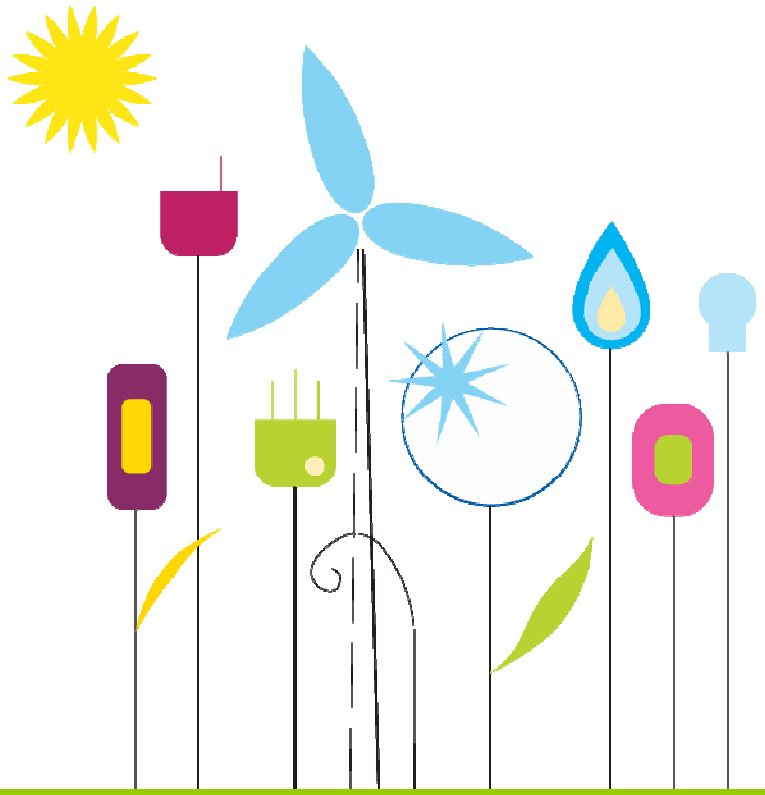
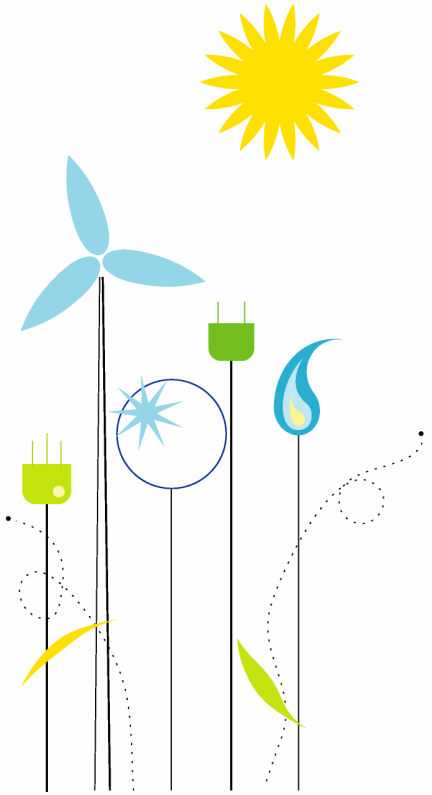


CCS Demonstration Projects

Iain Wright, CO_2 Project Manager, BP

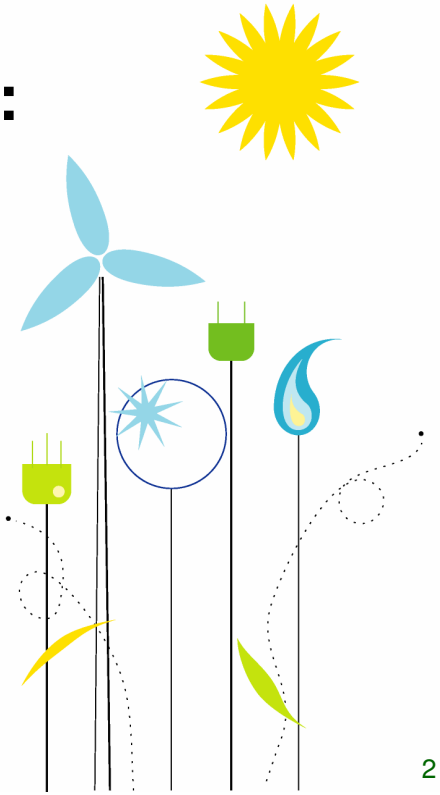
EU Parliament: CCS Hearing

Brussels: March 5th 2008



Agenda

- The Significance of CCS
- Industrial-Scale Deployment: Challenges
- Lessons Learned from BP's CCS projects:
  - In Salah (Algeria)
  - Peterhead (Scotland)
  - Carson (California)
  - Abu Dhabi (UAE)
- Questions and Answers



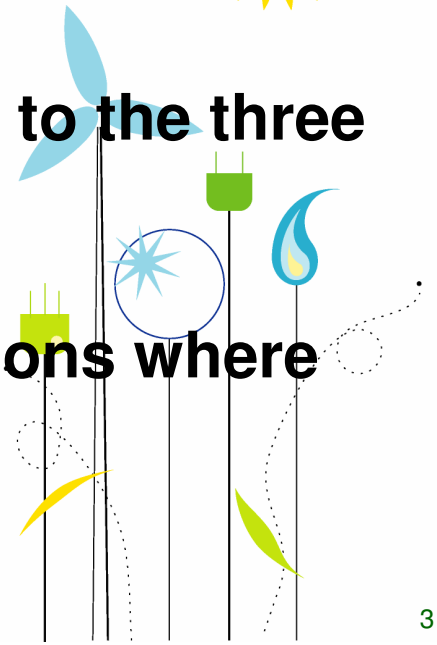
Summary

- **BP is Taking Big Steps Towards CCS Deployment**

- **What's required:**
  - **Regulatory Framework: Is it Legal?**
  - **Policy Framework: Can I Get Paid (enough)?**
  - **How to deal with: Long-term CO_2 Stewardship?**

