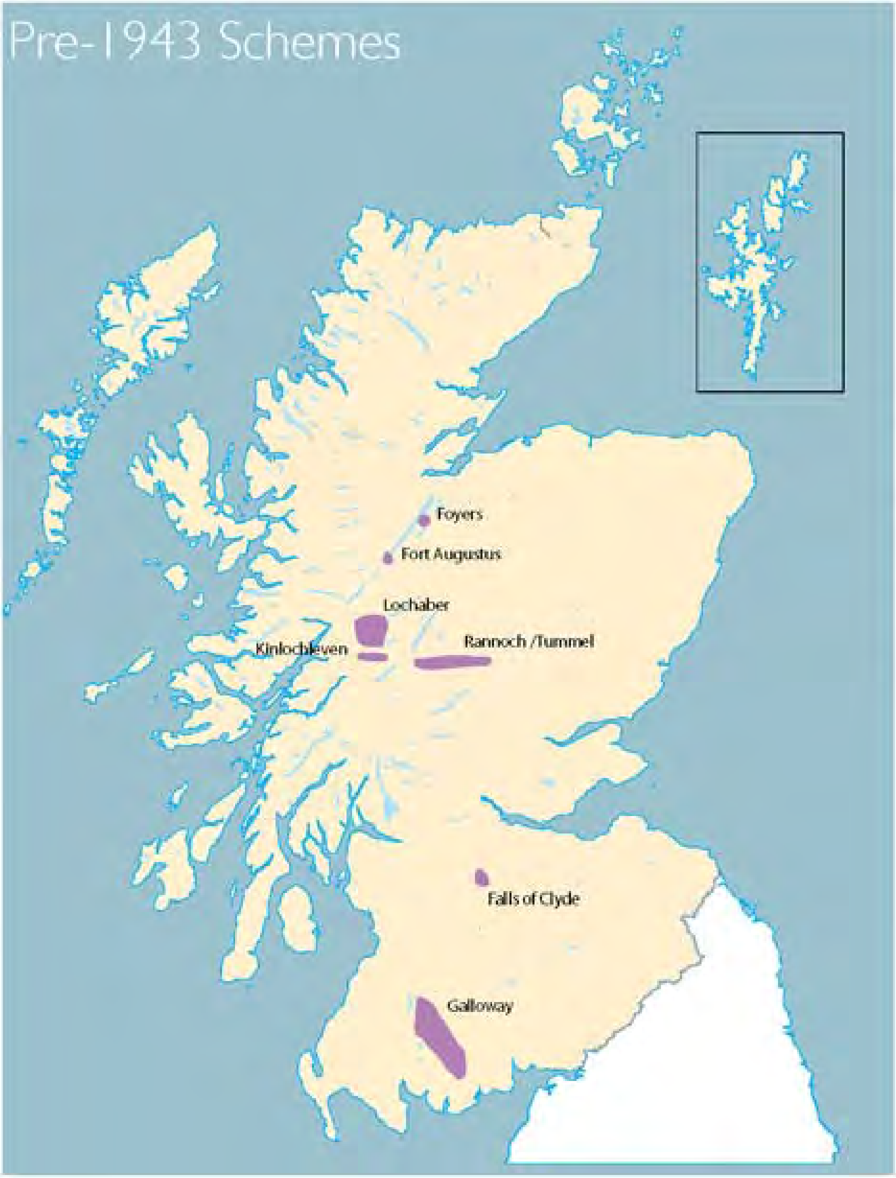
Gazetteer

Hydroelectric schemes in Scotland 1890-1975



Timeline pre-1943

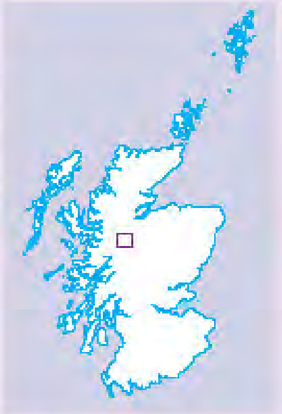
1891	**Fort Augustus**
1896	**Foyers (smelter)**
1909	**Kinlochleven (smelter)**
1925-7	**Falls of Clyde**
1929-34	**Lochaber (smelter)**
1933	**Tummel Bridge and Rannoch**
1934-6	**Galloway**
1943	**Hydro Electric (Scotland) Act**

Fort Augustus (1891)

Architects and engineers	Not known. Built by the monks of the nearby monastery at Fort Augustus.
Components	Small intake on the banks of the River Tarf, concrete-lined aqueduct and turbine hall. Now no longer in use.
Installed capacity on completion	18 KW

The small turbine hall which once formed part of the Fort Augustus hydro scheme.

The turbine hall and aqueduct of the Fort Augustus hydro scheme are the earliest built evidence of a scheme in Scotland. The scheme was built and operated by the monks of the local St Benedict's Abbey in the village and powered the abbey and the homes of the village's 800 inhabitants . Legend has it that when the monks played the electric organ the lights in the village went dim.



