The Future Role of Biofuels:
GHG Emission Balances, Biodiversity/Land Use Impacts, Food Security, and Costs

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Biofuels?

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- **In the late 1980ies, Axel critically reviewed biodiesel from rapeseed oil (1st LCA!)**
  - Low net GHG reduction; agrochemicals…
  - High economic costs
- **Debate came back strong in this century:**
  - GHG from direct + indirect land-use changes; loss of biodiversity, water use, agrochemicals, erosion…
  - Economic loss, food insecurity, land tenure stress…
- **Safeguards and guidance needed!**

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Sustainable Global Energy

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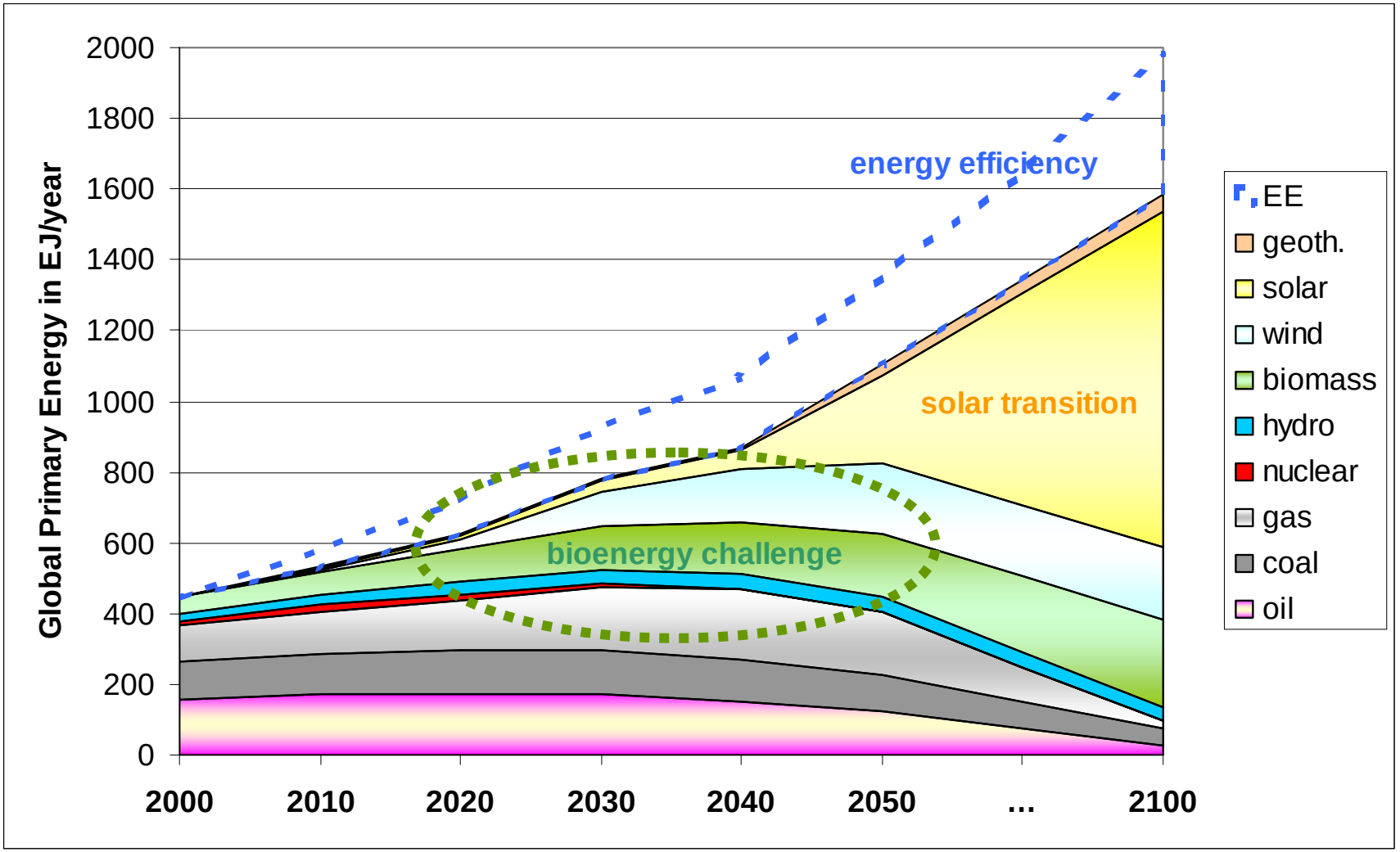

Source: IEA (2007), IPCC (2007), UNPD (2004) and WBGU (2003)

