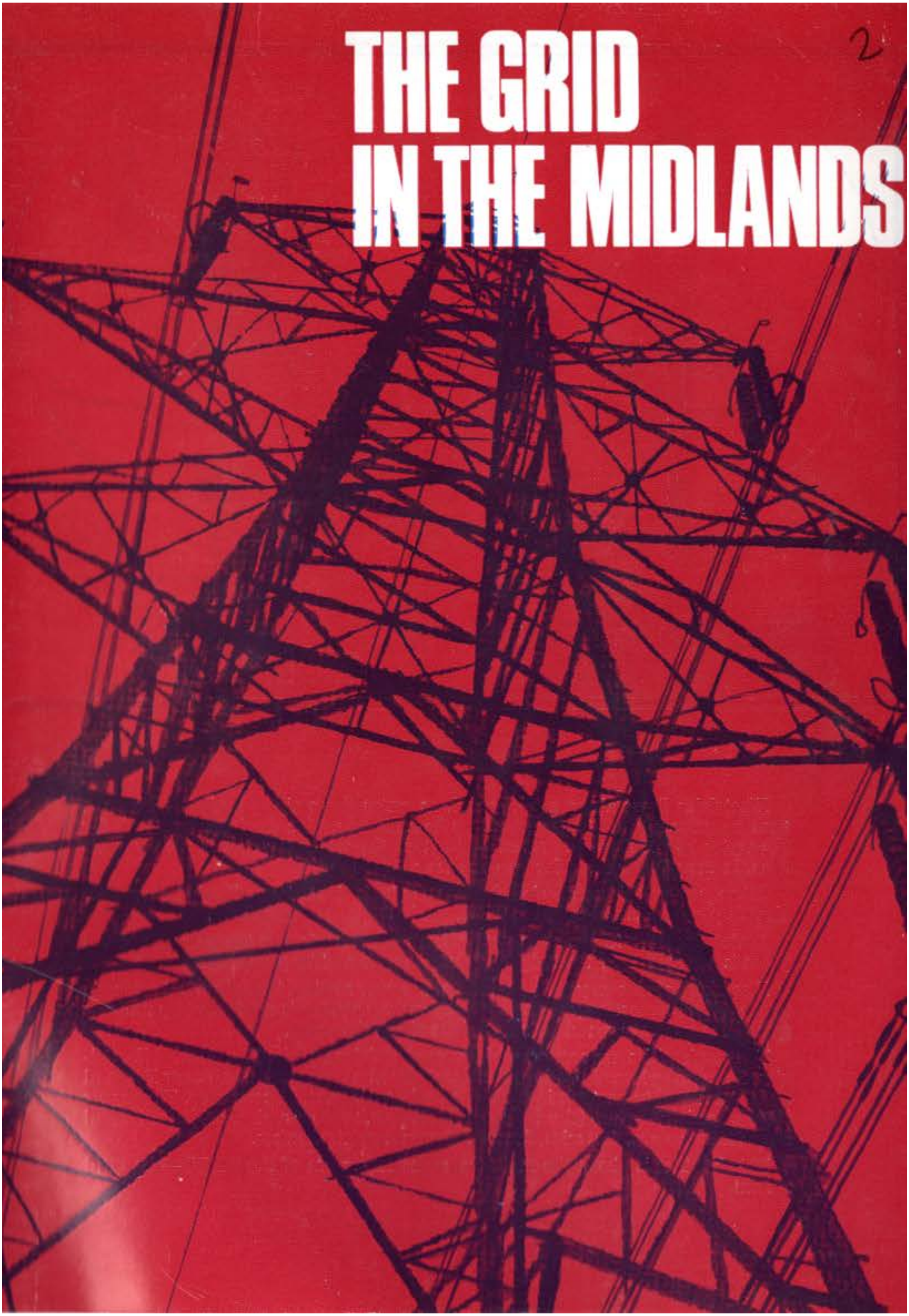
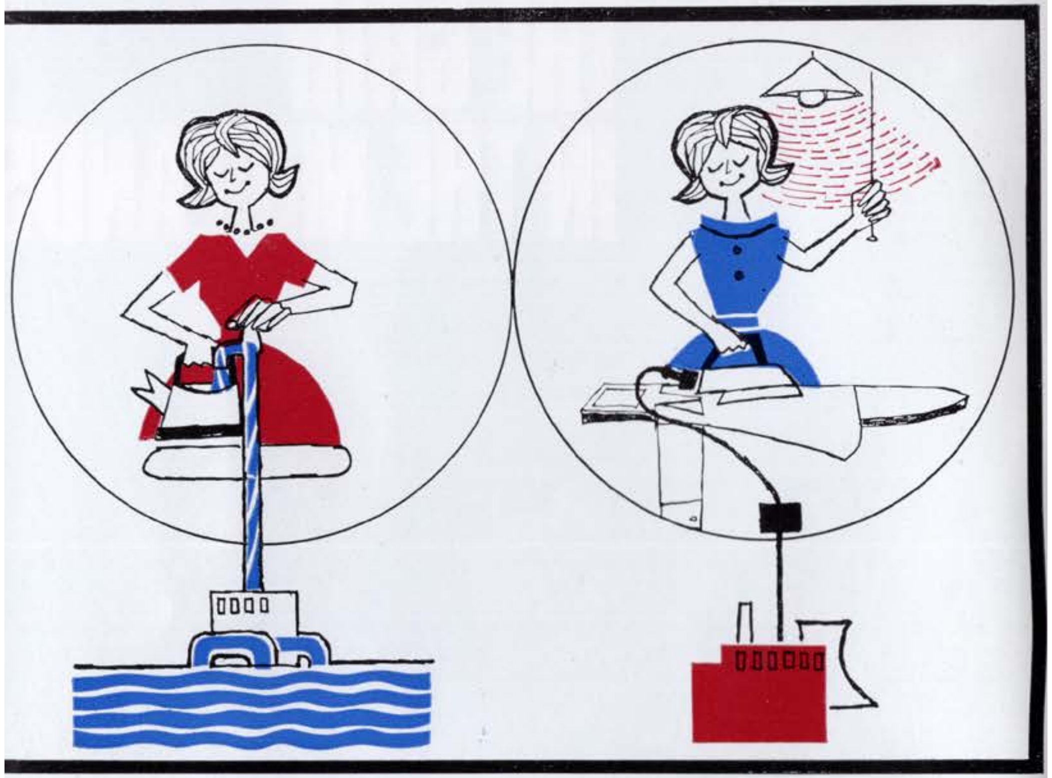
THE GRID IN THE MIDLANDS





