

**RENEWABLE ENERGY 101** Sam Dunaiski



### 2020 RENEWABLE ENERGY SUMMIT 2020 VISION: THE PATH TO 100% CLEAN ENERGY

**RENEW** WISCONSIN







### BIOENERGY







### HISTORY

### Oldest Source of Energy

- Now used for Heating, Fuel, and Electricity
- Multiple Benefits













### HOW IT WORKS

- Raw Manure = Fuel Source
- Microbes Digest Manure and Organic Waste
- Biogas: Natural Gas
- Bi-products: Compost & Fertilizer

**RENEW** WISCONSIN





LIQUID STREAM













- Farm Digesters
- Ethanol Plants
- Wastewater Treatment Plants
- Landfill Gas Systems
- Food Waste Systems
- Timber Waste Processing





### GEOTHERMAL









- OLD Technology
- Residential Facilities to Power Plants
- Heating & Cooling Pumps

















- Homes, Schools, Churches, Businesses, other Facilities
- More efficient than heating or cooling surrounding air
- NO Geothermal Power Plants
  Western U.S.









### HYDROPOWER







### HISTORY

- Greek Origins
- 1882: Vulcan Street Plant
  Becomes 1<sup>st</sup> US Power Plant
- 1900s 1970s: Major
  Building Period for
  Hydroelectric Dams





### VULCAN STREET PLANT REPLICA

on November 25, 1882, Central Station Street Hydroelectric Central Street began operation The Vulcan Street began operation and lit the homes of Plant featured a direct-current Edison Plant featured a direct-current Street Nulcan Street Plant furnace, and other mills a blast furnace, and other mearby homes with Edison bulbs. The nearby homes with Edison bulbs. The nearby homes with Edison bulbs the rearby homes with Edison bulbs the street Plant represents an early Vulcan Street Plant represents an early vulcan Street Plant represents an early of hydro=power to generate electricity and perhaps one of the earliest incity and perhaps one of the earliest incity and perhaps one of the earliest of electricity commercially and provided incandescent lighting service to the public. In 1932, to commemorate the 50th anniversary of the original plant opening, this replica was constructed by the Wisconsin-Michigan Power Company. Like the original, it houses an Edison "K" dynamo. In 1987, the building was moved here from (now Olde) South Oneida Street.

> ERECTED 2014 WISCONSIN HISTORICAL SOCIETY CITY OF APPLETON













### HOW IT WORKS



- 105 Facilities
- 546 MWs 241,000 Homes
- Largest Percentage (40%) of Wisconsin Renewables
- 4.1% of Total Electricity Generated in Wisconsin









### SOLAR ENERGY







### HISTORY

- Mirrors and Magnifying Glasses
- 1883: Photovoltaic Effect discovered
- 1954: First commercial use by Bell Labs
- 1970s: NASA, Space Race, Oil Crisis

























### "UTILITY SCALE" SOLAR



















# WIND ENERGY







### HISTORY

- 200BC Simple Windmills
- 1000s Exported to Europe
- 1850 Halladay Windmill
- 1890s First Electric Turbines
- 1980s First Wind Farms







### HOW IT WORKS









### TALLER TURBINES







### **Wisconsin Wind Farms**

March 2019



Source: RENEW Wisconsin • Created with Datawrapper









# **BATTERY STORAGE**







### BATTERY STORAGE

- Materials: Lithium, Cobalt, Nickel, Graphite
- Reused and Recycled
- Backup Power for Homes, Buildings and Electric Grid
- Electric Vehicles









### RENEWABLES ON THE HORIZON

- RENEWABLES in MISO Queue:
- 5,656 MW Solar (130MW today)
- 1,196 MW Wind (737 today)
- 321 MW Battery Storage
- 33% Total Renewable Energy









### MORNING BREAKOUT SESSIONS: 10:45AM – 11:30AM

- Energy Storage Room HI
- Biogas in Wisconsin's Carbon-Free Future Room J
- EVs Driving Renewable Energy Growth –Room KLOP
- Transitioning from Coal Room MNQR





# AFTERNOON BREAKOUT SESSIONS: 1:30PM – 2:15PM

- Energy Storage Room HI
- Biogas in Wisconsin's Carbon-Free Future Room J
- EVs Driving Renewable Energy Growth –Room KLOP
- Transitioning from Coal Room MNQR

