RESOURCE REPORT 2017

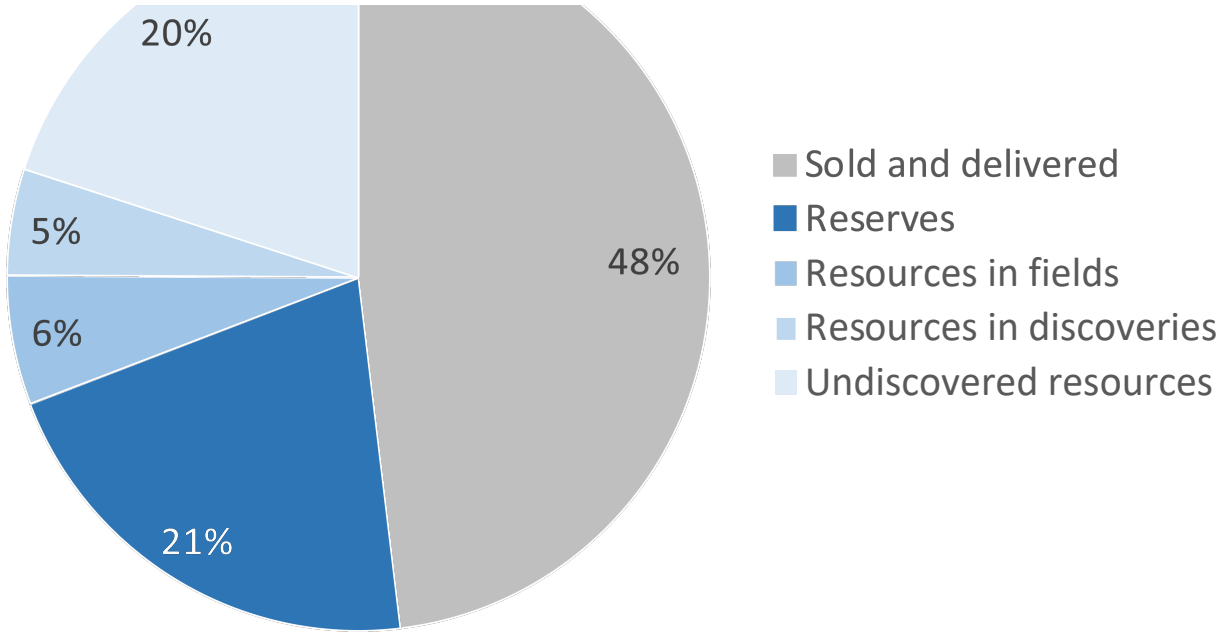
More than half left

Oljedirektoratet 14.06.2017

Greater knowledge and new solutions have increased estimated resources on the Norwegian continental shelf (NCS). After almost 50 years of offshore production, more than half these assets remain to be recovered. Continued learning and technological advances could boost the estimate even further. These resources represent big value.

Resource accounts 2016

Total petroleum resources on the NCS were estimated at 14 284 million scm oe at 31 December 2016. The NPD's resource accounts provide an overview of total expected recoverable petroleum, including amounts yet to be discovered. They build on information reported to the NPD by the operators as well as the directorate's own data



Large remaining resources

Sold and delivered: 6 863 million scm oe

Reserves: 3 009 million scm oe

Reserves are oil and gas resources sanctioned for development.

Resources in fields and discoveries: 1 542 million scm oe

Resources are oil and gas proven and expected to be recovered, but not sanctioned for Development.

Undiscovered resources: 2 870 million scm oe

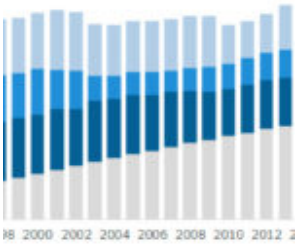
Undiscovered resources have not been proven and are not discussed in this report. See the resource report for 2016 for details about them.

Undiscovered resources in Norway's Barents Sea sector have almost doubled after new mapping in the eastern part of Barents Sea North. The results of this work were published on 25 April 2017, and will first be incorporated in the resource accounts for 2017 due to be published in February 2018.

READ MORE: Full resource accounts for 2016

Possible additions to the resource accounts

Large quantities of petroleum are excluded from the resource accounts because they are either non-commercial or not technically recoverable today. Maturing and adopting technology could also make part of these resources profitable. This is referred to here as the technical potential.



Estimated resources up 40 per cent since 1990

Greater knowledge and new solutions have increased estimated resources on the NCS by 40 per cent since 1990. A number of fields have more than doubled their resources since the first production estimates were made

Historical development of estimated resources

NPD's target for resource growth

The NPD has established an ambition for increasing reserves in 2014-23 by 1 200 million scm of oil. This is intended to ensure that attention is focused on expanding reserves while making it possible to follow up developments systematically.

