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Economic Development Benefits of Plug-in Electric Vehicles in Massachusetts

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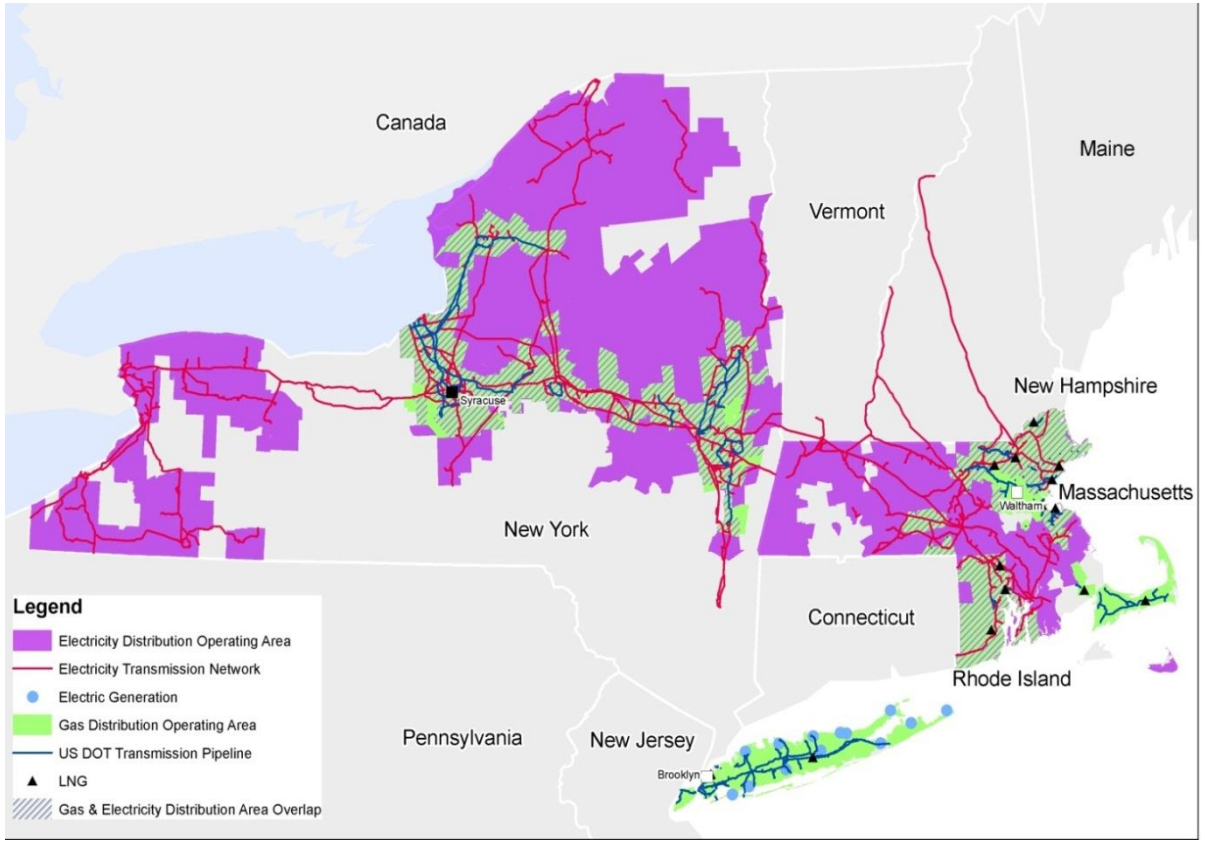

- 3.5 million electric distribution customers in Upstate New York, Massachusetts and Rhode Island
- 3.5 million gas distribution customers in Upstate New York, New York City, Long Island, Massachusetts and Rhode Island
- Electric and gas transmission
- LNG facilities and solar electric generation
- Traditional electric generation on Long Island

Electrifying transportation is key to achieving MA emissions goals

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- 2008 Massachusetts Global Warming Solutions Act (GWSA) law established green house gas (GHG) emissions limits equal to 25% below 1990 levels by 2020 and 80% below 1990 levels by 2050 **(80X50)**
- Transportation accounts for about 42% of MA GHG emissions. Unlike the electric power and heating sectors, transportation GHG emissions have not declined since 1990.
- In 2014 MA signed 8-state zero emissions vehicle (ZEV) memorandum of understanding (MOU) Action Plan to deploy 3.3 million ZEVs and supporting infrastructure by 2025 aimed at achieving the transportation sector's share of these emissions targets **(MA share: 300,000 vehicles**)
- ZEVs include battery electric vehicles, plug-in hybrid electric vehicles and fuel cell electric vehicles
- MA had already adopted CA ZEV standards in 2005 requiring automakers to sell an increasing number of ZEVs in the state beginning in 2009
- In 2016 MA Exec Order 569 set a time table for achieving GWSA goals starting in 2018, including a requirement that auto manufacturers sell an increasing numbers of ZEVs each year between 2018 and 2025

