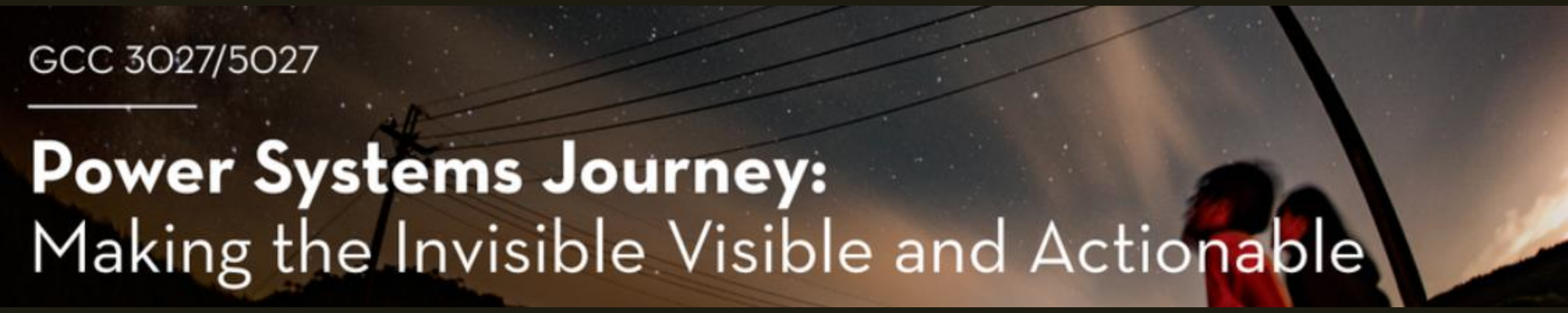


ASES Solar 2019 Conference, Minneapolis, MN
Switch presentation, 8/8/19

Jonee Kulman Brigham & Paul Imbertson
University of Minnesota

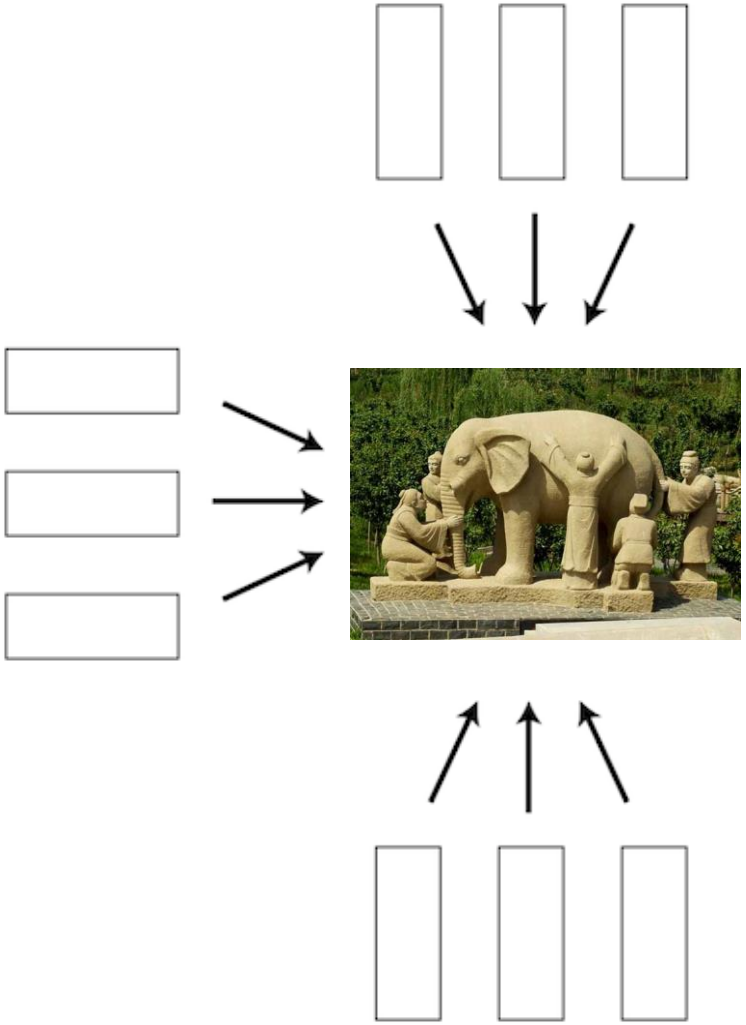
www.powersystemsjourney.net

- Grand Challenge
- Public Understanding is Essential
- Make the Invisible Electric Grid, Visible
- Art + Stories + Science + Engineering + Maps
  >>**Explore Stories** of energy history & of energy future

