USDA

United States Department of Agriculture

Ohio Natural Resources Conservation Service

Ohio Maple Days:

NRCS Programs and Success Stories

December 7th, 2024 | Keith Libben, P.E. – Ohio Department of Agriculture

Natural Resources Conservation Service

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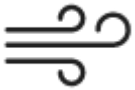
Working with NRCS: 5 Steps to Assistance

1. Planning: Visit a local USDA field office to discuss your goals
2. Application: Find the right financial assistance programs
3. Eligibility: Ensure your eligibility by filing appropriate forms
4. Ranking: Applications are ranked according to resource concerns
5. Implementing: Sign a contract & implement conservation practices

Natural Resource Concerns

Soil: Erosion, reduced soil health, reduced soil quality

Water: Excess water, insufficient water, water quality issues



Air: Dust, smoke, emissions, odors

Plants: Pests, reduced health, reduced productivity, reduced diversity

Animals: Meeting livestock basic needs, habitat for fish and wildlife

Energy: Inefficient energy use of equipment, facilities, field operations

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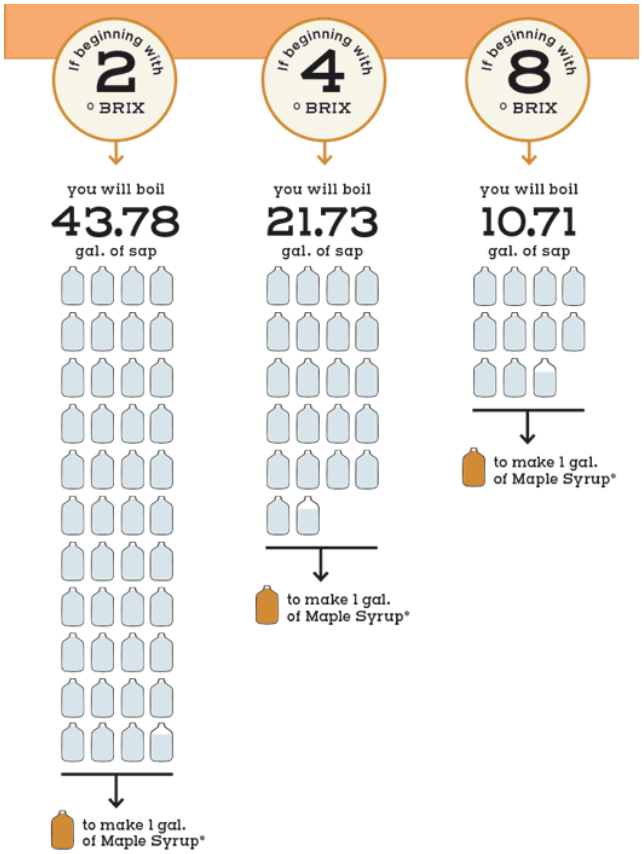
Energy In Maple Syrup

- **Boiling Maple Sap = Heating and Boiling Off Water**
- **Primary Energy Uses**
  - Heating sap to boiling temperature
  - Evaporating water to concentrate sap
- **Ways to Save Energy**
  - Improve evaporator thermal efficiency
  - Increase the sap Brix prior to boiling
  - Increase the sap inlet temperature
- **Other Energy Uses**
  - Heating the sugar house
  - Vacuum pumps
  - Refrigeration
  - Bottling
  - Lighting



