Introduction to Exploration and Production

# Safety and Environment in Exploration and Production

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Society of Petroleum Engineers

#### Intro to E&P - Safety and environment [and sustainability]



Sustainability (however defined)

A major concern for:

- Society
- The energy industry (in general)
- Oil and gas (in particular)

Sustainability issues

Project level

- Health and safety
- Environmental impact
  - Pollution
- Social impact

Corporate level

- Corporate governance
  - Diversity
  - Corruption
  - Treatment of stakeholders
- Climate change
  - Greenhouse gasses (GHG)

Health, HSE safety, environment

> Environment, ESG social, governance



#### Sustainability - Some terminology

#### Terminology

HSE - Health, safety, environment

- Project health, safety and environmental protection.
- Regulated by company and government.

**ESG** - Environmental, social and governance

- Aims to uncover and enhance investment value, by focusing on sustainability issues
- Analogous to the focus on health & safety a generation ago
- Goals
  - Increase profitability
  - Attract investment
  - Raise market valuation
- Regulated by investors, ratings agencies, public opinion, NGOs.

#### Other terminology

CSR - Corporate social responsibility

- Project, not business, focus
- Corporate self-regulation
- No longer thought strong enough

SLO - Social licence to operate

- Acceptance by local communities and stakeholders
- Social, not regulatory, permission
- Project, not business, focus
- Still important, along with ESG

SRI - Socially responsible investment

- Business focus (like ESG)
- Around for longer than ESG
- Ethical and moral criteria
  - Not financial value
- Uses negative screens
  - No alcohol, tobacco or firearms

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#### Safety - A key concern



#### Piper Alpha, 1988, UK North Sea

Oil production (processing) incident 167 killed, only 61 survivors Production stopped at 5 other fields Loss of exports £1.3 billion 1988-89 Response:

- 'Safety-case' non-prescriptive management system introduced
- Safety awareness programmes for personnel
- External safety audits

#### Exxon Valdez, 1989, Alaska

Oil transportation incident

Oil tanker struck a reef

Spilled 260–750 thousand barrels oil

Oil covered 2,100 km2 of coastline, and 28,000 km2 of ocean

Response:

- US Oil Pollution Act 1990
- Tankers now double-hulled
- Increased penalties
- Better navigation equipment

#### Deepwater Horizon, 2010, US GOM

Oil drilling incident

Explosion and fire killed 11 workers

Offshore drilling rig Deepwater Horizon sank

Large oil spill in Gulf of Mexico









#### UK North Sea injury rate has decreased over the years



https://oilandgasuk.cld.bz/Health-and-Safety-Report-2019

#### Climate change, driven by greenhouse gases (GHG) - A major challenge

Greenhouse gases (GHG) are natural and man-made gasses that trap heat in the atmosphere

- Carbon dioxide (CO2)
- Methane (CH4)
- Nitrous oxide
- Fluorinated gases

Each gas has a different climate change potency

Volumes are quoted in tonnes of CO2 equivalent (tCO2e)

le. equivalent climate change potential.



https://www.flickr.com/photos/carbonquilt/8228691679/in/photostream/



https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

A **tonne of CO2** would occupy a volume about the size of a house Density CO2 = 2 kg/m3 Density air = 1.2 kg/m3

#### What are the main greenhouse gases?

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Pecentages express greenhouse potency of each gas

## https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

#### What activities contribute to greenhouse gas emissions?



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#### Industry

- Fossil fuels burned at industrial facilities for energy
- Emissions from chemical, metallurgic, and mineral transformation processes

In US

- Transportation 34%
- Electricity 33%
- Industry 15%
- Residential, commercial 10%
- Other (non-fossil) 7%



- Fossil fuels burned for road, rail, air, and marine transportation
- 95% of the world's transportation energy comes from petroleum fuels



https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

#### What can be done to mitigate climate change?

It is going to be very difficult to remedy climate change

Problem may be under-stated by climate scientists.

**Regulatory remedies** 

- Sustainability reporting (ESG)
- Carbon pricing

**Technical remedies** 

- Renewable energy
- Electrification
- Natural gas
- Carbon capture
- Hydrogen
- Geoengineering

Social remedies

- Smaller cars
- Less meat and dairy
- Less heating and air conditioning
- Changed flying habits

Political and social challenges are greater than technical.

Changing people's behaviour is difficult.



