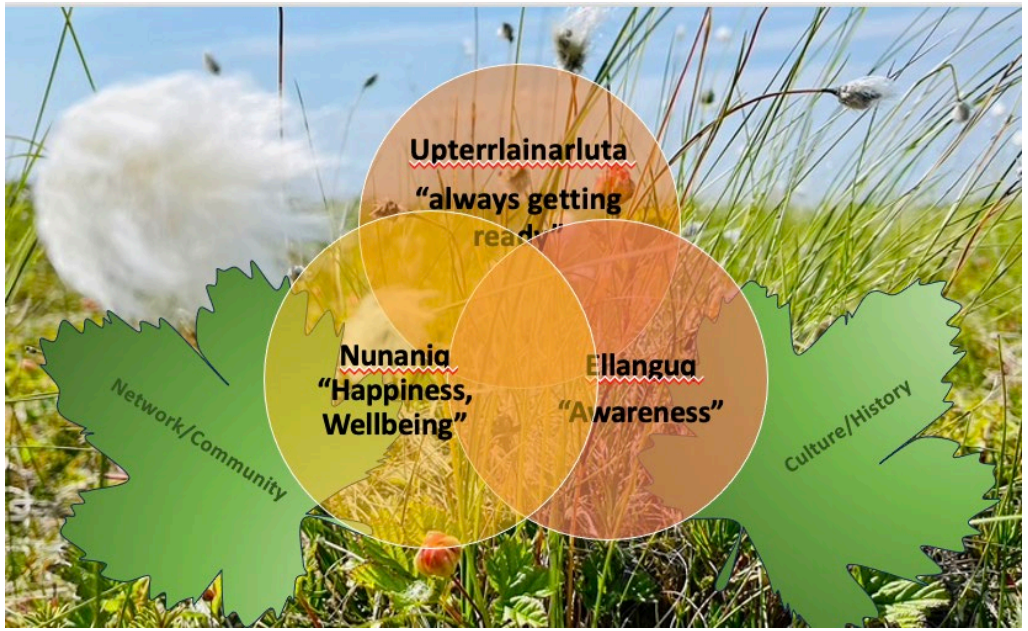
A RESILIENT AND AUTONOMOUS MICROGRID POWERED BY MARINE RENEWABLE ENERGY

Karl Hill and AlexAnna Salmon, Igiugig Village Council, November 18, 2024



Government Services

For Profit LLCs

Utilities/Infrastructure Housing

Igiugig Village Council

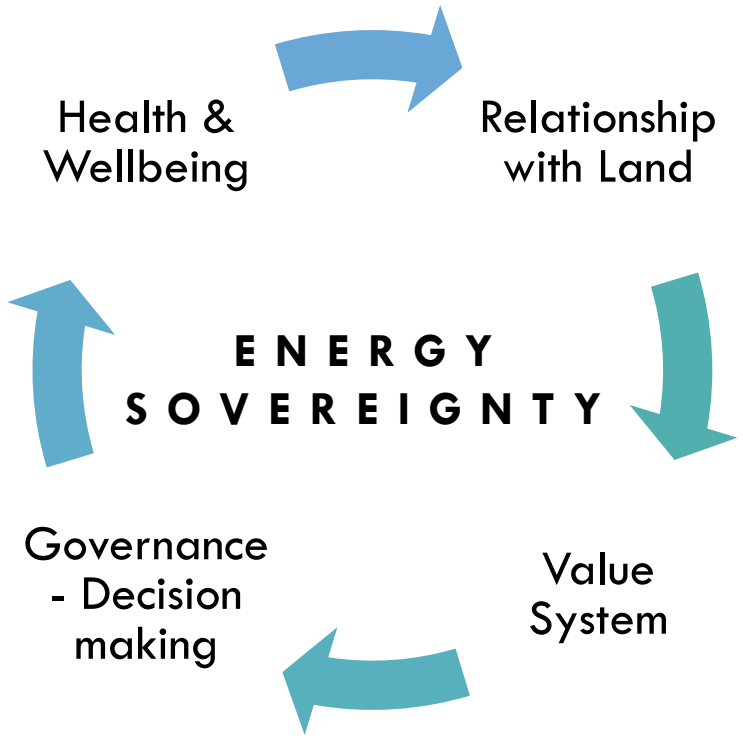
Language/Culture

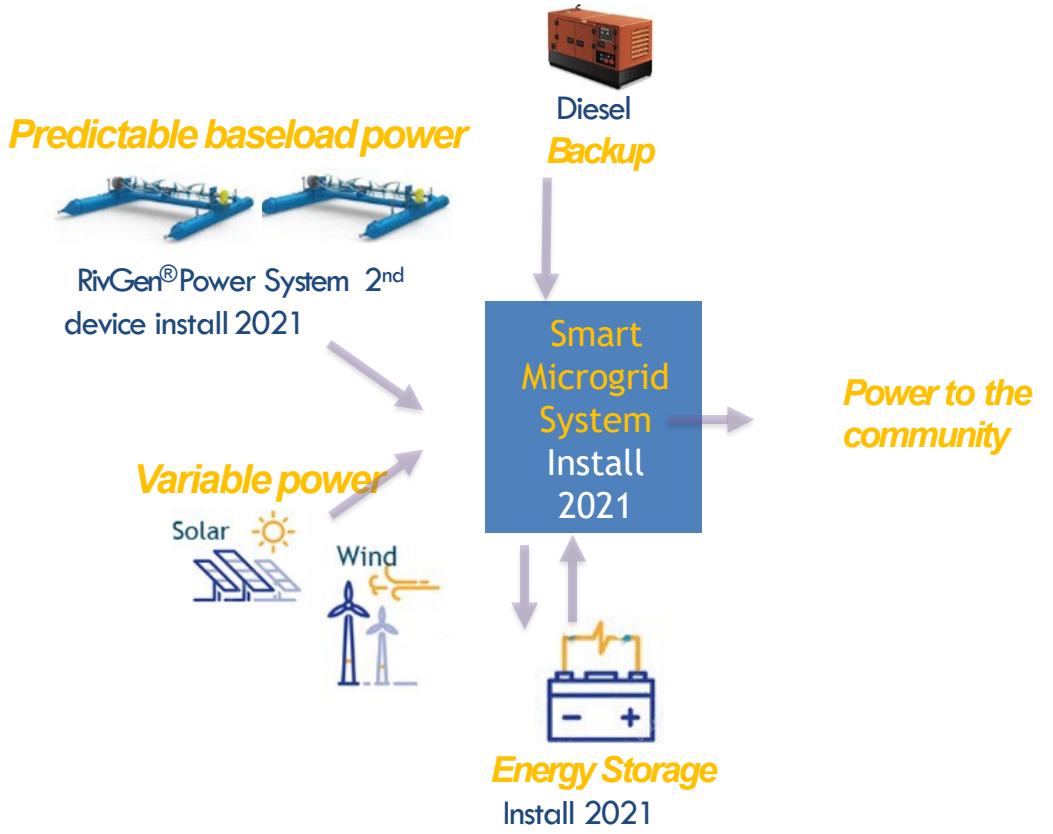
Education/ HealthCare

The People & Values

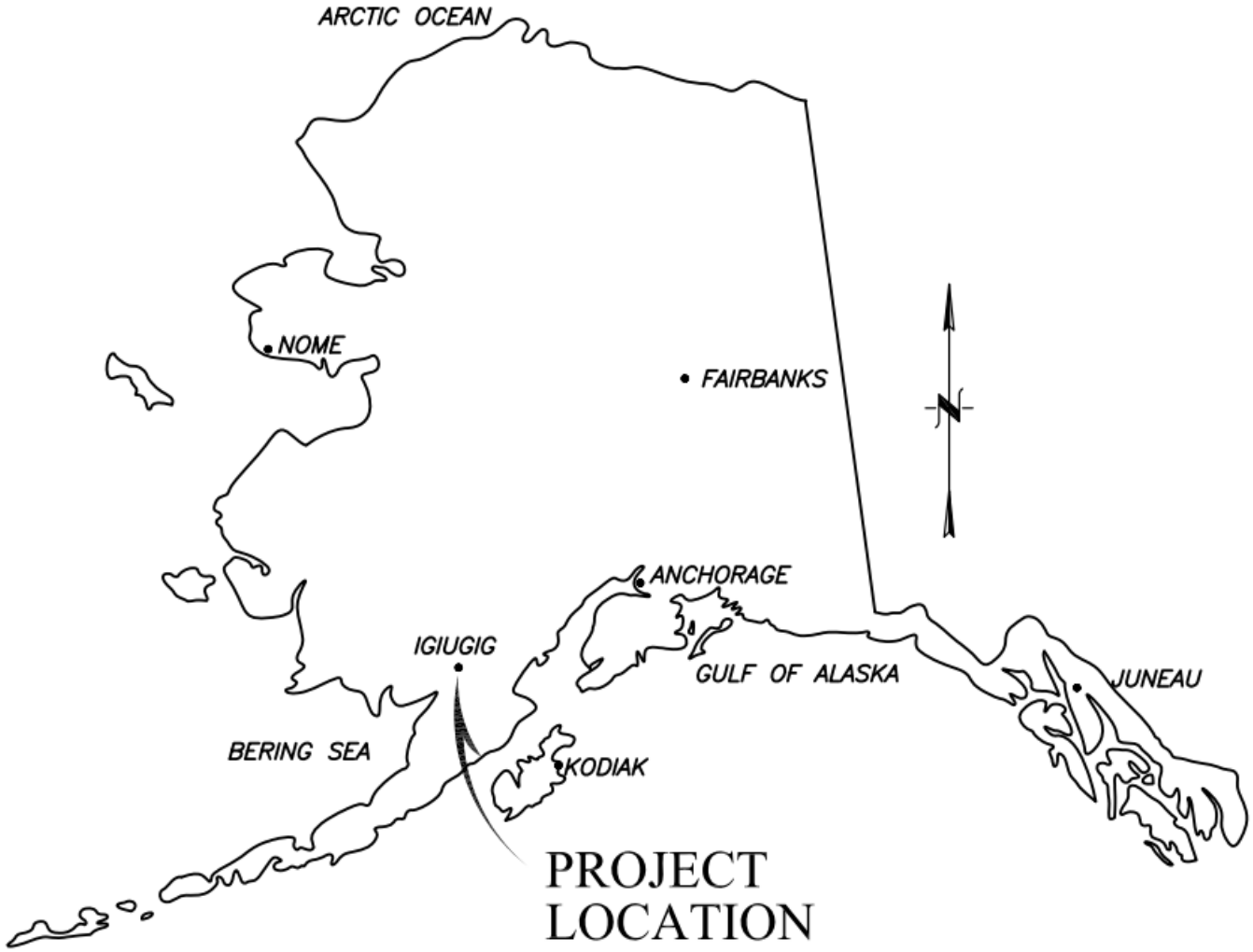
Local Businesses

