Utah's Transition to Clean Energy

A study by the League of Women Voters of Utah

This study is to inform League members about the need to advocate for clean energy and to give them the means to do so, with the goal of decreasing the greenhouse gas emissions warming our climate.

The League of Women Voters of Utah is a non-partisan 501(c)(3) non-profit political organization that encourages the informed and active participation of citizens in government. It works to increase understanding of major public policy issues and influences public policy through education and advocacy.

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Executive Summary

Climate change is upon us. In Utah, the climate has warmed 3° F, greater than national and global averages. It's not too late to mitigate the worst suffering non action will entail, but the time is now: Experts say a 50 percent reduction in carbon emissions by 2030 and net zero emissions by 2050 are necessary to reduce climate damage.

Utah has the motivation and the potential to benefit from clean energy. Motivation, because greenhouse gases contribute to the year-round air pollution that threatens Utah's economy and residents' health. Potential, because Utah's abundant solar and geothermal resources offer substantial clean-energy options; the state's superior outdoor environment attracts the workforce needed to problem-solve this transition; the natural beauty of many rural areas encourages tourism and outdoor recreation as alternatives to fossil-energy jobs.

Utah's political will, however, has not caught up to its geophysical potential, although we see progress. Significantly, the 2019 Legislature appropriated $200K for an air-pollution / climate-change study from the Kem Gardner Institute; *The Utah Roadmap* was presented in January 2020. But a 2020 bill supporting the *Roadmap* did not move out of the House Rules Committee, aptly depicting the challenges this topic faces.

Rivalling the *Roadmap* in importance was HB 411, a 2019 bill passed by the Legislature that allowed communities to contract with Rocky Mountain Power for clean electricity. Twenty-four communities joined this effort, with a goal to create net 100 percent renewable-energy portfolios by 2030.

Legislation and government grants are also currently targeting a just economic transition for rural Utah, especially in counties whose lifeblood is coal. Assistance in education, job training, infrastructure, and connectivity are at the forefront of this effort.

Real estate developers, the military, financial institutions, and colleges and universities are all moving forward with policies and projects that address GreenHouse Gas (GHG) emissions in varying degrees. Our higher education system, along with our growing technology industry, are fonts for innovative research on topics such as electric grid flexibility, battery storage, biogas, and sequestration.

Nevertheless, significant challenges exist. Governor Herbert's 2020 budget offered $100M for clean energy bills, yet only $10M was funded, and the majority of clean energy / climate change bills failed. Particularly challenging to a clean energy transition is the proposed Inland Port, in Salt Lake City, which analysts say will exacerbate air quality issues in the Wasatch Valley and encourage coal mines to stay open.

The League of Women Voters supports a sustainable environment and believes that climate change is a serious problem demanding attention. The authors of this study hope the information within will encourage League members to contact local, state, and national representatives while offering them clear talking points. By mirroring changes we wish to see as well as advocating for wider actions, League members can contribute to Utah's transition to clean energy at both local and personal levels.

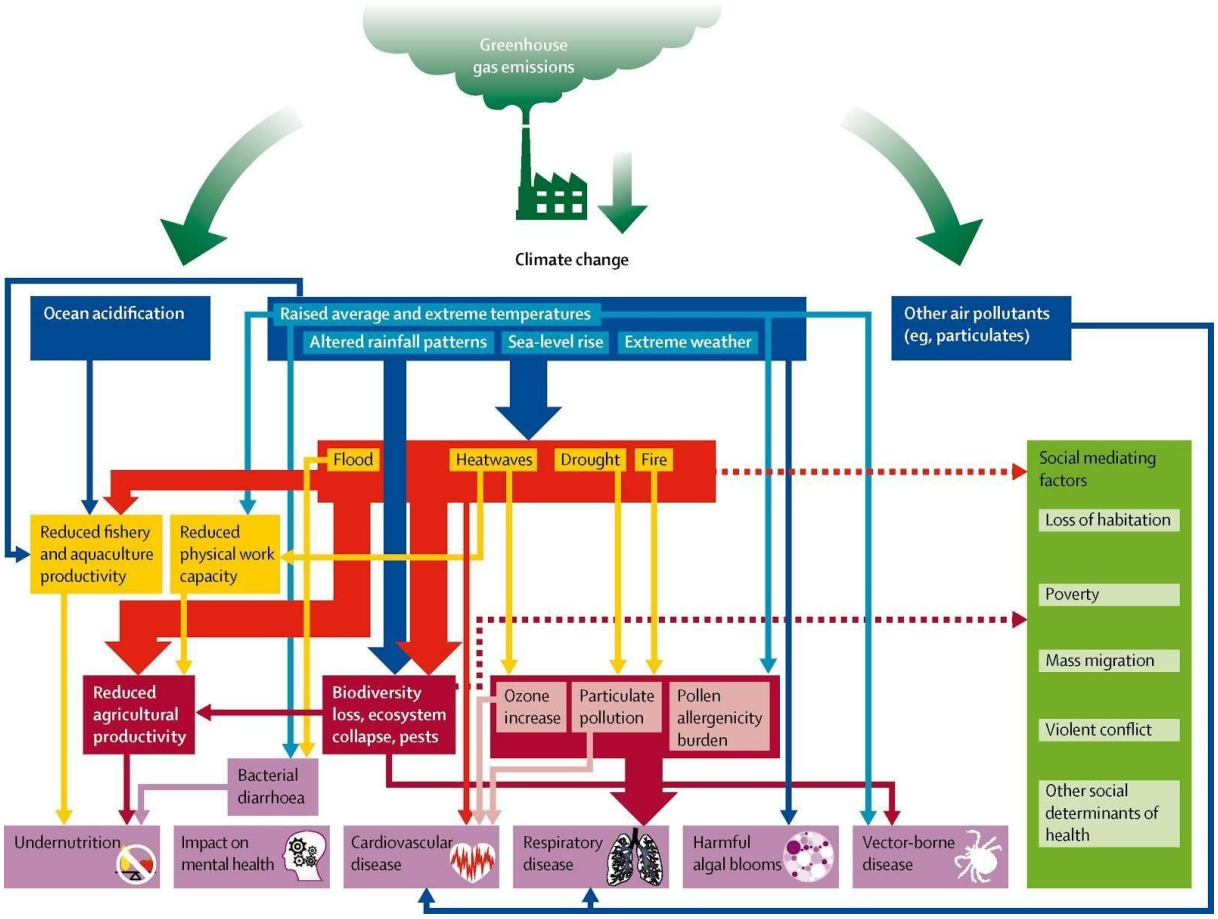
Why is Transition Necessary?

Each day we are confronted with evidence of climate change: sea-level rise, melting glaciers and permafrost, intense and extensive fires, violent hurricanes and cyclones, flooding, drought, and steadily increasing average temperatures.

Peer-reviewed scientific research agrees climate change is real and caused by increased levels of atmospheric GHG, primarily carbon dioxide (CO2), due to human burning of fossil fuels. Because of CO2's molecular structure, it absorbs infrared radiation (heat) emitted by the Earth thereby warming the atmosphere. The effects of increased GHG are summarized in the following figure:[1]

As one can see, the effects are interconnected and vast. Certain effects also reinforce others, creating feedback loops that amplify the original effect. For example, rising CO2 levels cause higher air temperatures, which lead to glacier melt, which leads to higher sea levels and diminished surface ice to reflect the sun's rays, which in turn leads to more atmospheric warming and glacier melt. In another example, thawing permafrost leads to the release of trapped methane, a potent GHG, which leads to more atmospheric heat retention and more permafrost thawing.

[1] Watts, N., Amann, M., Arnell, N. et al. (2018) The 2018 Report Of The Lancet Countdown On Health And Climate Change: Shaping The Health Of Nations For Centuries To Come. *Lancet*. **392**: 2479–514. (Figure 1) http://dx.doi.org/10.1016/S01406736(18)32594-7 Accessed Dec. 8, 2019.



Air pollution [2] [3] [4]

A direct impact of burning fossil fuels is increased air pollution. Pollution contains particulate matter (PM10, less than 10 microns, and PM2.5, less than 2.5 microns); gases such as methane, CO2, ozone, NOx (nitrogen oxide compounds), SOx (sulfur

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[2] The *Utah Roadmap: Positive Solutions on Climate and Air Quality.* (Jan. 31, 2020). Kem C. Gardner Policy Institute. https://gardner.utah.edu/wp-content/uploads/TheUtahRoadmap-Feb2020.pdf Accessed Feb. 10, 2020.

[3] *Utah Physicians for a Healthy Environment 2018 Report on Air Pollution and Health Research*. (2018) https://www.uphe.org/air-pollution-health/2018-report-on-air-pollution-and-health-research/Accessed Dec. 9, 2018.

[4] New Report: Salt Lake County Air Quality Worsened for Ozone (2019) https://www.lung.org/local-content/_content-items/about-us/media/press-releases/new-report-salt-lake-county.html Accessed Feb. 8, 2020.

oxide compounds), and VOCs (volatile organic compounds); and toxic chemicals such as lead.

Of these, PM2.5 and ozone are of particular concern for humans. PM2.5 can clog the lungs' air sacs and cause emphysema, chronic obstructive pulmonary disease (COPD), asthma, and bronchitis. PM2.5 particles also carry toxic chemicals, bacteria, and viruses on their surfaces, which can penetrate the air sac walls and enter the bloodstream, affecting other organs. This increases the risk for heart attacks, cardiovascular disease, and strokes.

According to an American Lung Association 2019 report, Salt Lake City is ranked as the 14th most polluted city in the country for ozone. Breathing ozone leads to constriction of airways, resulting in shortness of breath, asthma, and long-term cardiovascular damage.

Poor air increases the risk of miscarriage and pre-term births; it is especially damaging to developing brains in fetuses and young children, with connections to autism, behavioral problems, and depression in adulthood. In addition, air pollution is associated with neurological diseases such as Amyotrophic Lateral Sclerosis (ALS) and Alzheimer's, as well as increased relapses for those with multiple sclerosis. Cancer, infections, kidney, liver, and bowel diseases are all exacerbated by air pollution.

These health concerns are particularly relevant in the Salt Lake and other northern Utah valleys, where winter inversions concentrate pollutants and high summer temperatures result in greater ozone production. Physicians agree there is no safe level for air pollution, as effects are cumulative.

Air quality in Utah and elsewhere will be adversely affected now that the Trump administration's EPA is rolling back the CAFE (Corporate Average Fuel Economy) standards established in 2012.[5] The 2012 standards required the fuel-economy average to increase 5 percent each year, reaching 46.7 mpg in 2026. The new rule will freeze the average at 37 mpg from 2021 to 2026. The national impact of this rule change was addressed in a New York Times article: "The new standard would lead to nearly a billion more tons of planet-warming carbon dioxide released and the consumption of about 80 billion more gallons of gasoline over the lifetime of the

[5] Davenport, Coral. (Mar. 30, 2020). "*Trump Administration, in Biggest Environmental Rollback, to Announce Auto Pollution Rules".* **The New York Times**. U.S. to Announce Rollback of Auto Pollution Rules, A Key Effort to Fight Climate Change – The New York Times Accessed Mar. 30, 2020.

vehicles built during the terms of the rule, according to a recent draft of the plan." [6] In addition, "… the new fuel economy target would lower the prices of new cars and light trucks by about $1,000, but it would increase the amount consumers would pay for gasoline by about $1,400."

In Utah, experts warn that our improving air quality has been driven by federal environmental regulations now under attack. With the CAFE standards and other regulations rescinded, Utah's growing population and its accompanying fuel use could offset past and present gains starting as early as 2022.

In another action, the EPA revoked California's waiver to impose its own mileage standards[7], currently stricter than the federal ones. Many automakers have been producing vehicles using California CAFE standards, due to the state's substantial market share. The EPA has been sued by California and 22 other states over the waiver revocation. As of this writing, the suit has not been resolved.

Rising temperatures

Increases in CO2 levels in the atmosphere are largely responsible for the average global temperature rise of ~ 1° C (or ~ 1.8° F) since 1900, the result of increased fossil-fuel consumption beginning with the industrial revolution. Nationwide, 2015-2019 were the warmest years in 140 years of record-keeping[8], driving an average temperature increase of 2.5° F[9]. In eastern Utah, warming is occurring even faster than the US average (~3° F between 1901 and 2015), as seen in the following figure.[10]

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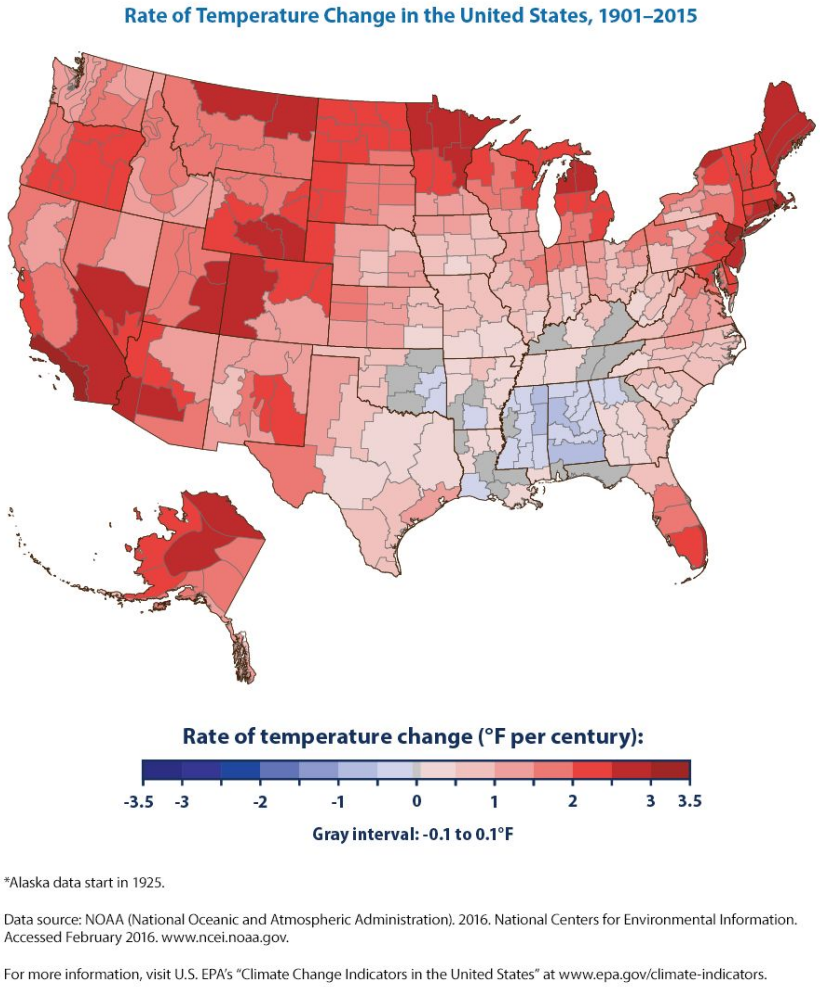
[6] Ibid.
[7] Ibid.
[8] Ruis-Grossman, S. and O'Connor, L. (Dec. 30, 2019). *7 Numbers Show How Dire Climate Change Got This Decade*. Huffington Post. https://www.huffpost.com/entry/decade-end-climate-numbers_n_5e026b09e4b0b2520d10f41d Accessed Feb, 6, 2020.
[9] America Warming: The Fastest Warming Cities and States in the U.S. (Apr. 17, 2019). https://www.climatecentral.org/news/report-american-warming-us-heats-up-earth-day Accessed Mar. 24, 2020.
[10] Rate of Temperature Change in the United States, 1901-2015. (2016). https://www.epa.gov/sites/production/files/styles/large/public/2016-07/temperature-download3-2016.png Accessed Feb. 25, 2020.



