Utah Water-Energy Intensity Study

Studying the Water-Energy Nexus in Utah
Meeting the Water and Energy Challenge

Introduction/Background Information

Hansen, Allen & Luce (HAL) was organized in 1974 by Dr. Vaughn E. Hansen. He was an influential member and founder at Utah State University in their Water Laboratory. After leaving the university scene, Dr. Hansen wanted to organize a highly skilled and ethical team to serve the engineering water needs of Utah and other states in the west. This year they are celebrating their 40th anniversary.

Over the last 40 years, Hansen, Allen & Luce has been working for many clients within the Intermountain West. They have staff that are highly educated and trained with B.S., M.S., M.Eng., and Ph.D.'s that have prepared hundreds of studies, designs, master plans, and other projects. Although there are many types of engineering services offered, their main focus is to be a leader in water resource engineering.

Hansen, Allen & Luce are interested in having a group of BYU Civil and Environmental Engineering Seniors do a study on Utah's water usage and its relationship to the amount of energy we spend on it. A service of this kind has not been done before in Utah, and would provide a unique opportunity to research, calculate, and document all findings and present them to Hansen, Allen & Luce in April 2015.

Project Description and Scope of Services

Purpose

The purpose of the project is to determine the energy intensity (EI) of Utah's public water and wastewater services. This would mean trying to calculate an average kilowatt hours per million gallons (kWh/MG) for the State of Utah. Currently not well documented, EI of water services has significant implications for the state's future water-energy challenges. The project is sponsored by HAL and encouraged by the Utah Division of Drinking Water.

Qualifications and Skills

It would be recommended that students proposing on this project have the following skills. However, it is not necessary to have all of them:

- Interested in sustainability and optimization of water systems

- Interested in research
- Interested in having a water emphasis project
- Decent people and interviewing skills
- Know programs such as Excel and ArcMap (any GIS program would work)
- Have some experience in or an understanding of hydraulic design

Scope

The table below broadly outlines the tasks and timing associated with the project.

Task	Timeline
1. Meetings and coordination	October–April
2. Data collection	January–March
3. Analysis	February–March
4. Preliminary report	February
5. GIS database	March
6. Design exercise	March
7. Final report	April
8. Poster and presentation	April

1. Meetings and Coordination

A kickoff meeting at HAL offices should happen in December or early January. Other coordination meetings for project activities throughout as needed should occur during winter semester.

2. Data Collection

The project team should focus first on gathering data on EI throughout the Wasatch Front. Data may be collected through online surveys, site visits, and interviews. HAL can help coordinate some of the communication. A plan for gathering data is needed by the project team to carefully record and format the data for proper analysis.

First, energy consumption data can be found and separated into the following processes. Data may be monthly, annual, etc., as long as the energy and water data are compared over the same time period:

- Sourcing—include production and conveyance energies for both surface- and groundwater
- Water treatment
- Water distribution
- Wastewater collection and conveyance (pumping)
- Wastewater treatment (categorized by technology—activated sludge, trickling filter, etc.)

Next, flow or volume data corresponding to the previous components should be found. Data may be monthly, annual, etc., as long as the energy and water data are compared over the same time period. This will provide the information necessary to compute an EI. Note that detailed data from every process or component may not be available.

Additional questions to gather information could include:

- How aware is the utility of its energy requirements?
- Does the utility regularly track its energy use?
- Does the utility have any energy-related policies, plans, or goals?
- How does the utility work toward energy efficiency?
- What energy problems has the utility experienced or what does it anticipate?
- What type of treatment technologies does the utility use?
- How does the utility use water storage?
- Does the utility have a known inefficiency or other problem that the team could design a solution for?
- Other relevant information

3. Analysis

The project team would then analyze the data and compute the EI (kWh/MG) for each process and/or technology and for each utility. Again, not all levels of data may be available; at a minimum, the overall EI for the given utility should be estimated. The team should identify trends and compare differences within the state and elsewhere and formulate conclusions and recommendations. If possible, the team could extrapolate the results to determine how much of Utah's energy use is water related.

