

Re-use & Decommissioning report

The power of collaboration

2022

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Preface



Jacqueline Vaessen
General Manager Nexstep

I am honoured to write this preface to the fifth Re-use and Decommissioning report, which I consider quite a festive moment. Unfortunately, circumstances in the world are not all festive. After being released from most of the COVID-19 restrictions and getting ready for return to a 'new normal', the world was shocked by the Russian invasion of Ukraine. This war affects us all, mostly of course all the victims of the war in Ukraine, but we feel it in the entire world, for example in the tremendous increase in prices for oil and gas. It once again stresses the importance of domestic oil and gas production, therefore exploration and production in the North Sea will remain important for our energy mix.

This report gives an overview of the oil and gas infrastructure that is forecasted to be decommissioned during the next decade. Looking into the future, we once again see a slight shift of decommissioning. This can be explained by the difficult years 2020 and 2021, with extremely low prices, the COVID-19 pandemic, and the problems with restrictions on emissions of nitrogen-based compounds which delayed or restricted decommissioning activities. We do however see a transformation in this pattern. In 2022 several decommissioning activities are taking place and we'll highlight some of them in this report.

// Collaboration became the guiding principle for our activities within Nexstep //

I am happy that after years of preparation the joint campaign contract for decommissioning of Mud Line Suspension wells has been awarded in January this year. This is a major achievement for Nexstep and a breakthrough being the first project worldwide in which so many operators will jointly decommission wells. It is a perfect example of Nexstep's role in facilitating and stimulating effective and good value decommissioning. I am grateful to everyone who worked so hard to make this possible.

The title of this report is "The power of collaboration" and the joint campaign is an excellent example of this. Collaboration became the guiding principle for our activities within Nexstep. And we have shaped that collaboration in many ways; in our collaboration with the heavy lifters that led to the portal, in the joint trials for Through Tubing Cementation, in the joint search for the hydrogen pilot, in the collaboration with NOGAT and NGT for the comparative assessment et cetera.

Since the beginning of Nexstep we have organised shared learning sessions and the database now contains over 350 learnings. Shared learnings are a valuable asset to the industry, but it would be even better if we could incorporate lessons learnt in a decommissioning project still in preparation. Therefore we started the Peer Assist initiative. You can read all about it in this report. It promises to be a valuable tool.

I will no longer be writing this preface, as I will be leaving Nexstep after the handout of this report. Looking back on the past four and a half years I can say that we have come a long way. So many achievements, and we achieved that all together!

Thanks to everyone I have worked with in the past years and who helped bring Nexstep to where it is today. I feel confident that Nexstep will thrive in the years to come, and I will be following it closely.

Jacqueline Vaessen
General Manager Nexstep

**// Thanks to everyone I have
worked with in the past years
and who helped bring Nexstep
to where it is today //**

Nexstep Factsheet

Decommissioning in the Netherlands

status December 31, 2021

Operational infrastructure offshore

Gas platforms	Oil platforms	Subsea installations	Wells	Pipeline (kms)
106	12	16	411	3069

Suspended infrastructure offshore

Gas platforms	Oil platforms	Subsea installations	Wells	Pipeline (kms)
32	3	3	260	661

Decommissioned infrastructure offshore

Gas platforms	Oil platforms	Subsea installations	Wells	Pipeline (kms)
26	6	12	781	803

Decommissioned infrastructure offshore 2021

Gas platforms	Oil platforms	Subsea installations	Wells	Pipeline (kms)
0	0	2	20	239

Offshore infrastructure forecasted to be decommissioned 2022-2031

Gas platforms	Oil platforms	Subsea installations	Wells	Pipeline (kms)
84	9	15	452	1924

Operational infrastructure onshore

Well locations	Processing locations	Other locations	Wells	Pipeline (kms)
198	33	87	609	1757

Suspended infrastructure onshore

Well locations	Processing locations	Other locations	Wells	Pipeline (kms)
129	3	21	422	688

Decommissioned infrastructure onshore

Well locations	Processing locations	Other locations	Wells	Pipeline (kms)
37	6	27	1411	140

Decommissioned infrastructure onshore 2021

Well locations	Processing locations	Other locations	Wells	Pipeline (kms)
0	0	6	9	0

Onshore infrastructure forecasted to be decommissioned 2022-2031

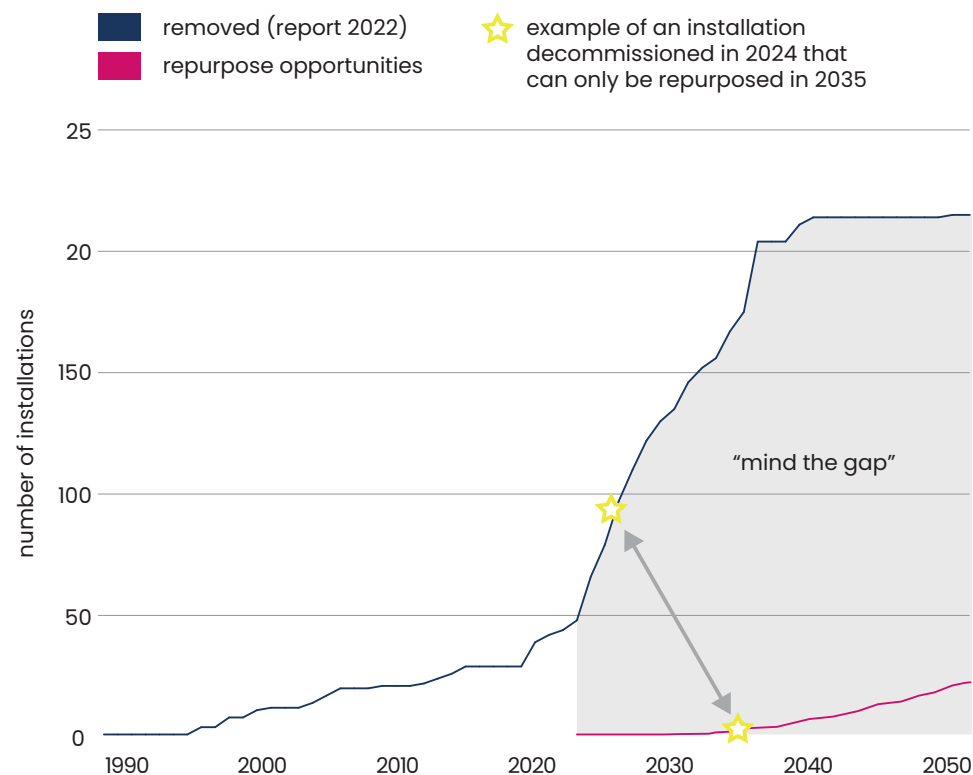
Well locations	Processing locations	Other locations	Wells	Pipeline (kms)
161	10	78	490	955

Nexstep Factsheet

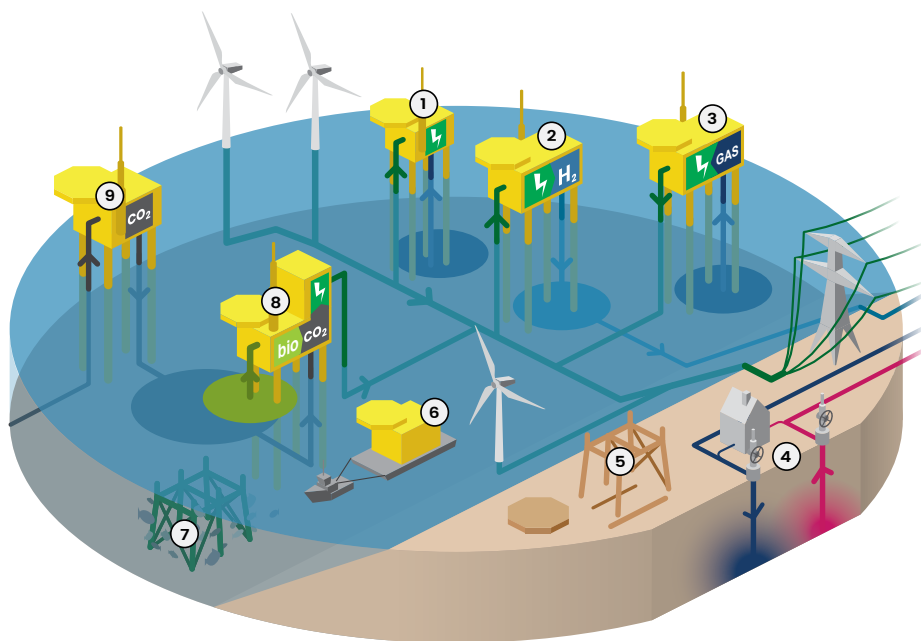
Re-using / repurposing oil & gas infrastructure

The Netherlands is facing an ambitious challenge to meet the targets of reducing its CO₂ footprint and to transition towards a sustainable energy system. In some instances there will be opportunities to re-use or repurpose existing oil and gas infrastructure to accelerate the energy transition. In practice, the decommissioning of the infrastructure would be earlier than the demand for re-use or repurpose. Approximately half of the infrastructure offshore is scheduled to be decommissioned in the next decade. It is important now to determine which infrastructure can contribute to the energy transition and to ensure that this infrastructure is not decommissioned prematurely, preventing unnecessary future investments.

Number of installed and removed offshore installations



Investigated options for re-use/repurposing of infrastructure:



- | | |
|--------------------------------------|---------------------------|
| 1 offshore electrification | 6 relocation |
| 2 production and storage of hydrogen | 7 rigs to reef |
| 3 gas to wire | 8 biomass production |
| 4 geothermal | 9 CO ₂ storage |
| 5 recycling | |

Of the 34 platforms that have been removed, 15 were re-used for hydrocarbon production:

Platform	Installation year	Operator	Re-use year	Re-used for
E18-A	2009	Wintershall Noordzee bv	2019	D12-B
K10-C	1981	Wintershall Noordzee bv	1997	Q04-A
K10-V	1993	Wintershall Noordzee bv	2005	L05-C
K11-B	1995	Neptune Energy Netherlands bv	2005	G14-A
K12-A	1983	Neptune Energy Netherlands bv	2006	K12-K
K12-E	1986	Neptune Energy Netherlands bv	2005	G16a-A
K13-D	1978	Wintershall Noordzee bv	1987	L08-H
L10-G	1984	Neptune Energy Netherlands bv	1988	L10-L
L10-K	1984	Neptune Energy Netherlands bv	2000	L10-M
L11a-A	1990	Neptune Energy Netherlands bv	1999	K09ab-B
P02-NE	1996	Wintershall Noordzee bv	2001	Q04-B
P02-SE	1997	Wintershall Noordzee bv	2002	P06-D
P06-S	1997	Wintershall Noordzee bv	2013	Q01-D
P14-A	1993	Wintershall Noordzee bv	2008	E18-A
Q01-Helder-B	1986	Petrogas E&P Netherlands bv	1989	Q01-Haven-A

In addition to re-using oil and gas platforms on other locations for the same purpose, infrastructure may be repurposed. It is estimated that some 10% of the infrastructure may be re-used/repurposed.

Current repurposing projects:

PosHYdon pilot	Production and transportation of green hydrogen on Neptune Energy's Q13a-A platform
Storage of CO ₂	Porthos / Aramis
GZI Next	NAM's repurposing of onshore gas treatment installation to new energy hub in Emmen

1 Decommissioning & re-use

Nexstep's fifth annual report is launched in a year in which activities have started to return to normal, although following the Russian invasion in Ukraine the importance of the security of supply for energy and materials became evident. Besides the shocking impact on many people, the effect on the energy market is tremendous. Energy prices have increased significantly and have become very volatile. A request to the E&P companies to expedite the development of domestic hydrocarbon resources goes hand in hand with an urge to accelerate the energy transition.

Obviously, higher prices for oil and gas, and efforts to develop more resources will have a dampening effect on the activity levels for decommissioning and re-use. Even without these effects a noticeable shift in decommissioning activity can be seen, as this report provides the status and forecast as per the end of 2021. From the start of Nexstep reporting on, we see such shifts occurring each and every year. Although delayed by a couple of years, we now do see evidence of an increasing decommissioning activity.

