

FINAL REPORT No. 342

ITEM No. 33

15886

BRITISH

THE GERMAN WARTIME ELECTRICITY SUPPLY

CONDITIONS, DEVELOPMENT, TRENDS

This report is issued with the warning that, if the subject matter should be protected by British Patents or Patent applications, this publication cannot be held to give any protection against action for infringement.

UNCLASSIFIED

BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE
LONDON - H.M. STATIONERY OFFICE

TK/P763

THE GERMAN WARTIME ELECTRICITY SUPPLY

Conditions, developments and trends.

Reported by:

H. NEUBRUNN, A.M.I.E.E.

Control Office for Germany and Austria

BIOS Target No. C33/113

BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE
32 Bryanston Square, London, W.1.

SUMMARY

General

1. The object of this report is to describe the conditions, development and trends of the German electricity supply from 1938 to 1945; particular emphasis has been laid on economic aspects, on the direct and indirect influence of war conditions and on administration. Only a broad outline is given of purely technical developments, the investigation of technical detail having been beyond the terms of reference of this investigation.
2. The report is based on statements taken from high-ranking German officials in the period 7th September to 18th October 1945, and on information extracted from documents made available by them.
3. Except where otherwise mentioned, the geographical area covered is Germany as it existed on 1st January 1938 (Altreich). However, due attention has been paid to the German plans to coordinate the power resources of the whole of Europe.

Generating Capacity and Electricity Production & Consumption

4. The ill-effects of over-investments in electricity generating and transmission plant in the period 1923-1929 made the electricity supply industry (and to a certain extent also other industrial undertakings) adverse to further investments in electricity supply plants at the beginning of the re-armament period.
5. When, in 1937, the supply undertakings at last decided to extend their generating and transmission plant, the commodity quota system had already been introduced and the steel quota allocated for power supply was inadequate to make good the deficiency of building construction.
6. The Power Supply Act of 1935 conferred only veto-power on Government agencies. A War Emergency Act in 1939 conferred also compulsory powers on the Government. However, no coordinated planning took place until 1941, when Dr. Todt became Generalinspektor für Wasser und Energie.
7. The war situation being initially favourable to Germany, Dr. Todt embarked on ambitious projects for the development of the European water power resources.
8. Contrary to German expectations the war was not over in 1942, and the power supply situation became critical. Work was, therefore, discontinued on the larger long-term water power projects and an emergency programme called the Wärmekraft-Sofortprogramm (WKS) set up for the building of 10 standard thermal power stations of 300 MW ultimate capacity each. The steel allocations were increased, but insufficiently. The plans for five stations were dropped almost immediately, while of the remaining five, three were nearing completion of their first stage (150 MW) only by the end of the war.

14. From 1933 onward, electricity consumption and production increased at a more rapid rate than the output capacity. By 1942, electricity production in the Altreich was about 180% over the 1933 figure, while output capacity had increased by only about 40%.
15. The utilization of generating plant, as expressed by plant factor increased correspondingly. In 1941, the highest average plant factor in Greater Germany was reached by the size group of power stations of over 100 MVA individual capacity; it averaged 55.8% (based on output capacity) and 47.2% (based on installed capacity) for the public stations of this size group and 68.0% and 52.9% respectively for the industrial stations.
16. From 1942 onward, output capacity was inadequate to meet the winter peak loads and restrictions and load shedding had to be resorted to. In 1933, the annual peak load was 62.3% of the output capacity of the public system; it was 95.7% in winter 1941/42, and in winter 1942/43 a load of 355 MW had to be shed though the supply system had then suffered practically no war damage. About 800 MW were shed in 1943/44 and over 2500 MW in January, 1945.
17. Both generating capacity and electricity production show a continuous trend for concentration in few large stations. In 1941, 33.7% of the total output capacity was concentrated in 54 stations (0.6% of the total number) which accounted for 41.7% of the total electricity production. The concentration was more marked in public than in industrial plant.
18. Of the electricity production in coal fired public stations 38.5% was derived from hard coal in 1934 and 61.5% from brown coal. In 1943, 50.3% were produced from hard coal and 49.7% from brown coal (Greater Germany) despite the fact that electricity production from brown coal itself showed a steady increase.
19. In 1942, public power stations consumed for electricity production 12.8 million metric tons of hard coal and 45.7 millions of brown coal, corresponding to about 5.4% and 16.9% of the hard and brown coal consumed in Greater Germany. In 1941, the average coal consumption in public stations in Greater Germany was 1.56 lbs. per kWh for hard and 5.3 lbs/kWh for brown coal stations.
20. The diesel-oil consumption of public stations in Greater Germany was reduced from 17.3 million tons in 1939 to 5.2 million tons in 1941.
21. There were only minor changes in the importance of the individual consumer groups. Industry accounted for 82.0% of the consumption in 1936 as compared with 84.5% in 1942. Of the total consumption by industry in Greater Germany, 27.7% were consumed by chemical, 14.3% by mining and 10.0% by light metal reduction plants; electric steel production accounted for 2.3%.
22. In 1943, the cost of new power stations was from 185 RM per kW for hard coal stations of 300 MW to 350 RM per kW for brown coal stations of 20 MW capacity. The corresponding figures for steel requirements were 100 to 210 kg per kW and for heat consumption 2800 to 4000 kcal per kWh.

23. The net imports of electricity of Greater Germany (including Austria) increased from about 700 million kWh in 1938 to 1180 million kWh in 1942. The main source of imports was Switzerland (about 950 million kWh net per annum from 1938 to 1944.

24. Strenuous efforts were made to reduce the winter peak load by staggering industrial processes etc; though these showed some favourable results where "power wardens" were appointed, press and propaganda campaigns had no noticeable effect.

25. Special schedules, the "Abschaltelisten" served as a guidance for the Bezirkslastverteiler for shedding load. Restrictions on consumption (kWh) were introduced in winter 1943/44 and 1944/45.

G r i d

26. Ever larger sections of the German grid were operated as frequency blocks until in 1944 the number was reduced to two, namely, the Central German and the Western German frequency blocks.

27. Towards the end of the war, frequency reduction had to be resorted to. The minimum reached was 43.3 c/s in the Central German block and about 41 c/s in the Western German block.

