Episode 4- The Last Mile

Andee Lister: Food, energy, water – to bring them together and actually know how one impacts the other – it's very enlightening.

Tosin Ayudeli: When it comes to food, energy and water – I never knew in the past that they are connected.

Valentyn Panchencho: Gathering a lot of data – big data – local 'Last Mile' data –is really interesting because a lot of time you need to interview people, or ask some experts for some help.

Darren Bingham: I really appreciate the idea of making our supply chains more transparent.

[Audio logo: Crucial FEWSION & NSF motif]

Narrator: Welcome to *Crucial FEWSION*. In this episode we're focussing on 'The Last Mile' of food, energy and water supply chains … that's where FEWSION data's information ends … and the choices being made by you and your local community take over. FEWSION project Director Ben Ruddell explains WHY involving Citizen Scientists is SO crucial to understanding this 'Last Mile'…

Ben Ruddell: FEWSION data provides an averaging total picture of what your county or city is doing … rather than your individual or corner grocery store supply chain.

We don't have any data about your personal behaviour. Data privacy being what it is in the United States, and consumer protections, we don't have the ability to access your personal data – which is generally a good thing, although it does prevent us from being able to answer that question about how your personal consumption creates a footprint. And so that's a gap that needs to be filled.

The idea behind Citizen Science is that we can collect a different type of information. It's not available from the government. It can only be contributed by individual people. And there's a power there. Volunteers or students or even interested professionals in a local community they can follow a FEWSION for Community Resilience process. And we can coach them through that, we can help them lead that. And when done you have a map of your own personal – and your own local community's Last Mile supply chain – as opposed to the meso-scale supply chains which FEWSION data provides.

Sean Ryan: My name is Sean Ryan and I'm the local coordinator for the Citizen Science component of the FEWSION project.

The project's designed to have two cohorts of Citizen Scientists. We've recruited citizens from the City of Flagstaff primarily. There's been a mixture of students, retirees and other individuals interested in food, energy and water systems. They're looking to collect data to map the supply chains for food, energy and water of the local community.

… we ask volunteers to engage in both a learning process and an opportunity to engage with experts – that includes the data scientists and leadership staff from the FEWSION project. And then it also includes going out to engage additional community members and collect data based on those supply chain systems.

Narrator: Martha Johnson was one of the first cohort of FEWSION citizen scientists.

Marty: So I was part of the food group and a large part of what we did is in-depth interviewing of key stakeholders in our community dealing with food.

It was eye opening when we tried to reach out to chain stores – just how little they were willing to communicate with us. I was looking for them to answer the following questions:

- How much food do the bring in monthly, yearly?
- How much water do they typically use on average?
- How much energy they're using?
- What does their disaster preparedness plan look like?
- Do they have backup generators?

Things like that. It was just difficult to get them to respond – maybe they're just too busy…

So, after we didn't have success reaching out to some of these chain stores, we started reaching out to more local community members that are involved with local food movements – specifically Community Supported Agriculture, Flagstaff Food Link, the City of Flagstaff Sustainability Department, Diablo Trust … those types of organizations. They were able to tell us significantly more… they were just a lot more willing to share information – about how much food their bringing in. And we were at least able to meet with them in person – whereas with some of the bigger stores in town we just spent hours on the phone and they just kept referring us to someone else.

There's growers here – folks that have been growing food here for decades. And that's always impressive too, because its hard! That I think is the most eye opening – how successful folks are here at growing and there's folks that are cattle ranchers here, andfo raise chickens and things like that. That's I think what's most impressive to me. It was an in-depth interview and so we sent the responses to the FEWSION folks.

Sean Ryan: Last Mile data can be relatively difficult to collect on a large scale and it is also more specific to any given community. And so, having citizens with that local knowledge and understanding of what local systems might look like – as well as having citizen volunteers who can contribute a level of work that might not otherwise be achieved by a small group of researchers, is important for this project.

Since that point we've had students that have also engaged in that process, and those student groups have focussed more specifically on the grocery sector of food as well as the potable water sources for this community.

