LEECH LAKE BAND OF OJIBWE
COMMUNITY SOLAR FOR COMMUNITY ACTION
Using Community Solar to Provide Low-Income Households with Solar Generated Energy Assistance

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EXECUTIVE SUMMARY

Low-income individuals expend a significantly greater percentage of their income on the cost of energy than middle- or upper-income families. When individuals or families must allocate a high percentage of their total income to cover their cost of energy, they are living in energy poverty. Nationally, energy burden for low-income households is 7.2% of total income, while for median-income households the ratio is 3.5% and for higher incomes its 2.3%.[1] To help relieve this energy burden amongst low-income populations across the United States, in 1981, the federal Low-Income Home Energy Assistance Program (LIHEAP) was established, which provides financial relief to low-income families by offsetting a portion of their costs of energy. While the goal of the program is to make our economy and nation stronger, each year federal LIHEAP funds are only able to support approximately 26% of eligible households in communities across the US.

In 2015, the national poverty rate was 13.5 percent, and 43.1 million Americans lived in poverty. Over 33 million American households struggle with energy poverty, forcing households to make difficult choices between home energy and other basic necessities, such as health care, housing, or adequate nutrition.

According to the 2014 US Census Bureau, "Income and Poverty in the United States" report, The Low-Income Home Energy Assistance Program (LIHEAP) provides critical home heating and cooling help to millions of vulnerable American families. After years of underfunding LIHEAP, Congress appropriated $5.1 billion for the program in FY2009 and FY2010, and $4.7 billion in FY2011.[2] Since then, funding has fallen to $3.39 billion in FY2017. As a result, 1.1 million eligible US households are not receiving energy assistance each year. Across the nation, critical energy assistance grants have been reduced and remain stagnant for every state.

In 2017, the National Energy Utility Affordability Coalition (NEUAC) released its annual plea to Congress to increase LIHEAP funding. The NEUAC shows that Minnesota's LIHEAP allocation dropped from $160 million dollars in FY2010 to $114.5 million dollars in FY2017.[3] With 628,945 eligible households in the state, only 126,149 were served, leaving 79.9% of our most vulnerable households unserved.[4] Moreover, federal funds are driven directly into the hands of electric and gas utilities, leaving low-income people with little agency in making their own energy choices. The process of funneling billions of dollars to fossil fuel-burning utilities continues annually, worsening environmental problems and failing to address the root causes of energy poverty. The current utility subsidy model is expensive and inadequate. LIHEAP fails to take advantage of clean energy technology, which has the potential of securing a sustainable future that empowers low-income homeowners with an opportunity to reduce their energy burdens.

Historically, because of the significant upfront investment costs associated with solar installations; and given that deployment incentives are aligned to benefit upper income individuals and businesses with significant tax liabilities, solar has been primarily for the upper echelons of society, resulting in a "renewable divide". However, low-income communities can stabilize energy costs, reduce household energy burden, and provide access to clean energy to families at the lower end of the economic ladder. Creating a new model of low-income energy assistance generates the power to make a difference in the lives of our low-income populations.

To address the need to assist low-income households burdened with energy poverty, the Rural Renewable Energy Alliance (RREAL) in partnership with the Leech Lake Band of Ojibwe pursued a new approach using clean, renewable energy produced by a community-based development approach. This model called "Community Solar for Community Action (CS4CA) has the potential to tap into the economic value of hedge created when leveraging the cost differential between anticipated energy costs of energy assistance recipients and the solar energy production generated via community based solar assets. Over time, the predicted delta between the two cost assumptions creates the potential to serve more households receiving energy assistance; while containing LIHEAP costs and reducing harmful greenhouse gas emissions generated from brown power, by replacing it with clean, renewable, predictable solar energy.

BACKGROUND

This first of its kind project offers the Leech Lake Band of Ojibwe, RREAL, and others preliminary research to better understand the feasibility of using community-based solar power to service Energy Assistance-eligible low-income families. Using funds received through the U.S. Department of Energy, The SunShot Prize: Solar In Your Community Challenge marketplace; RREAL is working with the Midwest Renewable Energy Association (MREA) to present an assessment of the preliminary results of the energy, economic, social and environmental outcomes to date; while also projecting future energy, economic, social and environmental outcomes arising from the installation of five community-based solar photovoltaic (PV) arrays installed and operating as integrated energy assistance resources for the Leech Lake Band of Ojibwe.

In partnership with the Leech Lake Band of Ojibwe, RREAL designed and installed five solar arrays equaling 217.6 kW_{DC} anticipated to generate an estimated 230,944 kWh of energy per year, with an economic value of $23,586 during its first full year of energy production. More importantly, the energy production over the life of the combined systems will generate an estimated 6,426,316 kWh of clean renewable energy, $913,691 in avoided electricity costs, and will offset 5,588 **$MTCO_{2e}$** of greenhouse gas emissions over a thirty-year time horizon.

The thesis of this case study, is that by directing a portion of LIHEAP grant funds away from brown energy supplied by utilities and instead invest in the development of community-based solar for low-income households; more households will be served, less greenhouse gas emissions will be dispersed, and taxpayers will benefit from the long-term predictability of the year-round energy production of the community solar assets.

New policies and energy production practices are on the horizon. Statewide renewable energy standards are paving the way for new community solar policies, to encourage weatherization and energy efficiency to be integrated with solar within LIHEAP. In addition, social finance innovations are on the verge of creating a reliable energy assistance funding mechanism. RREAL is actively engaged with several national coalitions to collaborate and develop solutions to reduce energy burdens among low-wealth communities by leveraging renewable energy innovations in the United States.

The Rural Renewable Energy Alliance (RREAL) is a nonprofit organization based in Minnesota dedicated to making solar energy accessible to communities of all income levels. Founded in 2000, RREAL has been championing the use of solar energy to address low-income energy poverty through its *Solar Assistance* program. *Solar*

Assistance delivers solar installations to families and communities eligible for federal Energy Assistance as a clean, lasting, and local solution to low-income energy poverty. As a nonprofit general contractor, RREAL has nearly two decades of low-income solar design-build experience and has risen to become a national thought leader on matters of energy and equity.

