DESIGN AND DEVELOPMENT OF MICROGRID FOR REMOTE COMMUNITIES

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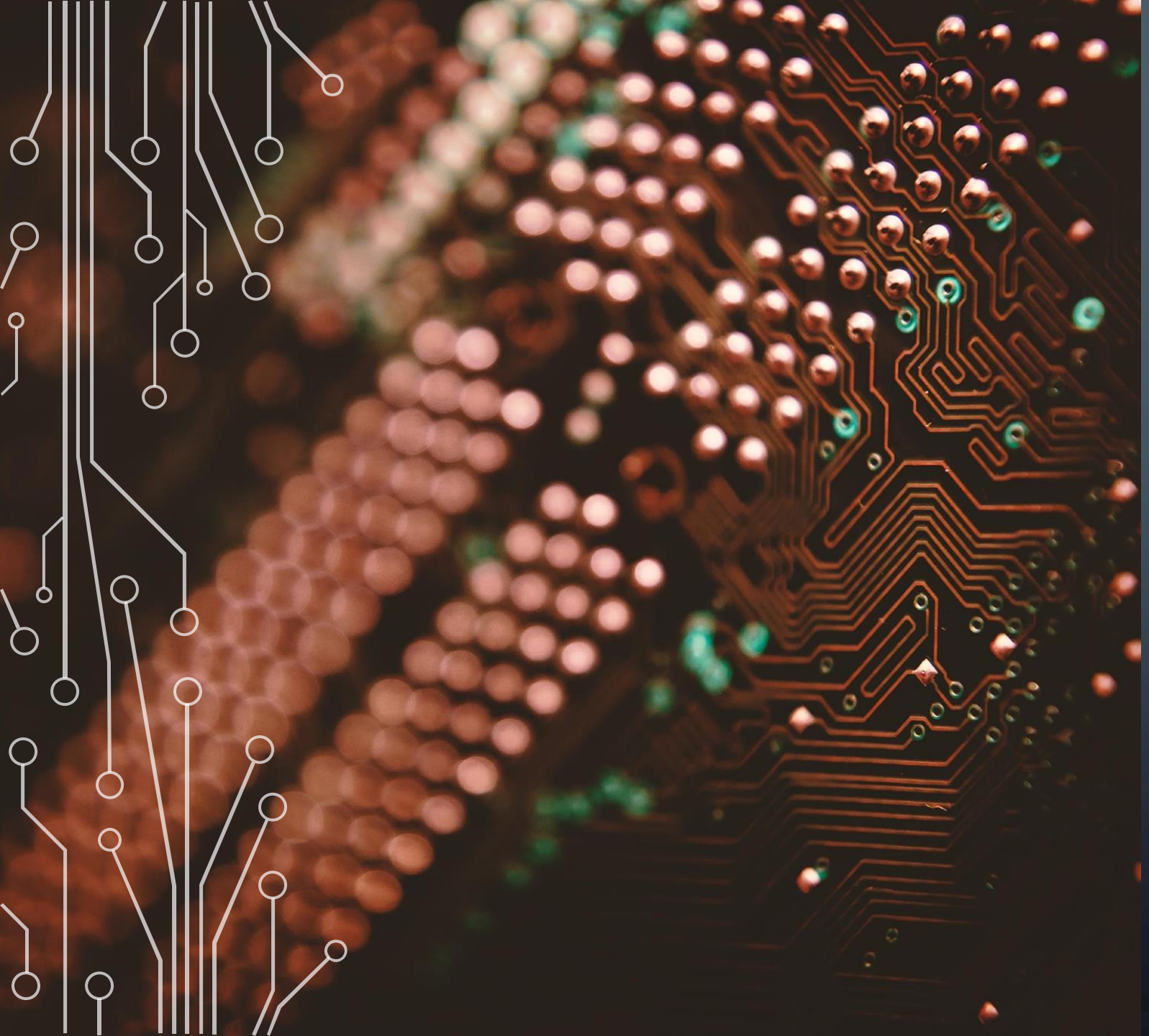


