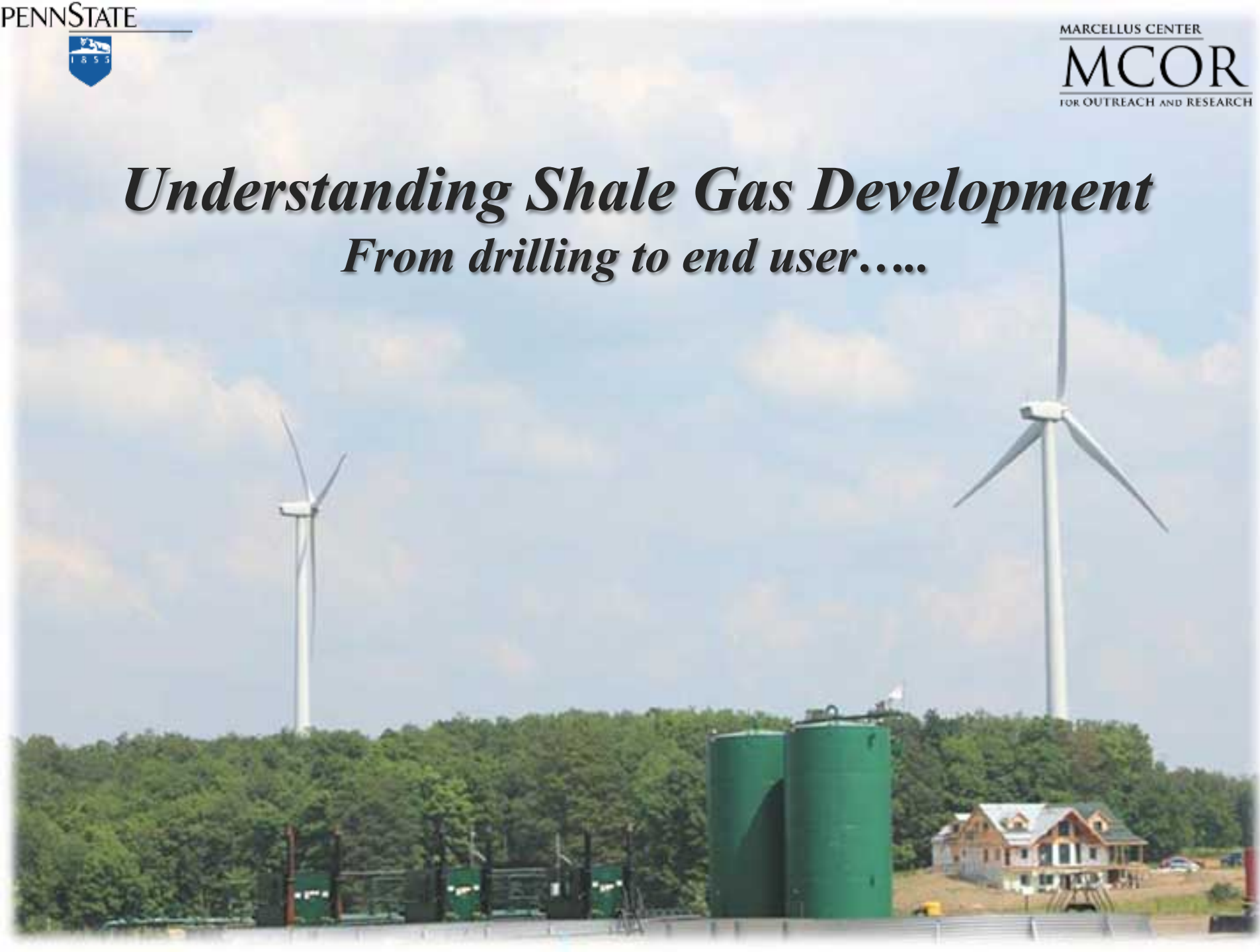




# *Understanding Shale Gas Development*

## *From drilling to end user.....*





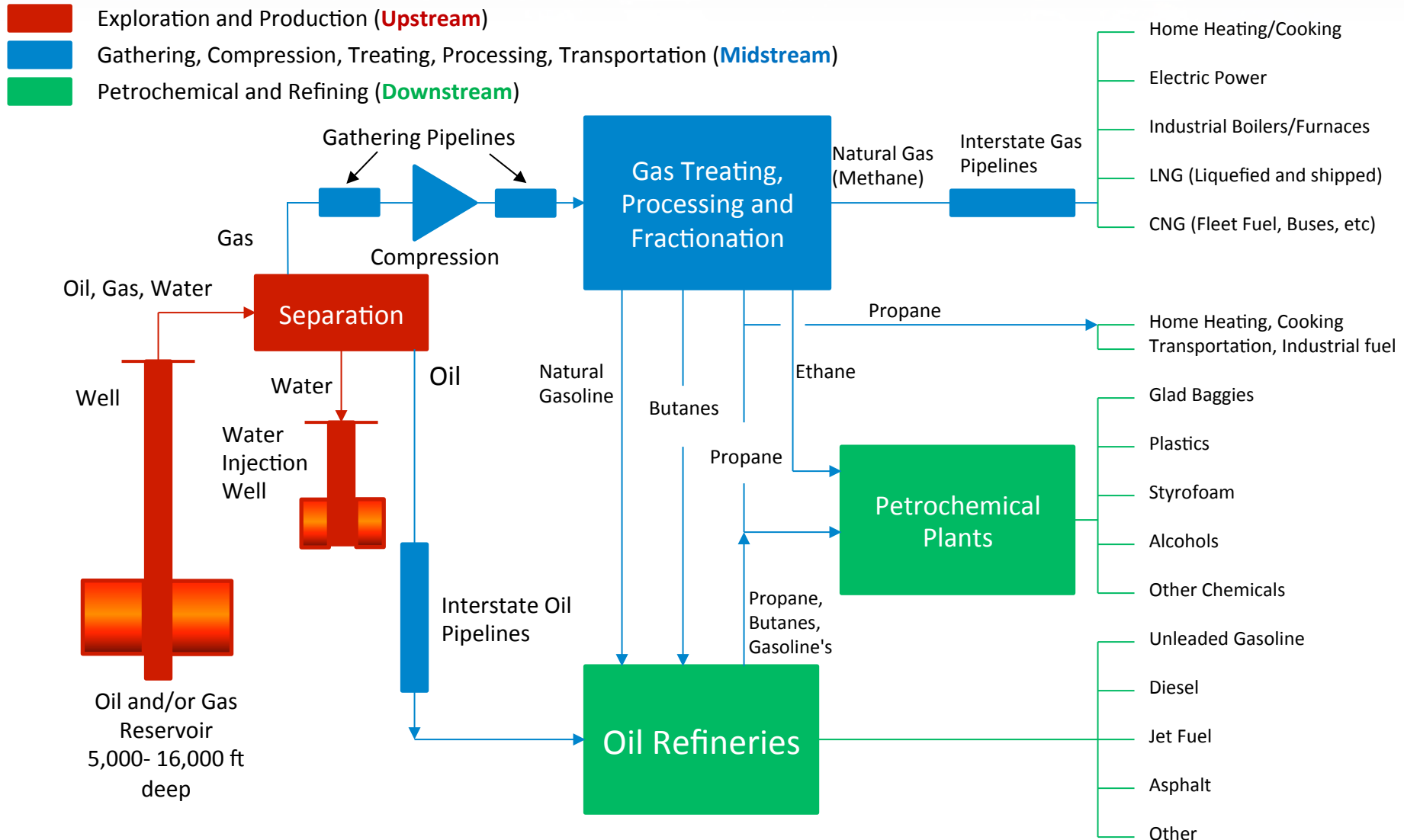
# Key Questions

- What is the development process and why is it important?
- Where are various materials, equipment & labor sourced, how are they handled on site, what happens to them after use?
- What are the implications of development – landowner, local business, workforce, community, environment?
- Are other technologies available and what are the trade-offs?

# Discussions Continue to Evolve

- Information sources varied, differing levels of accuracy and quality.
- Scientific process, scientific uncertainty.
- Role of media and social media?
- Dynamic, fast-paced change (technology, regulations and policies, markets, etc.).
- Polarization (is it growing?).

