Plenary Lecture: International Issues

A Session promoted by ENAEE with the collaboration of IFEES

HOW ARE THE QUALITY SYSTEMS (ACCREDITATION) IN HIGHER EDUCATION COPING WITH GLOBAL WARMING ISSUE?

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- Introduction and scope
- Energy related global warming (GW)-bau (reference) scenario
- Energy related global warming - 450 scenario
- Main engineering accreditation systems
- Relationship of graduate outcomes to GW
- What are some universities doing about GW?
- Concluding remarks

INTRODUCTION AND SCOPE (1)

- Transportation, urbanisation, industrialisation, population growth, emerging mega economics
- Increasing energy utilisation & demand
- Increasing compliance to environmental regulations
- Interphase between sustainability & catastrophe
- Nothing like the dilemmas before (climatic episodes)
- Where are we going in terms of energy, particularly coal?
- IEA data, special thanks to Fatih Birol
- What is the role of higher education-accreditation in addressing GLOBAL WARMING?

INTRODUCTION AND SCOPE (2)

Are we asking a relevant question?

- GW vs. Engineering Accreditation, is it a justified question? Global, swift, economical, political
- Do accreditation systems address specific issues?

  an ability to apply knowledge of mathematics, science, and engineering“
- Responsible for teaching “relativity”

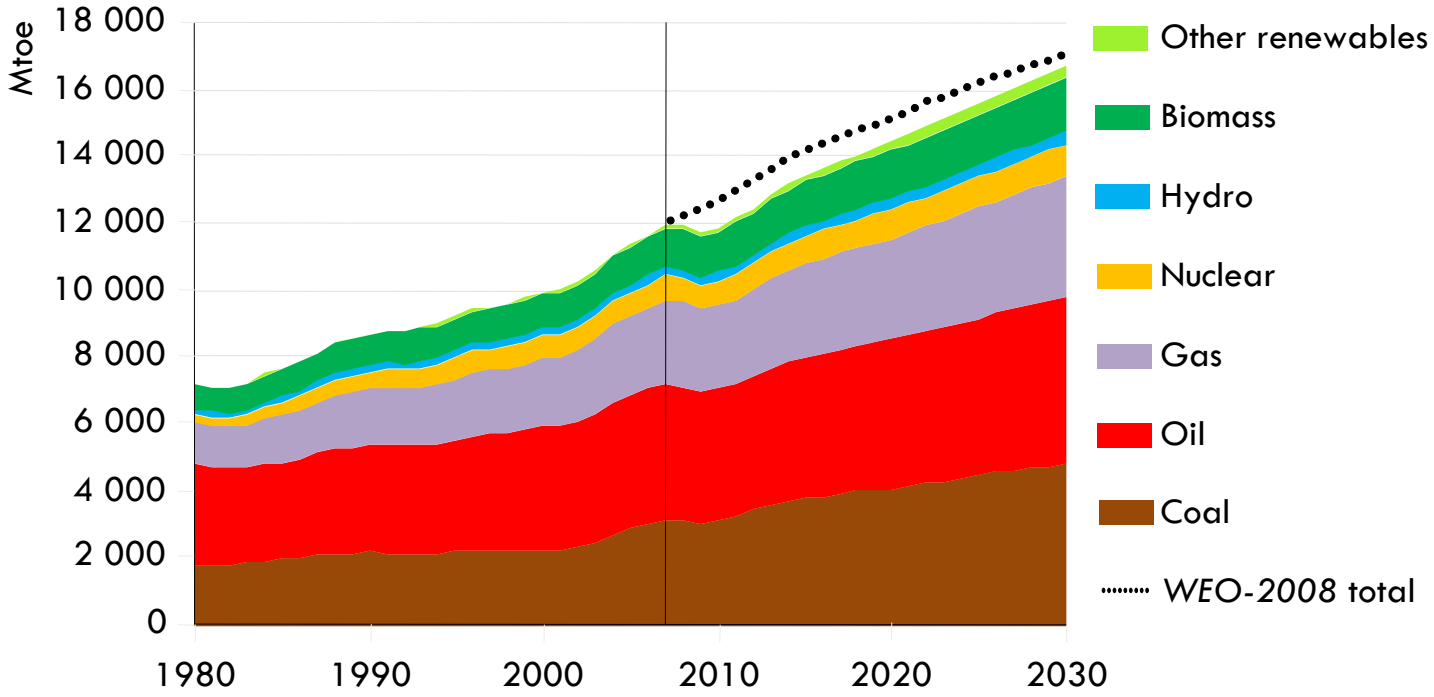
  at least to go and learn and revisit the theory if needed in proper conduct of the profession

INTRODUCTION AND SCOPE (3)

- GW the greatest threat to human existence caused by human activity
- Engineers one of the groups having greatest responsibility in the making and finding solutions to this catastrophe
- Therefore need to be questioned

ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (1)

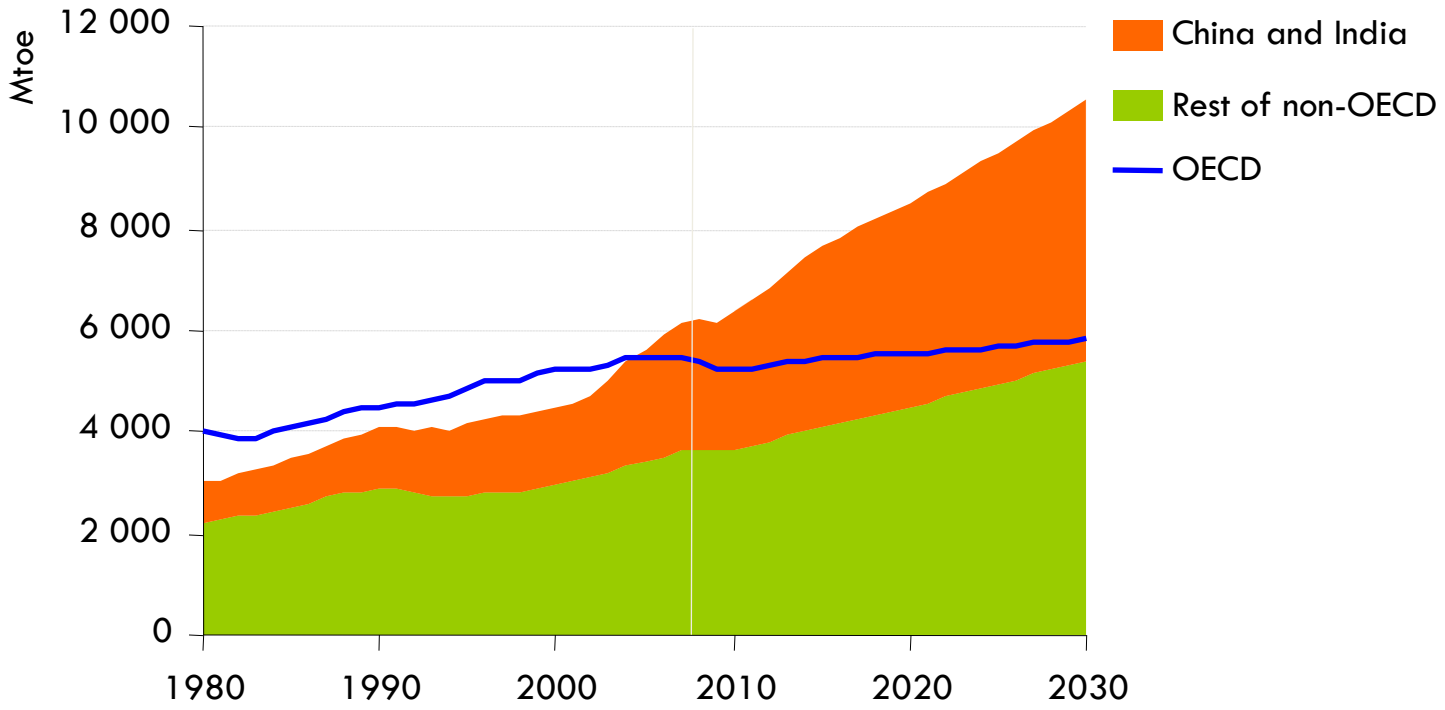
World primary energy demand by fuel
in the Reference Scenario



