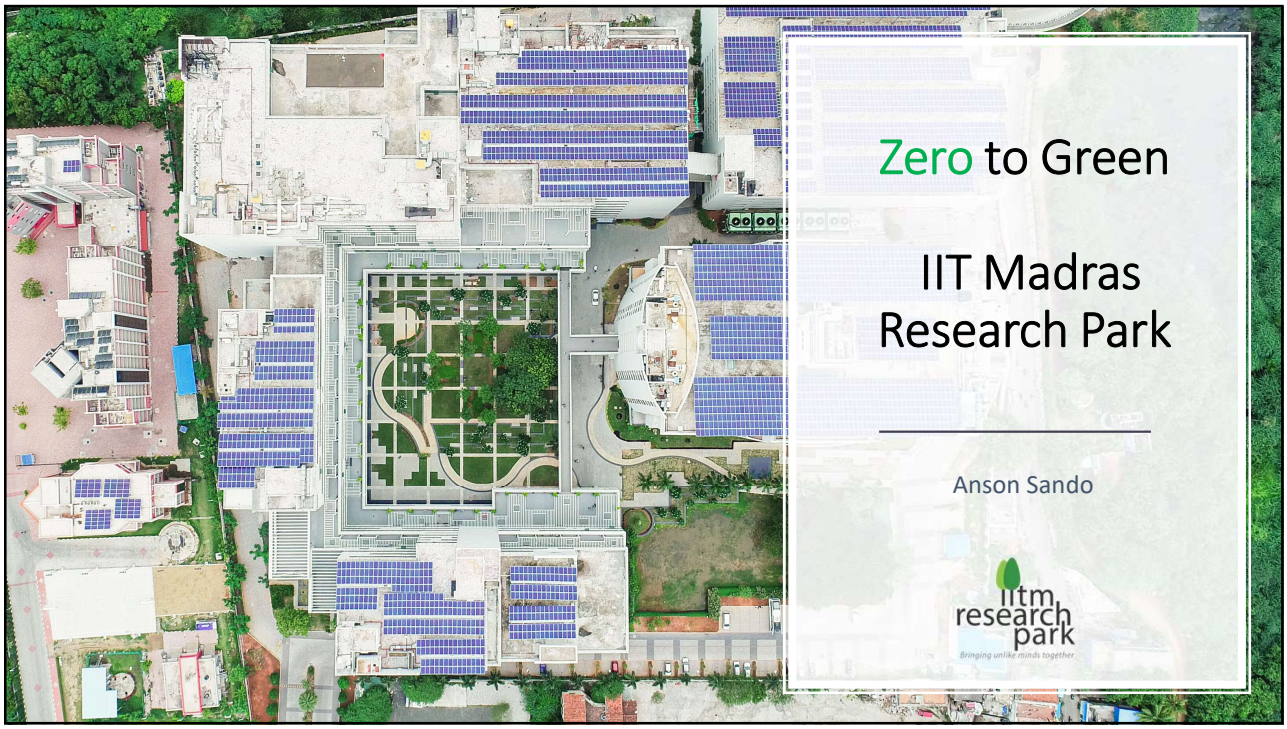



1

# INDIA - TODAY

iitm research park

Total GHG EMISSIONS
3rd

PER CAPITA EMISSIONS
103rd

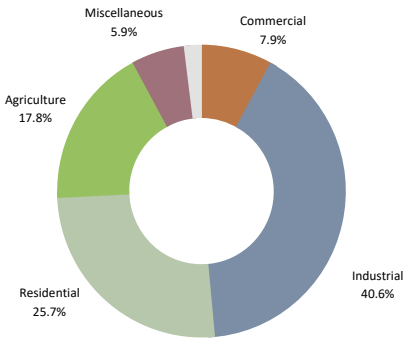
- As India's GDP grows → GHG emissions increasing: MUST Act Now
  - Expanding economy, population and industrialization
  - India estimated to see the largest increase in energy demand of any country in the world until 2040
- Imperative that India must get to net-zero while growing its GDP
  - Decouple GHG emissions from GDP growth
  - R&D and Innovation can get us there by 2047
- Solar and the 100X growth story
  - 1 to 100 GW Solar Since 2012
  - Lowest cost energy generation in world today – Solar in India



2

# GOING GREEN: WHERE DO WE START?

- **75%** electricity consumed by Commercial, Industries and Resedential
- Cost of electricity **highest** for commercial category.
  - Commercial tariff **40% higher** than that for other categories
- Industry consumes 40% of total electricity in India today and growing
- 700–900 million sq.m urban space to be built every year for next decade
- Commercial + Industrial sector will deploy **capital if there is RoI**
  - All other sectors can follow