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#### Energy scenarios and outlooks

#### Scenarios

- Plausible descriptions of long-term future
- What **could** happen
- Not
  - What will happen (a forecast)
  - What should happen (a policy)

Published by many organisations

Shell credited with starting them

Very good source for understanding implications of climate change



#### How much energy is needed for a decent life for all?









Each person in the US uses the equivalent energy of **300** labourers, working 10h/300d per year. Others calculate this as 150 "energy slaves", working 24h/365d per year.

100 gigajoules of primary energy for each person on earth may be required in future, assuming continued energy efficiency improvements.

With a population of 10 Bn in 2100 double the energy would be needed.

Source: "Pathways to Net-Zero Emissions" (Shell 2016)

\* Source: Shell analysis







[End]

[Animated]

#### ESG - Environmental, social and [corporate] governance

Companies under pressure from investors, stakeholders, communities and regulators to:

- Act sustainably, fairly & responsibly
- Report performance on these ESG issues

ESG reporting parameters

- Non-financial corporate sustainability metrics.
- Not (yet) part of mandatory financial reporting
- Voluntary disclosure made in annual reporting.
- Used by investors to identify risks and opportunities.

ESG parameters report company position on things like:

- Climate change and environmental impact
- Treatment of workers, communities and supply chain.
- Transparency (anti-corruption)

Companies report on ESG to increase profitability

- Not just to get acceptance
- Acceptance was main aim of
  - CSR corporate social responsibility
  - SLO social licence to operate

Profit motives to report on ESG

- Attract investment
  - Private and institutional
  - Debt (loans)
  - Equity (raising company value)
- Attract and retain talent
- Satisfy regulators and stakeholders

Help with ESG reporting

- Global Reporting Initiative (GRI)
- Sustainable Accounting Standards Board (SASB)
- CDP (sustainable investment disclosure charity)
- Traditional rating agencies (S&P, etc)

#### ESG - Example factors

ESG factors

- Cover a wide range of issues, not traditionally part of financial analysis
- Can be tricky to define and research

The below metrics are general to all business Oil and gas E&P will require sector-specific measures.

Environmental Issues	Social Issues	Governance Issues
Climate change and carbon emissions	Customer satisfaction	Board composition
Air and water pollution	Data protection and privacy	Audit committee structure
Biodiversity	Gender and diversity	Bribery and corruption
Deforestation	Employee engagement	Executive compensation
Energy efficiency	Community relations	Lobbying
Waste management	Human rights	Political contributions
Water scarcity	Labor standards	Whistleblower schemes

www.cfainstitute.org/en/research/esg-investing

#### Carbon pricing

Economists (and O&G industry) favour carbon pricing

- · Simple, predictable, effective, inexpensive, fair
- Compared to clumsy regulation
- External costs of emissions tied to source
  - 'Polluter-pays'
- Clear incentive to reduce emissions
- · Stimulates clean technology and market innovation

#### Types of carbon pricing

- Emissions trading system (ETS)
  - Cap-&-trade
  - Sets emissions target
- Carbon taxes
  - Set carbon price directly
- Carbon offsets
  - Pay others to reduce emissions on your behalf

#### Tax-and-dividend

- Potentially fairer, more acceptable approach
- Taxes collected are re-distributed to mitigate energypoverty



Climate Changed

#### Oil Companies Join Corporate Lobbying Push for U.S. Carbon Tax

By <u>Jennifer A Dlouhy</u> and <u>Ari Natter</u> 20 May 2019, 11:00 CEST *Updated on 20 May 2019, 17:14 CEST* 

- ▶ BP, Shell will bankroll push for carbon tax-and-dividend plan
- ► Moves come amid mounting pressure from shareholders and public

https://www.bloomberg.com/news/articles/2019-05-20/oilcompanies-join-corporate-lobbying-push-for-u-s-carbon-tax

"Oil companies [...] campaign for ... tax on carbon dioxide emissions even though it may lead to higher prices for their products."

#### Carbon pricing approaches

Emissions trading (ETS)

- Cap-and-trade system
- Caps total level of greenhouse gas emissions
- Allows industries with low emissions to sell their extra allowances
- Creates supply and demand for emissions allowances
- Establishes a market price for greenhouse gas emissions.
- Helps ensure that the required
  emission reductions will take place
- Keeps emitters (in aggregate) within their pre-allocated carbon budget.

