SRRR Workshop

Actions to meet challenges to sustaining our lives on Earth

Part 2) Wed. November 29 - Energy: Constraints & Consequences.

Proceedings

Agenda

Welcome & introduction: David Berry

Societal Collapse as a Planetary Process, or Your Facts, While Interesting, are Immaterial When Considering Energy: Ron McCormick, Ecologist, US, Bureau of Land Management, Respondent Rhonda Kranz Q&A.

An Advance and Opportunity: Imaging & Quantifying Methane Emissions:

- ***Above & Below Ground Natural Gas Pipe Leaks***
- ***Orphaned/Abandoned & Under-Producing Well Emissions***
- ***Integrated Methane Monitoring Management System***

Allen Waxman, Chief Scientist, CH4IQ, Erwin Villiger, LMI, Stan Bronson, Acre, David Berry, Director, SRRR. Response Bob Wilkinson Q&A

Multisolving: A Growing Movement of People Working Together Across Sectors: Elizabeth Sawin, Founder Multisolving Institute. Response Sharon Franquemont Q & A

Discussion among presenters, respondents and comments from the chat.

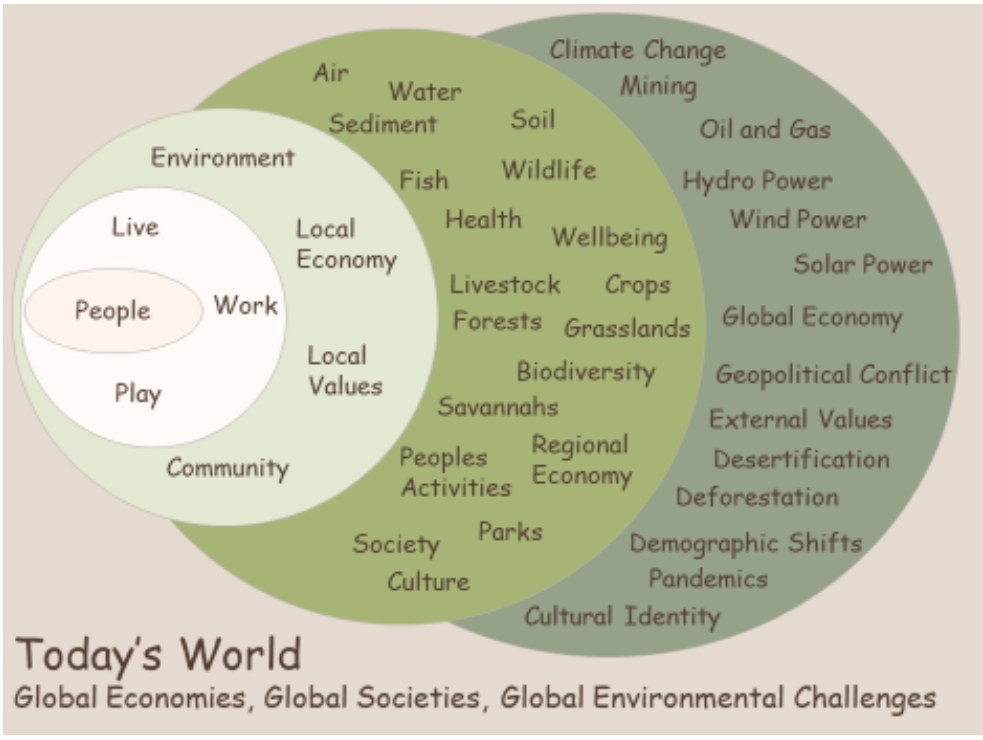
Adjourn

Societal Collapse as a Planetary Process, or Your Facts, While Interesting, are Immaterial When Considering Energy

Ron McCormick, Ecologist, US, Bureau of Land Management,

Ron McCormick is a classically trained field naturalist who came to embrace the ecology of complex systems in his late thirties and has never looked back. His decades of thinking about and applying systems theory to social-ecological problems has led him to the concepts of Landscape Conservation Design – what society desperately needs at this critical juncture. His day job as an ecologist for the Bureau of Land Management offers him access to wild places where he takes photographs of wild spaces.

