

CLIMATE CHANGE: In Our Backyard

(MOVIE NARRATOR) Gasoline. Liquid power to run millions of automobiles everywhere. Yet how many know what happens to the gas after it is poured into the gas tank? Let's go after that drop of gasoline.

(NARRATOR) Wait a minute, these days we know what happens inside a car – what about when Mr. Gas Drop leaves the engine? -- Among other chemicals, he turns into carbon dioxide. How much? 20 lbs. of carbon dioxide for every gallon of gas burned.

(NARRATOR) Imagine if what came out of the tail pipe were a solid instead of a gas. How would that get cleaned up? Instead, out of sight out of mind, carbon dioxide builds up in our atmosphere. So what do gas drops and carbon dioxide have to do with global warming anyway?

(LINDA GREENLAW) Hi, I'm Linda Greenlaw. When old timers on this island talk about the old-fashioned winters, I can't help but wonder if we really are going through climate change. They always tell you that the winters used to be so much harsher. That back fifty or sixty years ago the ocean used to freeze between Isle Au Haut and Stonington. I mean, it's seven miles.

In this program we're bringing home to northern New England a global issue, climate change. We'll be looking at how climate change affects me living here on the coast of Maine, a family in the woods of New Hampshire, a family in a city in Vermont and, in turn, how are we, here in Northern New England, affecting the world's climate.

(NARRATOR) After 17 years as captain of a swordfish boat, Linda turned her hand to lobster fishing. She returned to Isle au Haut, on the coast of Maine where her family has lived for four generations. Like most mornings when she's not on tour promoting her latest book, Linda gets her lobster boat, the Mattie Belle ready...today with the help of Simon, her sternman.

(LINDA GREENLAW) I wonder what the weather is going to do tomorrow not next year, you know? I don't spend much time thinking about climate change.

(NARRATOR) Global warming or climate change doesn't always seem like an urgent issue here in Northern New England where we often wish for warmer weather but the dire warnings from scientists are about events right here in our backyards, if we know where to look.

(GREG ZIELINSKI) An easy definition for the difference between weather and climate is time and space. Weather is what's happening in the atmosphere at any one moment, precipitation, what's the temperature, what's the relative humidity. Climate is looking at long-term averages over a longer period of time.

One way to evaluate how New England's climate, and how its weather has varied over time, is to look at the written records. Individuals back through time kept diaries on what was happening, especially farmers. The archives of these written documents, individual diaries, journals, annals, even the newspapers are a very important source for what has been happening in New England over the last 300 to 400 years.

This is February of 1893...it was about a ten-day period when areas in New England got 40 to 50 inches of snow in ten days. George Lang in Rye, New Hampshire, for example, said "very thick weather," which usually means very cloudy, then he says "wind from the east," as a nor'easter, "a real old ringtail snorter of a snowstorm going at noon." So you can imagine the blowing snow, the drifting snow and what this was like with this "ringtailed snorter of a snowstorm."

We are starting to compile a lot of this information and actually making it available on the web so that individuals, instead of looking at the big picture, can say, well there, here's what happened in our town, this is how climate has varied in our town.

(LINDA GREENLAW) My grandmother told me one time, when she was a young girl that it froze solid for almost the entire winter so that the boat couldn't come back and forth with the mail. And they sent a group of men, eventually, with a toboggan, to walk the seven miles over the ice to Stonington to get the mail. Apparently they came back without the Sears catalogs and the women were so mad, like it was too much weight, right?

(NARRATOR) Here, in New England, it's not uncommon to hear stories like Linda's about how much colder the climate used to be. But how do scientists tell one year's mild winter is an isolated event or part of global warming?

(DUPIGNY-GIROUX) I'm a data person. A lot of climatologists, a lot of applied climatologists work with data a lot, in terms of manipulating it, and massaging it, to see what the trends, the patterns, the statistical characteristics are. And trying to extract from there, kind of like a detective, exactly what's going on, from one place to the next, from one time period to the next.

(NARRATOR) These are not just abstract figures. The numbers crunched by climatologists can explain a great deal about the world around us.

(DUPIGNY-GIROUX) A lot of people know Vermont is known for its McIntosh apples and that hasn't always been the case. It's actually as of the 1930s, when we went through a number of decades that were particularly cold, and all of the other varieties that had been introduced into the state didn't make it. And the McIntosh was the only variety that actually did, and so survives today as being the predominant variety or strain that is produced here in Vermont.

(NARRATOR) Historic records, extreme weather, floods and droughts -- it's a lot for an average New Englander to take in -- but scientists have come to some conclusions about our climate from this complex web of weather data.

(JASON ALLARD) Over the course of the past century, New England seems to have warmed to a little less than a degree Fahrenheit, maybe around .7 degrees Fahrenheit. But the warming along the coast has been larger, maybe a degree and a half Fahrenheit

(NARRATOR) The discussion of climate change is entangled with several myths. The biggest myth is that there is an on-going debate in the scientific community about whether or not the climate is changing. Scientists don't debate the existence of climate change. In fact, based on statistical data showing temperatures around the world, scientists agree that the average temperature on earth is warming. This is an average -- some temperatures may be decreasing.