Global demand grows by 40% between 2007 and 2030,
with coal use rising most in absolute terms, IEA

ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (2)

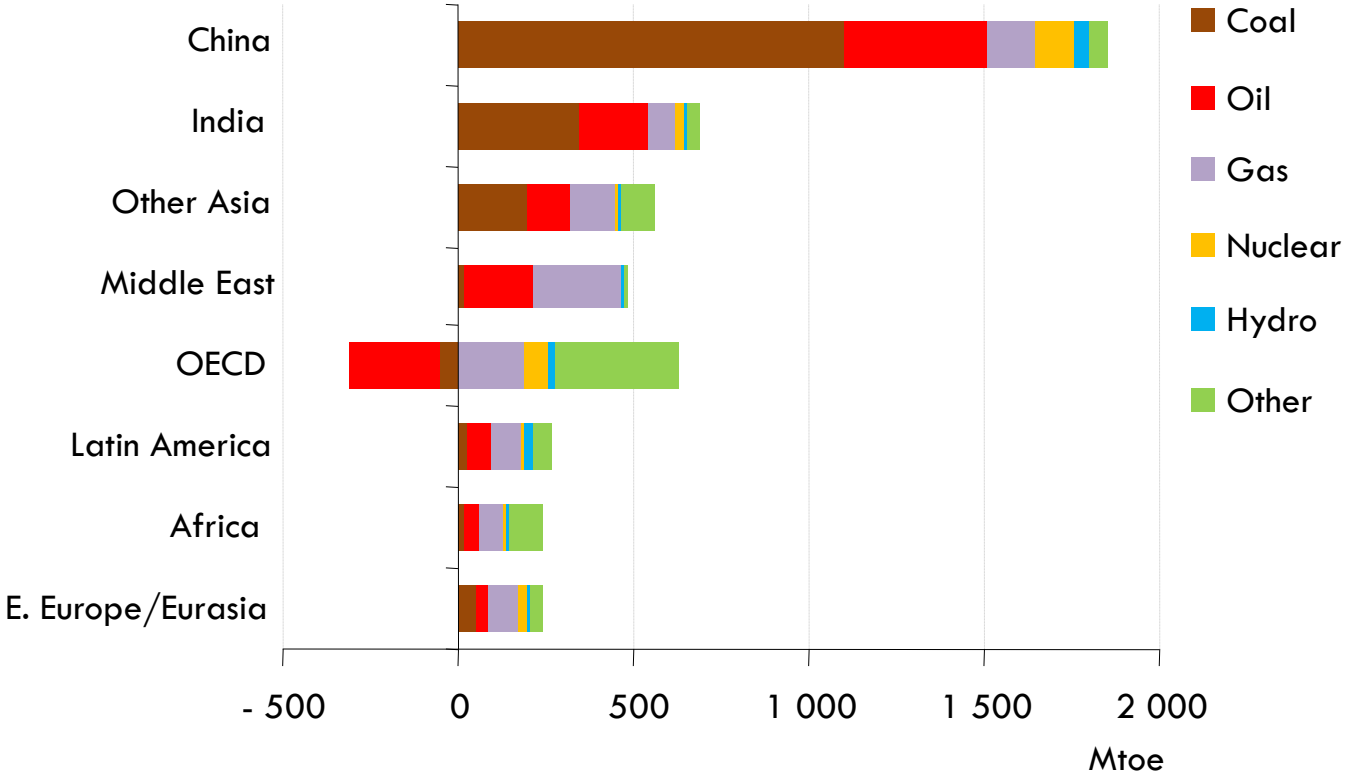
World primary energy demand
in the Reference Scenario



Non-OECD countries account for 93% of the increase in global demand between 2007 & 2030, driven largely by China & India (IEA)

ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (3)

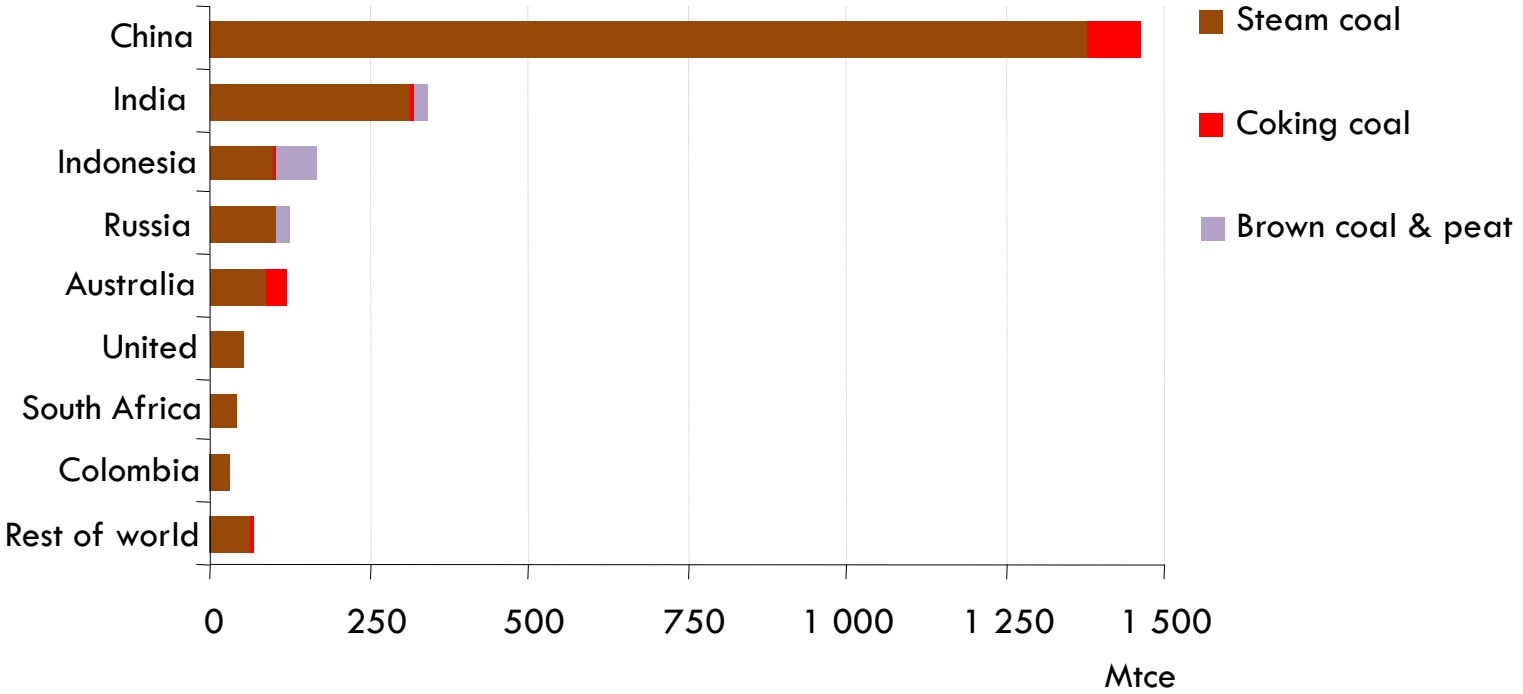
Change in primary energy demand by fuel in the Reference Scenario, 2007-2030