Frames: “The Grid As…”

Interdisciplinary Course Framework:

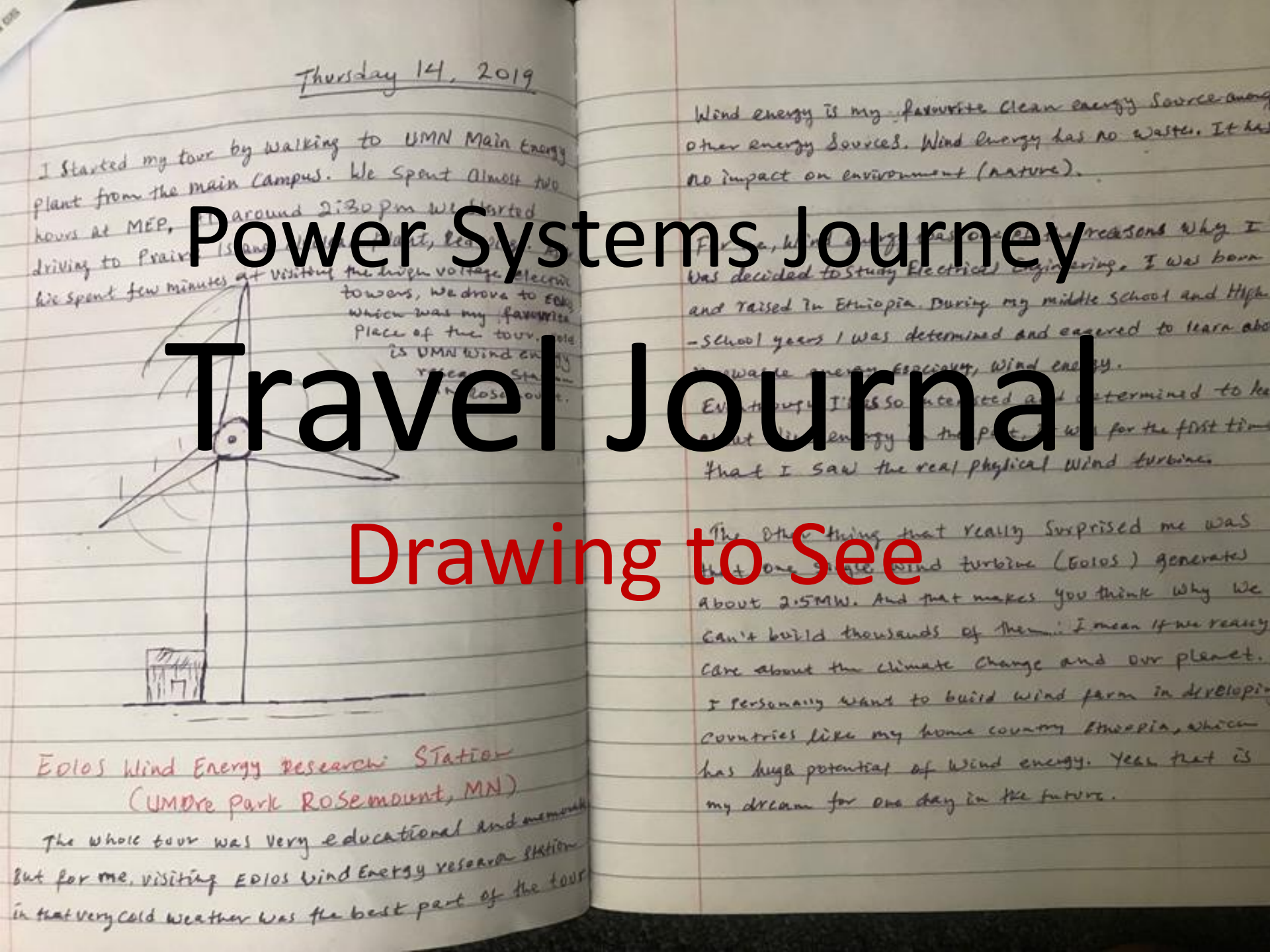
- **Grand Challenges**
- Systems & Systemic change
- Theories of change
- Climate Change
- Energy Transition
- Power Systems Engineering
- Culture/History of Technology
- **Art (Broadly Understood)**
- **Story**
- Geographic Thought
- GIS Story Maps
- Design Thinking
- Environmental Humanities
- Communications Design
- Behavioral Psychology



