Dolphyn as an example of Capacity Building

What is Dolphyn?

Dolphyn is an innovative process designed to produce "green" hydrogen on a large scale.[1] The acronym stands for "Deepwater Off-shore Local Production of Hydrogen". Under the proposed design for this project, hydrogen is produced by desalination of sea water (removal of salts and minerals) and splitting of water into hydrogen and oxygen via electrolysis. A floating off-shore windfarm will power the electrolysis, making the production process carbon neutral at point of production. Analysis has indicated that producing hydrogen off-shore and transporting it back to shore could be cheaper and more efficient than producing hydrogen onshore with electricity generated off-shore.

The lead partner for the Dolphyn project during Phases 1 and 2 of the first Low Carbon Hydrogen Supply (HS) programme was ERM, a management consultancy specialising in sustainability.

Under Phase 1 of HS, ERM evaluated the technical and economic feasibility of alternative designs for off-shore low-carbon hydrogen production at either a centralised or decentralised facility. They also produced a Front-End Engineering Design (FEED) for a smaller-scale (2 MW) prototype of the strongest design option[2] (the FEED stage is a basic engineering phase involving creating initial drawings that can then be used as the basis for estimating the costs of constructing the prototype).

To deliver the additional design work funded under Phase 2 of HS, ERM engaged several sub-contractors from related industries such as oil and gas, renewables, chemicals, hydrogen production, energy, construction, trading, and marine operations.[3] Phase 2 work on the Dolphyn process included: 1) further developing the 2MW prototype design and 2) a pre-FEED design for a commercial-scale (10 MW) version.[4] In Phase 2, ERM also identified the Kincardine off-shore windfarm field near Aberdeen as a potential location for a Commercial Scale Demonstration, Kincardine being a consented site deploying similar technologies to those planned for the first Dolphyn production unit.

Dolphyn as an example of building capacity in the emerging hydrogen economy

This case study explores how involvement in the Dolphyn HS project has enhanced the ability of private-sector partners to work in the area of hydrogen. It also considers how the project has

[1] "Green" hydrogen, by definition, does not require carbon capture and storage (in contrast to "blue" hydrogen produced from steam methane reforming (SMR) of natural gas).
[2] Dolphyn Hydrogen, Final Report (Phase 1b – FEED for 2MW Scale Prototype), 9 October 2019
[3] ERM Dolphyn Hydrogen Phase 2 - Final Report, 2 July 2021
[4] ERM Dolphyn Hydrogen Phase 2 - Final Report, 2 July 2021

fostered collaboration between private-sector organisations operating in hydrogen technology. In addition, the case study looks at how the Dolphyn HS work has laid the foundation for future cooperation with other private sector companies and academics looking to move into hydrogen.

The case study primarily draws on an interview with the lead for the Dolphyn HS project and an interview with one of its main subcontractors for the Phase 2 work of HS, Tractebel ENGIE, an engineering company focusing on carbon-neutral energy sources. The case study also references the two reports ERM produced for Phases 1 and 2 of HS, wider dissemination materials, and media coverage of the Dolphyn project.

What motivated the Dolphyn project team to participate in an HS project?

For ERM – a company specialising in providing management consultancy in sustainability – leading the Dolphyn HS project work was a strategic move.[5] ERM did not expect any immediate economic return from the project work itself. Instead, they anticipated that the knowledge attained from direct involvement in developing new hydrogen technology support future business development.:

> *"…it has enabled us to grow a UK hydrogen consultancy business off the back of the learnings and provided the status that comes from being involved in a high-profile project like this."* (Dolphyn HS Project Lead)

The company has also found that the publicity generated from the project has raised its reputation within the emerging hydrogen energy sector. The lead for the Dolphyn project explains:

> *"ERM, as a company, is a consultancy first and foremost [but] in the case of this first-of-a-kind project, we are also a technology developer. It might appear an unusual place for us to be …as a consultancy, but ERM's primary goal is to maximise impact, and it is therefore a logical step for us. The project is BEIS funded with no profit, it's a development project, so the payback period is tens of years. So why are we doing this?' Well, we're doing this to build a hydrogen team and, through that team, to drive growth in a key net zero demand market. We have achieved those aims."* (Dolphyn HS Project Lead)

