Sustainability Engineering Research
in Saudi Arabia

Dr. Alice Agogino, Dr. Nezar AlSayyad,
Kimberly Lau, Yael Perez, Tobias Schultz, Ryan Shelby
Department of Mechanical Engineering and Architecture, University of California, Berkeley

Statement of the Problem

To use existing sustainable engineering technologies to reduce:

i.energy consumption,
ii.water consumption, and
iii.greenhouse gas (GHG) emissions

Few sustainability assessment metrics and tools account for local social, geographic, and economic conditions.

Objectives

- Understand the meaning of sustainability in the Kingdom of Saudi Arabia (KSA).
- Develop sustainability metrics for technology evaluation.
- Design appropriate sustainable engineering technologies for the KSA.
- Develop a “roadmap” to develop renewable energy, and reduce carbon emissions and water use.

Capturing cultural differences

- Spring 2009: 82 students from Dar Al-Hekma College and 41 students from UC Berkeley participate in a survey regarding their attitudes towards sustainability.

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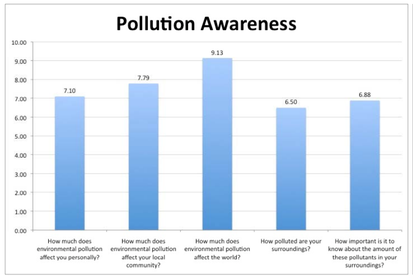
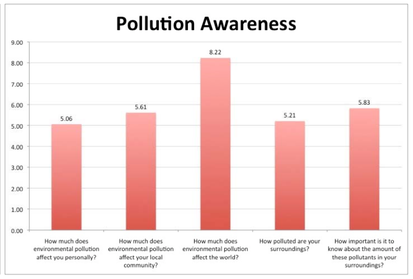
Results

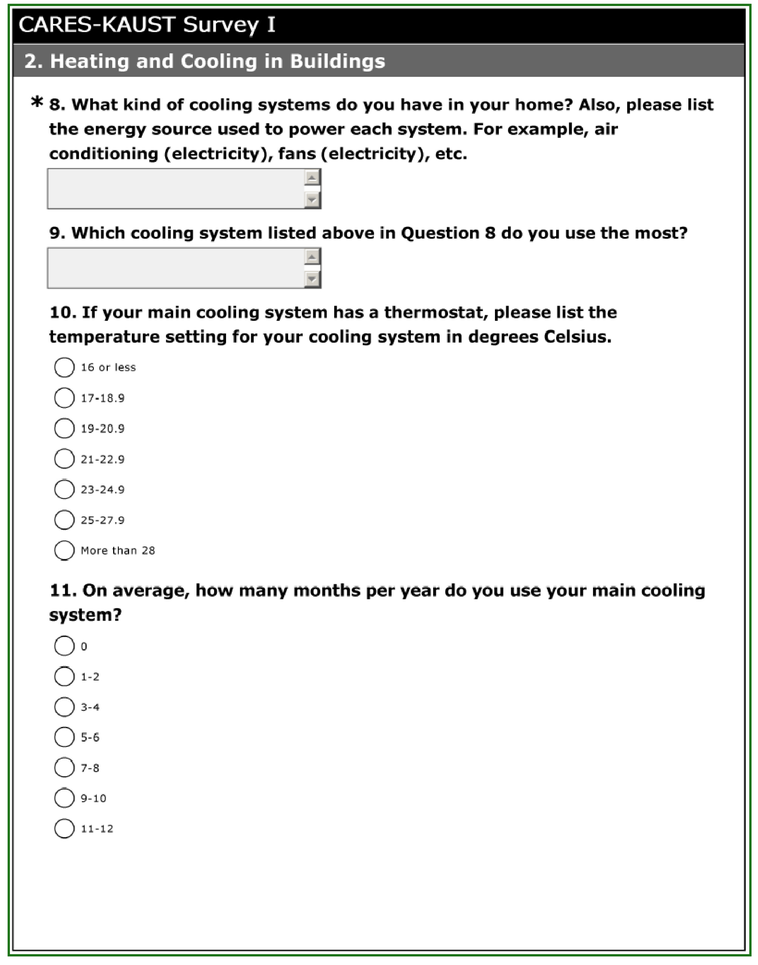




- Dar Al-Hekma students showed higher levels of sensitivity to sustainability issues.
- This result may reflect gender differences: all of the Dar Al-Hekma students were women, and 90% of the UC Berkeley students were men.
- Or disciplinary differences: Dar Al-Hekma students highly interdisciplinary, while UC Berkeley students studied engineering.
- Future research will work to better understand regional, gender, and disciplinary differences.

