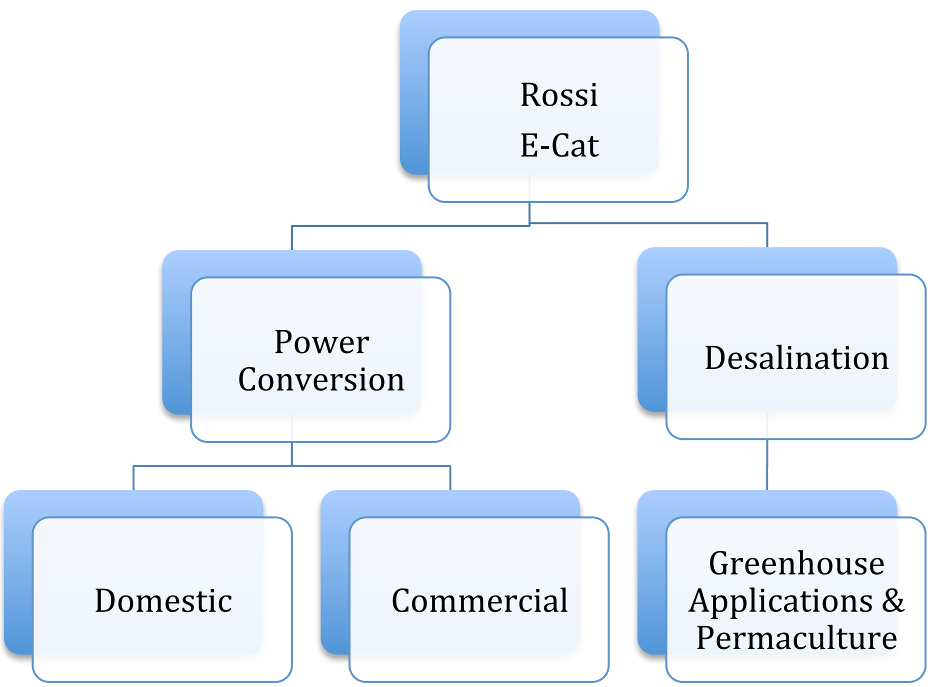
Benchmarks and Timeline for E-Cat Developments involving Desalination and Power Generation



As can be seen by graphic above, the E-Cat development will consist of two simultaneous programs:

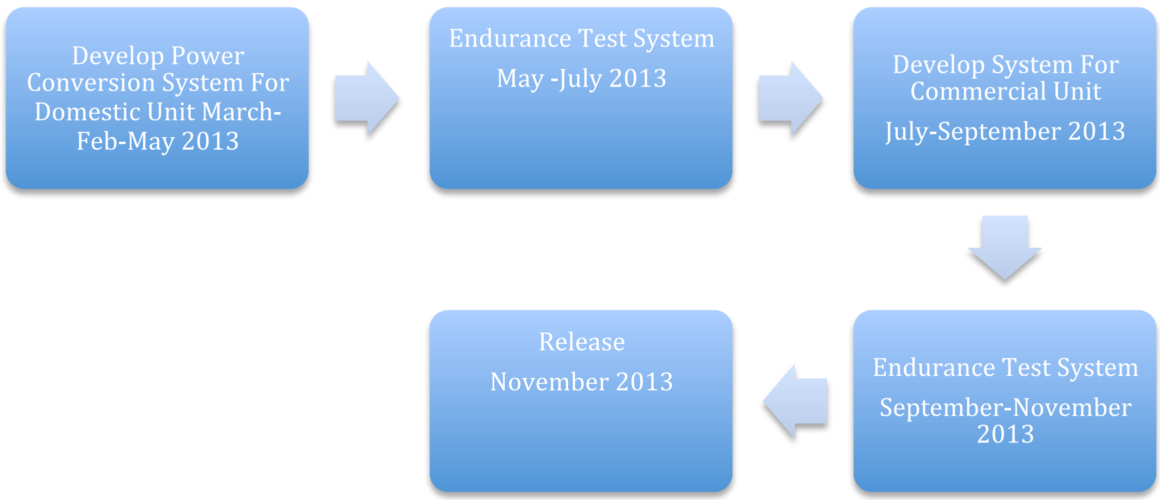
One for Power Conversion (Generation) and another for Desalination.