Igiugig Native Corporation





The Smart Microgrid Solution for Igiugig



PROJECT LOCATION MAP

ANNUAL COST TO OPERATE IGIUGIG ELECTRIC CO. 2023-24

Fuel	71.84%
Depreciation Expense	12.95
Payroll Expenses	8.12
Power Plant	3.79
General Administrative	1.26
Internet	0.69
Merchant deposit fees	0.60
Utilities	0.36
Repairs & Maintenance	0.13
Miscellaneous	0.10
Other	0.17
Total	$377,736.11

Fuel Prices in Igiugig
#1 Diesel $10.10 per gal
#2 Diesel $10.94 per gal
Gasoline $10.94 per gal

Electricity
$0.91/kWh
$0.72/kWh power cost equalization subsidy up to 750kWh

PROJECT SUMMARY

Project Need

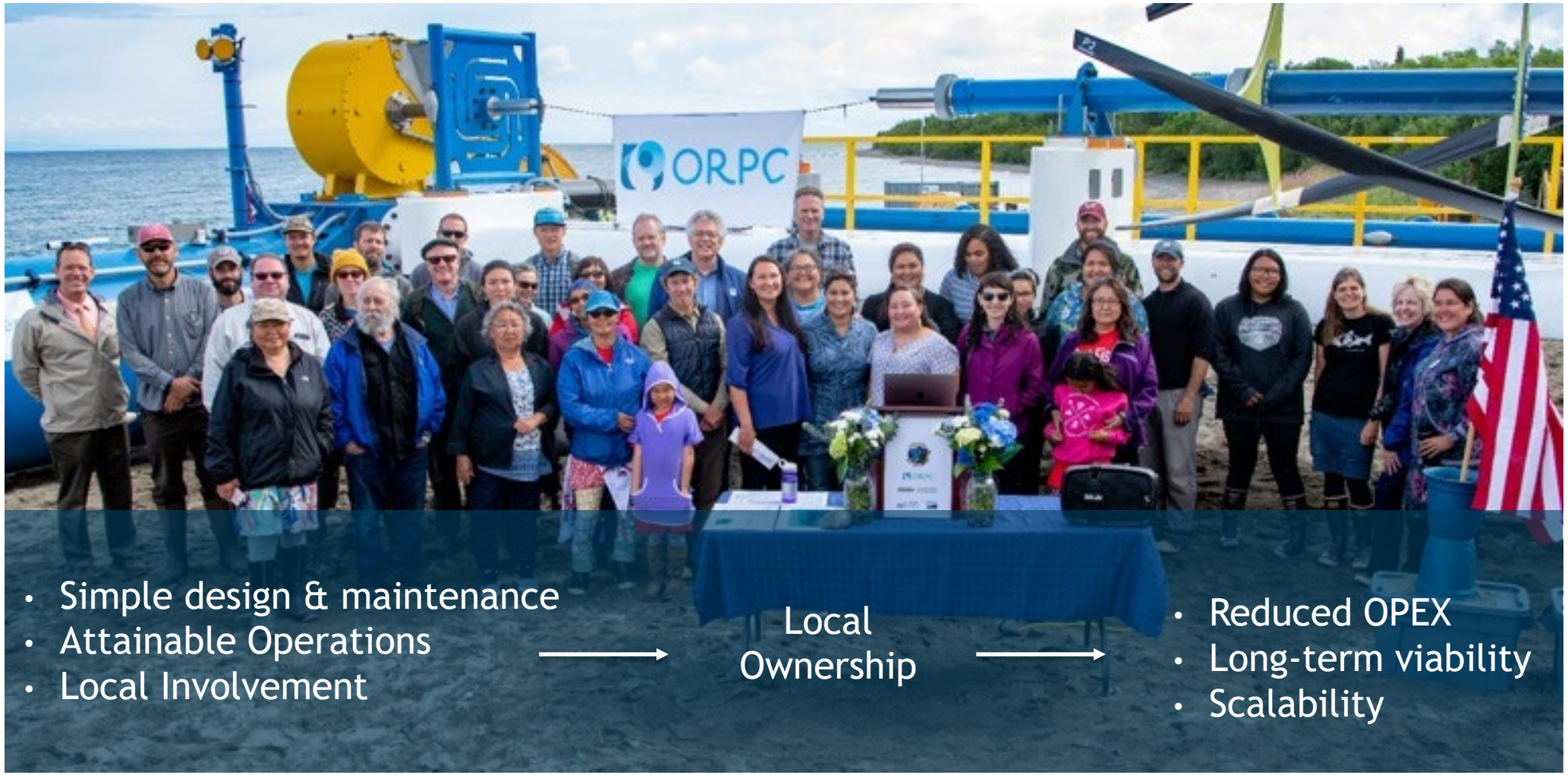
- Igiugig has very high energy costs. Like most remote northern communities, we are not connected to a centralized electrical power grid or fuel supply pipelines
- The power plant is comprised of three diesel generators, each with 65 kW generators, which produce 325 MWh/year using a total of 24,789 gallons of diesel

