which oil and gas companies can use to manage and work with their data, including APIs to enable software applications to connect directly to the data.

The Energistics data standards will become a component of the OSDU Data Platform, as part of its "Domain Data Management Services."

The OSDU platform is designed to be implemented on cloud services, which can include public cloud (like Google, AWS, Azure) or private cloud / systems on company premises.

Legal points

Energistics will continue as a separate entity, in order to preserve the tax-exempt status of the organization and to ensure the standards remain fit for purpose as needs change.

There will be a new Energistics board, with a controlling director representing The Open Group, 2 directors representing Open Group members of OSDU, and 2 directors who are current dues paying members of Energistics.

Geothermal energy – understanding the business case

While geothermal energy seems unlikely to make a big change to the world energy system, it also offers too much potential to ignore. Our webinar on Jul 9 studied the business case for geothermal energy developments.

Speakers included John Leggate, Independent Energy Transition Advisor and board member of renewable energy Companies ; Zammy Sarmiento, a geothermal consultant based in Manilla; Karl Farrow, CEO, CeraPhi Energy Ltd, and former operations director, Petrofac; and Greg Coleman, CEO, Future Energy Partners, a former VP HSSE with BP.

John Leggate, Independent Energy Transition Advisor and Board Member

John Leggate, Board member across the renewables sector (energy storage, wave and wind energy), senior advisor on the energy transition and veteran of BP, noted that the claims for geothermal have parallels in tidal and wave energy, in that they are globally abundant, locally focussed, green, and reasonably predictable.

Serious efforts have been underway to make marine energy commercially viable for more than 40 years, and "even today there are few viable options in spite of significant research, investment and demonstrator plants. Atlantis Energy is an exception and have demonstrated commercial viability at scale in the tidal energy space, although tidal energy is still a multiple of the cost of offshore wind, which is still following its natural cost-down curve," he said.

We should probably not expect the costs of geothermal energy to come down quickly either, since the most expensive part, the wells and infrastructure , is oil field technology and with its inherent costs. "It's all great heavy duty equipment, and with the usual oilfield price tickets," he said.

While geothermal energy has costs similar to oil and gas production, it has revenues typically for power and hot water utilities, he said. And the sale prices of heat and power could well be regulated, so there is not the possibility of upside profits from short term shortage of supply pushing the prices up.

Operational interventions can be very expensive for both marine energy and geothermal energy. With marine energy you often need a vessel and a potential dive spread, and with geothermal energy you need to haul heavy weight specialist equipment to the well sites.

Currently there is ferocious competition in the renewable energy sector, with offshore wind currently costing under £35/MWH, and going down every year with no end in sight, as wind turbines get bigger and bigger. With wind power growing in the UK at 2GW a year, "it could be that energy transition is nearly over before the geothermal contribution gets its skates on."

On the other hand, if 'big oil' gets stuck into geothermal, "bringing their money, human capital, and know-how of drilling and well operations," everything could change, he said. "That could happen."

With these high levels of uncertainty, Mr Leggate believes that geothermal is not safe territory for investors without deep pockets. This is not a dotcom play – these are serious infrastructure investments," he said.

Just being able to produce low grade heat does not necessarily mean you can monetise it, even if there are plenty of homes nearby who might need it. This is a non-fungible asset class – and transporting and selling heat is very different from selling electricity.

The market potential for heat could be much better in parts of the world which have established district heating plants or commercial consumers, supplying heat to many homes or factories by pipeline, such as in Nordic countries.

Many UK projects seem to be dependent on government support. However, there are some commercially viable geothermal projects across the globe, including in Iceland, Philippines, New Zealand, and Japan.

Other factors to consider are the legal complications of taking on abandoned oilwells, including the well status, clarity of ownership and land access, and indeed future decommissioning obligations – "in summary, a bit of a legal minefield".

The question is what works and what doesn't. "We owe it, when we talk about geothermal, to break it down, and discuss the quality of resources and the deliverability to the commercial market. Ultimately many of the geothermal resources may in reality be stranded assets," he said. "The trick is to find the global sweet spots where the technology and the commercials really work."

