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LOGAN CITY'S ADVENTURES IN MICRO-HYDROPOWER
How Federal Regulations Discourage Renewable Energy Development

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Abstract

In 2004 Logan, Utah, saw the opportunity to place a turbine within the city's culinary water system. The turbine would reduce excess water pressure and would generate clean, low-cost electricity for the city's residents. Federal funding was available, and the city qualified for a grant under the American Recovery and Reinvestment Act. Unfortunately, Logan City found that a complex and costly federal nexus of regulatory requirements must be met before any hydropower project can be licensed with the Federal Energy Regulatory Commission. This regulation drove up costs in terms of time and money and, as a result, Logan City is not planning to undertake any similar projects in the future. Other cities have had similar experiences to Logan's, and we briefly explore these as well. We find that regulation is likely deterring the development of small hydropower potential across the United States, and that reform is warranted.

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Logan City's Adventures in Micro-Hydropower:

How Federal Regulations Discourage Renewable Energy Development

Megan E. Hansen, Randy T Simmons, Ryan M. Yonk, and Ken J. Sim

Small-scale hydropower is one of the most promising new sources of clean power. Cities like Logan, Utah,[1] are taking advantage of the opportunity to develop green energy in their own backyards by installing micro-hydropower systems. As they do so, they often find themselves trapped in a frustrating regulatory system that costs them time and money.

In 2004, Lance Houser saw an opportunity. As assistant engineer for Logan City, Houser recognized the potential for the city's culinary water system to generate clean, low-cost electricity. All it needed was the installation of a micro-hydro turbine within the existing pipeline. This project would create enough energy to power 185 local homes. It would require no new construction, but rather would modify an existing pipeline within an existing building. The project would have no additional environmental impacts. It would solve a problem while providing extra benefits to the city. In short, Houser's idea made sense.

With the encouragement of federal policies, cities like Logan are implementing renewable energy projects such as small and micro-hydropower. The American Recovery and Reinvestment Act of 2009 (ARRA), commonly known as the Recovery Act or the stimulus bill, officially provided $16.8 billion for "Energy Efficiency and Renewable Energy."[2] The Department of Energy, however, measures this number differently, and estimated the actual number to be closer to $90 billion (DOE 2012). Part of that funding went to renewable energy projects like Logan City's micro-hydro project. In total, the city planned to spend up to $1.4

[1] The city is referred to as Logan, Utah, or Logan City based on local custom.
[2] H.R. 1, 111th, 2009, div. A, title IV.

million to complete the project, of which half was local funding and half was the ARRA-supported grant.

Unlike traditional large-scale hydropower, small and micro-hydropower systems often do not require dams, reducing the technology's environmental impacts. Micro-hydro systems most commonly work through a "run-of-the-river" system in which water from a river is diverted to a pipeline. This water then flows through a turbine or waterwheel, powering a generator and producing electricity (DOE 2012). Micro-hydro turbines take advantage of the kinetic energy in flowing water by converting that energy into usable electricity. A system generating only 10 kilowatts can power a large home, small resort, or hobby farm (DOE 2012).

Small and micro-hydropower systems are indeed small, but collectively they have high energy-generation potential. According to a feasibility assessment of small and low-power hydroelectric plants, generation of as much as 30,000 megawatts of energy is possible through small and low-power hydroelectric projects[3] throughout the United States (Idaho National Laboratory 2006, 1). This is enough energy to power more than 65,000 homes on an annual basis.[4] If developed, this system would more than double total hydroelectric generation in the United States (Idaho National Laboratory 2006, v).

Although micro-hydro projects usually have limited or even no environmental effects, the federal permitting process is onerous. Logan City's micro-hydro project would generate electricity from a renewable source, reducing the city's reliance on energy generated from higher-emission coal and natural gas. As of 2012, over half of the city's electricity generation came from coal and about 6 percent came from gas (Logan City Light & Power, n.d.). As the EPA website notes, "Hydropower's air emissions are negligible because no fuels are burned"

[3] Small and low-power hydroelectric projects are defined as generating 30 megawatts or less.
[4] Based on average household consumption of 30 kWh/24 hours = 1.25 kW per day.

