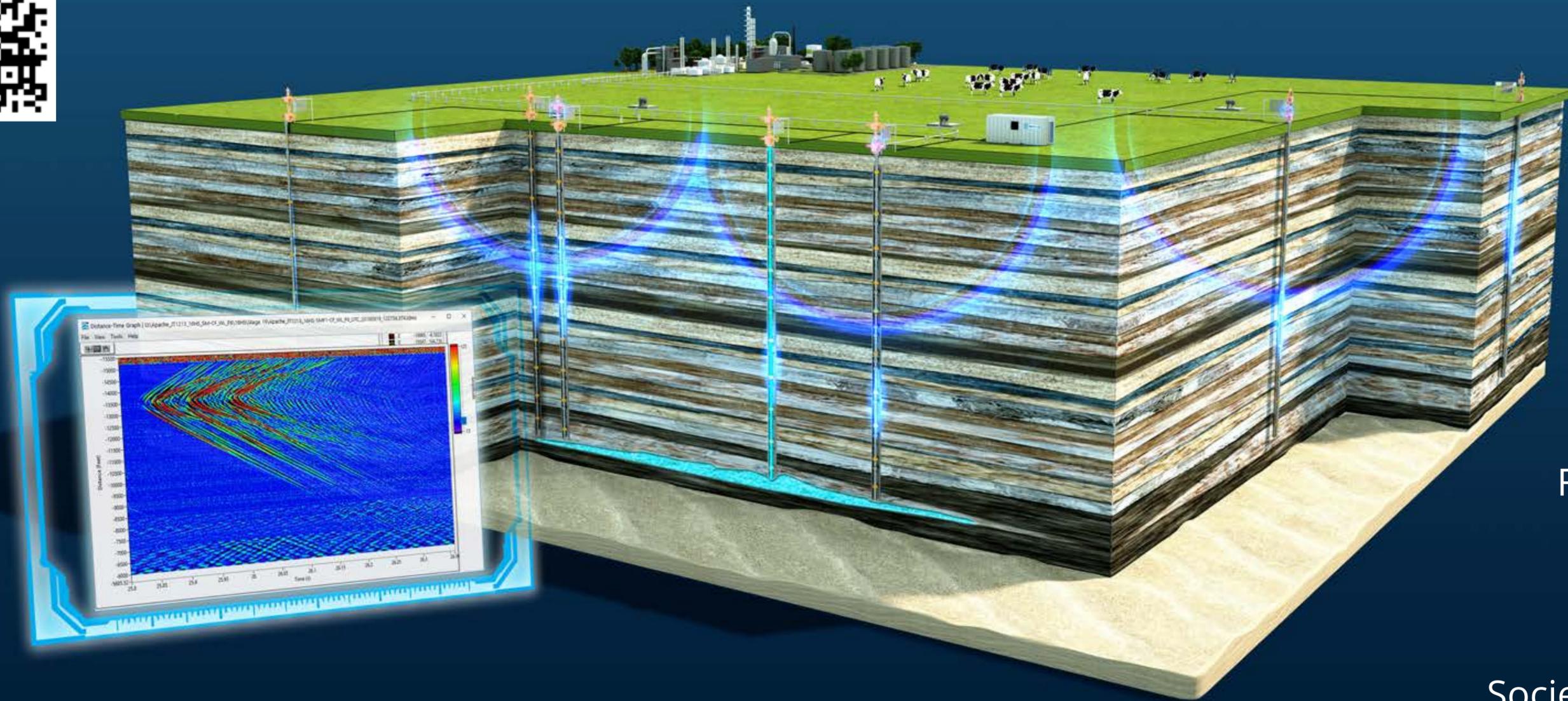


# Carina<sup>®</sup> CarbonSecure<sup>™</sup>

The proven, permanently installed distributed sensing-based solution that delivers safe and reliable carbon capture and storage (CCS) monitoring cost-effectively, throughout the lifetime of the project.



- Safety
- Repeatability
- Full automation
- Cost savings
- Sustainability
- Societal Acceptance

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## The solution

Carina® CarbonSecure™ is a proven, permanently installed distributed sensing-based solution that delivers safe and reliable carbon capture and storage (CCS) monitoring cost-effectively, throughout the lifetime of the project.

With minimal environmental impact, the system provides a reliable continuous or on-demand monitoring solution for all stages of any CO<sub>2</sub> carbon storage operation, both offshore and on land. It ensures maximum safety over the various stages of the CCS process, and also long-term monitoring and management of the CO<sub>2</sub> storage reservoirs while offering significant cost-savings.

