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## Energy Harvesting from Airports

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# ENERGY HARVESTING FROM AIRPORTS

32nd National Training Aircraft Symposium (NTAS) (2nd  
March- 4th March ,2020),

Embry Riddle Aeronautical University,  
Daytona Beach,  
Florida

By Deekon Roy

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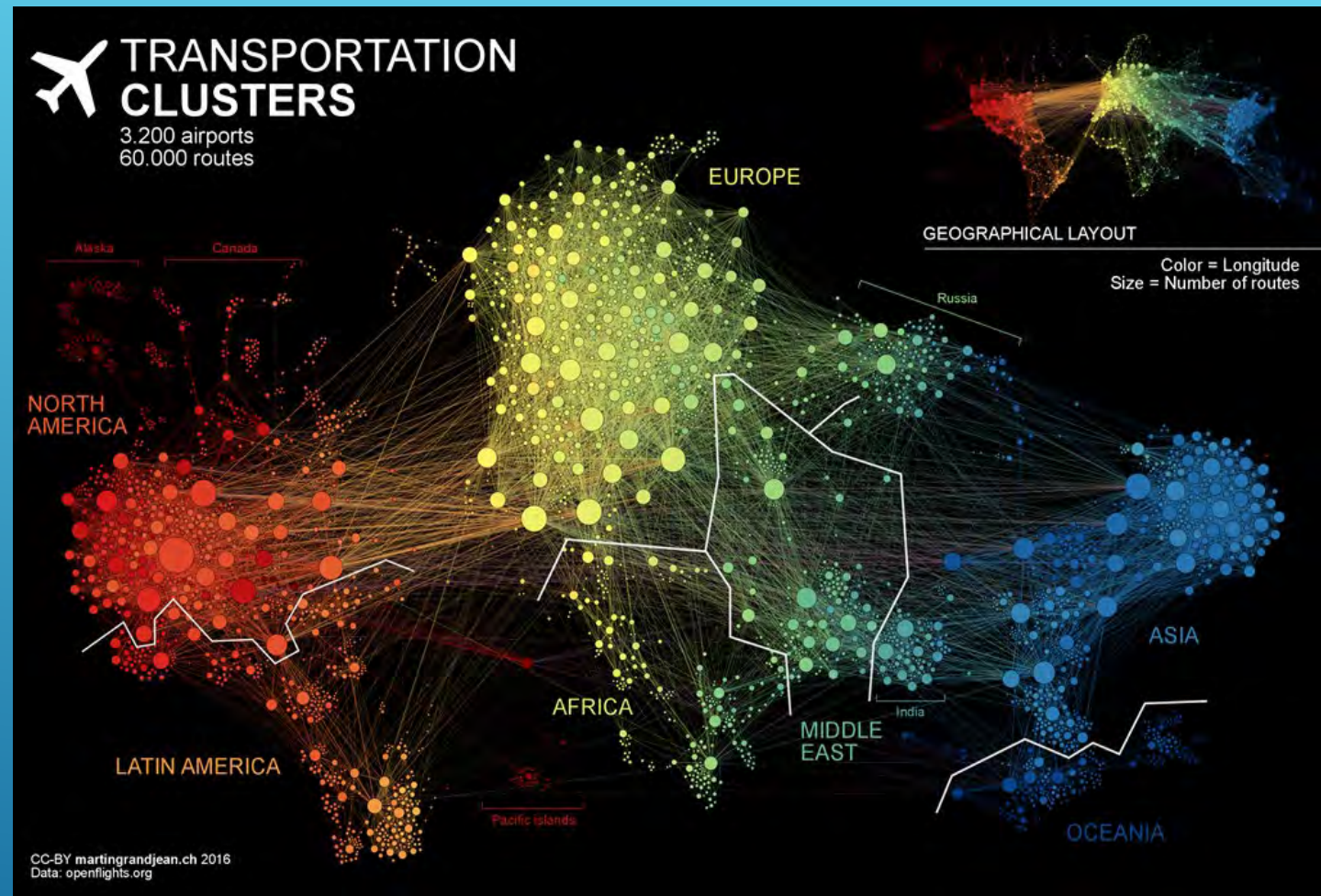
India



