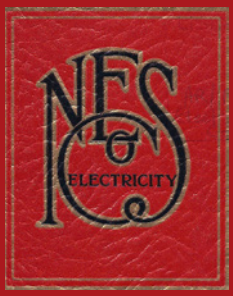


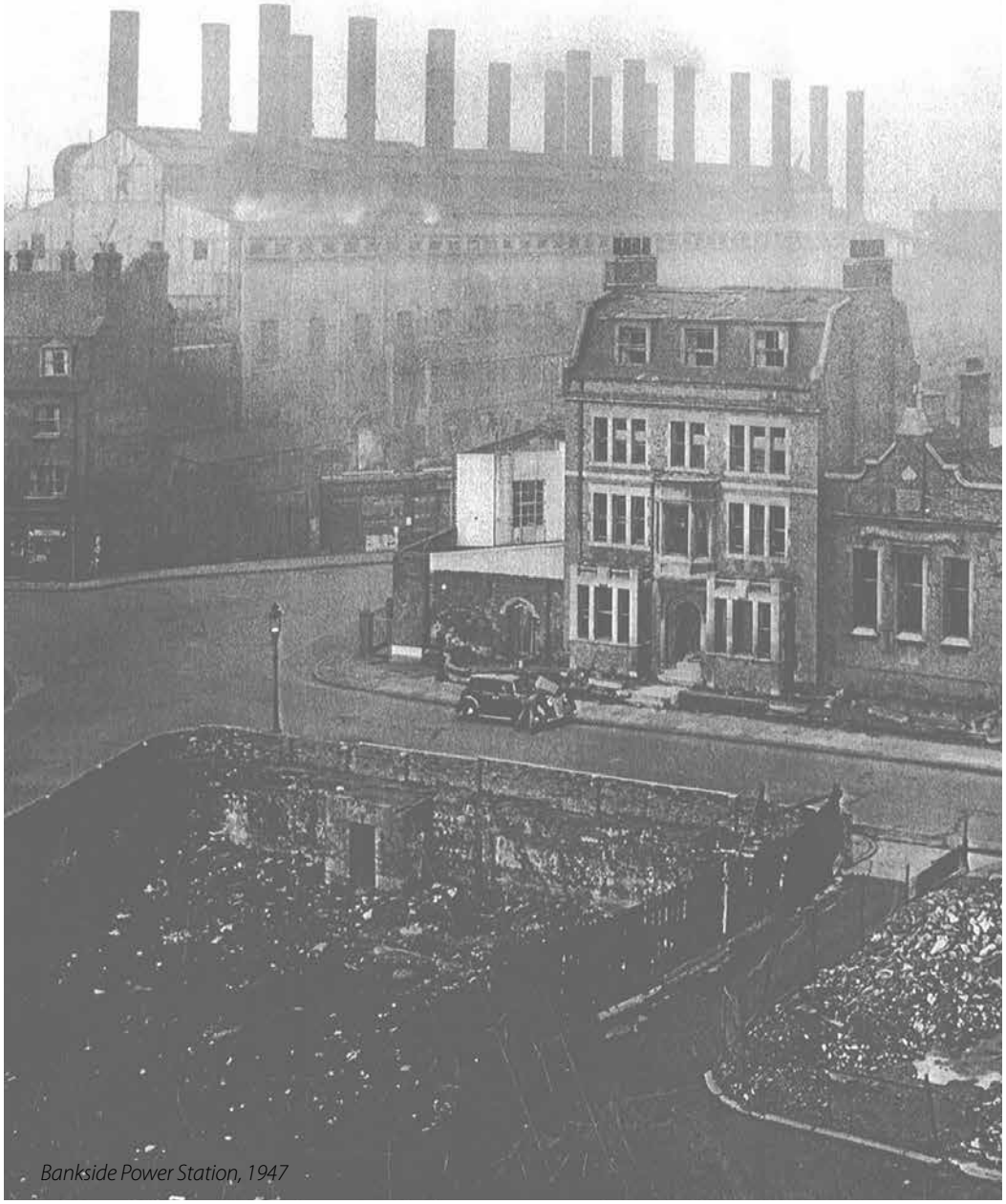
THE GENESIS OF THE ELECTRICITY SUPPLY INDUSTRY IN BRITAIN: A CASE STUDY OF NESCo FROM 1889 TO 1914

A short summary

Tom McGovern and Tom McLean

Newcastle University Business School,
Newcastle upon Tyne, UK;
Durham University Business School,
Thornaby, UK.

