NREL
NATIONAL RENEWABLE ENERGY LABORATORY

NREL's Planning "Campus of the Future"

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Presentation Outline

1. Steps we took in planning our campus
2. Progress to date
3. Tools available (CNRC)

Why Consider Campus Planning?

- Planning allows you to look at the building energy supply and demand and transportation energy as one integrated system.
- Campus planning establishes a framework for low energy buildings, alternative transportation, storm water management, quality of life issues that allow one to attract\retain staff
- Looking at the whole system, provides opportunities for using renewables that go beyond the building boundaries.

Our Planning Process

Form internal working group to do "internal" homework

- Form Internal team
- Define our site planning values, goals and expectations
- Characterize our future direction in terms of type and size of growth and needs
- Understand the external factors that will impact our site
- Hold focus group meetings with staff to understand their perceptions, values and goals for site

Hire a site planner

- Hold two design charrettes
- Present options to NREL staff
- Involve Design Advisory Board (DAB) and Executives in the process

Campus of the Future - Priorities

- Safe, secure and sustainable
- Iconic facilities
- LEED Platinum/Gold certified facilities
- Carbon neutral
- Net zero energy buildings
- Living Laboratory

Example - External Factors That Impact Our Site (2003)

- More people
  - More space, more parking, public transportation
- Site reflects mission
  - Should be clear that many technologies support a single mission
  - Not silos (architecturally and organizationally)
- 24x7 operations – onsite and remote teleworkers
  - Increased access with increased security (physical and cyber)
- Increased on-site mobility
  - “Always on, always connected”
  - Easily reconfigurable space
- Benefits of sharing knowledge/collaborating increases importance of ‘common’ or ‘shared’ space
  - ‘Student Union’ concept
- Computational science as third leg of science (applied, theoretical, virtual)
  - Onsite computing, connections to external resources
- Integration of ‘smart’ badges with ‘smart’ buildings
  - Building control systems adapt to loads, predict usage, provide increased security

Design Issues Related to Energy\Sustainability to Consider in Integrated Campus Planning

Energy Use

- Building energy efficiency (demand reduction)
- Efficient layout of site utilities
- Supply side options and integration

Other Related Site Issues

- Circulation, Parking and Public Transportation
- Density and Footprint
- Storm Water Management
- Image

