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***ENERGY, INNOVATION AND CLIMATE
CHANGE
The challenge of addressing global public
goods***

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Climate change is an appropriate test to:

- highlight the difficulty/inadequacy of the theory of public goods –mainly but not only- neoclassical to deal with global public goods.
- raise some research questions that could find an answer within the evolutionary framework



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ENERGY, POLLUTION AND CLIMATE CHANGE

After the industrial revolution we entered the era of “anthropocene”

“ANTHROPOCENE IS THE FIRST GEOLOGICAL ERA IN WHICH THE NATURE IS NOT AN EXOGENOUS FORCE DOMINATING MANKIND LIFE.

ON THE CONTRARY, WE HUMAN BEING ARE RESPONSIBLE FOR THE EQUILIBRIUM OF THE PLANET”

Paul Crutzen, Nobel Prize, 2005



ANTHROPOCENE: THE ERA OF HUMAN IMPACT ON THE EARTH'S EQUILIBRIUM (P.Crutzen)

CO₂ and **methane** are the most impacting gases on climate change (IPCC Reports 1-4; S.Weart 2003)

Before the industrial revolution, - in 420.000 years

- CO₂ volume from 200 ppm to 280 ppm in the atmosphere
- Methane volume from 0.4 ppm to 0.7 ppm

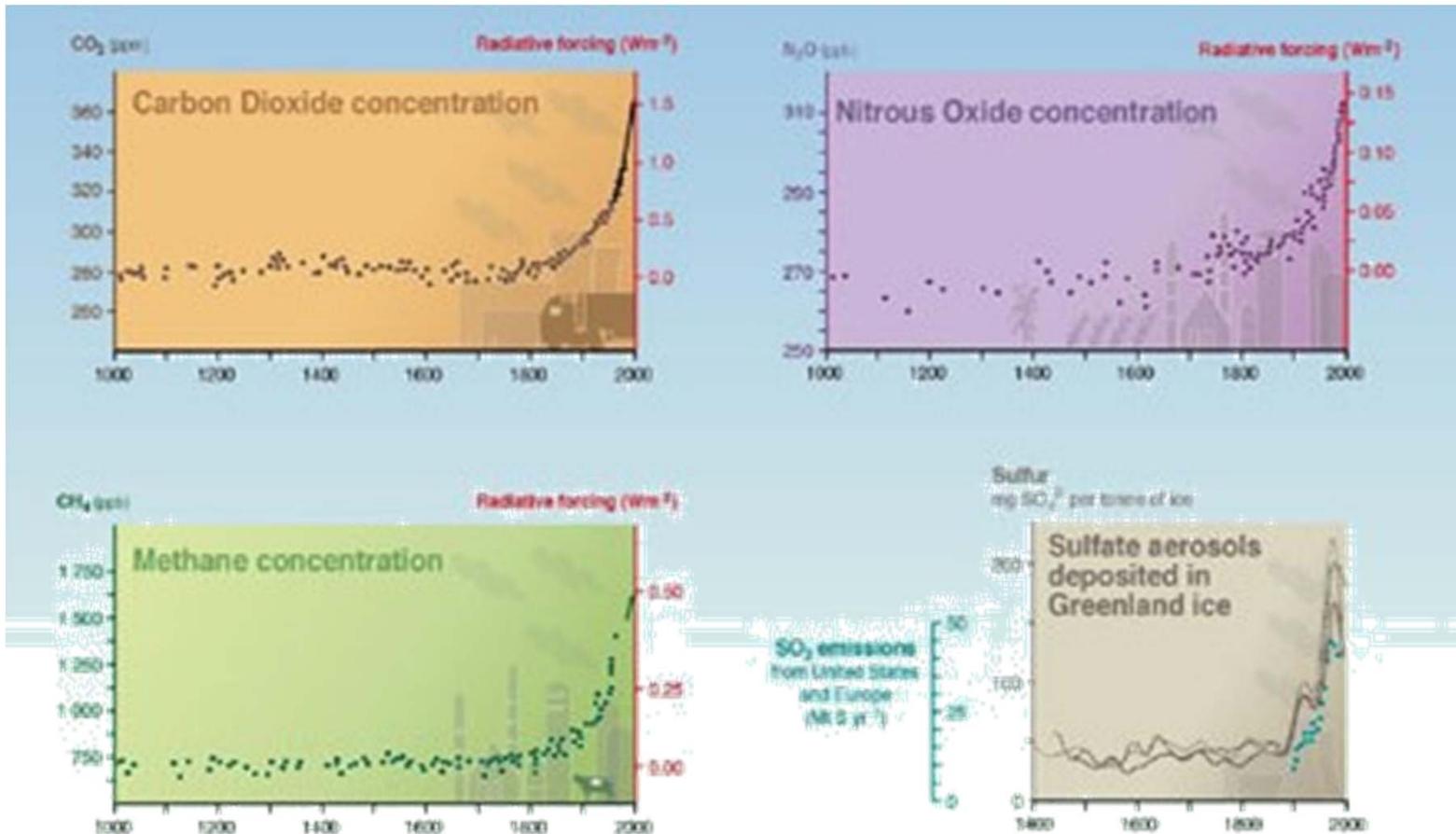
After the industrial revolution – in less than 200 years

