Solar on the Farm: Improving Your Ag Operation with On-site Energy

Workshop held on November 14, 2023 at Kildee Farms in Culpeper, VA
Energy Talk

Definitions
- 1,000 KW = 1 MW
- 1,000 MW = 1 GW
- kWh = electricity produced
- Transmission/Distribution/Substation
Virginia Clean Economy Act

- Mandatory Renewable Portfolio Standard
  - 100% renewable energy by 2050

- From 2025, 75% of Dominion’s renewable generation MUST come from within VA

- Distributed Generation Cap → 6%
Benefits of Distributed Generation

- Less Transmission
- Energy Independence
- Protection from Increasing Utility Rates
- Collectively decreases the need for large scale solar
Cost of Solar

Electricity costs according to data from Lazard

- Nuclear
- Gas (peaker)
- Thermal Solar
- Coal
- Geothermal
- Natural Gas
- Solar Panels
- Wind

Levelized cost of electricity per megawatt-hour vs Year from 2009 to 2023.
Estimated rooftop solar potential of Virginia

Last updated: 06/2019

Sunlight on rooftops
Shady → Sunny

Existing solar arrays

Median household income

Buildings

79% solar-viable

2,400 existing solar installations

Based on 40% data coverage over buildings in this geographic area. All estimates are based on buildings viable for solar panels. Included panels receive at least 75% of the maximum annual sun in the county. For Virginia, the average value of the threshold is 1,057 kWh/kW. Read about Project Sunroof’s methodology for defining solar viability below.

Source: Google Project Sunroof
About ¼ of Virginia’s demand from rooftop solar

Source: Google Project Sunroof
What is Farm Solar

Types:

- On-Site Operations
- Community Solar (Under 5MW)
- Utility Scale Solar (Over 5MW)

“Add-Ons”

- Batteries
- Agrivoltaics
Agrivoltaics

- Co-location of agricultural production and energy production
- Elevated panels
- Crop success has been found with winter wheat, kale, broccoli, potatoes, swiss chard. Shade tolerant crops tend to do better
SEPARATE LAND USE ON 2 HECTARE CROPLAND

1 Hectare
100 % wheat

1 Hectare
100 % solar electricity

= 100 % wheat
100 % solar electricity

COMBINED LAND USE ON 2 HECTARE CROPLAND: EFFICIENCY INCREASES OVER 60%

1 Hectare
80 % wheat
80 % solar electricity

1 Hectare
80 % wheat
80 % solar electricity

= 160 % wheat
160 % solar electricity

Figure 6: Product visualization under agrivoltaic systems.
Photo source—Fraunhofer Institute for Solar Energy Systems
Battery Backup

Advantages:

- Grid resilience & independence
- Benefit to peak load
- Bi-directional EV’s
- Virtual power plant/Microgrid
- Federal incentives (30%)

Challenges:

- Cost
- Lack of state incentives
On Site Solar: Incentives Available

1. Federal Tax Credit (30% of total cost)

2. USDA Rural Energy for America Program (REAP): Up to 50% for energy efficiency and renewable energy projects

3. Renewable Energy Certificates (RECs)
REAP grants
Hi! I’m Corey Ramsden.

VP, Go Solar Programs
Solar United Neighbors
• Leads operational and technical support
• Washington, DC
• Solar owner since 2012
WHAT IS SOLAR UNITED NEIGHBORS?

We’re a vendor neutral, national 501(c)(3) nonprofit.
WHAT IS SOLAR UNITED NEIGHBORS?

We help people go solar, join together, & fight for their energy rights.
Our National Impact

8,000+ families with solar
68 Megawatts of solar
898,000 Tons of CO2 Saved
What is REAP?
REAP – Rural Energy for America Program

The Rural Energy for America Program helps farmers & rural business owners access renewable & efficient energy technologies.
REAP — Rural Energy for America Program

Two Programs:
Loan Guarantee Program
• Up to 75% of total eligible project costs
• Rates vary by lender.
• $1M max amount; 40-year max term

Grant Program
• Up to 50% of total eligible project costs
REAP – Rural Energy for America Program

Eligible Technologies:
Renewable Energy Systems ($1M max)

- Biomass (25%)
- Geothermal for electric generation or direct use
- Hydropower (below 30 megawatts)
- Hydrogen
- Small and large wind generation
- Small and large solar generation
- Ocean (tidal, current, thermal) generation
- Storage? – Only when paired w/ eligible technology

Energy Efficiency Improvements ($500K max)
What’s new with REAP?

