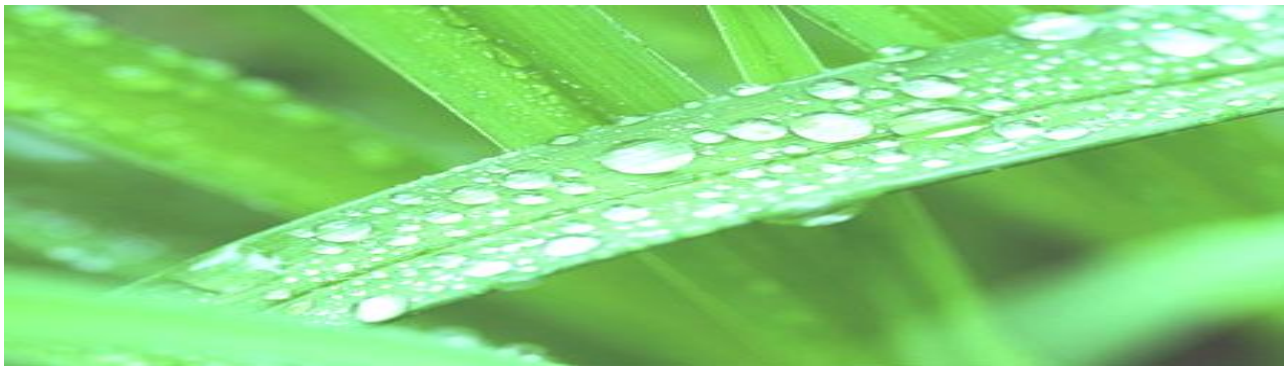
# Design, Supply, Installation, Testing & Commissioning of Kinetic Energy Recovery System (KERS)






**Reviewed by:**

MILTON SIKDER, CEng, CDCS

MIMechE, MBA, MISHRAE

Certified Energy Manager, BEE

**SIKCO**

info@facilityindia.com


February, 2015

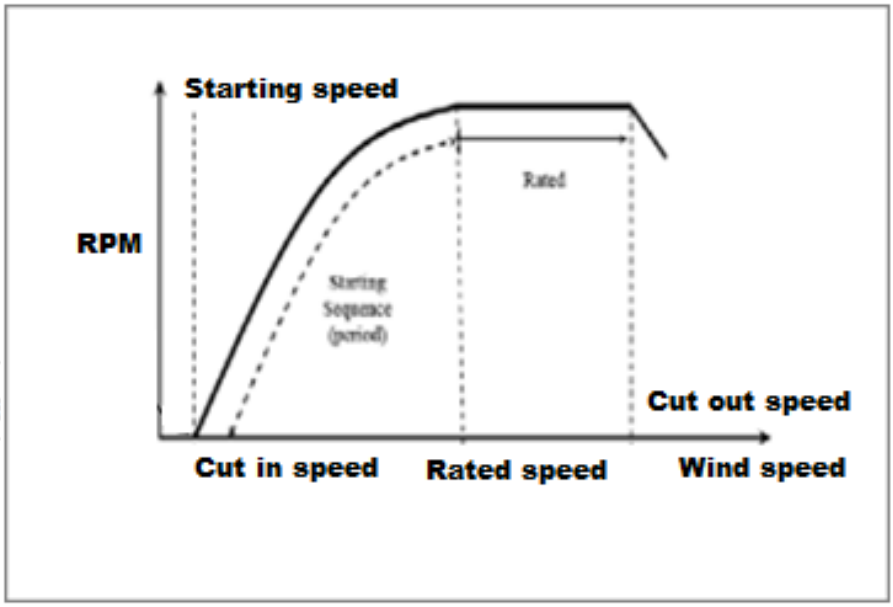
# SIKCO Kinetic Energy Recovery System

Source: The flow of equipment exhaust in buildings and industries

## INTRODUCTION

Wind energy is capable of meeting a fraction of energy needs around the globe. Wind Energy is harnessed by means of wind turbines that make use of natural resources. Contrary to this, our system makes use of wind originating due to manmade sources to generate energy. KERS or Kinetic Energy recovery system converts the lost fraction of energy in the form of heat/wind to useful energy. **Based on the high speed possessed by the exhaust air flow in industries and buildings, a wind turbine can be put in place to extract the energy.**

