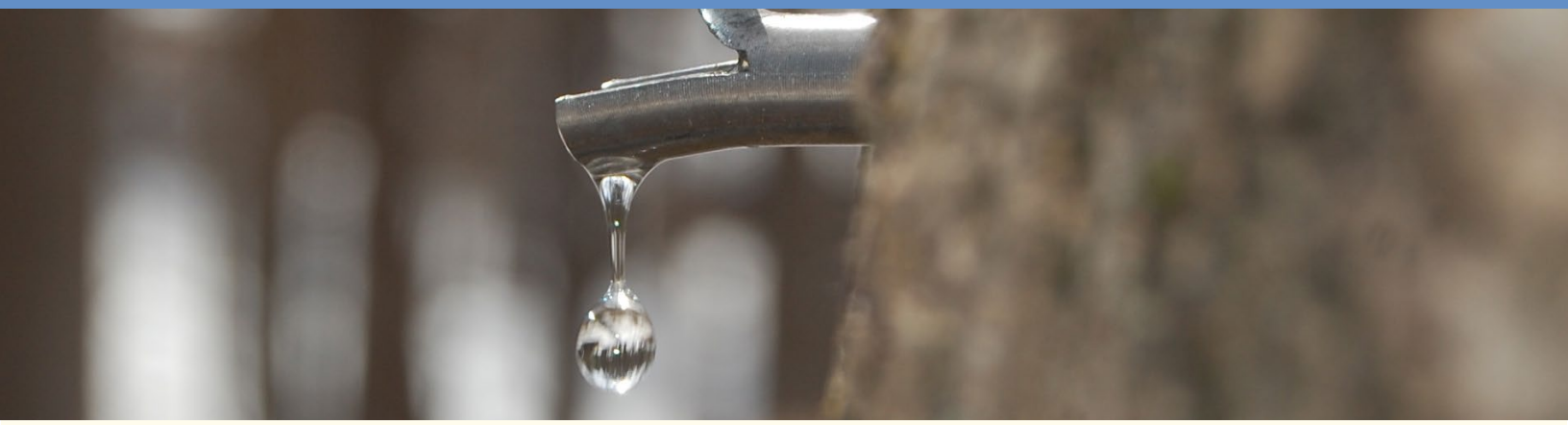
ENERGY-RELATED AGRICULTURAL BEST PRACTICES

# General Energy Efficiency

## For Maple Farms



## Maple farms can use less energy, save money, and be more resilient with equipment upgrades that can pay for themselves

There are several measures and technologies available that can help New York State maple farms—whether small with tens or hundreds of taps, or large with thousands of taps—reduce energy and save money.

### Reverse Osmosis

In modern sugarhouses, much of the water content in sap is removed using reverse osmosis (RO). RO can quickly remove water from sap and can be safely left unattended while running. It costs less to remove water with RO and less energy is required for RO than to boil water away as steam.

RO is a process by which sap is passed through a porous membrane, utilizing hydrostatic pressure greater than the osmotic pressure. Water is squeezed out of the membranes, but the sugars, minerals, and other compounds are too big to fit through the membrane and are left behind in a concentrated form. It is that concentrate that is then boiled in an evaporator to make finished maple syrup.

RO uses pumps to push sap through membranes and concentrate it to various sugar levels depending on the equipment used. Small RO systems might bring the sugar level from 2% up to 4%, and commercial units typically concentrate to between 10% and 20% while specialized high-Brix systems can bring the sap to as high as 32% sugar concentration. Rough numbers show that 4% concentrate cuts time in half, 8% cuts in half again, 16% cuts in half again, and 32% cuts in half again. What started as an eight-hour workday with the evaporator can be cut down to a few hours and half as much energy required when using RO.

RO systems need routine maintenance, such as cleaning membranes after each use and replacing membranes every 5 to 10 years, but the effectiveness of RO systems in reducing evaporator runtime and saving energy makes them worthwhile.

### Evaporator Efficiency

While RO is the key technology for efficiency and cost savings, further savings come with reduced energy use in the evaporator. The energy needed to convert raw sap to syrup can be reduced in the evaporator by 1) pre-heating the sap, and 2) improving evaporator efficiency. Sap preheating can be done using different techniques and a steam recovery device can be a very efficient way to preheat sap. Preheating using recovered steam from the boiling sap does not require additional energy, as it captures heat that would have been wasted. Improved evaporator efficiency reduces heat lost up the smokestack or as radiant heat from the sides of the firebox, increasing the amount of heat transferred to sap from combusted fuel.

