



Phase 1 Cost Curves



VMT Reductions

VMT Assumptions

- Costs are not currently in LEAP
 - Costs are highly uncertain for top-down approach
 - Costs vary widely by VMT measure – hard to apply as “uniform” cost



Energy Efficiency

Commercial and Residential Costs 2013USD

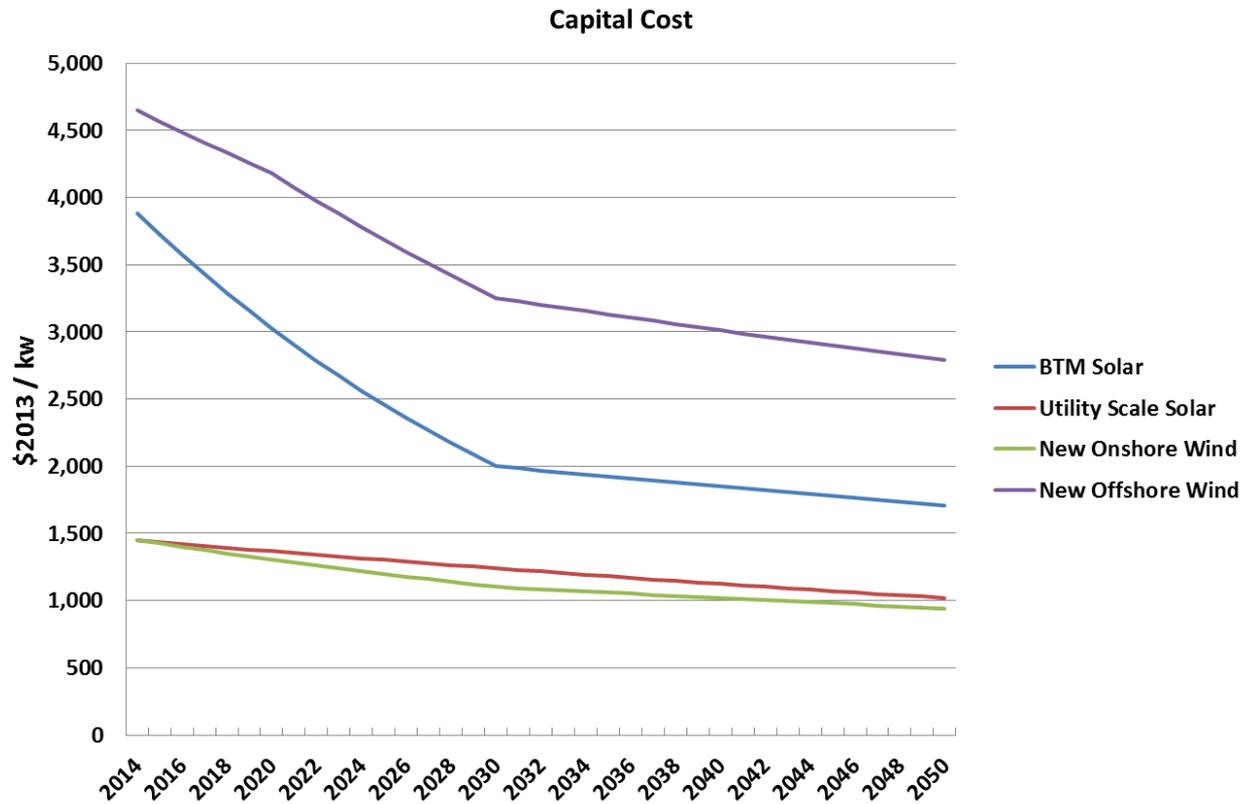
	Commercial - Thousand 2013 USD	
	Electricity	Gas
2016	55359.44	8962.851
2017	55799.24	9389.66
2018	55799.24	8832.739
2019	55799.24	8832.739
2020	55799.24	8832.739
2021	55799.24	4416.369
2022	41539.5	4416.369
2023	41539.5	4416.369
2024	41539.5	4416.369
2025	31154.62	4416.369
2026	31154.62	4416.369
2027	31154.62	4416.369
2028	31154.62	4416.369
2029	31154.62	4416.369
2030	31154.62	4416.369
2031	31154.62	4416.369
2032	31154.62	4416.369
2033	31154.62	4416.369
2034	31154.62	4416.369
2035	31154.62	4416.369
2036	33923.92	6182.917
2037	36693.22	7949.465
2038	39462.52	9716.013
2039	42231.82	11482.56
2040	45001.12	13249.11
2041	47770.42	15015.66
2042	50539.72	16782.2
2043	53309.02	18548.75
2044	56078.32	20315.3
2045	58847.62	22081.85
2046	61616.92	23848.39
2047	64386.22	25614.94
2048	67155.52	27381.49
2049	69924.82	29148.04
2050	72694.12	30914.59