(BARRY ROCK) We know for a fact that 20 thousand years ago we were under 2 miles of ice and so the climate has obviously changed dramatically in that period of time. I think the real issue with climate change is not whether it's occurring, but are we somehow a cause of that change?

(NARRATOR) To separate the human causes of climate change from the natural ones is the great challenge of the climate change issue. However, one possible and clearly understood cause of warming in Northern New England, like the rest of our planet, is what's known as the greenhouse effect

(BARRY ROCK) The greenhouse effect is very natural it's real, it's not a theory, it's the reason that you and I are here today. There are gases in our atmosphere that are transparent to light energy and so we have a gas molecule here and the light energy just passes right through it.

That sunlight strikes the molecules of a plowed field and the molecules of that plowed field start vibrating and they generate heat. Well the same molecule that allowed the light to pass through now absorbs the heat and keeps the heat in the atmosphere. It acts like glass panes in the greenhouse and that's why it's called the greenhouse effect.

If we look at Venus as a planet it is very hot, 800°F, melts metals. Mercury on the other hand is closer to the sun but only half as hot and it's because what little atmosphere that mercury apparently has, has virtually no greenhouse gas in it. Mars, on the other hand, is a cold desert because it doesn't have enough greenhouse gas in its atmosphere to warm it. So again we see that the greenhouse effect is a natural thing and that the three terrestrial planets that we use in our comparison are each different, not so much because of their distance from the sun, but because of the amount of greenhouse gas they have in their atmosphere.

(BARRY ROCK) There are two or three greenhouse gases that are of real concern to us: water vapor is one that's a naturally occurring greenhouse gas. Carbon dioxide is another greenhouse gas and a problem with carbon dioxide is that it has a long lifetime in the atmosphere. CO₂ pumped in the atmosphere today will be around 100 years from now.

Methane, swamp gas, is another example of a greenhouse gas and methane is 20 times more powerful than carbon dioxide as a greenhouse gas.

(NARRATOR) Scientists have been testing for gases in the atmosphere for centuries, but a consistent, written record only goes back about 50 years. How, then, do they know that these greenhouse gases are increasing?

(PAUL MAYEWSKI) We've been studying ice cores all over the world for the last 20-25 years. We work in Asia, the Arctic, and the Antarctic. In many ways it's as if you were able to travel along a glacier, stop, drill down into the ice and recover a buried record of climate.

The ice cores are phenomenal records of how the climate has changed and how the chemistry of the atmosphere has changed because they trap within them literally everything that's in the atmosphere. But we not only trap snow, we also trap chemicals that literally float out of the atmosphere when it's not snowing. It's called dry deposition, and it's also possible to capture gasses that are in the atmosphere. And it's trapped, eventually compressed, squashed down into thinner and thinner layers so we can tell summer, winter, summer, winter, and then we can tell the difference, whether or not one winter was stormier than the next. Whether a summer was warmer than the previous summer.

...once we have identified sites that we think are going to give us good records, which in a place like Antarctica is literally anywhere, then we come in with various size drills. And that would allow us to go down into the glacier three or four thousand meters, twelve, thirteen thousand feet, and recover records that could be as old as half a million, potentially a million years long.

(PAUL MAYEWSKI) When they come out of the ice corer, we are dressed in very clean clothing. We wear face masks, we have gloves on, plastic gloves so that we don't contaminate the cores ourselves because the chemistry that we're looking at is very, very low level. It's parts per billion, and in fact if you took a shower, washed your hands, and touched one of these ice cores you probably would contaminate it with sodium chloride from the tiny bit of moisture that you have on your fingers. So they're very low levels.

(SHARON SNEED) When we melt the cores and turn them into actual water samples, we're able to do it at such a fine enough resolution, that we can see seasonal storms. In the past, we were lucky to see years or decades, but we can see the changes of the seasons in the storms now; that's been a real accomplishment.-

(NARRATOR) When scientists compare the climate record derived from ice core samples with recent written climate information, they find that the two overlay almost perfectly, validating the accuracy of the ice cores to an amazing degree.

(SUSAN KASPARI) You can get these shifts in climate that can happen over real short time periods, so you've got this combination of the natural environment and how we as humans are imprinting our behavior on top of it. That if naturally it can change that quickly, then what we're doing on top of it maybe can compound that.

(NARRATOR) This startling discovery by ice core researchers— that natural climate change is not a gradual process, but that the earth can suddenly cool or warm drastically in just a few years – has had a major influence on fields beyond climatology, from paleontology to archeology. Ice core data showing sudden ice ages and droughts sheds new light on many of the most mysterious events in human history – from the Mayans abandoning their cities to the disappearance of Norse settlements in North America. Are we as vulnerable as these ancient civilizations, who never imagined their great cities would end with a shift in the climate? How can we look into the future and predict changes before it's too late?

