

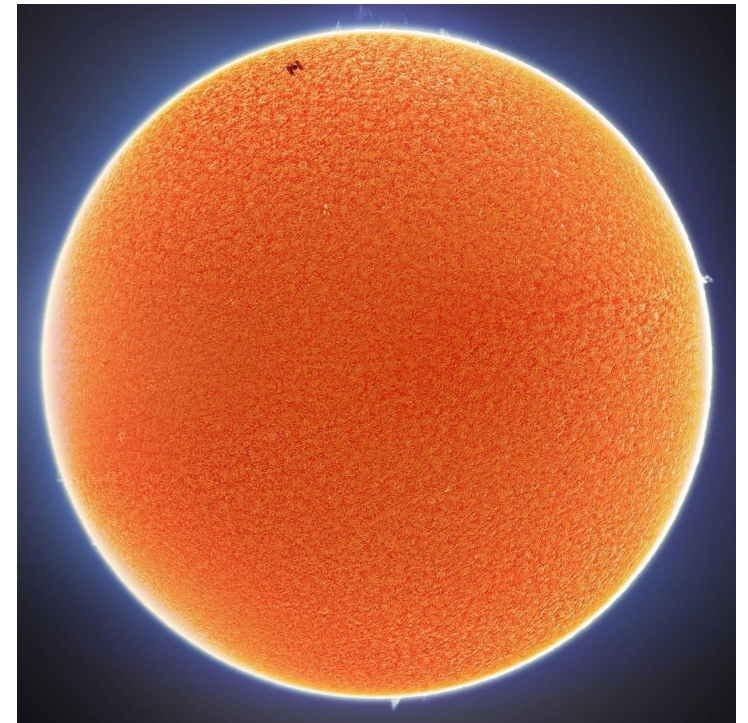
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ENVS 119 - Energy & the Environment

