University of Texas at El Paso
Energy Dashboard

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Faculty Advisers
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  Faculty Adviser
    Dr. Eric D Smith
Agenda

- Project Background
- Project Objectives
- Systems Engineering Design Process
- Dashboard Prototype
- Acknowledgments
About Green Fund

What is the GF?
GF stands for Green Fund, which is a fee referendum that will cost $3 per student per semester, raising up to $40,000 per year for campus sustainability projects. These projects will minimize UTEP's negative impact on the environment by:

- Investing in renewable energy such as solar panels
- Promoting environmental sustainability in campus and the community
- Providing educational opportunities such as student internships
- Increasing energy efficiency
- Conserving water and other resources

*GF will NOT pay for anything the university is already required to do by law or policy.

Who and how are projects chosen?
The Green Fund Grant Making Committee will oversee the funds. It will be conformed by four students, two administrators and one faculty appointed annually.

To choose the projects, students, faculty or staff can submit proposals asking for funding, and the GF Grant Making Committee reviews the proposals and selects them based on The Green Fund Bylaws. To read the GF Bylaws, click here.

How will I know where my money go?
The GF Grant Making Committee will report all GF projects to the Student Government Association annually and the projects will be made available online.

When can I vote for the GF?
Voting will take place on April 21 and 22. Stay tuned for the URL link!
Green Fund passes at UTEP!

This past Thursday April 22, students let their voices be heard. 59% of student voters supported the green fund, a student referendum asking for a $3 increase in student fees for student-led initiative green projects. Thanks to everyone that voted.

The results are as follows:

Accepted 2435
Rejected 1088

Thank you and stay tuned for new updates on how YOU can participate as a member of the Grant Making Committee, or propose a green project on campus.

Source: The Prospector, UTEP

Comments
energydashboard 2011.7.11 08:53
I need to find the person in charge for this website. I am working on the Green Fund sponsored UTEP Energy Dashboard.
Jorge 2010.6.17 12:51
the bylaws: https://docs.google.com/view?k=d9k6m9q3b691m8mc
Jorge 2010.4.16 10:44
the by-laws should be posted in the SGA voting site soon.

Add a comment
Project Abstract

• Facility Services at UTEP has the need to design and develop an Energy Dashboard automated web services system that provides information on the energy efficiencies within buildings and facilities on campus.

• The Facilities Services department has the long term goal to provide energy efficiency on campus through an intelligent building program that provides centralized operations to monitor, control and manage energy use in UTEP via an Operations Center.

• The UTEP Energy Dashboard will able to display the energy consumption for all the UTEP buildings, any cluster of buildings, or an individual building.

• The UTEP Energy Dashboard System will be able to convert and display the kilowatt-hour electrical utilization and the estimated gasoline consumption equivalent.

This project is the first UTEP Green Fund initiative and is the introductory step in creating a smart energy grid for the campus.
Stakeholders

- The stakeholders involved:
  - **UTEP Green Fund**: Funded the project, initial requirements, supervise and manage project progress
  - **UTEP Facilities Services**: Technical Resource support, detailed requirements, etc.
  - **The Center for Environmental Resource Management (CERM)**: guidance and fundamental expertise
  - **Research Institute for Manufacturing and Engineering Systems (RIMES)**: leadership, mentoring and technical expertise for the engineering project team.
  - **Others**: ECE (communications expertise), ETC (IT expertise)

**NOTE:** For Campus wide deployment other stakeholders need to be included (e.g., CIO, Public Relations, etc.)
The objectives of this project are to:

• Develop a database of similar projects by researching the literature on the Web on energy dashboards and building energy efficiency systems.

• Develop the system requirements for the UTEP Energy Dashboard system starting with an “As-Is” condition and leading to a “To-Be” state.

• Design a database and Web Services for the UTEP Energy Dashboard.

• Deploy a prototype that will display the energy consumption of one campus building.
Team Members and Responsibilities

**Project Manager/Systems Engineer:**
- Project lead
- Identifying customers and understanding customer needs
- Discovering requirements and defining system functions
- Model the system, clarifies requirements, reveals bottlenecks and fragmented activities, reduces cost and exposes duplication of efforts
- Integrate; bringing system elements together so they work as a whole, this requires extensive communication and coordination.
- Launch the system, making the system do what it was intended to do
- Assess performance, re-evaluation

**ECE RA:**
- Help define requirements
- Develop code, develop model
- Test the model
- Build pilot
- Test pilot

**Advisor:**
- Management
- Expertise
- Supervision
- Support by appropriate campus official
Systems Engineering Process

- **Process Input**
  - UTEP needs, objectives, and requirements:
    - Mission
    - Measures of effectiveness
    - Environment
    - Constraints
    - Technology base
    - Requirements from specifications and standards