- CO₂ volume from 280 to 360 ppm
- Methane volume from 0.7 to 1.8 ppm

UNFCCC 2007 sets a target-volume of **450 ppm** for **2020**, associated with a 2° C average warming (UNFCC 2007, IEA 2012)



INDICATORS OF HUMAN INFLUENCE ON THE ATMOSPHERE IN THE INDUSTRIAL ERA



source: IPCC Third Assessment Report



HUMAN INFLUENCE ON THE ATMOSPHERE IN THE INDUSTRIAL ERA

Phenomena caused by human activity (IPCC 2013, D.Helm 2012):

- The use of **fossil fuels** in urban industrialized areas (CO₂);
- Burning biomasses, forestries, waste and organic materials in rural areas; the usage of **fertilizers** (CO₂ + NO_x) (IEA2011)

Energy produced the most noteworthy impact on GHG on the atmosphere in 15 millions years (Paul Crutzen 2005; with E.

Stoermer 2002; W. D'Andrea, W.Huang et al. 2011)



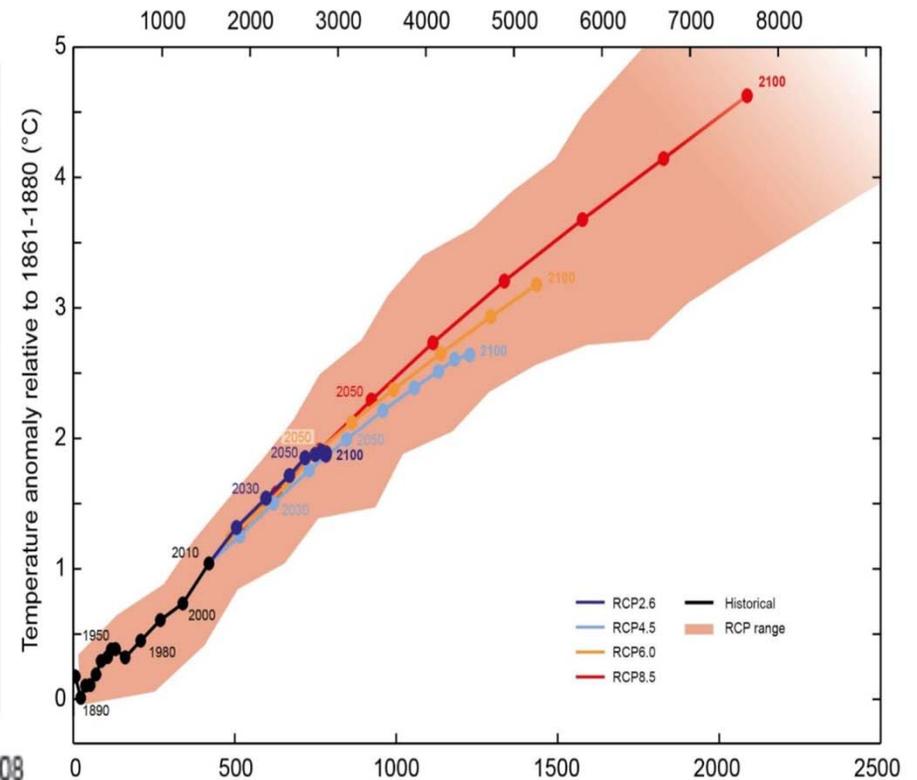
NATURAL CYCLES BECOME ENDOGENOUS

IPCC REPORT (2013, 5TH report, WG1)