The IRA:

- $1.7B additional funding available until 2031
- Raised the maximum grant from 25% to 50%
- Raised project size cap to $1M for renewable energy projects
Eligibility

2 groups are eligible for REAP grants:

1. Farmers
   - 50% or more of gross income from agricultural operations

2. Rural small businesses:
   - Rural area (per USDA Rural Eligibility Map)
   - Small business (net worth < $15M, net annual income < $5M)
Business benefits to going solar

- Enjoy more energy choice
- Reduce & control energy costs
- Improve your energy security
- Clean, abundant solar energy
- Save up to 50% with REAP grant
- Tax incentives (ITC and MACRS)

ITC: Investment Tax Credit
MACRS: Modified Accelerated Cost Recovery System
How to apply for a REAP solar grant
Overview

1. Select installer
2. Get unique ID from www.sam.gov
3. Fill out REAP application
4. Submit to USDA
5. Hear back 60 days after deadline
About the application

● Scored out of 100 points
● Our guide offers step-by-step guidance, including how to estimate your project’s score
● 4 deadlines each year:
  ○ Mar 31 **
  ○ Jun 30
  ○ Sep 30 **
  ○ Dec 31 **

** Award requests of $20K or less have funding carve out while it lasts
Submit your REAP application **before** building your project.
What you’ll need to apply

You’ll need the following documents:

1. 3 years of tax returns
2. Employee payroll (for small businesses)
3. Electric bills for last 12 months
4. Project quote from installer
5. Financial documentation of committed funds
Application forms

The main component of the application is Form RD-4280-3A.

You’ll also fill out:

1. Form SF-424 (Application for Federal Assistance)
2. Form SF-424C (Budget Information – Construction)
3. Form SF-424D (Assurances for Construction Programs)
4. Form RD-1940-20 (environmental documentation)
Follow step-by-step instructions

How to apply

Starting the application: Form RD-4280-3A

The heart of the REAP grant application is Form RD-4280-3A “Application for Renewable Energy Systems and Energy Efficiency Improvement Projects – Total Project Costs of $80,000 or Less”. Please confirm you have the right form; there are separate forms for larger projects. The majority of folks apply for the smaller tier “$80,000 and under project size” or mid-tier “$80,000 to $200,000 project size”.

The mid-tier project size application is very similar to the small tier project size application. It does have additional components. One component is a technical feasibility study. Your solar project company should assist you with this.

You can download the PDF version of Form RD-4280-3A “Application for Renewable Energy Systems and Energy Efficiency Improvement Projects – Total Project Costs of $80,000 or Less” [here](#). Or, you can contact your state Office of Rural Development’s Rural Energy Coordinator. Open the PDF outside of a web browser. This will allow you to save your work and use the self-calculating features built into the PDF form. Do not fill in the application inside a web browser. The inputs will be erased if you close or change something in the browser.

Block I. A. Application legal name

Use your farm or small business entity’s legal name. Folks who apply as sole proprietors or single member limited liability companies rely on their social security number later in the application when they register in the System for Award Management (SAM). This is common practice but it is important that the form or small business legal name match the tax identification number.

How to apply

Blocks I. B., C., and D. are self explanatory.

Points Tip

Up to 10 discretionary points may be awarded by the Office of Rural Development’s State Director for any of these criteria:

- Achieves geographic diversity
- Owned by a veteran
- Owned by a socially-disadvantaged group (members of which have been subjected to racial, ethnic, or gender prejudice because of their identity without regard to their individual qualities. Note: The application must include a statement indicating the applicants are socially-disadvantaged).
- The project advances a Presidential Initiative or a Secretary of Agriculture priority
- Project location is on a federally-declared disaster area (within the last two years)

Block II: Project Title

Folks typically title their project with a short description. For example, “14.5 KW Solar Array for Sally Smith’s Apple Farm”.

