

Why We Can Win the Climate Mitigation and Clean Energy Transition

UUCWC

April 16, 2024

Why Im Optimistic

We'll Get to 100% Clean Energy before 2050

Local Action – Tracking Progress

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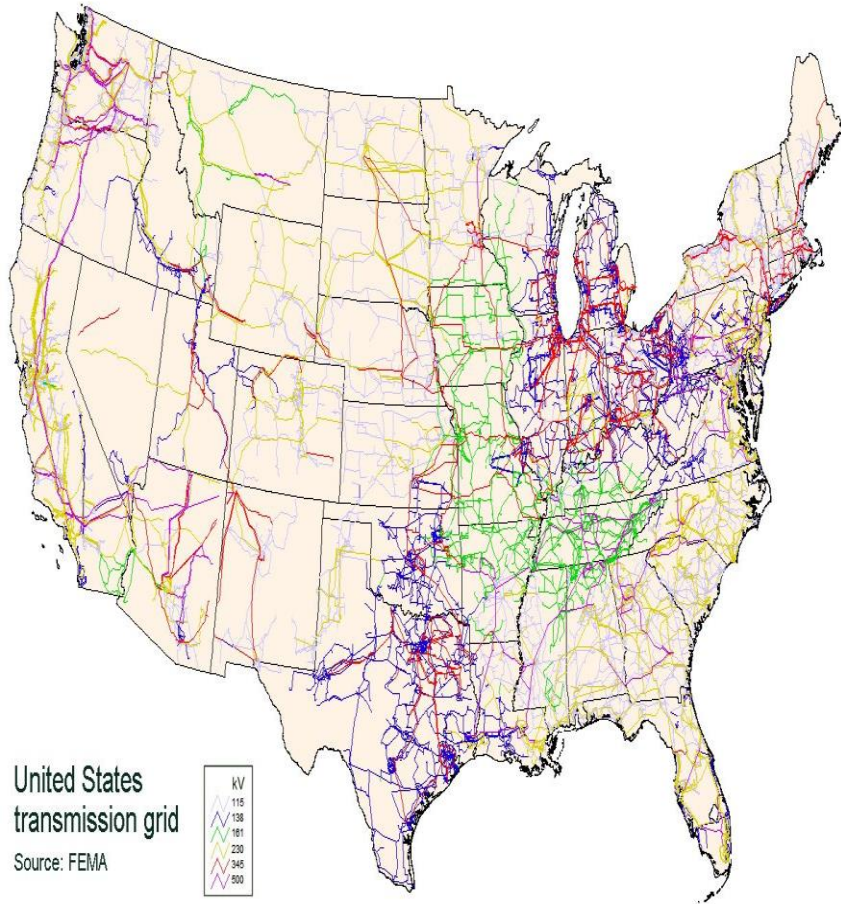
Local Action – Tracking Progress

- **The Size of the Issue – Climate and Energy Systems**
- **Mitigation Strategies/Measures– at the State, Local, and Household Levels**
- **The Costs and Benefits of those Mitigation Strategies/Measures**

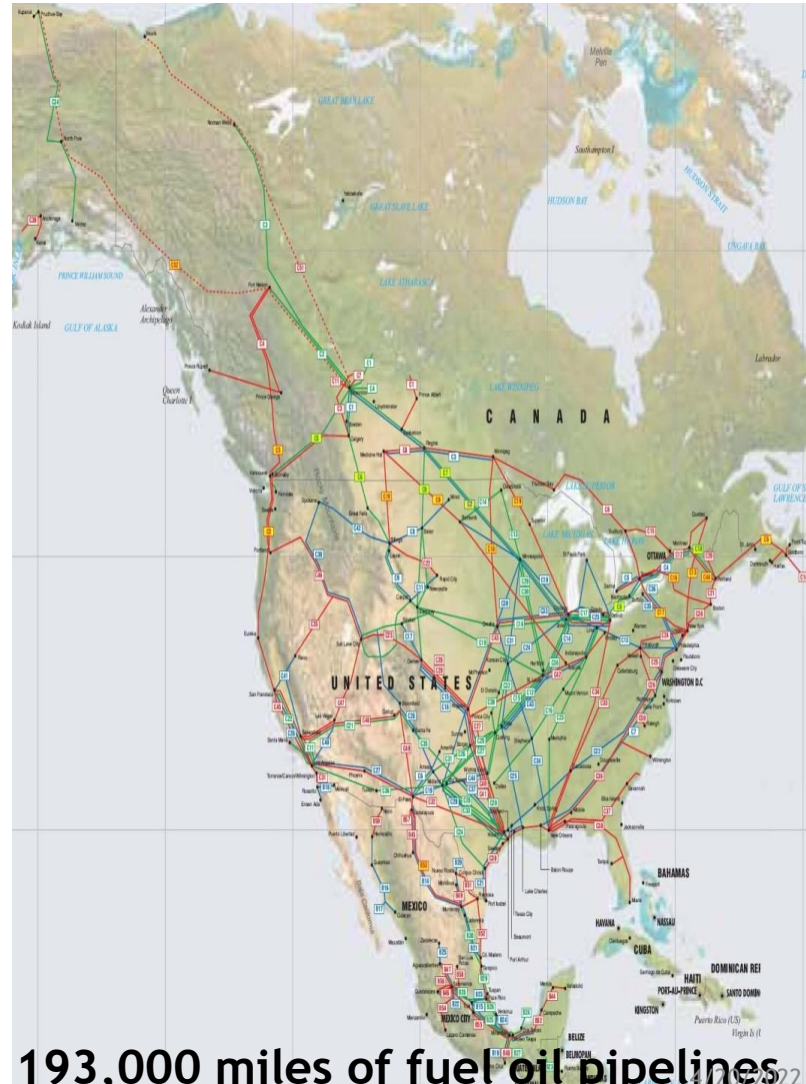
- **Energy Policies to reduce GHG emission Pollution – It starts with a Plan**
- **3 Charts on why I'm Optimistic**

The US Energy System of pipes and wires are large enough to X-cross the US over 200 times
Energy is over \$1.96 trillion – almost 6% of US GDP - In NJ - \$43.6B PA \$70.8B - 2021

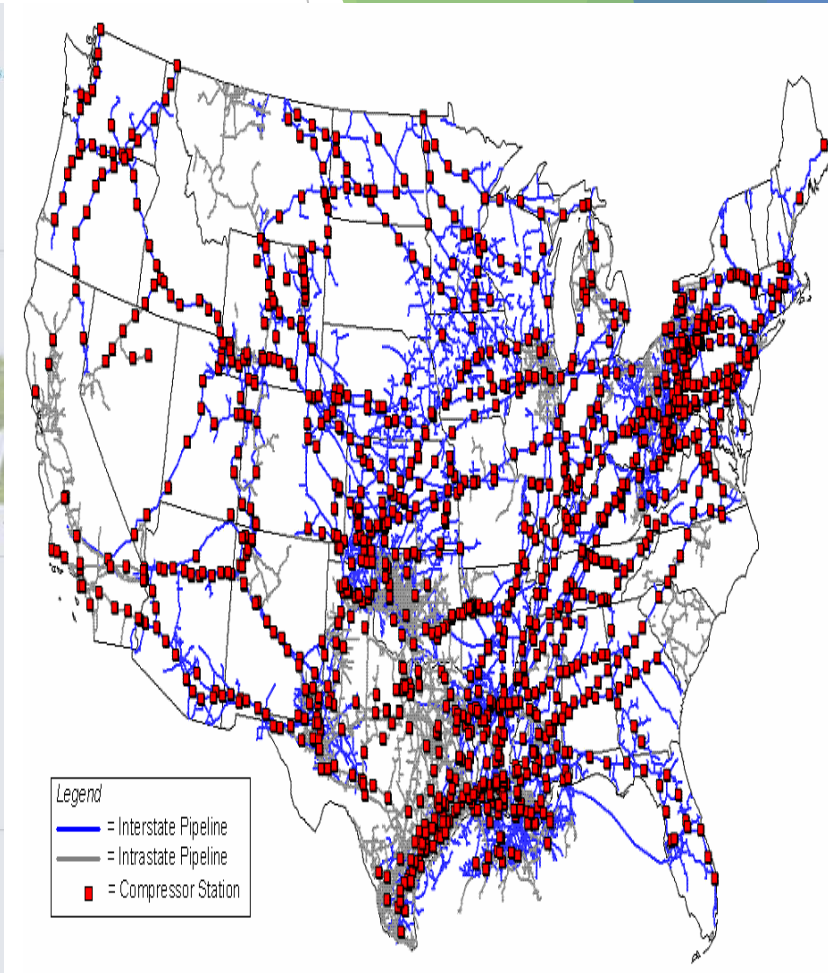
[U.S. Energy Information Administration - EIA - Independent Statistics and Analysis](#)



200,000 miles of electric transmission wires and 5.5 million miles of distribution wires