13 - Solar Energy

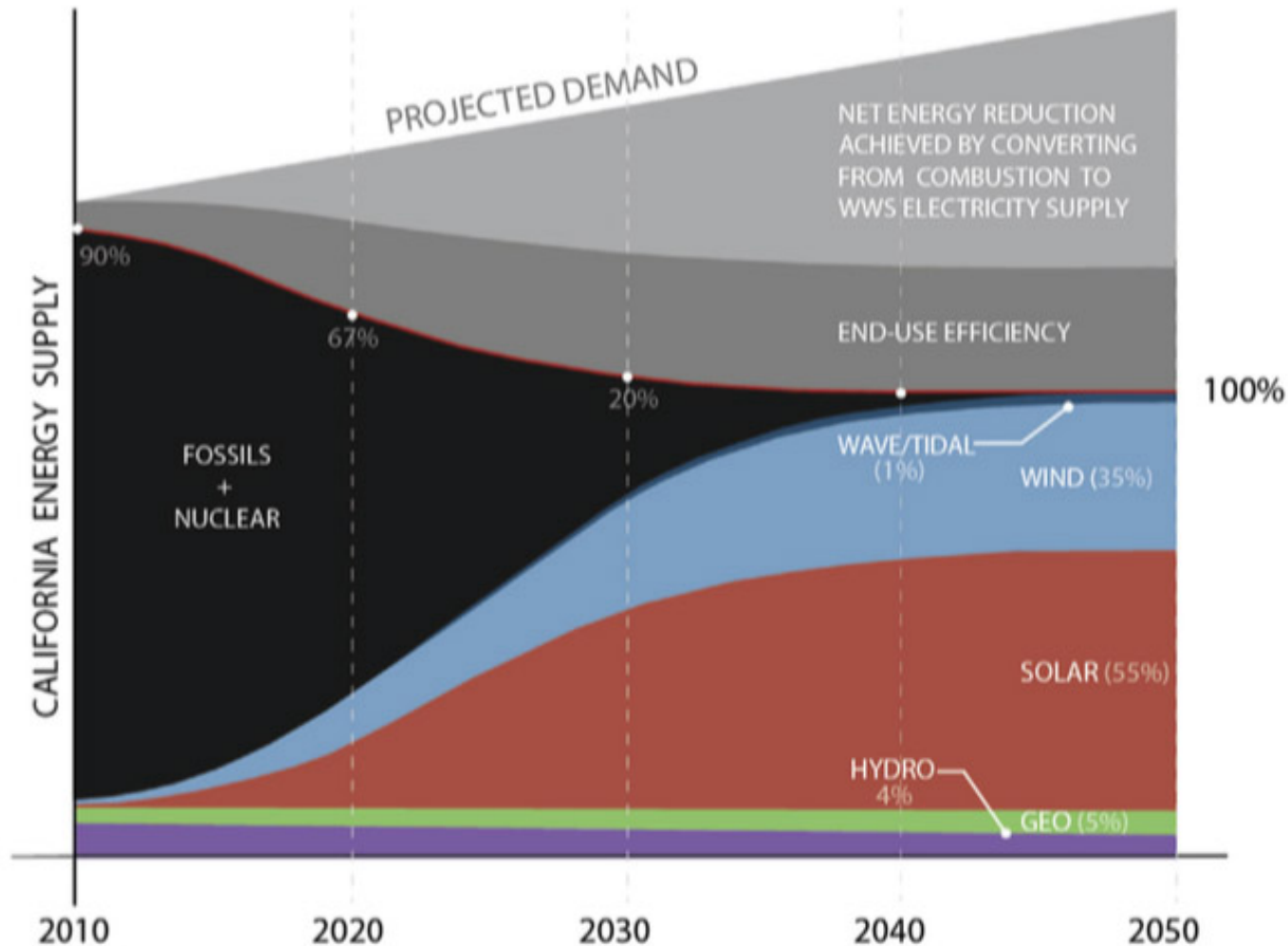
Today

- Solar electricity in the US
- Solar electricity in CA
- Intermittency of Sun power
- Better house = Solar house
- Principle of passive design
- Wrap-up



CA Energy Revolution

Wind + Solar + Conservation



A roadmap for repowering California for all purposes with wind, water, and sunlight, 2014, Stanford

How much can the Sun can power?

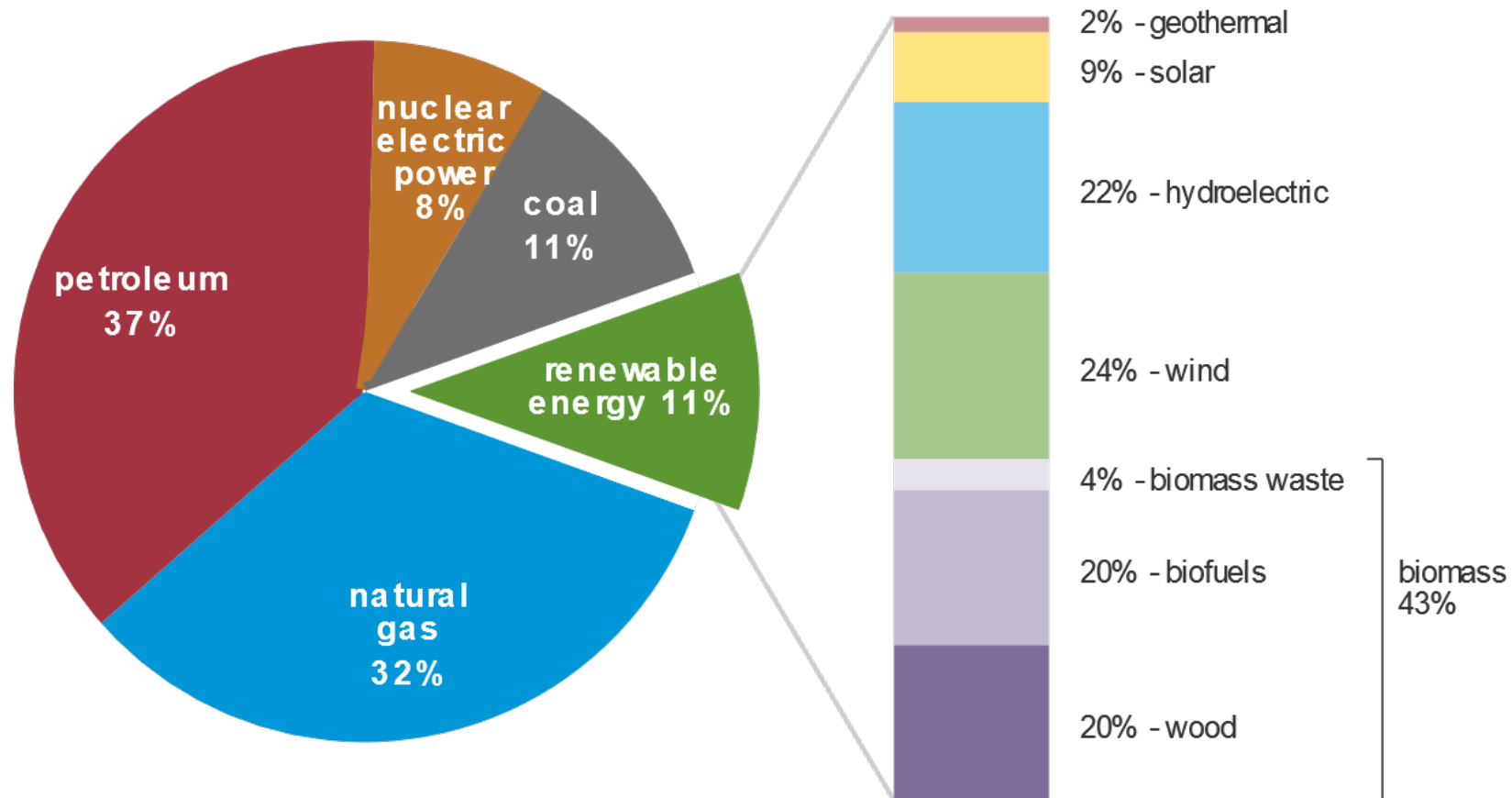
- Solar energy reach the Earth surface giving $\sim 1,370 \text{ W/m}^2$ or $\sim 140 \text{ W/ft}^2$
- Best solar panels and collectors have a 20% efficiency (most around 16%)
- $140 \text{ W/ft}^2 \times .20 = 28 \text{ W/ft}^2$
- To replace a 2,300 MW nuclear power plant, we need: $(2,300 \text{ MW} \times 1,000,000 \text{ W/1MW}) / 28 \text{ W/ft}^2 = 82,142,857 \text{ ft}^2$ or 2,000 acres (about 2 x 2 miles).
- But... this Solar farm would produce only 4-6 hours per day, during day time!

