Anselm Eisentraut
Bioenergy Analyst

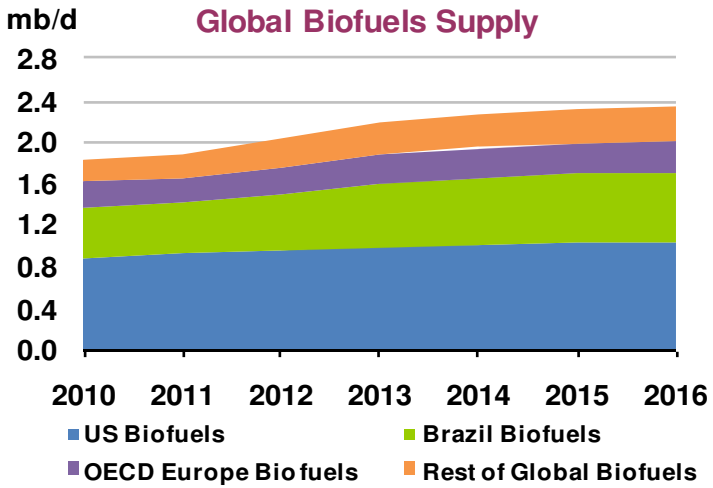
Current status and future outlook for biofuels

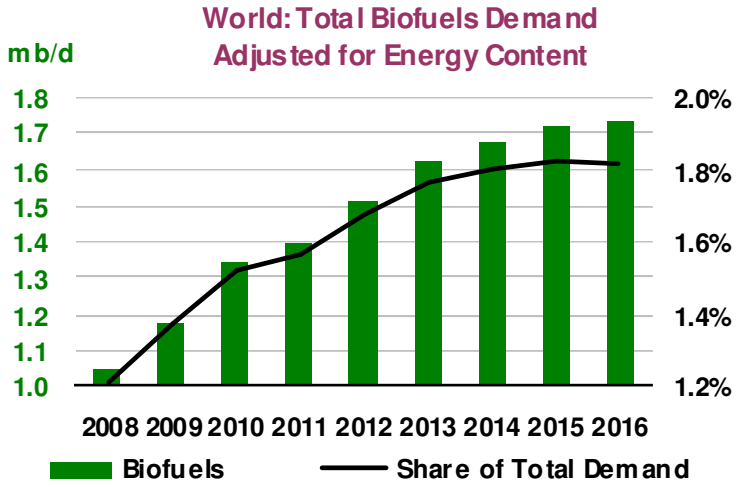
EBTP 4th Stakeholder Plenary Meeting
Brussels, 14.09.2011

International Energy Agency

MEDIUM-TERM OIL&GAS MARKETS 2011

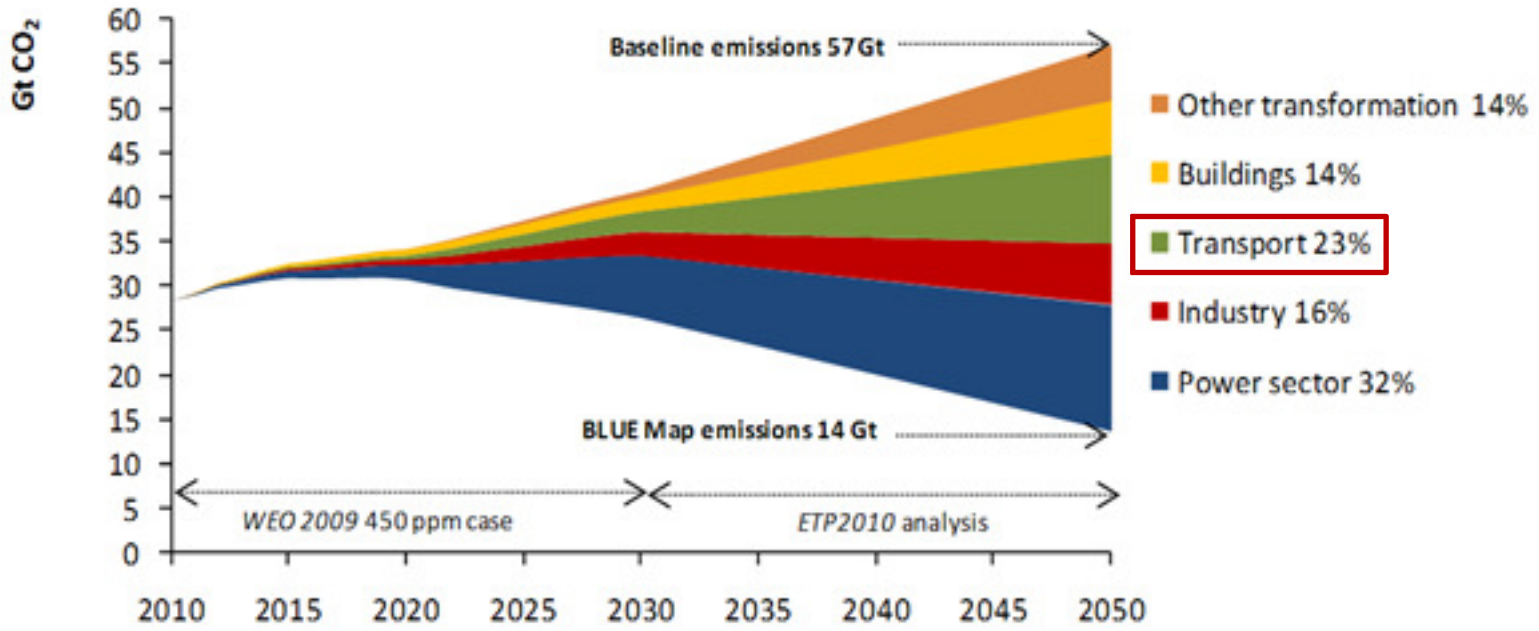
Global Biofuel Production – Medium-Term Outlook





