



European Geosciences Union



GIFT - 2010

Energy and Sustainable Development

*Geosciences Information for Teachers Workshop
Vienna, Austria, 2-5 May 2010*

European Geosciences Union
GEOFYSICAL INFORMATION FOR TEACHERS (GIFT) WORKSHOP
Austria Center Vienna
2-5 May, 2010

Dear Teacher,

Welcome to the 8th GIFT workshop on the theme of « Energy and Sustainable development »!

Energy is one of the great challenges for our society. New policies on energy will require important choices. This is particularly true with the relatively recent realization of the environmental problems that each form of energy may create. Therefore, for an objective comparison of the different means of energy production, it is necessary to examine the advantages and the drawbacks for each energy form.

To achieve these objectives, the GIFT-2010 workshop, after an initial general conference on global energy perspectives, will comprise 3 different thematic groups of presentations all given by leading experts in the field.

The first theme will address the « classical » coal, oil and nuclear energy production sources, with emphasis on their future evolutions. The second theme will offer an overview of renewable wind, solar and tidal energy sources, with hands-on activities particularly related to eolian energy. The final theme will be dedicated to renewable energy and sustainable development education in secondary schools, which may be the most effective way to inform future adults and future decision makers.

A visit to the United Nations Office for Outer Space Affairs, through the courtesy of Werner Balogh, Hans Haubold and Niklas Hedman will mark the end of the workshop.

Before we get « officially » started, you are in for a very special treat: our traditional visit to the Museum of Natural History, through the courtesy of Mathias Harzhauser and Herbert Summesberger. This year it will include the new “Biology” exposition. Following our tour, we will distribute documents and have a small reception in the museum cafe. Furthermore, Herbert will lead a geological excursion on Wednesday afternoon after GIFT-2010 is officially over!

This year, for the first time, we have organized two new activities:

- 1) A “round table discussion” at the end of the first theme which will permit the teachers to ask specific questions to the speakers. Do not hesitate to ask questions -showing your interest is the best way to thank the speakers for addressing you in this workshop!
- 2) A specific Educational Session, open to all the participants in the EGU General Assembly: EOS2- Science in tomorrow’s classroom, convened the EGU Committee on Education. This poster session will take place on Tuesday afternoon from 17:30 to 19:00. Many of you have submitted abstracts for presentations of your own work. We encourage ALL OF YOU to attend the session, look at the posters, ask questions, meet colleagues from around the world and learn through the exchange of professional experience!

We hope that you will take seriously the GIFT agreement we have asked you to endorse. The GIFT workshop is kindly sponsored by several science organizations. We would like to continue offering teachers the opportunity to attend GIFT and similar workshops, but this depends upon us being able to show our sponsors that teachers have used the new GIFT information and science didactics in their daily teaching, or as inspiration for new ways to teach science to students in their schools.

Therefore, we ask you 1. to fill out the evaluation forms as soon as possible and send them back to us as well as 2. make a presentation of your experiences at GIFT to a group of your teaching colleagues sometime after you return from EGU, and 3. send us reports and photographs about how you have used the GIFT information in your classrooms.

We also encourage you to write reports on the GIFT workshop in publications specifically intended for geosciences teachers.

Information on past and future GIFT workshop is available on the EGU homepage. Look at <http://gift.egu.eu> where you can find the brochures (pdf) and also the slides of the different presentations given at the GIFT workshops for the last 6 years. Beginning in 2009, we have also included web-TV presentations, which may be freely used in your classrooms.

Also, look at “The Eggs”, the EGU newsletters also on the EGU homepage. Kostas Kourtidis, the editor of the newsletter invites all teachers to look at: <http://www.the-eggs.org/> with a dedicated education column, where you can write reports on your own work and submit them at <http://www.the-eggs.org/submit/> and also use the archive at <http://www.the-eggs.org/archive.php> to read about other teachers’ work!

We hope that you enjoy and learn during your time at the 8th GIFT workshop!

A handwritten signature in blue ink, reading "Carlo Laj". The signature is written in a cursive, flowing style.

Carlo Laj
On behalf of the Committee on Education of EGU

Acknowledgements

The GIFT-2009 workshop has been organized by the Committee on Education of the European Geosciences Union. EGU has supported the major share of the expenses, but the workshop has also benefited of the generous help of:



The European Space Agency



University of Bergen
Department of Earth Sciences



Total S.A.
La Defense, France



The Direction des Sciences de la Matière of the
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Areva, France



The Associazione per la Geofisica « Licio
Cernobori » in Trieste, Italy



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Academy of Sciences, China



CataGIFT, Generalitat de Catalunya, Agència de
Gestio d’Ajuts Universitaris i de Recerca, Barcelona,
Spain



The American Geophysical Union, USA



Fusion For Energy, Barcelona, Spain



Program O3E part of the ALCOTRA Intereg Programs



Westermann, Frankfurt, Germany

And we thank all the speakers who have contributed to this educational workshop and their institutions!

European Geosciences Union

Committee on Education

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Committee on Education



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Francesca Funicello



Jean-Luc Berenguer



Phil Smith

Program

European Geosciences Union - General Assembly
GEOSCIENCE INFORMATION FOR TEACHERS (GIFT) WORKSHOP
Austria Center Vienna

*Energy and Sustainable
Development*

Sunday May 2, 2010

16:30 - 18:30 **GUIDED TOUR OF THE VIENNA MUSEUM OF NATURAL HISTORY**
Herbert Summesberger and Mathias Harzhauser
Vienna Museum of Natural History

Distribution of documents & ice breaker reception

Monday May 3, 2010

Chairperson : Carlo Laj

08:15 - 08:30 **WELCOME !**
Tujia Pulkkinen
President EGU

PRACTICAL INSTRUCTIONS FOR THE WORKSHOP
Carlo Laj
EGU Committee on Education
Laboratoire des Sciences du Climat et de l'Environnement
Gif-sur-Yvette, France

08:30 – 09:15 **ENERGY PERSPECTIVES 2020/2030**
Didier Houssin
Directorate of Energy Markets and Security
International Energy Agency
Paris, France

09:15 – 10:00 **ENERGY CHALLENGES : A VIEW FROM TOTAL**
Jean-François Minster
Senior Vice President
Scientific Development
Total, France

10:00 – 10:30 COFFEE BREAK

- 10:30 – 11:15 **PROSPECTS AND CONDITIONS FOR A WORLD NUCLEAR
« RENAISSANCE »**
Bertrand Barré
AREVA
Paris, France
- 11:15 – 12:00 **NUCLEAR FUSION : ONE ENERGY OPTION FOR THE FUTURE**
Federico Casci
Fusion for Energy
Barcelona, Spain

12:00 – 13:30 LUNCH (SANDWICHES)

Monday May 3, afternoon

Chairperson: Eve Arnold

- 13 :30 - 14 :15 **CLEAN COAL TECHNOLOGIES**
Jürgen Ilse
German Hard Coal Association
Herne, Germany

- 14:15 – 15 :00 **CO₂ STORAGE**
Michael Kühn
Potsdam, Germany

15 :00– 15 :30 COFFEE BREAK

- 15 :30 - 16 :30 **ROUND TABLE**
QUESTIONS ON ENERGY TO OUR SPEAKERS
D. Houssin, J.-F. Minster, B. Barré, F. Casci, J. Ilse, M. Kühn
Moderator : C. Laj

TEACHER-TO-TEACHERS PRESENTATIONS

- 16 :35 - 17 :00 **TIDAL ENERGY IN EASTERN CANADA: THE BAY OF FUNDY**
Steve Wohlmuth
Central Kings Rural High School
Nova Scotia, Canada
- 17 :00 – 17 :15 **CAN ELECTRIC CARS REDUCE THE ENERGY CONSUMPTION AND
THE CO₂ EMISSIONS OF OUR SOCIETY? WHAT CAN WE EXPECT?
(A SCHOOL PROGRAM)**
Albert Jaros
BRG 16, Wien
- 17 :30- 18 :00 **THE EARTH OBSERVATION PROGRAMME OF ESA
EDUCATIONAL TOOLS FOR SCHOOLS**
Francesco Sarti
ESA – ESRIN
Frascati, Italy

Tuesday, May 4, 2010

Chairperson : Angelo Camerlenghi

08:30 – 09:15	THE BIOFUELS DELUSION Mario Giampietro Universitat Autònoma de Barcelona Spain
9:15 – 10:00	SPACE FOR SUSTAINABLE DEVELOPMENT Pierre-Philippe Mathieu ESA-ESRIN Frascati, Italy
10:00 – 10:15	COFFEE BREAK
10:30 - 11 :15	WIND ENERGY Charlotte Hasager RISOE – DTU Denmark
11 :15 - 12 :00	SOLAR POWER: PHOTOVOLTAIC SYSTEMS FOR A VARIETY OF APPLICATIONS. Christian Hinsch Juwi Holding AG • Wörrstadt Germany
12 :00- 13 :30	LUNCH
13 :30 – 15 :00	HANDS-ON ACTIVITIES Charlotte Hasager et al. In 4 splinter rooms
15 :00 - 15 :30	COFFEE BREAK
15 :30 – 18 :00	VISIT POSTER SESSION EOS2 AND EXPOSITIONS

Wednesday May 5, 2010

Chairperson Annegret Schwarz

08:30 - 09:15	"UN-DECADE ESD (2005-2014) - RESULTS AND PERSPECTIVES AFTER THE FIRST FIVE YEARS" Gerhard de Haan Freie Universität Berlin Germany
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Christine Künzli & Franziska Bertschy
Fachhochschule Nordwestschweiz Solothurn,
Universität Bern, Switzerland

10:15 – 10:30

COFFEE BREAK

11 :00 – 12 :30

**VISIT TO THE UNITED NATION OFFICE FOR OUTER SPACE
AFFAIRS (UNOOSA)**

Werner Balogh, Hans Haubold, Niklas Hedman

12 :30

LUNCH and *GOODBYE* !

Speakers



Standing on each side of the bronze elephant (an artwork of the Viennese artist Gottfried Kumpf) in front of the entrance, our two hosts for the visit to the Vienna Museum of Natural History :

Mathias Harzhauser, on the left, Head of the Department of Geology and Palaentology, has earned his degrees from the University of Vienna and has been employed by the NHM after his Master's thesis. His PhD thesis deals with the « Paleooceanography of the Oligocene and Lower Miocene Gastropoda of the Eastern Mediterranean and the Western Indo-Pacific.

Herbert Summesberger, on the right, has earned his degrees from the University of Vienna. His PhD thesis deals with structural geology, stratigraphy and palaentology in the Northern Calcareous Alps. He has organized several international symposia and is the leader of the Working Group on Geosciences, School and Public Relations of the Austrian Geological Society. Retired since 2004, he is a member of the Board of the Friends of the Museum of Natural History, and organizes exhibitions and seminars for High School teachers. He has also written highschool books and a Vienna city guide for building and decoration stones.



The Museum of Natural History was established during the years 1872 to 1889 by emperor Franz Joseph I. In 1758 Francis Stephen of Lorraine, the husband of Maria Theresia bought the world's most famous natural history collection at his time from Johann Ritter von Baillou and is celebrated as the founder of the museum's collections. This was the basis of one of the largest Natural History Museums of the world equally important as a centre of natural sciences as well as a cornerstone of national education.

The Geological and Palaentological Department has about 20 millions of fossils in its scientific collections, only a small part of them is on display in the exhibition halls. Most important exhibits in the halls are the largest turtle of the world, a fine pterosaur collection and the famous collection of eocene fish from Bolca near Verona (Italy).

