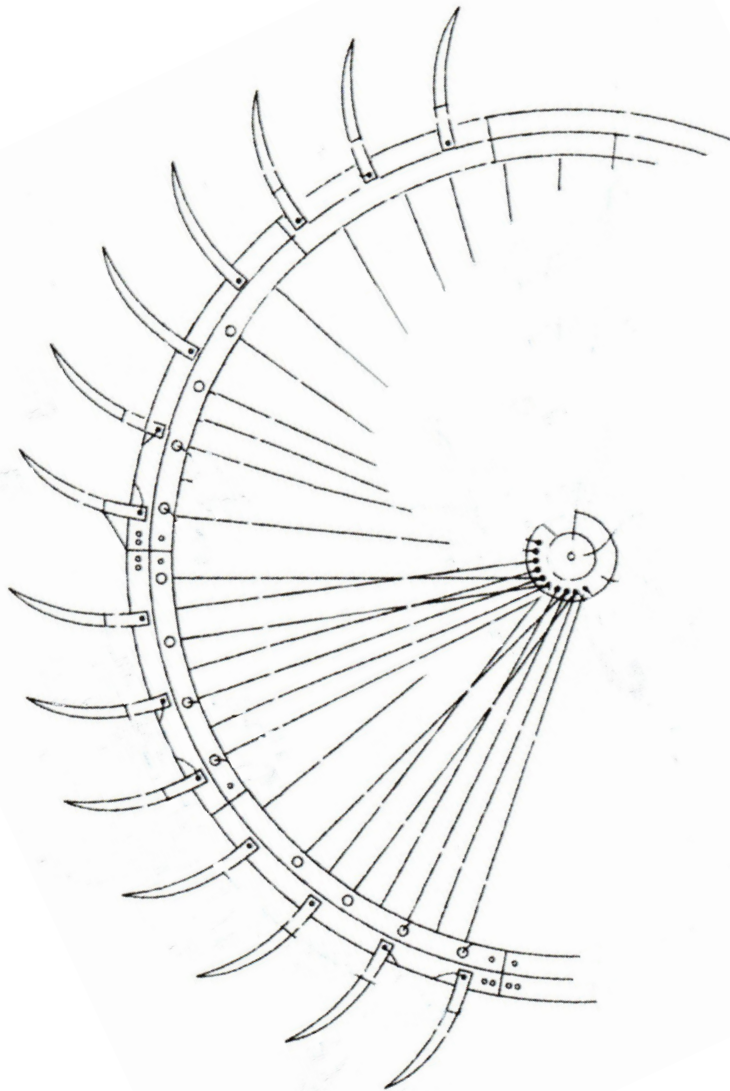


Non Tidal River Hydro Kinetic Energy

A Practical, Profitable and Sustainable Plan for
Development and Full Scale Implementation



HK ERA

Hydro Kinetic Energy Research Associates LLC

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Introduction

Purpose and Goal

The purpose of this white paper is to introduce the reader to a recently patented waterwheel technology designed to make use of a heretofore untapped renewable energy source, non-tidal rivers. Armed with this information, Hydro Kinetic Energy Research Associates, LLC (HK ERA) is seeking a partner or purchaser for this patent and its future development and refinement.

Rationale

The United States, as are many nations around the world, is seeking to lower dependence on fossil fuels to meet energy demands and limit climate impact. Current alternatives have limitations due to their intermittent availability:

- Solar energy capture is only available during daylight hours
- Wind energy capture is dependent on minimum, maximum or no air flow
- Nuclear energy holds promise but has formidable consumer push-back coupled with exorbitant start up costs and waste challenges.

However, the United States riverine system can yield over one hundred TWH (terra watt hours) of FOSSIL FUEL FREE energy, which translates to power for millions of homes. Approximately 30 GW of this energy can readily be provided by green passive noninvasive waterwheels, as shown in this new patented technology.

