Powersource Evolution

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Nissan’s approach for sustainable mobility

Technologies for Powersource Evolution
Agenda

- Nissan’s approach for sustainable mobility
- Technologies for Powersource Evolution
CO₂ reduction scenario

- CO₂ reduction as below is required
- Powersource Evolution becomes essential

  - Short-term: Engine efficiency improvements
  - Mid-term: Promote EVs, conversion to renewable energy

Comparison of CO₂ Emissions from New Cars (Well to Wheel) (%)

Improvement of power source, comparison of CO₂ emissions through energy conversion (Well to Wheel) (%)

Use of electricity from renewable energy
Use of hydrogen from renewable energy

450ppm
CO₂ reduction in real world

- In real world, vehicles are used in various conditions
- CO₂ reduction to be approached from several aspects
Development approach

- For efficient CO2 reduction in real world, “Triple Layered Approach” has been applied

  - **Society**
    - Reducing traffic jams
      - Comprehensive approach with other sectors

  - **Individuals**
    - Support of eco-driving
      - Fuel consumption meter
      - Eco-driving advice, etc.

  - **Vehicles**
    - More efficiency in various aspects of driving
      - Improve engine efficiency
      - Improve transmission efficiency
Technologies for “society” level approach

“SKYPLECT” to analyze actual traffic information, “fastest route guidance” to realize smooth traffic

**SKY PROJECT**

- Utilize “probe” information
- Trial with many cities

**Fastest route guidance**

- “fastest route” calculation
- Shorter travel time by 20%
- Less CO2 by 17%

Actual traffic information

VICS only: ≒ 280km
VICS + Probe: ≒ 440km
Technologies for “individual” level approach

- “eco-mode” to control powertrain most effective,
  “eco-pedal” to directly support eco-driving

**eco-mode**
- Moderate accel operation
- Cooperative control Eng and CVT
- “eco-mode” indicator

**eco-pedal**
- Avoid excessive acceleration
- Direct information of fuel economy deterioration
Technologies for “vehicle” level approach

- “Downsizing Engine” and “new CVT” was launched in Micra, minimizing PT losses. Nissan Micra M/T achieved 95g CO2

<table>
<thead>
<tr>
<th>Downsizing Engine (HR12DDR)</th>
<th>CVT with idling stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>- miller cycle + supercharger</td>
<td></td>
</tr>
<tr>
<td>- direct injection</td>
<td></td>
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<tr>
<td>- comp. ratio 13</td>
<td></td>
</tr>
<tr>
<td>- dual com phaser</td>
<td></td>
</tr>
<tr>
<td>- high flow EGR</td>
<td></td>
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<tr>
<td>- DLC coating</td>
<td></td>
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<tr>
<td>- micro finishing</td>
<td></td>
</tr>
<tr>
<td>- ratio coverage 7.3</td>
<td></td>
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<tr>
<td>- with 2 speed CVT</td>
<td></td>
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<tr>
<td>- electric oil charge pump</td>
<td></td>
</tr>
<tr>
<td>- inner lock feature for idling stop</td>
<td></td>
</tr>
<tr>
<td>- light and compact design</td>
<td></td>
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<tr>
<td>- low fric. belt</td>
<td></td>
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</tbody>
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Technologies for “vehicle” level approach

- HEV launched “1 Motor 2 clutch” type HEV, mass-produced EV “LEAF”

**1 motor 2 clutch**
1M2C system located in T/M

**Motor**
synchronous motor

**Inverter**
high power IGBT

**Battery Pack**
laminate type high energy density
Nissan’s concept toward Sustainable Mobility

- Nissan’s Sustainable Mobility technologies are to be launched within two pillars – Zero Emission and PURE DRIVE.
Agenda

- Nissan’s approach for sustainable mobility
- Technologies for Powersource Evolution
Many technologies are under development within each area (engine, transmission, electric components, etc.)
Approach “as Powertrain”

- Several Paths to improve PT efficiency
- To clarify effectiveness of each technology as combination, approach “as Powertrain” becomes essential

\[ \eta_{PT} = \eta_{ENG} \times \eta_{T/M} \]
Evolution of Conventional Powertrain

- As first step, reduction of energy losses are essential
- Various technologies have developed to reduce each energy losses, but conventional powertrain has theoretical limit to improve

![Diagram showing energy loss reduction in a powertrain system]
By “as Powertrain” approach, technologies can be arranged in conventional PT zone as below.

- **Conventional PT**
  - Energy loss reduction
  - High technological complexity, difficulty, cost, etc.

- **HEV**
  - Regenerate lost energy

- **Plug-in HEV**
  - Use renewable energy

**Powersource Evolution**

**CO2**

- **ICE CO2 Limit**
- **HEV CO2 Limit**
- **P-HEV CO2 Limit**

**Zero**
Switch to Energy Regeneration Stage

- CO2 reduction technologies are to shift; energy loss reduction tech. → lost energy regeneration tech
- Reduction / regeneration of energy loss have technical limits, to reduce CO2 further, Powersource has to evolve

<table>
<thead>
<tr>
<th>Output from Powertrain</th>
<th>Fuel Energy (Gasoline)</th>
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<tbody>
<tr>
<td>100</td>
<td>Heat loss (Cooling loss)</td>
</tr>
<tr>
<td>6</td>
<td>Heat loss (Emission loss)</td>
</tr>
<tr>
<td>18</td>
<td>Energy loss reduction</td>
</tr>
<tr>
<td>49</td>
<td>Regenerate lost energy</td>
</tr>
<tr>
<td>20</td>
<td>Heat from Brakes</td>
</tr>
<tr>
<td>13</td>
<td>Travel resistance</td>
</tr>
<tr>
<td>7</td>
<td>Heat Energy</td>
</tr>
<tr>
<td>1</td>
<td>Kinetic Energy</td>
</tr>
</tbody>
</table>
Technologies have to be arranged to consider all stages under “As Powertrain” and “As Powersource Evolution” concept.
Powersource Evolution

- Technologies have to be arranged to consider all stages under “As Powertrain” and “As Powersource Evolution” concept.
Nissan’s concept toward Sustainable Mobility

- Nissan’s aforesaid Sustainable Mobility technologies are to be launched continuously along the concept!

<table>
<thead>
<tr>
<th>Emission</th>
<th>Power Source</th>
<th>Umbrella Concept</th>
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<tr>
<td>Zero</td>
<td>100% Electric</td>
<td></td>
</tr>
<tr>
<td>Low CO₂ (Low-fuel Consumption)</td>
<td>Petrol Diesel</td>
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Thank you for your attention!