

San Diego & Northern Baja

Presentation 3 – Mapping Water and Energy



Presented by
Trevor Conger
Ashjeet Talwar

Recap

- San Diego and Northern Baja are both part of a region that is experiencing its 4th year of consecutive drought.
- Though San Diego's tap has not run dry, locals still have to rethink our water strategy. Its time to accept the fact that these droughts are only getting drier and longer. We cannot simply continue to rely on local supplies while our reservoirs are nearly empty and our aquifers remain depleted.
- In Northern Baja they feel the full force of the drought. For many it is difficult simply to obtain the water to supply the household.
- As a result, San Diegans need to work with their neighbors to adopt sustainable methods of obtaining freshwater for our communities without drastically affecting the environment.

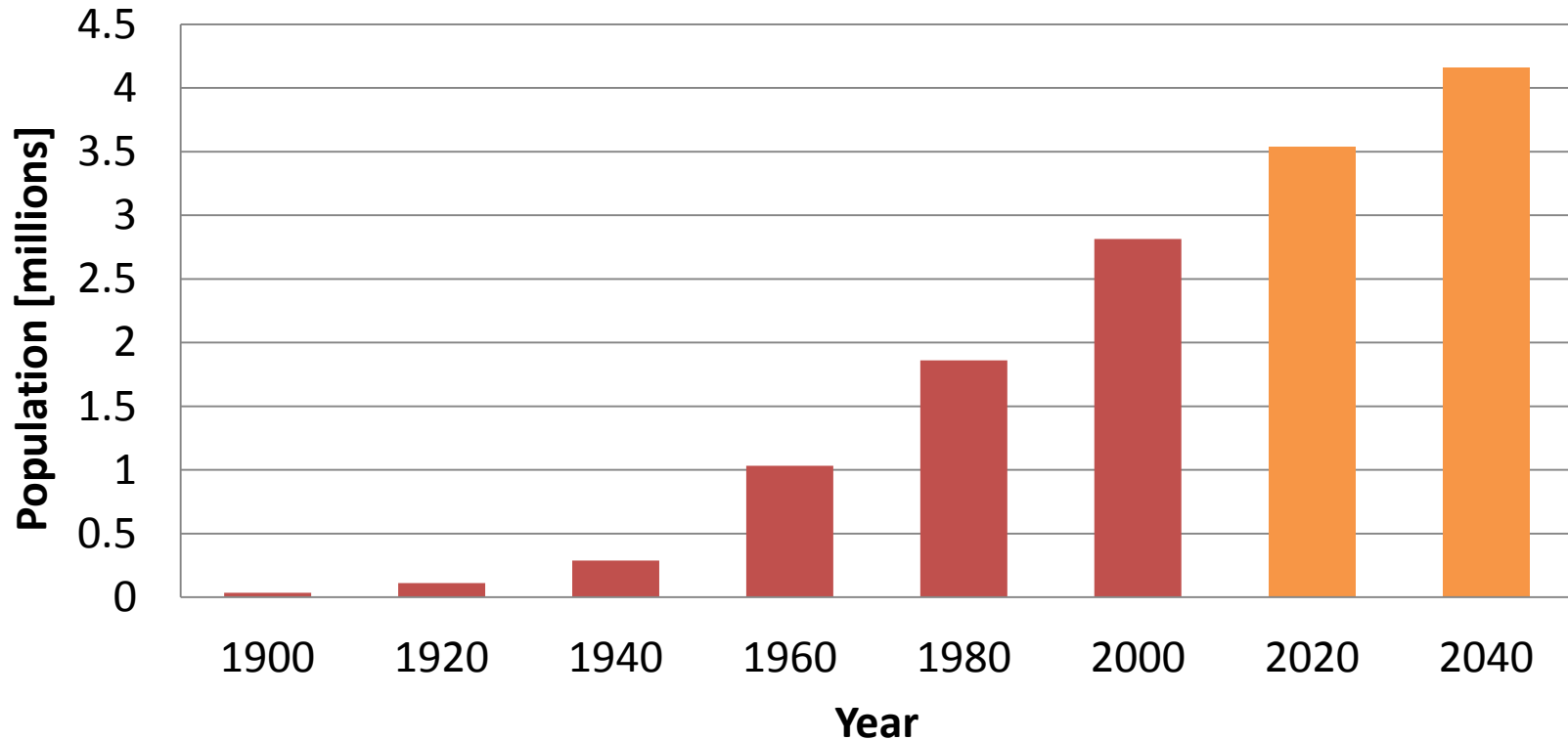
Recap

- San Diego as well as Northern Baja should also consider policies that move towards cleaner energy.
- In the next few slides, we will examine the potential of switching over to methods such as solar and wind power generation.
- Most of our analysis was performed using Esri's ArcGIS software.

Recap

- In order to move to a more sustainable San Diego, one has to take into account projected population growth which in turn determines the demand for energy.

Population of San Diego County



- By 2040, San Diego County's population is projected to be 4.24 million.

SANDAG



*Depleted Irrigation to the Rice
Farms of Richvale, CA*

By 2050 the demand for water will **increase by 37%** while the major sources of water — the Colorado River and the rivers of Northern California — could **shrink by 20% or more.**

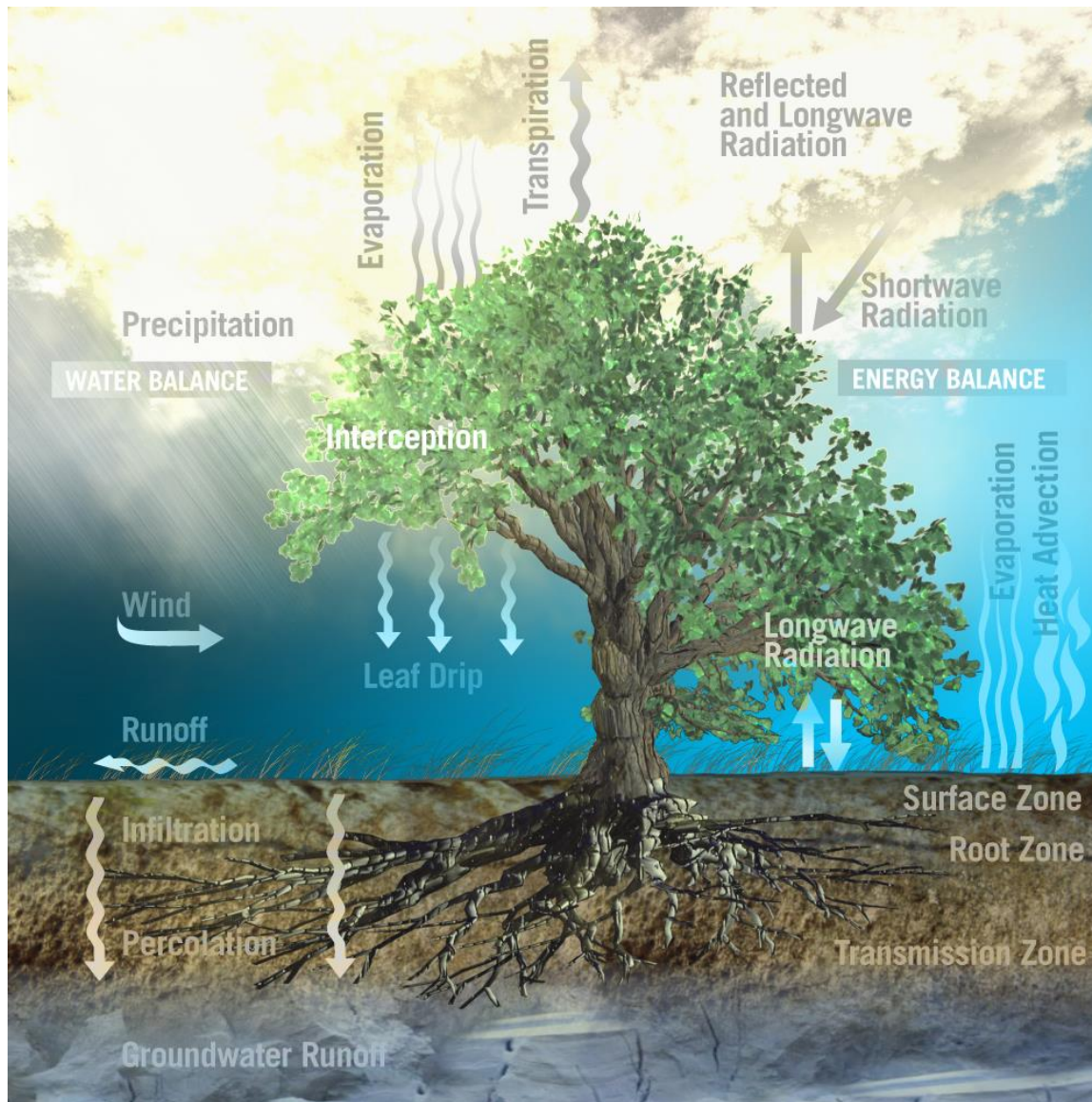
The San Diego Foundation

San Diego County & The Water Situation

San Diego County acts as a Coastal Hydrological Cycle



4° ESO Bilingual Group



Three Primary Components to the Hydrologic Cycle

- Precipitation
 - Evaporation
 - Surface Runoff
- San Diego County has been experiencing increasingly infrequent *precipitation* in recent years from drought.
 - However, when it does rain the *surface runoff* can have a profound affect on the environment and our communities.

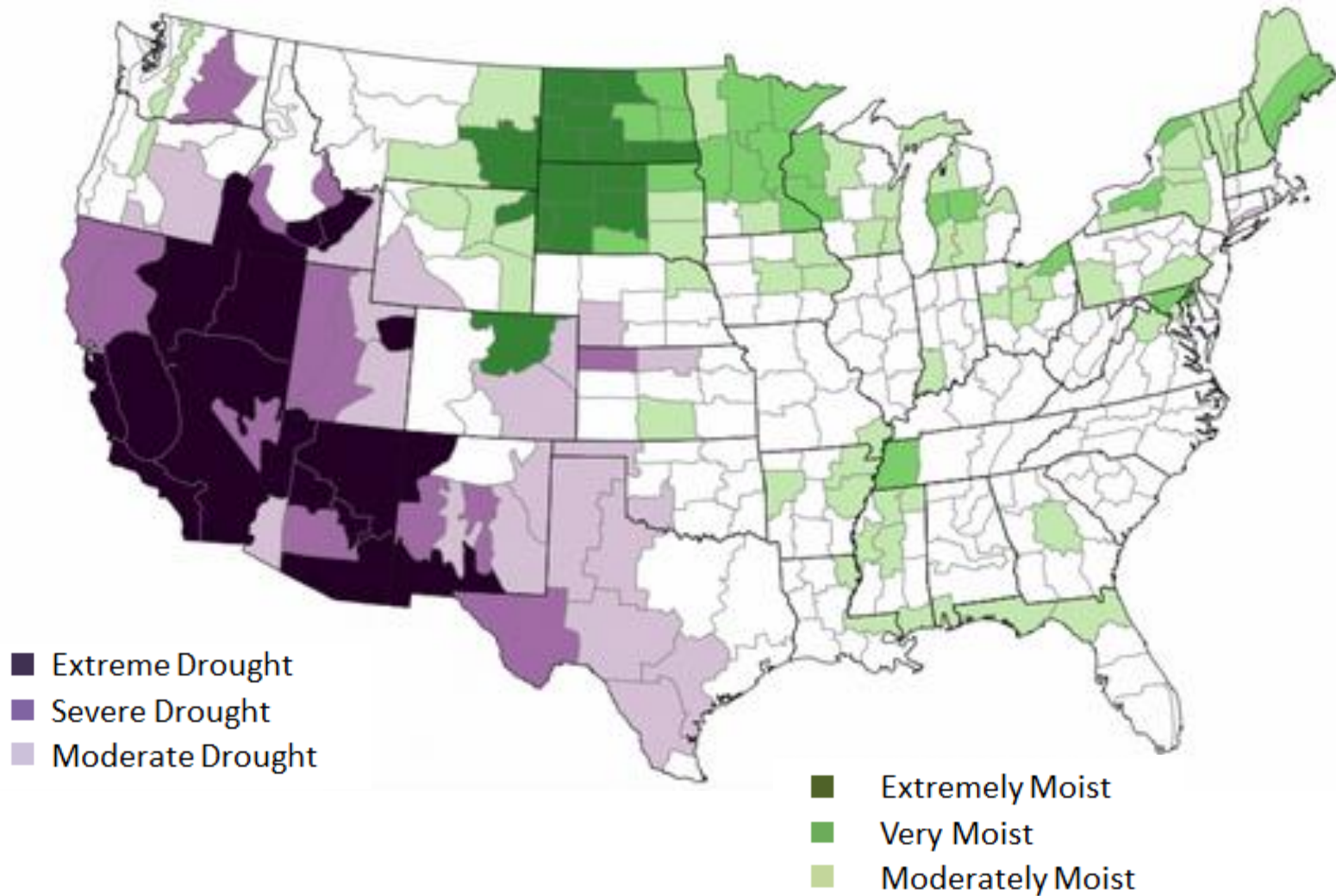
European Space Agency

This is what happens as a result of intense surface runoff...



Image shows part of the Interstate 10 that was washed away from this last weekend's rain (July 18-19, 2015). Just months prior, the freeway passed an inspection with an A rating.

