

Renewable Transportation on Martha's Vineyard



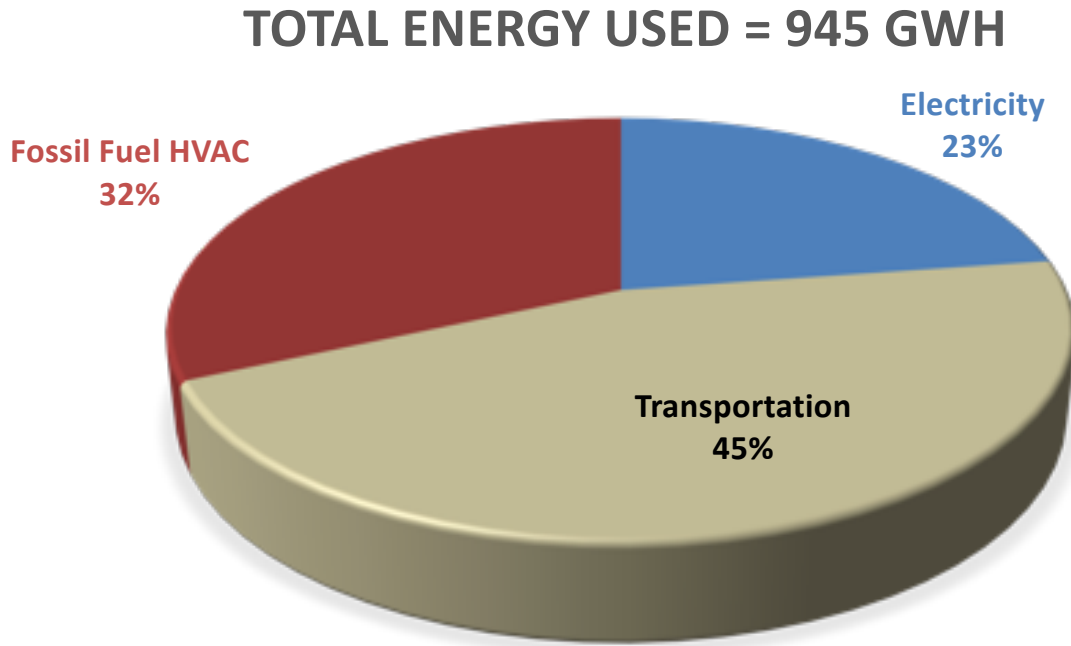
Erik Peckar Tom Soldini Alan Strahler

February 2020

2020 is a Turning Point for Transportation

- The challenge in replacing fossil fuels in transportation has been energy storage and charging.
- Most of the technologies and solutions are available now, either in mass production or early deployment.
- The economics of renewable transportation have caught up to fossil fuels.
- Vehicle/vessel/aircraft lifetimes are long.
 - Transitioning the current fleets will take 10-20 years.
 - Planning must begin now!

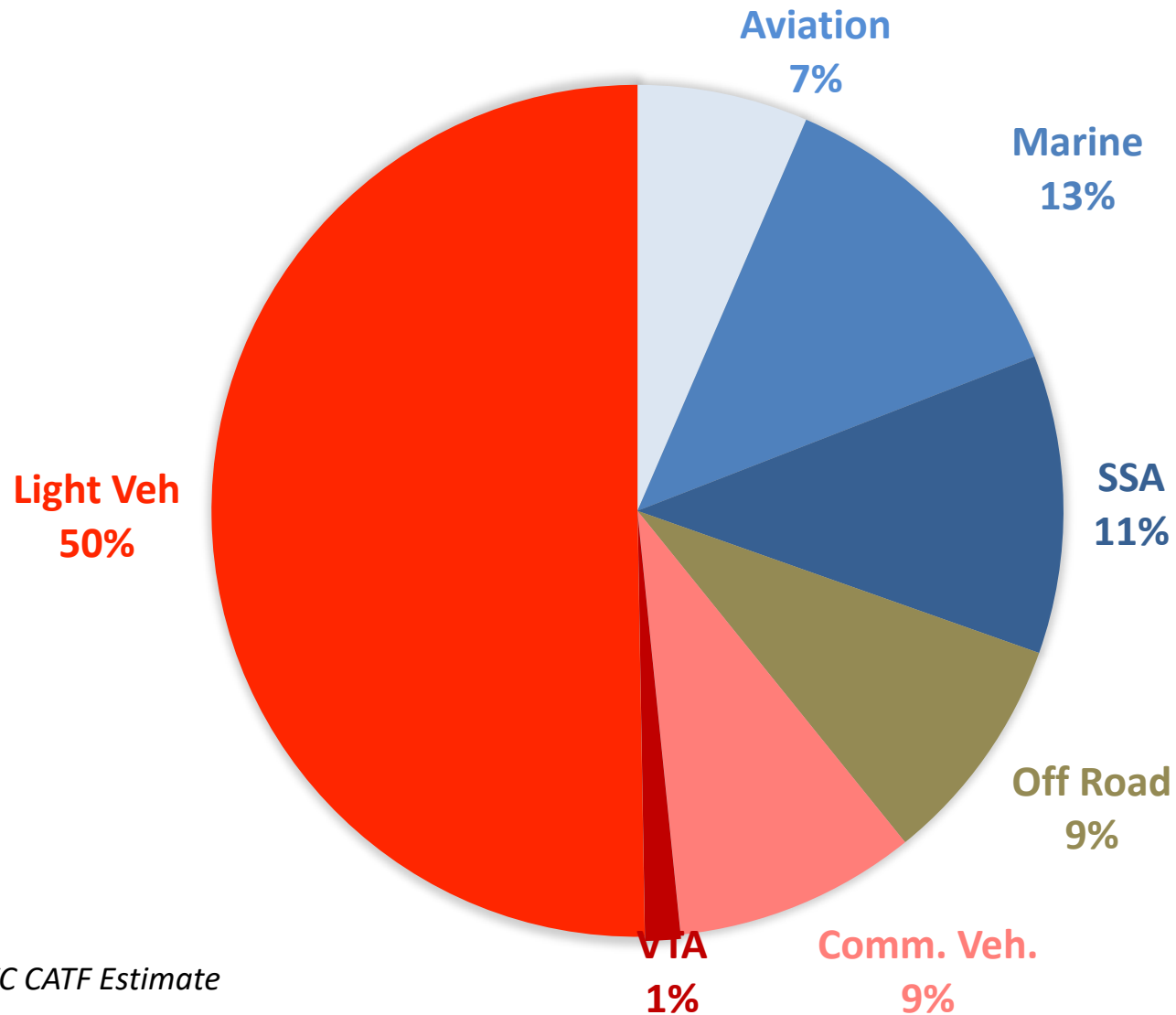
MV Energy Baseline 2018 (GWh)



