digital energy journal

OPERATIONS

March - April 2024

CARBON CAPTURE AND STORAGE TECHNOLOGY

Finding Petroleum

Official publication of Finding Petroleum

digital energy journal

Issue 106 March - April 2024

Digital Energy Journal
United House, North Road,
London, N7 9DP, UK
www.d-e-j.com
Tel +44 (0)208 150 5292

Editor and Publisher
Karl Jeffery
jeffery@d-e-j.com
Tel +44 208 150 5292

Advertising sales:
David Jeffries, Only Media Ltd
djeffries@onlymedia.co.uk
Tel +44 208 150 5293

Production
Very Vermilion Ltd.
www.veryvermilion.co.uk

Subscriptions:
£250 for personal subscription, £795 for corporate subscription.
E-mail: subs@d-e-j.com

Cover image: a Stryde seismic survey node in a mountain survey. Stryde recently sold 25,000 nodes to Ukrainian seismic acquisition firm Georozvidka LLC to do 2D and 3D surveys for oil and gas exploration; it also sold 12,000 nodes to Geopartner Geofizyka to boost a seismic survey near Krakow, Poland. Its nodes have also been used by DTEK Oil&Gas in Ukraine

How to implement digital technology

Speakers from Repsol, Chevron, Baker Hughes and AWS discussed the best way to implement new technology, following the experience implementing Baker Hughes' Leucipa automated production management software

Baker Hughes announced the launch of Leucipa, its oil field production automation software, at its Annual Meeting a year ago in January 2023.

In its 2024 Annual Meeting, it gathered representatives from Repsol, Chevron and cloud provider AWS, together with its chief digital officer James Brady, to discuss the implementation, and thoughts about how to make partnerships work.

The software was developed and implemented in a collaborative way, rather than with a conventional vendor buyer product relationship.

Repsol

Oil and gas producer Repsol first started working with Baker Hughes on this technology project in 2020, said Fernando Ruiz García, Global E&P Production Engineering Senior Manager in Repsol. From the beginning, it felt more like a partnership than a traditional client-vendor relationship, he said.

"Accountability and flexibility from both teams has been the key," he said.

There were challenges getting agreement between Repsol staff about what the software should do, considering the different needs of offshore and onshore operations around the world.

There was also a lot of honest feedback from Repsol back to Baker Hughes, which helped identify areas for improvement, he said.

The company conducted staff training at the same time as it rolled out and implemented the software.

Leucipa has around thirty new areas of functionality, including for managing production from unconventional assets and integrated flow modelling management.

There are tools for gathering real time data to calculate fifty different business indicators, and tools for forecasting and decision support, he said.

There are digital tools to make it faster to build models within Leucipa for a new asset, and faster to calibrate them.

One new tool is the Well Opportunity Monitoring System (WOMS), which identifies the best way to improve operation of the well, taking data from multiple optimisation systems.

On many of Repsol's wells, the optimisations are incorporated automatically, with settings being changed by machine to the ones it recommends.

The big challenge is still making the software work better for people. Repsol is looking for "continuous enhancement of the user experience," he said. "Engineers need something intuitive, easy, fast."

Repsol would also like to continue to find more uses for the data, "to squeeze the data to get the best information that we can to take the best date-driven decision."

The company calculates that use of the tool already leads to an average of 3 per cent increase in production average in the last 3 years, he said.

Chevron

Patrick Ryan, general manager, digital solutions and analytics at Chevron says his work is often dominated by the challenge of making multiple software tools work together. "My job is to put together a patchwork quilt of applications, some from third parties, some our own," he said.

It is likely that some of the software companies will try to expand their products to cover more of the workflow in the future. This will mean customers like Chevron have a fewer number of applications in use, he said.

More data standards would be very helpful. "There's some movement in this space in the subsurface world with OSDU, a little bit with IOGP," he said. But "we're a long way away from one set of integrated data standards."

Without data standards, software tools need to be designed to handle data in multiple formats, or data needs to be manipulated into a different format so a certain tool can handle it. This means extra work.

"It will be a tough sell to get a lot of people to agree on one standard, [but] the benefits are too great," he said.

Mr Ryan is pleased to see relationships between operators and software companies being more partnership based and focussed

Full house – 2,000 people attended Baker Hughes' Annual Meeting in Florence in January

on business outcomes, rather than focused on the transaction of selling the software, he said.

In the past, many software products sold in such a transactional way failed to be useful to the business, he said.

The agreement between buyer and seller of software needs to be designed so that it incentivises the partnership, he said.

When implementing new technology in a company, it is important to support people in using the tools, providing them training, rather than focussing entirely on the technology itself, he said.

And if people do not use the tools you provide them, it makes it very hard to make a case in the company for investing in new ones in future, he said.

"It feels like there's gathering momentum behind digital and advancement of digital."

Baker Hughes perspective

While Baker Hughes might ideally like to develop all its digital technology products in-house, it often chooses to partner with other companies because it could enable products to be brought to market faster, said James Brady, chief digital officer with Baker Hughes oilfield services and equipment.

Baker Hughes chose to partner with Amazon Web Services for hosting its Leucipa software. "They had cloud architectures, cloud infrastructure, relationships, which helps us build faster," he said.

It has also partnered with a software company specialising in AI, to build AI tools, including a generative AI prototype, he said. Baker Hughes also acquired a software and services company dedicated to optimizing assets through field level connectivity and workflow automation capabilities to reinforce the Leucipa solution.

For drilling, Baker Hughes has a strategic investment in and collaboration with a Houston company called Corva which provides drilling software as a service. Baker Hughes is an international reseller of existing Corva drilling software for global customers but will also expand its offerings together in the well construction digital space through co-developed applications.

As part of the collaboration, it was able to incorporate its i-Trak drilling automation tools and real time hydraulics management into Corva. This means that drillers "have a single experience," he said, rather than look at separate screens for different software products.

In a similar way, Baker Hughes collaborates with CMG, which produces a reservoir simulator. It collaborates with Shell to jointly develop the JewelSuite subsurface modelling software.

Altogether, the benefits of digital technology to industry might be described as "turning the loop faster," he said. By 'loop,' Mr Brady means the repeated process of measuring, analysing, and acting to improve operations. In the pre-digital era, companies went around this loop "very slowly," on monthly or yearly cycles.

In today's digital era, "measuring" is effectively a solved problem, in that digital technologies can take measurements, he said. Although it requires that the sensors are installed and connected to a communications system, which is not the case for all wells today.

"Analysing" data is also effectively a solved problem, he said.

We are some way off having digital systems which can act on the results of the analysis if that would mean no human involvement. "We will not say we are 'pure digital' until you deal with that part of the loop. The bottleneck is the human being," he said.

Baker Hughes saw 2023 as a "year of formation" forming its strategy and relationships, including for Leucipa (production), with Corva (drilling) and JewelSuite (subsurface). "2024 is about executing on that," he said.

AWS

For a successful partnership, the companies involved need to be committed to solving a particular problem, said Julien Debard, head of global technology partnerships with Amazon Web Services (AWS).

Partners need to reach alignment on what they are building, whether a product or a strategy. They also need to have alignment on what they are not going to build. "We have to work consciously on not adding too much scope," he said.

It is important that the partners are talking openly to each other about what they want to do.

All partners can have different objectives. The project may need to meet them all, he said, or sometimes one of the partners must de-prioritise an objective.

With Leucipa, a lot of time went into setting objectives, and deciding how the partners would determine that the project had been successful.

AWS seeks to build mechanisms to make the partnerships work. "Jeff Bezos said, 'good intentions don't work, mechanisms do,'" he said.

A process commonly used at Amazon with projects is to write a fictitious press release, 'announcing' the launch of the product 18 months or so in the future. This press release can also include quotes from imaginary customers, and a list of questions being answered, such as what investment the first customers put in. Having such a vision of the future is helpful in giving people a target to aim for.

At the start of the project, Amazon plans a face-to-face meeting between the partners to ensure everyone is aligned on the goals. It insists on a face-to-face meeting to ensure people scrutinise what they are agreeing to thoroughly. Then it plans monthly, quarterly, and annual reviews to see how it is progressing toward the goal.

