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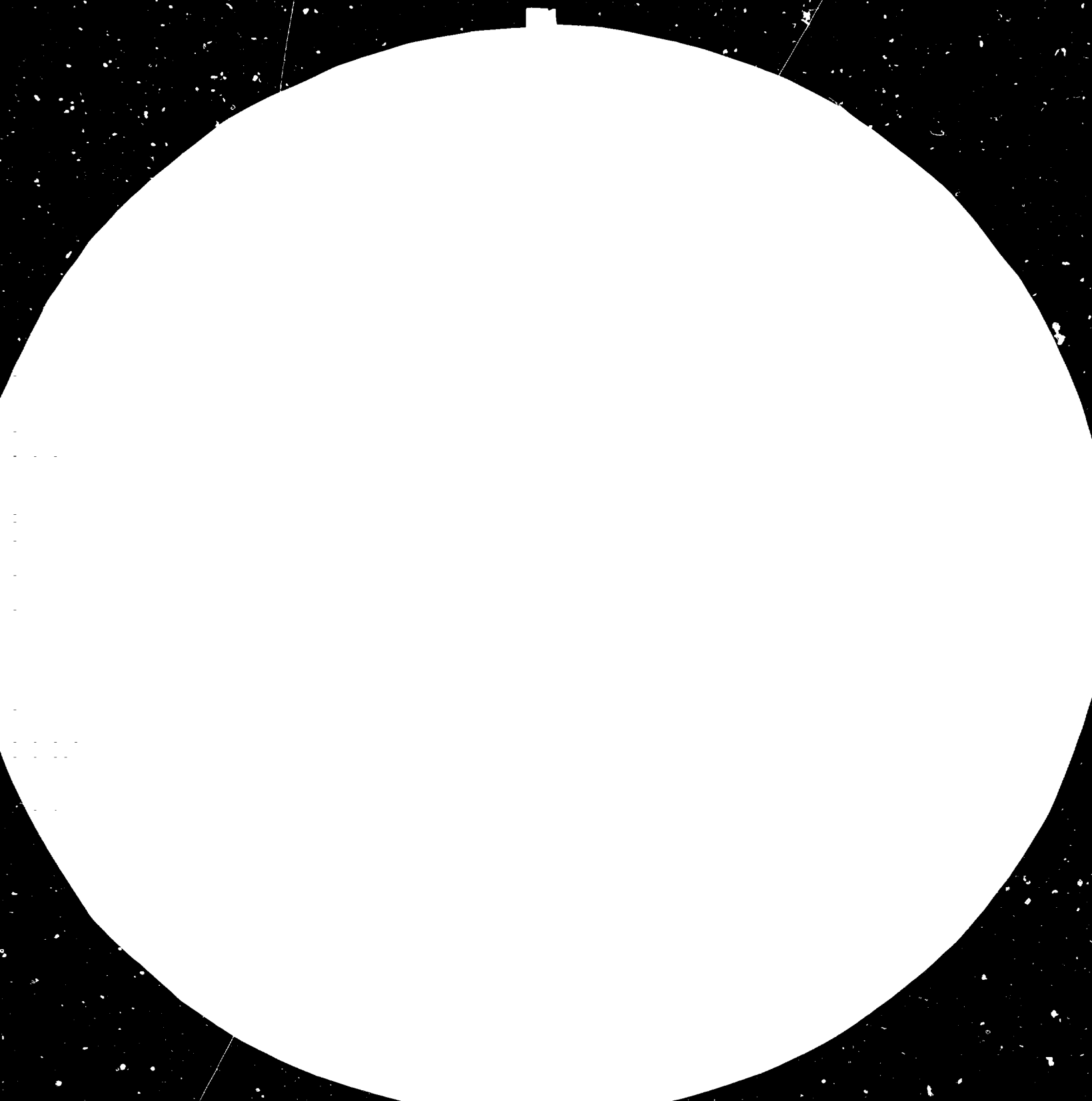