28. The grid was extended by 220 kV and lower voltage lines and plans were made to form one German high voltage grid with trunk lines to be operated at 380 kV A.C. and 450 kV D.C.

39000 km

29. In 1942 the total grid length of Greater Germany was 24230 miles, of which 2350 miles were built for operation at 220 kV and 9000 miles for 100 to 150 kV; 85% of the total grid length was installed in the Altreich. In 1943, nearly 2000 miles of route length were operated at 220 kV. At the end of the war 328 miles of 220 kV line were under construction and nearly complete, the cost, including 5 substations, being estimated at 85 million RM.

30. By a large scale drive in 1942, copper conductors were replaced by aluminium or iron conductors. 74,000 tons of copper were thus made available for armaments production.

D i r e c t E f f e c t s o f W a r C o n d i t i o n s (i n c l u d i n g A i r A t t a c k)

31. In 1943, the number of persons employed in electricity production and distribution in Greater Germany was 213,000. The specific manpower requirements had been reduced from 13.6 per MW output capacity in 1939 to 9.6 in 1943, or from 3.5 to 2.4 per million kWh produced.

32. Although scheduled repairs could be maintained at a fairly constant level, they decreased considerably in proportion to the total output or installed capacity. Operational breakdowns became, therefore, more frequent and reached 1200 MW in December 1944 for public plant alone (Greater Germany).

33. There was no shortage of brown coal. Shortage of hard coal made itself felt for the first time in winter 1943/44, causing an outage, for a short time, of 100 MW of public plant. The coal shortage became serious only in winter 1944/45 where the outage due to this reason rose to about 1100 MW in February, 1945. North-West and South-east Germany were the areas mostly affected by this shortage (Greater Germany).

34. Until the last weeks of the war, bomb damage caused to generating plant was from a national point of view negligible. No systematic air attacks were carried out on the electricity supply system - to the greatest amazement of the official German circles who considered this the most vulnerable point of their economy besides the transport system. The few attacks which were made were either ineffective or else came too late. The only effective damage caused to the electricity supply system was incidental to attacks on other targets.

35. There was not enough reserve equipment in Germany to form a national pool. There were only one or two reserve power transformers for 110/220 kV. "Built in" reserves had to be used.

36. Considerable damage to power plant by air attack was caused only from autumn 1944 onward. Fighter aircraft caused serious damage to the transmission lines. In the early stages of the war considerable difficulties had been caused by cables from barrage balloons.

37. Reduction in electricity consumption after concentrated air attacks on large towns was due to reduction of requirements rather than to inadequate electricity supplies.

38. By February, 1945, the loss of output capacity of public plant due to seasonal shortage of water supply, scheduled and non-scheduled repairs, air raid damage, loss of territory, coal shortage, etc. amounted to about 7300 MW or about 50% of the total output capacity of the public stations in Greater Germany.

O r g a n i s a t i o n a l a n d T e c h n i c a l D e v e l o p m e n t

39. There has been a marked trend towards concentration of the public electricity supply on a few large undertakings, and for the Reich, the Länder and other public "corporations" to gain financial control.

40. The organisation of the Generalinspektor für Wasser und Energie was set up in 1941 and by the end of the war it had gained control over the electricity supply in Germany, partly direct and partly through the Reichslastverteiler organisation. Especially the latter, acting as a "works management" of the German grid, is credited with having averted major breakdowns in the German electricity supply.

41. The main technical development on conventional lines were the use of high steam pressures and temperatures (up to 2000 lbs. per sq. in. and 930° F), higher utilisation of the iron in power transformers (up to 16000 Gauss) and oil-less circuit breakers of various types. Boilers for very high furnace temperatures were built (Schmelzkammerfeuerung).

42. The main development on unconventional lines was the linking of electricity with gas production (Lurgi system), the development of gas turbines for power stations and the so-called "Drehkessel"; underwater stations were built in which water turbine and generator are combined in one.

43. Work was carried out on high voltage D.C. transmission (450 kV) with a view to transmitting power from Norway to the Continent. The experimental installations included plant for transmission of 60 to 100 MW over a distance of 70 miles.

44. Preparations were made to raise the operating voltage of an existing transmission line to 380 kV A.C. and to build other 380 kV lines. Investigations were made for the use of multiple conductors for e.h.t. overhead transmission lines.

The "Reichsvereinigung Eisen" was set up in 1942. Partly taking over the duties of the former "Generalbevollmächtigter für Eisen und Stahl", it directed production and distribution of iron and steel as the supreme self-administrative body of this industry.

The "Reichsgruppe Energiewirtschaft" - REW was formed in 1934 as the leading agency concerned with power supply within the organisation of Industry and Trade. In its capacity as an auxiliary organisation of the GIWE, it examined applications for building permits and administered the quotas of raw and other materials for the entire public electricity and gas supply. As representative of all interests in electricity, gas and water, it had to hold the balance evenly between the interests of these technical branches and to protect them.

The "Wirtschaftsgruppe Elektrizitätsversorgung" - WEV came into being in 1934 as a sub-section of the Organisation of Industry and Trade, in succession to the former free trade association, the "Vereinigung der Elektrizitätswerke". In its capacity as an auxiliary organisation of the supreme Reich authorities, it carried out their special orders by submitting expert opinions, etc. As the representative of the interests of this branch of industry (self-administrative organisation), it had to advise its members and look after their interests in their relations with the supreme Reich authorities.

The "Reichsverband der Elektrizitätswirtschaft": see following explanations.

3. The inter-relations of the various official and semi-official agencies

(i) General

When dealing with the inter-relations of the various agencies, it must be borne in mind that in practice the strength of the position held by an executive organ is not always determined solely by juridical regulations. Particularly under the National Socialist regime there were deviations, politically determined according to the personalities who were at the head of the various agencies or to their personal relationships with people who meant something in politics. Thus, for example, the "Generalbevollmächtigte für die Chemische Erzeugung" held a stronger position than he was outwardly entitled to according to the structure of the organisation as a whole, as long as the Four-Year Plan represented actual power.