Tom McGovern Newcastle University Business School, Newcastle upon Tyne, UK;
Tom McLean Durham University Business School, Thornaby, UK.



Bankside Power Station, 1947

The growth of NESCo

In the beginning electricity was produced in company installations or in small inefficient generating stations. Steam engines were widely used for producing power.

In 1889 NESCo was a local lighting company supplying an area of 10 square miles which, by 1900, had increased to just 16 square miles. Thereafter, with its re-emergence as a power company, NESCO expanded rapidly aided by parliamentary legislation which granted power companies the right to supply electricity over larger areas. This enabled NESCo and its associates to establish by 1911 a network of interconnected transmission lines to supply three-phase alternating current at 40 cycles to 1400 square miles in the north-east of England. The difference between the northern and southern extremities of the transmission system was 70 miles.

Period 1: The emergence of NESCo from 1889 to 1899

Two rival companies were established in Newcastle in January 1889 to supply electricity for lighting: NESCo and the Newcastle and District Electric Light Company (DisCo).

Parliament allocated to both companies the same areas of supply in Newcastle. Representatives from the two companies met to discuss possible arrangements. NESCo had ruled out an amalgamation because of the presence of London directors on the DisCo board and of being bound to any particular system (alternating current versus direct current). An agreement was concluded whereby NESCo would supply the eastern part of the city and DisCo, one of whose directors was Charles Parsons, would concentrate on the western part.

The benefit of this arrangement was that it 'saves useless expenditure of capital which would be involved in the laying of two sets of mains in the same streets and the consequent additional interference with the public throughfares'. Dr Theodore Merz and Dr Robert Spence Watson formed NESCo as a lighting company following the passage of more favourable legislation in 1888.

John Theodore Merz

The social and cultural capital of the two men played an important role in the company's formation. They were brothers in-law and both were Quakers. Theodore Merz was an intellectual of German origins who wrote a four-volume History of European Thought in the Nineteenth Century. He was also a chemist and industrialist who had invested in Joseph Swan's incandescent light company. Merz was married to the sister of John Wigham Richardson who was a leading shipbuilder on the River Tyne.

Tom McGovern Newcastle University Business School, Newcastle upon Tyne, UK;
Tom McLean Durham University Business School, Thornaby, UK.

Robert Spence Watson

Robert Spence Watson was a solicitor and an important public figure in the north of England. He was the Chairman of the National Liberal Federation and became a Privy Councillor in 1907. NESCo was incorporated on 8 January 1889 with a small paid up capital. On 29 March 1889, shares were allotted to the amount of £8850. To obtain a license from the Board of Trade to maintain electricity works in Newcastle required the support of the Corporation. It could be argued that NESCo's formation was very opportune as local authorities were not actively engaged in electricity supply because its success had not been demonstrated.

NESCo operated under a license for three years until it obtained Provisional Orders through an Act of Parliament. In return for the Corporation withdrawing its opposition to the granting of Provisional Orders, NESCo agreed to supply and distribute electricity in Newcastle for 31 years as opposed to the 42 years fixed by the Act of 1888.

As the production of electricity became successfully established, local authorities entered the industry in the 1890s, in some cases, buying out on favourable terms the operations of the private companies.

The Newcastle Corporation considered purchasing NESCo in 1895 but was dissuaded from doing so because the company charges were low, there was a competing company that would also have to be purchased, and the savings would not be large.

The board of directors comprised men from some of the most important industrial concerns in the north east of England who provided the critical mass of structural and financial capital to establish the company. These directors included: the chairman Alderman Thomas Gibson (Mayor of Newcastle in 1882); Dr John Theodore Merz; Dr Robert Spence Watson; Sir Lindsay Wood (Managing Director of Hetton Collieries and Chairman of the Durham Coalowners' Association); John H. Armstrong (Armstrong family and later Chairman of NESCo); and Sir James Knott (shipping magnate who established the Prince Line Company in 1895, and a coal owner).

