Climate, Agriculture, and Energy in Vermont

For C7. Fuel, Food and Other Uses for Ag and Forest Land; VECAN 2014

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Outline

- GHG from agriculture sector
- Farm energy production, especially digesters and Act 148 banning food waste from landfills
- Land use rules and precedent
  - Solar projects and the statewide energy facility permitting process, and protection of soils
  - Use-value appraisal ("current use") for solar and other energy uses

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Outline, (there's more)

- Food versus fuel debate (energy crops)
- Some interesting projects
  - Farm-scale fuel (UVM economic analysis for on-farm usage, 2014 field trials)
  - Water quality effects of grass-based agriculture and energy
  - Biomass heating of greenhouses
  - Wind power yes!

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GHG from Agriculture in Vermont

- We're part of the problem
  - ➢13-15% of VT's GHG
    - ~6% Enteric fermentation (mostly CH_4 via cow belching)
    - ~2% Manure management (manure storage CH_4 and N_2O)
    - ~2% Agricultural soils (N_2O)
  - ➢So: 10% produces food and feed, the other 3-5% is transportation, electricity (very small GHG), and heating (water, process, space)

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Energy use in the food system

- Per capita increase in food related energy use
  - 1997 – 2002 16.4%
  - 2002 – 2007 7.7%
- … while per-capita energy use declined
- More food waste (14.5% and 10.1% increases, 1990-2000 and 2000-2007, respectively)
- Energy substituted for labor – both as prepared food and as energy use in cooking
- Transportation increase

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Farm solutions to GHG

- Digesters
  - 94% of the GHG reduction is from burning the methane that would otherwise come off the manure pit.
  - 6% reduction from value of offsetting usage of electricity that would've emitted GHG
  - Highest per cowpita digester usage in the United States? Fleet of 17.
  - Still, only 10% of the manure.

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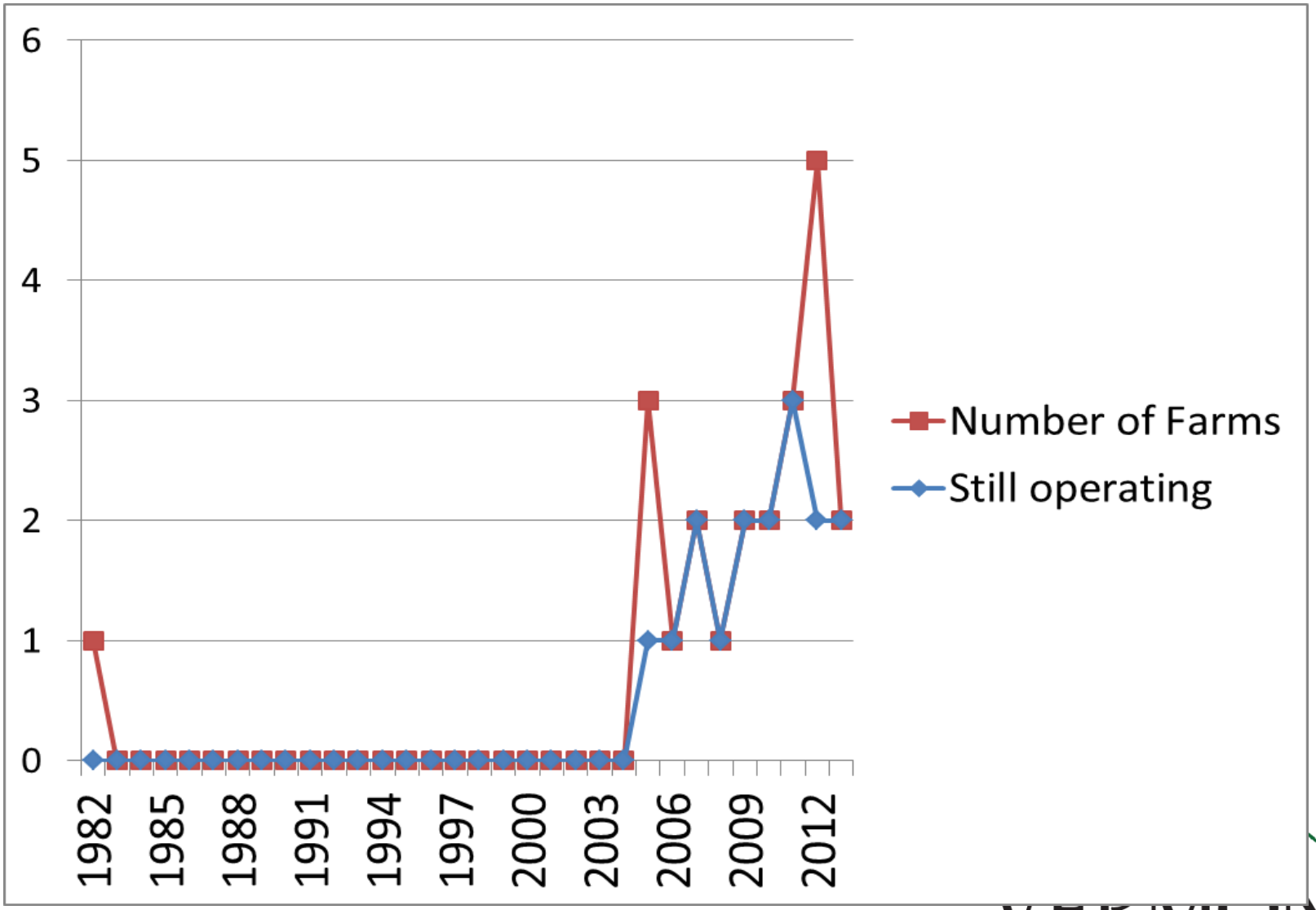
Digester development history, yearly



