Plan.It

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Motivations - WWAGD?

We want to help users interpret the plethora of data out there to determine whether or not solar or wind renewable technology is right for them.

Users are :
- **Residents**
- **Government**

Location

User inputs (City, State) → Find latitude/longitude associated with (City, State) in **us_cities.csv**
Returns (latitude, longitude) → Find nearest latitude/longitude coords of a location in the **WTK database**
Returns (latitude, longitude)

Solar Energy

Wind Energy

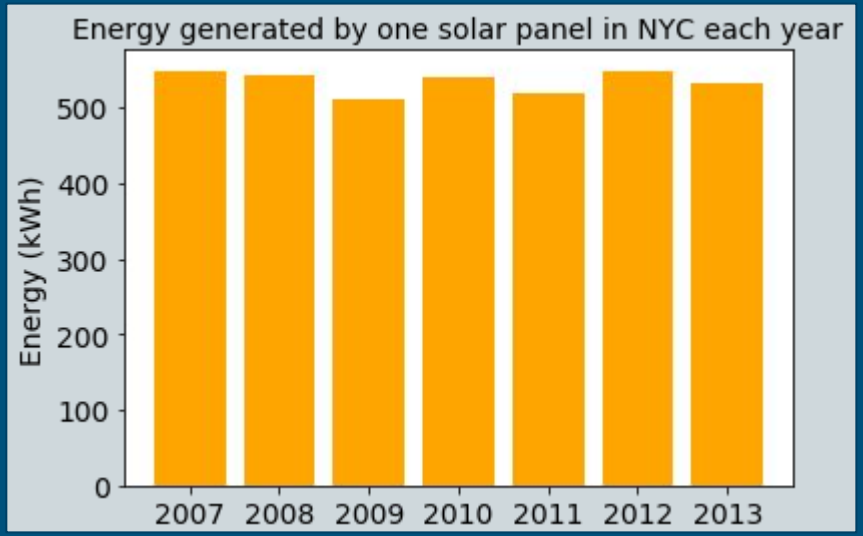
Solar Energy

Global horizontal incidence (GHI) at ~5 million locations across the US each hour of the year for 7 years

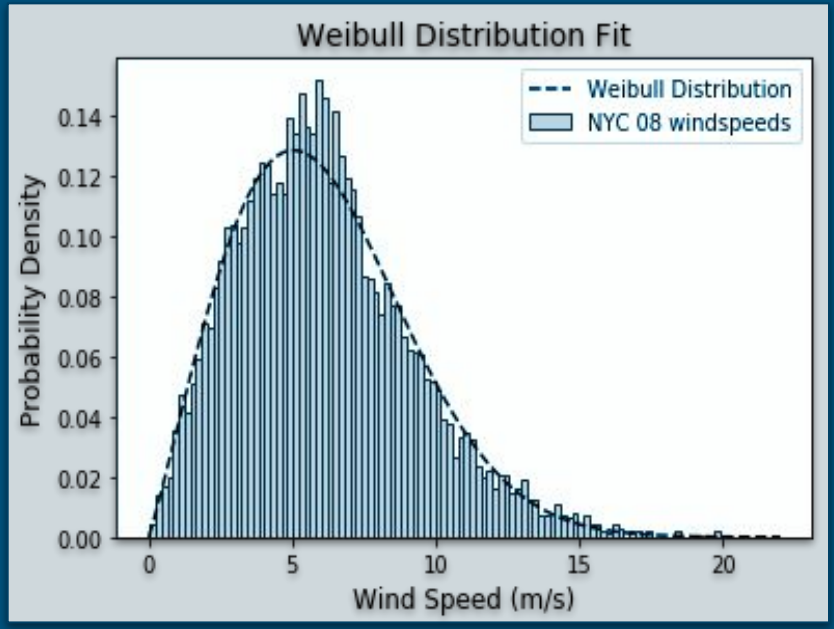
Inputs:
- WTK Database
- Location index

Outputs:
- Solar energy generated by a single solar panel per year

$E = \varepsilon \cdot A \cdot G$
- ε = solar panel efficiency (20%)
- A = solar panel area (65 x 39 in^2)
- G = GHI



Wind Energy



$$p(v) = \left(\frac{k}{c}\right)\left(\frac{v}{c}\right)^{k-1} e^{-\left(\frac{v}{c}\right)^{k}}$$