(2013). If Logan City's project were to run 24/7 for one year, and if all of the energy it replaced came from coal-powered plants, the project would offset approximately 3.7 million pounds of carbon dioxide (US Energy Information Administration 2013).[5]

Despite the project's small size and its environmental benefits, Logan City had to navigate a complex regulatory web before its micro-hydro plant, known as the Dewitt Springs Pipeline Project, could be completed. Because of this, the project ended up taking four years and costing almost $3 million. By comparison, experts at Natural Resources Canada estimate that the total cost of a similar project in Canada would have been between $225,000 and $375,000 (Natural Resources Canada 2004).[6]

Dewitt Springs, a naturally flowing fountain of pure water in Logan Canyon, provides about 70 percent of Logan City's water supply. The city obtains the rest of its water from wells. Water from Dewitt Springs is diverted to a control vault used to remove pressure, and is then distributed among storage tanks until it is released according to demand. In 2008, the city updated its Dewitt Pipeline, increasing both the water supply to the city and the pressure on the system. The city's pressure-reducing valves soon proved ill-equipped to handle the new load (White 2011). Rather than simply replacing all the valves, which would provide a costly, short-term fix, the city decided to place a micro-hydro turbine within the Dewitt Springs pipeline (Houser, personal communication, December 12, 2012). The turbine would help reduce pressure and would generate low-cost, renewable energy for the city.

What started out as an economically feasible idea ended up well over budget. Logan City will not be starting any new projects of a similar size or scope, because the costs of this project

[5] Based on average CO_2 emissions of 2.14 lbs. per kWh of electricity generated from coal. A 200 kW project would produce 1.75 million kWh per year, if run constantly.
[6] US dollars converted from 2004 Canadian dollars.

far outweighed the benefits. Houser told us that because of "the cost of the permitting headache and the nightmare and the frustration of the process, there is no economic benefit to doing a project that size again" (personal communication, December 12, 2012).

The Recovery Act provided the initial stimulus for Logan City's project by allocating billions of dollars to renewable energy development. The Dewitt Pipeline project received approximately $700,000 in Recovery Act money as a cost-match grant through the Utah Division of Drinking Water (Houser, personal communication, September 6, 2013).[7] In passing the act, the federal government sought to "preserve and create jobs and promote economic recovery" and to "invest in transportation, environmental protection, and other infrastructure that will provide long-term economic benefits."[8] Unfortunately, Logan City's micro-hydro project did not create any new jobs, but rather increased the workload of existing city employees. Although the project is environmentally friendly, it will most likely not lead to significant economic benefits.

In completing the Dewitt Pipeline project, Houser worked closely with the Federal Energy Regulatory Commission (FERC), which oversees all permitting of hydropower plants. The Federal Power Act grants FERC the "exclusive authority to license most nonfederal hydropower projects" (FERC 2004). The licensing process can be long and costly. Those seeking a license through FERC may have to obtain permits from as many as 25 different regulatory agencies. Meeting mitigation requirements for the project's impact on endangered species, water quality, and other environmental concerns can take years (Campbell 2010, 8).

Although it is tempting to point to one specific regulation as the root cause of today's impediments to small hydropower development, a federal nexus of regulation is the real

[7] We attempted to confirm this funding on the Recovery.gov tracking website, but were unable to do so. It may be that specific information is self-reported by recipients of ARRA money.
[8] H.R. 1, 111th, 2009, § 3.

problem. FERC's responsibilities include implementing and ensuring compliance with a laundry list of legislation, including the Energy Policy Act of 2005, the Federal Deepwater Port Act of 1974, the Clean Air Act, the Clean Water Act, the Coastal Zone Management Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, the National Environmental Policy Act of 1969 (NEPA), the National Historic Preservation Act, the Rivers and Harbors Act, and the Wild and Scenic Rivers Act (FERC 2013a). Navigating this regulatory nexus can be complicated, time-intensive, and costly.

In this intimidating list of regulatory requirements, Houser and his team found the requirements of NEPA especially daunting. NEPA was passed to "encourage productive and enjoyable harmony between man and his environment" and to "eliminate damage to the environment."[9] The act also created the Council on Environmental Quality, which develops regulatory standards for NEPA's implementation. More specific regulatory requirements are left to federal agencies, such as FERC, to develop.

The NEPA process requires analysis of the environmental effects of a proposed action, usually in three stages. First, a project may be categorically excluded if it is expected to have no significant environmental impacts. Second, a federal agency may require an environmental assessment (EA) to help determine the expected impact of a project. If the EA results in a finding of no significant impact, then the process stops here. If the EA, however, finds expected environmental impacts to be significant, then an environmental impact statement (EIS) may be required to evaluate in detail the effects of the proposed action, along with any viable alternatives. This is the third stage of the process. An EIS is more extensive than an EA and includes the opportunity for outside parties to provide input (EPA 2012).

[9] US Code Title 42, §§ 4321–47.

FERC allows exemptions from certain licensing requirements for municipal projects under 40 megawatts where the existing pipeline or canal was not originally built for power generation and where the project is not located on federal lands. FERC's conduit exemption differs from the regular licensing process in that exempt projects are issued licenses in perpetuity, rather than having to reapply in 50 years (FERC 2013b). The exemption is also meant to streamline the process by relieving in-conduit projects from the NEPA requirement that an EA or EIS be prepared. As the FERC website notes, however, "this does not mean that the Commission cannot require an EA or EIS to be prepared if your project appears to have adverse effects on the environment" (FERC, 2013c).