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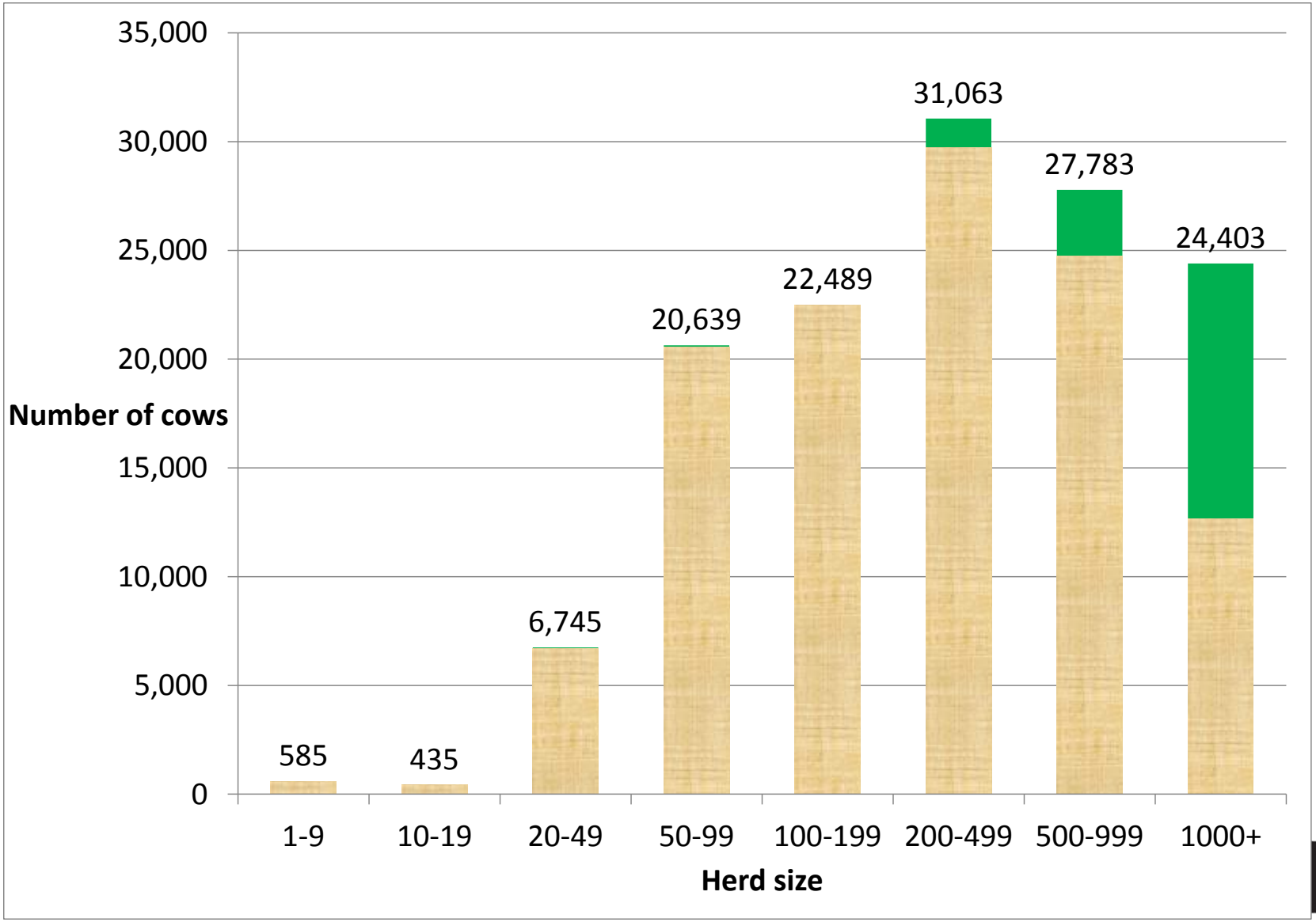