Source: MVC CATF Estimate

MV CO₂ Emissions from Transportation in 2018

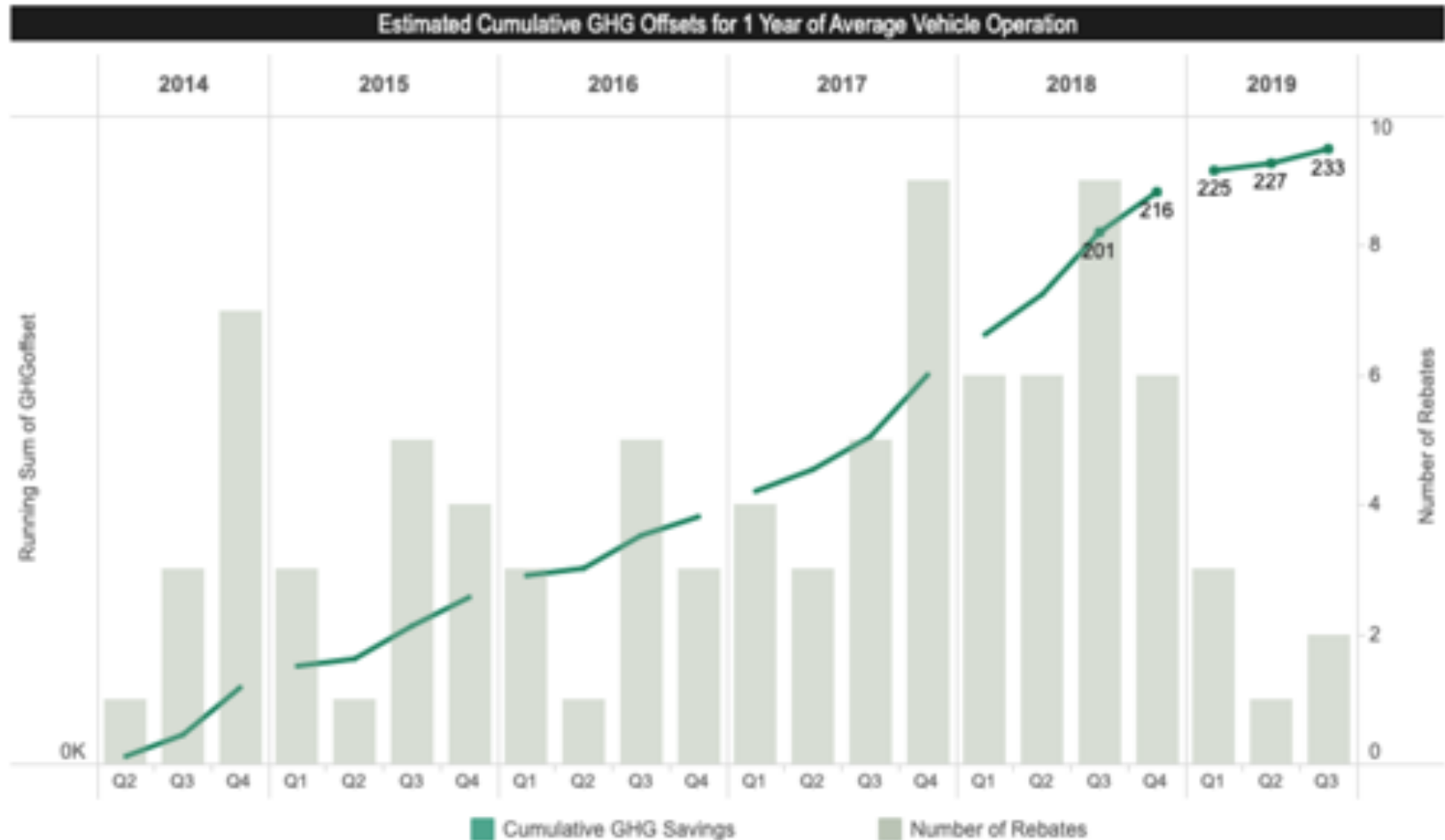
Total = 115,792 Metric Tonnes CO₂



Source: MVC CATF Estimate

Electric Vehicles

Dukes County Snapshot Continued – Emissions



Cumulative GHG savings is in Metric tons

According to EPA 233 metric tons of GHG is equivalent to the CO2 emissions of 26,218 gallons of gas consumed - <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Electric Vehicles Have Arrived – What's Available Today?

