

# Green Car Options



# Outline

- Types of electrified vehicles available
  - How they work
  - Pros and cons
  - Charging
  - Batteries
  - Incentives
-

# Types of Electrified Vehicles

- Hybrid (Full and Mild)
  - Plug-in Hybrid
  - Full Battery Electrics
  - Fuel Cell Electric (Hydrogen)
-

# Types of Electrified Vehicles

## Mild Hybrids

- No Plug
- Internal combustion engine but no electric motor that drives the wheels
- Additional battery capacity (48v vs 12v)
- Regenerative braking
- Use traditional transmission
- Stop/Start system
- Examples: Chevy Impala, Mercedes E-Class



# Types of Electrified Vehicles

## Strong Hybrids

- No Plug
- Internal combustion engine and electric motor (or two)
- Do not use traditional transmissions
- Electric motor power assist
- Regenerative braking
- Electric only mode
- Medium sized battery
- Examples: Toyota Prius, Chevy Malibu, Hyundai Sonata



# Pros and Cons of Hybrids

## Pros

- Improved fuel economy
- Improved performance
- Lower maintenance costs
- Unlimited range



## Cons

- Higher purchase price
- Manufacturers tend to offer hybrid option on higher trim levels



# Types of Electrified Vehicles

## Plug-in Hybrids

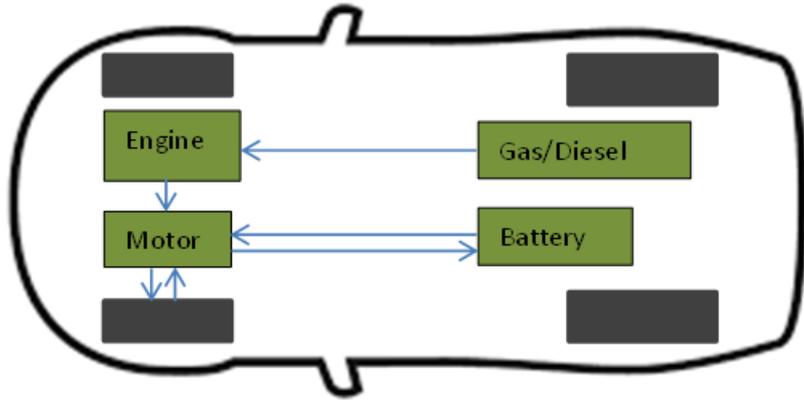
- Needs a plug... sort of
- Internal combustion engine and an electric motor
- Strong regenerative braking
- Medium electric mode range
- Medium-large battery
- Examples: Chevy Volt, BMW i3, Toyota Prius Prime, Chrysler Pacifica



# Types of Electrified Vehicles

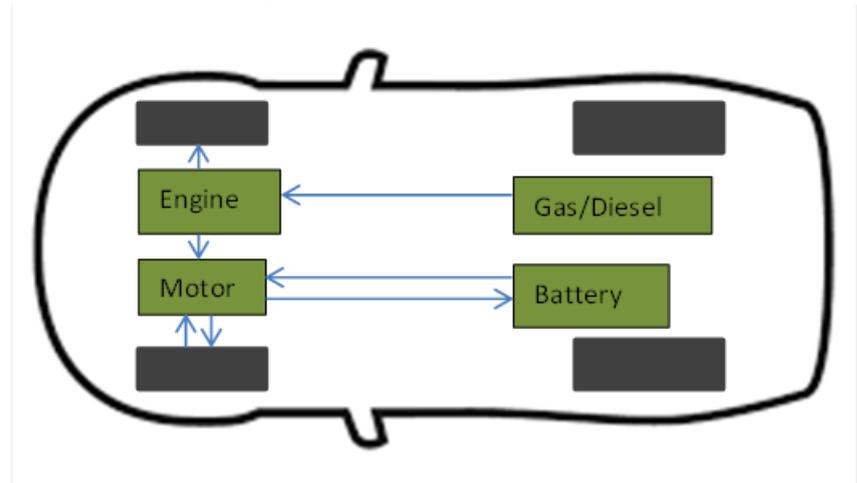
## Two Types of Plug-in Hybrids

### Series



**Ex. Chevy Volt**

### Series Parallel



**Ex. Toyota Prius Prime**

# Pros and Cons of Plug-in Hybrids

## Pros

- Improved fuel economy
- Improved performance
- Lower maintenance costs
- Adequate electric range
- Ability for unlimited range
- Eligible for Government rebates
- Short charging times