Project Objective

- To acquire and install a smart microgrid and energy storage system, capable of managing high-penetration renewable energy sources that will provide power to all Igiugig homes and facilities for sustainable energy supply and resilient operations

TECHNOLOGY SELECTION

Ensuring long-term viability through local ownership



IGIUGIG HYDROKINETIC PROJECT: PHASE I

PHASE I HIGHLIGHTS

- Funded by the Department of Energy Water Power Technology Office
- Igiugig Village Council selected ORPC for its patented marine renewable energy technology which seemed viable for river conditions and ease of deployment

PHASE I HIGHLIGHTS

- First tribal entity to hold a FERC hydrokinetic pilot license
- Deployed and tested Rivgen 2.0 over two Alaskan winters (-40°C) and two frazil ice events
- Recorded tens of millions of sockeye salmon transiting past the device, with no observed injuries or mortalities
- During spring ice break-up, over 2 ft of lake ice flowed safely over device

PHASE I HIGHLIGHTS

- Smolt outmigration monitoring
- Adaptive Management Meetings
- Monitoring
  - Igiugig Village Council
  - ADF&G
  - University of Alaska Fairbanks
  - Pacific Northwest National Laboratory
    - AquaAcoustics 2022

IGIUGIG HYDROKINETIC PROJECT: PHASE II

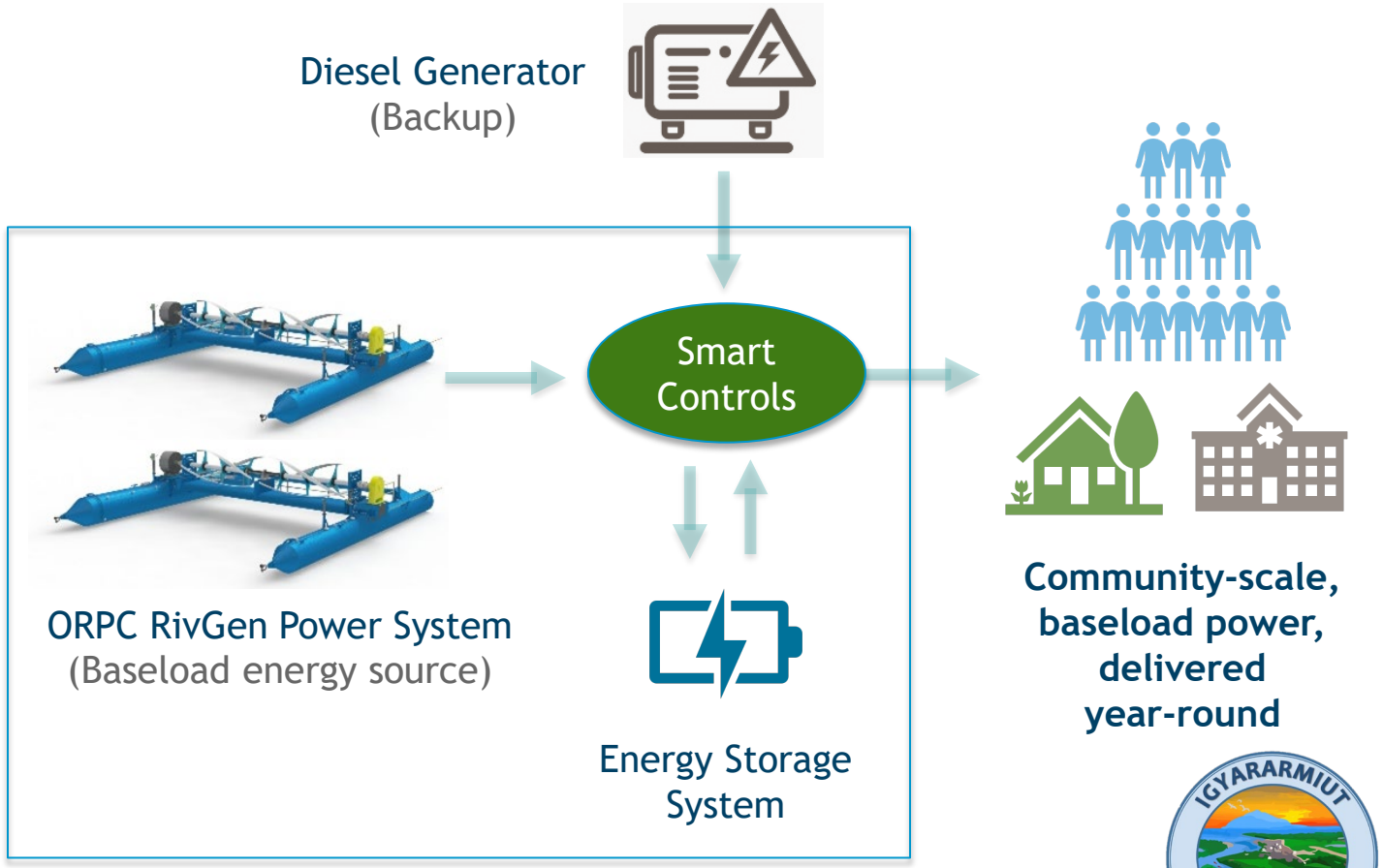
PROJECT FUNDING & TECHNOLOGY PARTNERS

FUNDED BY THE U.S. DEPARTMENT OF ENERGY OFFICE OF INDIAN ENERGY

- ORPC, Schneider Electric, Alaska Energy Authority
- Energy Transitions Initiative Partnership Project
- National Renewable Energy Labs