Health effects include direct heat-related conditions such as heat stroke, heat exhaustion, and mental stress, as well as indirect effects resulting from algae blooms and an expanding range of insects carrying infectious diseases. Higher temperatures also promote greater ozone production from airborne pollution.[11]

Water [12] [13]

Utah is the second most arid state in the country. Eighty percent of Utah's water

[11] The *Utah Roadmap: Positive Solutions on Climate and Air Quality.* (Jan. 31, 2020). Kem C. Gardner Policy Institute. https://gardner.utah.edu/wp-content/uploads/TheUtahRoadmap-Feb2020.pdf Accessed Feb. 10, 2020.

[12] Ibid.

[13] *Southwest – Fourth National Climate Assessment.* (2018). https://nca2018.globalchange.gov/downloads/NCA_4_Ch25_Southwest_Full.pdf Accessed Feb. 6, 2020.

comes from melting snowpack, which has decreased in some areas by as much as 80 percent between 1955 and 2013. According to the National Climate Assessment of 2018, “With continued greenhouse gas emissions, higher temperatures would cause more frequent and severe droughts in the Southwest… [and] increase the risk of mega droughts—dry periods lasting 10 years or more.” Furthermore, alterations in the Southwest’s water cycle, including decreases in snowpack and its water content, earlier peaks of snow-fed streamflow, and increases in the proportion of rain to snow up the likelihood of future water shortages. As water supplies diminish, Utahns will face difficult decisions regarding allocation among residential, agricultural, and industrial uses.

Diminished inflow into and greater evaporation from rivers, lakes, and reservoirs will worsen water shortages. As lakes dry up, dust from exposed lake beds blows into surrounding communities, worsening air quality.[14]

Rising temperatures also lead to earlier and more intense runoffs and increase the likelihood of severe floods.[15] Over the past 20 years, flash-flood incidents have increased by up to 600 percent.[16]

Wildfires and forests [17] [18] [19]

Some invasive organisms typically killed by cold temperatures, such as the bark beetle, are surviving winter in greater numbers as temperatures rise. Between 1979 and 2012, bark beetle infestations killed 7 percent of forested areas in the West, making our forests even more vulnerable to wildfires. Together with warmer, drier air and drought conditions, wildfires are becoming more intense and widespread. The

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[14] Maffly, B. (Dec. 13, 2019) Study: 90% of dust in northern Utah comes from shrinking lakes. **Salt Lake City Tribune**.

[15] *Crossroads Utah - Utah’s Climate Future*. Utah Rivers Council. (2012). https://static1.squarespace.com/static/5a46b200bff2007bcca6fcf4/t/5a53c23de2c483782a8d2a56/1515438656552/Crossroads.pdf Accessed Feb. 9, 2020.

[16] The *Utah Roadmap: Positive Solutions on Climate and Air Quality.* (Jan. 31, 2020). Kem C. Gardner Policy Institute. https://gardner.utah.edu/wp-content/uploads/TheUtahRoadmap-Feb2020.pdf Accessed Feb. 10, 2020.

[17] *Southwest – Fourth National Climate Assessment.* (2018). https://nca2018.globalchange.gov/downloads/NCA_4_Ch25_Southwest_Full.pdf Accessed Feb. 6, 2020.

[18] Klopfenstein, Jacob. (Oct. 18, 2018) Wildfires burned 485,989 acres in Utah this year – more than double for 2017| KSL.com Accessed Feb. 9, 2020.

[19] Utah Forest Health Highlights. (2018). https://ffsl.utah.gov/wp-content/uploads/statehighlights2018.pdf Accessed Feb. 18, 2020.

2018 National Climate Assessment report estimated that, in the West, "…the area burned by wildfire from 1984 to 2015 was twice what would have burned had climate change not occurred." In 2018, 485,989 Utah acres burned, double the 2017 number, costing the state ~$ 35 M in firefighting costs.

Not only are wildfires costly, they contribute to particulate and CO2 emissions and destroy wildlife habitat and vegetation important for absorbing precipitation and preventing floods. Although less intense wildfires can be beneficial to forests by removing flammable underbrush and activating certain seeds to germinate, intense fires kill native seeds, allowing invasive weeds to root.

Outdoor recreation

Warmer temperatures will have profound effects on Utah's outdoor recreation economy. As Ski Utah reported, during the 2017-18 season "Out-of-state skier and snowboarder spending ($1.068 billion) resulted in the creation of more than 21,000 total jobs and $226.4 million in state and local tax revenue."[20] Diminishing snowpack is a direct threat to this important economic driver.

Other outdoor activities, such as fishing, rafting, boating, and hunting, are dependent on healthy rivers, lakes, and reservoirs. In 2012, fishing contributed more than $700M to the economy. According to the Utah Rivers Council, "Rivers are life-support systems that keep most fish and wildlife species alive in our state…and why 80 percent of our wildlife species depend on rivers for a portion of their life cycles. Saving life from extinction in Utah means saving our rivers from being dried up."[21]

Inland Port [22]

The plan to build an inland distribution port in northwestern Salt Lake City is a major concern for increased air pollution and GHG emissions. The number of daily vehicle trips associated with the Port is projected to be at least 24,600 (11,600 diesel trucks and 23,000 cars), up from a total of ~12,000 Salt Lake City vehicle trips in 2019.

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[20] *Utah Sets Record for Skier Days in 2018-2019*. Ski Utah. (May 21, 2019). https://www.skiutah.com/news/authors/pr/utah-sets-record-for-skier-days-in Accessed Feb. 9, 2020.

[21] *Crossroads Utah - Utah's Climate Future*. Utah Rivers Council. (2012). https://static1.squarespace.com/static/5a46b200bff2007bcca6fcf4/t/5a53c23de2c483782a8d2a56/1515438656552/Crossroads.pdf Accessed Feb. 9, 2020..

[22] *Common Sense vs. the Utah Inland Port*. (2019). https://66701292-937d-4a988bdda8df4141811b.filesusr.com/ugd/b237b1_f25dfb8e44e94dc18c8724745f401878.pdf Accessed Jan. 25, 2020.

Increases in air cargo flights and train traffic will also ramp up pollution. Westside residents, of whom 63 percent identify as minorities (compared to 24.9 percent in SLC as a whole), would be disproportionately affected.

Population growth

Utah's population was ~3.2 M in 2019 and is projected to grow to ~5 M by 2050.[23] With increased population comes greater demand for food production, transportation, industry, heating, and cooling. Without a transition to clean energy, Utah's emissions will grow proportionally, and the effects detailed above will worsen.

Conclusions

The need to transition to clean energy is urgent. The Intergovernmental Panel on Climate Change (IPCC) concludes that, to limit warming to 1.5° C (2.7° F) by the end of the century, global CO2 emissions must be cut in half by 2030 and reach net-zero by 2050.[24] Utah needs to address the implications of rising temperature and increases in air pollution. As noted in the Kem C. Gardner Institute's Utah Roadmap, "…poor air quality is a growing and alarming obstacle to retaining current businesses and attracting new companies to Utah, particularly in the state's burgeoning technology sector, which depends on attracting highly educated talent."[25]

One consideration is whether we have the tools to move quickly to clean energy sources. Says Utah State University Professor Robert Davies, a noted physicist and climate scientist, "… we have what we need to do this. New technology is coming, of

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[23] *State and County Projections*. https://gardner.utah.edu/demographics/population-projections/ Accessed Feb. 6, 2020.

[24] *IPCC, 2018: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. https://www.ipcc.ch/sr15/ Accessed Nov. 13, 2019.

[25] The *Utah Roadmap: Positive Solutions on Climate and Air Quality.* (Jan. 31, 2020). Kem C. Gardner Policy Institute. https://gardner.utah.edu/wp-content/uploads/TheUtahRoadmap-Feb2020.pdf Accessed Feb. 10, 2020.

course, and that will help, [but] we need to move toward massive deployment of existing technologies."[26]

Where Are We Now?

Public opinion

According to the Yale Climate Opinion Maps 2019, 62 percent of Utahns believe global warming is happening, 53 percent believe it is affecting weather, and 83 percent approve of funding research into renewable energy sources.[27] Utahns' belief in global warming is still slightly below the national average, but it is significantly higher than in 2009, when a Utah official publicly disputed climate change science while arguing most Utahns agreed with him.[28]

The past decade of prolonged winter inversions and medical research documenting adverse health effects from air pollution has convinced a majority of Utahns that air pollution affects health and that individuals as well as state and federal governments should act to improve air quality.[29]

At the same time, increasingly extreme weather-related disasters, including more intense hurricanes, stronger tornadoes, floods, and droughts with resulting catastrophic wildfires have convinced most Utahns that actions should be taken to prevent devastating climate change. Public opinion is now on the side of science and supportive of policies to help the transition to clean energy.

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[26] Davies, Rob. *Earth's changing climate – a community primer.* Chapter 2 in Addressing climate change at the community level in the United States (2018). Lachapelle, P. R., & Albrecht, D. E. (Eds.).

[27] Marion, Jennifer, Peter Howe, Matto Mildenberger, Anthony Leiserowitz, and Xinian Wang. Yale Climate Opinion Maps 2019. (Sept. 17, 2019). https://climatecommunication.yale.edu/visualizations-data/ycom-us/ Accessed Feb. 7, 2020.

[28] Roche, Lisa Riley. (Jun.16, 2009) "*Herbert Challenges Reality of Global Climate Change."* **Deseret News**. https://www.deseret.com/2009/6/16/20323882/herbert-challenges-reality-of-global-climate-change#utah-lt-gov-gary-herbert-listens-to-speakers-during-the-second-of-three-days-of-western-governors-association-meetings-during-plenary-ii-tapping-the-wests-renewable-energy-potential-at-the-chateaux-in-park-city-on-monday Accessed Feb. 7, 2020.

[29] Holst, Thomas. *Blog: Wasatch Front Air Quality: Getting Better or Worse? (*February 14, 2019). https://gardner.utah.edu/blog-wasatch-front-air-quality-getting-better-or-worse/#_ednref3 Accessed Feb. 15, 2020.

The Legislature has also shown a change in attitude toward air pollution and climate change. In 2019, it appropriated $200,000 for the Gardner Institute to research "policy options to further reduce air pollution, reduce emissions and address changing climate causes and impacts."[30]

Business

Insurance companies and financial markets[31] [32]

Industries and businesses are becoming increasingly aware of the dangers high GHG levels pose to profits and business models. On the front lines are insurance companies, which are expending larger and larger sums of money to cover property damage caused by flooding, storms, and fires. As warming intensifies, insurance companies must incorporate climate change into their risk assessment models to survive.

Other aspects of the insurance business are also vulnerable. According to the Insurance Information Institute, "Global warming has the potential to affect most segments of the insurance business, including life insurance, particularly if rising temperatures lead to an up-tick in death rates. Property losses of all kinds are most likely to rise…. and there is the potential for much higher commercial liability losses if shareholders and consumers try to hold businesses responsible for changes to the environment."

Some insurance companies are exploring ways to reward customers for reducing GHG. Incentives such as "Pay-As-You-Drive" base car insurance rates on miles driven: less driving = lower premium. Another option allows property owners to

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[30] *Utah Roadmap, The: Positive Solutions on Climate and Air Quality.* Kem C. Gardner Policy Institute. p 10. (January 6, 2020). https://gardner.utah.edu/wp-content/uploads/Utah-Roadmap-Public-Draft.pdf Accessed Jan. 7, 2020.

[31] *Background on: Climate change and Insurance Issues* (Nov. 1, 2019). Insurance Information Institute. https://www.iii.org/article/background-on-climate-change-and-insurance-issues Accessed Feb. 4, 2020.

[32] Sorkin, A.R. (Jan. 14, 2020, updated Feb. 24, 2020). *Blackrock C.E.O. Larry Fink: Climate Crisis Will Reshape Finance*. https://www.nytimes.com/2020/01/14/business/dealbook/larry-fink-blackrock-climate-change.html?searchResultPosition=2 Accessed Feb. 24, 2020.

rebuild homes damaged by fire or other disasters with “green” materials, thereby lowering emissions.

The impact of rising temperatures could ultimately have systemic effects on world financial markets, according to Larry Fink, CEO of BlackRock (world’s largest asset management fund with $7 trillion). Says Fink, “Even if only a fraction of the science is right today, this is a much more structural, long-term crisis.”[6] BlackRock is planning to use its influence to push energy companies toward renewable energy.

Rocky Mountain Power (PacifiCorp)

Rocky Mountain Power (RMP), a subsidiary of PacifiCorp, supplies electricity to 915,000 customers in Utah.[33] PacifiCorp operates in six western states--Utah, Wyoming, Idaho, California, Oregon, and Washington--and provides 11,000 to 12,000 megawatts (MW) of power.

Every two years, PacifiCorp identifies energy resources for the next 20 years and develops an Integrated Resource Plan (IRP). The company performs a detailed data analysis, taking into account fuel costs, operating expenses at existing plants, costs of developing or expanding renewable resources, tax policies, transmission needs, legislation, reliability of the system, and input from outside stakeholders. Once the IRP is chosen, it is submitted for approval to the Public Service Commission, which is tasked with ensuring the lowest cost and least risk for customers.

In 2018, coal accounted for 66 percent of Utah’s electricity generation[34] and contributed 50 percent of its CO2 emissions.[35] PacifiCorp’s 2019 IRP[36] projects more renewable energy sources, new battery storage, improvement and expansion of transmission capacity, and decreased dependence on coal over the 20-year period ending in 2038. In the short run (by 2023), PacifiCorp projects 3,000 MW of new

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[33] *Just the Facts*. Rocky Mountain Power. https://www.rockymountainpower.net/content/dam/pcorp/documents/en/rockymountainpower/about/2019_Facts_RockyMountainPower.pdf Accessed Feb. 26, 2020.

[34] *U.S, Energy Information Administration, Utah Page.* https://www.eia.gov/state/?sid=UT Accessed Feb. 25, 2020.

[35] The *Utah Roadmap: Positive Solutions on Climate and Air Quality.* (Jan. 31, 2020). Kem C. Gardner Policy Institute. https://gardner.utah.edu/wp-content/uploads/TheUtahRoadmap-Feb2020.pdf Accessed Feb. 10, 2020.