Electricity flows along a wire much as water flows along a pipe. When you turn on your kitchen tap, water flows immediately. You don't have to wait for the water to get from the reservoir because the water pressure is there all the time, in the pipe, waiting for you to turn on the tap.

When you switch on an electric light the bulb lights immediately because the **electric** pressure is there, in the wires, ready for you to switch on.

Water for your kitchen tap comes from a reservoir and the pressure in the pipes is controlled by the height of the reservoir and by pumping stations.

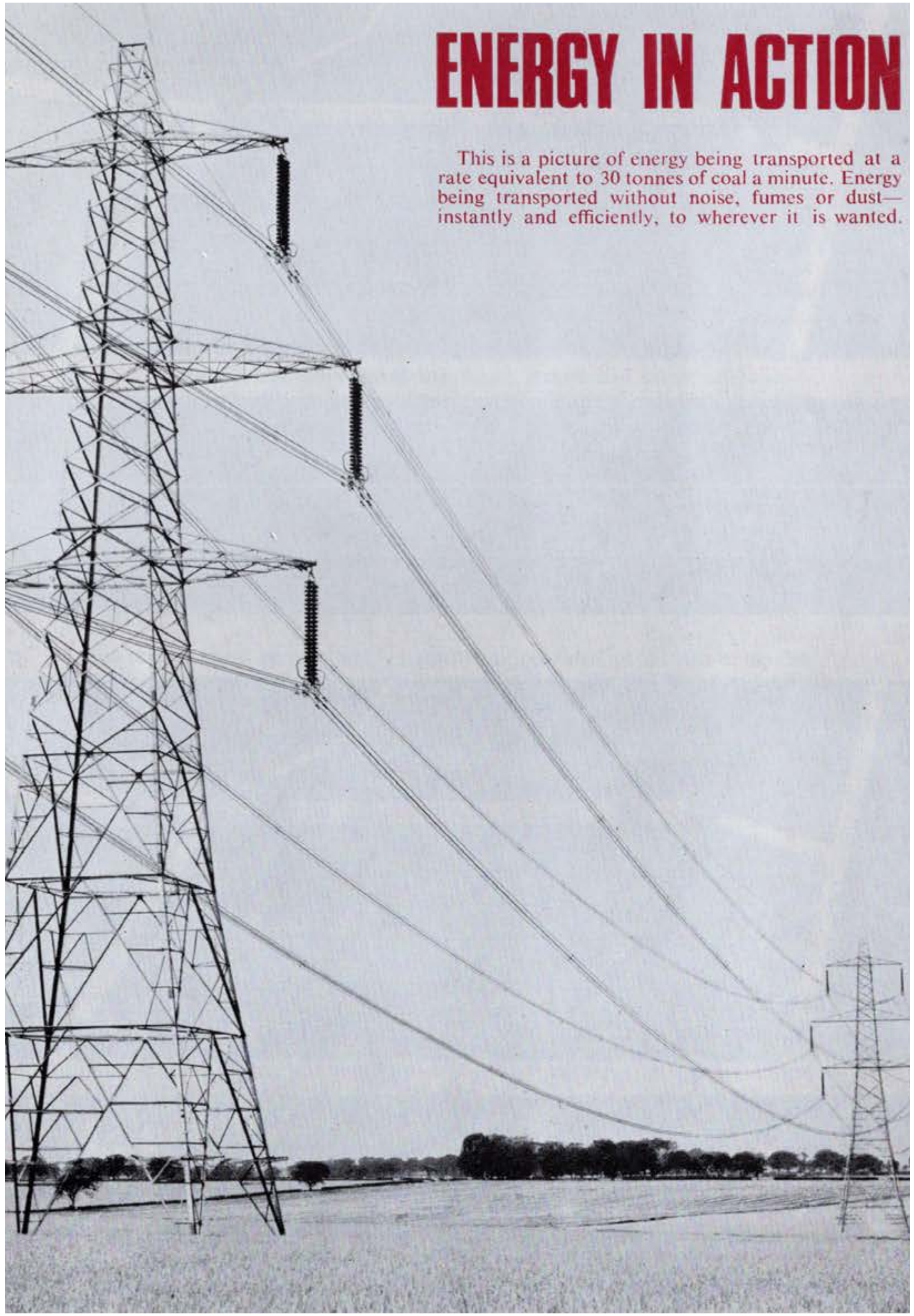
Electricity comes to your switch from a power station. The electrical pressure in the wires connecting your house to the power station is controlled by the output of the generators and by substations along the route.