Sharing learnings

Operators have embraced the shared learnings sessions during which the do's and don'ts of executed projects are being discussed. Also, a number of Peer Assist events have been organised in which a planned decommissioning project of an operator was presented to other operators for their early input in the design phase. The learnings are captured in the shared learnings database available to Nexstep members.

Joint campaigning

In January 2022, after almost three years of intense preparations, finally a contract has been signed by six Dutch operators and Oceaneering for the Joint Well Campaign to decommission at least

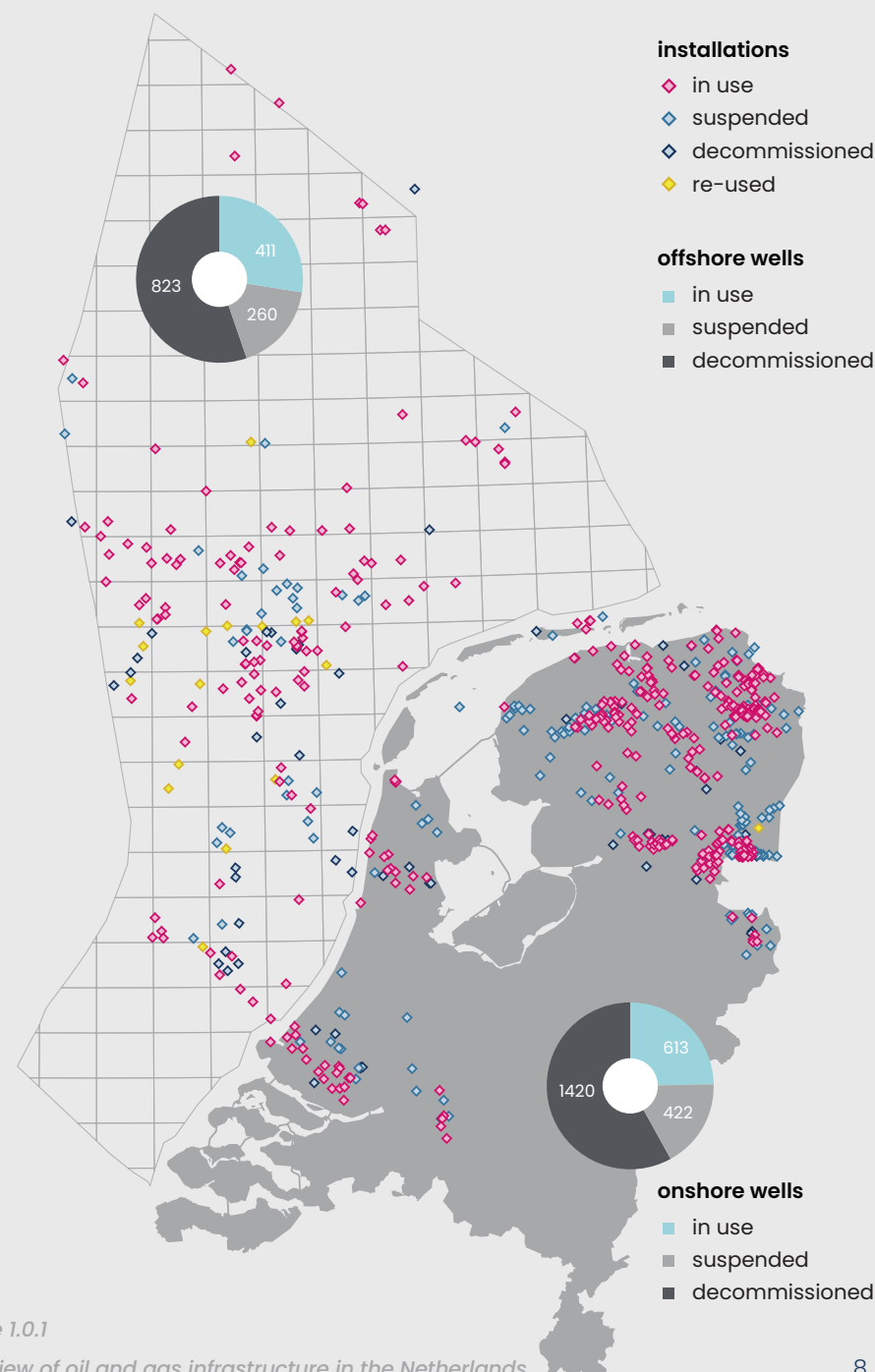


Figure 1.0.1

Overview of oil and gas infrastructure in the Netherlands

24 mud line suspension (MLS) wells in the Dutch part of the North Sea. The campaign consists of a seabed survey in April 2022, which was efficiently completed in half the planned time. This will be followed by conductor clean-out in the second and third quarter of 2022 and the actual decommissioning in 2023. The work will be carried out from a vessel with special equipment to safely remove old drilling fluid from the annular spaces of a number of wells. The seabed survey also covered a number of additional wells that may be added to the 2023 decommissioning scope.

A next campaign for remaining offshore MLS wells will be investigated using a drilling rig or work platform. Also, opportunities for a joint campaign to remove offshore platforms are on the agenda. Several operators have already initiated or even contracted larger campaigns within their own portfolio. Wintershall Noordzee has started an offshore campaign to decommission 24 wells using the Swift-10 rig. TotalEnergies and Petrogas have jointly contracted a jack-up rig to decommission 31 wells. Later this year Neptune Energy will start a decommissioning campaign of 24 wells. Onshore, NAM is decommissioning seventy wells with a purpose-built modular unit, and will decommission and restore the locations when re-use is not a feasible option. The increase of scale and the learning curve of such repetitive operations are expected to significantly reduce the cost of decommissioning.

Major milestones

With regard to re-use, a major milestone this year will be the final investment decision for the Porthos CO₂ storage project. The storage permit application has been filed and is awaiting award. This year the first well intervention to decommission a well CO₂ proof has been executed and the other former gas production wells on the P18-A platform will be converted to CO₂ injection wells in 2023-2024. The start of CO₂ injection is expected in 2025.

The pilot for hydrogen generation on Neptune's Q13a-A Amstel platform is progressing. The electrolyser has been ordered and will be available for onshore testing early 2023. After successful testing it will be moved to Q13a-A for offshore testing.

Onshore, NAM is further developing the GZI Next energy hub. On the 35-hectare location a total of 28,500 solar panels with a capacity of 12 MW (equivalent to the consumption of some four thousand households) have been installed. Further evaluations are ongoing for the development of hydrogen and green gas production on the same site. It is also considered whether other gas treating facilities can be transformed into new energy hubs.

New Mining Act

A new Mining Act has passed the House of Representatives in February of this year with specifically more opportunities for re-use and repurpose. It will formally still need to pass the Senate. To limit the decline in exploration and production of oil and gas, the investment allowance has been increased from the conditional 25% to a generic 40%, retroactively effective from January 1st, 2020. Obviously, this is not applicable to spendings for decommissioning.

As of January 1st, 2022, it is required to give formal notice within four weeks of permanent suspension of mining works, including wells. Subsequently a decommissioning plan is to be filed within one year of permanent suspension unless it is eligible for re-use/repurpose or when decommissioning is combined with other mining works or wells. The requirement to establish a financial security arrangement for decommissioning for offshore has now been extended to onshore as well. For offshore pipelines, a reference is made to a Comparative Assessment methodology to identify the best concept for decommissioning.

Interview



Hans Vijlbrief
Secretary of State for the
Extractive Industries

You have recently been appointed as Secretary of State for the Extractive Industries.

How did you become aware of Nexstep's activities?

"I have been updated about Nexstep and am impressed by the possibilities of reusing existing infrastructure and using it for the energy transition."

What do you find most surprising about Nexstep?

"How quickly Nexstep has come to concrete projects and results. Nexstep has put the opportunities for reuse and abandonment on the map."

The title of this report is "The power of collaboration". In January 2022 the first joint campaign for abandoning wells has been awarded. Do you see more opportunities for collaboration?

"This campaign will lead to substantial reductions in abandonment costs of wells due to the fact that collaboration between operators is stimulated. It is great that this is the worldwide first campaign with so many operators. And, as a country, we are showing that it can and should be improved. We should also try to apply this collaboration in other fields, such as CO₂ storage and hydrogen production and transport."

// Nexstep has put the opportunities for re-use and abandonment on the map //

Sometimes there is a gap between the time infrastructure becomes obsolete and the timing of possible reuse. The current Mining Act is supporting this, but in the public opinion it is often viewed as a way to postpone decommissioning.

What is your vision on that?

"That certainly is a point of attention. The scope of the Mining Act is to stimulate reuse and in no way giving the possibility to get out of the clearance obligation. We will investigate the potential of reusing existing mining locations and infrastructure, onshore as well as offshore. In this way we want to gain insight into the technical and economic feasibility of re-use and how it can contribute to making gas infrastructure more sustainable, by using it for green gas and hydrogen."

How do you see the future of the gas industry?

"The coming years we will still need natural gas. That is why we will continue to extract gas from the small fields in the Netherlands, but only if that can be done in a safe and responsible way. At the same time, we want to make the gas value chain more sustainable by scaling up the production of green gas and hydrogen. The knowledge and skills of the employees in the gas sector can be used to accelerate the transition to sustainable heat and to be able to store CO₂."

Interview

What do you think is the added value of Nexstep?

"Nexstep can bring relevant parties in the gas sector together and facilitate good collaboration between them. We don't have much time to realize the energy transition, so if Nexstep can provide acceleration and a more efficient deployment of resources, this is an enormous added value."

How do you see Nexstep's role in the future? Where do you see the biggest opportunities for Nexstep?

"Nexstep can play an important role in providing a sustainable repurposing of existing infrastructure. In case infrastructure turns out to be superfluous, Nexstep can help to remove it as efficiently as possible."



2 Expected decommissioning in the Netherlands 2022–2031

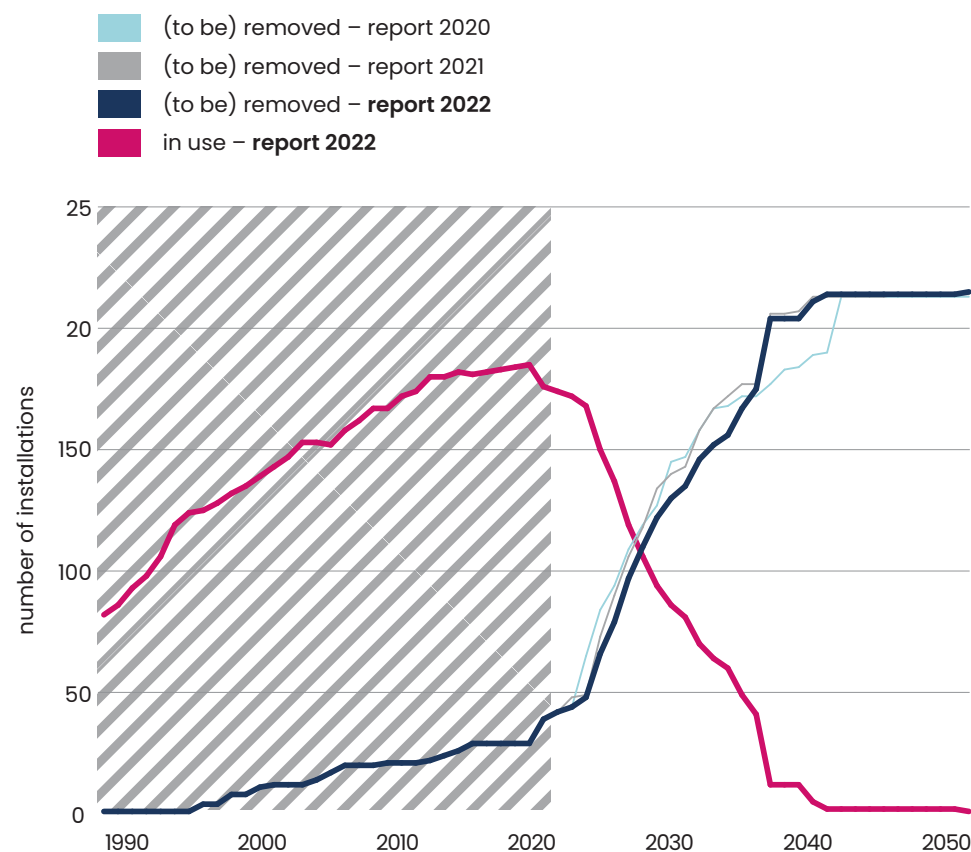
In 2022, as the economy just started to recover from the COVID-19 pandemic, the world was affected by the Russian invasion of Ukraine. While European countries are striving for an increasing security of energy supply, their governments are all aiming to quickly increase domestic production and strategic reserves. Together with the increasing prices of oil and gas this may cause a further shift of decommissioning to the future.

