

Enefit American Oil is intent upon mining oil shales of Utah's Green River Formation. The deposits lie not only here in Utah, but also in Wyoming and Colorado. Exxon, Shell, and other major oil producers have, by and large, been stymied in their attempts to profitably steam, freeze, burn, or bake hydrocarbons out of these rocks. But Enefit believes that it has a better process to wring kerogen--and ultimately oil--from the shale. Rikki Hrenko, the company's president, explains.....

A lot of people just don't understand what we're doing, they don't have any idea what mining oil actually means.

We're mining oil, which is a little bit different than what Oil Sands is doing, or than what they're doing with fracking for conventional oil and gas. So just to make sure that that's clear to everyone: the resource is different, the environmental impacts are different, the process is very different.

The US Geological Survey estimates that the Green River Formation holds the equivalent of three trillion *recoverable* barrels of oil in Utah, Colorado, and Wyoming. Exxon and Shell struggled to recover deeply buried oil shale using *in situ* processes that require tremendous amounts of energy and capital. But Enefit proposes to mine deposits at or near the surface. The company's mine site in the eastern Uinta Basin straddles the White River just south of a tiny industrial outlier called Bonanza.

The U.S. has the world's largest oil shale deposits; about 72% of all of the world's oil shale is located right here in Utah, Colorado, and Wyoming. Three to four trillion, exactly. Eight hundred billion recoverable, with roughly a third of that in the Uinta Basin.

We're in the Green River Formation, and the mining horizon that we're targeting, as I said, is fifty-five to sixty feet thick. It starts at the Mahogany marker, it goes down through the Mahogany bed. Technically, the Mahogany zone is a little bit wider than this usually, with a lower target oil yield, so we're targeting in on twenty-seven gallons per ton. And that's where the 2.6 billion barrels comes from.

We have about 30,000 acres inside of our target mining horizon, which is fifty-five to sixty feet thick. We've got about 2.6 billion barrels.

Enefit's process is unique. The company is wholly owned by Eesti Energia, based in Estonia, currently the world's largest producer of energy from oil shale. Over the years, this parent company has been streamlining its refinery processes. It boasts that, rather than using outside sources of energy like natural gas or coal, it can obtain all of its refining energy from the oil shale itself.

We mine, we bring the oil shale to the surface. We then put it through a retort, just a simple pyrolysis process of heating in the absence of oxygen. We get out a vapor, that vapor contains the organics, which will be condensed down into oil. So that vapor goes through an atmospheric condensation tower. You would see this at basically any refinery, where the light ends, the

gases, come out of the top, and you get different fractions of oil according to the weight coming off on the lower sections.

So after you have extracted the kerogen out of the oil you're left with a char. And it combusts that char to provide a very hot ash. That hot ash is circulated back with the raw incoming oil shale to heat it up. And that's what is actually the heat carrier or the heat driver for the process. So there's no external energy used in the process, no electricity, no gas heaters. It's all coming from that heated oil shale and circulating back to heat up the raw incoming oil shale.

The University of Utah released an extensive economic analysis of unconventional oil in 2013, offering a shakey nod of confidence that oil shale can be mined profitably near the surface. Rikki Hrenko smiled at this academic opinion. She believes that Enefit American Oil can beat the odds.

We have a dedicated development budget that is much larger than the \$42 million that we spent to purchase the project. That is committed, and what we intend to do is to develop the project on our own until the point of construction. When we start talking about the budget needed to construct or to build the industry, then we're talking about multi-billions.

Hrenko is very deliberately guiding her fledgling oil shale company through the maze of permits required by local, state, and federal governments. The process is slow but the payoff—and consequences—could be huge.

If we had all of our permits by the end of 2016, we would start construction in 2017. We need a three-year period to bring in the utilities, open the mine, and construct the facilities. We would then start production at 25,000 barrels a day in 2020, and we would start a second construction phase and bring in the full 50,000 barrels a day by 2024.

Fifty thousand barrels a day is anticipated to produce about 2,000 direct jobs, so there's going to be about 1,500 construction jobs, and for the thirty-year life of the project, long-term employment, we're talking about 2,000 new direct jobs. So it's a significant employer for the basin.

