

“The Greening of Gemini”

3rd National Science Foundation Large Facilities Workshop

Scripps Institution of Oceanography & the University-National Oceanographic Laboratory System (UNOLS)

San Diego, CA. May 4-7, 2010

The Greening of Gemini

- **Context**
- **Gemini's Green initiatives**
- **Next steps**
- **Recommendations**



Context

Hawaii



Chile



Mauna Kea, Hawaii

Built : 1999

Building 8,651 sq ft

Dome 26,248 sq ft

Hilo, Hawaii

Built : 1998

Extended : 2008

30,847 sq ft

Built : 2003

17,665 sq ft

Built : 2001

Building 15,199 sq ft

Dome 26,248 sq ft

La Serena, Chile

Cerro Pachón, Chile

Mauna Kea, Hawaii

Hilo, Hawaii

33%

16%

DISTRIBUTION OF GEMINI'S
ENERGY CONSUMPTION (kWh)

9%

42%

La Serena, Chile

Cerro Pachón, Chile

Mauna Kea, Hawaii

Hilo, Hawaii

43%

23%

DISTRIBUTION OF GEMINI'S

ENERGY COSTS (US\$)

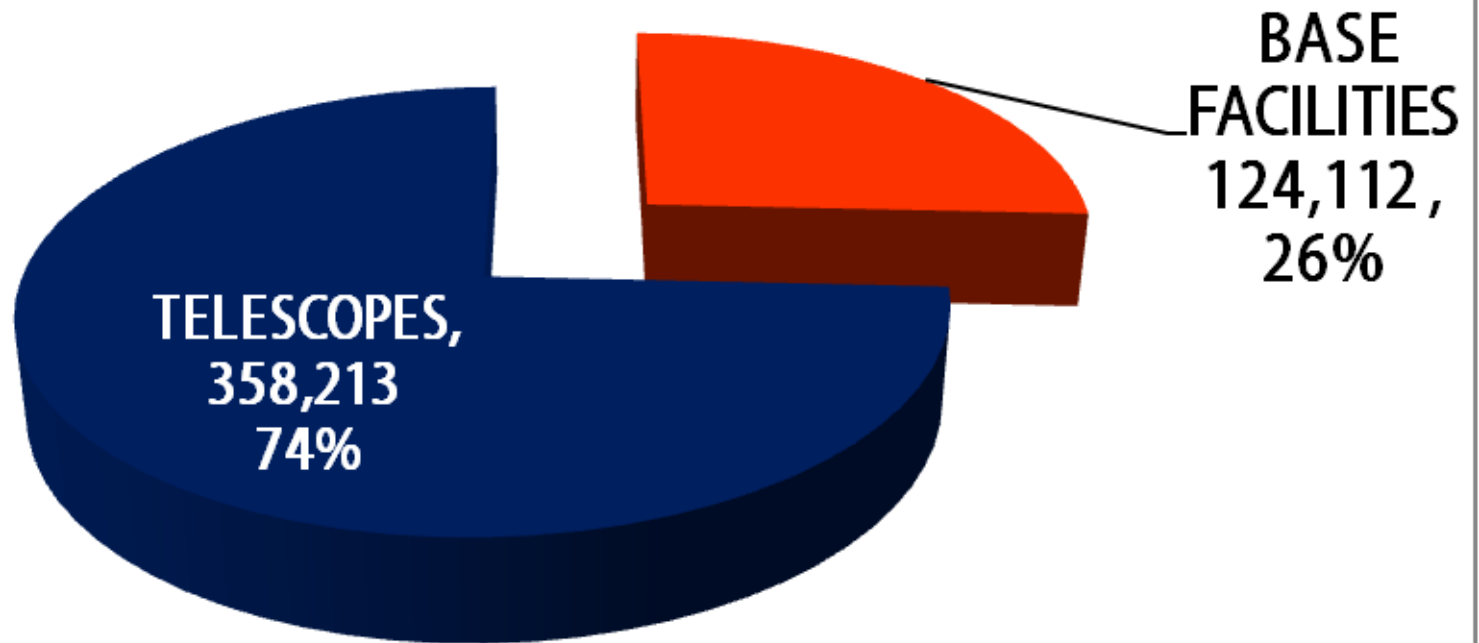
6%

28%

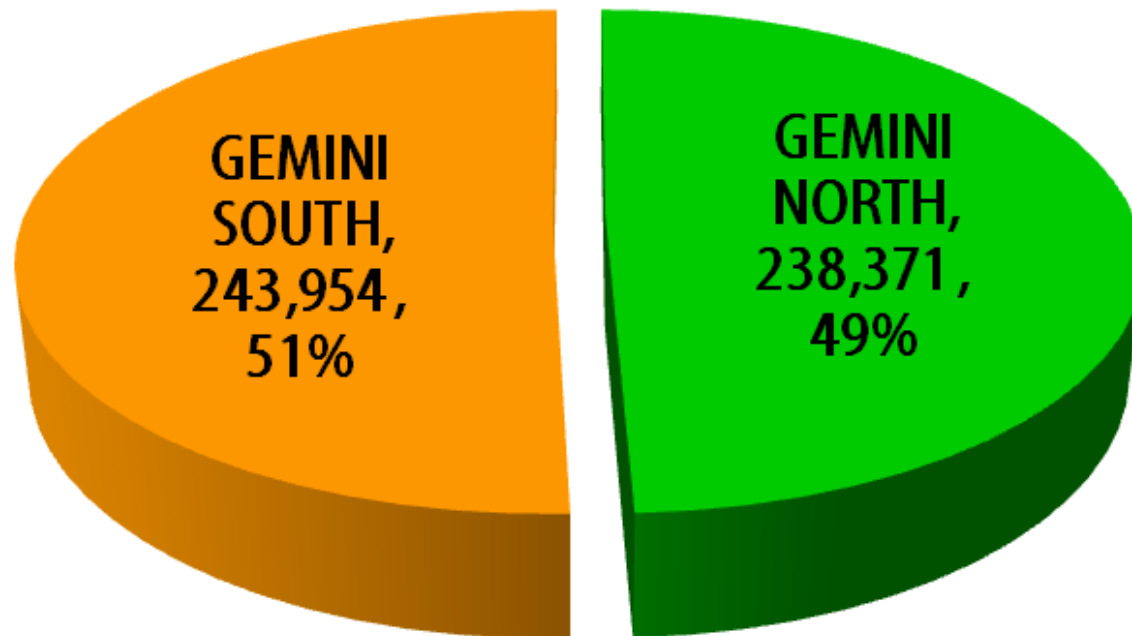
La Serena, Chile

Cerro Pachón, Chile

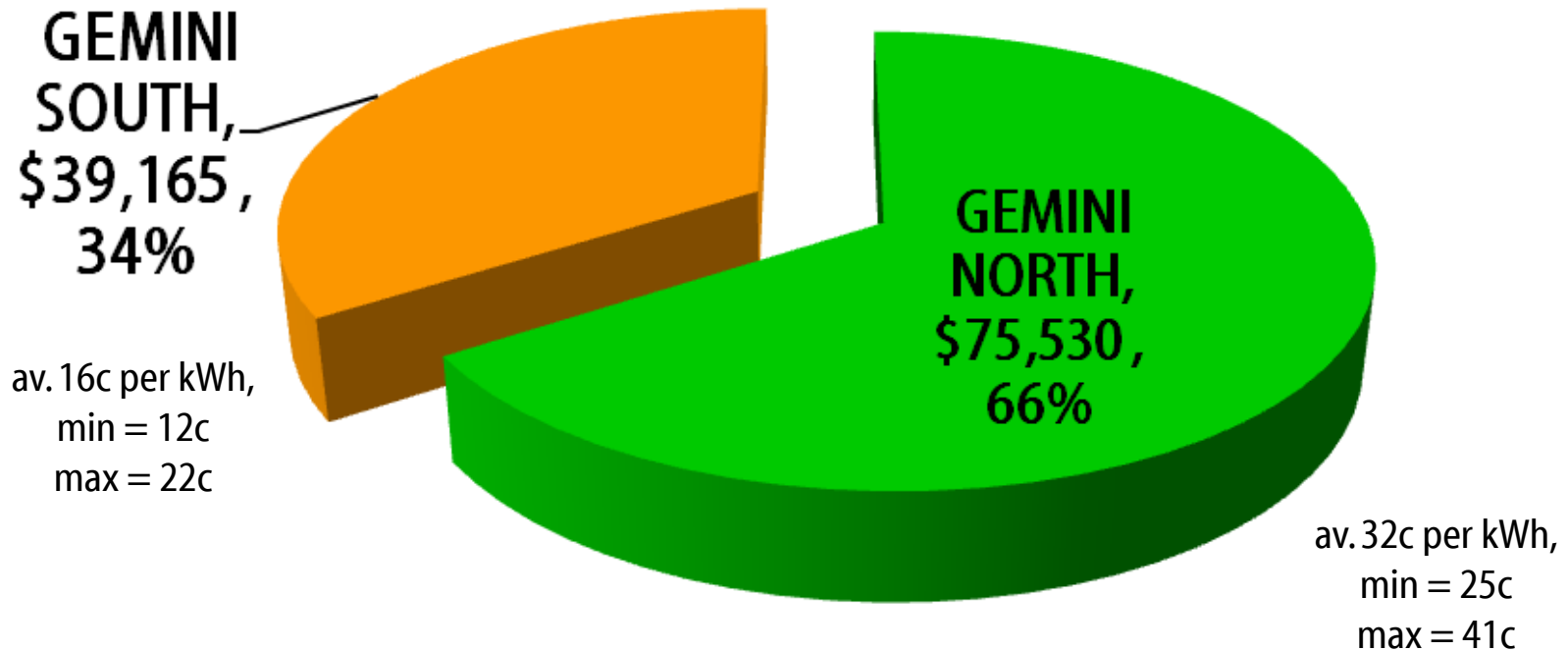
DISTRIBUTION OF ENERGY CONSUMPTION (kWh) APRIL 2007-MARCH 2010