- Global biofuels production rises from 1.8 mb/d (105 billion L) in 2010 to 2.3 mb/d (135 billion L) in 2016
  - A total increase of 0.5 mb/d…
  - …equivalent to an average yearly growth of 4.3% or 90 kb/d
- On an energy adjusted basis versus oil, biofuels supply increases from 1.3 mb/d (2.4 EJ) in 2010 to 1.7 mb/d (3.4 EJ) in 2016
  - Energy adjusted supply growth to meet 9% of gasoline and gasoil growth, with ethanol at 24% of gasoline growth and biodiesel at 4% of gasoil growth
  - Yet, in 2016, biofuels satisfy only 1.8% of total global demand

The BLUE Map Scenario – Towards a low-carbon energy sector



- **Baseline Scenario** – business-as-usual; no adoption of new energy and climate policies
- **BLUE Map Scenario** - energy-related CO_2-emissions halved by 2050 through CO_2-price and strong support policies
  - Serves as basis for all IEA Technology Roadmaps
  - **23% of global emission savings occur in the transport sector**

IEA Technology Roadmaps

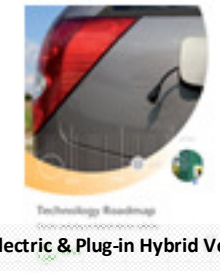
- Roadmaps are intended to:
  - Highlight pathway(s) to reach large scale use of low-carbon technologies, consistent with *Energy Technology Perspectives* publication
  - Focus on the key steps over the next 5-10 years, as well as long-term milestones, including:
    - Identify barriers and obstacles and how to overcome these
    - Identify key conversion pathways
    - Key RD&D gaps and how to fill them while ensuring sustainability
    - Identify market requirements and policy needs
    - Define international collaboration needs

  For more information: www.iea.org/roadmaps

- IEA Technology Roadmap - Biofuels for Transport
  - Developed under consultation of industry, governmental and research institutions as well as NGOs
  - 2 expert workshops on technologies and feedstock availability and sustainability

    → the latter feeds also into the upcoming Technology Roadmap on **Bioenergy for Heat and Power**