4. Preliminary Report

The team should document their findings to date and discuss preliminary observations.

5. GIS Database

If time permits, the development of a GIS database of the findings could be included to help visualize and share the data.

6. Design Exercise

In the course of data collection and interviews, utilities may identify certain inefficiencies or other problems which need to be addressed. The team will choose one such project and prepare a preliminary design for a solution. Examples include energy generators, pump upgrades, flow metering, or etc. The proposal should identify possible inefficiencies that could occur in water systems and propose possible solutions to make them more efficient.

7. Final Report

The final report should include additional data, observations, and conclusions. The team would need to prepare supporting graphs, tables, and maps.

8. Poster and Presentation

The team would also need to prepare a poster and oral presentation to communicate results.

Key Milestones

The main parts of the project that will be important to accomplishing this project include:

- Collect water volume data from available online sources
- Identify and contact water supplier entities (for example, cities or suppliers) for their energy usage
- Calculate an average kilowatt hours per million gallons (kWh/MG) for the State of Utah
- Create a GIS database to store and share found data
- Identify and design a system to help improve water and energy efficiency
- Create a 50% report
- Create a final report
- Create a poster and prepare a presentation on the project

Although it may not be possible to focus on the whole state of Utah, it would be desired that within the semester that this data would be gathered for at least the Wasatch Front (Utah, Salt Lake, Davis, Weber, and Box Elder Counties) first. HAL can help select which entities to contact to obtain a representative sample. The team will need to provide a preliminary plan on how they will collect, organize, share, and present their data.

Outcome and Performance Standards

Teams will provide the work “as is” meaning that there is no engineering stamp certifying the work.

Aside: The ability to continue receiving support from outside sponsors is somewhat contingent on the good work you and the undergraduate students do. You represent the BYU Civil & Environmental Engineering Department. The expectation is that you will interact in a professional manner at all times with your mentor and project sponsor, treating them with the utmost respect and consideration of their busy schedules. While successful completion of the design project is fundamental to the outcome of the work, it is expected that you will also learn important team dynamics and leadership principles. This means that in the process of completing the project you are also seeking to help each member of your design team to grow and develop confidence in his/her engineering abilities.

Deliverables

The deliverables for this project are:

- A final report with design alternatives for the project that include economic and environmental considerations.
- A poster reflecting a summary of your design project.
- A presentation summarizing your design project.
- All deliverables are due by Friday April 1.
- During the week of April 4th both a presentation to sponsors and poster session for students, faculty and other interested people will be organized.

The final report, poster, and presentation should address EI study as well as the design exercise. IT should also include the methodology, results, discussion, conclusion, etc., with tables, figures, and maps as necessary.

Term of Contract

Undergraduate students are to work during winter semester, eight hours/week/student with at least 3 hours working together. Any class time or time spent on class assignments counts towards the eight hours.

Payments, Incentives, and Penalties

For this project, there are no payments or incentives provided by the sponsor. The schedule for the deliverables and requirements of the class must be met in order to receive an optimal grade. Penalties for incomplete, unsatisfactory, or late work can result in receiving a lower grade

Much of the capstone work is graded by graduate student mentors, which include evaluations of the following components:

- Team process (how well you work together to accomplish the goals)
- Project proposal
- Project Management Plan (PMP)
- 50% complete status report
- Final report, poster, and presentation
- Overall satisfaction of the client in meeting specific deliverables

Contractual Terms and Conditions

There will be no monetary compensation with respect to the work completed, and all work is completed and delivered on a “best effort” basis.

Aside: Each member of the undergraduate team will be asked to sign a non-disclosure agreement that simply states the work you do belongs to the project sponsor.

Evaluation and Award Process

3 different graduate students will evaluate proposals blindly, and the average of their scores will be the grade you are given on the proposal and used for granting awards where there is competition. They will be evaluating you from the exact rubric listed below.

