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fleet ENERGY

An Utility Energy Storage Service Provider

March 10, 2011

This presentation was provided to the Rocky Mountain Clean Diesel Collaborative (RMCDC). The RMCDC promotes the reduction of diesel emissions and fuels usage, but does not promote the usage of specific products or vendors.

John R. Bryan
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An Introduction to the Rocky Mountain Clean Diesel Collaborative



Grid Supporting Heavy Vehicles

Impact of an Integrated Electrical System

as of March 10, 2011

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The Fleet Energy Business

Fleet Energy owns batteries in commercial installations.

- Revenue Stream 1: local utility pays for use of the batteries.
- Revenue Stream 2: end user pays when not in use by the utility.
- Fleet Energy helps the Utility maintain 110v at 110v.
- The batteries charge and discharge faster and cheaper than a power plant.
- Alleviates the negative impact of wind and solar based generation.
- Fleet Energy will own the batteries as a distinct but integrated asset.
- Equipment will be installed in secure environments: school buses, stadiums, large fleet vehicles, and mobile trailers.

FEC's Management Team

- **CEO of FEC, LG Chavez, Automotive Fleets and Business Management**

- Burt Automotive Network, growth of \$526M to \$2,120M over 13 years
 - Managed 1,600 employees at peak in 2008
 - \$1.5 Billion in 2008 Commercial Fleet sales of over 75k units
 - Customers Include: Qwest Communications, Hertz Rent-a-Car, Enterprise Rent-a-Car, Xcel Energy, Comcast, etc
- Director and Vice President of Biological R&D at American Home Products
- University of Colorado - Boulder, BA in MCD Biology; University of Virginia, Ph.D. in Microbiology and Immunology



- **President of FEC, Paul Wimer, Capital and Finance Development**

- Chief Executive Officer at Bannon Automotive LLC
- Managing Director at Topspin Partners LP
- Associate Partner at Andersen Consulting
- Yale University, BS in Chemical Engineering; Harvard Business School, MBA



- **CTO of FEC, John Bryan, Utility Engineering Project Management**

- Program Manager at Xcel Energy, Led and Implemented Industry Leading Utility R&D programs including:
 - 1 MW / 7.2 MWh Wind2Battery Program w/ 11.5 MW Wind Farm integration to MISO Markets
 - Vehicle to Grid Vehicle Electrification: 6 Ford Escape Retrofit with MISO Markets Integration
 - Outage Management System: Real Time Outage Management and Feeder Signal Data
 - SmartGridCity: Program Management and System Benefits
- Program Manager for Qwest Communications
- Quality Engineer for Textron Automotive (production manufacturing for Ford, General Motors, Toyota, Mitsubishi, etc)
- University of Missouri, MBA - Finance; Vanderbilt University, BE - Mechanical Engineering



Total US Road Fleet Vehicles Emissions

Year of Total US Vehicle Fleet	Number of Vehicles in US	Millions of Tons of CO2
2008	255,917,664	1,643.17
2001	235,331,381	1,619.27

<http://www.fhwa.dot.gov/ohim/hs01/vm1.htm>

<http://www.fhwa.dot.gov/policyinformation/statistics/2008/vm1.cfm>

Global Vehicle Fleet CO₂ Emissions

Year of Total US Vehicle Fleet	Number of Vehicles in US	Millions of Tons of CO ₂
2008	255,917,664	1,643.17
2001	235,331,381	1,619.27

Following the US example of vehicle use and MPG, CO₂ emissions would be **166% greater** than today.

Today's technology is not a solution for the reduction of global carbon dioxide emissions.