NREL's South Table Mountain Site

2003 Site and Facilities

South Table Mountain Site - 2003

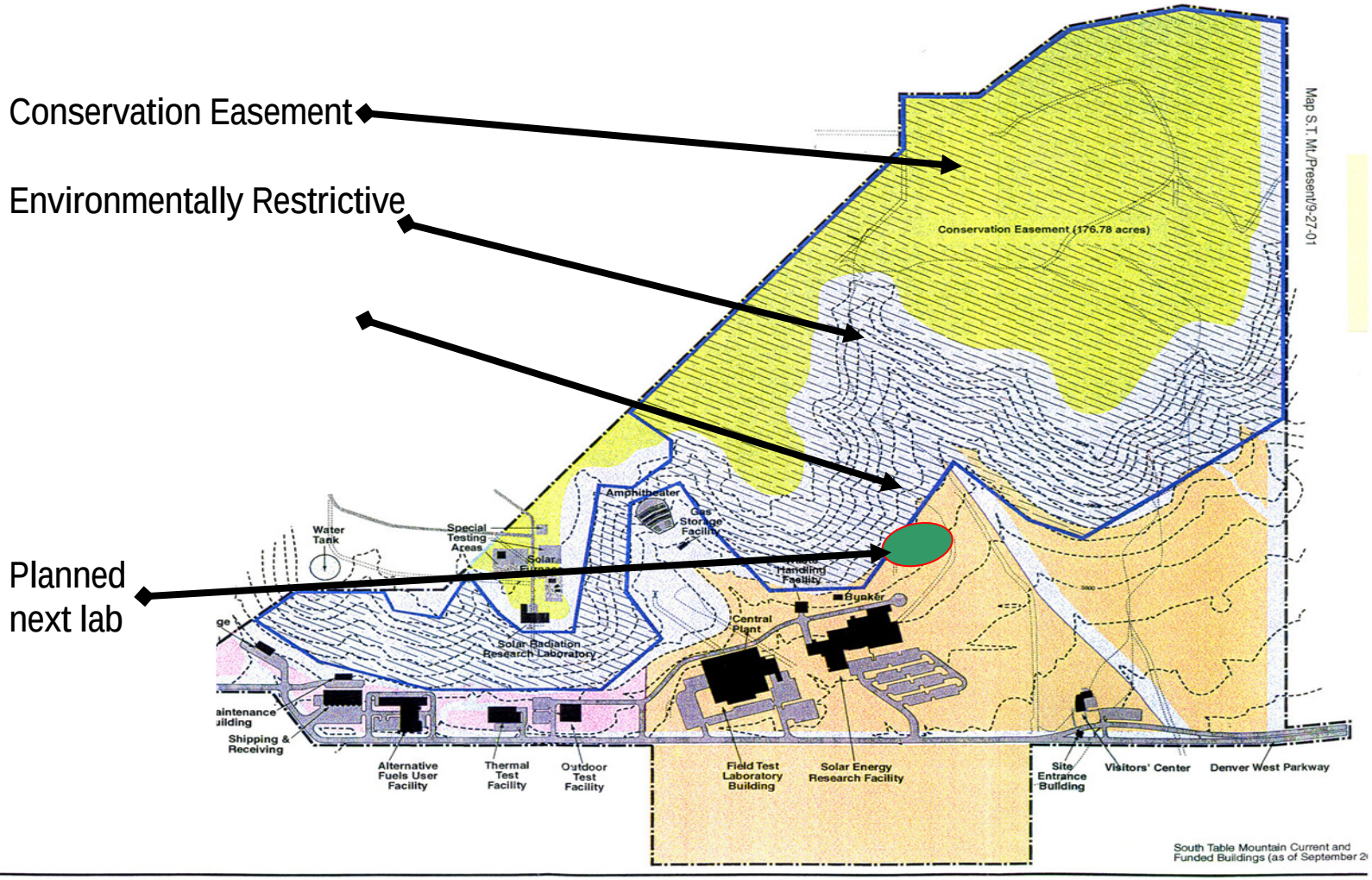


Figure 3. South Table Mountain Current and Funded Buildings

First Design Charrette
Three Schemes

COMPACT VILLAGE

PROGRAM ~3.5% GROWTH

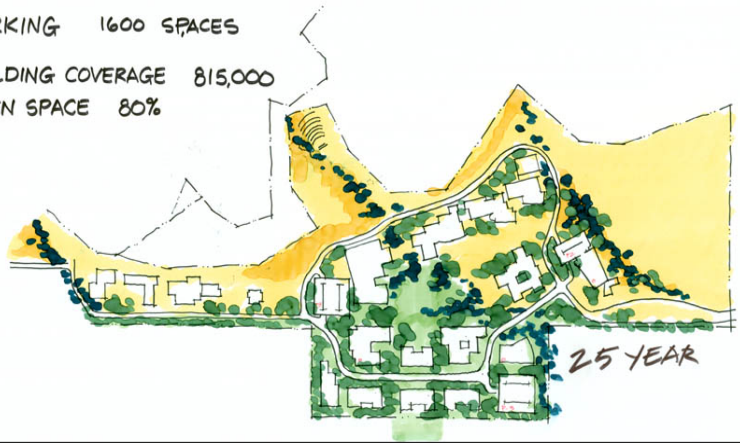
EXISTING LAB	388,000
NEW LAB	853,700
NEW ADMINISTRATION	652,800
TOTAL	1,894,500
PARKING	1340 SPACES
BUILDING COVERAGE	758,000
OPEN SPACE	87%

25 year

PARK LOOP

PROGRAM ~3% GROWTH

EXISTING LAB	388,000
NEW LAB	705,000
NEW ADMINISTRATION	637,500
TOTAL	1,730,000
PARKING	1600 SPACES
BUILDING COVERAGE	815,000
OPEN SPACE	80%



LINEAR VILLAGE

PROGRAM

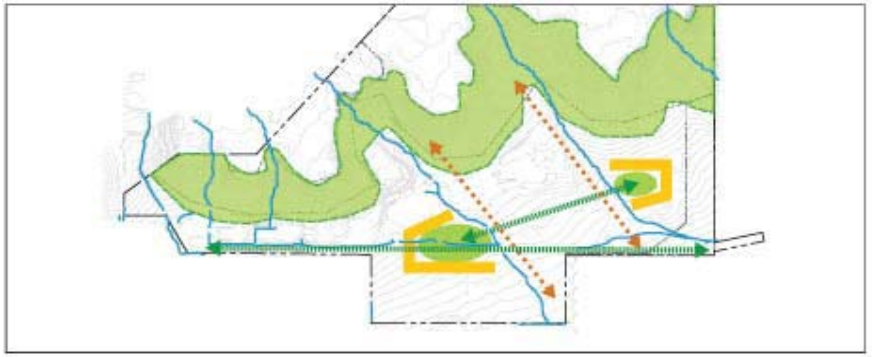
EXISTING LAB	388,000
NEW LAB	1,000,000
NEW ADMINISTRATION	540,000
TOTAL	1,928,000
PARKING:	1700 SPACES
BUILDING COVERAGE	1,170,000
OPEN SPACE	75%

