Exclusive Incenting of Plug-in Electric Vehicle Purchase is a Less Effective and Costly Strategy for Minimizing the CO_2 Emissions Caused by NJ Light Duty Vehicle Travel

(Version 1.3.1)

by
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[2] [3]

ABSTRACT

The NJ Board of Public Utilities has recently approved a $30M per year rebate program that encourages NJ light duty vehicle drivers to purchase and grid-charge higher cost **Plug-in** Hybrid ICE/Electric[4] and All-Electric vehicles at utility ratepayer expense. No incentives are provided, however, to encourage the purchase of lower cost **non-Plug-in** Hybrid ICE/Electric vehicles that achieve equivalent CO_2 emission reduction at less public cost per vehicle, when used by average NJ drivers [5].

I am a Physicist and active NJ Professional Engineer, specializing in Energy, Power, Communication, and Control Systems with 40 years of experience in advanced technology product development and system integration. I have a B.S. degree in Engineering Physics, and M.S. and Ph.D. degrees in Electrical Engineering.

The techno-economic analysis I present in the Appendix supports my claim that incenting the purchase and grid-charging of **Plug-in** electric vehicles has much higher societal cost than incenting the purchase of **non-Plug-in** Hybrid ICE/Electric vehicles. This conclusion assumes that the State's goal is to achieve the highest and fastest reduction of the CO_2 emissions caused by **all** light duty vehicle travel within the state.

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[4] ICE => Internal Combustion Engine
[5] See `https://nj.gov/governor/news/news/562020/approved/20200117b.shtml`

This is especially true, considering that

1. Large **ratepayer-funded incentives** are being paid to NJ residents who purchase a **Plug-in** Electric vehicle, **independent of the number of miles they actually drive each year**[6], while

2. **No federal or NJ incentive** exists to encourage the purchase of a **non-Plug-in** Hybrid ICE/Electric vehicle despite it having a comparable CO_2 footprint as its Plug-in EV counterparts, when driven by average NJ drivers (who statistically drive 13,476 miles per year).

3. Properly incenting higher volume purchase of more affordable Hybrid ICE/Electric vehicles enables a more rapid retirement of existing lower fuel economy ICE vehicles, thereby minimizing the cumulative CO_2 emissions caused by **ALL** NJ light duty vehicle travel over the upcoming years.

4. Incenting **non-Plug-in Hybrid ICE/Electric** vehicle purchase using NJ Societal Benefit funds is justified because **it enables the State to meet its 2030 clean energy goals at least utility ratepayer cost** without having to upgrade regional electric grid infrastructure to deliver major new electric capacity otherwise needed to replace the transport energy now provided by gasoline.

   These non-Plug-in Hybrid ICE/Electric vehicles can be fueled with domestically-sourced E10 gasoline, causing no greater CO_2 emissions/mile than NJ grid-charged Plug-in EVs, when used by the average NJ driver. These same Hybrid ICE/Electric (and **Hybrid Fuel Cell/Electric vehicles**) can consume carbon neutral fuels, when available in the near future, **causing no global warming**, no matter how many miles traveled daily.

   This allows both EDCs (Electric Distribution Companies) and grid power providers to focus on

   > reducing the CO_2 emissions caused by **present heating, cooling, and appliance** electric demand,

   rather than

   > incenting new demand for Plug-in EVs without any restrictions on the use of fossil fuel power plants.

5. **Hybrid ICE/Electric** and **Hybrid Fuel Cell/Electric** technologies are more viable than Battery All-Electric technology for meeting the **light and heavy transport** needs of New Jersey, while reducing the net CO_2 emissions caused by this travel (at much lower ratepayer and truck owner cost).

[6] The average miles one drives in an existing low fuel economy ICE vehicle versus driving the same miles in a replacement electric vehicle determines the expected societal benefit (i.e., averted CO_2 emissions) of substitute travel in the lower CO_2 emissions/mile electric vehicle.

