SHELL EXPLORATION & PRODUCTION
Unconventional Resources: Potential and Challenges

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THE ENERGY CHALLENGE

RISING GLOBAL ENERGY DEMAND
100 = global primary energy demand 2000

CHANGING ENERGY MIX
Million barrels oil equivalent per day

* Shell estimates
MEETING THE ENERGY CHALLENGE

THE WORLD IN 2050

9 billion people
2.5 billion more than today

4-5 times richer
with most extra wealth coming from developing countries

Double the energy
using twice as much energy as now

 Twice as efficient
using half the energy as now to produce each dollar of wealth

6-10 times more energy
from renewable sources

MORE ENERGY
SECURE ENERGY
RESPONSIBLE ENERGY

The world wants to know:
• Is there enough to meet growing demand?
• Can our industry bring it to market in time?
• Will supplies be safe from disruption?
• Can the planet handle it?
NATURAL DECLINE RATES – SUPPLY WILL STRUGGLE TO KEEP PACE

Natural Decline – *no consensus view – range from 2% to 9% per year*

64 mb/d of gross capacity needs to be installed between 2007 & 2030 – six times the current capacity of Saudi Arabia – to meet demand growth & offset decline

Source: IEA World Energy Outlook, Nov 2008
AND ENVIRONMENTAL STRESSES ARE INCREASING
WHAT IS UNCONVENTIONAL OIL?

- No single global definition
- Heavy oil / oil sands
- Oil shale
- Gas-to-liquids
- Biofuels

“Unconventional” extraction technology

“Unconventional” source
OIL SANDS

Oil sands

OIL SHALE

Lean shale

Moderate rich shale

Rich shale
UNCONVENTIONALS POTENTIAL

Source: modified from Oil Shales of the World: Their Origin, Occurrence, and Exploitation by Paul L. Russell and UNITAR Heavy Oil & Oil Sands database
Canada, with 173 billion barrels in oil sands reserves, ranks 2nd only to Saudi Arabia in global oil reserves.

Source: CAPP – Oil and Gas Industry: Activity, Trends and Challenges
US OIL SHALE RESOURCE POTENTIAL

Source: U.S. Geological Survey, Oil Shale Assessment in the Green River Formation, Piceance Basin, Northwestern Colorado
In situ Conversion Process (ICP)

In situ Upgrading Process (IUP)

Mechanical/Cold
- Mining
- Cold Production

Heat
- Steam Drive
- Cyclic Steam Simulation
- Steam Assisted Gravity Drainage
- Air injection (THAI, ISC)

Heat and/or Chemicals
- Solvent-Based Processes (i.e. Vapex, CO2, etc.)
- Hybrids

Heat
- In situ Upgrading Process (IUP)
- In situ Conversion Process (ICP)

Surface Upgrading technologies

CO2 solutions
IN SITU HEAVY OIL RECOVERY TECHNOLOGIES

COLD HEAVY OIL PRODUCTION WITH SAND

CYCLIC STEAM STIMULATION (CSS)

STEAM ASSISTED GRAVITY DRAINAGE (SAGD)

SHELL IN SITU UPGRADING PROCESS (IUP)
CHALLENGES TO UNCONVENTIONAL OIL DEVELOPMENT

- Responsible development
- Permitting process
- Regulatory environment
- Costs
- Infrastructure
- Water management
- Land and reclamation
- Emissions, including greenhouse gas management
6 CARBON REDUCTION PATHWAYS

• Increasing the efficiency of our operations, seeking to be first quartile.
  - Establishing a substantial capability in CO₂ Capture and Storage (CCS).

• Continuing to research and develop technologies that increase efficiency and reduce emissions in hydrocarbon production.
  - Aggressively developing low-CO₂ sources of energy, including natural gas and low CO₂ fuel options.

• Helping manage energy demand by growing the market for products and services that help customers use less energy and emit less CO₂.
  - Working with governments and advocating the need for more effective CO₂ regulation.
STATE/PROVINCIAL GREENHOUSE GAS INITIATIVES

*MB is also in the Midwestern Accord.

Other States and Provinces with GHG Targets or Plans

Regional Greenhouse Gas Initiative (RGGI)
Western Climate Initiative (WCI)
Midwestern Regional Greenhouse Gas Reduction Accord
States with hashed lines are developing low carbon fuel standards (LCFS).

Source: Cambridge Energy Research Associates
CARBON CAPTURE AND SEQUESTRATION

SHELL CARBON CAPTURE AND STORAGE PORTFOLIO

- MONGSTAD
- BARENDRECHT
- WEYBURN MIDALE
- WESTCARB
- QUEST
- CO2SINK
- GORGON
- OTWAY

- **Demonstration / research projects**
- **Industrial scale (>100,000 tonnes per year) projects under development**

Shell is also a member of multiple CCS research partnerships.
SUMMARY

• With the era of “easy-to-access” oil drawing to an end, unconventional hydrocarbons will play an increasingly important role in meeting growing global energy needs.

• We believe that there is a role for the appropriate development of resources such as oil shale and extra heavy oil as part of the overall energy mix.

• The management of emissions (including CO₂), water, land use, reclamation and energy intensity are key issues the industry is addressing and seeking to continue to improve performance.
PROFILE

- We are active in more than 100 countries
- Worldwide we have 102,000 employees
- We produce around 3.2 million barrels of oil equivalent per day
- Our fuel retail network of around 45,000 service stations is the world’s largest
- We sell transport fuel to some 10 million customers a day
- In 2008 we generated an income of $26.5 billion
- And spent over $1.2 billion on R&D
- We are listed on the stock exchanges of Amsterdam, London and New York

Source: 2008 Annual Report
Three Hard Truths

• Surging energy demand
• Supply will struggle to keep pace
• Environmental stresses are increasing
Shell energy scenarios help us to imagine alternative futures

A world of energy security and reactive change

A world of emerging coalitions and accelerated change

Demography
Demand
Environment
Choices
Resources
Technology
SHELL CANADA'S OIL SANDS PORTFOLIO

PEACE RIVER
- 25 kbbl/d on stream
- Carmon Creek (100% Shell):
  - 80 kbbl/d potential
  - Preparing regulatory application

COLD LAKE – ORION
- Steam Assisted Gravity Drainage project
  - Phase 1 start-up September 2007 (growing to 10 kbbl/d)

GROSMONT
- Pilot at Peace River since 2004
- Grosmont appraisal activities under way
- Focus on maturing the technology

AOSP (60% Shell)
- 90 kbbl/d on stream
- 60 kbbl/d in construction
- 300+ kbbl/d expansion potential

ALBERTA

Peace River
Grosmont
Athabasca
Cold Lake
Edmonton
US OIL SHALE RESEARCH LOCATION

SHELL RESEARCH
- Ongoing research since 1981, in the field since 1996:
  - In situ Conversion Process works on a small scale

RD&D LEASES
- 5 leases on federal land in Colorado awarded 2006
  - Shell (3), Chevron (1), EGL Resources (1)
  - In success case each lease can be converted for commercial use