193,000 miles of fuel oil pipelines in US



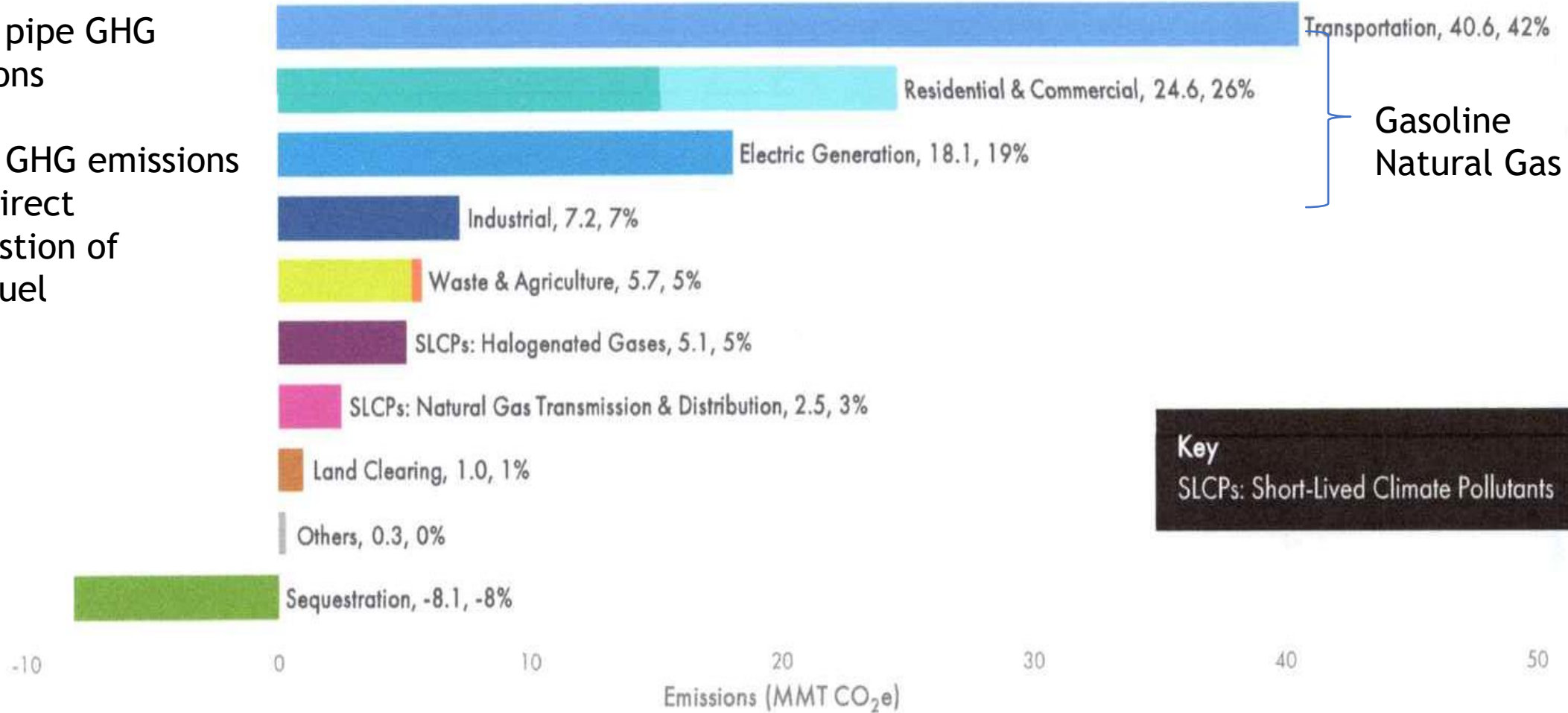
300,000 miles of inter and intrastate natural gas pipelines and 2.1 M miles of distribution pipes

Figure ES.2. New Jersey GHG Emissions Inventory for 2018 (MMT CO₂e and Percentage).
 Opportunities for emissions reductions are present in each of the categories.

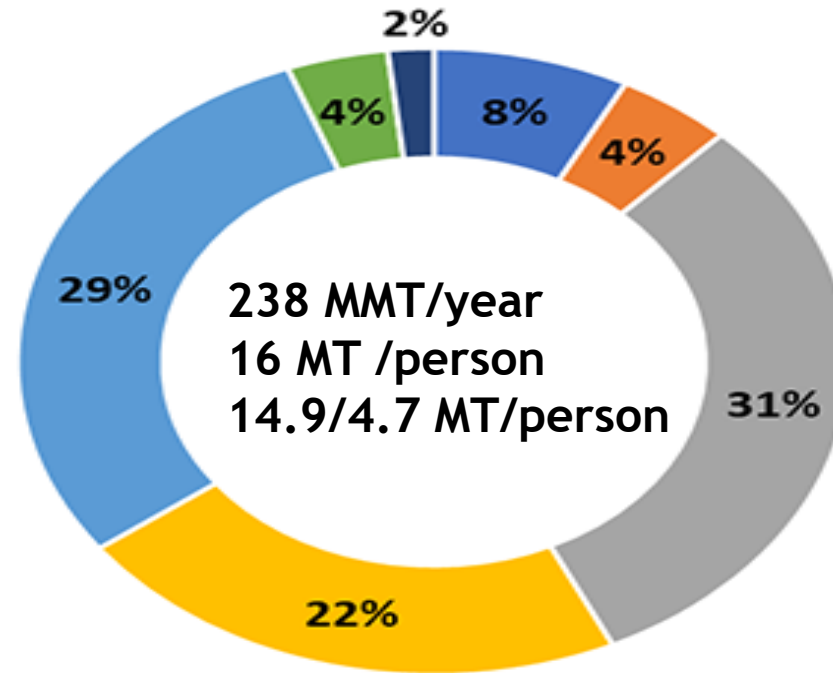
100 MMT per year
 11 MT per person (14.9/4.75 MT/person)
[Our World in Data](#)

End of pipe GHG Emissions

84% of GHG emissions from direct combustion of fossil fuel



Pennsylvania 2020 GHG Emissions % of Total by Sector



Coal and
natural
gas
mining



- Residential
- Industrial
- Electricity Production
- Waste Management

- Commercial
- Transportation
- Agriculture

gasoline



https://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/ClimateChange/FINAL_2023_GHG_Inventory_Report_12.13.23.pdf

[CO₂ emissions - Our World in Data](#)

2019 NJ Energy Master Plan – Strategies to get to 100% Clean Energy by 2050

The EMP puts mitigation in 5 basic buckets – a more integrated approach <https://nj.gov/emp/>

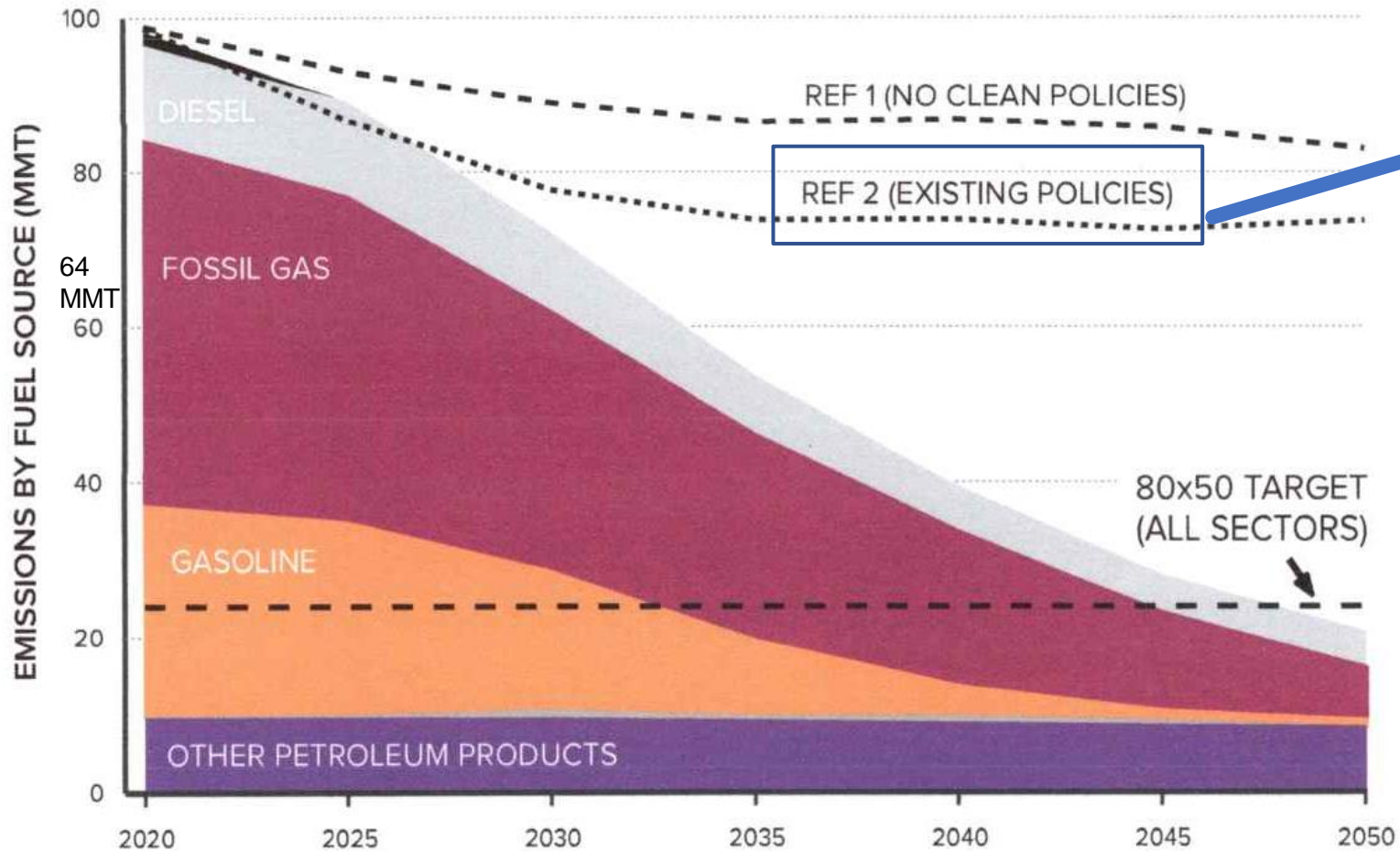
2019 NJBPU EMP STRATEGIES	INTEGRATED ENERGY PLAN
Reduce energy use and emissions from the transportation sector	Accelerate the transition to electric vehicles powered by clean renewable electricity
Accelerate the deployment of renewable energy and Distributed Energy Resources (DER)	Expand in-state renewables and within PJM to supply clean electricity for the transportation and building sectors Retain near term but no expansion of existing natural gas and nuclear capacity for reliability
Maintain energy efficiency and peak demand reduction	Continue and expand existing EE and DR programs with a focus on heat pumps and EVs - powering New Jersey economy w clean energy
Reduce energy use and emissions from the building sector	Existing building electrification powered by clean renewable electricity Develop electrification programs for new construction
Decarbonize and modernize the New Jersey energy systems	Electricity to double by 2050 Plan grid modernization - integrated distribution plans Natural gas and gasoline usage declines