Recently, RREAL forged a new, nationally relevant, scalable model of energy assistance: *Community Solar for Community Action* (CS4CA). This community solar approach promises to have a much broader impact than focusing solar installations household by household. In partnership with the Leech Lake Band of Ojibwe, RREAL deployed a 217.6 kW_{DC} solar electric system that is integrated into the Tribal energy assistance program. Commissioned in 2017 this solar energy system represents a new model of energy assistance serving low-income households in Minnesota. The scattered community solar arrays are owned by the Leech Lake Tribal Government and generate power consumed on-site with the excess power fed into the regional power grid and purchased by one of five utilities that serve the Reservation. Each of the sites' meter owners tracks solar energy generation throughout the year and provides realized savings to the Leech Lake Energy Assistance Program (LLEAP).

This report seeks to analyze as a case study this first in the nation community solar garden built exclusively to serve eligible low-income families receiving energy assistance through the Leech Lake Energy Assistance Program (LLEAP). Developed in partnership with the Rural Renewable Energy Alliance (RREAL), this case study report seeks to analyze the economic, social and environmental impacts of the five-community solar photovoltaic (PV) arrays. Using this case study as a community-based solar model, LLEAP and RREAL are actively alleviating a portion of the energy needs of Tribal members, while serving to educate and provide insights for others about how to replicate the CS4CA model across the country.

Every winter, eligible households on the Reservation are denied Federal Low-Income Home Energy Assistance Program (LIHEAP) benefits because federal funds are insufficient to serve economically distressed communities. Over 100% of households in the Leech Lake community are living in poverty. Net proceeds generated by the LLEAP CS4CA asset are projected to supplement energy assistance for an estimated 70 to 100 households annually, based upon the amount each household will receive from the solar production.

The CS4CA model has the capacity to be replicated elsewhere due to the existing network of Local Community Action Partnership agencies (Service Providers) that provide energy assistance services to 96% of counties across the United States. As part of the U. S. Department of Energy (DoE) sponsored Solar in Your Community Challenge, RREAL is working to demonstrate the replicability and scalability the CS4CA model offers. Leveraging its existing relationships with service providers in Minnesota and Vermont, RREAL is creating awareness of the CS4CA program for development of new community solar assets in the future.

Building upon the LLEAP project, RREAL considers social impact investment using the Pay for Success finance model as a tool to unlock billions in capital to finance and develop thousands of low-income community solar projects across the U.S. in a short period of time. RREAL is actively seeking partnerships to demonstrate and validate this model. Using the Pay for Success model, social impact investors serve as the provider of capital needed to build the solar arrays, while enabling the service providers the authority to distribute the energy production to eligible energy assistance recipients, and upon verification of agreed upon metrics, the payor using LIHEAP funds will repay the social impact investors principal and a modest return on investment.

ACRONYMS

AMI	Area Median Income
CAA	Community Action Agency
CAP	Community Action Partner
CO2	Carbon Dioxide
COE	Cost of Energy
CS4CA	Community Solar for Community Action
DHHS	Department of Human & Health Services
EA	Energy Assistance
EAP	Energy Assistance Program
EIA	Energy Information Administration
HHD	Head of Household
HHS	Health & Human Services
HHSPG	Health & Human Services Poverty Guidelines
IOU	Investor Owned Utility
kW	Kilowatt
kWh	Kilowatt Hour
LiDAR	Light Detection and Ranging
LIHEAP	Low Income Home Energy Assistance Program
LLREA	Leech Lake Reservation Energy Assistance
LLR	Leech Lake Reservation
MW	Megawatt
MWh	Megawatt Hour
MREA	Midwest Renewable Energy Association
MTCO2e	Metric Tonnes of Carbon Dioxide Equivalents
NPV	Net Present Value Discount Rate
OLA	Office of the Legislative Auditor
PFS	Pay for Success
PUC	Public Utility Commission
RES	Renewable Energy Standard
RPS	Renewable Portfolio Standard
RREAL	Rural Renewable Energy Alliance
SEA	Solar Energy Alliance
SIB	Social Impact Bond
SMI	State Median Income
WAP	Weatherization Assistance Program
WX	Weatherization Transfer

DEFINITIONS

The following are the definitions of economic input values and economic assumptions that were incorporated into the economic modeling.

a. *Initial capital cost ($):* initial project cost
b. *Avoided electricity cost ($):* calculated value of future energy production (using assumed escalators and discount adjustments)
c. *Operating expenses ($):* calculated value of future insurance, operations and maintenance costs (using assumed escalators and discount adjustments)
d. *Total Lifetime Benefits ($):* calculated net difference between avoided electricity cost and operating expenses
e. *Lifetime IRR (%):* discounted rate of NPV of all cash flows project to zero over the lifetime of the asset.
f. *Lifetime NPV ($):* difference between the present value of cash inflow and the present value of cash outflows over the lifetime of the asset.
g. *Lifetime LCOE ($/kWh):* calculated lifetime cost of future energy divided by the future energy production (using assumed escalators and discount adjustments)

METHODOLOGIES

a. <u>Funding</u>

Funding needed to create the Leech Lake solar project was achieved by combining both grant funds and donations. In total, $600,000 in funds were contributed and used to construct five solar PV arrays located on Leech Lake Band of Ojibwe land.

Funding provided for development and construction of five solar arrays equaling 217.62 kW_{DC} / 187.7 kW_{AC} which will produce a total of approximately 232 MWh of solar energy and eliminate 105.8 MTCO2e in greenhouse gas emissions annually. The LL CS4CA solar asset is capable of providing LLEAP supplemental energy assistance to 70 to 100 households with affordable renewable energy.