Solar energy (US) = 1% of all energy

U.S. primary energy consumption by energy source, 2019

total = 100.2 quadrillion
British thermal units (Btu)

total = 11.4 quadrillion Btu

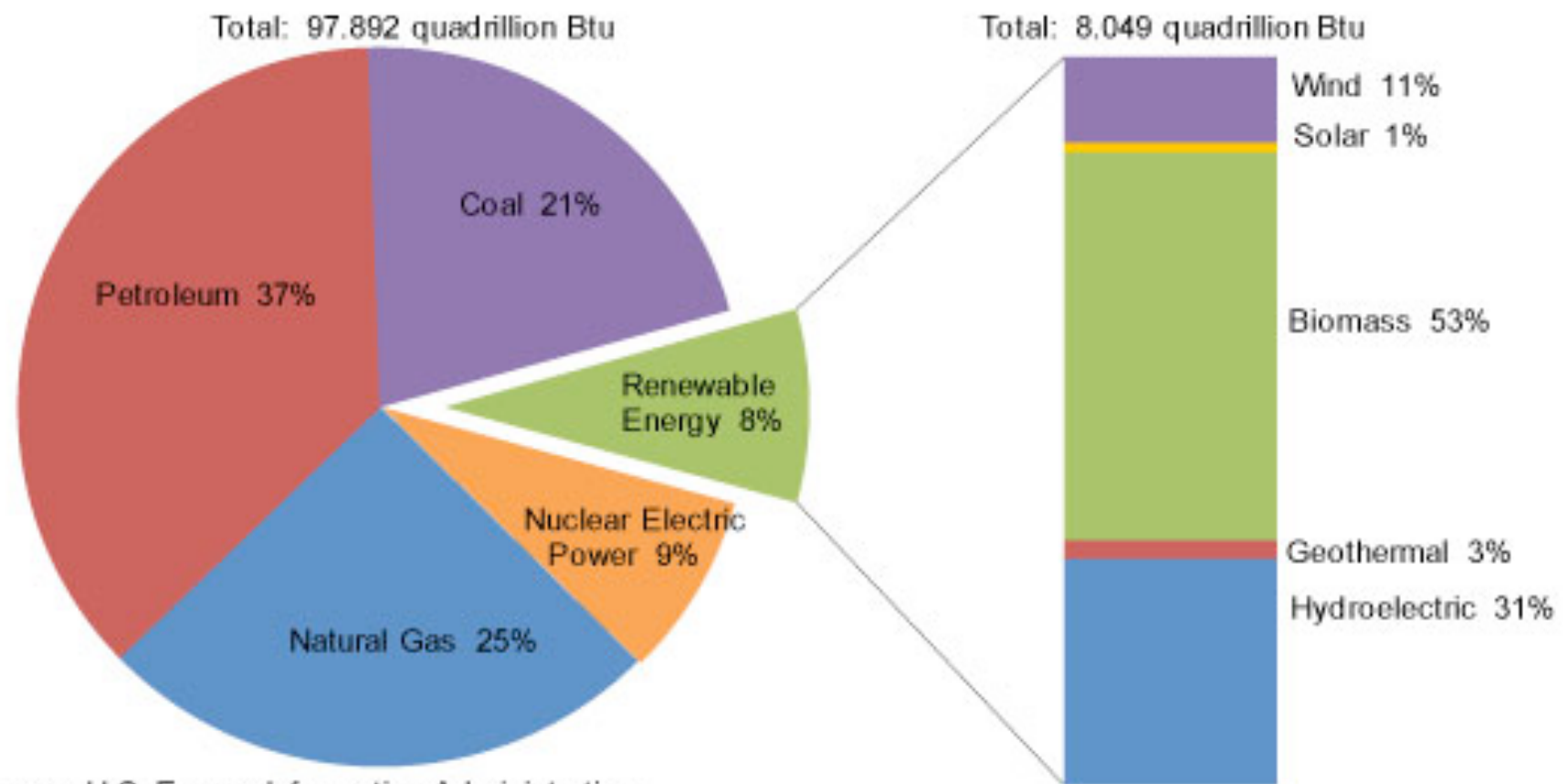