**SRM**  
INSTITUTE OF SCIENCE & TECHNOLOGY  
Deemed to be University u/s 3 of UGC Act, 1956

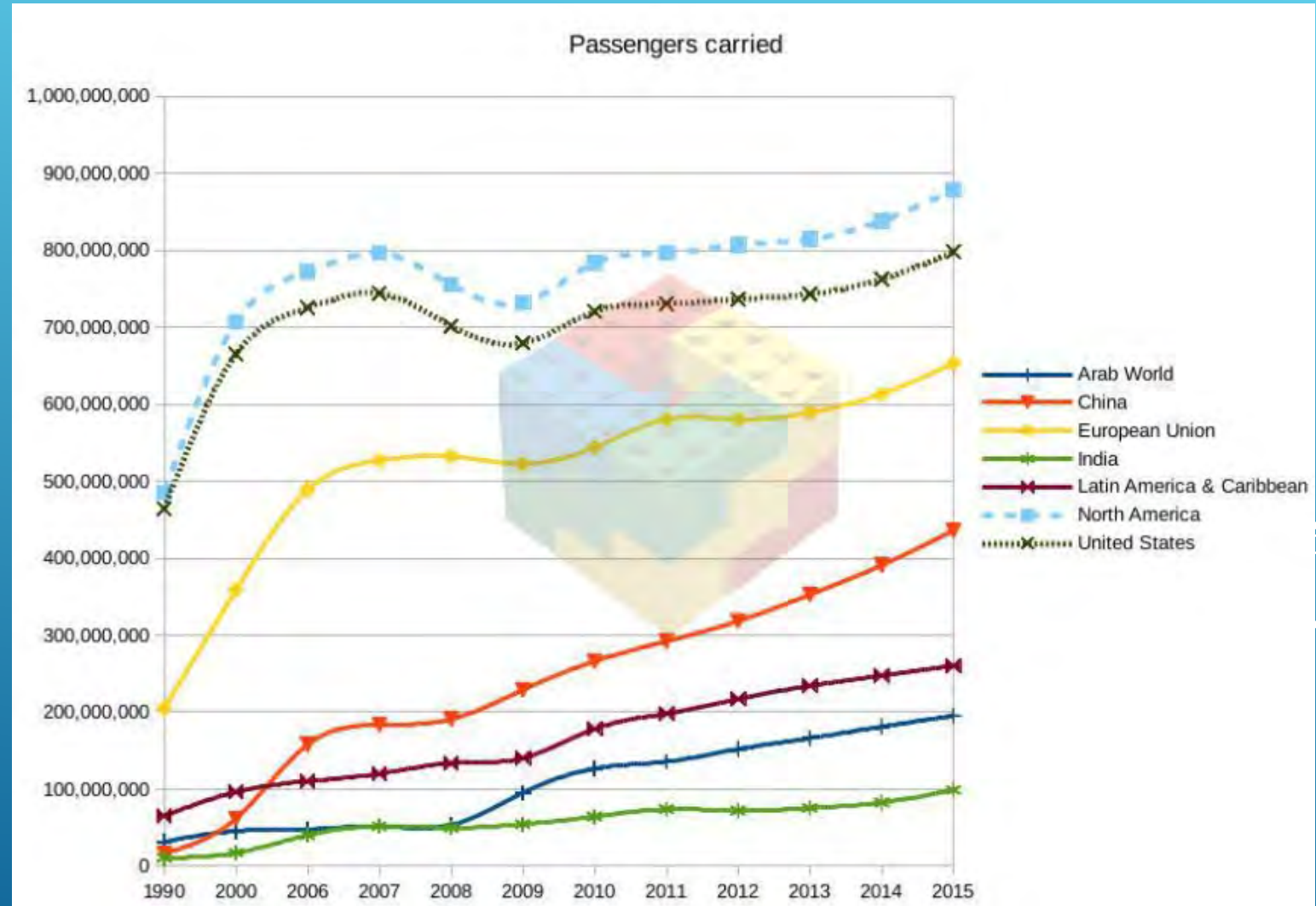
## ➤ Importance of Airports:

- Air transportation is one of the major systems which saves travel time.
- 3000 airports worldwide, cater to more than 50 million passengers annually.