The following is a summary the grant awards secured for the development of the project.

i. Grants
   1. Legislative Citizen Commission of Minnesota Resources, Environment and Natural Resources Trust Fund
   2. McKnight Foundation
   3. Bush Foundation
   4. Carolyn Foundation
   5. Initiative Foundation
   6. Shakopee Mdewakanton Sioux Community
   7. Headwaters for Justice

II. Awards
   1. Clean Energy Community Award

b. <u>Project Locations</u>

Working significantly in collaboration with the Leech Lake Division of Resource Management, the Rural Renewable Energy Alliance (RREAL), a 501(c)(3) nonprofit organization dedicated to making solar energy accessible to communities of all income levels, worked on site selection, feasibility analysis, design and construction of the five solar arrays.

i. *Jackson Village*
   Leech Lake Facilities Management Office

16126 John Moose Drive NW
Cass Lake, MN 56633

ii. *Leech Lake Tribal College*
6945 Little Wolf Road NW
Cass Lake, MN 56633

iii. *Palace Casino Hotel*
Leech Lake Band of Ojibwe
19699 69th Avenue NW
Cass Lake, MN 56633

iv. *Prescott Community Center*
Leech Lake Housing Authority Office
611 Elm Avenue NW
Cass Lake, MN 56633

v. *RREAL HQ South*
Rural Renewable Energy Alliance Headquarters Office
3963 8th Street SW
Backus, MN 56435

c. <u>System Costs</u>

The following total system costs, average system costs, and estimated annual system energy production assumptions are summarized below.

i. Total system cost: $600,000
ii. Total system size: 217.62 kW_{DC} / 187.7 kW_{AC}
iii. Average system cost per watt:
   a. DC cost/watt: $2.76
   b. AC cost/watt: $3.20

d. <u>Installed System Sizes (DC and AC)</u>

i. *Jackson Village*
   a. DC system size: 43.2kW
   b. AC system size: 37.5kW
   c. Estimated annual energy production: 46,130 kWh

d. Average $/kWh: $.1044

ii. *Leech Lake Tribal College*

a. DC system size: 46.08kW
b. AC system size: 39.98kW
c. Estimated annual energy production: 49,175 kWh
d. Average $/kWh: $.1011

iii. *Palace Casino*

a. DC system size: 44.64kW
b. AC system size: 39.98kW
c. Estimated annual energy production: 49,175 kWh
d. Average $/kWh: $.1011

iv. *Prescott*

a. DC system size: 42.78kW
b. AC system size: 37.5kW
c. Estimated annual energy production: 46,130 kWh
d. Average $/kWh: $.1011

v. *RREAL HQ South*

a. DC system size: 40.92kW
b. AC system size: 32.8kW (AC)
c. Estimated annual energy production: 40,334 kWh
d. Average $/kWh: $.1032

ASSUMPTIONS

The assumptions used to calculate the energy production potential of the solar arrays are summarized below are based upon a combination of actual and agreed upon values. These assumptions were used to project the future energy, economic, social and environmental benefits generated from the arrays over a projected thirty-year time horizon.

RREAL installed Heliene modules on the five solar arrays for the Leech Lake Band Energy Assistance project, locally manufactured and listed on the Bloomberg New Energy Finance PV Module Maker Tier One list. For more information about the modules and inverters used, refer to the manufacturers' data sheets in the appendix.

a. <u>System Modeling Assumptions</u>

The following definitions are provided to assist the reader understand the system owner, production and cost assumptions used in the economic modeling.

a. *System ownership status:* tax-exempt
b. *System size:* AC production
c. *First year energy production:* 1230 kWh/watt
d. *Total installation cost*: $3.20 per watt AC production
e. *System term (years):* 30
f. *Electricity rate:* weighted average kWh based upon utility provider current rates using invoice verification method)
g. *Annual electricity rate escalator:* 2.2 percent

b. <u>Operating & Return Assumptions</u>

The following definitions are provided to assist the reader understand the assumptions used in the economic modeling relating to operating and returns.

a. *Insurance cost ($/kW/Yr):* $0
b. *Operations and maintenance cost ($/kW/Yr):* $5
c. *Inverter replacement ($/W):* $ 0.15
d. *Panel degradation rate (%):* 0.5
e. *Inflation adjustment (%):* 2.0
f. *NPV Discount Rate (%):* 3.25

c. <u>Environmental Assumptions</u>

The Leech Lake Band of Ojibwe, RREAL, and the vast majority of climate scientists acknowledge the impacts that climate change is having on our environment. With this in mind, the CS4CA model potential to provide long-term, clean, renewable energy to low-income families receiving energy assistance produces a win-win-win outcome for the families served, the environment we all rely upon, while reducing taxpayer investments used to support the LIHEAP program.

In addition to the costs of associated with owning or renting, ongoing costs of heating and maintaining households continue throughout the calendar year. And because energy assistance is a band aid approach to resolving the energy burden of low-income families, imagine how solar energy could be used to lift families out of energy poverty, while also lessening the negative effects that fossil-fuels have on our environment. By using the infrastructure already in place, Community Action Agencies serving low-income communities across the U.S. have the potential to serve more families by providing them with solar powered energy assistance using the CS4CA model. Over time, the predictability of the levelized cost of energy produced by solar arrays reduce the overall costs of LIHEAP. The result is that the energy burden of families served by energy assistance could free up for other basic needs, like healthcare, food, and educational development. Liberation from energy poverty will allow recipients more freedom to engage in personal and community advancement.