The increase in China's demand for energy – for coal in particular – dwarfs that of all other countries & regions (IEA)

ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (4)

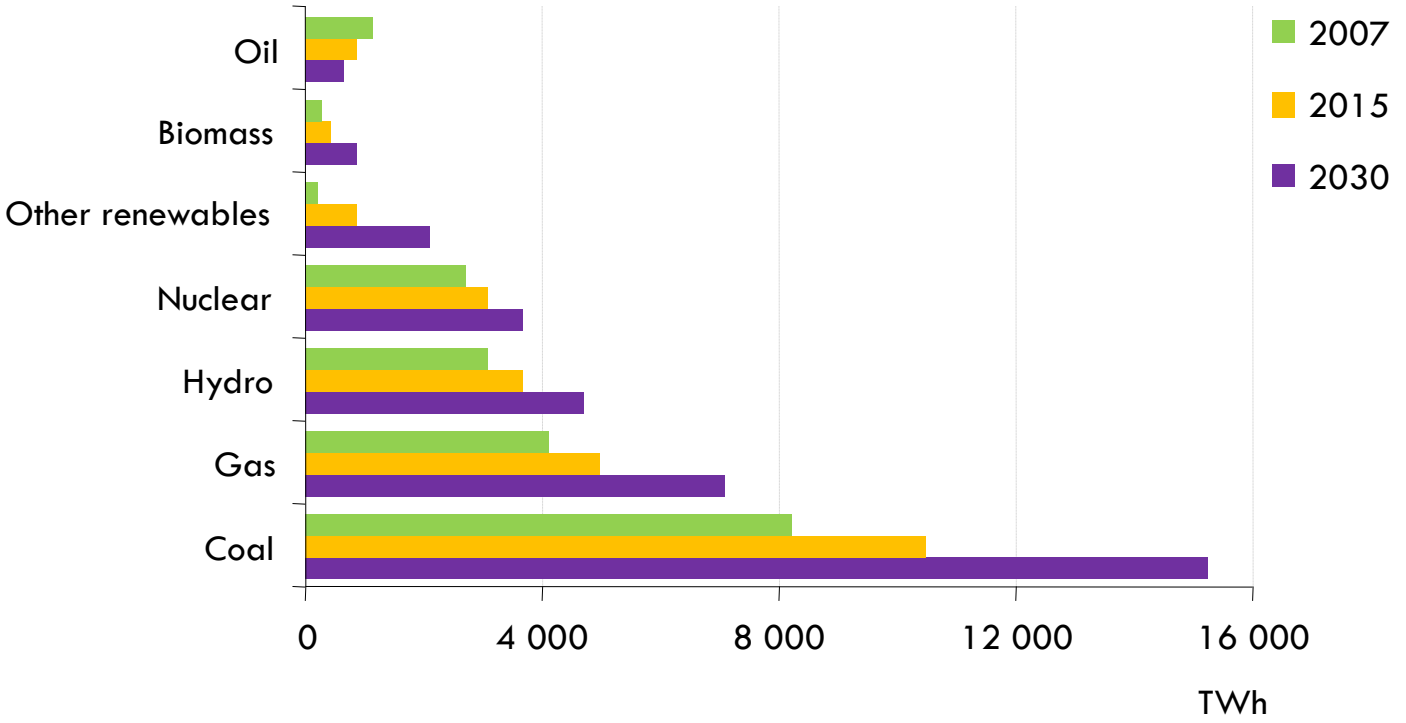
Change in coal production by type & region in the Reference Scenario, 2007-2030



Over 60% of the growth in coal output in 2007-2030 is projected to come from China, as it strives to satisfy a near-doubling of domestic demand (IEA)

ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (5)

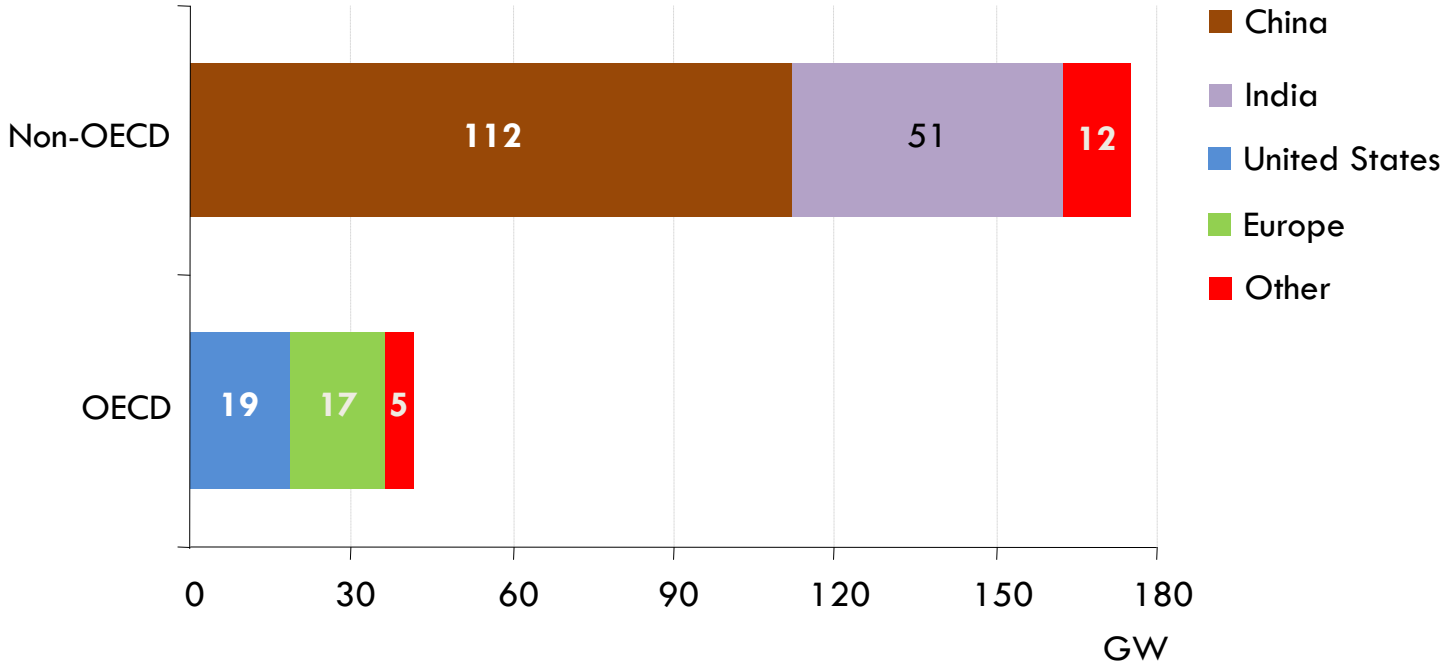
World electricity generation by fuel in the Reference Scenario



Power generation based on all types of energy except oil is projected to grow, with the biggest increases in absolute terms coming from coal- and gas-fired capacity (IEA)

ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (6)

Coal-fired power-generation capacity under construction by country



The bulk of coal-fired capacity currently being built is in non-OECD countries – more than half of the world total in China alone (IEA)

ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (7)