Also remarkable is the collection of the Department of Mineralogy and Petrology including famous gemstones and Austrian minerals from the « Hohen Tauern ». The most important specimen on display is the bouquet of flowers made of more than thousand diamonds and an equal number of coloured gemstones. Three easter eggs are made of topaze an citrine by Carl Fabergé, the Russian czar's jeweller. The meteorite collection including a 900 kg iron meteorite from Australia is among the most celebrated in the world. On display is also a piece of rock brought back from the moon by Apollo 17 astronauts.

In the Department of Prehistory several rooms are dedicated to excavations from Austria, dating from the Stone Age to the Early Middle Ages. One of the jewels is the world-famous statuette of the « Venus of Willendorf » dating from about 25,000 years B.C.

Address: 1, Maria-Theresien-Platz - Vienna 1010



Didier Houssin

Director
Directorate of Energy Markets and Security
International Energy Agency, Paris

Didier Houssin was appointed Director at the International Energy Agency on 16 July 2007. Since September 1st, he has been in charge of the Directorate of Energy Markets and Security.

Didier Houssin, a French national, was Managing Director of BRGM, the French Geological Survey, since 2004 where he had extensive management responsibilities over the 850-strong group. Among other matters, he has been involved at BRGM in carbon capture and sequestration and in geothermal energy.

Prior to joining BRGM, Didier Houssin was the former Director of Energy and Mineral Resources in the French Ministry of Economy between 1997 and 2004. In this capacity, he was the French delegate to many activities of the IEA, notably as Chair of the Standing Group on Emergency Questions at the time of preparation of emergency action plans in 2003 and as a member of three country studies' in-depth review teams.

He was also seconded for three years to Total from 1987 to 1990, where he dealt in particular with European energy matters. He also had several positions in the French Ministry of Industry dealing with financial and European affairs.

Didier Houssin graduated from the Ecole Nationale d'Administration and has a Masters in International Law. He also has Degrees in Philosophy from Université de Paris 1 - la Sorbonne and in Political Science from the Institut d'Etudes Politiques de Paris.

Energy Perspectives 2020/2030

Didier Houssin

Director,
Directorate of Energy Markets and Security
International Energy Agency, Paris

The past 18 months have seen enormous upheavals in energy markets around the world, yet the challenges of transforming the global energy system remain urgent and daunting. The global financial crisis and ensuing recession have had a dramatic impact on the outlook for energy markets, particularly in the next few years. World energy demand in aggregate has already plunged with the economic contraction; how quickly it rebounds depends largely on how quickly the global economy recovers. Countries have responded to the threat of economic melt-down as a result of the financial crisis with prompt and co-ordinated fiscal and monetary stimuli on an unprecedented scale. In many cases, stimulus packages have included measures to promote clean energy with the aim of tackling an even bigger, and just as real, longterm threat — that of disastrous climate change.

How we rise to that challenge will have far-reaching consequences for energy markets. As the leading source of greenhouse-gas emissions, energy is at the heart of the problem and so must be integral to the solution.

The scale and breadth of the energy challenge is enormous — far greater than many people realise. But it can and must be met. The recession, by curbing the growth in greenhouse-gas emissions, has made the task of transforming the energy sector easier by giving us an unprecedented, yet relatively narrow, window of opportunity to take action to concentrate investment on low-carbon technology. Energy-related carbon-dioxide (CO₂) emissions in 2009 will be well below what they would have been had the recession not occurred.

Households and businesses are largely responsible for making the required investments, but governments hold the key to changing the mix of energy investment. The policy and regulatory frameworks established at national and international levels will determine whether investment and consumption decisions are steered towards low-carbon options. Accordingly, this Outlook presents the results of two scenarios: a Reference Scenario, which provides a baseline picture of how global energy markets would evolve if governments make no changes to their existing policies and measures; and a 450 Scenario, which depicts a world in which collective policy action is taken to limit the long-term concentration of greenhouse gases in the atmosphere to 450 parts per million of CO₂-equivalent (ppm CO₂-eq), an objective that is gaining widespread support around the world.

Global energy use is set to fall in 2009 — for the first time since 1981 on any significant

scale — as a result of the financial and economic crisis; but, on current policies, it would quickly resume its long-term upward trend once economic recovery is underway. In our Reference Scenario, world primary energy demand is projected to increase by 1.5% per year between 2007 and 2030, from just over 12 000 million tonnes of oil equivalent (Mtoe) to 16 800 Mtoe — an overall increase of 40%. Developing Asian countries are the main drivers of this growth, followed by the Middle East. Projected demand growth is slower than in WEO-2008, reflecting mainly the impact of the crisis in the early part of the projection period, as well as of new government policies introduced during the past year. On average, demand declines marginally in 2007-2010, as a result of a sharp drop in 2009 — preliminary data point to a fall in that year of up to 2%. Demand growth rebounds thereafter, averaging 2.5% per year in 2010-2015. The pace of demand growth slackens progressively after 2015, as emerging economies mature and global population growth slows.

Fossil fuels remain the dominant sources of primary energy worldwide in the Reference Scenario, accounting for more than three-quarters of the overall increase in energy use between 2007 and 2030. In absolute terms, coal sees by far the biggest increase in demand over the projection period, followed by gas and oil. Yet oil remains the single largest fuel in the primary fuel mix in 2030, even though its share drops, from 34% now to 30%. Oil demand (excluding biofuels) is projected to grow by 1% per year on average over the projection period, from 85 million barrels per day in 2008 to 105 mb/d in 2030. All the growth comes from non-OECD countries: OECD demand actually falls. The transport sector accounts for 97% of the increase in oil use. As conventional oil production in countries not belonging to the Organization of the Petroleum Exporting Countries (OPEC) peaks around 2010, most of the increase in output would need to come from OPEC countries, which hold the bulk of remaining recoverable conventional oil resources.

The main driver of demand for coal and gas is the inexorable growth in energy needs for power generation. World electricity demand is projected to grow at an annual rate of 2.5% to 2030. Over 80% of the growth takes place in non-OECD countries. Globally, additions to power-generation capacity total 4 800 gigawatts (GW) by 2030 — almost five times the existing capacity of the United States. The largest additions (around 28% of the total) occur in China. Coal remains the backbone fuel of the power sector, its share of the global generation mix rising by three percentage points to 44% in 2030. Nuclear power output grows in all major regions bar Europe, but its share in total generation falls.

The use of non-hydro modern renewable energy technologies (including wind, solar, geothermal, tide and wave energy, and bio-energy) sees the fastest rate of increase in the Reference Scenario. Most of the increase is in power generation: the share of non-hydro renewables in total power output rises from 2.5% in 2007 to 8.6% in 2030, with wind power seeing the biggest absolute increase. The consumption of biofuels for transport also rises strongly. The share of hydropower, by contrast, drops from 16% to 14%.

Energy investment worldwide has plunged over the past year in the face of a tougher financing environment, weakening final demand for energy and lower cash flow. All

these factors stem from the financial and economic crisis.

In the oil and gas sector, most companies have announced cutbacks in capital spending, as well as project delays and cancellations, mainly as a result of lower cash flow. Power sector investment is also being severely affected by financing difficulties, as well as by weak demand, which is reducing the immediate need for new capacity additions.

Falling energy investment will have far-reaching and, depending on how governments respond, potentially serious consequences for energy security, climate change and energy poverty. Any prolonged downturn in investment threatens to constrain capacity growth in the medium term, particularly for long lead-time projects, eventually risking a shortfall in supply. This could lead to a renewed surge in prices a few years down the line, when demand is likely to be recovering, and become a constraint on global economic growth. These concerns are most acute for oil and electricity supplies. Any such shortfalls could, in turn, undermine the sustainability of the economic recovery. Weaker fossil-fuel prices are also undermining the attractiveness of investments in clean energy technology (though recent government moves to encourage such investment, as part of their economic stimulus packages, are helping to counter this effect). Cutbacks in energy-infrastructure investments also threaten to impede access by poor households to electricity and other forms of modern energy.

The financial crisis has cast a shadow over whether all the energy investment needed to meet growing energy needs can be mobilised. The capital required to meet projected energy demand through to 2030 in the Reference Scenario is huge, amounting in cumulative terms to \$26 trillion (in year-2008 dollars) — equal to \$1.1 trillion (or 1.4% of global gross domestic product [GDP]) per year on average. The power sector requires 53% of total investment. Over half of all energy investment worldwide is needed in developing countries, where demand and production are projected to increase fastest. With little prospect of a quick return to the days of cheap and easy credit, financing energy investment will, in most cases, be more difficult and costly in the medium term than it was before the crisis took hold.

Continuing on today's energy path, without any change in government policy, would mean rapidly increasing dependence on fossil fuels, with alarming consequences for climate change and energy security. The Reference Scenario sees a continued rapid rise in energy-related CO₂ emissions through to 2030, resulting from increased global demand for fossil energy.

Having already increased from 20.9 gigatonnes (Gt) in 1990 to 28.8 Gt in 2007, CO₂ emissions are projected to reach 34.5 Gt in 2020 and 40.2 Gt in 2030 — an average rate of growth of 1.5% per year over the full projection period. In 2020, global emissions are 1.9 Gt or 5% lower than in the Reference Scenario of WEO2008. The economic crisis and resulting lower fossil-energy demand growth account for three-quarters of this improvement, while government stimulus spending to promote low-carbon investments and other new energy and climate policies account for the remainder.

Non-OECD countries account for all of the projected growth in energy-related CO₂ emissions to 2030. Three-quarters of the 11-Gt increase comes from China (where emissions rise by 6 Gt), India (2 Gt) and the Middle East (1 Gt). OECD emissions are projected to fall slightly, due to a slowdown in energy demand (resulting from the crisis in the near term and from big improvements in energy efficiency in the longer term) and the increased reliance on nuclear power and renewables, in large part due to the policies already adopted to mitigate climate change and enhance energy security. By contrast, all major non-OECD countries see their emissions rise. However, while non-OECD countries today account for 52% of the world's annual emissions of energy-related CO₂, they are responsible for only 42% of the world's cumulative emissions since 1890.

These trends would lead to a rapid increase in the concentration of greenhouse gases in the atmosphere. The rate of growth of fossil-energy consumption projected in the Reference Scenario takes us inexorably towards a long-term concentration of greenhouse gases in the atmosphere in excess of 1 000 ppm CO₂-eq. The CO₂ concentration implied by the Reference Scenario would result in the global average temperature rising by up to 6°C. This would lead almost certainly to massive climatic change and irreparable damage to the planet.

The Reference Scenario trends also heighten concerns about the security of energy supplies. While the OECD imports less oil in 2030 than today in the Reference Scenario, some non-OECD countries, notably China and India, see big increases in their imports. Most gas-importing regions, including Europe and developing Asia, also see their net imports rise. The Reference Scenario projections imply an increasingly high level of spending on energy imports, representing a major economic burden for importers. Oil prices are assumed to fall from the 2008 level of \$97 per barrel to around \$60 per barrel in 2009 (roughly the level of mid-2009), but then rebound with the economic recovery to reach \$100 per barrel by 2020 and \$115 per barrel by 2030 (in year-2008 dollars). As a result, OECD countries as a group are projected to spend on average close to 2% of their GDP on oil and gas imports to 2030. The burden is even higher in most importing non-OECD countries. On a country basis, China overtakes the United States soon after 2025 to become the world's biggest spender on oil and gas imports (in monetary terms) while India's spending on oil and gas imports surpasses that of Japan soon after 2020 to become the world's third-largest importer. The increasing concentration of the world's remaining conventional oil and gas reserves in a small group of countries, including Russia and resource-rich Middle East countries, would increase their market power and ability to influence prices.