National Extent of Drought - July 2014



National Climatic Data Center

DROUGHT SEVERITY Data as of March 31

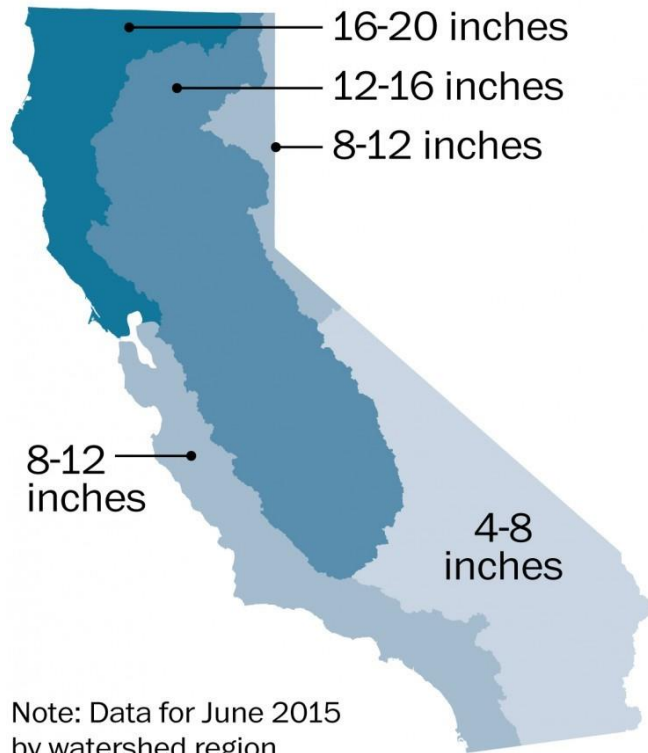
- Exceptional
- Extreme
- Severe
- Moderate
- Abnormally dry



Source: National Drought Mitigation Center

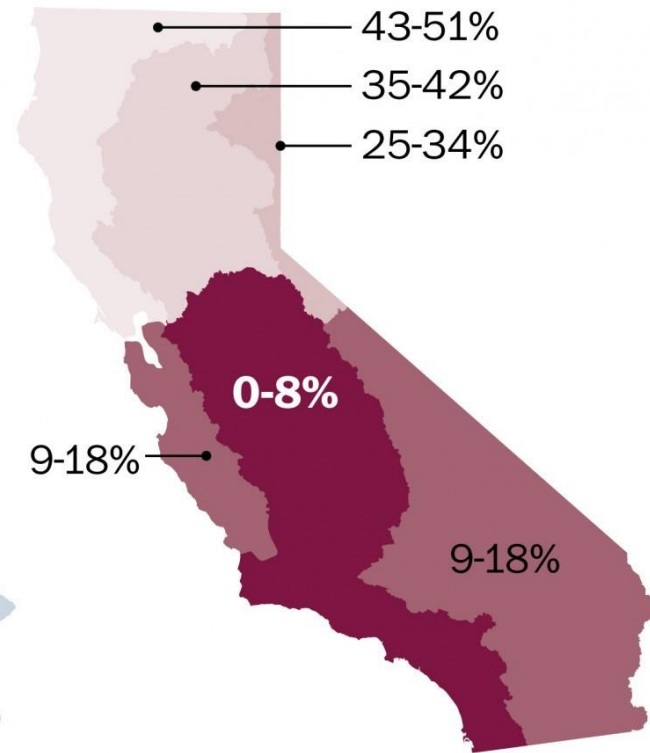
THE WASHINGTON POST

Precipitation needed to end the drought in six months



Source: NOAA

Probability of the drought ending in six months

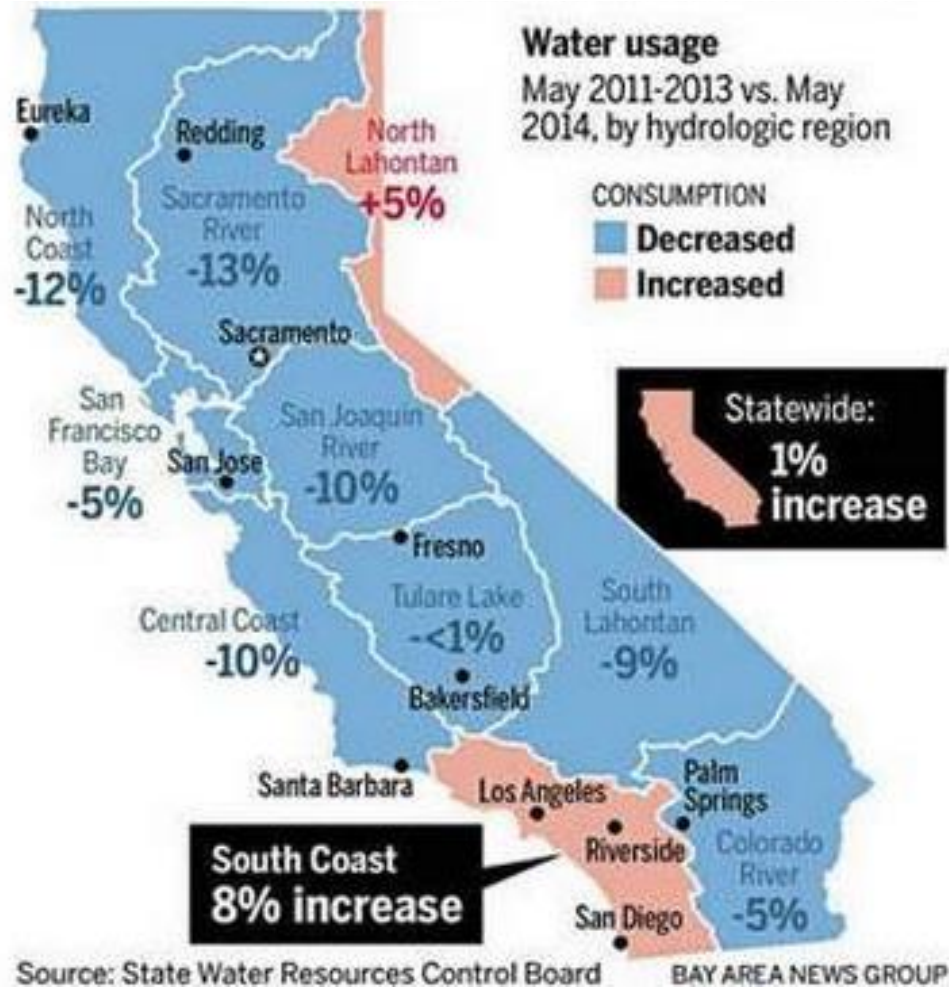


THE WASHINGTON POST

- The 1-2 inches of rain in the San Diego County this July has not scratched the surface of California's drought.

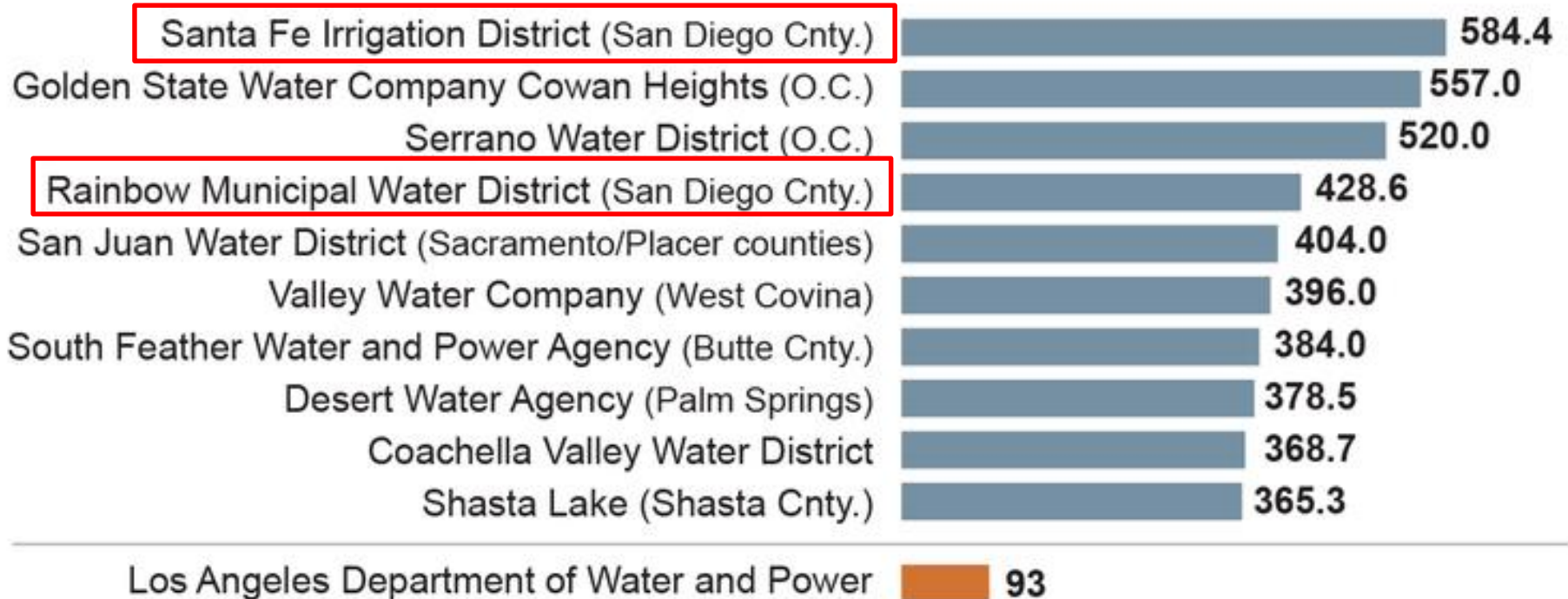
Who saved, who didn't?

Though most regions reduced their consumption this year, CA as a whole consumed 1% more than the average May over the past three years, mainly due to Southern California



Highest water consumption in California

Self-reported residential gallons per capita per day in September 2014: *



*12% of water districts did not report their data.

Source: State Water Board

@latimesgraphics

- San Diegans need to start thinking about alternative sources for water.

Traditional Sources



Desalination in California

The nation's largest ocean desalination plant is under construction in Carlsbad and set to open in 2016. Only three small plants are open now, and about 15 others are proposed.

Desalination plants

- Existing (Red square)
- Proposed (Blue square)

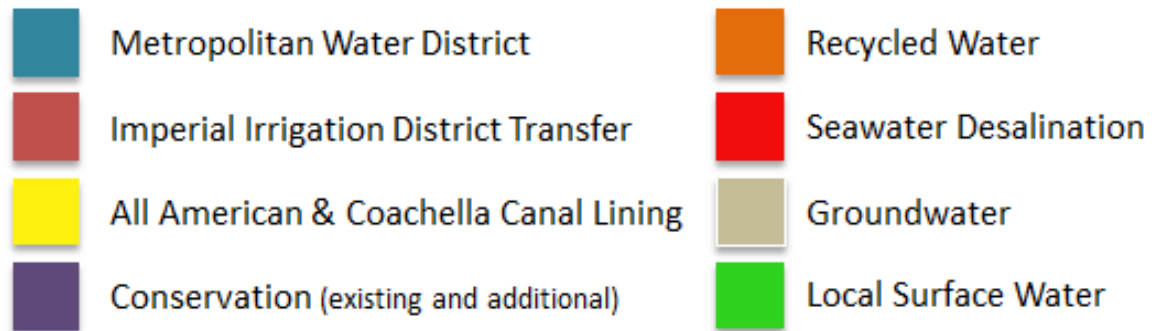
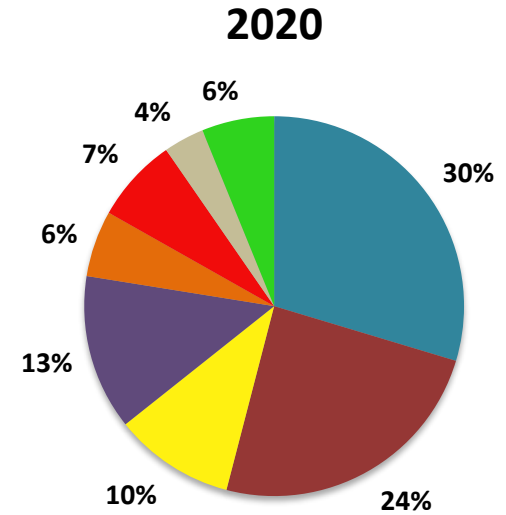
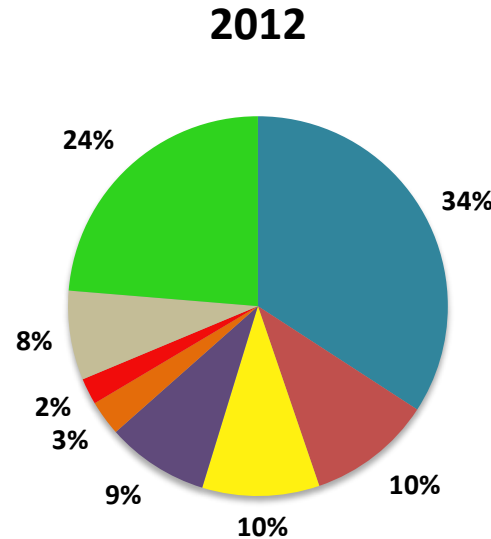
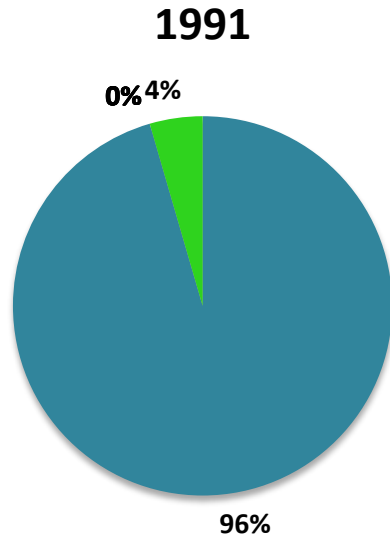


