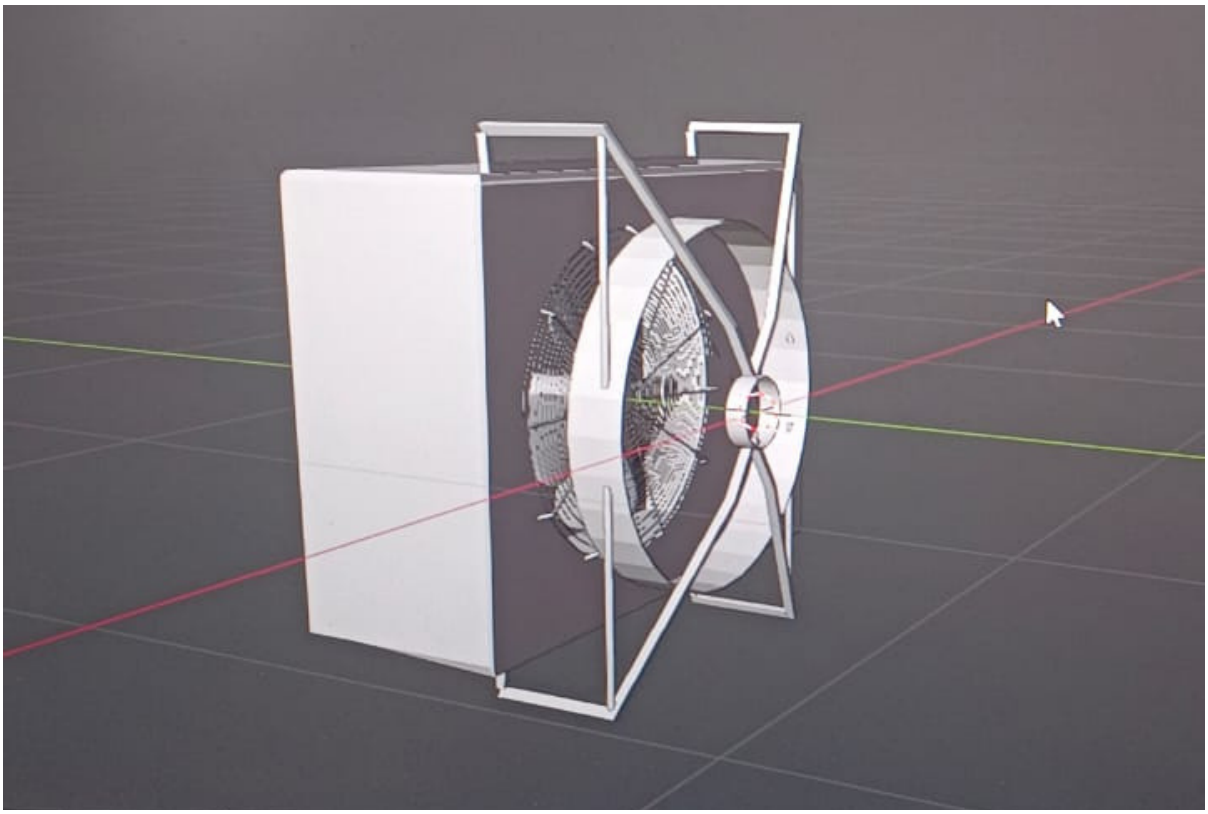
STIMUTECH

- AC OUTDOOR UNIT WIND TURBINE
- SMALL SCALE DUCTED WIND TURBINE
- LARGE SCALE DUCTED WIND TURBINE



AC Outdoor Unit Wind Turbine

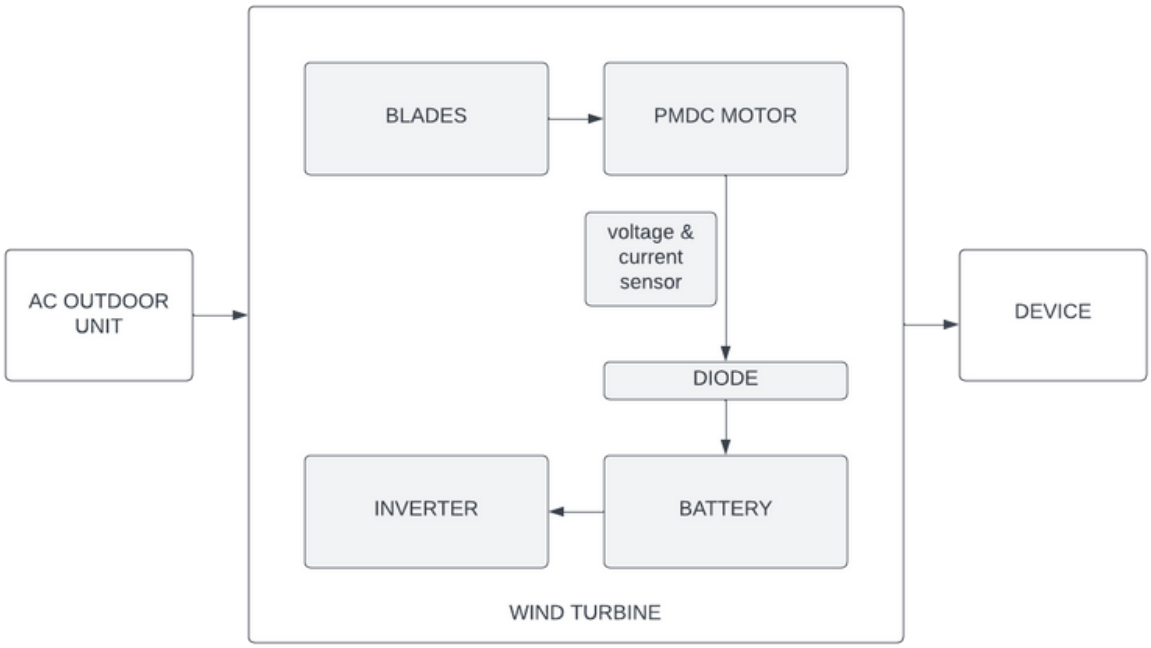
—

STIMUTECH

Overview

The objective of the project is to convert the free source of energy from the AC outdoor unit into usable electricity by means of a wind turbine. This can be used directly to run some device or can be stored in a battery.

