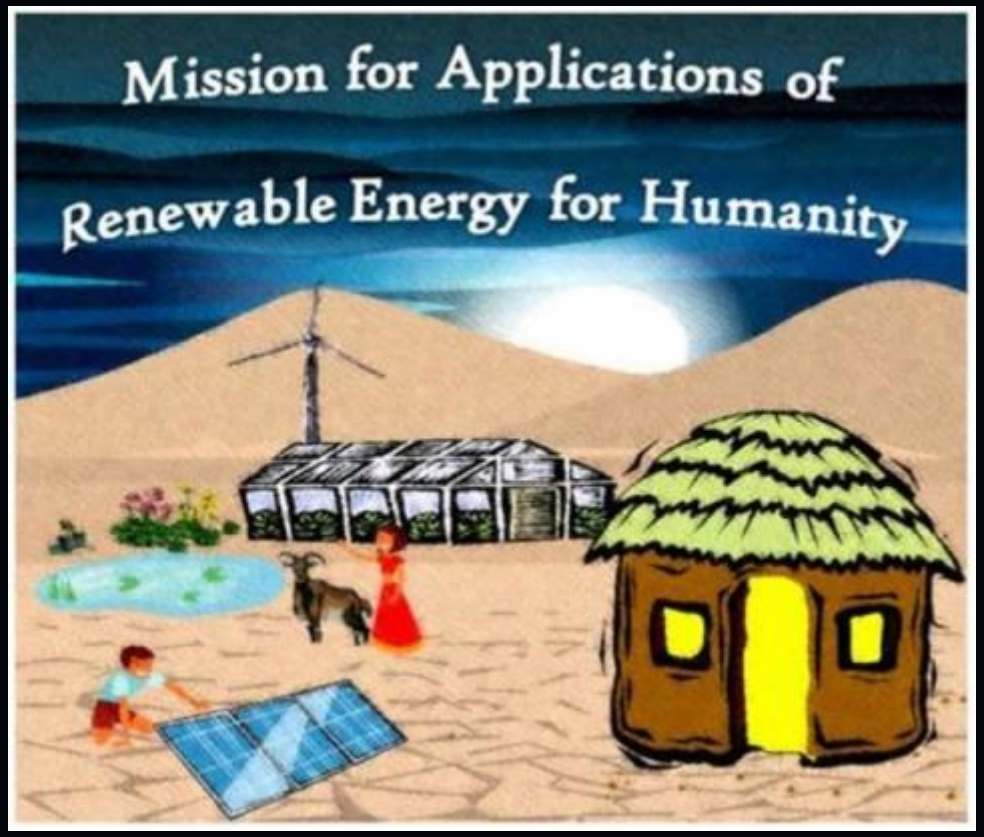


# Alternative Energy Pre-Project Evaluations and Energy Audits


# Alternative Energy System Planning and Energy Auditing

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**Energy Efficiency Management For a Cleaner and Brighter World**

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

# Introduction

## Why you should consider an energy audit before committing to a renewable energy project?

- Understand current energy usage profile
- Map consumption patterns and habits that reduce cost savings of renewable energy
- Rapidly changing technologies for more efficient, cost-saving renewable energy technologies and hybrid systems available for integration need to be evaluated for the project
- Meet the requirements of the International Energy Efficiency Financing Protocol (IEEFP)

# Introduction

- International Energy Efficiency Financing Protocol (IEEFP)

The IEEFP's objective is to create a better understanding by LFIs and other global stakeholders on how Energy Savings Ps generate savings from existing operating expenses of end-use consumers, and how this equates to new cash flow and increased credit capacity for end-use consumers to repay EEP loans.

# Introduction

- Steady increase in the rates of utilities
- Number of tax and utility incentives to help offset costs of your energy management plan
- Growing regulations on the impact on the environment
  - Greenhouse Gas  emissions
  - Energy and water use
  - Waste production and disposal of materials

# Proposed Course of Action

- **What do we propose?**
  - Existing Utility Usage and Costs Analysis
  - Energy Efficient Technology Upgrades
  - Energy Savings Guidance and Implementation
  - Applying for Energy Grants Available
  - Cash Flow Analysis Identifying
    - Projected Project Costs
    - Yearly Finance Terms and Payments
    - Energy Savings
    - Grants
    - Overall Positive Cash Flow


# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Where to Save Energy Costs?