# PROJECTED GROWTH IN AIR TRAVEL

- Flow of passengers and cargo via air has been increasing, and is expected to rise further.
- To manage such large inflow, airports are expanding and would use more power to operate.

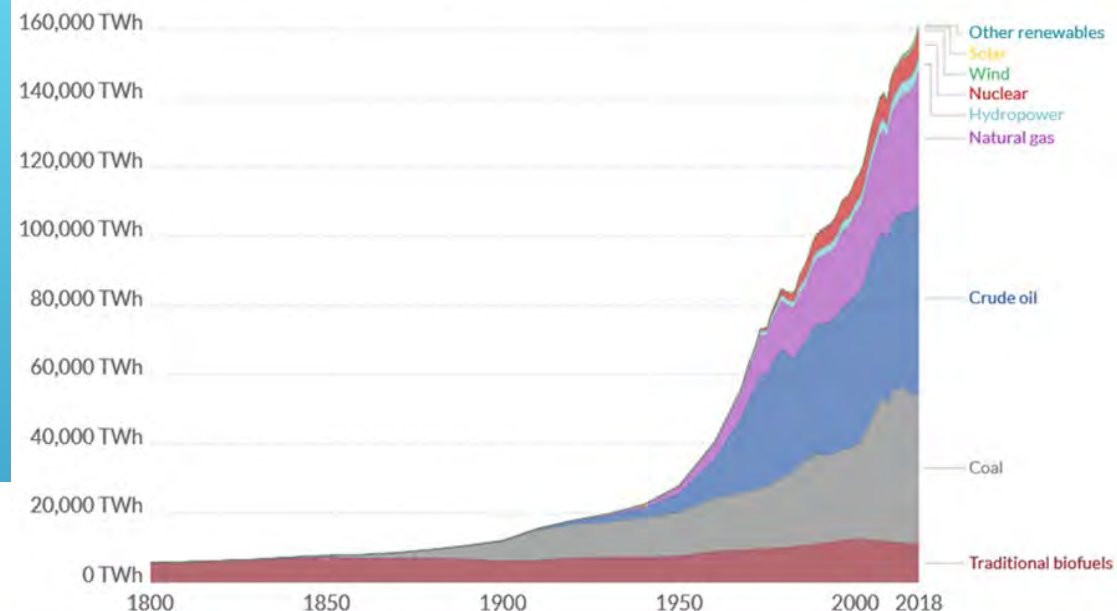




# ELECTRICITY GENERATION GLOBALLY

## Global primary energy consumption

Global primary energy consumption, measured in terawatt-hours (TWh) per year. Here 'other renewables' are renewable technologies not including solar, wind, hydropower and traditional biofuels.

