# Climate Change & $CO_2$: An Energy Industry Perspective on Responsible Energy

**Joe Powell – Chief Scientist Chemical Engineering**

**Mahesh Iyer – Research Engineer**

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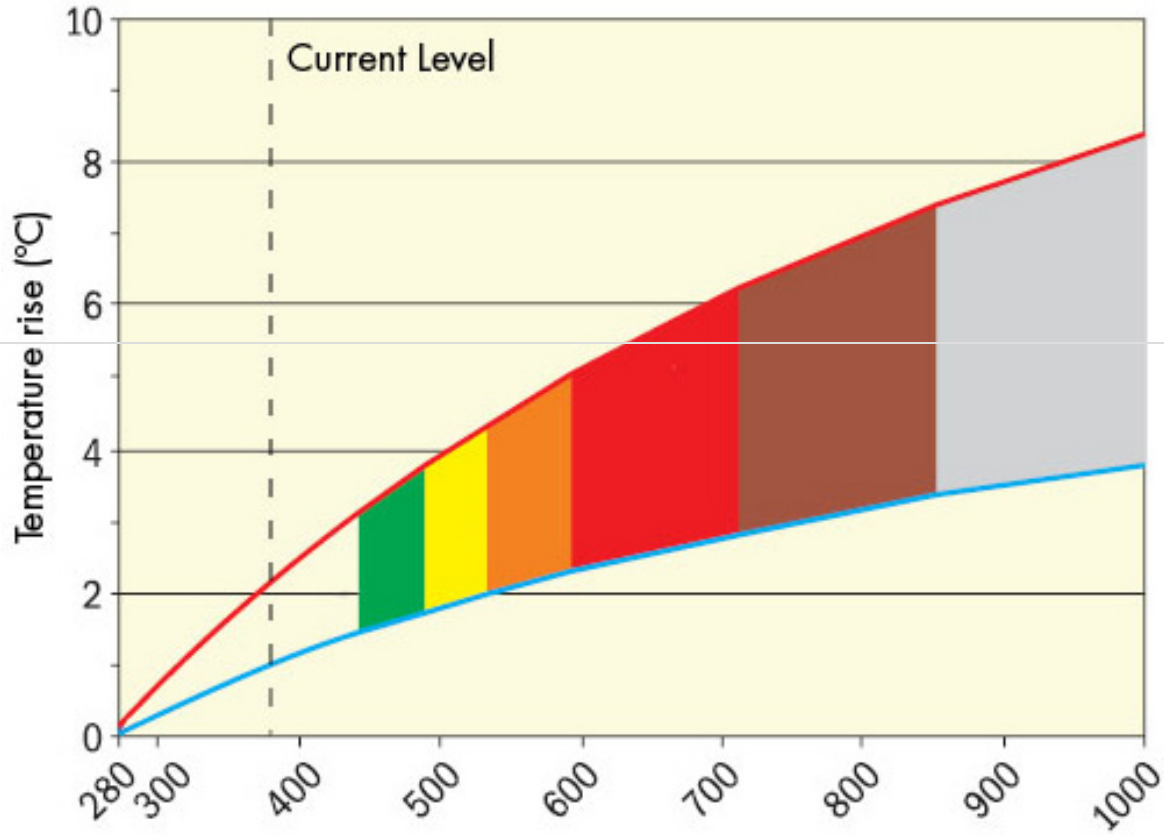
# Shell's position

- **We were one of the first energy companies to acknowledge the threat of climate change; to call for action by governments, our industry and energy users; and to take action ourselves.**
- **We have stepped up our appeals to government for urgent and wide-ranging policies, and our own efforts to develop the technologies needed to reduce CO2 emissions from our operations and products.**

