Energy
Resources Lab

NOVA Labs

For this lab you will be partaking in a virtual lab challenge to make an energy plan for a major city.

Your job will be to balance cost with efficiency to meet the city's energy needs.

Please access the website below for the lab. Either click on the blue link or copy and paste the black link.

https://www.pbs.org/wgbh/nova/labs/lab/energy/

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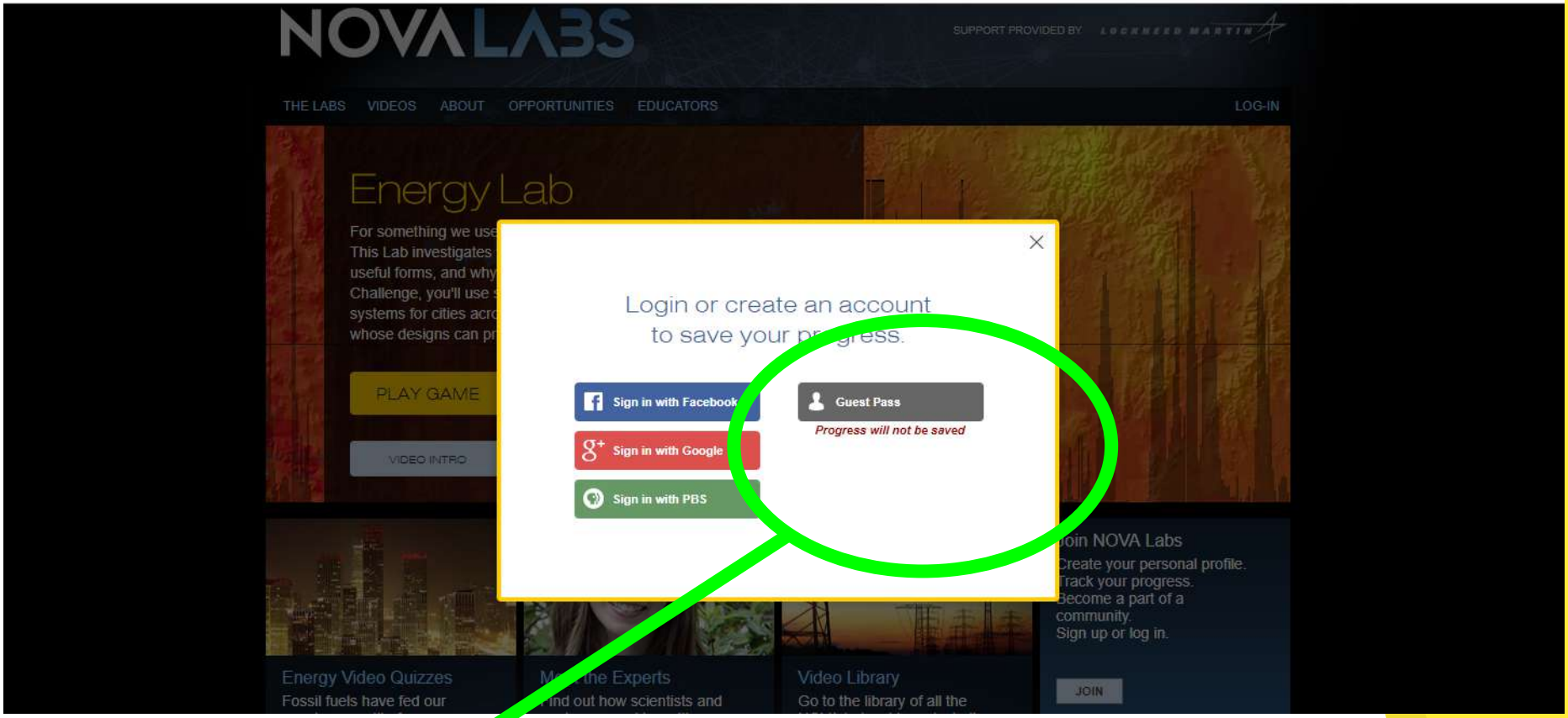


It might ask you to sign in. Please select “guest”. You don’t need to make an account or anything, but this does mean that you will need to complete the activity all at once since it won’t save your work. So pick a time that you can dedicate at least 30 minutes to the lab.


Research Challenge
Design a Renewable Future
Renewable energy sources are easy to find, but using them to power cities and towns is far more complicated.
Conditions on the ground can vary dramatically from one location to the next—not to mention one month… or day… or hour to the next.
Your challenge is to sort through these variations and design energy systems that meet demand and save the greatest amount of carbon emissions for the least amount of money.
BEGIN
Leaderboard
CO2 SAVED (TONS)
COST PER TON
1 filip.lasl... 40,535 $22
2 hartma.coo... 41,190 $24
3 fowers.rea... 42,350 $28
4 Dinaki 42,844 $29
5 ethan.m.ha... 36,616 $25

Let's begin

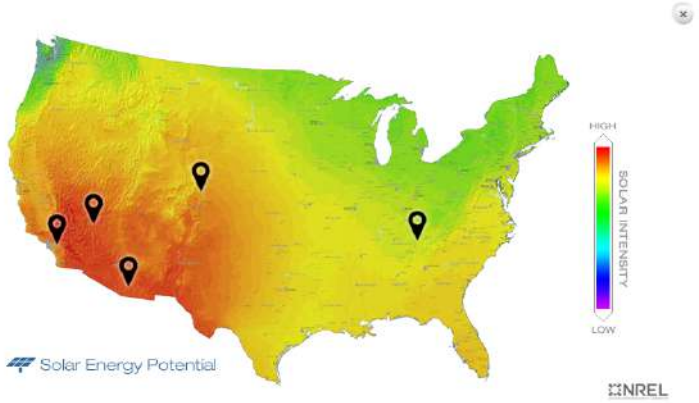
Before we get to the challenge, let's look around and learn about energy.

