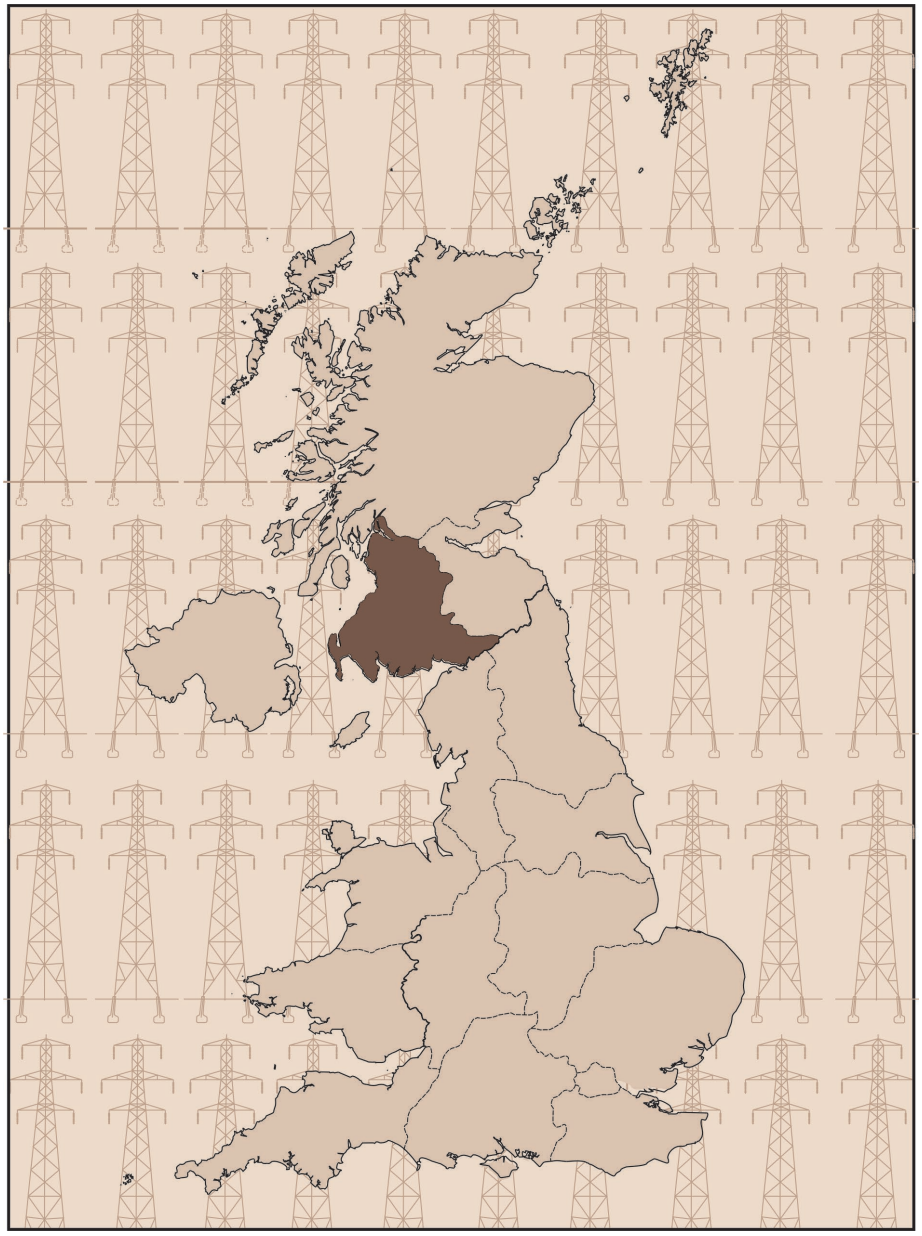

THE SOUTH WEST SCOTLAND ELECTRICITY BOARD AREA

Regional and Local Electricity Systems in Britain

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Mill Street was an early AC station (60Hz) opened in January 1896. DC supply was added in 1901 for the municipal tramway. Peak capacity of 2,200kW was reached in 1920 and the power station was closed a decade later.

Ordnance Survey Six Inch Map series, Ayrshire XXXIII, NW, 1908 (National Library of Scotland).

Introduction

Public electricity supplies began in Britain during the 1880s. By 1900 most urban places with over 50,000 population had some form of service, at least in the town centre. Gradually the isolated points on the national map began to coalesce, especially when the national grid helped local organisations to connect small towns, villages and eventually farms.

In the process of electrification, hundreds of municipal and company organisations developed local and sometimes regional systems. Before nationalisation in 1948, however, there was little consolidation of areas.

The study of British electricity systems is a remarkably daunting task. While there is a rich legacy of detailed annual surveys, these publications have to be tracked down. The user is then faced with immense alphabetical listings of all sorts of enterprises, often in places which no longer have much meaning except to local residents. Since there are few contemporary maps, listing and grouping the electricity organisations geographically is difficult and often time-consuming.

These notes are offered as an outline guide to the pre-1948 local authorities and companies that developed electricity supplies in South West Scotland.

The South West Scotland Electricity Board Area

The area was first defined by the Ministry of Fuel and Power in a White Paper published in January 1947, a month before debate began on the Electricity Bill.[1] Fourteen area boards were to be established for electricity distribution or retailing. Generation and transmission were to be the responsibility of the British Electricity Authority.

Each area board was defined to provide a diversity of load between urban and rural areas and, where possible, avoided cutting across distribution networks. The South West Scotland Area, as defined at this time, had been part of the Central and South Scotland Electricity Scheme Area. Other parts of this large area were transferred to the South East Scotland and North of Scotland Hydro Electric Boards.

In detail the South West Scotland Area included the whole counties of Ayrshire, Dumfries-shire, Kirkcudbrightshire, Lanarkshire, Renfrewshire, Wigtownshire, and parts of Dunbartonshire, Roxburghshire and Stirlingshire.

[1] Ministry of Fuel and Power, ***Electricity Supply Areas***, Cmd 7007. (London: HMSO, 1947).

Constituents of the South West Scotland Electricity Board

When the Board began operations on 1 April 1948 it incorporated the distribution services and areas of nine local authorities and five companies.[2] The constituent areas varied enormously in size. Dumfries-shire County Council covered 1,175 square miles while the Electric Supply Corporation in Dumbarton occupied an area of 1.75 square miles.

With a total area of about 5,000 square miles and a population of about 2.5 million, the Board included every kind of district from the uplands of Kirkcudbright to the densely populated areas of central Glasgow.

Glasgow was the obvious centre for the head office but office space was hard to find in 1948. Temporary accommodation was made available in a villa at 62 Dalziel Drive and in the former offices of the Glasgow Corporation and the Clyde Valley Electric Power Co. In 1949 the Board was exploring the possibilities of erecting a head office in the planned new town of East Kilbride.[3]

Development of Electricity Supply Areas

The 1948 pattern illustrated in **Figure 1** represented the climax of over 50 years of development. Unusually for a new innovation, electricity for public supply was subject to tight national regulations from an early stage. The Electric Lighting Act 1882 required "undertakings" to apply for a licence or provisional order from the Board of Trade.[4] This requirement followed the precedents for earlier public utilities which had to "break up the streets" to lay mains or tracks. Electric Lighting Orders provided the basic conditions of a franchise to operate within a defined area, limiting the maximum prices that could be charged to consumers and, for private companies, a time limit of 21 years after which the local authority could purchase the system. An amendment in 1888 extended the time period to 42 years. All the Electric Lighting Orders were subject to Parliamentary approval. Major changes such as amalgamation of companies and extension of area required special acts.

Only a few public electricity systems were established under the 1882 Act. By 21 December 1882 the Board of Trade had received 109 applications for Electric Lighting Orders. After scrutiny by the office and Parliament, 69 ELOs were granted to local authorities and companies. Eight of these came to fruition over the next decade, while the others were abandoned as the early optimism waned given the uncertainties of the market for electricity and the limitations of early technology.

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[2] By 1946 the Dunbartonshire and Lanarkshire County Councils owned the franchise areas within those counties and, by agreement, the electricity systems were operated by the Clyde Valley Electric Power Co. The Town Councils of Dumbarton and Helensburgh also owned the franchises, leasing the operations to the Electric Supply Corporation and the Clyde Valley Co. respectively.

[3] South West Scotland Electricity Board, ***First Annual Report and Accounts,*** HC 350 (London: HMSO, 1949), pp.4-5.

[4] Basic details of this Act and subsequent legislation are outlined in ***Electricity Supply in Great Britain: A chronology*** (London: Electricity Council, 1977).