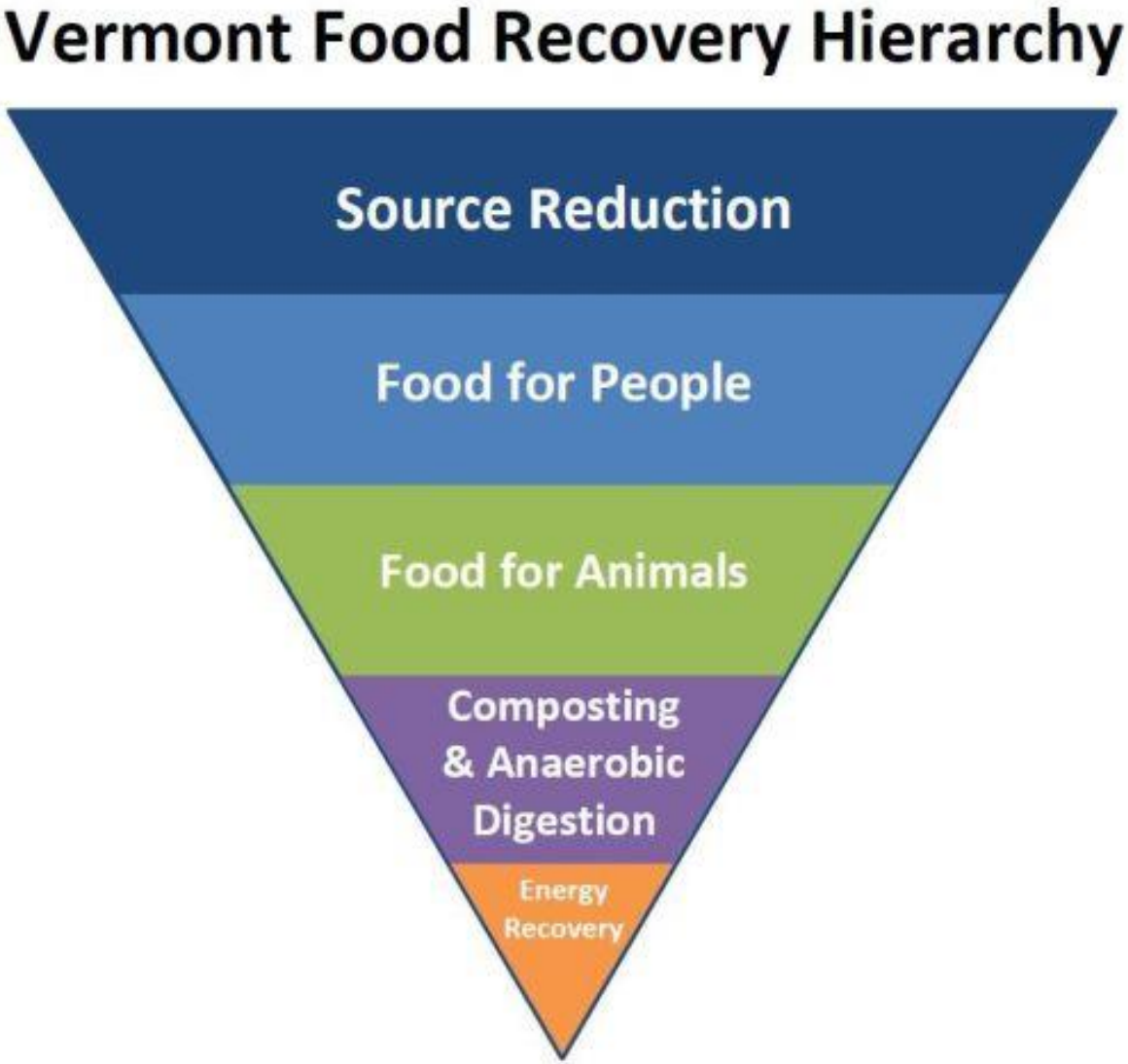
Dairy herd size (134,000)



