Environment and Natural Resources Trust Fund
2011-2012 Request for Proposals (RFP)

Subd: 07e

Project Title: Low Environmental Impact Sustainable Neighborhoods

Category: F3+4. Renewable Energy

Total Project Budget: $ $250,000

Proposed Project Time Period for the Funding Requested: 2 yrs, July 2011 - June 2013

Other Non-State Funds (secured): $ 22,000

Summary:

A groundbreaking approach to climate change, air pollution, stormwater, and energy reduction in existing neighborhoods built upon a community driven "mini-district" system to sharply curtail demand, and incorporate renewable energy.

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Location:

Region: Metro

Ecological Section: Minnesota and NE Iowa Morainal (222M)

County Name: Hennepin, Ramsey

City / Township: Minneapolis, St. Paul

PROJECT TITLE: Low Environmental Impact Sustainable Neighborhoods
PROPOSAL NUMBER: ID # 153-F3+4
SUBMITTED BY: John Carmody, University of Minnesota
REVISED: October 12, 2010

I. PROJECT STATEMENT

This project addresses climate change, air pollution, water/stormwater management, and a ground-breaking approach to energy reduction and sustainability in existing residential areas by developing a neighborhood-scale district system using a single block as the basic energy/water/waste systems integration scale.

- Recent research suggests much greater efficiencies are possible with small district energy systems integrated on a one- to nine-block scale compared to simply retrofitting or adding renewable energy sources to individual houses.
- Each block is served by a small building placed on a portion of a residential block, a vacant lot, or in a utility easement that contains the relevant block-scale plant. The structure will house the energy and water systems and act as a focal point for the co-operative collection of recycling, waste, compost, and support for community gardens.
- This single-block approach is replicable and can be applied to any existing neighborhood in urban areas or moderate-sized towns throughout Minnesota.

The long-term goals of the project are to:

- Develop a replicable, cost-effective neighborhood-scale district system that provides highly efficient heating and cooling to houses in the neighborhood. The system will take advantage of economies of scale and higher efficiencies possible at the neighborhood level. The block plant building will incorporate water, storm water, and waste management to reduce environmental impacts and costs of these systems and take advantage of energy synergies where possible.
- Optimize the energy conservation and efficiency measures of the individual houses that may enable 50-70% savings for the neighborhood as a whole.
- Utilize renewable energy sources for the neighborhood system to the maximum extent feasible to support household energy and transportation energy. These include geothermal, solar thermal, solar electric, and bio-fuels that can support heat pumps, co-generation, and transportation fuels. Initial studies suggest that this local, mixed energy supply could meet or exceed the remaining household loads on an annual basis.
- Engage residents in guiding solutions for their neighborhood, forming a cooperative that provides economic benefits, strengthens community, and provides jobs, and improving overall performance through better education and participation.
- Provide a cost-effective method of replacing aging infrastructure in cities and towns.

This proposal is for the first phase of the development of a "Low Environmental Impact Sustainable Neighborhood." It includes a comprehensive feasibility and design study applied to two pilot neighborhoods. The study will identify and evaluate technologies that have potential advantages at the neighborhood scale, identify regulatory barriers and policy implications, determine market acceptance, and provide an illustrative design applying the system to the two pilot neighborhoods.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: **Identify and evaluate pilot neighborhoods for study** **Budget**: $30,000

The project team will develop a methodology and criteria for selection of the pilot neighborhoods. Candidate neighborhoods will be identified and evaluated and two will be recommended for further

study. The concept can be applied in several situations such as a typical neighborhood with multiple property owners (in urban or small town settings), a neighborhood near the University with a single property owner for the whole block, or an attached single-owner housing project such as University-owned housing. Each of these possible of settings will be evaluated based on potential benefits, environmental impact and general applicability as well as regulatory and market barriers. Part of the analysis will be to select neighborhoods where there is strong neighborhood interest and a high likelihood of funding and project implementation following the feasibility study.

