

# UC Riverside Physical Master Plan Study

*Planning for a  
Carbon Neutral Campus*

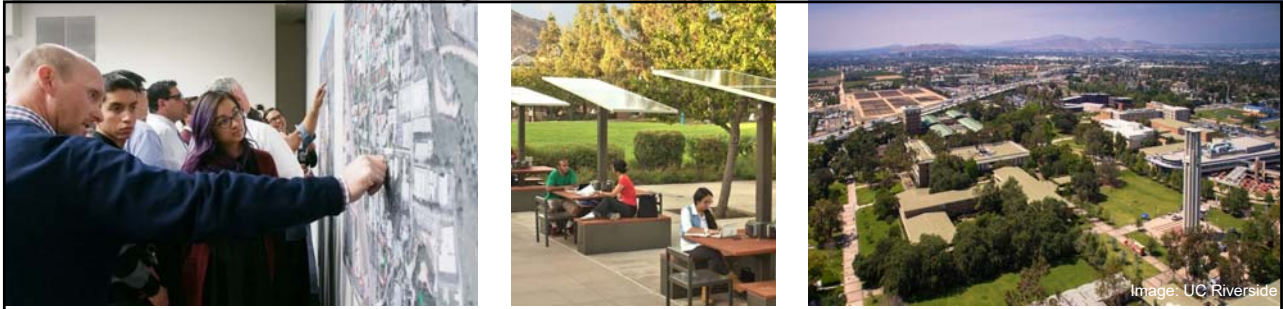
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PRINCIPAL



# How Can You Create a Carbon Neutral Campus by 2025?

Image: UC Riverside

BRIGHTWORKS SUSTAINABILITY



In 2013, the University of California Carbon Neutrality 2025 Initiative committed the entire UC system to emitting zero net greenhouse gases from all of its campuses and vehicle fleets by 2025 - something no other major university system has done.

UC Riverside selected Brightworks Sustainability to help it define, quantify, and illustrate five aggressive yet feasible scenarios to achieve carbon neutrality.

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## Why Aim for Carbon Neutrality?

- AB 32 - The California Global Warming Solutions Act - required the California Air Resources Board (CARB) to establish a GHG cap-and-trade program.
- Emitters of >25,000 Metric Tons CO<sub>2</sub>e must purchase an allowance for each ton of GHG they emit.
- Regulations require the University to report investments in energy efficiency and other projects consistent with the goals of AB 32.



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## Campus Planning Variables



Image: UC Riverside

- **Growth:** existing and new facilities
- **Energy-efficiency:** upgrade existing buildings, build new high performance buildings
- **Renewables:** Solar roofs/canopy, campus ground solar, off-site/utility-scale solar or wind
- **Carbon offsets:** annual purchase of remaining carbon footprint

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## Strategies Considered: Buildings

### Passive Design / Building Fabric

- Low SHGC glazing / external shading
- Low infiltration fabric
- Low U-value fabric elements
- PCM boards
- Natural ventilation

### Lighting

- LEDs, daylight dimming, occupancy sensors, etc

### HVAC

- Insulated low pressure drop ductwork and pipework
- High efficiency heat exchangers
- High efficiency VAV, DDC controls, energy recovery, full economizer, demand control ventilation, etc
- Auto windows for natural ventilation
- Condensing boilers
- High efficiency chillers