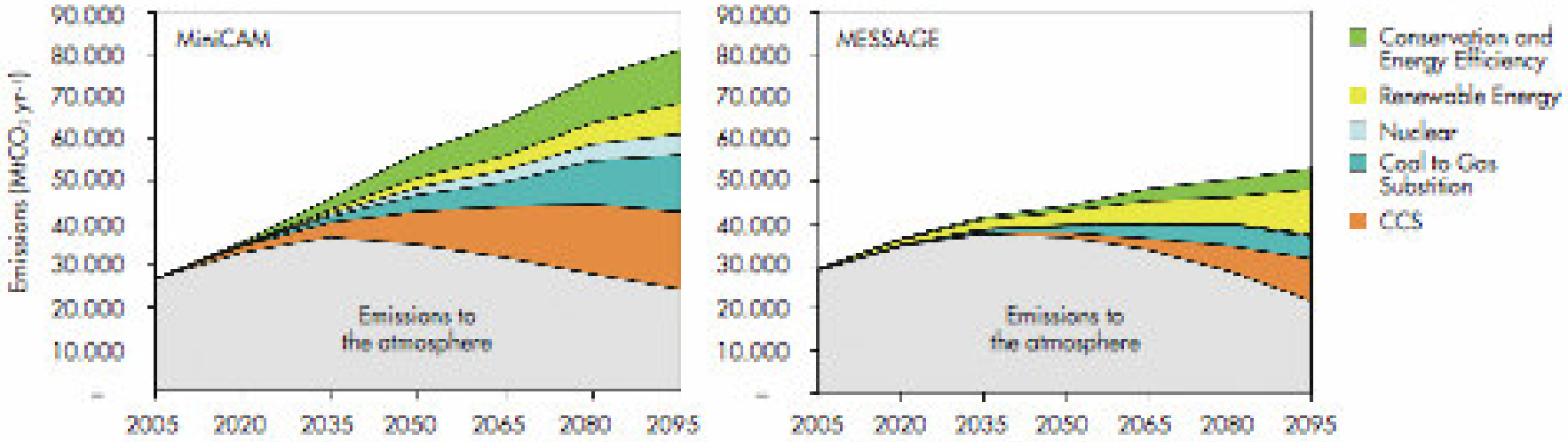
- **Early-Mover Projects are developing answers to the three key questions.**

- **BP is ready to invest in CCS projects in locations where the three key questions are answered.**



CCS Can Solve a Quarter of Climate Change

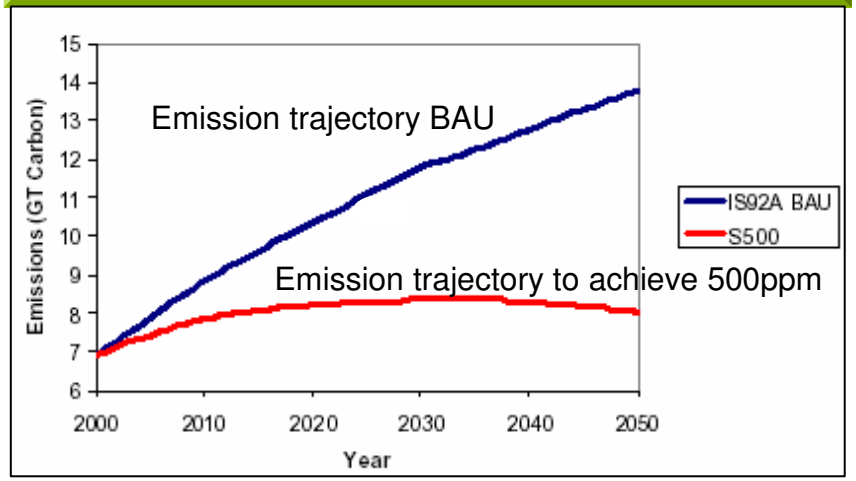
- **UN IPCC Scenarios (CCS can contribute 15-55%)**



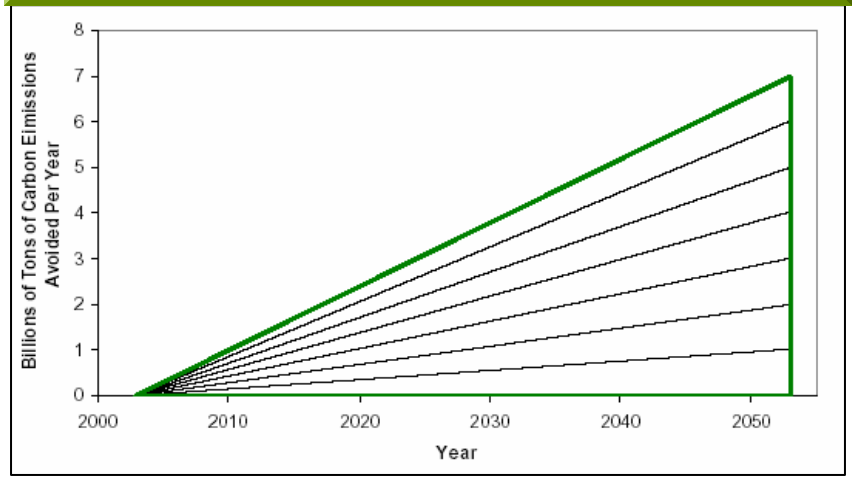
- **Princeton CMI "Wedges" Socolow/Pacala**

