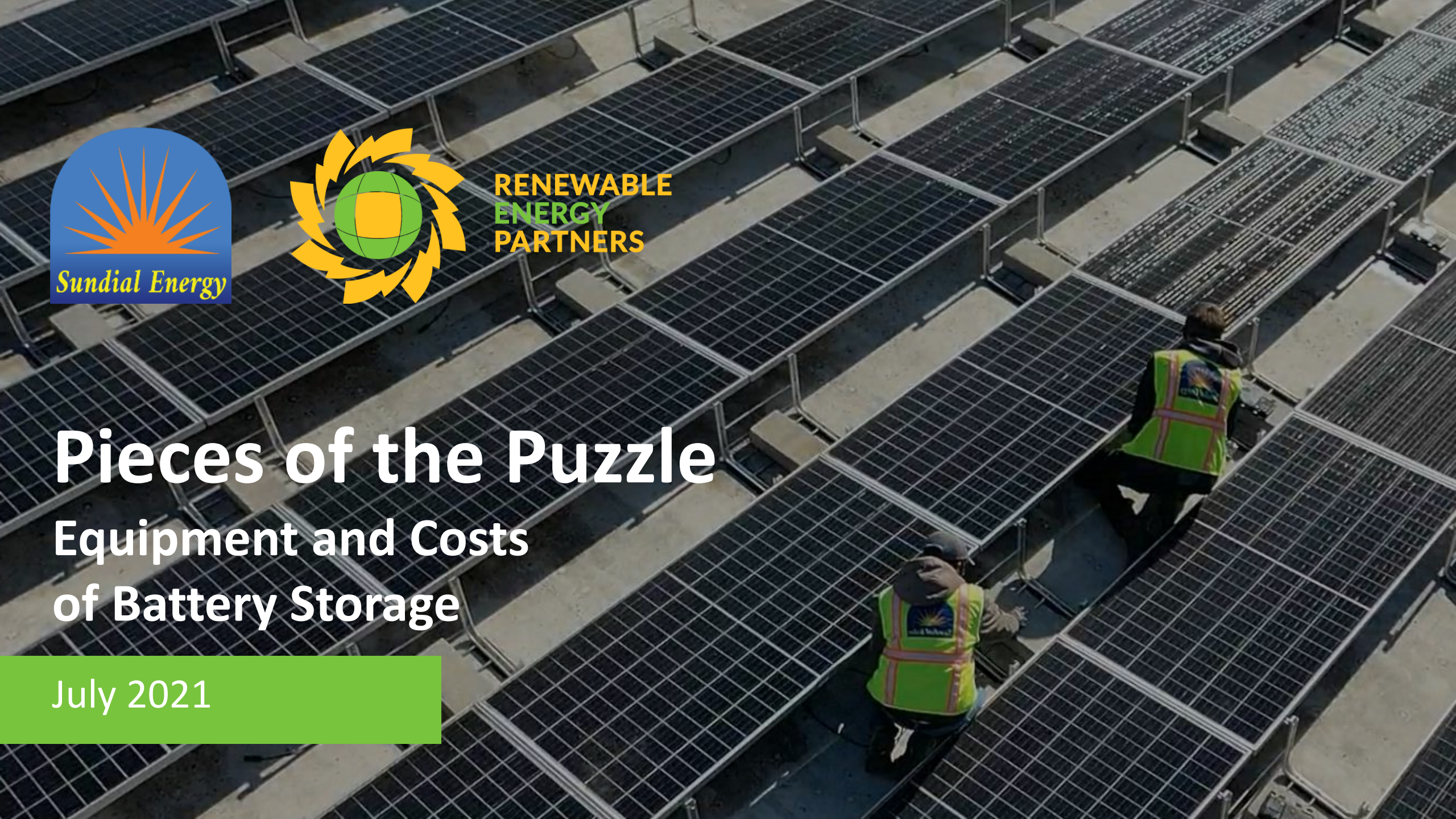


Pieces of the Puzzle

Equipment and Costs of Battery Storage

July 2021

Presenters Background

Shree Pandey

Sundial Energy

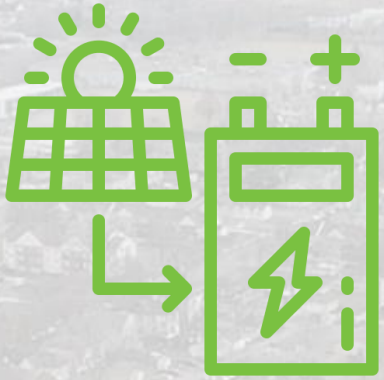
- Master Electrician
- Lead battery system architect
- 6 years in solar design and construction

Nate Broadbridge

Renewable Energy Partners

- Project manager
- Coordinator between utility, design team and facility
- 4 years in solar project management