DISTRIBUTION OF ENERGY CONSUMPTION (kWh) APRIL 2007-MARCH 2010



DISTRIBUTION OF ENERGY COSTS (US\$) APRIL 2007-MARCH 2010



- Nearly a decade in operations mode
- A consolidated “Two telescopes – One Observatory” philosophy
- More strategic planning
- More staff involvement
- More focus on sustainable operations

GEMINI OBSERVATORY

Our working culture

Nuestra cultura de trabajo

- ◆ TAKING RESPONSIBILITY AND ACCOUNTABILITY FOR OUR ACTIONS
- ◆ ASUMIENDO LA RESPONSABILIDAD DE NUESTRAS ACCIONES

- ◆ ACTING WITH INTEGRITY IN ALL WE DO
- ◆ ACTUANDO CON INTEGRIDAD EN TODO LO QUE HACEMOS
- ◆ HAVING MUTUAL TRUST IN ALL RELATIONSHIPS
- ◆ CONFIANDO MUTUAMENTE EN TODAS NUESTRAS RELACIONES
- ◆ NURTURING SAFETY OF PEOPLE AND EQUIPMENT IN ALL OUR ACTIONS
- ◆ FOMENTANDO LA SEGURIDAD DE LAS PERSONAS Y EQUIPOS EN TODAS NUESTRAS ACCIONES



Gemini Green Blog

Written by admin on Mon, 2008-08-04 16:00, updated on August 7, 2008

Gemini Observatory will begin a “green” facilities program in 2009; an issue that is of interest to many of our staff. So, as part of the planning process for next year, we want to obtain staff comments on the subject and have created a blog for this purpose.

We want to encourage all staff to use this communication channel to establish a knowledge base on green issues that should be of relevance to Gemini. Our aims are high levels of sharing and collaboration on the subject; building a productive green building program from the contributions from all that are interested in the topic, from whatever angle.....

