

Fossil fuels and minerals

Scotland has a wide range of natural resources for energy, construction and manufacturing, making a major contribution to the economy.



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Summary

Scotland's geological resources are all those materials that can be extracted from the Earth and used in practical applications. They include fossil fuels for energy; materials used in construction; metallic minerals; and a wide range of other 'industrial minerals' that are used, for example, to make glass and ceramics. In 2010 the total value of minerals produced onshore in Scotland was over £550 million, while in 2009 direct oil and gas exports from Scotland were valued at [£2.5 billion](#). Geological resources underpin a significant part of Scotland's economy, and are crucial to many aspects of modern life. Many of these resources are non-renewable, and therefore need careful management.

Introduction

Scotland's geological resources are part of its wider geodiversity, and have been exploited for thousands of years, since early inhabitants used local stone for building and toolmaking. Lead and silver have been mined in Scotland since the 13th century, and some of the major deposits were known in Roman times. The Industrial Revolution in Scotland was largely driven by the availability of coal in the Central Belt, and most of Scotland's cities are built from local stone. More recently, offshore oil and gas have boomed. The range of geological resources found in Scotland underpins many aspects of our daily lives, being particularly important for energy and construction. This topic covers both land-based and offshore resources.

Scotland has abundant fossil fuel resources for energy, including onshore coal and offshore oil and gas. Some areas may also be suitable for the production of geothermal energy. Widespread areas of hard rock, and sand and gravel can provide all the aggregates needed for construction and infrastructure development. There are many areas of rock suitable for use as building, paving and roofing stone, although these are currently only worked to a limited extent due to the availability of cheap imports. Some smaller deposits of certain industrial and metallic minerals also occur in Scotland. [Groundwater](#) can also be considered as an important resource.

Description of fossil fuels and minerals



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Energy resources

Scotland and the surrounding continental shelf are rich in fossil fuel resources, chiefly onshore coal and offshore oil and gas. Peat is also worked for fuel on a small scale.

Extensive coal deposits are found in the Central Belt, and have been mined on a large scale since the 18th century. In the past, coal was extracted from underground mines, but all coal mining in Scotland is now opencast. Total annual production of coal in Scotland has been in the range of 5–8 million tonnes during the last decade ([6 million tonnes in 2010](#)). Scotland still has a significant coal resource, with almost [30 million tonnes of coal](#) at consented opencast sites in Scotland, as well as other deposits, including deeper coal seams that remain unmined. Extensive exploration in the past means that the location of most coal deposits is well known¹.

In the future, some of Scotland's coal could be exploited through new technologies, such as underground coal gasification (UCG) or coal bed methane (CBM). UCG is a method of converting deep coal into a synthetic combustible gas while still underground, which allows energy to be extracted from coal resources that cannot be mined by conventional means. CBM involves extraction of the methane that occurs naturally within coal seams, leaving the coal unaltered.

The development of new methods such as these mean that Scottish coal has the potential to make a major contribution to the country's energy budget for many years to come. However, the use of coal would need to be balanced with the drive towards a low carbon economy, for example through the use of carbon capture and storage (CCS).

Oil was produced onshore in central Scotland from oil shales during the latter part of the 19th century. These shales may now also offer the potential for shale gas extraction.

However, the main resources of oil and gas lie offshore, in the North Sea and on the Atlantic margins west of Shetland, and those in the North Sea have been exploited on a large scale since the 1960s. Some 39.5 billion barrels of oil equivalent have been extracted from the UK Continental Shelf since 1970. Although the North Sea is a mature oil and gas province, widespread exploration continues on the Atlantic margins, and ongoing exploration and development are expected to continue to prove new reserves. Current estimates suggest that there could be up to [24 billion barrels of oil equivalent still to be recovered](#), indicating that oil and gas could continue to make a major contribution to the Scottish economy at least until 2035.

The longevity of the oil and gas industry will depend on the price of oil and gas, the tax regime and technological developments, as well as exploration and operational costs. Oil and gas are currently Scotland's principal sources of fuel and power, although their contribution to electricity generation is expected to reduce as renewables become more important.