Block III: System for Awards Management (SAM) Commercial and Unique Entity ID

Each applicant to the REAP grant program must have a Unique Entity ID corresponding to the tax identification number or social security number provided on all components of the REAP grant application.

In order to obtain a Unique Entity ID, you must register your business in SAM and request a Unique Entity ID. This ID code is necessary to complete the REAP application.
Besides REAP, what else should I know about solar for my farm or rural business?
Besides REAP...

- Tax benefits (ITC & MACRS)
- Local solar export crediting rules
- Interconnection & potential costs
- Changes to your utility tariff
Federal Tax Credit & MACRS

- Federal Investment Tax Credit (ITC)
  30% of system cost
  + 10% for domestic content (not enough market info yet)
  + 10% for energy communities (there’s a map for this)

- MACRS
  Accelerated depreciation of asset over a 5-year schedule
  Bonus depreciation available in year 1 (phasing out)
### Example Business Financials

**SAMPLE CASH PURCHASE (25 kW solar)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPITAL COST (upfront)</td>
<td>$70,000</td>
</tr>
<tr>
<td>REAP GRANT (50% of system cost)</td>
<td>-$35,000</td>
</tr>
<tr>
<td>FEDERAL TAX CREDIT AT 30% (after tax filing)</td>
<td>-$21,000</td>
</tr>
<tr>
<td>NET INVESTMENT (after you get grant + credit)</td>
<td>$14,000</td>
</tr>
<tr>
<td>YEARS 1 – 5 AVOIDED TAX (MACRS)</td>
<td>-$X,XXX**</td>
</tr>
<tr>
<td><strong>NET INVESTMENT AFTER MACRS</strong></td>
<td>$X,XXX</td>
</tr>
</tbody>
</table>

**MACRS value depends on your federal and state tax rates.**

Please consult your tax professional for regulations and guidance specific to your business.
Solar Export Crediting

- The value of what you export to the grid
- Net Metering
- Other compensation types
- Ask your installer what applies in your area
Interconnection

- Maximum you can generate annually
- Approval to connect to local utility system
- Solar can trigger system upgrades (transformer replacement, new lines, etc.)
- Very location-specific
- Cost often born by project owner
Tariff changes

- Not common but can happen
- Sometimes tied to a change in your transformer size
- Charged for demand (power) vs. just energy (kWh)
Photo courtesy of the American Solar Grazing Association (www.solargrazing.org)
Support for REAP applicants
REAP Education Outreach & Support

- REAP Application Guide
- Solar Help Desk
- Ready, Set, Solar! (REAP Edition)
Our new REAP application guide:
solarunitedneighbors.org/reap
Our guide includes:

- Program basics
- Eligibility
- Application process
- Forms & materials
- How to apply:
  - Step-by-step
  - Score estimates
- List of pros
Solar Helpdesk
solarunitedneighbors.org/helpdesk
Solar Helpdesk

A light touch:
Solar questions, proposal tips, practical answers

Get a free roof review
Curious if your home is good for solar? We can tell you!

Phone Call
Have more questions or prefer to chat with someone over the phone?
Book 15 minutes with our team!

Solar Questions?
Have a question about your proposal or just a general one about going solar?
We can help!
Ready, Set, Solar! (REAP Edition)
solarunitedneighbors.org/rssreap
Questions?