U.S. Patent Jan. 3, 2023 Sheet 11 of 11 US 11,542,915 B1

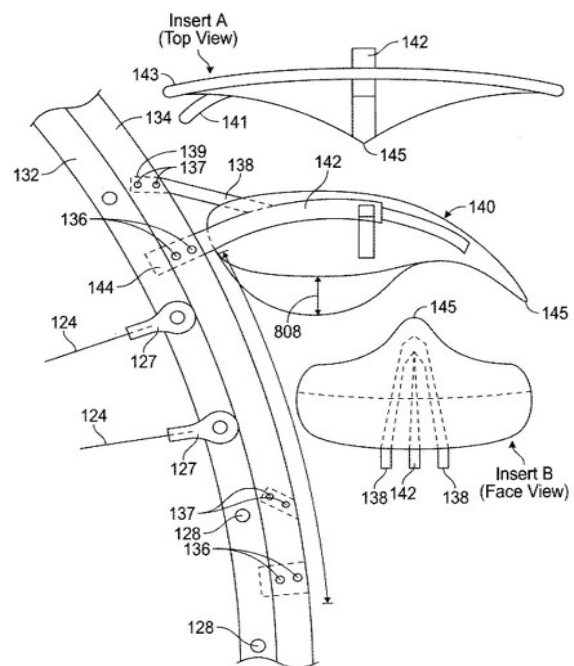
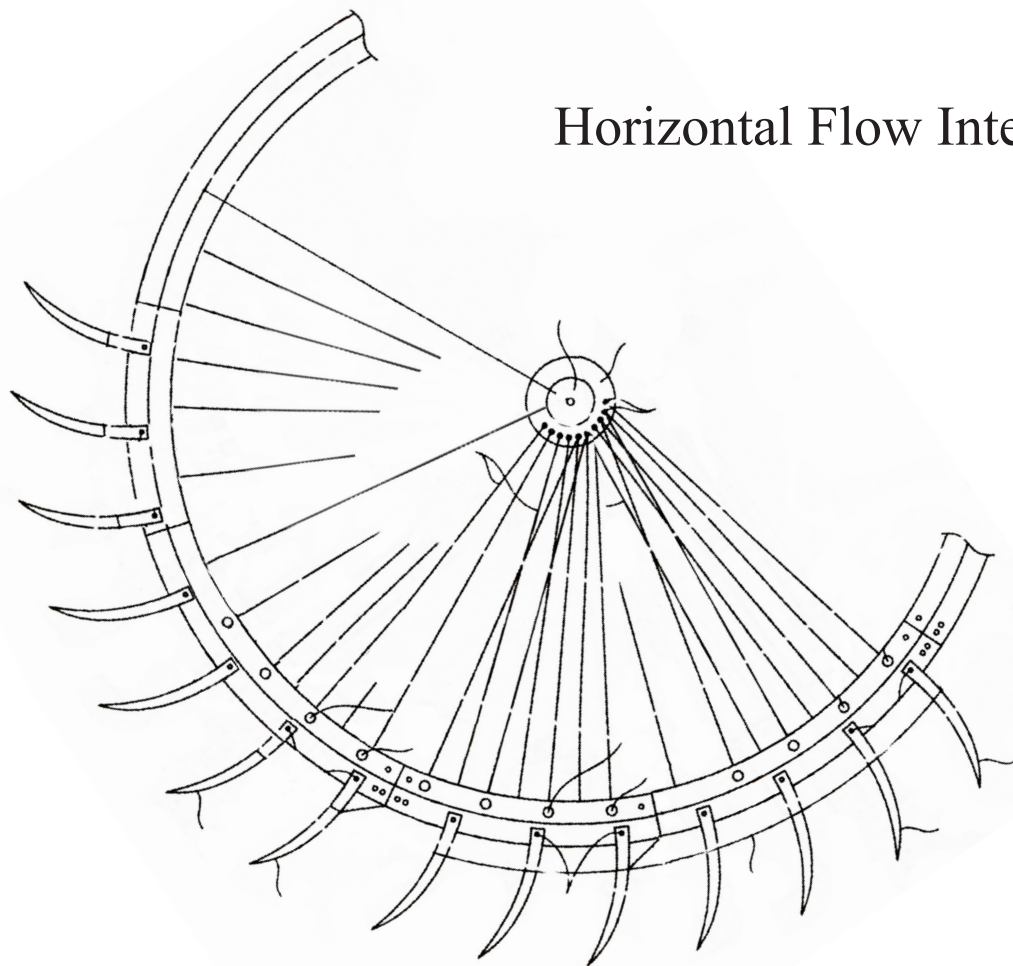


FIG. 7C

Background

The non-tidal river system in North America has typically been utilized as dammed reservoirs with gates, valves, and turbines driving generators. This has seriously altered the landscape, and the advantages are often offset by the damage. Our approach to non-tidal hydrokinetic energy (NT HKE) capture and development is a more river and environment friendly, passive, continuous system designed for longevity and efficient operation. HK ERA has designed and patented the first large scale “Horizontal Flow Interface” in full consideration of the U.S.Army Corps of Engineers (COE) guidelines.



