NREL
NATIONAL RENEWABLE ENERGY LABORATORY

# Research Campus Energy I2SL China

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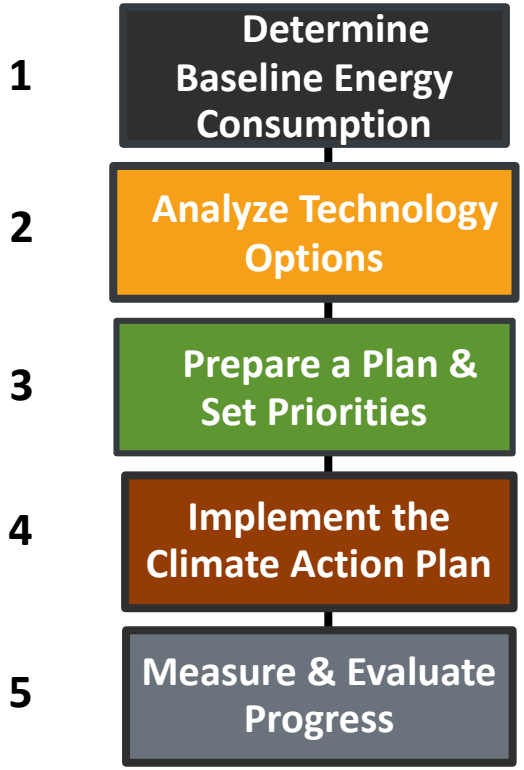
# Key Elements of a Smart Lab

| Key Element | Approaches to Overcome Barriers |
|---|---|
| Optimized ventilation and exhaust systems | Partner with industrial hygiene to determine lowest safe ventilation rate for each lab space and exhaust stack discharge velocity |
| Variable air volume | Upgrade constant air volume systems to variable air volume |
| Minimized system fan energy | Minimized system pressure drops and set duct static pressure to lowest adequate level |
| Optimized fume hoods | Partner with EHS/IH and lab staff to determine fume hood number, size, and containment requirements |
| Continuous commissioning | Use building control system and tools to optimize lab mechanical systems operations |
| Energy-efficient lighting | Implement energy-efficiency lighting technologies and controls |
| Lab staff is engaged in sustainable practices | Provide sustainable best practices to lab staff |
| Consider demand-based ventilation controls (DBVC) | Partner with EHS/IH to determine if DBVC would allow reduced ventilation rate, especially for non-fume hood driven labs. |

# Climate Neutral Research Campuses




**Focus of this presentation: 1-2**

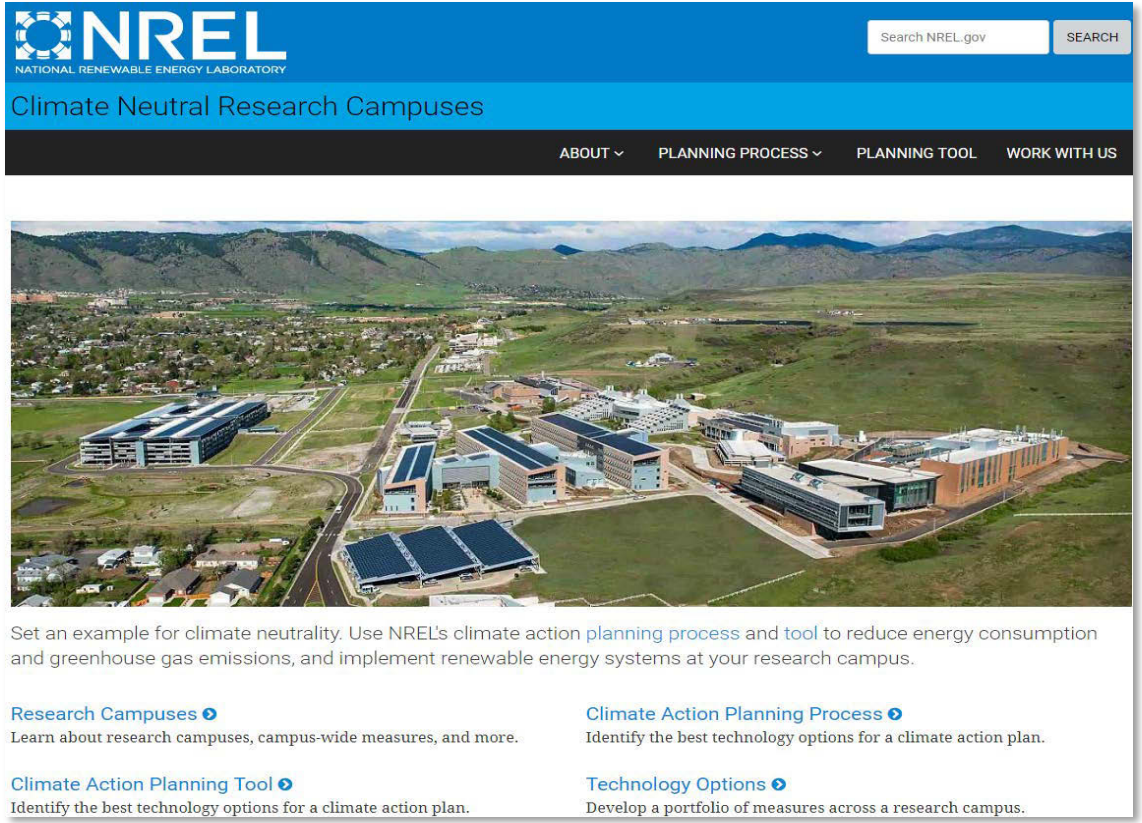
**Research campuses consume more energy per square foot than most facilities. They also have greater opportunities to reduce energy consumption, implement renewable energy systems, reduce greenhouse gas emissions, and set an example of climate neutrality.**

