

COLLABORATIONS TO CHARGE AHEAD WITH ELECTRIC VEHICLES

BRENDAN JORDAN, VICE PRESIDENT



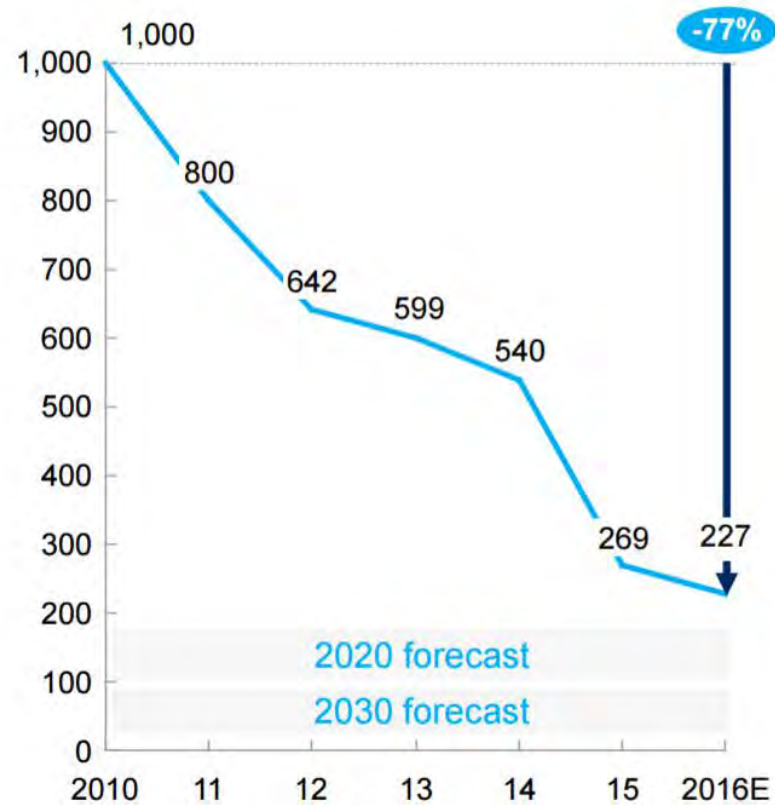
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Declining battery costs, accelerating EV sales

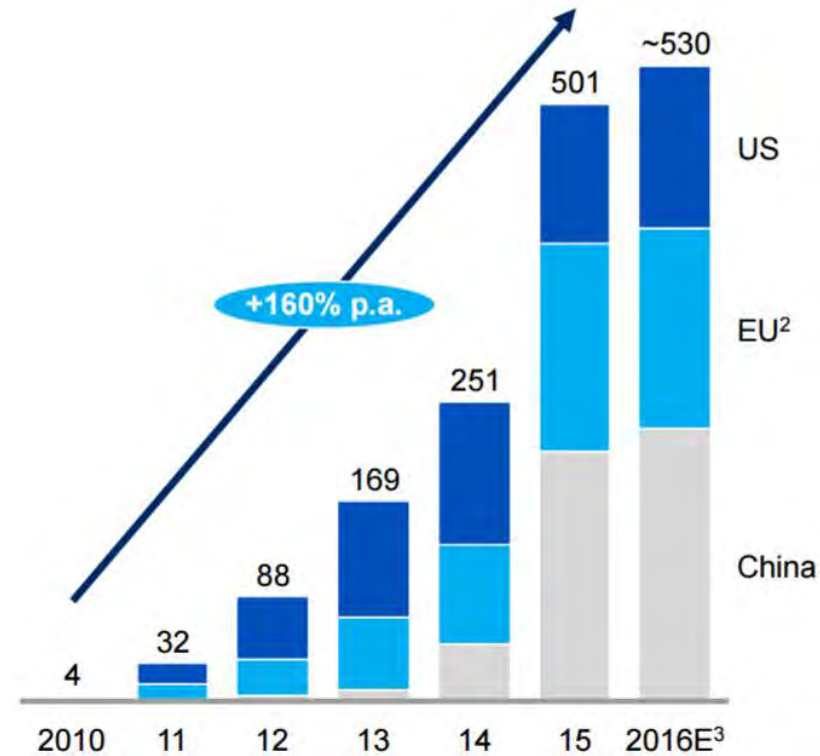
Average battery pack price

\$ per kWh



US, EU, and China electric vehicle sales¹

Units, thousands



Source: Bloomberg New Energy Finance



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Rapid growth projected in EV market