## Strategies Considered: Infrastructure

### Heating

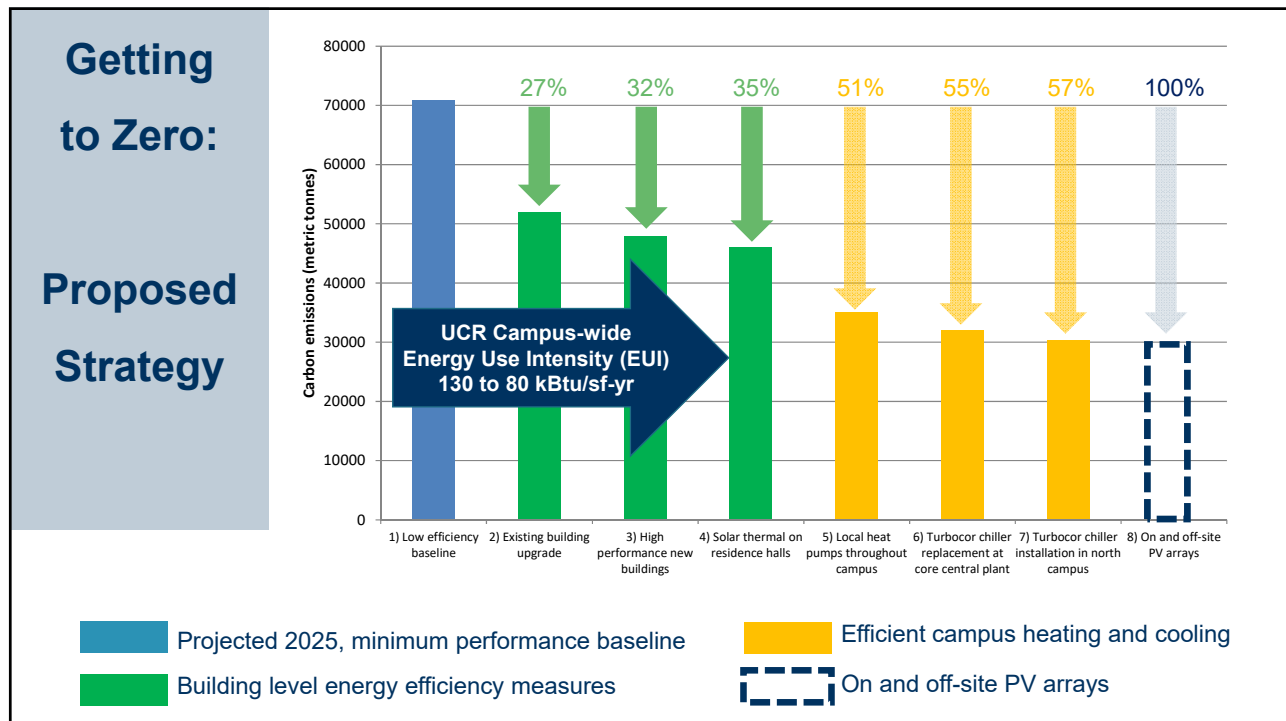
- Steam to hot water network conversion
- Biomass and/or waste
- Biogas
- CHP
- Local gas boilers
- Centralized heat pumps
- Local heat pumps

### Cooling

- Local chillers
- Centralized chillers
- Magnetic bearing chillers

### Power

- Load shifting
- Battery storage
- Fuel cells





### Scenario 0: Existing Campus, 2015



6.4 Million Square Feet



130 Average EUI

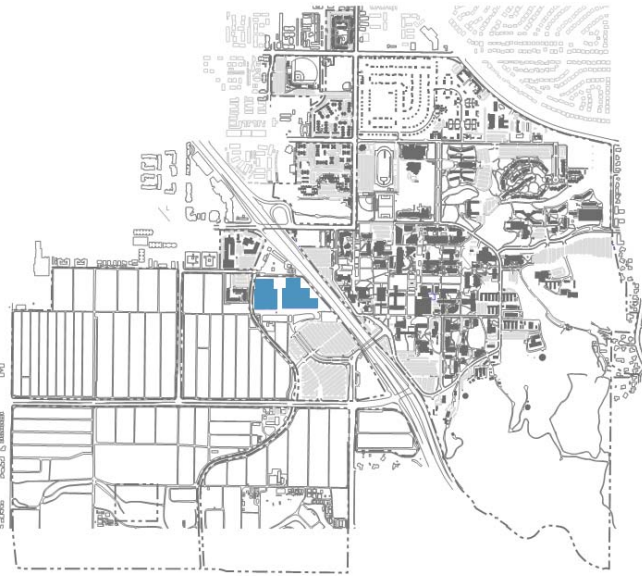


3.6 MW Rooftop Solar



None (\$942,000/yr)

