



Consumer Handout Packet

Arrowhead Electric Cooperative, Inc.
PO Box 39
Lutsen, MN 55612

Dear Arrowhead Electric Cooperative member-consumer:

Thank you for requesting information about interconnecting a renewable energy system (generator) to Arrowhead Electric Cooperative's system. To assist our member-consumers, we have developed a streamlined process for the safe, reliable, efficient, and cost-effective interconnection of small renewable energy systems. Much of this guide is specific to solar photovoltaic systems (PV), however, those interested in Wind or other renewables will also find a lot of helpful information.

Our mission is to protect the safety of cooperative personnel and member-consumers, maintain the integrity and reliability of the grid, and establish mechanisms to ensure rate equity for all member-consumers. Because renewable energy systems can affect the safety and reliability of the distribution system, we have developed technical interconnection rules that address those safety and reliability impacts. These rules ensure that we can continue to provide you and all other member-consumers with safe and reliable electricity service.

We are ready to help you by providing information and answering questions. We want to give you the tools you need to make an informed decision about a renewable energy system.

In this packet, you will find the following documents:

- Interconnection information, including an interconnection application, a summary of the cooperative's interconnection process, a schedule of interconnection costs, and the cooperative's interconnection agreement.
- Steps to a PV system, which will walk you through the various issues associated with a PV system.
- Questions you may want to ask installers before purchasing a system.
- Frequently asked questions (FAQs) and answers to these questions that member-consumers most often ask their cooperatives.

We look forward to working with you. If you have any questions, please don't hesitate to contact me at 218-663-7239 or jbuttwelier@aecimn.com.

Yours sincerely,

Joe Buttwelier
Director of Member Services



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Capital Cost Recovery Resources

As interest in renewable energy grows, some cooperative member-consumers are considering the purchase of a PV system. If you are interested in installing a PV system to replace some of the electricity that your cooperative provides, talk with a cooperative representative about your plans.

Before you decide to buy a PV system, however, you should examine the economics to determine whether such a system will lower your monthly electricity costs. The Energy Matters Web site—<http://www.solar-estimate.org>—can help you determine the annual operating cost of a PV system.

Ten Steps to a PV System

Is a PV system right for you? These 10 steps will help you to decide.

1. Determine how much electricity you use and what it costs, both annually and by the kilowatt-hour. Then find ways to make your home more efficient and reduce your energy use.

Start by calculating your average electricity bill. Then conduct an energy audit of your home to identify ways of using energy more efficiently and reducing energy use. Implementing energy efficiency opportunities will almost always speed up the rate of return on your PV investment and additionally may enhance the viability of a PV system project by giving you the lower capital expense associated with a smaller system that will satisfy the new lower energy load. This could lower your electricity bill significantly. The National Rural Electric Cooperative Association (NRECA) recently reviewed several Web sites that host online energy audits. The review identified one Web site—Home Energy Saver—as among the best (<http://www.touchstoneenergysavers.com/homeAudits.html>).

A home energy audit may be a good idea. It does not make sense to spend a significant amount of money on a PV system that will produce electricity to power inefficient lights, appliances, and electronics.



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2. Determine your solar resource.

The solar resource is the average amount of sunlight that reaches a given site. The greater the solar resource, the more electricity a PV system will generate.

A qualified PV installer can provide information on your solar resource. Alternatively, you can evaluate it using an online tool, such as PVWATTS Version 1 from the National Renewable Energy Laboratory, available at <http://www.nrel.gov/rredc/>

Several site conditions can influence PV performance—shade, roof condition, space required, orientation, and tilt. Shade is likely to have a greater impact on PV system performance than less-than-optimal PV module orientation and tilt (see below).

A qualified PV installer can use software tools to assess the degree of shading a proposed array will experience throughout the year and determine the best PV design.

3. Determine your site's suitability.

If your PV system is to be roof-mounted, the condition of the roof is important. The cost of repairs or a complete re-roofing will be substantially greater once the PV array is in place.

Another consideration is the space available for an array sized to meet your needs. In bright sunlight, a square foot of a PV module will produce approximately 10 watts of electricity. That's a helpful rule of thumb for estimating how much area you will need. A 1,000 watt (1 kW) PV system, for example, is likely to need 100–200 square feet of area, depending on the type of module used.