Technology Options for GHG Stabilization

The Stabilisation Wedge



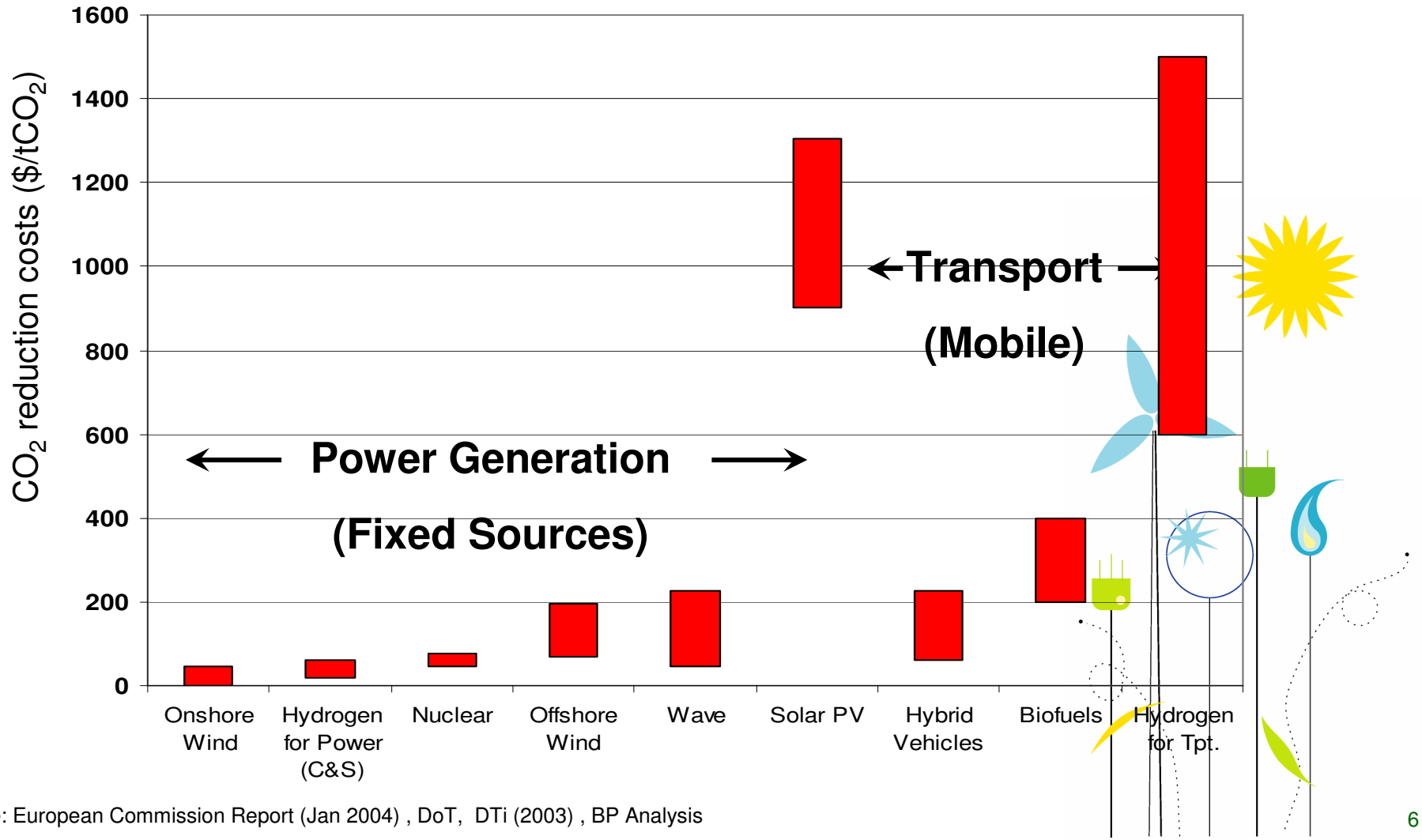
1 GtC Slices of the Stabilisation Wedge



Examples of Lower Carbon Slices	Scale for 1GtC Reduction by 2050
Increased **energy efficiency** across the economy	'Emissions/$GDP' increased
Increased **energy efficiency** (e.g. vehicles only)	2 billion gasoline/diesel cars achieving 60mpg
Fuel switching natural gas displacing coal for power	1400GW fuelled by gas instead of coal
Solar PV or **wind** replaces coal for power	1000x scale up PV; 70x scale up for wind
Biofuels to replace petroleum based fuels	200x10^6 ha growing area (equals US agricultural land)
Carbon Capture and Geological Storage	CO_2 captured from 700 1 GW coal plants; storage = 3,500x In Salah/Sleipner
Carbon Free Hydrogen for Transport	1 billion H_2 carbon free cars; H_2 from fossil fuels with CO_2 capture & storage or from renewables or nuclear
Nuclear displaces coal for power	700 1GW plants (2x current)
Biosequestration in forests and soil	Increase planted area and/or reduce deforestation

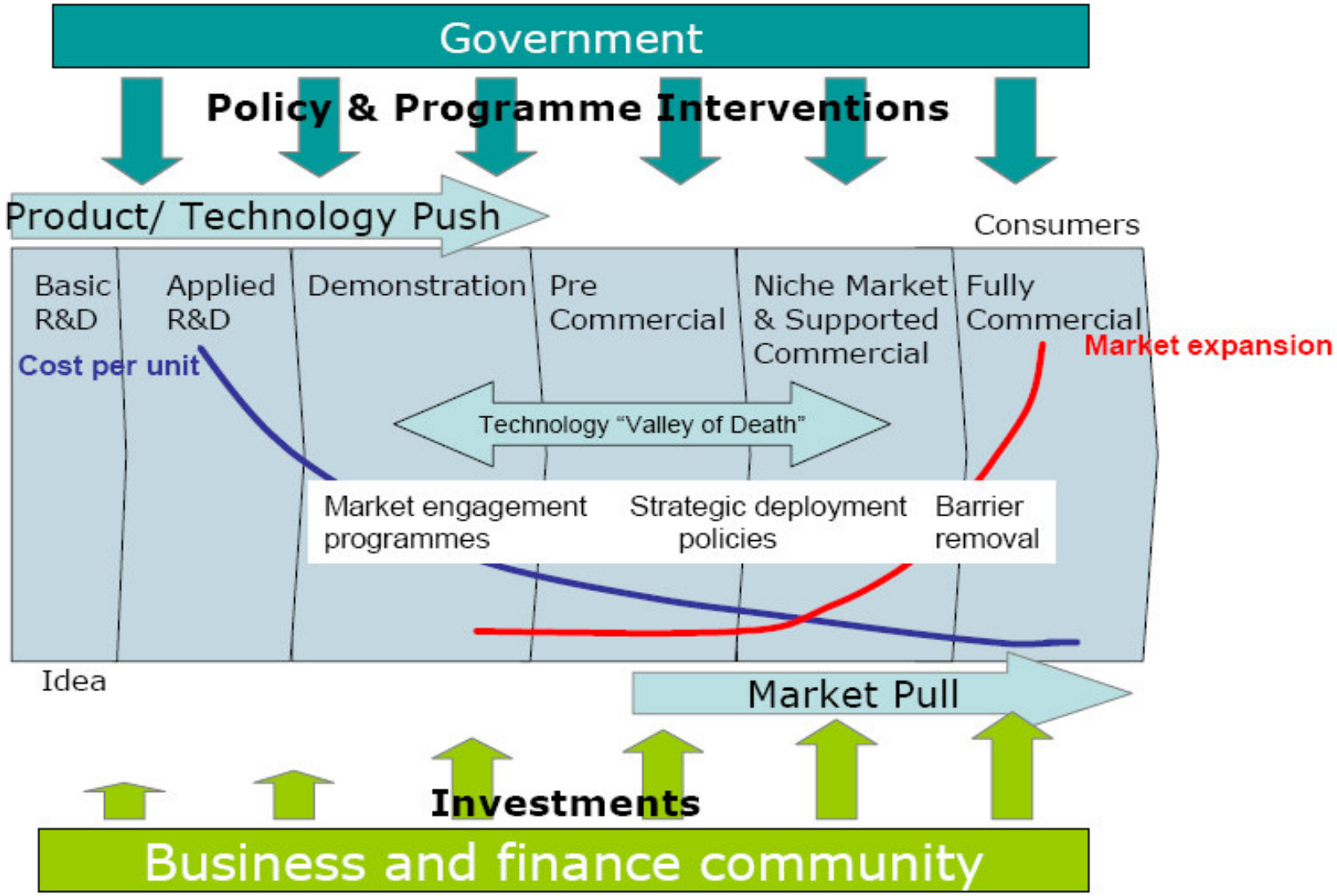
CO_2 Reduction Options ($/te)

