



CLIMATE CHANGE: A 21st CENTURY PUBLIC HEALTH CRISIS

Christine Vatovec, PhD, Megan Malgeri, MD
Community Medical School

Public health emergency

**GLOBAL
CLIMATE
AND HEALTH
FORUM**



“Climate change is a global health emergency that threatens to

- reverse decades of health and development gains,
- cause widespread human suffering,
- deepen global health inequities, and
- put at risk the environmental and economic systems we depend on for our survival.”

This global Call To Action has now been signed by more than 100 health care organizations representing:

- ✓ six million health care professionals
- ✓ over 125 countries.

2019 Top ten threats to human health:

#1 Air pollution and climate change

#2 Non communicable diseases

heart disease, diabetes, cancer

#3 Influenza

#4 Fragile and vulnerable settings

with minimal health care access

#5 Antimicrobial resistance

#6 Ebola and high- threat pathogens

#7 Weak primary care

#8 Vaccine hesitancy

#9 Dengue

#10 HIV



PUBLIC HEALTH

Why physicians see climate change as a health emergency

SEPTEMBER 20, 2019

“Solving the global climate crisis could be the greatest opportunity of our time...”



Health Institute, during a grand-rounds program at the AMA headquarters in Chicago. He added that three ways to attack global warming—reducing air pollution, eating less meat and driving less—all

**Reducing air pollution
Eating less meat
Driving less**

**All have tremendous
health benefits**

For a decade and a half, Dr. Patz served as a lead author for the U.N. Intergovernmental Panel on Climate Change (or IPCC)—the organization that shared the 2007 Nobel Peace Prize with Al Gore.

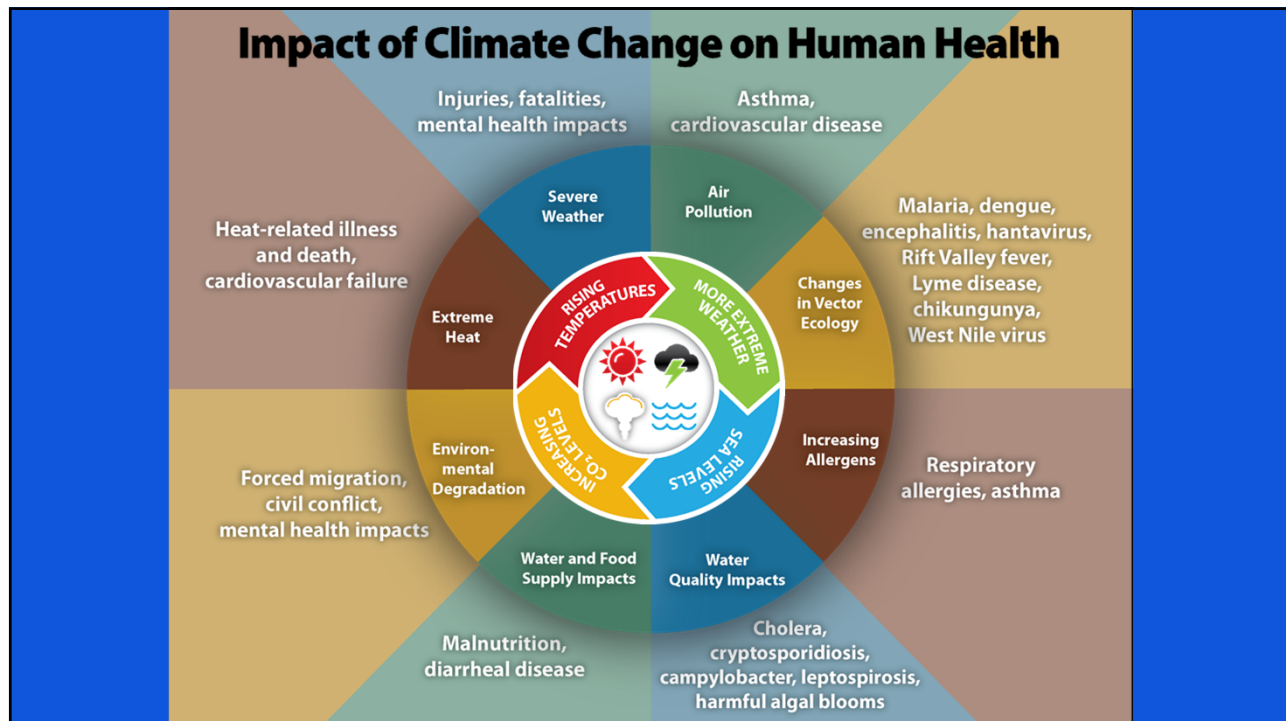
AMA adopts new policies at 2019 Annual Meeting

JUNE 12, 2019

Educating Physicians and Medical Students on the Adverse Health Effects of Climate Change

The AMA adopted policy to ensure physicians and physicians-in-training have a basic knowledge of the science of climate change and an awareness of the associated health risks.

"It is important that current and future physicians are able to describe the risks that climate change poses to human health so that they can counsel their patients on how to protect themselves from the health risks posed by climate change," said AMA Board Member S. Bobby Mukkamala, M.D.

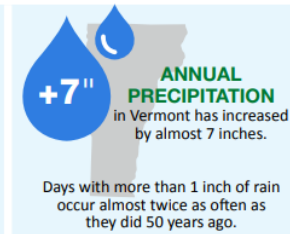
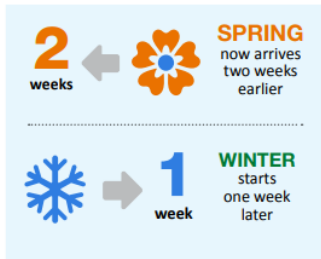
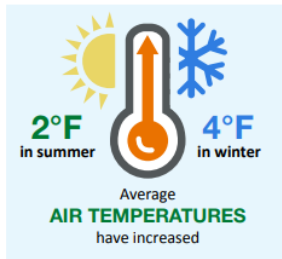




CLIMATE CHANGE + YOUR HEALTH

Climate change is real and has already affected Vermont.

IN THE PAST 50 YEARS:



Primary climate-related health threats for Vermont

Vermont is expected to continue warming in the future, leading to hotter summers, shorter and milder winters, stronger storms, and more frequent droughts.