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Global Biomass Potential

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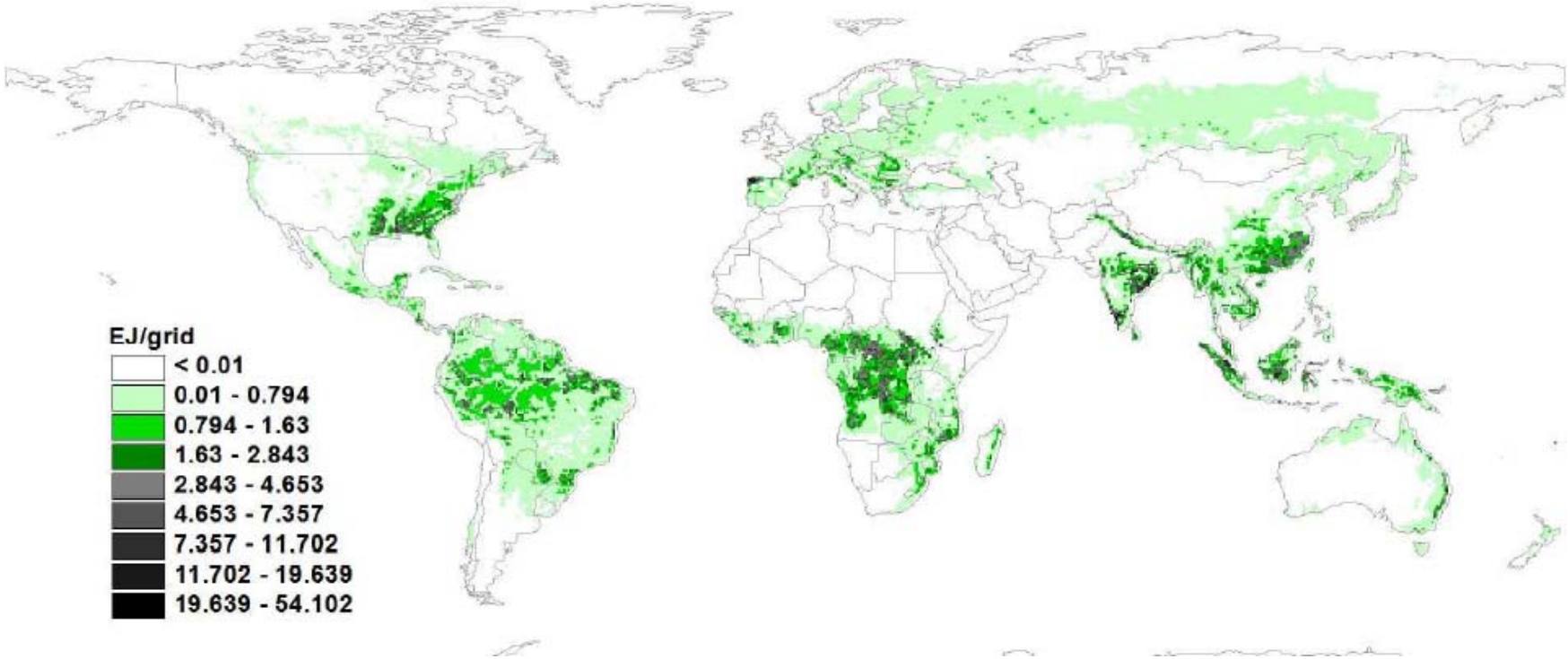