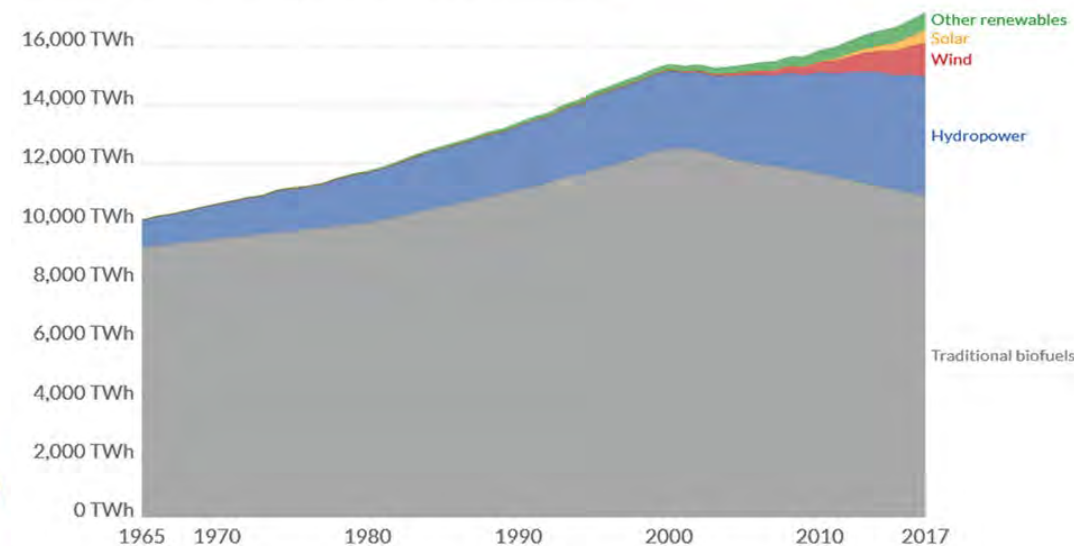


Source: Vaclav Smil (2017) and BP Statistical Review of World Energy

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## Global renewable energy consumption, World

Renewable energy consumption measured in terawatt-hours (TWh) per year. Traditional biofuels refer to the consumption of fuelwood, forestry products, animal and agricultural wastes.

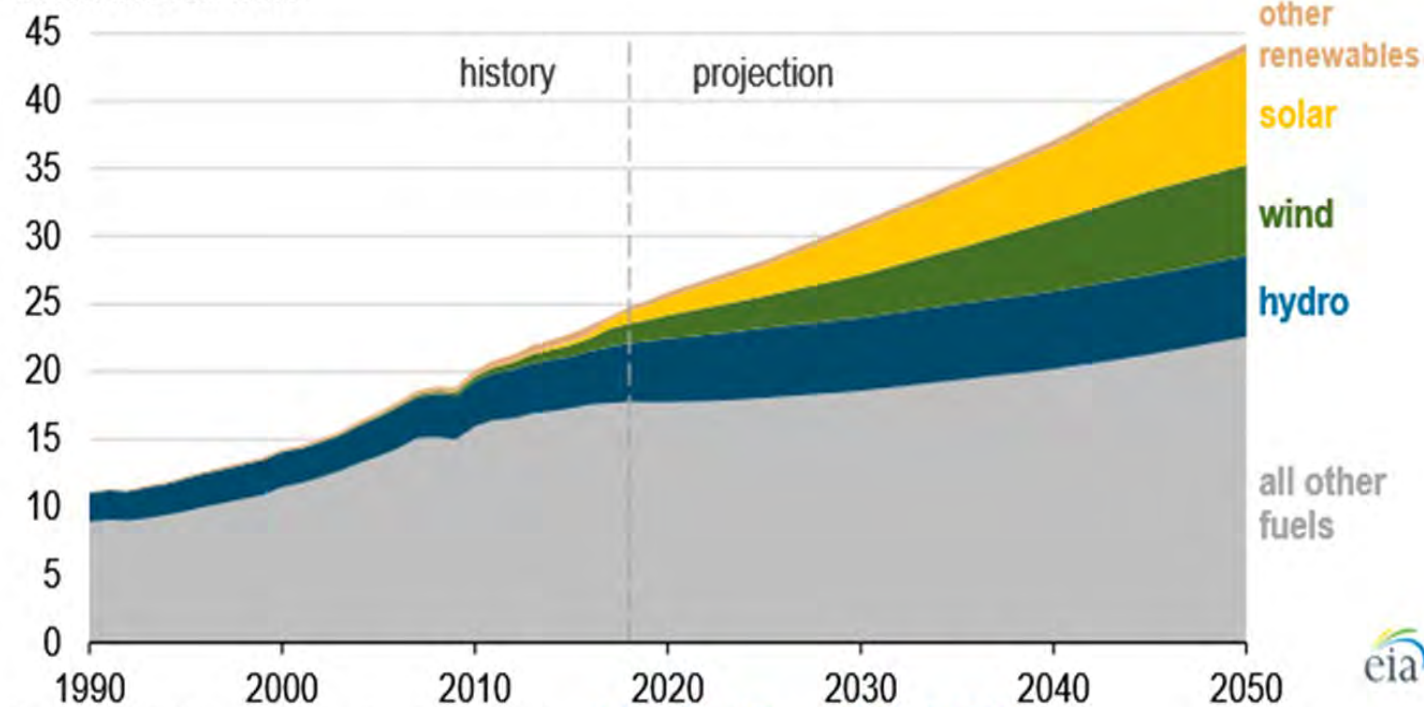


Source: Vaclav Smil (2017) & BP Statistical Review of Global Energy (2019)