Timeliness - 1 pt off per full hour late, up to 5.	5
Grammar/Spelling - 1 pt off per blatant error, up to 10.	10
Cover Page - Title, Data, Sponsor, Team Name, Team Members, Department of Civil & Environmental Engineering, Ira A. Fulton College of Engineering and Technology, Brigham Young University - 1 pt per piece of information included.	8
Cover Letter - brief letter of introduction that 1) states your intent to propose and 2) how you may be contact - 4 pts per piece completed.	8
Executive Summary (3/4 to 1 page that summarizes the contents of your proposal) - 7 points for completion, helpfulness - 3 pts max.	10
Team Abilities (Adjust the SOQ to make it relevant to the project) - Summary AS A TEAM of 1) relevant courses and experience, and 3) abilities to complete the work on time and in a professional manner, 4) including use of specific engineering tools/software. Include résumés. 2 pts for including résumés, 6 more points max, 2 per piece completed.	8
Key Personnel - 1) Identify which individuals will focus on which pieces of your potential tasks, and 2) some kind of organizational chart or visual describing how you will work together as a team. 5pts max per piece.	10
Project Understanding - 1) Did they address specific items mentioned in the RFP? 2) Do they repeat basic background in somewhat new terms to *demonstrate their understanding* of the project? 3) Do they mention key deliverables they may need to provide? 4) Did they articulate a *specific* approach for developing design alternatives and deliverables? 4 pts max per piece.	16
Formatting - Does it look professional? Consistent? Yes or no, 5 pts each.	10
Concise vs. Wordy, Meaningful vs. Fluffy, repetitive wording. 8 pts means concise, and accurate, and specific. 1 pt means often confusing, wordy, or vague.	8
Clear and professional flow of writing and style. 7 pts means that you would feel comfortable handing this in if it were your own; it is easy to read and understand; feels professional; 1 pt means it feels like it was cut-pasted, rushed, and done with little thought; hard to read; feels like a high school essay.	7
Video Interview - Message is clear and consistent with proposal, each member participates, professional but catches your attention. Leniency on video/audio quality will be given with a focus on the content and overall organization.	20
Total	120

Process Schedule

October 21, 4:00 pm - Request for Proposals will be available online: http://cecapstone.groups.et.byu.net/content/winter-2015-projects
October 27, 4:50 pm - Question and Answer period with respect to the proposal and submission procedures. The period where you can register your intent to propose on a project will begin. Each team will need to identify the primary target of their proposal and three other alternatives (no proposal necessary). Public knowledge of an intent to propose should help distribute proposals more evenly.
*November 17, 4:00 pm - Three copies of the proposal must be submitted at the beginning of class. Team video interviews should be made available online or on disc and referenced in the proposal.
December 1 - Award notification.

*The review committee reserves the right to reject any proposal or presentation that is not submitted in a timely fashion or in accordance with the instructions given in this RFP.

Contacts

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Submittal Requirements for the proposal

For this class the requirements are:

Turn in three copies of the proposal that should include:

- Cover letter
- Executive summary, 1 page or less (by itself)
- Work plan that outlines the approach to solving the problem, how the team will work together (including weekly work schedule that shows the hours each team member will work and the time block the team will be together, this is a necessary requirement).
- Necessary tools, data, equipment, etc. A couple of paragraphs or a bullet list with one sentence explanation for each item.
- Schedule indicating important milestones.
- Engineering Design Budget. This is an estimate of the design phase cost.
- Outcome and Performance Standards. Provide the following statement: “Teams will provide the work “as is” meaning that there is no engineering stamp certifying the work.”
- Statement of qualifications that outlines the background, experience, education, and organizational structure of the team. Include some discussion of how you plan to become a “high functioning” team in the course of completing the project.
- Outside consultants (professors or others) that are necessary to “make this work.”
- Appendices:
- Appendix A: 1 page resume for each member of the team
- Appendix B: (if necessary)