Water and
foodborne diseases



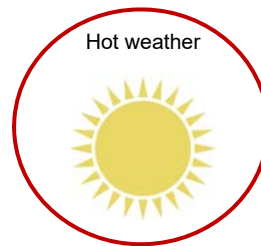
Vectorborne
diseases



Mental health



Hot weather



Cyanobacteria



Extreme
storm events



Air pollution
and pollen



Source: Vermont Department of Health, Climate & Health Program

Extreme Heat

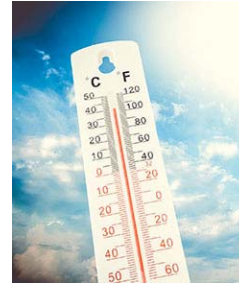
Heat causes more deaths in the U.S. than tornadoes, hurricanes, floods & lightening combined

Heat-related health impacts:

- Heat stroke
- Dehydration & kidney injury
- Worsening respiratory & cardiovascular disorders
- Indirect effects: heart attack, suicide, stroke, respiratory illnesses, cognition, worsening diabetes

Most vulnerable populations:

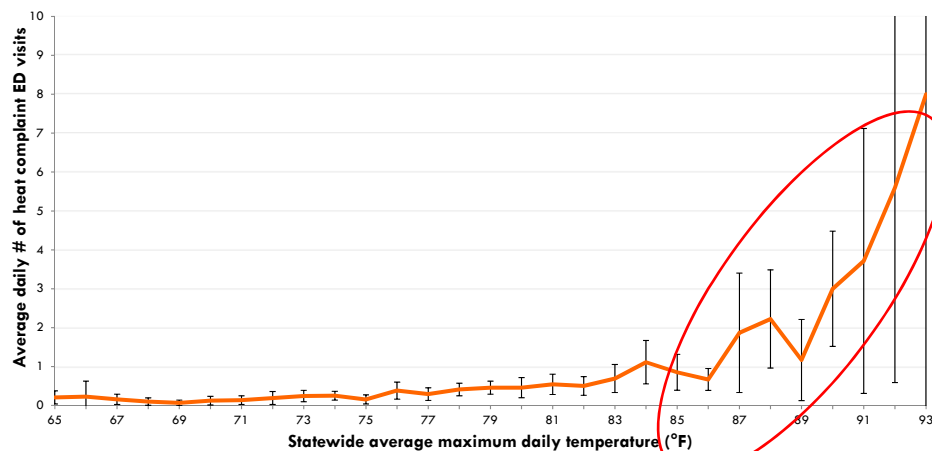
Children, elderly, low-income, outdoor workers, athletes



Sources: CDC, NOAA

Hot Weather Already Leads to Increased Illness & Death in Vermont

Average daily emergency department visits for heat complaints in Vermont, by maximum daily temperature, 2004 - 2013

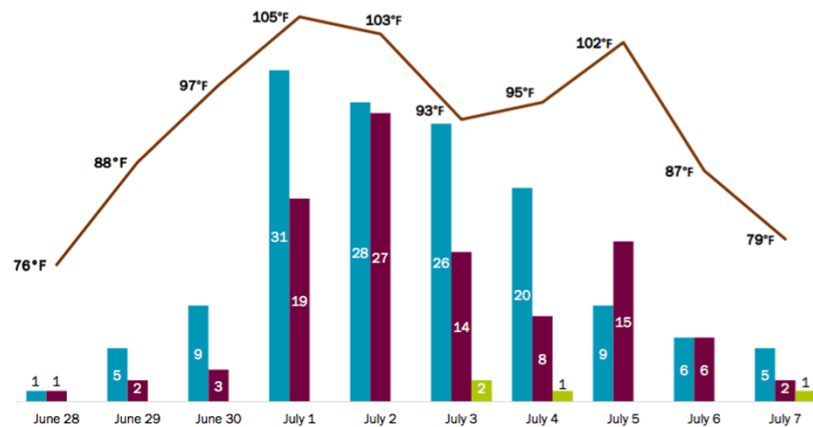


Source: Vermont Early Aberration Reporting System

Error bars indicate 95% confidence intervals

2018 Heat Wave impacts

Heat-related **EMS calls** and **ED visits** increased with the **heat index** during the heat wave of July 2018. There were also four heat-related **deaths**.



Ulmer, J. Vermont
Department of Health

Lack of Acclimation in Vermont



- Possible reasons for the relatively low threshold for heat illness in Vermont:
 - Limited physiological adaptation due to infrequent hot summer temperatures
 - Behaviors are difficult to change when extreme heat is so infrequent
 - Many homes/businesses in Vermont are not designed to deal with extreme heat

Source: Denise Alosa, Athletic Trainer

Extreme heat: cases

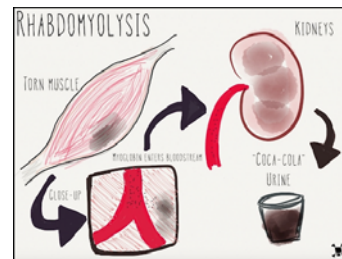


Summer heat can cause sickness and death. On days when the average statewide temperature reaches at least 87°F, **EMERGENCY ROOM VISITS** for heat-related complaints are 8 times more likely.

- Healthy people
 - Marathon, sporting events- heat stroke, dehydration, rhabdomyolysis

- Vulnerable populations

- • COPD, asthma
- Congestive Heart Failure
- Stroke survivor
- Essential hypertension



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Source: Vermont Department of Health, Climate & Health Program

Extreme Storm Events

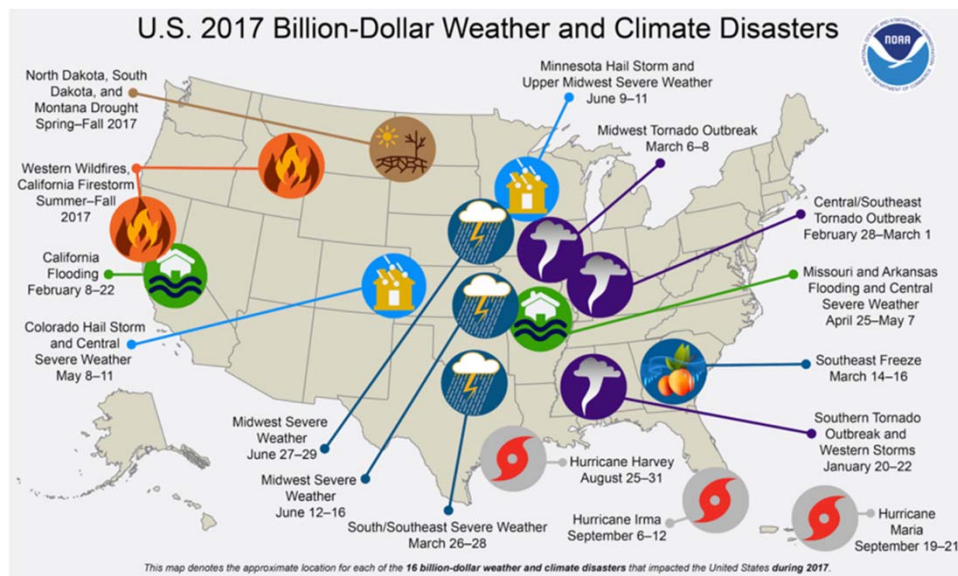
Health impacts of extreme weather:

- Injury
- Water contamination
- Mold growth & respiratory health
- Indirect effects: long-term mental health impacts

Most vulnerable populations:
Children, elderly, low-income,
communities in floodplains



Sources: CDC, VT Department of Health Climate & Health Program



Irene Impacts in Vermont

- six deaths
- mold growth in water logged buildings
- extensive property and infrastructure damage, power outages, and other service disruptions
- wellheads submerged and contaminated by floodwaters
- 30 public water systems issued boil water notices
- 17 wastewater treatment facilities reported compromised operations
- septic system failures, fuel spills, other hazardous contamination
- over \$10 million estimated damage to crops and farmlands
- \$150 million overall cost to Vermont, and 7-10 billion overall





Extreme storms: cases

- Irene survivor:
 - Days of being stranded in her home w/o:
 - electricity
 - Access to fresh food
 - clean water
 - triggered depression
- Mold concerns in COPD patient
- Farmers



- Victims of natural disasters are at an increased risk of **anxiety, depression, PTSD, and suicide.**
- Up to **54% of adults** and **45% of children** suffer **depression** after a natural disaster.
- Forty-nine percent of the survivors of Hurricane Katrina developed an anxiety or mood disorder, and **1 in 6** developed PTSD. Suicide and suicidal ideation **more than doubled.**



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Source: Vermont Department of Health, Climate & Health Program

Air pollution & respiratory health

Air pollution causes

- 7 million deaths per year globally
- 200,000 premature deaths per year in the U.S.