Source: IIASA, Kraxner 2007, Rokiyanskiy et al. 2006

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Global Biodiversity

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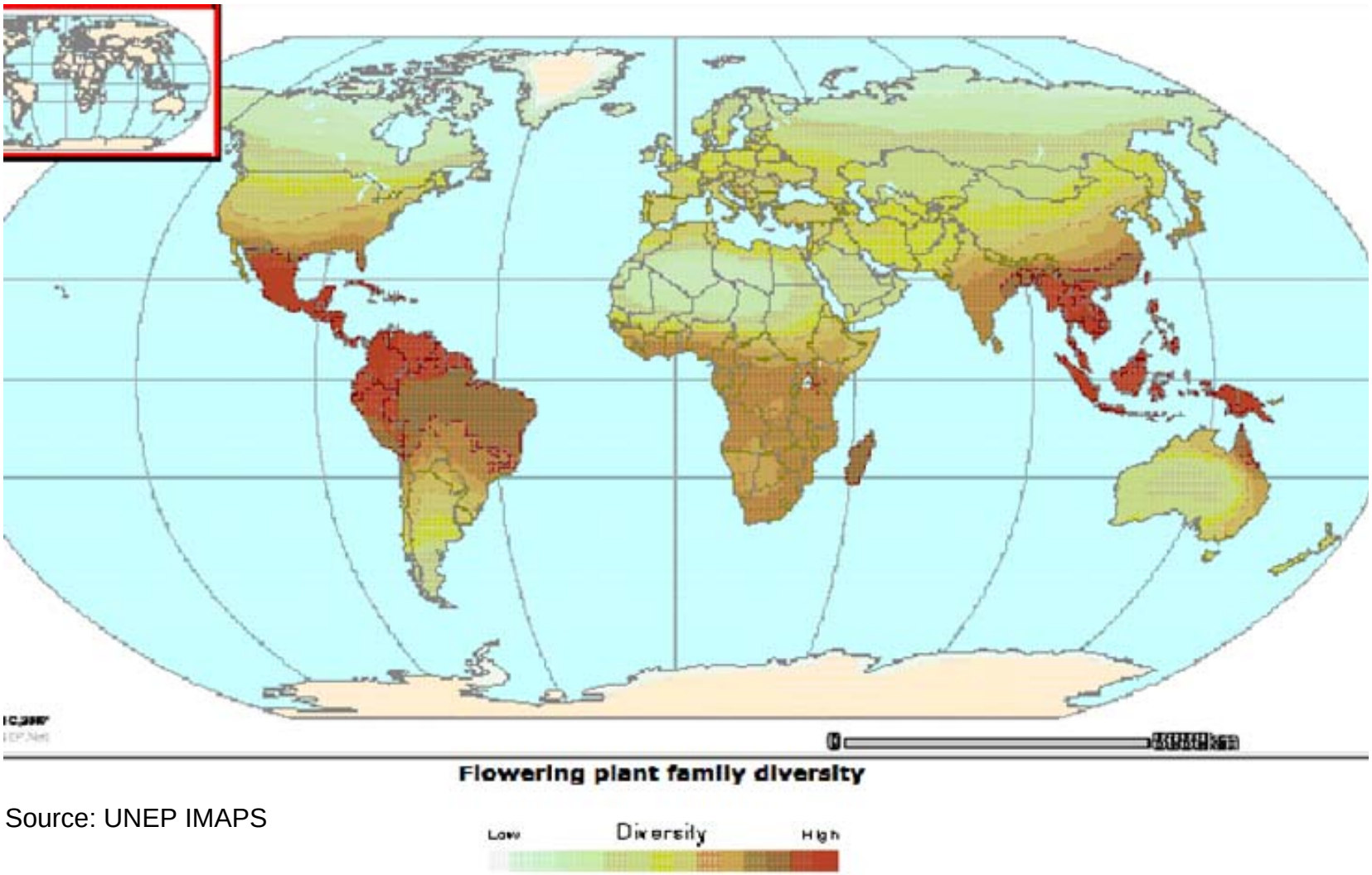

Source: UNEP IMAPS

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GHG Emissions of Bioenergy

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- **Bioenergy life-cycle GHG emission more or less understood:**
  - Uncertainty in N_2O and CH_4 (for biomethane);
  - Data variation in cropping (yield, fertilizer), conversion and background systems (electricity, process heat)
- **But land-use change (LUC) impacts need consideration:**
  - GHG from direct **and indirect** land-use changes
  - **Net result** can be positive or negative

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Direct/Indirect GHG from LUC

