The NPD’s updated estimate for undiscovered resources is 4,000 million standard cubic metres of oil equivalent (scm oe), up by almost 40 per cent from the previous report. This big growth reflects the NPD’s mapping of resources in the northern part of Barents Sea East. The new estimate shows that remaining resources can provide the basis for oil and gas production over many decades.

DISTRIBUTION BY AREA

Estimates for undiscovered resources in the North and Norwegian Seas and in Barents Sea South at 31 December 2017 (figure 3.2) are virtually the same as in 2015. Uncertainty in these estimates is greatest in areas with little information and a short exploration history, such as much of the Barents Sea. That applies particularly to Barents Sea South-East and North. Uncertainty is considerably smaller in the North Sea and the well-explored part of the Norwegian Sea.

The estimate for undiscovered resources shows that the amount remaining could provide the basis for exploration and oil and gas production over several decades to come. More than 60 per cent of undiscovered resources are expected to lie in the Barents Sea, with the remainder divided more or less equally between the North and Norwegian Seas (figure 3.3).

Liquids are expected to account for just over half the undiscovered resources. As figures 3.3 and 3.4 show, the distribution between liquid and gas varies from one sea area to another.

HISTORICAL CHANGES

The estimate for total undiscovered resources has varied over time (figure 3.5). New knowledge from mapping and exploration wells may lead to substantial revisions of the figures, both positive and negative. Over time, however, estimates will reduce naturally as prospects are drilled. After rising from 1996 to 2002, the estimates declined up to 2017. The discovery of Ormen Lange in 1997 raised great expectations for a number of large structures in the deepwater areas of the Norwegian Sea. However, disappointing wildcats prompted a downgrading of the estimates in 2003. That related particularly to the gas potential in the deepwater areas.

While the estimate for the Barents Sea increased in 2010, those for the North and Norwegian Seas were reduced. These reductions primarily reflected lower expectations for gas. The main reason in the Norwegian Sea was further disappointing exploration results with large structures in the deepwater areas. Changed expectations of the potential off Lofoten, Vesterålen and Senja, based on seismic data acquisition and mapping by the NPD, also affected the results. See the NPD’s 2010 reports on Petroleum resources in the sea areas off Lofoten, Vesterålen and Senja, and Geofaglig vurdering av petroleumressursene i havområdene utenfor Lofoten, Vesterålen og Senja (in Norwegian only).

The background for the 2012 increase in the Barents Sea was the NPD’s mapping and inclusion of Barents Sea South-East. This area was incorporated in the Norwegian sector after the boundary treaty with Russia came into force in 2011. In the same year, the sea areas around Jan Mayen were included in the estimate for the Norwegian Sea. That increased the total estimate for undiscovered resources.

Before 2017, the resource estimate for the Barents Sea primarily covered undiscovered resources in Barents Sea South – including those in plays which extend into Barents Sea North. The NPD’s mapping of the latter area in 2016-17 led to the eastern part being separated out with its own estimate. See the NPD report on Geological assessment of petroleum resources in eastern parts of Barents Sea North 2017. This area accounts for about 35 per cent of the undiscovered re-
Fact box 3.2: Undiscovered resources are estimated for each play

The estimate for undiscovered resources is based on the NPD’s analyses of available data from the NCS. These assessments cover company and NPD interpretations of seismic data, mapping, studies and evaluations of prospectivity in areas both open and closed for petroleum operations. Data from wells, discoveries, fields and mapped prospects occupy a key place in this work. The NPD uses this information to define plays and then to develop a resource estimate for each of these.

A play is a geographically delineated area where several geological factors interact so that producible petroleum can be proven. These are as follows. 1) A permeable/porous reservoir rock, where petroleum can accumulate. Reservoir rocks in a specific play will be at specified lithostratigraphic levels. 2) A trap, which is a tight rock or geological structure encasing the reservoir rock so that petroleum is retained and accumulated. The trap must have formed before petroleum has ceased to migrate. 3) A source rock, such as shale, limestone or coal, containing organic material which can be converted to petroleum. This rock must also be mature – in other words, temperature and pressure must be such that petroleum actually forms. A migration route has to exist so that petroleum can move from source to reservoir rock. A play is confirmed when it yields producible petroleum. Production does not have to be commercial. If producible petroleum has yet to be proven, a play is unconfirmed.

