

Economic Development in the Third World and Innovations in Industrial Structure in Industrialized Countries: the Example of West Germany and France

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Introduction

For a long time the Third World has played an unessential role in world trade, and if its part was essential it was limited to the field of raw materials and to the role of buyer of production plants and technologies. The politically grounded sudden increase in oil prices in 1973 and the following explosive developments until the beginning of the 80s changed the directions of international capital flow and the importance of – at least some – Third World countries, but the far-reaching structure of trade exchange stayed the same. Nevertheless it was the petro-dollars which above all led to an immensely increasing demand from the developing countries. Those states with revenues from the processing of oil resources became important trade partners of the industrialized countries (Molitor, 1980, p. 838).

A factual change of the international division of labour was tendentially noticeable when countries like Brazil, Mexico, and India (to give only three examples) came to rank as threshold countries. Those countries producing on low wages engendered strong competition with industrialized countries in the field of less complicated mass products. This turn on the world market effected a change of the industrial structure in the established industrialized countries; the textile industries are impressive examples. But to produce, especially in the case of mass production, also involves a need for machines, technologies, and production plants. The tendential turn in the international division of labour caused by the developments in the Third World introduces a structural change in the industrialized countries as a result of the new conditions of competition: the crisis of the labour – intensive branches with mass production vs. the boom of branches building machines and plants.

This connection between economic development in the Third World and the innovation of the industry structure in the industrialized countries also arose in the context of the increase of oil-prices with a progressively increasing energy need in the Third World. But to unfold the economic effects depends on the development of the structure of energy consumption, the ability to solve the problems resulting from incompatible interests of industrialized and developing countries, and on the markets being available so the industrialized countries.

1. Development of Energy Need in the Third World and Appropriate Technological Concepts

Energy demand is going to triple by the year 2020; at the same time fossil energy sources will increase by 25 % and the non-fossils by about 700 % (Häfele/Sassin, 1977, p. 201; WEC, 1978 a, p. 17; Jansen, 1982, p. 361; Gerwin, 1980, p. 124). By that date, the share of the renewables is expected to be about 10 % (WEC, 1978 b; Jansen, 1982, p. 364), which means 20–25 % of the actual demand. Within these tendencies the Third World plays an important role. Its share will increase from 15 % in 1980 to 40 % in 2020 (WEC, 1978 b, p. 10; Jansen, 1982, p. 365). which means an increase of the actual consumption of about 860 %.

The change of the energy demand structures follows specific developments in the Third World. The industrialization which the »Group of the 77« aims at will lead to a fourfold increase in existing production; the share of the population living in towns will increase from the present level of 30 % to 45 % in the year 2000, and 65 % in the year 2025 (UN World Population Conference, 1974; Häfele/Sassin, 1977, pp. 202–203), meanwhile mainly in the Third World population will increase from the actual 4 billion people, to 7 billions in 2000, and 9 to 10 billions in 2050 (Häfele/Sassin, 1977, p. 201; Gerwin, 1980, p. 38). Within this change the new living conditions will lead to new habits of consumption, giving a further impetus to energy needs (Pindyck, 1977, p. 251). So about 90 % of the Third World energy demand around the years 2020/2030 will be located in densely populated regions. This means that about 50 years hence there will be an enormous demand for large-scale energy technologies (above all: solar technologies), but at the moment and for the next 25 or 30 years the demand is concentrated on small-scale concepts, appropriate to the decentralized demand structure.

This situation implies a conflict between developing and industrialized countries. The example of biogas plants reveals a competence in the development of small-scale technologies in India, the People's Republic of China, and the Republic of Korea (Weimert et al., 1981, p. 238). A decentralized energy supply, an increase of crops, an intensification of farming and the use of machines is rendered possible and this also helps to lessen the migration processes (Weimert et al., 1981, p. 239; Guldager, 1979, p. 268; Rady, 1979, pp. 586–587; Teufel, 1976, p. 78). Possitive effects are also to be reached by solar technologies in the case of desalting sea-water, building pumping stations and stopping the erosion of the soil (Dequin, 1979, pp. 441–443; Rady, 1979, p. 555; Weimert et al., 1981, pp. 30–31; Nations Unies, 1983, p. 7). But to intensify these effects, there is a immense need of technological research on materials, efficiency, design, and size that cannot be done by the developing countries (Guldager, 1979, p. 631; Sharma, 1979, p. 155; Kohli, 1979, p. 95; Hayes, 1979, p. 237). So the infrastructural effects in the Third World as they are generated by solar technologies for irrigation and cooling plants (Hoez, 1978, p. 89) depend on R&D in industrialized countries and on the conditions of technology transfer.