Using the U.S. EPA Pollution Prevention (P2) Program Calculator, this report presents the greenhouse gas emissions offsets resulting from the energy production produced by the LLEAP solar arrays. Analysis includes outcomes already produced, in addition to future greenhouse gas emissions the solar arrays will produce over their thirty-year lifetime. It is generally accepted that for every 250 kW of community solar garden energy production produced, approximately 900,000 pounds of $CO2_e$ per year will be avoided, while producing usable clean energy for families now and in the future.

d. Social Assumptions

Working to address low-income households served by LLEAP, RREAL analyzed how the solar production can be used to address priorities identified in the recent DEFG Annual Survey.[5]

When asked, low-income survey respondents indicated the following:

a. 20% of respondents indicated they applied for energy assistance over the past two years
b. 61% of respondents indicated interest in types of payment assistance; payment arrangements
c. 79% are at least somewhat interested in learning about ways to save on electric or heating bills
d. 55% are concerned about paying fees and penalties (late fees; reconnection charges)
e. 39% would choose a flat bill with the same guaranteed monthly bill payment

LIHEAP dollars are targeted towards eligible families based upon the priorities for allocating the finite funds to families with the greatest home energy needs in relation to household income and number of household members. Priority is granted to households with elderly members (60+), disabled members, and/or households with young children (5 and under); whose household income is at or below 50 percent of the state median income.

Nationally, there are two primary LIHEAP fuel assistance offerings: heating assistance and winter/year-round crisis assistance. In 2014, the average home heating expenditures for LIHEAP recipient households was $797, although variations in states during FY 2014 ranged from $226 for summer crisis assistance to $301 for heating assistance, and when combined increased to $366 when heating and winter/year-round crisis benefits were combined.[6]

Based upon FY2014 data, estimated annual household average benefit from LIHEAP fuel assistance, by type of assistance in Minnesota is:

a. Heating Assistance: $495

Importantly, due to the cold climate in Minnesota, the average LIHEAP benefit per household is 35 percent higher than the national average of $366. The effect for Minnesota households receiving LIHEAP assistance is that an even higher percentage of household income must be dedicated to energy costs.

Using these assumptions, a primary goal for RREAL and LLEAP is to understand how to efficiently distribute energy production from the solar arrays to communities members over time. The remainder of this report will attempt to extrapolate outcomes of other future low-income community solar projects designed using the Community Solar for Community Action model.

This information is relevant to a broad multidisciplinary group of stakeholders; ranging from private and public sectors; is how this model will impact economically distressed households served, as well as, low-income services providers, taxpayers, governmental entities, policy makers, regulators, utilities, solar developers, investors, workforce development, and numerous other groups.

PRELIMINARY RESULTS

Preliminary results of the five LLEAP solar arrays energy production generated through December 31, 2017 is presented herein. System commissioning of one array occurred in 2016, with the remaining four arrays being commissioned throughout 2017. Power production has been collected and actively monitored using Fronius (solar.web) monitoring software.

a. Economic Metrics - Actual Energy Production & Avoided Energy Costs

During calendar year 2017, partial production from the five solar PV arrays combined to total 121.534 MWh, equaling $12,415.85 in avoided energy cost. The following represents the site based metrics for energy production and avoided energy costs.

2017 Actual Energy Production & Avoided Energy Costs - this table summarizes the energy production period, actual energy production (kWh) and actual avoided energy costs ($) generated by each solar array.

Location	**Production Period (2017)**	**Actual Energy Production (MWh)**	**Actual Energy Production Value ($)**
Jackson Village	Jun – Dec	22.244	$ 2,322.29
Leech Lake Tribal College	Sept - Dec	4.188	$ 423.37
Palace Casino	Jun – Dec	22.623	$ 2,287.23
Prescott	Jan – Dec	46.130	$ 4,663.74
RREAL HQ S	May – Dec	26.344	$ 2,719.22
Totals		**121.534**	**$ 12,415.85**

Methodology Sources:

1. Actual Energy Production (MWh) was collected by RREAL using Fronius Primo inverters.
2. Actual Energy Production Value ($) was calculated using the applicable utility provider weighted average retail rate of electricity (net metered) multiplied by the energy production value, per site and was validated through received utility credits.

b. Households Served

Most important to the success of the LLEAP project is its impact to tribal members families served by the energy production. Due to the privacy of energy assistance recipients utility data, the actual number of tribal households is not know. Therefore, for modeling purposes, the number of heating assistance households served was calculated using the Minnesota average household energy assistance benefit of $495.

2017 Households Served - number of Leech Lake Band of Ojibwe households benefiting from solar production generated by five solar arrays, based upon Minnesota average energy assistance benefit ($495).

Location	2017 Production Period (Months)	2017 Energy Production (kWh)	Energy Production Credits ($)	Heating Assistance Households Served ($495/household)
Jackson Village	Jun – Dec	22,244	$ 2,322.29	4.7
LLTC	Sept - Dec	4,188	$ 423.37	.9
Palace Casino	Jun – Dec	22,623	$ 2,287.23	4.6
Prescott	Jan – Dec	46,130	$ 4,663.74	9.4
RREAL HQ S	May – Dec	26,334	$ 2,719.22	5.5
Totals		**121,529**	**$ 12,415.85**	**25.1**

Methodology Sources:

1. Energy production data was collected by RREAL using Fronius Primo inverters.
2. Energy production credits ($) is the economic value of the energy credits produced during 2017 by each solar array.

Importantly, although the energy production generated was sufficient to cover the economic value of 25 households annual heating energy assistance credit, the LLEAP retains the authority to allocate energy production to eligible households in amounts different than calculated above.

c. Avoided Greenhouse Gas Emissions

The following analysis calculates the avoided greenhouse gas emissions ($MTCO_{2e}$) resulting from the energy production of the five arrays in 2017, using the U.S. EPA Pollution Prevention (P2) Calculator.[7]

2017 Greenhouse Gas Emission Offsets - summarizes the amount of GHG emission offsets produced from the five solar arrays during calendar year 2017.