"I am an optimist about the possibilities for geothermal energy to be a serious contributor to the energy transition. It does not seem right to leave this resource in the ground when it's got an important piece to add to the energy landscape. I fully support digging in deeper and finding case studies to encourage the development of a commercially viable geothermal marketplace," he concluded.

Zammy Sarmiento

Zammy Sarmiento, a geothermal consultant, and former reservoir advisor with PT Pertamina Geothermal Energy, Jakarta, shared some advice about how to make projects work. He has been involved in over 2 GW of geothermal energy installations over a 43 year career.

Mr Sarmiento's first projects were with the state owned Philippine National Oil Company, so it was in effect the government supporting the work.

A particular area of interest is geothermal projects near volcanoes, known as "volcano hosted geothermal systems". There may still be magma in the subsurface. The magma may be 6km deep, but if the rock is permeable, heat will be able to transfer upwards in water. There needs to be enough water to carry the heat, and preferably not water with any acidity or alkalinity. There needs to be a caprock, to limit how far the water can flow upwards.

The prospects being developed are generally 250 to 300 degrees C, at the point where the well meets the hot water, which is high enough to make a project work based on electricity sales, if the electricity price is high, he said.

The sequence of project development is similar to conventional well construction. You start by reviewing prospects, then proceed with subsurface surveys, and if you find something which looks viable, find out for sure by drilling.

Most of the risk happens in the exploration stages, where there can be ambiguities in interpretation of results.

Typical capex costs are $4m per megawatt, of which 30 per cent is on drilling. A typical cost of wells in Indonesia is $4m to $6m. The power plant, which converts the heat to power, is a further major expense.

The survey work will typically look for where volcanoes have existed, and if any wells in the region have already been drilled. You will also consider access to the site by road, and distance to a power transmission line. You consider the grid electricity price. You look at environmental risks, such as if it is in a national park, or there are indigenous people. You see if there are government incentives.

The subsurface modelling work can include trying to characterise rock structures using satellite images.

Magnetotelluric (MT) surveys (inferring the earth's subsurface electrical conductivity) are "most reliable" in delineating the lateral and vertical extent of permeable reservoir, he said. Salt water is a good conductor of electricity, and so will show on the MT survey. Although it does not tell you if the water is hot, or if the reservoir is permeable enough.

Sometimes seismic surveys and micro seismic monitoring are also used. Some companies do thermal gradient modelling. They also analyse areas with high levels of gas. "To tell you frankly, most of what we do, we adopt from the oil industry," he said.

Volcanic areas don't tend to have high acidity levels in the water, except close to the crater. "You need to assess the area thoroughly to identify the acid potential of the resource," he said.

Typically, A minimum resource area that can be developed ranges from 3.5 to 6.5 km2, with a capacity of 30-50 MW per well. Generally companies plan 2-3 exploration wells with an objective of 50 to 100 MW in total.

The top of the "reservoir" is the caprock. This is where the water is no longer flowing upwards due to the low permeability of the caprock, but is able to flow horizontally.

Eventually you can make a resource assessment, and a financial pre-feasibility study for the whole project, to justify the costs of bringing in a rig. You have to decide what depth to drill to and what size hole.

Some people drill "slim" holes because they think it saves money. But often "it's only cheaper by 20-30 per cent" – and comes with downsides of trickier drilling and lower production rates. "We had experiences where we had to drill 11 of these holes before we reached the outflow zone, due to results we relied on with slim holes," he said.

A typical specification for a geothermal well has a 30 inch conductor to 100m, 18 5/8 inch casing to 200m, 13 3/8 anchor casing to 400m, 9 5/8 inch production casing to 800m, and 7 inch to 2200m. The full depth can be 3000m.

Some water won't flow naturally into wells which have been drilled, due to low temperatures or low permeability, wells getting damaged with mud during drilling, or cold temperatures at the top of the casing. Mr Sarmiento has experimented with compressed air, steam injection with portable boilers, and gas lift to get hot water out.

In terms of the financials, project teams typically look for a minimum 14 per cent internal rate of return, although it could be as much as 30 per cent. It is helpful that the price of electricity has been very high in the Philippines in the past, although the price is lower now, because the price of coal is low, he said. A typical power purchase agreement in the Philippines is around $0.12 / Kwh, sometimes indexed to the price of coal.