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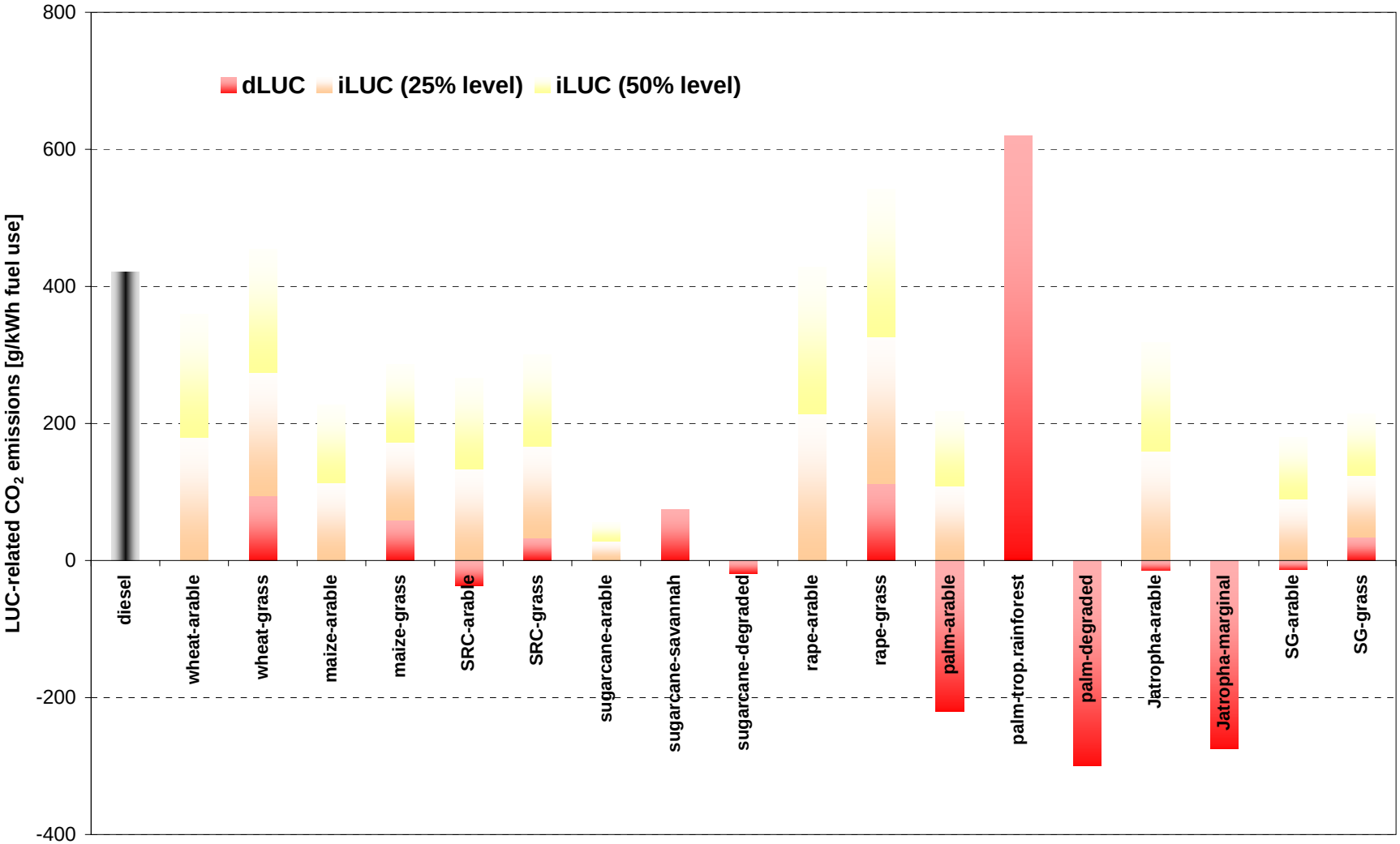

