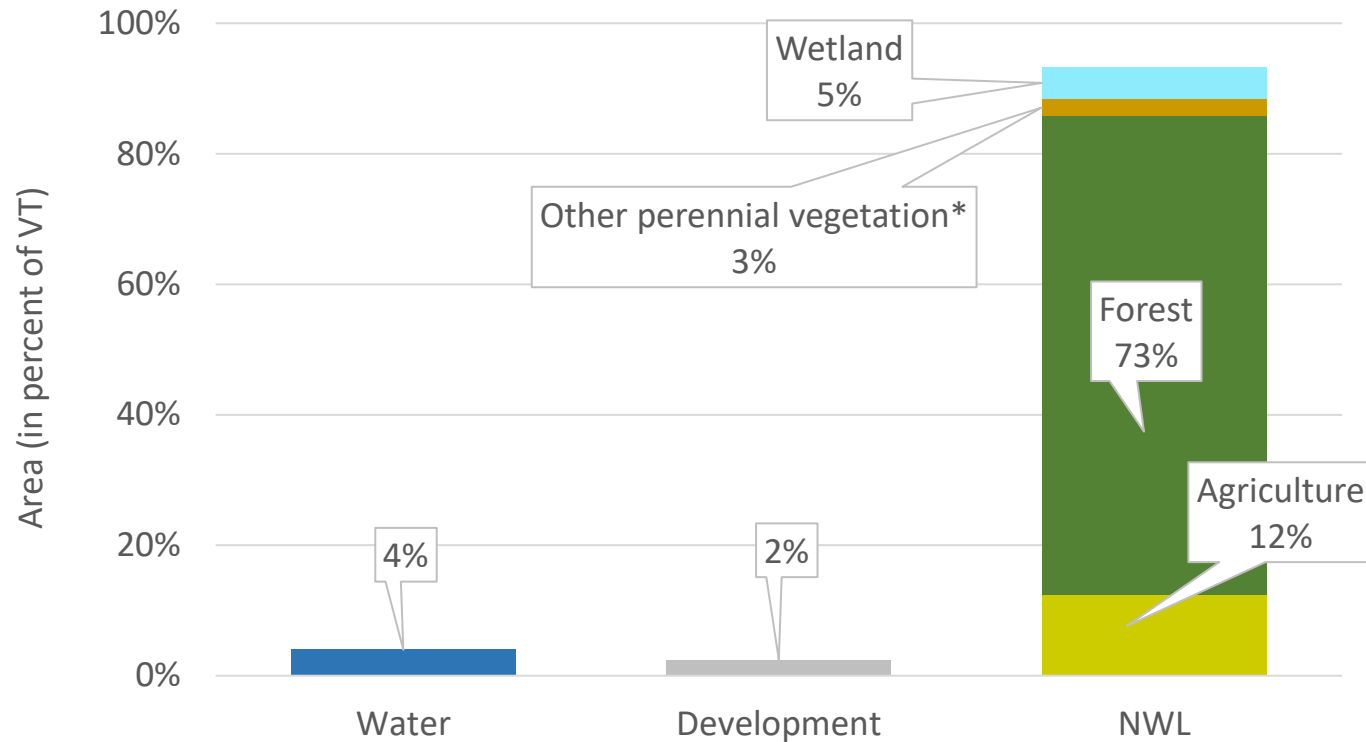


Initial VT Climate Action Plan & Agriculture

Ryan Patch
Agriculture Climate and Land Use Policy Manager
Vermont Agency of Agriculture, Food and Markets
Presentation to: House Committee on Agriculture, Food Resiliency, and Forestry
January 18, 2023

Natural & Working Lands (NWL) cover 94% of Vermont



*Other perennial vegetation includes grasslands, shrub/scrublands, and turf

Ag & Eco Subcommittee Membership & Staff

Co-Chair: Abbie Corse*, The Corse Dairy Farm

Co-Chair: Billy Coster, ANR

Member #1: Lauren Oates*, The Nature Conservancy

Member #2: Anson Tebbetts* (Ryan Patch), VAAFMM

Member #3: Iris Hsiang*

Member #4: John Roberts, Champlain Valley Farmers Coalition

Member #5: Judy Dow, Gedakina

Member #6: Alissa White, University of Vermont

Member #7: Jake Claro, VT Sustainable Jobs Fund

Member #8: David Mears, Audubon Vermont

Member #9: Charlie Hancock, Cold Hollow to Canada

Staff: Ali Kosiba, FPR; Marli Rupe, DEC; Bob Popp, VFW; Alex DePillis, VAAFMM; Judson Peck, VAAFMM

*Vermont Climate Councilor

Section 11.4: Agricultural Pathways for Mitigation (19 pages)

Section 13: Pathways for Adaptation and Building Resilience in Natural and Working Lands (38 pages)

Section 14: Pathways for Sequestration and Storing Carbon (13 pages)



INITIAL VERMONT CLIMATE
ACTION PLAN

Vermont Climate Council
DECEMBER 2021

Vermont is Getting Warmer and Wetter: Climate Change Study

The Green Mountain State has warmed nearly 2°F, with a 21% jump in precipitation

Key findings



Climate change is here –
and impacting communities
across Vermont.



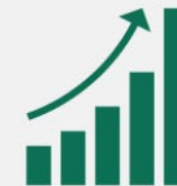
Vermont is getting warmer.
Winters are warming more
quickly. Snow season is
getting shorter.



Vermont is getting wetter.
Heavy rain events happen
more often, contributing
more flooding and water
quality problems.



Multiple, complex impacts
could lead to surprises.



Climate impacts and risks
will increase without action.



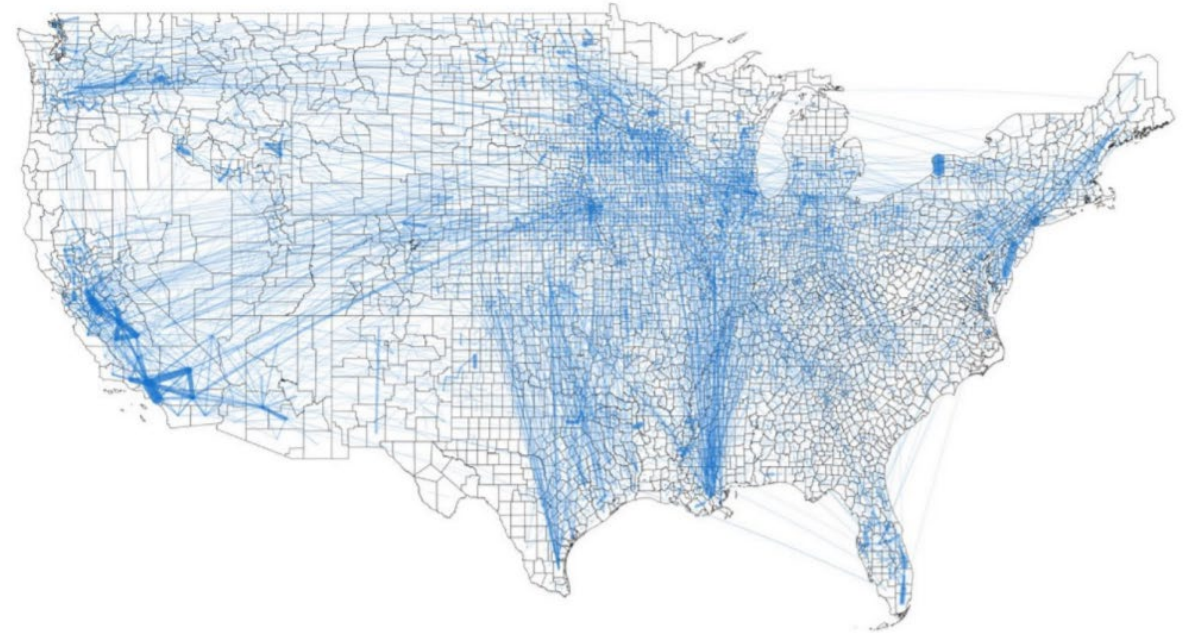
[Dig in to learn more...](#)

