DOCKETED	
Docket Number:	18-MISC-04
Project Title:	Vehicle Grid Integration Roadmap Update
TN #:	225129
Document Title:	Presentation from Economic Potential Panel - LBNL's LAAFB Pilot
	Revenue Potential and Participation Costs
Description:	N/A
Filer:	System
Organization:	Jason MacDonald/LBNL
Submitter Role:	Public
Submission Date:	10/29/2018 10:58:25 AM
Docketed Date:	10/29/2018

Comment Received From: Jason MacDonald Submitted On: 10/29/2018 Docket Number: 18-MISC-04

Presentation from Economic Potential Panel - LBNL's LAAFB Pilot Revenue Potential and Participation Costs

These are the slide I will be using in the panel on economic potential.

Additional submitted attachment is included below.





Revenue potential and participation costs from the Los Angeles Air Force Base Vehicle-to-Grid Demonstration

Jason MacDonald Energy Technologies Area Lawrence Berkeley National Laboratory

October 29, 2018

THE GRID INTEGRATION GROUP

LBNL's LA AFB Project

- Manage dispatch and charging of 29 vehicle PEV fleet
- Goals:
 - 1. Ensure sufficient charge to meet mobility needs
 - 2. Charge PEVs under cost-minimizing schedules
 - Optimize participation in Regulation markets to generate revenue





- Initial calculation of regulation revenue potential argued that a 15kW bi-directionally capable vehicle could achieve an average of ~\$101/month from CAISO Frequency Regulation Market Participation ^[1]
- Implicit assumptions:
 - Full 15kW capacity offered to both regulation up and down
 - Historic combined Day-Ahead Regulation Market Clearing Price (MCP) of <u>\$16/MW-h</u>
 - Vehicles are ineligible to participate from 8AM to 5PM
 - <u>No</u> battery imposed <u>energy constraints</u> on bidding
 - <u>No impact of continuous provision on energy stored</u>

[1] C. Marnay et al., "Los Angeles Air Force Base Vehicle to Grid Pilot Project," presented at the ECEEE 2013 Summer Study on Energy Efficiency, Club Belambra Les Criques, Presqu'île de Giens, Toulon/Hyères, France, 2013.



Revisited

- Prices on average, were higher.
 - For all hours: \$19.27/MW-h
 - For eligible hours: \$18.07/MW-h
- Revenue Potential: \$124/month
- Greater than 2/3rd of revenue derived from Regulation Up participation
- Eligible hours include greatest value hours for Regulation Up, but exclude highest Regulation Down



Table 4.1: Revenue potential of a generic fleet of 41 vehicles

	Average	Median	Minimum	Maximum
Fleet Capacity [kW]	615	615	615	615
Reg_Dn Revenue [\$/month]	\$1,610	\$1,436	\$816	\$4,062
Reg_Up Revenue [\$/month]	\$3 <i>,</i> 488	\$3,406	\$2,016	\$5 <i>,</i> 390
Total Revenue [\$/month]	\$5 <i>,</i> 097	\$5 <i>,</i> 027	\$2 <i>,</i> 832	\$8,571
Generic Vehicle Revenue				
[\$/veh/month]	\$124	\$123	\$69	\$209





At the LA AFB

- Mixed vehicle fleet with varying parameters
- CAISO Rules require a resource must have 1 full hour of battery capacity to provide Regulation
 - For simultaneous up and down, battery SOC should be near 50% of the useable range
 - Vehicles must have greater than two hours of battery capacity at full charge to fully participate
- At rated values, battery capacity is limiting all but one of the installed vehicles.

Table 5.1: LAAFB vehicles and their power and energy capacities							
Vehicle	EVSE Manufacturer and Model	Qty	Rated Charge Power [kW]	Rated Battery Capacity [kWh]			
Nissan LEAF	Princeton Power Systems GTIB-208-30	13	15	24			
Phoenix Motor Cars Shuttle Bus	Coritech VGI-50-DC	1	50	100			
EVI Stake and Box Trucks	Coritech VGI-50-DC	4	50	54			
VIA Van	Coritech VGI-15-AC	11	15	21			
Fleet Totals		29	610	859			

Table 5.2: Revenue potential at LA AFB during performance period

	Average	Median	Minimum	Maximum
Fleet Capacity [kW]	424	424	424	424
Reg_Dn Revenue [\$]	\$1,110	\$990	\$563	\$2,801
Reg_Up Revenue [\$]	\$2,404	\$2,348	\$1,390	\$3,716
Total Revenue [\$]	\$3,514	\$3 <i>,</i> 466	\$1,953	\$5,909
Nissan Leaf Vehicle Revenue [\$/veh]	\$99	\$98	\$55	\$167
Phoenix Bus Vehicle Revenue				
[\$/veh]	\$414	\$409	\$230	\$697
EVI Truck Vehicle Revenue [\$/veh]	\$224	\$221	\$124	\$376
VIA Van Vehicle Revenue [\$/veh]	\$83	\$82	\$46	\$139

But do we get the rated capacity out of our vehicles?

BERKELEY LA

THE GRID INTEGRATION GROUP

5

De-rating and More Representative Hours

- Vehicle OEMs operate EVs within a subset of their battery capacity to extend life
 - Our experience: ~70% of rated cap
 - Termed "useable" SoC
- At high SoC, charging power is throttled on the vehicle
 - More significant for 50kW charging
- Improving eligible hours:
 - Eligible all weekend
 - Expand weekday ineligibility from 7AM to 6PM allows the for time for fleet to prepare vehicle SOCs for market participation or mobility



After accounting for all derates, and more realistic hours, the available fleet revenue reduced by nearly ½ of original analysis



Costs of Frequency Regulation Participation

- Fixed Costs*:
 - Capital: bi-directional charging stations, electrical service upgrades, metering and telemetry infrastructure
 - Interconnection: Distribution interconnection studies, certified meter installation and certification
- Monthly Transaction Costs:
 - CAISO Resource ID Fee: \$1000/month
 - CAISO miscellaneous Fees (Bid-segments, Flexible Capacity obligation, etc.): <\$40/month
 - Scheduling Coordinator Fees:
 - "Manual Billing": \$118.46/month
 - "Meter Data Feed": \$216.50/month
 - Network access fee (CAISO's private Energy Communication Network): ~\$100/month through AT&T's ANIRA VPN router
- Transaction costs account for nearly 50% of Day Ahead revenue potential for V2G resource aggregations of a comparable size

* Costs discussed are additions to the cost of deployment of a PEV fleet.



Thanks!

Contact:

- Jason MacDonald: jsmacdonald@lbl.gov
- Doug Black (Principal Investigator, LAAFB Pilot): <u>drblack@lbl.gov</u>

LA AFB Final Report Reference:

https://www.energy.ca.gov/2018publications/CEC-500-2018-025/CEC-500-2018-025.pdf

Funding:



California Energy Commission



US DOD's Environmental Security Technologoy Certification Program

THE GRID INTEGRATION GROUP

