Oakland EcoBlock

Demonstrating Capability and Scalability in Retrofitting a Sustainable Neighborhood

A Multi-Disciplinary, Whole-Systems Approach

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Project Summary

Background: From the end of the Civil War to the Great Depression, urban expansion in the U.S. occurred through a development pattern of gridded streets and blocks, serviced by the streetcar. Every U.S. city has extensive neighborhoods of this type, usually located adjacent to downtowns and emanating outward from them. These first-ring, 'streetcar suburbs' represent an estimated 30% of U.S. urban-suburban residential stock and their infrastructure, energy and water systems are in need of urgent repair or replacement. Moreover, the assumptions of unlimited energy and water behind their original design and construction need to be re-thought taking into account the realities of climate change. These neighborhood suburbs represent a huge opportunity to create greater urban sustainability and resilience at a distributed, fine-grain scale.

Purpose: The EcoBlock is an urban sustainability experiment in Oakland, CA that brings together residents of a local neighborhood block and a multi-disciplinary team of urban designers, engineers, social scientists and policy experts from Berkeley, Lawrence Berkeley Labs, NASA Ames Research Center, Stanford, local non-profits, grassroots organizations, PG&E, EBMUD, the City of Oakland and the State of California. Built on local community buy-in, the project will apply a whole-systems design approach to retrofitting the block from a high energy and water dependency to the lowest energy and water footprint possible – transforming an obsolete, resource-wasteful model into an integrated design that guarantees long-term sustainability.

Proposition: To test the hypothesis that retrofitting on the block-scale is more efficient and cost-effective than the individual house-scale in achieving maximum renewable energy, water conservation, and local wastewater treatment and reuse – because it combines the flows and efficiencies across multiple units.

Objective: To build and blueprint a pilot system that demonstrates a highly-efficient, affordable neighborhood block-scale energy, water, and wastewater treatment-and-reuse platform and retrofitting-process that can be replicated anywhere in California and the United States.

Opportunity: Over 40% of U.S. GHG emissions emanate from commercial and residential buildings, and the residential share amounts to roughly 53% of the total. Due to their density, streetcar suburbs account for close to 40% of the U.S. population and 40% of residential GHG discharges – a significant greening opportunity. Aggregating PV solar collection, DC-AC inversion, and storage at the block-scale can provide 100% (or more) of a block's energy demand. On the water side, the EPA estimates that 40% -50% of California's home water consumption goes to lawns and gardens. Treating and reusing wastewater locally can substitute for this wasteful use of valuable potable water. When this replacement is combined with internal grey-water recycling, rainwater collection, efficient fixtures and taps, residential water consumption can be reduced by 80%. Our project will demonstrate integrated solutions that eliminate home and vehicle GHG emissions, dramatically cut water consumption, recycle wastewater and promote investment in jobs, people, renewables and infrastructure.

Mission: Using a cross-disciplinary, whole-systems approach, the project will incorporate state-of-the-shelf solar, water and wastewater solutions to repurpose homes into high-performance dwellings that are maximally efficient, comfortable and secure. This requires: (a) individually retrofitting the energy, water and waste-water systems of 28 contiguous houses in a block situated in Oakland's northwestern Golden Gate neighborhood, and (b) linking them into an 'intelligent' operating system with these principle characteristics:

1) **A net-energy positive, shared-rooftop, solar-powered DC microgrid with advanced energy storage** – providing around-the-clock energy, with the option of sending any surplus electricity to the grid;
2) **28 shared-electrical vehicle (EV) charging stations powered by the microgrid** – distributed evenly around the block, fast chargers will accelerate EV use, while car sharing will add to sustainable mobility;
3) **40% water savings** – from the terrestrial use of NASA's International Space Station grey-water recycling system in sinks, showers & washing machines; plus rainwater harvesting & water-saving fixture retrofits;
4) **An additional 40% water savings** – thanks to a block-scale, solar-powered bio-digester that recycles all household 'black water', and provides topsoil-grade compost and recycled, nutrient-rich water to irrigate:
5) **Organic fruit & vegetable gardens** – a closed-loop that eliminates dependence on potable water, recycles carbon, nitrogen & phosphorus in soils, avoids CO_2, & water-use in agriculture, saves GHG emissions from trucking & refrigeration ('food miles'), provides food security at a time of increasing agricultural stress, while nourishing a local ecosystem rich in small mammals, insects, pollinators and songbirds;
6) **Environmental equity** – sustaining a green, cool & pleasant neighborhood for all, and averting urban heat-island effects, predicted to increase with the inevitable rise of temperatures in the decades ahead.

Timeline: Working in cooperation with block residents, the design and technical implementation will be led by a team of Berkeley, Stanford, NASA Ames and Lawrence Berkeley Lab engineers, social scientists and grad students. The partnership is responsible for steering the project to a successful outcome within 2-3 years.

Financing: The program will be 100% underwritten by a mix of corporate and private foundations, as well as state and federal funding. The budget is approximately $9 million. Property owners bear no cost.

Social Policy: Working with California State Commissioners and Legislators, the project will help design new regulations to accelerate sustainable neighborhood retrofitting, and engage financial institutions to create financing solutions that stimulate the scaling of sustainable neighborhood block-repurposing at affordable cost.

Conclusion: The sustainability crisis makes it clear that the challenges of rebuilding our cities and responding to global warming are converging. Century-old streetcar suburbs are vulnerable to climate change and in need of urgent repair. Block-scale retrofits offer a holistic solution that: (1) upgrades ageing building stock, (2) re-designs neighborhoods to run on solar power, (3) accelerates EV adoption & solar-powered mobility, (4) provides steep water conservation, (5) reuses waste-streams, (6) promotes urban food systems, and (7) drives local investment in green jobs – a long-term answer to revitalize our communities for a healthier, safer future.

Oakland Eco-Block Team

A. Project Management Team

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