Source: California Department of Water Resources

BAY AREA NEWS GROUP

Washington Post

San Diego County Water Diversification



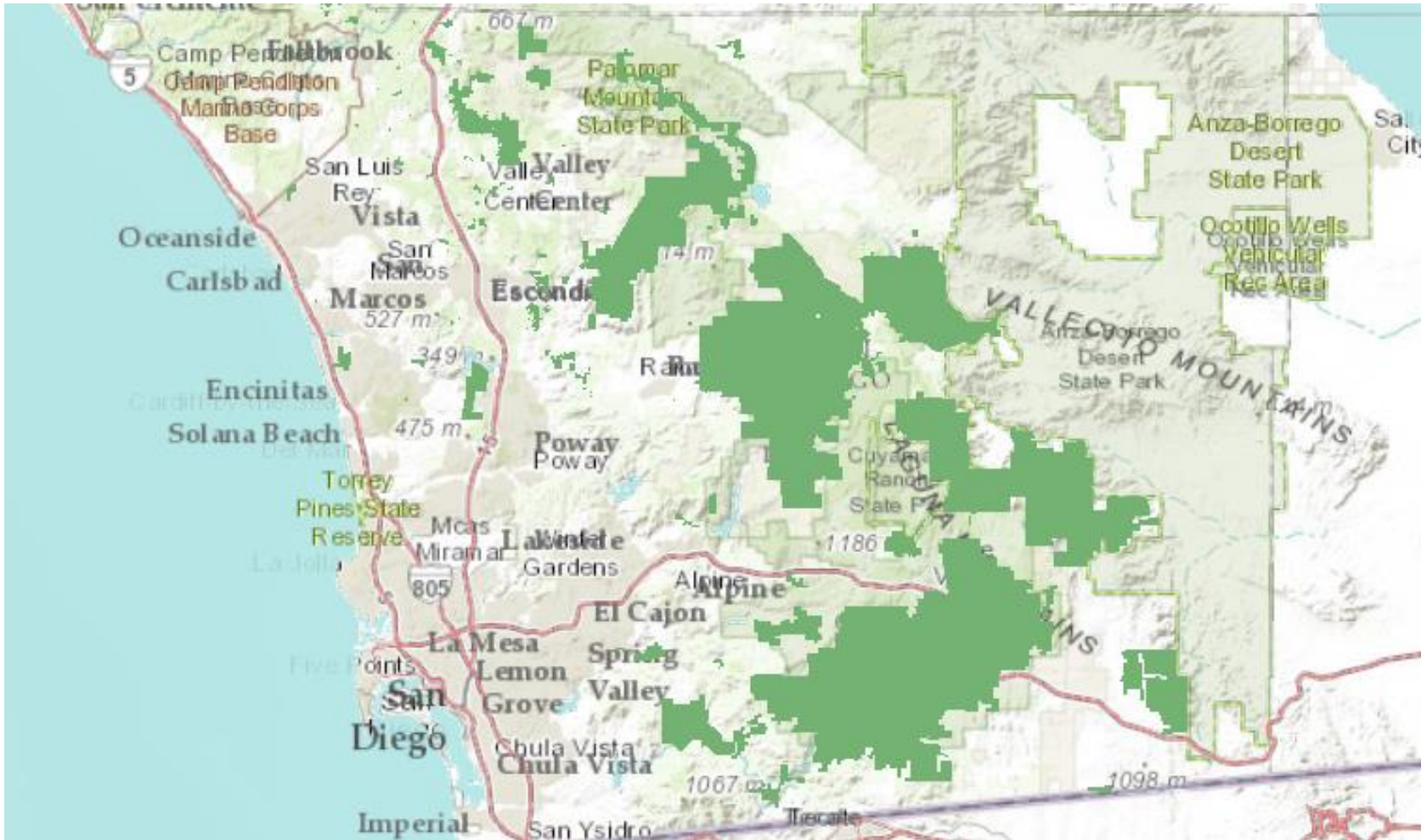
San Diego County Water Authority

San Diego Regional Breakdown



San Diego Gas & Electric

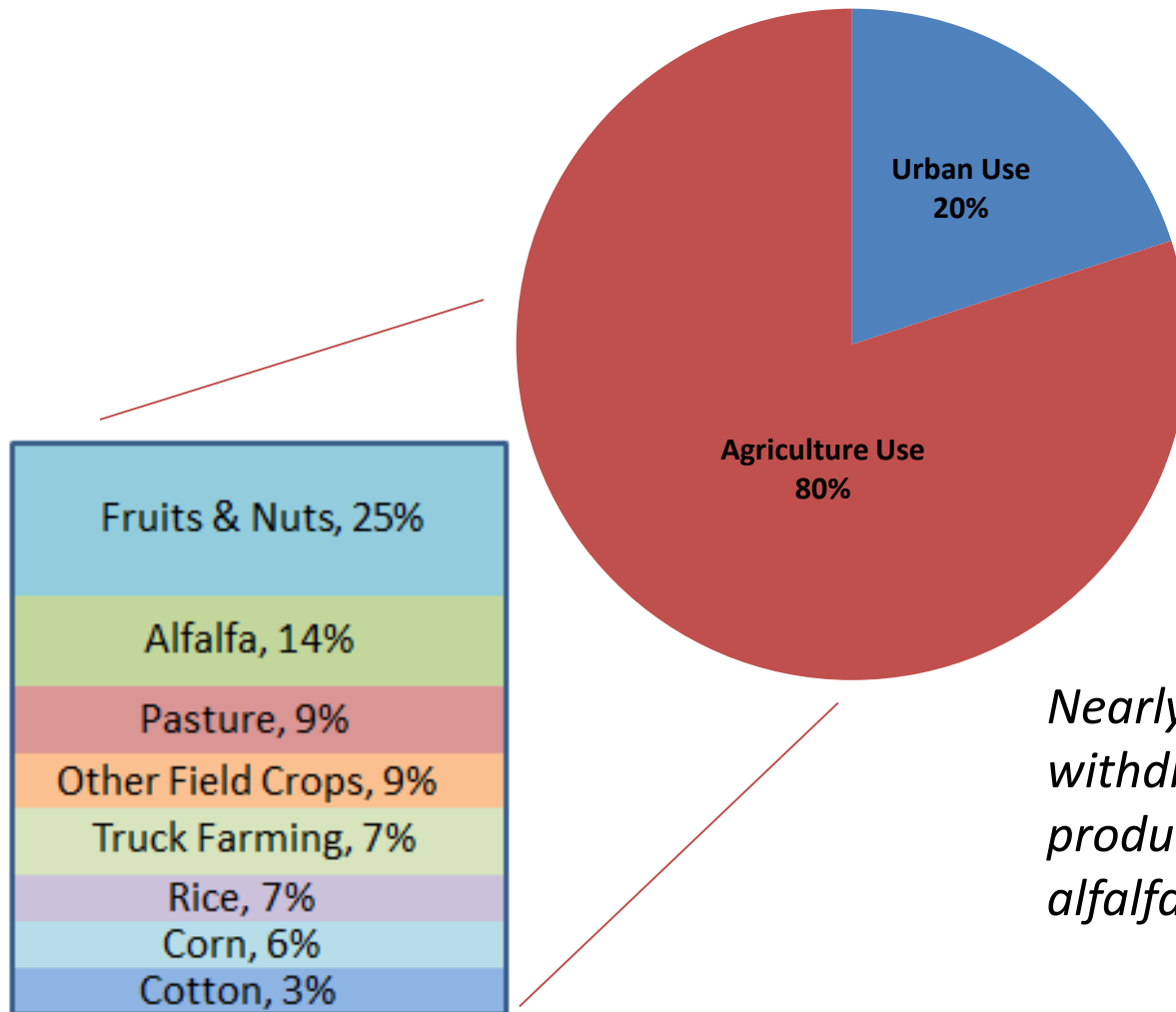
Agriculture



Major Agricultural Areas in *Green*

SanGIS Data Warehouse

Freshwater Use in CA by Sector and Crop



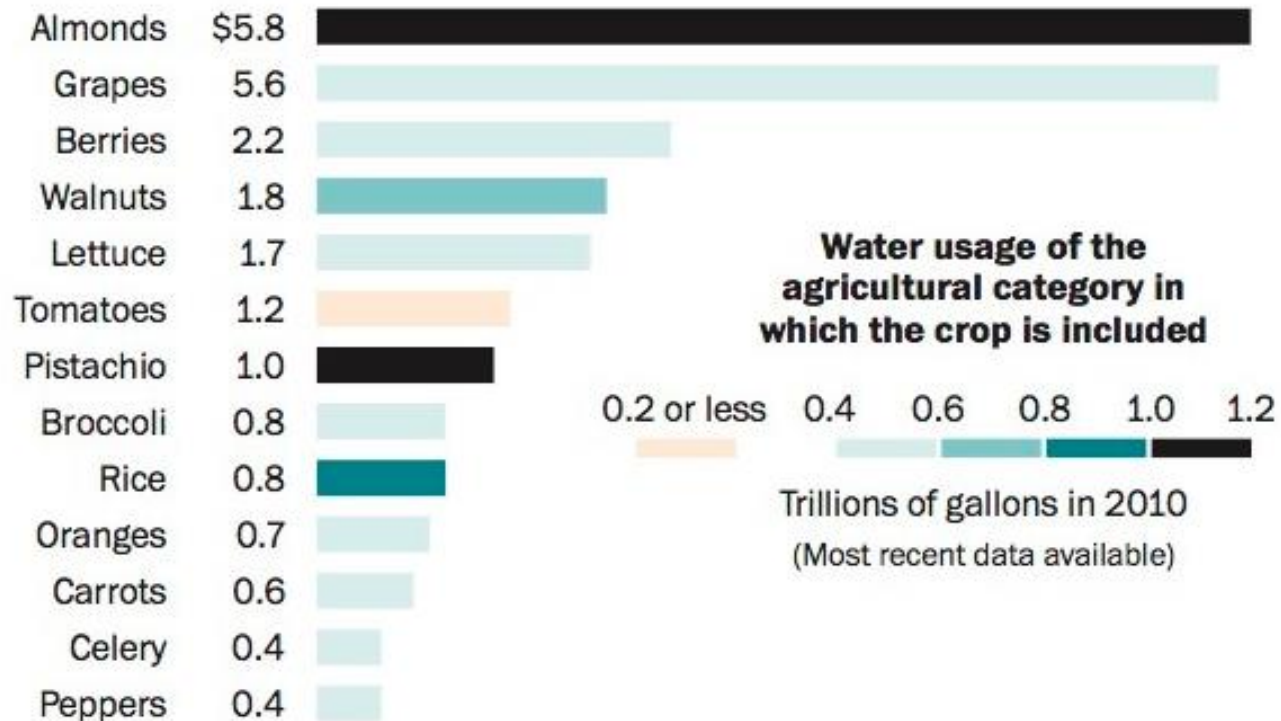
Nearly 40% of CA's freshwater withdrawals are used for the production of fruits, nuts, and alfalfa.

Hanak, Mount, and Chappelle 2014 – Hamilton Project

California's agricultural water sponges

Some of California's top agricultural commodities soak up a lot of water in order to cultivate crops.

Crop value in 2013 *In billions*



Sources: United States Department of Agriculture National Agricultural Statistics Service, California Department of Water Resources

CRISTINA RIVERO/THE WASHINGTON POST

Key Points

- Recently, it has become increasingly difficult to create policies that focus on reliable source that will meet the demands of San Diego County.
- Hence, the San Diego Water Authority has begun to implement supply diversification to release pressure off of the Colorado River and develop local reserves.
- In essence, practicing local *conservation* and *recycling* as well as employing new techniques like *desalination* will ultimately be the path to a sustainable San Diego.