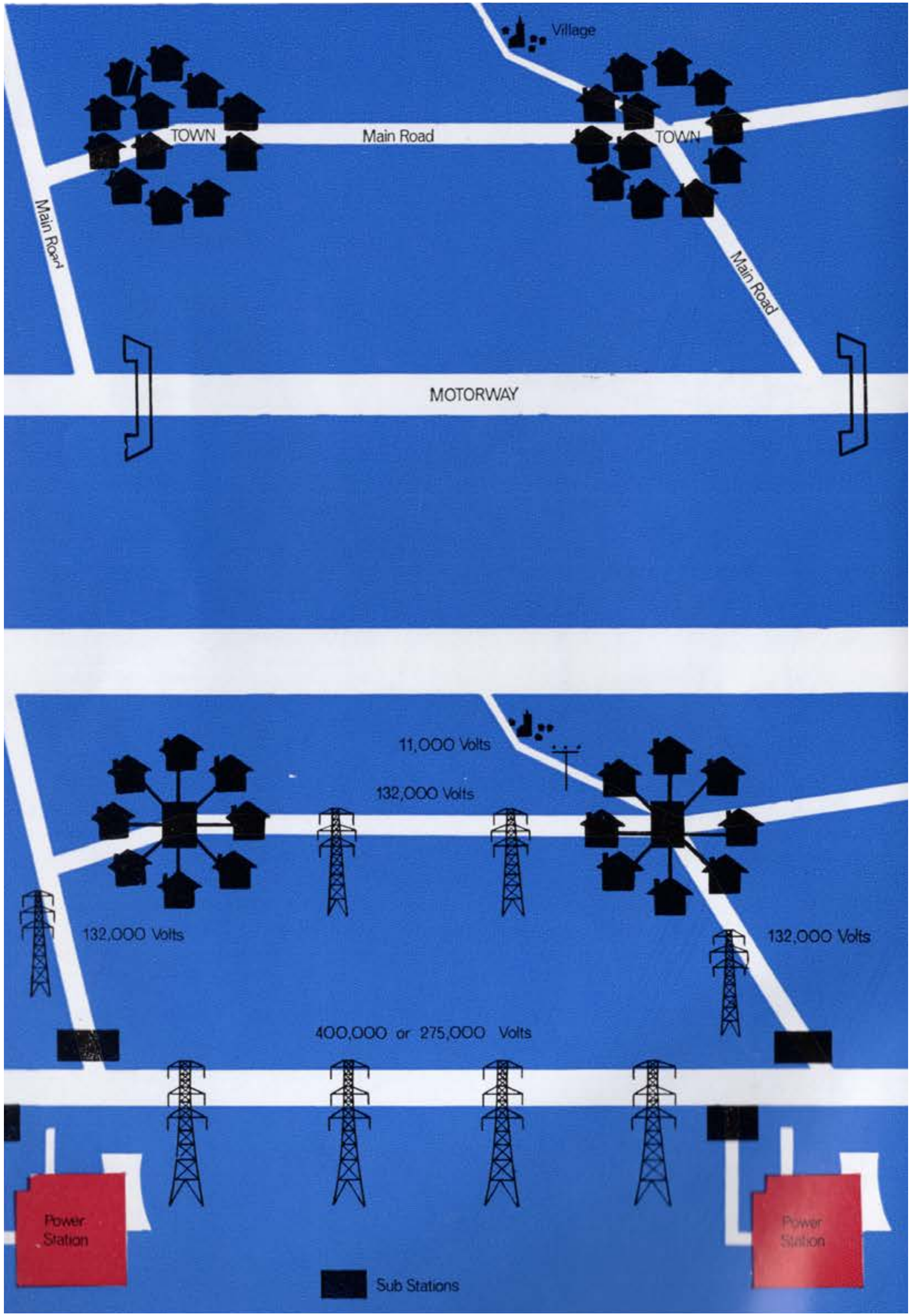
Two authorities are concerned in your electricity supply. The Central Electricity Generating Board produce the electricity at power stations all over England and Wales and transmit it in bulk to a main substation in your area. Then your local electricity board (the MEB or EMEB) take over and provide individual supplies to houses, factories, farms and commercial premises.