In considering the inter-relations of the agencies mentioned, the following three may be omitted:-

The "Amt Energie", which represents merely another official designation for the GIWE. There was no one working in the Amt Energie who was not simultaneously employed in the GIWE. The Amt Energie, as a purely war-time creation, would have disappeared automatically with the dissolution of the Reichsministerium für Rüstung und Kriegsproduktion after the war. On the other hand, a control office corresponding to the Abteilung Energiewirtschaft of the GIWE must be provided for within one of the ministries also in peace-time if a central control of the power industry is considered necessary.

The "Hauptabteilung II" (Main Section II) of the Reichswirtschaftsministerium, as, after its production duties had been taken over by the Reichsministerium für Rüstung und Kriegsproduktion, it was concerned only with questions of consumption. In this capacity, it no longer took part in controlling the Power Industry. Its former participation in the control of electricity supply was taken over by the Rohstoffamt of the Reichsministerium für Rüstung und Kriegsproduktion.

The "Reichsverband der Elektrizitätswirtschaft" had the duty of maintaining contact and exchanging experience between its German and foreign members. Its Directors and Secretaries were always those of the WEV, in whose premises the Reichsverband had their official domicile. It did not engage in tasks relating to the control of internal German power supplies.

(ii) The Relation of the GIWE to the other Agencies

With his department Energiewirtschaft and its control over the RLV (which to all intents and purposes had also become a department of the GIWE) the GIWE held the central and leading position. He alone was directly responsible for the legislation in the sphere of power supply as well as for enforcing these laws, except tariff and price regulations over which, however, he had a decisive influence. Through the Reichslastverteiler, the supreme network command centre, he also ensured the smooth working of the entire electricity supply system. He further saw to it that the entire public supply system was adequately supplied with labour, plant and fuel. He had to supervise the Reichsgruppe Energiewirtschaft and the Wirtschaftsgruppen Elektrizitäts-versorgung and Gas- und Wasserversorgung. Finally, he held a leading place in the "Energie Planung", the Power Planning Sub-Committee of the Zentrale Planung, in that he provided the Chairman, his department, Power Supply, acted as its secretariat, and he fixed and prepared the agenda for the meetings.

This meant, of course, that all supply undertakings and industrial power stations as well as the other control agencies of this branch of industry were dependent on him. They had always to apply to the GIWE for permission to instal new plant, for means to meet new demands of electricity, or for leniency in cases where disconnection of supplies had been, or was expected to be, decided upon.

Within the GIWE there was the closest co-operation between the Abteilung Energiewirtschaft and the Reichslastverteiler. The heads of both departments met at least twice a week. The officers of both sides were also in closest contact. The Reich Load Dispatcher contacted the various agencies who provided him with directions and general information or issued directives for allocation of current (Rohstoffamt and Planungsamt) mainly through the Abteilung Energiewirtschaft of the Reichsministerium für Rüstung und Kriegsproduktion, which had a liaison officer to his department. Both offices also collaborated in planning the extension of plants. If the Reichslastverteiler found from his working experience that there were gaps in the high voltage network, he asked the Abteilung Energiewirtschaft to provide a remedy in the form of corresponding new plant. Vice versa, the department Energiewirtschaft would consult the Reichslastverteiler as to the necessity and priority, for instance, of a suggested new transmission line. The Reichslastverteiler confined his activities to his own sphere of authority as the supreme command post of the network. He left it to department Energiewirtschaft to solve problems of payment and other economic problems arising from his decisions in the field. But, again, the relative guiding principles had been discussed beforehand between departments Energiewirtschaft and Reichslastverteiler.

The GIWE and the Rohstoffamt. Of all the highest ranking government agencies, the Rohstoffamt of the Reichsministerium für Rüstung und Kriegsproduktion was probably the one submitting the largest number of requests to the GIWE. These referred to:-

the building of new, and the extension of existing, power stations and distribution plant to ensure in time an adequate power supply for contemplated new raw material plant;

adequate power supply to existing raw material plants and their protection against power curtailments.

Relations between the two departments were mainly informal, consisting of verbal consultations between officers from either side.

The GIWE and the Planungsamt. Here the GIWE exercised a double function:-

as the party interested in and responsible for setting up and operating power supply: In that capacity, the GIWE tried to secure from the Planungsamt the highest possible quotas of iron, of building volume (expressed in the amount of Reichsmarks allocated for building), of labour and of coal for public supply;

as an executive organ of the planned economy, the decisions reached by the Planungsamt on the order in which large electricity consuming industries were to be expanded were very important for GIWE, since he adapted his plans for power stations and networks to such decisions.

The Planungsamt also decided on the extent and order of priority of reductions of electricity supplies to which the individual branches of industry would be subjected in case there were interruptions in the power supply owing to heavy damage to electrical plant, or to transport breakdowns. Plans were drawn up to deal with such a contingency in case it should arise. Officials of both departments collaborated in the drawing up of such plans.

The GIWE and the Zentrale Planung. The Zentrale Planung made the final decisions in matters within the competency of the Planungsamt (see previous paragraph). This was usually done only after negotiations with the representatives of the interests concerned.

The GIWE and the Energieplanung. The leading position of the GIWE in power planning is described at the beginning of this Section. The Energieplanung was very successful in carrying out its task of clearing up differences of opinion between GIWE on the one hand and the most important agencies, including those representing particular industries, on the other. Here, the heads or representatives of the most important departments were brought together under the chairmanship of Secretary of State, Schulze-Fielitz, of GIWE. All applications for the building of important new plants or the effecting of important extensions were passed to it, either by the Abteilung Energiewirtschaft, which acted as its secretariat, or from among the members. The GIWE carried out the resolutions. Meetings were held at about 2-monthly intervals.

The GIWE and the Reichskommissar für die Preisbildung. Soon after the office of the Reichskommissar für die Preisbildung had been established in 1936, it was invested with the right, based on the Energiewirtschaftsgesetz of 1935, to control also the tariffs and prices charged by electricity supply undertakings. This resulted in continuous close contact between the two agencies. The Reichspreiskommissar frequently obtained expert opinions from the Reichsgruppe Energiewirtschaft and the Wirtschaftsgruppe Elektrizitätsversorgung. He usually negotiated with the representatives of these organisations in the presence of the official from the GIWE. The terms of activity of the Reichskommissar für die Preisbildung included public supply as well as the industrial power plants.

