Sustainable Life Cycle Management of complex products: Automobiles

- Input / material issue?
- Output / Sustainability issues
- Product Sustainability Index

Wulf-Peter Schmidt

Manager Sustainability
Vehicle Environmental Engineering

Ford of Europe

Feel the difference

Material input vs. Emission output perspective

Peak oil
Resource depletion
Limits to Growth

Issue: Quantity (and quality) of Material used

Recycling Regulation

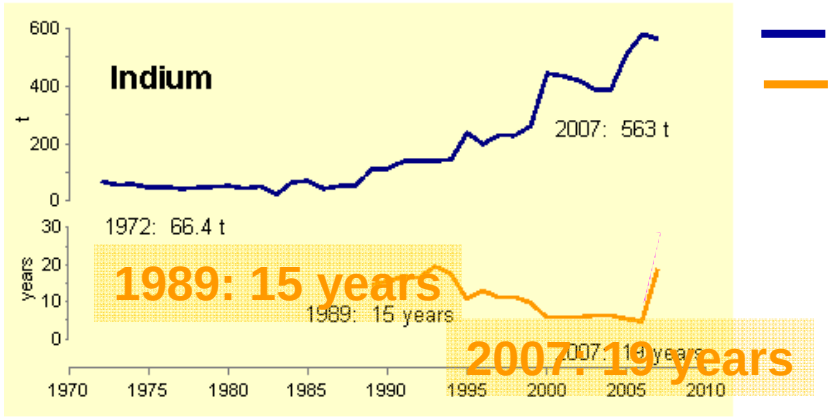
Life Cycle Management

Pollution
Climate Chaos
Limits to Growth

Issue: Quality (and quantity) of Emission

Emission Regulation

Resource Issue – depletion or economics?



Refinery production

Static life time of reserves

Real price indices of metallic minerals (2000 = 100)