Implications of the energy trends in the Reference Scenario, IEA

- Current energy trends are patently unsustainable — *environmentally, economically & socially*
- Rising CO_2 emissions imply an inevitable rise in global greenhouse-gas concentration & potentially catastrophic climate change
- Increasing oil & gas imports & prices threaten to exacerbate energy insecurity
- Current trends in least-developed regions would leave millions dependent on traditional fuels & lacking access to electricity

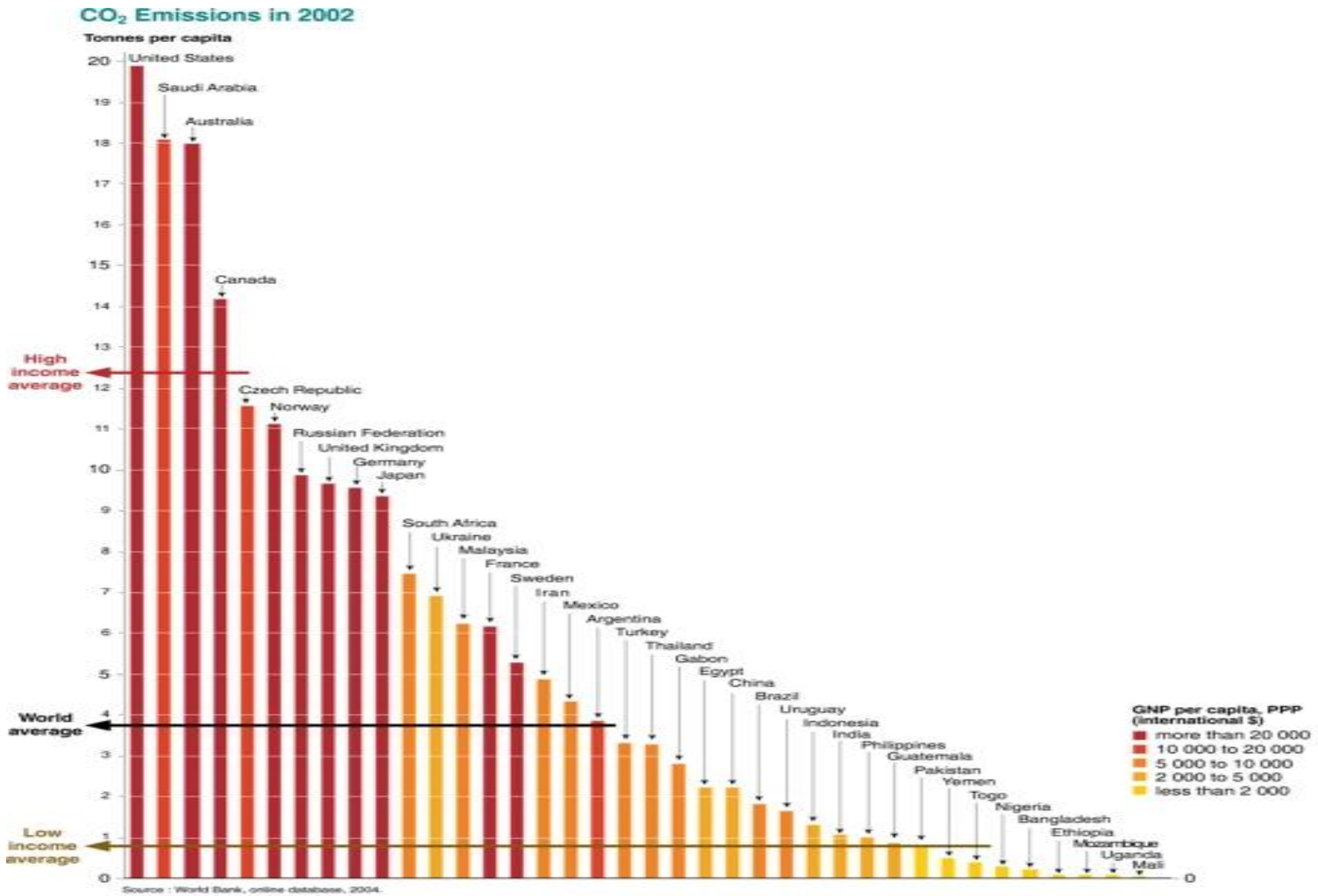
ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (8)

- Australia, Canada, China, India, Japan, South Korea, USA, administration support group
- Yearly average atmospheric T increase scenario 2 C
- Population increase + energy demand
- If business as usual, equilibrium warming range 1990 to 2100, EPA

low	2.3 ˚C	bad
best guess	4.8 ˚C	very bad
high	10.1 ˚C	catastroph

2.5 ˚C warming, a monumental challenge

ENERGY RELATED GLOBAL WARMING BAU-REFERENCE SCENARIO (9)

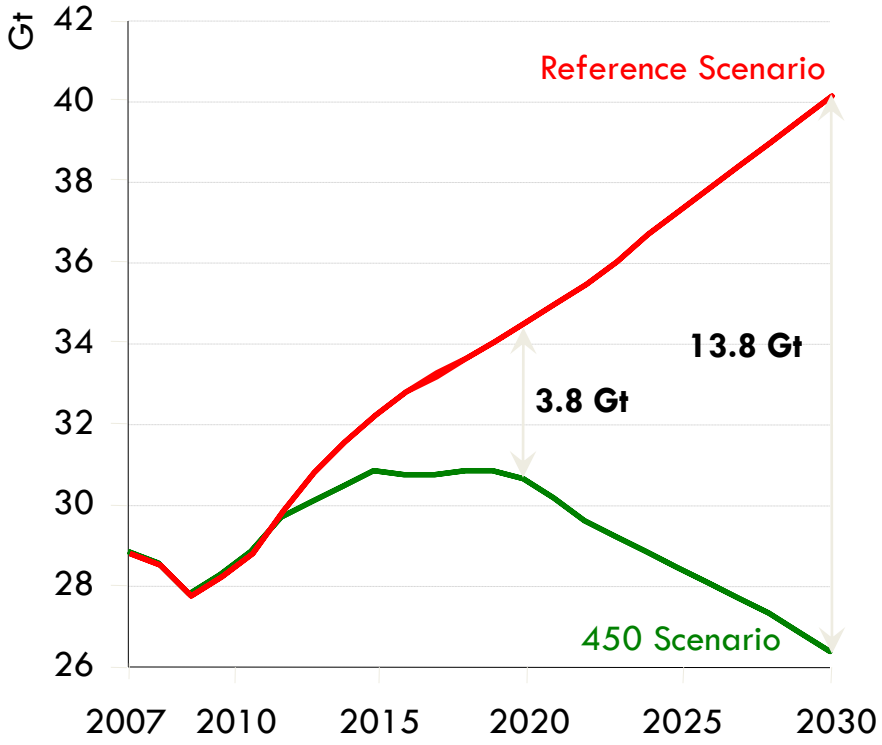


ENERGY RELATED GLOBAL WARMING 450 SCENARIO (1)

- 450 Scenario is low-carbon energy technologies and energy efficiency programme to avoid severe climate change by 2030
- Expected to improve economics, health and energy-security
- Cumulative incremental investment of $10.5 trillion is needed compared to reference scenario
- Agreement on instruments, incentives and financing of investments in non-OECD countries is still not clear
- In 450 Scenario in OECD countries carbon price reaches $50 pt of CO2 in 2020 and $110 in 2030

ENERGY RELATED GLOBAL WARMING 450 SCENARIO (2)

