Economics, Public Perception, and Policy

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Production, Price, and Technology

Source: eia.doe.gov
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Gulf of Mexico Deepwater Oil Production

Sources: MMS, EIA Office of Oil and Gas; includes lease condensate
Assuming global warming is happening, do you think it is caused mostly by

- human activities?
- natural changes in the environment?

Base: Americans 18+ November 2016
Carbon Neutral

Carbon neutral industry

• Maintains current energy supply mix
• Adds no additional carbon to the atmosphere

Life Cycle GHG Emissions from Crude Oil

Oil and Gas Combustion Accounts for Most Greenhouse Gas (GHG) Emissions

More than 85% of produced oil is combusted.

Note: CO2e based on 100-year global warming potential.
Source: U.S. Environmental Protection Agency (EPA), Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016, April 2018
Estimated Anthropogenic Methane Emissions by Source

US - 2014
- Manure Management 10%
- Landfills 16%
- Enteric Fermentation 26%
- Natural Gas and Petroleum Systems 31%
- Other 9%
- Coal Mining 8%

Global - 2010
- Enteric Fermentation 29%
- Wastewater 9%
- Oil and Gas 20%
- Landfills 11%
- Coal Mining 6%
- Agricultural (Manure) 4%
- Biomass 3%
- Stationary and Mobile Sources 1%
- Rice Cultivation 10%
- Other Ag Sources 7%
- IGSD 2010

CO2 Enhanced Oil Recovery with Monitoring, Measurement, and Verification (EOR+)

<table>
<thead>
<tr>
<th>EOR+ Scenario</th>
<th>Description</th>
<th>Incremental recovery % OOIP</th>
<th>Net Utilization tCO₂/bbl</th>
<th>Net Carbon Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>Miscible WAG flood with vertical injector and producer wells in a “five spot” or similar pattern. Operational practices seek to minimise CO₂ use.</td>
<td>6.5</td>
<td>0.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Advanced</td>
<td>Miscible flooding following current best practices optimised for oil recovery. May also involve some “second-generation” approaches that boost utilisation and recovery.</td>
<td>13</td>
<td>0.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Maximum Storage</td>
<td>Miscible flooding where injection is designed and operated with the explicit goal of increasing storage. Could include approaches in which water is removed from reservoir to increase available pore volume.</td>
<td>13</td>
<td>0.9</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Table adapted from IEA 2015

Ratio tons stored to tons combusted for 85% combustion with 420 kg CO₂/bbl combusted oil

Up to 139 GtCO₂ storage potential starting at $70/bbl oil price excluding capture cost (Godec et al. 2011)
Government Initiatives

• Stick
  – Carbon tax
  – Increase consumer prices to enable lower carbon alternatives
  – Regressive for the consumer by nature

• Carrots
  – Cap and trade
  – Tax credit
  – Subsidy
  – Applied with objective to enable development of a target technology

• Barriers to International Political Initiatives
Industry Commitment

Oil and Gas Climate Initiative (OGCI)

OGCI members collectively account for

- **PRODUCTION**: 30% of global O & G production
- **GLOBAL REACH**: 130 countries with 21 million employees
- **INVESTMENTS**: $6.3B in low carbon technologies

http://oilandgasclimateinitiative.com/
Upstream oil and gas production

CCUS and CCS

• Knowhow
• Infrastructure

• Energy security
• Sustainability

Critical new market for our workforce