Power Systems Journey

Travel Journal

Drawing to See



Thursday 14, 2019

I Started my tour by walking to UMN Main Energy plant from the main Campus. We Spent Almost two hours at MEP, around 2:30 pm we started driving to Prairie Island Nuclear Plant, Red Wing. We spent few minutes at visiting the high voltage electric towers, we drove to Eolos which was my favorite place of the tour. Eolos is UMN Wind energy research Station (Rosemount).

Eolos Wind Energy Research Station (UMore Park Rosemount, MN)

The whole tour was very educational and memorable but for me, visiting Eolos Wind Energy research station in that very cold weather was the best part of the tour.

Wind energy is my favourite clean energy source among other energy sources. Wind energy has no wastes. It has no impact on environment (nature).

For me, wind energy has one of the reasons why I decided to study Electrical Engineering. I was born and raised in Ethiopia. During my middle school and High-school years I was determined and eagered to learn about renewable energy especially, wind energy.

Even though I'm so interested and determined to learn about wind energy in the past, it was for the first time that I saw the real physical wind turbines.

The other thing that really surprised me was that one single wind turbine (Eolos) generates about 2.5MW. And that makes you think why we can't build thousands of them. I mean if we really care about the climate change and our planet. I personally want to build wind farm in developing countries like my home country Ethiopia, which has huge potential of wind energy. Yeah that is my dream for one day in the future.

Butterfly Effect

Bell Museum

I was instantly drawn to the Butterflies because of how they glowed in the light. For the period of time that the lights were off the butterflies were not illuminated and therefore blended in with the rest of objects. This showed me the connection between the object and the grid because in that room without the grid the viewer would not get the full experience because of the lack of light.

Taylor Karasch

Endless Power Cave

U of M Power Plant

I noticed that this cave seemed to go on forever with pipes seeming to enter and exit and obscure places. I also noticed that there was grating on the floor which must be for the water when it condense from the steam, but I am not certain. The tunnel also seemed to be very old.