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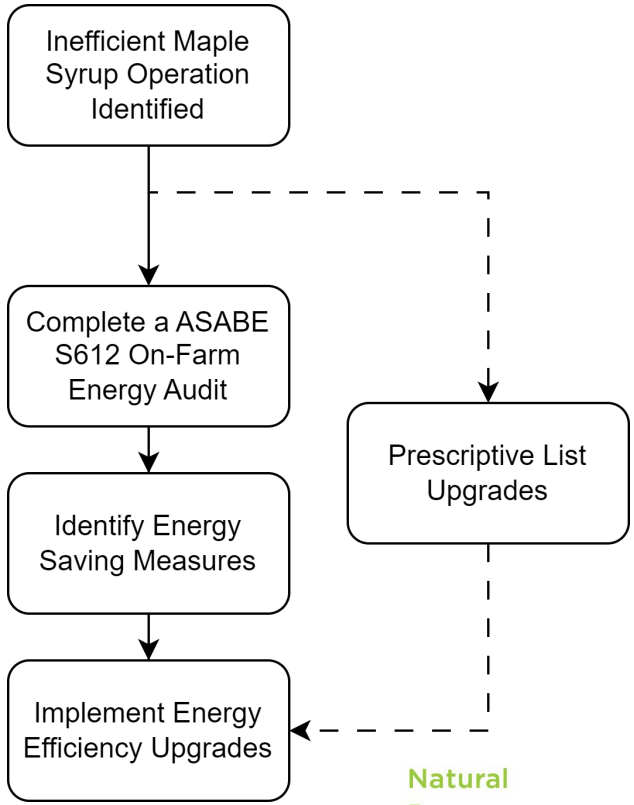
NRCS Energy Practices

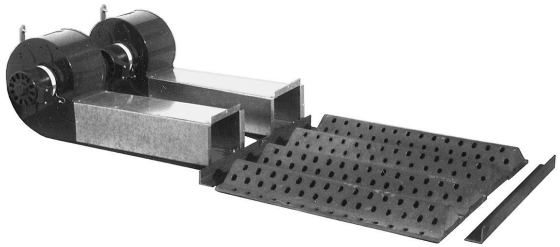
- **CPS 374 – Energy Efficient Agricultural Operation**
  - Maple Syrup Scenarios
    - High efficiency evaporator
      - Air-injected wood-fired
      - Gasifier wood-fired
      - Oil-fired
    - Reverse osmosis
      - <250 – 1,000+ GPH
    - Sap preheating
      - Sap preheater
      - Steam enhanced preheater
- **Energy Upgrade Implementation**
  - ASABE S612 On-Farm Energy Audit
  - State Approved Prescriptive List Upgrade



Prescriptive upgrades
Equipment and system upgrades included on the State-approved prescriptive list have been shown to improve energy efficiency and conform to relevant practice criteria. As such, design and implementation do not require additional specific analysis of energy efficiency performance parameters.

NRCS Energy Practices

- **CPS 374 – Energy Efficient Agricultural Operation**
  - Maple Syrup Scenarios
    - High efficiency flue pan evaporator
      - Air-injected wood-fired
      - Gasifier wood-fired
      - Oil-fired



High Efficiency Evaporators

AT A GLANCE:

- New flue pan designs increase surface area, increasing evaporation rate
- Forced draft systems increase BTU output
- Choose an efficient arch (firebox) – fully insulated with fire brick and ceramic blanket
- Firebox should have an air-tight door

LIMITATIONS:

- Access to electrical power – Generator? Solar?
- Fuel source?
- Cost
- Existing sugarhouse space and layout
- Proper installation

ENERGY SAVINGS:

- Flue pans can increase evaporation rate by 50% and fuel efficiency by 20%
- Forced draft system can increase BTU output by 10 to 20% and decrease wood consumption by 30%

NRCS Energy Practices

- **CPS 374 – Energy Efficient Agricultural Operation**
  - Maple Syrup Scenarios
    - Reverse osmosis

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Reverse Osmosis

AT A GLANCE:

- Can remove up to 75% of the water
- Reduces energy costs by 50% to 75%
- Allows for increased expansion by shortening time and energy needed to produce a given output of syrup
- Wide range of sizes, from 25 to 4,000 gallons/hr, can handle most applications

LIMITATIONS:

- Access to electrical power – Generator? Solar?
- Freeze protection
- Match to size of evaporator
- Sap & Permeate storage
- Consumables and Cleaning

ENERGY SAVINGS:

- It is estimated to reduce fuel usage by 50%–75% over open pan evaporation
- A 65% reduction in fuel usage (or approximately 2/3 less wood) is common
- This will vary depending on the efficiency and setup of the current evaporator

NRCS Energy Practices

- **CPS 374 – Energy Efficient Agricultural Operation**
  - Maple Syrup Scenarios
    - Sap preheating
      - Sap preheater
      - Steam enhanced preheater

Pre-Heaters

AT A GLANCE:

- A sap warming pan produces 5% fuel savings
- A pre-heater produces 13% fuel savings
- A steam-enhanced unit has 40% fuel savings
- Units increase evaporation rates, resulting in reduced labor and increased production capacity

LIMITATIONS:

- Pre-heater and Steam units require use of a hood
- Hood units require higher ceiling heights
- Hood units require support and a strong enough structure to suspend the unit over the flue pan
- Compatibility with existing evaporator?

