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Hydro Doesn’t Have to Be Big

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Lea-Rachel Kosnik finds ample opportunities for expanding hydro in the U.S. without invoking the specter of environmentally questionable projects.

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Part Two (Jan. 23): Why environmentally friendly hydropower is possible

Part Three (Jan. 24): Build new, low-impact hydropower facilities but keep the old

First of three parts

The era of large hydropower dams is clearly over in the United States. Hydropower production, however, has a future: By concentrating on small hydropower facilities with limited impacts on river ecosystems, we can maintain — and even improve upon — an important renewable energy resource.

Two-thirds of all renewable electricity production in the United States — itself about 7 percent of the nation's total energy consumption — currently comes from hydropower. Electricity generated through the kinetic energy of falling water, a proven technology, provides a number of benefits beyond acting as a renewable source of electric power.

First, all water power is emissions free and, in this era of growing concern over climate change, that is of increasing value.

Second, water power is energy efficient. Other forms of generating power, from fossil fuels to solar power, have conversion rates of energy into electricity that average 50 percent or less; traditional hydroelectricity boasts an efficiency conversion rate of 90 percent, better than any other form of generation.

Third, water-powered electricity plants are extremely cost-effective. The main cost of most water-powered facilities is their initial construction and installation. Thereafter, they require no fuel inputs and very little maintenance.

Fourth, water power is both instantaneous and flexible; it requires only seconds to open a floodgate or press a switch and release water into a turbine for generation — a blessing during sudden (and frequent) increases in peak electricity demand.

Other sources of energy, including renewables such as wind or solar power, have flexibility and reliability problems as they generate electricity only intermittently and, perhaps even worse, unpredictably.

Hydropower also can be entirely domestic. Decentralized and thus less susceptible to industry-wide power outages, it features excellent reliability and energy-efficiency properties.

Its reputation in recent years, however, has grown seriously tarnished as a result of the harm that large, conventional hydropower plants often cause river ecosystems. The construction of new, large hydropower dams is not only environmentally harmful and politically unpalatable (at least in the developed world) but also simply not viable as an option for increasing renewable energy alternatives.

Hydroelectric power initially emerged in the late 19th century. In the United States, some of the first hydroelectricity-powered streetlights stood near Niagara Falls, in New York. Once the technical viability of hydroelectric power was established, hydropower production grew rapidly in the United States until, in the early 1900s, hydropower accounted for more than 40 percent of the total U.S. electricity supply (and more than 75 percent of electricity supplied in the West and the Pacific Northwest).

Such large hydroelectric dams as the Hoover in the Southwest and the Grand Coulee in the Northwest, built in the 1930s, brought Depression-era jobs to a flailing U.S. economy and eventually supplied the industrial sector with the electricity necessary to ramp up armament production for World War II.

But after the war, hydropower's dominant role in the nation's overall electricity supply diminished.

Today, hydropower generates between 7 percent and 10 percent of the total U.S. energy supply — a falling percentage. Around the world, hydropower's share of energy production averages 17 percent, and in some countries, such as Canada, Brazil, Norway and New Zealand, hydropower actually serves as the primary source of electricity production.

Large hydropower plants constitute most of the current capacity of hydropower production worldwide, so the discussion of these projects is implied whenever arguments occur over the relative benefits of hydropower capacity development.

The most contentious aspect of large hydropower dams is their environmental impact on local rivers, most specifically on fish. While the net number of fish may not diminish (certain fish thrive in reservoirs and the altered water flows downstream of a dam), indigenous fish, particularly those that migrate (such as salmon, trout, sturgeon, lampreys and shads), often receive injuries. For example, significant declines in native fish species resulting from large dam development have been cited along the Columbia, Snake and Mississippi rivers.

As a result, construction of large, traditional hydropower plants has essentially stalled in the U.S. and in most developed nations. Although many under- and less-developed nations continue to build new, large hydropower dams (prominent examples of which include the Three Gorges in China and the Ataturk Dam in Turkey), international funding for such projects has largely dried up. The World Bank, in its dam-funding heyday in the early 1970s and 1980s, approved more than eight dam-related projects a year; today it approves fewer than one a year.

The story is similar in the United States. In 1993, for the first time in its 70-year history, the Federal Energy Regulatory Commission, the agency responsible for hydropower dam licensing, denied an operational license for a traditional hydropower project — essentially because of the dam's negative riverine impacts.

Hydropower's story, however, does not end here.

The negative impacts on rivers diminish with plant size. Though exact definitions vary, in general, small hydropower plants generate between one megawatt and 30 megawatts of power, and micro hydropower systems produce less than one megawatt of power, enough to supply a small village or town.

These plants affect rivers and streams only minimally. Significant power can be generated with flows of just two gallons per minute or from drops as short as two feet. This allows a substantial amount of river flow to remain in-stream, available to maintain riverine integrity. Small and micro hydropower systems, therefore, generate emissions-free electric power without many of large dams' negative environmental effects.

Consider the other benefits, too. Small and micro hydropower prove much more reliable than such alternative renewables as solar or wind power. The sun goes down at night and for much of

the winter, and in any given day, can spend a lot of time behind clouds, which reduces (but doesn't eliminate) solar energy output. Wind is also variable, intermittent and unpredictable on a daily basis.

Small and micro hydropower sites, meanwhile, can be winterized to provide power throughout the year. Additionally, even very small microhydro systems, at about 18 kilowatt-hours, will produce more power than many (more expensive) photovoltaic systems. (Ten 100-watt bulbs lighted for an hour consume one kilowatt-hour.)

Small and micro hydropower development continues to take place worldwide; China now houses more than 43,000 small hydro facilities producing more than 19,000 megawatts of electricity, and more than 100 other countries have constructed small hydro plants in recent years.

In the United States, the Department of Energy completed a study in 2006 on the possibilities for small and micro hydropower development across the U.S. and found a total available capacity, for facilities generating less than 30 megawatts of power, of more than 275,000 megawatts — nearly three times our current hydropower production. This capacity, while concentrated in the Pacific Northwest, is distributed across the United States.

A smooth, functioning economy depends on reliable energy supplies. Climate concerns depend on increased use of emissions-free energy supplies. For an economically strong, emissions-free future, look to small hydropower — and that's what we'll do in the second part of this series.

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