Achieving ZEV goals is technically and economically feasible

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Plug-in electric vehicles (PEVs), including battery electric vehicles and plug-in hybrids, are now a cost effective option for most commuters:

- Most commuters travel less than 40 miles to work, average 14 miles
- Upfront purchase price of PEVs higher than gasoline cars but total PEV ownership costs now lower due to:
  - 77% drop in battery prices last six years
  - Fuel cost savings
  - Lower repair and maintenance costs
  - Government rebates
- PEV ownership costs projected to hit parity with gasoline cars, without rebates, by 2025, based on battery price projections

But progress toward ZEV goals minimal due to lack of demand

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- ZEVs account for only 0.8% of new light duty vehicle sales in MA *
- ZEVs make up only 11,455 of the current MA fleet (July 2017) and just 0.2% of the MA light-duty vehicle fleet *
- Number of ZEVs on the road in MA needs to increase:
  - by factor of 26 to hit 2025 goal of ZEV MOU mandate of 300,000 (~ 5% of fleet)
  - to 1.3 million ZEVs by 2030 to stay on track to hit 80X50 **
  - to 4.9 million ZEVs in 2050 to make 80X50 (~ 90% of fleet) **

* autoalliance.org/energy-environment/zev-sales-dashboard and Moody's Analytics.

*** MJ Bradley & Associates, "Plug-in Electric Vehicle Cost-Benefit Analysis: Massachusetts," November 2016 (MJB), p. 9. Study available at: http://mjbradley.com/sites/default/files/MA_PEV_CB_Analysis_FINAL_17nov16.pdf .*

Policymakers are looking for ways to spur the ZEV market

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- Programs and incentives to build more charging stations (to reduce “range anxiety”)
  - Chicken and egg problem
- Incentives, rebates and subsidies to lower EV costs and increase consumer demand
- Customer outreach and advertising to increase awareness of rebates, incentives and the technical and cost saving benefits of PEVs
- Time-of-use rates to encourage private off-peak charging during times of known surplus capacity, reducing costs
- Targets for electrification of fleet vehicles at state and local government agencies and private businesses

Economic implications of hitting MA ZEV targets are significant

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Besides allowing us to hit achieve our 80X50 GHG emissions goals, hitting ZEV targets can provide local economic development benefits due to:

- PEV-related infrastructure spending
- PEV ownership cost savings
- Electric system efficiency improvements

PEV-related infrastructure spending

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ZEV-related infrastructure spending would rise dramatically under MA short- and long-run emissions goals and associated ZEV deployment mandates – **short-term** economic impacts would be significant

- Construction of tens of thousands charging stations – by utilities, charging companies, auto manufacturers
- Utility system upgrades – ZEV electric load would become significantly larger than current industrial sector (24% of load by 2050) *
- Construction of renewable generation to charge PEVs (solar, wind hydro)
- Construction of green transmission lines to connect renewables to PEVs
- Increased property tax revenue in communities where infrastructure is built.

** Ibid, p. 11*

PEV ownership cost savings

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*MJ Bradley (MJB) projects 80X50 ZEV penetration would save MA customers $4.2 billion in vehicle ownership costs by 2050 **

- PEV purchase price remains above gasoline vehicle price…
- … but falling battery prices and lower fuel and maintenance costs overwhelm the purchase price disadvantage, even with no subsidies or incentives.
- This could save MA customers $4.2 billion in annual vehicle ownership costs by 2050 under an 80X50 PEV penetration scenario ($2.1 billion real).
- **These savings would boost local spending, economic activity and jobs**.

MJB 80X50 PEV Penetration Scenario for MA with Off-Peak Charging
Projected Fleet Average Vehicle Costs Per Vehicle Owner (nominal $)

	Gasoline Vehicle ($/yr)		
	2030	2040	2050
Vehicle Purchase ($/yr)	$4,408	$6,212	$8,105
Gasoline ($/yr)	$1,308	$1,819	$2,389
Maintenance ($/yr)	$257	$329	$409
Total Annual Cost ($/yr)	$5,973	$8,360	$10,903
	PEV ($/yr)		
	2030	2040	2050
Vehicle Purchase ($/yr)	$4,818	$6,496	$8,432
Electricity ($/yr)	$682	$799	$920
Gasoline ($/yr)	$222	$274	$344
Personal Charger ($/yr)	$81	$101	$123
Maintenance ($/yr)	$136	$179	$224
Total Annual Cost ($/yr)	$5,939	$7,849	$10,043
	Savings Summary		
	2030	2040	2050
Vehicle Cost savings ($/yr)	-$491	-$385	-$450
Fuel Cost savings ($/yr)	$404	$746	$1,125
Maintenance/repair savings $/yr)	$121	$150	$185
Total savings per PEV Owner($/yr)	$34	$511	$860
# Massachusetts PEVs (millions)	1.3	3.2	4.9
Total MA Savings ($m/yr)	$44	$1,635	$4,214

