“A global overview on heavy duty hybrid vehicles”

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Outline

- Short introduction VITO
- IEA-IA-HEV : Annex XII - Heavy-duty Hybrid Vehicles
- EIT–KIC-InnoEnergy
- Conclusions

Short introduction VITO

- Mission : As independent and customer-oriented research organization, VITO (± 600 employees) provides innovative technological solutions as well as scientifically based advice and support in order to stimulate sustainable development and reinforce the economic and social fabric of Flanders.
- Active in Sustainable Technologies in the field of :
  - Energy
    - Smart grids & integration of (PH)EV's
    - Batteries & Ultracapacitors
  - Environment
  - Materials
  - Remote sensing
- More information : www.vito.be
- More information : bluways.com

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IEA–IA–Hybrid & Electric Vehicles

- International Energy Agency (IEA) : www.iea.org
- Implementing Agreement (IA) : Hybrid & Electric Vehicles (HEV)
  - Information source on hybrid & electric vehicles
  - More information : www.ieahev.org (newsletter, ...)
- Some running IA-HEV Annexes (task groups) 1994 - today :
  - Annex I: Information Exchange
  - Annex X: Electrochemical Systems
  - Annex XI: Electric Cycles
  - Annex XII: Heavy-Duty Hybrid Vehicles
  - Annex XIII: Fuel Cells Vehicles
  - Annex XIV: Market deployment of Evs & HEVs : “Lessons Learned”
  - Annex XV: Plug-in Hybrid Electric Vehicles, …

IEA–IA–HEV : Annex XII : Heavy-Duty Hybrid Vehicles

- Objective
  - Report the current status of the heavy-duty hybrid vehicles “playing field”. Besides a general description of the current heavy-duty hybrid vehicle situation, the status report will also focus on emerging hybrid vehicle technologies and market trends.
- Activities
  - Collect and organize information on heavy-duty hybrid vehicles technologies and market potential
  - Share and disseminate knowledge in participating countries
- Period : from 01/01/2007 until 30/11/2010
- 6 Participating countries : Belgium (VITO), Canada (NRCan), Finland (Aalto University), Switzerland (HESS), The Netherlands (Agency NL), United States (NREL)
- Website Annex XII: http://ieahev.vito.be
- Operating Agent : VITO (BE), contact : carlo.mol@vito.be

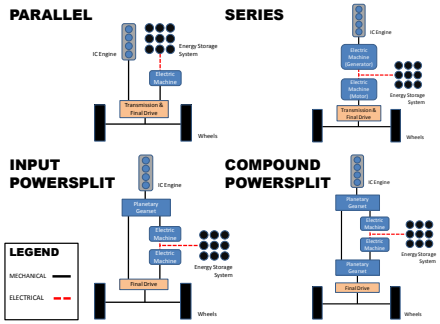
IEA–IA–HEV : Annex XII : Heavy-Duty Hybrid Vehicles

- Structure of Annex XII
  - Subtask I: Heavy-Duty Hybrid Vehicle Technologies
    - Technology oriented subtask
    - Study on components, systems and configurations
  - Subtask II: Heavy-Duty Hybrid Vehicle Market Situation, Trends and Potential
    - Market oriented subtask
    - Study on market potential in different applications : costs vs benefits
  - Subtask III: General Information Gathering and Dissemination
    - Support subtask I and II, write end report
    - Full end report only available for participating countries
    - Dissemination to broader public : website, papers, presentations, …

HEV (hybrid)(electric & hydraulic)

PHEV (plug-in hybrid)

EV (all electric)



Classification

» Important to setup a classification on heavy-duty vehicles because they all have it's own specific requirements, driving cycle and other boundary conditions -> big impact on potential of electrification for vehicles suitable for the application















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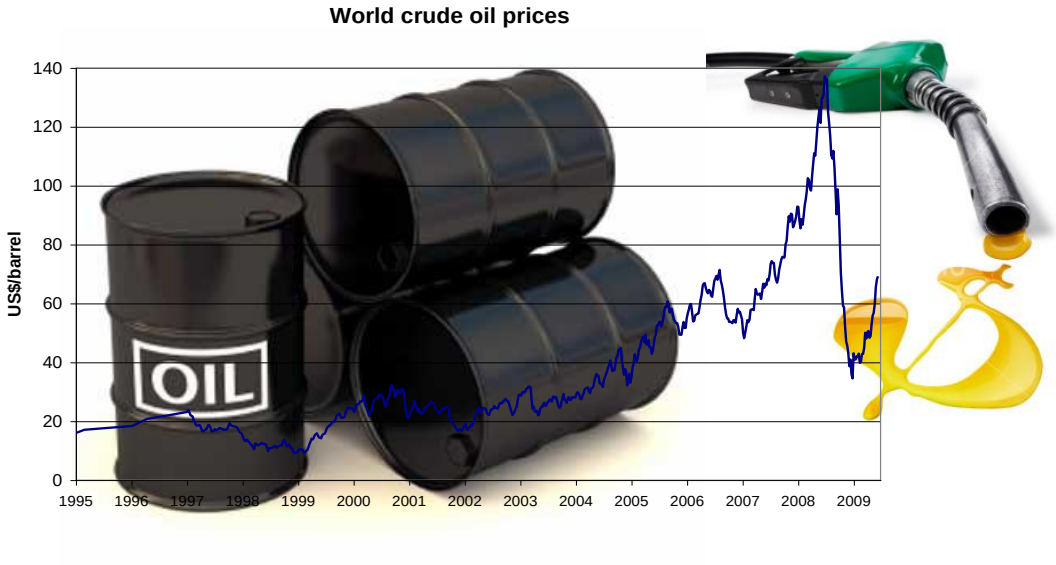
Classification