Workflow



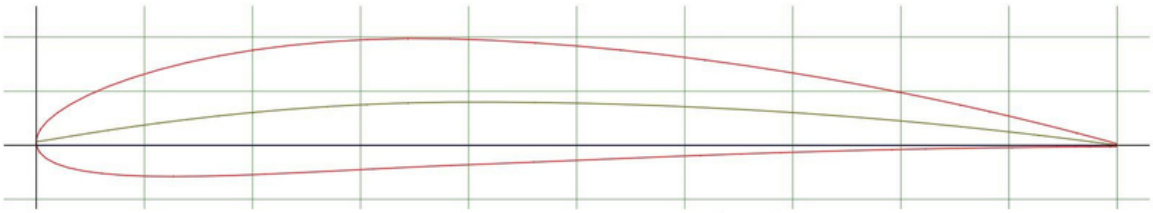
Specifications

Blades	Biodegradable Plastic	Naca Profile 4412
Resistor	-	5 ohms

Componen	Type	Spec
Generator	PMDC	100W
Battery	Lead Acid	12V,7.5AH
Inverter	-	,12V/220V

Naca Profile Analysis for Blades

NACA 4 digit airfoil generator (NACA 4412 AIRFOIL)



Max Camber (%)	4	First digit. 0 to 9.5%
Max camber position (%)	40	Second digit. 0 to 90%
Thickness (%)	12	Third & fourth digit. 1 to 40%
Number of points	81	20 to 200
Cosine spacing	☑	Cosine or linear spacing
Close Trailing edge	☐	Open or closed TE

Plot

Send to airfoil plotter Add to comparison Add to My airfoils

Dat file

```
NACA 4412 Airfoil M=4.0% P=40.0% T=12.
  1.000167  0.001249
  0.998653  0.001668
  0.994122  0.002919
  0.986596  0.004976
  0.976117  0.007801
  0.962742  0.011341
  0.946545  0.015531
  0.927615  0.020294
  0.906059  0.025547
```

Blade Trials




Power Generation

$P = ½ * \rho * A * V^3$

P = 0.5 * 1.225 * 0.53582 *

729 P = 239.25032 W

Cp - Coefficient of Power = 0.5

Final P = 239.25032 * 0.5

P = 119.62516W

Power generated in trials

S.No	Diameter (D) In cm	Wind Speed (V) In m/s	Cross-Sectional Area (A) In m^2	Power ($P = ½ \rho AV^3$) In W
1	40.69	4.9	0.25930	12
2	35.56	5.5	0.19852	19.817
3	50.8	6.5	0.405160	66.76
4	48.26	4	0.36565	15.09
5	43.18	4.5	0.29272	17.2
6	43.18	3.5	0.29272	8.09
7	58.42	9	0.53582	138
8	50.8	4.8	0.40516	28.9
9	58.42	6.2	0.53582	82.36
10	50.8	4.8	0.90516	64.56

Power generated with various Load Resistance

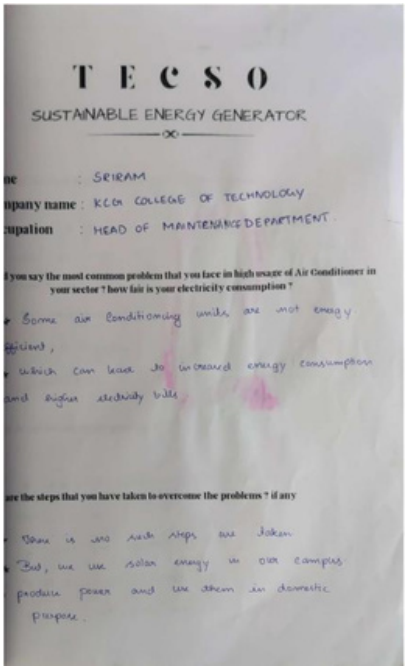
Resistance	Power
5 ohms	28.8W
6 ohms	24W
7 ohms	20.57W
8 ohms	18W
9 ohms	16W
10 ohms	14.4W

$P = V^2/R$ [V = 12V]

Comparison of ML Techniques

S.No.	Algorithm	Accuracy		Average
		Dataset 1	Dataset 2	
1.	Naive Baiyes	54.5%	92.54%	73.52%
2.	Random Forest	86%	95.91%	90.95%
3.	KNN	83.6%	91.77%	87.68%
4.	Simple Vector Machine	80%	97.22%	88.61%

Site Survey



TECSO

SUSTAINABLE ENERGY GENERATOR

: SRIRAM

: KCG COLLEGE OF TECHNOLOGY

: HEAD OF MAINTENANCE DEPARTMENT

you say the most common problem that you face in high usage of Air Conditioner in your sector ? how fair is your electricity consumption ?

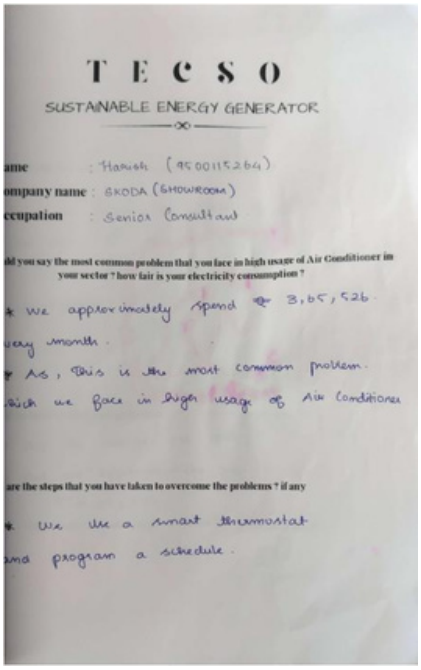
Some air conditioning units are not energy efficient,

which can lead to increased energy consumption and higher electricity bills

are the steps that you have taken to overcome the problems ? if any

Some of the such steps are taken

But, we use solar energy in our campus to produce power and we them in domestic purpose.



TECSO

SUSTAINABLE ENERGY GENERATOR

: Haresh (9500115264)

: SKODA (SHOWROOM)

: Senior Consultant

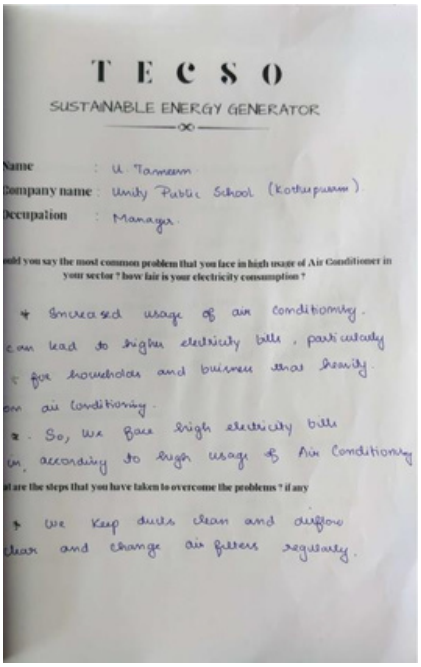
you say the most common problem that you face in high usage of Air Conditioner in your sector ? how fair is your electricity consumption ?

We approximately spend ₹ 3,65,526 every month.

As, This is the most common problem which we face in high usage of Air Conditioner

are the steps that you have taken to overcome the problems ? if any

We use a smart thermostat and program a schedule.



TECSO

SUSTAINABLE ENERGY GENERATOR

: U. Tanveem

: Unity Public School (Kothapuram)

: Manager.