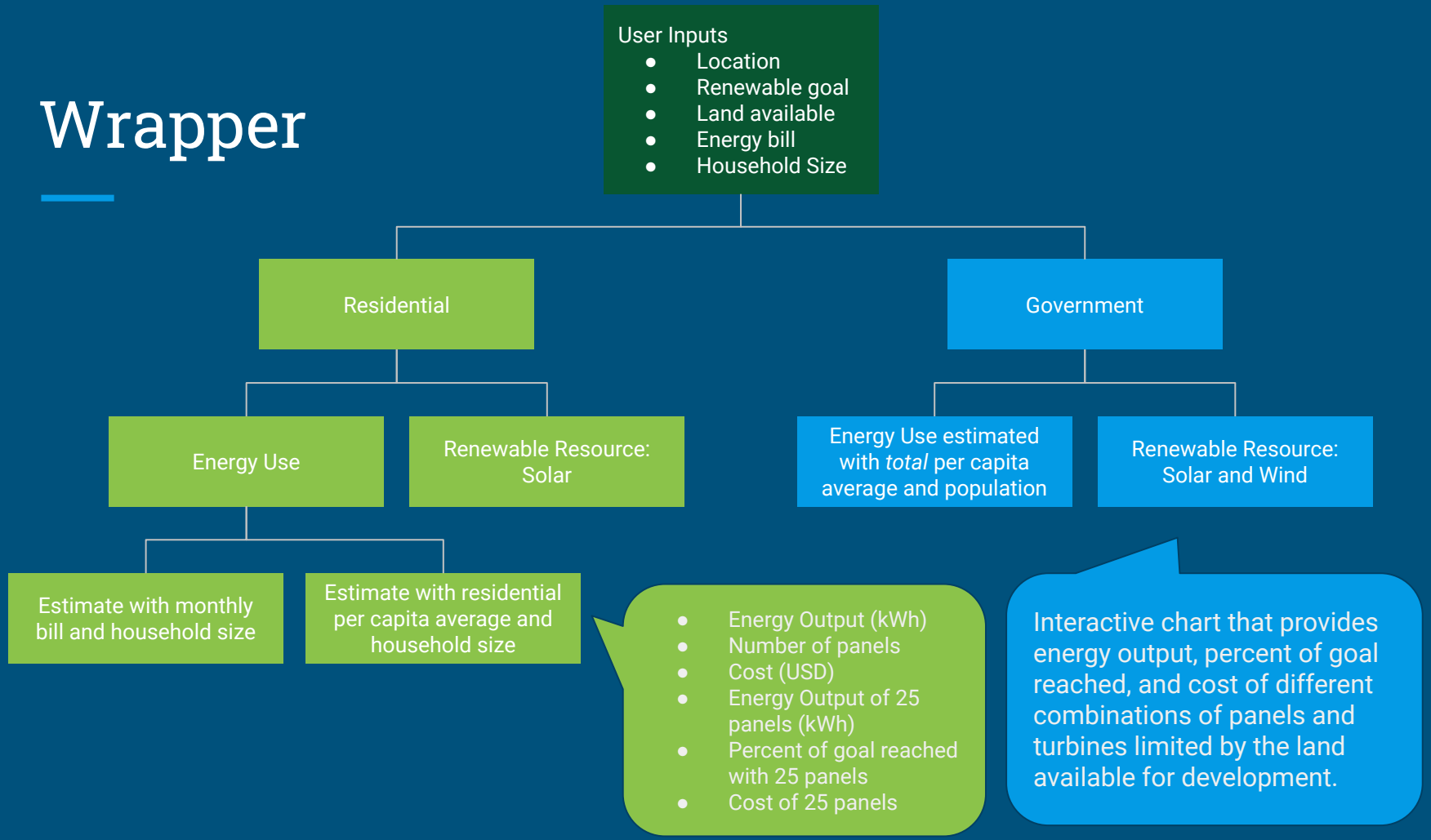
Wind speed at 100 m at ~5 million locations across the US each hour of the year for 7 years

- Yearly wind speeds fit with a Weibull distribution
- PDF dependent wind speed calculated
- Average annual energy output (per wind turbine)

