Changing Paradigms in International Energy
Arthur Hanna, Managing Director, Accenture Energy Industry Group

Consequences of an Emerging U.S. Energy and Climate Policy on Global Energy Markets Conference
March 2nd 2010
The last few years has highlighted the additional turbulence and change we can expect to see in the energy system over the next 10 years

“The coming oil glut that will force prices to drop sharply”
FT, 30/12/09

“Copenhagen Fallout: Carbon Prices Fall on Weak Accord”
WSJ, 21/12/09

“European nuclear industry in grip of revival”
FT, 02/07/09

“Shale gas skepticism, and shale gas enthusiasm”
FT, 03/09/09

“America’s Natural Gas Revolution: A ‘shale gale’ of unconventional and abundant U.S. gas is transforming the energy market.”
WSJ, 02/11/09

“Gas, gas, gas”
The Economist, 14/12/09

“Supply crunch alarm – oh, no, wait…”
FT, 15/01/09

“Peak Demand or Peak Consumption? A Look at OECD Oil Demand”
The Oil Drum, 11/11/09

“The IEA on the carbon price: CO₂ has to cost much more”
FT, 10/11/09

“EU’s limited global clout under spotlight”
FT, 14/01/09

“Crude oil’s rollercoaster prices”
BBC, 07/08/09

“2010 could be warmest year on record”
The Independent, 10/12/09

“Planet B: How the underwhelming Copenhagen accord could yet turn into a useful document”
The Economist, 30/12/09

“Act now if you don’t want the lights to go out: The big energy companies are ready to change. But we’re still waiting for the Government to guide us to a low-carbon future”
FT, 02/07/09

“Cold weather ‘doesn’t undermine global warming science’”
Telegraph, 06/01/10

“A numbers game: The West African oil frontier”
FT, 16/09/09

“Climategate: The Fallout Continues from CRU Hacking”
WSJ, 30/11/09
“The sheer amount of uncertainty makes predicting the future difficult – everyone has an opinion”

Total Primary Energy Demand (EJ/y)

Source: Accenture “Predicting the Future” study

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Accenture’s “Predicting the Future” study helped us to understand the array of viewpoints of energy prognosticators.

The report consists of three parts:
1. How future energy demand profiles differ—wide variation in demand forecasts
2. Why energy demand profiles are different—fundamental differences in structure and assumptions
3. The influence of organizational standpoint—where you stand depends on where you sit
As our study showed, industry paradigms will be influenced by a wide variety of factors - from environmental to economic to technological to political.

Key takeaway: the complexity of managing any response will be magnified.
Accenture’s Delphi study identified policy and regulation as one of the key accelerators of change in the energy industry.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Driver</th>
<th>Time of occurrence</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D1</td>
<td>2010</td>
<td>2015</td>
</tr>
<tr>
<td>Post-Kyoto policies – binding targets</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>New buildings in OECD</td>
<td>P</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>• 40% smart technology</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>On-grid solar, no subsidies, commercially viable</td>
<td>T</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Renewable energy sources 15%</td>
<td>P</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Natural gas replaces oil</td>
<td>P</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Advanced storage and smart grids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• commercial OECD</td>
<td>T</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>CCS – 12% global power generation</td>
<td>P</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>Alternative transport fuels &gt;30%</td>
<td>T</td>
<td>T</td>
<td></td>
</tr>
</tbody>
</table>

* Does not include results for "2010"  
Source: Accenture Delphi II study

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Estimated timing?
Experts expect major change to occur sooner than conventional reports predict

- Major changes in the energy sector will begin to occur post 2020
- Next 10 years (2010 to 2020) will be a transition period
- Changes will happen faster than conventional forecasts
- Energy policy will be an important driver
Paradigm shift 1: Copenhagen and beyond...managing returns around legislation rather than output efficiency

Figure 10. Key components of a solution to address fossil fuel emissions in the value chain.