Energy transition needs today's technology – Baker Hughes

We need to achieve the energy transition with technology which is available today, such as to improve efficiency, and aim to achieve some decarbonisation by 2030, says Baker Hughes' CEO

The energy transition needs to "scale technology which is available today," and move faster with it, said Lorenzo Simonelli, CEO of Baker Hughes, in his keynote address to the Baker Hughes Annual Meeting in Florence in January.

That means accepting the continued use of hydrocarbons. "There is no world without the use of hydrocarbons over the next few decades," he said. Gas is "both a transition and a destination fuel."

The company just announced its largest ever equipment order to supply gas equipment for Saudi Arabia, to help the country develop a gas infrastructure. Gas will be essential in displacing coal, he said.

"We look at technology today that's available to reduce emissions, and continue to innovate with new technologies."

"We realise by 2030, projects will need to have decarbonization. It is not about 2050, it is about what we do from now to 2030."

Lorenzo Simonelli, CEO of Baker Hughes, giving the keynote speech at Baker Hughes' Annual Meeting in Florence

Efficiency

Efficiency is very important in achieving sustainability, making operations more efficient and using efficiency to achieve change, he said.

At the moment, oil and gas companies are improving efficiency by around 2 per cent a year. If it could improve by 4 per cent a year, that would mean 30 per cent reduction in CO2 emissions by 2030.

Baker Hughes is particularly interested in better solutions for mature fields, which it defines as fields which have been operating for 25 years, or which have produced 60 per cent of their reserves.

Today about 70 per cent of today's oil and gas production comes from mature fields. If production efficiency could be improved by 20 per cent that would be a major increase. Baker Hughes has a range of services related to this, including to improve production and reduce water usage.

The company is "starting to see success" from its Leucipa software for field production optimisation and Cordant software for asset performance management and process optimization. These tools are helping to drive efficiency, he said.

Meanwhile, Baker Hughes continues its focus on 'new energy'. It saw $750m of orders relating to geothermal, CCS and hydrogen during 2023. It recently opened a new hydrogen test centre in Florence.

The Florence event in January was Baker Hughes' largest ever annual meeting with over 2000 participants, he said.

The event theme was 'energising change', referring to the challenge of putting energy into the quest to increase energy supply and develop new technology.

AVEVA – emissions data at the 'asset' level

Industrial decarbonisation can get much easier to 'operationalise' if you can work at the 'asset' level instead of the 'tag' level. AVEVA explained what that means

Companies that are successful in working with industrial emissions data usually work with the data at the 'asset' level, rather than at the 'tag' level, said Craig Harclerode, oil and gas Industry Principal with software company AVEVA, based in Houston.

Mr Harclerode is a former chief automation officer with Amoco Oil, including working in Texas City Refinery, Honeywell, Aspen Technology and OSIsoft.

He was speaking at the first of a series of four AVEVA webinars about digital technology and decarbonisation on March 19, "Why Strategic Alignment is Critical to Enable Effective Decarbonization."

Working with data at the 'tag' level means that your main unit of data is the data generated by sensors on each piece of equipment, such as a pump temperature sensor.

Companies normally have a system to store this data as it is generated, for example the OSISoft PI "historian" software owned by AVEVA.

They might employ an individual to build a spreadsheet of the emissions made by each piece of equipment, which can be added up to provide emissions of the 'asset' that the equipment is part of, such as a refinery coker unit.

But when we are aiming to reduce emissions,

we need to understand what causes emissions to go up and down, and to do that, we need the full picture of the whole asset.

For example, a compressor might be operated for different reasons during the day, and to reduce emissions, you need to know what those reasons are. It may have inlet gases at different temperatures at different times, and the temperature may also affect the completeness of any reaction, and so the composition of the flue gas. You will only have that knowledge if you are looking at the whole asset, rather than just the compressor.

As another example, if a piece of equipment is not running at full load, there can be scope to improve energy efficiency.

For subject matter experts to be innovative in finding new ways to decarbonise, they need comprehensive data about what is happening with the asset, not just individual components in it, he said.

Getting from 'tag' data to 'asset' data can be seen as analogous to how accounting software takes in data about individual transactions and provides profit and loss for your whole company, and your purchases and sales in different categories, he said.

You need the equivalent of a chart of accounts, a framework for how the various sets of tag data are put into classes and rolled up.

Working with emissions data at the 'asset' level rather than the 'tag' level also means that individual errors, such as faulty sensor, matters less, he said. It is easier to get a consistent picture. The adding up of individual tag data is automated, and so less likely to include mistakes.

Operationalising carbon

Mr Harclerode sees the ability to work at the 'asset' data as being very helpful when you seek to 'operationalise' carbon emissions data, having your engineering and operating staff make decisions from day to day which take emissions into account.

Too often in companies, there is a big difference between the strategies that companies set at a high level with carbon, and what they are able to achieve, he says. And this gap can be due to weaknesses in their ability to 'operationalise' the carbon decisions.

Operationalising emissions management means you have accurate baselines (knowing where you start from), you have information to make decisions to drive continuous improvement on carbon, and you can determine that you are making continuous improvement.

It means that people who have the biggest capability to minimise and manage emissions, the operators and engineers, can see the result of their actions in carbon terms. "You can confidently state, 'I'm on this trajectory to meet my stated net zero goals,'" he said.

This work to make the right decisions relating to carbon needs to happen alongside work to make the right decisions on a financial basis, he said.

Templates

The easiest way to get from tag data to asset data is using configurable templates.

The template describes how the various data points are rolled up to give an asset wide perspective. In a similar way, accounting software comes with a template 'chart of accounts' which shows how the various data points are rolled up to give an overall financial picture of the business.

The templates should be designed and managed by subject matter experts, such as an expert in refinery furnaces. They do not need programming expertise to work with.

AVEVA provides starter templates, which helps companies get started.

If changes are made in one template, they can be propagated everywhere that template is used.

If companies are using some assumptions or estimates in the calculations, this can be included in the template.

As an example, the compressor may have a blowdown system, which releases a burst of compressed air to remove contaminants from the system. Rather than calculate the specific emissions every time you do a blowdown, you might use an estimate and bring that into your template.

TotalEnergies

TotalEnergies is "doing all the things I've talked about," Mr Harclerode said. "They are the 'poster child in my opinion."

TotalEnergies presented its approach to operationalising carbon data at an AVEVA event in Amsterdam in 2022.

This includes moving to an asset-based system for managing operational data, rather than a tag based one.

The company has over 400 templates which show how tag-based data can be rolled up to asset data for specific equipment types. This master data is the foundation of their work to manage operational performance.

In a second use case, TotalEnergies showed how it managed emissions for a particular class of assets, in this case furnaces and heaters, which generate over 80 per cent of refinery emissions.

They made templates for how the data from a furnace or heater is rolled up from the various data sources.

So now, the company has greenhouse gas data for every furnace and heater consistently available and can analyse the data to show if it is achieving corporate goals and making improvement.

This included modelling every molecule as it flows through the asset. Each molecule has different characteristics, in terms of how it reacts, how much is reacted, and how it absorbs heat. The result can give you a very accurate determination of the different greenhouse gases in the exhaust.

TotalEnergies explained in its presentation how it has expanded the 'asset-centric' concept from initially looking at furnaces and heaters, to cover their entire exploration and production activities, Mr Harclerode said.

The concept can be implied to any industrial system, he said, with templates developed on a company wide basis.

Layered analytics approach

Mr Harclerode recommends a "layered approach" to analytics.

"All too often I see companies want to start with AI and ML," he said. "It's not that those don't have a place, but the effectiveness of those higher-level analytics is going to be impacted severely but how much you have as foundational analytics."

Having a system of integrated layers of analytics proves "critical in getting value from technology," he said.

The conversion from tag based data to asset based data described above can be part of the first layer of your data analytics system.

So, from then on, all of the analytics is being made on assets rather than individual equipment.

The subsequent levels gradually go from diagnostic and simple predictive analytics to more prescriptive analytics.

Level 2 is simple real time calculations and metadata integration. You have basic calculations about emissions and basic diagnostics. You can calculate your energy efficiency and the asset performance.

Level 3 is more complex real time calculations with events and notifications. Level 4 is real time data analytics.

Both of these levels mean doing analytics with data as it is generated (streaming), such as at one second frequency.

