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Climate Innovation: Digital Technology for Sustainable Agriculture and Infrastructure Development

Rishee Jain Stanford University David Farnham ClimateAi

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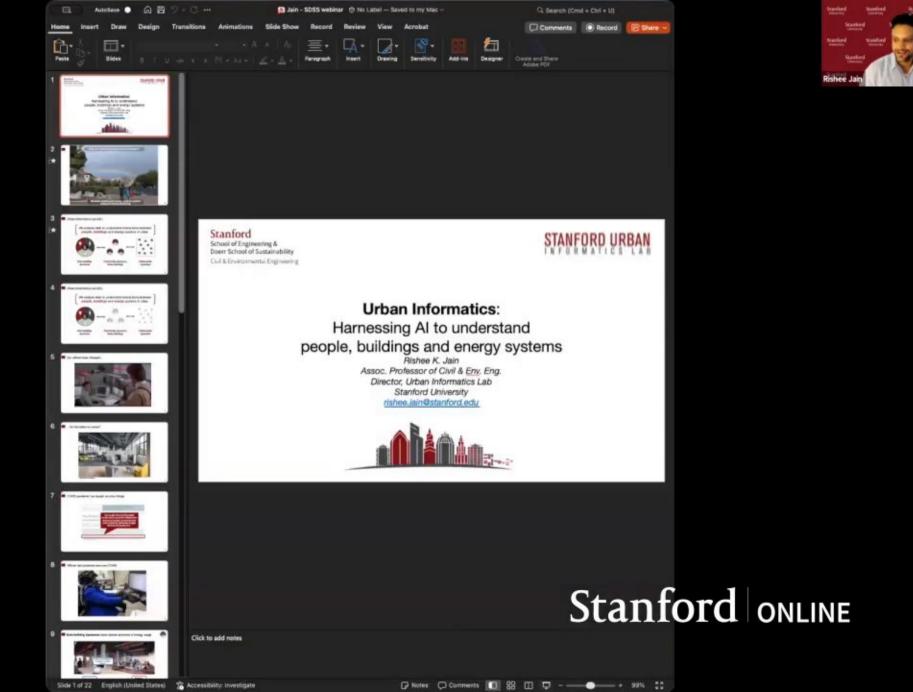












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School of Engineering & Doerr School of Sustainability

Civil & Environmental Engineering



Urban Informatics:

Harnessing AI to understand people, buildings and energy systems

Rishee K. Jain
Assoc. Professor of Civil & Env. Eng.
Director, Urban Informatics Lab
Stanford University
rishee.jain@stanford.edu







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Urban Informatics Lab (UIL)

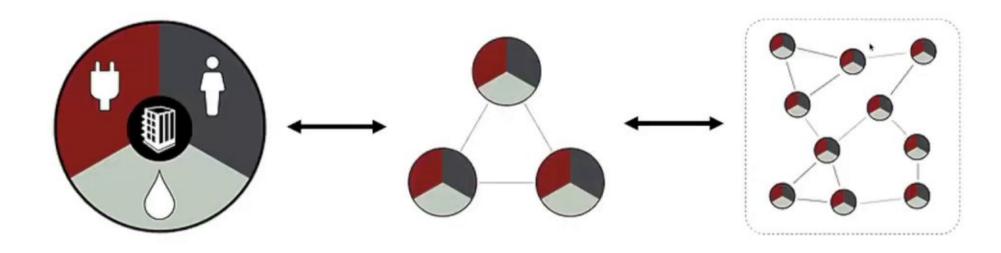


We analyze data to understand interactions between **people**, **buildings** and **energy** systems in cities.

Urban Informatics Lab (UIL)



We analyze data to understand interactions between **people**, **buildings** and **energy** systems in cities.



Intra-building dynamics

Community dynamics (inter-building)

Urban-scale dynamics

Our offices have changed...





Image source: Office Space (1999), Judgmental Films

...for the better or worse?



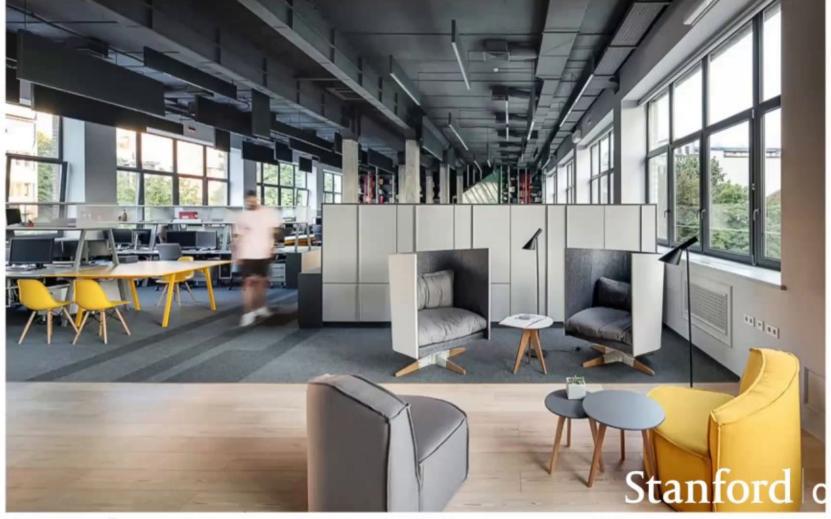


Image source: Formaspace

COVID pandemic has taught us a few things



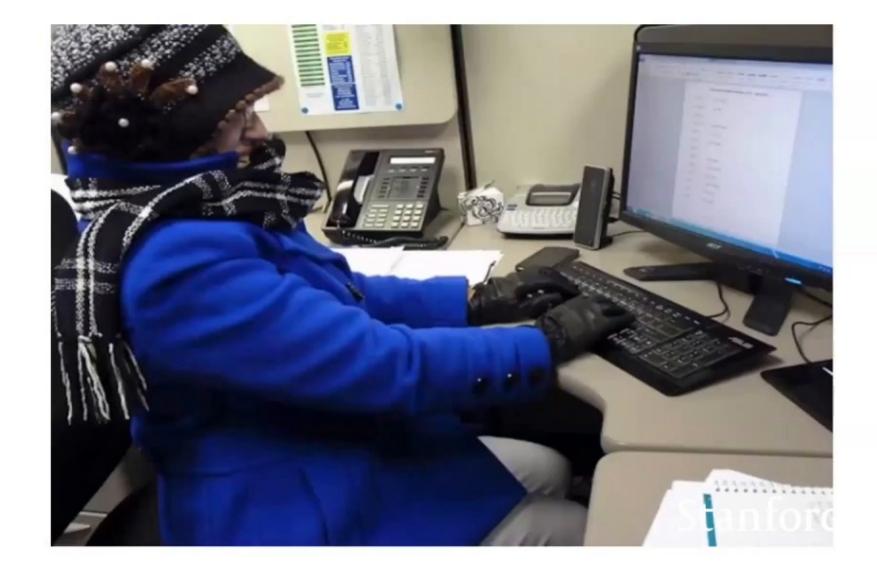
human behaviour

The effects of r among informa

Our results show that firm-wide remote work caused the collaboration network of workers to become more static and siloed, with fewer bridges between disparate parts.

