Texas Water Resources Institute

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Hydropower is...

- an energy produced from the force of moving water.
- a nonpolluting, nonconsumptive energy.
- an underdeveloped energy source.
- a technology ready to be applied.

These are a few of the reasons that scientists around the country are taking a fresh, new look at hydropower–a technology developed several generations ago to produce electricity.

Similar in concept to old-fashioned water wheels, hydropower uses falling water or flowing rivers to turn turbines to generate electricity. The process neither consumes the water nor alters it in any way. It simply uses the force created by the movement of the water.

Once a generating plant is installed, maintenance and operation costs are minimal compared to other types of power production.

Only a small amount of power produced in Texas is hydro, however, because rivers flow intermittently and because surface water is limited. Texas hydropower plants now produce one percent of the state's energy and are used in most cases for peaking –times of high electric demand–or emergency purposes.

Despite energy crises and rising energy costs, increasing electric power demands in Texas require a doubling of electric generating facilities about every eight years. Natural gas, which has been the principal power generation fuel in Texas, is no longer available in the quantities needed for energy production. Power companies are turning to coal and lignite as well as nuclear energy for future power production in the state, but costs of these sources are certain to increase.

Energy problems in the state will not be solved with hydropower projects, but water which flows over existing dam spillways and through existing canals can be put to work generating electricity. Many cities and public utilities could install some generating units at existing dams and, after the initial capital outlay, produce energy at a fraction of the cost of the alternative methods of producing electricity.

PRESENT HYDROPOWER

The Lower Colorado River Authority (LCRA) operates a series of six dams in a stairstep fashion so that water released from one to the other generates electricity. In addition to forming the Highland Lakes for water supply and recreation, these dams have collective generating capability of 230 megawatts.

"While hydroelectricity comprises less than 10 percent of the annual electric generation at LCRA," says a river authority report, "it is particularly important during certain periods. When a steam plant is shut down for inspection or when peak load is too much for the steam plants, hydro really comes into play, taking up the slack."

Other agencies presently generating hydropower in Texas include the Guadalupe-Blanco River Authority, Brazos River Authority, Sabine River Authority, U.S. Army Corps of Engineers, and the International Boundary and Water Commission.

A large generating plant is now in the design stage for Amistad Dam on the Rio Grande River, and construction by the U.S. Army Corps of Engineers should begin in late 1979. Water will fall 176 feet at the 66 megawatt capacity plant to be operated by the International Boundary and Water Commission.

TEXAS' POTENTIAL

A Corps study on hydropower potential throughout the U.S. reports 460 sites in Texas with some hydropower potential. Two hundred and thirty of these sites are located on existing dams. The Corps is in the process of ranking and screening these sites to determine which ones warrant further study.

Because Texas does not have the natural sites for tall dams nor the abundant water to send through largescale hydropower plants, nearly all hydropower potential in the state falls into the "low-head" classification of hydropower production. Low-head refers to that power which can be generated by dropping water from relatively low dams and passing it through hydraulic turbines specially designed for smaller flows and lower head or drop. Low-head plants generate electricity with water falling 10 to 50 feet.

Low-head sites could include a private "backyard" system capturing the energy of a small creek; a small system on a sizeable dam; or a low-head run-of-river development to benefit a small community or industry. Irrigation canals, for instance, are important potential sources of low-head power which could provide energy for pumping water to sprinkler systems.

Low-head installations have become increasingly attractive not only because of the rising costs of fossil fuel, but also because of the serious objections to environmental impact of large-scale projects. Even though low-head hydropower is not as economical as other power sources now, it could be–and probably will be–economically competitive in a few years because other types of energy are continuously increasing in cost. When oil was $2.25 a barrel in 1970, low-head hydropower was not as economically attractive as today when Middle East oil is $15 per barrel and future supply is uncertain.

Costs of low-head hydro plants could decrease as engineers design standardized turbines for variable flow. The adjustable turbine blades and gates presently required on Texas rivers, because of intermittent or variable flow, increase design costs 25 to 50 percent over simpler designs.