All Electric Vehicles sorted by electric range



Tesla Model S
Starting at \$78,000
285–370 miles



Tesla Model X
Starting at \$83,000
250–325 miles



Tesla Model 3
Starting at \$39,900
240–310 miles



Hyundai Kona Electric
\$36,950
258 miles



Kia Niro EV
\$38,500
239 miles



Chevrolet Bolt EV
\$36,620
238 miles



Jaguar I-PACE
\$69,500
234 miles



Nissan LEAF
Starting at \$29,990
150–226 miles



Audi e-tron
\$74,800
204 miles



BMW i3
\$44,450
153 miles



Volkswagen e-Golf
\$31,895
125 miles



Hyundai Ioniq Electric
\$30,315
124 miles



Kia Soul EV
\$33,950
111 miles



Honda Clarity Electric
\$199/mo. lease only
89 miles



Fiat 500e
\$32,995
84 miles



Smart EQ fortwo
\$23,900
58 miles

Plug-In Hybrid Vehicles sorted by electric range



BMW i3 REX
\$48,300
153 / 200



Chevrolet Volt
\$33,520
53 / 420



Honda Clarity Plug-In
\$33,400
48 / 340



Chrysler Pacifica Hybrid
\$39,995
32 / 520



Cadillac CT6 Plug-In
\$75,095
31 / 430



Hyundai Ioniq Plug-In
\$26,350
29 / 630



Kia Optima Plug-In
\$35,390
29 / 610



Ford Fusion Energi
\$34,595
26 / 610



Kia Niro Plug-In
\$28,500
26 / 560



Toyota Prius Prime
\$27,350
25 / 640



Mitsubishi Outlander
\$34,595
22 / 310



Volvo S90 T8 Plug-In
\$63,900
21 / 490



Volvo XC90 T8 Plug-In
\$67,000
19 / 380



Volvo XC60 T8 Plug-In
\$55,300
18 / 370



BMW i8
\$147,500
18 / 320



Subaru Crosstrek Hybrid
\$34,995
17 / 480



Porsche Panamera E-Hybrid
\$102,900
16 / 480



Audi A3 e-tron
\$39,500
16 / 400



BMW 530e
\$63,400
16 / 370



Porsche Cayenne E-Hybrid
\$79,900
14 / 490



BMW 330e
\$45,600
14 / 350



Mini Cooper Countryman
\$36,900
12 / 270



Mercedes GLE 550e
\$66,700
10 / 460



Mercedes GLC 350e
\$50,650
9 / 410

- 16 all battery electric vehicles (BEV) models available
- 24 plug-in hybrid (PHEV) available

What's Available Tomorrow 2020/2021?



- BMW i4
 - Cost \$70k
 - 300 mile range; 0-60 in < 4 seconds
- Ford Mustang Mach – E
 - Cost \$44k - \$61k
 - Optional AWD
- Mercedes EQC
 - Cost \$70k
 - Electric SUV
- Mini Electric
 - Cost \$30k
 - 110 mile range
- Polestar 2
 - \$63k
 - Owned by Volvo
 - Range 275miles
- Tesla Model Y
 - \$48k - \$61k
- Volvo XC 40 Recharge
 - All electric SUV – 200mi range

Pick Up Trucks and SUVs

- Rivian R1T
 - \$69,000
 - 400+ mile range
 - Late 2020 release
 - 750 horsepower
 - Flexible skateboard chassis
- Tesla Cybertruck –
 - \$40 – \$70,000
 - 250 - 500+ mile range
 - Late 2021 release – RWD version
 - 800 Horsepower
- Electric Ford F-150
 - Will use Rivian platform
 - 300 mile + range
 - Price TBD – likely similar to Rivian
 - 2021?
- GMC Hummer
 - Fall 2020?
 - 0-60 in 3 seconds



- Lordstown Endurance
- Bollinger B2

Electric Vehicle Incentives – MA & Dukes County Snapshot

- Federal Incentives
 - \$7500 federal tax credit for new BEVs and PHEV
 - Availability depends on model purchased
 - Will phase out to 50% of the full amount once manufacturer has reached 200,000 vehicles sold
- MA State Incentives
 - MA Offers Rebates for Electric Vehicles (MOR - EV)
 - \$2500 cash rebate for the purchase or lease of BEV
 - \$1500 for PHEV
 - \$27M available in 2020 and 2021
 - Began in 2014

Rebates by Vehicle Make	
Smart	24
Tesla	17
Chevrolet	12
Nissan	8
Kia	6
BMW	5
Ford	4
Volkswagen	4
Honda	3
Mercedes-Benz	2
Mitsubishi	2
Zero	2
Hyundai	1
Toyota	1
Volvo	1

