A Story of Data and Energy

A Story of Data and Energy:
Weather and **Renewable Energy** in Spain

1. Problem with energy generation in Spain
2. Seasonality of weather, how it affects renewables
3. Different regions have different weather patterns
4. Recommend solutions to this problem based on the analyzed data

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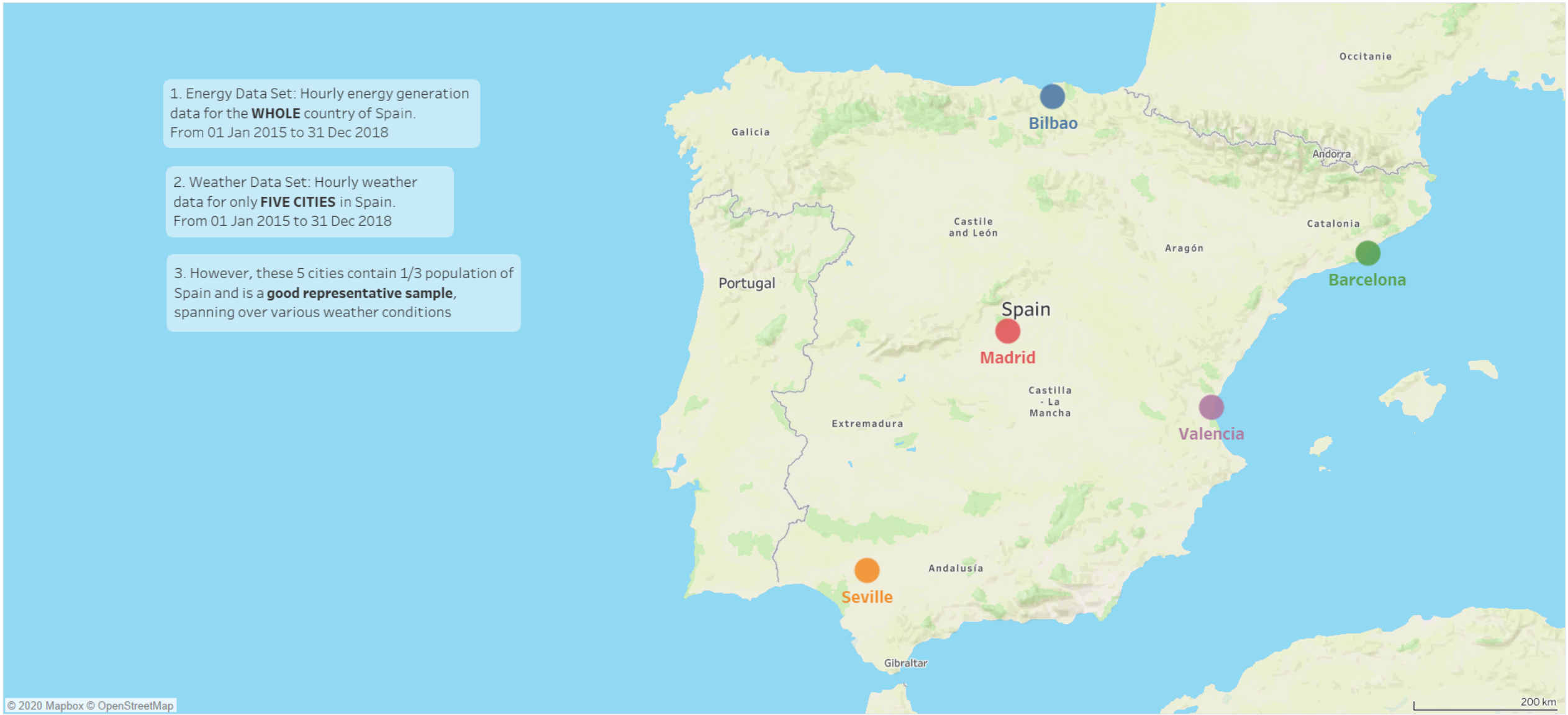
1. Energy Data Set: Hourly energy generation data for the **WHOLE** country of Spain.
From 01 Jan 2015 to 31 Dec 2018

2. Weather Data Set: Hourly weather data for only **FIVE CITIES** in Spain.
From 01 Jan 2015 to 31 Dec 2018

3. However, these 5 cities contain 1/3 population of Spain and is a **good representative sample**, spanning over various weather conditions