AGENDA

- Problem Identification
- Concept Generation
- Implementation and Solution
- Cost Generation
- Demonstration

PROBLEM IDENTIFICATION

- Access to power is a main differentiator between first and third world countries. Traditional sources are sometimes ineffective and costly. For that reason alternative resources are looked upon for security, convenience, self-sustainability, and for environmental benefits
- This is a major issue when it comes to remote areas in Canada. Due to the size of the country, it's often costly to deliver power to remote areas
- The objective of our Capstone Project is to deliver uninterrupted high-quality power to customers in remote areas, and to find the right balance between self-sustainability and cost. This will be done by designing a Microgrid.

Concept Generation

- Purely Wind Farms
- Purely Solar Farms
- Hybrid of Wind, Solar and Diesel Fuel system

SOLUTION AND IMPLEMENTATION

- After careful consideration, our team decided to proceed with the hybrid system running on a combination of renewable sources (solar & wind) and supplementary diesel electric
- A pure wind turbine system is not a feasible option for the specific off grid community selected as Deer Lake experiences relatively low wind speeds for most months of the year
- Although solar panels are comparatively less taxing in terms of maintenance and upkeep, solar panels are intermittent sources of energy. Solar panels require adequate sunlight in order to operate

SOLUTION AND IMPLEMENTATION: WHY MATLAB

- Limited project funding
- Qualification issues due to being students
- Previous experience using the MATLAB software
- Versatility of MATLAB
- Governing Bodies

SOLUTION AND IMPLEMENTATION

- We will be using Matlab Simulink toolbox to build our system using the power systems toolbox
- We will first test and analyze the already prebuilt IEEE Bus 34 Node Test Feeder & the simple microgrid model

Solution and Implementation: IEEE & ANSI Implementation Requirements

IEEE 1547 - Standard for Interconnecting Distributed Resources with EPS

-standard to help utilities tap surplus electricity from alternative sources such as DG

-focuses on the technical specifications and testing of the interconnection

-1547.1, .2,.3,.4

ANSI C84.1

-establishes the nominal voltage ratings and operating tolerances for 60-Hz EPS above 100 volts

-System Voltage Classes (LV, MV, HV, EHV, UHV)

-Protection against undervoltage and overvoltage + practical and economical solution

