

# Survey of Energy Use and Energy Conservation in Greenhouse Production in Northern New England

## Summary of Results December 2011

by

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This survey was conducted among growers in Maine, New Hampshire and Vermont in 2010-2011 to obtain baseline information on energy consumption and conservation measures used in greenhouses. Results will provide key information on the current status of energy use in the region, and lead to targeted programs that effectively meet grower needs. A total of 53 surveys were completed from the 2,000 sent out, the results of which are summarized below.

### Key outcomes:

Responses differed significantly in the three states, but for simplicity, below are the results averaged among all states.

- 56.6% of the growers surveyed were retail vegetable growers, 66% were retail ornamental growers and 52.8% were co/owners of a horticultural business
- 34.0% had 1-2 full time employees, 26.4% had over 6, 13.2% had 3-4 and 17% had none.
- Bedding plants accounted for 28.5% of revenue for the growers surveyed, 11.8% were vegetables, 11.7 were flowering potted plants, 11.3 were perennials and 9.5 were vegetable starter plants.
- About 50% of the operations had less than 10,000 ft<sup>2</sup> of greenhouse space; 26.4% had 10,000-25,000 ft<sup>2</sup>.
- Across all three states, the percentage of greenhouse space used increases from January to May. Usage peaks in May to 95.3% and gradually decreases over the rest of the year
- 49.1% of the growers surveyed use oil to heat their greenhouses, 47.2% used propane gas, and 22.6% used wood fired heaters.
- 62.3% of those surveyed spent less than \$10,000 on fuel annually; 5.7% used \$25,000-50,000.
- To save energy 58.49% of the growers surveyed adjust their planting dates, 56.6% seal gaps around doors and vents, 51% get their boiler or furnace checked annually, 45% insulate the endwalls, 28% use bottom heat, 23% use energy efficient light bulbs. 47.2% use electronic thermostats and horizontal air flow systems, The most popular energy saving measure for all states surveyed was adjusting planting dates (of total)
- When asked what limits them from improving energy conservation, 37.7% said it was too expensive, 17% said they didn't have time or didn't know the cost benefits, 15% didn't know if they qualified for tax incentives and 11% didn't know what to do.
- When asked what would help them adopt more energy conservation measures, **51% said providing tax incentives** would be the most helpful; **43% said providing free energy audits**, **40% felt they needed assistance with learning what programs were available** to help them.
- When asked what research information would help them adopt more energy conservation, **39.6% said cost benefit analyses** would be the most helpful, 34% said learning what benefits they would receive from making changes would help, and 21% felt guidelines on what to do to reduce energy use was needed.

Personnel at the UVM Entomology Research Laboratory are working with growers in Maine, New Hampshire and Vermont to arrange for energy audits through various state and federal programs. Growers who are interested in having an energy audit should contact Margaret Skinner to learn how to get involved. Tel: 802-656-5440; email: mskinner@uvm.edu

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## Data tables by survey question

### 1. What is your type of business?

| Response                     | All States | ME    | NH    | VT    | Other |
|------------------------------|------------|-------|-------|-------|-------|
| Retail vegetable grower      | 56.6       | 54.55 | 45.45 | 68.42 | 0     |
| Retail ornamental grower     | 66         | 59.09 | 63.64 | 78.95 | 0     |
| Landscaper                   | 22.6       | 18.18 | 27.27 | 26.32 | 0     |
| Head grower                  | 39.6       | 36.36 | 45.45 | 42.11 | 0     |
| Research tech.               | 1.89       | 4.55  | 0     | 0     | 0     |
| Wholesale vegetable grower   | 30.2       | 36.36 | 18.18 | 31.58 | 0     |
| Wholesale ornamentals grower | 32.1       | 40.91 | 18.18 | 26.32 | 100   |
| Garden center                | 47.2       | 31.81 | 63.63 | 52.63 | 100   |
| Greenhouse worker            | 17         | 9.09  | 27.27 | 21.05 | 0     |
| Interiorscapes               | 5.66       | 4.55  | 9.09  | 5.26  | 0     |
| Cut flower grower            | 25         | 13.64 | 36.36 | 33.33 | 0     |
| Co/Owner                     | 52.8       | 59.09 | 45.45 | 47.37 | 100   |
| Univ. researcher             | 3.77       | 9.09  | 0     | 0     | 0     |
| Other (specify)              | 15.1       | 18.18 | 9.09  | 15.79 | 0     |