Key

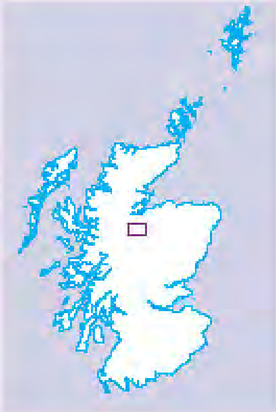
- Dam
- Power Station
- Surge Tower
- Valve House

Foyers (1896)

Architects and engineers	Cameron & Burnett with Lord Kelvin as the scientific adviser to the British Aluminium Company.
Components	Loch Eilde Mor Dam, River Foyers Intake, Foyers powerhouse and integrated smelter (now disused)
Installed capacity on completion	3,750 KW

The powerhouse with integrated smelter at Foyers

The British Aluminium Company development at Foyers was the first large-scale use of hydropower in Scotland. The scheme was highly influential, proving not only the viability of the technology to produce electricity with water-driven turbines but also that the power produced could be successfully applied to industrial processes. The British Aluminium Company went on to develop two other large smelters in Scotland at Kinlochleven and Lochaber.

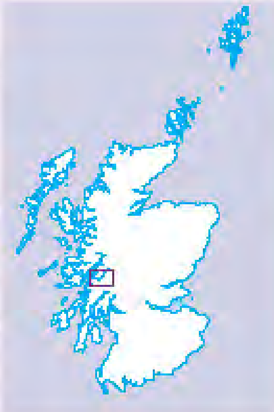


Key

- Dam
- Power Station
- Surge Tower
- Valve House

Kinlochleven (1909)

Architects and engineers	Thomas Meik & Sons, construction engineer Sir Robert McAlpine.
Components	Blackwater Dam, sealed concrete aqueduct, intake gatehouse, penstocks, powerhouse. The site formerly included an adjacent smelter (now demolished) and carbon silos (now redeveloped into an indoor climbing centre).
Installed capacity on completion	25,725 KW



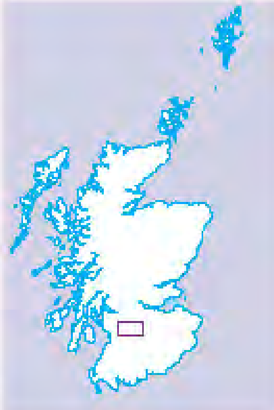
The powerhouse at Kinlochleven with penstocks carrying water through to the turbines inside.

The Kinlochleven water power scheme for BAC was a major technological achievement on its completion in 1909, with an installed capacity of internationally important proportions. The site retains six of the original turbines and generators and the system is still in use to generate power. The smelter closed in 1990 and the site has been subject to redevelopment, including the construction of an indoor ice climbing wall in the former carbon silos.

Key
- Dam
- Power Station
- Surge Tower
- Valve House

Falls of Clyde (1925–7)

Architects and engineers	Sir Edward MacColl with advice from Amenity Committee consisting of the Earl of Home, Sir John Stirling Maxwell of Pollok and Sir Robert Lorimer, architect; plans and specifications by Messrs Buchan & Partners, engineers; Sir William Arrol & Co civil engineering contractors; the English Electric Company hydroelectric plant.
Components	Bonnington tilting weir; Bonnington Power Station including surge tower; Stonebyres tilting weir; Stonebyres Power Station including surge tower.
Installed capacity on completion	15,520 KW



Stonebyres power station, designed in the Modernist style and almost identical to that at Bonnington located upstream.

The Falls of Clyde scheme is the earliest large-scale scheme for public supply in Britain. The scheme is also of considerable technical importance as an example of run-of-the-river technology being utilised for power generation in a spectacular landscape setting. The Falls of Clyde development consists of two nearly identical power stations at Bonnington and Stonebyres, both of which utilise the flow of the River Clyde for power generation.

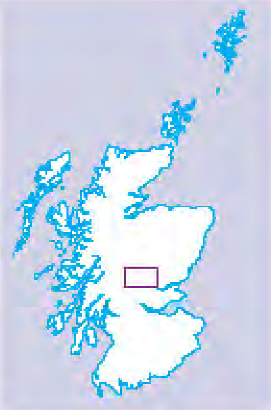
Key
- Dam
- Power Station
- Surge Tower
- Valve House

Tummel Bridge and Rannoch (1933)

Architects and engineers	Sir William Halcrow consulting engineer, Balfour Beatty engineers and contractors.
Components	Loch Ericht Dam, Rannoch valve house, Rannoch Power Station, Dunalastair Dam, Tummel aqueduct, Tummel Bridge Power Station.
Installed capacity on completion	82,000 KW (Combined total)