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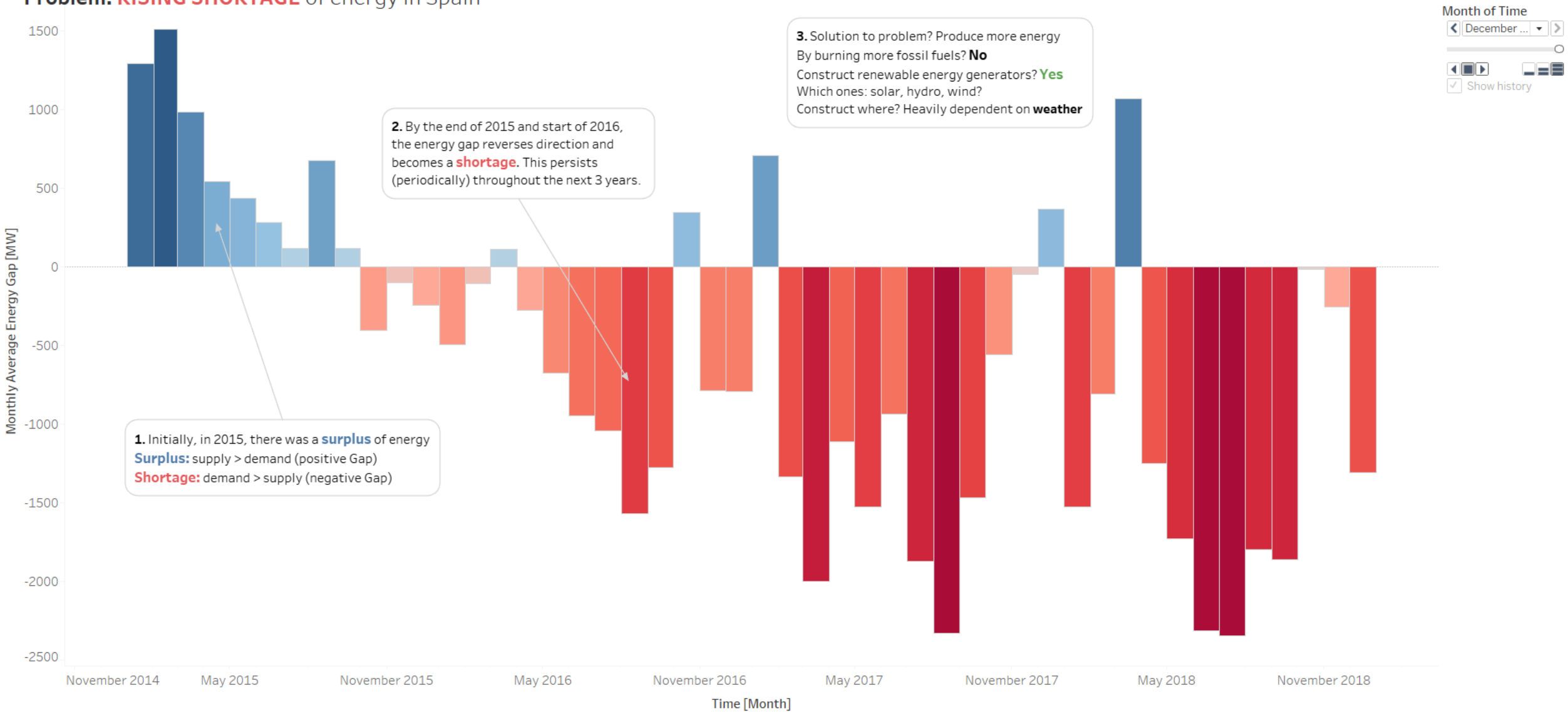
Problem: RISING SHORTAGE of energy in Spain