### Upgrades and Retrofits

- Replace existing inefficient equipment:
- Replace Incandescent and older florescent lights
- Replace low efficiency appliance with high efficiency energy star rated appliances appropriately sized
- Upgrade or replace HVAC equipment with modern high efficiency / renewable energy friendly devices
- Correct deficiencies in building envelop that are allowing infiltration or radiant energy losses
- Correct poor power-factor performance of facilities and equipment

# Renewable Energy Opportunities

- Solar Hybrid Photo-Voltaic and Solar Thermal Systems
- Wind Energy Recovery Systems
  - Community sized horizontal axis wind turbines
  - Localized atheistically acceptable vertical axis wind turbine arrays
  - Small scale roof mounted enclosed vertical axis wind turbine
- Thermal Heat Recovery
  - AC condenser heat
  - Absorption cooling
  - Thermal Energy Conversion (TEC)

# Renewable Energy Opportunities

- Hydro-Power
  - Conventional and Micro turbine systems
  - Wave/Tidal Flow systems
  - OTEC Systems (Ocean Thermal Energy Conversion)
- Bio-Mass Gasification Technologies
- Energy Storage
  - Batteries
  - Water Energy Storage (Hydro / Thermal)
  - Hydrogen Gas Store
- Water Conservation / Rain Water

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

# Minimizing Renewable System Costs

## Light Fixture Upgrade Cost Savings Example

Cost to operate a $0.75, 150 watt incandescent bulb for one year
Operating Cost = 150W x $0.10/kWH x 3,000 Hours = $45.00 per Year
1,000

Cost to operate a $20.00, 42 watt compact florescent bulb for one year
Operating Cost = 42W x $0.10/kWH x 3,000 Hours = $12.60 per Year
1,000

100 Bulbs x $32.40 = $3,240 per year savings

ROI = $32.40 = 162%
$20

Simple Payback = $20.00 = 0.62 Years
$32.40

**Solar Energy System Upfront Costs Savings**

150 watts – 42 watts = 98 watts per bulb saved
100 Bulbs x 98 watts = 9.8kW reduction in load

9.98kW x 130% sizing factor = 22.5kW Solar Array

**22.5 kW system costs (@$5 per watt) – $2000 for compact florescent bulbs = $110,500 reduction in up front cost of Solar Energy System**


# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Minimizing Renewable System Costs

- Conduct an energy audit of facilities to be powered by the renewable energy source
- Identify power requirements for facilities and approximate costs of renewable systems
- Identify energy efficiency measures for facilities and calculate load reduction and cost savings after implementation
- Identify power requirements for solar energy systems and costs savings based on proposed reduce load
- Recommend integrated and optimized renewable energy / energy conservation project architecture

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Solar Hybrid Photo-Voltaic and Solar Thermal Systems

- Provide architecturally adaptable structural roofing and solar power
- Provide electrical power for equipment
- Provide heating/domestic hot water
- Provide active thermal heat removal to cool roof and lower energy costs

Click for Real-time data from Yale Divinity School

http://sustainability.yale.edu/solar-energy

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

### State of the Art Solar Technology fit to your business' needs

- Antiquated bulky and heavy rigid solar panels may weigh down your financial goals
- Modern more energy delivering panels are flexible and integrated into building structures
- Cheaper more cost effective technology allows for a virtually invisible footprint for many solar installations



# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Modern Thin-film versus Older Rigid Panel Systems

### Modern Thin Film Technology

- Less expensive per kH rating and total power produced
- Lighter and less expensive to install
- More annual production per rated system kW then rigid panel systems
- Flexibility of architectural design, adapts to your building structure
- Hybrid thermal/PV systems for greater total BTU harvesting
- Hybrid applications create a thermal heat barrier blocking solar radiation for lower cooling costs
- Produces at least partial power in all light conditions (cloud cover, dawn, dusk)