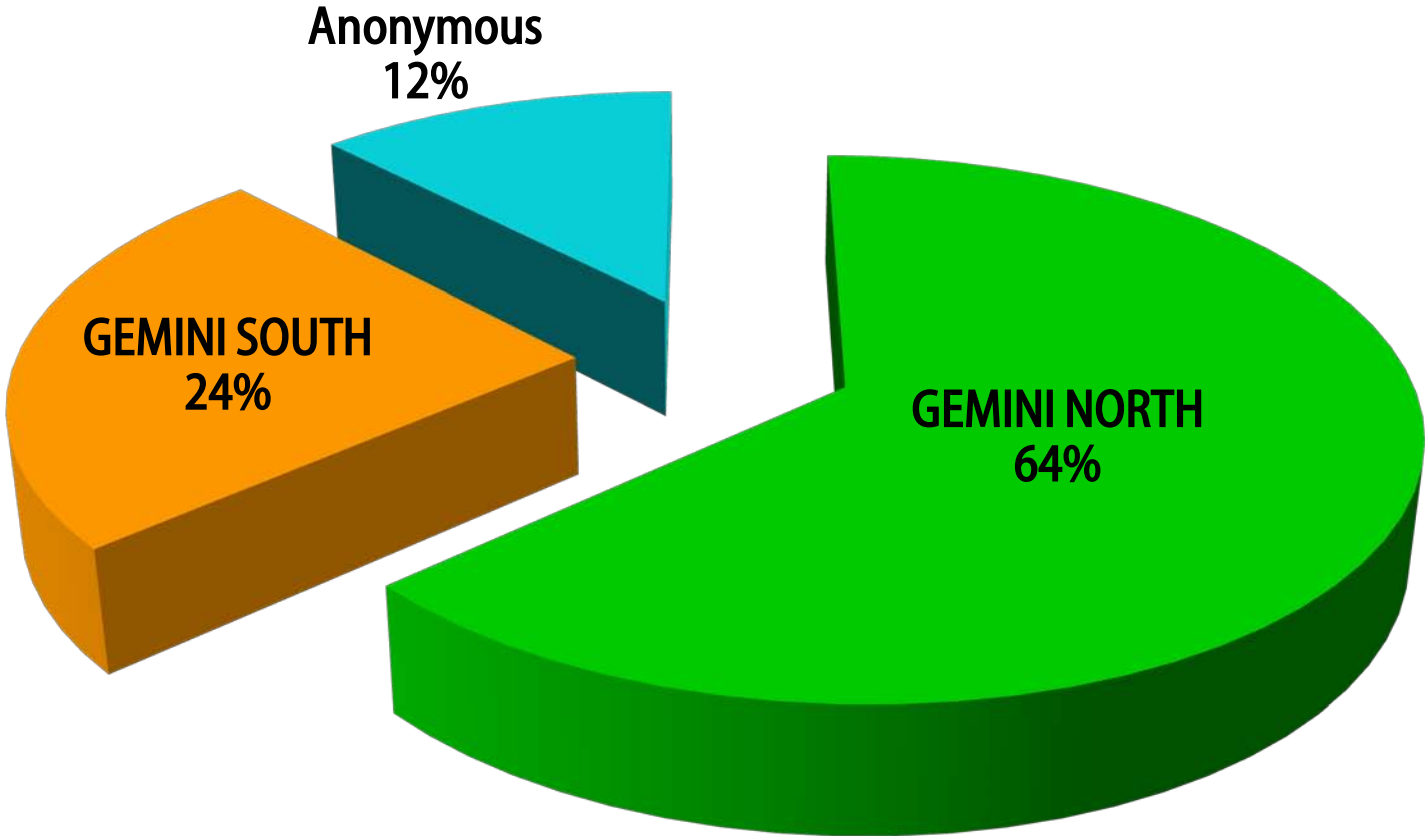


of our fossil-fueled vehicles: proper tire

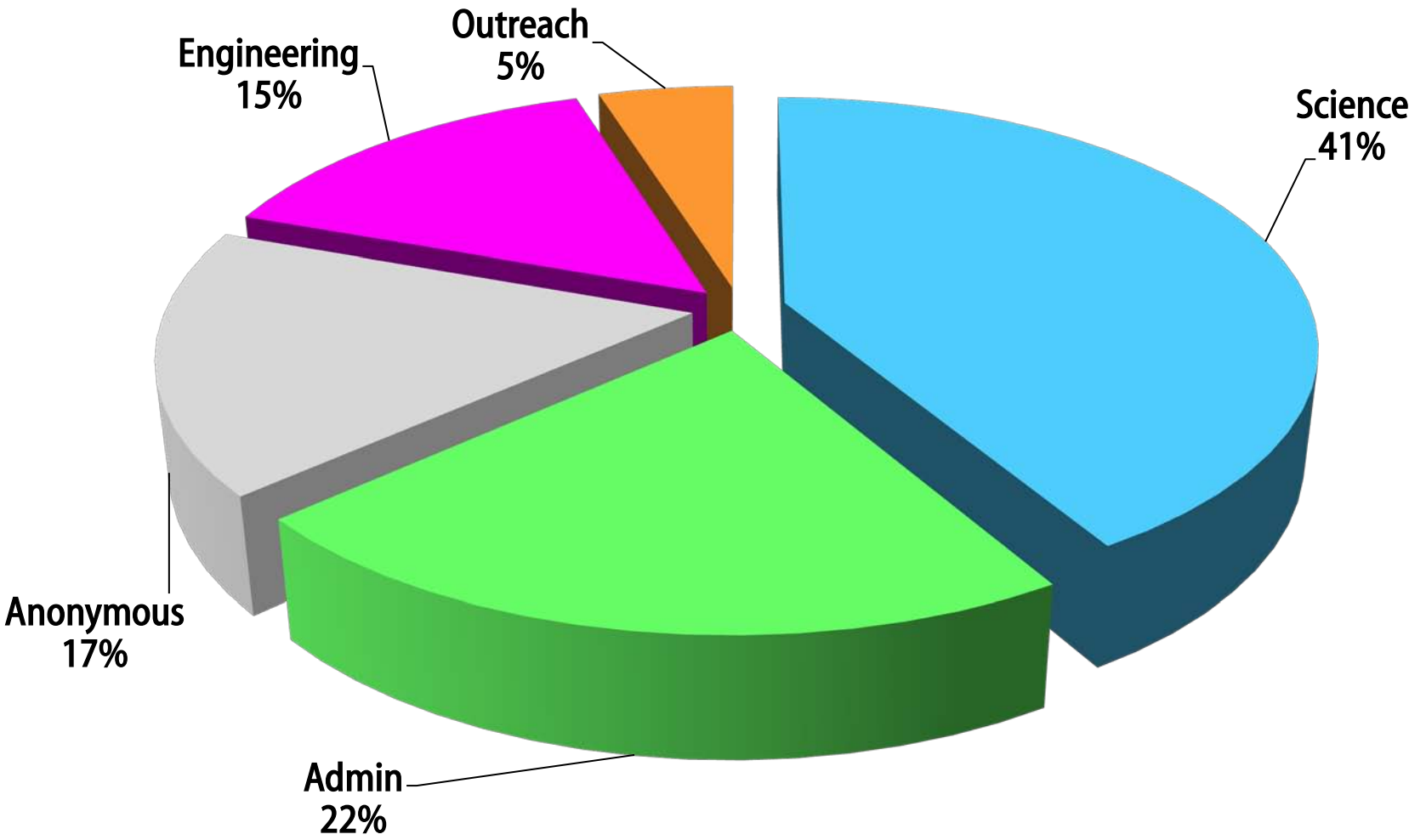
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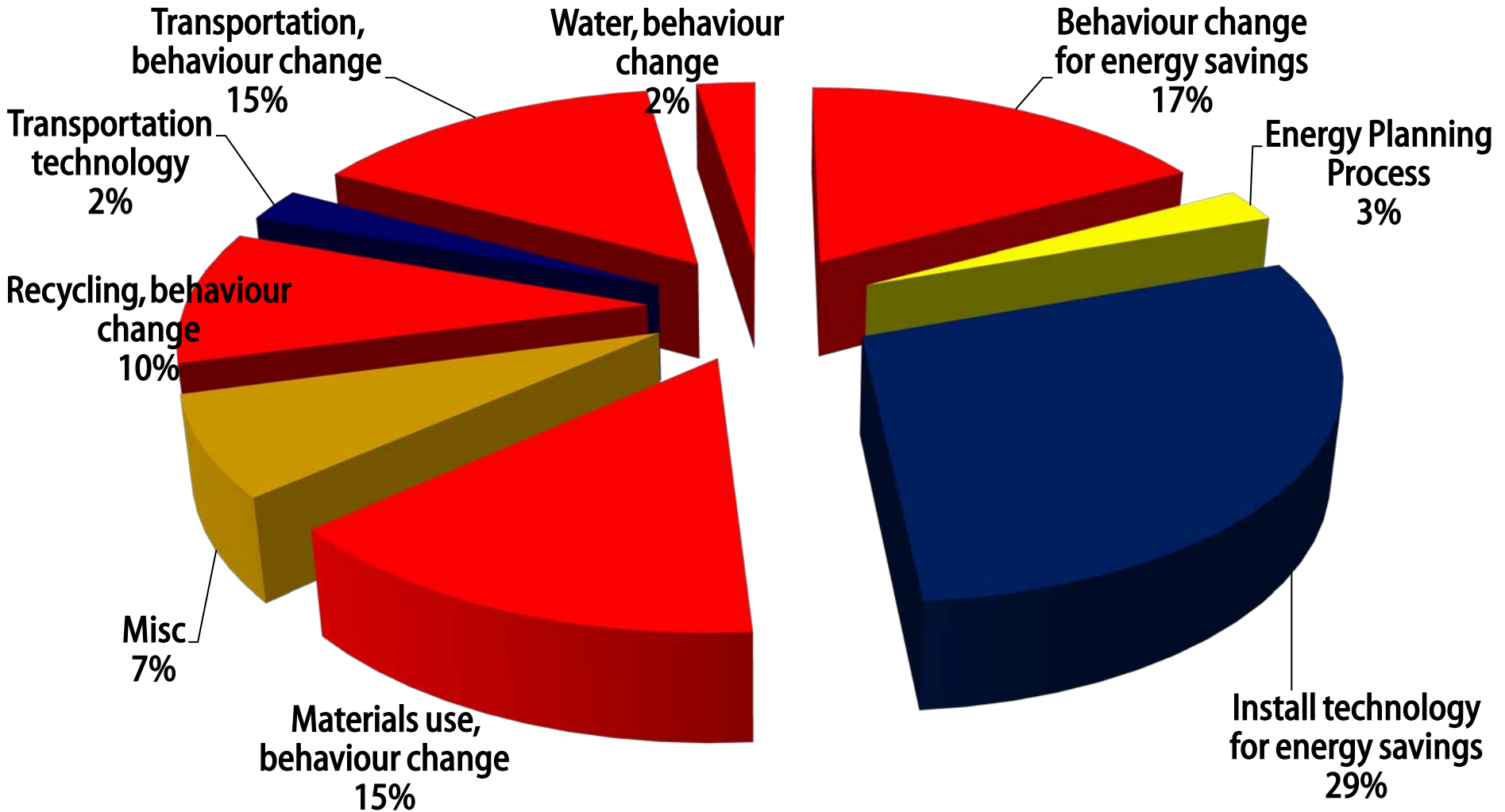
Where did the ideas come from?



Where did the ideas come from?



What type of change?



What type of change?

31% of comments promoted technology

59% promoted **behavior change**



What type of change?

Gemini approached the challenge in two ways.....

- ❑ Created an internal structure for energy planning
- ❑ Began implementing changes where a good start could be made quickly (“low hanging fruit”)