Ron began with a disclaimer: the thoughts and conclusions in this presentation are those of the author and not the views of the Bureau of Land Management or any other federal agency.

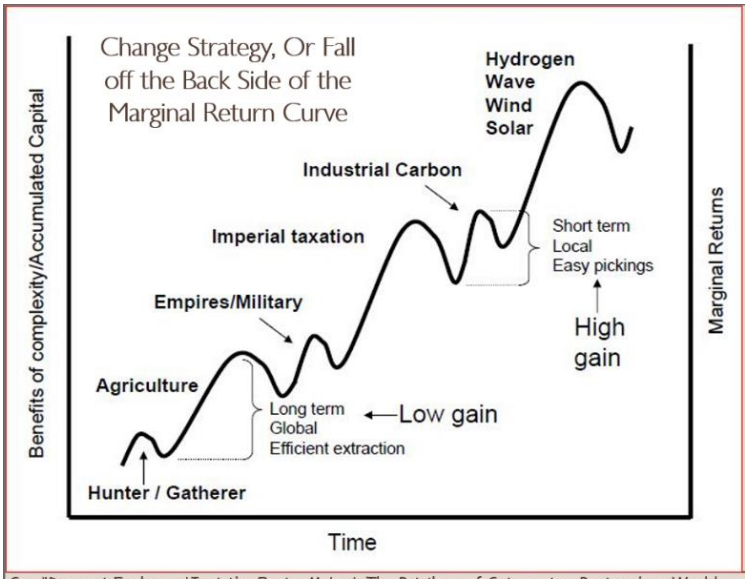


There is a conceptual model of ecological systems on the planet, representing how all human societal systems emerged from that ecological context, and remain fully embedded within. We start with an organism on a landscape and an energy source - sunlight. Organismal & landscape structures support and constrain population processes. This continued to expand until we mistakenly came down from the trees, formed tribes and started using social media.

In the presence of a usable energy gradient, biological systems self-organize into open and holarchic designs. We are familiar with hierarchies that are top-down and usually based on aspects of power and control. Holarchies are more bottom up and cooperative, exhibiting emergent behaviors - like mitochondria getting into biological cells and soon we developed hearts, lungs, immune systems and the habit of wearing digital watches on our wrists.

Before speaking of the several epochs of global societal evolution and their relationship to marginal return curves, Ron briefly reminded everyone of the three laws of thermodynamics:

1) Conservation of energy, you can neither create or destroy energy, only transform it into more useful or less useful forms;
2) Entropy is always positive, that is, disorder always increases;
3) (Nobody really cares about the third law, so let us just not worry about that).

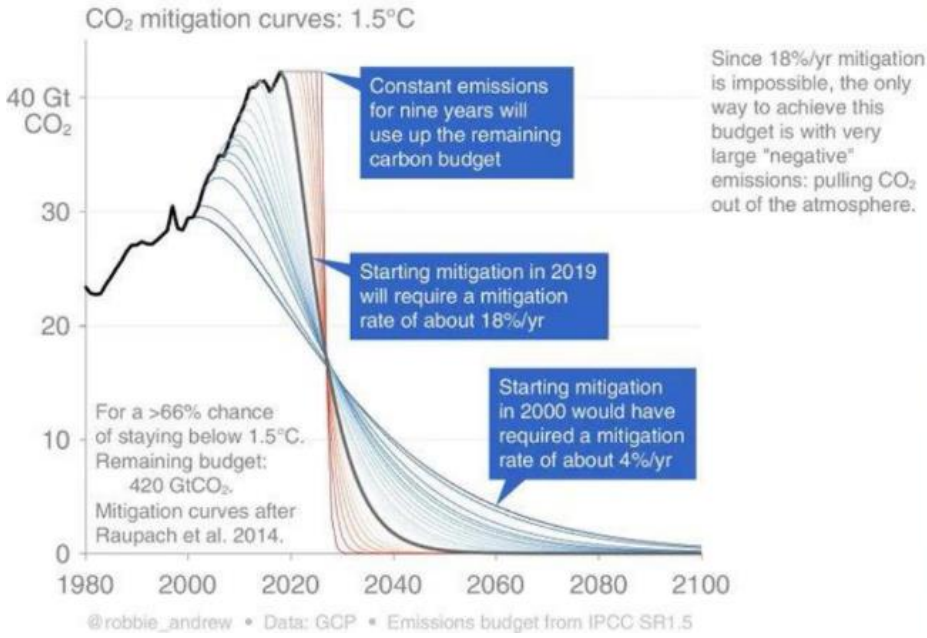


See "Dragnet Ecology – 'Just the Facts, Ma'am': The Privilege of Science in a Postmodern World Allen, et al., 2001. *Bioscience* 51 for further details