Concentrated Solar Power

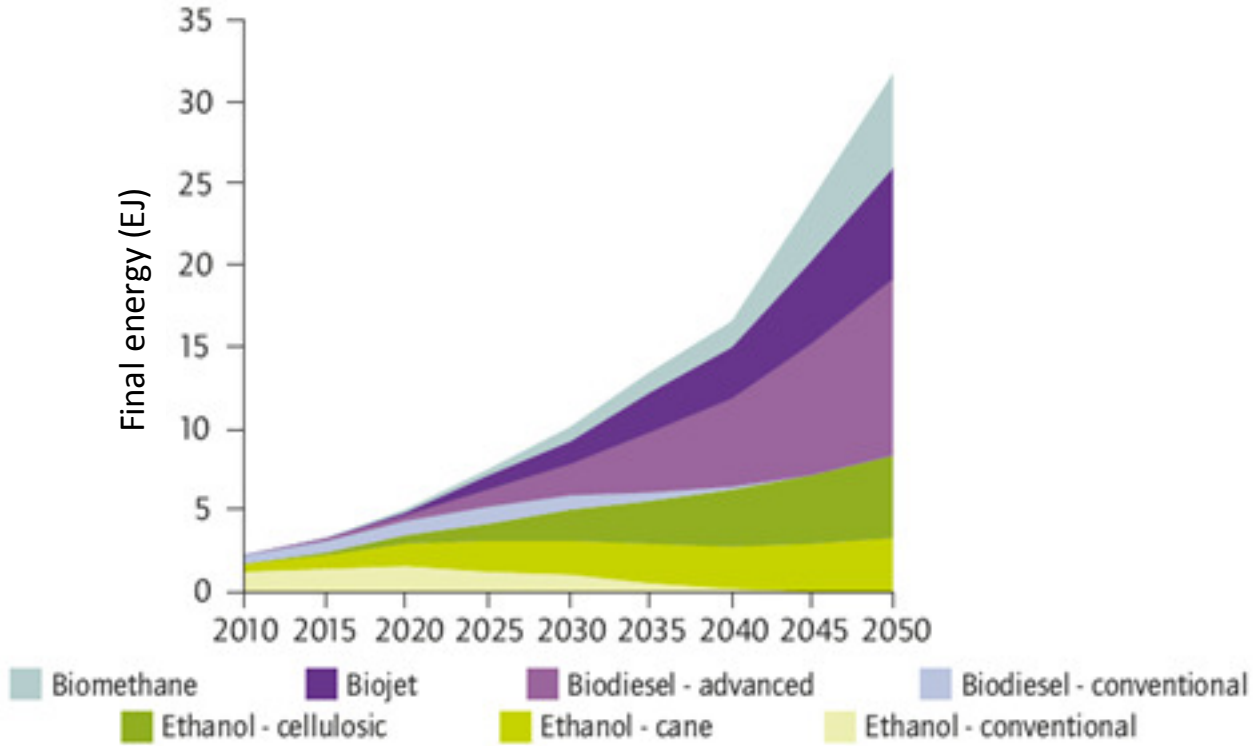

Electric & Plug-in Hybrid Vehicles


Smart Grids


Solar Photovoltaic Energy

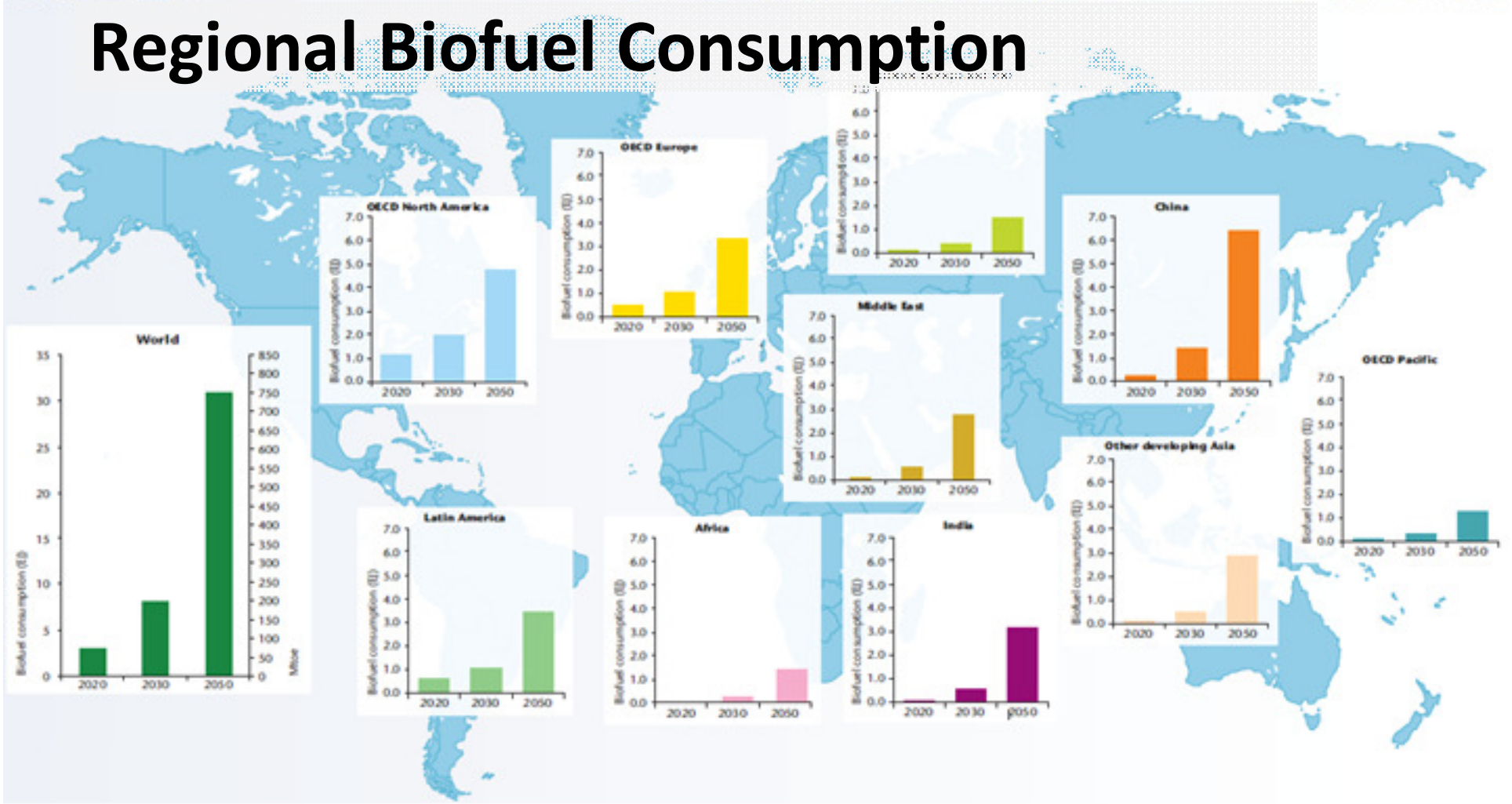

Wind Energy

IEA Biofuel Roadmap: Vision



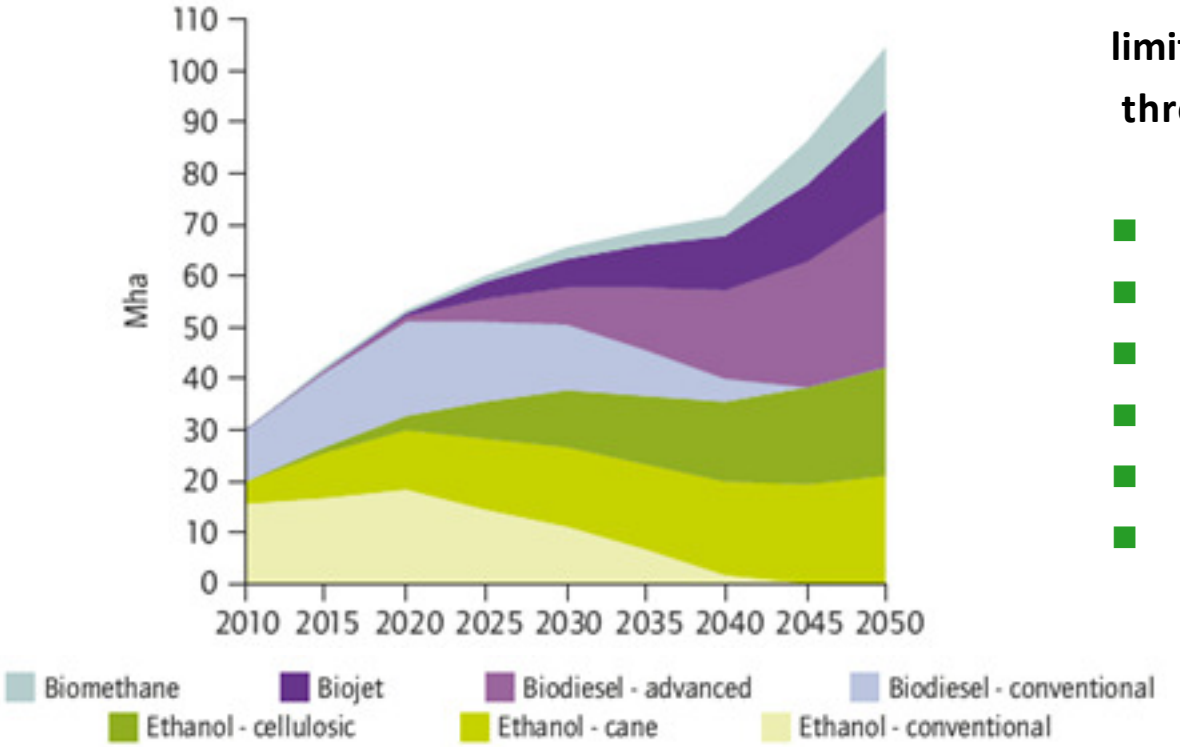
- Global biofuel supply grows from 2.5 EJ today to 32 EJ in 2050
  - Biofuels share in total transport fuel increases from 2% today, to 27% in 2050
  - Diesel/kerosene-type biofuels become particularly important to decarbonise heavy transport modes
- Biofuels could reduce global transport emissions by 2.1 Gt CO_2-eq. in 2050
- **Large-scale deployment of advanced biofuels will be vital to meet the roadmap targets**