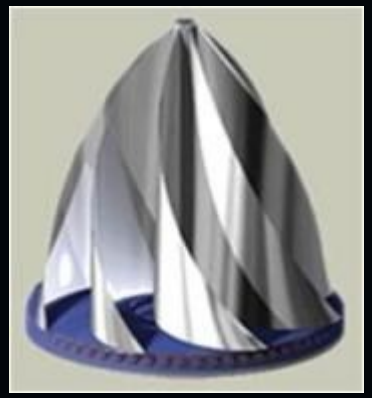
### Older Rigid Panel Technology

- More expensive per kH rating and total power produced
- Heavy and requires expensive frame work and structural support
- Less annual production per rated system kW then thin film
- Highly protrusive structures with extensive wind loading problems
- Only produces power under a narrow range of lighting conditions
- High maintenance costs
- Power production drops drastically below rated capacity when subjected to higher temperatures found on roof installations

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Affordable Wind Energy Technology for Rural and Urban Applications



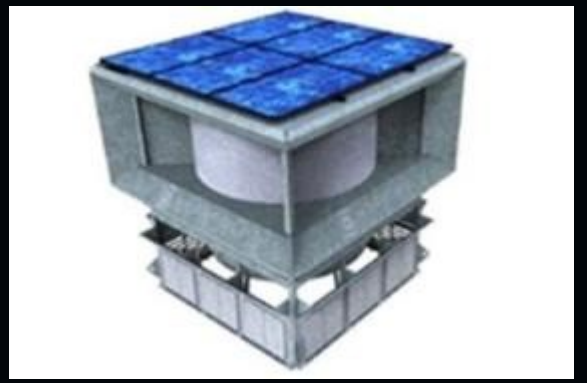
Eco Whisper Turbine

### Horizontal Wind Turbines

- Main shaft is in a horizontal orientation
- Best for open spaces such as rural areas

### Vertical Wind Turbines

- Main shaft is in a vertical orientation
- Ideal for urban settings
- Enclosed configurations for rooftop applications



Windation TWM-5000 Solar –Wind Hybrid

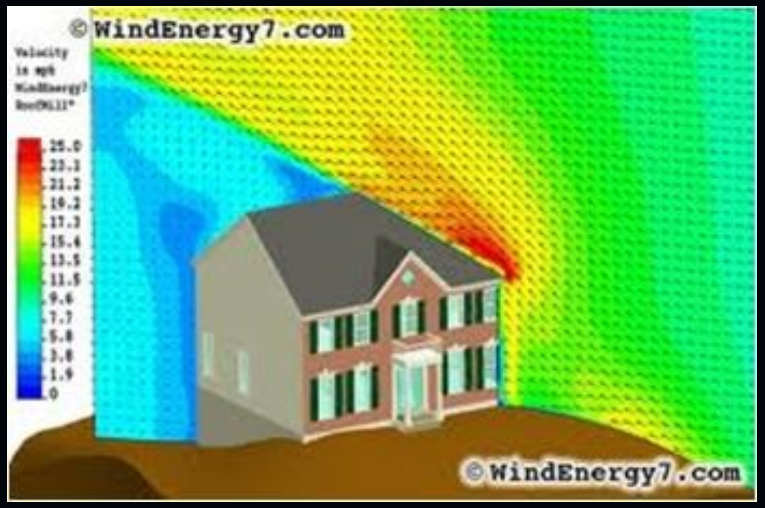
# Mission for Applications of Renewable Energy for Humanity

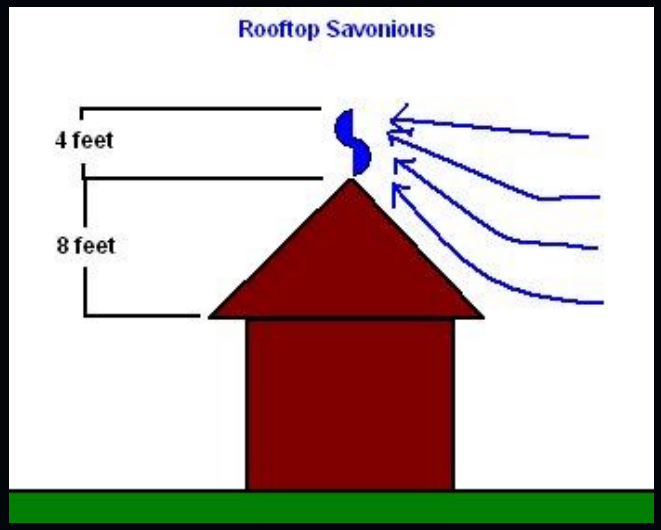
## Alternative Energy Pre-Project Assessment

