

Betts, Green Energy Times, 2016

Alan K. Betts (<http://alanbetts.com>)

This is a collection of my 2016 articles in the Green Energy Times (<http://www.greenenergytimes.org/>).

They are largely edited or updated from articles I wrote for the Rutland Herald, sometimes with different titles and pictures chosen.

They blend science and opinion with a systems perspective, and encourage the reader to explore alternative and hopeful paths for their families and society. They are written so that a scientist will perceive them as accurate (although simplified); while the public can relate their tangible experience of weather and climate to the much less tangible issues of climate change, energy policy and strategies for living sustainably with the earth system.

This was an election year in the US, and politically inspired attacks on climate science sharpened my response.

I believe that earth scientists have a responsibility to communicate clearly and directly to the public¹ –as we all share responsibility for the future of the Earth. We must deepen our collective understanding, so we can make a collective decision to build a resilient future. *All my articles are available from my web-site, and can be freely reused under a Creative Commons license.*

Green Energy Times, 2016

Betts, Alan, Climate Reflections on 2015. Green Energy Times, February 15th, 2016.

<http://www.greenenergytimes.net/2016/02/15/climate-reflections-on-2015>

Betts, Alan, Welcome This Early Spring. Green Energy Times, April 15th, 2016.

<http://www.greenenergytimes.net/2016/04/15/welcome-this-early-spring/>

Betts, Alan, Transforming Energy Use in New England. Green Energy Times, June 18th, 2016.

<http://www.greenenergytimes.net/2016/06/18/transforming-energy-use-in-new-england/>

Betts, Alan, Vermont Climate Scientist Receives Global Environmental Award. Green Energy Times, August 18th, 2016. <http://www.greenenergytimes.org/2016/08/18/vermont-climate-scientist-receives-global-environmental-award/>

Betts, Alan, Please tell me the Weather next month. Green Energy Times, August 18th, 2016.

<http://www.greenenergytimes.org/2016/08/18/climate-prediction-global-carbon-emissions-could-peak-as-early-as-2020/>

Betts, Alan, Libertarian ideology alleges that climate change is a hoax. Green Energy Times, October 21th, 2016. <http://www.greenenergytimes.org/2016/10/21/libertarian-ideology-alleges-that-climate-change-is-a-hoax/>

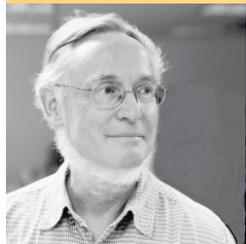
Betts, Alan, One world is ending, start working on the next. Green Energy Times, December 15th, 2016.

<http://www.greenenergytimes.org/2016/12/15/one-world-is-ending-start-working-on-the-next/>

¹ **Betts, A. K. (2011)**, Communicating Climate Science. *EOS Transactions*, 92, No. 24, 14 June 2011. Available at <http://alanbetts.com/research/paper/communicating-climate-science/#abstract>

Climate Reflections on 2015

By Alan Betts, <http://alanbetts.com/writings>



In winter I like to look back on the year that is past. So far the winter has been much warmer than the last two. We have the very strong El Nino in the equatorial Pacific

to thank for this. I still had fresh brussel sprouts and kale to eat from the garden until 1st February. My spring spinach and lettuce are alive under glass and on warm days we have been thinning and eating some. The early February thaw meant that for the very first time in my memory, I was able to start digging under the rye cover crop in February!

This past year 2015 set a new record global temperature by a very large margin, shattering the myth that climate warming was slowing down. Globally weather extremes keep escalating. Undoubtedly the best news was the December climate agreement in Paris with the consensus support of 196 countries. Nations made commitments to reduce the burning of fossils fuels to

try to restabilize the climate system. This is a daunting task, since we have waited so long, but at least we are now heading in the right direction, with clear targets and progress reviews every five years.

Grassroots democratic pressure helped a lot – many Vermonters went to Paris – and the moral clarity of Pope Francis was on the minds of many leaders. Fortunately these activists realize just how much work lies ahead for the rest of this century. Follow-through will be difficult for many leaders, as they slip back into local politics, election cycles and business as usual. Vermont can play a leading role.