Horizontal Flow Interface

Background, cont.

The utilization of hydro-kinetic energy using undershot waterwheels has been known for centuries (see images below). However, since the evolution and development of fossil fuels they are becoming a thing of the past. Waterwheels are historically on fixed foundations in river systems around the world. These foundations require modification to the river bottom and bank.

Our patented design is land side mounted which significantly minimizes engineering, testing, construction, and maintenance. This design allows for more ready adaption when river levels change due to floods and droughts.



Confirmation Resource

Internet images of waterwheels found in the Middle East

The confirmation of non-tidal river hydro-kinetic energy (NT HKE) as a viable resource was researched and reported in 2008 with thorough and positive findings that clarified the need for further detailed research and consideration. This report was then followed up by the 2012 Department of Energy (DOE) commissioned report which confirmed and enhanced the results previously reported in 2008. An excerpt of the 2012 research study including the results summary are contained in the next two (2) pages.



Assessment and Mapping of the Riverine Hydrokinetic Resource in the Continental United States

2012 TECHNICAL REPORT

Assessment and Mapping of the Riverine Hydrokinetic Energy Resource in the Continental United States

Hydrologic Region	Theoretical Power (Annual Energy ,TWh/yr)	Technically Recoverable Power (Annual Energy, TWh/yr)
New England	14.4	0.2
Mid Atlantic	33.5	1.0
South Atlantic Gulf	38.5	1.2
Great Lakes	6.2	0.01
Ohio	79.2	6.9
Tennessee	20.4	1.0
Sauris Red-Rainy	1.8	0.03
Upper Mississippi	47.0	5.1
Lower Mississippi	208.8	57.4
Texas Gulf	8.9	0.05
Arkansas Red	45.1	1.3
Lower Missouri	79.8	5.6
Upper Missouri	74.3	2.8
Rio Grande	29.5	0.3
Lower Colorado	57.6	3.9
Upper Colorado	46.9	1.1
Great Basin	6.9	0
California	50.9	0.7
Pacific Northwest	296.7	11.0
Alaska	235	20.5
Total	1,381	119.9

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Design Theory

Key Advantage of Direct River Interface Technology

Through an in-depth study of existing and proposed systems for non-tidal river energy capture, it was noted that all were designed around a rotating blade or turbine type impeller. This design is inherently inefficient due to accelerating the natural resource before conversion and energy capture. The importance of yielding an extra 15 to 45% in energy capture while not accelerating the natural resource was a guiding component of this patented design.

Flowing water with its fluid dynamic characteristics is typically captured and converted with a 90-degree rotational mechanical force. This is accomplished through the introduction of a variably pitched angled surface via an axially situated propeller or impeller. The angle of this surface interacting with moving water is the angle of incidence. This “incidental” energy capture is factored substantially lower by the angle of incidence.

By situating the interacting flat surface perpendicular to the moving fluid force there is no incidental loss factor. The direct capture and conversion of a greater percentage of the moving fluid mass energy provides for a much more efficient, dependable system. The direction of the moving force is directly converted into substantial radial rotational torque. The system only moves as fast as the natural resource and will provide greater energy yield per cu ft of moving water.