http://www.shell.com/home/content/responsible_energy/environment/climate_change/

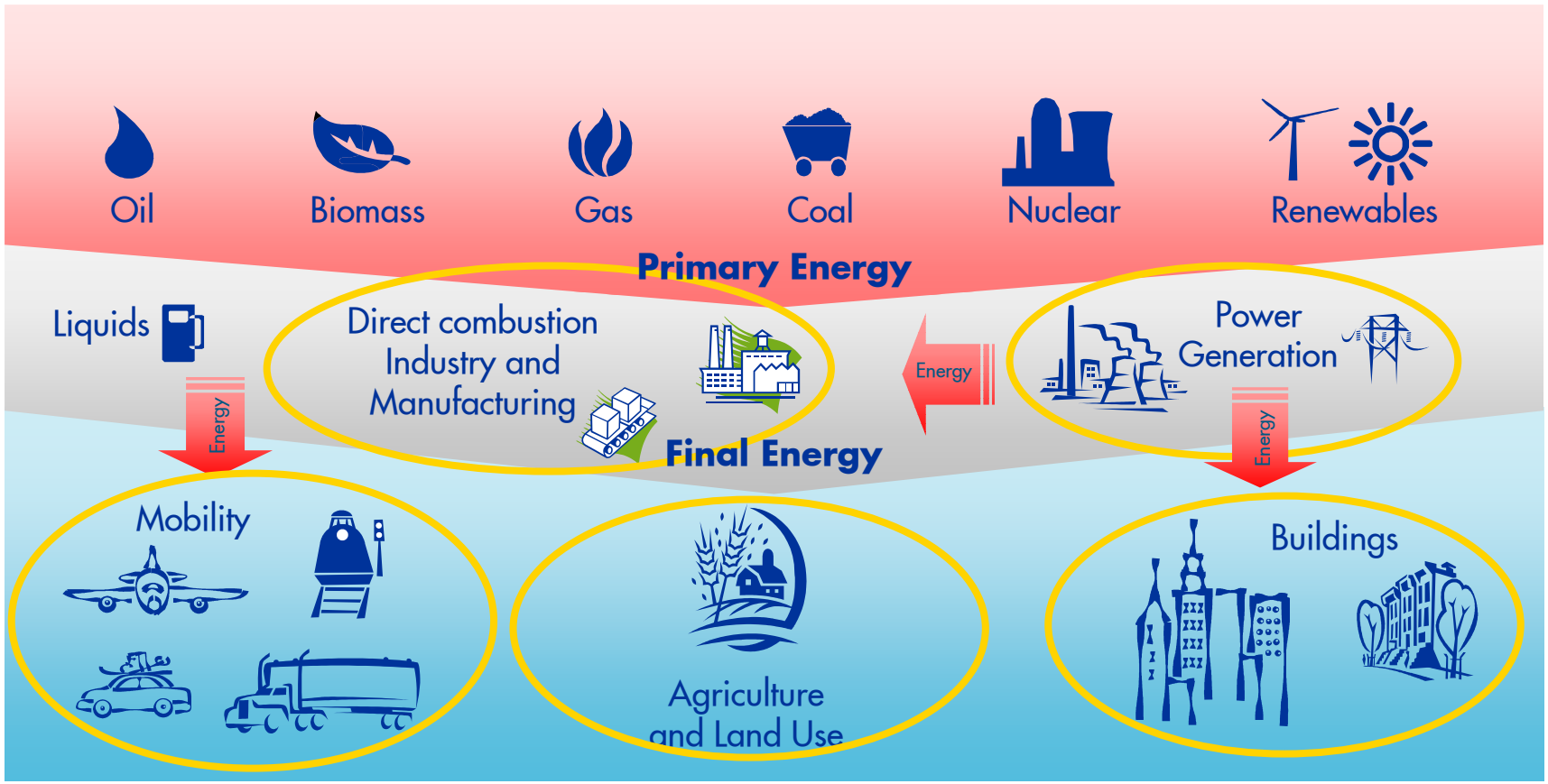
# Climate and $CO_2$: A serious global threat

**There is now a strong scientific consensus that recent changes in our global climate are almost certainly caused by human activity..**




Over the last century the amount of these greenhouse gases (GHGs) in our atmosphere has risen steadily, almost certainly as a result of human activity. For example, CO2 levels have risen from 280 parts per million (ppm) to nearly 380ppm, driven in large part by our usage of fossil fuels. Concentrations of other GHGs, like methane have also risen, mainly because of deforestation and more intensive agriculture.

# KEY SECTORS IN THE 'ENERGY AND $CO_2$ ECONOMY'



# KEY LEVERS IN THE ECONOMY

$$CO_2 \text{ emissions} = \text{People} \times \frac{\text{GDP}}{\text{Person}} \times \frac{\text{Energy}}{\text{unit GDP}} \times \frac{CO_2}{\text{unit energy}}$$

**Only four factors govern the outcome, being**

- Population Number of people
- Standard of Living GDP per person
- Energy Intensity Energy per unit of GDP (efficiency of the economy)
- Carbon Intensity $CO_2$ per unit of energy (reflects the energy source)

# OPTIONS FOR CHANGE - ENABLING TECHNOLOGIES

**Emission reduction ($CO_2$/unit energy)**

A further shift to natural gas

Nuclear power

Renewables

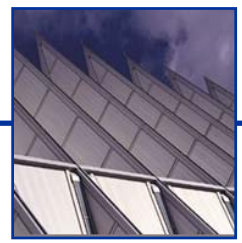
Bio-products

Carbon capture and storage

**Energy conservation and efficiency (energy/unit GDP)**

Mass transportation

Road transport



Buildings

Low energy appliances


Doing things differently

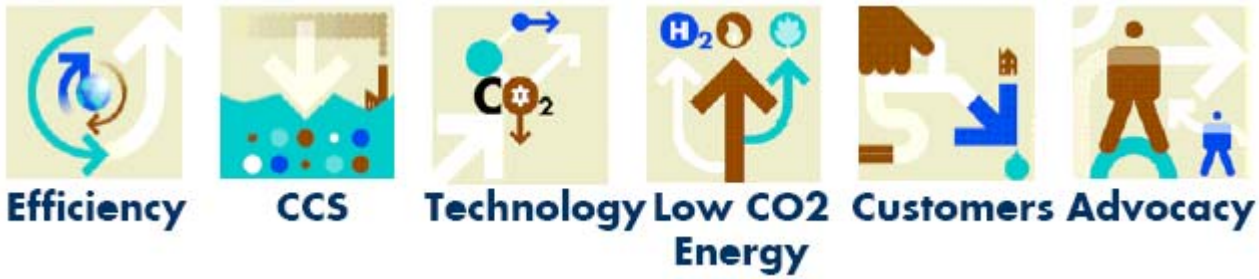

# 3-2-1-6-5 Strategy

## 3 - HARD TRUTHS


## 2 - SCENARIOS


## 1- PREFERED APPROACH


## 6 – REDUCTION PATHWAYS




## 5 - POLICY OBJECTIVES

# 3 - Hard Truths...

- The global demand for energy is growing, both in the developed and developing world.