A prospect is a possible petroleum trap with a mappable, delineated rock volume.

For a more extensive description of the methodology, see the resource report for 2016.
**WELL AND RESOURCE DENSITY**

With some exceptions, the North and Norwegian Seas and Barents Sea South have been opened for petroleum operations. These areas total about 579,000 km². By comparison, mainland Norway covers some 324,000 km².

Wildcats completed at 31 December 2017 totalled 731 in the North Sea, 241 in the Norwegian Sea and 116 in Barents Sea South. Figure 3.7 shows the number of wildcats per block as an illustration of the degree of exploration.

Total resource density (proven and undiscovered) in Norway’s North Sea sector is very high, at 66 million scm oe per 1,000 km². This is very high, also in a global context, and comparable with the best petroleum provinces in the Middle East.

The Norwegian and Barents Seas cannot be compared with the North Sea, which represents a unique source of oil and gas that is organically rich Late Jurassic shales. These rocks extend across much of the North Sea at a favourable depth for generating hydrocarbons. Moreover, the traps formed at a favourable time in relation to hydrocarbon migration. Similar conditions are found on the Halten and Dønna Terraces in the Norwegian Sea. However, traditional plays with Jurassic source and reservoir rocks do not function in the deepwater areas to the west. These sediments lie too deep. On the other hand, a potential exists in younger Cretaceous and Palaeocene rocks.

Geological developments in the Barents Sea have differed greatly from those in the North Sea, and were strongly influenced by several phases of burial, uplift and subsequent erosion. As a result, Jurassic rocks only lie at a favourable depth for generating hydrocarbons in certain areas. Uplift and erosion have also meant that petroleum is not always retained in the traps, primarily because of leakage. In areas where Jurassic rocks are absent or too shallow, Triassic or older sources could generate hydrocarbons. These source rocks do not appear to be as rich as their Jurassic equivalents in the North Sea.

The Barents Sea is a very large area, and extensive parts of it are relatively little explored. Its geological history is more complicated than in the other sea areas. Every well, whether dry or proving a discovery, provides new information about the geology and petroleum systems. Most of the prospects to be drilled in 2018 are geologically independent of those explored in the NCS.
Shallow drilling is used to acquire data on the sedimentary strata. Measuring five-seven centimetres in diameter, the cores acquired provide information on rocks types and sedimentary structures. They can also provide the basis for indicating the potential of the formations to act as source, reservoir or cap rock. These cores provide a good foundation for regional correlations and increased understanding of geological developments. The drilling depth of this type of well is limited to 200 metres beneath the seabed.

Geological investigation of Barents Sea North began with the acquisition of 2D seismic data in the mid-1970s. A need eventually arose to acquire geological samples to understand which rocks (reflectors) were giving the signals which appeared on the seismic maps. Knowledge about the age of the rocks was also important for understanding geological developments in Barents Sea North over time. A number of scientific shallow wells were drilled in the late 1980s to learn more about the geology of the area.

Funds were appropriated over the government budget in 2015 for shallow drilling, and geological material was obtained from cores up to 200 metres long. The primary area for this acquisition was south and north of Kvitøya. The NPD drilled seven wells at locations chosen on the basis of 2D seismic data (Figure 3.10). The aim was to take cores from lithostratigraphic boundaries which occur mainly at deep levels in the Barents Sea but which, for various geological reasons, are shallower in the area investigated. A total of 1 048 metres of geological material were recovered, and these cores have increased understanding of the geology in northern parts of the Barents Sea.

Results from the six shallow wells south of Kvitøya showed that the oldest rocks are Carboniferous and Permian carbonates and shales. The boundary between Permian and Triassic is well preserved in the cores. Cores from the seven wells have been subjected to detailed geochemical analyses. Rocks with a good to very good source potential are found in the six southernmost wells. Gas analyses also show that the area has a functioning source rock. Oil samples from well 7933/4-U-3 show a marine source rock, probably from the Triassic.

See the 2016 resource report and Geological assessment of petroleum resources in eastern parts of Barents Sea North 2017 (NPD) for more information on the NPD’s acquisition of geological data and mapping in unopened areas of the NCS.