# Transport Options

By Ray Johnston

# Electricity can help us move

- On electric skateboards
- On electric bikes
- In electric cars
- Electric Buses
- Electric Trains
- And Electric Planes ……

- We'll just look at cars today……

# Cars – the Options

- Conventional Internal Combustion Engine (ICE)
- Hybrid
- Plug in Hybrid (PHEV)
- Battery Electric (BEV)
- Hydrogen (Fuel Cell)

# Internal Combustion Engine (ICE)

- Burns petrol, diesel, LNG, hydrogen, etc
- Very inefficient conversion of fuel to motion
- Most energy goes into heating, noise, and exhaust products
- Uses lots of fuel to start moving (poor engine performance at low revs)
- Wastes a lot of energy stopping (brakes heat up)
- Most efficient when maintaining a steady speed
- Poor in stop/start (city) situations

# Internal Combustion Engine (ICE)

- **Advantages**
- Lower price (at the moment)
- Long distances
- Quick refuel
- **Disadvantages**
- Expensive to own and run
- Complex, so less reliable and more expensive to service
- Highly polluting
- At the mercy of fuel retailers

# Hybrids

# Hybrids

- Have an ICE, electric motor/generator(s) and a small battery (0.75 kWHr)
- Electric motor(s) start car moving
- Electric motors become generators to slow the car and charge the battery when braking (regeneration)
- Battery / motors designed for short distances only
- Much more economical in stop start situations
- Slightly less efficient on longer trips (more weight)

# Hybrids

(Prius drive system Silicon Chip Dec 2019)