### 2. Where is your business located?

| State         | % Total | Number surveyed |
|---------------|---------|-----------------|
| Maine         | 41.5    | 22              |
| New Hampshire | 20.8    | 11              |
| Vermont       | 35.8    | 19              |
| Other (PA)    | 1.89    | 1               |

### 3. How many full time employees do you have?

| Response        | All States | ME    | NH    | VT    | PA  |
|-----------------|------------|-------|-------|-------|-----|
| None            | 17         | 27.27 | 0     | 15.79 | 0   |
| 1-2             | 34         | 45.45 | 27.27 | 21.05 | 100 |
| 3-4             | 13.2       | 13.64 | 0     | 21.05 | 0   |
| 5-6             | 7.55       | 9.09  | 18.18 | 0     | 0   |
| Over 6 (number) | 26.4       | 4.55  | 54.55 | 36.84 | 0   |
| NA              | 1.89       | 0     | 0     | 5.26  | 0   |

### 4. What percentage of your revenue comes from greenhouse crops?

| Response                 | All States | ME    | NH    | VT    | PA |
|--------------------------|------------|-------|-------|-------|----|
| Bedding plants           | 28.5       | 33.41 | 33    | 20.79 | 20 |
| Flowering potted plants  | 11.7       | 8.5   | 7.64  | 15.74 | 50 |
| Foliage plants           | 3.83       | 2.5   | 2.09  | 6.58  | 0  |
| Perennials               | 11.3       | 9     | 20.27 | 9.47  | 0  |
| Cuttings/plugs           | 4.34       | 9.09  | 0     | 1.58  | 0  |
| Cut flowers              | 3.34       | 2.14  | 1.91  | 5.74  | 0  |
| Vegetables               | 11.8       | 5.68  | 11.73 | 18.05 | 30 |
| Vegetable starter plants | 9.51       | 12.86 | 3.45  | 9.63  | 0  |
| Other (3-4)              | 6.62       | 8.18  | 7.27  | 4.79  | 0  |
| Other (5-7)              | 2.21       | 0.23  | 3.36  | 3.95  | 0  |

**5. How many square feet of greenhouse do you have (ft.<sup>2</sup>)?**

| Response       | All States | ME    | NH    | VT    | PA  |
|----------------|------------|-------|-------|-------|-----|
| 1-10,000       | 50.9       | 68.18 | 27.27 | 47.37 | 0   |
| 10,001-25,000  | 26.4       | 27.27 | 36.36 | 15.79 | 100 |
| 25,001-50,000  | 15.1       | 4.55  | 18.18 | 26.32 | 0   |
| 50,001-75,000  | 1.89       | 0     | 9.09  | 0     | 0   |
| 75,001-100,000 | 1.89       | 0     | 0     | 5.26  | 0   |
| Over 100,000   | 1.89       | 0     | 9.09  | 0     | 0   |

**6. What percentage of greenhouse space do you use per month**

| Month | All States | ME    | NH    | VT    | PA  |
|-------|------------|-------|-------|-------|-----|
| Jan   | 20.8       | 18.05 | 30    | 18.21 | 30  |
| Feb   | 28.2       | 22.73 | 40.45 | 25.74 | 60  |
| Mar   | 60         | 60    | 67.64 | 53.47 | 100 |
| Apr   | 87.2       | 87.5  | 89    | 85.26 | 100 |
| May   | 95.3       | 95.45 | 100   | 92.11 | 100 |
| Jun   | 79.7       | 75    | 90.91 | 80.21 | 50  |
| Jul   | 52.6       | 44.77 | 74.73 | 51.63 | 0   |
| Aug   | 42.3       | 36.36 | 65    | 38.37 | 0   |
| Sept  | 39.8       | 32.95 | 53.18 | 42.21 | 0   |
| Oct   | 33.1       | 25.45 | 50    | 33.79 | 0   |
| Nov   | 25.7       | 25.23 | 43.18 | 17.58 | 0   |
| Dec   | 22.6       | 18.64 | 40.91 | 16.53 | 0   |