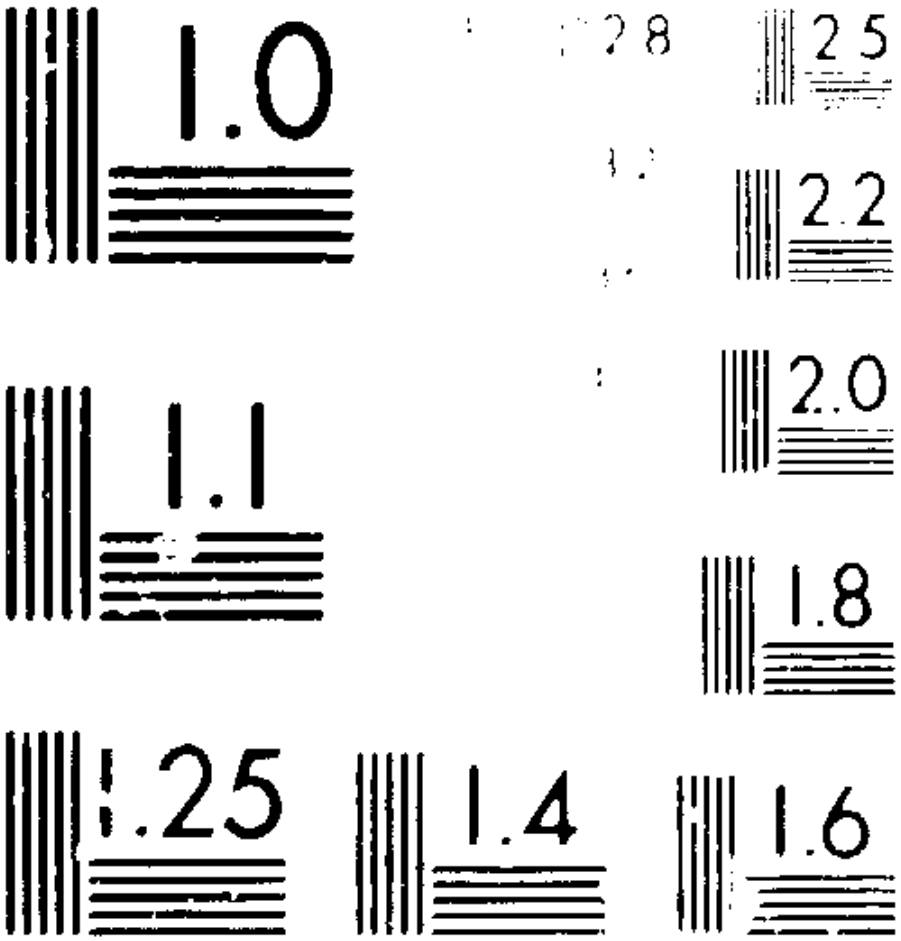

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PROMOTION OF LOCAL INITIATIVES IN SMALL HYDRO POWER DEVELOPMENT in The Socialist Federal Republic of Yugoslavia*

by

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Introduction

Electricity is one of the principal forms in which energy is used. While the level of electricity consumption in developing countries is still very low, the annual rate of growth of these countries' electricity consumption in the 1970-1979 period was 9.2 per cent or nearly double the respective rate of the developed market economy countries (4.6 per cent).

The expansion of electricity supply capacity, however, poses several problems for developing countries. First of all, the financial requirements for the investment are considerable, claiming 7 - 8 per cent of these countries' total investment resources. Second, the development of domestic technological and industrial capacity for supplying power equipment and related services is very limited. The resulting dependence of developing countries on foreign sources of equipment and services makes the foreign exchange component of electric power development projects comparatively large. Third, the market for heavy electrical equipment is controlled by a relatively small number of large companies from industrialized countries. Fourth, the expansion of electricity supply capacity in developing countries is taking place in a period of considerable uncertainty as regards the appropriate fuel mix and thus also as regards the choice of the most suitable equipment. Further, the relative share of hydro-electric capacity in developing countries is expected to increase since the rising price of primary energy makes this particular source increasingly competitive.