** Source: Ibid, Table 2, p. 20.*

Potential electric system benefits of PEV charging

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MJB predicts 80X50 ZEV penetration would save MA ratepayers $1.4 billion in electricity costs by 2050 (~ $704 million in real terms)

(Off Peak Charging Scenario)	Utility Revenues and Costs (Nominal $m)		
	80X50 PEV Penetration Scenario		
	2030	2040	2050
Total Utilitiy Revenue from PEV Charging	$931	$2,594	$4,495
Total Incremental Cost to Serve PEV Charging	$666	$1,763	$3,068
Incremental T&D Cost to Serve PEV Charging	$173	$544	$1,135
Net Utility Revenue	$265	$831	$1,427

Source: Ibid, Section 3.3

- Off-peak charging for most ZEVs could increase electric system efficiency, lowering average unit costs
- "Incremental T&D costs" represent new capital spending required for on-peak portion of new ZEV load
- Electricity price increases would lower consumer and business costs, boost regional competitiveness and spending, and lead to more economic growth and jobs

Economic benefits and costs of 80X50 ZEV penetration

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MJB 80X50 PEV Penetration Scenario with Off-Peak Charging for Massachusetts*
Stakeholder and Economic Development Impacts

	2030	2040	2050
PEV Impact ($ millions)			
Net PEV ownership savings	$44	$1,635	$4,214
Decreased spending on gasoline	-$1,412	-$4,944	-$10,021
Decreased spending, auto repair&maint	-$157	-$480	-$907
Increased spending on electricity	$2,149	$3,746	$4,050
Increased spending, personal chargers	$105	$323	$603
Increased spending, new motor vehicles	$533	$909	$1,602
Electric ratepayer savings	$265	$831	$1,427
Jobs Created by PEV Impact (#)			
Net PEV ownership savings	206	4,992	8,190
Decreased spending on gasoline	-3,300	-7,395	-9,605
Decreased spending, auto repair&maint	-1,151	-2,340	-2,949
Increased spending on electricity	2,149	3,746	4,050
Increased spending, personal chargers	40	67	74
Increased spending, new motor vehicles	956	1,020	1,153
Ratepayer savings	1,702	3,388	3,702
Total	602	3,478	4,615

Stakeholders

Directly Impacted

- Consumers (savings)
- Gasoline distributors (losses)
- Automotive repair (losses)
- Electric utilites (gains)
- Local retailers (gains)
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- Consumers/businesses (savings)

MJ Bradley Study Input

Each individual PEV impact has a positive or negative impact on the local economy and jobs

Net # of jobs created

REMI Output (Jobs Created)

** Source: MJB Study (Ibid), 80X50 penetration scenario with off peak charging and REMI model for Massachusetts.*

Summary of ZEV environmental and economic impacts

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Net environmental, cost and economic impact of converting 90% of cars and light-duty vehicles in Massachusetts to PEVs by 2050, with off-peak charging:

	2030	2040	2050
CO2 Reductions (millions of tons)			
w/ baseline generation	12	17	22
w/ 80% low carbon generation	12	18	24
Customer Savings			
Vehicle Ownership Cost Savings ($2016m)	$33	$992	$2,078
Electricity Cost Savings ($2016m)	$198	$505	$704
Net Economic Impact - State of Massachusetts			
Jobs Created	602	3,480	4,616
Gross State Product ($2016m)	$378	$1,202	$1,811
Personal Income ($2016m)	$388	$1,143	$1,714
State Tax Revenue ($2016m)	$41	$121	$182

** Source: MJ Bradley Study, Ibid (assumes 80% renewable electric power generation) and REMI model for Massachusetts*

Risks to the outlook

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- PEV ownership cost savings
  - Assumes battery prices continue to fall
  - Assumes EIA's baseline electricity and gasoline price forecast (electricity prices could be higher and gasoline prices lower under an 80X50 scenario for the electric sector)
- Impact of PEV charging on electric system
  - Electric system benefits hinge on off-peak charging and correct rate design
  - Large scale adoption of PEVs necessary to realize significant benefits
- What consumers want -- so far, no significant demand for PEVs
- Upside economic potential – positive impact of EVSE may not be fully taken into account

Summary and conclusions

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- Achieving ZEV 80X50 goals in MA can help residents, businesses and communities achieve their environmental, cost-saving and economic development goals:
  - Lower GHG emissions that contribute to climate change
  - Lower local emissions such as smog and particulates that have negative health and environmental effects
  - Lower transportation costs
  - Lower per unit utility costs (with off-peak charging)
  - Promote local economic growth and job creation