Rebates Reserved & Issued	
BEV	70
PHEV+	9
PHEV	11
ZEM	2
Grand Total	92

Top EV Retailers by Rebates		
Dealer or Store	City	
Tesla Motors Inc.	Multiple	5,858
Quirk Chevrolet	Braintree	1,313
Mirak Chevrolet	Arlington	399
Muzi Chevrolet	Needham Heights	235
Acton Toyota of Littleton	Littleton	207
Herb Chambers BMW	Allston	203
Smart Center Boston	Somerville	203
Herb Connolly Chevrolet	Framingham	199
Colonial Chevrolet	Acton	177
Marlboro Nissan	Marlborough	164
Boch Chevrolet	Norwood	142
Marcotte Ford	Holyoke	142
Milford Nissan	Milford	123
BMW of Peabody	Peabody	99
Herb Chambers Ford of Braintree	Braintree	99

Electric Vehicle Benefits – 100% Shift to EVs by 2040

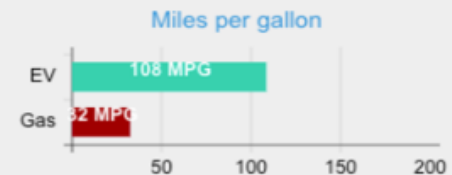
- Benefits
 - EV Lifetime Cost is lower
 - Fuel savings (based on 10k miles/year)
 - Very Low maintenance costs (no oil changes)
 - Incentives drive down higher sticker price
 - Perfect for MV
 - Off-island
 - Round trip to Boston is 150 miles
- (Perceived) Negatives
 - Range
 - Increasing and charging networks
 - Charging times – EV
 - Overnight
 - Road Trips
 - Upfront Cost



Kia Soul EV 2018

Your annual fuel savings:

\$691



<https://chargehub.com/en/calculator.html>

Charging Stations – Costs and Incentives

LEVEL 1 STANDARD OUTLET

- Plug into a standard 120V wall outlet
- Connector provided with every EV
- Great for overnight or workplace charging
- Ideal for typical commutes (up to 40 miles)



40 miles
overnight

LEVEL 2 240 VOLT OUTLET

- Faster charging for longer drives
- Provides a full charge for most EVs in:



100% Electric

4-8 hours
empty to full
charge



Electric & Gas

1-2 hours
empty to full
charge



25 miles
per hour of
charging

DC FAST CHARGE

- Much faster charging at public locations
- 3 different connectors depending on vehicle:



CCS Combo
65 miles
in 20 minutes



CHAdeMO
67 miles
in 30 minutes



Tesla Supercharger
130+ miles
in 20 minutes



0 to 80%
30-40 minutes

New Tax Credit

- 30% of total installation cost (up to \$1k)
- Retroactive to 2017 through 12/31/2020

Cost for home installation

Level 1

- Standard with all car models

Level 2

- \$450 - \$1000 all-in
- Commercial use
 - \$3k - \$10k

Level 3 – Commercial use

- \$12k - \$35k for hardware
- \$10k – \$25k for transformer upgrades

How “Green” is your EV Compared to a Gas Powered Car?

Manufacturing

- Gas Powered Car
 - 7 tons of emissions
- EV
 - 8 tons of emissions

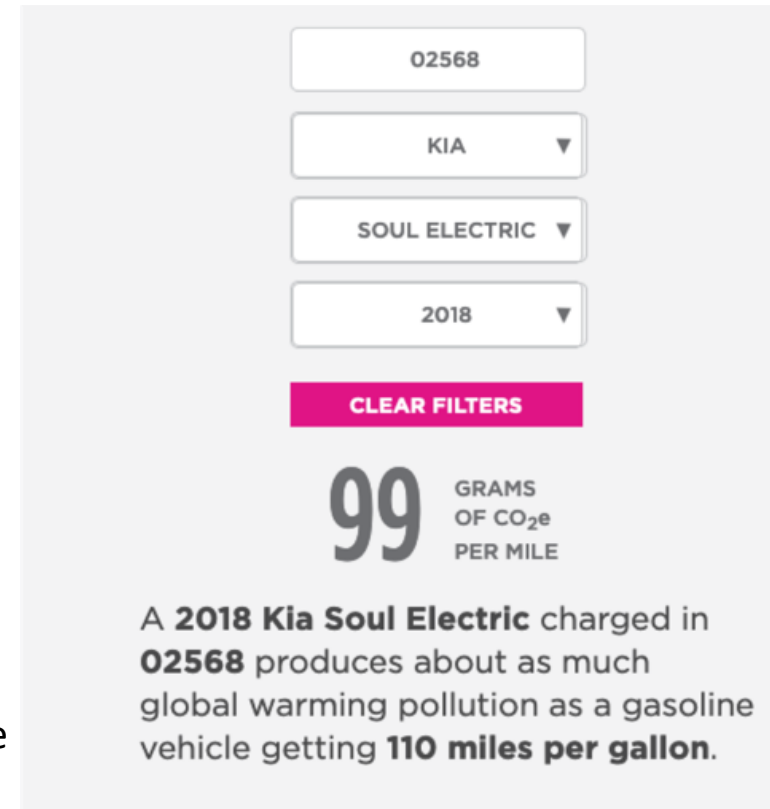
Driving

- Gas Powered Car
 - Pollution with every gallon burned
 - At end of life – 57 metric tons of emissions
- EV
 - Cleaner than gas depending on how electricity is made
 - 2/3 of Americans live in regions where charging an EV produces fewer emissions than driving a 50mpg gas car
 - At end of life – 28 metric tons of emissions

Disposal

- Is less than 1 ton of emissions for both cars – batteries can be recycled or reused

An 84 mile range EV can cut emissions by over 50% compared to a similar sized gas power car – as we source more renewable electricity (solar, wind, hydro) for the grid, this number will improve.