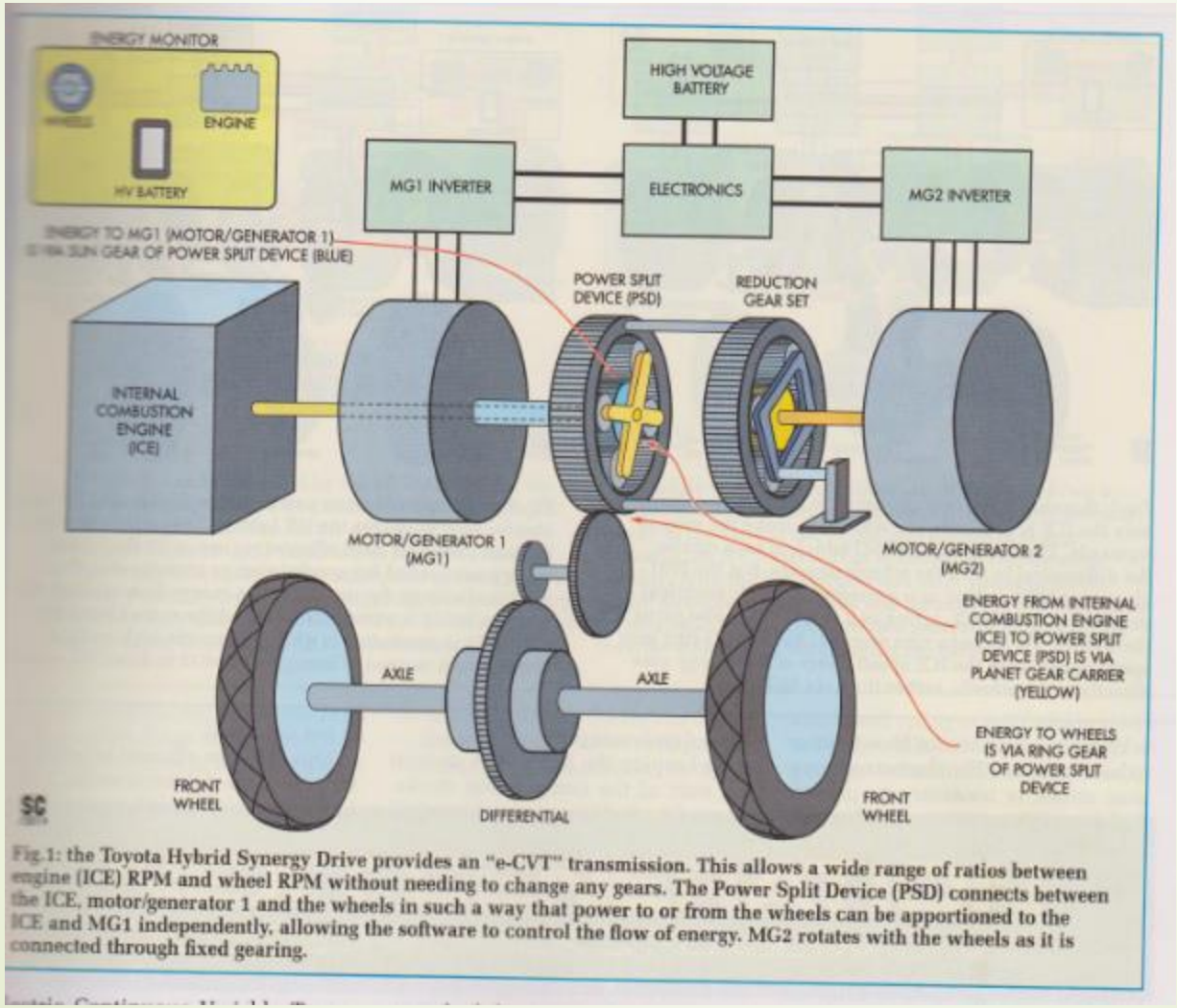
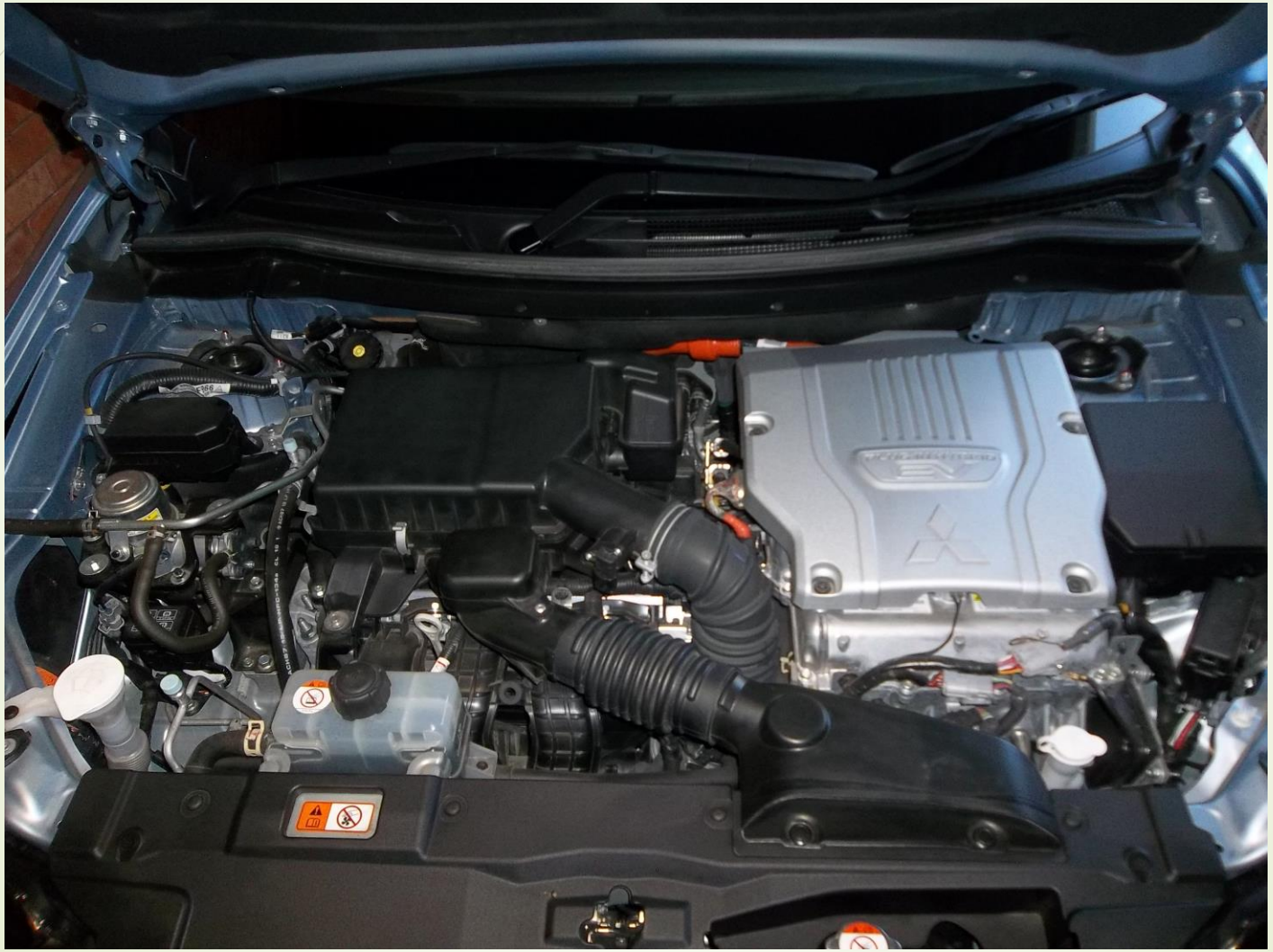