450
400
350
300
250
200
150
100
50
0

1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010

Asia, Speculation

Production increase

EU report: Critical raw materials for the EU

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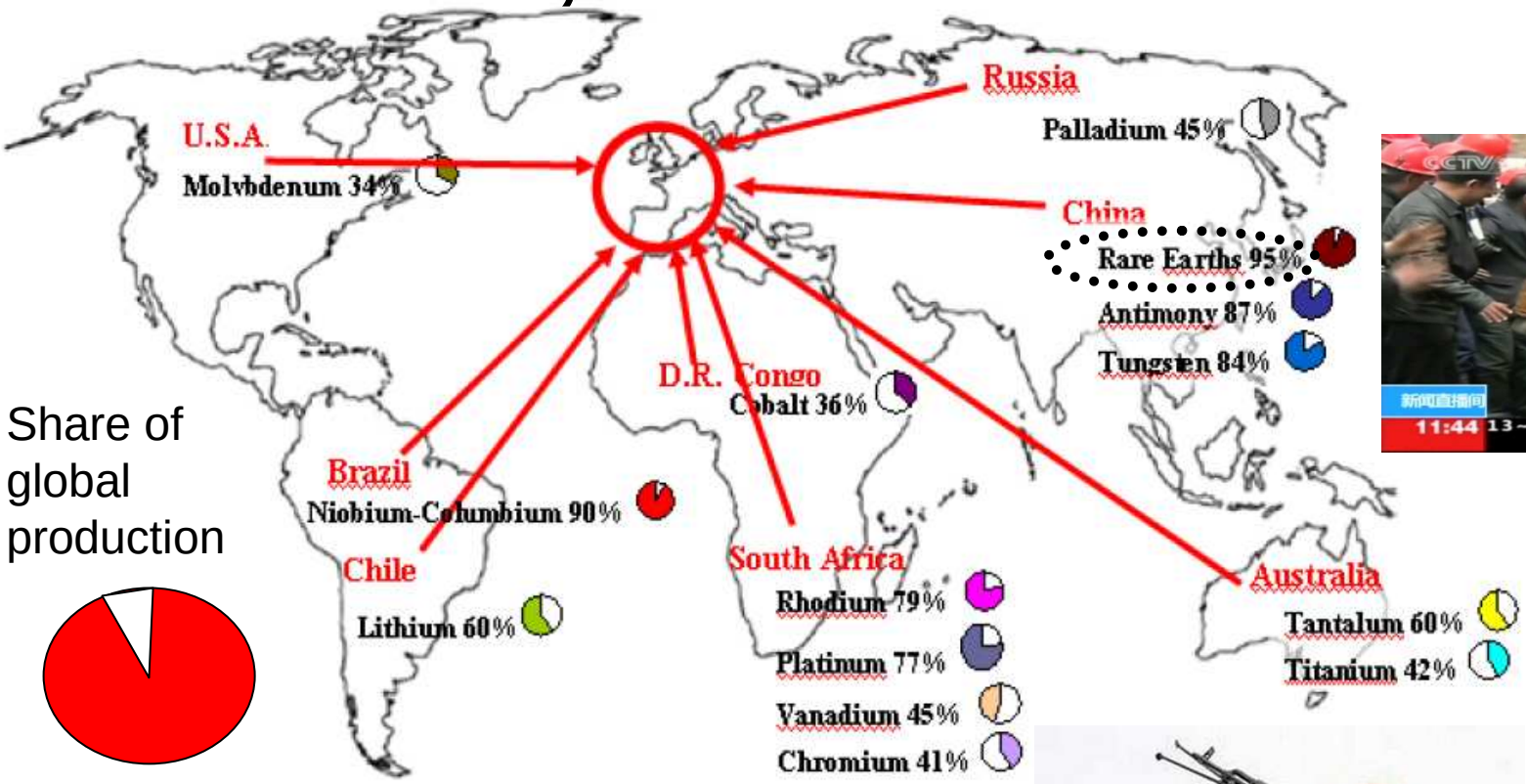
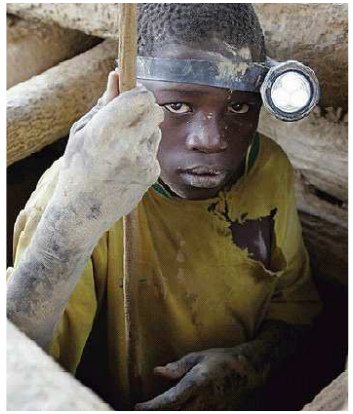
Dependency issue – politics, trade, ethics, environmental, etc.



Share of global production



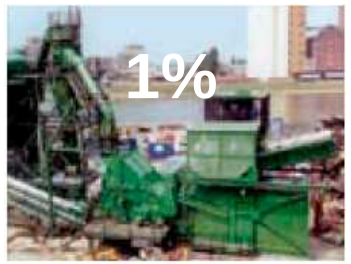
Source: EU Commission:**COMMISSION STAFF WORKING DOCUMENT *accompanying the* COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL THE RAW MATERIALS INITIATIVE — MEETING OUR CRITICAL NEEDS FOR GROWTH AND JOBS IN EUROPE;** SEC(2008) 2741, Brussels 2008

Recycling & Design as solution?