Regional Biofuel Consumption



- Biofuel use will increase considerably in all regions
  - Biofuel demand driven mainly by OECD countries until 2020
  - In 2050, non-OECD countries account for 70% of total biofuel consumption
- Trade will be vital to supply biomass and fuels to regions with strong demand

Land Requirements



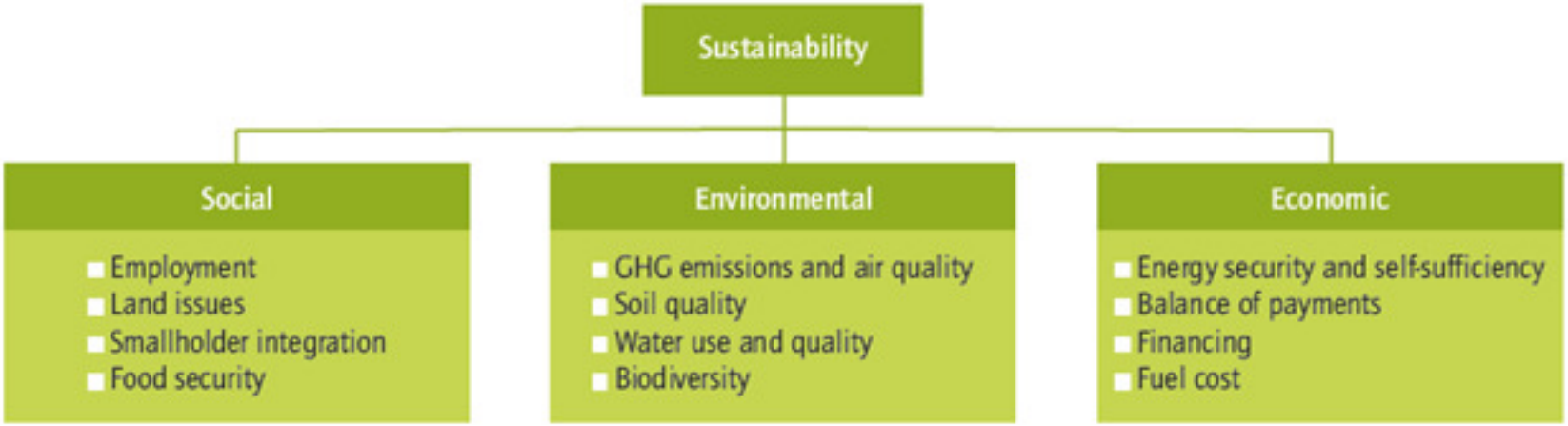
Note: This is gross land demand, excluding land-use reduction potential of co-products

Pressure on agricultural land can be limited and risk of ILUC can be mitigated through:

- Productivity improvements
- Use of residues and wastes
- Use of pasture/ unused land
- Potential for wood biomass
- Biomass cascading & biorefineries
- Land-use zoning and sustainable land-use management schemes

- Land required to produce biofuels increases from **30 Mha** today to **100 Mha** in 2050, in addition to **1 billion tons of residues**
  - Sustainable land expansion will be challenging given increasing demand for food and biomaterial
- Sound policies are needed to ensure sustainability and mitigate risk of indirect land-use change (ILUC)
- In the long-term, a sustainable land-use management for all agricultural and forestry land is needed.

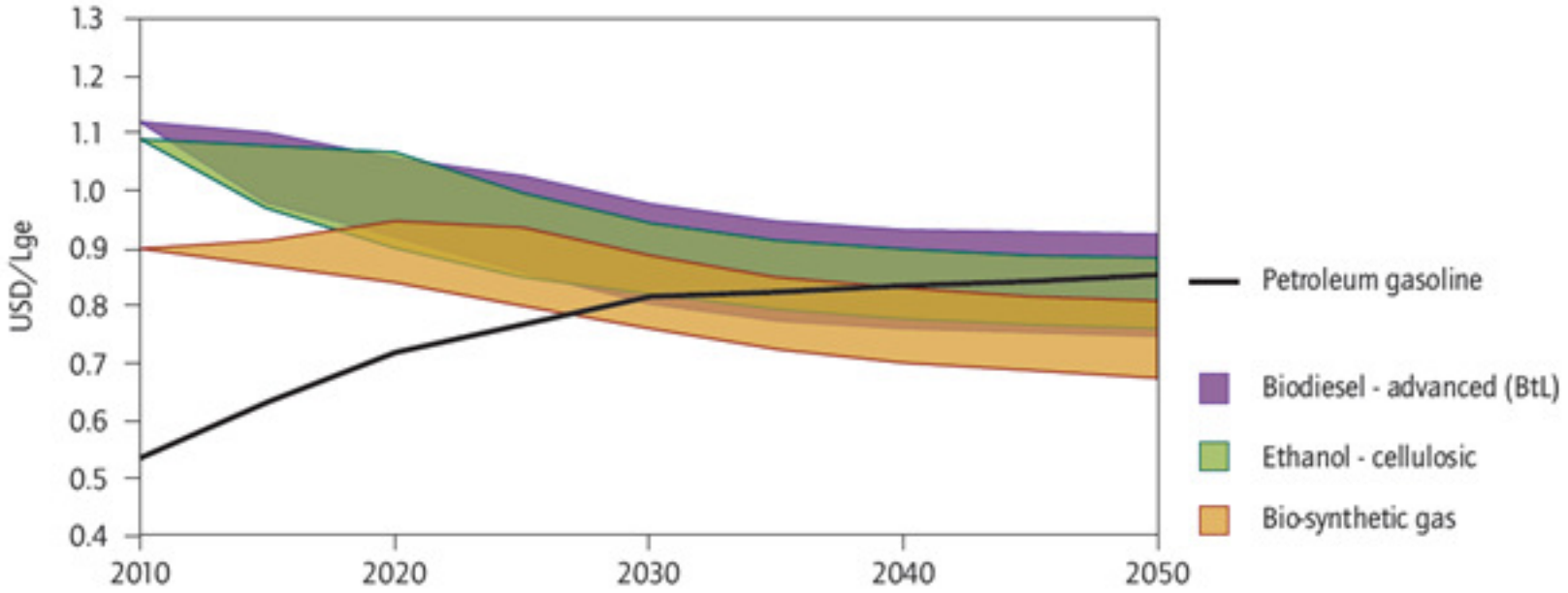
Sustainability of Biofuels



- Sound policies are needed to ensure biofuels are produced sustainably
- Adoption of internationally aligned sustainability certification for biofuels
  - Certification schemes should be based on international sustainability criteria (as developed *e.g.* by the Global Bioenergy Partnership, GBEP)