[36] https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf Accessed Nov. 13, 2019.

solar**;** 4,600 MW of new wind; and 600 MW of new battery storage. The company also projects 700 MW saved by energy efficiency and 400 miles of new transmission lines connecting southeastern Wyoming to northern Utah. Of PacifiCorp's 24 coal-fired units, 16 will be retired by 2030 and 20 by 2038. Utah's Hunter and Huntington coal-fired units will remain in operation until 2037 and 2042, respectively.

CO2 emissions generated by PacifCorp are projected to be down 43 percent by 2025, 59 percent by 2030, and 90 percent by 2050, relative to 2005. Utah Clean Energy commented on RMP's IRP: "Accelerated coal plant retirements are especially important because we need to decarbonize our energy grid much faster in order to mitigate the harmful consequences of climate change. While accelerated coal retirement is a positive step, it does not go nearly far enough."[37]

Securitization[38] [39]

Closing power plants presents issues for power companies, customers, and the communities that rely upon them for high-paying jobs. To consider retiring plants, the interests of all stakeholders must be addressed.

One promising way to accelerate retirement of fossil-fuel plants is securitization. Utilities invest heavily in building and operating these plants; if they are retired before the end of their useful lives, remaining capital assets (stranded assets) are forfeited. Securitization is a means to recover those assets.

To understand securitization, imagine refinancing a home mortgage. When a homeowner takes out a 30-year loan at a high interest rate and rates decrease, it can be beneficial to refinance the balance. With older fossil-fuel plants, the original construction cost (the "mortgage") was financed by a loan from the utility or other source at an interest rate of 8-9 percent. Customers pay off these loans via monthly user fees over the lifetime of the plants. If a plant closes before the end of its projected lifetime, the utility loses the customers' remaining payments. If, however,

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[37] *Rocky Mountain Power's Energy Plan Released*. (Oct. 27, 2019) Utah Clean Energy. https://utahcleanenergy.org/issues/create-clean-energy/item/575-new- Accessed Dec. 12, 2019.

[38] Farrell, J. (May 13, 2019) *Power Plant Securitization: Coming to a State Capitol Near You*. https://ilsr.org/power-plant-securitization-coming-to-a-state-capitol-near-you/ Accessed Feb. 26, 2020.

[39] *Harnessing Financial Tools to Transform the Electric Sector*. (Nov. 2018) Sierra Club. https://www.sierraclub.org/sites/www.sierraclub.org/files/sirerra-club-harnessing-financial-tools-electric-sector.pdf Accessed Feb. 26, 2020.

the utility sells ("refinances") the loan, it recovers the value of customers' payments and can invest in cleaner energy.

The securitization process requires several steps:

- State legislation must establish a utility's "property right" to customers' loan payments and must guarantee the utility will continue to collect customers' payments over the lifetime of the bond. The state assumes no financial liability in the process.
- The utility then sells its property right to a bond company, which issues a bond in private financial markets. Such bonds generally carry an interest rate of 3-4 percent.
- Once the bond is sold, the proceeds are given to the utility to invest in facility upgrades. The bond is repaid by customers in monthly installments at the lower interest rate.

In this win-win scenario, utility customers benefit by receiving lower-cost, cleaner electricity, and the utility is able to invest "stranded assets" in less expensive and more efficient energy generation. In addition, a portion of the recovered assets can be used to help impacted communities invest in job retraining or alternative employment opportunities.

Securitization legislation has been implemented in 21 states. In Florida, Duke Energy recovered $1.3 billion in assets in a closed nuclear power plant and projects customer savings of $700 million over 20 years. In Michigan, Consumers Energy sold $390 million in bonds to recover assets in retired coal-fired plants. Utah has not passed legislation to authorize securitization, but a draft bill was presented by Sen. Jacob Anderegg to the Public Utilities, Energy, and Technology Interim Committee in October 2019. This bill was not introduced during the 2020 legislature.

Sustainable residences[40] [41]

Local development companies such as Wasatch Group and Clearwater Homes are undertaking sustainable housing projects in the Salt Lake Valley. Wasatch Group has built **Soleil Lofts**, an all-electric 600-apartment complex in Herriman powered by

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[40] Walton, R. (Dec. 9, 2019). *Project of the Year: Soleil Lofts Solar + Storage Development*. https://www.utilitydive.com/news/project-solei-sonnen-pacificorp-rmp-batteries-solar-dive-awards/566230/ Accessed Dec. 12, 2019.

[41] *Telegraph Exchange Lofts Rezoning, Master Plan Amendment and Planned Development Meeting Agenda*. (Jan. 9, 2020) webatomics.com/ELPCO/TelegraphExchange-PDF.pdf Accessed Feb. 12, 2020.

solar energy. Each apartment has an individual storage battery and features Energy Star appliances. Total energy storage capacity for the complex is 12.6 MW. Rocky Mountain Power will manage the power needs of the complex and be able to draw on stored power when needed for the grid. This novel model integrates renewable energy generation with a battery storage source for the utility.

Clearwater Homes is also undertaking an all-electric residential development, **Telegraph Exchange Lofts**, in Salt Lake City. Electric power will be provided by offsite solar farms. Its 47 parking stalls will feature charging stations for electric vehicles.

Institutions

US military

The US military has recognized the dangers of climate change to national security for many years. Because of its size and influence, the military's views and actions are very significant. (The 2020 military budget is $748 billion; it was 3.4 percent of our country's GDP in 2019.)

As early as 2008, National Defense Magazine quoted Retired Navy Admiral Joe Lopez: "National security and the threat of climate change [are] real, and we can pay for it now or pay even more dearly for it later." [42] In 2015, the Department of Defense issued a report that again stressed the impacts of climate change on national security issues.[43] Two critical areas are global instability caused by food and water shortages, natural disasters, and disease; and climate damage to military installations that affect preparedness and training.

The military cannot predict when or where global crises will occur, so its focus is preparedness. Energy is central to that mission. Says Jon Powers, former Chief Sustainability Officer for the US, "For the military, energy touches every part of the mission. Domestically, commanders must ensure energy security and reliability to

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[42] Magnuson, Stew. Climate Change Fears Spill Over to The Defense Community. National Defense Magazine. (Aug. 1, 2008) Climate Change Fears Spill Over to The Defense Community Accessed Mar. 1, 2020.

[43] Department of Defense. National Security Implications of Climate-related Risks and a Changing Climate. (Jul. 23, 2015). https://archive.defense.gov/pubs/150724-congressional-report-on-national-implications-of-climate-change.pdf Accessed Feb. 18, 2020.

support mission-critical functions like communications or flying unmanned air vehicles in combat on the other side of the globe. As a result, it should come as no surprise that the military has become a driving force in pursuit of a renewable energy economy."[44]

To promote energy reliability and independence, the Army built a 65-MW solar and wind facility at Fort Hood, Texas, the Army's largest active-duty base in the US. This micro grid provides approximately half the base's power and saves taxpayers $100 million in energy costs. Of local interest, Camp Williams, Utah National Guard's facility, receives power from two wind turbines with a combined capacity of 885 kilowatts (kW).[45]

The Navy is also committed to exploring alternative energy sources. For example, "the Great Green Fleet initiative, an aircraft-carrier strike group… traveled the world in 2016 with every service ship and aircraft operating on a 50/50 blend of biofuel and petroleum." [46]

Although the military will continue to develop renewable energy sources, it may also be forced to build more sustainable structures and relocate facilities threatened by rising sea levels.

Utah colleges and universities

Weber State University, Utah State University, the University of Utah, and Westminster College are signatories to the American College and University Presidents' Climate Statement, which commits to carbon neutrality by 2050. In addition, various campuses partner with UTA to provide free passes to students, staff, and faculty for buses, TRAX, and FrontRunner. Use of mass transit reduces emissions and the need for expanded parking facilities.

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[44] Powers, J. (July 20, 2017) Former US Chief Sustainability Officer: The Military is Leading the March Toward Energy Independence. Former US Chief Sustainability Officer: The Military Is Leading the March Toward Energy Independence | Greentech Media Accessed Mar. 1, 2020.

[45] Camp Williams Utah National Guard (USA) - Wind farms – Online Access – The Wind Power Accessed Mar. 1, 2020.

[46] Reinhardt, F. L. and Toffel, M. W. *Managing Climate Change Lessons from the U.S. Navy.* (Jul.-Aug., 2017) Harvard Business Review. Managing Climate Change: Lessons from the U.S. Navy Accessed Mar. 1, 2020.

Weber State University[47] has a four-point plan to achieve carbon neutrality by 2050: efficiency first; electrify everything; use renewable energy; reinvest energy savings to make further improvements. The latter is especially important. The University has a $5 million fund that offers loans for energy efficiency and alternative energy projects. Energy dollar savings are used to repay loans, which helps more funds become available for energy-saving projects.

WSU has used its fund to build a ground-source heat-exchange system (geothermal heat pump) to heat and cool buildings as well as a 1.8 MW solar array that fully supplies its Davis campus with electricity. The fund was also used to electrify its vehicle fleet. WSU has adopted Leadership in Environmental and Energy Design (LEED) standards for all new buildings. By these and other measures, WSU has impressively decreased energy costs 47 percent and reduced carbon emissions 25 percent since 2009.

Following the 2019 passage of resolutions by the Faculty Senate and USU Student Association, **Utah State University**[48] established a Greenhouse Gas Steering Committee. The Committee produced a draft report that assessed ways to become carbon neutral by 2050. Proposed strategies included purchasing renewable energy from Rocky Mountain Power, investing in energy efficiency, establishing a "shadow" carbon price of $40/ton to guide capital expenditure decisions, and a mandatory $10/flight fee for University air travel, with revenue used for carbon offset projects.[23]

In March 2020 USU President Noelle Cockett announced she would commit to several actions from this report. These include setting aside up to $1.2 million over the next 20 years to purchase renewable energy from an outside entity, spending $500,000/year on energy efficiency, establishing a $10/trip fee for University air travel, and promoting campus programs on sustainability awareness.

Brigham Young University is committed to "be wise stewards of the earth and its resources," according to its sustainability mission statement.[49] Water conservation is a priority, and BYU has converted outdoor sprinklers to use non-potable water. It also installed high-efficiency plumbing fixtures and appliances, reducing water usage by 50 percent from those sources. BYU's landscaping features appropriate plants for the

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[47] Weber State University Energy and Sustainability Office. https://www.weber.edu/sustainability/energy-sustainability-office.html Accessed Oct. 3, 2019.
[48] Greenhouse Gas Steering Committee. http://sustainability.usu.edu/sustainability-council/GHGcommittee?fbclid=IwAR31_qptned8OoVpkfzOUQxUs_06UVdg2yI1JLyjqXSMKBX1mmzBHouyehg Accessed Feb. 26, 2020.
[49] BYU Sustainability. https://sustainability.byu.edu/ Accessed Feb. 29, 2020.

desert environment and employs a sophisticated watering system where "valves are connected to a computer irrigation system that considers all soil types, sun-orientation, wind, rain, and other environmental factors, allowing the plant material to thrive."[50] Additionally, BYU strives to lower energy consumption by installing larger windows in buildings to take advantage of natural light. Occupancy sensors and LED bulbs also reduce energy use.

The University of Utah has committed to carbon neutrality by 2050.[51] The U of U took a giant step toward that goal when it contracted to buy half its electricity from a renewably sourced geothermal plant in Nevada.[52] Policy now requires new buildings costing more than $2.5 million comply with LEED standards. Interdisciplinary research in air quality, energy, ecological and environmental change, nature and cultures, and food systems is explored in the U's Global Change and Sustainability Center.

Utah Valley University[53]**,** a commuter school, relies on its partnership with UTA to encourage mass transit and lower GHG emissions. UVU maintains eight free charging stations for electric vehicles on campus. Water conservation is also a component of UVU's sustainability plan--highly efficient dishwashers have been installed in dining halls and two ponds provide water to maintain the grounds, lessening demand on municipal water. UVU offers an Environmental Studies degree and many courses on sustainability.

State government actions to date

Although some elected Utah officials publicly question climate science, the tide appears to be turning. Outcry for state-based action has increased as residents experience the effects of a warming climate. Local coverage of climate science research from Utah universities, coverage of the US departure from the Paris Climate Accord, and the impact of worldwide climate-related events have heightened concern.

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[50] BYU Sustainability – Campus. https://sustainability.byu.edu/campus Accessed Feb. 29, 2020.
[51] University of Utah Sustainability. http://sustainability.utah.edu Accessed Feb. 23, 2020.
[52] Tanner, Courtney. (Feb. 11, 2020) *U. to get 50% of its electricity from renewable sources after signing geothermal energy deal*. **Salt Lake Tribune**.
[53] *What is UVU doing?* www.uvu.edu/sustainability/doing/-What is UVU Doing | Sustainability | Utah Valley University Accessed Feb. 29, 2020.

Since 2017, state legislators have shown an increasing willingness to work with citizens, environmental groups, and academics to adopt a science-based approach; draft legislation to address the impacts of a warming climate; and move to clean, renewable-energy sources. That said, without continued public pressure, sustained growth in state revenues, decline in alternative-energy costs, viable economic options for rural Utah, and stronger political will, Utah clean-energy advocates will likely continue to face challenges.

2017-2018 legislation

Submitted in 2017, **HCR 7 - Concurrent Resolution on Environmental and Economic Stewardship,** was largely driven by a dedicated group of students. It recognized a warming climate and asserted Utah's responsibility to address it while promoting a growing economy. Failing in committee in 2017, the Resolution passed in 2018. Key to its passage were efforts by the students, working with local representatives and members of Citizens' Climate Lobby, to frame the resolution as support for "environmental and economic stewardship," and to engage a broad coalition of businesses.

In 2018, Utah's first bipartisan carbon pricing bill, **HB 403 Tax Modifications**, was introduced in the House. As economist Yoram Bauman stated, "the basic idea of HB 403 is to tax 'bads' instead of 'goods.' In other words, reduce taxes on productive items (basic human needs and profit) and increase taxes on the counterproductive (pollution, CO2)." [54]

Components of the bill were:

- Fee of $10/metric ton on CO2 emissions, increasing by 3.5 percent annually, plus inflation. Tax applied to motor gasoline; on-road diesel fuel; aviation fuel; natural gas; electricity providers; and consumption of coal, off-road diesel, and fuel gas by large emitters. Zero-carbon energy not taxed.
- 90 percent of revenue rebated to consumers through elimination of several state taxes, including sales tax on grocery food; sales and use tax on electricity, and home heating fuels.

[54] *Utah's Climate Resolution & Bipartisan Carbon Pricing Bill,"* (Mar. 22, 2018), Citizens' Climate Lobby, https://citizensclimatelobby.org/utahs-climate-resolution-bipartisan-carbon-pricing-bill/ Accessed Feb. 4, 2020.

- Refundable income-tax credit to mining and manufacturing companies equal to 50 percent of their carbon-tax liabilities, to help maintain competitiveness.
- 10 percent match of the federal Earned Income Tax Credit for low-income working families
- Extension and expansion of the existing Retirement Tax Credit.
- 10 percent investment in improving air quality in areas out-of-compliance with EPA standards and boosting economic development in Carbon and Emery counties, through the Utah Coal Country Strike Team.
- Create the Carbon Emissions Tax Expendable Revenue Fund for tax revenue disbursements.