Updated status of target for growing oil reserves

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RESOURCE REPORT 2017

Development of the NPD's resource estimate

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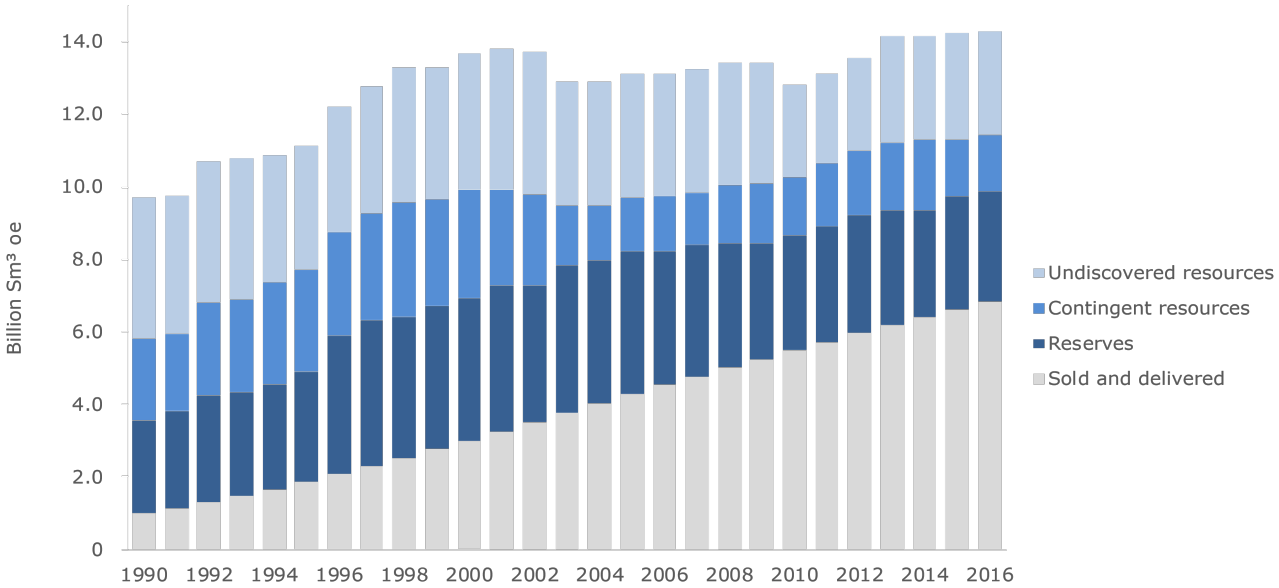
The NPD's overall resource estimate has risen by 40 per cent since 1990. Total proven resources alter as a result of new discoveries and changes to estimates for individual fields. The latter can rise as a result of drilling appraisal wells, mapping, and conducting detailed studies which improve knowledge of reservoir size and recovery mechanisms.

Oil and gas resources



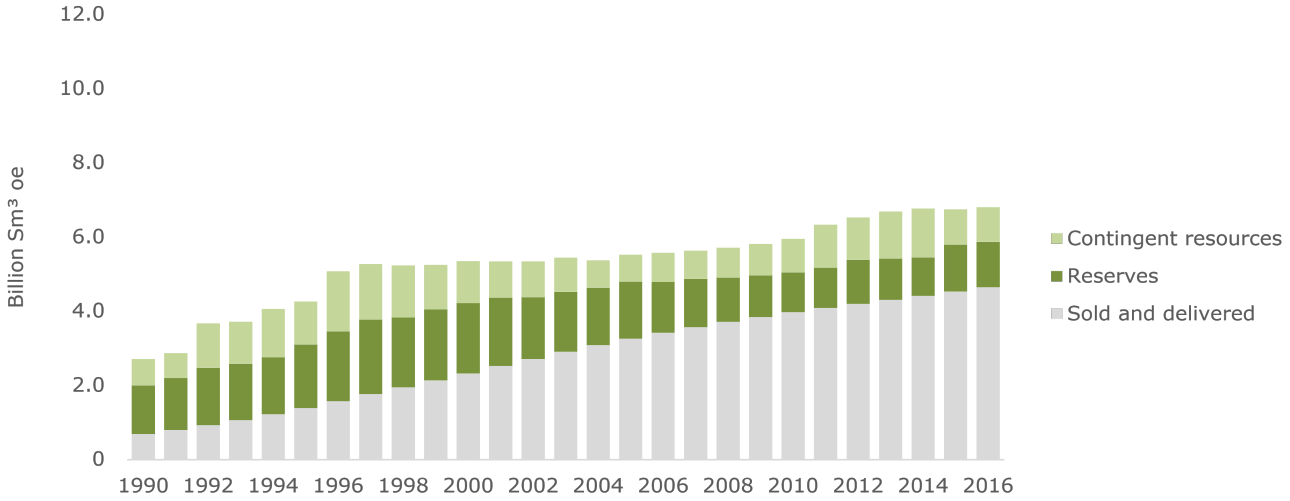
Total estimated resources at the end of each year. Changes in the distribution reflect maturation. New discoveries, for example, mean that volumes move from undiscovered to contingent resources.