Executive Summary

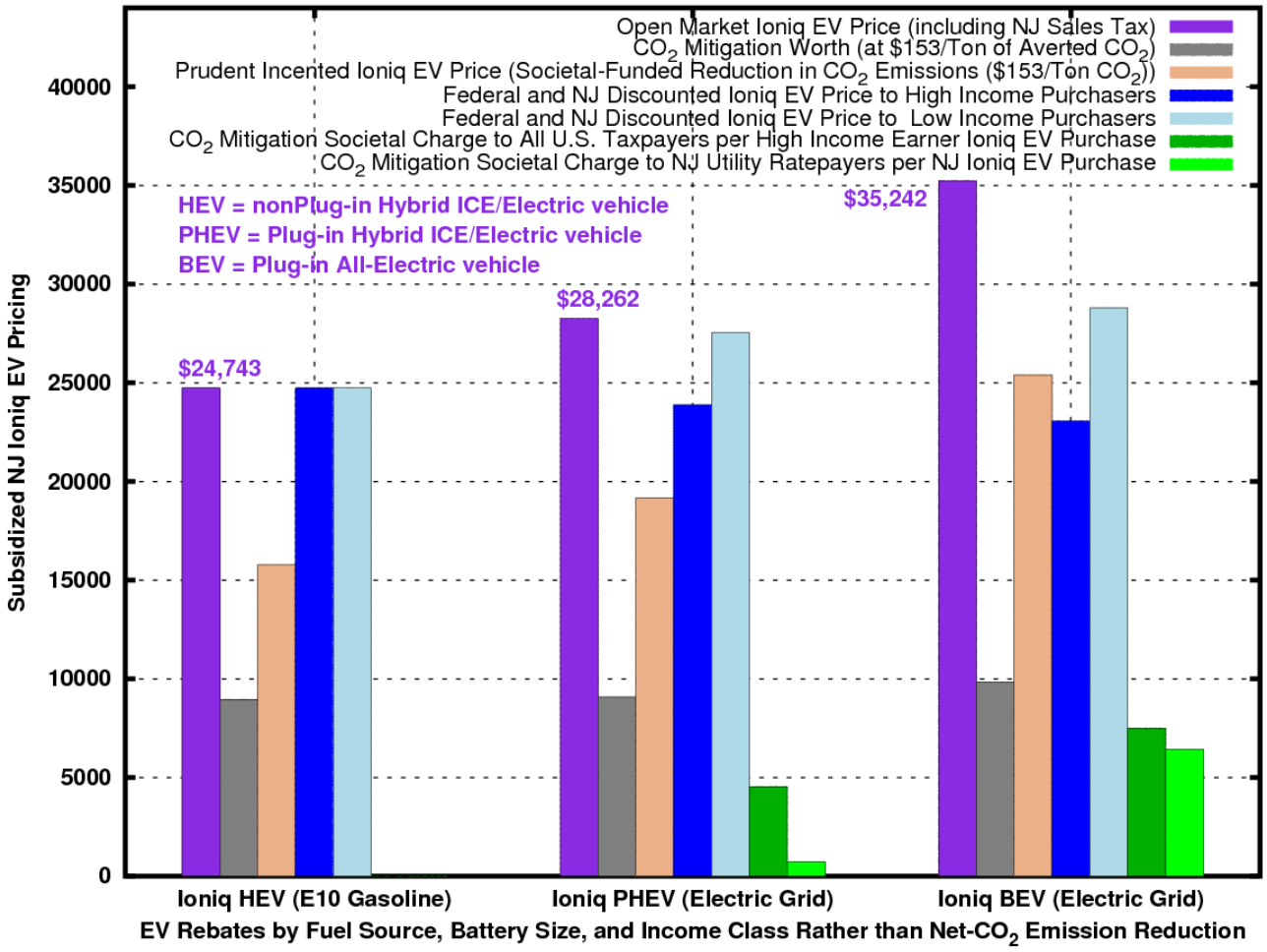


Figure 1: Current Government Incentives for Three Example NJ 2020 Ioniq Electric Vehicle Purchases

Figure 1 is derived from data contained in Table 1 below.

All results are based upon

1. Hyundai Ioniq Electric vehicles being driven by average NJ drivers (i.e., 202,000 miles) over a 15 year period as replacements for their existing 20 MPG E10 gasoline-fueled reference vehicles.

Ioniq Electric [Vehicle Type, Real Cost, Fuel Mix, Battery Capacity]	[Income Bracket, **Final Vehicle Cost** (after Incentives)]	15 Year Societal Cost @ ($153/Ton CO_2)	Federal Tax Credit	NJ Incentives	[Gov't Incentive, **Resultant Averted CO_2 Tax Rate**, Prudent Incentive (@$153/$CO_2$ Ton), **Incentive Disparity**]
Hybrid (ICE/Electric), **$24,743** E10 Gasoline, **1.56 Kw-hrs**	[High Income, **$24,650**]	$4,716, (30.8 tons CO_2)	$0	$0	[$0, **$0/Ton of Averted CO_2**, $8,960, **$8,960 too little**]
Hybrid (ICE/Electric), **$24,743** E10 Gasoline, **1.56 Kw-hrs**	[Low Income, **$24,650**]	$4,716, (30.8 tons CO_2)	$0	$0	[$0, **$0/Ton of Averted CO_2**, $8,960, **$8,960 too little**]
Plug-in Hybrid (ICE/Electric), **$28,262** Grid-electric + E10 Gasoline, **8.9 Kw-hrs**	[High Income, **$22,623**]	$4,595, (29.9 tons CO_2)	$4,543	$725	[$5,268, **$89/Ton of Averted CO_2**, $9,081, **$3,813 too little**]
Plug-in Hybrid (ICE/Electric), **$28,262** Grid-electric + E10 Gasoline, **8.9 Kw-hrs**	[Low Income **$27,431**]	$4,595, (29.9 tons CO_2)	$0	$725	[$725, **$12/Ton of Averted CO_2**, $9,081, **$8,356 too little**]
Plug-in All-Electric, **$35,242**, Grid-electric, **38.3 Kw-hrs**	[High Income, **$21.295**]	$3,840, (25.0 tons CO_2)	$7,500	$2,189 + $4,250 = $6,439	[$13,939, **$216/Ton of Averted CO_2**, $9,836, **$4,103 too much**]
Plug-in All-Electric, **$35,242**, Grid-electric, **38.3 Kw-hrs**	[Low Income, **$28,795**]	$3,840, (25.0 tons CO_2)	$0	$2,189 + $4,250 = $6,439	[$6,439, **$100/Ton of Averted CO_2**, $9,836, **$3,397 too little**]

