ID.	TG3 PRIORITIZED AREA	PROBLEM STATEMENT / CHALLENGE	SUPPORTING TECHNOLOGY & KNOWLEDGE INNOVATIONS[7]
#14	**Data gathering and optimization of drilling operations** A considerable step has been taken in drilling performance the last few years, but still there is room for further improvement in efficiency and eliminating non-productive time (NPT). There is a need for improved predictability when drilling new plays. In addition, the regular quality and accuracy of formation data should be improved to deliver optimum wells in development drilling and getting more accurate assessments of exploration wells.	The prioritized area covers the full digitalization chain: data gathering- >data management / systems - > data application. Data gathering in drilling and completion operations can be split into operational data from the drilling operation itself, formation evaluation data, and production data after putting the well on stream. The first data set can be used to optimize the drilling operations including automation and repetitiveness. This has the potential to reduce drilling time and non-productive time (NPT), and therefore reduce drilling costs and emissions significantly. In combination with formation evaluation data (MWD/LWD) it would provide better control and earlier detection of anomalies, and therefore reduce NPT, improve safety and mitigate major accident risks. Data gathering and interpretation while drilling is important for real time operations, improving the chances for landing production or injection wells in the most optimum place, as well as for improving reservoir models. Providing power downhole will simplify the drilling assemblies (BHA) and make them more compact. It will also aid in developing future sensor technologies and push BHA limits. The downhole measurement of the production flow to manage the reservoir and minimize the energy consumption of the well (see ID#1 above) is essential. The right tools for measuring temperature, pressures and composition can make a considerable difference and in combination with downhole control/ steering, the reservoir can be managed in the most optimum way for value creation and minimized emissions.	• Automated drilling operations with next generation sensor technologies, artificial intelligence and physical models. • Further robotization of rig operations. • New sensory input like measurement-while-drilling / logging-while-drilling, improved look around and look head perspectives. • More efficient data transfer like wired pipe with downhole power supply. • Development in data interpretation and display results. Utilize AI also here. • Wireless technologies for downhole production monitoring. • Improved interoperability and connectivity between systems. • Electrification of downhole components. • Inflow control devices (ICVs). • AICV development and development of interpretation models and reservoir models to simulate the effect on volumes. • Digital tools for safe and efficient simultaneous operations. • See also ID#10-13 above.

7 These are examples. Other solutions addressing the prioritized technology areas should also be sought and developed.

ID.	TG3 PRIORITIZED AREA	PROBLEM STATEMENT / CHALLENGE	SUPPORTING TECHNOLOGY & KNOWLEDGE INNOVATIONS[7]
#15	**Improved drilling equipment** Development of rig equipment is conservative and rig contractors are reluctant to take bigger investments after the difficult times they have been through. But the time is here to take a closer look at the next generation rig equipment and the operational and energy efficiency improvement required.	Less complex and more reliable equipment would reduce non-productive time, "invisible" lost time and maintenance time, which are significant contributors to drilling costs. Monitoring wellhead fatigue and having tools improving well-head fatigue is essential for having enough operating days for drilling, completion, and P&A of subsea wells. Power systems on offshore rigs are designed for peak loads, and most of the time they run at low thermal-efficiency loads. Hybrid system could improve efficiency and reduce GHG emissions.	• Electric BOP. • Improved monitoring of BOP. • Hybrid technologies and batteries. • Modelling of sea movement. • Systems and methods for mitigation of wellhead fatigue. • Systematic use of improved wellhead monitoring for fatigue. • Energy management systems.
#16	**Advancement in well construction and methodologies** Better well construction can increase recovery by making un-drillable wells drillable. It can also have significant cost and emission effects by reducing the time of the drilling operations as well as through enabling the use of less materials, e.g. through reduced casing and mud use or by avoiding additional subsea production system (SPS) equipment.	Reduce drilling time: Cost estimates in Section 3.5 suggest that drilling will contribute with almost a third of NCS investments over the next two decades. 85% of this is time dependent. Reducing productive as well as non-productive drilling time will hence contribute significantly to overall cost-reductions. Problematic wells are prone to unplanned/invisible lost time caused for instance by need to circulate mud or drilling side-tracks. Downtime (NPT) is also caused by equipment failure and drilling trouble such as stuck pipe, kicks and mud loss.	• Expand planning tools from automation of engineering to incorporate all planning (drilling, completion, intervention, well integrity monitoring and P&A). • Improved managed pressure drilling (MPD) for subsea wells on the NCS. • Improve rotating control device (RCD) technology for optimized dual gradient drilling. • Better fluid design for wellbore stability and lower friction. • Improve technologies mitigating risk of not reaching target depth in extended reach wells. • Riserless drilling post BOP installation. • Improved AICD modeling and simulation methodology for improved understanding of the effect of this tool. • Improve batch drilling methods, and utilization of dual and offline activity rigs.
		Increase recovery: 1. Drill problematic and "un-drillable" wells, e.g. inhomogeneous reservoirs with varying pressure zones. 2. Improve completion	Same as above, in addition: • Further develop autonomous inflow control devices (AICD).

