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Toward Deep Emission Cuts by the Joint Efforts of Developed and Developing Countries through Sectoral Approach

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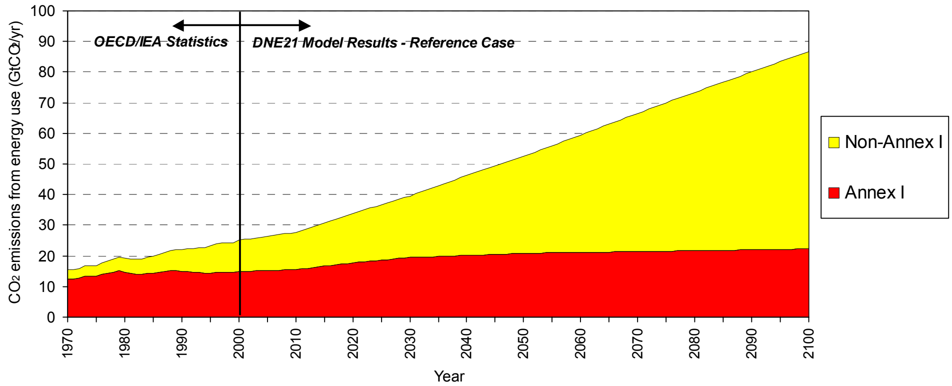
Contents

- Why are sectoral approaches needed in both developed and developing countries?
  - Current energy efficiencies vary widely across the countries.
  - Global emission reductions would be smaller than expected under KP emission cap regime.
  - Many advantages of sectoral approaches (elaborated later)
- Case studies for hard global warming mitigation
  - Ideal case for global emission reductions (uniform marginal cost)
  - Practical but firm approaches to achieve substantially the ideal target of deep emission cuts: sectoral approach by intensity bench marks
- Conclusion

Outlook of Global CO_2 Emissions



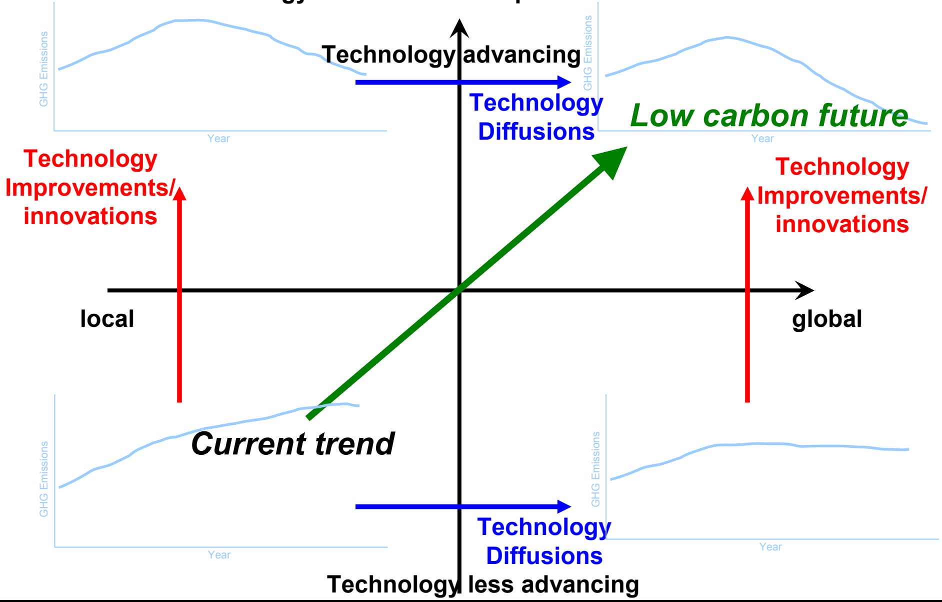
DNE21 model results, 2003

- **Most of the emission increase will take place in developing countries.**
- **Early emission reductions are needed in developing countries as well as in developed countries.**

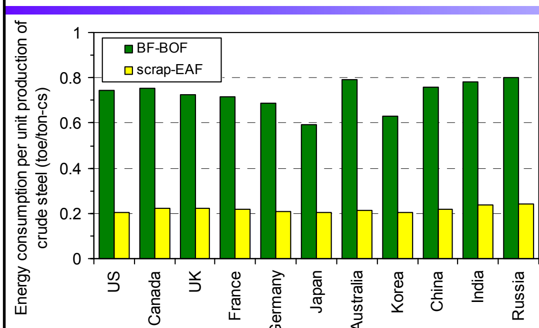
Why are sectoral approaches needed in developed and developing countries?