2. Interest of Industrialized Countries in the Production of Energy-Technologies

The interest of industrialized countries in development and production of energy technologies lies in the possible economic effects. Therefore, they concentrate their activities on the development of solar-technologies. The German solar industry expects a market about 2.7 billion US-Dollars for German solar technologies in the year 2000 (BSE, 1982, p. 6). For the time after, a fast expansion of this market is expected, because the share of solar energy in total energy consumption will increase progressively and the need for energy within the Third World will increase constantly. Meanwhile, the need for large-scale technologies expands. Therefore, the production of energy technologies offers an opportunity to the industrialized countries to participate in a market which is in constant expansion.

Thereby the interests of industrialized countries are inconsistent with those of the developing countries. Whereas the developing countries are highly interested in technologies that are adequate to decentralized supply structures, those small-scale technologies are outside the interests of industrialized countries; most of all, they are interested in the production of large-scale-plants. Within the field of small-scale solar technologies that are easy to produce and on a low technological level they would very soon have to expect the competition of the threshold countries which are producing on low wages. In contrast large-scale technologies offer the advantage that the production presupposes an intensive technological know-how and R&D and adequately qualified manpower. For this reason West Germany concentrates its activities on the solar-tower concept and less intensively on the less complicated solar-farm concept and on the development of solar-cell technology.

The commitment in France is very similar; but the concentration on the solar-tower and the solar-cell is not as strong, whereas there are remarkable activities concerned with the development of solar-pumps up to a power of 100 kW. This is a reflection of the special French situation with the possession of the Franc-Zone as a »chasse gardée«. These countries are dependent on French technologies and are unable to develop and to produce competitive products. In contrast West Germany aims at the specialization on the complicated parts of those technologies and the transfer of the production parts that are at a low technological level.

In this way, the industrialized countries are able to avoid competition with advanced developing countries in this field for a longer time. Within this context conflicting interests with the developing countries arise rather by accident. The industrialized countries are concentrating on the promotion of the national technological concepts and enterprises. The interests of the developing countries are considered insofar as they coincide with the profit interests of the national firms. Because of the dominance of the industrialized countries and the technological dependence of the Third World the question whether technologies are developed and on which concepts they concentrate is a decision taken by the technology producers. The prospective need of large-scale solar technologies and the existing relations of technological dependence allow them to concentrate on

the profitable parts of the solar market; it is only the competition among them that demands a variation of these strategies.

The situation in the market and in the context of the development and production of technologies for the utilization of renewable energies allows very independent decision-making in industrialized countries. The orientation of production as well as the adjustment to the competition of countries producing on a low-wage level can be done in accordance with national conditions and possibilities. So the organization of the national solar-industries follows the general need of the Third World, but it fulfills only the part which is of economic relevance to itself. The interests of the developing countries are included insofar they coincide with those of the industrialized countries or their satisfaction acquires economic relevance. Insofar the innovation of the industry structure by building up export oriented solar industries follows the developments in the Third World, but the link with existing need is only very general. Which of the existing needs will be satisfied is a question for consideration – that means a question of the examination of the profitability by the firms. In this way the importance of the Third World as a trade partner for the industrialized countries increases, but there is only little change in the existing conditions of dependence. In the case of innovative technologies the industrialized countries are in a position that allows them to pursue their own interest in relation to the Third World.

