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Utilisation industrielle et commerciale de l'énergie et des combustibles

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Industrial and Commercial Utilization of Energy and Fuel

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General Introduction

A great deal is known and much has been written about the production of energy. The means whereby it can be transported from one place to another has also been reviewed in considerable detail. Utilization, on the other hand, has received less attention in the technical literature. No doubt this is due to the great variety of applications which the fuels and electricity are called upon to serve. What is pertinent in one case may have little relevance in another. However, we must never lose sight of the fact that it is demand, perhaps even more than supply, which has provided the real dynamic influence for development in the industries in which we serve or with which we are associated.

Utilization, and the factors which affect its growth and efficiency, are the topics dealt with by most of the papers submitted by this Section. The changing requirements of industry and commerce have been outlined by several of the authors. Regional and local considerations have been recognized; so has the qualitative effect of the different sources of fuel and power. Gains in efficiency have been given a prominent place and the changing

techniques whereby energy can be employed in the conversion of crude into semi- or fully manufactured goods have received due consideration. By building on these views and drawing heavily on papers which have previously been published by the World Power Conference we find that we are also able to trace out some of the more obvious relationships between energy consumption and economic growth.

There can be little doubt that a ready supply of energy can itself help to stimulate expansion. Nor are its beneficial effects confined to the primary processing and intermediate stages of manufacturing. Secondary activities, including the trades and services, are also influenced by the quality, price and efficiency with which the various fuels and electricity can be put to work. So much so that some economists regard the usage of energy in any particular country or region as a fairly precise measure of its progress and material well-being.

Whether some such correlation has any validity or not, this much is certain: the energy component of the material stream has been growing relatively as well as absolutely. Most economies, as they have developed, have devoted a smaller proportion of their national income to the purchase of raw material. Energy, however, being required at all stages of production – primary, secondary and tertiary – has moved steadily upward and more or less in line with each industrial community's total output of goods and services.

To put it another way, heat, light and power are in universal demand. Hence, as each stage of fabrication and servicing becomes more elaborate, so will their overall requirements for energy tend to increase. In most countries the demand for energy has been found to mount more rapidly than population. More often than not its use is a cause as well as an effect of greater industrial productivity. Countries whose industrial output is high are therefore found to be among the principal consumers of energy. Meanwhile, those which are comparatively underdeveloped industrially have yet to experience requirements of comparable magnitude.

Effective demand, it can be shown, is a function of many things: of cost, quality, assurance of supply and the ability to execute new developments. Price, the variety and nature of the energy supplied and the requisite capital to ensure its prompt delivery are also relevant considerations. The character and stage of growth of the user industry must be taken into account. So must the changing efficiencies with which this energy is being applied to the various tasks which it is being called upon to perform. Technical information and the requisite skills without which many of these activities are impossible, must also be there. Each of these conditions is therefore helping to modify, in one way or another, the significant relationship which appears to exist between energy consumption, industrial productivity, personal income and national economic growth.

2. Energy as an Item of Cost

Most of the papers which we have reviewed have referred, in one way or another, to the cost of energy and its effect upon a particular industry or group of industries. One of the Canadian authors writes that, "total expenditures on fuel and power as a percentage of Gross National Product, range anywhere from 6% to 12%, depending upon the year and the country

involved". "Industries, also, vary. Direct purchases may be as low as one or as high as fifty percent of the value which they add to their bought-in material. In respect of primary manufacturing, these outlays are usually upwards of 10%. Energy, as a cost item in secondary manufacturing, averages out at around 3% in North America. In the case of thermal power, it may be as high as 60%. Thus a movement either way in the price of energy often has an appreciable effect upon the monies available for the purchase of other goods and services."

It is to be noted, however, that price discrepancies between one part of the world and another are narrowing. Advances on the transportation front have gradually helped to wipe out what was, until comparatively recent times, a very important determinant of industrial location. Certainly the expanded use of oil, with its high B.t.u. content and its more efficient means of movement by tanker and by pipeline has helped to average out geographical differences. Also, like natural gas, it has frequently been found in regions which were formerly regarded as energy deficient. This, together with the steady depletion of resources in the more highly industrialized coal-producing countries, has also helped to loosen the ties which at one time existed between coal and the location of most types of manufacturing and commerce.

