

# Energy Fuels Announces Strategic Venture with Nanoscale Powders to Develop Innovative Rare Earth Metal-Making Technology

written by Igor Makarov | December 15, 2021

*Nanoscale's patented rare earth metal-making technology has potential to revolutionize rare earth metal making by reducing costs, significantly reducing greenhouse gas emissions, and reducing energy use*

December 15, 2021 ([Source](#)) – Energy Fuels Inc. (NYSE American: UUUU) (TSX: EFR) (“**Energy Fuels**” or the “**Company**”) is pleased to announce the execution of a Memorandum of Understanding (“**MOU**”) with Nanoscale Powders LLC (“**NSP**”) for the development of a novel technology (the “**Technology**”) for the production of rare earth element (“**REE**”) metals (the “**Project**”). We believe this Technology, which was initially developed by NSP, and will be advanced by the Company and NSP working together, has the potential to revolutionize the rare earth metal making industry by reducing costs of production, reducing energy consumption, and significantly reducing greenhouse gas (“**GHG**”) emissions. Producing REE metals and alloys (“**REE Metals**”) is a key step in a fully integrated REE supply chain, after production of separated REE oxides (“**REE Oxides**”) and before the manufacture of neodymium iron boron (“**NdFeB**”) magnets used in electric vehicles (“**EVs**”), wind generation and other clean energy and advanced technologies.

Energy Fuels is quickly building a new, environmentally friendly

REE supply chain in the United States, and the Project with NSP represents an exciting opportunity to significantly improve the REE metal-making process and potentially provide Energy Fuels with a competitive advantage in the REE supply chain. At its White Mesa Mill (the “**Mill**”) in Utah, the Company is currently producing mixed REE carbonate (“**REE Carbonate**”) while recovering uranium from natural monazite sands (“**Monazite**”) which are produced as a low-cost byproduct of heavy mineral sands mining in the U.S. and around the globe. Energy Fuels’ REE Carbonate is the most advanced REE product being produced in the U.S. today. The Company is also moving quickly toward producing REE Oxides at the Mill using proven solvent extraction (“**SX**”) technologies. The Mill has over 40 years of experience producing uranium and vanadium oxides using SX technology.

Founded in 2008, NSP originally focused on producing solar quality silicon metals and refractory metal powders, eventually turning its attention to the production of titanium and alloy powders through sodium reduction. More recently, NSP has developed a process to create REE Metals from REE Oxides through molten sodium reduction of anhydrous REE chloride materials in a process similar to the Kroll process (called the “Hunter Titanium Process”) which is used for the production of titanium metals through sodium reduction.

The production of REE Metals utilizing the Technology will involve feeding anhydrous REE chloride materials, which are free of water, into a molten sodium bath. A rapid reaction takes place between the molten sodium and the REE chlorides. The process is highly exothermic, releasing energy, so the molten sodium acts to control the rate of the reaction. The reaction products are REE Metal and sodium chloride, commonly known as salt.

The NSP sodium reduction of REE Metals has several advantages

over the industry standard REE metal making method, which utilizes electrolytic reduction of REE oxides in molten lithium fluoride/REE fluoride baths. First, the NSP process does not have any associated air emissions, and therefore presents a significant improvement over the current technology, which emits carbofluoromethane (CF<sub>4</sub>) gas, which is a powerful GHG. Second, current estimates indicate that the NSP process is significantly cheaper to operate than the conventional electrolytic methods, because it does not consume graphite crucible materials and utilizes significantly less energy and labor. Finally, the NSP process requires anhydrous chloride feeds, which we believe can be generated directly from rich liquor streams coming from the Mill's planned SX circuit. This could eliminate the need for oxalate precipitation and calcination of materials destined for REE metal making. As a result of these factors, operating cost savings are currently estimated to potentially be several times less than conventional REE metal-making methods.

As with any new technology, risks are present which must be evaluated and addressed, including successfully creating anhydrous chloride feeds at a commercial scale with the associated risk of elevated levels of oxygen in the final product, and the risk of being able to successfully remove and consolidate final REE Metal products.