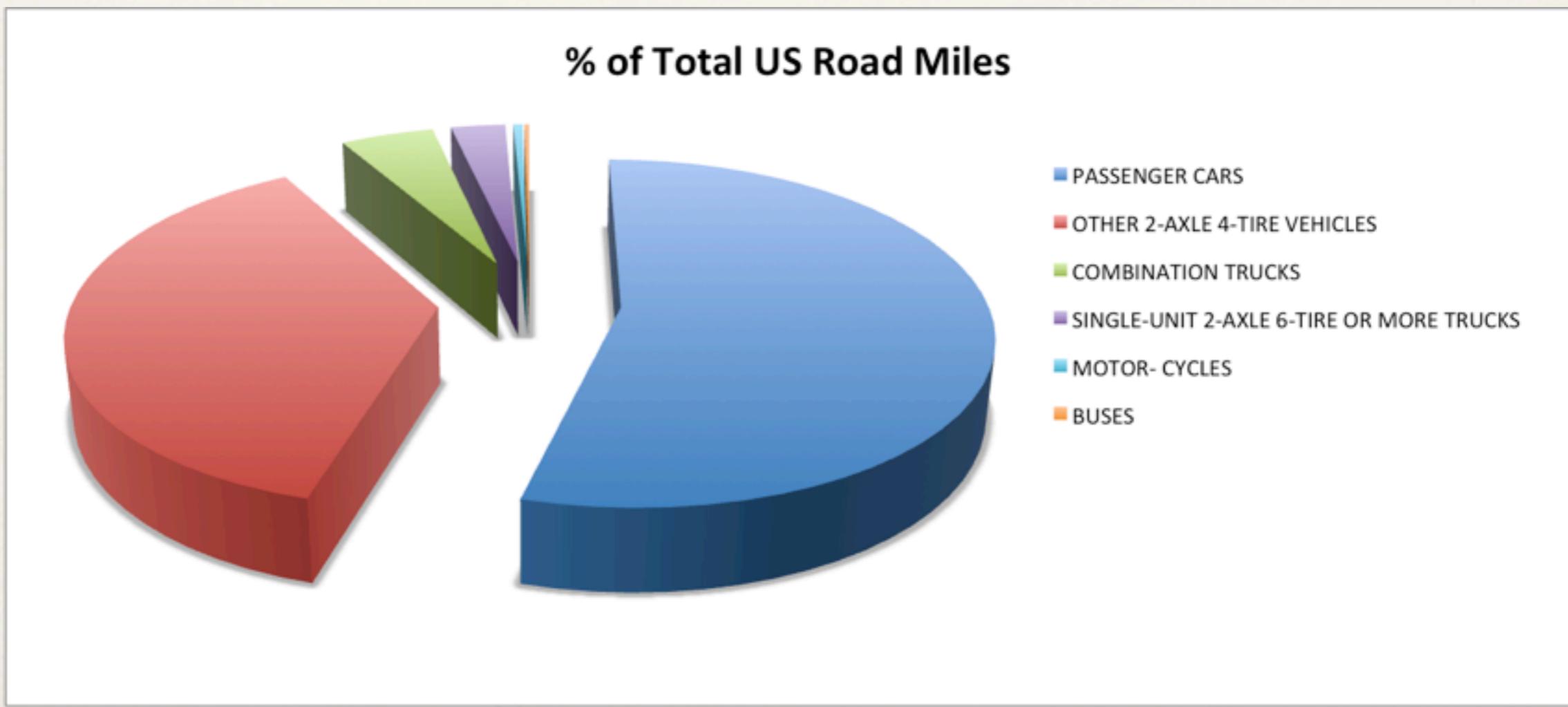
Country	Total CO ₂ Emissions	Per Capita Emissions	Population	Vehicle Emissions	% of Total	US Vehicle Emissions	US Total Emissions	% Increase
1 China	6534	4.91	1,341,130,000	1840.64	28%	7088.12317	11781.48	180%
2 United States	5833	19.18	310,901,000	1643.17	28%	1643.17	5833.00	100%
3 Russia	1729	12.29	141,927,297	487.06	28%	750.11234	1992.05	115%
4 India	1495	1.31	1,191,350,000	421.15	28%	6296.50783	7370.36	493%
5 Japan	1214	9.54	127,390,000	341.99	28%	673.280003	1545.29	127%
6 Germany	829	10.06	81,802,000	233.53	28%	432.338887	1027.81	124%
7 Canada	574	17.27	34,345,000	161.70	28%	181.519756	593.82	103%
8 United Kingdom	572	9.38	62,008,048	161.13	28%	327.724144	738.59	129%
9 Korea, South	542	11.21	49,773,145	152.68	28%	263.060391	652.38	120%
10 Iran	511	7.76	74,847,000	143.95	28%	395.58041	762.63	149%
11 Saudi Arabia	466	16.56	27,136,977	131.27	28%	143.424005	478.15	103%
12 Italy	455	7.82	60,494,632	128.17	28%	319.725458	646.55	142%
13 South Africa	451	9.25	49,991,300	127.05	28%	264.213381	588.17	130%
14 Mexico	445	4.04	112,322,757	125.36	28%	593.646803	913.29	205%
15 Australia	437	20.82	22,555,000	123.10	28%	119.207398	433.10	99%
16 Indonesia	434	1.83	237,556,363	122.26	28%	1255.52986	1567.27	361%
17 Brazil	428	2.18	190,732,694	120.57	28%	1008.058	1315.49	307%
18 France	415	6.48	65,447,374	116.91	28%	345.901626	644.00	155%
19 Spain	359	8.86	46,122,169	101.13	28%	243.764299	501.63	140%
20 Ukraine	350	7.61	45,822,214	98.60	28%	242.178981	493.58	141%
	24,073					22,587	39,879	166%