PV modules should be oriented geographically to maximize the amount of daily and seasonal solar energy. In general, the optimal orientation for a PV module in the northern hemisphere is true south.

Most PV modules are mounted flat on the roof and so have the same tilt as the roof. The optimal tilt angle for maximizing annual energy production of PV modules is an angle equal to your latitude. Because most roofs are pitched at an angle less than the latitude, you and your installer will need to factor your roof



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angle into the performance calculations when sizing your system. Some roof-mounted systems can be adjusted for the sun's higher position in the sky in the summer and lower position in the winter.

Although most PV systems are roof-mounted, pole- and ground-mounting also are options. Both have more opportunities for incorporating tracking to maximize electricity production than do roof-mounted systems. A tracking device can increase the output by 25–40% over a stationary-mounted system. In addition, a pole-mounted system can be located far from shading and the array can be tilted and oriented in the best position. However, adjusting the tilt of a pole-mounted array for summer and winter sun may require at least two people.

Talk with a qualified PV installer about the best mounting option for your site.

4. Determine the size of the PV system.

Realistically, the size of your system is likely to be determined more by cost than by desired output. It makes sense, however, to estimate the amount of electricity that you want your PV system to produce. If cost is a constraint, the system could be installed in two phases.

Before determining the size of your PV system, it is advisable to adopt energy efficiency measures that will reduce your annual energy use and thus maximize the value of your PV system.

You can ask your PV installer to help determine the size of your system. You also can begin by calculating your electricity usage and the annual average peak solar hours at your site. A peak sun hour is the average amount of sunlight—summer and winter—available at your site. NREL publishes solar radiation resource maps that provide data on peak sun hours at http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/atlas/.

Divide your annual electricity usage (in kWh) by the number of peak sun hours to determine the wattage needed for your system.

Alternatively, you can calculate your average daily electricity usage (in kWh) and refer to a chart that estimates the system size needed to reduce your electricity use by 25%, 50%, 75%, or 100%. See <http://www.thesolarenergycompany.com/images/sizingPV/SizingChart.pdf> for more information.



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DOE provides an estimate of the area needed for variously sized PV systems—including 1 kW, 2 kW, 4 kW, and 10 kW systems—for various module efficiency, available at

http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10840.

5. Find out what incentives—rebates, tax credits, and loans—are available.

The Emergency Economic Stabilization Act of 2008 includes a residential solar investment tax credit provision. The provision extends the 30% investment tax credit (ITC) for residential solar property for eight years, through December 31, 2016. The provision also removes the cap on qualified solar electric property expenditures (previously \$2,000) for a system placed in service after December 31, 2008.

The Database of State Incentives for Renewables & Efficiency (DSIRE) provides detailed information on each state's incentives that apply to renewable energy systems, including PV. You can access the database at

<http://www.dsireusa.org>.

A few states offer generous incentives for PV systems, some offer more limited incentives, but many offer none. These incentives can reduce the installed cost of a PV system significantly. The DSIRE database, available at

<http://www.dsireusa.org/>, provides detailed information on renewable energy tax incentives, loans, grants, and rebates available in each state.

6. Determine the estimated installed cost of the system and calculate return on investment.

PV systems are rated in kilowatts of DC generating capacity (kWdc), and tend to range in size from less than 1 kW to 10 kW. The average cost of an installed residential PV system typically ranges from \$8/watt to \$10/watt, depending on the size of the system, the region of the country, and the size and maturity of the PV market in that region. A recent study by DOE's Lawrence Berkeley National Laboratory identified a range of \$7.60/watt to \$10.80/watt. An average 2 kW system is likely to cost between \$16,000 and \$20,000. As a rule of thumb, the larger the system, the lower the per watt cost.



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If you are considering the purchase of a battery bank, the cost will be higher. For a pole- or ground-mounted PV system, installation costs will be greater. In addition, a tracking device on a pole-mounted system will boost the cost of your PV system. You can compare the cost-effectiveness of fixed mount and a single- or dual-axis tracking for your site at <http://www.nrel.gov/rredc/>.

