



Zero Emissions Technologies and Future Fuels: Sustainability for Oil, Gas and Coal

**Strategy of the International Energy Agency,
Working Party on Fossil Fuels (WPFF)
(2010 – 2012)**

**Briefing on the Strategic Context, Approach and
Flagship Activities**

DRAFT: March 29, 2010



Zero Emissions Technologies and Future Fuels: Sustainability with Oil, Gas and Coal

WPF Strategic Context

Strategic Context: Overarching Dimensions

Energy Demand, Supply and Security



Rapid Population Growth and Need for Affordable Energy
Long-Term Energy Demand Growth
Emerging Supply Constraints
Energy Security Driving Fuel Diversity, Efficiency, Flexibility
Fossil Fuels Indispensable to Meeting Long-Term Global Energy Needs

Global Climate Change



Impacts Potentially Costly and Destabilizing
Energy Sector Largest Contributor to GHG Emissions
Urgent and Daunting Scale of Stabilization Challenge
Global Technology Portfolio Deployment with CCS Critical

Energy Technology Systems



Large-Scale; Capital Intensive
Slow Capital Turnover Rates
Long Project Development Timelines
Massive Infrastructure Investment Requirements
Workforce Issues
New Commercial and Policy Frameworks to Attract Private Investment

Global Leadership and Cooperation



Concerted Action and Sustained Leadership to Accelerate Technology Deployment
Unprecedented Levels of Technical, Political and Scientific Cooperation
Science and Engineering Education Needs
Global Engagement

Strategic Context: Key WPPF Messages

The World Economy Runs Almost Entirely on Fossil Fuels

Long-Term Energy Demand Growth Requires a Portfolio of Supplies

Continued Reliance on Fossil Fuels Drives Urgency of CCS Deployment

Rapid “Motorisation” is Driving Increases in Oil Demand

Constraints in Conventional Oil Supplies Call for Flexible “Future Fuels”

The Expanding Portfolio of Fossil Fuel Technologies Offer Improved Flexibility, Efficiency and Sustainability

Government Role in Energy Technology Demonstration and Early Deployment is Critical

The WPPF’s new strategy, *Zero Emissions Technologies and Future Fuels: Sustainability for Oil, Gas and Coal* will take action on a range of key fossil energy issues under three strategic platforms: Future Fuels; G8 Follow-up and CCS Implementation and Global Outreach. These key messages set the strategic context for the WPPF’s new approach, strategic work platforms and flagship activities.

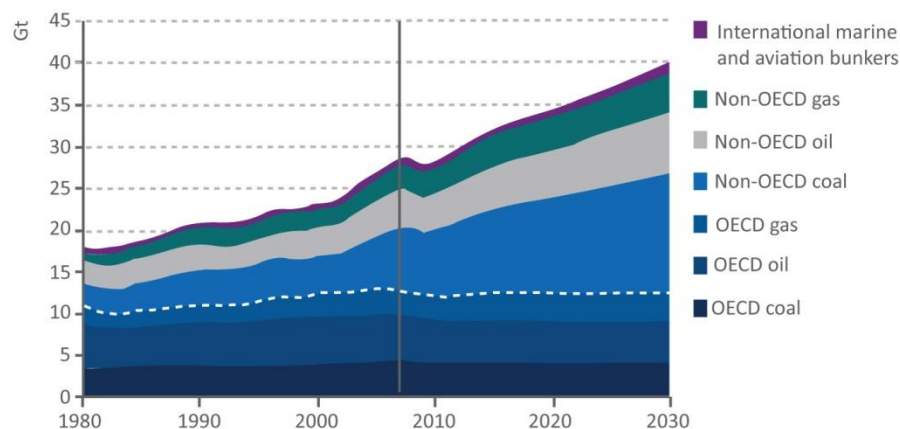
Strategic Context: The World Economy Runs Almost Entirely on Fossil Fuels

Long-Term Energy Demand Growth Requires Global Commitments to Energy Security and Sustainability

Non-OECD Countries Will Account for Most Energy-Related CO₂ Emissions Growth

The world economy runs almost entirely on fossil fuels and established trends indicate they will continue to be a significant share of the global energy mix over the long-term. In the IEA's reference scenario, primary world energy demand – driven by population and economic growth – will increase significantly, 45% between now and 2030 or an average of 1.6% per year. Fossil fuels will account for more than 75% of incremental demand, 90% from non-OECD countries with China and India alone accounting for over half. Even the very ambitious scenario to stabilise CO₂ emissions at the 450 ppm scenario calls for fossil fuels to provide 65% of the world's energy. Part of the WPF's strategic focus is to help build global commitments to affordable, reliable and secure energy supplies that are brought to market and utilized in an environmentally sound and sustainable manner.

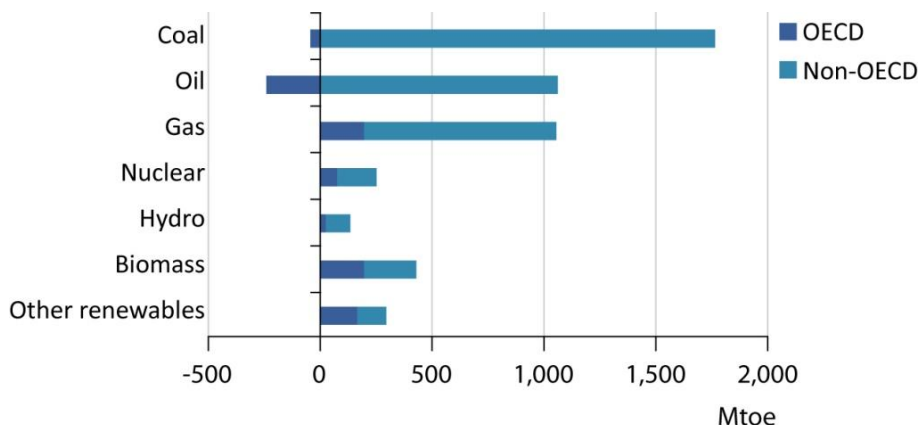
Energy-related CO₂ Emissions by Fuel and Region (Reference Scenario)



Worldwide, 61% of GHG emissions are linked to energy production, delivery and use. Current trends indicate that nearly all new energy demand and 97% of CO₂ emissions growth is expected to come from non-OECD countries. This development will require major investments not only in energy supply infrastructure for coal, oil and natural gas but also technologies to mitigate CO₂ emissions and other environmental impacts. Furthermore, global engagement among OECD and non-OECD countries is needed to build capacity and share knowledge and best practices on energy supply and low carbon energy technology deployment strategies. WPF's global outreach to IEA non-members is a key part of its strategic efforts.