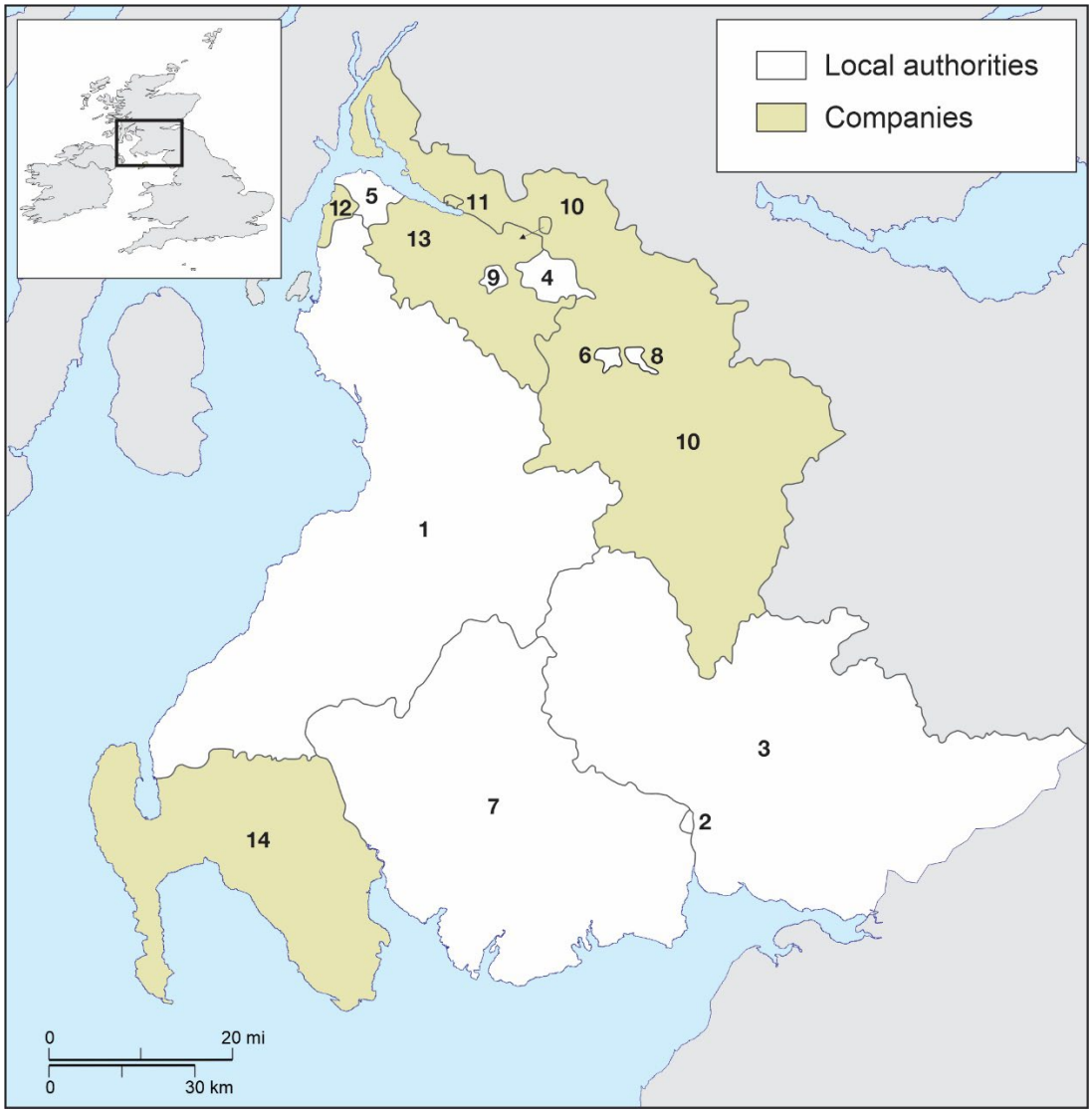

Figure 1 CONSTITUENT AREAS OF THE SOUTH WEST SCOTLAND ELECTRICITY BOARD 1948.

Table 1 SOUTH WEST SCOTLAND ELECTRICITY BOARD CONSTITUENT UNDERTAKINGS 1948.

Map No.	Local Authorities	Map No.	Companies
1	Ayrshire Electricity Board	10	Clyde Valley EP Co
2	Dumfries Corporation	11	Dumbarton (Electric Supply Corporation)
3	Dumfriesshire County Council	12	Skelmorlie ES Co
4	Glasgow Corporation	13	Strathclyde ES Co
5	Greenock Corporation	14	Wigtownshire Electricity Co
6	Hamilton Corporation		
7	Kirkcudbright County Council		
8	Motherwell & Wishaw Corporation		
9	Paisley Corporation		

Key to Abbreviations
EP Co: Electric Power Company
ES Co: Electricity Supply Company

Three applications for places in the region were made: two for Glasgow and one for Greenock. Glasgow Corporation withdrew its application and the Brush Electric Light & Power Co. of Scotland's submission "…was not considered as the provisions of the Act had not been complied with."[5] The Greenock Board of Police was granted an ELO and opened an experimental water-powered lighting system in March 1885. Although closed in May 1887, Greenock retained the powers of the ELO and completed a full system in 1899.[6]

Although general urban electrification failed to take off in the region, private systems began to develop. Private generation provided a market for electrical equipment, helped the training of workers and gave opportunities to refine the new technology.

Arc lighting for the interior spaces of railway stations was an early example of private electricity usage. This began in Glasgow in September 1879 at St Enoch station, the terminus of the Glasgow & South Western Railway. The Caledonian company followed in 1881-82 at Buchanan Street and Central stations and the North British Railway's Queen Street buildings were lit by electricity by 1886.[7]

Henry Alexander Mavor (1858-1915) in partnership with William C. Muir and later W.H. Coulson played an important role in early electrification in Glasgow.[8] The first major installation, in 1884-85, was a powerhouse in Miller Street for the lighting of the General Post Office. This was followed in 1888-89 by a second power station in John Street to fulfill a contract for lighting the new Municipal Buildings. At this time the company was ready to offer a public supply in the city centre. Since all the work had been carried out without any statutory authority the company made an application for an Electric Lighting Order.

Beyond Glasgow, electric lighting was installed at Earnoch colliery near Hamilton in 1881 and at Murdostoun Castle near Wishaw in 1882.[9] James Goodwin & Co. also introduced electric light in their Motherwell engineering works in 1882.[10] Sir William Thomson (later Lord Kelvin) added a gas-engined generator at Netherhall House in Largs around the same period.[11]

The Glasgow International Exhibition of 1888 was promoted to outshine the 1886 Edinburgh International Exhibition and the 1887 Royal Jubilee Exhibition in Manchester. Opened in May 1888, the Glasgow event featured electric lighting on a grand scale. The Anglo-American Brush Electric Lighting Co. had the largest contract for lighting the grounds, most of the Main Building and the Machinery Court, while two other companies were responsible for the lighting of the Fine Art Gallery and the first-class refreshment rooms. The illuminated Fairy Fountain built by W. & J. Galloway of Manchester was one of the most popular evening attractions. Electric

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[5] "Report by the Board of Trade respecting the applications to and Proceedings of, the Board of Trade under the Electric Lighting Act 1882," ***Parliamentary Papers*** 1883. HC 237.
[6] D.G. Tucker, "Hydro-electricity from public supply in Britain 1881-1894," ***Industrial Archaeology Review*** Vol.1(2), 1977, pp.126-163.
[7] Colin Johnston and John R. Hume, ***Glasgow Stations*** (Newton Abbot: David & Charles, 1979).
[8] S.G.E. Lythe and Doris Black, "Henry Alexander Mavor", ***Dictionary of Scottish Business Biography*** Vol 1 (Aberdeen: Aberdeen University Press, 1988), pp.176-177.
[9] G. Thomson ed. ***The County of Lanark: Third Statistical Abstract of Scotland*** Vol.8 (Glasgow: Collins, 1960), p.103.
[10] Robert Duncan, ***Steelopolis: The making of Motherwell c.1750-1939*** (Motherwell District Council, 1991), p.58.
[11] Brian Bowers, ***A history of electric light and power*** (Stevenage: Peter Peregrinus, 1982), pp.128-9.

launches were also featured on the River Kelvin. With an attendance of 5.7 million, the Exhibition was a successful venture and helped to publicise the value of electricity.[12]

Public electricity supply systems began to take off in 1889-90 when applications for Electric Lighting Orders resumed. Nationally there were 17 applications in 1889 and 161 in 1890. Seven applications came from South West Scotland in 1890. The four successful applications were from the Ayr Commissioners of Police, the Glasgow Town Council, Kelvinside Electricity Co. and the Scottish House-to-House Electricity Co. which was granted an ELO for Coatbridge.[13] The unsuccessful applications for Glasgow by the House-to-House Co. and Muir, Mavor & Coulson[14] were not proceeded with, given the Board of Trade's preference for municipal applicants. The Patrick, Hillhead and Maryhill Gas Company application for its area was not allowed since it had no powers for electricity supply.[15]

With the authority of an ELO, the new electricity organisation began work on building a local system. Glasgow bought the Mavor & Coulson system in 1892 and opened its own generating station on Waterloo Street the following year. The Kelvinside company opened in 1893, Coatbridge in 1894 and Ayr in 1896.

While the Board of Trade developed regulations for safety, inspected and approved new systems as well as collecting annual returns, the Board provided no guidance on general policy or technical matters. These were left to the operator and consulting engineer to decide. Consequently after 1888 large numbers of fragmented operators developed DC and AC systems with little attempt at co-ordination. AC systems with frequencies varying from 25 cycles (Hz) to 100 cycles were established. The lack of standardisation would become a major problem when interconnection between areas became advantageous.

An outline of development is presented in three phases: local initiatives from the 1880s to World War I, state intervention to the 1940s, and nationalisation from 1948.

I Local Initiatives

Figure 2 and **Table 2**, derived from a rare map of electricity undertakings in the British Isles, provide a snapshot of the development of public supply areas over the previous three decades.

The ten local authorities were clear examples of local initiative in developing electric light and power. Glasgow Corporation (population 784,496 in 1911) was the largest of the local authorities. In 1912 the city electricity department was operating three power stations at Port

[12] Perilla Kinchin & Juliet Kinchin, ***Glasgow's great exhibitions 1888 1901 1911 1938 1988*** (Wendlebury Oxon: White Cockade, 1988), pp.16-53.
[13] The House-to-House Electricity Supply companies made 51 applications in 1890. Only five were successful and the Coatbridge franchise went into operation while the other four ELOs were later revoked for lack of activity.
[14] Mavor & Coulson focused on electrical engineering especially mining machinery after the sale of the electricity company to Glasgow Corporation.
[15] "Report by the Board of Trade respecting the applications to and the proceedings of the Board of Trade under the Electric Lighting Acts 1882 and 1888 during the past year". ***Parliamentary Papers*** 1890. HC 273.

Dundas, St Andrew's Cross and Kelvinside (capacity 39,830kW). The Lanarkshire County Council serving Cambuslang parish from a small distributor plant (capacity 300kW) was the smallest local authority undertaking.

The nine companies in South West Scotland were very varied in scale and location. Some were part of the Glasgow conurbation, others were situated in the fringes of the region. Portpatrick Electric Supply Co, launched in 1904 by a village that had earlier aspirations to be a port town, contrasted with the Coatbridge & Airdrie Co. which served two industrial towns with a combined population of some 77,000 in 1911. Some companies, such as those operating in Kilmacolm, Portpatrick and Skelmorlie, were local in origin. Others were subsidiaries of larger organisations from outside Scotland. The Dumfries company was owned by the India Rubber, Gutta-Percha and Telegraph Works of Silvertown, London. Dumbarton's system was owned by the Town Council but leased to the Electric Supply Corporation. A similar situation was also found in Hamilton where Edmundson's Electricity Corporation operated the system on behalf of the local authority. The Coatbridge & Airdrie Co. was by 1912 a distant outlier of the County of London Electricity Supply Co.

Figure 2 ELECTRICITY UNDERTAKINGS IN SOUTH WEST SCOTLAND c. 1912.