Expanding access to modern energy for the world's poor remains a pressing matter. We estimate that 1.5 billion people still lack access to electricity — well over one-fifth of the world's population. Some 85% of those people live in rural areas, mainly in Sub-Saharan Africa and South Asia. In the Reference Scenario, the total number drops by only around 200 million by 2030, though the number actually increases in Africa. Expanding access to modern energy is a necessary condition for human development. With appropriate policies, universal electricity access could be achieved with additional annual investment worldwide of \$35 billion (in year-2008 dollars) through to 2030, or just 6% of the power-

sector investment projected in the Reference Scenario. The accompanying increase in primary energy demand and CO₂ emissions would be very modest.

Although opinion is mixed on what might be considered a sustainable, long-term level of annual CO₂ emissions for the energy sector, a consensus on the need to limit the global temperature increase to 2°C is emerging. To limit to 50% the probability of a global average temperature increase in excess of 2°C, the concentration of greenhouse gases in the atmosphere would need to be stabilised at a level around 450 ppm CO₂-eq. We show how this objective can be achieved in the 450 Scenario, through radical and co-ordinated policy action across all regions. In this scenario, global energy-related CO₂ emissions peak at 30.9 Gt just before 2020 and decline thereafter to 26.4 Gt in 2030 — 2.4 Gt below the 2007 level and 13.8 Gt below that in the Reference Scenario.

The reductions in energy-related CO₂ emissions required in the 450 Scenario (relative to the Reference Scenario by 2020 - just a decade away - are formidable, but the financial crisis offers what may be a unique opportunity to take the necessary steps as the political mood shifts. At 30.7 Gt, emissions in 2020 in the 450 Scenario are 3.8 Gt lower than in the Reference Scenario. With a new international climate policy agreement, a comprehensive and rapid transformation in the way we produce, transport and use energy - a veritable lowcarbon revolution - could put the world onto this 450-ppm trajectory.



Jean-François Minster

Senior Vice President Scientific Development,
Total

CAREER

1973: Engineer Ecole Polytechnique

1979: Docteur d'Etat-ès-Sciences Physiques. Institut de Physique du Globe de Paris (Geochemistry and Cosmochemistry Laboratory).

1980-1981: Post-doc Fellow Physical Oceanography, Department of Earth and Planetary Sciences MIT (USA).

1981: Creation and Direction of Physics and Chemistry of Hydrosphere Laboratory (Paris)

Summer 1982: Invited Scientist at Lamont-Doherty Geological Observatory of Columbia University (USA).

1985-1996: Creation and direction of Geophysics and Oceanography Laboratory (Toulouse)

July 1986: Visiting scholar, Woods Hole Oceanographic Institution (USA), July 1986.

1990-1996: Director of Institut of Earth Sciences, University Paul Sabatier (Toulouse)

1996-2000: Director of Institut National des Sciences de l'Univers (INSU) and Département des Sciences de l'Univers of CNRS

2000-2005: Chairman of the board and Executive Director of Institut Français de Recherche pour

l'Exploitation de la Mer (IFREMER)

2005-2006: General Science Manager (CNRS)

2006 - : Senior Vice President Scientific Development (Total)

RESEARCH

Chronology of meteorites and the formation of the solar system

Inverse problems of trace elements in magmatic series

Chemical geodynamics

Deep Ocean Hydrothermalism

Ocean cycle of trace metals and carbon

Ocean circulation and satellite altimetry

Monitoring and dynamics of ice caps using satellite techniques
90 referred publications – 3 books – about 100 general audience publications
Supervisor of 22 thesis

TEACHING

1982-1995: Assistant Professor in Ecole Polytechnique (Paris)
1985-1996: Professor in University Paul Sabatier (Toulouse) (Physics, Geophysics, Geochemistry, Oceanography)

ANIMATION

Director of a 60-person laboratory during 11 years
Director of a 130-person Institute during 6 years
Director of a 7000-person Department during 3,5 years (INSU)
Chairman and Chief executive officer of a 2000-person Institute during 5 years (Ifremer)
General Science Manager of 31,000-person organisation during 1 year (CNRS)
Numerous National and International Science committees

DISTINCTIONS

"John Davis Budhue" fund of the Meteoritical Society, 1976
Clarke Medal of the American Geochemical Society, 1982
Member of Academia Europea since 1988
"Group Achievement Award" of NASA, 1993, 1994
Médaille d'Argent du CNRS, 1993
Prix du Général Muteau, Académie des Sciences, Institut de France, 1994
Chevalier dans l'Ordre National du Mérite, 1995
Grand Prix de l'Académie de l'Air et de l'Espace, 1996
Correspondant of Académie des Sciences since 1997
Fridjof Nansen Medal of European Geophysical Society, 1998
William T. Pecora Prize (NASA) for Topex-Poséidon, 1998
Prize Dargelos of Ecole Polytechnique, 1999
Member of Académie des Technologies since 2000
Légion d'Honneur, 2003

R&D at Total: Thinking the Energy future

Jean-François Minster

Senior Vice President, Scientific Development,
Total A.C.

R&D at Total is based on visions on the energy future that rely on three elements:

- World energy demand will continue to increase because of the needs of an increasing population, of emerging economies and of the well-being of the poor populations; reduction of energy consumption linked to slow-down of economies, as has happened during the world economic crisis, is not a solution.
- Climate change issues imply a change of the energy mix, accelerated progress in energy efficiency and the development of carbon capture and sequestration for concentrated sources of CO₂; this transformation requires massive investment efforts and necessarily requires long, decadal, timescales.
- Contribution of fossil energies will remain dominant in the energy mix for the next two decades, despite the fact that oil production should reach a ceiling of less than 100 Mbb/day near 2020.

To address these issues, Total R&D is continuously increasing its effort with six objectives:

- Knowledge, tools and competences for discovery and optimal exploitation of technologic oil and gas resources *to satisfy world energy demand*.
- Development and industrialization of solar and biomass renewable energies, and carbon capture and sequestration *to transform the world energy mix*.
- Development of innovative and market competitive products that take into account improved energy efficiency for our customers, a reduction of their environmental impact and toxicity, and an easier life cycle management, *aiming to the replacement of present products by improved ones, and to the satisfaction of new markets*.
- Development and industrialization of processes for oil, gas, biomass and coal transformation, in order to cope with the *evolution of resources and the market, to improve reliability, security and energy efficiency, to reduce environmental impacts, and to enhance economic margins*.
- Understanding and measurement of the impact of the Group activity on water, air, soil, biodiversity and the ecosystems, aiming to *satisfy regulations, improve environmental security, and to evolve toward sustainability*.
- Development of competences on advanced technologies (biotechnologies, nanotechnologies, high performance computing, information and communication technologies, analytical techniques), aiming to their *rapid and early introduction in the Group activities*.



Bertrand Barré
Scientific Advisor

AREVA
Paris, France

Bertrand Barré is Scientific Advisor to the Chairperson of the AREVA group, and Professor Emeritus of nuclear engineering at the French « Institut National des Sciences et Techniques Nucléaires », INSTN.

Born in December 1942, B. Barré joined the French Atomic Energy commission, CEA, in 1967 and has been working ever since, both in France and abroad, for the development of Nuclear Power.

Alternating scientific and managerial positions, Mr Barré was notably Nuclear Attaché at the French Embassy in Washington (USA), Director of Engineering in TECHNICATOME (now AREVA-TA), Director of the Nuclear Reactor Directorate of the CEA and Vice-president in charge of R&D in COGEMA (now AREVA-NC).

Bertrand Barré is Past President of the European Nuclear Society (ENS) and of the International Nuclear Societies Council (INSC), and Immediate Past-Chairman of the International Nuclear Energy Academy (INEA).

Bertrand Barré was the first Chairman of SAGNE, the Standing Advisory Group on Nuclear Energy advising the Director General of IAEA, and has been a Member of EURATOM Scientific & Technical Committee since 1995.

Prospects and conditions for a world nuclear « Renaissance »

Bertrand Barré

AREVA, Paris
France

1. Present status of nuclear power (440 power plants in 30 countries producing 15% of the world electricity. Two decades of fast growth followed by two decades of slow growth or stagnation)
2. A changing context (geopolitics of fossil fuels, needs of the emerging countries, concern for climate change) triggering a significant change of mood in many countries (USA, UK, Italy, Sweden but also Middle East, etc.), dubbed “renaissance” in the press.
3. Public opinions remain cautious at best
4. For the “renaissance” to materialize, there are conditions to be met:
 - a. Economics vs fossil sources
 - b. Prevention of severe accidents (Generation III)
 - c. Acceptable management of spent fuel/HLW
 - d. No rampant proliferation
5. If renaissance does materialize, uranium availability will become a concern and lead to a change in reactor technology (Generation IV)



Federico Riccardo Casci

Head, Project Office
Fusion for Energy

Barcelona, Spain

- Degree in Mechanical Engineering at the Politecnico of Milan (Italy) in 1982;
- Currently working as the Head of the Project Office at Fusion for Energy (Barcelona, Spain), the agency in charge of the European in-kind contribution to the ITER project. He is responsible for activities such as project and configuration management, planning and quality assurance (2007 – to date);
- His past activities include:
 - Contribution to the preparation of the ITER site in Cadarache (France) in areas such as transport of large components, logistics, electrical power and water supplies and socio-economic studies (2005-2007);
 - Coordination and follow-up of the implementation for ITER-related technological tasks (2000-2002), coordination at a European level of Public Information (PI) incl. liaison with PI officers in the European Associations, the EU Commission and in European organizations (2000-2005) and support on machine assembly issues (2004-2005);
 - Responsible for the design integration of ITER internal components in liaison with the other ITER sites (1993 – 2000);
 - Responsible for the system integration of the proposed European fusion machine (NET) with activities in the integration of the components with configuration and interface control (1985-1993).
- His main fields of competence include:
 - Design and analysis of mechanical/nuclear fusion components;
 - Definition of interfaces in fusion machines and integration of components into the main device;
 - Implementation and follow-up of technology contracts in the areas of components design, remote handling, assembly, codes development and in other fields such as socio-economic studies, site implementation and quality assurance.
 - Dissemination of scientific information and interaction with target audiences on outreach and education on fusion and energy.
- He has been working for over 25 years in an international environment, including working closely with other European research institutions;
- European member of international study groups and workshop sessions, he has also participated in many international conferences in the field of fusion and energy;
- He is author of a large number of technical publications and contributions to scientific conferences (both fusion specific and energy-related).

Nuclear Fusion : One Energy Option for the future

Federico Riccardo Casci

Fusion for Energy – Barcelona / Spain

Fusion reactions power the sun by converting hydrogen into helium. In these reactions hydrogen mass is converted into energy, in accordance with Einstein's well-known $E=mc^2$ equation relating mass and energy. Hydrogen atoms in the sun and stars fuse under the extreme pressure of gravity.

On Earth achieving fusion reactions requires very high temperatures, for D-T fusion in the range 100 –150 million degrees. At such temperatures the gaseous fuel is completely ionised, forming a "plasma".

In principle, fusion is possible with many light elements. Among all reactions the fusion of deuterium (D) and tritium (T), i.e. D-T fusion, converting these two hydrogen isotopes into helium and neutrons, is the easiest to achieve and has been chosen for future fusion power plants.

Fusion offers the prospect of a fully sustainable energy source: it does not produce greenhouse gases, it is inherently safe, its fuel is abundant and available everywhere, and it is expected that the activated parts of a fusion plant can be recycled after approximately 100 years of storage. Fusion could enter the energy mix on a commercial basis in the second half of the century.