The payback for a PV system is the amount of time it takes for the system to pay for itself in energy savings. Depending on the level of government incentives, the payback period can range from fewer than 10 years to more than 20 years, depending on the cost of the system, the amount of electricity produced, and the retail price of electricity that you buy from Arrowhead Electric Cooperative..

You can calculate the simple payback of a PV system using the following formula:

Total of Life Cycle Costs (capital costs + finance costs + O&M costs - federal and state incentives) / Average Value of Energy Generated per Year (kWh generated * cost of power).

In addition, an online calculator is available at <http://www.solar-estimate.org>.

Note: The payback may be overestimated by using either the formula or the solar-estimate.org calculator if the system is dual-metered but not net metered.



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7. Determine what zoning regulations apply to the installation of a PV system, if any, and what building and electrical permits are required. Talk with your neighbors about your plans.

Local zoning laws may restrict where you can place PV panels on your home. Check with your city or county to find out about any restrictions.

You may need to obtain a building permit to install a PV system. Building and electrical codes also may apply. Contact your local building department or ask your PV installer to include the cost of permits in the cost estimate.

After your PV system is installed, it must be inspected and approved by the local permitting agency (usually a building or electrical inspector) and Arrowhead Electric Cooperative. Inspectors may require your installer to make corrections. A copy of the building permit showing the final inspection sign-off may be required to qualify for a solar rebate program, if that type of incentive is available in your area.

Fees for building permits for PV systems range from \$200 to \$500. If a fee seems inappropriate or excessive, you may be able to get it reduced or waived. Find out what you are being charged for and offer to provide documentation or information that may make the fee unnecessary.

At this stage, talk with neighbors about your plans and listen to any of their concerns. If there are any other PV system owners in your area, talk with them about any concerns their neighbors had and how they dealt with these concerns. Many states have “solar access” laws, which protect homeowners from the most common (aesthetic) complaints.

8. Ask your cooperative about its interconnection requirements, including costs and liability insurance.

If you have not already talked with Arrowhead Electric Cooperative about your plans, do so now. Discuss the steps you have taken to get to this point and provide information on the PV system you are considering. You need to make sure that the system meets the cooperative’s criteria for interconnection.

Arrowhead Electric Cooperative requires an interconnection agreement, which is included in this packet of information.



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9. Find a PV system installer (if you haven't already done so).

Using a professional PV installer is the best way to avoid installation problems with your system. A qualified, experienced installer will design a system that meets your needs and site conditions. The installer also can help you with the paperwork for tax credits and rebates.

You might want to start looking for an installer by asking current PV system owners in your area for references. Several Web sites also provide listings of qualified installers. Among them are the American Solar Energy Society, at <http://www.findsolar.com/>; Home Power magazine, at http://www.homepower.com/view/?file=HP116_pg102_IPP; Energy Matters' Solar-Estimate at <http://www.solar-estimate.org/index.php?verifycookie=1&page=solar-installer&subpage=>; and the North American Board of Certified Energy Practitioners (NABCEP), at <http://www.nabcep.org>. NABCEP, considered the most respected solar certification organization in the United States, has a certification program for PV installers. To be certified as a PV installer under NABCEP, an individual must have several years of installation experience and training and also take an examination.

Another option is to ask your state's renewable energy organization or energy office about installers. DOE's EERE Web site provides contact information for state energy offices, available at http://www.eere.energy.gov/state_energy_program/seo_contacts.cfm. Regional organizations, such as the Midwest Renewable Energy Association (MREA—<http://www.the-mrea.org>) may also be able to help. Also, check the local chapter of the Solar Energy Industries Association (SEIA) to find PV installers.

Both finding the installer who is right for you and establishing a good working relationship with that individual are essential to a successful PV project.

Once you have a short list of installers, contact at least two of them for quotes for the equipment and installation. Question any quote that appears to be too high or too low.

Some states link installation requirements to incentives. Check the DSIRE database for the requirements in your state, available at <http://www.dsireusa.org/solar/index.cfm?ee=1&re=1&spv=1&st=0>.