3. Developing Countries Between their Role as a Part of the World Market and a Part of an Influence-Zone

Because of their climate, the countries of the Third World are forming the market for the solar industries of the industrialized countries. As these countries do not possess efficient research structures, institutes for technology development and technology adjustment, and enterprises, they are dependent on cooperation with industrialized countries. In this way, possibilities for the preparation of technology exports and the opening of markets are set up for the industrialized countries.*

Scientific cooperation among industrialized and developing countries prepares the transfer of technology into the Third World (Rouvé, 1979, p. 56; Nüsser, 1979, pp. 81–87), and the opening of markets, and leads to technological dependence of the developing countries (Thomas, 1979, p. 1404). These exports of technologies follow on the preparation by education and trainee programmes and presuppose it (Menck, 1979, p. 1019; Nüsser, 1979, p. 86; Warnecke, 1979, p. 70). Cooperation in the field of scientific research (FRG, 1981, p. 20 and pp. 40–41; DSE, 1979, p. 39) and R&D (Kürsten, 1979), p. 164; AGF, 1979, p. 180) are based on the opening and reservation of markets. Which forms these relations take, depends extensively on the situation of the developing

* Scientific education and the assimilation of research strategies and concepts of problem solving are important if a choice has to be made among alternative technologies the solar industries of industrialized countries offer.

countries. If they are able to decide autonomously and if they do form a part of the world market for solar technologies, they are able to give another form to their relations with the industrialized countries than those countries which are parts of an zone of influence. The countries of the Franc-Zone are included in a French zone influence where French dominance is not only assured by contracts but also manifests itself economically. 40 % of the exports of these countries are sent to France and 40 % of the imports also come from there (Boyd, 1982, p. 47; Hull, 1979, p. 223; Schwarzbeck, 1981, p. 3). This dominance of France in its relations with the Franc-Zone; the monetary links and the constant French surplus in trade unions reduces the sovereignty of these countries, especially with regard to their financial autonomy. No economic and social development can be realized without cooperation with France (Boyd, 1982, p. 46). As a »chasse gardée« of France, the Franc-Zone is dependent on French technologies and in this context it functions as a testing ground (Schwarzbeck, 1981, pp. 3–4). Their own needs are regarded only insofar as those are economically relevant to French industry. The interests of the countries of the Franc-Zone are dependent on their inclusion in the programme »Sahel Energie Nouvelle«. Within this context the specific needs of the Sahel countries are to be ascertained and transformed into solar research and technology development (Desprairies, 1980, p. 22). France however develops the technologies because of its interests in the construction of a national solar industry and its interests in the concrete technologies are determined by this aim. The activities of TRANSENERG, which stands under the supervision of the French Ministry of Industry is to be seen in this context. This combination of French nationalized enterprises and research organizations has to analyse the present and future energy reserves, to prepare the programme on development and planning of all forms of energy technologies, to find out the financial framework for the realization of these aims, and to educate qualified personnel (ibid.). Within this context, France does not plan any scientific technological and only little industrial cooperation. The participation of the countries of the Franc-Zone is mostly limited to the pure consumption of French solar technology; its dependence on the French economy and the slight contact with the world market blocks the possibility of using alternative offers of other industrialized countries. Therefore, the use of solar technologies to solve energy problems in the Franc-Zone is limited to concepts that are of economic relevance to the French solar industry.

Completely different are the opportunity open to those countries which decide autonomously and in a sovereign fashion and in this way do form a part of the world market. These Third World countries are able to choose among competitive offers of the industrialized countries, and they have the possibility of using the scientific, technological, and industrial cooperation completely for their national development – especially if those countries like India, Brazil, and Mexico are relatively industrialized and do possess a large market for solar technologies. This chance is open especially when – as in the case of West Germany solar technologies – neither an domestic market nor an export one (as in the case of the Franc-Zone) is reserved. It is the autonomy of decision-making on the import of solar technologies and the size of the market (e.g. the energy supply of the villages in India

