

Zero-Carbon Buildings and Cities in California: A Feasibility Study

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On behalf of



Project purpose and phases

Purpose: To study feasibility of zero carbon buildings and communities to inform state and municipal policy

Phase I: Zero Carbon Buildings

- Spreadsheet tool for all of CA
- Wedge analysis to 2050
- Energy, water, waste and transportation
- Six building types
 1. Single-family residential
 2. Multi-family residential (low-rise)
 3. Large office
 4. Strip mall
 5. School
 6. Warehouse
- Location-sensitive

Phase II: Zero Carbon Communities

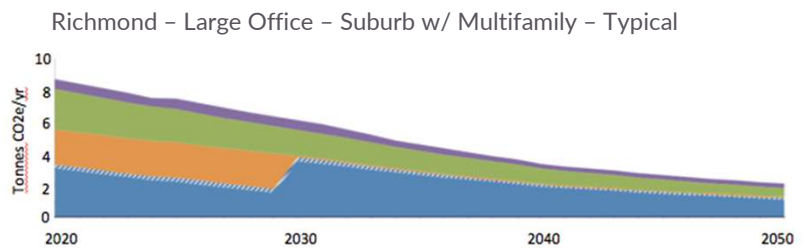
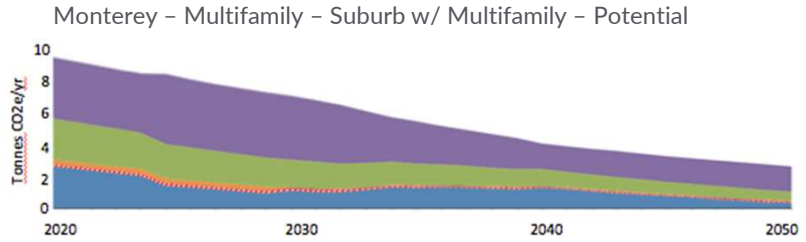
- Case study of Richmond, CA
- Techno-economic modeling to 2050
- More energy strategies, plus water, waste and transportation
- Multiple scales
 1. Building (new energy strategies)
 2. Block
 3. Neighborhood
 4. Municipality
- Extend findings to other cities

Phase 1 | Example Results

Step 1: Enter General Development Information	
Building Information	
Building Type	Large Office
Strategy Categorization	All Strategies
Cost Categorization	All
Location	
County	Contra Costa
City	Richmond
Hydrologic Information	
Hydrologic Region	San Francisco
Climate Information	
Climate Zone	3
Transportation Information	
Metropolitan Planning Organization (MPO)	Metropolitan Transportation Commission (MTC)
Place Type	Suburb With Multifamily Housing

Step 2: Performance Level Specification	
Water Performance Level	Typical
Waste Performance Level	Typical
Transportation Performance Level	Typical
Operation Performance Level	Typical

- Remainder to Zero Carbon
- Mitigated Carbon Increase
- Waste Reductions
- Operation Reductions
- Unmitigated Carbon Increase
- Water Reductions
- Transportation Reductions
- Carbon Sink



Phase 2 | Scope and Scenarios

Scope

Operational energy from buildings and transportation in Richmond



Industry, refrigerants, and embodied carbon are out-of-scope for our study

Scenarios

- 1 **Adjusted CAP**
Anchored to Richmond's Climate Action Plan
- 2 **ZCC**
Work backwards, assuming ZCC by 2050

Phase 2 | GHG Mitigation Strategies



Energy and Water Efficiency

e.g., gray water, plug load and lighting efficiency, codes and standards



Load Shifting

Toward hours with the cleanest electricity, for EVs and buildings



Reduce VMT

e.g., transit-oriented development, bicycle and pedestrian infrastructure, free shuttle system



Renewable Generation

Rooftop PV and community-scale PV; electricity from landfill biogas; carbon-free electricity from MCE



Electrification

Of vehicles and buildings; ex. high-efficiency heat pumps



Energy Storage

Community-scale, combining multiple energy storage technologies

Phase 2 | Modeling Methodology