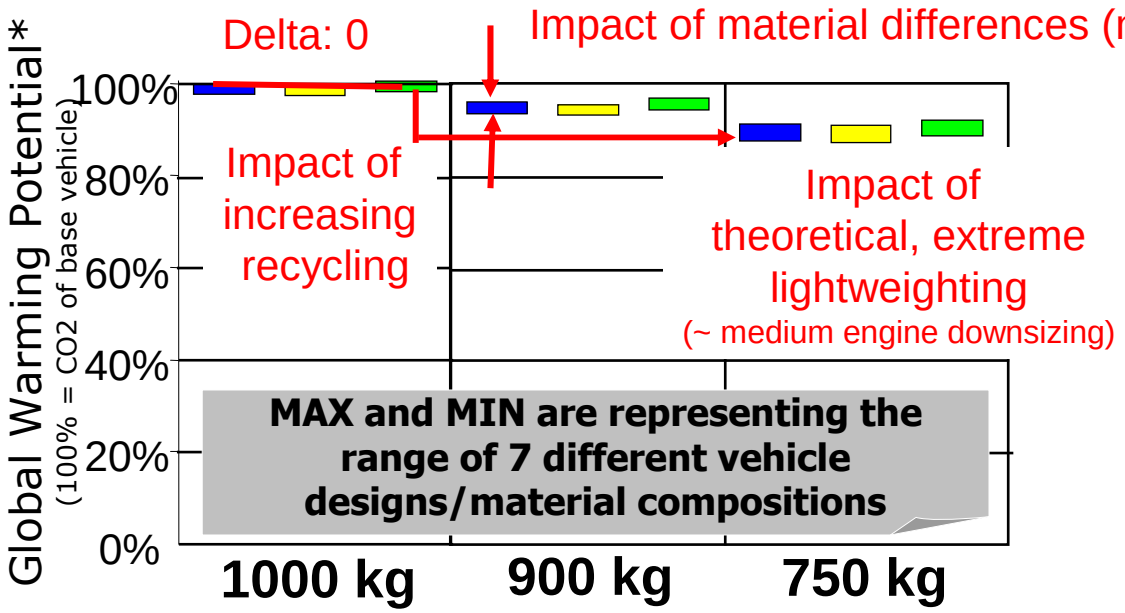
Materials & Parts

Manufacture and Assembly

Vehicle Use



End of Life



- Situation today (Metal recycling, organics/ceramics to landfilling)
- Mechanical Recycling
- Energy Recovery of organics, recycling of metals, landfilling of ceramics/glass

* Similar for other environmental impact; Source: EU funded, ISO14040 reviewed LCA LIRECAR

Material input/up-stream issues - conclusions

- Mainly a **supply chain management** issue for **manufacturers**.
- Mainly a **trade and** political **issue for governments**.
- Mainly a **substitution** issue for **research**.

- "**Material ecology**" is **too limited** in scope:
  - **Efficient use** of materials **is a given** due to costs, weight, logistics, etc. → tailored to application.
  - **Recycling** is done **where reasonable** / no additional relief – positive value of end-of-life vehicles.