- EVs to be 35% of global new car sales by 2040.
- During 2020s, EVs will be a more economic option than gasoline cars, *without a tax credit.*
- Lithium-ion battery costs dropped 64% since 2010, falling further in the future.
 - Bloomberg New Energy Finance
- Price-parity, w/o tax credits, by 2025-2030 (Bloomberg New Energy Finance, McKinsey)

 Audi A3 \$33,700 31 eMiles/550 Total	 BMW i3 \$35,895 81 eMiles/150 Total	 BMW i8 \$132,000 22 eMiles/270 Total	 BMW X5 xDrive40e \$51,027 19 eMiles/400 Total	 Cadillac ELR \$67,500 37 eMiles/340 total	 Chevy Volt \$25,720 53 eMiles/420 Total
 Ford C-MAX Energi \$27,763 21 eMiles/620 Total	 Ford Focus Electric \$21,670 76 eMiles	 Ford Fusion Energi \$29,113 21 eMiles/620 Total	 Mercedes B-Class ED \$33,950 85 eMiles	 Nissan LEAF S \$21,510 84 eMiles	 Nissan LEAF SL \$21,510 107 eMiles
 Smart fortwo \$18,200 68 eMiles	 Porsche Cayenne E \$72,865 16 eMiles/300+ Total	 Porsche Panamera E \$99,595 14 eMiles/540 Total	 Tesla Model S \$67,500 240 eMiles	 Tesla Model S P90 \$83,570 270 eMiles	 Tesla Model X \$62,500 257 eMiles
 Volvo XC90 T8 \$64,332 14 eMiles/350 Total	 VW E-Golf \$21,495 83 e Miles	 Chevy Spark EV \$17,620 82 eMiles	 Fiat 500e \$24,300 87 eMiles	 Toyota Prius Plug-In \$27,490 11 eMiles/540 Total	 Kia Soul EV \$24,450 90 eMiles






