INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

## The IPCC scientific perspective: Policies, Instruments and Co-operative Arrangements for Mitigation

# Energy Supply and Transport

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**CLA Energy Supply Chapter 4**

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# Energy Supply

## Key mitigation technologies and practices

### a) currently commercially available:

- improved supply and distribution efficiencies;
- fuel switching e.g from coal to gas;
- nuclear power;
- combined heat and power;
- renewable energy for heat and power –
  solar, geothermal, bioenergy, hydro, wind.

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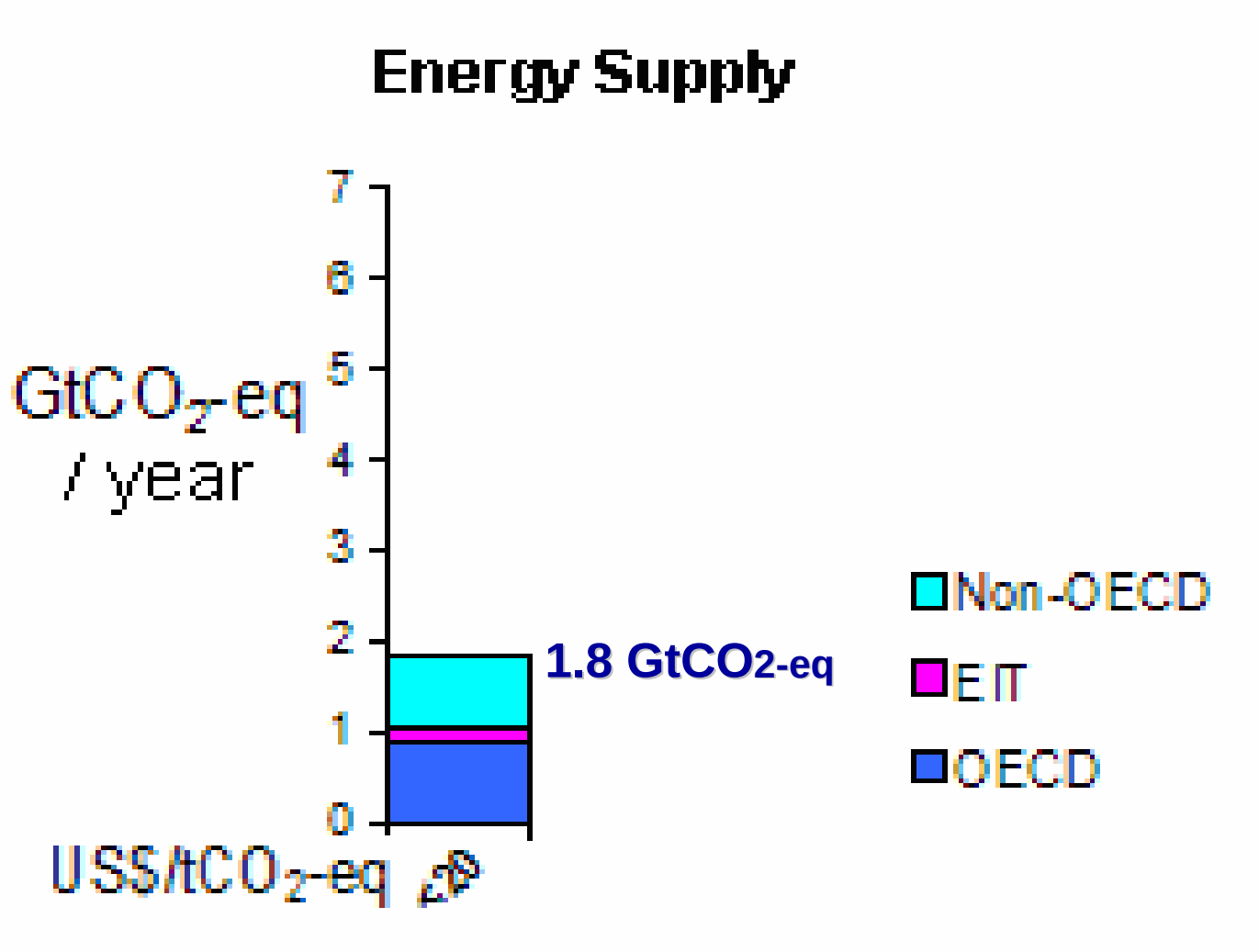
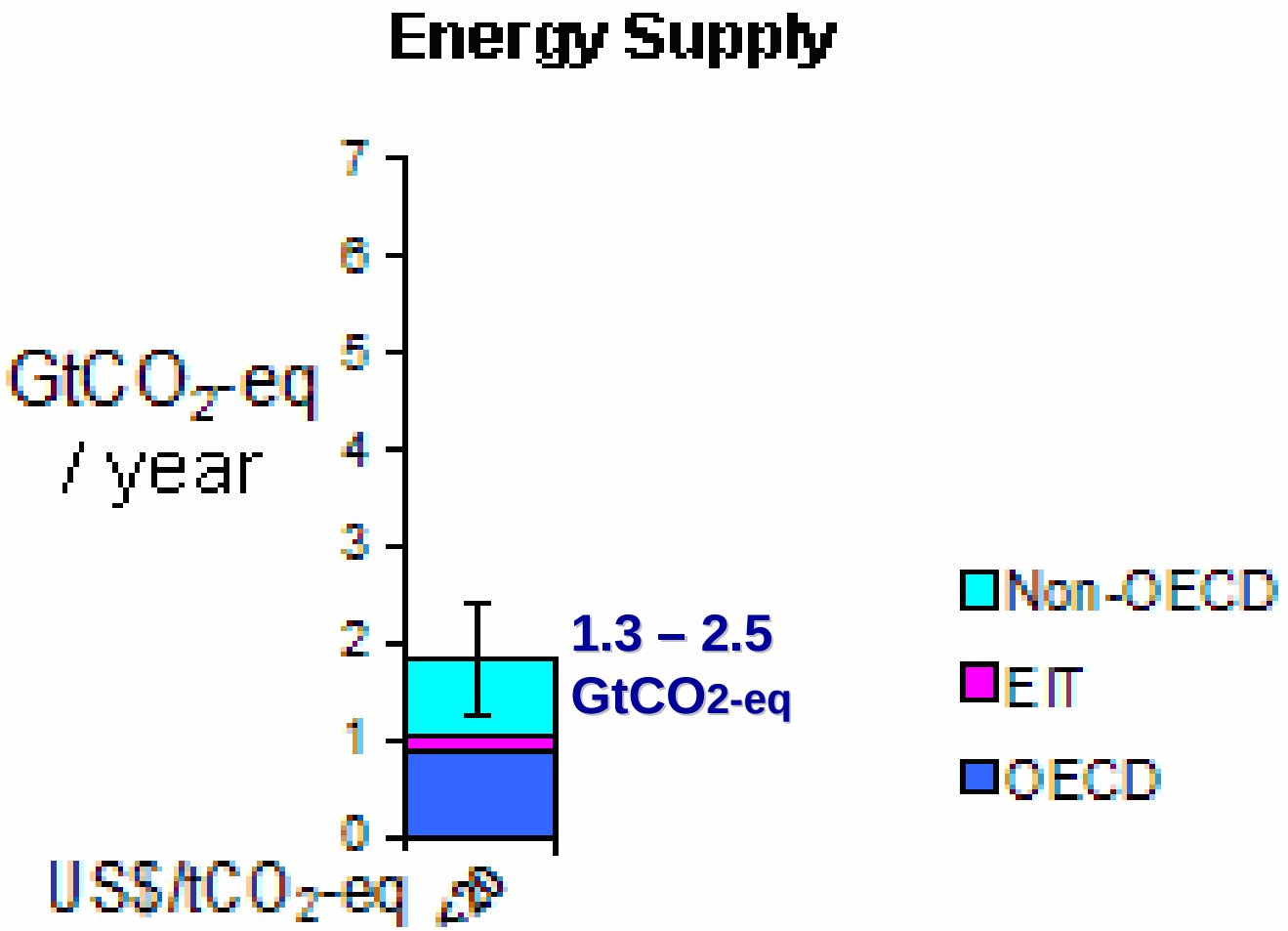
### b) projected to be commercialized by 2030

- carbon capture and storage (CCS) for
  coal, gas and biomass-fired electricity and CHP;
- advanced nuclear power;
- advanced renewable energy –
  ocean energy, concentrating solar power.

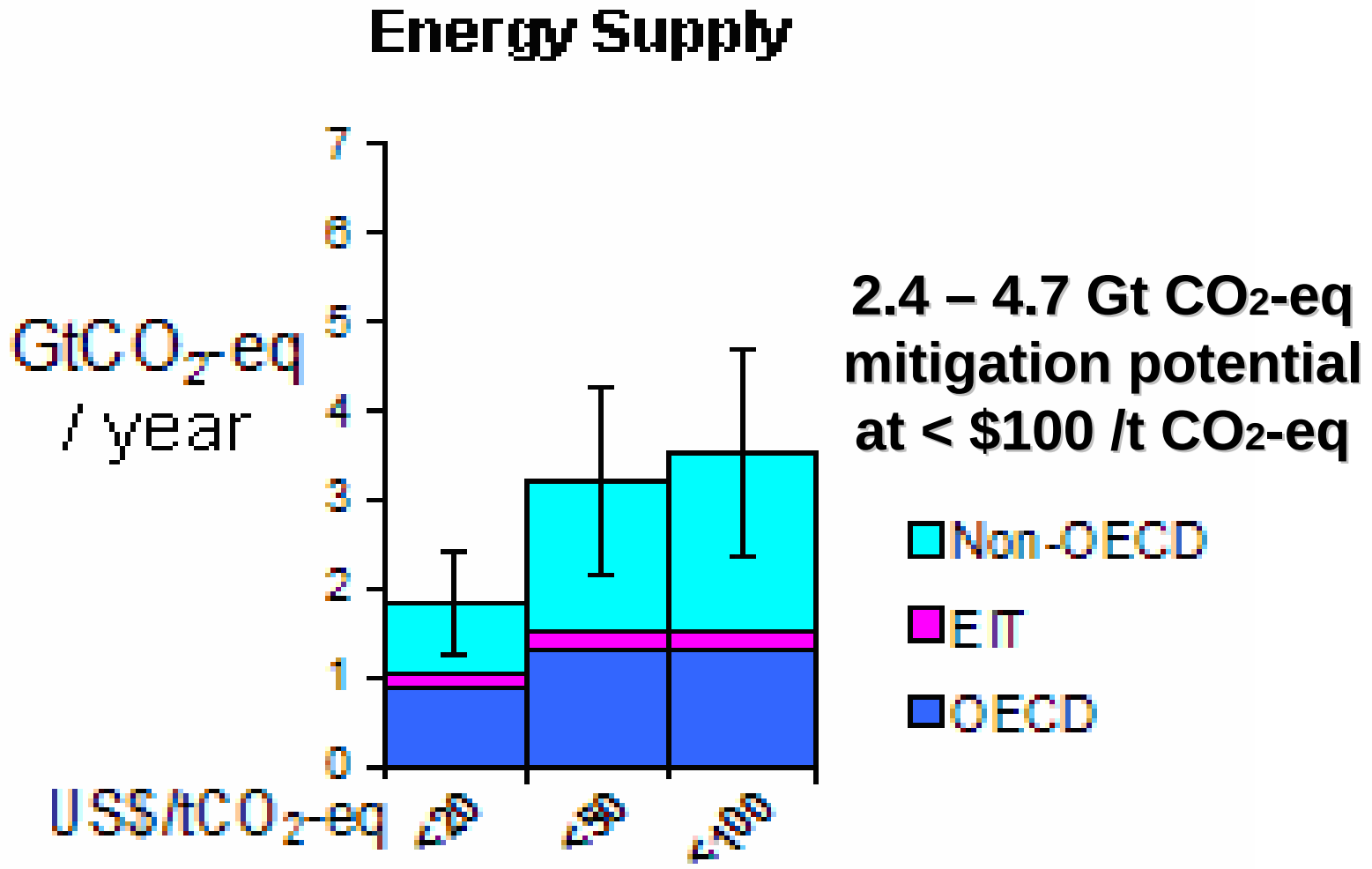
# Energy supply economic potentials above the baseline by 2030 as a function of carbon prices up to US$ <20 / t $CO_2$ -eq.