Sustainability of Cars – The Output/Downstream Challenges

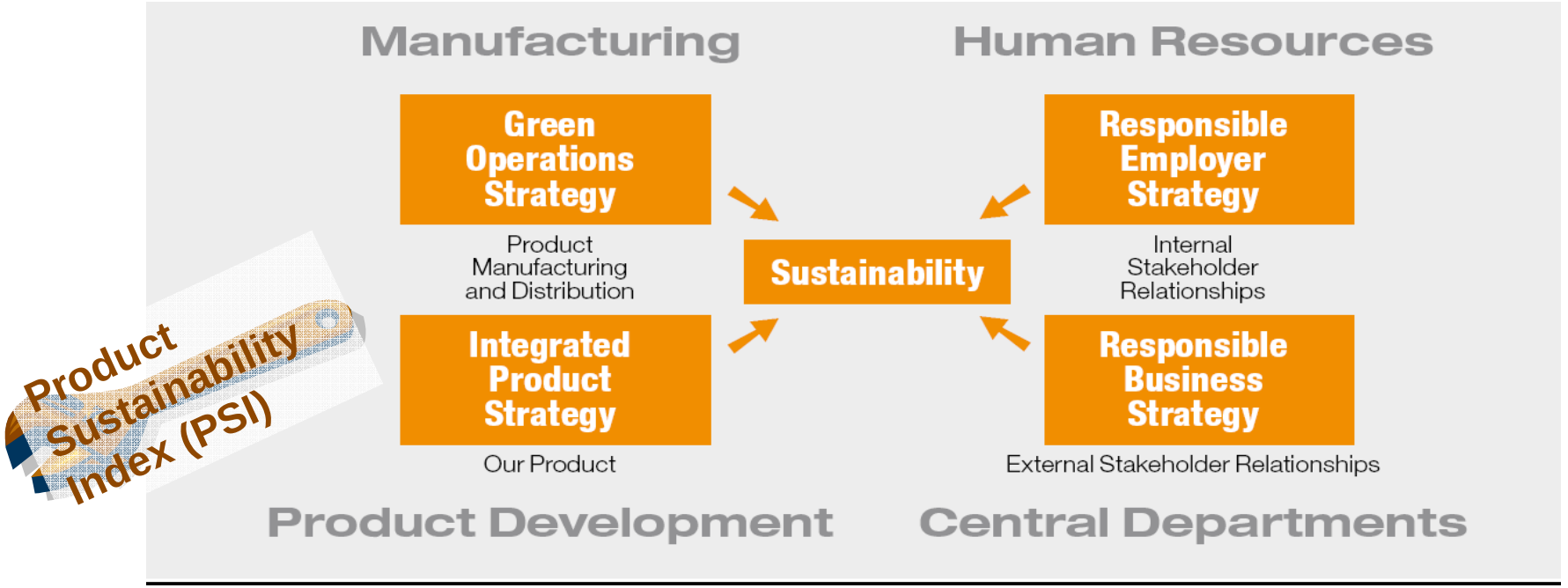
Environment

Society

Economy

Complexity of cars

Ford of Europe‘s functional organisation of sustainability – combining input/output



- Main organisational functions are responsible / accountable for their bit of sustainability
- Tailored Sustainability Management Tools

What is PSI measuring – how and why?