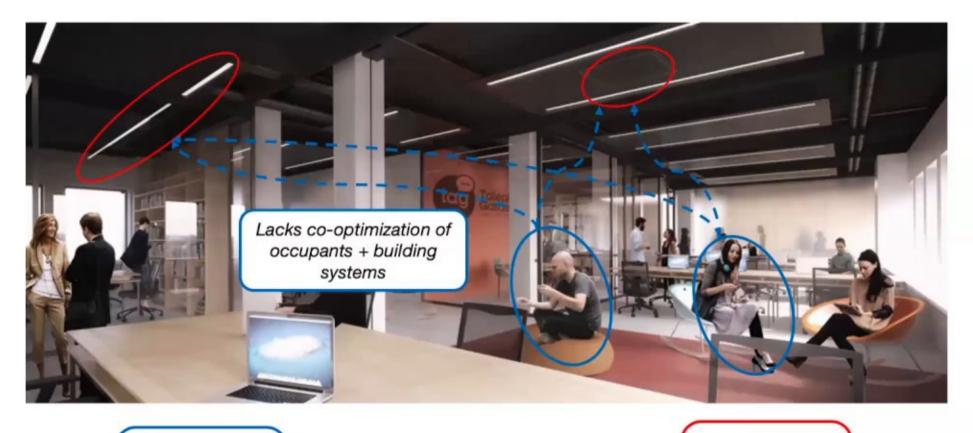
Offices had problems even pre-COVID





Intra-building dynamics: socio-spatial dynamics of energy usage





Occupants

- Space
- Time
- Social/Org

Data-driven optimization + design

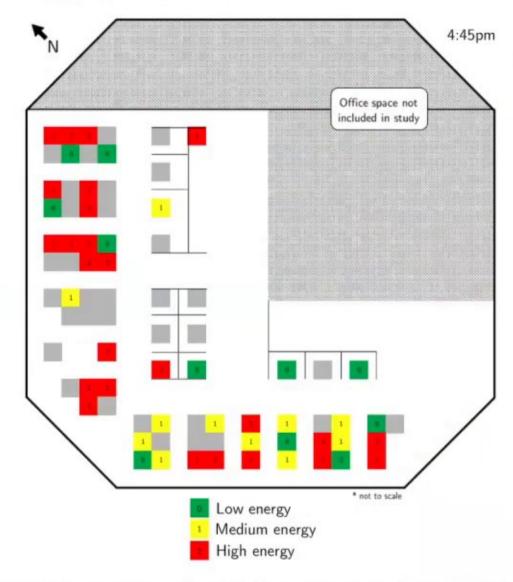
Building systems

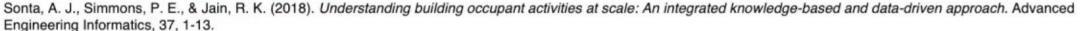
- Space
- Time

Privacy-aware occupant state inference



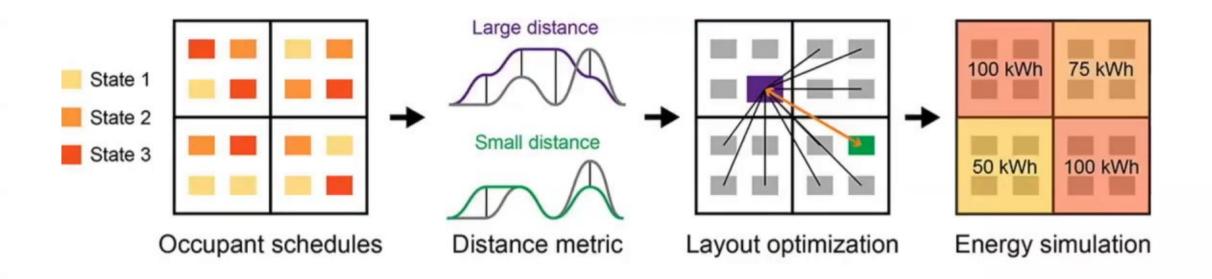
Activity States Visualized (Real office in San Francisco)





Occupant layout optimization: application to lighting systems





Low-cost dynamic design solution results in 5% energy savings for 150+ person lighting system

Beyond energy: opportunities for social interactions

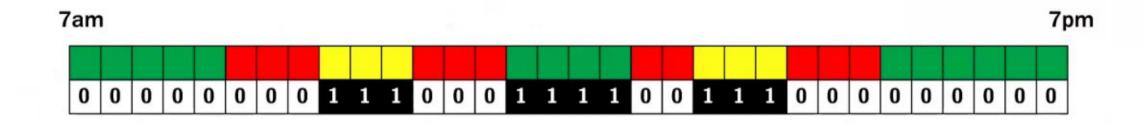




- Low energy
 - Medium energy
- High energy

Beyond energy: opportunities for social interactions



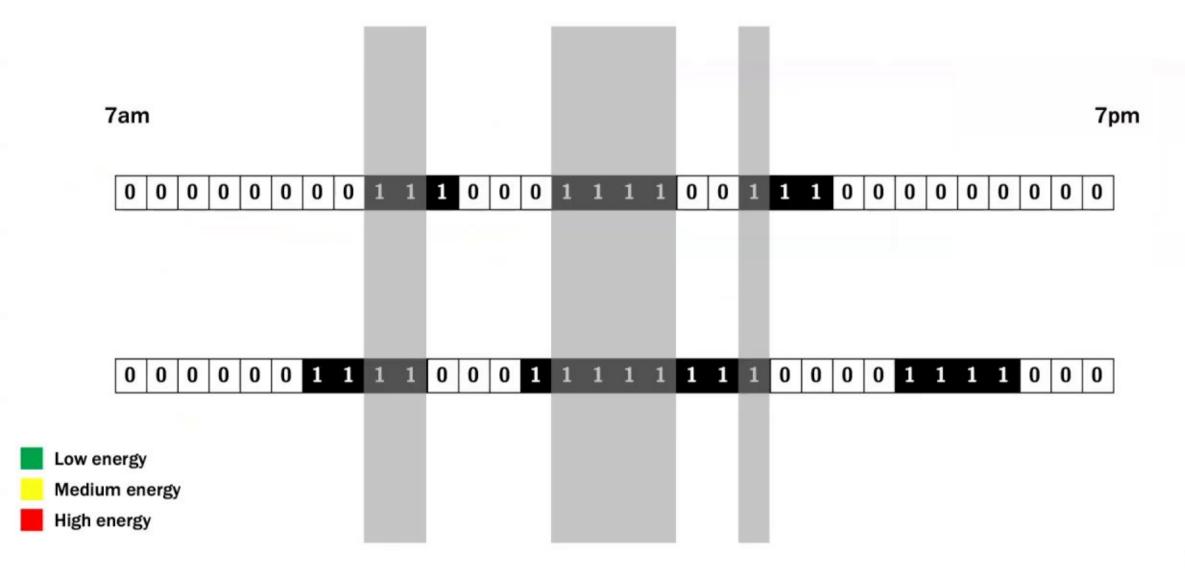




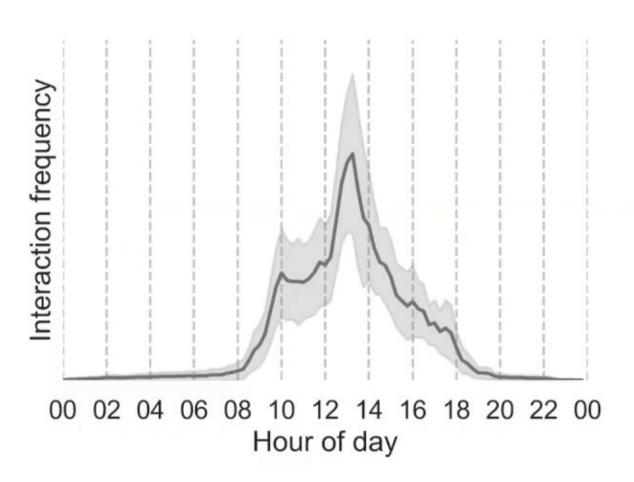
- Low energy
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- High energy