http://www.ucsusa.org/global_warming/science_and_impacts/science/each-countrys-share-of-co2.html

USA 2008 Data	PASSENGER CARS	MOTOR-CYCLES	BUSES	OTHER 2-AXLE 4-TIRE VEHICLES	SINGLE-UNIT 2-AXLE 6-TIRE OR MORE TRUCKS	COMBINATION TRUCKS	PASSENGER CARS AND OTHER 2-AXLE 4-TIRE VEHICLES	SINGLE-UNIT 2-AXLE 6-TIRE OR MORE AND COMBINATION TRUCKS	ALL MOTOR VEHICLES
Average Miles per Gallon	22.6	56.5	6.4	18.1	8.5	5.4	20.5	6.2	17.4
Average fuel consumption per vehicle (gallons)	522	33	1,316	605	1,456	12,101	557	4,075	667
Fuel Consumed (gallons)	71,497,204,361	256,358,445	1,109,635,856	61,198,934,410	9,888,728,710	26,814,441,218	132,696,138,770	36,703,169,928	170,765,303,000
Average Miles Travel per Vehicle	11,788	1,868	8,436	10,951	12,362	64,764	11,432	25,254	11,619
Number of Motor Vehicles Registered	137,079,843	7,752,926	843,308	101,234,849	6,790,882	2,215,856	238,314,692	9,006,738	255,917,664
Emissions per Gallon	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4
Emissions per Year per Vehicle (Tons)	5.06	0.32	12.76	5.86	14.12	117.38	5.40	39.53	
Emissions per Year for Each Class (Million Tons)	693.52	2.49	10.76	593.63	95.92	260.10	1,287.15	356.02	1,643.17

Total US Road Miles

USA 2008 Data	PASSENGER CARS	MOTOR-CYCLES	BUSES	OTHER 2-AXLE 4-TIRE VEHICLES	SINGLE-UNIT 2-AXLE 6-TIRE OR MORE TRUCKS	COMBINATION TRUCKS
Number of Motor Vehicles Registered	137,079,843	7,752,926	843,308	101,234,849	6,790,882	2,215,856
Millions of Annual Miles per Vehicle Class	1,615,850	14,484	7,114	1,108,603	83,951	143,507
% Miles in the United States	54.3%	0.5%	0.2%	37.3%	2.8%	4.8%



<http://www.fhwa.dot.gov/policyinformation/statistics/2008/vm1.cfm>

Commercial Fleet Vehicles

The Class 2 and 3 truck* has had the largest increase of vehicles on the road with 12,942,600 additional in the United States with 49% of the increase since 1992.

*6,000 to 14,000 lbs GVWR (e.g. F-150 to F-350)