Most of industrial centrifugal fan is installed at the top of a building or exhaust tower in an industry. The air flows through a channel due to drawing in action of the fan. This is pushed by the fan towards the turbine, via the channel cover that has a mesh or net in order to prevent dust from accumulating on the surface of the blades of windmill causing slow rotations. The spinning action of turbine from incident airflow is a function of speed of the fan and discharge. Centrifugal action creates suction effect that causes air to fill into the evacuated region causing ventilation. The air is concentrated on the windmill using a case that also protects the structure from any foreign objects. Finally conversion of mechanical energy in the form of rotation to electricity is achieved with the help of an PM alternator.



General HAWT characteristic speed curve shows as the wind speed increases the RPM reaches the rated value. The value rises till the rated RPM is attained.

Since the speed of air is almost constant, no external devices are required for regulating voltage and power output other than charge controller. Charge controller limits the rate at which current is added or drawn from the battery. It prevents against overcharging and thereby prevents the dangers of over voltage. It is then connected to an inverter.

# DESIGN AND IMPLEMENTATION

## Working Principle:

Predominantly there are 2 kinds of wind turbines: Horizontal Axis (HAWT) and Vertical Axis (VAWT). Horizontal Axis turbines are comparatively more efficient.

*ρa = Density of air at 287K*
*Ha =Height of air column*
*Hm=Height of mercury column*
*Qa =Discharge at room temperature*
*Cd =Cofficient of discharge*
*τ=Torque*
*d1, d2= Inlet, Throat Diameters*
*N=RPM of rotor*
*A=Area of Blower*

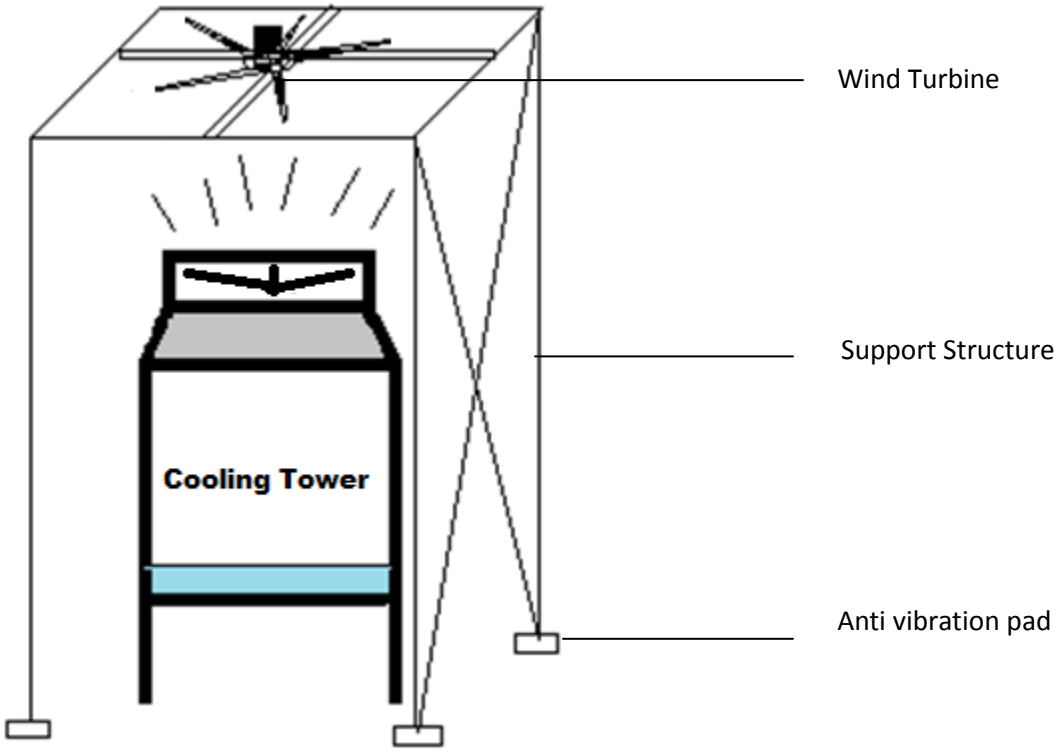
The blades are fixed on the orbital path of each other. In ordinary situations a small amount of power is required to start the rotation. However the wind velocity in this case is high and no external power is required. Given below are the equations to

