DESIGN WITH CARBON: Reconsidering landscapes from planning to soils.

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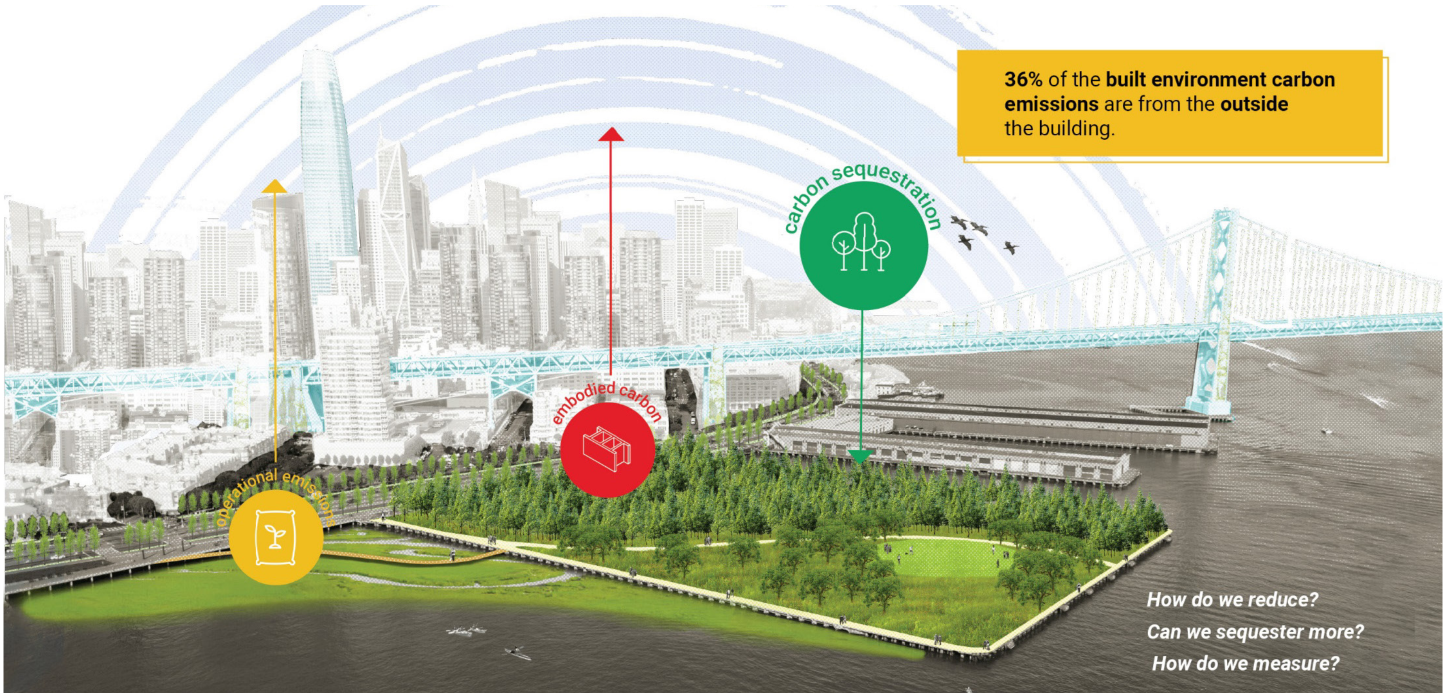

OVERVIEW

Transform your practice by taking responsibility for the carbon footprint of your work. This session reviews innovative tools and frameworks, from planning scale to site and garden design, integrating metrics and soil science. Each panelist will share their findings from translating primary research into accessible tools and best practices.

LEARNING OUTCOMES

- Gain a general understanding of the key concepts of emissions, embodied carbon, operational carbon, life-cycle-analysis, and natural carbon sequestration.
- Learn about the state of research on carbon sequestration and carbon storage in the environment— including new regulatory and certification trends impacting considerations of carbon in design.
- Explore different tools and best practices for how to measure carbon impacts of planning, landscape, and horticultural designs.
- Review a wide array of avenues and strategies for climate advocacy within landscape architecture.

SPEAKERS

Christopher R. Ng-Hardy, ASLA, LEED AP
Senior Associate
Sasaki

Chris focuses on the integration of ecology and culture, with a commitment to exemplary craft in the built environment. Chris led Sasaki's CarbonConscience research project team from 2019 to present. This project included building both landscape and architectural datasets and the translation into an free and accessible design application, bringing together embodied, sequestered, and stored carbon metrics for planning and urban design analysis. Chris believes that every project is not only a design opportunity, but an opportunity to experiment, listen, and learn.