Narrator: Andee Lister, Denise Stoner, Darren Bingham and Valentyn Panchenko are four of those Citizen Science students…

Andee L: I am a citizen scientist working on the food, energy, water nexus specifically focusing on grocery stores in Flagstaff, Arizona. Its interesting. Really just kind of getting into this whole notion of like okay – where does the food come from, where does it go – how is it grown and then where is it taken to.

Denise Stoner: For our small community – we're in a high desert and we can't really grow very much of our food and we rely on other communities to provide it for us.

Darren B: Yeah Coconino County – we don't produce a lot of our food – looking at how food moves is really important when as a place you're very food insecure. I know that Coconino County most of our agriculture is in grazing and pasture raising of cattle. We actually don't consume a lot of that – we actually export that to get fattened in other places and so we just have a lot of range. And so that was interesting to see that majority of our animal export was to LA, New Mexico and then parts of middle of the country where you fatten up the cows.

Denise Stoner: To think that if we had a tragic event that prevented us from receiving our vegetables from Southern Arizona or California and how dependent we are on those systems – shocked me!

Valentyn P: And example from City of Flagstaff for me was surprising that a lot, a lot dependent on LA - Los Angeles area – an in case of for instance earthquake in LA area it will be a shock on the whole city … even If it's a thousand miles from Flagstaff.

Andee L: Prior to this class I was like – oh I'm just going to go to the grocery store and pick up some things. Now I'm just like – wow, I wonder where this broccoli came from – did it come from southern Arizona, did it come from California or Mexico? Where did this broccoli come from? And the same thing with the meat that I eat – chicken turkey, you know where is that coming from. Again – never would've questioned that prior to this class.

----- Segue into Water and Energy…

Sean Ryan: For all of our participants food has been one of the most tangible items that they can relate to and track. So, it's been a great starter. Some components of water and energy can be easy to track down because public utilities have to be very transparent in what they do.

Julia Collier: My name is Julia Collier. I was in the water group – water and energy. I think about energy vampires and the 'End of the World' every day...

Narrator: As one of the first cohort of FEWSION Citizen Scientists, Julia and her group investigated where the City of Flagstaff's water comes from – and the interconnection between local water supplies and energy. They found a lot of information from the 2013 through 2024 City of Flagstaff's Master Plan…

Julia Collier: The city's water system consists of two surface water treatment plants, 24 active wells, 3 concrete storage reservoirs, and 6 steel water storage tanks and 7 pump

stations. The city's primary water supply is a Lake Mary well field, groundwater and surface water from Lake Mary. In 2013 Lake Mary wells provided 20% of the water produced, local wells produced 29%, Upper Lake Mary 18% and Woody Mountain wells 32%.

Over by the 'Edge of the World' near Woody Mountain, the Mogollon Rim ends, there's a big drop off and giant cliffs. And so, out there they are pumping water from wells. So along with water from Lake Mary – that's where Flagstaff's water is coming from.

Narrator: That's why Julia thinks about the 'End of the World' a lot – it's not an apocalyptic scenario … its the name of the place where many of the groundwater wells that supply around a third of Flagstaff's water are located. Once she had found out where her community's water was sourced, she started looking into the energy and dollar costs of delivering that water.

Julia Collier: In the year of 2016 – water, waste water, reclaimed water and storm water annual operating budget was 17.8 million dollars. The total water useage was 93 gallons per capita per day. It took just over 20 million Kilowatt hours to produce and deliver potable water – that's a lot!

So the energy behind getting the water to your house is kind of invisible – when you turn on the tap you just see water, you don't see the whole process behind it.

In 2016 almost 11 million KiloWatt Hours were used to treat the effluent and produce reclaimed water. A lot of energy is used to treat the waste water.

I wasn't very aware of these numbers before being involved with FEWSION. I didn't really think about it. There's something about these big numbers that really hits home. And makes me realize how I contribute to those big numbers.

Narrator: When FEWSION's student citizen scientists started working out how much water they use – they had NO IDEA how much energy and water are intertwined … and how that connection affects their water footprints, says Tosin Ayudeli & Andee Lister…

Tosin A: What surprised me the most was when I had to do my water footprint. I never knew that I used that amount of water in a week. I think it was shocking for me.