Non-OECD Countries Are Driving Future Energy Demand

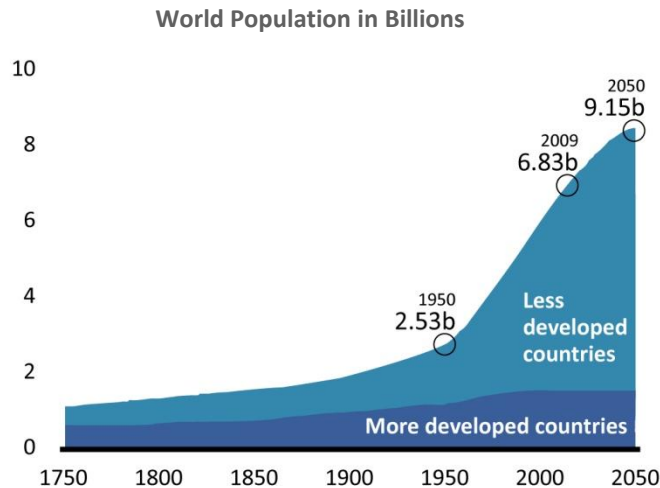
Change in Energy Demand by OECD and Non-OECD Regions



Strategic Context: Long-Term Energy Demand Growth Requires a Portfolio of Sustainable Supplies

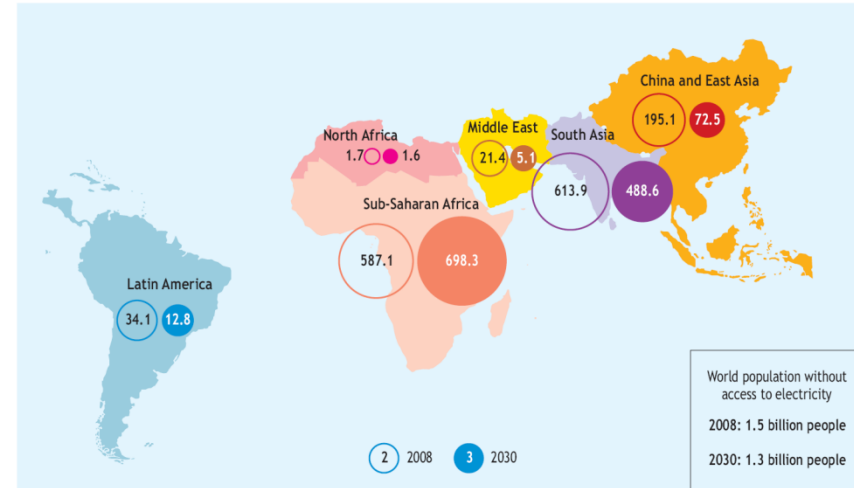
Energy Poverty Mitigation Calls for Affordable Fossil Energy Supplies and Global Strategies for Sustainable Development

World population, especially in non-OECD countries, is growing rapidly and economic prosperity and modern energy is not evenly distributed. Some regions lack the most basic energy services – today, about 1.5 billion people have no access electricity and round 2.5 billion people, or almost 40 % of the global population, rely on traditional biomass such as wood and dung for heating and cooking.



Some Regions Lack the Most Basic Energy Services

World Population Without Access to Electricity
2008: 1.5 Billion People and 2030: 1.3 Billion People



The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

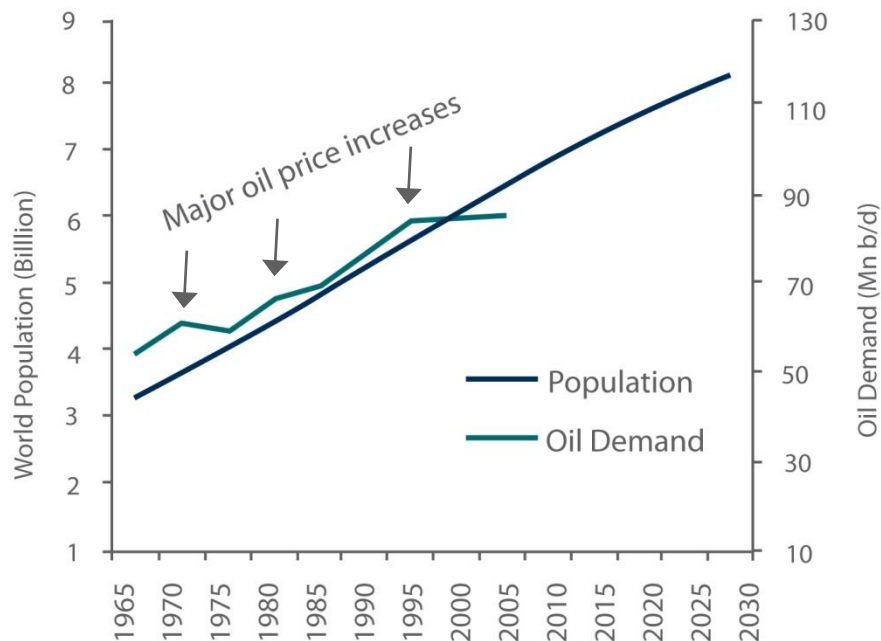
While energy poverty remains a major issue, many countries with large populations such as China and India are quickly growing their economies and per capita income, energy use and CO₂ emissions. As per capita income and energy use increase, the transition to commercial energy sources such as electricity, natural gas and petroleum products permit the use of modern technologies that transform economies, improve living standards and help support sustainable development. However, the resulting growth in CO₂ emissions is a major challenge. A key WPFf commitment is to advance global strategies for affordable, sustainable energy supplies that address CO₂ emissions .

Strategic Context: Rapid “Motorisation” is Driving Increases in Oil Demand

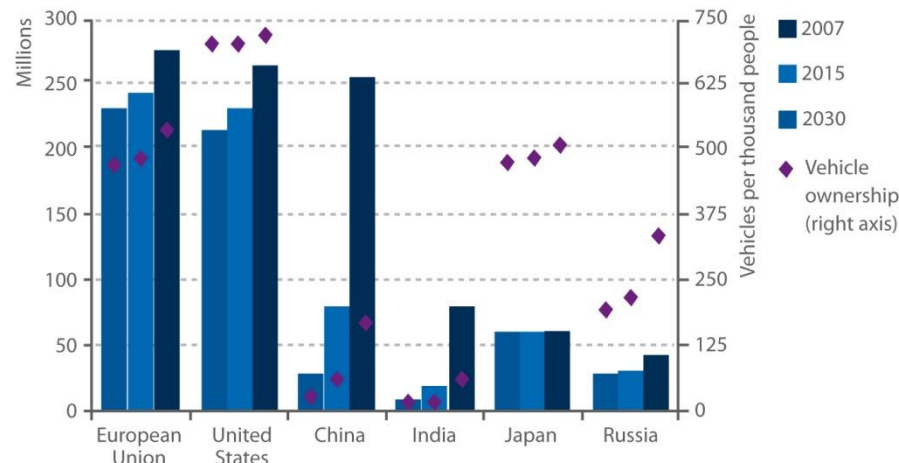
As Population and Economies Grow, Auto Ownership Increases and Becomes a Key Driver for Oil Demand

Non-OECD Countries Are Rapidly “Motorising”

Oil demand is a function of population and GDP growth and as both continue to increase, oil demand is projected to increase as well. China is a key driver of global oil demand growth, accounting for half of the world’s total. Furthermore, around 75% of the projected demand increase comes from the growing transportation sector.