Many examples of a substantial increase in resources can be found on the Norwegian continental shelf (NCS). The estimated amount of oil and gas in many fields has more than doubled since the first recovery estimates were produced. Ekofisk and Troll made the biggest contributions to boosting resources in the 1990s.

Oil resources

The growth in 1990-96 derived both from a detailed review of project opportunities in fields and from the discovery of large fields such as Grane and Norne during this period. This was

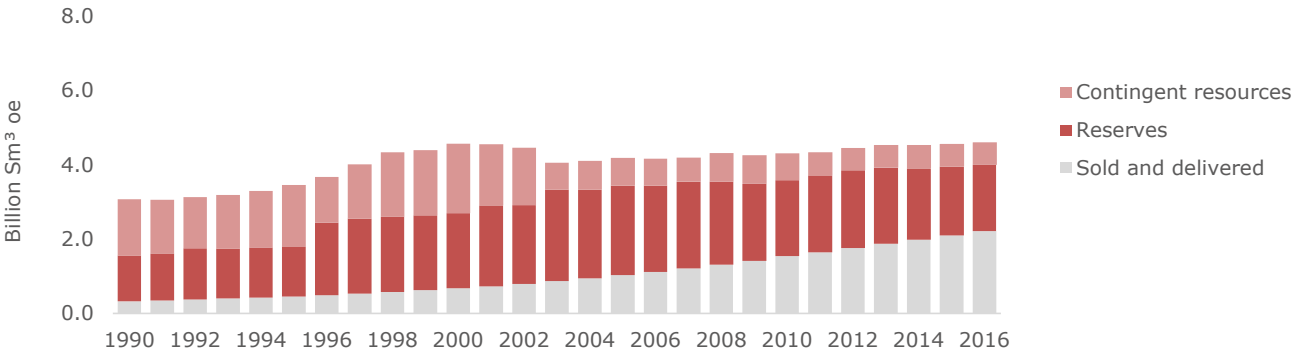
followed by a number of years with a steady rise in resources until the Johan Sverdrup discovery provided a sharp upturn.



Estimated proven oil resources at the end of each year.

Gas resources

A change made by the NPD in 2003 in the method used to calculate recovery from fields led to a reduction in recoverable gas resources. Subsequently unchanged, this approach now forms the basis for the NPD's estimates and analyses..



Estimated proven gas resources at the end of each year.

Improved recovery from fields

Water injection, several new installations and an increased number of wells on Ekofisk mean that expected recovery is now more than three times above the estimate in the first development plan.

The Ekofisk field. (Photo: ConocoPhillips)

On Troll, oil reserves are now four times greater than had been assumed when the decision to develop was taken. The main reason is continuous development of the field, with a number of new installations and a commitment to drilling and completion technology. At the same time, gas recovery has increased through measures to reduce reservoir pressure.

Johan Sverdrup was estimated to be a medium-sized oil field in 2010, with opportunities for further growth through continued drilling activity. It is now more than 20 times larger than that initial estimate

Reasons for reductions in estimate resources

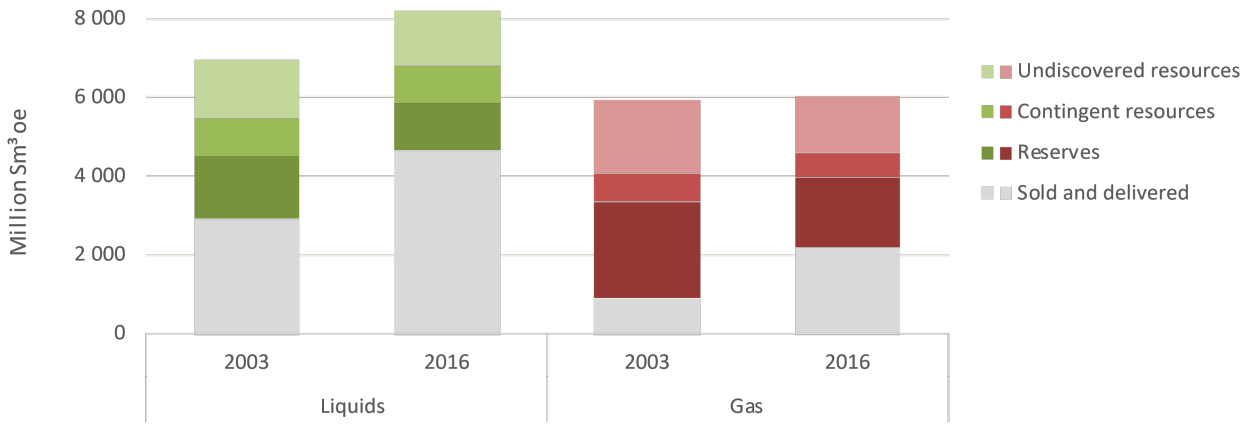
Expected recoverable resources can also be reduced. This could occur if resources in place prove to be smaller than first thought, or because producing the field is more complicated than predicted.