The GIWE and the Reichsgruppe Energiewirtschaft, the Wirtschaftsgruppe Elektrizitätsversorgung. The GIWE is clearly in a position of leadership as regards both organisations, both legally and in practice. According to the Act for the Provisional Development of the Organisation of Industry and Trade, dated 27.9.1934, it was the duty of the

Reichswirtschaftsminister to appoint and dismiss the heads of both agencies and to confirm in office their general secretaries; but he exercised these powers only in consultation with the GIWE. On the other hand, the GIWE, in pursuance of the Energiewirtschaftsgesetz, delegated to the Reichsgruppe Energiewirtschaft the preliminary scrutiny of applications for building permits. In practice, such an organisation cannot exist indefinitely in opposition to its ministry, in this case the GIWE, even if it is not formally subject to Government supervision, the more as its very existence depends on its success in having the wishes of its members favourably considered by the Ministry.

The procedure of preliminary examination of applications submitted to the Reichsgruppe Energiewirtschaft was as follows: Applications for permits to build new or to enlarge existing plant were addressed in the first instance to the Reichsgruppe Energiewirtschaft. Here the applications were examined and passed on to the GIWE, together with the recommendations of the REW. The REW could at the same time ask the applicant for further information or explanations. This relieved the GIWE of such routine work. In most cases, the GIWE decided in accordance with the suggestions of the REW; there were cases, however, mainly where arguable decisions on policy were involved, where the decisions of the GIWE differed from the suggestions of the REW; as a rule, such decisions were taken only after direct discussions with a representative of the REW had taken place.

The relation between the GIWE and the REW concerning problems of rationing and allocations of raw materials is described on pp. 75-76.

The relation between the GIWE and the Wirtschaftsgruppe Elektrizitätsversorgung was mainly governed by the fact that the latter was a sub-organisation of the Reichsgruppe. However, the GIWE very often made use of the WEV directly in asking for their collaboration in individual cases, mainly when purely technical matters were concerned. The WEV pursued, in collaboration with the Verband Deutscher Elektrotechniker (VDE) and the electro-industry, the standardisation of boiler capacities, turbines, generators, transformers, etc.

The GIWE and Other Official and Semi-Official Agencies and interested parties. Formally, only public supply undertakings were entitled to the GIWE's support in questions of manpower, fuel (coal), transport facilities, building materials and the speeding up of repairs. Industrial power stations were, in these respects, cared for by the agencies concerned with the direction of the individual industries; thus, these questions were taken up by the Generalbevollmächtigte für die chemische Erzeugung on behalf of stations operated by chemical works, by the Reichsvereinigung Kohle on behalf of stations of collieries and coke ovens, by the Reichsvereinigung Eisen on behalf of steel and iron industries, etc. In practice, however, close collaboration in questions of electricity supply existed between these agencies and the GIWE. When such an agency failed to have its requests met by the ministry concerned (e.g. when the Generalbevollmächtigte für die chemische Erzeugung did not receive the specialists applied for from the Reichsarbeitsministerium), it applied to the GIWE. The latter then either supported the agency's claim against the ministry concerned, or else gave direct aid from the public system.

Mutual aid was also frequently given where the allocation of quotas and the provision of building materials were concerned. The Reichsvereinigung Kohle, Reichsvereinigung Eisen and Generalbevollmächtigter Chemie often placed iron or copper quotas, either by way of an advance or permanently, at the disposal of the GIWE for use in individual public supply plants in which they were especially interested. Thus the 220,000 volt transmission lines from Central Germany to Bavaria, and also the 220,000 volt line from Upper Silesia to Vienna on which work had been commenced, were constructed mainly from iron quotas supplied by the Generalbevollmächtigter Chemie.

The Reichslastverteiler - RLW had to fight continually against the industrial agencies, including the Haupt-Ausschüsse and Ringe of the Reichsministerium für Rüstung und Kriegsproduktion, during the worst current shortage, as they tried to circumvent his regulations by issuing counter-regulations; local state and party offices, such as those of the Gauleiter or Wehrkreisbeauftragte, also frequently attempted to enforce wishes of their own, divergent from the instructions of the RLW. But, supported by repeated and strict instructions issued personally by the Reichsminister für Rüstung und Kriegsproduktion, the RLW was always able to assert himself. Even the most influential parties finally accustomed themselves to the procedure of submitting their wishes to the RLW and, if the latter could not fulfil them, calling upon the Planungsamt, or, if necessary, the Zentrale Planung.

State Railways: The Deutsche Reichsbahn (German State Railways) took pains to keep their electric traction independent of public supplies and to have their own self-contained system with single-phase alternating current; they therefore strongly supported the technical arguments in favour of the selected choice of 162/3 cycles per second. The State Railways, were however, by law just as dependent on the GIWE as any other electricity producer. Hence there was close co-operation in matters concerning their electric plant between the State Railways or the Reichsverkehrsministerium on the one hand and the GIWE on the other.

(iii) The interrelations of the other agencies

The Reichskommissar für die Preisbildung, the Reichsgruppe Energiewirtschaft and the Wirtschaftsgruppe Elektrizitätsversorgung. See pp. 72-73.

The Hauptausschuss Kraftwerks und Leitungsbau, the Reichsgruppe Energiewirtschaft and the Wirtschaftsgruppe Elektrizitätsversorgung. The Hauptausschuss had to see that the building of plant already in course of construction proceeded according to schedule. The relevant information was obtained from monthly progress reports submitted to the Reichsgruppe. The Reichsgruppe also

