New Solar Breakthrough May Compete with Gas
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International Automated Systems, Inc. [IAUS] has developed a unique solar power technology that it believes will be the first to compete with gas, coal, and oil. Two primary issues have prevented solar power from replacing fossil fuels: The first obstacle is the high cost of equipment. Currently, solar power equipment is far too expensive to compete with fossil fuels. The second is production capacity. Even if the price of today's solar power technologies was in line to compete with fossil fuels, the production capabilities are so limited it would take decades to even scratch the surface of replacing fossil fuels.

IAUS's new solar power technology presents a breakthrough on both fronts. The company's unique solar power technology is priced to replace fossil fuels, and its annual production capabilities marginalize any other solar technology- making it perhaps, the energy sector's holy grail in a market currently grossing more than $3 trillion annually but fueled by less than 1% solar.

IAUS Solar Technology- What Makes it Different?

(Figure 1: IAUS Solar Tower with Four Circles of Panels)

IAUS Solar Panels- IAUS has developed a very unique thin panel with lens-like properties that focuses the sun's energy to a high-temperature focal point on a receiver. The heat is converted to steam which is then used to generate electricity. IAUS'S unique panels are inexpensive, efficient, and low maintenance. Typical solar reflector panels (e.g. solar dishes, troughs, heliostats) are very expensive and require a great deal of periodic, manual fine-tuning to sustain a solar focal point on its target. Once installed, IAUS'S panels need no manual fine-tuning to maintain its focal point. This significantly reduces the cost of plant operation.

In addition to IAUS'S actual field tests, optical ray-tracing simulations have been conducted to verify the efficiencies of IAUS'S panel design. IAUS'S unique solar panels show efficiencies of over 90%. In the field, IAUS'S panels produce temperatures from 1,600-1,800 degrees Fahrenheit while tracking the sun.

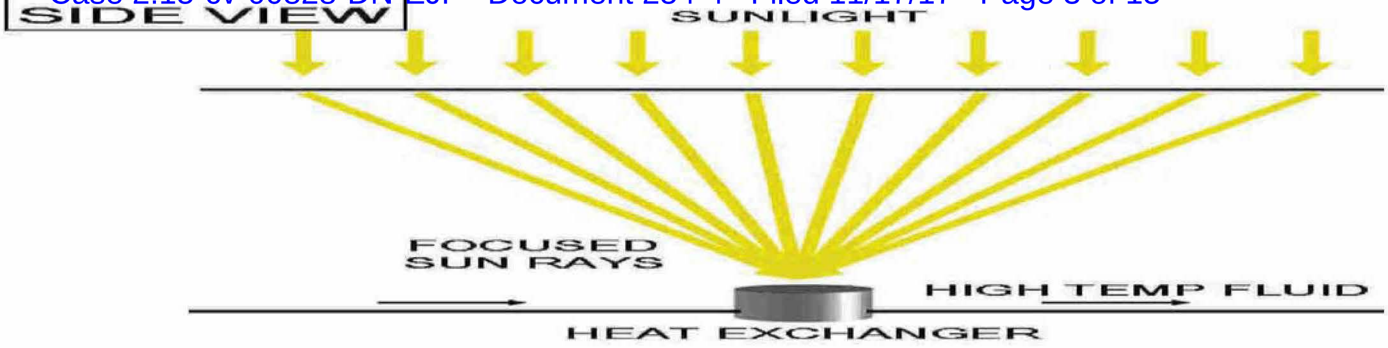
By adding the new compound parabolic concentrator IAUS's temperature can exceed 2500°F.

Seventeen panels fit together in a circular pattern which spans approximately 39 feet in diameter. Four of these circles are mounted to a single tower equipped with dual-axis, automated tracking. The panels follow the sun east to west, north to south, producing higher number of hours than single axis concentrator solar power (CSP) systems and flat-plate mounted Photovoltaic (PV) systems.

IAUS'S unique panels are made up of a very durable, engineering grade monomer material that has been known to endure extreme weather conditions for more than 60 years with low degradation. IAUS'S panels are 100% recyclable.

