



Minutes – Friday, February 28, 2025
Video Conference
9 am to 11 am

Attending: Brian Eden, Dan Lamb, Chengxuan Li, Timor Dugan, Dave Bradley, Dawn Montanye, Gerri Wiley, Guillermo Metz, Hailley Delisle, Hung Ming Tseng, Inger Aaberg, Ingrid Zabel, Janelle Bourgeois, Laura Vineyard, Marie McRae, Nick Goldsmith, Paul Moore, Peter Hinkley, Michael, Ray Burger, Rod Howe, Sheila Out, Susan Harris, Susan Riley, Terry Carroll, Tom Hirasuna, David Kay, Evan Kurth, Rebecca Evans, Savannah Vega, Peter Bardaglio

Digital Twinning & Energy Planning – Timur Dogan and Team

Timur Dogan is associate professor in the Department of Architecture and director of the Environmental Systems Lab at Cornell University. Timur and his team at the lab have developed digital building modeling tools to help the City of Ithaca plan for building electrification. They demonstrated these tools and explained how they use them to quantify the energy consumption and carbon footprint of buildings.

- Timur introduced his team of grad students who work with him on the project – two of them attended the presentation, Chengxuan Li and Hung Ming Tseng
- What unites all the members of the team, despite their diverse backgrounds, is commitment to decarbonizing buildings
- Must eliminate all CO₂ emissions from the built environment by 2040 to meet 1.5°C climate targets
- Almost 30% of global emissions are from building operations: heating, cooling, lighting, etc.
- Construction is responsible for 10% and transportation (light vehicles) accounts for another 14%
- UN projects that we'll double our building floor area by 2060 as 2 billion new urban dwellers are added
- Huge opportunity to decarbonize our build environment and create sustainable urban areas
- When City of Ithaca launched Green New Deal and reached out to us, we were excited about opportunity to see how they could use some of tools they'd been developing
- Transportation, energy supply, and buildings were all areas they were interested in
- Started with question of creating digital replica of city – gather all publicly available information they could to create models and then test for accuracy and try out different ideas before even thinking about developing policies
- Mapped out different building uses and looked at city permit data going back to 1963
- Insulation upgrades increased rapidly in 1980s with first oil crisis, then furnace upgrades in 2010 and after, followed by installation of photovoltaics more recently
- Taking and synthesizing all of data has been biggest chunk of work so far

- Use data to create 3-D volumes of buildings
- Interested in understanding physical properties of buildings – what are they made out of, are the walls insulated or not, do they have brick or timber façade, etc.
- How is building used, how many people are in building, what kind of appliances are they running?
- Draw on information from DOE national labs that have been surveying country on energy usage patterns and how they unfold over time
- Then consolidate all that information in energy model – worked on developing 5,000 different energy models for city
- One of big challenges is workflows are designed for very large cities where most of buildings are big boxes – not case for Ithaca, obviously
- Big goal was to get better at geometry of buildings in Ithaca – also to take into account vegetation and its impact on building energy use --- big headache for energy modelers
- Decided to fly drone over city with high resolution camera that allowed them to reconstruct building geometry very accurately, better than what they could do with traditional GIS data
- Especially interested in how building facades are designed – how many windows and how are they oriented?
- Use machine learning to capture details with great accuracy to create detailed model of city
- Looked at determining photovoltaic potential of rooftops in city, generating radiation maps for each building – can tell with one foot accuracy where best sites are for rooftop solar and what sites to avoid
- Combining high performance areas with moderate areas, determined that city could come close to net zero with rooftop solar – other options include largescale solar on land just outside city, hydropower potential, and using areas such as parking lots in city for solar
- How would solar potential match up with energy needs of fully electrified building? Some buildings, of course, wouldn't work – would need to participate in community solar outside city to help balance out unequal access to solar resource
- Have created unique energy model for every building in city
- Avangrid share dataset of billed data that allowed group to test accuracy of models and validate them
- Showed they were slightly overpredicting both demand for electricity and gas – able to make adjustments that resulted in almost perfect match
- Demonstrates that modeling they've been doing is pretty useful for testing various scenarios
- For example, lots of buildings in city have envelope issues where air tightness could be improved – insulation improvements and dealing with thermal bridges
- Timor showed example of fully electrified building in Frankfurt, his hometown – heavily insulated to reduce demand, solar integrated into façade and roof of building, high efficiency electric appliances, and energy storage in basement
- Estimated baseline energy consumption in Ithaca is about 450 GWh per year – most of it is heating demand