Various configurations of human societies have emerged over the last 15,000 years, with ever increasing complexity despite needing to rely on both high quality and lower quality energy. These cascading emergences of increasingly ordered and self-organizing social-ecological structures appears to go against the second law. However, by taking advantage of excess energy in the system to elaborate social structures our current fossil sun-based system actually hastens total energy dissipation towards a state of equilibrium, that is, entropy occurs but at a different level in the universal system.

Ron categorized Joseph Tainter's eleven themes of societal collapse, compared them to current trends in North America and elsewhere in the world, and reminded participants that it is rarely only caused by resources depletion (see Tainter (1987) "The Collapse of Complex Societies")

1. Depletion/loss of vital resources on which the society depends.
2. The establishment of a new resource base.
3. The occurrence of some insurmountable catastrophe.
4. Insufficient response to circumstances.
5. Other complex societies.
6. Intruders.
7. Class conflict, societal contradictions, elite misbehavior.
8. Social dysfunction.
9. Mystical factors.
10. Chance concatenation of events.
11. Economic factors.



Since 18%/yr mitigation is impossible, the only way to achieve this budget is with very large "negative" emissions: pulling CO_2 out of the atmosphere.

Respondent, Rhonda Kranz: Thanked Ron McCormick for the provocative presentation. Rhonda asked: "How do you, and people you work with, integrate and bring these ideas into the workplace especially the government.

Ron McCormick: Donella Meadows' list of places to intervene in a system is still our best model for changing how a society approaches virtually anything in the social-ecological realm.

Leverage Points: Places to Intervene in a System - The Donella Meadows Project

Most scientists, politicians and concerned citizens tend to talk about numbers yet that is the least effective place to intervene when desiring system change. The most effective place to intervene is to get scientists, politicians and concerned citizens to change their mental model of what is an economically viable social system (acceptable and valued by all) that optimally uses those goods and services that a given landscape can provide, for the length of time desired.

An Advance and Opportunity: *Imaging & Quantifying Methane Emissions*

- ***Above & Below Ground Natural Gas Pipe Leaks***
- ***Orphaned/Abandoned & Under-Producing Well Emissions***
- ***Integrated Methane Monitoring Management System***

Allen Waxman, Chief Scientist, CH4IQ, Erwin Villiger, LMI, Stan Bronson, The Alliance for a Climate Resilient Earth (ACRE), David Berry, Director, SRRR. Response Bob Wilkinson