$\rho a = P/RTr = (101325)/(287*301) = 1.17\ kg/m3$
$Ha = (\rho w \times hm)/\rho a$
$Hm = (\rho m \times hm)/\rho a$
$Q = Cd\ a2\ \sqrt{(2gHm)}/(1-(d2/d1)4)\ m3/s$
$Blower\ output = (\rho a\ Qa\ Ha\ g)/1000$
$Power\ of\ wind = 0.55\rho AV3$
$Power\ of\ turbine = 0.5CpAV3$
$As = 0.1196\ m2$
$P_{turbine} = \tau\omega$
$\tau = (P_{turbine} \times 60)/(2\prod N)$

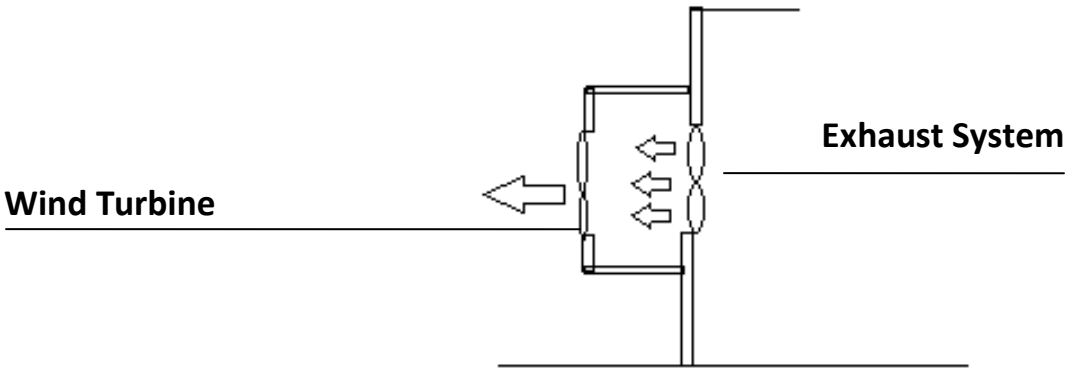
# SIKCO wind energy recovery system

(From Exhaust System, Cooling Tower etc. )

## SIKCO wind energy recovery system principle:




**Recovery System on Cooling Tower Power**




**Power Recovery on Exhaust Fan System**

## SIKCO Wind Turbine Model:

| Turbine Model | RPM | Design Air Velocity | Tentative Power Recovery | Back Pressure | Accessories Included |
|---|---|---|---|---|---|
| SIKCO Wind 2000 | 400 | 4.9 m/sec | 03 Kwh | Nil | Suitable MS Structure, Alternator, FRP Blades, Digital Charge Controller, Cables & Connectors, C-10 Battery, On grid Inverter, Distribution board, Digital meter |
| SIKCO Wind 3000 | 400 | 4.9 m/sec | 04 Kwh | Nil | |
| SIKCO Wind 5000 | 400 | 4.9 m/sec | 07 Kwh | Nil | |
| SIKCO Wind 12000 | 500 | 6.9 m/sec | 12 Kwh | Nil | |
| SIKCO Wind 24000 | 100 | 4.9 m/sec | 24 Kwh | Nil | |
| SIKCO Wind 36000 | 150 | 5.9 m/sec | 36 Kwh | Nil | |
| SIKCO Wind 48000 | 200 | 6.9 m/sec | 48 Kwh | Nil | |
| SIKCO Wind 72000 | 300 | 7.9 m/sec | 72 Kwh | Nil | |

**Benefits:**

1. Recovery of waste kinetic energy
2. Running auxiliary lights/appliances round the clock
3. Recovery up to 40% + energy
4. Becoming green
5. Increasing company profitability
6. Reduce energy dependability