So let us start by facing some truths that were necessarily ignored in Paris – in order to get an agreement. One basic issue is that the developed countries dream that climate change can be dealt with within the global market, and the economic, financial and technical framework that has made them rich and powerful. Yet this is the very framework that has accelerated climate change in recent decades. In addition, the absolute necessity of a fossil carbon pollution tax was not even on the table. Vermont should introduce a carbon tax this session.

"Vermont should introduce a carbon tax this session"

The developing countries want to lift their people out of poverty, and their elites think in the same terms of consumer growth, centralized power systems and more cars that have fueled climate change. The rich nations are happy to profit from these expanding markets, and eager to add a lot of renewable energy systems to the mix.

But as Pope Francis said, our increased power has not been linked with deeper moral values, and a true sense of our common home and common destiny. One result is that the exploitation of the Earth and the exploitation of the poor by the wealthy are now intertwined. In Paris, the rich developed countries were reluctant to make agreements to share resources with developing countries. Sharing intellectual property rights on essential renewable technology would reduce their profits. So financial commitments from the rich to the poorer nations were small compared with the scale of the challenge.

Some were surprised at the about-face of China in the past year, but two of the reasons for this are salutary. The air pollution in Chinese cities from burning coal is so unhealthy that urban revolt is brewing.

And China has realized that its future economic growth could be based on supplying the world with cheap renewable technologies for decades to come.

Sitting by the fire and dreaming of spring this January, we need also to dream how to transform our 'buy more' consumer society and growth economy into something sustainable that the Earth can handle. This will take vision, time and real effort for a decade or more.

Dr. Alan Betts of Atmospheric Research in Pittsford, VT is a leading climate scientist. Browse alanbetts.com.



Melting Earth by Les James Humor. Image: Flickr



Welcome This Early Spring

By Alan Betts, <http://alanbetts.com/writings>



When the Earth becomes vibrant again with life in spring, we welcome the change, and many feel a surge of joy and gratitude. I know

that spring is very early this year – the daffodils bloomed in Pittsford, VT in March, the earliest date ever. This is no surprise as winters are 10° warmer when there is little snow. This past winter set record new temperatures globally, and we can expect a much warmer world in coming decades.

Globally, December was very warm, January broke that record, and then February broke the record again by a huge margin that surprised even climate scientists. The figure shows the average winter temperature anomaly in degrees Celsius (above the mean climate for 1951-1980). Notice the red patch of warm water in the eastern Pacific, related to the strong El Nino. But notice the red and brown colors across the northern continents and in the Arctic, where it was warmer than it has ever been in winter. It was so warm that even in the Arctic night, the sea-ice extent stopped growing a month early at a new record low in February.

For a gardener, but not for skiers, the warm winter was satisfying. The ground in my garden in Pittsford was unfrozen for parts of January, February (for the

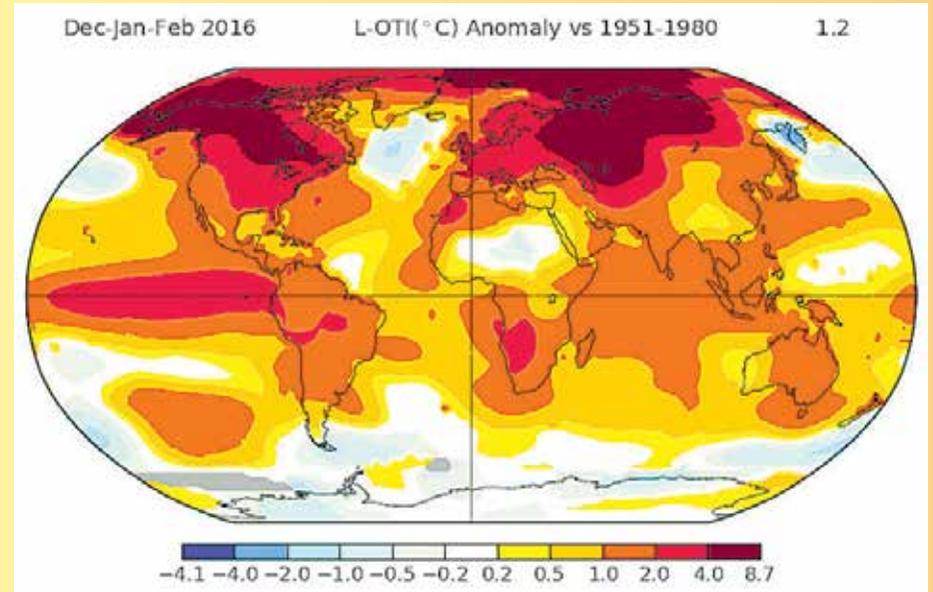
first time) and almost all of March, so I was able to dig my cover crop of rye grass. Unprotected spinach survived the winter, again for the first time. Under glass, lettuce and spinach thrived, and started growing by the end of February. The daffodils bloomed in late March. Putting all the pieces together I realized that spring comes nearly four weeks early, when there is a warm winter with no snow cover.