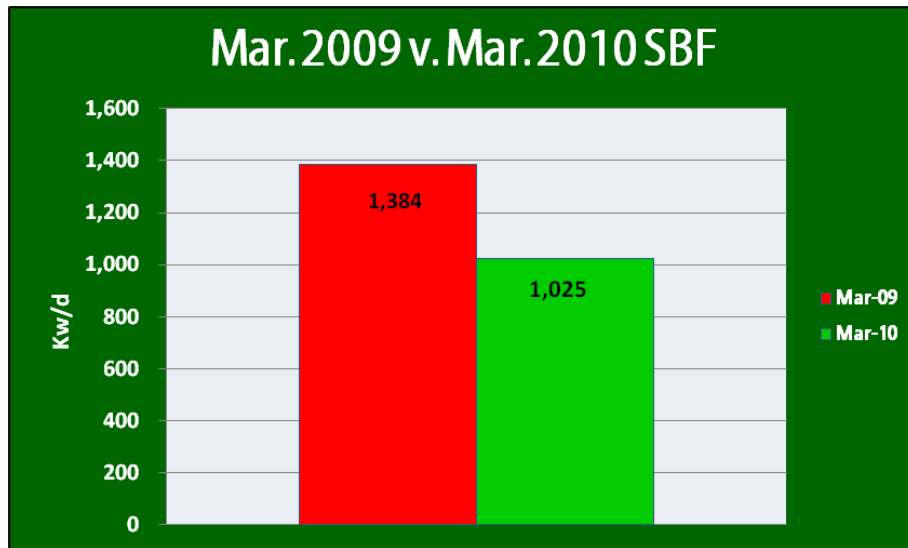
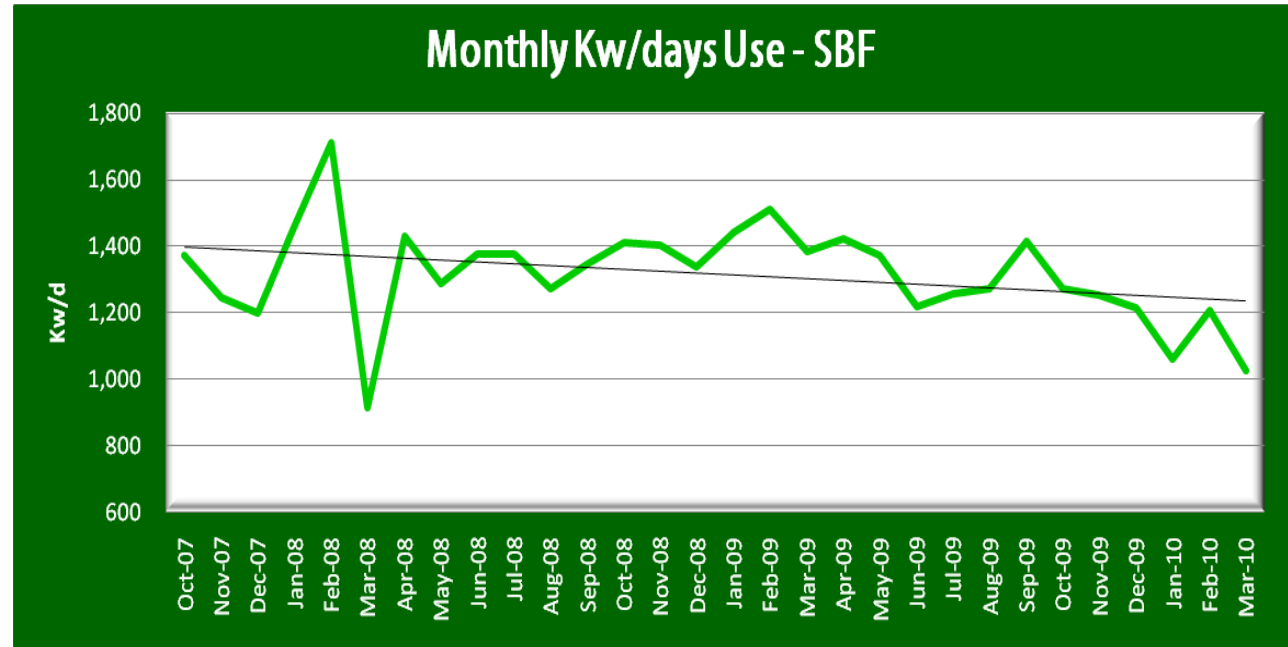
Oversight & Direction

An Energy Planning Oversight & Control Committee was created to set the overall direction of the energy plan and oversee the development of the early initiatives

The Committee comprises personnel from all areas with a direct involvement in energy issues, including facilities management, engineering, information systems, administration and finance

Oversight & Direction

Electricity consumption is reviewed monthly and posted on our website



The information is segregated per each facility and identifies long term and seasonal fluctuations

Oversight & Direction

GEMINI GREEN MISSION

“Gemini is committed to operating responsibly in the interests of our communities, local and global, now and always. Our corporate citizenship promotes sustainability through effective, efficient operations and positive environmental stewardship...”

“..... We will carefully consider and protect Earth’s valuable environmental resources, while fulfilling our commitment to science and applying solid financial principles to our operations....”

The Greening of Gemini



- Context
- Gemini's Green initiatives
- Next steps
- Recommendations

AIR CONDITIONING

- ❑ Installed programmable thermostats at base facilities
- ❑ New program implemented for telescope control device managing the way the observing floor is cooled at the beginning of the observing night
- ❑ Replacement of old chillers with more efficient models

PRINTER & COMPUTER EFFICIENCY

- ❑ (More electronic, and fewer paper, forms)
- ❑ Rationalizing the number of printers
 - ✓ Fewer “personal” printers
 - ✓ Intelligent group printers
- ❑ Monitoring printer usage
- ❑ Discouraging printer use

PRINTER & COMPUTER EFFICIENCY

- ❑ Survey found 400+ pieces of electrical equipment per site plugged in out of hours and 100+ turned on but not in use.
- ❑ Getting staff to turn-off when not in use
- ❑ New computer monitoring system provides system-wide uptime and usage statistics
- ❑ Initial experimentation with virtualization

TRANSPORTATION

- ❑ Collective transport options from base to summit are in place at Gemini South and pending further consideration at Gemini North
- ❑ Fuel economy is now much more an issue
- ❑ Bicycle racks for staff



TRAVEL

- ❑ Astronomy @ Gemini = international collaboration = international travel
- ❑ Encourage staff to limit travel wherever possible
- ❑ We promote virtual meeting technologies
- ❑ We remind staff of their “travel CO2 footprint”
- ❑ We publicize our “travel carbon footprint”

Travel

Example e-mail

Hi Pete,

Here is your itinerary for your trip to San Diego. Please review it and confirm if I should issue the tickets.

Thank you,

Edith

Environmental Note:

We know that air travel is often an inevitable requirement for Gemini staff, but we are also aware that it is an activity that has an unfortunate environmental impact and our CO2 footprint from travel has been significant. For example, in 2008, the carbon dioxide (CO2) produced by staff travel was about twice the CO2 caused by our consumption of electricity on Mauna Kea. Gemini is publishing tables indicating our miles traveled by air to promote general awareness of this issue.

To learn more about the environmental impact of air travel and “carbon footprints,” please visit:

http://www.sightline.org/research/energy/res_pubs/rel_air_travel_aug04

Staff who would like to understand the carbon footprint associated with their travel can consult the carbon calculator at <http://www.carbonfund.org/Calculators/>

Information about Gemini’s travel CO2 footprint is published on the internal web at

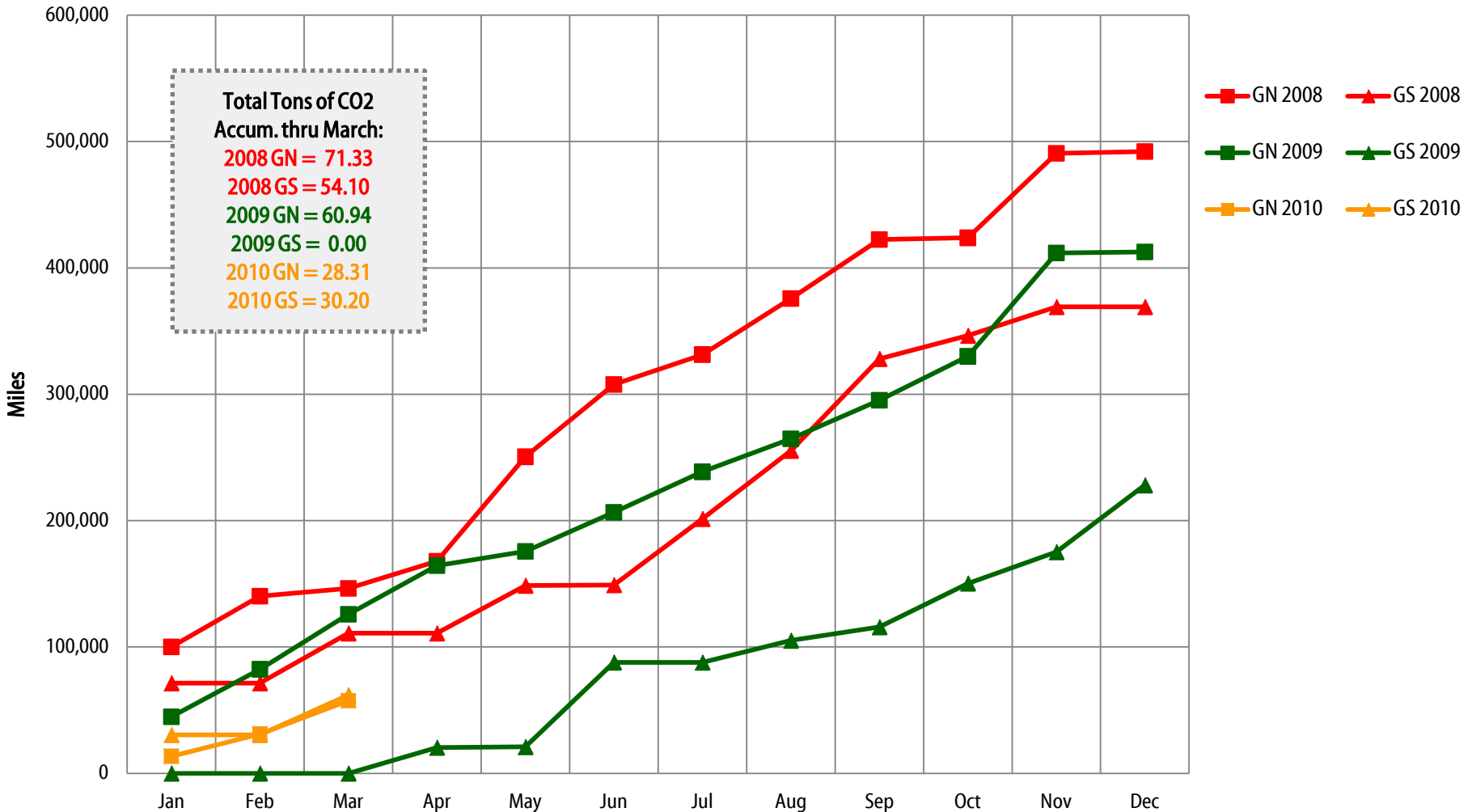
http://internal.gemini.edu/index.php?q=afg/afg_goes_green