ENERGY SAVINGS:

- A pre-heater will increase the efficiency of the evaporator by 15%–20%, leading to a 13%–17% savings in energy.
- A steam-away unit will increase the efficiency of the evaporator by 65%–75%, leading to a 40%–43% in energy savings.

Agricultural Energy Assessment (228)
On-Farm Energy Audit

- Establishes baseline for energy use by each component in the system
- Provides recommendations for equipment improvements and upgrades,
- Identifies potential energy reductions and financial savings for each recommendation
- Provides cost estimates of potential improvements, and expected payback time for energy efficiency upgrades
- Must be completed by a Qualified Individual

Table 5. Rated Electricity Usage by Existing Equipment

2022 Existing Equipment – Electricity Usage						
Item	Type	Horse-power	Watts/ Amp	Duty Cycle	Hours Per 60 Days	Total KWH
Sump Pump Transfer (Brown) (A)	115V AC	1/2	1127/9.8	On Demand	10	11.27
Sump Pump Transfer (Lower Barr) (B)	115V AC	1/2	1127/9.8	On Demand	10	11.27
Sump Pump Transfer (Upper Barr) (C)	115V AC	1/6	506/4.4	On Demand	10	5.06
6 Gallon Electric Water Heater	115V AC		2000 W	Thermo-stat	216	432
Space Heater (D)	115V AC		1500 W	Below 32°	1440	2160
Space Heater (D)	115V AC		1500 W	Below 32°	1440	2160
Radiant Heater (Sink Area) (E)	115V AC		1500 W	On Demand	50	75
Radiant Heater (Sitting Area) (E)	115V AC		1500 W	On Demand	50	75
CDL Hobby RO (F)	115V AC		1955/17	On Demand	82	160.3
Evaporator Forced-Air Burner (G)	115V AC	1/6	506/4.4	On Demand	86.5	43.77
Overhead Heater Blower (H)	115V AC		70/0.61	On Demand	72	5.04
Overhead LED Lights	115V AC	25W ea.	275 W	On Demand	760	209
Total						5347.71

Agricultural Energy Assessment (228) On-Farm Energy Audit

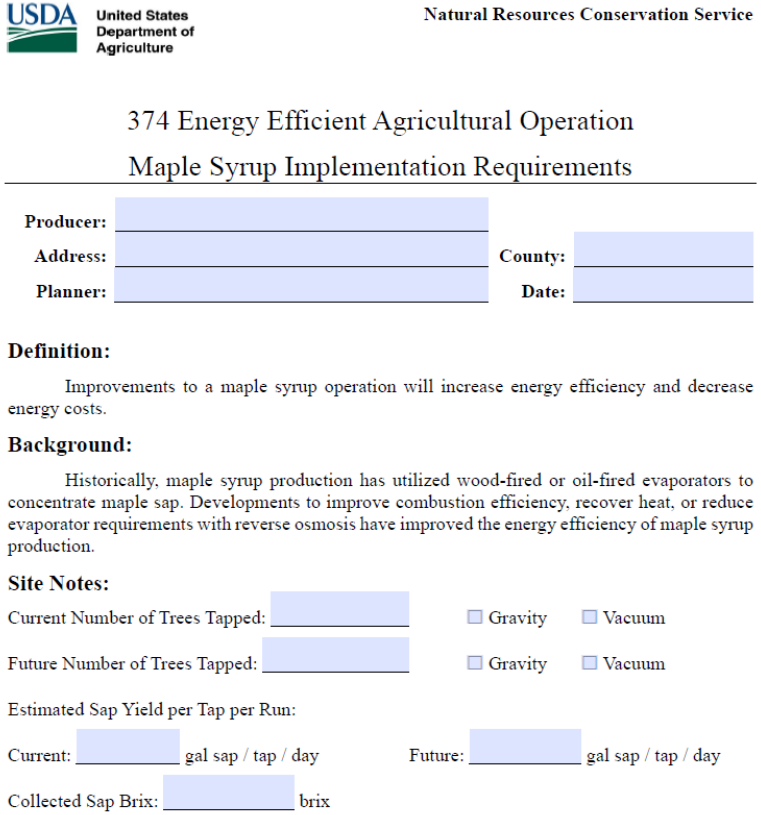
A ***Qualified Individual*** is an energy auditor who has at least one of these qualifications:

- Professional Engineer's license
- Association of Energy Engineers (AEE) – Certified Energy Manager (CEM)
- Association of Energy Engineers (AEE) – Certified Energy Auditor
- State certified/licensed farm energy auditor (if applicable)
- Included on the state's list of vendors for CEMA 228

State law may require a professional engineer's license for this activity.

Ohio Prescriptive Lists

- **Prescriptive List**
  - Cookie cutter solution
  - State preapproved energy upgrades
  - No energy audit and additional energy saving calculations
  - A written summary to justify compliance with the prescriptive upgrade and the CPS
  - Require a plan view drawing to show the installed equipment



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374 Energy Efficient Agricultural Operation

Maple Syrup Implementation Requirements

Producer: _____

Address: _____ County: _____

Planner: _____ Date: _____

Definition:

Improvements to a maple syrup operation will increase energy efficiency and decrease energy costs.

Background:

Historically, maple syrup production has utilized wood-fired or oil-fired evaporators to concentrate maple sap. Developments to improve combustion efficiency, recover heat, or reduce evaporator requirements with reverse osmosis have improved the energy efficiency of maple syrup production.

Site Notes:

Current Number of Trees Tapped: _____ ☐ Gravity ☐ Vacuum

Future Number of Trees Tapped: _____ ☐ Gravity ☐ Vacuum

Estimated Sap Yield per Tap per Run:

Current: _____ gal sap / tap / day Future: _____ gal sap / tap / day

Collected Sap Brix: _____ brix

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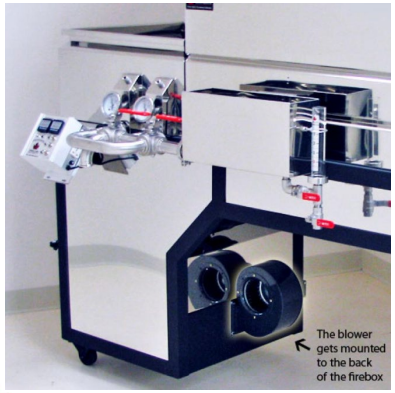
Ohio Prescriptive Lists

- **Structure**
  - Initial Condition
  - Prescribed Upgrade
  - Upgrade Assumptions and Justification



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Evaporator Enhancement for Maple Syrup Production

Initial Condition:

The operation produces maple syrup by boiling the collected maple sap using an energy inefficient evaporator. Inefficient evaporator conditions include:

- Evaporators with a flat pan design
- Evaporators with uninsulated or exposed fireboxes
- Wood fired evaporators without an air-tight arch or without an air injection or gasifier system

Prescribed Upgrade:

Replace existing inefficient evaporator with one of the following high-efficiency evaporators designed with air-tight arches, high-area flue pans, and full insulation to provide the respective energy efficiency enhancements:

- An air injected wood-fired evaporator; or
- A wood-fired evaporator with a gasifier; or
- An oil-fired evaporator

Upgrade Assumptions:

- An operation producing 100 gallons of syrup annually
- 2 Brix sap is concentrated to 66.9 Brix
- $330 per chord of wood
- New evaporator prices estimated from $11,800 to $21,000
- Average cost of electricity = $0.14 / kWh