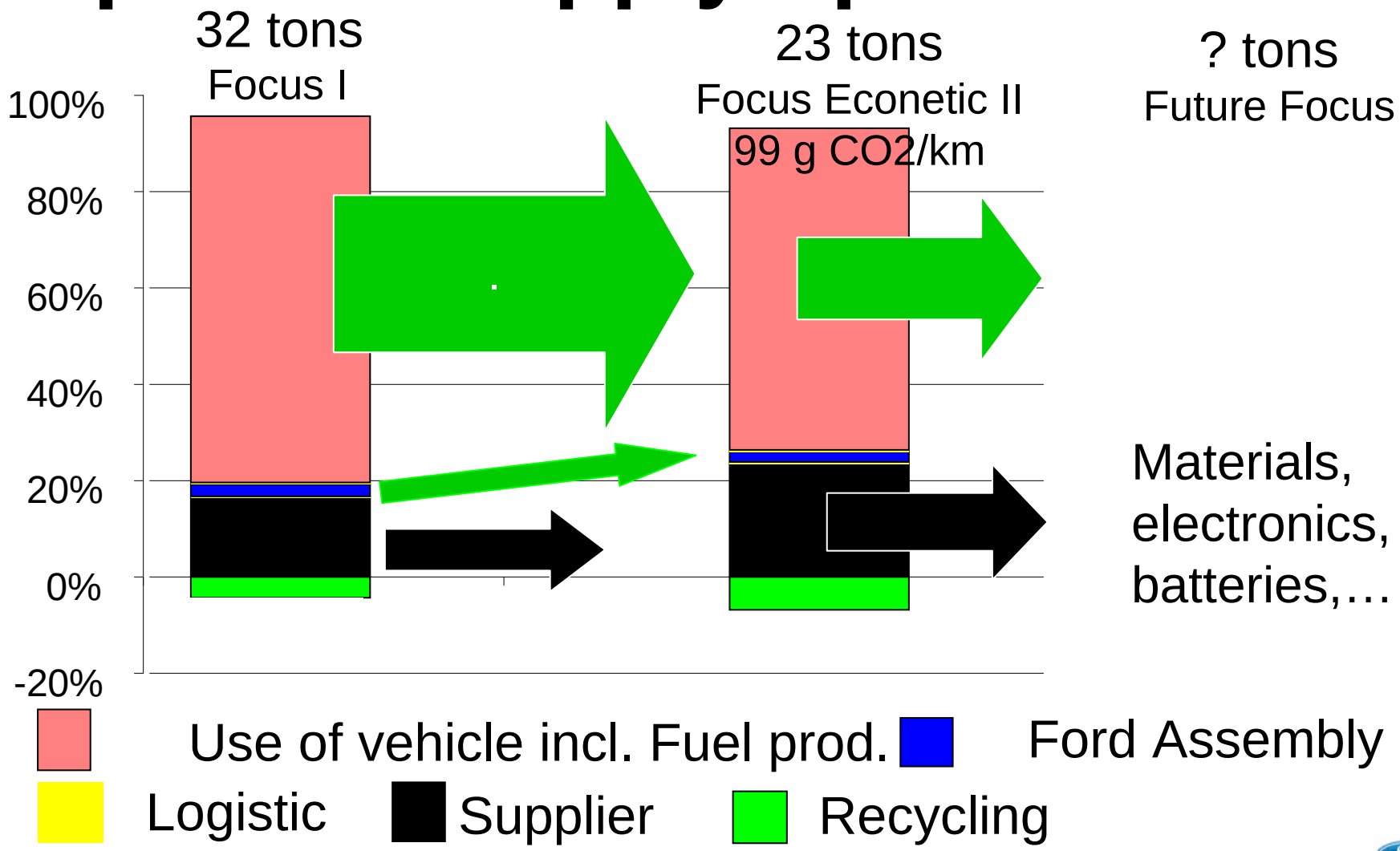
Indicator	Metric	Why Important?
Life Cycle Global Warming Potential	Climate Change gases along the product life cycle* (LCA)	Carbon intensity as main strategic issue
Life Cycle Air Quality Potential	Summer Smog gases (NOx, VOC) along the life cycle* (LCA)	Potential trade-off: non-C(emissions
Sustainable Materials	recycled & natural materials per vehicle polymer weight	Resource Scarcity
Restricted Substances	Allergy-tested label etc. (15 point rating)	Substance risk manageme
Drive-by-Noise	Drive-by exterior Noise = dB(A)	Society concern
Safety	Different Safety criteria	Main direct impact
Mobility Capability	Mobility capacity (seats, luggage) to vehicle size	Crowded cities (future: disabled)
Life Cycle Ownership Costs	Price + 3 years fuel, maintenance costs, taxation - residual value	Consumer focus/ Competitiveness

*(from raw material extraction through production to use (150000 km) and recovery)

Note: legal compliance issues (recycling) are the baseline, i.e. not a topic of PSI.

