Biofuels and Bioenergy – a Changing Climate.
IEA BIOENERGY CONFERENCE
Vancouver, 23-26 August 2009.

BIOMASS - a Saviour or a Sin?

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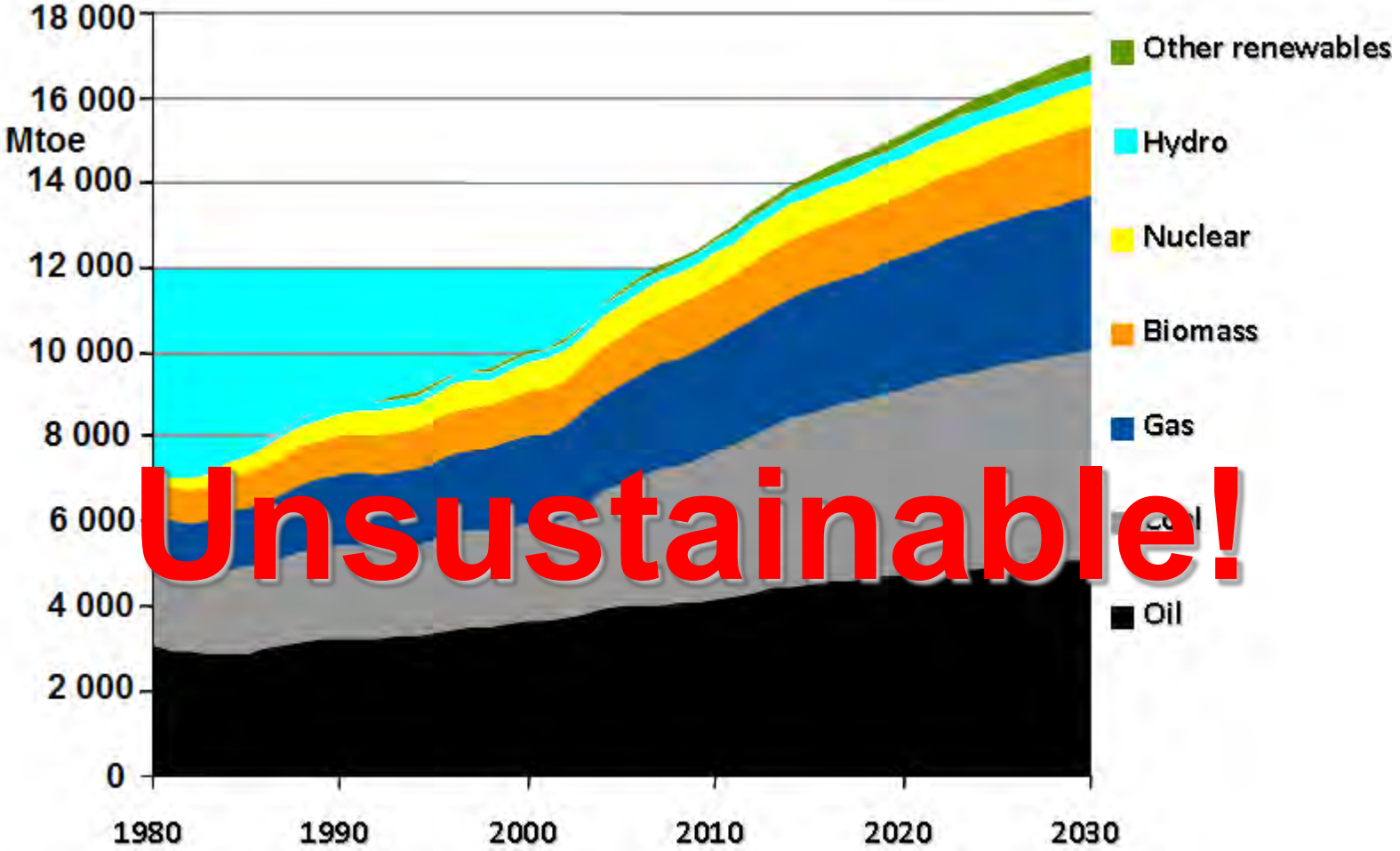
Aims in the next 15 minutes…..

- to review the current use of biomass for bioenergy;
- to consider the challenge for climate change mitigation;
- to identify the *SINS* of biomass that are barriers to its greater uptake;
- and to outline the potential for bioenergy to become a *SAVIOUR*.

World primary energy demand in the IEA WEO 2008 Reference Scenario – 1980-2030.



Current policies will lead to growth of 45% in energy demand by 2030 and a fossil fuel future.

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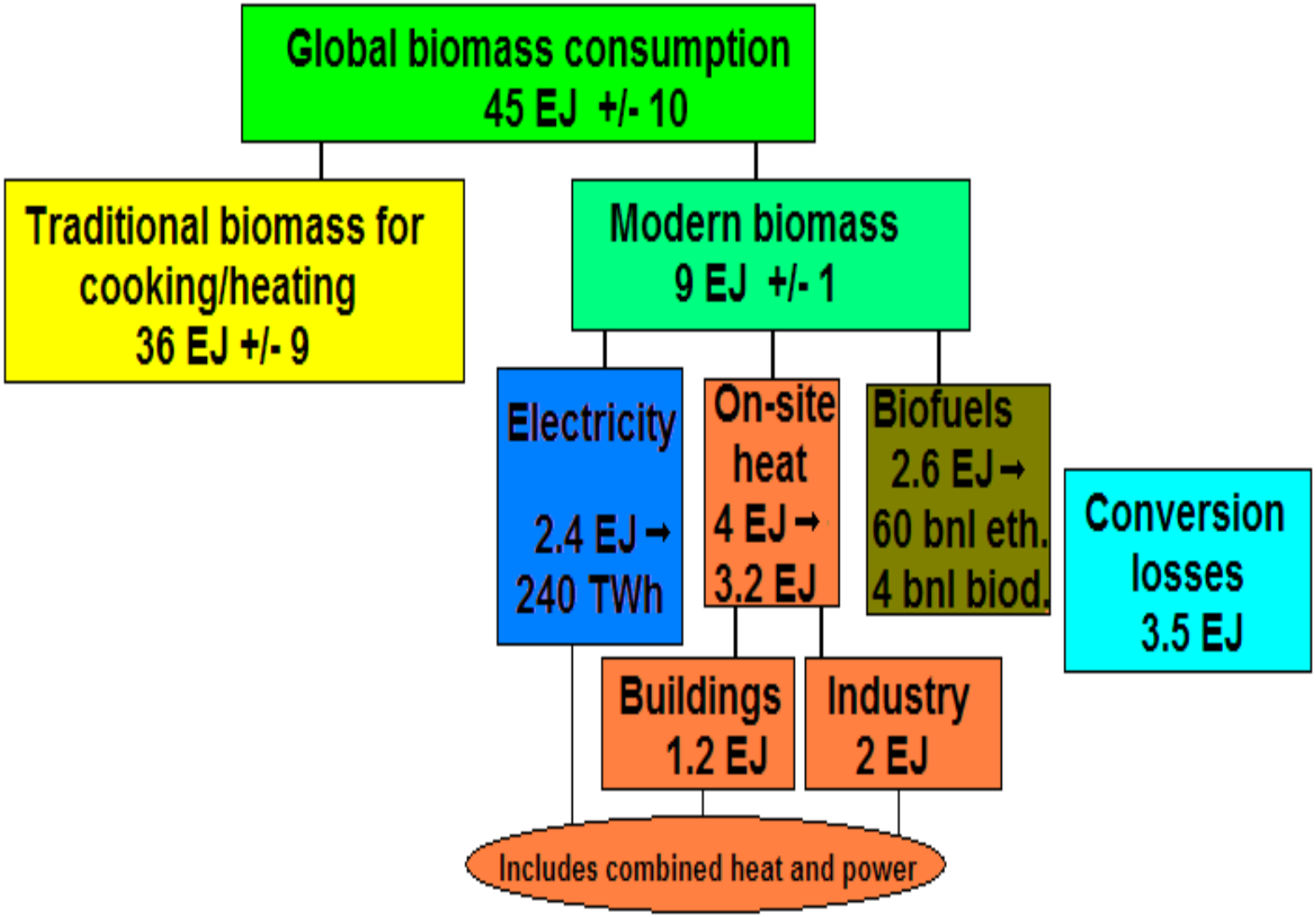
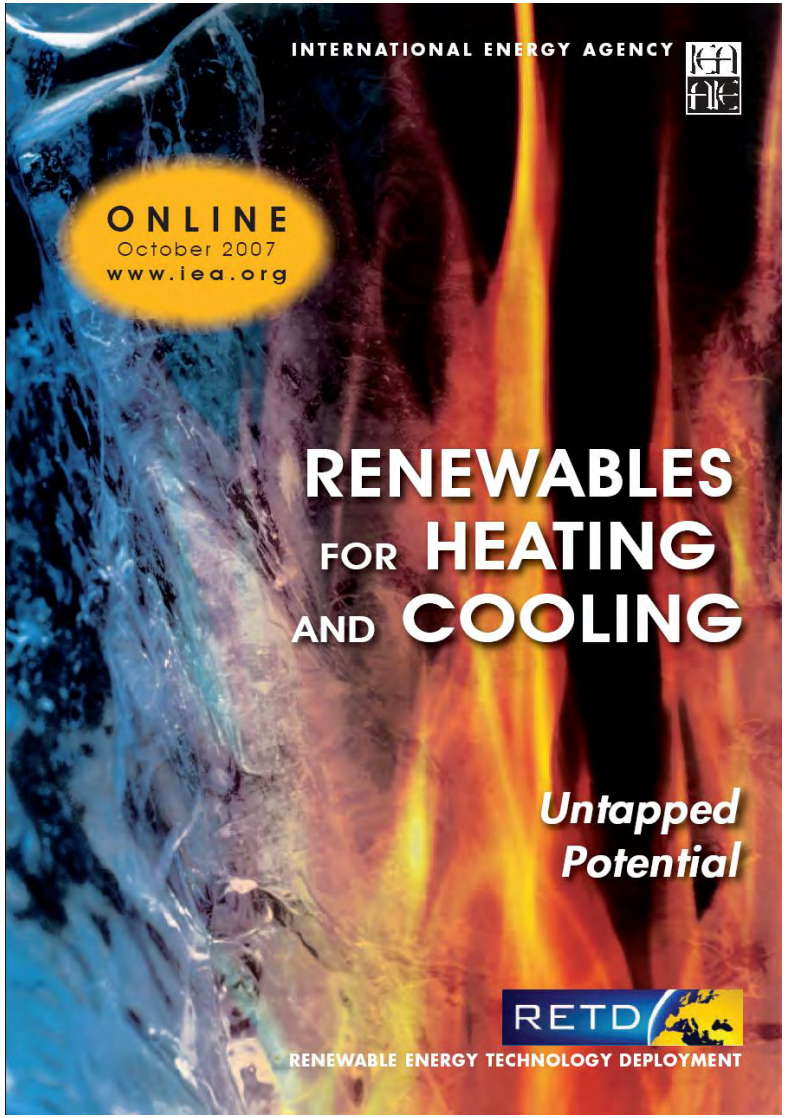
Global biomass resource - around 10% of primary energy



Renewables for Heating and Cooling – the sleeping giant!



Free download from www.iea.org under "Publications"

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The report examines the various REHC technologies, costs, markets and policy effectiveness.

	Installed capacity GW_{th}	Energy output EJ/yr
Solar thermal	**100-110**	**0.2 - 0.22**
- water and space heating		
- solar assisted cooling	<0.05	
Bioenergy	**1000-1200**	**3.0 – 4.0**
- pellet heating		
- CHP		
- anaerobic digestion		
- MSW waste-to-energy		
Geothermal	**25-30**	**0.27 - 0.28**
- deep conventional		
- deep advanced		
- shallow geothermal	**Total**	**3.5-4.5 EJ/yr**

Heat from modern biomass is around 3.8 EJ/yr

Renewable electricity (excluding hydro) 1.9 EJ/yr

Global biofuels use is around 1.7 EJ/yr

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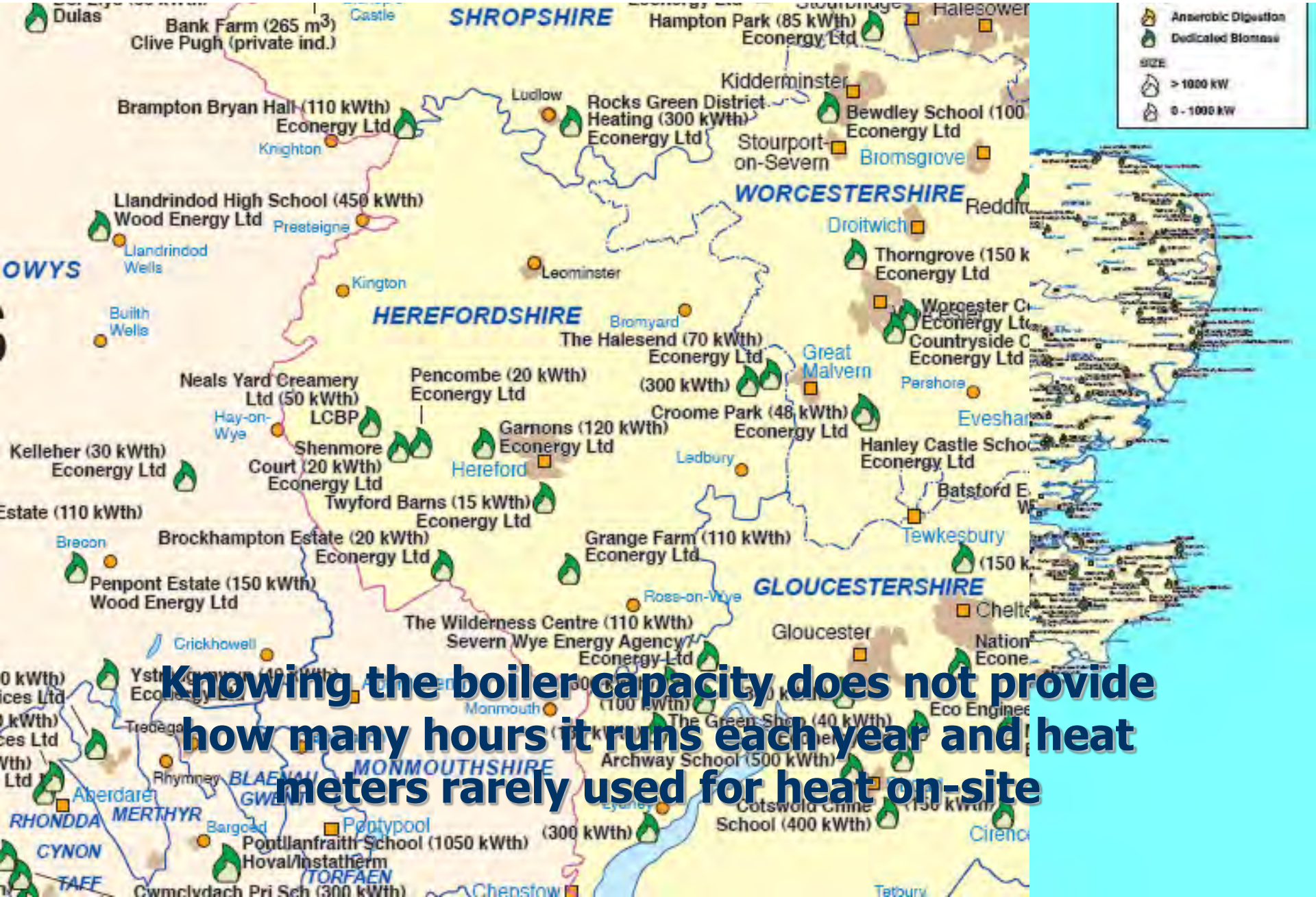
But biomass heat data is poor.