See the NYSERDA Energy-Related Agricultural Best Practices factsheet on Maple Evaporator Energy Efficiency to learn more about efficiency upgrades for evaporators.

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The table below summarizes common recommendations that improve energy efficiency on maple farms.

| Energy Efficiency Recommendation | Description | General Operational Requirements | Potential Energy Savings[1] | Typical Simple Payback[2] | Possible Barriers | Non-Energy Benefits | Industry Information and References |
|---|---|---|---|---|---|---|---|
| **Technologies** | | | | | | | |
| **Reverse Osmosis (RO)** | RO to decrease evaporator run time and fuel requirements. | RO design needs to be scaled appropriately for number of taps. | 50–75% | 3–8 years | Cost; access to electricity; space kept above freezing. | Reduced labor hours. | MFEP 2012, Heiligmann et al. 2022. |
| **High Efficiency (HE) Evaporator** | Modify/retrofit evaporators to improve efficiency; or purchase a new, efficient unit. | Retrofits best for existing, low-production farms. Scaled appropriately for RO system. | 15–30% | 4–10 years | Cost; current evaporator design; workspace; availability of components. | Reduced labor hours. Improved workspace conditions. | MFEP 2012, Heiligmann et al. 2022. |
| **Preventative Maintenance** | | | | | | | |
| **Evaporator burner tune-up** | Conduct annual service and perform a combustion test to ensure proper firing. | Access to a service technician. | 1–5% | 1–3 years | Equipment access (which should be corrected). | Avoiding premature equipment failure. | Atkinson & Marchetti 2010. |

***Table Notes:***

*1. The column for **Potential Energy Savings** represents the potential savings as a percentage of the total energy use for each technology category. E.g., if running an evaporator represented 50% of a farmer's energy usage, and if the above table showed a Potential Energy Savings of 20%, then the net effect would be a 10% overall energy savings (50% * 20% = 10%). A farmer can then predict the **Annual Cost Savings** by estimating 10% off their annual energy costs. If a farmer's annual energy cost is $10,000 then the potential cost savings for upgrading to an HE Evaporator would be 10% * $10,000 = $1,000 per year.*

*2. **Simple Payback** is defined as the installation costs divided by the potential energy cost savings. A farmer can then predict the **Expected Implementation Cost** by taking the cost savings from item #1 above and multiplying it by the Simple Payback for the Technology being investigated. If this example of an HE Evaporator had a **Typical Simple Payback** of 5.0 years, then the estimated upgrade cost would be $1,000 * 5.0 = $5,000.*

***References:***


- *Atkinson, H. & Marchetti, L. 2010. Guidelines for the Improvement of Combustion Efficiency for Maple Producers. Thunderbolt Research Corp. Available at: https://mapleresearch.org/pub/combeffic/*
- *Heiligmann, R.B., Koelling, M.R., Perkins, T.D., & van den Berg, A.K. 2022. North American Maple Syrup Producers Manual. Available at: https://mapleresearch.org/pub/manual/*
- *Massachusetts Farm Energy Program (MFEP). 2012. Best Management Practices for Maple Sugaring. Massachusetts Department of Agricultural Resources, Amherst, MA. Available at: https://massfarmenergy.com/wp-content/uploads/2014/03/Maple%20Sugaring%20Best%20Practices.pdf*
- *New York State Energy Research and Development Authority (NYSERDA). 2022. Maple Evaporator Energy Efficiency. Energy Best Practices for Agriculture factsheet. Available at https://agenergyny.org/factsheets/*


## Resources

Energy efficiency resources are being developed for farmers by Cornell Cooperative Extension and the New York State Energy Research and Development Authority, in collaboration with topic-experts in New York State. Visit AgEnergyNY.org to find cost-saving resources for farms:

- Recommendations for energy-efficient technologies
- Conservation practices to optimize energy use
- Easy access to funding resources

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## Ready to get started?

**Visit AgEnergyNY.org to learn more and to get advice on energy efficiency and farm operations, learn about available grants and incentives, or obtain a free energy audit of your farm operations.**

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