Main climate-related concerns:

- Tropospheric Ozone
- Wildfire smoke
- Allergenic pollen
- Mold & moisture in buildings



Health impacts of air pollution:

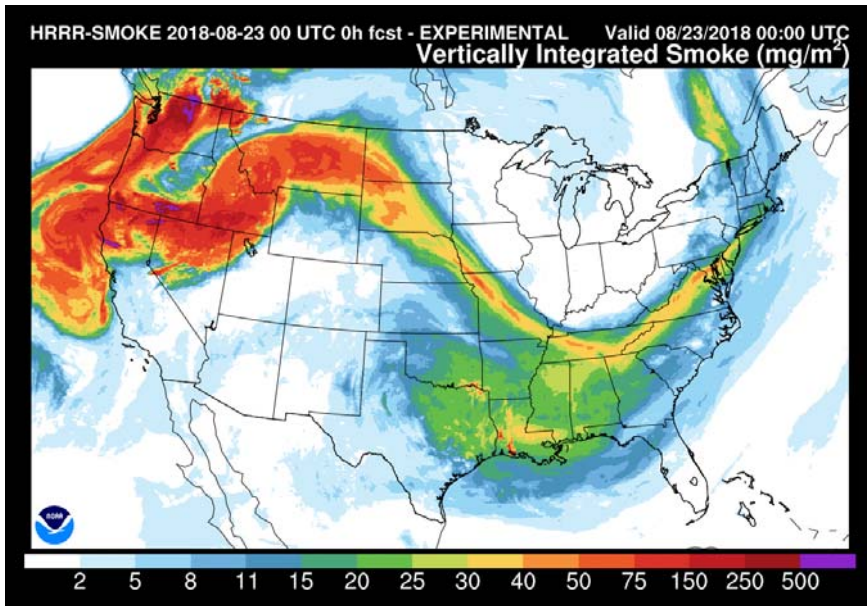
- Respiratory illness (COPD, asthma)
- Aggravated cardiovascular illness
- Increased allergy-related illness

Most vulnerable populations:

Children, elderly, low-income, pre-existing conditions, pregnant women & fetal health (pre-term delivery, low birth weight), people living near highways

Sources: CDC; World Health Organization, 2014; Ciaizzo *et. al*, 2013; American Lung Association

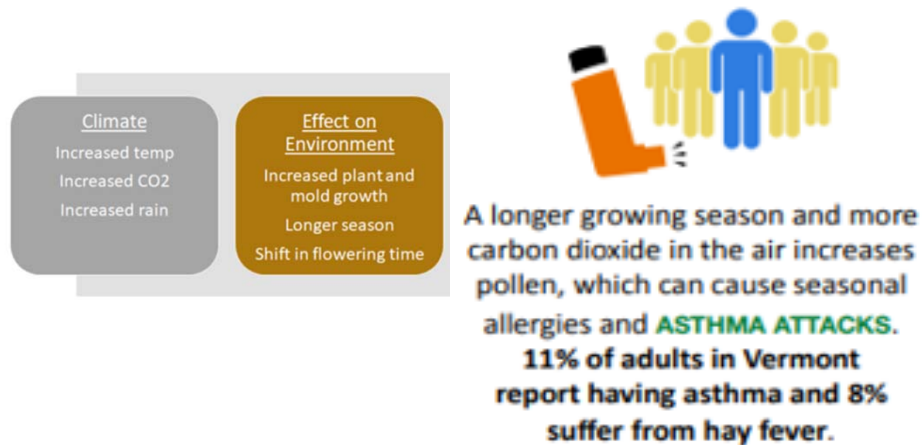
Even Western fires can affect Vermont



Source: National Oceanic and Atmospheric Administration; Jared Ulmer, VDH

Respiratory allergies

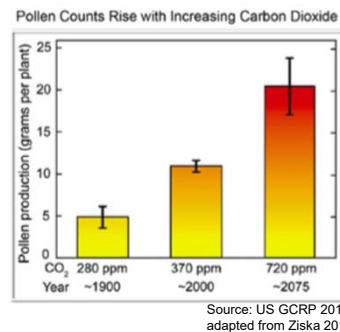
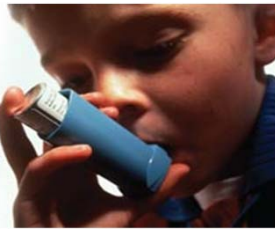
Longer warm season and more CO₂ increases pollen



Sources: University of Minnesota Global Health Center; VT Department of Health Climate & Health Program

Air pollution: cases

- More allergies, new cases, more extreme reactions
- Asthma, bronchitis, COPD patients suffer
- Chronic cough
- Cardiovascular disease



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Source: Vermont Department of Health, Climate & Health Program

Vector-borne Diseases

Relationship to Climate Change

- Increased temperatures & precipitation/humidity increase habitat and breeding success of vectors (e.g. mosquitoes, ticks)

Warmer conditions have contributed to increased black-legged (deer) TICK POPULATIONS and lengthened their active season.



In 2015, Vermont had the highest number of LYME DISEASE cases per capita in the U.S.

Examples:

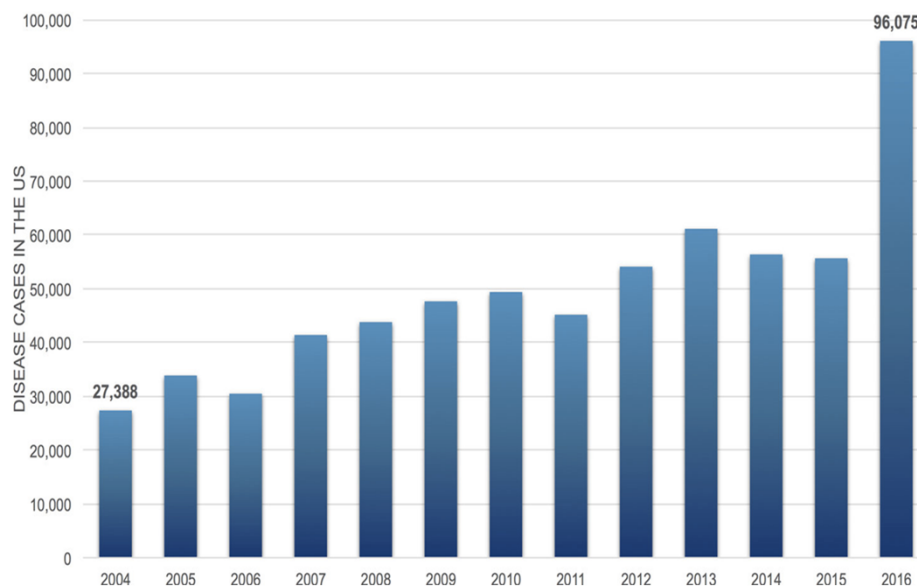
- Malaria (more than 400,000 deaths each year globally)
- West Nile virus
- Zika virus
- Lyme disease