Knowing the boiler capacity does not provide how many hours it runs each year and heat meters rarely used for heat on-site

Transport biofuel options

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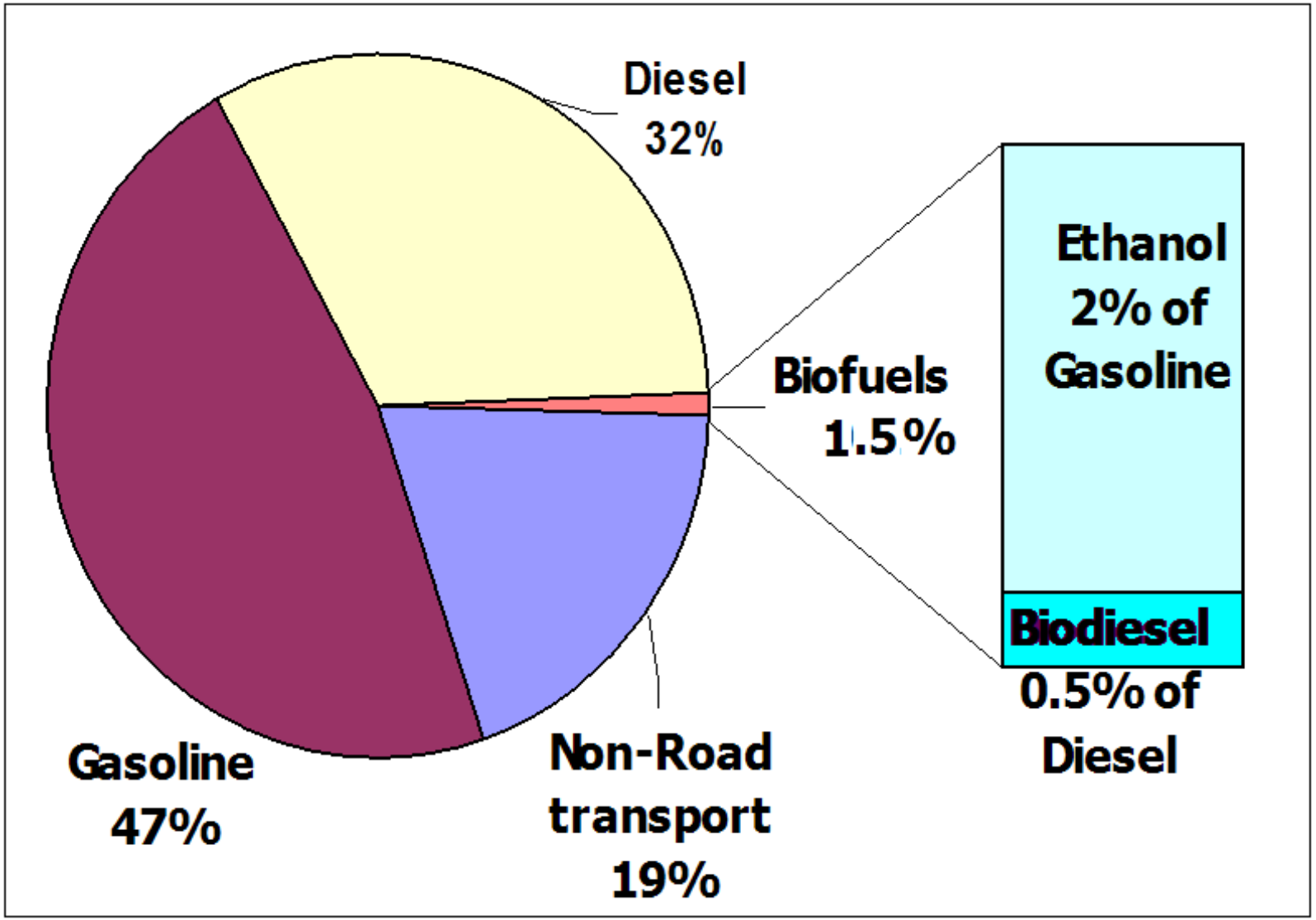
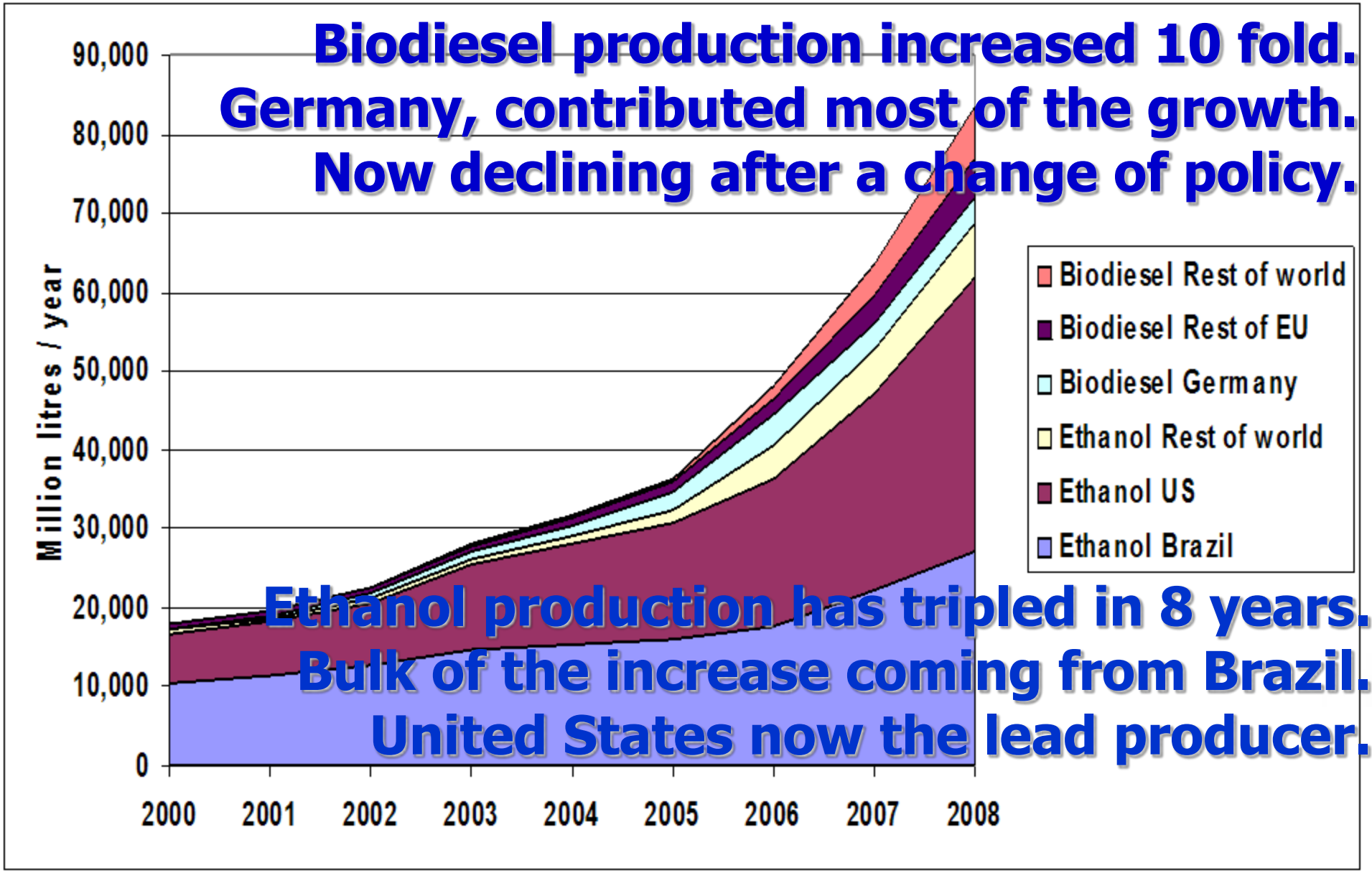
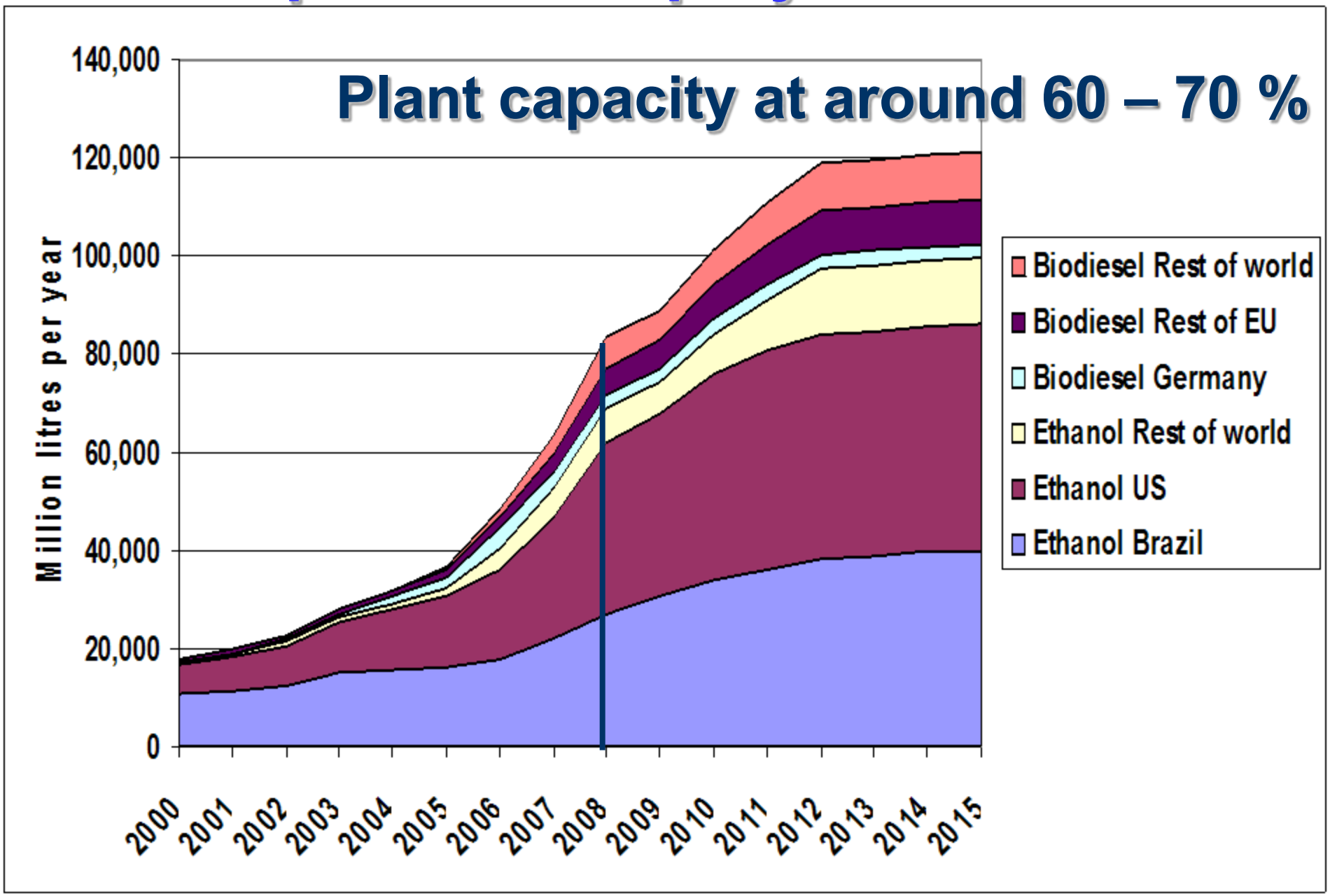
Transport fuels – global refined oil products and biofuels.