These streaming analytics can trigger 'carbon events'. For example, you can have an alert if you exceed your target carbon intensity for a system. Then you can try to understand how you have deviated from your plan.

At the higher levels, you do more predictive analytics and compare what happened with what you planned.

Level 5 is predictive analytics with prescriptive guidance; level 6 is predictive asset optimisation.

You should ensure the analytics are focussed on business value, he says. "Don't do analytics for analytics sake."

Ultimately you have the possibility to visualise all the data on a single dashboard or "single pane of glass", financial and operational data as well as emissions data.

Ideally you can have an 'orchestrated view' of the whole enterprise, including engineering, maintenance, operations and financial information.

The end result of all of this is that you have what can be thought of as an 'industrial digital twin', a digital version of what is happening in the real world, which can support decision making.

Digital strategy

Companies then need a digital strategy, for the technologies they want to implement.

For example, consider how you approach the cloud. Many companies want a hybrid digital infrastructure, part in the cloud and part on premise, so your technology needs to facilitate that, he said.

You need a system for master data management, how you store the 'master version' of data generated by the asset, synchronising between the source and the data storage.

You need digital tools to support field workers and other individuals involved in running the equipment.

Your digital strategy may also address which software tools you plan to build in house.

Ideally, you will have an open framework of digital technology, which makes it easy to bring in new digital applications, or to add a new physical asset.

You will have other digital systems, such as 2D and 3D design systems, maintenance management systems, spare parts, work order management, financial systems. The HR systems are relevant because they may govern who has access to which data.

Most companies also have a separate CO2 data system, where they store the carbon data and make high level reports, he said.

Mr Harclerode noted the importance of working with a software company with a background in industry, such as AVEVA. "We have industry in our DNA," he said. "We've focussed on building out your industrial data infrastructure."

"A lot of companies are trying to sell technologies that are 'general' [based on] websites and clicks, that have trouble with the nuances and challenges of industrial data."

Customer-centric asset performance management tools

Digital tools for Asset Performance Management (APM) will be more effective if they provide the right information at the right time. We spoke to Don Busiek of AspenTech to find out more

With digital tools for asset performance management, the priority is presenting the right information to the right person at the right time.

This concept mirrors the functionality of a well-designed car dashboard which aims to convey essential information to the driver without confusing them.

Many drivers have had the frustrating experience of seeing a warning light on the dashboard they do not understand, or had problems which a simple digital system could have helped avoid.

In such instances, a sophisticated car APM system could alert drivers to excessive speed or potential equipment overheating, offer operational advice, and enable garages to schedule services during the vehicle's downtime, argues Don Busiek, Strategic Business & Technology Leader of the Asset Performance Management (APM) business unit at AspenTech.

This principle of timely and relevant information extends to the industrial sector, where monitoring individual pieces of equipment is no longer a significant challenge, he says.

However, the difficulty comes when many pieces of equipment are working together, and the operator is trying to maintain an understanding of everything that is going on. They need the right information at the right time to make the best decision.

Getting it right means modelling the customer processes, such as understanding what the driver is doing and what information might be helpful, rather than seeing it as a purely technical problem, he says.

For example, if you want to give someone an alert, it might be helpful if that alert is seen within a software tool that the customer is already using.

Mr Busiek imagines a world where someone who reads the news online every day would see an alert about equipment showing up in their news feed. Alternatively if someone washes dishes every day at 9pm, this alert might appear on a display adjacent to their sink.

Mr Busiek emphasises the importance of distinguishing between alerts and notifications within asset performance software. An alert effectively tells someone they have a problem which requires their immediate attention. A notification, on the other hand, is more informational, highlighting something of specific interest to the user.

According to Mr Busiek, it is helpful if domain experts are involved in building the tools, because they know what information would be useful at any time.

Additionally, when trying to understand the cause of any asset problem, it can be helpful to see the full picture of what is happening, including the processes that have been put in place around it.

Asset performance management aims to look at activities as a process. For example, a failure in step 4 might be caused by something which happened in step 2, he says.

Maintenance system evolution

To understand where we are today, it may be helpful to think about how APM systems have evolved over the past few decades, Mr Busiek argues.

Not so long ago, cars would be driven until something broke, and they would only be repaired at that point. That was how the automotive sector managed asset performance.

Sometime around the 1990s we saw the evolution of a planned maintenance software approach, with equipment being maintained according to a schedule, he said.

Today, a car has instrumented hardware, more software than a laptop, and problems are often diagnosed in a garage using computer software. It is therefore easy to imagine how performance management systems could do more than they do today.

Building the model

When it comes to building an APM model, an it normally needs to be configured specially for the asset.

For example, the requirements of when the asset operator should be alerted will probably

Don Busiek, Strategic Business & Technology Leader of the Asset Performance Management (APM) business unit at AspenTech

be different for every asset.

If you have already built an APM system on a similar asset, you can use that system as a template to build the next one, he said. The process of building models can therefore accelerate, particularly if you are making models for the same equipment.

This approach was exemplified at a customer event in Milan, where an AspenTech customer shared their experience deploying the software to one hundred different assets, including different 'classes' of the same asset.

Persuading people

Persuading people to accept the system can be a challenge, however. Experienced maintenance engineers may develop the skills to diagnose any problem in seconds and therefore intuitively know exactly what to do to fix it. As a result, they may not immediately recognise the benefit of a digital tool.

Yet, as Mr Busiek points out, APM tools normally go further than diagnostics. They can include tools to help you diagnose a problem, and work out which step is best to take, thereby enhancing the expertise of even the most experienced engineers.

Meanwhile "digital natives" from younger generations come to work expecting a 'Facebook like' experience, Mr Busiek maintains . And they don't know how to fix a problem with the equipment.

Customer collaboration

Working closely with customers is very important in developing asset performance management tools which provide them with exactly what they need.

Many people talk about customer collaboration, but very few do it right, Mr Busiek says. "I spend half my life on the road talking to customers."

AspenTech arranges regular online customer meetings on specific topics. It invites the customers who care the most about the topic it is addressing. It also invites all the relevant staff from AspenTech to these calls, including developers, quality managers and product managers. Customers are asked to make suggestions, which can then be incorporated into the software.

AspenTech also runs user conferences. These may include 'fireside chats,' where a representative of a customer has a 1:1 discussion with someone from AspenTech about their experience with the software in front of an audience, including many AspenTech company staff. For example, an oil company representative explaining their biggest challenges in using the software.

Such interactions are crucial for AspenTech to precisely tailor their APM solutions, ensuring they meet customer requirements and avoid the pitfall of unused features, like unappreciated heated seats in a car, he says.

Helping **Energy Industry suppliers** implement their **Digital Supply Chain Integration** with customers in any industry.

Watch the overview video

OFS PORTAL™
TRUSTED ENERGY SUPPLY CHAIN NETWORK

www.ofs-portal.com @OFSPortal
info@ofs-portal.com @OFSPortal

Connecting automation with the virtual world

There are many ways it could be useful to be able to connect an industrial automation system with a virtual world

A plant operator onsite might want to see additional information about how the plant is operating, via a headset device using augmented reality.

A remote expert might find it useful to see a virtual version of the real plant, for diagnosing problems. The virtual version of the real plant might also be used for training.

To explore if it could be possible, the OPC Foundation, which maintains standards for information exchange in industrial automation, has been exploring how its data standard OPC UA could be used for communication with a virtual world.

The need for a 'standardized metaverse solution' for OPC was originally suggested by Dr. Holger Kenn, Director AI and mixed reality (MR) Business Strategy at Microsoft, during a meeting of the OPC Foundation board of directors in October 2022.

Consequently a working group was established, chaired by Erich Barnstedt, Chief Architect, Standards, Consortia & Industrial IoT, Azure Edge & Platform at Microsoft.

A number of "use cases" were developed connecting OPC UA to the metaverse, and the code has been published on the OPC Foundation GitHub repositories.

One example is software for the Microsoft HoloLens augmented reality headset, for remote assisted maintenance.

Data from the industrial asset, a wind farm in this case, is first sent in OPC UA format to an edge device running Azure Kubernetes service "Edge Essentials" on Windows IOT.