Passenger Light-Duty Vehicle Fleet & Ownership Rates (IEA Reference Scenario)



China and India’s huge and growing populations are quickly “motorising” by increasing rates of vehicle ownership. In 2009, China overtook the U.S. as the world’s largest auto market with 13.5 million vehicles sold vs. 10 million in the U.S. Auto sales, demand for transportation fuels and CO₂ emissions growth from transportation has shifted to non-OECD countries. One of the most cost effective measures to reduce CO₂ emissions from transport and manage demand is through fuel economy improvements. Other promising options that the WPF is advancing include alternative fuels production with CCS applications such as hydrogen, biofuels, coal-to-liquids (CTL), gas-to-liquids (GTL) as well as electrification.

Failure to meet oil demand projections could result in upward pressure on oil prices. While high oil prices can dampen discretionary oil demand, it historically rebounds when oil prices decline and continues its growth trajectory along with growth in world population.

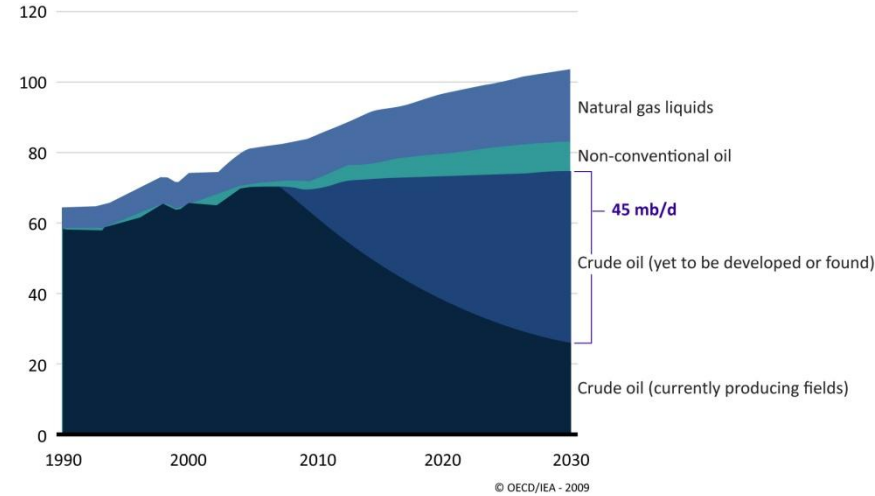
Strategic Context: Constrains in Conventional Oil Supplies Call for Flexible “Future Fuels”

Increasing Demand for Transport Fuels Requires Flexibility of Supply Options from Unconventional Liquid Fuels

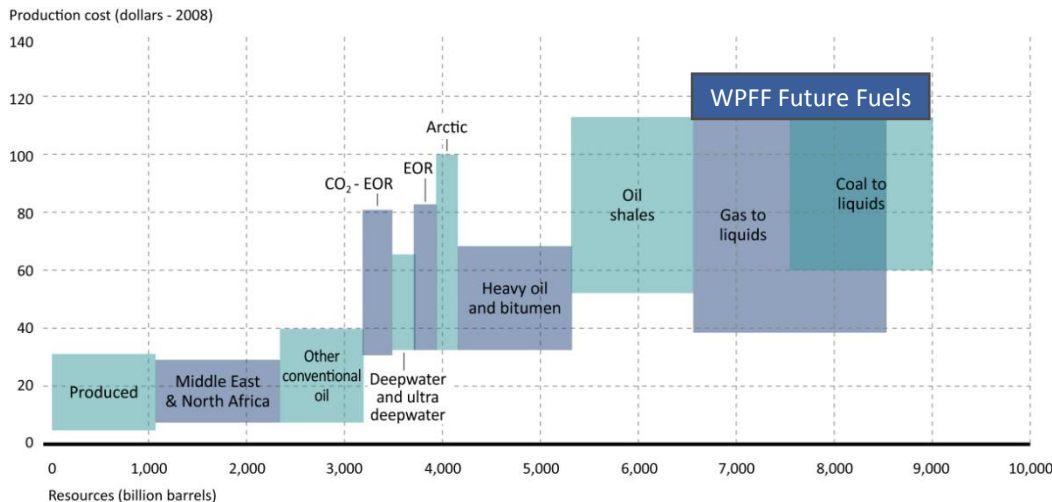
Supply Constraints in Conventional Oil Production

Oil and the transport sector are inextricably linked and increasing demand for transport fuels requires the flexibility of new supply options such as unconventional fossil fuels or “future fuels.” Current global liquids production is about 85 million barrels per day and many experts anticipate near-term declines in conventional production. Just to keep current supply flat, an additional 45 million barrels per day – roughly four times the capacity of Saudi Arabia – will be needed. The supply gap left by the decline of conventional oil production can be met by synthesizing unconventional fossil fuel such as GTL and CTL into transportation fuels, a key focus of the WPF Future Fuels Strategic Work Platform.

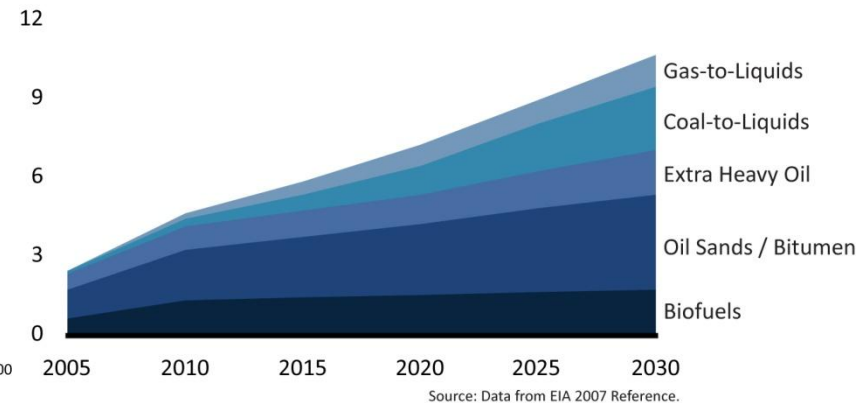
World Oil Production (million barrels per day)



IEA Resources-to-Reserves – Production Cost Curve



Global Production of Unconventional Liquids (million barrels per day)