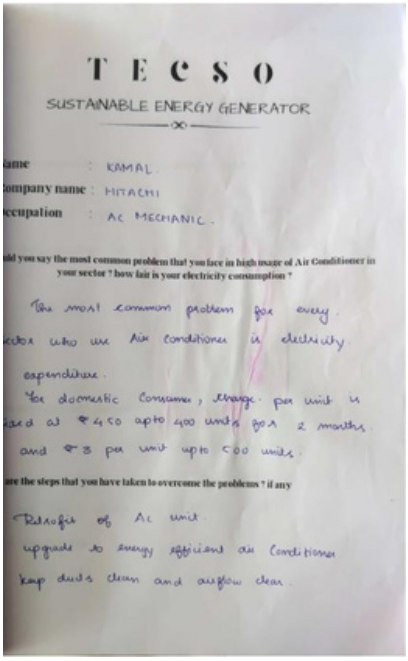
you say the most common problem that you face in high usage of Air Conditioner in your sector ? how fair is your electricity consumption ?

Increased usage of air conditioning can lead to higher electricity bills, particularly for households and business that heavily on air conditioning.

So, we face high electricity bills in according to high usage of Air Conditioning

are the steps that you have taken to overcome the problems ? if any

We keep ducts clean and airflow clear and change air filters regularly.



TECSO

SUSTAINABLE ENERGY GENERATOR

: KAMAL

: HITACHI

: AC MECHANIC

you say the most common problem that you face in high usage of Air Conditioner in your sector ? how fair is your electricity consumption ?

The most common problem for every sector who use Air Conditioner is electricity expenditure.

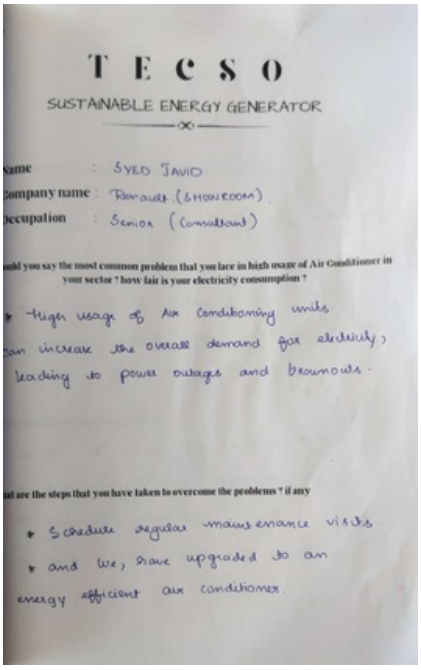
For domestic Consumer, charge per unit is fixed at ₹ 4.50 upto 400 units for 2 months and ₹ 8 per unit upto 500 units.

are the steps that you have taken to overcome the problems ? if any

Retrofit of AC unit

upgrade to energy efficient air conditioner

keep ducts clean and airflow clear.



TECSO

SUSTAINABLE ENERGY GENERATOR

: SYED JAVID

: Renault (SHOWROOM)

: Senior (Consultant)

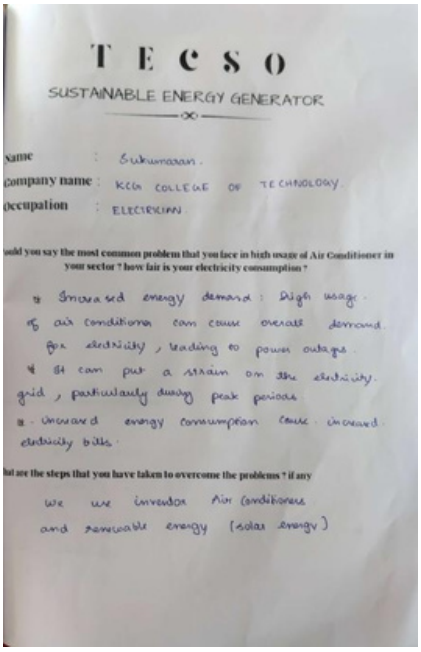
you say the most common problem that you face in high usage of Air Conditioner in your sector ? how fair is your electricity consumption ?

High usage of Air Conditioning units can increase the overall demand for electricity, leading to power outages and brownouts.

are the steps that you have taken to overcome the problems ? if any

Schedule regular maintenance visits

and We, have upgraded to an energy efficient air conditioner



TECSO

SUSTAINABLE ENERGY GENERATOR

: Sukumaran.

: KCG COLLEGE OF TECHNOLOGY

: ELECTRICIAN

you say the most common problem that you face in high usage of Air Conditioner in your sector ? how fair is your electricity consumption ?

Increased energy demand : High usage of air conditioners can cause overall demand for electricity, leading to power outages.

It can put a strain on the electricity grid, particularly during peak periods.

Increased energy consumption cause increased electricity bills.

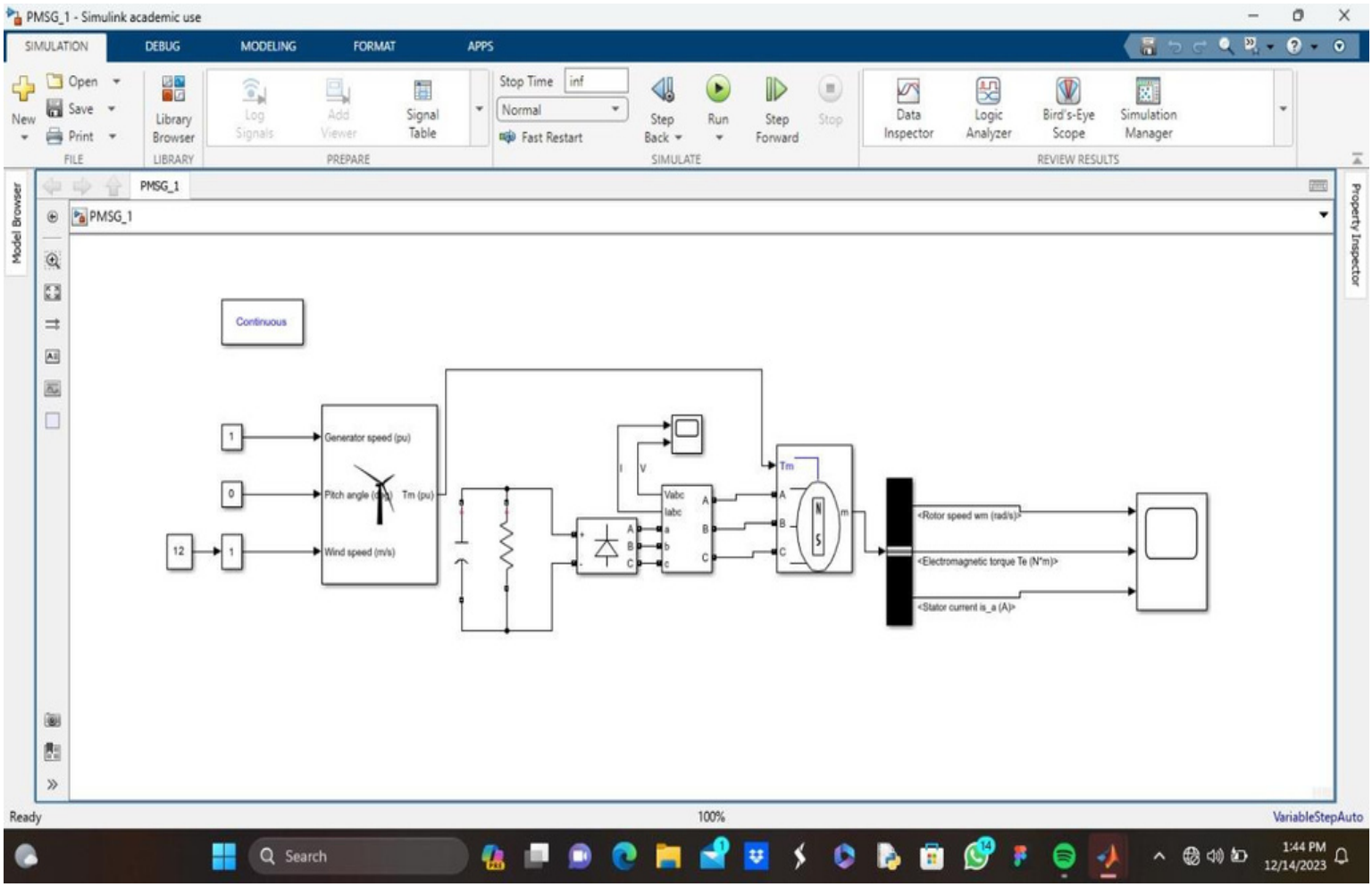
are the steps that you have taken to overcome the problems ? if any