THIS DOCUMENT HAS DETAILS ON BOTH POWER GEN AND DESALINATION

2013 Benchmarks and Timeline for

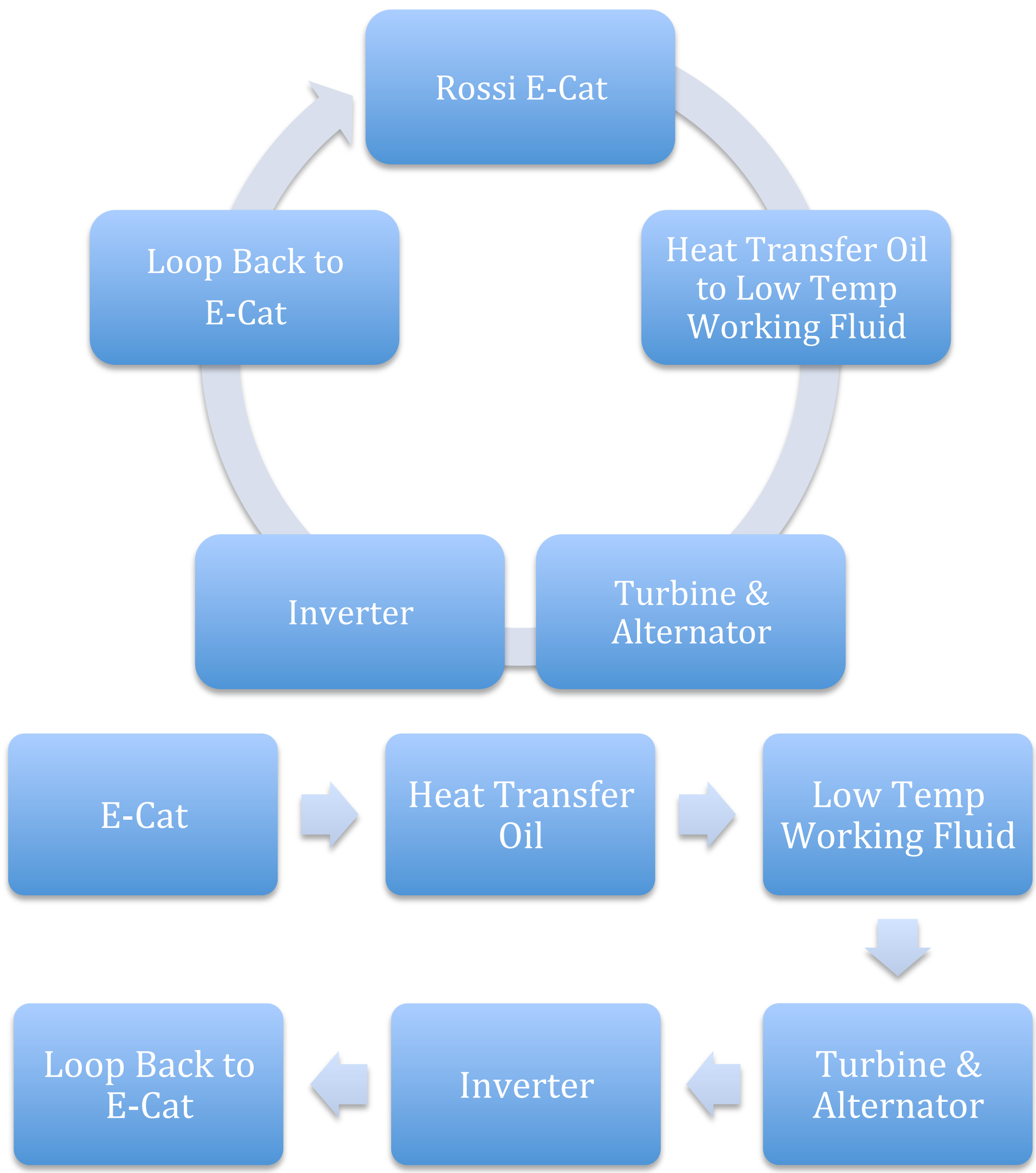
E-cat Power Generation (Electricity)

And Desalination prototypes



This graphic details the timeline for development of the Rossi E-Cat power conversion and desalination systems. As seen, the first power conversion proof of concept will be with the domestic unit. After this essential building block is endurance tested, this data is incorporated into the program for the commercial unit. This system is then endurance tested. Both are scheduled for release by the end of 2013. The three-month blocks are minimum time frames, assuming no delays in the process. We will have both programs operating simultaneously, ie Desalination prototype and Heat to Electricity.

Block Diagram for Rossi Power Conversion



Heat to Electricity conversion technologies

Research and Development – 2 Projects

Starting February 2013

Quantum Well Thermoelectric Converter (QTEG)

This system has yet to be built and tested, but both JPL and the US Department of Energy have done most of the theoretical background work necessary to the development of the unit. It is anticipated that our R and D company will be prototyping proprietary units that will be tested in our laboratories using this technology. We have the IP to make this technology even more efficient

In a recent report from JPL (Jet Propulsion Laboratories), the proposal was made for the construction of a quantum well thermoelectric converter with a nominal efficiency of 22%. This number is 2% above the minimum specified by Andrea Rossi

Previously, TEG devices in bulk form could only deliver an efficiency of 5%. With quantum well technology, this will push the efficiency into the 20% range, and perhaps beyond. Predicted dollars per watt at this time are quite high, but competitive with photovoltaic systems. The first proposed applications will be for space-based systems that demand high reliability, and earth based that require a rugged construction for harsh environments. One application will be for cogeneration or heat energy recovery in diesel and other internal combustion vehicles.

Those systems run in the same temperature range that the E-Cat is operational, from 125-400 degrees C. The devices are usually tailored to the specific temperature regime, so when the 600 degree E-Cat becomes available, that device will be designed specifically to that blackbody temperature output. Also, from the available research, the higher efficiencies are in the high temperature regime, which means this system may need to be implemented in the 400 degree E-Cat. Work in quantum well technology is foregoing, and further improvements will develop in the low to middle temperature regimes, such as the 125 degree range.

Low-Temperature Boiling Point Working Fluid

In this system, a working fluid is selected with a lower boiling point than water. Several fit the bill for this one: ethanol, and some Freon-replacement fluids. These have typical boiling points of 40-50 degrees C, far below the present E-Cat range of 125 degrees. Therefore, instead of low grade steam, a medium-pressure vapor will be generated due to the phase transition that will be sent to the turbine for mechanical power conversion. Typical efficiencies that are expected will run in the 33-40 percent range, which are acceptable. This means that, for the home E-cat, a 5000 watt source of heat will produce approximately 1666 watts of electrical energy for the home, the rest being used as co-generated heat to warm household water supplies and the living space.

In the 1MW E-Cat, the net output will be 333 KW, with the rest being output as heat for either the apartment complex, swimming pool and Jacuzzi heating, or similar uses. The size of the turbines will be different for the large scale 1MW units, and are anticipated to cost approximately $5000 per unit. Generator cost is not included. For the home scale E-Cat, the turbines can be either injection molded out of high impact plastic, or produced on a 3D printer for cost reduction, dropping the production costs to $400-$500. Reliability will be the same. Therefore, for the overall cost the home E-Cat will have a base price of $1500, with a turbine cost of $500, and an alternator for $300, with wiring running about $200, and heat exchangers $300 for an overall cost of $2800. This is somewhat cost competitive with domestic gensets, which run from $2500-$3000, but deliver 5000 watts instead of 1600 plus. The overall cost will either need to be decreased, or the power level increased to be more competitive.

Downsides

The working fluids of the first system would be somewhat toxic if a leak developed, and those would need to be anticipated. Freon leaks occur in air conditioning systems and are costly to replace. The ethanol is less costly, but flammable. Another alternative is liquid carbon dioxide, but that one is an oxygen displacer, and represents a health risk in that respect if a leak developed.

