



# NorthWestern Energy & City of Bozeman **Bozeman Solar Project**

May 13, 2016



- Background
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- Project Overview
- Techie Stuff

**Background**



## Sustainable Energy Workshop

NorthWestern Energy, City of Bozeman & Solar Electric Power Association

85 stakeholders

\$3 Million investment for renewable energy pilots, with \$1 Million committed to Bozeman





1. Interest and market for solar photovoltaics
2. Declining solar PV prices
3. Challenges and opportunities in grid integration
  1. Grid stability
  2. Load vs. PV production
  3. Fair long term models

*Safe and reliable  
systems and service*



**BOZEMAN**<sup>MT</sup>  
City Sustainability



**SEL** SCHWEITZER  
ENGINEERING  
LABORATORIES  
(in progress)





*Evaluate long-term sustainable models for the integration of renewable energy to the grid*



## Pilot Project Technologies

- 385 KW Solar Array
- Smart Inverter Controls
- Enhanced metering

## Gather Information

- Data
- System testing
- Costs and Benefits

# Project Benefits



- **385 KW Solar Array**
  - 533,000 kWh/yr
  - Enough to power 59 homes based on 750 kWh/month
- **Data, Data, Data**
  - Measure and Analyze and Quantify
  - Benefits of renewable energy on the distribution system.
  - Distribution improvements/added controls needed to maintain safe and reliable circuits.
  - Sustainable models for renewable energy
- **Partnerships**

# High Level Overview



## City of Bozeman Water Reclamation Facility





Operational in Sept. 2016





- 1,150 – Suniva 335 Watt Monocrystalline panels
  - Manufactured in US
  - Technology derived Georgia Tech.
- 14 – 24KW Fronius inverters
  - Smart Inverter enabled





# Who is building the project?

**BOZEMAN** <sup>MT</sup>  
The Most Livable Place

Partnership

**NorthWestern**  
Energy  
*Delivering a Bright Future*

 **ONSITE ENERGY**  
SOLAR ELECTRIC SERVICES

**REDLEAF**   
CONSULTING

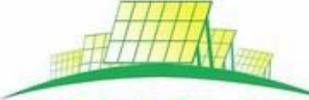
  
**THIRD  
ELEMENT**  
— ESTABLISHED 2012 —  
*By Quality Matters*

Water Rock

Alternative Energy Services   
 **Gardner  
Energy**

  
**ALLIED  
ENGINEERING  
SERVICES, INC.**  
35 FT Solutions that  
Diverse Projects

Meridian Land Survey, Inc.