There will continue to be exceptions to the rule. The level of energy costs is still a deciding factor in respect of some of the primary and resource-processing industries which use energy most intensively. The occasional one, as the real price of fuel or power continues to go down, will choose to locate close to the market rather than to the principal source of energy. Others, such as the manufacture of pig iron, steel, uranium, aluminum, magnesium, titanium, abrasives, and some of the bulkier electro-chemicals are bound to benefit from such further improvements as are made on the cost side. On balance, and with the prospects of technology adding to the number of materials requiring large amounts of energy in their initial treatment, one would expect the number of these industries to grow rather than diminish. Paper number 143 G/3, which shows that the intensive use of electrical energy is essential in the production of most of the newer, reactive metals makes this point quite forcibly.

3. The Influence of Quality on the Nature and Location of Certain Industries

Another condition of availability – and one which is frequently more important than cost – is that of quality. Coal, even the higher priced varieties, is among the least transportable of our several forms of energy. A number of industries, particularly steel and the other metallurgical types are therefore drawn to a comparatively few regions where the better grades of coking fuel exist. In some ways, natural gas is also unique. It is ideal for the production of ammonia, acetylene, and certain other organic chemicals.

Gas manufactured from coal also can be used advantageously in the production of ceramics, high quality steel and other metals and in food processing where cleanliness and ease of control are paramount considerations. Also, in lending itself more readily to automation than coal or the heavier fuel oils, gas, however produced, can effect savings in direct labour costs and in the amount of plant required per unit of output. The gaseous

fuels are therefore winning out in industries favouring the installation of continuous production lines and processes. Paper 43 G/5 lists numerous cases in which the use of gas has helped to increase the through-put of factories and catering establishments in the United Kingdom.

Oil and water power, because there are alternatives, no longer provide the same drawing power as do coking coal and natural gas. Usually, if the source areas have an advantage it is one of price. Oil can be transported almost anywhere, and it can be stored more economically than any other fuel. Electricity can now be produced by various means. It can also be provided wherever the need is greatest. The only proviso is that the demand be large and consistent enough to require the output of an efficient generating unit. Hence we find that oil refineries, and also stations for the production of thermal electricity, are springing up in the older industrial areas.

In paper 115 G/1 reference has been made to the fact that energy in Belgium is being increasingly utilized in its secondary or more highly manufactured forms. As elsewhere, electricity is taking over from the unprocessed fossil fuels. Crude oil is also being manufactured into a growing variety of products each of which is better suited to particular types of furnaces and engines. More coal is also being converted to the gaseous state. Crude and residual oils are also being gasified. Quality consideration and the fact that in these more manageable forms energy can be used more effectively in lieu of labour have encouraged these developments to take place.

4. Efficiency in Use

One of the main characteristics of energy use has been the increasing efficiency with which it has been put to work. Better equipment is continually being devised with a view to reducing inter-plant losses and making sure that each B.t.u. or kilowatt hour performs a maximum amount of work. Frequently this involves heavy investment in plant and equipment. These facilities, once they are in place, effect savings in energy and in other costs as well. Often salary and wage payments are reduced per unit of output. Existing facilities may also be used more effectively.

There is considerable evidence to support the contention that industry is using its intake of fuel and power more productively. The Canadian Paper 15 G/2 tells us that the output of Canada's mining and manufacturing industries has been growing at least as fast as, if not faster than their purchases of energy. Over the past two decades the average annual rate of growth of energy consumption and manufacturing has been of the order of 5%. During the same interval the gross value of production of all the goods which these manufacturing concerns produced has been rising at a rate closer to 6%.

More concrete evidence has been placed on the record by contributors from Belgium, Japan, the Union of Soviet Socialist Republics and United Kingdom. In Belgium, we are told, in paper 115 G/1 the average efficiency of central electric stations has risen from around 20% to better than 24% and that of oil refineries has gone up from 95% to nearly 97%. The same applies to briquetting plants. Meanwhile facilities converting coal to manufactured gas have improved the use of fuel from a low of 60% in 1950 to around 76% at the present time.

