EcoTest as a Basis for a Global Green Labelling – Discrepancies between manufacturer’s specifications and actual fuel efficiency

GFEI Workshop on In-use Fuel Economy

Session 1 – Current status and recent findings in measuring in-use fuel economy

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ADAC Technik Zentrum

- ADAC is the world’s 2nd largest automobile club with more than 18.9 m members enjoying the status of a consumer protection organisation
- ADAC Technik Zentrum: Test centre of the European FIA clubs
- Emission tests, car reviews, crash tests, product tests, total cost of ownership, etc.
- What does consumer protection mean?
  - no commercial interest in products
  - neutral publication
  - focus on product improvement

The players in consumer protection:
FIA partner clubs, EU, Federal Government, ICRT

Example: European Test Consortium for Child Restraint Systems
ADAC emissions lab and low-temperature dynamometer

Emissions lab
- Temperature range: -10°C to +40°C
- max. speed 200 kph
- Simulation of uphill sections (up to 20%)
- CO, HC, CH₄, THC, NMHC, NOₓ, NO, NO₂, PM, PN, CO₂
- official type approval lab

Low-temperature dynamometer
- Temperature range: -25°C to +30°C
- Horsepower up to 2 x 260 kW (2 x 350 hp)
- max. speed up to 260 kph
- OBD data interface
- Variable wheelbase: between 2.36 and 3.36 m
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ADAC EcoTest

- Since 2003 comprehensive consumer information regarding the eco-friendliness of vehicles
- Assessment of fuel consumption (CO₂ emissions) and pollutant emissions
- Based on specially developed real-life driving cycles, which go beyond the mandatory type approval test cycles
- Objective: innovation, light-weight design and fuel efficiency across all vehicle classes
- Manufacturers use EcoTest as a standard and include the test label in their advertising
- Adjustment of the test and rating criteria as from April 2012:
  - Inclusion of the WLTP cycle (the coming world-wide test cycle)
  - Well-to-wheel assessment for better comparability of electric vehicles
  - Electric cars are assessed on the basis of the energy consumed (kWh) incl. self-discharge and the CO₂ emissions from power plants based on the German (D) electricity mix (Source: Federal Environment Agency, UBÄ) and renewable energies
  - Stricter CO₂ limits
  - Adjustment of pollutant assessment to Euro 6 (petrol engines)
  - Measurement and assessment of the particle number
EcoTest rating is more than CO$_2$ and fuel consumption

A car has to be:
- clean
- efficient
- tested under conditions near to reality

EcoTest rating:
- Polutant rating (absolut)
- CO$_2$ rating (well-to-wheel, class dependent scale)

Additional information: Fuel consumption
EcoTest rating – 5-star rating system

- **Small ecological footprint**
  - >90
    - 5 stars
  - 70...89
    - 4.5 stars
  - 50...69
    - 4 stars
  - 30...49
    - 3 stars

- **Large ecological footprint**
  - <30
    - 1.5 stars
EcoTest test cycles

- **NEDC cold**
  Initial assessment; testing for pollutants such as HC, CO, NOₓ, particulate matter and NEW! the particle number of diesel and direct-injection petrol engines; NEW! daytime running lights (if present) or low beams are on during test; CO₂ testing

- **WLTP**
  “World cycle” replaces NEDC hot; with air conditioning on and NEW! daytime running lights (if present) or low beams are on during test; CO₂ testing

- **ADAC Motorway test**
  With air conditioning on and NEW! and daytime running lights (if present) or low beams on during test; testing for pollutants such as HC, CO, NOₓ, particulate mass; CO₂ testing
EcoTest test cycles

- **Petrol and diesel vehicles**
  No special sequence

- **LPG/CNG vehicles**
  NEW! EcoTest is run only on LPG/CNG drive

- **Hybrids**
  Battery state of charge (SOC) 60-70 %

- **Plug-In-hybrids**
  Measurement of full battery and measurement of empty battery – standard averaging; measurement of the charge (energy input) in kWh and calculation of CO₂ emissions (1 kWh = 563 g/kWh; Source: UBA; this value is corrected as needed)

- **Electric vehicles**
  Measurement in electric vehicle cycle (all three cycles back to back) until SOC < 50 %; measurement of the charge (energy input) in kWh and calculation of CO₂ emissions (1 kWh = 563 g/kWh; Source: UBA; this value is updated as needed); power plant emissions are not relevant
ADAC EcoTest

Polutants rating – thresholds

- All types of drives or fuels are equal in ADAC EcoTest.

Unlike under current legislation
- no bonus for diesel engines applies in ADAC EcoTest
- test of aggressive driving emissions (Motorway / off-cycle)

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ADAC EcoTest

CO₂ rating – thresholds, well-to-wheel

- CO₂ ratings are based on a system of relative class-dependent scales.