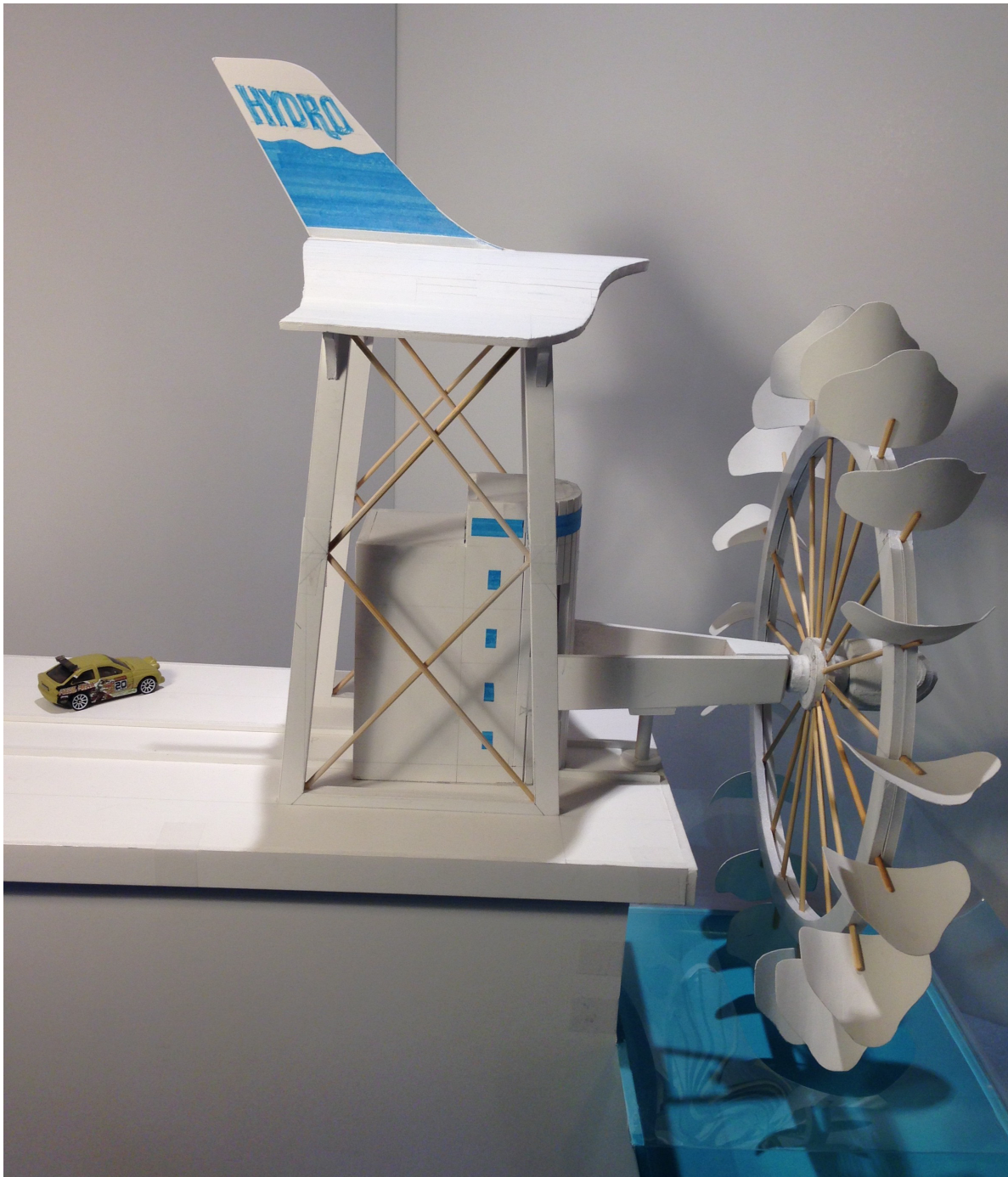
A simplistic example of direct capture is the traditional riverboat, where a directly perpendicular flat-surfaced paddle wheel navigates upstream with a modestly powered steam engine.

Overview of Design and Patent

Our river interface machine (waterwheel) simplifies the operation of a 100 ft diameter modern undershot waterwheel with 36 interface blades. Other unique design features include:

- All foundations are completely shoreside.
- System default counterweight lifts the waterwheel unit clear of the river in the event of any system failure or emergency.
- Design can be readily modified and scaled for a wide range of river conditions and sizes. Machines are sized from .25 MW (250 kw) up to 2.1 MW
- Independent Microgrid arrays can be easily engineered.
- Very low operating RPM ensures a longer machine life cycle and eliminates the challenge of intermittent capture inherent in wind and solar energy systems.