We’re simulating a neighborhood microgrid



Distributed Energy Generation

Simulation of four properties each with their own energy storage, usage, and/or generation

Microgrid Battery Storage

Each property is designed to utilize their energy storage in a unique way and is programed to prioritize community energy interactions differently

Community Energy Transfer + Sale

The project goes one step further. Each property in the community continuously buys and sells electricity to each other

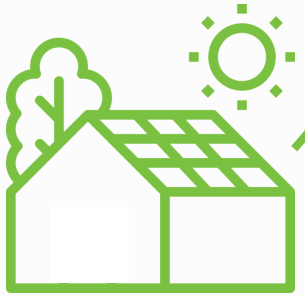
Our project integrates four simulated homes

Property 1

Equipped with one Sonnen Eco10 Battery and one Eco 4

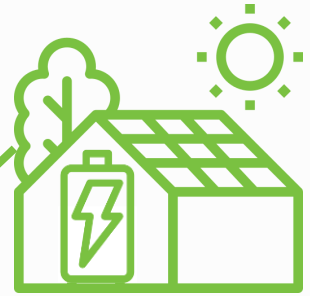
Property 2

Has exclusively solar with no battery



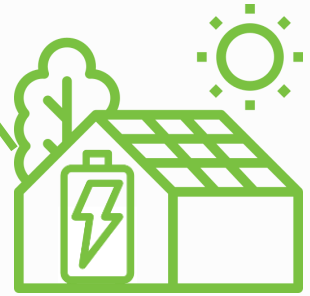
Property 3

Equipped with a Sonnen Eco10 Battery and Solar



Property 4

Equipped with a Sonnen Eco10 Battery and Solar



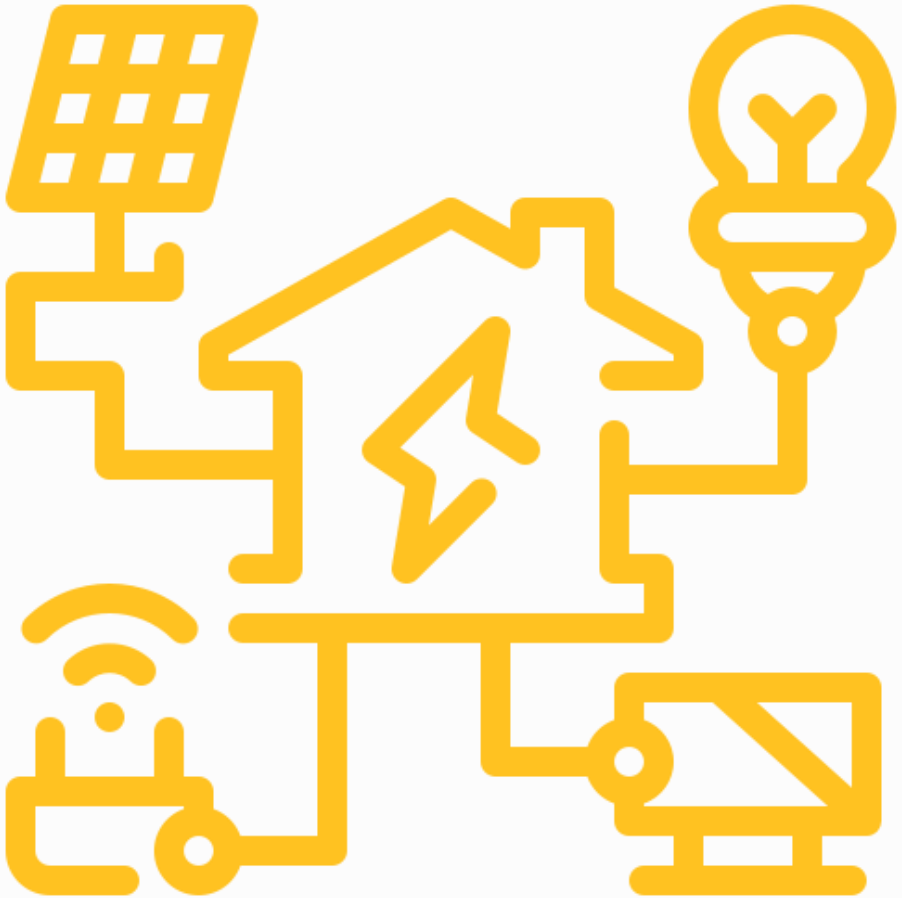
A unique demonstration required planning

In order to understand the project's equipment and costs:

- ☑ **Create a core design team**
  Sundial | REP | Sonnen Batterie | Werner Electric
- ☑ **Fully understand the electrical infrastructure**
  Solar system's inverters | Battery inputs | Building service | Utility requirements
- ☑ **Design, iterate, review, repeat!**
  We developed multiple versions of line diagrams, presented to Xcel, and iterated based on their feedback
- ☑ **Procure materials and plan for construction**
  2020 saw major fluctuations in pricing and lead time on equipment