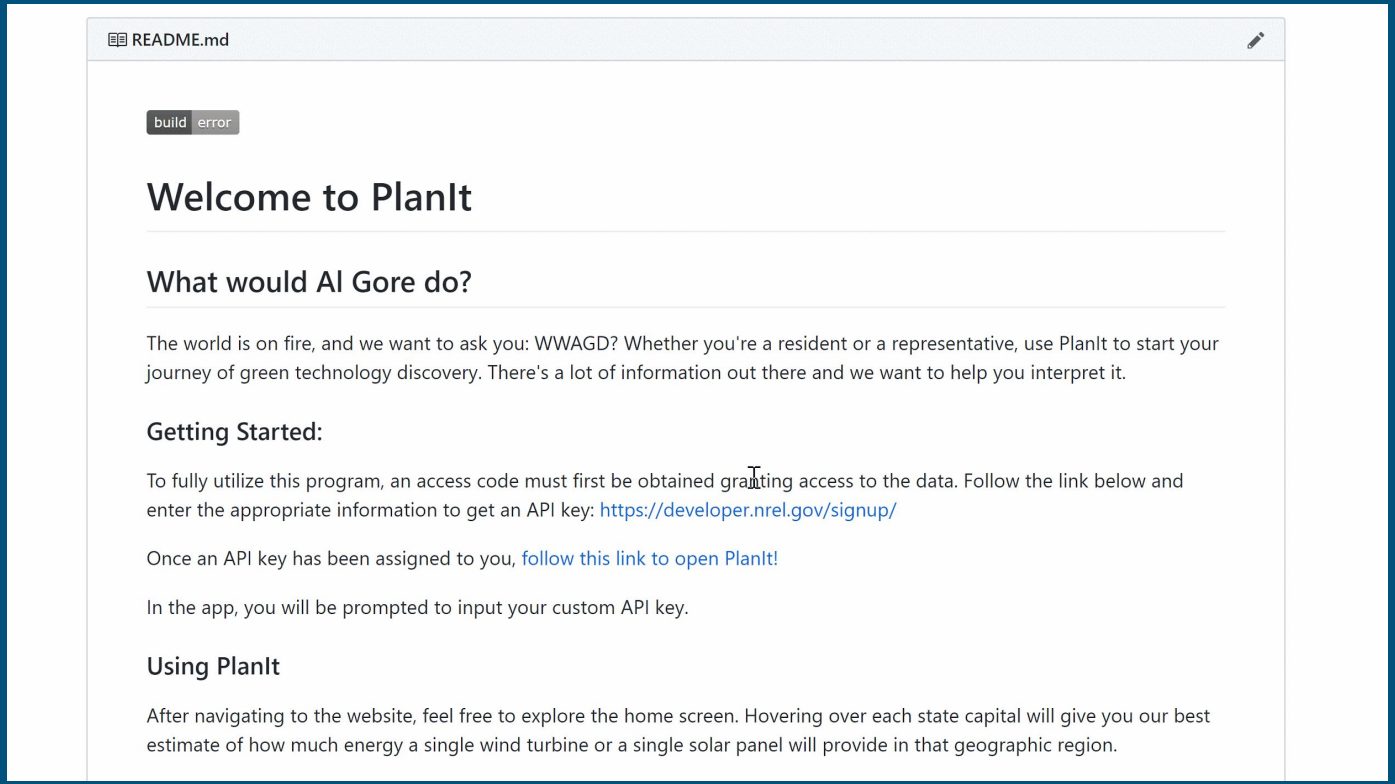
Calculate the energy that could be generated based on the amount of land available for wind turbines.