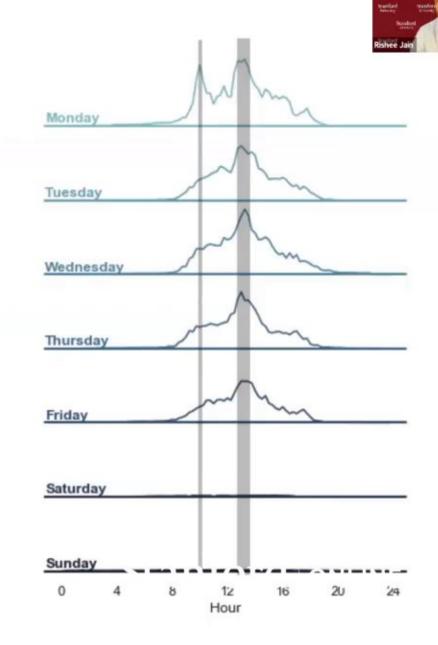
Beyond energy: opportunities for social interactions





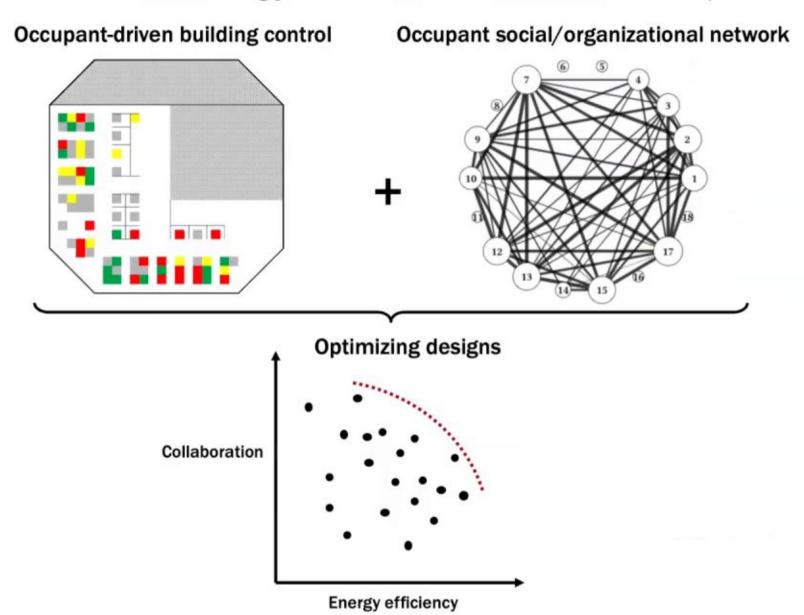
When do interactions occur?





Future vision: towards energy efficient and collaborative spaces





Phi-GPT: Foundational GenAl model for modeling operations of faci

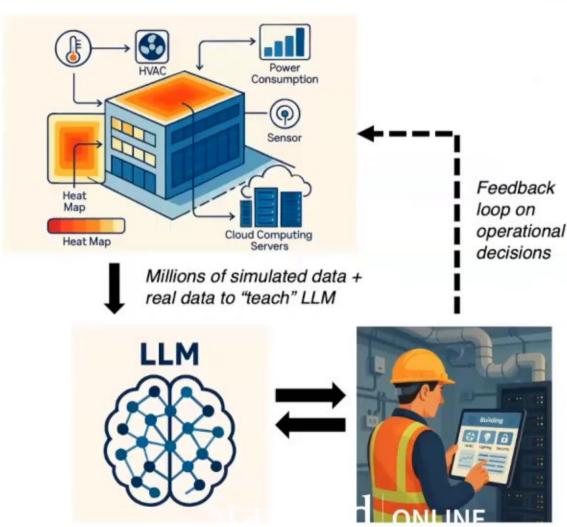


Challenge: Need to make multidimensional decisions on facility operations (cooling, energy usage, worker movement)

Problem: Traditional process models are too onerous; data-driven models need lots of data + bad at out of sample predictions + hallucinations

Approach: "Teach ChatGPT building physics and other first-principles"

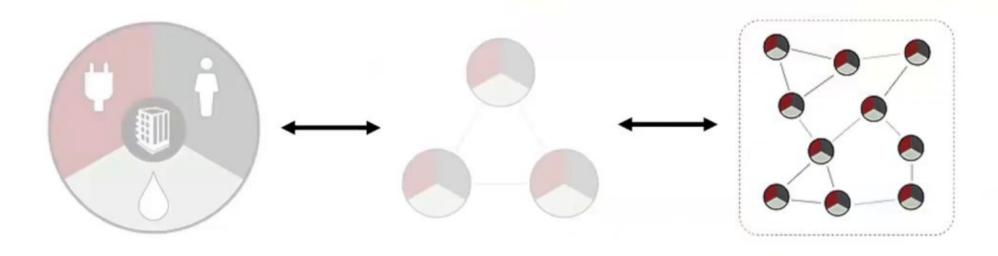
Potential Impact: Enable near-real time model informed decision making on data center operations



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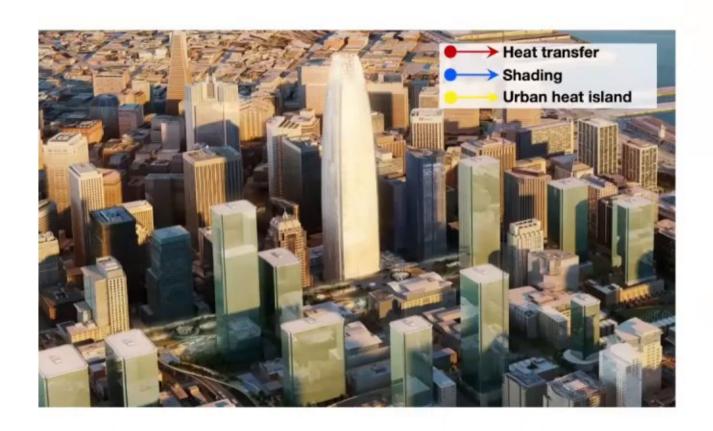
Intra-building dynamics

Community dynamics (inter-building)

Urban-scale dynamics

Data-driven Urban Energy (**DUE**) – Simulation (**-S**), Benchmarking (**-** Analytics (**-A**)





^{1 -} Nutkiewicz, A., Yang, Z., & Jain, R. K. (2018). Data-driven Urban Energy Simulation (DUE-S). Applied Energy, 225, 1176-1189.

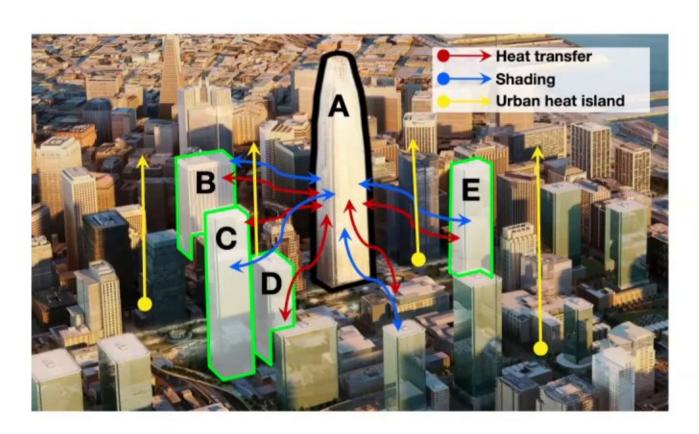
²⁻ Nutkiewicz, A., Chol, B., & Jain, R. K. (2021). Exploring the influence of urban context on building energy retrofit performance. Advances in Applied Energy

³⁻ Yang, Z., Roth, J., & Jain, R. K. (2017). DUE-B: Data-driven Urban Energy Benchmarking of Buildings... Energy and Buildings, 163, 58-69.

^{4 -} Shivaram, R., Yang, Z., & Jain, R. K. (2021). Context-aware Urban Energy Analytics (CUE-A)... Sustainable Cities and Society, 102978.

Data-driven Urban Energy (**DUE**) – Simulation (**-S**), Benchmarking (**-**Analytics (**-A**)





Designer/Owner: What is the energy impact of design changes/retrofits given the urban context?

DUE-S^{1,2}: Al + Physics

Policy-maker: Which buildings do we target for what type of retrofits?