# Segments of the Oil and Gas Industry



# Upstream Development – Pre-Drilling

## General Operations

- Leasing
- Legal
- Seismic
- Pad Development
- Others...

## Activities / Workforce

- Hospitality services
  - Hotels
  - B&B's
  - Restaurants
  - Convenience stores

## Activities / Workforce

- Leasing
- Permitting
- Legal
  - Lawyers
  - Abstractors
  - Para-legal
- Civil engineering
- Heavy construction
- Logging & land clearing
- Surveying
- Mechanics
- Fencing
- Equipment Rental

# Upstream -> Siting Process







# Upstream -> Seismic



# Upstream Development - Drilling

## General Operations

- Drilling
- Casing
- Cement
- Solids management
- Others...

## Activities / Workforce

- Engineering
- Employment pre-screening
  - Workforce readiness
- Hot shot
- Hoses
- Fluids
- Wildlife Inventory

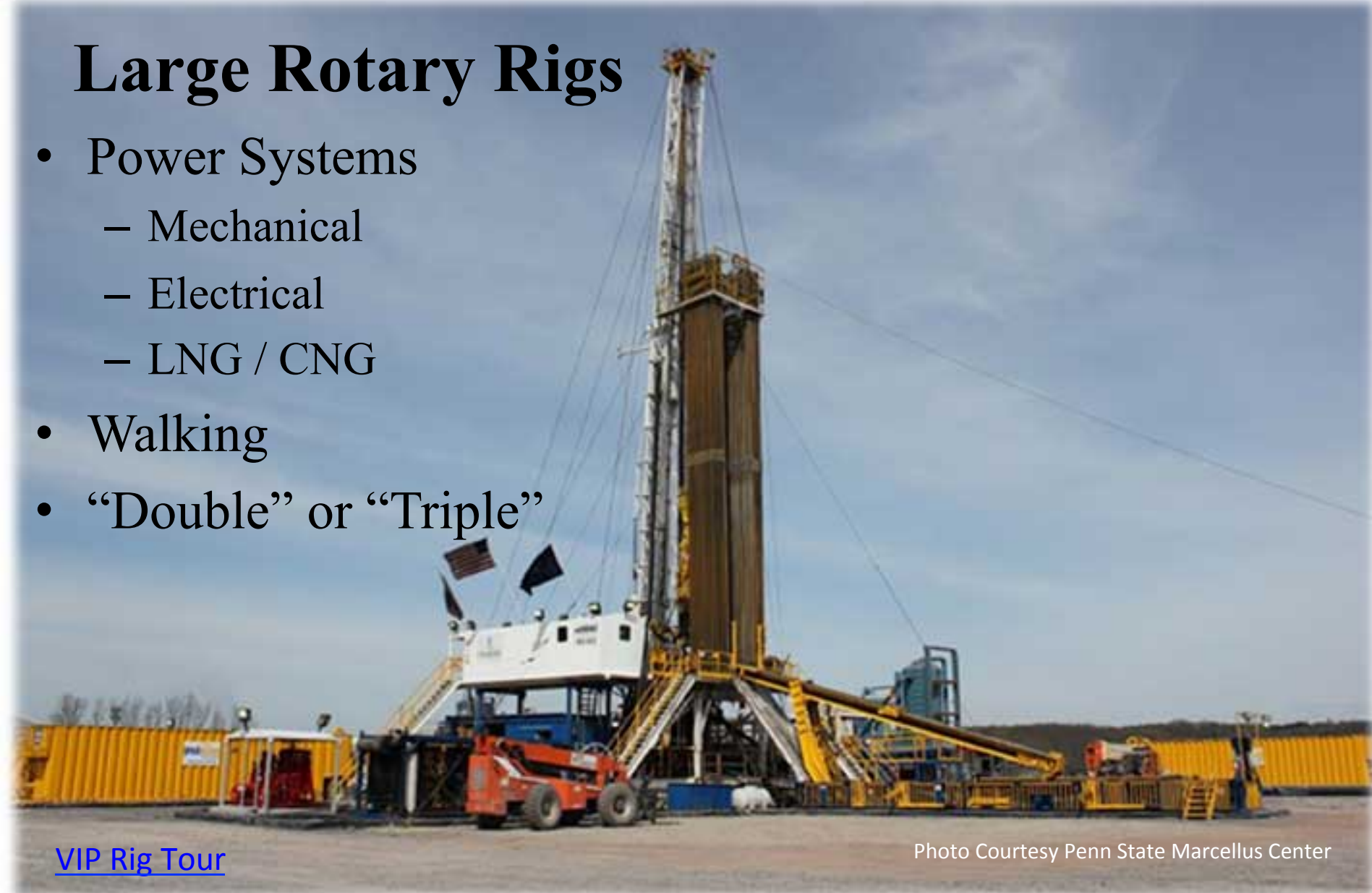
## Activities / Workforce

- Heavy hauling
- Auto Sales and Service
- Water handling/ management
- Environmental support
- Machine/fabrication shops
- General welding
- Mechanics & Diesel technician
- Compressor technician
- Pipe threading
- Pressure testing
- Food service
- Laundry

# Upstream -> Drilling

## Large Rotary Rigs

- Power Systems
  - Mechanical
  - Electrical
  - LNG / CNG
- Walking
- “Double” or “Triple”



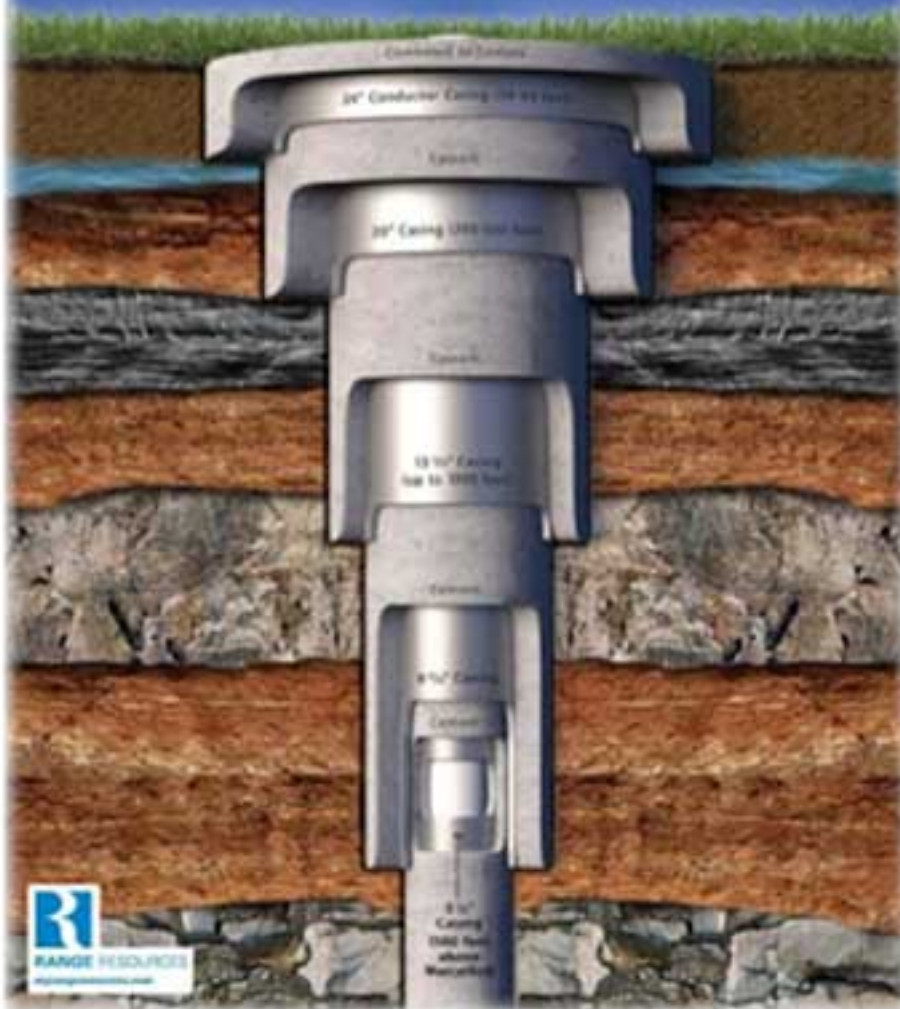
# Upstream -> Drilling Pad



# Upstream -> Well Construction

## General Casing Design for a Marcellus Shale Well

More than three million pounds of steel and concrete isolate the wellbore.  
The Marcellus Shale is typically 6,500 feet below the Earth's surface and water table.