We use inverter Air Conditioners and renewable energy (solar energy)

Advantages

- Less loss of energy due to DC Net Metering
- Fixed rpm => Fixed output
-

Matlab Simulation

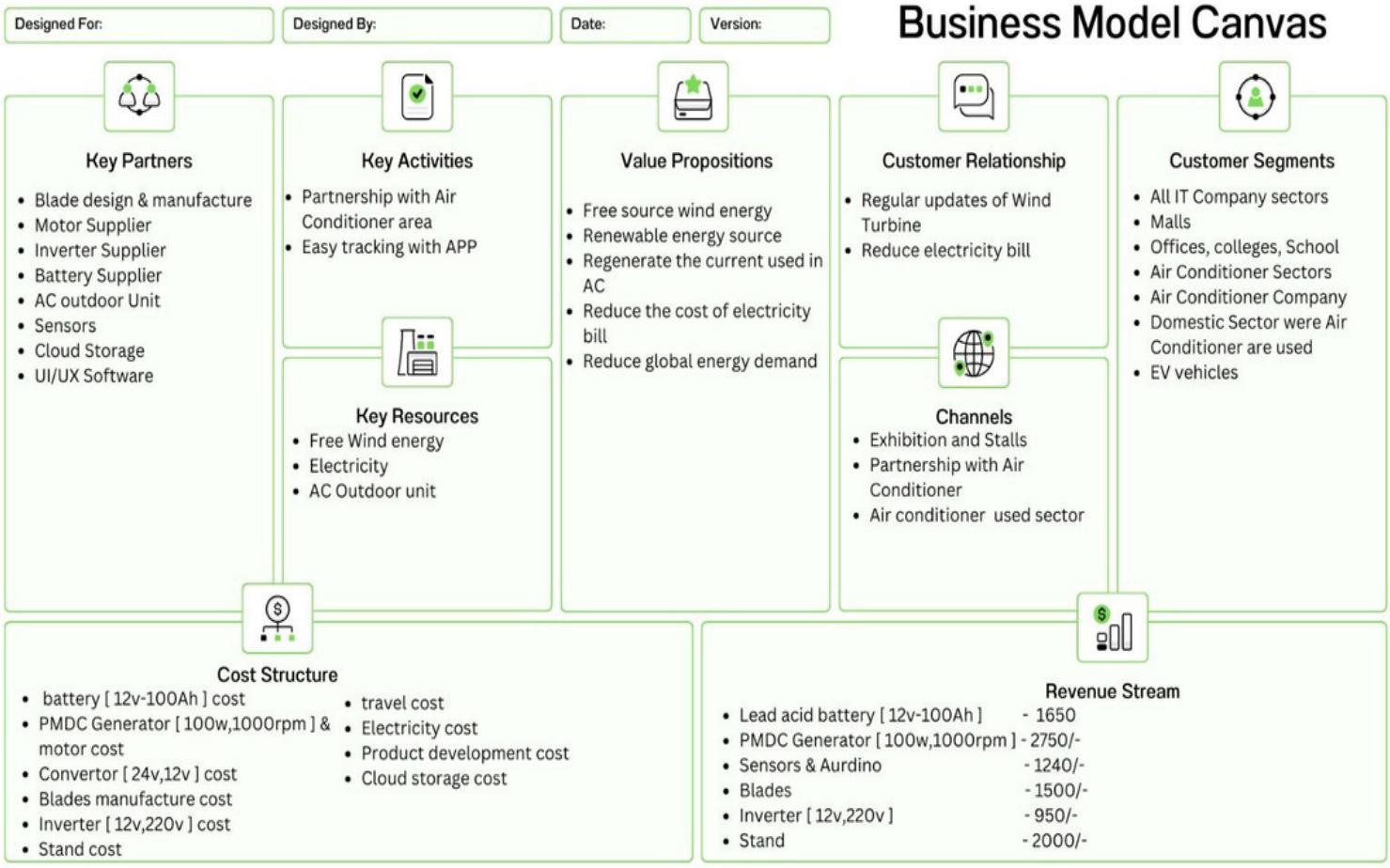


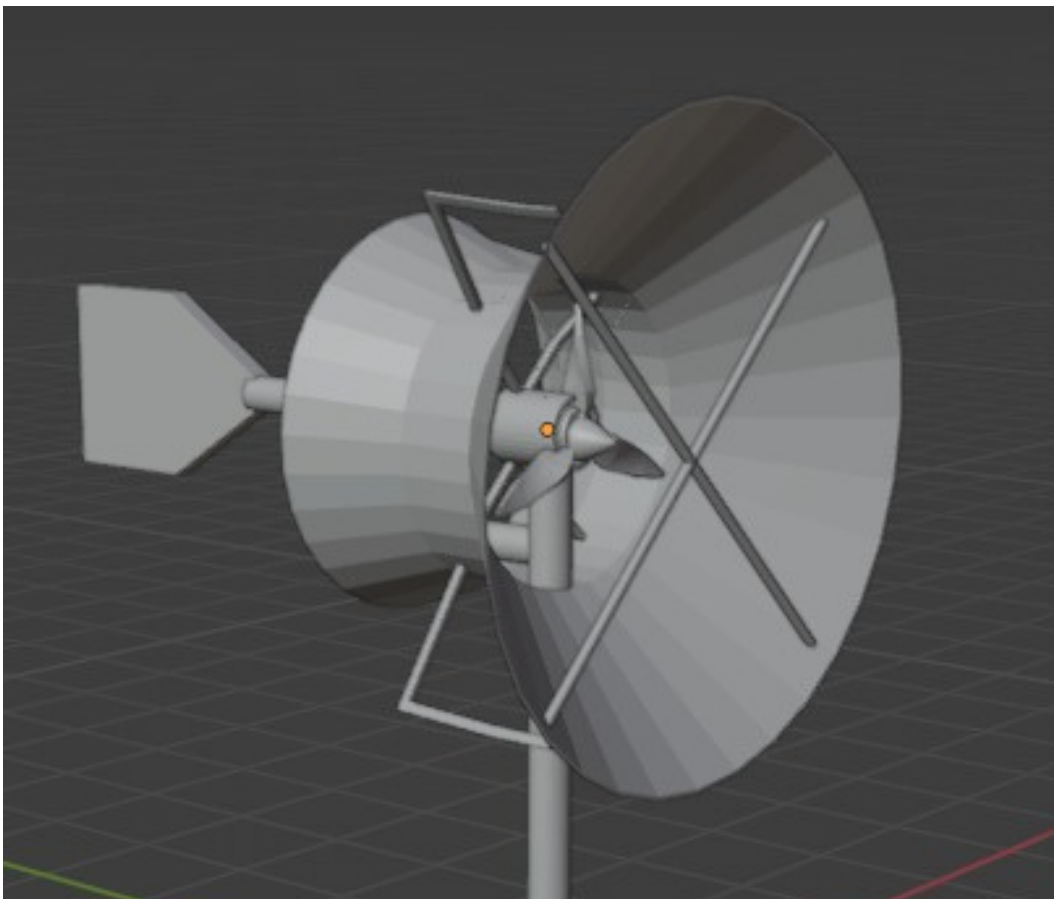
Ducted Mounting Stand

Bernoulli’s Theorem

This decreased pressure in the air at high speeds also clarifies An air stream's velocity increases when the static pressure surrounding it decreases. This causes the air around the stream to be brought in, or entrain, and increases the total amount of air carried in that direction by drawing in more air from the sides. Directional velocity flow of a stream of air that is free to flow in the direction of its velocity. the directional motion turns into “static” pressurization as we see inside the duct system.

Business Model Canva





SMALL SCALE DUCTED WIND TURBINE

SPECIFICATONS

COMPONENTS USED

- Voltage sensor (0-25V)
- Current sensor(0-25A)
- ESP32 - WIRELESS CONTROLLER
- ARDUINO UNO

PMSG:

3Φ PMSG.

Chord length	0.28m	2.00m
PMSG - 32pole	300w	5Kw

@ 10m height designed for a rated wind speed of 12m/s

Off- grid

DC Load — 12V/24V from Battery

AC Load — Through Inverter

On- grid

AC Load

BATTERY:

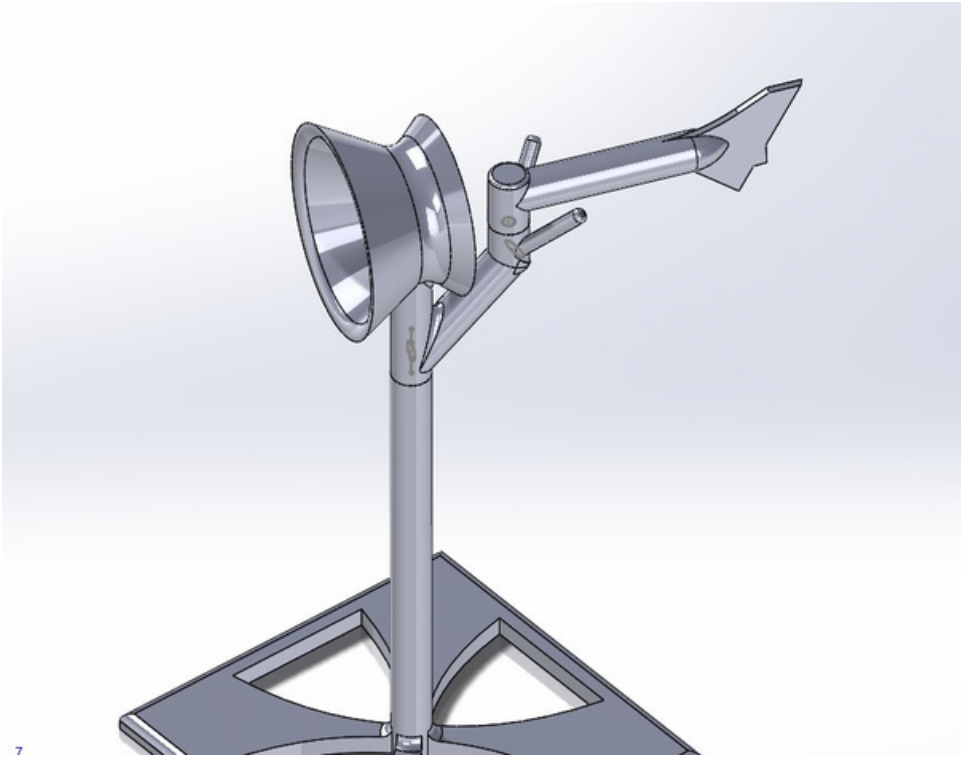
Voltage: 12V,Capacity: 7.5AH (LEAD ACID)

