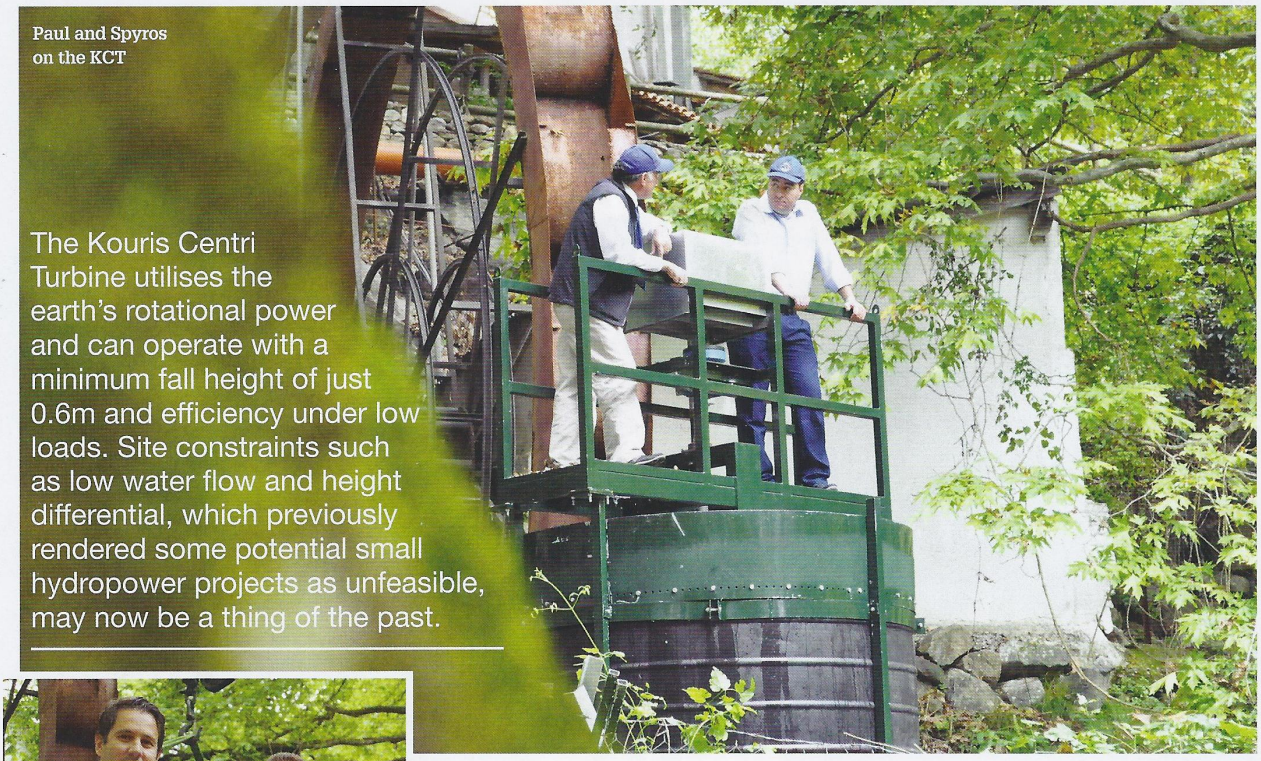
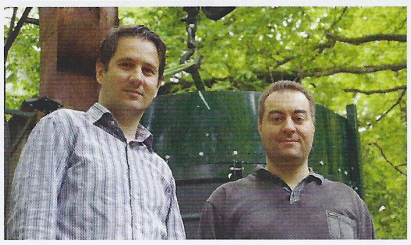
Putting a new spin on turbine development



Paul and Spyros on the KCT

The Kouris Centri Turbine utilises the earth's rotational power and can operate with a minimum fall height of just 0.6m and efficiency under low loads. Site constraints such as low water flow and height differential, which previously rendered some potential small hydropower projects as unfeasible, may now be a thing of the past.



Left: **Akis Kofos and Spyros Lyssoudis, Joint Managing Directors of KapaLamda – manufacturers and distributors of KCT. Paul Kouris is the inventor of the Kouris Centri Turbine.**

Paul Kouris, a barrister living in Melbourne, Australia is the inventor of the Kouris Centri Turbine (KCT). Back in 1975, while at university, he was using the kitchen sink and noticed the vortex forming in it. Kouris decided to experiment with this natural force to produce power and after numerous attempts involving small scale models in his back yard, the first KCT prototypes emerged.