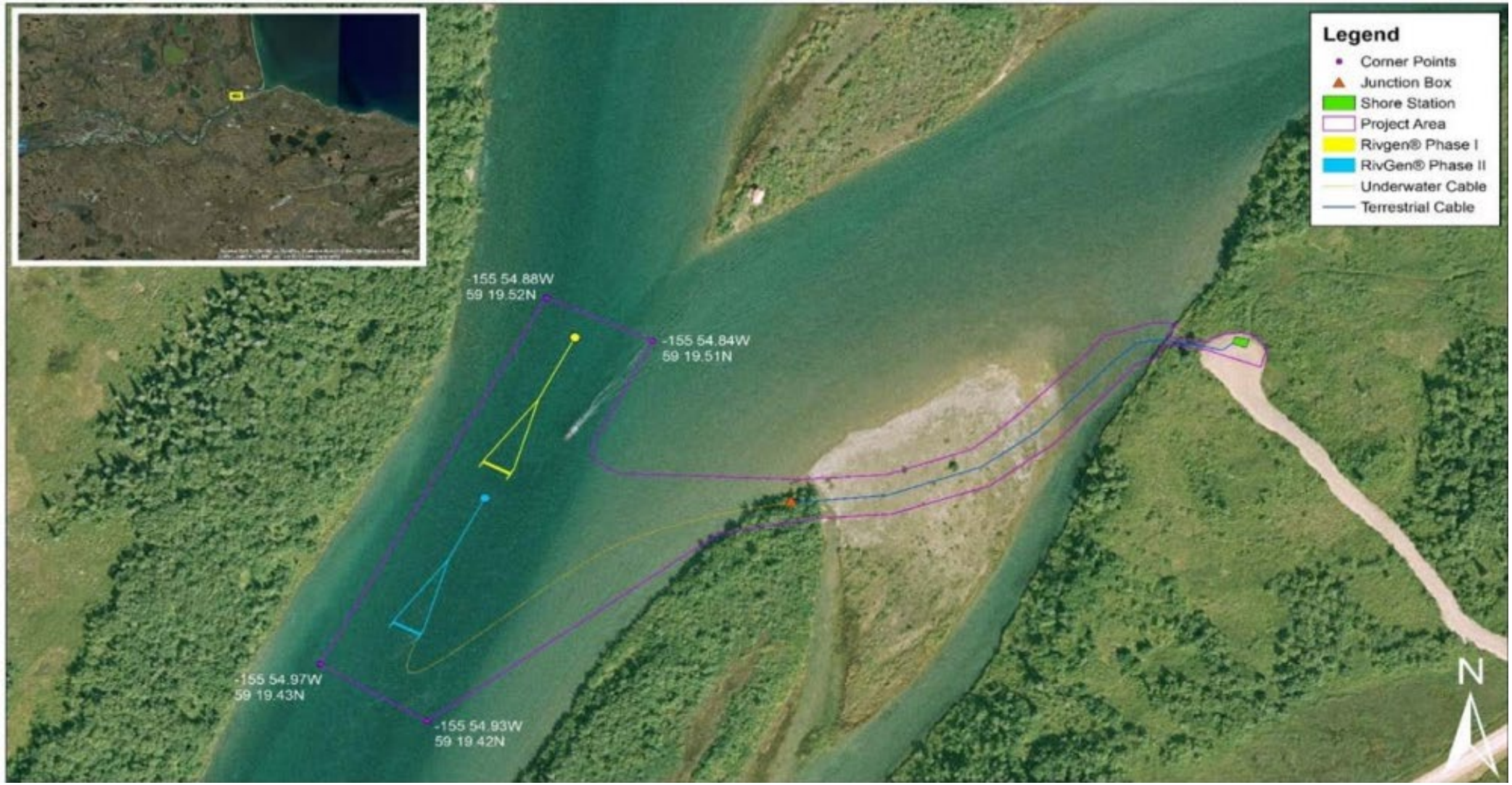
A MICROGRID DELIVERS BASELOAD RENEWABLE ENERGY FROM FREE-FLOWING RIVERS

- A RivGen-powered smart microgrid can relegate diesel generators to backup only.
- RivGen provides predictable baseload power.
- Energy storage and smart controls, coupled with RivGen baseload power, improve the value proposition of intermittent sources like wind and solar.



WORK COMPLETED TO DATE
AND
LESSONS LEARNED

WORK COMPLETED TO DATE



- Phase I: RivGen 2.0 Power System device, cabling, anchor, shore station with electronics, and interconnect to Igiugig Electric Company.
- Phase II: RivGen 2.1 Installation with similar infrastructure and connection