25 year

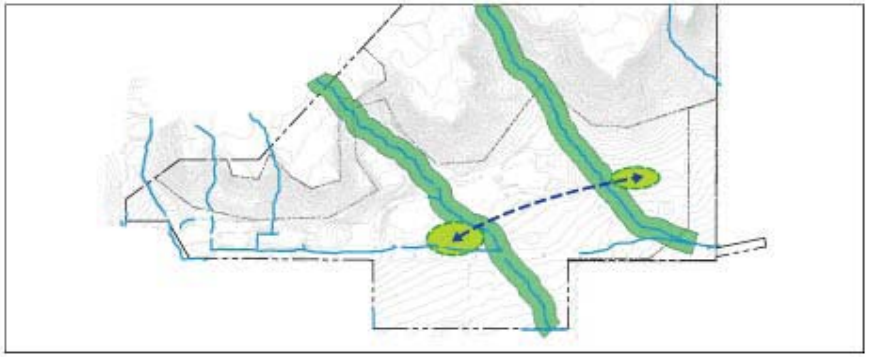
Issues Studied in Master Planning

After analyzing the existing context and site constriants, the design team developed a oncept for the NREL campus based on the following principles:

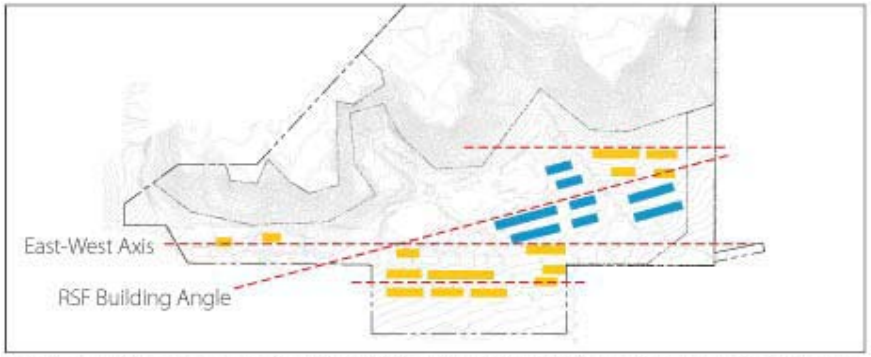
3. Integrate open space network and landscape features with storm drainage and detention facilities



1. Create an attractive, memorable and inspirational campus for employees and visitors by reinforcing unique natural characteristics on and near the campus.



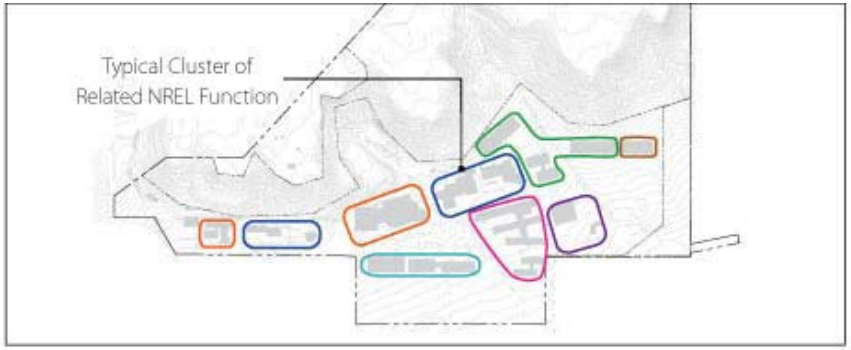
4. Preserve the two dominant arroyos on the campus by establishing a development setback requirement and create two major open space quads that are visually and physically connected.



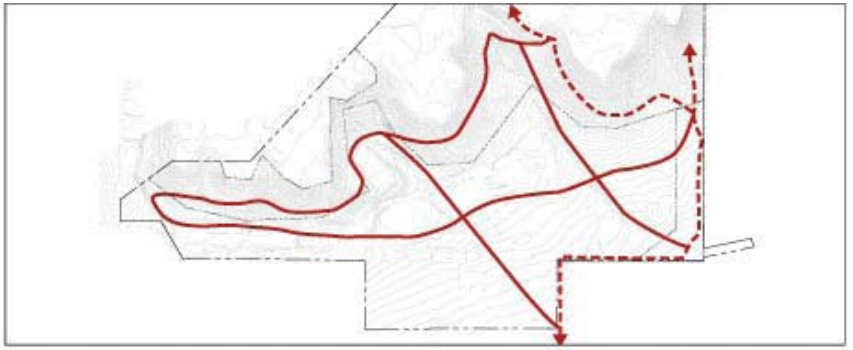
2. Orient buiildings along predominantly east-west axes in order to maximize solar access and daylighting

5. Provide a secure research environment by establishing campus and security perimeter beginning with multiple entrance gates.