Can we embrace a changing climate, a changing Earth, with the same joy and gratitude as we welcome spring? This is not so easy. Because we fear change, many turn to denial. But because we are an integral part of the interconnected life on Earth, we must try, or we could slip into denial, fear or even despair at the changes ahead. And that is too bleak.

The political season is in full swing with a presidential election ahead, and the electorate is very angry with the failure of the federal government to address what they see as the real issues. But perceptions of reality differ widely, and accusations and blame are flying in many different directions. Yes, the political system works to further the interests of the rich and powerful at the expense of the poor and the Earth itself, and this must be challenged. But few look at the whole picture, where we all share responsibility for the future of the world we have created from our dreams and sense of entitlement.

But change is coming whether we like it or not – the Earth is so much more powerful than our civilization. Our dream of unlimited human power that came with the discovery of fossil fuels and nuclear

Change is coming whether we like it or not – the Earth is so much more powerful than our civilization.



Difference map of mean 2015-2016 winter temperatures from the global climatology for 1951-1980 from NASA-GISS (downloaded from <http://data.giss.nasa.gov/gistemp/maps/>)

fission is a mirage. We have to make the giant shift to both the acceptance of our responsibility for the future; and the realization that we must create a sustainable path for our civilization that recognizes our integral, inseparable relation to the Earth itself. And for this to work we must accept new paths with gratitude and joy in the heart, rather than grudgingly regret that the dream has faded.

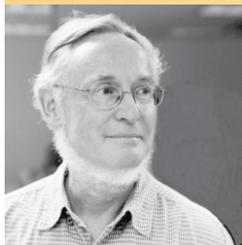
So it is spring and easy to start working with the earth. Go out and plant

seeds, and watch them grow into a joyful harvest. Start to dream where we might go this year as communities cooperating with the soil, the sun, rain and wind. Can we and our families come closer to the Earth and its renewable resources so we can embrace change? And share what you grow and what you learn with your neighbors.

Dr. Alan Betts of Atmospheric Research in Pittsford, VT is a leading climate scientist. Browse alanbetts.com.

Transforming Energy Use in New England

By Alan Betts, <http://alanbetts.com/writings>



It has been an unusual spring. After a warm winter, the early daffodils bloomed in late March here in Vermont, but their blooms were killed by

a very heavy frost in April. But spinach and lettuce that overwintered survived that severe frost, and so did hardy seeds including peas that I planted around the beginning of April. As a gardener I adapt to change.

Awareness is spreading in New England that our entire energy system must change, so what do we need to do? We know how to retrofit our houses so that it take less energy to heat them in winter. Energy teams can go through your home and add insulation, seal up the doors and replace old windows. I was pleasantly surprised how comfortable my old house on a hill became without drafts! We know how to build net-zero houses for new construction – essentially buildings that are so well sealed that they use air-to-air heat exchangers to ventilate the home, and transfer heat from exhaust air to the cold incoming air in winter.