Click on the “potential” under solar.

This map shows the areas within the United States that have the most intense sunlight and thus the highest potential output for solar power.

Red is higher, green is lower. Note: this doesn't mean that green areas *can't* have solar, it just means it won't be as effective.

Which city would be the best place to put solar power based energy production?



The cities are labeled on the previous screen. You can close this and re-open it

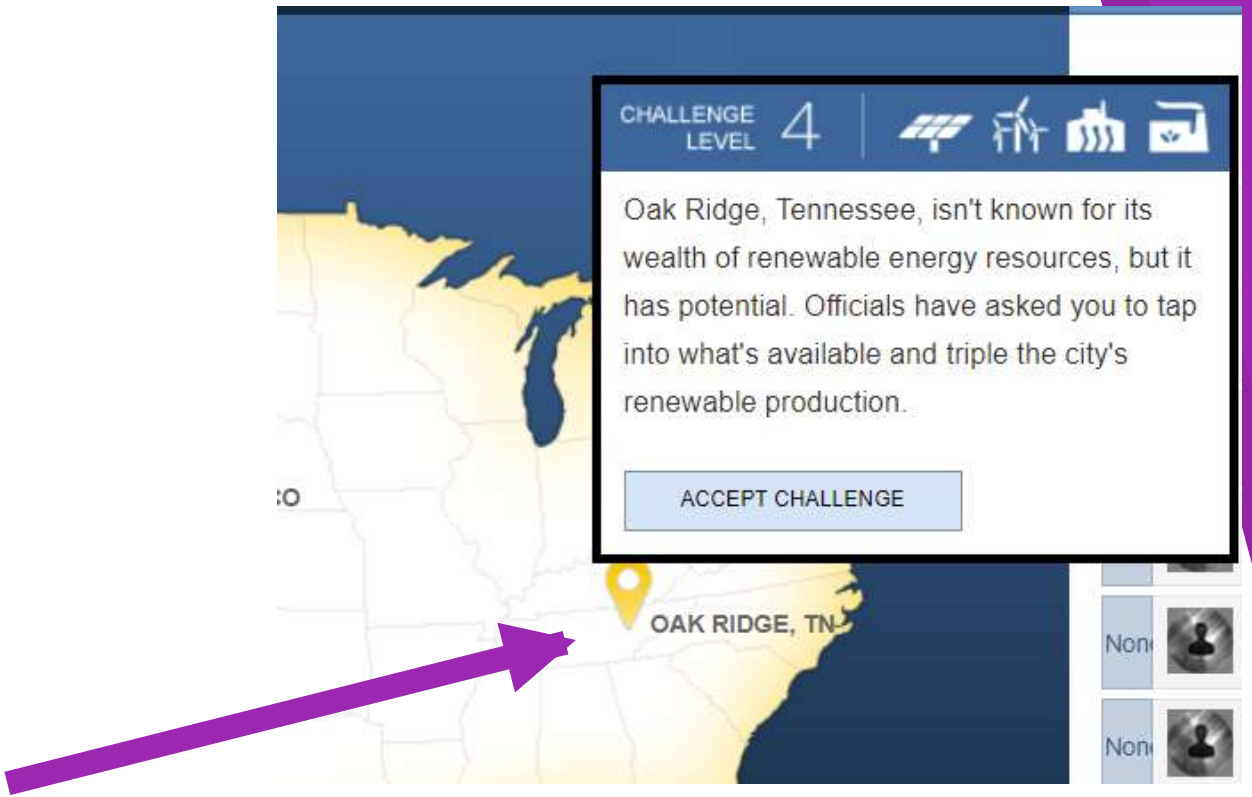
Repeat

Check out the maps for Wind, Geothermal and Biomass. Identify the cities that would be **best** for energy production of each type.

Oak Ridge, TN

As a class, we will first be designing a system for Oak Ridge, TN.