The project sub-contractors involved in Phase 2 of HS were subcontracted to contribute to the design work for the combined electrolysis and windfarm prototype. This provided clear incentives for them to build their knowledge of hydrogen projects and work on a leading first-of-a-kind innovation. Reputational benefits also played a large part in their decision to take on the project. For example, the Tractebel team partner felt that the HS design work had lent

[5] Since 2022, ERM has sought to make Dolphyn distinct from its main consultancy business by setting up Dolphyn Hydrogen as a separate subsidiary company of ERM. This new company will lead the follow-on demonstration and implementation work for the Dolphyn project commissioned under the second round of HS funding (HS-2).

additional external credibility to their company's existing track record of developing engineering solutions for renewable energy sources:

> *"We do have a couple of [similar] innovations running…[where] we invest[ed] ourselves… [such as] centralised off-shore hydrogen...[and] off-shore solar energy. So [in terms of] our overall reputation for being innovative, [Dolphyn]…is a unique reference in our… portfolio…because…Dolphyn is one of the rare [projects] where we get paid…where we have a client and where someone chose us. So, commercially speaking, that is worth a lot more."* (Project partner, Tractebel ENGIE)

Key finding: Due to the innovative nature of the technology, companies who have prior experience of developing hydrogen production designs often have to self-fund this work. Public funding may encourage external private investment by acting as a signal of the future value of this technology. In addition, being involved in a publicly funded project such as HS can help raise the profile of these companies' hydrogen expertise.

To what extent has the Dolphyn project improved collaboration between private sector companies with expertise in renewable energy?

As a consultancy breaking into a nascent hydrogen market, ERM's independent status enhanced the extent to which knowledge was shared between different organisations during the Dolphyn HS project. To bolster its in-house capacity to deal with complex aspects of designing the off-shore project, ERM engaged multiple subcontractors in a highly collaborative way, as the Dolphyn HS project lead explains:

> *" Our suppliers and sub-contractors, from Phase 2 onwards, have been an integral part of the design team. They are on the inside rather than us reaching out and saying, "Hey, if you could do this innovation, that would be great."… [In contrast to our] standard supply chain…they are a central part of our team."* (Dolphyn HS Project Lead)

A senior member of the Tractebel team observed that, in their experience, cooperation between multiple private sector organisations working in renewable energy is typically discouraged, so the Dolphyn project had provided a rare and valuable opportunity for these organisations to work together:

> *"...one of the best collaborations we have [is] with…ERM…it's also one of the rare collaborations we have with ODE and with the other [partner organisations]… because in this project, we are, in a way, obliged to collaborate [with ERM and the other partners], which is not always the case. Typically clients…prefer to put as much as possible in one basket..."* (Project partner, Tractebel ENGIE)

The Dolphyn HS project lead also felt that the exposure gained from the HS work had laid the foundation for building future private-sector collaborations in the hydrogen sector, including partnering with large energy companies:

"All of the effort that we're investing in commercialisation has come about because of the high level of interest around the Dolphyn within the energy developer community. This interest has been broad and has been building quickly. We are now talking regularly to many of the largest established energy companies and some of the more innovative startups and new market entrants. -…[Our] conversations are very much focused in identifying opportunities for developing collaborative projects. Our discussions are about partnering to deploy Dolphyn commercial-scale projects rather than just providing advisory support or technical services.

A lot of these energy companies have off-shore windfarms with no grid connection, and hydrogen provides a very interesting route to market. This provides a real opportunity for Dolphyn and the energy market more generally. Without this BEIS funding, we wouldn't be where we are in terms of those conversations. So, I think the main bit that's come out of it [the HS project] is the upcoming pipeline of commercial-scale projects and the relationships we [have] got [into] with those [future projects]." (Dolphyn HS Project Lead)

Key finding: Public funding can be crucial in encouraging outsider companies to enter the hydrogen sector. As Dolphyn illustrates, this outsider status will necessitate building a novel broad coalition of private sector partners to deliver not only the technical work. This, in turn, helps the nascent hydrogen industry accelerate more quickly than would otherwise be the case.

How has the Dolphyn HS project fostered future collaboration between the private sector and academia?