Operation	Annual Fuel Energy Usage (MMBTU)	Annual Electrical Energy Usage (kWh)	Energy Usage per Gallon of Syrup (MMBTU/gal)	Annual Energy Cost ($/yr)	Payback Period (yr)
Wood-fired Flat Pan Evaporator	137.2	-	1.372	$2,264.55	-
Air-injected Wood-fired Evaporator	68.6	9.0	0.687	$1,133.54	10.4
Wood-fired Evaporator With Gasifier	68.6	9.0	0.687	$1,133.54	18.6
Oil-fired Evaporator	63.3	9.0	0.634	$1,602.01	24.8

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Ohio Prescriptive Lists

- **Structure**
  - Initial Condition
  - Prescribed Upgrade
  - Upgrade Assumptions and Justification

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Reverse Osmosis for Maple Syrup Production

Initial Condition:

The operation does not use reverse osmosis to process the maple sap prior to the evaporator. Maple syrup is produced by boiling the collected maple sap in an evaporator. All excess water is removed via evaporation in the pan to concentrate the maple sap.

Prescribed Upgrade:

Integrate a reverse osmosis system meeting the following criteria into the maple syrup production process to remove water from the maple sap prior to the boiling process:

- Capable of concentrating the maple sap to at least 4 Brix
- Adequately sized to meet the production rate of the associated evaporator

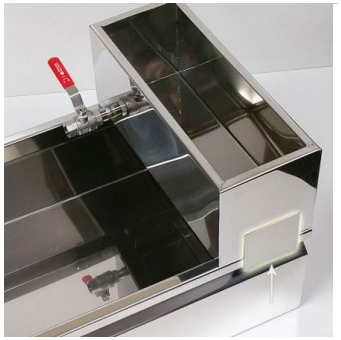
Upgrade Assumptions:

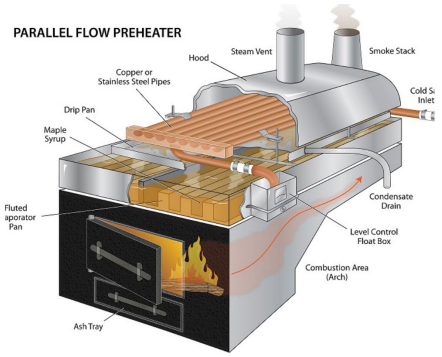
- An operation producing 100 gallons of syrup annually
- 2 Brix sap is concentrated to 8 Brix by the reverse osmosis unit and then to 66.9 Brix by the evaporator
- $330 per chord of wood
- A reverse osmosis unit upgrade costs $5,600
- Average cost of electricity = $0.14 / kWh

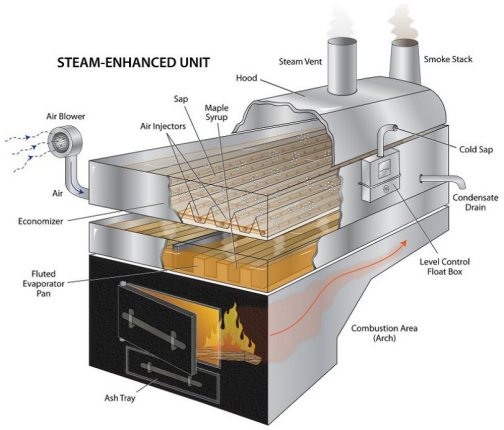
Operation	Annual Fuel Energy Usage (MMBTU)	Annual Electrical Energy Usage (kWh)	Energy Usage per Gallon of Syrup (MMBTU/gal)	Annual Energy Cost ($/yr)	Payback Period (yr)
No Reverse Osmosis	91.5	-	0.915	$1,509.70	-
With Reverse Osmosis	20.6	0.4	0.206	$340.35	4.8

Ohio Prescriptive Lists

- **Structure**
  - Initial Condition
  - Prescribed Upgrade
  - Upgrade Assumptions and Justification







Sap Warming Pan, Sap Preheater, and Steam Enhanced Preheater for Maple Syrup Production

Initial Condition:

The operation does not use a sap warming pan, a sap preheater, or a steam enhanced preheater to process the maple sap prior to the evaporator. Maple syrup is produced by boiling the collected maple sap in an evaporator. Excess water is removed via evaporation in the pan to concentrate the maple sap.

