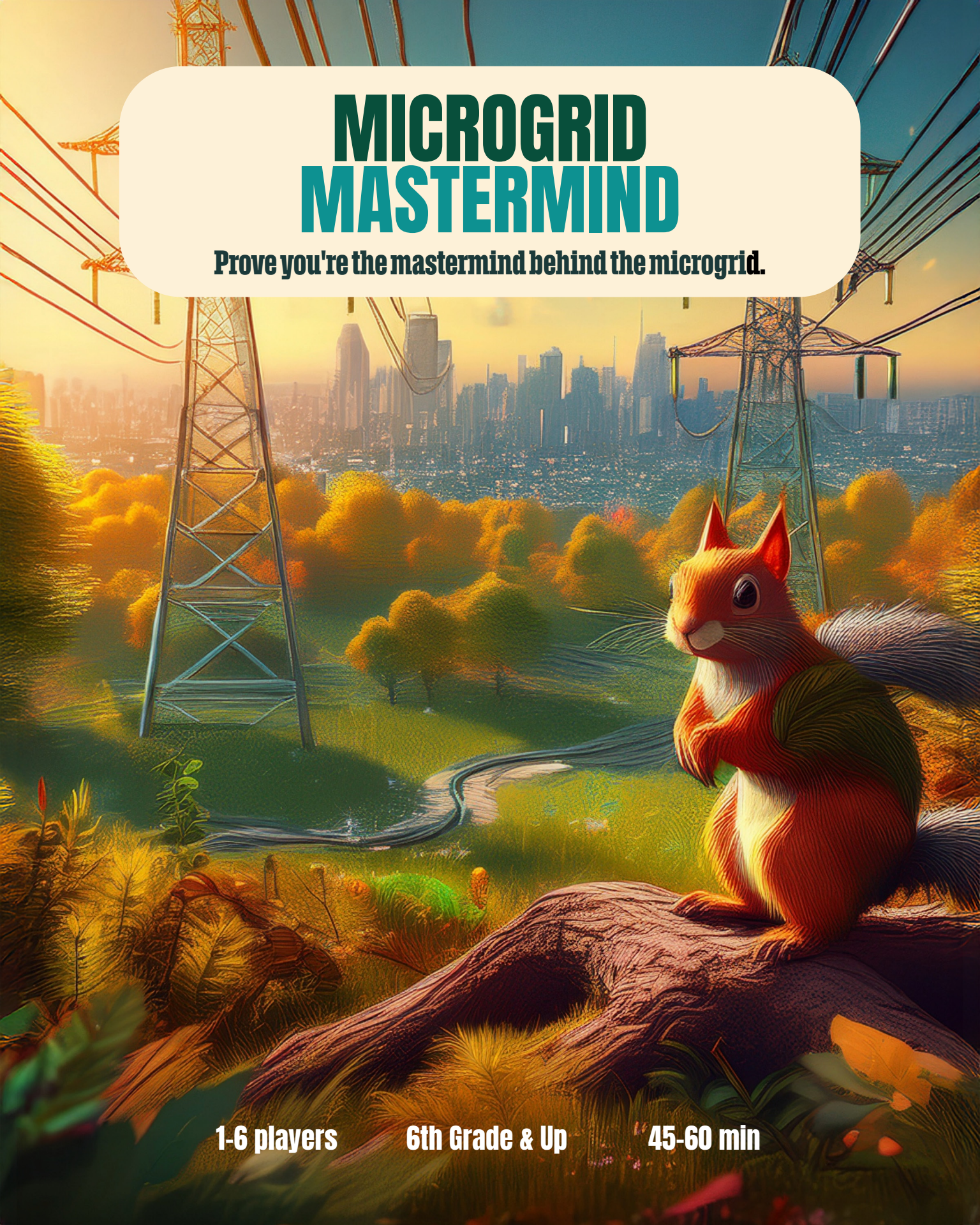

MICROGRID
MASTERMIND
Prove you're the mastermind behind the microgrid.
1-6 players
6th Grade & Up
45-60 min

The Grid Keepers

Energy systems across the U.S. are reaching a critical breaking point. Outdated infrastructure, increasing load, and growing threats from extreme weather are causing frequent blackouts, pushing communities to the edge. Amid the chaos, one brilliant systems engineer and community advocate emerged: Dr. Elia Voss, known to many as **The Grid Master**.