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## World net electricity generation, IEO2019 Reference case (1990-2050)

trillion kilowatthours



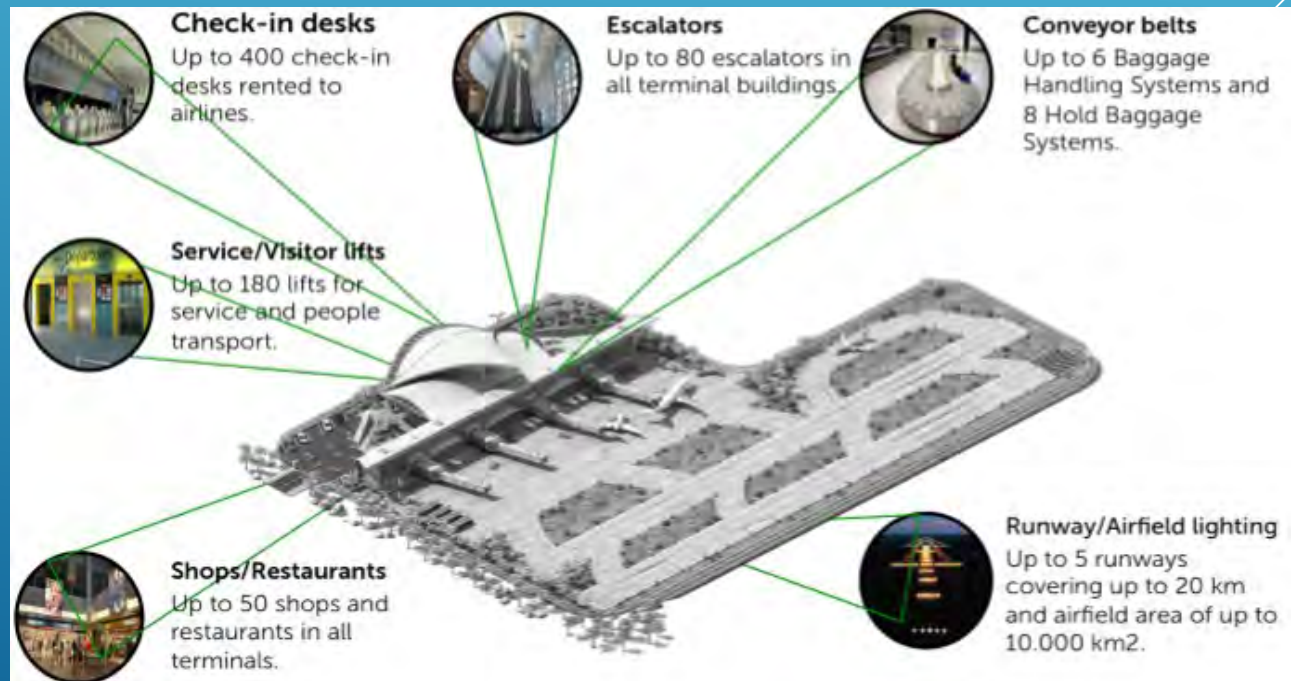
Source: U.S. Energy Information Administration, [International Energy Outlook 2019](#)



# POWER SOURCES AND THEIR DISTRIBUTION AT AIRPORTS

For regular operations at airport, constant power supply is required. Their primary sources are:

- Electricity: For operations of systems and facilities that are necessary at airports.
- Fuel : For heating systems, emergency generators ,ground vehicles etc.





# CURRENT PROBLEMS FACED

- Airports are increasing in size have increased power requirements.
- Large scale setup of microgrids have high cost.
- Increasing energy costs lead to higher landing fees.
- Unexpected cut off of power from grid have caused issues in the past.