The ADAC EcoTest offers consumers useful information for comparing vehicles of the same size and vehicle class and considers the source of the fuel (well-to-wheel).
### CO₂ rating – vehicle classes and sample cars

<table>
<thead>
<tr>
<th>No.</th>
<th>Vehicle class</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Microcar</td>
<td>Smart</td>
</tr>
<tr>
<td>2</td>
<td>City</td>
<td>Fiat 500, Peugeot 107, VW up!</td>
</tr>
<tr>
<td>3</td>
<td>Supermini</td>
<td>Ford Fiesta, Peugeot 208, VW Polo, Audi A1</td>
</tr>
<tr>
<td>4</td>
<td>Small family</td>
<td>Mercedes A-Class, Toyota Auris, VW Golf</td>
</tr>
<tr>
<td>5</td>
<td>Family</td>
<td>3-series BMW, Mazda 6, Opel/Vauxhall Insignia, Toyota Avensis</td>
</tr>
<tr>
<td>6</td>
<td>Executive</td>
<td>Audi A6, 5-series BMW, Mercedes E-Class, Volvo V70</td>
</tr>
<tr>
<td>7</td>
<td>Luxury</td>
<td>Audi A8, 7-series BMW, Mercedes S-Class</td>
</tr>
</tbody>
</table>

A family will seek for the cleanest and most efficient car in the category Small Family, a single person in a large city will seek for the cleanest and most efficient Microcar, etc.
For Global NCAP we need to develop a conclusion for energy sources in different countries to drive clean vehicle technology (efficient, clean), as well as clean energy production and energy supply.
Well-to-Wheel (WTW) – CO$_2$ emissions in EcoTest vs. manufacturer’s specifications

The EcoTest CO$_2$ results of electric cars may considerably depart from manufacturers’ specifications due to energy generation and driving cycles.
5-stars-vehicles in EcoTest (Top 3):

- **CNG:**
  - Mercedes E 200 NGD 7G-TRONIC PLUS
  - Audi A3 Sportback g-tron S tronic
  - VW Golf 1.4 TGI BlueMotion

- **Electric:**
  - VW eGolf
  - VW e-up!
  - Tesla Modell S
  - BMW i3

- **Hybrid:**
  - Toyota Prius 1.8 Plug-In Hybrid
  - Toyota Auris 1.8 Hybrid
  - Toyota Prius 1.8 Hybrid

- **Diesel:**
  - Mercedes E 220 BlueTEC BlueEFFICIENCY Edition 7G-Tronic
  - Mercedes C220 BlueTEC
  - VW Golf 1.6 TDI BlueMotion
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Limits and tolerances in fuel efficiency specifications

- Discrepancies between manufacturer’s specifications and actual fuel efficiency has been a frequent reason for litigation between consumers and manufacturers.

- When it comes to fuel consumption, we must distinguish between
  - manufacturer’s specifications based a test cycle (NEDC – New European Driving Cycle) in line with EU Reg. 715/2007 (type approval)
  - the fuel consumption of a specific vehicle in real-life use in traffic
  - the fuel consumption of the specific vehicle in cause measured in a test cycle (NEDC – New European Driving Cycle) in line with EU Reg. 715/2007

- Whereas manufacturers’ fuel efficiency specifications are verified under defined conditions in a lab, the fuel consumption observed by the motorist depends on personal driving styles, the speed profile, weather conditions, vehicle payload etc.

The fuel consumption observed in real-life traffic cannot be compared with manufacturers’ fuel efficiency specifications.
Fuel consumption in EcoTest vs. manufacturer’s specifications

- Petrol n = 137
- Diesel n = 156
- Electric n = 12
- Hybrid n = 24
- LPG n = 5
- CNG n = 11

20% underconsumption
10% underconsumption
Same
10% overconsumption
20% overconsumption
30% overconsumption
Fuel consumption in EcoTest vs. manufacturer’s specifications – Classified by fuel type

- Petrol: n = 137
- Diesel: n = 156
- Hybrid: n = 24
- LPG: n = 5
- CNG: n = 11
- Electric: n = 12

Percentage divergence [%]
Fuel consumption in EcoTest vs. manufacturer’s specifications – Classified by vehicle class

- Vehicle class 1+2: n=21, percentage divergence [\%] = 18
- Vehicle class 3: n=46, percentage divergence [\%] = 16
- Vehicle class 4: n=138, percentage divergence [\%] = 14
- Vehicle class 5: n=86, percentage divergence [\%] = 12
- Vehicle class 6: n=37, percentage divergence [\%] = 14
- Vehicle class 7: n=17, percentage divergence [\%] = 10
Fuel consumption in EcoTest vs. manufacturer’s specifications – Classified by fuel type and vehicle class

- Petrol
- Diesel
- Hybrid
- LPG
- CNG
- Electric

Vehicle classes with numbers of test cars:
- Vehicle class 1+2: n=21
- Vehicle class 3: n=46
- Vehicle class 4: n=138
- Vehicle class 5: n=86
- Vehicle class 6: n=37
- Vehicle class 7: n=17