# Range of economic potentials above the baseline by 2030 as a function of carbon prices up to US$ <20 / t CO2 -eq.

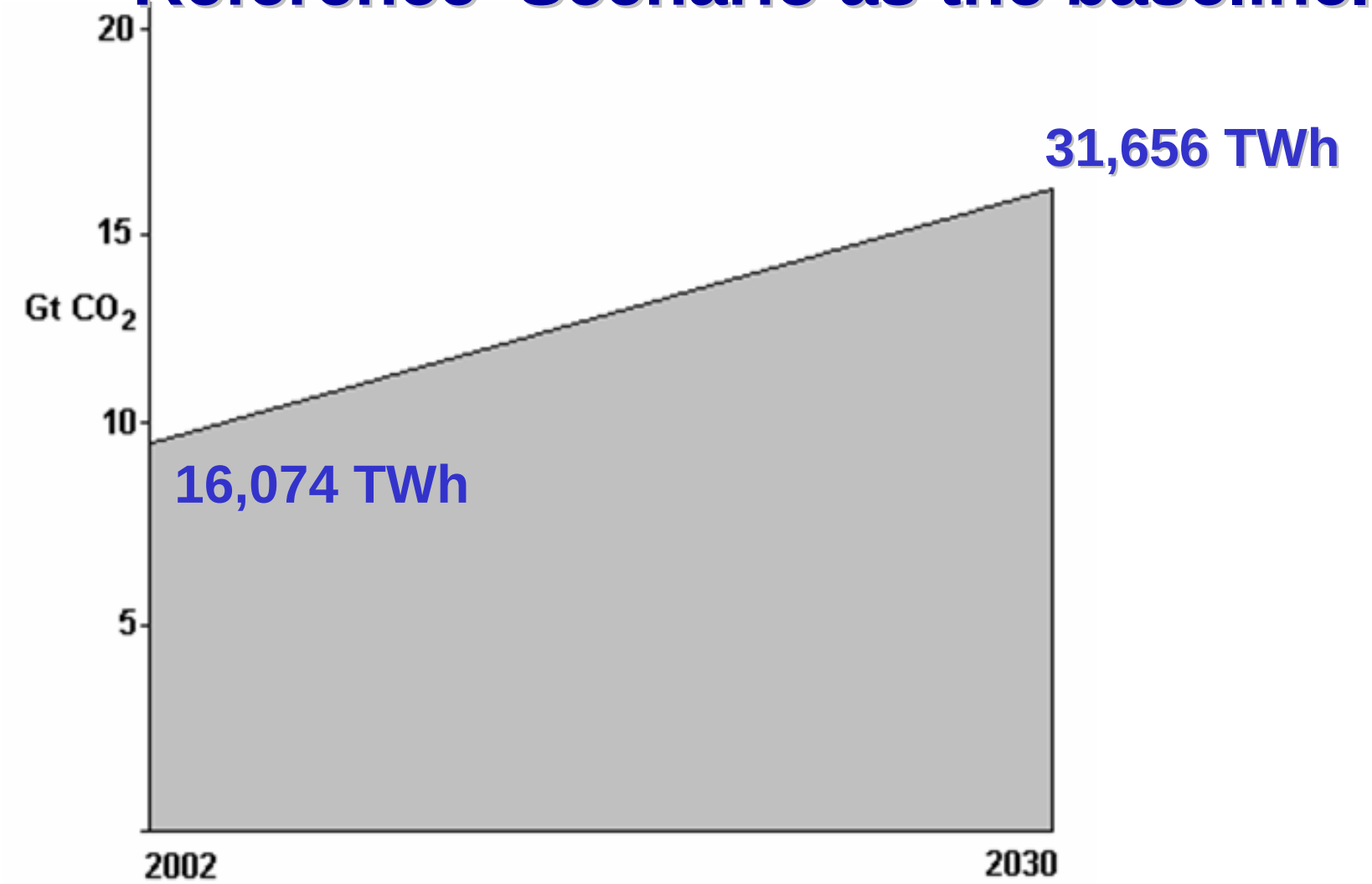


# Economic potentials above the baseline by 2030 as a function of carbon prices of US$ <20, 50 and 100 / t $CO_2$-eq.

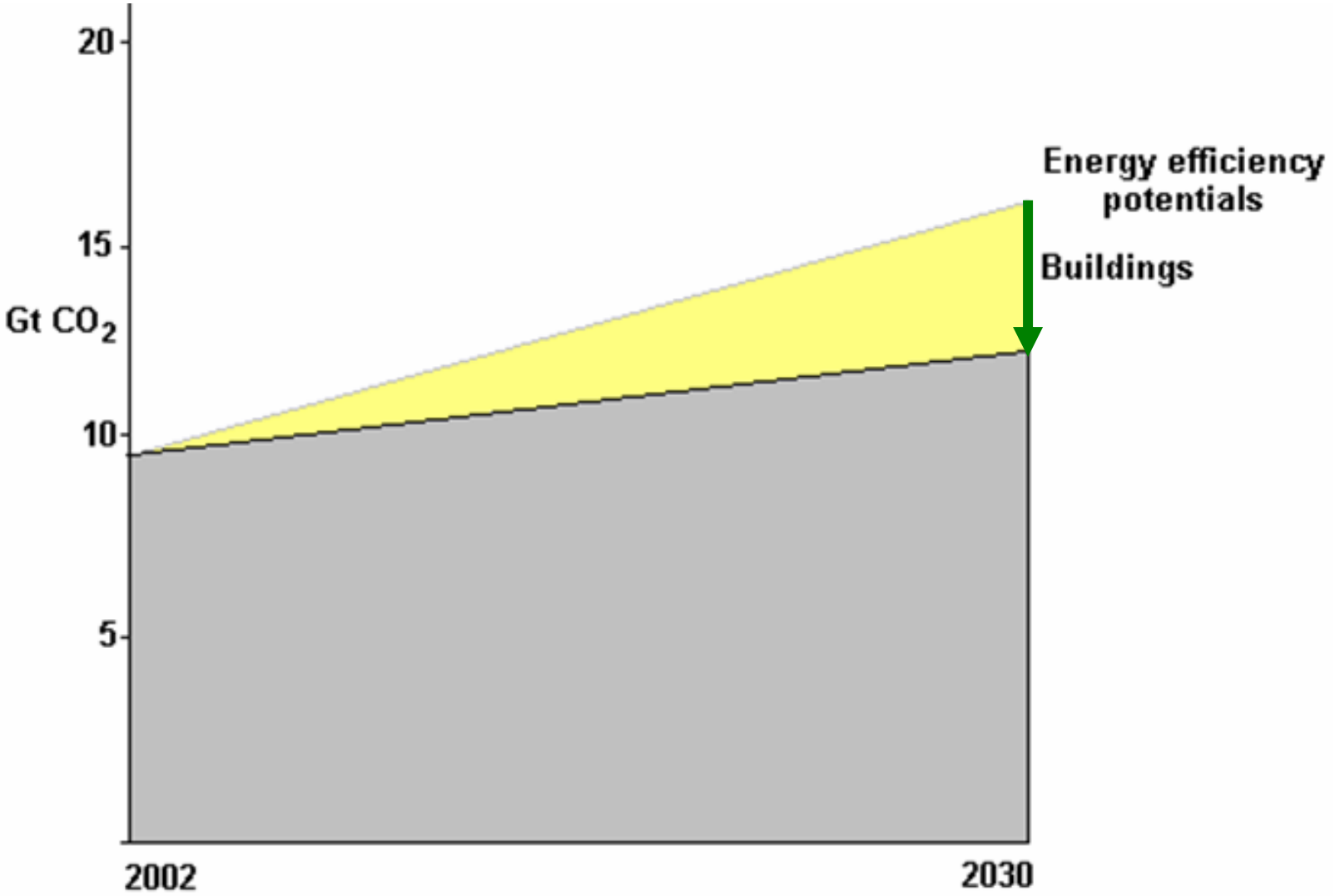



**2.4 – 4.7 Gt $CO_2$-eq mitigation potential at < $100 /t $CO_2$-eq**

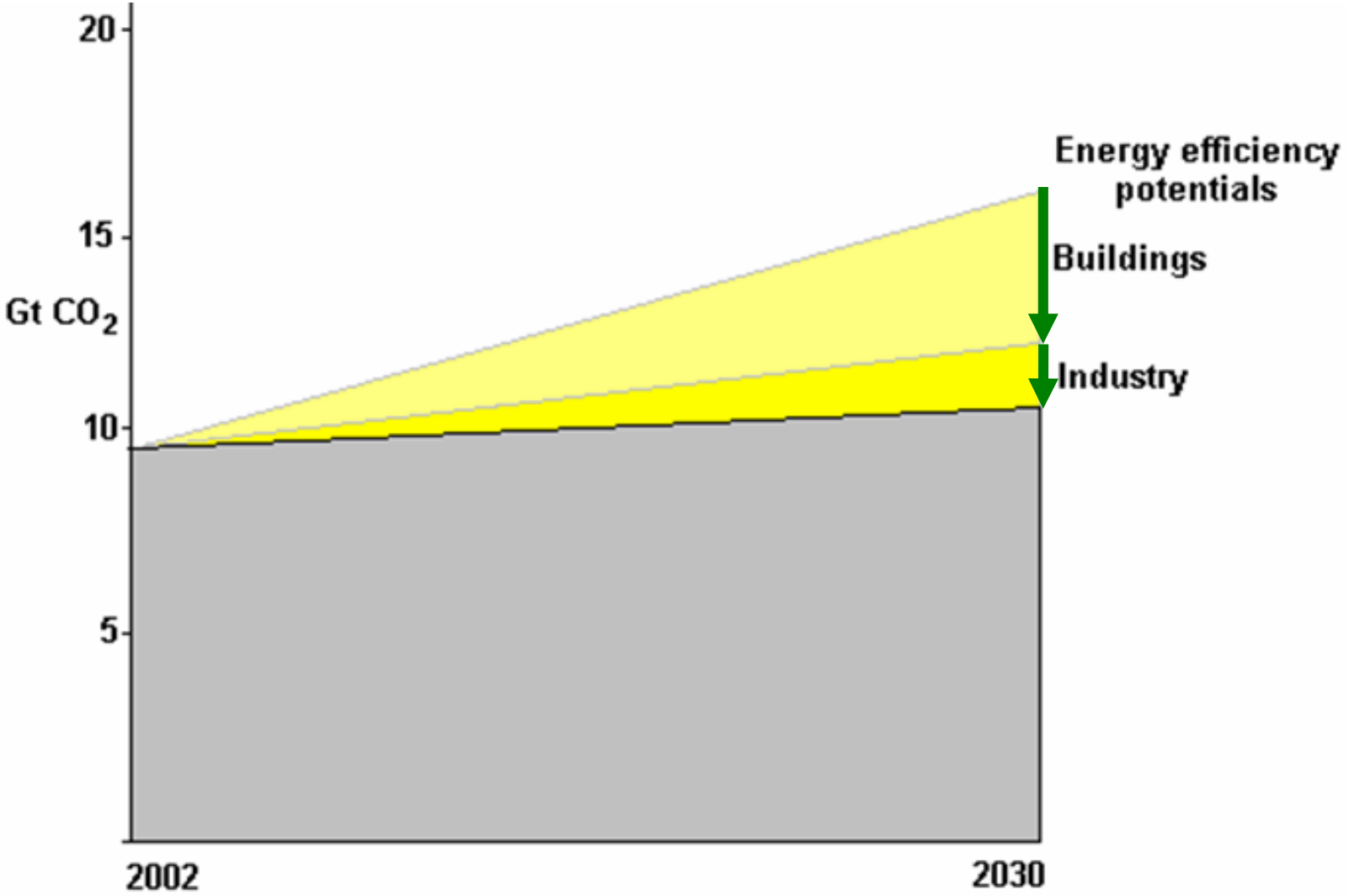
# Electricity sector emissions, 2002 to 2030. Took IEA World Energy Outlook 2004 Reference Scenario as the baseline.



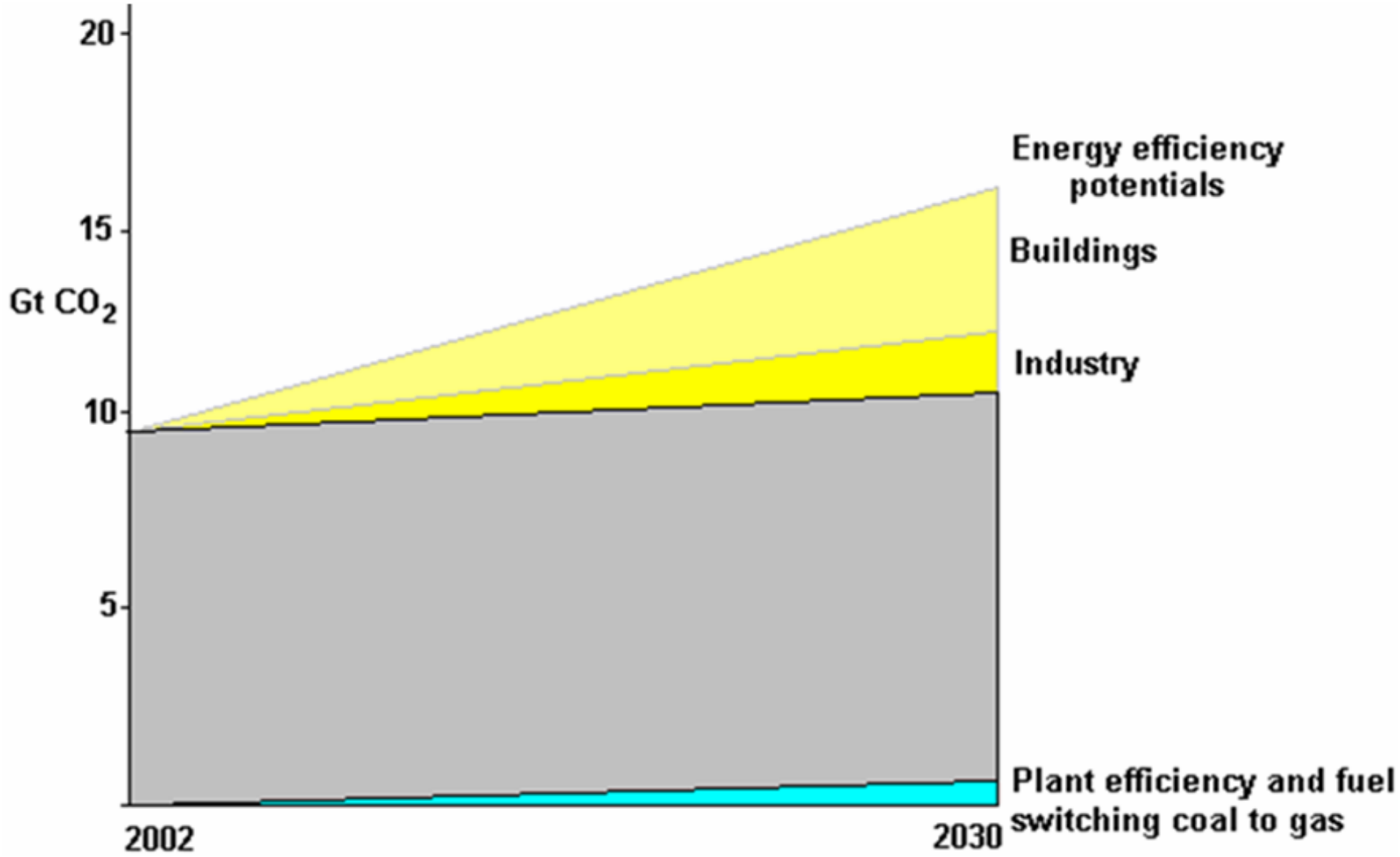
# Potential below baseline from electricity saving in Building sector at <US$ 50 /t $CO_2$