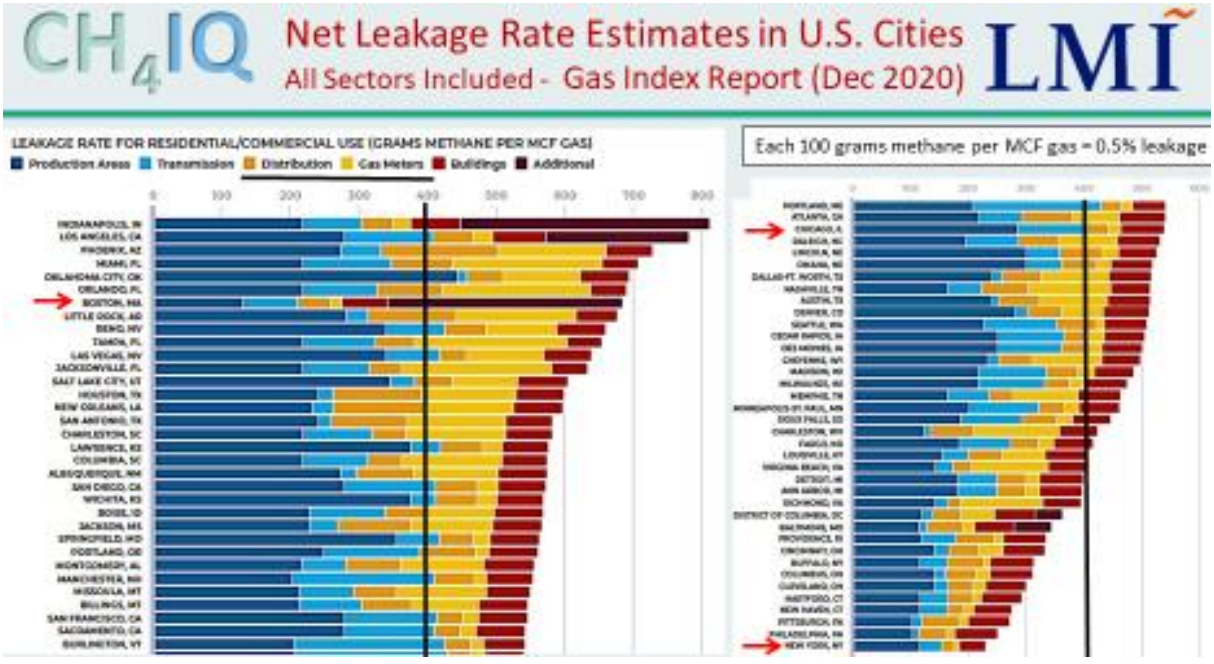
David Berry founded the Sustainable & Resilient Resources Roundtable. At the White House Council on Environmental Quality for 7 years, he chaired groups he founded on Sustainable Development Indicators and Industrial Ecology. They raised awareness and encouraged creative action and cooperation among organizations. David represented the US at United Nations meetings on sustainability. He served on the Board of the Balaton Group, a leading forum for systems thinking and sustainability. For 20 years, he co-led the Prayer Vigil for the Earth on the National Mall, bringing together Native peoples and leaders of many faiths to share traditions and aspirations for living in harmony with Nature and each other. His deeper workis woven into talks, retreats and facilitating in several countries. David Berry said the four organization team (CH4IQ, LMI, ACRE and SRRR) proposes a significant advance in methane emissions imaging, quantification and monitoring. This approach will accelerate reductions in emissions of methane, a greenhouse gas considerably more impactful per gram of emissions than carbon dioxide.

Stan Bronson is on the Steering Committee of the Sustainable and Resilient Resources Roundtable (SRRR). He is Co-founder and Director of Partnerships, Stimson Center's Alliance for a Climate Resilient Earth (ACRE). He previously founded and directed the Florida Earth Foundation and was Chief Operating Officer of Callery-Judge Grove the largest citrus producer in the US.

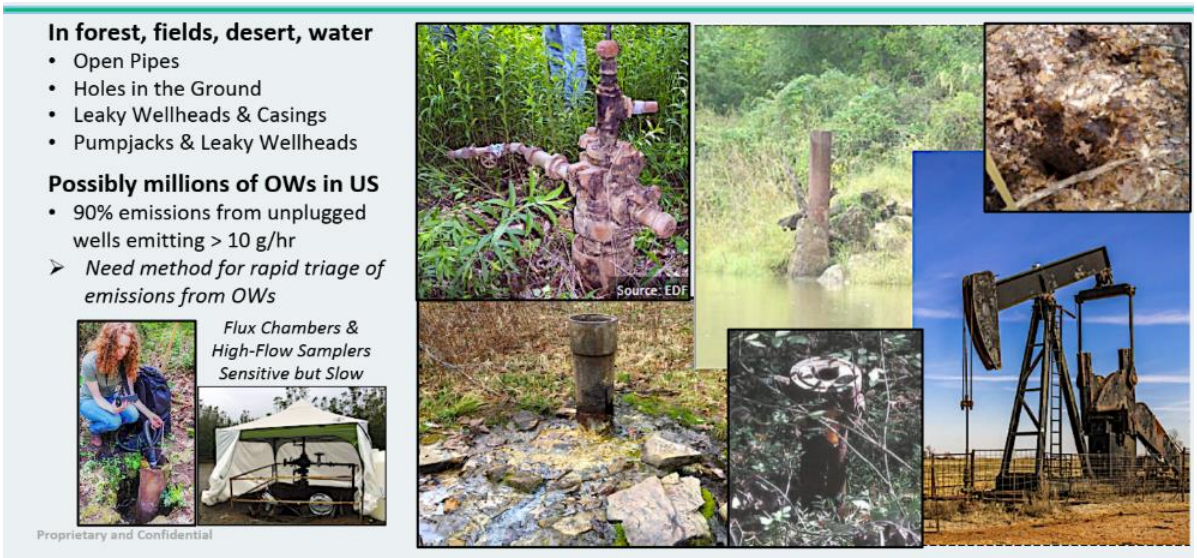
Stan gave an overview of stages in the natural gas supply chain and which government agencies have responsibility to monitor emissions. Federal agencies are primarily concerned with production & processing and with transmission & storage. The states are responsible for emissions in the distribution sector. Stan said the team sees opportunities for its approach to orphaned wells and to distribution lines mainly located in the nation's cities and towns,