The movement for the efficient use of electricity in Japan, which is

described in paper 9 G/10, tells us what can be done in circumstances when power is in relatively short supply. A chemical plant, for example, reduced its gas requirements by about 20% in the space of less than three years. A shipbuilding company effected a 43% reduction in power demand per ton of output between 1951 and 1956. In the textile industry a number of staple fibre plants conserved about 30% of their power usage and the nylon industry made a 15% reduction in the space of five years. Several primary industries were also studied. Three to eight percent less electricity was used in the manufacture of electrolytic soda, 35% less was used in the electrolytic refining of copper and 19% less power was used in the smelting of every ton of aluminum in Japan in the period between 1951 and 1956.

Paper 112 G/15 deals with improvements in efficiency in the utilization of fuel by the oil industry in the U.S.S.R. Less crude oil, for example, is used in the manufacture of petroleum products. The quantity employed, as a percentage of the total output of all oil refineries in the U.S.S.R., fell from 5.65% in 1950 to 5.25% in 1956. In high temperature cracking plants, the corresponding drop was from 11.32% down to 8.71%. In catalytic cracking units the figure dropped from 36.37% in 1952 to 26.77% in 1956. In pyrolysis plants the saving is reported to be from a 30.53% usage in 1950 to one of 23.80% in 1956.

The manner in which power is supplied to these refineries has changed considerably since the late 1930's. Many of the process steam requirements which were met by medium pressure boiler plants prior to 1941 are now derived in the form of surplus, low-grade steam from central electric power stations located nearby. This, together with the considerable improvement in efficiency which accompanies the use of electric motors rather than mechanical drives in the refineries, are additional features of the post-war period. Other innovations such as the utilization of heat from hot oil products, the return of steam condensates to the central power stations and improvements in the efficiency of the refineries' own furnaces are discussed in some detail by the authors.

Both contributions from the United Kingdom contain examples of fuel savings which have resulted from the introduction of either gas or oil in lieu of coal. Paper 29 G/4 explains that, as a result of oil firing, the output of a number of metallurgical plants has increased by as much as 30%. Furnace maintenance has also been reduced substantially. These results have been brought about by the controllability, high-temperature luminous flame, and the high heat availability of petroleum and its products. Smaller furnaces treating non-ferrous metals have had their capacity increased by as much as 100%, following conversion from coke to oil. The liquid fuels also appear to be preferred in the brick and refractory-making industries as reductions in firing cycles have both increased the capacity of existing plants and have reduced the amount of energy required per unit of output.

5. Energy Requirements by Type of Industry

It will be seen from a perusal of these papers that there is a wide variation in the amount of energy consumed in the different types of industry and in commerce. Primary manufacturing is the most energy intensive group though a few other activities such as the generation of electric power are also heavily dependent upon fuel. Among the primary industries, the

production of bulky, low-cost building materials like cement, industrial materials like abrasives and coke, and the processing of other commodities like the non-ferrous metals, the manufacture of pulp and paper and the production of heavy chemicals and fertilizer also have high input coefficients.

Paper 143 G/3 entitled "Electrical Energy in the Production of Metal", looks to the future in this regard. Because very little power is required for the reduction of gold, silver, the platinum metals and copper, processing plants and refineries for these metals will continue to be built at locations which are substantially unaffected by the price which has to be paid for energy. When it comes to iron, lead, nickel and zinc, coal will probably continue to be the dominant energy factor. The availability of oil and natural gas will also continue to discourage the introduction of electricity into these reduction processes. As for the reactive metals, however, electric power is essential to their separation. Used either directly or indirectly, it may always be required for the manufacture of aluminum, magnesium, uranium, beryllium and others. Plants manufacturing the bulkier of these metals should continue to locate at tidewater locations where hydro-electric energy is available at relatively low cost. Most of the other metals which require electrical energy in their production are more likely to be market-oriented. Chromium, silicon and titanium are still high-priced products, in which the share of total cost attributable to electrical energy is relatively low. These industries, together with those producing the ferro-alloys, zirconium, beryllium, thorium, and the like will therefore tend to locate in and around the principal iron producing centres where industry is already well established and sales contacts are more numerous.