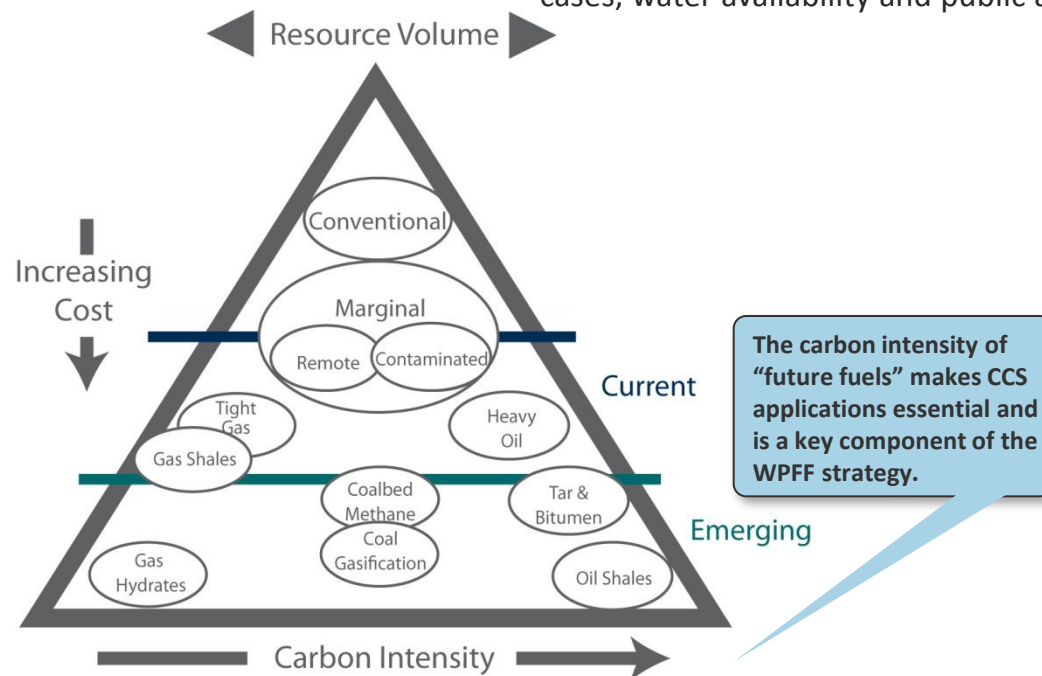
Strategic Context: Constraints in Conventional Oil Supplies Call for Flexible “Future Fuels”

“Future Fuels” Can Enhance Supply Security but Issues Related to Cost and Carbon Footprints Must be Addressed

Maturing conventional oil and gas fields and slowing production are raising the importance of unconventional hydrocarbons or “future fuels” as an energy source. Unconventional fossil fuels include an array of resources that, depending on the conversion technology and configuration, can be utilized to produce transportation fuels, electricity, chemicals, hydrogen, heat and power or a combination. Globally, there are massive resources of unconventional fossil fuels but a number of challenges – socio and economic, environmental and technical – must be addressed by the public and private sectors before there is significant production.

Challenges to Large-Scale Production

The key challenges of large-scale “future fuels” production is that they are carbon intensive and in general, technically challenging to extract and require more energy to access and produce into suitable transport fuels than conventional supplies. Consequently, they are more expensive and have greater life-cycle CO₂ emissions. The volume brought to market will depend on many factors including: cost and availability of conventional oil; investment levels; technology improvements; CCS applications; environmental regulations and in many cases, water availability and public acceptability.





Zero Emissions Technologies and Future Fuels: Sustainability for Oil, Gas and Coal

WPF Strategic Approach

WPPF Strategic Work Platforms

Zero Emissions Technologies and Future Fuels: Sustainability for Oil, Gas and Coal

2010 - 2012

The growing energy security and sustainability challenges arising from the WPPF strategic context outlined in the previous slides call for urgent international awareness and concerted action among national governments, organizations and the private sector. The need for collective responses to these challenges represent the key context for the WPPF's Mission and current strategy encompassing three strategic work platforms:

Future Fuels

Focus: Next-Generation Fossil Fuels

Explore and engage in dialogue on the implications of future fossil fuel related market and technology trends for energy security, sustainability, economic impacts and importance to IEA member countries.

G8 Follow-up and CCS Implementation

Focus: International Concerted Action and Coordination of High-Level National Policy Responses to CCS Priorities

Mobilize both concerted action at the international level and high-level national responses, to follow-up and facilitate implementation of the IEA's 27 CCS recommendations to the G8 and the G8's recommendation to governments to deploy 20 large-scale CCS demonstration projects by 2020.

Global Outreach

Focus: Partnerships with Key Countries and Stakeholders on WPPF Strategic Priorities

Raise awareness and facilitate regular exchanges on progress of fossil fuel issues and build broader consensus and synergies on strategic priorities with key fossil energy consuming and producing non-member countries and stakeholder groups.

Each strategic work platforms will direct activities on a broad range of key fossil fuel and technology issues to ensure the sustainability of oil, gas and coal in meeting world energy demand growth.

WPF Strategic Work Platform: Future Fuels

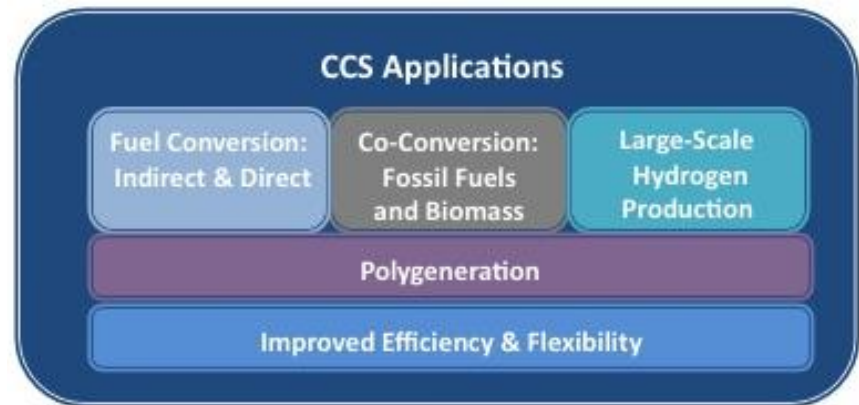
Future Fuels

How fast and how large the “future fuels” industry grows to help fill the supply gap left by declining conventional oil production depends on their economic competitiveness with other liquid fuels and how the technical, socio-economic, environmental challenges are resolved. Sustainable use of these “future fuels” requires policy measures to help mitigate project risks but there must also be continued advancement of a portfolio of technologies that enhance efficiency, environmental performance, reliability and fuel flexibility while lowering costs and carbon footprints.

Focus: Next-Generation Fossil Fuels

Explore and engage in dialogue on the implications of future fossil related technological trends for energy security and sustainability, including economic impacts and the importance to IEA member countries of relevant energy developments.

WPF Future Fuels Focus Areas



The WPF will focus its Future Fuels activities on a variety of fuel conversion and co-conversion technologies, large-scale hydrogen production from fossil fuels and the cross-cutting areas of polygeneration, improved efficiency and fuel flexibility. CCS applications for all these technology areas are key.