Pamela Conrad, ASLA, LEED AP
Principal, Founder
CMG Landscape Architecture, Climate Positive Design

Pamela Conrad, ASLA, LEED AP, PLA is a Principal at CMG Landscape Architecture and Founder of Climate Positive Design. Conrad focuses on climate mitigation and resilient design in the public realm. Her work is informed by a background in Plant Science and a passion for the environment rooted in growing up on a farm. She is an ASLA Climate Action Committee member, 2018-2019 LAF Fellow for Innovation and Leadership and recipient of the 2019 NCRE Women of Influence Award. She has published numerous works and presented internationally for developing the landscape carbon calculator Pathfinder app and Climate Positive Design Challenge.

Deanna Lynn, Assoc. ASLA
Landscape Designer
Wild Land Workshop

Deanna Lynn is a landscape designer with Wild Land Workshop in Carmel Valley, California. Deanna received her MLA from the University of Oregon. Her master's project, Landscape Design for Carbon Sequestration, won an ASLA student honor award. She has been an active community organizer for years, leading volunteer restoration projects and climate action planning. Deanna received a BA in music from the University of Southern California and has performed and recorded music along the west coast, and on radio and television.

SESSION OUTLINE

Global Carbon Paradigm

- The shifting time value of carbon
  - Importance of staying within the 1.5oC carbon budget vs. 2oC
  - Timeframes of emissions reductions to meet the global carbon budgets - 340GT remains. 65% emissions reductions needed by 2030, Zero emissions by 2040. That has changed from prior understanding as emissions have continued to increase and the timeframe is now getting closer. (Architecture 2030, IPCC 1.5oC Special Report & 6th Assessment)
- Building and construction accounted for 39% of global emissions in 2019 (WGBC, 2020). Ar chitecture 2030 estimates that the built environment and infrastructure combined contribute over 50% of current global climate emissions (Architecture 2030, 2020).
- Impact of the built environment on global emissions (AEC industry)
  - Broken out by sector/ embodied vs. operations
- Global Conversation
  - AEC leadership at annual UN Framework Convention on Climate Change (COP26) confer ence to embolden governments to accelerate and increase their Nationally Determined Contributions (NDCs) to meet the Paris Agreement
  - Architecture 2030 Built Environment Communique at COP 26
    - ASLA and IFLA Signatory - to support the interdisciplinary built environment efforts
    - IFLA Climate Action Commitment - to show and commit to landscape architecture cli mate action
      - 6 Key Areas of the Commitment with Action Plans to Follow
- Interdisciplinary National Leadership for the Built Environment to meet Commitments and the importance of metrics and carbon accounting
  - Landscape Architecture - Climate Positive Design Challenge, ASLA Advocacy Guide
  - Architecture - Architecture 2030 + AIA 2030 Commitment
  - Engineering - Carbon Leadership Forum, MEP 2040

Overview of carbon in the built environment

- Key issues, definitions, and assumptions
  - Operations emissions - Emissions from maintenance and use of facilities after installation and project occupation.
  - Embodied carbon - Estimate of the probable carbon emission from a material or product's sourcing, fabrication, transport, and installation on a site.
    - LCA (Life Cycle Assessment) & EPD (Environmental Product Declarations) Definitions and Industry Snapshot
    - Carbon Factors - a multiplier that refers to emissions per mass of a given material.
    - How to make calculations and estimates
  - Carbon Sequestration - the amount of carbon actively stored or fixed from the atmosphere in vegetation or soils, after construction.
    - Modes for sequestration & analytical approaches
  - Carbon Storage - the mass of carbon locked up within building materials, vegetation, or soils that is not readily off-gassed into the atmosphere.

SESSION OUTLINE

- Carbon in natural systems
  - Carbon Cycle
    - The natural cycle of photosynthesis, decomposition, and respiration.
  - Natural Carbon pools
    - Storage of significant amounts of carbon in natural systems.