Problem of the size of hydro power units

The financial requirements for the construction of large hydro power units are considerably higher, but the price of the hydro electric energy supplied by them is much lower than that of energy generated by thermal power units of equal size.

Small hydro power projects require lower investment, but the price of the energy generated by such units is proportionately higher. However, due to their rising foreign currency debts and too high interest rates, developing countries are expected to turn to smaller hydro power projects and to try and utilize local financial resources.

As regards the technological side of the problem, the equipment and technology for large hydro power units - unlike those for thermal power units - cannot be easily standardized since hydro power plants may greatly differ from each other. However, small and in particular mini and micro hydro power generation (MHG) units can easily be adapted to different topographical and geographical conditions. This allows a standardization of design for such units and hence of the procurement procedures, while at the same time opening the possibility of a greater utilization of local engineering resources.

Finally, MHG development, owing to the relatively simple technology it involves, lower financial requirements and a lesser degree of sophistication in planning and programming it requires, opens the possibility for new and unconventional institutional arrangements within the national energy sector.

In this connection the objective of this paper is to review some of the recent Yugoslav experiences in the promotion of local initiatives in the institutional, economic and technological aspects of MHG development.

Yugoslav Approach to MHG : Socio-Economic Background

Since the war, energy consumption in Yugoslavia has risen sevenfold. By the end of 1981, the total installed capacity of the country's energy sector reached 15,011 Mw, 6,253 Mw of which derived from hydro electric power plants. The latest survey of Yugoslavia's existing hydro power units of less than 10 Mw have a total output of 140 Mw. In the country's total installed capacity, and especially in the annual output of Yugoslavia's hydro power system as a whole, this accounts for a very small percentage.

However, according to technical and economic estimates, further construction of small and MHG units would make it possible to include into production still unexploited hydro-potentials of a total output of 336.8 Mw. Since small streams, rivulets, brooks etc., which are mostly situated in remote mountain regions, are not yet investigated hydrologically and technically, these 336.8 Mw of non-utilized potencials should be understood as a conservative estimate which might be multiplied through a further investigation of minor water flows.

This becomes more important if the fact is considered that, because of the high degree of exhaustion of the country's existing hydro power potentials suitable for the construction of large power generation units, Yugoslavia will be forced in future to concentrate on the erection of medium (between 10 and 100 mW), small (between 1 and 10 Mw) and even MHG units (less than 1Mw).

However, intensive exploitation of rich water flows which are suitable for the installation of major power plants is only one of the factors which impose the need for wider investigations and speedier MHG development.

The second important factor is a considerable uncertainty concerning the international market and the prices of primary energy resources, the continuous rise of which following the oil crisis in the mid-1970s has imposed a heavy burden on Yugoslavia's balance of payments, the country being a net importer of energy.

The third reason for the rising importance of MHG development in Yugoslavia can be found in the country's newly adopted economic policy of stablization which, among other things, has imposed heavy restrictions on new investment projects, particularly those including a considerable foreign exchange component.

The last though not the least reason for shifting priority to small-scale and MHG development in Yugsolavia is the fact that the existing national electric power system and distribution network contain too many vulnerable points to keep them fully operational in war conditions. In view of the need to increase the country's defence capacities, in accordance with the doctrine of total national defence, the conclusion has been reached that the existing unified system of power generation and distribution should be accompanied by a parallel, highly decentralized network of small and MHG units, for use in case of armed aggression.

Centralized vs. Decentralized Institutional Framework

The Socialist Federal Republic of Yugoslavia consists of six republics and two autonomous provinces. Being a community of voluntarily united peoples, their republics and autonomous provinces, the Federation safeguards only the fundamental common interests such as national freedom and defence, territorial integrity and sovereignity, the political system and the system

of socio-economic relations, while all other common interests are met through various forms of mutual co-operation and agreements between the individual republics and provinces, local communities, enterprises and other social and/or economic subjects.

Thus Yugoslavia's unified electric energy system and distribution network rest upon the co-ordinated activities of eight republican and provincial institutions - Electric Energy Communities, specialized for planning, financing, producing and distributing electric energy within their respective territories.