Andee L: The single most surprising thing is my daily water useage – and virtual water. This was the first time that I actually heard the term virtual water – all the water that goes into energy, and then producing food and things of that sort. It interesting to make those connections and to really acknowledge that sector. So just to give you an idea of what my daily water useage is – taking into account showering, drinking water and all those other activities I enjoy. It's about 2100 gallons of water a day. I can't even imagine what that looks like over the year.

Narrator: Yes – you heard right. An American's daily combined direct and *virtual* water use can be over 2000 gallons, a day. A DAY!!! Now these numbers can be *complicated* – because it depends on exactly **how** you measure the water.

Direct water is the water you actually see – drink, shower in, do your laundry with and so on. Virtual water – is the water you don't actually physically interact with – but it goes into growing the food you eat – and making the power you use.

And there are two more ways of classifying water – 'blue' and 'green'.

'Blue' water – is physically pumped from surface and groundwater sources – you drink it, shower in it, **and it goes into producing a fair bit of your food, energy and many other products that you use**.

'Green' water is the stuff that comes down naturally as rain and helps to grow the food you eat where crops are grown in climatic regions that don't require irrigation.

FEWSION data shows that the average American uses 426 gallons of water a day – IF you just count 'blue' water. But when you add in the green water as well – then you get a much higher daily per person water footprint – around 2000 gallons a day for the average American.

But it's the blue water that really matters - because that's what depletes our rivers and aquifers if we don't use it sustainably.

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- **Delete them completely**
- **Put them in a separate 'add 'Personal Habits to Lower your Energy and Water Footprints' section at the end of the main podcast.**

Laura Diez: With water useage when it comes to our daily lives we don't really understand how water is arguably our most scarce resource.

Narrator: Laura Diez is not an official FEWSION project Citizen Scientist but as well as just graduating from NAU with a Masters in Climate Science, she hosts her own weekly podcast on sustainability and has some suggestions on how we can take action to reduce personal water use in our daily lives…

Laura D: [And] there are a lot of things in our household that are really guzzling water that we don't always pay attention to. So really basic things that you can see your water useage – is your showerhead, your toilets, sinks, dishwaters, things like that. Even just switching to a low flow showerhead or a low flow toilet can save you half of the amount of water compared to a traditional toilet or showerhead. So a low flow showerhead now is only taking about 2.5 gallons of water per minute that you're showering, whereas a traditional showerhead can take anywhere between 4 and 8 gallons of water and a toilet is pretty similar. So, a low flow toilet takes 1.5 gallons per flush as opposed to the 5-7 gallons of a traditional toilet.

Narrator: A lot of water is used to make power we often take for granted. Why does power generation use water and how much? Thermoelectric power plants use a fuel like coal,

natural gas or nuclear fusion to generate heat, boil water, and make steam which drives turbines that make the electricity. They're thirsty…

It takes one thousand Kilowatt hours of electricity to power 330 homes for an hour – on average. Or one kilowatt hour to power a third of a home for one hour. And the average conventional coal or nuclear power plant uses 9 gallons of water to a generate that 1 kilowatthour of electricity - some coal-fired plants use as much as 56 gallons to make 1 kWh. Exactly how much water's used depends a lot on the cooling system - older plants with once-through cooling using a lot more water than newer plants with closed-cycle systems. Renewable energy sources like hydro, solar and wind typically use a lot less water – sometimes just a fraction of a gallon per kilowatthour. There's a lot of variation – so you can check out a detailed table of water consumption rates for all the different types of US energy generation on this FEWSION webpage if you want.

BUT with 84% of electricity in the US coming from thermoelectric power plants – that's a LOT of water - between 3 and 6 billion gallons a year. In fact well over a third of all the freshwater extracted in the US every year is used to generate our power.

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As well doing obvious – like turning lights off when you're not in a room – its good to clamp down on energy vampires … - and they're in everyone's homes these days, right?

Laura Diez: Yes – energy vampires is the idea that there are products that we leave plugged in to our outlets that are continuously sucking electricity to the grid – even if they're not being productive. A really common one is a coffee maker or a game console. People who leave their X-boxes on sleep mode all day and don't turn them off at night.

Narrator: [And] to find them, at night when all the lights are out – anything around your house that has a little glowing light on it that you can see in the dark – that's likely to be one of these energy vampires in your house.