Outcomes	**Completion**
1. Part 1 of feasibility study recommending two pilot neighborhoods for study.	End of 6 months

Activity 2: **Identify and evaluate appropriate technologies.** **Budget**: $90,000

A. Perform analysis of a block-scale district energy system using renewable energy sources
A simple overall energy analysis of a single block energy district in at least one of the pilot neighborhoods identified in Activity 1 will be performed to examine the feasibility of a system using a combination of solar photovoltaic, solar thermal, geothermal and biomass energy sources being able to supply at least the combined heating and power needs of the block-scale district on a sustainable basis. The energy analysis will include an assessment of the optimum house retrofit packages to match the heating and cooling demands with the energy supplied by the block-scale district energy system. The feasibility analysis will also examine the costs of the relevant equipment with regard to minimizing capital costs.

B. Perform analysis of block-scale district water management and waste treatment systems
A simple overall analysis of the water, stormwater, and wastewater streams in at least one of the pilot neighborhoods identified in Activity 1 will be performed in order to evaluate the feasibility of whether managing these streams is technically and economically viable on a block-scale district. Concepts will be explored such as using stormwater/wastewater for thermal storage and using stormwater for irrigation to grow large trees to shade and provide urban cooling with much higher evapotranspiration rates.

C. Perform analysis of other systems
Potential solid waste recycling and disposal, organic (food and yard) waste management, transportation and food production impacts at a neighborhood scale will be analyzed.

Outcomes	**Completion**
1. Part 2A of feasibility study evaluating energy technologies.	End of 18 months
2. Part 2B of feasibility study evaluating water/wastewater technologies.	End of 18 months
3. Part 2C of feasibility study evaluating solid waste and other systems.	End of 18 months

Activity 3: **Identify and evaluate regulatory barriers and policy implications.** **Budget**: $40,000
Issues to be evaluated include the interface with existing utilities, land ownership, and other legal and financial/business issues related to a cooperative neighborhood infrastructure and organization.

Outcomes	**Completion**
1. Part 3 of feasibility study evaluating regulatory and policy implications.	End of 12 months

Activity 4: **Identify market issues and evaluate market acceptance.** **Budget**: $40,000
The market acceptance issues of neighborhood-scale systems will be identified and evaluated using interviews, neighborhood forums and surveys.

Outcomes	**Completion**
1. Part 4 of feasibility study evaluating market acceptance issues.	End of 18 months

Activity 5: **Develop conceptual design for two neighborhoods.** **Budget**: $50,000

This illustrative design study will include configurations, strategies, and preliminary costs. The design process will engage the neighborhoods and form partnerships for actual implementation. The ultimate strategy is to demonstrate the concept in existing neighborhoods leading to easier regulatory and market acceptance in future applications.

Outcomes	Completion
1. Part 5 of feasibility study developing conceptual designs for pilot neighborhoods.	End of 18 months

III. PROJECT STRATEGY

A. Project Team/Partners

The project will be managed by John Carmody at the Center for Sustainable Building Research and Pat Huelman of the Cold Climate Housing Program at the University of Minnesota. Other University team members are Institute of Sustainable Enterprise (Tim Smith), the Energy Systems Design Program (Louise Goldberg), the Mechanical Engineering Department (Jane Davidson). Recruiting and developing partners is critical to implement the plan. Strategic partner selection will build an effective approach to low-impact sustainable development at a neighborhood scale. Project partners include: City of Minneapolis (Gayle Prest); City of Saint Paul (Anne Hunt); University Neighborhood Alliance (Dick Gilyard); Xcel Energy Innovation Corridor project (Greg Palmer), Center for Energy and Environment (Sheldon Strom); Neighborhood Energy Connection (Chris Duffrin), and Kestrel Design (Peter MacDonagh).