Cumulative CO2 atmospheric concentration from 1870 (GtCO2)



Cumulative total anthropogenic emissions from 1870 (GtCO2)



(W.D'Andrea, W.Huang et al. 2011 US N.A.of Science)



ENERGY TRADE-OFFS IN A DYNAMIC PERSPECTIVE: DO THEY SET LIMITS TO GROWTH?

Energy dependency for growth VS limited primary energy sources



«peak theory» ? (M.K.Hubbert 1956)

- **Energy revolution overcomes these limits -ie break-through technological innovations → renewable sources, shale gas...**
- **Limited resources have been a spur to innovation:**
 - New resources of **unconventional gas/oil** (fracking)
 - Renewables : a new paradigm in the energy sector (decentralized generation)
→ Schumpeter's "creative destruction" in the energy industry
 - Positive externalities: dramatic changes in energy production & consumption, potential new lifestyles based on energy efficiency



ENERGY TRADE-OFFS: DO THEY SET LIMITS TO GROWTH?

The use of fossil fuels vs climate change



«environmental unsustainability»?

- **Uncertain outcome** (IPCC1-4; 5°WG I 2013)

Technological innovation and the transfer of technology are the key to overcoming this trade-off. However, **climate change is a global public good**

- **We have no conceptual framework & institutional tools to address it**



CLIMATE CHANGE : A GLOBAL PUBLIC GOOD

GPGs: “public goods whose benefits extend to all countries, people, and generations” (C.Mendoza UNDP 2003)

- **across space** (between regions, countries)
- **across generations**

We face the **INEQUAL DISTRIBUTION** of :

- **IMPACT:** future location of agriculture (e.g.Russia,Canada); desertification (e.g. Niger);
- **RISKS:** raising sea level (e.g. small islands Maldives, Indonesia); health (D.Helm 2012)
- **COSTS:** 1% global GDP: est cost of cutting CO2 by 2050 consistent with 550 ppm (Stern Rev2007)
- **BENEFITS:** uncertain outcomes

Mitigation requires global policies; **Adaptation** requires local policies



Which SOCIAL WELFARE FUNCTION for Global Public Goods ?

- **INTRAGENERATIONAL ISSUES :**
 - Cost-efficiency VS social justice
Valuation methods: monetary or social metrics? (CBA or HDI)?

- **INTERGENERATIONAL ISSUES :**
 - **Distributional issues** (Weber 2011, Sen 2010)
 - **Perception of risk** (Simon 1957; Kahneman, Tversky 1979; Weber 2011; G.Heal, 2011, A.Millner 2013)

THESE ISSUES RAISE CORRESPONDING THEORETICAL QUESTIONS



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THREE MAIN HURDLES to address GPGs

1. **ECONOMIC MODELS** of public goods are inadequate to address GLOBAL public goods, as climate change
2. **DIFFERENT MODELS** of GOVERNANCE & CULTURE (USA, UE, CHINA) should converge to common policies. Limits of the Kyoto Protocol
3. **LACK OF JURISDICTION.** International institutions & negotiation forums confronting global strategies



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ADDRESSING GPGS: *Hurdle 1*

ECONOMIC MODELS of PGs are inadequate to address GLOBAL PGs

- i. Global scope & property rights
- ii. Individual/collective decisions under uncertainty
- iii. Separation of criteria of efficiency & justice?
- iv. Undesired macro-consequences of microeconomic models
- v. Burden sharing



i. Global scope and property rights

- The theory of public goods uses homogeneous preferences & policies to internalize externalities (from Wicksell 1984, to Pigou 1920, to Coase' "property rights" 1960)