- **Cost of CO_2 mitigation (above today's economics)**

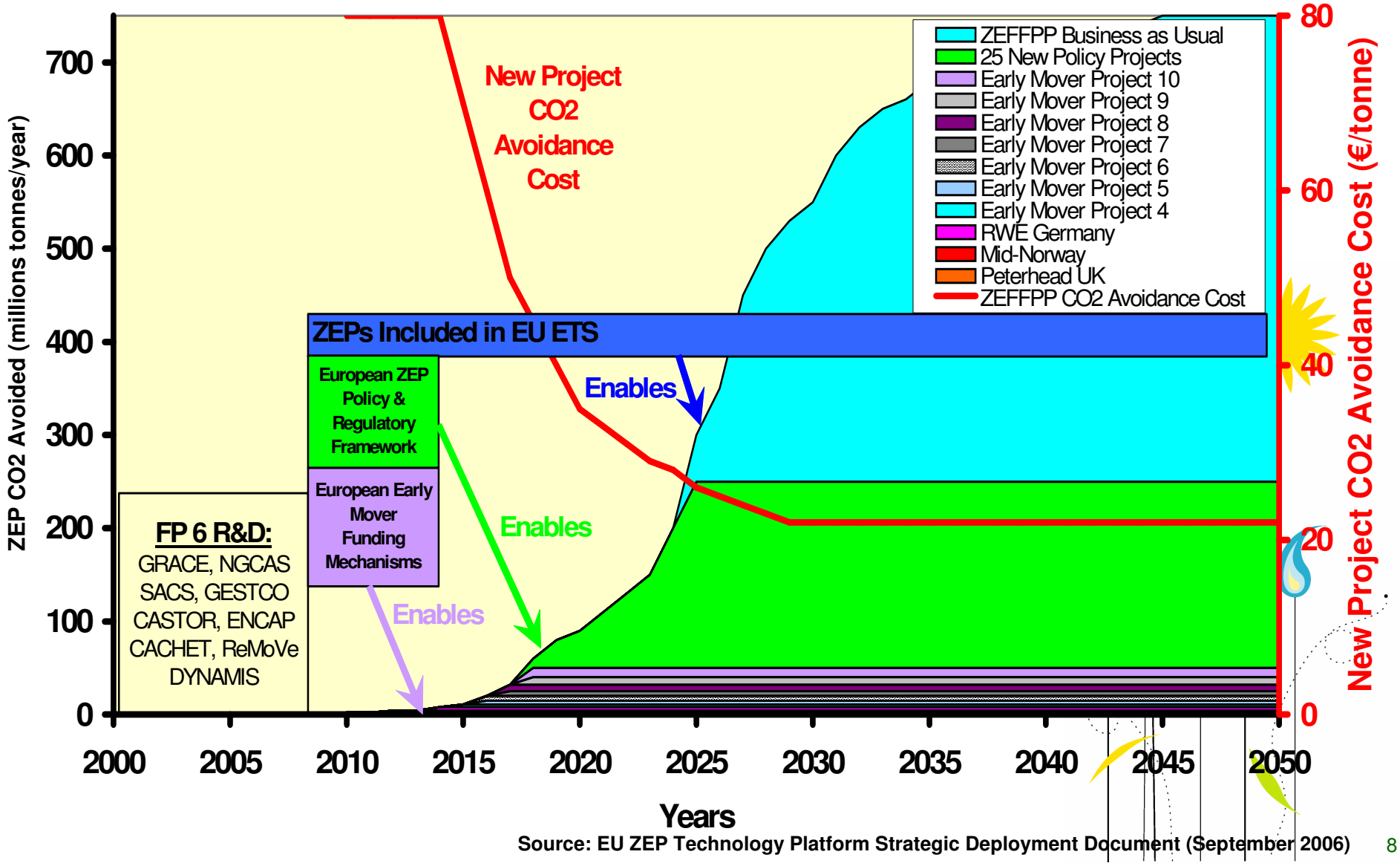


Source: European Commission Report (Jan 2004) , DoT, DTi (2003) , BP Analysis

We Need a Market to "Pull" the Technology