Note: Sum of components may not equal 100% because of independent rounding.

Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2020, preliminary data

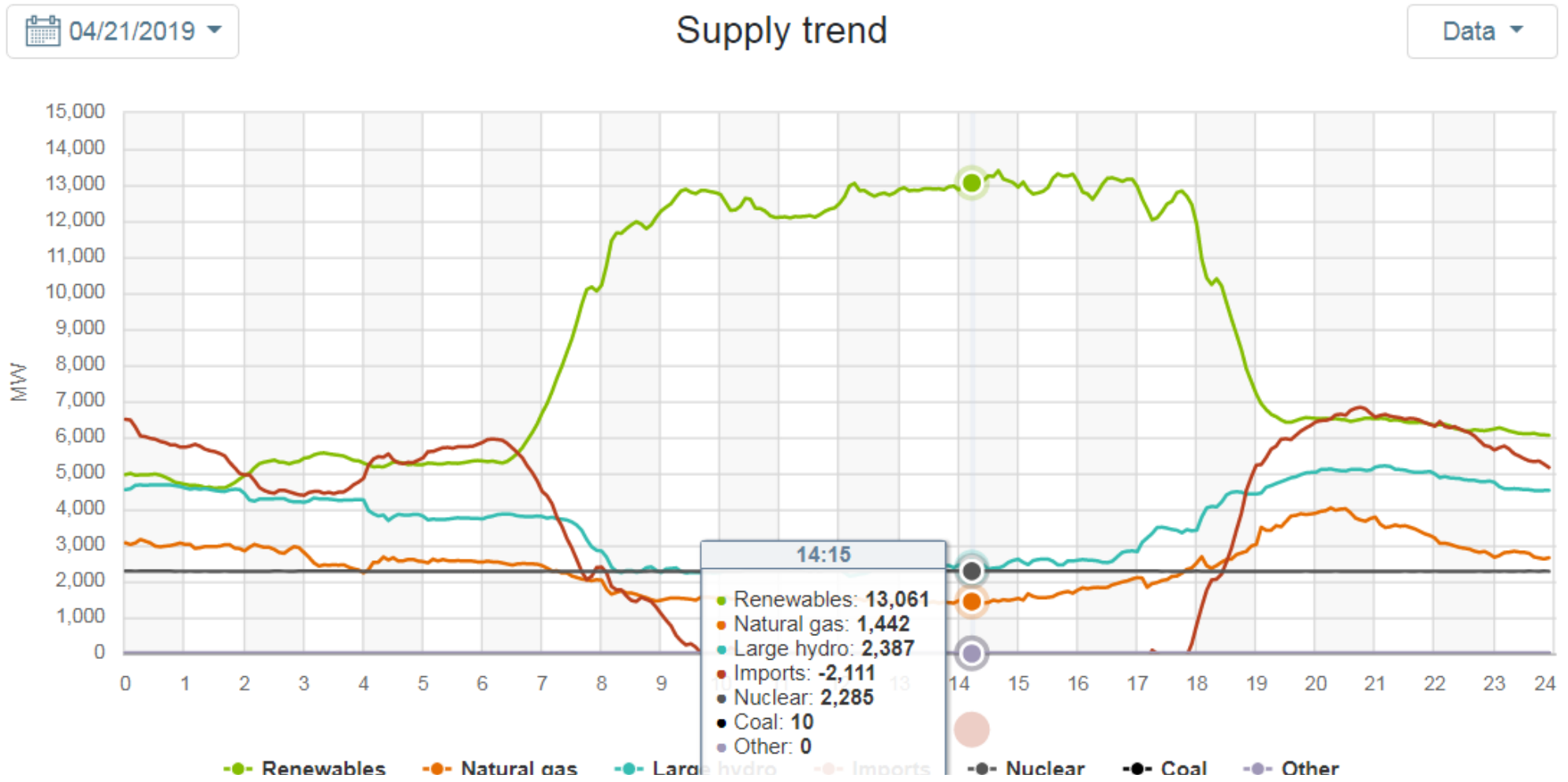
Solar = 0.08% of all energy in 2010 (x13)

