Session 3
How to better reflect & improve in-use Fuel Economy?
*Renault & On-board eco driving technologies*

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GFEI Workshop - In Use Fuel Economy
*London – July 16, 2014*
HOW TO IMPROVE IN-USE FUEL ECONOMY

01 TECHNOLOGY ALONE WILL NOT SOLVE ALL CHALLENGES

02 HELP YOURSELF…WITH THE SUPPORT OF NEW PRODUCTS & SERVICES: DRIVING ECO²

03 CONCLUSION
TECHNICAL CHALLENGE

STILL A POTENTIAL TO IMPROVE THE ENERGY EFFICIENCY OF INTERNAL COMBUSTION ENGINES, BUT NOT ENDLESS....

![Graph showing CO2 emission and energy need over time for C Segment Sedan, comparing gasoline and diesel engines.]

- Emission: [g/km]
- Energy Need: [MJ]
- Efficiency: η = 40%, η = 30%, η = 25%, η = 20%, η = 15%
EUROPEAN EMISSION REGULATIONS: MORE STRINGENT AND CLOSER TO REAL DRIVING CONDITIONS

NOx + ON BOARD DIAGNOSIS

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<thead>
<tr>
<th></th>
<th>EURO5</th>
<th>EURO6C</th>
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<tbody>
<tr>
<td>NOx certification</td>
<td>180</td>
<td>80</td>
</tr>
<tr>
<td>OBD Diag. number</td>
<td>15</td>
<td>75</td>
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+ increased frequency and reduced thresholds

NEW PROCEDURE WLTP

CYCLE ENGINE OPERATIONS

REAL DRIVING EMISSION

PEMS
In road driving conditions
or
random cycle on dyno

CERTIFICATION CONDITIONS

- Vehicle Inertia close to real
- AC condition
- Battery State Of Charge
- ...

DSPG/EL – GFEI
July 16, 2014

CONFIDENTIAL
RENAULT PROPERTY
TECHNICAL CHALLENGE

MANY LEVERS TO LOWER THE $\text{CO}_2$ EMISSION AND FUEL CONSUMPTION

CO$_2$ & Fuel Consumption levers

- **Vehicle Energy Need**: Weight, Aerodynamics, Ancillaries Electricity Consumption
- **Powertrain Efficiency**: Mechanical Yields, Powertrain Energy Management
- **Energy Production**: Energy Conversion, Aftertreatment

**DRIVER**

NEDC: $1 \text{ CO}_2$ g/km $\approx 10$ kg or 0.020 SCx or 8 Newton or 30 Watt (elec)
HOW TO IMPROVE IN-USE FUEL ECONOMY

01 TECHNOLOGY ALONE WILL NOT SOLVE ALL CHALLENGES

02 HELP ALSO YOURSELF… WITH THE SUPPORT OF PRODUCTS & SERVICES

Eco-driving: Strategic, tactical, and operational decisions of the driver that influence vehicle fuel economy

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University of Michigan Transportation Research Institute, 2901 Baxter Road, Ann Arbor, MI 48109-2150, USA

Transport Policy 22 (2012) 96–99

A good 15% fuel reduction is easily achievable at a very low carbon abatement cost.
Since 2008, a dedicated in-house eco-driving programme

**Objective:** Support the driver to better use his vehicle and minimize its real fuel consumption.

**DRIVINGECO²** = \textit{ECO}logical and \textit{ECO}nomical driving

All the means given to the driver to consume less fuel

- Technical/non technical
- Before, during and after driving

Driving eco² is made of **product** and **services**

- **On-board:** Driving style indicator, eco-mode button, gear changes indicator, trip report, eco-coaching, eco-navigation
- **Off-board:** \textit{eco-trainings} (B2B and Bt2C) and \textit{eco-challenge} (B2B), particularly useful for private fleet operators
1. Delegation « My car is doing »
   - eco-mode

2. Implication « My car is teaching me »
   - eco-driving assistance
   - eco-scoring, coaching, challenge

3. Training « A coach is teaching me »
   - embedded technologies are helping me before & after the training like a tutor
Trip report, driving style indicator and eco-coaching allow to reduce until 25% its consumption by an implication of the driver.
DRIVING ECO² IN THE VEHICLE

1. Dashboard
   Driving style indicator, Gear changes indicator

2. Eco-mode button

3. R-Link
   Trip report, Eco-coaching, Eco-navigation
1 – DASHBOARD: DRIVING STYLE INDICATOR

- A bright witness on the dashboard allows to inform the driver about its real time driving style and thus to adapt its driving accordingly.

- Taken into account the vehicle speed, the management of the accelerations, the management of the decelerations and the speeds changes.

- The style of driving is permanently indicated by variation of color and luminous intensity.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
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<tbody>
<tr>
<td>Green</td>
<td>good economical driving</td>
</tr>
<tr>
<td>Yellow</td>
<td>consumption and emissions can be improved</td>
</tr>
<tr>
<td>Amber</td>
<td>driving is too dynamic and eco performance is low</td>
</tr>
</tbody>
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2 - ECO-MODE BUTTON

This mode, actionable with a simple pressure on a button, allows fuel savings, immediate and simply by modifying the performances of the vehicle:

- Modification of the accelerator pedal mapping
- Reduction of engine torque
- Thermal comfort is adapted to reach smoothly desired cooling/heating (regulated A/C)

Driver can disconnect this eco-mode via a kick-down on the accelerator pedal.

Did you know about it?

The eco-mode button only allows to reduce vehicle fuel consumption up to 10%.
3 – VIEW THROUGH R-LINK, THE RENAULT NAVIGATION SYSTEM

- After his journey, the customer can view his eco-driving performance
3 – DRIVER EDUCATION USING THE NAVIGATION SYSTEM

TRIP REPORT

Journ. Summary
Distance: 4.6 km - Duration: 0 h 7 min

- Average consumption: 0.3 L/100km
- Total consumption: 2.7 L
- Average speed: 44.2 km/h
- Kilometers saved: 0.3 km

ECO COACHING

Eco advice
Destination: 9999.9 km - Duration: 99 d 23 h 32 m

Maintain a steady speed as soon as possible (from 40km/h). Brake with the engine and use your foot brake as little as possible. Allowing the vehicle to slow naturally helps to cut the fuel flow.

Current trip: Anticipation 6 / 10
3 - ECO NAVIGATION

- This feature, integrated into the navigation system allows the driver to take the lowest fuel consuming trip for a given route and indicate the speed limit authorized on the section.
ECO DRIVING: A STRONG LEVER TO INCREASE EV DRIVING RANGE

Reachable for the driver?

- Partially
- No
- Partially
- Fully
DRIVING ECO² IN RENAULT ZOE ELECTRIC VEHICLE

Dashboard
Driving Style Indicator, Econometer

R-Link
Eco-scoring, Eco-coaching,

Eco-mode Button
DRIVING ECO² CUSTOMER FEEDBACK?

- Survey in France & Netherland (Q4 2013)

The idea of the Driving Eco 2 functions are widely appreciated: at last, something that is directly related to the driving, and the gamification aspect makes it fun and easy to use. It is even more appreciated by the Zoe owners who find it almost indispensable.

Several respondents would like to be able to share their scores with other R-link owners.
SOME TAKEAWAYS

- Whatever the powertrain and the fuel, whatever the market, whatever the driving conditions, closing the gap between homologated and in-use fuel consumption values will need to reinforce driver education & empowerment.

- This potential is still widely open. New embedded technologies and off-board services are introduced by almost all OEMs.

- Broad customer acceptance

- Not only for mature markets.…