HB 403 was exactly what HCR 7 envisioned--incentives for reducing emissions while growing the economy—but the legislation was finalized too late to be considered by the House. In 2019 it was reintroduced, with changes, as HB 304.

2019 legislation

In Gov. Gary Herbert's 2019 budget, he advised the Utah Legislature to spend an unprecedented $100M on initiatives to clean Utah's air (in 2018 just $1 million was appropriated). The one-time funding was to cover a diverse set of initiatives, including a wood-burning conversion program; electric car charging stations; eco-friendly swaps for construction equipment, locomotives, and heavy-duty trucks; and a statewide teleworking program.

Despite Herbert's ambitious tone, just $28 million was appropriated, as new economic numbers showed slower revenue growth than projected. Yet air-quality advocates felt the final appropriation was a positive step.[55] Jessica Reimer, policy associate with HEAL Utah, speculated the higher funding could indicate a future shift. "Public awareness about air quality is growing, so there's a lot more pressure. There's a lot more education of legislators happening to [help them] really understand what the impact of poor air quality means for our economy and our public health." Rep. Patrice Arent, D-Millcreek, who created the bipartisan Clean Air Caucus, noted funded projects were based on, "Where's the bang for the buck? What is the best use of our state dollars? Where will we reduce the most…over a lifetime?"

[55] Taylor Stevens. (Mar. 15, 2019) *"Legislature falls far short of governor's goal of investing $100M to improve air quality. Advocates say it's a good first step,"* **Salt Lake Tribune**. https://www.sltrib.com/news/politics/2019/03/15/legislature-falls-far/ Accessed Mar. 26, 2020.

Of passed bills that received funding, Rep. Steve Handy's (R, Layton) **HB 411 Community Renewable Energy Act** was perhaps the most significant. The result of collaboration among Park City, Salt Lake City, Summit County, and Rocky Mountain Power (RMP), the bill offers support for Utah municipalities and counties in their quest for net-100 percent renewable energy portfolios by 2030. The communities must be serviced by Rocky Mountain Power and had to commit by December 31, 2019. The bill outlines rates and terms of service; it also allows customers to opt out if they find clean-energy power too expensive. Customers who live in a participating community and don't opt out become part of the plan.

HB 411 received 24 commitments: Park City, Salt Lake City, Moab, Summit County, Cottonwood Heights, Holladay, Salt Lake County, Oakley, Kearns, Kamas, Millcreek, Francis, Ogden, Grand County, Orem, West Jordan, Springdale, Alta, Coalville, and West Valley City. This innovative law offers these communities the chance to benefit from the environmental, economic, and health opportunities provided by renewable energy. By 2030, about 840,000 people in Utah, more than a quarter of the population, could be receiving all power from clean energy.[56]
Introduced by Rep. Joel Briscoe (D), **HB 304 Fossil Fuels Tax Amendments** reflected the same principle as 2018's HB 403: tax the bad; don't tax the good. It used similar language as HB 403, refining some provisions to reflect input from key legislators and businesses. It also provided the Legislature greater discretion in allocating revenue to air quality, through a clean-air grant program, and in boosting economic development and diversification in rural communities.

The bill was assigned to the House Revenue and Taxation Committee late in the session. Following a hearing, it was tabled with a recommendation by Rep Tim Quinn (R) to be postponed for study in the interim session. This was viewed as a win by the LWV and other supporters, but the bill failed to be considered during the interim and was not reintroduced in the regular session.

Other clean-air bills did pass in 2019, albeit with reductions in scale and/or funding. Bills established environmental monitoring for the Inland Port and surroundings (SB 144); revisions to emission testing requirements (HB 263); repeal of limitations to enact restrictions on vehicle idling (HB 148); a voluntary wood-burning conversion program (HB 357); a pilot program to offer free UTA fares on certain days (HB 353); a resolution encouraging the purchase of Tier 3 gasoline by retailers and consumers

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[56] *20 Utah Communities Commit 100% Renewable Energy by 2030,"* (Dec. 20, 2019). Solar Power World Online https://www.solarpowerworldonline.com/2019/12/20-utah-communities-commit-100-percent-renewable-energy-by-2030/ Accessed Feb. 4, 2020.

(HCR 11); and a resolution supporting rural development and the sale of wind, solar, hydrogen, hydroelectric, and geothermal energy (HCR 2).

Citizens' initiative

After a carbon-pricing bill failed in the legislature two years in a row, Yoram Bauman, a lead author of the previous legislation, and a group of citizens launched a campaign called, "**Clean the Darn Air**," to put carbon pricing on the 2020 docket. The initiative largely reflected the provisions in HB 304. It included a modest carbon tax, starting at $12/metric ton CO2 beginning in 2022 and rising 3.5 percent plus inflation annually. One-third of the revenue was slated to go to improving air quality and funding rural economic development; 67 percent to reducing taxes, including eliminating the sales tax on grocery-store food, providing a 20 percent match of the federal Earned Income Tax Credit, and increasing the Retirement Tax Credit.

Largely relying on volunteers, the campaign spent six months gathering signatures for the proposal, with the goal of 116,000 signatures by February. Ultimately, the campaign collected about 30,000 signatures.[57] The group is shifting focus, with plans to refile the petition for 2022 or 2024. Bauman suggested the experience would better prepare advocates for another attempt.

At the conclusion of the 2019 legislative session, the Kem C. Gardner Policy Institute at the University of Utah was tasked by the Legislature to provide recommendations to assist with air quality and climate change policymaking. Natalie Gochnour, director of the Policy Institute and a well-respected economist, along with a 37-person technical advisory committee, led the research. Building on work by Envision Utah and the 2007 Blue Ribbon Advisory Council under former Governor Jon Huntsman, and using HCR 7 as its blueprint, the Institute released the "**Utah Roadmap – Positive Solutions on Climate and Air Quality**," in January 2020.

The Utah Roadmap is seen by many as a game changer. The report focused on widely supported goals, offering an approach that could bridge the partisan divide. Including Utah business entities, clean-energy advocates, climate scientists, and local and state regulators in the advisory group ensured a "Utah way" in the development of recommendations. Since publication, the Roadmap has been cited

[57] State Carbon Pricing Network - Utah,Climate XChange Education and Research, Inc. (2020) https://climate-xchange.org/network/#utah Accessed Feb 4, 2020.

as potentially offering "a path forward for other conservative states looking to reduce GHG emissions." [58] Of particular interest are:[59]

> * Milestone 1: "We recommend the following emissions-reduction goals be adopted by resolution or statute in 2020: Reduce criteria-pollutant air emissions below 2017 levels by 50 percent by 2050; and reduce CO2 emissions statewide by 25 percent below 2005 levels by 2025, 50 percent by 2030, and 80 percent by 2050."
> * Milestone 7: "We recommend the state become a leader in national discussions about how to harness the power of market forces and new technologies to reduce carbon emissions in a way that protects health, sustains economic development, and offers other benefits to Utahns. Energy storage, research and development for energy technologies, revenue neutral/border adjusted carbon pricing, cap and trade, and other approaches may offer promising options for reducing emissions."

A 2020 resolution by Rep Briscoe to support the tenets of the Roadmap was held by the House Rules Committee so it did not receive a public hearing (see page 30).

2020 legislation

Once again, Gov. Herbert urged the Legislature to invest $100 million in clean energy—specifically, "green transportation."[60] Yet despite a sizeable increase in the number of bipartisan bills dealing with clean energy, these bills continued to meet obstacles.[61] A review of failed bills shows common elements: language that touched on climate change; requirements impacting large-scale electrical utilities; enactment

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[58] Faves, Judy. (Jan. 22, 2020). "*Has Conservative Utah Turned a Corner on Climate Change,"* Inside Climate News https://insideclimatenews.org/news/21012020/utah-climate-change-plan-conservative-legislature-coal-emissions-salt-lake Accessed Feb. 4, 2020.

[59] *"Recommendations in Brief, The Utah Roadmap – Positive Solutions on Climate and Air Quality",* (2020, Jan 6), Kem C. Gardner Institute, https://gardner.utah.edu/wp-content/uploads/Rec-in-Brief-Public-Draft.pdf , pg. 2. Accessed Feb 4, 2020.

[60] Wood, Benjamin. (Jan 8, 2020). *"Gov. Gary Herbert's final budget asks for investment in education and green transportation"* **Salt Lake Tribune**. https://www.sltrib.com/news/politics/2020/01/08/gov-gary-herberts-final/ Accessed Mar. 26, 2020.

[61] Rogers, Bethany. (Feb 12, 2020). *"Utah's Clean Air Caucus rolls out long to-do list for 2020"* **Salt Lake Tribune.** https://www.sltrib.com/news/politics/2020/02/11/utahs-clean-air-caucus/ Accessed Mar. 26, 2020.

that required a large appropriation or was tied to tax incentives (the latter was especially problematic).

Herbert's budget proposal was conditioned on the $160 million tax reform package approved in special session in December 2019. The reform package dedicated income tax revenue to public education, shifted the state's sales tax to align with a services-driven economy, and placed revenue in the unrestricted General Fund. Controversy led to a public referendum, which blocked the proposal until voters decided whether to repeal it in the November 2020 election. In January 2020, Utah lawmakers scrapped the divisive proposal.

Legislative leaders warned the "dramatic death of the tax reform package would squeeze the state budget in almost every category besides education." Forecasts indicated an "ongoing surplus of $518 million in the education fund and less than 20 percent of that amount to spread across the rest of government."[62]
Given these constraints and uncertainty around the economic impact of the coronavirus pandemic, impacts to pending legislation, related funding, and other appropriations were significant as of the date of this report.

Key 2020 bills[63]

Per the *Deseret News*, "while Lawmakers gave $10 million for air quality, advocates worry of complacency. The tight fiscal year, and even lack of inversions, may have hampered some initiatives."[64] Despite budget concerns, a new state office building on Capitol Hill (estimated at $80M) and several projects included within HB 3 Appropriations Adjustments and SB 3 Current Fiscal Year Supplemental Appropriations Bills secured sizable funding.

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[62] Rogers, Bethany (Mar. 2, 2020). "*Utah lawmakers get creative with requests for 'education' funding*" **Salt Lake Tribune** https://www.sltrib.com/news/politics/2020/03/02/utah-lawmakers-get/ Accessed Mar. 26, 2020.

[63] "*2020 Utah Bill Tracker: House & Senate,"* Climate Utah. https://www.climateutah.com/2020-legislation Accessed Mar. 20, 2020; 2020 Utah Bill Tracker, HEAL Utah, https://www.healutah.org/billtracker/ Accessed Mar. 20, 2020.

[64] O'Donoghue, Amy Joi . (Mar. 14, 2020). "*Lawmakers Give $10 Million for Air Quality but Advocates Worry of Complacency"*. **Deseret News**. https://www.deseret.com/utah/2020/3/14/21175217/lawmakers-give-10-million-for-air-quality-but-advocates-worry-of-complacency Accessed Mar. 28, 2020.

To take advantage of education funding, some of the following passed bills were "creatively" introduced in the Higher Education Appropriations Subcommittee:[65]

- Rural Electric Vehicle Charging Infrastructure ($2M one-time): Provides matching grants for electric-vehicle-charging infrastructure in rural Utah for some highways, national/state parks, and other areas.
- Enhanced Mass Transit Strategic Business Plan ($1.6M one-time): Funds development of strategic business plan to expand FrontRunner service.
- USU Electric Vehicle Research Grant Match ($3M one-time): Funds external support to develop technologies related to electrified transportation at USU's Sustainable Electrified Transportation Center.
- Uinta Basin Ozone Research ($200k one-time): Funds scientific research by USU's Bingham Research Center to understand the formation of ozone.
- Carbon Capture Demonstration ($2M one-time): Funds to be leveraged against $10 million in other contributions for construction and demonstration of innovative carbon capture technology.

Clean energy & electric vehicle legislation – Passed

- HB 259 requires Utah Department of Transportation to plan electric vehicle (EV) charging stations along certain state highways.
- HB 396 requires the Public Service Commission to approve up to $50M in utility-owned EV charging infrastructure equipment and services.
- HB 269 creates a nonrefundable income tax credit for certain commercial energy systems using hydrogen electrolysis systems.

Clean energy & electric vehicle legislation – Failed

- HB 194 created a standard for utilities to reach 50 percent energy generation from solar, wind, hydro, geothermal, and nuclear.
- HB 281 created tax credits of up to 8.9 percent of purchase price/lease payment for new or used electric, plug-in electric, or hydrogen-fueled vehicles under $45K. Fiscal note $3M.
- SB 77 created incentives for utility and residential energy storage. Fiscal note $5M.
- SB 78 provided grants for purchase of storage systems for small-scale solar-energy generation and market place transition. Fiscal note $5.1M.

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65 Rodgers, Bethany (Mar. 2, 2020). *"Utah lawmakers get creative with requests for 'education' funding"* **Salt Lake Tribune**. https://www.sltrib.com/news/politics/2020/03/02/utah-lawmakers-get/ Accessed Mar. 26, 2020.

Climate and clean air legislation – Passed

- HB 59 provides an income tax credit related to heavy-duty vehicles that run on natural gas, electricity, or hydrogen.
- HB 180 creates an exemption for electric vehicles from emissions compliance fees.
- SB 112 authorizes the Inland Port Authority to establish a community enhancement program to address Port impacts.
- HB 235 creates a pilot program to inform potential buyers of single-family homes about energy efficiency, cost savings, and air-quality impacts

Climate and clean air legislation – Failed

- HCR 11 encouraged using Utah Roadmap recommendations to guide solutions to improve air quality and reduce emissions. Companion bill HB465 created a Task Force to recommend ways to address air quality and climate change using the Roadmap.
- SCR 12 supported federal action to address climate change; encouraged consideration of carbon dividends by Utah's federal delegation.
- HB 176 sought to reduce vehicle emissions by offering incentives for low-income individuals to trade older vehicles for cleaner cars.
- SB 92 required the Department of Transportation to lead the development of a statewide rail plan.

Economic help for rural Utah

Although many elected officials are aware of the effects of air pollution and climate change on our state, the Legislature faces resistance to clean-energy bills each session. Several counties depend on fossil-fuel jobs to support their community's families. Elected leaders from these counties resist attempts to replace fossil-fuel energy with clean sources. Economic development of rural Utah counties is a key component in Utah's attempt to transition to clean energy.

The good news is that Utah leaders are aware of the economic problems facing rural Utah. In 2017, Governor Herbert challenged Utah business to create 25,000 jobs throughout rural Utah in the next four years.[66] This is a challenge, but it helps to understand that the impact of small businesses is far greater in a county of a few thousand residents than along the Wasatch Front. According to the Office of Rural

[66] *Utah Office of Rural Development Program Guide*. (Oct. 10, 2018). Governor's Office of Economic Development (GOED). https://business.utah.gov/news/office-of-rural-development-releases-2018-program-guide/ Accessed Dec. 8, 2019 and Feb. 27, 2020.