WPPF Strategic Work Platform: Future Fuels

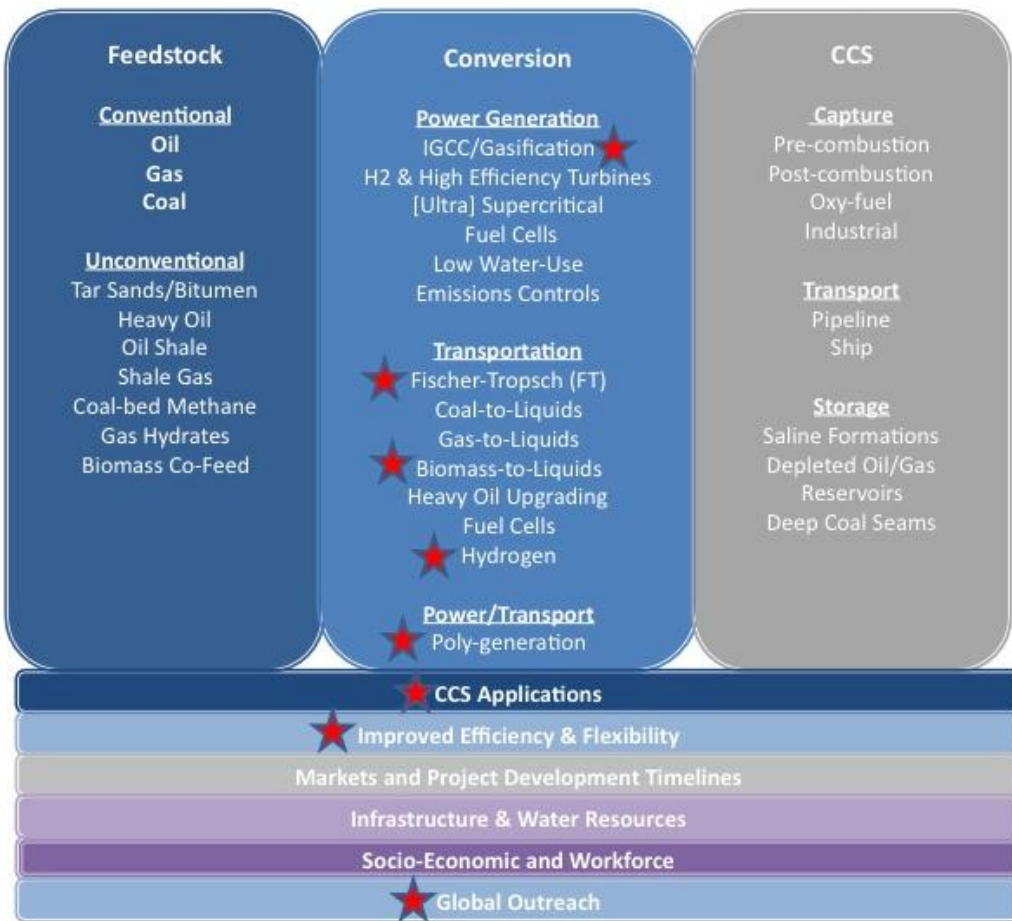
Technologies Offer Increased System Flexibility, Efficiency and Sustainability

Flexibility Offers a Pathway Toward Energy Security and Sustainability

A variety of fossil fuel feedstocks can be utilised to deliver one or more forms of energy such as electricity, a variety of transportation fuels, large-scale hydrogen, heating or cooling, chemicals or ammonia. This increased fuel flexibility and product versatility offers many advantages including a strategic path towards greater energy sustainability.

CCS Applications Are Critical

CCS applications for various fossil fuel technology configurations is a critical necessity and one of the WPPF's strategic priorities. CCS systems are the only technologies available to mitigate CO₂ emissions from large-scale power plants and industrial facilities and could reduce the cost of stabilizing atmospheric concentrations of CO₂ emissions by trillions of dollars. Given the continued reliance on fossil fuels, CCS systems are an essential component of a portfolio of energy technology solutions.



★
WPPF strategic
focus areas

The best way to manage supply risk, increase energy security, improve carbon management and environmental performance is through investments, spread across energy sources, technologies and supply infrastructure.

WPF Strategic Work Platform: G8 Follow-up and CCS Implementation

G8 Follow-up and CCS Implementation

Since 2005, the WPF has supported the IEA's contribution to the *Gleneagles G8 Plan of Action on Climate Change, Clean Energy and Sustainable Development* and in 2008, the IEA, in partnership with the Carbon Sequestration Leadership Forum (CSLF), provided 27 recommendations to the G8 on near-term CCS opportunities. In turn, at the Hokkaido Summit in July 2008, G8 leaders recommended CCS-related actions, including deployment of 20 large-scale demonstration projects by 2020, which are the priority of the WPF's G8 Follow-up and CCS Implementation focus areas.

Focus: International Concerted Action and Coordination of High-Level National Responses to CCS Priorities

Mobilize both concerted action at the international level and high-level national responses to follow-up and facilitate implementation of the IEA's 27 CCS recommendations to the G8 and the G8's recommendation to governments to deploy 20 large-scale CCS demonstration projects by 2020. Flagship activities will include:

IEA WPF G8 Follow-up and CCS Implementation Focus Areas

20 Large-Scale CCS Demonstration Projects by 2020

CCS Technology Roadmaps and Global Cooperation

Policy Measures to Accelerate Commercial CCS Deployment

Governments have a key role to play developing policy measures to accelerate technology demonstration and deployment. To mitigate project risks and enhance availability to financing, the WPF will work with governments to take a long-term sustainable approach that may include: clear regulatory frameworks, processes to fast-tracking technology demonstrations and incentives to mobilize private investments.

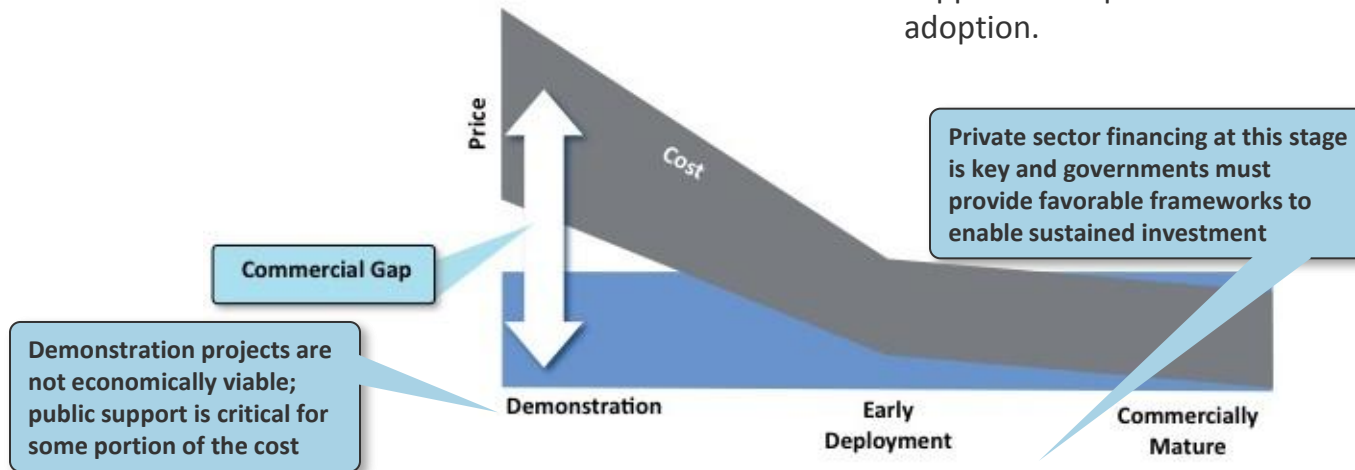
WPF Strategic Work Platform: G8 Follow-up and CCS Implementation