Figure 1. Renewable energy consumption in the nation's energy supply, 2010



Source: U.S. Energy Information Administration

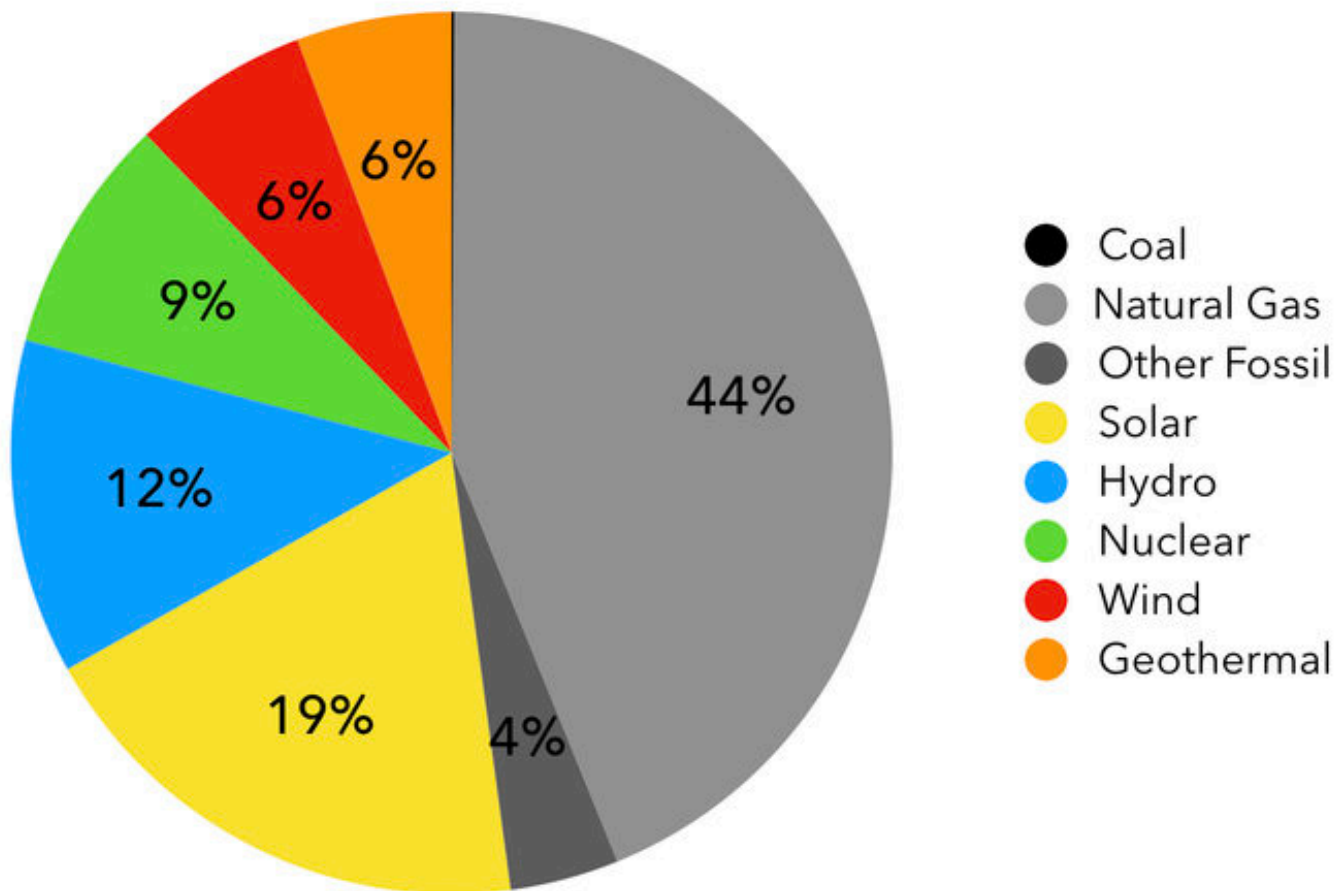
Typical (CA) Electric Generation Day



Source: CALSO

Solar is already 20% of all electricity in CA!

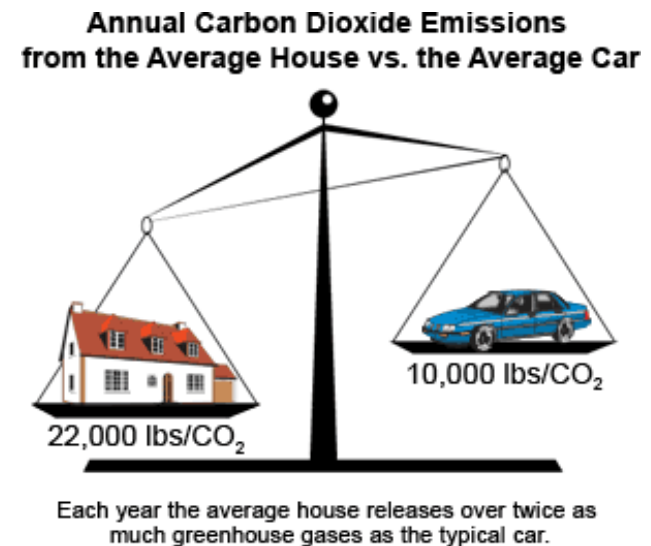
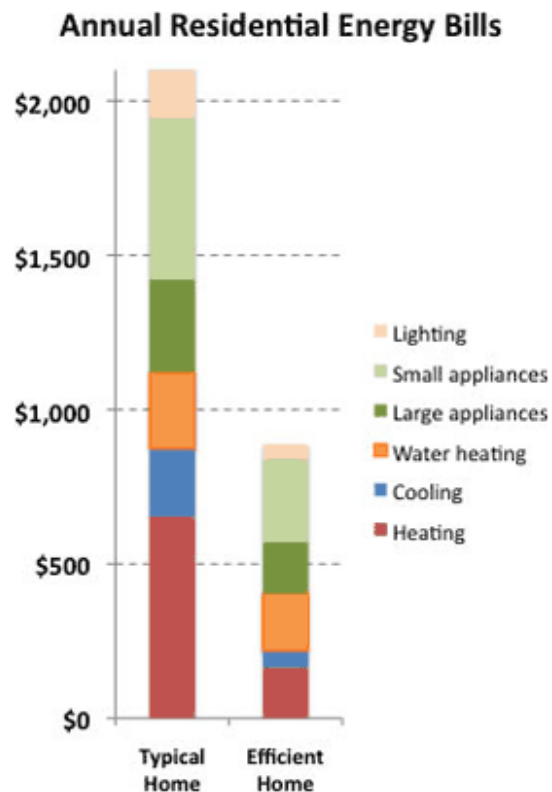
California's Energy Mix, 2018



Source: Data from U.S. Energy Information Agency referring to 2018 in-state electricity generation

Solar electricity is just one part of the story...