Data for LUC-induced GHG emissions only,
excluding life-cycles

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Total GHG from Biofuels

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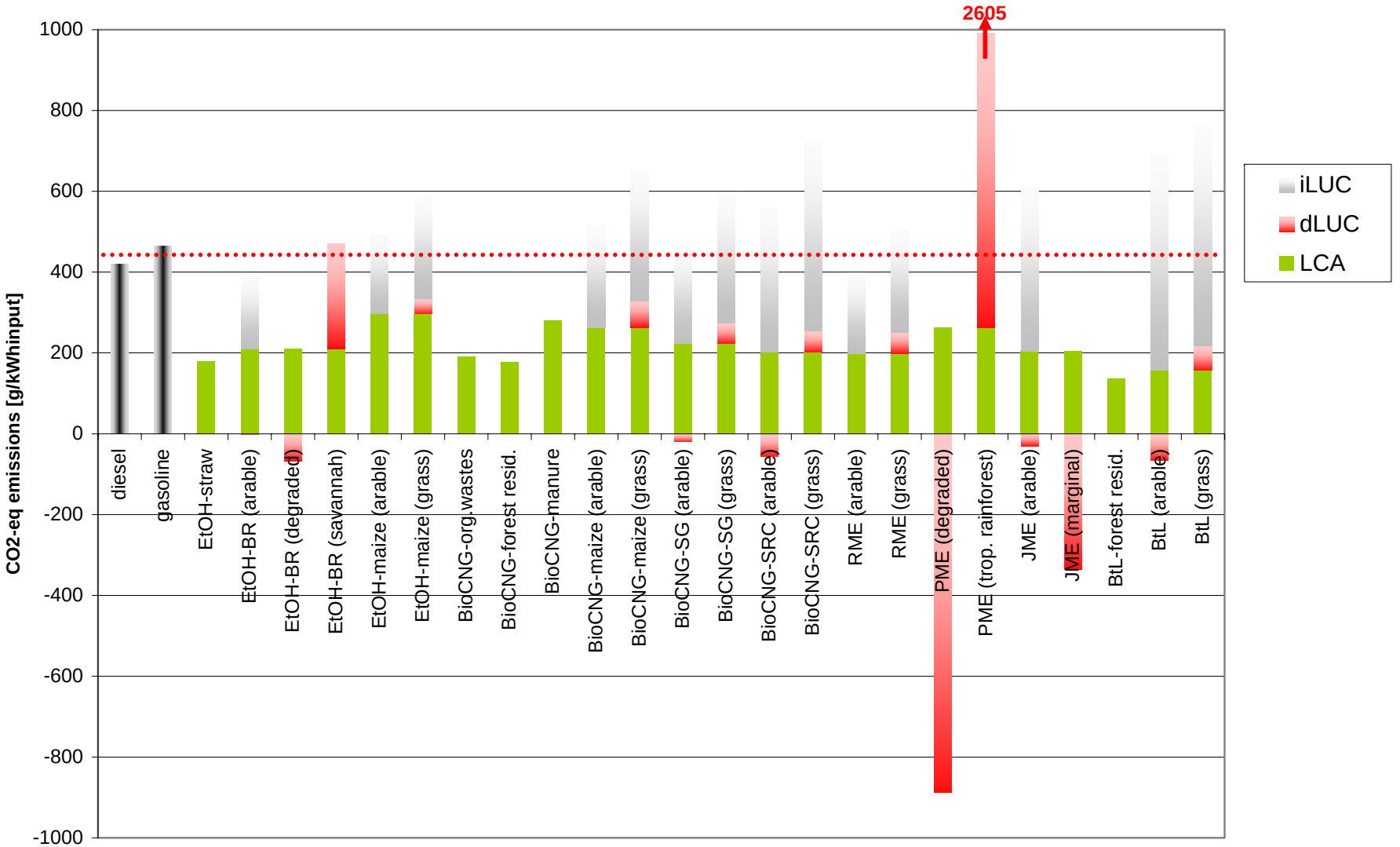

data from GEMIS 4.5; GHG emissions from life-cycles + LUC, allocation by LHV

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Biofuel Costs: 2030 outlook

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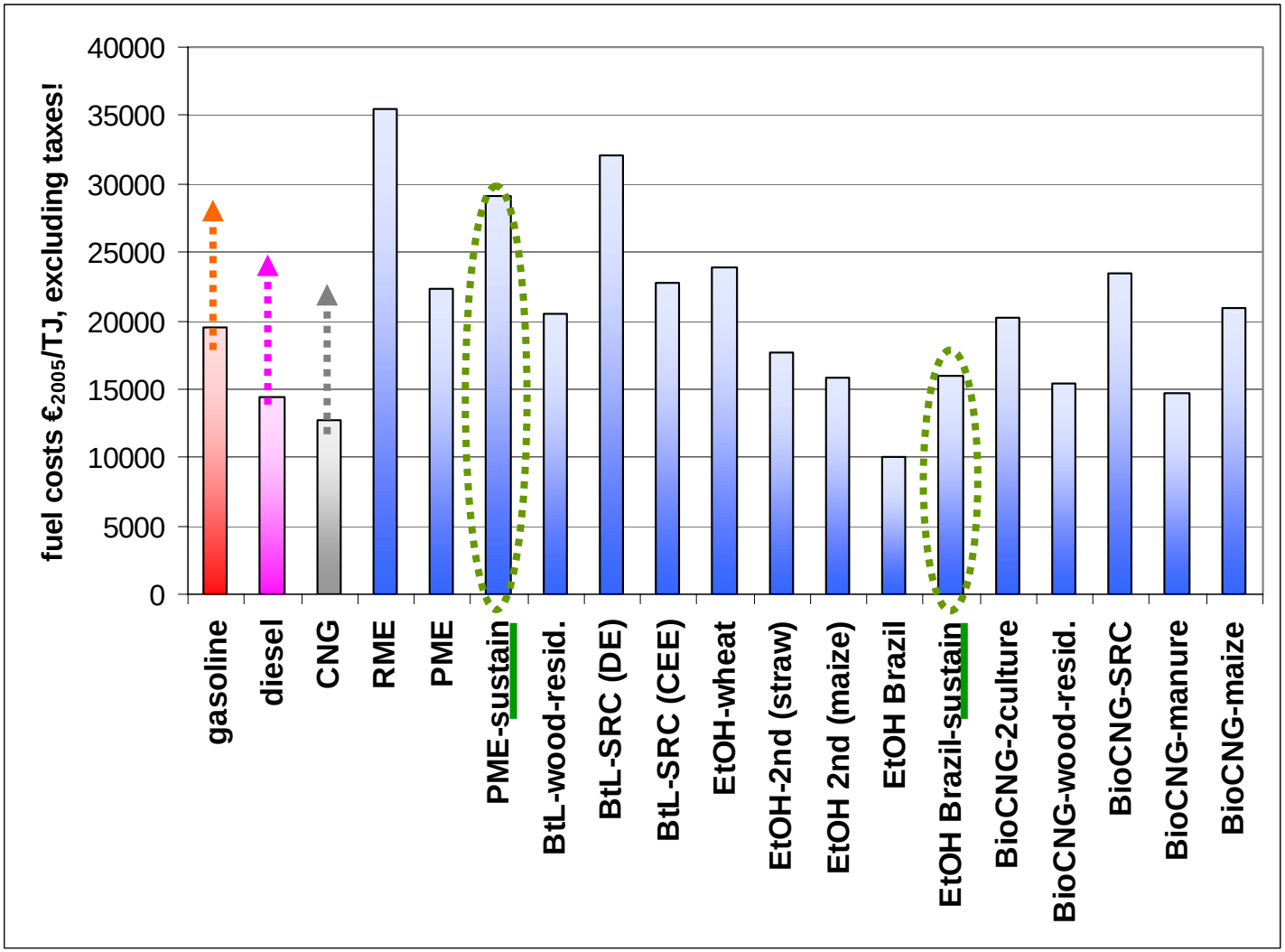