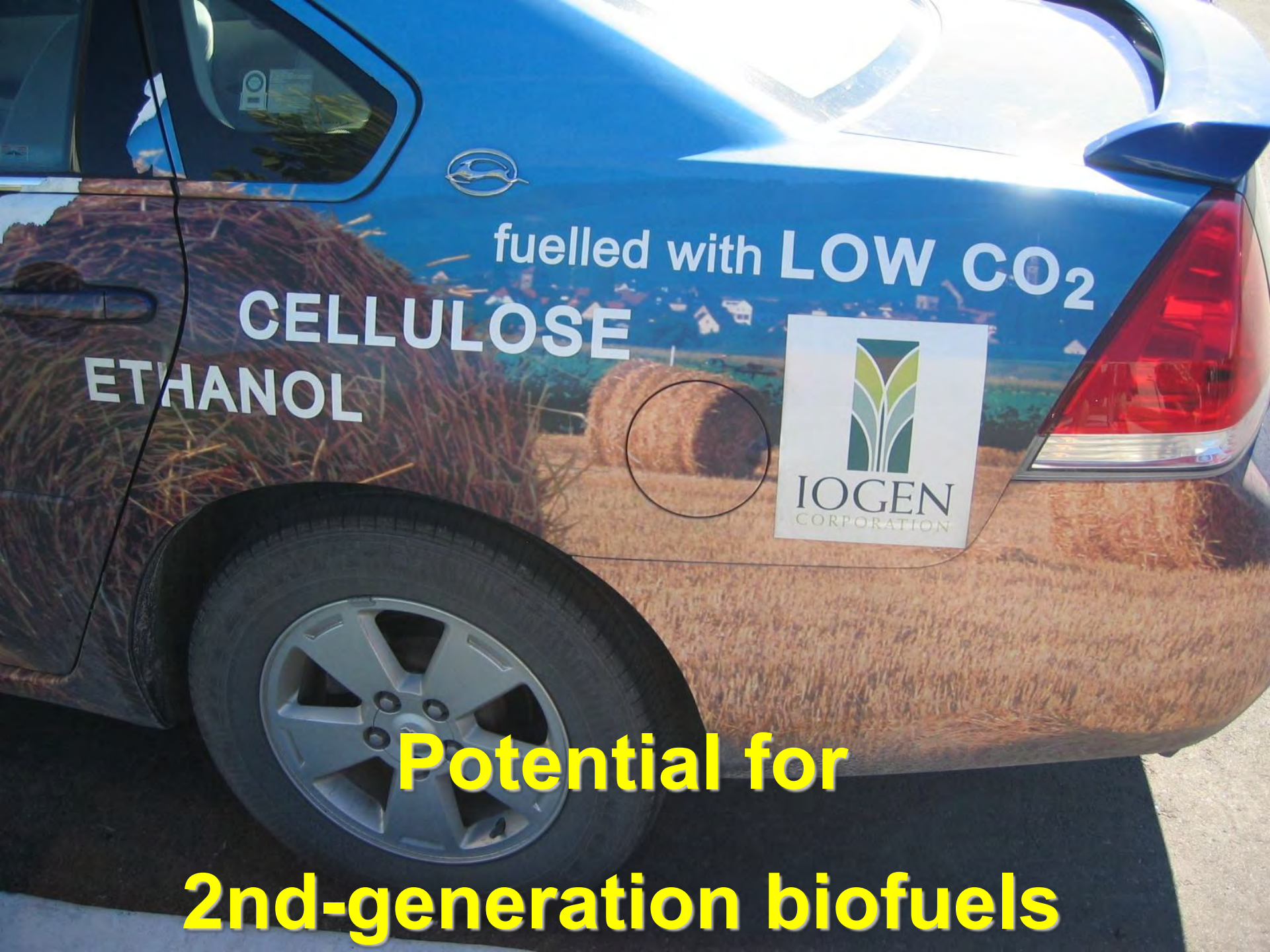


Recent trends in biofuel production



Biofuel production projections to 2015





Potential for 2nd-generation biofuels

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AGENCE INTERNATIONALE DE L'ENERGIE

FROM 1st- TO 2nd-GENERATION BIOFUEL TECHNOLOGIES

An overview of current industry and RD&D activities

RALPH SIMS, MICHAEL TAYLOR
INTERNATIONAL ENERGY AGENCY
AND JACK SADDLER, WARREN MABEE

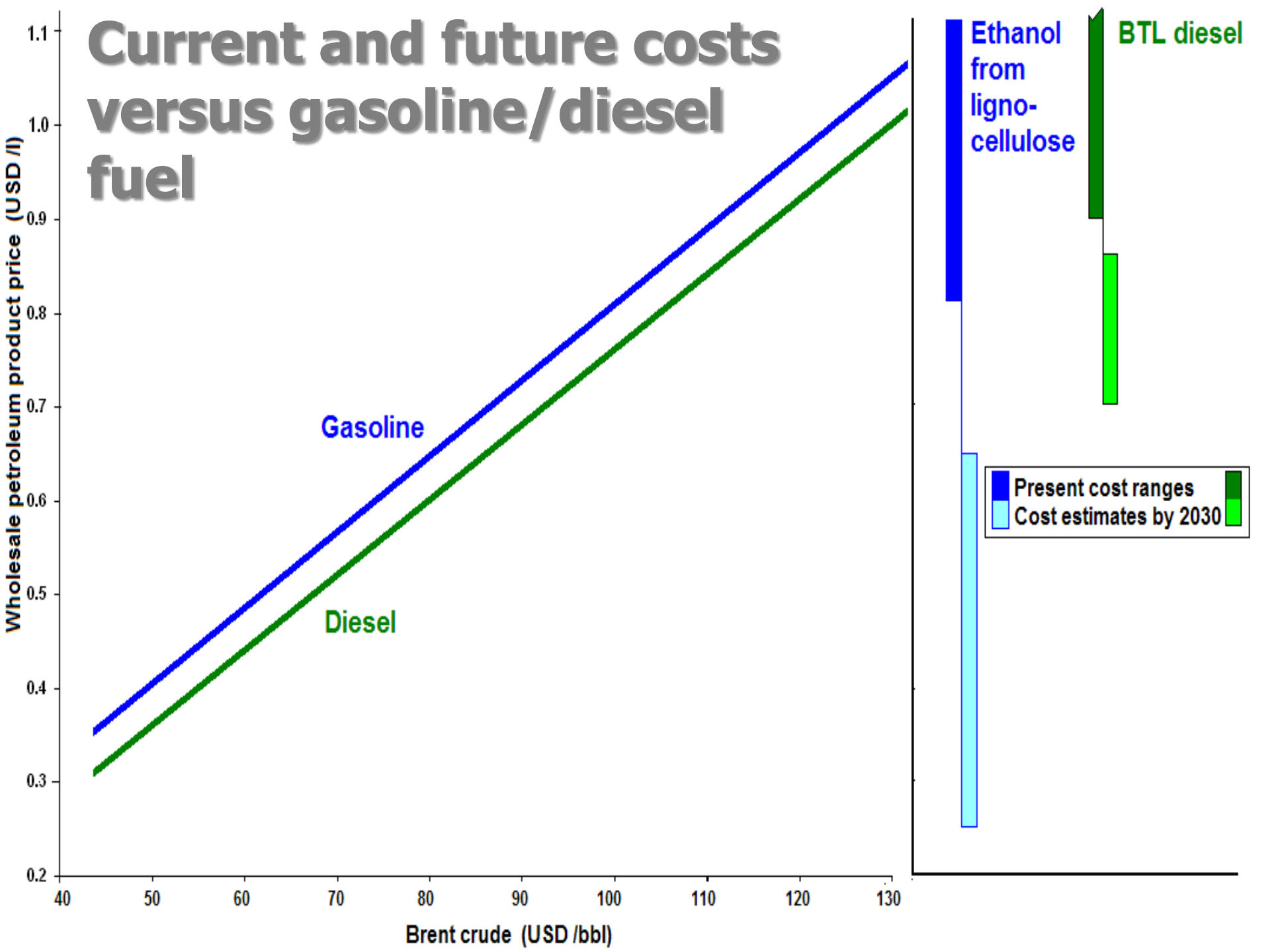
IEA Bioenergy

Free downloads of the full 124 page report are available on www.iea.org

Potential for 2nd-generation biofuels

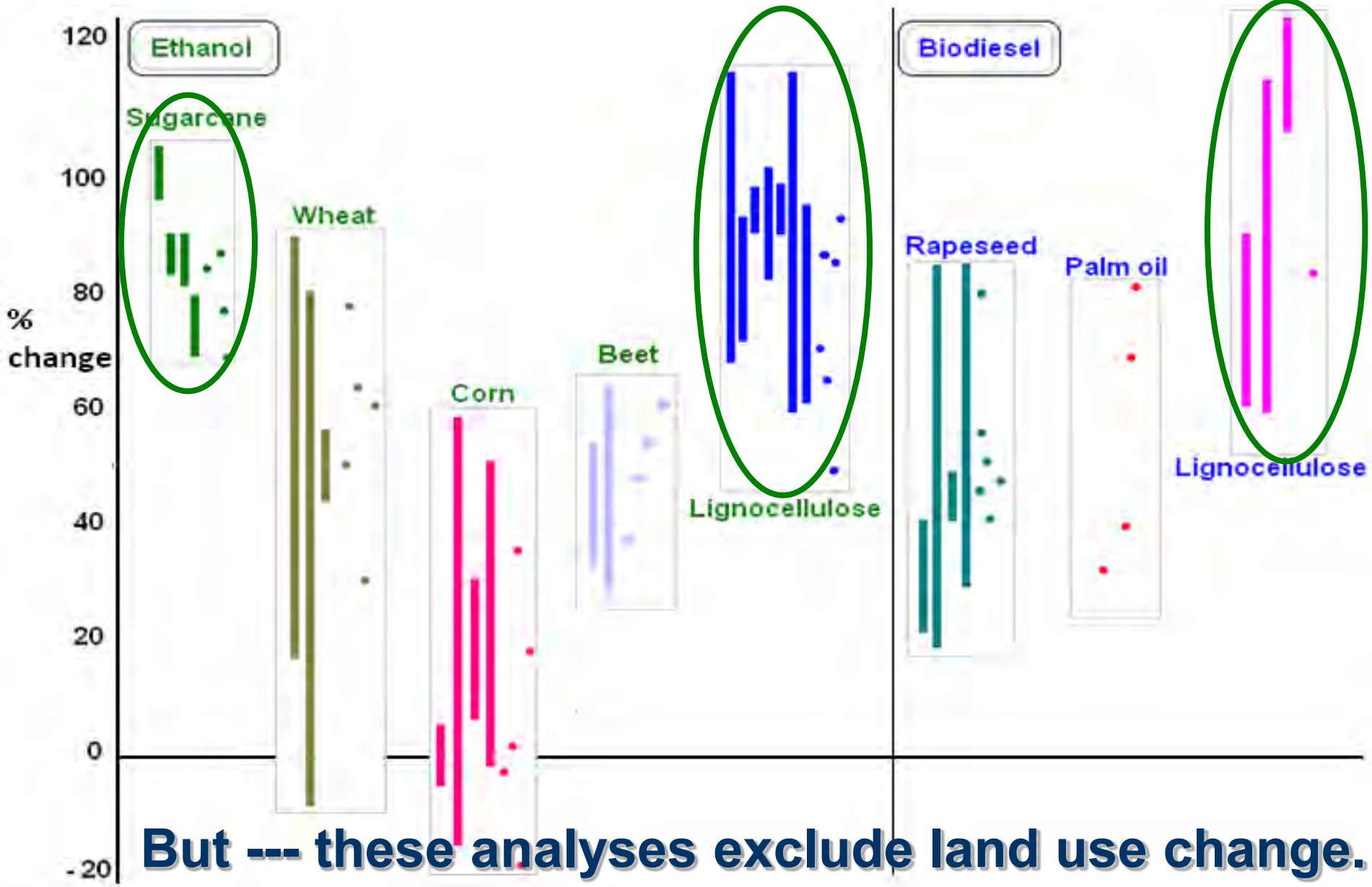
- Where energy crops are grown for feedstocks, similar issues of sustainable production, land use change, and food-versus-fuel competition exist as for 1st-generation biofuels.
- Both *biochemical* and *thermo-chemical* conversion routes have reached the demonstration stage - but key technical and economic issues remain to be resolved.
- More investment in RD&D is needed. Private investment has declined - but more government funding may be forthcoming.
- The future potential for 2nd-generation biofuels remains uncertain and full commercialisation is unlikely to occur for some years to come.

Current and future costs versus gasoline/diesel fuel



Biofuels GHG abatement potential

Source: IEA & UNEP for OECD (2008) based on 60 published studies



But --- these analyses exclude land use change.

Biomass the Sinner……

- Land use competition for food/fibre.
- Energy crops compete for water use.
- Mining of soil nutrients.
- Supply chain logistics and costs.
- Health concerns from smoke.
- Local air pollution and dioxins.
- Greenhouse gas emissions uncertain.
- Can be high costs- $/ t CO_2 avoided.
- Exploitation of rural landowners.
- Don’t know the resource available.

How much biomass will become available in the future?

- Future supplies hard to determine.
- Crop and forest residues and animal wastes are cheap and easy to assess.
- Waste-to-energy resources are limited.
- Sustainable production of biomass from energy crops is under scrutiny.
- Potential of GM crops is unknown.
- Land available for energy crops will depend on future farm management regimes and crop yield increases.

Assessment of biomass supply potential in 2050 (IEA Bioenergy, IPCC)

• Energy cropping	0-700 EJ
• Energy cropping on marginal land	<60-100
• Forest residues	30-150
• Agricultural residues	15-70
• Organic wastes	5-50
• Animal manures	5-55
Total	120 – 1200

Which means

"We really have no idea"!!