Dr. Voss believes power should be **smart, strong, and fair**. She designed the **Microgrid Mastermind Model**, a revolutionary energy system that combines **clean energy sources like hydro, solar, and wind** with **on demand resources like coal, natural gas, and nuclear**.

Her system can work. But it needs one thing to succeed, a smart, fast-thinking team, to run it.

That's where you come in:

You are the **Grid Keepers**, a team trained to keep the power on, no matter what. Each of you holds a real-world energy job (just with cooler titles):

 Chief Operations Officer – Oversees the growth of the grid and sees the big picture.

 Load Legend – Tracks and predicts how much power the city needs.

 Volt Architect – Builds and repairs all kinds of power plants.

 Line Specialist – Makes sure the grid is connected, and tackles infrastructure repairs.

 Dispatch Officer – Handles surprise events like storms or squirrel attacks.

 Energy Resource Manager – Manages fuel, and system upgrades.

Each round, you'll take actions like placing a plant or buying fuel and use your role's special ability throughout the game to keep the grid running smoothly.

But watch out for blackouts that will push the blackout meter higher.

If the meter tops out, before the 6th round is finished... Game Over!

No power. No celebration. **YOU LOSE** ❌💡❌🎉❌

If you get through the 6th round without topping out the blackout meter, your grid avoids a complete shutdown, and **YOU WIN**. 🎉

So... gather your team, spin the spinner, and brace for squirrel sabotage, **to prove you're the Mastermind behind the Microgrid**!

How it Works

Goal of the Game

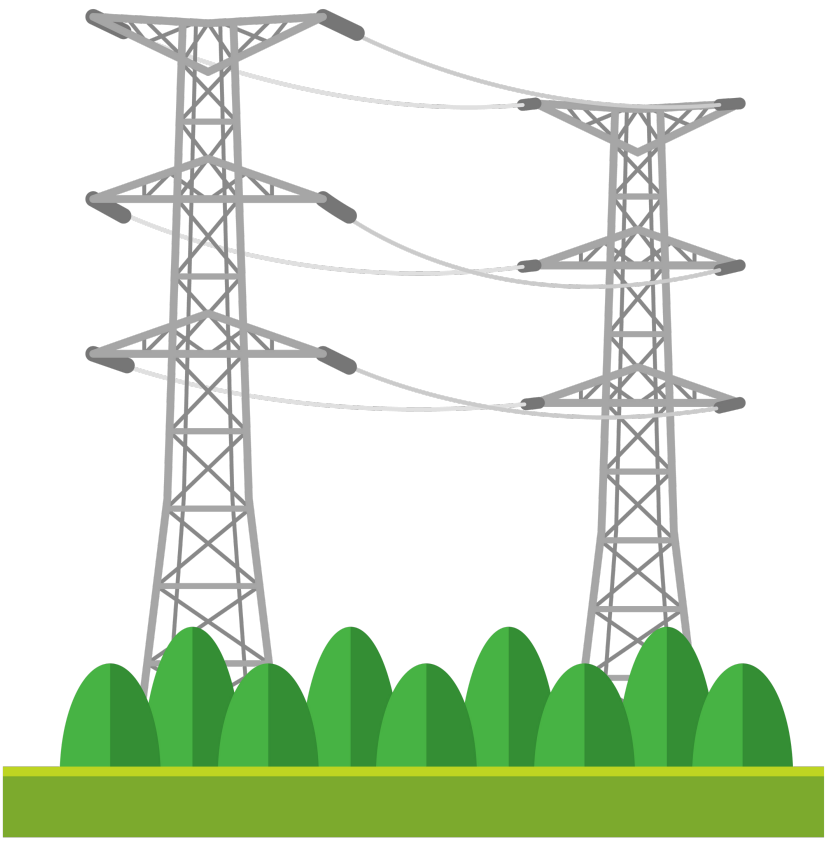
- Prove you are the mastermind behind your microgrid!
- Have fewer than 10 blackouts by the end of Round 6, and avoid a grid SHUTDOWN

Game Overview

- Up to 6 people per grid
- A full game = 6 Rounds
- This is a cooperative game - either everyone wins or everyone loses
- Blackouts => tick in the meter => At 10 ticks, game over, you lose!