# Roof Top Turbine Technology Quietly Captures Turbulent Winds Energy Magnified by Roof Effect Forces

### Roof Effect Winds

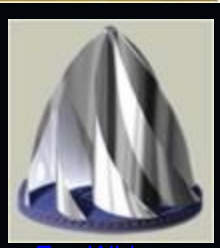
- 3 to 4 times the available power of concurrent ground level winds
- Highly Turbulent wind flows actually improve the turbine's performance




- Requires systems designed to take advantage of turbulent flows

[Windation TWM-5000 Solar –Wind Hybrid]



[Eco Whisper Turbine]

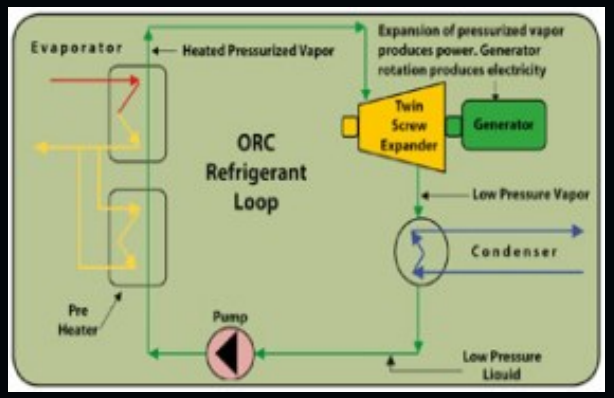
# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Electricity from Thermal Heat Energy Capture

**Turn otherwise wasted/exhausted heat energy into electrical energy using mechanical transformation**

- Boiler Waste Heat
- Solar Thermal Heat
- Stationary Engine (Generators, etc) Exhaust
- Air Conditioner Chiller Coil Waste Heat
- Waste Heat from Other Combustion Sources




**Sample Solar Thermal Application**

- Kona, Hawaii
- Gross Power 100kW
- Thermal Input 325-650kWt
- Hot Water Input 160-245 F
- Hot Water Input 160-245 F
- Hot Water Flow 115 GPM
- Cold Water Input 48 F
- Cold Water Flow 115 GPM


http://electratherm.com/

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Electricity from Thermal Heat Energy Capture

### Relative Sizes of 65kW Renewable Energy Systems


Size of a 65kW Waste Heat Generator

Size of a 65kW Solar Cell Array

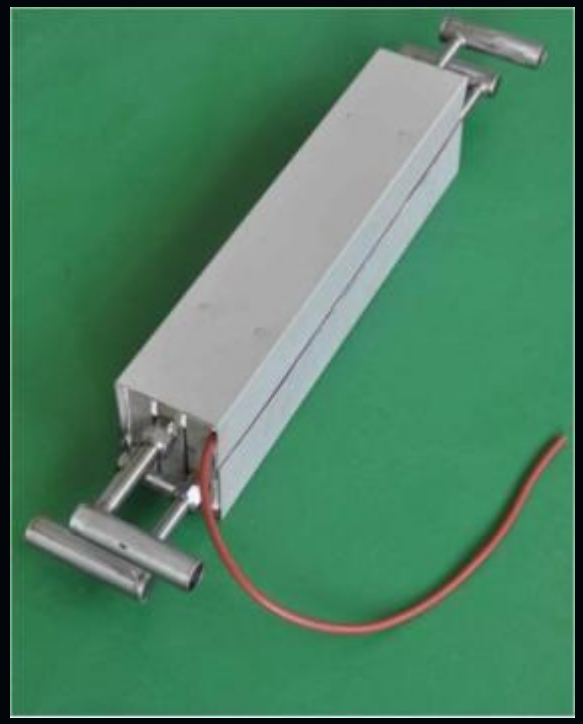
# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Electricity from Thermal Heat Energy Capture

