Energy Service Providers Journey to Net Zero
Quantifiably reducing carbon footprint in the value chain and driving high performance

(David Shackleton, August 2022)
Dual Challenge creates new Industry Imperative

**Global Energy-related CO₂ emissions; IEA net zero and Low Co-operation case**

![Graph showing CO₂ emissions from 2010 to 2090.]

**Dual challenge**

- 40% Growth in World Economy by 2030
- 40% Reduction in Energy-related CO₂ emissions by 2030 for 1.5°C

**Industry Imperatives**

- **RETURNS**
  - Capital Efficiency
- **SUSTAINABILITY**
  - More Energy, less Carbon
- **EARNINGS GROWTH**
  - Cost Efficiency & Consistency

Source: IEA NZ2050 (2021)

The Climate Challenge

### Green House Gas Emissions – Total 55 GtCO₂e in 2019

<table>
<thead>
<tr>
<th>Source</th>
<th>Contribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>65%</td>
</tr>
<tr>
<td>Methane</td>
<td>11%</td>
</tr>
<tr>
<td>N₂O, F-Gases</td>
<td>8%</td>
</tr>
<tr>
<td>A/C, Aerosols</td>
<td>16%</td>
</tr>
<tr>
<td>Forestry &amp; Land Use</td>
<td>11%</td>
</tr>
<tr>
<td>Fossil Fuel &amp; Industrial Processes</td>
<td>28%</td>
</tr>
<tr>
<td>Other Sources</td>
<td>28%</td>
</tr>
<tr>
<td>Other Fossil Fuels</td>
<td>30%</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>42%</td>
</tr>
</tbody>
</table>

**Total from Fossil Fuels ~ 70%**
**Total from Oil & Gas ~ 42%**


### Dual challenge

↑ 40% Growth in World Economy by 2030
↓ 40% in greenhouse gas emissions by 2030 for 1.5 degC

Greenhouse Gas Emission Scopes

- **Scope 1 (DIRECT)**: Emissions directly caused by the company, including:
  - Purchased electricity, steam, and cooling for own use
  - Leased assets
  - Employee commuting
  - Business travel
  - Use of sold products
  - End-of-life treatment of sold products
  - Leased assets

- **Scope 2 (INDIRECT)**: Emissions caused by the use of purchased goods and services, including:
  - Purchased good and services
  - Capital goods
  - Fuel and energy activities
  - Transportation and distribution
  - Waste generated in operations

- **Scope 3 (INDIRECT)**: Emissions caused by the use of company facilities and value chain activities, including:
  - Employee commuting
  - Business travel
  - Process of sold products
  - Use of sold products
  - End-of-life treatment of sold products
  - Leased assets
  - Franchises
  - Investments

**Schlumberger 2019 Emissions**
- **Oil and Gas 2019 Emissions**: 23 GT CO₂e
- **Schlumberger 2019 Emissions**: 0.055 GT CO₂e

**Source:**
### Schlumberger Emissions 2019 – CO₂e Tonnes

**Total Emissions:** 39,950,588 T

- **Scope 1:** 1,416,000 T
- **Scope 2:** 760,000 T
- **Scope 3:** 52,450,000 T

#### Key Emission Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Scope 1</th>
<th>Scope 2</th>
<th>Scope 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased goods and services</td>
<td>759,102</td>
<td>104,860</td>
<td>6,265,681</td>
</tr>
<tr>
<td>Capital goods</td>
<td>1,416,313</td>
<td>115,101</td>
<td>159,659</td>
</tr>
<tr>
<td>Fuel and energy related activities</td>
<td>1,782,926</td>
<td>100,756</td>
<td>1,782,926</td>
</tr>
<tr>
<td>Upstream transportation and distribution</td>
<td>100,000</td>
<td>2,000</td>
<td>negligible</td>
</tr>
<tr>
<td>Waste generated in operations</td>
<td>negligible</td>
<td>935,213</td>
<td>negligible</td>
</tr>
<tr>
<td>Business travel</td>
<td>negligible</td>
<td>100,000</td>
<td>negligible</td>
</tr>
<tr>
<td>Employee commuting</td>
<td>negligible</td>
<td>negligible</td>
<td>negligible</td>
</tr>
<tr>
<td>Upstream leased assets</td>
<td>104,860</td>
<td>negligible</td>
<td>negligible</td>
</tr>
<tr>
<td>Downstream transportation and distribution</td>
<td>negligible</td>
<td>negligible</td>
<td>negligible</td>
</tr>
<tr>
<td>Process of sold products</td>
<td>negligible</td>
<td>negligible</td>
<td>negligible</td>
</tr>
<tr>
<td>Use of sold products/services</td>
<td>negligible</td>
<td>negligible</td>
<td>negligible</td>
</tr>
<tr>
<td>End-of-life treatment of sold products</td>
<td>negligible</td>
<td>640,000</td>
<td>negligible</td>
</tr>
<tr>
<td>Downstream leased assets</td>
<td>negligible</td>
<td>1,489,130</td>
<td>negligible</td>
</tr>
<tr>
<td>Franchises</td>
<td>negligible</td>
<td>1,804,615</td>
<td>negligible</td>
</tr>
</tbody>
</table>