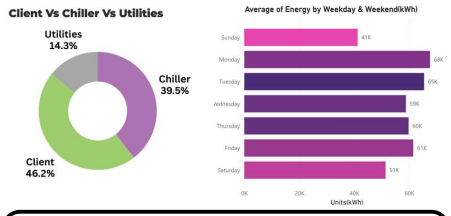

**Share of Electricity Consumption - India**



3

# IIT Madras Research Park – The Showcase

- IITM Research Park: 1.2M sq.ft Commercial Complex spread across 11.7 Acres
  - Average daily consumption - 70 MWh
  - Contracted Demand – 5000 kW
  - Total cost of electricity ₹12.31 per unit
  - 8 Chillers – 3000 TR; 6 DG sets – 1150 kVA
- Understand the in/outs of consumption →
  - How do we fix a leak if we don't know where it is?
  - Deep-data driven approach
    - Analyze consumption profile, dissect trends and deliver efficiency and savings
  - Develop → Test → Rinse → Repeat



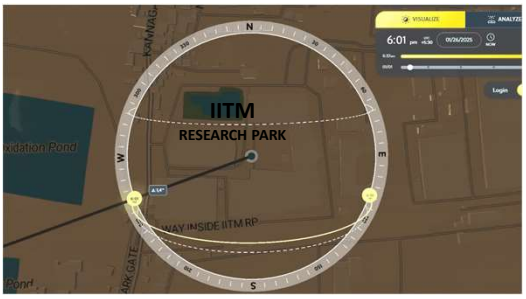

**1.2 Million Data Points**



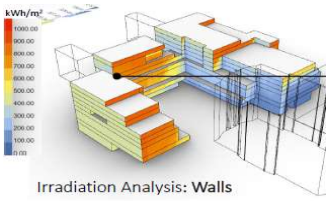
4

# Step 1: Reduce

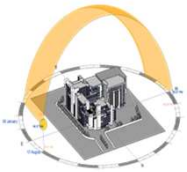
- Greenest form of energy is the one we don't use
- Identify the needle movers
  - In Buildings: Energy used in cooling alone is 40%
- Solar Heat Gain analysis showcased our own gaps
- Inefficiencies of cooling large spaces → Technology to address the same
- Data driven approach for decision making
- Sustainable design, material, and construction should be the norm




SUN-PATH Analysis



Irradiation Analysis: Walls

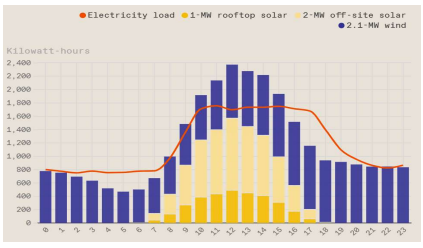




# Step 2: Energy Generation → Renewable

- Constraints: Limited space and large investment
  - Rooftop Solar typically provides only 5 – 10% of total requirement
- Open Access: Captive/Group-Captive
  - Smaller Investment and larger capacity
  - IITMRP today: 5 MW Solar and 2 MW Wind providing 80% power
- Regulations changing and fundamental nature of RE will come to light
  - *Banking* went from 12 months → 1 month → Minutes
  - Intermittency of renewables means Storage is only way to match demand and supply
- Demand – Supply mismatch (Day and Month)
- Energy storage key in moving towards 100% RE

| Factors involved | 1 MW Solar without trackers | | 1MW Wind | |
|---|---|---|---|---|
| | Total Cost | Investment through Group Captive Mechanism | Total Cost | Investment through Group Captive Mechanism |
| CAPEX Cost (₹) | 4,00,00,000 | 32,00,000 | 7,50,00,000 | 1,50,00,000 |
| Land Required | 3.5 acres | | 1.5 acres | |



# Step 3: Energy Storage

- Thermal: 40% energy at IITMRP used in air-conditioning
- IITMRP designed, developed and commissioned chilled water storage system with capacity of 300,000 ltrs
- Stores chilled water at 6°C: store anytime, use when needed

- Battery Storage: (Short duration – Within a Day use)
- LTO - Fast charge-discharge
- NMC/LFP - Slow charge-discharge
- First of its kind indigenously developed MWh battery storage deployed

- Is there a long-duration storage requirement?
- 60% of India's Wind generation happens across 4 months
- Could Green Hydrogen be an option?
- Early results of Zinc-Air look promising + explore other options






# Step 4: Energy Management

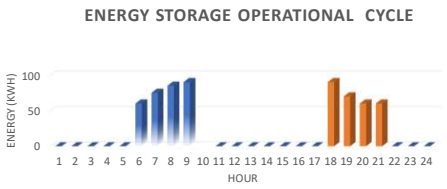
- Multiple sources of energy generation + storage and varying consumption patterns
  - Solar and Wind
  - Three types of Storage
  - Multitude of consumption heads
- EMS → Match demand and supply 24*7 to meet true RE requirements
- Use case is multi-fold on daily basis