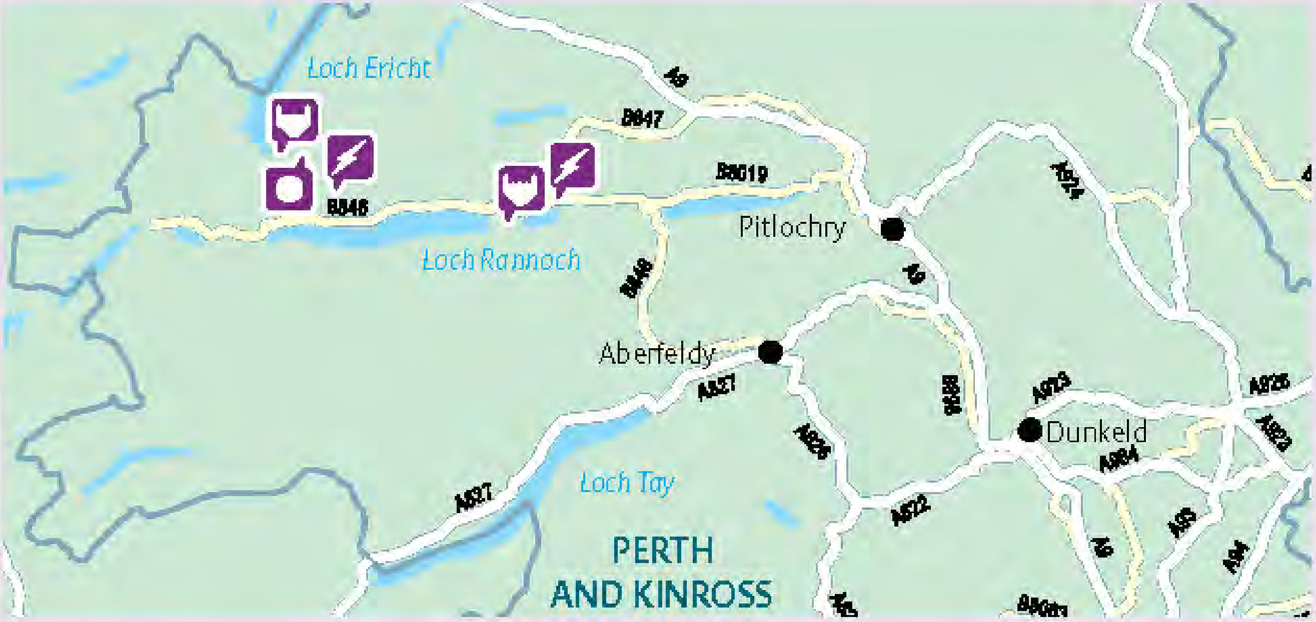
Rannoch Power Station, designed in a Classical Modernist style.

The Grampian Hydroelectric Scheme was the first major public supply development which utilised high-head reservoir storage technology. The geography of the Tummel valley was well suited to the development of a hydroelectric scheme, but local demand for electricity was insufficient to justify its completion. The development of the national grid in the mid-1920s meant that power generated in the Highlands could be exported to the populous central belt.



Key

- Dam
- Power Station
- Surge Tower
- Valve House

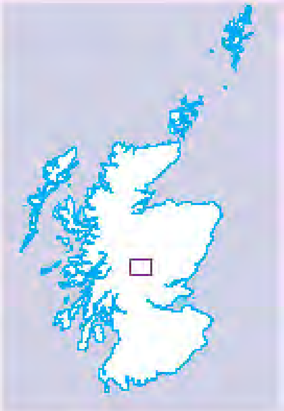


Lochaber (1929-34)

Architects and engineers	William Halcrow, supervising engineer; Balfour Beatty general engineers.
Components	Laggan Dam, Loch Treig Dam, penstocks, Lochaber powerhouse and adjacent smelter and Loch Spey Dam (1943).
Installed capacity on completion	86,750 KW