(SCOTT OLLINGER) The first predictions of climate change actually occurred longer ago than you might guess. In the early 1900's at the onset of the industrial revolution when people started burning oil as a form of energy, the scientist Arrhenius actually made some estimates as how much global temperature ought to rise.

Sound from opening animation
music

(NARRATOR) With the advent of the automobile, we have become more and more dependent on fossil fuels for energy. And Fossil fuels are by definition carbon based fuels. From Model T's to Mustangs, in any engine that runs on fossil fuels, carbon combines with oxygen to release carbon dioxide.

In the United States, the largest portion of human produced carbon dioxide comes from generating power -- - with automobile emissions a close second...while a smaller share of human produced carbon dioxide comes from bio-mass burning, such as crops and forests.

Ice core research shows that for over 450,000 years – or since the time that some of the first human-like animals walked the earth – carbon dioxide has remained within a limited range – then around 1900 at the beginning of the industrial revolution, carbon in the atmosphere shoots up dramatically -- over 30 percent.

(SCOTT OLLINGER) Can we ever imagine a scenario where we have taken a major component of the Earth's atmosphere and changed it by 30% and expect nothing to happen. To me and many other people, the idea that we can do that and expect no consequences is relatively unrealistic I would say.

(CAMERON WAKE) You know, scientists naturally are skeptics. So any time you have all scientists lining up

on one side of an issue, I think you got to be – you have to be concerned, because naturally we're trained to be skeptical.

(NARRATOR) The vast majority of scientists now agree that burning fossil fuels and other human changes in our environment are effecting the climate. When asked to predict the future though, there's a lot more disagreement.

(BARRY ROCK) That's amazing. How many models are combined in this model?

(GEORGE HURTT) About a dozen.

(BARRY ROCK) That's incredible.

(NARRATOR) Scientists like Dr. Hurtt create computer models that simulate various scenarios for future climate change. Dr. Hurtt can adjust the amount of carbon in the atmosphere, for instance, and then see how the temperature changes.

(GEORGE HURTT) Nobody that I've seen can build a climate model that can withstand the doubling of atmospheric carbon dioxide concentration and not have some global warming. So while these models all produce different estimates, they suggest that if you increase carbon dioxide concentration, you will get warming. The question is how much and how fast.

(NARRATOR) Hundreds of scientists from across the country recently gathered their climate research and models into a comprehensive National Assessment on Climate Change. Part of that effort, The New England Regional Assessment, made predictions about climate trends for our region.

(BARRY ROCK) We used 2 climate models in the New England regional assessment, one called the Canadian model the other called the Hadley model. The two models differ from one another. The Hadley suggests that over the next 100 years there would be a warming of approximately 6 °F for the region. The Canadian model suggests a 10 ° warming over the next 100 years for the region. And the average New Englander probably doesn't think 6 or 10 degrees is a big deal, but in fact, if we look at the average temp for the last 30 years for Boston and we add 6 degrees to that, we get the 30 year average temp for Richmond Virginia. And if we add 10 degrees to the average temperature of Boston, than we get the 30 year average of Atlanta, Georgia. And our viewers know very well that there is not a lot of skiing that goes on in Atlanta, Georgia or Richmond, Virginia -- it's just fundamentally different than New England. And so my real concern about warming in the future is that if it were to occur in either the 6 degree or 10 degree version, then New England would be a fundamentally different place.

(NARRATOR) When people talk about global warming, they often mention that sea levels will rise; it's easy to picture polar ice caps reacting to warmer temperatures by shrinking and melting. What many people don't realize is that the majority of sea level change is the result of the way water expands when heated. As temperatures warm the oceans, the water or H₂O molecules move further apart and occupy more space...so

the oceans expand and sea levels rise.

The news is full of stories about the more dramatic effects of sea level rise, such as entire island nations-disappearing. It might not be as obvious, but here in northern New England, rising sea levels are a concern as well.

(GREG ZIELINSKI) Where the global impact of climate change on New England could be felt, is if you have sea level changing and then you bring in a big storm, then all of a sudden, tidal surge and the winds and waves impact a greater area on the coast than maybe it had in the past

(NARRATOR) Some marine species may react positively to temperature increases...others may not survive even a small temperature shift.

(LINDA GREENLAW) That looks like a good one, right there, maybe.

(LINDA GREENLAW) Early in the spring, when the water's still cold, the lobsters aren't moving around a lot. They're waiting for the climate to warm the water up enough so that they can molt or shed and they're in very shallow water, they're hiding in the rocks. But then as they form their new shell, they're coming out and looking for stuff to eat. Now they're hungry, the water's warm, they're moving around and this is when they're trappable. If the climate changes and we have a warmer, earlier spring, then the lobsters will molt earlier and we'll have an earlier season, maybe a better season.