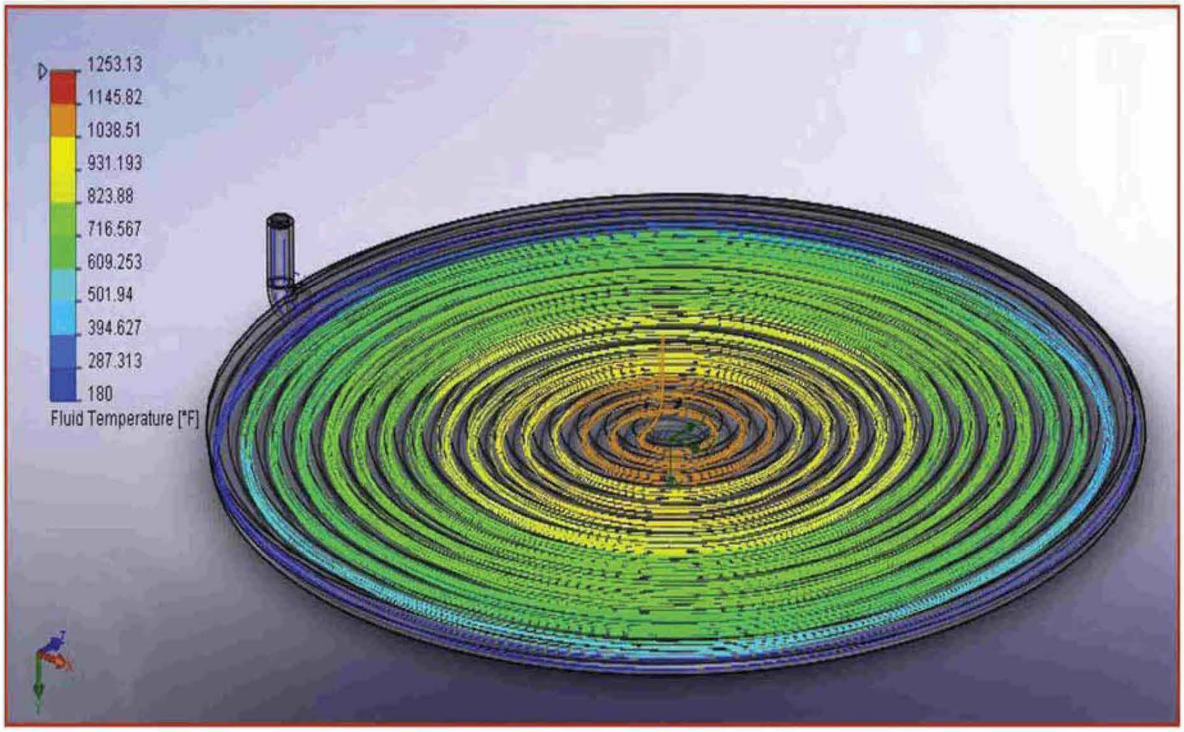
The panels are also designed to rotate about themselves to reduce wind load on the system. As the wind approaches some predetermined velocity the panels will break loose and turn about there axis. This prevents the plastic panels from breaking while reducing wind load on the mechanical structure. This has the added advantage of reducing the metal in the mechanical structure thus reducing the cost of the structure. This also reduces maintenance cost in replacing broken lenses.

IAUS Receiver- Each circle of panels or lenses has only one receiver. There are four circles of lenses and four receivers per dual-axis tracking tower. The receiver is a heat-exchanger that directly transfers the heat from the high-temperature focal point into water. Water flows into each receiver until it reaches a temperature between 1,000-1,100 degrees Fahrenheit.

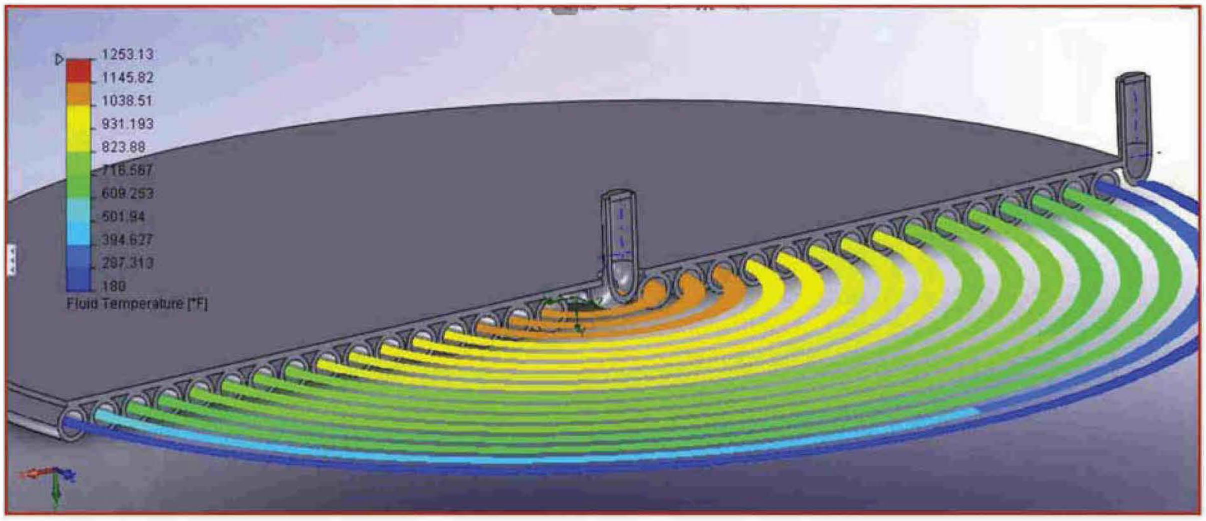


(Figure 2: Side view rendition of one of IAUS'S circle of solar panels or lenses focusing on a solar receiver heat exchanger)