- However, most sustainability issues are relevant to the whole agricultural/ forestry sector
- Ultimately, all agricultural and forestry products should be certified

Biofuel Production Costs 2010-50



Production costs shown as untaxed retail price

- Most conventional biofuels still have some potential for cost improvements
- Advanced biofuels reach cost parity around 2030 in an optimistic case

- Total expenditure on biofuels 2010-50 sums up to USD 11-13 trillion (*i.e.* 11-12% of total fuel costs)
- **Incremental costs compared to use of fossil fuels are in the range of +/-1% of total fuel cost spending in the next 40 years**

Key policy actions

- **Stability:**
  - Create a long-term policy framework for biofuels.
- **Innovation and Deployment:**
  - Provide sustained funding for advanced biofuels RD&D and commercial deployment.
  - Support research efforts on land availability mapping and biomass potential analysis.
- **Sustainability:**
  - Adopt sound, internationally aligned sustainability certification for biofuels.
  - Link economic incentives to sustainability performance of biofuels.
  - Incentivise use of wastes and residues.
- **International Collaboration:**
  - Engage in international collaboration on capacity building and technology transfer.
  - Promote the alignment of biofuel and other related policies (agriculture, forestry, rural development).

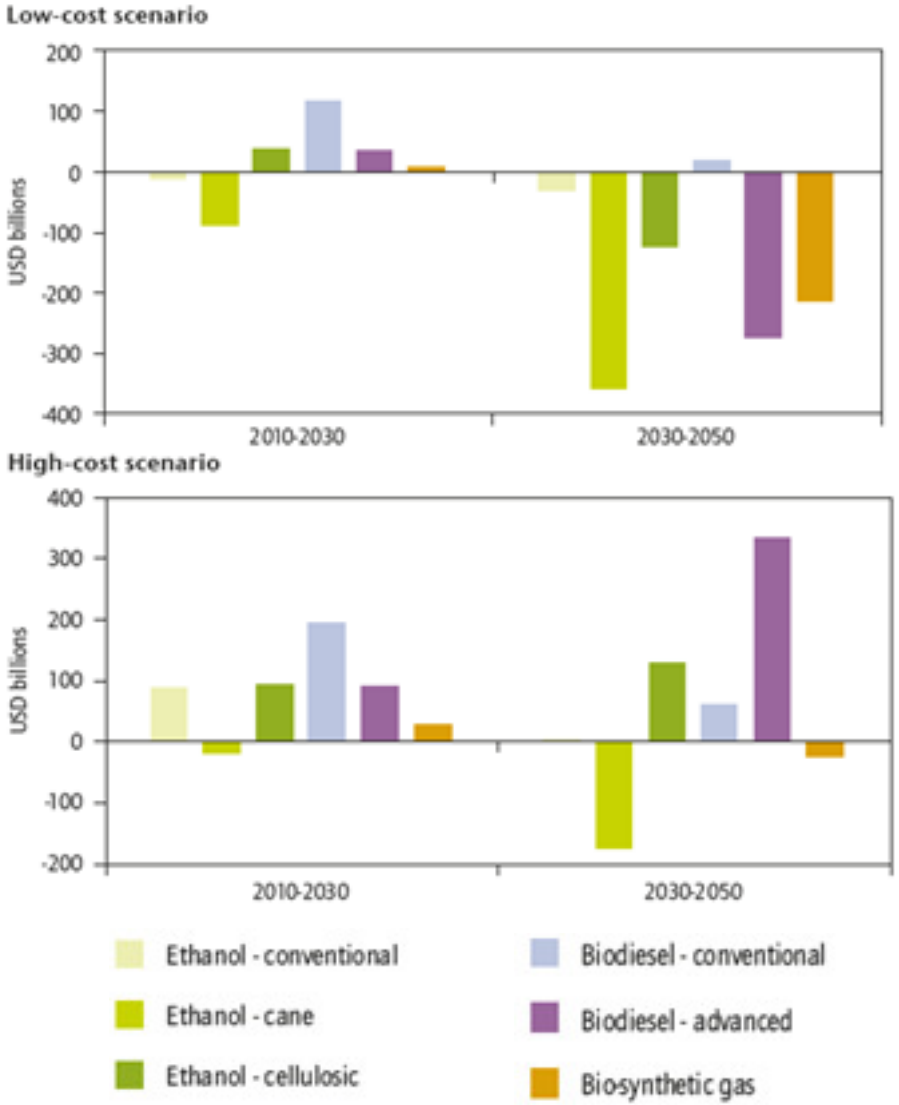
Acknowledgements

- **Thanks to the co-authors:**
  - **Adam Brown, Lew Fulton, Jana Hanova and Jack Saddler**

- IEA Technology Roadmap - Biofuels for Transport
  Available: ***www.iea.org/roadmaps***
- **Contact:**
  Anselm.Eisentraut@iea.org

- **Forthcoming:**
  IEA Technology Roadmap – ***Bioenergy for Heat and Power***
  Available early 2012