Most data anyway tracked by PD / panel charts

Tailpipe/Life Cycle CO2 down
Footprint of supply up



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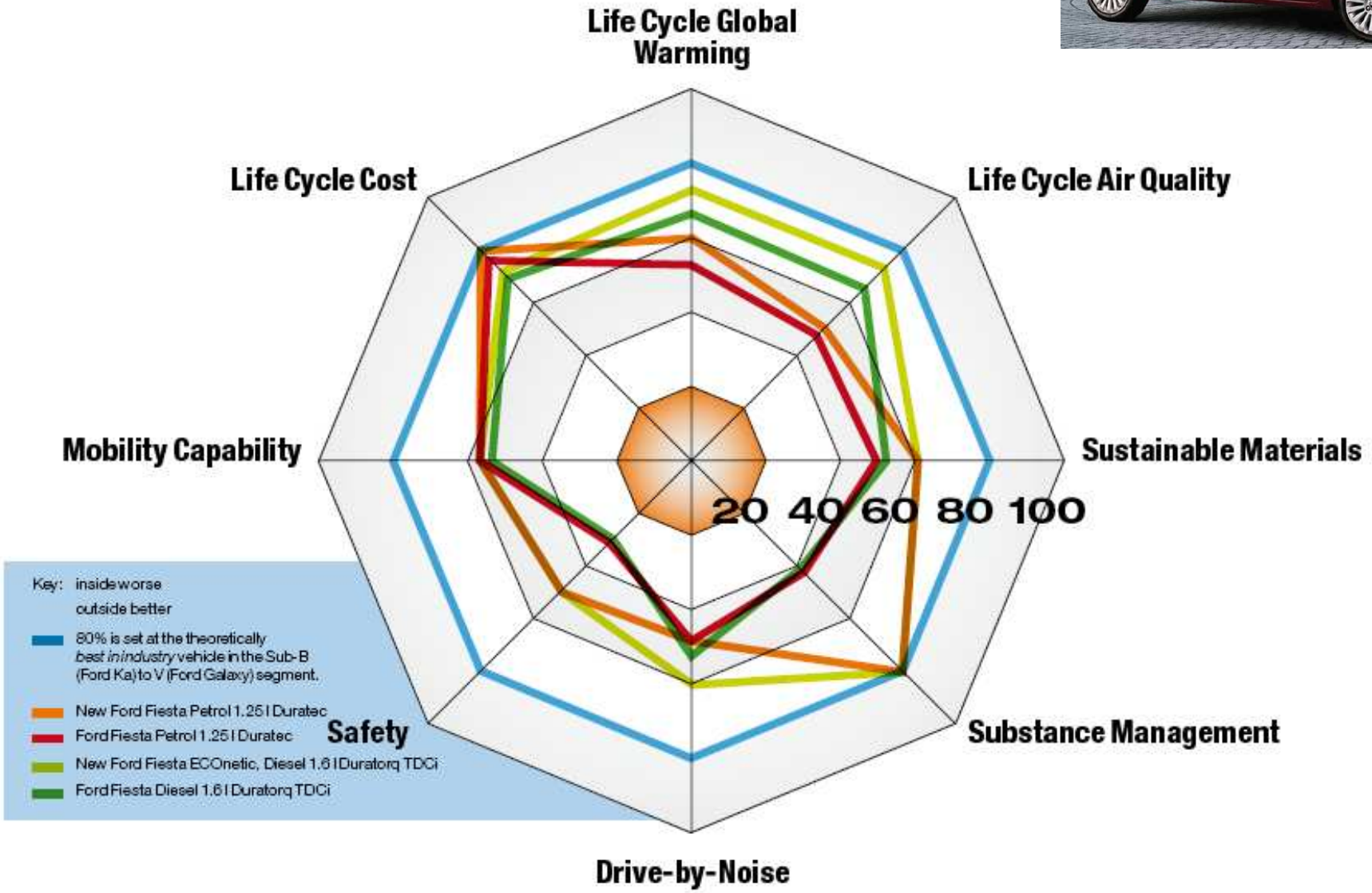
Product Sustainability Index –
managing all aspects of vehicle sustainability



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Conclusions

- Need to concentrate on **hot-spots** (vehicle level) due to vehicle complexity
- **Holistic life cycle perspective** important – environment, social and economic – not only Material Ecology
- Material issues can**not be limited to material/input perspective** but need to be seen in perspective of life cycle sustainability as well as politics/trades.

Back-up

Balancing sustainability requirements in today‘s vehicles

Bi-Fuel
CNG/
Gasoline



Bi-Fuel
LPG/
Gasoline



Flexifuel-
Bio-Ethanol/
Gasoline




Tri-Fuel
Bio-Ethanol/LPG/Gasoline

Econetic
Diesel
Vehicles




98 g CO2/km | 99 g CO2/km | 139 g CO2/km | 189 g CO2/km

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Outlook – Electrification?