Edith Bastias

Gemini South Travel Coordinator

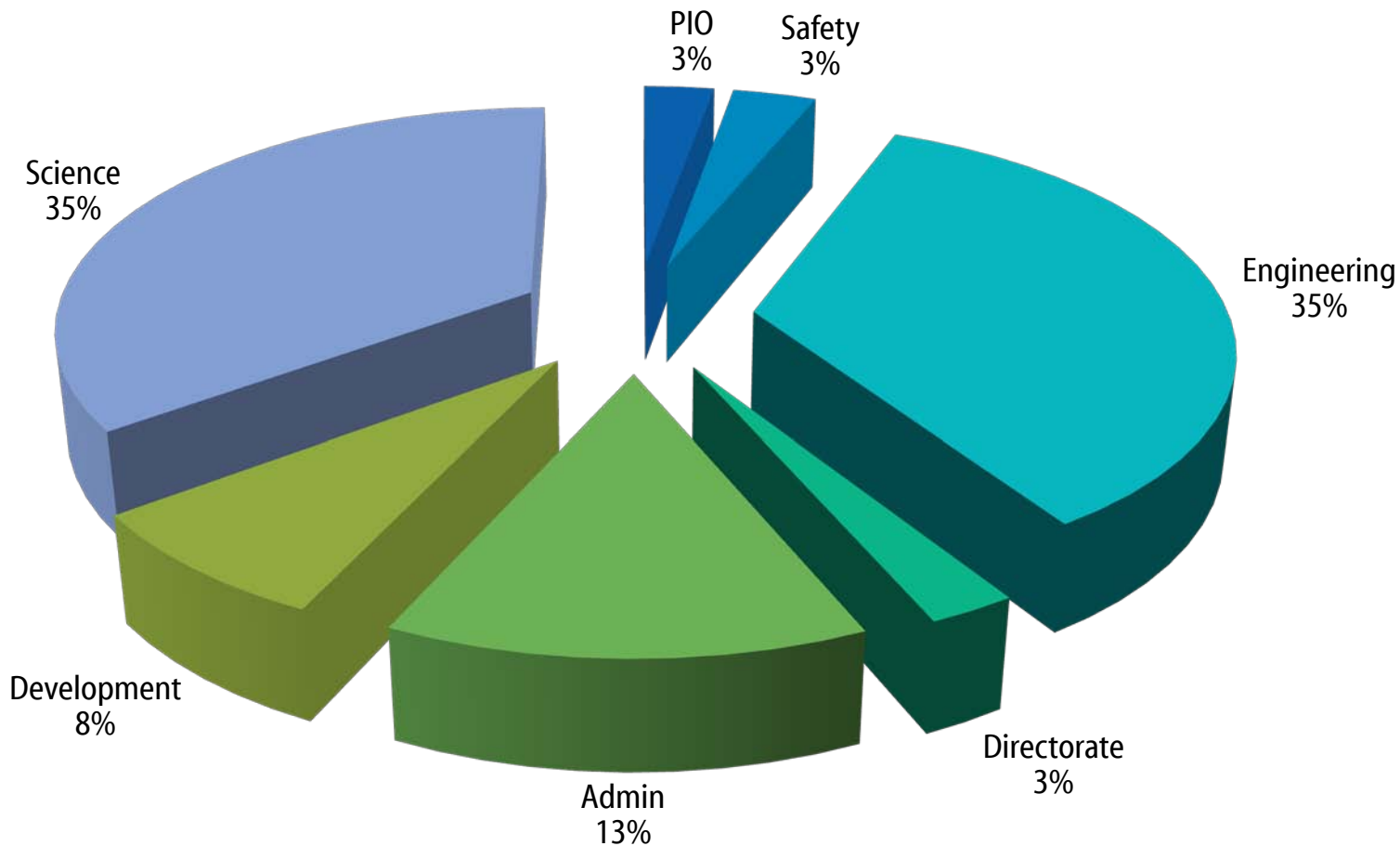
Gemini Travel CO2 Footprint : January to March 2009 v. 2010

Admin Accum.Total Miles



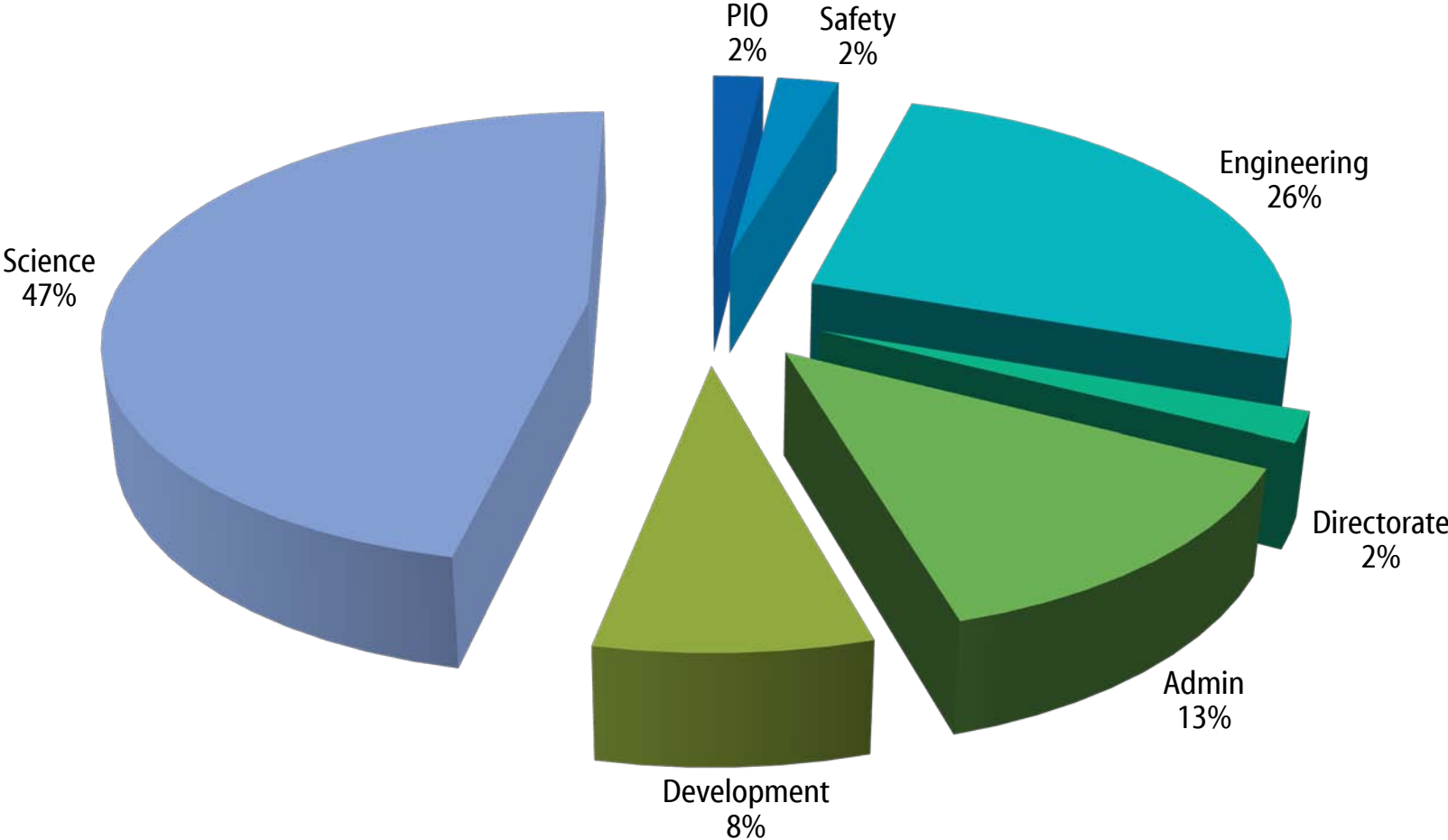
Gemini Travel CO2 Footprint : January to December 2008