Issues Studied in Master Planning (continued)

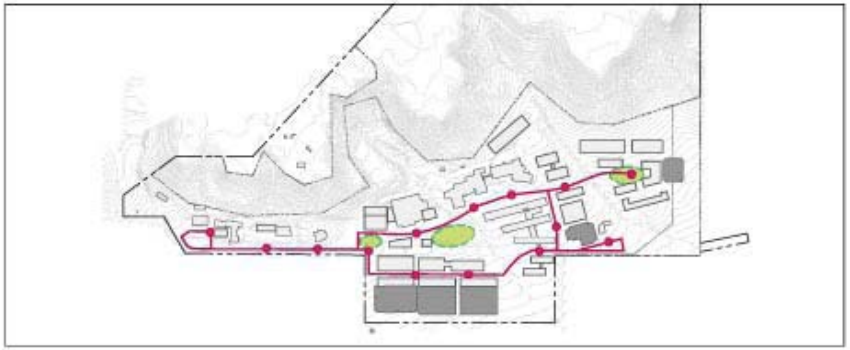


6. Organize placement of buildings according to the interconnected processes of research and development for the TYSP program.

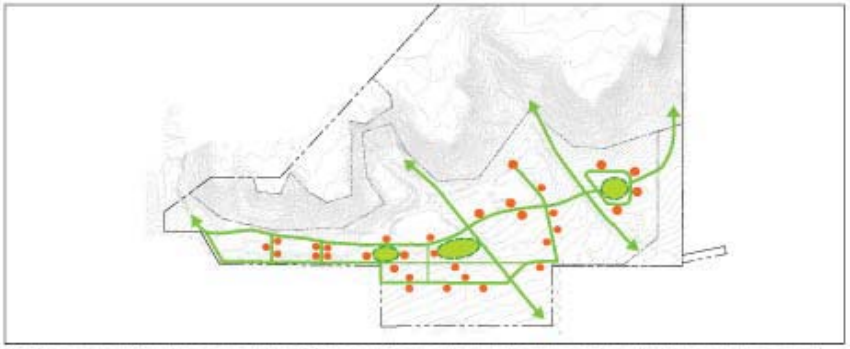


9. Connect the pedestrian network to the existing trails located both on and adjacent to the campus.

7. Promote a pedestrian-oriented environment that is safe and easily navigable for employees and visitors.



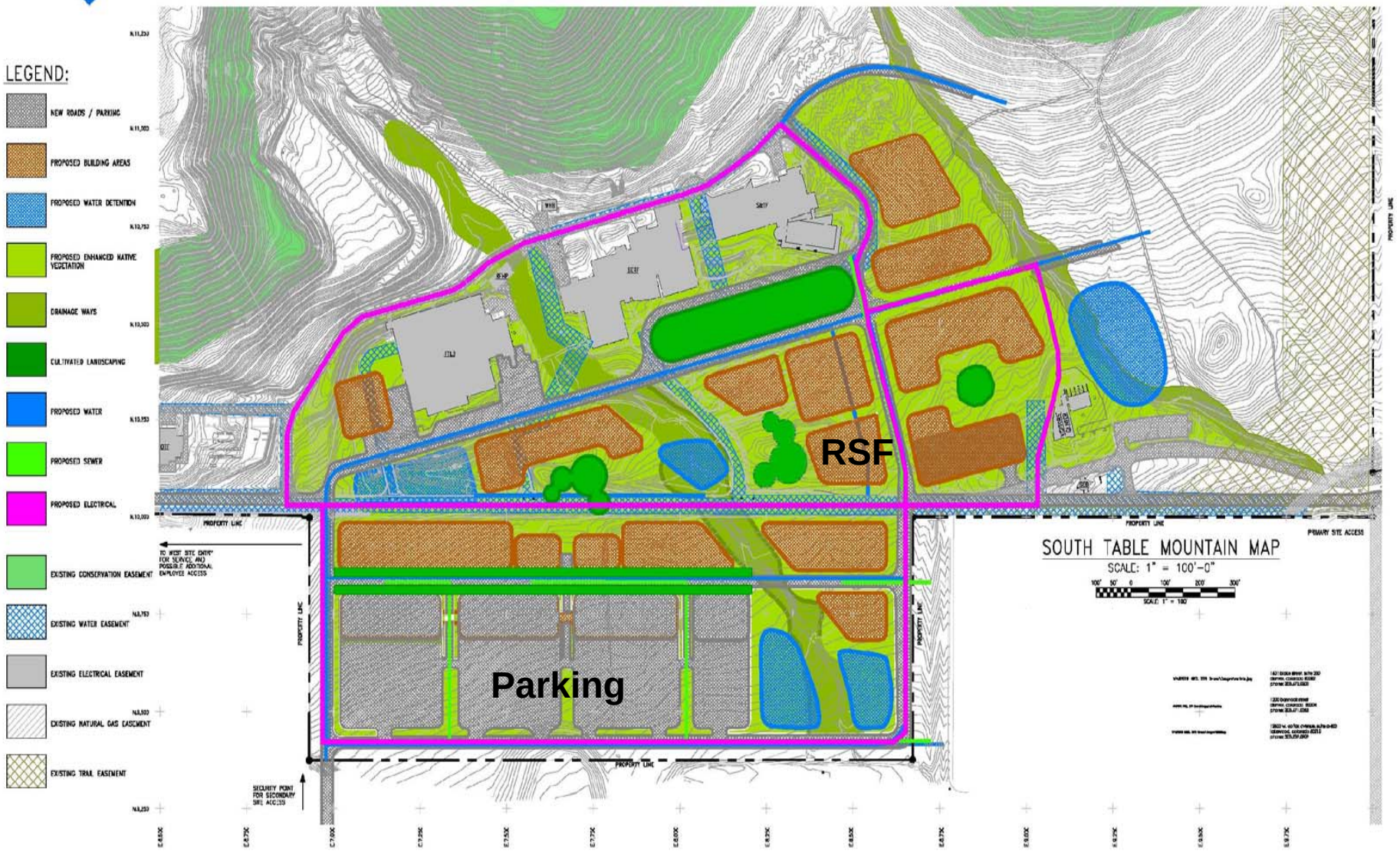
10. Provide a campus shuttle to destinations througout the site with stops associated with parking, building entries and major open spaces.