Resources can also decline if projects are not regarded as sufficiently profitable. In most cases, the resource base for projects which are not implemented remains in place. New technology, other concepts or changes in profitability calculations may allow such resources to be developed later.

Biggest increase for oil

Growth in the resource estimate has primarily been driven by an increase in the estimated quantity of oil. The latter accounts for more than 85 per cent of remaining proven fluids. Natural gas liquids (NGL) and condensate are the other fluid products.

Proven fluid resources in 2016 were almost the same as the estimated figure in 2003, and much more is expected to be found. Proven resources increased by 20 per cent or 1.9 billion scm oe over the same period.



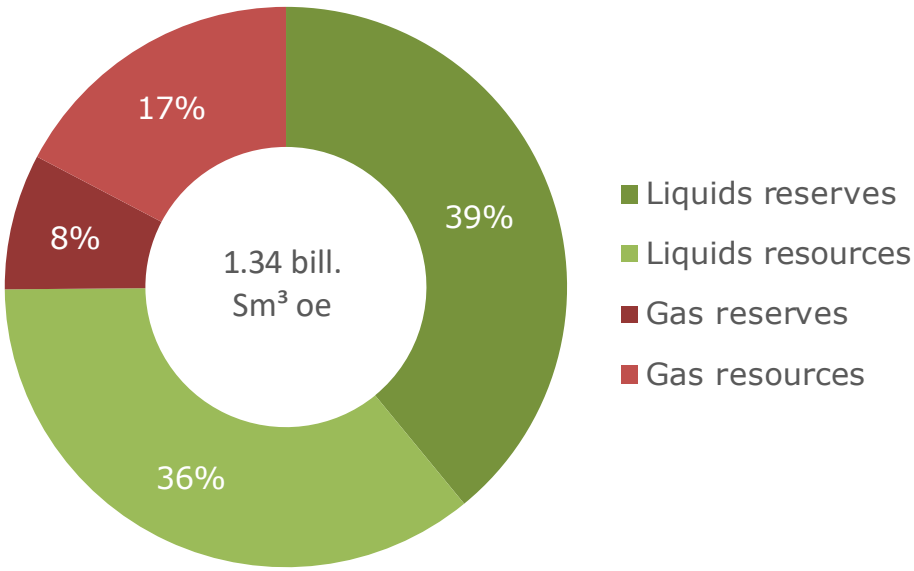
Resource accounts for 2003 and 2016 for liquids and gas respectively.

The estimate for total gas resources has risen marginally since 2003. Sold gas and gas reserves add up to about the same figure as proven gas reserves in 2003. Undiscovered and contingent gas resources are slightly higher than the estimated undiscovered quantity in 2003.

New fields contribute most

About 70 per cent of the growth since 2003 has come from discoveries made during the period. The remainder derives primarily from measures implemented or planned to improve recovery from the fields.

The figure below shows the status for and volume of discoveries since 2003. Fluids account for 75 per cent of proven petroleum resources. More than half the fluids and a third of the gas discovered since 2003 have been sanctioned for Development..



Status and volume of resources discovered since 2003.

Big oil discoveries

Johan Sverdrup, the biggest oil discovery after 2003, has reserves of 298 million scm oe in its first development stage. In addition, plans call for substantial resources to be developed in subsequent phases on the field.