From there, data is sent to Azure Event Hub, then to a new component "UA Cloud Twin" developed by Microsoft. This generates a "digital twin" of the wind farm.

The Azure digital twin service sends data to Azure data explorer, where it is stored for pick-up by an application. The application displays it on a headset such as HoloLens.

A video showing condition monitoring data overlayed over real wind farm assets is on YouTube.

https://youtu.be/87r-RTfM54g

Empirisys CEO wins IChemE medal

The Institution of Chemical Engineers (IChemE) has awarded its 2024 "Franklin Medal," described as "one of the most prestigious accolades in the Chemical Engineering community," to Gus Carroll, CEO of Empirisys, a UK company which uses data science to help identify ways to improve process safety.

The award recognises the work by Mr Carroll over his whole career of 30 years, also working with hazard operating companies, trade associations and with regulatory authorities.

Empirisys is chaired by Ian Conn, a former CEO of Centrica and chief executive downstream with BP.

Empirisys employs data scientists, process safety experts and engineers, combining their expertise to find ways to get value from existing data.

The company has a three step approach to getting insights from data, according to its website.

The first step is accessing data from the company and putting it in a structured form, and looking for patterns and correlations in it.

The second step is to get insight from this analysis, using both machine learning tools and domain expertise.

The third step is suggesting specific actions which can be made, to target the root cause of specific problems.

Empirisys works in oil and gas, chemicals and the construction sectors.

It has a product called "Sense", which is a staff surveying tool, enabling companies to understand staff 'sentiment', distilling thousands of responses into a small number.

It also has a product "Boost", to work with observation data, which is often otherwise discarded after it has been looked at once.

www.empirisys.io

Oilfield scale digital twins

FieldTwin, the oilfield 'digital twin' software from FutureOn, has a version 8 release, with improved tools to build models, add data and work with them

FieldTwin, the software tool to make a 'digital twin' of an offshore oilfield or wind farm, from FutureOn of Norway, has a version 8 release.

The new version has advances to make it easier to build models of fields, add data to them, and export the models into other systems.

The purpose of the software is to help staff at energy companies work collaboratively on development projects.

The software is not intended for detailed design, but it can be used to make high level designs, such as subsea field layouts, pipeline routing, and basic construction. It can be used for external collaboration, so for operators and EPCs to work together.

The benefit compared to detailed design software is that it is possible to visualise an entire oilfield, or sections of it, at once.

The models can hold plenty of granular information, including water depths, well specifications, pipeline information, a model of topsides.

The company claims its clients have reduced the amount of time taken to design a subsea field layout by 30 per cent, reduced the time for making reports before the detailed design stage of 60 per cent, and reduced pipeline routing time by 50 per cent.

The software offers useful tools for sharing and communications, for example the ability to export any part of a model into PowerPoint, and then visualise it from any angle as part of a PowerPoint presentation.

New functionality

The new version loads models up to ten times faster. "We have done a lot of optimisation in how we render and visualise different objects," said Jostein Lien, Senior Vice President of Products at FutureOn.

For example, pipelines can be rendered (drawn by the computer) in bulk, rather than one by one, as they were in the previous version.

Version 8 also has tools to select multiple objects quickly.

You can set up projects as 'child projects' and 'parent projects,' where a 'child' can relate to a 'parent.' This makes it easier to manage the complexity.

The new version has an optimised "tree view" of the settings and an easier interface, which should be easier to navigate.

You can set limits on what a person in a certain 'role' can do, including someone accessing the software via other software tools and an API.

You can set up tasks for yourself and others, as a 'workflow,' or with certain tasks due to be completed on certain dates.

You can store different versions of a project.

You can connect metadata to different points in the model. To illustrate the benefit of this, in one FPSO model, there were forty-two separate places where a riser could be attached, and no-one knew which one to use, he said. Now, metadata can be associated with all of the wells, for example to say if it is producing oil or gas, or used for water or gas injection.

The new version has a "span estimation tool," where you can estimate distances in reality, such as the length of a pipeline. You can place your mouse somewhere on a pipeline in the model and see how far that point is from the start of the pipeline in reality, or how deep the water is at that point.

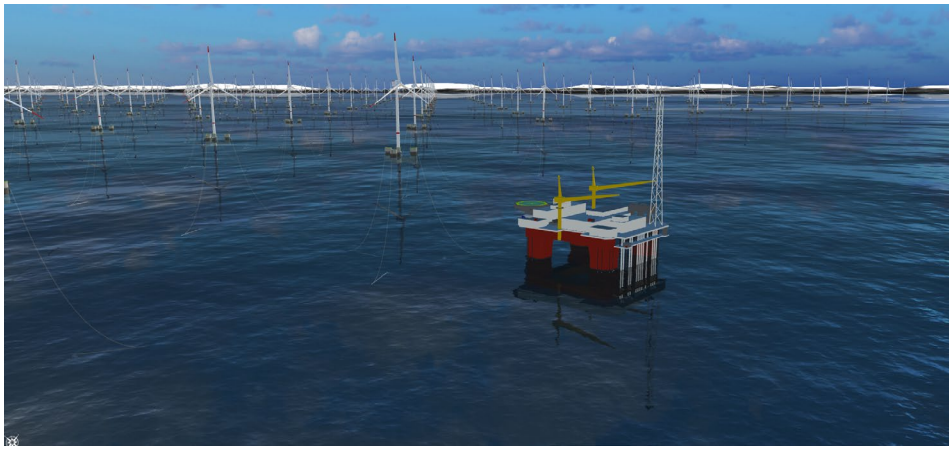
You can upload other files to connect to the digital twin, such as a video file taken by a ROV.

You can connect a file to multiple objects at once, for example if you have a piping and instrumentation diagram, you can connect it to multiple Christmas trees at once.

Another new development is what FieldTwin refers to as a 'pretty button.' When activated, the digital model is shown with visual effects such as shade and illumination, which make it more attractive. This can be used to create images for marketing material or presentations.

You could work all the time in "pretty mode" if you have a powerful enough computer, he said.

You can export 3D models from the software in the gLTF format, which is designed to work with web technologies. gLTF format models can be viewed in PowerPoint and many other viewers.



A 'digital twin' of an offshore oil field and wind farm

So, you can bring your digital model, or selected elements of it, including topsides, wells, reservoirs and water depths, into a PowerPoint slide, and rotate it as part of a presentation.

The new version is able to give you a schematic view of any equipment, without showing the infrastructure it is connected to. For example you might want to see a schematic of a Christmas tree.

Future releases

For future releases, FutureOn is considering adding functionality to split a model into chunks, or 'branches'. This could be used to compare different construction options.

There will be more advanced reporting systems in the next version.

It is developing tools to integrate ROV (remote operated vehicle – subsea) survey data, so people can upload and index ROV videos. It would be extremely useful if you could click on an area of the model and then directly see a ROV video of it.

It is developing new tools for modelling infrastructure, including with different connection types, mooring types, and riser types.

In the next version, there will be more functionality to design and model wells, including designing the well trajectory (pathway), recording any hazards, and noting the stratigraphy the well passes through. There will be tools to add more well attributes, including casing sizes and valves.

It is looking to make it easier to import well bore data from other software tools. You will also be able to export well and pipeline models into well simulation software from PETEX, or pipeline modelling tools with Schlumberger's Olga.

This article is partly based on a webinar "New Release: FieldTwin 8.0'" held on Feb 27. You can watch online at **https://youtu.be/p2YUK-kI4cjk**

Using private 5G networks

By setting up your own private 5G network you can get the coverage, reliability, security, flexibility and predictability you need. Ericsson explains how it can work

By Alastair Glover, Private Networks Marketing Director, Ericsson

Private 5G networks offer a range of benefits, empowering oil and gas companies to become more resilient.

Private 5G networks provide increased coverage, reliability, security, flexibility, and predictability.

Private 5G networks operate on licensed spectrum, eliminating signal interference, traffic congestion or limited coverage areas, often encountered with wi-fi networks.

With 5G's ability to provide guaranteed quality of service (prioritizing traffic based according to the criticality of each use case) IT teams can ensure that critical applications consistently receive dedicated bandwidth, allowing effective functionality.