Corey Ramsden
corey@solarunitedneighbors.org
Solar on the Farm: Improving your ag operation with on-site energy
Clifton Farm
Rixeyville, Va

DIY Solar System for Farm and Home

Background

Family Farm - 1844 - 5th Generation

300 Acres

1845 Farm House restored to period conditions

5 Barns and Sheds

Wood Working Shop

Old Summer Kitchen

House Well and Ag Well serving 80 to 90 Angus Cow/Calf Operation
12.6 KW Ground Mount System with 40 Panels

Grid Tied
Installed April 2016
40 - 315 watt panels
40 Power Optimizers
2 Solar Edge Inverters (6000 watts each)
Ground Mount Iron Ridge Rail System

All Ordered online from California
$22,600
Also needed:

Foundation and Structural Plans and Certification  $800

Building Permits for Electrical and Structure  $575

Concrete and Rebar  $1500

3 inch Galvanized Pipe  $1700

Electrical Cable, Conduit and Boxes  $800

Total Materials Cost  $29,670

30% Tax Credit of Approx. $9000
Concrete Foundation Beams and 3 Inch Pipe Structure
Inverters and Disconnects AC and DC
## DIY Man Hours

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layout and Sitework</td>
<td>12</td>
</tr>
<tr>
<td>Excavation, Forming, Pouring</td>
<td>18</td>
</tr>
<tr>
<td>Erection of Posts, Rails, Panels</td>
<td>28</td>
</tr>
<tr>
<td>Fence</td>
<td>4</td>
</tr>
<tr>
<td>Electrical and Trenching</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>69 hours</strong></td>
</tr>
</tbody>
</table>
Grid Tied using Net Metering From Rapp Elec Coop

Forward Meter reading

Reverse Meter Reading

Net Meter Reading
As of Jan. 4, 2023

80 Months of Service
System has provided 73% of our total electrical requirements
Has saved $14,950 in electrical costs over the 7 years
Simple ROI of approximately 11 years

Solar system production 115,000 Kwh
1437 Kwh per month

METER
From Grid 103,834 Kwh 538 Kwh/Mo
To The Grid 60,390 Kwh
To House 158,000 Kwh 1975 Kwh/Mo
Key Takeaways

Size your system based on 12 months of actual usage
Buy a system based on matching its AC output to your needs
Panels produce DC which inverters convert to AC with losses
  Panels degrade about 0.5% per year
  Buy high efficiency panels
  Buy a couple extra panels as spares

Annual Kwh / 12 / 30 / 4.2 Sun Hours in Virginia times 1.15 = DC size
  For 20,000 Kwh annual use, need 15.2 KW DC System
  For 100% replacement with Solar
Solar on the Farm: Improving your ag operation with on-site energy
Virginia SRECs
Solar Renewable Energy Certificates

PEC - Solar on the Farm
Topics Covered

- Example: 50kW system on a farm
- What is an SREC?
- Virginia Clean Economy Act
- What is “Selling Your SRECs”? (Pros/Cons)
- Valuing SRECs: Market & Pricing
- Process & Timeline
  - Selecting a Payout Option
  - Registration
  - Energy Reporting
  - Payments Over System Lifetime
- Your Questions
Example Farm System

50 kW system

$2,400 per year

(price fluctuates)

$200 per month
Credited Energy

Tax Credits

SRECs
1 REC = the “renewableness” associated with 1 MWh hour of energy

RECs are not synonymous with “carbon offsets”
SRECs are not energy.

selling SRECs ≠ selling energy
10 kW DC system operating at full capacity for 2 hours makes 20 kWh kilowatt-hours
SRECs are the renewable attribute of solar energy.
Think of your SRECs as a separate value stream.

SRECs - attribute of energy

plain ol' undifferentiated energy
SRECs often used to substantiate compliance.

**Goal**
100% clean energy in Virginia by 2050

2022 Virginia utility-scale electricity mix:
- Natural Gas: 60%
- Nuclear: 29%
- Coal: 4%
- Biomass: 5%
- Solar: 2%
Virginia’s “Solar Carve-Out”

Overall Energy Demand

Annual % Target for Clean Energy

VA Solar “Carve-Out” 1% of annual target
Aggregators buy and sell RECs.
Selling Your SRECs
What does it mean to do that? Pros/Cons?

- When you sell your SRECs, you essentially trade away your right to substantiate claims about renewable energy produced at your site.
  - “Bull Run Farm operates on 100% solar energy produced here on site.”

