



Harvesting renewable, low-cost electricity from gravity-fed water pipes

The **LucidPipe™ Power System** from Lucid Energy is a new, water-to-wire energy recovery solution that enables water-intensive industrial, municipal and agricultural facilities to produce clean, reliable, low-cost electricity from their gravity-fed water pipelines and effluent streams.

LucidPipe utilizes a patented, in-pipe turbine that captures energy from fast-moving water inside of large diameter, gravity-fed pipelines, with no impact on flow or operation. Depending on head pressure, flow and pipe diameter, each LucidPipe turbine produces up to 100 kilowatts of renewable, zero-emissions electricity by extracting excess head pressure. To maximize power generation, multiple LucidPipe units can be rapidly and easily installed into a single pipeline for a system that can produce more than a megawatt of electricity.

HOW IT WORKS

LucidPipe utilizes a unique, lift-based, vertical axis spherical turbine that fits inside of large diameter (24" -96") water pipes. Water flows through the hydrodynamic turbine, generating power as the turbine spins. The hydrodynamic turbine has been carefully designed and lab-tested to maximize efficiency and power generation without interrupting the flow of water. As velocities increase, power production increases. Due to the lift-based design of LucidPipe, the system generates power across a very wide range of flow conditions, volumes and velocities.

LucidPipe extracts very little head pressure per turbine, just 1 – 5 PSI. This allows the modular LucidPipe system to be placed in series, while allowing for uninterrupted water flow. LucidPipe does not need to be

placed in a pressure transient zone or where extreme differential pressures are needed. The modular nature of the LucidPipe Power System and the operational flexibility it affords make it truly unique.

PROVEN TECHNOLOGY

Lucid Energy successfully piloted LucidPipe in a water pipeline at Western Municipal Water District in Riverside, California. This pilot fed more than 20 megawatt hours of renewable electricity to the grid. As a result of the successful pilot, Riverside Public Utilities decided to install a permanent system. The LucidPipe Power System installation at Riverside was awarded a 2011 Outstanding Energy Management Award by the California-Nevada section of the American Water Works Association.

ADVANTAGES

Clean, baseload energy without the intermittency of wind and solar

Virtually no impact on water flow

No environmental effect

Quick installation

Recovers process-based energy

Operates across a wide range of head and flow conditions

PRODUCT FEATURES

Water to wire power system

Qualifies for Investment Tax Credits

Modular installation scales to power available in pipeline

Works well behind the meter to power smart water grid devices



PERFORMANCE AND TECHNICAL SPECIFICATIONS

The unique flexibility of the LucidPipe Power System design accommodates multiple configurations and flow systems. This enables LucidPipe to be used in a broad range of applications for municipal, industrial, irrigation, oil & gas and desalination facilities among others. The capacity factor for water and wastewater applications of LucidPipe is 2-3X that of solar and wind power.

1. The LucidPipe Power System is designed for use in large-diameter (24"-96") water pipes for maximum efficiency and energy output. The renewable energy produced can be used off grid, fed back into the grid or used to directly power devices and equipment such as pumps, meters, controls, smart water devices, mixers, lights at the outfall, hypochlorite machines, etc.

2. Water velocity helps determine the optimal size of the LucidPipe system that can be operated in a pipeline. Also factored in are the pipeline diameter, head pressure that is available for extraction and the capacity factor (frequency and duration of water flow). Best performance and reliability of the LucidPipe turbine is achieved at velocities greater than 4 ft/s.

LUCIDPIPE POWER DATA OVERVIEW Renewable Energy from Water/Wastewater Pipes

LUCIDPIPE DIAMETER (IN)	RATED POWER (KW)	RATED FLOW (CFS/MGD)	PRESSURE EXTRACTION (PSI) <small>GENERATED/STOPPING</small>
24	15	33/21	4.3/0.9
36	33	71/46	4.3/0.9
42	45	96/62	4.3/0.9
48	58	124/80	4.3/0.9
54	73	156/101	4.3/0.9
60	90	192/124	4.3/0.9

Specifications are subject to change

3. Water velocity is the most important indicator for determining the energy generating capacity of a pipeline. The power generated by the LucidPipe is proportional to the cube of the water velocity. Typical water velocities in pipelines are 4-7 ft/s. In some cases, reducing the diameter of the pipeline or incorporating a tapered/funnel pipe can accelerate velocities through the turbine and increase energy output."

4. The LucidPipe automatic and remote control system can stop or slow down the turbine as needed. LucidPipe is designed to be a component of a large water operation. The system allows for monitoring, managing and controlling water velocity to maintain output to the optimal operational efficiency.

The numbers in the table below are based on a gauge pressure of 25 PSI. Higher gauge pressure allows higher velocity at which LucidPipe could be installed to generate more power.