The Dolphyn HS project lead felt that the funding from HS Phases 1 and 2 had allowed ERM to apply for patents for the core design more quickly than they would have otherwise. Having these core patents in place has, in their view, removed the commercial risk of involving universities in follow-on projects, such as the second HS programme. (A barrier to industry-academic collaboration in areas of technological innovation, such as hydrogen, is that universities will usually seek to own the resulting intellectual property in return for their contribution to the project). The ERM lead explained that with these initial patents already in place, ERM would be happy for universities to take intellectual ownership of more minor technological innovations that follow:

"…we have good relationships with a number of universities, and we're actively talking to them about…[follow-on] projects and funding research with them. Because we're now at a point where we know the commercials, we've got our investors lined up, and we've got our patents in place. So, commercially, we have strong foundations to build on.

In practical terms, there's a real benefit to us going to universities and saying, 'We now know the bounds that we're working within, help us optimise our process and help our supply chain innovate. We don't want to be manufacturing some new kind of vessel that's perfect for this. We are happy for the University to own the arising IP, provided you issue a license to use the IP for future development of Dolphyn.' (Dolphyn HS Project Lead)

Key finding: Publicly funding the initial stages of a hydrogen supply project can accelerate the process of acquiring patents. The existence of patents then removes the potential commercial barriers to a private developer bringing academic and other partners on board.

How did the Dolphyn HS project improve the supply chain for follow-on projects?

The Dolphyn project lead noted that the publicity generated from the public funding that Dolphyn received under HS has helped make potential suppliers aware of the growing hydrogen market. They explained how many of these suppliers were already keen to be involved in low-carbon projects and contacted ERM once they learned about the HS work:

> *"The key area in which public funding has worked, has been with supply chain engagement and development. So, we've had hundreds…of suppliers of pipes, pumps, gaskets, widgets…[and] all of the [other] bits that you need to build this sort of thing...*
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> *…All of that supply chain [is] mostly in the UK [and currently supplying] the oil and gas sector or the off-shore wind sector. We've had a really good gradual drip feed of people saying, 'Hey, we've read this; by the way, we manufacture this for the oil and gas industry…We'd love to move into low carbon. Do you mind putting us on your supply database so that when it goes out to tender, we get an option to bid into it?' So that has been great.*
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> *That database has been building over the last few years and is now into the hundreds, maybe 500 or 600 suppliers across the UK."* (Dolphyn HS Project Lead)

Key finding: The publicity generated by government funding of hydrogen supply projects can raise supplier awareness of the emerging opportunities being created by hydrogen.

What was Dolphyn's impact on jobs and skills within ERM and the other organisations in the project team?

For ERM and its team, while not creating entirely new additional jobs at this stage, involvement in the Dolphyn HS project has resulted in a substantial redeployment of existing staff towards hydrogen, which sets the platform for future job creation, especially through future deployment and commercialisation:

> *"Within ERM, we have around 50 people currently working on the project with similar support from a number of contractors. [We] estimate around 150 people total." (Dolphyn economic data form)*

A consequence of this redeployment is the new hydrogen-specific knowledge that the staff from ERM and the other organisations in the team have gained while working on the Dolphyn

HS project. In all cases, this has improved the capacity of the organisations involved to work on future hydrogen projects:

> *"[We have] Between 5 to 10 experts and project managers in-house that are involved in this project, and for most of them, it is the first time they actually looked into this combination of technologies. Most of them have been heavily involved in off-shore wind, even floating wind, but never touched upon hydrogen…all of them…have [now] widened their technical knowledge."* (Project partner, Tractebel ENGIE)

> *"So, we've now got around 120 hydrogen specialists in the UK, and that is now ERM's global specialist capability for hydrogen…the UK was a bit ahead [compared to] many other regions in the world, and the skills and expertise we've got in the UK from supporting projects like Dolphyn mean we've got a lot of people with very transferrable skills that could work on those projects around the world."* (Dolphyn HS Project Lead)

The interviewee from Tractebel did note, however, that delays in securing follow-on funding presented a barrier to retaining staff after the project. They explained how the length of time that it took to confirm that Dolphyn had been awarded follow-on funding for off-shore demonstrations under HS2 had led to an unfortunate and, in their view, unnecessary loss of expertise:

> *"… [continuity of] resources…is really crucial…[for] keeping those skilled people on board…otherwise you've built up skills [in staff] who are then gone and not always [to somewhere also in] the off-shore hydrogen scene. Some [people] they don't care. They go to nuclear [energy], [or] they go to something else…that is really a waste of the [HS] investment…"* (Project partner, Tractebel ENGIE)

Key finding: Public funding can provide an incentive for private companies with a pre-existing interest in hydrogen to allocate more of their resources to working in this area. Designing programmes to allow for continuity of funding can help to ensure knowledge and skills and retained and built upon, increasing the impact and societal benefits of the initial investment. This sets the platform for job creation through deployment and commercialisation.