Carbon taxes

- Set price on carbon
  - Unlike ETS which sets emission target

Carbon tax approaches

- Emitter taxes
  - Tax emissions
- Consumer taxes
  - Tax usage of fuel, energy, etc
- Remove subsides
  - On fossil fuels
  - Type of negative tax

Tax-and-dividend

- Potentially fairer, more acceptable approach
- Taxes collected are re-distributed to mitigate energy-poverty

Carbon offsets

- Payment for emission reductions by others, to compensate for own
- Another way of pricing GHG emissions

#### Energy for heavy industry

Steel and concrete are very important for human development

- But both have a high carbon footprint
- Both require very high temperatures
  - That cannot be provided by [renewable] electricity

Pantheon dome, Rome

- Completed 126 CE
- World's largest unreinforced concrete dome
- After Roman Empire concrete
  became rare until mid-18th century

Cement contributes 8% of worldwide man-made CO2 emissions

- 50% from the chemical process
- 40% from burning fossil fuels





## Bill Gates backs startup using sunlight to create 1,000C-plus heat

Tue 19 Nov

Guardian

**<u>Helicg</u>** en uses mirrors to concentrate solar energy that can power heavy industry



🔺 Heliogen's solar energy plant in Lancaster, California Photograph: Heliogen

Bill Gates is backing a new venture which aims to turn sunlight into a source of heat exceeding 1,000C that could help replace fossil fuels.

#### Carbon capture, usage and storage (CCUS)

Most scenarios to manage global warming assume carbon capture usage and storage will work

- But an unproven technology
- Costs are high

#### Aims

- Prevent release of CO2 into atmosphere.
- Reduce global warming and ocean acidification.

#### Process

- Capture waste carbon dioxide (CO2)
- Transport to storage site
- Deposit in permanent location

Capture generally from point source

- Cement factory
- Power plant
- Hydrogen production plant
- By a process known as scrubbing with chemicals or membranes

Deposit usually in underground geological formation

- Depleted oil field
- Saline formation
- Coal bed
- Deep ocean

Carbon capture **usage** storage (CCUS)

• E.g. Injection of CO2 into oil field for enhanced oil recovery

#### Direct air capture of CO2 is possible

• CO2 is 'scrubbed' from air



#### Geoengineering

Large-scale intervention in the Earth's climate system

- Pump particles into atmosphere
- Place mirrors in space
- Create clouds
- Increase crop & desert reflectivity
- Ocean iron fertilization

#### Mount Pinatubo eruption 1991

- 20 megatons sulfur dioxide injected into high atmosphere
- Sulfate layer scattered sunlight
- Planet cooled by half a degree C for four years

#### Controversial

- Involves "messing with nature"
- Political hot-potato

#### 00000

SPACE MIRRORS Orbiting mirrors deflect sun's rays READINESS: •••• COST: **\$\$\$** FLAW: unknown weather effects; fails to prevent acidic oceans

### ARTIFICIAL TREES

CO<sub>2</sub> sucked from air and stored underground READINESS: • • COST: **\$\$\$** FLAW: large geological cache needed



### OOOO REFLECTIVE CROPS Planting crops that

Planting crops that reflect more sunlight READINESS: © © COST: \$ FLAW: large land area needed; fails to prevent acidic oceans

### FORESTING

Trees absorb CO<sub>2</sub> READINESS: **© ©** COST: **\$** FLAW: large land area needed Particles in the stratosphere reflect sun's rays READINESS: • COST: **\$** FLAW: risk of ozone depletion; unknown weather effects, fails to prevent acidic oceans

AEROSOLS

#### 00000

CLOUD SEEDING Atomising seawater creates clouds to reflect sun's rays READINESS: • • • COST: \$\$ FLAW: unknown weather effects, patchy success; fails to prevent acidic oceans

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CARBONATE ADDITION Ground limestone helps oceans absorb CO2 READINESS: © © COST: \$\$ FLAW: unknown effects on ecosystems

O
 BIOCHAR
 Agricultural carbon waste is
 burned and buried
 READINESS: 
 COST: 
 SS
 FLAW: large land area needed

#### 

OCEAN FERTILISATION Iron filings stimulate CO<sub>2</sub>-eating plankton READINESS: ©© COST: **\$\$** FLAW: unknown effects on ecosystems

New Scientist 2009

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## Questions?



**Society of Petroleum Engineers**