**Approach**

1. Site survey
2. Auditing waste source appliances/equipments
3. Submission of proposed solution with suitable wind turbine model
4. Submission of energy production and usage pattern
5. Submission tentative payback
6. Discussion payment terms and conditions

**Methodology:**

1. Considering the sweeping area and air velocity to select wind turbine model
2. No alteration of air management of source equipments
3. Adjustable height of support structure to set target air velocity
4. Convert alternating current to DC to charge battery
5. Inverting DC current to AC through on grid inverter
6. Small Battery bank to use for stabilizing power and help to lead power
7. Once battery full, power suppose to divert to load directly

## SIKCO Wind Turbine Specifications:

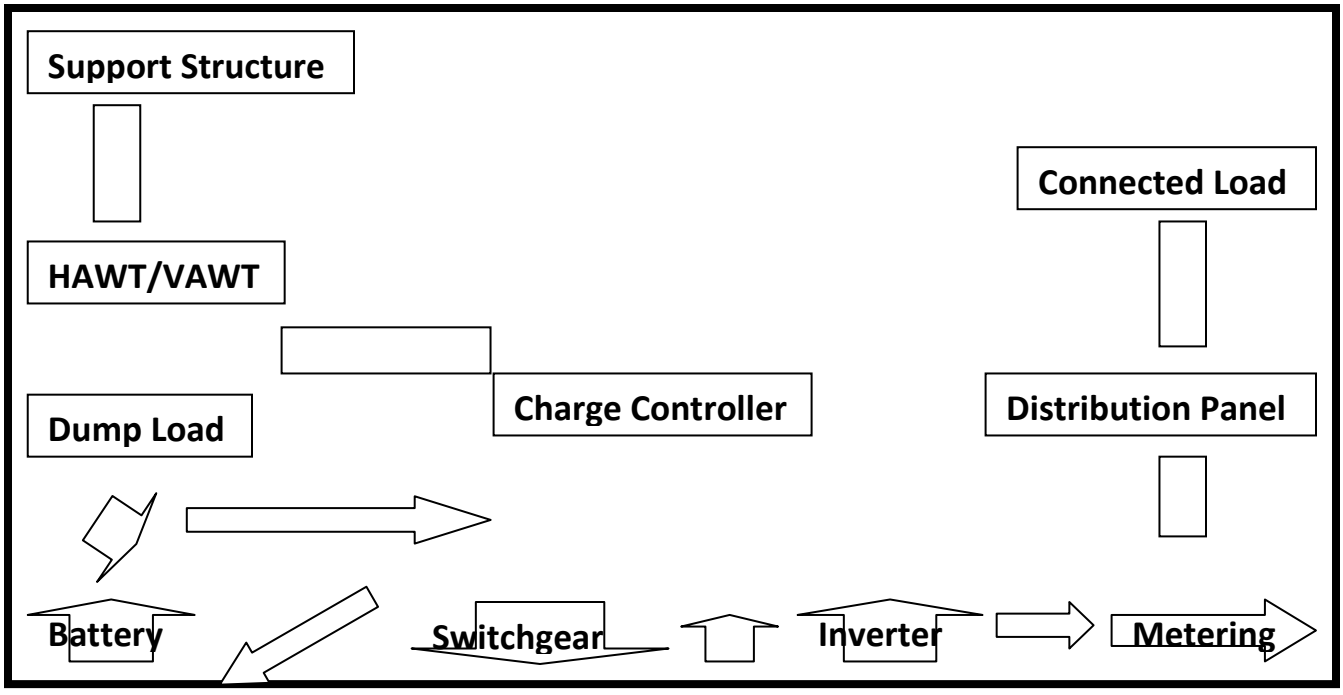
| ERS-1 Specification | |
|---|---|
| Wind Turbine Category (per IEC61400-2 [4]) | Small Wind Turbine |
| Wind Turbine Type | Horizontal/Vertical Axis Wind-Turbine as per site requirement |
| Wind Turbine Configuration | Fixed direction |
| Wind Turbine Weight | As per model |
| Number of Blades | 6 |
| Rotor Diameter | As per wind turbine model |
| Rated Power | 100 watts |
| Rated Rotor Speed | 500 rpm |
| Rated Wind Speed | 4.9 m/sec |
| Rotor Tip to Wind Speed Ratio, | 6 |
| Stopping Mechanism | Disc Brake |
| Support Structures | MS, Aluminum Epoxy Coated |