In an unprecedented international collaboration, the European Union (with Switzerland), India, Japan, the People's Republic of China, the Republic of Korea, the Russian Federation and the United States of America, have joined forces in the ITER project. The target of ITER is to produce 400-700 MW of fusion power. This device will be located in Cadarache (France) and its construction is due to last about 10 years. ITER will demonstrate the feasibility of fusion as an energy source, testing much of the technology needed for a full-scale reactor.

ITER follows from a very successful scientific and technological programme and provides a strong focus for the worldwide effort in the field. The specialised technologies required are being developed in close collaboration with industry. The ITER construction will foster industrial involvement, preparing for the transfer of fusion know-how.



Juergen Ilse

Head Environment and Energy

GVSt

Herne, Germany

Juergen Ilse is “head of Environment and Energy“ at Gesamtverband Steinkohle e. V. (GVSt, German Coal Association). GVSt is both an industry and employers’ association and represents the interests of its members in economic and social policy issues. In addition GVSt represents the interests with regard to coal utilisation.

Juergen Ilse studied mining engineering at RWTH Aachen University and received a degree as “diploma engineer”. This was followed by a two-year technical and legal training at the Chief Mines Inspectorate of North Rhine-Westphalia in Dortmund.

Mr. Ilse is responsible for the representation of the coal industry’s interests in the fields of environment and energy policies and the process of developing environmental legislation for Germany and the EU. For his economic sector he is in charge of producing the annual monitoring reports on preventive climate action and CO₂ emissions reduction. As co-author of the Federal Environment Agency’s National Inventory Report for the German Greenhouse Gas Inventory he is in charge of the chapter on “diffuse emissions (methane) from the coal industry“.

Coal reserves and resources as well as potentials for underground coal gasification in connection with carbon capture and storage (CCS)

Juergen Ilse

Head Environment and Energy,
GVSt (German Coal Association),
Herne, Germany

Coal is the energy source with the largest geological availability worldwide. Of all non-renewable energies coal and lignite accounting for 55 % of the reserves and some 76 % of the resources represent the largest potential. Reserves are those geological quantities of a mineral which can currently be mined under technically and economically viable conditions. Resources are those quantities which are either proven but currently not economically recoverable or quantities which can still be expected or explored on the basis of geological findings.

The global availability of energy source does not only depend on geological and economic factors. The technical availability, e.g. mining and preparation capacities, the sufficient availability of land and sea-borne transportation as well as transloading capacities and also a political availability are required likewise. The latter may be disturbed by domestic-policy disputes like strikes or unrest or by foreign-policy disputes like embargos, trade conflicts or even tensions and wars in the producing regions.

In the energy-economic discussion the reach of fossil primary energies plays a central role with the most important questions being: when will which energy source be exhausted, which impact will future developments have on the energy price, what does the situation of the other energies look like and which alternatives are there? The reach of coal can only be estimated because of the large deposits on the one hand and the uncertain future coal use and demand on the other. The stronger growth of population and the economic catching-up process in the developing and threshold countries will result in a shift of the production and demand centres in the global economy. However, also in case of further increases the geological potential will be sufficient to reliably cover the global coal demand for the next 100 years.

The conventional mining of seams at great depths or of thin seams reaches its technical and economic limits. However, these otherwise unprofitable coal deposits can be mined economically by means of underground coal gasification, during which coal is converted into a gaseous product in the deposit. The synthesis gas can be used for electricity generation, as chemical base material or for the production of petrol. This increases the usability of coal resources tremendously. At present the CCS technologies (carbon capture and storage) are a much discussed alternative to other CO₂ abatement techniques like efficiency improvements. The capture and subsequent storage of CO₂ in the deposits created by the actual underground gasification process seem to be technically feasible.



Michael Kühn

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Michael graduated from the Leibniz University of Hannover (Germany) in 1993 with a Diploma/MSc in Chemistry. From 1994 to 1996 he was PhD student at the University of Bremen at the Geochemical Institute. During 1997 and 1998 Michael was employed as a Research Scientist at the Alfred-Wegener-Institute for Polar and Marine Research (Bremerhaven, Germany).

From 1998 to 2003 he held the positions of Lecturer and Research Fellow at the Technical University of Hamburg-Harburg (Germany) in the Department of Water Management and Water Supply. He has been awarded a Higher Doctorate degree (Eng.D., Habilitation) based on his thesis "Reactive Flow Modeling of Hydrothermal Systems" in 2003.

During 2003 and 2005 Michael was employed as Research Scientist in the Computational Geoscience group of the division of Exploration and Mining at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Perth, Australia. During 2003 and 2005 Michael was Senior Research Scientist at the RWTH Aachen University in the department of Applied Geophysics and Geothermal Energy.

Starting in 2007 as Principal Research Scientist at the GFZ German Research Centre for Geosciences in Potsdam he is since 2009 Head of the Centre for CO₂ Storage at the GFZ.

Geological Storage of CO₂

Michael Kühn

GFZ German Research Centre for Geosciences, Potsdam, Germany

Carbon capture and storage (CCS) is considered to be one of the options, beside others, to mitigate climate change by reducing the amount of carbon dioxide (CO₂) released to the atmosphere. Part of the entire CCS chain is the geological storage of CO₂ which is briefly described in the following and discussed in detail during the GIFT course 2010.

Principle

After injection of CO₂ into an appropriate storage formation the fraction retained depends on a combination of physical and geochemical trapping mechanisms. Cap rocks above the storage formation, normally layers of shale and clay rock, physically block the upward migration of CO₂. Capillary forces retain CO₂ in the pore spaces of the reservoir rocks. So called geochemical trapping occurs as CO₂ reacts with the formation fluids and the host rocks. Dissolution of CO₂ into the formation brine occurs over time scales of hundreds of years resulting in a formation water with increased density which tend to sink rather than rise towards the surface. Over thousands of years CO₂ might even be converted into solid carbonates storing it on the long term.

Questions

Following the Intergovernmental Panel on Climate Change (IPCC 2005) the following questions arise and need to be answered with regard to geological storage of CO₂:

- What actually happens to CO₂ in the subsurface?
- How do we know what is happening?
- Can we monitor CO₂ once it is injected?
- What techniques are available for monitoring whether CO₂ is leaking?
- Is it possible to predict the long term storage of CO₂ in geological reservoirs?

Containment of CO₂ in the reservoirs

The fraction of CO₂ which needs to be retained in appropriate and managed geological reservoirs can be estimated from engineered and natural analogues. It is assumed that the amount of CO₂ retained in the storage reservoir is very likely to exceed 99 percent over 100 years and is likely to exceed 99 percent over 1,000 years (IPCC 2005). Studies are performed to come up with strategies of how to deal with non-permanent storage based on different approaches. As can be expected, results are specific and vary with the applied methods and assumptions. However, if CCS is to be acceptable as a mitigation measure, there must be an upper limit to the amount of leakage that is allowed to take place which can either be quantified by monitoring or modelling techniques.

There are two different types of leakage scenarios: (1) abrupt leakage, through injection well failure or leakage up an abandoned well, and (2) gradual leakage, through undetected faults, fractures or wells (Figure 1). These potential leakage pathways exist for the CO₂ itself but as well need to be considered with regard to formation fluids mobilized by the CO₂ (Figure 1).

Monitoring Challenges

As CCS moves towards wider implementation, the requirement for effective storage monitoring is defined. The EU Directive (2009) establishes that storage site monitoring needs to line out if a site is performing as predicted and, if not, to provide the information necessary for effective remediation. Monitoring will additionally be required to validate and calibrate predictive models of medium and long-term site performance, in order to allow a site to be closed and liability to pass to the national authority. Monitoring is required to assure operational health and safety by giving early warning of leakage of the CO₂ plume or mobilization of formation fluids from the site.

A wide range of monitoring tools and methods, geophysical, geochemical, well-based, surface-based and even airborne and satellite monitoring systems, have been successfully demonstrated at a number of CO₂ injection sites. Suitable monitoring systems are highly site dependent however, and the challenge for industrial-scale storage is to select which tool combinations together provide a cost-effective and technically robust site monitoring system.

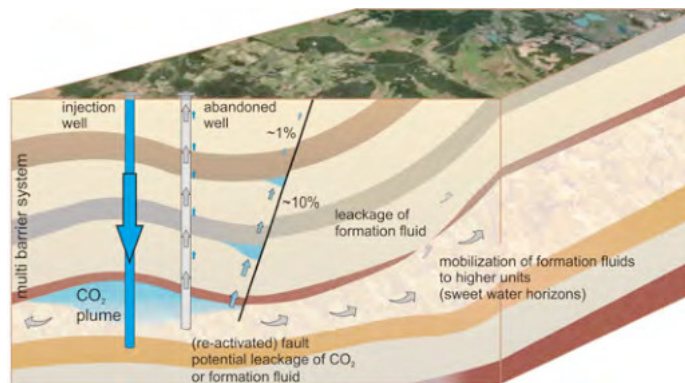


Figure 1: Challenges for geological CO₂ storage with regard to containment in the reservoir

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Steve Wohlmuth

Central Kings Rural High School
Department of Geography and Geology
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Steve is married and has three children (twin girls 7 years of age and a son who is 10 years old). Steve's parents immigrated to Canada in the 1950's. His father was born in Kapfenberg, Austria and his mother was born in Hamburg, Germany.

Education

M.Ed Acadia University: Major: Education
B.Ed Dalhousie University: Major: Education
B.A. Saint Mary's University: Major: Geography

Professional Experience

Steve has taught Global Geography and Geology for 18 years at the senior high school level. (students age 15-17) Steve has also been a School Board Consultant and continues to support teacher training for university students. Steve has professional memberships with Atlantic Geoscience Society and Canadian Geographic Society.

Teaching Interests

Steve is a strong proponent of student field trip learning opportunities for high school students. Steve has lead geology field trips to Iceland and Hawaii five times over the past decade. These field trip opportunities focused on volcanism, natural hazards and renewable energy sources.

Steve has also developed classroom curriculum in the areas of climate change, volcanology and renewable energy.
readings at Eldfell Volcano in Iceland)



(Student taking thermal

Exploring Our Potential: Tidal Energy Eastern Canada: The Bay of Fundy

Steve Wohlmuth

Central Kings Rural High School
Department of Geography and Geology
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Located on Canada's east coast, the province of Nova Scotia has one of the best tidal energy locations in the world. Recent research has indicated that Nova Scotia's Bay of Fundy may be North America's best site for tidal power generation. Approximately 100 billion tons of seawater flows in and out of the Bay every day – more than the combined flow of all the fresh water rivers in the world. Construction is now underway for North America's first in-stream tidal technology demonstration facility, the first device was installed in November 2009 and two other devices scheduled for installation in the summer of 2010.

The Fundy Tidal project stands to provide an added source of green energy, in conjunction with the existing wind, tidal, hydro and biomass operations that Nova Scotia currently has in place. These renewable energy reserves contribute to approximately 17% of Nova Scotia's energy consumption, or roughly 400MW. With additional tidal energy contributors in the Bay of Fundy could on their own produce renewable energy in excess of 330MW. This would push Nova Scotia's renewable energy into the 24% range or roughly 175 000 homes. The 330MW generated are based on the turbines extracting 15% of the available tidal energy so as to not disturb the local ecosystems each would be placed within. If either of the Minas Channel or Minas Passage within the Bay of Fundy could run at a slightly higher efficiency they could easily provide substantially more renewable energy. If 50% of the tidal energy could be extracted we could see numbers close to 2000MW based on those two sites alone. That is enough energy to supply 900 000 homes!