The increased adoption of advanced chemical methods of processing has generally lessened the need for the direct application of fuel and power as such in the chemical industries. Instead it has become more desirable to apply energy in the form of mineral acids or ammonia made from natural gas or oil. These reducing, bleaching or other agents can sometimes be manufactured locally or occasionally supplied in readily transportable form. Hence, developments on the chemical front may well influence the locational pull which a ready supply of primary energy has formerly had on some of these heavy industries. Utilization of the by-product heat content of sulphur and several other lesser known fuels may also accompany developments of this kind.

Conversely, developments in long distance transmission of hydro power may enable the energy of power sites remote from load centres to become competitive in such centres with other sources of energy; at the same time, it becomes economically undesirable to release such energy at the power source at very low prices to chemical or other industries with a low value of output in relation to input of energy. A case in point is described in Paper 145 G/17. It analyses the relative merits of using power from the Aswan Dam in Upper Egypt for the production at Aswan of ammonia for nitrogeneous fertilizers, which has so far been thought the most practical use of this power, as against the case for using the latest transmission techniques to connect the Aswan power stations with the grid in the heavily populated area of Lower Egypt, for general use. It suggests that fertilizers can be made more economically from oil, and particularly from refinery waste gases; that the power can now be economically applied in upper

Egypt; and that therefore no more Aswan power should be allowed to be used for fertilizers than is required to serve the fertilizer plant already committed.

New applications of energy are of course constantly being developed. An example of the substitution of heat from electricity for the heat of the sun in the drying and curing of agricultural crops is described in the Trinidad paper 24 G/13. Refinement and extension of known applications of a specialized nature are exemplified in the Italian paper 78 G/9, which discusses the methods and economics of lighting heavily travelled highways to a level approaching daylight visibility.

6. Processes and Load Balancing Arrangements Developed with a View to Improving National Self-Sufficiency

Several writers have concerned themselves with the energy supply position of their own country. In both Sweden and Japan most of the fuel is imported. Every effort is therefore being made to make maximum use of indigenous hydro-electric resources. In paper 119 G/12 the economic and technical trends in metallurgical steel processes are examined in the light of the particular needs of the Swedish steel industry. It appears, as a result of these researches, that the sponge iron process which uses coke and a source of hydrogen such as natural gas, oil refinery gas, or coke oven gas as its principal reducing agent probably uses less energy than any other method of reducing iron ore. The sponge iron products can also be melted more efficiently in an electric furnace. However, for a large scale production the blast furnace can still compete with a sponge iron furnace even in Sweden. This is because pig iron produced by the blast furnace method can be charged into steel furnaces as liquid metal. Also new oxygen steel processes have been developed during the last few years which can be used to facilitate the conversion of hot metal into steel. One of these oxygen steel methods is referred to in paper 119 G/12 as the Kaldo Oxygen Steel Making Process.

Turning to Japan, paper 8 G/11 describes the manner in which surplus water and off-peak hydro-electric power generating capacity can be converted into storable products such as calcium carbide so as to reduce Japan's dependency upon imported coal and oil. The electro-chemical industry has largely been developed as a result of surplus hydro-electric power. This has been made available by operating a number of plants producing carbides on daily or seasonal off-peak capacity using water which cannot be stored for base-load use. It has been possible to improve greatly the efficiency of use of the water power resources of that country. Similar conclusions are deemed to apply to other electric furnace industries, and to the electrolysis of hydrogen. The following statement also appears in paper 8 G/11, "It is obvious that the carbide industry is an effective tool, not only to regulate power supply throughout the year, but also to adjust general peak loads, monthly, weekly or even daily." A further quotation: "The pumped-storage power station, which is operated in various countries and is being projected for Japan, will be much more costly and less efficient power-wise than a hydrogen electrolysis plant of the same capacity." Consequent economies in thermal generation, and improvements in energy quality such as greater stability of voltage, current and frequency in the power systems have also been mentioned.

