06.17.2022

Petaluma Fairgrounds Advisory

Balanced Decarbonization

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The Greenest Building is...

One That is Already Built
The Greenest Building is...

One That is Already Built
APPENDIX

STUDY AREA 1 DETAIL

Study Area 1: Fairgrounds
(Figure 1)
The Sonoma Marin Fairgrounds is located in the geographic center of Petaluma. This location has the potential to bridge the east-west divide and address our shifting economy and our agricultural future. It also serves as one of the largest evacuation centers in Sonoma County. The property touches on all aspects of the Scope of Issues.
Building Sector Decarbonization
Global Building Sector GHG Emissions

- Transport: 23%
- Other industry: 23%
- Other construction industry: 10%
- Residential (direct): 6%
- Residential (indirect): 11%
- Non-residential (direct): 3%
- Non-residential (indirect): 7%
- Buildings construction industry: 10%
- Other: 6%

37% of total global GHG emissions come from the building sector.
Building Sector: \textbf{13.4 Gt/Yr = 37\%} Global \textbf{Energy-Related} GHG Emissions

- **Indirect Emissions**: 6.5 Gt/Yr \quad 18\%
- **Embodied Emissions**: 3.6 Gt/Yr \quad 10\%
- **Direct Emissions**: 3.3 Gt/Yr \quad 9\%

\textbf{Building Sector:} 13.4 Gt/Yr = 37\% \textbf{Global Energy-Related} GHG Emissions

\textbf{World Energy Outlook 2021}
Building Sector GHG Emissions – ZERO by 2040 Strategy

**POWER**
- Convert to Renewable Energy

**BUILDINGS**
- High-Performance Codes
- All-Electric Buildings
- Building-Integrated Renewables

**INDUSTRY**
- Convert to Renewable Energy
- Decarbonize Materials & Production

25% Growth
50% ZNE Retrofits
Building Life-Cycles
Material Life-Cycles

Biological Cycle

Technical Cycle

Bill McDonough

Cradle to Cradle
Assembly Life-Cycles

Triple-Glazed IGU

Double-Glazed IGU

- Glass Panes
- Glass Coating (typ. Low-E)
- Gas-filled Cavity (typ. Argon)
- Desiccant
- Spacer Bar
- Sealant
Whole Building Life-Cycles

<table>
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<th>Layers</th>
<th>Years</th>
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<tr>
<td>Stuff</td>
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<td>60-200</td>
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<td>&gt;BLDG.</td>
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Stewart Brand

How Buildings Learn
Whole-Life Carbon Accounting
Scope 1, 2 & 3 Emissions

1 DIRECT
- Processes
- Buildings
- Transport

2 INDIRECT
- Off-site Power

3 INDIRECT
- Upstream Activities
- Downstream Activities

Upstream (inputs) Reporting Entity Downstream (outputs)
Operational Emissions – Direct ≈ Scope 1

Gas Cooking

Gas-Fired Water Heaters

Gas-Fired Boilers
Operational Emissions – Indirect ≈ Scope 2

- Rooftop Chillers
- Heat Pumps
- Lighting
- Plug Load
Operational Emissions – Indirect ≈ Scope 2

Electricity by Source

- Coal – 30%
- Gas – 34%
- Oil – 1%
- Nuclear – 20%
- Hydro – 6%
- Wind – 6%
- Biomass/Solar/Geothermal – 3%

US Energy Information Agency
Embodied Emissions ≈ Scope 3

Steel Furnace

Concrete Trucks

Concrete Batching Plant

Concrete Placement
Balanced Building Sector Decarbonization
Build to Code
ASHRAE 90.1 2019 + IECC 2021

Electrification + Renewables
No Gas + On-Site + Off-Site

Zero-Out Embodied Carbon
Re-Use + Reduce + Sequester
Indirect Emissions

Direct Emissions

Embodied Emissions

Power

Industry

Residential

Non-Residential

Building Sector GHG Emissions – Growth Strategy
Building Sector GHG Emissions – Retrofit Strategy

Indirect Emissions

Direct Emissions

Embodied Emissions

Power

Residential

Non-Residential

Industry
3x RETROFIT + 1x GROWTH = ZERO by 2040

Indirect Emissions

Direct Emissions

Embodied Emissions

Power

Residential

Non-Residential

Industry

Building Sector GHG Emissions – Balanced Retrofit + Growth
The Greenest Building is...

One That is Already Built
Energy-Positive Buildings

Bullitt Center
Miller Hull

Wayne Aspinall Federal Building
Westlake Reed Leskowsky
Carbon-Positive Materials

Mjøstårnet
Brumunddal, Norway
Voll Arkitekter
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