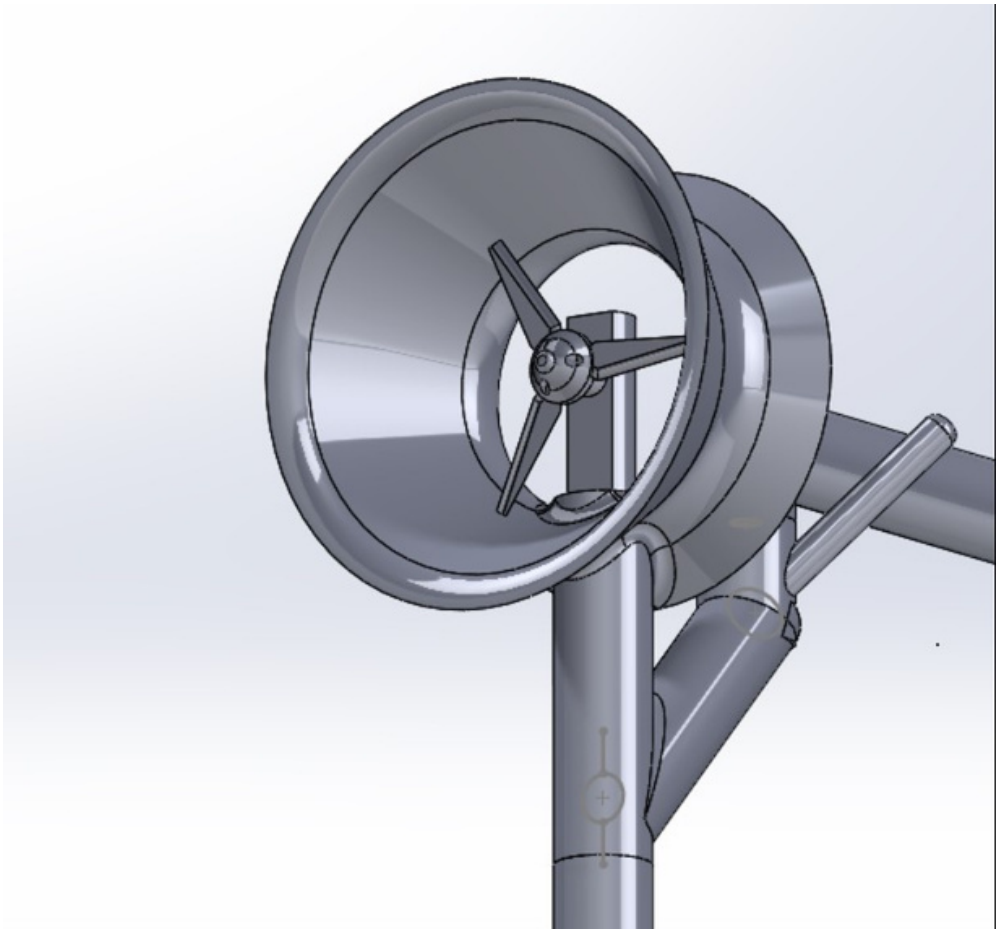
Maximum current: 14A

INVERTER:

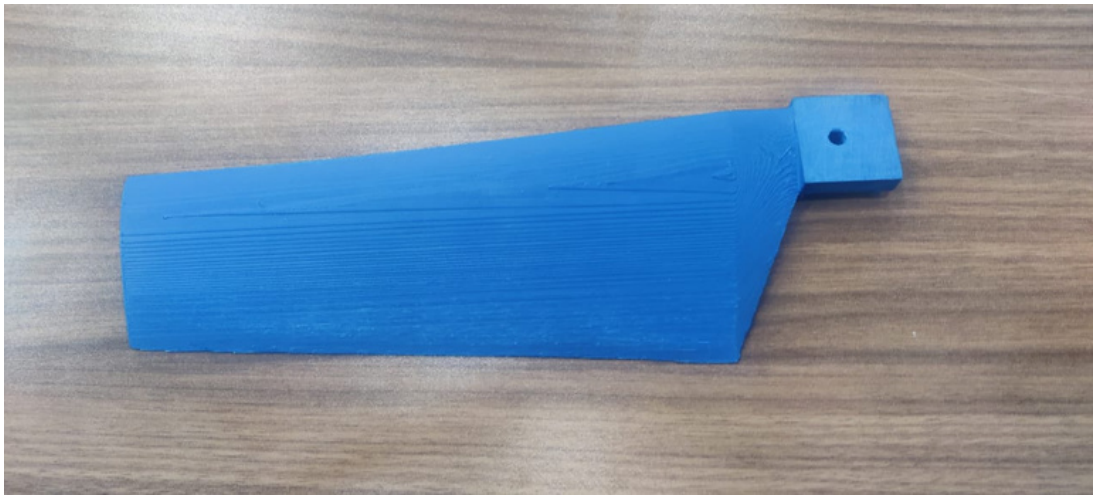
12V DC ⟶ 230V,50hz, AC

DUCTED WIND TURBINE





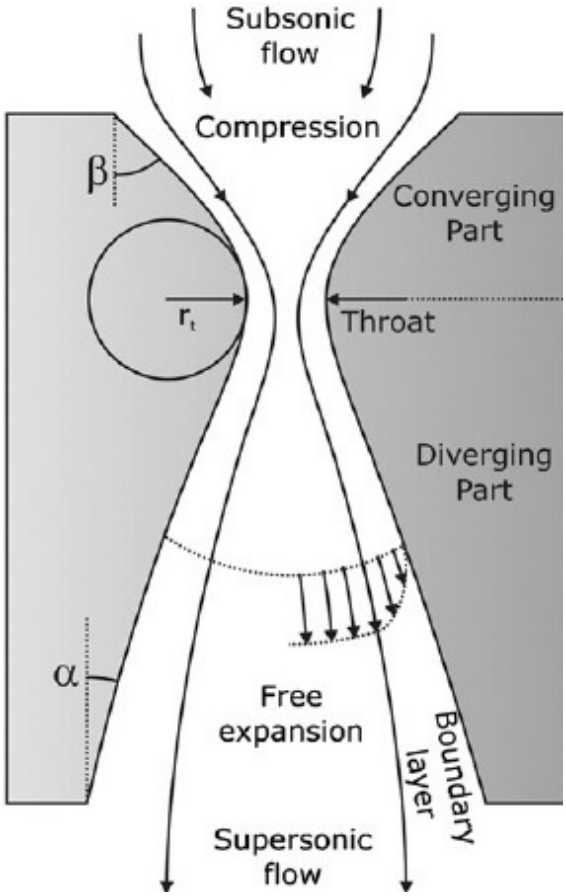
BLADE DESIGNS

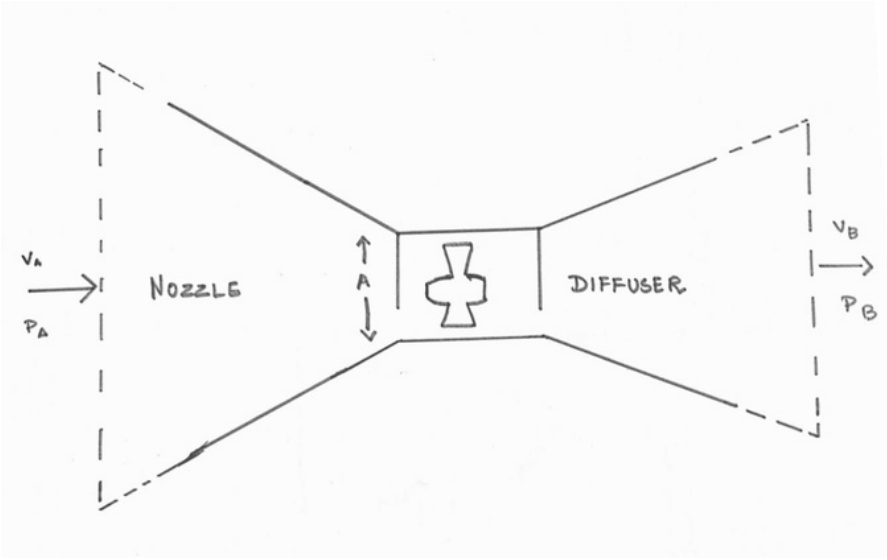


WIND TURBINE BLADE FOR LOW & MEDIUM WIND SPEED

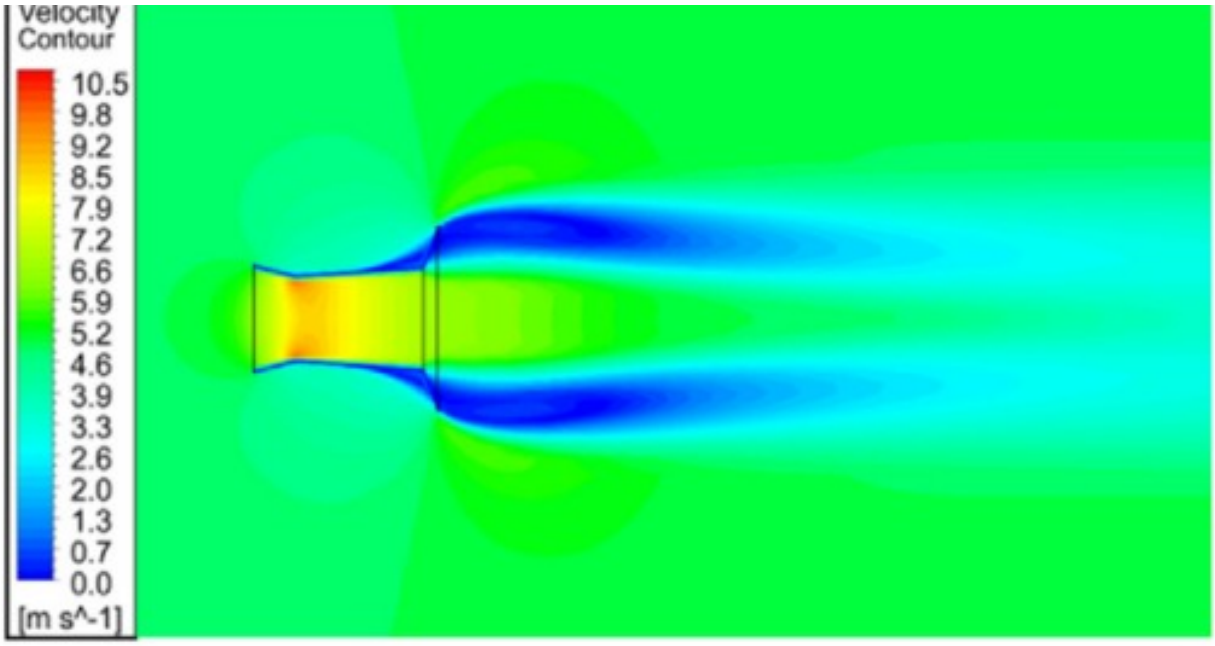
WIND TURBINE BLADE FOR HIGH WIND SPEED

DUCT DYNAMICS



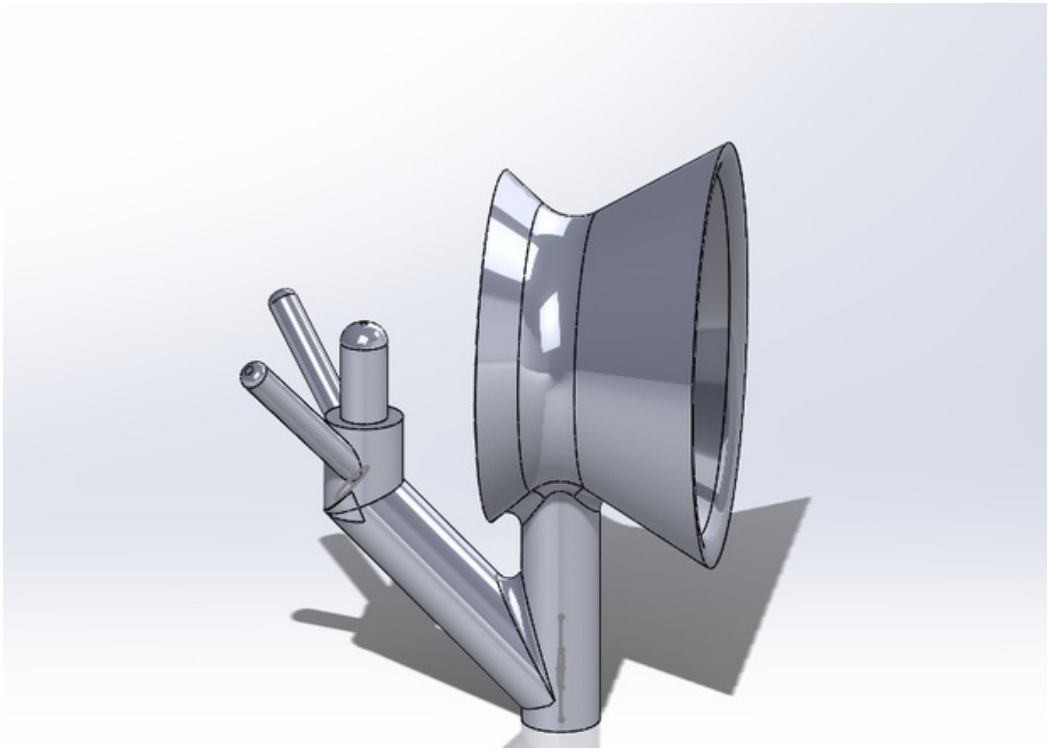


COMPUTATIONAL FLUID DYNAMICS of DUCT



Velocity Contour of the Duct

FURLING MECHANISM

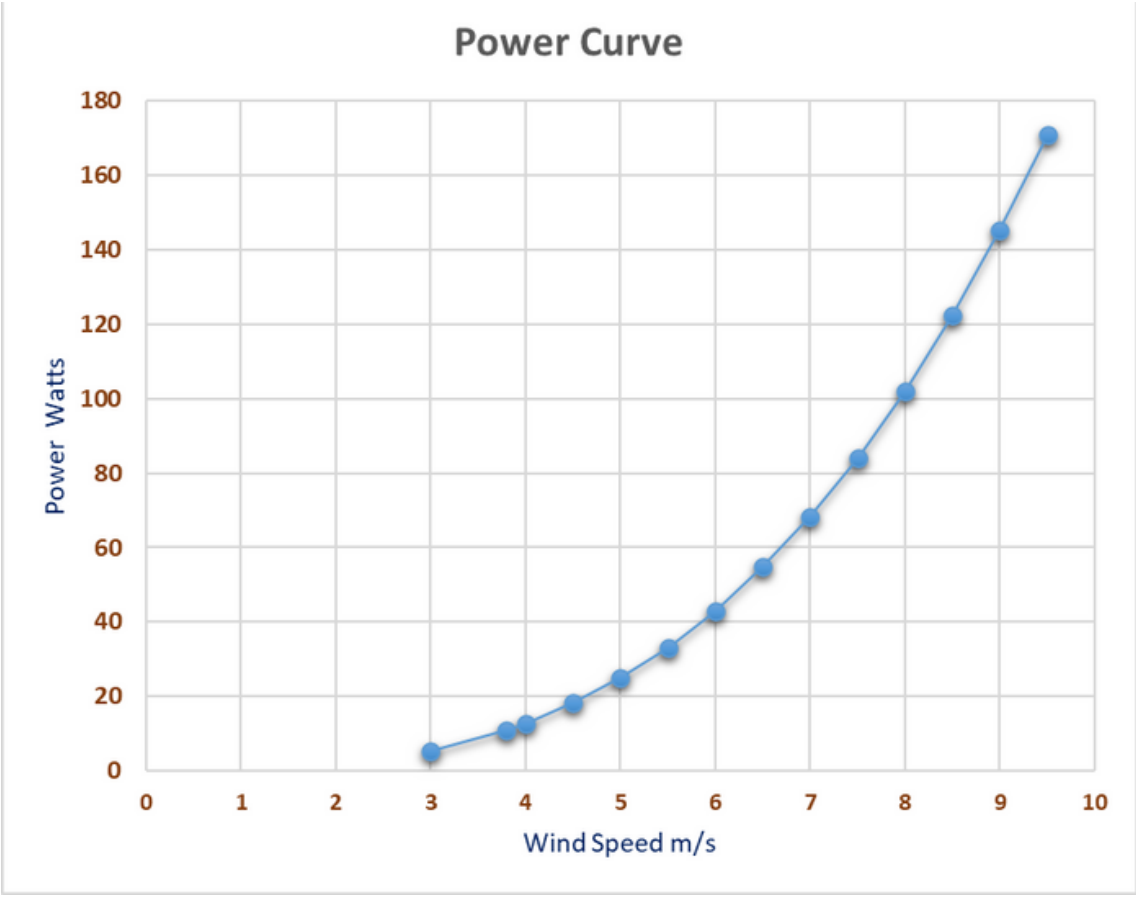


POWER CALCULATIONS

D - Dia in cm	V - Velocity in m/s	A - CSA in m2	Wind Power in watts
58.42	3	0.67	5.38
58.42	3.8	0.67	10.94
58.42	4	0.67	12.76
58.42	4.5	0.67	18.17
58.42	5	0.67	24.92
58.42	5.5	0.67	33.17
58.42	6	0.67	43.07
58.42	6.5	0.67	54.76
58.42	7	0.67	68.39
58.42	7.5	0.67	84.12
58.42	8	0.67	102.09
58.42	8.5	0.67	122.45
58.42	9	0.67	145.35
58.42	9.5	0.67	170.95

FORMULA =
$1/2\ \rho\ AV^3$ [A=[D] / 4 / 1000]Cp

CP = 0.5 (betz limit)



Rate of Investment

ROI Calulation for Designed DWT (350W) @12m/s
Annual Energy Consumption and Money saved @ Rs 8 per unit

YEAR	Month	Avg WS10M	No: of hours	Wind Power in watts	DWT	Energy/ month (kWH)	@Rs 8 /unit