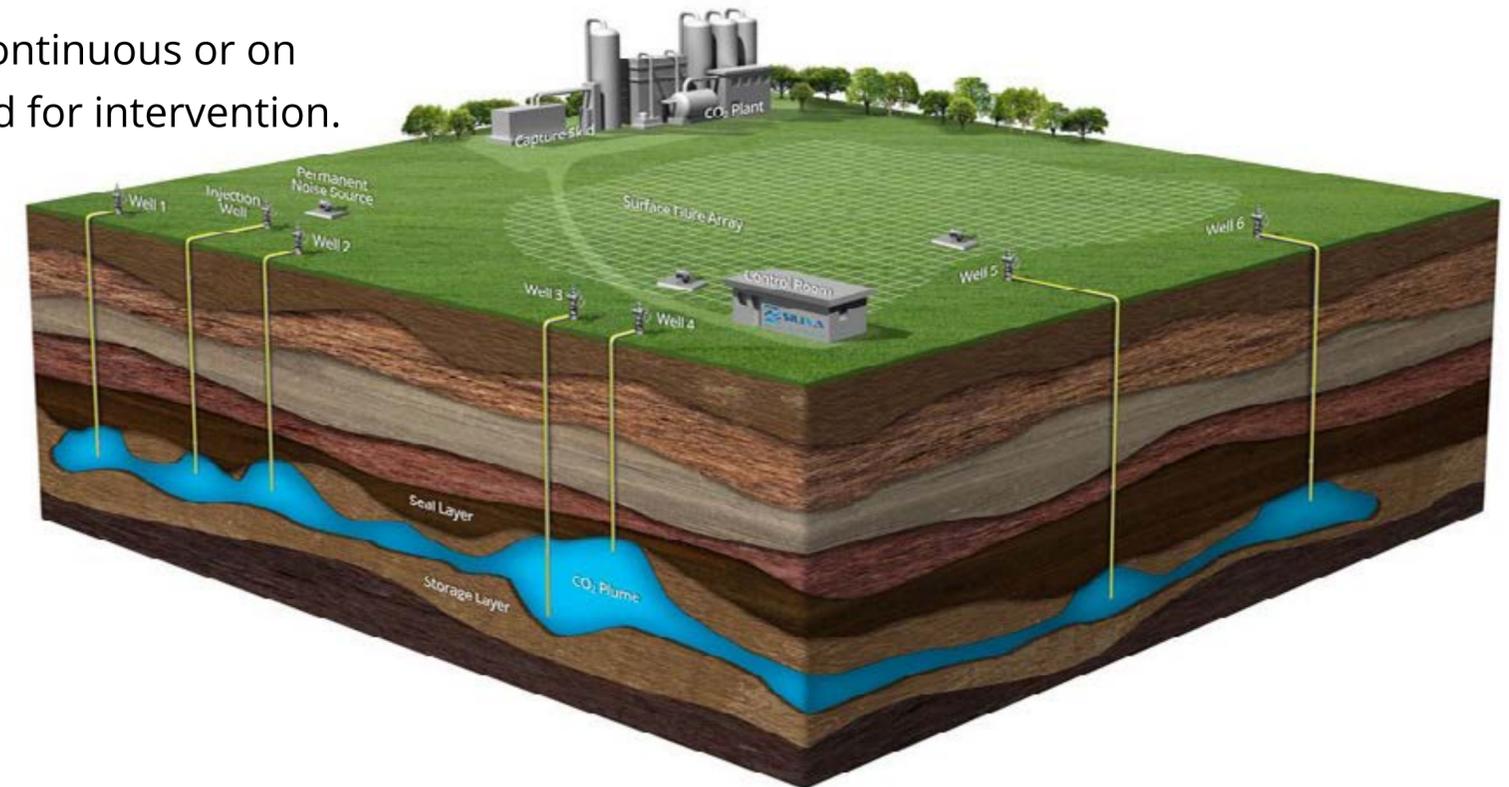
## Elements of the solution

The fiber array is permanently installed at the time of well completion.

This ensures high repeatability and continuous or on demand data availability without need for intervention.