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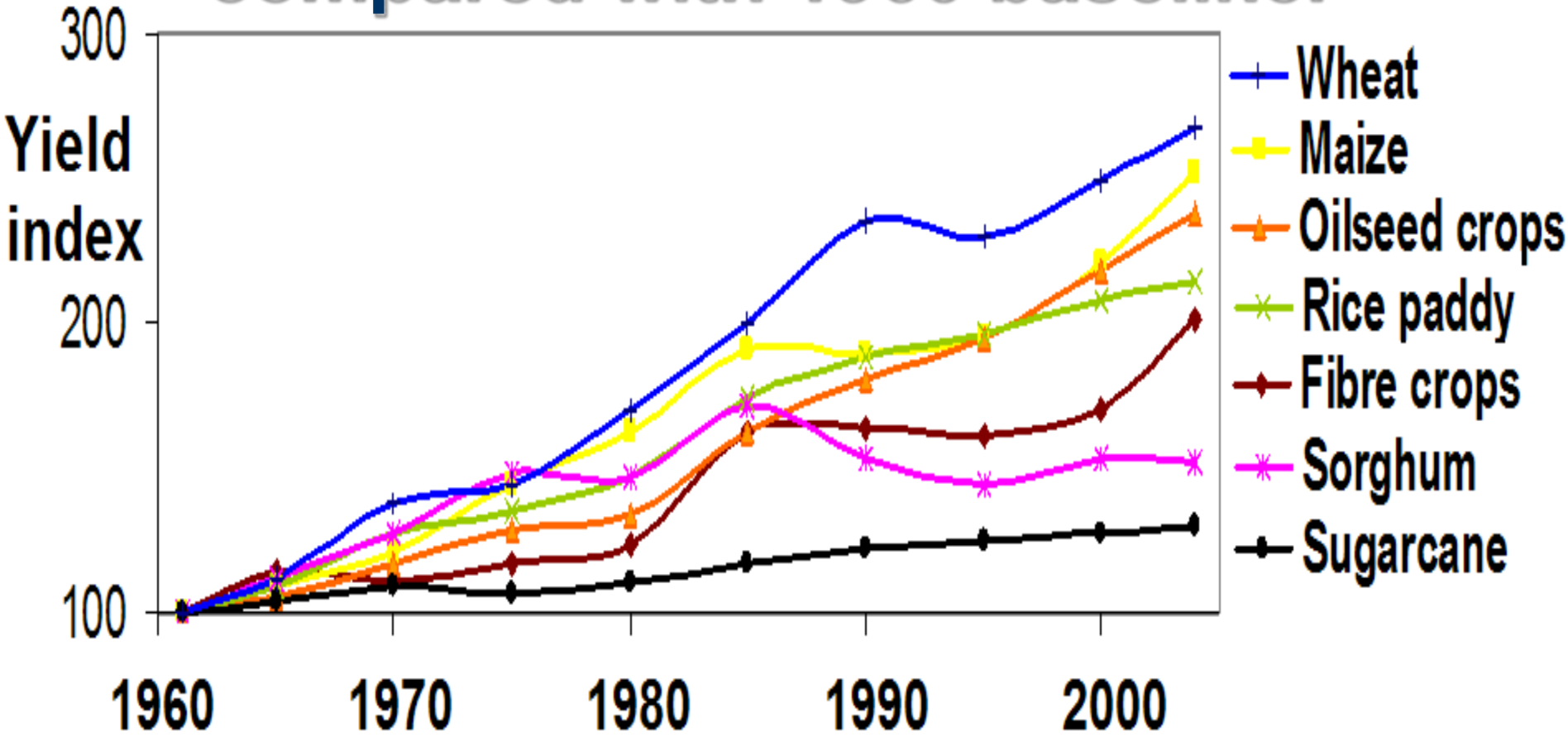
Worldwide average crop yield trends compared with 1960 baseline.



Can increases in crop yields continue?

Will production remain sustainable?

Can supply chain systems be improved to reduce delivered costs?

John Deere/Timberjack

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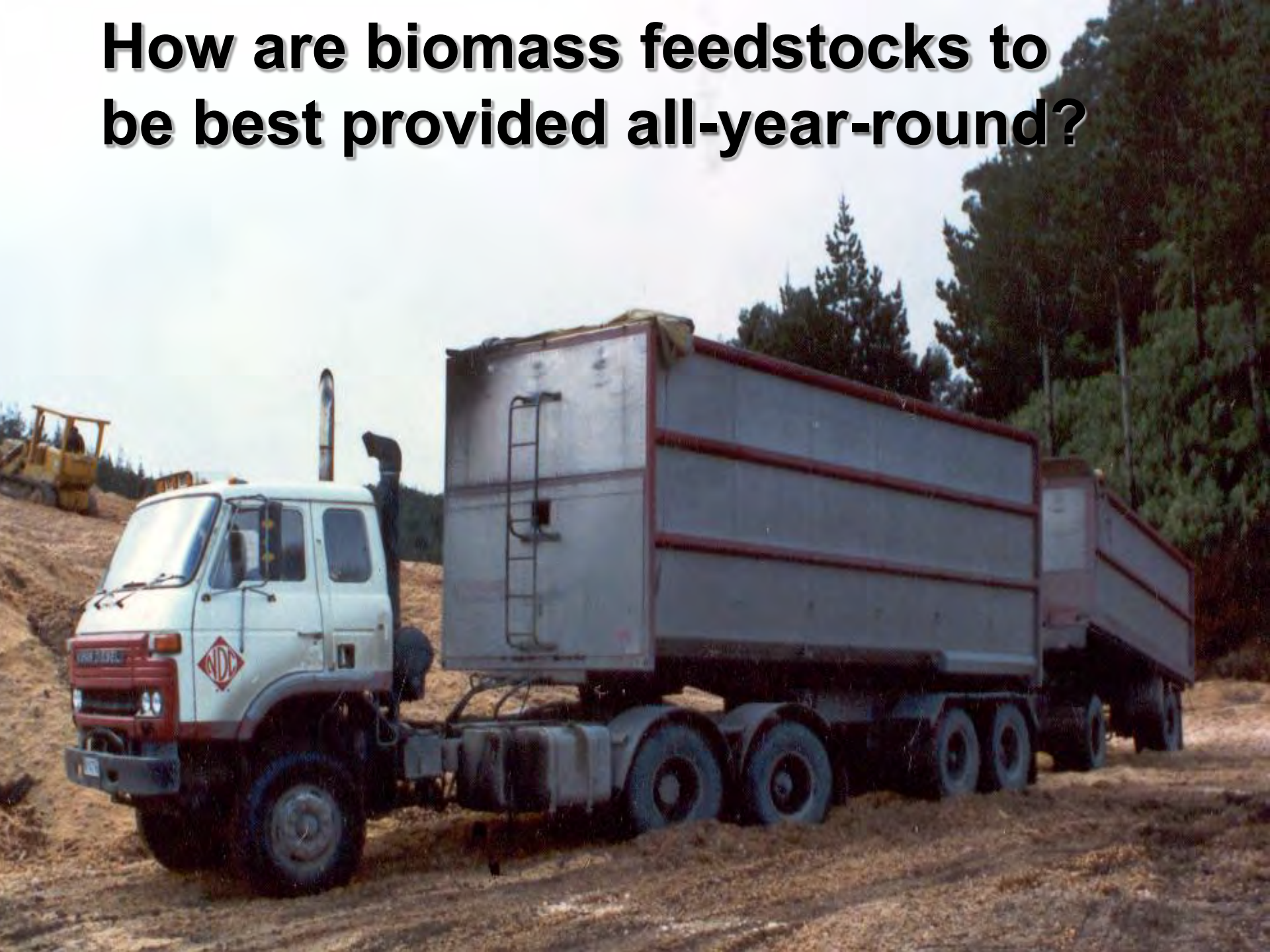
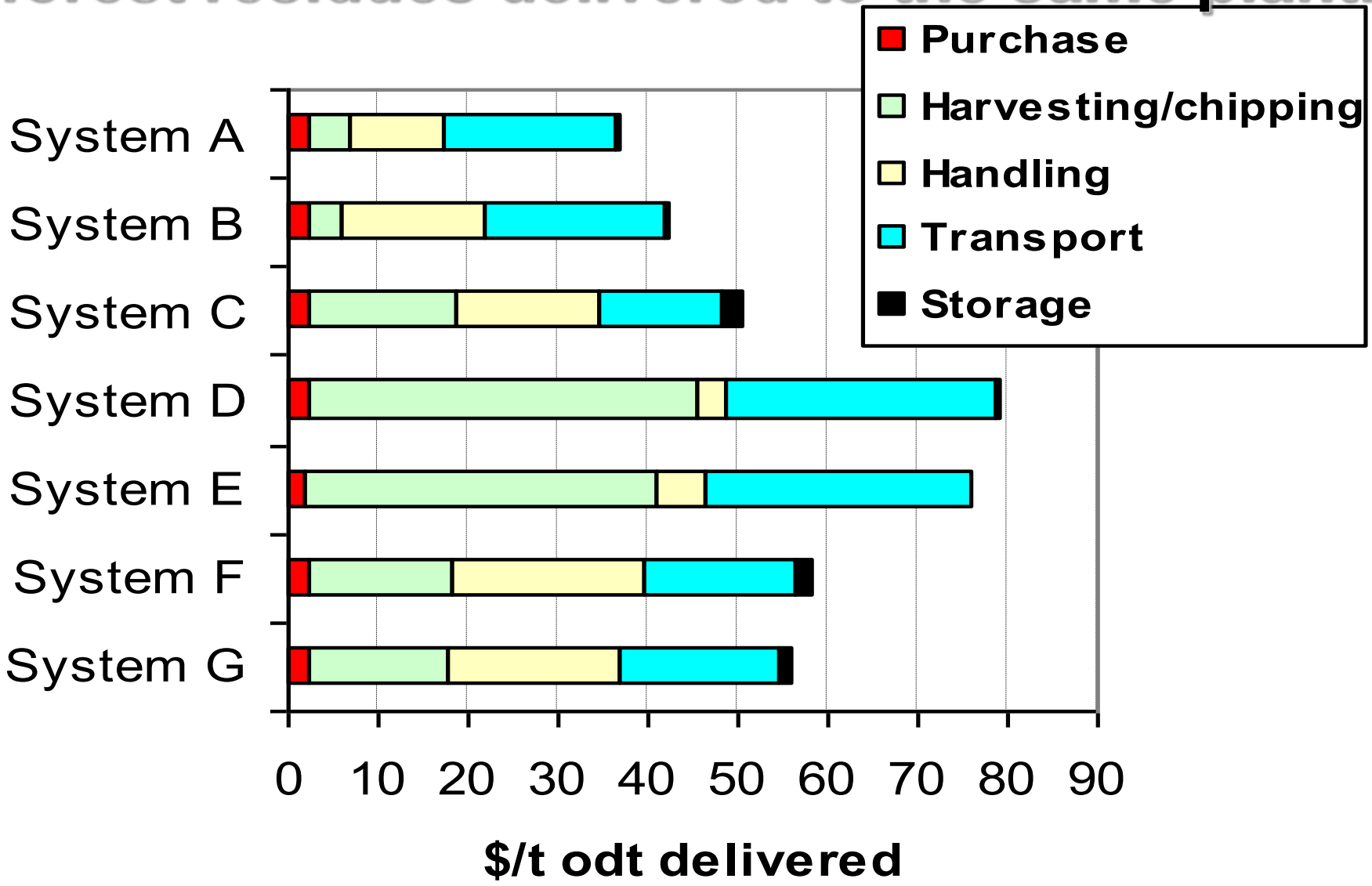
How are biomass feedstocks to be best provided all-year-round?



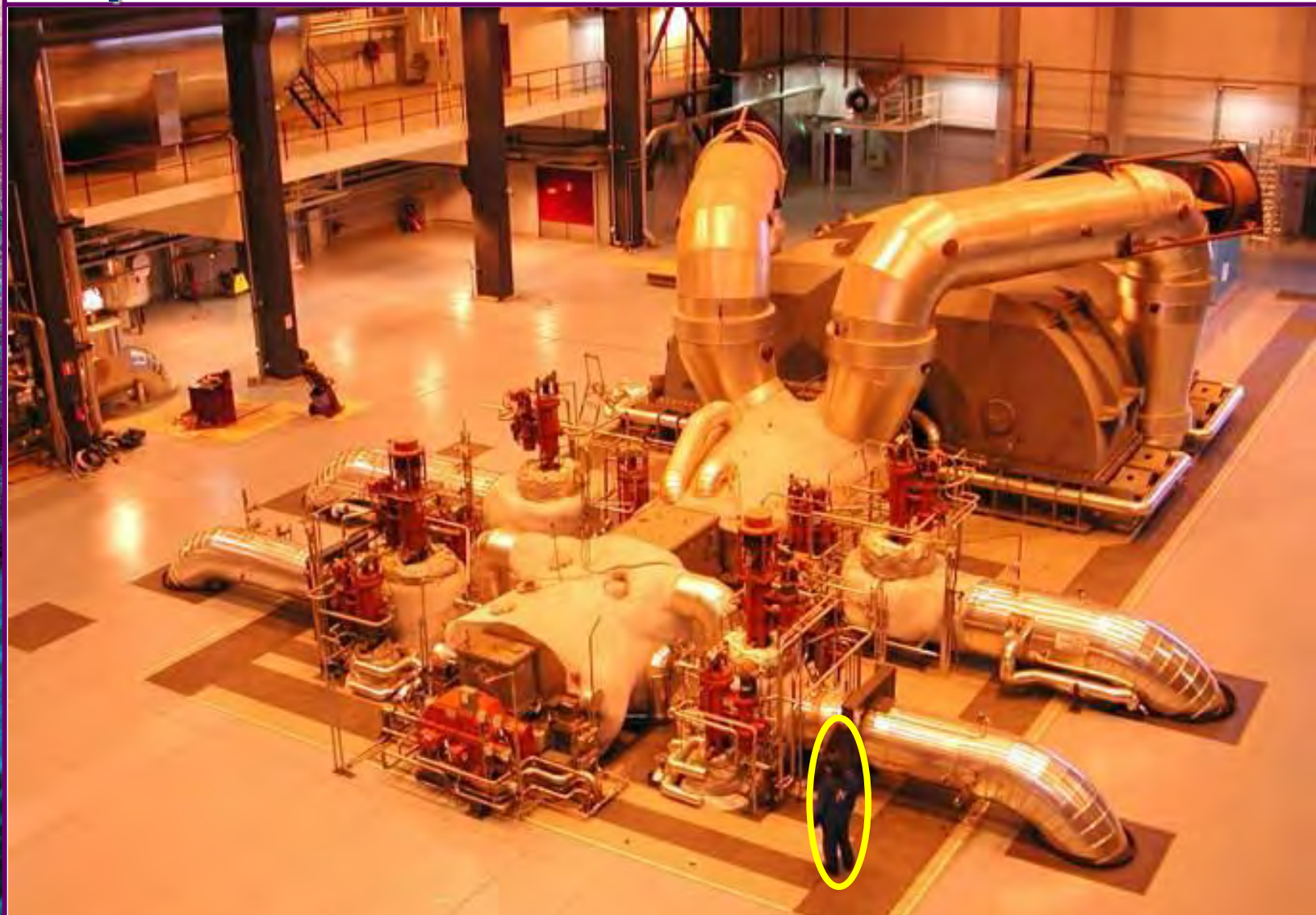
Example of variations in supply costs for forest residues delivered to the same plant.