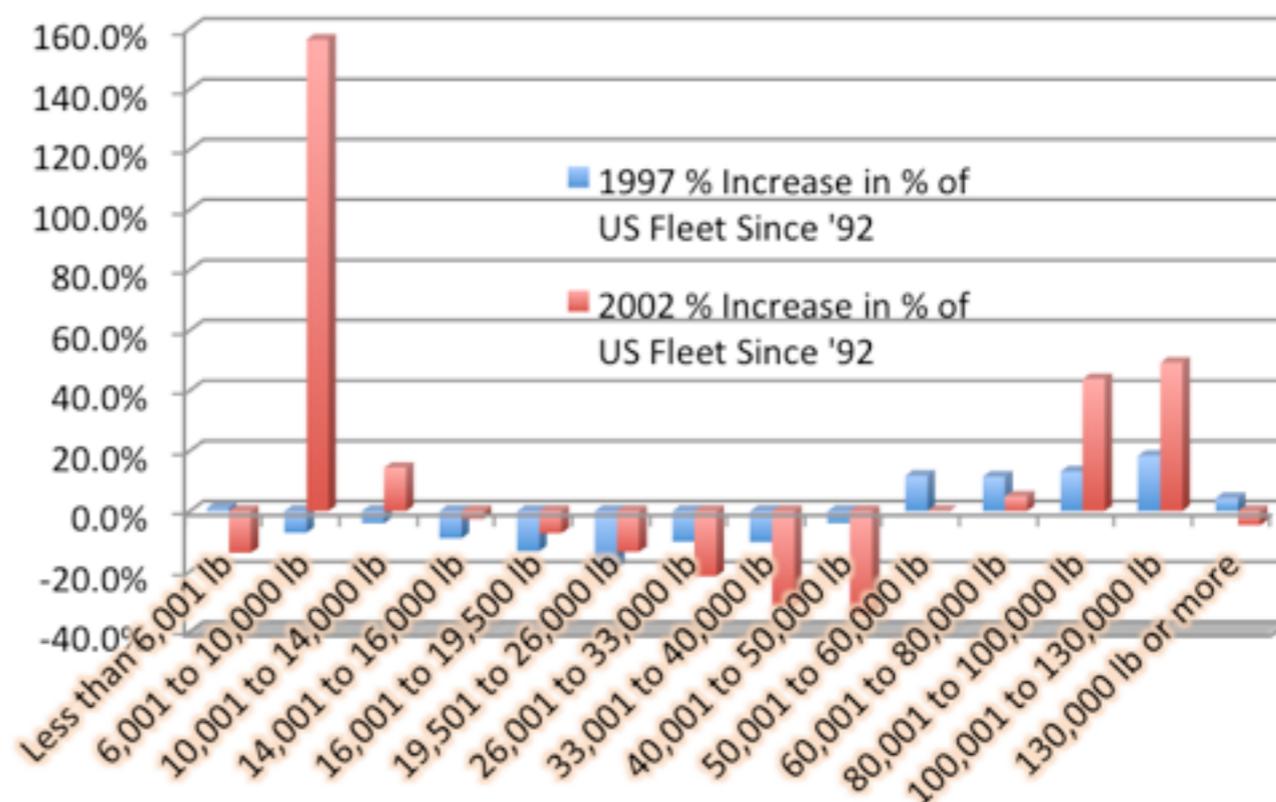


Table 1-15: Annual U.S. Motor Vehicle Production and Factory (Wholesale) Sales (Thousands of units)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	10 Yr Avg
Production, total	13,025	12,774	11,425	12,280	12,087	11,960	11,947	11,260	10,752	8,673	11,618
Passenger cars	5,638	5,542	4,879	5,019	4,510	4,230	4,321	4,367	3,924	3,777	4,621
Commercial vehicles ^a	7,387	7,231	6,546	7,261	7,577	7,731	7,625	6,893	6,828	4,896	6,998
% of Total	57%	57%	57%	59%	63%	65%	64%	61%	64%	56%	60%

^a Includes trucks under 10,000 pounds gross vehicle weight rating (GVWR), such as compact and conventional pickups, sport utility vehicles, minivans, and vans, and trucks and buses over 10,000 pounds GVWR.

http://www.bts.gov/publications/national_transportation_statistics/

Installed Cost of Electric Vehicle Batteries

Range in Miles	High Cost of Batteries (kWh)	Low Cost of Batteries (kWh)	High (and Low) Miles per kWh and Cost of Pack per Vehicle Class					
			8	4	2	1	0.7	0.33
			Sub-Compact	Sedan	Small SUV	Class 3 Truck	Class 8 Truck	Transit Bus
40	\$650	\$350	\$3,250 (\$1,750)	\$6,500 (\$3,500)	\$13,000 (\$7,000)	\$26,000 (\$14,000)	\$37,143 (\$20,000)	\$78,788 (\$42,424)
75	\$650	\$350	\$6,094 (\$3,281)	\$12,188 (\$6,563)	\$24,375 (\$13,125)	\$48,750 (\$26,250)	\$69,643 (\$37,500)	\$147,727 (\$79,545)
100	\$650	\$350	\$8,125 (\$4,375)	\$16,250 (\$8,750)	\$32,500 (\$17,500)	\$65,000 (\$35,000)	\$92,857 (\$50,000)	\$196,970 (\$106,061)
150	\$650	\$350	\$12,188 (\$6,563)	\$24,375 (\$13,125)	\$48,750 (\$26,250)	\$97,500 (\$52,500)	\$139,286 (\$75,000)	\$295,455 (\$159,091)
200	\$650	\$350	\$16,250 (\$8,750)	\$32,500 (\$17,500)	\$65,000 (\$35,000)	\$130,000 (\$70,000)	\$185,714 (\$100,000)	\$393,939 (\$212,121)
400	\$650	\$350	\$32,500 (\$17,500)	\$65,000 (\$35,000)	\$130,000 (\$70,000)	\$260,000 (\$140,000)	\$371,429 (\$200,000)	\$787,879 (\$424,242)

