FACT SHEET AND FREQUENTLY ASKED QUESTIONS:
THE ENERGY AND CLIMATE PLAN AND
STANFORD ENERGY SYSTEM INNOVATIONS (SESI) PROGRAM

SUSTAINABILITY OPPORTUNITY

Situated on 8,180 acres, Stanford requires a significant amount of energy to support its academic mission and the research functions housed within more than 1,000 campus buildings. Efficiently managing energy supply and demand, as well as the corresponding greenhouse gas (GHG) emissions, is therefore critical to the university's future operations. Since the 1980s, Stanford has employed best practices to minimize the cost and environmental impact of its operations. The campus has employed energy metering in all its facilities, used efficient natural-gas-fired cogeneration for its energy supply, retrofitted buildings with efficient systems, implemented stringent building standards, invested in renewable power, conserved water, and reduced automobile commute emissions. Now, Stanford accepts the challenge to go beyond these efforts and raise the bar in the use of innovative and renewable energy supplies to further reduce its environmental impact and operational cost.

STANFORD’S EMISSIONS & SOLUTIONS

Stanford joined the California Climate Action Registry (CCAR) in 2006 and has prepared third-party-verified inventories of Scope I and II GHG emissions for the main campus each year since. In 2010 the university transitioned to the Climate Registry, an international North American emissions registry. In addition to the official inventories, Stanford prepares unofficial inventories of its Scope III emissions, as well as those attributed to steam and chilled-water deliveries to Stanford Hospital and Clinics from the Central Energy Facility (CEF). At present, Stanford’s total emissions are estimated to be 270,000 metric tons of carbon-dioxide equivalent. This number is expected to temporarily increase as the university expands its academic offerings, and dramatically decrease when SESI is implemented in 2015.

Stanford’s long-range Energy and Climate Plan, developed collaboratively, peer reviewed, and incorporating both engineering and financial models, presents a three-pronged balanced approach to improve infrastructure and dramatically reduce GHG emissions, despite campus growth and without relying on market carbon instruments.

The solutions proposed in the Energy and Climate Plan, including the Stanford Energy System Innovations (SESI) program (see next), will reduce the university’s GHG emissions 50% below 1990 levels by 2015. The SESI program and the proposed new heat recovery system within will also provide an 18% savings in the university’s potable water consumption.
THE ENERGY AND CLIMATE PLAN:
A BALANCED APPROACH

Given Stanford’s planned growth to support its academic mission, its large and diverse existing campus building inventory, and its on-site energy plants, a balance among investment between new buildings, existing buildings, and energy supply is required for a successful long-range Energy and Climate Plan.

A balanced approach for key components in the Energy and Climate Plan

1.) **High performance new building design:** Constructing new high-performance buildings to minimize the impact of growth on campus energy systems and GHG emissions is a key strategy at Stanford. The Guidelines for Sustainable Buildings, originally published in 2002 and updated in 2008, in combination with the Guidelines for Lifecycle Cost Analysis and the Project Delivery Process Manual provide the framework for minimizing energy demand in new construction and major renovation projects on campus.

2.) **Energy conservation in existing buildings:** Building-level energy metering in all its facilities since the 1980s has allowed Stanford to understand how and where energy is being used in order to facilitate strong energy efficiency programs. While the University has pursued aggressive energy conservation for many years, a continuance and expansion of programs like the Whole Building Energy Retrofit program and the Energy Retrofit program comprise a critical component of the Energy and Climate Plan.

3.) **Campus energy supply and SESI program:** Stanford has pursued an efficient energy supply through the use of natural gas-fired cogeneration for virtually all its energy since 1987. However, fossil fuel use in cogeneration is the largest contributor of GHG emissions for Stanford, and conversion to new options that assure reliability, contain cost, and reduce GHGs are an essential third strategy in the Energy and Climate Plan.