## Cons

- Higher purchase price
- EV range impacted by cold weather
- Possible higher repair costs due to the complexity of the system



# Types of Electrified Vehicles

## Full Battery Electric

- Plug is mandatory
- One or more electric motors
- No internal combustion engine
- No Transmission
- Strong regenerative braking
- Medium to long range
- Extra large battery
- Tesla, Chevy Bolt, Nissan Leaf, BMW i3



# Pros and Cons of Full Battery Electric

## Pros

- No GHGs or Air Emissions
- Improved performance
- Lower maintenance costs
- Medium to long range
- Government incentives



## Cons

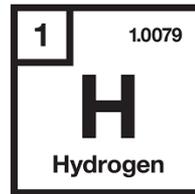
- Higher purchase price
- Range impacted by cold weather
- Range anxiety



# Types of Electrified Vehicles

## Fuel Cell Electric (Hydrogen)

- No Plug
- Fuel Cell Stack
- Electric motor
- Hydrogen Fuel tank
- Long range
- Medium sized battery
- Need a hydrogen refueling station
- Honda Clarity, Toyota Mirai, Hyundai Tucson



# Pros and Cons of Fuel Cell Electric

## Pros

- No GHGs or air emissions from the tailpipe, only water
- Better performance... not really
- Unlimited range... maybe
- Government incentives



1	1.0079
<b>H</b>	
Hydrogen	

## Cons

- Very high purchase price
- No or extremely limited access to fueling stations
- Highly energy intensive to produce hydrogen
- Complex technology could be costly to repair



# Charging

➤ **Vast majority of charging takes place at home**

➤ **Charging options**

➤ Level I (120 volt – 10-24+ hours charge time)

➤ Level II (240 volt – 4+ hours charge time)

➤ Level III (Fast Charging 400+ volt – 20-30+ minutes charge time to 80%)

➤ **Charging infrastructure gives EV owners a sense of security even if it's not used**

Charge stations



# Charging

- **Quebec has roughly 1250 public charging stations in operation**
    - 70+ fast charging stations
    - 4 Tesla fast charging stations
  - **Ontario, Quebec and British Columbia offer between \$600-\$1000 rebate on the purchase and installation of a home charging station**
    - Installation costs vary but could be between \$1000-\$2000
  - **Websites and Apps make it easy to find charging stations**
    - Plugshare – shows stations nearest to you, availability, and even residential chargers that people offer to other EV owners
-

# Batteries

➤ Lithium-Ion is king

➤ Lithium-based battery

energy densities is around 250 Wh/kg, compared to 35-40 Wh/kg for typical lead acid car battery

➤ Energy densities for lithium-ion batteries have gone from around 100 Wh/kg to over 250 Wh/kg since 1990

➤ This is expected to continue to increase to upwards of 325 Wh/kg



# Batteries

➤ Biggest draw back to these batteries is cost

➤ Costs of battery packs have decreased industry-wide by approximately 14% a year since 2007, going from more than US \$1000 per kWh to around US \$400 per kWh.

➤ Tesla's new Gigafactory is expected to increase global battery production by 500,000 units a year by 2020



# Incentives

- **Quebec offers a rebate up to \$8,000 depending on the vehicle plus \$600 rebate for installation of a home charger**
    - Go to <http://vehiculeselectriques.gouv.qc.ca> to find out more
  - **Ontario offers a rebate up to \$14,000 depending on the vehicle plus up to \$1,000 rebate for installation of a home charger**
    - Go to <http://www.mto.gov.on.ca/english/vehicles/electric/index.shtml> to find out more
-



**Questions?**

---