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Clean&

Anyone who ever rafted down a river, fished from a riverbank, or even simply watched coursing water from a bridge above knows how powerful rivers can be. For thousands of years, humans have built dams across rivers to store water for drinking and irrigation, and to prevent the flooding of land downriver. In the late 19th century, dams began serving another purpose: generating electricity.

Today, hydroelectric dams generate nearly one fifth of the world's power supply. Although hydroelectricity creates no waste or emissions, it does have environmental impact. Dams can prevent fish from migrating and nutrients from flowing to wetlands downstream. Reservoirs flood areas that might include critical habitat. In addition, people and communities are often displaced when a reservoir is created.

Across the globe, the need for clean, renewable energy is coming into conflict with environmental and social needs. The following articles illustrate how this dilemma has played out in two different countries. Each author arrives at his own conclusions. As you consider the issues raised in each story, we invite you to do the same.

VECTORSTOCK

Green?

The Hydropower Debate

Kárahnjúkar Dam, Iceland

by Soren Schlassa

In the summer of 2010, I accompanied my mother on a research trip to Iceland, where we stayed at the home of her research colleague. Walking around the capital, Reykjavik (population: 200,000), with my host's son, I was astounded at the closeness of the community: every five minutes, it seemed we would run into somebody he knew.

In area, Iceland is slightly larger than the state of Indiana. But while Indiana's population is approximately 6.5 million, Iceland's is 300,000. The small population and low population density contribute to a unique culture, one that prizes not only social interaction but also community involvement. There seems to be a nationwide mentality that people do their family or friends a disservice if they don't make themselves useful. One result of this is huge protests; for example, 12,000 people attended a recent rally to oppose the construction of a dam. In Iceland, that's four percent of the population; in the United States, that would be 12 million people.

The object of the protest was the Kárahnjúkar dam. Some Icelanders contend that the dam destroyed precious wilderness in the name of corporate profit, while others argue that it makes sense to use Iceland's resources to provide jobs for Icelanders. When I first learned about the project, I agreed as I usually do with those who wanted to preserve the local environment. But I soon discovered that this issue was not as simple as choosing the environment over business.

Alcoa, an international producer of aluminum, had constructed an aluminum smelter in Reydarfjordur, a town that had had a population of less than 1,100 and was shrinking as residents moved away in the absence of jobs. The region may not have had jobs, but what it did have was power—an enormous amount of untapped geothermal and water power.

To capitalize on those resources, the Icelandic government and the national power company Landsvirkjun had worked hard to bring the smelter—and the jobs that came with it—to Eastern Iceland. To support the smelter, Landsvirkjun created a huge dam complex capable of producing 4,600 gigawatt hours annually—enough to power 382,000 average American homes for a year. At a cost of $3 billion, the dam represented both the biggest construction project and the largest public-private investment in Iceland's history.

Iceland's geography comprises glaciers, volcanoes, and lava fields—a unique combination found almost nowhere else in the world. Although the country has an area of only 64,000 square miles, there are many distinct ecosystems, some existing only in very small parts of the country. The dam's reservoir swallowed up 25 square miles that encompassed as many as 60 waterfalls as well as habitat covered in a distinct type of moss eaten by reindeer and used by nesting birds. Opponents of the dam also point out that the complex is built in a geologically volatile area next to the largest glacier in Europe, which is melting rapidly. In fact, the entire project was rejected by the Icelandic Planning Committee on the grounds that "economic benefits would not compensate for potential environmental harm." The project continued when the decision was overturned by the environmental minister—some say for political reasons—after only minor changes were made to the proposal.

Locals say that the smelter has raised spirits by bringing more people into the community and encouraging development. The construction and maintenance of the nearby hydropower project also stimulated the local economy and created jobs in the community. But beyond the economic benefits to individuals and the community,

taking advantage of Iceland's natural resources by attracting heavy industry may be in the best interest of the country as a whole. Aside from fish, unused cheap energy is Iceland's biggest commodity. The abundance of undeveloped land gives industry both a place to set up and a source of cheap, clean energy.

Heavy industry, normally a carbon-intensive process, is much more sustainable when the energy is hydroelectric or geothermal. It is estimated that the smelter in Reydarfjordur will emit 90 percent less carbon than plants that use carbon-based energy. For every metric ton of aluminum produced, a coal-fired smelter produces around 13 metric tons of carbon, while the hydroelectric-powered Reydarfjordur smelter emits only 1.8. With figures like these, proponents argue that *not* harnessing this energy would be a disservice to the global community.

Arguments that call into question the global ethics of a project like the Kárahnjúkar dam will become more frequent and more necessary as concerns grow over water and energy usage. As demand for energy—especially clean energy—increases, projects that pit opposing environmental benefits against one another will also become more frequent, and increasingly relevant to the global population.