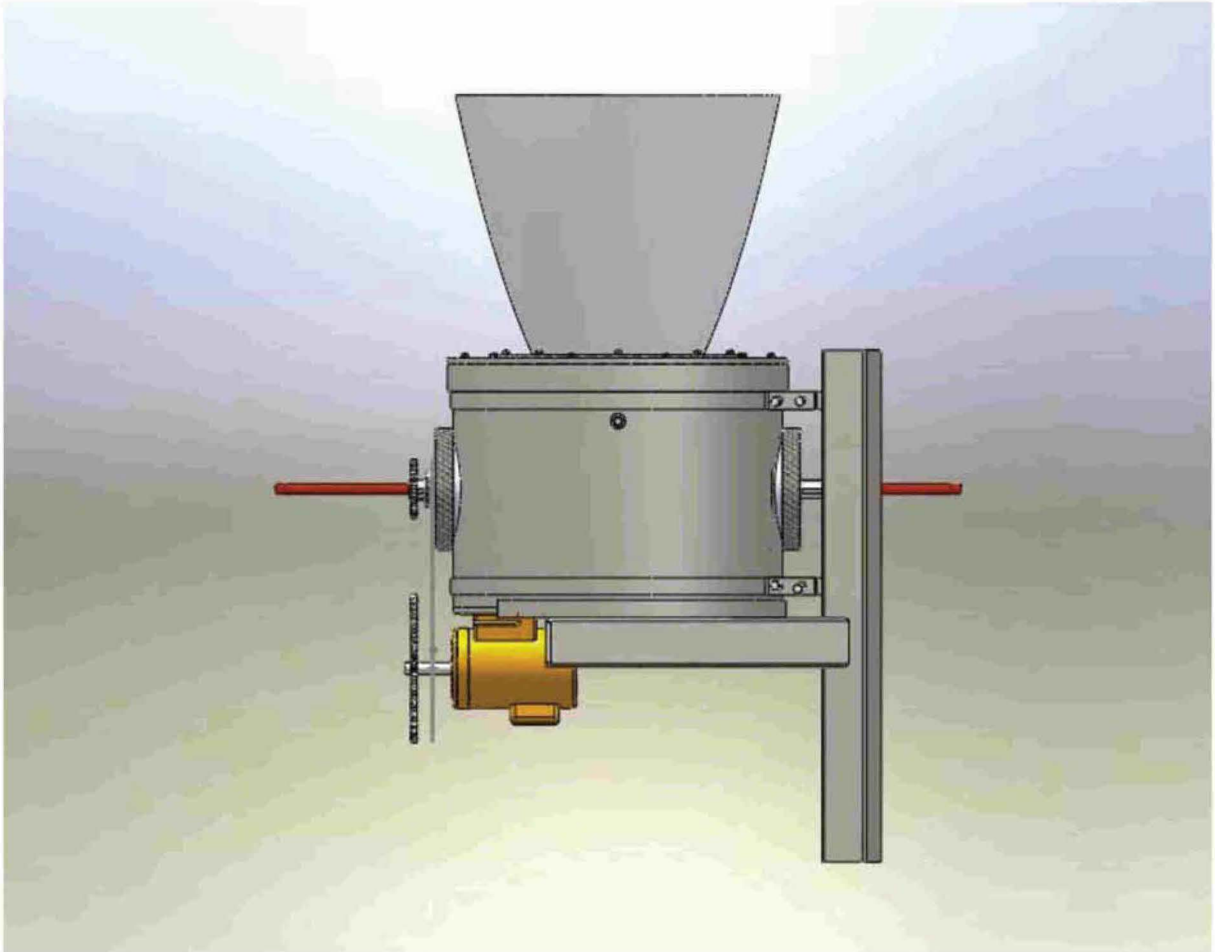
In addition to performing field tests on its receivers, independent thermal dynamic and hydraulic flow simulations were conducted to verify flow rates and thermal efficiency. These numbers supported that IAUS'S receiver has a heat-absorption rate efficiency of over 90%.