8. Orient and visually connect building entries to the pedestrian network, street system and open spaces.

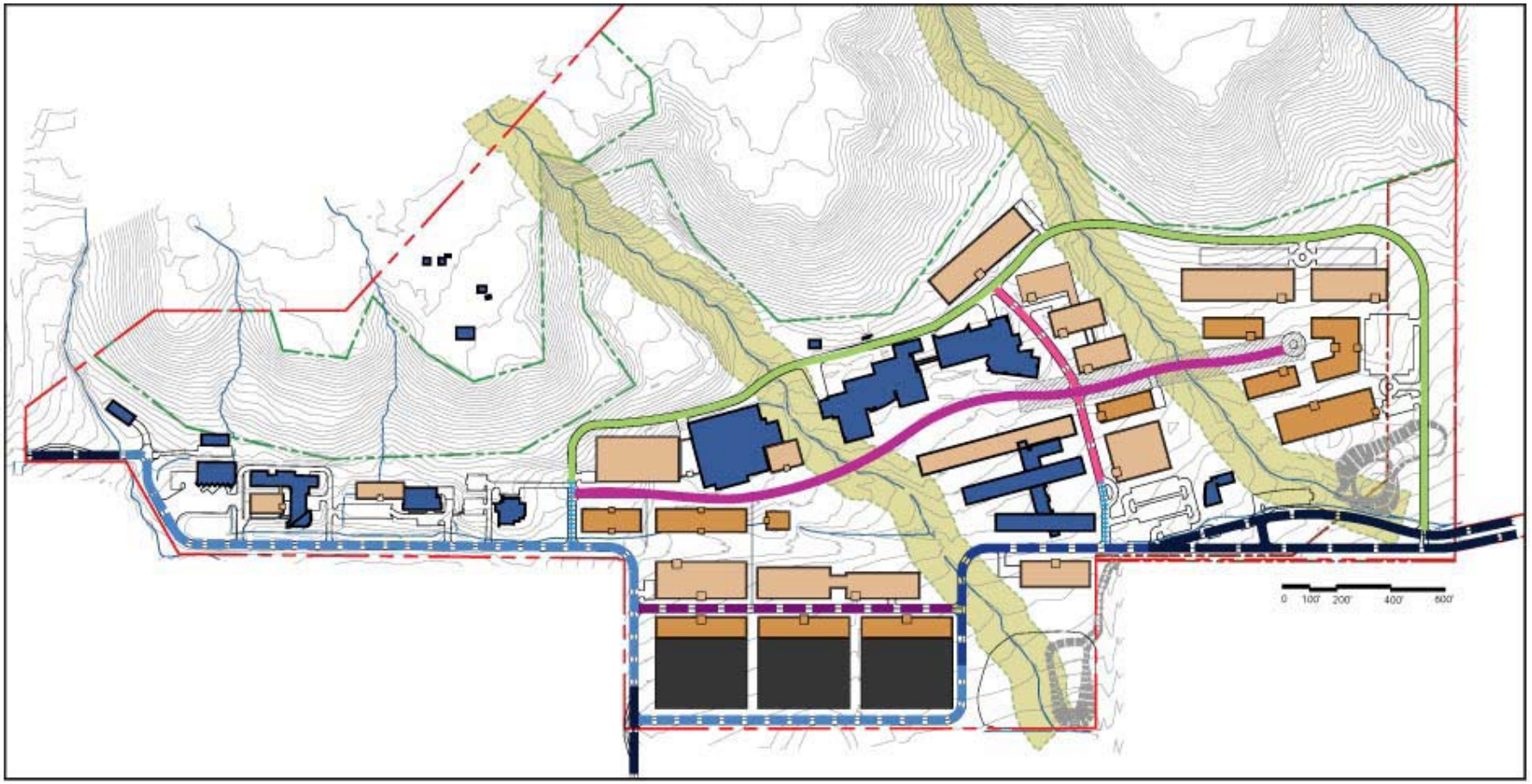
General Development Vision – 2003

NREL's Site Master Plan - 2008



South Table Mountain Site - 2008

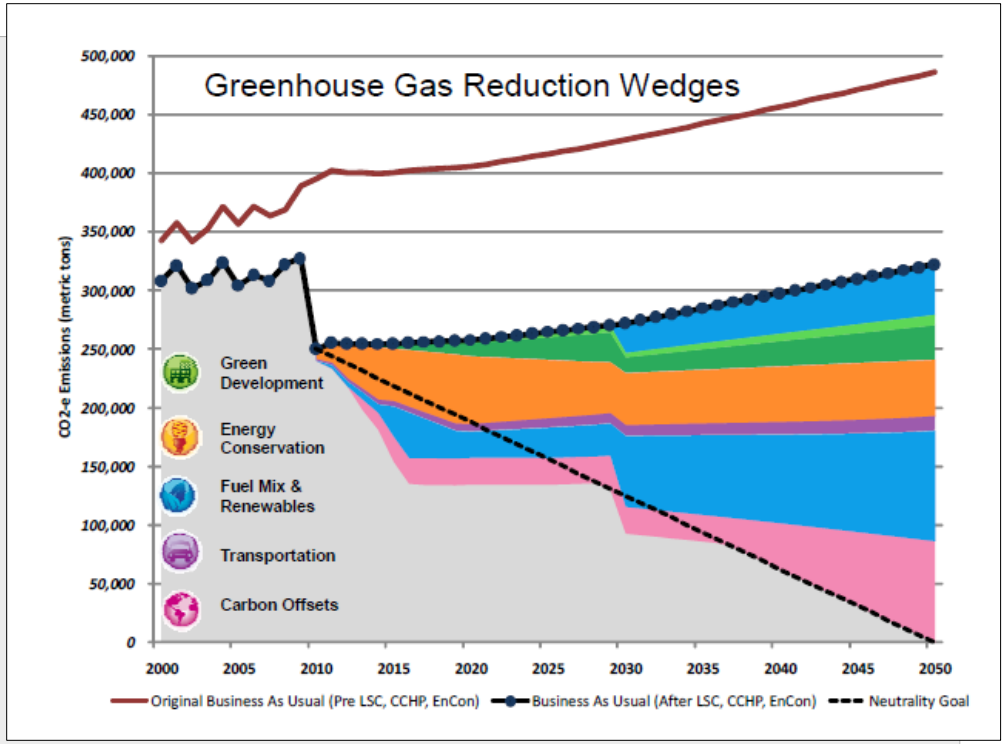
Master Plan - 2011



Today's Campus Build Out Plan – A Compelling Vision

What were the key factors that led to this innovative campus plan?

- Buy-in from the top
- Vision that recognizes and balances competing needs
- Consensus building regarding the plan ("Bring the right people together")
- From the energy point of view – Hierarchy of Actions – People, Efficiency; Efficient/Renewable Energy sources; Offsets
- A Portfolio of actions required for Deep Savings
- Climate Neutral Research Campuses - http://www.nrel.gov/applying_technologies/climate_neutral/



www.nrel.gov/applying_technologies/climate_neutral/

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Applying Technologies

Climate Neutral Research Campuses

More Search Options SEARCH
Site Map

- Determine Baseline Energy Consumption
- Analyze Technology Options
- Plan & Prioritize
- Implement the Climate Action Plan
- Measure & Evaluate Progress
- Climate Action Planning Tool
- Working with Us

Labs21 Approach

Climate Action Planning Tool for Research Campuses

Climate Neutral Research Campuses

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.