Crude oil @ 65 US$/bbl; taxes excluded;
interest rate for capital: 5%

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Conclusions

- GHG emissions LUC **dominant**: C-rich soils; indirect LUC for arable and grassland
- Focus on **residues/wastes** + **marginal/degraded** land → negative biodiversity/social tradeoffs?
- **Most** of future biofuels more costly than fossil fuels (@ crude oil <100 US$/bbl)
- Sustainable biofuels only a moderate contribution to global energy → but **important development implications**

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Degraded Land Mapping

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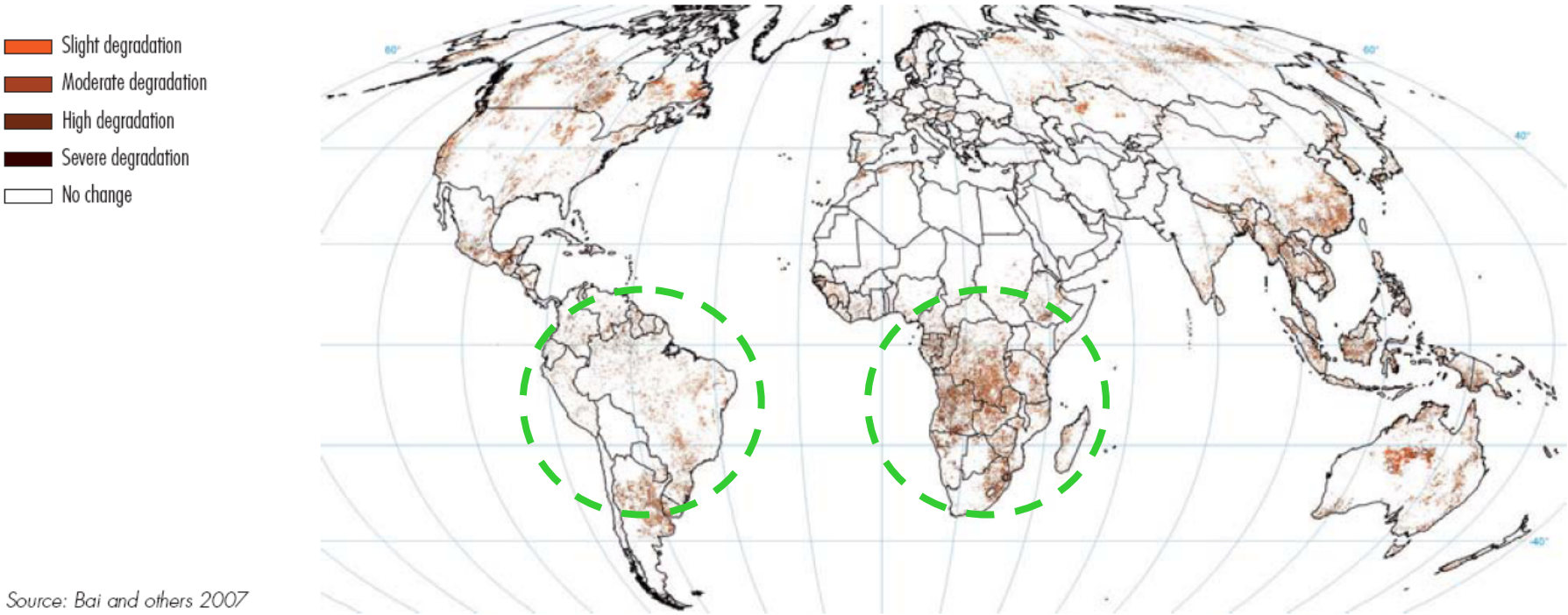
FAO's Land Degradation Assessment in Drylands (LADA):

