



Wind Energy: Building Augmented Wind Turbines BAWT in TIDCO AERO-TOWER



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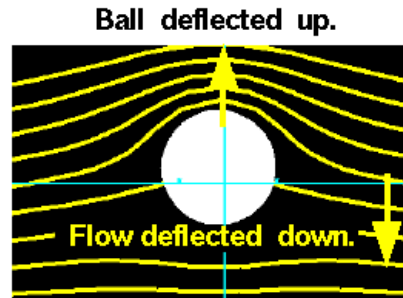
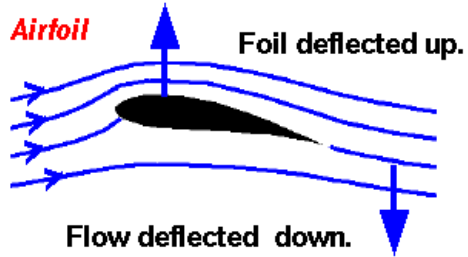
Wind Energy Aircraft wing lift → Payload
 Wind blade lift → rotates the generator



Newton's Third Law Applied to Aerodynamics

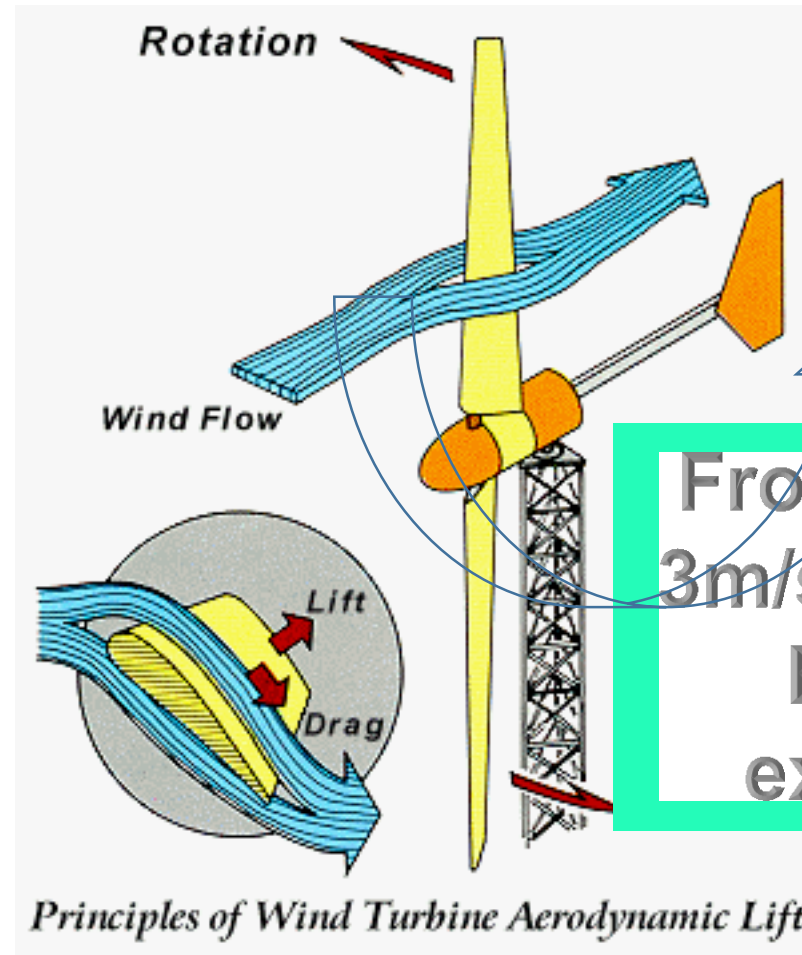
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For every action, there is an equal and opposite re-action.



<http://www.grc.nasa.gov/WWW/K-12/airplane/newton3.html>

**900km/hour
Fuel is burnt
to gain 250m/s**



**From thin air
3m/s to 25m/s
Energy
extracted**

Principles of Wind Turbine Aerodynamic Lift

• Wind Energy Fundamentals



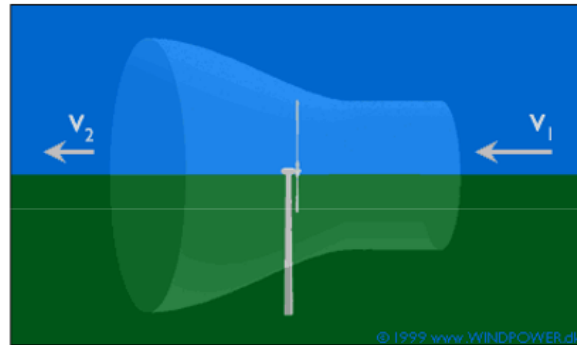
Efficiency in Extracting Wind

Betz Limit & Power Coefficient:

