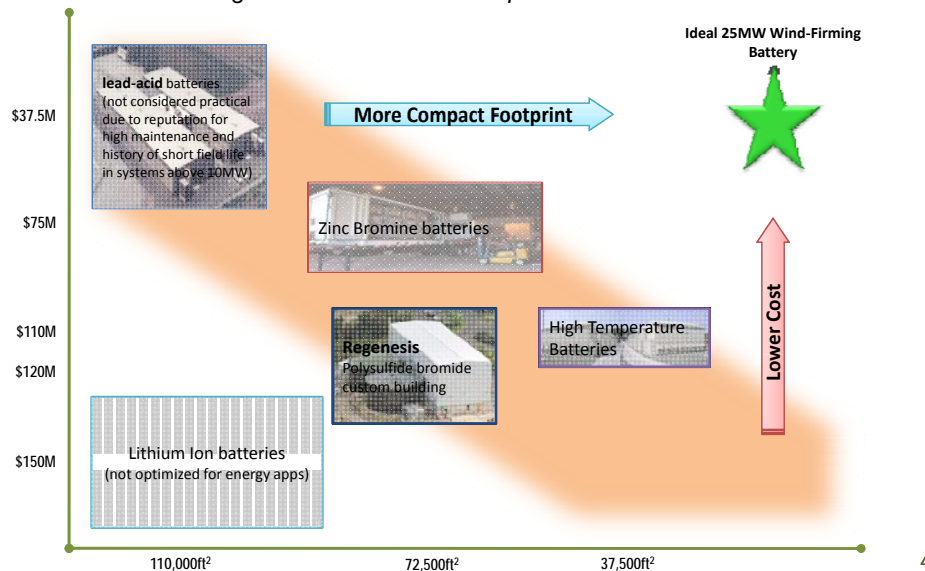
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Primus Value Proposition

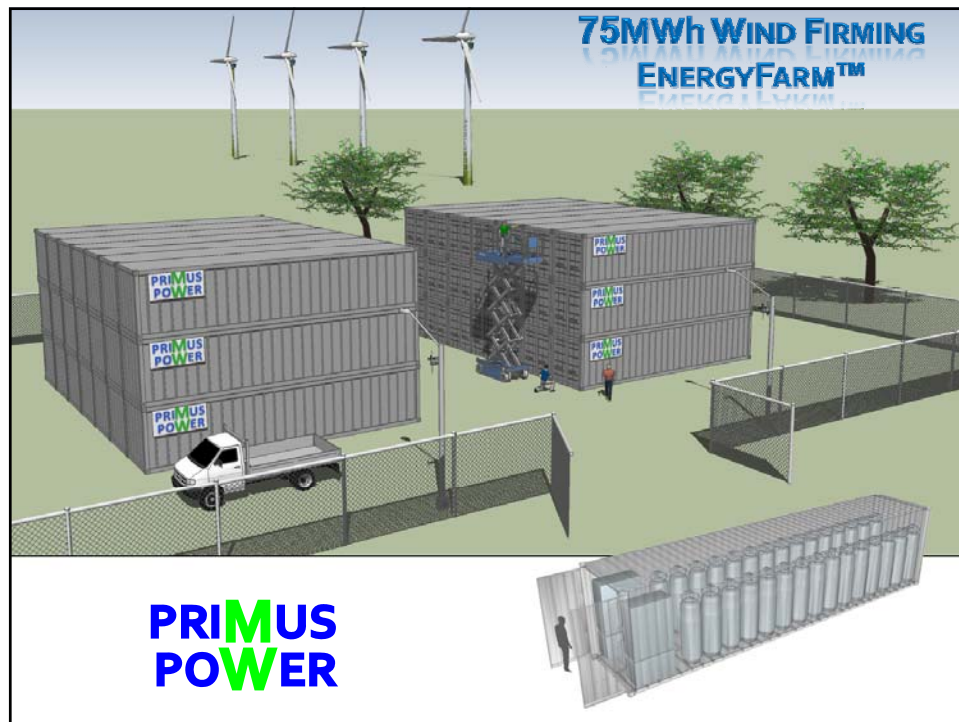
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3-hour Grid Storage Solutions must be compact and affordable



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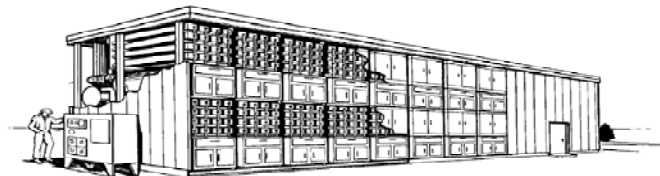
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Development History