Technology Diffusions and Improvements

Both technology diffusions and improvements are needed.



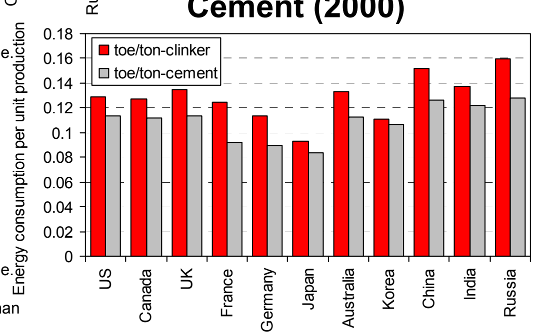
Comparisons of Energy Efficiency (1/2)



Iron & steel (2000)

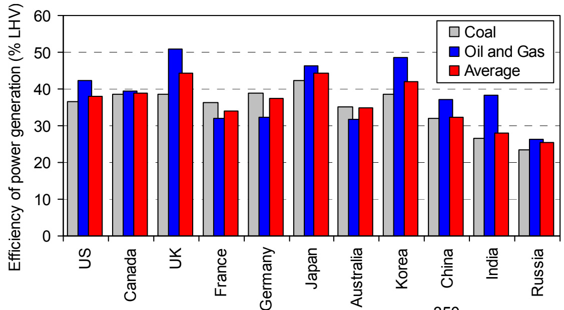
Note: Electricity is converted by using 1MWh=0.086/0.33toe.
Source: Estimates by RITE from IEA (2006),
IISI (2005) etc.

Cement (2000)



Note: Electricity is converted by using 1MWh=0.086/0.33toe.
Waste biomass use is excluded in the energy efficiency.
Source: Estimates by RITE from Humphreys and Mahasenan (2002), IEA (2006) etc.

Comparisons of Energy Efficiency (2/2)

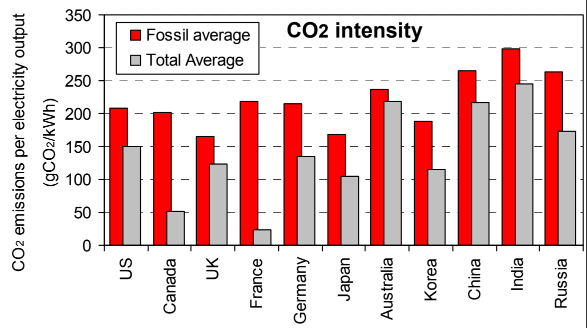


Efficiency

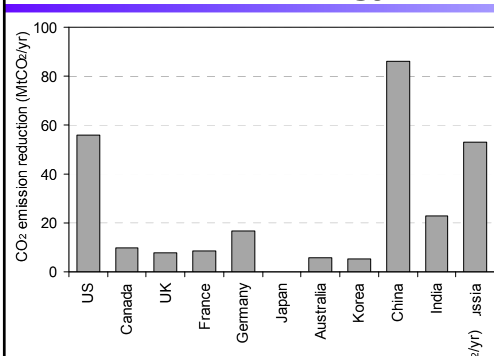
Power sectors (2005)

Including CHP

Source: IEA, 2007



Potential Reductions of CO_2 Emissions by Technology Diffusions Only (1/2)

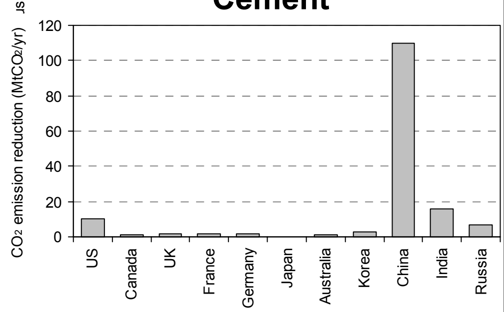


Iron & steel

If the efficiencies of BF-BOF and EAF in Japan in 2000 are achieved in all the countries,

Global reduction will be 0.35 $GtCO_2$/yr.