Karl Farrow, CeraPhi Energy

CeraPhi Energy, based in Great Yarmouth, UK, has developed technology to repurpose oil and gas wells or failed geothermal wells to produce clean energy. The technology is applied under an energy development agreement on a licensing basis. Its founders coming from a background in the oil and gas industry.

CeraPhi's uses its proprietary technology together with proprietary fluids in its closed loop system, whereby the fluids are circulated down the well from the surface through a custom designed close loop system, utilising only the bottom hole temperature from the existing well, the heat is transferred to a secondary system on the surface using a binary cycle principle.

The CeraPhi system eliminates the need to seek subsurface hydrothermal systems as in conventional geothermal and removes the need to produce these fluids which in turn removes the risk of environmental contamination and the controversial use of subsurface water which is a natural resource itself. Not needing subsurface fluids removes the need for hydrofracturing or hydraulic stimulation which has been associated with seismic activities under similar condition as fracking, this process is eliminated using CeraPhi system.

CeraPhi is involved in one project with a North Sea operator focused on extracting thermal energy from a normal production well which are now non-productive and entering decommissioning and abandonment phase. The project involves the reuse of field wells to produce thermal energy aimed at supporting the provision of clean energy to the facility to help the operator reduce its carbon emissions by up to 20%.

Re-using oil and gas wells makes a lot of sense, says Karl Farrow, Founder and CEO. "A lot of money was sunk into these assets in the past. It seems a shame to poor concrete into them. Every well has thermal energy and to be able to commercially harvest this thermal energy using the principles of Geothermal means you can support Oil and Gas operators create a natural energy transition using skills and resources from the industry and make this part of your energy transition."

It can be easier to monetise geothermal wells if you can sell or utilise the heat directly, rather than convert the heat to electricity, he said. The company envisages a "cascade" of utilisations, with heat at different temperatures being used for different purposes, with hot water flowing from one to the next as it cools.

For example, CeraPhi is working on one well site with three wells aiming to generate around 250 kW electricity. and 3MW thermal, with a 94 per cent efficiency. Using a Combined Heat and Power system, whereby the primary heat would be used for residential heating equivalent to >470 homes, and the secondary heat applied to a climatised agricultural glass house agricultural food production.

The economic model for this type of project over a long-term Power and Heat Purchase Agreement "PPA/HPA" could generate revenues of >£8m for power, >£22m from heat sales >£26m from sales of climate-controlled food products from agriculture production, not to mention the >£1m for deferred / avoided decommissioning costs.

Against an initial CAPEX of £0.5m for well surveys, £8m on intervention and topside packages (CAPEX) with an O&M cost over 20 years estimated at approximately £4.8m.

That means a potential profit over 20 years of £35.8m.

"Probably 95 per cent of [oil and gas] wells around the world show usable heat that can be used and made commercial under the right conditions and circumstances," he said.

By working with wells which are already drilled, rather than seeking to drill new ones, much of the risk of a geothermal project is removed. "We look at these like exploratory wells pre-drilled," he said.

The right way to develop geothermal projects could be to develop modular technologies, with a standard model of "plug and play", and where it is easy to re-use equipment on different wells, he said.

"We've been working with lots of operators and partners, making the right structure of costs to make this work."

The CeraPhi well technology also enables the production of clean thermal energy production at the same time as hydrocarbon production, meaning this can provide a suitable medium to support the decarbonisation of site operations and or addition revenue stream and a clean energy transition which can be built into an exploration development plan in advance.

This means an asset could be designed to last >100 years shifting from an emission's free hydrocarbons production phase to a clean thermal energy phase in a sustainable commercial transition, he said.

The key to this is to look at private wire offtake where you do not necessarily need to connect the power generation to a grid but provide a scalable 'microgrid' solutions, which involves a provider and user of the energy, he said.

CeraPhi has come up with project plans which have a levelised cost of ownership (cost over the lifecycle of the installation) of less than wind and solar in some areas," he says. "It is about scaling and getting the right combination together. It can't be applied everywhere, or in all situations."