How do we design with a Carbon Conscience? >urban design planning scale

- Sasaki's research project, lessons, and results
  - A summary of a broad research inquiry into embodied carbon and development of the Carbon Conscience design tool, an interactive design tool to assist designers with evaluat ing proposed urban design and planning projects in respect to carbon-related impacts.
  - Key decisions and processes considered
  - Methodology
    - Architecture
      - Whole Building Average Assessments
        - Structure, facades, floors, and program variables
    - Landscape
      - Hardscape by landuse, using average coverage assumptions plus carbon factors de rived from white papers, LCAs and EPDs.
      - Softscape by reference ecosystem typology using living and non-living biomass metrics from UNFAO and white papers. Nursery costs extrapolated from key refer ences, however poses an area that requires significant additional research as an in dustry.
      - Existing to Remain - using these datasets to also appropriately value preservation's impact on carbon budgets.
  - Application development - Gamma Version now made public.
  - Internal Tests & Application.
  - Initial conclusions and next steps for considering carbon in landuse allocations:
    - It's easy to overlook preservation
    - Material Costs Outweigh Installation Costs for most land uses. "Less is more"
    - Transportation Costs can dramatically change the bottom line for landscape materials. Regional Sourcing should be a priority.
    - Local energy regimes have huge impacts on actual EPDs and Carbon Factors.
    - Carbon Neutral and Positive Design through landscape systems for projects with signif icant architectural programs requires a significant investment in restoration ecology. Looking to explore how we can connect these studies to recommendations for conser vation easements and 'carbon credit' systems.
    - Peer Feedback and enrichment from Pathfinder and Atelier10 - moving to standardiza tion of assumptions and approaches.

SESSION OUTLINE

How do we inform the details of our landscape design for carbon impacts? >site scale

- Site Design Strategies
  - Embodied and operational carbon emissions reductions
  - Maximizing carbon sequestration and storage
- Measuring
  - Advancement of tools and resources
    - Adding custom elements
    - Expansion of materials palette, ecosystem restoration and protection + syncing with Carbon Conscience
    - Support and collaboration with Atlanta Beltline (Atlanta Beltline Inc. and Alta)
- Metrics and Rating Systems
    - Climate Positive Design Challenge Impacts to Date
    - Scaling-Up Impacts
      - Importance of data aggregation for advocacy and collaboration
      - LEED/Sites Pilot Landscape Carbon Credit
      - Municipal standards - SF Climate Action Plan update, Toronto Green Building Stan dards, etc.
- Getting involved as a landscape architect - ASLA Advocacy Guide

How do we design and manage planted landscapes for carbon sequestration > plant-soil con tinuum scale

- Takeaways from the science of carbon sequestration
    - Carbon stored long-term through mineral protection, not organic matter complexity
    - Healthy (diverse and abundant) soil microbial ecosystem essential to create conditions for mineral protection in aggregates.
    - Functional diversity of plants above and below ground best supports healthy soil micro bial ecosystem, thus supporting long-term carbon storage
    - Design for the whole ecosystem, not focused on individual plants
- Planting design for carbon sequestration
    - Pack in biomass above and belowground through larger, deeper rooted plants, and functional diversity.
    - Include a diversity of plant species from a diversity of plant families
    - Include more woody plants, deciduous trees, nitrogen fixing plants, warm season grass es, and perennials in your plant mix.
    - Choose native plants: more diversity of all life in the system means a more productive system, means more carbon storage.
- Soil management for carbon sequestration
    - Cover the soil with plants
    - Don’t disturb the soil
    - Don’t take more out of system than you put into it

ADVOCACY RESOURCES

ACT Best Practices for Designing Low-Carbon Resilience is a joint statement from the Canadian organizations CSLA, CIP, FAIC, and CWWA for integrating the two streams of climate action - mitigation and adaptation.

AIA Large Firm Roundtable Countdown on Carbon includes guidelines for member firms calling for a significant commitment by practices to respond to climate change in the built environment; applies to all 60 member firms, which employ more than 245,000 people worldwide.

AILA Climate Positive Design Position Statement outlines key objectives, AILA's position and advocacy plan, case studies and references for Australian landscape architects.

Architecture 2030 is a US non-profit that provides carbon performance guidance to the architecture field along with the AIA 2030 Commitment.

Architecture 2030 Built Environment Communique is an interdisciplinary message directed at world leaders at the United Nations Framework Convention on Climate Change (UNFCCC) to encourage accelerated Nationally Determined Contributions (NDCs) for countries supporting the Paris Agreement.

ASLA Climate Action Resources include the Smart Policies for a Changing Climate, case studies and resources for designers.

IFLA Climate Action Commitment is the International Federation of Landscape Architects call to action for over 70,000 landscape architects in 77 nations around the world which supports the Architecture 2030 Built Environment Communique for COP26.