Study of the activities of these Communities shows that differences in economic development between the individual republics, and, still more, special problems of energy supply in different geological and hydrological conditions have produced different levels of interest and experience as regards small-scale and MHG units development. To date, the best results have been achieved where the existing hydro power potentials suitable for the installation of medium- and high-power plants are more or less exhausted and where no major coal and/or alternative energy resources are available. Recently, the increased interest in MHG development has been motivated by other factors mentioned above, particularly by the current severe Government control of investment and the utilization of foreign financial resources.

"Political Economy" of MHG Development

Taking all this into consideration, individual republican Electric Energy Communities and other interested subjects have developed various ideas and adopted several programmes for MHG development.

For instance, the Republic of Slovenia, which is situated in the north-western part of Yugoslavia and which was the first to decide a few years ago to direct part of its efforts towards MHG development has set up a special Business Committee for this purpose. The Committee has drawn up a programme under which as many as 100 MHG units are to be erected in Slovenia during the 1981/1985 period. However, the realization of this programme has been slower than expected because it has met with several obstacles. The first of these is connected with the supply of domestic

standardized equipment. Although possessing considerable technological knowledge and experience in manufacturing equipment for high-power hydro electric plants, Yugoslav industry faces difficulties in the development of large-scale production of low-cost, simple technology for MHG units. Nor has the question of financing MHG development been solved yet in a satisfactory manner. The Slovenian Republican Electric Energy Community lacks the necessary funds for offering credits to the final users of MHG energy as do also domestic equipment manufacturers.

The difficulties faced by the public sector in promoting MHG development have motivated various other subjects, mainly at the local level, to start their own programmes of MHG development. In this respect the most interesting example can be found in the commune of Tolmin.

Situated in the hilly part of western Slovenia, this commune lacks major rivers but is rich in small streams and mountain brooks. The electrification process in this area has proceeded at a very slow rate, so that electricity did not reach the last village before 1978. However, even today many isolated farms and hamlets situated high in the mountains are not supplied with public electricity, since current economic calculations do not justify the erection of transmission lines and transformer substations. For these reasons, highlanders of the commune of Tolmin had to depend on their own supply of electricity which they ensured by installing private aggregates on small rivers and brooks in which their region abounds. Recently, induced by the general increase in energy prices and the diminished possibilities of employment in the valley, they have set up a special section for MHG development within the communal branch of the Youth Organization for the Promotion of Technical Culture.

The first task of the Section, carried out by local schoolboys and schoolgirls, was a register of the existing MHG units. The register shows that there are 11 such units in addition to 6 saw-mills and 4 flour-mills utilizing the power of the Tolmin watercourses. Of the MHG units, one has a capacity of 30 Kw, three have 15 Kw each, and the rest vary between 3 and 12 Kw, with a total installed capacity of 116 Kw and a monthly output of 83,664 Kwh. The inquiry has further shown that if to the operating units abandoned MHG units and disused sites were added, the Tolmin commune could count on at least 153 micro-sites, suitable for the erection of MHG units. Aware of the importance of this fact for meeting the energy requirements of isolated farms

and small-scale industry, and also those of national defence, the Tolmin Communal Assembly has commissioned the Ljubljana Institute for Turbo-Engineering to work out a study of all available hydro potentials, prepare respective hydrological and technical analyses, and determine the optimum types and outputs for future MHG units within the commune's area.

At this point it should be mentioned that the successful survey carried out by the Tolmin branch has initiated wide investigation activities, on the republican level, of the Organization for the Promotion of Technical Culture. Students, schoolboys and schoolgirls, led by their instructors, have been engaged on measuring hydrological and other parameters of all potential watercourses in Slovenia. For this purpose a special publication has been prepared which contains instructions for measuring the fall and flow of water and all necessary technical parameters, and includes drawings of MHG units suited to the characteristics of individual watercourses.

In other units of the Yugoslav Federation similar programmes and initiatives are being considered or are already in progress.

