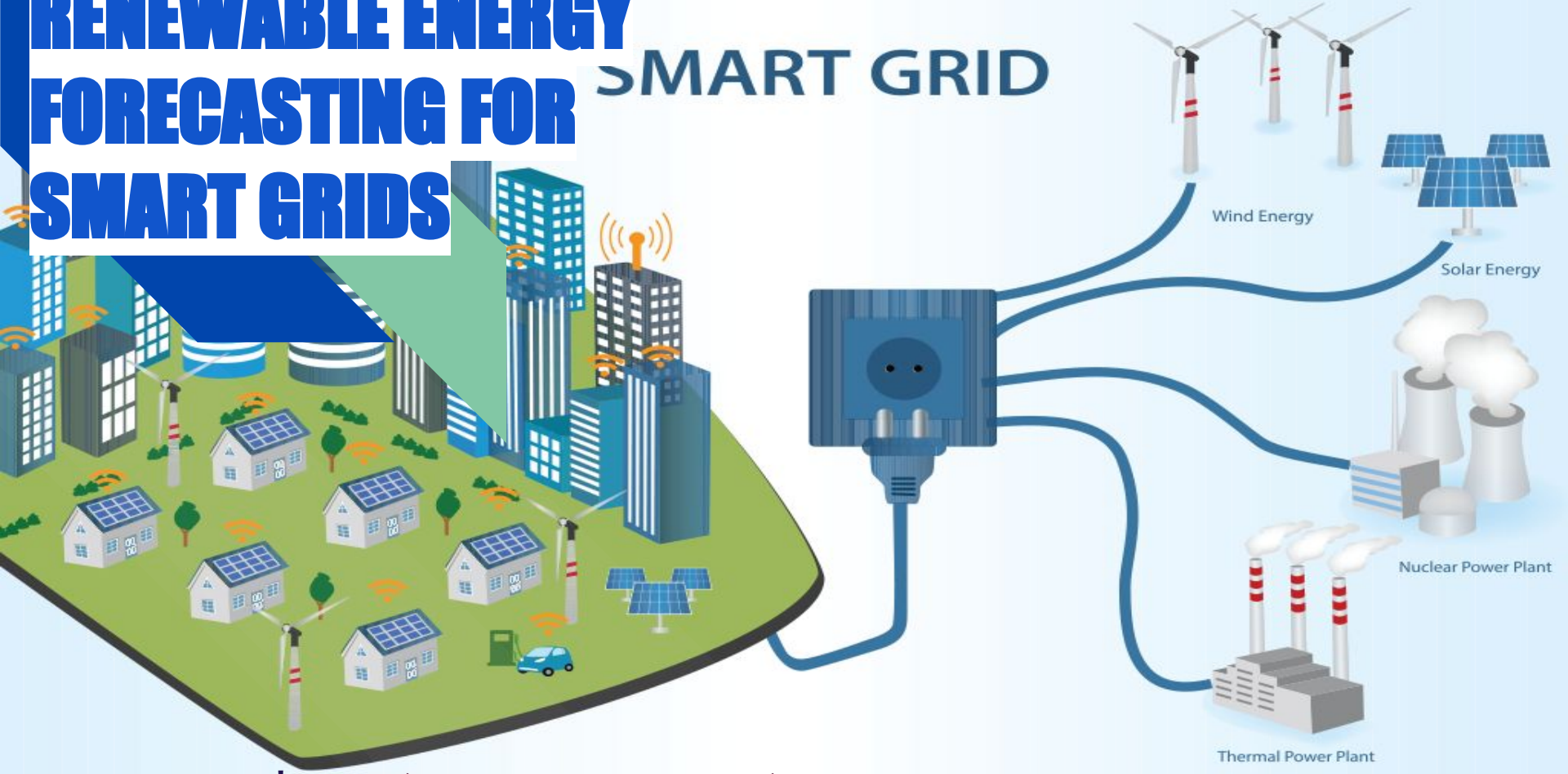
RENEWABLE ENERGY FORECASTING FOR SMART GRIDS



Team AyeAyeTea!