**7. What kind of heating and cooling systems do you use?**

| Response                  | All States | ME    | NH    | VT    | PA  |
|---------------------------|------------|-------|-------|-------|-----|
| Oil fired heater          | 49.1       | 63.64 | 54.55 | 31.58 | 0   |
| Propane gas fired heater  | 47.2       | 36.36 | 27.27 | 68.42 | 100 |
| Wood fired heater         | 22.6       | 22.73 | 0     | 36.84 | 0   |
| Pellet fired heater       | 9.43       | 4.55  | 18.18 | 10.53 | 0   |
| Solar powered heater      | 0          | 0     | 0     | 0     | 0   |
| Swamp cooler              | 0          | 0     | 0     | 0     | 0   |
| Horizontal air vents      | 37.7       | 18.18 | 54.55 | 47.37 | 100 |
| Geothermal heating syst.  | 3.77       | 4.55  | 0     | 5.26  | 0   |
| Electronic thermostats    | 41.5       | 45.45 | 36.36 | 36.84 | 100 |
| Horizontal air flow syst. | 41.5       | 31.82 | 45.45 | 47.37 | 100 |
| Manure heating systems    | 0          | 0     | 0     | 0     | 0   |
| Wind generator system     | 0          | 0     | 0     | 0     | 0   |
| Bottom heat               | 22.6       | 13.64 | 27.27 | 31.58 | 0   |
| Biodiesel fired heater    | 0          | 0     | 0     | 0     | 0   |
| None                      | 3.77       | 4.55  | 9.09  | 0     | 0   |
| Other                     | 17         | 18.18 | 18.18 | 15.79 | 0   |
| Other                     | 7.55       | 13.64 | 9.09  | 0     | 0   |
| Other                     | 0          | 0     | 0     | 0     | 0   |

**8. How much do you spend per year on fuel?**

| Response           | All States | ME    | NH    | VT    | PA  |
|--------------------|------------|-------|-------|-------|-----|
| Less than \$10,000 | 62.3       | 81.82 | 36.36 | 52.63 | 100 |
| \$10,001-25,000    | 24.5       | 18.18 | 45.45 | 21.05 | 0   |
| \$25,001-50,000    | 5.66       | 0     | 9.09  | 10.53 | 0   |
| \$50,001-75,000    | 1.89       | 0     | 0     | 5.26  | 0   |
| Over \$100,000     | 1.89       | 0     | 9.09  | 0     | 0   |

**9. How much do you spend per year on electricity?**

| Response           | All States | ME    | NH    | VT    | PA  |
|--------------------|------------|-------|-------|-------|-----|
| Less than \$10,000 | 90.6       | 95.45 | 90.91 | 84.21 | 100 |
| \$10,001-25,000    | 1.89       | 4.55  | 0     | 0     | 0   |
| \$25,001-50,000    | 1.89       | 0     | 0     | 5.26  | 0   |
| \$50,001-75,000    | 1.89       | 0     | 9.09  | 0     | 0   |
| Over \$100,000     | 0          | 0     | 0     | 0     | 0   |

