Avoiding Drowning by Pooling Our Resources

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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)

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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

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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 reimplementing, 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

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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

- Lets take a very quick look
    - There is a talk in the 2:00 session specifically about OED

ED

Open Energy Dashboard

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Line graph with group

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

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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

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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

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How OED met this need
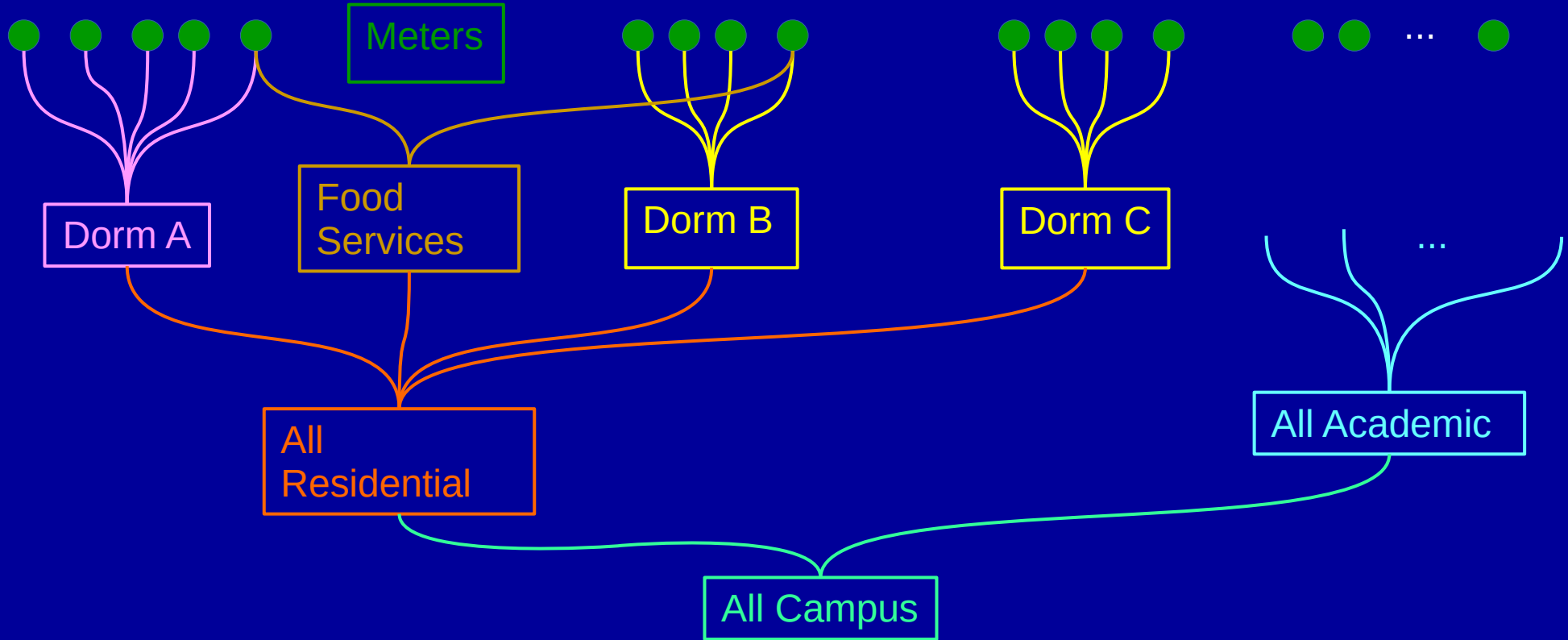
- OED allows for arbitrary groups of meters and other groups
- There is a tool that allows OED sites to create these groups on their own

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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

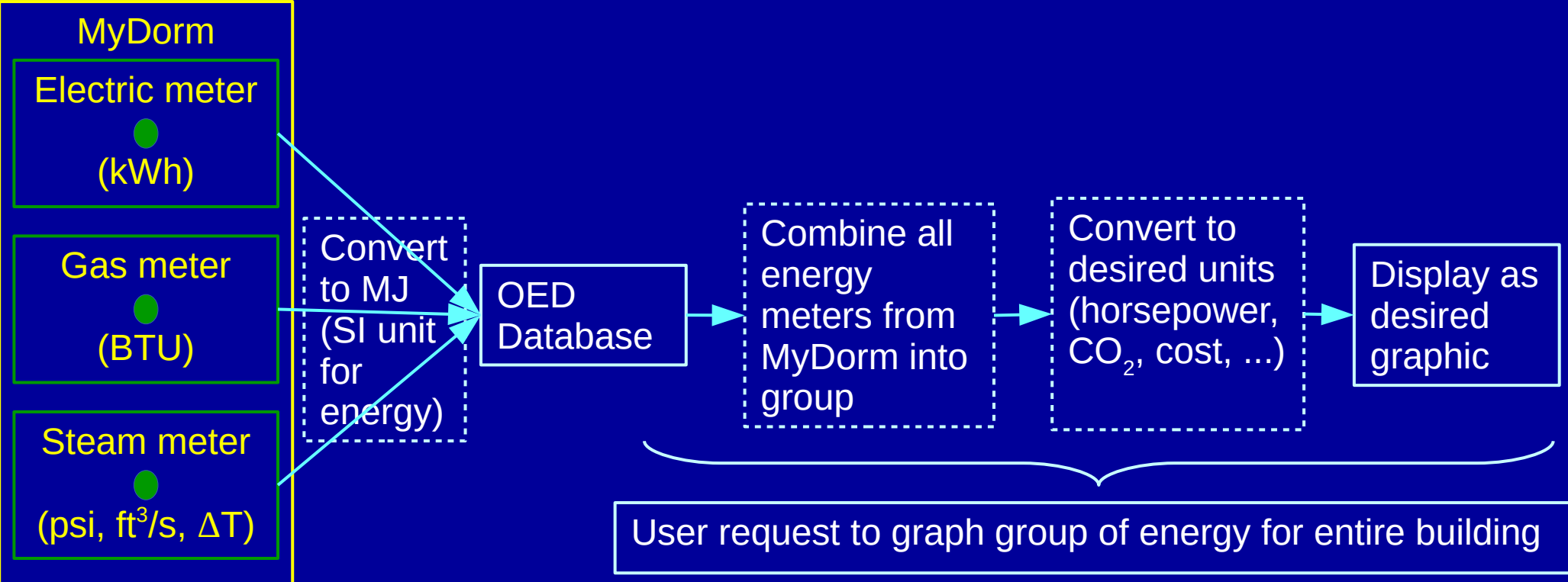# Linear transformations

- 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 * kWh
    - Liter is SI unit for volume
        - Liter = 3.78 * gallons

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What linear transformations allows

MyDorm

- **Electric meter** ● (kWh)
- **Gas meter** ● (BTU)
- **Steam meter** ● $(psi, ft^3/s, \Delta T)$

Collect meter data

Convert to MJ (SI unit for energy) → OED Database → Combine all energy meters from MyDorm into group → Convert to desired units (horsepower, CO_2, 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

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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

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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

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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

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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

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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

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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?

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Thoughts/questions on these ideas

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

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Ideas for projects that might be good for collaborative development?

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- 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

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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?

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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

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