(Problem Statement : AG 343)

PS by MathWorks

OVERVIEW : THE RATIONALE

1. Traditional Grid, and problems
   - Manual operation
   - Oversights, inefficiencies and losses
   - Blackouts
2. Smart grids
   - Automated production and distribution
   - Demand-supply matching
   - Macro and Micro level monitoring
3. Energy bucket
   - Renewable (Intermittent)
   - Conventional (Consistent)

BREAKDOWN OF PROBLEM

Components of product :

1. Data sets containing historical consumption and production data
2. Simulated model of smart grid
3. Prediction models for real-time projection of supply and demand
4. Scheduling system for seamless supply from various sources
5. Front end system for display of recommended supply changes to operator

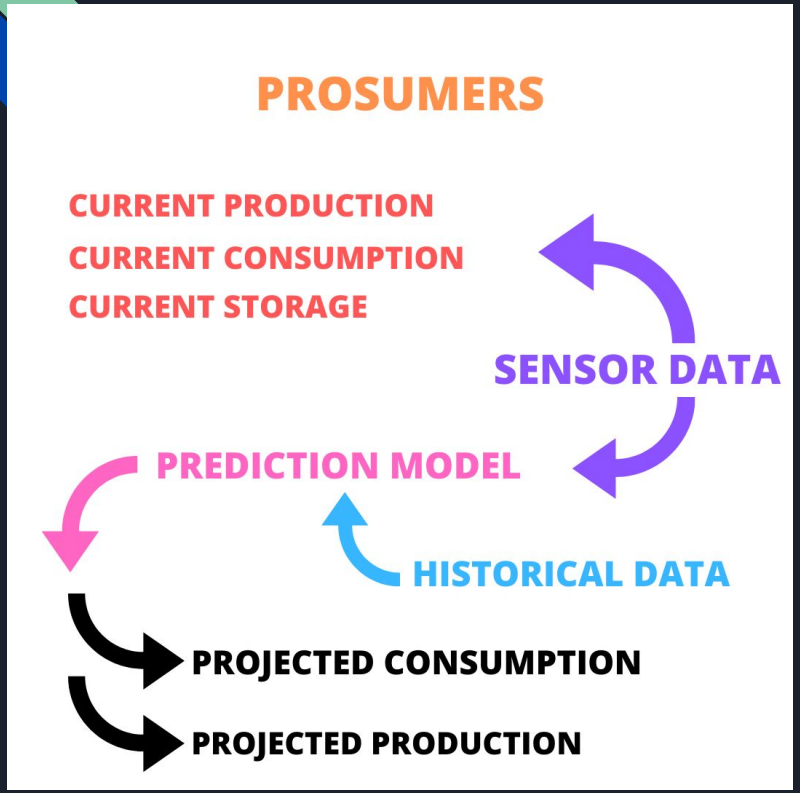
THE SIMULATION

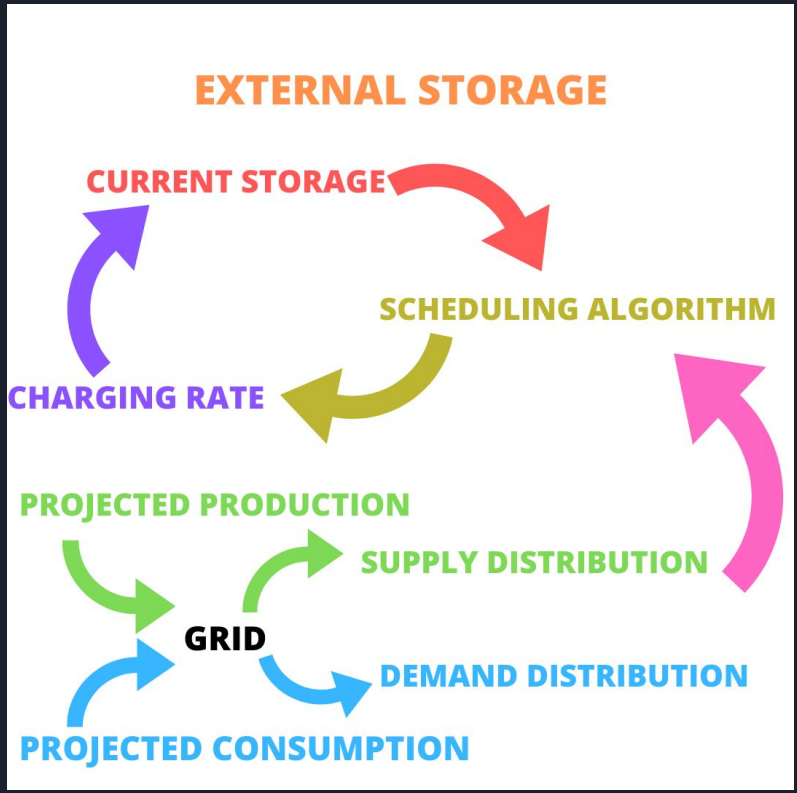
Two kinds of grid elements :