7. Changing Patterns of Use

Though there are numerous similarities in the use patterns of different countries, the manner in which they are supplied is, generally, in a state of flux. Industrial and commercial requirements are growing more rapidly than the national average; meanwhile residential and transportation needs are increasing less rapidly. Certainly the Canadian and Indian data seems to confirm this view, Canada representing the case of the fairly advanced industrial economy, and the Indian experience and projections (papers 74 G/7 and 45 G/8) portraying vividly the case of the underdeveloped area launching into programs of more extensive and intensive utilisation of energy. When it comes to the various fuels and water power, however, the picture differs markedly from one country to the next. The only generalization which may safely be applied in this instance is that the liquid fuels and, in some cases, water power are continuing to take over a proportionately larger share of the total energy requirement of the industrial and commercial sectors in countries represented at this Conference.

8. Subjects for Discussion at the Conference

Judging by the papers presented, and the topics which have been summarized above, it would appear that the following could be usefully developed by an exchange of views at the Montreal Sectional Meeting:

a) What effect does the quality of different sources of energy have upon the location of different industries and the manner in which they may reduce their capital and operating costs?

b) The amount of energy required to produce a given result is being reduced in one industry after another. How are these gains being brought about and can they continue? Specific examples may be cited in order to shed further light upon these questions.

c) Which industries use the most energy and which the least? Those which are energy intensive may tend to locate where their fuel and power requirements may be purchased at relatively low unit costs. Will there be a tendency for more of these types of economic activity to move to the source areas? Or, alternatively, is the drawing power of the energy producing areas likely to diminish with time?

d) What are some of the more important process developments which have a significant bearing upon the amount of energy required in some of the more secondary types of production? Authors whose papers have concentrated upon the development of certain types of plant or upon improvements which have been made in existing processes should make a point of entering into this discussion.

Utilisation industrielle et commerciale de l'énergie et des combustibles

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Introduction

On est très renseigné sur la production de l'énergie et la documentation écrite ne manque pas à son sujet. On a également passé minutieusement en revue les moyens permettant de transporter l'énergie d'un endroit à un autre. On a par ailleurs prêté beaucoup moins d'attention au problème de l'utilisation de l'énergie. Cela est dû sans doute à la multiplicité des usages des combustibles et de l'électricité. Des considérations qui pourraient être valables dans un cas pourraient ne pas s'appliquer à un autre cas. Cependant nous ne devons jamais perdre de vue le fait que les besoins en énergie ont stimulé, tout autant si ce n'est plus que la production énergétique, le développement des industries que nous connaissons.

La plupart des études présentées par la section G ont trait à l'utilisation de l'énergie et aux facteurs qui la conditionnent. Plusieurs auteurs ont donné un aperçu de la variation des besoins de l'industrie et du commerce. On a tenu compte des considérations régionales et locales ainsi que de l'effet qualitatif des différents types d'énergie. On a donné une place prépondérante aux progrès réalisés dans le rendement et on s'est penché sur le problème

du changement des techniques permettant à l'énergie d'être employée dans la conversion des matériaux bruts en produits semi finis ou complètement manufacturés. En nous fondant sur les opinions exprimées par les auteurs et en nous reportant à des documents ayant déjà été publiés par la Conférence mondiale de l'Énergie nous nous trouvons en mesure d'établir quelques uns des rapports les plus évidents qui existent entre la consommation énergétique et la croissance économique.

Il est incontestable qu'un bon approvisionnement en énergie peut de lui-même stimuler l'expansion industrielle. L'utilité de cette énergie disponible ne se limite pas d'ailleurs aux traitements primaires ni aux stades intermédiaires de fabrication. Les activités secondaires, lesquelles comprennent les métiers et les services, sont également affectées par la qualité, le prix et l'efficacité des différents types d'énergie. Cela est si vrai que certains économistes se servent de l'usage qui est fait de l'énergie dans une région ou un pays donné pour brosser un tableau assez précis de son progrès et de son bien-être matériel.

Que cette comparaison soit valable ou non une chose est certaine: l'énergie a pris une place de plus en plus importante dans les développements économiques. En se développant économiquement la plupart des pays ont consacré une partie moindre de leur revenu national à l'achat de matières premières. L'énergie, cependant dont on a besoin à tous les stades de la production – primaire, secondaire et tertiaire – est devenue de plus en plus importante et elle a plus ou moins suivi la courbe du rendement total en biens et en services de chaque communauté industrielle.