Elements of the solution include:

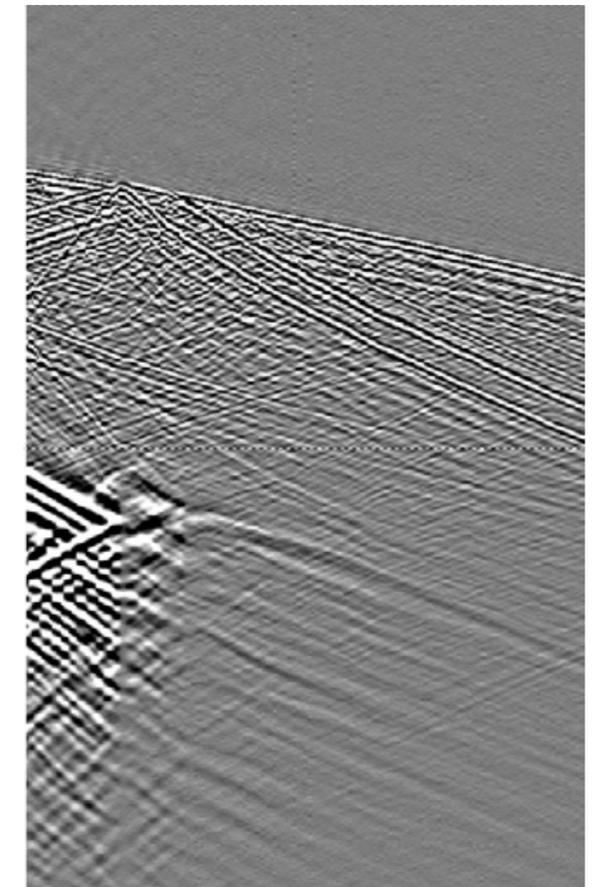
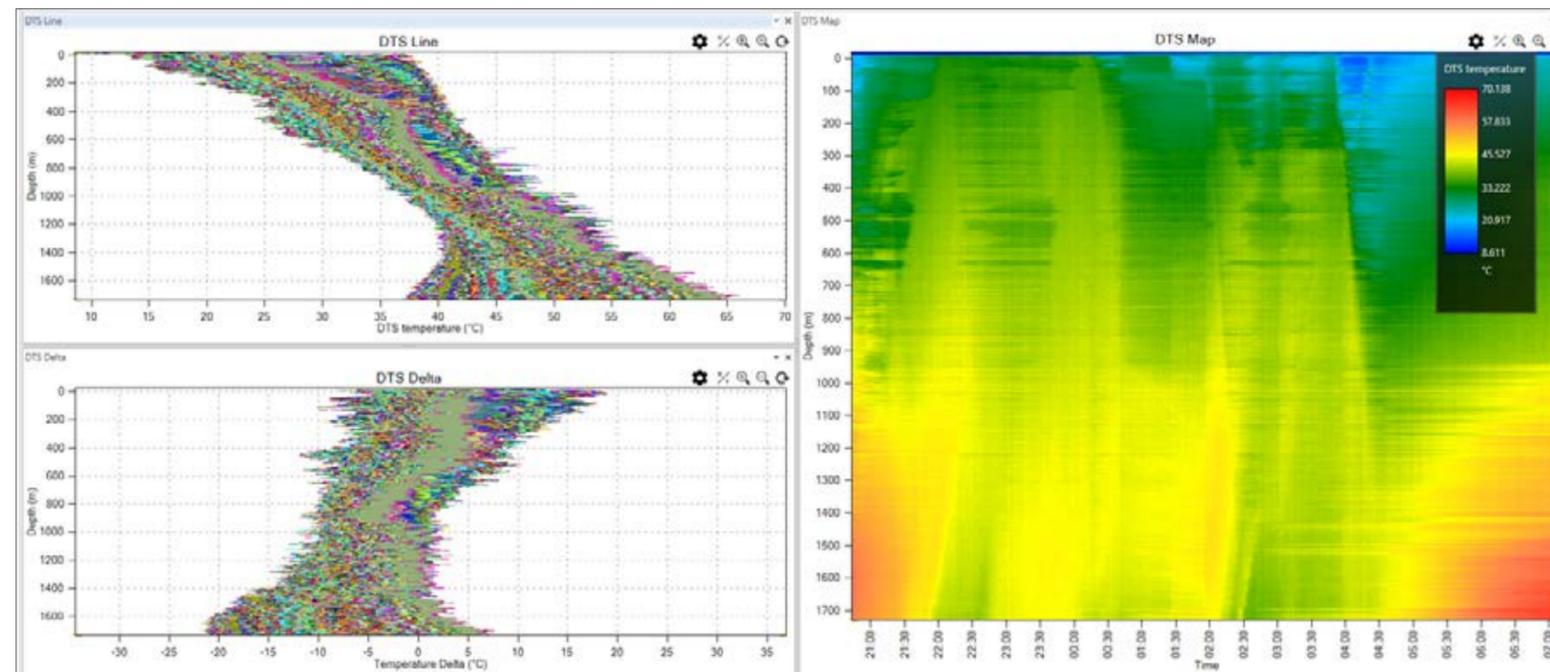
- » Time-lapse 3D VSP
- » Microseismic monitoring
- » Passive seismic
- » Temperature and acoustic leak detection for well integrity monitoring