Table 1: Current EV Incentives Are a Function of Battery Size, Grid Connection, and Income Level Rather than the CO_2 Mitigation Achieved by Competing Vehicle Technology/Fuel Candidates

2. Hyundai Ioniq Plug-in Hybrid and All-Electric vehicles being recharged using the NJ regional electric grid[7].

The Federal-posted EPA fuel economies for these three types of model year 2020 Hyundai Ioniq Electric vehicles can be viewed at

`https://www.fueleconomy.gov/feg/Find.do?action=sbs&id=42243&id=42290&id=42273`

Comparing gray bar heights in Figure 1 for the Ioniq Electric vehicle types listed shows that each averts nearly the same amount of expected CO_2 emission societal damage ($\approx$ **$9,000**) should a 20 MPG gasoline-fueled ICE vehicle be replaced.

Examining all dark and bright green bar heights in Figure 1 show that no incentive exists to encourage NJ drivers to purchase a **non-Plug-in** Ioniq Hybrid/Electric vehicle despite its expected equivalent CO_2 reduction performance and $3,519 and $10,497 cheaper costs (MSRP + sales tax) compared to its Ioniq Plug-in Hybrid ICE/Electric and All-Electric counterparts.

Comparing the dark blue versus light blue bar heights associated with each of the three electric vehicle types demonstrates that the chief benefactors of the joint "**Federal + NJ State Plug-in Only Electric Vehicle Incentive**" are NJ's high income earners, who receive $4,543 and $7,500 more than NJ low income earners [8] towards purchasing an Ioniq Plug-in Hybrid or All-Electric vehicle, respectively.

This is despite the fact that

> **The societal benefit** (i.e., averted CO_2-emissions) **achieved by competing electric vehicles is independent of the income class of the vehicle owner** (for the same miles driven).

Table 1 contains a detailed breakdown of the data used to generate Figure 1. The last column of this table provides the following information:

1. the total societal charge paid by U.S. taxpayers and NJ utility ratepayers per vehicle to purchasers of NJ Hyundai Electric vehicles.
2. the effective "averted CO_2" tax rate that NJ taxpayers and utility ratepayers pay due to these Government incentives,
3. the expected societal benefit (i.e., averted CO_2 damage (@ $153/Ton CO_2)) to accrue from driving these vehicles rather than a reference 20 MPG gasoline vehicle, and

[7] See `https://inets.org/jcpl2019Mix.jpg` and `https://inets.org/jcpl2019Emissions.jpg`.

[8] A low income NJ resident is defined here to be a NJ federal taxpayer whose federal tax liability is zero after personal standard or itemized deductions. A high income NJ resident is defined to be a NJ taxpayer whose federal tax liability, after personal standard or itemized deductions, is at least $7500 for the current year.

4. Government's under (**blue-highlighted**) or over (**red-highlighted**) incenting of EV purchase, based upon a prudent \$153/Ton (averted CO_2 emission) incentive level[9] .

Ioniq Electric Vehicle Type	Average Fuel Mix	15 Year Societal Cost (\$153/Ton CO_2)	Federal Tax Credit	NJ Incentives	[Total Gov't Incentive, **Averted CO_2 Valued** @\$153/Ton]
Plug-in Hybrid (ICE/Electric)	Clean Energy (Solar) + E10 Gasoline	\$1,640	\$4,543	\$725	[\$5,268, **\$12,036**]
Plug-in Battery All Electric	NJ Electric Grid @ (.89 lbs CO_2/Kw-hr)	\$3,840	\$7,500	\$2,189 + \$4,250 = \$6,439	[\$13,939, **\$9,836**]
Plug-in Hybrid (ICE/Electric)	NJ Electric Grid @ (.89 lbs CO_2/Kw-hr) + E10 Gasoline	\$4,595	\$4,543	\$725	[\$5,268, **\$9,081**]
Hybrid (ICE/Electric)	E10 Gasoline (17.7 lbs CO_2/Gallon)	\$4,716	\$0	\$0	[\$0, **\$8,960**]
Plug-in Hybrid (ICE/Electric)	Coal Electric Grid @ (2.10 lbs CO_2/Kw-hr) + E10 Gasoline	\$8,612	\$4,543	\$725	[\$5,268, **\$5,064**]
ICEV@20 MPG	E10 Gasoline	\$13,676	\$0	\$0	[\$0, **\$0**]

Table 2: The Societal Payback from Government-Legislated Plug-in EV Purchase Incentives Depends Heavily upon EV Charging Station Average Fuel Mix

[9] **\$153/Short Ton (CO_2)** is the U.S. Goverment Interagency Working Group's prudent estimate of the present cost of future (2035) CO_2 emissions, given the latest evidence of the increasing probability of extremely damaging ecosystem events caused by escalating atmospheric CO_2 levels.