400 Mile Range Electric
Commercial Truck would
cost **\$260,000**...
...just for the battery.

Electric Vehicles as Energy Storage

	PASSENGER CARS	MOTOR-CYCLES	BUSES	OTHER 2-AXLE 4-TIRE VEHICLES	SINGLE-UNIT 2-AXLE 6-TIRE OR MORE TRUCKS	COMBINATION TRUCKS	PASSENGER CARS AND OTHER 2-AXLE 4-TIRE VEHICLES	SINGLE-UNIT 2-AXLE 6-TIRE OR MORE AND COMBINATION TRUCKS	ALL MOTOR VEHICLES
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Average Miles Travel per Vehicle	11,788	1,868	8,436	10,951	12,362	64,764	11,432	25,254	11,619
Average Miles Travel per Day per Vehicle (Average)	32.29	5.12	23.11	30.00	33.87	177.44	31.32	69.19	31.83
Average Range Needed (Double the Average)	64.59	10.24	46.22	60.00	67.74	354.87	62.64	138.38	63.67
Mile per kWh per Class	4	16	0.33	1	0.5	0.25			
kWh Needed per Vehicle	16.15	0.64	140.07	60.00	135.48	1,419.48			
Total GWh	2,213	5	118	6,075	920	3,145	8,293	4,183	12,476
% of Fleet Electric									
1%	22.13	0.05	1.18	60.75	9.20	31.45	82.93	41.83	124.76
5%	110.67	0.25	5.91	303.73	46.00	157.27	414.65	209.17	623.82
10%	221.35	0.50	11.81	607.45	92.00	314.54	829.30	418.35	1,247.65
20%	442.70	0.99	23.62	1,214.91	184.00	629.07	1,658.60	836.70	2,495.30
33%	730.45	1.64	38.98	2,004.60	303.60	1,037.97	2,736.69	1,380.55	4,117.24
50%	1,106.75	2.48	59.06	3,037.27	460.00	1,572.68	4,146.50	2,091.75	6,238.24

50% of the US Fleet would hold **6,238 GWh** of Electrical Energy Storage

Scale of The Electrical Energy Grid

50% of the US Fleet would hold **6,238 GWh** of Electrical Energy Storage

In 2009, Northern Colorado's (PRPA) total energy sales to its 145,236 customers was **3,055 GWh** at an average of \$58.49 per MWh and had a peak customer demand of **588 MW**.

In 2009, PJM Interconnect's total energy sales to its 51,000,000 customers was **682,189 GWh** at an average of \$38.92 per MWh and had a peak customer demand of **144,644 MW**.



US Electrical Grid Produced **4,119,000 GWh** of Energy in 2009 or 470 GW each hour. This US Fleet could average **13 hours per day** of stored energy.

<http://www.EIA.DOE.Gov/>

Two Services Represent \$1.5B in Annual Market Potential

	2009 Ft Collins (PRPA)	PJM Interconnect (51 Million People)	United States (Extrapolated from PJM)	Global (Extrapolated from PJM)
Total of All Services	\$84,907,618	\$26,551,300,000	\$160,350,544,795	\$730,975,078,099
Energy Service	\$46,237,974	\$11,163,100,000	\$67,417,006,572	\$307,327,622,162
Capacity Service	\$36,252,765	\$8,752,400,000	\$53,615,237,018	\$244,410,782,117
Operating Service	\$1,339,949	\$323,500,000	\$1,953,704,762	\$6,375,277,816
Regulation Service	\$945,627	\$228,300,000	\$1,398,514,534	\$8,906,171,741
Spinning Service	\$131,302	\$31,700,000	\$191,444,949	\$872,722,238