Lower maintenance

Maintenance Schedule for your 2016 Chevrolet Cruze Limited



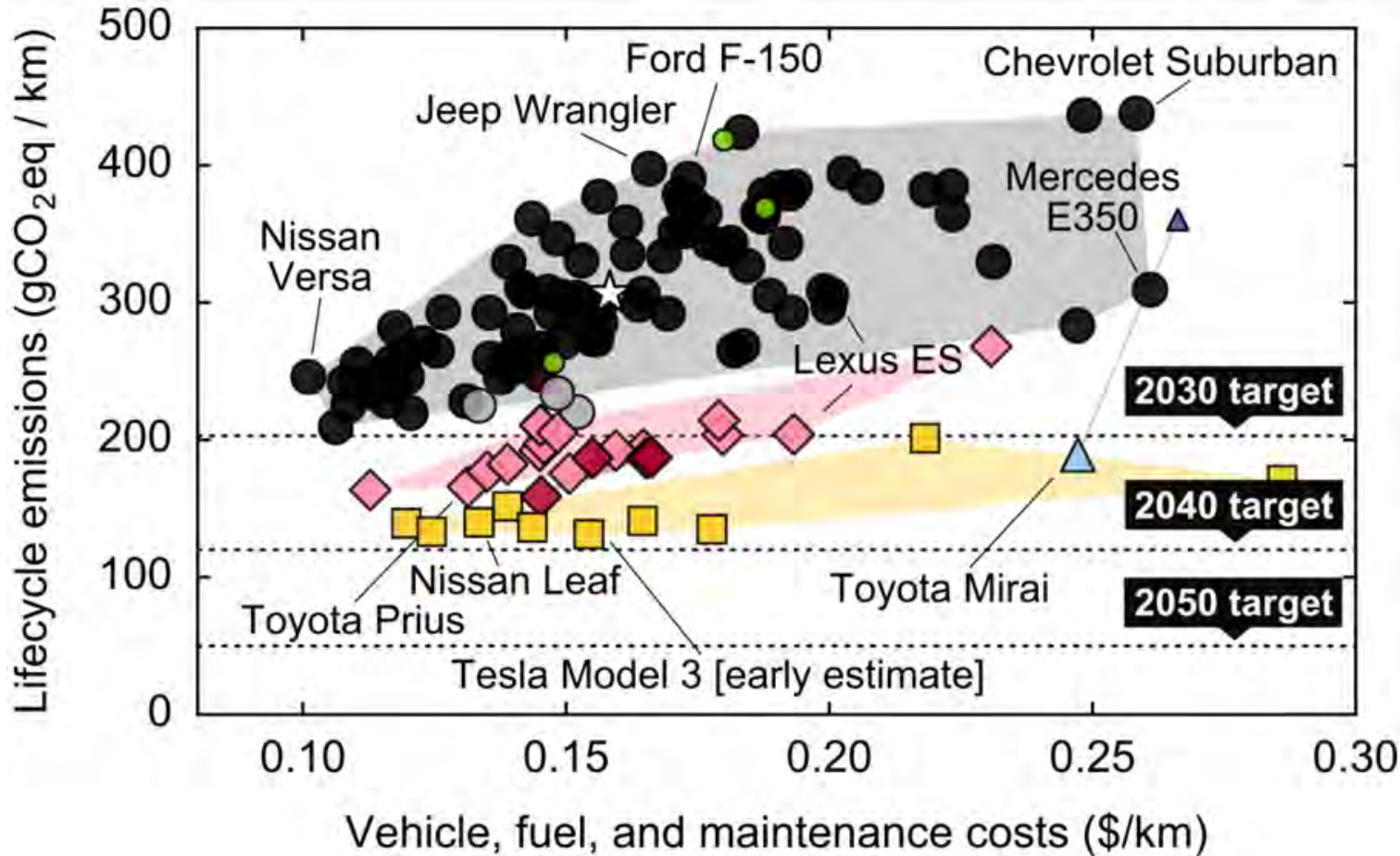
Maintenance Schedule for your 2017 Chevrolet Bolt EV

 Certified Service	7,500 miles	15,000 miles	22,500 miles	30,000 miles	37,500 miles	45,000 miles	52,500 miles	60,000 miles	67,500 miles	75,000 miles	82,500 miles	90,000 miles	97,500 miles	105,000 miles	112,500 miles	120,000 miles	127,500 miles	135,000 miles	142,500 miles	150,000 miles	
Rotate tires, if recommended for the vehicle, and perform Required Services. Check engine oil level and oil life percentage. Change engine oil and filter, if needed.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Replace passenger compartment air filter (or 2 years, whichever comes first).			✓			✓			✓			✓			✓			✓			✓
Replace engine air cleaner filter (or every 4 years, whichever occurs first).						✓						✓						✓			
Replace spark plugs and inspect spark plug wires.													✓								
Replace spark plugs. Inspect ignition coils boots. (Applies to: 1.4 L)								✓								✓					
1.8L Engine Only: Replace timing belt, idler pulley, and timing belt tensioner (or every 3 years, whichever comes first). (Applies to: 1.8 L)													✓								
Change automatic transmission fluid, if equipped. If filter is serviceable, change filter. (Applies to: Severe)						✓						✓							✓		
Change manual transmission fluid. (Applies to: Manual, Severe)						✓						✓							✓		
Drain and fill engine cooling system (or every 5 years, whichever comes first).																					✓
Change brake fluid (or every 3 years, whichever occurs first).						✓						✓							✓		
Change clutch fluid (or every 3 years, whichever occurs first). (Applies to: Manual)						✓						✓							✓		
Inspect evaporative control system.						✓						✓							✓		
Inspect engine accessory drive belts for fraying, excessive cracks or obvious damage (or every 10 years, whichever occurs first).																					✓