The Clyde Valley Electrical Power Co. was incorporated by private Act in 1901 and authorised to provide supply to industrial customers and bulk supply to authorised undertakings.[16] An amendment in 1904 allowed the company to hold Electric Lighting Orders. Although promoted by regional colliery and manufacturing interests, the new company soon became subject to outside business interests. The contract with British Westinghouse, signed in September 1902 to build the power stations, transmission lines and substations, followed a common American practice of taking shares in the power company. By December, British Westinghouse held 80 percent of the 60,000 ordinary shares of the company. David A. Starr was appointed manager in 1903 after being strongly recommended by George Westinghouse.[17] Construction began and the Yoker power station entered service in August 1905. The Motherwell station opened in January 1906. By 1913 the initial generating capacity of 8,000kW had been raised to 37,500kW and sales had reached 48.6 kWh. Glasgow Corporation's sales in 1913 amounted to 54.9m kWh.

***Table 2** SOUTH WEST SCOTLAND: ELECTRICITY UNDERTAKINGS c.1912.*

UNDERTAKING	*COUNTY*	*SUPPLY BEGAN*
Local Authorities		
Ayr	Ayr	1896
Glasgow	Lanark	1893
Govan	Lanark	1900
Greenock	Renfrew	1899
Kilmarnock	Ayr	1904
Lanarks County Council[1]	Lanark	1905
Motherwell	Lanark	1901
Paisley	Renfrew	1899
Partick	Lanark	1902
Wishaw	Lanark	1908
Companies		
Coatbridge & Airdrie	Lanark	1894
Clyde Valley Electrical Power	Lanark/Renfrew	1905
Dumbarton[2]	Dumbarton	1906
Dumfries	Dumfries	1906
Hamilton[3]	Lanark	1902
Kilmacolm	Renfrew	1904
Portpatrick	Wigtown	1904
Skelmorlie	Ayr	1911
Strathclyde	Renfrew/Dumbarton	1906

Notes:

[1] Providing a local service in Cambuslang parish.

[2] Operated by Electric Supply Corporation.

[3] Operated by Edmundson's Electricity Corporation.

Source: "Map showing Electric Lighting, Power and Traction Undertakings in Operation." Supplement to ***Garcke's Manual of Electrical Undertakings.*** Undated but c 1912. [Copy from National Library of Scotland].

[16] John C. Logan, "An economic history of the Scottish electricity supply industry 1878-1930". PhD thesis, University of Strathclyde, 1983, 2 vols. Chapter 8 (pp.363-510) has a very comprehensive account of the Clyde Valley Co.

[17] David A. Starr (1859-1919) was a Canadian engineer who after working as a consulting engineer had joined British Westinghouse in 1901. As general manager of the Clyde Valley Co, he played a major role in the development of electricity supply in the Glasgow region. See: obituary in ***Journal of the Institution of Electrical Engineers*** Vol.57, 1919, p.624.

Electrification in the region around 1912 was still incomplete with only a small part of the area covered by Electric Lighting Orders. Significant places without a public supply included Port Glasgow (population 18,529 in 1911), Renfrew (12,565), Kirkintilloch (11,532), Irvine (10,179), Helensburgh (8,529) and Stranraer (6,444).

Lighting was still the dominant use for electricity until the late 1890s. The most profitable demand was in shops, offices, hotels, theatres (and later cinemas) and public buildings. Residential sales were more limited—by the expense of installation and the high retail prices. With lighting, much of the load on generating equipment was confined to the evening hours, a feature that also contributed to the high prices. Diversification of the load to other uses, especially in the daytime, was essential if electricity was to become a viable alternative to gas. Such diversification began with the electrification of tramways and the substitution of electric motors for small steam engines and manual power.

The limitations of DC supply became apparent to many larger undertakings after 1900 and in the search for economies of scale the introduction of more efficient prime movers became a priority. Glasgow introduced its first turbo-alternator at the Port Dundas station in 1904. A network of substations was developed from this time, where the AC current at high voltage was converted to DC for local distribution. Mixed AC/DC systems became increasingly common. Conversion to a full AC system was, however, a slow process. Dumbarton, Glasgow, Greenock, Kilmarnock and Motherwell still had DC customers in 1952.[18] Unlike Glasgow, the Clyde Valley Co. began with a full AC system with all generation by steam turbines.

The 1912 data do not cover private generation which was very important at the time, not only in isolated establishments but also in urban centres where there was already a public supply. Some examples are outlined here to give a sense of the scale and scope of private generation otherwise absent in many accounts of electrification.

Major private generators in Glasgow city included the Parkhead steelworks of William Beardmore and the North British Locomotive Works at Springburn.[19] Beyond the city boundaries Babcock & Wilcox at Renfrew had a power station (2,000kW in 1912) and Watson's paper mill at Linwood had an all-electric powered operation by 1902.[20] In Clydebank the new Dalmuir Naval Construction Works (1904) used gas engines for generating electricity for the yard,[21] and the Singer sewing machine factory had an independent power station which by 1923 had a capacity of 10,000kW.[22] Although less than a mile from the Yoker power station of Clyde Valley Electrical Power Co, the Clyde Trustees when planning the new dock (opened in April 1907) built a power station to serve the Rothesay Dock.[23] Other newly established firms in

[18] ***Electricity Supply Handbook*** 1952 pp.145-162.
[19] As early as 1901 the Hyde Park Locomotive Works had a generating capacity of almost 1,750kW, equivalent to about one third of the Glasgow Corporation's capacity. See: ***The Engineer*** Vol.91, 1901, pp.493-500.
[20] "Electrical power at a paper mill", ***The Engineer*** vol.94, 1902, pp.58-60.
[21] John R. Hume and Michael S. Moss. ***Beardmore: the history of a Scottish industrial giant*** (London: Heinemann, 1979), pp.60-66.
[22] Institution of Mechanical Engineers, ***Proceedings***, 1923, p.790.The Glasgow summer meeting offered many works visits in the Clydeside area including the major power stations.
[23] "Clyde Trustees' new dock", ***The Engineer*** Vol.103, 197, pp.415-420. The power station had a capacity of 1,170kW.

the vicinity such as Coventry Ordnance and Yarrow's avoided the expense of generating plant, by taking power from the mains of the Clyde Valley Company.[24]

For more isolated industrial plants there was little choice but to build their own generating facilities. This was certainly the case at the Nobel explosives works at Ardeer, near Stevenston, Ayrshire.[25] New motor works such as the Argyle at Alexandria and the Arrol-Johnston at Heathall, near Dumfries, also produced their own electricity for lighting and power.[26]

Industrial demand for power grew very rapidly in World War I.[27] Sales of the Clyde Valley Co. nearly tripled from 51m kWh in 1914 to 129m kWh in 1918. In order to serve the needs of heavy industry in the southeastern fringes of Glasgow, a new power station was built at Clyde's Mill. The first 5,000kW turbine entered service in November 1916 and a second followed in January 1918.

Elsewhere many of the new wartime plants, such as the Georgetown Scottish Filling Factory west of Renfrew, had to construct a power plant. The vast Gretna explosives manufacturing complex, straddling the border with England, also developed its own electricity generation.[28]

Hotels were early in adopting electric lighting as one of the amenities of high-class hospitality. The Central Hotel of the Caledonian Railway in Glasgow, opened in 1885, was still producing its own power in 1921 with seven steam generators.[29] At Turnberry, Ayrshire (opened in 1906), the Glasgow and South Western Railway used diesel engines for its independent electricity supply.

Other large institutions of a different type were also introducing electric lighting. The Crichton Royal Institution on the southern fringes of Dumfries built a power station in 1894.[30] New hospitals such as the City of Glasgow Asylum at Gartloch (opened 1896) and the Renfrew District Asylum at Dykebar near Paisley (1909-) installed electricity from the outset.

Throughout the region country houses, estates and larger farms added electricity. Eglinton Castle, near Irvine, Ayrshire, included an "electricity works" in the extensive grounds.[31]

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[24] See: "Coventry Ordnance, Scotstoun", ***The Engineer*** Vol.103, 1907, p.601; and "New Yarrow works on the Clyde", *The Engineer* Vol 104, 1907, p.488.

[25] John E. Dolan and Mike K. Oglethorpe, ***Explosives in the service of man: Ardeer and the Nobel heritage*** (Edinburgh: Royal Commission on the Ancient and Historical Monuments of Scotland, 1996).

[26] G.T. Bloomfield, "New integrated motor works in Scotland 1899-1914", ***Industrial Archaeology Review*** V (2), 1981, pp.126-142.

[27] W.R. Scott and J. Cunnison, ***The industries of the Clyde Valley during the war*** (Oxford: Clarendon Press, 1924).

[28] Wayne D. Cocroft, ***Dangerous energy: The archaeology of gunpowder and military explosives manufacture*** (Swindon: English Heritage, 2000).

[29] Oliver Carter, ***An illustrated history of British railway hotels 1838-1983*** (St Michael's-on-Wyre: Silver Link Publishing, 1990), p.67. Generation at Turnberry is noted on p.75.

[30] R.D. Cowan, "Electricity supply in Dumfries and Galloway", Chapter 4, (iii) in David Dick, ed. ***A Scottish Electrical Enlightenment: Celebrating 100 years of the Institution of Electrical Engineers in Scotland 1899-1999*** (Glasgow: IEE, 2000), p.169.

[31] Ordnance Survey, Six Inch Map series, Ayrshire XVII SW, 1908 (National Library of Scotland Collection).

ELECTRIC TRAMWAY SYSTEMS IN SOUTH WEST SCOTLAND[1]

	YEARS OPERATING	ROUTE MILES	MAX NO. OF CARS
Airdrie & Coatbridge Tramways Co.	1904-1922[2]	3.63	15
Ayr Corporation	1901-1931	6.46	29
Dumbarton Burgh & County Tramways Co	1907-1921	13.10	32
Glasgow Corporation	1898-1962	141.37	1,227
Greenock & Port Glasgow Tramways Co	1901-1929	7.42	46
Kilmarnock Corporation	1904-1926	4.24	14
Lanarkshire Tramways Co	1903-1931	28.43	92
Paisley District Tramways Co	1904-1923[2]	18.25	77

Eight electric tramway systems were developed in the region between 1898 and 1907, three by local authorities and five by companies. Glasgow Corporation operated one of the largest tramways systems in Britain and served an extensive area well beyond the city limits. In the early 20th century the Glasgow system was regarded as a model municipal operation.[3] It was also very profitable and made major contributions to the Common Good Fund.

