

Oil (and/or gas) reserve definitions

Nobody can know precisely how much oil exists under the earth's surface or how much it will be possible to produce in the future. All numbers are, at best, informed estimates. Within the broad concept of oil 'reserves', there are several key distinctions, most notably those of proved, probable, and possible reserves.

Estimated Ultimate Recovery (EUR)

A hydrocarbon reservoir contains a finite, but unknown, resource of oil. EUR is an estimate of the total amount of oil that could ever be recovered from the volume initially in place. It is a subjective estimate, formed using incomplete information. Whilst some consider EUR to be fixed by geology and the laws of physics, in practice, estimates of EUR can change as knowledge grows, technology advances, and the economic environment evolves.

The EUR is typically broken down into three main categories: cumulative production, discovered reserves, both commercial and sub-commercial, and undiscovered resource. Cumulative production is an estimate of all of the oil produced up to a given date. Discovered, commercial, reserves, are typically broken down into proved, probable, and possible reserves.

Proved reserves

Although there is no single, universally accepted technical definition of proved reserves, the most widely agreed is "those quantities of petroleum anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions"¹. A probability cut-off of 90% is often used to define proved reserves, meaning that the proved reserves of a field are defined as that volume with a 90%, or greater, chance of being produced over the lifetime of the field. In this sense, these proved (1P) reserves are a conservative estimate of future cumulative production from a field.

N.B. in the Statistical Review, data have been compiled using a combination of primary official sources and third-party data which may use different probability cut-off points. Every effort is made to align these figures to report on the same basis. Unfortunately, it is not possible to guarantee that these are all on this 90% basis.

Probable reserves

Probable reserves have been variously designated as 'indicated' or 2P reserves, the latter referring to reserves which are estimated to have a better than 50% chance of being technically and economically producible.

Possible reserves

Possible reserves have been designated as 'inferred' reserves, sometimes referred to as 3P. These volumes include reserves which, at present, cannot be regarded as 'probable', but are estimated to have a significant (albeit less than 50%) chance of

¹ Society of Petroleum Engineers, Petroleum Resources Management System, June 2018, p. 3

being technically and economically producible. Frequently, a 10% cut-off is used for 3P reserves.

In general, a portion of a field's probable and possible reserves tend to get converted into proved reserves over time as operating history reduces the uncertainty around remaining recoverable reserves: an aspect of the phenomenon referred to as 'reserves growth'.

Similarly, over the lifetime of a prospect from discovery to production, oil volumes will be move from the "sub-commercial" to the "commercial" as information, technology and the economic environment change such that an development decision can be made.

Therefore, for oil to be classified as reserves it "must be discovered (*information*), recoverable (*technology*), commercial (*economics*), and remaining (as of a given date) based on the development project(s) applied"². Whilst the progress of technology is generally agreed to be in one direction, both the information and economic environment can act on reserve classification in both directions.

Recovery Factor

The ratio of reserves to oil initially in place for a given field is often referred to as the recovery factor. Recovery factors vary widely across countries, geologies and technologies, and may change over time based on operating history and in response to changes in technology and economics. For the UK, for example, the expected recovery factor from the Continental Shelf is 43%, such that of the resource initially in place, 57% will remain in the ground.³

The recovery factor may also rise over time if additional investment is made in secondary recovery techniques that change reservoir or resource characteristics, such as gas injection or water-flooding to augment the natural pressures within a given reservoir.

There is an observed tendency for recovery factors to rise over time, to make the finite resource go further: this is another aspect of reserves growth and a major factor behind increases over time in estimates of ultimate recoverable resource made by organisations such as the US Geological Survey.

² Society of Petroleum Engineers, Petroleum Resources Management System, June 2018, p. 3. with parentheses/ italics added by BP for clarity.

³ UK Oil and Gas Authority, Recovery factor Benchmarking, September 2017.