Miles traveled as percentage of total Gemini miles traveled: Jan - Dec 2008



Gemini Travel CO2 Footprint : January to December 2009

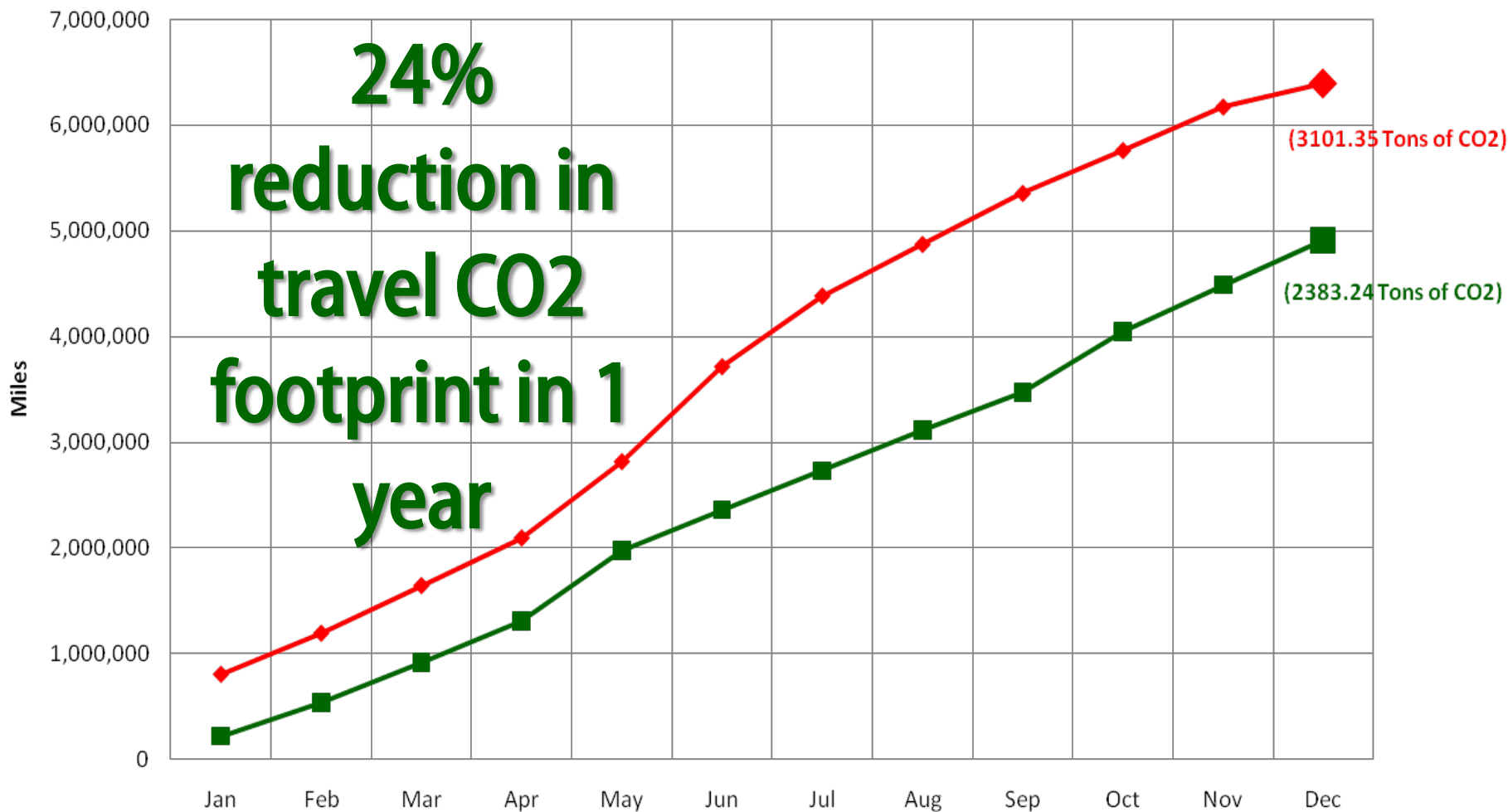
Miles traveled as percentage of total Gemini miles traveled : Jan - Dec 2009



Gemini Accumulated Travel Miles - Total

2008 Accum. Total Miles

2009 Accum. Total Miles



RECYCLING



- ❑ Gemini North already had a developed recycling program, based on Hawaii's successful HI-5 beverage deposit program
- ❑ Chile lags way behind in recycling and Gemini South had to research and patch together its own recycling program
- ❑ The sites now have distinct, but comprehensive recycling plans and their influence is spreading

Recycling

RECYCLING POINT



- Paper
- Cardboard
- Glass
- Plastics
- Aluminum cans
- Tetrapak
- Plastics
- Batteries
- E-waste
- Light bulbs & tubes
- Metals
- Tires



David Moe

Recycling



CENTRAL RECYCLING POINT : North Wing, South Base Facility

Recycling



CASA VERDE

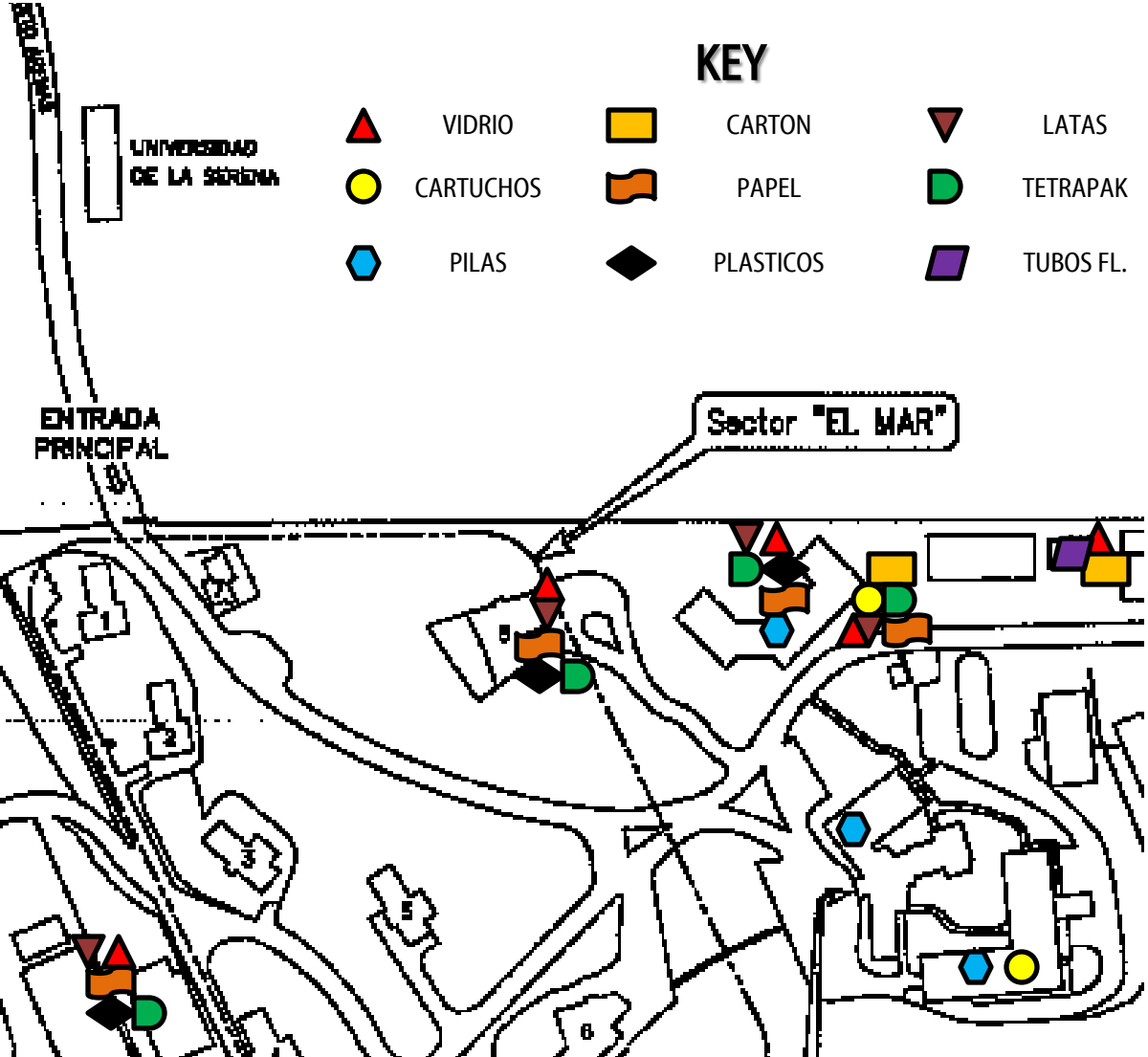
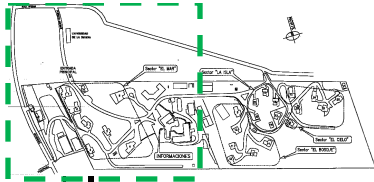
Recycling