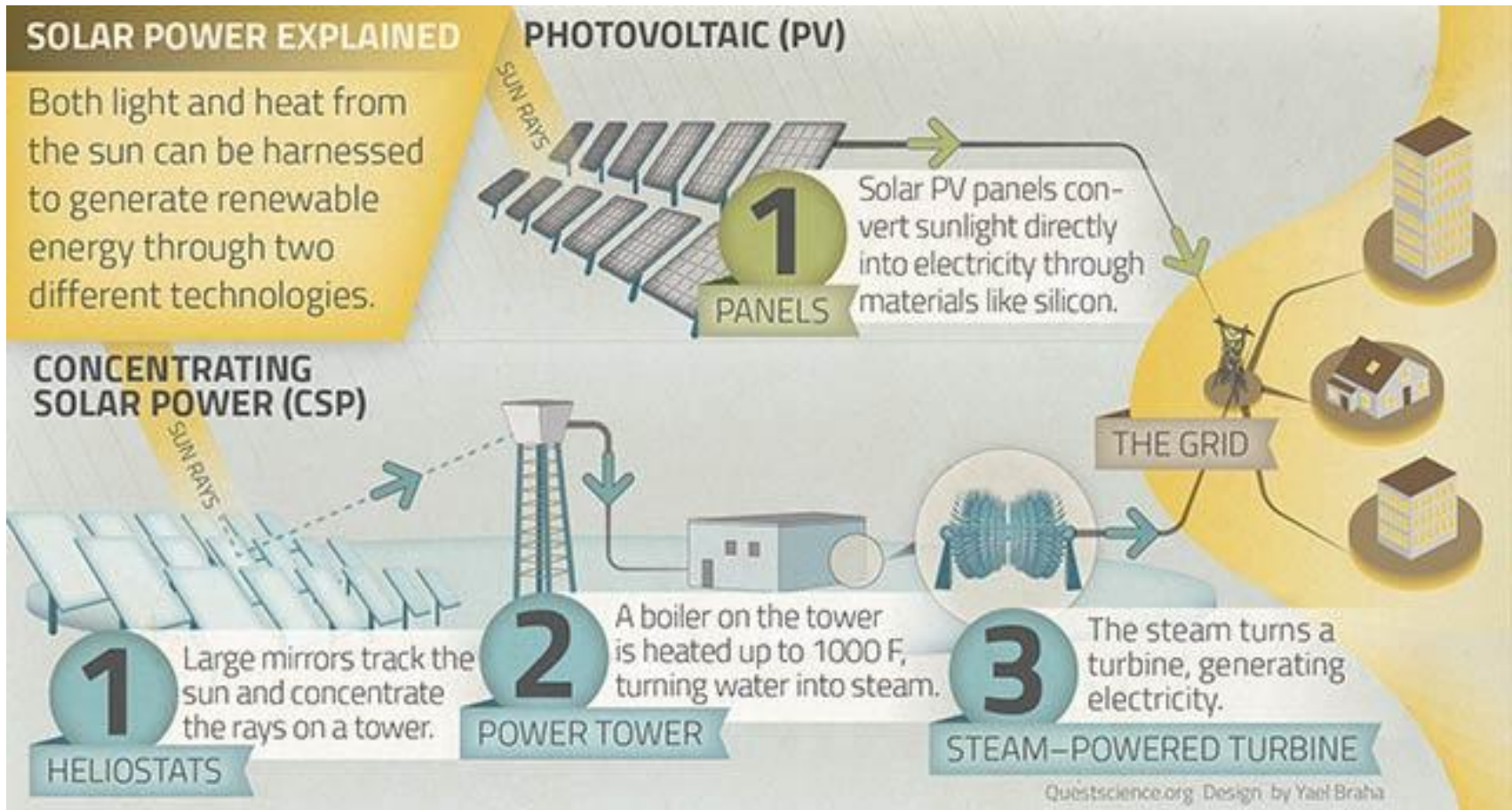
San Diego County

Energy

Solar Power

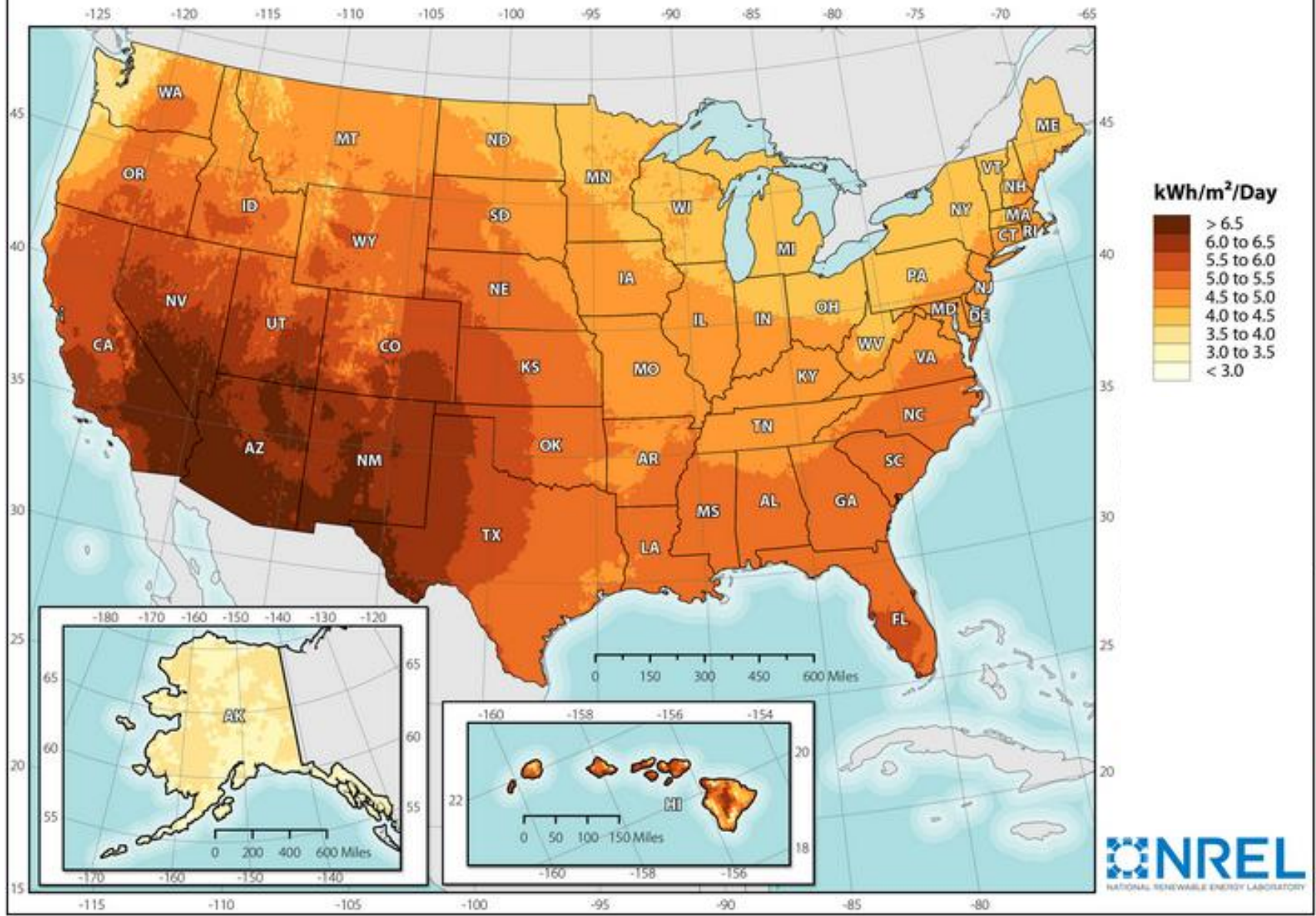
Two Primary Types of Solar Power

- *Photovoltaic (PV)*
- *Concentrated Solar or Solar Thermal*

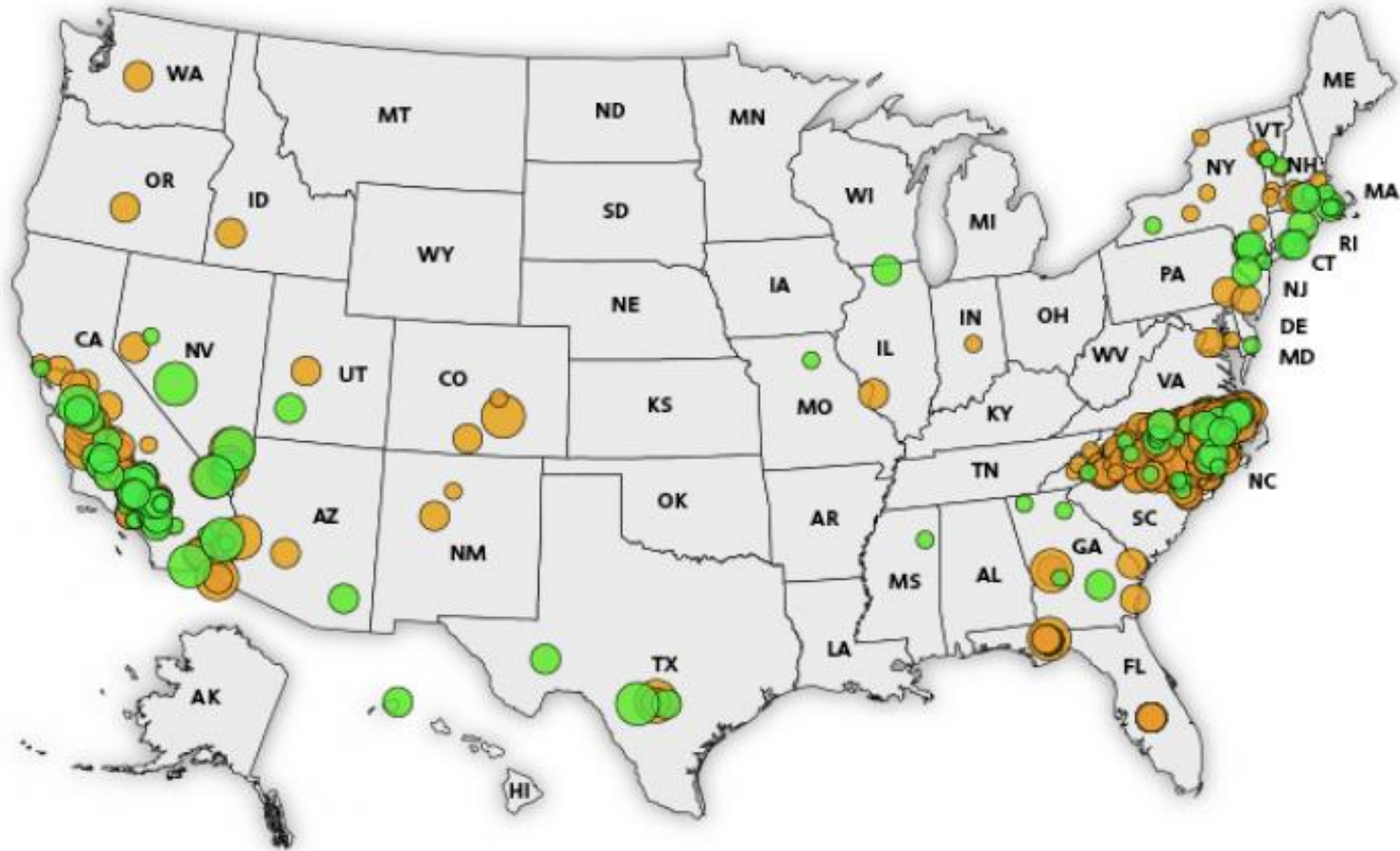


KQED Science Department

Photovoltaic Solar Resource of the United States



US planned utility-scale solar projects in advanced development or under construction



Development status

- Advanced development
- Construction begun

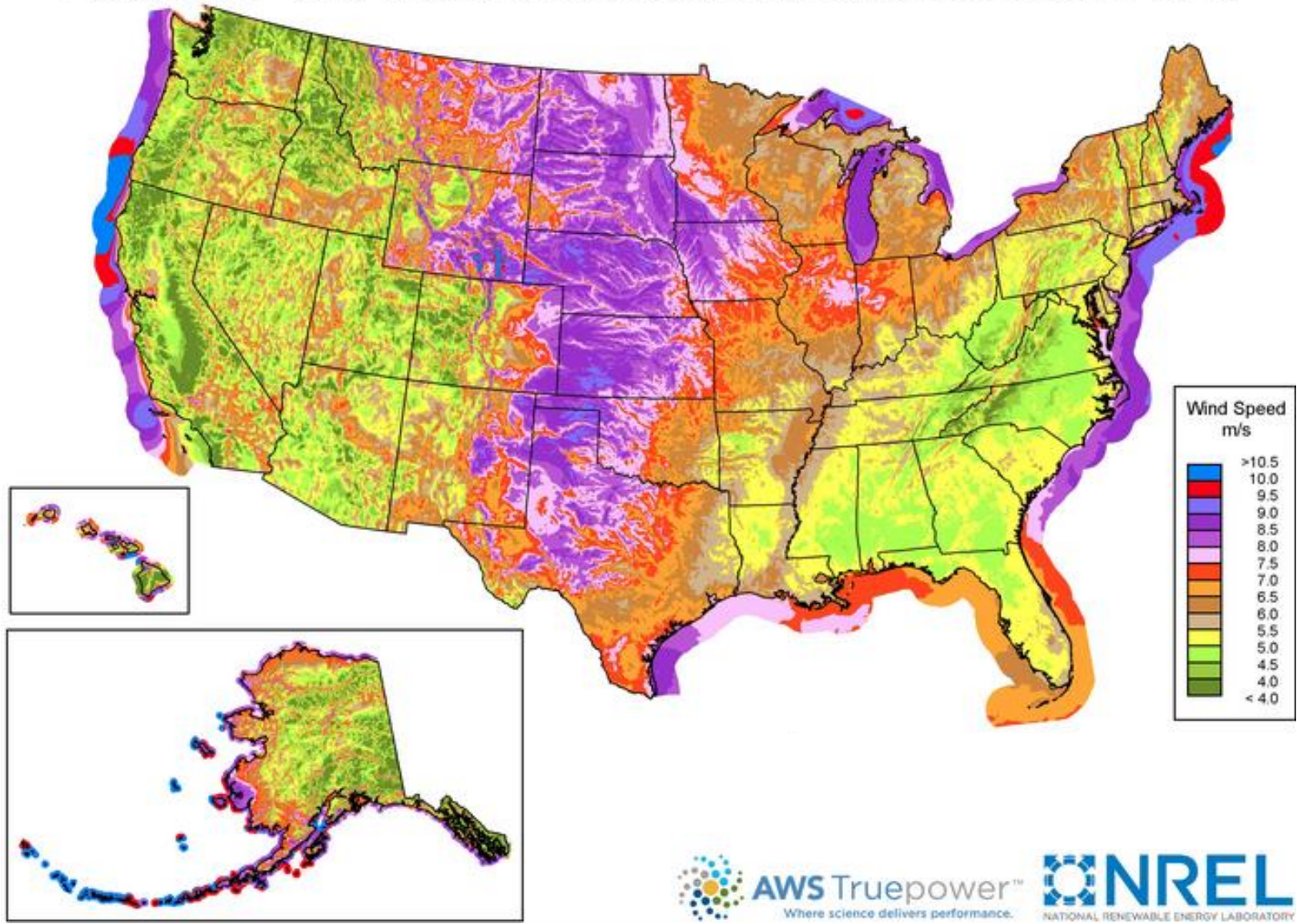
Planned capacity (MW)

- 0 - 5
- 6 - 100
- 101 - 1,250

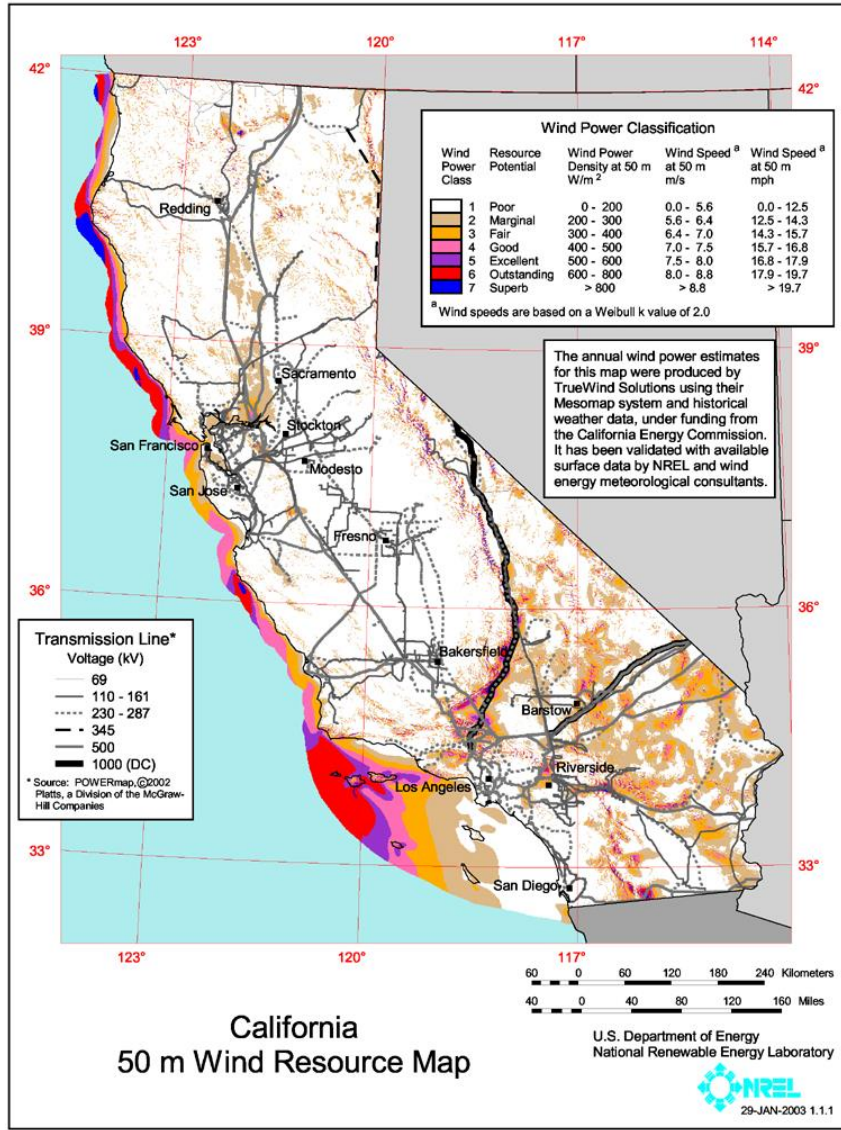
As of Feb. 19, 2015.
Source: SNL Financial
Map credit: Whit Varner

SNL Financial

United States - Land-Based and Offshore Annual Average Wind Speed at 100 m



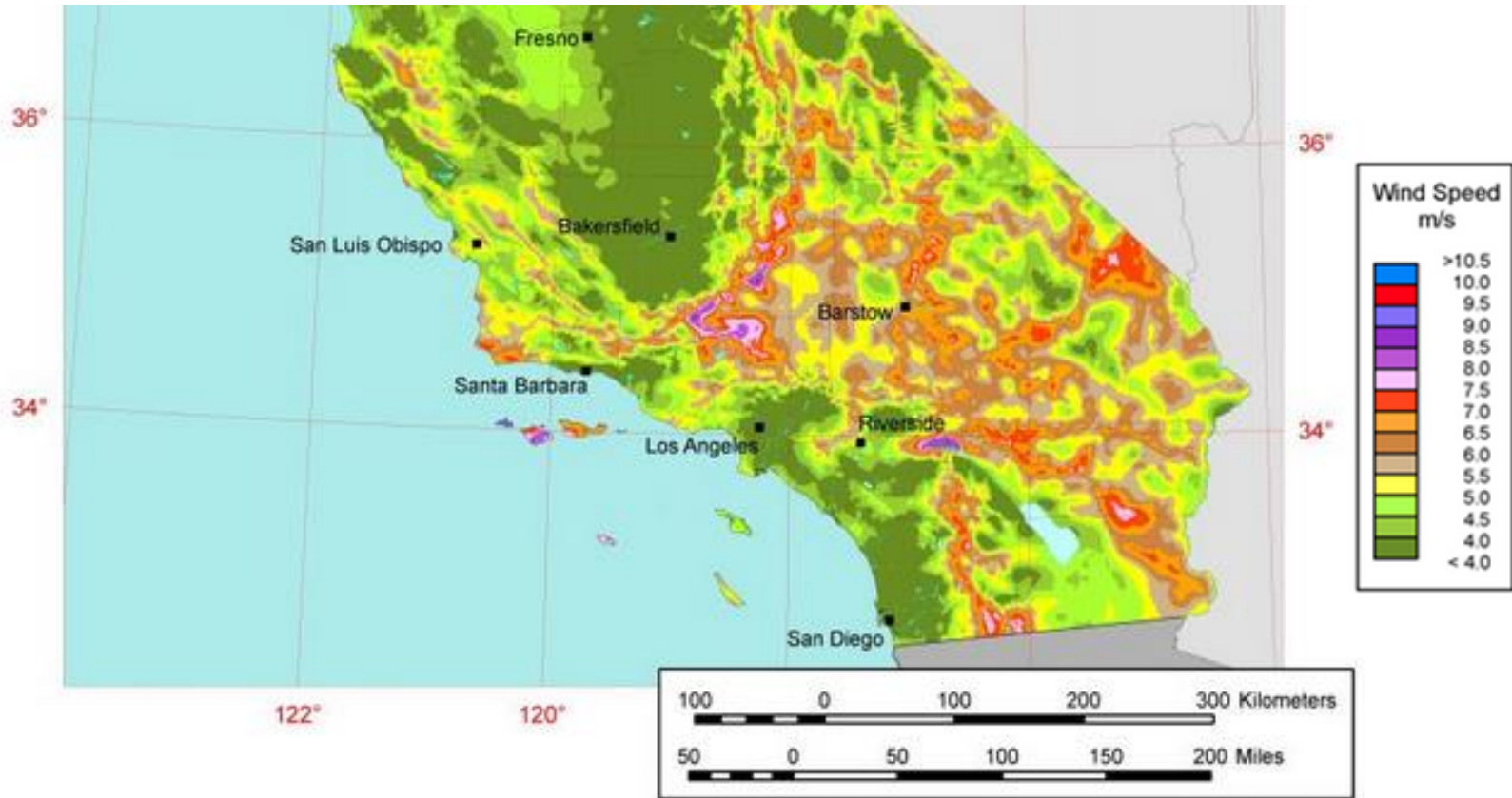
Wind Power



- San Diego County has poor potential for Tidal and/or offshore Wind Power Generation
- Most of the County's wind potential is inland and along the Mexican border as shown.