Development division of the Governor's Office of Economic Development (GOED), ". . . one job created in Millard County has the same relative impact as 186 jobs created in a Wasatch Front county." [67] A graphic showing the relative impact of job creation in rural counties is at the end of this section.

Guided by the Governor's challenge, the Legislature has passed major bills funding programs to train residents of rural counties with skills needed in today's economy. Especially promising is the Rural Online Initiative (ROI), which established an online course at Utah State University to teach skills needed for freelance jobs, remote employment, and online commerce. This program began reaching rural residents in October 2018. The *Rural Online Initiative Annual Program Report Year 1* notes that from May-July 2019, 281 participants completed the Master Remote Work Professional certificate, and 55 remote jobs were created in 16 rural counties.[68]

Other programs created by GOED to stimulate rural Utah economies include:

- **Rural Economic Development Incentive (RED)**--provides incentives to businesses that create jobs paying at least 110 percent of average county wage in counties with less than 31,000 people.
- **Rural Fast Track Grant (RFT)**–incentivizes existing businesses in rural counties to expand.
- **Business Expansion and Retention Grant (BEAR)**–provides grants for economic planning and development projects by rural leaders.
- **Enterprise Zone Tax Credits**–provides tax credits to businesses, Native American Tribes with tribal lands, and cities with a population of 20,000 or fewer located in a county with fewer than 70,000 people.
- **Targeted Business Tax Credit**--encourages private business projects to create jobs in counties of fewer than 25,000.
- **Utah Rural Jobs Act**–facilitates loans for start-up companies and for the expansion of existing businesses in the following industries: Aerospace, Agribusiness, Defense, Energy and Natural Resources, Financial Services, Information Technology, Life Sciences, Manufacturing, Outdoor Products, Software Development.[69]

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[67] Ibid. pg. 3.

[68] *Rural Online Initiative Annual Program Report. (*Fall 2019). Utah State University Extension and Agriculture, https://remoteworkcertificate.com/ROI_Annual%20Report_Y1.pdf pg. 5. Accessed Dec. 8, 2019.

[69] *Utah Office of Rural Development Program Guide*. (Oct. 10, 2018). Governor's Office of Economic Development (GOED). https://business.utah.gov/news/office-of-rural-development-releases-2018-program-guide/ pgs. 10, 7-8, 13-14, 15-16, 20-22. Accessed Dec. 8, 2019 and Feb. 27, 2020.

Other state programs not primarily designed to promote economic development in rural Utah have potential to build rural economies. They include:

- **Enterprise Zone Nonprofit Tax Credit**—similar to the Enterprise Zone Tax Credits for businesses, designed to encourage 501C(3) nonprofits to develop projects such as building museums, visitor centers, and theaters.
- **Recycling Market Development Zone Tax Credit**—encourages businesses that collect, process, or distribute recycled materials. Composting is considered recycling for these credits.[70]

Two grant programs for rural Utah, funded by the legislature, began July 2019:

- **Rural Rapid Manufacturing Grant**: Funds nonprofit companies or institutions of higher learning to partner with rapid manufacturing companies to create jobs paying 125% of the average local wage. [71]
- **Rural Co-working and Innovation Control Grant**: Provides funds for counties, cities, higher education institutions, or private companies to create facilities with broadband service, equipment, utilities, furniture, etc. for workers in online employment. [72]

In August 2018, the Kem C. Gardner Policy Institute, with the support of state, business, and community leaders, created the Utah Coal Country Strike Team (UCCST) to focus on Carbon and Emery counties, which experienced 16 percent job loss from 2008-2017 due to declining coal production. UCCST proposes improving their economies with workforce training for IT and other jobs, housing revitalization, investment in infrastructure, training to develop tourism, and tax incentives.[73] Reports from the first and second year of these projects are encouraging. For a full report on funding allocated/spent and numbers of jobs being created by these projects, see the 2019 Report for the Governor's Office of Economic Development.

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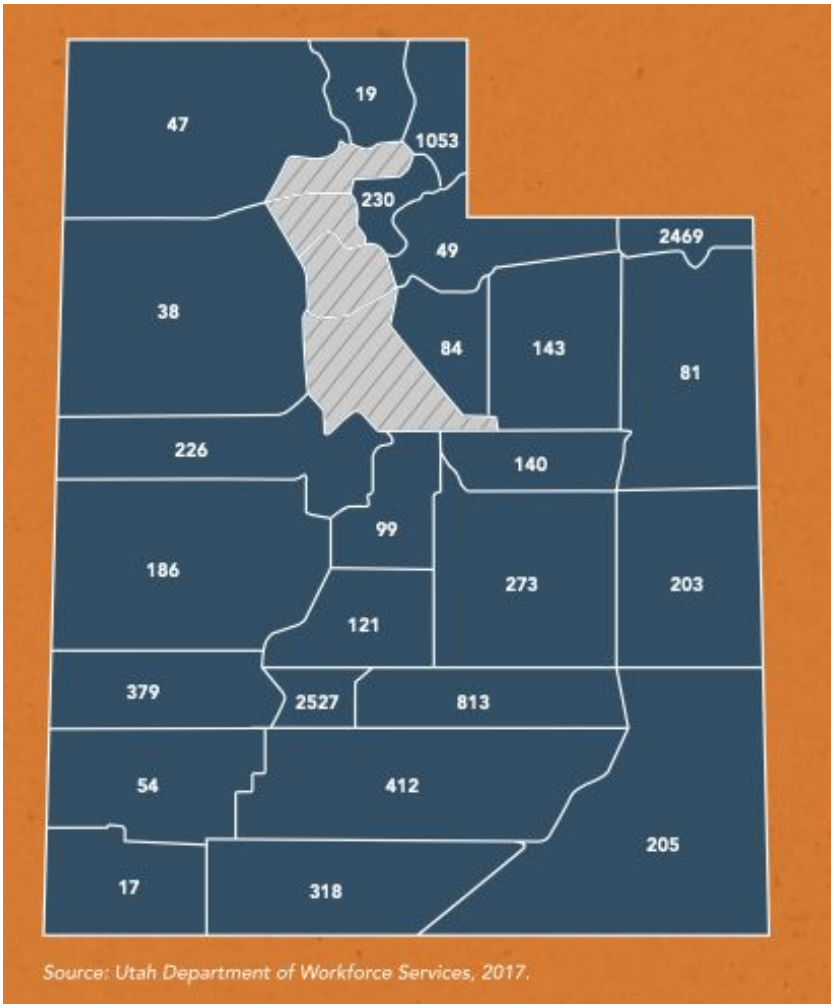
[70] Ibid, pgs. 17-18.

[71] *Rural Rapid Manufacturing Grant Program,* 2019. Governor's Office of Economic Development (GOED), Office of Rural Development (ORD), https://business.utah.gov/wp-content/uploads/2019/06/Rural-Rapid-Manufacturing-Grant-Program-Information-and-Instructions.pdf Accessed Nov. 11, 2019.

[72] *Rural Coworking and Innovation Control Grant.* https://business.utah.gov/wp-content/uploads/2019/06/RCIC.pdf Accessed Nov. 11, 2019.

[73] *Coal Country Strike Team Executive Summary (June 14, 2019)* Kem C. Gardner Policy Institute, https://gardner.utah.edu/wp-content/uploads/CC-ExecSum.pdf pgs. 1, 8, Accessed Jan. 8, 2020.



Impact of Jobs in Rural Counties Vs. Wasatch Front Counties[74]

Mass transit

Transportation accounted for 29 percent of US greenhouse gas emissions in 2017, the largest single category.[75] Transportation-related emissions also have deleterious health effects. Even relatively low levels of fine particulate matter (PM 2.5) pollution, much of which originates from vehicle exhaust, were associated with about 30,000

[74] *Utah Office of Rural Development Program Guide,* (2018, Oct. 10), Governor's Office of Economic Development (GOED). https://issuu.com/goed/deocs/utah-goed-2019-annual-report Accessed Dec. 3, 2019.
[75] I*nventory of U.S. Greenhouse Gas Emissions and Sinks*. (2019, April 11). https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks. Accessed Jan. 2, 2020

deaths in the US in 2015.[76] In Utah, vehicles are responsible for about half the PM 2.5 emissions during wintertime inversions.[77]

A study of the effect of Utah Transit Authority (UTA) mass transit service found that the service reduced emissions of various pollutants by about 1.5 percent. All modes of transit (bus, light rail, and commuter rail) reduced CO2 emissions relative to single-occupancy car trips, though bus and commuter rail service increased NOx emissions relative to car trips.[78] The study also noted that sulfur dioxide emissions are higher with TRAX light rail compared to single-occupancy car trips due to the electrical grid's dependency on natural gas and coal, though those emissions generally occur outside the Wasatch Front airshed. In this study, time of year and location influenced the magnitude of emissions reductions or increases from mass transit. The study illustrates the important but currently limited role that mass transit plays in reducing GHG emissions.

As land-use density increases, well-designed mass transit systems become more time-efficient for passengers and thus more attractive. Transit-oriented developments (TODs) address this issue by siting new developments near transit routes. The Wasatch Front Regional Council Wasatch Choice 2050 Vision incorporates TODs in the long-range regional vision and foresees increasing the share of the region's population living in multifamily housing from 25 to 40 percent by 2050.[79] UTA has the authority to pursue joint venture TODs on UTA-owned land, but state law capped the number at eight projects. UTA asked the legislature to raise the cap,[80] and in 2020, it complied; SB 150 eliminated the cap altogether.

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[76] Bennett, J. E., Tamura-Wicks, H., Parks, R. M., Burnett, R. T., Pope III, C. A., Bechle, M. J., ... & Ezzati, M. (2019). Particulate matter air pollution and national and county life expectancy loss in the USA: A spatiotemporal analysis. *PLoS medicine*, **16(7)**.

[77] Call, B. (Jun. 13, 2019). *Understanding the sources and causes of Utah's air pollution*. https://deq.utah.gov/communication/news/featured/understanding-utahs-air-quality Accessed Jan. 2, 2020.

[78] Mendoza, D. L., Buchert, M., & Lin, J. C. (2019). Modeling net effects of transit operations on vehicle miles traveled, fuel consumption, carbon dioxide, and criteria air pollutant emissions in a mid-size US metro area: findings from Salt Lake City, UT. *Environmental Research Communications*. **1** (2019) 091002.

[79] Davidson, L. (Sept. 13, 2019). "*Here's how officials plan to handle the 2 million more Wasatch Front residents expected by 2050*." **Salt Lake Tribune**. https://www.sltrib.com/news/politics/2019/09/12/wasatch-front-will-see-m/ Accessed Feb. 26, 2020.

[80] Davidson, L. (Jun. 27, 2019). "*Despite earlier scandals, UTA wants legislators to allow it to partner in more 'transit-oriented developments"*. **Salt Lake Tribune**. https://www.sltrib.com/news/politics/2019/06/24/despite-earlier-scandals/ Accessed Feb. 26, 2020.

The proliferation of rideshare services has led to declines in mass transit ridership.[81] However, UTA is conducting a pilot program through November 2020 with micro-transit in southern Salt Lake County, where passengers can use an app to hail a vehicle that picks up other passengers along the same route and connects to bus, light rail, and commuter rail stations.[82] This program can fill in bus and rail service gaps and could reduce GHG emissions, depending on how often vehicles pick up multiple passengers and the carbon intensity of the vehicles used. The program could also partially ameliorate the reduction in mass transit ridership due to rideshare services by integrating rideshare with public transit.

Where Do We Need to Go?

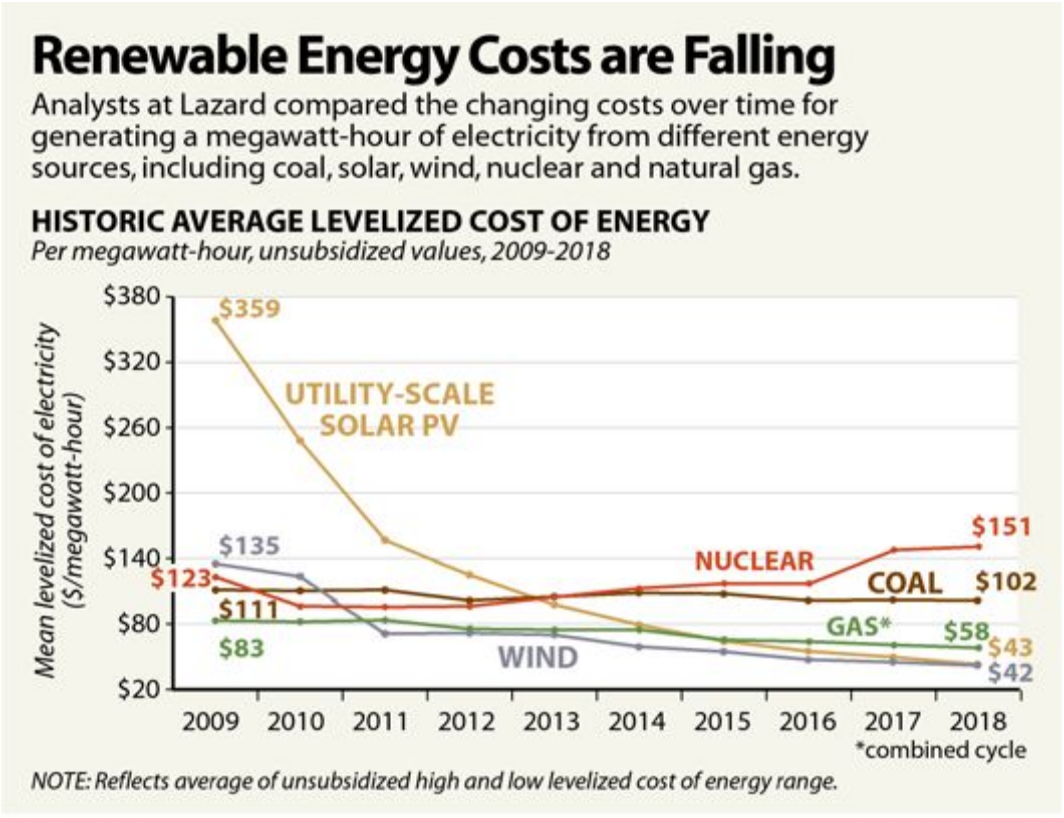
Sustainable alternatives for energy production

To reduce harmful GHG emissions, we must transition to sustainable, renewable energy generation. The economics of this are changing rapidly; energy prices from renewables compared to fossil fuels are competitive or nearly so.[83]

[81] Graehler, M., Mucci, A., & Erhardt, G. D. (2019). *Understanding the Recent Transit Ridership Decline in Major US Cities: Service Cuts or Emerging Modes?*. In **Transportation Research Board 98th Annual Meeting**, Washington, DC, January.