  
**RBI SOLAR**  
A ROUGH BROTHERS COMPANY

**NorthWestern**  
Energy  
*Delivering a Bright Future*

# **Techie Stuff**

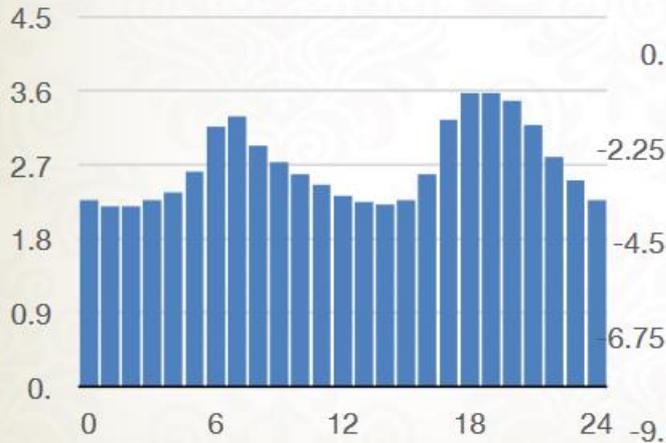
**(A brief overview)**



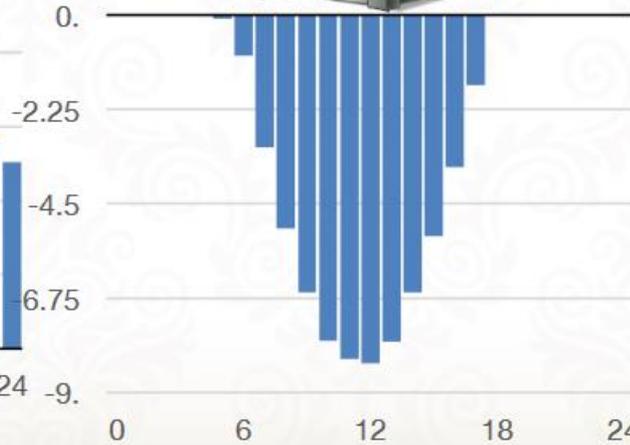
# Solar Generation Profile



Average Daily Profile



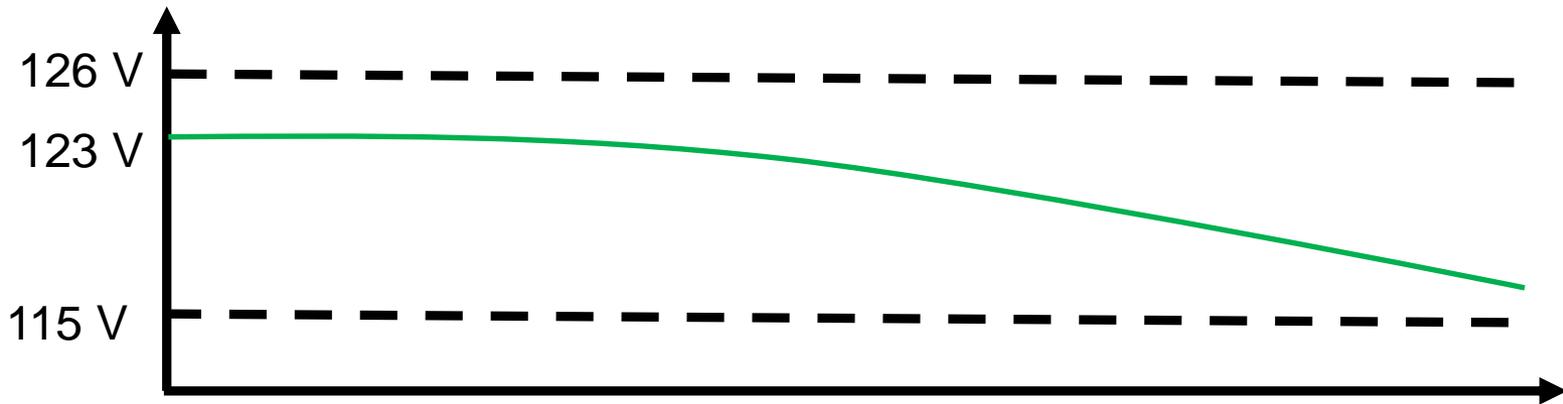
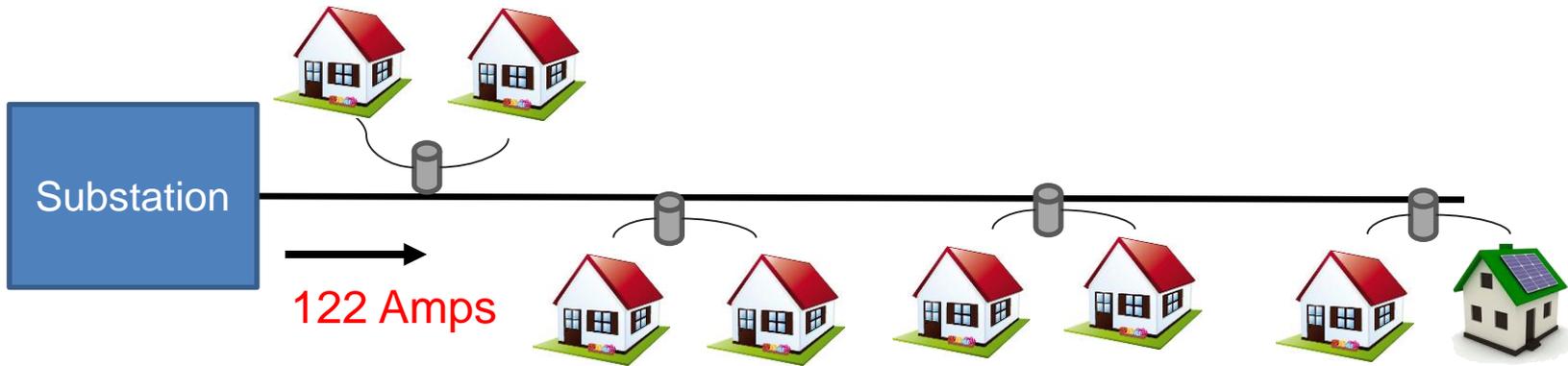
Average Daily Profile