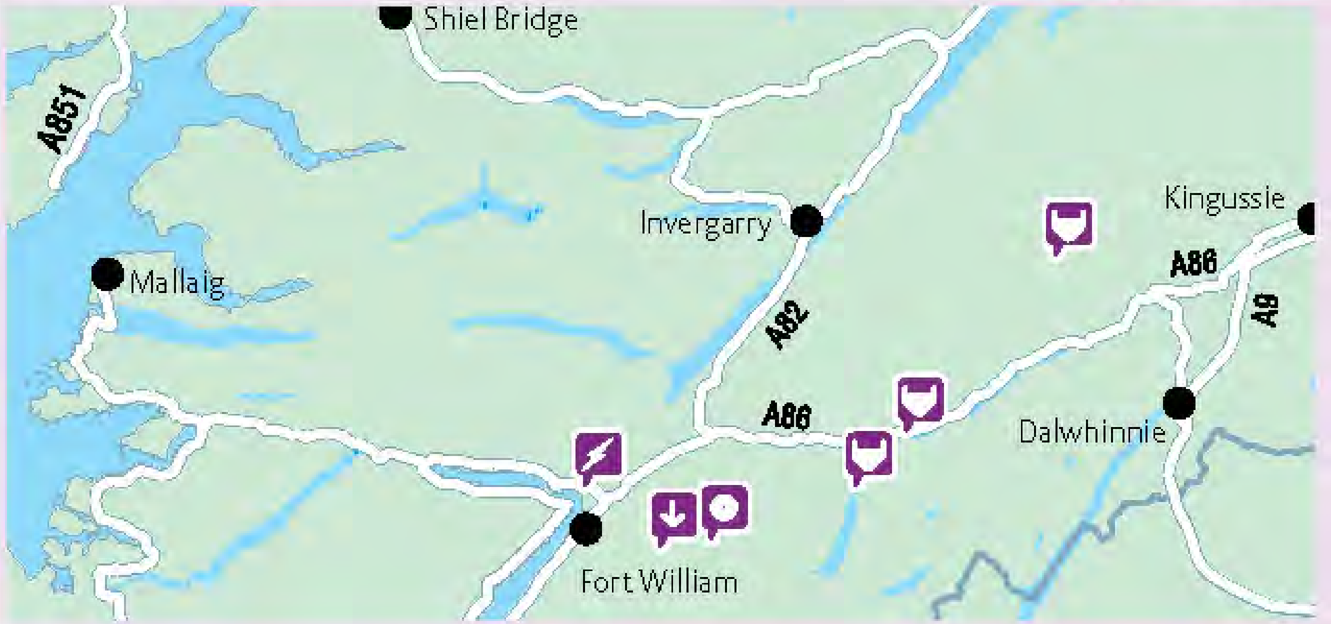
Laggan Dam which provides key storage capacity for the Lochaber scheme.

The Lochaber water power scheme for BAC was one of the most ambitious civil engineering projects of the 20th century in Britain. The development included a pioneering dam at Loch Treig and required a tunnel to be blasted under the shoulder of Ben Nevis. The installed capacity of the scheme was internationally significant and not bettered until 1950. The scheme is still in operation today, providing power to the adjacent aluminium smelter.



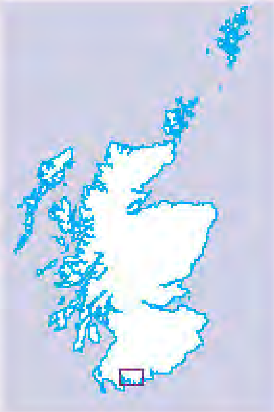
Key

- Dam
- Power Station
- Surge Tower
- Valve House



Galloway (1934–6)

Architects and engineers	Sir Alexander Gibb consulting engineer, Merz & McLellan electrical engineers, Payler & Son (Glasgow) construction engineers.
Components	Loch Doon Dam, Kendoon Dams, Kendoon Power Station, Kendoon Surge Tower, Carsfad Dam, Carsfad Power Station, Earlstoun Dam, Earlstoun Power Station, Clatteringshaws Dam, Glenlee Power Station, Glenlochar Barrage, Tongland Dam, Tongland Power Station.
Installed capacity on completion	102,000 KW (aggregate total for whole scheme)

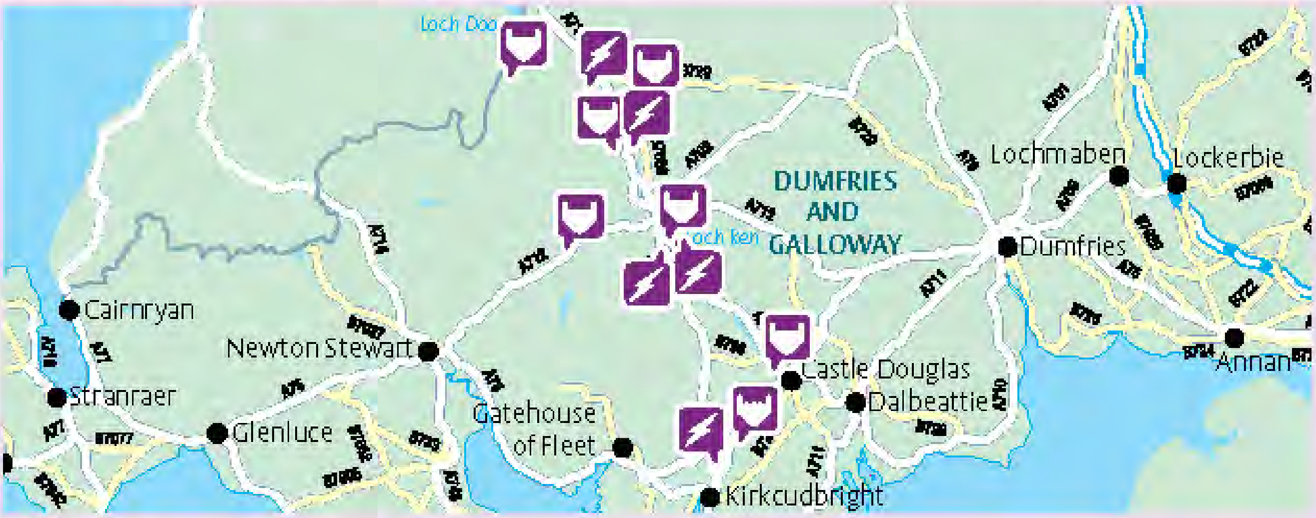


Interior of Kendoon power station, one of 5 power stations on the scheme.