FEC's Services are Highly
Competitive in These Two Markets

<http://www.prpa.org/>

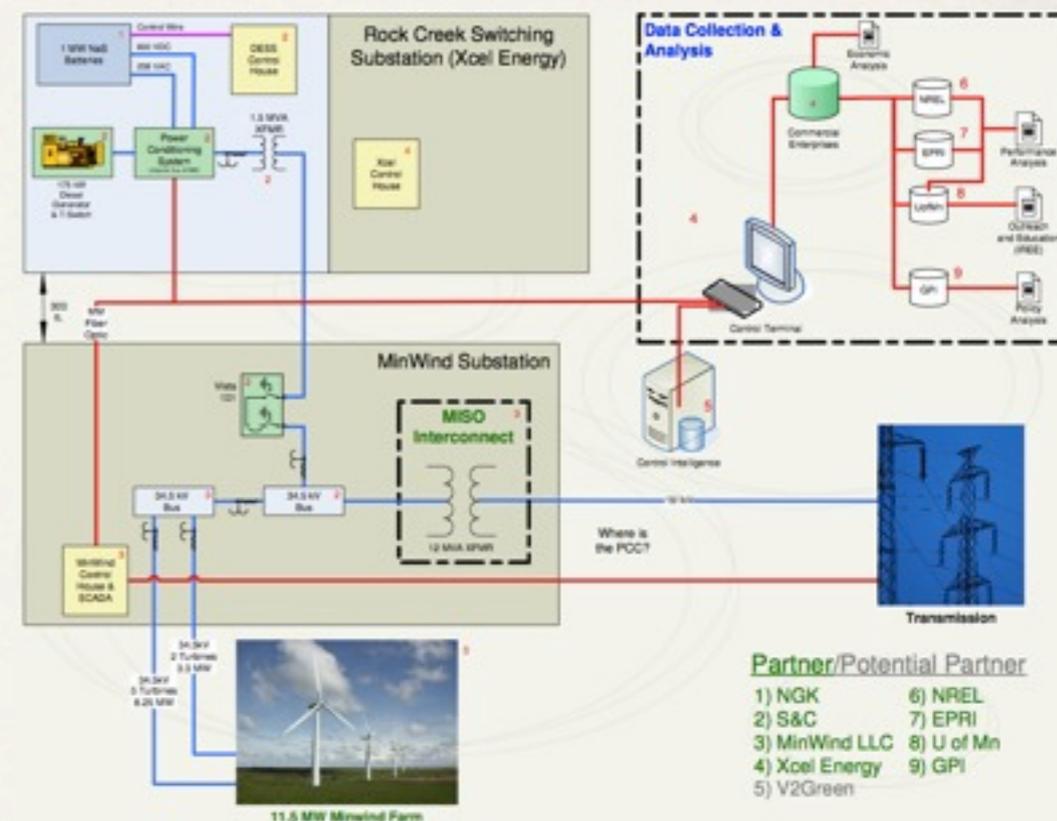
<http://pjm.com/about-pjm/who-we-are/~media/about-pjm/newsroom/2009-financial-report.ashx>

Where Does this Battery Live?



It Took 6 Months to Find an Internal Department

- Generation?
 - No, was not an “original source” of energy
- Regulatory?
 - No, not Operations or Proven
- Transmission?
 - No, could not coordinate power (FERC Rules)
- Distribution?
 - No, was not always at Distribution Sites
- Environmental?
 - No, Not Operations
- Vehicle Fleets?
 - No, Not Operations
- CEO?
 - No, Not Sustainable
- Information Technology?
 - No, 20 Year Asset
- Load?
 - No, too large and a rate based asset



Utility Industry has Layered Complexity

Local Rules (UG or OH)

State Regulatory Policy (IOUs)

State Legislative Policy (30% RPS)

An Example
Next Slide 

Federal Regulatory (FERC's 18% OR)

Federal Reliability and Safety (NERC)

Capital Policy (Buy or Lease)