The transformation of our electrical energy system to renewables is under way. Solar panels on houses, shared community solar arrays, and many multi-megawatt arrays are feeding the grid. I now enjoy looking at my electric bill every month, and seeing the large credit from the 5kW of solar power that I purchased from a community array. Electrical storage for the grid is about to take off with the rapid fall in the price of batteries driven by the electric car firms like Tesla. Much of what is needed could

be largely completed in less than ten years if we made the effort. Yes, complaints are increasing from those that don't like to see solar panels everywhere, but the long-term benefit to society and the Earth is immeasurable. We could do better with more thoughtful community planning, but US society has traditionally preferred the freedom of this somewhat chaotic entrepreneurial growth.

It is time to tackle transportation, which uses so much fossil fuel both in a rural states and in urban areas. Industry would like us to buy a lot of electric cars, so we can continue to commute alone. Electric cars with a 200-mile range at a reasonable cost should be available by the end of this year, and they will help. But we should think about how to start the shift from using heavy single-occupancy-vehicles to get around. We have not made a change this big for a century, when trains and then automobiles replaced horse and buggy.

Uber has shown how taxi services can be improved by networking. Now we need networked passenger vans and private cars on our highways, so that I can easily share rides between my home in Pittsford and Burlington. It seems that this would not be difficult to set up. China is leap-frogging over Uber, and developing a broad Web-linked transportation system.

Another revolution would be lightweight electric vehicles, derived from tri-cycles, rather than cars. Add an all-weather aerodynamic shell, and with only 10% of the weight of a car, it is much easier to get adequate range using lithium batteries. Yes, commuting would be a little



Electric-assist tricycle with solar panel on roof. Photo courtesy of Organic Transit.

slower, as they are currently limited to about 20 mph, unless the rider pedals as well, when they can go faster. However, the cost in both dollars and damage to the Earth is far less.

One fringe benefit of using an electric trike to commute would be that exercise improves health and productivity. Our sedentary existence is a huge drain on our physical condition and medical finances. We should start planning and building a real bike networks in our cities and across New England, so these lightweight efficient vehicles do not have to share the highways with trucks. In Europe, Germany has started down this path.

Globally, tens of millions of electric bicycles and tricycles are now sold annually, but this county is largely ignoring this shift. We dream of 'solving' climate change without really changing the way of life that created it!

Dr. Alan Betts of Atmospheric Research in Pittsford, VT is a leading climate scientist. Browse alanbetts.com

Please tell me the weather next month!

By Dr. Alan K. Betts

Climate Prediction: Global Carbon Emissions Could Peak as Early as 2020



Much of the northeast is experiencing drought this summer. It is patchy because a lot of summer rain comes from scattered

thunderstorms. Despite periods of drought and heavy rain, our garden here in Vermont is growing well this summer. In part, this is because I have watered the whole vegetable garden twice and a few crops more frequently. There has been one unexpected but delightful change in our local ecosystem, perhaps because of the warm winter, as well as the dry weather. This spring and summer there have been so few mosquitoes that weeding is a delight, and it is a pleasure to eat dinner on the lawn in the evening. It is such a contrast from some recent years, when I wore a net over my head in the vegetable garden.

Last month I visited the European Weather Centre in England, which provides the best ten-day forecasts for the planet. For 30 years, I have worked with scientists there to improve the modeling of the transfer of heat and water from land to atmosphere, since this affects the weather. Computers have improved so much that these forecast models can calculate changes in pressure, temperature, wind and precipitation every hour everywhere on the globe for points that are only 5-10 miles apart for one to two weeks ahead.

So now I am asked, "Weather forecasts have become pretty good for even next week, but what I really want is a forecast for the next two months, so I can make plans for my work, my crops and my vacation." This is a much more difficult modeling challenge. Every day, we measure the state of the atmosphere with surface weather stations, weather balloons and instruments on perhaps a hundred satellites, and all this data goes into models for the global weather, running continuously on some of the largest computers available. One hundred forecasts may be run out for the next two weeks. For the first few days, they are very similar, because they remember the measurements they started from, so we know with some certainty what the weather will be. But as complex jet-streams and storms develop, the hundred forecasts spread apart, and after two weeks we cannot be sure what will happen.