Soren Schlassa is a freshman at Pacific Ridge School in Carlsbad, CA. He enjoys math, Ultimate Frisbee, and traveling. With his history teacher, he is in the early stages of setting up an online exchange between his school and a high school in Qatar to help dispel stereotypes about the Middle East. He hopes to someday be a school teacher.

Ganges River Dams, India

by Kartik Sameer Madiraju

When I traveled to Delhi in the summer of 2010 to learn more about environmental policy and resource protection in India, I arrived in the midst of a national controversy. The Ganges River, the life source of half a billion Indians and a religious symbol for all Hindus, was to be dammed at its source, the Gangotri Glacier. To make matters worse, over 300 run-of-river hydroelectric dams were planned for the system of rivers that originate from the Ganges. Run-of-river dams exploit a river's naturally fast flow by diverting water from the riverbed into a small tunnel toward a turbine. The water is then returned to the river further downstream.

In 2010, protests erupted in opposition to the construction of the Loharinag-Pala Dam, a run-of-river project that would divert more than 60 miles of the Ganges into a tunnel to produce electricity. The major problem with such dams is that ecosystems are disrupted when part of a river is suddenly dried out. In the Ganges, this poses a threat to the already endangered Ganges River Dolphin. In addition, the stagnant pools of water left along the riverbed can provide breeding sites for malaria-carrying mosquitoes. Furthermore, when their natural source of drinking water is diverted, local villagers are forced to buy water at prices they cannot afford. And India's government approves these projects in bunches, creating "cascade dams." This means that the river is dammed many times, and the flow diverted into several tunnels for power generation—thereby multiplying all of the potential resulting problems.

Ironically, 89 percent of hydroelectric dams in India operate below capacity, with more than half operating below 50 percent of their potential. The reasons for this inefficient output are numerous. First, because the Ganges

is a silt-rich river, dam reservoirs hold less and less water as silt accumulates at the bottom, and silt also damages the turbines of run-of-river dams like the Loharinag-Pala, making them less efficient. Further, engineers often exaggerate a dam's potential energy output in order to fast-track its approval. If a dam underperforms, another dam is commissioned to compensate for the deficiency in power output. In this way, the river is being destroyed for nothing.

I was especially shocked by what I learned about water policy and environmental law in India because this is a country that has enough sunlight to power all its industries, enough agricultural waste to create biomass reactors, and strong wind speeds for wind farms. Yet the Indian government still spends close to $11 billion annually on hydroelectric dam projects. I believe it is unnecessarily compromising a delicate ecosystem and a cultural icon for power that can be generated elsewhere.

As it turns out, the Ganges dam-building controversy had a bittersweet ending: all 300 projects were scrapped, but only after a renowned environmentalist, Dr. G.D. Agrawal, fasted for 30 days to draw attention to the issue. Because the Indian government is sensitive to the religious beliefs of its people, the Ganges might end up being saved, but what about other rivers around the world? Even if we do not worship our natural environment, there should still be a way we can protect it without crippling our development.

Globally, the most effective way to prevent the unnecessary and hasty construction of large-scale hydroelectric dams is to change our way of thinking. Governments have a responsibility to invest in alternative methods of producing electricity to address this dilemma. And if a hydroelectric dam must be built, then policymakers should provide stringent criteria for how the dam is constructed and how ecosystems will be protected. In addition, engineering firms should be held accountable for the power capacities they promise when proposing a new dam project.

Change originates at the grassroots level, the community level. Next summer, I intend to work with groups in India that effect this sort of change. One program called Lighting a Billion Lives, run by The Energy and Resources Institute, aims to sell solar lanterns at affordable prices to residents of impoverished areas in India, so that they do not have to purchase power from hydroelectric dam contractors. When people no longer depend on dams for power, hopefully fewer of them will be built.

I went to India hoping to learn how its policymakers viewed the environment; what I found was a nation seeking a balance between progress and sustainability. That balance is sought by all nations, but it can only come when we recognize the value of freshwater in terms other than the kilowatt hours it can provide. i

Kartik Sameer Madiraju is an engineering student at McGill University. His research in fuel cell technology and work in environmental protection have inspired him to pursue a career in environmental law and politics. A published writer of short fiction and poetry, Kartik also enjoys badminton, traveling, singing, and watching hockey.

Kartik wishes to acknowledge Advocate M.C. Mehta, Dr. G.D. Agrawal, the members of Chinmaya Mission, and the members of Ganga Ahvaan.

Selected Resources

See these websites to learn more about different types of dams, their benefits, and their impacts.

Building Big: Dams
www.pbs.org/wgbh/buildingbig/dam

Hydropower Reform Coalition
www.hydroreform.org

International Hydropower Association
www.hydropower.org

U.S. Bureau of Reclamation: Hydroelectric Power
www.usbr.gov/power/edu/pamphlet.pdf

United States Society on Dams
http://ussdams.com/ussdeducation

World Commission on Dams
www.dams.org

World Wildlife Fund: Dams Initiative
wwf.panda.org/what_we_do/footprint/water/dams_initiative