- Supplies of “easy oil” - accessible, conventional oil and gas -
  cannot keep up with the growth in energy demand.

- More energy means more $CO_2$ emitted at a time when climate change looms as a critical global issue

# 2- Scenarios

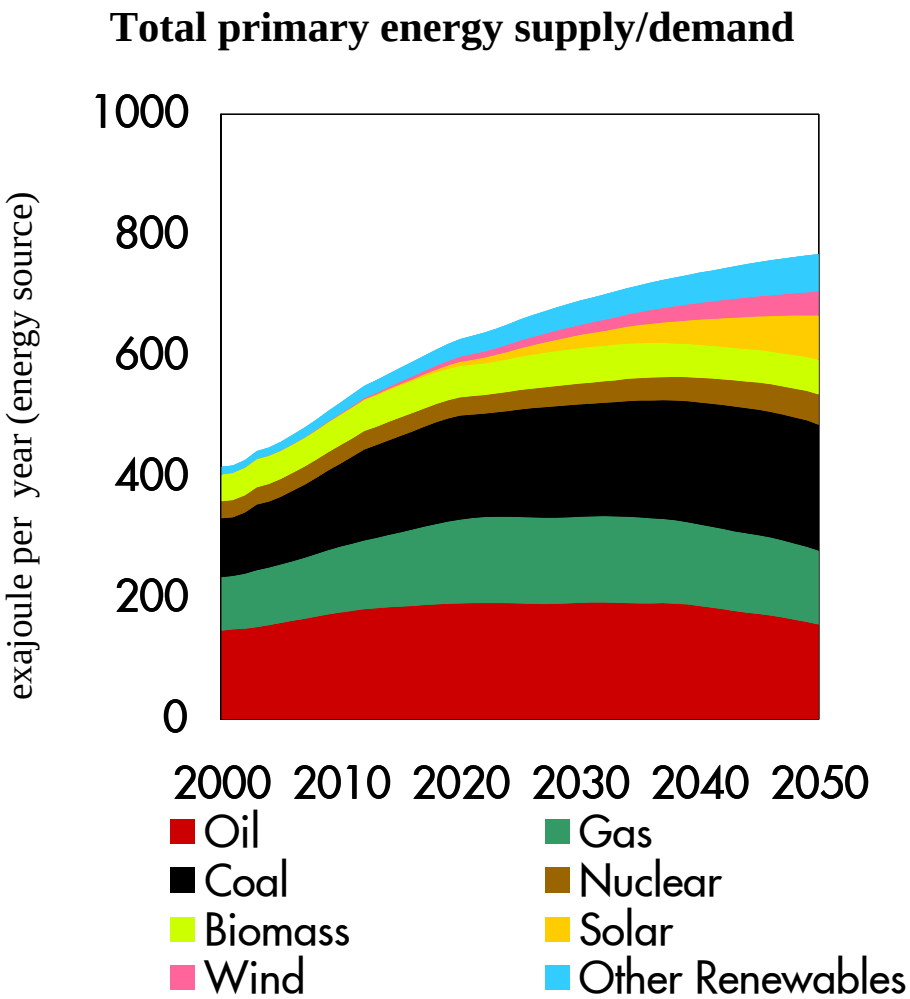
SCRAMBLE

In the first scenario – called **Scramble** – policymakers pay little attention to more efficient energy use until supplies are tight. Likewise, greenhouse gas emissions are not seriously addressed until there are major climate shocks.

BLUEPRINTS

In the second scenario – **Blueprints** – growing local actions begin to address the challenges of economic development, energy security and environmental pollution. A price is applied to a critical mass of emissions stimulating the development of clean energy technologies, such as CO2 capture and storage, and energy efficiency measures. The result is far lower CO2 emissions.