Source: Brilliance of Bioenergy. Sims R E H, Earthscan

Is the “Energy in” less than the “Energy out”?

What technology improvements in bioenergy conversion plants can be expected in the next decades?



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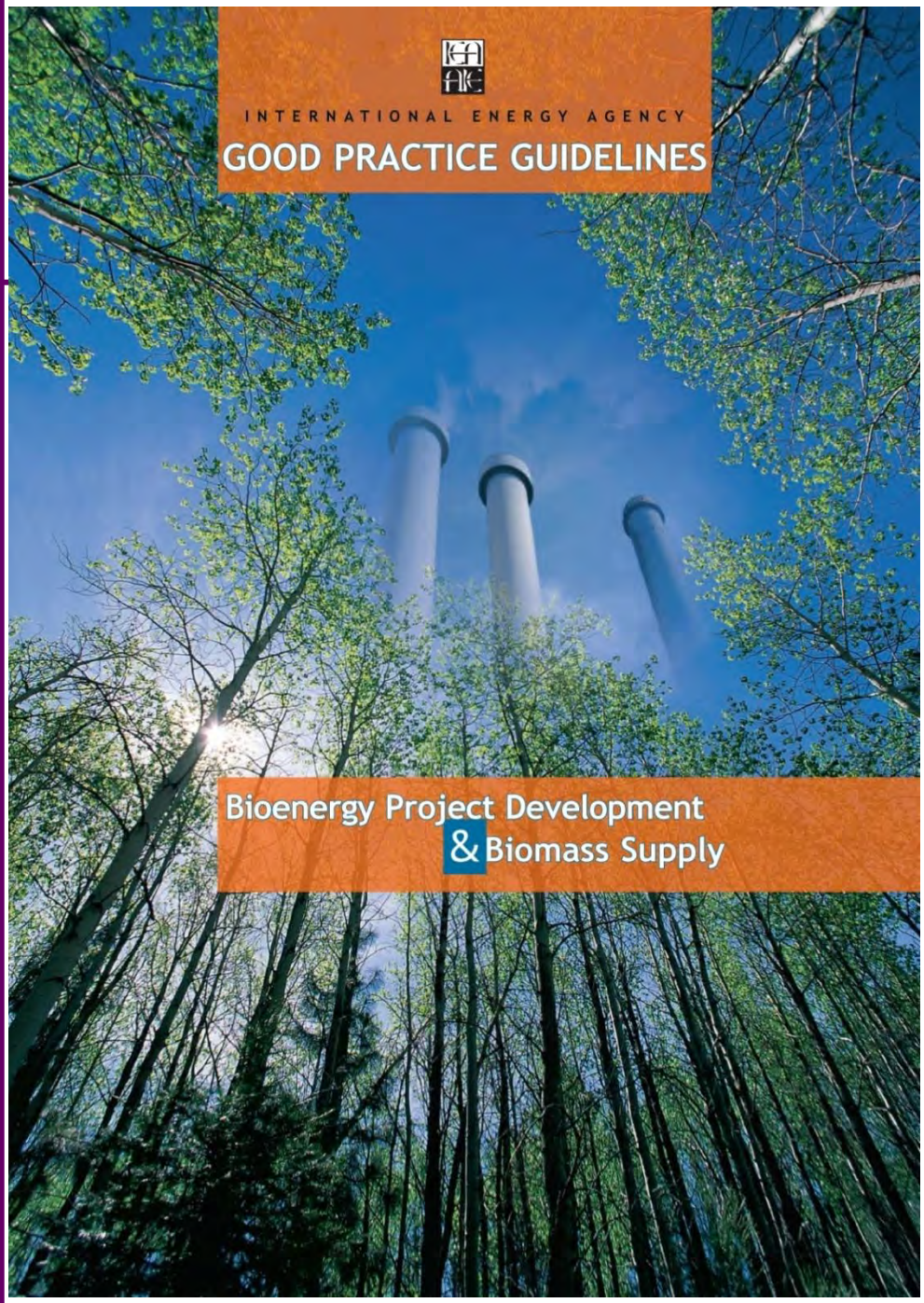
Sustainable?
Or not sustainable?

It is not always easy to develop a bioenergy plant.

The Rocky Point sugar mill cogeneration plant in Australia took 2 years of planning and needed 17 contracts and consents before building could begin!



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A publication to assist the challenge of securing long-term, sustainable biomass supplies and developing a bioenergy plant.

Free download at

www.iea.org

Biomass the Saviour

- Increased security of energy supply (US).
- Greenhouse gas mitigation potential (EU).
- Supports sustainable development (DCs).
- Treatment of organic wastes.
- Provides employment opportunities.
- Is a tradeable energy carrier.
- Is a store of energy.
- Can produce multi- and co-products.
- Can be used to physically reduce atmospheric CO_2 concentrations.

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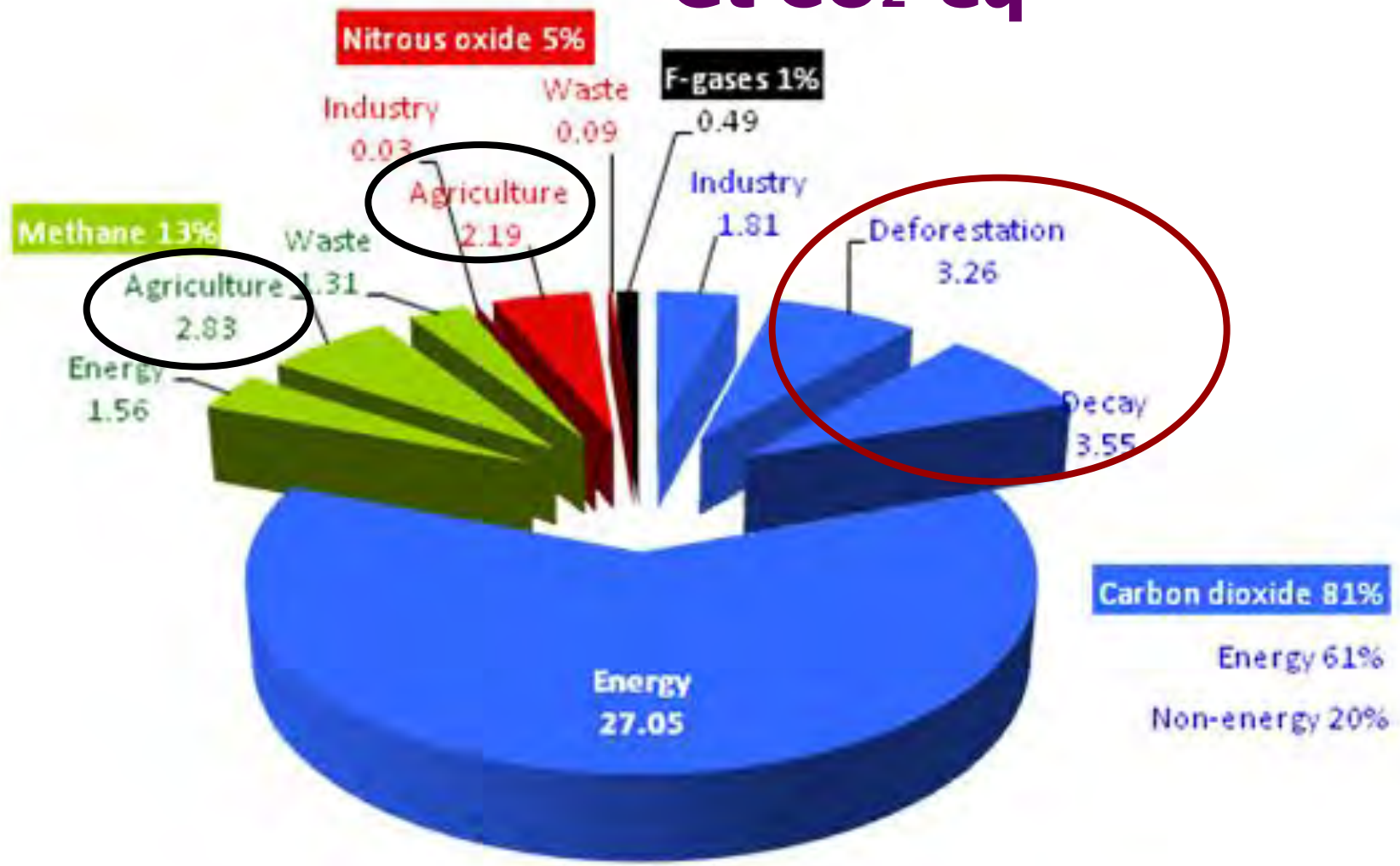
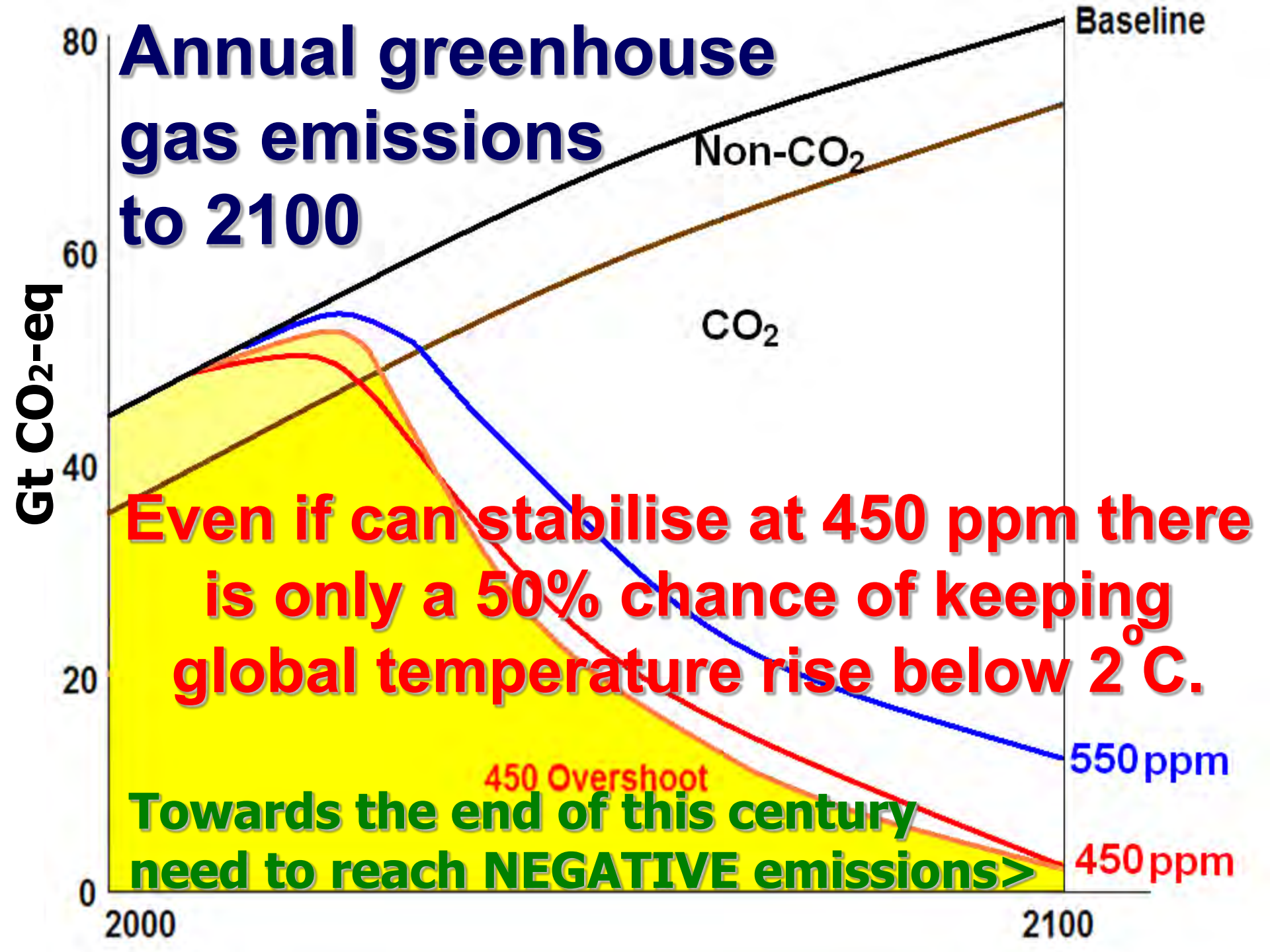
Annual global greenhouse gas emissions