Percentage divergence [%]
Conclusion

- EcoTest measurements show an increased consumption in comparison to the manufacturer's informations
- The largest deviations are indicated for vehicles with electric and hybrid drive
- EcoTest is suitable to provide a basis for the GreenNCAP

- With the exception of EcoTest, all popular eco-friendliness car ratings are based on manufacturer’s specifications and thus do not reflect actual fuel consumption.
- EcoTest offers more realistic emission and fuel consumption data for consumers and can be used as a basis for the new Green NCAP protocol and roadmap.
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Global NCAP Cars, EcoTest Results in Detail

Ford Figo 1.0 Trend
Suzuki Alto 1.0 Basic
VW Polo 1.2 Trendline
Tata Nano
Hyundai i10 1.1 Classic
## Global NCAP Cars, EcoTest Results in Detail

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Power [kW]</th>
<th>Engine /fuel</th>
<th>FC [l/100km]</th>
<th>CO2 EcoTest</th>
<th>Pollution Score</th>
<th>CO2 Score</th>
<th>EcoTest Score</th>
<th>EcoTest Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ford Figo 1.0</td>
<td>48</td>
<td>Gasoline</td>
<td>8,14</td>
<td>210,94</td>
<td>25</td>
<td>4</td>
<td>29</td>
<td>*</td>
</tr>
<tr>
<td>Trend</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyundai i10 1.1</td>
<td>51</td>
<td>Gasoline</td>
<td>6,85</td>
<td>186,00</td>
<td>43</td>
<td>10</td>
<td>53</td>
<td>***</td>
</tr>
<tr>
<td>Classic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suzuki Alto 1.0</td>
<td>50</td>
<td>Gasoline</td>
<td>5,70</td>
<td>151,69</td>
<td>31</td>
<td>21</td>
<td>52</td>
<td>***</td>
</tr>
<tr>
<td>Basic</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tata Nano</td>
<td>28</td>
<td>Gasoline</td>
<td>4,30</td>
<td>120,95</td>
<td>49</td>
<td>34</td>
<td>83</td>
<td>****</td>
</tr>
<tr>
<td>VW Polo 1.2</td>
<td>51</td>
<td>Gasoline</td>
<td>7,12</td>
<td>195,78</td>
<td>43</td>
<td>11</td>
<td>54</td>
<td>***</td>
</tr>
<tr>
<td>Trendline</td>
<td></td>
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</tbody>
</table>
The best vehicle is the Tata Nano with 83 points in the EcoTest, the fuel consumption is 4.30 l/100 km or 25.32 mpg (US), resulting in CO2-emissions of 121.0 g/km (WTW).

The worst vehicle is the Ford Figo with 29 points in the EcoTest, the fuel consumption is 8.14 l/100 km or 47.93 mpg (US), resulting in CO2-emissions of 210.9 g/km (WTW).
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Green NCAP: Requirements from FIA

- Green NCAP is a common Project of the Global New Car Assessment Program (GNCAP) and the Goibal Fuel Economy Initiative (GFEI).

- **Aim:**
  - Setting a more stringent test procedure for environmental performance of cars similar to NCAPs which already do this for crash tests and successfully rate safety features of vehicles.
  - Development of a new rating system to assess and quantify environmental performance of cars based on
    - tailpipe emissions ($\text{CO}_2$, CO, NO$_x$, PM$_{10}$, PM$_{2.5}$ and HC in g/km or µg/km)
    - energy efficiency (in MJ/km)
    - noise (in dB).
### EcoTest as a Phase-in for a Green NCAP Roadmap

<table>
<thead>
<tr>
<th></th>
<th>Cars per Year</th>
<th>Emissions</th>
<th>NEDC (cold)</th>
<th>ADAC Highway (warm)</th>
<th>WLTP (warm)</th>
<th>WLTP (cold)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EcoTest Data from ADAC</td>
<td>ADAC: 150 European cars per year</td>
<td>CO2, HC, CO, NOx, PM</td>
<td>for cross check</td>
<td>for off cycle banning</td>
<td>for real world driving</td>
<td>no</td>
</tr>
<tr>
<td>Global Green Label from GreenNCAP</td>
<td>ADAC: 150 Euro. + Latin NCAP, Global NCAP</td>
<td>CO2, HC, CO, NOx, PM</td>
<td>Phase 1</td>
<td>Phase 1</td>
<td>Phase 1</td>
<td>Phase 2</td>
</tr>
<tr>
<td>Global Green Label from GreenNCAP</td>
<td>GNCAP Labs (European, Transatlantic)</td>
<td>CO2, HC, CO, NOx, PM</td>
<td></td>
<td></td>
<td></td>
<td>Phase 3</td>
</tr>
<tr>
<td>Global Green Label from GreenNCAP</td>
<td>Further development stages like Euro NCAP</td>
<td>further Roadmap within GNCAP</td>
<td></td>
<td></td>
<td></td>
<td>+ (...)</td>
</tr>
</tbody>
</table>

### Examples for GreenNCAP Label
Thank you very much for your attention!