# Blueprints: What This Means for Energy

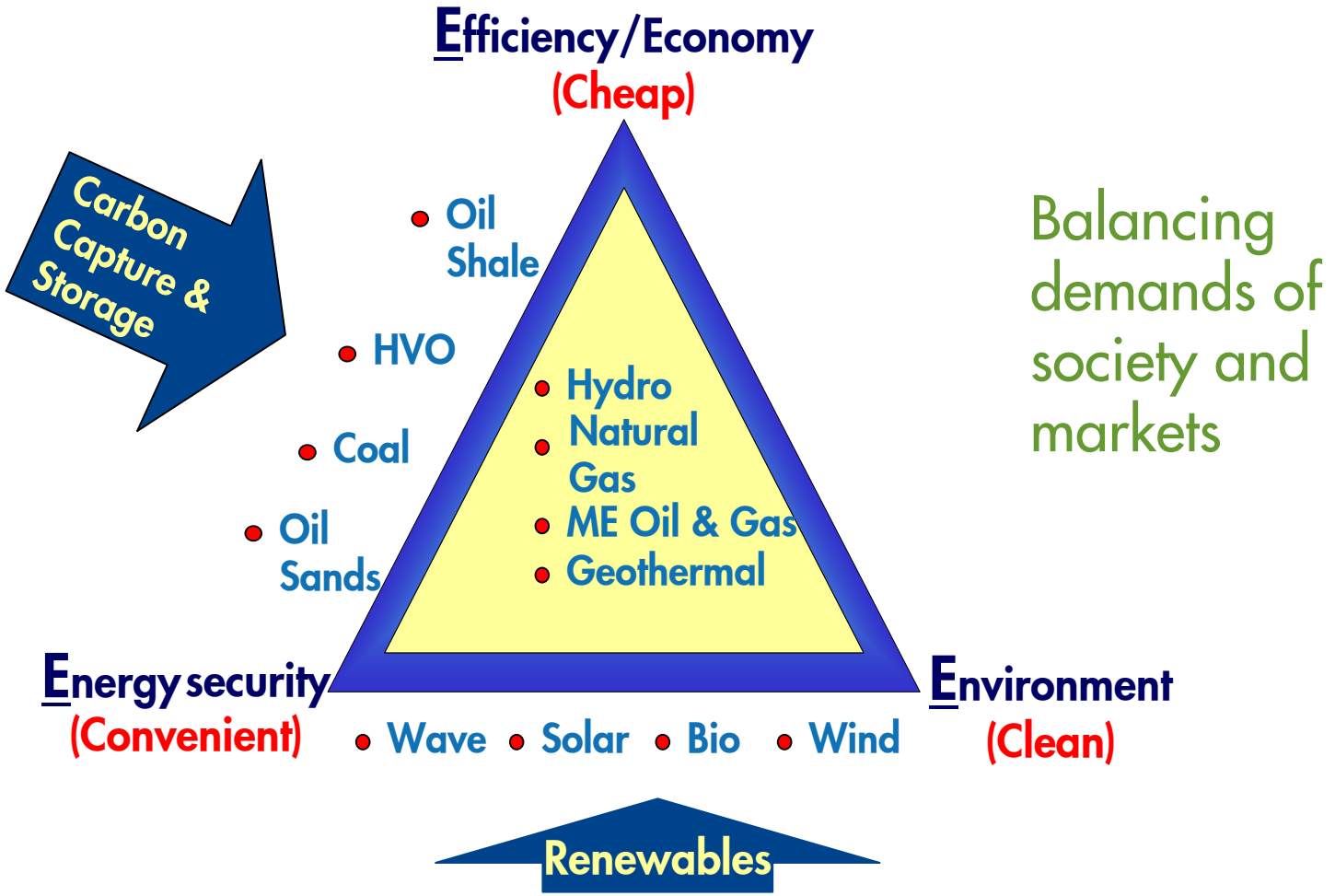



- Broader anticipation of challenges
- Critical mass of parallel responses to hard truths
- Effective carbon pricing established early
- Aggressive efficiency standards
- Growth shifts to electrification
- New infrastructure develops
- CCS emerges after 2020

Source: Shell International BV and Energy Balances of OECD and Non-OECD Countries©OECD/IEA 2006

# The Energy Challenge Trilemma

## The "three Cs" or "three Es"




Balancing demands of society and markets

# 6 - REDUCTION PATHWAYS


1. Increasing the efficiency of our operations, seeking to be first quartile.


2. Establishing a substantial capability in CO2 Capture and Storage (CCS).


3. Continuing to research and develop technologies that increase efficiency and reduce emissions in hydrocarbon production.


4. Aggressively developing low-CO2 sources of energy, including natural gas and low CO2 fuel options.


5. Helping manage energy demand by growing the market for products and services that help customers use less energy and emit less CO2.