Solution and Implementation: Requirements

I. Continuity & Quality of Power

I. Battery Storage and Diesel Generator for system backup & emergencies

I. Self Sustainability

I. Loss Reduction

I. Cost Effective Solutions

I. Power balance equation ($P_{GENERATION} = P_{DEMAND} + P_{LOSSES}$) to be satisfied

Budget

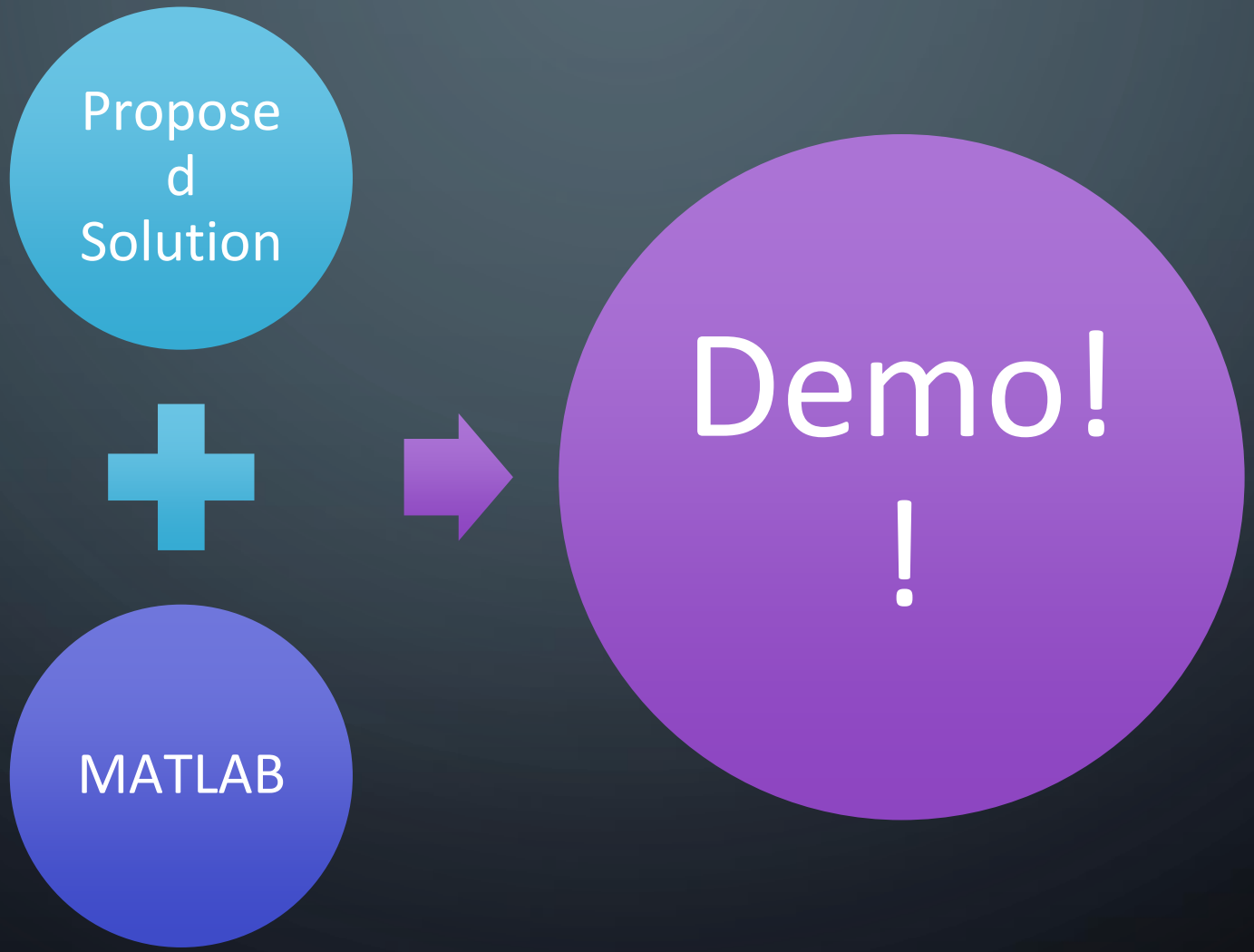
- When it comes to Wind Turbines it is estimated that commercial wind turbine range from $1.3M to $2.2M per MW of nameplate capacity installed. The majority of the commercial scale turbines that are currently installed have a capacity of 2 MW and cost around $3-4M
- **Labor**: We would need to consider helicopter rates for foundation work, assembly and erection and stringing that varies between $5000 – 7000 per hour. If this project takes 5 years we are looking at $68.4 – 95.8 million on a 7.5 hour day
- **Services**: The operation and management will be overseen by Hydro One remote communities. Average connection costs for a cluster of 20 communities including Deer Lake is $30000-40000/kW

Budget

- **Materials and equipment**: Based on the Red Cluster study that would include Deer Lake and 19 other remote communities and spans 1000 Km of transmission lines and other materials and equipment, is estimated by OPA to be around $1.2 billion. We estimated that based on Deer Lake we only need 93 Km of transmission lines. Based on the above estimate, the cost for Deer Lake would be $111.6 million.

Design	Estimated Cost (M)
Purely Wind	$211.4
Purely Solar	$213
Hybrid	$230.3 (due to fuel costs)

DEMO



THANK YOU