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Memorandum

TO: City Council
THROUGH: Rob Dumouchel, City Manager
FROM: Janette Keiser, PE, Director of Public Works
DATE: September 14, 2022
SUBJECT: Micro-hydro

I. Issue: The purpose of this Memorandum is to recommend acceptance of a grant to further explore using the pressure differentials in our water mains to generate electricity.

II. Background:

A. History of micro-hydro research: In 2009, Public Works commissioned a feasibility study of using its water mains for micro-hydro generators. The idea was to install hydroelectric turbines in three pressure reducing stations (PRVs). The conclusion was that the project was not feasible for a variety of reasons. One of the primary reasons was the variable flow; that is, the water flow during the daytime was much more than the water flow at night. What was needed to even out the flows, and make the cost/benefit ratio more attractive was a new water storage tank.

In 2014, Public Works commissioned a second feasibility study, this time, including, in the computations, a new .75 million gallon water storage tank, which the City had planned to built. Further, the PRVs were coming to the end of their useful lives and needed to be replaced. This meant that it might be possible for some of the capital costs for the micro-hydro equipment to be folded into the PRV replacement costs. Even with that, while the cost/benefit ratio was somewhat higher, the conclusion was that the s ystems were still too small to be not cost effective. Technology to take advantage of the low generation amounts was still not feasible.

Last year, Public Works was approached by a company, InPipe Energy, which wanted to explore the possibility of using Homer's water mains for micro-hydro. The company had been referred to the City of Homer by the Alaska Energy Authority as a community that was interested in micro-hydro power. InPipe offered to write an application for Alaska Energy Authority (AEA) grant funding for a micro-hydro project. I was skeptical because, while I understood and believed in the concept, earlier efforts to prove it in Homer had been unsuccessful. However, InPipe had a new technology, which combined the functions of micro-hydroelectric generation with pressure management, meaning we could

replace the aging PRVs and generate electricity at the same time. Since they were going to look into this and produce the grant application at no cost to the City, I took them up on their offer.

They looked at the same PRVs the previous consultants evaluated, studying the earlier reports and collecting updated data regarding water flow and pressures. InPipe concluded the cost/benefit ratio had improved to the point they were willing to invest their own time and energy in pursuing further concepts. They prepared a grant application, which we submitted to the AEA in January 2022. I didn't expect much to come of it. Months later, the AEA notified us they had included the design portion of Homer's Energy Recovery Project on its list of "Renewable Energy Fund Round 14 Recommended Projects to the Legislature" and the project was funded through the Legislature's Capital Budget, effective July 1, 2022. I was stunned!

B. AEA Grant Agreement. The AEA is ready to offer us a grant agreement in the amount of $79,500, which is what we showed in the Grant Application for the costs of engineering and FERC permitting. If we want to move forward, the City Council needs to authorize the City Manager to accept the grant and execute the appropriate documents. We recommend doing this because we believe, that while results are not yet guaranteed, it is worthwhile to take another few steps forward.

While earlier feasibility reports were not favorable, several things have changed. First, the technology has progressed. It is now possible to retrofit the PRVs with new equipment that will manage the pressure and general small volumes of electricity, at the same time. Second, InPipe advises us that the federal government has increased the incentives for renewable energy, which substantially decreases the capital costs. Accepting this grant gives us the opportunity to take one last look at the possibilities, at almost no cost to the City. While there is an in-kind match requirement, this can be paid with staff labor, which we do anyway to service the PRVs. If the micro-hydro idea doesn't work out, we are not losing much. If it does work out, it could become a huge asset to the City and a model for this renewable technology.

C. InPipe Energy. We further recommend that the City Manager be authorized to enter into a sole source contract with InPipe Energy to perform the design services required to take the next steps. If it weren't for InPipe Energy, we wouldn't have taken this next look at the possibilities and InPipe is the only available source of their proprietary technology, which could tip the scales in favor of financial feasibility.

D. Recommendations: We recommend the that the City Council authorize the City Manager to execute (1) a grant agreement with the AEA and (2) a sole source contract with InPipe Energy.

Appendix C Grantee Proposal/Scope of work

Submit Mechanical and Electrical Engineering Final Design including a Notice of FERC exemption (regulatory/permitting).