Chennai International Airport



Chicago O'Hare International Airport



OR Tambo International Airport power outage



Air India Maintenance hangar, Mumbai

# MOTIVE

To suggest a better method for utilizing available ambient energy at airports.

Decorative white lines consisting of several parallel diagonal strokes in the bottom right corner of the slide.



# OBJECTIVES

- Implement existing and upcoming technologies at airports for power generation.
  - Utilize the airport's configuration to allow effective harvesting of energy.
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# MOTION/PIEZO POWER GENERATORS

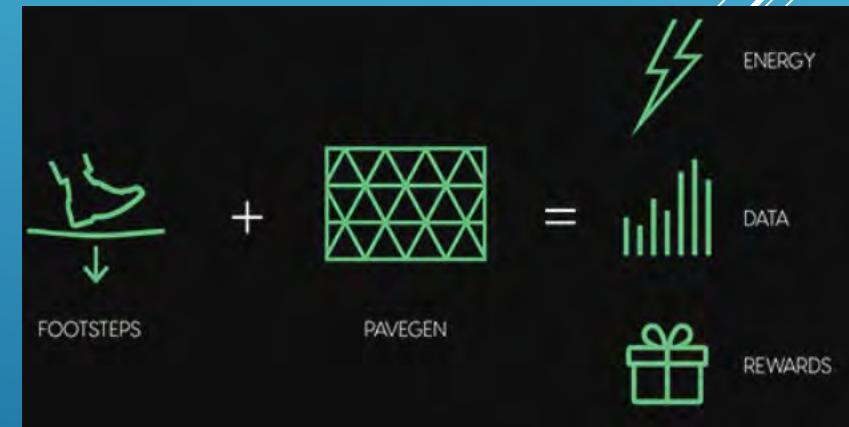
## Motion Power Generator:

### Pavegen flooring tiles

According to the manufacturer they produce 7W per person at 12v DC, which is enough to run a LED street lamp for 30 seconds.



Kinetic Tiles from *Pavegen*



# TRANSPARENT SOLAR PANELS AND HIGH PERFORMANCE SOLAR PV PANELS

## Solar Glass:

Polysolar PS-CT-64 20% transparent panels

Power output(ideal condition): 7.68kWp (7.68kW/m<sup>2</sup>)

Power output per m<sup>2</sup> for useful sunlight hours:

$3.84 * 6 * 290 = \underline{\underline{6681.6kW \text{ for } 1m^2 \text{ panel area}}}$

(290 days ,considering cloudy/ non-operational factors)

(6 hours for usable energy attainment in the day)



PS-CT-64 panel by *Spirit Energy*, UK



# MICRO WIND TURBINES, VERTICAL AXIS WIND TURBINES

## Small Scale Wind turbine:

Eco Whisper Wind Turbine-325

Blade diameter = 3.25m (30 blades)

Height = 19.6m

Cut in speed: 2m/s or 4 knots

Approx. area per turbine : 25m<sup>2</sup>

Power output by turbine: 5kW (peak rating)

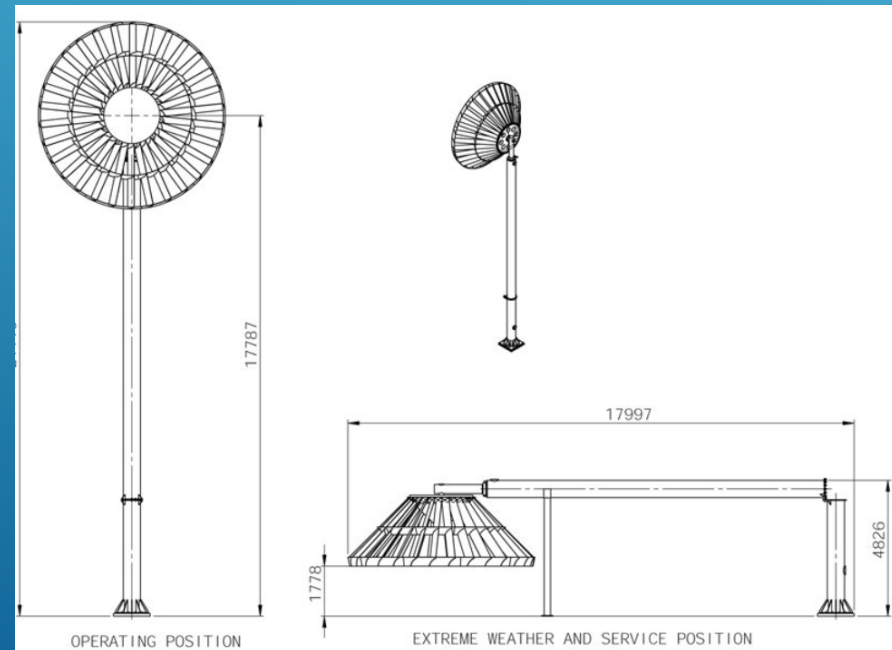
Assuming 10 turbines installed at a sample airport:

Area required for 10 turbines: 250m<sup>2</sup> (estimated)

Power output for 10 turbines over a period of one year:  $10 * 5 * 12 * 300 = \underline{\underline{180,000 \text{ kW}}}$



Eco Whisper  
Turbine



# CLASSIFICATION OF AIRPORTS

**Low Energy Airports:**   **Medium Energy Airports:**   **High Energy Airports:**

Merrill C.Meigs Field Airport



Princess Juliana International



Kansai International Airport



Paro International Airport



Chicago Midway International



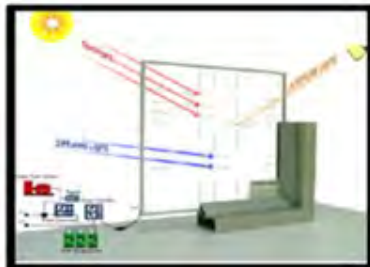
Dubai International Airport





# COMPONENTS WORKING TOGETHER

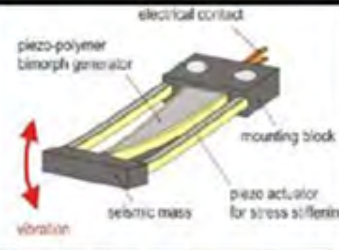
Solar Glass



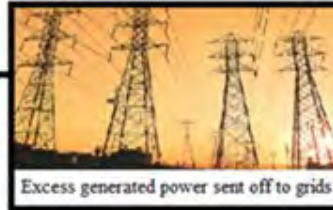
Vertical Axis Wind Turbines



Piezoelectric generators



Solar PV Panels

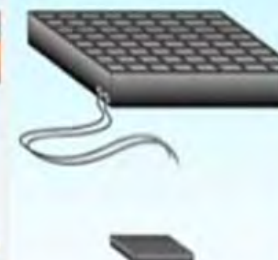
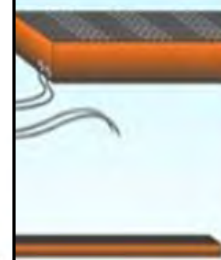