Private networks also offer incremental security benefits when compared to wi-fi. Private 5G networks inherit and build on the same mission-critical security features that have served critical infrastructure in nation-spanning networks in previous generation cellular networks with 3G and 4G.

Private cellular networks mitigate credential-based attacks through SIM-based authentication. Access to the network requires approved physical or eSIMs that are paired with each device, offering precise control over authorized users.

Even in the case of a bad actor obtaining a device with an approved SIM, their access is restricted to the specific network portions approved for that device.

5G can offer a lower total cost of ownership than wi-fi, since it requires less infrastructure, such as cellular access points, to cover the same area. The ratio of cellular access points to wi-fi access points can be 1:10. This translates into lower costs for cabling

and maintaining the network.

Thus, deployment and management are streamlined, ensuring rapid and straightforward implementation with no 'dead zones'. You can ensure continuous connectivity even for mobile use cases such as inspection and connected workers.

Offshore installations

Offshore installations also face challenges with varying network access, leading to reliance on two-way radio solutions for employee communication.

Two-way radio systems can be integrated with critical communications solutions supported by cellular connectivity.

An example of where radio can be supported by cellular connectivity is GroupTalk, offering a cloud-based push-to-talk service.

Another example is RealWear's connected wearable solution. It provides frontline workers with hands-free access to information and remote collaboration tools. Integrated with Microsoft Teams, this solution facilitates global communication between field operators and remote experts.

These solutions leverage the dedicated bandwidth, ultra-low latency, and reliability of 5G to function effectively.

Automation

Automation can be used together with cellular. Drone and robotics company UAVIA utilizes Ericsson's private 4G and 5G solutions to operate its drones. Its drones scan industrial systems, identify leaks, and automatically guide maintenance efforts to replace faulty equipment.

Another example is integrating methane and CO2 sensing into robotics systems. Marie-Noëlle Semeria, Chief Technology Officer of TotalEnergies stated, "The successful integration of methane and carbon dioxide quantification into UAVIA's Robotics Platform reinforces the leader position of TotalEnergies in accurate quantification of greenhouse gas emissions. It opens the path to near-continuous measurement."

Baker Hughes' most interesting CCUS technologies

Baker Hughes is developing technologies for gas power generation with CCS and lower emissions, direct air capture, compact carbon capture, solvents, algae which convert CO2, and electrical hydrogen compressioN

Energy technology company Baker Hughes is developing a number of technologies for different areas of CCUS. We spoke to Chris Barkey, Chief Technology Officer for the Industrial & Energy Technology division of Baker Hughes.

Mr Barkey is a former group director of engineering and technology for Rolls-Royce, where he was responsible for the entire engineering function of the company including roughly 17,500 engineers.

A portfolio of different technologies is being developed for carbon capture. The most appropriate one will depend on factors such as the concentration of CO2 in the input flow (very low for DAC [Direct Air Capture]), the volume of CO2 to capture (very high for a power station), and other factors such as the space available for equipment.

NET Power

The NET Power technology is for gas power generation with carbon capture.

Baker Hughes has invested in NET Power and announced a 'strategic partnership' in February 2022.

With the NET Power system, gas is combusted with pure oxygen, rather than air. The turboexpander (to generate power) is turned by high pressure CO2, rather than using the heat of the engine to make high pressure steam. Most of the CO2 is compressed and recirculated back to the turboexpander while a small portion exits the cycle, like a slowly overflowing bucket, and is captured.

The oxygen to feed into the combustor is generated from air, taken from an air separation unit.

Baker Hughes believes that the technology will be "hugely competitive" compared to conventional methods, combined cycle gas turbines (CCGT) which heat steam to drive a turbine, with a carbon capture system fitted on the back. This is for multiple reasons.

Firstly, it removes the step of using the heat of the combustion to heat water to drive the turbine. This increases overall efficiency.

Secondly, there is no CO2 released to the atmosphere at all. A conventional carbon capture system is normally only about 90 per cent efficient, with about 10 per cent of the CO2 released to the atmosphere. If gas is burned in oxygen, it produces only water and CO2. It is easy to separate out the water vapour by condensing the mixture, and then all the remaining gas, all CO2, can be sent to storage.

Chris Barkey, former group director of engineering and technology for Rolls-Royce

Thirdly, there are no NOx emissions. The air separation unit produces oxygen at about 99.5 per cent purity. So there is very little nitrogen entering the combustor. A conventional gas turbine system needs an additional scrubber to remove the NOx.

The air separation unit uses a lot of energy, but then so does a carbon capture unit, so there may be no big overall difference there.

The NET Power technology is being designed for power plants at "utility scale" in the 300 MWe range.

A 50 MWe test system is being built in Texas, to be operational in 2028.

Mosaic Materials – DAC

Baker Hughes acquired Mosaic Materials, a company which is developing an adsorbent material for direct air capture, in April 2022. It is further developing the technology.

The CO2 is captured in a proprietary metal organic framework (MOF) material which adsorbs CO2.

This MOF has enormous surface area crammed into a small volume – a sugar cube sized piece of MOF has the surface area of a football field, Mr Barkey said.

There is an exothermic reaction when CO2 is adsorbed onto the material.

The technology was originally developed at the University of Berkeley. It is already being used by the US Navy and NASA to improve breathing air quality on submarines and spacecraft.

So far, Baker Hughes has been testing a "Bravo" scale unit capturing 150 tonnes a year. It uses the names Alpha, Bravo, Charlie to signify a gradual scaling up of technology in development. Bravo should complete testing and assessment by the end of the year when we will move onto Charlie, the exact size is still to be determined. Meanwhile the chemistry and other factors are being tweaked, Mr Barkey said.

Trials are being made to find the best method of heating the material evenly so that it desorbs (releases its CO2). If any part of the material does not get heated, it will not desorb and so the whole process will be less efficient. It could be conventional convection heating, or microwaves, he said.

The material needs to be manufacturable in sufficient scale and cost and it needs to be durable. "The last thing we need is for it to be perfect for three weeks then you have to change it out," he said.

Indications so far show a small amount of degradation after first use, but only to a certain point, then degradation flatlines, he said.

"I'm really excited about Mosaic. Compared to some of the other direct air capture technologies it has [good] capacity for adsorption, and speed of cycle," he said. "It makes it a really powerful and competitive product."

It may also be suitable for carbon capture from point sources.

Baker Hughes is trying to accelerate the technology development to bring it to market as fast as possible he said.

Compact carbon capture

Baker Hughes is developing a compact carbon capture system, which uses rotating beds to increase the dynamics in system compared to conventional static gravity towers to bring the solvent into contact with the gas.

It may be suitable for applications which do not have space for conventional carbon capture towers, or do not want towers for other reasons, such as use offshore and on ships. It may also be less expensive, particularly in CAPEX, for emitters with lower volumes.

In conventional carbon capture, two towers are used, where the solvent flows down with gravity. In the first tower it comes into contact with the CO2 rich gas, and in the second tower the solvent is heated and releases the CO2.

The compact carbon capture system uses rotating beds instead of towers, where the solvent is sent from the centre towards the edge by centrifugal force instead of using gravity.

Baker Hughes is currently testing a 5 tonnes CO2 per day system and is currently planning a larger 15 tonnes a day demonstration plant.

Other technologies

Baker Hughes is developing a Regenerative Froth Contactor which creates a froth in the solvent (many small bubbles). This increases the contact area for dissolving gases into it. It can work with any solvent. This technology is at a "slightly lower technology readiness level but still an exciting technology", Mr Barkey said.

For carbon capture solvents, Baker Hughes is looking at the chilled ammonia process, which uses standard ammonia as the solvent. Trials so far have shown that the solvent's capability is not influenced by trace components such as NOx, oxygen, and other flue gas impurities. It does not show thermal and oxidative degradation.

Baker Hughes is also looking at potassium carbonate solvent, which has shown so far to be low cost, low toxicity, to have good ease of regeneration, low corrosiveness, low degradation and high stability. There is a test project at the U.S. Department of Energy's National Carbon Capture Center in Wilsonville, Alabama. This solvent could be ready for wider development in the 2025-2026 time scale, he said.

For CO2 utilisation, an interesting technology is biological methanation, where specialized microorganisms convert hydrogen and CO2 into methane.