Column 3 of Table 2 lists the expected societal damage (@ \$153/ton of CO_2 emissions) due to 15 years of average NJ driving (i.e., 202,000 miles) in each of three competing Ioniq electric vehicle types (compared to a reference 20 MPG ICE vehicle), when the new electric capacity required to periodically recharge the Plug-in EV's traction battery is obtained according to three possible future grid fuel mix scenarios:

1. New electric capacity is provided by either autonomous or grid-tied **clean energy power systems** (0 lbs. CO_2 per Mw-hr) emission intensity,
2. New electric capacity continues to be delivered over the electric grid at the **EDC's current emission intensity** (890 lbs. CO_2 per Mw-hr),
3. New electric capacity is delivered over the electric grid using available out-of-state underutilized **coal power plants** (2100 lbs. CO_2 per Mw-hr) emission intensity, or

Comparing Column 3 values in Table 2 illustrates that the Societal benefit payback from a Plug-in Electric vehicle's use is highly dependent upon the CO_2 emission intensity of the energy mix regularly used to charge its traction batteries.

For example, an Ioniq Plug-in Hybrid ICE/Electric vehicle **if regularly charged using grid electricity from a coal power plant** (See the table row containing the gray Fuel Mix cell), is expected to produce \$3896 more CO_2 damage (@ \$153/Ton CO_2) on average over a 15 year lifetime, when compared to using the competing lower cost gasoline-fueled Ioniq Hybrid ICE/Electric vehicle.

On the other hand, the same Ioniq Plug-in Hybrid ICE/Electric vehicle **if regularly charged using clean energy harvested fron on-site solar panels** (See table row containing the green Fuel Mix cell), is expected to produce \$3076 less CO_2 damage (@ \$153/Ton CO_2) on average over a 15 year lifetime, when compared to using the competing lower cost gasoline-fueled Ioniq Hybrid ICE/Electric vehicle.

Lastly, the same Ioniq Plug-in Hybrid ICE/Electric vehicle **if regularly charged using electricity delivered over NJ's present electric grid** (See table row containing the white Fuel Mix cell), is expected cause near identical amounts of CO_2 damage (**\$4,595** versus **\$4,716**) on average over a 15 year lifetime, when compared to using the competing lower cost gasoline-fueled Ioniq Hybrid ICE/Electric vehicle.

Consequently, I urge that utility ratepayers not be charged for the building and operation of grid infrastructure and public EV charging stations whose **new electric grid demand** is either fully or partially met using CO_2 emitting power plants.

RECOMMENDATIONS

The Board of Public Utilities will shortly finalize NJ's 2020 EV Purchase Incentive Program. I urge the Board to take this opportunity to

1. **reapportion Societal Benefit fund use so as to balance out the Federal Tax Credit to EV purchasers that rewards high income and excludes low income earners**. Doing so will result in a combined "Federal + NJ State EV Purchase Incentive" that is based upon expected CO_2 emission reduction, rather than EV buyer income class,

2. **reallocate Societal Benefit funds based upon the achievable CO_2 mitigation of each available electric vehicle technology+fuel source**, rather than incenting only those EV types that promote regional electric grid expansion, and

3. **incent average NJ drivers** to replace their existing ICE vehicles with the **most affordable** Electric vehicles on the market (i.e., **E10 gasoline-fueled Hybrid ICE/Electric vehicles**). Achieving this will most rapidly reduce light duty vehicle CO_2 emissions in New Jersey over the coming 10 years, and at least utility ratepayer cost.

APPENDIX: TECHNO-ECONOMIC ANALYSIS

1 "Averted CO_2" Incentive Cost Metric

If an important use of the Societal Benefit funds collected from all NJ utility ratepayers is to minimize the CO_2 emissions caused by energy consumption within the State, then comparison of the cost vs. benefit of **the expected CO_2 reductions from competing proposed clean energy incentives** should be the metric applied for deciding which possible incentive to adopt.

The statistical metric to be minimized in this analysis is

The Incentive Cost per Ton of Expected "Averted CO_2 Emissions"

that induces a NJ resident to replace his existing heating, cooling, transport, or power system with a system that causes less CO_2 emissions and minimzes the resident's **personal** cost of doing such.

When evaluated using this metric, certain clean energy system candidates will exhibit inferior societal benefit for the incentive required, and consequently should not be heavily-funded by NJ ratepayers.

2 Relevant Facts

1. The average U.S. driver travels

   13,476 miles/year = 365 days x 36.9 miles/day[10]

   in his vehicle. The average NJ driver travels slightly less.