The Stirling Cycle Tesla Turbine Converter

This design does away with the phase change entirely, and uses a high-pressure gas to convert the heat into mechanical energy using the Stirling cycle. For example, using the case of a "perfect gas", if the cold side were 300 degrees Kelvin (27 degrees C), and the hot side were 400 degrees Kelvin (127 degrees C), then the temperature differential would be 4/3, or 33%. If the static pressure were 30 atmospheres, then the pressure delivered to the turbine would be 10 atmospheres, or 147 psi. It is possible to go to higher pressures, and Philips of Eindhoven has run test buses on 100 atmospheres pressure in their systems. However, for safety considerations, the initial units will be "throttled back" to reduced pressures to prevent blowouts. Conversion efficiencies are anticipated to be in the 33-40% range, however we have received information that this could be substantially higher. Testing will determine the ultimate efficiency of both systems. Costs will be higher, since more material will be needed to contain the higher pressures. This will result in approximately $200-$300 cost increase for the home unit, and $2000 for the commercial.

This system would most likely use either dried compressed air, or nitrogen and is non-toxic. The only problem would be a catastrophic failure of one of the system components. Also, the overall efficiency may be higher, and the figures given may err on the conservative side. If the conversion efficiency were higher, it would justify the additional cost for this system. Testing would need to be done to determine this.

Eco Global Fuels

TECHNOLOGY

RESEARCH AND DEVELOPMENT COMPANY

BENCH MARKS FOR E-CAT TECHNOLOGY

Thermal heat to Electricity

Nikola Tesla's Bladeless Disk Turbine

"The New Hollow-Shaft Tesla Turbine"

First of all, we will look at some of Nikola Tesla's historic experiments to get an idea of the relationship between disk spacing, horsepower, torque, and efficiency. Tesla started out building a 6-inch turbine followed by a 12-inch, 9.75-inch, 18-inch and finally a 60-inch. With the smaller turbines he used a disk spacing of .03 inches (0.8mm), with disc thickness the same (.03").

Once he moved to 18-inch diameter disks, he increased both the disk thickness and spacing between them to .0625 inches (1.6mm). While working with the Allis Chalmers company of Milwaukee, Wisconsin, his largest design - a 60-inch diameter turbine, was built using a disk thickness and spacing of 0.125 inches (3.2mm).

Tesla's 10-inch turbine produced 110 horsepower, his 18-inch produced 200-300 hp, and the 60-inch produced 675 hp. Tesla also mentioned in his aircraft designs that for **maximum efficiency the exhaust port should be reduced**, but for **maximum horsepower the exhaust size should be increased**. In addition, Tesla stated that the greatest efficiency is achieved when the disks rotate at the speed of the fluid, **but maximum torque is realized when the disks rotate at just over 50% of the fluid speed**.

Other factors that affect efficiency and power are the same as those affecting aircraft, cars or any aerodynamically sensitive object: surface finish and geometry. To put it rather bluntly, it is virtually impossible to calculate the obtainable torque and horsepower due to aerodynamic complexities; however, if you follow the basic design and construction methods already established, you will achieve results that are relatively close to Tesla's experiments.

Quoting from Tesla's own patent:

> "Owing to a number of causes affecting the performance, it is difficult to frame a precise rule which would be generally applicable, but it may be stated that within certain limits, and other conditions being the same, ***the torque is directly proportionate to the square of the velocity of the fluid relatively to the runner and to the effective area***

> ***of the disks and, inversely, the distance separating them***. The machine will, generally, perform its **maximum work** when the **effective speed of the runner is one-half of that of the fluid**; but to attain the highest economy, the relative speed or slip, for any given performance should be as small as possible. This condition may be to any desired degree approximated **by increasing the active area of and reducing the space between the disks**."

If you start with disk spacing that is optimal for a particular working fluid viscosity, then the torque is directly proportional to the square of the working fluid velocity, relative to the disk speed, and relative to the effective area of the disks. Also, as the disk diameter decreases, torque drops off exponentially. If you decrease the disk diameter by half, the torque drops off by a factor of four, but the disk speed increases by a factor of two.

While some theoretical calculations project a yield of only 2-3 horsepower for a 10-inch disk, the effect of the working fluid is obviously being overlooked. The best way to begin figuring horsepower and torque is through empirical (experimental) process. Tesla recorded approximately 110 hp for his 10-inch (9.75-inch disk diameter) turbine using 25 disks at 175 pounds of steam pressure. Even though he didn't record actual torque specs, theoretical calculations for boundary layer disks show an exponential increase of torque over horsepower.

In other words, as the horsepower doubles *the torque quadruples*.

- Assuming a 10-inch turbine delivers approximately 110 hp, the torque would theoretically be in the neighborhood of approximately 216 newton-meters.
- Since 1 Nm = 0.7376 ft. lb., this translates into about 160 foot pounds of torque. This horsepower-to-torque relationship follows typical turbine characteristics; the 1987 Chevy turbine experiment resulted in a 120 hp bladed design delivering 350 ft. lb. of torque.

One last piece of the puzzle we need to examine is the aerodynamic effect of the disk geometry. First of all, we want gas adhesion to the disk surfaces to be as great as possible, which means the disks must be as highly polished as possible. Imperfections in the disk surface causes vortices in the gas flow, resulting in lose of adhesion, and lower energy transfer efficiencies.

Next we have to consider the maximum boundary layer dimensions. An excellent study on the subject is **H. C. Smith's "Illustrated Guide to Aerodynamics."** On pages 57-60 he covers the dynamics of the entire boundary layer, including the laminar region and turbulent region. On page 60 Smith states that the laminar region extends to 0.03 inches thick, or double that (0.06 inches) for two disks placed next to each other. He goes on to say that the transition layer is about 0.1 inches thick, with the turbulent region as thick as 0.5 inches.

Theoretically, a Tesla turbine will still work with up to **1.0 inch gap between the disks**, ***with greatly reduced torque***. That explains why his turbines continued to work well even with a 0.125-inch spacing. ***To compensate for the torque loss, the diameter of the disks must increase as the spacing increases***.

Since larger gaps allow turbulent regions to operate, the energy transfer mechanism shifts from adhesion to turbulent parasitic drag. Of course, the fluid properties, pressures, etc. have a lot to do with laminar vs. turbulent flow also. Tesla used round washers around the periphery of the disks to assist in spooling up the turbine; these washers work on a strictly parasitic drag principle and are absolutely necessary to get the turbine moving when the gas back-pressure (due to centrifugal force) is at zero.

One last thing to consider is that if the spacing between the disks becomes too small, an aperture closing effect causes the high velocity gas to go around the disk pack rather than through it. That is also why spacing between the disks and housing must be kept at a minimum, or one must provide labyrinth seals to prevent gas blow-by.