What to call climate change where you live

Intensity shows risk level from low (lighter) to very high (darker)

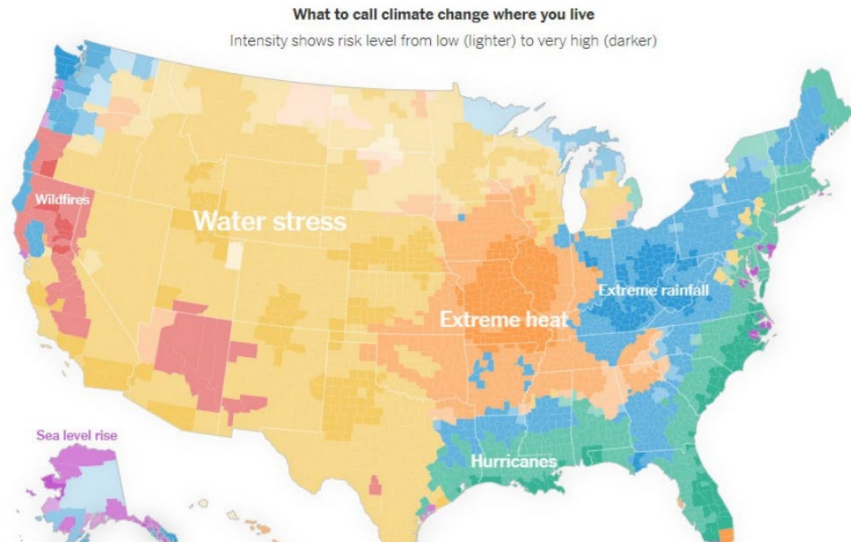


Food Flows: Downscaled to All Counties



Source: Ellen Kahler, VSJF Presentation to House Agriculture:

<https://legislature.vermont.gov/Documents/2022/WorkGroups/House%20Agriculture/Food%20Security/W~Ellen%20Kahler~New%20England%20Feeding%20New%20England-%20Cultivating%20a%20Reliable%20Food%20Supply~1-26-2021.pdf>



Food Flows: Downscaled to All Counties

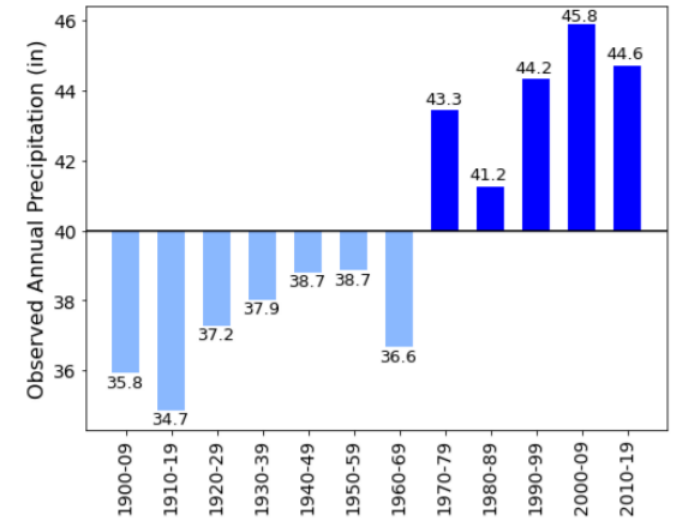
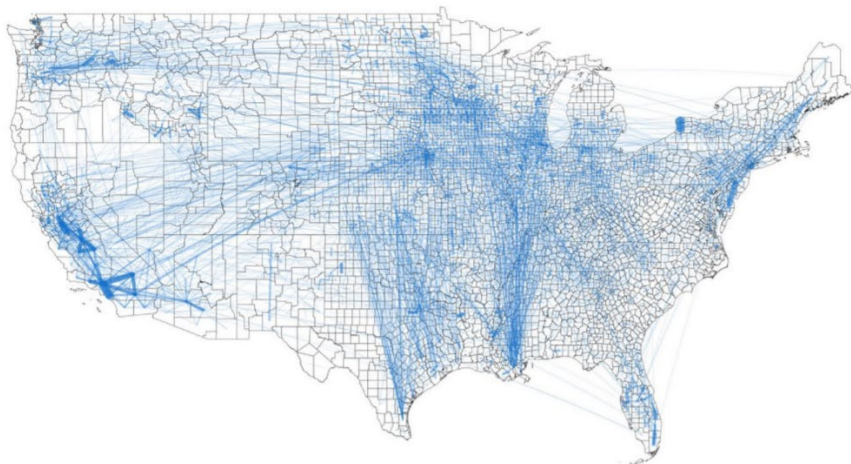


Figure 1-8: Decadal averages of observed annual precipitation in Vermont

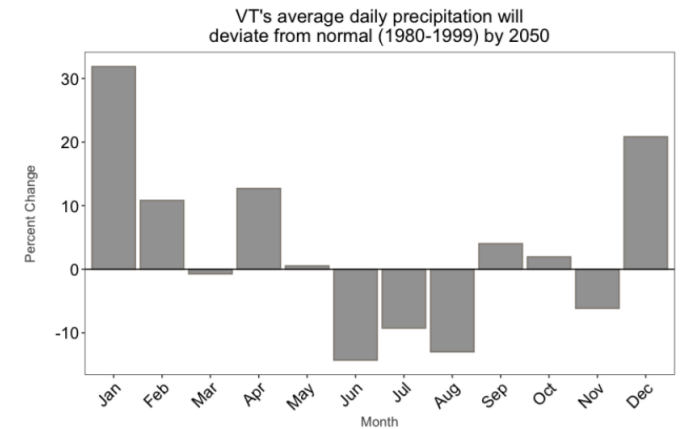


Figure 5-5: Projected daily mean precipitation in 2050 as percent deviation relative to 1980s–1990s shows lower summer growing season precipitation (USGS, 2021a)

USDA-NRCS SOIL HEALTH INFOGRAPHIC SERIES #002



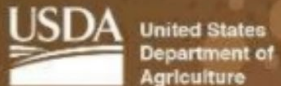
what's underneath

healthy soil has amazing water-retention capacity.