We started with four primary decisions

Solar Equipment
(Jinko 400 + Enphase IQ7)

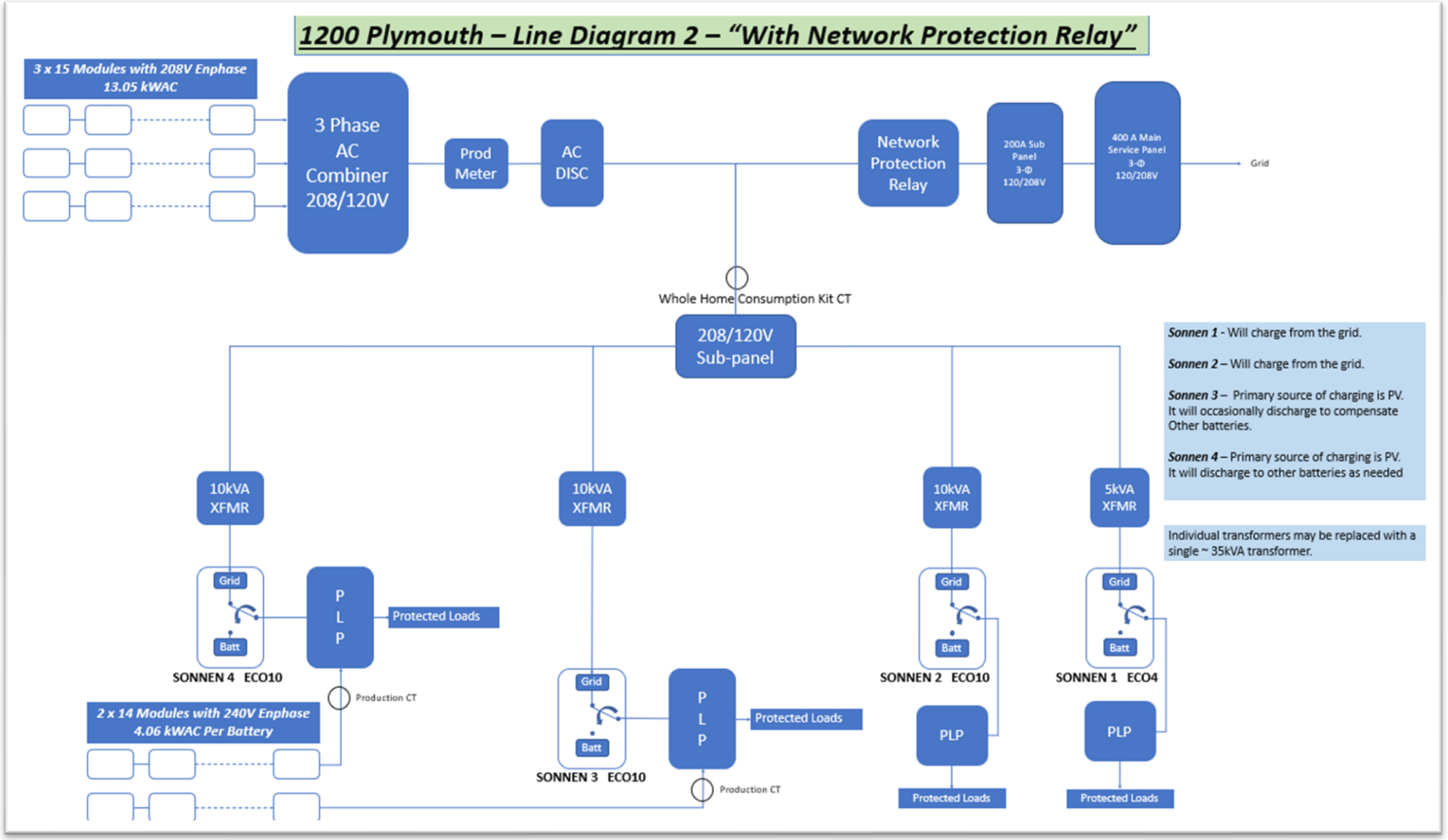


Electrical Purpose
(Critical Loads vs. Peak Shaving)

Monitoring and comms
(eGuage and Enphase)

Battery type and manufacturer
(safety, customizable features, etc.)