DUE-B3:





Physics

^{1 -} Nutkiewicz, A., Yang, Z., & Jain, R. K. (2018), Data-driven Urban Energy Simulation (DUE-S). Applied Energy, 225, 1176-1189.

²⁻ Nutkiewicz, A., Choi, B., & Jain, R. K. (2021). Exploring the influence of urban context on building energy retrofit performance. Advances in Applied Energy

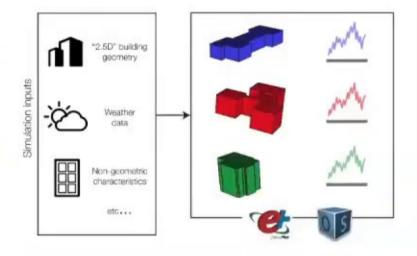
³⁻ Yang, Z., Roth, J., & Jain, R. K. (2017). DUE-B: Data-driven Urban Energy Benchmarking of Buildings... Energy and Buildings, 163, 58-69.

^{4 -} Shivaram, R., Yang, Z., & Jain, R. K. (2021). Context-aware Urban Energy Analytics (CUE-A)... Sustainable Cities and Society, 102978.

Data-driven Urban Energy – Simulation (DUE-S) Framework

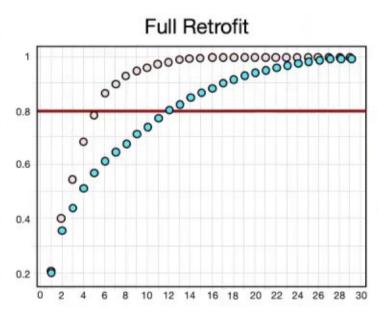


(1) Create baseline energy simulations



Results: DUE-S reduces number of buildings needed to achieve 80 possible urban electricity savings





Number of Retrofitted Buildings

Data-driven Urban Energy Simulation (DUE-S): Key results





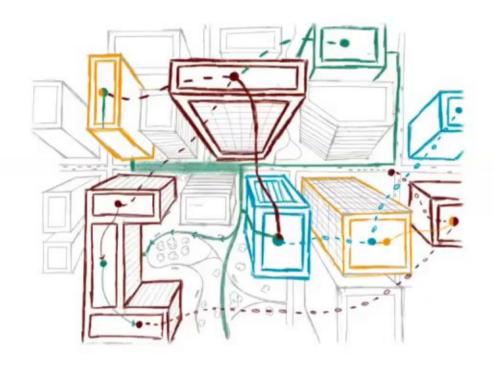
Integrates AI + physics for urban scale building energy modeling (with context)



Inform retrofit targeting to reduce required buildings by 50%

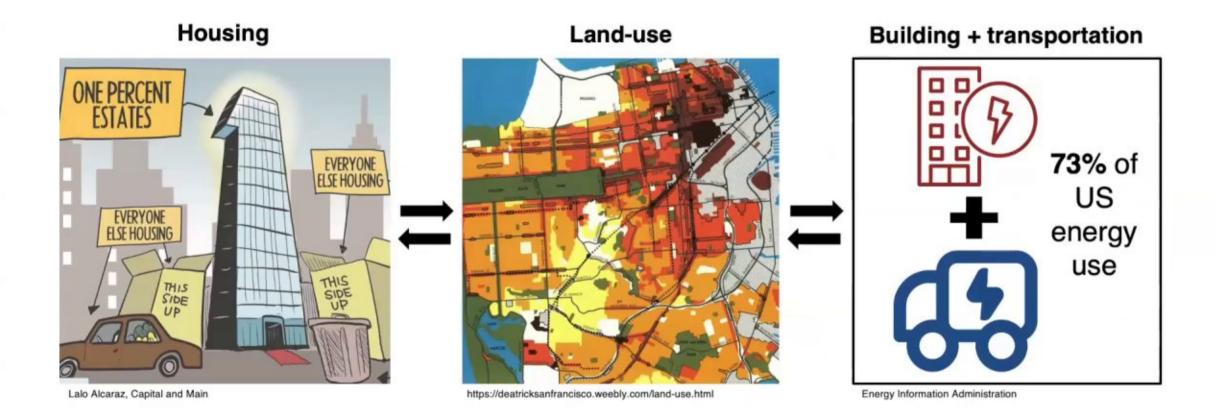


Opens pathways for large-scale system synergies (renewable energy, transport)



Future vision: affordable housing, land-use and energy sustainabilit intertwined challenges







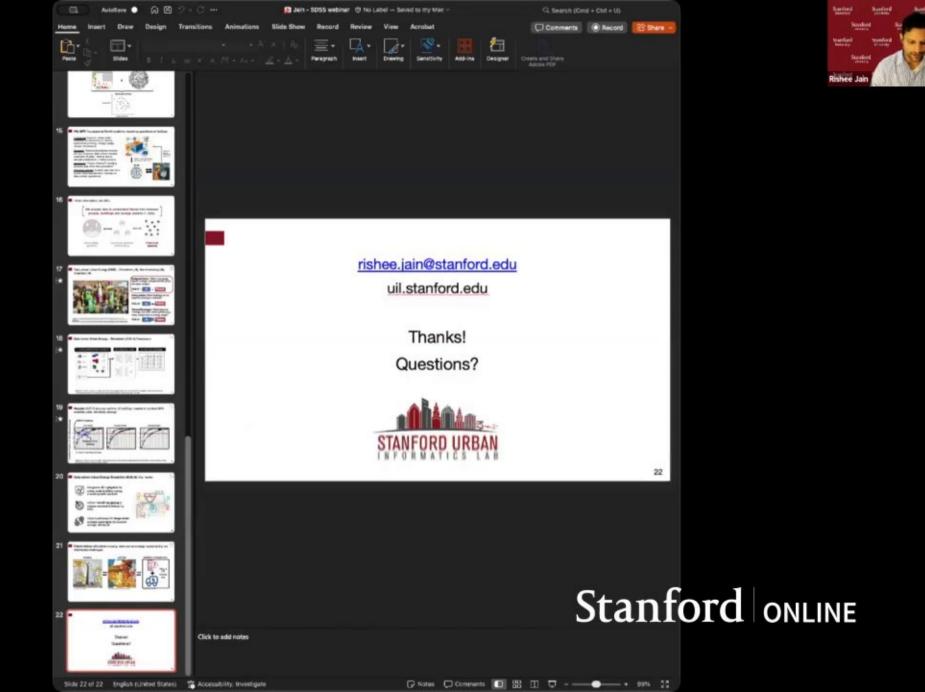
rishee.jain@stanford.edu

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Thanks!

Questions?



