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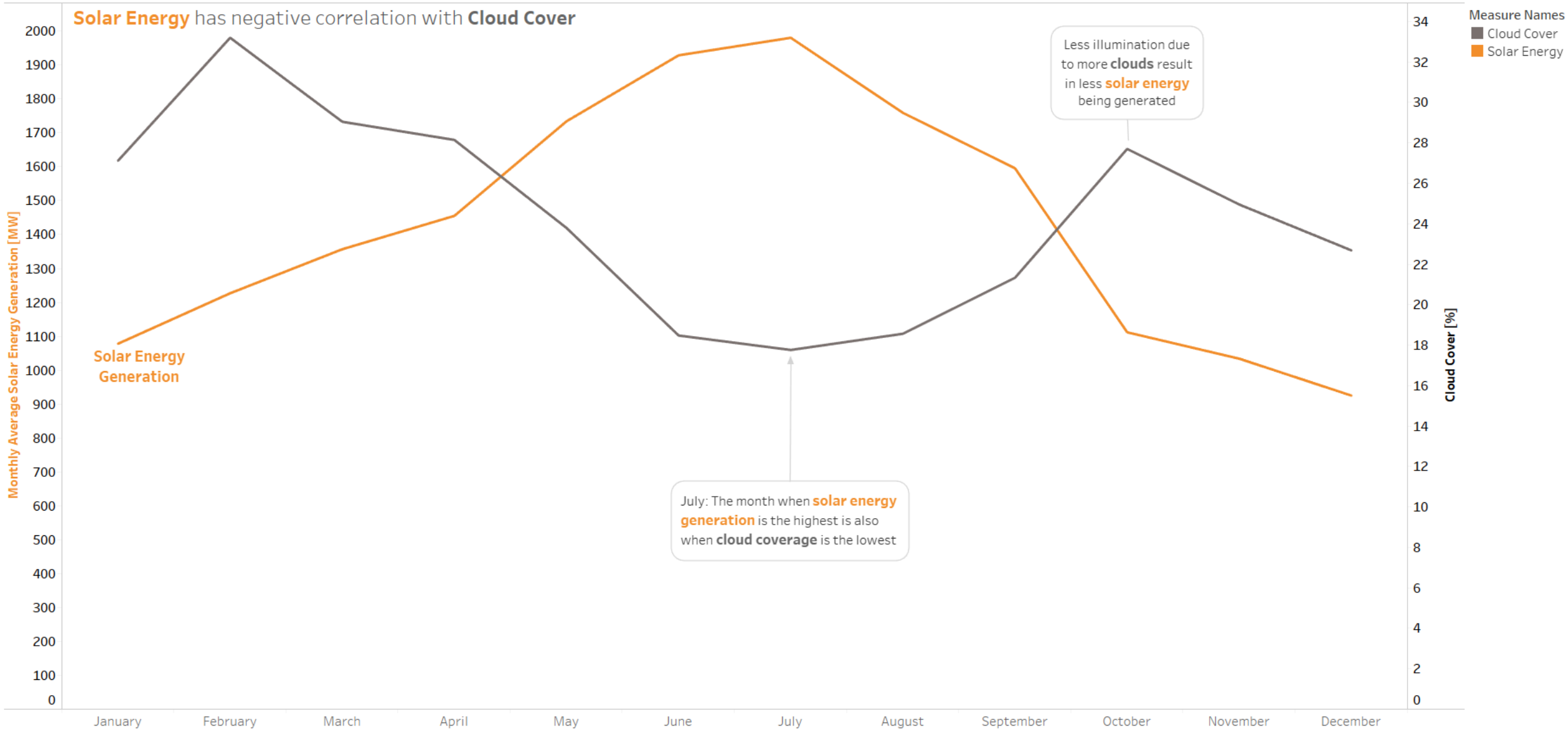