Another point of reference



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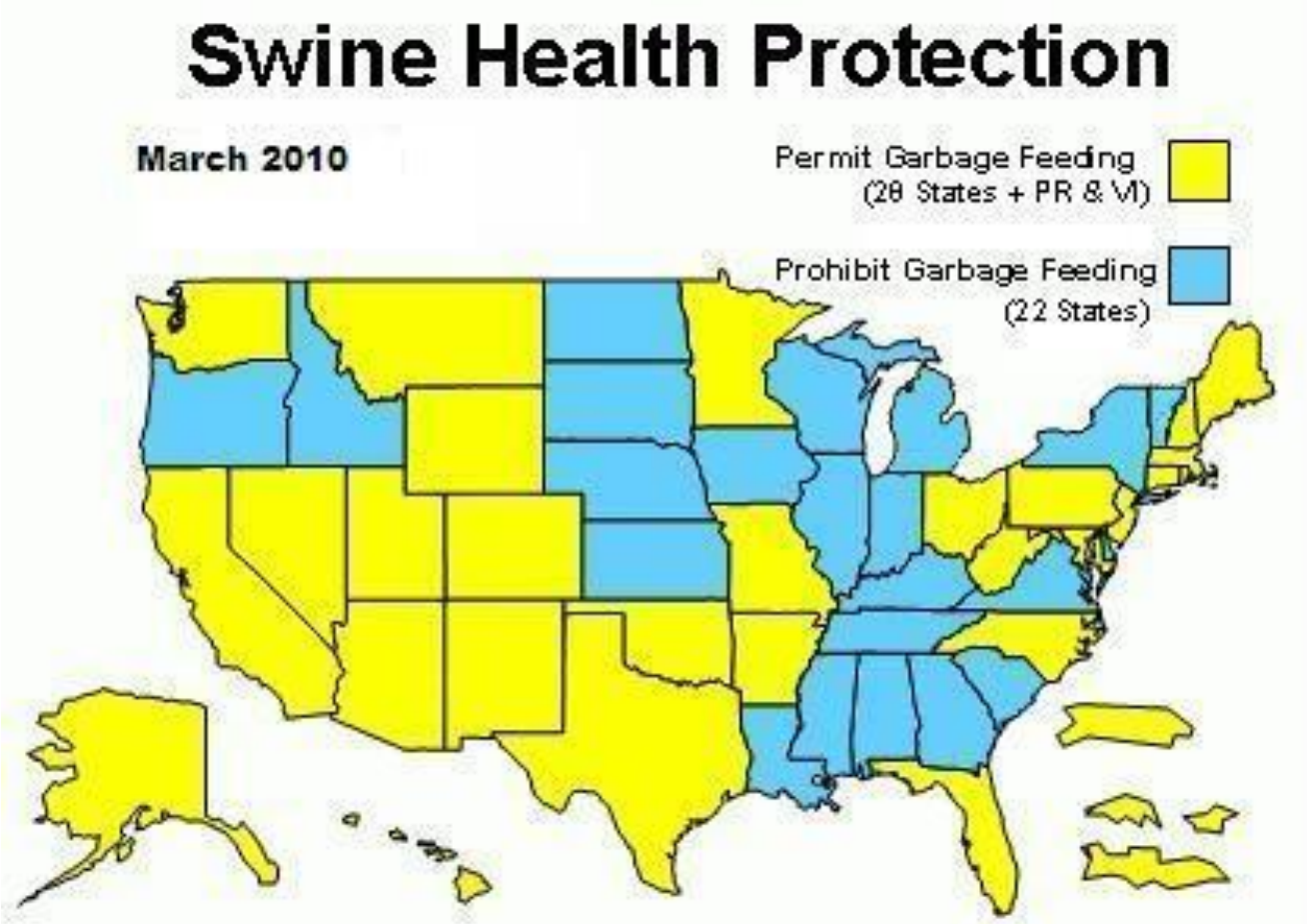
Animal feeding