When we run fifty forecasts for the coming season, these too spread out a lot within a month. The earth does have some long term memory, the energy stored in the oceans, and the moisture in the soil that came from last month's rain, the snow cover in winter and ice in the Arctic that keeps temperatures below freezing by reflecting sunlight. These do influence the weather patterns for months. But the global jet stream patterns that strongly influence weather can change every week, so it is harder to predict their pattern a month ahead. However, the seasonal climate of the earth seems more predictable than our models. Scientists are studying whether the links between stratosphere and troposphere play a role.

So, seasonal forecasting still needs improvements in our models. The official three-month outlook for August to October from NOAA is that the northeast will be warmer, but precipitation will be average. The corresponding seasonal forecast from the European Weather Centre is that the northeast will be warmer and drier than average. If this is correct, our drought will continue.

On the energy front, it is clear we need a carbon tax on fossil fuels to nudge the energy system to become more efficient, and accelerate the development of renewable energy resources. In Canada, this helped the economy of British Columbia, and Alberta is now following the same strategy. But on our national front, one political party drifts still further into a fantasy world, where devastating the planet's climate and ecosystems to satisfy its financial sponsors will somehow save America's ego.

Yet despite establishment resistance, the stunning speed of renewable energy development with the rapid fall of the prices of solar panels and lithium batteries is accelerating change. Global carbon emissions could peak as early as 2020, so keep pushing for goals that will bring us a sustainable future.

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August lilies. Photo: Alan Betts.

VERMONT CLIMATE SCIENTIST RECEIVES GLOBAL ENVIRONMENTAL AWARD

Dr. Alan K. Betts Receives the First Bert Bolin Global Environmental Focus Group Award

Alan K. Betts is the first recipient of the Bert Bolin Award/Lecture of the AGU Global Environmental Change Focus Group. He will present this lecture at the 2016 American Geophysical Union Fall Meeting, to be held 12-16 December in San Francisco. The award recognizes an earth scientist for his or her ground breaking research or leadership in global environmental change through cross-disciplinary, interdisciplinary, and trans-disciplinary research in the past 10 years.

CITATION

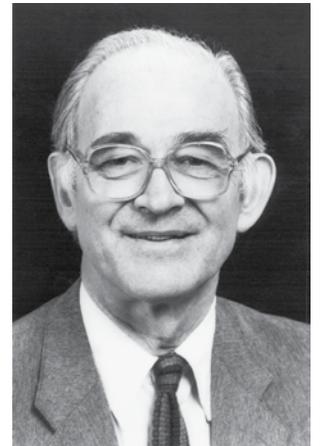
Alan Betts' research "has been transformative by providing a new understanding of one of the fundamental climate processes – land-atmospheric coupling and how it varies from the diurnal to monthly time-scale, with land cover, and how it may vary under environmental change. His environmental change leadership in Vermont has been exceptional. His writings, public talks and TV interviews dealing with weather, climate, climate change, energy and policy issues have fostered positive debate; as they both clarify the climate issues we all face, while encouraging readers and listeners to explore alternative, hopeful paths for themselves, their families and society," said Prof. Rong Fu, President, Global Environmental Change Focus Group at the University of Texas

RESPONSE

"I am grateful to the AGU Global Environmental Change Focus Group for selecting me as the first recipient of the Bert Bolin Award.

"My work over the past forty years has covered a wide range of topics central to understanding the Earth's climate over land and ocean, and the coupling between the oceans and land-surface, the atmospheric boundary layer, clouds, convection and radiation across scales. Because I have worked as an independent scientist in Vermont for decades, this work would not have been possible without the support of so many across the globe. I would specifically like to thank Martin Miller, Anton Beljaars, Pedro Viterbo and Gianpaulo Balsamo (and the late Tony Hollingsworth) at ECMWF for

Bert Bolin (1925-2007) a world leading climate scientist and science organizer. He is the man who got the world to agree on climate. Photo: simpleclimate.wordpress.com.



thirty years of collaboration using data to evaluate and improve the physics of their analysis-forecast system. My recent work on land-atmosphere-cloud coupling over the Canadian Prairies that this award cites would not have been possible without the foresight of Ray Desjardins at Agriculture-Canada, and the generous support of other Canadian scientists. My understanding of the Amazon owes much to my Brazilian friends and collaborators, Maria and Pedro Silva Dias. Long-term support from NSF and grants from NASA made all this possible.