Another interesting project is electrochemical hydrogen compression. Mr Barkey describes this as "very early stage" technology. Baker Hughes signed a "strategy collaboration agreement" with HyET Hydrogen, the developer of the technology, in December 2023.

The technology uses a membrane, with an electrical force. The hydrogen molecule is split into protons and electrons. The proton goes through the membrane, the electron goes around it through an electrical circuit. Only protons can pass through the membrane. On the other side of the membrane, it rejoins with the electron, but at double the pressure. For a detailed explanation see "Electrochemical hydrogen compressor" on Wikipedia.

A further interesting technology under development at Baker Hughes is a gas turbine which can run on 100 per cent hydrogen.

The development process

For every technology developed by Baker Hughes, a comprehensive 'technology discovery process' takes place. There is due diligence for both the technology and the market, looking at potential market size and the advantage the technology will have over competition, if there is any. Once a commitment is made to invest in the technologies, Baker Hughes develops a commercialisation plan and a plan to develop the technology over multiple generations.

Regulators commonly ask for the "best available technology", so if you are producing the best available technology that is a good commercial place to be.

"For each of these technologies we believe we have strong competitive advantage," Mr Barkey said. "They are all interesting and exciting."

"[But] you never quite know what moves the competitors will make, that's the joy of business, you know they won't stand still." digital energy journal

How US tax credits drove CCS

Tracking of US CCS projects, and permit applications for CO2 injection wells, shows how much the Inflation Reduction Act has motivated projects. John Thompson from CATF explained

The reason CCS has not yet taken off on a big scale is purely about money, not the technology, said John Thompson, technology and markets director with non-profit environmental organisation Clean Air Task Force, speaking at Carbon Capture Journal's webinar on February 22, "Developments with US carbon capture and storage".

"Until August 2022 with the Inflation Reduction Act (IRA) there was no economic story, no financial reason to really develop the technology, because projects couldn't be economic. That's beginning to change."

The US has offered a tax credit for CO2 storage since 2009, but it was initially only $20 a tonne for saline storage, $10 if CO2 was used for EOR (enhanced oil recovery). The saline storage credit increased to $50 in 2015, and to $85 with the Inflation Reduction Act.

CATF's tracking of US carbon capture projects shows that there are many more projects in the US now than pre-IRA.

You can also track applications for "Class VI wells" (CO2 injection wells) on the US Environmental Protection Agency website (https://www.epa.gov/uic/current-class-vi-projects-under-review-epa).

This page shows when applications were filed and when a final decision is expected. It shows a huge growth in applications after IRA was passed. In 2021 there were only 15 applications, by 2023 there had been 122 applications, Mr Thompson said.

Initial interest was mainly in carbon capture projects with a highly concentrated stream of CO2, so carbon capture is less expensive. This is found with manufacturing of ethanol, hydrogen and ammonia. There have been a small number of permit applications for direct air capture projects and natural gas power generation, which have a much lower concentration of CO2 in the gas stream.

There remains an important question about whether the 45Q tax credit is high enough to justify investing in carbon capture in steelmaking, cement, refineries, and other 'hard to abate' industries. They have many chemical processes which themselves emit CO2, and so cannot be simply replaced by renewable electricity. Typically CO2 from these is in a gas stream at a low concentration, so it is expensive to separate, he said.

"It is an open question whether 45Q at its current level is enough to drive some of the really hard-to-abate sectors," he said.

"First mover projects are vital," he added. "The ones that go first are going to unlock a lot of the issues we're going to see. How quickly we get permitting, what's public acceptance like, do we have enough funding, what are the policies we need to fill those gaps if they exist."

Before the Inflation Reduction Act, nearly all carbon capture in the US has been for EOR, because it was the only way to make it work commercially.

But it could only work in locations with a cheap source of CO2 close to an existing oil patch. It was also subject to the volatility of the oil price, he said.

But the $85 tax credit under 45Q is big enough to make it viable to store CO2 in saline aquifers, as with the CENLA Hub, he said. And although a $35 to $60 tax credit is available for CO2 used in EOR projects, it is not leading to any new EOR projects, so far, he said.

Mr Thompson's role at CATF includes developing its "Industrial Impact" area of work, which aims to bring decarbonisation tools to specific industries, using learnings from its carbon capture team.

He also leads CATF's carbon capture group. This team has made a big contribution to developing low carbon policy in the US, including a role in designing the 45Q tax credit scheme.

Refinery of the future

The Zero Carbon Fuel team at CATF will shortly release a report "Refinery of the Future", covering how to use CCS, hydrogen and electrification in a refinery.

The report was written together with consultancy Advisian. It studied typical designs for refineries in Singapore, GCC countries, US Gulf Coast and Europe. It looked at their announced decarbonisation plans, their options to reach net zero, and their costs.

It identified that different pieces of equipment would use different decarbonisation strategies – some would use CCS, some would run on hydrogen, some could be electrified.

CO2 pipeline safety

On the question of CO2 pipeline safety, Mr Thompson noted that there have been CO2 pipelines in the US in commercial operation for over 50 years, without a single death. CO2 pipelines have a better safety record than natural gas pipelines.

It is not risk free. There was a major CO2 pipeline breakage in Mississippi, when a landslide severed a pipeline, and 30-40 people sought medical treatment. "We are lucky no-one was killed in that," he said.

CO2 pipeline safety is highly regulated, and new regulations are about to be announced by the US Pipeline and Hazardous Materials Safety Administration (PHMSA).

"We don't ignore [risks] or minimise it; I think it's a risk that is easily addressed," he said.

digital energy journal

CapturePoint's CO2 storage in Louisiana

CapturePoint is planning perhaps the largest onshore CO2 storage project in the US and has a major initiative to engage the local community by supporting the training of young people. CEO Tracy Evans told the story

CapturePoint, an oil and gas producer and CO2 storage company based in Allen, Texas, is planning perhaps the biggest onshore CO2 storage project in the US.

Tracy Evans, CEO, told the story in a Carbon Capture Journal webinar on February 22.

The project is called "Central Louisiana Regional Carbon Storage Hub," abbreviated to CENLA Hub. The injection and storage site is in Vernon Parish, in central / west Louisiana, midway between the city of Shreveport, in the northwest corner of the state, and the Gulf Coast.

It has multiple aquifer injection sites which can each handle 7.5 million tonnes a year (mtpa) CO2 injection and store 250 million tonnes CO2. Total storage capacity is estimated at 1 gigatonne, based on data from test wells, including logs and cores.

The company considers the region to have "excellent geology" for CO2 storage. "This particular site is probably one of the best, if not the best in the US - at least onshore," Mr Evans said. "It basically ticks almost every category you could come up with for a great CO2 sequestration site."

Most of the CO2 is coming from gas processing plants, removing CO2 from produced gas which would otherwise be emitted to the atmosphere. There are around 30 gas processing plants in the region. The natural gas processing reduces CO2 in the gas to under 2 per cent, the typical specification for a natural gas pipeline.

To date, the CENLA Hub team has signed up with 5 gas processing plants and one methanol plant, to receive 1.75m tonnes a year of CO2. There will be a 125-mile pipeline from the processing plants to the CENLA Hub site, where CO2 will be injected to the subsurface.

CapturePoint is sponsoring a training program in pipeline construction (see next section). This is in a region where there are so few working opportunities for young people that they are forced to move away to start a career, according to a representative of the school board.

Tracy Evans, CEO, CapturePoint

CapturePoint, formerly Perdure Petroleum, is also an oil and gas producer and specialist in CO2-EOR. It has existing CO2-EOR operations in Texas, Kansas and Oklahoma, sequestering around 1m tonnes CO2 a year in total.

It is also developing new CO2 deep underground storage projects in Colorado, Oklahoma, New Mexico, Mississippi and Wyoming. Its work is financed by private equity investors.

The subsurface

In the first stage of the CENLA Hub, the CO2 will be injected into three individual "injection zones" comprising one "injection site". Two wells will be drilled into each zone.

Each injection site's subsurface has been modelled, to confirm it has a "confining zone," which ensures that CO2 stays in each zone. There is a further "confining zone" above all three zones, Mr Evans said.

The thickness of the first injection zone ranges from 300 feet to 800 feet. The second is around 1500 feet thick, and the third is 2500 feet thick. The 1500- and 2500-feet zones are 50-60 per cent sand.