offers a potential market for solar cells of about 150 million m₂; BSE 1982, p. 11) that increases the importance of Third World countries for the industrialized countries. Cooperation gives a chance to the consumer countries to participate in the economic effects of the supply of energy technologies. It is characteristic that countries which are parts of the world market because of their autonomy on import decisions and which form considerable parts of it because of the size of their needs, agree on cooperation with West Germany. Important examples are the cooperation arranged in the field of the so called villages with Egypt, the People's Republic of China, Indonesia and Mexico (FRG, 1981, p. 30). In this way, the production and provision of complicated elements is the task of German enterprises, the more simple production and the erection of buildings is done by the Third World partners (Simonis/Häusler, 1981, p. 351). Also India was successful in introducing cooperation with West Germany. In this case the collaboration of Bharat Heavy Electricals (BHEL) and the German MBB that started in the context of nuclear energy (Sid Ahmet, 1980, p. 35) is being continued. Near Madras there is an experimental plant of 10 kW-power which has been erected for the development of a proto-type for decentralized energy supply and is adequate to satisfy village needs (Kleinhans/Scharmer, 1983, pp. 18–19). Within this area of cooperation BHEL will produce the receivers for solar radiation and the mechanical apparatus will be provided by MBB (op.cit., 1983, p. 19; AGF, 1979, p. 81). This collaboration opens to India a participation in the considerable economic effects by supplying the Indian villages; where about 400 million people, which is more than the half of the Indian population, lives.

The situation of Third World countries in regard to supply adequate to the demand for energy technologies (especially: solar technologies) and the intensive participation in the economic effects depends on the autonomy of their decisions. As the example of the Franc-Zone has shown, the traditional international division of labour among developing and industrialized countries is reproduced, if the developing countries are part of an influence-zone; and the French neo-colonial policy reduces the consumer countries' participation in development and production of solar technologies – if there is any – to a minimum. The satisfaction of the demand for technology almost exclusively depends on the economic interests of France. On the other hand, those Third World countries which are forming the world market for solar technologies are able to enforce scientific, technological, and industrial cooperation and in this way satisfy their own demand for technologies.

The different situations of Third World countries are leading to different conditions for industrialized countries in the context of solar technologies. While France need not expect any competition in the Franc-Zone and possesses a market for its solar technologies, West Germany has to open its market through cooperation. At first sight West Germany is in this way confronted with the lack of a division of labour with the consumer countries, while France is able to sell complete technologies. But, on the one hand this leads to a concentration on the production of complicated technological elements in West Germany, while France is also producing the less profitable elements.

So the effects on the necessity of technological innovation that exist in relation to West Germany are as little in evidence in the French situation as is the promotion and coupling of the German solar technologies with the economic development of the cooperation partners.

4. Innovation in the Industrial Structure in West Germany and France

Different forms are connecting West Germany and France with the regions where considerable need for solar technologies exists. The reservation of markets by French neo-colonial policies in the Franc-Zone is confronted by the German cooperation with economically fast developing threshold countries which form an enormous market for solar technologies.

These different orientations of the two industrialized countries and the need for technology of the export markets are not without consequences for technological development in West Germany and France. Additionally, there are differences in the extent of the need for technology and the tendencies in development of the markets opened up for solar technologies. The innovations in the industrial structures do adjust to these specialities; on the other hand national specialities and their importance for the relations to the Third World are leading to a reinforcement of the differences among West Germany and France.

4.1. The French Concept: Organization of Branch and Export Market by State Policy

The connection of innovations in French industrial structure with the developments in the Franc-Zone is characterized by three constellations: the dominance of the French economy in the Franc-Zone, the dominance of the French state over the national economy, and the political dominance of France over her former colonies. So the French state represents the central instance of mediation between the new technology supply structures and national innovations in the structure of industry.

Although there is a tradition in solar research of more than 25 years (Rodot et al., 1980, p. 226) France was confronted with the problem that there have been neither onsets of a national solar industry nor tendencies for innovation in the industrial structure. By state policies and by state introduced cooperation in the field of industrial R&D an attempt was made to form a homogeneous solar industry adequate to meet the need of the 21 nationalized enterprises from six different branches (Cavard/Criqui, 1979, pp. 356–359). Special state organizations have been founded to compensate for the lack of this new branch and the lack of research in the national industry. In 1974 the COMES (Commissariat des Energies Solaires) was founded, which was replaced by the A.F.M.E. founded in 1982 (Agence Française pour la Maîtrise de l'Energie) that tried to reorganize French solar research. In spite of this change the duties remained the same; these organizations had to manage R&D-programs, to prepare the methods of use of

the energy technologies, to offer assistance to potential users in choosing appropriate technologies and to continue international cooperation (A.F.M.E., 1982, p. 5). In this way A.F.M.E. has an political aim for the industry and includes much more than the promotion of research on the industry which was done by the COMES (Desprairies, 1980, p. 67; Descours-Desacres, 1980, p. 33). Moreover to improve export chances the A.F.M.E. promotes the early presentation of French energy technologies and materials (A.F.M.E., 1982, p. 9).