Many oil and gas fields in the North Sea that are approaching, or at the end of, production, are likely to offer appropriate locations for CCS. This involves capturing carbon dioxide from large emission sources such as power stations, and storing it in suitable rock units deep beneath the Earth's surface. Although CCS technology is currently at a developmental stage, [research has shown that Scotland has large areas of rock that would be suitable for carbon dioxide storage](#).

Geothermal energy for heating can be extracted from shallow levels (e.g. via ground source heat pumps) in many areas, and the possibility that substantial reservoirs of geothermal energy exist at deep but accessible levels in some parts of the country is now being investigated.

Construction resources

Scotland's varied geology provides extensive resources of raw materials for construction. Hard igneous rocks are common throughout much of Scotland, and these are widely quarried for aggregate, particularly dolerite in the Central Belt and granitic rocks elsewhere. [Over 19 million tonnes of igneous rock were quarried in Scotland in 2010](#), with a large proportion coming from Scotland's only coastal superquarry at Glensanda, on Loch Linnhe, which has an annual production capacity of over 9 million tonnes. Smaller amounts of sandstone are also quarried for aggregate and building stone, and limestone and dolomite are quarried in a few localities for both construction and agricultural purposes. Some aggregate is also dredged from offshore areas.

Scottish aggregate is largely used within the UK, in road building and other infrastructure, but some is exported. Aggregate production was relatively stable over the decade to 2008, but has since seen a drop due to the recession. Scotland has an abundant resource of hard rock for aggregate, which has the potential to supply domestic demand for many decades to come.

Deposits of glacial sand and gravel are common across Scotland, and were the main source of aggregate prior to the 1970s, but have since been overtaken by crushed rock². They typically form relatively small deposits, and many of those close to urban centres have already been worked out or are not accessible for quarrying. Around 8 million tonnes of sand and gravel were quarried in Scotland each year from 2002 to 2010.

The great diversity of bedrock geology in Scotland is reflected in its substantial and impressive stone-built heritage. The local variations in stone type and architectural style that accompany the changes in local bedrock character – for example the extensive use of Rubislaw granite in Aberdeen and Craigleith sandstone in Edinburgh – provide many of Scotland's settlements with a distinctive identity and sense of place. Much of the stone-built heritage dates from the 19th century, when many hundreds of quarries throughout Scotland produced building stone. Today, only a handful of Scottish quarries supply stone for building and paving, and much of the natural stone used today is imported from England and further afield. Having been out of favour for many decades, the demand for local stone is now rising due to growing interest in using it in modern buildings, increased funding for townscape heritage and urban regeneration projects, and the need to repair decaying stone buildings. New and varied sources of local building stone will be required in future to meet the growing demand.

Industrial minerals

Relatively small amounts of clay and fireclay are worked for brickmaking. Talc, largely used for roofing felt, is worked in a quarry on the island of Unst in Shetland. Scotland has some deposits of silica sand that meet the purity specification required for glassmaking, largely in the Central Belt, where there are a small number of working quarries. A high purity silica sand mine at Lochaline was closed in 2009. Around 500,000 tonnes of silica sand was produced in Scotland per year between 2002 and 2008 (figures are not available for 2010). Scotland has significant resources of silica sand, which could be worked in the future.

Barytes is an industrial mineral, which is principally used as a component of drilling mud in oilfields. Scotland has large deposits of barytes in the area around Aberfeldy, and these are currently worked at the Foss mine, which produced over [30,000 tonnes of barytes in 2010](#). A larger barytes deposit with measured resources of some [7 million tonnes](#) exists nearby but is not currently worked.