NSP holds two U.S. patents and one pending patent application for the Technology, under which it has proven the ability to produce REE Metals on a kilogram batch scale basis at the U.S. Department of Energy's Technology Readiness Level ("**TRL**") 5. Energy Fuels' initial investment in the Project is intended to advance the Technology to allow for: (i) the continuous, pilot-scale production of 10 kilograms per hour of neodymium-praseodymium ("**NdPr**") metal that meets typical specifications for NdFeB magnets at TLR Level 7; (ii) the separate build of a batch reactor able to produce key minor magnet metals (e.g.,

dysprosium, terbium); and (iii) the demonstration of samarium-cobalt alloy production. The Project will be directed by Energy Fuels with technical support from other research firms and institutions as required.

Under the MOU, the parties will negotiate and enter into binding agreements ("**Definitive Agreements**") that govern the Project, including the creation of a new entity that will hold an exclusive license to the Technology as it relates to REE Metal making. The MOU contemplates a phased development of the Project to scale-up to the production of 1,000 metric tonnes of one or more REE Metals per year. Energy Fuels will have the right to earn up to a 100% interest in the entity and Technology, as it relates to REE Metal making, by making the following capital investments:

1. US\$250,000 within five (5) business days after execution of the MOU;
2. US\$250,000 within five (5) business days after execution and delivery of the Definitive Agreements;
3. US\$1 million within five (5) business days after execution and delivery of the Definitive Agreements to be applied to the Project's 2022 budget and work plan; and
4. Energy Fuels will fund all future approved annual budgets as may be required for commercialization of the Project, up to a maximum additional expenditure of US\$8.5 million over three (3) years, totaling US\$10 million for the Project.

Upon the successful completion of the Project and the \$10 million investment, Energy Fuels will control the exclusive rights to the entity and the Technology as it relates to REE Metal making. Energy Fuels will also have the right to cease funding at various decision points during the Project, at which point Energy Fuels will hold a percentage of the new entity and

Technology, proportional to its amount contributed. If Energy Fuels ceases funding prior to earning 100% of the Technology, NSP will have the right in certain circumstances to acquire Energy Fuels' interest in the entity and Technology by reimbursing Energy Fuels for its expenditures on the Project.

Mark S. Chalmers, President and CEO of Energy Fuels stated: "Metal-making is a critical step in the rare earth supply chain. Energy Fuels has already restored monazite 'crack-and-leach' capabilities to the U.S. at our White Mesa Mill in Utah, where today we are producing a high-purity mixed rare earth carbonate, which is ready for separation. No other company in the U.S. is currently producing a high-purity REE product ready for separation at commercial levels. We are also quickly moving toward adding solvent extraction separation equipment at the Mill and associated permitting that will allow us to produce commercial separated rare earth oxide powders in the coming years. In fact, we are already well advanced with piloting these capabilities on a continuous 24/7 basis at the Mill today.

"The next step in rare earth processing and refining is turning those separated rare earth oxide powders into usable rare earth metals and alloys, particularly NdPr metal needed for NdFeB magnets used in EVs, wind generation and other technologies. We are interested in Nanoscale Powders' technology because we believe it has the potential to produce REE metals at lower cost, using less energy, and producing significantly less greenhouse gas emissions than conventional REE metal making methods. If successful, Nanoscale's metal-making technology could be orders of magnitude safer and less expensive than the current established technology. This is the type of technology we as Americans need to develop to produce advanced rare earth materials in a cost-competitive manner, while achieving the highest standards of protection of public health, safety, and the environment. Nanoscale Powders has proven their technology

on a small scale, and we look forward to working with them to advance the technology to pilot scale, and then to commercial scale in the coming years. Our relationship with Nanoscale Powders demonstrates Energy Fuels' commitment to fully integrating a domestic REE processing supply chain in the most optimal and environmentally prudent manner possible."

Implementation of this initiative is subject to the execution of Definitive Agreements.

## **ABOUT ENERGY FUELS**

Energy Fuels is a leading U.S.-based uranium mining company, supplying  $U_3O_8$  to major nuclear utilities. Energy Fuels also produces vanadium from certain of its projects, as market conditions warrant, and is ramping up to commercial-scale production of REE carbonate. Its corporate offices are in Lakewood, Colorado, near Denver, and all of its assets and employees are in the United States. Energy Fuels holds three of America's key uranium production centers: the White Mesa Mill in Utah, the Nichols Ranch in-situ recovery ("**ISR**") Project in Wyoming, and the Alta Mesa ISR Project in Texas. The White Mesa Mill is the only conventional uranium mill operating in the U.S. today, has a licensed capacity of over 8 million pounds of  $U_3O_8$  per year, has the ability to produce vanadium when market conditions warrant, as well as REE carbonate from various uranium-bearing ores. The Nichols Ranch ISR Project is on standby and has a licensed capacity of 2 million pounds of  $U_3O_8$  per year. The Alta Mesa ISR Project is also on standby and has a licensed capacity of 1.5 million pounds of  $U_3O_8$  per year. In addition to the above production facilities, Energy Fuels also has one of the largest NI 43-101 compliant uranium resource portfolios in the U.S. and several uranium and uranium/vanadium mining projects on standby and in various stages of permitting and development. The primary trading market for Energy Fuels'