KAUST sustainability footprint

- First step: assess campus residents’ current levels of energy, water usage, and waste disposal.
- Questionnaire was designed for collecting this information from KAUST faculty, students and staff.
- Results will be used to better understand where KAUST can reduce its footprint.



CARES-KAUST Survey I

2. Heating and Cooling in Buildings

*** 8. What kind of cooling systems do you have in your home? Also, please list the energy source used to power each system. For example, air conditioning (electricity), fans (electricity), etc.**

9. Which cooling system listed above in Question 8 do you use the most?

10. If your main cooling system has a thermostat, please list the temperature setting for your cooling system in degrees Celsius.

- ◯ 16 or less
- ◯ 17-18.9
- ◯ 19-20.9
- ◯ 21-22.9
- ◯ 23-24.9
- ◯ 25-27.9
- ◯ More than 28

11. On average, how many months per year do you use your main cooling system?

- ◯ 0
- ◯ 1-2
- ◯ 3-4
- ◯ 5-6
- ◯ 7-8
- ◯ 9-10
- ◯ 11-12

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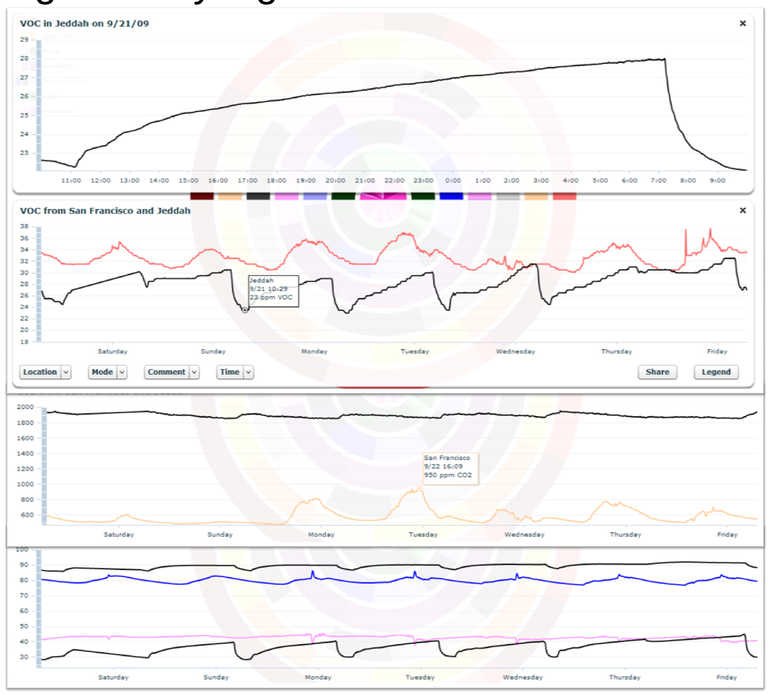
Air Quality Monitoring

- Dar Al-Hekma and UC Berkeley are collaborating with the Black Cloud project, to monitor air quality across the planet.
- Six parameters are being measured: CO2, VOC's, lights, noise, temperature, and humidity.
- A monitoring unit was installed indoors at Dar Al-Hekma, in Jedda.
- Indoor Air quality data has been broadcasting online ever since.

Results

- VOC levels in Jeddah are lower than those in San Francisco, while CO2 levels are significantly higher.