**Thermal Energy Conversion (TEC). Generate electricity from the following sources**

- Heated or chilled waste water
- Solar Thermal Heated water
- Combustion Engine cooling fluid or heated lubricants
- Air Conditioner Chiller Coil water/coolant
- Waste Heat from Other Combustion Sources



200W Thermal Energy Conversion

**TEC versus Monocrystalline Solar PV**

| | | | |
|---|---|---|---|
| •$/Watt | $9 | •$/Watt | $5 |
| •System Watts | 2000 | •System Watts | 2400 |
| •Price | $18,000 | •Price | $22,500 |
| •Production /yr | 9,344kWH | •Production /yr | 5,045kWH |
| •Savings/yr | $1,0402 | •Savings/yr | $757 |
| •Payback Years | ~12.8 | •Payback Years | ~29.8 |

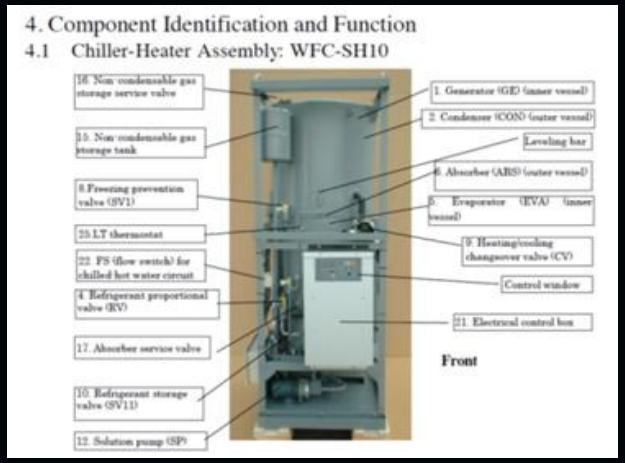
# Mission for Applications of Renewable Energy for Humanity

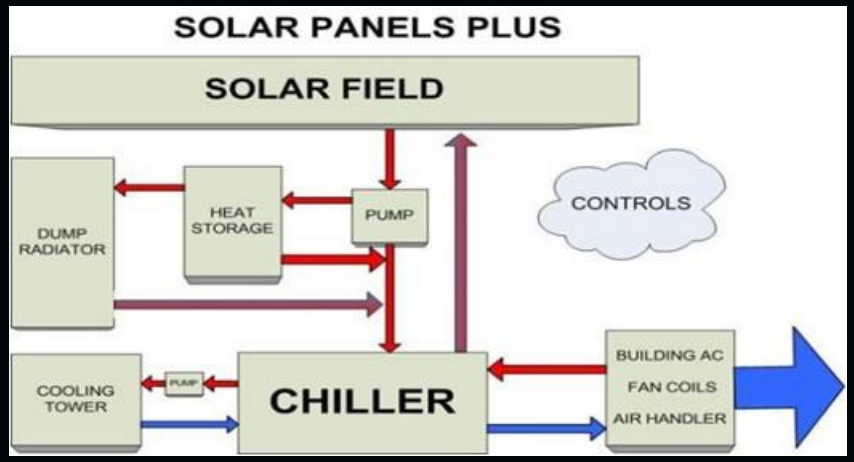
## Alternative Energy Pre-Project Assessment

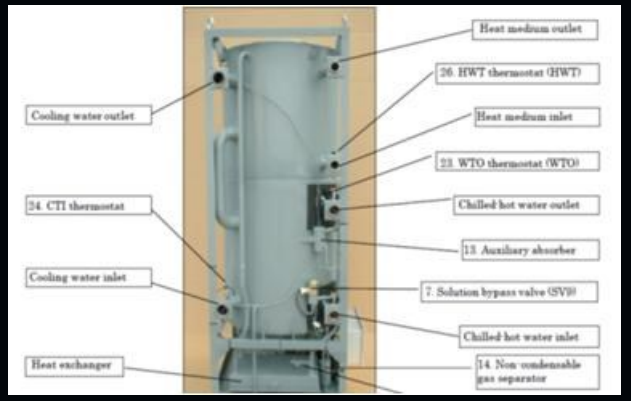
# Minimizing Renewable System Costs

## Absorption Chiller Technology

- Cold air and water directly from the sun
- Proven technology that has been in commercial use around the world since the early 20th century
- Environmentally friendly with not CFC or Freon
- Low to no outside energy requirements lowers facility energy demands