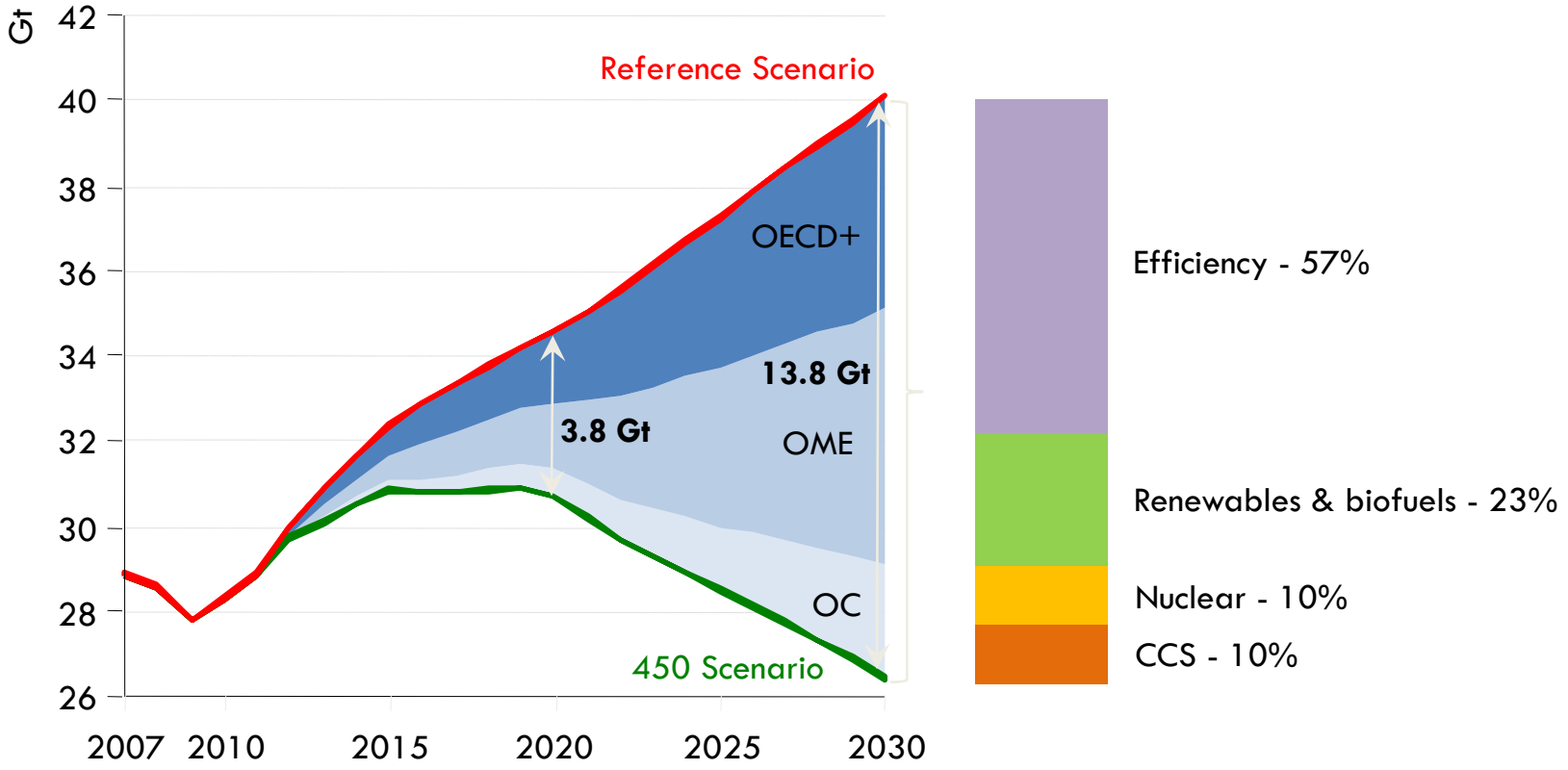
Energy-related CO_2 emissions by scenario



In the 450 Scenario, emissions peak before 2020 at 30.9 Gt, falling to 26.4 Gt by 2030 – almost 14 Gt lower than in the Reference Scenario (IEA)

ENERGY RELATED GLOBAL WARMING 450 SCENARIO (3)

World abatement of energy-related CO_2 emissions in the 450 Scenario



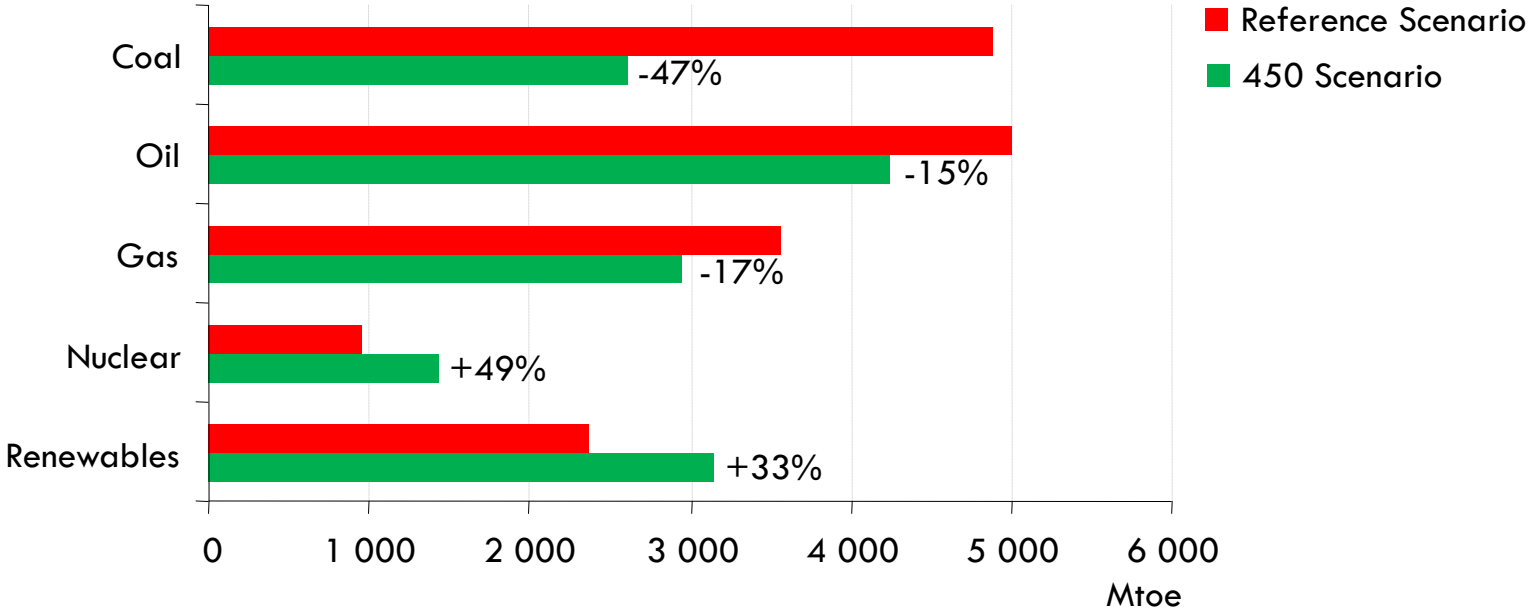
Efficiency measures comprise two-thirds of the abatement in 2020, and 57% in 2030. Renewables contribute around one-fifth of the total emissions reduction. (IEA)

ENERGY RELATED GLOBAL WARMING
450 SCENARIO (4)-IEA remark

- Emissions climb, crisis in the nuclear power industry
- Tsunami at Fukushima, Japan and Germany called a halt to reactor programmes, and other countries are reconsidering nuclear power.
- "People may not like nuclear, but it is one of the major technologies for generating electricity without carbon dioxide," said Birol.
- Gap left by scaling back the world's nuclear ambitions is unlikely to be filled entirely by renewable energy, meaning an increased reliance on fossil fuels.