Logan City applied for and was granted a conduit exemption in January 2011 (FERC 2013d). According to Houser, "the irony of the whole thing is that you get the exemption but all it saves you is about three to four months" (Houser, personal communication, December 20, 2012). Although the conduit exemption categorically exempts qualified projects from completing a formal EA, FERC still requires such projects to complete an environmental report in the form of a draft preliminary EA. This report must include "a description of the project's environmental setting, the expected environmental impacts, and proposed measures to protect the environment" (FERC 2004, p. 6-3). FERC required this environmental analysis even though the water used in the turbine comes from Dewitt Springs, not from the river (Houser, personal communication, December 12, 2012). The project would only affect an existing pipeline.

Although FERC is directed by legislative mandate, the agency is ultimately responsible for interpreting this legislation and deciding what level of analysis will be required for a given project. As described earlier, the real problem is not simply an overreaching bureaucratic agency or one specific piece of legislation, but rather a regulatory nexus that includes both interested agencies and

regulations that affect hydropower development. Small-scale, low-impact projects are often subject to the same level of scrutiny as large projects that would require dams. This scrutiny drives up costs and discourages small projects that might otherwise make economic sense.

Although federal stimulus money provided the impetus for Logan City's project, this funding came with strings attached. The Recovery Act contains a "Buy American" stipulation, requiring that no funds be provided through the act "unless all of the iron, steel, and manufactured goods used in the project are produced in the United States."[10] This ban on importing turbines prevented Logan City from buying less-expensive foreign alternatives.

Many of the same regulations designed to protect the environment created obstacles for Logan City's environmentally friendly micro-hydro project. The Endangered Species Act (ESA) required Houser to show that the project would not adversely affect any species or habitat listed under the act "on a project that disturbed nothing outside of an existing building" (personal communication, December 12, 2012). FERC requires permit applicants to complete a draft biological assessment to "address project effects on federally listed or proposed species or critical habitat in the project vicinity" (FERC 2008, 11).[11] In Logan City's case, this requirement meant conducting analysis to show that the county's three species listed as "candidate" species, one as in "recovery," and three as "threatened" would not be harmed by the project (U.S. Fish & Wildlife Service, n.d.). Although the ESA was intended to protect the environment, in Logan City's case it ended up creating obstacles for an environmentally friendly project.

Though the Dewitt Pipeline project would require no construction except for the modification of an existing structure, FERC required Houser to show that no historical structures were being negatively impacted by Logan City's project (Houser, personal communication,

[10] H.R. 1, 111th, 2009, title XVI, § 1605.
[11] 18 C.F.R. § 5.18(b)(3)(ii).

December 12, 2012). Section 106 of the National Historic Preservation Act requires FERC to consider the potential impact of a project on "historic properties" that are "included in or eligible for inclusion in the National Register of Historic Places." This consideration may require consultation with "the Advisory Council, State Historic Preservation Officer, National Park Service, Tribal Historic Preservation Officer, members of the public, and affected Indian tribes," all of which must be documented in the FERC license application (FERC 2008, 15).

If not for the regulatory red tape, micro-hydropower would make economic sense. These small systems harness the energy in flowing water and transform it into usable electricity, usually through the installation of a turbine and generator. After installation, maintenance and operational costs are low. Hydropower generates electricity more efficiently than any other form of electrical generation, with a conversion rate of 90 percent compared to an average of only 50 percent for other types of power generation (Kosnik 2010, 450). Despite this fact, hydropower potential is not being developed at the same rate as other renewable energy technologies. One online newspaper, *Green Energy Times*, finds it "sobering" that a FERC proceeding is required before hydropower generation of any size can take place. The article contrasts this requirement with the lack of regulation of solar power generation, saying, "If a Federal proceeding were required to connect rooftop solar PV panels to the grid then there would be very few grid-tied solar PV arrays" (Perkins 2013).

How did such a small, simple project end up costing almost $3 million? Figure 1 shows the financial costs and benefits of the Dewitt Pipeline project. Houser estimates that an additional $110,000 could be added to the total if his time were included. He also estimates that the city spent about $400,000 just dealing with FERC (personal communication, December 12, 2012). The financial benefit generated in 2012 will be an annual benefit; however, the specific amount

will vary each year since the amount of power generated depends on flow rates and how often the micro-hydro project is run.

The numbers in table 1 are based on both financial statements and firsthand interviews with city employees. The start-up costs in column 2 come from Logan City's financial statements, which can be found online. We then sat down with Houser to confirm that these costs were associated with the Dewitt Springs project and that they included ARRA grant money.