Follow along during the live session as we collaborate to create a cleaner energy plan

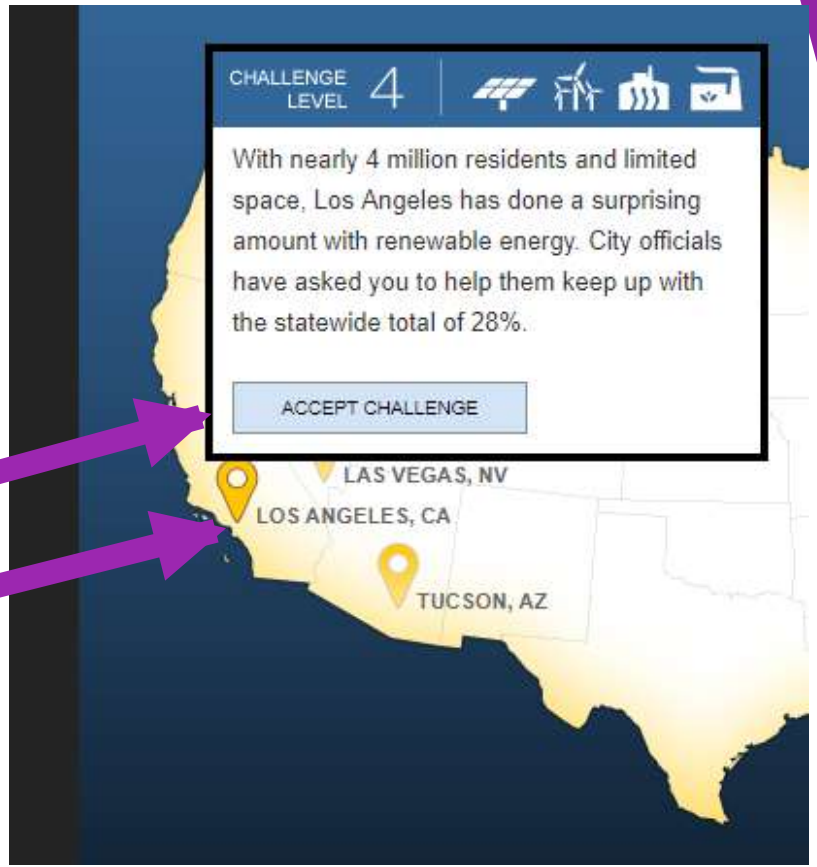


Los Angeles

You will now design a system for Los Angeles on your own.

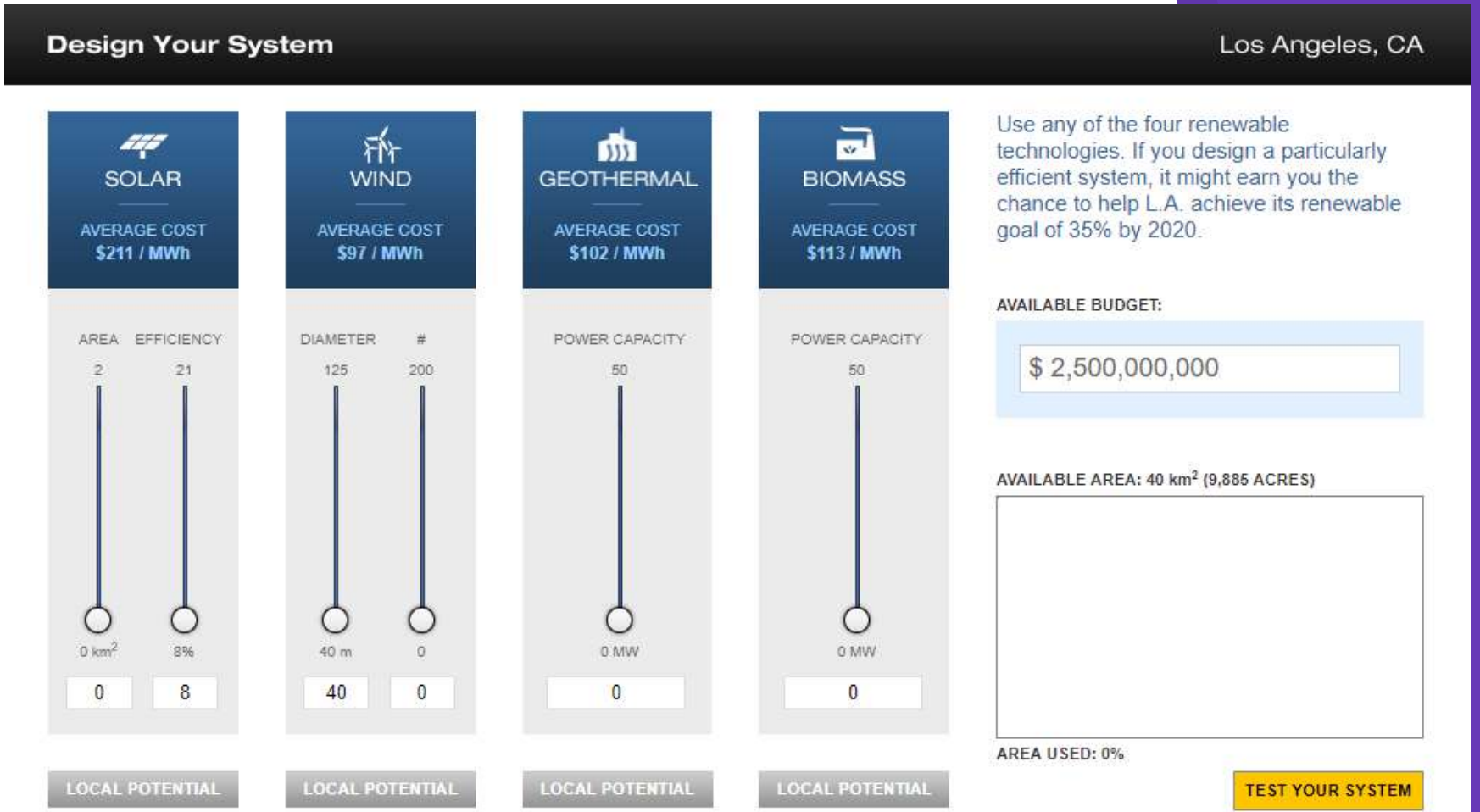
Please click on L.A. on your map in the lower left corner.