Location	2017 Energy Production (kWh)	2017 GHG Avoided Emissions ($MTCO_{2e}$)
Jackson Village	22,244	19.373

Leech Lake Tribal College	4,188	3.647
Palace Casino	22,623	19.703
Prescott	46,130	40.176
RREAL HQ S	26,334	22.944
Totals	**121,529**	**105.843**

Methodology Source: EPA Pollution Prevention (P2) Program Calculator

PROJECTED RESULTS

Because solar PV arrays are fixed assets that generate long-term, predictable energy production for up to 30 years or more, energy production modeling was necessary to estimate the economic, social, and environmental impacts of the LLEAP solar arrays. As such, the Midwest Renewable Energy Associations (MREA) solar finance simulator tool, developed with funding from the U.S. Department of Energy SunShot Initiative, located at www.solarprojectbuilder.org was used to develop the output values summarized below.

MREA's team used pre-construction preliminary feasibility analysis reports, manufacturers cut-sheets, utility information, and actual energy production data compiled since January 2017 to build a set of modeling assumptions used to compile the information summarized below.

The information presented is divided into two primary group: a) First Year Projections and b) Total Lifetime Projections; and further separated into to three sub-groups: a) Energy Production and Economic Projections, b) Social Impact Projections; and c) Environmental Impact Projections.

a. <u>Energy Production & Economic Benefit Projections (2018)</u>
The following information represents the calculated energy production, avoided energy value, and energy production credits (net) that are anticipated to be generated by each of the five arrays over the course of calendar year 2018. Importantly, because solar arrays owners must plan for ongoing operations and maintenance costs; the first year energy production credits is the net value of the first year avoided energy value, less the predicted operations and maintenance costs associated with each system.

2018 Energy Production Projections - the following represent first year annual energy production (kWh), first year avoided energy value ($), and energy production credits (net) ($) by system location.

Location	First Year Annual Energy Production (kWh)	First Year Avoided Energy Value ($)	First Year Energy Production Credit (Net) ($)
Jackson Village	46,130	4,816	4,629
LLTC	49,175	4,972	4,772
Palace Casino	49,175	4,972	4,772
Prescott	46,130	4,664	4,477
RREAL HQ S	40,334	4,162	3,998
Totals	**230,944**	**23,586**	**22,648**

b. First Year Social Impact Projections (2018)

2018 (First Year Annual Projections) - this information represents the number of families projected to be served in 2018, based upon households receiving the annual Minnesota average heating assistance benefit of $495.

Location	First Year Annual Energy Production (kWh)	First Year Avoided Energy Value ($)	First Year Energy Production Credit (Net) ($)	Heating Assistance Households Served ($495/household)
Jackson Village	46,130	4,816	4,629	9.4
LLTC	49,175	4,972	4,772	9.6
Palace Casino	49,175	4,972	4,772	9
Prescott	46,130	4,664	4,477	9
RREAL HQ S	40,334	4,162	3,998	8
Totals	**230,944**	**23,586**	**22,648**	**45**

Importantly, LLEAP retains the authority to allocate energy production to eligible households in amounts different than calculated above.

c. First Year Environmental Impact Projections (2018)

The following two tables present the a) first year annual avoided GHG emissions and b) first year annual avoided GHG emission offset equivalents; which represent the amount of greenhouse gas emissions that are projected to be avoided by replacing the energy consumed by recipients of the energy produced by the LLEAP solar arrays.

First Year Annual Avoided GHG Emissions by Site - this table represents the total amount of avoided GHG emissions offset by first year annual energy production at each site.

Location	First Year Annual Energy Production (kWh)	First Year Annual GHG Avoided Emissions ($MTCO_{2e}$)
Jackson Village	46,130	40.176
Leech Lake Tribal College	49,175	40.176
Palace Casino	49,175	42.828
Prescott	46,130	42.828
RREAL HQ S	40,334	35.128
Totals	**230,944**	**201.136**

Methodology Source: EPA Pollution Prevention (P2) Program Calculator. The following formula was used to calculate the GHG avoided emissions in $MTCO_{2e}$ - 1,640.7 lbs CO_2/MWh x (4.536 x 10^{-4} metric tons/lb) x 0.001MWh/kWh

First Year Energy Production - GHG Emission Offset Equivalents - this table highlights calculated avoided GHG emission represented in household electricity needs, gallons of consumed gasoline, and avoided pounds of coal burned based upon one years energy production from each solar array.

Location	First Year Energy Production (kWh)	Household Electricity Needs Served in 1 Year	Gallons of Gasoline Consumed	Avoided Pounds of Coal Burned

Jackson Village	46,130	5.1	3,863	37,561
LLTC	49,175	5.5	4,118	40,040
Palace Casino	49,175	5.5	4,118	40,040
Prescott	46,130	5.1	3,863	37,561
RREAL HQ S	40,334	4.5	3,378	32,842
Totals	**232,024**	**25.7**	**19,340**	**187,684**

Methodology Source: EPA Pollution Prevention (P2) Program Calculator

1. *Home Electricity Needs Served*: based upon an average US household consuming 12,148kWh annually, using the following calculation - 12,148kWh X1,199 lbs CO_2 per MWh generated X 1/(1-0.073 delivered/MWh generated x 1 MWh/1,000 kWh x 1 metric ton/2,204.6 lbs).
2. *Gallons of Gasoline Consumed*: based upon an average 22.0 miles per gallon, using the following calculation - 8.89 x 10^{-3} metric tons CO_2/gallon gasoline x 1/22.0 miles per gallon x 1 CO_2, CH_4, and N_2O/0.989 CO_2.
3. *Avoided Pounds of Coal Burned*: based upon the average heat content of coal consumed for electricity generation in the U.S., using the following calculation - 21.10 mmbtu/metric ton coal × 26.05 kg C/mmbtu × 44 kg CO2/12 kg C × 1 metric ton coal/2,204.6 pound of coal x 1 metric ton/1,000 kg.

d. <u>Total Lifetime Energy Production & Economic Benefit Projections (2018 - 2038)</u>

Due to the inherent predictability of solar insolation, solar developers are able to reliably model how much energy will be produced by an array, based upon its geographic location and system design. Along with reasonable assumptions, the following data has been modeled to predict the total lifetime benefits to be produced by the five arrays over the next 30 years; based upon the energy production projections, using the assumptions highlighted in the Assumptions section of the report.