On pourrait dire aussi que la chaleur, la lumière et l'énergie sont exigées partout. A mesure que les stades de la fabrication et des services deviennent plus élaborés les besoins en énergie tendent à s'accroître. Dans la plupart des pays on a constaté que les besoins en énergie augmentaient plus rapidement que le chiffre de population. Il arrive souvent qu'en employant l'énergie on stimule la productivité industrielle laquelle à son tour augmente les besoins en énergie. Les pays dont le rendement industriel est élevé sont donc les principaux consommateurs d'énergie. Par contre les pays industriellement peu développés sont loin d'avoir des besoins d'une importance comparable.

On peut voir que la consommation dépend d'un grand nombre de facteurs: coût, qualité, disponibilité de l'énergie et possibilités de développements. On peut également considérer le prix, le type et la nature de l'énergie fournie ainsi que le capital nécessaire pour assurer sa livraison rapide. Il faut tenir compte du caractère et du stade de croissance de l'industrie qui en fait usage. Il faut également envisager les différentes conditions dans lesquelles on applique cette énergie aux diverses tâches qu'elle est appelée à accomplir. Il faut également avoir les renseignements techniques nécessaires ainsi que le personnel qualifié sans lesquels une grande partie de ces activités serait impossible. Chacune de ces conditions tend par conséquent à modifier les importantes relations qui semblent exister entre la consommation en énergie, la productivité industrielle, le revenu personnel et la croissance économique nationale.

2. L'énergie comme facteur de coût

La plupart des études que nous avons passées en revue ont fait allusion d'une façon ou d'une autre au coût de l'énergie et à ses effets sur une indus-

trie particulière ou un groupe d'industries. L'un des auteurs canadiens écrit que "les dépenses totales en matière de combustible et d'électricité considérées comme pourcentage du produit national brut vont de 6% à 12% selon l'année et selon le pays considéré". "Les industries varient également. Les achats directs peuvent ne représenter qu'un pour cent ou au contraire s'élever jusqu'à cinquante pour cent de la valeur. En ce qui concerne les fabrications primaires les dépenses sont généralement supérieures à 10%. L'énergie considérée comme facteur de coût dans une fabrication secondaire est en moyenne d'environ 3% en Amérique du Nord. Dans le cas de l'électricité en provenance de centrales thermiques elle peut aller jusqu'à 60%. C'est ainsi que le prix de l'énergie qu'il soit faible ou qu'il soit élevé, peut avoir un effet sensible sur les fonds permettant l'acquisition d'autres produits ou d'autres services."

Il y a lieu de noter cependant que les écarts de prix qu'on décèle dans les différentes parties du monde ont tendance à se réduire. Les progrès accomplis dans le domaine du transport ont permis de supprimer l'élément qui, tout récemment encore, conditionnait l'emplacement des usines. Il est certain qu'en utilisant de plus en plus le pétrole dont le pouvoir calorifique est élevé et qu'il est facile de transporter dans des citernes ou au moyen de pipelines on a facilité la répartition géographique des industries. Par ailleurs on a souvent trouvé du pétrole et du gaz naturel dans des régions qu'on considérait autrefois comme privées de toutes ressources énergetiques. Ces découvertes liées à l'épuisement graduel des ressources houillères dans les pays fortement industrialisés ont également permis le relâchement des liens qui autrefois existaient entre les mines de charbon et l'emplacement de la plupart des centres industriels et commerciaux.

Il y aura toujours des exceptions à la règle. L'importance du coût de l'énergie est encore un facteur primordial en ce qui concerne certaines industries primaires et de traitement des matières premières lesquelles ont besoin de grandes quantités d'énergie. A mesure que le coût réel du combustible ou de l'électricité continuera de diminuer il arrivera exceptionnellement qu'une industrie préfèrera s'installer près de ses débouchés commerciaux plutôt qu'à proximité de sa source principale d'énergie. D'autres industries comme celles de la fabrication de la fonte brute, de l'acier, de l'uranium, de l'aluminium, du magnésium, du titanium, des abrasifs et de quelques-uns des produits électrochimiques les plus volumineux bénéficieront forcément de la réduction éventuelle des dépenses. A tout prendre et eu égard au fait que la technologie permettra d'allonger la liste des matériaux dont le traitement initial exige de grandes quantités d'énergie, on peut s'attendre à ce que le nombre de ces industries aille en augmentant plutôt qu'en diminuant. Le document 143 G/3 fait ressortir ce point en montrant qu'il est essentiel de faire un grand usage de l'énergie électrique dans la production de la plupart des nouveaux métaux réactifs.