RECYCLING POINT
PUNTO DE RECICLAJE



RECYCLING SITES – AURA COMPOUND (WEST), LA SERENA, CHILE



□ The Gemini Recycling Program is now being adopted across the AURA campus in Chile

GREEN CLEANING

- ❑ Some cleaning products can negatively impact health and the environment
- ❑ Cleaning practices can be based as much on perceived risk as actual risk
- ❑ We have reviewed and changed some of our practices and amended our purchases of cleaning products
- ❑ Our Janitorial staff have played an important part in this initiative and improved our ecological standards

MISCELLANEOUS

❑ ELIMINATION OF DISPOSABLE CUPS

Objections to disposable cups are environmental concerns

They're cheap but are produced from hydrocarbons such as oil and gas, producing pentane emissions

As they are inert, they remain in landfills for a very long time



MISCELLANEOUS

❑ COMPOSTING

Staff are given opportunities to contribute to composting, by gathering food waste, such as coffee grindings, for use as natural fertilizer at our base facilities or by staff at home, if they want



MISCELLANEOUS

❑ UTILITY COMPANY INVOLVEMENT

We sought advice from HELCO in Hawaii and CONAFE in Chile.

Nothing new for HELCO. A total novelty for CONAFE in Chile's IV Region.

Rebates from HELCO.

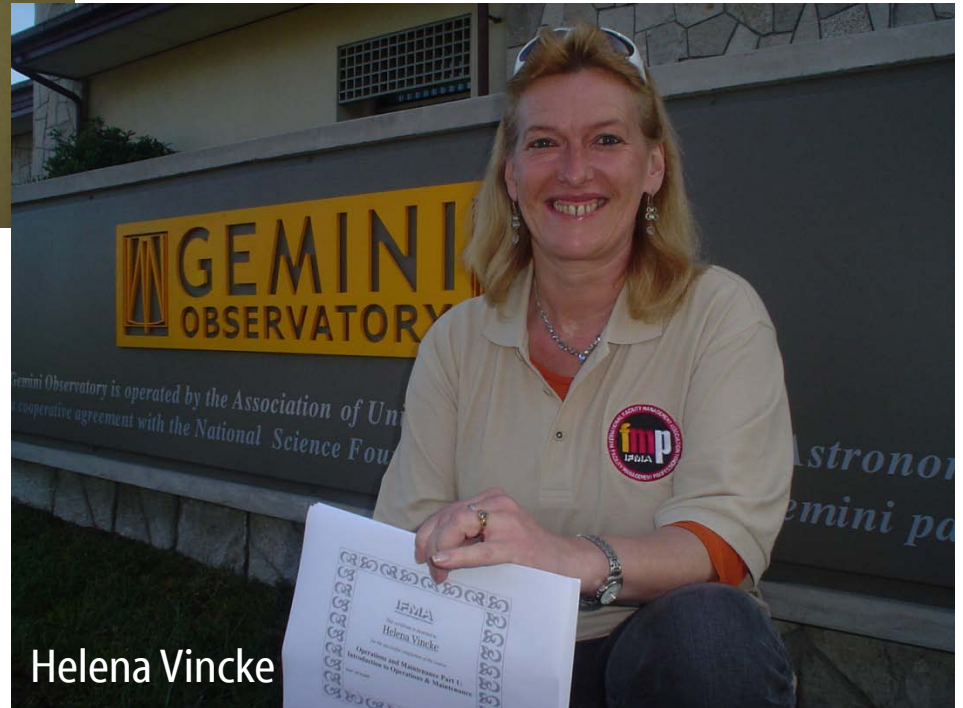
Good tips from both.



Facilities focused education



Sarah Blanchard



Helena Vincke



MISCELLANEOUS

❑ A FEW “KISS” INITIATIVES

We have reduced lighting in some areas by as much as 50%.

Staff are pleased with the changes.

Motion sensors have been placed in kitchens, bathrooms and places infrequently used (e.g. electrical rooms)



MISCELLANEOUS

❑ A FEW “KISS” INITIATIVES

During hot summer days, when we can take advantage of cooling breezes, we sometimes take the dramatic step.....

..... of opening the base facility doors just before the office opens, so that staff feel far less inclined to use their air conditioning controls



SOLAR POWER

- ❑ Gemini has researched opportunities for using solar power for electricity generation in both Chile and Hawaii
- ❑ Solar in Chile is not yet an attractive option. Few incentives to promote installation of solar. Proposals have indicated up to a 32 year payback!
- ❑ Solar is a **very** attractive option for us in Hawaii though 😊....why?

- Gemini leases roof space to energy contractor (“integrator”) at no cost over a 20-year period.
- Solar integrator installs, finances, owns and maintains a state-of-the-art solar PV system.
- Integrator sells energy generated by the solar system to Gemini at a fixed rate per kWh, lower than HELCO, under a long-term Power Purchase Agreement (PPA).



How does this work?

- Substantial energy tax credits (30% federal, 35% state) are available to for-profit companies, but non-profits cannot benefit from tax credits—hence a third-party “Power Purchase Agreement” (PPA) through an ESPC.
- An “integrator” (i.e. energy contractor) carries all costs, including interconnect study required by the utility company (HELCO) and ongoing maintenance.
- FEMP exists to help non-profits create specs for RFPs, choose winning bid, set up PPA and solve legal concerns (= No-cost guidance and consulting for Gemini)
- Federal ESPC projects have already been implemented by 19 federal agencies in 47 states.



Costs & Benefits

- Installation costs Gemini virtually nothing.
- Payback begins immediately: we pay \$0.18 for each kWh generated by solar, instead of \$0.29 per kWh to HELCO.
- Cost of solar-generated electricity is fixed, unlike HELCO rates which fluctuate.
- Proposed ~200 kW system can produce 250,000 kWh p.y (approx 20% of HBF energy needs) with US\$25K savings in Y1



Costs & Benefits (Hilo Base Facility example)

WE'D SOON BE PAYING ~33% LESS (\$/kwh) FOR THIS SOLAR POWER THAN WHAT WE PAY NOW FOR HELCO POWER.....AND WHAT WE PAY NOW IS ~40% LESS THAN WHAT WE'VE PAID IN THE RECENT PAST (2008)

Date:	February 7, 2010	Integrator	Hawaiian Energy
Initial PPA Term:	20 Years	Averaged Utility Avoided	0.27
Solar System DC Watt:	221.38	Average Utility Escalation	6-7% Averaged Yrly
Solar System AC Watt:	185.74	PPA Escalation:	4% Fixed Yearly Escalation
Solar Output 1st Yr kWh:	294,405	PPA rate per kWh	\$0.18
Construction Commencement:	31-Mar-10	In-Service-Date:	20-May-10