Allen Waxman, PhD Physicist (Astrophysics U. of Chicago 1978)
* 35 years leading development of multi-sensor imaging & analysis systems for DoD & IC
* Invented short-wave infrared (SWIR) spectral camera for methane emissions imaging & quantification (awarded 7 US patents)
* Founded MultiSensor Scientific, Inc. & subsidiary MultiSensor Canada, divested in 2019
* Founded CH4IQ (Methane Imaging & Quantification),

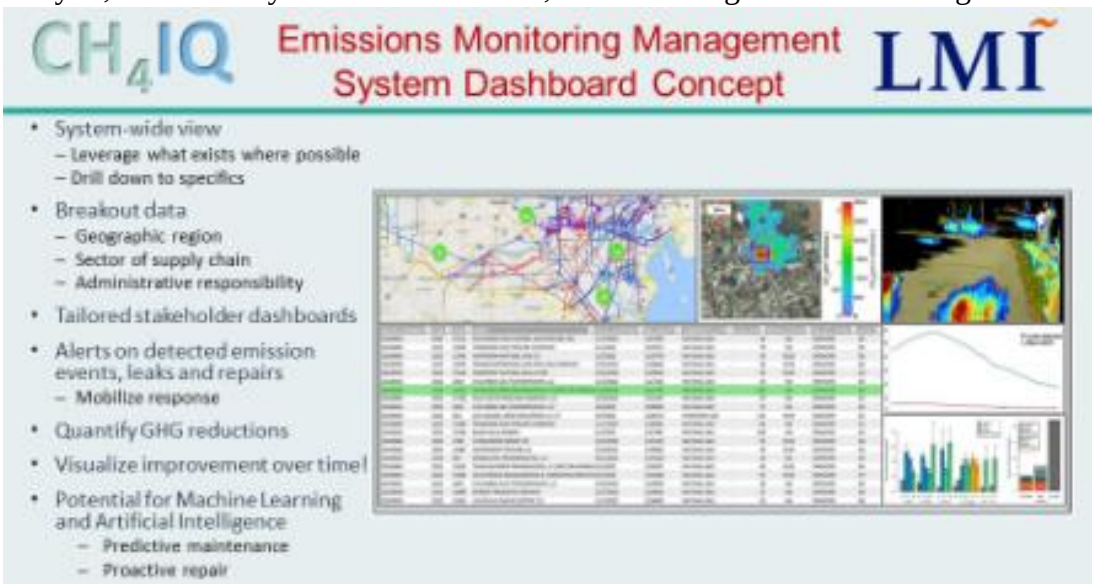
Allen Waxman outlined the magnitude of natural gas emissions. He showed this chart of emissions for production, transmission, distribution, meters and buildings for a large of number of cities. Each 100 grams of methane per MCF gas is equal to 0.5% leakage. When emissions are to the right of the black line (more than 200 MCF) the use of natural gas can have a greater greenhouse gas effect than burning of coal.