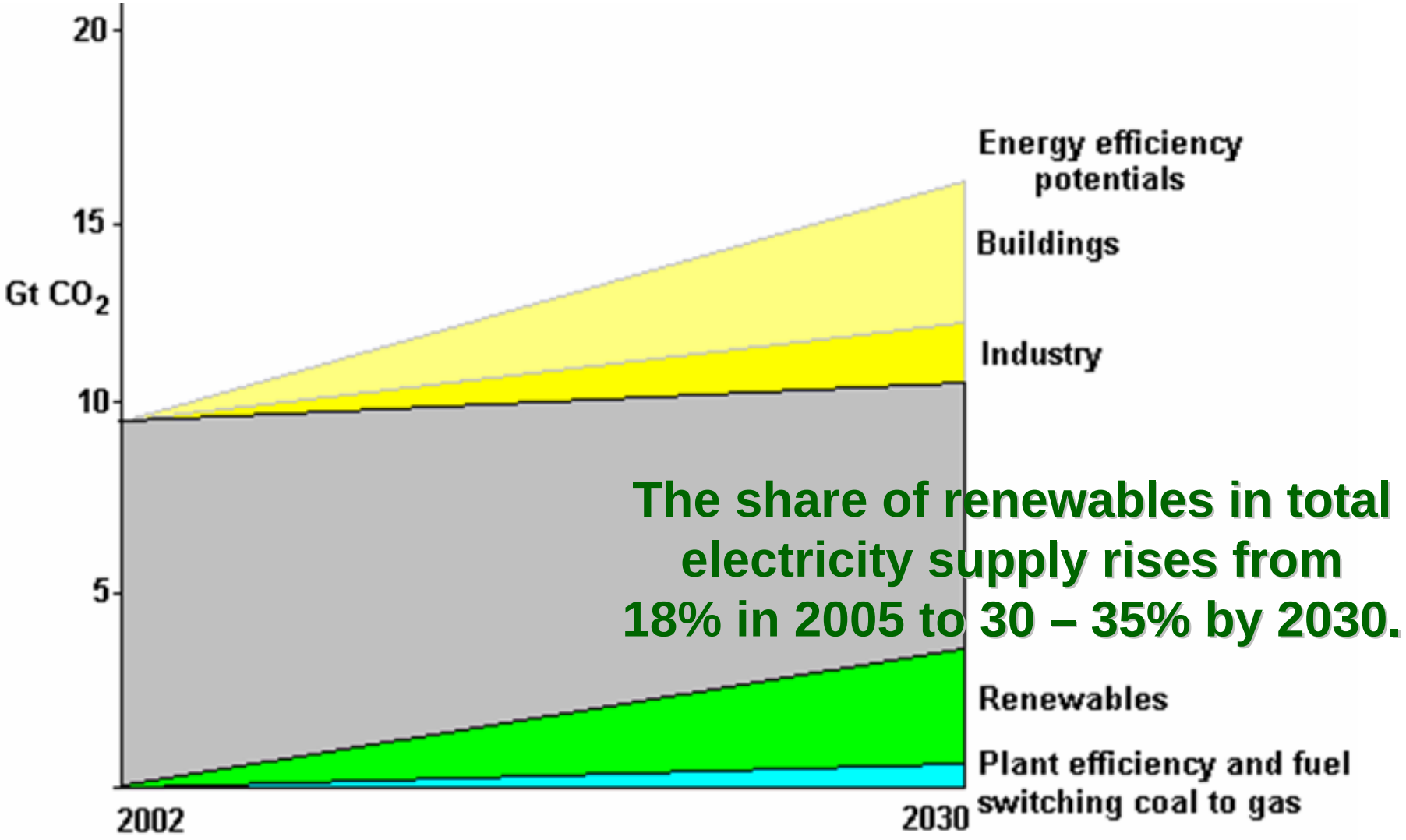
# Potential from electricity saving in Industry sector at <US$ 50 /t $CO_2$



# Potential from improved generation plant efficiency and fuel switching at <US$50 /tCO2

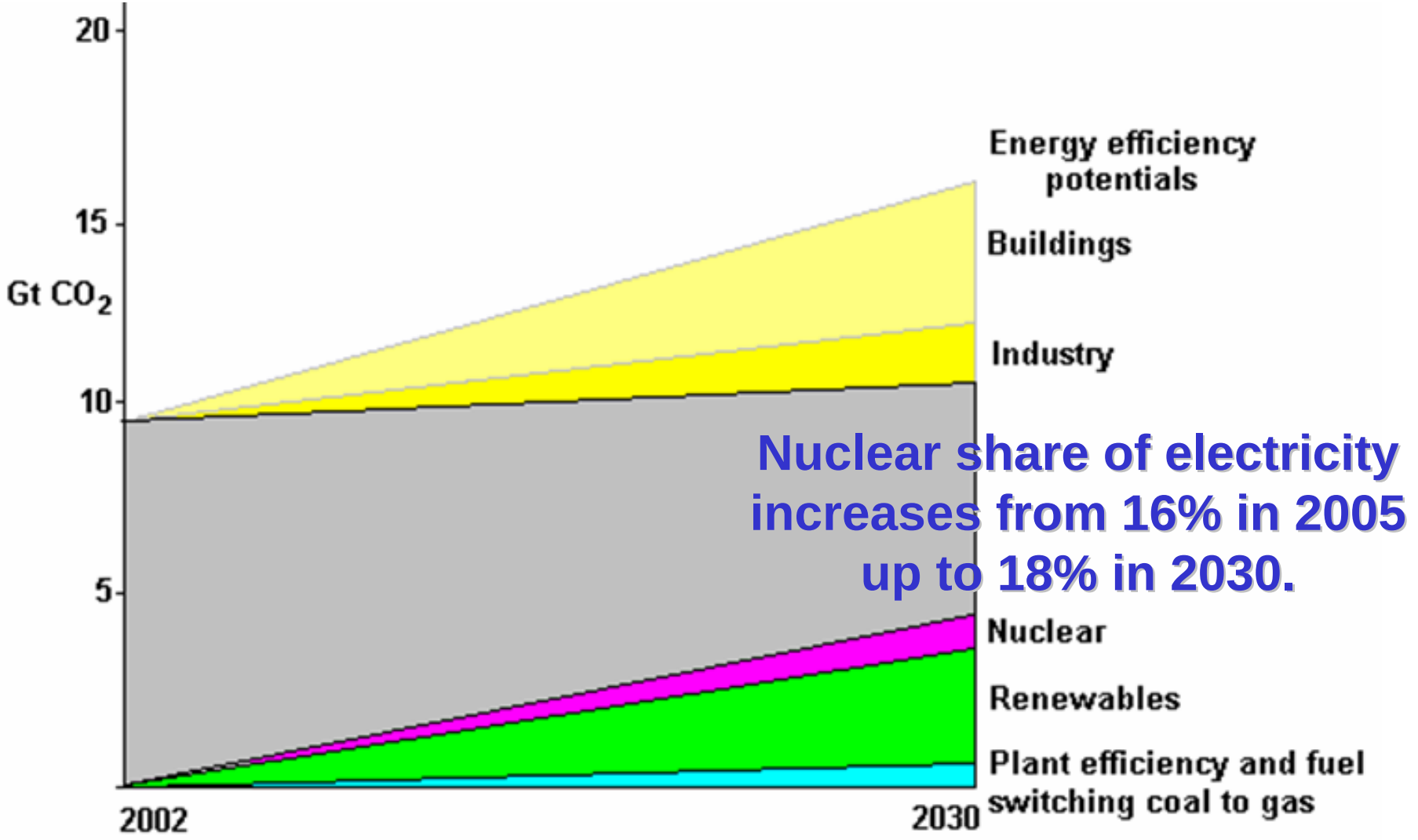


# Potential above baseline from hydro, wind, geothermal, bioenergy, solar at <US$ 50 /tCO2



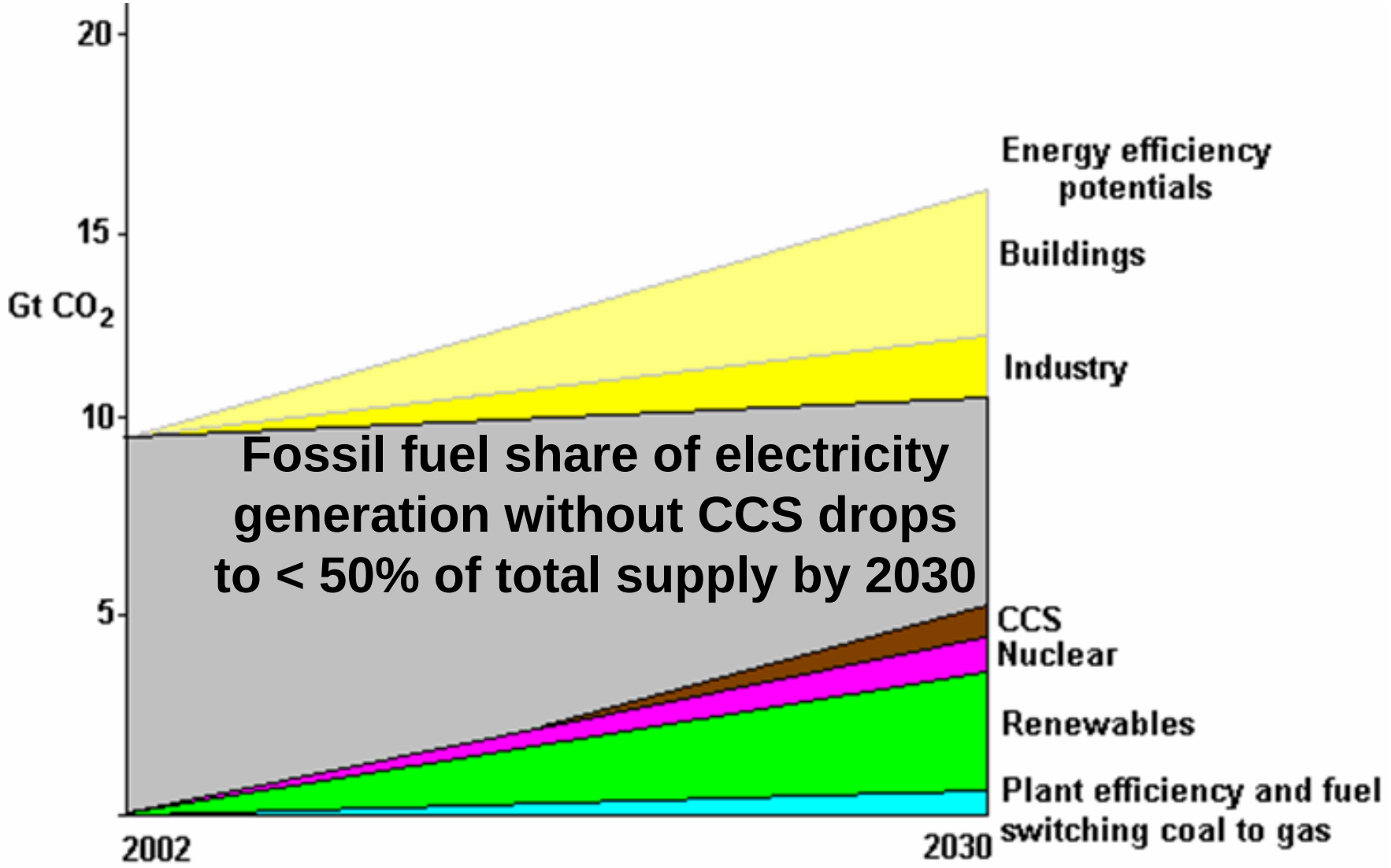

**The share of renewables in total electricity supply rises from 18% in 2005 to 30 – 35% by 2030.**

# Potential above baseline from nuclear power at <US$ 50 /tCO2




**Nuclear share of electricity increases from 16% in 2005 up to 18% in 2030.**

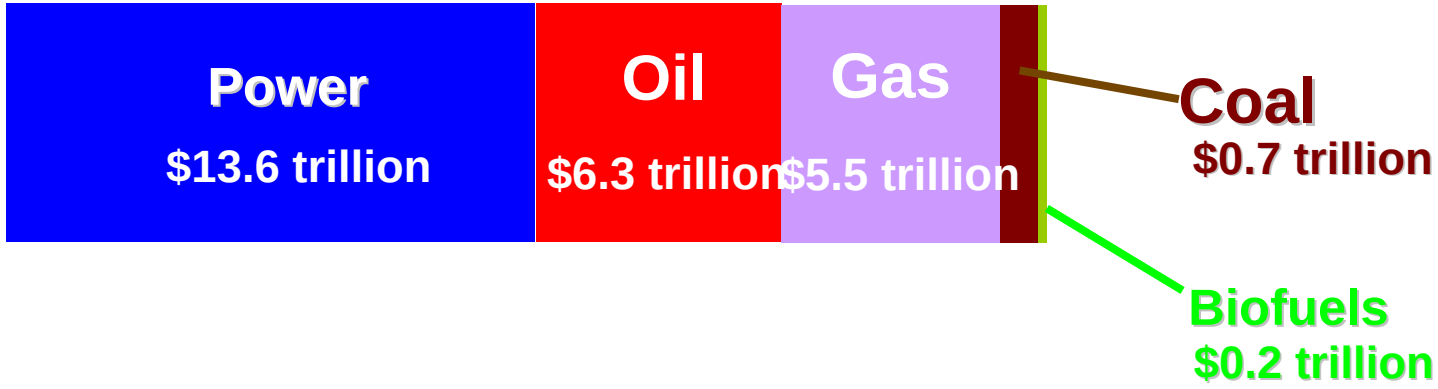
# Potential from CCS in new coal and gas plants beginning 2015 at <US$ 50 /tCO2