Accept this challenge



Read

Read about the need of L.A.’s energy and then design your system


Design Your System
Los Angeles, CA
SOLAR
AVERAGE COST
$211 / MWh
AREA
EFFICIENCY
2
21
0 km²
8%
0
8
LOCAL POTENTIAL
WIND
AVERAGE COST
$97 / MWh
DIAMETER
#
125
200
40 m
0
40
0
LOCAL POTENTIAL
GEOTHERMAL
AVERAGE COST
$102 / MWh
POWER CAPACITY
50
0 MW
0
LOCAL POTENTIAL
BIOMASS
AVERAGE COST
$113 / MWh
POWER CAPACITY
50
0 MW
0
LOCAL POTENTIAL
Use any of the four renewable technologies. If you design a particularly efficient system, it might earn you the chance to help L.A. achieve its renewable goal of 35% by 2020.
AVAILABLE BUDGET:
$ 2,500,000,000
AVAILABLE AREA: 40 km² (9,885 ACRES)
AREA USED: 0%
TEST YOUR SYSTEM

Cost

AVAILABLE BUDGET:

$ 2,500,000,000

You've only been given a certain amount of money to complete this task.

Most cities want to spend as little as possible while meeting the needs of the people.

You can spend all the money, but you can't go over budget (into the red)

Different types of energy will cost more than others. Solar is the most expensive, costing 211$ per Megawatt hour (MWh).

A MWh is a unit of energy, like how meter is a unit of distance or gram is a unit of mass.

A light bulb is typically 60 watts; leave it on for an hour you have used 60 watt hours, or .000006 MWh.

1 MWh is a lot of energy.

Balance

Use any of the four renewable technologies. If you design a particularly efficient system, it might earn you the chance to help L.A. achieve its renewable goal of 35% by 2020.

AVAILABLE BUDGET:

$ -4,893,353,000

AVAILABLE AREA: 40 km² (9,885 ACRES)

AREA USED: 205%

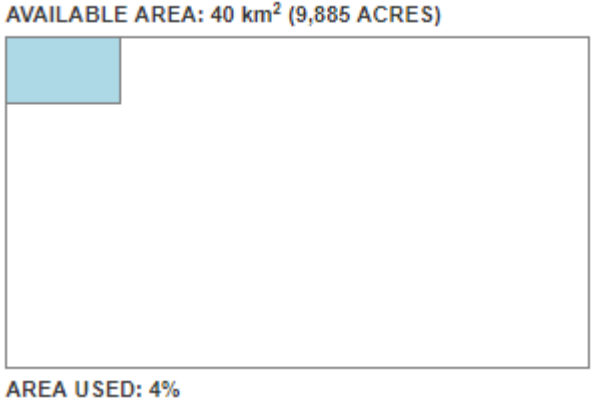
It's not as simple as just maxing out all the bars and saying "we'll just put a ton of everything in the city. You're going to go way over budget and need more space than you are given.

Area

You have been given **40 km^2**
of land to develop into energy producing machine.
You CANNOT go over this amount, cuz then you'll be building in people's backyard and that makes nobody happy.

Some energies will take up more space than others. Some take up very little space.

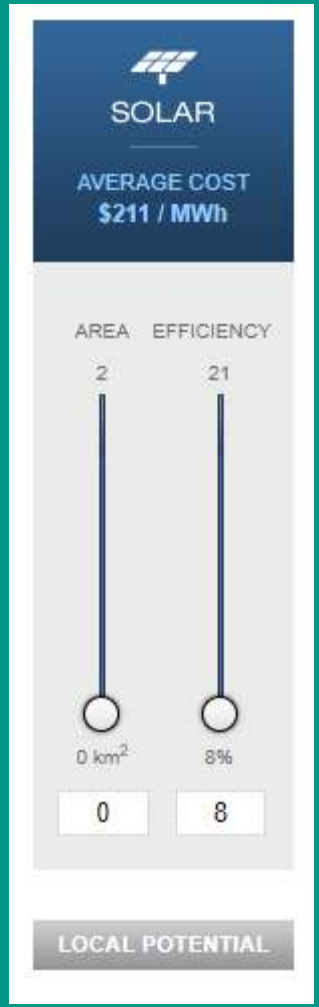
Watch the "Area Used" on the bottom, it will tell you how much land you've used. Don't use more than 100%. (even though it will let you)



Solar power has 2 sliders. area and efficiency.