(Figure 3: Top cut section view of water absorbing the sun's heat through IAUS's solar receiver heat exchanger)



(Figure 4: Middle cut section view of water absorbing the sun's heat through IAUS's solar receiver heat exchanger)



(Figure 4.1 New solar receiver showing the concentrator along with the movable heat exchanger)

New concentrator and heat exchanger- Referring to fig 4.1 this is the new heat exchanger design featuring the concentrator with the new heat exchanger and the rotation mechanism. The top portion is the concentrator which takes the incoming rays from the lens and further concentrates the suns rays which also increases the temperatures that hit the heat exchanger portion. The heat exchanger rotates to control the temperature at any given point on the heat exchanger. The rotation also eliminates hot spots on the heat exchanger reducing the chance of melting or burning the heat exchanger. This also provides a more even temperature exchange between the heat exchanger and the heat absorbing medium inside.

This heat concentrator and heat exchanger combination also reduces the infrared radiation coming off of the heat exchanger.

This heat concentrator and heat exchanger design also allows the solar energy to be used to convert zinc from zinc oxide without using a hydrocarbon compound to isolate the oxygen atom from recombining with the zinc.

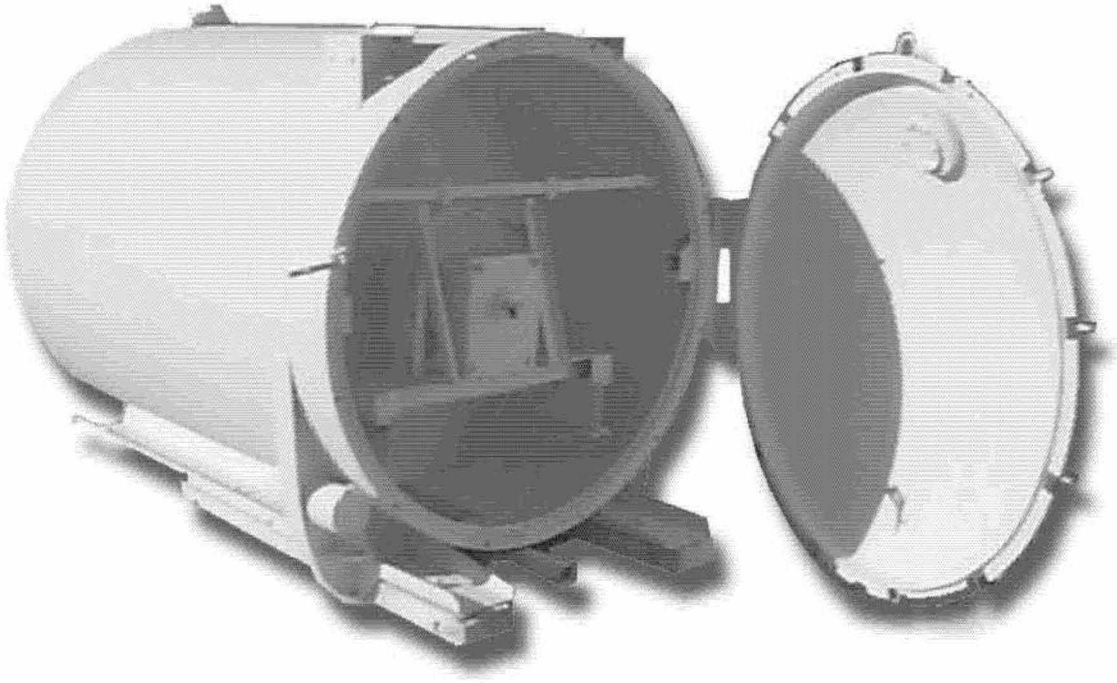
IAUS Turbine Eliminates Need for Boiler- IAUS'S solar thermal collectors can easily work with either a traditional steam turbine, or with IAUS'S new, proprietary turbine. IAUS'S proprietary turbine steam cycle does not need an expensive, high-maintenance boiler. Instead IAUS'S solar collector system can feed the super-heated water directly into IAUS'S turbine.

IAUS'S solar power technology successfully operates without a boiler or pressure vessel because it utilizes a unique, bladeless turbine design developed by IAUS to drive the electric generator. IAUS'S turbine runs on both high quality and low quality steam with a bi-phase flow capability. Unlike traditional turbines, the high-temperature water does not need to pass through an expansion tank to flash to steam prior to IAUS'S turbine. Instead, IAUS'S bladeless propulsion turbine can run directly on super-heated, high-pressure water. The expansion or phase change (flashing) from water to steam happens right at the nozzle of IAUS'S turbine.