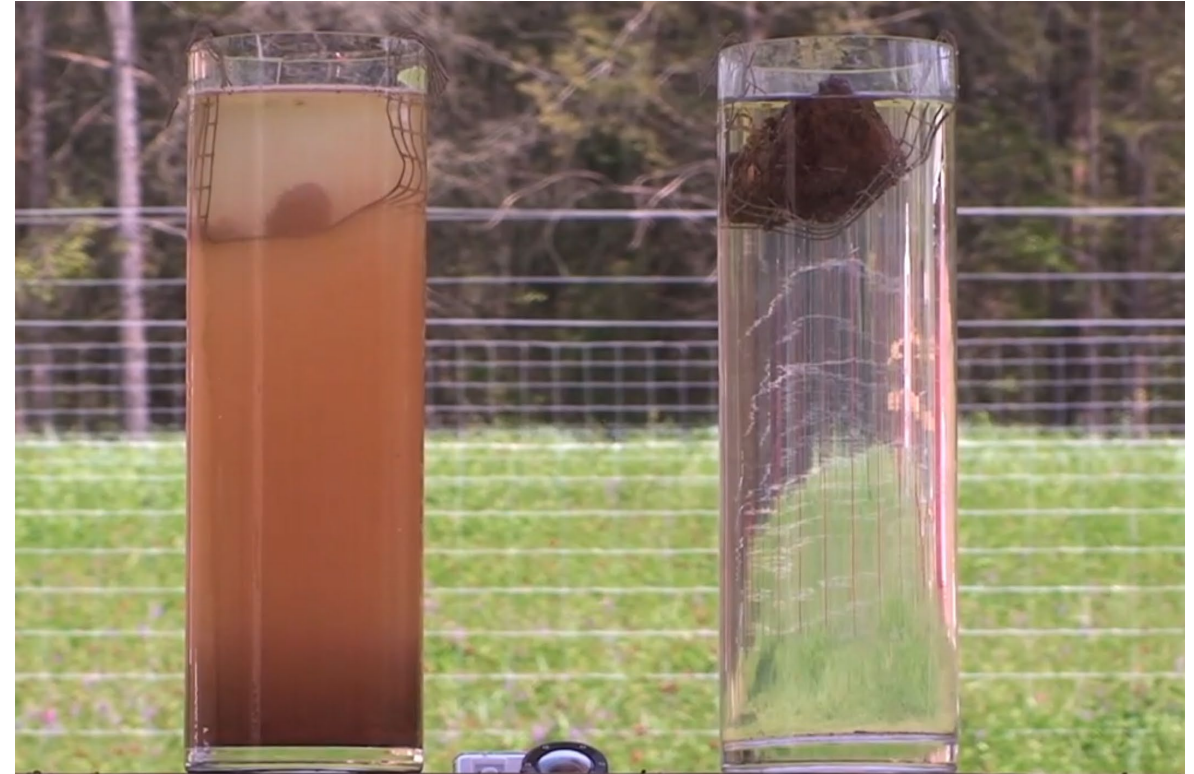
Every **1%** increase in organic matter results in as much as **25,000** gal of available soil water per acre.

Source: Kansas State Extension Agronomy e-Updates, Number 357, July 6, 2012

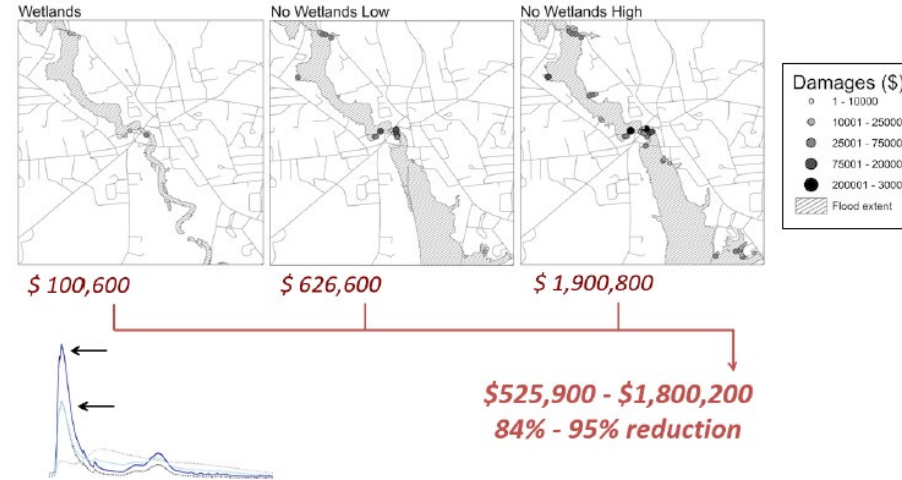


Want more soil secrets?
Check out www.nrcs.usda.gov

USDA is an equal opportunity provider and employer.



Middlebury - economic damages



Key findings

- During Tropical Storm Irene in 2011, floodplains and wetlands diminished damages in Middlebury, VT, by 84 to 95 percent – saving potentially as much as \$1.8 million in flood damages.
- Middlebury saves an annual average of \$126,000 to \$450,000 in damages due to the Otter Creek floodplain, which reduced damages by 54 to 78 percent, on average, across 10 flooding events.



50% of wetlands in the watershed are managed by farms

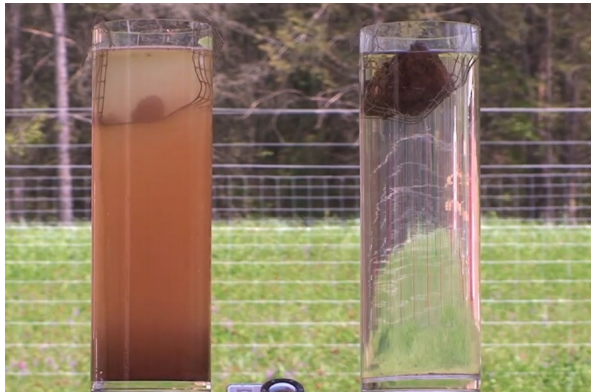


Table 2. Soil carbon stocks to 30 cm depth in MT carbon per hectare, collected on Vermont farms in 2021 by the State of Soil Health project.

Field Type	Number of fields	MT Carbon per hectare		
		Min	Mean	Max
Vegetable	17	31.1	65.1	98.6
Field crops	4	75.7	107.7	148.8
Corn	112	33.4	84.1	144.0
Pasture	21	63.4	95.8	170.4
Hay	37	31.3	94.1	164.1
<i>All fields</i>	<i>191</i>	<i>31.1</i>	<i>86.1</i>	<i>170.4</i>

Table 4. Long term research trial of corn cropping systems at Borderview Farm documents changes in organic carbon content. Treatments with the same letter did not perform significantly different from each other. **Bolded treatments were significantly different from continuous corn.**

Corn cropping system	Organic matter % in 2021	Additional annualized change in organic matter over 11 years over continuous corn
Continuous corn	3.29% ^c	~
Corn-hay rotation, year 2	4.25%^a	0.087% per year
Corn-hay rotation, year 7	3.55%^b	0.024% per year
No till	3.60%^b	0.028% per year
No till and cover crop	3.56%^b	0.025% per year
Winter cover crop	3.28% ^c	~

Study generated rough estimates of realistic potential for soil carbon sequestration in the top 30 cm (1 foot) of agricultural soils in Vermont: Investments in soil building raising SOM from 4.3% to 6% over 19 Years.

That would sequester an equivalent of 937,494 MT CO₂e annually. Annual soil carbon sequestration at that annual rate is the same as the emissions from 200,000 cars.

