SHALE GAS FUNDAMENTALS

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NATURAL GAS

• How it formed

• What makes shale gas different
  – Directly producing from source rock
  – New resource pool: plentiful
  – Low permeability: must be fractured
  – Horizontal wells: why necessary
  – Unique environmental hurdles
oil and gas migrated from the source rock to the reservoir rock and trapped beneath the cap rock

impervious cap rock

porous reservoir rock

organic rich source rock exposed to heat and pressure
DRILLING AND COMPLETION

• Features Common to All Wells
  – Isolation of fresh water
  – Isolation of saline water and shallow gas
  – Create a conduit for producing the fluid
  – Casing and cementing to achieve this

• Shale Gas: need to fracture rock
HORIZONTAL WELL COMPLETION

Figure 2. Casing and Cementing of a Horizontal Well

- Conductor Casing
- Aquifer
- Cement
- Surface Casing
- Drilling Mud
- Intermediate Casing
- Salt Water Zone
- Production Casing
- Production Tubing

Source: GWPC. Not to scale.
HYDRAULIC FRACTURING

• Process Steps
  – Perforate the first zone
  – Inject fluid and sand at high pressure
  – Fracture rock and remove fluid
  – Leave sand behind to “prop” fractures open
  – Repeat in multiple zones
  – Produce from all zones simultaneously
HYDRAULIC FRACTURING

• Economic Issues
  – Total organic carbon
  – High depletion rates
  – Possible remedy: refracturing

• Environmental Issues
  – Fresh water usage
  – Chemicals in frac fluid
  – Disposal of flow-back water
  – Naturally occurring radioactive elements
HYDRAULIC FRACTURING

• Environmental Issues (contd.)
  – Well water contamination
  – “Earthquakes”
  – Excessive road usage
• Potential Remedies for Above