This is also the primary reason we now advocate using the shaft-less, or rather, **Hollow Shaft Tesla Turbine modified design (HSTT)**. The exhaust flow may now pass unimpeded directly through to the exhaust "chamber" which is essentially, and for all practical purposes – a hollow shaft. This novel design also eliminates another rather problematic area of a Tesla Turbine's construction, that being the shroud necessary to pass the exhaust gasses around the bearing frame/chamber. Bearing failure is now virtually eliminated due to excessive heat intrusion, as, the exhaust is now passing directly from the disk pack, down through slits in the hollow shaft, and directly out said shaft to either a collection conduit, or routed through to another of a multi-stage bladeless turbine pack.

We have now replaced the through bolts, with actual reinforced pins that securely act as both anchors for the disk pack to shaft mount, and for gyroscopic stabilization pieces. The simple process to form the spacers is now a stamped process thus elimating another costly production end cost. The shaft is tooled from one piece of tool hardened stainless steel through conventional machining. The disks are now specified as either Inconnel®, or Hastaloy® due to the high Nickel content and are stress relieved.

We have long been an advocate for creating vortex induced turbulence inside of the disk pack. After years of research, and hands-on design and testing experience, I have now devised a way to induce turbulence PRIOR to passage of the active motive fluid into the disk pack. This is done through a novel disk design resembling a conventional circular saw's blade. Instead of a circular disk shape, I have now opted for an indented rim disk. This design also introduces pressure waves, and creates an ideal environment for the creation of an active vortex, which, through observation, aids in acceleration of the fluid through the disk pack. First a pressure wave is created, and then an instant release as the fluid is now "sucked" into the disk pack through natural ventilation processes. Pressure, vacuum, release, thus an increase in the fluids available power through a massive increase in adhesion and viscosity presented at the very rim of the disks. Please see CAD diagrams at end of this article for full illustrations.

In conclusion, regarding the disk's spacing for a 10-inch turbine, disk spacing anywhere from 0.03 to 0.0625 inches is ideal, with 0.125 inches tolerable with larger (48-inch to 60-inch) turbines, torque being the factor to watch.

To end with quotes from Nikola Tesla:

"Such a machine is a thermodynamic transformer of an activity surpassing by far that of any other prime mover, it being demonstrated in practice that each single disk of the rotor is capable of performing as much work as a whole bucket-wheel. *Besides, a number of other advantages, equally important, make it especially adapted for operation as an internal combustion motor."*

"Just what is your new invention?" I asked. "*I have accomplished what mechanical engineers have been dreaming about ever since the invention of steam power,*" replied Dr. Tesla. " *That is the perfect rotary engine. It happens that I have also produced an engine which will give at least twenty-five times as much power to a pound of weight as the lightest weight engine of any kind that has yet been produced. "In doing this I have made use of two properties which have always been known to be possessed by all fluids, but which have not heretofore been utilized. These properties are adhesion and viscosity."*

"*Then, too,*" Dr. Tesla went on, "*there are no delicate adjustments to be made. The distance between the disks is not a matter of microscopic accuracy and there is no necessity for minute clearances between the disks and the case. All one needs is some disks mounted on a shaft, spaced a little distance apart and cased so that a fluid can enter at one point and go out at another. If the fluid enters at the center and goes out at the periphery it is a pump."*

"If it enters at the periphery and goes out at the center it is a motor. "Coupling these engines in series, one can do away with gearing in machinery. Factories can be equipped without shafting. The motor is especially adapted to automobiles, for it will run on gas

explosions as well as on steam. The gas or steam can be let into a dozen ports all around the rim of the case if desired. It is possible to run it as a gas engine with a continuous flow of gas, gasoline and air being mixed and the continuous combustion causing expansion and pressure to operate the motor."

"*I have got more than that,*" replied Dr. Tesla. "*I have an engine that will give ten horse power to the pound of weight. That is twenty-five times as powerful as the lightest weight engine in use today. The lightest gas engine used on airplanes weighs two and one-half pounds to the horse power. With two and one-half pounds of weight I can develop twenty-five horse power.*"