Gt CO_2-eq



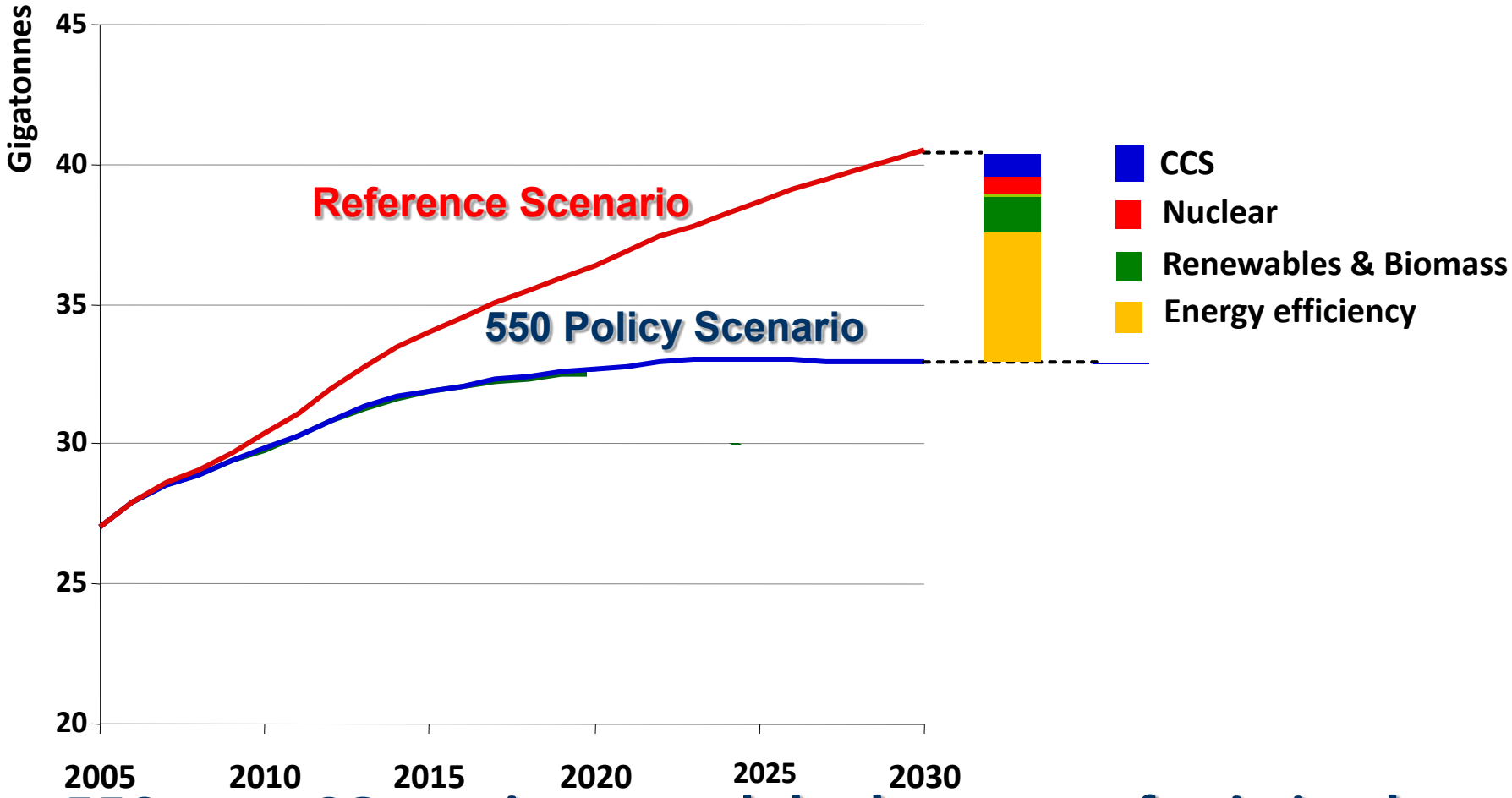
Energy ~65%. Agriculture around ~10%.

Land use change ~15%.


Annual greenhouse gas emissions to 2100
Baseline
Non-CO2
CO2
Gt CO2-eq
80
60
40
20
0
2000
2100
Even if can stabilise at 450 ppm there is only a 50% chance of keeping global temperature rise below 2°C.
550 ppm
450 Overshoot
450 ppm
Towards the end of this century need to reach NEGATIVE emissions>

IEA WEO 2008 climate-policy scenarios.

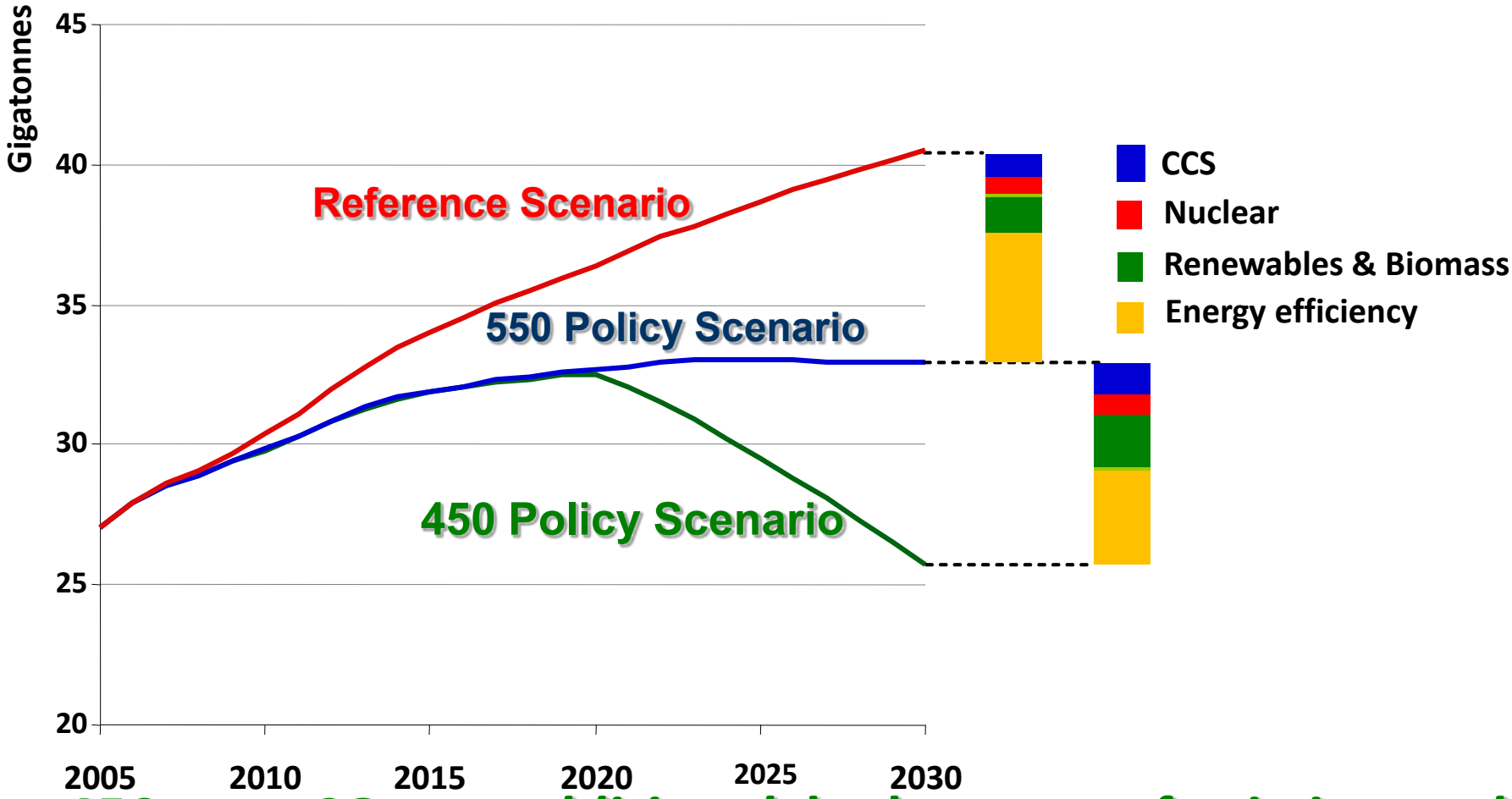
Reductions in annual energy-related CO_2 emissions



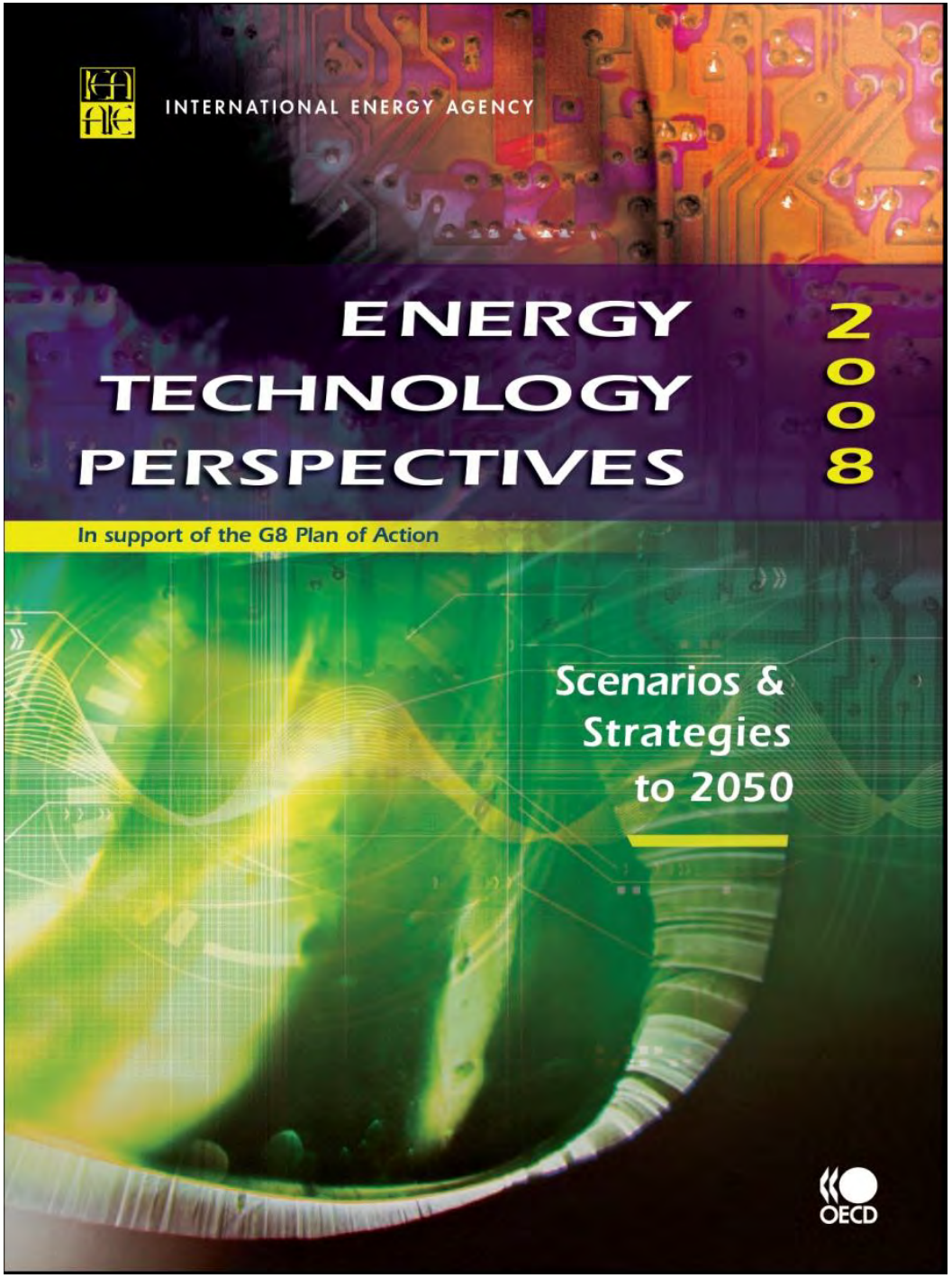
For 550 ppm CO_2-eq increased deployment of existing low-carbon technologies accounts for most of the savings at US$ 90 /t CO_2

IEA WEO 2008 climate-policy scenarios.