Given that energy production at the existing Central Energy Facility (CEF) produces 90% of Stanford’s GHG emissions and consumes 25% of the campus’s potable water supply, changes to Stanford’s energy supply are the major focus of the Energy and Climate Plan. As a result of the significant overlap between campus heating and cooling needs, the plan proposes a replacement CEF that employs an innovative heat recovery design that is 52% more efficient than the existing CEF operations without renewable energy factored in, and with state-mandated 33% renewables will be 112% more efficient in the use of natural gas to meet campus energy needs. Waste heat collected from buildings via the chilled-water loop will be captured at the CEF for reuse, reducing the use of conventional chillers to discharge waste heat out of cooling towers. Instead, heat recovery chillers will move the waste heat collected from the chilled water loop to a new hot-water loop scheduled to replace Stanford’s aging steam distribution system. The solutions identified using this approach are outlined in detail in the full text of the Energy and Climate Plan, available at [http://sustainable.stanford.edu/climate_action](http://sustainable.stanford.edu/climate_action).

**INNOVATION: HEAT RECOVERY**

Analysis has revealed a 70% real-time overlap of heating and cooling demands on campus, which presents the opportunity for heat recovery—using waste heat collected by the chilled-water system to meet the university’s concurrent heating need. In the new heat recovery design, waste heat collected from buildings via the chilled-water loop will be captured at the new Central Energy Facility for reuse, eliminating the use of conventional chillers to discharge waste heat out of cooling towers by 70%, which translates to an 18% savings in Stanford’s total potable water use as well. Instead, heat recovery chillers will move waste heat collected from the chilled-water loop to a new hot-water loop that will replace the existing steam loop. While the heat recovery approach necessitates a modestly higher up-front cost than a conventional boiler and chiller plant design, it also represents a lower up-front cost than a new cogeneration plant, provides the lowest lifecycle cost of all options, and will pay Stanford back many times over in coming years, while significantly improving the university’s environmental sustainability.

The simultaneous overlap of annual heating and cooling demand on campus
BEYOND COGENERATION

An energy supply system that uses fossil fuels to produce electricity and then recovers waste heat from the combustion process for heating or other productive uses is known as Combined Heat and Power (CHP), or cogeneration. Conversely, an energy system in which heat and power are produced separately, usually by on-site heat production equipment and off-site power plants respectively, is known as Separate Heat and Power (SHP).

Whether CHP or SHP is more energy efficient, economic, or environmentally preferable for a given site depends on many factors, including climate, relative heat and power loads, the energy efficiency of equipment used in each process (including off-site power production in the SHP option), and capital equipment cost.

At Stanford these factors result in CHP (new system with hot water) and SHP being generally equal in expected overall long-term efficiency if only natural gas is used to fuel equipment in both cases for direct comparison. However, when renewable electricity and heat recovery are also possible, the SHP option becomes clearly superior in terms of efficiency, economy and the environment. Given the significant amount of heat recovery that is possible at Stanford, along with state mandates of 33% renewable electricity, an energy supply system featuring SHP with heat recovery offers significantly lower long-term cost and environmental impact than CHP.

In the ongoing pursuit of sustainability, the heat recovery system will move Stanford into a new energy era with a significantly lower reliance on fossil fuel, lower energy costs, reduced GHG emissions, and less water use. Just as Stanford’s move to cogeneration 25 years ago represented a major shift in campus energy supply technology for the better, so too does heat recovery represent a significant shift of the campus energy supply to a more efficient and sustainable technology for the future.
BOARD APPROVAL

In late 2011, Stanford University’s Board of Trustees gave concept approval to the Stanford Energy System Innovations (SESI) program, a $438 million dollar investment to meet campus energy needs through a collection of independent projects. Learn more here.

NEXT STEP: IMPLEMENTING SESI PROGRAM

The SESI program focuses on improving Stanford’s energy supply system and includes a new replacement central energy facility, a new electrical substation, and the steam to hot water conversion process for underground piping and within affected buildings.

Projects to convert over twenty miles of steam pipelines to hot-water piping across the entire campus are proceeding, and will be completed in 2015. Since most campus buildings are currently configured to receive steam, building-level modifications are also under way. In the fall of 2010, the first regional heat exchange station went live, serving more than a dozen buildings placed on new hot water service, including the new LEED Platinum Knight Management Center at the Graduate School of Business and other nearby facilities.