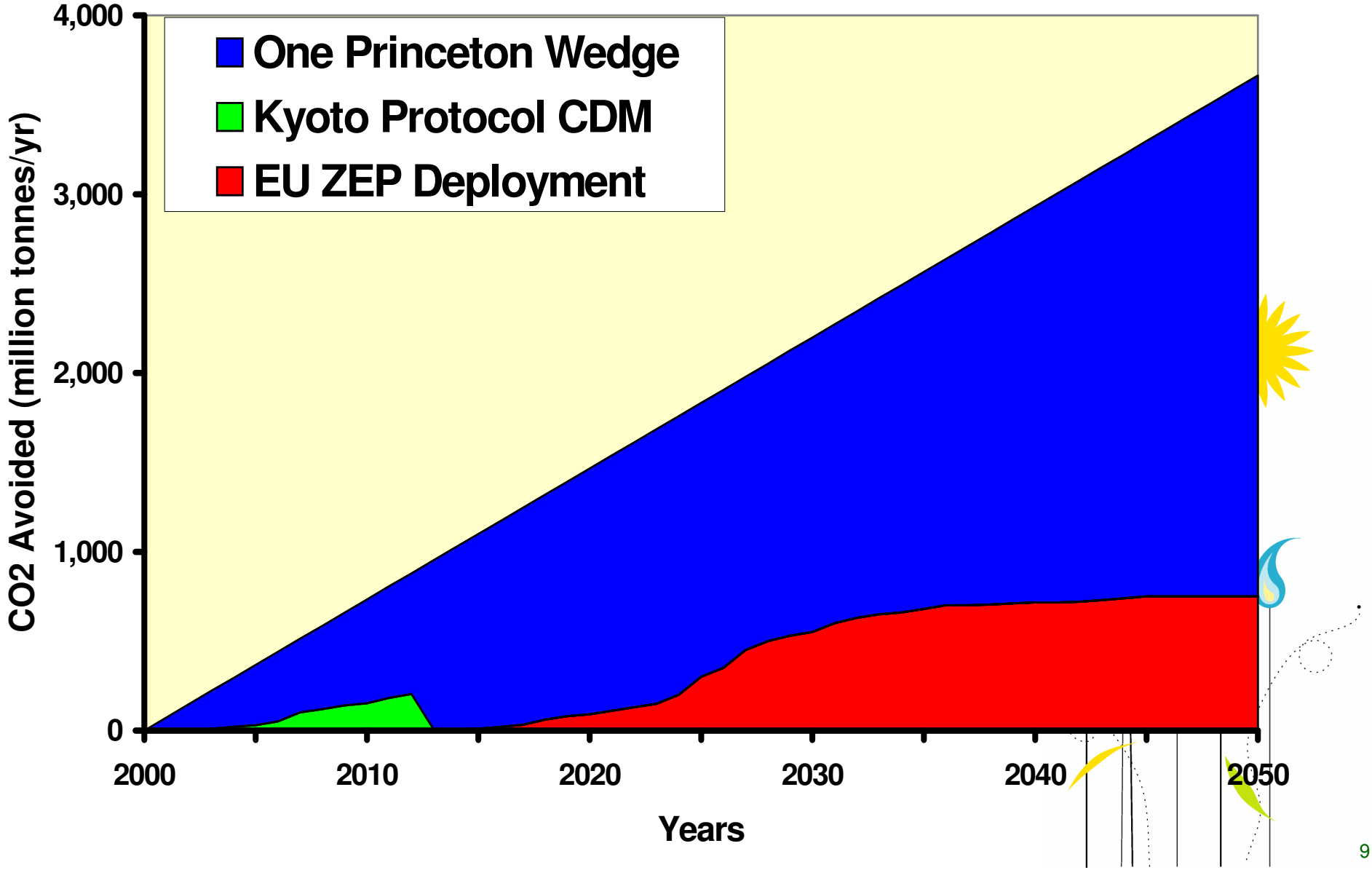


European Roadmap for CCS (ZEP) Deployment



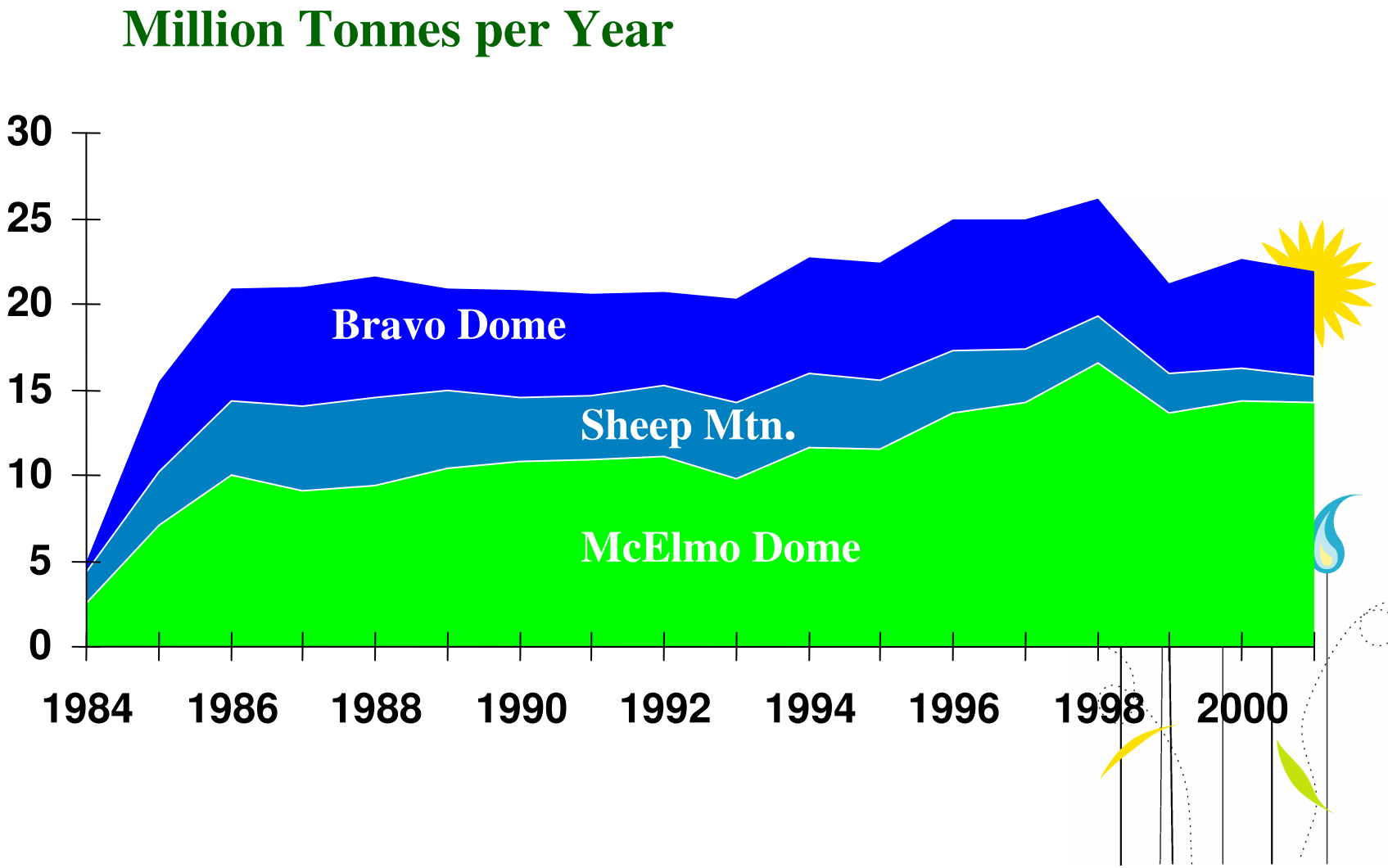
Source: EU ZEP Technology Platform Strategic Deployment Document (September 2006)