B. Timeline Requirements

This project will be completed over an 18-month period. The activity breakdown is shown below:

	6 mo.	12 mo.	18 mo.
Activity 1: Identify and evaluate neighborhoods	X		
Activity 2: Identify and evaluate appropriate technologies	X	X	X
Activity 3: Identify and evaluate regulatory barriers and policy implications	X	X	
Activity 4: Identify market issues and evaluate market acceptance		X	X
Activity 5: Develop conceptual designs for two pilot neighborhoods		X	X

C. Long-Term Strategy and Future Funding Needs

This Phase 1 feasibility and design study will provide the necessary background information to proceed to engineering design and deployment of the pilot projects. During Phase 1, the team partners will work to secure funding for the engineering design of the pilot projects in Phase 2. Federal research and demonstration funds and utility program funds will be sought for Phase 2. This project will provide a clear pathway leading to replicable projects in other neighborhoods and cities. The project will attempt to reduce complication and cost while creating a template that can be adjusted to suit various sustainable approaches. We believe this energy reduction platform will be transformative in terms of increasing the speed in which residential conservation and sustainability can spread across the country.

IV. PROJECT ILLUSTRATIONS

Figure 1: At the block scale, a small building placed on a portion of a residential block, a vacant lot, or in a utility easement. The block-scale plant provides heating and cooling to the houses.

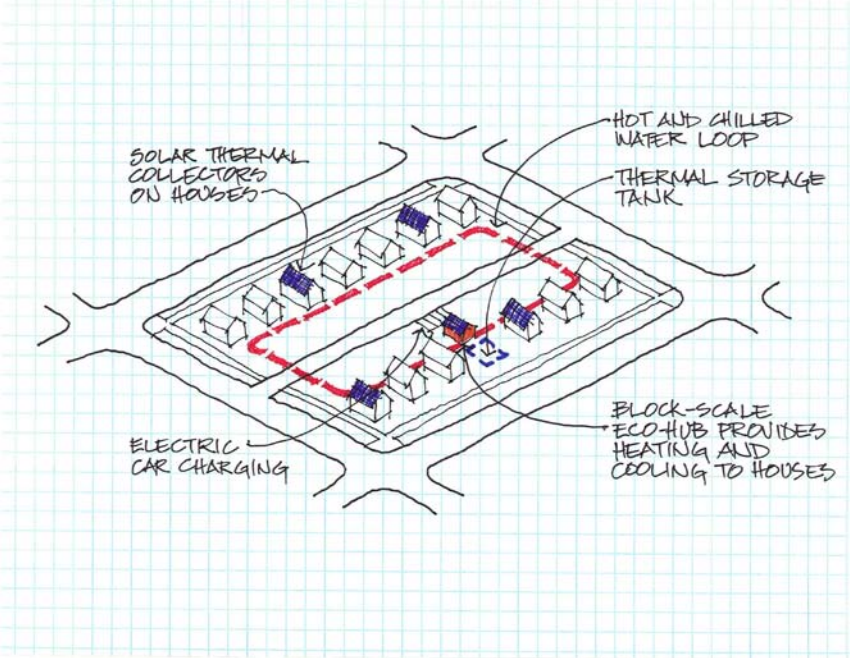
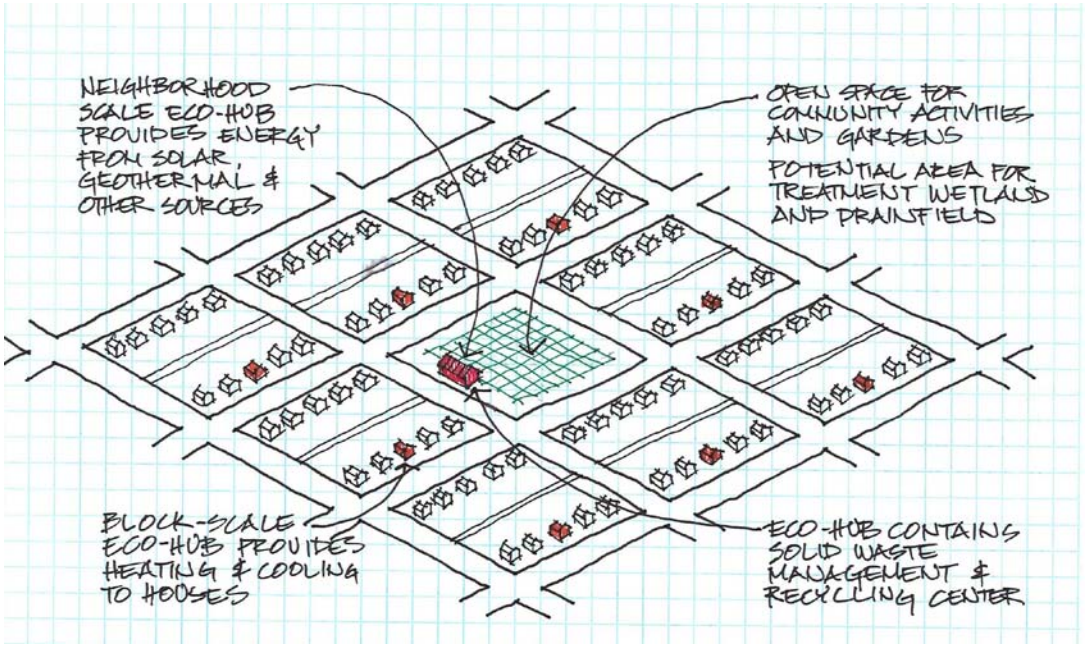