| ERS-2 Specification | |
|---|---|
| Wind Turbine Category (per IEC61400-2 [4]) | Small Wind Turbine |
| Wind Turbine Type | Horizontal/Vertical Axis Wind-Turbine as per site requirement |
| Wind Turbine Configuration | Fixed direction |
| Wind Turbine Weight | As per model |
| Number of Blades | 6 |
| Rotor Diameter | As per wind turbine model |
| Rated Power | 300 watts |
| Rated Rotor Speed | 400 rpm |
| Rated Wind Speed | 4.9 m/sec |
| Rotor Tip to Wind Speed Ratio, | 5 |
| Stopping Mechanism | Disc Brake |
| Support Structures | MS, Aluminum Epoxy Coated |

| ERS-3 Specification | |
|---|---|
| Wind Turbine Category (per IEC61400-2 [4]) | Small Wind Turbine |
| Wind Turbine Type | Horizontal/Vertical Axis Wind -Turbine as per site requirement |
| Wind Turbine Configuration | Fixed direction |
| Wind Turbine Weight | As per model |
| Number of Blades | 6 |
| Rotor Diameter | As per wind turbine model |
| Rated Power | 2000 watts |
| Rated Rotor Speed | 200 rpm |
| Rated Wind Speed | 6.9 m/sec |
| Rotor Tip to Wind Speed Ratio, | 6 |
| Stopping Mechanism | Disc Brake |
| Support Structures | MS, Aluminum Epoxy Coated |

| ERS-4 Specification | |
|---|---|
| Wind Turbine Category (per IEC61400-2 [4]) | Small Wind Turbine |
| Wind Turbine Type | Horizontal/Vertical Axis Wind -Turbine as per site requirement |
| Wind Turbine Configuration | Fixed direction |
| Wind Turbine Weight | As per model |
| Number of Blades | 6 |
| Rotor Diameter | As per wind turbine model |
| Rated Power | 7500 watts |
| Rated Rotor Speed | 400 rpm |
| Rated Wind Speed | 6.9 m/sec |
| Rotor Tip to Wind Speed Ratio, | 6 |
| Stopping Mechanism | Disc Brake |
| Support Structures | MS, Aluminum Epoxy Coated |


## System components:



## System Configuration:


Alternator (03 phase)

↓

Energy meter

Charge controller → Battery Bank

↓

Off grid Inverter

↓

Energy meter

Distribution Board

↓

Remote Monitoring management (Optional)

Load (Preferable Linear Load)

Payback: SIKCO Wind 7200

| | ANNUAL PRODUCTION (SIKCO Wind 7200) | |
|---|---|---|
| 1 | DG power cost per KWH in INR | 20 |
| 2 | Grid power cost in INR | 12 |
| 3 | Grid power & DG power cumulative cost in INR | 15 |
| 4 | Total used energy in watts at present @ 300 watts/hr | **7200** |
| 5 | Proposed energy to be used in watts | **7200** |
| 6 | Present power consumption per month | 216 |
| 7 | Present electricity billing per month | 3240 |
| 8 | Present electricity billing per year | **38880** |
| 9 | Proposed grid power consumption per month | 0 |
| 10 | Proposed grid electricity billing per month | 0 |
| 11 | Proposed electricity billing per year | **0** |
| 12 | Estimated expenditure = Income (Year 1) | **38880** |
| 13 | AMC Charges @ 10% pa | **3888** |
| 14 | Electrical rate annual inflation assumption | 0.11 |
| 15 | Capex of each system (Approx.) | 100000 |
| 16 | **Pay Back Period** | **2.57** |
| 17 | **Life time income (25 Years)** | **972000** |