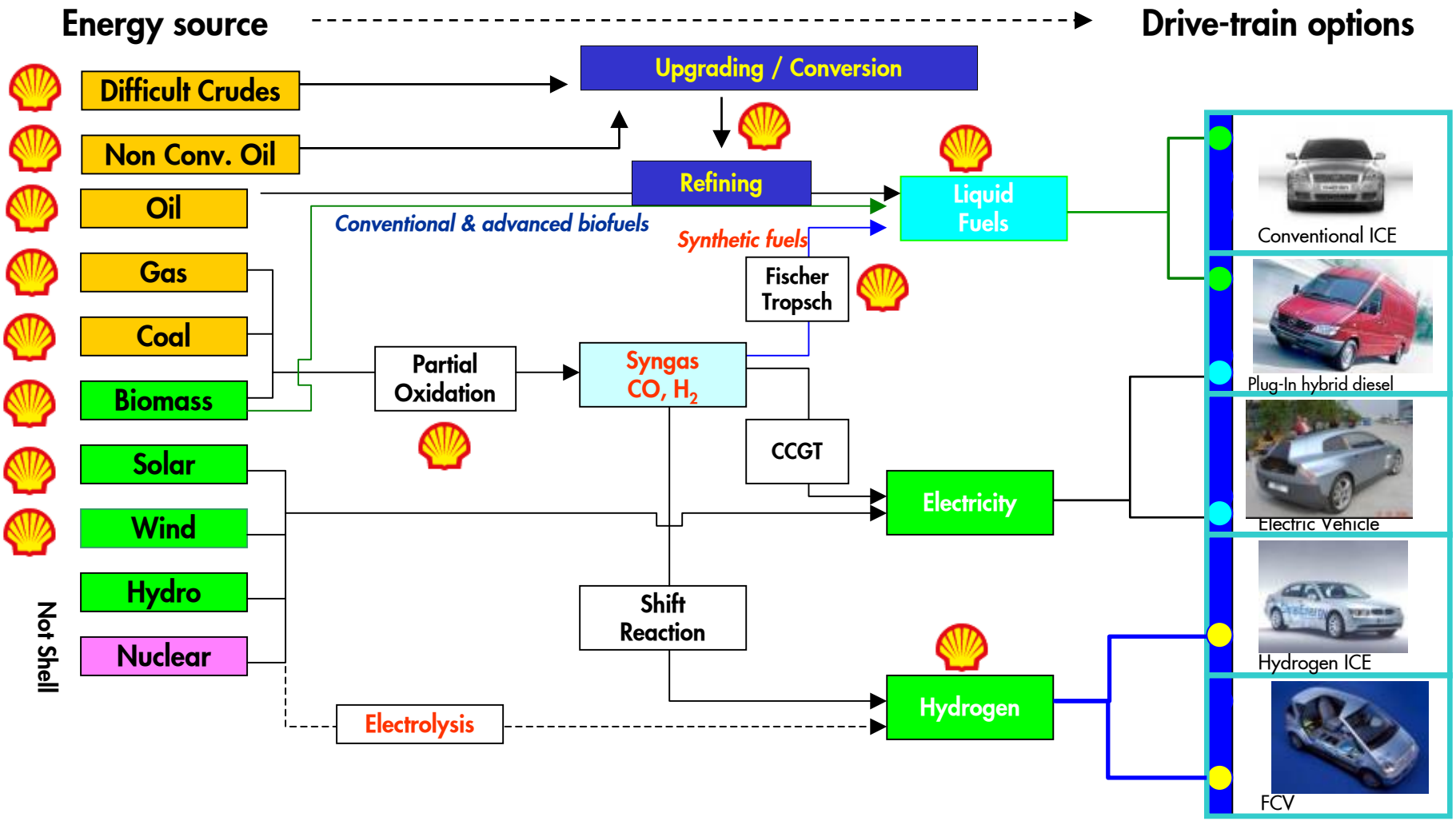

6. Working with governments and advocating the need for more effective CO2 regulation.

# Future Energy & Shell
# Energy diversity

- Liquified Natural Gas
- Clean coal
- Unconventionals (oil sands, shale, heavy oil)
- Enhanced oil recovery
- Carbon capture and sequestration
- Renewables:  wind, solar, biomass