## Scenario 1: 2025 High Performance Buildings



8.9 Million Square Feet



80 Average EUI

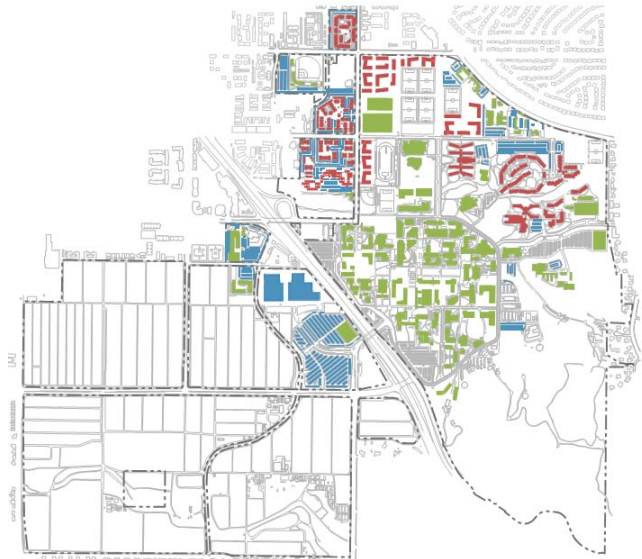


3.6 MW Solar



\$644,000/yr Carbon Offsets

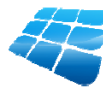
## Scenario 2: 2025 High Performance Solar On Campus