Lead time for new low-head projects is relatively short compared to different types of electrical generation plants. Low-head plants can be built with two years time for designing and licensing procedures and two to three years for constructing. Anticipated lead time today for a coal-fired plant is seven to ten years and for a nuclear plant, twelve to fourteen years.

"Low-head sites," according to Jack Runkles, director of the Texas Water Resources Institute, "will not by themselves solve the energy problems in Texas; they may, however, produce a considerable amount of environmentally-acceptable, economically-competitive energy."

INSTITUTE GROUP

The Institute called a group of scientists and engineers together to explore potential hydropower development in Texas. The group includes representatives from the Texas Energy Advisory Council, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, Brown and Root Company, Texas Department of Water Resources, and Texas A&M University Department of Civil Engineering.

Runkles assembled the group because "the trends in energy production and cost of energy make it necessary that we give more serious attention to energy available from renewable resources. Hydroelectric energy potential may have been largely overlooked by this generation because of the availability of fossil fuels."

The group concluded at a meeting on the Texas A&M University campus this winter that the major constraints to hydropower in Texas are institutional: for instance, water rights issues, water use conflicts, and federal licensing procedures. These constraints, as well as economic realities, far outweigh technological difficulties in developing potential hydropower generating sites in the state.

Runkles hopes the first meeting of the group will serve as a catalyst for further study to determine:

1. What actually is the potential for hydropower production in Texas?
2. What are the economic, environmental, and social costs of developing hydropower in Texas?

NATIONAL EMPHASIS

The U.S. has developed only 45 percent of its hydropower potential compared to Europe's 80 percent, but a new national emphasis may change the low U.S. figure.

Part of President Carter's 1978 National Energy Plan directed the U.S. Department of Energy (DOE) to establish a loan program to encourage the development of small hydroelectric projects in connection with existing dams not now being used to generate electric power. Loans will be available through the DOE for cities, electric cooperatives, industrial development agencies, and other nonprofit organizations to study hydropower feasibility.

The DOE classifies hydropower plants by capacity. Small-scale plants are those with less than 15,000 kilowatt capacity. Three hundred of the potential lowhead sites identified in Texas by the Corps fall into this small-scale classification. Small-scale hydropower is considered by the DOE as one of twenty alternate energy sources ready for commercialization. This means that the technology is readily available to plan, design, construct, and operate hydropower plants. Major problems, according to the DOE, in implementing small-scale plants are regulatory aspects, cost constraints, and availability of water.

Because of the many years the U.S. has concentrated on generating electricity from diminishing energy sources and because of the new national interest in hydropower, an apt description of the technology comes from the Idaho Water Resources Research Institute:

"Hydropower is... an obsolete technology whose time has not yet come." Its time, however, may be fast approaching.

Photographs in this issue show three of the six small hydroelectric plants owned by the Guadalupe-Blanco River Authority. The six plants in Guadalupe and Gonzales counties produce a little over 100,000 megawatt hours of power each year which is sold to Centra/ Power and Light Company.

Dams in Texas with hydroelectric generation capabilities

Dam and Reservoir	Owner	Generating capability in megawatts
Morris Sheppard Dam and Possum Kingdom Lake	Brazos River Authority	23
Whitney Dam and Lake	U.S. Army Corps of Engineers	30
Sam Rayburn Dam and Reservoir	U.S. Army Corps of Engineers	52
Denison Dam and Lake Texoma	U.S. Army Corps of Engineers	70
Toledo Bend Dam and Reservoir	Sabine River Authority	83
Falcon Dam and Reservoir	International Boundary and Water Commission	41
Max Starcke Dam and Lake Marble Falls	Lower Colorado River Authority	30
Alvin Wirtz Dam and Lake Lyndon B. Johnson	Lower Colorado River Authority	50
Tom Miller Dam and Lake Austin	City of Austin (Leased to the Lower Colorado River Authority)	15
Inks Dam and Lake	Lower Colorado River Authority	12
Mansfield Dam and Lake Travis	Lower Colorado River Authority	85
Buchanan Dam and Lake	Lower Colorado River Authority	42
Series of low dams on the Guadalupe River	Guadalupe-Blanco River Authority	16
	Total:	549