For instance, in the Republic of Serbia, which is situated in the south-eastern part of Yugoslavia, several regional and local MHG development programmes have been registered. One of these, curiously enough, has been initiated by the huge Lim Hydro Electric Plants Company of Nova Varoš. The Company, which includes severa high power generation units, has decided to increase its own capacities by building a network of MHG units. The project was commissioned to an engineering company which, after thorough hydrological and technical and economic analysis, proposed the construction of ten fully automated MHG units. Energy generated by these units is to be added to the total output of the Lim Hydro Electric Plants Company and distributed through the existing network of public electricity supply.

In the Republic of Bosnia and Herzegovina and the Republic of Croatia, both situated in the central part of Yugoslavia, similar programmes are under study. One of these is specially interesting as it considered the introduction of the private sector into energy production. The idea is that a private citizen, interested in energy production as a form of small enterpreneurship, could combine his own resources with suitable bank loans and

build an MHG unit which would be connected with the existing distribution network. The owners of private MHG units would naturally be paid for all energy supplied by their units according to a mutually agreed tariff, which need not necessarily be the same as that for public electri c energy. The proposal for introducing the private sector and for its co-operation with the public energy sector is quite unconventional for Yugoslavia as a socialist country, but the idea is a good illustration of the acute necessity to increase energy supply in developing countries and of the existing wide possibilities for MHG development. However, it must be added that the current prices of energy equipment offer poor prospects for the introduction of the private sector in the field of power generation in Yugoslavia. Namely, 1 Kw of installed capacity of an MHG unit adapted to mountain waterfalls currently costs about US $ 230, while the price of energy generated by an MHG unit of the 'valley' type may reach as much as US $ 870 per 1 Kw of installed capacity. However, according to the current price of public electricity, the investment would pay off within only 5-6 years. This means that the biggest burden for most of the potential energy entrepreneurs in Yugoslavia would be the initial, fixed financial requirements which they could only meet by combining their own savings with bank loans. There is an additional problem of a technical nature: for connecting private MHG units with the public distribution network special automatic devices are required which are not manufactured, at least not at low costs, in Yugoslavia.

Some Technological Obstacles

This brings us to the problem of the procurement of domestically manufactured equipment of MHG development in Yugoslavia. As mentioned before, MHG development is based on low-cost, simple and standardized equipment. Among the Yugoslav manufacturers of such equipment perhaps the greatest results have been achieved by "Litostroj" of Ljubljana. This company has developed prototypes of three turbines: (i) a microhydro of 100 Kw, (ii) a minihydro of 1000 Kw, and (iii) a smallhydro power generation unit of 10 Mw. However, an assembly-line production of these turbines has not yet begun and this makes "Litostroj" products very expensive. Among other Yugoslav manufacturers of energy equipment especially noteworthy are the achievements of "Uljanik" of Pula. Though having less experience than "Litostroj", engineers and technicians of "Uljanik" have shown an impressive technological creativity

in the research and development of MHG units. Within a comparatively short time they have developed MHG units with water turbines suitable for the exploitation of different falls and quantities of water and of continuous or intermittent water inflows. Here again remains the problem of the cost which, because of the small-scale production or, in fact, of only single specimens, can hardly be met by private citizens or even by village communities and other similar subjects.

Conclusions

As can be seen, in Yugoslavia considerable success has been achieved and valuable experience gained in MHG development. Owing to the country's flexible socio-economic system, special success has been achieved in complementing the centralized public energy sector with various local initiatives and programmes. What is called "energy consciousness" has become part of the thinking and living of various subjects, - from school-children to small farmers and craftsmen, their village communities, and other social and economic subjects, at all levels.

However, some of the described experience and achievements show that much work will still have to be done.

This goes particularly for the question of financing MHG development. As mentioned before, different options are considered among which, particularly for the requirements of small farmers and craftsmen in remote, hilly areas, favourable credits from manufacturers and bank loans should be envisaged as the best means for solving the problem.

The technological problems of MHG development in Yugoslavia have been mostly resolved, but only at the level of prototypes and production of single specimens. Mass prdocution of low-cost, simple and standardized equipment is an objective still to be reached.