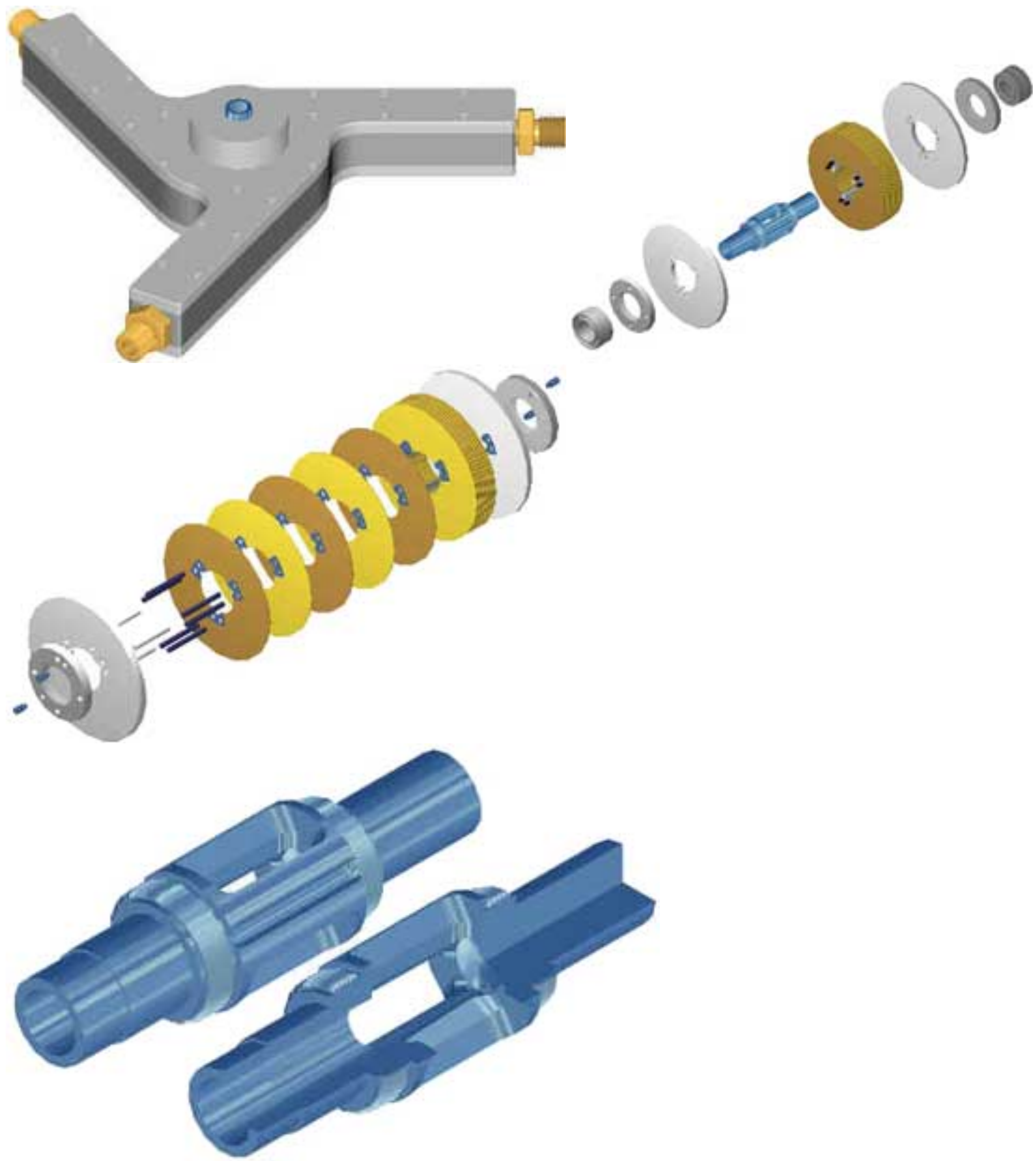
"That means the solution of the problem of flying," I suggested. "*Yes, and many more,*" was the reply. "*The applications of this principle, both for imparting power to fluids, as in pumps, and for deriving power from fluids, as in turbine, are boundless. It costs almost nothing to make, there is nothing about it to get out of order, it is reversible--simply have two ports for the gas or steam, to enter by, one on each side, and let it into one side or other. There are no blades or vanes to get out of order--the steam turbine is a delicate thing.*" I remembered the bushels of broken blades that were gathered out of the turbine casings of the first turbine equipped steamship to cross the ocean, and realized the importance of this phase of the new engine.

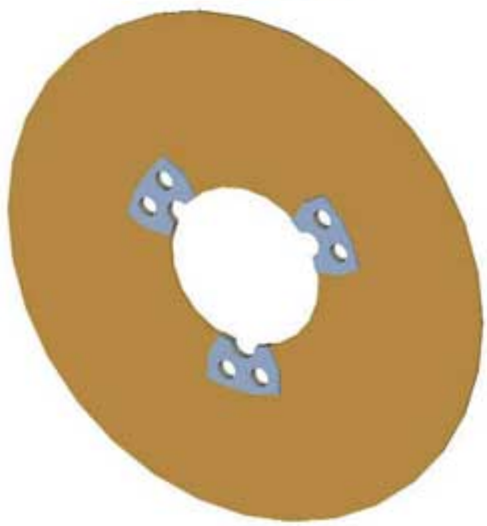
"The expansive power of steam, as well as its propulsive power, can be utilized as in a turbine or a reciprocating engine. By permitting the propelling fluid to move along the lines of least resistance a considerably larger proportion of the available power is utilized. "As an air compressor it is highly efficient. There is a large engine of this type now in practical operation as an air compressor and giving remarkable service. Refrigeration on a scale hitherto never attempted will be practical, through the use of this engine in compressing air, and the manufacture of liquid air commercially is now entirely feasible. With a thousand horse power engine, weighing only one hundred pounds, imagine the possibilities in automobiles, locomotives and steamships. In the space now occupied by the engines of the Lusitanian twenty-five times her 80,000 horse power could be developed, were it possible to provide boiler capacity sufficient to furnish the necessary steam.

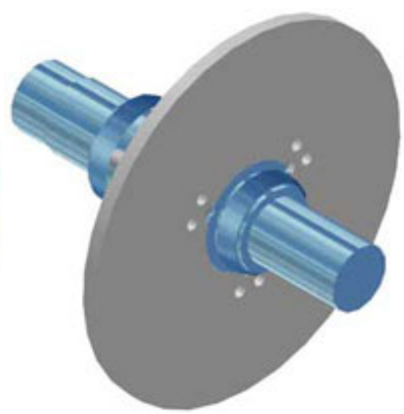
"**I have accomplished what mechanical engineers have been dreaming about ever since the invention of steam power,**" replied Dr. Tesla. "**That is the perfect rotary engine.** It happens that I have also produced an engine which will give at least twenty-five times as much power to a pound of weight as the lightest weight engine of any kind that has yet been produced. "In doing this I have made use of two properties which have always been known to be possessed by all fluids, but which have not heretofore been utilized…

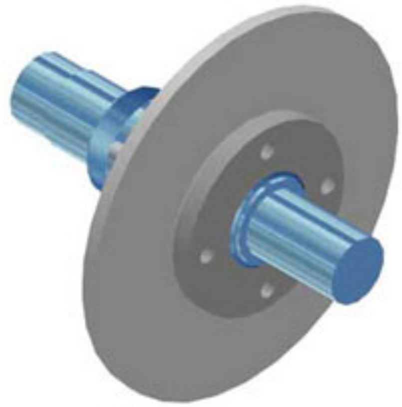
One moving part – the rotor (bladeless disk pack). All motive fluid or gas MUST act to be converted to mechanical energy (the rotation of the shaft). Robust design. No mechanical wear, with magnetic bearings utilized. Extremely simple, and inexpensive construction, through either metal casting, pressing, or newly developed 3-D rapid prototyping technologies. Powerful. Small footprint. A 100 kW Tesla Turbine occupies a space of a mere 20" diameter by 4" thick.