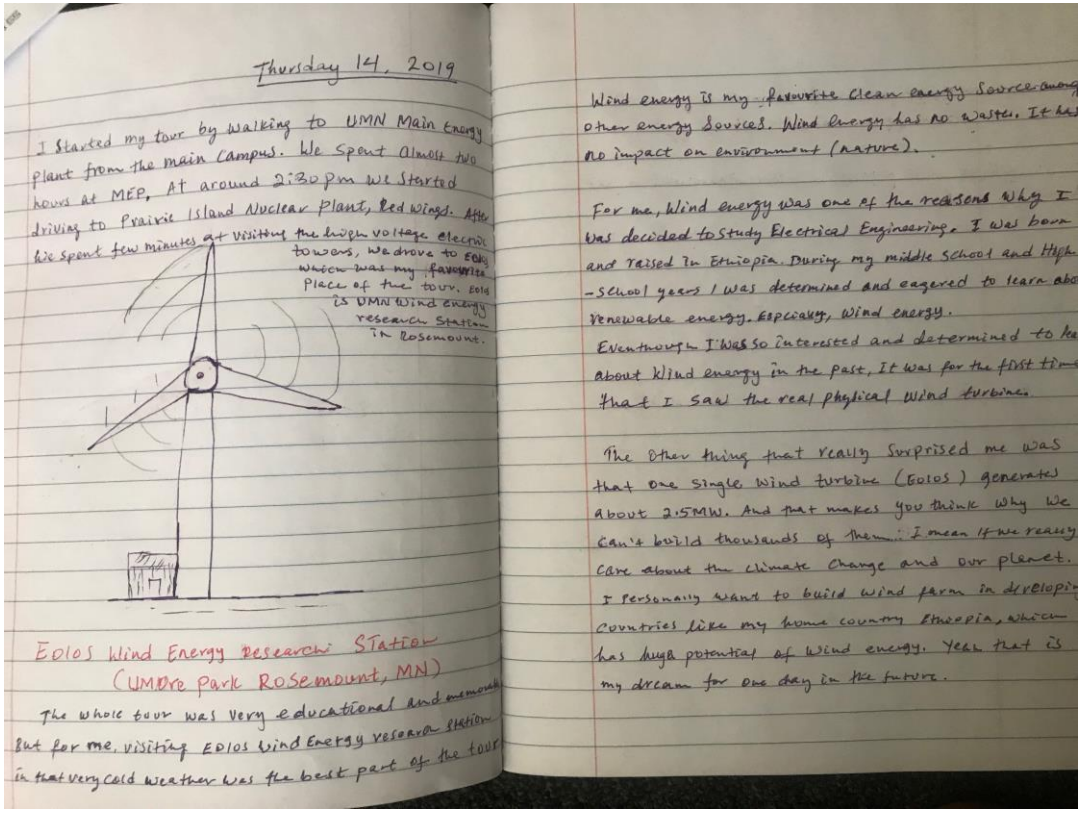
Bryan Chantigian
February 14th, 2019

Eolos Wind Energy Research Station

UMore Park

Wind is the flow from an area of high pressure to an area of low pressure. Wind does exist for the reason that the sun does not heat the earth at the same time. As long as there is a sun that doesn't heat the planet evenly, the wind will blow, and as the wind is blowing, we can always generate electricity from the wind.

Raji Dinka



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Allen S. King Plant

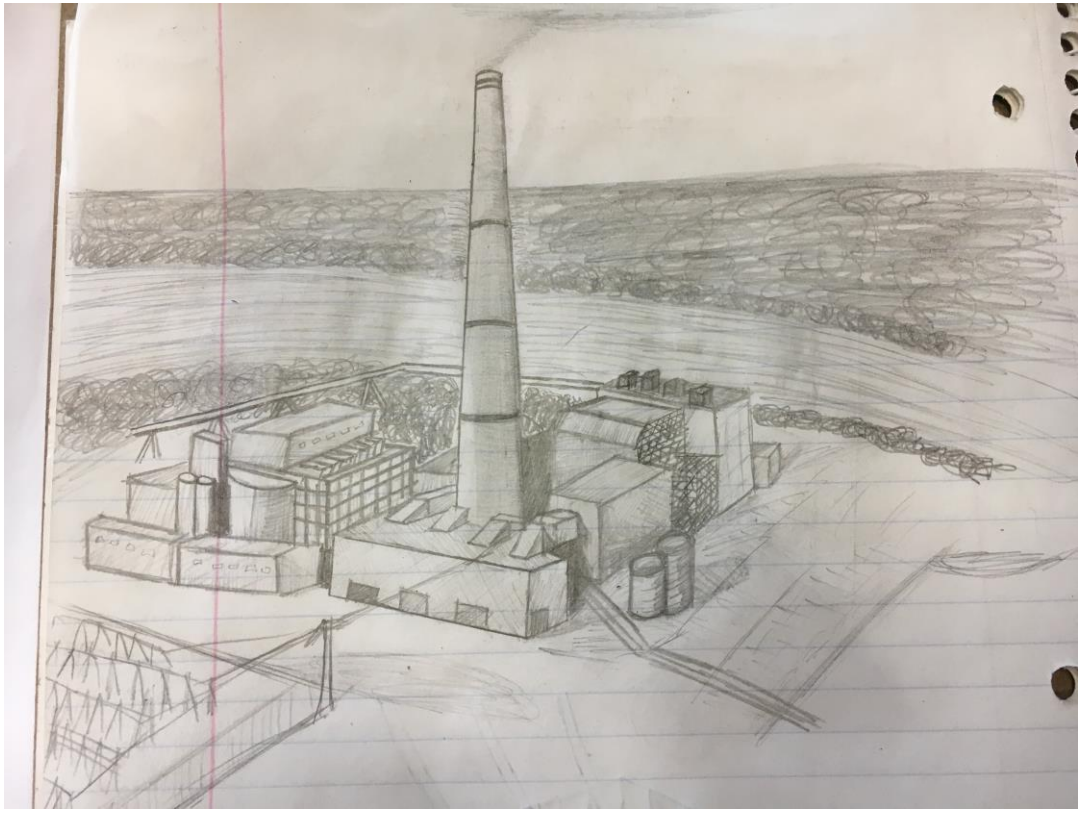
There is a single cooling tower, and the plant is located next to the St. Croix river.