8.9 Million Square Feet



80 Average EUI



13 MW Rooftop Solar

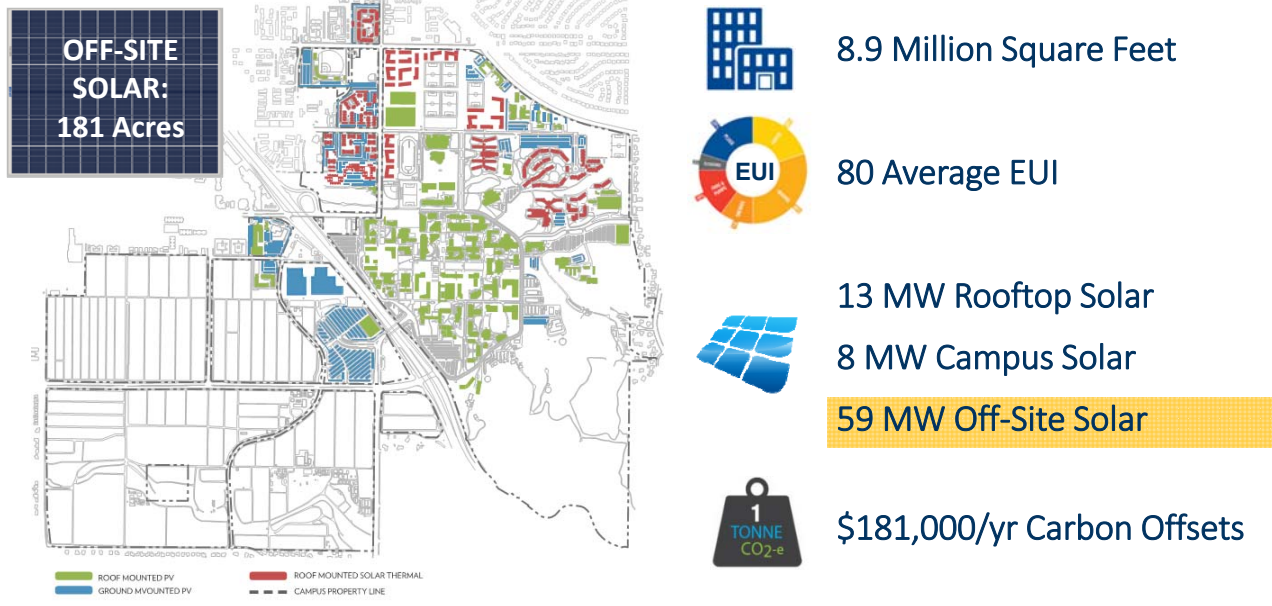
8 MW Campus Solar



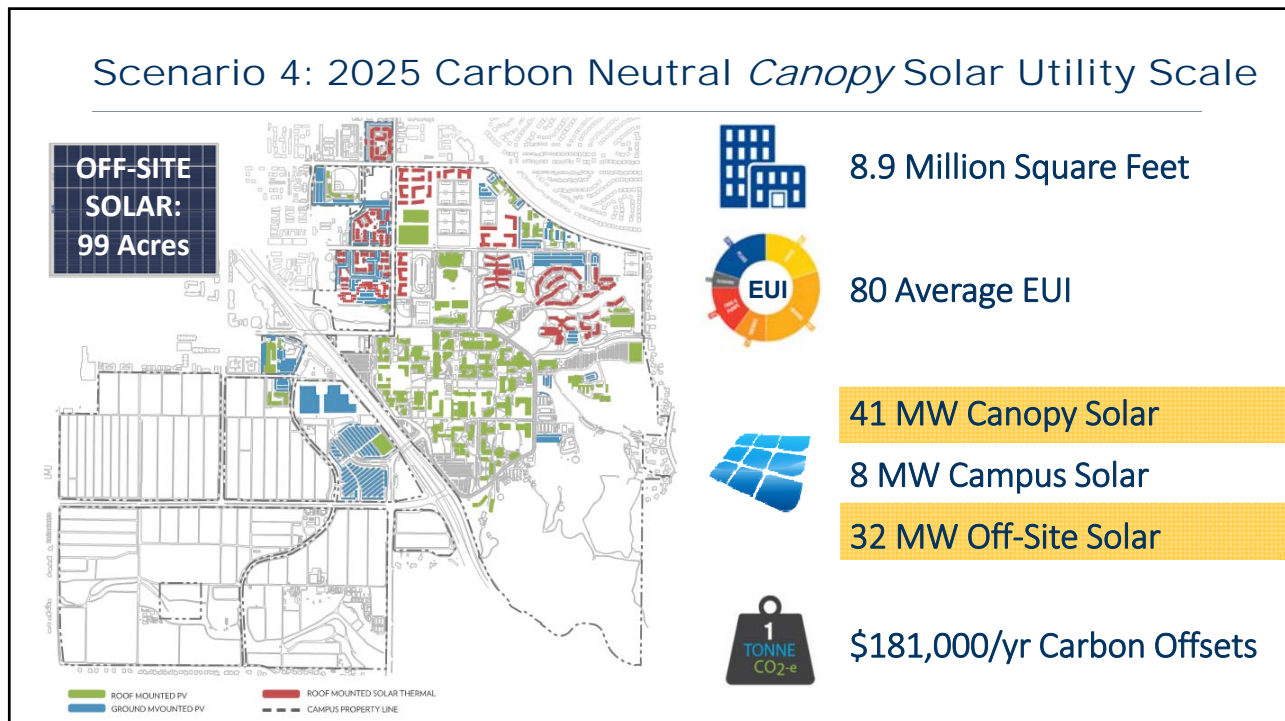
\$521,000/yr Carbon Offsets

■ ROOF MOUNTED PV      ■ ROOF MOUNTED SOLAR THERMAL  
■ GROUND MOUNTED PV      - - - CAMPUS PROPERTY LINE

### Scenario 3: 2025 Off-Campus, Utility Scale Solar



### Scenario 4: 2025 Carbon Neutral *Canopy* Solar Utility Scale





**Action: 4.3 MW Campus Solar Added in 2017**



Image: UC Riverside

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