

Intro:

Dustin outlines construct of Food-Energy-Water as a series of natural cycles which humans can augment to extract resources to meet their needs. Each cycle has an energy accumulation phase, a concentration phase, and extraction phase, and a recovery phase. These natural cycles operate at different spatial and time scales and each phase has its own flux (pass through rate) and storage that may change daily, weekly or seasonally. Harmonizing these natural rates/fluxes with the human demand schedule presents both challenges and opportunities.

This is summarized in a broad scientific question: What is the sustainable output of these natural cycles and how can they be augmented/accelerated to match the extraction demands that are placed on them?

In different environments (e.g. confined aquifer vs. large river system) different phases of the cycle may be the limiting rate step. Thus the solutions to enhance the storage/resilience/sustainable-extraction will be different, but the net impact to the cycle may be the same. In other words, the technologies or practices applied will differ between climates/geographies, but the outcome of increasing storage/resilience/sustainable use will be the same.

NSF Solicitation (March 16th) : \$50M in funding split between Cat1 (\$1M-\$3M) and Cat2 (<\$1M)

4 tracks:

- 1) Modeling: must be generalizable to different locations. Scale should be **regional**.
- 2) Data analytics and decision/policy support. Bring science to long-term planning (decadal)
- 3) Innovative systems: technologies and best practices with a strong focus on waste utilization
- 4) Education and outreach attached to 1-2-3 (limit \$1M)

NSF conference on FEW occurring January 19-21 in D.C. Great opportunity to meet big-wigs.

Meeting opinions on NSF solicitation

The balkanization of the NSF problems is the same problem we're having at WSU, focusing on these too much could actually take away from our broader mission. It could be interesting to propose projects that cross the boundaries of these tracks, but this may not be permitted under the NSF structure. Inquiry at the NSF meeting may garner further insight in this idea.

Discussion of a demonstration project was mixed since \$3M is below the threshold of a regional scale (and most local scale) demonstrations. NSF funding may be used to scope out and establish the baseline for a future demonstration project. Demonstrations using WSU's unique location were proposed. The rural population scale matches much of the USA and developing countries. WSU is adjacent to Yakima Valley system, regional scale, that has more interesting features in water.

Brainstorming FEW cycles

The abstract concept is brought down to earth by replacing broad concepts with specific technologies that replace or augment the natural cycles. Feedback and virtuous cycles are identified between the

conventional silos of food, energy, and water. Initial project proposed by Dustin does well connecting controlled environment agriculture with energy conversion, but may lack obvious connections with water. Several suggestions from the group aim to bring water and social components into the proposed project, but a successful project concept must also address the un-intended consequences and un-anticipated obstacles. Is it possible to build these into or detect this during a demonstration/test bed? It is a great challenge socially to scale up solutions from Palouse to greater Columbia basin, since humans often behave irrationally. Participants see the potential for many very interesting social issues (e.g. land cover of crops replaced with greenhouses, social norms of migrant workers setting down roots).

The group believes that this type of approach has the potential to engage a lot of different faculty at WSU and contribute to FEW with a focus on the SYSTEMS problem. The work can engage modelers, technologists, economics, and human behavior/preferences. The group coalesces around a division of ideas at two conceptual scales. The first being a more abstract scoping of the natural and human augmented systems. Can new metrics be established that identify the bottleneck in the cycle or allow for a generalizable construct that applies to a) the food cycle, b) the water cycle, c) some abstract human cycle, while also being readily adjustable to different locals?

The second track aims to be a case study of 3-6 novel technologies that complement each other from different phases of this cycle concept. These technologies may not be the best in their field technologies, but if there are hidden synergies or they are especially suited to integration with each other, they may provide for a better holistic solution than best-of-kind technologies in each individual field.

Meeting Follow Up

Meeting was summarized. Attendees and collaborators are asked to submit ideas for contribution to a FEW collaboration through a google spreadsheet. Ideas are solicited that broadly fall under the two tracks. A follow up meeting is to be planned prior to the NSF conference.