Game Play

- Load Phase
- Predicted Phase
- Building/Action Phase
  - Each player has a choice between 6 actions to perform during their turn
    - Get a power plant
    - Place a nature tile
    - Purchase fuel
    - Get a transmission line
    - Get a distribution line
    - Get a substation
- Event Phase
- Exchange fuel
- Actual Phase
- Fufill Load



Player Roles

Each player chooses a role card at random, at the start of the game.

Note: If playing with fewer than 6 players, only use the same number of roles as there are players (e.g., five players = five role cards drawn).

Chief Operations Officer

Special Power (once per game)
Look through all nature tiles and choose one tile to place. Shuffle after choosing.
Other Power (once per round, For an Action)
Draw the top 3 nature tiles and choose one to place. Shuffle after choosing.

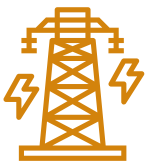
Load Legend

Special Power (once per game)
Prevent up to 3 blackout stacks
Other Power (once per round, For an Action)
Add 1 generation stack to a renewable plant, up to capacity

Volt Architect

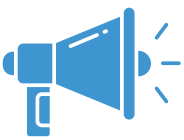
Special Power (once per game)
Place a power plant for one less action than required.
OR
Replace a coal plant with a natural gas plant, & gain an extra action next round.
Other Power (once per round, For an Action)
Repair a power plant that was destroyed in the previous round.

Line Specialist



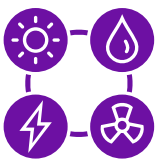
Special Power (once per game)
Prevent damage/destruction of up to 3 pieces of infrastructure(*transmission/distribution line, or substation*).
Other Power (once per round, For an Action)
Bury a transmission line to protect it.

Dispatch Officer



Special Power (once per game)
Look at the top 6 event cards, remove 1 permanently. Place the rest back on top of the deck in any order.
Other Power (once per round, For an Action)
Draw 5 event cards, choose 3 and place the others back on top of the deck.

Energy Resource Manager



Special Power (once per game)
Exchange coal & natural gas fuel at a doubled rate (*1 fuel = 2 generation stacks*)
Other Power (once per round, For an Action)
Increase generation capacity of a non-renewable plant by +1 for the round.

Setup & Play

Choose Your Difficulty

Difficulty	Starting Loads	Blackout Cards	Meter Start
Easy	2	1	1
Medium	3	3	2
Hard	4	6	3

- Shuffle in the number of blackout cards, set by your level of difficulty, into the event card deck

Set up: Starting Grid

Each grid will start with the following (consult as a team as to where components are to be placed):

- 1 city tile
- 3 Nature Tiles (*only one must be placed adjacent to the city tile, but all must touch*)
  - Waterfall Mountain
  - Forever Forest
  - Elkhorn Plains
- Loads (according to chosen difficulty)
  - spin for a number to place your loads in your city tile
    - *numbers (1-9) correspond to each hole in the city tile where you place your load plugs.*
- 3 Distribution Lines (blue)
- 2 Substations
- 2 Power plants
  - Either a wind or solar
  - Coal power plant
- 3 Transmission Lines (orange)
- 1 Squirrel
  - *place all on Forever Forest tile*

If not all lines/substations are needed to connect your grid, place them in your inventory to place later in the game.

Infrastructure Placement Tips

Substations:
- go on corners of city tile

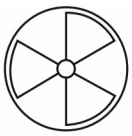
Distribution Lines:
- all load plugs need to be connected to a substation using distribution lines

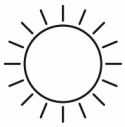
Transmission lines:
- connect power plants to substations, or power plants to power plants

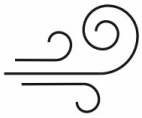
Components

Power Plant Icons

Nature Tiles are equipped with icons show what power plants can be placed on a specific type of tile.


NUCLEAR

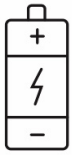

SOLAR


WIND


HYDRO


NATURAL GAS


COAL

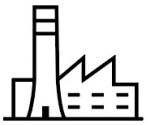

BATTERY STORAGE

City Tile Regions

The city tile is split into 4 regions.