Figure 2: The block-scale district system can be expanded to several blocks within a neighborhood allowing for district scale wastewater treatment. The neighborhood scale plant may house multiple forms of energy production, and co-operative collection of recycling, waste, compost and support for community gardens.



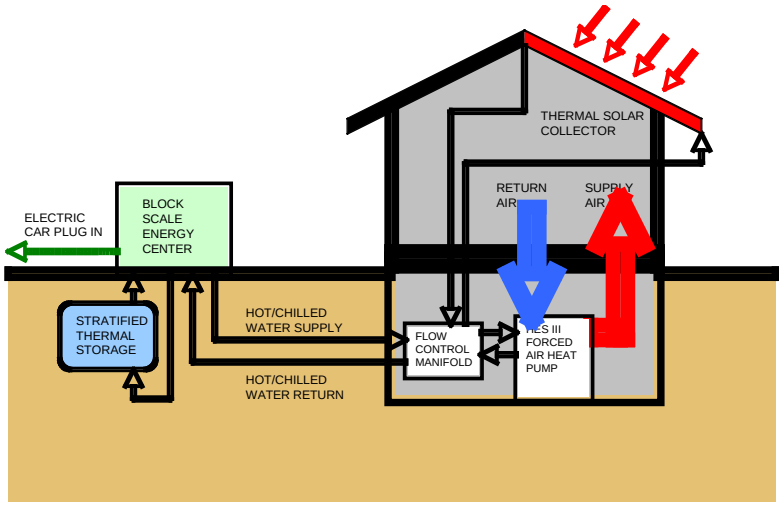


Figure 3: Individual house with block-scale energy plant

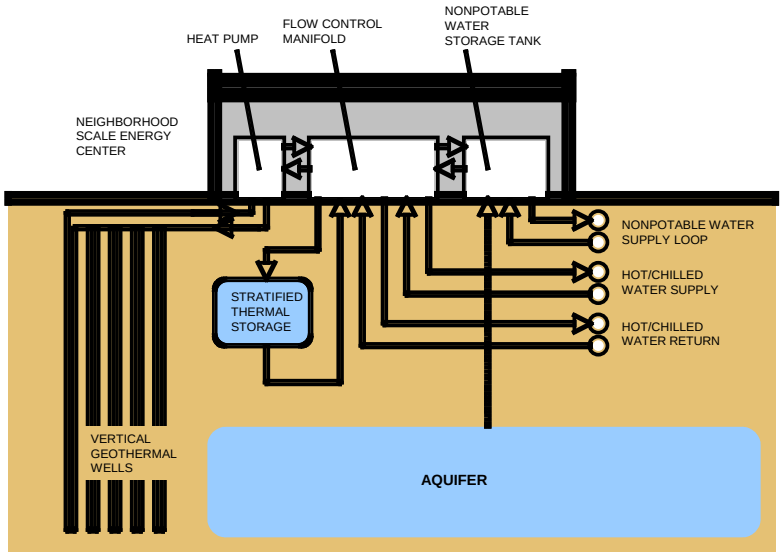


Figure 4: Neighborhood-scale plant with potential for multiple energy inputs such as solar thermal, geothermal and combined heat and power systems.