Average Daily Profile



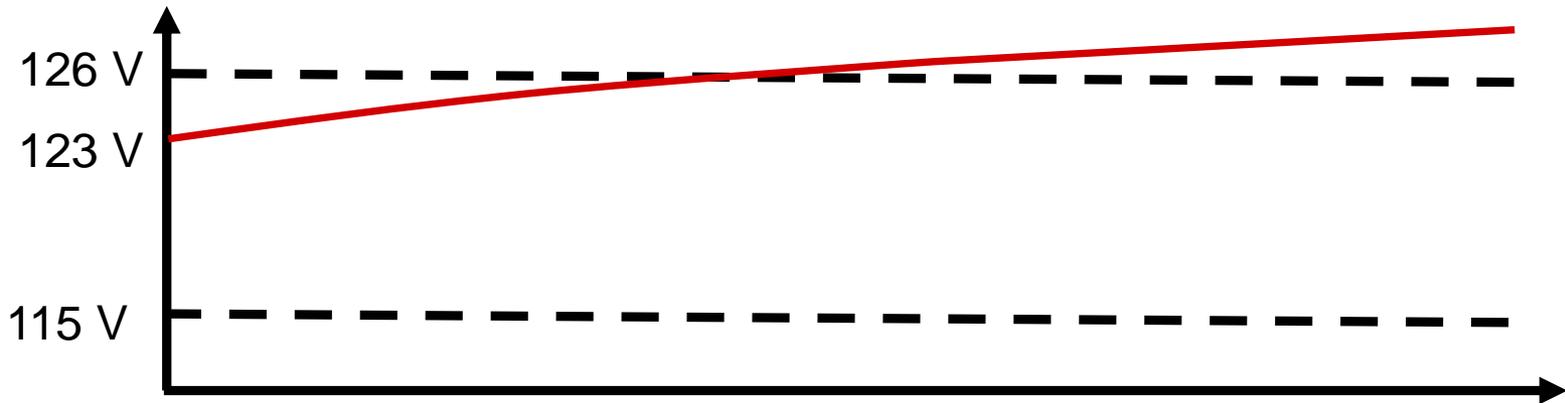
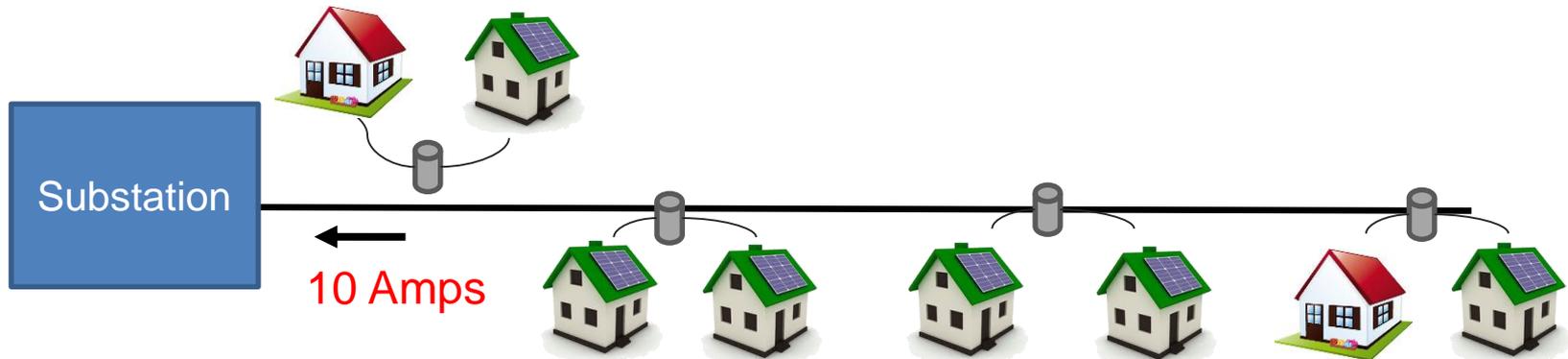
Milsoft  
Users Conference