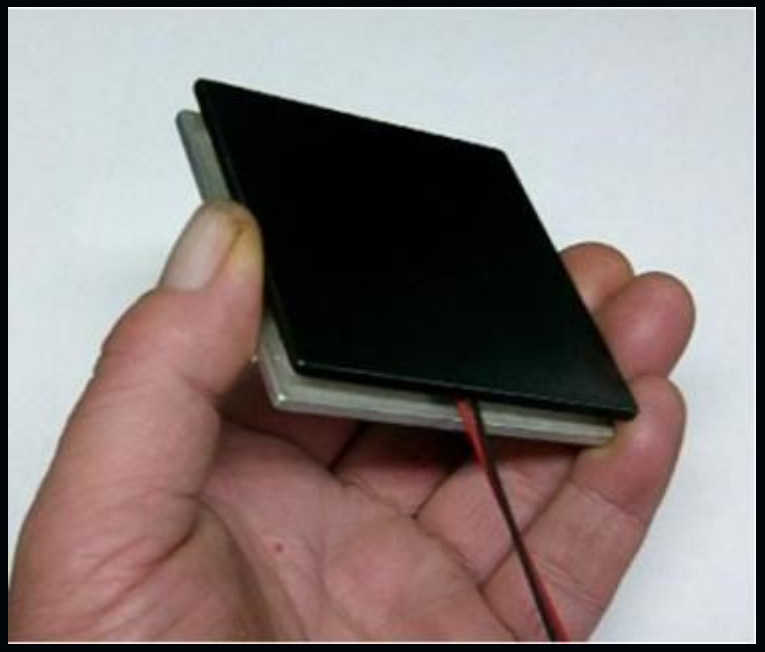

Solar Panels Plus

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Electricity from Thermal Heat Energy Capture

**TEC provide more usable power per square foot than Solar PH**



15 Watt Thermal Energy Conversion Cell

15 Watt Polymorphous Solar Cell

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Electricity from Thermal Heat Energy Capture

**TEC provide more usable power per square foot than Solar PH**

Size of a 1215 Watt Solar TEC generator

Size of a 1200 Watt Solar Cell Array

# Thermal Energy Storage and Reuse

Hot water storage, captures excess energy produced from renewable sources and waste energy from other processes for use when needed.

- Heat can be captured and stored for use later as domestic hot water (HVAC/Boiler condenser waste heat, solar heat)
- Solar Thermal Heat
- Stationary Engine Exhaust (Generators, etc)
- Air Conditioner Chiller Coil Waste Heat
- Waste Heat from Other Combustion Sources


A Therma-Stor heat recovery system is a double-walled heat exchanger with water storage tank that captures lost heat from your cooling system to heat your water for free. The heated water is then stored in the system until it is needed.

Ice Storage

# Thermal Energy Storage and Reuse

Cold water storage captures excess energy produced from renewable sources and waste energy from other processes for use when needed.

- Ice is made from excess renewable energy or during off-peak demand times for next day use to provide cooled air for buildings
- Ideal for coastal wind energy systems as night time winds are more prevalent
- Absorption Cooling from air-conditioner compressor waste heat sources and/or solar thermal sources work well


Ice Storage

# Bio-Mass Gasification

- Process of converting waste bio mass materials into gas and useable energy.
- Modular community sized plants can handle almost all municipal wastes such as paper, food, wood, plastics, animal waste, and other animal/plant materials
- Process are clean automated and low maintenance
- Combine with heat capture technologies to produce more electrical power, bottled gas, or liquid fuel (diesel)