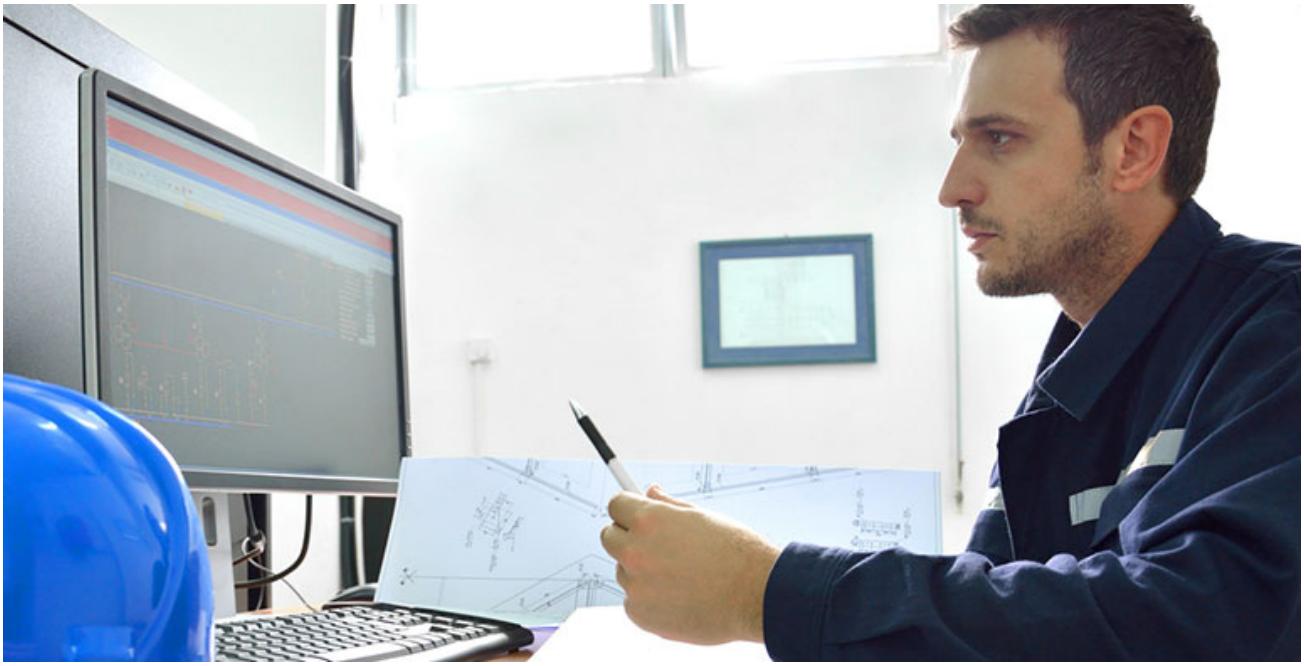
A number of other large oil discoveries have also been made, including 7220/8-1 Johan Castberg and 7324/8-1 Wisting in the Barents Sea. Both are expected to yield more than 50 million scm of oil.

Gas discoveries

The biggest gas discovery since 2003 is 6406/9-1 Linnorm, with 24.9 million scm oe of recoverable resources. Dvalin is the largest sanctioned for development, with recoverables of 18.8 million scm oe. A plan for development and operation (PDO) was submitted in 2016..

Projects on fields contribute to reserve growth

Measures and new projects on the fields added more than 500 million scm oe to recoverable resources in 2003-16.



Substantial efforts are devoted to continued development of fields. That helps to extend their producing life and improve recovery

Contributors to this growth include:

- optimising recovery
- constructing new production facilities
- extending the producing life of Fields
- identifying new opportunities

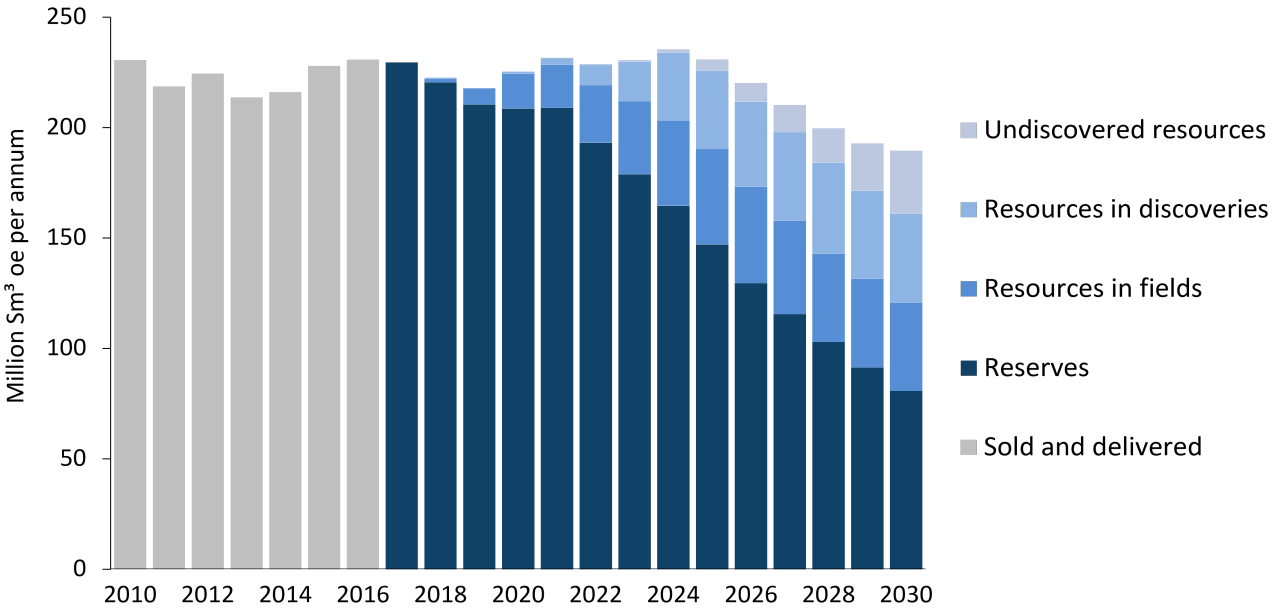
- drilling many new wells.