Policies
- Multi-track approach
- Industry sector solutions
- Urgent focus on the demand side
- Bolstered carbon markets
- Demonstrable benefits for participation
- Roadmaps to economy-wide emissions caps

Energy sources
- Oil and gas
- Biofuels

Decarbonized transportation fuels
- Biofuels
- Electrification
- Hydrogen production
- Biofuels and hydrogen distribution systems

Energy transformation
- Petrochemical plant

Decarbonized generation
- Nuclear power
- Renewables
- Carbon capture and storage (CCS)
- Efficiency improvements

Electricity grids
- Smart grids
- New technology deployment
- Smart metering
- Enabling demand-side management

Electric and hybrid vehicle infrastructure
- Demand-side management
- Electric storage
- Charging infrastructure
- New business models

Natural gas grids

Energy consumption
- Transportation
- Industry

Industry sector efficiency
- Best practice sharing
- New technology deployment
- Emissions trading

Residential and commercial

Demand side in the built environment
- Smart buildings
- Smart metering
- Energy-efficiency improvements
- Demand-side management

Source: Accenture study “To Copenhagen and Beyond: A pragmatic approach to mitigating climate change”
In all major regions, energy policy will be increasingly be driven by climate change...

In your opinion, which energy policy driver is the most important for policymakers in the following regions?

Mean values out of 30

Allocate 30 points across the three drivers (where 0 points = driver not relevant, 30 points = driver is the only relevant factor)
Due to rounding some columns may not add to 30

Source: Accenture Delphi II study

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Paradigm shift 2: The use of gas as a cleaner, primary oil substitute will increase as supply, delivery and price volatility concerns abate.

World primary natural gas demand by scenario

Gas demand continues to grow in both scenarios, peaking by around 2025 in the 450 Scenario & highlighting the potential role of gas as a transition fuel to a clean energy future.

### Paradigm shift 3: A multi-polar shift in demand and supply from developed toward emerging markets

**Demand Side**

<table>
<thead>
<tr>
<th>Region</th>
<th>2006 Consumption (mmbbl/d)</th>
<th>2030 Consumption (mmbbl/d)</th>
<th>% Share of Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. America</td>
<td>25.1</td>
<td>26.2</td>
<td>5%</td>
</tr>
<tr>
<td>OECD Europe</td>
<td>15.7</td>
<td>15.0</td>
<td>-3%</td>
</tr>
<tr>
<td>OECD Asia</td>
<td>8.5</td>
<td>8.7</td>
<td>1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>2006 Production Growth (mmbbl/d)</th>
<th>2030 Production Growth (mmbbl/d)</th>
<th>% Share of Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle East</td>
<td>25</td>
<td>31</td>
<td>25%</td>
</tr>
<tr>
<td>Eurasia</td>
<td>12</td>
<td>17</td>
<td>21%</td>
</tr>
<tr>
<td>Africa</td>
<td>10</td>
<td>14</td>
<td>15%</td>
</tr>
<tr>
<td>L. America</td>
<td>15</td>
<td>20</td>
<td>22%</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>9</td>
<td>9</td>
<td>4%</td>
</tr>
<tr>
<td>N. America</td>
<td>7</td>
<td>12</td>
<td>23%</td>
</tr>
<tr>
<td>Europe</td>
<td>6</td>
<td>4</td>
<td>-10%</td>
</tr>
</tbody>
</table>

Asia drives over two thirds of demand growth to 2030, while production based in a wide variety of emerging economies will play an increasing role in meeting global demand.

Source: EIA, Accenture analysis

* May not sum to 100% due to rounding and negative values

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Paradigm shift 4: Refining will undergo a significant geographical and product shift.