	Residential - Thousand 2013 USD	
	Electricity	Gas
2016	55110.78	16137.21
2017	55548.61	16905.66
2018	55548.61	15902.95
2019	55548.61	15902.95
2020	55548.61	15902.95
2021	55548.61	7951.474
2022	41352.92	7951.474
2023	41352.92	7951.474
2024	41352.92	7951.474
2025	31014.69	7951.474
2026	31014.69	7951.474
2027	31014.69	7951.474
2028	31014.69	7951.474
2029	31014.69	7951.474
2030	31014.69	7951.474
2031	31014.69	7951.474
2032	31014.69	7951.474
2033	31014.69	7951.474
2034	31014.69	7951.474
2035	31014.69	7951.474
2036	33771.55	11132.06
2037	36528.41	14312.65
2038	39285.27	17493.24
2039	42042.13	20673.83
2040	44798.99	23854.42
2041	47555.85	27035.01
2042	50312.71	30215.6
2043	53069.57	33396.19
2044	55826.44	36576.78
2045	58583.3	39757.37
2046	61340.16	42937.96
2047	64097.02	46118.55
2048	66853.88	49299.14
2049	69610.74	52479.73
2050	72367.6	55660.32



Utility Scale and Distributed Renewable Electricity Generation

Capital Cost Curves



Initial costs

- “Lazard’s LCOE Analysis Version 9.0” (Lazard’s, 2015)

Cost Curve Assumptions

- On & Off Shore Wind:
 - “Forecasting Wind Energy Costs & Drivers” (LBNL; NREL, 2016)
- BTM Solar:
 - “Tracking the Sun, DOE SunShot” (DOE; LBNL, 2016)
- Utility Scale Solar:
 - CA Pathways detailed input database (Energy & Environmental Economics, 2015)



Clean Imported Electricity

Clean Electricity Import Capacity

- Assumed two new transmission lines into ISO-NE in 2019 and 2025
- Each line assumed capital cost of \$1.6 billion and 1090 MW capacity = \$1.47 million/MW
- Annualizing all costs over assumed 40 year lifetime with a 7% interest rate using capital recovery factor method
- All capital costs entered into LEAP assumed to be overnight
- Cost info source: 2016 New England Clean Energy RFP bid, Northern Pass (redacted bid – unclear if it includes O&M cost)