# IEA World Energy Outlook, 2008

## Reference Scenario

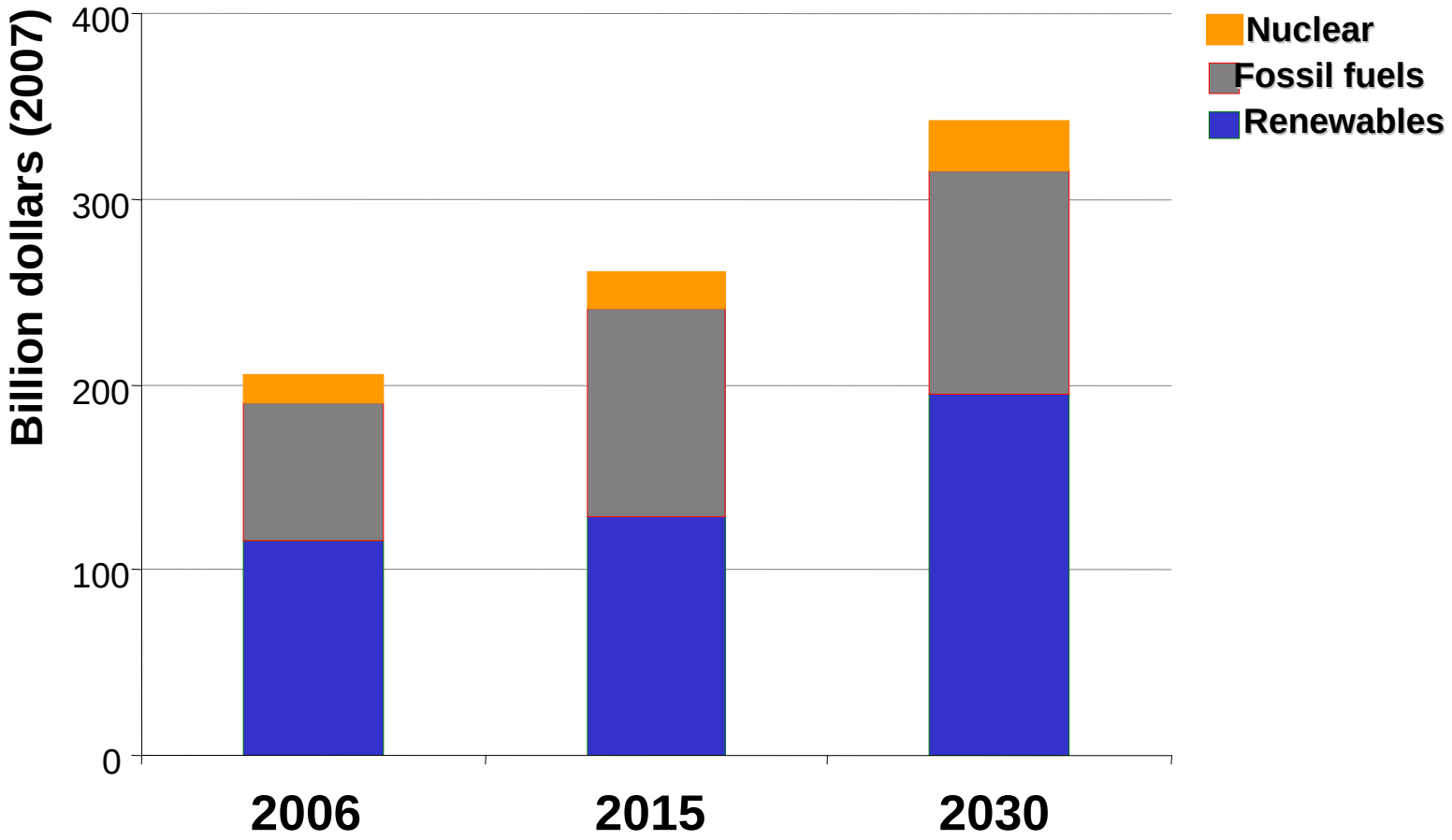
## $26.3 trillion cumulative energy-supply investment is needed in 2007-2030.




**The credit squeeze could delay spending, thereby potentially setting up a supply-crunch once the economy recovers.**

# IEA WEO 2008, Reference Scenario.

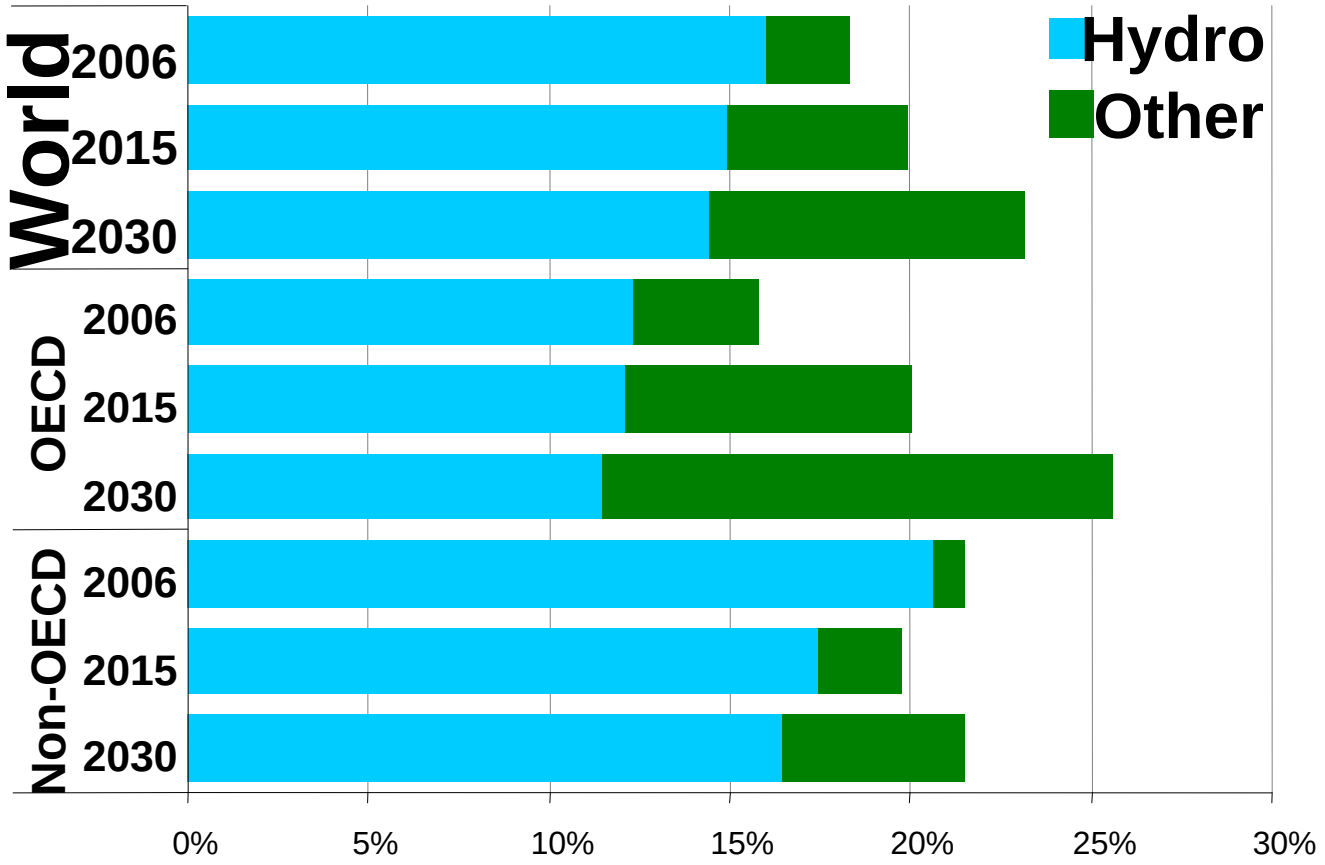
## Annual investment in new power generation plants 2007-2030




**Total investment in new renewables capacity = $3.3 trillion – more than in fossil-fuel power plants.**

# IEA WEO 2008 Reference Scenario

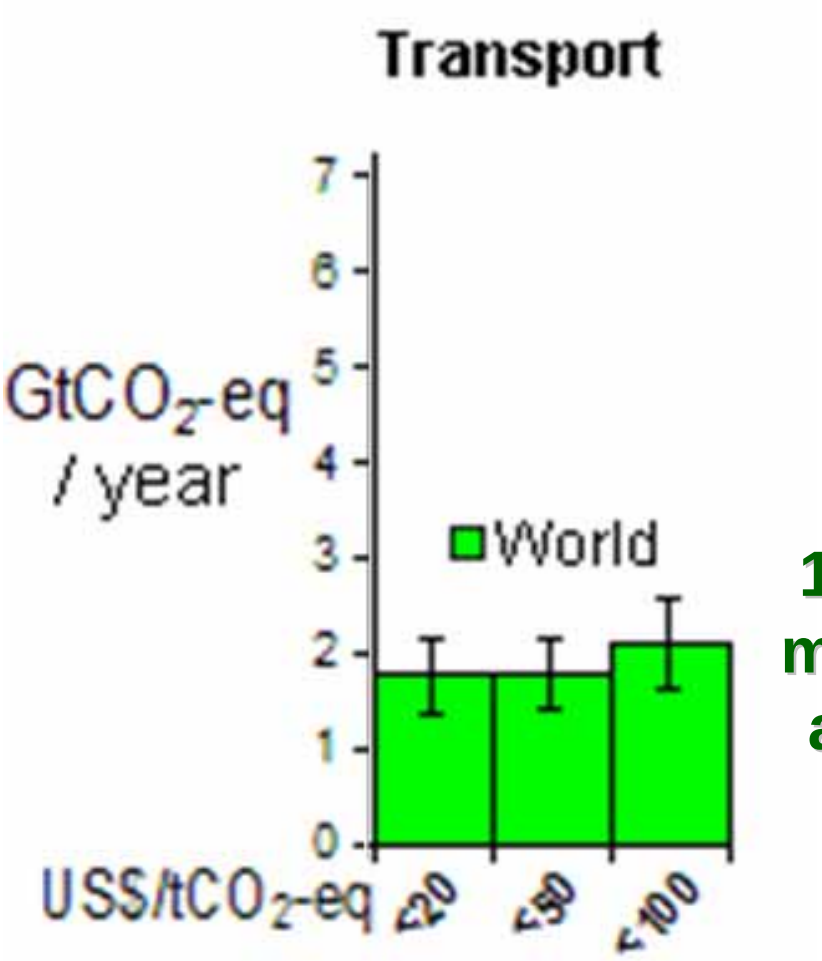
## Share of renewables in electricity generation




**Renewables grow from 18% of total electricity generation in 2006 to exceed gas-fired power in 2010 and reach 23% in 2030 - as a result of high fossil-fuel prices and government support.**

# Transport Sector

## Economic potentials above the baseline by 2030 as function of carbon prices of US$<20, 50, 100/t $CO_2$-eq.




**1.6 – 2.5 Gt $CO_2$-eq mitigation potential at < $100 /t $CO_2$-eq**

**Transport not split into regions because of international aviation fuel.**

# Key mitigation technologies and practices:

## a) currently commercially available

- more fuel efficient, lighter vehicles;
- hybrid vehicles;
- cleaner diesel vehicles;
- first generation biofuels;
- modal shifts from road to rail and public transport;
- non-motorised transport (walking, cycling);
- land-use and transport planning.

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## b) projected to be commercialized by 2030

- second generation biofuels;
- higher efficiency aircraft;
- hydrogen fuel cell vehicles developing;
- electric and advanced hybrid vehicles with more powerful and reliable batteries.

# Electric car charging point, Camden, London

# Transport Mitigation

**There are many mitigation options that provide good economic potential in the transport sector.**

**However their effect may be counteracted by continued high growth in transport demand and strong consumer preferences.**

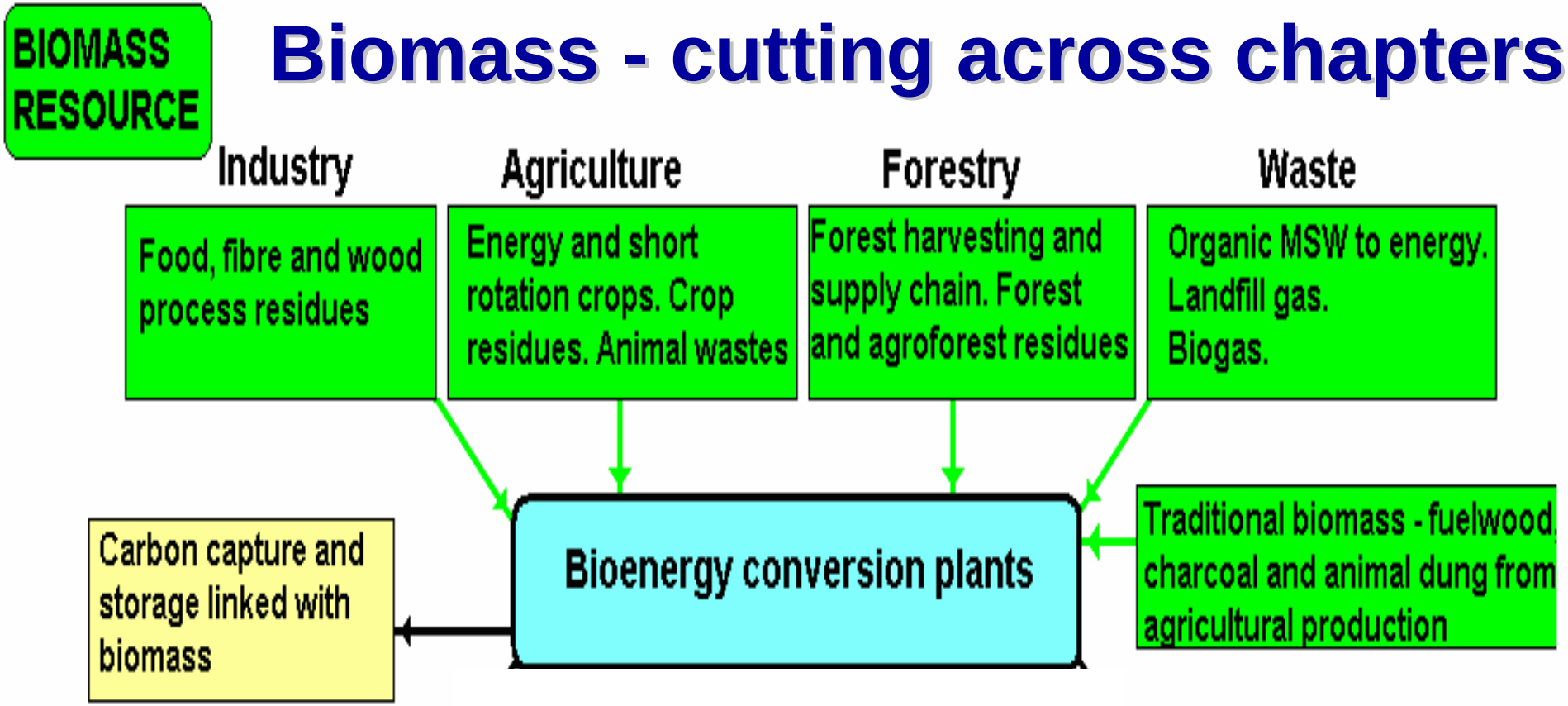
**Liquid biofuels is one option but currently under close review.**