READ MORE: Projects on fields yield substantial reserve growth

Production forecast

All the resources in the accounts are expected to be produced, but the future level of production will depend on such factors as:

- which measures have been implemented on the Fields
- which discoveries are sanctioned for development, and when they are due to come on stream
- which new discoveries have been made, how large they are, and how and when they are developed.



Production history and forecasts broken down by maturity of resources, 2010-30. As the figure shows, the level of production is expected to be relatively stable in coming years.

According to the production forecast, output is expected to remain at the level maintained so far in this decade. The contribution from petroleum sanctioned for development will stay at a high and stable level over the next five years. While the level of production will be maintained in the subsequent five years, the contribution from resources in fields and discoveries yet to be sanctioned for development will increase. Undiscovered resources are expected to acquire greater significance for production towards 2030.

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Target for growth in oil reserves

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The NPD has established an ambition of increasing reserves in 2014-23 by 1 200 million scm of oil. This is intended to ensure that attention is focused on expanding reserves while making it possible to follow up developments systematically.

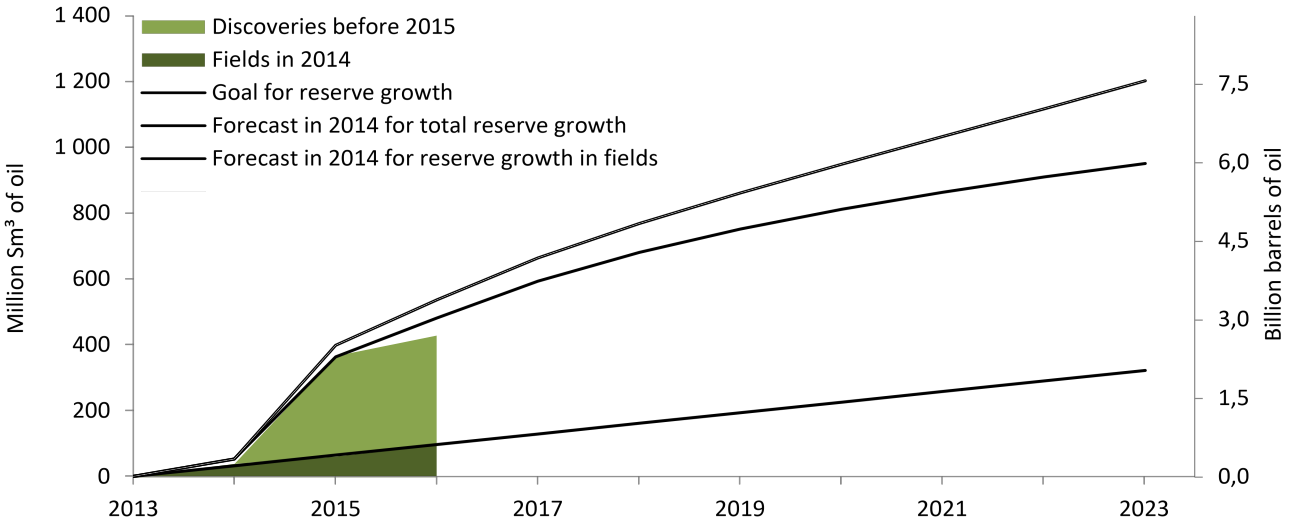
Launched in the 2014 resource report, the target continues a similar goal introduced in the 2005 resource report. This is summarised in the report on Evaluation of reserve growth for oil – 2005-2014.

The new ambition for reserve growth is 50 per higher than its predecessor. That increase largely reflects a substantial expansion of oil in the discovery portfolio since 2005

Status

The figure below presents the rise in oil reserves compared with the growth rate in the 2014 forecast. "Fields in 2014" represents the increase in reserves from fields which were on stream or sanctioned for development before the target was set. Growth here has been in line with the forecast.

"Discoveries before 20915" represents oil reserves in fields proven before the target was set, and sanctioned for development afterwards. The figure shows that development decisions in 2016 yielded a smaller-than-expected rise in reserves.