My overview of the Bay of Fundy Tidal Power Project will concentrate on the types of in-stream turbines being tested in the Bay of Fundy, site selection and the environmental impacts being monitored during the two-year assessment phase.

(Source: 2010 Offshore Energy Research Canada)



Mag. Albert Jaros

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Albert Jaros, from Vienna in Austria, studied Mathematics and Physics at the University of Vienna. After graduation in 1980 he worked as a technical consultant for private industry for several years.

At the same time he started teaching grades 5 to 12 at a Viennese high school. He is now physics curator and trainer of new teachers for physics and mathematics at his school. In 1989 he co-authored the Austrian high-school physics curriculum. Since then he has also been author of physics text books. He was active in teacher training, school development and introduced extra-curricular science activities at his school.

Can electric cars reduce the energy consumption and the CO₂ emissions of our society? What can we expect?" - A school project.

This school project of a physics class at 10th-grade level tries to assess whether electric cars can reduce energy consumption and CO₂ emissions significantly. The class was divided into four groups. The first group has researched the average fuel consumption and the CO₂ emission per km of cars powered by combustion engines. The second group has tried to find out the efficiency of the motor and the accumulator used in electric cars and the average energy consumption per km. The third group has studied how electric energy is generated at present in Austria and globally, and how much CO₂ is produced by this processes. The fourth group has had to prepare a spreadsheet which allows pooling the data found by the first three groups. The aim was to display the impact of the introduction of electric cars on a wider scale.



Francesco Sarti

Education and Training Activities
Directorate of Earth Observation Program
European Space Research Institute (ESRIN) of
ESA
Frascati, Italy

Francesco was born in Rome, Italy. After his Master Degree in Electrical Engineering at the University of Rome *La Sapienza* and a first research contract at the CNR (optimisation techniques on parallel computers), he was hired in 1990 at the European Space Agency, ESA, in Germany (Operation Center, Darmstadt, ESOC) to work on mission analysis (optimum orbit control with finite thrusts).

He then moved to precise orbit determination and, later, to orbit and attitude control, when he started working at the ESA establishment in The Netherlands (ESTEC) as a spacecraft control systems engineer. In 1996 he attended the summer session of ISU in Vienna (Dept. of Satellite Applications & Remote Sensing). After this first experience in the field Earth Observation, he moved to Toulouse, France, in 1997, where he got a Post-graduate Master in Applied Remote Sensing and Image Processing from the University of Toulouse *Paul Sabatier* followed by a PhD on the subject of optical-radar remote sensing for the monitoring of surface deformation and change and its application to natural risk management. During his studies in France, he was first employed by CESBIO with a research contract on the combined use of optical and radar remote sensing for natural risk evaluation and later by CNES (Centre National des Etudes Spatiales, Toulouse) as a SAR applications engineer in Earth Observation. During this period at CNES, he was Project Manager for the *International Charter on Space and Major Disasters*, conducted R&D activities for remote sensing applications to disaster management and natural risk monitoring, performed studies for the interferometric monitoring of several seismic areas, provided training activities in Earth Observation in Latin America.

In 2001, he joined again ESA and was detached to the Italian Space Agency (ASI) as a technical interface ASI-CNES for the cooperation COSMO-SkyMed/Pléiades.

From 2002 until present, he is in ESA Earth Observation (ESRIN, Italy), working first in the Industry Section (EOMD programme and Project Manager for the International Charter) and finally as a Scientific Coordinator of the Education and Training Activities in Earth Observation.

His publications are mainly in the area of application of radar and optical remote sensing to damage mapping, tectonics, and disaster management.

His hobbies are music, classical piano, painting, and sport.

The Earth Observation Programme of ESA – Educational tools for schools

Francesco Sarti

Education and Training Activities
Directorate of Earth Observation Program
European Space Research Institute (ESRIN) of ESA
Frascati, Italy

Earth Observation (EO) from satellites is increasingly important for the understanding of the Earth's system and its processes. Today, this is more important than ever, in a planet threatened by global change and climate change, where the uncontrolled use of natural resources like biomass, carbon and clean water associated to the explosion of demography could make life conditions of future generations hard, unless a policy of sustainable development is adopted. Youngsters and future decision-makers should be made well aware, through adequate education programmes, of the importance of an intelligent development, making a sustainable use of natural resources and preserving the environment. The observation of the changing earth from space can provide a valid support to the creation of public awareness and the education of young generations about these issues.

The first missions conceived by Earth Observation Programme of the European Space Agency (ESA) were in the area of meteorology, with the successful launch of Meteosat in 1977, followed by a series of meteorological satellites, including Meteosat Second Generation and METOP (all operated by EUMETSAT). Moreover, in 1991, ESA launched its first EO satellite with a synthetic aperture radar payload, ERS-1, followed by ERS-2 (1996) and Envisat (2002), the largest EO satellite ever launched and with a variety of different sensors for the observation of land, ocean, cryosphere and atmosphere, providing a precious information serving the scientific community, as well as an increasingly larger number of operational and commercial users.

In parallel, ESA is preparing scientific Earth Observation missions called Earth Explorers, dedicated to the study of scientific challenges identified by the science community. The first two, GOCE (measuring the Earth's gravity field), and SMOS (determining soil moisture and ocean salinity) are already in orbit, whereas CryoSat (observing continental ice sheets and marine ice cover) is about to be launched, to be followed by other satellites for a variety of scientific objectives.

Other important issues are the observation and fast response in case of natural disasters and all environmental hazards. In this context, GMES (Global Monitoring for Environment and Security), a joint initiative of ESA and the European Union, aims to monitor the state of the environment on land, at sea and in the atmosphere and to deliver policy-relevant EO information that can be used to improve the security of the citizens. Its Space Component comprises five types of new missions called Sentinels, plus so-called Contributing Missions from Member States and other organisations, with their associated Ground Segment infrastructure, developed by ESA. The Sentinel missions include radar and superspectral imaging for land, ocean and atmospheric monitoring.

Associated to this challenging programme of Earth Observation, ESA is carrying out a programme of EO Education, in cooperation with other national space agencies and with international bodies, like UNESCO or the Committee on Earth Observation Satellites (CEOS) and its Working Group for Education. In this frame, dedicated tools for schools, such as Eduspace, have been developed with the objective to create awareness about the potential of Earth Observation from space among young generations and to bring 'space' closer to youngsters. A variety of different tools have been developed and a series of training courses at different levels (university, post-doc, scientific or professional-oriented) are provided by ESA and other institutes cooperating with ESA.



Mario Giampietro

ICREA Research Professor

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Education

- (i) *Wageningen University, The Netherlands (October 2003)*: Ph.D. in Social Sciences:
- (ii) *CEFAS, Viterbo, joint program Università La Tuscia, Viterbo & Università Cattolica di Piacenza, Italy (June 1982)*: MS Food System Economics (1 year program);
- (iii) *Università La Sapienza, Rome, Italy (July 1981)*: “laurea” in Biological Sciences (4-year program);
- (iv) *Università La Sapienza, Rome, Italy (1978)*: “laurea” in Chemical Engineering (5-year program)

Working Groups, Initiatives, and Advisory Boards

- (i) *International Assessment of Agricultural Science and Technology for Development (IAASTD) (2005–present)*. <http://www.agassessment.org/>
Lead author for Chapter 4 – on Drivers of Technological changes.
- (ii) *Millennium Ecosystem Assessment (2004–2005)*.
<http://www.millenniumassessment.org/en/index.aspx> **Chapter Review Editor** in relation to Volume 4, Multi-Scale Integrated Assessment,
- (iii) *Biennial International Workshop on Advances in Energy Studies, Porto Venere, Italy (1998–present)* – <http://www.chim.unisi.it/portovenere/> **Co-founder and permanent member of the organizing committee.**
- (iv) *Scientific Society LIPHE4 (2004–present)* – www.liphe4.org **Co-founder and president** of LIPHE4, a non-profit, scientific association, with a summer school on the Theory and Applications of Participatory Integrated Assessment of Sustainability - <http://www.liphe4.org/school.html>
- (v) *University of Klagenfurt, Virtual Collegium of Social Ecology (2003–present)*: Member of the Scientific Advisory Board
- (vi) *Joint Research Center of the European Commission, Ispra, Italy – IPSC, Unit Knowledge Assessment Methodologies (2004–present)*: Senior Adviser to the virtual network of young practitioners. <http://alba.jrc.it/ibss/>
- (vii) *European Society for Ecological Economics (1996–2003)*: Elected member of the Board.
- (viii) *WWF Italy (2003–present)*: Member of the Scientific Advisory Board.

(ix) Member of the Editorial Advisory Board of international Journals: *Agriculture, Ecosystems & Environment (Elsevier)* (1991–present); *Environment, Development and Sustainability (Kluwer)* (1999–present), *International Journal of Water (Inderscience)* (2000–present); *International Journal of Transdisciplinary Research* (2006–present).

Books

- * Polimeni, J., Mayumi, K., Giampietro, M., and Alcott, B. 2008 *Jevons' Paradox: the Myth of Resource Efficiency Improvements* Earthscan Research Edition, London, 192 pp.
- * Giampietro, M., and Mayumi, K., 2009 *The Biofuel Delusion: the Fallacy behind large-scale Agro-biofuels production* Earthscan Research Edition, London, 320 pp.

The biofuel delusion

Mario Giampietro

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Climate change and peak oil pose a double threat to the sustainability of our current pattern of development. In relation to this double threat biofuels have been presented to the general public as the perfect “silver bullet” for the energetic problem: the claim has been that biofuels can represent an alternative large scale supply of liquid fuels which is both “zero-emission” and “fully renewable”. Because of this claim national governments have been pouring huge amount of resources in the development of biofuels from crops, whose production has already reached an important scale (e.g. in 2009, one forth of the corn produced in the USA went into the production of ethanol!). Unfortunately, this enlargement of scale is proving that the biofuel idea is not as good as expected. When carried out at a large scale, the various processes of agrobiofuel production induce important environmental impact and compete with the production of food, reducing the food security for the poor. Moreover, in developed countries these processes consume more or less the same amount of energy which generate, and therefore they are not economically viable. In tropical areas (ethanol from sugarcane and diesel from palm-oil) the very low productivity of labour translates into forms of quasi-slavery for the workers. In addition to that the expansion of plantations is displacing and evicting rural communities from the land. For these reasons, this presentation aims to clarify the biofuel issue, using 5 sections:

SECTION 1 – What are biofuels?

- 1.1 First generation biofuels: (i) non-tropical agriculture (e.g. corn/ethanol; rape-seed oil/diesel); (ii) tropical agriculture (e.g. sugarcane/ethanol; palm-oil/diesel)
- 1.2 Second generation biofuels – cellulosic ethanol

SECTION 2 – Basic Concepts of Energetics

- 2.1 Not everything that burns is a fuel – the quality of energy sources
- 2.2 Energetic Return On the Investment (EROI)
- 2.3 The metaphor of the heart transplant (power level in the energy sector)

SECTION 3 – The problems with biofuels

- 3.1 It is impossible to replace a significant quantity of oil (e.g. 5%) with agro-biofuels if the production should be “fully renewable” and “zero emission”;
- 3.2 There is a systemic problem with biofuels as primary energy source - low EROI and low power level in the energy sector.

SECTION 4 – What about the second generation?

- 4.1 State of the art of the second generation of biofuels;

4.2 Can the second generation change the gloomy picture of biofuels?

SECTION 5 – Conclusion – pros and cons of biofuels

5.1 The fact the biofuels are neither a viable or desirable large-scale substitute for oil, does not imply that there is no future for bioenergy. Actually, bioenergy (which is different from biofuels) has always been used and always it will.