Andre Bombardier

02-28-2019

How does drawing water from the river for steam generation affect the fish and other aquatic animals?

Wonder: What kind of non emission effects the plant has on the environment.



Receiving light

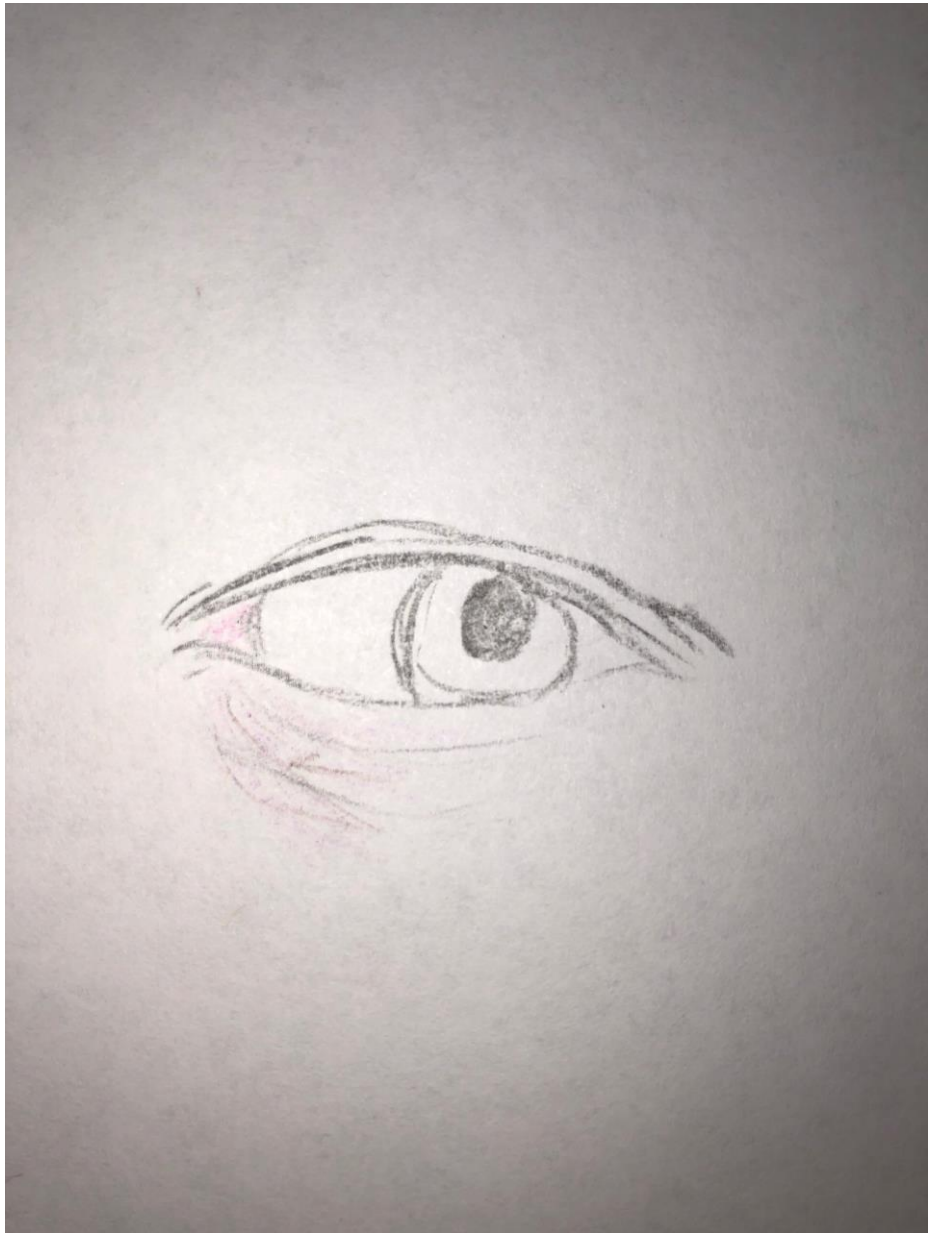
Bell Museum
Nick Schatz
3/7

John's Eye

Bell Museum
Jesse Amdahl