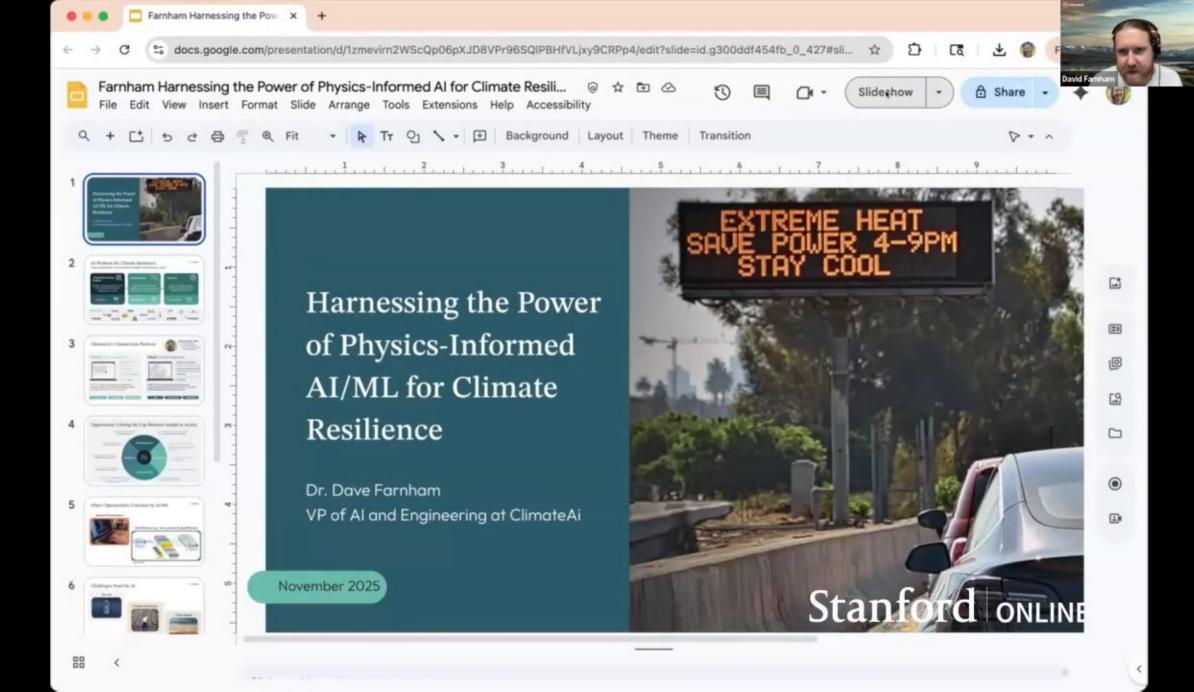














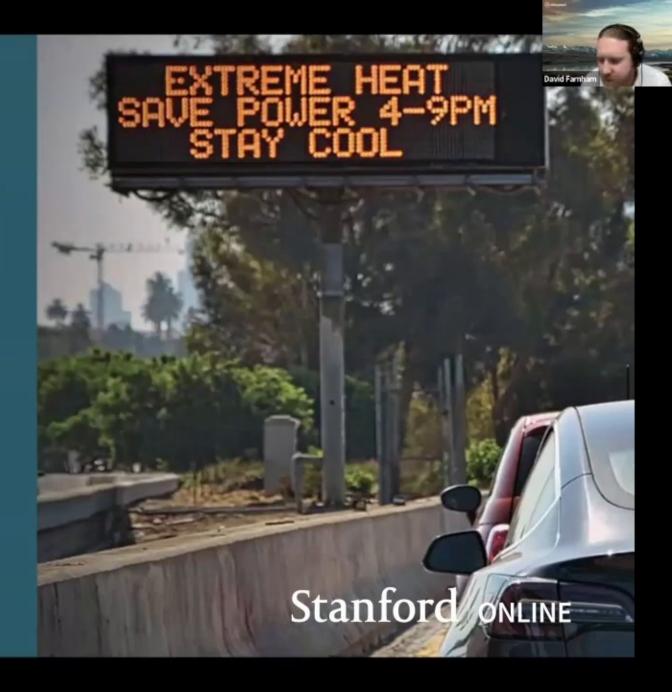
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Harnessing the Power of Physics-Informed AI/ML for Climate Resilience

Dr. Dave Farnham

VP of Al and Engineering at ClimateAi



November 2025

AI Platform for Climate Resilience

C David Famili

Linking weather and climate insights to business value

ClimateAi Forecast **Engines**



Weather, seasonal, and long-term technology developed and patented over 7 years

Global

Impact Models



+

Calibrated risk thresholds translate accurate forecasts into business value for top companies

HITACHI

Validated

Al Driven



Agentic workflows connect customer data and ClimateAi insights to drive action

Powerful

10+

SUNTORY

















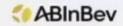














ClimateAi's ClimateLens Platform



Dave Farnhan

VP of Al and Engineering

 15+ years modeling climate & weather risks to critical infrastructure

Monitor (Seasonal Forecast)



CROP OUTLOOKS

GDD TRACKING

AI AGRONOMY AGENTS

PEST & DISEASE

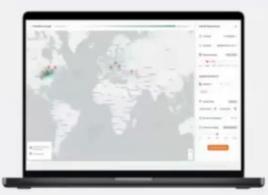
MONITOR day-to-day operations and seasonal production plans to minimize risk of extreme weather. Available via platform or API integration.

Sourcing

Production

Sales/Marketing

Adapt (Climate Projections)



CHRONIC & ACUTE RISKS

NOVEL LOCATION DISCOVERY

WATER RISK

TCFD/CSRD

ADAPT to future climates by identifying risks and opportunities related to key business metrics: crop yields, water availability, and other business drivers.

R&D



Opportunity: Closing the Gap Between Insight & Action

"I need to translate forecasts "We don't need more weather; we need to know what it means for volumes." into business impact" "We need more reliable INTERPRETABILITY "I need a standardized way of custom dashboards" working across teams so we can move faster and make consistent decisions." "We need information that plugs **FLEXIBILITY** straight into our workflow" **ACTIONABILITY** "Real advice as if I cloned my best agronomist. "One step further than Excel, No extra tabs, just answers." "Faster and with fewer hand-offs." COMMUNICATION "Something like: Watch out, hot weather "An early warning system -or heavy rains are coming-please an email or SMS to growers" protect your crop."

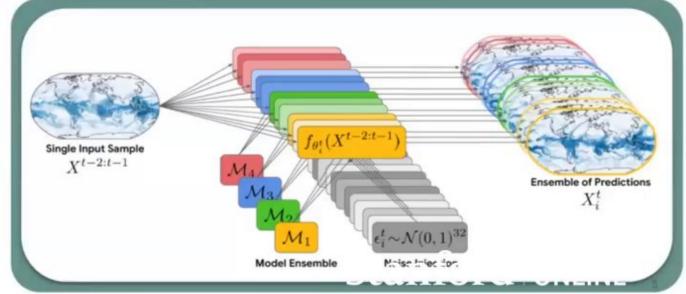


Other Opportunities Unlocked by AI/ML

Speed of Development



Fast Inference (e.g., more uncertainty quantification)



Alet et al. 2025



Challenges Posed by AI





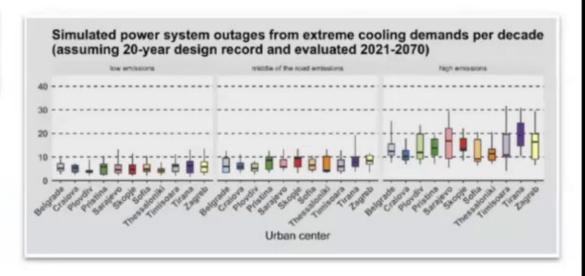


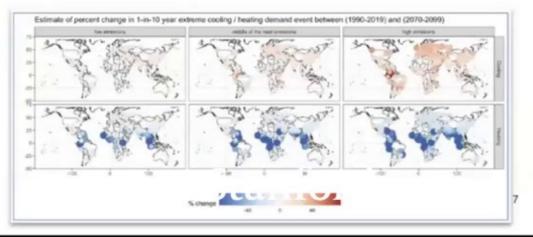


Extreme Heat, Grid Reliability, and Economic Costs

Goal: Anticipating investment needs to ensure reliable power systems in the face of climate change and rising extreme cooling energy demands







Hitachi Leverages ClimateAi's Cyclone Forecasts



Use Case

Power Internal Models

Supply Chain Risk



ClimateAi Enables Global Supply Chain Risk Model for Hitachi

Discover how Hitschi usus ClimateA/s platform to anticipate extreme weather risks and saleguard its global supply chain.

directo, ad

API data empowers Hitachi to monitor climate risks at supplier locations worldwide, months in advance.