Another possible and ambitious approach is the ability of converting large scale infrastructure like coal or gas fired power plants to geothermal, where existing large-scale infrastructure and consumers are already normally in place and whereby you are just changing the feed stock, instead of burning fossil fuels to create thermal energy it is provided directly from geothermal.

Size of the market

CeraPhi counts that there are 560 UK onshore oil and gas wells in various stages of production, of which 163 are in "phase 1 abandonment" – not yet filled with concrete, yet not producing.

If all of these wells were converted to geothermal wells, it would create £30m of revenue from sales of heat or power generation. "On average, with our modelling, any well can produce about 0.5 MW of heat," Mr Farrow said.

If the hot water downstream of the power generation stage, at about 30 degrees C, can be resold, such as for residential heating, it could potentially provide 1.2 MW, or about £60m a year.

This calculation is based on the estimated price of decarbonised gas heating, at £50 per MW, and on the basis that heat is only needed for 6 months a year.

If the cost of hydrocarbons rises, either due to carbon taxes or commodity prices, selling geothermal heat will become more attractive, he said.

Globally, there are 10m onshore oil and gas wells drilled, of which 1.7m are in the US, with a further 50,000 new wells a year. Together they could provide 60 terawatt hours of heat per year, worth £3bn, he says.

Greg Coleman, Future Energy Partners

Greg Coleman, CEO of consultancy Future Energy Partners, says he has noted many oil and gas professionals showing interest in moving into geothermal energy. "It's a natural transition," he said.

The oil and gas industry has many competencies relevant to geothermal, including drilling, product management, managing capital, and decision making based on limited information. Some of the same environmental issues apply in geothermal as in oil and gas drilling, such as getting permits to drill and relationships with local communities.

And the oil and gas industry is used to working with high temperature fluids, or fluids which have high levels of salt, or acidity.

There are some differences. Geothermal energy uses a different range of exploration techniques, such as magnetotellurics (MT) to track subsurface salty water, which is not so widely used in oil and gas exploration.

The market for geothermal is very different to oil and gas, being very localised, and local markets may pay different energy prices.

Mr Coleman is involved in a number of energy projects in East Africa, which has a huge need for new sources of energy, including to provide electricity for air conditioning, he said. Kenya already produces 800 MW of electricity from geothermal. Otherwise, it can only generate power from hydroelectric or diesel generators.

One study claimed there was 15 GW of geothermal potential in East Africa, he said, "which isn't huge, but it's a lot more than they have right now."

Analysis from the International Renewable Energy Agency (IRENA) on levelised costs of energy found that the cost of geothermal have actually risen over the past 10 years, from $0.049 to $0.073 per Kwh, while solar and wind are going down "quite dramatically". But geothermal can still provide baseload power, unlike solar and wind.

Mr Coleman's own analysis looked at areas of the world which have both high near surface temperatures (such as 200 degrees C) and high electricity prices (>US$0.12/ kwh), The most promising places on this basis were Italy, Philippines, Kenya, Tanzania and Uganda.

But government incentives change the analysis, for example the Ethiopian government was offering to buy geothermal electricity for US$0.07 / kwh which it resold to the public for 1.9 cents.

There is a "Geothermal Risk Mitigation Facility for Eastern Africa" (GRMF) which has grant money available for studies, exploration wells and some infrastructure. https://grmf-eastafrica.org/, It is intriguing that the money is labelled as for risk management rather than development itself. This may imply that while there are development funds available from other places, de-risking is the main challenge, he said.

The risks are not just subsurface. There is a foreign exchange risk, if you are making dollar investments but selling heat in local currency. There are risks of changes from governments, such as license cancellation or project nationalisation. There is liquidity risk, that your incoming funds are not enough to pay suppliers, such as from late customer payments.

The cost of capital "is zero in some parts of the world, and in other parts it is very high."

In some parts of the world the price of electricity is fixed by government, and in other parts of the world it is on a market, which means that geothermal providers can stand to make big profits in a time when other sources of power generation are inoperable. For example, there was a story of a person in Texas whose home electricity bill rose from $90 a month to $8000 in a week during recent power shortages, Mr Coleman said.

"My conclusion is the opportunity exists and should grow," he said. "We need more capability / talent. And oil and gas professionals have a lot to learn, they shouldn't assume they can go from being a geologist to a geothermal professional."