Reductions in annual energy-related CO_2 emissions



For 450 ppm CO_2-eq *additional* deployment of existing *and new* low-carbon technologies accounts for most savings at US$ 180 /t CO_2


INTERNATIONAL ENERGY AGENCY
ENERGY TECHNOLOGY PERSPECTIVES 2008
In support of the G8 Plan of Action
Scenarios & Strategies to 2050
OECD

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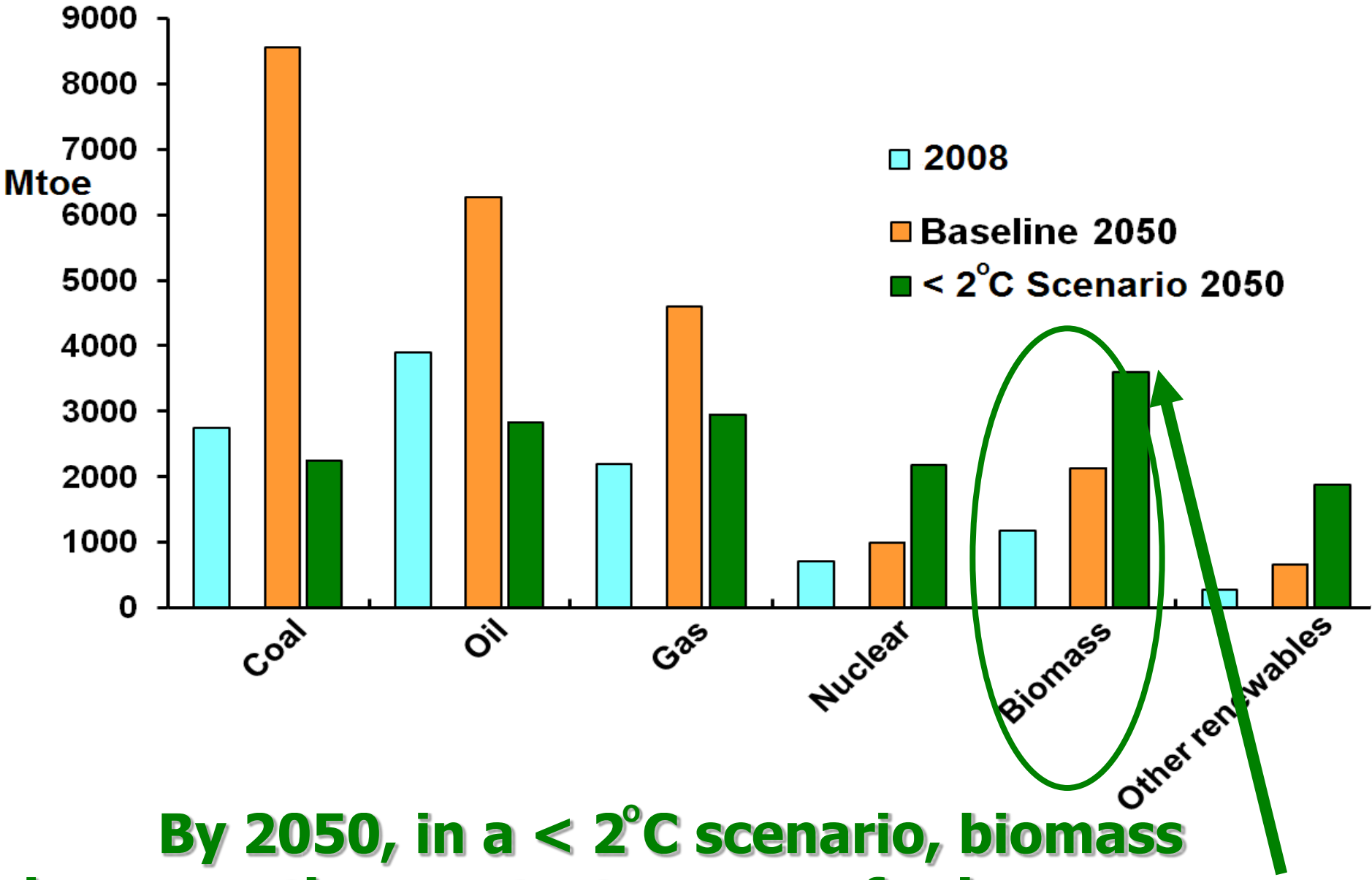
Primary energy supply by *2050*.

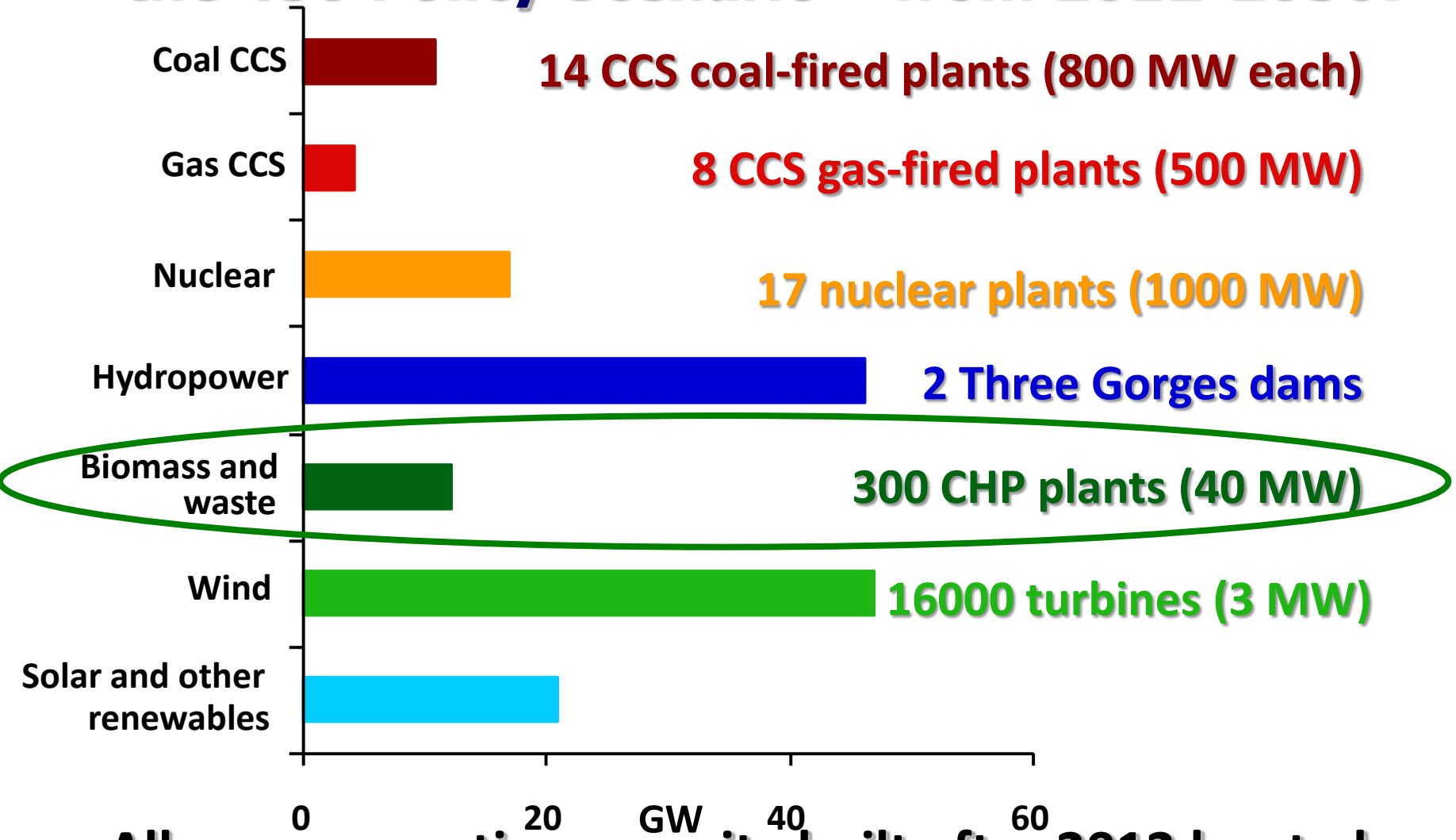


By 2050, in a < 2°C scenario, biomass becomes the greatest source of primary energy

The Biomass Resource in the ETP

- In the < 2°C Scenario, biomass will increase three times to around 3600 Mtoe / year (150 EJ/yr).
- This will require 15 000 Mt biomass / year.
  - around half from crop and forest residues
  - rest from purpose-grown energy crops.
- 9 000 Mt /yr used for bio-chemicals, heating and cooking.
- 3 000 Mt /yr used for transport fuels.
- 3 000 Mt /yr to produce 2450 TWh of electricity.

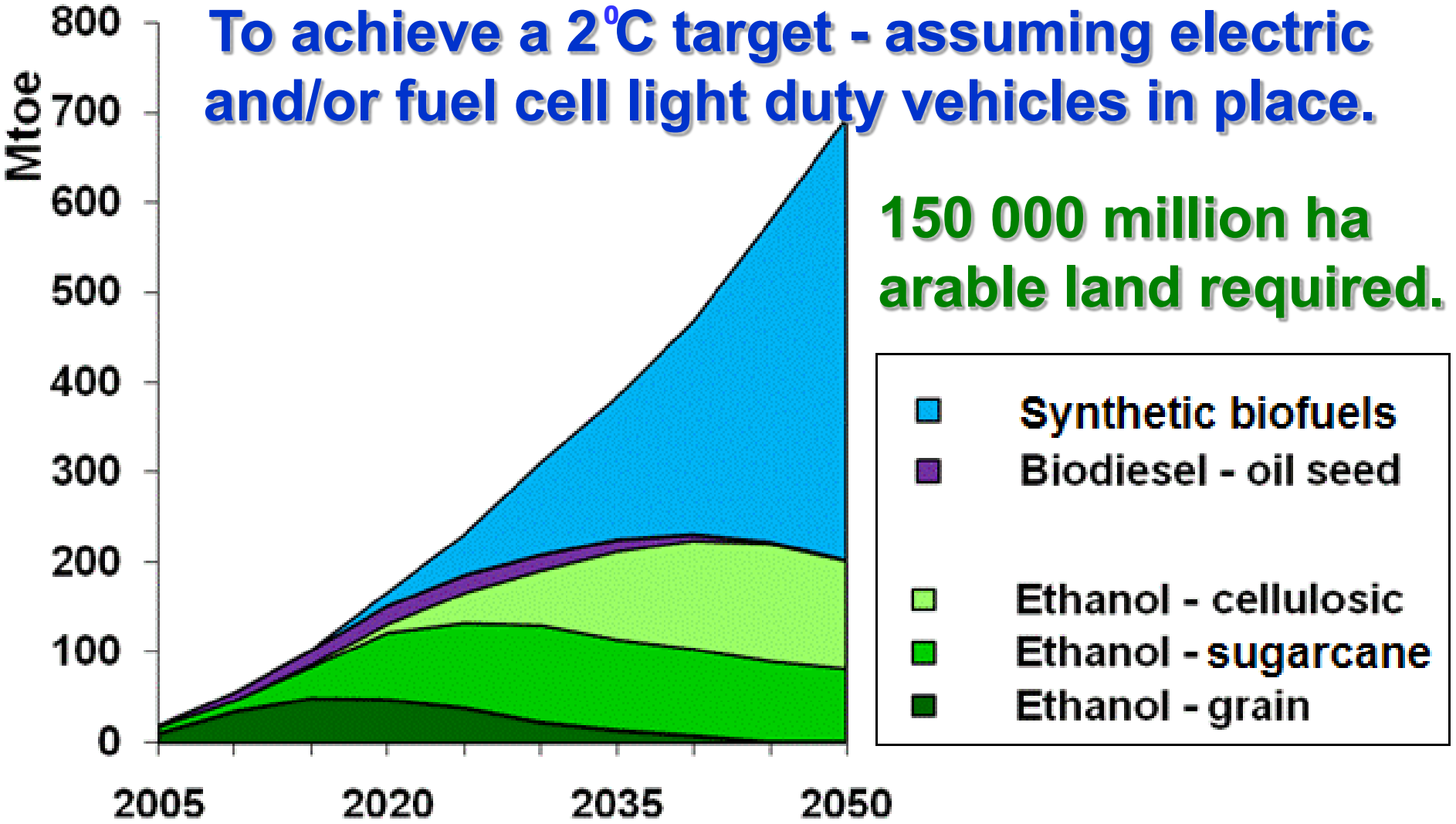
Annual power capacity additions needed to meet the 450 Policy Scenario – from 2012-2030.



All new generating capacity built after 2012 has to be "carbon-free" and 15% of existing capacity retired early.

Biofuels in 2050 – IEA "ETP" scenario

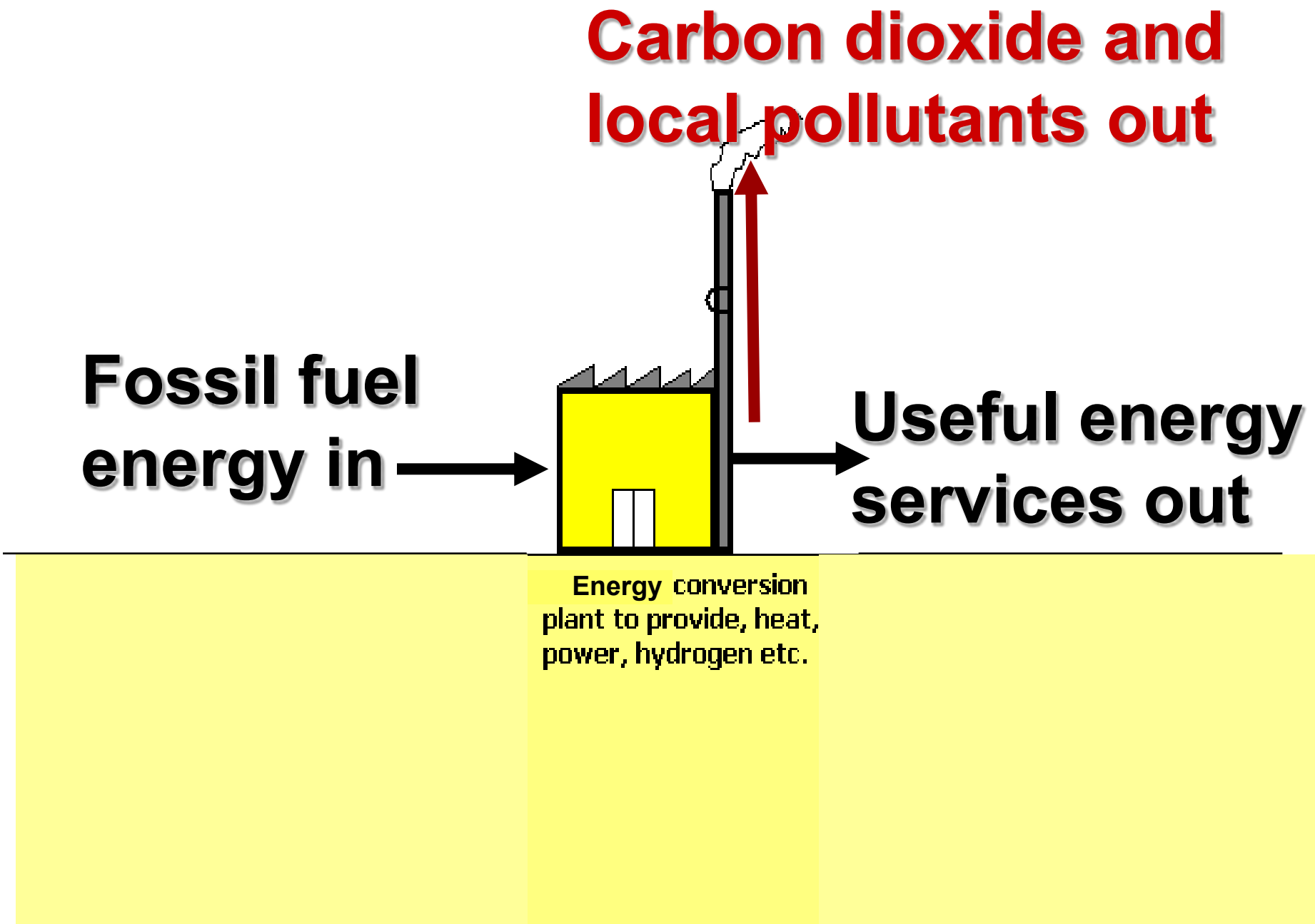
To achieve a 2°C target - assuming electric and/or fuel cell light duty vehicles in place.