Mooring Anchor Deployment

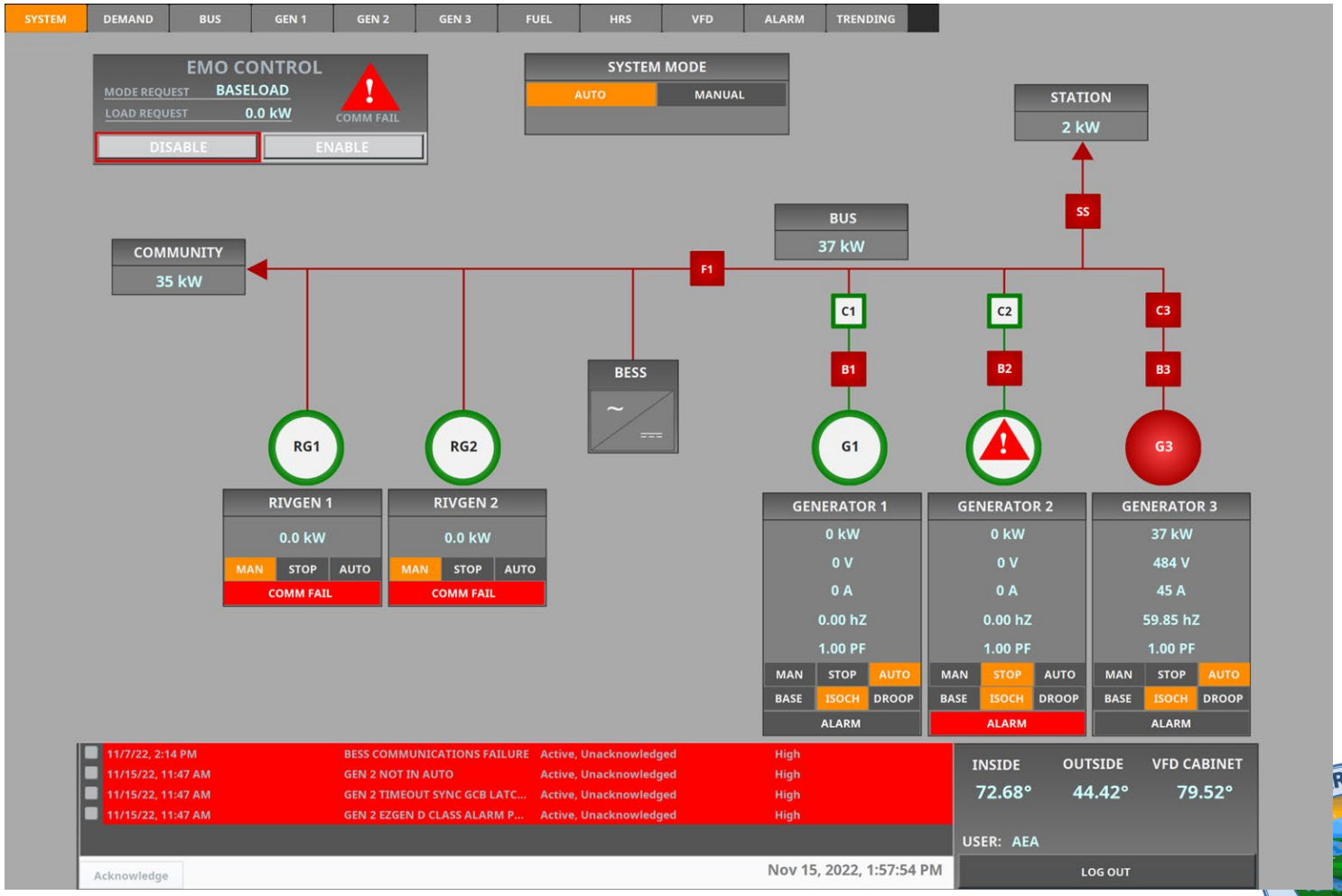
Power & Data Cable Deployment

BATTERY ENERGY STORAGE SYSTEM

- Installed fall 2021, commissioning began spring 2022…still underway
- Ability to be grid following or forming
- Rated for 253 kWh, 125kW inverter

GENERATOR CONTROL UPGRADES

- Installed summer 2022
- Remote view
- SCADA access



LESSONS LEARNED

- Phase II of the project is still happening…we're continuing to learn lessons
  - Weather and seasonality can impact project timelines
  - Communication between project teams is key
  - Expect frazil ice conditions
  - Interconnection and commissioning will never go as planned

WINTER OPERATIONS