# Biomass - cutting across chapters

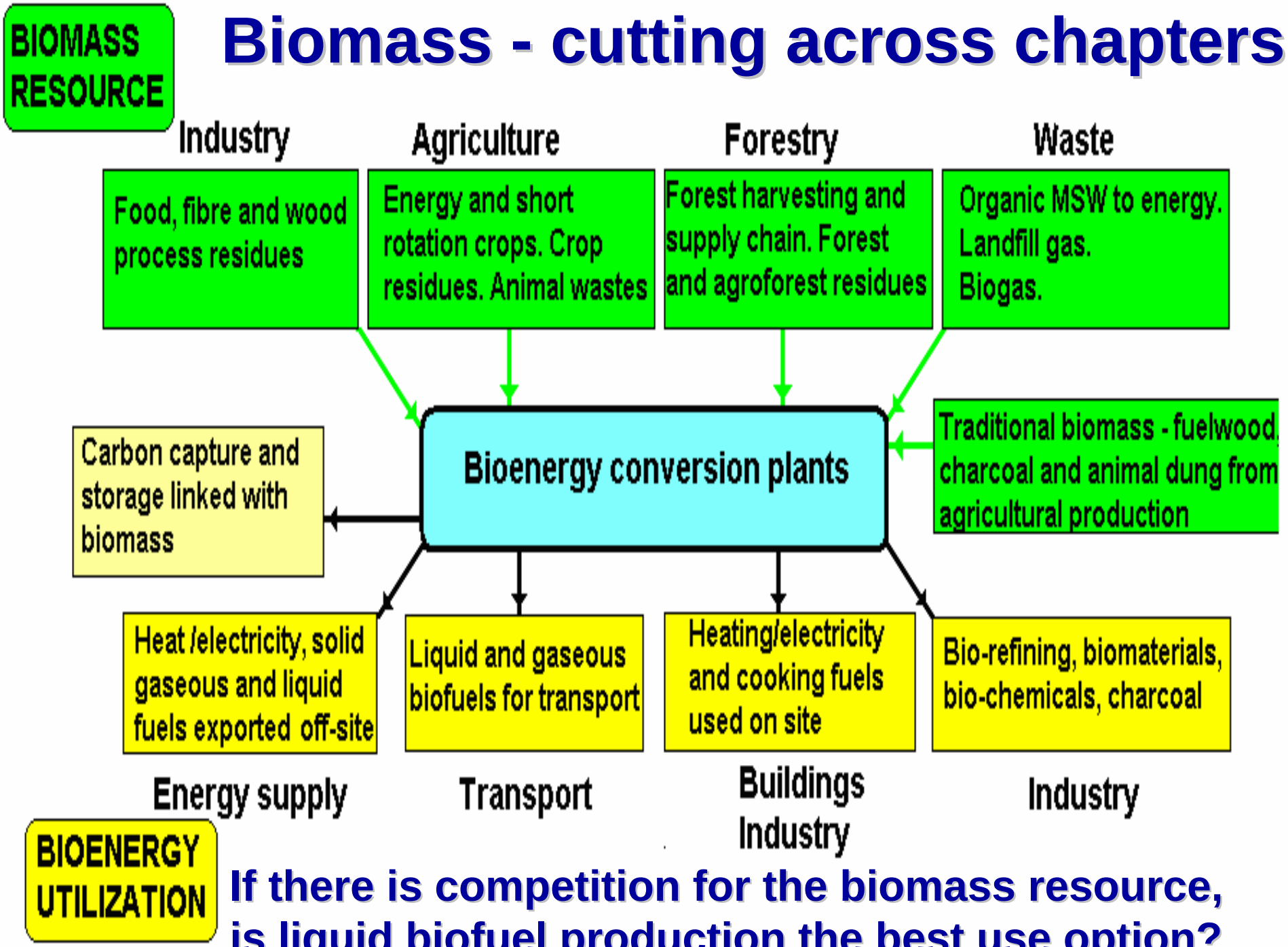
BIOMASS RESOURCE

| Industry | Agriculture | Forestry | Waste |
| --- | --- | --- | --- |
| Food, fibre and wood process residues | Energy and short rotation crops. Crop residues. Animal wastes | Forest harvesting and supply chain. Forest and agroforest residues | Organic MSW to energy. Landfill gas. Biogas. |

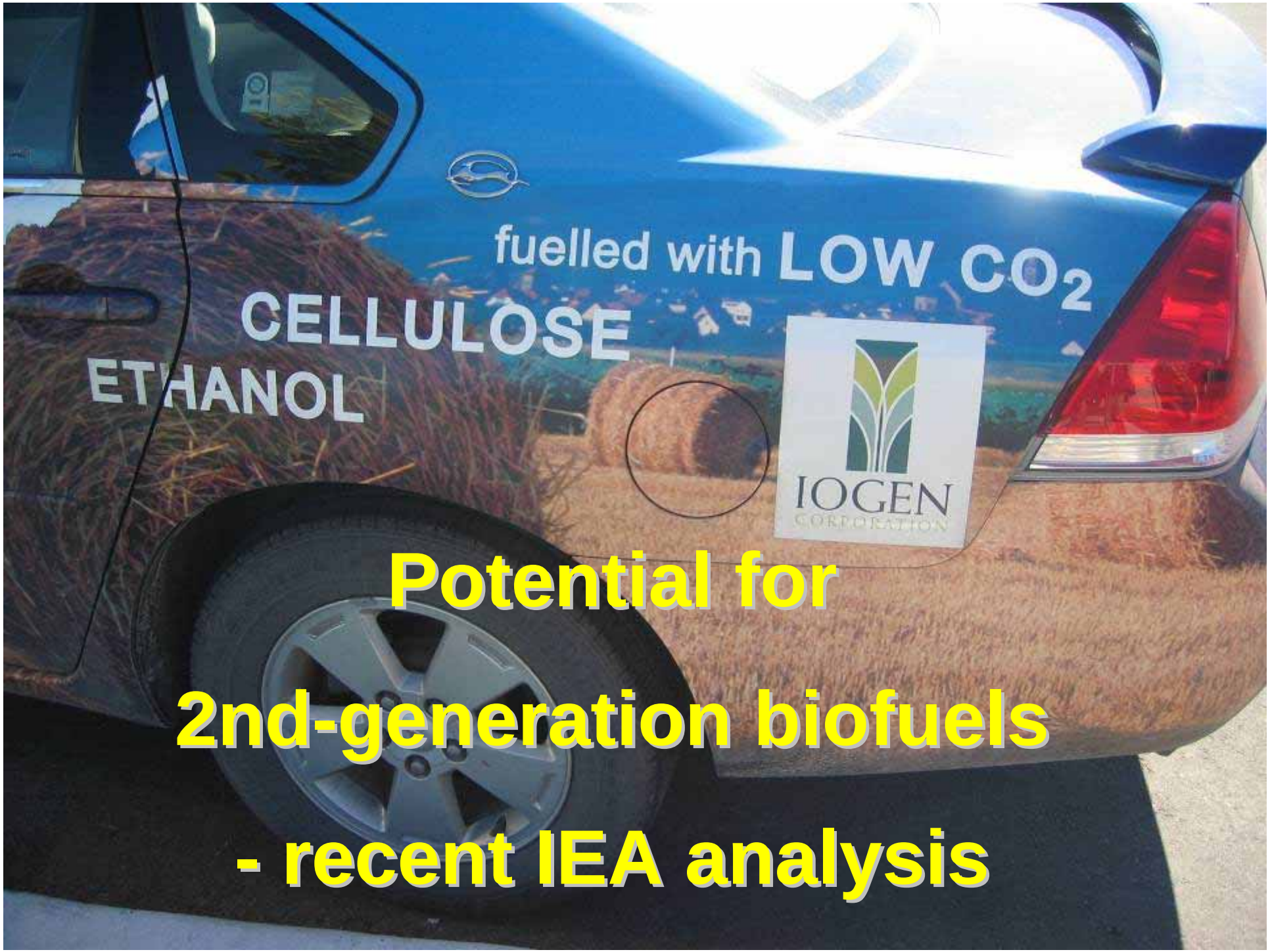
# Biomass - cutting across chapters



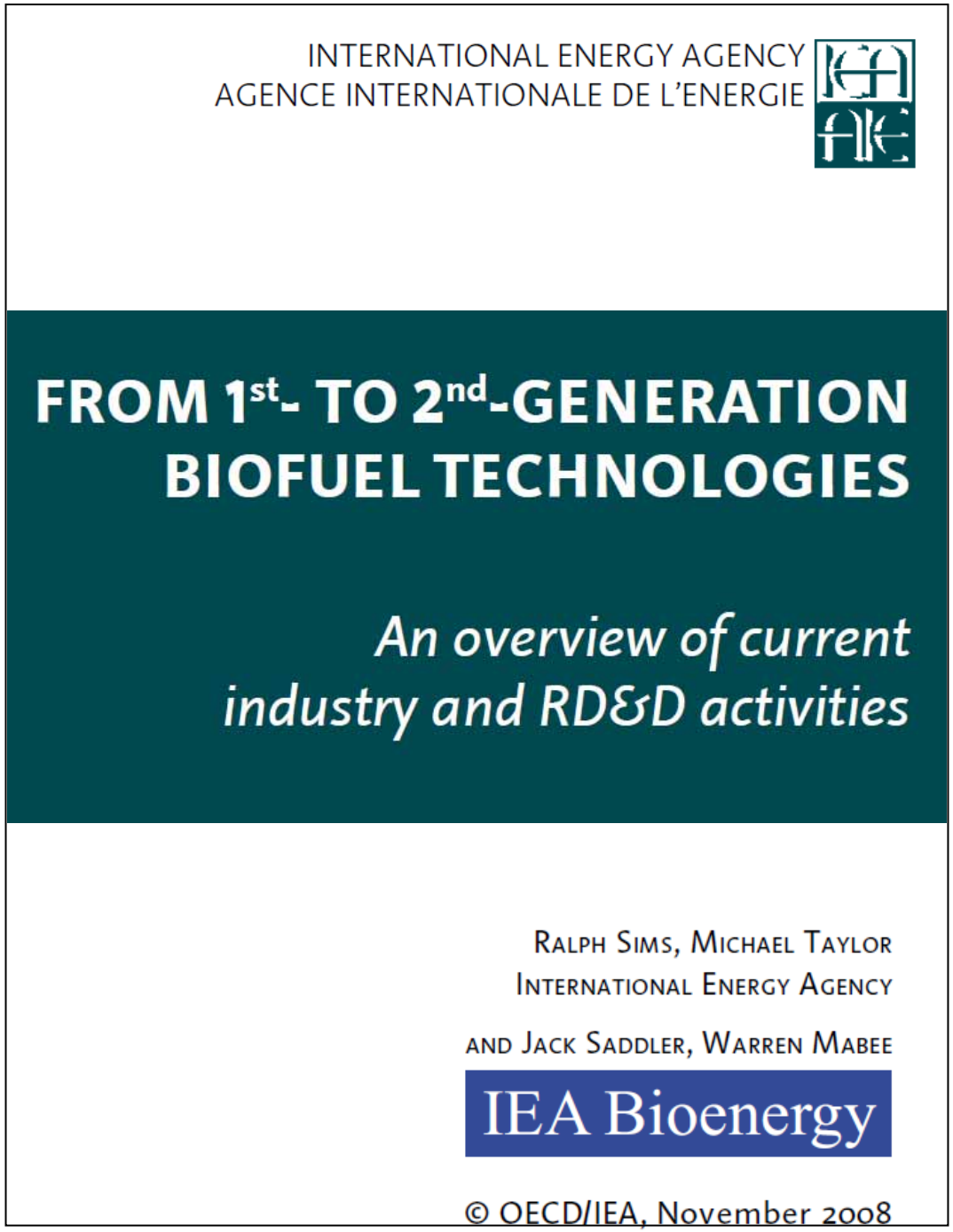
# Biomass - cutting across chapters




**If there is competition for the biomass resource, is liquid biofuel production the best use option?**




# Potential for 2nd-generation biofuels - recent IEA analysis




**Free downloads of the Extended Summary and full 120 page report are available on www.iea.org**

# Potential for 2nd-generation biofuels

- The present share of 2nd-generation biofuels is less than 0.1% of total biofuel production.
- Biomass residues and wastes can be used as feedstocks.
- Where energy crops need to be grown, similar issues of sustainable production, land use change, and food-versus-fuel competition will exist as for 1st-generation biofuels.