- Swapping out gas usage for decently efficient electrification could bring demand down to 285 – if only proper insulation provided for every building to bring it up to code, it would drop to 248 – combining the two would reduce it to 174
- Hope this kind of data could be used in city to help develop appropriate policies
- Electrification is very effective in eliminating GHG emissions – alone it can reduce CO2e emissions by 70% – much more effective than with envelope upgrades alone
- One of big drivers for homeowners is cost so we have to develop understanding of cost – actually quite challenging because there are not good data sources for cost
- Using an NREL database from 2018 so prices outdated – but helpful to get sense of order of magnitude – comparisons may hold true if not total numbers
- Ithaca currently spends \$30M annually on fuel for buildings – that's baseline
- Going to pay more for electrification compared to gas – something like \$42M a year for city – upgrading envelopes could bring that cost down to about \$18M – combining electrification, envelope upgrades, and onsite solar could bring annual costs down to \$3M
- Significant upfront costs, however, to carry out these improvements – envelope upgrades, in particular, are quite costly
- Electrification alone doesn't provide any opportunity to recoup costs – but combined with envelope upgrades and onsite solar can achieve 12 year ROI at least with some buildings
- Looks like commercial buildings are where you can biggest bang for the buck – when you take available incentives into account, low income, multi-residential housing comes to forefront
- With digital twinning, can pull out individual buildings and assess which ones make most sense to start with from financial perspective as well as impact on GHG emissions
- Timor and his team have mapped this all out for city and spent lot of time putting together user interface that's easy to use to explore data – not public facing right now – only city and county sustainability offices have access
- Have developed similar tool for utilities to help them better understand what happens to grid with electrification
- Going forward want to look at ways to make envelope retrofits cheaper – looking at ways prefabricated envelope upgrades are being used in Europe and how that approach can be used in Ithaca
- Also collaborating with KMPG on developing digital twin modeling focused on flooding – also interested in traffic modeling
- Another area of interest involves microclimate and heat mitigation – working on creation of simulation tools that can be brought into digital twin as another layer
- In addition, developed software for tracking mobility patterns in city – which streets have most traffic and where are people when, etc.

Q&A

- Peter: Especially interested in 3-D modeling with vegetation included – how accurate is depiction of vegetation?
- Timor: Based on 2020 survey – full digital twin would include feedback loop that involves continuous scanning of city and continuous input of data from city
- Peter: Do you actually own and operate yourself drone(s) you use to scan city?
- Timor: Scanning is carried out with affordable consumer drone

- Peter asked Rebecca Evans how she and Timor first crossed paths – relationship between Environmental Systems Lab and city began when Luis was sustainability director and it's continued with Rebecca
- Timor: Really kind of a coincidence in sense we met just as we were getting underway with exploration of energy systems at urban scale – really helpful to get real world feedback from city based on issues they are addressing
- David Kay: Really impressed with how much work has gone into development of digital twin – data seems to indicate that working at larger scale for example with grid makes most sense – what do you think about solar farms outside city as an approach to decarbonization – also at county scale how can this work be used to explore different growth scenarios for population and to address issues such as urban sprawl?
- Timor: Did not include utility costs involving grid capacity as electrification takes place – but one of innovation potentials involved with looking at things on urban scale is ability to identify synergies that you might otherwise overlook
- Just beginning to scratch surface of how to make decarbonization more cost effective by looking at how to carry it out at urban scale not just on individual building by building basis – in discussions with Avangrid about how to collaborate on this approach
- Very excited about potential of digital twin to better understand different mobility and densification scenarios – where, for example, electric buses or on-demand shuttles to help shorten commuter times
- We have lots of data but sometimes hardest nut to crack involves question of how should we be looking at data
- Dawn Montanye: In our outreach at Cooperative Extension, we work with homeowners to help them take advantage of incentives for electrification, heat pumps, etc. – our community energy advisors often work with low-income and marginalized communities
- We are primarily response-oriented but your model could help us be more pro-active in our outreach – could also help us in our data gathering to see what kind of changes are taking place – perhaps we could take a community-wide or neighborhood approach as you are suggesting
- Research is very exciting and could be helpful in work we are currently doing
- Timor: We would love to share data with you and see how you use it – it would give us a chance to see how spot on we were and to do a before and after as you engage with communities
- Laura Vineyard: Our group at Center for Community Transportation would love to have better grip on where private and public EV chargers are located and to what extent they are available – we have two NYSERDA grants seeking to build more EV infrastructure
- Have you done any work looking into general layout of where EV chargers currently exist?
- Timor: We haven't really worked in depth on this issue but would be interested in using the simulation platform to optimize placement of chargers and to determine where there aren't enough EV chargers and how much more might be needed
- Susan Harris: Our NYS public health organization works with health consequences of climate change – Susan noted that they are having their annual conference in Ithaca this year – she went on to share the details of her organization and upcoming

conference – pointed out discrepancy between our premier climate law but don't have education at K-12 level to match it – we've kicked can down road and now it's for them to deal with climate change