Nuclear Re-Licensing

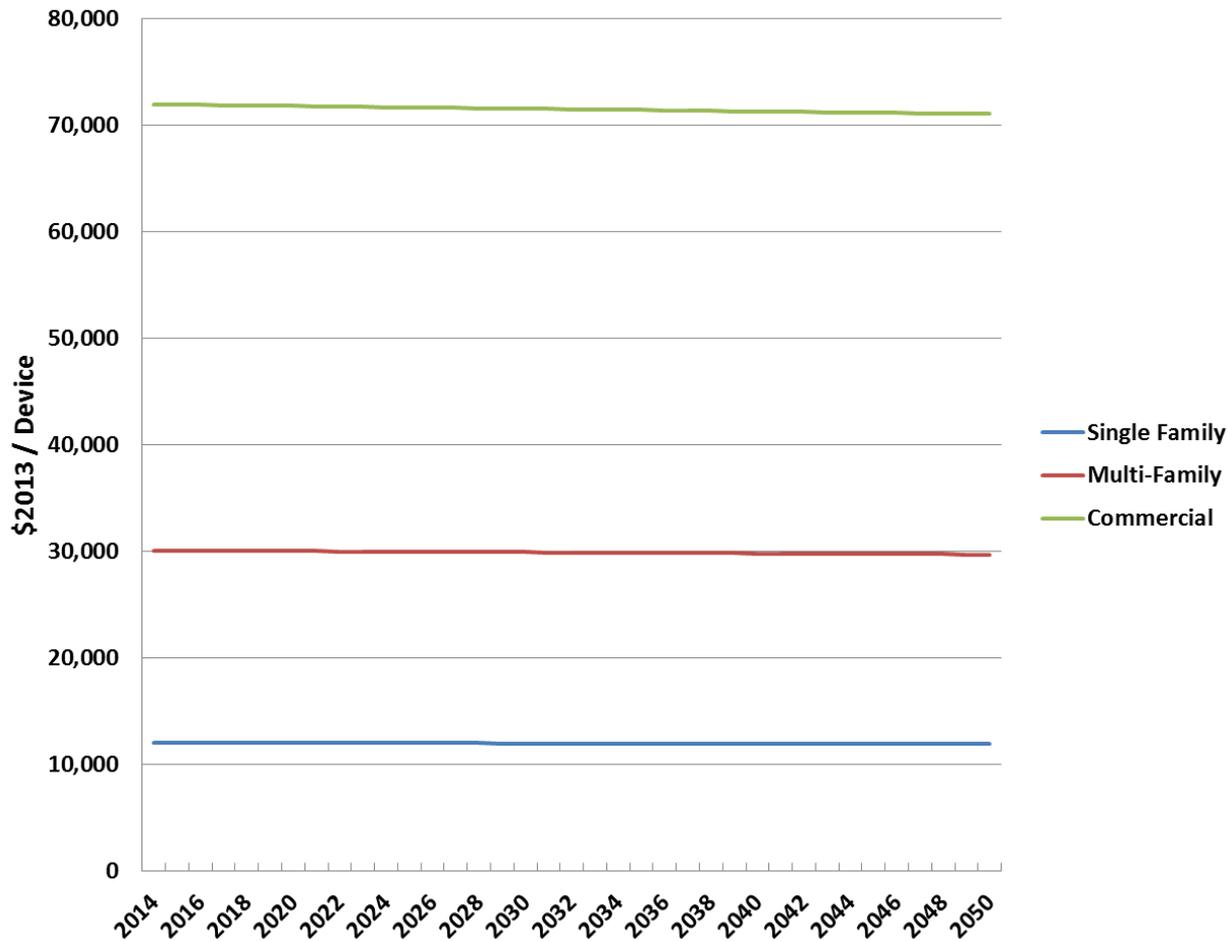
Nuclear Capacity

- Costs categories:
 - Current-term outages
 - Not included in LEAP
 - Refurbishments
 - Not included in LEAP
 - Costs associated with running / building other plants
 - When nuclear plants are re-licensed no new plants are needed
 - Total 2015-2050 capital cost savings = 45 million dollars