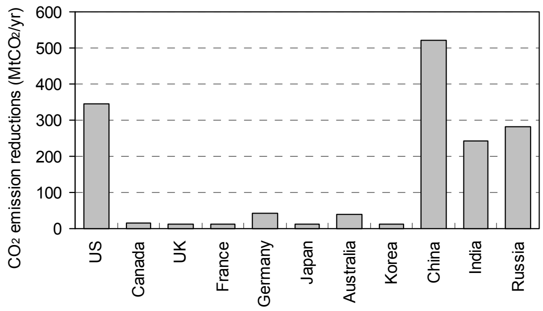
Cement



If the efficiency of clinker productions in Japan in 2000 is achieved in all the countries,

Global reduction will be 0.22 $GtCO_2$/yr.

Potential Reductions of CO_2 Emissions by Technology Diffusions Only (2/2)



Power sector

If the efficiency of coal/oil and natural gas in Japan and United Kingdom in 2005, respectively, is achieved in all the countries,

Global reductions will be 2.1 $GtCO_2$/yr.

Wide technology diffusions are very important.

But note that some of the reduction potentials can also be achieved in BaU case.

Sectoral Approach for Global Deep Emission Cuts

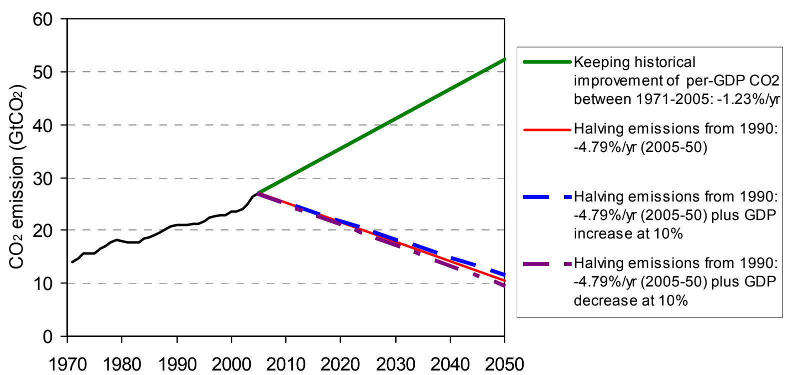
Advantages

- **Action oriented approach: People can understand what they should do in order to achieve the targets.**
- **Target setting for deep emission cuts: Setting of deep cut targets can be pursued on a practical base through sectoral expert's discussions.**
- **Fair and equitable target setting: Consideration of different regional technology levels can bring about fair and equitable targets. Fair competitive conditions can be generated in industry sectors.**
- **Good harmony with pledge & review regime: Many countries including developing countries can participate in the framework due to the flexibility.**

- **Binding national cap will not be able to achieve global deep emission cuts in practice. Rather, sectoral approach with intensity targets can achieve them.**
- **One of the shortcomings is the difficulty to define the benchmarks including the boundaries. However, IEA, APP works will be able to support it.**

Emission Cap v.s. Intensity Targets

- Expected emission reductions can be the same for the two types of targets.
- Most of the emission reduction is brought about by the intensity improvement and not by activity reductions.
- The intensity targets framework produces almost the same environmental effects as the emission cap framework does.



Procedures toward Agreement of Post-Kyoto Regimes

Global agreement on the ultimate long-term target/global target of emissions

Top-down approach

Considering "differentiated responsibilities and respective capabilities"

Bottom-up approach (Recommend)

National emission targets (Binding target)

↓

Sectoral measures within nations

↓

Failure in some countries

Emission reductions: smaller than expected

Soft global agreement on burden shares

↓↑

Global agreement on sectoral benchmark targets (Pledge & Review/binding targets)

↓ If needed

National emission targets (Pledge & Review)