ENERGY RELATED GLOBAL WARMING 450 SCENARIO (5)

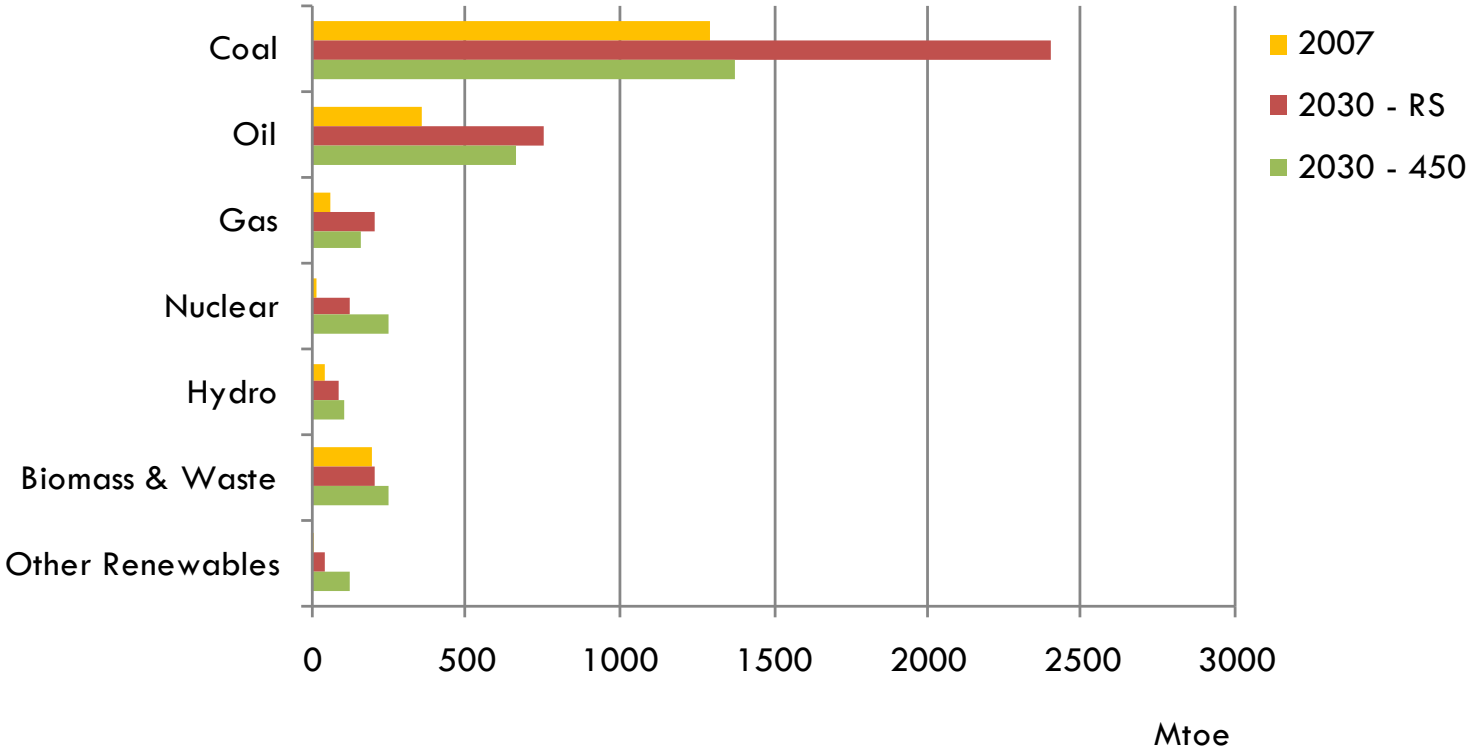
World primary energy demand by fuel & scenario in 2030



The share of fossil fuels in total primary energy demand in the 450 Scenario declines from 81% today to 68% in 2030, with gas remaining at close to today's levels of 20% (IEA)

ENERGY RELATED GLOBAL WARMING 450 SCENARIO (6)

Primary energy demand in China by fuel & scenario



Coal use barely rises above 2007 levels by 2030 in the 450 Scenario – a huge reduction on the Reference Scenario – thanks to electricity savings & switching to low-carbon technologies (IEA)

MAIN ENGINEERING ACCREDITATION SYSTEMS (1)

- EUR/ACE- European Accreditation of Engineering programs
- ABET – Accreditation Board for Engineering and Technology
- National Accreditation Systems (Washington Accord)
- Institutional Accreditation System (Institution of Chemical, Mechanical, Electrical, Computer and other Engineers)
- All outcome based (CQI) systems opposed to former input based systems

EUR/ACE Learning Outcomes

- Knowledge and Understanding
- Engineering Analysis
- Engineering Design
- Investigations
- Engineering Practice
- Transferable Skills

RELATIONSHIP OF THE GRADUATE OUTCOMES TO GW (1)

Transferable skills (EUR/ACE)-First Cycle

- Demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethic, responsibilities and norms of engineering practice

Engineering Practice

- should also recognize the wider, non-technical implications of engineering practice, ethical, environmental, commercial and industrial.

RELATIONSHIP OF THE GRADUATE OUTCOMES TO GW (2)

ABET Program Educational Objectives

- Outcome a: "an ability to apply knowledge of mathematics, science, and engineering"
- Outcome b: "an ability to design and conduct experiments, as well as to analyze and interpret data"
- Outcome c: "an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability"

RELATIONSHIP OF THE GRADUATE OUTCOMES TO GW (3)

ABET Program Educational Objectives

- Outcome d: "an ability to function on multi-disciplinary teams"
- Outcome e: "an ability to identify, formulate, and solve engineering problems“
- Outcome f: "an understanding of professional and ethical responsibility"
- Outcome g: "an ability to communicate effectively“

RELATIONSHIP OF THE GRADUATE OUTCOMES TO GW (3)

ABET Program Educational Objectives

- Outcome h: "the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context"
- Outcome i: "a recognition of the need for, and an ability to engage in life-long learning"
- Outcome j: "a knowledge of contemporary issues"
- Outcome k: "an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice"

RELATIONSHIP OF THE GRADUATE OUTCOMES TO GW (4)

Institutional learning outcomes- IChemEng

- Underpinning mathmatics and science
- Core chemical engineering (including core process safety)
- Engineering practice and advanced chem. eng practice
- Design practice and advanced design practice
- Essential embedded learning, sustainability SHE,ethics
- Essential embedded learning, transferrable skills
- Advanced chemical engineering, depth, breadth

RELATIONSHIP OF THE GRADUATE OUTCOMES TO GW (5)

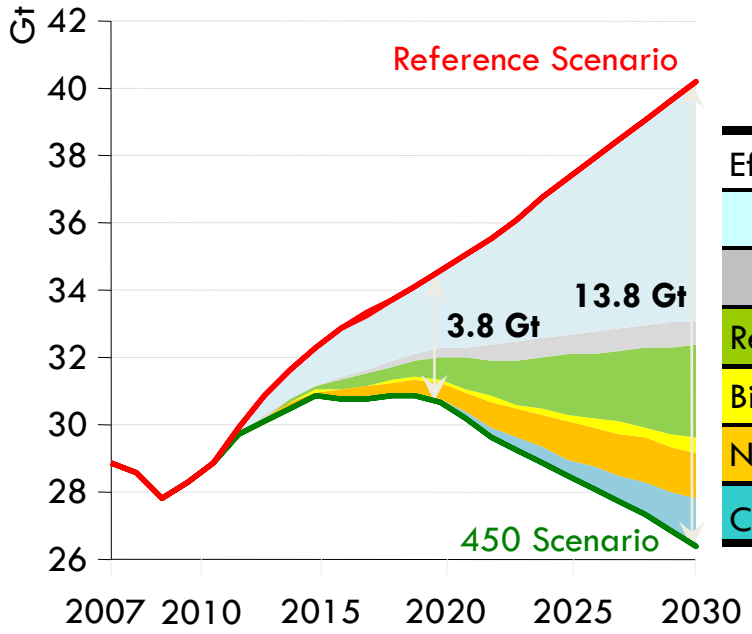
(Ins.Chem.Eng.)