- ***Mature electrochemistry*** through 15 years of well-funded work by the Electric Power Research Institute on large-scale Zn-Cl₂ systems in the 70's & 80's
 - » 125kW/600kWh system built by EDA in the early 80's
 - » EPRI designed a complete 100MWh system
 - » CEC funding enabled proof-of-concept of current version of the technology



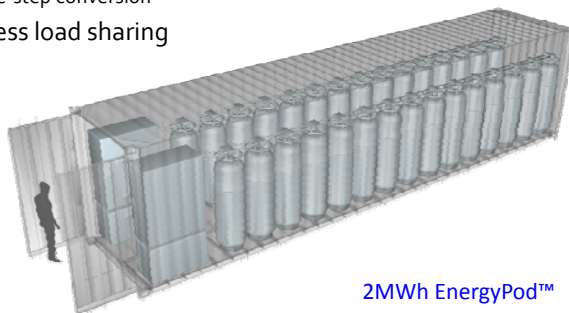
3MW EPRI System Design

EnergyPods™ & EnergyFarms™

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“Plug & Play” EnergyPods™ create EnergyFarms™

- 660kW / 2MWh per 40' ISO
- 2x16 EnergyCells™ in series
- 750 – 1000 V_{DC}; 500A_{DC}
- 480V_{AC} /3-phase integration
 - ✓ single-step conversion
- Seamless load sharing
- Substation applications
- 200MW/acre & 600MWh/acre



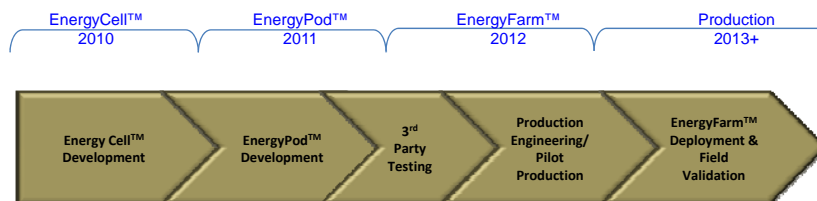
2MWh EnergyPod™

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WFEF Schedule

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Major Milestones			
<ul style="list-style-type: none"> Detailed EnergyFarm™ customer specification Validated EnergyCell™ technology performance 	<ul style="list-style-type: none"> Validated EnergyPod™ technology performance 	<ul style="list-style-type: none"> Final EnergyFarm™ product design and functionality 	<ul style="list-style-type: none"> Commissioned EnergyFarm™ Quantified economic benefits Quantified enviro. benefits Final report

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WFEF Status To Date



- Technical
 - ✓ Optimizing chemical and electrical operating parameters to improve efficiency and energy density
 - ✓ Evaluating new commodity materials to optimize reliability and battery life
 - ✓ Out-sourcing non-cell components to reduce technical and schedule risk

- Overall
 - ✓ Metrics and Benefits Reporting Plan work initiated
 - ✓ Detail Requirements Specification underway
 - ✓ Four patents filed with several in progress
 - ✓ Facility move in planning stages; expected move in August

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State & Federal Funding



- Primus Power received one of sixteen DOE Smart Grid Storage Demonstration Awards (\$14M of an overall \$47M project)
 - ✓ Enables 3-year roadmap to commercialization
 - ✓ Additional DOE (ARPA-E) application submitted to evaluate alternative electrode materials

- Primus Power received one of five CEC PON-08-011 Smart Grid Demonstration awards
 - ✓ Follow-on contribution to original CEC grant funding
 - ✓ Provides support for EnergyCell™ and production process development

Funding	(\$M)
DOE	14
CEC	1
Primus	32.7
TOTAL	47.7

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Expected Outcomes



- Deployment of affordable, reliable energy storage technology with quantified benefits
- Over 100 high tech and manufacturing jobs created
- Acceleration of cost-effective renewables integration in wind firming application
- Reduction in greenhouse gases
- Other benefits as identified through modeling studies with MID

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Challenges



- Cost
 - ✓ Production facility design and build
 - ✓ Component materials costs
- Technical
 - ✓ Materials stability over the life of the battery
 - ✓ Effective thermal modeling and thermal management
 - ✓ Automation and communications within a utility environment
- Resources
 - ✓ Availability of/access to technical team
 - ✓ Lab/equipment availability

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Do Differently?



- Primus
 - ✓ DOE funding is critical to timely development!
 - ✓ ARPA-E future opportunity
 - ✓ Streamline internal processes for acquiring funding

- CEC
 - ✓ Continue aligning funding opportunities to DOE programs; creates easier access to and administration of funding
 - ✓ However, CEC component could focus on earlier deliverables and be shorter in duration
 - ✓ Provide clarity re reviewers and level of detail needed in light of confidential nature of the information