Tramway power supply, as a proportion of total sales, was very important in the early years and ensured the viability of many public supply systems. In Greenock, for example, tramway power supply represented 49.5 percent of total electricity sales in 1901/2, a proportion that declined to 29.3 in 1911/12 and 9.4 percent in 1914/15 as power sales to local industry developed. By 1925/26 tramway sales accounted for only a small proportion of total sales—7.6 percent in Dumbarton and 6.7 percent in Greenock.

Only the Lanarkshire Tramways Co (in Motherwell) and the Glasgow Corporation had specialised power stations generating solely for supply to the tramways system. The Pinkston power station, opened in 1901, was one of the largest of its type in Britain. In 1903 its capacity was 10,000kW and this was doubled by 1914.[4] With an output of 68.9kWh in 1927/28,[5] Pinkston was the fourth largest power station in Scotland.

As well as for its size, Pinkston was significant for the AC frequency adopted in the late 1890s as the station was being planned. Designed by Horace F. Parshall (1885-1932), an American engineer living in Britain, the Glasgow tramway power station generated at 25 cycles per second (Hz). This frequency had been adopted at Niagara Falls in the early 1890s and was soon regarded as ideal for traction purposes. Rotary convertors appeared to work best at this frequency for converting AC to DC. Parshall used this frequency for the Central London Railway that opened in 1900.[6]

Glasgow Corporation Electricity Department and the consulting engineers for the Clyde Valley Electrical Power Co also adopted the frequency around 1902/3. About the same time, Birmingham Corporation and the British Electric Traction Company's Black Country subsidiaries also began building 25Hz systems. The power companies in South Wales and Cornwall introduced this frequency in their service areas. The widespread adoption of this frequency was taking place about the same time as 50Hz was becoming a national standard.

Glasgow Corporation Tramways was very protective of its independent power supply, resisting any moves to merge the power station into the general supply system. In the late 1920s, the Corporation defended Pinkston against the Electricity Commissioners' refusal to give consent for extensive modernisation.[7] Claiming that the refusal exceeded the powers of the Commissioners, the Tramways Department was able to redevelop Pinkston, raising its capacity to 33,000kW by 1934 and to 55,000kW by 1940.

When the Corporation had to approach the Commissioners again, in 1945, for permission to rebuild parts of the station, consent was only to be allowed with conditions. One major condition was the conversion from 25Hz to 50Hz. The last rebuilding took place between 1950 and 1954. A 30,000kW turbine was installed and a large cooling tower was erected on site. Pinkston outlived the tramways in Glasgow. In 1958 the power station was transferred to the South of Scotland Electricity Board and remained in service until 1975.

Electric tramways provided fast, efficient and cheap urban transport and were very profitable before 1914. Motor bus competition after the war quickly eroded the viability of the smaller systems.

In contrast to some other large British conurbations, Glasgow was slow in adopting electric traction for railways. The promoters of the Glasgow subway chose cable for propelling the underground cars, a system that lasted from 1896 to 1935 when it was rebuilt for electric traction by the Corporation. Electrification of the major suburban railways around Glasgow began in the late 1950s and was completed in 1960/61.[8]

[1] Compiled from Keith Turner, ***Directory of British Tramways***, Vol.3 (Stroud: The History Press, 2010).
[2] Sold to Glasgow Corporation.
[3] The symbolism, especially for American visitors, is explained in Bernard Aspinall, "Glasgow trams and American politics 1894-1914", ***Scottish Historical Review*** Vol.56(1), 1977, pp.64-84. City pride was expressed in publications such as ***Municipal Glasgow: its evolution and enterprises*** (Glasgow: Corporation of the City of Glasgow, 1914).
[4] Technical details of the power station were published in "Glasgow electrical tramways", ***Tramway and Railway World*** Vol.19, August 1910, pp.343-356; ***The Engineer*** Vol.113, 1912, pp.640-662. (Reporting on the summer meeting of the Institution of Electrical Engineers in Glasgow.) The first turbine was introduced in 1909.
[5] Electricity Commission, ***Generation of electricity in Great Britain. Year ending 31 March 1928*** (London: HMSO, 1928).
[6] Parshall also designed the generating stations at Radcliffe (Lancashire Electric Power) and Thornhill (Yorkshire Electric Power). In both cases 50Hz AC was adopted.
[7] See ***Annual Reports of the Electricity Commissioners***.
[8] George Blake, ***Glasgow Electric: the story of Scotland's new electric railway*** (British Railways Nov1960). Website: www.railwayonline.co.uk 41pp.

II State Intervention

Difficulties of interconnection, differences in AC frequencies, and the need for coal conservation by the use of larger scale plant became major issues in World War I when electricity consumption nearly doubled. The Electricity (Supply) Act 1919 created a new organisation, the Electricity Commissioners, to replace the role of the Board of Trade.[32]

A key mandate of the Commissioners was the restructuring of generation and transmission, by voluntary means since the earlier compulsory powers had been deleted from the legislation. The first stage of the procedure for establishing Joint Electricity Authorities was the definition of a series of Electricity Districts covering parts of the country where reorganisation was most needed. All the electricity undertakings in the defined area were then invited to submit proposals for reorganisation schemes emphasising the technical, administrative and financial aspects of a JEA.

Figure 3 WEST OF SCOTLAND ELECTRICITY DISTRICT DECEMBER 1921.

[32] Two of the Commissioners came from Glasgow. William Walker Lackie (!869-1945) had been chief engineer for the Glasgow Corporation's Electricity Department from 1902 to 1920 and was a Commissioner until 1934. Archibald Page (1875-1949) was an Electricity Commissioner from 1920 to 1925, having previously served with Glasgow Corporation from 1905 and briefly with the Clyde Valley Company from 1917 to 1920. Most of the design work on the new Dalmarnock power station was attributed to Page. See obituaries in ***The Engineer*** Vol.179, 1945, p.133; Vol.187, 1949, pp.275-6.

A West of Scotland Electricity District (**Figure 3**) was defined by December 1921 and a date for submission of proposals was set for the following December. Various local meetings of electricity undertakings and local authorities were held from early 1922 but no proposal could be agreed upon until late 1923. There was no agreement for creating a JEA but the final proposal was for an Advisory Board similar to that being formed in Manchester for the South +East Lancashire area. A local inquiry was held in Glasgow during April 1924. Throughout the proceedings over two years, Glasgow representatives had been strongly opposed to any outside control of the city power stations, including the Tramway Department's Pinkston station. Recognizing the strength of Glasgow's opposition, the Electricity Commissioners deferred making any pronouncements on the evidence presented at the inquiry.[33]

One positive outcome of the debates centred around Glasgow was the formation of a joint electricity board covering the northern and central parts of Ayrshire. The Ayrshire County Council and the Town Councils of Ayr and Kilmarnock made an application for a special order for the formation of a joint board on 15 February 1923. With the concurrence of the Secretary for Scotland this was approved on 26 November 1923. The order came into effect on 1 May 1924 about the same time as the local inquiry was concluding in Glasgow.[34]

Table 3 SOUTH WEST SCOTLAND: ELECTRICITY SUPPLY UNDERTAKINGS 1925/26.

UNDERTAKING	*SYSTEM*	*GENERATING CAPACITY kW*	*PER CAPITA CONSUMPTION kWh*
Local Authorities			
Ayrshire Electricity Board	AC/DC	36,600	93.7
Dumfries Corporation	AC/DC	1,450	44.6
Glasgow Corporation	AC/DC	148,500	184.8
Greenock Corporation	AC/DC	21,500	132.3
Hamilton Corporation	DC	1,180	53.7
Lanarkshire County Council	DC	230	24.4
Motherwell & Wishaw Corporation	AC/DC	2,100	99.9
Paisley Corporation	AC/DC	6,300	107.0
Companies			
Coatbridge & Airdrie ES Co	AC/DC	-	150.3
Clyde Valley EP Co	AC	103,750	..
Dumbarton[1]	AC/DC	-	278.1
Kilmacolm EL Co	DC	150	19.2
Skelmorlie ES Co	DC	107	21.3
Strathclyde ES Co	AC	-	..

Note:

[1] Electric Supply Corporation

Source: Compiled from Electricity Commissioners, ***Engineering and Financial Statistics 1925/26.***

[33] See John C. Logan, PhD thesis 1983, pp.521-527 and ***Annual Reports of the Electricity Commissioners***: 1921-22 and Appendix A; 1922-23, p.11; 1923-24, p.34; 1924-25, p.23.

[34] ***Annual Reports of the Electricity Commissioners***: 1922-23, pp.58-59; 1923-24, pp.54-55, 118; 1924-25, p.118.

The 14 undertakings in 1925/26 (**Table 3**) operated a variety of systems. Most were mixed AC/DC reflecting the move away from DC that had been popular in the early years of electrification. With an economic operating radius of 1-1.5 miles from the generating plant, DC was suitable only for city centres or small towns and villages such as Kilmacolm and Skelmorlie. AC frequencies were divided between 25 cycles per second (Hz) in Glasgow and the Clyde Valley and 50Hz in Paisley, Greenock and Ayrshire.

Data on generating capacity show a huge range in size from Glasgow Corporation with 148,500kW to the Skelmorlie company with only 107kw. Steam turbines were dominant in all the larger stations and varied in size from the 18,750kW units at Dalmarnock and Clyde's Mill to a 750kW machine at Dumfries. Older reciprocating steam engines were still common, especially for generating DC such as in Hamilton.

Statistics on electricity consumption per head of population reveal major contrasts among electricity undertakings. Five places exceeded 100.0kWh per person. Each place had a distinctive market profile reflecting the local economic and social geography. Two towns, Dumbarton and Dumfries, with similar-sized populations (around 22,000) had very different market profiles. Dumbarton was dominated by power sales at 87.5 percent, while Dumfries had a more balanced structure of sales (44.4 percent in lighting and 51.1 percent in power). Annual per capita sales in Dumbarton amounted to 278.1kWh while sales in Dumfries reached only 44.6kWh.

Transmission lines supported by tall steel towers became the most visible effect of state intervention as they appeared in the landscape during the early 1930s. Glasgow men also played a significant role in the promotion and development of the national transmission grid. Such a grid was a key recommendation of the Weir Report[35] which formed the basis for the Electricity (Supply) Act 1926. The government moved quickly in forming the Central Electricity Board in 1927. Sir Andrew Duncan (1884-1952)[36] was appointed chairman in January 1927 and the CEB with seven part-time members began meeting in March. Archibald Page, previously an Electricity Commissioner, was appointed general manager and chief engineer.[37]

The first grid scheme, for Central Scotland, had already been prepared by the Electricity Commissioners and consulting engineers. It was presented to the CEB in April 1927 and accepted with few modifications. Edward MacColl (1882-1951) was appointed as manager and chief engineer for Central Scotland.[38]

The Central Scotland scheme had three main components:

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[35] Ministry of Transport***, Report of the Committee appointed to review the National Problem of the Supply of Electrical Energy*** (London: HMSO, 1927), 39 pp.