Main categories	Sub categories
Bus	• city • regional • long distance
Truck	• city distribution/delivery truck • regional distribution • inter- and national transport
Mobile workmachines	• Construction, mining, and earth moving: loaders, excavators, dumpers, bulldozers, etc. • Agriculture and forestry: tractors and their accessories, harvesters, forwarders, etc. • Transportation of goods and material handling: forklifts, straddle carriers, RTGs, terminal tractors, etc. • Municipal or janitorial machines: gardening, cleaning, etc.

Driving forces for electrification



- Economical : fuel cost reduction, …
- Ecological : reduce global and local impact (urban traffic) on the environment
- Technical : performance, comfort, …
- Legislation : emission standards, …
- Government : oil independency, strategic energy plans (EU Renewable Energy Directive), …

Benefits & Barriers for electrification of heavy-duty vehicles

- Benefits :
  - Increase energy efficiency
  - Reduce fuel consumption and emissions, …
- Barriers :
  - Added cost for electrification versus benefits
  - Very diverse market with small production volumes compared to passenger car market
  - Procurement procedures, …

- Matching the right vehicle with the right application (driving cycle, …) = major challlenge

- Choise of the right powertrain has a very big impact, but there are other parameters to take into account for higher energy efficiency

Other parameters for optimizing heavy-duty vehicles

- Hybrid and Electric powertrains (fuel savings reported in a broad range from -5% up to -50% depending on application)
- But also technology improvements besides powertrains are crucial for fuel savings :
  - Eco-driving (-8%)
  - Low-friction tires (-3%)
  - Lightweight materials
  - Aerodynamics
    - Platform for Aerodynamic Road Transport (www.part20.eu)

Trends and insight – Hybrid & Electric Buses

- Hybrid & Electric Buses on the market : City buses
  - Number of hybrid city buses growing worldwide
  - Ex. : New York City Transit bus fleet
    - 12 month period study showed 34% to 40% higher fuel economy over the baseline diesel units operating under similar driving conditions
    - Also hybrid versions in articulated city buses

Figure 7. Orion VII bus with BAE Systems HybriDrive hybrid propulsion system

Trends and insight – Hybrid & Electric Buses

- Hybrid & Electric Buses on the market : Trolleybuses
  - + All electric drive (local zero emission & noise)
  - + Brake energy recuperation in overhead lines (15 to 35%)
  - + Dual-mode possible
  - + Up to 220 passengers (high throughput)
  - - Visual aspect & investment cost
  - Examples in countries like Switzerland, Germany, Italy, the Netherlands, …

Conclusions IEA-IA-HEV Annex XII

- Heavy-duty vehicles market is very diverse with very specific applications/ drive cycles and this in relative small production numbers
- Matching the right vehicle with the right application = challenge
- Market of heavy-duty hybrid vehicles is still more or less in prototype / demonstration phase, except for some applications (e.g. city buses)
- Technical results (lab- and real life fieldtests) show substantial benefits on e.g. fuel consumption, but not yet enough market data available on the added cost vs benefits (ROI)
- Electrification of heavy-duty vehicles has a lot of potential, but …

Conclusions IEA-IA-HEV Annex XII

- Further research needed for next generation of heavy-duty hybrid vehicles to get to mass market :
  - European Green Car Initiative (EGCI) & American Recovery and Reinvestment Act (ARRA)
  - EU FP7 - Hybrid Commercial Vehicle (HCV), USA - 21st Century Truck Program, …

- Information dissemination is crucial :
  - IEA-IA-HEV : Annex XII - Heavy-duty Hybrid Vehicles (International)
    - www.ieahev.org & http://ieahev.vito.be
  - IEA-IA-AMF : Annex XXXVII : Fuel and technology alternatives for buses (International)
    - http://www.iea-amf.vtt.fi/annex/annex37.html
  - Hybrid User Forum (Europe)
    - http://wp1173759.wp202.webpack.hosteurope.de/www/wordpress2/
    - a forum which brings together (potential) users of hybrid buses, hybrid trucks and hybrid delivery vehicles with vehicle manufacturers.