ID.	TG3 PRIORITIZED AREA	PROBLEM STATEMENT / CHALLENGE	SUPPORTING TECHNOLOGY & KNOWLEDGE INNOVATIONS[7]
#17	**Subsea well intervention technologies** Technologies for cost-efficient and safe maintenance of subsea wells. The main effect of more cost-efficient subsea well intervention is added volumes from improved well productivity. Conducting subsea well interventions without heavy rigs could also save emissions.	The intervention ratio for wet wellheads on the NCS is about 70% lower than for dry wellheads. The reason is mainly the large costs of conducting well interventions on subsea wellheads relative to dry wellheads – typically 5-10 times higher from a rig than from a fixed platform. In addition, subsea well interventions are often postponed due to poor weather conditions.	• Simpler standardized well intervention systems. • Remote on seafloor devices and technologies. • Dedicated floater with operational motion characteristics for all year operations.
#18	**Recompletion and multilateral technologies** The priority "Recompletion and multilateral technologies" consists of technologies and knowledge needed to re-utilize existing wells partly or fully. The priority is also part of improved reservoir management. This priority also covers the potential volume effects of improved technologies within P&A.	Utilizing existing wells in a better way could: (i) reduce costs and emissions by reducing the number of drilling days and the need for materials; and (ii) enable new volumes as improvements in such technologies will make more resources technically and economically recoverable.	• Multi-lateral technologies with better control over each wellbore. • Technologies for sidetracking and retrofitting. • Further develop through-tubing-rotary-drilling (TTRD) and coiled-tubing-drilling (CTD). • Technologies for improved control for each wellbore. • Improve monitoring and management of production and injection in multi-lateral wells (MLW). • Well construction with life-time perspective, e.g. for later use for CCUS.
	Opportunities within utilization of existing wells that pertains to improved water management is covered in TG2 within the opportunity "Water management". Furthermore, opportunities within utilization of existing wells that pertains to subsea well interventions is covered in TG3 within the opportunity "Subsea well interventions".	Utlizing P&A technologies: This could enable new wells that would otherwise be viewed as uneconomical and enable new marginal volumes.	• Improved slot recovery.

ID.	TG3 PRIORITIZED AREA	PROBLEM STATEMENT / CHALLENGE	SUPPORTING TECHNOLOGY & KNOWLEDGE INNOVATIONS[7]
#19	**Challenging reservoirs** The opportunity "Challenging reservoirs" consists of technologies and knowledge associated with recovering tight and/or inhomogeneous reservoirs (permeability less than 10 millidarcy (mD)). Such formations often call for the use of unconventional technologies to achieve profitable development.	An NPD study suggests that 12.5 billion barrels of oil equivalents could be realized from tight reservoirs on the NCS. Costs could be high and recovery from tight reservoirs could also lead to high CO_2-emissions. Research and technology development should aim at producing such reservoirs with CO_2-emissions at least as low as conventional reservoirs.	• Improved completion technologies and stimulation. • Multi branch wells with fracking in each branch. • New fracking methods – e.g. straddle or large-scale versions of existing technologies such as Fishbone. • Mud/Polymer technologies. • Zonal control to enable production from both tight and highly productive formations in the same wellbore. • Knowledge transfer from other petroleum provinces. • Improved modelling.
#20	**More efficient P&A** P&A on the NCS is currently done with rigs. This is costly and time-consuming. More cost-efficient and at least equally safe methods should be sought to minimize the scope required to be performed with the rig. More efficient P&A should be achieved also by developing downhole tool technologies for optimized P&A that don't relate to rigless, where there still is significant room for improvements.	P&A operations have a significant cost, and it is a large well inventory that needs to be plugged on the NCS. Within P&A, the potential to minimize rig scope and leave as much metal in the ground as possible, is identified as giving the lowest CO_2-footprint and the most cost-efficient P&A. To achieve a more efficient P&A of wells, a stepwise approach is needed: • Improve the understanding of P&A Barrier integrity risk to be able to challenge the current standards (D-010). • Improved understanding could enable new alternative plugging methods. • Alternative plugging methods could enable rigless P&A, e.g. light intervention vessels equipped with wireline or coiled tubing units.	• Slot recovery. • Improve understanding of P&A barriers. • New barrier solutions, e.g. active stimulation of shale swelling. • New metal plugging techniques (e.g. Bismuth). • Tubing slicing via wireline / micro-tube removal tool (e.g. Aarbakke). • Multiple string removal technology and bond logging. • Casing removal through improved jacking solutions utilizing vibration techniques and roller expansion. • Alternative energy solutions e.g. laser and plasma. • Multiple string bond logging. • Expandable tool and solutions for improved annulus well bore sealing. • Cleaning and flushing systems for decommission of subsea wellhead and manifold systems. • New well construction design for more efficient P&A operations. • Technologies enabling a future low carbon emission and cost-efficient rig-less P&A.