Energy Value Chains

Overview of Fundamentals

What is a “Value Chain?”

• The process of linking specific functions from input through output to delivery, enhancing the economic value of the final product
• Related concepts – “supply chain” “business system,” “industry system”
• The challenge – building value chains around dynamic commodity markets that require fixed infrastructure for physical delivery and “liquidity” for price risk management
**Generic Value Chain**

- **Primary Activities**
  - Inbound Logistics
  - Operations
  - Outbound Logistics
  - Marketing & Sales
  - Service

- **Support Activities**
  - Firm Infrastructure
  - Human Resource Management
  - Technology Development
  - Procurement

**Source:** Porter, 1985

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**How Thinking Has Changed, I**

**Traditional Value Chain:** *Starts with core competencies*

- Assets/Core Competencies
- Inputs, Raw Materials
- Products/Service Offering
- Channels
- The Customer

**Modern Value Chain:** *Starts with the customer*

- Customer Priorities
- Offering
- Inputs, Raw Materials
- Assets/Core Competencies

**Source:** Porter, 1985

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How Thinking Has Changed, II

Source: McKinsey & Company

EXHIBIT 5

The value delivery system vs. the traditional model

Traditional product-oriented system

Create the product  Make the product  Sell the product

Product design  Procurement  Marketing
Process design  Manufacturing  • Research
Service  • Advertising

Value delivery system

Choose the value  Provide the value  Communicate the value to the customer

Understand value drivers  Product, process design  Sales message
Select target  Procurement, manufacturing  Advertising
Define benefits, price  Manufacturing  Promotion, public relations

Energy Value Chain Issues
Human Resource Management

Source: McKinsey & Company

Derivation of Basis Risk

"Basis"
- Differential between cash/spot and nearest futures price as a result of time, product forms, quality, location

"Basis risk”:
- Uncertainty as to whether differential will widen or narrow
Balancing the Market

Mean reversion is a reality if market-clearing participants exist

LOW  Prices  HIGH

Demand  Supply

Mean Reversion: Oil Price Example

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Price Volatility and Risk Trade Offs with Competition: Open Access Example

Commodity price risk flows

E&P  Pipelines  LDCs  End Users  Power

Capacity price risk flows

Risk accepting entities

Mechanisms to Manage Price Risk

• Trading in futures contracts
• Long-term contracts
• Fixed-price contracts
• Storage for physicals hedging
• Ability to use alternate fuels; efficiency; conservation
• Allow residential customers to choose budget payment plans; energy service contracts for commercial and industrial customers
• Develop mechanisms for capacity risk
Global Oil Market Illustration

Physical Market
- Specific Market
  - Spot Deals
  - Forward Deals
  - Tenders
  - Bilateral

Term Market
- Tenders
- Bilateral
- Futures
- Swaps & Other OTC
- Formal Options

Source: Oil in Asia by Paul Horsnell, 1997, Oxford Institute for Energy Studies
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Industry Organization: Vertical Integration?

Source: McKinsey & Company

Energy Value Add Comparison with Other Industries

Source: McKinsey & Company
Derivation of Market Power

Production → Transportation → Distribution → End Use

- Monopoly producer
- Barriers to entry, exit

- Technical economies of scale (?)
- Natural monopoly systems
- Barriers to entry, access

- Monopsony buyer
- Barriers to entry, exit

Energy Value Chain and Example SD Issues

- Access for private investment
- Rights of way and lands ownership
- Environmental impacts
- Transparency
  - Allocation of economic rents and revenue management
- Local content
- Community relations and community benefits

- Access for private investment
- Environmental impacts
- Transparency
- Allocation of economic rents and revenue management
- Consumer interface
  - Access to service, reliability, quality of service
  - Subsidy and system loss issues and pricing for core customers
US Value Chain Example

The Major Energy Value Chains

- **Oil and Gas Field Production**
  - Crude Transport
  - Oil Refining (product markets)

- **Processing (if needed)**

- **Gas Separation (if needed), Gathering**

- **Oil and Gas Field Production**

- **Pipeline Transportation (imports/exports)**

- **Local Distribution**
  - **Liquefaction (LNG)**
  - **LNG Tanker Shipment (imports/exports)**

- **Regasification**

- **Liquefaction (LNG)**

- **Marketing and Distribution (if applicable)**

- **Direct Use (e.g., vehicle transport)*

- **Electric Power Generation (utilities, IPP, industrial)**

- **Electric Power Transmission**

- **Electric Power Distribution**

- **Compressed natural gas (CNG; methane) and LPG are also used for vehicle transport; alternative fuels can be used.**

- **Alternative generation technologies can be used.**

- **Domestic production can be liquefied and stored; LNG can be regasified for seasonal use; or used in transport.**

- **Upstream**

- **Midstream**

- **Downstream**

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$16 Trillion Energy Investment Required Across the Energy Value Chains, 2001-2030


Investment Requirements in the Oil Sector ($ billion)

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<thead>
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<tr>
<td>Exploration &amp;</td>
<td>$689</td>
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<td>Development</td>
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<td>Tankers</td>
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<tr>
<td>Pipelines</td>
<td>20</td>
<td>23</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$917</strong></td>
<td><strong>$1,045</strong></td>
<td><strong>$1,135</strong></td>
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Investments Required in Natural Gas Sector

<table>
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<th>Sector</th>
<th>Cost</th>
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<tr>
<td>E&amp;P</td>
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<td>LNG</td>
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<td>Transmission</td>
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<td>Local Distribution (Gas &amp; Power)</td>
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<td>WORLD TOTAL</td>
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Source: IEA Global Investment Outlook, 2003

Comparative Risks and Returns: Electricity Lags Oil & Gas

Source: IEA Global Investment Survey 2003