Source: <https://evtool.ucsusa.org/>

Resources - Links

The US Dept. of Energy has an eGallon tool showing state-by-state electricity vs. gas fuel costs.

- energy.gov/maps/egallon

ChargeHub's "Savings Calculator" can help you visualize the estimated savings from switching to EV.

- chargehub.com/en/calculator

The Union of Concerned Scientists' "EV Emissions Tool" breaks down the per mile emissions from gasoline, hybrid, and electric vehicles. You can input your zip code, make, model, and year to get as accurate a result as possible.

- ucsusa.org/clean-vehicles/electric-vehicles/ev-emissions-tool

The Clean Charge Network has an easy online questionnaire to help match you with personalized EV or Plug-In Hybrid options.

- cleanchargenetwork.com/buying-an-electric-car/quiz-which-electric-car-is-right-for-you/

ChargeHub has a side-by-side comparison tool for all your home charger needs.

- chargehub.com/en/home-charging-station-comparison
- <https://cdn2.hubspot.net/hubfs/260434/Installing%20EV%20Charging%20at%20Home.pdf>

VP Electric vehicle day

- Sign up to email list in the back

www.vineyardpower.com

Drive Green Website (All things EVs)

- <https://www.greenenergyconsumers.org/drivegreen>

Other Modes of Transportation

Beyond Cars and Pickups: Other Electric Transporters

- Semi Trucks
- Box Trucks
- Refuse Collection Trucks
- Construction Excavators and Wheel Loaders
- Farm Tractors
- Ferries and Boats
- Transit Buses and VTA
- Schoolbuses
- Aircraft
- Bikes and Scooters



Group



Electric Tractors for Semitrailers

- Tesla Semi
 - 300- or 500-mile range, 2020 production, limited volume
- Nikola Motor Company, Nikola Tre
 - Range 250 mi, orders accepted
- Daimler Freightliner Semi Truck
 - Early vehicles in use, production 2021, 250 mi range
- BYD Day Cab Electric Semi Truck
 - 124–167-mi range, in production
- Volvo VNR Electric Semi Truck
 - 200 mi range, 2021



Electric Box and Smaller Trucks

- Daimler Fuso eCanter Line
 - 62 mi, 7700 lbs, since 2018
- Daimler Freightliner EM2 106 Box Truck
 - 230 mi, 480 hp, production 2021
- Lion8 All-Electric Urban Truck, Canada
 - Schoolbus chassis in production since 2014, now being adapted to medium and heavy trucks
- BYD Step Van, Stake-bed, Box, and Refrigerated Trucks



MVC Task Force Energy Model Group



Electric Refuse Collection Trucks

- BYD Class 6 and Class 8 -- Operating in China, now NA
- Volvo -- Operating in Europe
- Lion -- Operating in Canada
- Mack – Prototype testing for NYC Sanitation Department



Electric Excavators

- Green Machine E210, E240 Electric Mini Excavator
 - 56 kWh battery, charges from 220 v outlet in 10 hours
- Bobcat E10e Miniexcavator 2019
 - Indoor demolition; available in Europe in 2019, NA is next
- Volvo ECR25 Compact Excavator
 - 8 hrs on a charge, late 2020
- Takeuchi TB220e Electric Excavator
 - Plugs in to 480 v circuit for indoor demolition



Electric Wheel Loaders

- Volvo L25 Electric Wheel Loader
 - 8-hour operation; mid-2020
- Schaeffer 23E, 24E Electric Wheel Loader
 - 5 hours, charge with 230 v household supply
 - European, now being imported to US
- Kramer 5055e Wheel Loader
 - 80 V battery, 416 Ah, charges 240 V 5-8.5 h, running time 3-5 hrs
 - European



Electric Tractors

- Soletrak eFarmer
 - 26 kWh battery, 3-6 hrs, adjustable tracks, rear hitch
- Fendt e100 Vario Electric Tractor
 - 100 kWh, 70 hp, 5 hrs
- John Deere 2016 Prototype
 - 130 kWh, 150 kW drive motors



Scandinavian Electric Ferries

- *Ellen* – First Fully Electric Ferry
 - Denmark inter-island ferry, 22 nautical mile range, 13-15.5 knot speed, 650 tonnes, lightweight construction (heavy batteries)
 - 31 cars or five trucks, 198 passengers
 - 4.3 MWh, 840 special maritime Li-ion batteries, 42 modules, in two rooms of 10 strings for redundancy
 - 53 Ellens now on order



Sweden's HH Hybrid Electric Ferries

- Aurora and Tycho Brahe
 - Electrified 2017
 - 780 ft long, 8,414 tonnes, carries 125 passengers, 260 trucks, 240 cars, 9 train coaches, 3 mi passage Denmark to Sweden
 - 640 6.5 kWh batteries in containers on ferry decks, 2 of 4 diesel engines retained for emergency use

SSA Conversion?