The main contribution to innovation in the industrial structure according to the new needs is done in the framework of the C.N.R.S. There 500 engineers are working on the field of solar research, which is the half of all scientists engaged in France in this area (Rodot et al., 1980, p. 248). The C.N.R.S. carries out the PIRDES (Programme Industriel de la Recherche et du Développement) which is intended to achieve a strong organization of industrial research. Besides, it is cooperating with the nationalized French enterprise E.D.F. to plan and build solar thermal technologies (Hoez, 1978, p. 90). Out of this collaboration results the demand for an market oriented structure in the field of solar thermal research; the C.N.R.S. plays an important part in the CETHEL-group, which followed from this demand by state organization as a centre for the development of the French solar industry.

The orientation of the French solar industry on the Franc-Zone is a consequence of the French policy. During the Decolonization and the period in which the young African states won their independence France introduced a new form of connection based on contracts of cooperation (Adamelobun, 1978, pp. 34–38). In this way the French state was able to continue the existing dependence and to reserve the market of the Franc-Zone to the dominant French economy. So in France not only the organization of the branch is achieved by state policy but also the organization of the market. This centering on the state and its orientation on the former colonies has an effect on the circumstances of innovation in the industrial structure and as a result the French solar industry reveals a R&D-orientation on technologies which are needed in the countries of the Franc-Zone.

The French program »Sahel Energie Nouvelle« takes the combination of market and innovation into account. Here the aims are regional research and adjustment of the technologies to the need of the Sahel countries, demonstration of the working characteristics of the technologies in the use of renewable energies and the offer of these concepts for the rural development in the Sahel countries (Desprairies, 1980, p. 22). The main point of the Sahel program is the promotion of solar technologies. On the basis of solar thermal processes 123 pumps, irrigation- and electrification-stations have been erected, which are normally limited on the kW-scale; on the basis of solar cells 15 such stations have been built up (ibid., pp. 22–23). In addition to the Sahel program there is cooperation with countries from the extended Franc-Zone (ibid., p. 23).

Supplementary to these activities the institution TRANSENERG was established by the Ministry for Cooperation (ibid., p. 21). Its task is the solving of concrete problems in developing countries. It is interesting that it is exclusively formed out of nationalized enterprises and state institutions which have to analyse the actual and future energy

resources, to prepare programs for the development and planning of all types of energy, to calculate the financial needs for the realization of these aims, and to educate qualified personnel (*ibid.*, p. 22). In this way a situation is presented in which a reserved and dependent market for French solar technologies exists, the nationalized enterprises and state institutes are analyzing the needs, and the state creates programs to build up a solar industry that is – at least for the near future – oriented on this zone. Because of the dependence of the Franc-Zone, which leads to the concentration on French technologies, the solar program is consequently oriented on technologies that are important for the French solar industry. Cooperation with developing countries is relatively rare and limited to the field of industrial collaboration but there is no endeavour to cooperate with consumers in the field of R&D.

Within the scope of solar technologies French policies do aim at the substitution of traditional sources of energy; an expansion of the demand and of the need of technology by assisting the regional development processes is not included in these activities. Because of the limitation to substitution there is a lack of a dynamic expanding need for technology, and the orientation on the Franc-Zone with its need for middle- and small-scale solar technologies (like pumps and irrigation stations and electric power generators) forms a narrow setting for the solar industry. The extraordinary importance of the French state for the French economy and of the Franc-Zone are leading to innovations in industrial structure introduced by the Third World need for solar technology, but the effects are limited by the demand structures in the countries of the Franc-Zone, which are concentrated on the less attractive solar technologies in the lower and middle scale of power generation. But because of the cooperation of industrialized countries like West Germany with advanced and threshold countries it is to be expected that these countries producing on low wages will come into competitive positions in the less complicated areas. So the limitation of the French solar industry to the market of the Franc-Zone will continue at least in the case of these technologies.