(LINDA GREENLAW) You're right, a good one, two good ones. (laugh).

(NARRATOR) What do these changes in the ocean mean for the future? How will they effect New England? This is where scientists disagree in their predictions.

One example of a sudden and frightening scenario for climate change involves the Gulf Stream. This current acts like a conveyor belt, bringing warm Caribbean waters up the East Coast of the United States and across the Atlantic to modify the climate of Great Britain. As salty, cold water sinks in the North Atlantic, the lighter, warm Southern water rushes in, causing the Gulf Stream Current.

However, when the planet warms and the ice caps begin to melt, fresh water is released into the ocean and the water in the North Atlantic becomes lighter and less salty. Therefore, it doesn't sink and the conveyor belt of the Gulf Stream could literally shut off. This would likely have a cooling effect on the climate of New England and cause a devastating drop in temperatures for Great Britain.

Although no one knows if this will happen, it shows that the results of global warming are unpredictable and can actually cause cooling in some areas. Since temperatures everywhere will not increase, many scientists prefer the terms "climate change" ...or "global change" ...instead of "global warming."

(NARRATOR) Jennifer Ohler and Bob Bower in Warner, New Hampshire see climate change from a different point of view – They live with their children Abby and Sam in the woods of New Hampshire, a very different ecosystem than the coast of Maine.

(BOB BOWER) We work full-time in the farming and logging business and we sell a lot of cord wood, its hard work, we're selling a hundred or better cords of wood, cut, split, and delivered each year. And we sell maple

syrup. We're certified organic and sell vegetables in the summer. We probably grow 5 acres and do a couple farmers' markets.

(BOB BOWER) ...and fill out with whatever pumpkins anyone wants to put in.

(NARRATOR) The forests and plants that Abby and Sam's family depend on are actually another factor, a potential balance in the climate change equation. When green organisms use the process of photosynthesis to convert sunlight into energy, they act as carbon "sinks" or things that absorb carbon.

(GEORGE HURTT) So one example of a carbon sink would be a tree. A tree is a carbon sink because a tree is made of carbon. A lot of people think that trees grow from the ground where as in reality they grow from the air. They take carbon dioxide, it's an invisible gas in the air, and convert it into wood...the primary process for carbon removal from the atmosphere is photosynthesis which drives plant growth.

(NARRATOR) Another carbon sink is phytoplankton, Especially in the ocean, these minute plants take up large amounts of carbon dioxide from the atmosphere.

(BARRY ROCK) We would be wise to think of forests as carbon dioxide sponges and we would be wise to think of standing forests as a warehouse of carbon dioxide that has been stored over perhaps a 100 years. When we cut the forest, we remove that ability to be a carbon dioxide sponge and very often what we do with the wood is we convert it into energy perhaps and so you're pulsing that carbon dioxide stored over 100 years back to the atmosphere. Perhaps people wouldn't think of the study of forests as part of the study on climate change, but in fact it is because of the ability of forests to act as carbon storehouses.

(NARRATOR) As well as storing carbon, trees and plants have a cooling effect on the earth they cover. Data shows that cities – where buildings and streets reflect heat back into the environment – are warmer than rural areas, creating an "urban heat island" effect. Also, farmed land reflects back more heat than forested land. And land covered by snow reflects the most heat of all.

In New England, temperatures have been effected over the last century by the movement of farms from New England to the Mid-west. The resulting re-growth of Northeastern forests has had a cooling effect on the region. While urban sprawl, by removing trees and covering the earth with concrete, is having the opposite: a warming effect.

From forests...to farms...to concrete, changes in land use as well as the production of greenhouse gases influence temperature. In addition, scientists are studying different chemicals in the atmosphere to determine their effects on climate.

(PAUL MAYEWSKI) There's a whole other side to climate, not just physical climate but also chemical climate, and chemical climate is really the study or investigation of all of those things which make up the air quality. In some cases those changes in air quality might affect physical climate. If you have a volcano that is spewing a tremendous amount of sulfur into the atmosphere, or by the same token, if you emit a lot of sulfur into the atmosphere because of the burning of fossil fuels, that sulfur mixes with water creates sulfuric acid, one of the two major components of acid rain. And as dramatic and potentially even more dramatic would be the impact humans have had on the chemistry of the atmosphere.

(JOHN ABER) One area that I've been particularly active in is in Nitrogen content of rainfall which has been known for twenty, twenty-five years as acid rain. There's two components of acid rain there's a nitrogen component and a sulfur component.

(NARRATOR) Nitrogen is always present in the atmosphere, but at the high temperatures in a modern automobile engine, the nitrogen is converted from a relatively inert form into nitrous oxide which in turn converts to nitrogen dioxide, that eventually falls back down to earth in the form of Nitric Acid. On the other hand, the sulfur component of acid rain comes mainly from coal burning industrial power plants. Winds blow sulfur from industries in the Midwest into our region that then falls as acid rain.