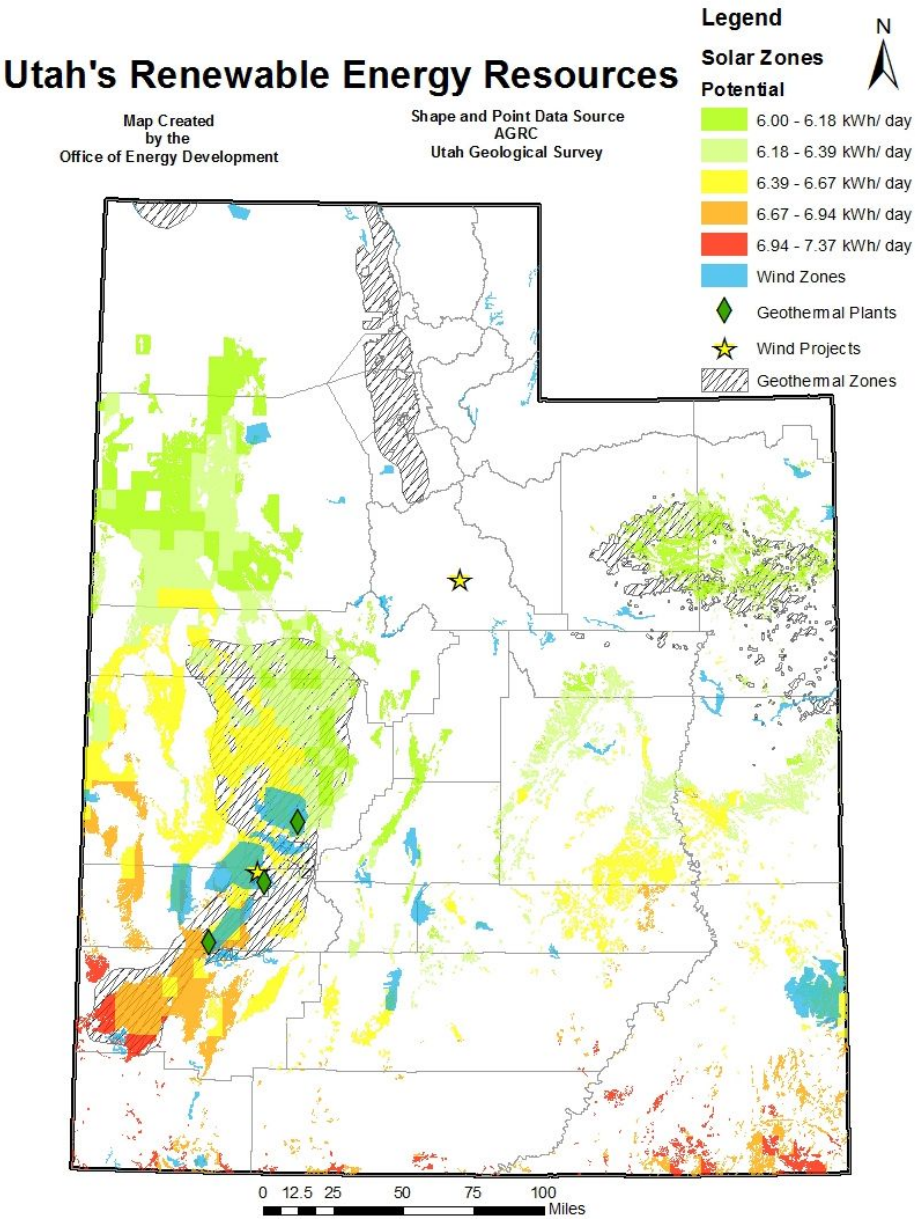
[82] Williams, C. (2019, November 22). UTA, ride-share company launch Salt Lake County microtransit pilot prograttps://www.ksl.com/article/46679250/uta-ride-share-company-launch-salt-lake-county-microtransit-pilot-program Accessed Jan. 2, 2020.

[83] Gearino, D. (Jan.3, 2019). *"A Clean Energy Revolution is Rising in the Midwest, with Utilities in the Vanguard"*. A Clean Energy Revolution is Rising in the Midwest, with Utilities in the Vanguard | Inside Climate News Accessed Dec. 12, 2019.



Costs are projected to decline further as newer technologies emerge and maintenance costs for aging fossil-fuel plants increase.

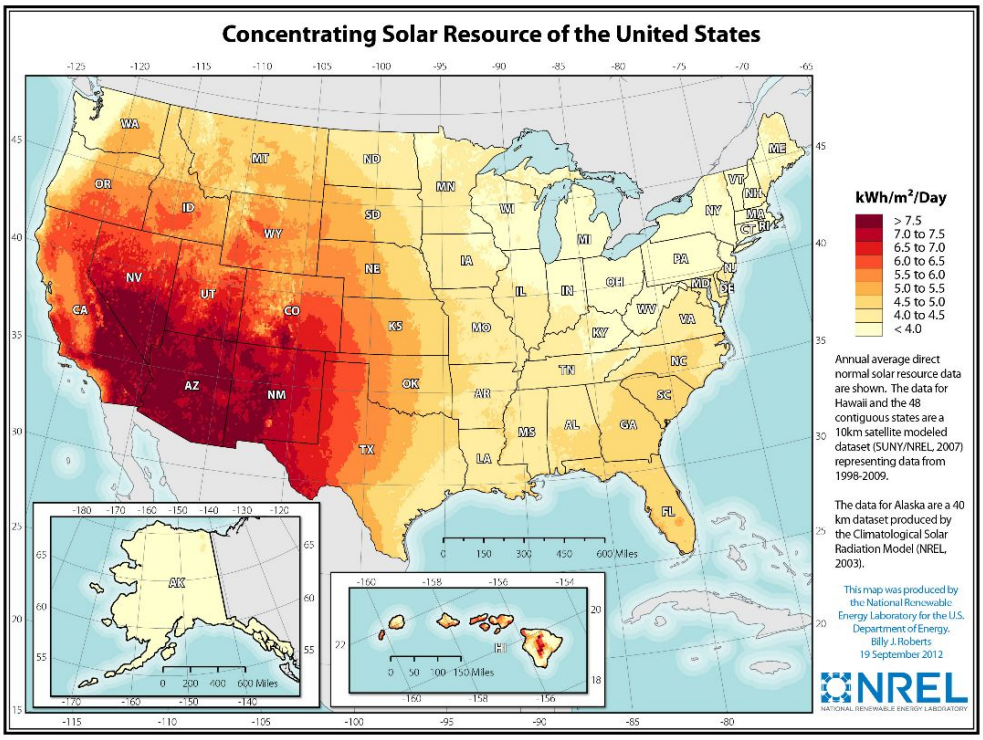
We have several sustainable energy resources in Utah:[84]



[84] *Utah's Renewable Energy Resources*. https://yourutahyourfuture.org/images/RenewableEnergyMap.jpg Accessed Feb. 19, 2020.

Solar

Solar exposure is abundant, particularly in southern Utah (darker colors indicate higher levels):[85]



Solar energy can be captured by rooftop photovoltaic panels (also called distributed solar) and by utility-scale solar arrays (photovoltaic or thermal). Currently about 35,000 Utah homes and businesses have rooftop panels, with a total capacity of about 300 megawatts (MW).[86] PacifiCorp plans to invest in utility-scale solar in southern Utah, adding 6,300 MW by 2037, to keep up with demand in Utah Valley. [87]

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[85] Puiu, T. (Apr. 19, 2019) "*What are the pros and cons of solar energy? Here's all you need to know".* https://www.zmescience.com/ecology/renewable-energy-ecology/solar-panels-pros-and-cons-056654/Accessed Feb. 6, 2020.

[86] Maffley, B. (Dec. 31, 2019, updated Dec. 31, 2019). "*How Much is Rooftop Solar? Advocates seek Utah Data to Counter Utility's 'lowballing'*". https://www.sltrib.com/news/environment/2019/12/31/how-much-is-rooftop-solar/ Accessed Feb. 23, 2020.

[87] https://www.sltrib.com/news/environment/2019/12/31/how-much-is-rooftop-solar/ Accessed Feb. 23, 2020.

In 2017, solar sources generated 4.8 percent of Utah's electricity--less than 0.5 percent of Utah's solar potential, thus offering a huge opportunity for expansion.[88]

Although solar energy is clean and sustainable, it has limitations. Rooftop panels can be expensive to install, energy production is dependent on sunshine, excess energy cannot yet be easily stored, and customers may not be adequately compensated for excess energy sold back to the grid. We can mitigate these drawbacks with tax incentives and on-site battery storage.

Geothermal [89] [90] [91]

Another promising renewable energy source in Utah is geothermal. In one method, heat found deep inside the Earth is converted to electricity; in another, the ground serves as an insulating heat reservoir.

In the former, superheated water near tectonic plate boundaries is pumped to the surface, producing steam that powers turbine engines to generate electricity. Benefits include no fuel costs, no GHGs, and reliable heat sources. Three plants currently operate in Utah: Blundell Geothermal (34 MW), Thermo No.1 (10 MW), and Cove Fort (25 MW); these produced about 1 percent of Utah's electricity in 2018. Untapped geothermal sources have the potential to generate an additional 10 percent of the state's electricity.

To use the ground as an insulating reservoir, water is circulated through pipes in buildings and into ground pipes. In summer, excess building heat is absorbed by the water and transferred to the ground, cooling the building. In winter, the process is reversed--heat extracted from the ground warms the building.

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[88] *U.S. Solar Potential and Actual Production by State*. https://www.everysolarthing.com/blog/us-solar-potential-and-actual-production/ Accessed Feb. 23, 2020.
[89] https://geothermal.org/PDFs/Final%20Utah.pdf Accessed Feb. 23, 2020.
[90] Allis, Rich. (Sept. 2016) *Utah Geological Survey is Major Player in Large Geothermal Project (FORGE) Near Milford, Utah*. https://geology.utah.gov/map-pub/survey-notes/ugs-is-major-partner-in-large-geothermal-project- near-milford-utah/Accessed Feb. 23, 2020.
[91] *State Profile and Energy Estimates*. U.S. Energy Information Administration. https://www.eia.gov/state/analysis.php?sid+UT Accessed Feb 24, 2020.

Wind [92] [93] [94]

Wind energy comprised 2.1 percent of the state's electricity production in 2018. Currently three large wind farms operate in Utah: Milford Wind in Beaver and Millard Counties (306 MW), Latigo Wind Park in San Juan County (62 MW), and Spanish Fork Wind in Utah County (18.9 MW). No new wind projects were under construction as of year-end 2019. New wind resources are part of PacifiCorp's 20-year plan, primarily in Idaho and eastern Wyoming, where conditions are more favorable. New transmission lines will connect those locations to Utah's grid.

Hydroelectric [95]

Hydroelectric power generated 2.3 percent of Utah's electricity in 2018. Of the 30 plants around the state, 18 are more than 50 years old. As Utah becomes hotter and drier and demand for water from growing urban areas increases, hydroelectric output may diminish.

Nuclear [96] [97] [98]

Nuclear energy is another possible fossil fuels replacement, and proponents tout its constancy over other renewable sources. Many Utah communities who own

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92 https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf Accessed Nov. 13, 2019.

93 *List of Power Stations in Utah.* https://en.wikipedia.org/wiki/List_of_power_stations_in_Utah#Wind Accessed Feb. 24, 2020.

94 *Wind Energy in Utah*. https://www.awea.org/Awea/media/Resources/StateFactSheets/Utah.pdf Accessed Feb. 24, 2020

95 *State Profile and Energy Estimates*. U.S. Energy Information Administration. https://www.eia.gov/state/analysis.php?sid+UT Accessed Feb 24, 2020.

96 Ciampoli, P. (Jul.24, 2019) *UAMPS Members Execute Power Sales Contracts for SMR Project.* https://www.publicpower.org/periodical/article/uamps-members-execute-power-sales-contracts-smr-project Accessed Feb. 24, 2020.

97 O'Donoghue, A. J. (Jul. 20, 2019). "*Planned Small Nuclear Project Reaches Milestone with More Utah Cities Signing On"*. **Deseret News**. https://www.deseret.com/2019/7/20/8937107/planned-small-nuclear-project-providers-to-someday-provide-base-load-energy-to-multiple-utah-cities Accessed Feb. 24, 2020.

98 *Blue Castle-Green River Nuclear Power Plant*. https://utah.sierraclub.org/content/blue-castle-green-river-nuclear-power-plant Accessed Feb. 24, 2020.

electricity generation plants have joined Utah Associated Municipal Power System. These communities have agreed to purchase 20 percent of the power capacity of a small modular nuclear reactor facility in Idaho, being built by NuScale Power. The total capacity of the planned facility is 720 megawatts, enough to power 750,000 homes. Current plans call for operation to begin in 2026.

While nuclear energy is "clean," as defined as non-carbon-based, it poses unique problems, one of which is safe disposal of radioactive waste that remains dangerous for thousands of years. Several years ago, a nuclear power plant was proposed for Green River, Utah, but financial issues have thus far prevented Blue Castle Holdings from moving forward. Several environmental groups oppose the project based on safety concerns, water needs (about 87 million gallons per day of operation), and high-level radioactive waste.

Remedies for rural Utah

State investment to help rural counties plan for and construct infrastructure to attract new industries is crucial. Three major employment fields are currently receiving the most attention: online or remote jobs; manufacturing, especially using new, high-tech materials; and tourism.

One intriguing possibility for coal-producing counties is the development of carbon fiber from coal. Carbon fiber, a high-tech material nine times stronger than an equivalent weight of steel, is used in industries including aerospace, automotive, wind turbine, and prosthetics. Currently, carbon fiber is made from petroleum, because the cost of producing coal pitch is non-competitive.

Carbon fiber from coal is created from waste products of coke production (coking). Coke, used as fuel in steel production, is created by heating coal to high temperatures in the absence of oxygen. Coke ovens have traditionally belched clouds of black smoke and carbon dioxide, but the use of bituminous coal and the installation of equipment to recapture CO2 and other gases have greatly reduced emissions.[99] Fortunately, most of Utah's coal is bituminous.

[99] Ashour, Baroa. (October 4, 2018). *How a Coke Plant Works.* Gasp, Inc. https://gaspgroup.org/how-a-coke-plant-works/ Accessed Mar. 5, 2020.

Carbon fiber is produced from coal tar, the waste residue from coking. Coal tar is distilled to produce creosote and coal tar pitch, used in roofing, paving, and paints. In laboratory experiments, coal-tar pitch has been melted and spun into carbon fiber.[100]

Utah Advanced Materials and Manufacturing Initiative (UAMMI) is a non-profit that promotes advanced materials manufacturing in Utah. UAMMI CEO Jeffrey Edwards reports his organization is working with the University of Utah Industrial Combustion and Gasification Research Facility (ICGRF) to create pitch made from coal at a competitive price. (Laboratory production of coal pitch runs $1000/pound.)