"Prohibited food waste is defined … as … derived from the meat of any animal … and refuse of any character that has been associated (handling, preparation, cooking, disposal, or consumption) with meat and meat products."

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So…

- Very large installed capacity of digesters
- …handling only ~10% of the state's manure
- 61% of the herd is on farms of fewer than 500 cows.
- Most digester operators are accepting <10% *food processing residuals.*
- What about food waste (*food residuals*) in digesters??

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Is it safe, and allowable?

- Food scraps (*food residuals*) being banned from landfill – NONE going to digesters
- Enough digester capacity to handle 100% of anticipated food residuals, as 10% of existing digester capacity.

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Other options for biogas

- Heat-only (and/or absorption chilling)
- Put it in a natural gas pipeline
  - Middlebury College contract, now
- Use it for the milk truck!

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More farm solutions

- Localization of food
  - Vermonters get more of their food directly from community-supported agriculture, farmers markets, and farm stands than residents of any other state.
  - Tripling of CSAs in eleven years, from 34 to 120 (2001 to 2012).

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Mitigate *and* Sequester

- Analogous to energy policy
  - "low-hanging fruit first" REALLY?
  - Parallel tracks: efficiency/conservation *and* clean power generation
  - Same with GHG
- We have the land (farm and forest). Show us the money, for sequestration.

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Sequester

- Early programs now in grasslands payments
- Transaction costs and qualification
  - Eligible technologies into limited markets
  - E.g. RGGI
- Energy and sequester and high-value markets?

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Some particulars of biochar

- In between charcoal (300-450 C) and activated carbon (700 C)
- Soil amendment (Shelburne Farm trials)
- Feed additive
- Energy recovery!!
- The Vermont model – value-added agriculture

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Land Use

- Solar farm?

« Don't let winter break you

On Mill Pond Way in Portsmouth, NH »

Solar Farms Move Us Closer to Vermont's Energy Goal

366 solar trackers and 8,784 JA Solar modules at Claire Solar in So. Burlington, Vt., the largest solar installation of its kind in North America

Since the last edition of *Green Energy Times* went to press, we have seen two more large solar arrays put online in Vermont. Both are in the state's Sustainably Priced Energy Development (SPEED) program, in the Standard Offer Program, which offers a guaranteed price advantage. Each has a capacity of about 2.2 MW, the maximum eligibility limit for the standard offer.

One of the projects went online in South Burlington in August. It was developed by Claire Solar Partners and AllEarth Renewables. The project has 366 AllSun Trackers, which follow the sun on both vertical and horizontal axes, maximizing the output of the photovoltaic (PV)

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Act 250, Section 248, & Taxation

- “Farming” as NOT development (Act 250)
- Energy projects a statewide jurisdiction, (Section 248) and *somewhat* incorporates Act 250. EGSPC. How to protect best farm land?
- Solar projects take farm land out of production (30 years?) – not “farming” – and not eligible for current use program, with few exceptions.