Voltage drop along a feeder ( $V = I \cdot R$ )



# What happens with too much solar with no system improvements?



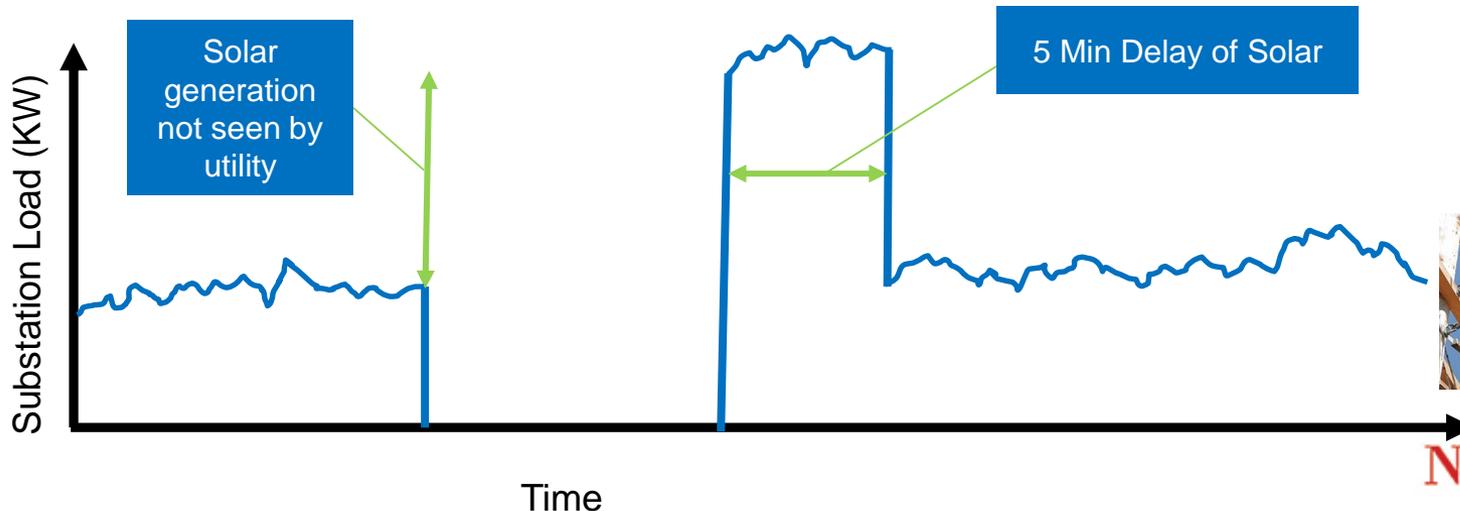
## Voltage Rise Issues

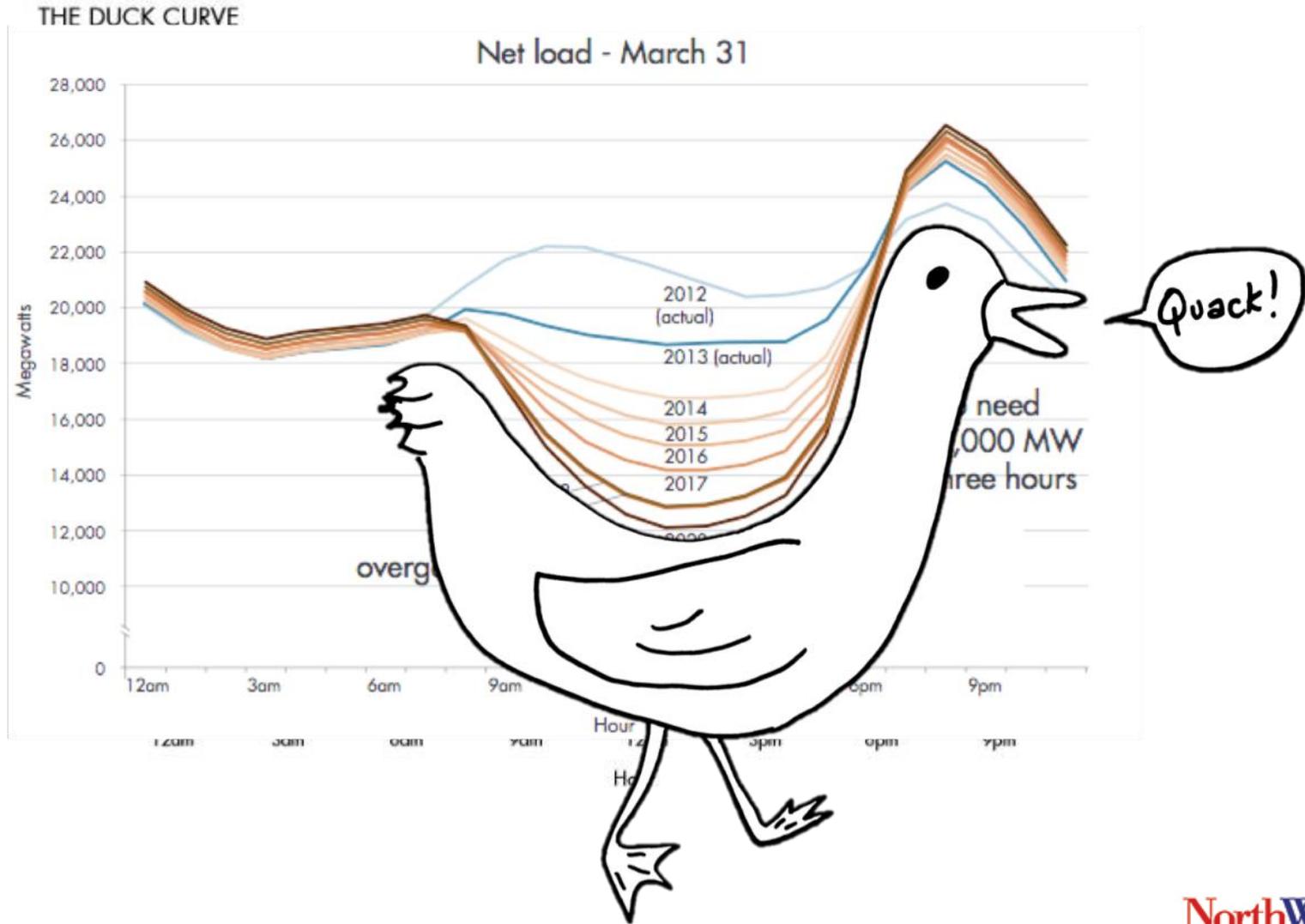
Equipment needs to be set up for reverse power flows. Not all substation controls have this capability. Requires communication and sensors.



## UL1741/IEEE 1547: Grid tied inverters take 5 minutes to sense voltage & frequency before reconnecting to the Utility.

1. What is the current flowing through the substation prior to an outage?
2. What about 30 seconds after an outage?
3. What if we are switching from one substation to another to bring on as many customers as possible (and the other substation is not upgraded with controls)?
  1. How do we keep our utility safe for both our customers and our crews working on them?







# Technology Brief – Energy Storage





- Share data with partners to develop innovative & sustainable models for the long term growth of Solar.



**Questions?**



Delivering a  
**bright future**

NorthWestern<sup>®</sup>  
Energy