This booklet is about the main transmission system of the CEGB—the Grid system.

ENERGY IN ACTION

This is a picture of energy being transported at a rate equivalent to 30 tonnes of coal a minute. Energy being transported without noise, fumes or dust—instantly and efficiently, to wherever it is wanted.





The Grid, then, is part of a transport system. It transports electricity from the power stations to the areas where people want to use it. But there is one big difference between electricity and water or any other product. Water can be stored in a reservoir until it is needed. Other goods can be stored at factories or at warehouses after manufacture. Stocks can be held to even out the ups and downs of public demand. But electricity cannot be stored. It must be made at at the same instant of time as it is used and it must have an instant transport system able to handle immediately the highest demands made upon it.

Any transport system, whether road, rail, water or electricity, needs routes for handling different volumes of traffic—it needs its motorways, its trunk roads, its minor roads, lanes and streets. It also needs a system of traffic control.

The Grid, in effect, forms the main road system of electricity supply. From the main roads the traffic filters off into lanes, streets and suburban roads—which in electricity are represented by the local lines and cables of the area board distribution systems.

Key points in the power traffic control system are the substations built wherever power is fed on to or taken off the Grid. These substations incorporate switches, which enable the power to be directed along the right lines, and transformers which transform the power to higher or lower voltages.

But just as the road system found a need for motorways to handle heavy long-distance traffic, so electricity found a need for a Supergrid to handle heavy transfers of power across the country.