Wind Potential

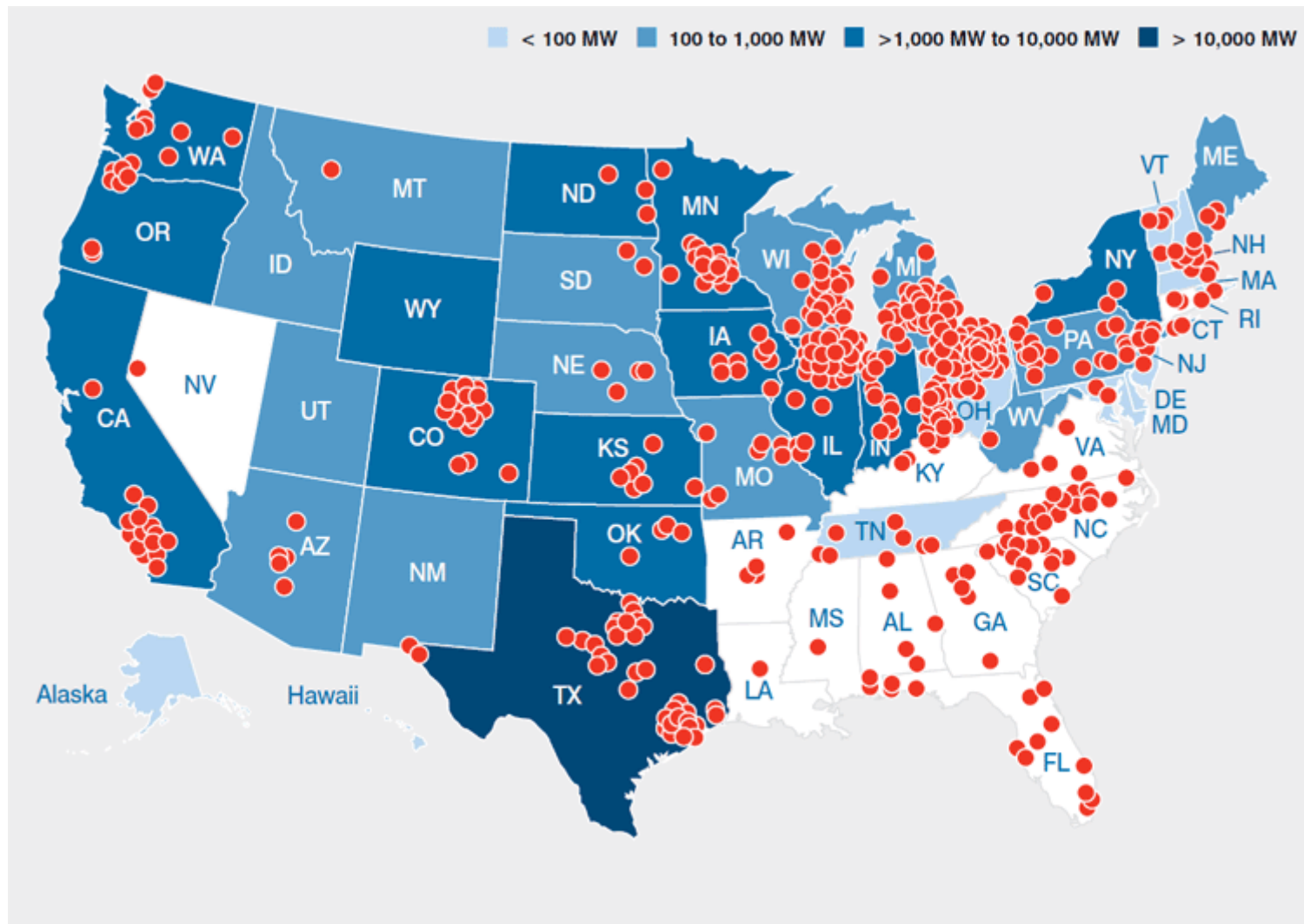
Looking in Closer at Southern California



AWS Truepower™
Where science delivers performance.



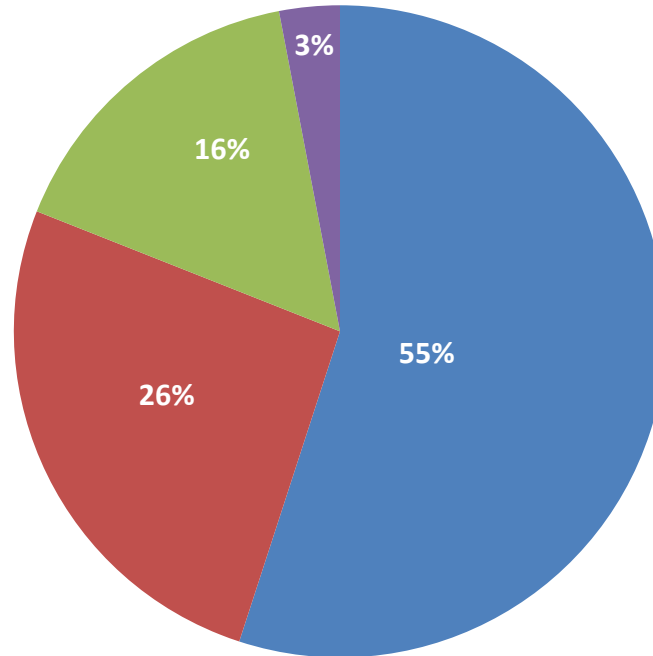
Wind Farms In the United States



U.S. Energy Information Administration (EIA)

San Diego County Carbon Emissions Breakdown

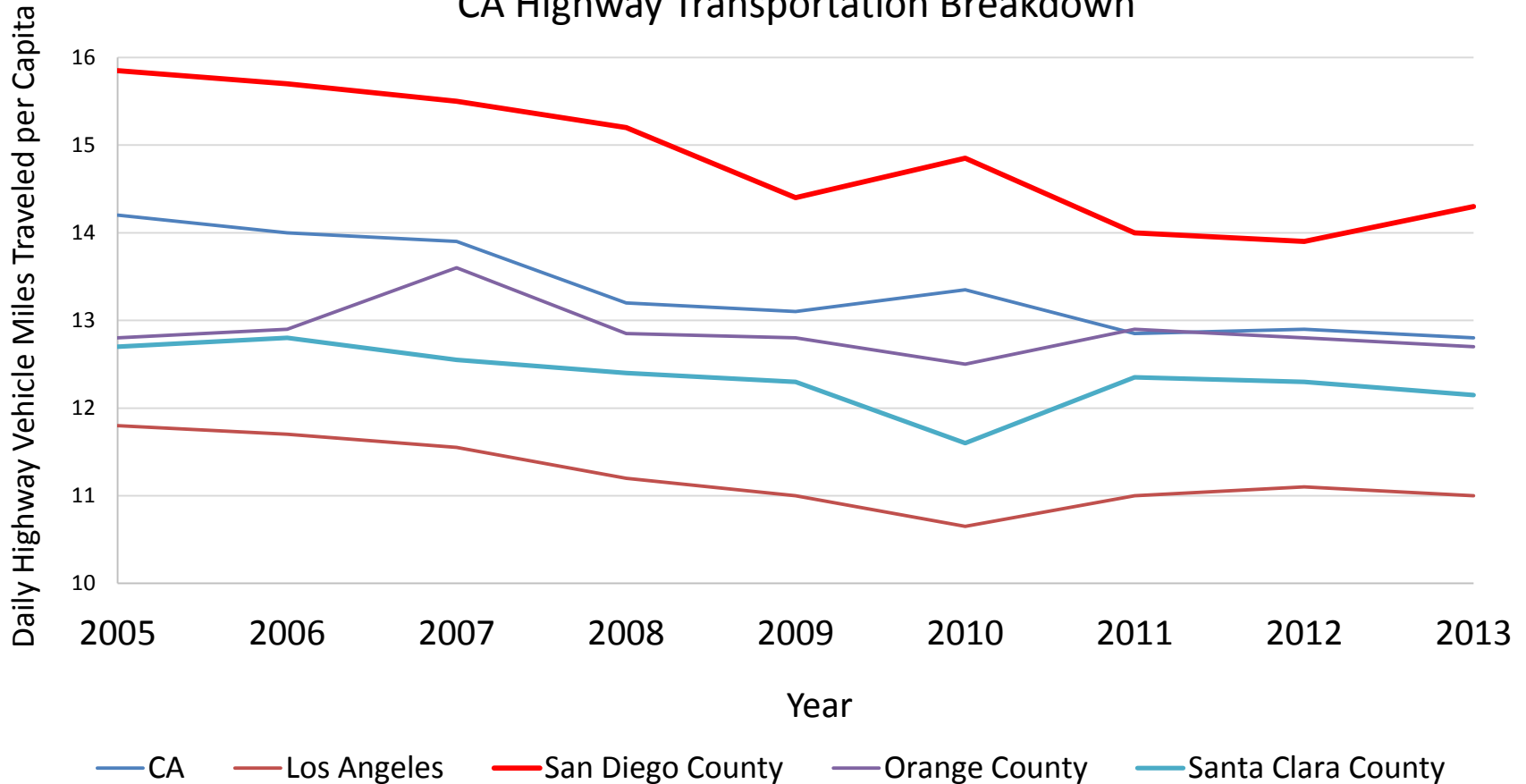
■ transportation ■ electric ■ natural gas ■ solid waste/waste water



Vast majority of San Diego County's Carbon Emissions comes from Transportation.

