About Electric Vehicle

- The first demonstration electric vehicles were made in the 1830s, and commercial electric vehicles were available by the end of the 19th century.
- The electric vehicles have not enjoyed the enormous success of internal combustion (IC) engine vehicles that normally have much longer ranges and are very easy to refuel.
- Concerning about the environment, particularly noise and exhaust emissions, coupled to new developments in batteries and fuel cells may swing the balance back in favour of electric vehicles.
- Some problems of electric vehicles:
  (a) Weight of battery
  (b) Time for recharge
  (c) Expensive

Comparison of energy from petrol and lead acid battery
(1) Traditional battery electric vehicle: The vehicle consists of an electric battery for energy storage, an electric motor, and a controller.

(2) Hybrid electric vehicle: combines a battery and an IC engine
A hybrid vehicle has two or more power sources.

(a) Series hybrid (串聯式)
(b) Parallel hybrid (並聯式)

In both series and parallel hybrids the battery can be recharged by the engine and generator while moving, and so the battery does not need to be anything like as large as in a pure battery vehicle.
**Series hybrid vehicle**

In the series hybrid the vehicle is driven by one or more electric motors supplied either from the battery, or from the IC engine driven generator unit, or from both. However, the series hybrid tends to be used only in specialist applications. For example, the diesel powered railway engine is nearly always a series hybrid, as are some ships.

**Parallel hybrid vehicle**

The vehicle can either be driven by the IC engine working directly through a transmission system to the wheels, or by one or more electric motors, or by both the electric motor and the IC engine at once. The parallel hybrids are wide applications.
Vehicles which use replaceable fuel as source of energy using either fuel cells or metal air batteries

- The basic principle of electric vehicles using fuel is much the same as with the battery electric vehicle, but with a fuel cell or metal air battery replacing the rechargeable electric battery.
- Daimler Chrysler have developed fuel cell cars based on the Mercedes A series, fitted with Ballard fuel cells as shown in Figure. This fuel cell runs on hydrogen which is stored in liquid form. This was the first fuel cell car to have a performance and range similar to IC engine vehicles. The top speed is 144 kmph, and the range 450 km.
- The fuel cells generally require hydrogen fuel. This can be stored on board, though this is not easy. An alternative is to make the hydrogen from a fuel such as methanol. This is the approach taken with the Necar 5, the car has a top speed of 150 kph.

The Necar 4 fuel cell car from 1999.
The basic principle of the fuel cell is that it uses hydrogen fuel to produce electricity in a battery-like device.

The basic chemical reaction is \(2H_2 + O_2 \rightarrow 2H_2O\)

- Because the types of fuel cell likely to be used in vehicles work at quite modest temperature (85 degree C) there is no Nitrous Oxide produced by reactions between the components.
- A fuel cell vehicles could thus be described as zero-emission.
- The key difference between fuel cell and simply burning the gas is that the energy is release as electric current, rather that heat.

**Principle of Fuel Cell**

- The details vary for different types of fuel cell, for an acid electrolyte (酸電解質) which the most common type.
- **Anode (正極):** 氫氣離子化 產生 電子及氫離子，此反應產生能量
  \(2H_2 \rightarrow 4H^++4e^-\)
- **Cathode (負極):** 氧氣與電子反應及氫離子 產生水
  \(O_2 + 4e^- + 4H^+ \rightarrow 2H_2O\)
The main problems centre around the following issues.

(a) Cost: fuel cells are currently far more expensive than IC engines, and even hybrid IC/electric systems.

(b) Rival technology: hydrogen is a fuel, and it can be used with exactly the same overall chemical reaction in an IC engine. Indeed, cars have been produced with fairly conventional engines running off hydrogen, notably BMW in Germany. The emission of these vehicles are free from carbon monoxide, carbon dioxide, hydrocarbons, and virtually all the unpleasant pollution associated with cars; the only pollutant is small amount of nitrous oxide.

(c) Water management: an important and difficult problem.