This Web site provides research campuses a five-step process to develop and implement climate action plans.

Technology Options

Develop a portfolio of measures across the campus.

1. Determine Baseline Energy Consumption
2. Analyze Technology Options
3. Prepare a Plan and Set Priorities
4. Implement the Climate Action Plan
5. Measure & Evaluate Progress

The process follows a logical hierarchy of actions to evaluate options by energy sector and set specific targets. It encompasses every energy system on campus, recognizing that campus-wide measures have greater potential for reducing carbon emissions. Use the Climate Action Planning Tool to determine which technology options will have the most impact on your campus.

The National Renewable Energy Laboratory (NREL) developed this Web site with support from Labs21—a joint venture of the U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP) and the U.S. Environmental Protection Agency.

Climate Neutral Research Campuses

Printable Version

Analyze Technology Options

An effective climate action plan follows a portfolio approach and addresses each energy sector on campus. This section outlines how various technology options would fit into a campus climate action plan and provides examples of how others have used these technologies. Links to definitions, technology basics, and references are also provided.

People and Policy

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

- Energy Conservation
- Flexible Work
- Land Use
- Space Planning

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.

- Energy Management
- New Buildings Standards
- Whole-building Renovation

Transportation

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

- Business Travel
- Commuter Programs
- Fleet Management

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Energy Sources

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

At the Central Plant

- Combined Heat and Power
- Fuel Mix
- Smart Grid

Use Renewable Energy

- Biomass
- Deep-Water Cooling
- Geothermal Energy
- Ground Source Heat Pumps
- Hydropower
- Landfill Gas
- PV
- Solar Thermal
- Wind

Offsets and 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 toward an interim goal.

- Carbon Offsets
- Green Power

After completing these steps, next prepare a climate action plan and set priorities.

Plan to Reuse Waste Energy – Energy Reuse Effectiveness -ERE

http://www.thegreengrid.org/en/Global/Content/white-papers/ERE

www.nrel.gov/applying_technologies/planning_tool/

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Applying Technologies

Climate Action Planning Tool

NREL's Climate Action Planning Tool provides a quick, basic estimate of how various technology options can contribute to an overall climate action plan for your research campus.

Use the tool to identify which options will lead to the most significant reductions in consumption of fossil fuels and in turn meet greenhouse gas reduction goals.

Follow these four steps:

1. Gather baseline energy consumption data
2. Enter baseline data into the calculator
3. Set and adjust emissions and technology options goals
4. Generate a report