TOPIC OF TODAY = NEW HORIZONS FOR URBAN TRAFFIC

USER CENTRAL APPROACH

CITIES

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EIT – KIC - InnoEnergy

- EIT = European Institute of Innovation and Technology (http://eit.europa.eu/)
- KIC = Knowledge and Innovation Communities
  - Climate change mitigation and adaptation: Climate-KIC
  - Sustainable energy: KIC InnoEnergy (http://www.innoenergy-initiative.com/)
  - Future information and communication society: EIT ICT Labs
- EIT – KIC : aim is closing the knowledge triangle “education-research-innovation” and make sure that research results gets valorized quicker in Europe

EIT – KIC - InnoEnergy

» CC BeNeLux focus is **"smart cities"** which integrates energy efficient buildings, smart grids and electric transport in a city environment

EIT – KIC - InnoEnergy

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Full Partners:

Education

Research

Industry

TU/e Technische Universiteit Eindhoven University of Technology

TNO

eandis

KATHOLIEKE UNIVERSITEIT LEUVEN

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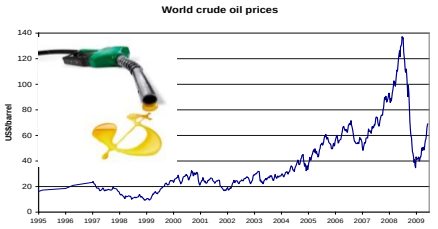
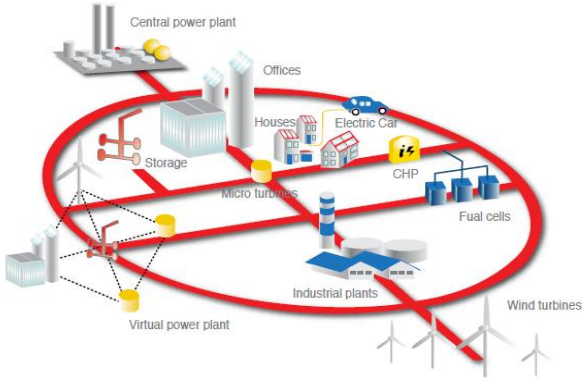
EIT – KIC - InnoEnergy

» CC BeNeLux focus is **"smart cities"** which integrates energy efficient buildings, smart grids and electric transport in a city environment





EVCity

"Business & services models to support the roll-out of electric vehicles in cities"

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EIT – KIC - InnoEnergy

» CC BeNeLux focus is **"smart cities"** which integrates energy efficient buildings, smart grids and electric transport in a city environment

Transport concepts : urban planning, multi-modal transport (walk, bike, public transport, shared car, private car), …

Electric vehicles & components : improvement of energy-efficiency of components & systems inside the vehicles, …

Infrastructure for electric vehicles : standardisation of plugs, communication protocols grid-vehicle, roaming and billing concepts, control algorithms for optimal coordinated charging with minimal impact on grid and maximum use of renewable sources, …

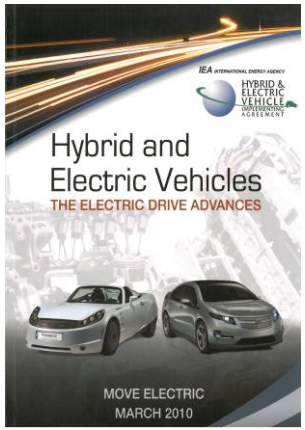
Renewable energy sources,Intelligent houses, energy effciency electricity/gas/heat/cold, ….

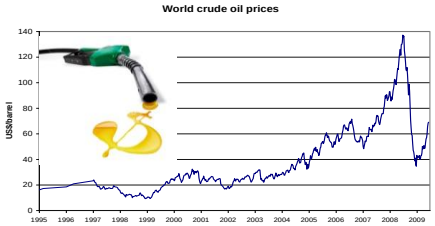
Political framework : supportive actions on legislation, incentives, … to stimulate the investments in renewable energy and infrastructure for electrified transport

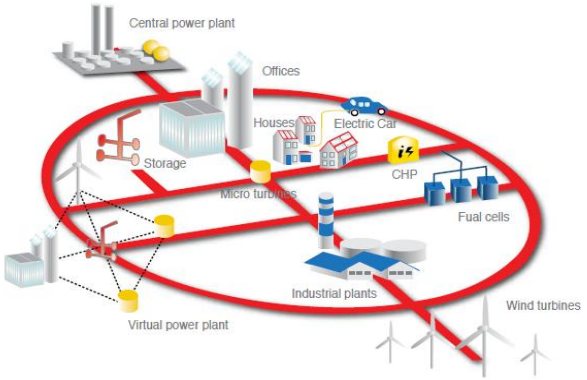
Conclusion

» New horizons for Urban Traffic ? YES !

» From vehicle side : IEA-IA-HEV : Annex XII - Heavy-duty Hybrid Vehicles
» From customer side : EIT–KIC–InnoEnergy : Smart Cities
» Think “holistic” !







Thank you for your attention !

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