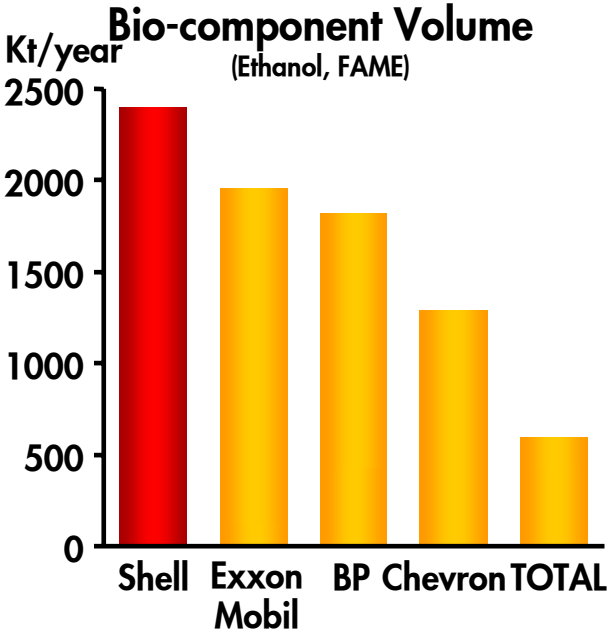
Brazos, Texas
160MW

# Focus on Sustainable Fuels

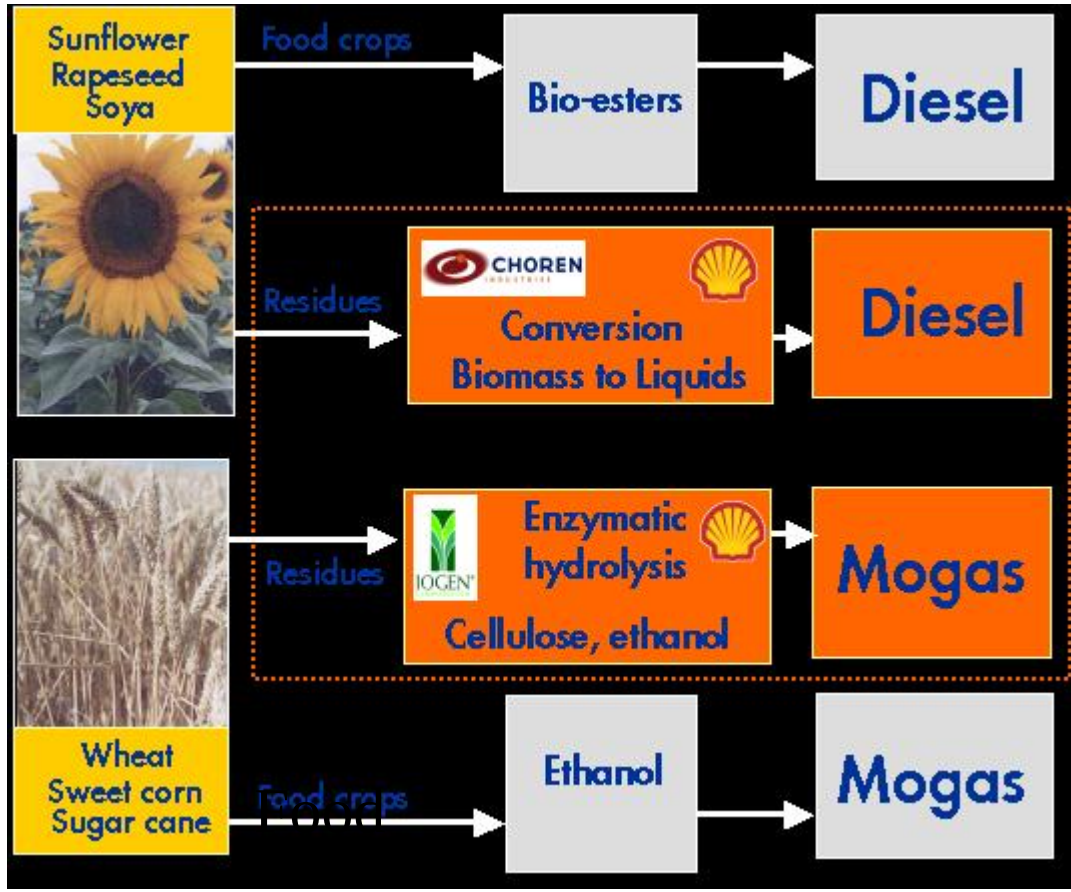


# Leading in Bio-fuels

## Global biofuels distribution today




Sources: Shell analysis, EUCAR/JRC/CONCAWE




**Advanced biofuels deliver substantial CO2 benefits and use residues not food crop**

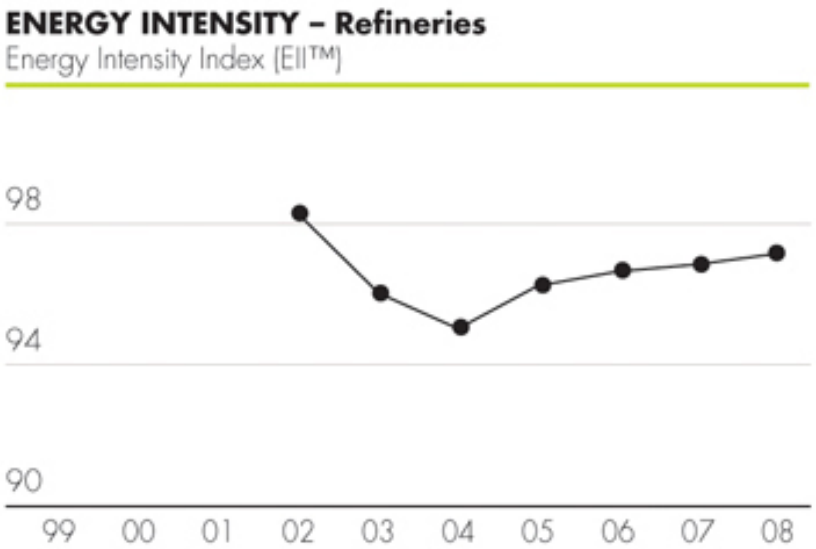
Virent™ "Bioforming"

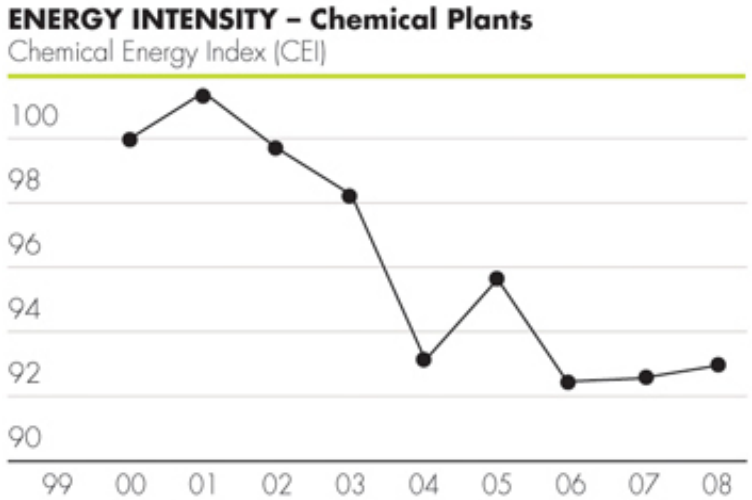
Marine Algae (HR Biopetroleum = "Cellana")

# Energy efficiency

- About three quarters of GHG emissions from our operations come from burning fuel to power our oil and gas production sites, refineries and chemical plants. So improving how efficiently we use energy in our operations is clearly important for further reducing our GHG emissions.
- The energy intensity of our oil and gas production business, has gotten steadily worse. It has risen by around 27% since 2000, as we, like our competitors, need more energy to produce from aging fields and more difficult oil and gas. To help us slow that rise, we launched a major energy efficiency programme in Exploration and Production in 2007. In line with this programme, all our upstream operations are putting energy management plans in place.
- Our refineries have improved their energy efficiency since 2002. They have been helped by Shell Global Solutions Energise™ programme, which uses advanced energy modelling and benchmarking to help identify areas where improvements can be made, and by a programme of business improvement reviews that target energy reductions. These two programmes have reduced our GHG emissions by 1.7 million tonnes a year and saved us a combined $180 million annually at our refineries and chemical plants.
- But more is needed. Energy efficiency at these plants has stagnated or gotten worse in the last two years. We have also launched a three-year capital investment programme specifically aimed at boosting refinery energy efficiency.