Vermont Climate Action Plan & Agriculture

Mitigation

- Reduction of GHG Emissions
- Sequestration and Storage of Carbon in Soils

Resilience

- Farms & Food Production
 - Viability
- Food System
- Watershed & Flood Resilience



Vermont Climate Action Plan & Agriculture

Mitigation

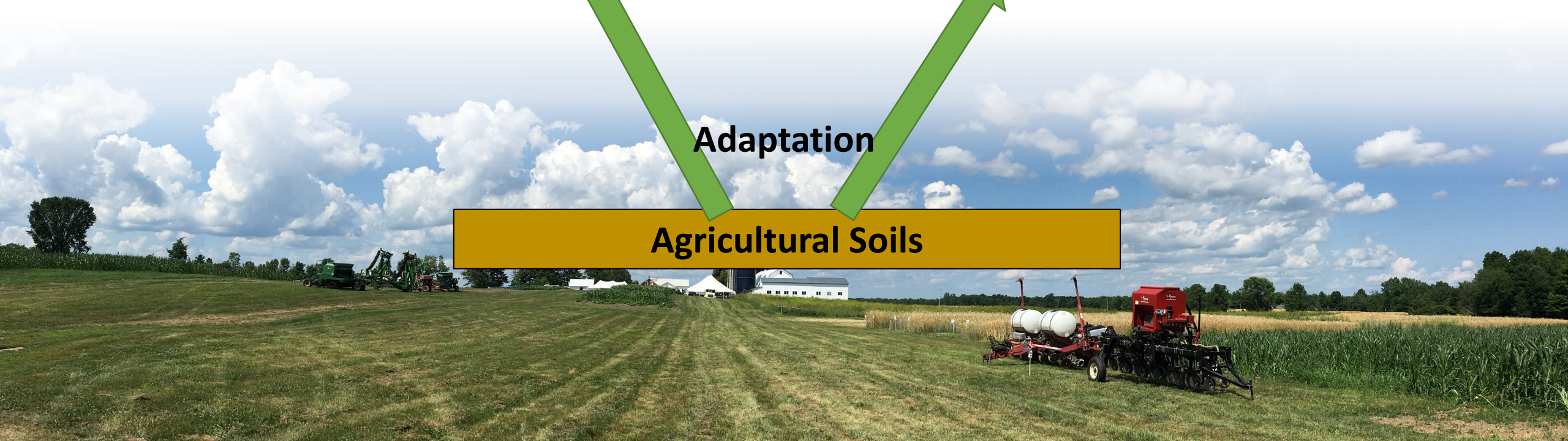
- Reduction of GHG Emissions
- Sequestration and Storage of Carbon in Soils

Resilience

- Food Security & Food Systems
- Farms & Food Production
 - Viability
- Watershed & Flood Resilience

Adaptation

Agricultural Soils



Vermont Climate Action Plan & Agriculture

Mitigation

- Reduction of GHG Emissions
- Sequestration and Storage of Carbon in Soils

- Reduces emissions
- Sequesters Carbon

Resilience

- Food Security & Food Systems
- Farms & Food Production
 - Viability
- Watershed & Flood Resilience

- Improve Drought & Flood Resilience
- Decrease input costs

Adaptation

Agricultural Soils

- Cover Crop
- Nutrient Management
- Conservation Tillage

- Conservation Crop Rotation
- Residue and Tillage Management, No Till
- Pasture and Hay Planting

- Precision Agriculture
- Prescribed Grazing
- Rotational Grazing

<u>Existing AAFM Programs that address Section 11.4: Agricultural Pathways for Mitigation from Initial Vermont Climate Action Plan</u>	
Recommendation Reference Number: CAP Section 11.4 & Section 14, Strategy 1, Action (a) - (j)	<u>AAFM Program</u>
a. Agronomic practice implementation	FAP
c. Grazing Management	
b. Expand Capital Equipment Assistance Program	CEAP
c. Grazing Practice Implementation	PSFW
e. Edge of Field Practices: CREP	BMP
h. Methane Capture & Utilization	
d. Agroforestry	Ag-CWIP
f. Agricultural Environmental Management Program	
g. Nutrient Management Plan Development and Implementation	
i. Research Manure management for climate	
j. Research Climate feed management	

1. Develop a methodology and protocol for quantifying climate mitigation, resilience, and adaptation impacts of existing state and federal water quality implementation programs as reported through the annual Clean Water Initiative Performance Report.

							(Sorted by Acreage)	
Practice Code	Practice Name	TOTAL					Total	Average
		2016	2017	2018	2019	2020		
340	Cover Crop	28,381	23,408	29,615	24,114	36,885	142,404	28,481
590	Nutrient Management	12,992	10,012	9,792	8,051	14,545	55,393	11,079
345	Conservation Tillage	8,940	9,506	10,703	12,143	8,142	49,434	9,887
328	Conservation Crop Rotation	10,516	11,709	13,156	4,632	2,181	42,194	8,439
329	Residue and Tillage Management, No Till	2,963	2,900	3,098	6,322	3,275	18,559	3,712
512	Pasture and Hay Planting	2,080	1,713	2,450	1,455	1,917	9,613	1,923
913VTA	Precision Agriculture	0	0	0	4,041	4,297	8,338	1,668
528	Prescribed Grazing	1,808	1,224	1,472	1,826	1,074	7,404	1,481
901VTA	Manure Injection	0	0	0	2,247	3,787	6,034	1,207
911VTA	Rotational Grazing	0	0	0	2,889	2,563	5,452	1,090
902VTA	Aeration	433	475	2,023	572	1,797	5,300	1,060
314	Brush Management	708	782	1,058	1,219	1,450	5,217	1,043
633	Waste Recycling	2,220	1,181	548	0	92	4,041	808
PAC	Production Area Compliance	0	792	540	1,185	1,385	3,902	780

