Avoiding Drowning by Pooling Our Resources

Steven Huss-Lederman
UMACS
September 28, 2019
Who am I?

- I worked as a professor of computer science for 23 years
  - After the last academic year I left my position
  - A primary focus of my current effort is supporting sustainability through the Open Energy Dashboard (OED)

- For about a decade, a great deal of my efforts and work with students has revolved around Humanitarian Free Open Source Software (HFOSS)
Overview

- What is the idea here
- Quick look at the Open Energy Dashboard (OED)
- OED as an exemplar of a collaborative project
- Considerations in working on a collaborative project
- Can the group dream of projects that might benefit from a collaborative approach
  - Can we find partners, a way forward
Overview

- What is the idea here
- Quick look at the Open Energy Dashboard (OED)
- OED as an exemplar of a collaborative project
- Considerations in working on a collaborative project
- Can the group dream of projects that might benefit from a collaborative approach
  - Can we find partners, a way forward
The philosophical orientation

- We are all very busy with pressures to get work done and projects implemented
- This often makes us think about what our institution’s needs are now and how to implement a project quickly and at limited cost
- Sometimes that is good but sometimes we pay a long-term cost
- The costs can include reimplementation, ongoing fees, lack of flexibility
- Today I want to think about a model where we actively and consciously work together to meet the needs of each institution and those of everyone involved
- We share the costs, we share the greater gains and (hopefully) everyone benefits from the collaboration
- Is it possible to avoid a type of the Tragedy of the Commons by pooling our resources?
  - Some say there is no technical solution to the Tragedy of the Commons so it involves the will to do it
Overview

- What is the idea here
- Quick look at the Open Energy Dashboard (OED)
- OED as an exemplar of a collaborative project
- Considerations in working on a collaborative project
- Can the group dream of projects that might benefit from a collaborative approach
  - Can we find partners, a way forward
Why talk about my project

- I hope my project (OED) will be a good example of how to work together
- I think it brings up some important ideas about this idea
- In the end, this session is about the general idea of working together and not about selling you on OED
What is OED?

- OED is an interactive energy dashboard that collects, stores and analyzes meter data
- It enables users to visualize and investigate resource usage
- Let's take a very quick look
  - There is a talk in the 2:00 session specifically about OED

Open Energy Dashboard
Overview

- What is the idea here
- Quick look at the Open Energy Dashboard (OED)
- **OED as an exemplar of a collaborative project**
- Considerations in working on a collaborative project
- Can the group dream of projects that might benefit from a collaborative approach
  - Can we find partners, a way forward
How OED differs from many dashboards

- Free
  - Legally and forever free
- Portable
- Features are driven by many institutions
- Features aimed at ones usable by many people
- Public open source
- Extendible
- Uses modern software and techniques to be stable, avoid bugs, be sustainable
How does this difference play out

- We will discuss a number of ways that the aims of OED impact its work
  - How it deals with feature requests
  - How requests from multiple institutions led to a general feature that was greater than its parts
Dealing with feature requests

• Anyone can make a feature request
  – OED gets feature suggestions from sustainability offices, energy managers, facilities, students, faculty and others

• We think about the importance, generality, timeliness and implementation effort as we sort and prioritize these requests

• One of the great aspects of an HFOSS project is you get involved with users from the wider community
  – Requesters learn from each other and the project members learn from an interdisciplinary environment
The pain and gain of lots of requests

- Today I’d like to discuss trying to combine seemingly different requests to create general features that served many people and improved the OED system
  - Aggregating data
  - Displaying data
Aggregating data

- People asked to show usage for
  - A dorm
  - All residential, academic, food services, athletic, laboratories, etc.
  - Different sides of dorms
  - Each floor of a dorm
  - Dorm usage that students can control
  - Whole campus

- This involves combining usage from multiple meters so are all related

- Most systems required manually doing each one where it generally took the dashboard provider to do it
• OED allows for arbitrary groups of meters and other groups
• There is a tool that allows OED sites to create these groups on their own
Displaying data

- People asked to show usage as
  - Many energy types: electric, gas, steam, …
  - Other resources: water, recycling, …
  - Combinations of resources: electric + gas for a building, …
  - In units that support sustainability: CO$_2$, equivalent miles driving a car, ….

- Other requests
  - Scale/split meter readings due to improper placement or multiple usage of energy
  - Baseline (remove usage when building empty)
  - Display usage as cost
Linear transformations

- OED will be able to perform a linear transformation on any meter or group readings
- OED will only store SI (metric) units
  - It will use linear transformations to convert actual readings to SI
- Examples
  - Megajoules is SI unit for energy
    - \( MJ = 3.6 \times kWh \)
  - Liter is SI unit for volume
    - \( \text{Liter} = 3.78 \times \text{gallons} \)
What linear transformations allows

Collect meter data

MyDorm

Electric meter
(kWh)

Gas meter
(BTU)

Steam meter
(psi, ft³/s, ΔT)

Convert to MJ (SI unit for energy)

OED Database

Combine all energy meters from MyDorm into group

Convert to desired units (horsepower, CO₂, cost, ...)