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10. Contract for installation of your PV system.

Before actually placing an order, ask the installer for the names of consumers who have installed a similar PV system. Contact those consumers to ask about system performance, reliability, and support from the installer. Also ask if the system is meeting their expectations.

Ensure that the PV panel manufacturer offers at least a 20-year limited warranty and the inverter manufacturer offers a five-year limited warranty. The panels and inverter should be Underwriters Laboratories (UL) listed. Also ask the installer about a warranty for the work.

Questions to Ask PV Installers

Arrowhead Electric Cooperative member-consumers interested in installing a PV system should ask installers or contractors the following questions:

1. What are your credentials? How long have you been in business? How many grid-connected PV systems have you installed?

Look for installers that have been in business for at least five years. Installers certified by NABCEP must pass a rigorous examination and demonstrate that they possess a high degree of experience or education related to PV system design and installation.

In addition, you should ask the installer for a portfolio of recent residential projects and the names of at least two people who have had a PV system installed that is the same as, or similar to, the one you are considering.

2. What is the estimated total installed cost? What do the panels cost? What does the inverter cost? What is the estimated installation cost?

It is important to know the total installed cost of a PV system to ensure sufficient budgeting for the system. Budget for installation labor expenses, as well as the cost of equipment rental, construction materials, electrical components, shipping, and sales tax.

3. How long is the warranty? What does it cover? Parts? Labor? Can it be extended? If so, what will it cost?



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The PV panel manufacturer should offer a 25-year warranty for crystalline modules and 20 years for thin films. Warranties for inverters should be for five years. Make sure the warranty covers all aspects of the removal, shipping, repair, and reinstallation of components. Arrowhead Electric Cooperative member-consumers should ask owners of PV systems purchased from the same installer about performance and reliability before making a decision on an extended warranty, if it is available.

4. Are the PV panels and inverter UL-listed?

Both the PV panels and the inverter should be UL-listed. Most utilities require that an inverter have a UL 1741 certification for interconnection with the grid. As part of the certification, the inverter is required to fail open in the absence of power on the grid.

5. Does the installer offer packaged systems?

Packaged systems, which include everything needed to generate electricity, can facilitate the interconnection process for Arrowhead Electric Cooperative. Our member-consumers should look for systems that are UL-listed and have been pre-certified. The cost of a grid-tied packaged system, uninstalled, depends on the system size.

6. If the system is to be roof-mounted, how will the installer mount it?

The performance of PV panels mounted flush on the roof will decrease during the winter if the roof is at a shallow pitch. Some installers may address this issue by adding one or two panels to the array. While the additional panels will compensate for the decreased winter performance, they also will significantly increase heat gain during the summer, reducing output.

Consumers may wish to consider alternatives, such as mounting panels at a greater angle on the roof or mounting the array on the ground or a pole.



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7. What are the advantages and disadvantages of adjustable rack mounts and tracking devices?

Adjustable rack mounts—both ground and roof—can be repositioned seasonally to optimize energy output but they will increase the cost of a PV system. Consumers should ask the installer to estimate the improved performance of a system with adjustable rack mounts and then weigh the higher output against the increased cost.

Tracking devices—PV mounting devices that follow the sun—can increase the output of a PV system by 25% to 40%, compared with a fixed-mounted array. They are either electrically or thermally operated and usually are mounted on a pole. Trackers are most effective at sites with dawn-to-dusk sun, and provide a great increase in output in the summer. Because of their moving parts, trackers may require increased maintenance.

Although trackers increase the cost of a PV system, the total cost of a tracked system may be less than that of a fixed system because a smaller tracked system can produce more electricity. For example, a 3 kW tracked system can produce as much electricity as a 4 kW fixed system. The higher output of a tracked system makes it possible to scale down the size—and thus the cost—of the PV system.

Consumers should ask the installer to evaluate their site with a tool such as the Solar Pathfinder (available at <http://www.solarpathfinder.com>) to determine if a tracker makes sense.



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Legal Notice:

The Consumer Handout Packet was created for the benefit of National Rural Electric Cooperative Association (NRECA) members and their consumer-members as part of the Cooperative Research Network's (CRN) Cooperative Small Wind Guide. Some of the contents of the Consumer Handout Packet is specific to Arrowhead Electric Cooperative.