- Utilizing a “REC Swap” mechanism allows flexibility in making claims. But there are limitations.
  - “Bull Run Farm operates on 100% solar energy.”
  - “Bull Run Farm uses 100% renewable energy.”
  - “All of our products are made with 100% solar energy.”
  - “All of our products are made with renewable energy.”
Aggregators often buy SRECs from owners in several ways.

Locked-Rate
3 year, 5 year
Annuity, Strip

Upfront
10, 15, 20, 25 year

Spot Market
<table>
<thead>
<tr>
<th></th>
<th>3-Year or 5-Year Locked-In Rate</th>
<th>15-Year Upfront</th>
<th>Spot Market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price paid</strong></td>
<td>$40.00 / REC Nov 2023</td>
<td>$180 / kW DC</td>
<td>$50.00 / REC Oct 2023</td>
</tr>
<tr>
<td></td>
<td>$38.00 / REC Nov 2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Price variability</strong></td>
<td>price fixed for term period</td>
<td>none</td>
<td>varies monthly</td>
</tr>
<tr>
<td><strong>Upfront amount</strong></td>
<td>-</td>
<td>100% for term</td>
<td>-</td>
</tr>
<tr>
<td><strong>Regularity of payments</strong></td>
<td>quarterly</td>
<td>all paid at contract signing</td>
<td>typical time between payments 1mo – 4mo</td>
</tr>
<tr>
<td><strong>Percentage of sellers who select this option</strong></td>
<td>65%</td>
<td>5%</td>
<td>30%</td>
</tr>
</tbody>
</table>
Timeline to first payment.

- Sign up
- Gather details
- Register system
- Registration approved
- Energy submitted
- SREC minted
- Payment deposited

~1 week
~1-3 weeks
~1-4 weeks
~1 week
~1-3 weeks

About 4-12 weeks
Full Energy Automation

We Do it For You

ENPHASE
solar energy
Fronius
SMA
APsystems
GENERAC
TESLA
GAF
SUNPOWER
Data Reporting & Meter Compliance

Revenue Grade Meters

- All production meters must be ANSI C.12 certified
- Older systems often need to be upgraded
- Preferably, systems should be Internet-connected
- Systems that are connected to the Internet can still report their production data by snapping monthly or quarterly photographs of a mechanical meter, though this is not a good long-term solution
VA DER REC Spot Price (CY2022, CY2023)
Virginia DER REC Market Example

$75/RE C ACP

VA Carve-out RECs

Demand +

Supply

Change in VA carve out %?
Solar on the Farm: Improving your ag operation with on-site energy
POWERS
FARM & BREWERY
Our Setup

22.4 kW, half rooftop, half pedestal (~19kW A/C)
- Would have preferred 100% rooftop
- Metal roof – did full weather sealing before install (~16’ x 44’ each)
- Installed by Virtue Solar

Net Metering (Dominion)
- Requires dedicated ag-use meter
- Literally nets in real time
- Cannot become a generator
The Money Part

$58,000 total install fee (2019) – look at price per kW

Paid for:

- $14k REAP grant
- $17k Income Tax Credit
- $27k Bank loan, 7 year term — balance this with your utility bill?
  - Crowdfund loan for retail operations?
Other Money Things

- Fauquier County Property Tax Exclusion
  - Note on zoning & permits
  - Fully exempt with new state laws

- Batteries vs Grid
  - Can you ensure you generate more than you use?
  - Do you have good grid reliability? Can you beat $12/mo in “grid fees”?
  - Sustainability/grid peak contributions