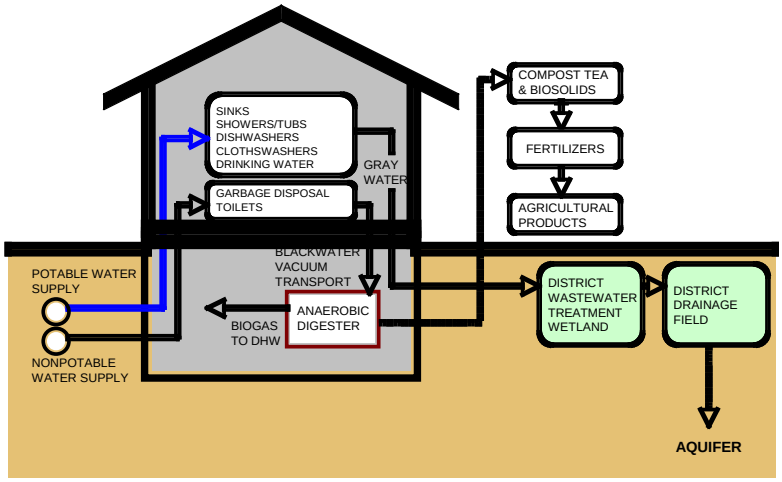


Figure 5: Individual house connected to neighborhood-scale wastewater treatment wetland and drainfield system.

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SUBMITTED BY: John Carmody, University of Minnesota

REVISED BUDGET INFORMATION (submitted October 12, 2010)

The table below shows the departmental affiliations of the research team members and their responsibilities on the project. The table also clarifies the source of the State and non-State matching funds. None of the LCCMR funding will be used for overhead (including the overhead charged by our three subcontractors—CEE, NEC and Kestrel). Note that the University staff listed on this proposal (except for Smith and Davidson) are not regular faculty and receive their main support from grant funds.

IV. TOTAL TRUST FUND REQUEST BUDGET (1.5 years)

BUDGET ITEM			AMOUNT
University Personnel:	**Affiliation**	**Role on Project, % time, Salary:FB**	
1. John Carmody	Center for Sustainable Building Research, College of Design	Project Manager, 10%, 75%:25%	$ 27,500
2. Patrick Huelman	Cold Climate Housing, Bioproducts/Biosystems Engineering	Co-project Manager, 10%, 75%:25%	$ 22,000
3. Louise Goldberg	Energy Systems Design Program, College of Design	Energy Systems Design, 12.5%, 75%:25%	$ 30,000
4. Tim Smith	Dept. of Bioproducts/Biosystems Engineering	Market & Policy Analysis, 11.5%, 75%:25%	$ 17,500
5. Jane Davidson	Dept. Of Mechanical Engineering	Renewable Energy Design, 5%, 75%:25%	(from match)
7. Richard Strong	Center for Sustainable Building Research, College of Design	Planning & Design, 4%, 75%:25%	$ 8,000
8. Tom Schirber	Cold Climate Housing, Bioproducts/Biosystems Engineering	Community/Bldg Systems, 20%, 75%:25%	$ 28,000
9. William Weber	Center for Sustainable Building Research, College of Design	Community/Bldg Systems, 10%, 75%:25%	$ 14,500
13. Graduate Student 1		Energy Systems, 50%, 75%:25%	(from match)
14. Graduate Student 2		Market and regulatory, 50%, 75%:25%	$ 42,500
Contracts:			
1. Sheldon Strom + staff	Center for Energy and Environment	Technical review/community outreach	$ 15,000
2. Chris Dufrin + staff	Neighborhood Energy Connection	Technical review/community outreach	$ 15,000
3. P. MacDonaugh + staff	Kestrel Design Group	Water & Wastewater Systems Design	$ 30,000
Software			$ -
Acquisition (Fee Title or Permanent Easements):			N/A
Travel			$ -
Additional Budget Items:			N/A
TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND $ REQUEST			$ 250,000