RESIDENTIAL


MARKET


INDUSTRIAL


DOWNTOWN

How the Grid Works

Your grid is similar to the electrical grid in real life. Here are some of the basics.

GENERATION STACK:
These green stackers, are representative of the energy output of your power plants.

LOADS:
Think of loads as light bulbs. Light bulbs use energy and that energy has to be provided some how.

LOAD STACK:
These red stackers, are representative of the energy that your loads are using, and must be fufilled by the generation from your power plants.

To match/fufill your loads, you will pair up your green Generation stacks with your red Load stacks at the end of each round, through the grid you have built.

Power plants > transmission lines > substations > distribution lines > loads

Any unpaired (unfulfilled) red Load stacks are representative of blackouts.

Components Continued

Bury A Line (Line Specialist)

The Line Specialist has the ability to bury a transmission line, for an action, once per round.

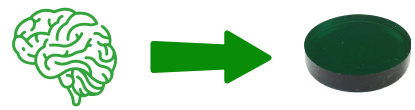
A buried line is identified by the bury marker being placed over the line.

Buried lines are not damaged or destroyed by most (**but not all**) events.

Power Tokens

Each player will receive a power token corresponding to their chosen role.
- *power tokens are color coordinated with the colors of the role cards*.

These tokens are used to keep track of when players decided to use their role's Special Power.

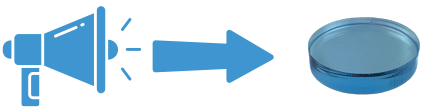


Chief Operations Officer

Load Legend

Volt Architect

Line Specialist



Dispatch Officer

Energy Resource Manager


PLOVER PRAIRIE
WATERFALL MOUNTAIN
Event Card
ACTUAL CARD
PREDICTED CARD
Dispatch Officer
Once per game
Look at the top 6 event
1
5

Lets Play!

Player Order

The player who can do the best squirrel impression goes first.
The player to their left (clockwise) starts the next round. Continue rotating clockwise each round.

Round 1

Predicted Phase

Draw a Predicted Card.

- Place Green Generation Stacks on the corresponding power plants as listed on the card
- Place Red Load Stacks on the corresponding load plugs in your city according to the number in the position of your load on the card

Building Phase

Each player will take one action to equal 6 actions total.

- If playing with less than 6 players the person that started the round will continue the actions until all 6 actions are used.

This phase is when you can buy, store and place infrastructure (i.e. power plants, transmission/distribution lines, and substations)

Players can find the actions they can choose to take on the back of their role card.

Building Phase Guidelines

Power Plant	# Of Actions Required To Build
Nuclear	4 actions
Battery Storage	3 actions
Coal, Natural Gas & Hydro	2 actions
Solar & Wind	1 action
Building Limitations	**Limitations**
Nature Tiles	1 per round
Power Plants	1 per round
Power Plants Per Tile	2 per tile
Fuel	**Amount of Fuel per Action**
Coal & Natural Gas Fuel	3 per action
Nuclear Fuel	1 per action

Event Phase

Take 3 event cards from the deck
The person that started the round will pull the 3 event cards
- Read aloud for your team
- Carry out the effects of your card(s)
- The only infrastructure that can be FIXED during the event phase are distribution lines

mechanics of specific event cards are listed under "Mechanics" section

Exchange Fuel for Energy

- Consult as a team to decide how much fuel to convert into energy for your power plants.
- Keep in mind how many loads you need to fulfill and how much energy you're generating
  - *This may change after the actual phase.*

Exchange fuel tokens for green generation stacks and place them on the corresponding power plants:
Coal and Natural Gas: 1 fuel token = 1 generation stack
Nuclear: 1 fuel token = 5 generation stack

Actual Phase

Draw an Actual Card.
- Add or take away generation stacks (green) from the corresponding plants as listed on the card
- Add or take away load stacks (red) from the corresponding loads as listed on the card

Fulfillment Phase

- Fulfill your loads by matching green generation stacks to red load stacks through your grid:
  - **Power Plant → Transmission Line → Substation → Distribution → Load**
- Any unfulfilled load stacks = blackouts!
- Adjust the blackout meter according to the number of blackouts (*see back of meter*)
- Excess green generation stacks are lost, UNLESS your grid has a battery with enough available storage.