Table 31

**Monthly Electricity Production by the 113
Principal Electricity Supply Undertakings by Source of
Energy (1942-1944)**

Month	Electricity production (million kWh) from				Production from water power (% of total)
	hard coal	brown coal	water power	total ^x	
<u>1942</u>					
January	1,669.75	1,728.80	545.45	3,944.00	16.05
February	1,499.31	1,576.15	388.61	3,464.07	11.22
March	1,479.89	1,633.12	598.28	3,711.29	16.12
April	1,203.94	1,479.56	738.39	3,421.89	21.58
May	1,220.21	1,470.70	766.26	3,457.17	22.16
June	1,182.18	1,481.37	729.41	3,392.96	22.41
July	1,268.94	1,502.67	747.62	3,519.23	21.24
August	1,288.11	1,520.52	727.23	3,535.86	20.57
September	1,433.60	1,537.95	589.73	3,561.28	16.56
October	1,533.03	1,649.17	584.02	3,766.22	15.51
November	1,525.32	1,681.18	616.13	3,822.63	16.12
December	1,613.93	1,749.40	571.16	3,934.49	14.52
Total	16,918.21	19,010.59	7,602.29	43,531.09	17.46
<u>1943</u>					
January	1,663.57	1,817.71	481.45	3,962.73	12.15
February	1,429.00	1,567.93	542.06	3,538.99	15.32
March	1,469.96	1,712.36	574.39	3,756.71	15.31
April	1,264.99	1,492.40	615.27	3,372.66	20.82
May	1,321.39	1,575.05	716.31	3,612.75	19.84
June	1,243.52	1,454.77	780.58	3,478.87	22.44
July	1,297.21	1,519.26	764.85	3,581.32	21.36
August	1,345.96	1,590.52	642.81	3,579.29	17.96
September	1,417.75	1,608.13	563.65	3,589.53	15.70
October	1,609.76	1,628.94	508.64	3,747.34	13.57
November	1,740.17	1,737.66	403.16	3,880.99	10.31
December	1,770.09	1,754.57	442.95	3,967.61	11.16
Total	17,573.37	19,459.30	7,036.12	44,068.79	16.00
<u>1944</u>					
January	1,686.90	1,698.20	586.50	3,971.60	14.75
February	1,559.10	1,639.20	643.70	3,842.00	16.80
March	1,687.68	1,770.12	608.77	4,066.57	14.97
April	1,383.17	1,459.32	828.79	3,671.28	23.55
May	1,412.81	1,443.26	916.97	3,773.04	24.30
June	1,395.19	1,423.63	897.23	3,716.05	24.26
July	1,387.62	1,437.70	847.77	3,673.09	23.05
August	1,529.38	1,576.18	758.03	3,863.59	19.55
September	1,541.59	1,482.39	705.12	3,729.10	18.63
October	1,270.27	1,241.56	706.64	3,218.47	21.95
Total - Jan.-Oct.	14,853.71	15,171.56	7,499.52	37,524.79	19.18

^x neglecting comparatively small production from other sources.

Table 32

Electricity Production of Public Stations in Greater Germany
by Power Districts and Sources of Energy (1941)

Power District	Output Capacity MW	Production (million kWh)				From other sources	From all sources
		From brown coal x	From hard coal	From water power	From other sources		
I	240	0.1	663.4	101.3	5.1	769.9	
II	597	5.7	2,211.4	242.9	118.9	2,578.9	
III	691	19.9	2,170.0	-	"	2,189.9	
IV	637	1,137.8	1,057.9	254.0	2.8	2,452.5	
V	1,081 ^φ	665.8	2,635.7	219.1	21.6	3,542.2	
VIa	701 ^φ	-	2,277.5	117.8	0.1	2,395.4	
VIb	1,719	5,104.0	2,803.8	336.5	3.4	8,247.7	
VII	1,172	7,197.7	186.1	10.8	5.8	7,400.4	
VIII	1,245 ^φ	4,299.7	240.9	364.3	231.1	5,136.0	
IX	1,009	268.0	207.6	3,724.2	2.4	4,212.2	
X	1,139 ^φ	0.3	1,086.5	2,781.9	10.0	3,878.7	
XI	577	408.9	305.9	1,248.0	3.8	1,966.6	
XII	109	"	250.5	"	8.5	259.0	
Total Reich	10,917 ^φ	19,107.9	16,097.2	9,410.8	413.5	45,029.4	

x Including coke and peat.

φ Excluding pumped-storage stations without natural inflow.

Table 36

Consumption of Hard Coal in Public Generating Stations
in Greater Germany by Power Districts (1940 & 1941)

Power District	Hard Coal Consumption			Electricity production from hard coal			Hard Coal consumption per kWh	
	1940	1941		1940	1941		1940	1941
	1000 tons	1000 tons	% increase or decrease on previous year	million kWh	million kWh	% increase or decrease on previous year	Kg	Kg
I	406	529	+ 30.3	503	663	+ 31.8	0.81	0.80
II	1,946	2,090	+ 7.4	2,035	2,211	+ 8.6	0.96	0.95
III	1,015	1,372	+ 35.2	1,685	2,170	+ 28.8	0.60	0.63
IV	551	701	+ 27.3	824	1,058	+ 28.4	0.67	0.68
V	1,555	1,709	+ 9.9	2,330	2,636	+ 13.1	0.67	0.65
VIa	1,277	1,393	+ 9.1	1,969	2,277	+ 15.6	0.65	0.61
VIb	1,761	1,943	+ 10.4	2,355	2,804	+ 19.1	0.75	0.69
VII	110	117	+ 6.4	175	186	+ 6.3	0.63	0.63
VIII	246	222	- 9.8	264	241	- 8.7	0.93	0.92
IX	113	126	+ 11.5	184	208	+ 13.0	0.61	0.61
X	636	867	+ 36.3	800	1,087	+ 35.9	0.80	0.80
XI	215	270	+ 25.6	256	306	+ 19.5	0.84	0.88
XII	165	226	+ 37.0	179	250	+ 39.7	0.92	0.90
I - XII	9,996	11,565	+ 15.7	13,559	16,097	+ 18.7	0.74	0.71

Table 37

Heat Consumption in Public Hard Coal Stations
in Greater Germany (1941)

Heat Consumption kcal/kWh	All Stations		Municipal Stations		non-Municipal Stations	
	output capacity		output capacity		output capacity	
	1000 kW	%	1000 kW	%	1000 kW	%
2500 - 4500	3,077	58.2	245	26.4	2,831	65.6
4500 - 6000	1,542	29.3	625	65.2	917	21.2
6000 - 7500	471	8.9	26	2.5	445	10.2
7500 -12500	190	3.6	58	5.9	133	3.0
2500 -12500	5,280 ^x	100.0	954	100.0	4,326	100.0

x May include stations firing only partly hard coal; output capacity of stations firing hard coal only was 4876 MW in 1941