V. OTHER FUNDS

SOURCE OF FUNDS	Description	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:	Federal Extension Funds	$ 22,000	*Secured*
Other State $ Being Applied to Project During Project Period:.	IREE Matching Funds	$ 50,000	*Secured*
In-kind Services During Project Period:		N/A	
Remaining $ from Current ENRTF Appropriation (if applicable):		N/A	
Funding History:		N/A	

Subcontractor Responsibilities
CEE and NEC are critical community partners with immense energy expertise and experience in existing urban neighborhoods. They will assist in identifying and interfacing with potential neighborhoods and providing technical review. Kestrel Design Group will be responsible for the innovative design of innovative on-site stormwater and wastewater treatment systems. Below are hourly billing rates for these subcontractors (no overhead included).

Kestrel	Peter McDonaugh	$64.84 per hour
Kestrel	Staff	$37.13 per hour
CEE	Dave Bohac	$84.23 per hour
CEE	Staff	$39.46 per hour
NEC	Chris Duffrin	$43.00 per hour

Project Manager Qualifications and Organization Description

John Carmody is the Director of the Center for Sustainable Building Research at the University of Minnesota. He holds a Bachelors and Masters degree in Architecture from the University of Minnesota. He has worked in building-related research for 30 years and is the author of several books on building design and construction. These include *Window Systems for High Performance Buildings* with Lawrence Berkeley National Laboratory, and the new edition of *Residential Windows: A Guide to New Technologies and Energy Performance*. Mr. Carmody was one of the leaders of a team that developed the *State of Minnesota Sustainable Building Guidelines* required on State-funded buildings. In 2008, the Center received funding to lead the State of Minnesota in its transformation to zero net energy and carbon buildings by the year 2030. His work also includes research on life cycle assessment of materials, affordable housing, post occupancy evaluations, and the development of decision-making tools for designers.

In 1997, the Building Research Group was established in the College of Architecture and Landscape Architecture and later became the Center for Sustainable Building Research (CSBR) in the newly formed College of Design. CSBR staff consists of 11 architects and one administrator. Through research, outreach and education, the Center for Sustainable Building Research is engaged in the transformation of the built environment. Working with other research entities within the University as well as public and private organizations is critical to CSBR's mission. CSBR serves as a resource for State of Minnesota, the design professions, the building industry, and the general public.

Research: CSBR conducts research in the following areas:

- Sustainable guidelines, standards and policy
- Affordable housing
- Windows and glazing
- Other building technologies
- Life cycle assessment tools
- Building evaluation

Outreach: CSBR provides outreach and dissemination of information to the design professions, individual communities, and the public agencies in the State. A particularly important aspect of CSBR outreach activities is the Design Assistance Program in collaboration with the Regional Sustainable Partnerships. As part of outreach activities CSBR staff members speak frequently at public seminars and at conferences.

Education: CSBR staff members teach in the MArch and MS Arch programs at the college. They also provide guest lectures and support for classes in other CDes Departments as well as in other colleges at the University. CSBR staff members also teach numerous continuing education classes through the AIA, USGBC, ASHRAE and other professional groups.

CSBR receives funding from a wide range of sources. In the last five years these include:

- *Federal*: Department of Energy, Department of Housing and Urban Development, Department of Transportation, Environmental Protection Agency, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory
- *State and local government:* University of Minnesota, IREE, and MNSCU; Minnesota Pollution Control Agency, Minnesota Housing, Minnesota Departments of Administration, Commerce, Transportation, and Natural Resources; Hennepin, Dakota and other metro counties; the Cities of St. Paul and Minneapolis.
- *Other*: McKnight Foundation, Wilder Foundation, Target Corporation, 3M Corporation, Xcel Energy, Green Communities Program, US Green Building Council, Green Building Initiative, Yonsei University Center for Sustainable Housing, Athena Institute