(JASON ALLARD) New England's often referred to as the tailpipe of America. It's because the general prevailing winds are westerlies, so everything west of here flows towards us. And particularly the storm tracks tend to move across the country and come right up over New England.

(JOHN ABER) The Clean Air Act amendments of 1990, which Senator Mitchell was so instrumental in working through the national legislature focused primarily on sulfur. And so there are substantial reductions in the amount of sulfur in the atmosphere.

Nitrogen is a more difficult pollutant to control because a much larger fraction of the nitrogen in the atmosphere comes from automobiles.

(NARRATOR) Carbon dioxide and nitrogen, both released from automobiles...and finally we examine one of the worst pollutants of all: Ozone – another by-product of burning fossil fuels.

It's useful to divide ozone into good and bad ozone. Ozone in the upper atmosphere is good ozone that occurs naturally. It blocks excess UV radiation from outer space.

However, ozone created by cars in the lower atmosphere is bad ozone, called smog. Smog is a deadly pollutant, damaging living tissues in plants, animals, and humans.

(JOHN ABER) Leaves have to be open to the atmosphere because they take up carbon dioxide...and being open to the atmosphere other gases in the atmosphere also penetrate. And so ozone also penetrates into the leaf. And there's just a direct linear relationship between how much ozone penetrates into the leaf and damage to the photosynthetic mechanism in the plant.

(BARRY ROCK) Forest watch is for kindergarten through twelfth grade students across the New England region to become actively involved in helping me monitor the forest health of white pine.

(TEACHER) First thing we are going to do is I have to take some samples off of this using the pole pruner.

(BARRY ROCK) White pine is a bio-indicator for ozone when it's exposed to ground level ozone or smog. The needles of the white pine will actually show visual symptoms and I train K through 12 teachers to train their students to recognize these symptoms. The students will collect samples of white pine outside their classroom every year which they send to me in little picnic coolers -- we call it piney express. And we then analyze the

samples that they send to us here at the university and the combination of student derived data and the sample information that we get here at the university has proven to be extremely valuable. And the take home lesson here is that there are many species very sensitive to air quality and white pine is one of those and that as the ozone level increases, the health of the tree decreases. As those ozone levels lower, the health of the same trees, the next year, springs right back so the trees are very resilient. They're very capable of improving their health status if the air quality improves.

(JOHN ABER) Actually crop plants, corn and soybeans respond even more strongly to ozone because they are growing at such a rapid rate. They're so open to the atmosphere, they're exposed to and take up so much ozone that they actually have a much larger decline in their growth rate.

(JENNIFER OHLER) I start all my seeds in the cellar from mid-march onward and so they start clustered around the wood stove where they germinate and then they get moved to the windows and then when its warmed up just a little, they get moved to the seedling greenhouse and then get moved down to the big hoop house and eventually to the ground.

(NARRATOR) If, in a hundred years, global warming brings the climate of Virginia or Georgia to Jennifer's home in New Hampshire, maybe she won't have to start her plants indoors. On the positive side of climate change, scientists are experimenting to see if forest and plant growth in New England will actually be stimulated by some of the changes: for instance, plants could benefit from a longer growing season, more carbon dioxide in the air and more nitrogen in the soil.

(SCOTT OLLINGER) The reason we are out here shooting leaves out of trees is because we're working on a project that essentially tries to map the rate of carbon dioxide uptake across a landscape by forests and the rate at which trees grows tends to be related to how much nitrogen is in their foliage. So what we spend a lot of time doing out in the woods during the summer is collecting lots and lots of leaf samples from the upper canopy of trees and analyzing them back in the lab for nitrogen concentrations...and these look to be actually quite nice healthy red oak leaves.

(NARRATOR) So far, scientists' findings show that climate change may cause plants to grow better in the short term.

However, long range experiments and models show that crop and forest growth will only increase for a short time, then fall off rapidly, even to the point of death. Too much nitrogen can actually kill plants and the overpowering effects of pollutants like ozone and acid rain eventually overcome the benefits of warmer weather.

(BOB BOWER) This is a hard year for syruping. Our production is down probably about a third of what we usually do. Most of the syrup that we've made since the beginning has been dark syrup which is usually the syrup that you make toward the end of the season. And because the winter was a lot of snow and cold, it was very difficult to set up this year.

(BARRY ROCK) In terms of Sugar Maple the news is not good. In the 1950's and 1960's 80% of the maple syrup produced for the world came from New England and Vermont my home state was the leader today 80% comes from Canada 20% comes from New England.

But about a third of the change can be related directly to wintertime temperatures. Maple and the flow of maple sap is directly related to cold nights and then warm days. Those conditions have been occurring earlier and

earlier. And in some seasons they haven't occurred much at all.

(BOB BOWER) Generally speaking, we're boiling earlier. In the past the rule of thumb was that if you set your taps out before town meeting day which around here is around the 9th or 10th of March that you were crazy.