5.2 There are special situations in which biofuels can provide a contribution to the energy sector (e.g. when produced from waste and easily accessible biomass). But this has nothing to do with the idea of replacing with biofuels a substantial part of current consumption of oil.



Pierre-Philippe Mathieu

European Space Agency (ESRIN - EOP/SE) –
Earth Observation Science & Applications
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pierre.philippe.mathieu@esa.int

Pierre-Philippe received its Master in Environmental Sciences in 1996 from the “University of Liège” (Belgium) and its Ph.D. in oceanography from the “University of Louvain” (Belgium) in 1998.

PP then started to work on the development of advanced data assimilation techniques for integration of satellite data into ocean models at the “Joint Research Centre” (Italy) and the “Netherlands Institute of Ecology” (Holland).

In 2000, PP moved to the “University of Reading” (UK), where he worked as a senior research fellow of the “National Environment Research Council”. His main research interest lied in the modelling and prediction of the climate system as well as in the use of climate information to support decision-making. During that time, PP got a degree in Management from the “University of Reading Business School” and worked as a consultant in Weather Risk Management for a small private company.

Since 2003, PP works as an “Earth Observation Applications Engineer” within the “European Space Agency” in ESRIN (Italy). He is in charge of fostering the use of EO information and managing a variety of EO application activities, including energy management, risk assessment, corporate sustainable development, climate change and the “Global Monitoring for the Environment & Security” (GMES).

PP is member of the GEO energy expert group, SCAR/SCOR expert group on oceanography, co-chair of the COSPAR panel on Capacity Building and co-editor of the IEEE “Journal of Selected Topics in Applied Earth Observations and Remote Sensing”.

Space for Sustainable Development: How Earth Observation satellites can help us Measure what we Treasure.

Pierre-Philippe Mathieu

European Space Agency, ESRIN, Frascati, Italy.

Perspective is a very powerful thing. Remember the "Earthrise" picture taken more than 40 years ago by the Apollo 8 crew, showing the Earth as a tiny blue globe suspended in the infinite vastness of space. This picture forever changed human's vision on its environment by inspiring many to realise the beauty of our "home" planet, while revealing at the same time its inherent fragility.

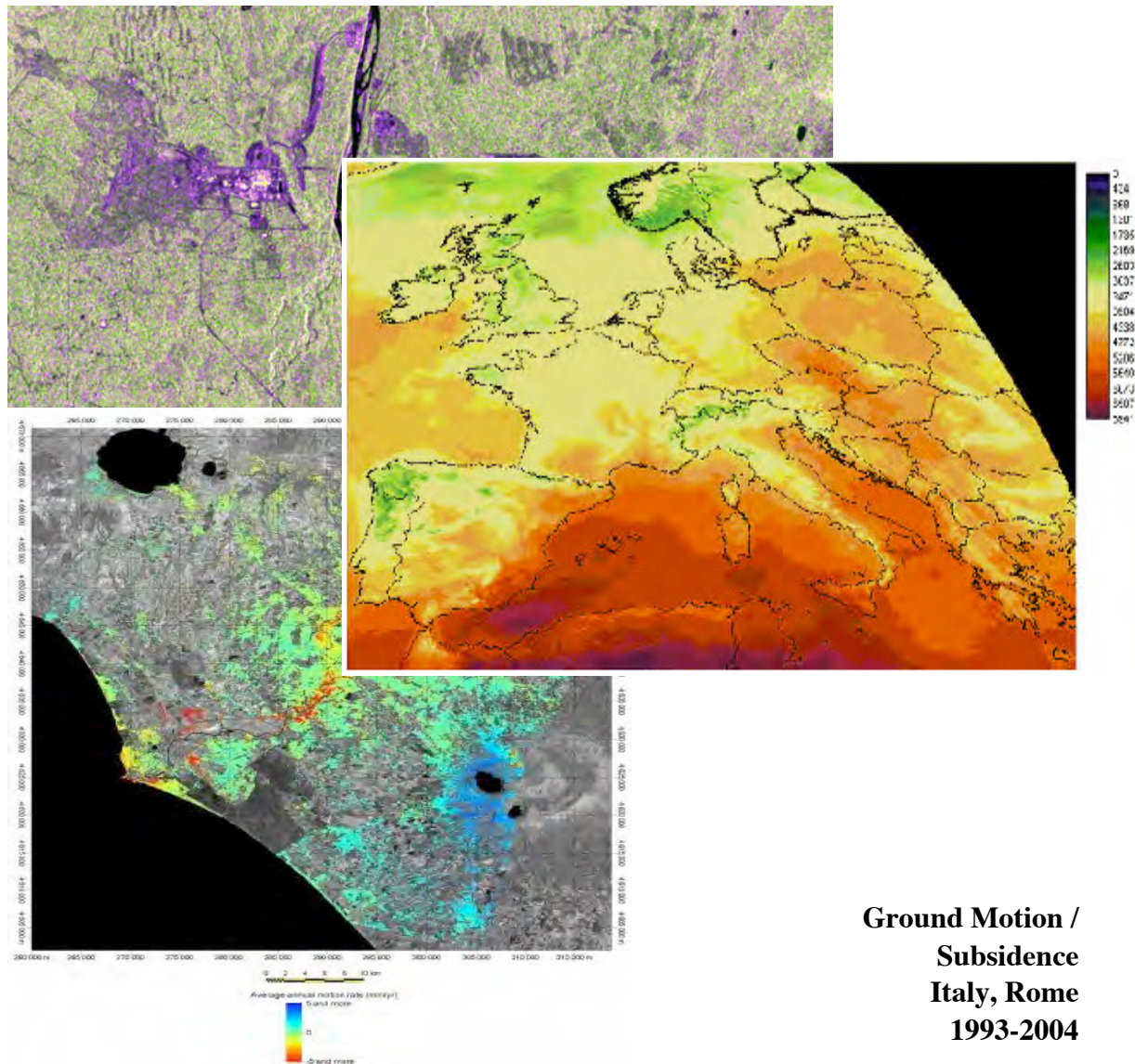
"Earth Observation" (EO) satellites have played a key role in raising awareness about how human activities globally affect the environment - contributing to the rapid depletion of natural resources - as well as convincing many of the need to manage these resources in a *sustainable* manner that would "*meet the needs of the present without compromising the ability of future generations to meet their own needs*" ("Our Common Future", report of the "World Commission on Environment & Development" headed by Gro Harlem Brundtland in 1987).

This unique all-embracing view from space contributed to pioneer the emergence of the concept of "Sustainable Development", whereby economic growth should ensure at the same time long-term quality of life and respect of the environment. Over the last decades, the principles of sustainability were progressively adopted by world leaders on the occasion of a series of Earth Summits (e.g. Stockholm, 1972; Rio, 1992), culminating in 2002 at the "World Summit on Sustainable Development" (WSSD) held in Johannesburg, calling for rapid implementation of sustainable development principles through "Agenda 21" plan and the "Millennium Development Goals".

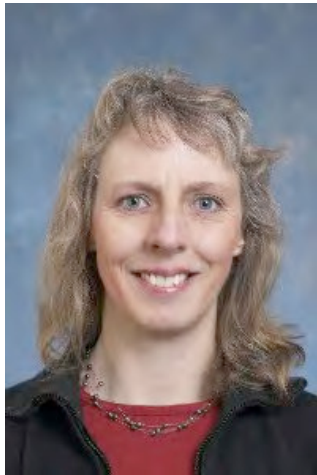
In this context, this presentation will examine how EO satellites - in particular from ESA missions - can contribute to meet this challenge, by providing a quantitative tool to quantify progress towards sustainability.

Examples of how EO satellites contribute to science and applications related to sustainable development will be provided. In particular, we will discuss how EO have revolutionized our understanding of how the "Earth System" operates, and how it is affected by human activities (e.g. vital sign of climate change, ozone hole, global sea level rise, deforestation). We will also examine how EO data can be used to support decision-making, with a particular focus on the production, transport and management of the energy system. Finally, we will conclude by discussing the recent developments of EO programme in Europe, including the new generation of research and meteorological missions but also the Sentinels series that will provide operational information services for Global Monitoring of the Environment and Security (GMES).

Some examples of EO information services



**Ground Motion /
Subsidence
Italy, Rome
1993-2004**



Charlotte Bay Hasager

Senior Scientist

Risø DTU

Wind Energy Division,

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Denmark

Tel: +45 4677 5014, Email: cbha@risoe.dtu.dk

Dr. Charlotte Bay Hasager is M.Sc. (1992) and Ph.D. (1996) from University of Copenhagen in Denmark, Faculty of Science. My scientific specialization is in climatology, micro meteorology, turbulence and satellite remote sensing. My Ph.D. thesis 'Surface fluxes in heterogeneous landscape' was on modeling non-linear processes and using satellite and airborne remote sensing. In satellite remote sensing both optical and radar data have been analyzed for various scientific purposes. During the PhD I spent six months in 1995 at Pennsylvania State University in Department of Meteorology, State College, USA working on satellite remote sensing and SVAT (soil-vegetation-atmosphere transfer) processes. I have been employed at University of Copenhagen 1990-92 and at Risø since 1993 in various positions, since 2001 as senior scientist. In the last 10 years I have mainly been involved in wind energy projects supported by national and international funds from EU FP5, FP6 and FP7 as well as from the European Space Agency. More details on projects and publications (25 refereed papers, 4 book chapters, 240 contributions) are available at <http://www.risoe.dtu.dk/phonebook.aspx?id=38348&type=person> In wind energy satellite remote sensing products such as land use, digital terrain elevation data and offshore winds have been investigated. In particular, ocean wind speed and direction observations have been investigated for wind resource estimation. Recently also ground-based lidar is being used in wind energy. The remote sensing technologies used in wind energy are presented in PhD Summer Schools each year at Risø DTU.

I am elected President for Atmospheric Sciences at the European Geosciences Union (2006-2011), co-chair for Wind Energy Community of Practice in Global Earth Observation (GEOSS) (2005-), member of steering committee for Danish Space Consortium (2005-) and external examiner at University of Copenhagen and Roskilde University Centre in Geography (1997-) (~25 M.Sc. and 50 B.Sc.). I supervise several PhD's and have also been PhD opponent.

Wind Energy Energies and Sustainable Development

Charlotte Bay Hasager

Education and Training Activities
Risø DTU – Wind Energy Division, Roskilde, Denmark

Modern wind energy started in the early 1970ties. A brief history on the size and production of wind energy at European and global scale will be presented. The story shows an increase in the rotor diameter of turbines from kW to nowadays several MW of one turbine. The installation of wind power capacity has increased with exponential growth in the last 25 years. In 2008 the installation of new energy capacity in Europe was larger for wind power 8,484 MW (43%) than for any other type of energy. In the same year USA installed 8,358 MW and China 6,300 new wind power capacity. For Europe in 2008 wind power provided 4.2% of Europe's electricity demand of 35.000.000 EU households, thus equivalent in avoiding CO₂ by taking 50.000.000 cars off the roads. See 2009 wind power in Europe at <http://www.ewea.org/index.php?id=1486>

In view of the climate debate and societal need for reliable energy the two issues will be described in regard to the energy balance of the Earth, and the implications of various energy sources.

The planned renewable goal of 20% in year 2020 of EU will be discussed. At present the penetration of wind power electricity is more than 20% of the annual consumption in Denmark. Where does Denmark plan to go and how may society handle too much or too little wind energy at a given day? Electrical cars are a solution to store and provide energy.