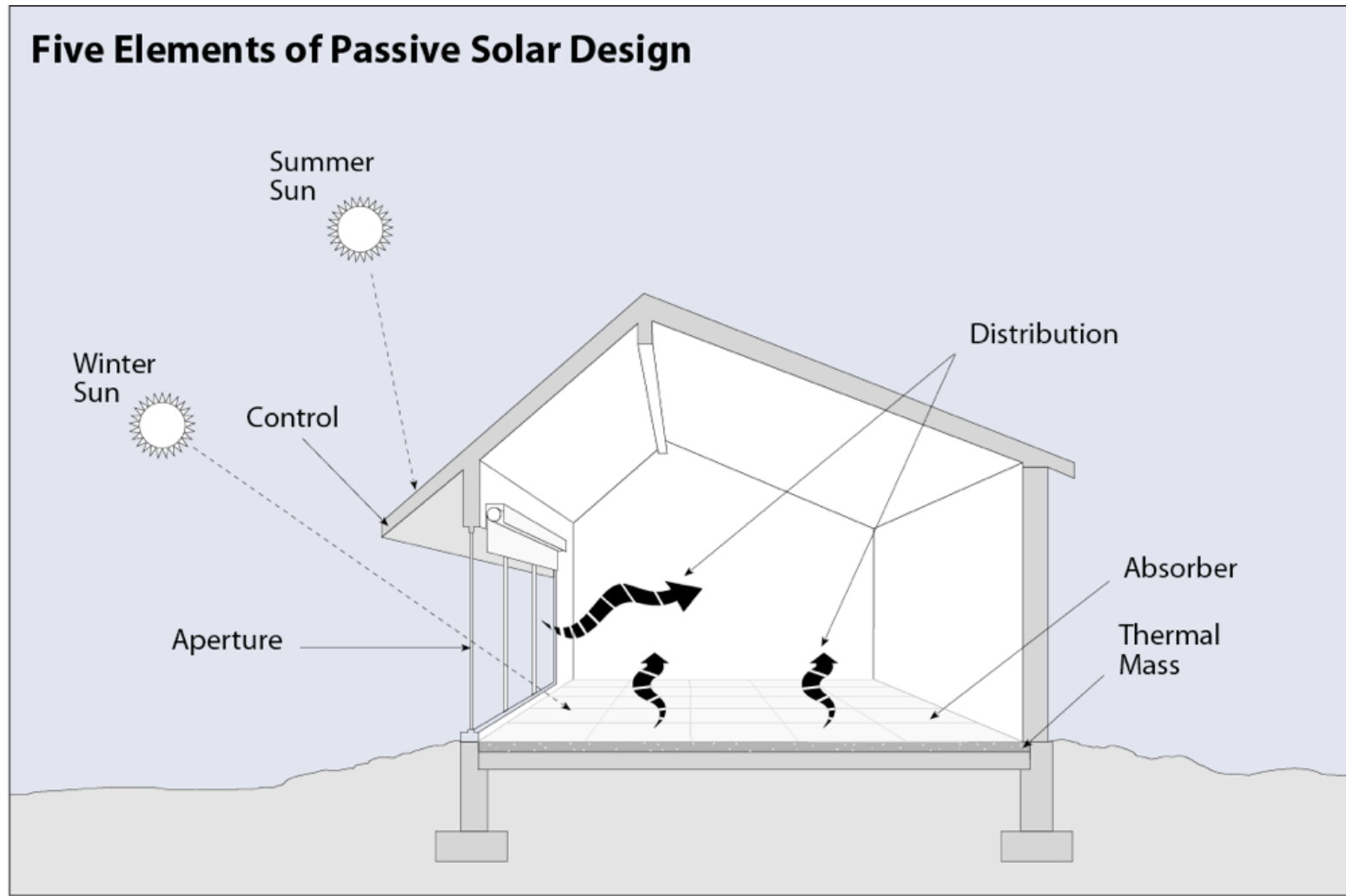
*“Residential heating+cooling contributes about **one-fifth** of the United States’ annual emissions of carbon dioxide gas.”*¹



¹ Chiras, Dan (2011-09-20). The Solar House: Passive Heating and Cooling (Kindle Locations 144-145). Chelsea Green Publishing. Kindle Edition.

² Source: Typical home - U.S. Department of Energy, 2009 Buildings Energy Data Book. Savings are HES team estimates.

Building passive design = Solar to heat/cool



Interested in Green Building Design?

Learn about (ENVS132 Spring):

- Passive Solar Residential Design
- Smart/Connected Homes
- How to do Energy Audits
- Healthy Homes



ENVS 132
Solar Home Design - #9

Renewable Energy
Benoit Delaveau, MS, BEAP

Learn about (ENVS137 Fall):

- Building Codes (regulations)
- Green Buildings Certifications
- LEED, Green Globes,...
- Sustainable Commercial Buildings



ENVS 132
Solar Home Design - #1

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End of Sun Energy Part.1