The decommissioning activities in 2021 and 2022 mainly focus on wells, both onshore and offshore. In our 2021 report the forecasted activity of offshore installation removal was low for both last year and this year. Activity was, and still is, expected to increase considerably in 2023. Various operators are tendering and awarding contracts for the removal of offshore installations. Most operators bundle the removal of several platforms into a single contract rather than awarding them as separate projects. Following the joint campaign for the decommissioning of mudline suspended exploration wells, it is intended to also evaluate a joint campaign for the decommissioning of similar platforms owned by different operators.

Update Road to 30%

In the Re-use and Decommissioning report of 2020, the team leads explained the different roadmaps of the 'Road to 30%', Nexstep's innovation agenda to reach the goal of a 30% cost reduction. In this year's edition, we like to update you on the progress in the different roadmaps.

Figure 2.0.1. Number of installed and removed offshore installations



Update Road to 30%



Arjan Vos

Team lead Nexstep
Wells Committee

Through Tubing Cementation

"In 2019, Nexstep started to investigate how to get the Through Tubing Cementation (TTC) method implemented in the Netherlands. This technique is more efficient, safer and reduces waste and emissions. It is applied in many wells in the UK and elsewhere in the world, but it has not yet been accepted as a well decommissioning technique in the Netherlands. It involves using the production tubing to practically place cement columns in the well. A major part of the tubing, like the well casings, remains in place. Under suitable conditions, this can be performed without a drilling rig. TTC will have an important contribution to Nexstep's goal of 30% cost reduction, while fulfilling the industry's HSE goals."

"The two field trials of TTC in 2020 showed no conclusive verification results of the cement bonding. Therefore new trials were executed in 2021, jointly funded by Nexstep members and performed on land by NAM. The results are being processed and look very promising. After the final results have been shared with the Nexstep

// Through Tubing Cementation can give a better insight in the best way of placing long cement columns //

Wells Committee, the topic will be further discussed with State Supervision of Mines to get approval for this technique in the Netherlands. Also, a project has been set up to do simulations with computational fluid dynamics. This technique can give a better insight in the best way of placing long cement columns."

Joint Campaign Mud Line Suspension

"The Joint Campaign for the Mud Line Suspension wells progressed well. Despite the fact that the road to a mutual contract was a challenging and long one, in the end we succeeded in our goal. Early 2022 the campaign was awarded to Oceaneering. The work started early April with the seabed survey which was efficiently completed in May in half the planned time. A second sailing is scheduled later this year to clean out the conductors. The wells will be decommissioned in 2023. Later on in this report there is an article on the joint campaign."

Update Road to 30%



Folkert Kaman
Team lead Nexstep
Facilities Committee

Collaboration with the service industry

"In the past couple of years, Nexstep organised several workshops with the service industry. From these discussions, it was concluded that we have several priorities: a validated Risk Allocation Matrix, a standardised contract template, a technical dossier index and a new approach to the pre-tender information process."

Online portal heavy-lift contractors

"A pilot version of an online portal for heavy-lift contractors has been developed to provide insight into the forecasted timing of removal of the Dutch offshore installations for the coming five years. The portal is now being tested and will be made available during the second half of this year."

**// The portal is now being tested
and will be made available during
the second half of this year //**

Powering platforms in lighthouse mode

"Together with the Dutch Marine Energy Council (DMEC), a study has been carried out for the potential of powering platforms in so-called lighthouse mode using marine energy. Unfortunately, the current commercially available devices are not suitable for the shallow water of the Dutch Continental Shelf, but we will follow developments in this field."

Joint campaign opportunities

"Additionally, the committee has identified a number of decommissioning campaign opportunities for offshore installations. The committee has initiated a survey among the operators of these facilities to gauge interest and identify possible barriers that stand in the way of pursuing these campaign opportunities."

HSE audit

"In May the assignment has been awarded to an internationally recognised lead auditor which will execute a Health, Safety & Environment audit of the Dutch decommissioning yards in the summer of 2022."

Update Road to 30%



Hans Janssen
Team lead Nexstep
Pipelines Committee

Determine decommissioning requirements

"The current Mining Act states that an offshore pipeline can be left in place, unless the Minister of Economic Affairs and Climate Policy (MEAC) determines that it must be removed.

In any case, it is crucial for the oil and gas sector to develop a methodology to determine the decommissioning requirements for pipelines, and thereby provide MEAC with a structured solution for the new requirements under Article 103 of the revision of the Mining Decree. This Article 103 includes a number of criteria to be considered in the assessment whether or not the pipeline can remain in place or should be removed after decommissioning. This is also in line with the internal need for operators to obtain more clarity about the probability that their pipelines would have to be removed and whether additional financial provisions are required."

**// With this framework,
the sector can deal with the
decommissioning of pipelines //**

Comparative Assessment

"The Comparative Assessment (CA) method developed by Nexstep is a structured approach to determine for each pipeline (or part thereof) whether it should be removed or can be left in place based on several criteria. The framework provides a roadmap (method) and script for the operator to answer this question for a to-be-decommissioned pipeline based on a societal cost/benefit analysis. With this framework, the sector can deal with the decommissioning of pipelines, and every operator can use this information for internal decision making for pipeline decommissioning policy in an unambiguous, traceable, comparable and transparent manner. The CA tool has been tested by operators to check its usability on assessing pipelines. The CA method was finalised in October last year with an extensive manual on how it should be used."

Update Road to 30%



Radboud Bisschop

Team lead Nexstep
Shared Learnings

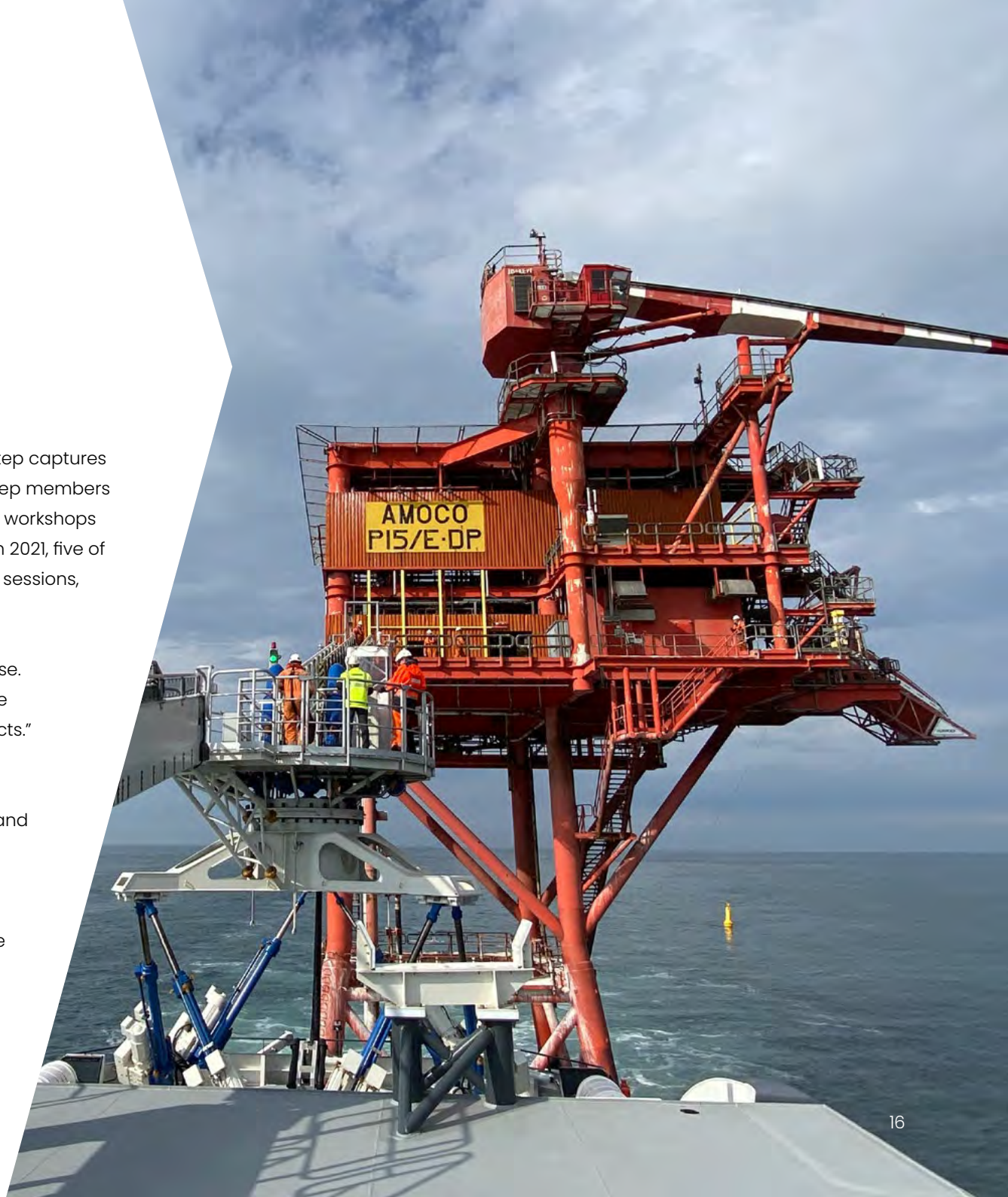
Shared learnings

"Learning from other projects is of great value to operator staff. Nexstep captures such learnings in a concise way and makes them available for Nexstep members using the 'Shared Learnings' database. Most learnings originate from workshops that Nexstep organises where experiences and insights are shared. In 2021, five of such shared learning sessions were held. Next to the shared learning sessions, learnings are also captured from presentations at conferences."

"Currently, there are more than 350 valuable learnings in the database. Nexstep continues its effort to increase the number of learnings in the database and promotes the use of the database in upcoming projects."

Peer Assists

"In 2021, Nexstep launched a new initiative to promote collaboration and proactively share experiences. We are very excited that in May 2021 the first Peer Assist session took place. A group of peers from several operators gathered in workshops to review the planning and the technical approach of a particular decommissioning project. To date two Peer Assists have been held in 2022 on offshore projects and more of them have been planned."



2.1 Total overview offshore & onshore

In general, we notice that decommissioning activities offshore and onshore are being deferred compared to previous years' reports. Specifics are described in more detail in the individual sections further in this report.