Milestones	Reimbursable Tasks	Grant Budget	Match Budget	Total Budget	Start Date	End Date	Deliverables
Final Design	Design review meeting, finalize design (Mechanical Engineering Design)	$45,000		$45,000			Mechanical design drawings
	Design review meeting, finalize design (Electrical Engineering Design)	$30,000		$30,000			Electrical design drawings
Regulatory	FERC Exemption	$4,000		$4,000			Notice of FERC exemption
Total		$79,500		$79,500			

Clean Energy Smart Water Better World

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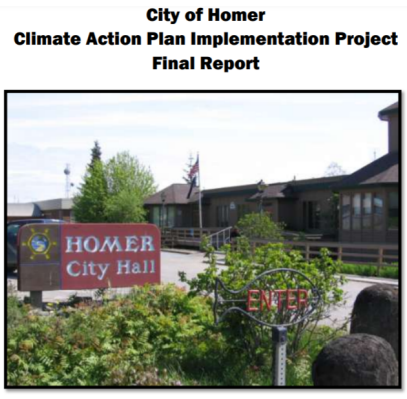
INPIPE ENERGY

City Sustainability Goals

- First City in Alaska to develop local Climate Action Plan
- Revolving energy fund for projects that reduce energy use in municipal facilities
- 2018 Comprehensive Plan objectives
  - "The City of Homer will be a community leader in implementing policies that promote energy efficiencies"
  - "The City of Homer will play an active role in influencing regional policies that promote the research, development, and use of sustainable energy alternatives"



Preliminary Assessment

- In-PRV Overview
- Summary
  - Hydraulics analysis for City of Homer sites meets key minimum requirements
    - ☑ Pressure differential
    - ☑ Flow rate
    - ☑ Energy generation capacity and production
  - Economic drivers support project feasibility
    - ☑ Available utility programs
    - ☑ Incentives and funding options
- Next Steps
  - Collaboration to pursue funding
  - Virtual site visits
  - MOU
  - Additional data gathering

In-PRV Overview

InPipe Energy has developed a solution that precisely manages pressure and provides a new source of low cost, renewable energy, reduces carbon, saves water and extends the life of critical infrastructure

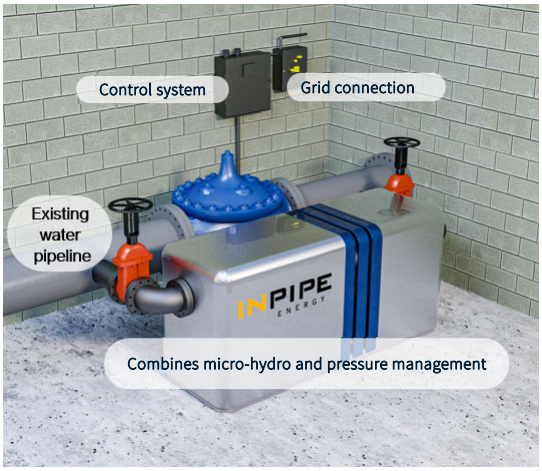
Wasted energy in pressure control

The mechanical mechanism used by traditional control valves wastes energy (up to 350 kW, 3.8M lbs. CO_2/Yr. per valve)

The In-PRV is a pressure recovery valve

The In-PRV™ produces renewable energy and accurately controls pressure

- Turn-key, software and sensor-based, modular solution, installs efficiently onto water pipelines and electric grid
- Offsets carbon emissions otherwise lost with wasted energy
- Digitally-enabled, providing mission critical data and control
- Lowest cost-of-energy for a distributed renewable energy source



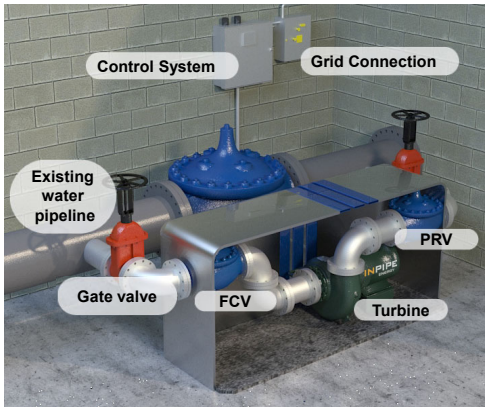
Patents pending

How it works

The In-PRV™ (Pressure Recovery Valve) accurately controls pressure while generating renewable energy