Solar glass replaces glass facades

Runway Generator

Railroad Generator

Runway Generator



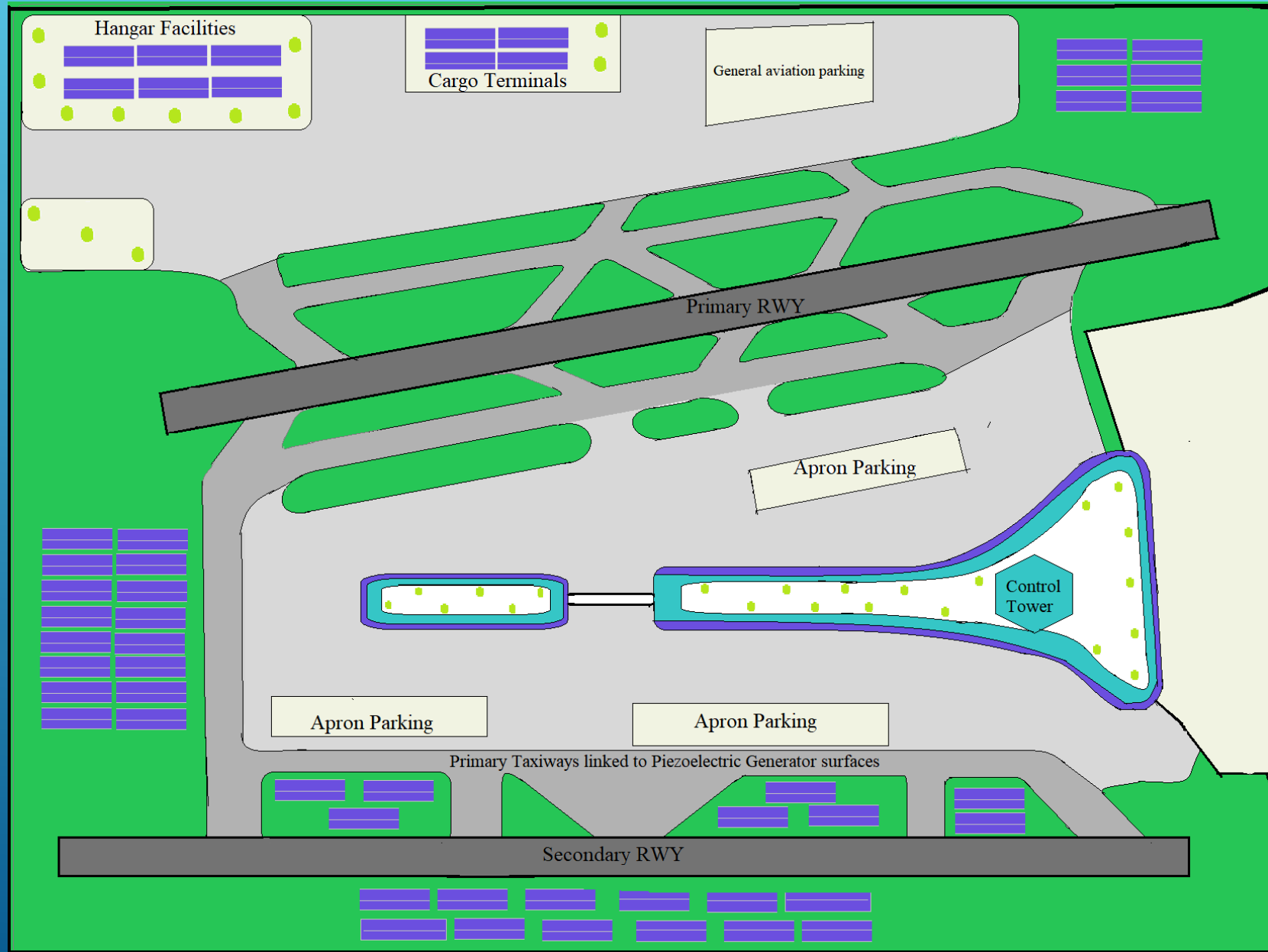
Piezoelectric applications







Experimental wind turbine installations at Honolulu International Airport



# SCHEMATIC DESIGN



## Keys

-  - Solar Glass Modules
-  - Solar PV Modules
-  - Wind turbine
-  - Piezo Devices

# COMPATIBILITY

- ▶ At any time one of the three systems would be operational.
- ▶ Secondary power is connected in form of industrial battery units.




Lockheed Martin: GridStar Flow battery pack



Tesla Megapack

# STEPS TO IMPLEMENTATION

- ▶ Identify critical electrical components.
  - ▶ Plan out key locations at the airport.
  - ▶ Create demands for renewable energy systems.
- 
- A decorative graphic consisting of several parallel white lines of varying lengths and orientations, located in the bottom right corner of the slide.



# THEORETICAL EXPECTATIONS

- Airports may operate off the grid.
- Reduction the carbon emissions from airports.
- Potential powerhouses for electric transportation systems .
- More focus on resource sustainability.



Eviation Alice



Electric Pickup Trucks



E-VTOL



World's first 100% solar powered airport

# CONCLUSION OF IDEA

- ▶ Harvesting energies available at airports.
- ▶ Scope for production of extra electrical power.



Solar farm at Indianapolis International Airport

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