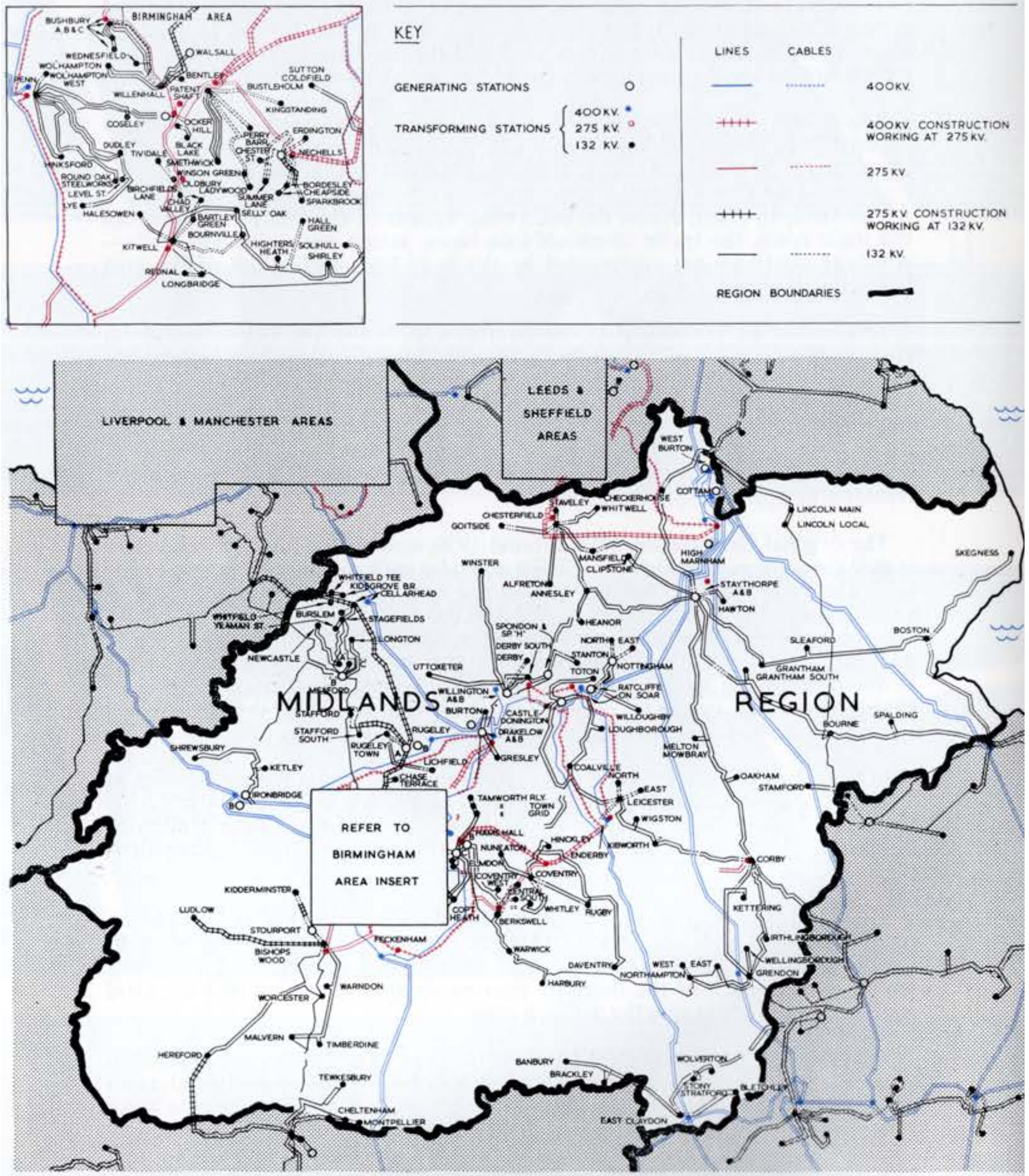
The original Grid system, built around 1930, operated at 132,000 volts. This is still the voltage at which the CEGB provides bulk supplies of power to the local electricity boards. But the CEGB has also now developed a Supergrid system, operating at 275,000 volts and 400,000 volts, which is used mainly to transfer large quantities of power from areas, such as the East Midlands, where coal is plentiful, to other parts of the country where local fuel supplies are scarce. All the big modern power stations are connected to the Supergrid so that their output can be sent instantly to wherever it is needed, the power being tapped off the Supergrid to supply local areas at 132,000 volts.

In providing this instant transport system, the Grid brings further benefits. It makes your electricity supply more reliable because it provides an interlocking network of power lines covering the whole country. If one power station or line breaks down, power can be drawn from other power stations along alternative routes.

The Grid cuts out unproductive capital investment. One power station operating on its own would have to carry enough spare generating plant to guard against breakdowns and to cover maintenance periods, and this plant would lie idle much of the time. By inter-connecting power stations the Grid enables them to act as standby for each other.

The Grid cuts the cost of electricity because at night and over weekends, when power demands are low, high-cost stations can be shut down and production concentrated at the lowest cost stations where modern plant makes the most economical use of the available fuel. This saves millions of pounds a year and permits the sale of cheaper off-peak electricity through the white meter and night storage tariffs.

GRID NETWORK IN MIDLANDS



WHY HIGH VOLTAGES ARE USED

Let us go back to the kitchen tap. We all know that water pressures vary. If a house has high water pressure you can turn on the tap and fill a kettle quickly. If the water pressure is low it takes much longer to get the same amount of water. The important point here is that the water pipe leading to the tap is the same size in both cases, but if the pressure is high then the same size pipe will carry much more water than if the pressure is low.

It is the same with an electric wire. The same size wire will carry much more electricity if the pressure is high than if it is low. Electrical pressure is measured in volts, and since the Grid system has to carry very large quantities of power, it is much more efficient to make it operate at very high voltages.