2022	Jan	9.48	24	169.87	254.81	189.58	1516.615
2022	Feb	6.73	24	60.78	91.17	67.83	542.6198
2022	Mar	7.77	24	93.53	140.30	104.38	835.052
2022	Apr	8.29	24	113.60	170.39	126.77	1014.178
2022	May	9.38	24	164.55	246.83	183.64	1469.126
2022	Jun	7.66	24	89.62	134.42	100.01	800.0862
2022	Jul	8.24	24	111.55	167.33	124.49	995.9375
2022	Aug	10.09	24	204.82	307.23	228.58	1828.622
2022	Sep	6.8	24	62.69	94.04	69.97	559.7282
2022	Oct	5.16	24	27.39	41.09	30.57	244.568
2022	Nov	4.19	24	14.67	22.00	16.37	130.9461
2022	Dec	4.36	24	16.53	24.79	18.44	147.54
						Rs	**10085.02**

ROI Calulation for Designed DWT (350W) @12m/s
Annual Energy Consumption and Money saved @ Rs 4 per unit

YEAR	Month	Avg WS10M	No: of hours	Wind Power in watts	DWT	Energy/ month (kWH)	@Rs 4 /unit
2022	Jan	9.48	24	169.87	254.81	189.58	758.3077095
2022	Feb	6.73	24	60.78	91.17	67.83	271.3099067
2022	Mar	7.77	24	93.53	140.30	104.38	417.5259912
2022	Apr	8.29	24	113.60	170.39	126.77	507.088838
2022	May	9.38	24	164.55	246.83	183.64	734.5628737
2022	Jun	7.66	24	89.62	134.42	100.01	400.0430854
2022	Jul	8.24	24	111.55	167.33	124.49	497.9687556
2022	Aug	10.09	24	204.82	307.23	228.58	914.3110279
2022	Sep	6.8	24	62.69	94.04	69.97	279.8641033