The Coriolis force is the energy produced naturally in a body (in this case water) by the forces imposed upon it by the earth's rotation. Water draining in the northern hemisphere will form a counter-clockwise vortex whereas in the southern hemisphere the vortex will be of a clockwise motion.

KCT is composed of a cylindrical chamber with an impeller placed in the centre. Water is channelled into the container from the top left or right side, depending on which hemisphere the site is in. The container is hollow at the bottom, so as the water is fed in from one side it forms a vortex while exiting from the bottom of the turbine. The impeller revolves with the vortex's force and the revolving impeller then powers a low rpm generator.

"The KCT works with rotational kinetic energy not lineal kinetic energy, or put another way, from flow and spin not fall," Paul Kouris explains. "Accordingly it does not require the huge infrastructure needed by conventional impulse turbines - be they Pelton, Francis or Kaplan. The KCT only requires a sufficient fall to allow a vortex to form, which to this point in time has been discovered to be as little as 60cm. The domestic KCT operates in a vortex chamber that is only 2m in diameter and 60cm deep, containing only ~1.3 m3 of water. It is dramatically smaller in size that a conventional turbine that needs a minimum fall of 3m, massive quantities of water, and all the infrastructure that goes with it, to be efficient."

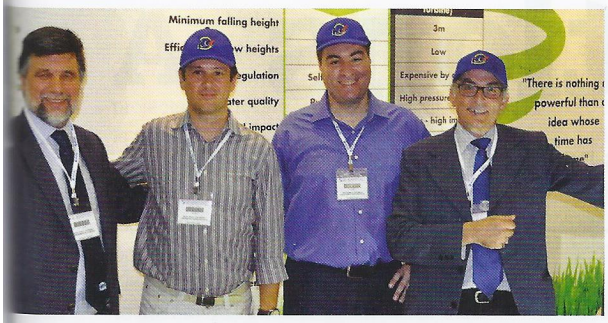
The implication of this is that hydropower sites with small differentials that were not considered attractive before can now be re-evaluated as prime locations for KCT installations. As a result, the actual market size for small scale hydro is significantly larger than anticipated. Even more importantly, hydropower is much more practical and accessible for use than previously thought.

Misconception

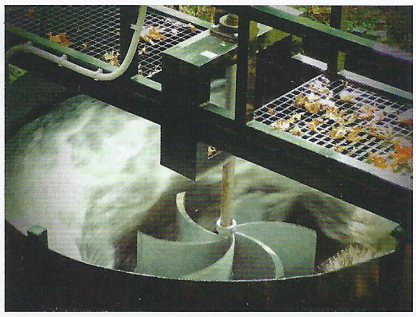
A common misconception prior to the KCT's development has been that harnessing hydropower from a vortex is inefficient. Spyros Lyssoudis, Managing Director of KapaLamda which manufactures KCT, explains how this has been disproved.

"As engineers we were trained to think that a vortex results in high energy losses. As a result, when I first heard of KCT I was sceptical and apprehensive," he admits. "The problem was that this theory was never proven. When I witnessed the pilot site in Australia, I was surprised to see how efficient it actually was. After implementing KCT in Greece, the output figures prove that the vortex is in reality extremely efficient."

Several tests were carried out during the first proof of concept. First, a holding tank was drained conventionally without a vortex and



From left to right: **Chris Thompson, Director at Kourispower Pty; Akis Kofos, Joint MD, KapaLamda; Spyros Lyssoudis, Joint MD, KapaLamda; Paul Kouris, Inventor, Proprietor and Licensor of KCT.**



Above: **The Kouris Centri Turbine takes advantage of the earth's rotational force.**
Left: **The modular and portable units can be installed on site within as little as 12 hours.**

established a benchmark drain rate of about 44 l/sec. Secondly, a vortex was established in this holding tank, and then it was drained. Forcing the water to exit via a vortex slowed it significantly to about 10 l/sec which supported the popular belief.

The third test involved inserting an impeller into the tank. Instead of introducing yet further inefficiency, the exact opposite occurred. As the impeller regulated the vortex, it made it more efficient, so much that not only was the original benchmark flow rate of 44 l/sec restored, but it was exceeded by 9% to 48 l/sec. In addition, the system was measured to generate from its rotational energy a further 183 watts.