Most vulnerable populations:

Children, elderly, low-income, outdoor workers

Sources: CDC; WHO

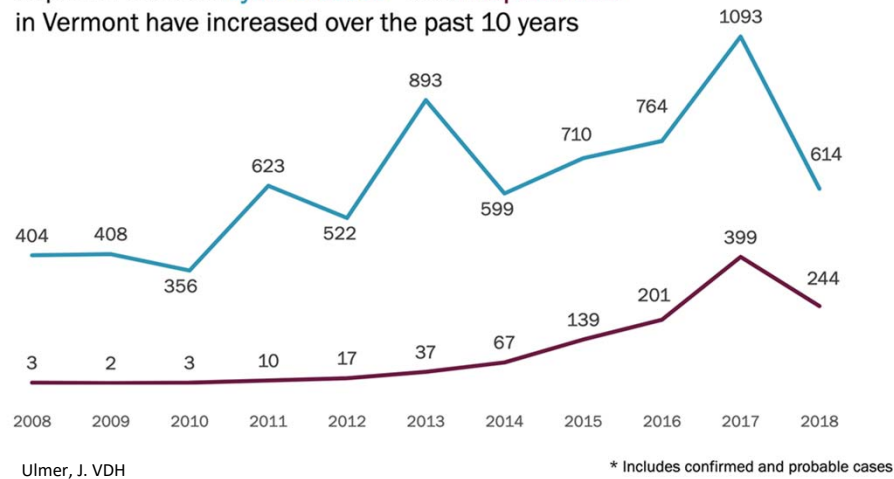
Disease cases from infected mosquitos, ticks, and fleas have tripled in 13 years.



Source: Lancet Countdown, 2018

Warmer conditions contribute to increased risk of tick and mosquito-borne diseases

Reported cases of **Lyme Disease*** and **Anaplasmosis** in Vermont have increased over the past 10 years



Vector borne diseases: cases

- Lyme disease- dramatic increase in:

- cases
- concerns
- mental health impacts



- Anaplasmosis

- West Nile

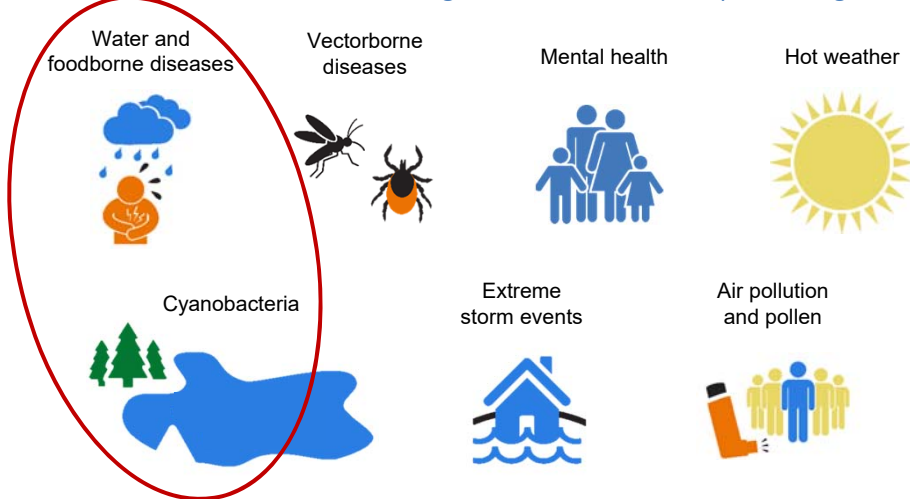
- "West Nile virus has been found in all counties of Vermont and continues to be detected in mosquitoes each year. However, it is a relatively rare cause of illness in people. Twelve cases in Vermont residents have been reported since 2011." -Vermont Dept. of Health

- Zika concerns



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Source: Vermont Department of Health, Climate & Health Program

Water and food-borne illness

Relationship to Climate Change

- Flooding events can lead to contaminated water & food sources
- Increased annual precipitation levels & warmer temperatures lead to algal blooms/cyanobacteria

Climate-related health effects:

- Exposure to pathogens in drinking water & food
- Exposure to chemical pollution in flood waters
- Exposure to cyanobacteria toxins in surface waters

Vulnerable populations:

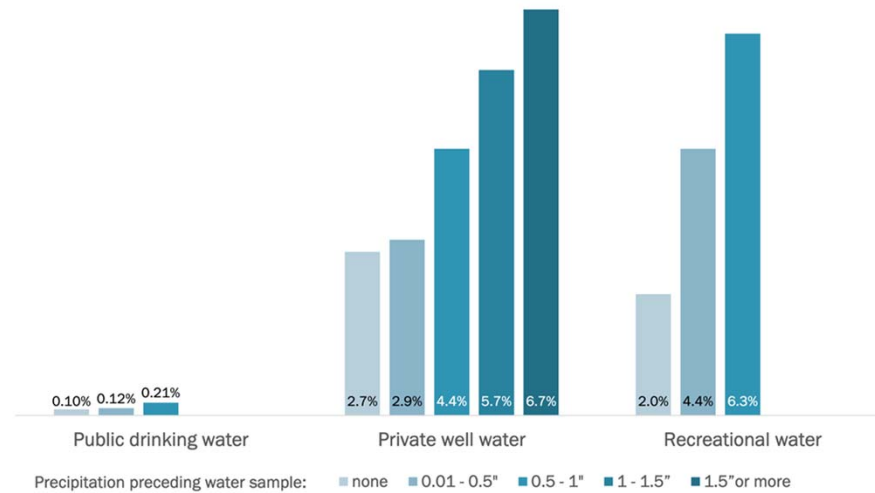
People coming in contact with contaminated water & food

Sources: CDC; WHO



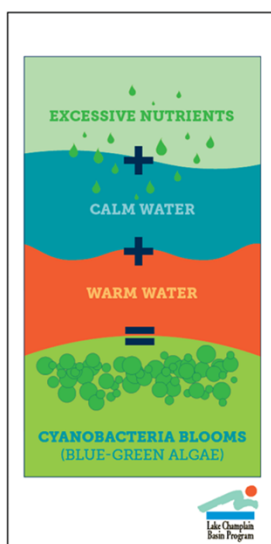
Heavy rains can increase contaminated runoff into drinking and recreational waters, leading to illness