2022	Oct	5.16	24	27.39	41.09	30.57	122.2839797
2022	Nov	4.19	24	14.67	22.00	16.37	65.47304331
2022	Dec	4.36	24	16.53	24.79	18.44	73.7700244
						Rs	**5042.509339**

ROI - Return on Investment

		Years
Max	ROI	5
Min	ROI	3

BOM:

MS Structure	6000
FRP Blades	2000
FRP Duct	2000
PMSG 350W	10000
Rectifier	250
Regulator	250
App Cost	2500
Sensor & Controller	2000
Product Cost in Rs	25000

WIND SPEED DATA @ GUJARAT

PARAMETER	YEAR	JAN	FEB	MAR
WS10M_MAX	2022	9.77	6.82	7.86
WS10M_MIN	2022	0.28	0.09	0.09
WS10M_RANGE	2022	9.48	6.73	7.77

PARAMETER	YEAR	APR	MAY	JUN
WS10M_MAX	2022	9.18	10.57	8.27
WS10M_MIN	2022	0.89	1.2	0.61
WS10M_RANGE	2022	8.29	9.38	7.66

PARAMETER	YEAR	JUL	AUG	SEP
WS10M_MAX	2022	9.5	10.1	7.08
WS10M_MIN	2022	1.26	0.01	0.27
WS10M_RANGE	2022	8.24	10.09	6.8

PARAMETER	YEAR	OCT	NOV	DEC
WS10M_MAX	2022	5.21	4.41	5.21
WS10M_MIN	2022	0.05	0.23	0.85
WS10M_RANGE	2022	5.16	4.19	4.36

Fabrication Difficulties

1. **Bearing - for Hub Rotation.**
2. **Tail Furling Fabrication - difficulty due to unavailability of materials and tools.**
3. **Duct fabrication - sheet metal not of required thickness, lack of rolling machine.**
4. **Missing of gas welding machinery - for sheet metal works.**