Over the next 30 years, the five LLEAP solar arrays are projected to generate 6.4MWh equaling $913,691 in avoided energy costs, less initial and future costs to produce net energy production credits equaling $247,274 to be used by LLEAP to serve tribal households receiving energy assistance. The social impact is that at minimum, 1350 households will benefit from this energy production and a total of 5,588 **($MTCO_{2e}$) of GHG emissions will be offset.**

Total Lifetime Energy Production & Economic Projections (2018 - 2038) - this table summarizes the system sizes (kW - DC & AC, first year annual energy production (kWh), lifetime energy production (kWh), lifetime avoided energy costs ($) and total lifetime benefits ($) generated by each solar array.

Location	First Year Annual Energy Production (kWh)	Lifetime Energy Production (kWh)	Lifetime Avoided Energy Value ($)	Total Lifetime Energy Production Credit (Net) ($)
Jackson Village	46,130	1,283,867	185,365	52,133
LLTC	49,175	1,368,294	191,355	49,489
Palace Casino	49,175	1,368,294	191,355	49,489
Prescott	46,130	1,283,567	185,365	52,299
RREAL HQ	40,334	1,112,294	160,251	43,864
Totals	**230,944**	**6,426,316**	**$913,691**	**$247,274**

e. Households Served

Total Number of Households Served Projections (2018 - 2038) - this data represents the projected total number of households receiving heating assistances (PV - $495/household - FV - $669) per year for 30 years produced by each array. PV - present value, FV - future value

Location	Lifetime Energy Production (kWh)	Lifetime Avoided Energy Value ($)	Total Lifetime Benefit ($)	Total Heating Assistance Households Served (FV - $669)
Jackson Village	1,283,867	185,365	52,133	277
LLTC	1,368,294	191,355	49,489	286
Palace Casino	1,368,294	191,355	49,489	286

Prescott	1,283,567	185,365	52,299	277
RREAL HQ S	1,112,294	160,251	43,864	240
Totals	**6,426,316**	**$913,691**	**$247,274**	**1,366**

As indicated earlier in the report, it is probable that LLEAP will disburse energy production credits to more households than calculated in the table represented above. Equally important to be considered is that households receiving energy assistance are not static over time.

f. Avoided Greenhouse Gas Emissions

As referenced in the preliminary results section, the annual and cumulative avoided greenhouse gas emissions were calculated using the U.S. EPA Pollution Prevention (P2) Program Calculator, available here. Using the P2 Calculator, first year annual energy production of each array in kWh was entered into the tools 'Green Energy' worksheet. Results from the calculator are presented both as annual and total lifetime GHG avoided emissions by site.

Total Lifetime Energy Production GHG Avoided Emissions by Site - this table represents the total amount of avoided GHG emissions offset each solar array over its 30 years of energy production.

Location	**Lifetime Energy Production (kWh)**	**Lifetime GHG Avoided Emissions (MTCO$_{2e}$)**
Jackson Village	1,283,867	1,118.155
Leech Lake Tribal College	1,368,294	1,191.685
Palace Casino	1,368,294	1,191.685
Prescott	1,283,567	1,117.894
RREAL HQ	1,112,294	968.728
Totals	**6,416,316**	**5,588.148**

Methodology Source: EPA Pollution Prevention (P2) Program Calculator

Total Lifetime (30 Year) Energy Production - GHG Emissions Offset Equivalents - this table highlights calculated avoided GHG emission represented in household electricity needs, gallons of consumed gasoline, and avoided pounds of coal burned based upon thirty-years of energy production from each solar array.

Location	**Energy Production (kWh) for 30 Years**	**Home Electricity Served for 30 Year**	**Gallons of Gasoline Consumed Over 30 Years**	**Avoided Pounds of Coal Burned Over 30 Years**
Jackson Village	1,283,867	143	107,514	1,045,378
LLTC	1,368,294	153	114,584	1,114,122
Palace Casino	1,368,294	153	114,584	1,114,122
Prescott	1,283,867	143	107,514	1,045,378
RREAL HQ	1,112,294	124	93,146	905,676
Totals	**6,426,316**	**578**	**537,339**	**5,224,676**

Methodology Source: EPA Pollution Prevention (P2) Program Calculator

KEY CONSIDERATIONS

The CS4CA project demonstrates low-income community solar can be cost-effectively developed, produced, and efficiently delivered for the benefit of recipients of energy assistance. This first in the nation project is a demonstrative example of how solar generated electricity can be economically delivered to low-income households served by the LLEAP.

Based upon the early results of this case study, its success presents the basis for replication elsewhere. As is the case with most pilot projects, unique constraints and limitations will be identified with any new proposed projects. However, creativity and collaboration can often resolve knowable constraints and limitations.

There were a few inherent design limitations the LLEAP project had to overcome, due to insufficient cooperation from the local utilities to allow for the development of a single site (200kW). Because five discrete solar arrays had to be built to accommodate the Minnesota

40kW cap on solar interconnection, design, construction, and permitting costs, as well as the costs association with installation and maintenance are higher than optimal.