The Galloway scheme was a pioneering development using hybrid run-of-the-river technology, specifically designed to be highly responsive to spikes in demand on the national grid. It was a significant achievement, something which many sceptics had thought would not be possible. The design is highly efficient with water having been used up to four times to generate power by the time it reaches Tongland at the bottom of the scheme.

Key

- Dam
- Power Station
- Surge Tower
- Valve House



Timeline post-1943

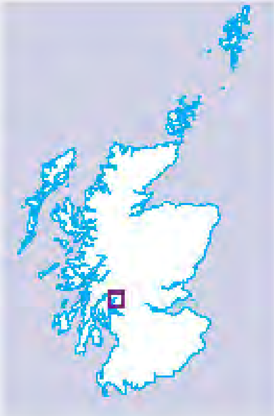
1943	**Hydro Electric (Scotland) Act**
1944-59	**Sloy / Awe**
1951-8	**Tummel Valley**
1952-63	**Affric-Beauly**
1957-61	**Conon Valley**
1957	**Great Glen**
1960	**Loch Shin**
1961	**Breadalbane**
1965	**Cruachan**
1969-75	**Foyers (conversion to pumped storage)**

Sloy / Awe (begun 1944, expanded 1951 and 1959)

Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel.
Components	Sloy Dam, Sloy Power Station, Allt-na-Lairige Dam and Power Station, Clachan Power Station, Sron Mor Dam and Power Station, Inverawe barrage, Inverawe Power Station, Nant Power Station.
Installed capacity on completion	341.9 MW (aggregate total for whole scheme)

Allt-na-Lairige Dam, the first in Western Europe to use pre-stressed concrete for construction.

The Sloy scheme was the first major development undertaken by the North of Scotland Hydro Electric Board (NoSHEB) following their inception in 1943. The initial phase of the scheme, completed in 1951, was relatively modest in size compared to the later extension, with a single dam and power station at Sloy on the banks of Loch Lomond. The bold Classical Modernist design emphasised the confidence of NoSHEB in their new venture.



Key

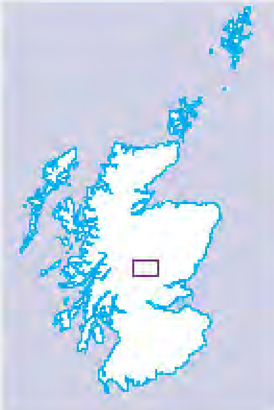
- Dam
- Power Station
- Surge Tower
- Valve House

Tummel Valley (begun 1951, expanded 1955 and 1958)

Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel, including James Shearer
Components	Pitlochry Dam and integrated Power Station, Clunie Dam, Clunie Power Station, Errochty Dam, Errochty Power Station, Trinafour Power Station, Guar Dam, Guar Power Station, Cuaich Dam, Cuaich Power Station.
Installed capacity on completion	163.7 MW (aggregate total for whole scheme excluding pre-1943 components)

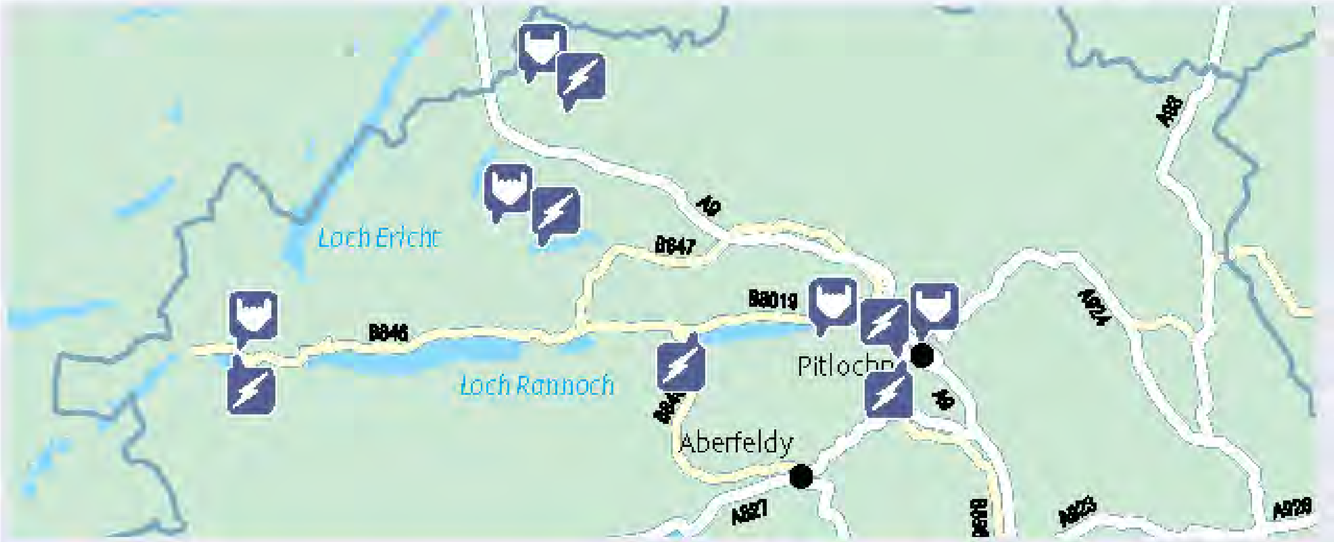
Errochty Power Station, designed by James Shearer and an archetypal example of his use of exposed coursed local stone facings.