Conversion of the remaining parts of campus to a hot water distribution system are underway and will be completed in 2015.

An aerial rendering of the new Central Energy Facility.

New hot water piping is installed near the new Central Energy Facility.

A new heat exchanger at the converted Sweet Hall.
FACT SHEET AND FREQUENTLY ASKED QUESTIONS:
THE ENERGY AND CLIMATE PLAN & SESI PROGRAM
CONTINUED

FREQUENTLY ASKED QUESTIONS

1. What is the SESI program?

Answer: SESI stands for Stanford Energy System Innovations. The SESI program focuses on projects designed to improve Stanford’s energy supply system, which are the major construction components of the Energy and Climate Plan.

As a result of the significant overlap between campus heating and cooling needs, SESI includes a replacement of the existing Central Energy Facility with a new CEF on the west side of campus that will employ an innovative heat recovery design that is 70% more efficient than the existing CEF. Waste heat collected from buildings via the chilled-water loop will be captured at the new CEF for reuse, reducing the use of conventional chillers to discharge waste heat out of cooling towers. Instead, heat recovery chillers will move the waste heat collected from the chilled-water loop to a new hot-water loop scheduled to replace Stanford’s aging steam distribution system throughout campus.

2. What are the major components of the SESI program?

Answer: SESI includes the following:

1. A new Central Energy Facility located on the west side of campus so as to free up core campus land for new academic buildings after demolition of the existing cogeneration plant;
2. A new electrical substation located next to the new CEF which also provides new capacity and frees up core campus space for academic use;
3. Conversion of the campus steam distribution system to hot water;
4. Conversion of 155 buildings to receive hot water instead of steam for heating and hot water services;
5. High voltage transmission system improvements to increase reliability of grid electrical service to the university.

3. How much will this initiative cost? Will there be savings?

Answer: The investment for the combination of projects included in the SESI program is $438 million, which is in the middle of the range of capital cost options to replace the aging cogeneration plant, but also provides the lowest lifecycle cost and environmental impact of all options considered. See the figure to the top right for a breakdown of SESI costs.

4. What is Direct Access? Has Stanford secured Direct Access?

Answer: In the pursuit of options to lower cost and improve flexibility in its electricity supply, Stanford has switched to Direct Access. Under Direct Access, customers can purchase their power directly from competitive energy service providers (ESPs). California enacted Direct Access in the 1990s to promote competition in the electricity supply market and provide consumers with a choice in energy service providers.

However, the state suspended Direct Access in 2001 during an energy crisis. A very small Direct Access allotment was made available in 2010 on a lottery basis. Stanford secured Direct Access during this lottery and has now moved its grid electricity purchases to an independent energy services provider. As a result of Direct Access to the California electricity market, Stanford can continue to pursue opportunities for a more economical and environmentally sound power portfolio.

5. What are the general next steps for implementation?

Answer: Construction of the new CEF, substation, hot water piping and building conversion are underway and will be completed in 2015. Live footage of the construction site as well as project updates can be found at the SESI website at sesi.stanford.edu.
FACT SHEET AND FREQUENTLY ASKED QUESTIONS:
THE ENERGY AND CLIMATE PLAN & SESI PROGRAM
CONTINUED

6. How long will the full SESI implementation last? What types of impacts are expected?

**Answer:** Full implementation of the SESI program will be completed in 2015. The Department of Project Management is coordinating closely with Stanford schools and departments throughout the implementation process.

Modification to the mechanical systems of each building will facilitate the hot water conversion process. At least two (2) major shutdowns will be required per building. In addition, there will be road and pathway closures typical of utility projects. Systematic and timely communication will be deployed to minimize impact.

7. Where can I find more information?

**Answer:** Resources are available online at [http://sesi.stanford.edu](http://sesi.stanford.edu). The site includes:

- A video overview of the plan’s key components that provides a historical perspective on Stanford’s environmental stewardship
- A live video of the Central Energy Facility construction site
- An interactive implementation map, outlining completed, planned and ongoing SESI construction
- Additional information and technical details on the SESI program

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