Blackout Meter

# Of Blackouts	# Of Levels
1 -3	+ 1 level
4 - 8	+ 2 levels
9 - 14	+ 3 levels
15 +	+ 4 levels

Round 2-5

Load Phase

At the beginning of each round, spin for a number (1-9).

- Each number (1-9) corresponds to the holes in the city tile to place your load plugs.
  - *If you spin a number where a load is already placed, spin again till you get an open spot*

Predicted Phase
Building Phase
Event Phase
Exchange Phase
Actual Phase
Fulfillment Phase

same as in round 1

Round 6

This round will "TEST" your grid of its resiliency!

Load Phase

Follow phase procedure as done in rounds 2-5

Predicted Phase
Building Phase

same as in rounds 2-5

Event Phase

Each player takes 1 event card, for a total of 6 cards.
If there are fewer than 6 players, still draw a total of 6 cards.
Read your card aloud to your team and carry out its effects.
Details for specific cards can be found in the "Mechanics" section.

Exchange Phase
Actual Phase
Fulfillment Phase

same as in rounds 2-5

If at the end of Round 6 you haven't reached LEVEL 10 on the Blackout Meter, CONGRATULATIONS, you've WON the game!

Game Mechanics

Event Card Mechanics

Squirrel Incident

Some event cards ask you to use the spinner to identify the destruction path of the squirrel;

1. **Spin for a number** (1-9) to determine how many tiles it moves through
2. Players will **take turns moving** the squirrel
    i. Squirrel can only move forward and left or right, **it can't move backwards.**
    ii. If the squirrel hits a dead end before it uses all its moves - its path stops there.
3. Reference your card to determine what component(s) are destroyed by the squirrel

If another squirrel card is drawn, the squirrel starts where it previously ended, unless otherwise stated on the card.

Rural Load Expansions

Rural load tiles can be put into play one of 2 ways:

1. Drawn through the nature tile stack
2. An effect of an event card

When a rural load tile is drawn:
Consult with your team where to best place the Rural Load Tile.

- This tile can be placed anywhere, except bordering the city tile, it already has a built in substation

- These tiles MUST have a distribution line in order to fulfill its load
    - If it's load isn't fulfilled = blackout

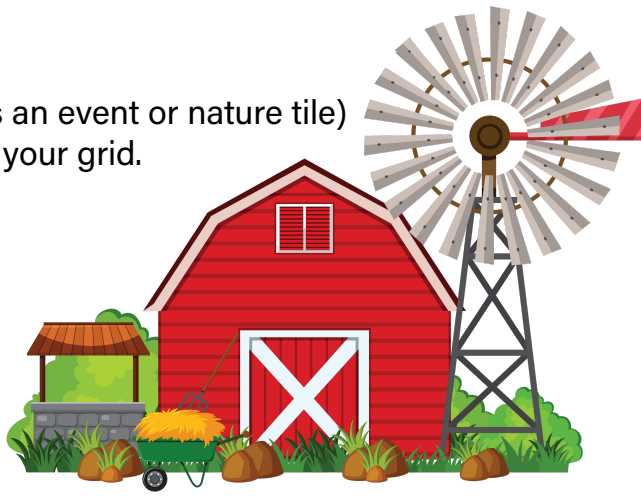
Rural Loads **MUST be fulfilled** each round following the activation of this card.

There are 4 total Rural Loads, each with a corresponding load to be fulfilled:

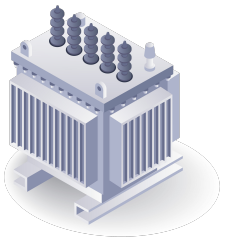
- Farm = 1 load stack / round
- County Fair = 2 load stacks / round
- Suburb = 3 load stacks / round
- Crypto Mining Center = 5 load stacks / round

<u>If another Rural Load Expansion is drawn</u>, (either as an event or nature tile)

- Repeat steps above for each rural load you have in your grid.



How to "Spin the Spinner"



Identify Substation

To identify a substation, you only have to **spin the spinner once**

- Spin and use the second most outer ring to determine in **which corner of the city** tile the affected substation is located.
  - NE, SE, SW, or NW corner

Some cards ask you to keep spinning till you identify a working substation, while others only ask to identify a set number of possible locations of a substation.