[36] Duncan, described by Hannah as an "arch-negotiator" was an ideal choice for this new form of public corporation. His negotiating skills were very important in reassuring municipal and company owners of power stations as well as the objectors to transmission line building. See: Leslie Hannah, ***Electricity before nationalisation*** (London: Macmillan, 1979), p.107.

[37] Page was knighted in 1930 for his contributions to the grid and succeeded Duncan as chairman of the CEB in 1935, serving in that capacity until 1944.

[38] MacColl had previously served with Glasgow Corporation Tramways and from 1919 with the Clyde Valley Co. In 1943 he moved from the CEB to the newly formed North of Scotland Hydro Electric Board. Peter L. Payne, "Sir Edward MacColl", in ***Dictionary of Scottish Business Biography*** Vol.2 (Aberdeen: Aberdeen University Press, 1990), pp.238-241.

- Building a 132kv transmission line linking the major power stations especially in Glasgow, Edinburgh and Dundee. Some lower voltage (33kv) lines were also built for more localised connections.
- Constructing transformer stations at the selected power stations and a few other points.
- Standardising the frequency of Glasgow and Clydeside from 25Hz to 50Hz. An earlier engineering survey in 1924 had provided details of the cost and works necessary to accomplish the changes.

The cost of all the work was estimated at £4,821,250 in 1927, made up as follows:[39]

Overhead Lines	£702,960
Transformer stations	£972,040
Other works	£225,000
Frequency standardisation	£2,921,250

The Central Scotland scheme was designed and built in three years and in all the details served as the prototype for all the other regional projects of the CEB. A formal opening at Portobello power station, Edinburgh, on 30 April 1930 was performed by Herbert Morrison, Minister of Transport. Some sections had already been energised by that time but some work was still unfinished. The link to the Grampian Electricity Supply Company's hydroelectric stations at Abernathy was completed in November and the line to Dundee in early 1931.

Major engineering works on the Central Scotland scheme were the river crossings which required very tall towers to clear the navigation channels on the River Cart at Renfrew, the Clyde at Yoker and the Forth at Kincardine. The line from Dalmarnock power stations to Port Dundas and Yoker was a particular challenge in finding space to locate the towers in the heavily built-up area of Glasgow. The restricted site at Dalmarnock meant that the transformer station had to be located several streets away. At the Dellingburn, Greenock power station, a special overhead gantry had to be designed for the transformer system.

When trading began on 1 January 1933, the grid had added a new layer to the complex of undertakings which operated the electricity supply system. The grid control office at Broomhill Drive, Glasgow, now managed the flows of power on the transmission lines and directed the hour-to-hour operation of the selected power stations. These stations, such as the one at Yoker, remained in the ownership and management of the Clyde Valley Co. but the daily operation was now directed from the grid control office. Planning for the future became increasingly centralised, particularly from London.

The South Scotland Electricity Scheme was the last of the nine regional schemes. Prepared by the Electricity Commissioners, the plan was submitted to the CEB in December 1930 and accepted at the end of July 1931. As well as providing bulk supplies to local distributors, the scheme was designed to connect with the neighbouring Scottish and English regions. The transmission system was completed by the end of 1933 but trading did not begin until 1

[39] Electricity Commissioners, ***Central Scotland Electricity Scheme 1927, Supplementary Particulars*** (London: HMSO, 1927).

January 1937 when all the hydroelectric stations were in service. The Glasgow grid office controlled all operations of the South Scotland scheme.

By this time most of the primary objectives of the 1926 legislation had been accomplished in Scotland:

- All central and southern parts of Scotland were interconnected.
- Electricity generation was concentrated in fewer coal-fired power stations. Obsolete generating plant in Dumfries, Glasgow (Port Dundas and St Andrew's Cross), Hamilton, Motherwell, Paisley and Skelmorlie had been shut down.
- The grid and bulk supply contracts with the CEB ensured the viability of the major Scottish hydroelectric projects of the interwar period. In the north, the Grampian Electric Supply Co. with power stations at Rannoch and Tummel linked with the grid at Abernathy. In the south, the Galloway Water Power Co. developed five new stations, each "selected" by the CEB and directly connected to the Kilmarnock-Carlisle 132kv line (Figure 4). With a total capacity of 102,000kw, the Galloway scheme was completed in late 1936. The power generated was mostly used in industrial central Scotland and North West England.[40]

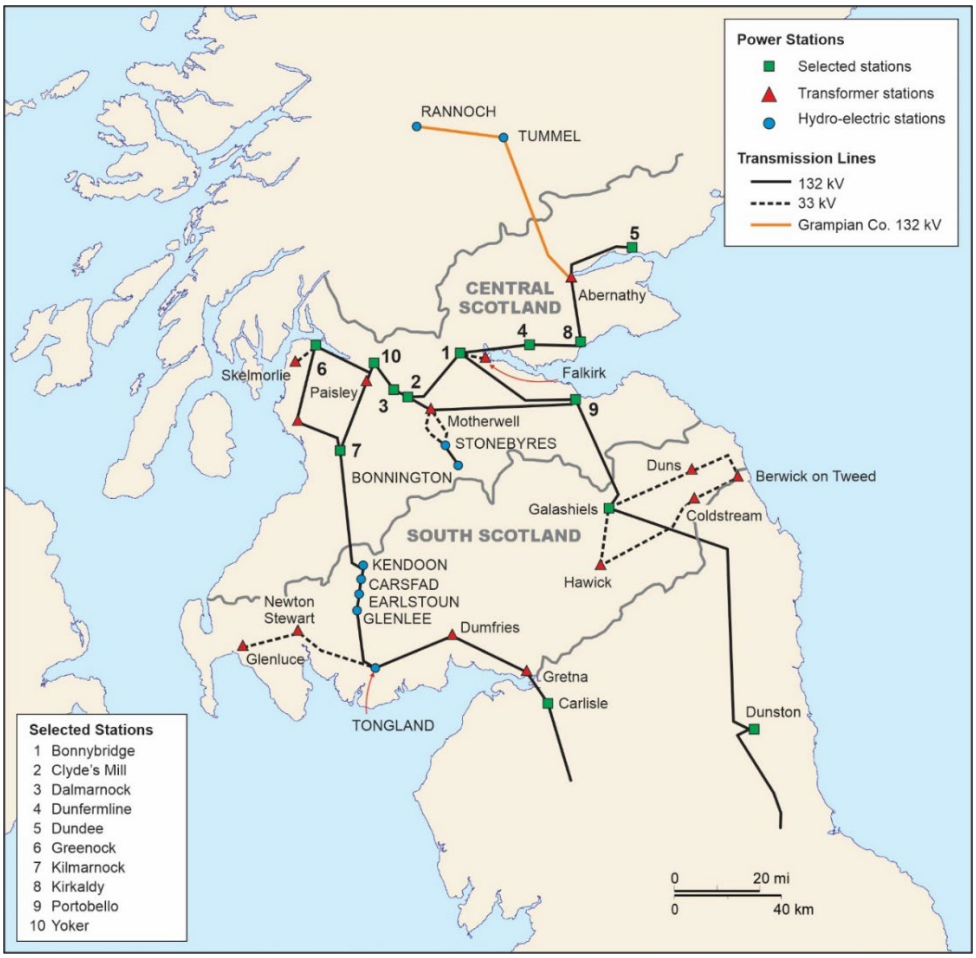

Figure 4 CENTRAL AND SOUTH SCOTLAND ELECTRICITY SCHEMES 1936.

[40] See Peter L. Payne, ***The Hydro*** (Aberdeen: Aberdeen University Press, 1988), pp.25-29. The notes on p.294 provide details of the many publications describing the construction of the Galloway power scheme.

Proposals for hydro-electric generation and building the grid prompted local action in developing rural electricity supply in Dumfries and Galloway. Dumfriesshire County Council applied for an Electricity Special Order on 21 June 1928. An order for Gretna and Dornock was granted in May 1929 and supply began in October. The rest of the county was covered by an Order granted in May 1931. Within a few years, most of the settled area was traversed by a network of overhead power lines and pole transformers.[41] In Wigtownshire, a company applied for an Order in May 1930, which was granted in June 1931. A temporary diesel-powered supply in Stranraer was in service by August.[42]

Kirkcudbright County Council followed with an application in November 1931 and was granted Orders, first for Kirkcudbright burgh in June 1932 and for the rest of the county in December. The County Council bought out several non-statutory companies in the area as it developed its distribution network. The results of the electrification, for a small population (30,341 in 1931) and large area (900 square miles) are impressive:

KIRKCUDBRIGHT COUNTY COUNCIL ELECTRICITY SUPPLY 1933-1948[43]

Year Ending May	*No. Customers*	*Farms Connected*	*Sales 000kWh*	*Average charge per kWh (d.)*
1933	104	-	11	5.34
1936	2,786	54	1,914	2.29
1939	4,449	217	4,346	1.80
1945	5,367	372	9,144	1.59
1948	6,514	461	13,008	1.47

By the early 1930s the previously empty area of the southern part of the region was covered by statutory electricity undertakings that received their power supply from the grid.

Table 4 shows the situation in 1935/36 when 17 undertakings were in operation. Over the previous decade many changes had taken place. One significant shift was the disappearance of wholly DC systems.

Generating technology emphasised economies of scale with larger units which brought major reductions in coal consumption. Most of the older, smaller stations had been closed down in places such as Dumfries and Hamilton which in 1925/6 had burned 5.42lbs and 4.62lbs of coal for every kilowatt hour generated. Large modern stations such as those owned by the Clyde Valley Co. had reduced their coal consumption from an average of 2.13lbs of coal per kWh in 1925/6 to 1.42lbs a decade later.

[41] J.S. Pickles and W.H. Wills, "Rural electrification: the use of the single-phase system of supply", ***JIEE*** Vol 93, Part II, 1946, pp.501-15.
[42] "The Wigtownshire electricity scheme", ***The Engineer***, Vol.163, 1937, pp.45-46.
[43] J. Laird and D.G. Ramsey, eds., ***The Stewartry of Kirkcudbright and Wigtownshire. Third Statistical Abstract of Scotland***, Vol.14 (Glasgow: Collins, 1965), p.50. More details on the Dumfries and Kirkcudbright electrification schemes were presented in the Electricity Commissioners, ***Sixteenth Annual Report 1935-36*** (London: HMSO, 1936), pp.28-38.