3/7/19

I wonder about the different things each set of eyes sees. I wonder about how every piece of the grid is designed to serve a human purpose.

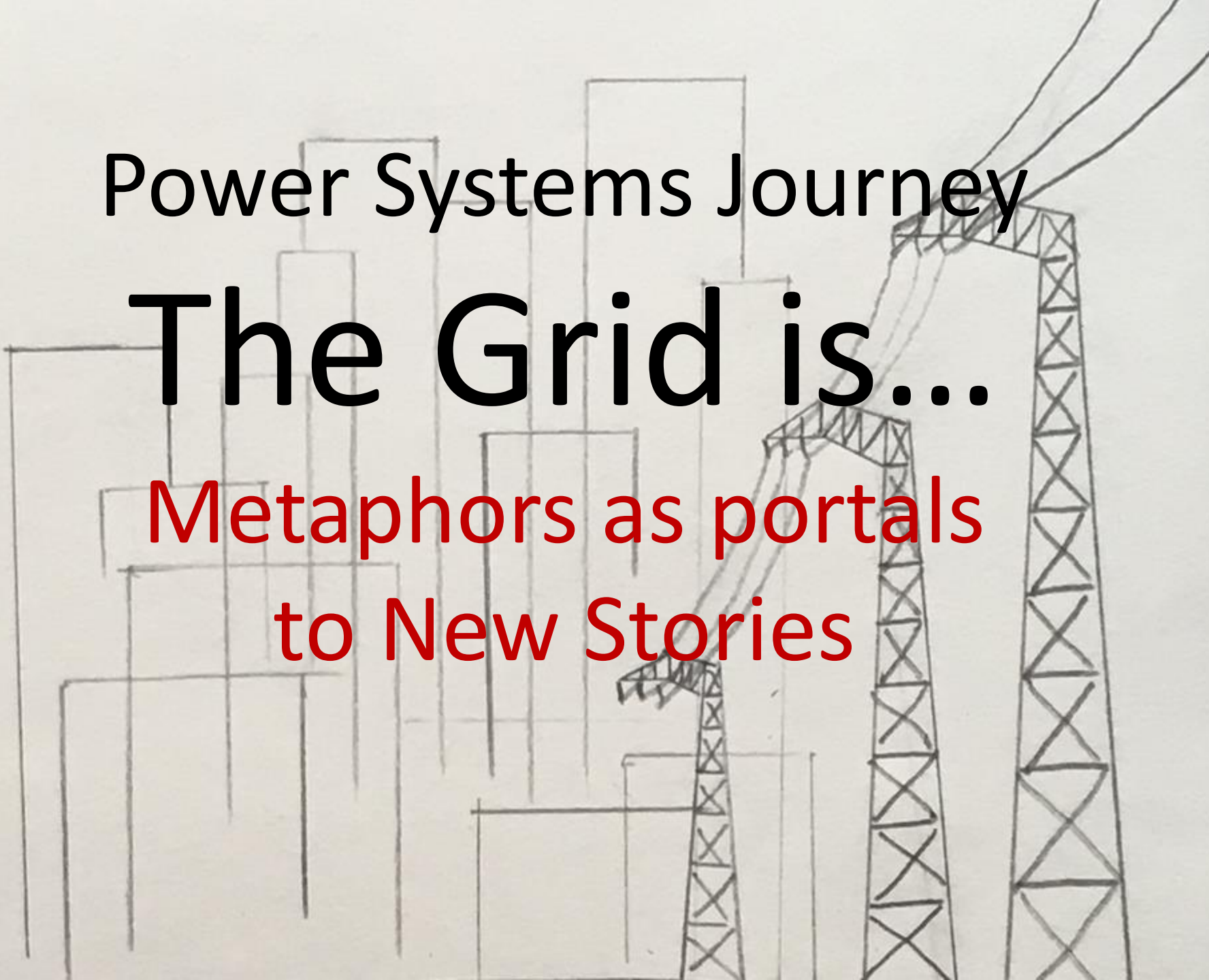
It makes me want to find other areas of the grid that are designed specifically for humans yet go relatively unnoticed by us in our day-to-day lives