---

**Explanation of Bill Detail**

<table>
<thead>
<tr>
<th>Customer Service</th>
<th>1-866-DOM-HELP (1-866-366-4357)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Balance</td>
<td>6.81CR</td>
</tr>
<tr>
<td>Payment Received</td>
<td>0.00</td>
</tr>
<tr>
<td>Balance Forward</td>
<td>6.81CR</td>
</tr>
<tr>
<td>Non-Residential (Schedule GS-1) Distribution Service Basic Customer Charge</td>
<td>04/22 05/23</td>
</tr>
<tr>
<td>FAUQUIER Utility Tax</td>
<td>1.08</td>
</tr>
<tr>
<td>Rider TRCR Credit</td>
<td>20.58CR</td>
</tr>
<tr>
<td>Rider VCR 2022 Credit</td>
<td>1.10CR</td>
</tr>
<tr>
<td>Total Current Charges</td>
<td>9.82CR</td>
</tr>
<tr>
<td>Total Account Balance</td>
<td>16.63CR</td>
</tr>
</tbody>
</table>

View payment options, request service changes and enroll in eBill at [www.dominionenergy.com](http://www.dominionenergy.com), search: Manage Your Account.
SRECs

Solar Renewable Energy Certificates

- A state-by-state program, with quotes set for energy producers
- Credits are generated by solar power generation
- Must be sold through a broker
- The market price for these credits appears to be declining

### Virginia SREC Pricing

<table>
<thead>
<tr>
<th>Option</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mint &amp; Sell (spot market)*</td>
<td>$69.50 – $63.50 (6-months)</td>
</tr>
<tr>
<td>3-Year (2023-2025)</td>
<td>$40.00 (12-months pre-paid)</td>
</tr>
<tr>
<td>5-Year (2023-2027)</td>
<td>$30.00 (12-months pre-paid)</td>
</tr>
<tr>
<td>15-Year Upfront</td>
<td>$125 per kW DC</td>
</tr>
</tbody>
</table>
Soft Benefits To Our (Retail) Business

- Initial publicity
- Roadside visibility
- Putting money where mouth is
- Opportunity to spread the word on solar?
Monitoring
Solar on the Farm: Improving your ag operation with on-site energy

Ashish Kapoor
Senior Energy & Climate Policy Analyst
akapoor@pecva.org
Contractor Perspective
What Service does a Solar Installer Provide?
Farm Utility Cost

Buy the Power OR Produce the Power with financing

Renting pros/cons

Long term finance

Short Term Finance

Benefits of Owning

with a cash investment
Net Metering Solar

Behind the Meter

Virtual Utility Scale
Our Work

• Engineering, Procurement, & Construction  (not door knocking)

• Grid-tied  (not off grid)

• Behind the meter  (used on site)

• Local

• People First
What Many Solar Contractors Do

• Interrupt
• Nag
• Translucent (not transparent)
• Promise moons
• Outsource sales
• Outsource design
• “use only the best” equipment
• Outsources installation
• Keep you in the dark
• Terrible to get ahold of after
What a Solar Contractor **Should Do**

- Interrupt
- Nag
- Translucent (not transparent)
- Promise moons
- Outsource sales
- Outsource design
- “use only the best” equipment
- Outsources installation
- Keep you in the dark
- Terrible to get ahold of after

- Have a warm introduction
- Vet the property / meters / rates
- Consult re: the financing & investment
- Fair Agreement
- Design
- Procure
- Permit
- Build
- Net Metering / Permission to operate
- Monitor
- Service
Does it make Cents?

- Project conservatively
- Use national weather data
- Incorporate the actual design
- Incorporate maintenance costs
Does it make Cents?

- Project conservatively
- Use national weather data
- Incorporate the actual design
- Incorporate maintenance costs
- Use a realistic utility rate escalator
- Incorporate incentives & funding

Is it better to own, or rent your power?
Financing Options
“Look Verrrry Closely”

• Feather out Investment Short (~5yrs)

• Improve Cash Flow Long (~25)

• Beware of dealer fees
Battery Backup

“Maybe?”

• Va Today: Power Back Up, Early Adopters, Solar Pairing

• Later? Time of Use-Solar Pairing

  + Installation, Maintenance, Noise, Virtual Power Plants

  - 2-3x Cost of Generator
Farm Utility Cost

Buy the Power OR Produce the Power

Renting pros/cons with financing

Long term finance

Short Term Finance

Lease

Benefits of Owning
Thank you