Government Role in Energy Technology Demonstration and Early Deployment is Critical

The challenges of meeting growing energy demand while ensuring sustainable supplies and combating climate change requires huge investments, largely in non-OECD countries, in massive, capital intensive energy systems. Yet the challenge is compounded by the slow turnover rate of fossil fuel technologies (typically 50-60 years for power plants) that will need to transition to low-carbon solutions. New energy investments must be technically, commercially and financially viable over these long project lifetimes.

Slow Turnover of Energy Systems is a Challenge for the Deployment of Low-Carbon Technologies

Energy technology innovation is a slow moving and complex set of processes that leads to the widespread commercial deployment of new and improved technologies and the knowledge and practices to support their effective use. Both public and private sector engagement is critical and governments have a key role in the early deployment stage when technologies are not economic on a standalone basis and require public support to help accelerate them toward commercial adoption.



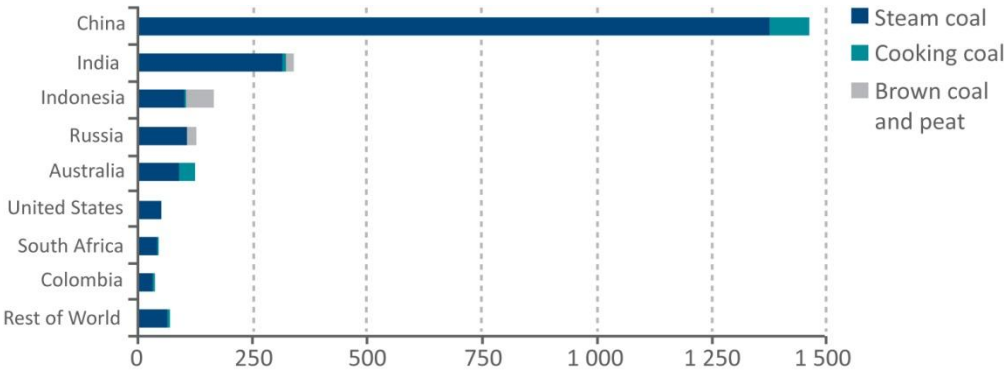
The demonstration phase is critical to “learn by doing.” It is an opportunity to upscale technology, share knowledge, understand and improve operating performance, determine true costs, inform emerging regulatory frameworks and promote the formation of business capacity needed for commercial deployment. Given the importance of government policies and incentives for the economic viability of new energy technologies, a key WPF priority is to work with IEA member governments to develop policy measures to accelerate commercial deployment and create an environment for knowledge sharing and long-term sustained private investment.

WPF Strategic Work Platform: G8 Follow-up and CCS Implementation

Continued Reliance of Fossil Fuels Drives Urgency of CCS Deployment

Economic growth in the fastest growing non-OECD countries such as China and India is largely fuelled by coal in the electric power sector, where the vast majority of the world's new coal-fired power plants are being built. Coal is attractive because it is a broadly available, affordable and secure domestic source of energy yet is production and use present challenges.

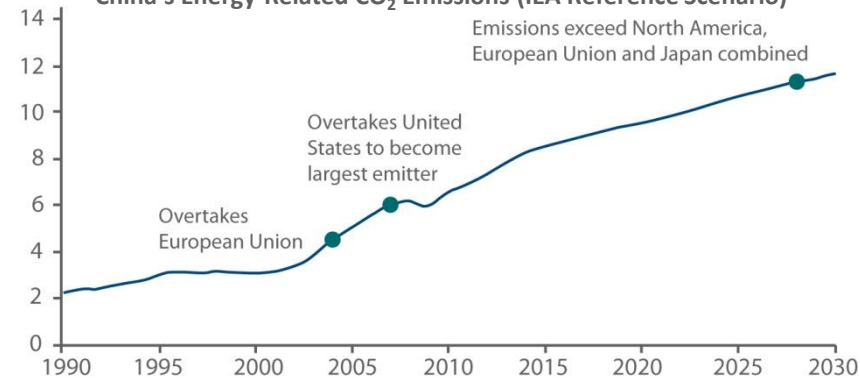
Incremental Coal Production by Type and Region, 2007-2030 (IEA Reference Scenario)



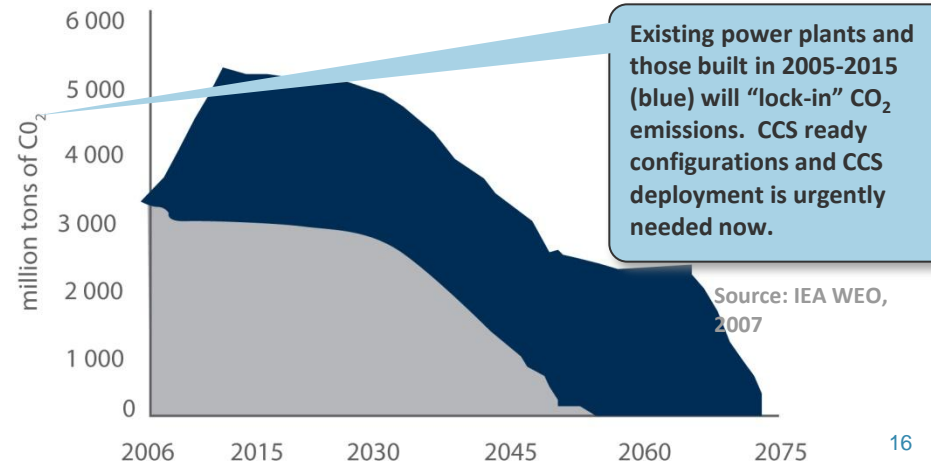
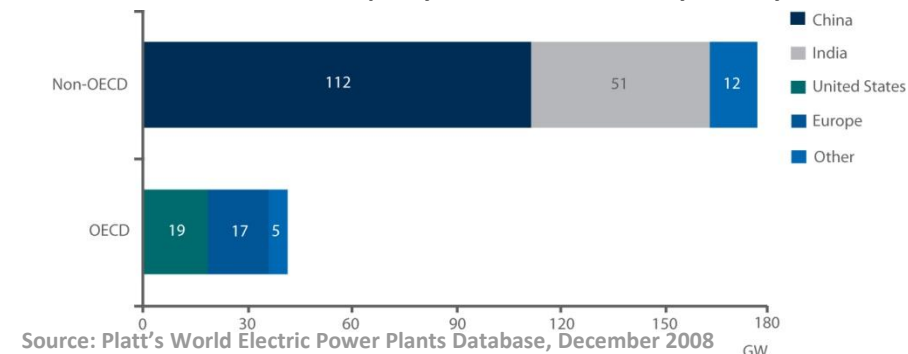
CCS Deployment in Non-OECD Countries is Critical

Continued long-term reliance on coal and other fossil fuels call for strategies to mitigate CO₂ emissions, a core WPF priority. Although 75% of power sector CO₂ emissions in 2020 are already "locked in" by current technology, investments in the next decade, especially in CCS technologies, are critical to a low-carbon future.