(d) Cooling: the thermal management of fuel cells is actually rather more difficult than for IC engines.

(f) Hydrogen supply: hydrogen is the preferred fuel for fuel cells, but hydrogen is very difficult to store and transport.
Another fuel cell vehicle of note is the Honda FCX shown as Figure, which was the first fuel cell vehicle in the USA to be registered officially as a zero emission vehicle (ZEV) with the environmental protection agency (EAP) in 2002.

Public service vehicles such as buses can more conveniently use novel fuels such as hydrogen, because they only fill up at one place. Buses are a very promising early application of fuel cells, and an example is shown in Figure. Citaro fuel cell powered bus, one of a fleet entering service in 2003.
Vehicle Supplied by Power Lines

They are a zero emission form of city transport that is still used in some cities. Normally electricity is supplied by overhead supply lines and a small battery is used on the trolley bus to allow it a limited range without using the supply lines.

Electric Vehicles which use energy directly from solar radiation (太陽能)
內燃機引擎運作基本原理

圖 1-1 當汽油燃燒（與空氣中的氧結合），則
良好燃燒的產物為水及二氧化碳。

圖 1-5 引擎內之一氣缸，圖上有氣門及，氣
級，活塞及氣缸。（克萊斯勒公司）

內燃機引擎運作基本原理

圖 1-7 當活塞上下移動時，氣缸內之動作。
內燃機引擎運作基本原理

圖 3-1 桿列式四缸火花點火，凸輪軸消震式引擎。《克萊斯勒公司》

圖 3-3 活塞的兩個極限位置為上止點及下止點，活塞衝程所帶的活塞的移動從BDC 到 TDC 或從 TDC 到 BDC。《通用汽車公司發動機部門》

內燃機引擎運作基本原理

圖 3-5 活塞與活塞環。上，將活塞環分開鎖在外圈之上。下，活塞環安裝在活塞的溝。活塞環活塞與螺栓連接，圖上只顯示連接之部分。
內燃機引擎運作基本原理

■ 3-6 斷缸壁與活塞間的空隙須維持起來，否則，壓縮後之空氣與燃料混合氣或高壓的燃油氣體會漏出。

■ 3-7 活塞迫於軸心上的連桿軸頭之後退連桿部件。活塞被部分則能夠顯示活塞與何種活塞連接於連桿上。

■ 3-8 由活塞及一活塞與連桿之組合，顯示活塞如何通過連桿，連結到曲柄輪之連桿轉動。

■ 3-10 四個渦輪轉動：(A) 活塞輪（馬達）(B) 活塞於下連桿。(C) 活塞輪(馬達)。當活塞輪(馬達)下降，(D) 活塞輪(馬達)上昇，(E) 活塞輪(馬達)上昇。當活塞輪(馬達)下降，(F) 活塞輪(馬達)上昇，(G) 活塞輪(馬達)上昇。
內燃機引擎運作基本原理

內燃機引擎運作基本原理

車上的燃料噴射系統，這是一種進氣口噴射系統，每一氣缸各有其各自的燃料噴射器。（作者未知）
內燃機引擎運作基本原理

![圖3-22 引擎的潤滑系統，顯示機油如何流至運動的引擎零件。]

![圖3-23 引擎的冷卻系統，顯示冷卻液在引擎水箱與水箱間的流動。另外，冷卻管內的箭頭表示冷卻液流過冷卻芯子的方向。](image)

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汽車電力電子基本原理

![圖 2-3  汽車電力系統位於引擎室的一些元件。（克萊斯勒公司）]

引擎電力電子基本原理

![圖 2-4 完整的電路。（繆特汽車公司）]

![圖 2-5 安培計及伏特計在電路上的連接方式。（繆特汽車公司）]
圖 2-9 上圖，汽車及卡車上所用之接地回路或單線電力系統。下圖，接回路系統在線路圖上之表示方式。（ATW）
常見之引擎之型式