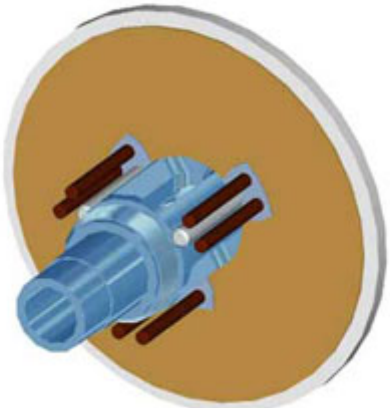
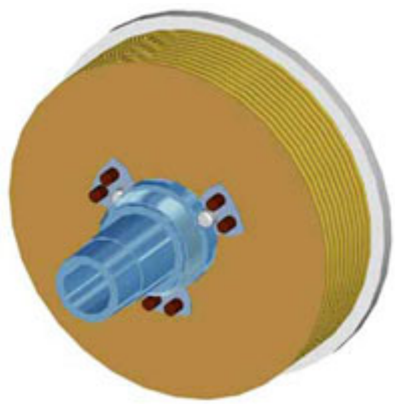
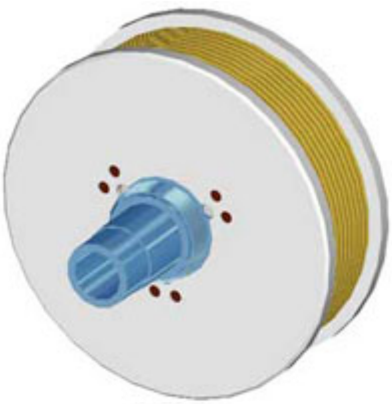
Novel Hollow Shaft Tesla Turbine design

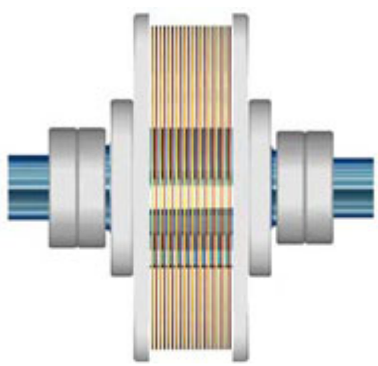


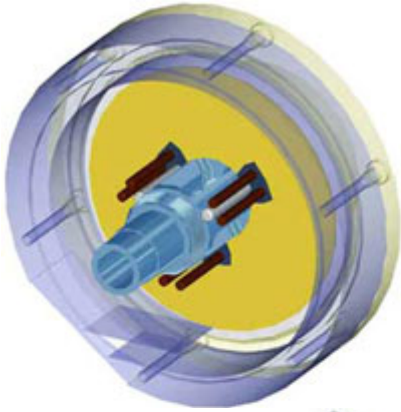
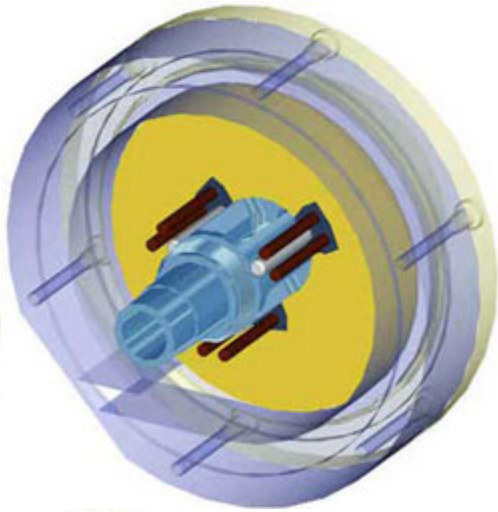