Table 1. Financial Costs and Benefits of Dewitt Pipeline Project to Logan City Taxpayers

Fiscal year	Start-up costs	Power generated	Financial benefits
2010	$0.370 million	0 kWh	$0.00
2011	$1.025 million	0 kWh	$0.00
2012	$0.700 million	1,121,401 kWh	$67,284.06 (avg. rate of $0.06 per kWh)
Totals:	$2.095 million	1,121,401 kWh	$67,284.06

Note: These costs do not include the $700,000 of federal grant money provided through ARRA.
Sources: Logan City Finance Department, 2008–2012; Chris Niemann, personal communication, January 22, 2013.

How long will it take Logan City to break even on its investment? The city's electric-meter foreman, Chris Niemann, estimates that if the project were to run 24/7, it would take 37 years for the project to break even. Since the project is usually operating under capacity, Niemann told us, "it's gonna take more like 50 years" (personal communication, January 22, 2013).

According to our own calculations, Logan City's project will not reach the break-even point until the beginning of its 32nd year of operation.[12] We calculate the net present value (NPV) of Logan City's project, the difference between the present value of benefits from the

[12] This undiscounted break-even point calculation includes only Logan City's contribution to the project and excludes the $700,000 received from ARRA. If those funds are included the project reaches the break-even point in its 42nd year.

project and costs of the project, as negative $650,000.[13] Because the NPV is significantly negative, if a business were deciding whether to take on this project, it would likely decide against it. Since the micro-hydro system is expected to last about 50 years, Logan City will be lucky if it can break even, let alone generate financial benefits (Houser, personal communication, September 6, 2013). Finances, however, do not take into account the project's real costs in terms of time and effort. The city will never be able to recoup the time it spent dealing with FERC and meeting the long list of federal regulatory requirements.

Using comparisons from other countries, we can estimate what a similar project would have cost in a less-restrictive environment. For example, if the requirement that all micro-hydro parts be American-made were to be removed, competition would drive prices down. According to a study by Natural Resources Canada, total costs, including construction, installation, and regulatory compliance, for a typical micro-hydro system range from $1,500 to $2,500 per kilowatt (2004, 31). This means that, in Canada, a 200-kilowatt project like Logan City's could cost between US$225,000 and US$375,000.[14] Nevertheless, the project's final cost amounted to nearly US$3 million.

Houser believes the high cost of regulations is also deterring other local cities from developing their micro-hydro potential. Cities like Hyrum, Millville, and Providence are all located within 10 miles of Logan, and each has the potential to develop micro-hydro energy. These cities are also smaller than Logan. "Where are they gonna get the economic backbone in their community to handle all the regulatory compliance requirements?" Houser asked (personal

[13] This calculation is based on an interest rate for the project of 4 percent and assumes that every year the project would produce the same financial benefit as its first year (Logan Municipal Council 2008). The 4 percent interest rate is based on the rate Logan City is currently paying for a bond it issued in 2008, and is likely to be a conservative estimate of an appropriate discount rate for a project with fairly high risk.
[14] This range was converted from 2004 Canadian dollars.

communication, December 12, 2012). Because of costly regulations, potential green-power generation will likely not be developed in these small cities.

Other cities across the United States have tried to implement micro-hydro systems, and, unfortunately, have had similar results to those experienced by Logan. Barre City, Vermont, has spent seven years meeting regulatory requirements and securing federal funding for a micro-hydro project of only 15 kilowatts (Delcore 2012). Afton, Wyoming, experienced similar difficulties in seeking a permit for its Swift Creek micro-hydro project. Because of unnecessary regulatory requirements, the project ended up costing $7.5 million (Spalding, personal communication, December 9, 2012). Tony Allen, the project manager, estimated that $5.6 million of that sum was spent on regulatory compliance alone (personal communication, January 8, 2013).

There is consensus in Congress to make it easier for small hydropower projects that will have minimal environmental effects to obtain a federal license. Washington state Representative Cathy McMorris Rodgers and Colorado Representative Diana DeGette cosponsored H.R.267, the Hydropower Regulatory Efficiency Act of 2013, which was signed into law by the president on August 9, 2013 (Govtrack.us 2013). The legislation is intended to streamline the permitting process for small hydropower projects and to increase the scope of projects eligible for licensing exemptions (Wright 2012). It is still too soon to tell whether this law will have its intended effects.

When it comes to micro-hydropower, regulations produce unintended consequences. Although the federal government attempts to encourage renewable energy production by providing funding through legislation like the ARRA, federal regulations enforced by FERC suffocate many green-energy projects. Many of these regulations, like the ESA and NEPA, are meant to protect the environment, but instead they end up discouraging renewable energy development.

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