Figure 2.1.1. Realised and forecasted decommissioning - offshore infrastructure

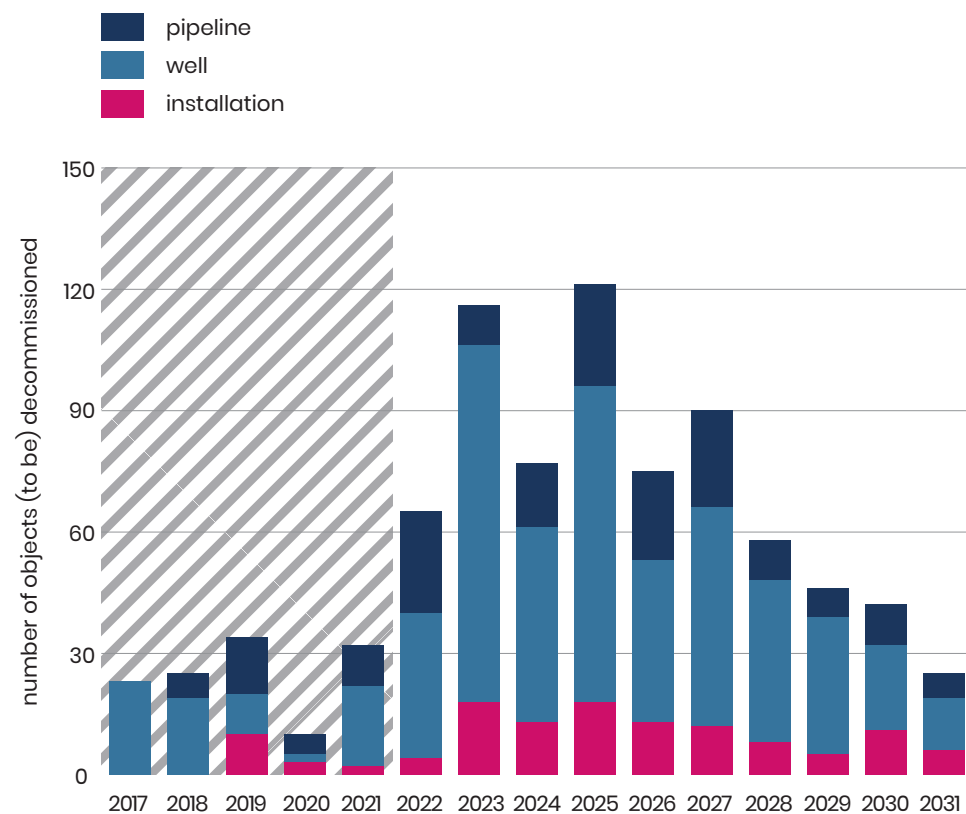
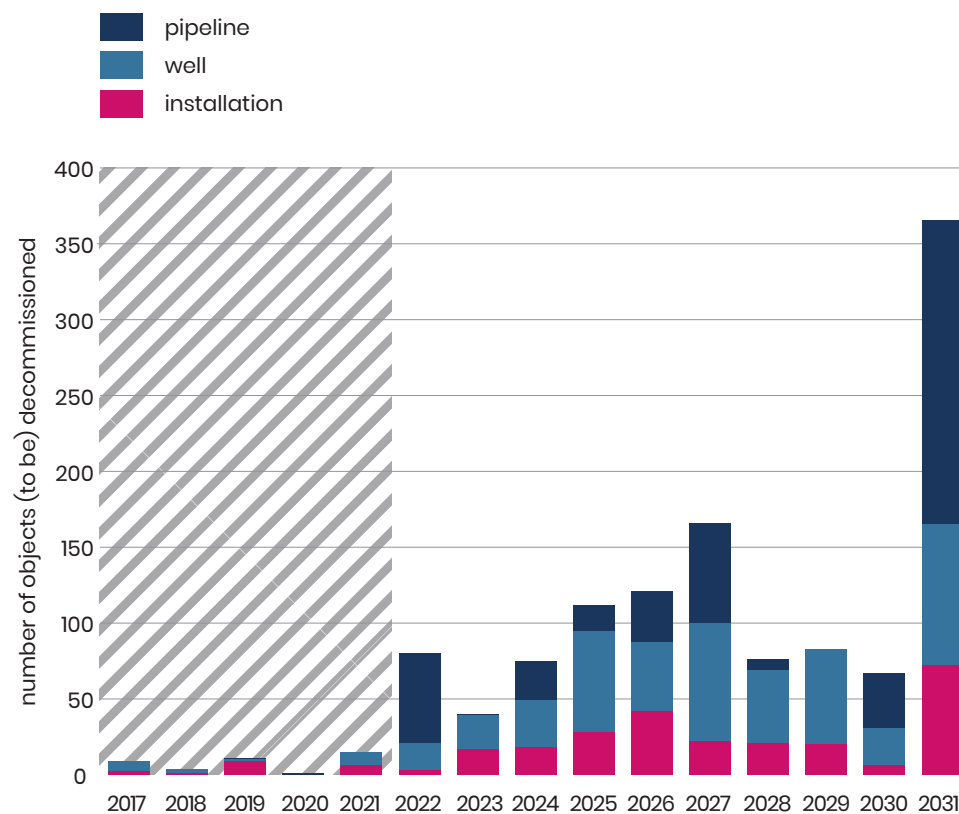


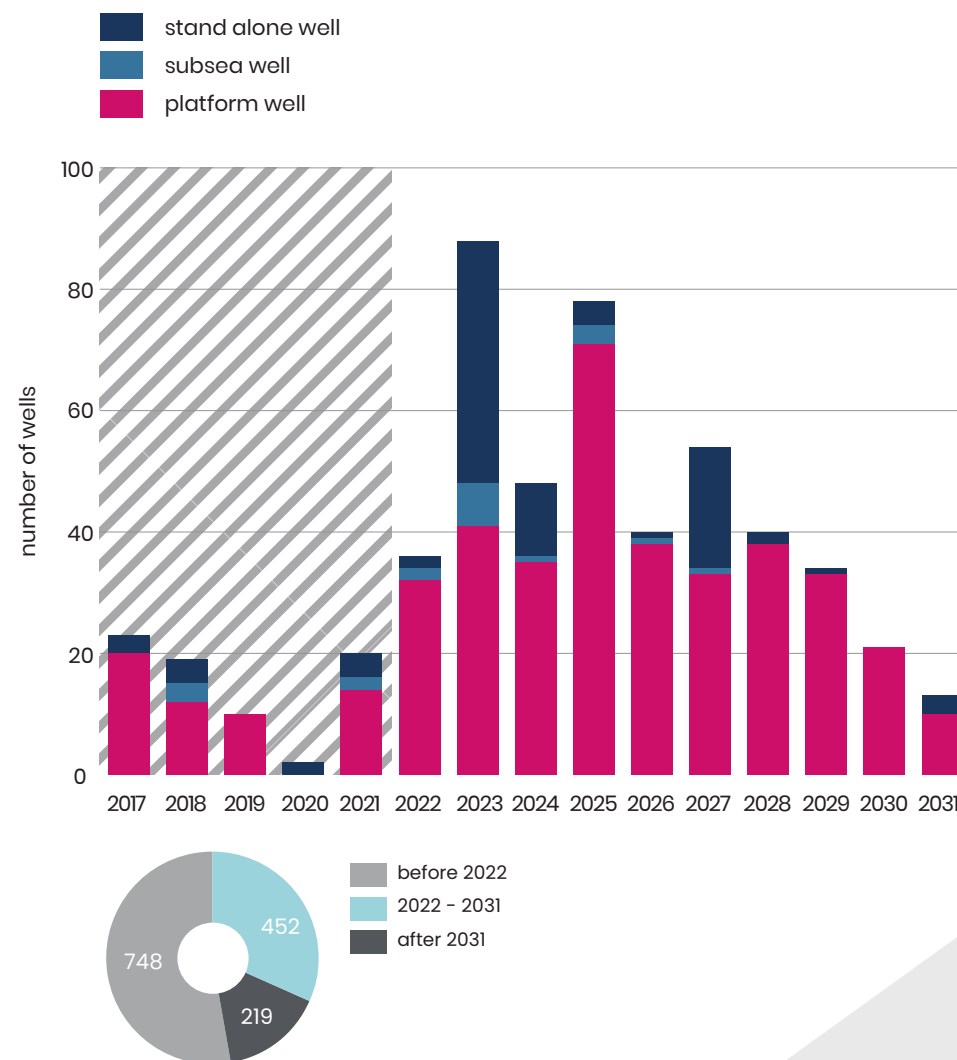
Figure 2.1.2. Realised and forecasted decommissioning - onshore infrastructure



2.2 Offshore wells

In 2021, Wintershall Noordzee started to decommission 24 wells in the Dutch and German sectors under a long-term contract using the Swift-10 jack-up rig. The contract has been extended for another 17 wells. In April this year, TotalEnergies and Petrogas have jointly contracted the Maersk Resolute jack-up rig for one and a half years to decommission 31 wells in the Dutch sector, starting in the third quarter this year. Neptune Energy will commence a 24 well decommissioning campaign in 2022. With such long-term contracts a learning curve is expected over time with increasing efficiency and lower cost.

Figure 2.2.1. Realised and forecasted decommissioning - offshore wells by well type

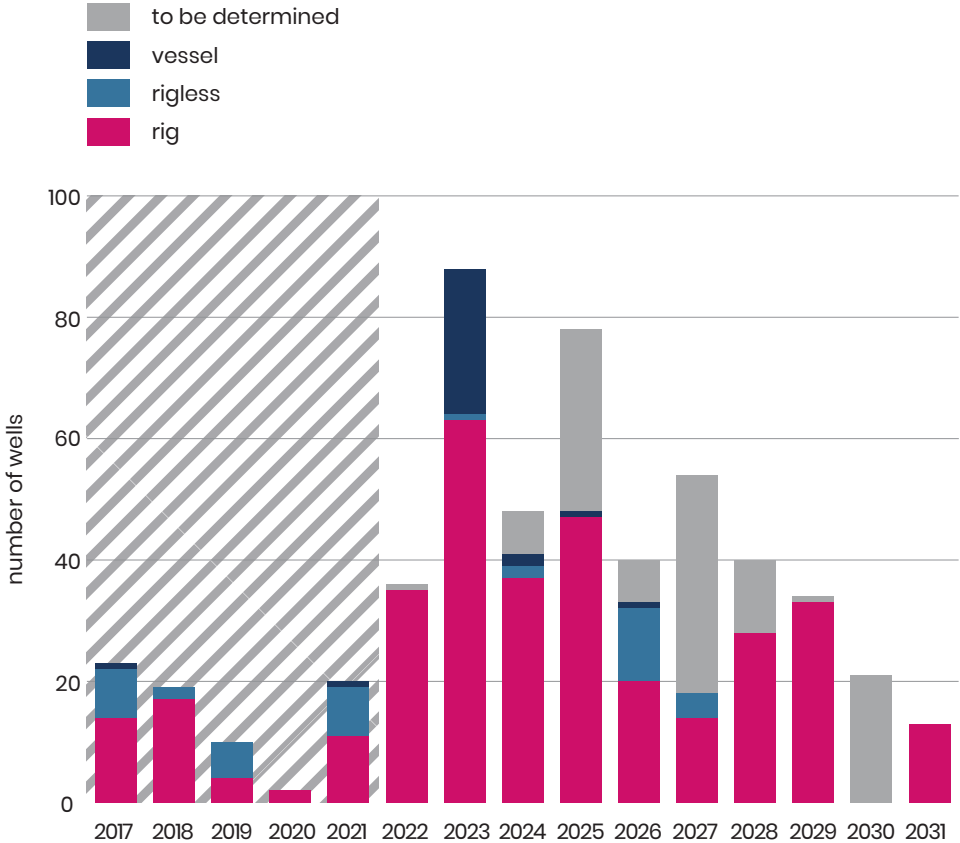


Over the next decade, each year, on average some 45 wells are expected to be decommissioned. Some 30 wells each year are expected to require a drilling rig. With an estimated three-week duration per well, this would equal continuous operation for two drilling rigs.

First joint campaign for mudline suspension wells

In April 2022 the first joint campaign for mudline suspension wells has been launched with an underwater survey of 44 wells and surrounding seabed. The decommissioning of at least 24 of these wells is planned for 2023 and will be executed using a vessel instead of a jack-up rig, as the work scope is relatively limited. However, special equipment is required to safely remove drilling fluid from annular spaces in a number of wells. The campaign is a joint effort initiated by Nexstep, and involves operators NAM, Neptune Energy, TotalEnergies, Wintershall Noordzee, Petrogas and ONE-Dyas.

Figure 2.2.2. Realised and forecasted decommissioning – offshore wells by decommissioning method



Interviews

Joint Well Campaign

In 2019, Nexstep embarked on a program to facilitate a joint campaign for Mud Line Suspensions (MLS) wells. MLS wells are relatively easy to remove and would therefore be an excellent example for a joint campaign, proving the benefit of cooperation. Early 2022 the joint contract was awarded to Oceaneering to contract those wells. Six operators are taking part in the campaign, which is a world first. We asked René Jansen and Nick Dancer about their findings.



Nick Dancer

General Manager
at Petrogas E&P NL



René Jansen

General Manager Decommissioning
and Energy Hubs at NAM

What made you decide to participate in the joint campaign?

ND: “In the Nexstep MLS Campaign, Petrogas E&P Netherlands is participating with four suspended wells to be permanently plugged and abandoned (P&A), and two additional wells are planned for the survey and inspection scope. In our previous plan, we had assumed that the wells would be abandoned with a jack-up rig. However, by joining the initiative, we get the efficiency of scale, and by using a vessel over a rig we have the opportunity of reducing the carbon intensity associated with well abandonment.”