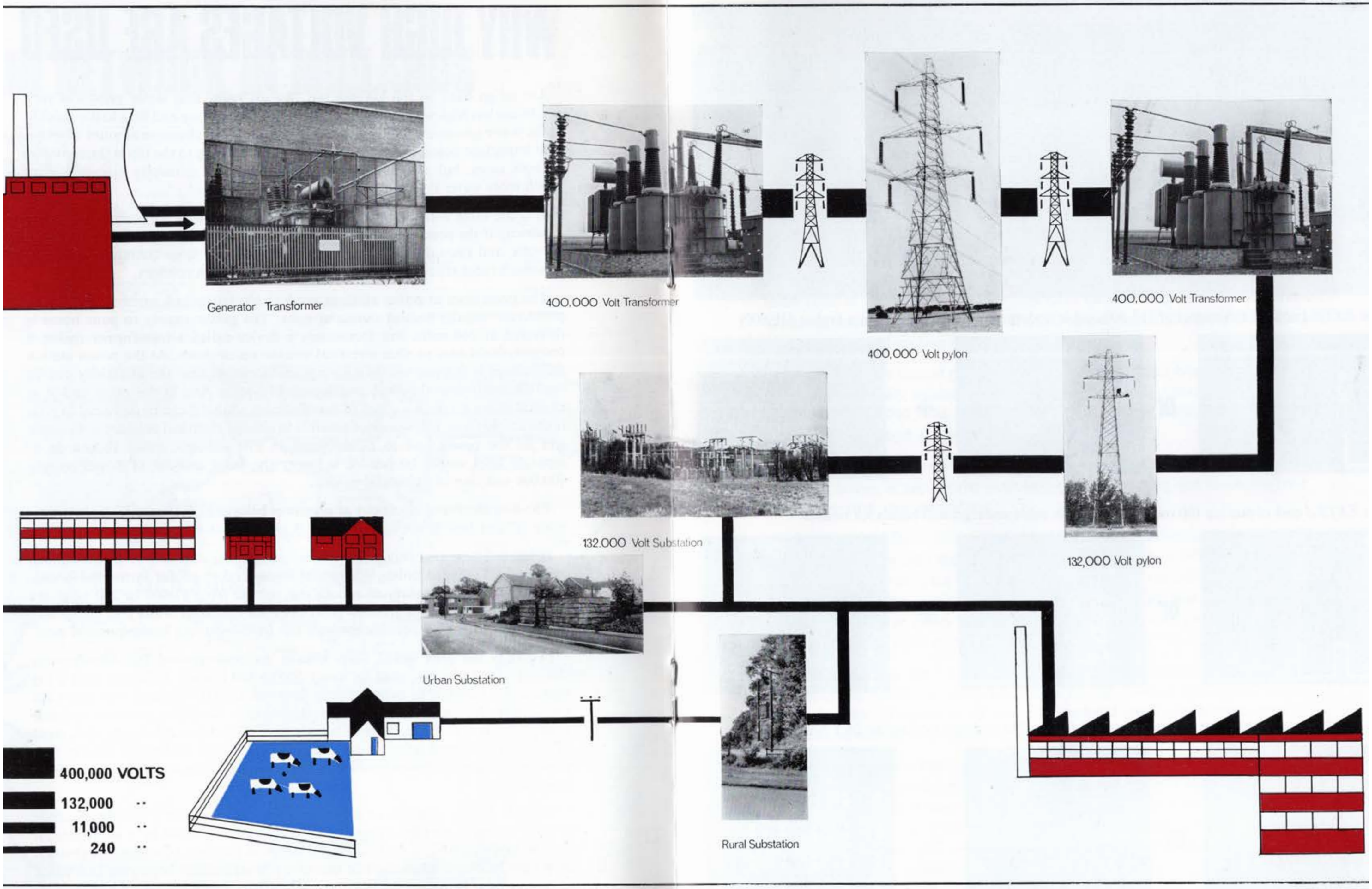
The generators at power stations produce electricity at a number of different pressures—usually several thousand volts. The power supply to your home is delivered at 240 volts. But fortunately a device called a transformer makes it comparatively easy to alter electrical voltage up or down. At the power station the voltage is stepped up through a transformer so that the electricity can be sent efficiently over the Grid and Supergrid system. And at the other end it is stepped down through a series of transformers, so that it can be delivered to your home at 240 volts. If it were not possible to change electrical pressure in this way and all the power had to be delivered in low voltages, many thousands of separate lines would be needed to carry the same amount of power as one 400,000-volt line of Supergrid pylons.

The distribution of electricity at pressures below 132,000 volts is the responsibility of area boards such as the EMEB and the MEB.

In the country, area board lines, mostly operating at 11,000 volts, are carried overhead on wooden poles. Where supplies are taken off for farms and houses the transformers necessary to reduce the voltage from 11,000 to 240 volts are mounted high up on the wooden pole. Great care is taken to site pole transformers so that as far as possible they are lost from sight in a background of trees.