1. Energy sensitive components
   - Producers
   - Consumers
   - Prosumers

     ... are all prosumers

   - Storage elements
2. Energy insensitive components
   - Distribution stations
   - Power Lines


PROSUMERS
CURRENT PRODUCTION
CURRENT CONSUMPTION
CURRENT STORAGE
SENSOR DATA
PREDICTION MODEL
HISTORICAL DATA
PROJECTED CONSUMPTION
PROJECTED PRODUCTION


EXTERNAL STORAGE
CURRENT STORAGE
SCHEDULING ALGORITHM
CHARGING RATE
PROJECTED PRODUCTION
SUPPLY DISTRIBUTION
GRID
DEMAND DISTRIBUTION
PROJECTED CONSUMPTION

SUPPLY - DEMAND PREDICTION

1. ARMA (Autoregressive Moving Average)
2. Support Vector Machines
3. RNNs
4. Principal Component Analysis
5. Random Forest Regression

... etc

DATA SOURCES

1. Kaggle :
    - PJM Hourly Energy Consumption Data
    - California Renewable Production 2010 - 18
    - 15 Years of Power Outages in the US
    - GREEND: GREEND Energy dataset
2. US National Renewable Energy Laboratory(NREL) Data Catalog
    - India Direct Normal & Global Horizontal Irradiance Solar Resources
    - Solar irradiance data from Nevada Power's Clark Station, Las Vegas, Nevada
3. EU Load, Wind and Solar prices in hourly resolution

... and many more.

REQUIREMENT AND APPLICATION OF SYSTEM

Users :

- Grid Operators
- Prosumers
- Auditors
- Law enforcement
- Distribution Companies
- Civil Society Stakeholders

DEPENDENCIES

- Python 3.8
- Python libraries (TensorFlow, sklearn, etc)
- Mathworks (MatLab, SimuLink, SimScape, etc)
- Web end (Javascript, LAMP, etc)

  Et cetera

- Platform independent - but Linux based control center

HARDWARE PREREQUISITES FOR OUR SYSTEM

- Smart metres
- Efficient storage system
- Control and Communication systems
- Data storage systems
- Sensors

SHOW STOPPERS

- Lack of data granularity
- Hardware deficiencies
- Inaccuracies in weather prediction

Et Cetera...

REFERENCES

- Machine Learning Techniques for Supporting Renewable Energy Generation and Integration :A Survey Kasun S. Perera, Zeyar Aung, and Wei Lee Woon
- Strategic scheduling in smart grids Alireza Nouri, Alireza Soroudi, Andrew Keane (2018)
- Distributed Algorithms for Peak Ramp Minimization Problem in Smart Grid Hung Khanh Nguyen, Amin Khodaeit and Zhu Han
- A Distributed Demand Side Energy Management Algorithm for Smart Grid Min-fan He , Fu-xing Zhang , Yong Huang , Jian Chen , Jue Wang and Rui Wang
- Energy Storage Optimization Strategies for Smart Grids : Claudio G. Codemo, Tomaso Erseghe, Andrea Zanella

That’s all folks!!!

Any questions?