Fig.1: the Toyota Hybrid Synergy Drive provides an "e-CVT" transmission. This allows a wide range of ratios between engine (ICE) RPM and wheel RPM without needing to change any gears. The Power Split Device (PSD) connects between the ICE, motor/generator 1 and the wheels in such a way that power to or from the wheels can be apportioned to the ICE and MG1 independently, allowing the software to control the flow of energy. MG2 rotates with the wheels as it is connected through fixed gearing.

# Hybrids

- **Advantages**
- Better economy in stop start city traffic
- Fewer emissions
- **Disadvantages**
- More expensive
- heavier

# Plug in Hybrids (PHEV)



# Plug in Hybrids (PHEV)

- Have ICE, electric motor/generator(s) and a bigger battery ( eg 10kWHr)
- Designed to travel 30 to 60 km on electric
- ICE normally only used on longer journeys
- Have series and parallel drive modes
- Have an on-board charger to charge the batteries
- Can drive the car using the electric motor(s) and/or ICE
- Recovers energy to battery on braking (regeneration)

# Plug in Hybrids (PHEV)

- **Advantages**
- Can run electric for most days
- Can travel long distances and refill quickly
- **Disadvantages**
- More expensive
- Carries heavy ICE that is mostly unused

# Battery Electric Vehicles (BEV)

# Battery Electric Vehicles (BEV)

- Electric motor(s) and bigger battery (25kWHr – 100kWHr)
- More expensive than an ICE (at the moment)
- Very cheap to run – especially if you have solar
- Very low service costs
- Quiet and smooth to drive
- No pollution
- More practical as charging infrastructure expands
- Mostly charged at home

# Battery Electric Vehicles (BEV)

- **Advantages**
- Powerful, pleasant and cheap to drive
- No pollution
- **Disadvantages**
- More expensive
- Takes some time to charge

# Fuel Cell / Hydrogen Cars

# Fuel Cell / Hydrogen Cars

- Have a fuel cell to generate electricity, small battery and electric motor(s)
- Fuel cells are efficient at generating electricity
- Refuel quickly and long range
- Hydrogen infrastructure very limited
- Owners must ‘buy’ Hydrogen
- Good for trucks ‘ trains / busses

# Fuel Cell / Hydrogen Cars

- **Advantages**
- Powerful, pleasant and cheap to drive
- Long range
- Quick to refill
- No pollution – exhaust is water
- **Disadvantages**
- Still in early stages of development
- Tied to Hydrogen suppliers

# End

That's it.

Questions?