3. Influence de la qualité sur la nature et l'emplacement de certaines industries

Une autre condition d'obtention de l'énergie, qui est souvent plus importante que le coût, est celle de la qualité. Le charbon, même lorsqu'il est très coûteux, compte parmi les types d'énergie les moins transportables. Un certain nombre d'industries, particulièrement la sidérurgie et les autres

industries métallurgiques, sont par conséquent concentrées dans les régions où l'on trouve les houilles de bonne qualité. A certains égards le gaz naturel est également hors de pair. Il est idéal pour la production de l'ammoniaque, de l'acétylène et de certains autres produits organiques.

Le gaz fabriqué à partir du coke peut également servir de façon avantageuse dans la fabrication des céramiques, de l'acier de haute qualité, d'autres métaux ainsi que dans la mise en conserve des aliments où la propreté et la facilité du réglage sont d'une importance considérable. Par ailleurs en se prêtant plus facilement à l'automatisation que le charbon ou les huiles lourdes, le gaz, quelque soit la façon dont il est produit peut permettre de réaliser des économies tant en ce qui concerne les dépenses directes de la main-d'œuvre qu'en ce qui concerne l'espace couvert nécessaire pour chaque unité de rendement. Les combustibles gazeux gagnent donc du terrain dans les industries où l'on préfère l'installation de chaînes de production et de procédés continus. Le document 43 G/5 énumère de nombreux cas où l'emploi du gaz a permis d'augmenter la cadence de fabrication des usines et des entreprises de préparation des aliments au Royaume-Uni.

Du fait qu'elle n'est plus seule l'énergie tirée du pétrole et des chutes d'eau n'a plus la même attraction économique que le gaz naturel par exemple. Ordinairement si les régions situées aux abords des sources énergétiques ont un avantage c'est un avantage pécunier. On peut transporter le pétrole presque n'importe où et on peut l'emmagasiner plus économiquement que tout autre combustible. On peut maintenant fabriquer l'électricité de différentes façons. On peut aussi s'en servir pour répondre aux plus grands besoins. La seule condition est qu'il faut que les besoins soient suffisamment soutenus pour absorber le rendement d'une génératrice à grande capacité. On voit maintenant des raffineries de pétrole ainsi que des centrales thermiques de production d'électricité faire leur apparition dans les anciennes zones industrielles.

On indique dans le document 115 G/1 qu'on utilise de plus en plus en Belgique l'énergie ayant subi un traitement secondaire ou même plus travaillée. Comme ailleurs l'électricité remplace les combustibles fossilisés et non préparés. Le pétrole brut est également travaillé afin de donner naissance à un nombre toujours plus grand de produits toujours mieux adaptés aux différents types de calorifères et de moteurs. On transforme de plus en plus le charbon pour lui faire prendre une forme gazeuse. On transforme également en gaz les pétroles bruts et les pétroles résiduels. Ce sont des considérations relatives à la qualité ainsi que le fait que l'énergie peut sous cette forme plus souple être utilisée plus efficacement avec moins de main-d'œuvre, qui ont été à la base des développements actuels.

4. Efficacité d'emploi de l'énergie

Une des principales caractéristiques de l'utilisation de l'énergie a été l'efficacité croissante avec laquelle on s'en est servi. On conçoit sans cesse de meilleurs appareillages pour réduire les pertes qui se produisent d'une installation à l'autre et pour que chaque unité thermique ou chaque kilowatt-heure fournisse une quantité maximum de travail. Cela implique fréquemment de lourds investissements de capital en matière de bâtiments et d'équipement. Cependant lorsque les installations sont en place on réalise des économies d'énergie et on évite d'autres frais. Souvent la somme des