Identification of "black spots" of land degradation by trends analysis

Global land degradation using biomass production and rain-use efficiency trends between 1981–2003



Source: Bai and others 2007

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Global Bioenergy Potentials

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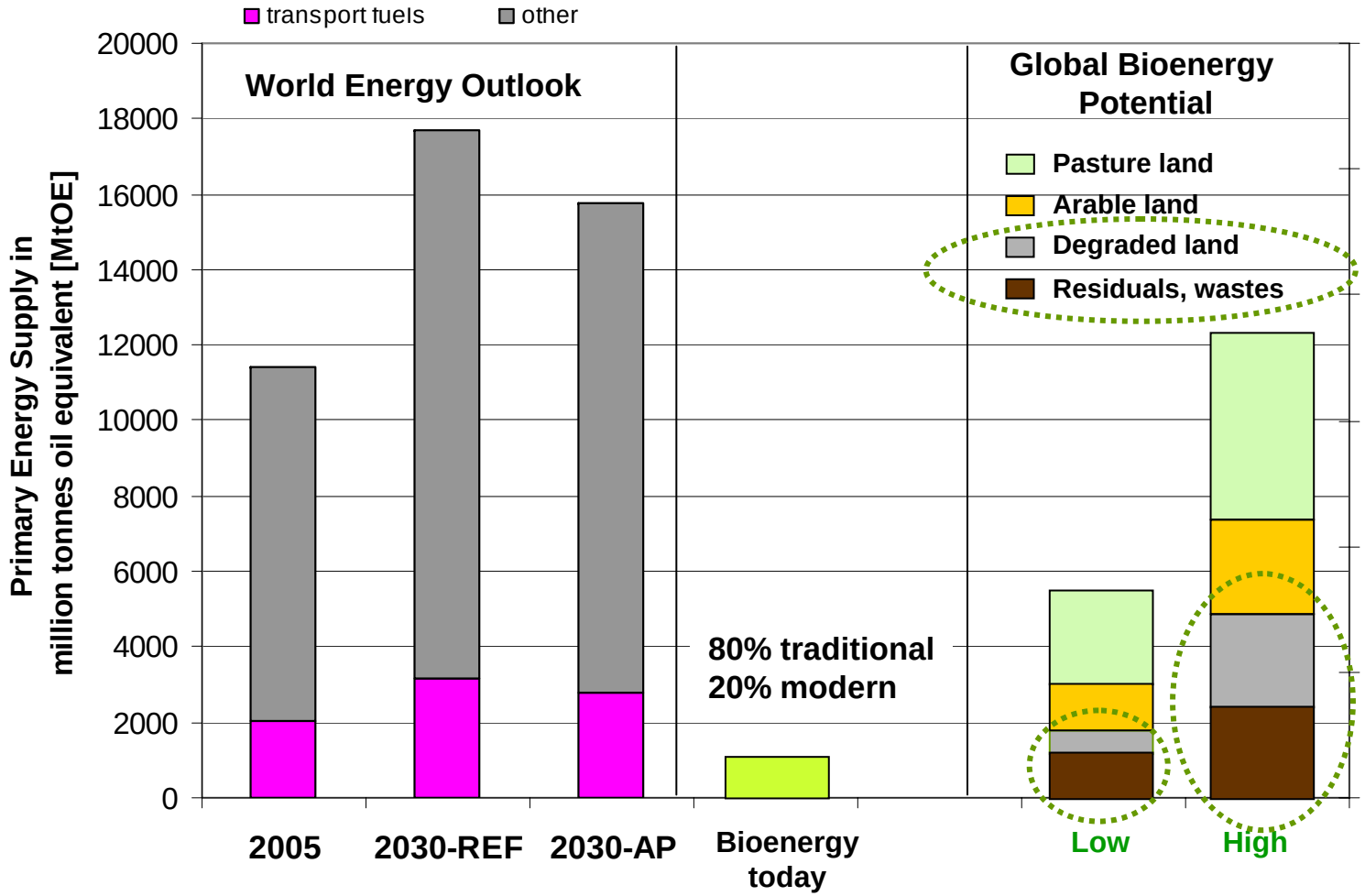