RJ: “One of the levers to reduce the abandonment cost is through collaboration. Scope aggregation, knowledge sharing, safe execution and a combined contracting strategy are important deliverables for collaboration. I am convinced that together we will stand stronger, and become more interesting for our partners. Within the abandonment field NAM has worked on multiple collaboration journeys, but it has shown to be challenging to find a common ground. With Nexstep we had already formed a common group, so participation was natural. NAM was able to provide scope, knowledge about wells and supply chain and support the contracting strategy.”



What was the collaboration between the six operators like?

RJ: "It was a long and challenging journey but we succeeded in delivering a collaboration model. We learned a lot from each other, moved in different directions but in the end, we found common ground. We showed that a true collaboration between multiple operators is preferred over a rig sharing agreement. However, the proof will be in eating the pudding, when the execution is done successfully."

ND: "Cooperation between operators through Nexstep has been very useful, mostly to share and collectively solve technical P&A issues and to develop a common P&A approach. By sharing our learnings, technology, equipment and engineering knowledge, we found innovative solutions to the various P&A challenges. It was certainly also beneficial to have 'one voice' towards the regulator, both for the regulator and the operators, and as such assess the required approvals for P&A concept and deviations. This approach resulted in an improved process of collecting the necessary documentation and regulatory approvals for the suspended wells."

Can you see that costs have been cut?

RJ: "Yes, and this question is not difficult to answer, keeping in mind that there should be a win-win for both the operators and for our contractors. Both parties need to benefit and if that leads to a cost reduction, new opportunities, and activities for the partners, we can be proud that we managed to set up this collaboration. At the end it is not only a collaboration of the six operators but also for Nexstep and the partners who will execute the work ... a win-win-win!"

Would you consider participating in another joint campaign?

RJ: "Yes, but I think we should take it a step further. We should create a collaborative, dedicated team of people from the operating companies, and maybe partners, and work on the joint campaigns day-in, day-out. This team should investigate a combined scope of work and standardise the front end and execution activities. The benefits would be that we will have a team that can share knowledge, stay high on the learning curve, and find new opportunities that can be used across the board. This will increase the focus on Decommissioning & Restoration, retain the knowledge and reduce the cost over a longer period."

ND: "It was unique and challenging to execute a decommissioning contract that was endorsed by six operators. However, we are confident that by working together, we will increase the efficiency of the operation, reducing both the environmental impact and the overall cost for the decommissioning of these wells."

Article

Wintershall Noordzee starts extensive decommissioning program in the Southern North Sea

In August 2021, Wintershall Noordzee embarked on a large-scale, cross-border decommissioning program in the Southern North Sea. This campaign, focusing on platform wells, demonstrates the company's commitment to decommissioning. The first part of Wintershall Noordzee's program entails the decommissioning of 24 wells in both the Dutch and German sectors of the North Sea, and the removal of two production platforms and two subsea installations.

The tender for this first phase of an extensive P&A program was granted to the Dutch contractor Swift Drilling and will last for approximately one and a half years. The Swift-10 jack-up rig was modified and prepared for this campaign after a period of stacking, arising from the worldwide economic slump in offshore activities. The rig first set sail to the P09 location in August 2021, where two subsea wells were decommissioned. After successful completion by mid-October, the domes were removed from the seabed.



Abandonment of the following two platforms, Q04-A and Q04-B, was time-driven because both installations were situated in the area designated for wind park Hollandse Kust Noord, where installation activities are planned to start mid-2022. The removal of the Q04-A and Q04-B production platforms was executed by Scaldis' Heavy Lift Vessel Gulliver in April-May 2022.

Part of Wintershall's activity cycle

Wintershall Noordzee, active in the Southern North Sea since 1965, has substantial experience in decommissioning and re-using its installations. Since the late 1980s, it has decommissioned over seventy wells and removed twenty production platforms, of which seven topsides were re-used at new locations in the Southern North Sea. Decommissioning and complete removal of its assets is part of Wintershall Noordzee's activity cycle.

As the company strongly believes in co-operation between producers, it shares the lessons learnt within the Nexstep organisation. In addition, it is participating in the Nexstep Joint Campaign on Mudline Suspended (MLS) wells. Eight wells are included in the survey for 2022 and at least five of them will be part of the vessel-based MLS well P&A campaign in 2023. Experience in this Joint Campaign with relatively fewer complex wells and shorter lead times per well will be crucial for the decision on future joint decommissioning activities.

Although the Swift-10 has been contracted for more than three years by Wintershall Noordzee only, options to share the rig with other operators are not excluded. A second phase of the P&A campaign is under preparation. Parallel to the well decommissioning scope, the company is also preparing for the removal of related installations.



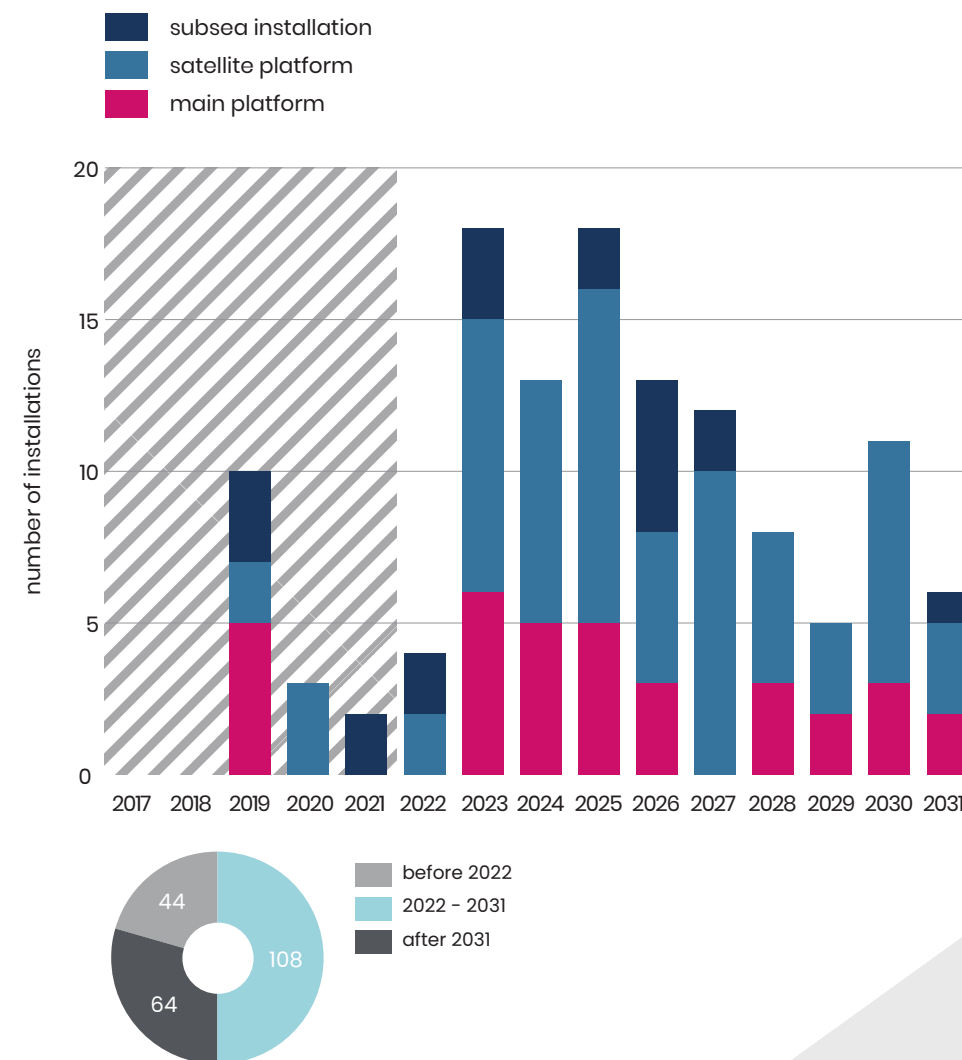
2.3 Offshore installations

In 2022 the removal activity is low: the Q04-A and Q04-B platforms have been removed to make space for the development of windfarm Hollandse Kust Noord. Furthermore, two subsea installations have been removed this year. Higher activity for platform removal is forecasted for 2023 to 2027, one-third of which consists of relatively larger main platforms. Over the next decade 108 platforms, almost two-third of all current platforms, are forecasted to be removed if not suitable for re-use or repurpose.

Current removal tenderings and grants

Various operators are currently in the process of tendering and various contracts are being negotiated and granted. Petrogas has recently awarded a contract to Heerema Marine Contractors for the removal of the four offshore oil platforms Helm, Haven, Helder and Hoorn with a likely timeframe for removal from 2023 onwards. Several other operators will be executing individual campaigns for the removal of multiple platforms from their own asset portfolio.

Figure 2.3.1. Realised and forecasted decommissioning – offshore installations by type



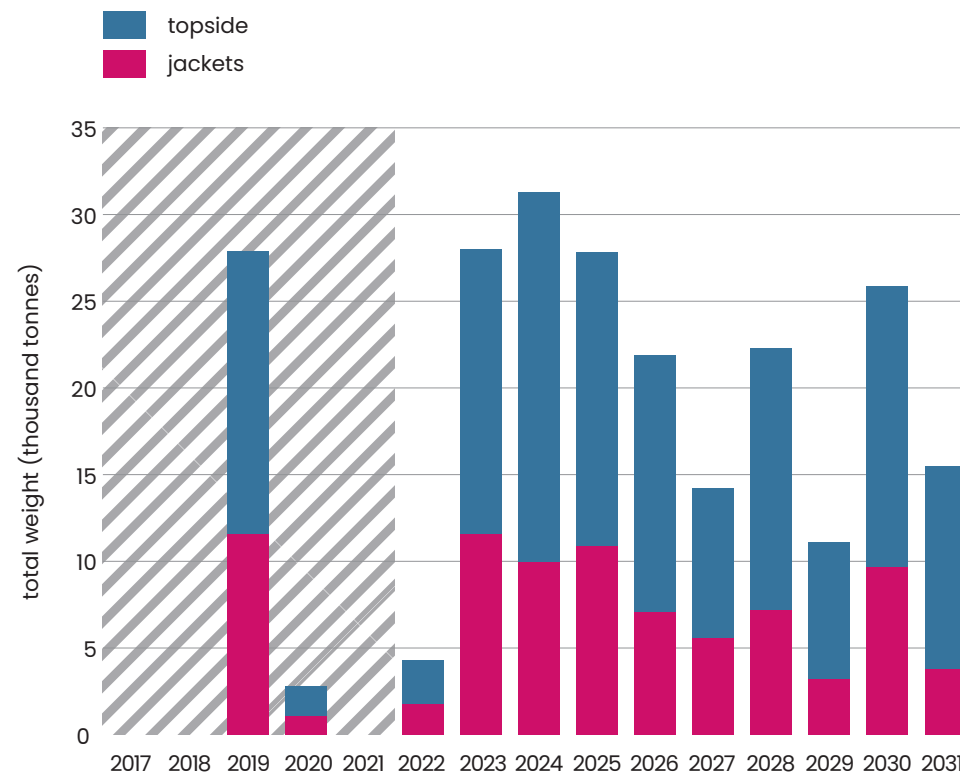
Turning idle platforms into lighthouse mode

Following the cessation of production, most operators are turning their idle platforms into so-called lighthouse mode, in order to minimise the operational cost until they can be decommissioned, preferably as part of a larger campaign. In lighthouse mode, the platforms are typically made hydrocarbon free and utilities with high maintenance cost, such as the accommodation, helicopter deck and crane, are taken out of service. For the required navigation lighting and foghorn, the installation is usually powered with a battery pack charged by solar panels and/or wind turbines and a maintenance visit by boat is typically foreseen only once per year.

For the re-use of TAQA's P18-A satellite platform for the Porthos CO₂ storage project, the first well intervention has been executed in 2022 to decommission one well to become CO₂ leak proof. The recompletion of the other P18-A wells to CO₂ injectors is expected to follow in 2024.

For the next five years a peak of some fourteen platforms is expected to be brought onshore each year for dismantling and recycling. In total, over 120 thousand tonnes of steel can be recycled, which is equivalent to the amount of steel of some seventeen Eiffel towers. For this year a review is scheduled for the capabilities and capacity of the Dutch onshore decommissioning yards.