Table 4 SOUTH WEST SCOTLAND: ELECTRICITY SUPPLY UNDERTAKINGS 1935/36.

UNDERTAKING	SYSTEM	GENERATING CAPACITY kW	PER CAPITA CONSUMPTION kWH
Local Authorities			
Ayrshire Electricity Board	AC/DC	34,000	241.1
Dumfries Corporation	AC/DC	120	162.9
Dumfries County Council	AC	-	99.9
Glasgow Corporation	AC/DC	138,000	357.7
Greenock Corporation	AC/DC	20,500	203.3
Hamilton Corporation	AC/DC	-	140.7
Kirkcudbright County Council	AC/DC	-	63.2
Motherwell & Wishaw Corporation	AC/DC	-	394.4
Paisley Corporation	AC/DC	-	592.1
Companies			
Clyde Valley EP Co	AC	132,000	..
Dumbarton[1]	AC/DC	-	360.8
Galloway Water Power Co	AC	38,250	-[2]
Lanark Hydro-Electric Power Co	AC	15,520	-[2]
Skelmorlie ES Co	AC	-	88.8
Strathclyde ES Co	AC	-	..
Wigtownshire Electricity Co	AC	-	70.3

Notes:
[1] Electric Supply Corporation
[2] Bulk supply only

Source: Compiled from Electricity Commissioners, ***Engineering and Financial Statistics 1935/36.***

Rationalisation of generation and interconnection of undertakings all contributed to reducing the cost of electricity. Other factors such as the growth of radio broadcasting[44] and lower prices for small appliances helped to boost electricity consumption. By 1935/36 there were eight places in the region with per capita consumption levels above 100kWh.

The growth of electricity sales, especially in the lighting segment, may be illustrated by the case of Paisley. Total electricity sales grew from 9.21million kWh in 1925/26 to 51.16m kWh a decade later. The lighting segment that included domestic uses expanded from 2.32m kWh to 11.24m kWh. Power sales also grew very substantially as a result of new arrangements with J. & P. Coats, the largest manufacturing concern in the town. Over the same period, per capita consumption in Paisley rose from 107.0kWh to 592.1kWh.

[44] The British Broadcasting Company began a service from Glasgow in March 1923 from a transmitter at Port Dundas power station. Alan Smith, "Broadcasting in Scotland", Chapter 7 in D. Dick, ed. ***A Scottish electrical enlightenment*** (2000), p.211.

Table 5 SOUTH WEST SCOTLAND ELECTRICITY BOARD AREA CORPORATE STRUCTURE OF ELECTRICITY HOLDING COMPANIES 1934/35.

1. Electric Supply Corporation	1.1 Dumbarton undertaking[1]
2. General Electric Co	2.1 Wigtownshire Electricity Co
Other Companies	3.1 Clyde Valley Electrical Power Co 3.2 Lanarkshire Hydro-Electric Power Co 3.3 Strathclyde Electricity Supply Co 4. Galloway Water Power Co 5. Skelmorlie Electric Supply Co

Note: [1] Ownership of the franchise remained with the Dumbarton Corporation.
Source: Political and Economic Planning, ***Report on the Supply of Electricity in Great Britain*** (London: PEP, 1936), pp.140-141.

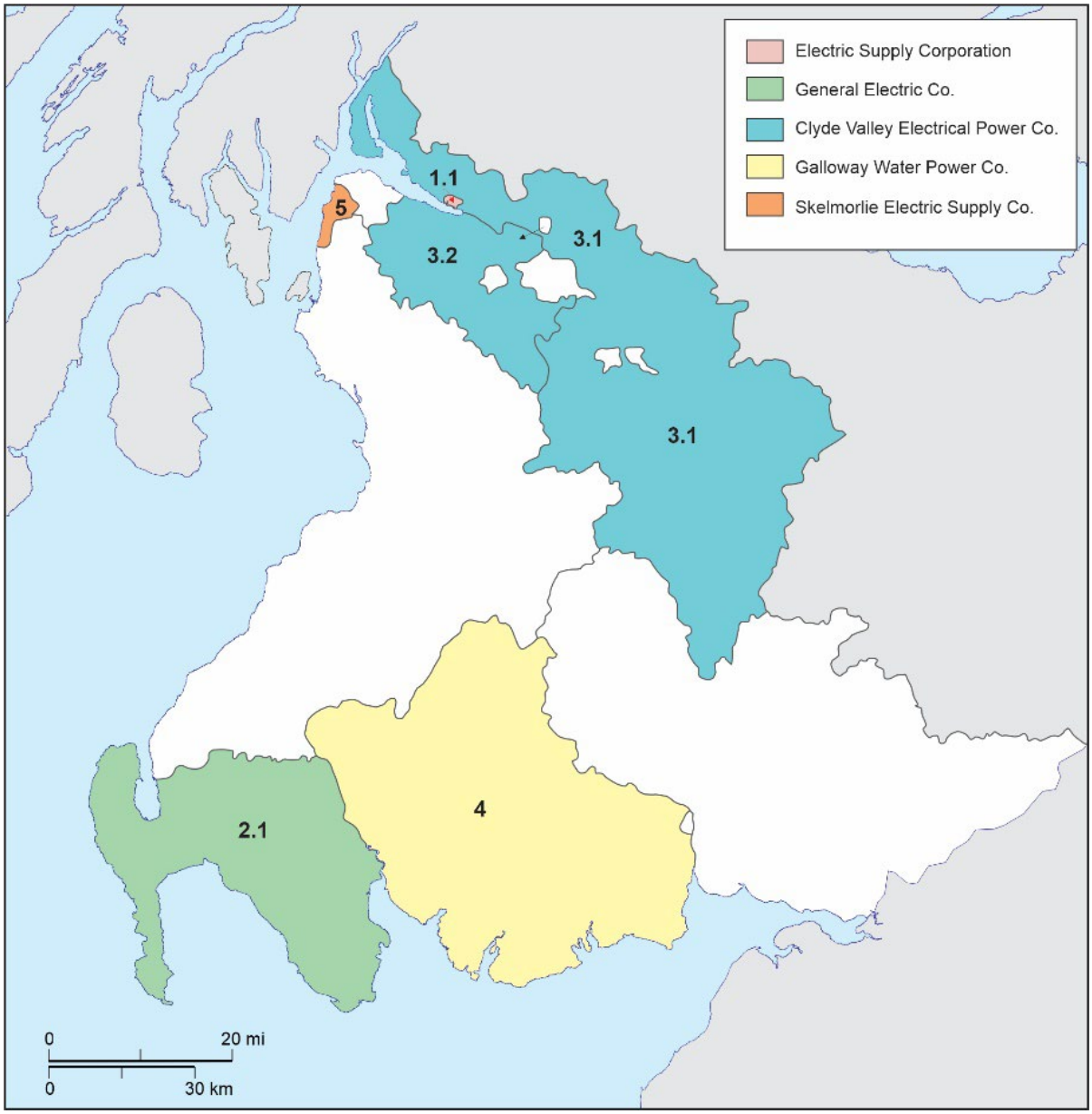

Figure 5 SOUTH WEST SCOTLAND HOLDING COMPANIES 1934/35.

Electricity holding companies had a limited role in South West Scotland (**Table 5** and **Figure 5**). The Electric Supply Corporation continued to operate the Dumbarton undertaking on behalf of the Town Council while the General Electric Co. owned the newly formed Wigtownshire Electricity Co. By 1935 the former Coatbridge & Airdrie Electric Supply Co. had been taken over by the Corporations of Coatbridge and Airdrie exercising their purchase rights (42 years) under the 1888 Act. Both towns made agreements with the Clyde Valley Company for operating the electricity system within the municipalities. Before the takeover, the Coatbridge & Airdrie Co. had been distant outliers of the County of London Electric Supply Co.

Although state intervention had begun to rationalise electricity generation, the efforts of the Electricity Commissioners to reduce the very large numbers of distributors were unsuccessful. The McGowan Report published in May 1936[45] and the subsequent government proposals were strongly opposed by many sections of the electricity supply industry. A recommendation in the McGowan Report, that all undertakings with annual sales of less than 10 million kWh should be amalgamated, was particularly controversial. Five of the nine local authorities were well above this limit. The government's Outline of Proposals published in April 1937[46] was met with strong opposition and more pressing issues of the time meant that reorganisation of distribution was set aside.

The Empire Exhibition held in Glasgow during 1938 was in a sense a last celebration of electricity before years of blackout and power shortages. Electricity generation in the Central Scotland scheme area increased rapidly after 1936, especially to meet the demands of rearmament and the war effort:

YEAR	*MILLION kWH*
1936	1,346.9
1939	1,673.3
1944	2,775.5
1947	3,124.9

Major new industrial plants on Clydeside included the Royal Ordnance Factory at BIshopton and the Rolls-Royce aero-engine works on the Hillington Industrial Estate. Generating capacity was extended at Dalmarnock (100,000kW), Clyde's Mill (50,000kW) and Kilmarnock (60,000kW). Bomb damage at Greenock during the raids in May 1941 resulted in a permanent loss of capacity.

[45] Ministry of Transport, ***Report of the Committee on Electricity Distribution***, May 1936 (London: HMSO, 1936). The report noted that there were no fewer than 635 separate authorised undertakings in Great Britain in 1934, comprising the Central Electricity Board, 3 Joint Electricity Authorities, 5 Joint Boards, 373 Local Authorities and 253 Companies and persons.
[46] Ministry of Transport, ***Electricity Distribution: Outline of Proposals*** (London: HMSO, 1937).

Table 6 SOUTH WEST SCOTLAND ELECTRICITY BOARD AREA.

CONSOLIDATIONS TO 1948

UNDERTAKING	*YEARS IN OPERATION*	*NEW OWNER*
Kelvinside ET Co	1893-1899	Glasgow Corporation
Govan Burgh	1900-1912	Glasgow Corporation
Partick Burgh	1902-1912	Glasgow Corporation
Wishaw Burgh	1908-1920	Motherwell Corporation
Ayr Burgh	1896-1923	Ayrshire Electricity Board
Kilmarnock Burgh	1904-1923	Ayrshire Electricity Board
Kilmacolm ES Co	1904-1925	Clyde Valley EP Co
Lanarkshire County Council	1905-?	Clyde Valley EP Co
Coatbridge & Airdrie Co	1894-1935	Coatbridge & Airdrie Burghs[1]

Note: [1] The local electricity system, though owned by the towns, was operated by the Clyde Valley Company by arrangement.