- **Process Output**

**Requirements Analysis:**
- Analyze Mission
- Operational Requirements
- Functional Requirements
- Performance Requirements

**Functional Analysis/Allocation:**
- Lower Level Functions
- Allocation of Performance and Limiting Requirements to all Functional Levels
- Functional Interfaces
- Functional Architecture

**Synthesis:**
- Transform Architecture Physical to Functional
- Alternative System Concept
- Configuration Items and System Elements
- Select preferred Product and Process Solutions
- Physical Interfaces (Internal/External)

**Verification**

**Requirements Loop**

**Design Loop**

**System Analysis and Control**

**Process output**
- Validation

Energy Dashboard
Concept of Operation

External Users

Internal Operations

Energy Dashboard

Aggregator

Aggregator

UTEP Internal

Smart Meter

Smart Meter

Smart Meter

Smart Meter

UTEP – Facilities Control Center
Architectural Block Diagram (ABD)

User
- Energy conservation research
- News Media
- UTEP facilities

UTEP students

UTEP faculty

El Paso community

Government

News Media

Personal Computer

Device

Smart Phone

GUI

Tablet

Gaming Device

IP Protocol

ISP

Portal

UTEP Network

Internet

Router

Switch

Dashboard Server

Analysis Software

Smart Meter

Internet

UTEP Energy Dashboard

Web page

IP Protocol

ISP

UTEP Network

IP Protocol

Router

Analysis Software

UTEP Energy Dashboard

Web page

IP Protocol

ISP

UTEP Network

IP Protocol

Router

Analysis Software

UTEP Energy Dashboard

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UTEP Network

IP Protocol
So How Do We Interface?

- **SNMP**
  - Located inside of the OSI model not on top, like HTTP
  - Protocol widely used for network management
  - Eaton made the Real-time and Interval Measurements available

- **The way it works**
  - We send a network packet request to GET with a value called an Object Identifier or OID
  - The meter responds with the current value of that OID
  - Find the right OID in the Management Information Block
So Why Use SNMP

• Secure interface to the meter
• Smaller bandwidth used on the UTEP network
• Access Time
  – Http > 15 Seconds
  – SNMP < 300 milliseconds
Top Level Operational Requirements

R.O.1 The system shall **be accessed** by the external user through an Internet enabled device.

R.O.2 The system shall **be operated** by the internal user through an network enabled device.

R.O.3 The system shall **have** an interface that makes energy information available through a network portal.

R.O.4 The system shall **manage** energy information through the Energy Dashboard interface.
R.F.1 The Dashboard System shall **collect** energy data from the AMI.

R.F.2 The System shall **store** energy data.

R.F.3 The System shall **monitor** critical changes within the system and data for maintenance purposes.

R.F.4 The System shall **analyze** the energy data.

R.F.5 The System shall **display** historical information of the environmental impact of used energy.

R.F.6 The System shall **create** reports of the energy data.
Top Level Non-Functional Requirements

R.N.1 The System shall utilize a user-friendly graphical user interface (GUI).

R.N.2 The System shall utilize different security levels of user access to ensure the security of the servers and the data.

R.N.3 The System shall be accessible through any IP, Wi-Fi, 3G, 4G and Bluetooth enabled device.

R.N.4 The System shall be compatible with the UTEP Energy Management Center.

R.N.5 The System shall be described in a set of System Engineering documents.
Top Level Performance Requirements

R.P.1 The System prototype shall ensure data storage capacity for at least 2 years.

R.P.2 The System prototype shall give the user access to the energy consumption reports in less than 400 milliseconds.

R.P.3 The System prototype shall be available 95% of 365 days of the year x 7 hours of the week x 24 hours of the day.

