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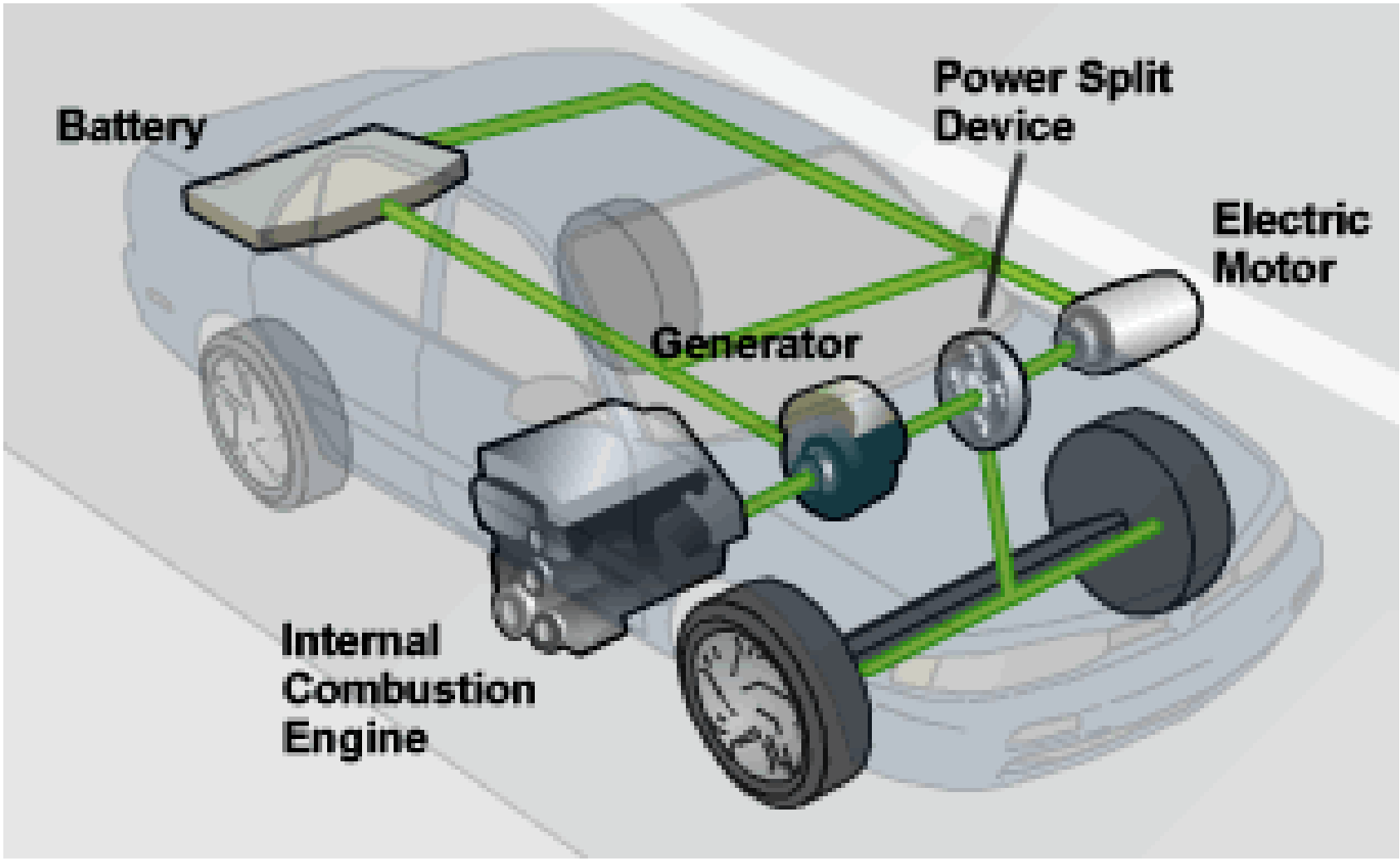
Split Cycle Air Hybrid Technology

Engine Expo 2008

Hybrid Vehicle

- Stores braking energy as electricity
- Two drive systems
- Gas system - Internal Combustion Engine
- Electric system consisting of:
  - Battery
  - Electric Motors
  - Generator
  - Power spliting device

Hybrid Vehicle Components



Advantages Of A Hybrid

- **Recovers energy normally lost**
- **Increased Mileage**
- **Reduces Emissions**
- **Environmentally friendly**

Issues With Electric Hybrids

- **Cost**
- **Complexity**
- **Added weight**
- **Life of Batteries**
- **Disposal of Batteries**
- **Safety Issues - High Voltage**

Air Hybrids using conventional Engines

- Stores braking energy as compressed air
- One drive systems - two driving modes
- Valve sequencing changes engine operation
- Air compressor
- Air motoring
- Internal combustion engine