The following are other general limitations that may impact other CS4CA projects:

a. ***Net metering policies***: is a billing mechanism that provides utility bill credits to solar energy system owners for the excess solar production that is delivered onto the utility distribution grid. The net metering rate offered by utilities is based upon state policy and directly effects whether an economic gain or loss resulting from the excess energy production of an array will have a net positive or negative economic value, based upon local utility rate tariffs.
b. ***Virtual net-metering policies***: is a billing mechanism to provide bill credits for excess solar production produced by a shared solar asset, whether owned by a utility, a private developer, or other owner. Similar to net metering, the economic value of the energy production credit is determined by state policy and local utility rate tariffs.
c. ***Community solar policy*:** is a solar policy that allows for the establishment of centralized solar arrays that generate solar energy production that is bought through subscription, based upon volume, or another form of subscription. Used in conjunction with virtual net metering, community solar policy is both state and utility specific.
d. ***Solar renewable energy credits (SREC)***: some state renewable portfolio standard policies allow for solar renewable energy credits markets to establish potential economic value resulting from solar energy production generated by solar arrays, based upon monetary value per MWh. States with established SREC markets provide the potential for greater economic value for prospective CS4CA projects.
e. ***Service provider***: the CS4CA model must actively partner with willing to administer and manage the disbursement of energy production credits. These may be community action partnerships (CAPs), community action agencies, or tribal entities serving low-income eligible recipients of energy assistance. Ideally, these organizations will be located in areas with virtual net metering and have other favorable solar energy policies.
f. ***Utility cooperation***: utility willingness to design a low-income community solar energy assistance model through bill credits with Community Action Partners and Energy Assistance Programs. NOTE: from a utility's perspective CS4CA project poses a potential double loss of revenue; a) from the loss of energy sales, and b) from the potential loss of revenue resulting from reduced energy assistance dollars.
g. *Social impact data:* due to the associated privacy concerns relating to the release of personal information or data, getting directly attributable data is generally not possible. However, general assumptions for service delivery of energy production is possible using the calculated energy production of CS4CA systems divided by annual average household benefit received. In addition, energy assistance providers retain great

flexibility to allocate energy production credits generated from CS4CA systems to those most in need, on an annual basis using virtual net metering policies. A lesson learned is to fully engage community energy assistance program partners in identifying and collecting social metrics to track program results of predetermined outcomes.

h. *Initial and Future Cost of Solar Assets:* inherent to all fixed assets, such as solar PV arrays, initial (design, permitting, construction, financing, and other transactional) costs, as well as, future (insurance, operating and maintenance, financing) costs directly reduce the net energy production credits available to benefit the households receiving the energy production of low-income community-based solar arrays.

While each key consideration summarized above will be project specific, all have been demonstrated to be limits rather than barriers to success for LLEAP and RREAL. Using this case study, lessons learned can be applied to other CS4CA projects and result in replication and expansion of low-income community-based solar projects being developed across the country. Creative solutioning is critical to moving beyond barriers for creating an economically, environmentally, and socially feasible program.

REPLICABILITY

Based upon the first in the nation status, the Leech Lake Reservation Energy Assistance low-income community solar project offers a compelling example of how ingenuity, collaboration and commitment can overcome challenges and result in family's energy poverty needs being addressed using solar PV energy produced using a community solar design model.

Through this innovative CS4CA project, each year up to 100 Leech Lake Band of Ojibwe households will receive energy assistance from power generated by the sun. Over the coming 30 years, upwards of 3,500 households will benefit from the clean, renewable energy produced by the LLEAP scattered solar arrays. In doing so, not only will families benefit, but due to this innovative approach to providing low-income households energy assistance, an estimated 5,588 $MTCO_{2e}$ of greenhouse gas emissions entering the atmosphere will be avoided.

Looking beyond the LLEAP case study, the lessons learned coupled with careful planning will lead to better outcomes for low-income populations. Most critical to developing the CS4CA model for scale is formation of committed cross-sector community development partnerships among Energy Assistance Service Providers, CAP agencies, state and local governing bodies, EPCs, social impact investors, intermediaries, evaluators, etc. Partnerships will emerge to bring forth new CS4CA projects using the PFS model for investment as a mechanism for developing low-income communities and social programs that serve them on a national scale.

This approach holds significant possibility when limitations are minimized and key considerations are optimized through responsibly measuring performance based outcomes of the people served by the dollars invested. Bridging barriers to entry such as democratizing access to clean energy for all by lowering initial and future costs of the solar arrays. Additionally, forming partnerships for developing community solar friendly policies, laws, and practices that include and level the playing field for low-income populations is a crucial component for arresting energy poverty. Another cornerstone of a Pay for Success model is the partnership between private investors and public funding agencies. PFS financing requires state and / or local agencies to step up and serve as the public payor. When outcomes are achieved, private investors are repaid for shouldering initial risk of low-income community development of solar assets and repaying initial capital costs associated with developing CS4CA projects.

The primary value of using community-based solar in meeting low-income households' energy assistance needs is the financial benefit of virtual net metering credits integrated into the energy assistance program. In this case study, each year, year-over-year, LLEAP has the flexibility to assign energy production credits generated from it's solar arrays to any configuration of eligible households in its service area.

Based upon the results of the LLEAP project, RREAL has performed analysis seeking to quantify the comparative benefits $600,000 spent on the status quo disbursement of LIHEAP grants verse $600,000 spent on a CS4CA pay for success, social impact bonding finance tool, verse $600,000 of equity spent to directly owned community solar assets using an installed cost/watt of $2.00. Conceptually, in both solar models (debt and equity financing), the service provider disbursing the solar energy credits, to eligible low-wealth recipients, will be administratively and operational responsible for the solar asset.

- LIHEAP - looks at the status quo delivered kWh based upon current cost per kWh, to generate number of households served, and GHG emissions generated.
- Solar using Pay for Success - uses the present value of the available for development amount, to generate number of households served and displaced GHG emission (over 30 years).
- Solar using Direct Ownership Model - uses the available for development amount, to generate number households served, and displaced GHG emissions (over 30 years).

Comparative Investment Models - using a baseline capital investment of $600,000 three models were run to calculate the total number of households served with energy assistance in Minnesota and the amount of GHG emissions generated or avoided based upon the power supply.