Transportation

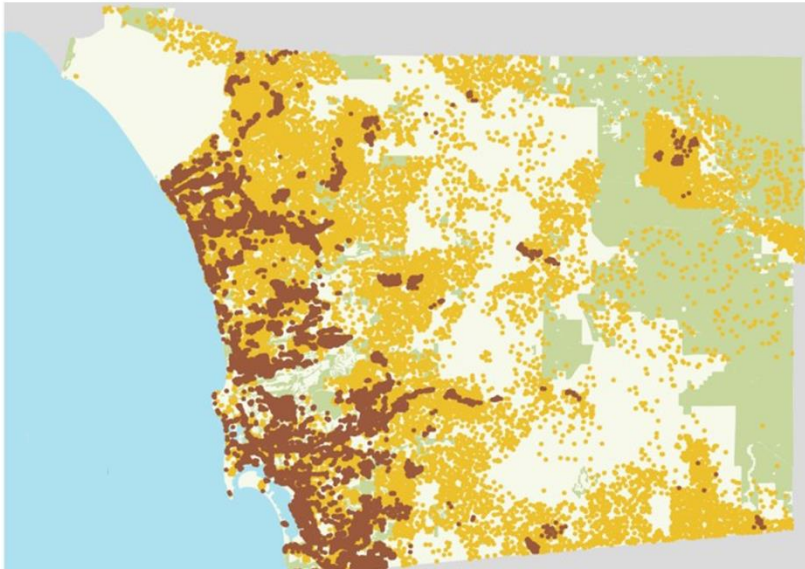
CA Highway Transportation Breakdown



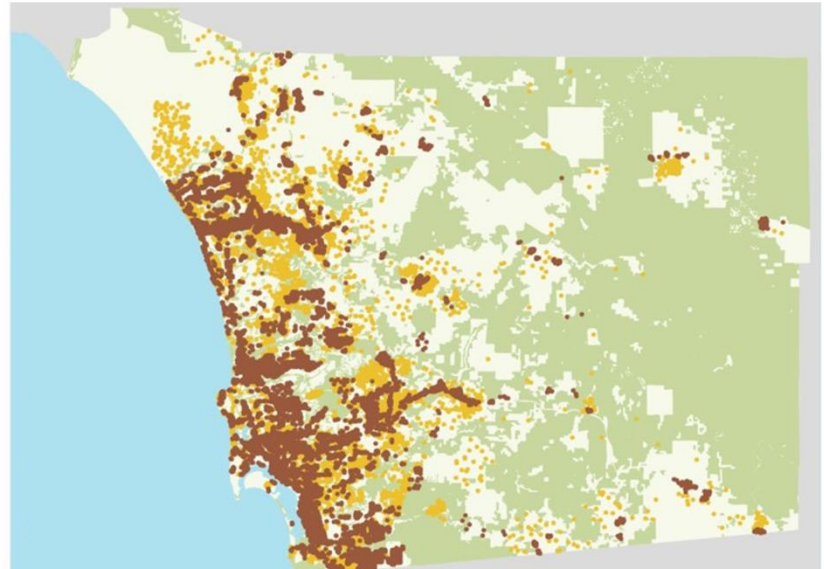
Equinox Center - 2014



San Diego Land Use

1999 Planned Land Use



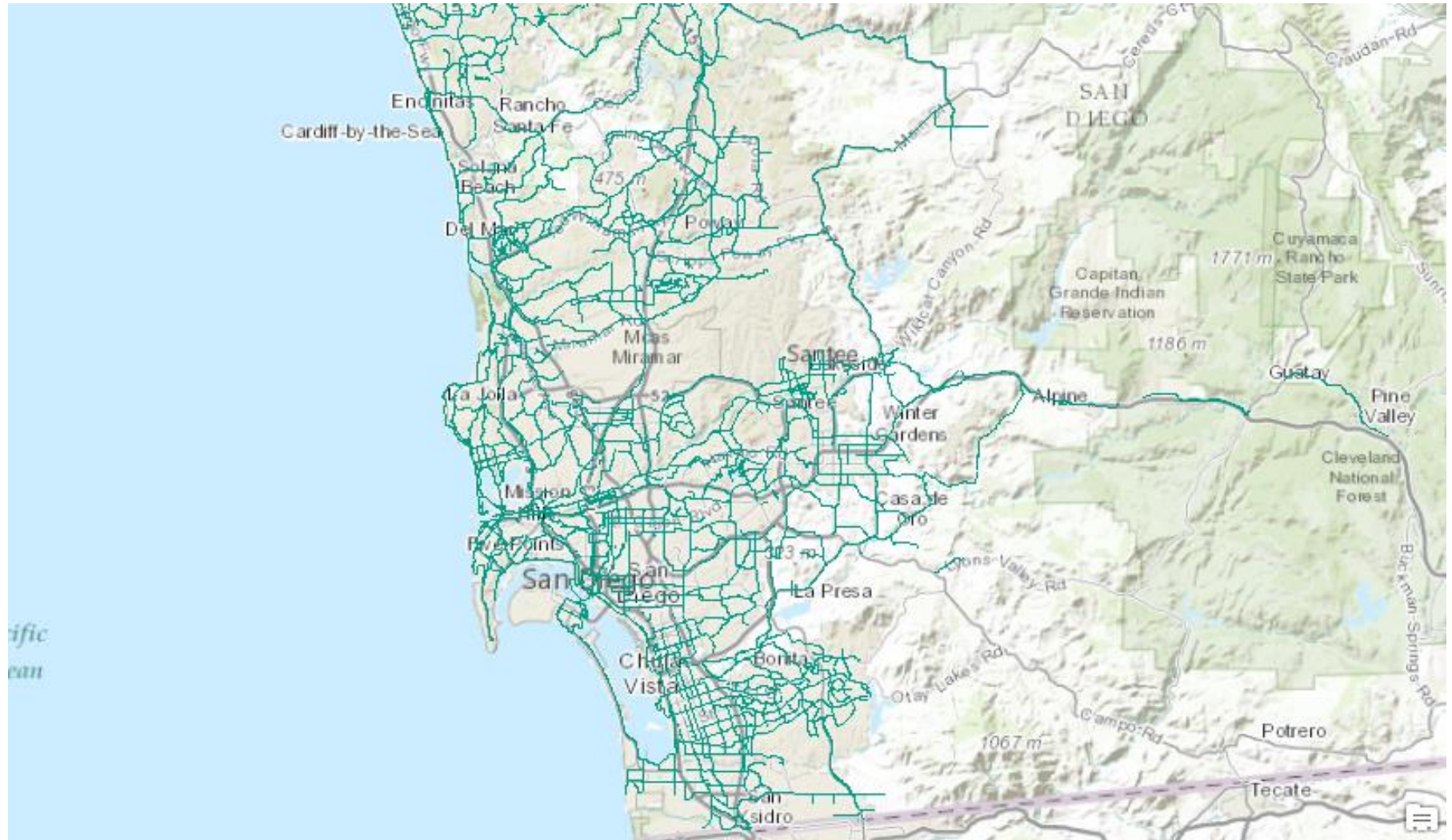
2015 Planned Land Use



-  Population Density
1 dot = 1 person
-  Employment Density
1 dot = 1 person

SANDAG -- San Diego Forward

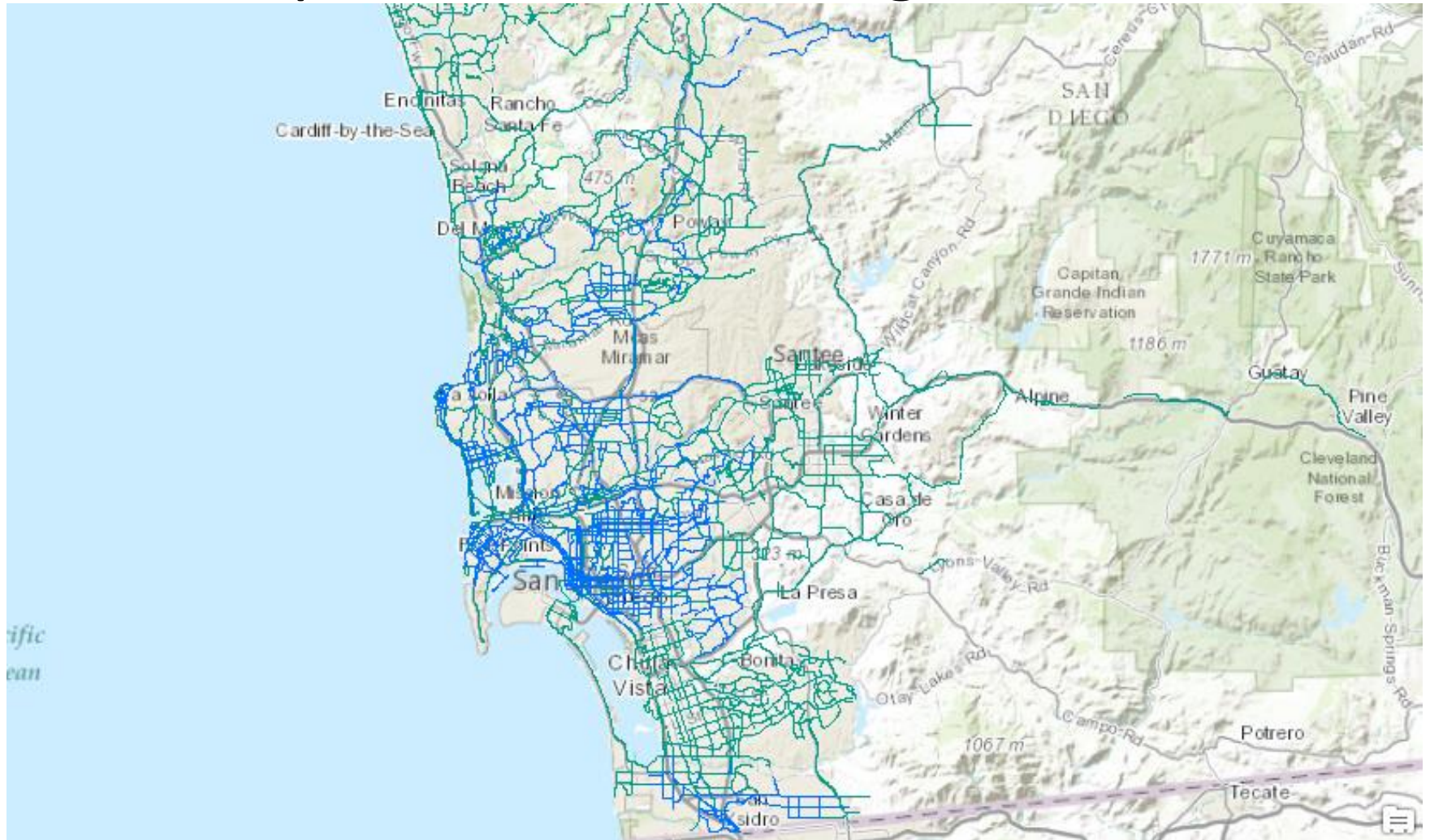
Transportation



SanGIS Database Warehouse

Current Bike Paths in **Green**

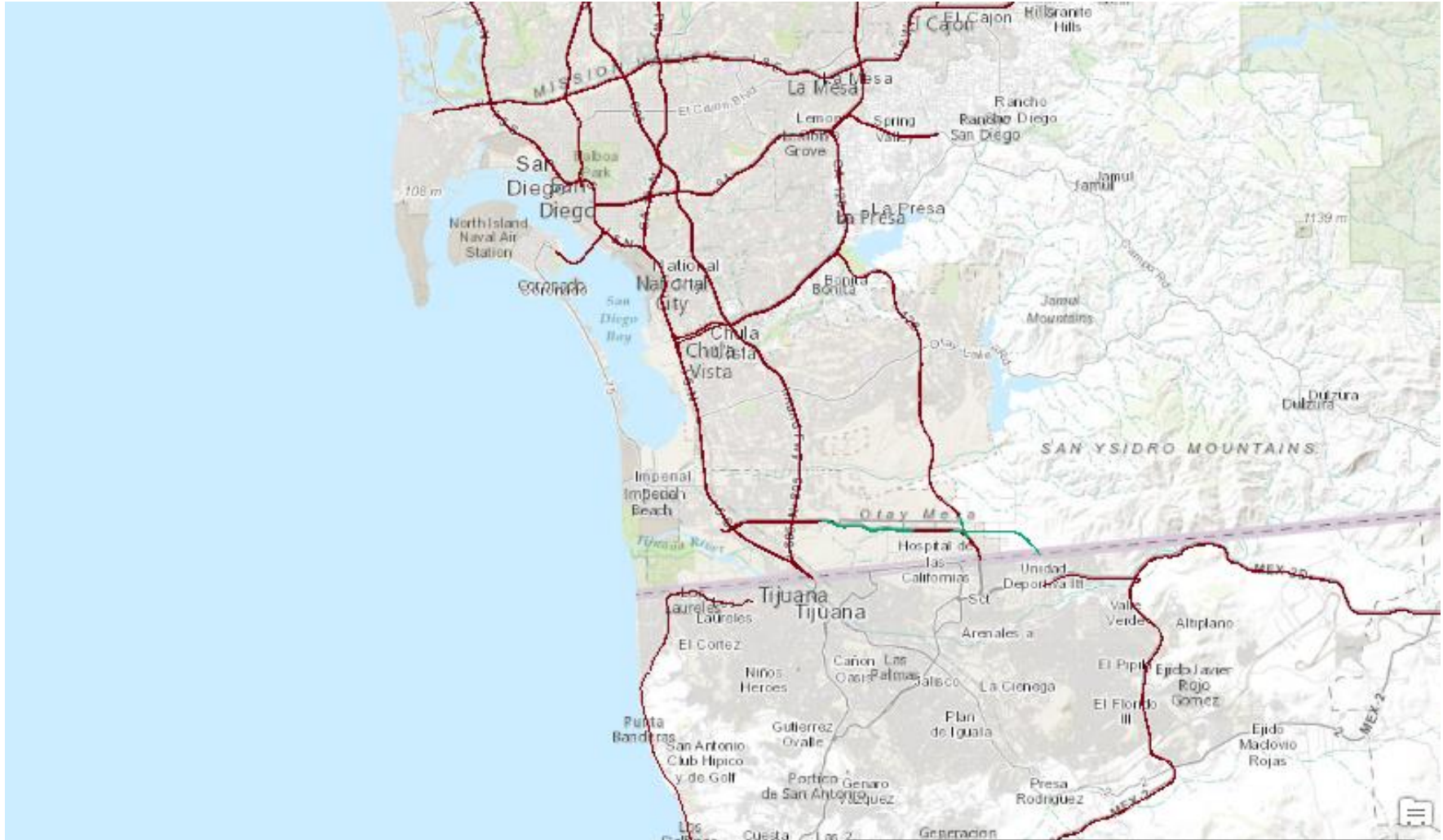
Transportation - San Diego Master Plan



Current Bike Paths in *Green*
Planned Bike Paths in *Blue*

SanGIS Database Warehouse

Transportation - San Diego Master Plan



Current Major Freeways in Red
Planned Major Freeways in Green

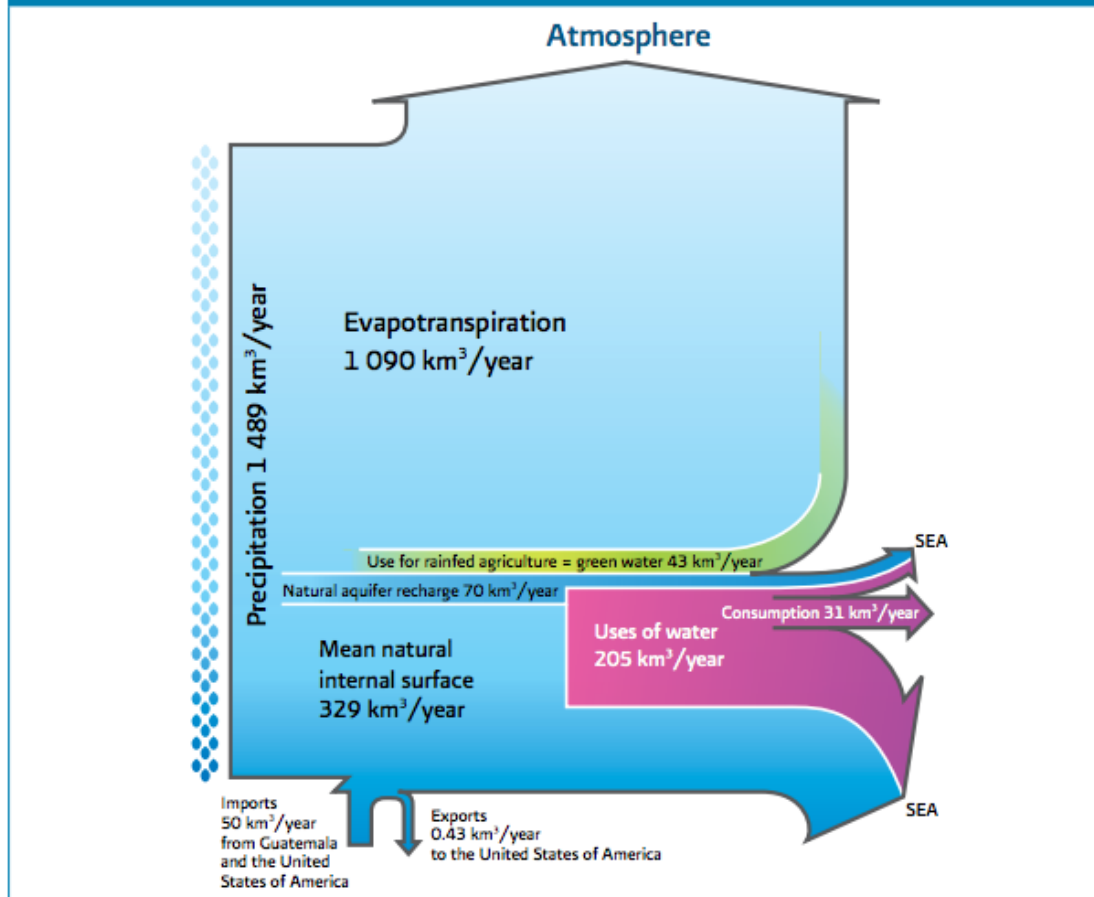
SanGIS Database Warehouse

Northern Baja

Water

Mexico Hydrological Cycle

G2.1 Mean annual values of the components of the hydrologic cycle in Mexico (billions of cubic meters, km³)



- Almost 70% evaporates and returns to the atmosphere, 20% runs off into rivers and streams and the remaining 4.7% naturally filters through to the subsoil and recharges the aquifers.

