Improving Sustainability in the Transport Sector

- A study by the Institute for Energy and Environmental Research (IFEU) in Heidelberg, concludes that lightweighting passenger cars, trucks, rail vehicles, nautical vessels and aircraft would have a significant impact on global, transportation-related GHG emissions.

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As a general indicator…

1 kg of aluminium replacing conventional vehicle materials

has the potential to eliminate

20 kg of CO_2 during the operating life of the average vehicle

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- Measures to reduce energy consumption should concentrate on the in-use stage
  - The in-use stage of the average vehicle's life cycle represents more than 80% of total energy consumption
  - Whereas the material production, manufacturing and end-of-life stages represent less than 20%

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- Life cycle example 1: Bumper
  - The bumpers of two similar European cars were compared
    - Similar vehicle weight (1,100 to 1,200 kg)
    - Similar diesel consumption of 6 litres per 100 km
    - Same crash testing requirements

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- Life cycle example 1: Bumper
  - Bumper specifics:
    - Mass of aluminium bumper: 3.2 kg
    - Mass of high strength steel bumper: 5.8 kg
    - The aluminium solution gives 45% direct weight savings
    - No indirect saving included in this example
    - Total recycling rate 91% for both bumpers

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- Life cycle example 1: Bumper
  - The full life cycle of both solutions were compared, including the full production chain, use and recycling.
    - Utilizing public available information on production, usage and recycling.
    - Observing the principles of life cycle assessment per ISO standard 14044 with regards to energy and greenhouse gas emissions.

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- Life cycle example 1: Bumper
  - With a lifetime of 200,000 km the aluminium bumper saves
    - 48 kg greenhouse gas emissions compared to the equivalent high strenght steel bumper.
    - Or 15 kg CO_2eq per kg aluminium
  - Carbon footprint
    - Aluminium bumper: 67 kg CO_2eq
    - Steel bumper: 115 kg CO_2eq

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- Life cycle example 2: Motor block
  - This medium weight compact car has a mass of 1,250 kg and a gasoline consumption of 7.5 litres per 100 km.
  - The car manufacturer has studied an aluminium version and a steel version with identical performance characteristics
    - Mass of aluminium component: 16.4 kg
    - Mass of steel component: 31.0 kg
    - Mass difference: 14.6 kg
    - Indirect mass savings: 23% of 14.6 kg = 3.4 kg
    - Effective weight savings: 18.0 kg

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- Life cycle example 2: Motor block
  - Results for this compact car show, after a lifetime driving distance of 200,000 km, savings
    - of approximately 280 MJ per kg of aluminium in primary energy and
    - about 20 CO_2eq per kg of aluminium in greenhouse gas.

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- The use of 7 million tonnes of aluminium for passenger car components manufactured in 2006, instead of heavier materials, will result in potential global savings of:
  - approximately 140 million tonnes of CO_2 equivalent greenhouse gas emissions
  - primary energy equivalent to around 55 billion litres of crude oil

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- Aluminium industry will:
  - Continue to reduce greenhouse gas emissions from its production facilities
- Transport design should:
  - Optimise vehicle recycling
    - Aluminium scrap is recyclable, has a high value and low energy needs during the recycling process
  - Optimise energy inputs in manufacture and use

Improving Sustainability in the Transport Sector

- Full report available on IAI website
  - www.world-aluminium.org
- Model and case studies available on request
  - IAI@world-aluminium.org
- IFEU reports
  - H. Helms, U. Lambrecht and U. Höpfner: Energy savings by light-weighting, IFEU (2003)
  - H. Helms and U. Lambrecht: Energy savings by light-weighting, part II IFEU (2004)
  - H. Helms and U. Lambrecht: The Potential Contribution of Light-Weighting to Reduce Transport Energy Consumption. Int. J. LCA 12 (2) 140 (2007), pp. 58–64