- If you don't have any substation is those locations after spinning the set number of times, that card has no effect

Identify a Transmission Line(s)

To identify a transmission line, you will have to spin a total of 2 times.

- First spin - **identify a nature tile** (inner most ring)
- Second spin - **identify the side** of the previously identified nature tile, where a transmission line can be located.
  - N, E, S, or W side (outer most ring)

Some cards ask you to keep spinning till you identify a servicing transmission line, while others only ask to identify a set number of possible locations of transmission lines.

- If you are asked to identify 2 transmission lines, you will **spin a total of 4 times**.
- If you don't have transmission lines in the identified locations after the set number of spins, that card has no effect on your infrastructure.

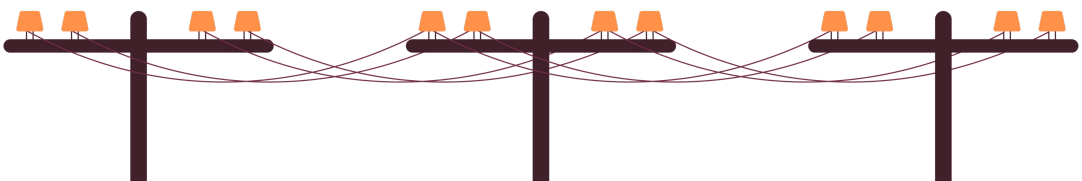
Identify a Distribution Line(s)

To identify a transmission line, you will have to spin a total of 2 times.

- First spin - identify a **region of the city** (third ring; *residential, market, industrial, downtown*)
- Second spin - **identify the side** of the previously identified city region, where a distribution line could be located.
  - N, E, S, or W side (outer most ring)

Some cards ask you to keep spinning till you identify a servicing distribution line, while others only ask to identify a set number of possible locations of distribution lines.

- If you are asked to identify 2 distribution lines, you will **spin a total of 4 times.**
- If you don't have distribution lines in the identified locations after the set number of spins, that card has no effect on your infrastructure.



How to "Spin the Spinner" Cont.

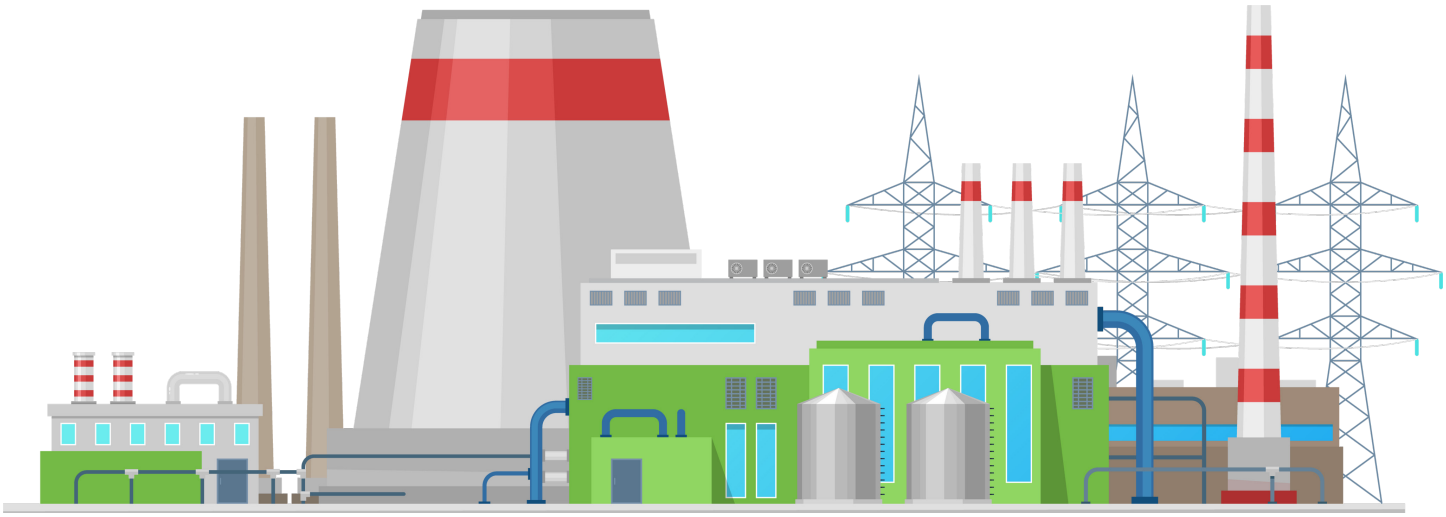
Identify a Power Plant(s)

To identify a power plant, you will have to spin a total of 2 times.