Norwegian Electric Fiord Ferries

- MF Gloppefjord and MF Eidsfjord, 2018
 - Smaller ferries that cross fiords in Norway
 - 120 cars and 349 people
 - Two 585 kWh batteries w/ generator backup for emergencies



Washington State Hybrid Ferries

- Three largest ferries will go to hybrid electric w/ USDOT funding.
 - 4 diesels -> 2 ; use 2 to recharge batteries, provide redundancy
 - Ultimately will plug in at harbor for most of power
 - Savings of 45,565 metric tons of CO₂, 184.5 metric tons NO_x
- Contract to build up to five new hybrid electric ferries, first in 2022
- By 2040, 22 plug-in hybrid, 4 diesel ferries, according to plan



MV Tacoma

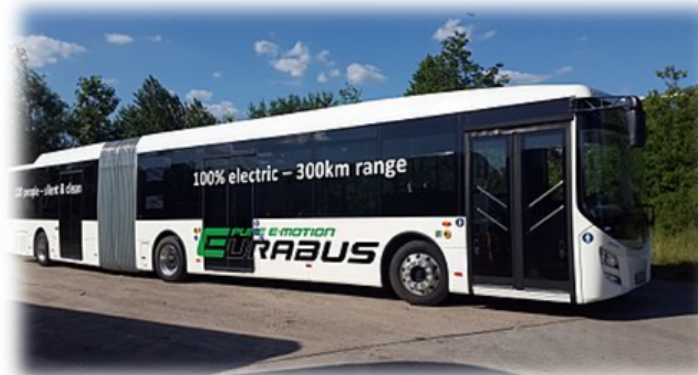
Electric Boats

- Calm Water Cruisers
 - Duffy Electric Boats, 1970 to present
 - 16-22', lakes and calm waters, touring
 - ElectraCraft Boats
 - 15-18', calm-water cruisers
- Sport Boats
 - Electric Boat Company, Canada
 - Uses BMW battery technology
- Electric Outboards
 - PureWatercraft engine (50 hp)



Electric Buses

- Electric Transit Buses –
 - A decade of development
 - Wikipedia lists 53 electric bus manufacturers
 - Quiet, pollution-free, low maintenance
 - Primarily in Europe and East Asia



Electric Schoolbuses

- Lion Electric
 - 65-155 mi range, 72 passengers
 - First manufacturer, Canadian, now selling in US
- Bluebird – 3 models
 - Up to 120 mi
 - Uses Cummins electric drive
- MVRHS
 - Will add 2 electric buses
 - Grant to cover differential cost above diesel



Vineyard Transit Authority

- VTA is going all electric!
 - Presently 12 electric buses
 - FY 21-23: 2 buses/yr
 - FY 24-26: 4 buses/yr
 - FY 27: last 3 buses
- Inductive charging at 3-4 locations
- Solar canopies at home base for all-renewable low-cost power



30-ft bus



35-ft bus



40-ft bus

Air Transportation

- Cape Air – Light Aircraft
 - MOU to purchase Eviation – “Alice” – 9-seater, 2024 target
 - Range – 620 mi
 - ½ of 40+ existing Cape Air routes are shorter than 115 mi
 - All routes less than 250 mi



Electric Bikes, Scooters and Cycles

- E-Bikes
 - Many sizes and shapes
 - Well suited to Vineyard bike paths
- Skateboards, Hoverboards
- Motor Scooters and Cycles



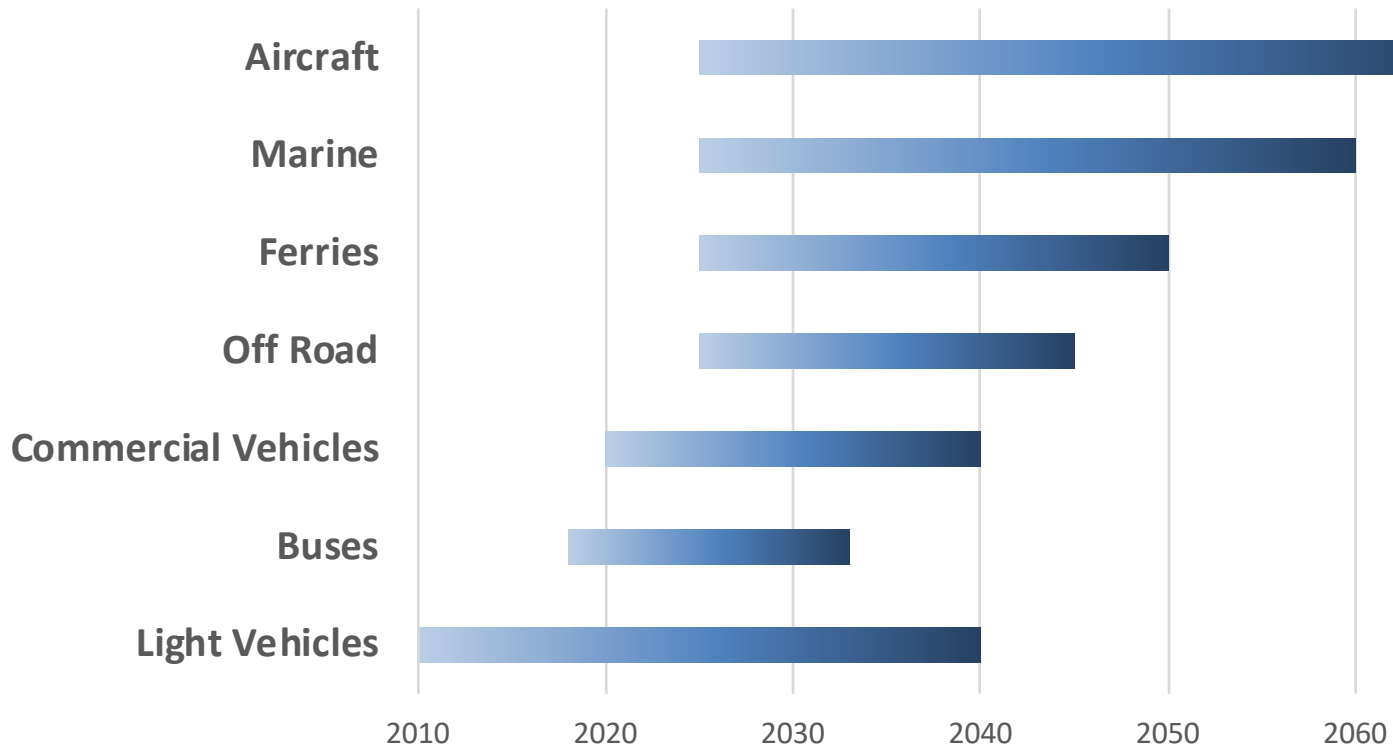
Walking – No Electricity Needed!