2. U.S. drivers typically keep their cars for 13-17 years before scrapping[11].

3. JCP&L's current charge for NJ residential class grid electricity is $0.15/Kw-hr.

4. The power plant CO_2 emissions caused per unit of NJ electric by JCP&L is .443 tons/Mw-hr.

5. The current NJ cost of E10 regular gasoline is $2.40/gallon.

6. The fossil CO_2 emissions per gallon of E10 gasoline combustion is 17.7 lbs.

7. One Gasoline Gallon Equivalent (GGe) of energy is 33.4 Kw-hrs.

[10] See `https://www.metromile.com/blog/2018-year-review/`.
[11] See `https://berla.co/average-us-vehicle-lifespan/`

3 Opportunity to Accurately Compare Three Electric Vehicle Technologies

Estimating the relative societal value of competing electric vehicle technologies/fueling choices is more accurate when such comparisons are made using competing implementations from the same manufacturer, for the same car model.

Three competing Hyundai Ioniq electric vehicle offerings provide such an opportunity:

1. the 2020 Hybrid ICE/Electric Ioniq Vehicle (**$23,200**),
2. the 2020 Plug-in Hybrid ICE/Electric Ioniq Vehicle (**$26,500**), and
3. the 2020 All-Electric Ioniq Vehicle (**$33,045**),

The EPA-measured fuel economies for these three vehicles can be viewed at[12]

`https://www.fueleconomy.gov/feg/Find.do?action=sbs&id=42243&id=42290&id=42273`

[12]Once at this site, If you further select the “Energy and Environment" tab, you will be presented with a comparison of the projected CO_2 emissions of the three Ioniq electric vehicle models, for the case where the plug-in vehicles are charged only with clean electricity (i.e., 0 lbs CO_2/Kw-hr), rather than electricity from New Jersey’s electric grid (i.e., 0.89 lbs CO_2/kw-hr). This analysis calculates and discusses the real CO_2 footprint of these plug-in EVs when charged by the NJ electric grid without restriction on the use of fossil fuel power plants.

4 CO_2 Emissions Due to Electric Grid Charging of Plug-in EVs

Jersey Central Power & Light is the second largest Electric Distribution Company (EDC) in the State[13].

Figure 2 is Jersey Central Power & Light's declaration of the **average fuel mix** used to produce the electricity delivered to its NJ residential customers between June 1, 2018 and May 30, 2019

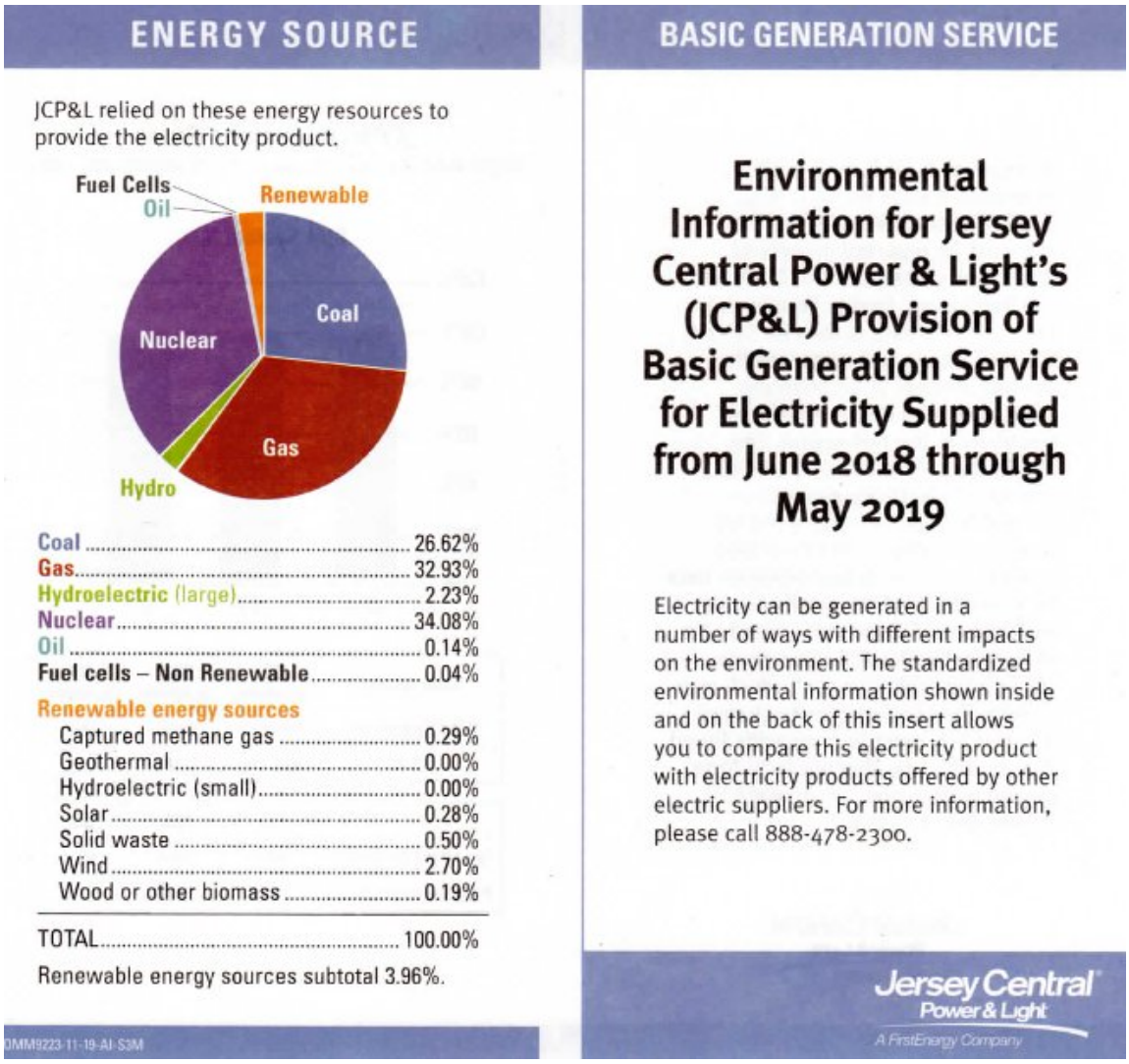
The figure reveals these power plant statistics for the electricity delivered to NJ customers:

59.7% was produced by **CO_2-emitting** fossil fuel power plants,

34.1% was produced by **carbon-free** nuclear power plants, and

6.2% was produced by **carbon-free** (2.2% hydroelectric) renewable energy sources.

[13] See
https://njcleanenergy.com/main/public-reports-and-library/links/electric-utilities-territory-map



ENERGY SOURCE

JCP&L relied on these energy resources to provide the electricity product.

Coal	26.62%
Gas	32.93%
Hydroelectric (large)	2.23%
Nuclear	34.08%
Oil	0.14%
Fuel cells – Non Renewable	0.04%
Renewable energy sources	
Captured methane gas	0.29%
Geothermal	0.00%
Hydroelectric (small)	0.00%
Solar	0.28%
Solid waste	0.50%
Wind	2.70%
Wood or other biomass	0.19%
TOTAL	100.00%

Renewable energy sources subtotal 3.96%.

DMM9223-11-19-AI-S3M

BASIC GENERATION SERVICE

Environmental Information for Jersey Central Power & Light's (JCP&L) Provision of Basic Generation Service for Electricity Supplied from June 2018 through May 2019

Electricity can be generated in a number of ways with different impacts on the environment. The standardized environmental information shown inside and on the back of this insert allows you to compare this electricity product with electricity products offered by other electric suppliers. For more information, please call 888-478-2300.

Jersey Central Power & Light
A FirstEnergy Company

Figure 2: JCP&L Fuel Mix for Producing NJ Ratepayer Electricity (June 2018 thru May, 2019)

Figure 3 is Jersey Central Power & Light's companion declaration of the **CO_2 emissions** associated with the production and delivery of this electricity to its NJ customers.

This JCP&L chart reveals that

886 lbs = .443 tons of CO_2

was emitted per Mw-hr of NJ grid electric distribution during that time.