Display as desired graphic

User request to graph group of energy for entire building

Notice use of groups and repeated conversions (linear transformations) to accomplish task
Big picture

- Getting requests from lots of sites allows for one to see relationships
- Designing a system to meet a general need is harder but the results are more general and easier than the combination of each individual request
- The general system does the work so the site only puts in the relationships and requests
- These mechanisms allow for other uses
  - Groups that display net CO$_2$ (consumption – green generation)
  - When done, sites can input own linear transformations to display any unit they want
  - Some we have yet to even dream of
Overview

- What is the idea here
- Quick look at the Open Energy Dashboard (OED)
- OED as an exemplar of a collaborative project
- Considerations in working on a collaborative project
- Can the group dream of projects that might benefit from a collaborative approach
  - Can we find partners, a way forward
The Free Open Source Software (FOSS) model

- FOSS is a well established development model in computer science
- Often many people and organizations contribute to a common project including its long-term maintenance
- There are sites/technologies to support this model
  - OED uses GitHub
- Some benefits that OED has had
  - Brings together multiple disciplines & fosters communication
  - Engages students to advance learning outcomes
    - Computer science students, classroom use, research projects
  - As an academic-based project OED seeks to support that mission
What did it take to start (and continue) OED

- Vision and goals of project that articulated the common good
- Understand it takes more effort and time than going it alone
- Spend time to understand the aspirations & needs of a diverse community that can gain from the project
- Be open in what you are doing: plans, regular updates, tell when having issues
- Seek and readily accept input for requests, issues, etc.
- Transparent mechanisms to discuss, understand, prioritize and give timeline for requests
- Have easy channel to accept input: email, phone/video calls, GitHub issue mechanism
- Make sure you continue to reach out as the project continues
A few other thoughts

- Verify early that you are doing something useful and you have real potential partners.
- You can have one or a few leaders at the start but you need to work to have the leadership be diverse as the project moves forward.
- Within reason, stay the course on your vision.
  - You will have tough times but quality work generally pays off.
- Step out of your normal comfort zone to interface with a larger community.
- It can take work to sell your institution on joining the common good and that free does not necessarily mean it will have more issues.
- Accept it may take a while to gain acceptance and recognition for what you are doing.
Student engagement

- About 40 computer science students so far have worked on developing OED
  - They joined by knowing me and word-of-mouth from other students
  - They do it for academic credit (nobody has received pay for this)
- Some worked a dozen hours and some have worked hundreds of hours
- Working on a project with real-world implications (HFOSS) has motivated many of the students
- Students have learned
  - to connect CS to sustainability
  - to communicate with a diverse community
  - real-world CS skills that have lead to internships and jobs
Has OED worked out?

• It really does work and it continues to improve
• The sustainability community really has directed the project
• We have a modest number of schools using it for sustainability
  – We had hoped for more and need to actively work on this
• Doing it right has taken more time than hoped, esp. given we engage students and appreciate their learning needs
• We have yet to receive (or really seek) funding to move the project forward
• It has been of great personal satisfaction for me
Getting OED to the next step

- I have been thinking about how to expand the sharing involved in OED
  - Should multiple campuses seek common funding to advance each campus while advancing the overall project?
  - How do we get more schools to engage with OED?
  - How do we get more student developers from across schools so we can deliver more features sooner?
Thoughts/questions on these ideas

- Next we will think as a group about apply these to other projects/areas
Overview

• What is the idea here
• Quick look at the Open Energy Dashboard (OED)
• OED as an exemplar of a collaborative project
• Considerations in working on a collaborative project
• Can the group dream of projects that might benefit from a collaborative approach
  – Can we find partners, a way forward
Ideas for projects that might be good for collaborative development?
Some ideas (if needed)

• Could courses be created across institutions that share core teaching materials or teaching effort?
  – Would multidisciplinary courses make sense?

• Would sharing data or progress across institutions lead to richer sustainability discussions? This includes creating a system to do this (some are in place but utility for students needs to be evaluated).

• Can we make our case studies more robust by trying across institutions and applying empirical research methods
Is it now feasible to split into groups to work on some of these ideas?

- What is the vision?
- What would success look like?
- Who should be involved, esp. those not here?
- Are there potential funding sources?
Conclusion

- Thank you for coming

- If you want to discuss collaborative projects more, feel free to contact me at huss@beloit.edu

- If you want to investigate OED then feel free to contact me