**10. How many energy saving measures do you use in your greenhouses?**

| Response                         | All States | ME    | NH    | VT    | PA  |
|----------------------------------|------------|-------|-------|-------|-----|
| High efficiency boiler           | 9.43       | 0     | 18.18 | 15.79 | 0   |
| High efficiency furnace          | 24.53      | 27.27 | 9.09  | 31.58 | 0   |
| Insulation energy curtain        | 13.21      | 18.18 | 18.18 | 5.26  | 0   |
| Oil heater                       | 26.42      | 36.36 | 36.36 | 10.53 | 0   |
| Solar water storage              | 3.77       | 4.55  | 0     | 5.26  | 0   |
| Use DIF                          | 22.64      | 13.64 | 36.36 | 21.05 | 100 |
| High insulation plastic          | 42.31      | 50    | 60    | 26.32 | 0   |
| Seal gaps around doors & vents   | 56.6       | 50    | 72.72 | 52.63 | 100 |
| Electronic thermostats           | 47.17      | 54.55 | 36.36 | 42.11 | 100 |
| Bottom heat                      | 28.3       | 22.73 | 27.27 | 36.84 | 0   |
| Horizontal air flow system       | 47.17      | 22.73 | 72.73 | 57.89 | 100 |
| Geothermal heating system        | 1.89       | 0     | 0     | 5.26  | 0   |
| Energy efficient light bulbs     | 22.64      | 27.27 | 9.09  | 26.32 | 0   |
| Wind generator                   | 1.89       | 0     | 0     | 5.26  | 0   |
| Bubble insulation system         | 20.75      | 31.82 | 9.09  | 10.53 | 100 |
| Solar panels                     | 1.89       | 0     | 0     | 5.26  | 0   |
| Energy audit                     | 7.55       | 4.55  | 18.18 | 5.26  | 0   |
| Annual furnace/boiler checkup    | 50.94      | 63.64 | 63.63 | 26.32 | 100 |
| Don't grow cold sensitive plants | 16.98      | 22.73 | 18.18 | 5.26  | 100 |
| Remay covering over crops        | 22.64      | 13.64 | 27.27 | 31.58 | 0   |
| Plastic covering over crops      | 9.43       | 9.09  | 9.09  | 10.53 | 0   |
| Adjust planting dates            | 58.49      | 50    | 63.64 | 63.16 | 100 |
| Grower cool-temperature plants   | 30.19      | 31.82 | 45.45 | 15.79 | 100 |
| Side wall insulation             | 33.96      | 27.27 | 36.36 | 42.11 | 0   |
| End wall insulation              | 45.28      | 36.36 | 45.45 | 52.63 | 100 |
| Other type of heat storage       | 0          | 0     | 0     | 0     | 0   |
| Other                            | 9.43       | 13.64 | 9.09  | 5.26  | 0   |

**11. What limits you from improving your energy conservation (1=least limiting, 3=most limiting)?**

| Response                                   | All States |      |      | ME   |      |      | NH   |      |      | VT   |      |      | PA  |     |   |
|--|------------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|---|
|  | 1          | 2    | 3    | 1    | 2    | 3    | 1    | 2    | 3    | 1    | 2    | 3    | 1   | 2   | 3 |
| No limits                                  | 11.3       | 0    | 0    | 13.6 | 0    | 0    | 18.2 | 0    | 0    | 5.3  | 0    | 0    | 0   | 0   | 0 |
| Too expensive                              | 15.1       | 20.8 | 37.7 | 9.1  | 22.7 | 45.5 | 0    | 27.3 | 36.4 | 31.6 | 10.5 | 31.6 | 0   | 100 | 0 |
| Negative impact on production              | 37.7       | 3.8  | 3.8  | 36.4 | 9.1  | 9.1  | 54.5 | 0    | 0    | 31.6 | 0    | 0    | 0   | 0   | 0 |
| Don't have time to make the changes        | 24.5       | 15.1 | 17.0 | 40.9 | 9.1  | 13.6 | 18.2 | 27.3 | 18.2 | 10.5 | 15.8 | 21.1 | 0   | 0   | 0 |
| Don't know what to do                      | 24.5       | 26.4 | 11.3 | 27.3 | 13.6 | 22.7 | 18.2 | 45.5 | 0    | 26.3 | 26.3 | 5.3  | 0   | 100 | 0 |
| Don't know the cost benefits               | 13.2       | 26.4 | 17.0 | 18.2 | 22.7 | 27.3 | 0    | 45.5 | 18.2 | 15.8 | 21.1 | 5.3  | 0   | 0   | 0 |
| Don't know if I qualify for tax incentives | 24.5       | 20.8 | 15.1 | 27.3 | 18.2 | 18.2 | 36.4 | 27.3 | 18.2 | 15.8 | 21.1 | 10.5 | 0   | 0   | 0 |
| It is too complicated                      | 20.8       | 18.9 | 7.5  | 22.7 | 27.3 | 4.5  | 27.3 | 18.2 | 18.2 | 10.5 | 10.5 | 5.3  | 100 | 0   | 0 |
| Other                                      | 13.2       | 0    | 3.8  | 18.2 | 0    | 0    | 18.2 | 0    | 0    | 5.3  | 0    | 10.5 | 0   | 0   | 0 |
| Other                                      | 1.9        | 0    | 1.9  | 4.5  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 5.3  | 0   | 0   | 0 |