Advanced Electric Heating

Cost Curves for Air-Source Heat Pumps

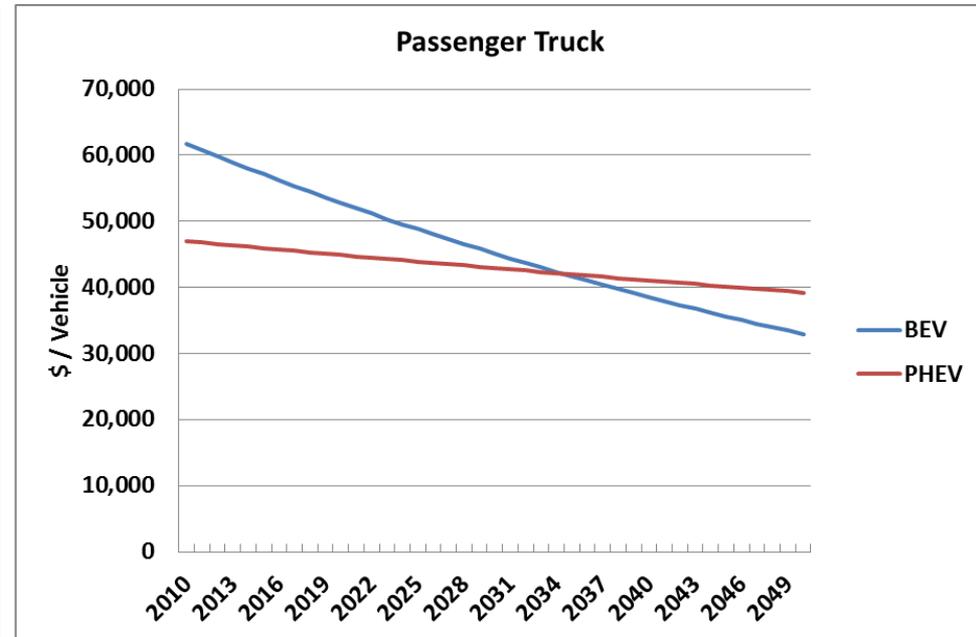
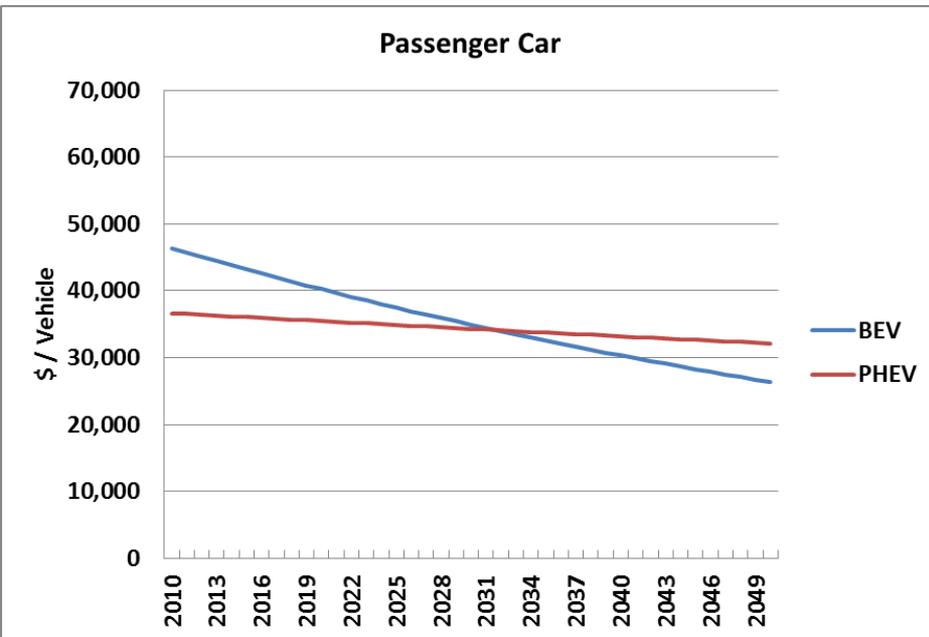