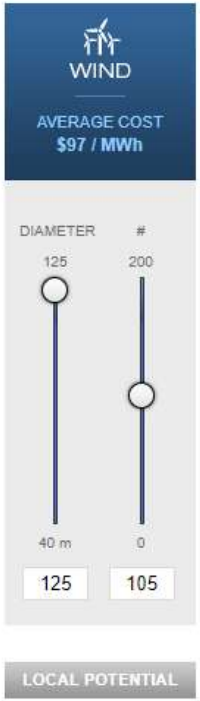
Efficiency means how well the system is working to convert solar power to energy. Higher efficiencies are MUCH more expensive, but lower efficiencies don't produce as much energy.

Area is a means of saying how much solar energy will be produced. The more area covered in panels, the more energy produced.



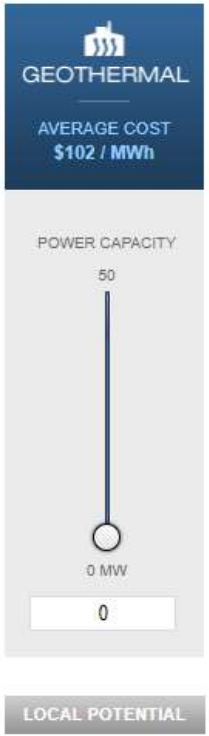
Wind has 2 sliders
diameter and number (#)

Diameter is a measure of how wide the wind turbines are. The wider they are the more energy they produce, but they get more expensive.



is the number of turbines that would be installed. The more turbines the more energy produced, but they take up a lot of space.

Geothermal has 1 slider



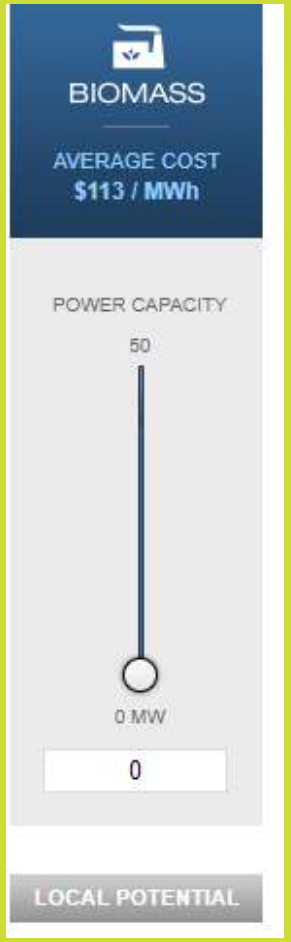
The slider represents how much power could be derived from geothermal sources.

Geothermal plants don't take up a lot of space, and don't cost a lot, but you might find they don't produce enough power for L.A. on their own.

BioMass also only has 1 slider

The slider represents how much power could be derived from biomass sources.

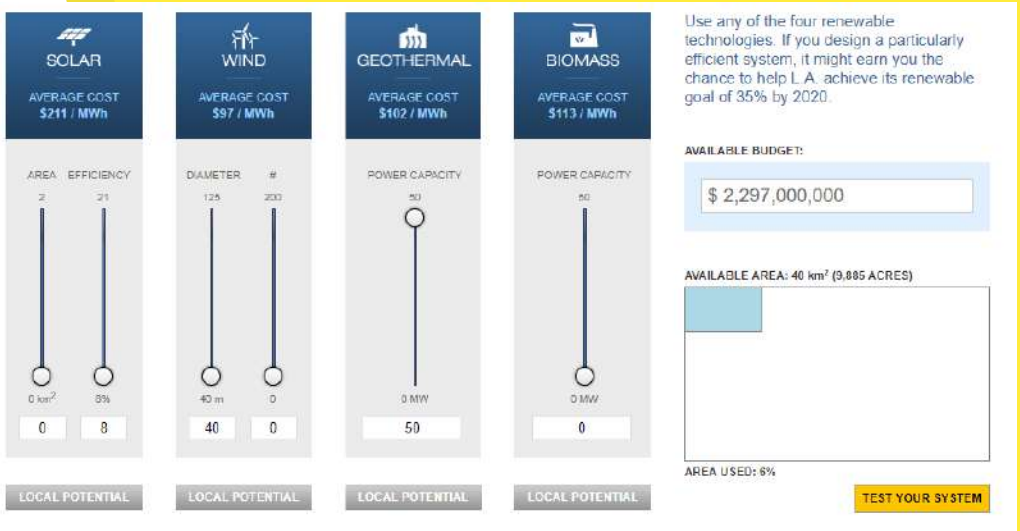
Biomass plants don't take up a lot of space, and don't cost a lot, but you might find they don't produce enough power for L.A. on their own.