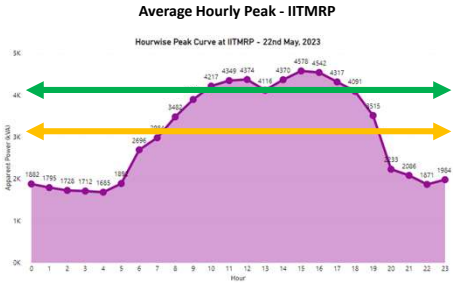
→ Time of Day pricing – Peak Tariff Hour usage

- In TN today, 25% higher electricity cost between 6:00 – 10:00 (AM/PM)

→ Fixing the Fixed Charges

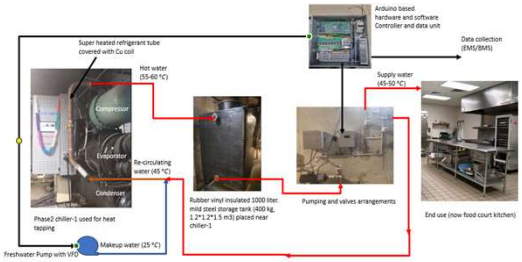
- ₹562 per kVa fixed demand charges
  - IITMRP at 5000 kVA contracted incurs ₹28L per month
- Do we really need it?
  - In last one-year IITMRP peak touched 4700 kVA for 7 minutes
  - Shave the mountain
  - 15 – 20 mins per day could cost ₹5 - ₹10L per month



# Step 5: Closing the loop

- The Hot and Cold problem → Opportunity
- Air conditioners/Chillers for heating
- Heat water from Chillers at IITMRP used in cafeteria




- End of life problems - Are we just shifting the goal post?
- Battery Recycling today: 95% material at 98% purity
- Solar panels, Wind Turbines and all components should follow suit





## The Green Print

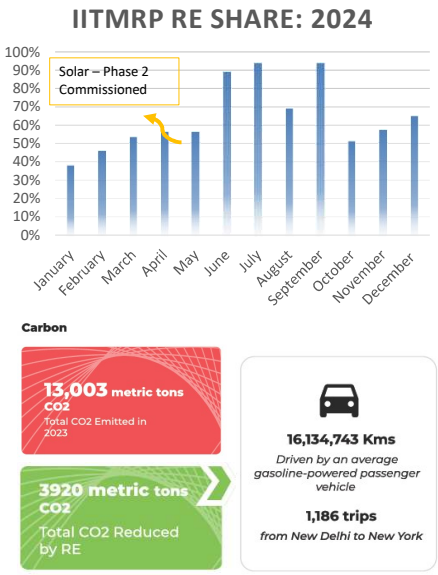
| Average Monthly Cost of Energy for a Commercial Complex in 2022 | | |
|---|---|---|
| | Current Scenario | Proposed Scenario with 90% RE |
| Particulars | Units (kWh) | |
| Solar (wheeled-in) | - | 5,81,250 |
| Wind (wheeled-in) | - | 5,41,437 |
| Commercial | 12,73,790 | 1,60,108 |
| Diesel Generator | 18,011 | 9005 |
| Total | 12,91,801 | 12,91,801 |
| Particulars | Per unit rates (₹/ kWh) | |
| Solar (wheeled-in) | - | 4.57 |
| Wind (wheeled-in) | - | 4.52 |
| Commercial | 8.70 | 8.70 |
| Diesel Generator | 31.33 | 31.33 |
| Storage (Assuming 30% RE) | - | 2.67 |
| Particulars | Overall average rates (₹/ kWh) | |
| Consumption charges/unit | 8.70 | 7.38 |
| Peak Hour Consumption Cost/unit | 0.64 | 0.48 |
| Demand charges/unit | 2.08 | 1.62 |
| Tax, meter rent/unit | 0.57 | 0.16 |
| Avg rate without DG | 11.99 | 9.63 |
| Avg rate with DG | 12.31 | 9.80 |
| Average Monthly Cost | ₹ 1,58,12,804 | ₹ 1,25,23,887 |
| Estimated Monthly Savings (₹) | | ₹ 32,88,917 |

# THE IMPACT

- 30 – 35% reduction in electricity costs
- Savings of ₹4.3 Crores in last 12 months on electricity costs
- Cut down emissions by 3920 tons of CO2

- Approach scalable across the country
  - Readily deployable in the existing infrastructure
  - Plus Billions of sq. ft yet to be built

- As costs decline → Industrial + HIG housing can follow
- Can all commercial, Industrial and residential go GREEN?
- Mission to help accelerate shift ; technology and cost ready – are you?








Let's work together..

Thank you!

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