Figure 2.3.2. Realised and forecasted decommissioning – offshore platforms weights

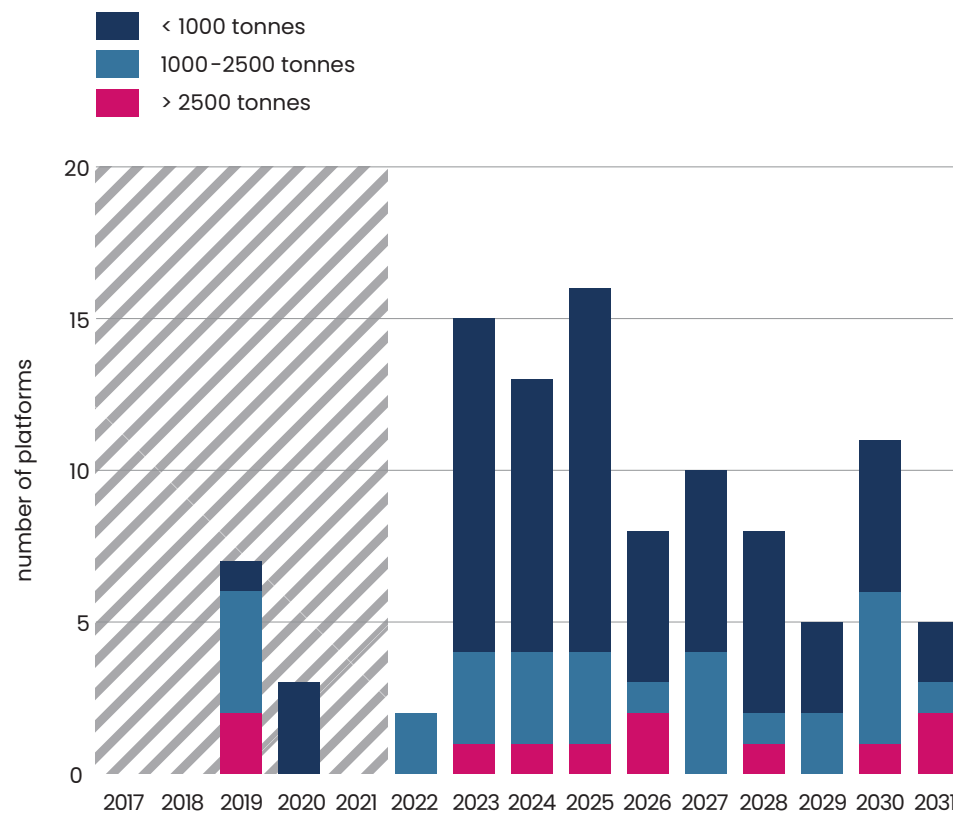


Become less dependent on heavy lift vessels

The decommissioning of offshore installations largely depends on the availability of the heavy lift vessels. However, the installation market for wind turbines is shifting towards ever larger turbines and will also be drawing upon the same pool of heavy lift vessels. This will apply especially to the larger and heavier platforms. Nexstep is promoting and developing methods to decommission wells rig-less in order to achieve the same result more efficiently and cost-effectively.

Similarly, alternative removal techniques for offshore installations should be developed in order to be less dependent on heavy lift vessels in a tightening market. Removal options that may also become interesting alternatives are so-called 'piece-small' or 'piece-medium' removal. In these alternatives, the deck is disassembled and removed in smaller parts or modules. This way a large crane vessel is not required, and a larger pool of smaller crane vessels and barges can be used. So far, this option has not been used much and removal using a heavy lift vessel has been the reference case.

Figure 2.3.3. Realised and forecasted decommissioning – offshore platforms by heaviest module weight



In 2020, the Nexstep members supported the proposal to organise Peer Assists. They saw the advantage of facilitating work sessions in which experienced decommissioning peers from various operators reacted to a planned decommissioning project, in order to improve it.

In June 2021, Nexstep's Shared Learning team organised the first Peer Assist session for TotalEnergies, where the planning and technical approach of a complex multi-platform removal project was reviewed. Operators have now embraced the Peer Assist and three sessions already took place.

In February 2022, TAQA presented the lighthouse mode conversion campaign of its P15-E and P15-G satellites during Nexstep's second Peer Assist session. Neptune Energy hosted a third Peer Assist in May 2022, on its plans to decommission the satellite platform G14-B.

In May 2022, Neptune Energy NL held the third Peer Assist for their current G14-B decommissioning plans.

Richard Jackson

Head of Decommissioning NL/UK
at Neptune Energy

Why do you want to hold a Peer Assist?

"Having been a participant in the two previous Peer Assists, it was clear that a Peer Assist, with insights from the wider operator decommissioning community, can provide great benefit to an operator and its decommissioning project. The open discussions and advice shared will help Neptune Energy to ensure that we have a safe and successful decommissioning project, and we are looking forward to receiving the other operators' support and comments in achieving this."

"In May 2022, the Nexstep's Shared Learning team organised a Peer Assist for Neptune's G14-B decommissioning: review the activities and plan for converting the asset to low running cost mode with remote monitoring and solar power systems, and to review the contracting strategy/approach."



Arnout van der Pol
Decommissioning Manager at
TotalEnergies EP Nederland

What did you present during the Peer Assist session?

"I presented our plans to remove and dispose our L07 assets; ten platforms and numerous flowlines built between the mid-70s and mid-80s. Production on L07 ceased in 2017, after which the platforms were cleaned and 'pre-abandoned', awaiting plug & abandonment of the wells and final removal. At the time of the Peer Assist we were in a 'pre-project' phase prior to going to the market. During the pre-project a lot of definitions and strategic choices are made that (can) have a significant impact during execution."

"The Peer Assist was organised in two virtual sessions of two hours, one of them with a focus on technical matters and the other more focused on strategic topics. Six other operators had appointed experienced peers to join the sessions, which resulted in over a hundred questions, findings and recommendations. These were all captured in a Peer Assist report and made available through the Nexstep Shared Learnings Database."

What made you decide to present your project?

"TotalEnergies has limited decommissioning experience and the L07 project is one of our first large projects worldwide. Naturally, we want to make use of experience

and lessons learnt from the industry. Even though Nexstep is sharing feedback through its shared learnings platform, the Peer Assist is the ultimate tool to actively gather feedback from a variety of different perspectives. Hence, we were very interested in the Peer Assist concept as of the very beginning."

Were there any useful practical suggestions?

"There were many good suggestions of which we implemented quite a number in the project definition. In my opinion, the most interesting topics are those 'grey' areas where it is difficult to objectively establish an optimal solution, and the various peers have various acceptable solutions. For example, one can think of the re-use of concrete mattresses for the protection of pipeline ends. We also received many recommendations to 'de-risk' the scope by either inspections, mitigations or adjusted specifications. These all lead directly to a clearer project definition for the removal contractor, which obviously benefits everybody."

Do you think this will help lower decommissioning costs?

"Most certainly, I believe the sharing of experience and lessons learnt is a key value driver of Nexstep, as together we can mature a lot faster than individually. Together we can make and keep decommissioning as pragmatic and low cost as it should be, while maintaining a high HSE standard. The value of the Peer Assist was unanimously recognised by both project staff and peers, and a repeat for other decommissioning projects or sub-projects was highly recommended."

Would you be interested in presenting another project for the Peer Assist?

"Certainly. Although the L07 project is a challenging project, there are enough interesting projects and topics ahead of us. I think we also have some lessons learnt from the first Peer Assist, so the next session could even be better than the first one."



Peter Kuipers
Decommissioning
Offshore Lead at TAQA Energy

In February 2022, TAQA presented the lighthouse mode conversion campaign of TAQA's P15-E and P15-G satellites during Nexstep's second Peer Assist session.

What did you present?

"I presented the lighthouse mode conversion execution plan of TAQA's P15-E and P15-G satellites. The most important driver for us is to get into lighthouse mode as soon as possible, thus reducing operational expenditure. During the Peer Assist we addressed how to deal with safe abandonment. How do you deal with the regulatory bodies? Does the Dutch State Supervision of Mines agree with the plans? How do you set up your cleaning scope to ensure that the platform is clean and safe before your heavy lift campaign starts?"

What made you decide to present your project?

"I presented TAQA's view on the life cycle of our platforms during the Facility Committee's fifth Shared Learning Workshop where it became clear that organising a Peer Assist could be very valuable prior to the removal of our two platforms. This would be the second Peer Assist organised by Nexstep."

Were there any useful practical suggestions?

"After the Peer Assist, we had about twenty comments that ranged from a confirmation of our approach to some clarifications, in which we gave the other party insight on our process, and finally some suggestions for improvement were made."

"I considered the Peer Assist more as an external constructability review meeting, which was very useful. We had our execution plan well in mind beforehand. The execution was scheduled for May, driven by long lead items (solar panel skids) and an optimal weather window. Of course, we already had our internal review, in which we went through the execution plan with our colleagues from different departments. We thought we had reached such an advanced stage of the project that we could ask our peers, the people who have done these types of decommissioning projects too, to have a look at it. It was useful because we received confirmation of our approach, and that obviously has a positive effect on future decommissioning projects. It is nice to be able to say that an approach has also been acknowledged by our peers."

Would you be interested in presenting another project for the Peer Assist?

"After the lighthouse mode has been completed, we will focus on the plug and abandonment phase, which is not something we would discuss within the facilities committee. The last phase, the heavy lift campaign and final removal of the platform could be a possible subject for a future Peer Assist where certain contract strategies or planning and execution aspects could be examined."

2.4 Offshore pipelines

The timing of decommissioning of pipelines is obviously linked to the decommissioning of wells on an installation. Once the wells are (temporarily) decommissioned and the connected pipelines are disconnected, flushed and cleaned, the installation can be classified as hydrocarbon free and turned into lighthouse mode.

Regular monitoring

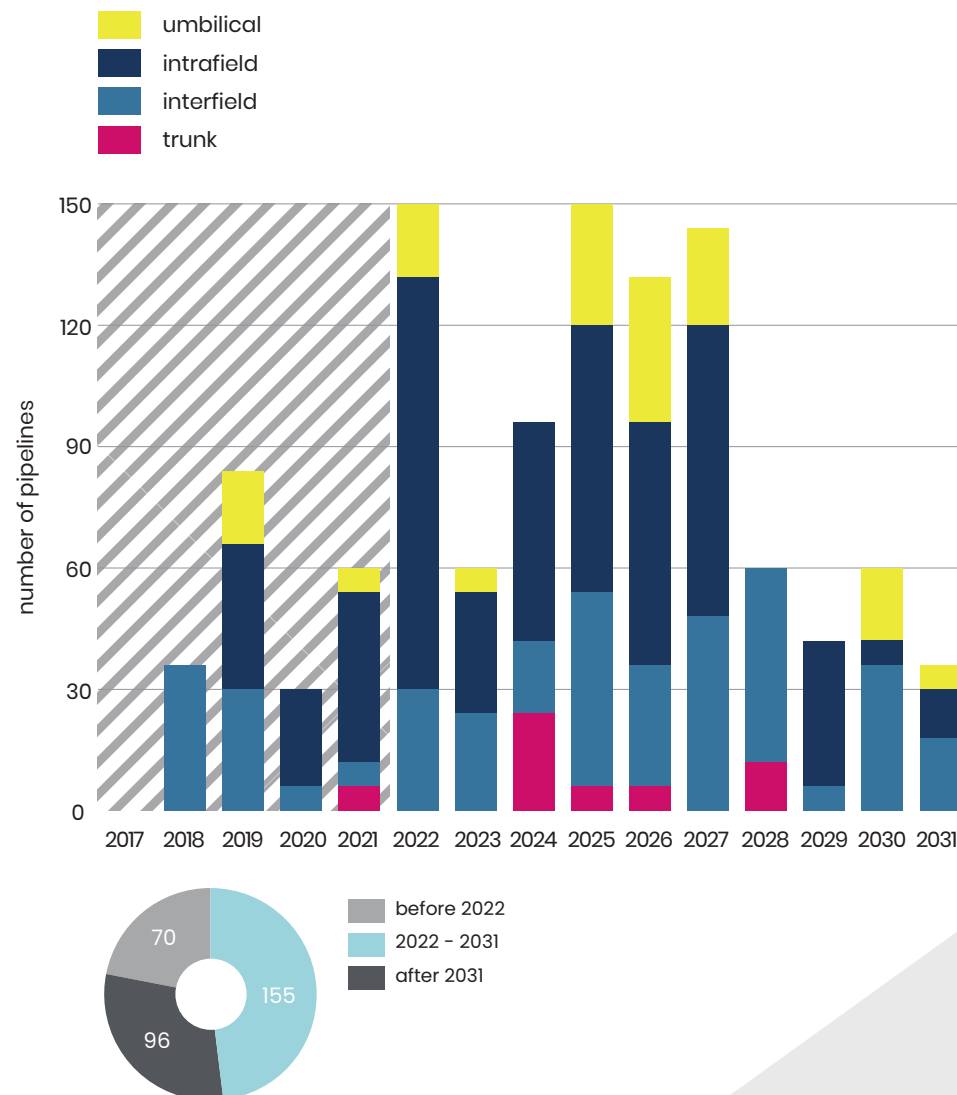
For pipelines that are permanently suspended, a notification must be made and a decommissioning plan must be presented, similar to the process for permanently suspended wells or installations. Pipelines that are decommissioned and left in-situ will need to be monitored on a regular basis to verify that they pose no harm to other stakeholders using the sea. In some parts of the North Sea sand dunes move due to currents. As a result of this, a buried pipeline could get exposed; corrective measures are then required, such as rock dumping of the exposed pipeline section.