The NREL Climate Neutral Research Campuses website provides research campuses a five-step process to develop and implement climate action plans.

**See: nrel.gov/climate-neutral/**

# Climate Neutral Research Campuses

## nrel.gov/climate-neutral



# 1. Determine Baseline Energy Consumption

**Determine current energy consumption** → **Determine resulting greenhouse gas emissions** → **Break down emissions by sector**

## Scope 1: Direct combustion of fuels at your site

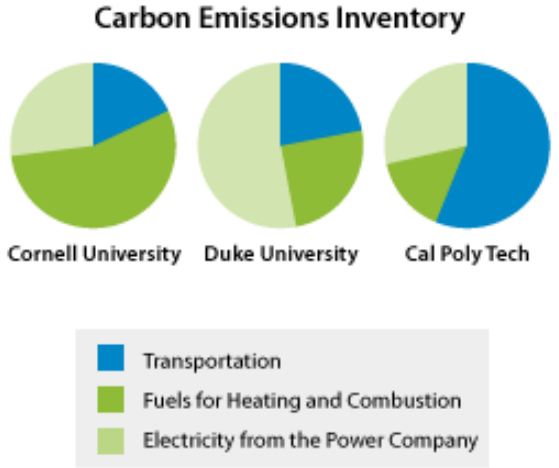
- Carbon emissions from direct combustion readily translate from fuel consumption data using standard engineering formulas.

## Scope 2: Indirect impact from purchased electricity.

- Carbon emissions from electricity consumption can be obtained for your utility company, region, and state from the U.S. Environmental Protection Agency's eGRID

## Scope 3: Transportation impacts from commuters and business travel.

- Can be derived from surveys of commuter and business travel patterns.



# 2. Analyze Technology Options

## People and Policy

Formulate policies with a long-term effect on energy consumption and identify human behaviors that lower energy use and greenhouse gas emissions.

## Buildings

Take a whole-building approach when evaluating campus buildings. Also, remember energy efficiency comes first. Maximize energy efficiency in both existing and new buildings before doing anything else.

## Transportation

Reduce vehicle miles traveled, switch your fleets to alternative fuels, and offer transportation alternatives that reduce occupant dependency on single-passenger vehicle.

## Energy Sources

Optimize the energy supply based on carbon fuels at the central power plant then add renewable energy systems wherever practicable.

## Carbon Offsets and Renewable Energy Certificates

Buy carbon offsets and green power as the last step in an overall strategy to meet long-term carbon reduction targets. You can also purchase offsets as a way to "top off" progress.

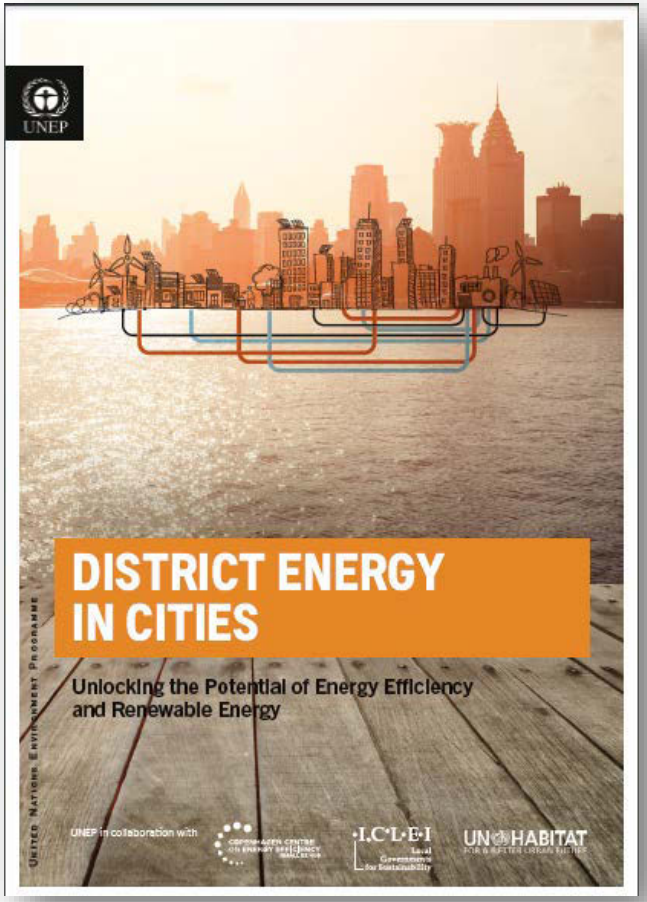
# Energy Sources: Renewable Energy on Campus