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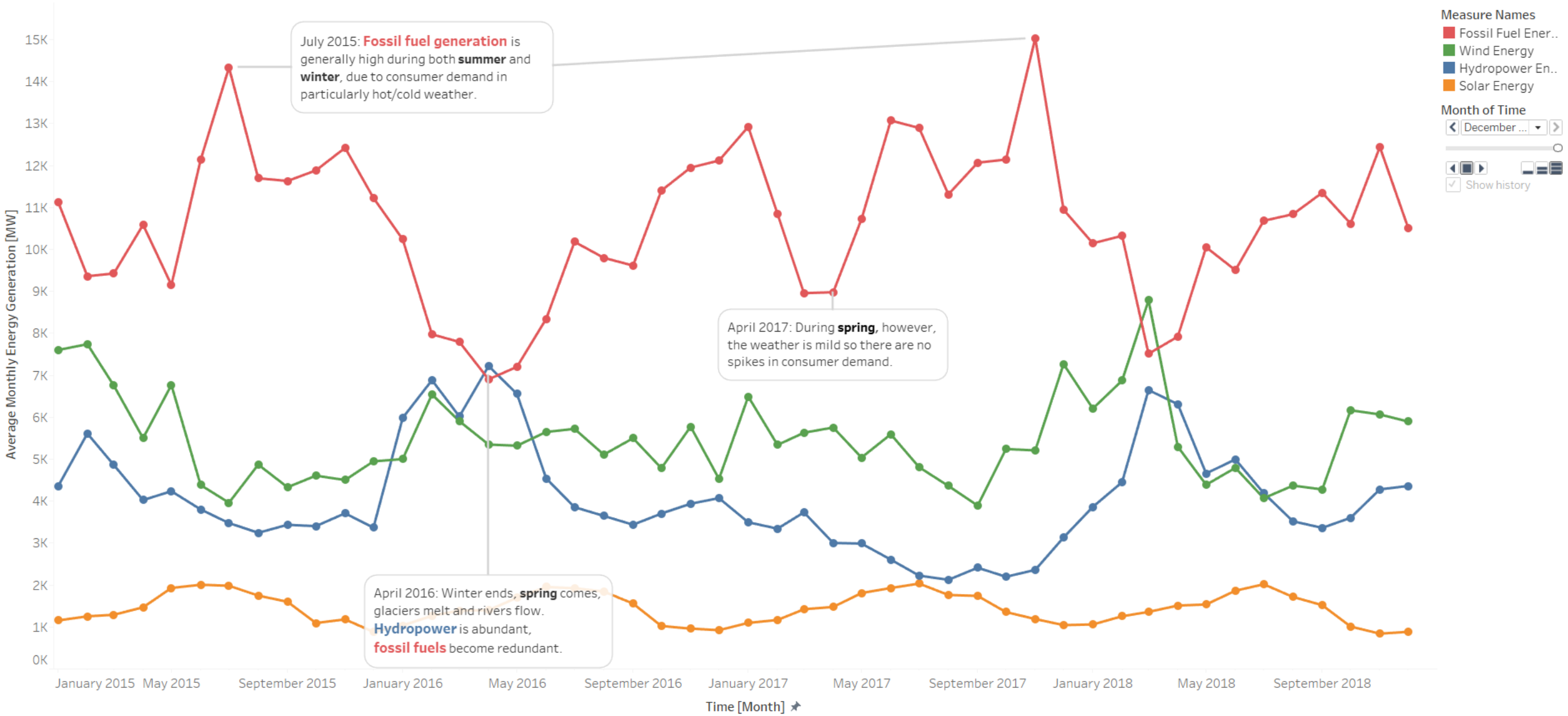

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City-specific Weather Metrics

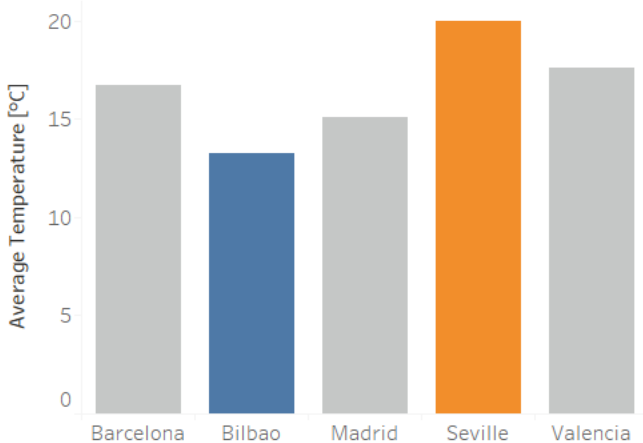
1. **Temperature:** **Seville**, in the southern part of Spain, is the hottest city, while **Bilbao**, situated in the north, is the coolest.

2. **Cloud Cover:** **Seville** has the least amount of clouds while while **Bilbao** is the cloudiest.

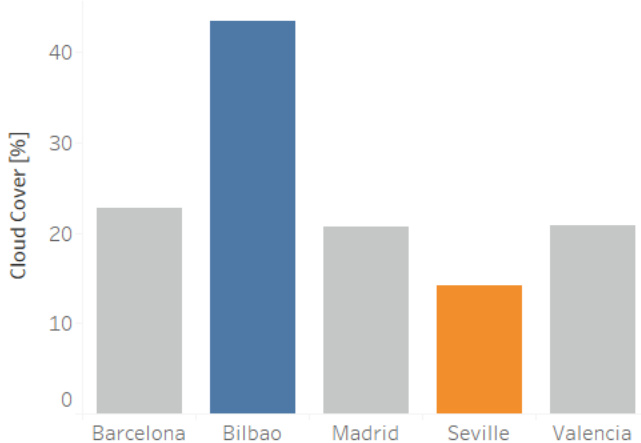
3. **Wind Speed:** **Barcelona** and **Valencia**, the coastal cities, are the windiest, although **Seville** and Madrid are almost comparable.

4. **Rainfall:** **Bilbao** has the highest precipitation, while **Seville** has one of the lowest.