E. coli detections increase after heavier precipitation



Source: Ulmer, J, VDH

Warmer water temperatures increase risk for cyanobacteria blooms that can produce harmful toxins



Change in Lake Champlain temperature, 1964-2009



Water and Food-borne illness: cases

- Statewide: 500 cases of food/water borne illness
- Cases **increase** with climate related events
 - Diarrhea, malnutrition
- Irene:
 - wellheads submerged and contaminated by floodwaters
 - 30 public water systems issued boil water notices
 - 17 wastewater treatment facilities reported compromise
 - septic system failures, fuel spills, hazardous contamination
 - over \$10 million estimated damage to crops and farmlands
- Irene survivor in clinic: scarcity, trauma
- Farmers with devastating damage to their crops
- cyanobacteria-algal blooms
 - rashes, sore throat, liver problems, death of animals
 - Missisquoi valley, Lake Champlain



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Source: Vermont Department of Health, Climate & Health Program

Mental health impacts

Climate-related health effects:

- Anxiety, depression
- Post-traumatic stress disorder
- Increased aggressive behavior & domestic violence
- Sleep disorders
- Solastalgia

Vulnerable populations:

People predisposed to mental illness, people who experience a traumatic event (e.g. flood, wildfire)



Sources: CDC; American Psychiatric Association

Long-term mental health impacts of Irene

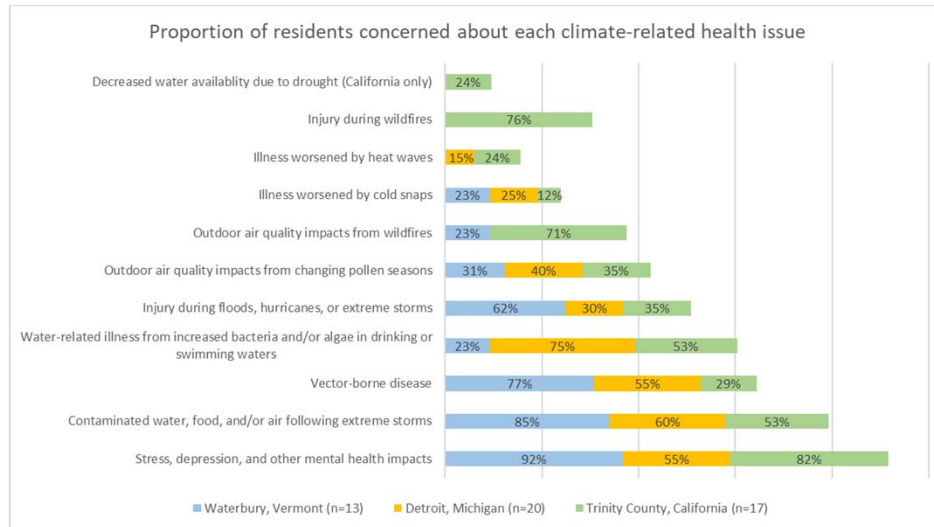
"Once you live through something, it's always there."

"It's hard for my husband to talk about. He still wears it very close. On rainy days he's looking out the window and checking the river levels. A nervous wreck. And he knows that it's not going to happen. **And I have to remind him it was a freak storm.**"

- Resident of Waterbury 5-9 years



Source: Christine Carmichael, PhD



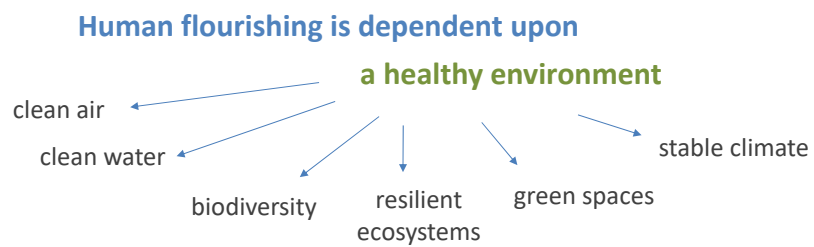
Source: Carmichael, Danks & Vatovec, *in preparation*.

Mental health: cases

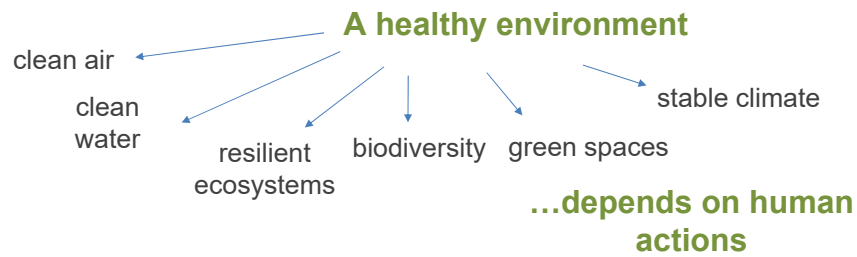
- Hopelessness, despair, eco-anxiety
- Depressed/anxious patients, youth especially
- Disaster survivors
 - climate grief
 - anx/depression/PTSD
- Farmers



**Addressing the climate crisis is the
greatest health opportunity of our time.**



References: Healthy Communities By Design (2007).



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Why physicians see climate change as a health emergency

SEPTEMBER 20, 2019

“Solving the global climate crisis could be the greatest opportunity of our time...”

Health Institute, during a grand-rounds program at the AMA headquarters in Chicago. He added that three ways to attack global warming—reducing air pollution, eating less meat and driving less—all