**12. What would help you adopt more energy conservation measures (1= little helpful, 3=very helpful)?**

| Response                                       | All States |      |      | ME   |      |      | NH   |      |      | VT   |      |      | PA  |     |     |
|--|------------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|
|  | 1          | 2    | 3    | 1    | 2    | 3    | 1    | 2    | 3    | 1    | 2    | 3    | 1   | 2   | 3   |
| Provide free energy audits                     | 22.6       | 17.0 | 43.4 | 13.6 | 0    | 0    | 18.2 | 36.4 | 45.5 | 21.1 | 10.5 | 36.8 | 100 | 0   | 0   |
| Provide tax incentives                         | 17.0       | 18.9 | 50.9 | 9.1  | 22.7 | 45.5 | 18.2 | 9.1  | 72.7 | 10.5 | 26.3 | 36.8 | 0   | 100 | 0   |
| Information fact sheets                        | 30.2       | 26.4 | 17.0 | 36.4 | 9.1  | 9.1  | 36.4 | 27.3 | 27.3 | 26.3 | 26.3 | 5.3  | 100 | 0   | 0   |
| Demonstration programs                         | 28.3       | 34.0 | 13.2 | 40.9 | 9.1  | 13.6 | 18.2 | 54.5 | 18.2 | 45.5 | 26.3 | 5.3  | 0   | 0   | 0   |
| Educational workshops                          | 28.3       | 26.4 | 24.5 | 27.3 | 13.6 | 22.7 | 18.2 | 27.3 | 45.5 | 21.1 | 21.1 | 15.8 | 0   | 0   | 100 |
| Assistance with learning of available programs | 11.3       | 28.3 | 39.6 | 18.2 | 22.7 | 27.3 | 9.1  | 27.3 | 63.6 | 10.5 | 21.1 | 31.6 | 0   | 100 | 0   |
| Create professional energy advising service    | 20.8       | 32.1 | 17.0 | 27.3 | 18.2 | 18.2 | 18.2 | 45.5 | 27.3 | 10.5 | 31.6 | 15.8 | 0   | 0   | 0   |
| Conduct efficacy trials and publish results    | 32.1       | 20.8 | 18.9 | 22.7 | 27.3 | 4.5  | 45.5 | 18.2 | 27.3 | 26.3 | 15.8 | 15.8 | 0   | 0   | 0   |
| Computer links to communicate problems         | 39.6       | 20.8 | 9.4  | 18.2 | 0    | 0    | 54.5 | 18.2 | 18.2 | 31.6 | 26.3 | 0    | 0   | 0   | 0   |
| Other  | 3.8        | 1.9  | 0    | 4.5  | 0    | 0    | 0    | 9.1  | 0    | 5.3  | 0    | 0    | 0   | 0   | 0   |

**13. What research/information is needed to help you implement more energy conservation (1=low need, 3=great need)?**

| Response                                     | All States |      |      | ME   |      |      | NH   |      |      | VT   |      |      | PA |     |   |
|--|------------|------|------|------|------|------|------|------|------|------|------|------|----|-----|---|
|  | 1          | 2    | 3    | 1    | 2    | 3    | 1    | 2    | 3    | 1    | 2    | 3    | 1  | 2   | 3 |
| Cost benefit analysis                        | 5.7        | 34.0 | 39.6 | 9.1  | 18.2 | 50   | 9.1  | 45.5 | 45.5 | 0    | 42.1 | 26.3 | 0  | 100 | 0 |
| Energy saving benefits                       | 13.2       | 37.7 | 34.0 | 13.6 | 27.3 | 45.5 | 27.3 | 27.3 | 45.5 | 5.3  | 52.6 | 15.8 | 0  | 100 | 0 |
| Negative production aspects                  | 28.3       | 35.9 | 7.5  | 27.3 | 36.4 | 13.6 | 27.3 | 54.5 | 9.1  | 31.6 | 21.1 | 0    | 0  | 100 | 0 |
| Production guidelines that reduce energy use | 24.5       | 35.9 | 20.8 | 22.7 | 40.9 | 22.7 | 27.3 | 36.4 | 27.3 | 26.3 | 26.3 | 15.8 | 0  | 100 | 0 |
| Degree day monitoring                        | 37.7       | 28.3 | 7.5  | 40.9 | 27.3 | 4.5  | 36.4 | 27.3 | 27.3 | 31.6 | 26.3 | 0    | 10 | 0   | 0 |
| Other  | 3.8        | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 10.5 | 0    | 0    | 0  | 0   | 0 |