In France the technological and industrial innovation in the domain of solar industry is done in the context of a protected market with structures that are essentially different from the world market. The resulting policies for the development of solar industry contain structural problems; on the one hand the research and production capacity of France is blocked by technologies of little economic relevance, on the other hand the innovations in the French industrial structure is carried out substantially outside the world market for solar industries. This is the case in regard to the supply of technologies as well as the conditions of production and development. Because of the orientation on the protected market of the Franc-Zone competition is of little importance and the all-embracing dominance of the state leads to a development of the solar industry that depends on the inner and the outer state policy (Papon, 1975, pp. 240-242; Cavard/Criqui, 1979, p. 356) and on the resultant economic planning (Papon, 1973, p. 232; Papon, 1979, p. 394).

The importance of the developments in the Franc-Zone for the innovations in the French industrial structure is clearly reproduced in the French policies for the setting-up of the

national solar industry. The solar technologies as well as the form of the relation to the market of the Franc-Zone both reflect the neo-colonial structures of this relations. But more than anything they point to the close economic and technological limits, which are arising for industrialized countries like France, if they do not develop potentials in the consumer countries, and if the lack of cooperation hinders the dynamic development of the need for large-scale technologies.

4.2. The German Concept: Promotion of the Technological Development and of Demand in the Third World

The German industry's orientation on the world market, and the policies of the German state, and the open market for solar technologies of economic relevance are leading to an intensive relationship between the developments in the Third World and the innovations in German industrial structure. The central elements connecting the development of demand with the technological and industrial innovation are the competitiveness of German high-technology enterprises and their established positions in the world market. Policies of the German state are building on these favourable constellations for industrial policies and are promoting the tendencies favourable for the future.

Hereby it is essential that policies on the solar domain can utilize an established industrial structure and a limited number of participating enterprises, which are engaged in solar research themselves. In the market of photovoltaics the firms Siemens and AEG, which have a long-standing experience in producing solar cells for the American NASA space expeditions, are active. The silicon production for these technologies is exclusively done by Wacker. In the domain of solar thermal technologies there was an early involvement of MAN and MBB; it is only Dornier that is participating in R&D. These enterprises have been guided exclusively by the profitability and the diversification of their activities by innovative technologies in an attractive market. So the state is in the position to limit its activities to the promotion of innovative technologies and of the adequate firm activities.

The »Programm Energieforschung und Energietechnologien« (Program on the promoting of energy research and energy technologies), which started in 1974 and has in the meantime been continued, promotes the structures of the industrial innovation and of the adjustment to the technological needs of the countries that are forming the world market. Thus of the financial means given to private enterprises, a share of 74 % is given to AEG and a share of 13 % to Siemens. Likewise, in the domain of the solar thermal technologies, the relation between the innovation of the industrial structure and the developments in the Third World is promoted. Here the deeply involved firms MAN and MBB are getting 39 % and 24,5 % respectively and Dornier has a share of 18,5 % of the financial means given to private firms. The promotion of these firms particularly committed to innovations is also a support of the development of technologies for the Third World and a support of a branch oriented on this region.

Simultaneously the German state comes to agreements on cooperation with consumer

countries. The scientific and technological cooperation forms an essential precondition for the technological and industrial innovation by setting-up a national solar industry. It is the increasing energy need and the present shortage of natural and non-renewable sources of energy in the developing countries and the rapidly industrializing Third World countries which leads the German government to expect a large potential market for energy technologies (BMFT, 1979, p. 433; BMFT, 1979a, p. 143). In this context the government is trying to open up these »interesting export opportunities for the German economy« (BMFT, 1979b, p. 15). By that »in practical all cases the expensive production of solar energy systems depends on the opening up of large and substantial markets, capable of leading to high production capacities« (BMFT, 1979b, p. 79). In this way the German state tries to integrate the consumption of the Third World into its policies for the development of solar industry and to initiate technological and industrial innovation. Existing intensive economic interlacings with the industrializing developing countries and the established positions in the world market of enterprises of the solar industry (Siemens, AEG, MBB, MAN) do render possible the introduction of state policies that are able to open up the markets necessary for the development of the solar industry.