Finally, where do new wind turbines have to be located. Where do we find windy areas, sufficient grid connection and avoid populated areas? What are wake effects and what about offshore – challenges and opportunities?

How do students and teachers continue with education in wind energy?

Links to education

Kid Wind <http://www.kidwind.org/>

Win with Miller http://www.windpower.org/viden/vind_med_moeller.html (in Danish, English, French, Spanish and German)

AWEA wind energy curriculum <http://www.awea.org/education/curriculum/>

Re-energy http://www.re-energy.ca/t_windenergy.shtml

Link for fun

Racing Aeolus! <http://www.windenergyevents.com/> (race in wind turbine cars)

Links to statistics

EWEA: European Wind Energy Association <http://www.ewea.org/>

GWEC: Global Wind Energy Council <http://www.gwec.net/>

AWEA: American Wind Energy Association <http://www.awea.org/>

IEA: International Energy Agency <http://www.iea.org/>

The offshore wind park Horns Rev 1 in the North Sea, Denmark with 80 2MW wind turbines. Fog is seen on a very special day. Photo by UNIFLY A/S.



Christian Hinsch

Director Corporate Communications

Juwi Holding AG,
Energie-Allee 1,
55286 Wörrstadt, Germany

hinsch@juwi.de

After examination at German secondary school (1986) Christian Hinsch studied mechanical engineering at the Technical University Braunschweig (Germany) with the focus on light-weight- and aircraft-construction. He spent his first four business years at the German Wind Energy Institute (DEWI) in Wilhelmshaven (Germany) as a scientific assistant. From January 1998 to April 2003 he was the editor-in-chief of two monthly magazines for renewable energies – the well-known publications “Neue Energie” and “New Energy”, published among others by the German Wind Energy Association in Osnabrueck. Since May 2003 he is Director of Corporate Communications for the juwi group in Woerrstadt (Germany), one of the leading project developing companies for wind, solar and bio energy. As managing director of two joint ventures with the local utility of Mainz, he is also responsible for the development and operation of wind and solar power plants in the area surrounding Mainz.

Solar Power: Photovoltaic Systems for a Variety of Applications

Christian Hinsch,

juwi Holding AG,
Wörrstadt, Germany

There is simply no better alternative for an environmentally friendly power supply in the future than to take the path leading to a solar energy era. Every day, the sun provides the earth with more than one thousand times the energy required by people around the world. In comparison with wind power, the proportion of solar power in the mix of renewable energies is still remarkably low. However, solar power makes an important contribution in providing for power needs that have, up until now, been covered by gas or coal power plants. In a few years, power generated on rooftops is going to be cheaper than power from the supply grid.

Photovoltaic systems with a nominal capacity of around 20,000 MW were installed all over the world by the end of 2009. For example in Germany the reason for the boom in this sector is the Renewable Energy Law (EEG), which guarantees fixed feed-in tariffs for solar energy supplied. Technological advancement helps the sector move forward. New products, such as thin-film modules, are taking the market by storm. Efficiency continues to increase while prices drop. New application opportunities make solar energy an all-around winner. From a single module on a building exterior all the way to large solar power plants capable of producing megawatts of energy – nothing is impossible with the next generation of PV modules. The major advantage of solar power generation is that it is safe and environmentally-friendly. The energy of the sun is directly transformed into electrical power, which is used to operate our machines and household devices.

One of the leading companies for project development of renewable energies is the juwi group. Juwi designs, builds, finances and operates large-scale photovoltaic installations on rooftops and in open-spaces. juwi delivers cost-effective and technologically advanced projects based on long-term experience. Tried and tested technologies are used for all of the PV power installations. Since 1996, juwi has installed more than 1,200 PV power plants with a total capacity of more than 400,000 kilowatts.

The author will present some basic information on solar power as well as legal regulations in some European countries. Furthermore, a variety of applications will be presented.

GIFT hands-on activities

Hands-on activities Tuesday 13.30 to 15.00 will take you through several practical aspects and possibilities of teaching on energy in the classroom.

You can select two out of the four hands-on activities. Care will be paid by the Committee on Education that the different groups are largely international.

<p>Splinter Room - Room SM 1 Blue level 40 seats 13.30 to 14.10 Energy Reduction at School – Education of Sustainable Development in Practice <i>(Annegret Schwarz, Patrick Kaminski, Jens Feith)</i></p> <p>14.20 to 15.00 Sustainable Living – addressing our impact <i>(Phil Smith)</i></p>	<p>Splinter Room - Room SM2 Blue level 40 seats 13.30 to 14.10 Wind energy siting and resources and balancing the electrical grid <i>(Charlotte Hasager and Gregor Giebel)</i></p> <p>14.20 to 15.00 Sustainable Energy – interdisciplinary education <i>(Torben Jensen)</i></p>
<p>Splinter Room - Room SM4 Yellow level 14 seats 13.30 to 14.10 Sustainable Energy – interdisciplinary education <i>(Torben Jensen)</i></p> <p>14.20 to 15.00 Wind energy siting and resources and balancing the electrical grid <i>(Charlotte Hasager and Gregor Giebel)</i></p>	<p>Splinter Room - Room SM5 Red level 14 seats 13.30 to 14.10 Sustainable Living – addressing our impact <i>(Phil Smith)</i></p> <p>14.20 to 15.00 Energy Reduction at School – Education of Sustainable Development in Practice <i>(Annegret Schwarz, Patrick Kaminski, Jens Feith)</i></p>

Energy Reduction at School – Education of Sustainable Development in Practice

Annegret Schwarz

Ministry of Education, Science, Youth, and Culture of Rhineland-Palatinate, , Mittlere Bleiche 61, D-55116 Mainz, Germany
Secretary for Education of Sustainable Development (ESD) and regional adviser for geography
<http://nachhaltigkeit.bildung.rlp.de>
annegret.schwarz@online.de



Patrick Kaminski

Tulla-Gymnasium, Danziger Str. 1, D-76437 Rastatt, Germany
patrick.kaminiski@web.de
Teacher for mathematics, physics, astronomy, and technics, head of the environment department, speaker at the international greening event



Jens Feith

Kurfürst-Salentin-Gymnasium, Salentinstraße 1b, D-56626 Andernach, Germany
feith@web.de
Teacher for geography and English, adviser for ESD (Education for Sustainable Development)



Workshop:

Education of Sustainable Development is very valuable in strengthening the capacity of students to make judgements and choices in favour of a safer, healthier and more prosperous world, thereby improving the quality of life in general. This learning process can provide a critical reflection and greater awareness in the younger generation, which leads to a change of lifestyle, including the patterns of consumption and production. Facing today's global problems, the importance of ESD, which is the motto of the UN-decade 2005 – 2014, is well known and broadly accepted. Teaching sustainable development, however, implies quite a challenge for the teachers who try to implement the topic in projects and regular lessons at school. Therefore, it is necessary to have good ideas how to teach ESD successfully.

In the workshop “Energy Reduction at School” as part of the hands-on activities, the participants are informed about various ways how to save energy at school and beyond, with the students being involved. The participation of the younger generation is motivating and fosters the process of becoming aware of the energy consumption and, consequently, of the environment and of global challenges. There are many examples how to teach ESD, for instance by measurements and experiments as part of an energy check at school, by competitions on energy reduction, or even by treaties with the parents. All these measures show practical means how to teach education for sustainable development in a successful way.

Sustainable Energy – interdisciplinary education

Torben P. Jensen

Langkaer Gymnasium and HF
Kileparken 25
8381 Tilst
Denmark
<http://www.langkaer.dk/>



Activities:

Lecturer Torben P. Jensen M. Sc. is a teacher of Geography and History and the webmaster at the high school of Langkaer Gymnasium and HF at Tilst, Denmark. For many years Torben has been involved in promoting the use of satellite images and GIS (Geographical Information System) in upper-secondary education and is also contributing to the digital map for schools. He has published Geography books for upper-secondary education and digital publications on the internet.

Sustainable Energy (Torben Jensen)

The education on Sustainable Energy is based on interdisciplinary education including several subjects: Geography, Physics, Chemistry and Biology.

In the Danish gymnasium (high school) there is a first-year basic natural science study programme (60 lessons). Langkaer Gymnasium and HF has chosen **Sustainable Energy** as the main focus of this basic course and the course material will be published in book form this summer.

Langkaer Gymnasium and HF participates in the international project of Global High Schools, which involves close cooperation between schools and students in Denmark and in other parts of the world such as Egypt (Cairo), New York, India and South Africa. In this project the students will also work with sustainable energy and use the course material mentioned above.

Parts of the course material will be available in English to be used in the Global High School project.

The book treats of subjects and questions such as,

- Sustainable Energy - introduction
- How Much Energy do We Use, how Much is Available and Where is it Found?
- How is Energy Made Renewable?
- How is Energy Accumulated and Transformed?
- What Effect Does our Energy Consumption Have on the Global Climate?

Sustainable Living – addressing our impact

Dr. Phil Smith, MBE

<http://www.tsn.org.uk/>
Coordinator,
Teacher Scientist Network (TSN)
John Innes Centre,
Colney Lane,
Norwich, UK, NR4 7UH
phil.smith@bbsrc.ac.uk



Activities:

Dr. Phil Smith has for the last 7 years run a highly successful independent science education charity, the Teacher Scientist Network, that works closely with science teachers across Norfolk in the East of England.

Trained as a plant pathologist with a specific interest in fungal diseases of cereal crops, Phil started engaging with schools during his PhD. This led to a highly successful partnership with a primary school teacher which continued after Phil ‘hung-up’ his lab-coat. Phil regularly runs courses for teachers and coordinates the Networks activities which all focus upon linking real science with the school community. Phil received an MBE, a national order of merit, for services to science education in recognition of both his own science communication endeavours and those of TSN as a whole in Summer 2008.

Hands-on Activities:

Resources to support the teaching on Sustainable Living.

TSN has successfully developed a library of free-to-loan resources for schools to borrow that facilitate hands-on approaches to learning – its Kit Club. These kits are all put together in response to teacher need and improved as a result of teacher feedback.

Teaching about sustainable living has just surfaced above the horizon in UK secondary schools (www.teachernet.gov.uk/sustainableschools) and we have just completed a project working with local partners to develop a TSN kit of resources to support teaching and learning in this area, maintaining a hands-on approach that is cross-curricular in nature but under-pinned by ‘sound science’

Some of these activities will be experienced by participants in the workshop and ways of developing such kits ‘back home’ explored.

Wind energy siting and resources and balancing the electrical grid

Charlotte Bay Hasager and Gregor Giebel

Risø DTU, Wind Energy Division

Frederiksborgvej 399, 4000 Roskilde, Denmark

http://www.risoe.dtu.dk/Research/sustainable_energy/wind_energy.aspx

Activities:

Dr. Charlotte Bay Hasager and Dr. Gregor Giebel are both senior scientists at Risø DTU, Wind Energy Division. We work in the Meteorology program.

Charlotte has around 20 years experience in satellite remote sensing and wind energy on land and offshore. In recent years the offshore wind farms and related issues have been her special focus area. Charlotte is currently president for Atmospheric Sciences Division at the EGU. Gregor has around 20 years experience in forecasting winds with numerical models using various data input. The results link to wind energy power production at regional up to European scale. A particular issue is where to locate wind farms in response to user needs, expected winds and potential power production and balancing the resources at different time-scales. Gregor is convenor of the session Wind Power Meteorology at the EGU.

Wind energy siting and resources and balancing the electrical grid (Charlotte Hasager and Gregor Giebel)



In wind energy the first question is usually what is the wind? How can you observe it? What is a sufficient time series? We will then address the statistics of mean wind speed and the Weibull distribution and provide a means to understand the wind power produced and the capacity factor. Finally also check this with online operation of active wind turbines.