2019 EMP Goals

Achieving 100% clean energy and 80% reduction in 2006 greenhouse gas emissions 125 million metric tons to 24 million metric tons statewide by 2050. 100% clean energy is defined as 100% carbon-neutral electricity generation and maximum electrification of the transportation and building sectors - specifically heating.

FIGURE 7.

Energy Emissions by Fuel Source, Least Cost Scenario



4/20/2022

Clean Energy Act of 2018 – Ref 2

The Clean Energy Act of 2018 was enacted by Governor Murphy in May 2018 and included the following:

- Energy storage goal of 600 MW by 2021 and 2,000 MW by 2030
- Class I RPS of 21% by 2021, 35% by 2025 and 50% by 2030 with a cap of 7% on the total cost.
- Modify or replace the SREC program
- A community solar program
- Utility EE goals of 2% annually for electricity and 0.75% for natural gas
- OSW goal of 3,500 MW

How does the 2019 NJBPU Energy Master Plan Translate to what you can do and what local governments can do

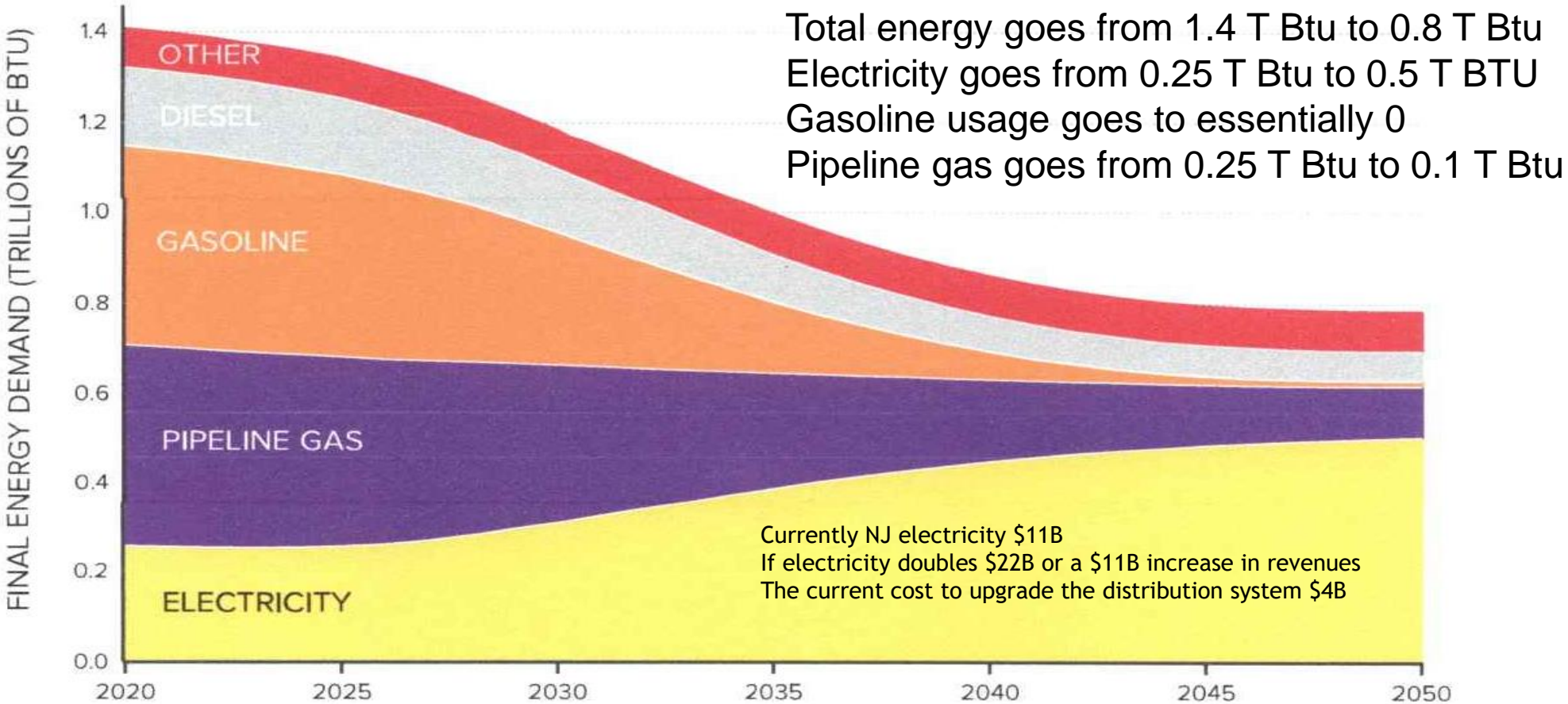
- Energy Storage - 2,000 MW by 2030
- Renewable Energy Portfolio Standard (RPS)- 50% by 2030 (100% clean electricity by 2035)
- Solar - additional 3,750 MW from 2021 by 2026 (existing 5,200 MW 7.6% total generation)
- Offshore Wins (OSW) - 7,000 MW by 2035 (11,000 MW by 2040)
- Electric Vehicles (EV) - 330,000 by 2025, 2 million by 2035
- EV Charging Stations (EVCS) - 1,000 level 2 and 400 DC by 2025
- **Cold Climate Heat Pumps - (400,000 residential, 20,000 Commercial)**
- Energy Efficiency electricity - 2% annual reduction in use
- Energy Efficiency natural gas - 0.75% annual reduction in use
- Clean Energy - (100% clean energy by 2050)
- Greenhouse Gas (GHG) reduction - 80% reduction in 2006 level by 2050
- **GHG reduction - 50% reduction in 2006 level by 2030)**
- GHG reduction - 28% reduction in 2005 level by 2025 - Paris Agreement

**New Jersey does not reach its goals unless every municipality reaches these goals
Every municipality does not reach these goals unless
every household and business reaches these goals**

Energy Savings to Electrify the Building and Transportation Sectors Powered by Renewable Energy

FIGURE H.