National Commission of Water (CONAGU)

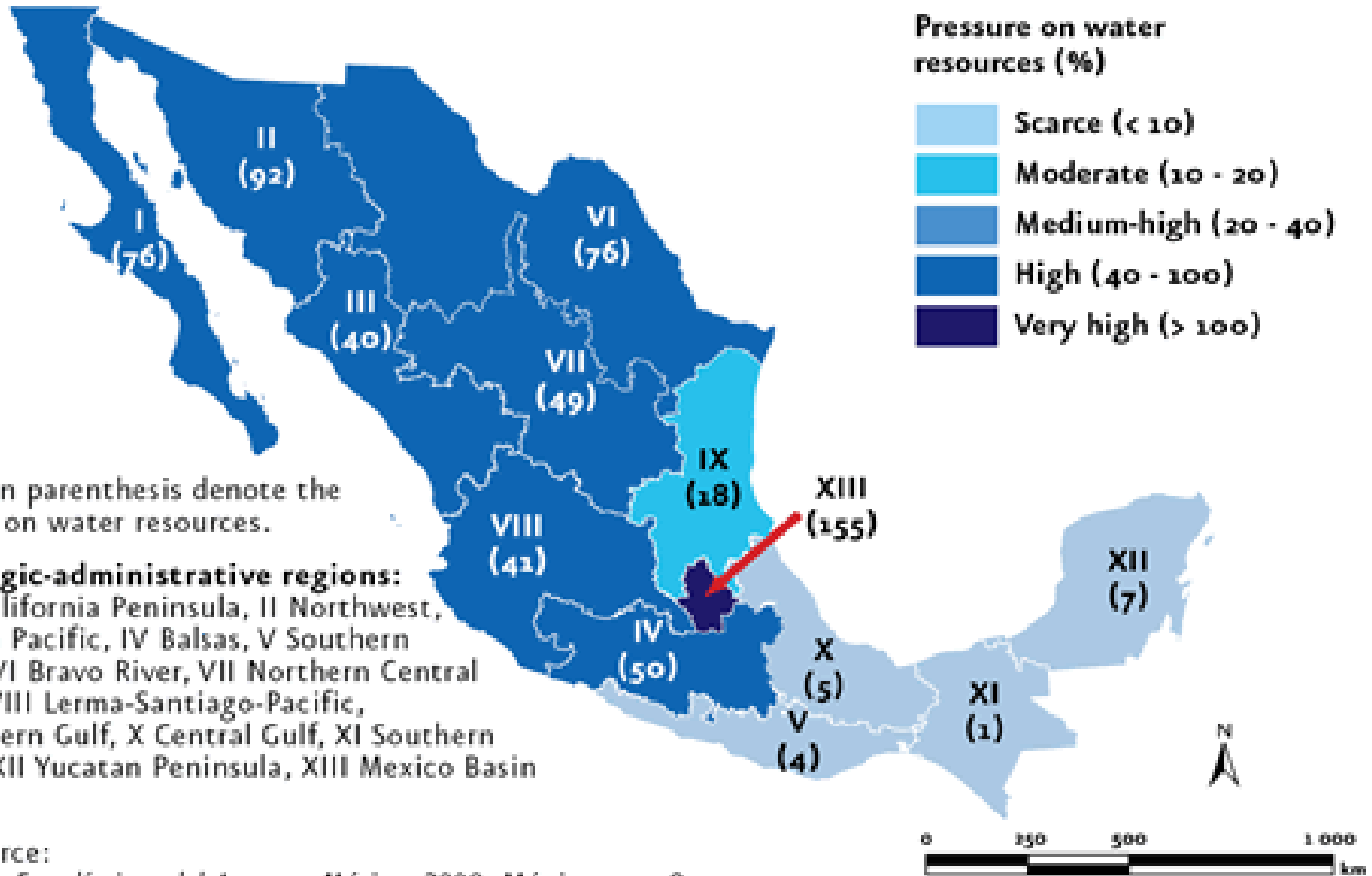
Northern Baja - Hydrology



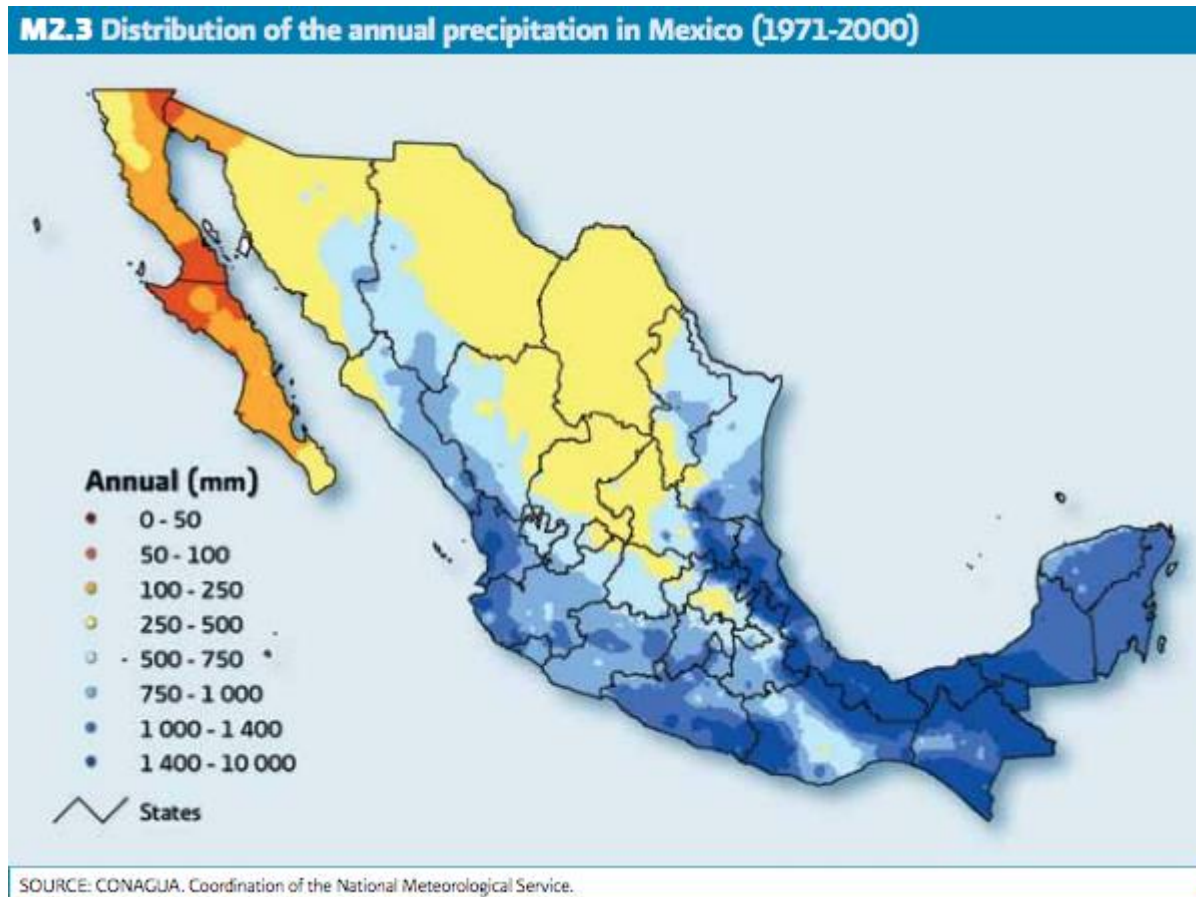
GENI Map using ArcGIS

Map 6.4

Pressure on water resources per hydrologic-administrative region, 2007



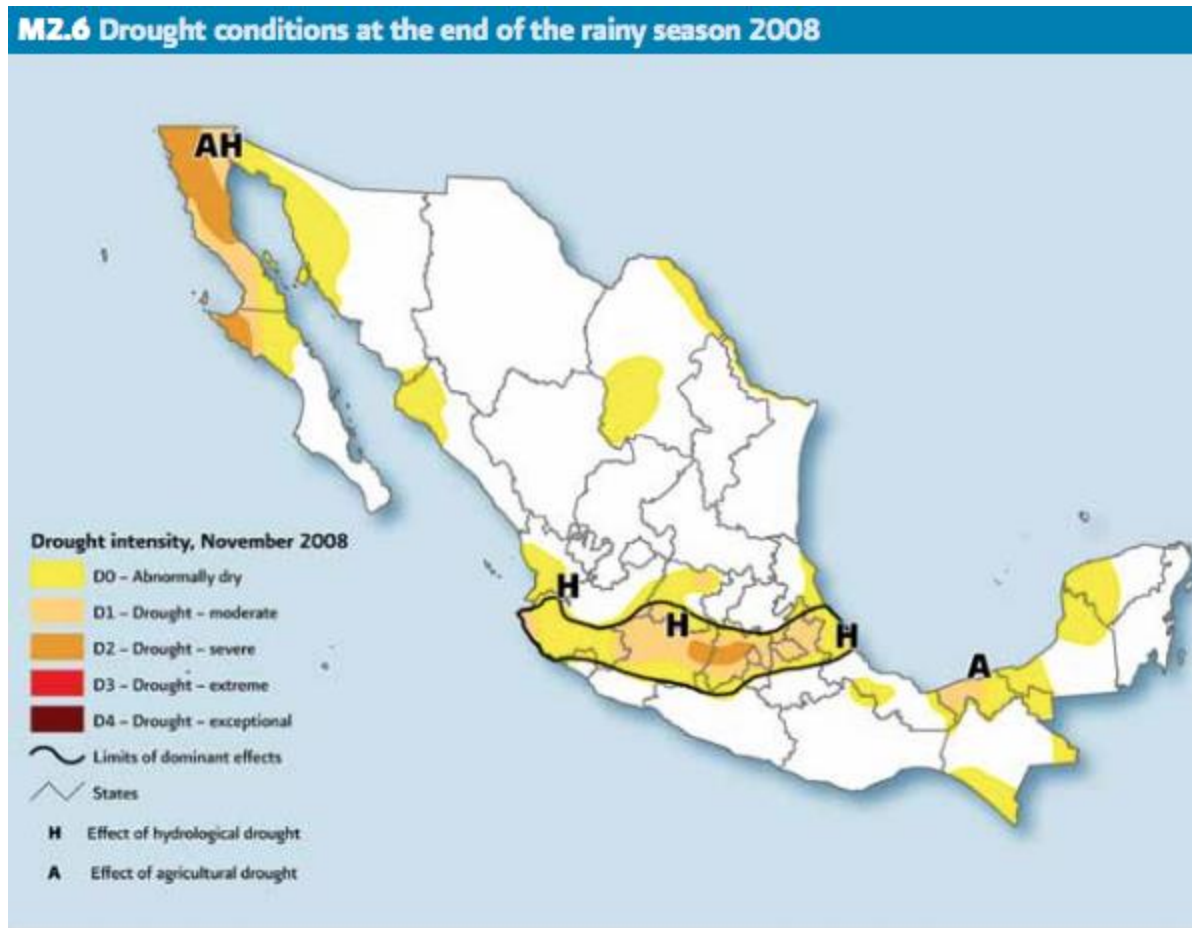
Annual Precipitation in Mexico



- Northern Baja is a drier region compared to the rest of the Mexico, but it is a massive commercial hub

National Commission of Water (CONAGUA)

Drought Situation in Mexico



- After the rainy season ends (June - Sept), the drought impacts Northern Baja severely

National Commission of Water (CONAGUA)

Aquifers in Mexico

MZ.9 Aquifers with saltwater intrusion and/or suffering from the phenomenon of soil salinization and brackish groundwater, 2008



- Overdrafted aquifers caused high indices of evaporation in areas of low groundwater levels, which leads to the dissolution of evaporate minerals and the presence of high-salinity connate water

National Commission of Water (CONAGUA)

Water Allocation in Mexico

M3.1 Intensity of offstream uses of water by municipality, 2008



National Commission of Water (CONAGUA)

Renewable Water Sources in Mexico

M7.2 Per capita renewable water resources by Hydrological-Administrative Region, 2030



SOURCE: CONAGUA. Deputy Director General's Office for Planning. Produced based on: CONAPO. Population Projections in Mexico 2005-2050. Mexico, 2007.

- As the population of Northern Baja increases, the demand for water will grow.
- The volume of wastewater that is treated and reused must increase significantly, with the aim of enhancing the availability of safe and clean water.

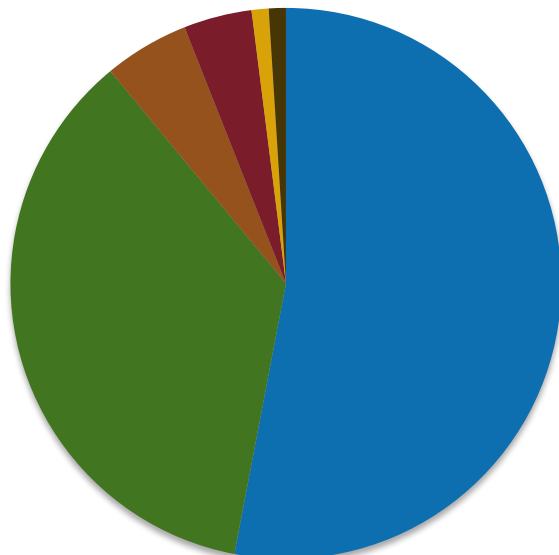
National Commission of Water (CONAGUA)