Capital Investment	**LIHEAP**	**Solar - Pay for Success**	**Solar - Direct Ownership**
Committed Investment	$600,000	$600,000	$600,000
Administrative Cost (10%)	$60,000	$60,000	$60,000
Solar Transaction Costs		$20,000	$20,000
Available for Development	$540,000	$520,000	$520,000
Present Value (debt assumptions 7 yr term & 4% interest rate)		$395,158	
Performance Metrics			
Cost Per kWh ($/kWh)	$0.1044	$0.0930	$0.074
Avoided Energy Cost ($)		$1,198,671	$1,424,010
Total Lifetime Benefit ($)		$542,925	$696,246
kWh Delivered (kWh)	5,127,414	8,300,253	9,860,246
Additional kWh Delivered (Solar Generated) (kWh)		3,127,839	4,688,210
2017 MN Ave Heating Assistance ($)	$495		
MN Ave Heating Assistance (30 Yrs)		$669	$669
# of households served	1,091	1,792	2,129
MTCO$_{2e}$ GHG generated	3,850		
MTCO$_{2e}$ GHG avoided		6,177	7,388

This comparative modeling represents investing an equal amount of LIHEAP grant dollars into community solar over a 30 year term enables more energy assistance eligible households to be served, than the current LIHEAP grant allocation model (status quo) which underserves this vital basic need. Environmentally, there is an additional benefit of displacing future GHG emissions by switching the power supply from existing brown power supplied by government subsidized (LIHEAP) utilities to renewable energy powered by a solar PV array that is locally owned and distributed to the low-income communities served.

Recognizing the fact that ninety-eight (98) percent of US counties disburse LIHEAP energy assistance grant funds via Energy Assistance Service Providers and CAP agencies that flow directly to utility companies; the CS4CA model bridges the solar divide empowering democracy by leveraging solar energy as fundamental to creating greater economic resilience and health in low-wealth communities. These Service Providers can leverage the existing LIHEAP infrastructure to disburse solar energy production credits to eligible energy assistance recipients. LIHEAP is a program that for generations has used CAP agencies to identify, process applications to determine eligibility, followed by disbursing energy transfer credits to utilities, using disbursement of LIHEAP funds for the benefit of low-income households across the country, seasonally. This same infrastructure can distribute CS4CA energy assistance year-round!

In recent months, the US Congress and Trump Administration have enacted the Tax Reform and Jobs Act in December 2017 that includes Opportunity Zones providing financial incentives for capital gain investments that impact low-income communities. Additionally, the Bipartisan Budget Act of 2018 passed in early February 2018, includes $100 million in funding to expand the Pay for Success model via the Social Impact Partnership to Pay for Results Act (SIPPRA). Preliminary reviews of SIPPRA indicate that the US Department of Treasury has created a new source of Housing and Human Services (HHS) funding (Government Payor) that are applicable to the CS4CA model. Over time the LIHEAP program can be reengineered to integrate community solar assets to provide greater economic stability for federal, state, and local governments, while providing reliable, clean, renewable energy serving the lives and health of more low-income families across the US.

CONCLUSION

The Community Solar for Community Action pilot implemented by the Leech Lake Band of Ojibwe represents a compelling model for replication at the national level. This first in the nation 100% low-income community solar model developed and implemented by the Leech Lake Reservation Energy Assistance program, in partnership with RREAL, has demonstrated that energy assistance can be economically delivered.

As of December 31, 2017, the five arrays installed have generated 121,529 kWh of clean, renewable solar energy, creating $12,415.85 in economic value for distribution to Leech Lake Band of Ojibwe tribal member families receiving energy assistance. The LLEAP array reduced approximately 105 metric ton of greenhouse gas emission equivalents from entering the atmosphere in 2017. Additionally, it is projected that 6,426,316 kWh of clean, renewable energy will be produced over the coming 30 years equaling an anticipated $913,691 in avoided costs, $247,274 in net energy production credits to be used to serve approximately 70 to 100 families per year; while displacing an estimated 5,518 $MTCO_{2e}$ of greenhouse gas emissions from entering the atmosphere.

The LLEAP CS4CA is powerfully demonstrating positive impacts of locally owned and distributed community solar integrated into energy assistance programs. This is an important first step in transforming a subsidy based model to a performance based model. It is inspiring additional CS4CA projects that will leverage social impact financing tools like Pay for Success (PFS) to intentionally and methodically measure environmental, social, and economic outcomes. Results based community solar development investments are incentives to serve those in need reducing reliance on the subsidized fossil fuel LIHEAP model. Leveraging private capital using PFS to finance and build solar arrays is a next logical step in advancing the CS4CA model. The value propositions are compelling for all of US.

PFS attracts private capital to spur investment while requiring measurable outcomes before public payments to the investors. Proving economic results and social impacts is central to the CS4CA PFS energy assistance innovation. Over the coming months, RREAL's will engage payors, energy assistance program administrators, intermediaries, and investors forging new opportunities to highlight the LLEAP pilot and build on its success.

The predictable levelized costs of energy solar PV generates over time is a solid measurable metric. Coupled with the existing energy assistance distribution infrastructure community action partners can efficiently distribute solar generated energy assistance to eligible recipients. Over time, this benefits families, community action partners, state agencies, the federal government, and ultimately tax payers.

Over the 30-year lifespan of the solar asset, the Leech Lake Band of Ojibwe pilot is projected to increase households served and reduce pollution. It has already created workforce development and jobs. Proven outcomes open the door to the possibility of allocating a carve out of LIHEAP grants at the state level to replicate the CS4CA model, increasing the number of households served, reducing the amount of harmful GHG emissions entering our atmosphere, and lessening taxpayer funds spent on escalating costs of utility supplied brown power. As demonstrated, CS4CA is a model that has the potential to produce Savings to Investment Ratio (SIR) greater than 1. Not to mention the social impact of providing reliable energy to our most vulnerable populations today and for generations to come. Finally, we all gain from the positive impact renewable solar energy plays on the health of humans and our shared home Earth. Community Solar for Community Action using Pay for Success for impact has the power to make a difference!

APPENDIX

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