Essential embedded learning, sustainability SHE,ethics

- The importance of environmental sustainability and the principal aspects of environmental impact-air, water, land and integrated systems
- Methods of identifying process hazards(eq.HAZOP) and of assessing environmental impact, with qualification appropriate to the program level

RELATIONSHIP OF THE GRADUATE OUTCOMES TO GW (6)-Research

Research relationship to GW, 450 Scenario



Share of abatement %	2020	2030
Efficiency	65	57
End-use	*59*	*52*
Power plants	*6*	*5*
Renewables	18	20
Biofuels	1	3
Nuclear	13	10
CCS	3	10

Efficiency measures account for two-thirds of the 3.8 Gt of abatement in 2020, with renewables contributing close to one-fifth (IEA)

RELATIONSHIP OF UNIVERSITIESTO GW (1)- Service to community

- Leading society to a low carbon, less auto-dependent and circular production economy fits squarely into educational, research, and public service missions of higher education (HE) – to provide the knowledge and the graduates to create a thriving and civil society.
- No other institution in society has the influence, the critical mass and the diversity of skills needed to successfully reverse GW
- Getting to climate neutrality may be the hardest thing that modern society will ever attempt. GW-ACUPCC

RELATIONSHIP OF UNIVERSITIES TO GW (2)- Service to community

- New technologies, economic instruments and a whole host of strategies for which the research capability of HE is crucial.
- Dealing with population, consumption and social equity is bigger than the Marshall Plan, the Apollo project, the Manhattan project and the attempt to eradicate cancer – combined.
- It will take great vision, leadership, research and becoming a model for society by HE

  (GW-ACUPCC)

WHAT ARE UNIVERSITIES DOING ABOUT GW (1)

Where does HE stand with regard to GW?

- The current (HE) system is (unwittingly) reinforcing the current unhealthy, inequitable, and unsustainable path that society is pursuing (Micheal Crow, ASU president, 2007)
- Urgent need for change in HE!

WHAT ARE UNIVERSITIES DOING ABOUT GW (2)

What's Happening @university campuses on educational side

- Exponential growth in distinct programs related to *environmental dimension of* sustainability in HE in the last decade.
- Exciting environmental studies and graduate programs in every major scientific, engineering and social science disciplines, business, law, public health, ethics and religion are abundant and growing. Progress on modeling sustainability has grown at an even faster rate,

WHAT ARE UNIVERSITIES DOING ABOUT GW (2)

What's Happening @university campuses on educational side

- In last few years, HE programs for energy and water conservation, renewable energy, waste minimization and recycling, green buildings and purchasing, alternative transportation, local and organic food growing and purchasing at a rate of increase unmatched by any other sector.
- HE is the largest user of wind power for electricity in the US.

WHAT ARE UNIVERSITIES DOING ABOUT GW (3)

What's Happening @ university campuses on student side

Student environmental movement most well organized, largest and most sophisticated student movement since 1960's.

These efforts have largely been distinct programs that are helping to *begin the cultural shift to making deep and comprehensive sustainability the goal of HE*.

WHAT ARE UNIVERSITIES DOING ABOUT GW (3)

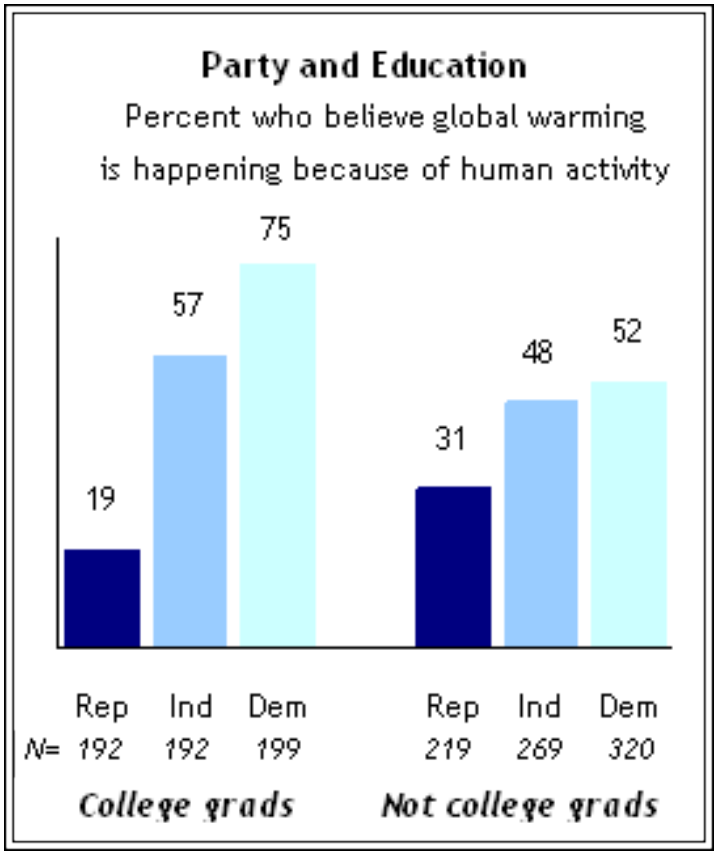
What's Happening @ university campuses on student side

Despite these efforts, overwhelming majority of graduates know little about importance of sustainability or how to lead their personal and professional lives aligned with sustainability principles.

Higher Education Leadership in Reversing Global Warming and Creating a Healthy, Just and Sustainable Society, *Presented at the Annual meetingof the Annapolis Group*, June 19, 2007,* Anthony D. Cortese, Sc.D.

DOES HE CHANGE OUR VİEW ON GW?

A Deeper Partisan Divide Over Global Warming , Pew Research Center, May 8, 2008



WHAT ARE UNIVERSITIES DOING ABOUT GW (4)

The American College & University Presidents Climate Commitment

- Dec 2006, 12 college and university presidents, working with the Association for the Advancement of Sustainability in Higher Education (AASHE), ecoAmerica and Second Nature, launched, *The American College & University Presidents Climate Commitment.*
- *ACUPCC is a high-visibility* effort to address GW by garnering institutional commitments to neutralize greenhouse gas emissions, and to accelerate the research and educational efforts of higher education to equip society to re-stabilize the earth's climate.

WHAT ARE UNIVERSITIES DOING ABOUT GW (4)

The American College & University Presidents Climate Commitment

- 12 presidents reached out to nearly 400 colleagues to join them as founding members of this effort.
- April of 2007 nearly 100 members of the Leadership Circle of Presidents
- At present nearly 300 signatories to ACUPCC representing over 2 million students (nearly 15% of the US student population).