Start: Gather baseline data

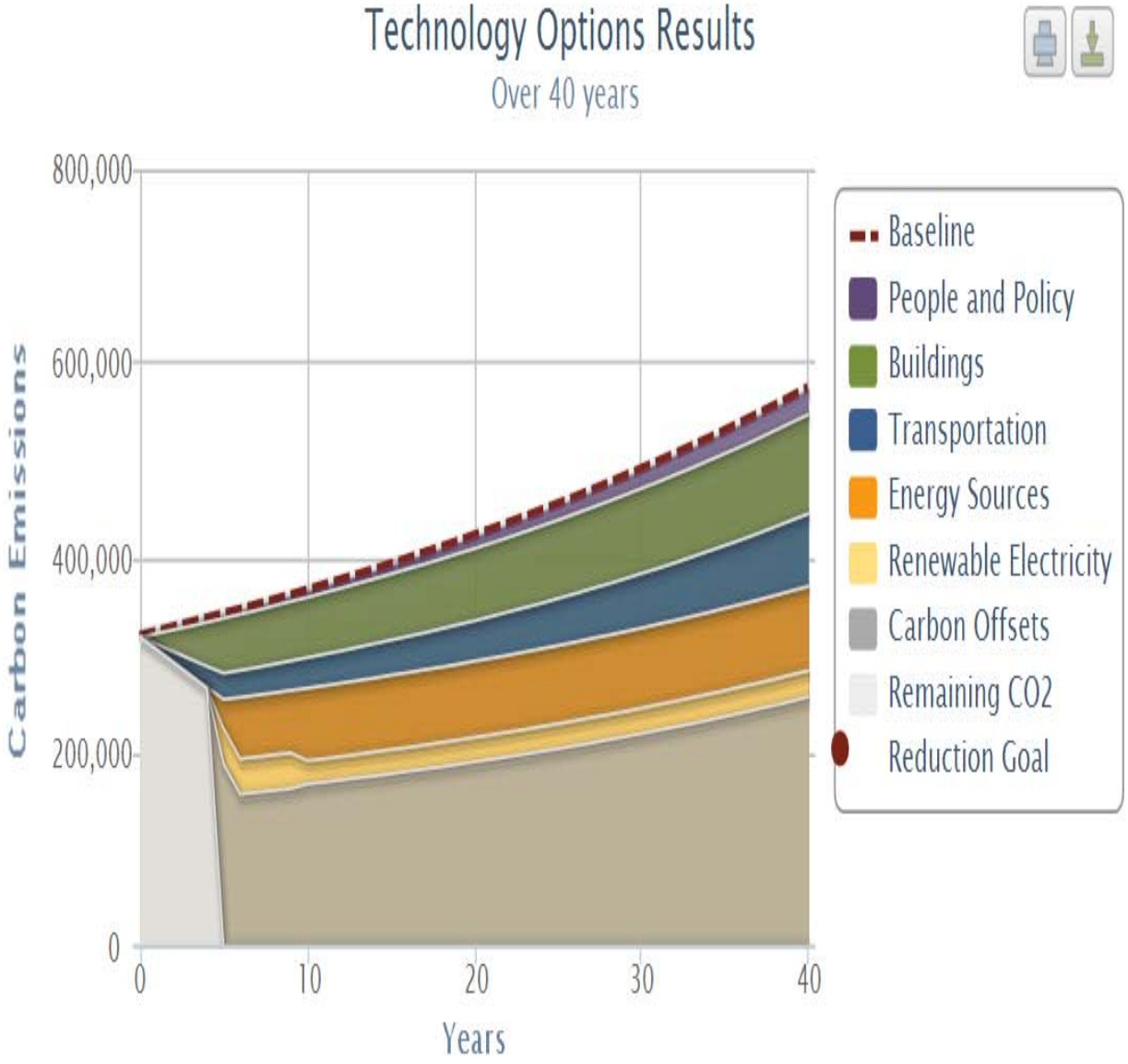
More Information

Tool Calculation Formulas and Assumptions

Climate Neutral Research Campuses Website

Help

Technology Option	Reduction/ Conversion Goal %	Year to Achieve Goal/ Year of Conversion
Space Planning and Use	20	1
Energy Conservation	20	5
New Buildings Design	50	1
Fleet Management	60	5
Commuter Programs	20	5
Business Travel	40	5
Fuel Sources: Coal to Gas	50	5
Fuel Sources: Coal to Wood	50	5
Combined Heat and Power	100	10
Renewable Electricity	50	5
Carbon Offsets and Certificates	100	5



Campus Build-out Status (June 2011)

Research Support Facility – A Net Zero Office Building

RSF Net-Zero Boundary

Photovoltaic System

- Power Purchase Agreement (PPA) provides full rooftop array on RSF 1
- Zero energy = building, parking lot and future parking garage arrays (2537 kW)

Existing and Future Onsite PV at STM*

720kW PV

AFUF	Alternative Fuel User Facility
ESIF	Energy Systems Integration Facility
FTLB	Field Test Laboratory Building
IBRF	Integrated Biorefinery Research Facility
NGBRF	Next Generation Biorefinery Facility
OTF	Outdoor Testing Facility
RFHP	Renewable Fuels Heating Plant
RFVSF	Renewable Fuels and Vehicle Systems Facility
RSF	Research Support Facility
S&TF	Science & Technology Facility
SEB	Security Entrance Building
SERF	Solar Energy Research Facility
SRRL	Solar Radiation Research Laboratory
TSRF	Translational Science Research Facility
TTF	Thermal Test Facility

94 kW PV
on STF rooftop

408 kW on
RSF2 rooftop

524 kW on visitor
parking structure

450 kW on
on RSF 1 rooftop

1156kW PV on
Parking garage rooftop

Solar Furnace
SRRL
Shipping
IBRF
IBRF
AFUF
TTF
OTF
RFHP
SERF
STF
FTLB
NGBRF
TRSF
TRSF II
RSF II
RSF I
RSF II
RFVSF
Central Plant
ESIF II
ESIF
Conference Center
Visitors' Center
Site Entrance
Future Building Site
Building in Progress
Existing Building
Solar Arrays
North
0
200
400

*Plus 1083 kW at the NWTC

Research Support Facility

Entrance (looking west)

Typical Office floor

Nancy.Carlisle@nrel.gov
Otto.VanGeet@nrel.gov

RSF II
21 kBtu/ft2
$246/ft2 construction cost

Sustainability - Dual Meanings

A building (or campus) that is truly sustainable is one that will endure.

- Bill McDonough

Campus, community or base sustainability -

- *Maximizing the efficient use of resources*, minimizing waste and serving as a positive force to reflect economic, environmental and community responsibility;
- *Creating a place* that is rooted in its context that is unique and meaningful to people. When people value a place, it will be sustained.

- NREL's GDV