Landscape Institute Climate Change Policy includes Landscape for 2030 - the UK landscape position statement on climate change, the Climate and Biodiversity Action Plan, and Carbon Zero: The professional institutions' climate action plan.

UK Green Building Council Principles for Delivering Urban Nature-Based Solutions sets out six principles to assist developers and owners in the design, delivery and operation of urban NBS, along with the methods that can be used to achieve them, and case studies of real-world application.

United Nations Sustainable Development Goals are an urgent call for action by all countries - that recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

TOOLS + RESOURCES

Pathfinder

https://climatepositivedesign.com/

Pathfinder is a free web-based application to evaluate the carbon impacts of landscape architecture. Pathfinder is hosted through the Climate Positive Design website, developed by Pamela Conrad, ASLA, with environmental consulting support from Atelier 10. It is the first detailed carbon calculator for built landscapes, surpassing former calculators such as Low Carbon Living, Build Carbon Neutral, and tools from Architecture 2030 in terms of breadth and specificity to landscape.

Pathfinder works through a web-based questionnaire for quantities of materials included within a project, and projects full life emissions and carbon sequestration. Methods and citations are provided, with primary references from Athena Impact Estimator, EPDs, and US Forest Service.

In addition to the carbon calculator tool, the climate positive design website has aggregate useful links, concept explanations, and case studies from CMG's portfolio.

See additional resources from Climate Positive Design: https://climatepositivedesign.com/resources/

Carbon Conscience

https://carbon-conscience.web.app

Building on a year-long internal research project to develop a database of carbon materials for early-stage design, Sasaki has developed the Carbon Conscience App to help designers assess carbon impact from the early stages of planning. Using the app in early phases, designers sketch site plans of buildings and landscapes, assign land uses, number of floors, and basic materials decisions and /or ecosystem typologies. Given that input, the app instantly estimates the potential for carbon emissions, carbon storage and carbon sequestration for design alternatives. The user can compare design options, test alternate land uses, structural systems, and landscape and façade materials—and see the impact of their choices. By switching from turf to meadow, from steel to mass timber, from concrete sidewalks to brick, Carbon Conscience can inform our choices early in the design process, laying the framework for lower, neutral, or positive carbon projects in detailed design phases.

This tool has a resolution of 1 square meter, and is useful for making comparative decisions between landuses, and not as a detailed or accurate carbon cost estimate. The embodied carbon values are also provided as a range, reflecting the range of 'carbon sensitive' decisions that can be made within materials and landuses as pertains to standard carbon factors.

This tool is currently the best for master planning scale and early sketch concept design applications when teams are roughing out the 'big moves' of a plan. For full draft white paper and bibliography: search carbon conscience at https://www.sasaki.com/

TOOLS + RESOURCES

Landscape Design for Carbon Sequestration

Master's project by Deanna Lynn

https://issuu.com/dmlynn/docs/lynn_mla_project

Landscape architects have the potential to contribute to climate change mitigation- through natural climate solutions that sequester carbon in ecosystems. However, landscape architects lack resources on how to design landscapes for carbon sequestration and, in particular, soil carbon sequestration. This project address these gaps by translating and interpreting the scientific literature to create an actionable framework for landscape architects. The framework consists of principles, strategies, and actions for design, installation, and management of landscapes for carbon sequestration. A key recommendation is that increasing the functional diversity of plants increases the potential carbon sequestration of the landscape by increasing its productivity and resilience. Additionally, plant functional diversity supports the soil microbial ecosystem, which is key to long-term soil carbon storage. This framework emphasizes that designing landscapes for carbon sequestration should prioritize belowground carbon dynamics and the functioning of the whole landscape system.

Tally & EC3

https://kierantimberlake.com/page/tally

Tally is a Revit plugin developed by KieranTimberlake that reads material definitions and volumes from the Revit model to rapidly produce whole-building Life Cycle Assessments. KieranTimberlake is an architecture firm with an in-house research department who designs custom tools.

Tally users analyze each Revit material in the model, and assign it a corresponding Tally material definition which has been sourced from material EPDs found on the Carbon Leadership Forum's (CLF) EC3 tool. CLF is a non-profit organization bringing together professionals and academics to address embodied carbon in the built environment.

Revit models in any stage of development can be analyzed. Running Tally on Schematic Design level Revit models can provide critical early guidance to designers, and can provide a baseline model for use in tracking the progress of the embodied carbon targets as the model develops. These early models can also serve as the required baseline in pursuit of the LEED NC-v4 MRc2 credit.