Extensive review of several different efforts at NTR HK capture around the world, clearly guided the current practical concepts, and the importance of embracing the US Army Corp of Engineers, Midwest USGS, US Coast Guard, Missouri, and Mississippi River authorities, and comply with specific rules for engaging the US River system. These rules guided the development of this current machine and its related Patent, U.S. Patent, No,11,542,915 granted on January 3rd of 2023. Subsequent notice was received on March 31, 2023, that the Patent Cooperation Treaty Application was found favorable. An excerpt of the approved patent can be found on the following page. A full copy of the U.S.patent can be found at <https://patents.google.com/patent/US11542915B1>





US011542915B1

(12) **United States Patent**
Wieser

(10) **Patent No.:** **US 11,542,915 B1**
(45) **Date of Patent:** **Jan. 3, 2023**

(54) **CONTINUOUS NON-TIDAL HYDROKINETIC ENERGY TRANSFER RESOURCE WITH MOVEABLE PLATFORM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **17/815,241**

(22) Filed: **Jul. 27, 2022**

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(51) **Int. Cl.**
F03B 17/06 (2006.01)

(52) **U.S. Cl.**
CPC **F03B 17/065** (2013.01); **F03B 17/063** (2013.01); **F05B 2220/32** (2013.01); **F05B 2240/91521** (2013.01); **F05B 2240/94** (2013.01)

(58) **Field of Classification Search**
CPC **F03B 17/063**; **F03B 17/065**; **F03B 17/066**; **F03B 7/00**; **F03B 7/003**; **F05B 2220/32**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,505,909 A * 8/1924 Melin F03B 17/063 416/149
2013/0320680 A1 12/2013 Wang
2014/0154050 A1 6/2014 Campeanu

FOREIGN PATENT DOCUMENTS

CN	106870256 A *	6/2017
GB	191301214 A	1/1914
GB	162750 A	5/1921
WO	2006082403 A1	8/2006
WO	106762353 A	5/2017

(Continued)

OTHER PUBLICATIONS

SIA Magazin, A 7.5 kW Prototype Poncelet Waterwheel With Maximum Power at 50 RPM, SIA Magazin, Aug. 20, 2018, 2 pages, SIA Magazine of Nering Industries, United States.

(Continued)

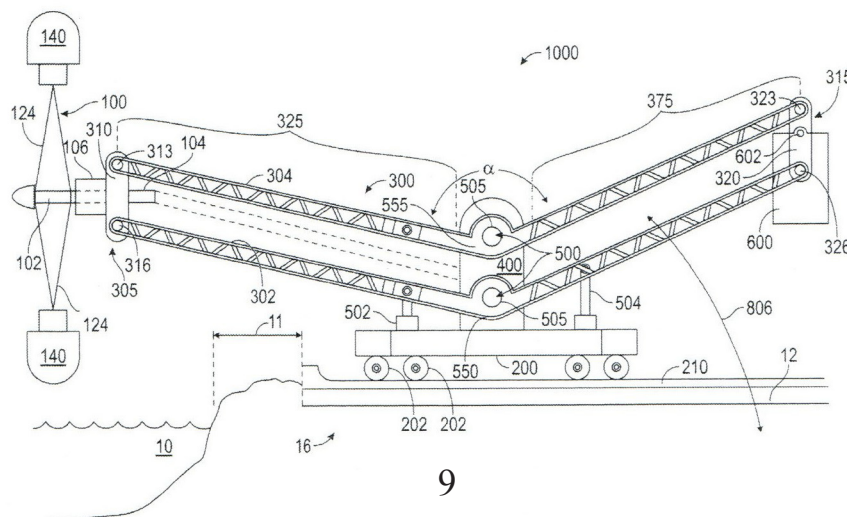
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(57) **ABSTRACT**

A hydrokinetic energy interface device includes a hydrokinetic wheel and a moveable support structure with an angled frame. The angled frame mounted upon the moveable support structure connects between a hydrokinetic wheel and a counterbalance. A bearing is mounted at a vertex between a first end and a second end of the angled frame. The angled frame pivots to move the hydrokinetic wheel and the counterbalance in opposite vertical direction. The hydrokinetic wheel maintains vertical alignment as the angled frame pivots. The hydrokinetic wheel can be formed with interconnectable rim sections. The hydrokinetic wheel may be cantilevered out away from a riverbank by the counterbalance. The hydrokinetic wheel may be raised or lowered by actuation. The movable support structure supporting the hydrokinetic wheel may be rolled away from a free-flowing river for maintenance, repairs, or modification.

20 Claims, 11 Drawing Sheets



Resource Development Phases and Goals

Phase One – Proof of Concept

Phase One development will produce all CAD drawings and component specifications for bidding and component purchasing. This data will inform design refinement and scalable production. Full-scale construction will provide continuous improvements in output and modularization. Initial construction will concentrate on components for .5 MW up to 2.1 MW. A primary goal will be to develop a unit to utilize the generators and controls in use within existing 2 MW windmills.