Emission reductions: as expected

Case studies of quantitative analyses for sectoral approach

Overview of DNE21+

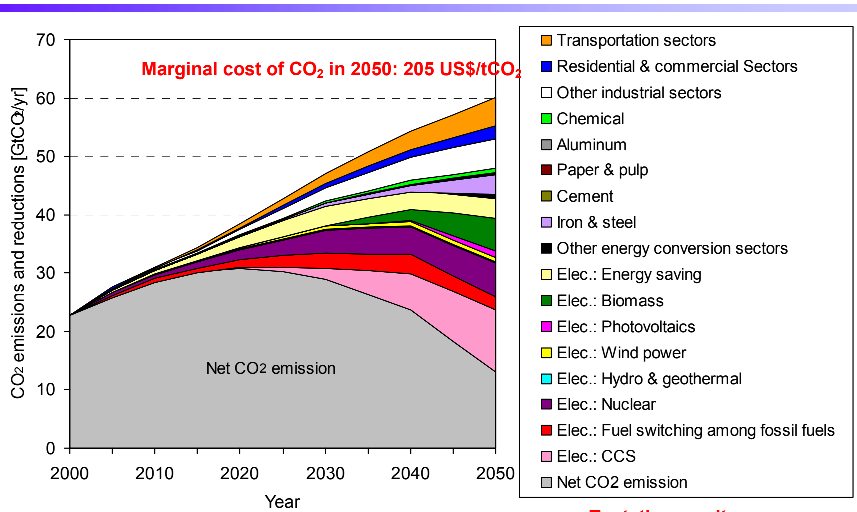
- Linear programming model (minimizing world energy system cost)
- Evaluation time period: 2000-2050
  Representative time points: 2000, 2005, 2010, 2015, 2020, 2025, 2030, 2040, 2050
- World divided into 54 regions
  Large area countries are further divided into 3-8 regions, and the world is divided into 77 regions.
- Bottom-up modeling for technologies both in energy supply and demand sides
- Primary energy: coal, oil, natural gas, hydro&geothermal, wind, photovoltaics, biomass and nuclear power
- Electricity demand and supply are formulated for 4 time periods: instantaneous peak, peak, intermediate and off-peak periods
- Interregional trade: coal, crude oil, natural gas, syn. oil, ethanol, hydrogen, electricity and CO_2
- Existing facility vintages are explicitly modeled.

The model has high resolutions in regions and technologies to analyze sectoral approach.

Assumed Technology Improvements
(Only a Few Selected Technologies are shown)

Technologies	*Assumed technology improvements*
PV	Cost reduction of 3.4% p.a.
Wind power	Cost reduction of 1.0% p.a.
Battery for PV/Wind power expands	375 (in 2000) → 7.6 US$/MWh (in 2050)
Advanced coal power with CCS	IGCC/IGFC with CO2 capture: 1,700 (in 2000) → 1,325 US$/kW (in 2050), 34.0 (in 2000) → 51.0% LHV (in 2050)
Advanced BF (adv. hydrogen use)	Coal input: 12.12 GJ/tCS; electricity input: 695 kWh/tCS (around 0.47 toe/tCS in total) (in 2050)
FCV	228.2 Million JPY/vehicle in 2050
EV	220.3 Million JPY/vehicle in 2050

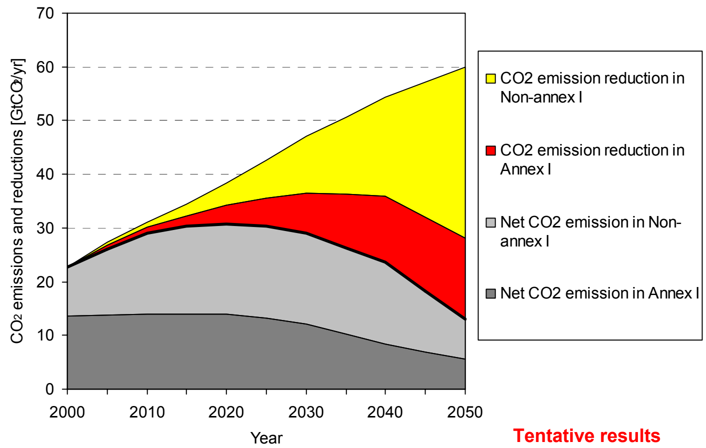
Ideal Emission Reductions for the 50 by 50



