Tue 8/25

What is the power system problem?

Why is the problem hard?

Example: Edison 1882 NYC Pearl St Station 50 customers.

Disconnected for large currents

A fault in the street lights can take out the generator and hence the entire system.

THINGS WE DON'T LIKE:

No protection for individual loads.
No generator protection
DC generator too complicated.

No protection for individual loads / Reliability Anything breaks, we lose power
No generator protection / Efficiency DC systems are low-voltage hence not so efficient.

Losses on the lines
We are worried about reliability...

**Idea: Interconnection!**

Every new line we add dramatically improves reliability.

In an electric grid:

\[ \text{Reliability} = \text{\$\$\$\$} \]

Gen 1 \( (\text{+}) \) \( \rightarrow \) \( 110V \) \( \rightarrow \) \( 100V \) \( \rightarrow \)

Gen 2 \( (\text{+}) \) \( \rightarrow \) \( 1A \) \( \rightarrow \) \( 15Ω \) \( \rightarrow \) \( 111V \)? \( \leftrightarrow \) \( 109V ? \)

Interconnection improves reliability but introduces the issue of coordination.

What is the voltage needed to drive 1A from Gen 2 to Gen 1?

If we're not careful the generators can easily destroy each other. (Not an issue w/o interconnection)

DC system: Coordination is tractable.

Ohm's law, resistor grid, **LINEAR.**
AC system is much more efficient. (For reasons we will soon see)

AC waveforms have an issue of phase

Not so obvious

AC system: Coordination is intractable (formally)

Problem is \textbf{NON LINEAR}.

\textbf{Summary:}

What is the power system problem?

Efficiency + Reliability.

Why is the problem hard?

Interconnection + AC physics.

The need for coordination + nonlinearity.