GHG Impact of ZEP Deployment in Europe



Industry Can Transport and Store CO_2

Permian Basin CO_2 Purchased for EOR



A Business Model for CCS in the Power Sector

Pre-Combustion Capture (IGCC)

Hydro-Carbon

CH_4

Coal, Gas

Syngas Manufacture

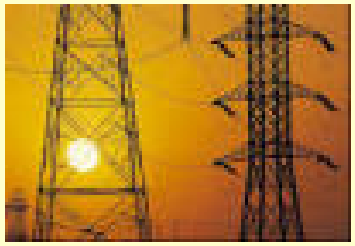
CO_2

CO_2 Storage

H_2

Combined Cycle Power Generation

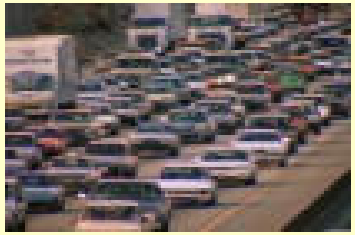
e^-



Low-Carbon Electricity

Provides optionality for future to supply H_2 into other sectors

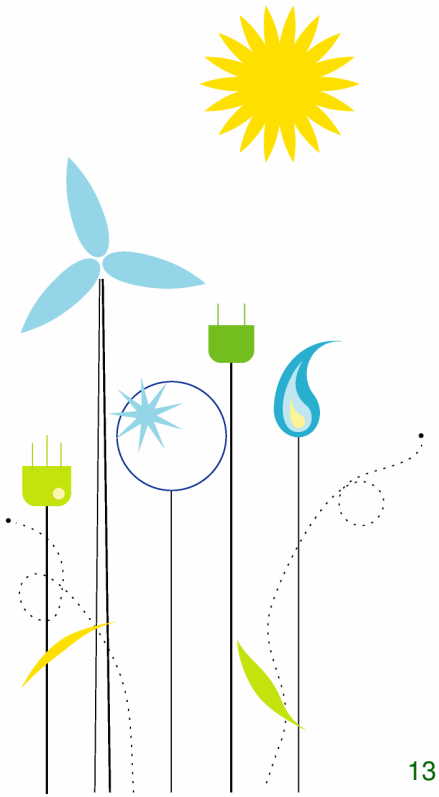
H_2



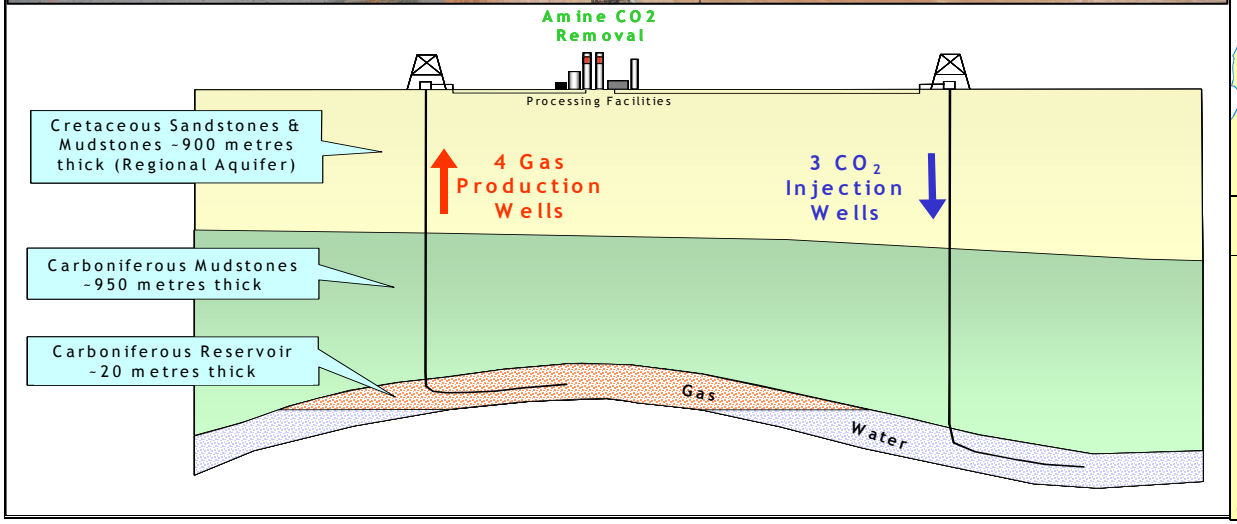
Transportation

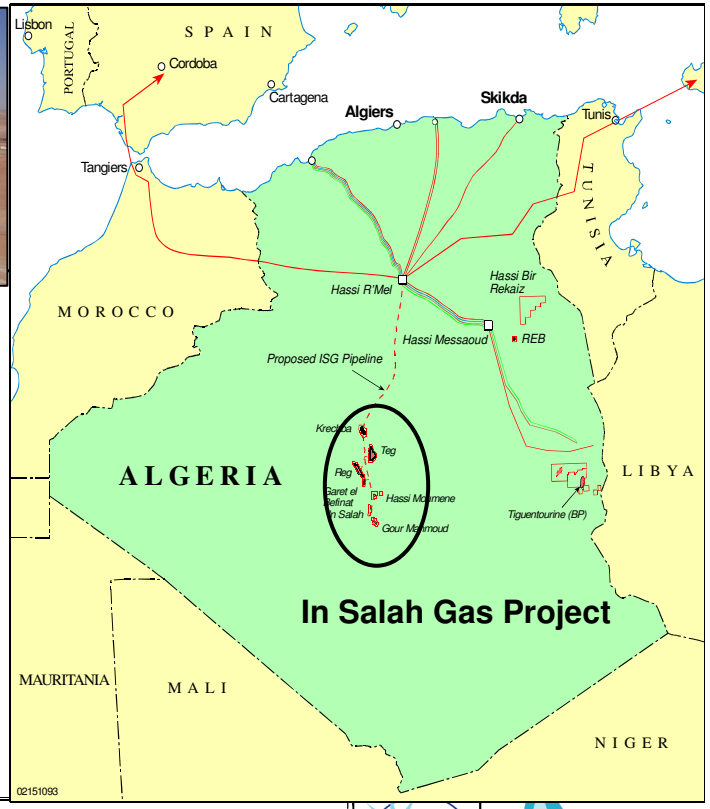
Lessons Learned from BP's CCS Projects

In Salah (Algeria)
Peterhead (Scotland)
Carson (California)
Abu Dhabi (UAE)