Back to Tom.....

In Summary...

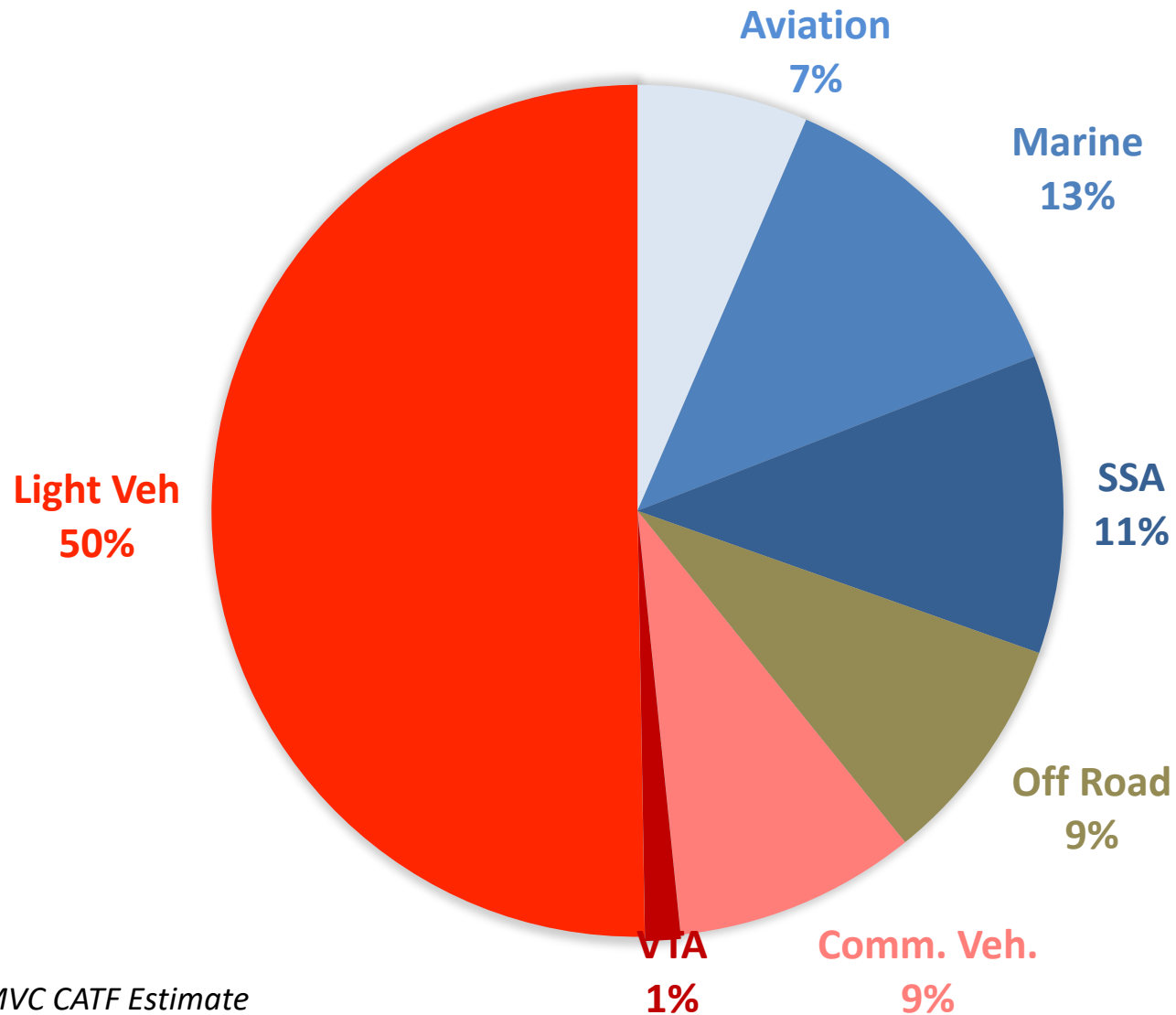
Current Roadmap for Electrifying MV Transportation