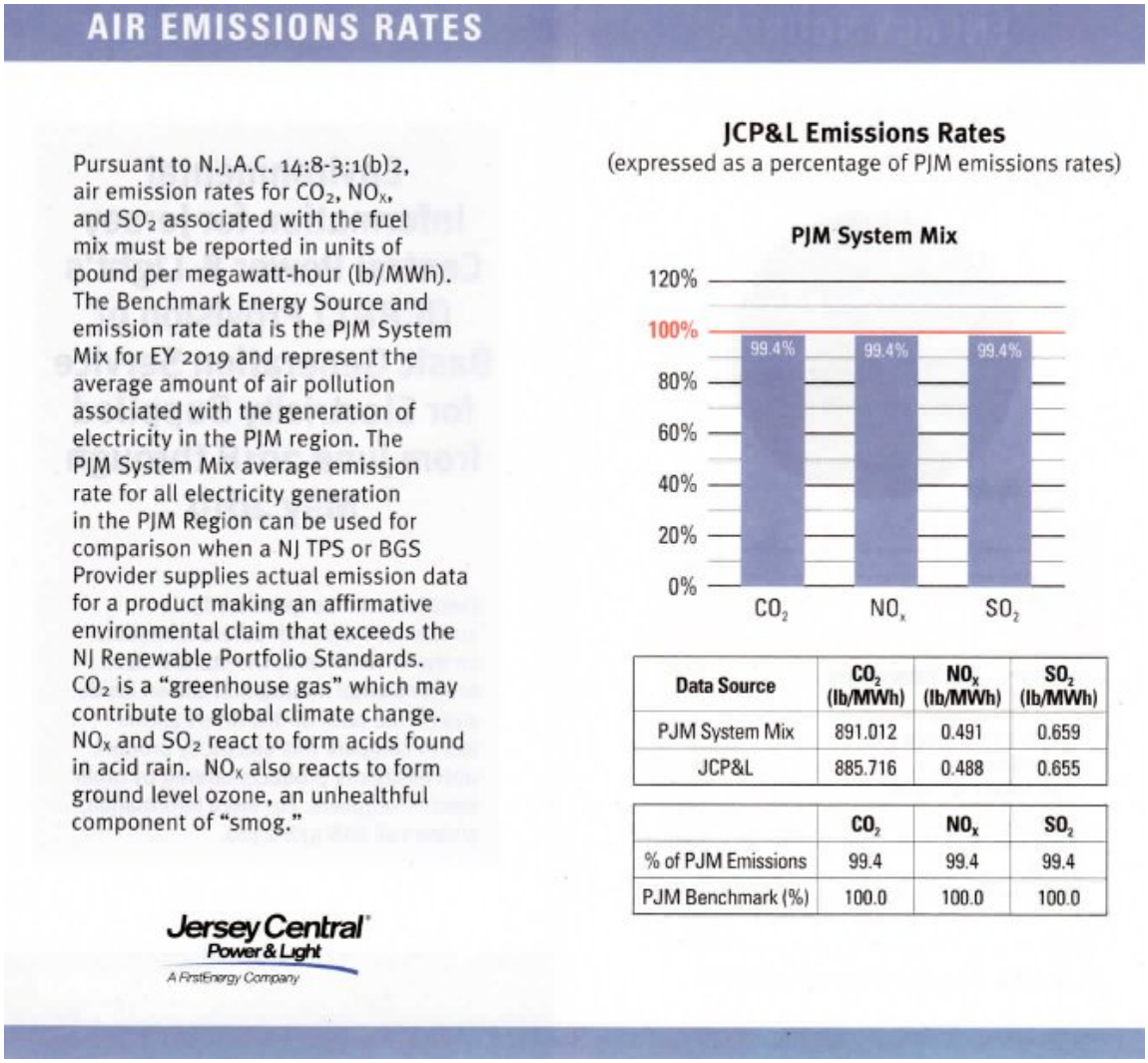


Figure 3: JCP&L's Corresponding Grid Electric Emission Intensity Declaration

5 2020 Ioniq Plug-in Hybrid ICE/Electric vehicle ($26,500)

The Hyundai Ioniq Plug-in Hybrid ICE/Electric vehicle is equipped with an 8.9 Kw-hr lithium-ion battery capable of powering 29 miles of all-electric vehicle travel. [14]

At $25 per mile of all-electric range, NJ State will pay each NJ purchaser of this vehicle

$725

from public State funds as an incentive to purchase[15].

The average U.S. driver travels

36.9 miles per day[16]

in his vehicle, while the average NJ driver travels slightly less.

Electric vehicles (both hybrid and all-electric) are designed to protect traction batteries from complete discharge. Assuming that EV traction batteries are normally not allowed to deplete more than 80% of their full capacities, the effective daily all-electric travel range of the Ioniq Plug-in Hybrid ICE/Electric vehicle is realistically

25.4 miles/day[17].

based upon 119 MPGe all-electric fuel economy.

The remaining

11.5 miles/day

of average NJ driver daily travel is fueled by gasoline using (hybrid ICE/electric) power at 52 MPG fuel economy.

If the Ioniq Plug-in Hybrid vehicle owner recharges his EV traction battery nightly using grid electricity, he is expected to consume

43.3 Mw-hrs[18]

[14] The actual range of this Ioniq vehicle is 630 miles when powered by both available battery and gasoline energy
[15] per NJ State Legislation S-2252 (P.L.2019, c.362)
[16] 36.9 miles/day = (13,476 miles/year)/(365 days/year)
[17] 25.4 miles = 119 MPGe x (.8 x 8.9 Kw-hr/(33.4 Kw-hr/Gge))
[18] 43.3 Mw-hrs = 15 yrs x 365 days/yr x (.8 x 8.9 Kw-hrs per day/.9 efficiency)

of grid electricity over the vehicle's expected 202,000 mile, 15 year lifetime.

At $0.15/Kw-hr current residential electricity rate, this is expected to cost the driver

$1.19/day .

During this same 15 year period,

1211 gallons (i.e., .221 gallons/day) of E10 gasoline[19]

will be burnt to power the EV during the same 202,000 miles of expected travel.

At an average NJ pump price of

$2.40/gallon (E10 regular gasoline),

this equates to an additional

$0.53/day gasoline cost,

yielding a combined total fuel cost of

$1.72/day

The CO_2 emissions caused by grid electric charging of the Ioniq vehicle over its estimated 15 year, 202,000 mile lifespan is

19.2 CO_2 tons[20] = 43.3 Mw-hrs x .443 tons/Mw-hr,

while another

10.7 CO_2 tons of emissions[21]

is emitted while combusting on-board gasoline.