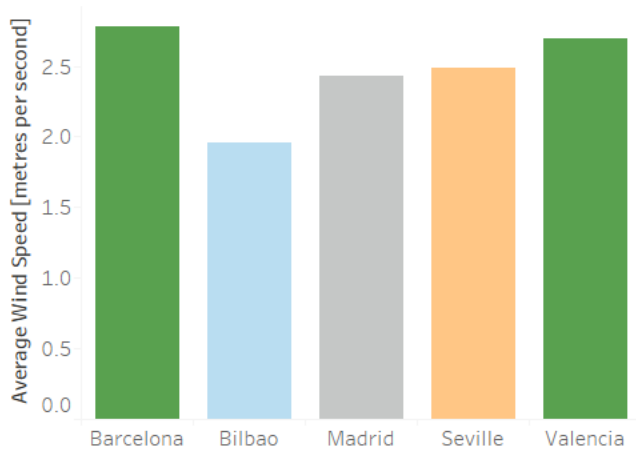
Temperature



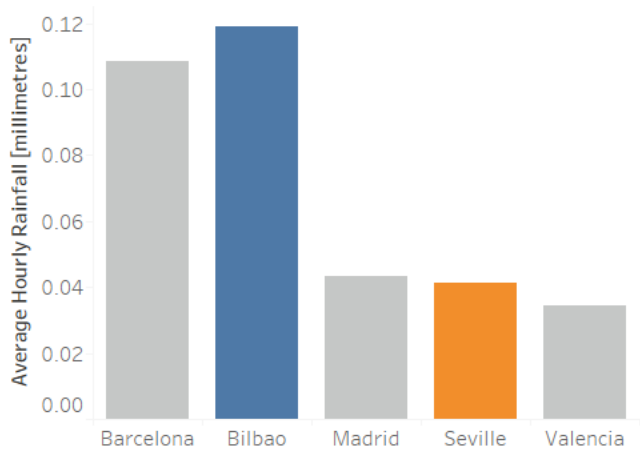
Cloud Cover



Wind Speed



Rainfall



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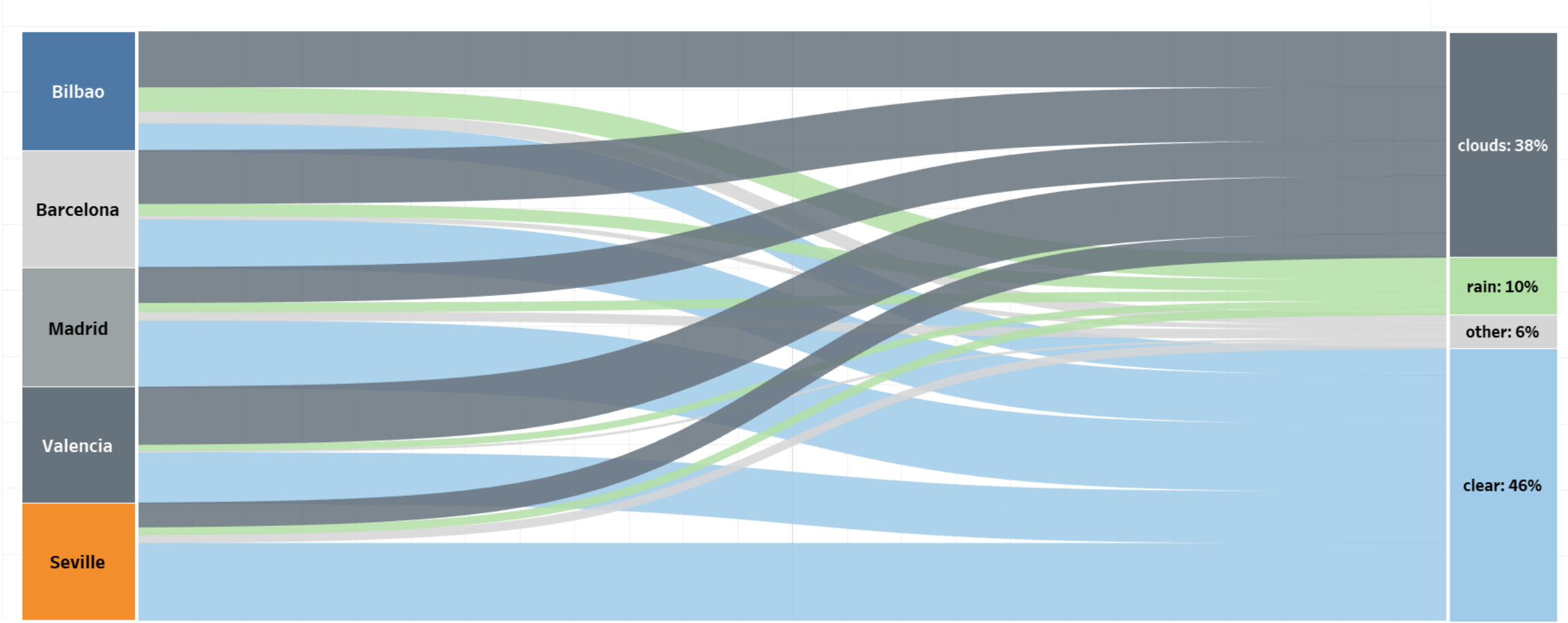
Sankey diagram to show weather conditions in each city

