Linda Engle Introduction: Sustainable Idaho is brought to you by the Portneuf Resource Council.

Madison Long: Welcome to Sustainable Idaho. I'm your host Madison Long and today I talked with Roy Mink, who has been involved with geothermal energy for over 40 years exploring Idaho mines, water and energy resources. He is also the President of MinkGeoHYdro, a geothermal application consulting firm and was the former Director of Geothermal Technologies Program for the U.S. Department of Energy.

According to the U.S. Energy Information Administration, Idaho only has one operational, utility-scale geothermal power plant. Located in Cassia County is the Raft River plant, managed now by Ormat Technologies. Could you give us an overview and history of the Raft River Geothermal Power Plant?

Roy Mink: It's got quite a history. The Raft River Geothermal Power Plant actually got started by a research project with the Idaho National Lab. At that time, it was the Energy Research and Development Administration, or ERDA, but they were very interested in demonstrating the binary technology of geothermal, which was a brand new technology.

They started drilling seven wells in about 1975, three full production wells, and three ejection wells. The five megawatt binary prototype power plant was actually constructed from 1978 to 1981. And 1981 to 1982, they actually fired the plant up. It was a collaborative effort between the Department of Water Resources, the Raft River Rural Electric, and the Idaho National Laboratory. That demonstration took place over a period of about a year, then they decided to close the plant down. Between 2002 and 2008, U.S. Geothermal built a 10 megawatt power plant at Raft River. In 2018, Ormat purchased the plant and operations from U.S. Geothermal.

ML: Power generated by the Raft River Geothermal Power Plant is sold to Idaho Power, within a U.S. Geothermal power purchase agreement, supplying 10 megawatts of energy. Although, according to Mink, this geothermal production is less than 1% of all Idaho's energy.

As part of the Snake River Plain volcanic center, Raft River is a high heat flow area, making it a hotspot for geothermal activity. But how does Raft River convert this hot water into electricity?

RM: This one is a binary cycle, which brings the water up from 5,000-foot wells to a working fluid. That fluid has a lower boiling point, usually isobutane or a component of an organic fluid. The geothermal water that comes up from the well after it extracts its heat in the binary cycle is then re-injected back into the ground to be reheated by the earth and cycled back up.

ML: A binary cycle plant uses two fluids. One is circulated underground to collect heat, which is transferred through a heat exchanger to a second fluid. That second fluid turns to high-pressure vapor and spins a turbine to generate electricity. The benefits to a lower boiling point include energy efficiency, less decomposition of heat-sensitive materials, and enabling the use of lower temperature heat sources. Other geothermal power plants might use a dry steam method where

steam is pulled directly from reservoirs, or a flash steam system where high-pressure hot water is converted to steam by reducing pressure. Is there a reason the binary cycle was chosen for Raft River?

RM: Mainly because the temperatures were lower than what you could use efficiently for a flash system. A flash system requires water in excess of 300 degrees and actually better if it's a much higher temperature and under higher pressure. The Raft River water came up to be about 170 to 300 degrees, so it was right below the threshold to be efficient for a flash system.

ML: Because of the hot, mineral-rich fluids used from underground, geothermal power plants are at risk for scaling, or the hardening of deposits as fluid temperature changes and also water corrosion. However, Mink notes that Raft River has benign water, with the total dissolved solids approximately 1,500 parts per million. This benign water is overall clean water, free from hard deposits that block pipes and lower energy production.

RM: In fact the water at Raft River is high enough quality that they use it for irrigation and stock water. It's a pretty clean water, so there's not really any problem with respect to the additives that you need when you're dealing with a high brine system like we find in some of the other states.

ML: According to the Union of Concerned Scientists, concerns around the environmental impacts of geothermal power plants include the release of carbon dioxide, methane, boron, and hydrogen sulfide. The removal of water from geothermal reservoirs, without re-injection, can create land subsidence, where the land surface sinks. Does Raft River face any of these issues?

RM: They did some studies on if there was any endangered species, they did some calculations if the system would affect the shallow groundwater that's used for drinking water. We really didn't have much environmental impact out there.

ML: In 2023, the U.S. Energy Information Administration reported that geothermal energy accounted for 16 billion kWh, while solar accounted for 165 billion Kwh, and wind 425 kWh. Do you have any insight about why geothermal energy is not as quickly utilized as compared to wind or solar?

RM: From my experience, it's been a problem in the past, is that front-end cost. There's a lot more cost to the front-end exploration and drilling in geothermal than you have for wind and solar. It's easier to measure the resource of solar. You do the same thing from wind. Very inexpensive. It's very easy to assess the potential. Geothermal requires a significant amount of exploration and confirmation drilling, very much like a mining operation. You've got a lot of front-end cost there relative to understanding the subsurface worth developing. I see that front-end cost has really been a detriment for Idaho as well as for the whole resource throughout the nation.

ML: According to the University of Michigan and the Center for Sustainable Systems, In 2025, geothermal electricity cost $88/MWh, nearly half the price of coal or gas but about $10-$20 more than onshore wind and solar.

Despite cost, the U.S. Department of Energy reports that geothermal energy can be a beneficial, reliable energy source available all year round, with high-capacity function, and production of solid materials to be used for other research or construction purposes. This energy is also continuously replenished by the decay of naturally occurring radioactive materials beneath the subsurface.

Looking more broadly at geothermal power in Idaho, how might the Raft River Geothermal Power Plant work to support Idaho Power's clean energy goal of 100% clean energy by 2045? This plan is made note of in their 2025 Integrated Resource Plan, or IRP.

RM: Idaho Power's recently added geothermal as a priority in their integrated resource plan. So having geothermal mentioned in the IRP of Idaho Power will go a long ways to help meet that goal, and I think we have the resources in the state. I think if we can possibly provide some incentives and also work with Idaho Power to get power purchase agreements, and with Rocky Mountain Power working with the laboratory and the universities on technologies to cut that front-end risk and front-end cost will make a lot of difference. And I know there's activities going on with the laboratories, not only Idaho National Lab, but reducing cost by new drilling technology, new geophysical techniques that could better map the subsurface for geothermal energy. We've got that potential. It's just a matter of kind a getting the pieces put together to have people come to Idaho to develop the geothermal in state rather than going to other states after it.

ML Outro: Thank you to Roy Mink for teaching us a little more about Idaho’s geothermal energy and the role the Raft River Geothermal Power Plant plays in that energy generation. For more information, check out our website at kisu.org/sustainableidaho.

L Outro: Funding for our Sustainable Idaho Student Hosts is provided in part by this radio station, the ISU Center for Ecological Research and Education, through the ISU Career Path Internship Program. Direction, funding, and additional support is provided by the Portneuf Resource Council.