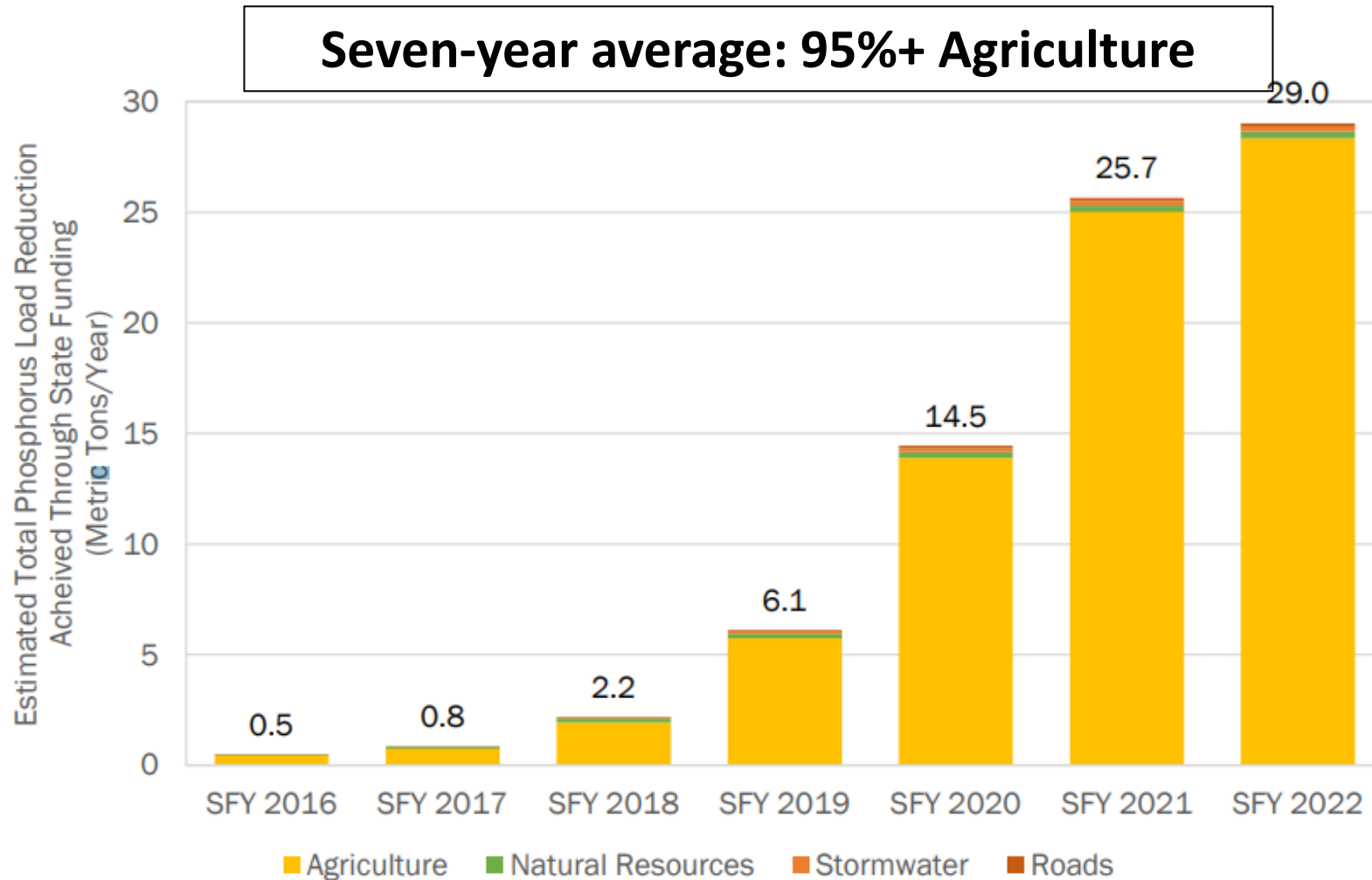


Figure 21. Annual estimated total phosphorus load reductions (metric tons per year) associated with state-funded clean water projects in the Lake Champlain and Lake Memphremagog basins by land use sector, SFY 2016–2022.³²

Agriculture = Most cost effective

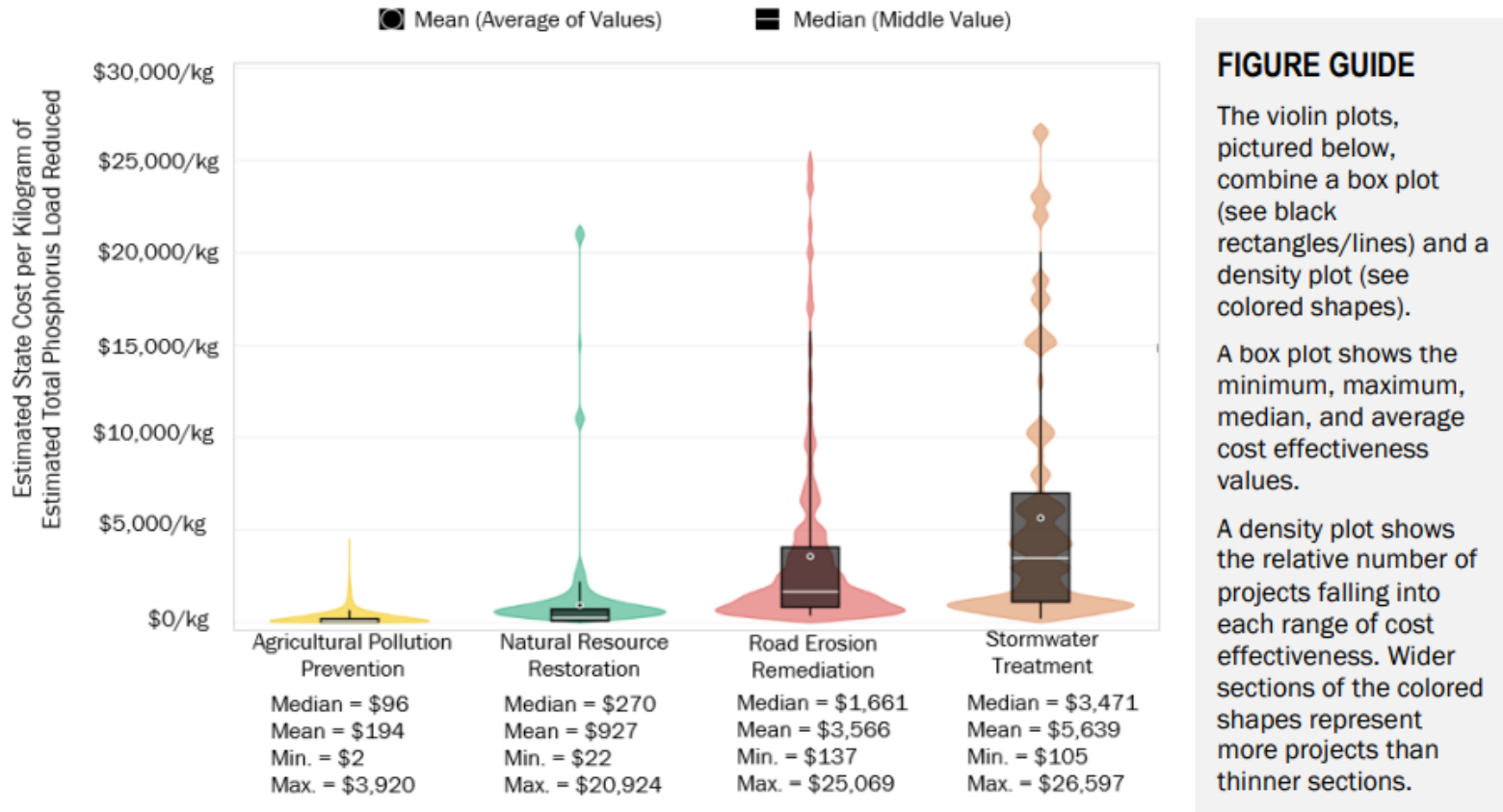


Figure 22. State investment per estimated kilogram of total phosphorus load reduced over the design life of each project type, based on clean water projects funded through State of Vermont agencies completed SFY 2016–2022 (excludes local and federal leveraged funds).³⁵