(BARRY ROCK) If the warming gets severe enough... the Canadian model showing a 10 °f warming the Hadley model a 6 °f warming, under either of those conditions we would lose our maples, period. The maple trees would die...

(ADAM MARKHAM) The people that come to New England in the fall expect to see that fiery color of the sugar maples. If we lose the sugar maples then we lose the main element of New England's fall color. We're in an interesting position in New England because there's a lot of businesses and parts of the economy that are likely to be affected by climate change...

Tourism is incredibly important to Vermont, New Hampshire, and Maine and skiing is probably the high end piece of that tourism. Skiers spend more than other tourists. Snow conditions are likely to get more unpredictable and probably we'll have less snow in general so any effect on those resorts will be very bad for communities that depend on them.

(NARRATOR) The economic effects on a region like New England that is so dependent on its natural resources could be staggering. And even if you're not directly involved in tourism or other industries that rely on nature or its products, the effect of climate change is likely to reach you.

(ABBY BOWER) When I run a lot, I have a lot of trouble breathing and I feel like my lungs are closing up.

(PAUL EPSTEIN) When we put weeds in containers and double the CO₂, they make 60% more pollen. So the weedy, opportunistic, nuisance pioneering pesky species, are seizing on the excess CO₂ to put their production into reproduction and dispersal. And we're seeing a doubling of asthma from the 80s to the 90s. It is about social factors, indoor air pollution. But it may be that warm winters combined with early arrival of spring, and then plus more CO₂, that all that is boosting the pollen that causes allergies, and hay fever, and asthma.

(JENNIFER OHLER) When I first took Abbey to the doctor to try to figure out why she couldn't breathe when she ran, he said that sports induced asthma, in his practice, has become an epidemic problem. And in his opinion, he said, and this was several years ago when Abbey was eleven, he said that he considered that it had to be pollution related because the kids haven't changed at all, it's the environment that's changed.

(CAMERON WAKE) One of the aspects of this that I'm really interested in is how does air quality affect human health. There have been a number of studies around the country, around the world, that have shown very clearly that poor air quality affects pulmonary functions, affects cardiovascular system.

Most of the studies have been done in big cities where there's a lot of pollution.—What some of the research is finding now is that longer-term exposure to lower levels can also result in significant human health impacts.

(PAUL EPSTEIN) Ozone gets into the alveoli, the air sacs, and destroys them. And we now know that ozone not only can trigger asthma attacks, it can cause new cases to begin in people who didn't have asthma. So, ozone, pollen, two issues related to burning fossil fuels. The third is diesel. It turns out that diesel is a good delivery system for pollen. So that they hang out together and go into the inner air sacs together. So, diesel, ozone, and pollen may all be playing a role in asthma.

(NARRATOR) Even Northern New England offers no escape from climate change. The American Lung Association has given a failing grade for air quality to Rockingham and Hillsborough Counties in New Hampshire -- and York, Cumberland, and Hancock counties in Maine. When scientists talk about global change, they mean global.

(CAMERON WAKE) So this is a filter based sampling system and we change the sample every 24 hours and we sample for soluble aerosols. Things like sulfate and nitrate that make up acid deposition and things like sea salt and dust.

Airmap is a NOAA-funded research project, centered here at the University of New Hampshire, involving a wide range of collaborators, that is really looking at the link between weather and air quality, to really understand why we have bad air quality.

There's not a lot of big local sources here and yet we suffer several ozone events each summer. For example sometimes Acadia will have the worst air quality in all of New England...

One of the key aspects of the Airmap project is linking air quality with weather. And we'd like to get that information out to New England citizens as quickly as we can.

Right now you can go to our web page and you can get up to the minute air quality information. And hopefully, in the future, the air quality, will also be part of your meteorologist's forecast of the weather. So you can begin to think of the weather not just as temperature and precipitation but also in terms of air quality, ozone concentrations, and fine particle concentrations, and carbon monoxide concentrations.

(NARRATOR) Because warming has an effect on weather systems and the water cycle, scientists predict more extreme weather events in the next century. An increase in droughts and floods is bad enough for the damage done to humans and their crops, but what people often don't think about is that these severe climate events also play into the spread of disease.

(NARRATOR from PSA) Have you heard the buzz about West Nile Virus?

(PAUL EPSTEIN) Now right here in New England, drought is playing a role in one vector-borne disease called West Nile. West Nile virus came to the US in '99, we don't know how it got here. But we do have a sense of the conditions that revved up the cycle of this disease that cycles among urban mosquitoes in the drains and birds in the city. It appears during droughts in April, May and June, and then we have later rains in the late summer and those can give you the kinds of mosquitoes that bite horses or people. The bridge vectors...

(ABBY BOWER) Mom was saying yesterday that there used to be no ticks at all around here and now there's tons.