The Phase One site should be situated in a desirable strong flowing section to allow for full development of the resource and design evolution of the machine and to achieve maximum efficiency and output. The ideal site for this initial facility is a point East of the Gasconade River inflow to the Missouri River.

Commencement Costs to Initiate HK Energy Development

CAD drafting of each component with relative engineering ¹	\$2,635,000
Civil Eng., Geology, Surveying, Boring, testing for COE, Permits ¹	\$1,640,000
Foundation Construction, Concrete, Steel, Rails, Pilings, etc ²	\$ 1,117,000
Machine Manufacturing, Machine Deck, Main Beams, Water Wheel	\$3,750,000
Real Estate, Legal Fees, Interest	Unknown
	incl below
Total Suggested Commitment for Phase 1 R&D and Initial site	\$20M US

Notes:

1. One-time cost, not repeated for each location thereafter
2. Values inflated to reflect typical prototype development

Other: Savings achieved through modular replication expected to be 25% or greater

Costs are constantly in flux and prone to inflation. Therefore, sufficient capital for Phase 1 is essential for project success.

Phase Two – Initial Array

Phase Two development will site and construct a typical replicable array of units linked together by DC cabling to simplify grid integration. An initial array of ten units at 0.5 MW each will safely provide 5.0 MW of fossil fuel-free energy. A full array of ten units will have a degree of back-up. Data obtained will aid in unit spacing, which will in turn inform progressive improvements that can be easily retrofitted to existing units, making further design refinement a normal result of expanded production. Planning and forecasting will be based on actual performance and allow a future green energy transition to a more dependable resource – naturally moving water.

Phase Two goals will be to establish a multi-unit array of machines. An array of ten (10) .5mw machines in a suitable location will be able to provide a fuel-free energy source for over 5,000 homes. Phase Two siting, permitting, and foundation construction can be commenced as early as funding allows. Ongoing development at the Phase One location will provide scaled components to achieve up to 2.1 MW of energy based on available location resource. A fully developed array of 10 machines at 2.1 MW output each will provide energy for 16,800 homes.

Projections:

- Costs: 2.1 MW unit @ \$2.25M USD / machine X 10 units / array = \$22.5M USD
- Revenue: 16,800 homes x \$110/month (example) = \$1,848,000/ monthly revenue stream= \$22,176,000/year gross return per array..

Phase Three – Full Production

Phase Three development will be ongoing and fully realized when these river interface machines are accepted and integrated into the future transition to green energy. Current data from the DOE on the available US Riverine systems energy resource cites more than 3,000 potential array locations. The independent operational characteristic of these machines is well suited to municipal and micro grid applications. Remote riverside communities could easily develop around a dependable energy supply.

Phase Three goals will be to see machines accepted in every potential non-tidal river application possible. The goals we have established are conservative and fully achievable with the existing technology that is currently available. Modernization will be a factor in the efficiency and long-term dependability of these machines. Current manufacturing technology will greatly simplify the process. Full development of this resource is projected to take 20 years to complete with a return on investment beginning year 3 to 6. (varies due to real estate investment).

Summary

Non-tidal hydro-kinetic energy at 63# per cu ft has been flowing from the Artic to the Equator for millions of years. It is truly one of earth's most plentiful natural resources. Which begs two questions... why is this energy not being harvested or is it? And if not, how can it be done? As an observer of the common, everyday occurrences of nature about us and being in close proximity to one of the nation's mightiest rivers – Missouri River, the quest for the answers to these questions was on.

After extensive research, it appears that the water flow energy currently being captured is minimal and very inefficient. Which leads to the next question...how to capture the power of this naturally occurring resource without damaging and diminishing it? The answer to this question is HK ERA's newly patented river interface machine aka waterwheel that is uniquely engineered to capture the maximum power of the naturally flowing non-tidal waters of the US and the world.

This patented river interface machine when placed in arrays along the nation's non-tidal flow waterways will provide millions of dollars of fossil fuel free energy for enumerable homes in our communities. The constant flow of water makes hydro-kinetic energy a more reliable energy source than the intermittent solar and wind being used today to offset fossil fuel consumption. Non Tidal River Energy is an excellent compliment to the Wind and Solar industries as a constant offset to their intermittent output.

Bottom line... it is time to environmentally and responsibly seize the energy from this amazing natural occurring and fossil-free form of power on our planet.