# Energy efficiency




- Sensitive to capacity utilization
- Measurement / metrics are important
  - Energy intensity index™ for refineries
  - Shell  Chemical Energy Index (CEI)

# Including future costs of emitting $CO_2$ in our business decisions

- We were the first energy company to include the future costs of emitting $CO_2$ into the financial planning and decisions we take about major new projects back in 2000. In 2007 we updated − and significantly raised- these costs. They are helping our new projects lower CO2 emissions from the very start - by changing their designs. We will continue to adjust cost levels and our approach as the future regulatory environment becomes clearer.

The business logic for this approach is clear:

- ✓ it raises awareness and signal our seriousness about the need to adapt to a world with stringent restrictions on emitting $CO_2$;
- ✓ it avoids expensive retrofits later;
- ✓ it reduces the risk of future liabilities for emitting $CO_2$; and
- ✓ it gives us a management tool for steering the Group's portfolio and designs

# Capability development in $CO_2$ capture and storage:

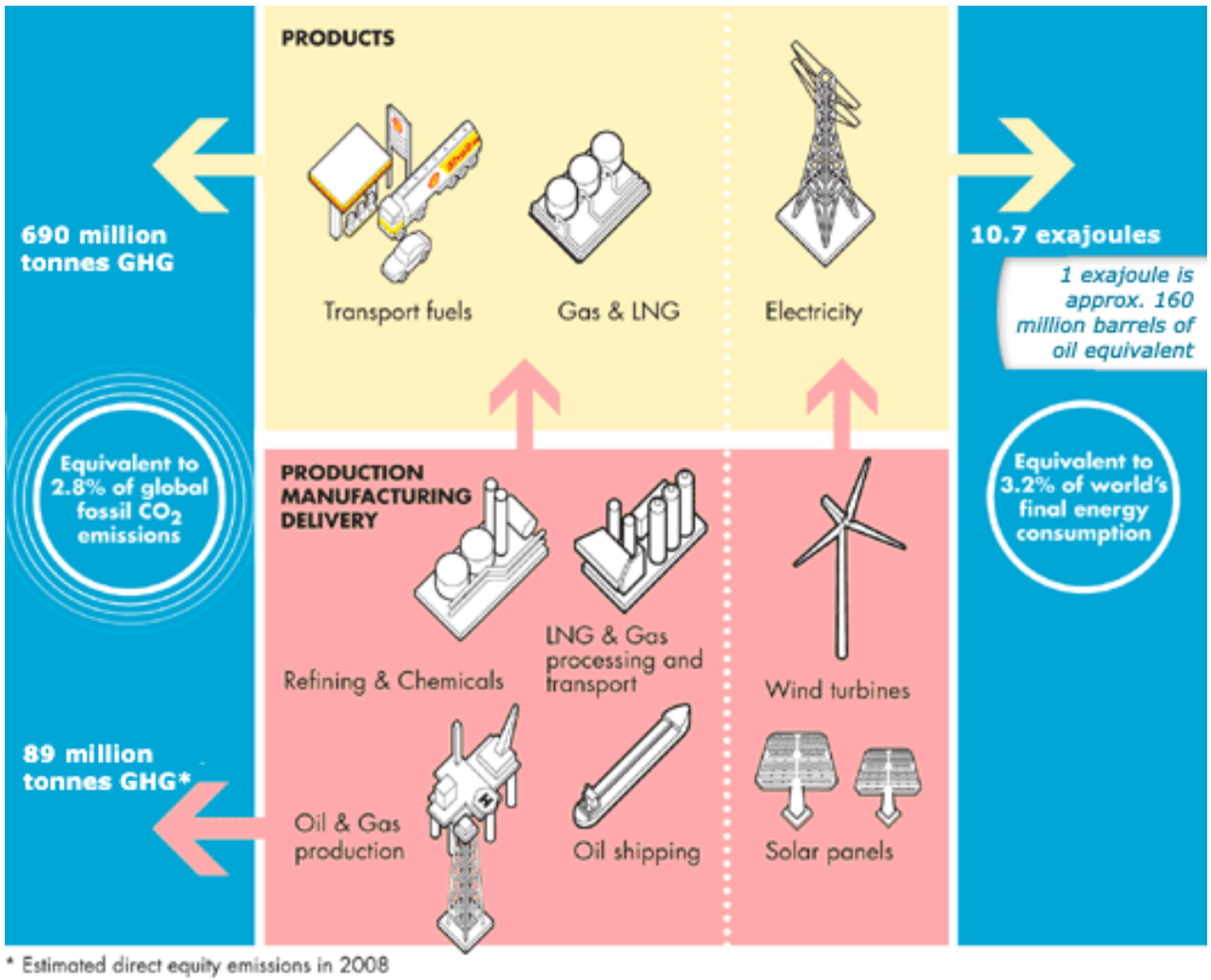
- As our Energy Scenarios make clear, capturing and storing CO2 (CCS) will be a critical technology for reducing GHG emissions.
- In our Blueprints scenario, $CO_2$ is captured and stored at 90% of all coal- and gas-fired power plants in developed countries by 2050.
  - It will also be important to manage CO2 emissions from our own facilities. Today, none of these facilities uses CCS because it adds extra costs, uses more energy and because permits requirements and liabilities for the CO2 are not clear.
  - We are working hard to get the regulatory support needed for CCS and to build our own capability.
- Earlier experience in $CO_2$ enhance oil recovery (US)
- While there is no silver bullet to eradicate the threat of global warming, one of the most promising technologies for rapidly reducing global emissions has been identified as Carbon Capture and Storage (CCS). A technology area that Shell is spearheading developments in.