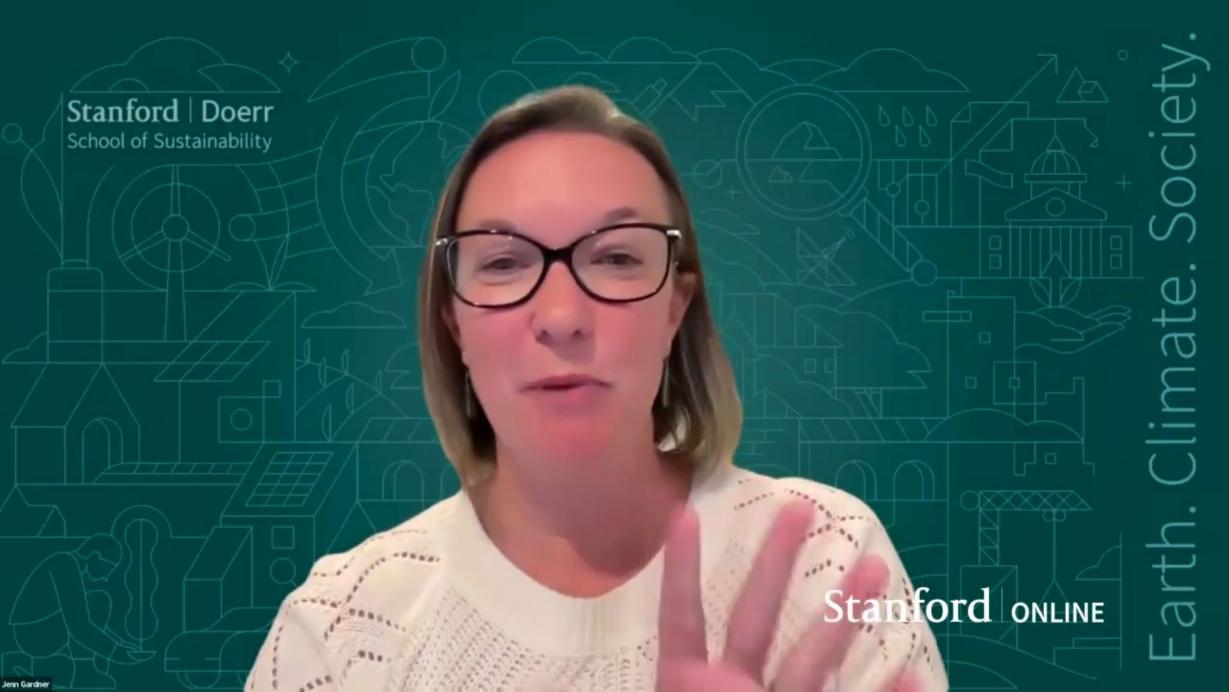
Hitachi ingests weather forecasts & seasonal cyclone forecasts that extend up to six months into the future and have an impressive 1-kilometer resolution on a global scale.

"ClimateAi's weather forecast data is potentially a game-changer for Hitachi."



































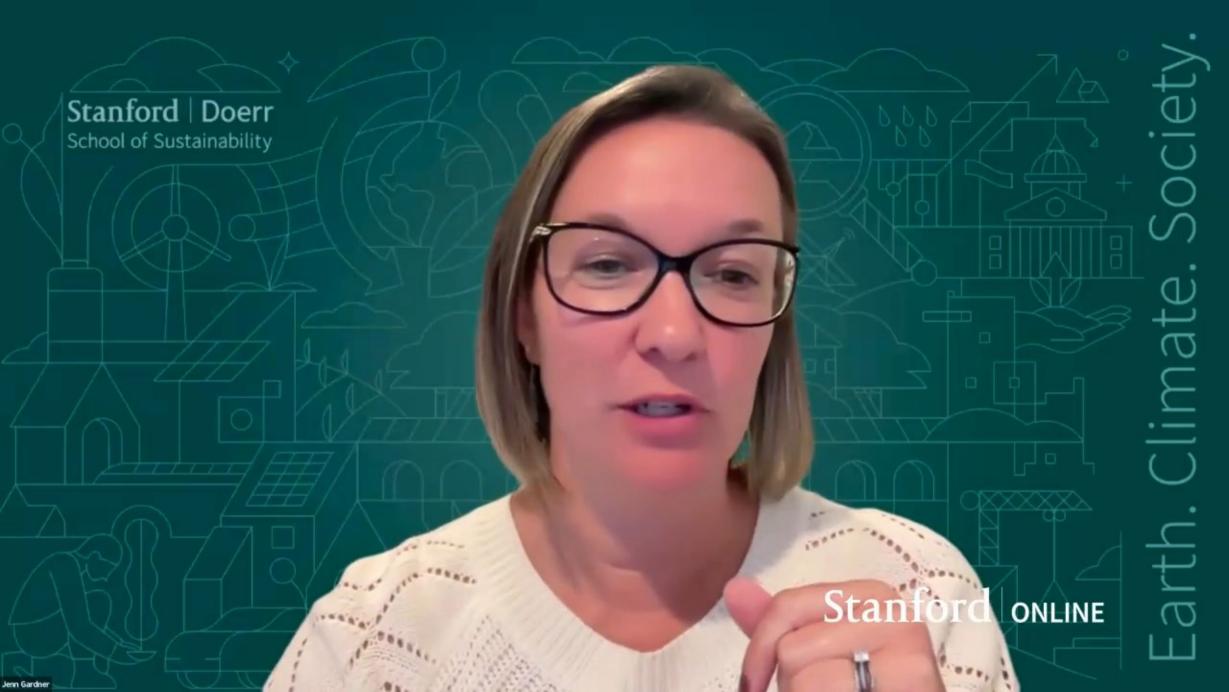
















































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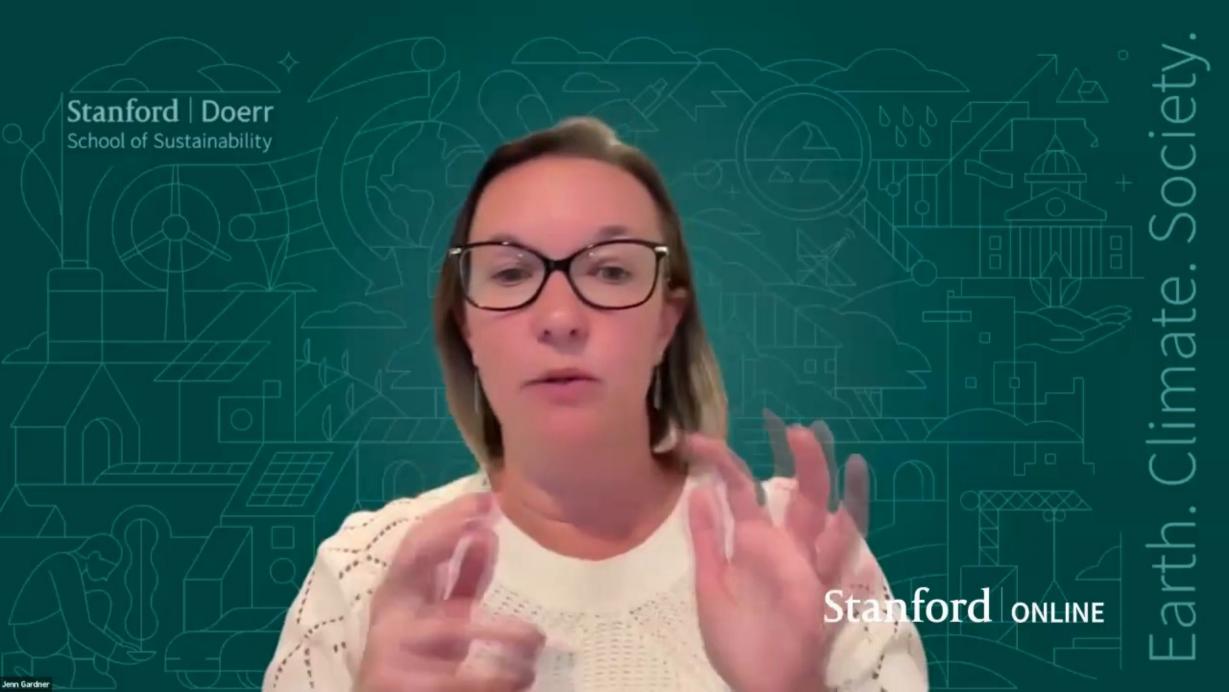