- Cost curve rates:
 - Detailed inputs to EIA AEO 2015 Reference Case



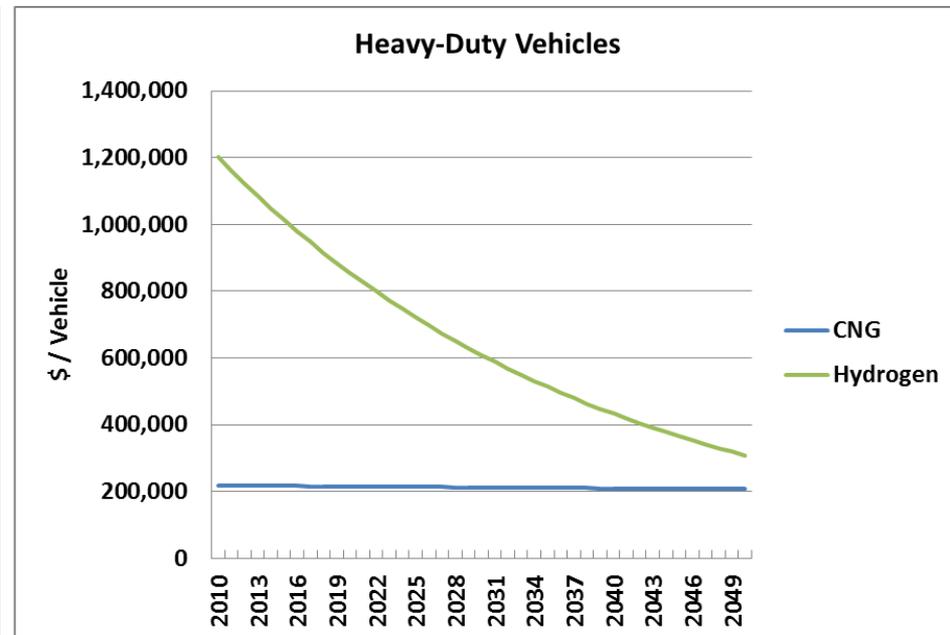
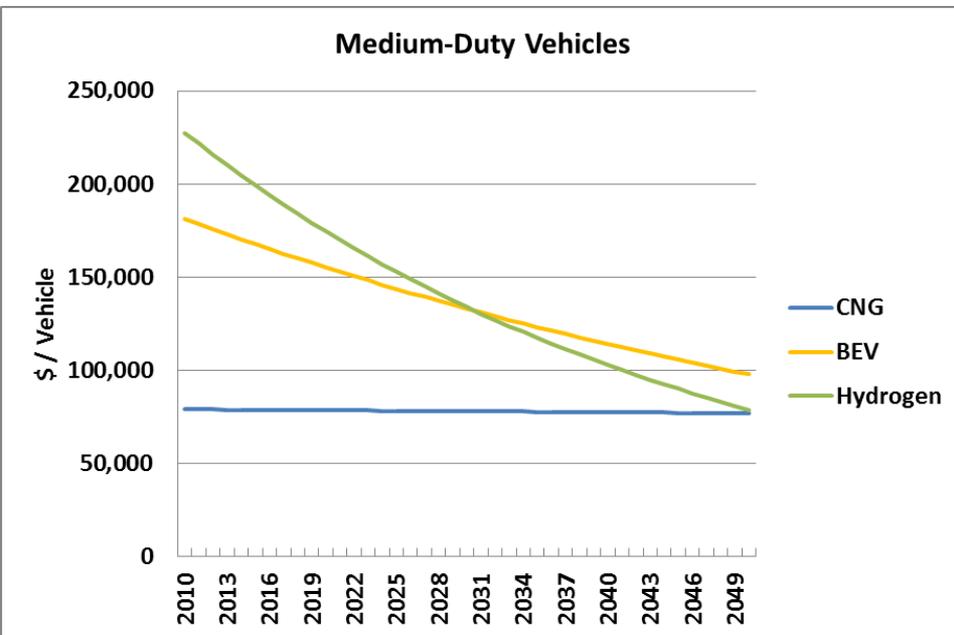
Light-Duty, Medium-Duty and Heavy-Duty Vehicle Electrification

Cost Curves - Passenger Cars and Passenger Trucks



- Initial costs and projected costs are based on detailed inputs used in the 2015 CA pathways GHG analysis.