# Carbon Capture and Sequestration (CCS)


- **"CO2SINK" project (2008+)**
  - **Ketzin, Germany**
  - **Joint Industry Project: 18 companies, 9 countries**
  - **Shell coordination of monitoring**
  - **Saline aquifer injection**
  - **60,000 tonnes $CO_2$ to be stored in 2 years (30,000 cars)**
  - **First on-shore project in Europe**

# Helping customers reduce emissions

**Our customers emit about nine times more CO2 using our products than we do making them. A small share of the energy products we make, such as electricity from our wind turbines, emit no CO2 at all during use.**




* Estimated direct equity emissions in 2008

# Helping customers reduce emissions

## Fuels and Power

- **Raising fuel economy**
  - **Shell "FuelSave": March 2009, Netherlands (additives and cleaning agents to improve fuel efficiency.**
- **Advanced biofuels (leading distributor)**
  - **Lignocellulosic ethanol (logen)**
  - **Algae (Cellana)**
  - **Gasification (Choren)**
  - **Bio-gasoline and green hydrogen (Virent)**
- **Lower CO2 electricity**
  - **LNG**
  - **Coal/biomass gasification with carbon capture readiness**
  - **Wind**

# Global Chemical Industry announces findings of Carbon Life Cycle Analysis

http://www.icca-chem.org/Home/News-and-press-releases/News-Archive/2009/Global-Chemical-Industry-announces-findings-of-/

- International Council of Chemical Associations (ICCA) - published LCA Report
- Global chemical industry's impact on greenhouse gas (GHG) emissions through the life cycle of chemical products and their applications
- McKinsey & Company - for every unit of GHG emitted directly and indirectly by the chemical industry, it enabled more than two units of GHG emission savings via the products and technologies provided to other industries and consumers.
- By 2030, the ratio of GHG emission savings to emissions could increase to more than 4:1, based on certain actions being taken by industry, stakeholders and policymakers.
- Shell Chemicals are leading producers of some of the key raw materials for products identified as providing the most significant emissions savings by volume in this report. These include:

  - **Building insulation**, where Shell Chemicals are a leading supplier of raw materials used to make two of the most effective and versatile insulation materials available;
  - **Low-temperature detergents**, which cut the energy used by washing machines by up to half; and
  - **Polyester Textiles**, where Shell Chemicals are a leading producer of the main component MEG, are less intensive to produce and longer lasting than cotton textiles.

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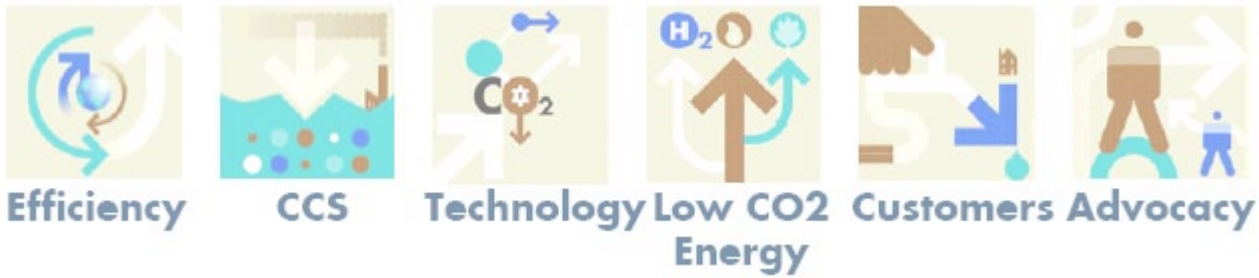


## 5 - POLICY OBJECTIVES

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**Governments need to develop internationally aligned policies to meet the energy challenge and address climate change. No one single instrument – whether a carbon tax or emissions trading -- will be effective for all sectors**

**They should include:**


- **cap and trade systems for large stationary sources**


- **clear incentives for Carbon dioxide Capture and Storage (CCS)**


- **a simple, credible target for the share for renewable sources in our energy supply**


- **separate measures in the transport sector such as vehicle efficiency standards; vehicle/road use programmes for modal switch and reduction of vehicle kilometres travelled; and broadening the fuel pool by incentivising the use of fuels based on their ability to deliver reductions in $CO_2$ based on WtW**


- **A series of robust energy standards for buildings and appliances with incentives to retrofit existing infrastructure.**

# Summary

- Addressing $CO_2$ and climate change is key component of business and technology strategy.
- Must actively deploy metrics to measure & control.
- Technology plays key role in developing solutions and options for future energy.

# Can technology reduce $CO_2$ emissions?

**Live webcast by**
**Jan van der Eijk**
**Chief Technology Officer, Shell**
**July 15th, 2009**
**8:00 am CST (2:00 pm GMT)**

http://www.shelldialogues.com/technologiesforco2