CapturePoint has already drilled through the confining zones and injection zones, taken core samples and analysed them, to confirm the porosity of the rock for holding CO2, and that there are seals above it.

Geographically, the site covers 15,000 to 20,000 acres (60 to 80 square kilometres).

The shallowest interval is 4500 feet below the surface, and the deepest is 7,500 to 10,000 feet underground. At these depths and pressures, CO2 behaves more like a liquid than a gas, and so does not flow in the way that a gas would. "We typically only work on sites below 3000 feet," he said.

The storage zones also have a very low dip of 1 to 2 degrees (nearly horizontal). With CO2 being less dense than water, it will move to the top of a space filled with water. If the zone has a significant dip, all the CO2 will flow to the higher end of it; having a low dip is very helpful.

The aquifers can be described as "railroad tracks", with a parallel top and bottom, and no faults. The permeability is "several hundred millidarcies to darcies," he said.

The rock has a sequence of sand and shale horizontal layers, with the shale acting as a "baffle," limiting vertical migration of the CO2.

A reservoir simulation showed that there would be a limited increase in pressure in the aquifer over the expected injection lifetime of 30 years, and with no need to produce any of the water in the aquifer to reduce pressure.

The limiting factor on the injection rate is actually the size of the wellbore – but a bigger diameter hole would be much more expensive to drill. The site is being designed with additional wells to provide the ability to continuously inject CO2 if another well is down for any reason.

A handful of wells previously drilled in the site for oil and gas exploration (between 5 and 7 on each site) have been plugged, but the project team needs to ensure that the plug makes a complete seal.

It can be easier to prove you have a "confinement zone," with enhanced oil recovery projects compared to aquifers, because if you did not have one, the oil would not still be trapped, Mr Evans said.

Development plan

The company has filed two permit applications for Class VI carbon sequestration injection well sites for the CENLA Hub. The permits are currently undergoing technical evaluation with the Louisiana Dept of Energy and Natural Resources (DENR), which now conducts and enforces U.S. Environmental Protection Agency permitting procedures within the state.

Louisiana DENR has stated has stated a goal of processing class VI permits within 24 months, but it is not a legal requirement, he said.

Getting the pipeline permits should be easier to achieve, since they are typically issued by states or local authorities, rather than the federal government, he said. In oil and gas states, there is historically less opposition to pipelines. CENLA already has landowner permission to survey 100 per cent of its pipeline.

"Our best guess is we should be able to have first injection in Q1 2026, if we get our Class VI permit in summer of 2025," Mr Evans said.

"These things take 9 months to a year to physically construct - building the capture facilities, the 125+ mile pipeline, drilling 6 wells on each site."

Each of the six wells should be able to take "slightly over" 1 million tonnes CO2 a year. The wells will be 9 5/8-inch diameter.

The 45Q tax credit has a 12-year life span, so investors have understandably raised questions of how the project will be profitable after this. Mr Evans responds that the project could be funded after the 12-year 45Q period through voluntary carbon credit markets or carbon taxes. "We do not think CO2 will go back to being vented," he said.

Mr Evans has been involved in CO2 for enhanced oil recovery (EOR) for 20 years. CO2-EOR is commercially viable by itself, leading to more oil production. But there are not enough EOR projects to handle all of the CO2 which needs to be captured, he said.

Also, the amount of CO2 which can be injected into a reservoir will quickly decline as the reservoir pressurises, so it can be of limited value when the goal is maximising CO2 storage.

Motivating emitters

Mr Evans was asked for ideas on how the chicken and egg problem can be solved in carbon capture - how emitting companies can be better motivated to invest in capture equipment if they don't know for sure there will be a service available to collect and store the CO2.

"The only way I know is to continue to show progress," he replied. The more people can see developments being made in CO2 storage, the more confidence they can have that storage will be available when they need it.

Many emitters initially tried to run CO2 storage projects themselves and are now showing more willingness to partner with a specialist company.

"I do think over the last 12 - 18 months there seems to be more willingness to sign contracts," he said.

It doesn't help that there is no economic penalty for atmospheric release of CO2 emissions in most of the US, he said.

CENLA Hub's community involvement plan

CENLA Hub's community involvement plan is to support training of young people from Vernon Parish in pipeline construction and maintenance. Vernon Travis, from the Parish school board, told the story

Louisiana Department of Energy and Natural Resources requires that every project must have some community involvement plan in order to obtain a Class VI permit to inject CO2.

CENLA Hub's community involvement plan involved co-sponsoring a training program for local young people attending the nine Vernon Parish high schools, called the "Capturing Better Futures" Initiative.

The program is in partnership with the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada, a union. Its name is commonly shortened to the United Association, or the UA.

Vernon Parish School board is also a partner in the initiative.

Louisiana is divided into 64 parishes, as other states are divided into counties. One of the CENLA Hub injection sites is in Vernon Parish.

The training program is co-ordinated by Vernon Travis, an elected member of Vernon Parish School Board in Louisiana. He is also a former army officer and chair elect of the US Consortium of State School Boards Associations (COSSBA).

The initiative will offer training to 30 students every year, for a two-year program, learning skills in pipeline construction and maintenance, steamfitting, and pipelaying.

The sponsors built out and furnished a classroom and training workspace at Leesville High School, and provided instructors, materials and transportation for students.

After the 2-year program, students can "go out and do limited work". But if they continue on a UA apprenticeship, they can eventually earn $50 to $60 an hour. The apprenticeship will only take four years, where it normally takes five.

Vernon Travis, an elected member of Vernon Parish School Board in Louisiana

CapturePoint will receive tax credits for its support under the 45Q tax rules, which authorise additional tax credits for carbon capture and sequestration (CCUS) projects that pay prevailing wages and employ apprentices from federally registered programs.

Mr Travis first met Sherry Tucker, CapturePoint's Vice President of Communications, Community Engagement and Government Relations, at a Washington DC reception in January 2023, when the idea was initially proposed, he said.

"I was able to go back to my school and superintendent and say, 'I have someone that really wants to partner with us and bring us training,'" Mr Travis said.

"We've always lacked partnering with some industries. You think, 'why not'. Well, we don't have any industry in our community. It is small, rural, it's a dying community. There's the Vernon Parish school system, a military base and Walmart. Those are the opportunities people have to get a job. Seniors are staying on jobs longer, so positions are not opening."

"Our kids graduate high school, they go to college or leave for big cities, where the jobs are."

"The number of kids in our schools decline by 200 kids a year. That shows how much we are losing our children and our families," he said. "A project like this has really changed the way we look at the future."

The project may be particularly suitable for children who are not suited for university. "I told our curriculum people, 'I don't want the college bound kids. I want them to go to college, get their degrees,'" Mr Travis said. "I want the 'at risk' kids, kids that were borderline, trouble, problem kids.

"We find those kids come to the conclusion, about 8th grade, they don't have any hope in the future, school is not for them."

"When you tell them they are going to get a program like [the one] CapturePoint and the UA has formed, they can join the UA, continue apprenticeships, that's amazing."

"One parent heard that, looked at the kid and said, 'do not screw this up.' The parents understood there was true hope, true future, something for them. They don't have to worry about kids driving to Lake Charles or Houston to find a job, 2.5 hours away. These students will be able to work at home, grow their families at home."

Explaining the project

In setting up the project, CapturePoint staff held many meetings with "all the public groups, the chamber of commerce, Vernon Parish Police Jury (the governing authority), city council, mayor," Mr Travis said.

"I knew CapturePoint needed to build pipelines and facilities; I knew the UA needed employees. I knew I had the bodies to fill those positions."

It helped that Mr Travis "went to school with both our state legislators," he said. He was able to liaise between them and CapturePoint, ensuring their questions and concerns were addressed.

Capture Point was able to explain to the relevant people how the storage would work, and the risks mitigated. It enables the legislators to assess the risks and potential gains to the community together, to see how they weigh up.

"There was some doubt in the beginning. They didn't know or understand. Any time I said, 'I need you to talk to so and so,' CapturePoint and the UA were willing to come."

Building a base

The training program aims to do far more than train students to work on the CENLA Hub project. It will give students a base to build their training further, and then find highly paid employment around the US.