Especially the interlacings with industrializing developing countries contain potentialities for a dynamic expansion of trade. The economic relations with India, Egypt, Mexico, Brazil, Argentine, and Indonesia include the important parts of the world market for solar technologies. There the applicability of solar technology is possible and because of the intensive processes of industrialization, increase of population, and urbanization constellations are created which lead to a progressively increasing demand for large-scale technologies to supply the urban regions of high energy demand densities. For the near future above all the German government expects a considerable demand for the solar-tower technology (BMFT, 1979b, p. 61).

This future demand for large-scale solar technologies is confronted with an actual demand for small-scale technologies adequate to the existing decentral supply situation. Because the consumer countries cannot develop and produce the technologies appropriate to these needs, they are interested in the transfer of suitable technologies and the assistance of industrialized countries in setting up national productive capacities for less complicated small-scale energy technologies. These interests of the industrializing Third World countries are met by the policy of the German state and its offer of bilateral scientific and technological cooperation. The cooperation with countries which have large markets but scarcely efficient scientific potential is integrated in the strategies of the German government to open several national markets to risky large-scale technologies (BMFT, 1979 c, p. 72; BMFT, 1979a, p. 144) and substitutes not only for the lack of an internal market but reserves also early in time large parts of future markets for the German solar industry.

In the domain of solar research West Germany signed contracts for scientific and technological cooperation with Egypt, India, Mexico, Brazil, Argentine, and Indonesia – to speak only of the countries with large markets. In these cases cooperation continues

the existing relations and develops them in the domain of the solar technologies. Above all the cooperation is appropriate by designed to assist the developing processes in the developing countries and this way to lead to an expansion of the demand for large-scale solar technologies to meet the needs of the increasing industrialization and urbanization. So the scientific and technological cooperation not only opens new markets for the German solar industry, but the division of labour involved leads to interlacing of the consumer market and the German solar industry. Therefore policies for the opening of markets are leading to a connection of the solar industry with the dynamic processes in the industrializing developing countries – the growth of the solar industry is decisively promoted by state activities.

Industrial division of labour among West Germany and threshold countries and scientific and technological cooperation are leading to innovations in the West German industrial structure, which are characterized by a concentration on complicate solar technologies like solar cells and large-scale solar technologies. In this way West Germany is successfully utilizing the developments of the industrializing developing countries and their increasing competition in the production of traditional mass products by meeting the resultant growing energy need with the development of an innovative solar industry; so the competition with countries producing on the basis of low wages can be partially countered by innovation in the industrial structure. This organization of the production of solar technologies additionally promotes the developments in the consumer country and is reproduced as an increasing demand for large-scale solar technologies. So the German concept has no fixed limitation of the innovation, but is linked with the dynamic development of the world market and the market already opened up. Here the developments in the Third World lead to innovations in the West German industrial structure that protects and enlarges its technological advantage, but on the other hand they also lead to the assistance of the developments of the consumer countries advancing to industrial partners – although on different levels.

5. Result: The Connection between Innovations in the Industrial Structure and the Structure of the Relations to the Third World

Changes in the energy price level and in the structure of the energy needs are creating a new market for energy technologies. As a result in the Third World a great demand for solar technologies is created, Developed and efficient R & D and production structures are necessary to satisfy these needs. These developments in the Third World provide opportunities for the setting-up of advanced national solar industries, they opportunities for technological and industrial innovation.

Between the structure of the consumer needs and the development and production of solar technologies a connection is established. State policies contribute to this development. The national policies for the promotion of technological development differ as a

result of the French orientation on the reserved markets in the Franc-Zone and the German orientation on countries that are parts of the world market. This proves that the neo-colonial policies of France are hindering the unfolding of the dynamic development of the market for solar technologies in the Franc-Zone. The technological innovation and the extension of the technological need is limited by the reservation of the market in the influence-zone and the special technology demand structure of the countries mainly depending on the Sahel-Zone; above all there is little demand for large-scale technologies. But more than these connections the orientation of the French solar industry on the reserved market is important for the reduction of the competitive power in international competition. As the market of the Frank-Zone in any cases is available to the French solar industry there is no need of offers for cooperation and for technology transfer that assists the consumer countries in solving their problems but are without any economic relevance to the industrialized countries. Interests of the developing countries are included insofar as they coincide with those of France. The consequence is that there are no impulses that would promote the developments in the Third World countries and the need of solar technologies and therefore would expand the innovations in France.