Final energy demand in the Least Cost scenario

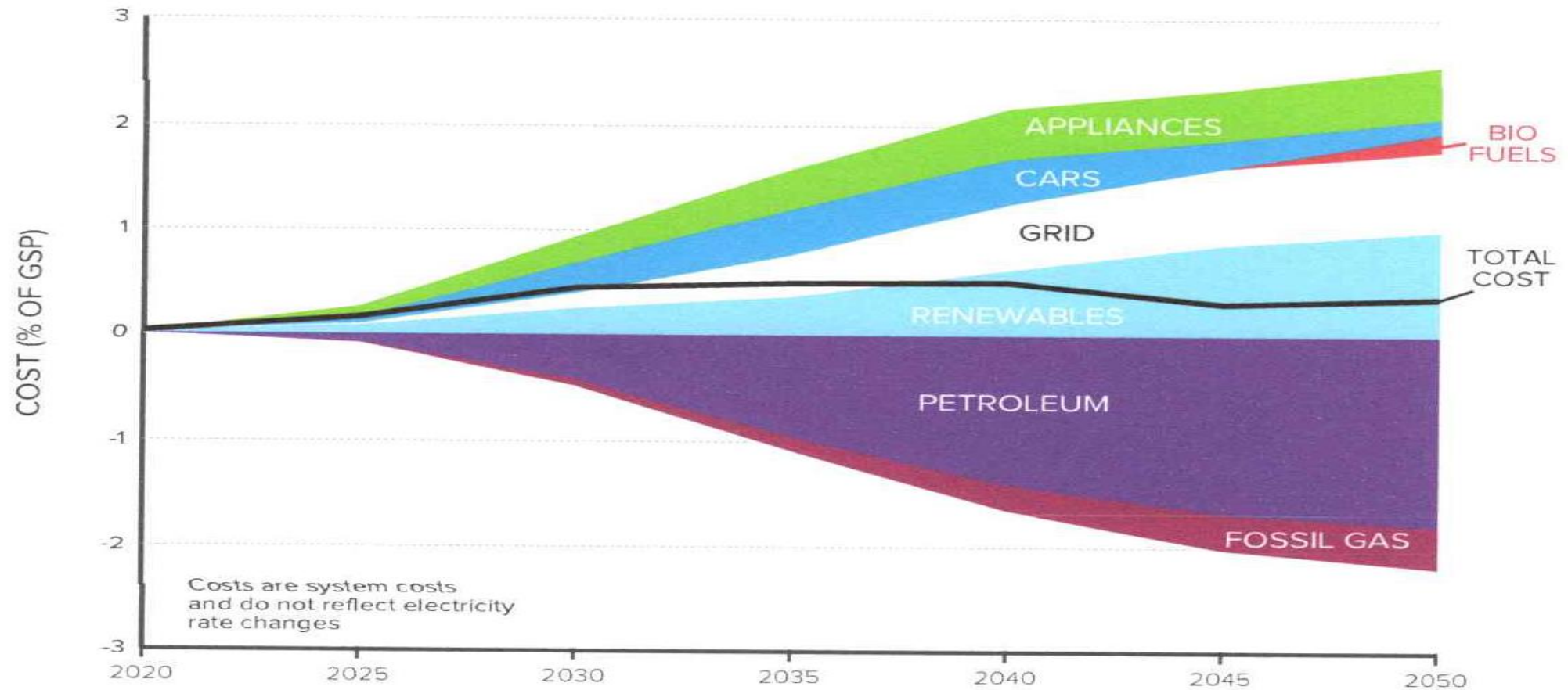


Cost to Electrify the Building and Transportation Sectors Powered by Renewable Energy

FIGURE G.

Incremental and avoided costs in the Least Cost scenario

See call-out box for description of this and similar charts.



The Incremental Cost and Benefits to Electrify the Building and Transportation Sectors Powered by Renewable Energy - Its Cost Effective

\$2B incremental cost in a \$1 T NJ economy or 0.2% increase

Average Annual Energy Cost, 2020-2050



Benefits and Incremental Costs to New Jersey in the Least Cost Scenario



From the 2019 NJ Integrated Energy Plan presentation – Nov 2018

Summary of Key Finding presented by Rocky Mountain Institute

- **New Jersey Can meet the goals of the 2019 EMP for 100% clean energy and 80% reduction in GHG emissions by 2050 with existing technologies**
- **Cost to meet the 2019 EMP goals are relatively small compared to total energy spending and offset by the benefits by 2 to 1**
- **Existing policies reduce GHG emissions but are not enough to achieve the 2019 EMP goals**
- **The least cost energy systems are substantially different from today's energy system**

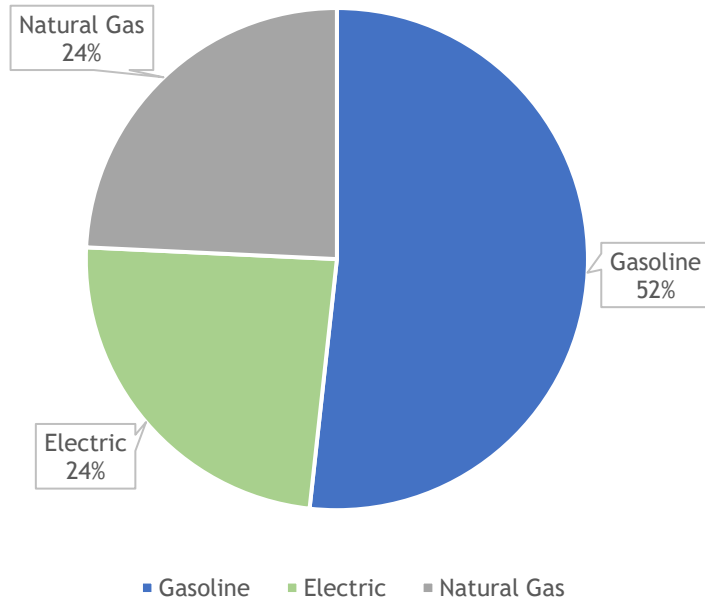
Six Simple Currently Cost Effective (without subsidies) Clean Energy Technologies (EE/RE) that can be Implemented

Incrementally and Integrated -not siloed
to Mitigate Climate Change by Reducing GHG at the HH and Local Level.

- Energy Efficiency - Whole House Weatherization (EE) (high efficiency shell measures)
- Building electrification - Heat pumps - induction stove - LED
- Electric Vehicles (EE) and EV Charging
- On-site Solar (RE) - Community Solar -(Grid scale Renewables -OSW)
- On-site Storage electric and thermal (CE) - (Grid scale storage) -
- Smart Grid - Grid Interactive Efficient Buildings (GEB)

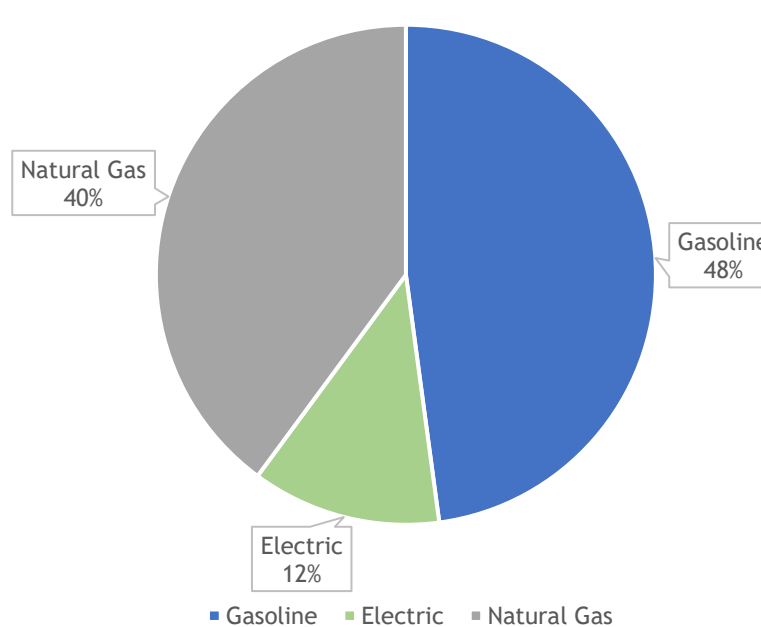
**Average New Jersey Single-Family Home -
 2,400 sq ft 2 cars at 25 mpg
 uses 1,000 gallons of gasoline per year, 1,000 therms of natural gas per year, 9,000 kwh of electricity per year**

Annual HH Energy Cost



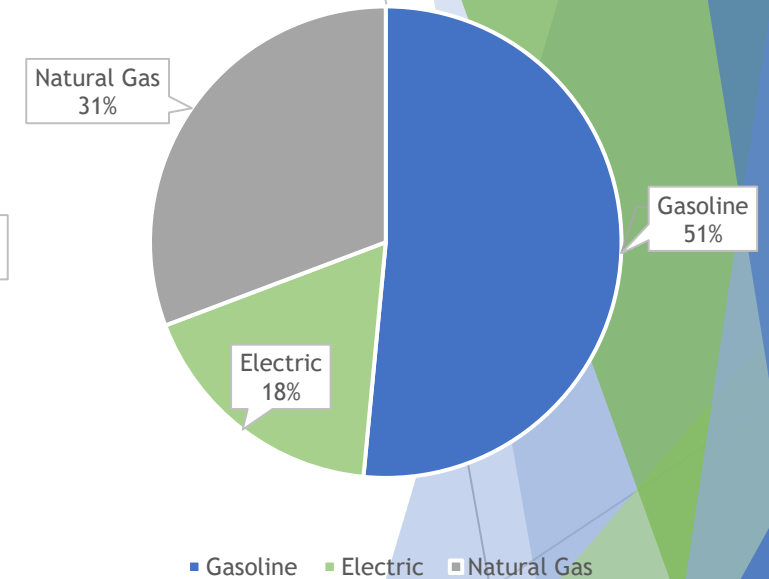
\$6,200

Annual HH Energy usage
 in MM Btus



250 MM Btus

Annual HH CO2 emissions
 In MT



**38,000 lbs.
 17 MT**

The key to reducing energy, cost, and GHG emissions is a plan

Transportation Sector - Going Electric

How to Change the Demand Curve for Oil and Gasoline
to Prevent Future Oil pipelines
Just think Integrated