Re-use pipelines for CO₂ storage

Shell, TotalEnergies, Gasunie and EBN are collaborating under the name Aramis CCS to realise a new open access transport infrastructure, enabling the storage of CO₂ in depleted offshore gas fields. A collection hub for CO₂ is foreseen at the Rotterdam Maasvlakte supplied from land by pipelines and ships from sea.

For CO₂ storage in depleted offshore oil or gas fields, as well as for hydrogen production, the existing pipelines may be re-used. The pipelines will obviously need to be able to handle these other fluids in terms of capacity as wells as of material integrity.

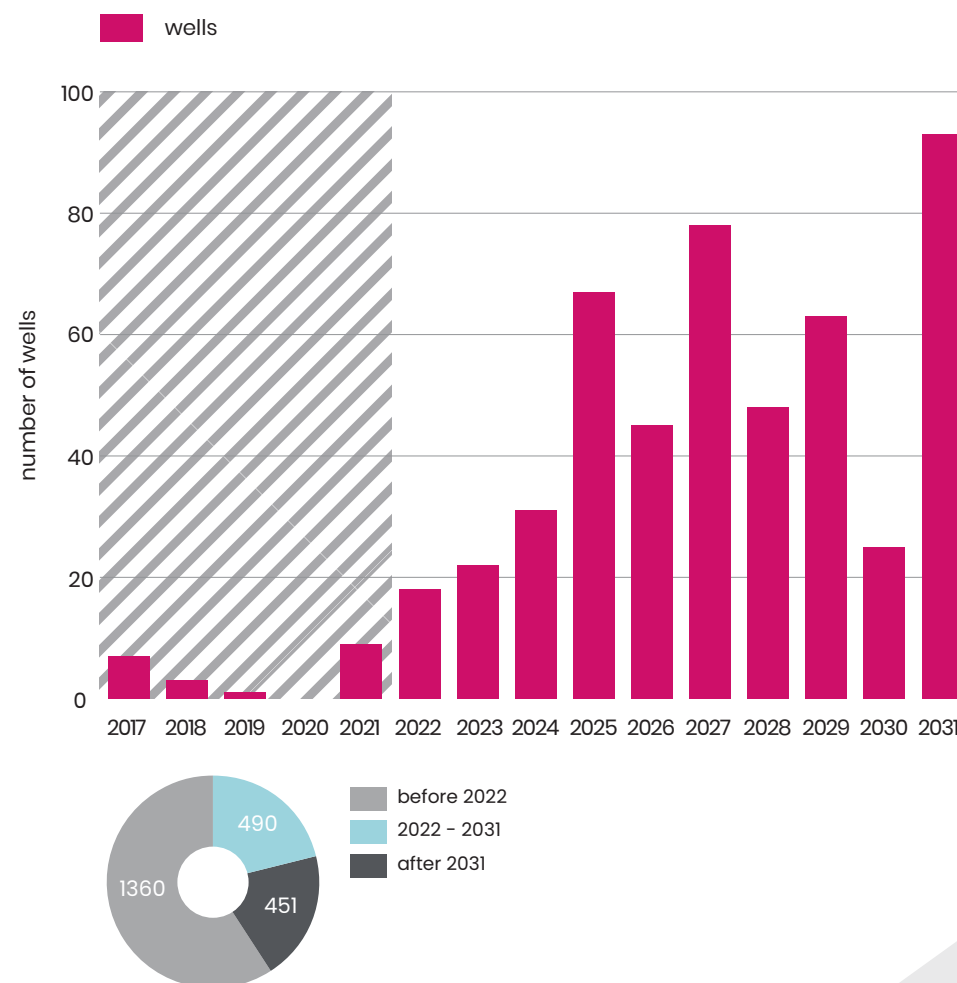
Figure 2.4.1. Realised and forecasted decommissioning – offshore pipelines by pipeline type



2.5 Onshore wells

In 2021 well decommissioning onshore was a continuous operation for NAM's special modular unit to isolate the subsurface zones; besides the original reservoirs all other formations that have flow potential are required to be isolated in a sustainable manner. Decommissioning the wells is preceded by the decomplexing or removal of the surface facilities. After the subsurface isolation with the modular rig, the wells will be monitored for at least three months. The final decommissioning of the wells involves setting a shallow plug and cutting and removing the steel casings to a depth of at least three meters below ground level. This is executed by the civil contractor who will also remove the buildings, pavement, foundations, underground pipework and cables, and fencing before the location can be restored.

Figure 2.5.1. Realised and forecasted decommissioning – onshore wells



Well decommissioning

This section provides some basic insight into well decommissioning, which is not as visible as the decommissioning of installations at sea or land, but does account for almost half of the total cost of decommissioning.

A well is typically drilled in sections that are secured with steel pipes, called casing, which are cemented to be kept in place. Each deeper section obviously has a smaller diameter resulting in a telescopic hole to the target reservoir; this is similar for wells for oil, gas and geothermal energy.

In order to turn a well into a production or injection well, a steel tubing is placed in the cased well and a set of valves is placed at the surface to be able to open and close the well. From its original looks, this set of valves is often still referred to as the Christmas tree although nowadays the set of valves are often embodied into a compact solid steel block. For wells that can flow to surface without lifting support, a downhole safety valve is included in the well to block any flow into the atmosphere in the extreme rare case that the Christmas tree would be struck by a boat, plane or truck.

Oil and gas wells are equipped with double safety barriers to prevent leakage of hydrocarbons to the environment; well integrity is absolute key. This practice from the oil and gas industry has recently also been adopted as standard practice by the younger geothermal industry in the Netherlands.

After a well is no longer used for production or injection, it will need to be decommissioned in such a way that all oil and gas reservoirs as well as other formations with flow potential are sealed off permanently. The plugging material

of choice since the start of the oil industry is cement. Oil and gas are successfully trapped for millions of years in the reservoirs because they are overlain with a caprock consisting of salts or shales. As salts and shales at greater depths, with higher pressure and temperature, display ductile behaviour these materials are expected to be the ultimate choice for isolating wells.

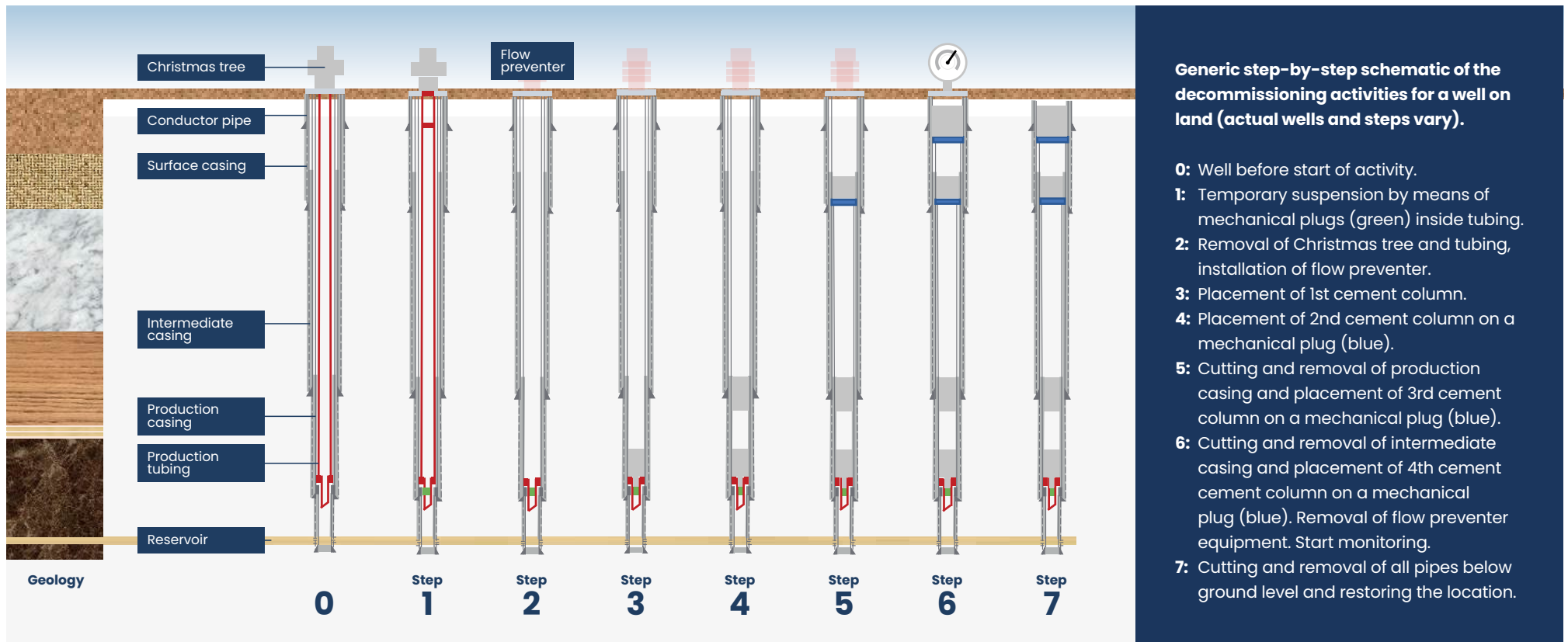
Innovation projects using natural materials

In 2017 a series of innovation projects with several Dutch operators and TNO was started to evaluate the potential for well decommissioning using natural formation materials such as halite salt and bentonite. These innovation projects started with literature research and were subsequently followed by laboratory testing. For bentonite projects, lab testing was scaled up from small to large size and in 2021 full scale testing of bentonite as a plugging material was carried out in a research well. In 2022 a pilot using bentonite will be executed in a gas production well.

Nexstep's roadmap to rig-less decommissioning

The decommissioning of a well consists of retrieving the tubing from the well and subsequently isolating all potential flowing formations by setting plugs at various depths and cutting and retrieving the steel casings several meters below ground or seabed level. Onshore, also a shallow plug is to be set and each well is monitored for at least three months before the casings are cut to confirm that the isolation has been executed successfully.

To carry out this work, typically a drilling rig or hydraulic work unit is required. Nexstep has launched a roadmap to develop so-called rig-less decommissioning.