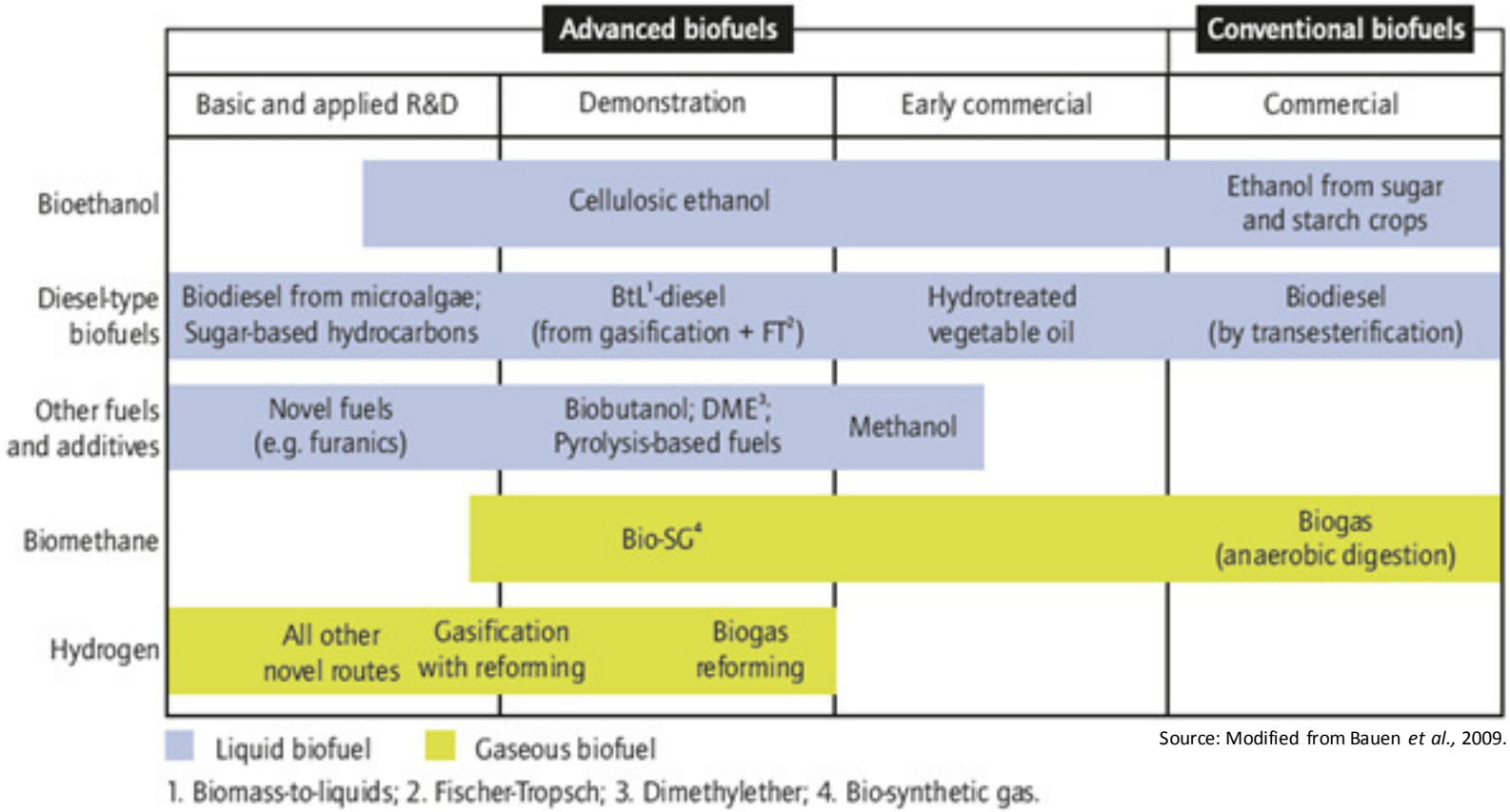
Incremental Costs of Biofuels



- Additional expenditure on biofuels (compared to diesel/gasoline):
  - USD 890 billion of fuel cost savings in the low-cost scenario
  - USD 810 billion additional expenditure in the high-cost scenario

- Incremental costs compared to use of fossil fuels are in the range **of +/-1%** of total fuel cost spending in the next 40 years

Overview on Biofuel Technologies

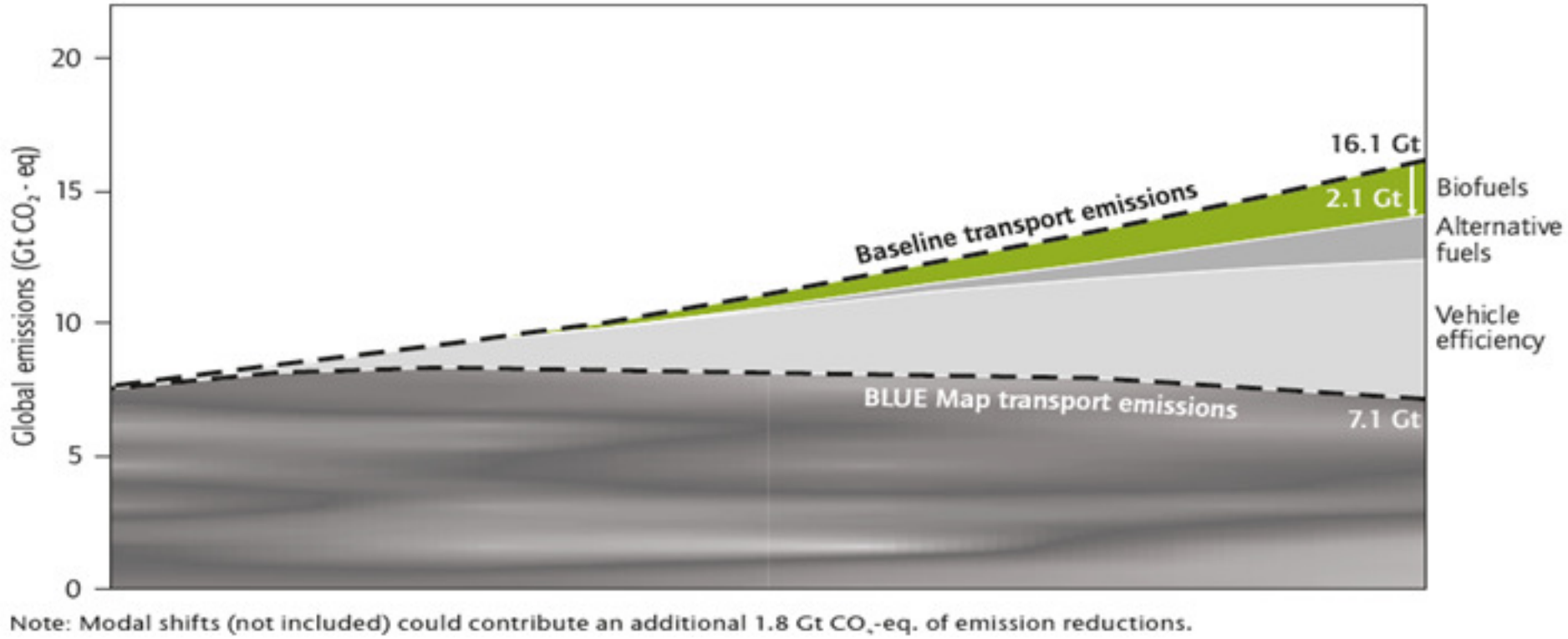


Source: Modified from Bauen *et al.*, 2009.