- Power Coefficient, **C_p**, is the ratio of power extracted to the total contained in the wind resource C_p
- Turbine power output

$$P_T = \frac{1}{2} * \rho * A * v^3 * C_p$$

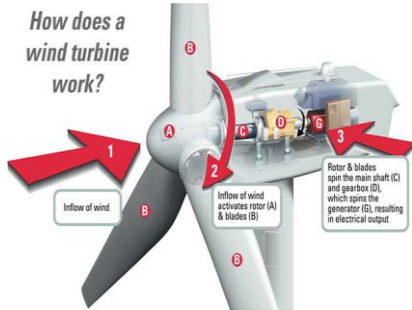
The **Betz Limit** is the maximal possible C_p = **59%** efficiency is the **BEST** a conventional wind turbine extracting power from the wind



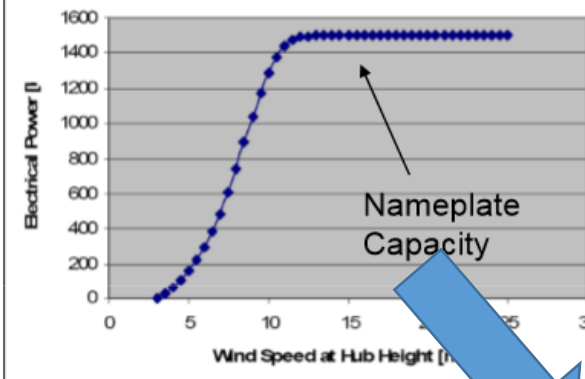
Power Curve of Wind Turbine

Capacity Factor (CF):

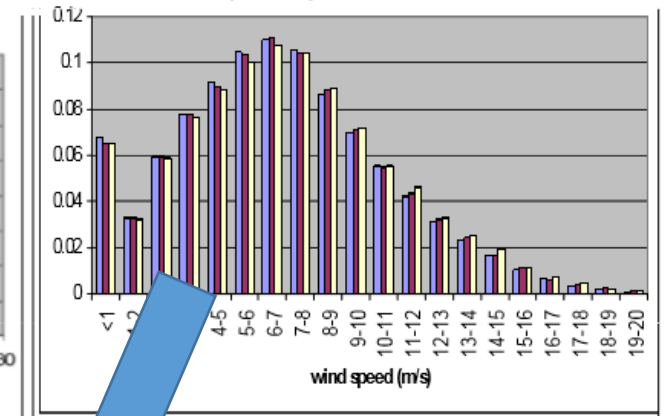
- The fraction of the year the turbine generator is operating at rated (peak) power
Capacity Factor = Average Output / Peak Output ≈ 30%
- CF is based on both the characteristics of the turbine and the site characteristics (typically 0.3 or above for a good site)



Power Curve of 1500 kW Turbine



Wind Frequency Distribution



Slides Courtesy :

Alex Kalmikov and Katherine Dykes With contributions from: Kathy Araujo PhD Candidates, MIT Mechanical Engineering, Engineering Systems and Urban Planning
MIT Wind Energy Group & RenewableEnergyProjectsInAction Renewable Energy Projects in Action

AEP: Annual Energy Production



Bahrain World Trade Centre's features

The First BAWT benchmark



Bahrain World Trade Centre project has provided a benchmark for adoption of energy-