Supply and Consumption of Electricity in the Individual Power Districts
(1941)

Power District	Electricity Consumption										
	Electricity production + imports million kWh	Total consumption million kWh		Electricity supplied direct by				Consumption by industry		Of which supplied direct by	
		million kWh	million kWh	Public plants		Industrial plants		million kWh	% of total consumption	million kWh	Industrial plants
				million kWh	% of total consumption	million kWh	% of total consumption				
I	903	761	639	122	16.0	507	66.3	392	115	22.6	
II	6,518	5,711	2,486	3,225	56.5	4,934	86.4	2,065	2,869	58.2	
III	2,404	2,964	2,754	210	7.1	1,509	50.9	1,359	150	9.9	
IV	4,026	4,905	3,419	1,486	30.3	4,182	86.3	2,771	1,411	33.7	
V	5,228	5,510	3,935	1,575	28.6	4,172	75.7	2,726	1,446	34.7	
VIa	7,499	6,640	1,957	4,683	70.5	6,021	90.7	1,630	4,391	72.9	
VIb	15,211	14,655	8,719	5,936	40.5	12,850	87.7	7,253	5,597	43.6	
VII	13,701	10,153	4,331	5,822	57.3	9,151	90.2	3,814	5,337	56.3	
VIII	8,806	8,013	4,561	3,452	43.1	6,676	83.4	3,420	3,256	48.7	
IX	5,680	6,149	4,822	1,327	22.3	5,019	81.6	3,790	1,229	22.5	
X	7,074	6,455	3,622	2,833	43.9	5,338	82.7	2,693	2,645	49.6	
XI	3,277	2,888	1,689	1,199	41.5	2,155	74.6	1,198	957	44.4	
XII	361	321	219	102	31.8	213	66.4	120	93	43.7	
I - XII	80,688	75,125	43,153	31,972	42.6	62,727	83.5	33,231	29,496	47.5	

including own consumption of power stations.

Table 39

Imports of Electricity by Greater Germany (1933-1941)

(Million kWh)

Country	1933	1934	1935	1936	1937	1938 ^x	1939 ^φ	1940	1941
Austria	309.1	339.9	370.9	355.5	422.1	-	-	13.5	37.3 ⁺
Belgium	-	-	-	-	-	-	-	-	-
Czechoslovakia	0.7	0.3	0.2	0.5	0.2	0.2	5.6	4.8	6.0
Danzig	negl.	negl.	negl.	1.8	1.7	1.9	1.4	11.4	4.8
Denmark	6.1	0.5	1.2	6.5	6.7	11.6	10.6	negl.	258.2 ⁺
France	27.8	25.5	35.8	42.8	35.2	58.5	35.0	negl.	negl.
Holland	negl.	negl.	negl.	negl.	negl.	negl.	negl.	1.5	3.1
Poland	14.1	3.1	2.3	0.9	1.2	10.2	57.8	negl.	negl.
Saar	45.5	41.1	689.2	802.3	763.8	737.7	930.4	1,007.5	1,060.9
Switzerland	320.5	419.2	689.2	802.3	763.8	737.7	930.4	1,007.5	1,060.9
Other countries	0.1	0.1	0.1	0.1	0.1	negl.	0.1	0.1	negl.
Total	723.9	829.7	1,099.7	1,210.4	1,231.0	820.1	1,040.9	1,038.8	1,370.3

x Including Austria.

φ Including Austria and Sudetenland.

+ Including Alsace-Lorraine and Luxembourg.

Table 40

Exports of Electricity by Greater Germany (1933-1941)
(Million kWh)

Country	1933	1934	1935	1936	1937	1938 ^x	1939 ^φ	1940	1941
Austria	5.3	6.0	5.9	5.7	8.5	negl.	negl.	41.4	24.9 ⁺
Belgium	negl.	negl.	negl.	negl.	negl.	negl.	negl.	1.2	1.0
Czechoslovakia	12.6	14.3	11.4	5.8	6.0	3.0	-	11.4	4.8
Danzig	5.9	11.1	20.5	15.0	19.3	20.4	16.7	0.2	negl.
Denmark	-	-	-	8.6	9.0	10.6	10.6	40.2	52.5
France	20.2	12.3	17.5	21.0	22.9	22.4	18.7	0.2	negl.
Holland	2.6	2.4	2.2	2.2	2.1	2.2	0.1	0.2	negl.
Poland	11.2	10.8	10.9	8.4	9.1	13.1	13.0	43.5	87.0
Saar	1.6	4.0	-	-	-	29.5	33.8	0.4	0.3
Switzerland	24.3	29.2	28.2	24.7	25.1	0.3	0.1	0.4	0.3
Other countries	0.1	negl.	negl.	0.1	negl.	0.3	0.1	0.4	0.3
Total	83.8	90.1	96.6	91.5	102.0	101.5	93.0	138.3	215.5

x Including Austria.

φ Including Austria and Sudetenland.

+ Including Alsace-Lorraine and Luxembourg.

Table 41

Net Imports (+) and Exports (-) by Greater Germany (1933-1941)
(million kWh)

Country	1933	1934	1935	1936	1937	1938	1939 [♠]	1940	1941
Austria	+ 303.8	+ 333.9	+ 365.0	+ 349.8	+ 413.6	- negl.	- negl.	- 27.9	+ 12.4 [♠]
Belgium	- negl.	- negl.	- negl.	- negl.	- negl.	- negl.	+ 5.6	+ 3.6	+ 5.0
Czechoslovakia	- 11.9	- 14.0	- 11.2	- 5.3	- 5.8	- 2.8	- 15.3	-	-
Danzig	- 5.9	- 11.1	- 20.5	- 13.2	- 17.6	- 18.5	-	-	-
Denmark	+ 6.1	+ 0.5	+ 1.2	- 2.1	- 2.3	+ 1.0	-	-	-
France	+ 7.6	+ 13.2	+ 18.3	+ 21.8	+ 12.3	+ 36.1	+ 16.3	-	+ 213.2 [♠]
Holland	- 2.6	- 2.4	- 2.2	- 2.2	- 2.1	- 2.2	- 0.1	- 0.2	negl.
Holand	+ 2.9	- 7.7	- 8.6	- 7.5	- 7.9	- 2.9	+ 44.8	- 38.7	- 49.4
Saar	+ 43.9	+ 37.1	-	-	-	-	-	-	-
Switzerland	+ 296.2	+ 390.0	+ 661.0	+ 877.6	+ 738.7	+ 708.2	+ 896.6	+ 964.0	+ 973.9
Other countries	-	+ 0.1	+ 0.1	-	+ 0.1	+ 0.3	-	- 0.3	- 0.3
TOTAL	+ 640.1	+ 739.6	+ 1003.1	+ 1218.9	+ 1129.0	+ 718.6	+ 947.9	+ 900.5	+ 1154.8