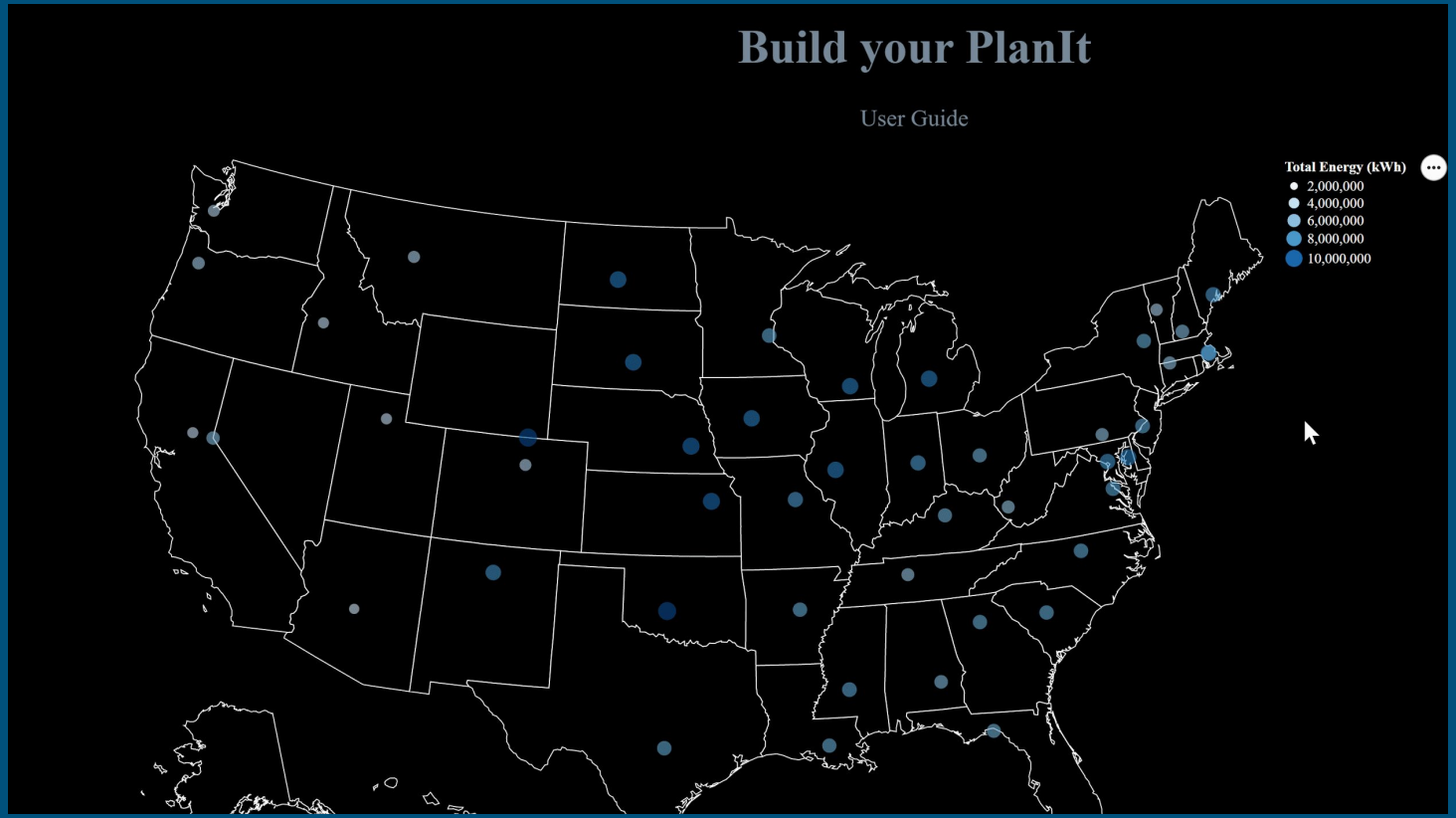
Cooney, O'Rourke. *Energy for Sus. Dev.*, **2016** (36) 44-54

Wrapper


User Inputs
Location
Renewable goal
Land available
Energy bill
Household Size
Residential
Government
Energy Use
Renewable Resource: Solar
Energy Use estimated with *total* per capita average and population
Renewable Resource: Solar and Wind
Estimate with monthly bill and household size
Estimate with residential per capita average and household size
Energy Output (kWh)
Number of panels
Cost (USD)
Energy Output of 25 panels (kWh)
Percent of goal reached with 25 panels
Cost of 25 panels
Interactive chart that provides energy output, percent of goal reached, and cost of different combinations of panels and turbines limited by the land available for development.

Application





Residential


Build your PlanIt
User Guide
Total Energy (kWh)
2,000,000
4,000,000
6,000,000
8,000,000
10,000,000

Government

Future Directions

On the application side …

-Dynos timeout if the calculation takes longer than 30 seconds, we must find a way to send at least one byte to the client to keep the dyno alive OR speed up/split up calculations

- Integrate unit tests from previous pull instead of remote server so they run with Travis

On the calculation side …

-Consider user inputted budgets

-Predict energy saved over time

-Take into account Climate Change

Lessons Learned

- Organize repository *from the start*
- Break functions down as much as possible
  - Facilitates writing unit tests
  - Easier to troubleshoot and/or debug
- Interfacing our code with apps can be difficult:
  - Choosing the right web server gateway interface (WSGI) for specific needs
  - Understanding server errors (H12 timeout error in this case)

Resources & Packages

Links:

- https://www.sciencedirect.com/science/article/pii/S0973082616308699
- https://www.energy.gov/sites/prod/files/2019/08/f65/2018%20Wind%20Technologies%20Market%20Report%20FINAL.pdf
- https://www.nrel.gov/grid/wind-toolkit.html
- https://aws.amazon.com/blogs/big-data/power-from-wind-open-data-on-aws/
- https://github.com/NREL/hsds-examples