In towns the area board lines usually go underground, but transforming stations have to be provided for every 200 to 300 houses. A factory with a big demand for power may take a supply direct at 11,000 volts and step down the pressure in its own substation. As the demand for electricity increases and new developments take place, the area boards have to find new substation sites, most of them in congested urban areas. Various camouflage devices are used so that these essential substations blend with their surroundings as inconspicuously as possible.

There is almost certainly an area board substation within a quarter of a mile of your home. It may be a small brick building surrounded by a shrubbery; it may be behind a pair of painted double doors at the back of a new supermarket or it may be disguised as the end one of a row of garages belonging to a block of luxury flats. In most cases the only indication of its presence will be the sign of the area board outside, and the warning "Danger—high voltage."


Generator Transformer
400,000 Volt Transformer
400,000 Volt pylon
400,000 Volt Transformer
132,000 Volt pylon
132,000 Volt Substation
Urban Substation
Rural Substation
400,000 VOLTS
132,000 ..
11,000 ..
240 ..

To underground the Supergrid thousands of miles of land as wide as a motorway would be needed.

The *EXTRA* cost of 100 metres of 132,000v cable underground equals 2.3 houses (value £10,000)

The *EXTRA* cost of putting 100 metres of 275,000v cable underground equals 9.8 houses

The *EXTRA* cost of putting 100 metres of 400,000v cable underground equals 26.1 houses

WHY NOT UNDERGROUND ?

Most people recognise the need for a Grid system but many people wonder why, in this age of great technological progress, the lines can't be put underground. The answer is in two words—heat and insulation.

When power flows along a wire, the wire tends to heat up. The wires of the Grid system carry enormous quantities of power and the heat has to be got rid of or the wires would burn out. If you hang the wires in the air, the air keeps them cool. If you put the big new Supergrid lines underground, an elaborate system of water cooling has to be installed—pipes buried alongside the cables, with pumping and cooling stations every two miles.

Insulation is the second point. The electric wires in your house, operating at 240 volts, are easily insulated with rubber or plastic. But insulation for wires operating at 400,000 volts is heavy and very expensive. Unless you use air—which is a very good insulator.

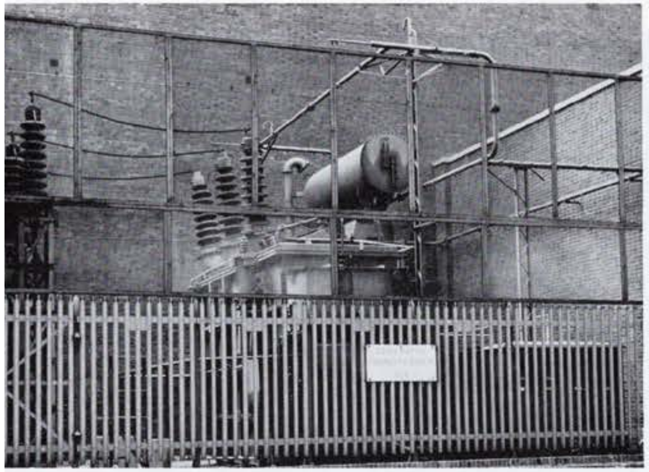
So if you put the wires overhead, the air cools them down and insulates them—and air is free. If you put the wires underground, cooling and insulation have to be provided very expensively.

The difference is fantastic. A kilometre of 400,000-volt underground cable would cost 16 times more than the equivalent overhead line. The CEGB and the cable manufacturers are carrying out constant research to cut the cost of underground cables. We lead the world in this field. But because of heat and insulation, putting high voltage cables underground will always be very much more expensive than putting them overhead.

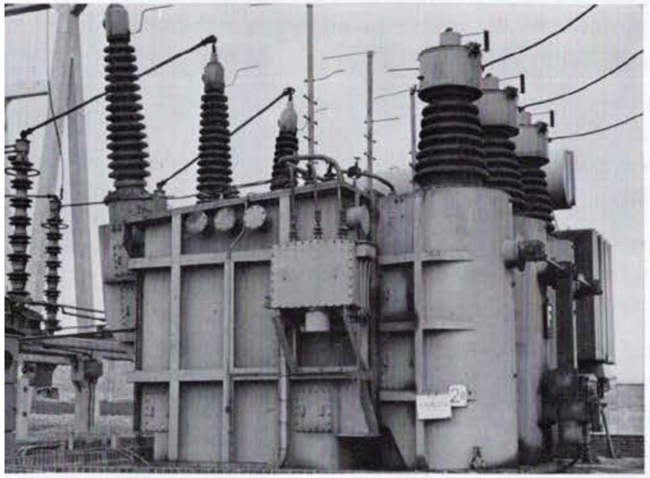
Undergrounding the Grid system would add considerably to everyone's electricity bill. And it's not just a question of money. It would also mean diverting immense national resources of men and material from new houses, schools, motorways, factories and other projects which are urgently needed.