♠ including Austria

♠ " " and Sudetenland

♠ " " Alsace-Lorraine and Luxembourg

APPENDIX II

Report to Albert Speer, Reich Minister for Armaments and War
Production, on the electricity supply situation in Berlin, Leipzig
and Kassel after large scale air attacks on these towns.
(Translation)

The percentage figures in this report refer to the electricity requirements which were to be expected, under the weather conditions which actually occurred on each individual day, had no air-raid taken place.

A. Berlin

The latest air attacks on Berlin occurred on November 22nd, 23rd and 26th and December 2nd, 1943, always during the early hours of the evening.

1. Electricity consumption and load

	Date	Daily electricity consumption		Peak load	
		1000 kWh	%	MW	%
M.	22 Nov.	9180	normal	640	normal
T.	23 "	6480	65	365	59
W.	24 "	6180	62	345	53
Th.	25 "	6600	66	370	56
F.	26 "	6960	69	405	63
S.	27 "	6050	65	352	56
Su.	28 "	4840	75	300	77
M.	29 "	7130	75	420	64
T.	30 "	7710	76	450	71
W.	1 Dec.	7780	76	470	73
Th	2 "	7750	75	485	75
F.	3 "	8190	76	470	70
S.	4 "	7340	78	450	70
Su.	5 "	5920	92	320	80
M.	6 "	8200	78	510	79
T.	7 "	8990	82	520	78
W.	8 "	9040	83	530	80
Th.	9 "	9220	85	560	85
F.	10 "	9000	85	565	86

Since Dec. 9th the electricity consumption has remained at about 85% of the normal consumption and seems to remain for the time being stationary at this level.

APPENDIX IV

The following are two specimens of "Abschaltelisten" (schedules for load sheddings) for power districts VI b and VII, as prepared by the respective Bezirkslastverteiler. They form a part of "List No. 5" covering all 13 Power Districts and issued by the Reichslastverteiler on November 18th, 1944.

List No. 5

for load sheddings in Power District VIb

Sheddings A

Works	Maximum requirements MW	Own production MW	Restrictions MW
1. I.G. Farben Oppau	50	-	15
2. Erftwerk	40	-	10

Sheddings B

Works	Maximum requirements MW	Own production MW	Restrictions MW Stages				
			1	2	3	4	5 +)
<u>Group 1 - Liquid fuel.</u>							
1. Ruhrchemie A.G. Holten.	15.0	----	----	----	----	----	----
2. Gelsenberg Benzin.	35.0	151.0	----	----	----	----	----
3. Ruhröl-Welheim	12.0	64.0	----	----	----	----	----
	62.0	215.0	----	----	----	----	----
<u>Group 4 - Rubber industry.</u>							
1. 9 Minor works.	5.56	0.48	0.37	0.85	1.32	1.52	2.85
	5.56	0.48	0.37	0.85	1.32	1.52	2.85

* for Stages 6 & 7 see summary.

Works	Maximum require- ments MW	Own pro- duction MW	Restrictions MW Stages				
			1	2	3	4	5
<u>Group 6 - Other chemical industries.</u>							
1. Ruhrchemie A.G. Holten.	15.0	8.0	3.0	4.0	6.0	10.0	11.0
2. Feldmühle A.G. Lülsdf	13.0	----	1.0	2.0	2.0	5.0	7.0
3. Aschaffenburg Zellstoffwerke.	2.5	----	0.1	0.3	0.6	0.8	0.9
4. Aschaffenburg Zellstoffw. Werk Stockstadt.	2.5	----	0.1	0.2	0.5	0.8	0.9
5. 18 Minor Works.	9.0	23.0	0.18	1.4	2.4	4.8	4.8
	42.0	31.0	4.38	7.9	11.5	21.4	24.6
<u>Group 8 - Other metals.</u>							
1. Stolberger Zink A.G.	1.8	----	----	----	0.2	0.3	0.4
	1.8	----	----	----	0.2	0.3	0.4
<u>Group 9 - Electric steel.</u>							
1. Edelstahl Krefeld.	36.0	----	----	----	6.0	12.0	12.0
2. D.Eisenwerke Mülheim Fr.Wilh. Hütte Ruhr.	15.0	8.4	----	----	1.0	3.0	3.0
3. Babcock-Werke, Oberhs.	4.8	----	----	----	0.2	0.2	0.2
4. Gusweider Eisen- werke A.G.	16.0	----	----	----	1.2	1.2	1.2
5. Elektrowerk Weisweiler.	28.0	----	----	----	3.8	7.0	7.0
6. Elektrostahlw. Hoffm.	1.5	----	----	----	----	0.5	0.5
7. Krupp, Werk Rostock.	25.0	55.0	----	----	----	3.0	3.0
	126.3	63.4	----	----	12.2	26.9	26.9
<u>Group 10 - Ferro-alloys.</u>							
1. 2 Minor works.	0.95	----	----	----	----	----	----
	0.95	----	----	----	----	----	----