In Salah CO_2 Storage Project: Algeria



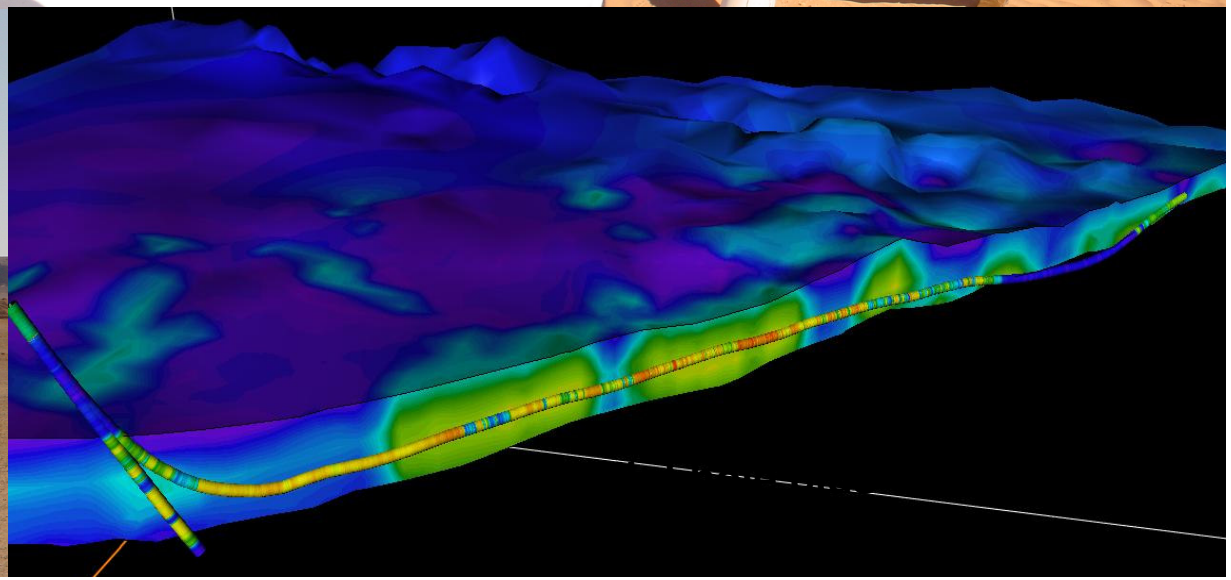


Climate Change Milestones

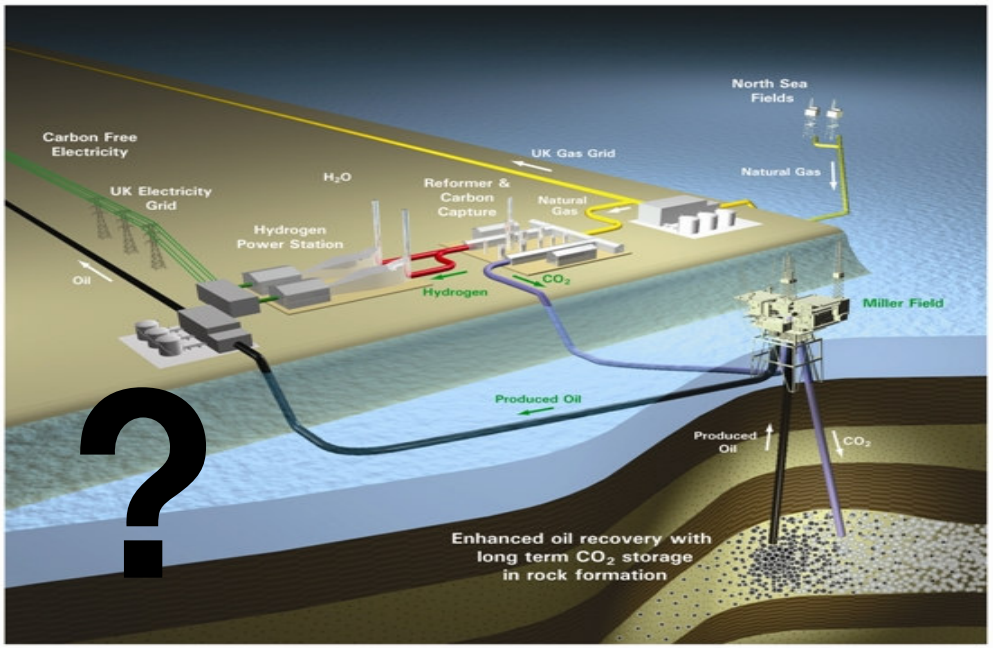
- Industrial Scale Demonstration of CO_2 Geological Storage (Conventional Capture)
- Storage Formation is very similar to the North Sea (USA & China)
- Started Storage in August 2004
- 1mmtpa CO_2 Stored (17mm tonnes total)
- $100mm Incremental Cost for Storage, No commercial benefit
- Test-bed for CO_2 Monitoring Technologies $30mm Research Project