WHAT ARE UNIVERSITIES DOING ABOUT GW (5)- Presidents'commitment

- Convene all parts of a college or university to address education, research and operational changes to combat GW.
- Declaring HE is ready and able to take on the challenge, and are leveraging their positions to call for change at the highest policy levels.
- Committing to transforming their own campuses – small cities unto themselves – and sharply reducing and eventually eliminating their emissions that contribute to climate change.
- Leadership-by-example by a multitude of schools will drive industry, government and other sectors of society to move towards a more sustainable future.

WHAT ARE UNIVERSITIES DOING ABOUT GW (5)-presidents' commitment

- Universities' powerful direct effect – beyond the impact of any research or policy work by individual institutions – of driving industry, government and other sectors of society to develop the technological and economic revolution that society needs.
- GW requires global solutions of an unparalleled nature. Continued individual contribution by HE institutions is not sufficient for the size and scale of challenge and the rapid timeframe for action that is necessary

WHAT ARE UNIVERSITIES DOING ABOUT GW (6)-Expectations from Universities

- Create a comprehensive institutional action plan to move towards climate neutrality.
- Completing a greenhouse gas emissions inventory within one year
- Within two years, setting a target date and interim milestones for becoming climate neutral.

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WHAT ARE UNIVERSITIES DOING ABOUT GW (7)-Expectations from Universities

- Taking immediate steps to reduce greenhouse gas emissions by choosing from a list of short- term actions.
- Making sustainability an integral part of the curriculum and educational experience all students.
- Making the action plan, inventory and progress reports publicly available.

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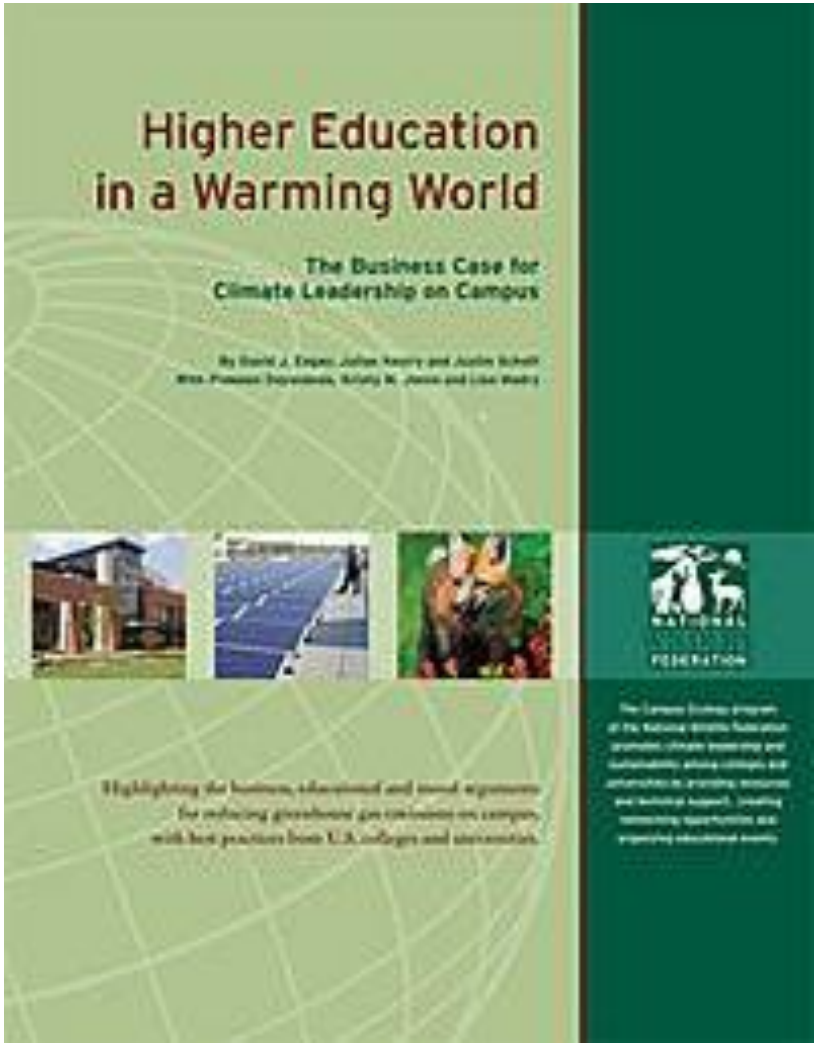
WHAT ARE UNIVERSITIES DOING ABOUT GW (1)- Commitments

- In the short term, each President is committing to immediately taking *two or more of the following* concrete actions:
  - Purchasing 15% of electricity from renewable sources;
  - Adopting U.S. Green Building Council's LEED Silver green standards or equivalent for new buildings;
  - Requiring ENERGY STAR certification for products purchased by the institution;

WHAT ARE UNIVERSITIES DOING ABOUT GW (2)

- In the short term, each President is committing to immediately taking *two or more of the following* concrete actions:
  - Offsetting emissions due to air travel;
  - Providing access to public transportation;
  - Participating in waste minimization program of Recyclemania
  - Supporting climate and sustainability shareholder proposals through their endowment.

WHAT ARE UNIVERSITIES DOING ABOUT GW (3)



WHAT ARE UNIVERSITIES DOING ABOUT GW (4)

- **Higher Education in a Warming World**
- ***Higher Education in a Warming World* - *The Business Case for Climate Leadership on Campus***
- ***Highlighting the business, educational, and moral arguments for reducing greenhouse gas emissions on campus, with best practices from U.S. colleges and universities***
- By David J. Eagan, Julian Keniry and Justin Schott with Praween Dayananda, Kristy Jones and Lisa Madry
- This richly detailed guide to climate action at colleges and universities focuses on the numbers -- with examples showing how schools cut emissions, saved money and made a difference. It gives how-to steps for conducting an inventory, creating a plan and leading toward a sustainable future.

WHAT ARE UNIVERSITIES DOING ABOUT GW (5)

- **What Climate Science Tells Us**
- The 2% per year path; 80% emissions reduction by 2050
- **Higher Education and the Case for Climate Action**
- U.S. higher education: Size, economics and values
- Campus climate footprint: Built space & GHG emissions
- Opportunities for the future: Return on investment, New majors & careers, Increased security
- **Stepping Up: Strategies for Climate Action**
- Establishing institutional commitment
- Building a climate action team
- Conducting a greenhouse gas inventory
- Developing and implementing a climate action plan

WHAT ARE UNIVERSITIES DOING ABOUT GW (6)

- **Implementing Climate Action Solutions**
  With case examples on: Energy efficiency, Renewable energy, Fuel switching & cogeneration, Green buildings, Transportation, Renewable energy credits, Campus habitat, Behavior change, Top 5 for a Fast Start.
- **Financing Climate Action**
  Including: Performance contracts, Student self-assessed fees, Revolving loan funds, Endowments, and more.
- **Becoming a *Campus Climate Champion***
- **Campus Ecology...It takes a big step to make a smaller footprint.**
- Get the full report: ***Higher Education in a Warming World - The Business Case for Climate Leadership on Campus***

CONCLUDING REMARKS

- **Energy utilization according to reference scenario is to result in acute GW and lead to catastrophe**
- **450 Scenario may curb heating to controllable levels of below 2 C warming by 2030**
- **Student outcomes stated in all types of engineering accreditation systems has relevant clauses, graduates should be followed by professional exam**
- **Many HE institutions all over the world are taking part in GW preventative movements in education, research and implementation (administration, students and publications) but further changes and efforts are needed**

ACKNOWLEDGEMENTS

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