(EPSTEIN) Well in New England, we have Lyme Disease. Lyme Disease is the number one vector-borne disease in the US. What does that mean? Vectors are things that carry organisms that cause disease. So, here's the ticks, they're vectors of Lyme bacteria. But we are also seeing that warming can increase the range of Lyme ticks. So it's the warm winters that allow the over-wintering of ticks.

(NARRATOR) The spread of disease reflects the movement of animals and insects from more moderate climates into New England...will New England eventually have to deal with malaria as well? The future is, of course, a mystery with many variables and unknowns. Does this mean that scientists suggest we wait until we know more before we take any action?

(DAVID HILL) I think that if all policy decisions that we made waited for absolute scientific certainty, just the very nature of scientific endeavor and, increasing our knowledge bit by bit of the world, would never allow us to make policy decisions, we would be paralyzed.

(NARRATOR) It's tempting to say it's too overwhelming and expensive for us to do anything that will make a difference. How can New Englanders do something about such a global problem?

(JENNIFER BOWER) We have only solar electricity except for a back-up generator – when there's not enough sun to keep things going. If we're not using something, it's not on. And that's a hard thing to always be careful about. The kids are very good about it, but as we expand the house and as they have more and more friends over who are new friends, then that gets a little harder. And people who haven't been here before are surprised at how often somebody's saying, "Turn off the lights."

(NARRATOR) Living off the grid like Bob and Jennifer may not be an option for you, especially if you live in a city. What else can you do?

Meet Lucy Meyers. She's leaving her school in Burlington, Vermont. That's the van sent by her after school day care to pick her up.

(DAVID HILL) When you burn a gallon of gasoline, even though a gallon of gasoline weighs less than 20 pounds, you end up producing 20 pounds of CO₂ because it's combining with oxygen in the air to produce CO₂ emissions of 20 pounds.

(NARRATOR) By carpooling 5 miles to daycare, the 6 children on the van save over 7 and a half gallons of gas per week, which keeps 150 pounds of carbon dioxide, plus nitrates, ozone and other by-products, from entering the atmosphere.

Meet Lori, Lucy's mother. She's leaving work at Ben & Jerry's Ice Cream in South Burlington. Lori is an art director and recently worked on Ben & Jerry's campaign called: One Sweet Whirled.

The company teamed up with the Dave Mathews Band and a coalition of environmental groups to encourage people to reduce their CO₂ emissions.

Not everyone works for a company like Ben & Jerry's, but employees can have a surprisingly large effect on company policies.

(ADAM MARKHAM) A very simple example would be somebody who has personally gone around and turned out all the lights in a facility after everyone has gone home because they feel they want to help the company save money and not waste energy. And that's the kind of individual action that people can take. There's about 39 million people in the northeast United States and if they all take a small action it'll make big difference. The northeast, if it was a country, would be the eighth largest emitter of greenhouse gasses in the world. So what we do here in the northeast US and in New England is globally important.

(DAVID HILL) Transportation is a huge part of most people's personal emissions. Typically it'll be a third to a half of a household's emissions. So a more efficient vehicle is one very important thing that people can think about. Ridesharing, the use of public transportation, bicycling...all these things are really valuable.

(LORI) We have a carpool list at work from my neighborhood, but I'm usually the one driving when we carpool because I need to pick my kids up after work.

(NARRATOR) Parents who pay the heating bill understand more than 7-year-olds like Lucy or her little brother Charlie how important it is to close a door.

Lori's husband, Jack, is a civil engineer. He's usually the one to get the fire going and today it's useful for drying off the children's hats and mittens. The Meyers mainly use oil heat, supplementing it with a gas burning fireplace.

(CAMERON WAKE) Everybody in the country emits a lot of carbon...It's really going to be citizens that drive the demand for green power, for example. There are a growing number of alternatives in terms of having the electricity that we use in our homes and our businesses be generated by sources that do not emit carbon dioxide and other greenhouse gasses to the atmosphere. Especially promising in New England is wind power.

(NARRATOR) Rather than generating your own wind or solar power, citizens can now sign up with green power companies, who supply consumers & businesses with energy from non-polluting power sources for a few cents more per kilowatt hour.

In Portsmouth, New Hampshire, the non-profit Clean Air – Cool Planet works to help individuals and companies in the Northeast find solutions to climate change.

(ADAM MARKAM) We've probably been working the longest with Shaw's Supermarkets. They are a New England chain, they originally were built up in Maine. You don't hear much about their environmental activities, but they're probably one of the main environmental leaders on climate change issues in the whole United States. They're also finding they can save a lot of money when they reduce energy use.

(KATHY LOFTUS) It takes a lot of energy to actually get that carton of milk that you are purchasing cold in the first place and safe for consumption in the first place.

Because of that huge dependence on energy and the expense of it all, Shaw's is spending close to 50 million dollars per year for energy.

(ADAM MARKHAM) They monitor all their energy use in every store on a daily basis so they can see if there's something they need to address. Is someone leaving the doors open all night and heat escaping. They cut their electricity bills roughly in half just by changing the lights out.