CO2 Storage Project

50mmscf/d CO2
(1mmtpa)
Compression
Transportation
Injection
Storage



Peterhead Hydrogen Project, Scotland



Project Milestones

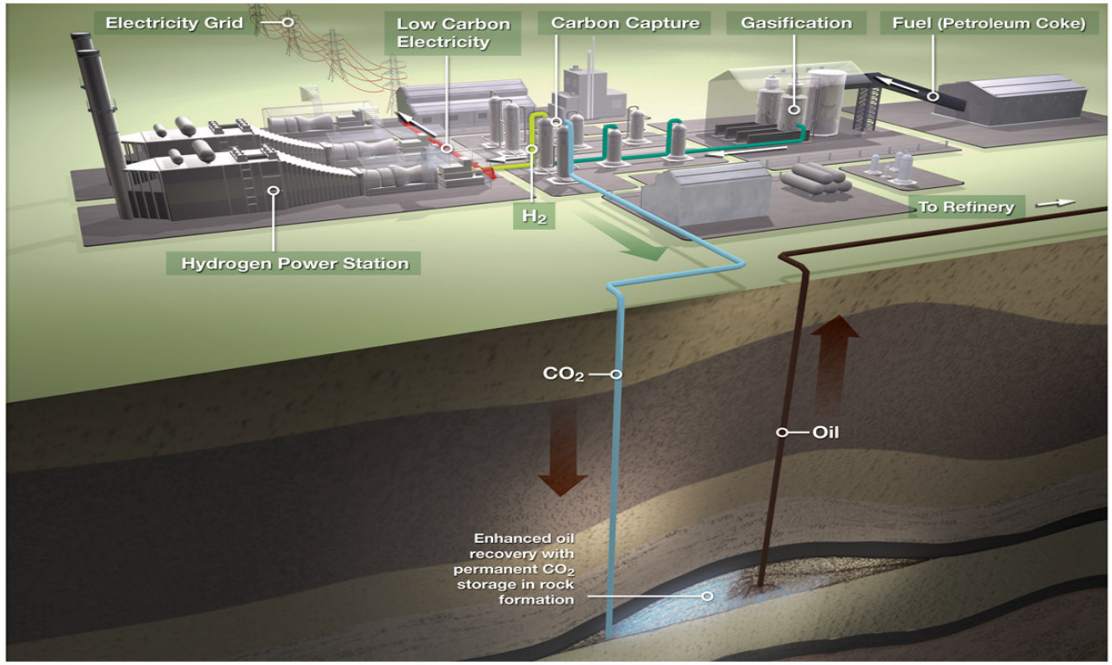
Would have been:

- Europe's largest hydrogen power plant
- 1st CO_2 EOR in North Sea
- 1st Storage-optimised EOR
- 1st CO_2 storage in an offshore oil field
- Auto Thermal Reforming

Climate Change Milestones

- **475 MW** of low-carbon electricity – **Starting 2010**
- **1.8 mmtpa CO_2** captured and stored = 500,000 cars off the road
- Infrastructure available **today**
- CO_2 EOR **does** have a regulatory framework

Carson Hydrogen Project, California



Project Milestones

Could be:

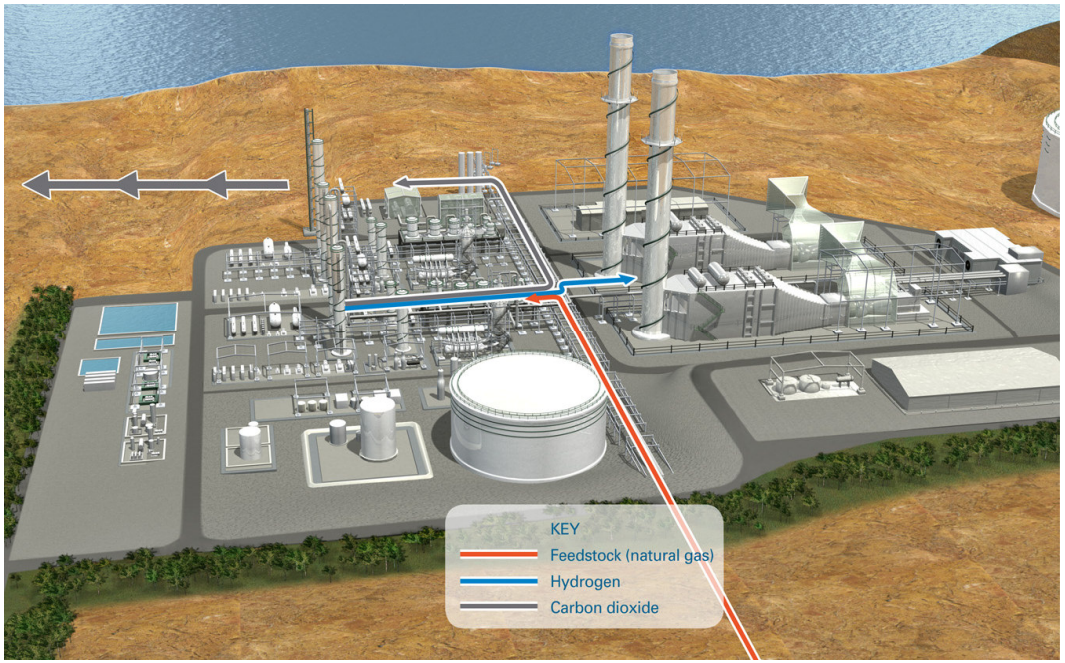
- World's largest hydrogen-fired power generation facility
- Gasification of petcoke – a solid fuel generated as a byproduct of the refining process

Climate Change Milestones

- **500 MW** of clean electricity ~ 325,000 Southern Californian homes
- **4 mmtpa CO_2** avoided, could startup 2012 = 1 million cars off the road
- Pipeline required to transport the CO_2 to EOR and permanent storage
- Lowest CO_2 emissions in the world for an IGCC plant.

alternativenergy
Powered by BP

Hydrogen Power Project, Abu Dhabi



Project Milestones

Could be:

- World's first power plant powered by hydrogen derived from natural gas
- Delivered CO_2 could replace natural gas for Enhanced Oil Recovery
- On-stream by 2012

Climate Change Milestones

- **420 MW** of low-carbon electricity = 5% of Abu Dhabi's capacity
- **1.7 mmtpa CO_2** avoided = decarbonizing Abu Dhabi's transport sector
- Secure geological storage of CO_2

Summary

- **CCS can be deployed Today with today's technology**
  - **Technology under development today could be deployed in 5-10 years time – to reduce costs**

- **Industry already has the Key Skills:**
  - **Operate large chemical plants (pre and post-combustion capture)**
  - **Manage high-pressure fluids in deep geological formations**
  - **Understand what makes a good storage site**

- **Europe has a Roadmap for CCS Deployment:**
  - **✓10-12 industrial-Scale Demonstration Projects**
  - **? Policy Framework to fund the Higher cost**
  - **✓Regulatory Framework for geological storage**
  - **• Public Acceptance**

- **China won't do this until the US/Europe lead the way**

Thank You - Questions?

Useful Links:

Check your carbon footprint at: www.bp.com
Princeton Wedges: www.princeton.edu/cmi
CCS Technology: www.co2captureproject.org
EU CCS Roadmap: www.zero-emissionplatform.org
New Hydrogen Power JV: www.hydrogenenergy.com
Iain's email: wrightiw@bp.com