These directors' social and cultural capital provided the legitimacy to establish NESCo in the market. Additionally, the directors provided cognitive capital in the form of managerial expertise and knowledge of their industry domain, and structural capital by affording access for the provision of electricity. A power station containing two 100-cycle 75 kilowatt Mordey alternators, each driven by a Robey slow-speed steam engine was built at Pandon Dene close to the Blythe and Tyne branch of the North Eastern Railway. Additional alternators were later installed of which the largest was 500 kilowatts.

The directors were convinced that there was a large demand for electricity for lighting. However, with little pre-existing information available and operating in a creation context with uncertain market conditions, the directors adopted a flexible strategy. A capital outlay of £8000 was invested to supply electricity for lighting for 4800 ten (reduced to eight) candle power lamps of which 3000 could be alight at any one time. Electricity was supplied to consumers at a price range from 3.6d (pence) to 4.5d per kWh which with discounts averaged out at 4d per kWh.

NESCo was able to grow through the financial support provided by the Chairman, Thomas Gibson, and the legal advice of Robert Spence Watson. From 1891 to 1899, sales grew from £4000 to £17,000 whilst net profits increased from £1000 to £6000. Finance was provided from local sources in the north east of England. Equity grew from £20,000 in 1891 to £64,000 in 1898 and then £115,000 in 1899 whilst debentures of ca. £15,000 to £25,000 were held until their repayment in 1899.

NESCo profited from the Newcastle Corporation's lack of interest in becoming a supplier of electricity, and the north bank of the Tyne comprised small municipal districts. There was available locally an abundance of cheap bituminous coal. Further, Tyneside had a dense industrial base and many regional companies had been progressive in adopting electricity. The shipbuilding industry was booming. Shipbuilders were early adopters of electricity and many Tyneside shipyards had installed electric power by the 1890s.

In 1898 the Newcastle Corporation filed a Bill in Parliament to erect a generating station to supply electricity to the tramways. NESCo and DisCo opposed the Corporation's Bill on the grounds that their Provisional Orders gave them the sole right to supply electricity within the Parliamentary boundary. However, their case was rejected and the opportunity to expand into traction was lost.

The development of the electric motor now enabled electricity previously restricted to providing lighting to be used for power. Unfortunately, the lighting companies' ability to supply this market was constrained by the small-size of the generating stations, the smallness of the area that they supplied under the Provisional Orders, and the liability to be purchased by the municipality. These constraints were removed following the recommendations of the Cross Committee (1898) and the Kitson Committee (1900). The companies, nevertheless, complained that these disabilities were removed only to be replaced by new constraints.

Power companies received authorisation to provide a bulk supply in areas where there were no authorised distributors, but they were excluded from supplying in areas where there was an authorised distributor unless they received the latter's consent. This consent could not be unreasonably withheld if the company could supply at a cheaper rate to consumers. Large towns were excluded from the power companies' areas because of the opposition of the municipalities. This policy change shaped the strategic thinking of NESCo's directors.

At the end of 1899, NESCo had 'an antiquated system of supply, difficult to extend and one from which it was impossible to supply motive power'. Its system was out of date and the Pandon Dene station was too small and supplied lighting to a small area of Newcastle. Between 1889 and 1900 NESCo had increased the area that it supplied with electricity from 10 to 16 square miles.

Tom McGovern Newcastle University Business School, Newcastle upon Tyne, UK;
Tom McLean Durham University Business School, Thornaby, UK.

A sum of £130,000 had been invested in the old system but it was plagued by constant faults and interruptions to supply. In response, the management invested £100,000 in laying a new direct current system and extending the Pandon Dene Power Station. There was a growing demand for electricity for lighting especially in the metropolitan areas and electricity was replacing steam power in some large factories. The application of electricity for traction was similarly increasing. Electrical generating plant had improved considerably as well as the methods for transmission of current. Competition from DisCo was more intense.

NESCo's strategic choice to meet the potential increase in demand was to develop a larger scheme, or to 'merge our small undertaking into the larger organisation which was being planned to embrace the whole district'. In the winter of 1899, the directors made the strategic decision to transform NESCo into a power company. The problem was that none of the directors had the knowledge of how to develop a district wide scheme.