**Transition Technologies**

Schlumberger-Private
Oil & Gas Emissions

2019 Estimates

23 GT CO2E – Oil & Gas related

- The oil & gas industry = 5 GT
- Using the refined products = 18 GT

32 GT CO2E – outside Oil & Gas

Source: IEA, McKinsey 2020
Oil & Gas Emissions

2019 Estimates

23GT CO2E – Oil & Gas related

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Using the refined products = 18 GT

32GT CO2E – outside Oil & Gas

Source: IEA, McKinsey 2020
UN Sustainable Development Goals

Built on decades of work by countries and the UN, based upon multiple summits, conferences, forums and agreements, starting in 1992

Related to Oil & Gas technology solutions
Our Science-Based Commitment to Net Zero

Industry leading Scope 3 inclusive target to get to NET ZERO BY 2050

Ambition to achieve NET ZERO with carbon-negative solutions

Comprehensive near-term roadmap with INTERIM TARGETS

- **30%** for 2025 (Scopes 1 and 2)
- **50%** for 2030 (Scopes 1 and 2)
- **30%** for 2030 (Scope 3)
Our Science-Based Commitment to Net Zero

Industry leading Scope 3 inclusive target to get to NET ZERO BY 2050

Ambition to achieve NET ZERO with carbon-negative solutions

Comprehensive near-term roadmap with INTERIM TARGETS

2025
Scopes 1 and 2
30%

2030
Scopes 1 and 2
50%

2030
Scope 3
30%

Scorecard
2021 emissions = 29.2 million tonnes
Scope 1 and 2 ↓ 25%
Scope 3 ↓ 38%
Taking Climate Action

Getting to Net Zero by 2050

Investing in the Energy Transition

Oil & Gas Decarbonization

Core Portfolio
New Energy
Digital

Transition Technologies
Schlumberger End-to-end Emissions Solutions
Drilling Emissions Management
Carbon Services for CO₂ Storage
Solutions to Reduce Emissions in Customer Operations

Transition Technologies

Schlumberger End-to-end Emissions Solutions

Drilling Emissions Management

Carbon Services for CO₂ Storage
Portfolio Vision: Transition Technologies
Driving Superior Business Outcomes with More Energy, Less Carbon

Less NPT
Less Waste
Less Driving
Less Resources
Less Emissions
Less Carbon
Less Cost

More

RETURNS
Capital Efficiency

SUSTAINABILITY
More Energy, less Carbon

EARNINGS GROWTH
Cost Efficiency & Consistency
Our Approach: Sustainability through Technology

Environmental Focus

Our United Nations Sustainability Development Goals

Solution Attributes

- Emissions Reduction
- Energy Consumption Reduction
- Renewable Energy / Electrification
- Surveillance & Assessment
- HazMat / HazChem Reduction
- Water Stewardship
- Waste Reduction
- Size Reduction

Image source: UN.org
Transition Technologies: Progress & Outlook

Portfolio review: 100+ impact-reducing technologies; Mapped to SDGs.

Impact quantification framework using 8 technology attributes.

Framework piloted. Sustainability embedded in R&D process.

Rapid expansion of portfolio and external accreditation of framework.
Transition Technology Portfolio

Address Methane Emissions
Reduce or Eliminate Flaring
Minimize Well Construction CO₂ Footprint
Full Field Development Solutions
Electrification of Infrastructure
### Transition Technology Portfolio