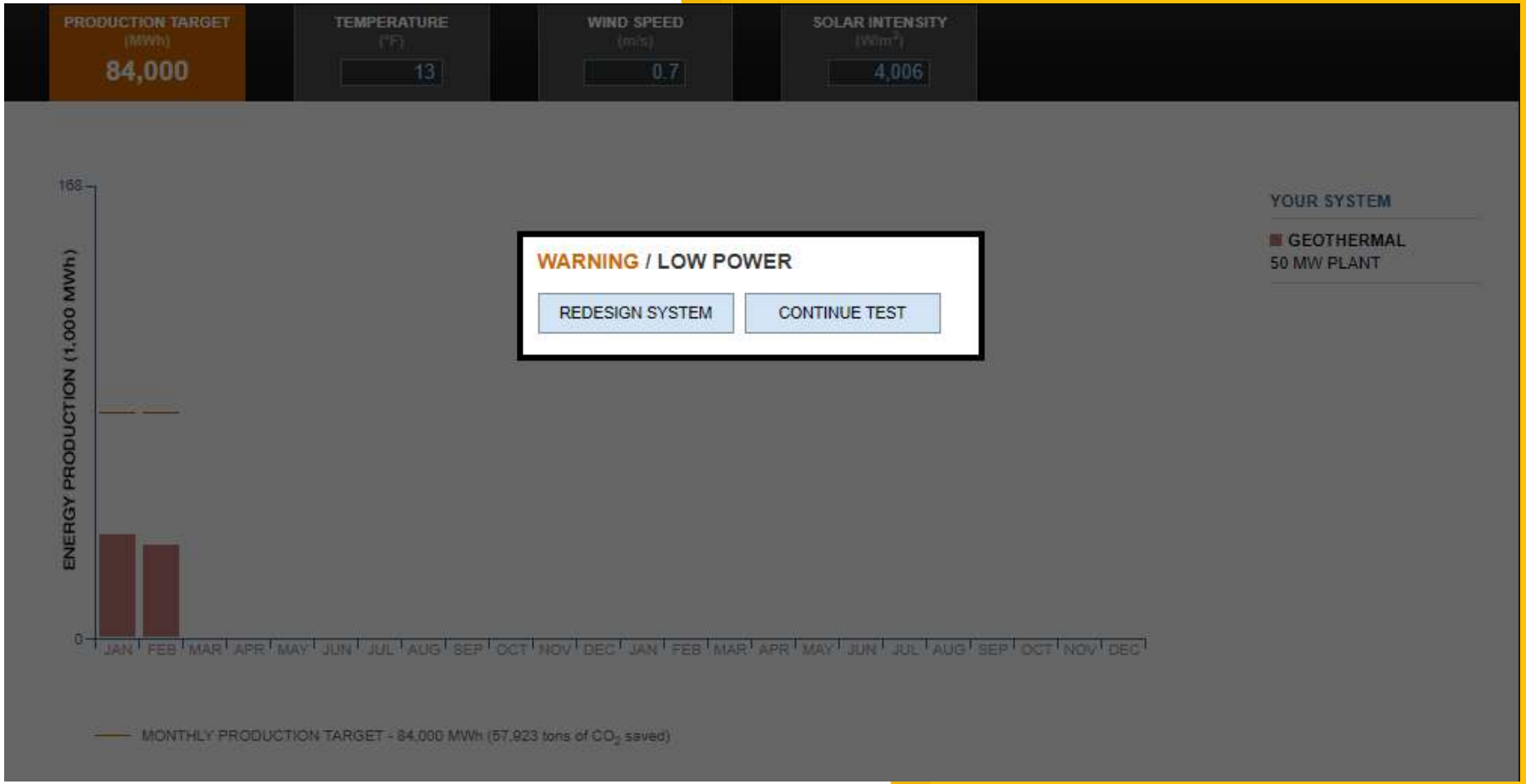


Test your system

When you're ready and have all your sliders set, and you're under budget and only using the area given to you, start testing your system.

For this example, I'm going to use only geothermal energy, just to see what happens. I don't recommend this!

