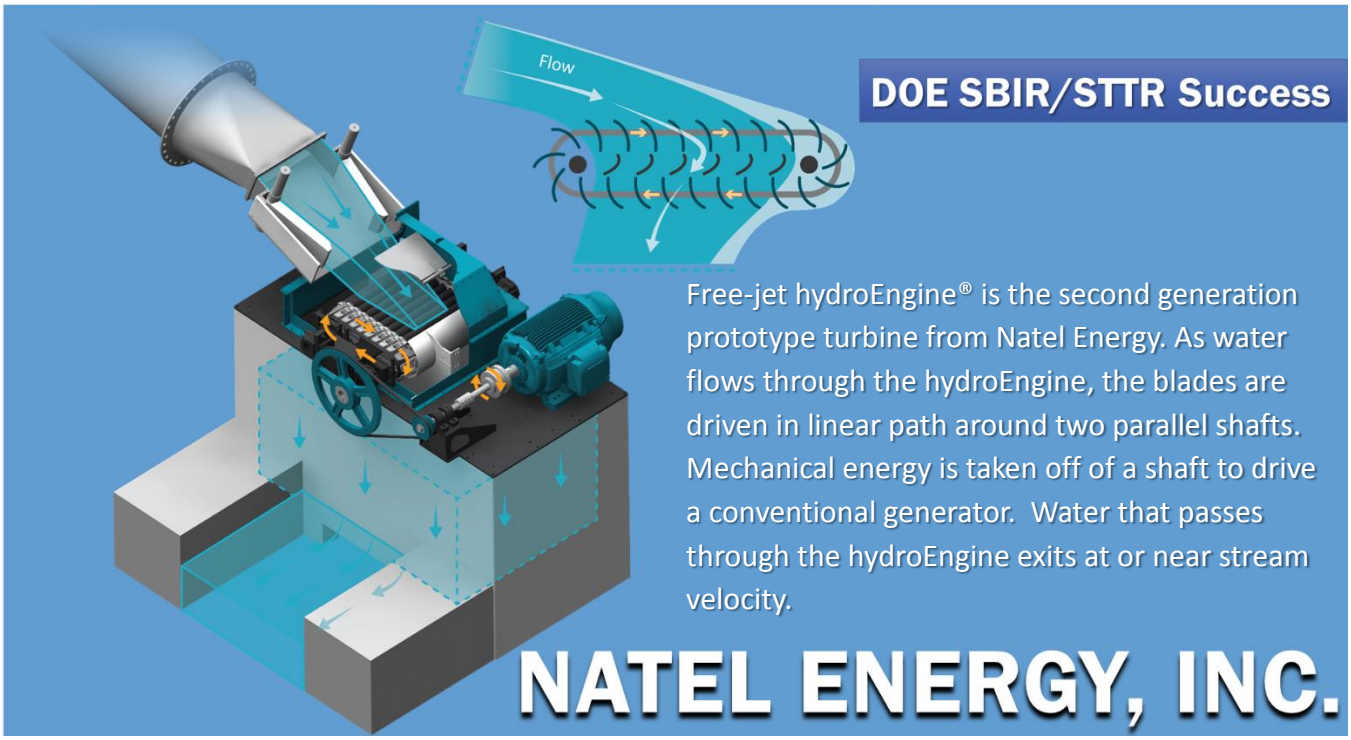
SBIR·STTR America's Seed Fund

U.S. DEPARTMENT OF ENERGY | SBIR/STTR Programs Office



Situated across the bay from San Francisco, Natel Energy Inc. (Natel) has many aspects in common with the epitome of the Bay Area startup, especially a young, motivated, and enthusiastic staff. On the other hand, Natel Energy operates in a very different technological field than the typical high-tech startup. Natel's products are not related to software or the internet but to the production of renewable energy through a new concept of ecosystem-friendly hydropower production. Natel's innovation in the world of hydropower generation is a completely new type of turbine that allows for low civil work and capital costs while maintaining the health of watershed ecosystems and the communities that surround them.

FACTS

PHASE III SUCCESS
At the end of Phase II Natel secured $10 million private investment to set up manufacturing.

IMPACT
Natel's new turbine technology makes it possible to tap into the undeveloped hydropower potential in the U.S. at drops between 5 and 20 feet, which is estimated at 70 GW.

DOE OFFICE
Energy Efficiency and Renewable Energy (EERE).