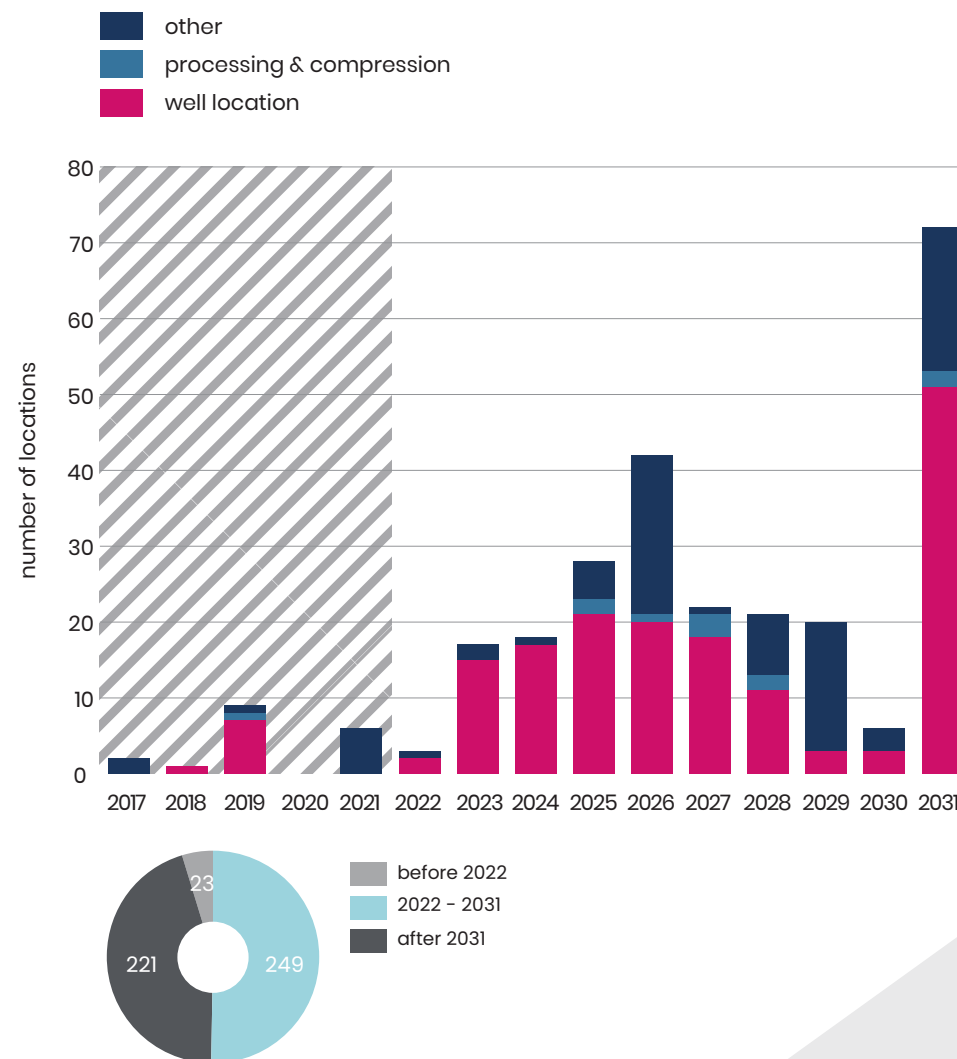
One of the options being pursued is Through Tubing Cementation whereby the tubing is left behind and cemented in place, a technique being accepted in various countries and historically in the Netherlands as well. By doing so the decommissioning could be executed without the need of a large drilling rig or hydraulic work unit, with fewer emissions, less traffic and handling and thus safer and at lower cost. On behalf of all Dutch operators, Nexstep has arranged investigations and field trials to demonstrate the technique, as explained on page 13 in this report.

Nexstep has identified more than 75 technologies that could improve well decommissioning. These have been assessed and ranked. One of the technologies subsequently being pursued by Nexstep involves the use of perforate and test to verify seals in the annulus. The presence of a good seal would avoid cumbersome and costly repair work. Part of this is the geoseal initiative to demonstrate that ductile caprock formations provide effective seals in a fully natural way, as they have done over millions of years already in sealing off the oil and gas reservoirs of today.

2.6 Onshore locations

Following the current well decommissioning activity, if re-use is not a viable option, the locations will be decommissioned and restored. In the years to come, a steady activity is expected of some fifteen to twenty locations, mainly well locations, each year. For onshore locations typically a civil contractor will remove all buildings, underground pipework, cables, foundations, pavement and fencing. Prior to restoration of the site, sampling of the soil and groundwater will determine whether cleaning is required. After restoration, the location is returned to the owner.

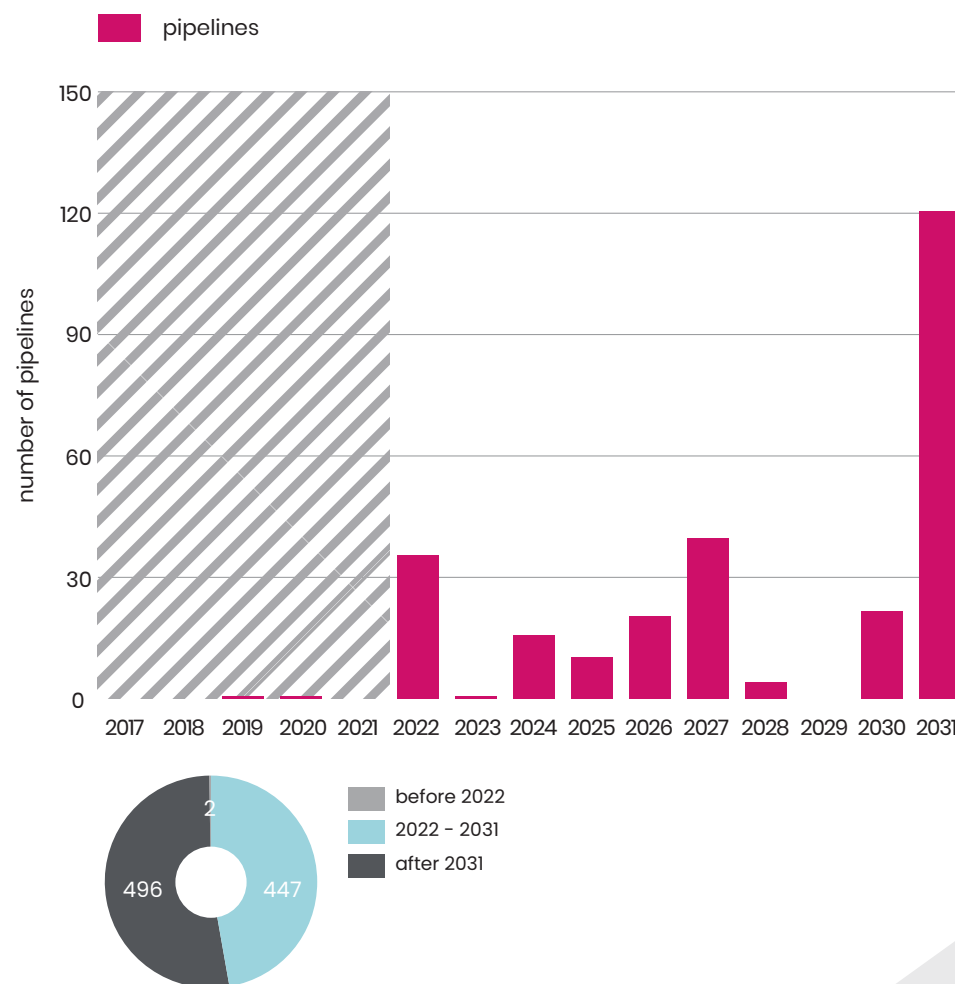
Figure 2.6.1. Realised and forecasted decommissioning – onshore locations by locations type



2.7 Onshore pipelines

Re-use of onshore locations is especially interesting for activities generating biogas, green gas, hydrogen or renewable energy as the locations are already connected to pipeline and electricity networks. To this purpose, operators engage with local stakeholders to discuss the potential for re-use before the decision is made to decommission and restore the location.

Figure 2.7.1. Realised and forecasted decommissioning - onshore pipelines



3 Expected offshore decommissioning cost

With the increasing decommissioning activity over the past and coming years operators are necessarily adding more detail to their cost estimates. Typically, this also increases the cost estimate itself. Also, various operators have yet immature decommissioning expertise, and their cost estimates may also increase with a growing number of realised decommissioning projects and the cost benchmarking Nexstep provides its members with.

Understandably, one would like to show the efforts of the industry paying off in terms of a reduction in the forecasted cost for decommissioning. Unfortunately, this is not apparent from our records yet. Nevertheless, we are confident that cost reductions can be realised through campaigning, learning curves, technology innovations, benchmarking and sharing learnings.

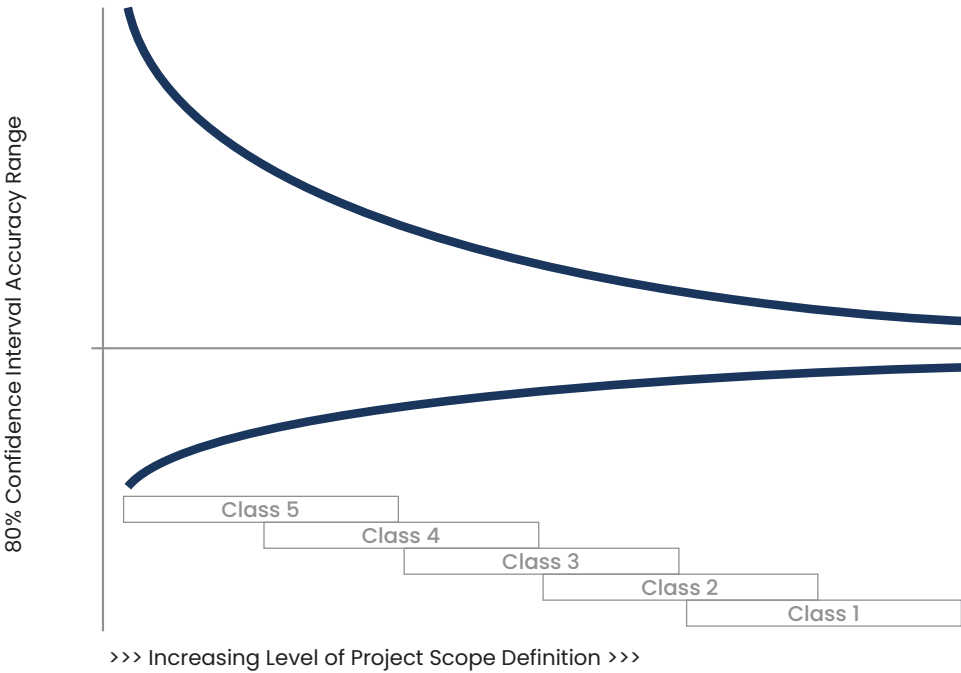
Towards more accurate cost estimates

The reductions that UK's North Sea Transition Authority (NSTA, formerly known as Oil and Gas Authority) present in their annual Decommissioning Cost Estimate report, are based on a probabilistic approach considering the accuracy of the cost estimates. Over the past years UK operators have progressed their cost estimates with high uncertainty. Starting with 72% of the total future costs having a Class 5 and 20% having a Class 4 estimate in 2017, these numbers have improved to 31% and 45% respectively in 2021. To address the possibility of operator optimism for the decommissioning scope, NSTA furthermore selects the higher end of the low and high-cost estimates. Because of more accurate cost estimates, an expected cost reduction can be reported. Nexstep has included the similar so-called ASTM (American Society for Testing and Materials) cost estimate class in our database, but so far this was not classified as an obligatory reporting parameter. In our next data survey this will be addressed such that we can report in a similar fashion to NSTA.



The Association for the Advancement of Cost Engineering has developed guidelines for estimating future expenses. As, closer to execution, a project's scope is further defined, the accuracy of the cost estimate will increase. Typically, E&P operators are using a stage-gate process for the different project phases from feasibility to investment decision. A Class 5 estimate for the feasibility phase typically has a confidence interval with a low estimate of -20% to -50% and with a high estimate of +30% to +100% around the deterministic cost estimate. For an approval of expenditure, typically requiring a Class 1 estimate, this confidence interval is much smaller (see table below).

Estimate Class	Expected Accuracy Range Typical variation in Low and High ranges at an 80% confidence interval	
	Low	High
Class 5	-20% to -50%	+30% to 100%
Class 4	-15% to - 30%	+20% to +50%
Class 3	-10% to -20%	+10% to +30%
Class 2	-5% to -15%	+5% to +20%
Class 1	-3% to -10%	+3% to +15%



The distribution of the total forecasted offshore decommissioning cost over the various categories has, as expected, not changed compared to previous years. Well decommissioning remains the largest cost factor followed by the removal of offshore installations.

Over the next decade 2.3 billion euros is expected to be spent on decommissioning with an annual spending between 120 and almost 400 million euros.

Figure 3.0.1. Annual expected costs of offshore infrastructure by category