1. Biomass-to-liquids; 2. Fischer-Tropsch; 3. Dimethylether; 4. Bio-synthetic gas.

- A broad number of conversion routes exist
- More RD&D is needed to get advanced biofuels to commercial-scale to prove they can meet cost and GHG targets

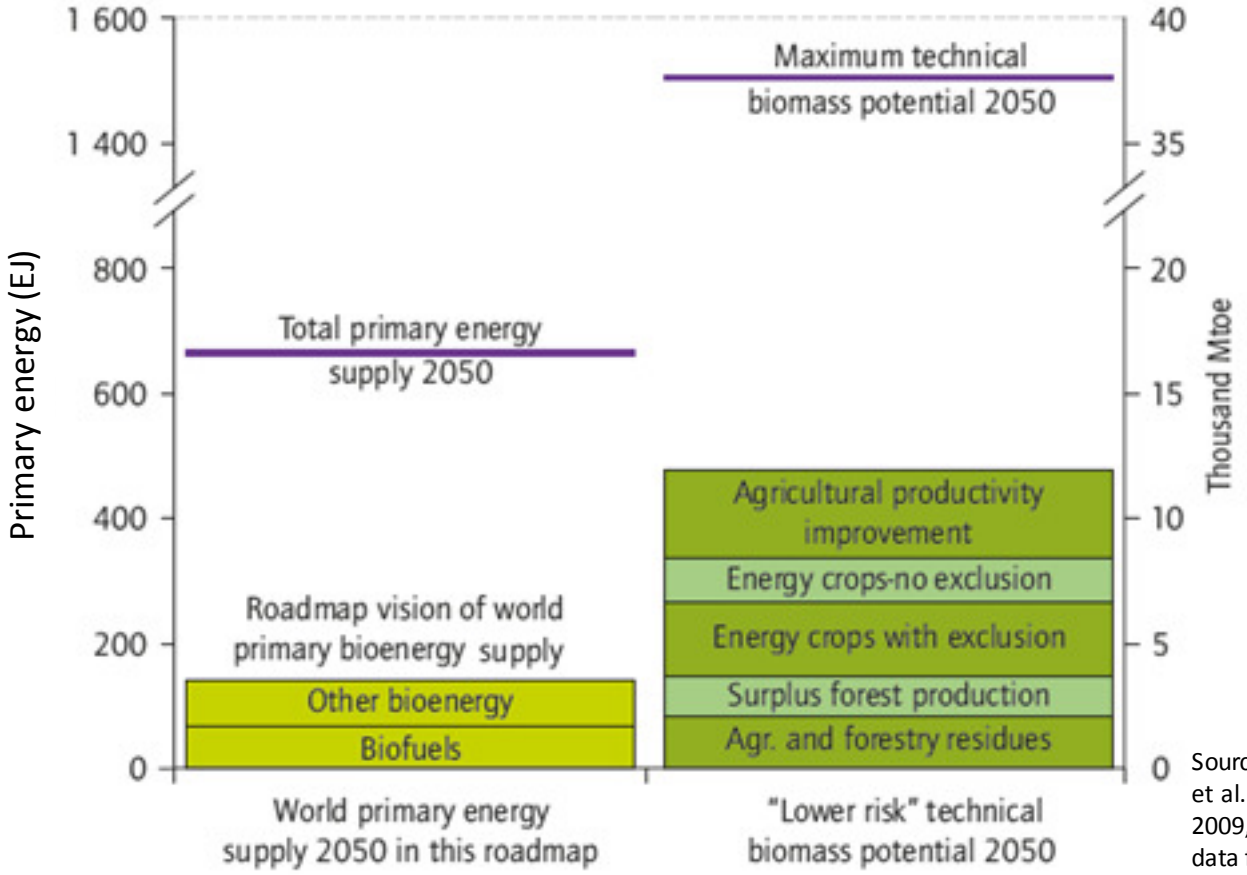
Biofuels Contribution to Emissions Reduction



Note: Modal shifts (not included) could contribute an additional 1.8 Gt CO_2-eq. of emission reductions.

- Efficiency improvements are the most important low-cost measure to reduce transport emissions
- Biofuels can reduce global transport emissions by 2.1 Gt CO_2-eq. in 2050
  → Need for efficient technologies that provide considerable life-cycle GHG emission reductions