- **But climate change is a *global public good* ; it involves:**

HETEROGENOUS STAKEHOLDERS & UNDEFINED BOUNDARIES

-heterogeneous preferences & very long term horizons (J. Stiglitz 1999, UNDP 2009; H.Kunreuther, 2011; D.Helm 2012):

Myopic tendency to focus on short term benefits & costs, misperception of risk, different risk aversion among stakeholders, problems of uncertainty & discount rates



ii. Individual / collective decision process under uncertainty

What metrics and which valuation method ? (A.Sen 2007, G.Heal 2011)

a) Monetary criteria → Cost Benefit Analysis i.e.

«formal procedure by which one organizes information to support decision making”.
Assumption: individual preference satisfaction ie: individual knowledge + consistent behaviour (E.Mishan 2007); however, for GPGs: which information? Very long term uncertainty, Aggregation? Long term discount rate ?

- **Deviations from rational behaviour** due to limited cognitive capacity & long term uncertainty : cognitive constraints (Simon 1957) ; or local encoding of information relative to reference points (Kahneman, Tversky 1979; Weber 2011)

- **Problems of aggregation:** the “single representative” is inappropriate for heterogeneous preferences of global stakeholders (Broome 2011)

- **Intergenerational issues** : which discount rate ? (S.Barrett 2003;), which distributional choice, differentiated priorities & responsibilities/vulnerabilities

b) **Social criteria** → **HDI** (UNDP 1990, 2010) based on A.Sen’s “Capabilities approach” (Mahbub ul Haq & A.Sen 1990; based on three pillars: pc income + life expectancy + years of education)



4 ***Further inadequacies of economic models***

iii. Separation of criteria of efficiency & justice ?

not possible in global negotiations & intergenerational decisions

iv. Undesired macro-consequences of microeconomic models

government failures; fallacy of composition; imperfect markets; mkt failures; eg European ETS (V. Termini 2006)

iv. Burden sharing: equity, responsibility, efficacy

it very much depends on the choice of the indexes: pc emissions vs total emissions vs past emissions; differentiated vulnerability

Economic theory and vision

- Economic theory does not offer a conceptual framework for the management of GPGs that accomodates both ***efficiency and equity*** considerations across **time** and **space**
- This framework is needed «to broaden ***consensus*** and provide ***policy strategies*** and find criteria and tools for ***burden sharing***» (IPCC, WG1 2013)
- Searching for theoretical answers to these questions, related to both individual behaviour & macro-consequences, a multifaceted and pragmatic approach should take regional experiences into consideration



Hurdles 2 & 3, ADDRESSING GPGS:

2. MACRO-MODELS OF GOVERNANCE & INSTITUTIONS (V.Termini 2013)

- the “EUROPEAN” model
centralised, «top-down», based on binding measures
- the “AMERICAN” model
«bottom-up»: based on enterprises innovations; exposed to lobbying, against binding intervention
- the “CHINESE” model
national sovereignty and strategy; no external interference; State and local government policies and massive investment to encourage innovation, «shared colonialism»

➔ GPGs require **FLEXIBLE POLICY MODELS - Limits of Kyoto Protocol**

3. LACK of JURISDICTION no legal/fiscal power - International Institutions & Negotiations Forums



VISION & TOOLS ...

- **INNOVATION & TECHNOLOGY TRANSFER IS KEY**

economic criteria: investment friendly environment, regulatory framework, Schumpeterian “creative destruction”

- **GPGs WELFARE FUNCTION**

principles of justice (J.Rawls 1971, A. Sen 2009, A.Sen & M.b ul Haq 2010)

Both criteria are required



...& POLICIES

- REGIONAL APPROACH IN GLOBAL NEGOTIATION FORUMS

(Montreal Protocol 1987; limits of the Kyoto Protocol)

- TOP DOWN + BOTTOM UP APPROACHES

- STRATEGIC + PARTICIPATORY MODELS OF INTERVENTION

Short term incentives and long term strategies (Kunreuther 2011) e.g. consistent regional fiscal policies & incentives to promote innovation & sustainable lifestyle. Ostrom's approach to local commons; EPI Index; (G.Heal 2011)

A proposal:

- INTERGENERATIONAL DEBT– COMPENSATION approach: today's liabilities (public & private debts) are a burden for future generations; future generations may be compensated by today's climate policies burden.