This work contains findings that are general in nature. Readers are reminded to perform due diligence in applying these findings to their specific needs.

Neither CRN nor NRECA nor Arrowhead Electric Cooperative assumes liability for how readers may use, interpret, or apply the information, analysis, templates, and guidance herein or with respect to the use of, or damages resulting from the use of, any information, apparatus, method, or process contained herein. In addition, the CRN and NRECA Arrowhead Electric Cooperative make no warranty or representation that the use of these contents does not infringe on privately held rights.



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Thank you for your interest in Renewable Energy!

This page outlines the steps required for your qualifying system to become interconnected with Arrowhead Electric Cooperative's distribution facilities.

1. Applicant must be or become a cooperative member.
2. Member must file applicable paper work and fees with the Cooperative at least 30 days prior to hook-up. This application includes;
 - Uniform statewide contract for cogeneration and small power production facilities of less than 40kW (enclosed)
 - Application for interconnection (enclosed)
 - A list of technical specifications for the renewable energy equipment.
 - Proof of liability insurance as noted in the Uniform statewide contract
 - A member request for a specific hook-up date
 - \$500 interconnection and net metering fee
3. The Cooperative will then have 30 days to accept/reject or require more information of the applicant.
4. If the application is accepted, the member may then install all additional private wiring and equipment for interconnection. Please note any upgrades to meter sockets and associated equipment is at the members expense and should be completed by a licensed electrician. Arrowhead Electric can NOT install net meters in small 60 or 100 amp meter sockets.
5. When the member completes the installation, the Cooperative and the state electrical inspector approve it.
6. The Member may be required to reimburse the Cooperative for extraordinary interconnection costs.
7. The Cooperative will issue a final written authorization for interconnection.

**Application for Interconnection
Member Owned Qualifying Facility
40 Kilowatts or Less**

Member Name _____ Location Number_(leave blank)_____

Local Address _____ Type Consumer _____ Phone Number _____

Manufacturer of Qualifying Facility _____

Nameplate Rating _____ Listing Authority (UL or..)_____

Energy Source _____ Type of Generator _____

Inverter _____

Operational Data 1. Voltage _____ 3. Max. Amperage _____
 2. Phase (1 PH, 3 PH.) _____ 4. % Power Factor _____

Description of Interconnection Equipment _____

NOTE: Please attach a copy of the Manufacturers Technical Specifications

Manual disconnect switch location _____

Proposed Interconnection date _____

Dec-Feb Mar-May Jun-Aug Sep-Nov

Energy consumption (Est. kWh) _____ _____ _____ _____

Energy production (Est. kWh) _____ _____ _____ _____

Demand (Est. kW) _____

Capacity (Est. kW) _____

I, the undersigned, have completed this application, which accurately describes the equipment that I will interconnect and operate in parallel with the Cooperative's distribution system.

I have read and understand the **Cooperative's Requirements for Interconnection** and understand that approval is dependent on compliance with these requirements and the accuracy of the information as included in this application.

Signature _____

Date _____

**UNIFORM STATEWIDE CONTRACT FOR COGENERATION AND SMALL
POWER PRODUCTION FACILITIES OF LESS THAN 40 KW**

THIS CONTRACT is entered into _____, 20____,
by ARROWHEAD ELECTRIC COOPERATIVE, INC. (hereafter called "COOPERATIVE")
and _____ (hereafter called "QF").

RECITALS

The QF has installed electric generating facilities, consisting of

_____(Description of facilities),

rated at less than 40 kilowatts of electricity, on property located at

_____.

The QF is prepared to generate electricity in parallel with the COOPERATIVE.

The QF's electric generating facilities meet the Requirements of the Minnesota Public Utilities Commission (Hereafter called "Commission") rules on Cogeneration and Small Power Production and any technical standards for interconnection the COOPERATIVE has established that are authorized by those rules.

The COOPERATIVE is obligated under federal and Minnesota law to interconnect with the QF and to purchase electricity offered for sale by the QF.