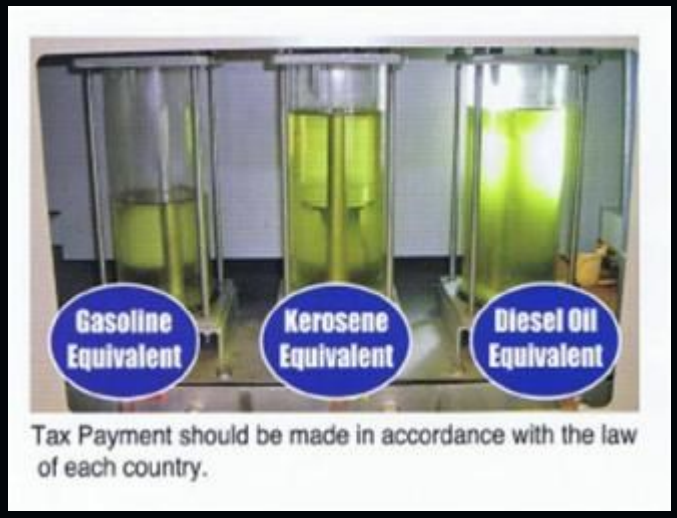
Community Power Corporation

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Solar/Wind Powered Waste Plastic to Fuel Oil and Gasoline Production Process

- Excess solar and wind power can be used to convert waste plastics produced by restaurants, food stores, carryout foods and various plastic bottles and wrappers can be cleanly into fuel oils and gasoline to be used for auto or electric generators




[Waste Plastics to Fuel Oil]

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

## Solar/Wind Powered Waste Plastic to Fuel Oil and Gasoline Production Process

- Envion, Inc. in Washington DC
- Plant costs $5 Million
- Process 6,000 tons of plastic annually
- Produces 1 million barrels of fuel oil annually
- $50 barrel = ~$50 million / year in Revenues

Waste Plastics to Fuel Oil

# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

### Hydro-Energy Power from Micro Turbine Technology

Community and Individual Sized Power Plant

- Operate with water pressure from any elevated water tank to reduce overpressure and recapture lost pumping energy.
- Quiet, efficient, and affordable
- Produce electrical energy automatically whenever the water runs
- Scalable to match energy needs and/or water supply

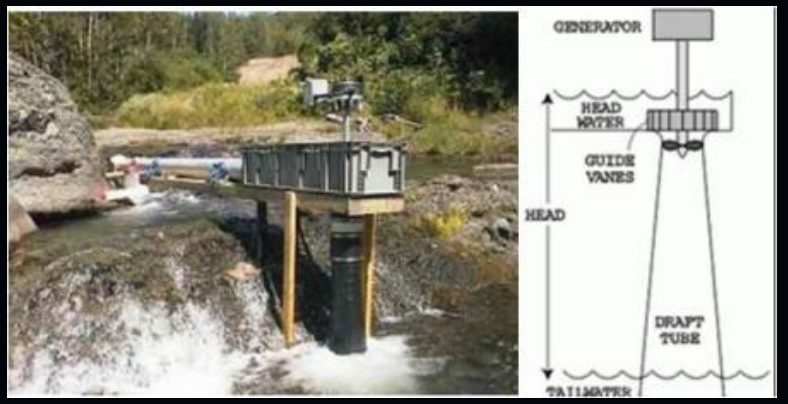
# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

### Hydro-Energy Power from Micro Turbine Technology

Community and Individual Sized Power Plant

- Micro turbines can extract energy from almost any source of running water without damming
- Systems can be ganged to take full advantage of all water flow without be environmentally intrusive
- Environmentally friendly systems fit in with the existing eco systems and are virtually invisible to the environment



# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

Water Conservation and Energy Recapture Saves Energy and Lowers Cost of Renewable Systems

30 kWH Wind Turbine and Solar Panel Systems that capture 1000 liters of Potable Water daily from the atmosphere under arid conditions