Metallic minerals

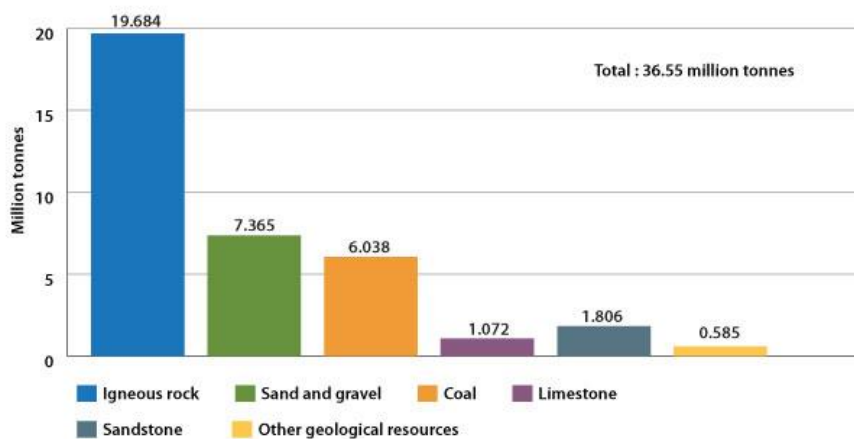
No metalliferous mines are currently working in Scotland, despite the country's long history of metal mining, with lead having been worked in the Leadhills area since the 13th century. The principal production of Scottish lead, together with small amounts of silver and gold, was at mines in the Leadhills–Wanlockhead, Tyndrum and Strontian areas. During the 19th and 20th centuries, substantial amounts of chromite were extracted from quarries on Unst, and iron ore from the Midland Valley³.

Significant gold deposits are known to exist, particularly that at Cononish near Tyndrum, which has been mined on a small scale in the past, and is currently the subject of exploration. It is considered to have resources totalling [154,000 ounces of gold and 589,000 ounces of silver](#). Exploration for other economic gold deposits continues in the area, and other small gold prospects are known to be in a number of places in Scotland.

It is likely that there will be an increase in demand for strategic metals used in new technologies, such as electric cars and wind turbines. These metals include the rare earth elements, platinum, lithium and tantalum. Some of these metals are currently sourced from only a small number of mines across the world, many of them in China or Brazil, and there are concerns about security of supply. There has to date been little or no systematic exploration for resources of most of these strategic metals in the UK, but potential deposits in Scotland are the subject of ongoing research.

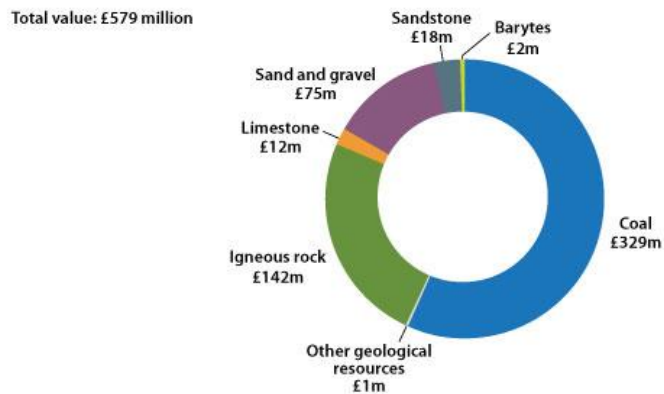
Figures 1 and 2 illustrates the amount and value of geological resources produced onshore in Scotland in 2010.

Figure 1: Geological resources produced onshore in Scotland in 2010 (excluding oil and gas)



Source: Based on data from the UK Minerals Yearbook 2011

Figure 2: Approximate value of geological resources produced onshore in Scotland in 2010 (excluding oil and gas)



Source: Based on data from the UK Minerals Yearbook 2011

References

¹ Rippon JH (2002) Coal. In: Trewin NH (ed.) The Geology of Scotland, pp 449-454. London: The Geological Society.

² Gribble CD (2002) Bulk Minerals. In: Trewin NH (ed.) The Geology of Scotland, pp 455-460. London: The Geological Society.

³ Rice CM (2002) Metalliferous minerals. In: Trewin NH (ed.) The Geology of Scotland, pp 431-448. London: The Geological Society.

Pressures affecting fossil fuels and minerals



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The majority of Scotland's geological resources are non-renewable, and need careful management to ensure sustainability. The key pressures can be divided into three main groups:

- exploitation;
- demand and economic factors;
- environmental issues and resource sterilisation.

Exploitation

Many of Scotland's geological resources have been worked extensively, chiefly during the last century. This is particularly true of fossil fuels (coal, oil and gas), aggregates, barytes and lead. In most cases, it will be many years before these deposits are worked out, but it is important to note that their lifetime is finite. Scotland has significant resources of coal, hard rock for aggregate, barytes and silica sand, and exploitation at the current rates can be sustained for many years.