The Tummel–Garry scheme was a development incorporating the pre-existing infrastructure from the pre-1943 Rannoch and Tummel schemes with several phases of expansion to create a scheme with nine power stations spread over a large geographic area. The scheme operates as a cascade down the Tummel Valley, with water reaching Pitlochry Power Station likely to have previously gone through up to five power stations higher up the scheme.



Key

- Dam
- Power Station
- Surge Tower
- Valve House

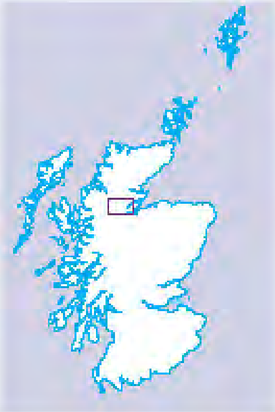


Affric–Beauly (1952, expanded 1963)

Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel.
Components	Mullardoch Dam, Mullardoch Power Station, Fasnakyle Power Station, Monar Dam, Deanie Power Station, Loichel Dam, Beannachran Dam, Culligran Power Station, Aigas Dam, Aigas Power Station, Kilmorack Dam, Kilmorack Power Station
Installed capacity on completion	168.4 MW (aggregate total for whole scheme)

Kilmorack power station is at the bottom of the scheme and is integrated into the dam which regulates the follow of the River Beauly.

The area of the upper tributaries of the Beauly River was identified as early as 1918 as a potential site for hydro. The Affric–Cannich section of the scheme was developed initially and with great regard to scenic amenity, with the upper reaches of the valley containing remnants of Caledonian pine forest. In the later northern section, Loch Monar is a double-arch dam, unique in Scotland.



Key

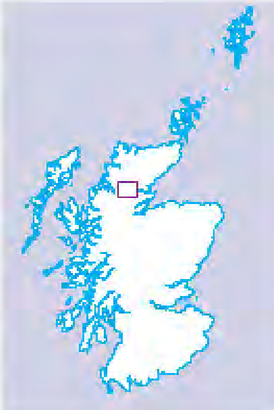
- Dam
- Power Station
- Surge Tower
- Valve House

Conon Valley (1957, expanded 1961)

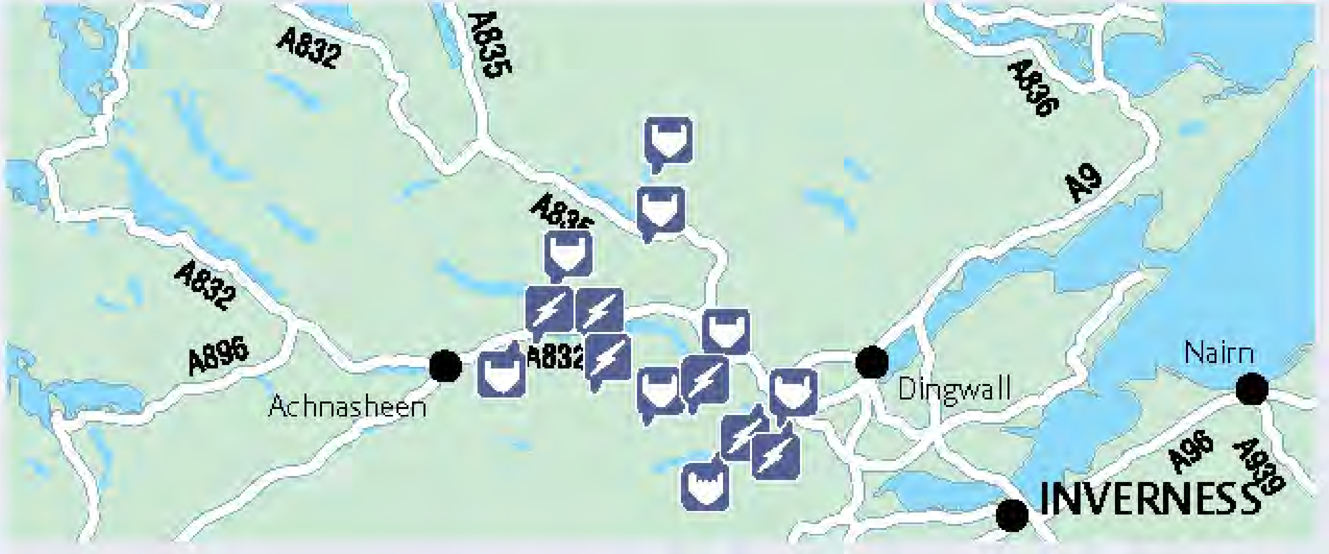
Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel.
Components	Fannich Dam, Grudie Bridge Power Station, Glascarnoch Dam, Vaich Dam, Mossford Power Station, Bran barrage, Achanalt Power Station, Meig Dam, Luichart Dam, Luichart Power Station, Torr Achilty Dam, Torr Achilty Power Station, Orrin Dam, Orrin Power Station.
Installed capacity on completion	107.3 MW (aggregate total for whole scheme)