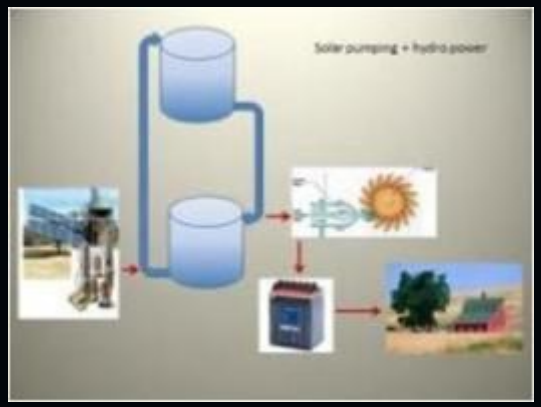
Eolowater Electricity and Fresh water

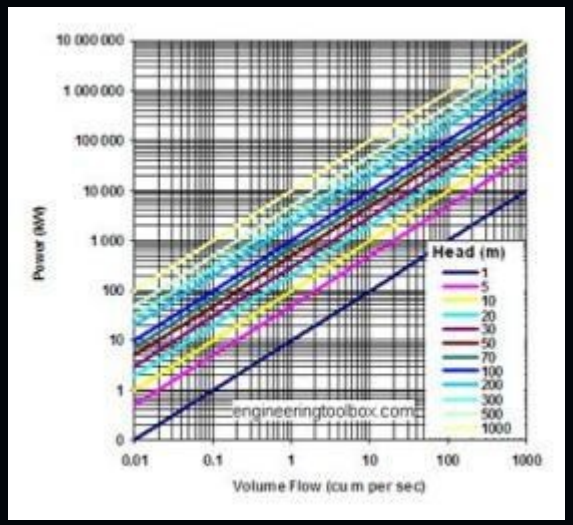
# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

Water Conservation and Energy Recapture Saves Energy and Lowers Cost of Renewable Systems

- Water flow restrictors that conserve water and save on average about $600 per year per faucet.
- Water flow energy recapture systems that use micro turbine to produce power from water coming from elevated storage tanks.



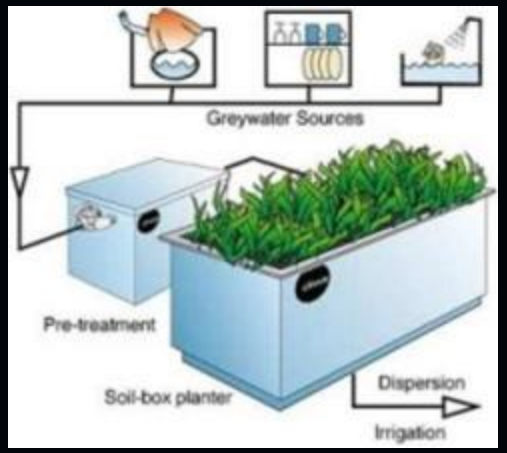



# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

Water Conservation and Energy Recapture Saves Energy and Lowers Cost of Renewable Systems

- Rainwater harvesting systems can readily supply water for most non-potable demand thus saving energy by pumping fresh water
- Grey water flirtation systems can take sink, wash, and bath water and make it useful for toilet flushing, irrigation and ground water replenishment, saving energy.




# Mission for Applications of Renewable Energy for Humanity

## Alternative Energy Pre-Project Assessment

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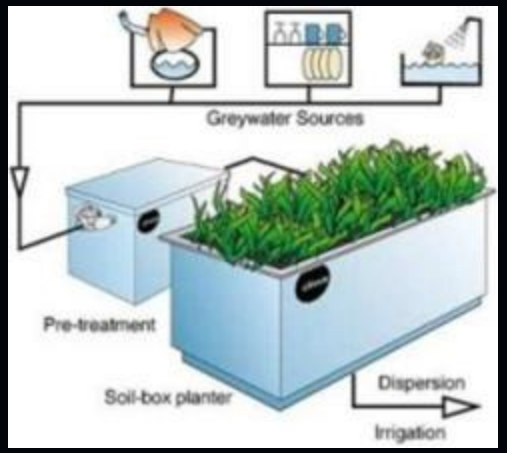

# Conclusion

- Renewable energy is the most cost effective solution for many locations
- Energy conservation measures must be identified in put in place first to reduce energy loads to most efficient levels
- Often integrated hybrid-renewable systems will be the only affordable way of implementing a successful and sustainable renewable energy system.
- Community collaboration can make the projects more cost effective and affordable for all members of the community
- Renewable energy is clean and green, thus preserving the fragile environment for future generations while saving $$ today.