# The reservoir management tool

The system delivers ultra high definition seismic, microseismic and temperature data in real time, offering a cutting-edge reservoir management tool to:

- » Assess the viability of geological formations for carbon storage during site characterisation
- » Monitor microseismic activity during the injection phase
- » Ensure well and storage integrity when CO<sub>2</sub> is being injected
- » Provide 4D monitoring of the CO<sub>2</sub> plume migration throughout the lifetime of the facility



(VSP data recorded by Carina Sensing System, Image courtesy of CO2CRC Ltd.)

# Benefits of the system

<b>Safety</b>	Accurate, long-term or on-demand, resilient monitoring throughout the entire CO2 storage area for the entire mandated period.
<b>Repeatability</b>	Permanent installations ensure high repeatability and continuous data availability without need for intervention.
<b>Full automation</b>	The system can be fully automated, enabling unmanned and remote operations
<b>Cost savings</b>	Carina CarbonSecure enables significant cost savings that are normally measured in millions of dollars
<b>Sustainability</b>	The system's extreme sensitivity enables seismic imaging with minimal source effort on land or with fewer shots in offshore applications. This reduces the environmental impact and overall project costs.
<b>Societal Acceptance</b>	As a proven technology with a significant track record throughout the hydrocarbon value chain, Carina CarbonSecure offers the reassurance needed to encourage greater and faster adoption of CCS worldwide.

## Why Carina CarbonSecure?

### High-resolution sub-surface imaging

Carina CarbonSecure makes CCS safer and more affordable, and therefore facilitates faster adoption of the technology in industry.

Using permanently installed fibre optic cables in CO<sub>2</sub> injection or observation wells, the engineered fibre optic system enables ultra-high definition 4D seismic and microseismic data acquisition on demand.

This enables operators to confirm caprock integrity and understand the evolution of the CO<sub>2</sub> plume within the reservoir.

The same fibre optic cables can be used for passive monitoring and detecting microseismic events, addressing concerns over seismic hazard and leakage pathways, including the integrity of the caprock or the wellbore.

Additionally, the system achieves much higher spatial coverage than is typical of traditional technologies, delivering data with greater detail in each shot record compared to geophones.

### Minimal environmental and ecological footprint

The system's extreme sensitivity and high dynamic range enable subsurface imaging with minimal source effort, hence operators can perform more frequent seismic acquisitions while reducing the environmental impact and overall project costs.

The system's ground-breaking dynamic range extends the monitoring reach up to 120 kilometers, a

breakthrough in subsea deployments, hence enabling safe and reliable monitoring of any offshore CCS facility as well.

Offshore seismic surveys can be performed with fewer shots, further reducing the project costs and environmental impact.