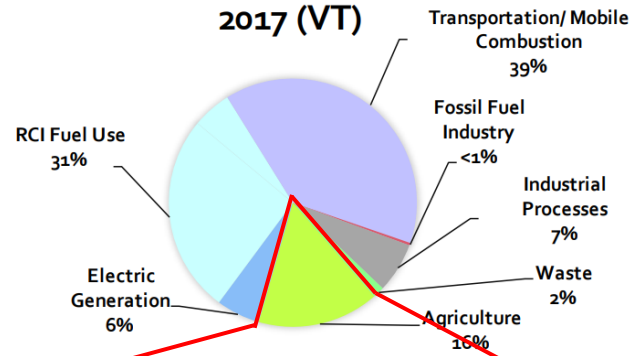
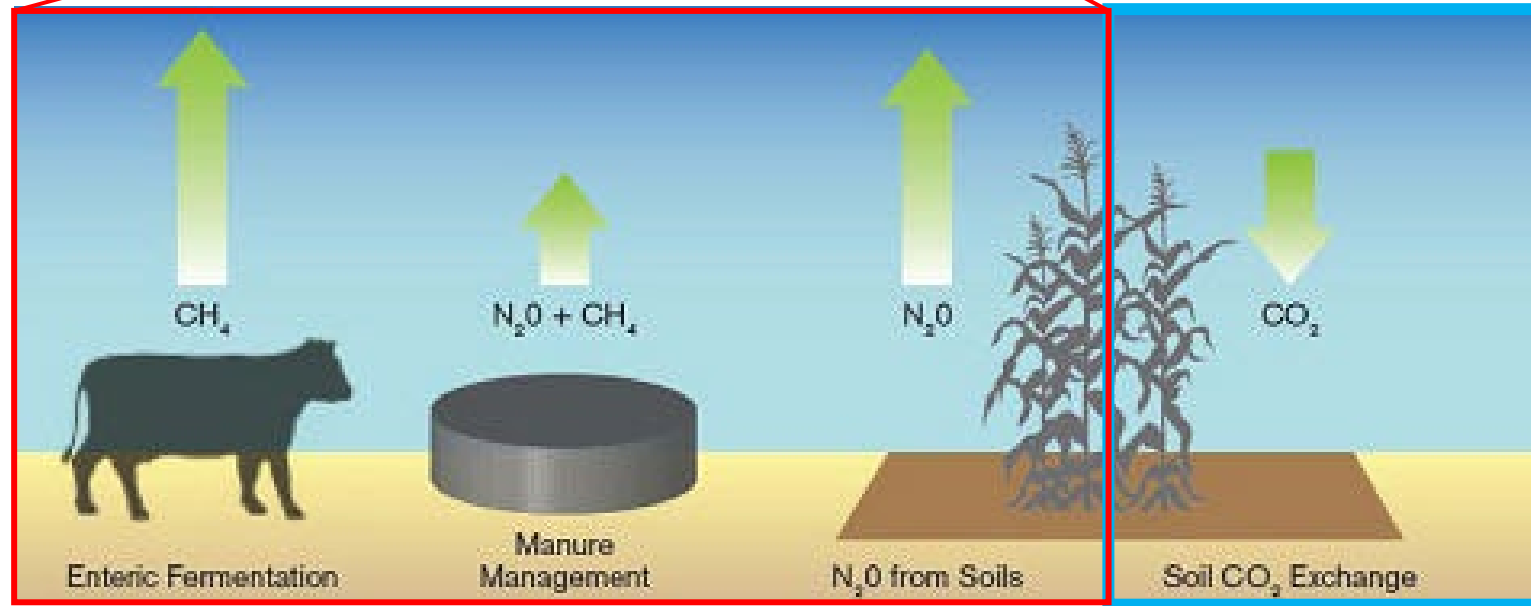


Figure 4: Vermont GHG percent contributions by sector.

GHG Emissions & Sequestration

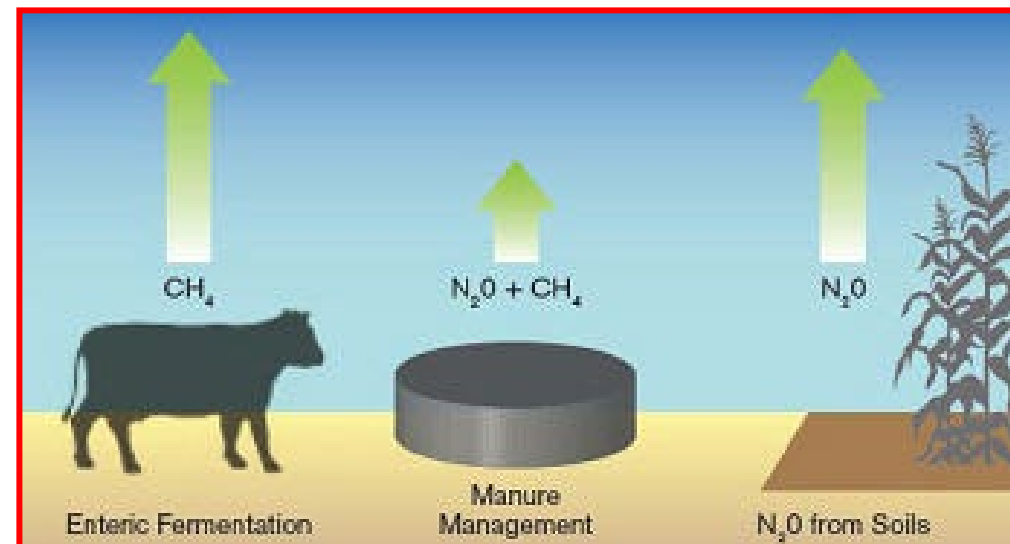


Source: <https://www.agr.gc.ca/eng/agriculture-and-the-environment/agricultural-practices/climate-change-and-agriculture/greenhouse-gases-and-agriculture/?id=1329321969842>

Source: https://dec.vermont.gov/sites/dec/files/aqc/climate-change/documents/Vermont_Greenhouse_Gas_Emissions_Inventory_Update_1990-2017_Final.pdf

Vermont's Current Greenhouse Gas (GHG) Emissions Profile: Agriculture

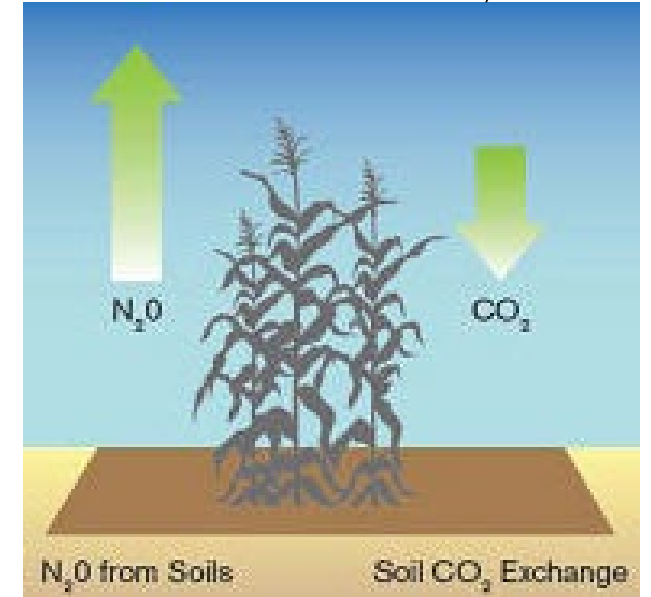
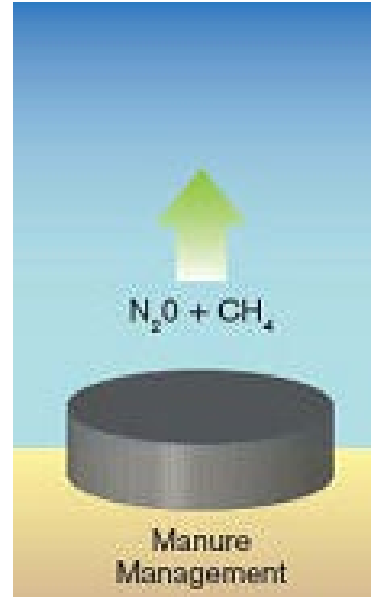
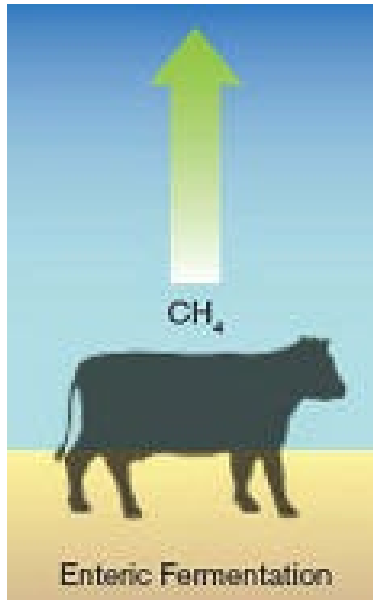
Agriculture
Enteric Fermentation
Manure Management
Agricultural Soils
Liming and Urea Fertilization