It can be seen by inspection that out of the 5 cities, **Seville** has the **clearest skies** and least **cloudiness** while Bilbao is the **rainiest**. However, it is difficult to compare (by eye) the **cloudiness** between **Bilbao**, Barcelona, and Valencia.



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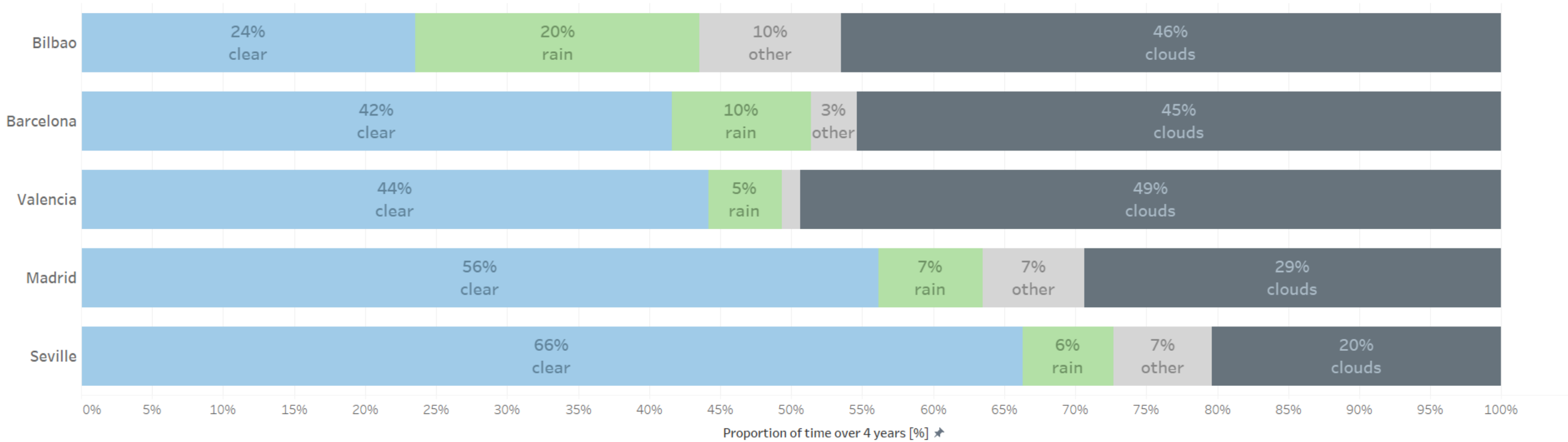

The southern city Seville has the **clearest skies** with a 66% proportion of all hours over 4 years, and the lowest **cloud coverage** proportion at 20%. Bilbao is the opposite, while also having the highest amount of **rain** at 20%. Surprisingly, the coastal cities Barcelona and Valencia have an unusually high **cloud coverage**, even being comparable to a northern city like Bilbao.

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Conclusion and Recommendations

1. The two data sets of energy and weather were first introduced, along with the five featured cities.

2. Then, the problem of **energy shortage in Spain** was identified.
Aim: Find out where to construct a new renewable energy generator to deal with this shortage.

3. Afterwards, discussed the relationships between weather, renewable energy generation and consumer energy demand. Described the weather in each city.

4. **Recommendations** (in order of confidence):
   (a) Seville (clear skies and few clouds): ideal location for a solar farm
   (b) Bilbao (cloudy, elevated and high precipitation): ideal location for hydropower
   (c) Barcelona/Valencia: (high wind speed): good locations for windpower

5. Locations are not limited to cities - any region with suitable weather conditions (e.g. clear skies and few clouds, elevated and high precipitation, consistent wind speed and flow) can be considered.