44 stories
Sail shaped

160-200m

Wind turbines
In 3 levels

Rotor Dia 29m

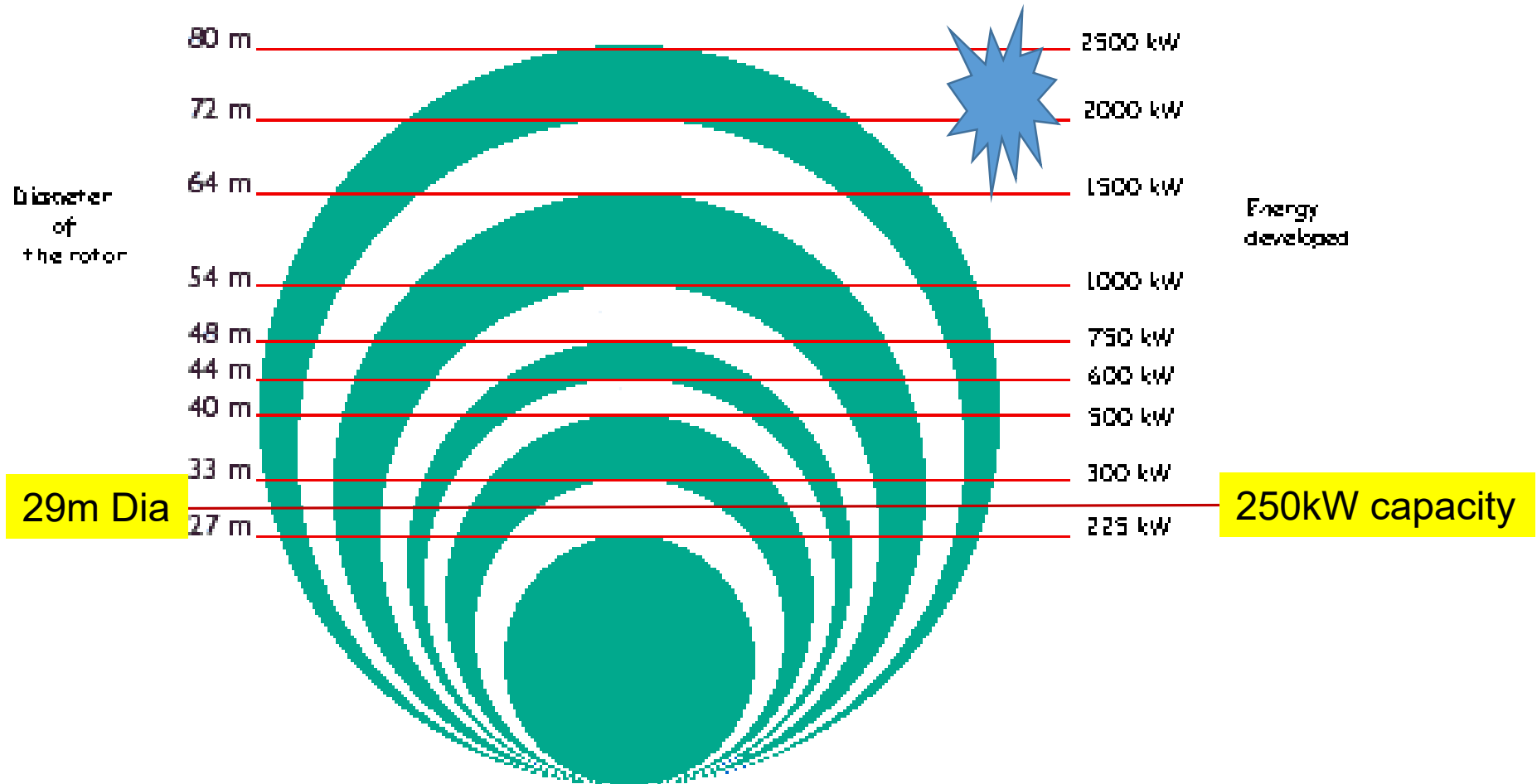
Expected Energy
11-15% of needs
of the building

AEP:(3 x 225kW)

11-13 Lakhs
kWh (units)