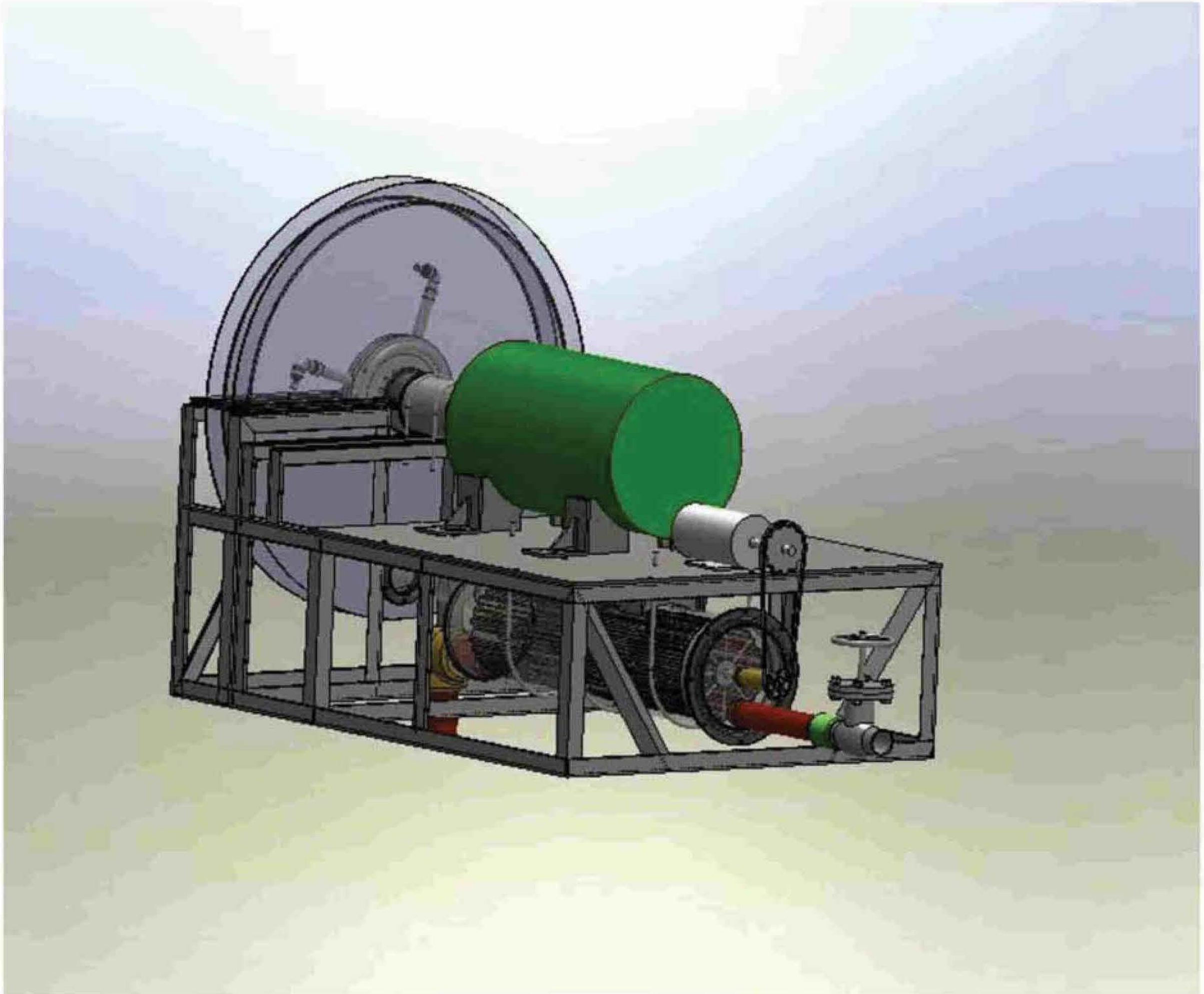
In a conventional power plant, the water is boiled and flashed to steam in a large, high-pressure tank called an expansion tank. The steam is then sent through a series of super-heating stages. The expansion tank and steam channels are large pressurized vessels that make up the boiler and must be regularly certified. If something goes wrong with this traditional power plant boiler system, it can explode like a bomb. Each weld must be routinely X-Rayed and the entire system continuously monitored with sophisticated and expensive equipment to ensure safety and the output of high-quality steam.

IAUS's system does not need an expensive and sophisticated boiler like this. Instead IAUS's turbine uses a series of smaller, high-pressure tubing, which is much safer, less expensive and easier to manage; and, it makes the Balance of Plant (BOP) steam production and monitoring equipment less complicated. These are significant advantages over traditional boiler systems required by conventional turbines.