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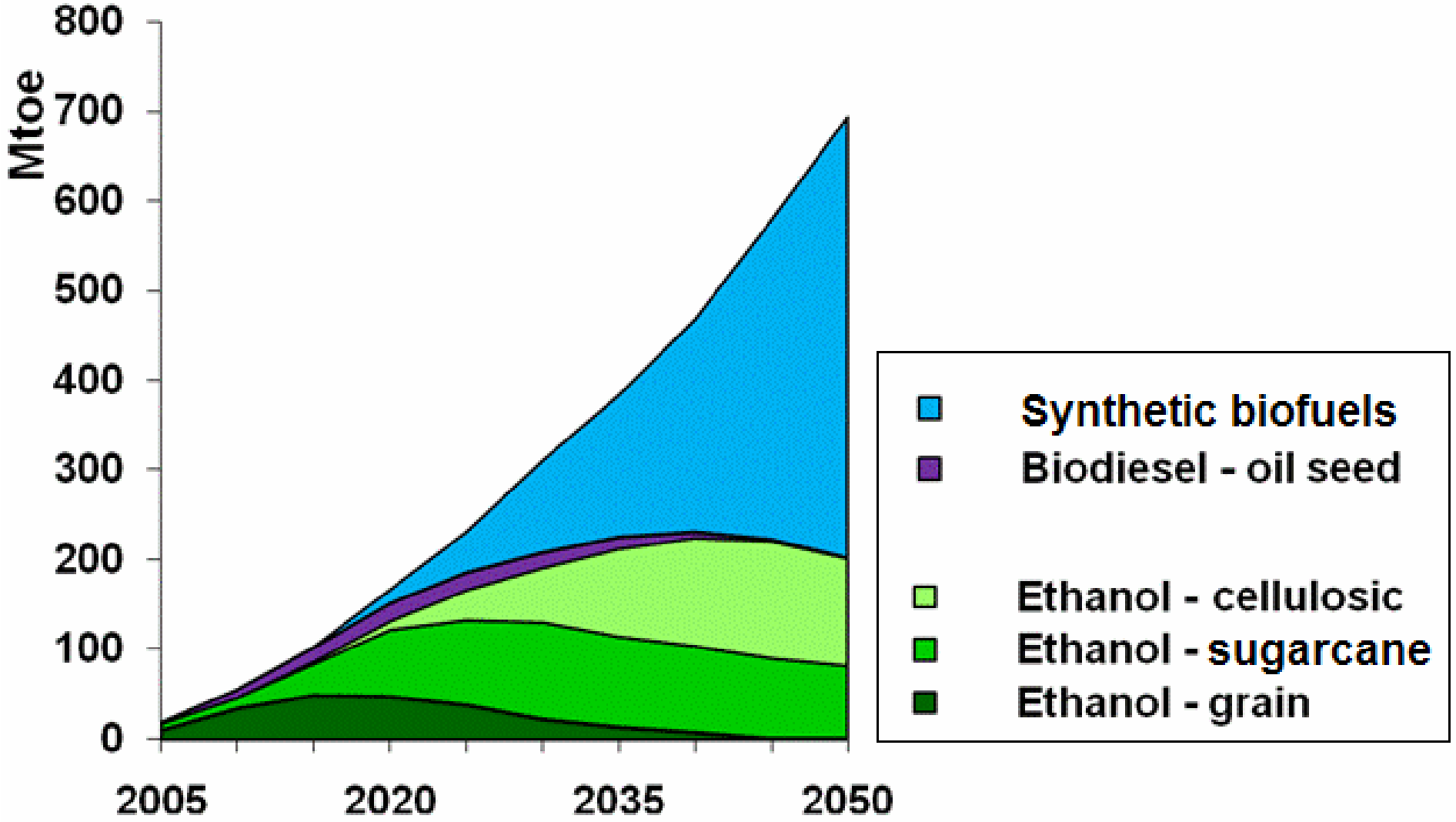
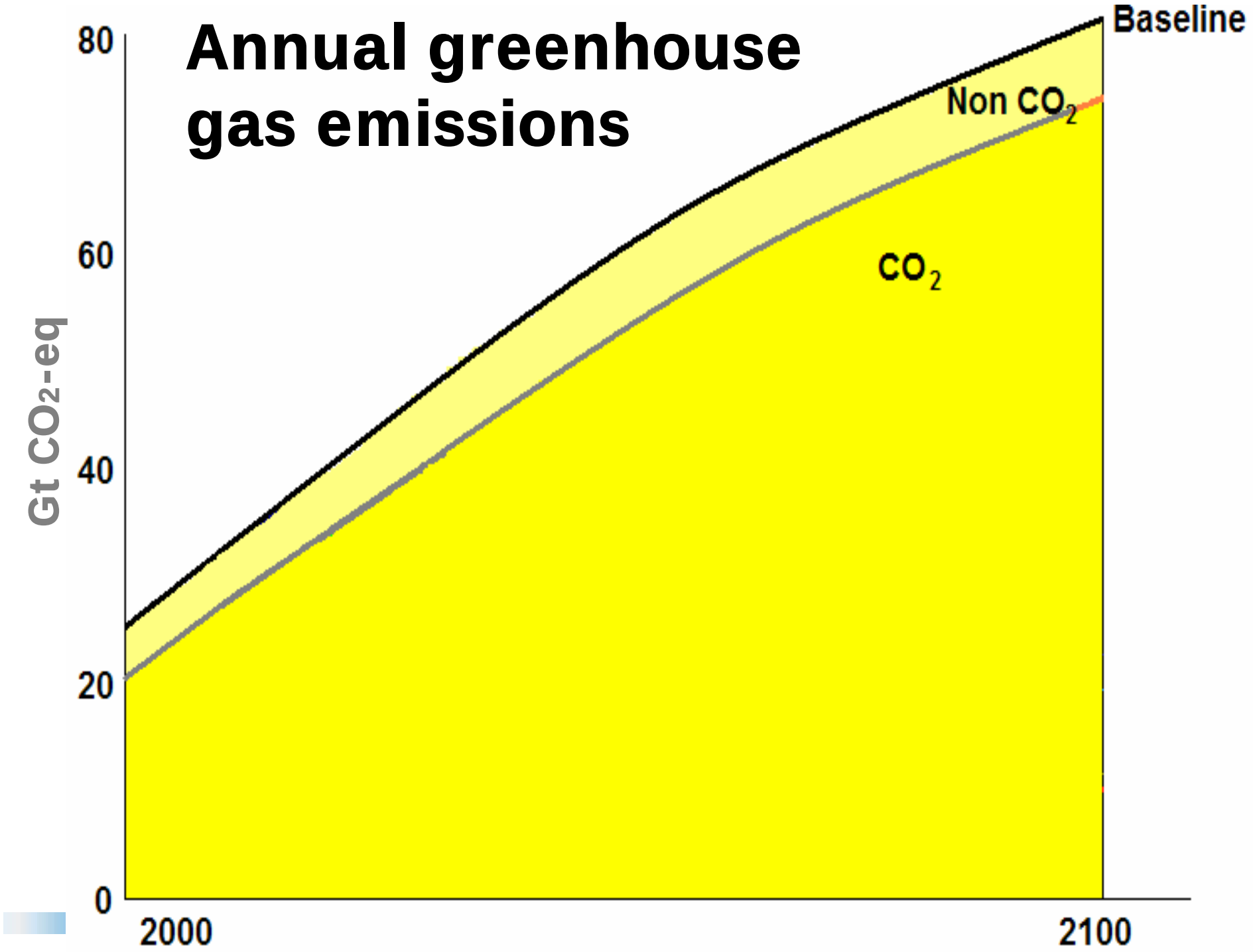
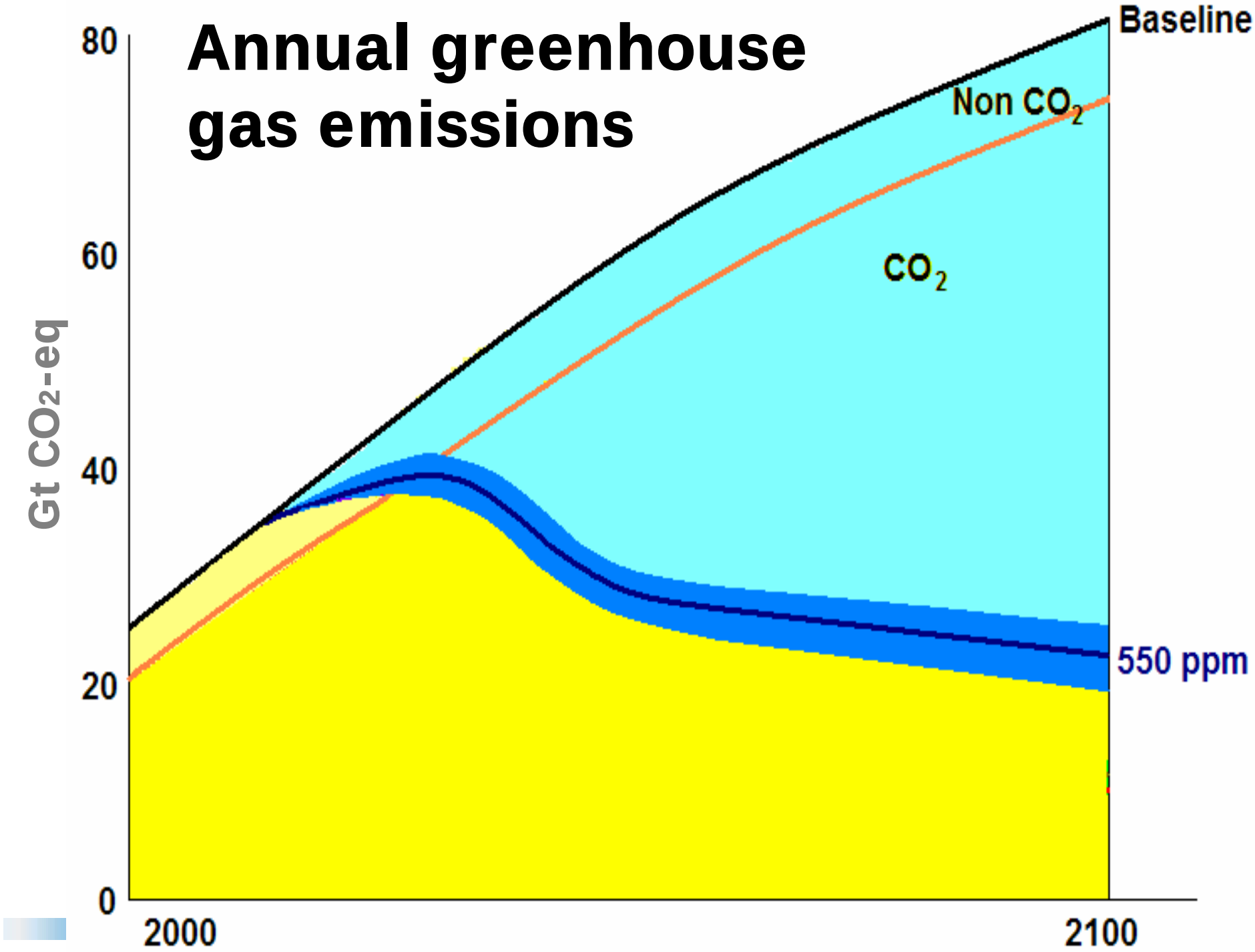
- Where energy crops need to be grown, similar issues of sustainable production, land use change, and food-versus-fuel competition will exist as for 1st-generation biofuels.
- **Both biochemical and thermo-chemical conversion routes have reached the demonstration stage - but key technical and economic issues remain to be resolved.**
- **Of the US$ 26.3 trillion cumulative investment needed in the energy sector by 2030 in the IEA WEO 2008 Reference Scenario, US$ 0.2 trillion is assumed for biofuels.**
- **The future potential for 2nd-generation biofuels remains very uncertain and full commercialisation is unlikely to occur for some years yet.**