FRAZIL ICE

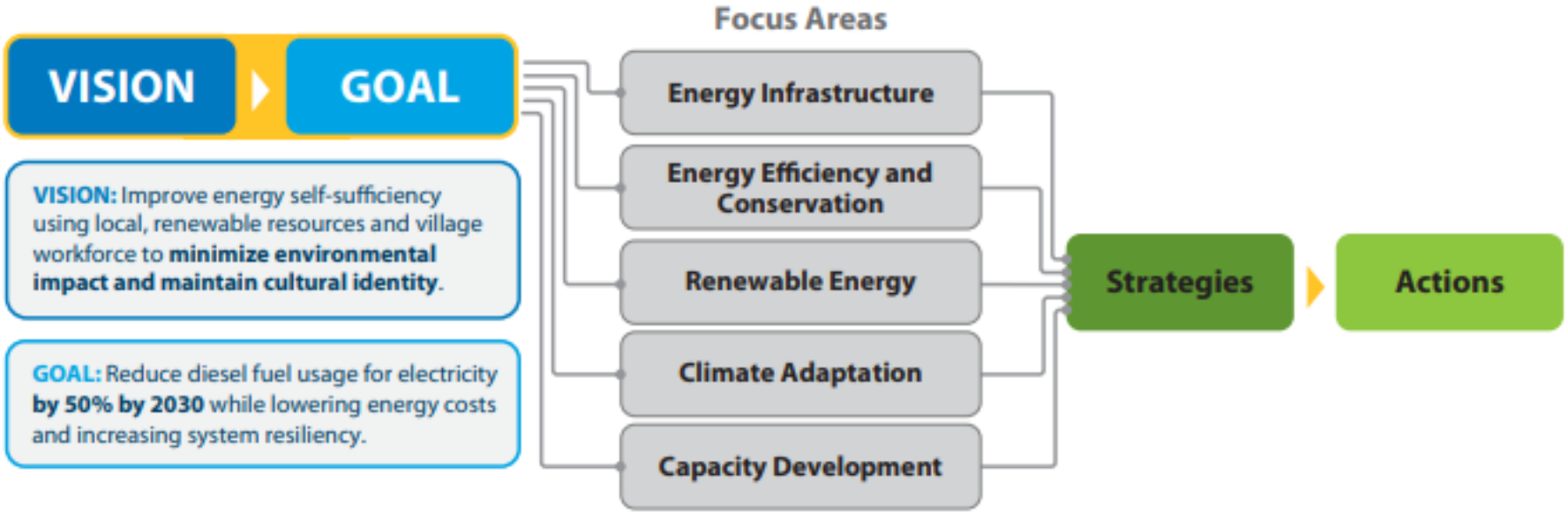
INTERCONNECTION SHORT

- Several millisecond anomalies occurred
- Blackout ensued
- Safety protocols
- Adjust and keep moving forward

RIVER DEBRIS INCREASE FROM STORM EVENTS

FUTURE ACTIVITIES & FUTURE PARTNERSHIPS

- Implement solution to diesel generator waste heat loop
- Complete Power Purchase Agreement/Service Agreement
- Complete commissioning Battery Energy Storage System and Microgrid
- Continue salmon smolt monitoring
- Stepping up the Storytelling!
  - Creating a 5 minute energy video
  - Drafted a chapter of Igiugig's energy transition story
  - Continue Implementation of Igiugig's Energy Plan.