 Certified Service	7,500 miles	15,000 miles	22,500 miles	30,000 miles	37,500 miles	45,000 miles	52,500 miles	60,000 miles	67,500 miles	75,000 miles	82,500 miles	90,000 miles	97,500 miles	105,000 miles	112,500 miles	120,000 miles	127,500 miles	135,000 miles	142,500 miles	150,000 miles	
Rotate tires, if recommended for the vehicle, and perform Required Services.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Replace passenger compartment air filter (or 2 years, whichever comes first).			✓			✓			✓			✓			✓			✓			✓
Drain and fill vehicle coolant circuits.																					✓

Slide courtesy of Fresh Energy

EVs are *already* the cheapest and cleanest



- Out of 125 vehicle models on the road today, plug-in hybrid and battery electric vehicles are most often cheaper than their fossil fuel counterparts *over the lifetime of the automobile*. They also offer the lowest GHG emissions.

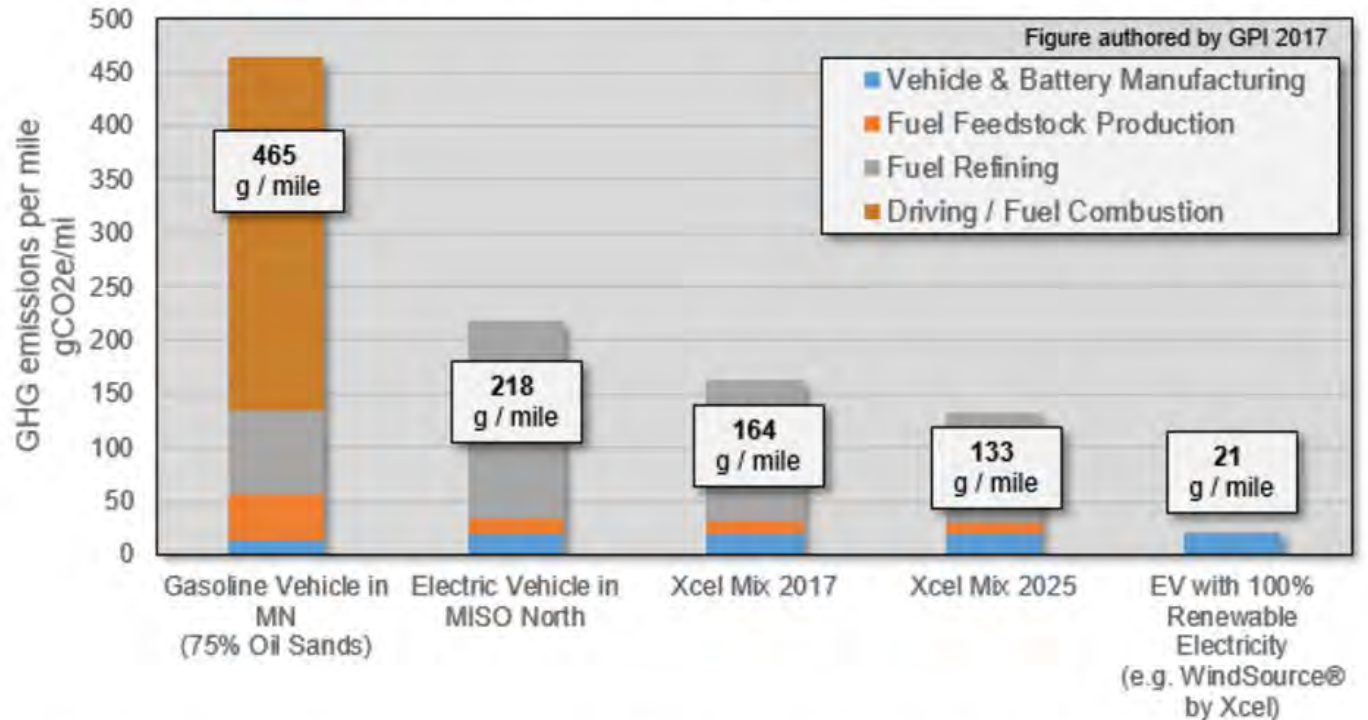
➤ MIT



EVs lower emitting in MN

- Average EV in MISO North is 53% better than an equivalent gasoline vehicle.
- 63% reduction in Xcel Energy territory.
- 95% reduction if charged w/ 100% renewables (e.g. WindSource, Wellspring, WindSense)
- More than 50% of EV drivers enroll in a 100% renewable program with their utility.