MUNICIPAL TAKEOVERS OF COMPANY UNDERTAKINGS

Dumfries Burgh	1923	

Table 6 shows the consolidation of undertakings from 1899 to the 1930s. Several of the changes were a result of local government amalgamations in Glasgow and the merger of Motherwell and Wishaw in 1920.

III Nationalisation

After three decades of discussion, the whole organisation of electricity supply was restructured following the Electricity Act 1947. From 1 April 1948, the South West Scotland Electricity Board took over the assets of 14 local authorities, boards and companies (**Figure 1**). The generating stations and transmission lines of the Central Electricity Board were transferred to the British Electricity Authority.

The arrangements of 1948 lasted only seven years. In the elections of 1950 and 1951, the Conservatives had stressed their intention to give more independence to the Scottish and Welsh parts of nationalised industries. By June 1952 the Minister of Fuel and Power was ready to act on the Conservative manifesto by hiving off the southern Scottish Boards from the BEA.[47] This was implemented by the Electricity Reorganisation (Scotland) Act 1954 which came into operation on 1 April 1955. The South of Scotland Electricity Board combined the South East and South West Scotland Boards together with the power stations and transmission lines of the BEA. Supervision of the new board was transferred from the Minister of Fuel and Power in London to the Secretary of State for Scotland in Edinburgh.

[47] Leslie Hannah, ***Engineers, managers and politicians: The first fifteen years of nationalised electricity supply in Britain*** (London: Macmillan, 1982), pp.161-162.

Electricity Distribution

The South West Scotland Board was responsible for integrating all the undertakings. Systems had to be standardised and the multiplicity of tariffs reduced. For administrative purposes, the Board area was subdivided into five sub-areas and 26 districts.

Figure 6 shows the geographical organisation in 1957, two years after the formation of the South of Scotland Board, when there were four sub-areas covering the South West and subdivided into 24 districts. One notable feature is the network of 58 service centres where consumers could pay their bills and purchase appliances. These service centres were an important and profitable part of the Board's business.

Between 1948/9 and the end of 1956 the number of consumers in the region increased by 25.9 percent while consumption rose by 60.2 percent. Meeting these demands meant considerable investment in new facilities as well as modernisation. One feature of modernisation was the conversion of DC systems to AC--Glasgow and Hamilton conversions were complete by 1957. The New Town at East Kilbride (designated in May 1947) needed a power infrastructure before development could begin. By 1961 the town had 31,000 residents. Major new factories such as the Pressed Steel railway rolling stock works at Linwood (1947) and the Caterpillar earth-moving machinery plant at Uddingston (1956) quickly became large consumers of power.

Figure 6 SOUTH WEST SCOTLAND ELECTRICITY BOARD AREA, 1957.

Electricity Generation and Transmission

The South West Scotland Division of the British Electricity Authority covered the same area as the distribution board. It was an amalgamation of the 132kv transmission system developed by the Central Electricity Board and the power stations previously owned by the companies and local authorities. The main tasks from 1948 were to integrate the various generating stations and their workforces, to modernise and standardise operations, and to expand capacity to meet the rapidly growing demand.

Table 7 lists the 14 power stations in the new organisation. Eight were hydro-electric stations. Two stations were extended after this time—Clyde's Mill and Dalmarnock. The original Dalmarnock structures were replaced by new buildings housing, two 60,000kW units. This work was completed by 1957.

Two new power stations were commissioned in the region. Braehead, designed by Glasgow Corporation engineers, entered service in 1951. Barony, near Cumnock, Ayrshire, was built near a colliery and designed for burning slurry waste from the washery. The station was commissioned in 1956.

Table 7 BRITISH ELECTRICITY AUTHORITY POWER STATIONS IN THE SOUTH WEST SCOTLAND DIVISION 1948/49.

POWER STATION	*CAPACITY kW*	*TYPE*[1]
Dalmarnock	237,500	S
Clyde's Mill	157,500	S
Yoker	100,000	S
Kilmarnock	85,000	S
Tongland[2]	33,250	H
Glenlee[2]	25,000	H
Kendoon[2]	21,000	H
Ferguslie[3]	17,750	S
Carsford[2]	12,000	H
Earlstoun[2]	12,000	H
Bonnington[4]	9,840	H
Greenock	8,000	S
Stonebyres[4]	5,680	H
Maxwelltown[5]	120	H
	724,640	

Notes:

[1] S – Steam; H—Hydro-electric.

[2] Previously owned by Galloway Water Power Co.

[3] Previously owned by J & P Coats, Paisley.

[4] Previously owned by Lanarkshire Hydro-Electric Power Co., a subsidiary of Clyde Valley Electrical Power Co.

[5] Previously owned by Dumfries Corporation.

Source: Compiled from British Electricity Authority, ***Annual Report 1948-49***, Appendix 15.

Plans for new coal-fired stations now concentrated on the eastern coalfields where long-term fuel supplies were available. From the mid-1950s nuclear power became the focus for new generating capacity in South West Scotland. Chapelcross near Annan, built by the UK Atomic Energy Authority, followed the same plan as Calder Hall in Cumberland. Designed for the

production of plutonium with electricity as a by-product, the plant entered service in 1959.[48] Consent for the Hunterston nuclear station was granted in July 1957 and construction began later that year. Owned by the SSEB, this station began operating in 1964.

The original Scottish grid system (**Figure 4**) continued to serve the original demands with few changes until the late 1940s. A wartime extension from the Galashiels to Carlisle had provided a further route for inter-regional transfers. The first major extension project was the building of the 132kv line from the Loch Sloy hydro-electric station to the northern suburbs of Glasgow. This was completed for the opening of the plant in 1950. Another connection, from the Tummel power station of the North of Scotland Hydro-Electric Board to Bonnybridge, was constructed in the early 1950s. These lines ensured the viability of the NSHEB and provided a valuable supplement to the central Scotland load centres. Other 132kv lines reinforced the grid supplies in Glasgow, Edinburgh, Fife and Galloway.

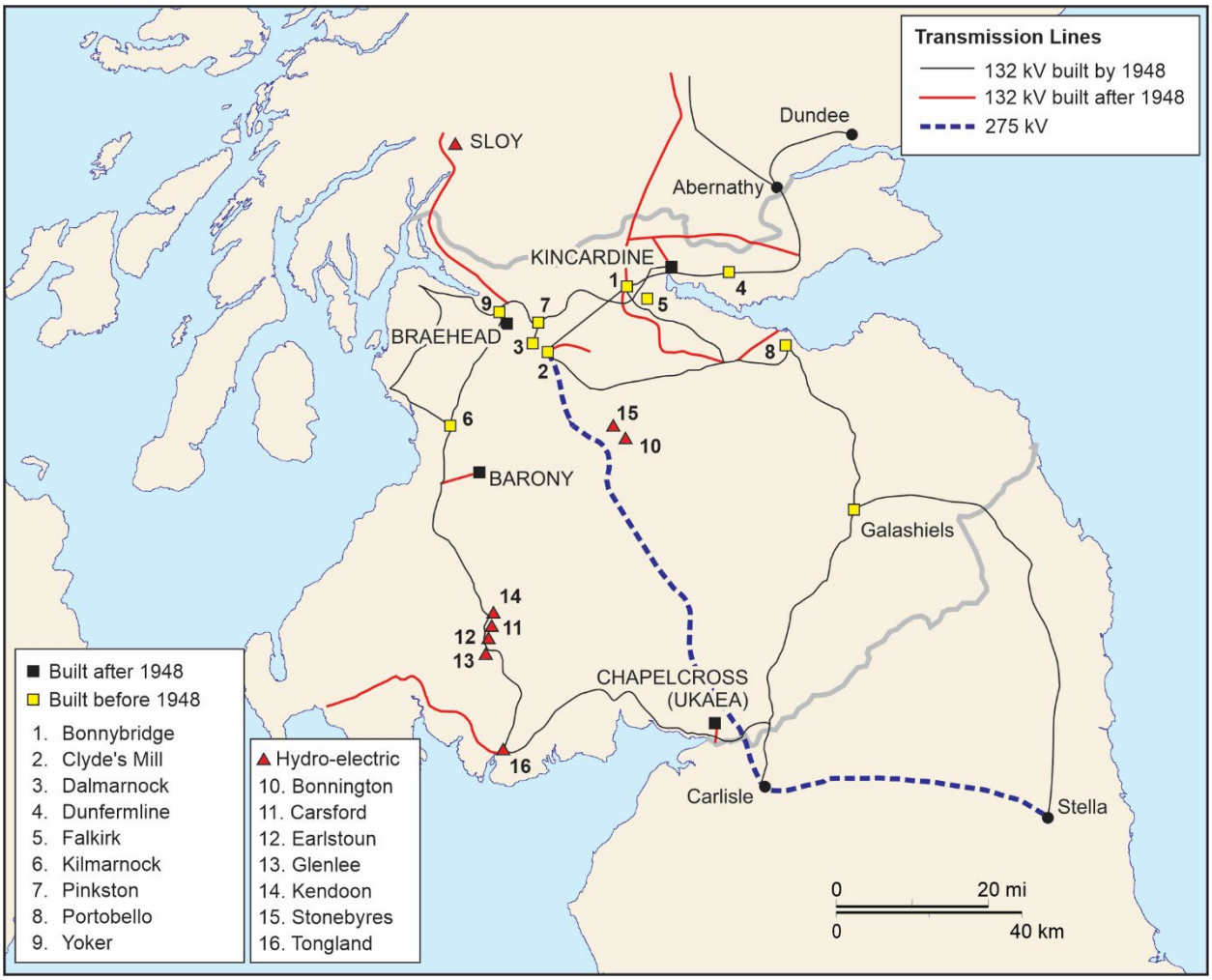

Figure 7 SOUTH OF SCOTLAND ELECTRICITY BOARD TRANSMISSION LINES 1959.

[48] G. Houston, ***The County of Dumfries, Third Statistical Account of Scotland***, Vol.12 (Glasgow: Collins, 1962), p.64.