Year	Annual kWh Solar Output	Utility Rate per kWh	PPA rate per kWh	Annual Utility Payment	Annual PPA Payment	Annual PPA Savings	Cumulative PPA Savings
1	294405	\$0.27	\$0.18	\$79,489.35	\$52,992.90	\$26,496.45	\$26,496.45
2	292933	\$0.28	\$0.19	\$82,668.92	\$55,112.62	\$27,556.31	\$54,052.76
3	291468	\$0.28	\$0.19	\$82,668.92	\$55,112.62	\$27,556.31	\$81,609.07
4	290011	\$0.29	\$0.19	\$85,975.68	\$57,317.12	\$28,658.56	\$110,267.63
5	288561	\$0.30	\$0.20	\$89,414.71	\$59,609.81	\$29,804.90	\$140,072.53
6	287118	\$0.32	\$0.21	\$92,991.30	\$61,994.20	\$30,997.10	\$171,069.63
7	285683	\$0.33	\$0.22	\$96,710.95	\$64,473.97	\$32,236.98	\$203,306.61
8	284254	\$0.34	\$0.23	\$100,579.39	\$67,052.92	\$33,526.46	\$236,833.07
9	282833	\$0.36	\$0.24	\$104,602.56	\$69,735.04	\$34,867.52	\$271,700.59
10	281419	\$0.37	\$0.25	\$108,786.66	\$72,524.44	\$36,262.22	\$307,962.81
11	280012	\$0.38	\$0.26	\$113,138.12	\$75,425.42	\$37,712.71	\$345,675.52
12	278612	\$0.40	\$0.27	\$117,650.08	\$78,438.42	\$39,211.66	\$384,887.18
13	277218	\$0.42	\$0.28	\$122,330.76	\$81,563.34	\$40,767.42	\$425,654.60
14	275832	\$0.43	\$0.29	\$127,165.01	\$84,803.34	\$42,361.67	\$468,016.27

PRUDENT RISK MANAGEMENT

WE CAN'T OBTAIN THESE TAX BENEFITS DIRECTLY. THE FACT THAT THE SOLAR SUPPLIER CAN SAVES US THESE INSTALATION COSTS

Total Installed System Cost	\$1,051,276
Gross System Cost with SalesTax	\$1,051,276
State 35% Tax Credit	(\$367,947)
Federal 30% Tax Credit	(\$315,383)
MACRS Accelerated Depreciation (Fed) / HI State	(\$364,100)
System Cost After all Incentives	\$3,847

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Gemini became a corporate member of the U.S. Green Building Council in 2009

As a consequence of Gemini's membership of USGBC, all full-time Gemini employees may utilize our member benefits. Gemini employees can:

- access members-only webcasts and podcasts featuring USGBC staff and industry leaders;
- learn about the LEED (Leadership in Energy & Environmental Design) rating systems and green building strategies;
- receive monthly e-newsletters covering the latest developments in USGBC matters;
- consider studying for LEED professional credentialing;
- connect with facility colleagues in USGBC's Member to Member Exchange (M2M) and its online discussion forums, considering best practices, etc.;
- become involved in key decision-making processes to push the green building industry forward;
- obtain financial savings on LEED reference guides, education courses and examination fees and LEED project certification.

In 2010, we have an Observatory project to: “review the U.S. Green Building Council’s operation and maintenance guidelines for Leadership in Energy and Environmental Design (LEED) certification standards for Existing Buildings, to determine the feasibility, approximate costs and expected benefits of seeking LEED certification....”

LEED provides a complete framework for assessing building performance and meeting sustainability goals.

LEED for Existing Buildings (LEED-EB) provides strategies for:

- ❑ sustainable site development,
- ❑ energy efficiency,
- ❑ water savings,
- ❑ materials selection and indoor environmental quality.

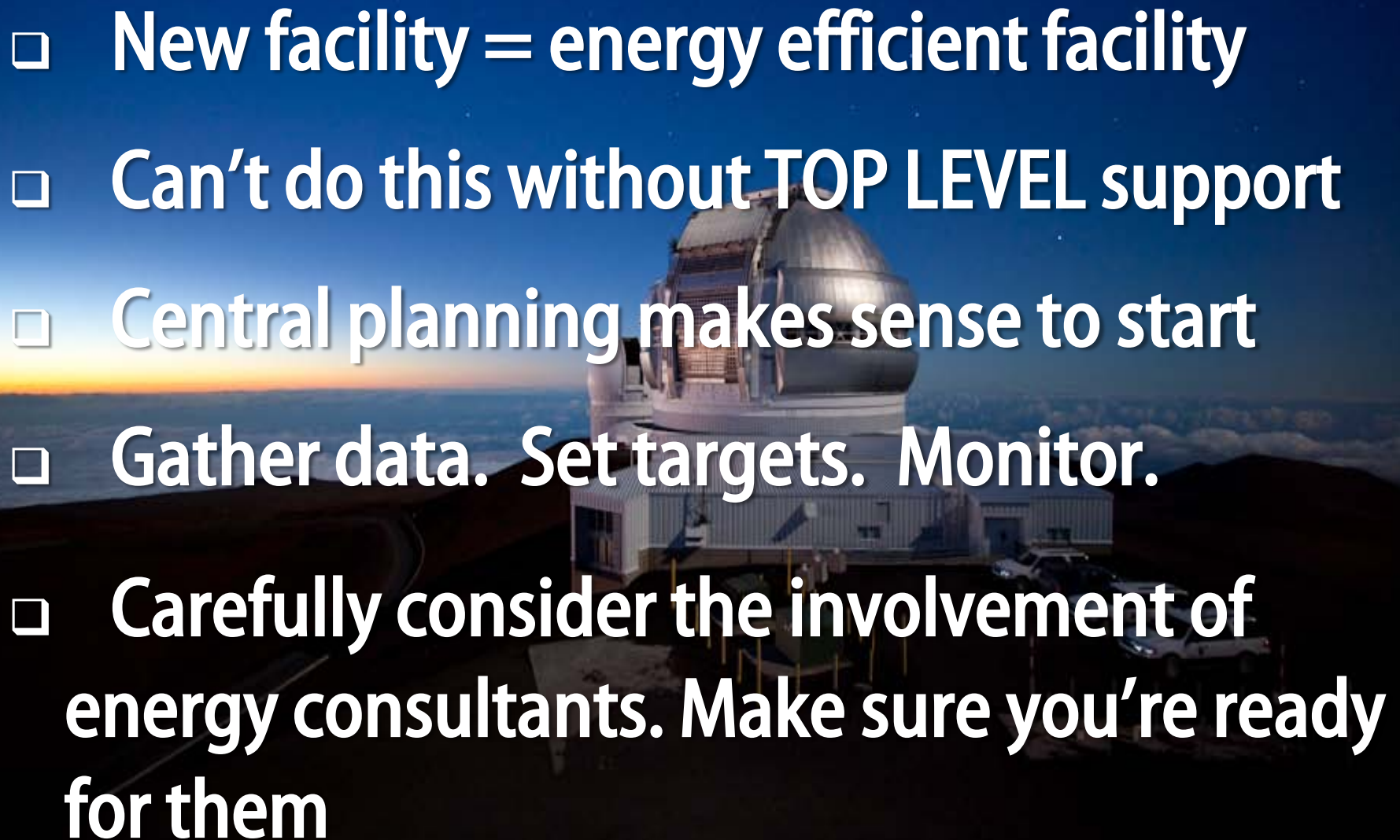
Our focus is not certification for certification's sake, but to use a structure to facilitate further energy related cost savings

The Greening of Gemini

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Recommendations

- ❑ **New facility = energy efficient facility**
 - ❑ **Can't do this without TOP LEVEL support**
 - ❑ **Central planning makes sense to start**
 - ❑ **Gather data. Set targets. Monitor.**
 - ❑ **Carefully consider the involvement of energy consultants. Make sure you're ready for them**
- 
- A photograph of an astronomical observatory with a large dome, situated on a mountain peak. The scene is captured at sunset or sunrise, with a bright orange and yellow glow on the horizon. The observatory's base is a multi-story building with several windows. The sky is a deep blue, and the overall atmosphere is serene and majestic.

Recommendations

- ❑ Avoid “green gimmickry”
- ❑ Take all the free help you can get!
- ❑ Publicize and congratulate
- ❑ “Systemize” your green program into your organization’s working culture e.g. does making your place “green” feature in your job description or annual evaluation?



*Protecting our Planet
for Future Generations*

The Greening of Gemini

Thank you