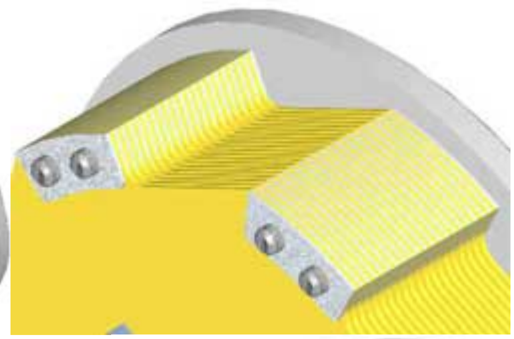


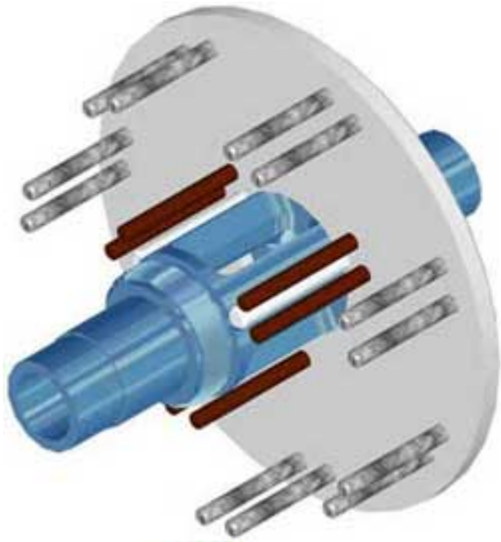


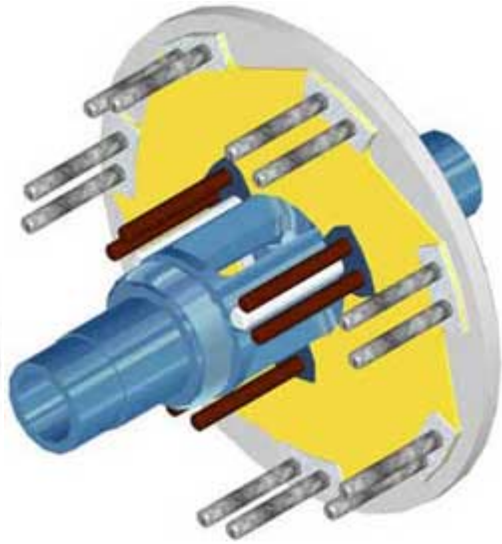




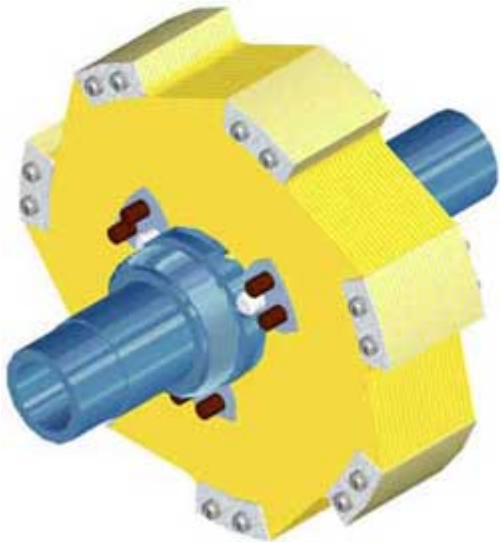



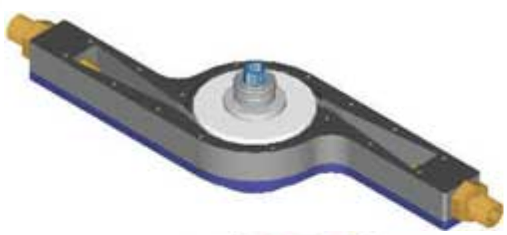



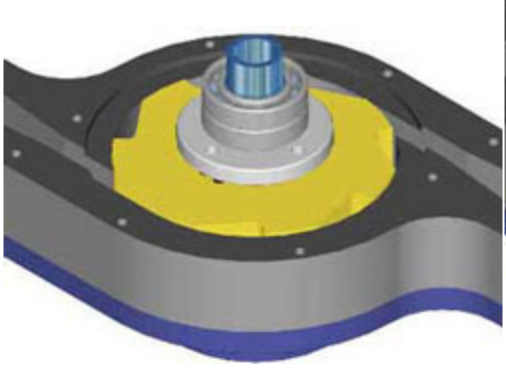



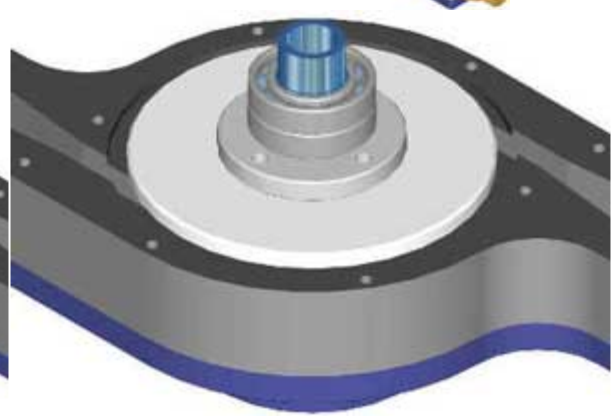


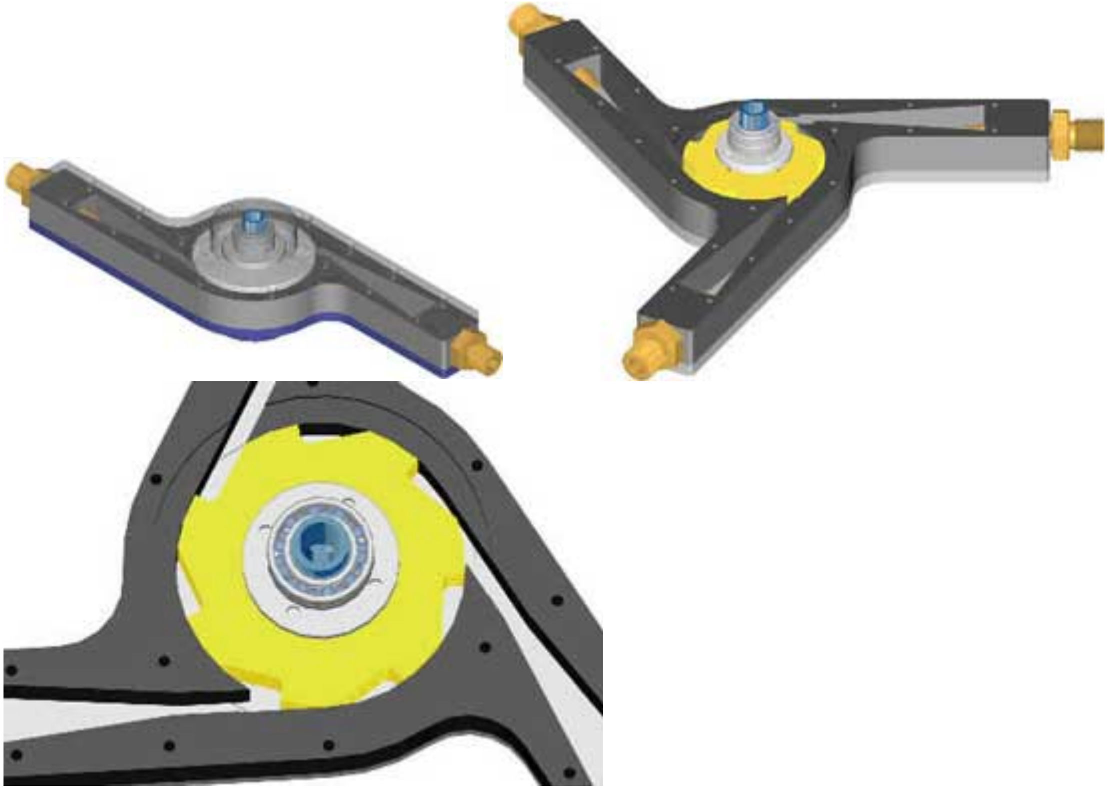












Shown above are figures illustrating the single, dual, and triple inlet configurations of the Hollow Shaft Tesla Turbine design. All Intellectual Property and Patents fully apply.

E-cat and Desalination

Research and Development project

Water Purification and Desalination – 2 Projects

Introduction

One of the best investments in our developing technologies is the potential of desalination, taking free water from the ocean, removing the salt, and selling it.

Because our technology separates hydrogen and oxygen, it also separates impurities, creating instant desalination, at a very low cost compared to other methods.

There is a rapidly dwindling fresh water supply in the world today. Roughly 1.5 billion people, more than 22% of the world's population, lack safe drinking water. According to an industry report, "the desalination market will generate expenditure in the region of $95 billion by 2015."

Global conglomerates have quickly entered this high-profit industry. GE, Siemens and Dow Chemical each have a big stake in the business, with operating plants all over the world. Firms like T. Rowe Price, Vanguard, and Berkshire Hathaway are monitoring the desalination technology because all these companies use old costly methods. It takes about 14 kilowatt-hours of energy to desalinate 1,000 gallons of seawater.