Orrin power station receives water from Orrin dam and is set into a steep bank with a partially buried turbine to maximise the head of water.

The Conon Valley scheme was developed in three phases between 1946 and 1961 with seven dams and associated power stations utilising a broad catchment from near Ullapool in the north, to Dingwall in the east and Achnasheen in the west. The scheme contains some unusual fish passes, including that at Orrin which is composed of four parallel chambers to accommodate frequent changes in water level which characterise this dam.

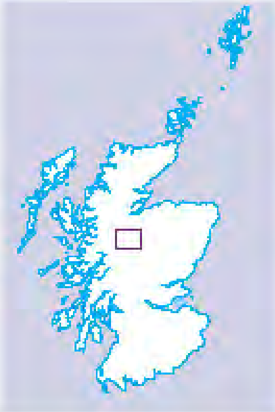


Key
- Dam
- Power Station
- Surge Tower
- Valve House



Great Glen (1957)

Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel.
Components	Quoich Dam, Quoich Power Station, Garry Dam, Invergarry Power Station, Loyne Dam, Cluanie Dam, Ceannacroc Power Station, Dundreggan Dam, Glenmoriston Power Station, Livishie Power Station
Installed capacity on completion	110 MW (aggregate total for whole scheme)



Invergarry power station contains a single high load factor turbine, using water with a low head from the nearby dam.

The Garry–Moriston scheme is centred on the area to the west of Fort Augustus in one of the wettest areas of the UK. Loch Quoich is the main storage for the southern section of the scheme and is the largest rockfill dam in Scotland. Ceannacroc Power Station was the first in the UK to be built underground, with the bare walls of the machine hall showing the hewn rock.

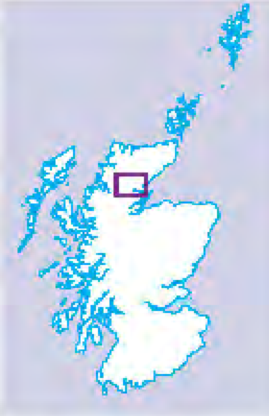
Key
- Dam
- Power Station
- Surge Tower
- Valve House

Loch Shin (1960)

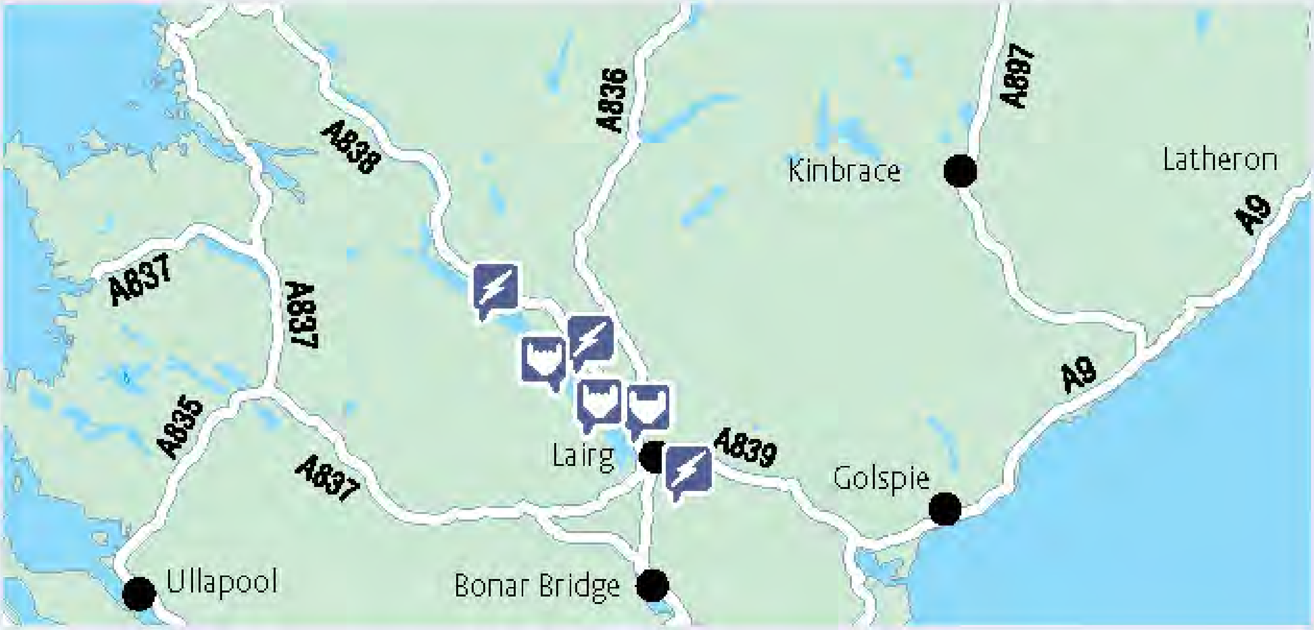
Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel.
Components	Lairg Dam, Duchally weir, Lairg Power Station, Shin Power Station and Dam, Cassley Power Station.
Installed capacity on completion	32.1 MW (aggregate total for whole scheme)