<table>
<thead>
<tr>
<th>Address Methane Emissions</th>
<th>Reduce or Eliminate Flaring</th>
<th>Minimize Well Construction CO₂ Footprint</th>
<th>Full Field Development Solutions</th>
<th>Electrification of Infrastructure</th>
</tr>
</thead>
</table>
| - Cameron low-emission valves | Nonroutine Flaring
  - Ora deep transient testing
  - EverGreen minimal environmental impact well effluent burner
  - Zero flaring well test and cleanup
  - Flaring emissions prediction | - ATC automatic tank cleaning technology
  - CemFIT Heal flexible self-healing cement system
  - ENVIROUNIT offshore slop water treatment
  - EverCRETE CO₂-resistant cement systems
  - GeoSphere 360 3D reservoir mapping-while-drilling Service
  - Intelligent Power Management
  - NeoSteer at-bit steerable system
  - Ora platform fluid sampling and scanning
  - Optiq Seismic fiber-optic borehole seismic solution
  - Performance Live digitally connected service
  - PowerDrive Orbit G2 rotary steerable system
  - TruLink definitive dynamic survey-while-drilling service | - Apura composite membrane
  - CYNARA acid has removal membrane systems
  - HiWAY flow-channel fracturing technique
  - NATCO DUAL FREQUENCY electrostatic treaters, coalescers, and deslators
  - Rapid multilateral systems
  - ReacXion fully dissolvable frac plug
  - REDA Maximus Eon extended-life, install-ready ESP motor
  - Saltel Xpandable expandable steel technology
  - Subsea boosting systems
  - Subsea multiface compression system
  - PureMEG MEG mechanical vapour recompression
  - PMM ESP Motor
  - HPS Multiphase Horizontal Pump
  - Select S and SulfaTREAT H2S Adsorbents
  - THIOPAQ O&G Bidesulfurization System
  - OCS-V and OCS-H Clamp Connection Systems | - All-electric subsea actuator
  - All-electric surface actuator |
| - Symmetry process software platform | Routine Flaring
  - Symmetry platform | | | |
| - Vx Spectra surface multiphase flowmeter | | | | |

Apura, ATC, CemFIT Heal, CYNARA, ENVIROUNIT, EverCRETE, EverGreen, GeoSphere 360, HiWAY, NATCO DUAL FREQUENCY, NeoSteer, Optiq Seismic, Ora, Performance Live, PowerDrive Orbit G2, PureMEG, Rapid Multilateral Systems, ReacXion, REDA Maximus, Saltel Xpandable, Select S, Symmetry, SulfaTreat, Transition Technologies, TruLink, and Vx Spectra are marks of Schlumberger. THIOPAQ O&G is a technology owned by Paqell BV, a joint venture of Shell International and Paques BV.
Zero-Flaring Well Testing and Cleanup

Technology-driven approach to reduce industry emissions

5% of oil and gas emissions are related to flaring activities

Our approach reduces emissions by eliminating flaring

<table>
<thead>
<tr>
<th>Central Asia</th>
<th>BP Oman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving production while eliminating all flaring-related emissions</td>
<td>Zero-flaring completions technique sets a new bar for delivery and efficiency</td>
</tr>
</tbody>
</table>

**Track record:**
- 500+ days in operation

**Emissions reduction:**
- >240,000 metric tons from well cleanup and production boosting

**Track record:**
- 10 wells per year

**Emissions reduction:**
- 80,000 metric tons CO2e elimination

Reduce or Eliminate Flaring

Transition Technologies is a mark of Schlumberger.
EverGreen
Minimal environmental impact well effluent burner

Emissions reduction compared with traditional burners

Unburned methane (CH4)

<table>
<thead>
<tr>
<th>Combustion efficiency, %</th>
<th>Traditional burners</th>
<th>EverGreen burner</th>
</tr>
</thead>
<tbody>
<tr>
<td>98.0%</td>
<td>98.5%</td>
<td>99.84%</td>
</tr>
</tbody>
</table>

71% reduction in CH4

Carbon equivalent (CO2e)

<table>
<thead>
<tr>
<th>Traditional burners</th>
<th>EverGreen burner</th>
</tr>
</thead>
<tbody>
<tr>
<td>6–10% reduction in CO2e†</td>
<td></td>
</tr>
</tbody>
</table>

Total reduction in emissions
324 metric tons of CO2e

Result | Peak Combustion Efficiency | Peak Destruction Efficiency | Fallout Efficiency, One-Day Cycle
---|-----------------------------|-----------------------------|-------------------------------|
%     | 99.84                       | 99.93                       | 99.999995                    |

†3 days flaring at 4,000 bbl/d using the Evergreen burner at 99.84% combustion efficiency compared with a traditional burner at 98% combustion efficiency
Low-Emission Valves
API- and ISO-certified valves to mitigate fugitive emissions

- Proven reduction in emissions
- Certified to industry fugitive emissions design standards API 624 and 621 and ISO 15848-1
- Traditional, well-known ball valve types—trunnion-mounted, floating, and rising stem ball valves—together with new technology, such as integrated-seat ball valves and gate, globe, butterfly, and plug valves
- Aftermarket services to ensure that the valves maintain their fugitive emissions certifications