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Ferrisburgh
SOLARFARM
POMERLEAU
REAL ESTATE
Burlington, Vermont

Food versus fuel

- Recent debate
- OK – how to crack the transportation nut? (~1/3 of energy use, 46% of GHG)
  - Biogas (RNG via pipeline or local filling stations)
  - Biodiesel
  - Electricity
  - Land use! (… and housing)

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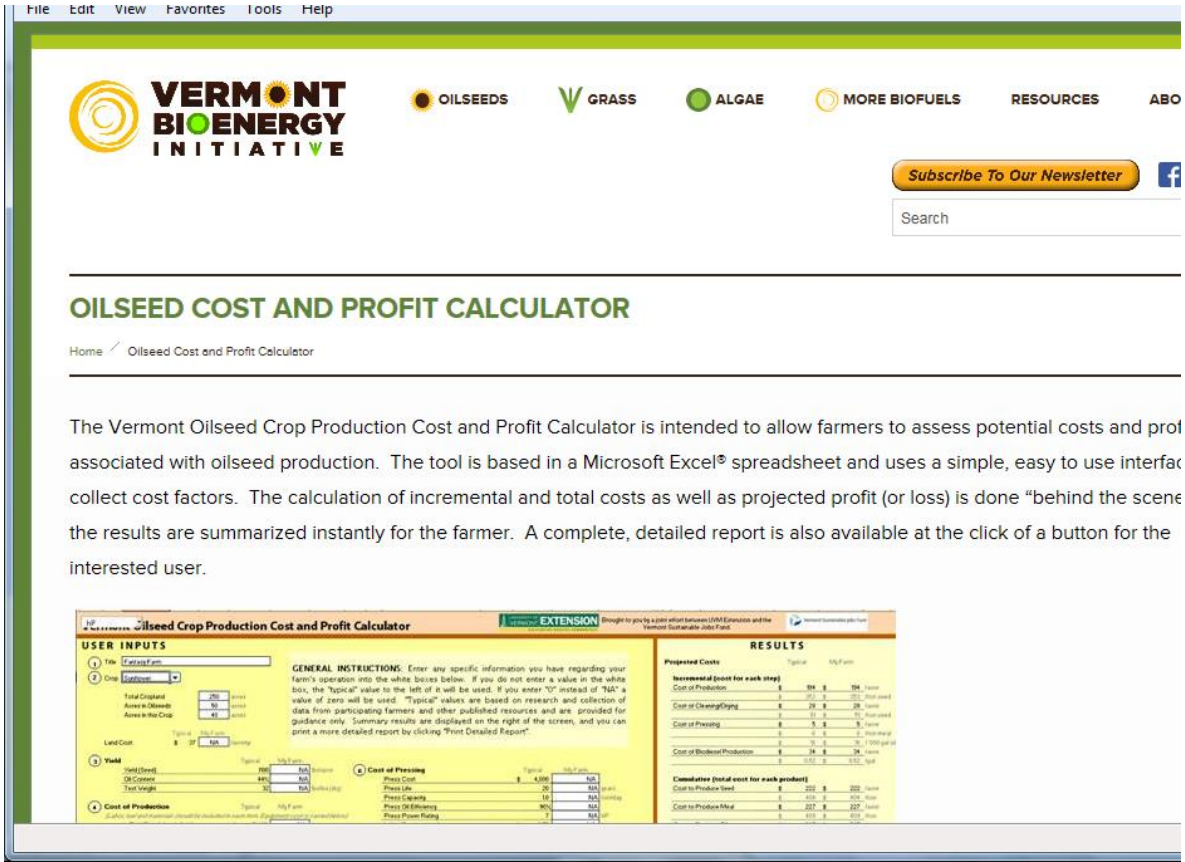
Farm Fresh Fuel

- http://vermontbioenergy.com/oilseed-cost-profit-calculator/



Revenue from feed (meal from oil press) is a significant revenue!