How has HS led to an expansion of subsequent hydrogen-focused projects?

As a consultancy, the technical knowledge gained via the Dolphyn project has enhanced ERM's capacity to assist existing energy companies in maximising the impact of their transition efforts. For example, in March of 2023, ERM prepared a scoping report for SEE Thermal as part of an Environmental Impact Assessment of SSE Thermal's proposed "Hydrogen Pathfinder" project in East Yorkshire.[6] This project aims to use electrolysis powered from renewable sources and store the resulting green hydrogen in local salt caverns previously used for storing natural gas.

[6] https://www.ssethermal.com/media/oxpnhbpc/aldbrough-hydrogen-pathfinder-environmental-impact-assessment-scoping-report.pdf

ERM has also seen increased demand for its consultancy services due to its first-hand technical experience of developing hydrogen technology, which led to the company purchasing several smaller consultancies with expertise in low-carbon energy.[7]

The success of the Dolphyn project under HS has also led to ERM making a more long-term commitment to developing hydrogen technology. In 2022, the company opted to create a subsidiary company that would be able to focus exclusively on the technical development and commercialisation of the Dolphyn project:

> *"Dolphyn (Hydrogen) is now its own company. It's being spun off as a non-consulting business to focus on technology supply development and commercialisation of the Dolphyn process. ERM is a consultancy, not a developer, but Dolphyn Hydrogen can work with a range of developers to develop the industry and grow low carbon hydrogen to meet net-zero needs more quickly and at scale."* (Dolphyn HS Project Lead)

ERM's decision to create a separate legal entity for its technological and commercial development work is significant, as it shows that HS has had a knock-on effect of encouraging new entrants into the emerging hydrogen market. Without the HS funding, ERM would have been unlikely to have branched out into the actual deployment of commercial hydrogen projects as, even with the public funding, some parts of the business had reservations about taking on a non-consultancy project prior to funding being provided:

> *"I'll be honest; it took a bit of selling internally to get approval to move into new areas of business outside of ERM's core domain. The funding support and the early development work it enabled provided the confidence needed to make this important step."* (Dolphyn HS Project Lead)

Key finding: Public funding can encourage new entrants into the emerging hydrogen economy by removing commercial barriers to working on a development project for the first time. If the funded project is successful, these new entrants may feel confident to permanently reallocate some of their resources towards developing hydrogen supply solutions.

What lessons can be learned?

The Dolphyn project illustrates how government funding of hydrogen supply projects can encourage new entrants into the hydrogen market. Although it might appear counterintuitive to have a lead partner from a related sector who has not previously embarked on developing hydrogen technology, this model can have advantages. In this situation, the lead partner plays an essential coordinator role, driving and enlisting the support of numerous partners to complete the work. This setup increases the number of organisations learning from the project.

In addition, it seems that the high profile of the funded work is useful for attracting other potential partners from the energy sector and academia, meaning that future projects will likely benefit from an even stronger coalition of partners. New markets need collaboration to achieve rapid growth.

[7] https://environment-analyst.com/global/107332/what-the-low-carbon-economy-transition-means-to-erm

The Dolphyn case also shows how public funding can provide a prompt to reallocate private company resources towards hydrogen. Following the success of the Dolphyn HS work, the lead partner decided to embed their coordinator role and set up a subsidiary company to lead similar development projects. In this respect, HS funding has had a knock-on effect of expanding the pool of organisations that can successfully lead projects to develop new hydrogen technology.

In addition, Dolphyn demonstrates how having a non-traditional lead partner can broaden the type of impact government funding has on the hydrogen sector. In its other role as a consultancy, ERM has used the knowledge acquired from the Dolphyn project to advise energy companies undertaking their own work to switch to hydrogen.

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