It also aims to make Vernon Parish more attractive for other industries, because they will see it has a trained workforce. "We don't have a reason for companies to say, 'we can't come to your area because you don't have a workforce.'"

Many industries in the US complain that they have a shortage of trained workers. Mr Travis points out there is no shortage of schoolchildren in the US, they just need to be trained. "You watch those yellow [school] buses every day full of workforce capable people," he said. "You have to train those kids the way they want."

Mr Travis also hopes the region will become an industrial hub for carbon emitting industries and carbon capture, building together over the coming decades.

A 5 minute video about the Capturing Better Futures Initiative is on YouTube at **https://www.youtube.com/watch?v=QmGvS7Jj0y0**

How to move CCUS faster – Baker Hughes event

Speakers from Wabash Valley Resources, GCCSI, Evida and Baker Hughes shared perspectives on how to get CCUS moving faster during the Baker Hughes Annual Meeting in Florence

Wabash Valley Resources, a company based in Indiana, USA, is planning a very low carbon intensity fertiliser plant, using blue hydrogen. Peter Sherk, a board member and investor, told the story, at a technical session at the Baker Hughes annual meeting in Florence in January.

The company acquired a gasifier complex in 2016. In 2017, it decided to add carbon capture to the process so it would produce very low carbon hydrogen which can be used to manufacture ammonia.

The plant is situated close to the NuStar ammonia pipeline which connects to the US Gulf Coast and runs through Midwest agricultural markets , so this could potentially be used to carry the ammonia to customers.

The plant is situated within the Illinois basin geological formation, where another CO_2 sequestration well was drilled in 2014 and has operated successfully ever since, safely sequestering 1 million tons of CO_2 per year

In the US, landowners need to be compensated for the use of the 'pore space required to put CO_2 in the subsurface under their land, just as they are compensated for oil and gas reserves associated with their land when a company produces hydrocarbons there.

Companies have been injecting waste water and chemicals into the subsurface for decades without having to pay for pore space that they go into, but CO_2 is viewed differently because there is direct revenue attached to the injection via the 45Q tax credits, he said.

Some landowners have high expectations for the revenues their pore space can earn, for example demanding payment of half of the CO_2 storage company's payments from the 45Q tax credit.

While payment this high "is not available," at the end of the day agreement on a price needs to be reached, he said.

The process of getting permits for a CO_2 injection well, known as a "Class VI permit", took five years, finally being received in January 2024. The plant now plans to be in production in 2026-2027, capturing 1.65m tonnes CO_2 a year.

A large part of the Class VI well application process requires the drilling of an 8000 foot deep test well, retrieving samples of the rock and then having those samples analysed for the ability to absorb CO_2 . Then sophisticated modelling is performed to anticipate the future flow of the CO_2 in the sub-surface. as well, the application requires cataloguing all the historical wells which may reach into the storage site, and determining that they are all safely plugged. It took half the five years to do prepare all this information, plus gather other data, and the other half for the EPA to review the data, Mr Sherk said.

There is an advantage in having a robust process in that it is easier to satisfy investors and all stakeholders that thorough investigations have been made to ensure the safety and effectiveness of the process , he said. When they have questions, they can be referred to the permit application.

Asked about the biggest risks with the project, Mr Sherk said that it is similar to any new venture, in that there is never enough money. You should carefully calculate how much it will cost to develop your project , and then double your estimate, he said.

The way to manage the CO_2 storage risk, like any business risk, is to identify all of the risks and then determine who is best placed to 'hold' the different risks. The insurance sector is engaged but has not yet fully developed insurance based solutions, he said.

Asked how much it costs to do CO_2 storage, we can see that the government's tax credit of $85/tonne under 45Q has proven to be a number which works, he said.

Another possible financial mechanism is the emerging market for clean (low carbon) ammonia, with the Korean and Japanese governments willing to pay a specified amount for it, he said.

US policy is not showing any preference for green hydrogen over blue hydrogen, but instead sets standards about the carbon intensity, he said.

GCCSI

Although conversations about CCS have been going on for decades now, it is "only just taking off" as a large scale, wide scale industry, with "aims to have climate-scale impact," said Erin Billeri, business development manager, Americas at Global CCS Institute.

GCCSI is headquartered in Australia and has 91 members in Americas, 56 in Europe, 31 in Japan, 24 in Australia, 8 in the MENA region, and 5 in China.

"We need to remind ourselves of the human aspects of getting a new industry off the ground," she said. "You need to build an army of expertise and resources."

People "need to be educated on the risks and opportunities to deploy capital to projects. Industry needs to invest in and develop projects."

Industrial companies which emit large volumes of CO_2 , such as manufacturers of steel, cement and ammonia, will have staff with engineering and project management skills, but they will not yet have much CCS understanding.

Finding a provider to transport and store CO_2 is not a readily available service in many regions. You can't just search on the internet for a company which will accept it.

Baker Hughes

Being able to say that you know exactly what is happening with the CO_2 in the subsurface is extremely important to ensure that these projects are accepted by the community and sustainable in the long term, said Alejandro Duran, Vice President, Reservoir and Consulting Services at Baker Hughes.

Baker Hughes has a structured offering on CO_2 storage monitoring services – the Carbon Watch - to help quantify the risks of a site and determine the right monitoring approach, he said.

The risks of CO_2 storage are well-known, leaks through old wells, leaks through the caprock, existing or reactivated faults which could allow CO_2 to pass through. The challenge we tackle is working out the best way to mitigate these risks in the most effective and economic way.

Our technology today allows to continually listen for noise from the subsurface with microseismic, use spot seismic (which can identify change in subsurface composition in a specific spot of the subsurface), use fibre optics in wells, log through several strings of casing, etc.

All this, powered by a digital twin of the resource, will allow identify any potential condition and intervene timely if needed.

Finding Petroleum

CALL FOR SPEAKERS:
WEBINARS ON IMPROVING DIGITAL COMPETENCE AND TRANSPARENCY

Digital Energy Journal would like to plan webinars over Summer / Autumn 2024 on the theme of digital competency and transparency.

This is in our domains of subsurface data and exploration, facility fuel consumption and emissions, methane emissions management, carbon emissions management, CO2 storage characterisation, CO2 storage monitoring, and wells / drilling.

Digital competency and transparency, simply put, could be defined as the ability to see digital services as tools, and what they are able to do.

Digital tools, like any other tool, need to integrate with the process they are supporting and do not stand alone. Everybody needs multiple tools to do their work. But tools are still extremely useful.

The digital business world is organised around 'products', because that is what works in Silicon Valley and what Silicon Valley investors like. But while a 'products' approach is good for the consumer world, it has a lot of failings in the industrial world

- Too much over-promising and focus on sales
- Too much extending of products to try to cover more requirements
- Too little consideration to the need of these products to integrate with other products
- Too little consideration to the fact that a customer or 'user' will use this product as one of many.

A competent and transparent approach, in contrast may involve:

- understanding in depth what processes people actually follow
- developing skills to map or draw abstractions of what people do, what technology does, how technology helps people and how well technology supports what they do
- for complex technology tasks such as reducing emissions, developing skills to split the overall task into layers and work with them all separately
- understanding how advanced technologies such as AI and analytics genuinely fit and support this, and how to get the most out of them

- working out how to better use data

If you are able to give a talk at a webinar on a theme related to digital competency and clarity please contact Karl jeffery on **jeffery@d-e-j.com**

UPCOMING PLANNED WEBINARS

Developments with new EU CO2 storage projects *19 Apr 2024*

Onshore Senegal - a different bet to more and more deeper, deeper, water! *June 21*

PAST WEBINAR VIDEOS AVAILABLE ONLINE

New capture and storage projects in the US *Feb 22, 2024*

Explore onshore Sub-Saharan Africa - not just deep, deep, water! *Feb 9, 2024*

Better ways to model and improve emissions performance of a facility *Dec 8, 2023*

W(h)ither Global Exploration? *Dec 1, 2023*

Better ways to sense oil and gas methane emissions - satelilte and airborne *Nov 17, 2023*

See **www.findingpetroleum.com** click on **'Videos'**

Event plans at www.findingpetroleum.com and www.d-e-j.com