Current estimates suggest that there could be up to [24 billion barrels of oil equivalent still to be recovered from the UK continental shelf](#), indicating that oil and gas could continue to make a major contribution to the Scottish economy at least until 2035.

Demand and economic factors

A major constraint on the exploitation of any geological resource is the demand for, and value of, that resource. Mineral producers in Scotland typically have to compete with cheaper imports from abroad, and production of many of Scotland's resources is only economic if the global price of that resource is relatively high. For example, Scottish gold is only economic when the global gold price is elevated, due to high production costs.

Demand for energy resources is generally strong, although the recession of 2008–09 led to a notable slowing in demand. [Coal produced in the UK has had to compete with cheaper imported coal in the past, but an increase in international coal prices since 2005 has made UK coal more competitive.](#) Demand for barytes is directly linked to the level of exploration for oil and gas on the UK Continental Shelf, as almost all Scottish barytes is used in the exploration industry as drilling mud.

Competition from cheaper imported stone has had an adverse effect on the Scottish building stone industry in recent decades. However, this is changing, as the demand for natural stone grows, and planning regulations in some areas encourage the use of local stone in building repairs and in new buildings. The closure of so many former stone quarries means that it is commonly not possible to repair old buildings with the same stone that was used originally, and new or re-opened quarries will be required to repair historically important buildings to high conservation standards.

Increased demand for metalliferous minerals is likely to have some influence on exploitation of Scottish mineral deposits in the near future. The current high gold price underpins the drive to re-open the gold mine at Cononish near Tyndrum, and the ongoing exploration in the same area.

Environmental issues and resource sterilisation

Drilling, mining and quarrying to exploit geological resources are activities that have the potential to be damaging to the environment. For this reason, planning laws are in place, which reconcile sustainable development with environmental protection. In general, this means that well-planned extraction of the geological resource can be carried out in many areas.

Some of Scotland's geological resources are effectively sterilised – unavailable for us to use – because they occur close to towns or areas that are protected for landscape and environmental reasons. This is particularly true of many of the stone quarries that have been filled in and built on as towns expanded. An example of this is Craigleith Quarry, source of much of the sandstone for Edinburgh's buildings, which has been built over and is now the site of a retail park.

It is anticipated that the long-term demand for fossil fuels will be reduced by the drive to a low-carbon economy. However, Scotland also offers the geological resources required for the storage of carbon dioxide generated by burning of fossil fuels. Development of CCS would allow continued use of Scottish coal.

Consequences of a change in fossil fuels and minerals



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Any mining, quarrying or drilling is likely to have an impact on the local environment, economy and people. These impacts may be positive or negative, and may be temporary or permanent. Potential negative impacts include air pollution by dust around quarries, noise pollution, waste, visual effects on the landscape, ecological impacts and increased use of transport infrastructure. Positive impacts may include jobs and contribution to the local economy, and beneficial changes to the area's ecology.

Extraction is now controlled by planning laws that require appropriate operation and subsequent restoration of all mine and quarry sites. Many mines and quarries are sympathetically restored after working and can become sites of importance for geodiversity and biodiversity.

Historical mining and quarrying in Scotland has left a legacy of environmental change. Some of these changes are negative, such as areas of contaminated land and water around mine dumps, and subsidence above abandoned coal mines. Other impacts are more positive, including the development of tourist attractions at old mines and the potential for geothermal energy from abandoned mine waters.

Response by society



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Sustainable development of geological resources is an essential part of modern life: the vast majority of day-to-day objects contain components that have originated, at some stage, in the Earth's crust. The objective is thus always to ensure that the need for these resources can be met, now and in the future, with as little impact on the surrounding environment as possible.

Extraction of geological resources in Scotland is covered by Scotland's planning laws. To ensure that sustainable development can take place, and that Scotland's resource needs can be met, the negative impacts must be minimised and the positive maximised.

Development of geological resources through mining and quarrying is frequently contentious, and often not welcomed by local communities. Local communities should be kept informed throughout all stages of the planning and development process.