Clyde's Mill was the terminus of the first section of the Supergrid. Completed in 1954 from Stella (near Newcastle) via the new Harker substation (near Carlisle}, the line operated at 132kv until 1958 when energised at 275kv. By this time the SSEB was planning a similar high-voltage transmission system that would link the new coal-fired plant at Kincardine with the nuclear station being built on the west coast at Hunterston.

In October 1959 the grid control office that had been operating since the early 1930s was transferred from Broomhill, Glasgow to a new location at Kirkintilloch.

Electricity distribution and generation were combined under the South of Scotland Electricity Board from 1 April 1955. In the decade after nationalisation generating capacity in the region was increased from 946,205kW to 1,702,880kW. Sales of electricity rose from 3,115million kWh to 6,345m kWh and the number of consumers from 956,000 to 1,342,000. Employment in electricity supply in the combined area grew from 8,945 in 1948/49 to 11,377 by 1957.

Table 8 POWER STATIONS IN THE FORMER SOUTH WEST SCOTLAND DIVISION 1959.

POWER STATION	***CAPACITY kW***	***Type[1]***
Clyde's Mill	277,500	S
Dalmarnock	257,500	S
Braehead	210,000	S
Yoker	100,000	S
Pinkston[2]	65,000	S
Kilmarnock	60,000	S
Barony	60,000	S
Tongland	33,250	H
Glenlee	25,000	H
Kendoon	21,000	H
Carsford	12,000	H
Earlstoun	12,000	H
Bonnington	9,840	H
Stonebyres	5,640	H
	1,084,380	

Notes:

[1] S – Steam; H—Hydro-electric.

[2] Transferred from Glasgow Corporation Tramways 30 October 1958.

Source: Compiled from South of Scotland Electricity Board ***Annual Report 1959***.

Summary

Table 9 shows various indicators of the growth of electrification after 1900. The dominance of local authorities in 1900 illustrates the strong municipal role in the region. From the 1920s county councils in Ayr, Dumfries and Kirkcudbright took the lead in extending electricity service into rural areas.

Table 9 SUMMARY OF DEVELOPMENT IN SOUTH WEST SCOTLAND.

	NUMBER OF UNDERTAKINGS[1]	LOCAL AUTHORITY UNDERTAKINGS	NUMBER OF POWER STATIONS	GENERATING CAPACITY (kW)	PER CAPITA CONSUMPTION (kWH)
1900	6	5	7	..	.. (4)[2]
1912	19	10	22	..	.. (36)
1925/6	14	8	18	322,373	165.0 (133)
1935/6	16	9	11	398,900	338.6 (374)
1948/9	..	..	14	724,640	814.1 (821)
1958/9	-	..	14	1,084,380	1,620.9(1,765)[3]

Notes:

[1] Excludes all non-statutory undertakings.

[2] Great Britain 1900-1948/9 from Leslie Hannah, ***Electricity Before Nationalisation: a study of the electricity supply industry in Britain to 1948*** (London: Macmillan, 1979), pp.427-8.

[3] Calculated from data in Electricity Council, ***Handbook of Electrical Supply Statistics 1977***, p. 63 and census returns.

A sense of the rapid growth of demand from the mid-1920s is illustrated by the two final columns in the table. Generating capacity in the region was always dominated by Glasgow and its immediate environs—over 60 percent from the 1920s. In 1958/59 the five power stations in and around the city accounted for 85 percent of regional capacity.

Per capita consumption in the South West Scotland (with Great Britain in parentheses) shows substantial rates of growth. Until the Depression regional consumption levels were above the national average. After 1930 levels of consumption rose at slower rates than in many parts of the country.

Electrification was a much slower process than the enthusiastic promoters of the 1880s expected. Much effort and expenditure were needed to create viable electricity undertakings in the larger urban centres. This point of viability was reached about 1900 but extending the benefits of electricity over wider areas took much longer and universal electricity was probably not achieved until the 1950s.

Note on Sources

The records of electrification in Scotland have some distinctive features reflecting the history, legislation and culture of North Britain. After the Electric Lighting (Scotland) Act 1890, the Secretary for Scotland had a role in reviewing applications for Electric Lighting Orders and loans to local authorities for developing electricity supply. The Secretary of State for Scotland gained new powers with the Hydro-Electric Development (Scotland) Act 1943. Full control of Scottish electricity came in 1955 with the Electricity Reorganisation (Scotland) Act 1954 when all the powers were transferred from London to Edinburgh.

Many aspects of regional identity are expressed in the 31 volumes of the ***Third Statistical Account of Scotland*** published between 1951 and 1992. Most of the city and county volumes

include details of public utilities such as gas, water and electricity. Parish accounts in the Lanarkshire volume (1960), for example, note the progress of electrification in the upper Clyde valley from the 1920s to the 1940s. In the parish of Carstairs, for example:

> The first contract for installing electricity in the houses was started in July 1931. Before that paraffin oil supplied the light in common use, both indoors and outside, although in Carstairs Junction the railway company previous to 1931 had generated electricity and given supply to one or two people there including the school-master.[49]

For the period before state intervention, Garcke's ***Manual of Electricity Undertakings***, first published in 1896, is the indispensable source. This annual volume lists all municipal and company electricity and tramway systems in comprehensive detail. Technical information on the generating and distribution systems is noted for each undertaking, as well as statistics on sales, revenue and expenditure. There are full details of personnel and company directors. Garcke also covers many of the non-statutory companies which were often significant in rural areas.

The contents of the ***Annual Reports*** of the Electricity Commissioners (1st, 1920-21 – 23rd, 1947-48) highlight the role of state intervention during this period and reflect the power of the Electricity (Supply) Act 1919. Under this legislation all power station and transmission line construction required consent of the Commissioners. Loans for local authority electricity undertakings, extensions of areas and transfers of ownership all required approval from London. Even the payment of subscriptions to associations such as the British Electrical Development Association and the Incorporated Municipal Electrical Association had to have the Commissioners' consent. The detailed supervision of expenditure also included the purchase of proceedings of conferences or meetings and the expenses of members and officers attending such meetings.

The ***Engineering and Financial Statistics***, also published by the Electricity Commissioners, were equally detailed. Local authorities and companies are separately listed with detailed tabulations of generating equipment, fuel consumption, output as well as sales (by type). Such data provide effective evidence on the scale and depth of electrification. The financial statistics cover revenue, expenditure and capital investment. All the returns for Scotland were tabulated separately, reflecting the legislative background and perhaps also recognising the differences in the local authorities' financial year.[50]

The Electricity Commissioners also published more specialised reports on plans for integrating local systems which formed the basis for the 132kv grid developed from 1927. All the publications of the Electricity Commissioners were issued under the authority of the Minister of

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[49] G. Thomson ed. ***The County of Lanark: Third Statistical Abstract of Scotland*** Vol.8 (Glasgow: Collins, 1960), p.541.

[50] Generally the Scottish local authority financial year ended on 15 May. There were, however, some variations such as Edinburgh (20 May) and Glasgow (31 May). See: ***Municipal Year Book 1970***, p.1793. In the Electricity Commissioners' ***Engineering and Financial Statistics***, the City of Aberdeen's financial year ended on 31 July.

Transport.[51] They were, however, Non-Parliamentary Publications of HMSO and consequently were not always acquired by libraries at the time.

The Annual Reports of the Central Electricity Board from 1929 to 1947 contain, especially in the earlier years, comprehensive details of the progress of constructing the transmission grid. CEB reports were privately published and are rare items in library collections.

After nationalisation, details of the distribution sector of the electricity supply industry were published in the Annual Reports and Accounts of the South West Scotland Electricity Board 1948/9-1954/5, while data on generation and transmission appear in the British Electricity Authority Annual Reports. The South of Scotland Electricity Board published its Annual Reports on a calendar year basis from 1955. All these reports were published as House of Commons sessional papers until 1971-72. Thereafter they were no longer published by HMSO.

Some publications of the Electricity Council (established in 1958 to provide coordination in England and Wales) include useful Scottish material.

The ***Handbook of Electricity Supply Statistics,*** published at intervals between 1966 and 1989, includes helpful summaries. ***Electricity Supply in Great Britain: A Chronology***, also published in various editions, is especially useful for details of legislation and major events, especially technical changes from Michael Faraday's fundamental discoveries of 1831.

In the postwar period the ***Electricity Supply Handbook*** (published annually by the ***Electrical Times*** from 1947) is a very useful compendium of facts, figures and personnel in the industry. The detailed maps of the grid system are especially important. Like many annual reference works of its type, these volumes are quite scarce.

Notable studies of electricity in Scotland include:

John C. Logan, "An economic history of the Scottish electricity supply industry 1878-1930". PhD thesis, University of Strathclyde, 1983, 2 vols.

David Dick, ed. ***A Scottish Electrical Enlightenment: Celebrating 100 years of the Institution of Electrical Engineers in Scotland 1899-1999*** (Glasgow: IEE, 2000).

Other works that have references to electricity include: ***Scottish Life and Society: A Compendium of Scottish Ethnology*** (14 volumes), 2000-

Since there is no specialised museum and archives for electricity in Scotland, the principal centre for any study must be in Edinburgh:

1. The National Library of Scotland has rich resources such as a complete set of Garcke's ***Manual of Electrical Undertakings*** 1896-1948 and important series such as the ***Electrical Review*** 1892- and ***Electricity Supply Handbook*** 1948-2004. The excellent map collection is also available online at www.maps.nls.uk.

[51] See ***Annual catalogues of British government publications 1920-1970*** (Bishop's Stortford: Chadwyck-Healey. 1974).

2. National Records of Scotland (previously Scottish Record Office, National Archives of Scotland) holds general legislative material on electricity supply (DD11/1-154) and official records such as minutes and annual reports of the North of Scotland Hydro-Electric Board (NSE) and the South of Scotland Hydro-Electric Board (SSE).

   The files once held records of pre-nationalisation undertakings but these appear to have been dispersed. Tracing their locations may be possible through the Scottish Archives Network (SCAN), also maintained by National Records of Scotland.

3. Historic Environment Scotland has material on industrial archaeology collected earlier by the former Royal Commission on the Ancient and Historical Monuments of Scotland. Many power station sites are included on the Canmore website at www.canmore.org.uk.

CLYDE'S MILL

Opened in November 1916 by the Clyde Valley Electrical Power Company to serve the heavy wartime demand in the region. Well situated for water and coal, it was extended many times. With a final capacity of 277,500kW in 1955, Clyde's Mill was briefly the largest power station in Scotland.

Ordnance Survey 1:25,000 series, Sheet NS66, 1951 (National Library of Scotland).