One further point—these very heavy power lines can't be buried in a one-metre trench below the pavement. Many cables are needed, laid side by side in an excavation totalling at least 10 metres in width—as wide as a three-lane highway. There is enormous disturbance to the countryside while the work is being done, and the land is permanently sterilised for any future development because access to the cables must be maintained for any repair work.

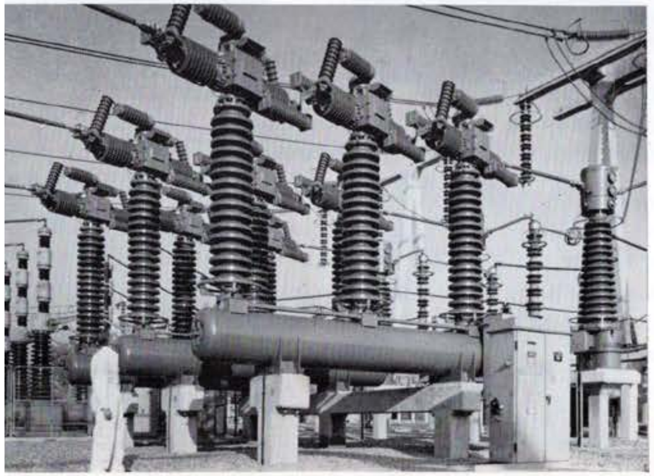
WHAT'S BEHIND YOUR SWITCH ?



. . . A power station of course but a lot of other things are needed to get the power to where you need it.
The generator transformer takes power from the generator at the power station and steps it up to high voltage for transmission over the Grid.

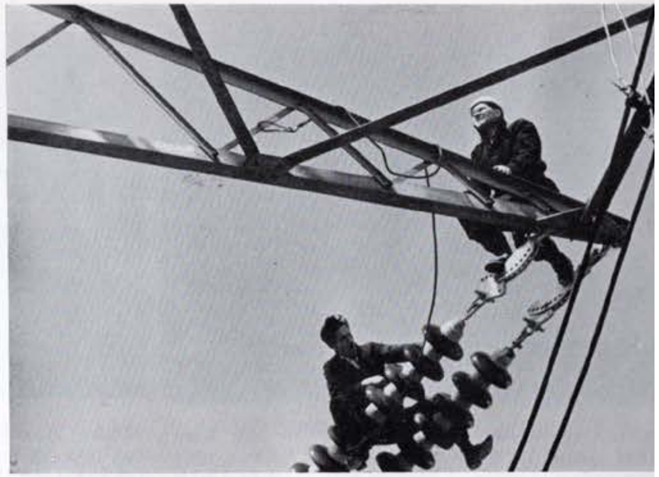


The Supergrid operates at even higher voltages to handle large blocks of power over long distances. This transformer connects the Grid to the Supergrid.

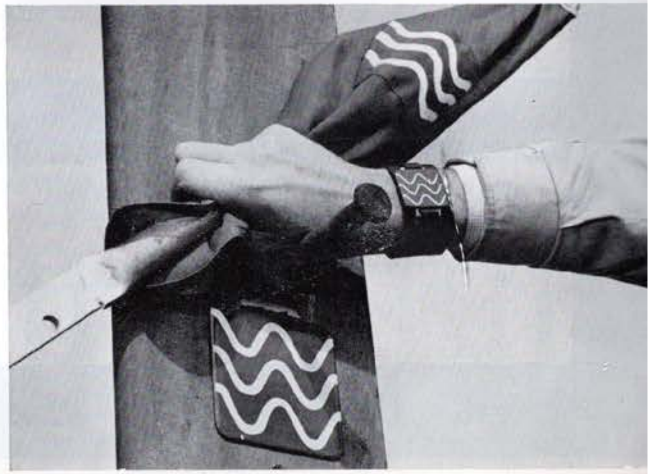


A circuit breaker is simply a big switch. This one operates at 275,000 volts instead of the 240 volts used in your home.

Overhead lines use air as insulation but where they are supported by pylons other insulation must be provided. These circular insulators, made of brown porcelain or toughened glass, can be seen on all equipment associated with the Grid.



At Grid control centres engineers assess the demand and direct the energy flows over the system so that, at every minute of the day and night, the public's demand for power is being met from the cheapest source.



You can't afford mistakes at high voltages. Each circuit has its own identification plate—repeated in the grid control room and out on site and even on the maintenance men's wrists.

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