- Steel Casing
- Cement
- Centralizers



# Upstream Development – Post-Drilling

## General Operations

- Well stimulation
- Water management
- Proppant & chemical management
- Others....

## Activities / Workforce

- Proppants / Chemicals
- Commercial Trucking
  - Transloading/ storage/ hauling
- Water management
  - Flowback iron
- Meters
- ROW Work
- Site Restoration
- Pipes & valves

## Activities / Workforce

- Gas field roustabouts
  - Employment pre-screening
  - Safety equipment
  - Food service
  - Local real estate
- Rail, river, and road
- Service yards/buildings
- Hot shot hauling
- Environmental support
  - Permitting
- Diesel technician/mechanic
- Equipment rental

# Upstream -> Completions



API Number:	37-081-20198
Operator Name:	Anadarko Petroleum Corp.
Well Name and Number:	COP 289 #B-1009H
Longitude:	-77.52224
Latitude:	41.38067
Long/Lat Projection:	NAD27
Production Type:	Gas
True Vertical Depth (TVD):	8,302
Total Water Volume (gal):	5,689,914

# Chemical Disclosure

[Fracfocus.org](http://Fracfocus.org)

## Hydraulic Fracturing Fluid Compositions:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
Water*	Anadarko	Carrier / Base Fluid		7732-18-5	100.00%	87.33412%	
Sand	Halliburton Energy Services	Proppant	Crystalline Silica (quartz)	14808-60-7	100.00%	11.81420%	
GBW-30	Halliburton Energy Services	Gelling Agent	Carbohydrates	Proprietary	95.00%	0.00011%	
			Hemicellulase Enzyme	9012-54-8	15.00%	0.00002%	
SP	Halliburton Energy Services	Gel Breaker	Sodium Persulfate	7775-27-1	100.00%	0.00011%	
Acid, Hydrochloric (7.5%)	Halliburton Energy Services	Solvent	Hydrochloric Acid	7647-01-0	7.50%	0.04549%	
HAI-05	Halliburton Energy Services	Corrosion Inhibitor	Propargyl alcohol	107-19-7	10.00%	0.00005%	
			Methanol	67-56-1	60.00%	0.00031%	
LCA-1	Halliburton Energy Services	Solvent	Paraffinic solvent	Proprietary	100.00%	0.00306%	

# Upstream-> Water Management



# Upstream-> Water Management



# Upstream-> Water Management



# Midstream

## General Operations

- Measurement
- Gathering
- Compression
- Construction
- Processing
- Treating
- Land reclamation
- Transportation
- Others...

## Activities / Workforce

- Construction/Fabrication
  - Compressor stations
  - Processing facilities
  - Custody transfer stations
  - Well head
  - Meter runs
  - Storage tanks
- Site reclamation
- Machine shops
- Earth moving
- Commercial trucking
- Service yards/buildings

# Midstream



Meter Runs

Separators

Production Tanks

Pig Launchers

Pig Receivers

Pipe Risers

# Midstream

## Gathering/Midstream



# Midstream

## **Gathering/Midstream**



# Midstream

## Gathering/Midstream



# Midstream

## Gathering/Midstream



# Midstream

## Gathering/Midstream



# Midstream



# Midstream



# Midstream Supply Chain

## Compressor Station



# Midstream Supply Chain



# Midstream Supply Chain





# Downstream

## Vehicle Conversion

- Compressed Natural Gas (CNG)
- Liquefied Natural Gas (LNG)

## Gas to Liquids (GTL)

- New engine technologies
- New Fuel Formulations
- Increased R & D

## Residential Gas Service

## Manufacturing

- Paper
- Steel
- Glass

## Petro-chemical

- Ethane
- Fertilizer
- Fuel conversion

## Power generation

Others...

# Thank You

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