An EV is about \$10,000 more than an ICEV

An EV is about 4 times more energy-efficient than a similar ICEV (25 mpg vs 03.kWh/mi)

EV is about 3 times lower cost to fuel than a similar ICEV (\$3.5/gal vs \$0.18/kWh)

Per car mag 40% less cost to maintain The EV over 10 years than a similar ICEV including the cost to replace the batteries

3.5 kilowatts (kW) of solar
SPB 10 years w/o incentive 4.5 years -
"free" fuel for 20+ years
Avoiding 4.62 MT of CO2 - (54%<)
Reducing both gasoline and natural gas
demand and emissions and storage solar electricity

MM Btu is a million Btus

Building Sector - Going Electric

How to Change the Demand Curve for Natural Gas to Prevent Future Natural gas pipelines

Start slow and small and build into a movement



Heat Pump water heater is 2 times the cost of an efficient gas water heater

Heat pump water heater uses 3 times less energy than an efficient gas water heater

But costs the same to operate

**1.5 kilowatts (kW) of solar
HPWH + solar = 9 years
Free hot water after that
Avoiding 2.3 MT (13% >) - 67%**

**Reducing natural gas demand in electric and heating sectors
A major advantage is you can store your solar electricity in the HPWH**

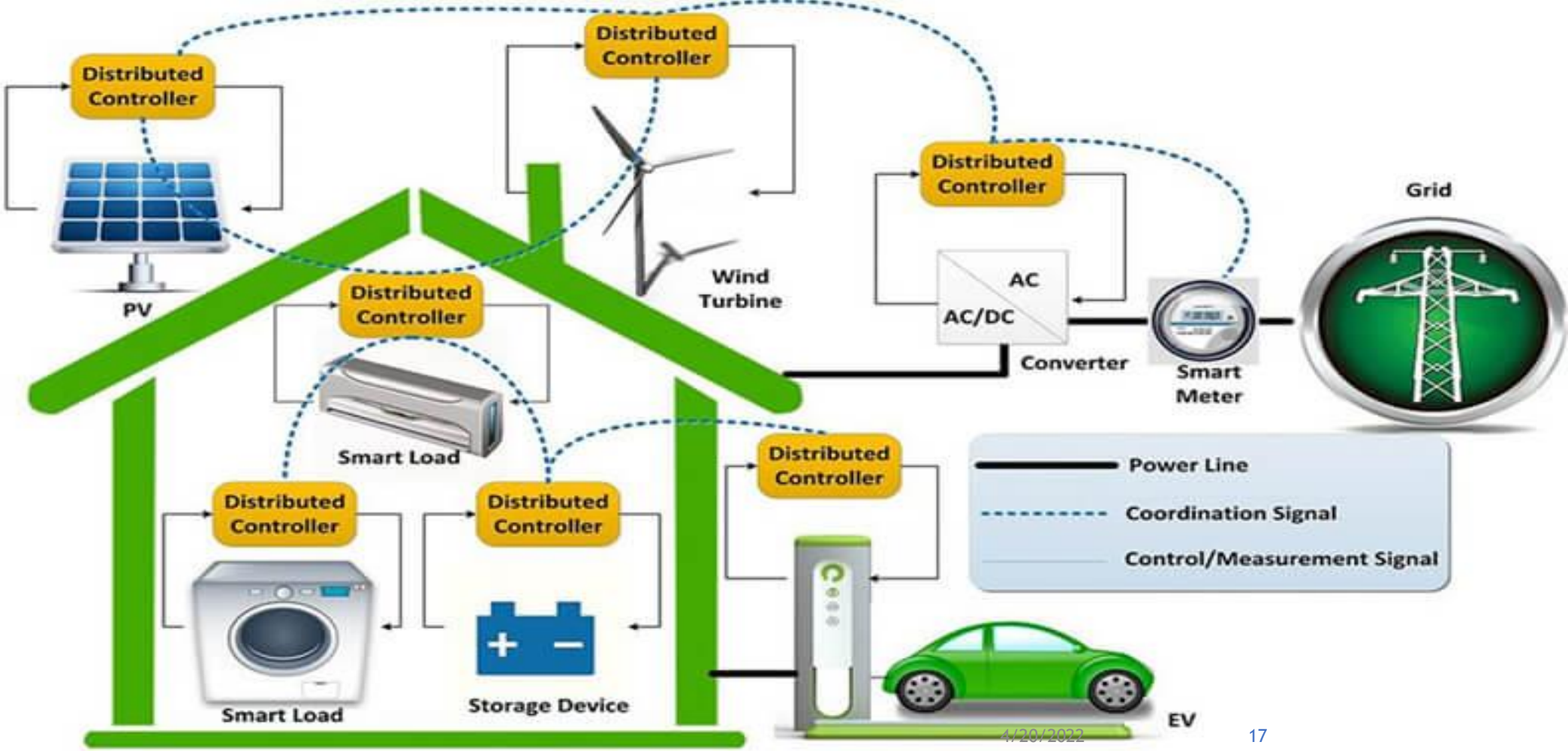
Heat Pump Water Heater

- 1 A fan pulls air through the top air filter.
- 2 Heat in the air is absorbed by eco-friendly refrigerant inside the evaporator coil and cool (dehumidified air) is exhausted.
- 3 Refrigerant is pumped through a compressor, which increases the temperature.
- 4 Simultaneously the cooler water from the bottom of the tank is pumped to the top of the appliance, where it circulates.
- 5 Hot refrigerant transfers its heat to the water inside the condenser coil.
- 6 Heated water is returned back to the top of the tank.
- 7 Condensate drain connection.
- 8 Backup electric heating elements.



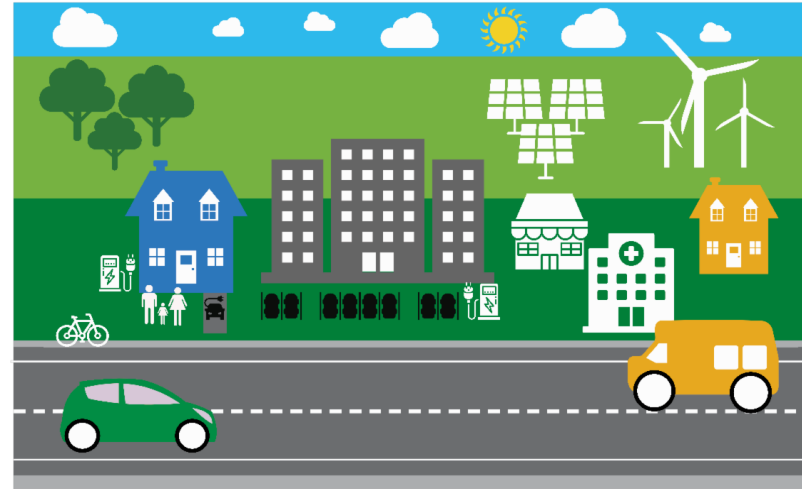
To extend the usability of solar energy

Smart Grid – Grid modernization – Smart Home or Office



How to Implement Energy and Climate Mitigation at a Local Level

Community Energy **Plan** - New Jersey Board of Public Utilities



Sustainable Jersey Guide
for **Sustainable Energy
Communities**



[Community Energy Plans | NJ OCE
Web Site \(njcleanenergy.com\)](https://www.njcleanenergy.com/Community-Energy-Plans)

\$10K per town \$25K OBC
Up to \$250K for implementation

https://www.sustainablejersey.com/fileadmin/media/Actions_and_Certification/Actions/Energy/SJ_Sustainable_Energy_Communities_Guide10_2021.pdf

A SUSTAINABLE JERSEY GUIDE

**Community Energy Plan
Workplan Template**



https://www.sustainablejersey.com/fileadmin/media/Actions_and_Certification/Actions/Energy/Community_Energy_Plan_Workplan_Template10_2021.pdf

4/20/2022

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Aggregated Community-Scale Utility Energy Data for Lawrence Township Mercer County

Municipality	County	Year	Utility	Residential Electricity	Commercial Electricity	Industrial Electricity	Street Lighting Electricity	Total Electricity (kWh)	Utility	Residential Natural Gas	Commercial Natural Gas	Industrial Natural Gas	Street Lighting Natural Gas
Lawrence township	Mercer	2015	PSEG	106,134,154	187,842,638	38,105,296	1,649,698	333,731,786	ETG/PSEG	9,648,317	12,973,782	2,288,252	NDA
Lawrence township	Mercer	2016	PSEG	105,603,678	199,808,852	38,262,441	1,646,646	345,321,617	ETG/PSEG	8,838,046	12,309,951	2,121,839	NDA
Lawrence township	Mercer	2017	PSEG	100,970,931	194,926,118	32,032,660	1,646,096	329,575,805	ETG/PSEG	9,191,212	12,872,924	1,880,139	NDA
Lawrence township	Mercer	2018	PSEG	104,482,043	202,739,946	35,160,031	1,652,724	344,034,744	ETG/PSEG	9,939,680	12,974,053	2,503,676	NDA
Lawrence township	Mercer	2019	PSEG	99,352,338	187,065,495	31,462,578	1,649,129	319,529,540	ETG/PSEG	9,448,441	13,179,329	2,152,911	NDA
Lawrence township	Mercer	2020	PSEG	102,989,913	161,806,084	50,289,084	1,669,701	316,754,782	ETG/PSEG	8,900,888	9,168,669	3,730,152	NDA
Lawrence township	Mercer	2021	PSEG	103,062,151	171,368,117	37,733,814	1,664,212	313,828,294	ETG/PSEG	9,306,149	11,290,947	3,637,900	NDA