How do you kill an energy vampire? You unplug it – try having the devices you don't use all the time plugged into a power strip with an on-off switch – to make it easier.

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If you want more tips on how to reduce your 'water footprint' and engage in an all-round more sustainable lifestyle take a listen to Laura's podcast..

Laura Diez: …my podcast is called *EcoChic* - the idea behind Eco Chic is that sustainability should be a good look. A lot of the things that I'm interested in sharing with people … are things that are not necessarily common knowledge – but totally should be. So, I like to talk about things like fast fashion, or the zero waste movement. Things that are trendy and relatable for young adults like myself [, but not necessarily in the realm of sustainability].

Narrator: And you can find the latest episodes of Laura's *Eco Chic* podcast series at www.lauraediez.com]

Narrator: With the FEWSION projects' data portal now on line – anyone can access and query the project's national, state and county level food, energy and water data – to better understand what's going on in their own communities, says education and FEWSION Citizen Science coordinator Sean Ryan…

Sean Ryan: … there've been many moments in this project where I've seen people be able to relate what it is they're doing to larger systems – and that's one of the great things I love to discuss with people. That's been a lot of fun. I would also say that every community and group we've engaged with thus far, not just here in Flagstaff, but certainly elsewhere across the country, has been very interested and sees direct applications in this work. And I think that speaks not only at a community level but also to the individual level – that food, energy and water are critical, they're tangible and they're places where people can connect scientific concepts and build knowledge around something that's very meaningful socially and culturally in their lives as well.

Marty Johnson: There was a lot of conversation about all the different things that are happening in this community with regard to food, energy and water… there was a lot of conversation about how we as individuals can do better.

There's always things you can do, ride your bike more, drive your car less, take shorter showers, eat less meat, composting, recycling. There's power purchase agreements for your utility – if you wanted to offset half of your energy useage with wind, for example, you could go through a company and there's no cost for you. Things like that.

Julia Collier: I make sure to turn off lights in every single room. Try to unplug appliances 'cos they can be 'energy vampires'. Every time I turn on the faucet of my sink when I'm washing dishes, I try to keep it at a trickle, I try to take shorter showers, make sure that my laundry loads are really full so that I'm not wasting water.

… it was really interesting to find out all of the unanswered questions that are out there. That was also pretty shocking of just … we don't have the answers to these questions. The Last Mile of consumptions of FEWs – we really have very limited data on that. And that's kind of the most important part. And so, learning about all the things that we don't know is very inspiring because it shows that there's a lot of potential to contribute to improvement.

These things that I'm doing at home – everyone can do this, they all compound. Kind of like voting. When you think that your vote doesn't count – it does! I kinda see the same thing with these resources, is that if everyone is cutting back their use and being aware of how much they're contributing to these huge numbers – then we can slowly bring those numbers down.

Narrator: In fact - personal action is *better* than voting – because when we use resources more wisely … we're all voting for the same candidate … the environment, its resources and our sustainable future – they win every time.

Sean Ryan hopes that the FEWSION project will be a resource to help Citizen Scientists well beyond the test community of Flagstaff…

Sean Ryan: Our vision is that it will be possible for anybody in the US to participate. And we certainly have had now several representatives from different universities, organizations and other communities contact us or start becoming involved in the process. However, at the level of detail that we've done, Flagstaff has been a pilot community and our goal is to really refine the process so that it could be scalable and other communities could learn from what it is that we're able to do here.

Narrator: If you're interested in finding out more about the educational opportunities with this project, then please email: fewsion@nau.edu

Outro

Narrator: In the next Episode of Crucial FEWSION we're going to be examining one of the best ways you can reduce your all-round personal resource consumption. By looking at what we eat … and in particular – the role of beef. We'll be talking with FEWSION project researcher Brian Richter – who's been a global leader in water science and conservation for over 30 years.

So listen up for Episode 5 of Crucial FEWSION – for some answers to the question:
'Is My Burger Killing A River?

Narrator: Thanks to contributors Andee Lister, Darren Bingham, Denise Stoner, Tosin Ayudeli, Valentyn Panchencho, [Laura Diez??] Julia Collier, Martha Johnson … for taking part in this episode of Crucial FEWSION.

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