Period 2: the growth of NESCo, 1900–1914

In response to the Corporation's Bill, and the more favourable environment for power companies, NESCo and DisCo's strategies focused on developing schemes to supply electricity for general power purposes. Charles Parsons and Alan Campbell Swinton filed a Bill to Parliament under the name of the Tyneside Electric Power Company to supply the whole of Tyneside.

If the Parsons' Bill was successful, NESCo would, in the interests of its shareholders, have had to consider merging into the larger organisation. This is where the family and Quaker connections were to play a crucial role. John Wigham Richardson was a shipbuilder who had established the Neptune Works on the River Tyne. He was also a director of the Walker and Wallsend Gas Company which had pioneered the use of gas for industrial purposes along the north bank of the River Tyne. Wigham Richardson had experience of the application of electrical power in shipbuilding and in 1898 he encouraged the Gas Company to enter the electricity supply business. This would provide the company with insurance to focus on whichever energy source became predominant. Charles Merz, Theodore's son, was engaged in a consultancy capacity to present the technical evidence to the Parliamentary Committee. He was 24-years-old.

Charles Merz (right) and his son Robert. Both were killed in an air raid on London in 1940.

Charles Merz read engineering at Armstrong College but never graduated. Instead he took an apprenticeship with NESCo and in 1892 began work at the Pandon Dene generating station where he gained experience of electrical generation, installation, and repairing boilers and faults in generators and cables. He spent part of his apprenticeship at Robey's to increase his mechanical knowledge of boilers. Merz then joined Thomson-Houston (BTH), an American subsidiary where his father was a director, to supervise the installation of steam engines and alternators at the Bankside Power Station on the Thames in London.

From 1896 to 1898 he worked on the construction of a new power station at Croydon where he was responsible for the installation of generating equipment and the workings of substations and street-lighting systems. On its completion, Merz was appointed manager and engineer and was accountable for operating the plant and electricity sales. After a brief period at BTH headquarters arranging subcontracts for equipment, he was sent to Cork in 1898 to install a tramway system.

Charles Merz had accumulated considerable human capital through experience and practical learning from his various work placements. He had developed a keen interest in the application of electricity for power purposes. Family connections provided Charles Merz with his first major break as John Wigham Richardson was his maternal uncle.

Parliament passed the Bill in 1899 on condition that the Neptune Bank site which had been purchased for the provision of gas was used. Charles Merz turned down the position of chief electrical engineer to the Gas Company, but agreed to supervise the construction and development of the Neptune Bank Power Station as an independent consulting engineer. He recruited William McLellan as his assistant. They had worked together on developing a tramways and lighting system in Ireland for the Cork Electric Tramways and Lighting Company.

McLellan was an engineering graduate from Liverpool University. He had previously worked at Cochran, the boiler manufacturer, and Siemens. The two men formed a formidable team: 'Merz was a man of imagination and drive and financial acumen. … Whilst McLellan … was the severely practical man, with a wide knowledge of all the electrical apparatus, from dynamos and motors to switchgear and cables.' The Gas Company had similar ambitions to NESCo to supply electricity to Tyneside.

Theodore Merz, John Wigham Richardson together with Charles Merz and William McLellan devised a rival scheme to that being proposed by Charles Parsons and Alan Campbell Swinton. This involved connecting the NESCo system to the Gas Company's Neptune Bank Power Station to supply the north bank of the Tyne. The close family ties helped to cement the agreement between the two companies.

Robert Spence Watson's law firm took on the legal work associated with promoting the Private Bill. In 1900 a Parliamentary Committee chaired by Sir James Kitson considered the two rival Bills. The NESCo case relied on the legal advice of Robert Spence Watson, the expert witness of Charles Merz, and the legal counsel who had previously defended the Newcastle Corporation's position.

Sir James Kitson was both a Liberal Member of Parliament and a Unitarian. He was also a member of the Institution of Civil Engineers and the Institution of Mechanical Engineers and had a very good understanding of industrial supply issues compared to the average politician. Kitson was also a director of the North-Eastern Railway (NER) Company.

Tom McGovern Newcastle University Business School, Newcastle upon Tyne, UK;
Tom McLean Durham University Business School, Thornaby, UK.

Charles Merz believed that the case put forward in support of the Tyneside Bill was ill-prepared which led to it being rejected. The NESCo–Walker scheme received Royal Assent, paving the way for NESCo to supply electricity to districts on the north and south banks of the River Tyne. The Pandon Dene Power Station was too small to meet the increasing demand for electricity for lighting and the new growing demand for power purposes.