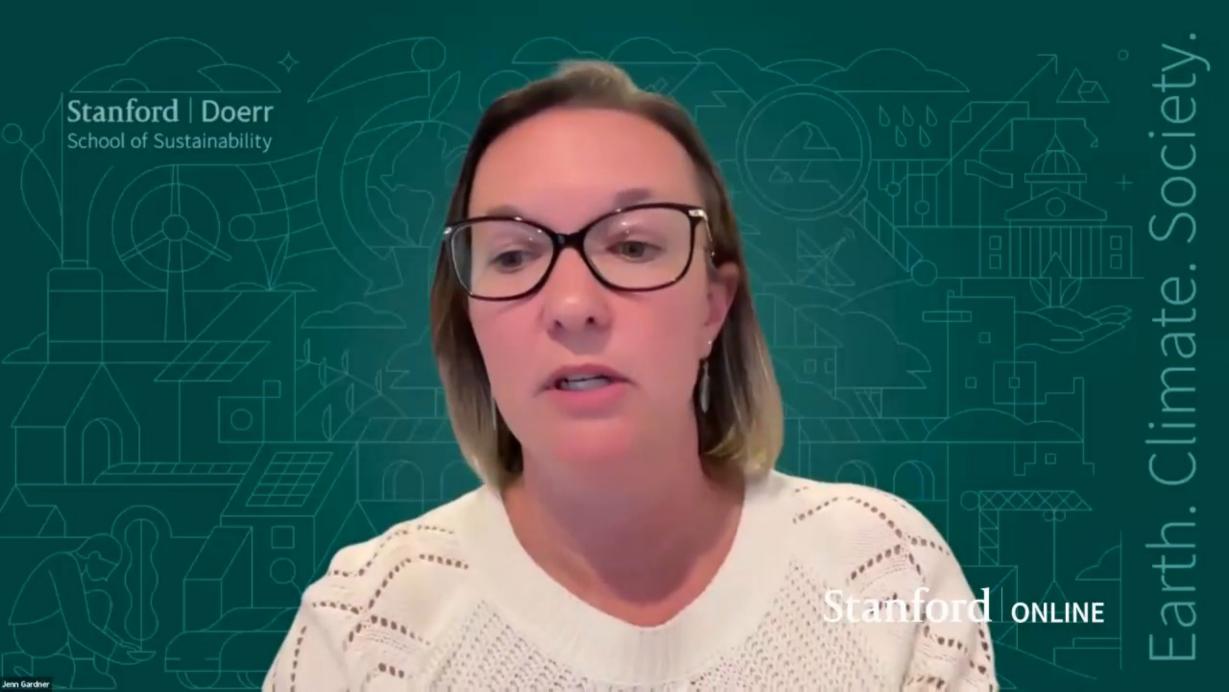












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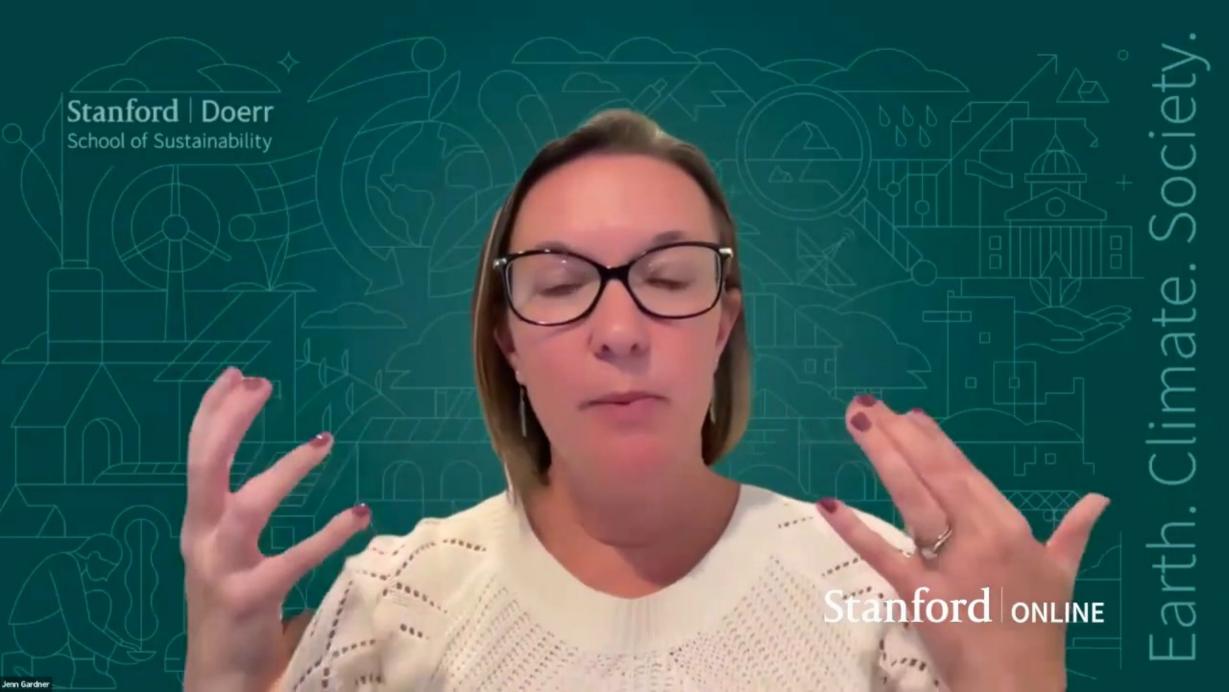