"My role as a climate advisor in Vermont owes a profound debt to the people of Vermont, who have deep roots in the land. They see what is happening to their climate, and have reached out to me, urgently seeking understanding and answers, as ongoing climate change is transforming the state. So for more than a decade, it has been clear that my research must address these critical questions; and translate all that we know, both locally and globally, into concepts that citizens and professionals can understand and apply to their work and lives." – Alan Betts, Atmospheric Research, Pittsford, VT.

Green Energy Times would like to congratulate Dr. Alan K. Betts for this outstanding achievement. We are grateful for his work and proud that he is a local Vermonter. Betts submits a regular column in each edition of Green Energy Times.

Libertarian Ideology Alleges that Climate Change Is a Hoax



Align our interests with the earth, not the wealthy!

By Dr. Alan K. Betts

In a letter to the American Meteorological Society in 1976, I argued that if earth scientists, who had at least some understanding, did not accept some responsibility for the earth, who would? It certainly would not be the political and economic system that was influenced only by short-term interests.

Forty years have passed, and now we see a very sophisticated network, funded by a group of libertarian billionaires, has bought control of the Republican Party in the US Congress and many state legislatures. Part of their doctrine is that climate science is a hoax. How has this happened and what motivated this fraudulent claim?

The 'libertarian' ideology is that government is to have a very limited role: primarily to protect wealth and property, and preserve the rule of law. It helps if you can also write the laws! The libertarian political agenda believes that the freedom to exploit the earth and its resources should not be limited by environmental regulation. This brings it into conflict with the earth's ecosystem on which life depends, because the impact of our industrial society is now global.

Environmental regulation of the massive waste streams from society and industry is viewed with hostility. Global

regulation to limit the burning of fossil carbon to protect the future of the earth's diverse ecosystem is a clear threat to their fossil fuel assets. So it was a good business plan to use one percent of their wealth to take over Congress, and subsequent tax cuts largely paid for this investment. Indeed their opposition to climate science, and their claim that climate change is a hoax, can be viewed as simply propaganda that is driven by their fear of government regulation, and the need to protect their wealth, assets and property at all costs. Pope Francis pointed out last year: the exploitation of the earth and the poor are now inseparable, and both are immoral.

The trouble with this plan is that the earth is far more powerful than our primitive self-centered ideologies. In fact, preventing or simply delaying a smooth transition to an efficient sustainable society, based of renewable sources of energy, greatly increases the risk that our societies will collapse in the face of climate extremes. And that rising seas will flood the coastal cities as the irreversible melting of the ice-caps accelerates.

Another deep issue we face is that the libertarians' web of lies undermines democratic society. For the most part the scientific community stays above the fray with the naïve hope that more research and clear simplified explanations of climate science will eventually be heard. Instead, the increasing din drowns their reticence, and scientists who speak out are vehemently attacked as part of a global conspiracy.

So let us step back and look for a way forward. Even more so than 40 years ago,



Earth-sky photo: <http://globalwarmingisreal.com>

the earth, earth scientists and all of us have a common interest. The earth with a certain beauty and grandeur is simply absorbing and adapting to a changing atmosphere and oceans, and climate change is accelerating. The earth's ecosystem in all its richness and complexity is adapting to change as fast as possible. But many life-forms will go extinct, and new ones will emerge.

We set this in motion, but almost none of it is under our control. All that we can do is slow down the pace of change by rapidly shifting from fossil fuels to renewable sources of energy, so that the earth as well as our societies will have more time to adapt.