Additional generating plant was required which led to NESCo purchasing from the Gas Company the incomplete Neptune Bank Power Station. Under the agreement, NESCo agreed to sell bulk electricity to the Gas Company for supply to its customers. The acquisition of the Gas Company's electrical undertaking was more for strategic than revenue purposes '… it [has] no doubt been the correct policy for the Company to obtain entire control of it and thus avoid any risk of the progress of electricity being prejudiced due to the Gas Company having both a Gas and Electricity Department'. Charles Merz was appointed the Consulting Engineer to NESCo.

William McLellan

In 1901 McLellan's name was incorporated into the name of the new firm now known as Merz and McLellan. That year Merz and McLellan was tasked with linking the NESCo transmission system with those already connected to the Neptune Bank Power Station. It was the first power station to be designed by the two men and incorporated their views on the 'primacy of industrial load, economy of scale, and turbine efficiency'. The station had the lowest generating costs in Britain. It was the world's first power station to provide electricity for power as opposed to lighting and the first in Britain to use a three-phase system.

Charles Merz used his network to seek advice on three-phase electric power from engineers at the General Electric Company in the US and Swiss engineers working for Brown Boveri. The advantage of three-phase supply was that higher voltages could be used by industrial motors and lower voltages could be supplied to domestic users. A periodicity of 40 cycles per second (40 Hz) became the standard frequency for the North East Coast area as it was suitable for lighting as well as rotary converters used in traction.

By the beginning of 1901 Neptune Bank was supplying three-phase alternating current to several shipyards and engineering companies including Armstrong Whitworth and Swan Hunter. Sir George Burton Hunter, the Chairman of Swan Hunter, had joined the NESCo board in 1900 along with Sir John Henry Brunel Noble whose directorships included the London and North Eastern Railway Company, the Easington Coal Company, and the North Eastern Board of Martins Bank. His father, Sir Andrew Noble, was the Chairman of Armstrong Whitworth.

Neptune Bank Power Station was publicly opened in June 1901 by Lord Kelvin. Sir Andrew Noble presided at the opening. The ceremonial opening of the power station by a renowned physicist and a prominent industrialist demonstrated the regional stature of NESCo. The boundaries of the electricity supply industry had been redefined to include power as well as lighting.

The generating plant comprised four 700 kilowatt alternators driven by slow-speed marine reciprocating engines supplied by the family connected firm of Wigham Richardson & Company and the Wallsend Slipway & Engineering Company. Merz and McLellan adopted the marine engines, first, because of their reliability and, second, the chief consumers were expected to be marine engineers. Further, the Merz and McLellan team possessed the relevant cognitive capital to persuade the engineers and Tyne shipbuilders of the cost advantages of replacing their small steam and gas engines by more adaptable electric power.

In 1902, two Parsons 1500 kilowatt steam turbine driven turbo-alternators, then the largest in the world, were installed to increase power production. Neptune Bank was the only British power station that had installed both reciprocating engines and turbines to generate electricity. The strong structural interrelationship between NESCo and the firm of Merz and McLellan was demonstrated by the consulting engineers being listed on the former's organisational structure. Merz and McLellan attended the NESCo 'meeting of officers' which discussed project planning and network operations.

Merz produced 'plant capacity reports' to assist NESCo with its strategic planning. He developed the technological and economic strategy that transformed NESCo from an urban lighting utility into a regional power company. The two companies had complementary capabilities: Merz and McLellan designed the power stations and possessed the cognitive capital to build trusting relationships with organisations located on the north east coast of England to persuade them to take power from NESCo. Merz and McLellan would then provide the consultancy service to design and install the equipment required by these new customers. Other electrical utilities also used consulting engineers, but the closeness of the relationship between NESCo and Merz and McLellan was unique amongst British electrical utilities which shaped the style of the regional system that developed.

Traction In 1902

NESCo sought Parliamentary approval to provide power on the north bank of the Tyne to the Tyneside Tramways and Tramroads Company. Family and cross-directorate connections played an important role in this expansion as John Wigham Richardson was an investor in the company.