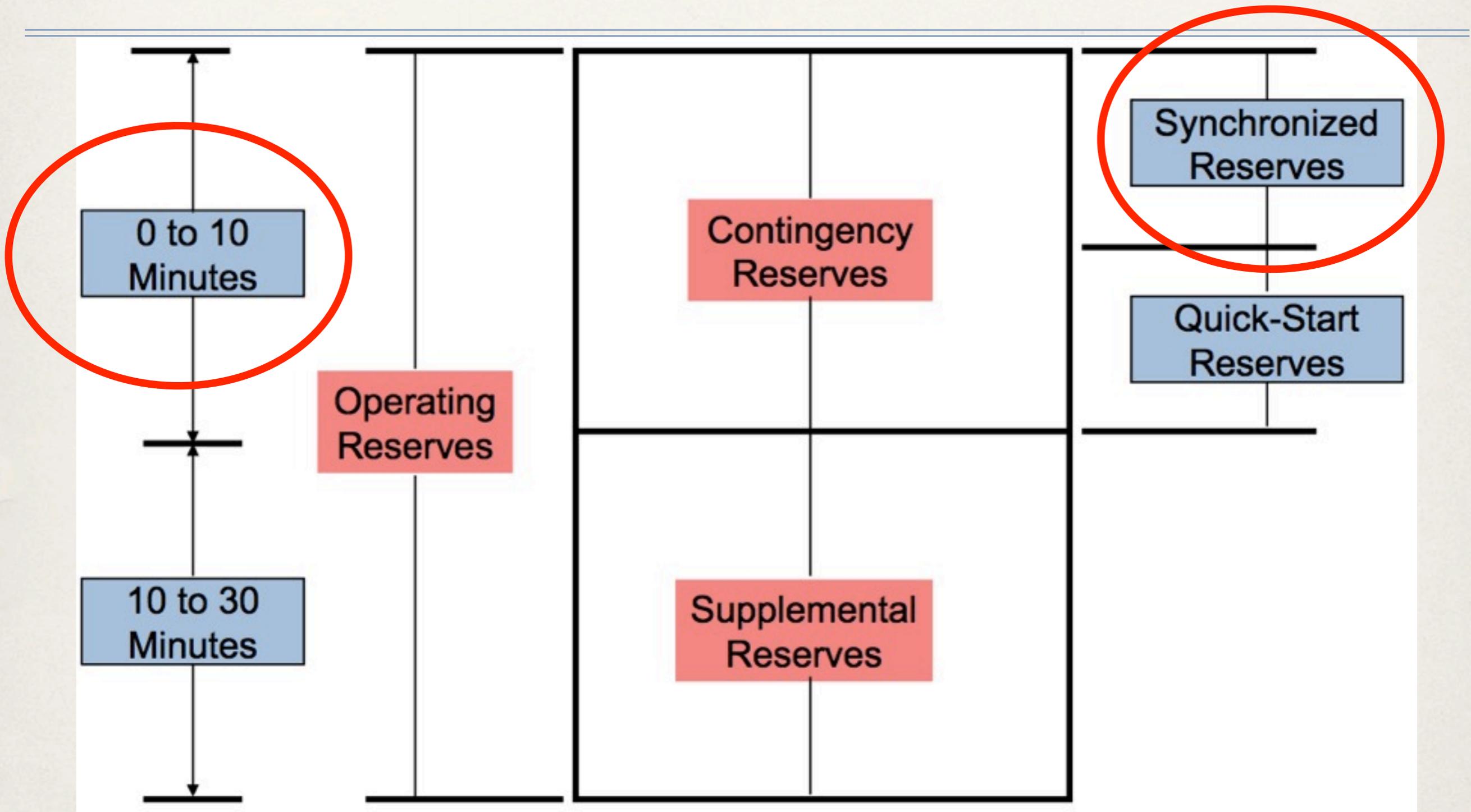
Utility Operations (AGC or SCADA)

IEEE Operations Requirements (110v \pm 5%)

Electrical Generation Standards (e.g. 60 Hz)

Mechanical or Chemical Materials Reality (e.g. Conductivity)

Reserves Requirements are Based on Equipment Operations



<http://ftp.pjm.com/training/~media/training/core-curriculum/ip-ops-101/ops-101-reserves.ashx>

Grid Supporting Vehicles' Impact

	Global	United States
Peak Generation (MW)	4,604,972	1,010,171
Annual Demand (MWh)	18,778,670,000	4,119,388,000
Population	6,873,000,000	310,395,000
Total Number of Vehicles	5,666,721,773	255,917,664
% of Total Demand	134%	28%
% of Peak Power	11,998%	2,470%
Minutes per Day Needed	12.00	58.30

Carbon Reductions

	Global	United States
Total Number of Vehicles	5,666,721,773	255,917,664
50% Electric Vehicles	2,833,360,886	127,958,832
Fuel based CO₂ Emissions Reduction	18,192 Million Tons from 39,879 Million Expected	821.59 Million Tons from 5,833 Million Tons Today
Increase in Grid Emissions	0%	0%

US Electrical Grid would have
Generation Following Demand
from the Transportation Sector.

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