China's Energy-Related CO₂ Emissions (IEA Reference Scenario)



Coal-fired Power Generation Capacity Under Construction by Country in 2008



WPF Strategic Work Platform: Global Outreach

Global Outreach

The global challenges outlined in the WPF strategy call for urgent international awareness and concerted action on the part of national governments, organisations and the private sector. The WPF will engage in global outreach with IEA member and non-member governments, key stakeholders, initiatives and organisations involved with fossil fuel technology issues.

Focus: Partnerships with Key Countries and Stakeholders on WPF Strategic Priorities

Raise awareness and facilitate regular exchanges on progress of fossil fuel issues and build broader consensus and synergies on strategic priorities with key fossil energy consuming and producing non-member countries and stakeholder groups.

IEA WPF G8 Global Outreach Focus Areas

Partner in Dialogue Processes with G8 Plus 5 and other Non-Member IEA Countries

WPF Implementing Agreements and IEA Oil and Gas Advisory Committee

Collaboration with Key Stakeholders

Collaboration with CCS Initiatives and Organisations (CSLF, GCCSI, EU ZEP, US Regional Partnership, APEC, WEC)



Zero Emissions Technologies and Future Fuels: Sustainability for Oil, Gas and Coal

WPF Flagship Activities

Flagship Activities

Future Fuels

- Examine conditions under which “future fuels” can make a contribution to filling the supply gap left from declines in conventional oil supplies and assess environmental, technology, and policy needs.
- Review polygeneration projects worldwide to understand the advantages and disadvantages of various concepts and configurations.
- In cooperation with the Hydrogen Implementing Agreement, examine the current status and scale of large-scale hydrogen production projects using fossil fuels and quantify production volumes, supply routes and uses.

G8 Follow-up and CCS Implementation

- Conduct the workshop, *CCS: Bridging the Commercial Gap*, in New York, NY on 29-30 September 2009 to address the G8 recommendation to develop financial incentives to accelerate CCS deployment.
- Conduct the *CCS Ready Workshop* in Ottawa Canada on 11 March 2010 to advance the G8 recommendation to define the concept.
- Support CCS Financing Roundtable discussions on commercial and financial structuring of commercial-scale projects with CCS in London (January 2010) and Washington, DC (April 2010).
- Conduct the *Peer Review Workshop: Status of the G8’s Recommendation to Launch 20 Large-scale CCS Demonstration Projects by 2010*, in Genoa, Italy on 15-16 April 2010; prepare a workshop report for the IEA / G8 CCS Implementing Process.

Global Outreach

- Assess global outreach needs and develop regional strategies.
- WPF 58th Meeting + Workshop on Next Generation Fossil Fuels 8 – 11 June 2010 in Beijing to discuss collaboration on WPF activities with China.

Flagship Activities, cont.

Future Fuels

G8 Follow-up and
CCS Implementation

Global Outreach

- Conduct a study on internal financing frameworks for CCS deployment with a focus on mechanisms for developing countries
- Conduct the workshop, *Peer Review: Status of the G8's Recommendation to Launch 20 Large-scale CCS Demonstration Projects by 2010*, in Genoa, Italy on 15-16 April 2010. The WPF will prepare a workshop report for submission to the IEA / G8 CCS Implementing Process.



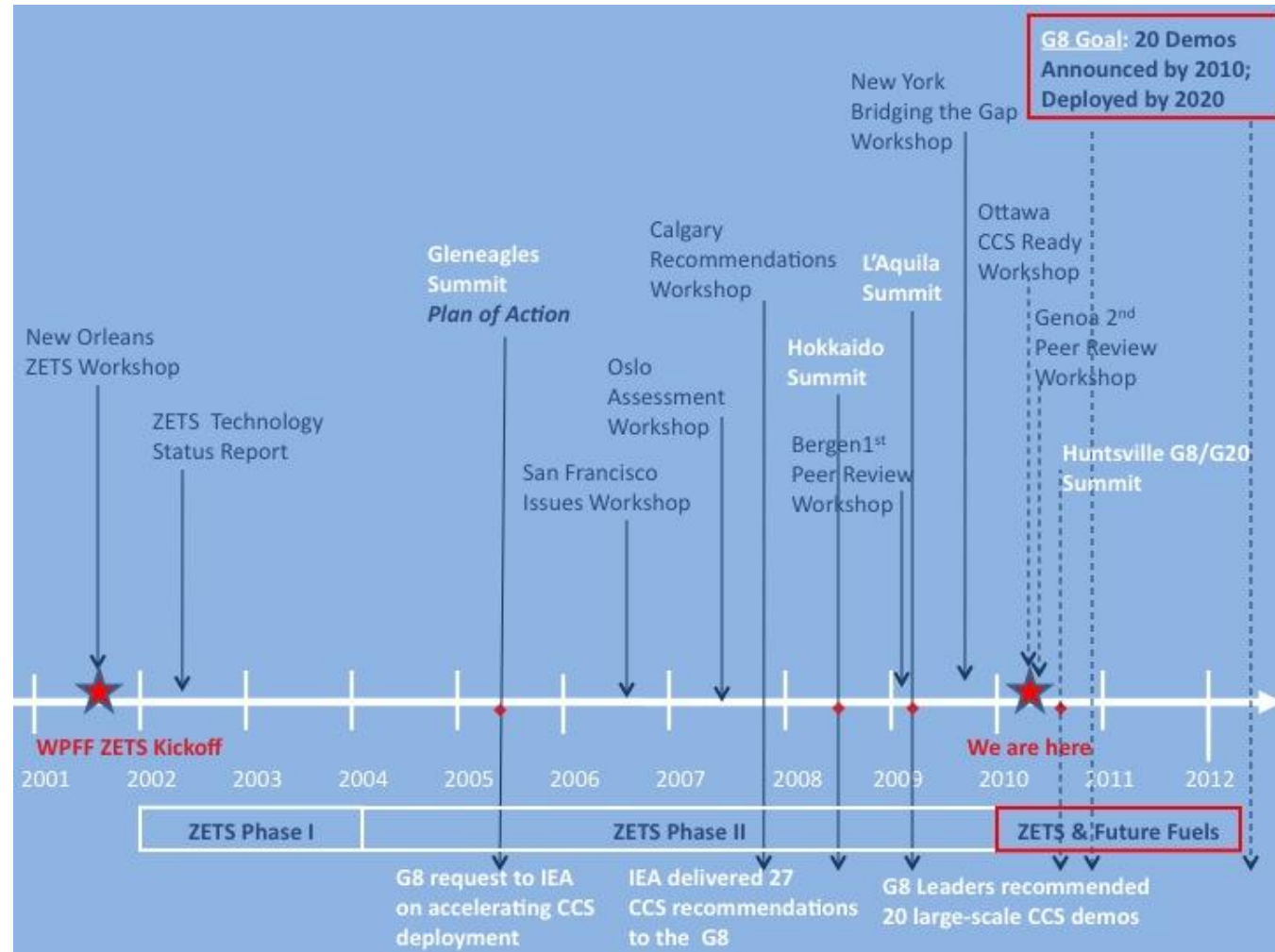
Zero Emissions Technologies and Future Fuels: Sustainability for Oil, Gas and Coal