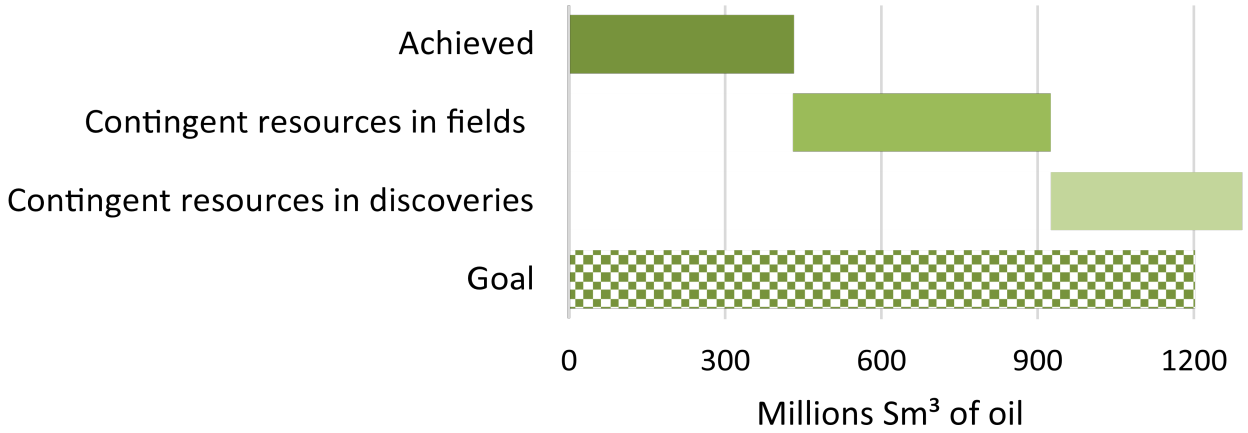
Growth of oil reserves in fields has matched expectations, while growth in discoveries is somewhat lower than forecast.

Optimistic about meeting the target

The first development phase on Johan Sverdrup was sanctioned in 2015. Five plans for development and operation (PDO) were submitted in 2016. Based on figures from the companies, the NPD expects the 2016 level to be maintained over the next few years. Big projects such as the next development stage on Johan Sverdrup and bringing Johan Castberg on stream will make a strong contribution to reserve growth in the near future.

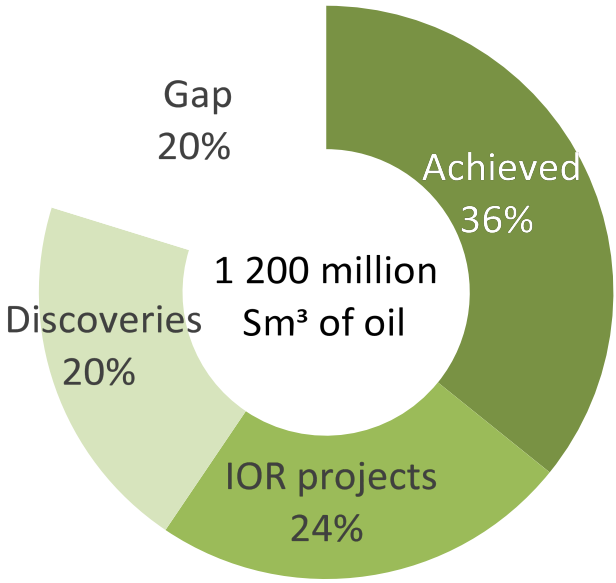
Development phases 1 and 2 on Johan Sverdrup. (Artist's impression: Statoil)

In addition to 991 million scm covered by development plans, 863 million scm of oil is found in fields and discoveries not currently scheduled for recovery. If all these projects are concretised and sanctioned by the end of 2023, total growth in oil reserves would be almost 1 300 million scm over the decade – in other words, well above the target set in 2014.



However, not all these projects are likely to be sanctioned by 2023. That applies particularly to the least mature and concrete projects. Resources concretised in field projects and

discoveries represent the growth expected to be sanctioned by 2023. The gap shows the additional decisions required.



Updated status for achieving the goal.

The resources are identified. This emerges from the NPD's resource accounts. New discoveries will also be made which could be sanctioned for development within the target period. The NPD is accordingly optimistic about meeting its goal.

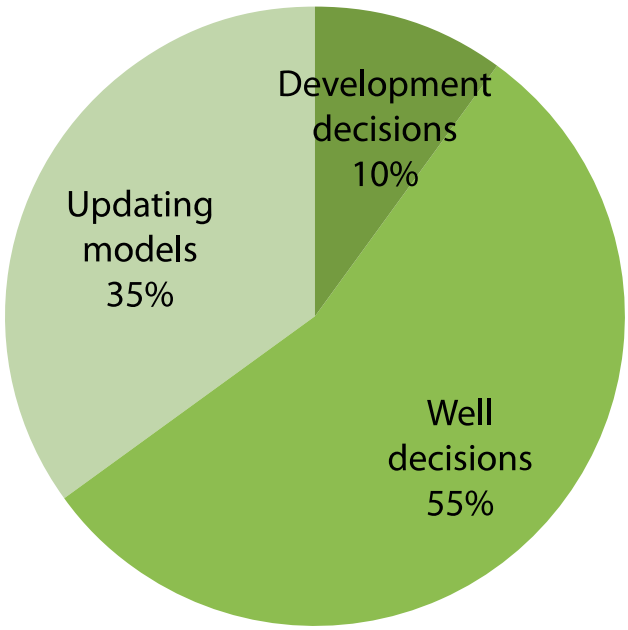
Above expectations on fields

At 31 December 2016, fields had contributed four per cent more than expected when the target was set. Given the challenges faced by the industry since the spring of 2014, this must be regarded as a positive development.