Agriculture	1.23	1.19	1.30	1.32	1.30	1.32	1.29	1.29	1.28	1.38	1.29	1.29	1.26	1.28	1.25	1.29	1.31	1.35	1.38	1.37
Enteric Fermentation	0.70	0.67	0.69	0.68	0.67	0.66	0.65	0.63	0.63	0.64	0.64	0.64	0.62	0.63	0.62	0.64	0.64	0.63	0.64	0.64
Manure Management	0.18	0.19	0.26	0.29	0.30	0.32	0.31	0.33	0.32	0.33	0.34	0.33	0.33	0.33	0.32	0.32	0.32	0.34	0.36	0.35
Agricultural Soils	0.35	0.34	0.34	0.34	0.32	0.33	0.33	0.32	0.32	0.31	0.30	0.32	0.31	0.31	0.30	0.32	0.33	0.33	0.33	0.33
Liming and Urea Fertilization	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.01	0.01	0.00	0.00	0.01	0.03	0.05	0.05	0.05

Source: https://dec.vermont.gov/sites/dec/files/aqc/climate-change/documents/Vermont_Greenhouse_Gas_Emissions_Inventory_Update_1990-2017_Final.pdf

Source: <https://www.agr.gc.ca/eng/agriculture-and-the-environment/agricultural-practices/climate-change-and-agriculture/greenhouse-gases-and-agriculture/?id=1329321969842>



Example Mitigation Strategies:

1. Dietary adjustments
2. Improved genetics
3. Improving reproductive performance



Example Mitigation Strategies:

1. Waste Storage Digestion / Energy Production
2. Covering Waste Storage Facilities



Example Mitigation Strategies:

1. Reduced Tillage
2. Cover Crop
3. Crop Rotation



Methods for Growing Crops have different outcomes



Management:

- Full width tillage
- No Nutrient Management
- No Field specific conservation practices



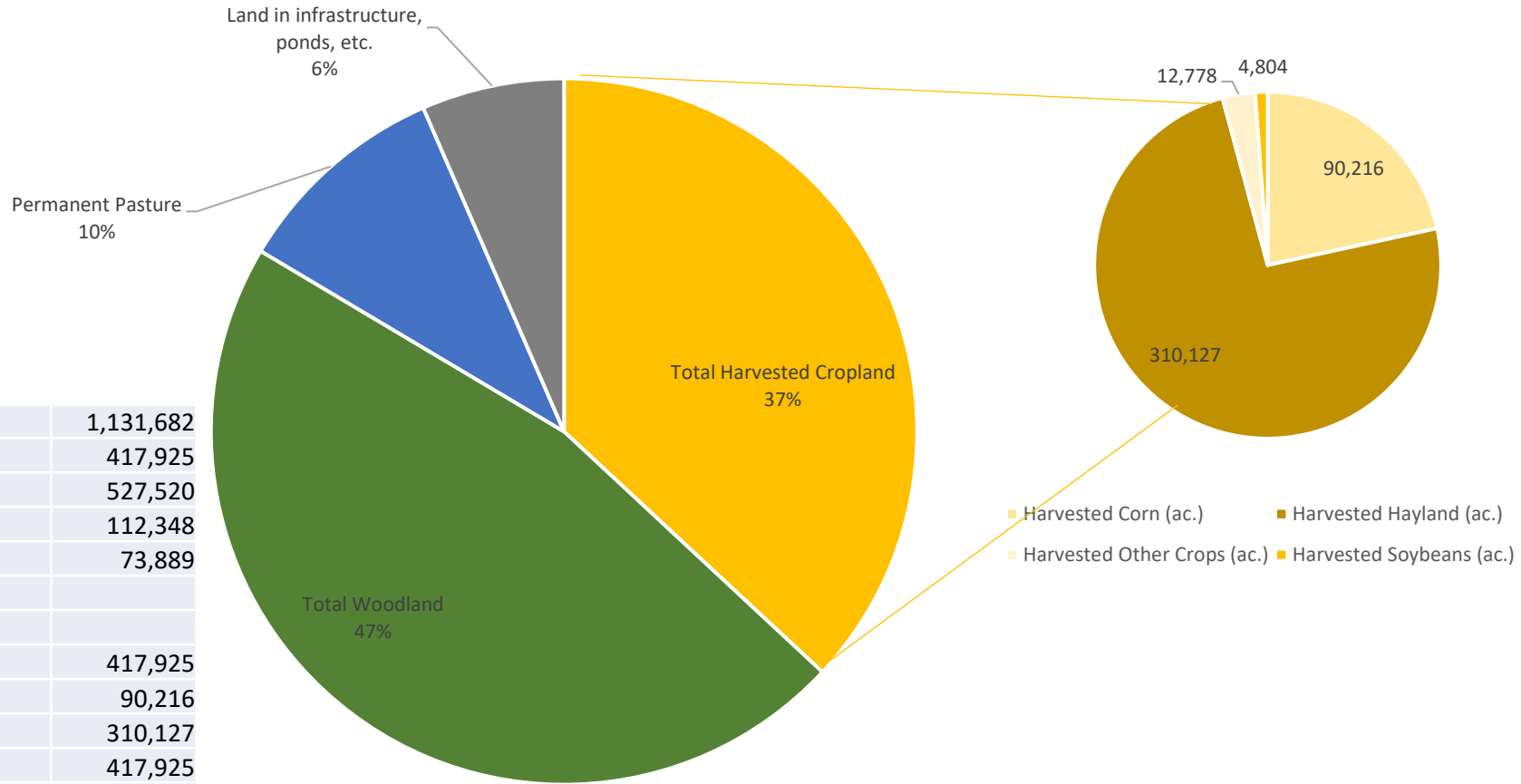
Management:

- Cover crop
- Reduced and No-Till technology
- Nutrient Management
- Riparian Buffers
- Crop Rotation

USDA COMET ERCs:

- 0.15 tons CO₂e/ac/yr
- 0.19 tons CO₂e/ac/yr
- 0.37 tons CO₂e/ac/yr
- 0.74 tons CO₂e/ac/yr
- 0.22 tons CO₂e/ac/yr

Land managed by farms in Vermont, 2017



Land in Farms	1,131,682
Total Harvested Cropland	417,925
Total Woodland	527,520
Permanent Pasture	112,348
Land in infrastructure, ponds, etc.	73,889
Total Cropland Harvested	417,925
Total Corn in VT	90,216
Total Hayland in VT	310,127
Total Other in VT	417,925
Total Soybeans	4,804

Source: 2017 USDA NASS Ag Census



The United States of America Nationally Determined Contribution

Reducing Greenhouse Gases in the United States:
A 2030 Emissions Target

After a careful process involving analysis and consultation across the United States federal government and with leaders in state, local, and tribal governments, **the United States is setting an economy-wide target of reducing its net greenhouse gas emissions by 50-52 percent below 2005 levels in 2030.** The National Climate Advisor developed this NDC in consultation with the Special Presidential Envoy for Climate, and it was approved by President Joseph R. Biden Jr..