Allen explained the advantages of optical technologies he has integrated to image, locate and quantify methane emissions. Current methods generally use chemical analysis (sniffers) to detect the presence of methane in an area but do not locate or quantify the leaks very well. The optics system using LiDAR the team is proposing, will provide the capacity to locate leaks and quantify the amount of gas leaking (flux) so that the largest leaks whether in distribution lines or the millions of orphan and under-producing gas wells can be repaired readily.



Erwin Villiger, PhD, has more than 25 years of experience at the nexus of national security and environment. He advises LMI's customers on applications of advanced analytic methods to support sustainability and climate risk assessment, mitigation, and resilience. He specializes in geospatial analytics and composite indicator system evaluation and development. Previously, he served as a research scientist for ISciences, LLC, supporting an Intelligence Community customer. He assessed the national security implications of climate change, including water scarcity analysis and modeling, extreme weather trend analysis, vulnerability and risk assessment, and technologies for monitoring compliance. He is an adjunct professor of energy, resources, and environment at Johns Hopkins' Paul H. Nitze School of Advanced International Studies and an environmental security fellow at the Virginia Tech Center for Leadership in Global Sustainability.



Erwin said a cloud-based Methane Monitoring Management System dashboard is needed to

- Gather & integrate relevant data from a Sensor-Stack (multiple data sources)
- End-to-End coverage of emissions across the natural gas supply chain
- Essential for live monitoring and tracking of methane emissions, gas leaks, and progress in fixing leaks

Erwin said the benefits of a live geographic dashboard with monitoring and alerting of critical leaks can prioritize repairs and ROI to bring funds to bear where needed (at-risk infrastructure, new piping). The information will be accessible by all stake-holders and emissions reduction can be visualized against a baseline of emissions. The data from locating, imaging and quantifying emissions from distribution lines and orphan wells as the team is proposing can feed into the EPA Inventory of GHG Emissions and the GHG Center to be led by NASA.

David Berry concluded by saying that the precise magnitude of the methane problem in unknown. Locating and quantifying emissions from leaks is essential to achieve GHG reduction goals. He mentioned the team's demonstration at a PG&E test site in July 2023 where two gas utilities, three national labs and two Californian regulators (CARB & CPUC) participated and concurred that it was a "Good technology, definitely a breakthrough."

The White House is looking for action it can take: David said data collected across all sectors and states is essential to a national Methane Monitoring Management System. Investing a

fraction of 1% of the budget for emissions reduction in measurement, monitoring and management, toward locating the leaks. will help target the remaining 99 % of the budget where it is most effective. We are talking with National Labs and gas utilities about collaboration to build the technology team to work on further development and implementation of proposed systems, with California as a testbed on distribution lines and Pennsylvania as a testbed on orphan wells. For this collaboration we are seeking funding from the relevant budget allocations. Funds directed to orphan wells, distribution and gathering lines, and general emissions quantification and reduction from federal, state and other sources.

Response: Bob Wilkinson said this is a very interesting technology. The quantification and specific location that this advance brings to methane monitoring is incredibly valuable. It is interesting that so much of the emissions are occurring at the meter and distribution end. I would have thought that it was loaded at the production end.

$50 K per instrument does not seem a high cost if one truck can do 20 thousand miles in 6 months. The save device could go city to city. If the quantity goes up will the cost come down to make this of interest for CARB in California and EPA nationally to fund?

Allen Waxman: I agree with you Bob, the cost of that technology will come down. The manufacturer recently had a major investment by Schlumberger, a major international oil & gas service company. They plan to bring those Lidar's into the production sector. For major oil companies $50 K is not a lot. If we want to use the LIDAR in the distribution sector, it becomes a cost to the local gas companies. Just as you said, Bob, at 20 miles per hour, we would need only one vehicle to monitor the whole state of Massachusetts or four vehicles to for California each year so at about $ 200 K per unit including vehicle so it is affordable for a gas company. Allen said the cost challenge comes when we address orphan wells of which there are millions in the US. Many states would require 10 or more methane imaging sensors, so that is why we are working to develop a low-cost ($10K - $15K) methane laser scanner for that application."