Propulsion Turbine- As previously mentioned IAUS'S solar collector system can operate with either a traditional high-end steam turbine or IAUS'S own proprietary steam turbine. There are many advantages to IAUS'S unique turbine. Rather than relying on turbine blades to spin the turbine cylinder, IAUS's Propulsion Turbine is designed to turn the cylinder without blades. IAUS'S turbine efficiencies are very similar to expensive, high-end, multi-stage turbines; however, IAUS'S turbine is low-cost and operates minus most of the expensive surrounding components and maintenance issues.



(Figure 5: IAUS bladeless propulsion turbine)



(IAUS's bladeless turbine)

Traditional turbine performance relies upon the environment within its blade chambers. Super-heated, high velocity steam particles are continuously striking the titanium turbine blades to turn the shaft. If steam condenses on the blades, a sharp drop in efficiency and damage to the turbine can result. Traditional multi-stage turbines require dry, high-quality steam.

IAUS's new turbine is structurally unaffected by low quality steam. It blows the energy away from its components instead of on them to turn the shaft. It is smaller than traditional turbines, less expensive, and requires very little maintenance. Unlike traditional turbines, IAUS's turbine can operate without corrosion or system failure on both high quality and low quality steam.

(Figure 5.1 this is the new heat exchanger that recovers the steam from the turbine)

Cooling Towers- Because of the unique nature of IAUS's turbine, the actual working chamber of the turbine can be used as both a direct heat-exchanger and water recovery system on the condensing side. This increases the efficiency and lowers the sophistication and cost of a dry cooling tower. IAUS's system can recycle virtually all of the water used in the process of power production instead of being wasted into the atmosphere like with wet cooling towers that are typically used in the condensing cycle of a traditional power plant.

Cooling towers are a critical component of traditional turbines that help maintain a sophisticated delicate balance. These towers cool the steam exiting the turbine, creating a vacuum. The towers must maintain a consistent low temperature otherwise the traditional turbine potentially faces both a sharp drop in efficiency and serious damage.

As previously noted, IAUS's unique turbine has no blades to corrode, therefore, the expended steam and water can be condensed within the working chamber of the turbine using a simple air-cooled recovery system. This water is re-pressurized by a high-pressure pump and re-circulated through the solar field to repeat the cycle. Very little water is wasted, unlike wet cooling towers.

Wet cooling towers, at a typical coal-fired power plant, waste enormous amounts of water. A family consumes as much water using electricity as they do in everyday water usage. Because IAUS'S turbine can operate without traditional wet cooling towers and recycles the water in a closed loop, it is perfect for areas of the Southwest where water conservation is very important.

Also, because IAUS'S turbine does not require such a delicate balance on the cooling side, IAUS power plants can operate a highly efficient co-generation cycle. The excess heat that is normally wasted in the production of electricity at a typical power plant can instead be put to some other use in conjunction with IAUS's power plants. The thermal and electrical load can easily be adjusted up or down depending upon the need, to best utilize the heat byproduct from the power plant. Putting the heat byproduct to use can increase the efficiency of the plant from approximately 20% up to nearly 70%. A traditional turbine is a poor design for co-generation. It creates difficult BOP consequences including the accelerated corrosion of the turbine itself.

Salt water or brackish water or polluted water recovery using bladeless turbine- In addition to not using water to cool the steam the new IAUS's turbine can also purify salt water, brackish water and or polluted water at little additional costs.

IAUS Solar Breakthrough Technology can Make Fresh Water from Sea Water for Free While Powering a City

Unlike photovoltaic (PV) solar panels, IAUS's new solar breakthrough technology can utilize waste heat to desalinate sea water for free. Waste heat is a byproduct of IAUS's solar power process as it produces electricity for the grid. Due to the unique design of IAUS's patented turbine, it utilizes a technique called vapor compression in the heat recovery process. Vapor compression is becoming a widely-used means for distilling water.

Utilizing the waste heat from an IAUS solar field to produce fresh drinking water increases the overall efficiency of the system to nearly 70% peak power production without a significant increase to the price. Fresh water has become a serious global issue and is predicted to be more perilous than forecasts of current energy issues—both are daunting without renewable energy advancements. In some parts of the world, fresh water is already becoming equal or more expensive to obtain than fuel.

Currently, desalinating sea water costs approximately $800-$1600 per acre foot of water. This price is about 10-20 times greater than the cost a typical farmer currently pays per acre foot to irrigate his crops. In coastal areas around the globe an IAUS solar plant could produce electricity from the sun at an economical price, whereupon the utility company could sell the power to citizens--while at the same time--desalinating water as a waste byproduct for free.