CLIMATE CHANGE: A SPUR TO INNOVATION

Climate change calls for an adequate conceptual framework and more theoretical answers; we recognize a “real world” dynamic tendency: a spur to innovation :

- ICT + new energy sources + new energy technologies
- Smart communities, smart grids, energy storage facilities...

“THE FATE OF THE WORLD WILL BE SUCH AS THE WORLD DESERVES Russel - Einstein Manifesto 1955

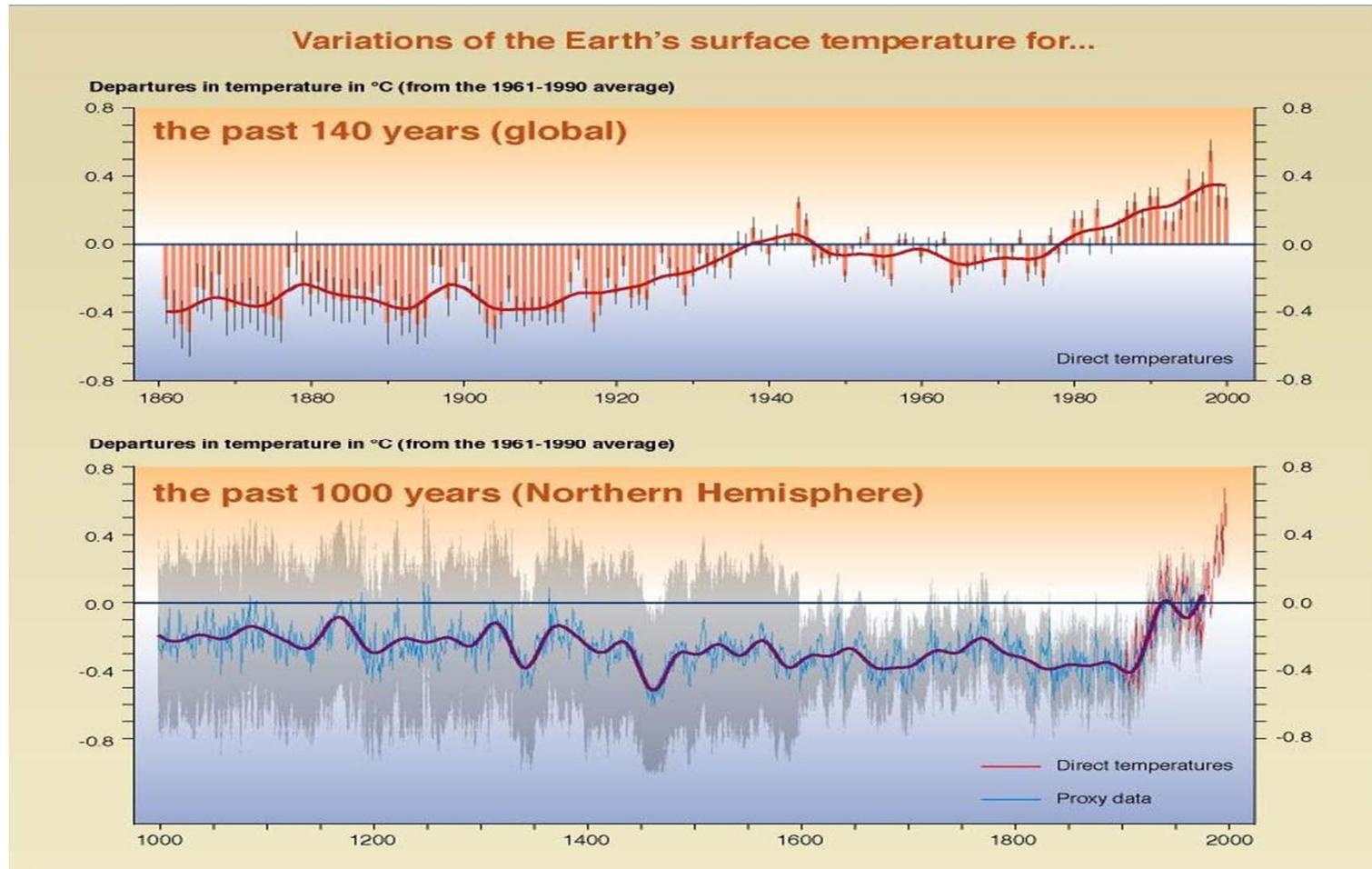


Thank You! 😊

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Il cambiamento climatico: variazione della temperatura terrestre