(KATHY LOFTUS) Over the last 10 years I'd estimate we've spent about 8 million dollars, that may be conservative, on technologies and energy environmental programs. And we have probably saved close to 10 million dollars and we've avoided millions of pounds of greenhouse gas emissions. So it's pretty exciting, pretty rewarding.

(ADAM MARKHAM) I think the best businesses recognize that it's not a choice between the environment and economic growth, you can go for both of those things at the same time.

(JACK MEYER) You know what the fun part about living in Burlington is?

(LUCY MEYER) What?

(JACK MEYER) Is that we can walk to the store. We don't have to drive the car every time we want to go.

(LUCY MEYER) What if we lived farther away?

(JACK MEYER) Then we'd have to get in the car every time we wanted to go to the store and we couldn't walk...

(NARRATOR) Unlike suburban or rural families that may live far from services, the Meyers family is lucky. They can take advantage of a lifestyle that is kinder to the planet. They're also lucky to live in Burlington, one of many communities within New England that have programs to help citizens reduce their energy consumption.

(LORI MEYER) Nice job. Slap five.

(DEBRA SACHS) The 10% challenge program, is a voluntary program for households and businesses to reduce greenhouse gas emissions. It's a program that the alliance for climate action decided to promote, to develop, to help people get involved and do their part about climate change.

(DAVID HILL) Right now, there are online calculators...there are both a business calculator and a residential calculator that can be used by people on the internet to estimate their current emissions and develop their own individual 10% reduction plan.

(NARRATOR) Many towns and other government and non-profit organizations offer advice on cutting greenhouse gas emissions. In addition, many energy companies will actually come to your home or business to help you figure out ways to reduce power consumption. In Burlington, the Meyers took advantage of an energy audit provided by the Burlington Electric Company.

(HORST) Usually when I do my energy audit I try to look for consumption patterns and I have printed out your consumption history for the last you know three years or so.

(LORI) Wow. Not a good year right now.

(HORST) That's why I'm here. We're trying to find out why is it going up and maybe we can find something.

(JACK) Yeah I'd be curious to find out, 'cause its...I'm dreading this next bill.

(DEBRA SACHS) Burlington Electric Department has a leased light bulb program which is very exciting. You can actually lease a high, energy-efficient light bulb for a few cents a month. So it's a win-win situation. You see a drop in your energy bill and the city sees lower growth rate in electricity. Burlington's using less electricity today than in 1980 as a result of all these energy efficiency programs.

(NARRATOR) Mr. Hartlieb set up a blow test for the Meyer's home. By strongly pulling air from the home, he's able to detect where outside air is entering.

(MR. HARTLIEB) This just shows us how much air leakage you have in the basement. It's a pretty good indication.

(JACK MEYERS) When Burlington Electric came and did the audit, one of the things we discovered is how leaky our basement is from air flow standpoint.

(LORI MEYERS) Yeah, its really amazing to see the difference when they turned on one of those machines we could see a huge air suction going down into the basement.

(JACK MEYERS) So as a result we have decided to put a mud room on the back to get rid of this leaky door that opens outwards.

(PAUL MAYEWSKI) If people understand what they are truly being asked to give up in order to have many of the new things that they have, they may very well choose slightly different paths.

(NARRATOR) Scientists warn that we're treading on thin ice by accelerating climate change, but who's

listening to the scientists?

From town councils to state legislatures, New Hampshire, Maine and Vermont are at the forefront of passing laws to limit greenhouse gas emissions. And on a global scale, over 100 countries have signed-on to the Kyoto Accord that addresses climate change. As the world's largest emitter of greenhouse gases, the United States is being pressured to join the world community, sign the accord, and take action.

(ADAM MARKHAM) The New England governors and the eastern Canadian premiers signed a historic pact in 2001 to reduce greenhouse gas emissions in the region. It's actually the most ambitious plan that any group of elected leaders in North America has come up with. They want to see a 75-85% reduction in greenhouse gasses eventually. And that's what scientists tell us is necessary.

So, its up to all of us citizens and institutions we work in to try and help the states reach that target and make sure its not just a paper plan but something that actually happens.

(SCOTT OLLINGER) You have to be very careful as a scientist to not have some opinion about what you think should be done be at the root of your science. And yet, as a result of doing all this work and being around many other people who do this work and also, just having seen the results that we now know to be true unfold over the last 10 years or so, one really gets the sense that what we're doing is flying on an airplane and slowing popping the rivets out of the airplane one by one and debating about what the long-term implications might be.

(LORI MEYERS) Good-night.

(LINDA GREENLAW) Perhaps the difficulty in trying to get people to take climate change seriously is that it doesn't really effect them yet. I've discovered that there are some things that I can do to affect climate change, for instance, when I re-power my boat, the new engine will be more fuel efficient. While scientists urge us to take this issue more seriously it's great to know there are things you can do to make a difference. I'm Linda Greenlaw. Thanks for joining me on this Quest.