Renewable energy feasibility studies in the KSA

RETScreen Clean Energy software was used to estimate power production, cost, and GHG emissions of several technologies:

Power generation technologies:

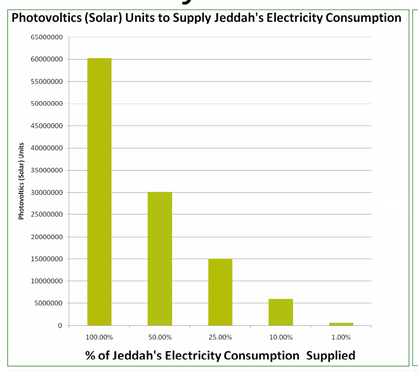
i. Wind Turbine Systems
ii. Tidal Power Systems
iii. Wave Power Systems
iv. Photovoltaic (Solar) Systems

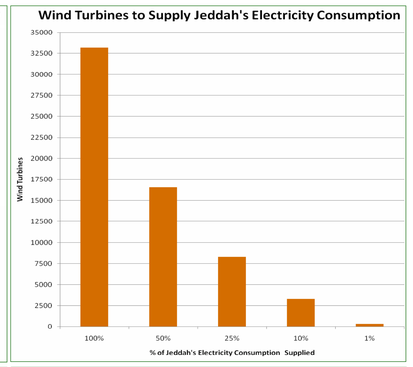
Water technologies:

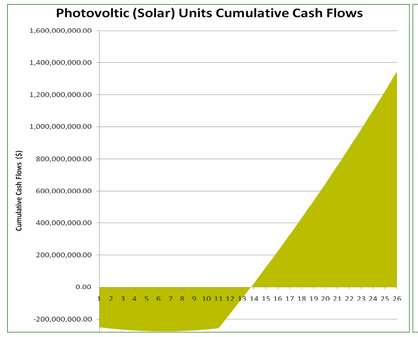
i. Solar Water Heater Systems
ii. Greywater Systems

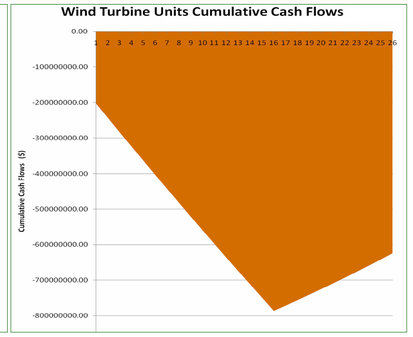
Results

- 333 wind turbines, or 603,135 PV panels, are needed to supply 1% of Jeddah's electricity.



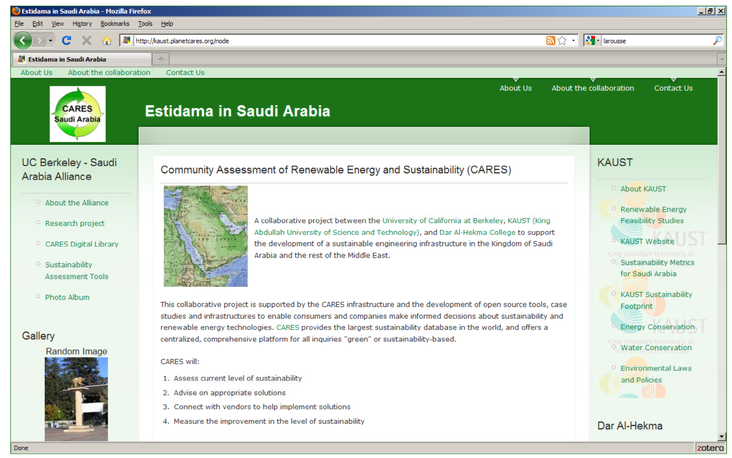






Establishing tools for collaboration

- Online portal for collaboration has been established.
- Portal will facilitate dissemination of findings.



Future Research

- Evaluate air quality and sustainability assessment data.
- Provide culturally-sensitive and geographically-relevant recommendations for appropriate sustainable technology solutions.
- Identify manufacturers in KSA that can implement the sustainable engineering technologies.
- Create "roadmap" for development of sustainable engineering technologies infrastructure.
- Expand the collaborative online portal.