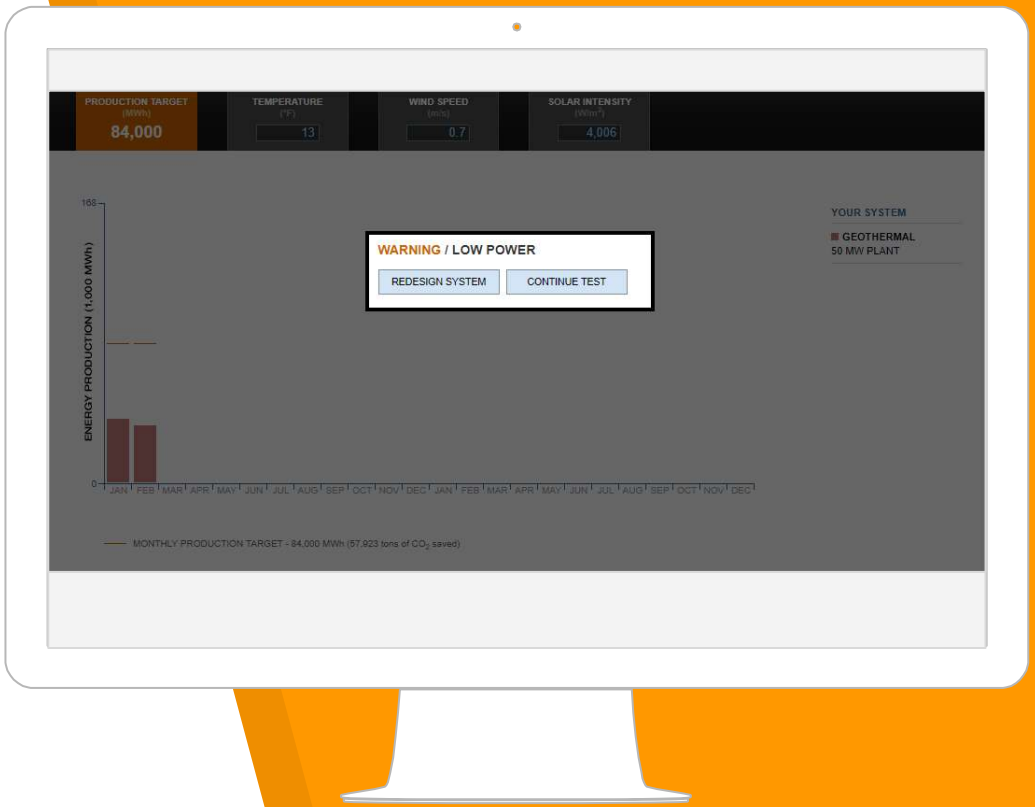



PRODUCTION TARGET
(MWh)
84,000
TEMPERATURE
(°F)
13
WIND SPEED
(m/s)
0.7
SOLAR INTENSITY
(W/m²)
4,006
168
0
ENERGY PRODUCTION (1,000 MWh)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
WARNING / LOW POWER
REDESIGN SYSTEM
CONTINUE TEST
YOUR SYSTEM
GEOTHERMAL
50 MW PLANT
MONTHLY PRODUCTION TARGET - 84,000 MWh (57,923 tons of CO2 saved)

Testing System

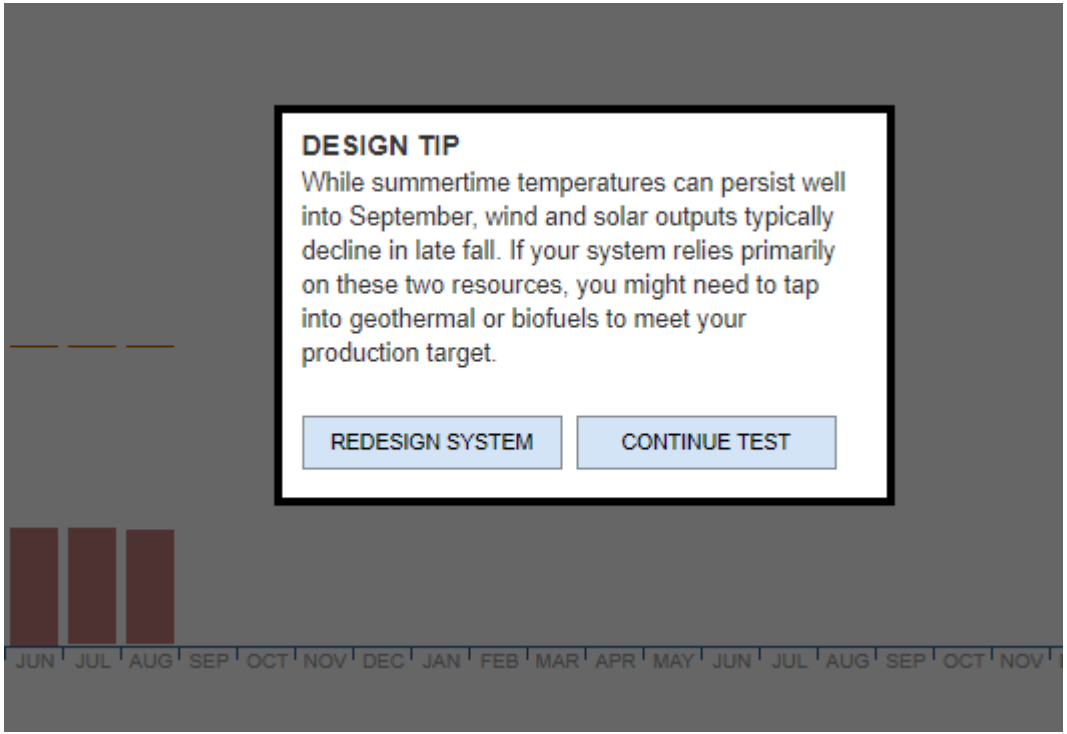
The system will now run a test. It will give you a target line of how much energy you should be producing at any given time. If you're not making these targets, it will have a pop-up that says "Warning/Low Power"

It will give you a chance to continue on and hope things improve, or go back and redesign your plans to try and produce more power.