- First spin - **identify a nature tile** (inner most ring)
  - *If the nature tile is already identified ignore this first spin*
- Second spin - **identify a corner** of the previously identified nature tile, where a power plant can be located.
  - NE, SE, SW, or NW side (second outer most ring)

Some cards ask you to keep spinning till you identify an operating power plant, while others only ask to identify a set number of possible locations of power plants.

- If you are asked to identify 2 power plants, you will **spin a total of 4 times**.
- If you don't have power plants in the identified locations after the set number of spins, that card has no effect on your infrastructure.



Goals

Green Powerhouse

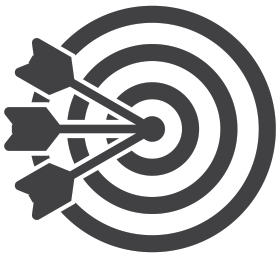
End the game with **only renewable power plants (solar, wind, hydro) generating power** in round 6.

A Balanced Grid

Build and Fuel at least **one plant of each fuel type (coal, natural gas, and nuclear)** by the end of the game.

Battery Bonus

Fill your battery to capacity at any point during the game.



The Architects Dream

Place **6 or more power plants** by the end of the game.

Variants

Time Crunch

When you don't have as much time...

- Only play **4 rounds**
- Set the **blackout meter max to 8**

Shift Change

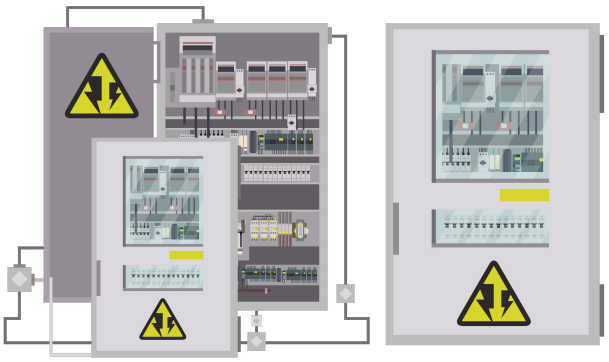
When you want to switch it up...

- At the beginning of **Round 4**:
  - 1-3 players: **swap** out current roles for new roles
  - 4-6 players: all players **rotate** roles clockwise

Solo Mode

When playing solo...

- Manage **3 roles**
- **Set up with**:
  - 2 Blackout Cards
  - Start blackout meter at level 2
  - 2 starting loads



The Story Behind Microgrid Mastermind

We're a team of four passionate students from the University of Nebraska-Lincoln who believe learning should be exciting, hands-on, and rooted in the real world.

Our journey started when we were hired by F. John Hay and Dr. Jenny Keshwani to help build a board game to teach people about the electrical grid along with the support of a grant from the Nebraska Center for Energy Sciences Research (NCESR) which is funded by the Nebraska Public Power District (NPPD), that idea turned into a board game called Microgrid Mastermind.

Combining our strengths in engineering, education, sustainability, and design, we set out to create a board game that makes the invisible world of electricity visible and understandable. Players don't just learn they strategize, cooperate, and face realistic challenges as they try to keep the lights on, and the grid running strong.

From balancing supply and demand to investing in renewable energy, Microgrid Mastermind helps young learners explore the complexity of our power systems in a way that's fun, memorable, and empowering.

We're proud of what we've built, and we're thankful to NCESR and NPPD for believing in our vision. As students, this project has been a powerful learning experience. As creators, our hope is to inspire energy awareness in classrooms and homes across Nebraska and far beyond.

Katie Morland, Sakshi Jani, Jada Vogel, Luke Freyhof

GROWABLE
Game-Based Learning Page

Microgrid Mastermind BOT
(chatGPT)