R.P.4 The System shall refresh information every 15 minutes.
## Risk Analysis

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Risk Cost</th>
<th>Risk Schedule</th>
<th>Risk Technology</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.O.1</td>
<td>The System shall be accessed by the external user through an Internet enabled device.</td>
<td>✓</td>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers, IEEE 802.6, 802.3, 802.2, 802.1</td>
<td></td>
</tr>
<tr>
<td>R.O.2</td>
<td>The System shall be operated by the internal user through an network enabled device.</td>
<td>✓</td>
<td>UTEP PP</td>
<td>UTEP web Privacy Policies, Institute of Electrical and Electronics Engineers, IEEE 802.6, 802.3, 802.2, 802.1</td>
<td></td>
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<tr>
<td>R.O.3</td>
<td>The System shall generate an interface that makes energy information available through a network portal.</td>
<td>✓</td>
<td>IEEE/ISO</td>
<td>Institute of Electrical and Electronics Engineers / International Organization for Standardization, IEEE 802.2</td>
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<tr>
<td>R.O.4</td>
<td>The System shall manage energy information through the Energy Dashboard interface.</td>
<td>✓</td>
<td>ISO</td>
<td>International Organization for Standardization</td>
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<tr>
<td>R.F.1</td>
<td>The Dashboard System shall collect energy data from the AMI.</td>
<td>✓</td>
<td>ISO/UTEP PP</td>
<td>International Organization for Standardization / UTEP web Privacy Policies</td>
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<tr>
<td>R.F.2</td>
<td>The System shall store energy data.</td>
<td>✓</td>
<td>ISO</td>
<td>International Organization for Standardization</td>
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<td>R.F.3</td>
<td>The System shall monitor critical changes within the System and data.</td>
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<td>IEEE</td>
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<td>R.F.4</td>
<td>The System shall analyze the energy data.</td>
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<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers, IEEE 829,1012,830,1061</td>
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<td>R.F.5</td>
<td>The System shall display the environmental impact of used energy.</td>
<td>✓</td>
<td>EPA</td>
<td>Environmental Protection Agency, Greenhouse Gas Emissions</td>
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<td>R.F.6</td>
<td>The System shall create reports of the energy data.</td>
<td>✓</td>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers, IEEE 1061,1012</td>
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<td>R.N.1</td>
<td>The System shall utilize a user-friendly graphical user interface (GUI).</td>
<td>✓</td>
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<td>The System shall be compatible with the UTEP Energy Management Center</td>
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<td>National Institute of Standards and Technology, U.S. Department of Commerce</td>
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<td>The System shall be described in a set of System Engineering documents</td>
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<td>R.P.1</td>
<td>The System prototype shall ensure data storage for at</td>
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<td>Institute of Electrical and Electronics Engineers, IEEE 12207</td>
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<td>The System prototype shall give the user access to the energy consumption in less than 400 milliseconds.</td>
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<td>The System prototype shall be available 95% of 365 days of the year x 7 days of the week x 24 hours of the day.</td>
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<td>R.P.4</td>
<td>The System shall refresh information every 15 minutes.</td>
<td>✓</td>
<td>IEEE</td>
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## Trade Off Study (functionality based)

<table>
<thead>
<tr>
<th>Tableau</th>
<th>Visual Studio 2010</th>
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<tbody>
<tr>
<td>predefined dashboard templates</td>
<td>flexible web design templates</td>
</tr>
<tr>
<td>no flexible analysis software</td>
<td>can add analysis software</td>
</tr>
<tr>
<td>no need for coding</td>
<td>needs code</td>
</tr>
<tr>
<td>drag and drop functions</td>
<td>drag and drop functions that can be modified with code</td>
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<tr>
<td>core functions require tutorial</td>
<td>common programming knowledge required</td>
</tr>
<tr>
<td>very user friendly</td>
<td>too many options</td>
</tr>
<tr>
<td>easy to add onto web page, by pasting links</td>
<td>flexibility to choose desired file format</td>
</tr>
<tr>
<td>requires a vendor database</td>
<td>flexible data base adoption</td>
</tr>
<tr>
<td>does not require compilation and debugging</td>
<td>need compilation and debugging</td>
</tr>
<tr>
<td>easily adapts to any web page</td>
<td>allows and adapts to multiple web page platforms</td>
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</table>

### Functionality Assessment

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<th>Good</th>
<th>Neutral</th>
<th>Bad</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>3</td>
</tr>
</tbody>
</table>

![Graph showing comparison between Tableau and Visual Studio 2010]
This use case describes the data flow within the UTEP Energy System to the external User.
Dashboard Use Case

• Brief description: Data flow from Energy Dashboard System to User.

• Information: Server, Database, Smart Meter and UTEP Energy Dashboard Portal.

• Scope: User energy data access.

• Primary actor: User

• Supporting actors: Device, Internet and UTEP Network.

• Precondition: The User request energy data.

• Trigger: Energy data provided.

• Main Success Scenario: User obtains desired data.
Live Webpage

http://energydashboard.utep.edu
ACKNOWLEDGEMENTS

• Green Fund Committee: Dr. Martinez, Omar Holguin
• Facilities Services: Dr. Villalobos, Javier Navar
• COE-ETC: Jose Hernandez, David Munoz
• RIMES: Dr. Pineda, Dr. Smith, Raul Lezama
Questions?