Multisolving: A Growing Movement of People Working Together Across Sectors

Elizabeth Sawin, Founder Multisolving Institute. Response Sharon Franquemont Q & A

Elizabeth Sawin, PhD, is Founder and Director of the Multisolving Institute, a think-do tank that

helps people implement win-win-win solutions that protect the climate while improving, equity, health, biodiversity, economic vitality, and well-being. She is a biologist with a PhD from MIT who has been analyzing complex systems related to climate change for twenty-five years. For several years she was a leader at Climate Interactive which hosts a team of system dynamics modelers who create user-friendly climate simulators—spanning topics of international policy, cutting-edge climate solutions, energy dynamics, climate justice, and more. They amplify the insights from these tools through interactive workshops, role-playing games, and events.

Beth spoke about examples from around the world of people addressing the immediate emergencies of the polycrisis while also building the infrastructure of a sustainable world and creating networks that can be a source of improvisation and adaptive capacity. She defined multisolving *(v):* as using one investment of time or effort to solve for several goals at once in a way that also improves equity.

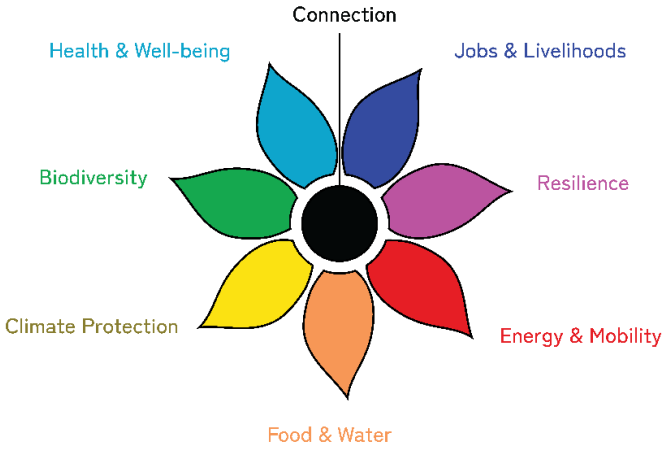
Five reasons to multisolve:

For justice & equity To win To unite today & tomorrow
To be prudent with $$ To build adaptive capacity To strengthen a web of relationships

Six obstacles to Multisolving:

"Mountains" of disciplinarity Swamp" of budgetary silos Jurisdictional "river"
"Quagmire" of disjointed time scales "Forest" of inequity "Desert" of unfamiliarity

Beth demonstrated the process of working together on Multisolving, by conducting a brief live online crowd sourcing poll of the meeting participants. For an example of insulating houses, we individually selected the significance for 8 types of benefits indicated by the petals of a flower. The size of each petal showed the average significance the group estimated would be the benefits of the intervention.



Beth concluded by saying that Multisolving seems like a no-brainer, but in fact it is rare in actual problem solving processes. The skills of Multisolving are the skills of bridging silos.

Beth shared a quote that participants liked: "Whenever I run into a problem I can't solve; I always make it bigger. I can never solve it by trying to make it smaller, but if I make it big enough, I can begin to see the outlines of a solution." -- *Dwight Eisenhower*

Response: Sharon Franquemont said she found the possibilities for integration and collaboration to be very exciting. She liked the Earth images for the obstacles to Multisolving, particularly the "Mountains" of disciplinarity given her background in education. In what ways are you reducing the separation of disciplines in an academic setting and creating the collaboration?

Beth Sawin: Much of what I shared comes from examples of people who are traversing the obstacles. The most important ingredient that we see, which takes time is building trust in

relationships. This starts with listening. A spur for it can be the frustration of realizing that we can't reach our goals without crossing some of these boundaries.

Open Discussion

Alexandra Sokol asked what the degradation timeline is on plastic distribution pipelines.

Allen Waxman; There has been a move away from the old iron and steel pipelines because they corrode. The replacement pipes are a hard type of plastic and people think that this will be a major improvement. From what I have heard and read, when the plastic pipes fail, they fail with a big crack as opposed to a hole. The big cracks propagate and can split a whole segment of pipe. In a place like California, where there are earthquakes, and the fear is that these pipes may crack prematurely. No one has had these pipes long enough to see how they age. What I have seen is that when a section of pipe needs to be replaced, they do not join well with the old iron pipes and the join can have a big leak. So there are a lot of problems with plastic pipelines.