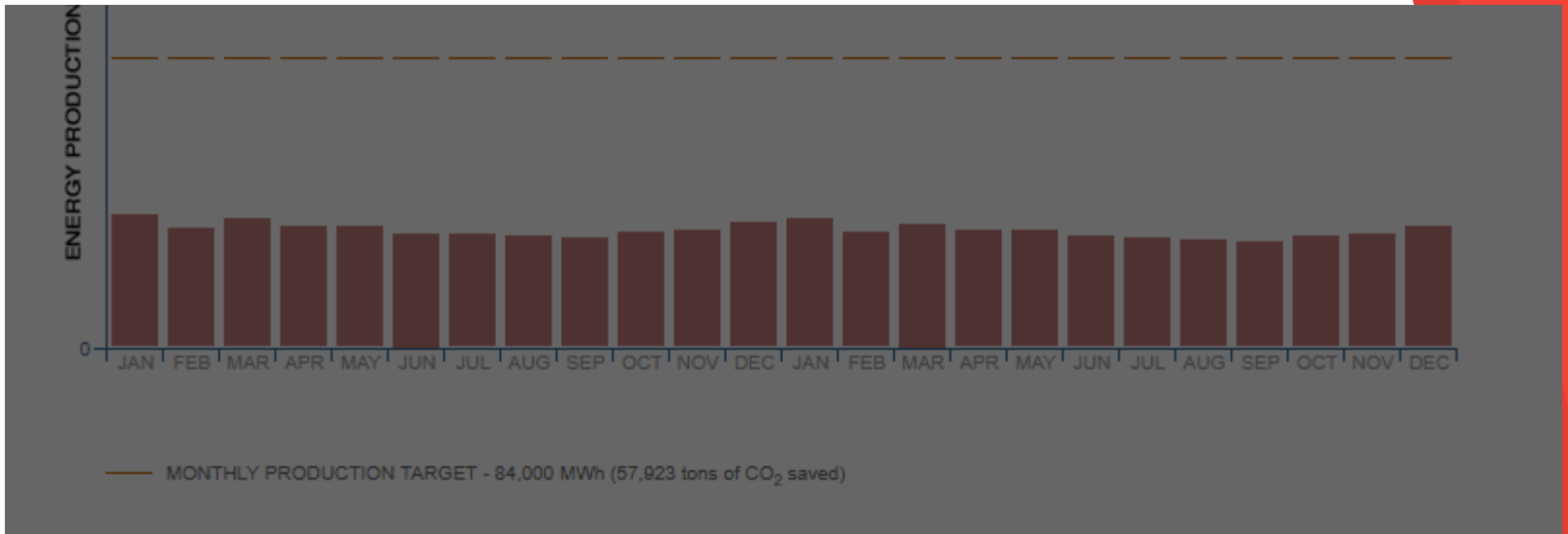
Tips

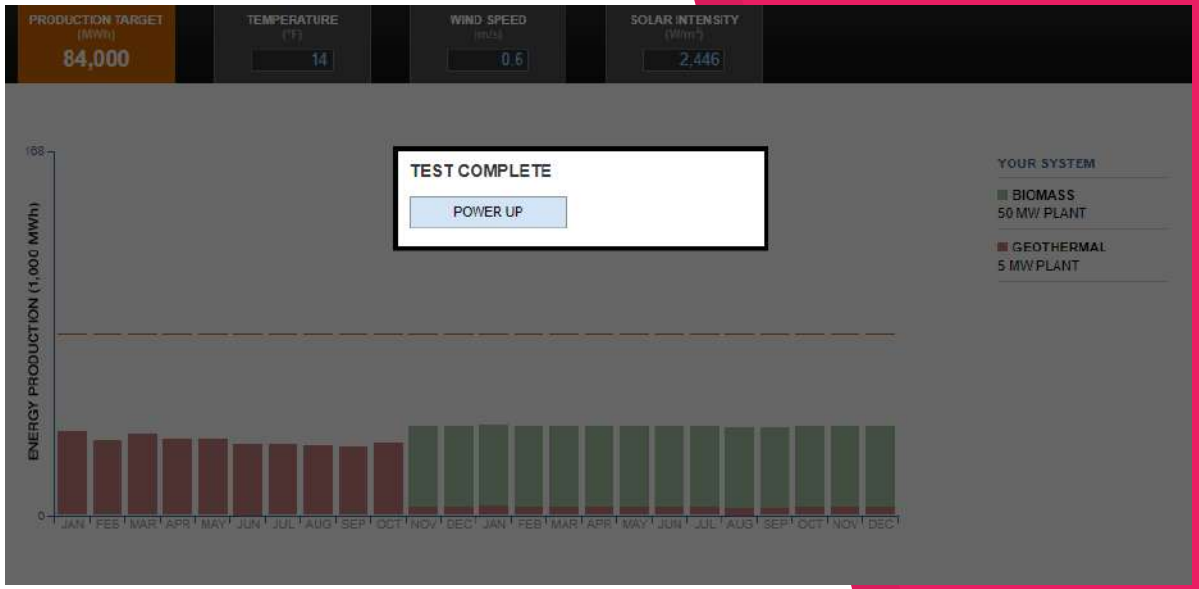
Occasionally it will pop-up with a tip. In this example its saying basically “hey, summertime is coming up with lots of sunny days, so solar power might start improving”



Terrible results

- At the end of the year, it seems I did terrible. I saved a ton of money, I produced “green” energy, I saved tons (literally tons) of carbon dioxide from being released into the air, I barely used any land…and the residents of L.A. probably haven’t had power for months.





Power up

Click power up and it will run for a simulated 2 week run for the current conditions.

Consider your successes. How much CO_2 did you save?