WWW.NATELENERGY.COM

The U.S. Department of Energy (DOE) aims to double hydropower generation in the U.S. by 2030 and has been investing in the development of innovative technologies that will dramatically change the concept of hydropower by lowering costs, improving performance, and preserving the environment. Natel's turbines represent one of the ways this goal can be achieved by mimicking a natural analog—beavers. Natel's turbines are designed to produce electricity using a cascade of low head structures similar to beavers' dams, as opposed to one big dam construction. The low head installations are designed to restore wetlands and slower the rate of water runoff, which is very important for mitigating floods, especially out west.

Typical hydropower plants involving big dams with head drops of hundreds of meters are very expensive because they require impressive civil work, beyond what can be seen by the common observer. This is due to the phenomenon of cavitation. When water falls down from a tall dam its pressure is very high because of its high potential energy. The water pressure changes dramatically as the water comes in contact with the fast moving turbine blades and sometimes can locally fall below the water's vapor pressure causing bubbles that subsequently implode releasing powerful and damaging shock waves.

To avoid cavitation in conventional hydropower plants, the water static pressure needs to be increased by encasing the turbine in a chamber dag below the river bed. The construction of such encasing spaces, which need to be kept dry is a very expensive proposition. In addition, stopping the river flow with a big dam negatively affects the entire ecosystem upstream.

Natel's turbines are different than turbines used in conventional hydropower plants. They do not require high pressure, which means the head can be much smaller; and they operate at constant water pressure, which eliminates the cavitation problem. Because the civil construction costs are so much lower than for big dams, these turbines can be installed in numerous small structures, taking advantage of natural river landscapes, and without disrupting the ecosystem.

For this picture to work in the real world, the turbines need to be very efficient and produce enough energy to make the installations cost effective. Because the power a turbine can produce is given by pressure $\times$ flow, operating at low pressures requires a very large flow, which is achieved by eliminating the architectural limitation of having a single rotor shaft. A conventional turbine, no matter what the specific design, is made of blades arranged around a rod-like shaft. If we think about stretching this design so that the rod resembles a conveyor belt, we increase the cross section of fluid the turbine can accommodate and therefore the flow, similar to the concept of adopting a bigger sail to make a sailboat go faster. This idea is at the core of Natel's innovative turbine technology.

Natel Energy was founded by two siblings, Abe Schneider, Natel's CTO and Gia Schneider, Natel's CEO in 2009. Soon after, Natel was awarded a DOE SBIR award funded by the Wind and Water Power Program within the Office of Energy Efficiency and Renewable Energy (EERE). Abe and Gia have been running the company with great foresight, making the best possible use of the Phase I and Phase II SBIR funds to fully develop multiple aspects of their prototype. At the end of their Phase II SBIR award in 2012, the development stage of their technology had advanced sufficiently for them to raise private capital in the amount of nearly $10 M from three billion-dollar family investment firms. Using these funds, Natel Energy has recently transferred operations to a large building facility in the former Alameda Naval Air Station in the San Francisco Bay Area, and is getting ready for transitioning to the next level of the

development stage, which will involve commercial product manufacturing. Abe and Gia Schneider have developed a clear plan for addressing the entire U.S. chain. Critical suppliers have been engaged from various US states and the work at Natel is going to focus primarily on assembly, including continuous prototype development, de-risking, and testing. After the DOE Phase II SBIR, Natel Energy further pusued product innovation guided by new technical insights and motivated by the market-dictated necessity to increase turbine efficiency and lower costs. Natel has already transitioned to a more advanced prototype than the one developed under the SBIR award. The new prototype, the Free-jet hydroEngine® was developed following Abe Schneider's insight that by changing the shape of the blades the powertrain could be arbitrarily extended, resulting in a turbine that operates in an open flow of water and does not need to be enclosed in a structure where the flow is directed inside a pipe. This insight has brought down the building material by 50% while boosting turbine efficiency. The new prototype is currently under continuous testing, operated by a new recirculating hydraulic testing set-up. Single parts, like the conveyor belt reinforced by carbon fibers and innovative bearings made to withstand years of continuous sheer forces, are tested in harder environments, subjected to a force of 50 tons and in contact with acid water containing grit and dirt.

In summary, Natel Energy has developed a clear path forward and is wisely leveraging current private investments to de-risk their 2nd Generation prototype and setting up for production scale manufacturing.

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