Tally can also compare Revit design options to further help designers at key decision points in the design process. As the model becomes more developed, the better the material take-offs and material assumptions can be, yielding more accurate results.

Because of the significance of embodied carbon contributed by a building's structural systems, it is critical that structural Linked Models are analyzed in Tally as well, and it is highly recommended that designers bring their structural engineers into the process early on, to establish embodied carbon project goals and set standards for either the engineer's use of Tally, or allowing access to their models so Tally can include their embodied carbon contribution.

TOOLS + RESOURCES

At the time of this session, Tally costs approximately $1200 per floating license per year.

Because of the seamless integration into Revit, Tally is our top recommendation for detailed embodied carbon and overall LCA studies for buildings once in schematic design phases.

Athena Sustainable Materials Institute

http://www.athenasmi.org/

Athena Sustainable Materials Institute (ASMI) is a Canadian non-profit think tank organized around life-cycle-assessment of products and whole buildings, including the creation and curation of LCA design tools and an impact estimator for buildings and pavement. In addition to these aggregate LCA tools, ASMI is involved across the LCA industry from development of ANSI standards to peer review of EPDs, and performs contracted LCA research for manufacturers and suppliers. ASMI tools are targeted to North American projects, and are subscription based.

The Athena EcoCalculator tools are relatively fast tools to use through provided spreadsheets to quickly assess potential impacts at a building specific - assembly concept design level of detail.

The Athena Impact Estimator for Buildings is a stand alone software that involves modeling a building within the program.

At the time of this session, the Athena tools are free.

Athena's tools are linked to a proprietary database and from the US life Cycle Inventory Database. The quality and comprehensiveness of the data included makes this product one of our top recommendations for detailed design of buildings at concept phases and evaluation of specific assemblies

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Additional Embodied Carbon Calculators

- One-Click LCA: The engineer's software of choice for LCAs as well as embodied carbon calculations. https://www.oneclicklca.com/
- Beacon (for structural systems), from the Embodied Carbon Lab at Thornton Tomasetti : https://core-studio.gitbook.io/beacon/
- Kaleidoscope (for facades) from Payette: https://www.payette.com/kaleidoscope/

TOOLS + RESOURCES

- Concrete LCA tool (for concrete mixes) from ZGF: https://www.zgf.com/news_post/lca-calculator-reduces-concretes-embodied-carbon/
- EA Tool (for structural systems) from SOM: https://www.som.com/news/new_tool_measures_emissions_from_buildings

Energy Modeling Programs

- Cove.tool (energy modeling for individual builds and neighborhoods): https://www.cove.tools/
- IES VE (whole building energy simulation): https://www.iesve.com/software/building-energy-modeling
- DesignBuilder (performance analysis tools): https://designbuilder.co.uk/

Additional LCA/EPD & References

- Epic (LCA) Database, University of Melbourne. https://msd.unimelb.edu.au/research/projects/current/environmental-performance-in-construction/epic-database
- U.S. Life Cycle Inventory Database. https://www.nrel.gov/lci/
- EPD International. https://www.environdec.com/
- Carbon Smart Materials Pallette: https://materialspalette.org/
- EPD Quicksheet: https://architecture2030.org/epd-quicksheet/
- Architecture 2030: https://architecture2030.org/
- USGBC - How LEED V4.1 addresses embodied carbon: https://www.usgbc.org/articles/how-leed-v41-addresses-embodied-carbon
- Society for Ecological Restoration Resource Center: https://www.ser-rrc.org/
- iTree (for detailed arboriculture tools): https://www.itreetools.org/
- Eco GIS (monitor energy consumption and CO2 emissions): http://www.ecogis.info/

Books on Ecological/Climate Friendly Landscape Design

Beck, Travis. 2012. Principles of Ecological Landscape
Design. Washington, DC: Washington, DC : Island Press.

Dunnett, Nigel and James Hitchmough 2014. The Dynamic Landscape: Design,
Ecology, and Management of Naturalistic Urban Planning. London ; New York: Spon Press.

Rainer, Thomas, and Claudia West. 2015. Planting in a Post-Wild World : Designing Plant Communities for Resilient Landscapes. First edition. Portland, Oregon: Timber Press.

Reed, Sue, and Dana, Kate. 2010. Energy-wise Landscape Design : A New Approach for Your Home and Garden. Gabriola, B.C.: New Society Publishers.