The second question is often how does wind energy fit into the grid for the users. Keeping the electrical grid stable is quite hard. Keeping the electrical grid stable when there is wind and solar power feeding in is extra hard. The Spanish Transmission System Operator Red Eléctrica de España has built a little game showing this: <http://www.ree.es/ingles/educacion/controla.asp>

In the following, Gregor Giebel will shortly introduce why the problem is getting smaller for larger regions, what the relevant time scales are for the grid, and give an indication of how much wind energy can actually be integrated in the network.



Prof. Dr. Gerhard de Haan

Dept. of. Educational Science and Psychology
Head of the Institute for “Educational Future Science”
Freie Universität Berlin, Germany

Academic Training

1998 Habilitation in Educational Science, Freie Universität Berlin, Germany
1984 Dissertation (Dr. phil.) in Educational Science, Freie Universität Berlin, Germany
1977 Diploma in Educational Science, Freie Universität Berlin, Germany

Professional Experience

Since 1991 Professor at the Department of Education and Psychology, Freie Universität Berlin, Germany
1990-1991 Professor for Education and Ecology at the College of Education, Neubrandenburg, Germany
1984-1990 Senior-Scientist at the Department of Education and Psychology, Freie Universität Berlin, Germany
1978-1983 Scientist at the Department of Education and Psychology, Freie Universität Berlin, Germany

Awards and nominations

2008 Awarded Person by the German Association of Outdoor Education (Bundesverband Erlebnispädagogik)
2008 Nominated for the German Environmental Award

Research Interests:

Education for Sustainable Development, Citizenship Education, Future Science, Knowledge Society, Transfer of Knowledge, Theories and Models of Education

Cooperation or Consultancy in National and International Committees

Since 2006 Appointed Member of the European Academy for the research on impacts of scientific and technological developments (Europäische Akademie Bad Neuenahr)
Since 2005 Chairman of the German Association for Citizenship Education

Since 2004 Member of the Steering Committee of the FoNa -Programme (Research for Sustainability) of the BMBF

Since 2004 Chairman of the German National Committee of the UN-Decade for Education on Sustainable Development

Since 2002 Chairman of Commission for Sponsorship in Graduated Studies of the City of Berlin

Since 1995 Chairman of the German Association for Environmental Education

Editorial Council of the journals:

Social Ecology. Journal for Environmental Thought and Social Research, Zagreb (Croatia).

Natur und Kultur. Transdisziplinäre Zeitschrift für ökologische Nachhaltigkeit, Bad Mitterndorf, Austria.

Umwelt & Bildung, Wien, Austria

„UN-Decade Education for Sustainable Development (2005-2014) – Results and Perspectives after the first five years“

Prof. Dr. Gerhard de Haan

Dept. of. Educational Science and Psychology
Head of the Institute for “Educational Future Science”
Freie Universität Berlin, Germany

The presentation provides an overview of the notion of ESD, the structure of the UN-Decade with a focus on Germany, its achievements so far and outlines the challenges lying ahead for the remainder of the Decade (and beyond).

In the first part of the presentation, the meaning of “ESD” and national and international implications of the term are explored. ESD is a concept much broader in scope than concepts such as “environmental education” and “development education” and it involves different aspects and strategies in different regions of the world.

Subsequently, the goals of the UN-Decade and the institutional structure that has evolved in Germany are outlined. In the wake of the World Summit of Sustainable Development in 2002 in Johannesburg, the United Nations General Assembly declared the years 2005 – 2014 a Decade of ESD. Its goal is to integrate the principles, values, and practices of sustainable development into all aspects of education and learning, in order to address the social, economic, cultural and environmental problems we face in the 21st century. In Germany, following a unanimous resolution of the German Parliament in 2004, the Decade has been implemented under the lead of the German Commission for UNESCO. As a consequence, a proper institutional structure, encompassing actors from academia, politics, the private sector and civil society, dealing with the promotion of ESD in all educational sectors has evolved.

In the following section, the presentation takes stock of what has been achieved so far, with a focus on the German case. Despite achievements such as a national plan on ESD, the increasing visibility of best-practice projects, capacity-building, advocacy-work etc. a series of challenges remain. Key words in this context are among others: lack of specific national ESD policies, lack of research and development, as well as lack of funding.

The presentation ends with a look at the outcomes of the World Conference, which took place in Bonn, Germany, from March 31st until April 2nd, 2009, in particular with regard to the “Bonn Declaration”, and concludes with an outlook on the way ahead.



Christine Künzli David

Interdisciplinary Learning and Education at the School
for Teacher Education,
Institute for Pre-Primary and Early Primary Education,

University of Applied Sciences Northwestern,
4502 Solothurn, Switzerland

Scientific Education

- | | |
|-------------|---|
| 2001 – 2006 | Dissertation at the University of Berne, Institute of Educational Science |
| 1991 – 1998 | Licentiate at the University of Berne. Major in pedagogy/pedagogical psychology, minors in general psychology and in general ecology. Teaching degree for secondary schools in addition |

Scientific functions

- | | |
|--------------|--|
| 2008 – today | Professor for Interdisciplinary Learning and Education at the School for Teacher Education, University of Applied Sciences Northwestern |
| 2004 – 2007 | Head of the center for education for sustainable development at the Institute for Educational Research and Development, School for Teacher Education, University of Applied Sciences Northwestern, |
| 2001 – 2006 | Research Assistant, Institute of Educational Science, University Berne |
| 1997 – 2006 | Research Assistant at the Inter-Faculty Office of Coordination for General Ecology (IKAÖ), University Berne |
| 1998 – 2007 | Lecturer for general didactics, psychology and pedagogy at the School for Teacher Education, University of Applied Sciences Northwestern |
| 1998 – 2001 | Lecturer for general didactics, psychology and pedagogy at the School for Teacher Education, Muristalden Berne |

Research Areas

Interdisciplinary Learning and Education
Education for sustainable development
Sachunterricht



Franziska Bertschy

Head of research and development as well as lecturer

Institute for Preschool and Primary School, NMS Berne, Nägeligasse 7, 3011 Berne, Switzerland

Scientific Education

- | | |
|-------------|--|
| 2003 – 2007 | Dissertation at the University of Berne, Institute of Educational Science. |
| 1994 – 2001 | Licentiate at the University of Fribourg. Major in pedagogy and pedagogical psychology, minor in history. Teaching degree for secondary schools in addition. |

Scientific functions

- | | |
|--------------|---|
| 2008 – today | Head of research and development as well as lecturer at the Institute for Preschool and Primary School, NMS Berne |
| 2001 – 2006 | Part-time Research Assistant, Inter-Faculty Office of Coordination for General Ecology (IKAÖ), University Berne. |
| 2001 – 2007 | Lecturer for General Didactics at the University of Applied Sciences Northwestern Switzerland (FHNW). |

Research Areas

Education for sustainable development
Systems thinking
Education for sustainable development and Sachunterricht¹
Effects of teaching

¹ Sachunterricht is a subject taught at primary school level in Germany and Switzerland that deals with the social and cultural issues and the natural environment. Sachunterricht thus covers the aspects of the conventional subjects of history, geography, social studies, biology, chemistry and physics that are dealt with at primary school level.

Education for sustainable development: specific practice on different educational levels

Christine Künzli David¹ and Franziska Bertschy²

1 - University of Applied Sciences Northwaestern, Solothurn, Switzerland

2 - Institute for preschool and Primary School, NMS Berne, Switzerland

In the workshop the didactic elements (learning objectives, contents, didactic principles) of education for sustainable development (ESD) will be presented.

Summing up, one can say: When it comes to education for sustainable development, the main issues are:

- about “as well as”, and not “either or” or “right and wrong” respectively;
- about development and reflection of visions with regard to sustainable development;
- to therefore abandon familiar mental patterns;
- about being able to asses coherent information and knowledge (with regard to sustainable development);
- to learn about perspectives and interests of different stakeholders and to integrate them when finding solutions;
- about negotiating win-win or consensus solutions;
- about being aware the impact one’s own behaviour has on other people, in particular worldwide impacts; and
- about reflection on experiences made and on one’s own opinions with regard to sustainable development.

Especially the relation between inter-disciplinarity and disciplinarity -within the scope of education for sustainable development - will be picked out as a central theme in the presentation. Against this background, the contributors are presenting a practical example of ESD for primary school (materials compiled by the teaching staff as well as the multifaceted experiences the teachers acquired through the ESD implementation). This practical examples were developed within the framework of the research project “Education for a sustainable development: Didactic concept and implementation in class”.

During the presentation and as conclusion, the specific practice of education for sustainable development on different educational levels will be addressed in form of exercises and discussions.

The aim of the Workshop is not to present pedagogic recipes — which would not meet the requirements of an education for sustainable development. But we would like to give an impulse to reflect on one’s work, and at the same time offer concrete help in finding a modern educational concept and implementing education for sustainable development in class.

The United Nations Office for Outer Space Affairs (UNOOSA)

SPACE SCIENCE AND TECHNOLOGY FOR THE BENEFIT OF HUMANITY

Werner Balogh, Hans Haubold, Niklas Hedman

The United Nations Office for Outer Space Affairs (OOSA) moved to Vienna in 1993 from the United Nations headquarters in New York. Initially created as a small expert unit within the Secretariat to service the ad hoc Committee on the Peaceful Uses of Outer Space established by the General Assembly in 1958, the Office became a unit within the Department of Political and Security Council Affairs in 1962, when the permanent Committee on the Peaceful Uses of Outer Space met for the first time, and was transformed into the Outer Space Affairs Division of that Department in 1968. In 1992, the Division became the Office for Outer Space Affairs within the Department for Political Affairs.

The Office implements the decisions of the General Assembly and of the Committee on the Peaceful Uses of Outer Space and its two Subcommittees: the Scientific and Technical Subcommittee and the Legal Subcommittee. The Office is responsible for promoting international cooperation in the peaceful uses of outer space for social and economic development, particularly for the benefit of developing countries.

The Office implements the United Nations Programme on Space Applications, which assists Member States, in particular developing countries, in sharing the benefits of space science and technology and their application to economic and social development. Within the framework of the Programme, the Office organizes training courses, workshops, seminars and other activities to increase awareness of space benefits and to strengthen the capacity of developing countries in space applications in areas such as remote sensing, satellite communications, satellite meteorology, basic space science, satellite navigation and space law. Since its inception in 1971, the Programme has organized, among other activities, about 200 training courses, workshops and conferences attended by more than 10,000 participants.

The Office also carries out pilot projects on various space applications as a follow-up to workshops and training courses.

On behalf of the Secretary-General, the Office maintains the Register of Objects Launched into Outer Space and disseminates information contained therein. As part of its technical assistance in the area of international space law, the Office provides a searchable index to the Status of United Nations Treaties Governing Activities in Outer Space, which is now available online. The Office prepares and distributes reports, studies and publications on various fields of space science and technology and their application, as well as on international space law.

The Office provided the substantive secretariat for the three United Nations Conferences on the Exploration and Peaceful Uses of Outer Space (UNISPACE), which were held in Vienna in 1968, 1982 and 1999. The Office now supports and participates in the implementation of the recommendations of UNISPACE III.

The Office has two sections: the Space Applications Section, which carries out the United Nations Programme on Space Applications, and the Committee Services and Research Section, which provides substantive secretariat services to the Committee, its two subcommittees and their subsidiary bodies.

The Office has a multinational staff, and has been headed by Mr. Sergio Camacho-Lara of Mexico since July 2002.