Tentative results

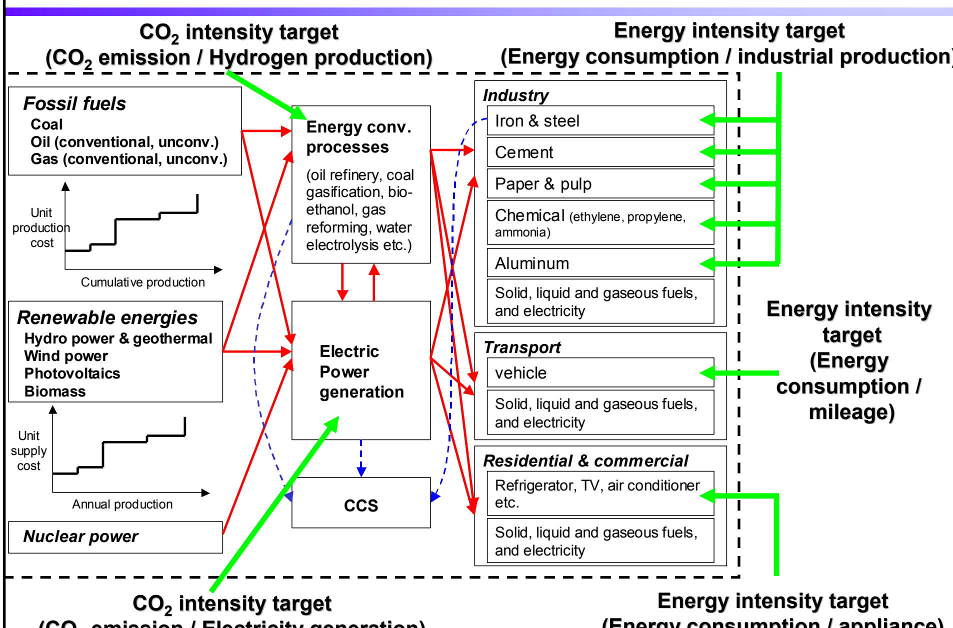
- **This is the ideal case which assumes a uniform marginal cost of CO_2 emission reductions among countries and sectors. However, this case study is too optimistic to be internationally implemented.**

Ideal Shares of Emission Reductions for Developed and Developing Countries
(From the viewpoint of cost effectiveness)



- **Nearly 60% and 20% reduction from 2000 levels is required in developed and developing countries, respectively, in 2050 from the viewpoint of cost effectiveness.**

Assumed Target Settings for Sectors



Assumed Intensity Targets for Each Sector

CO_2 intensity in power sector (e.g. ton-CO_2/MWh) and energy intensity in other sectors were assumed.

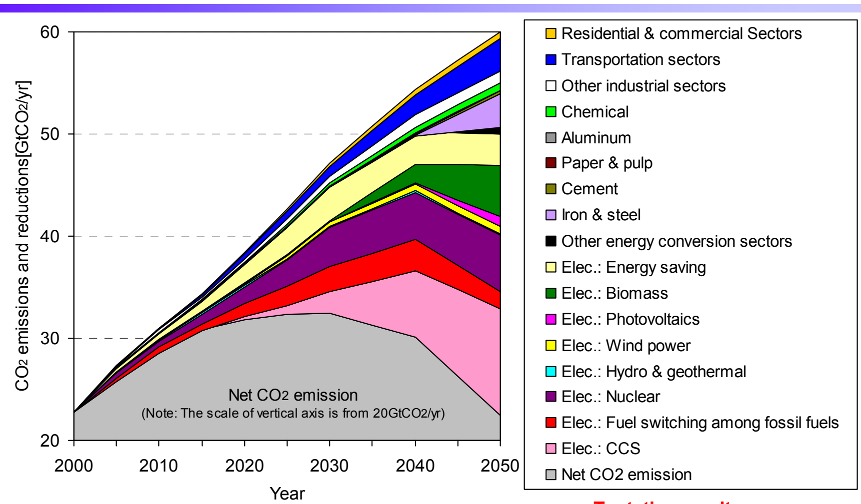
(Current levels in Japan = 1.00)

		Y2020	Y2030	Y2050
Power sector	Annex I	1.12	0.73	–0.37
	Non-Annex I	1.13	0.62	–0.45
Iron & steel	Annex I	0.92	0.90	0.65
	Non-Annex I	1.05	0.94	0.73
Cement	Annex I	1.05	1.03	0.89
	Non-Annex I	1.33	1.23	0.93
Small Passenger Car	Annex I	0.73	0.57	0.39
	Non-Annex I	1.11	0.88	0.37
Bus	Annex I	0.79	0.57	0.32
	Non-Annex I	0.89	0.67	0.33

Unit: The numbers designate the intensities relative to the current levels for Japan. The intensity is with respect to CO_2 emission and energy consumption for power and other energy conversion sectors and for all the other sectors, respectively.