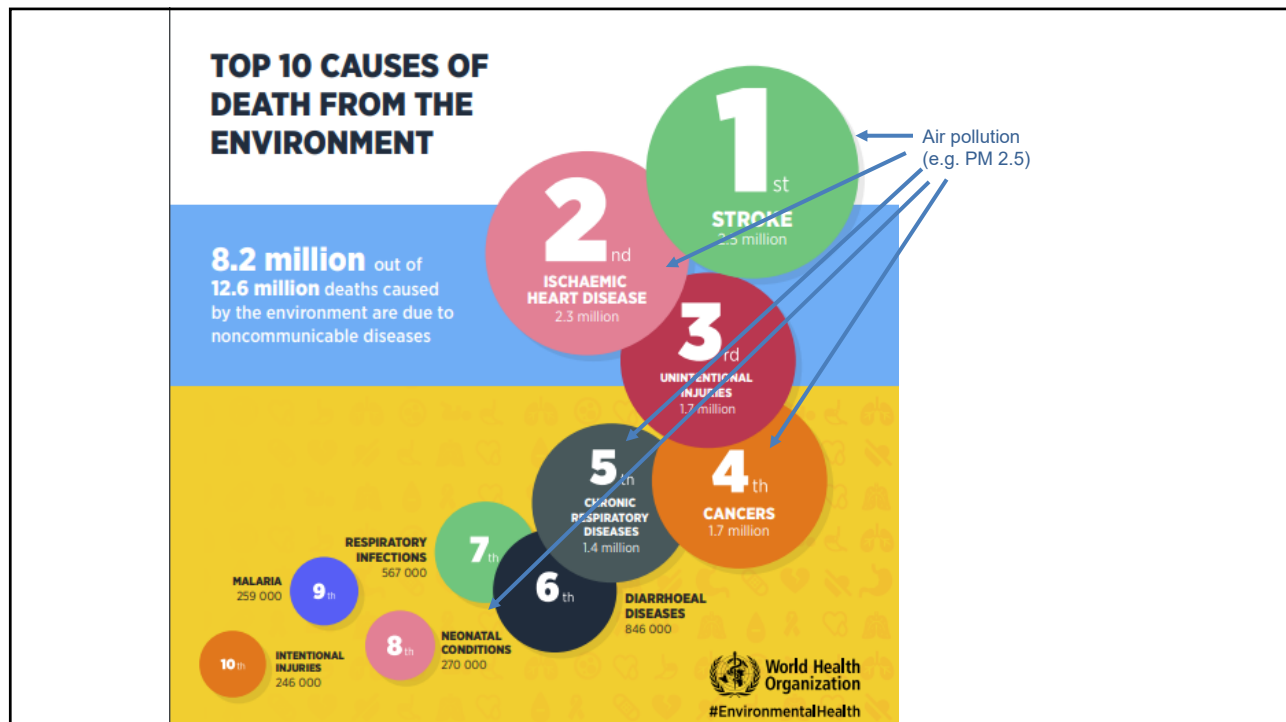
Reducing air pollution

Eating less meat

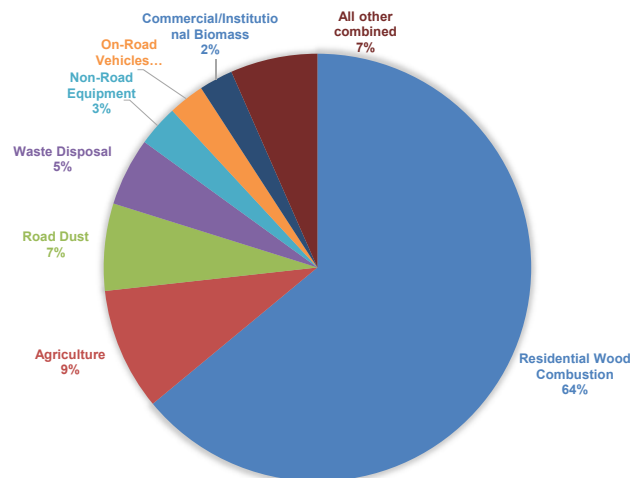
Driving less

All have tremendous health benefits

For a decade and a half, Dr. Patz served as a lead author for the U.N. Intergovernmental Panel on Climate Change (or IPCC)—the organization that shared the 2007 Nobel Peace Prize with Al Gore.

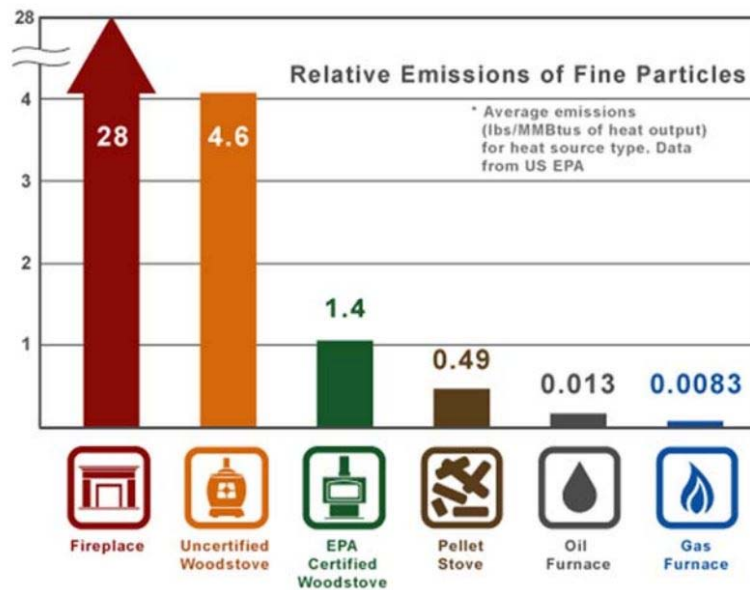


Fine particulate emissions sources in Vermont



Data source: EPA, 2014 National Emissions Inventory

Residential wood heating is the top PM_{2.5} contributor in VT



Source: EPA



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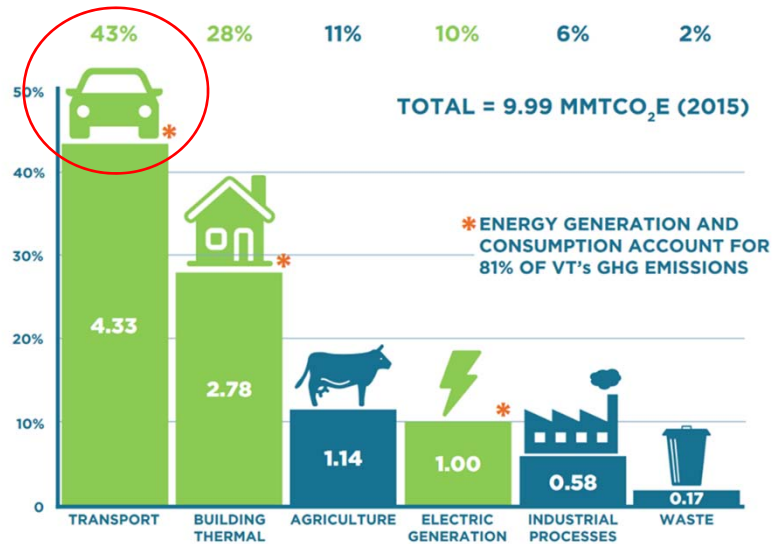
Active transportation (e.g. biking, walking) and healthier diets of sustainably-grown foods will improve human health... and - ****bonus**** - they both reduce greenhouse gas emissions



- 47% of adult Vermonters do not meet recommended physical activity levels
- 20% of adult Vermonters report not participating in any physical activity
- 61% of adult Vermonters do not consume recommended minimum of 2 fruit servings per day
- 70% of adult Vermonters do not consume recommended minimum of 3 vegetable servings per day

Sources: healthvermont.gov/3-4-50 & cdc.gov Vermont State Profile

Vermont's GHG emissions by sector



1. 2018 Greenhouse Gas Emissions Inventory Brief (1990-2015), VT Agency of Natural Resources.

Meeting Vermont's transportation goals will also benefit our health

If we can meet the transportation goals in Vermont's Comprehensive Energy Plan, we can expect the following benefits by 2050:



2,000 lives saved

due to more physical activity,
cleaner air, and safer roads



\$1.1 billion

in costs avoided from reduced health
care costs and increased productivity



38% less CO₂

from passenger vehicles, due to less
driving and more efficient vehicles

What are the goals?