Consequently, the total lifetime CO_2 emissions from traveling 202,000 miles in NJ using this Plug-in Hybrid ICE/Electric vehicle is expected to be

29.9 CO_2 tons

[19] 1211 gallons = 15 yrs*(365 days/yr)*(11.5 miles/day)/52 MPG

[20] These CO_2 emissions occur at the power plants producing the electricity to charge the EV, but not at the EV.

[21] 10.7 CO_2 tons = 1211 gallons x (17.7 CO_2 lbs/gallon)/(2000 lbs/ton).

6 2020 Ioniq Hybrid ICE/Electric vehicle ($23,200)

The Ioniq Hybrid contains a 1.56 Kw-hr lithium-ion battery capable of powering 5 miles of all-electric travel via its battery + electric motor drive train.

At $25/mile State rebate per mile of all-electric range, **NJ State should pay**

$125

to NJ residents who purchase this Hybrid ICE/Electric vehicle, **but does not**. Both NJ State and the Federal government fails to incent the hybrid ICE/Electric vehicle's

1. harvesting and transforming of clean vehicle kinetic energy into traction battery chemical energy by means of regenerative deceleration and braking, and
2. the use of this harvested clean energy to power the electric drive motor.

The Ioniq Hybrid has EPA-rated 58 MPG fuel economy and 655 mile travel range between refills.

If this vehicle is purchased and used by the average NJ driver, he will drive 202,000 miles over an expected 15 year lifetime, and consume

3,483 gallons[22]

of E10 gasoline, at an expected fuel cost of

$1.53/day[23]

and 15 year lifetime ICE CO_2 emissions of

30.8 CO_2 tons[24]

compared to

$1.72/day fuel cost, and 29.9 CO_2 tons of emissions[25]

of equidistance travel in the grid-charged Ioniq Plug-in Hybrid vehicle.

[22] 3,483 gallons = 202,000 miles/58 MPG.

[23] $1.53/day = (36.9 miles/58 MPG) x $2.40/gallon

[24] 30.8 CO_2 tons = (17.7 lbs/gallon) x 3,483 gallons / (2000 lbs/ton)

[25] 19.2 tons of these CO_2 emissions do not occur at car, but rather at the fossil fuel power plants that participated in plug-in EV charging.

7 2020 Ioniq All-Electric vehicle ($33,045)

The All-Electric version (BEV) of the Hyundai Ioniq is equipped with a 38.3 Kw-hr lithium-ion battery pack that can power 170 miles of electric travel.

At $25 State rebate per mile of all-electric range, a NJ resident who purchases this vehicle will receive

$4250

from the State.

This car's traction battery will be recharged at least once every 136 miles[26] of vehicle travel. If purchased and used by the average NJ driver, the BEV need only be recharged once every three days in order to keep its traction battery from discharging more than 65% of its capacity.

However, if this average NJ driver has the ability to recharge his BEV at home, he need only top off its battery with 10.3 Kw-hrs (28% of its capacity) nightly, requiring much less frequent use of public DC Fast charging stations now legislated for construction[27].

If the average NJ driver purchases and uses his Ioniq all-electric Ioniq vehicle over its estimated 15 year useful lifetime, he will have driven 202,000 miles powered by battery chemical energy.

At 133 MPGge fuel economy,

1519 GGe[28]

of battery-stored chemical energy is needed to drive these miles.

Assuming that on-site charging of the traction battery occurs at 90% efficiency,

56.4 Mw-hrs[29]

of on-site electricity is cumulatively required to provide this chemical energy over the vehicle's 15 year lifetime.

If the traction battery is charged only using clean energy sources,

[26] 136 miles = .8 x 170 miles

[27] On January 17, 2020, Governor Murphy signed S-2252 into law (N.J.S.A. 48:25-1), which establishes a Statewide public plug-in electric vehicle charging system. The bill directs a working group of the Board of Public Utilities, the Department of Environmental Protection, the Department of Transportation, the New Jersey Transit Corporation, the New Jersey Turnpike Authority, the South Jersey Transportation Authority, and the Department of Community Affairs to develop a Statewide plan for installing at least 400 public DC fast chargers and 1000 Level Two publicly-accessible chargers across New Jersey by December 31, 2025.

[28] 1519 GGe = 202,000 miles/133 MPGe

[29] 56.4 Mw-hrs = 1519 GGe x ((33.4 Kw-hrs/GGe)/.9)

no CO_2 emissions

will occur.

If the traction battery is charged instead using the NJ regional electric grid (at current CO_2 emission intensity),

25.0 CO_2 tons[30]

of emissions will occur at the fossil fuel power plants providing portions of this electricity.

The daily cost of the grid electric energy needed to recharge the Ioniq BEV's traction battery @13,476 miles/year vehicle travel is

$1.55/day[31]

[30] 25.0 CO_2 tons = (.443 CO_2 tons/Mw-hr) x 56.4 Mw-hrs