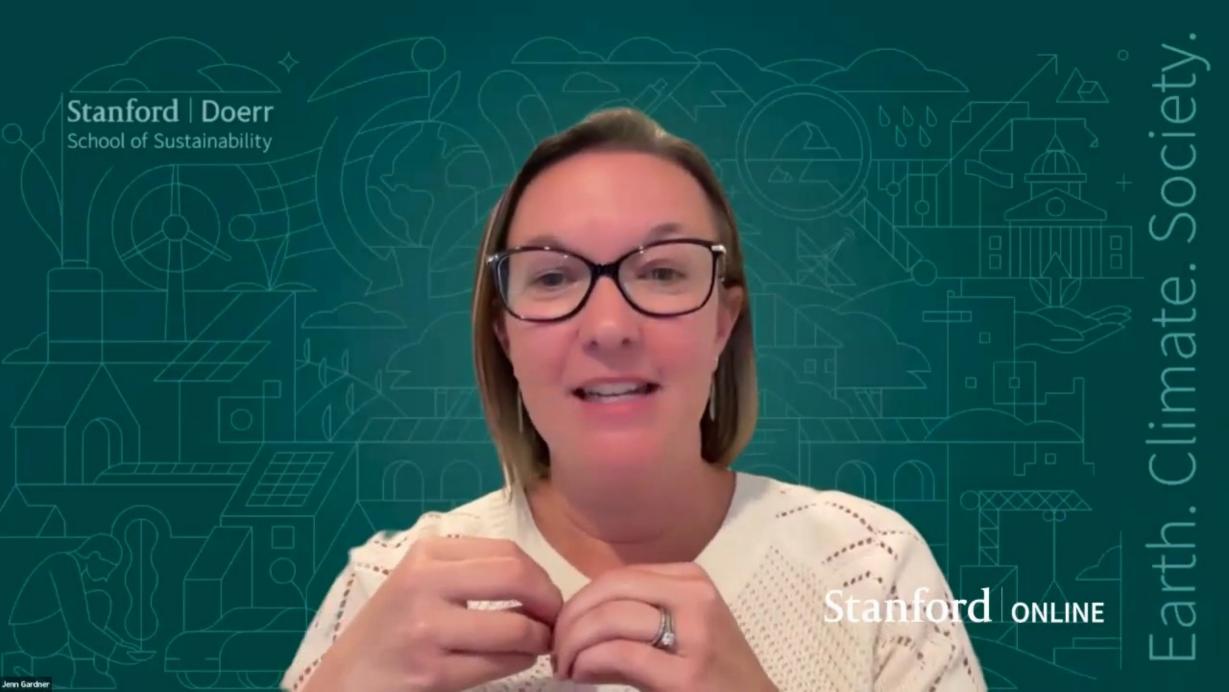
















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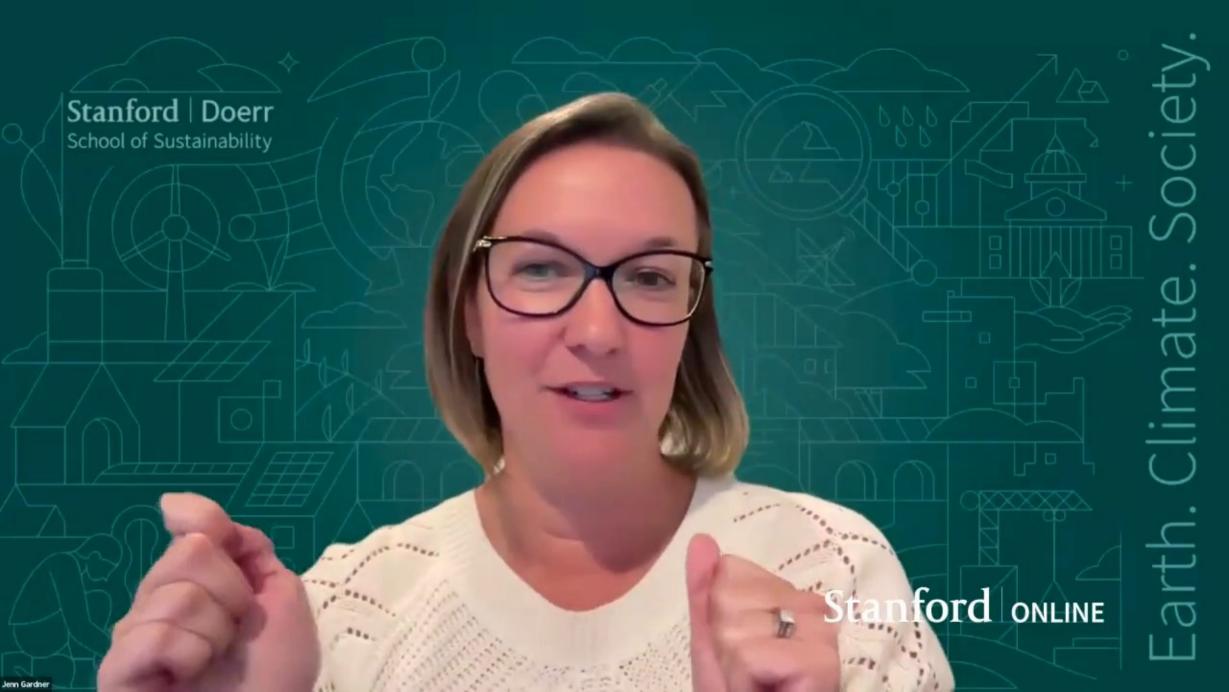










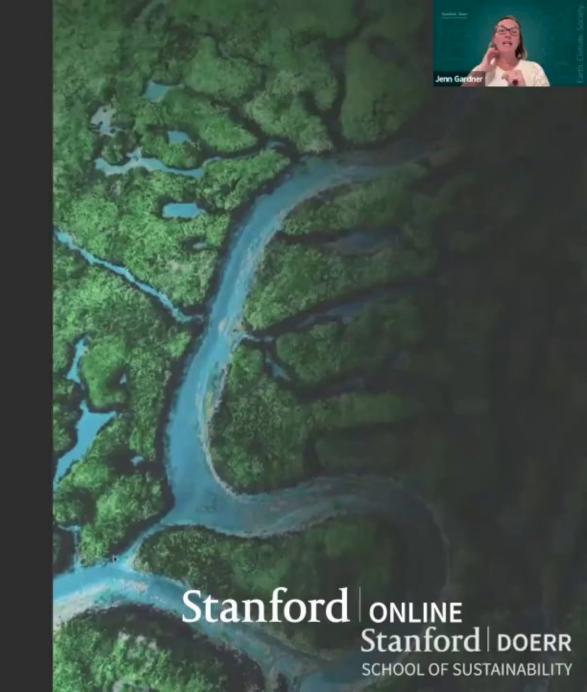




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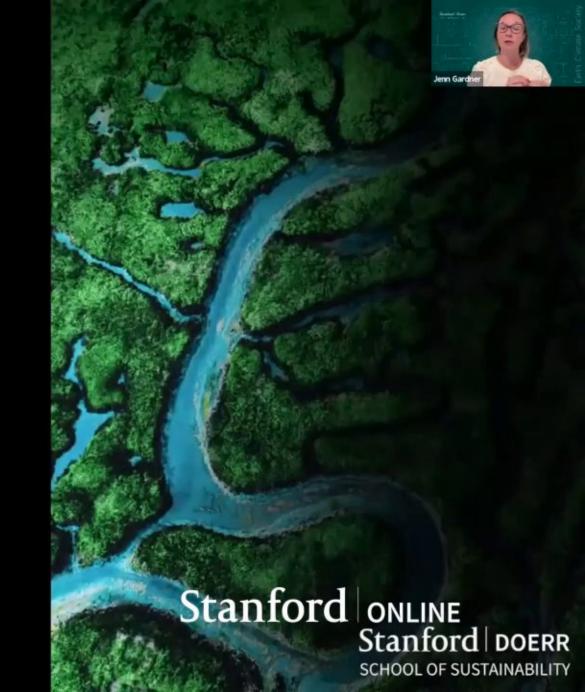




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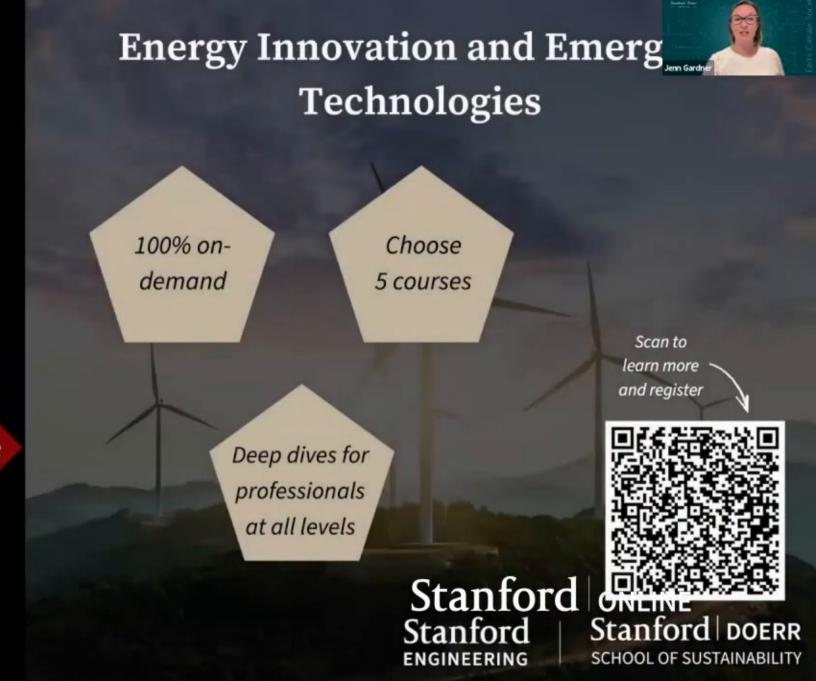
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