80% electric
vehicles by 2050



Reduce driving
alone by 20%*



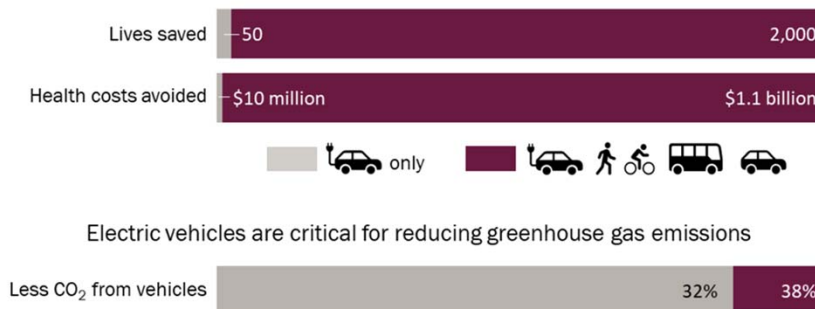
Increase walk,
bike, and bus
trips by 100%*



*by 2030, compared to 2011

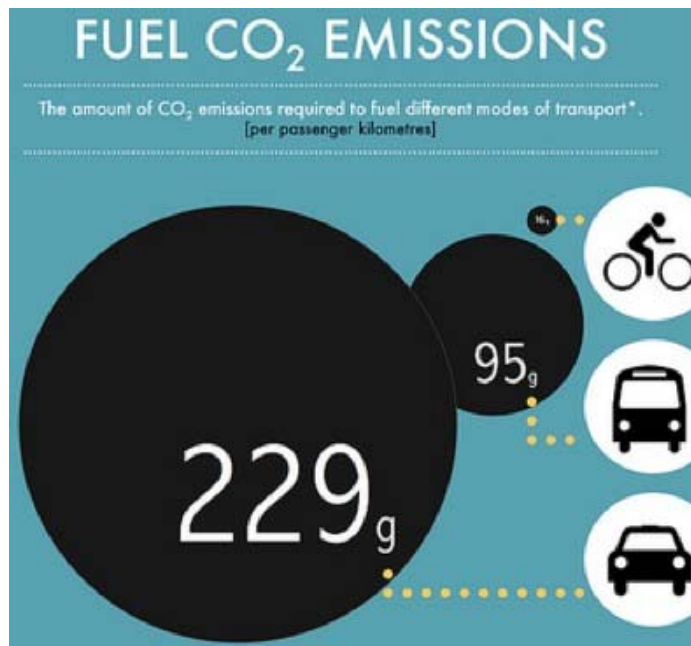
Source: Vermont Department of Health

Increasing walking and biking benefits health much more than electric vehicles



Electric vehicles are critical for reducing greenhouse gas emissions

Source: Vermont Department of Health

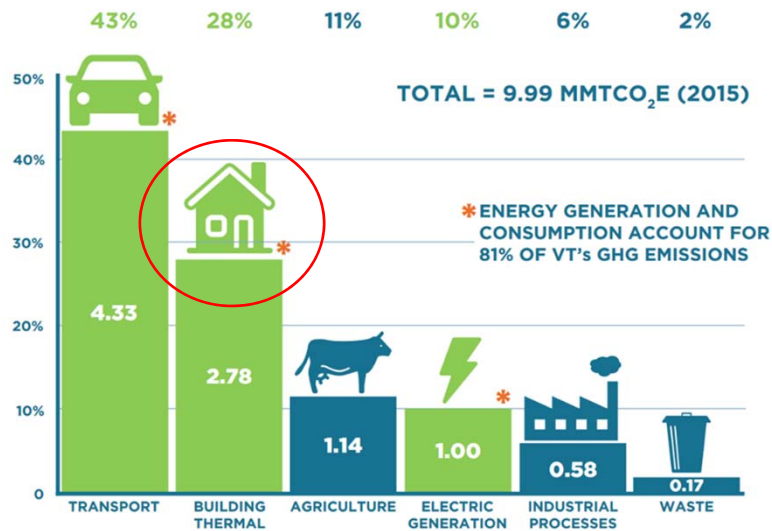


Amount of CO₂ emitted per kilometer traveled

Includes full life cycle of each mode, even the food required to power a person biking

Sources: European Cyclists Federation; Bike Portland.





Vermont's GHG emissions by sector















1. 2018 Greenhouse Gas Emissions Inventory Brief (1990-2015), VT Agency of Natural Resources.

Home weatherization benefits for health

Weatherization improves home conditions that affect health

Wx improves the home	
	Reduced energy bills
	Improved temperature control
	Improved indoor air quality
	Enhanced safety
	Reduced humidity
	Reduced mold
	Reduced pest intrusion

**Published evidence about the indoor environmental quality and health impacts of Wx was reviewed to identify the expected effects. The strength of evidence for each finding was based on the quality and amount of evidence available.*

Wx benefits health in many ways		
Health benefits...	...are associated with these improvements to home conditions.	Strength of evidence*
General Health		High
Productivity		High
Social Health		High
Upper Respiratory		High
Asthma		Medium
Cardiovascular		Medium
Financial Stress		Medium
Mental Health		Medium
Health Care Utilization & Costs		Medium
Accidental Injury		Low
Infectious Disease		Low
Neurological		Low

Source: Vermont Department of Health

Estimated health-related benefits

The estimated 10-year economic benefit per household is nearly three times greater than the initial expense.

Benefit category	Primary beneficiary	First-year benefit	10-year benefit
Thermal and electric energy cost savings	Household	\$1,174	\$11,740
Reduced impacts of asthma, cold, and heat*	Household	\$276	\$2,762
Reduced fine particulate emissions	Public	\$1,026	\$10,255
Total	Household + public	\$2,476	\$24,757

**More benefits are expected but could not be quantified, such as better mental and social health, fewer accidental injuries, and increased productivity.*

Visit healthvermont.gov/climate to learn more about these findings and estimated impacts.

Source: Vermont Department of Health

Actions to improve health & minimize greenhouse gas emissions

Personal level...moving beyond lightbulbs



- ✓ Make active transport a habit
 - Walking for 15 minutes a day can boost life expectancy by up to 3 years
 - On average a car emits 1 pound of CO₂ per mile driven
- ✓ If you do drive, go slower
 - Driving at 60 mph is 20 – 25% more efficient than driving at 75 mph (and it only takes 5 minutes longer for every 25 miles)

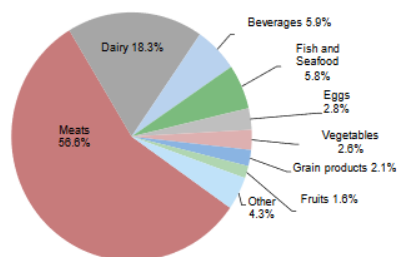
Actions to improve health & minimize greenhouse gas emissions

Personal level...moving beyond lightbulbs

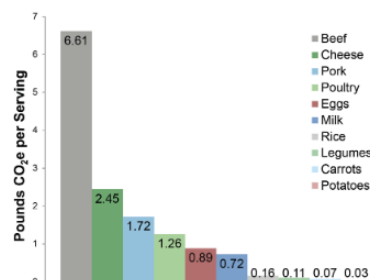


- ✓ Eat less meat
 - Appropriately planned vegetarian diets are associated with longer life expectancy (up to 8 years) and lower risk of several chronic diseases
 - One pound of beef releases 26 pounds of CO₂
 - Red meat, processed meats are probable carcinogens (IARC)

