// ENERGY EFFICIENCY SUCCESS STORIES

# COMBUSTION SYSTEM IMPROVEMENT IN NEW JERSEY

A 160-acre blueberry farm in Atlantic County, NJ approached USDA Natural Resource Conservation Service - New Jersey (NRCS-NJ) with a project idea to reduce water use, lower energy inputs, improve air quality, and decrease labor.

The farm worked with NRCS District Conservationist Michelle Pedano and NRCS Irrigation and Energy Specialist Rubén Pérez to find creative ways to support the farm's goals. A few years prior, the farm switched from overhead irrigation to micro-drip irrigation. Despite this change, the farm was still using five diesel pumps and five wells to meet their growing season water needs. While the farm had sufficient water, they knew that improving energy efficiency would translate into both water and cost-savings.

As a former irrigation salesperson, the farm's manager is comfortable trying new practices. Over the years, he's worked with NRCS-NJ on the installation of various conservation practices through the Environmental Quality Incentives Program. In 2023, the farm manager approached NRCS-NJ with a new idea: to replace the centrifuge irrigation pumps with electric submersible pumps with variable frequency drives.

Close-up of blueberry cluster. Photo by Christophe Paul, USDA-NRCS.

## How NRCS-NJ Helps Producers

For irrigation projects, NRCS tends to work with producers to address inefficient use of irrigation and improve precision of water first. In this case, irrigation efficiency had already been addressed and improved by switching from overhead sprinkler to micro-drip irrigation, allowing the farm to use less energy and less water by releasing the water with more precision. The farm's new goal was to further improve both water and energy efficiency in their pumping systems with the support of NRCS.

"To complete the farm's vision, we had to come at it from a more creative angle." Pedano said. "Energy is one of our resource concerns and we felt that with Rubén's assistance, we could quantify energy savings to justify financial assistance for the improvements the farm was hoping to make."

The farm elected to use electric pumps to replace its older, less efficient diesel pumps. Electric pumps are more efficient at converting energy into water movement and have lower long-term operating cost. However, the farm fields were far from electrical infrastructure. “That did add a wrinkle to the plan. We couldn’t get the electric company to run power back there,” Pedano said. The team didn’t give up. Pérez, Pedano, and the farm manager continued to investigate options and discovered that the farm would still achieve net energy savings by using EPA Tier 4 diesel generators to power the electric pumps.

## The Calculations

“We found that energy efficiency related to pumping water would be improved by at least 20% by doing this project,” Pedano said. “With more efficient pumps we only needed to use three set-ups (diesel generator/electric pump combinations) instead of five,” she added. Further calculations showed that the farm would also be able to decrease their emissions by using the new systems.

The energy requirement calculations for this type of project were complex. Pérez described his process: “I started with the crop’s water requirements. Then we asked, *‘What is the minimum horsepower needed to get the appropriate gallons per minute?’* Then we translated the horsepower to electricity (wattage) and asked, *‘How big of a generator do we need?’* Finally, that was used to find the energy requirements.”

Pedano and Pérez identified ‘Air Quality’ (emissions of airborne reactive nitrogen and particulate matter) as the resource concern to support the transition from diesel powered pumps to electric. The team identified the resource concern ‘Energy Efficiency of Equipment and Facilities’ for the Tier 4 diesel generators. While they’d tell you the project was complex, they can confidently say it has benefited the producer.

“The new system has also saved them time and effort.” Pedano said. “With the new pumps, the farm manager can run them from a program on his phone, requiring less of their time because they don’t have to go around and manually start the pumps up anymore.” Pérez and Pedano expect to receive a full report on fuel use and cost savings related to the new systems from the farm at the end of 2025. In the meantime, both NRCS staff members are confident that their creativity and perseverance through the complex project have paid off. “At the end of the day we know we’re saving some energy, and we know we’re saving some air quality”.



(Before) The farm’s five pumps were bringing in enough water, but the farm manager knew there was a way to reduce fuel use and improve efficiency. (After) New electric pumps, powered by new Tier 4 diesel generators are saving the farm money and reducing their emissions. Photos by Michelle Pedano, USDA-NRCS

## NRCS Energy Efficiency Practices - Combustion System Improvement

Not all engine swapping practices need to be this complicated. NRCS offers Combustion System Improvement practices to help farmers replace, repower, or retrofit an agricultural combustion system and related components and devices. The practice has two main purposes: 1) to improve air quality, and 2) to reduce the amount of energy a farm uses. Together, these improvements decrease emissions from on-farm activities while also saving farmers money.

Most equipment on the farm that use fuel can be upgraded to burn less fuel, burn cleaner, or be replaced by a more efficient system.

**A** **REPLACEMENT**

In a replacement, the entire combustion system is replaced with new equipment that has equivalent capability (e.g. the same horsepower or functional output). These new systems are required to meet certain emissions and efficiency standards. Replacement may involve switching from internal combustion engines to electric motors or upgrading to more efficient combustion engines (Tier 4). Once replaced, the old machinery or engine must be destroyed via dismantling and disabling.

**B** **REPOWER**

During a repower, the body of a tractor, pump or machine is kept and only the engine (or combustion system) is replaced with a newer, cleaner, and more efficient version. The remaining components (frame, pump casing, transmission, etc.) remain in use. Once repowering is complete, the old engine or combustion system must also be destroyed or disabled.

**C** **RETROFIT**

In a retrofit, the existing engine remains in place, and emissions-reducing components are added to measurably reduce emissions from the existing engine. Common retrofits include diesel oxidation catalysts (DOC), diesel particulate filters (DPF), or idle-reduction technologies.

## Getting Started Equipment Eligibility

To determine eligibility, NRCS uses the EPA's non-road diesel engine emissions Tier chart. Any in-use diesel-powered tractor or diesel-powered equipment in Tier 0 through Tier 2 can be replaced with Tier 4 equipment. Below are examples of mobile and stationary equipment that may qualify for Combustion System Improvement.

| Mobile Equipment Examples | Stationary Equipment Examples |
|---|---|
| Backhoes | Water Heaters |
| Tractors | Diesel-powered Irrigation Systems |
| Skid steer | Orchard/Vineyard Frost Protection Equipment |
| Sprayers | Diesel-powered Generators |
| Harvesters | Grain Drying System Burners |
| Loaders | Greenhouse Heating Systems |
| Forklifts | Maple Production Heating Systems |
| | Diesel Powered Vacuum Pumps |

Learn more about the EPA diesel engine non-road emission Tier chart.

## References:


Personal communications with Michelle Pedano and Rubén Pérez, NRCS-NJ on September 26, 2025 .

U.S. Department of Agriculture. (2018). "Combustion System Improvement." https://efotg.sc.egov.usda.gov/api/CPSFile/20553/372_CA_PS_Combustion_System_Improvement_2018


## Footnote:


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