- Consider available area:
  - Vacant land
  - Parking lots
  - Roofs (with 20-year-plus life and able to accommodate solar weight)
  - Shading
- Calculate energy use and cost, preferably by building
- Determine potential electrical interconnection points
- Research interconnection rules
- See: https://www.nrel.gov/technical-assistance/blog/posts/solar-ready-building-design-a-summary-of-technical-considerations.html

# Energy Sources: Available Area for Renewable Energy on Campus


| Potential Roof PV Area | Potential Carport PV Area | Potential Ground PV Area |
|---|---|---|
| 140,456 ft$^2$ | 118,722 ft$^2$ | 897,083 ft$^2$ |

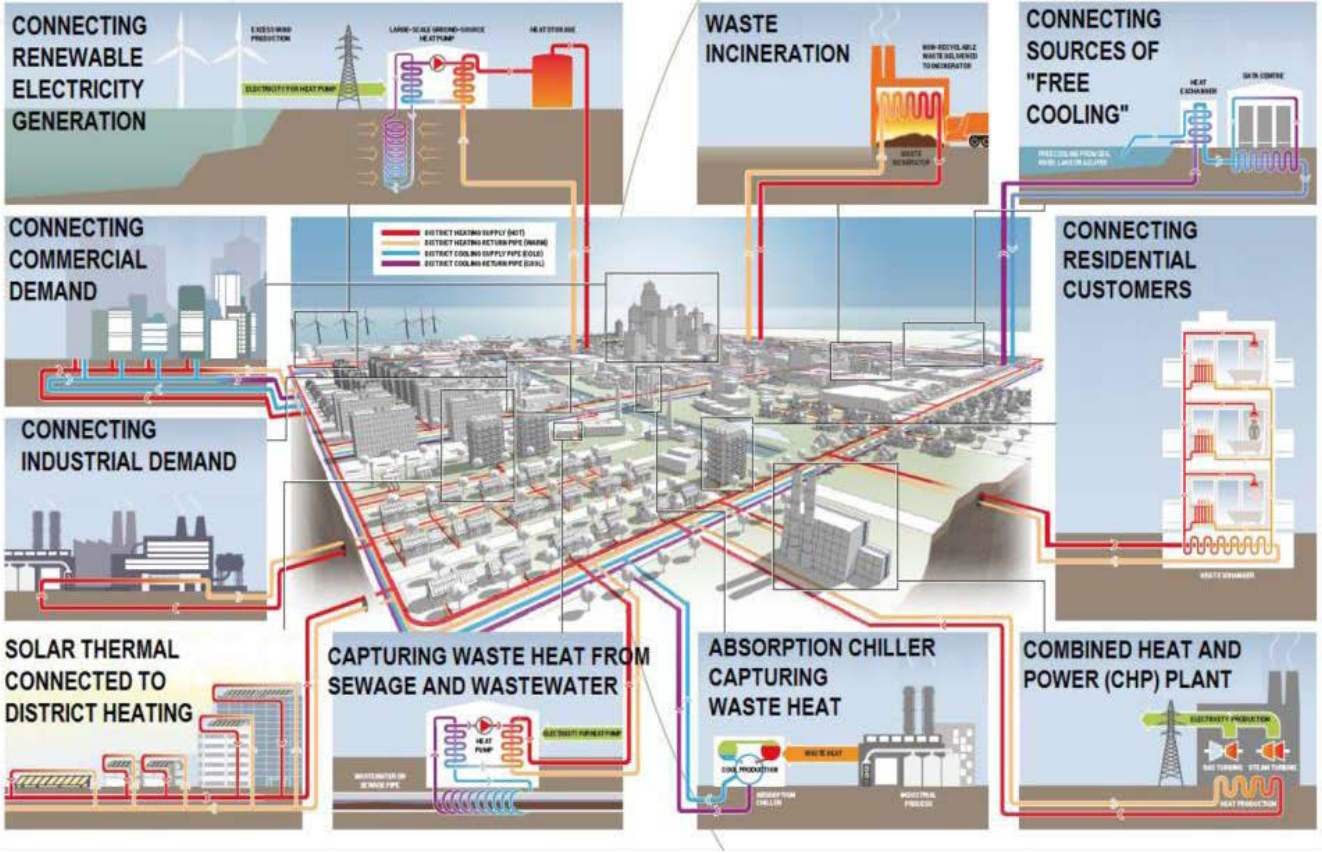
# District Energy



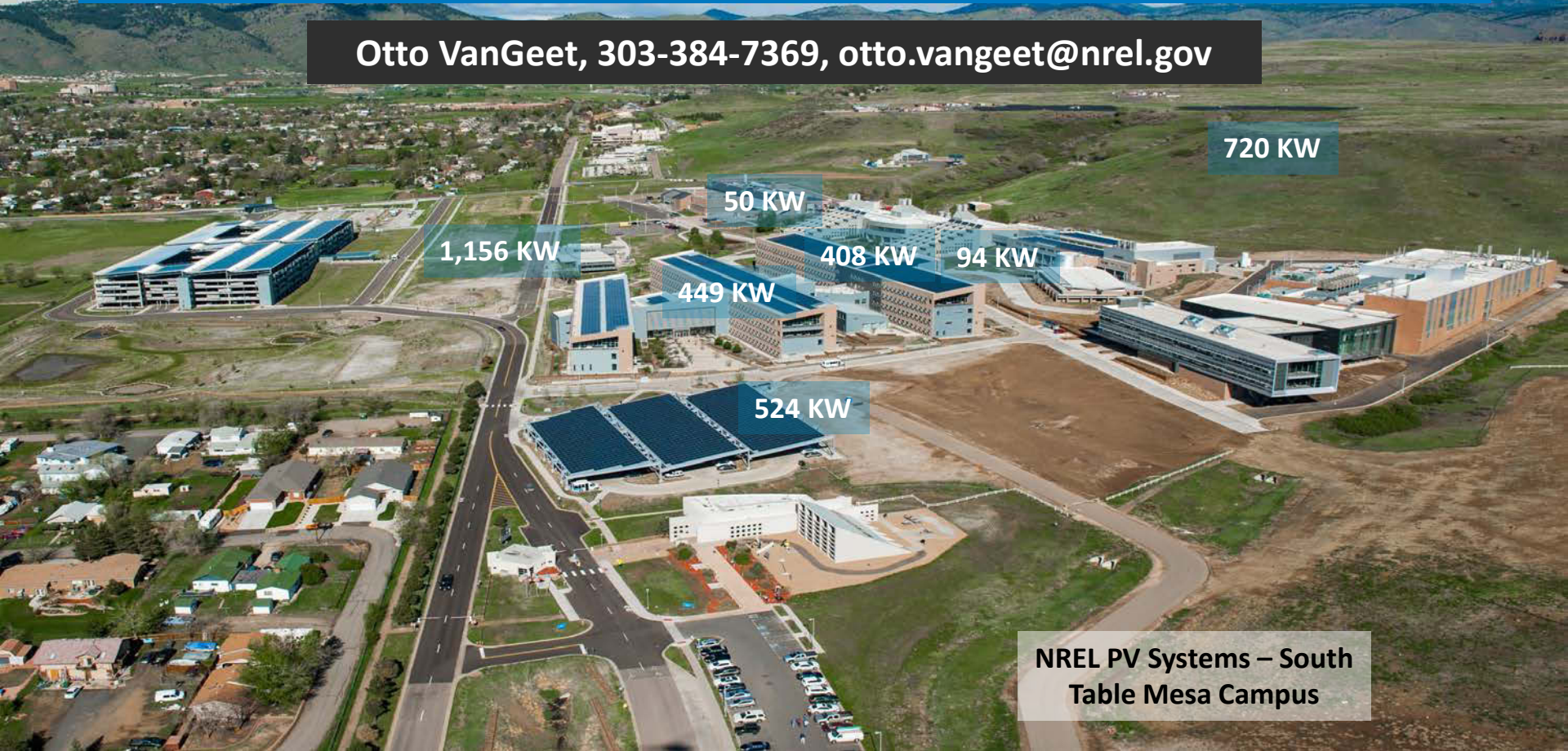

**UNEP District Energy**

http://staging.unep.org/energy/districtenergyincities

# WHAT IS DISTRICT ENERGY?



# Questions?


Otto VanGeet, 303-384-7369, otto.vangeet@nrel.gov
720 KW
50 KW
1,156 KW
408 KW
94 KW
449 KW
524 KW
NREL PV Systems – South Table Mesa Campus

# Notice

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