Greenhouse Gases Contribution by Food Type in Average Diet³



Pounds of CO₂e per Serving¹³
(4 oz. meat, 1/2 c. asparagus & carrots, 8 oz. liquids)



Source: University of Michigan Center for Sustainable Systems

Actions to improve health & minimize greenhouse gas emissions

Personal level...moving beyond lightbulbs



- ✓ Weatherize your home
 - Reduce exposure to mold & indoor air pollutants **Efficiency Vermont \$\$
- ✓ If you heat your home with wood, convert to an EPA-certified woodstove
 - Reduce particulate matter emissions and breathe easier

Actions to improve health & minimize greenhouse gas emissions

Personal level...moving beyond lightbulbs



- ✓ Keep a “consumption and waste” journal – identify ways to cut-back
 - **Electricity:** 5.906 metric tons CO₂/home – how much is wasted?
 - U.S. **landfills** released an estimated 148 million metric tons (163 million tons) of CO₂ equivalent to the atmosphere in 2014 alone
 - **Food waste:** up to 40% of food grown in the U.S. is wasted...releases GHG emissions when landfilled
- ✓ Gardening and/or support local agriculture (CSAs, farmer’s markets...decrease food miles)

Actions to improve health & minimize greenhouse gas emissions

Personal level...moving beyond lightbulbs



- ✓ Choose activities that are known to increase happiness with a minimal carbon footprint
 - Physical activity
 - Connect with friends & family
 - Keep learning
 - Help others
 - Practice mindfulness

Actions to improve health & minimize greenhouse gas emissions

Community level

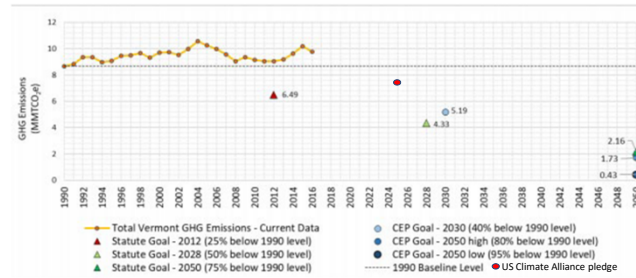
- ✓ Vote
- ✓ Share your voice
 - Write state and national representatives



Green Mountains?

Vermont GHG data shows we are not doing our part

Vermont GHG Emissions Compared to 1990 Baseline¹



Dept Public Service/Burl. Electric
Dept Annual Report, 2020

“Based on forecasted emissions data for 2017 and 2018, GHG emissions are expected to increase further over the next two years”

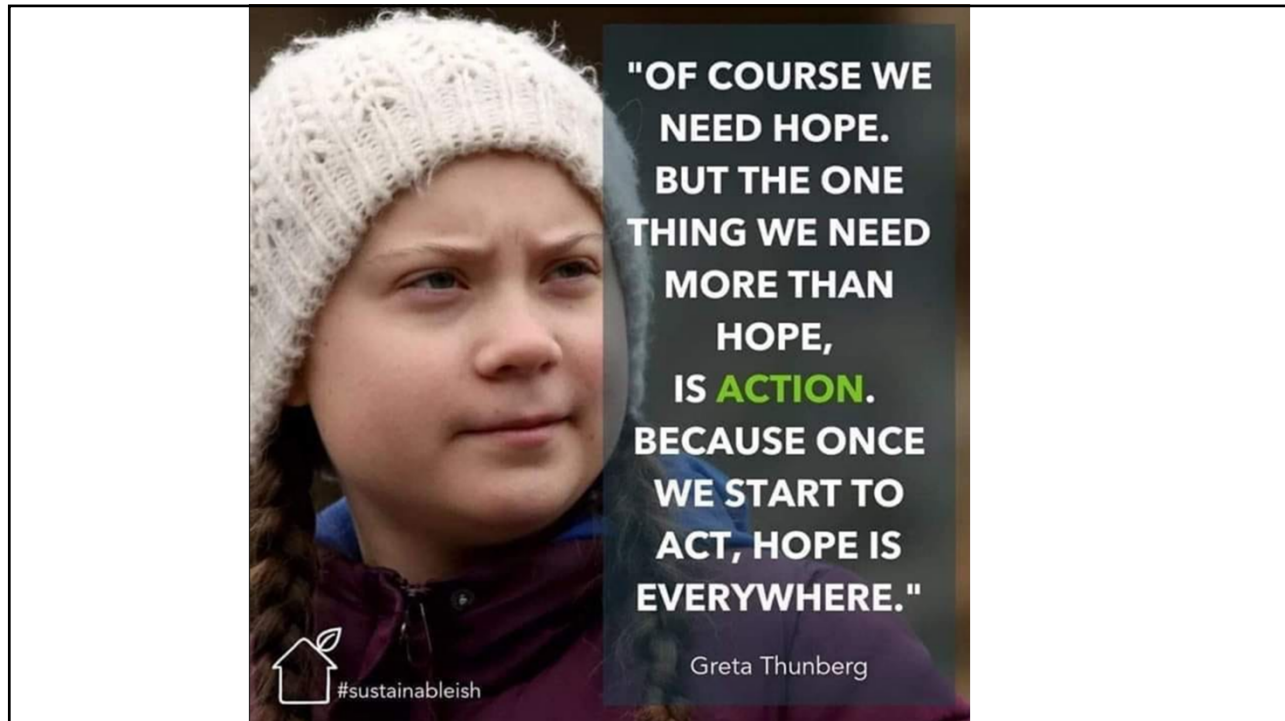
Actions to improve health & minimize greenhouse gas emissions



Community level

- ✓ Vote
- ✓ Share your voice
 - Write state and national representatives
 - Write an editorial
 - Talk to friends & relatives about climate change & health
- ✓ Support people-centered planning and avoid urban sprawl in your town
 - Support initiatives for active transport
- ✓ Build community
 - Check on neighbors during heat and other weather events
 - Join or support a related organization
 - Support sustainable businesses in your area
- ✓ Sign the call to action if you are a medical provider:

climatehealthaction.org



Resources & Next Steps

- Background information on climate & health
 - IPCC <https://www.ipcc.ch/>
 - CDC <https://www.cdc.gov/climateandhealth/default.htm>
 - Lancet Countdown: <https://www.lancetcountdown.org/>
 - VDH <https://www.healthvermont.gov/environment/climate>
 - Department of Defense Climate change report 2019
<https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF>
 - [Project Drawdown](#)
- Healthcare-related organizations focusing on climate & health
 - Medical consortium on climate and health
<https://medsocietiesforclimatehealth.org>
 - VTCHA <https://www.vtcha.org/>
 - Health Care without Harm (U.S./Canada)
<https://climatecouncil.noharm.org/>
 - My Green Doctor <http://www.mygreendoctor.org/>
 - Physicians for social responsibility: <https://www.psr.org/>

What questions do you have?

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