Project 1: Magnetic Water Treatment

This project treats the water with high strength magnetic fields, changing the structure and decreasing the surface tension. It makes the water "wetter" without the use of surfactants. Thus, the water becomes a better solvent, and nutrients as well as oxygen are more easily dissolved in it. It has yet to be determined the exact changes that are made from a quantitative standpoint, and what effect if any this has on the hydrogen bond angle. However, from an empirical perspective, it has been proven to have beneficial effects on living systems.

Project 2: Reduced Pressure Water Desalination

Currently, water is boiled at room pressure to remove salt as well as undesirable dissolved solids from the water to make it safe for human consumption. This is extremely energy intensive, as it takes a substantial amount of energy to change the phase of water from a liquid to vapor. It has been a serious limitation to the access of clean water around the world.

This project proposes the distillation of water in a reduced pressure vessel at approximately 0.5-psi static pressure. At this amount, the water will boil at slightly higher than room temperature, which means that much less energy will be required to purify the same quantity of water. There are two methods for accomplishing this: In one method, two tanks are brought down to the required low static pressure, and a small amount of heat is placed on the evaporator tank. Optimally, there will be a differential of 10-20 degrees C between tanks. This can either be an elevated temperature on the evaporator tank, or a reduced temperature on the condenser tank. Another possibility is to place a heat exchanger between the two tanks for condensing the water vapor.

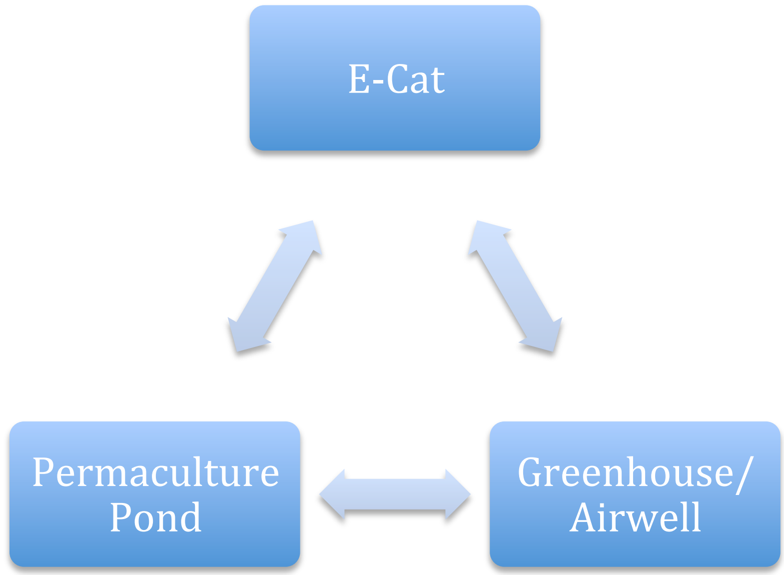
So what we need is a source of cheap, environmentally clean energy to do the desalination. One possibility is to use the Rossi E-Cat to provide the temperature differential. We do this by the use of a heat transfer oil through the reactor, routed to a heat exchange loop inside the evaporator tank. The tank is heated above the reduced boiling point by initially pumping it down with a vacuum pump so the boiling point is slightly above the ambient temperature. After vaporization, the water vapor is routed to a heat exchanger to chill it down, condensing it back into water. That water is then pumped into a holding tank. At 3.6 cents per kilowatt hour, it will cost 50.4 cents per 1000 gallons to operate, or .0126 cents per liter.

The other possibility is to use solar energy to accomplish the low-pressure distillation. Two water tanks are employed, one painted black for the evaporator side, and the other white for the condenser. The height of the tanks is variable, due to local ambient atmospheric pressure. At the top of a large mountain, for example, or high altitudes, a shorter standpipe will be required to get the correct pressure. The bottom of the tower is at atmospheric pressure, and to initially get the water up into the tower a vacuum pump is employed to raise the column to the top of the tank. The same is done for the condenser tower. Each system will work in pairs.

In operation, the black tank will be heated by solar energy, and the vapor travels through a ribbed heat exchanger, cooling it down and condensing it where it goes into the condensate or receiving tank. As long as there is enough input energy to run the evaporator, the system will continue to function.

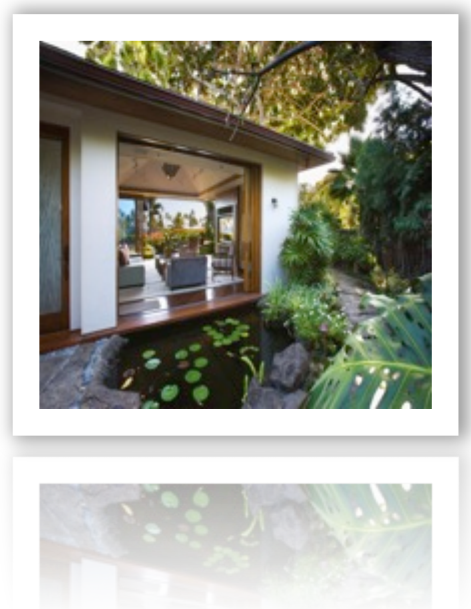
Which system is used will depend upon availability of solar energy. In areas where sunny days are few, the E-Cat will be used out of necessity, as well as extremes of latitude. The limitation of the solar system is climate and weather. The E-Cat has no such limitation. It can also be used on board ship as well as in "closed ecologies" including many agricultural areas

It is clear that if you can vaporize water with low energy input, you have the ultimate solution to desalination. When the water vaporizes- the salt is left behind. A low energy input solution to the world's water crisis (and a 95 Billion dollar industry)



The desalination system can also consist of "Airwell" systems, essentially large dehumidifiers built into shipping containers. The airwells are evaporative air conditioning systems designed to extract moisture even in arid areas. The theory is that you chill down the air below its dew point, collect the water, and return the air back to its original ambient temperature minus the water. As long as the air has a dew point above 0 degrees Celsius, there is enough relative humidity to run the system.

The greenhouse application is dependent upon a source of both water as well as heat, so when the desalination regime has proven itself. It will be incorporated into the greenhouse system. The greenhouse can either consist of hydroponic or aeroponic systems. Excess water is either recycled through the desal system, or used in several permaculture ponds to filter the water before it goes to the fish ponds. The excess ammonia from the fish pond is then cycled back into the greenhouse as bio-compatible fertilizer for the plants, completing the circle. Further details on agricultural applications can be seen at www.Bloomthedesert.com



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