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Farm Fresh Fuel

- Amount of land to feed a horse

  = amount of land for biodiesel

- Agronomy
  - Timing, predation, varieties, harvesting equipment
  - Vermont grows stuff -- OK

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Liquid Fuels, Vermont-style

- Grain farming for value-added products
  - Oil for food? Oil for fuel. Meal for feed.
- Local production, local usage
- Part of a diversified operation, and/or to process on contract

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300,000 gallons per year, potentially

3 gph

Grass

- Vermont grows hay
- Important water quality benefits of a perennial versus an annual (e.g. corn)
- Habitat of growing warm-season grasses for energy and fiber use.
- Pellets – OK. Less processing (and GHG?) than wood pellets. Need correct equipment

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Delta
4x4

Diameter similar to a hockey puck – minor processing

Grass

- Low-input, perennial
- Marginal or less-valuable land?
- No run-off
- Flexible
  - Forage, bedding, fuel, bulking agent for compost
- Agronomy well understood; polyculture, too?
- HABITAT, e.g. two grassland birds

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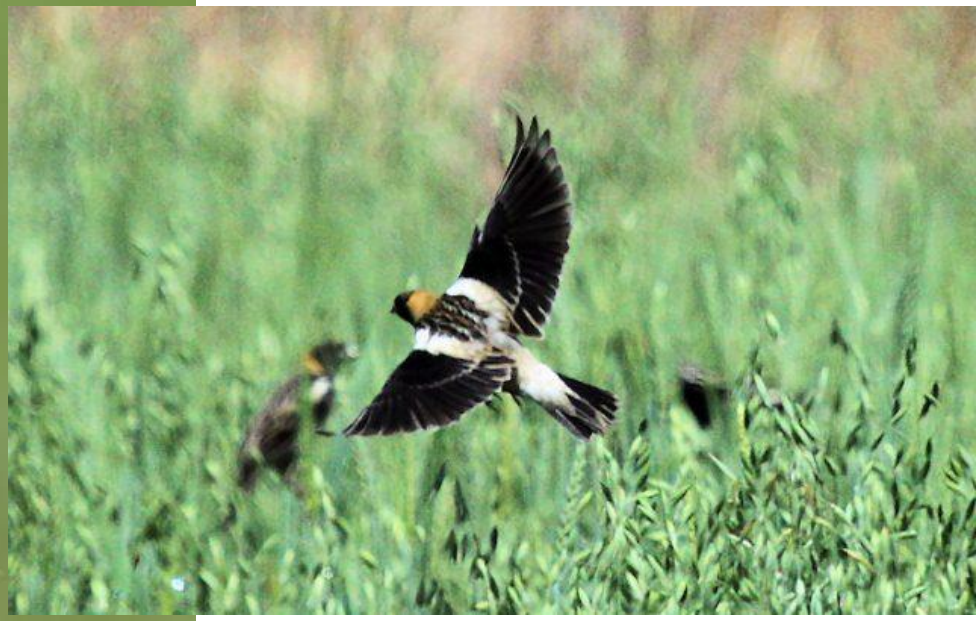
FALL
WINTER
SPRING

Bobolink



In Vermont, a 75% decline was noted between 1966 to 2007.

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Henslow’s Sparrow -- Endangered

Other bioenergy! Wood

- 100,000 acres of farmer-owned forest
- Estimated annual revenue, as fuel only:

  $1 million
- Forestry management, harvesting, storing, marketing, chipping, transporting, billing
- MOU with Upper Austria: bring back the business model, please
- Opportunity: LLC? Producer co-op?

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Greenhouses

- Big energy use and big revenue
- Critical conditions for plant growth
- Growing sector

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Bedding plant production

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In Ground Tomato Production


Seed Starting

Winter Spinach production

Maxim boiler with auxiliary hopper

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Wood pellets for greenhouse heat

Installing in ground water heat


Bench heating system now heated by boiler

Wind Power

- Yes!
- Footprint ¼ - ½ acres – way less than swept area
- kWh per acre 600,000 – 5,000,000
- Statewide, numerically based siting standard
  - Shadow flicker: hours
  - Sound: decibels
  - Safety setback: meters
- Quechee “test”?? ***Undue*** adverse impact?

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Parting thoughts

- Agriculture emits GHG!
  - … and dairy is > $0.5 billion of VT economy
  - … and agriculture is central to Vermont
- Energy projects can be on farm land
  - OK, and is there a strong connection to farming?
- Tons of opportunities
  - Major energy potential, diverse end uses
  - GHG mitigate *and* sequester

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