Prescribed Upgrade:

Integrate a sap warming pan, a sap preheater, or a steam enhanced preheater meeting the following criteria into the maple syrup production process to preheat the incoming sap by recovering heat from the evaporator steam:

- Constructed from copper or stainless steel
- Possess a drip pan to prevent condensed steam from reentering the maple syrup
- Be properly sized to the dimensions of the evaporator

Additionally, steam enhanced preheaters shall meet the following criteria:

- Include a pressurized dry air system to agitate and concentrate the sap prior to entering the evaporator pan

Upgrade Assumptions:

- An operation producing 100 gallons of syrup annually
- 2 Brix sap is concentrated to 4 Brix by the steam enhanced unit and then to 66.9 Brix by the evaporator
- $330 per chord of wood
- A steam preheater costs $4,500 and a steam enhanced unit costs $11,800
- Average cost of electricity = $0.14 / kWh

Operation	Annual Fuel Energy Usage (MMBTU)	Annual Electrical Energy Usage (kWh)	Energy Usage per Gallon of Syrup (MMBTU/gal)	Annual Energy Cost ($/yr)	Payback Period (yr)
No Preheater	91.5	-	0.915	$1,509.70	-
With Sap Warming Pan	89.1	-	0.891	$1,469.52	18.6
With Sap Preheater	78.2	-	0.782	$1,289.50	20.4
With Steam Enhanced Preheater	37.9	8.0	0.379	$626.28	25.6

Contracting and Installation

Must be NEW equipment from a reputable manufacturer

- **Installation per the manufacturer's recommendations**
  - Encourage using a technical representative from the equipment provider
  - Evaporator insulation or fire bricks
  - Testing and flushing of RO units and preheaters
  - Cleaning of RO membranes
- **Electrical work completed by a licensed contractor**
- **Photos, invoices, and documentation of:**
  - The installed units' make, model, size, and serial number
  - Verify all components are installed
  - Proof of operation for sap processing
- **As-builts and construction approval**

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Success Stories

Existing Condition:

- 100 Taps
- Homemade Arch
- 2x4 Flat Divided Pan

Upgraded Condition:

- 250 Taps
- Smokey Lake Corsair Arch
- 2x4 Raised Flue Pan
- Forced Air

Prescriptive List

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Success Stories

Existing Condition:

- 20 Taps
- Homemade Arch
- (2) 12”x20” Restaurant Pans

Upgraded Condition:

- 250 Taps
- Smokey Lake Corsair Arch
- 2x6 Hybrid Flue Pan
- Forced Air
- 50 GPH RO

Prescriptive List

Success Stories

Existing Condition:

- 540 Taps
- Homemade Arch
- 28”x10’ Homemade Pan
- 250 GPH RO
- Homemade “Pre-Heater”

Upgraded Condition:

- 700 Taps
- 2.5’x10’ CDL Venturi Evaporator
- 250 GPH RO (no upgrade)
- 2.5’x5’ Steam Enhanced Pre-Heater

Prescriptive List

Success Stories

Existing Condition:

- 475 Taps
- 2’x6’ Creekside Welding Evaporator (Propane)
- 250 GPH CDL Hobby RO

Upgraded Condition:

- 750 Taps
- 2’x6’ Creekside Welding Evaporator (Propane) – (no upgrade)
- 600 GPH CDL RO
- 2’x4’ Steam Enhanced Pre-Heater