From this small scale demonstration unit setup, that according to the conventional formula would produce approximately 1022 watts, the total output was boosted to 1295 watts – a 27% increase (the 9% or 90 watts increase in conventional output, plus the 18% or 183 watts generated by the vortex turbine in its own right, at the same time as it was providing the increased conventional output). Other experiments have yielded similar results, replicating and confirming these efficiency gains.

Small footprint

Compared with other turbines KCT has a very small footprint both in terms of size and site requirements and units can be transported easily to remote locations. The turbine is manufactured off-site in a number of standard configurations. Units are transported and assembled on site and the turbine can be placed in-line, on the bankside or using a forebay tank with a penstock. Multiple units can be used in conjunction either in series or in parallel. Use of the KCT can also increase the output of conventional hydropower schemes when used in conjunction with them.

Portable and modularly used in combination, the KCT can be installed on site within as little as 12 hours. As with most conventional schemes the site needs to be prepared and some concrete work may be required to provide a foundation on which the unit can be installed.

Besides site parameters, what dictates the potential power output of the KCT turbine is the size of the chamber. As the chamber size grows, so does the actual efficiency of the installation. Currently units can be manufactured from single phase 0.5kW up to 3-phase 20kW. Using multiple units in a series or in parallel can multiply the output of a site.

The smallest KCT turbine has a chamber diameter of 1m with 1m height, the largest 4.2m diameter with 2m height. The total height of a unit mostly depends on the method of installation as it may be buried in-ground, placed above ground or within a dam structure.

KCT installations have low maintenance requirements. As the turbine moves in a circular motion with the spiralling water, unlike impulse turbines, the metal fatigue is dramatically reduced. With a long life expectancy of 40 to 50 years, the turbine is very attractive for maintenance-free production and therefore ideal for remote sites.

The small footprint of the installation means it can be removed completely with ease and, with the exception of a small concrete slab base, the entire unit is fully recyclable. The turbine is unobtrusive due to its small size and multiple placement options.

Initial environmental findings also show that the turbine seems to bring certain benefits. As opposed to dams and other alternatives where high pressure depletes oxygen from the water, the vortex aerates the water with oxygenated air particles. This has a beneficial impact on water quality and water life, while at the same time the rotating blades are harmless to any fish travelling downstream.

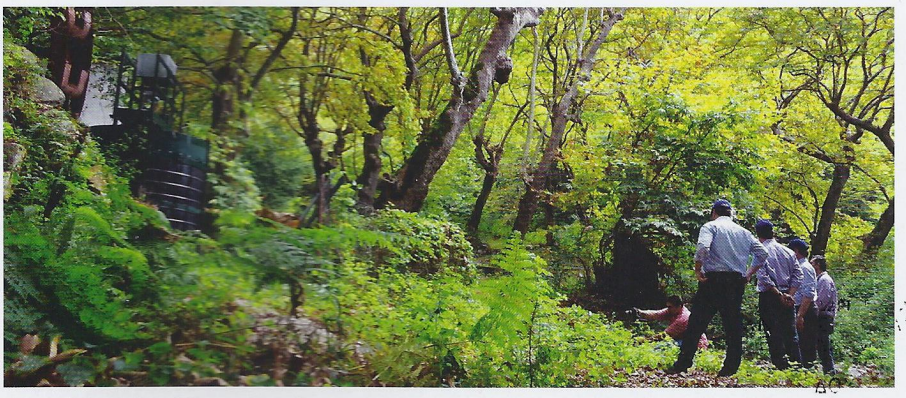
KCT has already been implemented in conjunction with a fishery site and the units can also operate in greywater sites too. Units can be used off-grid, on-grid or both as well as in conjunction with existing conventional installations.

Commercial installation

The first commercial European KCT installation in Greece has been handed over and contracts for distribution and installations in Angola have been secured. KapaLamda is now looking for partners across the world to serve markets locally through distribution and in some instances manufacture as well. Manufacture of the turbine in Greece for the European market has also recently attained ISO 9001:2008 certification.

"We find that the technology is so different that experienced engineers are astounded by the physics behind it," Paul Kouris commented. "It is still a common misconception that harnessing hydro power from a vortex is inefficient. As soon as we developed a technology guide that explained and showcased the technology in action, interest in the technology grew globally. Our job now is to build partnerships that will get this technology into the hands of those that need it the most."

The full technology report with technical details is available for download at www.KCThydropower.com along with videos showcasing assembly installation and operation. ■



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