NESCo expected to make 9.4% return on capital from this investment which was below the target return of 15%. This investment was approved on the basis of attracting more customers as the mains were laid. A new agreement was signed in July 1904 which committed the Tramways Company to take energy from NESCo for the next 15 years.

NESCo took a £13,000 shareholding in the company and Theodore Merz (who later became Chairman) and Sir John Noble were appointed to the board. Merz and McLellan argued that electrification enabled tramways to compete with railways because the increase in new passengers was 'frequently ten times as

Tom McGovern Newcastle University Business School, Newcastle upon Tyne, UK;
Tom McLean Durham University Business School, Thornaby, UK.

great as formerly'. There was opposition from NER which feared the impact on its business. During the parliamentary inquiry, Charles Merz suggested to George Gibb, NER's General Manager, that the company should consider electrifying the railway line.

Merz had the appropriate cognitive capital to understand the NER's strategic and operational requirements from observing inter-urban railway systems in the US. He had also acquired, whilst planning the Neptune Bank Power Station, knowledge of the Swiss mountain railway system which operated with three-phase alternating current.

Shortly afterwards, Merz and McLellan was commissioned by NER to draw up a scheme to create the first electric suburban rail network in Britain operating some 82 miles of single track. Merz's ability to draw on this structural mix of strong social and weak technical ties enabled him to apply knowledge in a new context and provide a technical solution which turned an objector into a customer and supporter.

Gibbs and Merz became close friends which produced a trusting relationship between their companies resulting in the accumulation of relational capital. From a structural capital perspective, Merz and McLellan provided NESCo with access to a new market. The few railways that had used electricity for traction had built their own power station to generate electricity.

Merz viewed this as uneconomic and preferred to spread the load factor between industrial, domestic and traction in order to reduce prices. He proposed to supply a portion of the electricity from the Neptune Bank Power Station which was nearly fully loaded with the bulk of the supply coming from the planned larger station at Carville. NER would pay NESCo 1.0d per kilowatt hour (kWh) for the first 3 million kWh in any one year, 0.75d per kWh for the next 3 million and 0.55d for all units over 6 million in any one year. A further guarantee was that the quantity of electrical energy taken or paid for would not be less than 5 million kWh in any year.

The contract allowed NESCo to use the new mains and substations to supply electricity to other consumers, which would reduce unit costs. The first part of the electrification scheme came into operation on 29 March 1904 and was the first example in Britain of a steam railway converting to electric traction.

Economies of scale

Before 1914 typically 40% of electricity was produced in generating stations and 60% on premises by the users. The average generating capacity of a power station was 5000 horse power, 'or about one-fourth of the capacity of one single generating machine of economical size and about one-thirtieth of the size of what may be considered as an economical power station unit'.

Most of these power stations were 'principally enlarged versions of the lighting stations built at the turn of the century'. In general, the industry with the exception of NESCo found it difficult to achieve economies of scale. NESCo's electricity output increased from under 1 million kWh in 1899 to just over 9 million kWh in 1903 which was 'a comparatively small output for a power scheme'. The environment in which NESCo was operating conformed to that of a creation context with considerable uncertainty about how to develop new business opportunities.

Large power stations had been created in other areas of Britain to deliver bulk supply whereas NESCo had invested in 'detailed distribution'. Merz contended that economic electricity production demanded large central power stations supplying large areas with lighting, traction and power. A mass production strategy aimed at high load factor users such as traction, collieries and chemical works was implemented which was based on similar strategies adopted by American and German companies.

This was a way of spreading risk against fluctuations in demand in any one sector. Merz and McLellan recognised that a power supply company's commercial success depended upon 'the cheapness and reliability of supply', which took precedence over 'economy of production'. This principle was embodied in the ground-breaking Carville generating station which opened in 1904. Merz and McLellan focused on controlling capital costs rather than running costs by emphasising simplicity of design together with a provision for future extensions.

Their unit system of construction comprised several independent units, each consisting of a boiler, generating set and switch-gear. This made it easy to isolate and repair faulty units. The Carville Station was a cladded steel frame building as opposed to brick and was 'the first large generating station of the modern type' in the world.