In 2019, the Utah Legislature appropriated a $500,000 grant for a pilot plant to be established in Carbon County by ICGRF. This plant will have facilities to experiment with larger quantities of pitch and, it is hoped, produce pitch at the economically viable cost of $5/pound. The U.S. Dept. of Energy is also expected to issue matching funding for states to invest in carbon fiber research in 2020. Reducing the cost to $5/pound would enable the use of coal-pitch for creating carbon fiber and provide a market for Utah coal. It could also attract industries to manufacture carbon fiber in Utah, which could in turn expand to industries that manufacture high-tech components from carbon fiber. Turning coal into carbon fiber without burning and releasing carbon dioxide into the air could add 300 permanent jobs to Carbon and Emery counties. It should be noted that starting pay for jobs manufacturing carbon fiber is half the starting pay for coal miners. And of course, coal must still be mined in order to be turned into carbon fiber.[101]

The third major type of economic development for rural economies is tourism. Counties can take advantage of funds from programs such as Business Expansion and Retention Grant (BEAR) (see pg. 31) to evaluate assets such as hiking, biking and other outdoor recreation; art events; historical and archeological sites; and festivals. Tax credits or other incentives can be provided for building new or renovating existing buildings for museums, visitor centers, theaters, restaurants, and lodging.

It is important for urban Utahns to recognize that people dependent on fossil-fuel energy jobs are unlikely to support transitioning to clean energy until they see a way to develop sustainable economies without fossil fuel extraction. Funding research and development in Utah rural economic development must be ongoing.

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[100] "*Coal Tar and Coal Tar Pitch."* (Dec. 28, 2018) National Cancer Institute. https://www.cancer.gov/about-cancer/causes-prevention/risk/subtances/coal-tar Accessed Dec. 13, 2019.

[101] Edwards, Jeffrey. December 12, 2019. Telephone interview with Ann Johnson.

Federal government

States that have embarked on paths to reduce GHG emissions and transition to 100 percent clean energy, as well as "The Utah Roadmap – Positive Solutions on Climate and Air Quality," provide valuable insights into coalition building and policies that encourage federal action. Beyond core components that have broad legislative appeal and are clearly understood by the public, "collaboration with environmental justice and labor experts will be needed to design climate policies at the federal level that identify and cut disproportionately high levels of toxic pollution concentrated in low-income communities and communities of color and ensure that the jobs of a 100 Percent Clean Future are good-paying, high-quality jobs." [102]

Essential to the climate crisis are Congressional bipartisan efforts such as the Climate Solutions Caucuses in both the Senate (2019) and House (2016). The 14-member (as of March 2020) Senate Caucus is designed to be a small, active working group; the 63-member House Caucus has facilitated climate change discussions and introduced bipartisan legislation.[103]

HR 763 - Energy Innovation and Carbon Dividend Act

A climate change solution seen as politically, environmentally, and economically viable is **HR 763 - Energy Innovation and Carbon Dividend Act**.[104] The bill, co-sponsored as of March 2020 by 80 Democrats and Republicans, was assigned in January 2019 to the Committees on Ways and Means; Energy and Commerce; and Foreign Affairs; it was referred to the Subcommittee on Energy shortly after, where it has remained. The provisions of HR 763 encourage people and businesses to substitute cleaner energy sources and to find more efficient ways to use energy.

Projections by sponsors of the Act are:

- 40 percent fewer carbon emissions over the next 12 years.
- 295,000 lives saved through 2030 due to better air quality
- $4,410 annual dividend for a family of 4 by year 10 (80 percent of mid- to low-income households get a boost or break even).

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[102] *"State Fact Sheet: A 100 Percent Clean Future,"* Center for American Progress (Oct. 16, 2019). https://www.americanprogress.org/issues/green/reports/2019/10/16/475863/state-fact-sheet-100-percent-clean-future/ Accessed Feb. 4, 2020.

[103] *"Republicans and Democrats working together in Congress,"* Citizens' Climate Lobby, https://citizensclimatelobby.org/climate-solutions-caucus/ Accessed Feb 28, 2020.

[104] *"Energy Innovation Act – How It Works,"* Citizens' Climate Lobby, https://energyinnovationact.org/how-it-works/ Accessed Feb 28, 2020.

- 2.1 million jobs created over 10 years in communities across America.

Four components drive this bill:

- A **carbon fee**, assessed at the first point of sale, placed on fossil fuels. Starting at $15 per metric ton of CO2 emissions, the fee increases $10 per year until emissions are reduced by 90 percent. For consumers, this equates to an additional 11¢ per gallon of gasoline, 6¢ per therm of natural gas, and 0.9¢ per kilowatt-hour of coal-generated electricity.
- Money collected from the fee is allocated in monthly equal shares to Americans with a SSN or ITIN to spend as they see fit; half shares are allocated to children 18 or younger. Those who do not file taxes would fill out a form to request this **carbon dividend.** In the first year, the adult dividend is projected to be $16-24/month; as fees rise, dividends increase. Administrative costs are paid from the fees.
- To protect US manufacturers and jobs, a carbon**-border-fee adjustment** is placed on emissions-intensive goods. This discourages businesses from relocating to unregulated countries and encourages other nations to price carbon.
- Current regulations such as auto mileage standards are preserved, but the bill **pauses the EPA's authority to regulate CO2 and other emissions covered by the fee** for the first 10 years after the policy is enacted. If emission targets are not being met after 10 years, the EPA must issue rules to put us on track. All other Clean Air Act regulations remain in force. The pause does not impact regulations related to water or air quality, health, or other issues.

When the program reaches its goal of cutting US GHG emissions 90 percent below 2015 levels, it automatically ends.

HR 9 - Climate Action Now Act [105]

Climate change is a global crisis. Without a seat at the table, the US will lose its ability to nudge other nations in the right direction. This bill calls for America to join 196 nations around the globe in upholding our commitments to the Paris Climate Agreement. Components are:

- Requires the president to develop and annually update a plan for the US to meet its commitments under the Paris Agreement.

[105] 104. *"Summary: H.R.9 — 116th Congress (2019-2020)"* https://www.congress.gov/bill/116th-congress/house-bill/9 Accessed Mar. 20, 2020.

- Prohibits federal funds from being used to withdraw from the Agreement.
- Outlines what must be included in the plan, including cutting greenhouse gas emissions by 26-28 percent below 2005 levels by 2025, and confirming that other countries with major economies are fulfilling their contributions.
- Requires the president to seek and publish comments from the public when submitting and updating the plan.
- Requires the president to report within 6 months on the effect the Agreement is having on clean-energy job development in rural communities.
- Requires the president to contract with the National Academy of Sciences to report potential impacts of a withdrawal from the agreement by the US on the global economic competitiveness of its economy and workers.

Having passed the House Foreign Affairs, Energy and Commerce Committee, in 2019, HR 9 has been awaiting Senate action. It is unlikely to gain traction under the Trump administration.

HR 330 - Climate Solutions Act of 2019 [106]

This bill establishes renewable energy standards, energy saving targets, and greenhouse gas emission reduction targets. Referred to the House Subcommittee on Environment and Climate Change upon introduction in January 2019, it has yet to see action. The bill would:

- Increase the percentage of electricity sold in the US generated from renewable sources to 100 percent 2035.
- Set cumulative energy-savings targets for retail electric energy and natural gas suppliers. Savings must be achieved through energy efficiency and a market-based trade system.
- Require the EPA to set annual emission-reduction targets for 2030-2050.

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[106] *"Summary: H.R.330 - Climate Solutions Act of 2019"* https://www.congress.gov/bill/116th-congress/house-bill/330 Accessed Mar 20, 2020.

Innovation

Grid flexibility and battery storage

Solar and wind energy are variable power sources. The sun doesn't always shine and the wind doesn't always blow when people want to turn on air conditioners, do laundry, or bake. Currently, when demand for electricity is greater than solar panels or wind turbines are producing, power from coal-fired power plants fills the gap. As more communities pledge 100 percent renewable energy by 2030, a cost-effective way to maintain constant energy must be developed.

Our current grid system was developed more than a century ago, and it served a much smaller population using less per-household electricity than now. Many strategies/technologies are now available to modernize this grid and to provide flexibility for wind and solar energy. One strategy is to balance demand through variable pricing, charging consumers more during peak times or when the sun/wind are not providing adequate power, encouraging thoughtful energy use. Another strategy uses smart technology to teach thermostats to use less energy when outside temperatures influence inside ones.

Regional connections also improve grid flexibility. If neighboring states have connected grids, power is less variable, because when Mother Nature is not cooperating in one area, another may be producing abundantly. Surplus power can be shared through high voltage direct current (HVDC) power lines. Accurate weather forecasting now informs a utility as to when solar or wind production may be limited, so it can schedule alternative energy sources.[107]

Even with sophisticated supply/demand scheduling, the major way utilities will deal with variable power sources is energy storage, primarily batteries. Cost has been the limiting factor, but prices are dropping rapidly. The National Renewable Energy Laboratory estimates current utility-scale battery storage costs $300-$350/kilowatt hour (kWh).[108] Jessica Trancik of MIT has determined that energy storage costs for 100 percent renewable energy would have to drop to $20 kWh in order to maintain "equivalent availability factor" (EAF) for power demand 24/7 over 20 years. David Roberts, Climate and Energy Reporter for Vox Media, claims a 100 percent EAF is

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[107] Hawken, Paul (Ed.) (2017). *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*. Energy Grid Flexibility, 30-31, 33. New York: Penguin Books.
[108] Cole, Wesley and A. Will Frazier. *Cost Projections for Utility Scale Battery Storage.* June 2019. National Renewable Energy Laboratory (NREL) https://www.nrel.gov/docs/fy19osti/73222.pdf Accessed Mar. 5, 2020.

unrealistically high, as existing power systems don't provide this today. Using non-renewable sources just 5 percent of the time could reduce storage cost to $150/KWh.[109]

Examples of expected battery-price drops in the near future include: High-temperature sodium sulfur batteries, now $500/kWh, are expected to decrease as much as 75 percent by 2030. Sodium nickel chloride batteries now $315-$490/kWh may decline to $130-$200/kWh by 2030. Aqueous sulfur-flow batteries are being developed for $10/kWh.[110] Lower battery prices, combined with other sources of energy 5 percent of the time, make 95 percent renewable energy a doable 2030 goal.

Non-battery storage options are also being tested. Thermal storage, such as storing heat in molten salt, and materials such as zinc can produce energy for solar plants after sunset. In many areas of the world, short-term hydroelectric power is being created by pumping water from a lower to a higher storage reservoir during the night, when power use is minimal; during peak hours, water is released to flow downhill and run power-generating turbines. A Nevada experiment uses gravity in a different way: Railroad cars equipped with generators and loaded with tons of rock ascend a 3,000-foot-high track during surplus energy time. When power is needed, the cars descend, and a regenerative braking system converts resistance to electricity.[111]

Options for a flexible grid and multiple storage materials and techniques are solving the problem of wind and solar variability. David Roberts predicts, "A US energy grid run entirely on renewable energy (at least 95 percent of the time), leaning primarily on energy storage to provide grid flexibility, may be more realistic, and closer to hand, than conventional wisdom has it."[112]

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[109] Roberts, David. "Getting to 100% Renewable Requires Cheap Energy Storage. But How Cheap?" September 20, 2019. https://www.vox.com/energy-and-environment/2019/8/9/20767886/renewable-energy-storage-cost-electricity Accessed Feb. 14, 2020.

[110] Patel, Prachi. September 16, 2019. *How Inexpensive Must Energy Storage Be for Utilities to Switch to 100 Percent Renewable?* IEEE Spectrum. https://spectrum.ieee.org/energywise/energy/renewables/what-energy-storage-would-have-to-cost-for-a-renewable-grid Accessed Mar. 5, 2020.

[111] Ibid.

[112] Roberts, David. "Getting to 100% Renewable Requires Cheap Energy Storage. But How Cheap?" September 20, 2019. https://www.vox.com/energy-and-environment/2019/8/9/20767886/renewable-energy-storage-cost-electricity. Accessed Feb. 14, 2020.

Renewable natural gas (RNG)

When fossil natural gas, which is primarily methane, is extracted from the ground through fracking, a percentage of this potent GHG escapes into the atmosphere; when it is burned as fuel, it releases CO2 (albeit about 30% less than oil). Although renewable natural gas (RNG) also produces carbon (CO2) when burned, RNG eliminates the extraction portion of the job by producing methane from decomposing organic waste.

When burned, RNG from landfill produces about 60 percent of the carbon intensity (greenhouse gas emissions per unit of energy) compared to fossil natural gas; it is strongly negative in this comparison when using municipal solid waste digesters and dairy RNG[113]. (A negative carbon intensity reflects an energy source that has a net effect of removing greenhouse gases from the atmosphere.)

An emerging commercial technology, RNG production may potentially reduce our need for fossil natural gas. Dominion Energy, in partnership with Smithfield Foods (the world's largest pork producer), is investing in RNG projects around the country. Covered pig waste lagoons and anaerobic digesters allow the methane to be recovered from the waste's bacterial decomposition ("Manure to energy"). One site is in Milford, Utah, and is slated to begin operations in 2020. The methane it produces is projected to be able to power more than 3,000 businesses.[114]
Food waste is another source of RNG, and has a side benefit of reducing input to landfills. A food-waste-to-energy plant opened in North Salt Lake in 2019 and is capable of handling 700 tons of waste per day. The waste is converted to RNG in an anaerobic digester, with projected emissions reductions equivalent to taking 75,000 cars off the road for a year.[115]

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[113]Jaffe, A.M., Dominguez-Faus, R., et al. (Jun. 2016). *The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute*.
https://steps.ucdavis.edu/wp-content/uploads/2017/05/2016-UCD-ITS-RR-16-20.pdf
Accessed Feb. 10, 2020
[114] The Utah Roadmap
https//gardner.utah.edu/wp-content/uploads/TheUtahRoadmap-Feb2020.pdf Accessed Feb. 10, 2020.
[115] Bennett, Lauren. *New Utah facility will turn food waste into renewable energy*. (2020).
https://www.deseret.com/2019/2/7/20665331/new-utah-facility-will-turn-food-waste-into-renewable-energy#wasatch-resource-recoveries-2-5-million-gallon-anaerobic-digester-nears-completion-in-north-salt-lake-plant-on-thursday-feb-7-2019-the-facility-will-capture-renewable-energy-from-food-waste-to-produce-enough-natural-gas-for-a-city-the-size-of-bountiful.
Accessed Feb. 26, 2020.

According to a 2014 USDA Biogas Opportunities Roadmap, "The United States currently has more than 2,000 sites producing biogas… [W]ith the proper support, more than 11,000 additional biogas systems could be deployed in the United States. If fully realized, these systems could produce enough energy to power more than 3 million American homes and reduce methane emissions equivalent to 4 to 54 million metric tons of greenhouse gas emissions in 2030, the annual emissions of between 800,000 and 11 million passenger vehicles."[116] When burned, RNG is less carbon intense than fossil natural gas, but high leakage rates throughout its production and transportation processes diminish its potential for reducing overall emissions.[117] For example, for heavy-duty diesel vehicles, a RNG leakage rate of 1% or less is needed to have a net positive effect on warming;[118] a California study estimated leakage between 2.4 and 4.3% with these vehicles.[119] Further research is needed.