The economics are tantalizing--2000 direct jobs, a cornucopia of tax revenues pouring into government coffers. But the stakes are high. No one in the oil shale business has forgotten that, in response to falling prices, Exxon pulled the plug on its nearby Colony Project in 1982, the year before Rikki Hrenko was born. 2100 jobs vanished overnight; eventually 24,000 people left Garfield and Mesa counties in western Colorado.

We very much welcome public involvement, and I think that that's absolutely crucial for a project like this—especially the local community. Those are the people that are going to be most directly impacted by this project. We have been very engaged with the public early on, so we've been forging relationships there with the community for quite a while already, reaching out to not just business groups like the Chamber, but to local community organizations, and also to environmental interest groups. Hearing what their issues and concerns are early on is really important to us.

Exploitation of oil shale is not without environmental consequence. Enefit would strip mine much of the land it controls; that landscape would have to be reclaimed. Air quality, already an issue in the once-pristine Uinta Basin, will have to be mitigated.

So we do have surface mining. But one important point is that we have an ongoing backfilling reclamation process, and we only open up a few hundred acres of the mine at any one point in time. After you've removed all of the organic material, the kerogen out of this rock, you're left with basically just a mineral matter. That mineral is put back into the open mining area, and then topography is replicated, so we try and reclaim topography as much as possible, so that we have an ongoing reclamation process for the mine. We open a few hundred acres, and we backfill and reclaim; open up the next few hundred acres, backfill and reclaim.

Hrenko concedes that it will be difficult, even impossible, to recreate the subtleties of topography like cliffs and ledges. She concentrates instead on just putting the drainages back where they belong.

Here in Utah, we recognize we're in a very arid environment, and we are designing a dry ash backfilling process. So it will not be a slurry, it'll be on a closed conveyor that is dry.

We recognize air quality in the basin, particularly ozone, is an issue. We have been collecting data on air quality for one and a half years now. We have a continuously-operating meteorological station, which in addition to standard meteorological data, also measures for PM 10, PM 2.5, CO, NO_x, SO_x and VOC.

Hrenko is quick to point out that her mine would use far less water than expected.

The largest consumer of water in the project is for dust control, both in the mining and in the spent shale or the ash backfilling.

We have a water right for 15 cfs, fifteen cubic feet per second, that was originally off of the White River, which we have been in the process of moving to the Green River. The White River has lower flow, so from an environmental point of view, there's a lot more water going through the Green River, and it's a lot more sustainable of a water source than the White River. We do have a lot of engineering to go still, but based on the engineering estimates that we have so far, for 50,000 barrels a day we're looking at using under 5 cfs of fresh water.

Then there is the issue of carbon dioxide released by the extraction and burning of any hydrocarbon. The oil shale industry in particular has grappled with the fact that, historically, it has always had a huge carbon footprint.

We are still working on the life cycle CO₂ balance for the Utah project, so that's something that we haven't formally done yet, as we're not through with the final design, depending upon what our final, final design looks like, that's going to impact what our carbon balance is going to be.

Enefit American Oil tries to be transparent about the amount of carbon that its oil shale will emit into the atmosphere. It's parent company in Estonia has published well-to-wheels *carbon intensity* measurements of 128 grams of CO₂ per megajoule. What's scary about this is not so much the engineering terms—well-to-wheels, grams, megajoules—but the fact that the total greenhouse gas impact of mining oil shale is likely to be significantly higher than conventional oil from Texas or Saudi Arabia. Hrenko is keenly aware of these numbers. She is still trying to maximize carbon capture opportunities into Enefit's retort and refining operations. She hopes oil shale's contribution to atmospheric carbon in Utah will be less than has already been demonstrated in Estonia, but she can't be more specific yet. We visited Enefit's future mine site, driving out bumpy, dusty roads beyond the White River.

We can't deny that there aren't going to be impacts from this process, from the mining and the industrial process. There's impacts for any kind of development, whether it's solar or wind or oil shale, for example. We've had a countless number of public meetings, and there have been times when questions have been raised that have honestly made me go back and say, Huh, we didn't really think about it that way. That's something we'd better make sure that we address.

We are very open to hearing those kinds of concerns, especially at this stage of the project when it's still early and we have something that we can do about those, we can still collect baseline data, we can still modify engineering plans.

To the company's credit, Enefit American Oil is trying to remain open to outside ideas, trying to grapple with sensitive questions like what really will be the size of its carbon footprint. At this point, one can hope that the answers will be included in the operation's design.