Community-Scale Greenhouse Gas (GHG) Emissions - Metric Ton Carbon Dioxide Equivalent (MTCO2e)

Municipality	County	Year	Residential Electricity	Commercial Electricity	Industrial Electricity	Street Lighting Electricity	Residential Natural Gas	Commercial Natural Gas	Industrial Natural Gas	Street Lighting Natural Gas	Other Heating Fuels	On-Road Vehicles
Lawrence township	Mercer	2015	26,881	47,576	9,651	418	51,388	69,100	12,188	NDA	4,451	168,040
Lawrence township	Mercer	2020	22,998	36,131	11,230	373	47,407	48,834	19,867	NDA	3,046	214,346

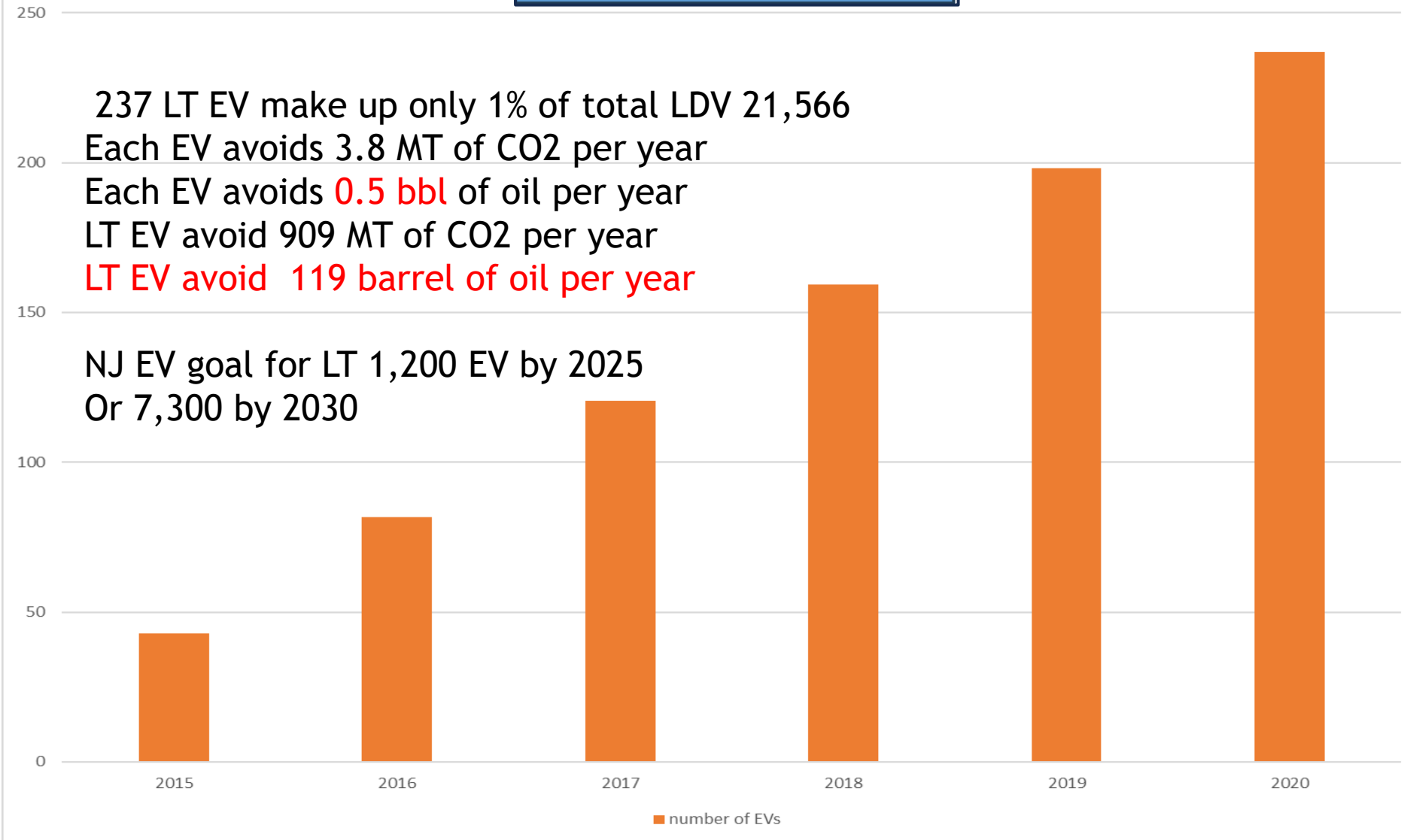
Electric Vehicle (EV) Ownership Data

June 2022

* Further information on Notes sheet

Municipality	County	Year	Total Personal Vehicles	# of EVs	% of EVs
Lawrence township	Mercer	2015	21,570	43	0.20%
Lawrence township	Mercer	2020	21,566	237	1.10%