- Installs easily with existing infrastructure
- Connects to the grid the same way as solar systems
- 1/3 the cost of current approaches

INTERNATIONAL AND US PATENTS PENDING



Site Suitability and Energy Production

Site data and assumptions

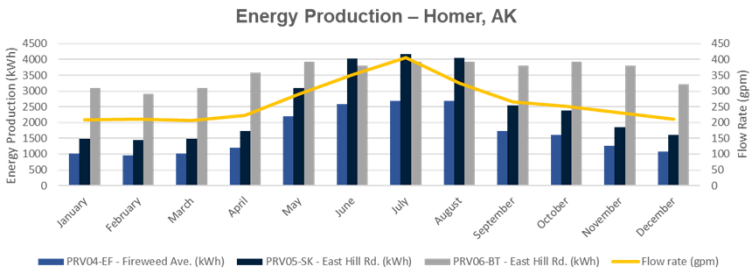
Site Name	Location	Inlet/ outlet size	Inlet PSI	Outlet PSI	Differential PSI	Available Head (ft.)
PRV04-EF	Fireweed Ave	4”	86	32	54	124.74
PRV05-SK	East Hill Rd.	4”	103	29	74	170.94
PRV06-BT	East Hill Rd.	3”	149	50	99	228.69

In-PRV Energy Production

Site Name	Location	Differential PSI	Available Head (ft.)	Estimated Annual Energy Production
PRV04-EF	Fireweed Ave	54	124.74	20,000 kWh/yr.
PRV05-SK	East Hill Rd.	74	170.94	30,000 kWh/yr.
PRV06-BT	East Hill Rd.	99	228.69	43,000 kWh/yr.

- Size of Project Total (3) Locations: 19 kW
- Estimated Annual Total Production: 93,000 kWh/year

In-PRV Energy Production Profile



- Consistent production characteristics
- Size of Project Total (3) Locations: 19 kW
- Estimated Annual Total Production: 93,000 kWh/year

Potential Financing Options

Funding source	Description	Comments
City of Homer	City owns project (revolving funds)	Project pays for loan servicing, City retains benefits, subsidized capital cost
Alaska Energy Authority	Renewable Energy Fund (REF) provides grant funding to finance in-state clean energy projects	Reduces out-of-pocket project costs, accelerates payback Due date January 18, 2022
Homer Electric	Energy efficiency grant options	Reduces out-of-pocket project costs, accelerates payback,

10 steps to a successful project

1. Hydraulic Analysis and Potential Energy Assessment ✔
2. Site Visit
3. Economic Assessment
4. Memorandum of Understanding
   - Align our interests with all the stakeholders
   - Procurement
5. Design Proposal
   - System layout
   - Schedule
6. Installation Contractor Quote
7. Contract
8. Regulatory/Permitting submittals
9. PPA/Interconnection
10. Installation

Next steps

- Collaborate to apply for funding
- Virtual site visits
- MOU
- Additional data gathering

Inflation Reduction Act HydroXS-related provisions

Enables HydroXS projects to qualify for incentives

- Definition of hydrokinetic energy extended to include systems in “pressurized water used in a pipeline (or similar man-made water conveyance which is operated for the distribution of water.”
- Reduced minimum project size changed to 25 kW from 150 kW.

Extends Investment Tax Credit (ITC)

- Renews the full 30% credit rate and creates a provides a 10-yr. extension
- Provides adders up to an additional 20% for projects that satisfy domestic content and energy community (brownfield site) requirements.
  - InPipe can meet criteria for an additional 10% (domestic content)
  - Potential +10% if at any time after 2009 had significant employment or tax revenues that are attributable to the extraction, processing, transport or storage of coal, oil or natural gas industries

Provides direct pay and transferability alternatives for tax credits

- Tax-exempt entities (including municipalities and other state and local governmental entities) can directly utilize incentives through a “direct pay” option

Hydroelectric production incentive (US DOE Section 242) program

- Provides a 2.3 cents/kWh incentive for the first 10 years of energy production for new hydro projects