Carville was the lowest cost power station in Britain with a capital cost of £16 per kW compared to £20–£26 per kW for other contemporary stations. The station running costs were as low as or lower than other power stations. It was the largest public power station in Europe and was powered by Parsons' steam turbines – two 1500 kilowatt units and two 3500 kilowatts units; the latter were twice the size of any turbine that had been constructed. Carville accounted for 64% of the system's capacity from 1906–10 and was the foundation of NESCo's rapid growth during this period.

Carville was also the first British power station to have a Control Room to manage the entire system on the control diagram and to make decisions on the loads carried by the various stations. Merz had taken this idea from practice in American power stations and it became a standard feature for all large electrical systems.

In 1910 NESCo opened the Dunston Power Station which contained turbo-alternators produced by Brown Boveri of Switzerland and AEG of Germany providing a total generating capacity of 33,850 kilowatts. The capital cost was £11 per kW which was well below the national average. The growth in electricity demand produced an increase in generation factors from 8% to 12% in the 1890s (mainly lighting) to over 20% from 1908 to 1914.

As NESCo used its capital equipment more intensely, its load factor after 1907 averaged 40% to 50%. This allowed NESCo to significantly reduce its production costs and electricity prices. The average price per unit was predicted to decrease because manufacturers expected 'an excessively low price for power, and … they expect(ed) to get their lighting thrown in at the same price'.

It was difficult to charge separately for power and lighting as many manufacturers used the same circuits for both. In 1900 NESCo's average price charged to manufacturers was 3d per kWh and for lighting 4.09d. By 1905 the average price for electricity had fallen to 1.16d per kWh, and by 1913 it was less than ½d per kWh.

Charles Merz was able to claim that there was not 'a single firm of shipbuilders or engineers on the north bank of the Tyne inside the power company's area of supply which does not take 95 per cent of its power from the company, the remaining 5 per cent being produced from small gas engines or from boilers fired with scrap

Tom McGovern Newcastle University Business School, Newcastle upon Tyne, UK;
Tom McLean Durham University Business School, Thornaby, UK.

wood'. The success of the mass production strategy is shown by the large expansion in sales after 1905 to the collieries, chemical and process industries, as well as the traditional manufacturing sectors.

Bulk sales also grew as some local authorities such as Middlesbrough, Tynemouth and Stockton opted to buy electricity in bulk from NESCo rather than extend their own generating capacity. This strategy produced an increase in net profit to £132,000 by 1914 and the growth in equity to over £1 million. Up to 1905, finance had been raised locally, but the growth strategy required raising finance nationally. Charles Merz had developed a relationship with the merchant bankers, Leonard and Walter Cunliffe. George Gibb had introduced Merz to Walter (later Lord) Cunliffe who had been appointed a director of NER in 1905. This led to an introduction to Sir Robert Kindersley who was a partner in the merchant bank Lazard Brothers. Debentures were issued through Lazard Brothers in 1906 followed by a large issue of 4½% debentures for £688,000 in 1909. Leonard Cunliffe joined NESCo's board in 1908 followed by Robert Henry (later Lord) Brand of Lazard brothers in 1913. NESCo had the financial network to raise capital for further expansion.

Acquisitions

In the neighbouring areas across the Tyne in Gateshead and Durham, electrification had been developed on a small-scale compared with the north side of the river. Small power stations were established at Jarrow, Gateshead and Durham supplying direct current for lighting and traction.

Electricity generation and supply resided with two companies controlled by the British Electric Traction Company (BET): the County of Durham Electric Power Distribution Company (CDEPDC); and the County of Durham Electric Supply Company (CDEPSC). Charles Merz used his connection with William Madgen who was a director of CDEPDC to persuade the Durham Company to take a bulk supply from NESCo. High tension cables were laid over the High Level Bridge to connect the Manors substation and the Gateshead Power Station which linked the two distribution systems.

Under the agreement, the Durham Company adopted the same 'voltage and periodicity' standards as NESCo. When BET faced financial difficulties in 1904, NESCo acquired the two Durham Power companies for £256,000 to control electricity supply on the north and south banks of the Tyne.

Although CDEPDC and NESCo operated as separate companies, the majority of the directors on the Durham Company board were from NESCo. The Gateshead and Jarrow power stations were connected to Carville and were in effect distribution centres to enable NESCo to supply electricity to other large towns and collieries in County Durham.