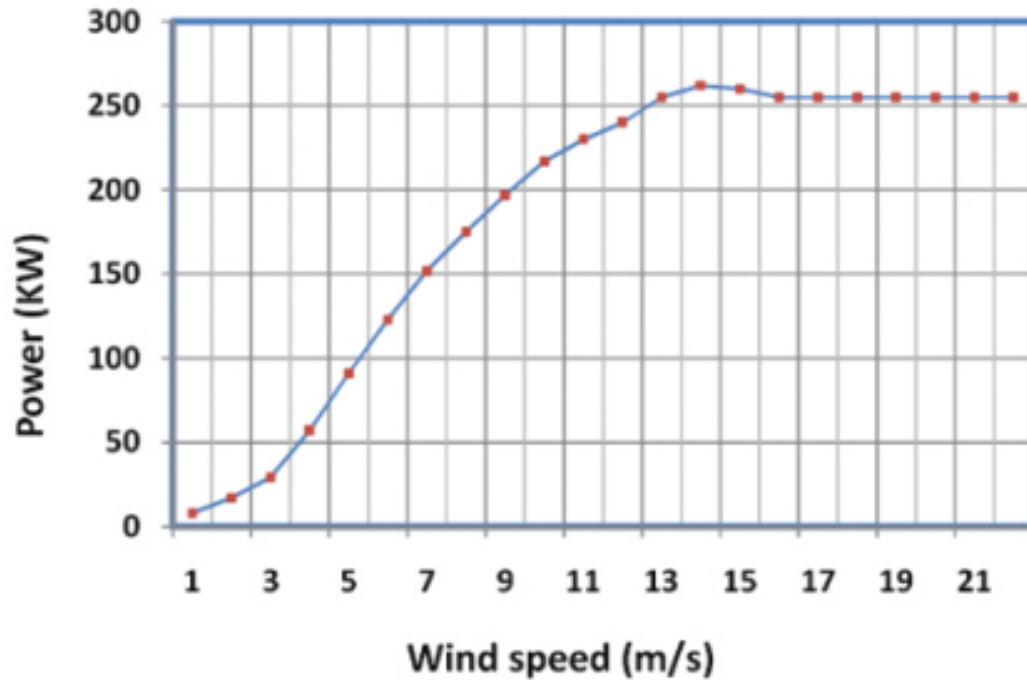
Wind Power versus Rotor Diameter



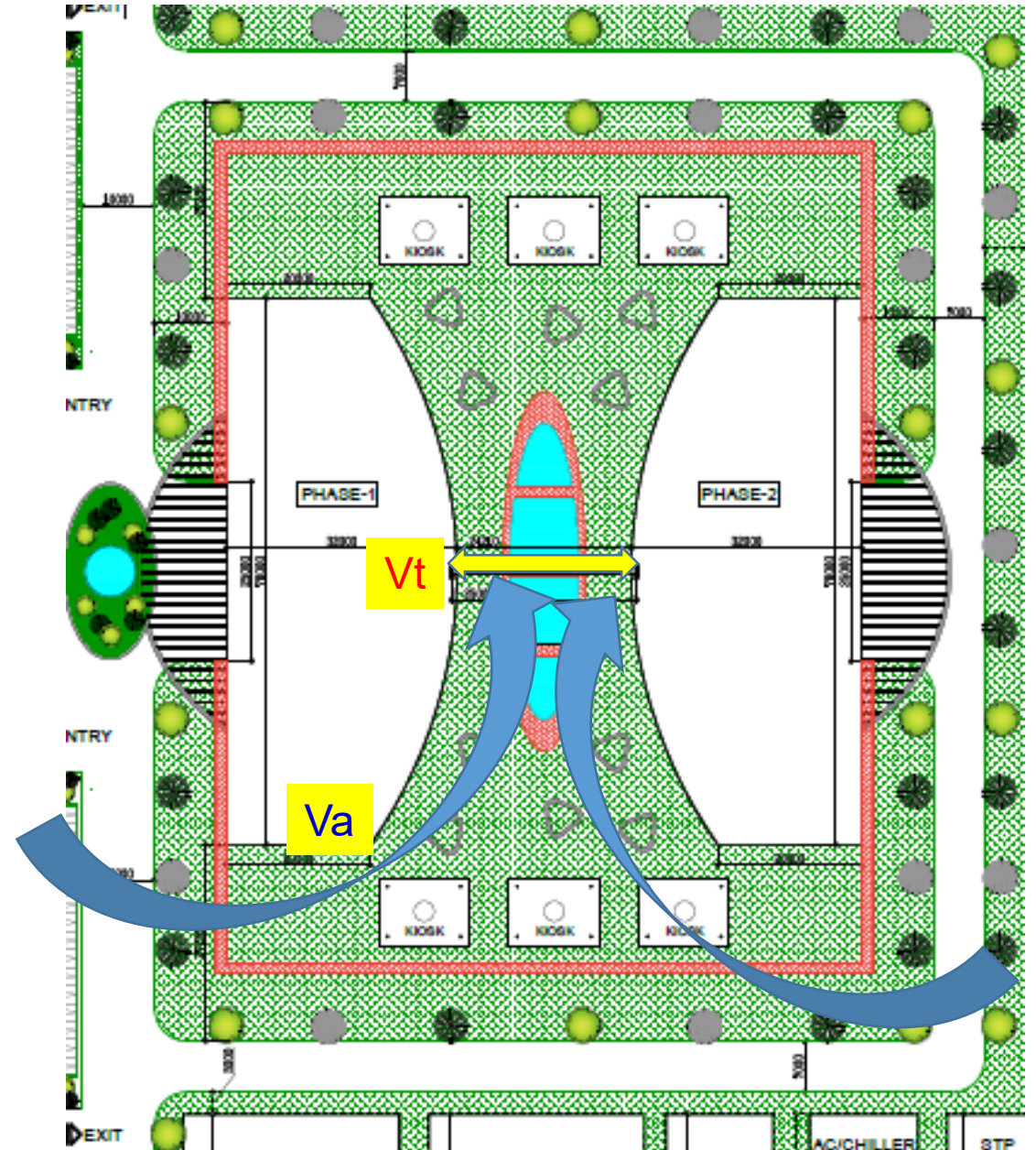


Power Curve of proposed WTG 250kW

Rotor diameter: 30m
Air-density: 1.225kg/m²



Wind Speed up ratio = $V_t/V_a=1.17$
Power augmentation = $1.17^3= 1.60$





Technically Feasible Aero-Tower (Green Building)