John Wells: I will never forget a time, while I worked for the Minnesota Environmental Quality Board, I was in a meeting called by the Environmental Protection Agency on non-point sources.

I realized that another section of EPA, perhaps ag chemicals, had called a meeting at the Minnesota Pollution Control Agency at the same time as the other division fo EPA in two different places. They didn't know that they were each calling a meeting of the federal EPA with participants from the same state agency. Things like that happen is partly because there are separate sources of funding from Congress or the State Legislator and the people involved are focused on their single issue problems. Beth, how do you scale up Multisolving to help integrate our addressing the many challenges we face?

Beth Sawin: There are some bright spots emerging. The Biden Administration speaks about "Whole of Government Climate Action." We are starting to see it in the states. Massachusetts has the first in the country cabinet-level position called the Climate Chief. Melissa Hoffer's job is to coordinate across the government to get more climate priorities enacted. In her first report, Melissa listed 9 priorities and one of them is Multisolving – she used that word. At the local level, municipalities are being brought together across jurisdictional lines to address watershed issues. People are trying and we are following closely. There are some additional costs in working across silos and we are working to help organizations make the case to budget that beaus the results are worth the extra cost.

Sandra Faber: A question to Ron McCormick. As an astrophysicist, I am one of the 2% of the people who understand the principles of entropy and can appreciate what you are saying. My question to you is do you think it would be useful to try to develop more detailed scenarios to consider what might happen with the many levels of systems that are going to be involved in this process of probable collapse in order to understand the possible outcomes better.

Ron McCormick: My first response would be no for various reasons. The Millennium Ecosystem assessment came up with 4 general models looking at society. Population and all interactions. The best model they had was a European lower middle class existence. They had a Mad Max dystopian scenario, a business as usual scenario with US based consumerism. Those models are probably the best we have and none of them are going to work at this point. In another model I have seen in Dunn Valley in Canada, they are purposefully, where they can, disconnecting themselves from the global supply chain, focusing on internal community, food sources and crafts. Local

communities might be the only systems that might survive. If you are over-connected to one or two sources, when those break, everything goes.

Beth offered a counterpoint to Ron's scenario. Vermont is by no means food self-sufficient and last year we were hit by floods that wiped out about one third of our crops. I used to be a local ag advocate but now I think our resilience will come from having multiple layers of connections at multiple scales.

Judith Blankman said she was not a scientist and has never worked in an ecological field but she worked in a compliance organization ion a bank that was able to get things done. We were able to move policies forward such as accessibility and they motivated people by tying managers' bonuses to performance goals related to the policies. A question for Allen: In the utilities are being held accountable for the environmental performance under their responsibilities. That can be done through their paychecks.

Allen responded that in his interactions with utility companies, they do not want to be told that they have methane leaks at al. If you hand them instrumentation to monitor, they push back. So sates mostly use the stick rather than the carrot and impose fines as opposed to bonuses.

John Wells: Yesterday Patrick said we have a lot of potential for solar and wind energy and today Ran said that is not going to work. So my question is, if not wind and solar, then what?

Ron McCormick: I was happy to see Patrick say that wind and solar are re-buildable not renewable that is a more accurate term. I think we should keep them on the table but the thermal content of many of the things we manufacture (like steel) - you can't do that with an electrical generator. Those are just some of the basics.

Peter Bond: I was most impressed by what Elizabeth Sawin had to say because her work is application to people all over the world. I did not hear anyone mention what a high proportion of the problems we are discussing are caused by American activities.

Sharon Franquemont said she really appreciated the quote from Eisenhower about making a problem bigger when seeking to understand and solve it. I challenge us all to make ourselves bigger as well. I agree with what Peter said. I wont to add that we heard that it would take years to produce a Covid vaccine – but it didn't. I think the biggest possibility is what Elizabeth said about collaborative efforts. This is how the Earth works.

Ron McCormick: Related to Peter's comment one issue is what are the people in a country willing to accept. China and the US are responsible for the most emissions. The developed world is not donating the funds set up at COP meetings, and an issues is what are people willing to pay for.