![圖 4-2] 三缸火花點火引擎，頂置凸輪軸以帶曲軸皮帶驅動。（通用汽車公司雪佛蘭部門）

常見之引擎之型式

![圖 4-3] 四缸引擎，凸輪軸在氣缸體內，具頂置氣門及進氣器，以及無分電盤點火裝置。（通用汽車公司雪佛蘭部門）
常見之引擎之型式

圖 4-5 四缸引擎，具有兩頂置凸輪軸，每一氣缸有四個氣門。（通用汽車公司奧斯摩比利門）

常見之引擎之型式

圖 4-6 V-4 引擎，具有內部平衡軸使運轉較平順。（德國戴姆勒汽車公司）

圖 4-7 平置式水冷四缸引擎，具有兩頂置單凸輪軸。（美國道奇陸公司）
常見之引擎之型式

圖4-8 五缸引擎，具有頂置雙凸輪軸。（美國寶馬公司）

常見之引擎之型式

圖4-9 渦輪增壓之五缸引擎，具有頂置雙凸輪軸及機油冷卻活塞。
常見之引擎之型式

引擎凸輪軸之驅動方式

![圖 4-10 直列六缸引擎，氣缸傾斜以降低引擎蓋之高度。（克萊斯勒公司）](image)

![圖 4-16 驅動凸輪軸的四種方式。（ATW）](image)
引擎結構

引擎結構

圖 5-5 四氣門 OHV 引擎的氣缸頭，以及連結於其上或安裝於其內的主要零件。

圖 5-9 四氣門 OHV 引擎的氣缸頭，以及連結於其上或安裝於其內的主要零件。
引擎結構

圖 5-13 進氣衝程

流過輔助進氣閥或噴射閥之空氣在燃燒室內產生渦流作用。（克萊斯勒公司）

引擎結構

圖 5-15 OHV 六缸引擎的氣缸蓋。其進氣歧管與排氣歧管連結到氣缸蓋的同一個。（克萊斯勒公司）
引擎結構

![引擎結構](image1)

圖 5-14 使用預燃室的分層燃燒火花點火引擎之一系列動作。（美國本田汽車公司）

引擎結構

![引擎結構](image2)

圖 5-16 V型引擎的單排氣系統使用一個觸媒轉換器。（通用汽車公司奧斯摩比部門）
活塞結構

汽門結構
汽門結構

正時記號

圖 6-4 DOHC 四缸引擎的凸輪軸及氣門機構之安排，進氣凸輪軸由曲柄軸以鏈條
帶動，排氣凸輪軸則通過進氣凸輪軸
上的螺旋帶動（美國豐田汽車銷售
股份有限公司）

圖 6-6 V型 OHV 引擎的曲軸箱及凸輪軸
軸，正時記號位於齒輪上。（通用汽車
公司雪佛蘭部門）

圖 6-7 V型 OHV 引擎內以鏈條傳動的曲柄軸
及凸輪軸齒輪，此正時記號在鏈輪上。
（克萊斯勒公司）
正時皮帶

圖 6-9 OHC 引擎若選擇使用帶狀的皮帶及輪
輪來驅動凸輪軸，皮帶張緊器用來防止
皮帶鬆弛。 （裕隆汽車公司）

正時

圖 6-30 進氣閥與排氣閥之正時。引擎的一個
完整循環顯示爲一 720 度的螺旋線，
用以代表曲柄軸轉兩整圈。不同引擎
之氣門正時也會不同。
引擎性能

图 7-10 燃烧压力与引擎扭力间之关系。(ATW)

引擎性能

图 7-13 在底盘测功器上的汽车，车轴驱动轮带动态测功器滚筒，以量测在轴转处所输出的扭力。(福特汽车公司)
引擎性能

图 7-11 共气门引擎（虚线）与四气门引擎（实线）的扭力曲线之比较。四气门引擎有较高的容积效率，在高速能继续产生高扭力。ATW

引擎性能

图 7-14 汽油中只有大约百分之 20 的能量可供移动车子之用。（福特汽车公司）