Transit Connect Electric

Technical Specification:

Range: ~ 130 km (80 mi)

Charging Time: ~ 6 - 8 hours

Energy Storage: Li-Ion Battery (~ 28 kWh)

Focus BEV

Technical Specification:

Range: ~ 120 km (75 mi)

Motor Power: 100 kW

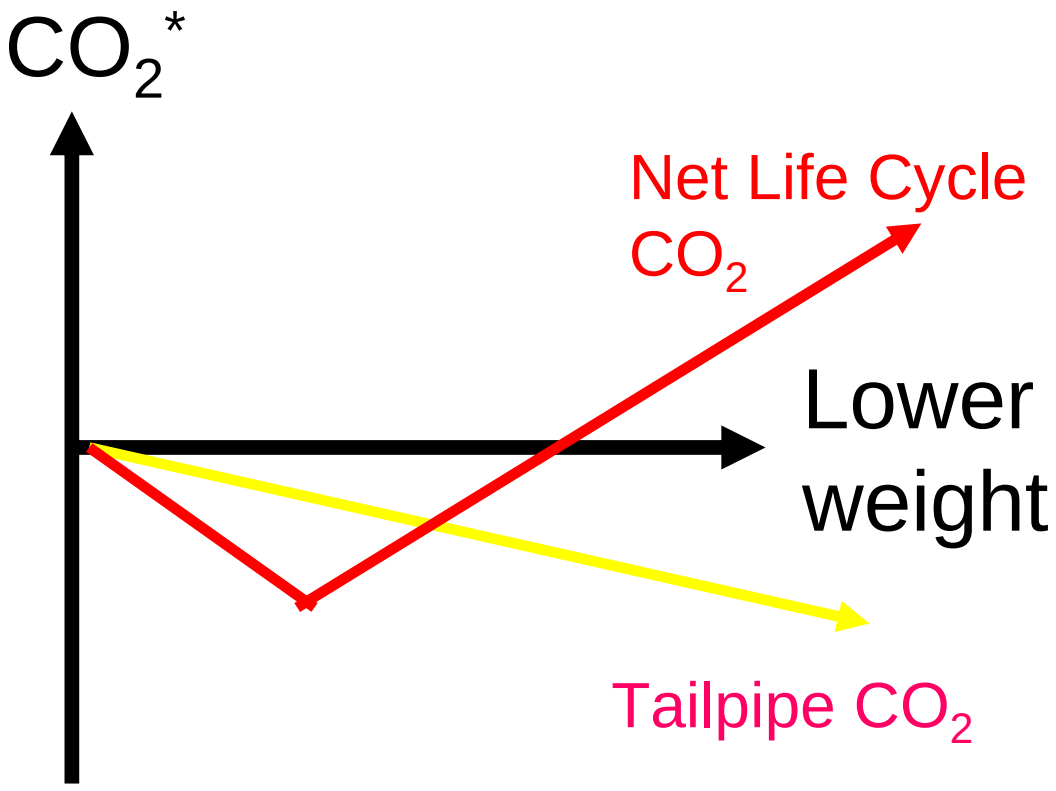
Charging Time: 6-8 hours

Energy Storage: Li-Ion Battery (23 kWh)

- Electric Ford Vehicles (HEV, PHEV, BEV) developed but market introduction requires incentives, production support, infrastructure, customer acceptance
- Battery technology currently very costly
- Renewable electricity / EU Emission Trading Scheme compensates for CO2

Life Cycle Perspective for strategic questions: Extreme lightweighting: Burden shifting when looking only at tailpipe CO_2 / Fuel Economy?

- **Lightweighting reduces tailpipe CO_2**
- **Significant light-weighting requires materials that are linked to high CO_2 in production**
- **Lightweighting (>300 kg) can lead to a net increase of CO_2 if not based on LC thinking**



* Compared to base weight