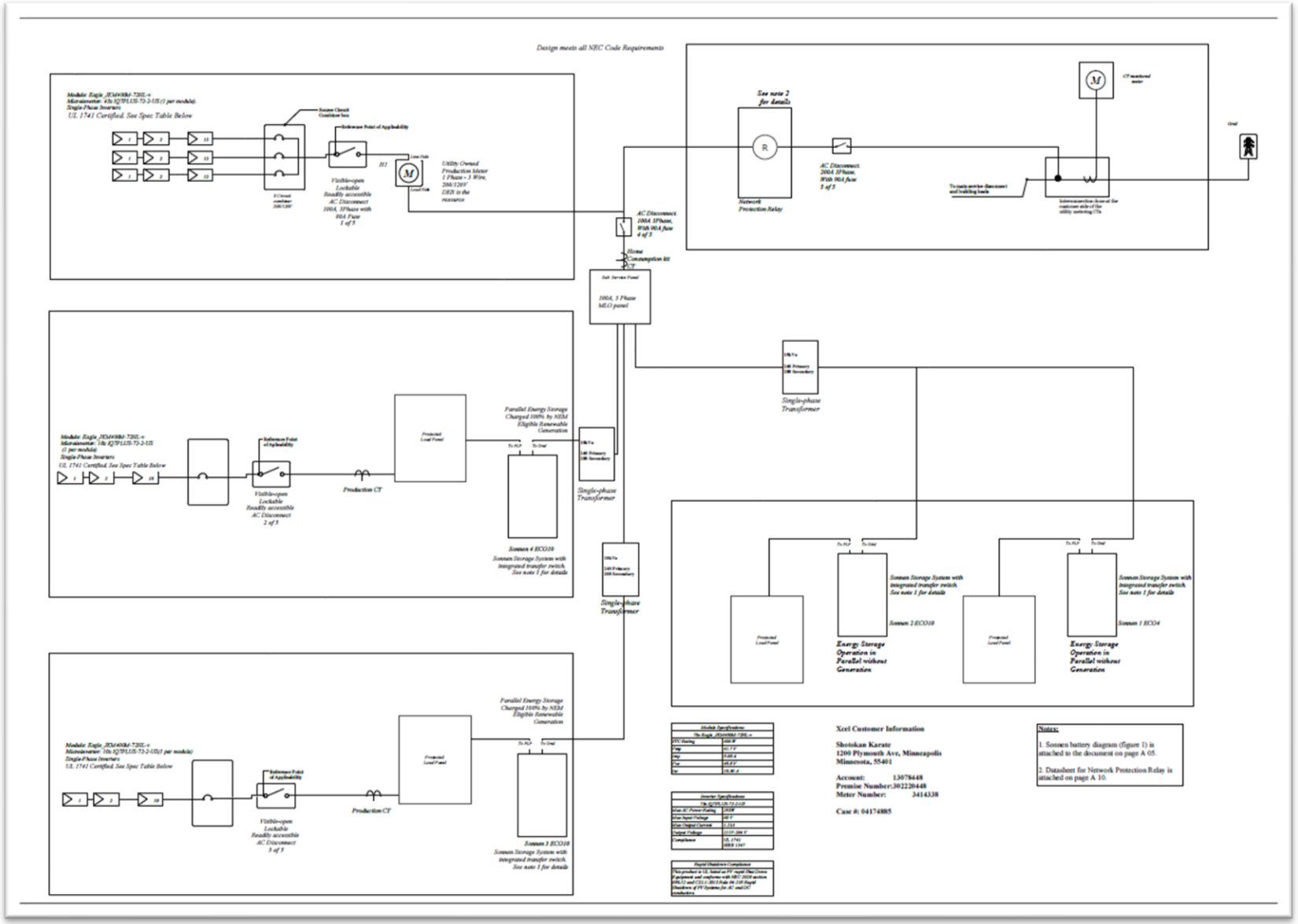
Initial draft took dozens of hours



Key Aspect:

Make sure your design team has a thorough working knowledge of utility requirements and equipment specifications

Final design took dozens more



Key Aspect:

Work with the utility in advance so that your interconnection application is not news to them

Gives utility engineers a chance to advise on the intricacies ahead of time

To implement at home:

The best application would be a condo or a multiplex that has a few units with not much distance between addresses.

A neighborhood block is doable but would require a tremendous amount of conduit and material.

In the end, the equipment list grew a lot

Costly requirements to a community-scale microgrid:

- ❑ Utility metering standards
- ❑ AC Equipment (switchgear and wire)
- ❑ Protected loads panels and rewiring
- ❑ Production CTs and transformers
- ❑ Design and engineering time
- ❑ New sub service panels
- ❑ Network protection relays
- ❑ Batteries themselves

Project Team

INSTITUTE ON THE ENVIRONMENT

Green Infrastructure Research

Sundial Energy

Engineering and Installation

RENEWABLE ENERGY PARTNERS

Host site and PM

Xcel Energy℠

Utility Partner

WERNER ELECTRIC
SOLUTION · SUPPLY · SUPPORT

Design and Equipment Supply

sonnen

Battery Storage Units