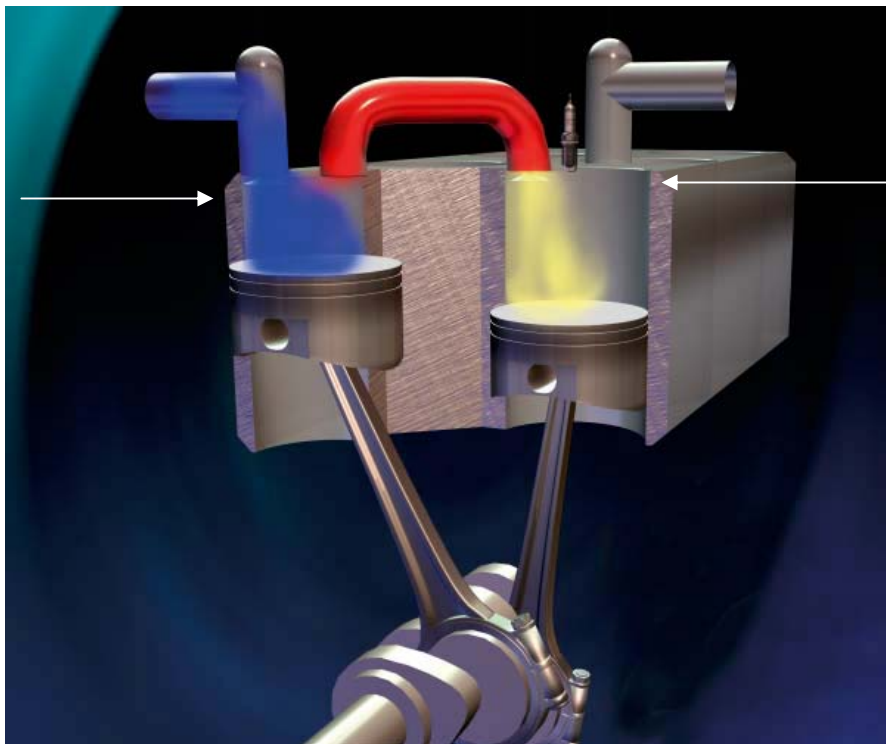
Issues with Air Hybrids using conventional engines

- **Complex valve switching system**
- **Costly VVA valves – hydraulic or electric**
- **Energy storage capacity of air tank**
- **Driving vehicle on air only**

New Developments in Hybrid Technology

Split-Cycle Air Hybrid

Compression

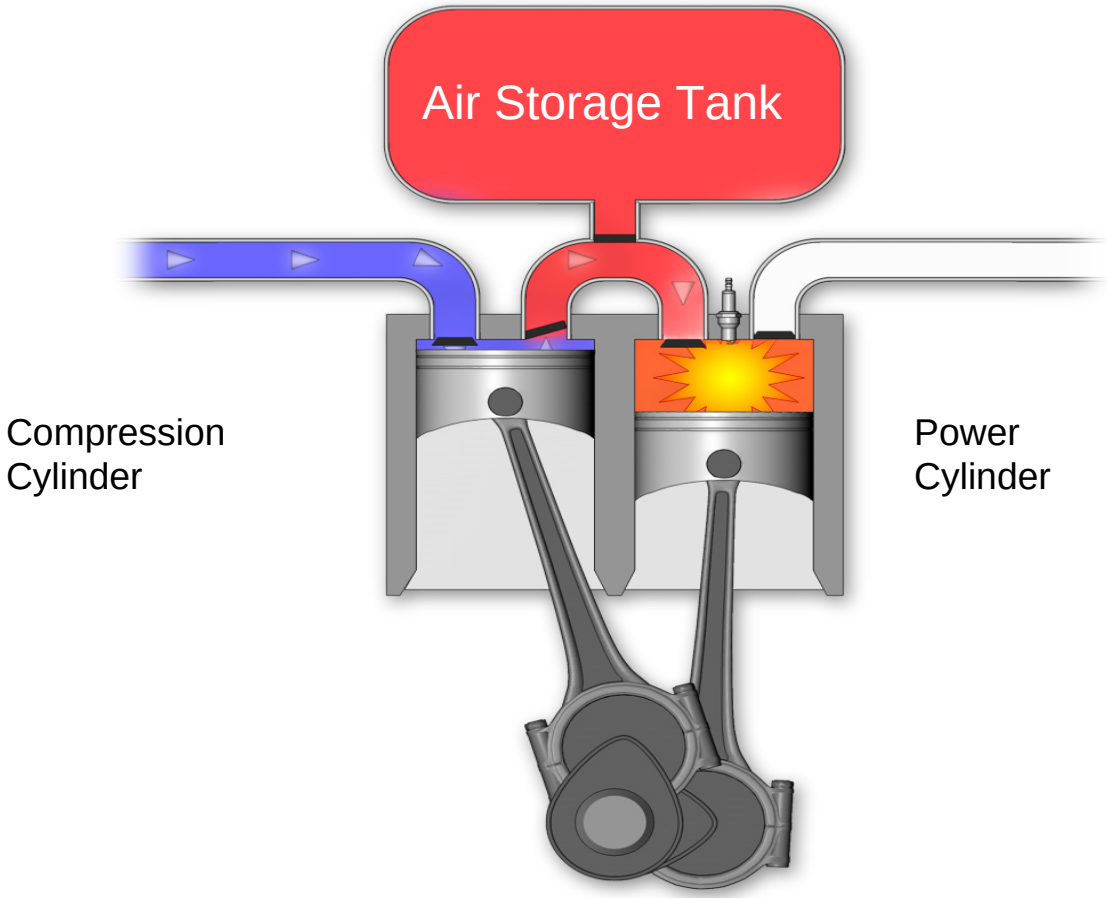


Combustion

Air Hybrid using split-cycle Engines

- Separates compression from combustion
- Built-in air compressor
- Fires after top dead center
- Requires fast combustion process
- Fuel only on combustion side of engine
- Air tank added to split-cycle engine

Split-Cycle Air Hybrid



High pressure air feeds combustion

Advantage of split-cycle Air Hybrid Engine

- **Lower cost – hundreds vs thousands**
- **No combustion chamber**
- **Higher compression ratio**
- **Simple operating scheme**
- **High pressure air feeds combustion**

Additional Advantages Of Split-cycle Air Hybrid

- **Air can Operate Accessories**
- **Engine Brake**
- **Less safety issues**
- **Long life for energy storage device**
- **Less environmental issues**

SCUDERI GROUP

Defining Tomorrow's Future Today

Introduces

Air Hybrid Engine Technology