IAUS solar desalination gives IAUS's product a unique edge over other technologies in coastal areas wherein fresh water is becoming a problem due to inland populated areas growing. This ability can greatly help inland communities as well. Some project that the State of Utah will exhaust its Colorado River water shares by the year 2020. Southern Nevada has long been attempting to increase its water shares from the same river. If Southern California coastal cities that are somewhat dependent upon the Colorado River were to utilize an IAUS solar desalination plant—more water shares could be available for Utah, Southern Nevada and others.

Electric Generator- IAUS'S turbine can turn either an induction or synchronized generator to produce AC power that is thereupon connected to the grid through a simple, inexpensive cut-off switch. A traditional turbine drives a synchronized generator and requires a very expensive, instantaneous cut-off switch control mechanism. This is another reason the BOP system for a traditional turbine is very sophisticated. If the supply steam is inadvertently reduced, the grid can turn the electric generator into a motor pulling for more steam supply than is available like a vacuum whereupon the turbine blades will cavitate, potentially causing them to shatter out the chamber like an explosion. This is extremely dangerous.

IAUS's bladeless turbine presents no such danger. The instantaneous shut-off mechanism in the BOP system for IAUS's turbine is not critical to the same degree and is therefore a simpler design and much less expensive. IAUS'S less sophisticated BOP controls not only save a great deal of cost in set up, they can also reduce O&M costs by nearly 1-2 cents or more per kWh.

IAUS'S turbine can be sized to virtually any generator, big or small and can start and stop instantaneously without any cavitations. This allows IAUS to construct its solar plant in smaller 1MW-10MW segments if desired. The turbines can be staged in and used only when needed, and they can be shut down at night. When using smaller plant segments, if one important component goes down, it doesn't shut down the whole plant. In contrast, a traditional turbine gen set would be a financial, operational and maintenance nightmare in multiple smaller sizes.

Each 1MW-10MW segment is self-contained and independent of the other. A 1 MW segment consists of approximately 20-25 towers that include 80-100 circles of lenses and receivers all powering a single turbine gen set and water recovery system. The IAUS plant design requires approximately 5-6 acres of land for every 1 MW of peak power capacity.

Comparisons to Other Solar Technologies

Photovoltaic (PV)

Currently, PV is the most expensive solar technology available. PV has advantages for very small, remote power needs, however, even if PV manufacturers are able to reduce costs with the prospect of thin-film or nano PV technology it still will not match the low cost and other advantages of IAUS'S system.

Hidden Costs of PV

Flat-Plate Installation- In addition to installed costs, PV has hidden costs. For example, advertised PV installed costs do not include dual-axis tracking systems. Therefore, a flat-plate mounted PV system measured during peak sun to be 1 KW ($7,000) of capacity actually produces nearly 30% less power annually than 1 KW ($1,500) of IAUS'S dual-axis solar technology.

Inverters- PV technologies produce DC power and therefore, require an inverter to covert DC to AC power. Inverters, regardless of how small or large cost about $500 per KW. While the inverter is usually included in the advertised, installed price of a PV system, it has a very limited life-span after which it must be replaced. The life-span for an inverter is roughly about 20 years. IAUS'S solar can produce either AC or DC power; therefore, IAUS'S system doesn't require an inverter which eliminates one of the front-end and back-end costs that come with PV systems.

Panel Replacement- In addition to inverters, PV panels also begin to degrade after 20-30 years and eventually need to be replaced as well. This means that after 30 years, when the equipment should finally be paid off and realizing the full benefits of free energy, the buyer will likely end up paying the entire cost of the solar plant all over again to replace it.

IAUS'S dual-axis solar tracking structure is made of steel and will likely hold up for more than 100 years. Also, IAUS'S actual solar panels are made of a material that has been known to last more than 60 years. However, if needed, the cost of panel replacement for an entire IAUS plant is approximately only 15%-20% of the original cost. The cost to replace the PV system after 20-30 years is virtually 100% of the original cost, which is literally repurchasing the entire plant all over again.

Maintenance Logistics- PV is more suited for residential installations than for utility-scale power plants. In fact, the U.S. Department of Energy has determined that solar thermal technology (not PV) is the most reliable solar power for utility scale power plants. While residential installations have benefits (especially in remote areas outside of the grid), they present different challenges. For example, a 100 MW utility scale solar power plant will power about 50,000 homes from a single location. Installation, part replacement, adjustment, maintenance, etc. can be done in one place. On the other hand, 50,000 homes with PV systems are like scattering 50,000 randomly located miniature power plants all over the map that also include remote locations for installation, part replacement, maintenance etc. Travel time becomes a significant cost, not to mention that each installation site is unique.