The number in the table is aggregated for only two regions and is shown only in the selected sectors; however, actually, the intensity targets are established for power sectors, other energy conversions, iron & steel, cement, aluminum, paper & pulp and chemical industries, vehicles (car, bus, and truck), and appliances (TV, air conditioner, and refrigerator) by region for the 54 regions and by time, which are determined from the results of the analysis in previous slide (ideal case study).

Emission Reduction Effects under the Assumed Intensity Targets by Sector



Tentative results

- **A realistic framework will promote deep emission reductions at global level.**
- **Other measures, e.g. deforestation reduction/afforestation, change in lifestyles, various kinds of domestic policy and measures, will also support deeper emission reductions.**

Averaged Costs of CO_2 Emission Reduction from the BaU Case

		Y2020	Y2030	Y2050
Vision 50/50	World	18.9	21.2	49.6
	Annex I	30.7	22.9	33.5
	Non-Annex I	7.3	14.4	52.6
Sectoral approach toward 50/50	World	21.7	20.7	45.4
	Annex I	34.9	25.0	32.8
	Non-Annex I	7.1	11.4	45.3

Unit: $/tCO_2$

Tentative results

- **The marginal cost is uniform for all the countries in the Vision 50/50 case, but the averaged cost in developed countries is larger than in developing countries up to around 2030.**
- **This means that there are large potentials of emission reductions at low costs in developing countries.**
- **The costs in the sectoral approach case can be designed with a minimum increase in the cost from the ideal case thanks to the model analysis.**

Conclusions

- **There are no pathways to deep emission reductions without the cooperation of developed and developing countries.**
- **Both technology diffusions and developments are needed.**
- **One of the practical and firm approaches to achieve such deep emission cuts is a sectoral approach with global agreements on intensity targets by sector including developing countries.**
- **Flexible regimes, which the sectoral approach possesses, are inevitable for global deep emission cuts.**
- **However, additional frameworks are also needed in addition to the sectoral intensity targets regimes. Such as**

  - Funding mechanisms to transfer high efficiency technologies to developing countries,

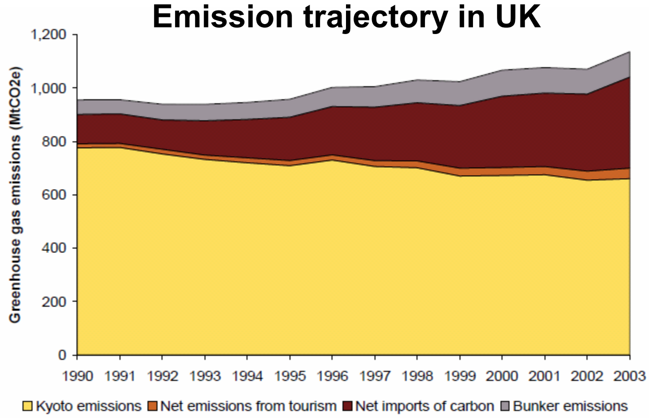
  - Strengthen R&D efforts both in international and national frameworks, and

  - Domestic efforts for changes in lifestyle, accurate energy price settings in end-use (e.g., final energy prices in some countries are still too low.)

Annex I

Global Emission Reduction Efforts Needed

Emission trajectory in UK



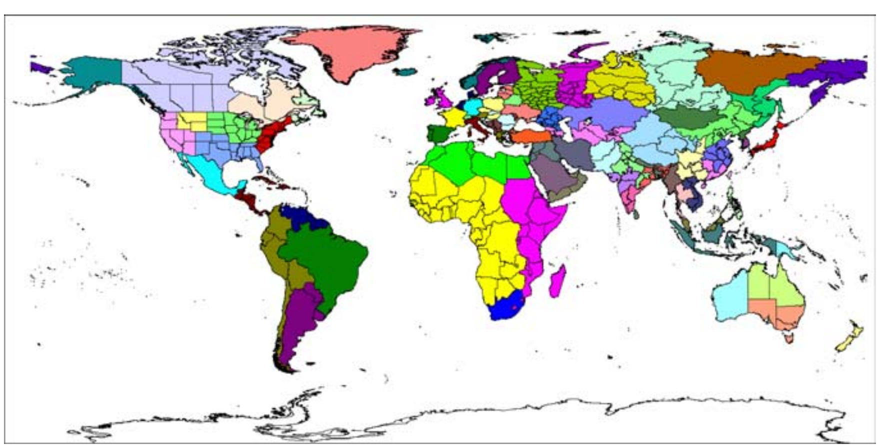
Source) D. Helm et al., Too Good to be True?-The UK's Climate Change Record, Dec. 2007.