As scientists we study with honesty and integrity the evolution of a system that is far more complex than we can imagine. It is a global challenge, so we reach out to

the global network of scientists that we trust: to share what we understand, and what we find puzzling. Every month new facets emerge that add insight into this amazing web of life that we are part of.

Every month my neighbors ask for my help and guidance. We long for simple answers as we face an uncertain future, but the truth, like reality itself, is complex. We must all look beyond our fears, dreams and ideologies to the earth itself for guidance, because the earth gets its stability by being fully connected. And we must keep improving energy efficiency and building renewables!

Dr. Alan Betts of Atmospheric Research in Pittsford, VT is a leading climate scientist. Browse alanbetts.com.

Dr. Bett's Climate Prediction is for a "warm fall."

One World Is Ending. Start Working On the Next.



Align our interests with the earth, not the wealthy!

By Dr. Alan K. Betts

The day after the election was dreary, but the vegetable garden was still vibrant. My cover crop of rye grass was growing well, and I had spread crushed leaves in other places. As I write in late November, the Brussels sprouts and kale have survived some hard frosts, and there are still a few beets in the ground. I even have a few lettuce plants heading up under glass, where I planted for the spring when more food may be needed!

The election showed the dark side of the American dream: the arrogance of power, the self-indulgent sense of entitlement and the strange concept of exceptionalism, masked as 'greatness,' which has been both a strength and weakness of this country. We saw different aspects on both sides and the darker side won. The country rebelled against the rich political elites, and neo-liberal global market capitalism. They elected a demagogue, who encouraged fear and hatred.

Many people are angry and suffering. To quote Naomi Klein: "Under neoliberal policies of deregulation, privatization, austerity and corporate trade, their living standards have declined precipitously. They have lost jobs. They have lost pensions. They have lost much of the safety net that used to make these losses less

frightening. They see a future for their kids even worse than their precarious present."

Where this will lead is still unknown. From the perspective of the global environment, the situation seems at first bleak. The triumph of the beliefs that we have unlimited power, climate change is a myth, and global treaties must be canceled could be a disaster both for the U.S. and the world. It could lead to global sanctions against the U.S. This political revolution might lead to chaos and the collapse of the US economy, which would also be bleak. Most likely we will have to survive four years of national paralysis, so start planning regular community events. This too shall pass.

A smooth transition to an efficient renewable energy economy now looks far less likely, although market forces will continue to drive renewable energy in New England with supportive legislatures. Remember to send your legislators letters of thanks and encouragement this holiday season!

But it looks as if the rest of the world will rise to the challenge and move forward with the Paris agreement without the US if necessary. We are ceding global leadership to China, which is taking over the manufacturing of many components of the global renewable energy transition. Massive air pollution problems have accelerated China's clean energy revolution, and they expect to profit from the global transition. This will not make our next government happy, but the Earth will be grateful. We should be grateful also that our temporary insanity is not the

Dr. Alan K. Betts's Climate Prediction for Mid-December 2016 to Mid-February 2017 is "warmer than average with more snow than last year."

It is time for everyone to do their part and help lift the earth to greatness.

Photo: <http://trogdon-stoutwhs.wikispaces.com/>



end of the world.

Keep your sense of humor and be creative with new diktats from Washington. Create elegant solar stickers, "Installed in the USA" to go over the "Made in China" stickers. When you reorganize your mission statements to emphasize that you are providing jobs for New Englanders, stress that you are using American sunlight to power American homes and protect the American climate for your children. Add the asterisk and fine print that says "This will make America great again". I suggest someone number and catalog the myriad 3 a.m. DT-tweets; so we can all find a fragment of a tweet to comply with - should the thought police

come. Plan to build some tiny passive solar rooms hidden within your fields of solar panels for the next underground railroad.

Above all, reconnect with the Earth, and plant more crops in American soil – this too will keep us on track. It is not too late to plant spinach and lettuce seeds under glass, to sprout next spring when you need consolation. It will be a long struggle to reclaim our humanity in the face of darkness, but the sun will be shining on us!

Dr. Alan Betts of Atmospheric Research in Pittsford, Vermont is a leading climate scientist. Browse alanbetts.com.