Energy Storage- PV systems can only store energy using batteries. Batteries are extremely expensive (about $600/kWh of storage) and have a very short life of about 5 years. Since IAUS'S system runs exclusively on heat, it can operate both as a hybrid power plant using other heat sources in addition to the sun such as biomass, natural gas, etc., or, it can store heat in a heat sink for continued operation after the sun has set. Unlike batteries, heat sinks are inexpensive (about $30/kWh of storage) and a properly designed heat sink will last virtually a lifetime.

Unlike IAUS'S technology, PV systems do not utilize the sun's heat. Since much of the sun's energy is heat, this energy is entirely wasted on PV systems. The heat byproduct from IAUS'S system after producing electricity can be utilized for a list of important uses- manufacturing and refining processes, desalination, heat storage, etc. When this heat is put to use, IAUS'S solar energy efficiency is improved again to more than 3-4 times the efficiency of PV systems.

Manufacturing- Currently, IAUS can produce approximately 350 MW of panels per year. It would cost a solar PV manufacturing company approximately $800 million to duplicate IAUS'S current annual production capacity. Within six months, IAUS can increase its annual capacity to 1,000 MW. Within a year, IAUS can increase its annual capacity to 2,000-4,000 MW. This annual solar panel production capacity would cost a PV manufacturing company a little more than $4 billion. To put IAUS'S production capabilities into perspective, one of the current leaders in PV manufacturing has an annual production capacity of 120 MW.

Environmentally Friendly- IAUS'S solar technology is also 100% recyclable. Today's PV systems using silicone are not.

Solar Thermal Mirrors

Mirrors Require Tighter Tolerances- Solar thermal mirror technology (also called Concentrated Solar Power (CSP)) has been around for decades (e.g. solar dishes, troughs, heliostats). IAUS'S technology is also a CSP system, and therefore, it operates under similar thermal dynamic principles. However, IAUS does not use expensive mirrors. Therefore, IAUS'S panels refract the sun's rays instead of reflect. The error ratio of reflecting the solar rays from a mirror to its target is four times greater than refracting the rays like IAUS'S system does. Therefore, mirror-based CSP support trusses, hinges and tracking systems require significantly tighter tolerances than IAUS's to maintain focus and remain correctly dialed in.

Shadowing Effect of Mirror Receivers- Also, since IAUS'S receiver is behind its panels instead of in front like mirror-based CSPs, it is far less expensive, easier to manufacture and install, and casts no shadow on the panels. IAUS has a smaller insulated receiver with only one flat side exposed to the concentrated focal point, yet it still maintains a greater surface area ratio between focal point size and target than mirror-based CSPs. This minimizes the possibility of the sun's rays missing the receiver. Attempting to increase the ratio between the focal point size and surface area on a mirror-based CSP system in order to minimize losses and increase efficiency would require a larger receiver and a larger receiver would block more incoming sunlight to the mirrors.

Maintenance Issues of Traditional Turbine- The lowest cost, mirror-based CSP systems use a traditional steam cycle to turn a conventional, bladed steam turbine and generator. As mentioned above, IAUS'S steam cycle does not require large expansion tanks to superheat the steam; it does not require water-cooled cooling towers to condense the steam; and it does not require the expensive and sophisticated monitoring devices for BOP due to the rugged durability of IAUS'S turbine under extreme environmental shifts.

The absence of both an expansion tank, traditional turbine and cooling towers not only significantly reduces the overall cost of equipment and installation, but also reduces daily operations and maintenance costs which translate into a lower wholesale price for electricity per kWh produced.

Not Much Room for Price Reduction- After decades of development, current mirror-based CSPs have streamlined down to what appears to a bare minimum cost without many more areas, if any, to cut prices. Each additional refinement or advancement to today's mirror-based CSPs from here on out will likely have an inconsequential impact on lowering the price. IAUS expects to be less than half of the cost of today's CSP technologies, with room to strip down more costs in the future.

CSP Manufacturing Capacity- Manufacturing capacity is a very limiting factor with CSP technology. Most CSP technology companies have a lower annual production capacity than PV manufacturing companies.

Status of IAUS'S Solar Technology

IAUS is poised to enter the market in full production with its commercialized product this year. IAUS has already successfully completed a mass-production test run of approximately 2 MW of IAUS solar panels. The dual-axis tracking structure has been constructed and designed for mass-production as well. IAUS'S proprietary software that controls the dual-axis tracking mechanisms has been completed. IAUS'S proprietary controls follow the sun, monitor wind-speed, and measure the sun's energy per square meter. Several generations of the turbine have been designed and tested.

(Figure 6: IAUS solar field under construction)