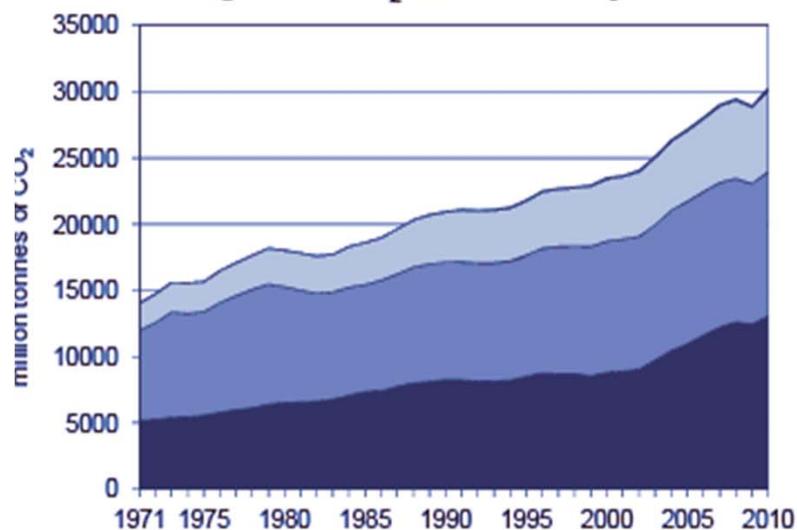
Fonte: IPCC Third Assessment Report
2001



HISTORIC VALUES OF CO₂ EMISSIONS

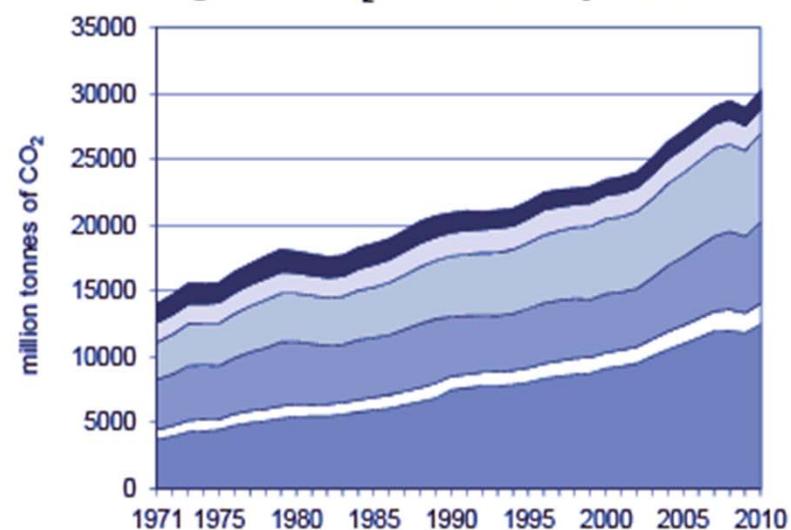
World

Figure 1. CO₂ emissions by fuel



■ Coal/peat ■ Oil ■ Gas □ Other

Figure 2. CO₂ emissions by sector



■ Electricity and heat ■ Other energy ind. own use
 ■ Manuf. ind. and construction ■ Transport
 ■ Residential ■ Other

Source: IEA CO₂ EMISSIONS FROM FUEL COMBUSTION *Highlights* (2012 Edition)