- **CO_2 emissions in UK have increased by 19% between 1990-2003, if the emissions are counted by consumption-base.**
- **Emission caps only on developed countries will not necessarily promote emission reductions at global level.**

Annex II

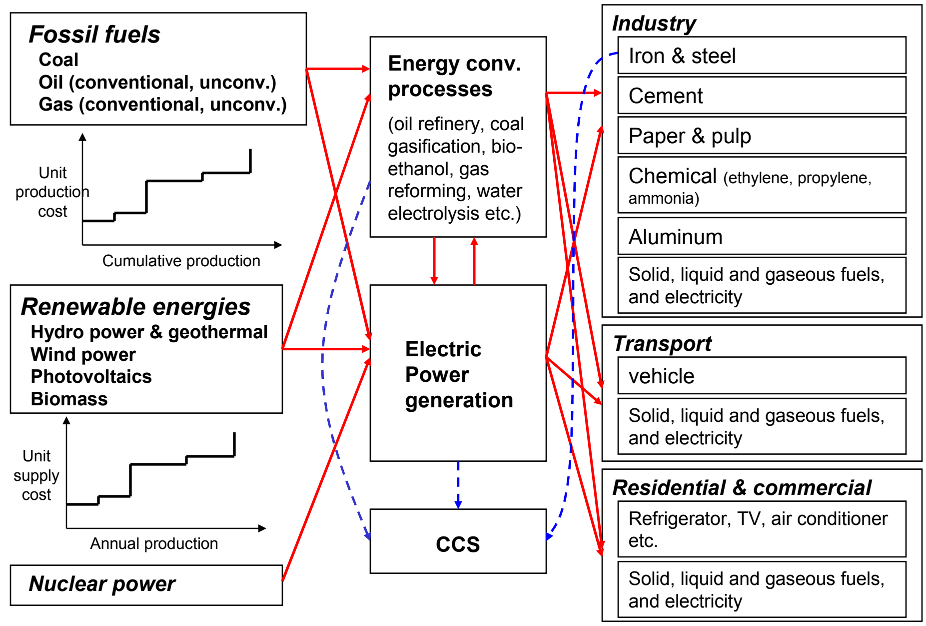
Region Divisions of DNE21+

World divided into 54 regions

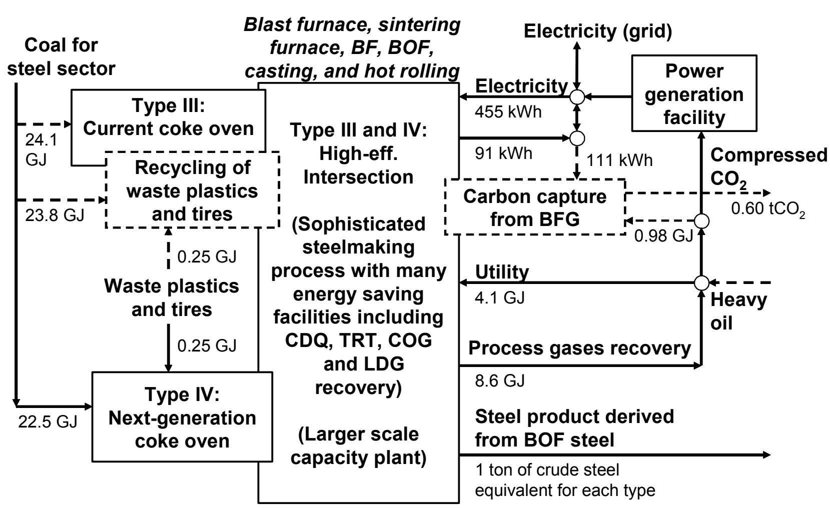


Detailed regional differences are evaluated.

Technology Descriptions in DNE21+ (1/2)



Technology Descriptions in DNE21+ (2/2)
–An Example for High Energy Efficiency Process in Iron & Steel Sector–



BF: blast furnace, BOF: basic oxygen furnace, CDQ: Coke dry quenching, TRT: top-pressure recovery turbine, COG: coke oven gas, LDG: oxygen furnace gas