Northern Baja

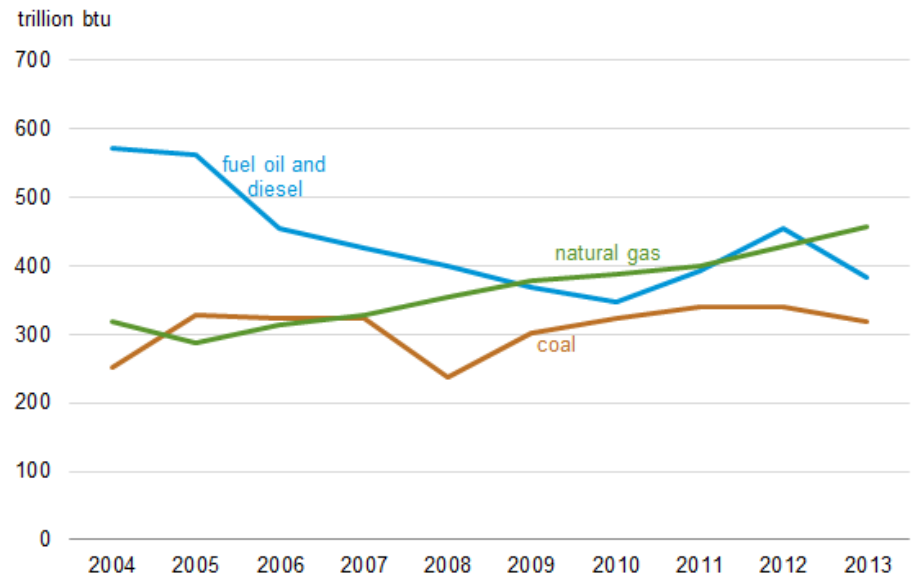
Energy

Total Energy Consumption Breakdown of Mexico

2012



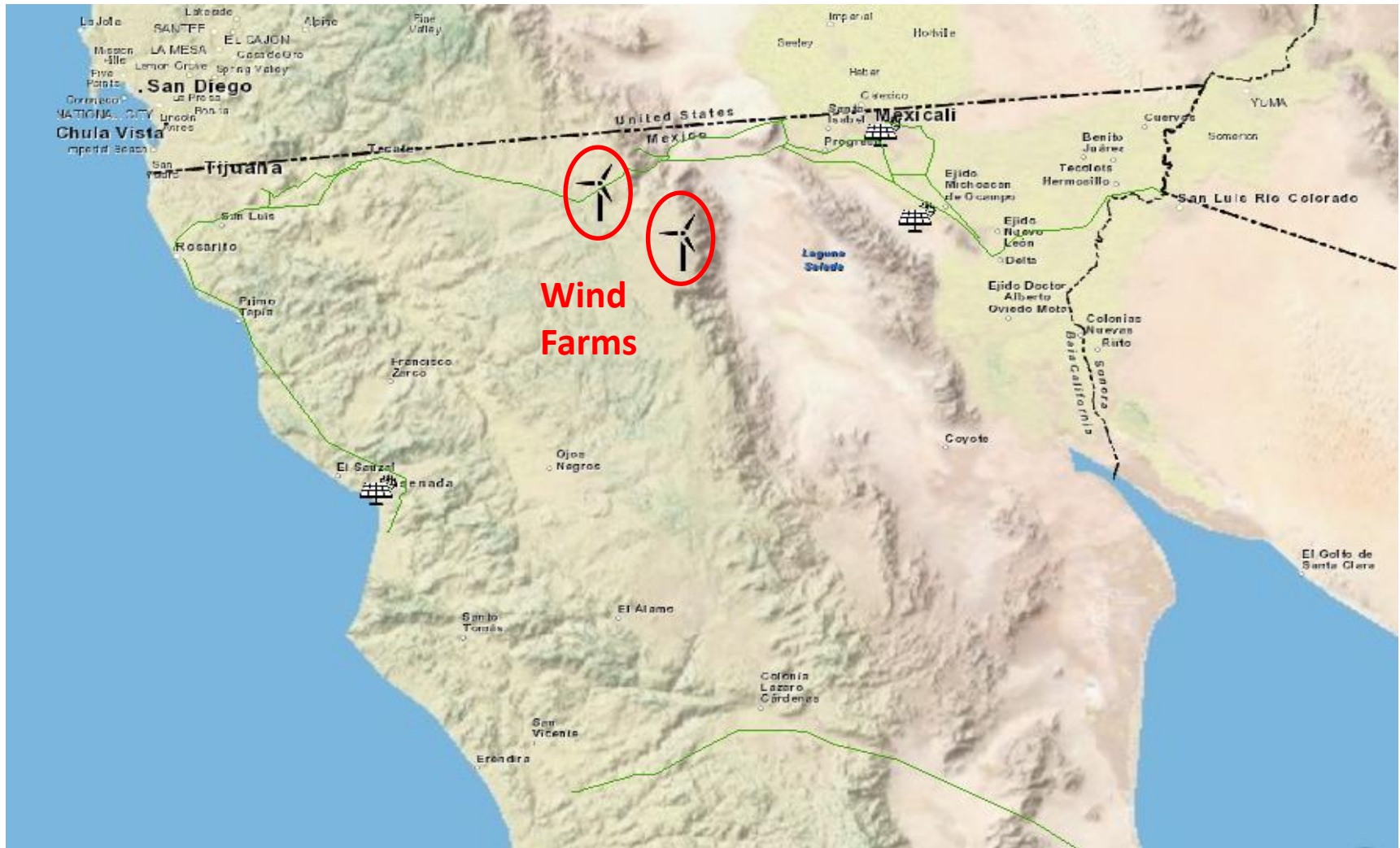
Consumption of fossil fuels for electricity generation, 2004-13



Source: Comisión Federal de Electricidad, U.S. Energy Information Administration

EIA U.S. Energy Information Administration

Northern Baja Solar & Wind Plants



GENI Map using ArcGIS

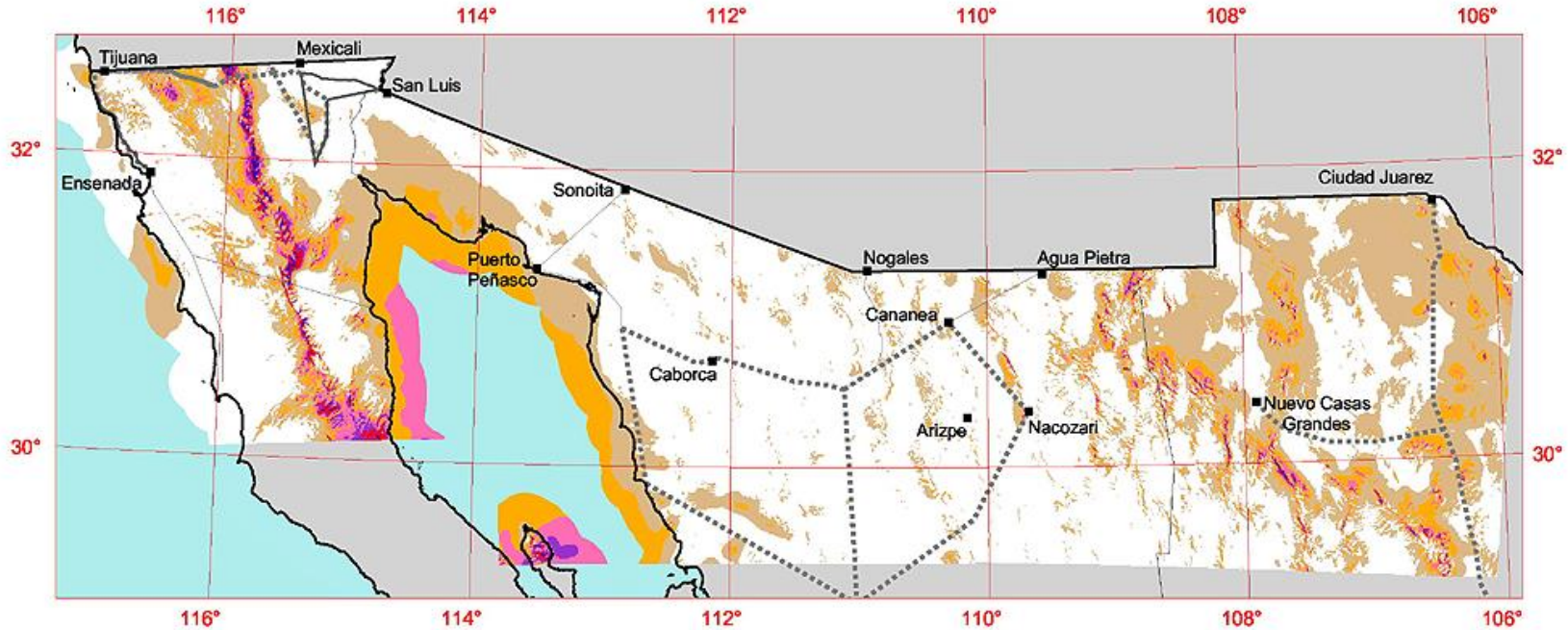
Northern Baja Solar & Wind Plants



**Solar
Power
Plants**

GENI Map using ArcGIS

Northwestern Mexico Border Areas - 50 m Wind Power



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed ^a at 50 m m/s	Wind Speed ^a at 50 m mph
1	Poor	0 - 200	0.0 - 5.6	0.0 - 12.5
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	> 800	> 8.8	> 19.7

^a Wind speeds are based on a Weibull k of 2.0 at sea level.

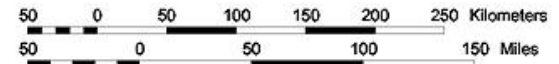
The annual wind power estimates for this map were produced by TrueWind Solutions using their Mesomap system and historical weather data. It has been validated with available surface data by NREL and wind energy meteorological consultants.

Transmission Line*

Voltage (kV)

- 69
- 115 - 161
- 230
- 345

* Source: POWERmap, ©2003 Platt's, a Division of the McGraw-Hill Companies



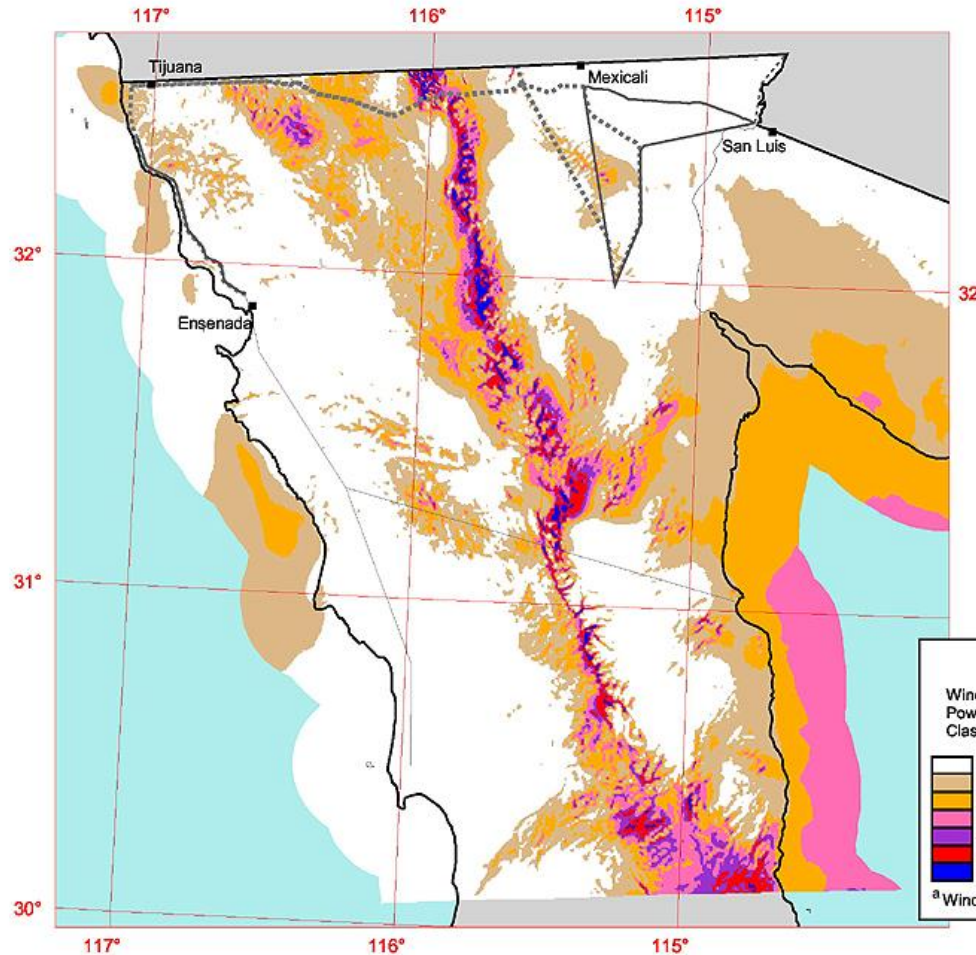
U.S. Department of Energy
National Renewable Energy Laboratory

11-FEB-2004 1.1.1

Baja California Norte

Border Region

50 m Wind Power



Transmission Line*
Voltage (kV)

- 69
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Platts, a Division of the McGraw-Hill Companies

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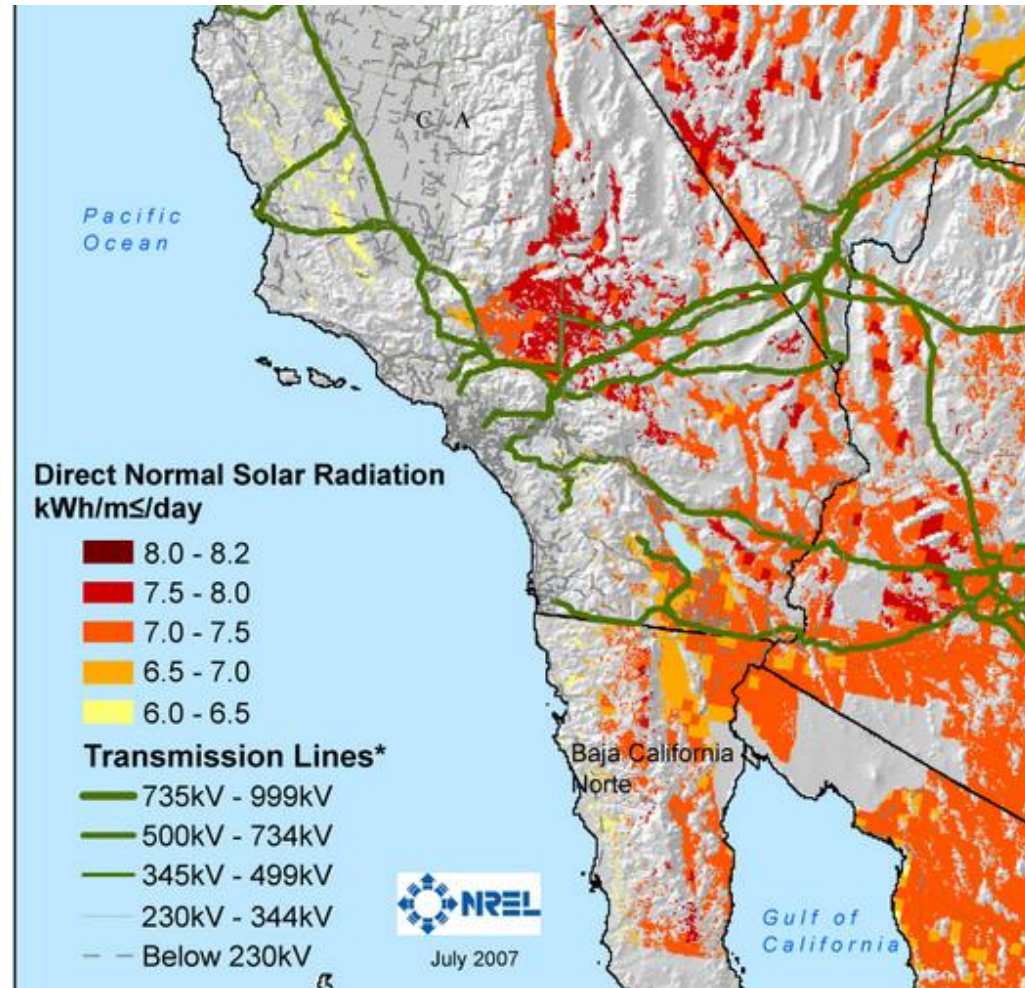


U.S. Department of Energy
National Renewable Energy Laboratory

06-FEB-2004 1.1.2

Solar Potential and Transmission Lines

Southwest U.S. & Northwest Mexico



The McGraw-Hill Companies

Conclusion

- As San Diego and Baja lie in a desert environment, they need to look into water conservation, recycling and desalination.
- Both regions have vast potential for clean, renewable energy.
- These mapping techniques help develop a road map so that these goals can be met in the near future.

Contact us for more information



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*GIS Mapping
Software*



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Questions