Cost Curves - Medium-Duty and Heavy-Duty Vehicles

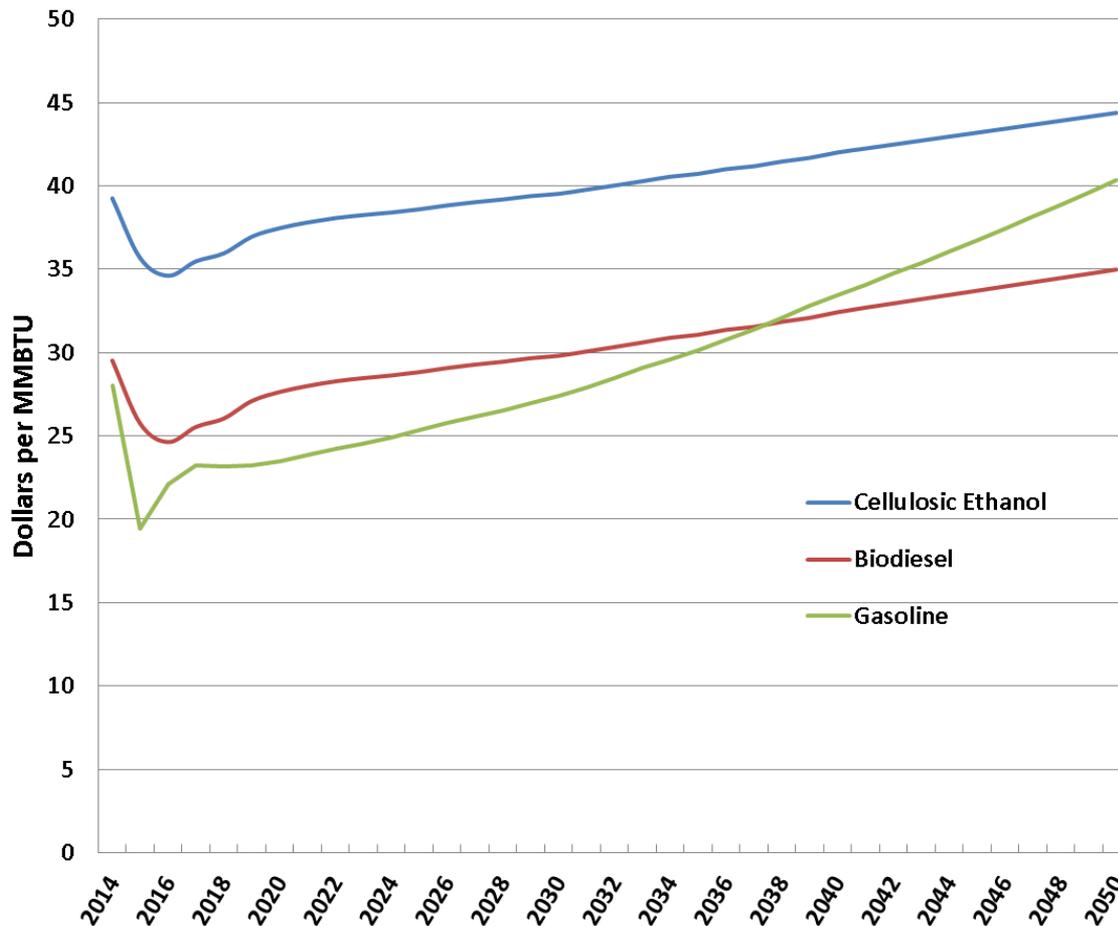


- Initial costs and projected costs are based on detailed inputs used in the 2015 CA pathways GHG analysis.



High Penetration of Advanced Transportation Biofuels

Advanced Biofuel Fuel Costs Compared to Conventional Gasoline



- Fuel Prices:
 - EIA AEO 2015 Reference Case