Because of the different structures of the relations to the Third World countries in West Germany the innovations in the industrial structure have a completely different form. The scientific, technological, and industrial cooperation between West Germany and the consumer countries in the Third World is appropriate to satisfy the needs for small-scale technological solution. In this way, with German assistance, the developing countries are in the position to produce by themselves the less complicated technologies appropriate to supply decentral needs which are economically irrelevant to West Germany. Moreover, the cooperation provides opportunities for the threshold countries to participate in the production of solar technologies in respect of the less complicated and less profitable parts that are of economic importance to the consumer countries.

This cooperation permits the West German solar industry to concentrate on R & D and on the production of large-scale technology and of complicated technological elements. The division of labour and the promotion of developments in the developing countries expands the need for advanced solar technologies, so that the market position of the German solar industry expands with the expansion of the market of solar industries. The form of the opening of markets requires special forms in the innovations in the industrial structure and assumes the assistance of attractive offers to the consumer countries and the competitive power of the technologies. With the orientation on the world market for solar technologies it is essential to take the interests of the consumer countries into consideration, and the resultant cooperation and division of labour interweaves the interests of West Germany with those of the developing countries. The contribution to the development of the partner countries in the Third World which this involves is linked to the innovations in the industrial structure of West Germany. Besides the concentration of the German solar industry on complicated large-scale solar technologies and on complicated technological parts provides opportunities for the specialization on the profitable parts of the solar market and leads to a connection of the developments in the

Third World with the resultant dynamic expansion of technological and industrial innovation in West Germany.

In France as well as in West Germany there is a relation between innovation in the industrial structure and the need of solar technology in the Third World. However the policies are leading to different forms. The neo-colonial relations of France with the Franc-Zone are aiming at the substitution of traditional energy sources and through a concentration of the effects on the French industry they are leading to a development that could be called a substitutive innovation, which lacks the dynamics of a progressive and constant growth of the solar industry. The success of the German orientation on the world market depends on the opening of markets to the solar industry by attractive offers, which take account of the interests of the consumer countries and their economic development. With this cooperation West Germany realizes a systematic connection of the German solar industry with the large markets for solar technologies in the Third World. The consequent effects on the industrial structure lead to a development that can be called a dynamic innovation, which is favours a progressive and constant growth of the solar industry. Finally there are not only connections between the developments in the Third World and the innovations in the industrial structure in the industrialized countries but the way they have their effect – substitutive vs. dynamic – depends essentially on the relations the industrialized countries establish with the consumer countries.

Abbreviations

A.F.M.E.	=	Agence Française pour la Maîtrise de l'Energie
BSE	=	Bundesverband Solarenergie e. V.
C.N.R.S.	=	Centre National de la Recherche Scientifique
EDF	=	Electricité de France
PIRDES	=	Programme Industriel de la Recherche et du Développement sur l'Energie Solaire

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is uncommonly complex. In a word it is unwieldy. It is argued that such presentation is likely to have adverse impact on comprehensiveness. No solution is suggested for the second situation; on the contrary a challenge is thrown to local legal draftsmen to provide a remedy. Having shown that comprehensiveness means more than adequacy, the author expresses the hope that legal draftsmen will turn out laws that are both adequate and wieldy.

Economic Development in the Third World and Innovations in Industrial Structure in Industrialized Countries: the Example of West Germany and France

By *Ulrich Hilpert*

Because of the increases of oil prices new energy technologies are encountering promising market conditions. The regions where these new technological concepts are suitable are mainly situated in the Third World; its climatic conditions, the dramatic increase of future energy needs and the social development to be faced in the near future will accentuate the need and expand the world market for solar technologies steadily. Industrialized countries are interested in participating in this new market and are setting up national solar industries. These innovations of the industrial structure are interwoven with the developments in the Third World. Which form they take depends on government policies and on the relations with the countries purchasing this technology.

The French neo-colonial policy within the Franc-Zone leads to a substitutive modernisation of French industry as the effects are limited to the traditional energy sources that are to be substituted; whereas the cooperation of West Germany with threshold countries leads to a dynamic substitution, the promotion of the processes for development in the buyer countries leading to a progressive increase of demand and to a sustained dynamism to expand the innovation of the industrial structure.