Figure 30: Global refining capacity by region

Figure 31: Global refining diesel capacity utilisation

Figure 32: Global refining gasoline capacity utilisation

Sources: Nomura 2020 Vision; BP Statistical Review
Paradigm shift 5: Delivering growth will require a shift in approach from “silo” to “JV ecosystem”

### Significant recent JV announcements

<table>
<thead>
<tr>
<th>Date</th>
<th>Parties</th>
<th>Description</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Feb 2010</td>
<td>Cosan, Shell</td>
<td>$12 bn joint venture*</td>
<td>Biofuels</td>
</tr>
<tr>
<td>11 Dec 2009</td>
<td>Shell, Petronas</td>
<td>JV to develop 12.6 bn barrel Manjoon field in Iraq</td>
<td>Oil</td>
</tr>
<tr>
<td>5 Nov 2009</td>
<td>CNPC, Chevron</td>
<td>Jointly develop Luojiazhai gasfield in Sichuan</td>
<td>Natural gas</td>
</tr>
<tr>
<td>3 Nov 2009</td>
<td>BP, CNPC</td>
<td>Invest $15 bn in Iraq Rumaila field</td>
<td>Oil</td>
</tr>
<tr>
<td>7 Sep 2009</td>
<td>Petroecuador, PDVSA</td>
<td>Set up JV to operate Sacha oil field</td>
<td>Oil</td>
</tr>
<tr>
<td>2 Sep 2009</td>
<td>ONGC Videsh, IndianOil, Oil India Limited</td>
<td>Invest $5 bn in Iran gas field</td>
<td>Natural gas</td>
</tr>
</tbody>
</table>

* Announced but not closed

** Includes: Rosneft Oil Co., Lukoil OAO, Gazprom OAO, TNK-BP and Surgutneftegaz

Please note - this data includes only Joint Venture deals that have involved a buyer and seller. Joint venture agreements that have occurred after the purchase of an asset are not included.

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Paradigm shift 5: Delivering growth will require a shift in approach from “silo” to “JV ecosystem”

• JVs formed to share costs and risks of major new field developments
  – Being used to bring NOC funding and political muscle together with technology and experience base of the IOCs
  – But also now proving just as common to bring NOCs together for international expansion
• Downstream IOCs accessing integration value without diverting funds from upstream
  – BP & Husky/Shell & Cosan
• Now seeing the emergence of more strategic multi-objective partnerships
  – e.g. Eni-Gazprom strategic alliance enables cooperation across the value chain: incl. gas market access and upstream assets in Russia and Libya
• Implications/Challenges:
  – Creation of a singular view of JV success to focus the combine organisations
  – Usual JV challenges of governance and day to day cooperation
  – Senior management to prevent wider strategic options aren’t lost in the day to day pressures to get JV operational
The likely result of these paradigm shifts is a radically altered competitor set.

<table>
<thead>
<tr>
<th>Oil and gas</th>
<th>Utilities</th>
<th>Chemicals</th>
<th>Renewables</th>
<th>Automotive</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.O.C.s controlling supply, forming alliances and operating outside their home country</td>
<td>Firms specializing in alternative energy will compete in power generation</td>
<td>Bioplastics will begin to compete successfully with conventional fossil-fuel based plastics</td>
<td>Huge opportunity in this area across the value chain—will we see an integrated renewables company?</td>
<td>New business models will enable electric vehicles to make big inroads into the market</td>
</tr>
<tr>
<td>Service companies extending their offering</td>
<td>Asset ownership by financial players rather than utilities</td>
<td>Carbon-leakage investments pushing activity into Middle East and Asia</td>
<td>Developing world—particularly Brazil and China—has stolen a march in areas such as wind, solar, and biofuels</td>
<td>Battery manufacturers and utilities will emerge as new players</td>
</tr>
<tr>
<td>Second-generation biofuels</td>
<td>Smart grid applications will drive competition from information and communications technology (ICT) firms, among others</td>
<td>Traditional transmission and distribution networks will be challenged by decentralized supply and international networks</td>
<td></td>
<td>Chinese manufacturers of both batteries and electric vehicles will represent major competition</td>
</tr>
<tr>
<td>Independents competing with unconventional production plays</td>
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</tbody>
</table>

Disruptive technologies (size of bubble indicates proportion of responses):

- Solar: 2.7%
- Biofuels
- Storage
- Nuclear
- Wind
- Battery
- CCS
- EVs
- Smart grid
- Unconventional gas

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