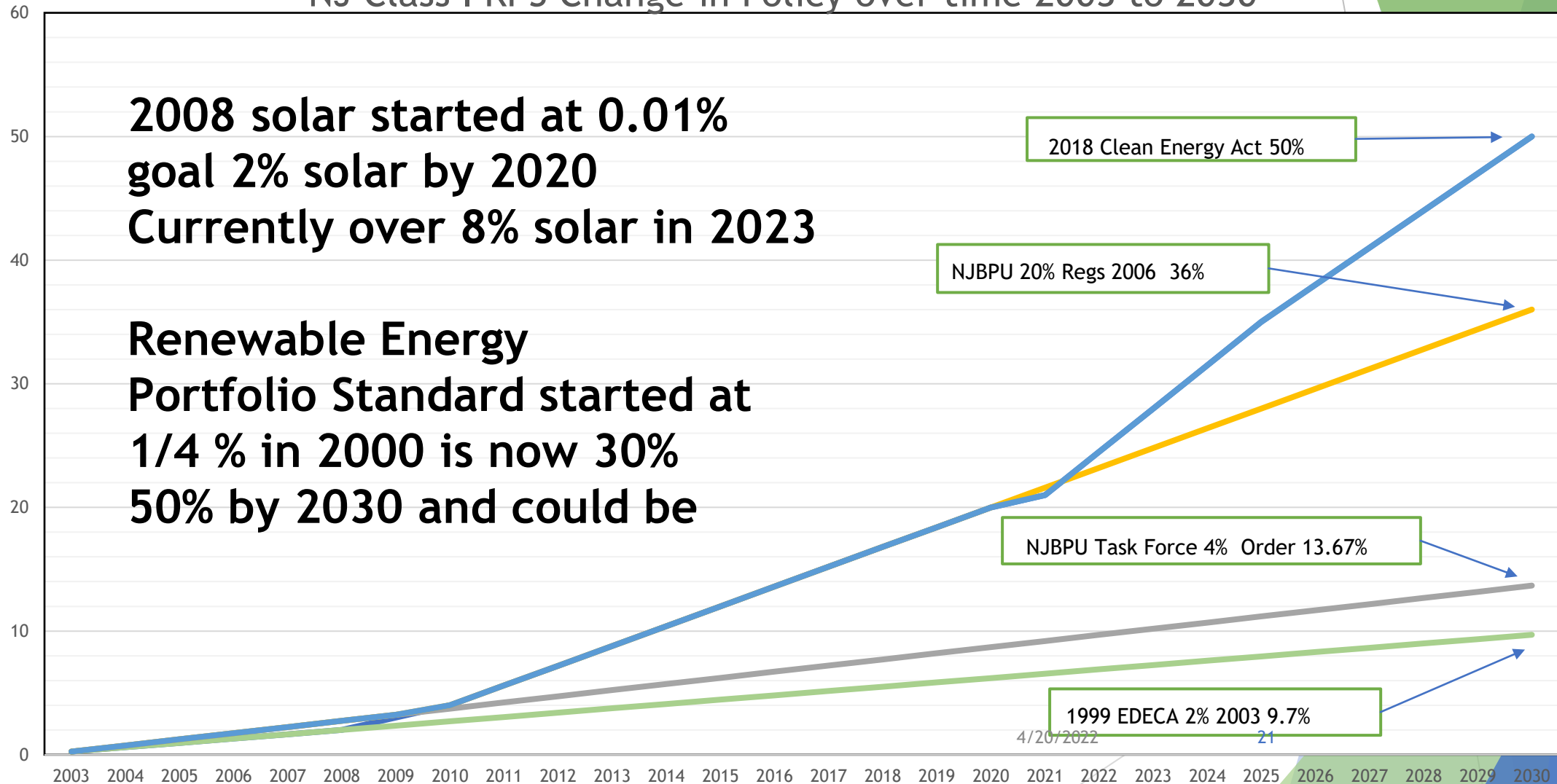
EV in Lawrence Township



How Clean Energy Policy Changes over time – to achieve larger goals

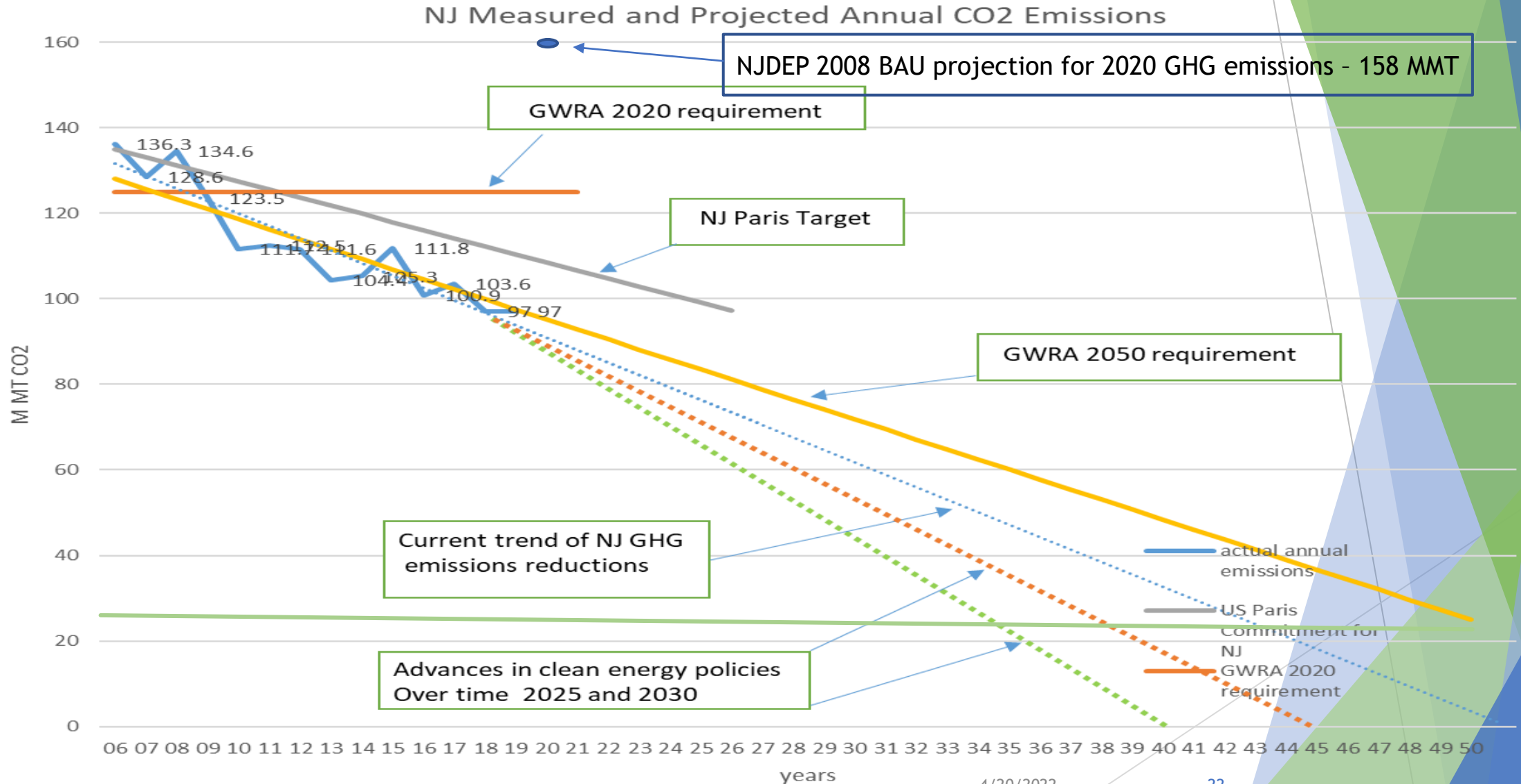
Optimism Curve

NJ Class I RPS Change in Policy over time 2003 to 2030



New Jersey's Progress to achieving its GHG emissions reduction goals and more

Why I'm Optimistic Getting to 50% by 2030 and beyond depends on us



Source for actual data NJDEP GHG emissions Inventory Report https://www.nj.gov/dep/aqes/NJ_GHGinventory2015Update.pdf

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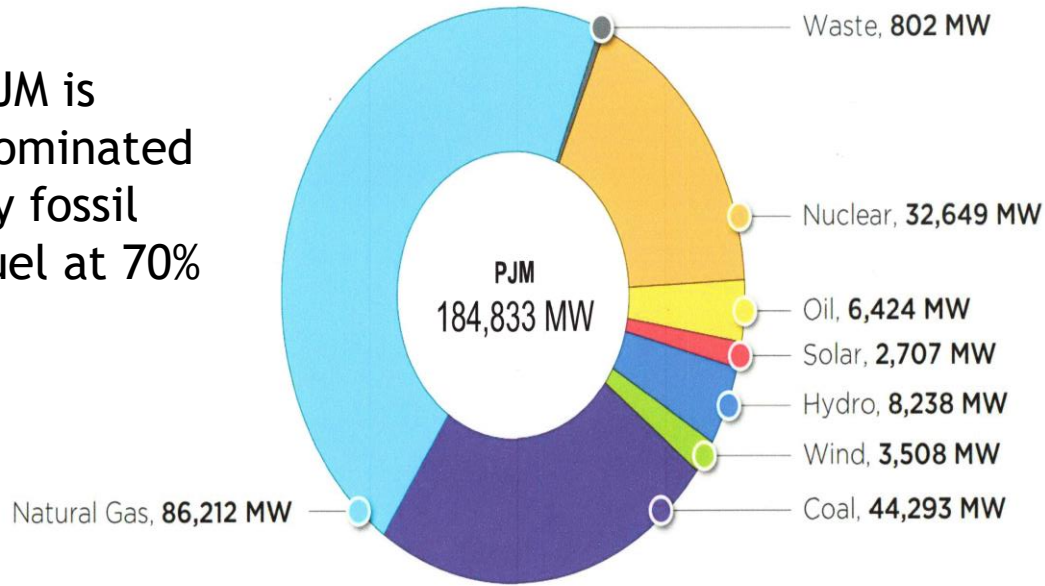
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This is why I am 100% convinced we will get to 100% Clean Energy well before 2050

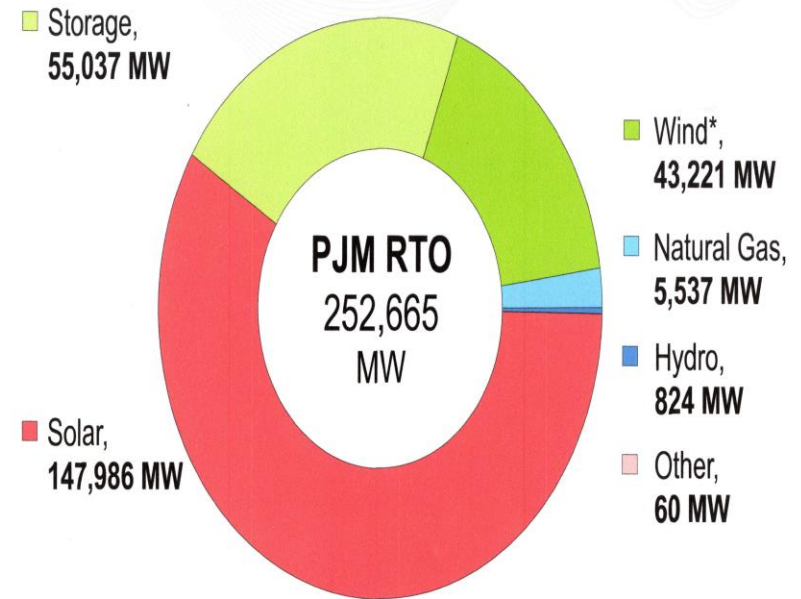


PJM is dominated by fossil fuel at 70%

PJM – Existing Installed Capacity
(CIRs – as of Dec. 31, 2022)



PJM Queued Capacity (Nameplate) by Fuel Type
(*Active* in the PJM Queue as of April 1, 2023)



*Wind includes both onshore and offshore wind

Why we are winning in the Clean Energy Transition And Climate Mitigation

Why Im Optimistic

We'll Get to 100% Clean Energy before 2050

Local Action – Tracking Progress

Thank You – Questions????

Michael Winkra

energy translator

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Additional Slides for reference

Is New Jersey a High Energy Cost State?

The answer is No - we are average at worst

Electricity NJ is ranked 12th highest at \$0.1648 per kWh compared to the US average of \$0.1319 per kWh

Natural Gas NJ is ranked 36st highest at \$1.48 per therms
Compared to the US average of \$1.260 per therms

Gasoline NJ is ranked 28th highest at \$3.41 per gallon
Compared to the US average of \$3.20 per gallon.