2000-8

Community Vision and technical planning

Community Vision

2011-14

Renewable feasibility studies by AEA and NREL

Feasibility

2014

Partnership with ORPC and Rivgen 1.0

River Energy

2019

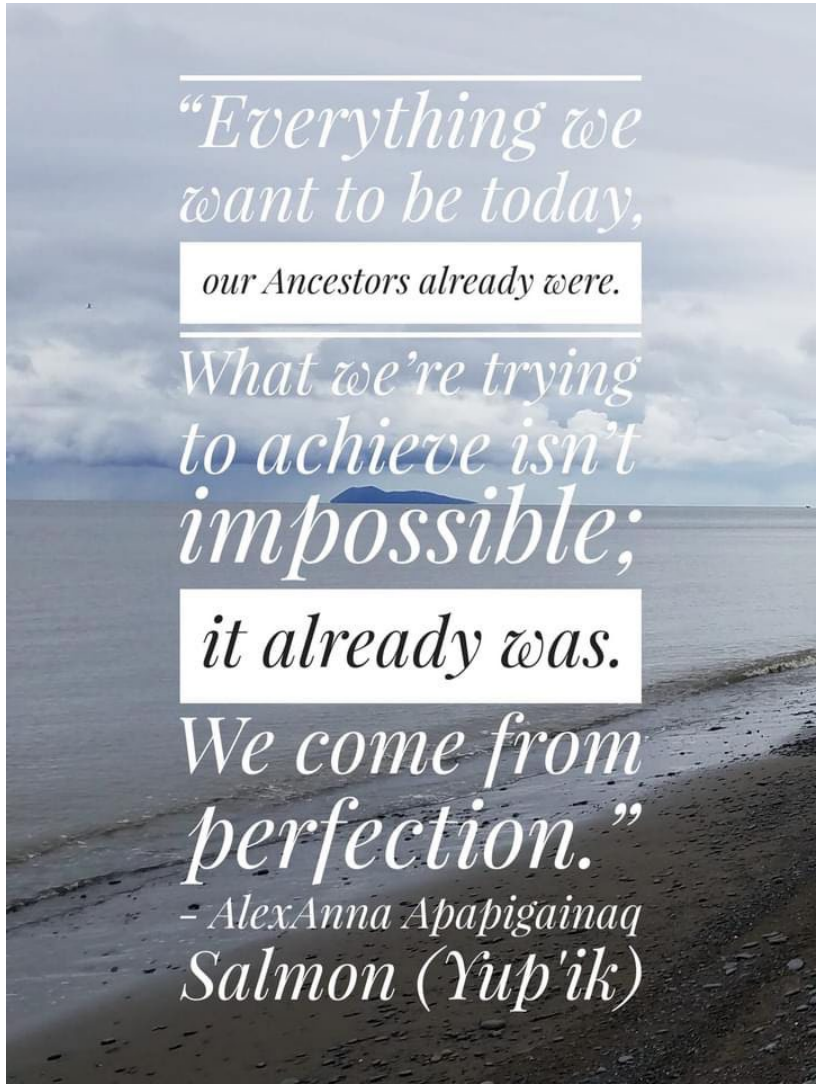
Test of RivGen 2.0

RivGen

2022

Working RivGen 2.1 and microgrid integration

Integration


"Everything we want to be today,
our Ancestors already were.
What we're trying to achieve isn't impossible;
it already was.
We come from perfection."
- AlexAnna Apapigainaq
Salmon (Yup'ik)

Igiugig

HYDROKINETIC PROJECT

The Igyararmiut have been actively exploring multiple sources of renewable energy to transition the community away from diesel generation. One solution is hydrokinetic energy—harnessing the power of moving water.

In 2019, Igiugig Village Council became the first tribal entity in the United States to secure a Federal Energy Regulatory Commission pilot license for a hydrokinetic project. Igiugig has partnered with ORPC, a Maine-based developer of marine energy solutions, to deploy and operate its hydrokinetic RivGen® Power System in the Kvichak River.

The two RivGen devices operate under the water's surface downriver from where you stand. The natural flow of the river rotates the turbines, sending power to generators on each device.

The generators then transmit the electricity through underwater cables to the two shore stations you see here.

Combined with smart grid controls and a battery energy storage system, the RivGen Power System can provide baseload power to the Igiugig microgrid.

SUSTAINABILITY

The Kvichak River joins eight other rivers flowing into Bristol Bay, home to the world's largest wild sockeye salmon run[1].

Drawing on deep Indigenous knowledge systems that inform the community's transition to renewable energy, Igiugig chose ORPC's technology as the least impactful to migrating fish.

For 9,000 years, the Igyararmiut have lived sustainably in the area. The community is implementing solutions that demonstrate how remote communities can transition from fossil fuels to ensure a safe environment and energy independence for future generations.

To learn more about how you can support this journey, please contact Jon Salmon at jonathan.salmon@igiugig.gov.

Quyana to the U.S. Department of Energy Office of Indian Energy and Water Power Technologies Office, the Alaska Energy Authority and Igiugig Village Council for support and funding.

For information on river and tidal energy solutions contact **info@orpc.co** or visit **www.orpc.co.**

[1] https://www.epa.gov/bristolbay/about-bristol-bay

ORPC

QUYANA TAILUCI! CHIN'AN GHELI

For more information on this project, contact:

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