Overhead lines were not feasible so a 22,000 volts underground cable system, which was the highest voltage in Britain, was laid to minimise power losses over long distances. As no British cable maker would to take on this job, Merz and McLellan used their international links to contract it to Algemeine Electricitat Geselschaft of Berlin. The Cleveland and Durham County Electric Power Company was established in 1903 to supply electricity to the Durham coalfield, Darlington, Stockton, Middlesbrough and parts of Teesside, but faced financial difficulties from its inception.

Merz and McLellan provided support to the Cleveland Company as NESCo was fully occupied with its recent acquisition of the Durham companies to engage in another take-over. In 1906 Merz and McLellan conceived the idea of floating a new company to acquire the Cleveland Company plus the failing Northern Counties Electric Supply Company which supplied electricity to some small towns in Northumberland, Durham and North Yorkshire. The latter had produced a power scheme for Northumberland, but Parliamentary approval was given in 1902 to the rival scheme produced by NESCo.

Under the new proposal, the Cleveland and Durham County Electric Power Company retained its name and continued to operate as a separate entity, although the new board contained directors who were close associates of Charles Merz. Merz arranged for the Cleveland Company to be physically connected to NESCo by a 20,000 volt cable laid under the Tyne at Hebburn. The Cleveland Company was not a financial success and its share capital was acquired by NESCo in 1917. NESCo and the Durham and Cleveland companies were registered as separate entities, though all three companies were controlled by one staff based in Newcastle.

It was an 'unwieldy arrangement', but amalgamating all three companies would have required Parliamentary approval which may have 'stir[red] up a lot of opposition'. In 1907, NESCo acquired the Durham Collieries Electric Power Company which was supplying power to the local collieries and the Sunderland District Electric Tramways. Many of these companies operated at different cycles and pursuing uniformity delayed the development of the system. However, the economies of integration and large-scale operation justified the conversion to a common system.

In 1909 the NESCo, Cleveland and Durham systems which were supplying areas in close proximity were connected together to create the first grid system in Britain running from north of the Tyne to south of the Tees. It was the largest integrated network in Europe. Charles Merz has been described as the 'British Edison' for his work on developing an economic and integrated electricity supply system in North East England. Charles Merz recognised that potentially useful energy was being wasted in factories, collieries and steel manufacturing.

In 1902 the Owners of the Priestman Collieries (OPC) planned to establish a modern coke-making plant near Blaydon Burn with 80 ovens that produced coal gas as a by-product which could be used to generate electricity. This provided NESCo with an opportunity to expand into the Blaydon district at the expense of its then competitor CDEPDC.

Merz and McLellan acted as a broker between NESCo and OPC and the commissioned report produced by the partners recommended constructing a power station at Blaydon to utilise the waste heat and gas. NESCo and OPC established the Priestman Power Company to administer the facility. Two Babcock and Wilcox boilers supplied steam to two 275 kilowatt Parsons three-phase alternators which began operating in 1904 supplying electricity to the Blaydon Burn Colliery. In early 1905 the Blaydon Power Station was connected by underground cable to NESCo's network enabling it to supply electricity to the CDEPDC network.

NESCo acquired the Priestman Power Company in 1914. Additional companies

Tom McGovern Newcastle University Business School, Newcastle upon Tyne, UK;
Tom McLean Durham University Business School, Thornaby, UK.

were formed to utilise the waste heat and gases from industrial processes. The Durham Collieries Electric Power Company was formed in 1905 to supply electricity to collieries in north Durham.

When the company faced financial difficulties in 1907 its debts were underwritten by NESCo which took control of the power station, and from 1909 operated its distribution system. In 1907 the Waste Heat and Electrical Generating Stations Company was formed to establish power stations in South Durham and Teesside to utilise the waste heat and gas from local blast furnaces, coke ovens and industrial sites to feed into the NESCo network.

By the end of the First World War, NESCo had 11 waste heat stations in operation. The interconnecting of the generation stations allowed Carville which had a capacity of 25,000 kilowatts following its extension in 1907 to supply the base load; the smaller stations were used for peak use, and the waste heat stations provided electricity at a very low marginal cost.

The memorial plaque to Charles Merz, formerly situated in Newcastle University

Note that references to source material have been removed from this extract in aid of clarity.

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Dunston Power Station, 1971