Power Systems Journey

The Grid is…

Metaphors as portals to New Stories



Group 12

The grid is like people at the state fair:

They go wherever there's room
They are in continuous, random motion though specified paths.
People are continuously bumping into each other, exchanging energy in collisions
The grid is like trying to find your car at the end of the day at the fair
It's easy to forget where your car is after an entire day of amusement
It is stressful when you have to think about it and remember
You wonder why you drove there in the first place
Some parking lots are better and more efficient than others
Some parking lots are public and some are privately owned and regulated
Parking spaces can be limited when the fair is busy
If not enough people come to the fair, then money was wasted on parking
It's not strictly in the power line. People swarm along the paths.

Group 4:

The grid is cotton candy

Starts in a raw state then processed to consume
Created from seemingly nothing
Heat and rotation transforms it into a concentrated form
Distributed to people in many different locations
Energizes us
Takes many different forms
Water renders it useless
Spun together and connected through human action
Culture establishes value
Many different distributors
SHOCKINGLY delicious, yet fragile
Makes money ($)

Group 15

The Grid as a Spider Web

Wires and distribution lines are the web.
Building are the spiders feeding on the electricity.
Power plants are the flies and insects in the web that the spiders feed on.
Humans are the microbes living within the spider using the energy within it.
Power poles are like the trees that the webs hang off of.

Group 3B:

The grid is a pond in a rainstorm

Ripples from every drop
Bouncing into each other

As water pours in
Water drains out
Unable to return to the sky from which it fell

The grid is Homeostasis
There's a give and take

The grid is a solar system.

The grid is a computer
Full of disparate parts

The grid is a brain
Complete with connections

Many dominoes lined up,

cardiovascular system

$$P_k = \sum_{j=1}^{N} |V_k| \left|V_j\right| (G_{jk} cos(\theta_k - \theta_j) + B_{jk} sin(\theta_k - \theta_j))$$

$$Q_k = \sum_{j=1}^{N} |V_k| \left|V_j\right| (G_{jk} sin(\theta_k - \theta_j) - B_{jk} cos(\theta_k - \theta_j))$$

The ***Future*** is….

~~Energy Storage~~

…Energy Stories

Invitation (Assignment)

PLAY!

Start Sketching

The Invisible Energy around you
& the Renewable Future

Start a Story

Find a metaphor and Fill in the Blank:

"Renewables are..."

Eg. "Renewables are … a race against time"

"Renewables are… a race we won!"

SHARE!

Tweet sketches and micro stories with #powersystemsjourney

Jonee Kulman Brigham, kulma002@umn.edu

Paul Imbertson, imberts@umn.edu

University of Minnesota

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