Payback: SIKCO Wind 48000

| | ANNUAL PRODUCTION (SIKCO Wind 48000) | |
|---|---|---|
| 1 | DG power cost in INR per KWH | 20 |
| 2 | Grid power cost in INR | 12 |
| 3 | Grid power & DG power cumulative cost | 15 |
| 4 | Total used energy in watts at present @ 2000 watts/hr | **48000** |
| 5 | Proposed energy to be used in watts | **48000** |
| 6 | Present power consumption per month | 1440 |
| 7 | Present electricity billing per month | 21600 |
| 8 | Present electricity billing per year | **259200** |
| 9 | Proposed grid power consumption per month | 0 |
| 10 | Proposed grid electricity billing per month | 0 |
| 11 | Proposed electricity billing per year | **0** |
| 12 | Estimated expenditure = Income (Year 1) | **259200** |
| 13 | AMC Charges @ 10% pa | **25920** |
| 14 | Electrical rate annual inflation assumption | 0.11 |
| 15 | Capex of each system (Approx.) | 490000 |
| 16 | **Pay Back Period** | **1.89** |
| 17 | **Life time income (25 Years)** | **6480000** |

## **Payback:** SIKCO Wind 180000

| | **ANNUAL PRODUCTION** (SIKCO Wind 180000) | |
|---|---|---|
| 1 | DG power cost in INR per KWH | 20 |
| 2 | Grid power cost in INR | 12 |
| 3 | Grid power & DG power cumulative cost | 15 |
| 4 | Total used energy in watts at present @ 7500 watts/hr | **180000** |
| 5 | Proposed energy to be used in watts | **180000** |
| 6 | Present power consumption per month | 5400 |
| 7 | Present electricity billing per month | 81000 |
| 8 | Present electricity billing per year | **972000** |
| 9 | Proposed grid power consumption per month | 0 |
| 10 | Proposed grid electricity billing per month | 0 |
| 11 | Proposed electricity billing per year | **0** |
| 12 | Estimated expenditure = Income (Year 1) | **972000** |
| 13 | AMC Charges @ 10% pa | **97200** |
| 14 | Electrical rate annual inflation assumption | 0.11 |
| 15 | Capex of each system (Approx.) | 1190000 |
| 16 | **Pay Back Period (Months)** | **1.22** |
| 17 | **Life time income (25 Years)** | **24300000** |

## Project Schedule

| Activities / Time | Week 1-2 | Week 3 | Week 4-5 | Week 6 | Week 7 |
|---|---|---|---|---|---|
| **Design, Planning & Manufacture** | | | | | |
| **Supply & Logistics** | | | | | |
| **Implementation** | | | | | |
| **Project Testing & Commissioning** | | | | | |
| **Project Acceptance Hand over** | | | | | |

# COMERCIAL DETAILS

| | | |
|---|---|---|
| Registered Name | : | SIKCO Engineering Services |
| Year of Incorporation | : | 2007 |
| Corporate Office | : | B-97, Sector -12,<br>Kharghar - 410210<br>Phone: (022) - 65174600<br>Email: info@facilityindia.com<br>Web: www.facilityindia.com |

| | |
|---|---|
| PAN | : BACPS8691E |
| Trade license | : II.17/1621 |
| VAT | : 27590766942V dtd 16.04.10 |
| CST | : 27590766942C dtd 16.04.10 |
| Service Tax No | : BACPS8691ESD001 |
| Banker | : Axis Bank Limited , Kharghar, Navi Mumbai |
| Bank A/C No (CAC) | : 910020018475555, IF CODE: UTIB0000489 |

**SIKCO is a registered trademark**
**SIKCO is a CRISIL certified company**
**SIKCO donate 1% of its earnings on underprivileged children's education**

CRISIL Certified | ZERO Tax Billing | 24 Months Warranty | Ready Stock

Contact: 022-65100181 (24 Hours) I 9920398976 (8AM-8PM) EMAIL: info@facilityindia.com

B-97, Sector-12, Kharghar-410210, Navi Mumbai
Tel: +91 22 65174600 www.sikco.in