Besides **Pandas** and **Numpy** ...

dateutil : for interpreting date logged data

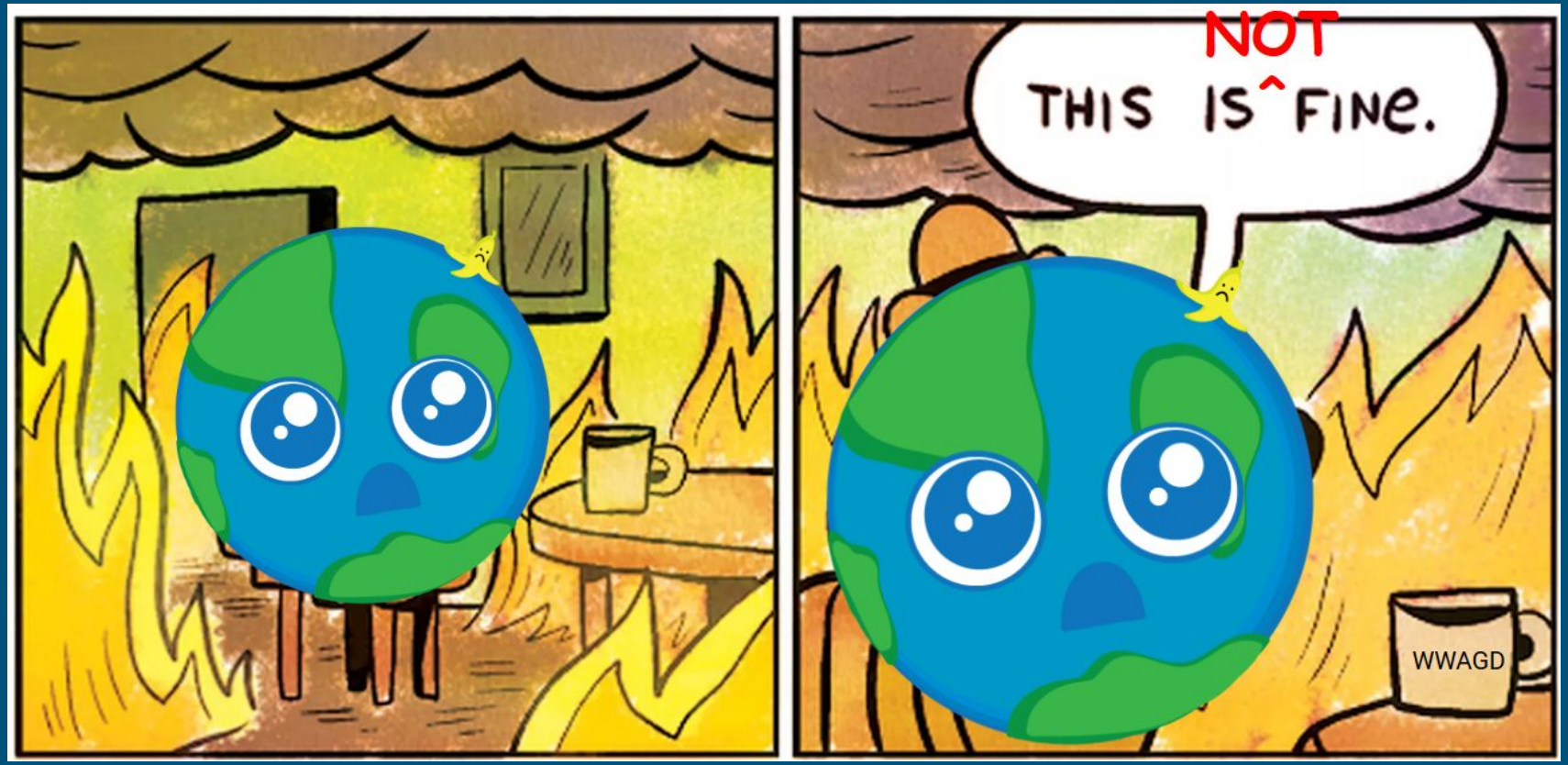
Pyproj : for quickly calculating nearest neighbors while taking into account the curvature of the earth

Reliability : for fitting wind data

Altair : for declarative, interactive visualizations

Flask : for app building in Python

Heroku : for app hosting



Check us out at our repository or try the app yourself!