The Loch Shin Power Station is incorporated into the dam and is directly opposite the small village of Lairg.

The Loch Shin scheme is the most northerly of the HEP schemes in Scotland and is situated in an area of lower relief, giving it a relatively modest output for the size of catchment. The scheme is centred around Loch Shin with the diverted headwaters of the Cassley and Brora rivers. As the small station at Duchally is so remote it is operated automatically by the water level and control gates.



Key
- Dam
- Power Station
- Surge Tower
- Valve House

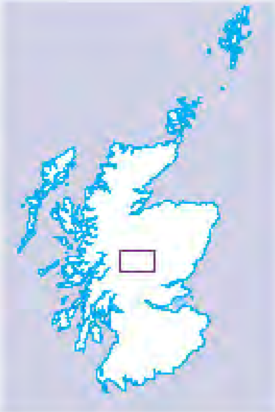


Breadalbane (1961)

Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel.
Components	Ben Lawers Dam, Finlarig Power Station, Breaclaich Dam, Lednock Power Station, Lednock Dam, St Fillans Power Station, Dalchonzie Power Station, Lubreoch Power Station, Lochay Power Station, Cashlie Power Station, Giorra Dam, Stronuich Dam.
Installed capacity on completion	100.3 MW (aggregate total for whole scheme)

Dalchonzie power station, an example of a smaller station forming part of the Breadalbane scheme.

This scheme is located in an area well suited to HEP with steep relief and high levels of rainfall. Behind Ben Lawers a system of pipes and tunnels collects water, diverting it into Lochan-na-Lairige. Water then descends 415 metres (the largest head of any Scottish HEP scheme) to Finlarig Power Station on the shores of Loch Tay. The scheme also contains an unusual diamond-headed buttress dam at Lednock.



Key

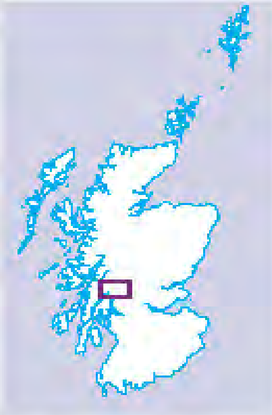
- Dam
- Power Station
- Surge Tower
- Valve House

Cruachan (1965)

Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel.
Components	Ben Cruachan Dam, Ben Cruachan turbine hall (contained in an underground chamber).
Installed capacity on completion	440 MW

The turbine hall of Cruachan Power Station, buried deep in an excavated cavern beneath the mountain.

Cruachan Power Station is a pioneering example of pumped storage and the first to be built on this scale in the UK. Water is received via pressure pipeline from Ben Cruachan Dam (above the turbine hall) and is used to generate power. At periods of cheap electricity the turbines are run in reverse to pump water back from Loch Awe to the reservoir. It can then be used subsequently for further generation.



Key

- Dam
- Power Station
- Surge Tower
- Valve House

Foyers (1969–75)

Architects and engineers	James Williamson & Partners engineers, NoSHEB Amenity Panel .
Components	Loch Eilde Mor, River Foyers intake (both part of 1896 scheme), Foyers pumped storage power station
Installed capacity on completion	200 MW
	Foyers Power Station is an example of pumped storage technology. The existing infrastructure for the 1896 scheme developed by the British Aluminium Company was redeveloped to provide the water storage required for the pumped storage scheme. Much like Cruachan (see previous), Foyers can respond to peak demands for electricity, and is able to begin generating from a cold start in under two minutes, or from a 'spinning reserve' in under 30 seconds.

Key

- Dam
- Power Station
- Surge Tower
- Valve House

Post-1943 Smaller schemes