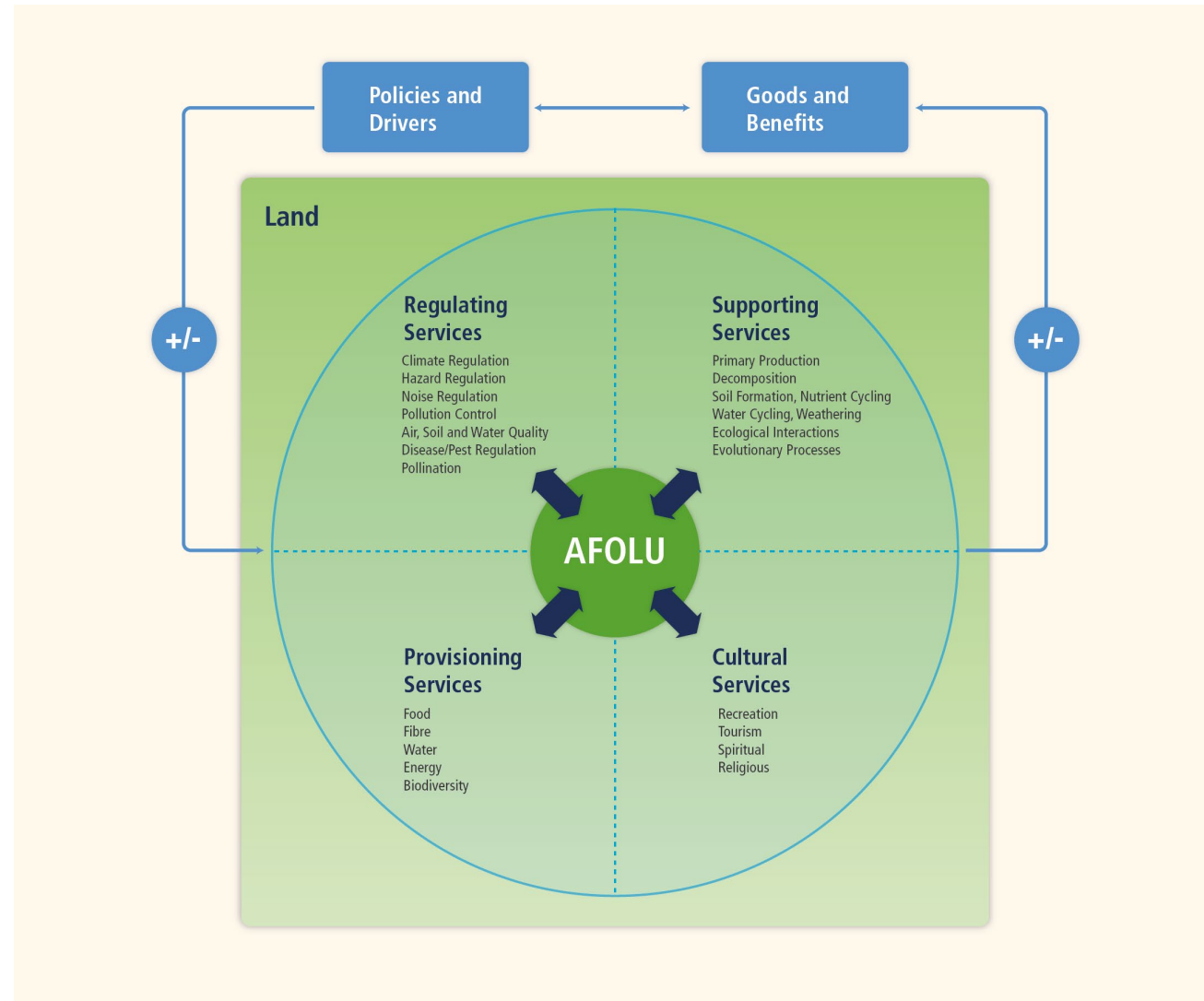
Beyond the energy sector, the United States will also **reduce emissions from forests and agriculture** and enhance carbon sinks through a range of programs and measures for ecosystems ranging from our forests and agricultural soils to our rivers and coasts. Actions to be pursued include, for example:

- **Agriculture and lands:** America's vast lands provide opportunities to **both reduce emissions, and sequester more carbon dioxide.** The United States will support scaling of climate smart agricultural practices (including, for example, cover crops), reforestation, rotational grazing, and nutrient management practices. In addition, federal and state governments will invest in forest protection and forest management, and engage in intensive efforts to reduce the scope and intensity of catastrophic wildfires, and to restore fire-damaged forest lands. Alongside these efforts, the United States will support nature-based coastal resilience projects including pre-disaster planning as well as efforts to increase sequestration in waterways and oceans by pursuing "blue carbon."

Agriculture, Forestry and Other Land Use (AFOLU)

Executive Summary

Agriculture, Forestry, and Other Land Use (AFOLU) is unique among the sectors considered in this volume, since the mitigation potential is derived from both an enhancement of removals of greenhouse gases (GHG), as well as reduction of emissions through management of land and livestock (*robust evidence; high agreement*). The land provides food that feeds the Earth’s human population of ca. 7 billion, fibre for a variety of purposes, livelihoods for billions of people worldwide, and is a critical resource for sustainable development in many regions. Agriculture is frequently central to the livelihoods of many social groups, especially in developing countries where it often accounts for a significant share of production. In addition to food and fibre, the land provides a multitude of ecosystem services; climate change mitigation is just one of many that are vital to human well-being (*robust evidence; high agreement*). Mitigation options in the AFOLU sector, therefore, need to be assessed, as far as possible, for their potential impact on all other services provided by land. [Section 11.1]



Source: https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter11.pdf

Image Source: https://www.ipcc.ch/site/assets/uploads/2018/02/01_figure_11.1.png

1. Develop a methodology and protocol for quantifying climate mitigation, resilience, and adaptation impacts of existing state and federal water quality implementation programs as reported through the annual Clean Water Initiative Performance Report.
2. The Vermont Climate Council has recommended developing and issuing a Request for Proposals (RFP) that will review and analyze methodological gaps of emission inventory tools currently used by the State of Vermont to quantify greenhouse gas emissions for evaluating changes in the Agriculture, Forestry and Other Land Use (AFOLU) sector and the tools' alignment with the Intergovernmental Panel on Climate Change (IPCC), Environmental Protection Agency (EPA), and peer state methodologies and approaches. The specific recommendations for this RFP can be found in the Carbon Budget Report memo found in Appendix 10.
3. Based on the findings of the technical RFP mentioned in action step (b) of this strategy, the VCC should consider recommending that the State of Vermont GHG emissions inventory protocol established in 10 V.S.A. § 582 be amended to include an inventory of GHG emissions that align with the intent and standards of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories that will include a net GHG emission accounting for the agriculture, forestry and other land use (AFOLU) sector

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