Annexed Information

WPF High-Impact Success: Continuation Under New Strategy (2010 – 2012)

In 2002, the WPF launched its strategy, *Zero Emissions Technologies (ZETS) for Fossil Fuels*, implemented in two phases. ZETS advanced carbon capture and storage (CCS) technologies in a number of key technical and non-technical areas including high-level interactions with the G8.

The WPF's new strategy, *Zero Emissions Technologies and Future Fuels: Sustainability for Oil, Gas and Coal* will continue its focus on CCS technologies but will also take action on a broader range of key fossil energy issues under three strategic platforms: Future Fuels; G8 Follow-up and CCS Implementation and Global Outreach.



IEA Working Party on Fossil Fuels (WPPF) Mandate and Organization

Objectives:

The WPPF objectives are to provide the IEA with advice on:

- ▶ Fossil fuel technology-related policies, trends, projects and programmes.
- ▶ Strategies which address priority environmental protection and energy security interests, including adequate, flexible and reliable supply of fossil energy for member countries.
- ▶ Carry out activities to meet those needs through collaboration, outreach and dialogue.

In addition, the WPPF reflects the IEA's commitment to outreach. Collaboration with non-OECD Member countries, particularly the major fossil energy consuming and producing countries, is central to the WPPF's upcoming activities.

Chairman

Mr. Jostein Dahl-Karlsen
Norway

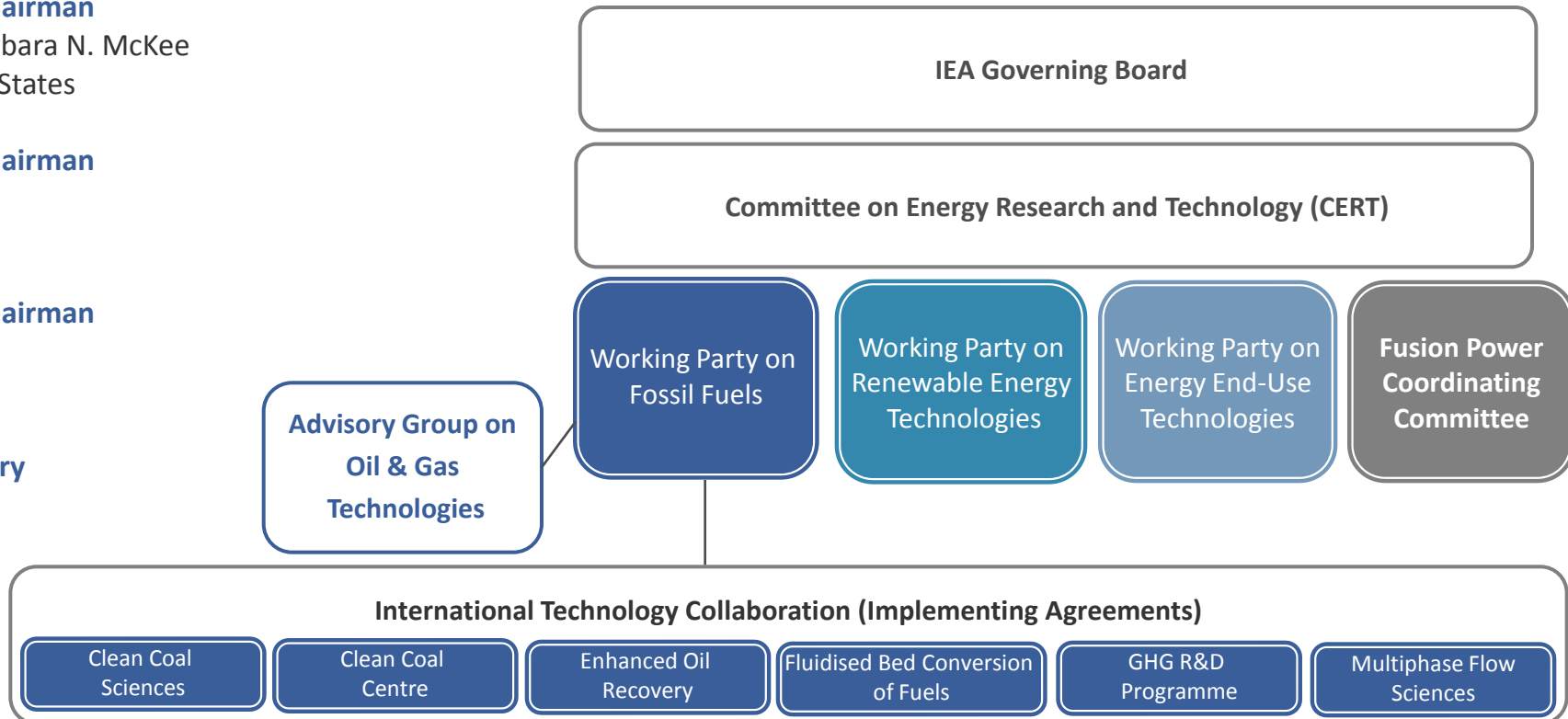
Vice-Chairman

Ms. Barbara N. McKee
United States

Vice-Chairman

Vice-Chairman

Secretary



International Energy Agency (IEA)

Energy Security

Promote diversity, efficiency and flexibility within the energy sectors of the IEA member countries. Remain prepared collectively to respond to energy emergencies. Expand international cooperation with all global players in the energy markets.

Environmental Protection

Enhance awareness of options for addressing the climate change challenge. Promote greenhouse gas emissions abatement, through enhanced energy efficiency and the use of cleaner fossil fuels. Develop more environmentally acceptable energy options.

Economic Growth

Ensure the stable supply of energy to IEA member countries and promote free markets in order to foster economic growth and eliminate energy poverty.

Engagement Worldwide

Energy issues transcend borders. All economies require access to energy to develop and grow. Environmental concerns affect everyone. The IEA is working closely with countries around the world to address energy challenges and find solutions.



IEA “Calgary” Recommendations to the G8 on Strategies to Accelerate CCS Deployment