<https://www.eia.gov/beta/states/states/nj/overview>

<https://www.eia.gov/beta/states/states/nj/data/dashboard/energy-indicators>

IRA Tax Credits - State Incentives

IRA Clean Vehicles <https://www.irs.gov/clean-vehicle-tax-credits> <https://www.energy.gov/save>

New - Tax credit up to \$7,500 new, qualified plug-in EV or fuel cell electric vehicle (FCV). Based on battery size and where manufactured. Income limits \$300K. Limit of vehicle price.

Used electric vehicle (EV) or fuel cell vehicle (FCV) \$25,000 or less, tax credit equals 30% of the sale price up to a maximum credit of \$4,000. Income limit \$150K. Limits on battery size and vehicle wt.

EV Charging – Personal \$1,000 - Businesses \$100,000

New Jersey

NJDEP <https://dep.nj.gov/drivegreen/>

Sale and used tax exemption on zero emission vehicles

Grants to offset Businesses installation EV charging equipment costs \$750 for Level 1 and \$4,000 for a Level 2

NJBPU <https://chargeup.njcleanenergy.com/home-ev-charger-incentive>

\$250 grant for residential EV charging equipment

Multi unit charger rebates

EV rebates between \$1,500 to \$4,000 depending on the vehicle

EV Charging incentive information is available from [Atlantic City Electric](#), [PSE&G](#), [RECO](#) and [JCP&L](#).

PA – PADEP <https://www.dep.pa.gov/Citizens/GrantsLoansRebates/Alternative-Fuels-Incentive-Grant/Pages/Alternative-Fuel-Vehicles.aspx>

400% of the federal Poverty level – Up to \$3,000 depending on income level and vehicle type

IRA Tax Credits

Home Energy

Primary residents, Renter and second homes used as residents

Energy Efficient Home Improvement Credit -These expenses may qualify [-requirements detailed on energy.gov:](#)

- Exterior doors, windows, skylights and insulation materials
- Central air conditioners, water heaters, furnaces, boilers and heat pumps
- Biomass stoves and boilers
- Home energy audits

Tax credit is a percentage of the total improvement expenses in the year of installation:

- 2022: 30%, up to a lifetime maximum of \$500
- 2023 through 2032: 30%, up to a maximum of \$1,200 (heat pumps, biomass stoves and boilers have a separate annual credit limit of \$2,000), no lifetime limit

Residential Clean Energy Credit These expenses may qualify [requirements detailed on energy.gov:](#)

- Solar, wind and geothermal power generation
- Solar water heaters
- Fuel cells
- Battery storage (beginning in 2023)

The amount of the credit you can take is a percentage of the total improvement expenses in the year of installation:

- 2022 to 2032: 30%, no annual maximum or lifetime limit
- 2033: 26%, no annual maximum or lifetime limit
- 2034: 22%, no annual maximum or lifetime limit

Get details on the [Residential Clean Energy Credit](#).

<https://www.energy.gov/save/home-upgrades>

Act 129 Electric Company Energy Efficiency Programs and Rebates

The Act directs only the state's seven largest electric distribution companies (EDCs) with more than 100,000 customers to provide EE&C plans

FirstEnergy Companies:

Duquesne Light:

PPL Electric:

PECO:

UGI Electric:

Measure		Met-Ed <small>(FirstEnergy Company)</small>	Penn Power <small>(FirstEnergy Company)</small>	West Penn Power <small>(FirstEnergy Company)</small>	Penelec <small>(FirstEnergy Company)</small>	Duquesne	PPL	PECO	UGI
LED Lamps – Regular and Specialty		✓	✓	✓	✓	✓	✓	✓	✓
LED Fixtures		✓	✓	✓	✓	✓	✓	✓	
CFL Lamps		✓	✓	✓	✓	✓		✓	
Energy Efficient Appliances		✓	✓	✓	✓	✓	✓	✓	✓
HVAC Programs		✓	✓	✓	✓	✓	✓	✓	✓
Behavioral Measures		✓	✓	✓	✓	✓	✓	✓	
School Education		✓	✓	✓	✓	✓	✓	✓	✓
Home and Online Energy Efficiency Audits		✓	✓	✓	✓	✓	✓	✓	✓
New Home Construction		✓	✓	✓	✓	✓	✓		
Room Air Conditioner Recycling		✓	✓	✓	✓		✓	✓	✓
Dehumidifier Recycling		✓	✓	✓	✓		✓		
Refrigerator/Freezer Recycling		✓	✓	✓	✓	✓	✓	✓	✓

New Jersey Clean Energy Program. More information on the Clean Energy Program can be found on this [website](#).

NJBPU and NJCEP Administered Programs



- New Construction (residential, commercial, industrial, government)
 - Large Energy Users
 - Energy Savings Improvement Program (financing)
 - State Facilities Initiative*
 - Local Government Energy Audits
 - Combined Heat & Power & Fuel Cells
- *State facilities are also eligible for utility programs

Utility Administered Programs



- Existing buildings (residential, commercial, industrial, government)
Energy Audit
- Efficient Products
 - Lighting & Marketplace
 - HVAC
 - Appliance Rebates
 - Appliance Recycling

What is your **household** Carbon Footprint

The average Single family House (SFH)

Just need to know your **household** annual energy usage

Annual **household** electric use – electric bill

Annual **household** natural gas use – natural gas bill

Annual **household** gasoline use – gasoline bills/mileage

Your **household** CO₂ =

energy usage * emission factor (lbs/unit of energy)

Household Energy use assumptions

2,400 sq ft single family home

Two average fuel economy cars driven the average per year

Gasoline – per EPA/DOE and USDOT-FHWA

13,000 miles/year/vehicle * 2 / 25 miles/gal = 1,000 gals/yr

Natural Gas per EIA average eff - furnace and hot water heater

1,000 therms per year

Electricity per EIA average central AC and lighting

9,000 kWh per years

Gasoline

1,000 gal/yr * 19.6 lbs of CO₂/gal = 19,600 lbs of CO₂/yr

\$3.50/gal * 1,000 gal/yr = \$3,500/yr (3.6% annual cost at medium income)

120,000 Btus per gallon = 120 MM Btus

Natural gas

1,000 therms/yr * 11.7 lbs of CO₂/therms = 11,700 lbs of CO₂/yr

\$1.30/therm * 1,000 therms/yr = \$1,300/yr (1.7%)

100,000 Btu per therm = 100 MM Btus

Electricity

9,000 kWh/year * 0.75 lbs of CO₂/kWh = 6,750 lbs of CO₂/yr

\$0.18/kWh * 9,000 kWh/yr = \$1,620 (1.7%)

3,412 Btu per kWh = 30.7 MM Btus

Total = 38,010 lb of CO₂ / HH or 20 T/HH - \$6,420/yr (6.9%)

Building Sector - Going Electric

How to Change the Demand Curve for Natural Gas to Prevent Future Natural gas pipelines

Start slow and small and build into a movement



GWH = \$1,200

230 therm - 23 million Btus \$340/yr emitting 2.3T

HPWH = \$2,500

2,000 kWh 6.8 million Btus \$330 /yr emitting 0.5T

3 times less energy - Avoiding 1.8 MT of CO2

2,000 kWh /year = 1.5 kilowatts (kW) of solar @ \$3/W = \$3,330 - \$990 = \$2,310

HPWH + solar = 10.5 years (ROI 9.5%)

Avoiding 2.3 T of CO2

Reducing natural gas demand in electric and heating sectors

A major advantage is you can store your solar electricity in the HPWH

Heat Pump Water Heater

- 1 A fan pulls air through the top air filter.
- 2 Heat in the air is absorbed by eco-friendly refrigerant inside the evaporator coil and cool (dehumidified air) is exhausted.
- 3 Refrigerant is pumped through a compressor, which increases the temperature.
- 4 Simultaneously the cooler water from the bottom of the tank is pumped to the top of the appliance, where it circulates.
- 5 Hot refrigerant transfers its heat to the water inside the condenser coil.
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Transportation Sector - Going Electric

How to Change the Demand Curve for Oil and Gasoline
to Prevent Future Oil pipelines

Start slow and small and build into a movement



MM Btu is a million Btus

Used EV for under \$20,000 (+ \$2,000 - level 2 charger)

50 miles RT for 260 days (5 day work week)

An average ICE vehicle

520 gal/ yr - **60.3** MM Btus - **\$1768**/yr.

An average EV

3,900 kWh /yr - **13.3** MM Btu - **\$644**/yr.

4.5 times less energy - **2.7** times less cost

Savings **\$1,124**/yr. avoiding **3.74** MT of CO₂

3,900 kWh / year - **3.5** kilowatts (kW) of solar

@\$2/watt SPB for EV and solar 15 yrs. (ROI

6.7%) - after **4.3** years driving on "free" fuel

Avoiding **4.62** MT of CO₂

Reducing both gasoline and natural gas demand and emissions and storage solar electricity

4/20/2022

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