Skagit PUD HydroXS Project Summary

InPipe Energy and Skagit Public Utility District completed the East Division Street Energy Recovery Project at Skagit PUD's East Division Street booster pump station in Mount Vernon, WA in July, 2021. Skagit PUD's installation is the first pressure recovery project in Washington state that utilizes the HydroXS from InPipe Energy, a new smart water and micro-hydro system that generates electricity by harvesting excess pressure from municipal water pipelines. By recovering the energy embedded in excess water pressure and converting it into electricity, the system generates up to 100,000 kilowatt-hours (kWh) or more of electricity per year while providing pressure management that helps save water and extend the life of the pipeline. The electricity produced offsets the use of grid power at the pump station, saving Skagit PUD (and its ratepayers) money and replacing the equivalent of 3.5 million pounds of fossil-fuel-based carbon emissions. This system has operated without incident. The project was made possible with assistance from Puget Sound Energy (PSE), as part of their "Beyond Net Zero Carbon" initiative, and a Coal Transition Board Grant from TransAlta energy company.

"Converting excess water pressure into clean, renewable energy is a win for the environment and our ratepayers, "said George Sidhu, Skagit PUD General Manager. "Environmental stewardship is one of Skagit PUD's core values; and in our actions, we want to preserve our region's natural resources. As a public utility, we're always looking to innovate and create greater efficiencies in the operation of our water system, and the East Division Street micro-hydro project checks all the boxes," Sidhu added.

"The world's water infrastructure is energy and carbon intensive," said Gregg Semler, president, and CEO of InPipe Energy. "We see a large, global opportunity for water agencies to meet their mission while also battling the impact of climate change. The sustainability of our nation's water systems is paramount, yet water agencies are being constantly challenged with rising energy costs and aging infrastructure. By providing a more precise way to manage pressure in pipelines – while also producing electricity – our In-PRV product helps water agencies offset their energy costs while saving water, reducing carbon and extending the life of their infrastructure."

In January 2021, Puget Sound Energy set its aspirational "Beyond Net Zero Carbon" energy company goal. Through this initiative, PSE targets reduction of its own carbon emissions to net zero and goes beyond by helping other sectors to enable carbon reduction across the state of Washington.

"We value the opportunity to provide this energy efficiency program grant to Skagit PUD to help them be more efficient and build resilience," said PSE President and CEO Mary Kipp. "This partnership reflects our commitment to combat climate change by reducing our own carbon emissions to net zero and helping other sectors to enable carbon reduction across the state of Washington."

TransAlta, which is in the process of phasing out its last coal-fired power plant in Centralia, Wash., by 2025, has committed to supporting local communities and renewable energy development through its Coal Transition Board Grant process.

"We are committed to the development of innovative new forms of renewable energy, and this energy recovery project at Skagit PUD sets a great example for the role water utilities can play in making both water and energy more sustainable," said John Kousinioris, CEO of TransAlta. "We are excited about the potential for the In-PRV to produce carbon-free electricity from water pipelines across North America."

“Water is a critical resource in Skagit County as it relates to power generation, and this project demonstrates our regional leadership,” Sidhu said.

The HydroXS Pressure Recovery Valve

Skagit PUD’s pump station is the second installation of the In-PRV in a municipal water pipeline. The first, in the city of Hillsboro, Oregon, came online in September 2020 and is on track to produce 200,000 kWh or more of electricity each year.

Here’s how the system works:

Water agencies typically deliver water to customers by gravity feed and use control valves, called pressure-reducing valves (PRVs), to manage pressure in their water pipelines. PRVs help protect pipelines from leaks and deliver water to customers at safe pressure.

Normal PRVs use friction to burn off excess pressure, which is dissipated as heat. All of that energy is, essentially, wasted.

InPipe Energy’s In-PRV pressure recovery valve system performs like a highly precise control valve. But it takes the process one step further by converting the excess pressure into a new source of carbon-free electricity.

The In-PRV is the first system that combines software, micro-hydro and control technology as a turnkey product that can be installed quickly, easily and cost-effectively throughout water systems with smaller-diameter pipelines and wherever pressure must be reduced.

From profile published in Water World:

https://www.waterworld.com/water-utility-management/energy-management/press-release/14206651/system-produces-renewable-energy-from-municipal-water-pipeline-in-wa

Video link:

https://www.youtube.com/watch?v=pKQF2bufqdo