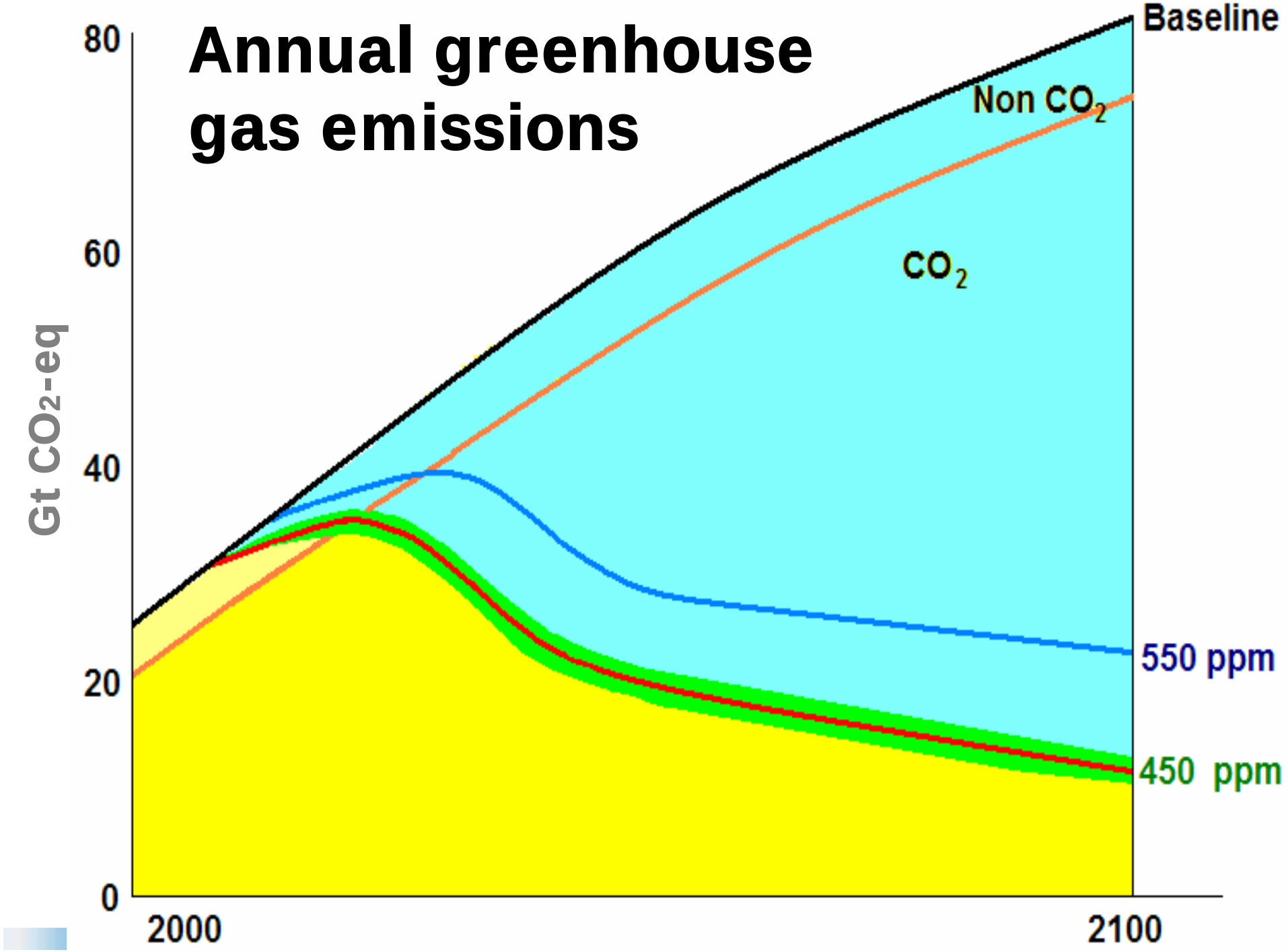
# Biofuels in 2050 – IEA “ETP” scenario

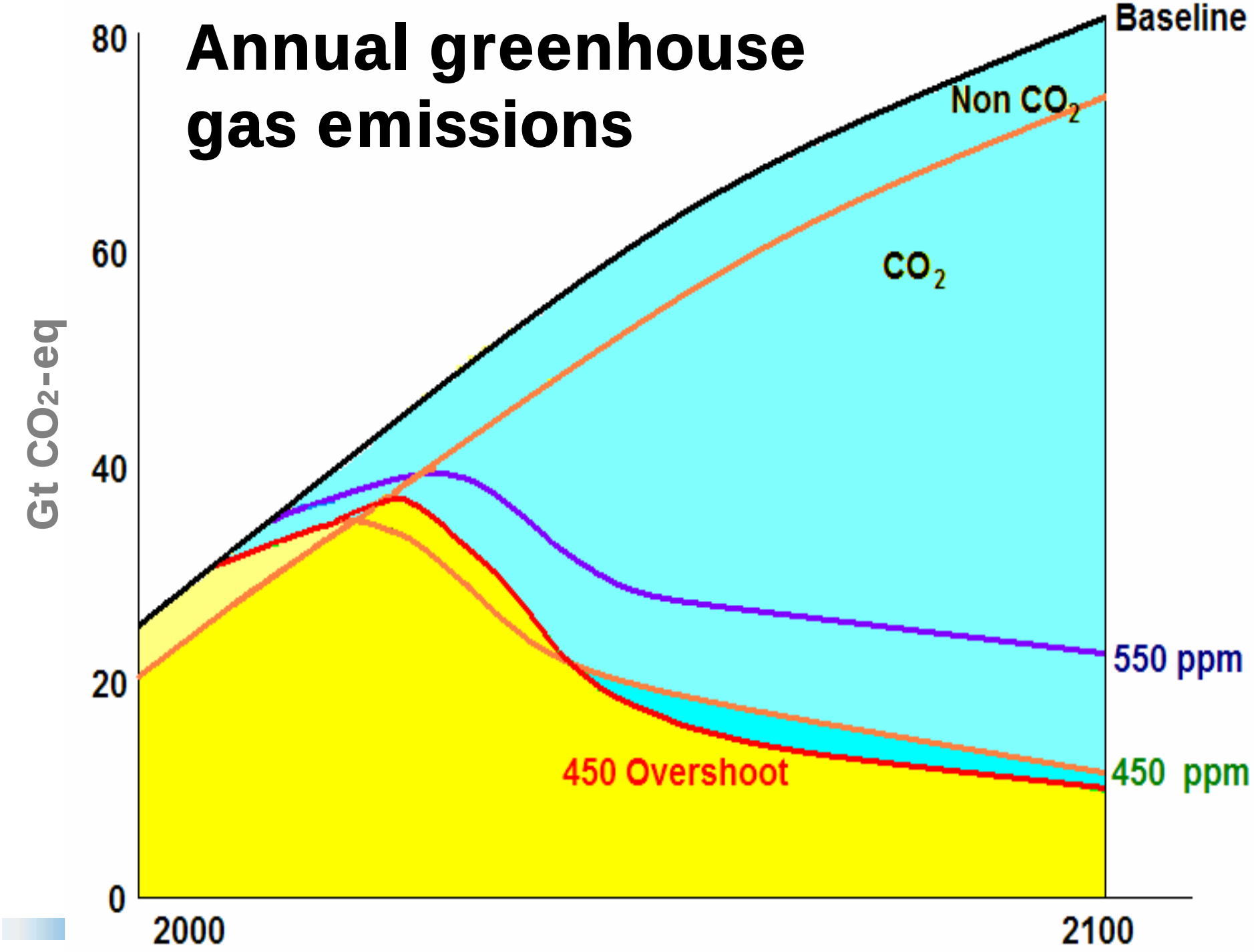


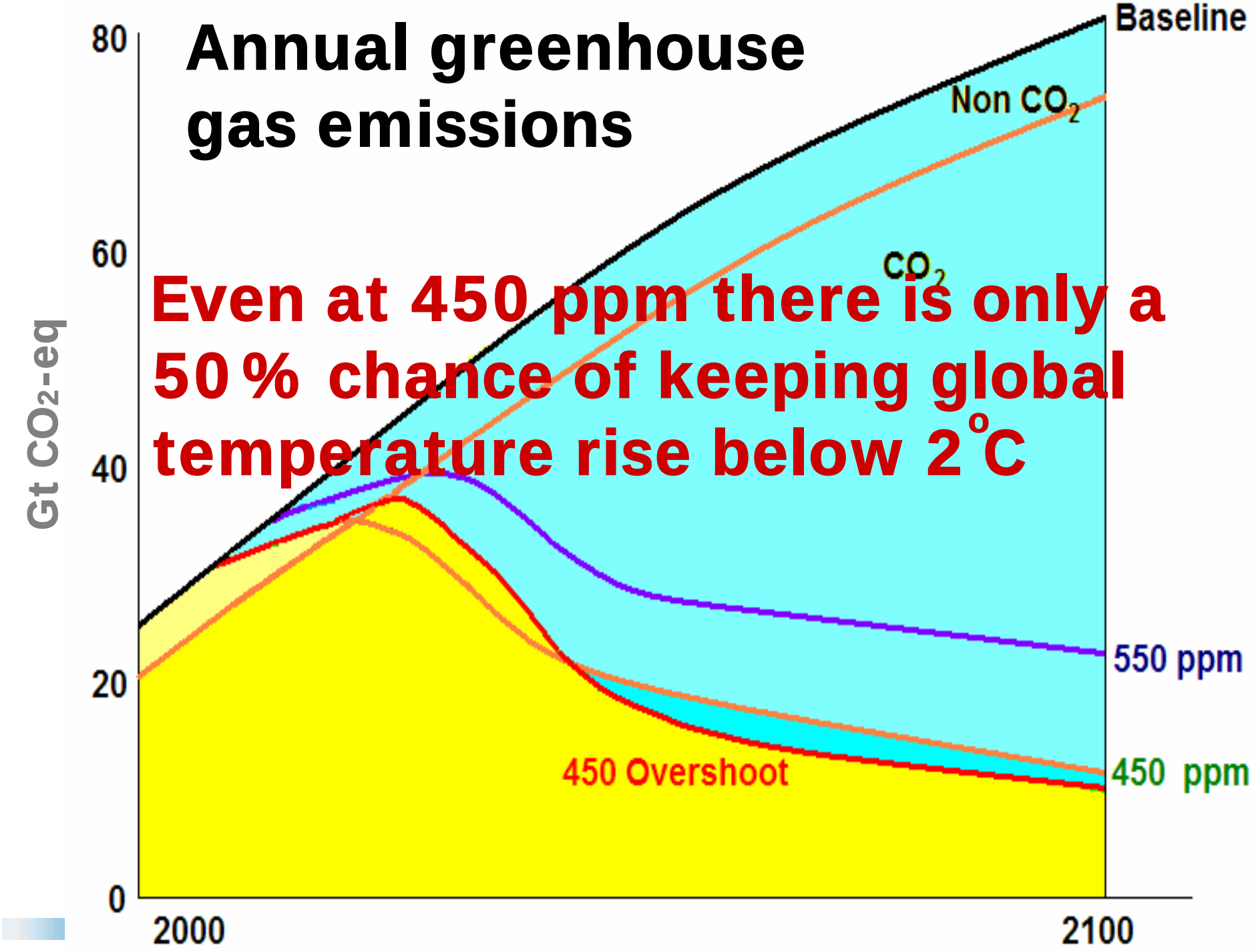

**Electric and fuel cell cars will have become common. Biofuels will be needed mainly for aviation, heavy trucks and marine purposes.**


Annual greenhouse gas emissions
Baseline
Non $CO_2$
$CO_2$
Gt $CO_2$-eq
80
60
40
20
0
2000
2100


Annual greenhouse gas emissions
Baseline
Non $CO_2$
$CO_2$
550 ppm
Gt $CO_2$-eq
80
60
40
20
0
2000
2100

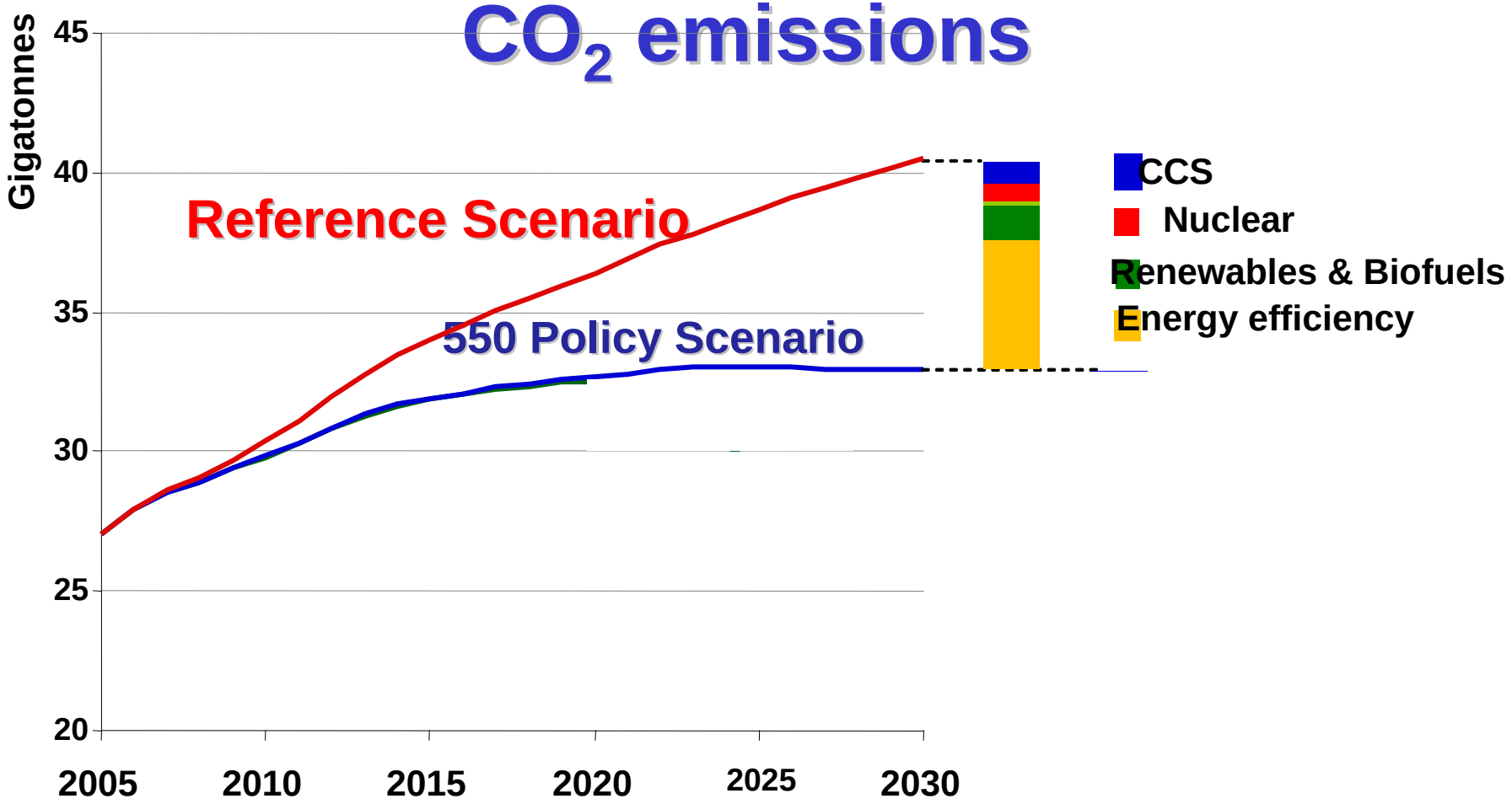

Annual greenhouse gas emissions
Baseline
Non $CO_2$
$CO_2$
550 ppm
450 ppm
Gt $CO_2$-eq
80
60
40
20
0
2000
2100


Annual greenhouse gas emissions
Gt CO2-eq
80
60
40
20
0
2000
2100
Baseline
Non CO2
CO2
550 ppm
450 ppm
450 Overshoot


Annual greenhouse gas emissions
Even at 450 ppm there is only a 50% chance of keeping global temperature rise below 2°C
Gt CO2-eq
80
60
40
20
0
2000
2100
Baseline
Non CO2
CO2
550 ppm
450 ppm
450 Overshoot

# IEA WEO 2008 climate-policy scenarios

## Reductions in annual energy-related $CO_2$ emissions




**Increased deployment of existing low-carbon technologies accounts for most of the $CO_2$ savings at US$ 90 /t $CO_2$ for 550 ppm $CO_2$-eq and US$ 180 /t $CO_2$ for 450 ppm $CO_2$-eq**