Table 11. Cost Savings in Operating the Evaporator with the Recommended Changes

Evaporator Cost Savings with Implementation of RO and Steam Preheater Recommendations						
Year	Evaporator Hours[2]	Gallons of Propane[3]	Pounds of CO_2	CO_2 Reduction[4]	Propane Expense[5]	Cost Savings
2024	85.63	373.35	4708	**6742**	$1101.83	**$1567.37**
2025	89.27	389.22	4908	**7496**	$1148.20	**$1743.38**
2026[6]	143.82	627.05	7907	**18,809**	$1849.80	**$4378.24**
Totals	318.72	1389.62	17,523	**33,047**	$4099.83	**$7689.00**
Energy Costs without Implementation of Recommendations						
Year	Evaporator Hours[1]	Gallons of Propane[3]	Pounds of CO_2	CO_2 Reduction	Propane Expense[5]	Cost Savings
2024	207.50	904.80	11,450	--	$2669.20	--
2025	224.81	980.20	12,404	--	$2891.59	--
2026	484.22	2111.20	26,716	--	$6228.04	--
Totals	916.53	3996.20	50,570	--	$11,788.83	--

Agricultural Energy Assessment

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Payment Rates – FY 2024

Scenario	Units	Typical Cost Share/Unit
Reverse Osmosis <= 250 GPH	Gallons per Hour	$33.71
Reverse Osmosis> 250 <1000 GPH	Gallons per Hour	$21.42
Reverse Osmosis >= 1000 GPH	Gallons per Hour	$16.40
Evaporator Oil-Fired	Square Feet	$685.58
Evaporator Wood-Fired, Gasifier	Square Feet	$874.98
Evaporator Wood-Fired, Air Injected	Square Feet	$491.01
Sap Preheater	Square Feet	$187.54
Steam Enhanced PreHeater <= 24 SF	Square Feet	$943.66
Steam Enhanced PreHeater > 24 SF	Square Feet	$492.66
Agricultural Energy Assessment	Ea	$2,156.79

Payment Rates – FY 2024

Example:
A producer has been approved to upgrade an existing 2'x8' evaporator and install a reverse osmosis system rated for 120 GPH

Typical Cost Share the producer would receive:

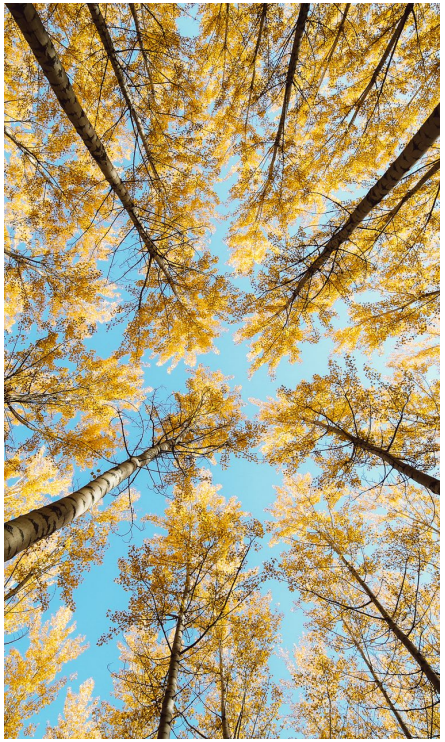
Reverse Osmosis: 120 GPH x $33.71 = **$4,045.20**

Evaporator, Wood Fired, Air Injected: 16 sq. ft. (2'x8') x $491.01 = **$7,856.16**

Forest Stand Improvement

To improve chances to get maple-related assistance, incorporate forestry- or wildlife-related practices into conservation plans. Practices include:

- Tree/shrub establishment
- Tree/shrub pruning
- Forest trails and landings
- Forest stand improvement
- Brush management
- Removal of invasive species
- Spot treatments
- Herbaceous weed treatment



Program Funding - Ohio

EQIP (Environmental Quality Incentive Program)

2024 Spending:
Farm Bill: $27,876,804
IRA: $31,199,000

2025 Allocation:
Farm Bill: $22,935,587
IRA: $42,935,295

EQIP Funding Pools
Cropland
Livestock
Grazing / Pasture
Forestry
Wildlife & Pollinator
Energy
Organic Initiative
Urban High Tunnel Initiatives
Beginning Farmers
Veterans
Historically Underserved

Application Dates

NRCS accepts applications year-round. State specific ranking dates can be found at www.nrcs.usda.gov/ranking-dates

If you apply after the program application date, NRCS will automatically consider your application during the next cycle.

Current EQIP Application Deadline is January 31, 2025

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Questions or Comments?

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