- Timor: We do need to engage with younger generation and get them excited about our work with technology that can help create a more sustainable environment
- We're very interested in incorporating public health as a layer in our model – cited example of extreme heat and its impact on health – also what happens in winter if power goes out, and in both seasons what happens if there are unexpected peak loads that put significant stress on grid
- We're very interested in adding any layer we can add to digital twin that will help city make better decisions

2025 TCCPI Priorities – All

TCCPI priorities for last year included advocating for state climate and clean energy policies, strengthening climate resilience, and supporting the Ithaca Green New Deal. A lot has changed over the last 12 months. The group discussed how these changes should shape the coming year in terms of topics we talk about going forward.

- Peter: Especially important in context of a federal government that's jettisoning whole concept of climate change, never mind addressing challenges and coming up with solutions to them
- We talked last year about importance of advocating for state climate and clean energy policies – we're going to continue that this year and hopefully bring in people who can help us understand what policies are and what they need to be, and why they're important – so that's one priority for this year
- What are other topics that people would like to see discussed this year?
- David Kay: I'm especially interested in thinking about how to talk with people you don't agree with and people who don't agree with you, people who are on other side or in middle, particularly at county level
- Where is the moveable middle and how do we reach out to them?
- Peter asked David to say a little more about the idea of the moveable middle
- David: We know from surveys at Yale and elsewhere that there is now a very small percentage of people who don't believe in climate change at all, but there is a huge proportion that doesn't prioritize the issue – how do we bring them into conversation?
- Peter: There's important work going on about how to get people who have different perspectives on climate change to talk with each other
- One of the folks who has done a lot of thinking about this issue is Katharine Hayhoe – she's now chief scientist at Nature Conservancy and who also teaches at Texas Tech – she comes from a strong religious background and has the ability to talk with people who aren't normally part of climate change conversations
- I'd really like to get her to talk with us – I'll reach out to her and see what I can do
- Ingrid Zabel: I'm on the Tompkins County Environmental Management Council – we've been talking about the need for us to connect more with County Legislature – we can't assume that they understand what's happening with climate
- Also looks like 5 of current legislators won't be seeking re-election – means new people will be coming in

- What can EMC and TCCPI do to connect better with County Legislature and inform them about climate issues? Invite some of them to come to one of our meetings? Plan some special event?
- Peter: Great idea – maybe we could invite 4 or 5 of them to meet with us to talk about what they see as their role when it comes to issues regarding climate crisis?
- Peter invited Ingrid to update group about financial crisis at PRI – Ingrid said PRI has been very open about what’s happening and there’s been coverage in local and national press about it – as result, tremendous outpouring of support, both large & small – very heartening
- We have very active program on climate change that’s continuing – we feel it’s an important part of what we do
- Peter explained in more detail that a major commitment from an anonymous donor has fallen through and it’s left PRI scrambling to respond to crisis – lot of planning for future rested on that commitment being fulfilled – now have to figure out how to reshape PRI taking into account this new reality
- Rebecca Evans: I’ve been looking into the reasons for fascism and why it’s been particularly successful now, in contrast to progressivism and climate movement
- Left has spent too much time policing its ranks instead of building coalitions and seeking unity
- Do we really want to keep having debates about whether the correct term is “climate change” or “global warming,” for example? Or should we be talking more about our hopeful vision for future and what can happen if we are successful?
- David Kay: My basic rule for community development is you have to start with what people care about the most and then think about how you connect what you want to talk about with what they care about
- Peter: There’s a lot of scary stuff going on right now but there are also real opportunities opening up because of the overreach on the part of the far right, to point out bankruptcy of authoritarian impulse
- Susan Harris: We could do a better job analyzing approaches to communication, exploring what strategies and techniques fascism deploys that have attracted attention and support, and maybe we can learn some lessons from that analysis
- Our conversations inside climate movement have not really resonated far and wide
- Peter: One of ways that’s been particularly effective in conveying seriousness of threat posed by climate change is to frame it in terms of public health – Peter suggested that he and Susan should think about who we could have come to TCCPI to discuss ways in which public health folks in NY are finding ways to talk about climate change that do resonate