596 million metric tons of methane emitted to the atmosphere annually
84\times stronger global warming potential of methane compared with \text{CO}_2 over a 20-y period

57\% \text{CO}_2e emissions from oil and gas operations caused by vented and fugitive methane
96\% Reduction in emissions possible from ISO and API certified Low-E valves
Symmetry
Advanced simulation technology improves product quality while reducing flaring for a major shale producer in Canada

- Ensuring product consistency in a challenging environment
- Advanced modeling for operational decision support
- Allowed the customer to assess the impact of composition and rate for each new well brought into production.
- Enable the customer to shift these wells to the primary production system an average of five days sooner than was previously the case
- Shifting the wells to production earlier in their clean-up process, allowed the operator to eliminate 0.25 MMscf of routine flaring per well.

Elimination of 5 days of gas flaring on each well

Emissions Reduction

Eliminated flaring 250 Mscf of gas for each new well brought into production

18 T CO$_2$e eliminated per well in a field with 50 to 100 wells drilled per year
EverCRETE
CO₂-resistant cement system

- Creates robust barrier
- Extends longevity through self-healing
- Significant reduction in CO₂ during manufacturing
- Primary application: CCUS and CO₂ injection for EOR

Comparison

<table>
<thead>
<tr>
<th>Conventional Slurry</th>
<th>EverCRETE RETE System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions per bbl</td>
<td>-63%</td>
</tr>
</tbody>
</table>

63% reduction in CO₂ emissions
34 metric tons CO₂ reduced

Typical section – injection well
Average 200 bbl fluid pumped

Minimize Well Construction CO₂ Footprint

Transition Technologies
CemFIT Heal
Flexible self-healing cement system

- Provides competent annular pressure seal thus assuring long-term well integrity
- Delivers superior mechanical properties to withstand downhole stresses preventing cracks and micro-annuli
- Auto-repairs recurrently should any cement defects appear, thus extending the longevity of the wells
- Significant reduction in CO2 during manufacturing

Case Study: Sustained Casing Pressure (SCP) Eliminated

Challenge:
45% of the wells in an offshore field had SCP. A liner, followed by tie-back was being used to cement the section without any success.

Result:
- >1,000 bbl of customized light weight CemFIT Heal system placed with minimal losses in highly deviated section
- Effectively resolved SCP, and in-turn any remedial treatment related emissions (> 165 CO2eq Tonnes Scope 1 Emissions per well)
- Enabled modified casing design saving up to 3 rig days per well (> 100 CO2eq Tonnes Scope 1 Emissions per well) & over USD 200,000

265 metric tons CO₂e emissions avoided
Intelligent Power Management

From reactive to predictive power management

- Fully automated smart engine management software
- Energy storage maximizes engine performance
- Zero emissions through use of hydrogen fuel cells

Path to ZERO EMISSIONS

**Today**

- 12% reduction in emissions†

**2023 Ambition**

- 100% reduction in emissions

<table>
<thead>
<tr>
<th>Results from automated software in US land rigs operating for more than six months</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,200 PER YEAR of metric tons CO₂ reduced</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emissions reduction based on power produced at the wellsite with green hydrogen fuel cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000 PER YEAR of metric tons CO₂ reduced</td>
</tr>
</tbody>
</table>

- Delivering consistent, sustainable, and efficient power
- Integrating advanced technologies into one solution
- Reducing maintenance, emissions, and fuel costs

†Results may vary by well type, engine type, crew, etc.
‡Based on USL a rig with automated software
Performance Live
Digitally connected service

- Safety and Sustainability
  - Remove people from the red zones
  - Reduce carbon footprint by leveraging digital tools
- Improved Service Delivery and Efficiency
  - Streamline operations and logistics
  - Minimize manual work and siloed operations
- Enhanced Customer Performance
  - Live control of wellsite operations
  - Faster and more informed decisions

CO2e
21%
45

United States – Permian Basin
Improved ROP and reduced footprint per well basis

DRILLING EFFICIENCY AND PRODUCTION OPTIMIZATION
Digitally connected service

Giving the present in the #AOG2022 with Gabriel Berkovic. We present evolution and results of the Performance Pad Engineering sector in Unconventional Drilling in YPF. In this presentation we show how, in collaboration with Perforación, the contractors, and transversal sectors, a 50% reduction in flat times was achieved in the drilling of horizontal wells.

We thank YPF SA and the Instituto Argentino del Petróleo y del Gas for giving us that opportunity.

#perforacion #estandarizacion #tiemposplanos #trabajonequipo #optimizacion #LEAN