GHG Emissions: Gasoline vs Electric in Minnesota

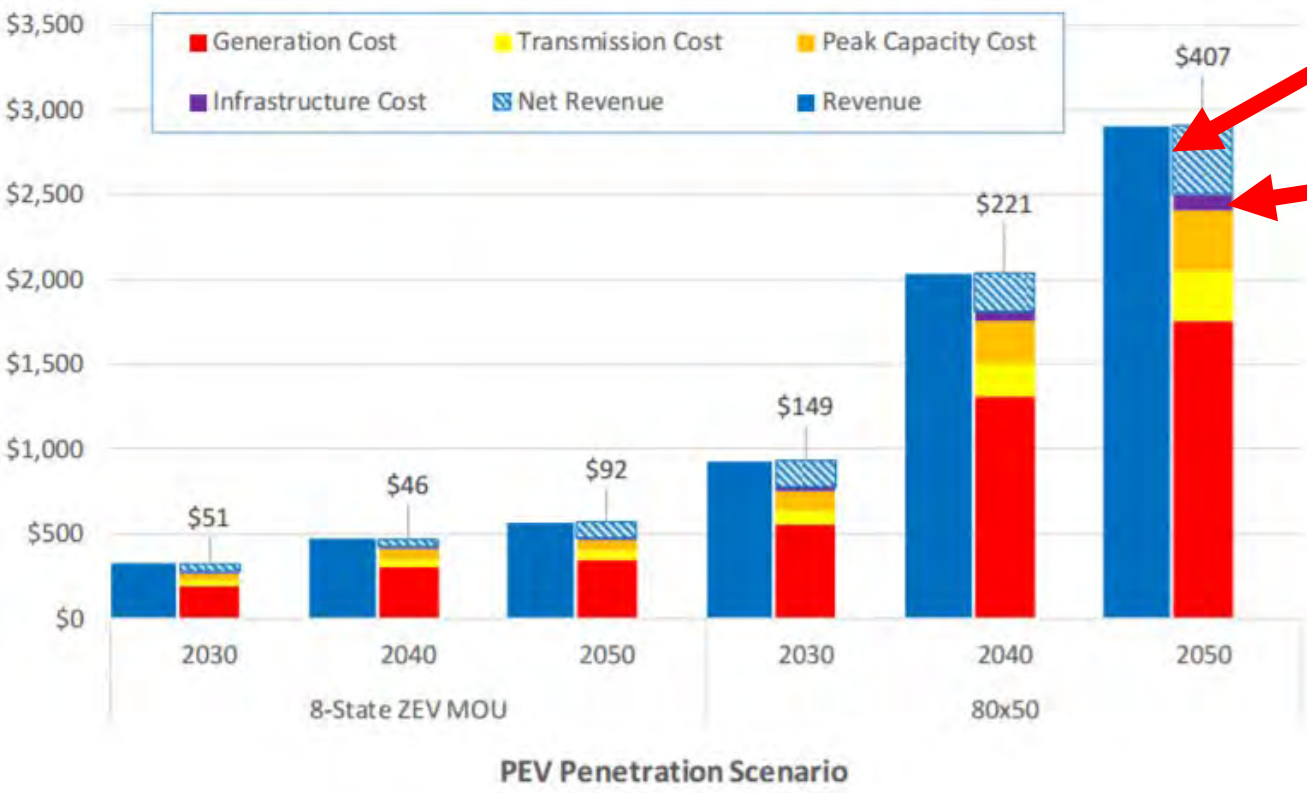


Source: Argonne National Laboratory; MN House Research Dept.; Xcel Energy; MISO.
Figure authored by Great Plains Institute. May, 2017.



Developing programs to benefit customers!

Pennsylvania: NPV Utility Costs & Net Revenue from PEV Charging
Baseline Charging
 (\$ millions)



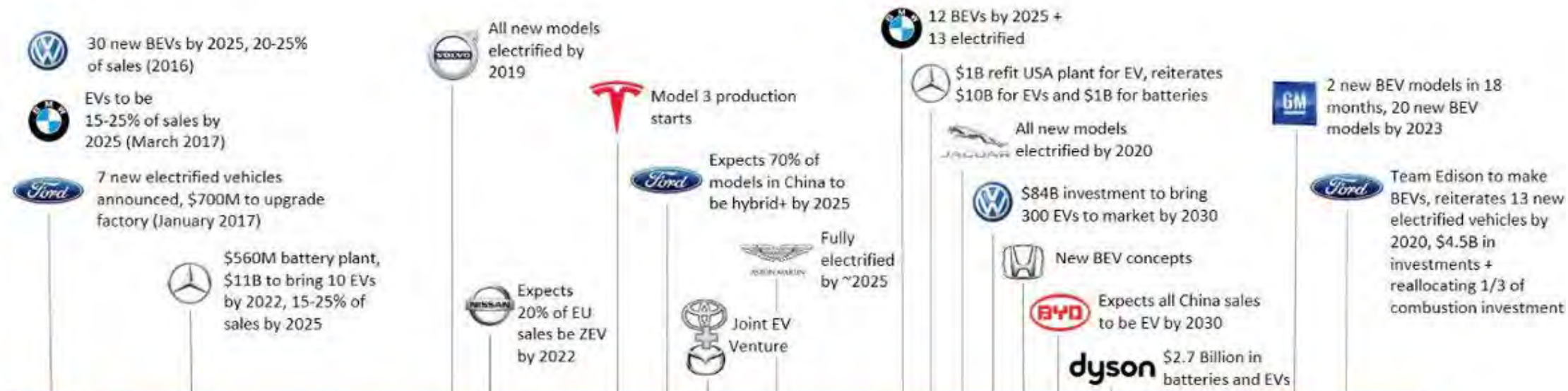
Revenue from EV electricity sales is greater than cost to serve EVs

=

net benefit to all ratepayers, lower electric rates for all

Source: M.J. Bradley

Nations Phasing Out Gasoline/diesel cars	Automakers with EV plans
China (2030)	VW – 30 BEVs by 2025
Netherlands (2025 – in discussion)	GM – 20 EVs (PHEV and BEV) by 2023
India (2030)	Daimler – 10 new EVs (PHEV and BEV) by 2022
Norway (2025) – already 40% of new car sales!	Volvo - all new models EV (PHEV and BEV) by 2019
France (2040)	BMW – 12 BEV, 13 PHEV by 2025
Britain (2040)	Jaguar – all new models PHEV by 2020
Germany (in discussion)	Ford – 13 EVs (PHEV and BEV) by 2022



BEV = Battery Electric Vehicle
 PEV = Plug-in Electric Vehicle
 ZEV = Zero Emission Vehicle
 EV or “electrified” = hybrid, plug-in hybrid, or BEV

Discussion

- What are the opportunities to collaborate?
- What resources do you need to make collaboration happen?