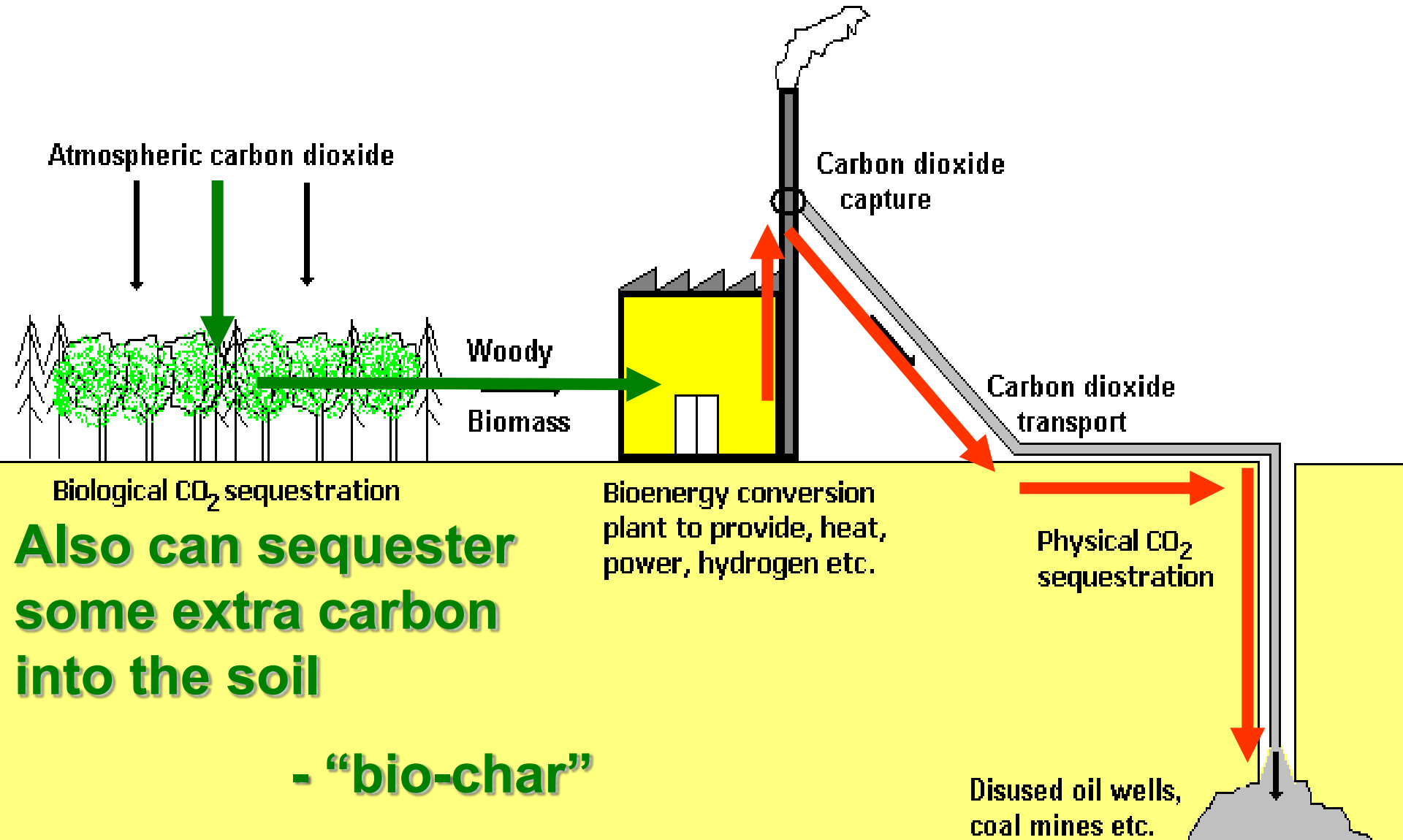
150 000 million ha arable land required.

Most biofuel growth after 2020 will be 2nd-generation. Synthetic biofuels after 2030 needed mainly for aviation, heavy trucks and marine purposes.

Carbon dioxide emissions.



Carbon dioxide capture and storage linked with bioenergy.



Also can sequester some extra carbon into the soil

- "bio-char"

Co-benefits need to be included in policy analysis

- Co-products e.g. animal feeds.
- Land and soil quality issues.
- Local air quality improvement.
- Employment opportunities.
- Rural community support.
- Distributed energy, local ownership, pride and independence.

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What role for forest biomass in the Copenhagen climate negotiations?

International Council of Forest and Paper Associations - statement on the REDD (Reducing Emissions from Deforestation and Degradation) to help shape national positions includes:

- recognition of woody biomass as a substitute for fossil fuels;
- recognition of long-lasting carbon pools in wood products and future potential for growth;
- ensuring benefits flow to local communities rather than to governments so local people become part of the solution.

New IEA report.

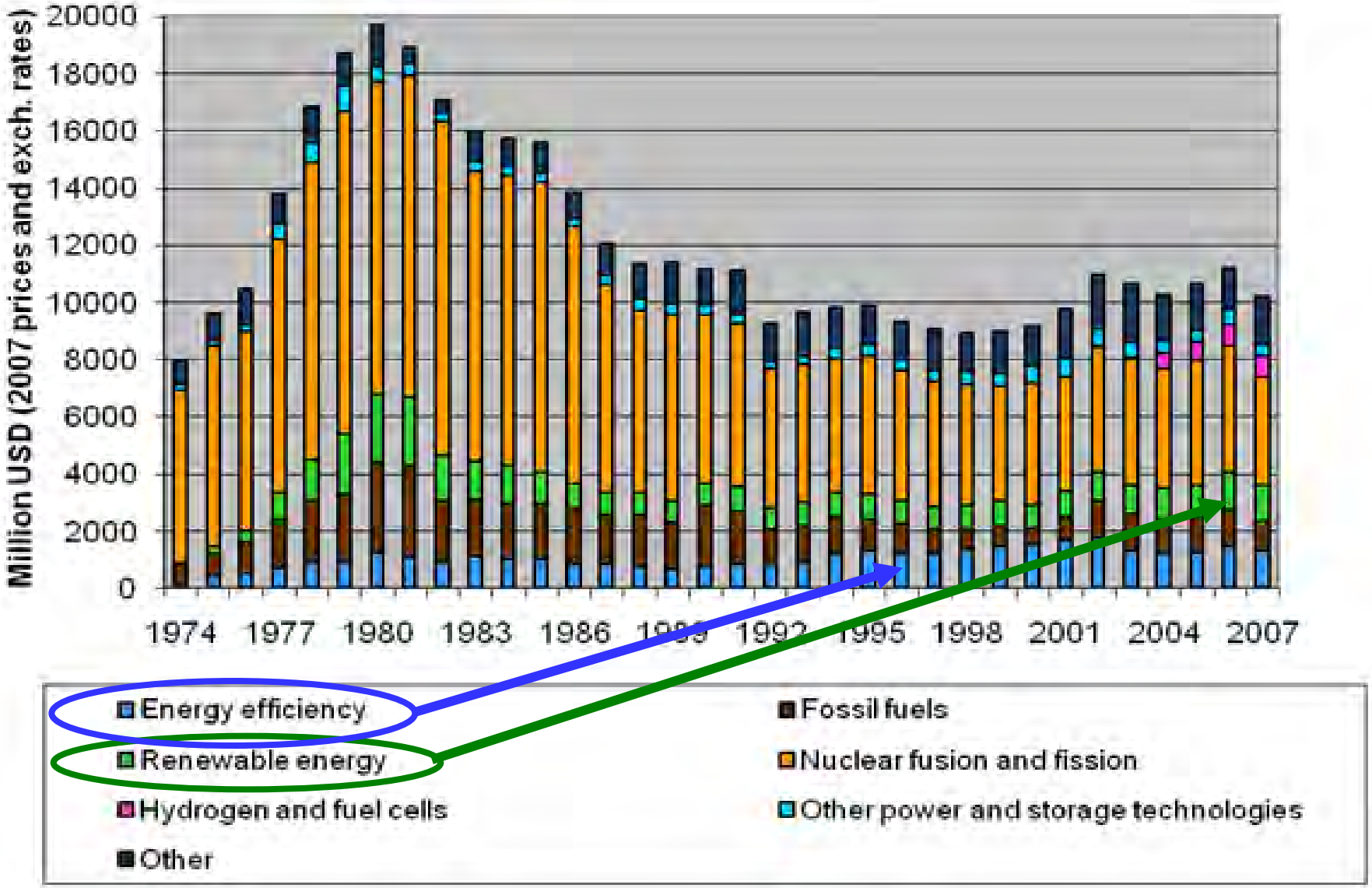
Aim is for local governments to lead – including bioenergy.

Cities, Towns and Renewable Energy

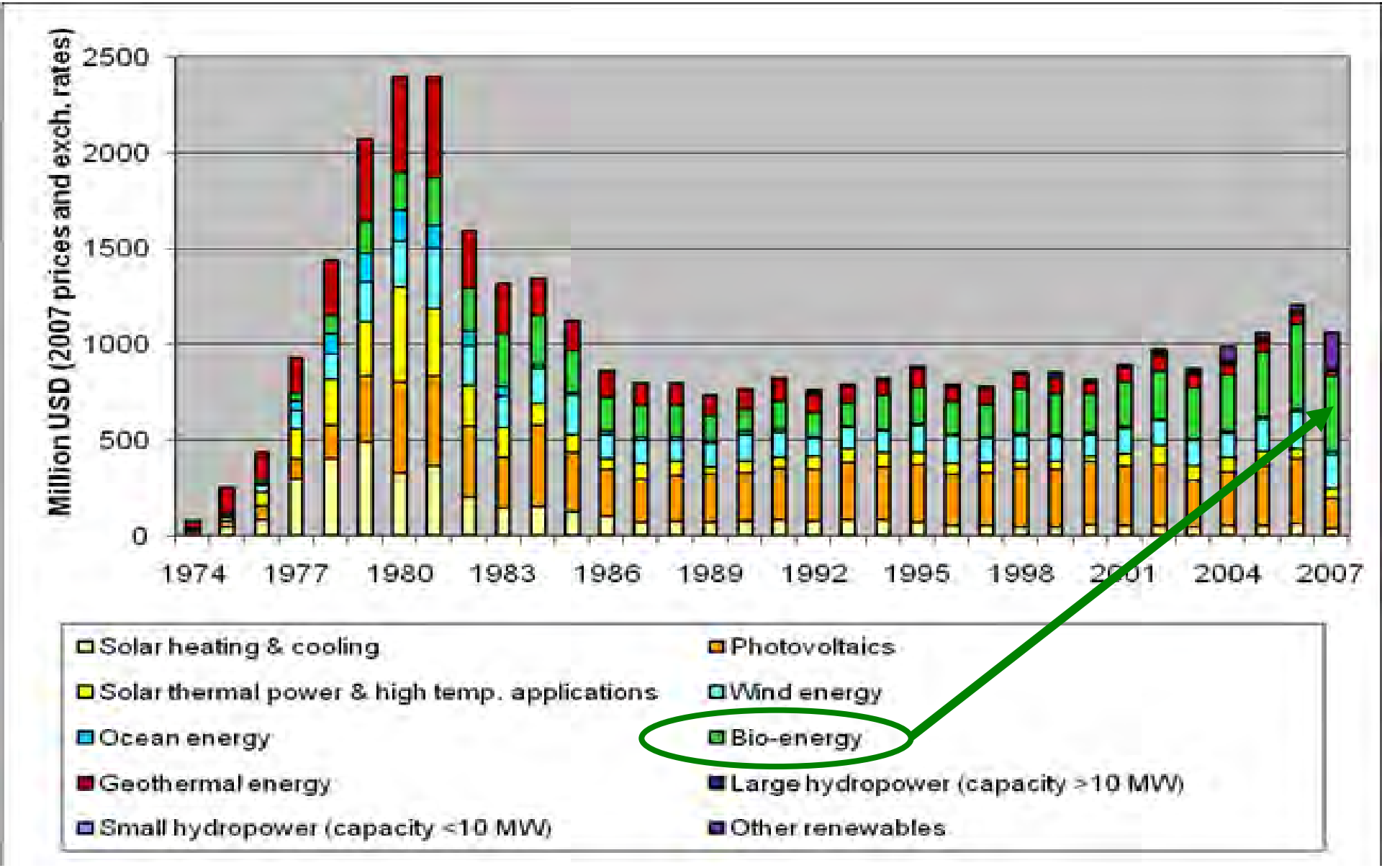
YIMFY

Yes In My Front Yard!

Public RD&D budgets for energy - IEA member countries 1974-2007.



Public RD&D budgets for Renewable energy - IEA member countries 1974-2007.



In summary

- Climate change is real and adaptation is inevitable.
- All national, provincial and municipal governments need to participate in the mitigation solutions to keep global mean temperature rise below 2^{O}C.
- The *sins* of biomass can mostly be forgiven - by careful management of the land and water and improving the various conversion processes.
- Bioenergy cannot be the *saviour* alone, but it has a key role to play by both displacing fossil fuels and sequestering atmospheric carbon.
- However….

we are running out of time……..