Works	Maximum require- ments MW	Own pro- duction MW	Restrictions MW Stages					
			1	2	3	4	5	
<u>Group 11 - Component industries.</u>								
1. O.K.D.Osnabrück.	9.0	----	----	----	0.6	1.3	2.0	
2. Klöckner-Werke Osnabrück.	5.0	22.0	1.2	2.5	2.5	3.0	3.6	
3. Bandeisenwalz- werk Dinslaken.	10.0	----	2.0	2.0	2.0	3.0	3.0	
4. Aug.Thyssen- Hütte Hamborn.	25.0	100.0	2.0	4.0	4.0	6.0	8.5	
5. D.Röhrenw. Thyssen Mülheim	17.0	12.8	1.0	2.0	2.0	3.0	4.6	
6. G.H.H.Boecker, Gelsenkirchen.	3.1	----	0.2	0.4	0.4	1.0	1.3	
7. Schalker Verein.	8.0	35.0	0.6	1.2	1.2	2.0	2.7	
8. MannesmannRö- hrenwerk Rems- cheid.	2.4	----	0.2	0.25	0.25	0.45	0.7	
9. Westf.Leicht- metallw.GmbH.	5.2	8.0	0.6	0.6	0.6	0.75	1.25	
10. Wissener Eisen- hütte AG.	5.0	15.0	0.37	0.47	0.47	0.93	1.5	
11. Charlottenhütte AG.	3.7	3.5	0.28	0.34	0.34	0.69	1.11	
12. Eichener Walz- werke.	3.5	----	0.26	0.33	0.33	0.65	1.05	
13. Dynamit AG. Treuendorf.	6.4	8.5	0.5	1.0	0.1	1.5	1.5	
14. Ver.Leicht- metallw.GmbH. Bonn.	5.3	----	----	1.0	1.0	1.0	1.0	
15. Klöckner- Humboldt-Deutz A.G.	4.2	----	0.2	0.4	0.4	1.0	1.4	
16. Spiegelglasw. Germania.	2.4	----	0.2	0.4	0.4	0.6	0.9	
17. Dürerer Metallw.	5.6	----	----	----	----	0.4	0.8	
18. Opelwerke Rüsselsheim.	4.2	9.0	----	----	----	----	1.0	
19. M.A.N.Gustavs- burg.	3.1	1.75	----	----	----	----	0.6	
20. Siemens- Schuckertw.	2.3	----	0.2	0.4	0.4	1.0	1.3	
21. 119 minor works.	59.1	7.65	2.6	6.06	6.06	11.0	11.0	
22. Lurgi-Thermi.	6.0	----	----	0.3	0.3	1.0	1.5	
	195.5	223.20	12.41	24.25	24.25	40.27	52.31	

Works	Maximum require- ments MW	Own pro- duction MW	Restrictions MW Stages				
			1	2	3	4	5
<u>Group 12 - Armaments (finishing) industry.</u>							
1. Gutehoffnungs- Hütte Oberhausen	10.0	45.0	1.0	2.0	2.5	2.5	2.8
2. Schmöle R.n.G. Menden.	2.6	0.16	0.2	0.2	0.4	0.4	0.4
3. Ed. Breitenbach GmbH.	3.0	----	0.23	0.28	0.56	0.56	0.56
4. Siegener Eisenbed. AG. Tiefenbach.	2.3	----	0.18	0.21	0.43	0.43	0.43
5. Ford-Werke AG. Köln Nichl.	2.9	----	0.2	0.4	0.4	0.4	0.4
6. William Prym, Stolberg.	2.7	----	----	----	----	----	0.3
7. Eisen-u. Hüttenw. A.G. Bandstahlw. Andemach.	3.5	----	0.12	0.24	0.35	0.35	0.35
8. Concordiah. GmbH.	2.7	0.4	0.08	0.16	0.25	0.25	0.25
9. Berg. Stahlind. Remschdt.	16.0	----	2.0	2.5	3.0	3.0	3.4
10. 19 minor works.	11.38	0.64	0.28	0.83	0.83	0.83	1.92
	47.08	46.20	4.29	6.82	8.72	8.72	11.11
<u>Group 13 - Mining.</u>							
1. Bergfiskus Ibbenbürr.	7.0	----					
2. Gelsenk Bergwerks AG. pit 2/5.	9.0	----					
3. Dito pit 4/8.	3.5	----					
4. 3 minor works.	3.3	----	0.9	1.0	1.0	1.1	1.1
	22.8	----	0.9	1.0	1.0	1.1	1.1
<u>Group 14 - Cement.</u>							
1. Dyckerhoff, Lengusch.	3.0	----	2.0	2.0	3.5	3.5	3.5
2. Bonner Portl. Zementwerke AG. Oberkassel.	4.4	----	2.0	2.0	3.5	3.5	3.5
3. Dyckerhoff-Portl.- Zementw. AG. Neuwied.	3.6	----	2.5	2.5	3.0	3.0	3.0
4. Zementw. Weisenau.	3.5	----	1.5	1.5	2.5	2.5	2.5
5. Dyckerhoff Amöneburg.	2.8	----	2.8	2.8	2.8	2.8	2.8
6. 4 minor works.	2.8	----	2.05	2.05	2.05	2.05	2.05
	20.1	----	12.85	12.85	17.35	17.35	17.35

Works	Maximum require- ments MW	Own pro- duction MW	Restrictions MW Stages				
			1	2	3	4	5
<u>Group 15 - Paper</u>							
1. 7 Minor works.	2.98	1.64	0.96	1.8	1.8	2.0	2.98
	2.98	1.64	0.96	1.8	1.8	2.0	2.98
<u>Group 16 - Textile.</u>							
1. Niehnes u. Düttig Nordhorn	2.0	9.0	1.0	1.5	2.0	2.0	2.0
2. Aschaffenburg Zellstoffwerke Malsum.	2.0	2.3	---	0.5	1.0	1.0	1.0
3. 18 Minor works.	7.84	7.92	1.57	2.22	2.91	5.12	5.12
	11.84	19.22	2.57	4.22	5.91	8.12	8.12
<u>Group 17 - Food</u>							
1. 8 Minor works.	3.0	---	0.25	0.29	1.29	1.39	1.39
	3.0	---	0.25	0.29	1.29	1.39	1.39
<u>Group 18 - Other works.</u>							
1. Rhein. Westf. Kalkw. Hönnetal- Ietmathe-Grüne.	2.65	---	0.35	0.45	0.65	1.15	1.15
2. Kabelw. Rheydt A.G.	2.5	---	0.67	0.88	0.88	1.27	1.27
3. 88 Minor works.	19.46	2.61	3.8	7.1	8.1	13.2	13.2
	24.61	2.61	4.82	8.43	9.63	15.62	15.62