The companies are taking action to improve recovery, decide on additional wells, and concretise new measures despite the decline in oil prices. Much work nevertheless remains to be done. Recovery from the fields must be further improved, and the licensees must decide on new measures if the target is to be met.

Drilling production wells makes the biggest contribution to reserve growth. (Photo: Lundin)

Growth in oil reserves on fields amounts to 101 million scm. More than half of this increase derives from drilling decisions. Development and adoption of new drilling and well technology must therefore have high priority.

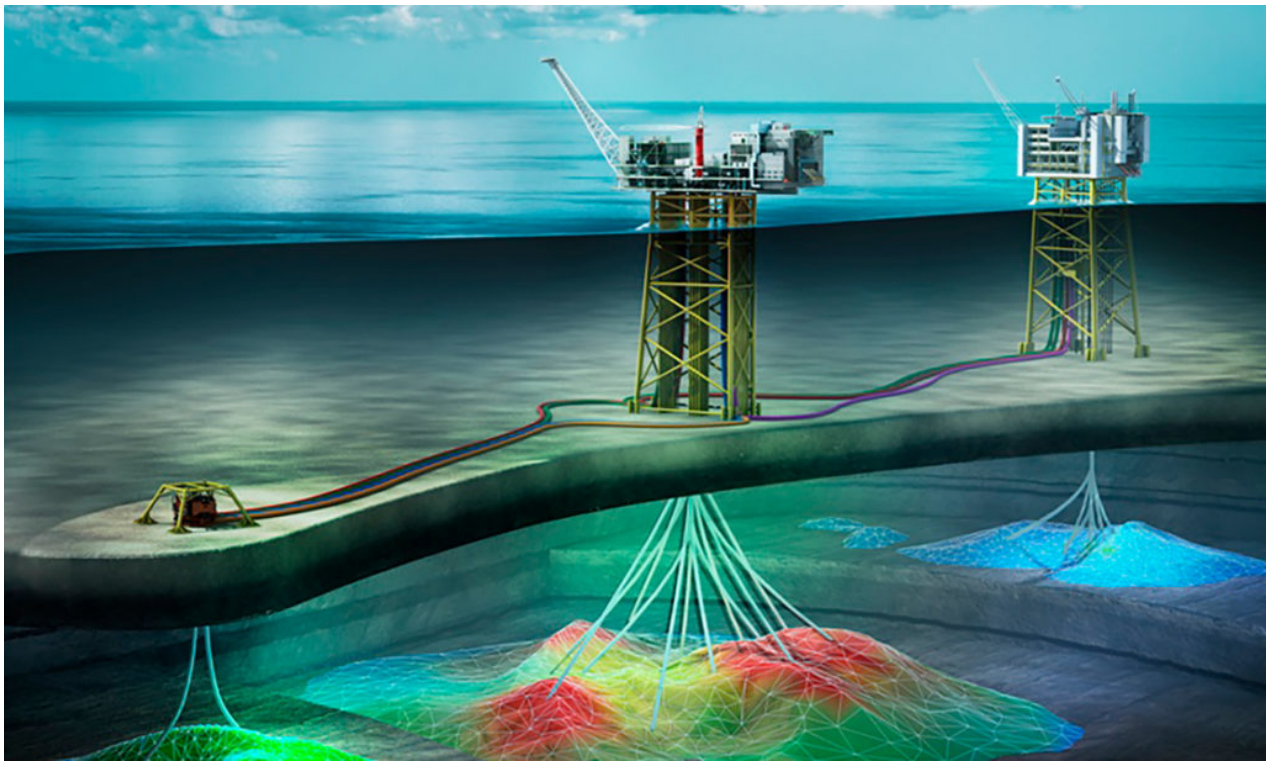


The main reason for reserve growth on fields is decisions on drilling more wells.

Decisions to develop supplementary resources in fields (which also requires the drilling of additional wells) contributes 10 per cent. Supplementary resources cover deposits associated with the field but not covered by the applicable PDO. An example is the deposits which make up the west flank of Oseberg. A decision to develop these was taken in 2015.

"Updating of models" contributes 35 per cent. This category embraces such changes as updating reservoir models and computational assumptions.

An example of such adjustments is provided by the Ivar Aasen field, where further investigation after the development decision showed that it was larger than earlier thought. That led to its reserves being increased by more than 30 per cent.



Further investigation of Ivar Aasen showed that this field was larger than earlier thought. (Artist's impression: Aker BP

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