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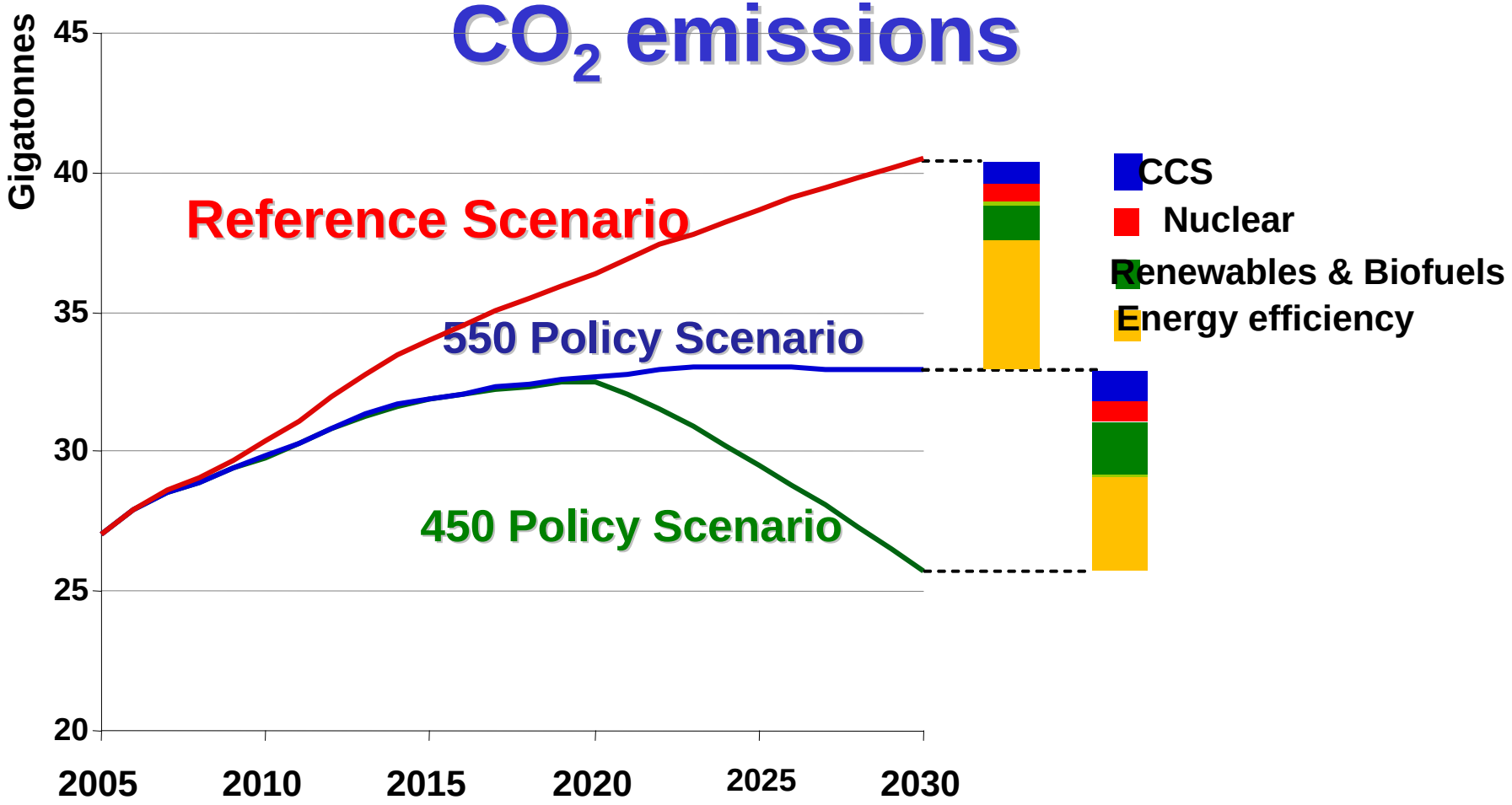


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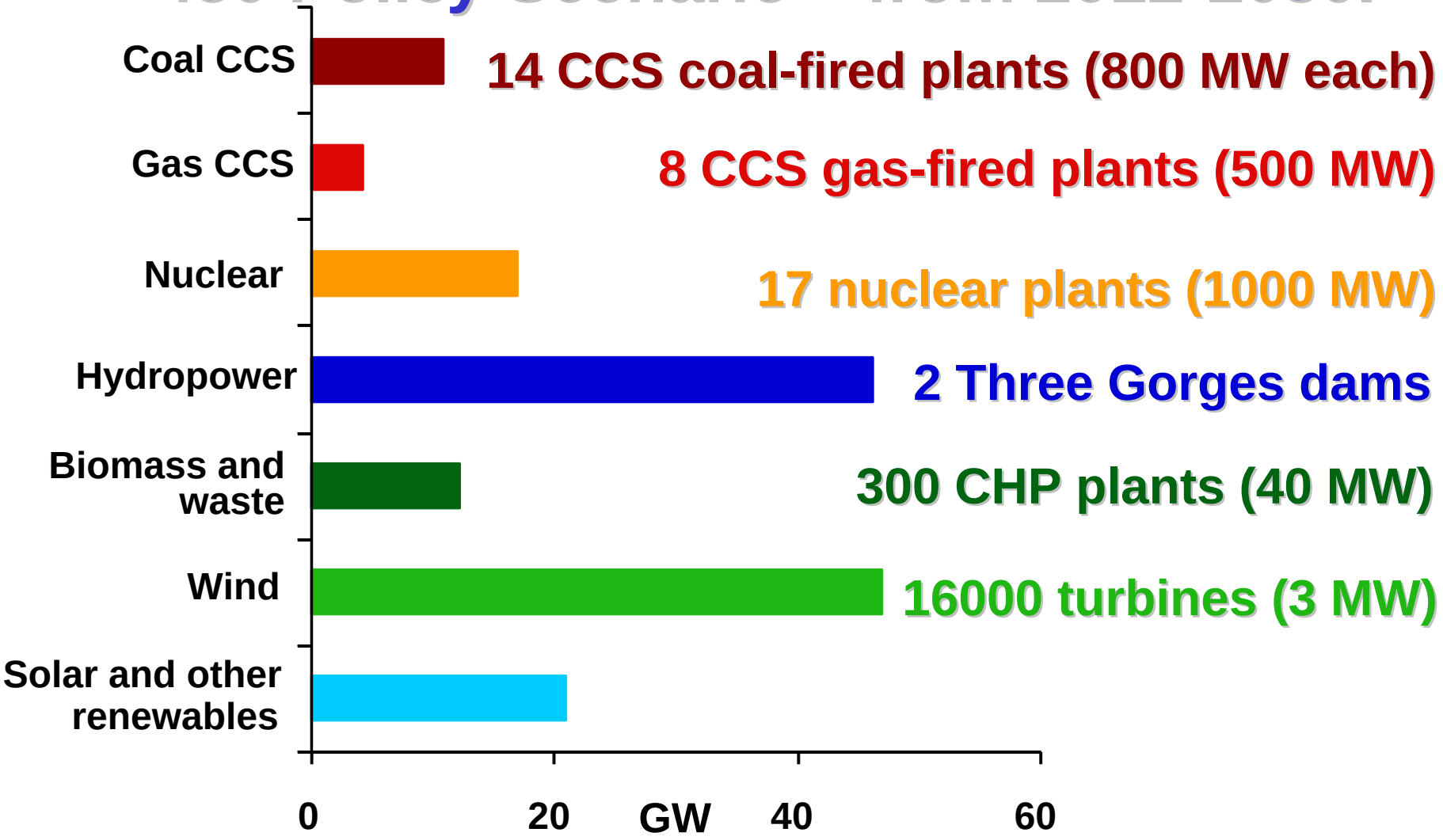
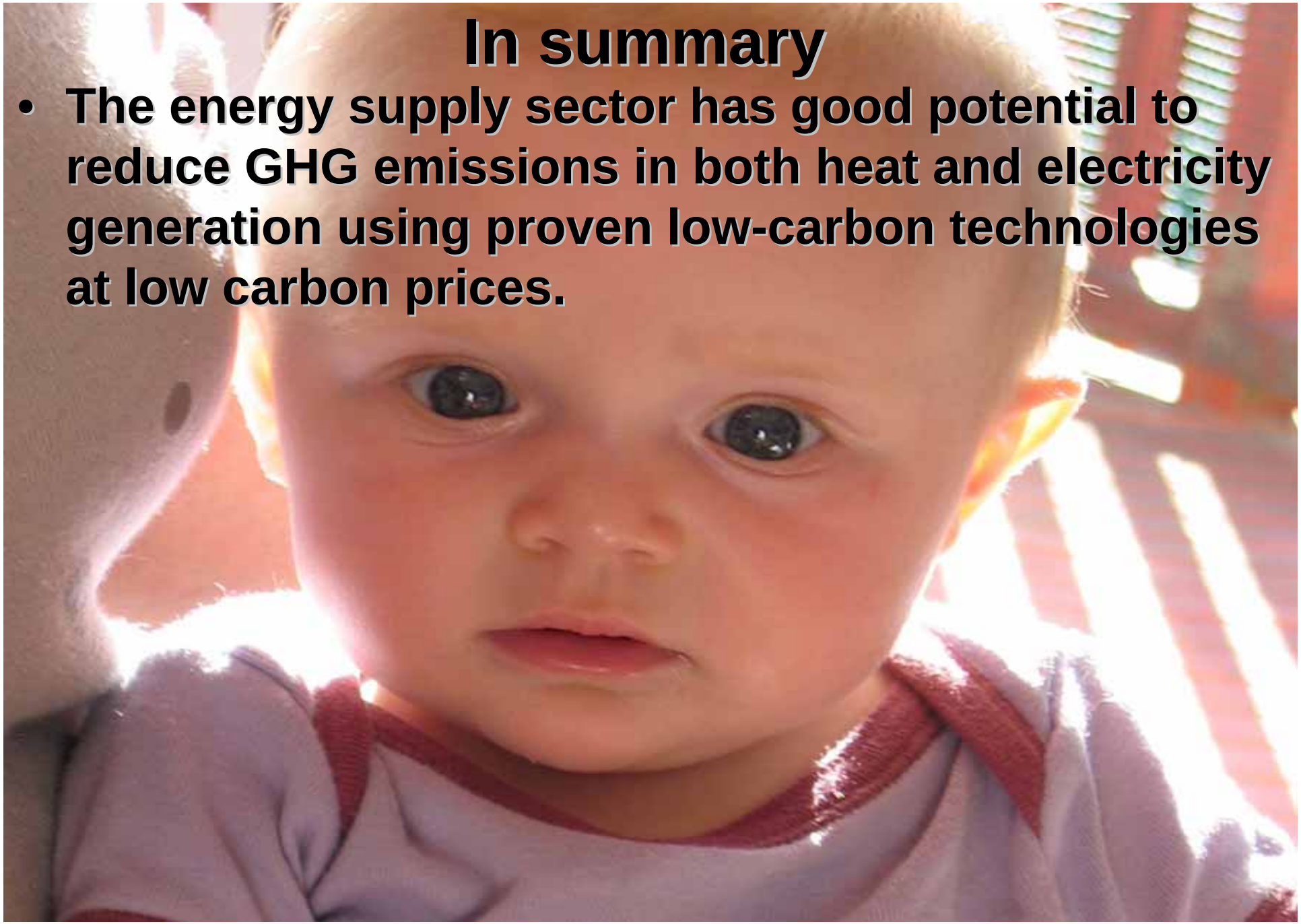
# Annual power sector capacity additions in the 450 Policy Scenario – from 2012-2030.

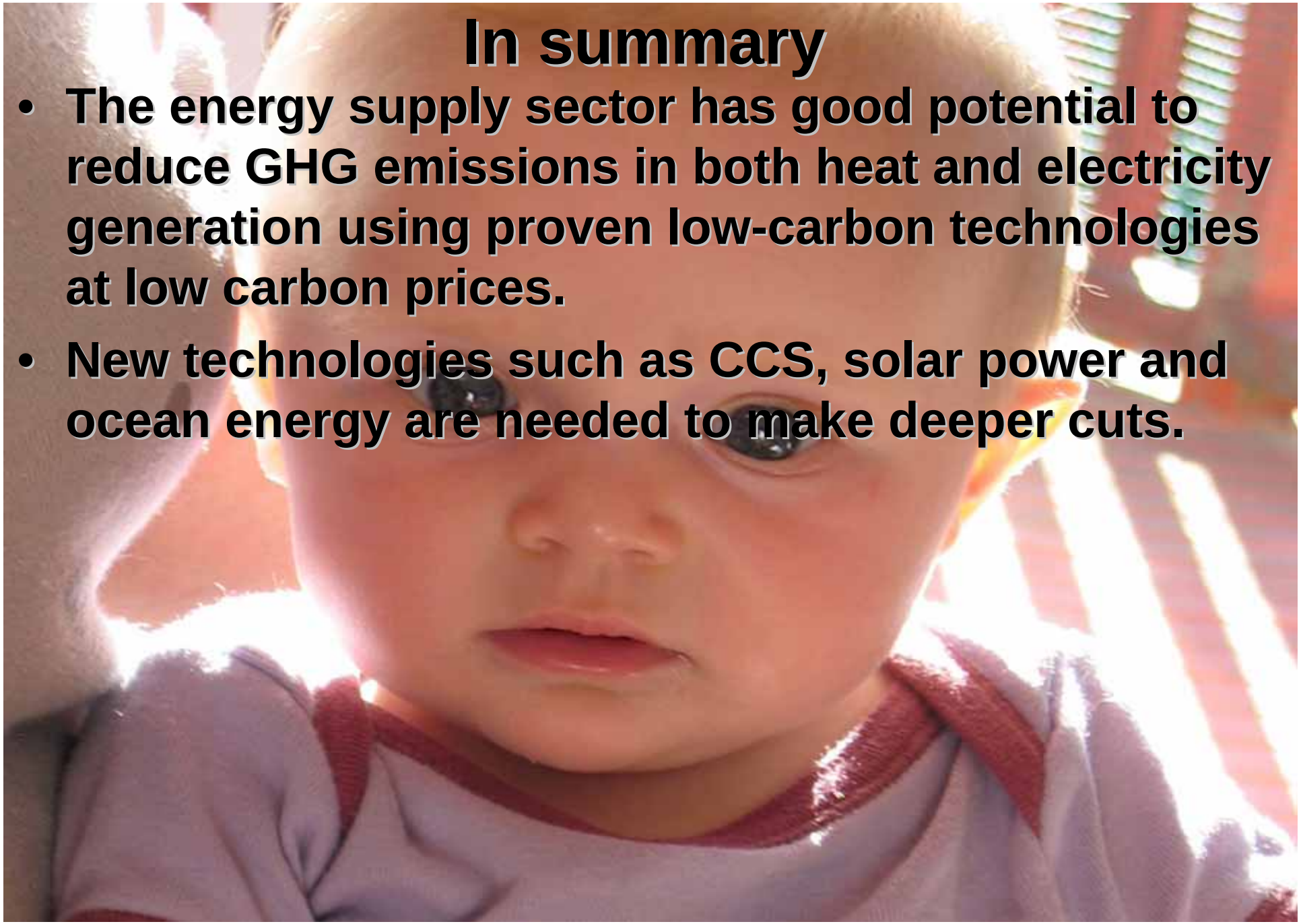



**All new generating capacity built after 2012 is "carbon-free" and 15% of existing capacity is retired early.**

# In summary

- **The energy supply sector has good potential to reduce GHG emissions in both heat and electricity generation using proven low-carbon technologies at low carbon prices.**





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- New technologies such as CCS, solar power and ocean energy are needed to make deeper cuts.

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- New technologies such as CCS, solar power and ocean energy are needed to make deeper cuts.
- The transport sector has good mitigation potential but it is constrained by ever-increasing travel demands and consumer behaviour.
- Biofuels could grow their current 1.5% share and reach over 5% by 2030 if 2$^{nd}$-generation fuels become commercially viable.
- We have the technologies but do not have the time