Source: MVC CATF Estimate

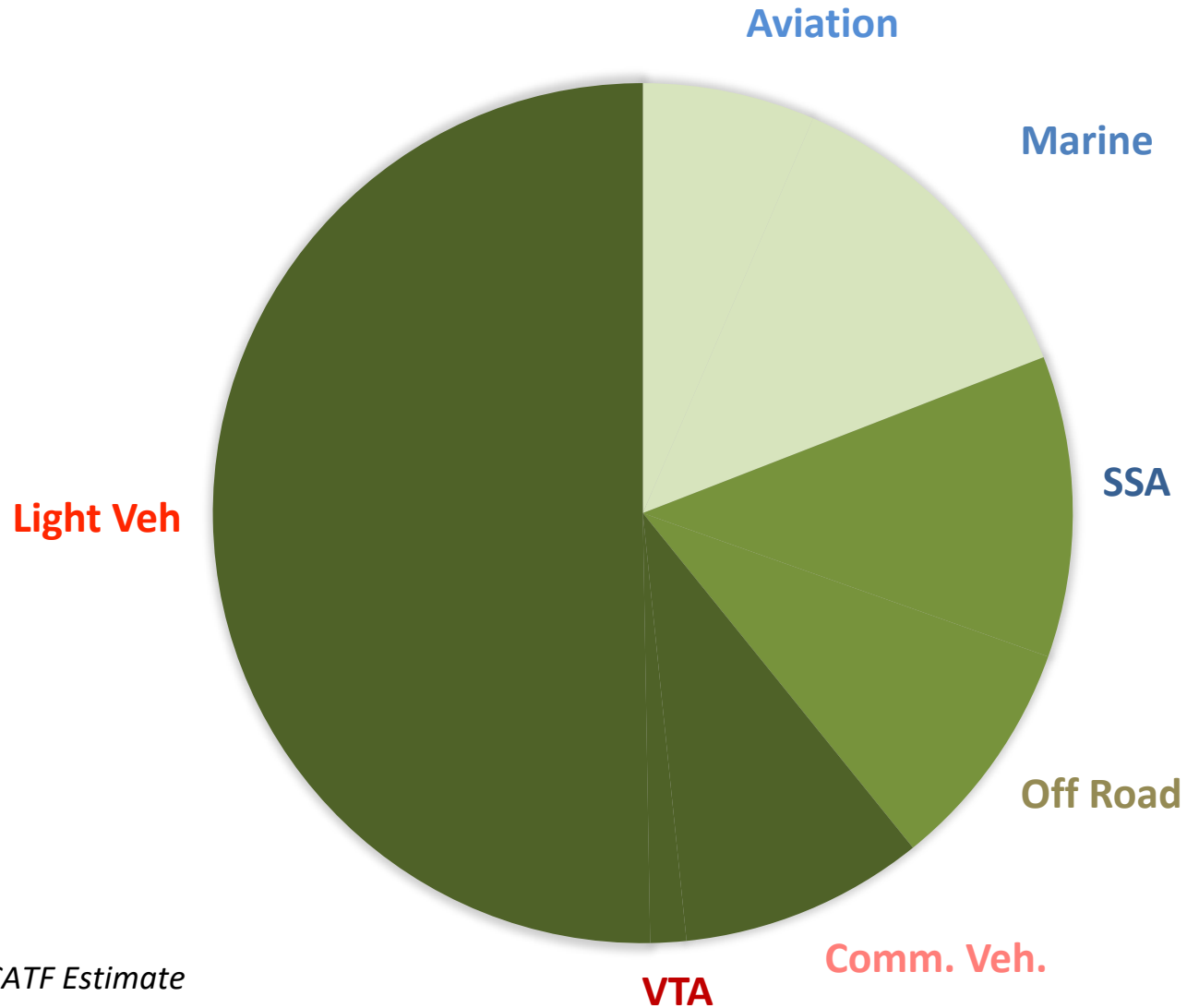
MV CO₂ Emissions from Transportation in 2018

Total = 115,792 Metric Tonnes CO₂



Source: MVC CATF Estimate

The Outlook for 2040?



Source: MVC CATF Estimate

A Call to Action!

As Individuals

- Put your fossil fuel usage on a diet
 - Become aware of the “carbon-cost” of every-day activities
 - Bundle errands and reduce number of trips.
 - Carpool
 - Use the VTA
 - Walk or use a bicycle
 - Buy “local”
 - Use videoconference or teleconference for meetings
- Plan on an Electric Vehicle for your next purchase
 - EVs are perfect “Island Cars”
 - Same for pickups in 1-2 years
 - Fun to drive!
- Install a charging station in your rental house

A Call to Action!

As A Community

- Support governmental investments in climate change mitigation and adaptation
 - Migrate municipal, county, etc. vehicles to EVs.
 - Hire Sustainability Professionals.
 - Build municipal or public/private charging stations.
- Support mass transit investments
- Support Town Meeting initiatives on 100% Renewable targets.
- Join or support the Island wide activities to address climate change



Discussion