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Biofuels: Going Ahead…

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- Degraded Land Potentials, Biodiversity and Social Effects: **Joint International Workshop of UNEP, FAO, CI, IUCN, Oeko-Institut, RSB and WWF June 30-July 1, 2008 in Paris**
- FAO BIAS Project: Guidance for developing countries (late 2008); GBEP Task Force on GHG methodologies; CEN TC 383 (2009 ff)
- **Axel now helps to initialize sustainable biofuels from degraded lands…**

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More Information

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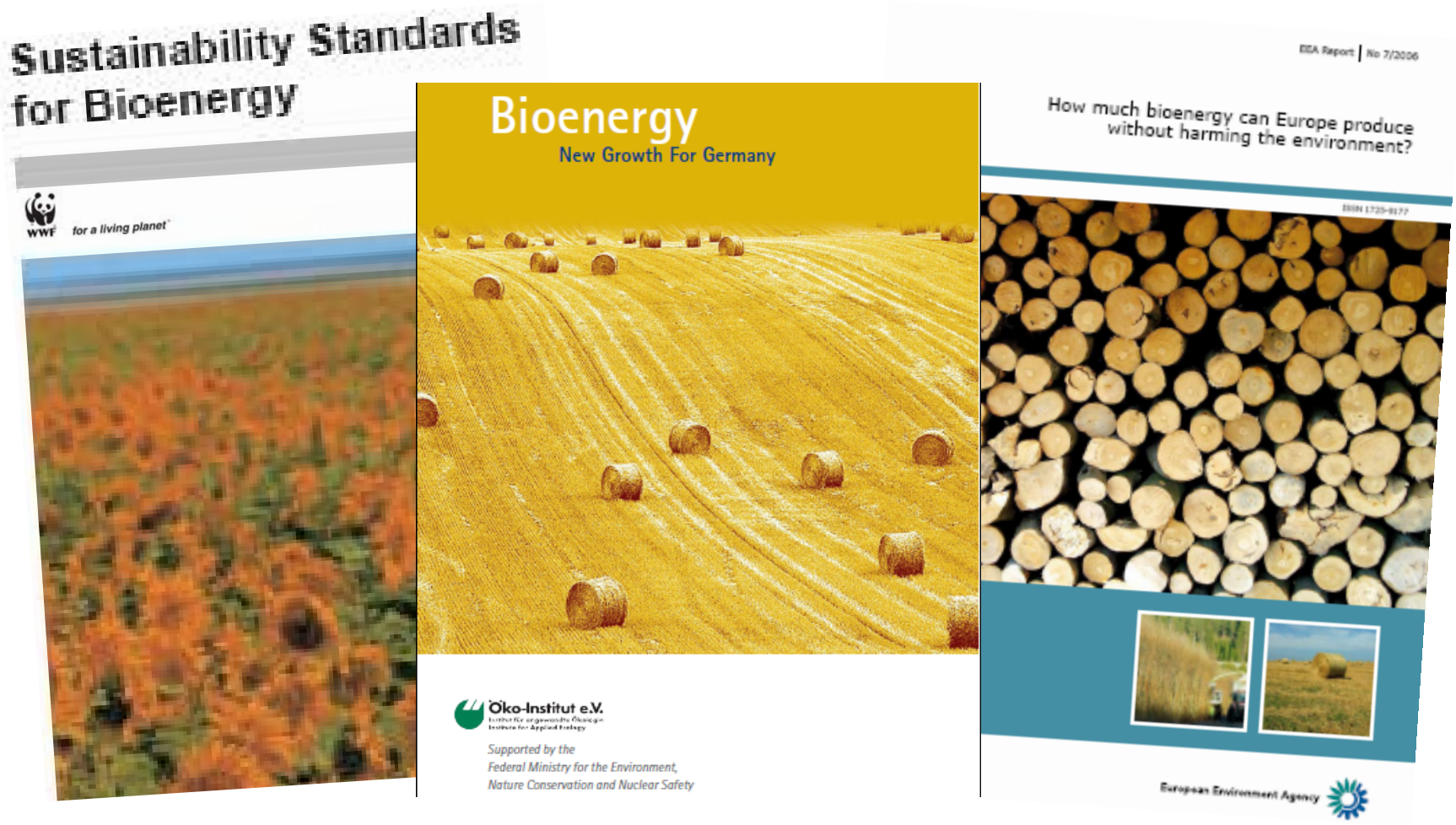

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