Global Biomass Potential

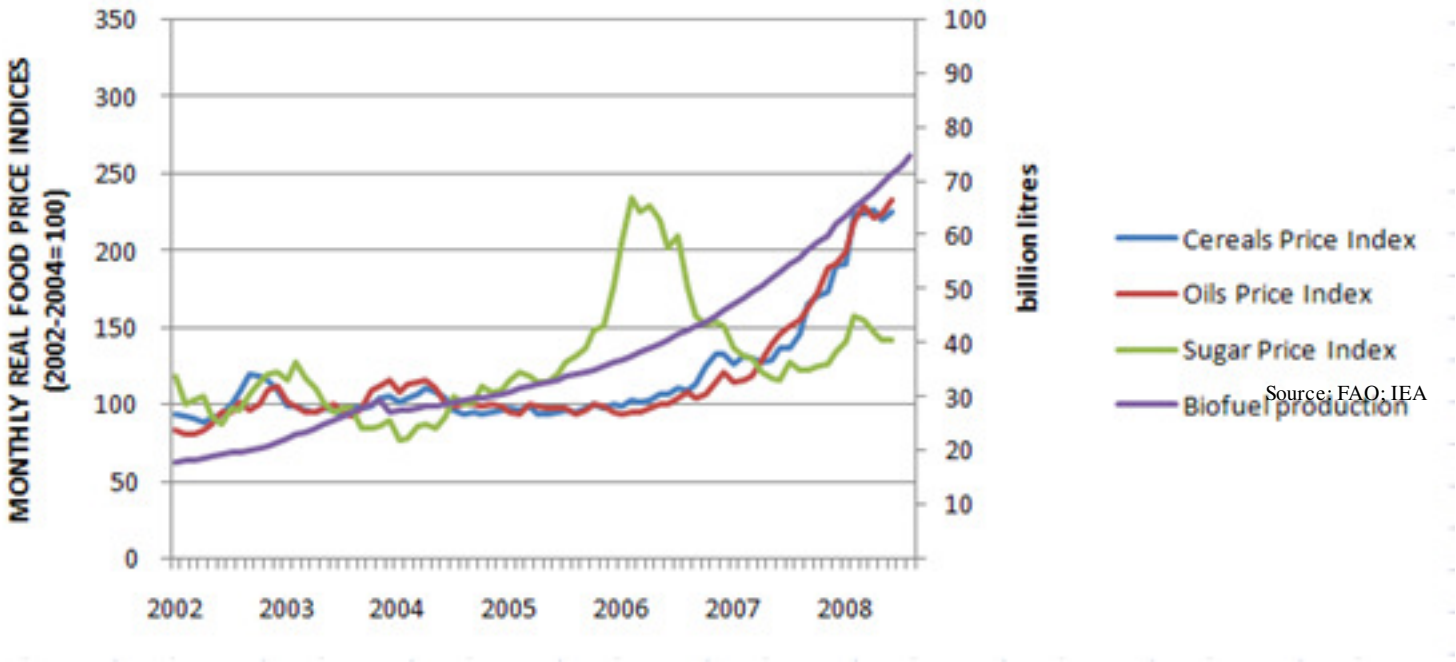


Source: Adapted from Dornburg et al., 2008 and Bauen et al., 2009, and supplemented with data from IEA, 2010c.

- A considerable potential of "low risk" biomass sources has been assessed
- Biomass for biofuel production (65 EJ) could come entirely from residues, wastes, and sustainably grown energy crops

However…

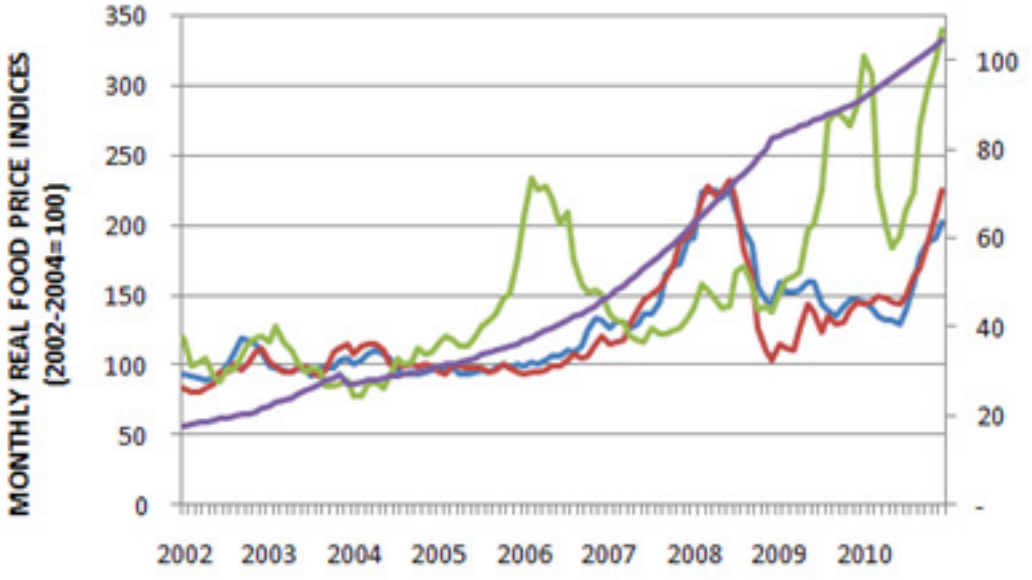
Biofuels sustainability increasingly questioned



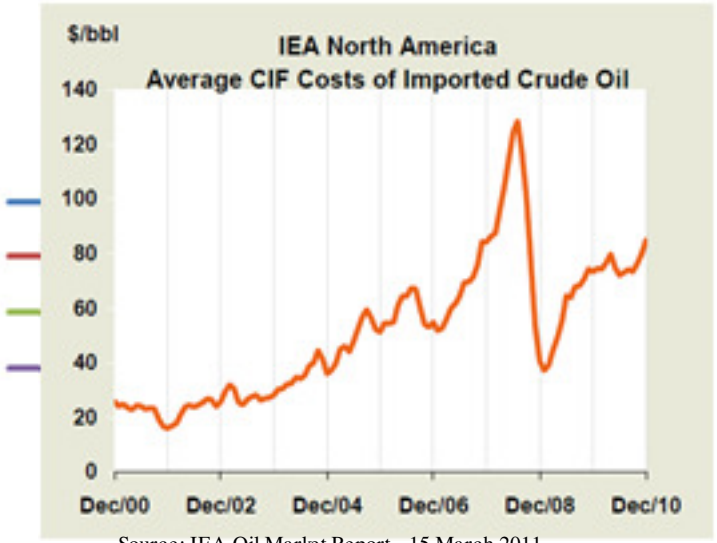
Source: FAO; IEA

- Discussion on competition with food production (food vs. fuel)
  - Biofuels responsible for 3%-75% of food price increase
  - "*Crime against humanity*" (Jean Ziegler, UN Special Rapporteur)

Biofuel sustainability



Source: FAO



Source: IEA Oil Market Report - 15 March 2011

- Agricultural commodity prices fell considerably after July 2008
- Latest studies suggest biofuels had only a limited impact on food prices
  - Biofuel production occupies "only" 30 Mha (<1% of 5 Gha agricultural area globally)
  - Biofuel production generates valuable co-products that enter the fodder market (dried distiller's grains, soy-meal)
- What are key factors impacting agricultural commodity prices?
  - Weather
  - Oil price
  - Speculative trading
  - Currency volatility