Additionally, not enough RNG currently exists to make meaningful reductions in the use of fossil natural gas; a California report found "there appears to be insufficient biomethane to displace the necessary amount of building and industry fossil natural gas consumption to meet the state's long-term climate goals."[120] Another report determined that the total RNG potential for the entire US is about equivalent to the amount of diesel fuel used in California alone.[121] And an analysis of various decarbonization pathways for heating buildings in California found that a pathway

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[116] *Biogas Opportunities Roadmap*. (2014). U.S. Department of Agriculture. https://www.usda.gov/oce/reports/energy/Biogas_Opportunities_Roadmap_8-1-14.pdf Accessed Feb. 13, 2020.

[117] Roberts, David. (2020). *The false promise of "renewable natural gas*, (2020). https://www.vox.com/energy-and-environment/2020/2/14/21131109/california-natural-gas-renewable-socalgas, Accessed Feb. 25, 2019.

[118] Alvarez, R.A., Pacala, S.W., et al. (2012). Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure. *Proc. Natl. Acad. Sci. U.S.A*. **109**: 6435-40. https://www.pnas.org/content/109/17/6435 Accessed Feb. 25, 2020.

[119] Wentworth, N. (Jun. 1, 2018). *A Discussion on the Future of Natural Gas in California*. https://escholarship.org/content/qt23k2q3jp/qt23k2q3jp.pdf?t=pxewgd Accessed Feb 25, 2020.

[120] Mahone, Amber et al. (2018). *Deep Decarbonization in a High Renewables Future*. California Energy Commission. https://www.ethree.com/wp-content/uploads/2018/06/Deep_Decarbonization_in_a_High_Renewables_Future_CEC-500-2018-012-1.pdf Accessed Feb. 26, 2020.

[121] *The Promises and Limits of Biomethane as a Transportation Fuel*. The Union of Concerned Scientists. https://www.ucsusa.org/sites/default/files/attach/2017/05/Promises-and-limits-of-Biomethane-factsheet.pdf Accessed Feb. 26, 2020.

that relied mostly on electrification and renewable energy was not only the only one capable of meeting energy requirements, but also was the least expensive.[122]

At present, RNG appears to be most useful in areas difficult to electrify, such as aviation and shipping. In the long run, studies show electrification will be the most important decarbonization pathway unless much larger quantities of RNG become available at competitive prices.

Sequestration

One step toward mitigating climate change effects is increasing sequestration (storage) of CO2 in soil and plant tissue. Natural climate solutions (NCS) with the largest sequestration potentials are reforestation, natural forest management, and a moratorium on grassland conversion.

A 2018 review in *Science Advances* found that developing new NCS in the US has the potential to sequester an additional 21 percent of CO2 emissions[123] (over 2016 levels of 6,526 million metric tons of CO2[124]). The review determined that, at a cost of $100 per metric ton of CO2, 91 percent of this potential could be achieved. A research group (the now-defunct Utah Agricultural Carbon Team) produced a 2010 white paper that examined the carbon sequestration potential of Utah ecosystems; it found they store approximately 28.5 million metric tons of CO2 each year.[125] According to the paper, the majority of storage (16.1 million metric tons) comes from the sagebrush steppe ecosystem, where much of Utah's grazing occurs.

The largest potential for increasing sequestration in this ecosystem is through restoration of over-grazed areas invaded by cheatgrass (*Bromus tectorum*). One federal study found the release of carbon dioxide from these areas was 6 metric tons

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[122] Sheihk, Imran and Callaway, Duncan (2019). *Decarbonizing Space and Water Heating in Temperate Climates: The Case for Electrification*. **Atmosphere**. *10*; 435.

[123] Fargione, J. E., Bassett, S., Boucher, T., Bridgham, S. D., Conant, R. T., Cook-Patton, S. C., ... & Gu, H. (2018). *Natural climate solutions for the United States*. **Science advances**, *4*(11), eaat1869.

[124] https://www.epa.gov/sites/production/files/2020-02/documents/us-ghg-inventory-2020-main-text.pdf. Accessed Jan. 2, 2020.

[125] Monaco, T., Cardon, G., Weimer, B., Parnell, J., & Mitchell, A. R. (2010). *Carbon Sequestration in Utah –Estimates by Ecosystem* (Working paper). Utah Agricultural Carbon Team.

per acre per year,[126] about 2.8 percent of US annual energy-related CO2 emission.[127] Another study estimated that cheatgrass invasion could lead to 50 million metric tons of CO2 emissions in the coming decades.[128] Although estimates of emissions from cheatgrass areas are rough, restoring healthy sagebrush communities will both increase carbon sequestration and improve rangeland productivity.

Current federal programs could potentially address carbon sequestration. The Natural Resources Conservation Service (NRCS), for example, offers financial assistance to landowners for practices that enhance biodiversity, such as restoring grasslands. The USDA Conservation Reserve Program (CRP) pays landowners to remove tracts of land from production, offering additional opportunities. These programs could specify sequestration as a funding requirement; monitoring would evaluate effectiveness.

Other policy mechanisms could provide monies for agricultural and natural sequestration projects. Examples include a cap-and-trade system for greenhouse gas emissions, a carbon fee/tax, and payments from the Land and Water Conservation Fund. Additionally, private investments can spur project development. One such example is the “carbon farm” Duke University is developing in North Carolina, where carbon-rich wetlands have been restored and carbon credits are sold to organizations seeking to offset emissions.[129]

Call to Action

The challenge to lower GHG emissions enough to limit global temperature rise to 1.5° C and avert catastrophic climate change requires individual, community, and

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[126] Myklebust, MC, LE Hipps, RJ Ryel. (2008). *Comparison of eddy covariance, chamber, and gradient methods of measuring CO2 efflux in an annual semi-arid grass,* Bromus tectorum**. Agricultural and Forest Meteorology** *148*; 1894-1907.
[127] *Inventory of U.S. Greenhouse Gas Emissions and Sinks*. (2019). https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks. Accessed Jan. 2, 2020.
[128]Bradley, B. A. (2009). *Regional analysis of the impacts of climate change on cheatgrass invasion shows potential risk and opportunity*. **Global Change Biology**, *15(1)*; 196-208.
[129] *Carbon Farming Comes to North Carolina*. (2019). https://sites.nicholas.duke.edu/dukenvironment/2019/04/carbon-farming-comes-to-north-carolina/. Accessed Jan. 2, 2020.

national/international government actions. As noted earlier, the window is closing rapidly. How we respond in the next 30 years will determine the extent of global warming. If we achieve carbon neutrality by 2050, it may be possible to limit warming to 1.5-2° C. If GHG emissions continue on the current trajectory, models predict temperatures rising 3-4° C (5.4-7.2° F) by the end of the century.[130]

LWV positions and activism

As members of the League of Women Voters ("the League"), we are supported by the League's positions on environmental issues. Since the 1920s and '30s, when members studied flood control, erosion, and the creation of the Tennessee Valley Authority, the League has been at the forefront of movements to protect air, land, and water resources, consistently supporting legislation to preserve our nation's natural resources and protect our public health.[131]

From the League's national and state/local positions, it is clear we place "Defending the Environment" second only to "Defending Democracy." League positions are:[132]

> The Environment:
>
> > "As citizens of the world we must protect our planet from the physical, economic and public health effects of climate change while also providing pathways to economic prosperity."
>
> Why it matters:
>
> > "The preservation of the physical, chemical and biological integrity of the earth's ecosystem is essential for maximum protection of public health and the environment. The interrelationships of air, water and land resources should be recognized in designing environmental safeguards. The federal government should have the major role in setting standards for environmental protection and pollution control."

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[130] Lachapelle, P. R., & Albrecht, D. E. (Eds.). Addressing climate change at the community level in the United States (2018) Chapter 2 Earth's changing climate – a community primer by Rob Davies, p.15-33, Fig. 2.4.

[131] *LWV 2018-20 Impact on Issues*, (2019 January) League of Women Voters, https://www.lwv.org/sites/default/files/2019-04/LWV%202018-20%20Impact%20on%20Issues.pdf, pg. 51, Accessed Feb 28, 2020.

[132] "The Environment," League of Women Voters – US, https://www.lwv.org/other-issues/environment, Accessed Feb 28, 2020.

What we're doing:

> "Our approach to environmental protection and pollution control is one of problem solving. The League's environmental goals aim to prevent ecological degradation, and to reduce and control pollutants before they go down the sewer, up the chimney or into the landfill. We support vigorous enforcement mechanisms, including sanctions for states and localities that do not comply with federal standards as well as substantial fines for noncompliance."

The League believes "climate change is a serious problem that requires immediate domestic and international action." Starting in late 2000, it significantly increased its advocacy concerning global climate change. Milestones include:[133]

- 2006 – Formed Climate Change Taskforce.
- 2008 – Called for moratorium on new coal-fired electric power plants; called for shift to renewable resources.
- 2009- Sent delegation to Denmark for the UN Framework on Climate Change; developed Toolkit for Climate Action to assist League members combat climate change.
- 2010- Lobbied for comprehensive legislation to set cap on GHG pollution; honored by Oxfam America for work on climate change.
- 2012- With environmental allies, collected three million comments in support of proposed EPA rules for new power plants and carbon standards for existing plants; launched initiative to urge President Obama to use executive authority under Clean Air Act to control carbon pollution.
- 2014-16 – Supported EPA regulations; pushed for full rejection of the Keystone XL Pipeline; supported People's Climate March and the UN Paris Climate Agreement; endorsed EPA regulations to reduce ozone.
- 2017-2018 – Opposed Trump administration's decision to withdraw from the Paris Climate Agreement and gut the Clean Power plan.

The League continues to actively encourage grassroots support among its nationwide members. It also partners with like-minded community groups to advocate for policies that address the causes of climate change and mitigate its effects on the health of communities, ecosystems, and habitats.

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[133] *LWV 2018-20 Impact on Issues*, (2019 January) League of Women Voters, https://www.lwv.org/sites/default/files/2019-04/LWV%202018-20%20Impact%20on%20Issues.pdf, pg. 63, Accessed Feb 28, 2020.

The League's formal statement of position on Climate Change Policy was announced in January 2019:[134]

> "The League believes that an interrelated approach to combating climate change—including through energy conservation, air pollution controls, building resilience, and promotion of renewable resources—is necessary to protect public health and defend the overall integrity of the global ecosystem. The League supports climate goals and policies that are consistent with the best available climate science and that will ensure a stable climate system for future generations. Individuals, communities, and governments must continue to address this issue, while considering the ramifications of their decision, at all levels—local, state, regional, national, and global."
>
> "The League believes the U.S. government should move ahead immediately, without waiting for other nations, on initiatives to reduce emissions of heat-trapping gases like carbon, methane, and other air toxics. Such actions will reduce the threat of global climate change, combat air pollution, increase energy security, and create new jobs."

Regarding curbing carbon emissions specifically, the League sees pricing carbon as a powerful tool. Attendees at the LWV-US National Convention in July 2018 overwhelmingly supported a resolution clarifying support of carbon pricing proposals: "The League of Women Voters stands united with, and in support of, efforts to price carbon emissions, whether cap-and-trade, carbon tax/fee, or another viable pricing mechanism." The League has no position on how generated revenue is to be used, nor does it "espouse a single method of pricing carbon over another."
For a more detailed account of League positions in the following areas, as well as related legislative advocacy and activism from the 1950s through 2019, see *LWV 2018-20 Impact on Issues*:[135]

- Resource Management
- Environmental Protection and Pollution Control
- Air Quality
- Water Resources
- Solid Waste
- Nuclear Waste

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[134] Ibid.

[135] Ibid., pgs. 51-67

- Climate Change
- Public Participation
- Agriculture Policies

Conservation and individual actions

Conservation is a simple concept--if we use less of something, we don't need to produce as much of it. Reducing energy usage (by lowering demand and/or by increasing efficiency) is an effective way to reduce GHG as we transition to clean energy. Suggestions include:

- Reduce thermostat setting in winter and raise it in summer.
- Replace or upgrade appliances with Energy Star models (www.energystar.gov). Rocky Mountain Power and Dominion Energy offer rebates for the purchase of high-efficiency appliances (www.wattsmart.com and www.thermwise.com).
- Replace incandescent and CFL bulbs with LEDs. If you live in zip codes 84116 or 84104, you can swap up to 15 old light bulbs for LEDs for free at community centers (www.empowerslc.org). Rocky Mountain Power offers incentives for improving efficiency with LEDs and insulation (www.wattsmart.com).
- Consider GHG ratings when purchasing automobiles. (Compare ratings, which cover manufacturing, fuel production, and emissions, at www.greenercars.org).
- Weather-strip windows and doors. Utah's Weatherization Assistance Program and Dominion Energy provide help to low-income households (www.utahca.org/weatherization and www.thermwise.com/home/HomeEnergyPlan.php). Dominion Energy performs $25 energy audits.
    - Drive less and use Tier 3 fuels (http://tier3gas.org/), or use mass transit.
    - Adopt a plant-rich diet, the fourth most effective means to lower CO2 emissions out of the 80 surveyed in *Drawdown*.[136] According to a 2018 study, "Present food supply practices are responsible for 26 percent of human-caused GreenHouse Gas emissions. Production of meat, farmed fish, eggs, and dairy products uses about 83 percent of the world's farmland while providing only 37 percent of protein and 18 percent of calories consumed. A diet that excludes animal products has the potential to reduce foods' land requirement by 76 percent and its

[136] Hawken, P. (Ed) (2017) *Drawdown*, New York, New York: Penguin Books. pp. 39-40.

GHG emissions by 49 percent. Additionally, as land recovered from food production returns to its natural state, it can remove large amounts of CO2, over 8 billion metric tons, from the atmosphere every year."[137]

- If economically feasible, install home solar panels (ranked tenth in *Drawdown*).

Organizations such as Utah Clean Energy, UCAIR, U.S. Department of Energy, and American Council for an Energy-Efficient Economy offer more suggestions for energy efficiency.

Collective actions

While individual actions can lessen GHG emissions, an effective response to global warming requires societal changes. As family and community members, we can raise awareness of the challenges before us and work with advocacy groups toward similar objectives. As citizens of our cities and counties, we can support local efforts such as HB 411. As citizens of our state, we can support The Utah Roadmap and clean energy legislation. And as citizens of our country, we can support the Paris Climate Agreement and HR 763. It is our responsibility to contact our elected representatives and voice support for positive climate action.

Rachel Carson, the American conservationist, biologist and author, whose book Silent Spring and other writings are credited with advancing the global environmental movement, once said, "If facts are the seeds that later produce knowledge and wisdom, then the emotions and the impressions of the senses are the fertile soil in which the seeds must grow." It is our hope that, armed with facts and knowledge and inspired by a sense of urgency and passion, this study will find "fertile soil."

[137] Poore, J. and Nemecek, T. (2018) Reducing foods' environmental impacts through producers and consumers. *Science* **360**, 987-992.

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