Advantages/Benefits ++
(2x250kW)

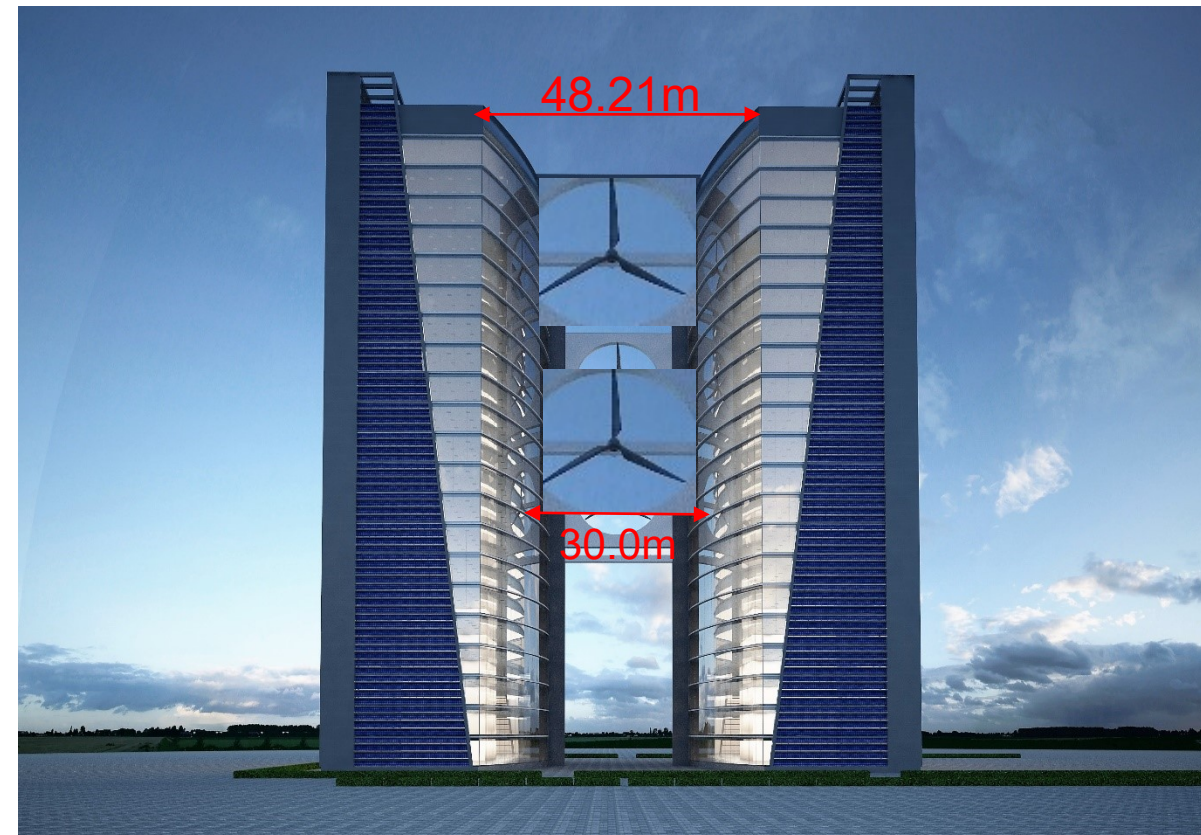
Architectural expression

Green Energy from wind
(@ 15 to 23% CUF)
(National Avg 25%
Max 40% Min 11%)

Technology is matured
customizable .Technically
feasible with existing WTGs
adapted to Building integration
at 3 to 5% of total project cost.

AEP Range (2x250kW)
6.5 to 9.0 Lakhs units
(kWh)

- Site : Vallam 12° 54' N and 79° 53.5' E (near Sriperumpudur)
- Wind : Avg assumed based on weather in web public domain 4.91m/s





Technically Feasible Aero-Tower (Green Building)

Challenges -ve to +ve

Low wind speeds 5m/s

(Wind speed-up 17%)

(Increased power 60%)

(Low CUF augmented)

Min Building Gap 30m

Rotor Dia : 27 to 29m

Available building height

64m (84-20m above GL ?)

High Cost challenge ?

(Customization can bring down cost per WTG at

2 crores/unit of 250kW)

Possible Supplier India/Europe

- Site : Vallam 12° 54' N and 79° 53.5' E (near Sriperumpudur)
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