# Why Carina CarbonSecure?

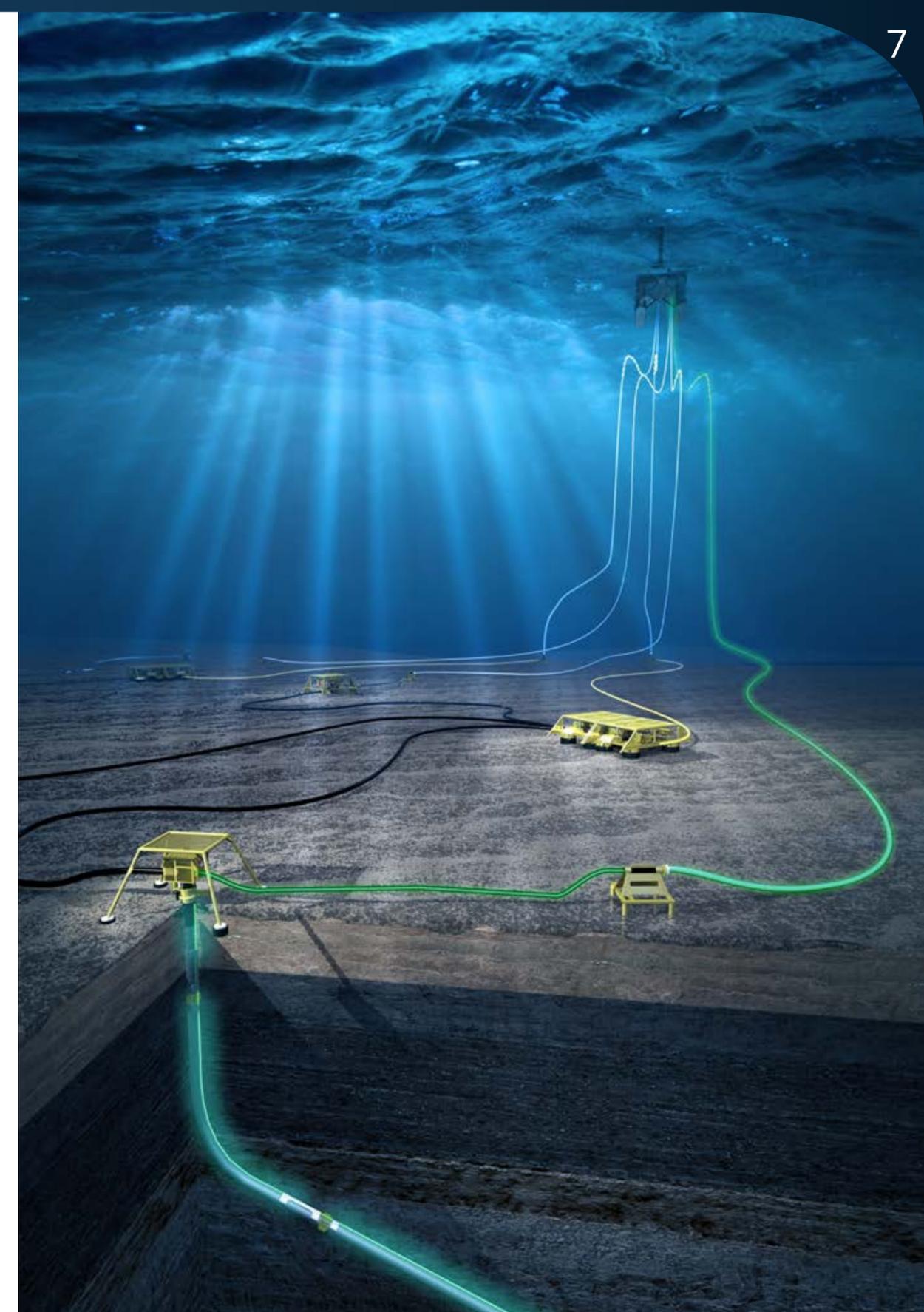
Carina CarbonSecure offers offshore and on-land operators the necessary monitoring measures with a reduced cost and environmental impact of their CCS facilities. The solution enables operators to provide the assurance to regulators and communities necessary to expand CCS adoption worldwide.

## Low maintenance

Fibre-optic cables have no mechanical parts and are suitable for corrosive and high temperature environments. They can be installed without maintenance requirements for decades, in line with mandated CCS monitoring periods.

## Reduced operating time with remote and unmanned operations

Seismic surveys can be performed remotely on-demand, without the need for manpower at the site. This also increases safety and reduces project costs.



# The enabling technology

At the core of Carina CarbonSecure is Silixa's Carina® Sensing System, a patented, precision-engineered fibre-optic acoustic sensing system that is proven to achieve 20dB or 100x improvement in signal-to-noise ratio compared to standard DAS systems.

It comprises an advanced optoelectronics interrogator and sensing cables, which are equipped with the new family of engineered Constellation™ fibres.

This fibre is engineered to provide bright scatter centres along its length to capture and reflect more light back to the interrogator.

This is achieved without introducing significant loss to the forward propagating laser pulses.

Carina Sensing System offers the best of both worlds: the extensive, high density coverage of distributed sensors and the sensitivity beyond that of point sensors.



# Carina CarbonSecure



“ Carina CarbonSecure is relatively new in the market, but it utilises proven technology with a significant track record throughout the hydrocarbon value chain.

We have leveraged the extensive experience, R&D investment, and technical expertise within Silixa to create a low-impact solution that can secure CO<sub>2</sub> storage facilities – and demonstrate that security – while transforming the CCS cost model.

We believe it is a vital step for creating a viable global infrastructure for essential CCS so that we can store more CO<sub>2</sub> safely. ”

Michael Mondanos, PhD  
Silixa