METHANE EMISSIONS DETECTION, GEO-LOCATION AND QUANTIFICATION
John Crane is an active participant in the effort to reduce methane emissions.
What is Driving Energy Companies to Act?

- Carbon footprint reduction and Environmental impact (Paris Agreement)
- Transform emissions into profitability; more energy availability for the market
- Safety
- Government regulations
- Pressure from Investors
- Pressure from Activists
GUIDED LDARM² PROGRAM

Leak Detection & Quantification

On-Ground Confirmation

Results Documentation & Continued Monitoring

Plan Execution

Emissions Mitigation & Repair Plan

Leak Detection • Repair • Mitigation • Monitoring
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## Methane Detection

<table>
<thead>
<tr>
<th></th>
<th>Flight Altitude</th>
<th>Single-Day Coverage</th>
<th>Detection Limit (kg/hr)</th>
<th>Resolution</th>
<th>Sensitivity</th>
<th>Offshore Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SATELLITES</strong></td>
<td>520 km</td>
<td>15 earth orbits</td>
<td>≥ 205</td>
<td>25m/pixel</td>
<td>18 ppb</td>
<td>No</td>
</tr>
<tr>
<td><strong>AIRPLANES</strong></td>
<td>1 km</td>
<td>Up to 100 mi²</td>
<td>≥ 32</td>
<td>10 ft/pixel</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td><strong>UAVs</strong></td>
<td>0-5 km</td>
<td>4-100 mi²</td>
<td>≥ 0.1</td>
<td>N/A</td>
<td>10 ppb</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>GROUND</strong></td>
<td>N/A</td>
<td>0.5 mi²</td>
<td>≥ 0.0004</td>
<td>N/A</td>
<td>TBD</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Satellite Methane Detection

- Largest aerial coverage option
- Results provided in ppb methane
- Identify super-emitters for further investigation
- Not dependent on local licenses, permits, or regional stability
Optical Camera
Methane Spectrometer
GPS

Leak size: 108 kg/hr

Time: June 9, 2019 10:42:15 CST

Wind speed: 14 kph, 305 deg

Site: Example
Asset No.: 12345
Owner: ABC Energy

Lat: Number.One°
Long: Number.Two°
UAV Methane Detection & Quantification

- Visual Line of Sight (VLOS) options and BVLOS (Beyond Visual Line of Sight) options
- Onshore and offshore applications
- Quantifiable, actionable reporting with repeatable workflows
- Future state: meet or exceed regulatory reporting requirements
On-Ground Confirmation

- Trained operators pinpoint and quantify leaks identified by satellite or airplane
- Meet or exceed regulatory reporting requirements
- Quantifiable, actionable reporting
Way Forward

• Best-in-class methane detection and quantification technologies
• Global footprint
• Data for each plume gets loaded into your spatial data and repair management systems
• John Crane work with your teams to create and implement repair, mitigation, and monitoring plans
• Partnering with customers to achieve energy transition goals