A contract between the QF and the COOPERATIVE is required by the Commission's rules.

AGREEMENTS

The QF and the COOPERATIVE agree:

1. The COOPERATIVE will **sell** electricity to the QF under the rate schedule in force for the class of customer to which the QF belongs.

2. The COOPERATIVE will **buy** electricity from the QF under the rate schedule in part 1. (above). The QF will use the rate schedule category indicated below:

X a. Net energy billing rate under part 7835.3300.

A copy of the presently filed rate schedule is attached to this contract.

3. The rates for sales and purchases of electricity may change over the time this contract is in force, due to actions of the COOPERATIVE or of the Commission, and the QF and the COOPERATIVE agree that sales and purchases will be made under the rates in effect each month during the time this contract is in force.

4. The COOPERATIVE will compute the charges and payments for purchases and sales for each billing period. Any net credit to the QF will be made under the following option:

 X 1. Credit to the QF's account with the COOPERATIVE.

5. The QF must operate its electric generating facilities within any rules, regulations, and policies adopted by the COOPERATIVE not prohibited by the Commission's rules on Cogeneration and Small Power Production, which provide reasonable technical connection and operating specifications for the QF. This agreement does not waive the QF's right to bring a dispute before the Commission as authorized by Minnesota Rules, parts 7835.4800, 7835.5800, and 7835.4500, and any other provision of the Commission's rules on Cogeneration and Small Power Production authorizing Commission resolution of a dispute.

6. The COOPERATIVE 's rules, regulations, and policies must conform to the Commission's rules on Cogeneration and Small Power Production.

7. The QF will operate its electric generating facilities so that they conform to the national, state, and local electric and safety codes, and will be responsible for the costs of conformance.

8. The QF is responsible for the actual, reasonable costs of interconnection, which are estimated to be \$500.

The QF will pay the COOPERATIVE in this way:

\$500 prior to final Interconnection

9. The QF will give the COOPERATIVE reasonable access to its property and electric generating facilities if the configuration of those facilities does not permit disconnection or testing from the COOPERATIVE 's side of the interconnection. If the COOPERATIVE enters the QF's property, the Utility will remain responsible for its personnel. Prior to final interconnection the QF will grant the COOPERATIVE an easement encumbering the QF's property for all areas in which the COOPERATIVE owns electric distribution or telecommunications facilities. The COOPERATIVE may waive the easement requirement if the an existing easement acceptable to the COOPERATIVE is on file and of record in the recorders office at the Cook County, Minnesota Court House.

10. The COOPERATIVE may stop providing electricity to the QF during a system emergency. The COOPERATIVE will not discriminate against the QF when it stops providing electricity or when it resumes providing electricity.

11. The COOPERATIVE may stop purchasing electricity from the QF when necessary for the Utility to construct, install, maintain, repair, replace, remove, investigate, or inspect any equipment or facilities within its electric system. The COOPERATIVE will notify the QF before it stops purchasing electricity in a manner consistent with that of all other member-consumers in that consumer class.

12. The QF will keep in force liability insurance against personal or property damage due to the installation, interconnection, and operation of its electric generating facilities. The amount of insurance coverage will be \$ 300,000.00 (The COOPERATIVE may not require an amount greater than \$300,000).

13. This contract becomes effective as soon as it is signed by the QF and the COOPERATIVE. This contract will remain in force until either the QF or the COOPERATIVE gives written notice to the other that the contract is canceled. This contract will be canceled 30 days after notice is given.

14. This contract contains all the agreements made between the QF and the COOPERATIVE except that this contract shall at all times be subject to all rules and orders issued by the Public Utilities Commission or other government agency having jurisdiction over the subject matter of this contract. The QF and the COOPERATIVE are not responsible for any agreements other than those stated in this contract.

THE QF AND THE COOPERATIVE HAVE READ THIS CONTRACT AND AGREE TO BE BOUND BY ITS TERMS.

AS EVIDENCE OF THEIR AGREEMENT, THEY HAVE EACH SIGNED THIS CONTRACT.

QF

By: _____
(Member-Owner)

Date: _____

COOPERATIVE

By: _____
(C.E.O.)

Date: _____