common shares is the NYSE American under the trading symbol "UUUU," and the Company's common shares are also listed on the Toronto Stock Exchange under the trading symbol "EFR." Energy Fuels' website is [www.energyfuels.com](http://www.energyfuels.com).

## **ABOUT NANOSCALE**

Nanoscale Powders LLC ([www.nanoscalepowders.com](http://www.nanoscalepowders.com)) is a Boston-based, privately held company, operating patented processes capable of producing a wide range of engineered metal, alloy and ceramic powders and powder-derived products, including solids as well as additive-manufacturing powders. For further information, please contact [Andrew.matheson@nanoscalepowders.com](mailto:Andrew.matheson@nanoscalepowders.com).

## **CAUTIONARY STATEMENTS REGARDING FORWARD LOOKING STATEMENTS**

*This news release contains "forward-looking information" within the meaning of applicable securities laws in the United States and Canada. Forward-looking information may relate to future events or future performance of Energy Fuels. All statements in this release, other than statements of historical facts, with respect to Energy Fuels' objectives and goals, as well as statements with respect to its beliefs, plans, objectives, expectations, anticipations, estimates, and intentions, are forward-looking information. Specific forward-looking statements in this discussion include, but are not limited to, the following: any expectation that the Project will be successful; any expectation that the Project has the potential to revolutionize the rare earth metal making industry by reducing costs of production, reducing energy consumption and significantly reducing greenhouse gas emissions; any expectation that Energy Fuels will be successful in integrating a domestic REE processing supply chain in the most optimal and environmentally prudent manner possible or at all; any expectation that Energy Fuels will move quickly toward producing*

separated REE Oxides at the Mill using proven SX technologies or at all; any expectation that the Technology is a superior technology for the production of REE Metals; any expectation that application of the Technology does not result in any associated air emissions and therefore presents a significant improvement over the current technology; any expectation that the Technology is significantly cheaper to operate than the conventional electrolytic methods or that operating cost savings are potentially several times less than conventional methods; any expectation that Energy Fuels' initial investment in the Project will advance the Technology to allow for the continuous, pilot-scale, production of 10 kilograms per hour of NdPr metal that meets typical specifications for NdFeB magnets at TLR Level 7 or that the other objectives of the Project will be achieved; any expectation that the parties will successfully negotiate and enter into binding Definitive Agreements such that the Project will proceed past the MOU stage; any expectation that Energy Fuels will earn a 100% interest in the Technology as it relates to REE Metal making; and any expectation that the Technology will be advanced to commercial scale in the coming years. Often, but not always, forward-looking information can be identified by the use of words such as "plans", "expects", "is expected", "budget", "scheduled", "estimates", "continues", "forecasts", "projects", "predicts", "intends", "anticipates" or "believes", or variations of, or the negatives of, such words and phrases, or state that certain actions, events or results "may", "could", "would", "should", "might" or "will" be taken, occur or be achieved. This information involves known and unknown risks, uncertainties and other factors that may cause actual results or events to differ materially from those anticipated in such forward-looking information. Factors that could cause actual results to differ materially from those anticipated in these forward-looking statements include risks associated with: technical difficulties; processing difficulties and upsets; the



risk of elevated levels of oxygen in the final product; the risk of being able to successfully remove and consolidate final REE Metal products; licensing, permitting and regulatory delays; litigation risks; competition from others; and market factors, including future demand for and prices realized from the sale of REEs and REE Metals. Forward-looking statements contained herein are made as of the date of this news release, and Energy Fuels disclaims, other than as required by law, any obligation to update any forward-looking statements whether as a result of new information, results, future events, circumstances, or if management's estimates or opinions should change, or otherwise. There can be no assurance that forward-looking statements will prove to be accurate, as actual results and future events could differ materially from those anticipated in such statements. Accordingly, the reader is cautioned not to place undue reliance on forward-looking statements. Energy Fuels assumes no obligation to update the information in this communication, except as otherwise required by law.