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SOLVING THE CLIMATE CRISIS: OPPORTUNITIES IN AGRICULTURE

HEARING

BEFORE THE

SELECT COMMITTEE ON THE CLIMATE CRISIS HOUSE OF REPRESENTATIVES

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

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SOLVING THE CLIMATE CRISIS: OPPORTUNITIES IN AGRICULTURE

WEDNESDAY, OCTOBER 30, 2019

U.S. HOUSE OF REPRESENTATIVES,
SELECT COMMITTEE ON THE CLIMATE CRISIS,
Washington, D.C.

The committee met, pursuant to call, at 2:35 p.m., in Room 210, Cannon House Office Building, Hon. Kathy Castor [chairwoman of the committee] presiding.

Present: Representatives Castor, Bonamici, Brownley, Huffman, Casten, Graves, Griffith, Palmer, Carter, and Miller.

Also Present: Representative Pingree

Ms. CASTOR. The committee will come to order. Without objection, the chair is authorized to declare a recess of the committee at any time.

Without objection, Representative Chellie Pingree, the gentlewoman from Maine, shall be permitted to join the committee on the dais and be recognized for questioning of witnesses.

Welcome, everyone. Today we will explore how American farms can be part of climate solutions and examine climate smart agricultural practices that can reduce greenhouse gas emissions and, at the same time, increase soil health and carbon sequestration in agricultural lands, all while helping make farms more resilient to the impacts of climate change. I would like to recognize myself now for 5 minutes for an opening statement.

Well, last week the Select Committee on the Climate Crisis began exploring natural climate solutions. Nature gives us effective and inexpensive opportunities to keep our air and water clean and to reduce carbon pollution. Today, we will discuss similar opportunities in agriculture and how farmers are contributing to climate solutions and can do more.

Farmers are on the front lines of the climate crisis. Earlier this year, the midwest experienced extreme rains followed by severe winds and blizzard conditions across the region. The effects were devastating. The storms decimated livestock, flooded some fields for months, and left millions of acres unable to be planted. Some areas along the Missouri River are still flooded now 7 months later.

Similar stories can be told in other parts of our nation, whether it is fires in the west or hurricanes in the southeast. In fact, extreme weather conditions made the past year one of the worst agricultural years in decades. The climate crisis is increasingly putting America's agriculture at risk through harsher floods, longer droughts, unexpected frosts, and other extreme weather events. You know, anyone who eats should care about the climate crisis.

In August, with Fred Yoder, I visited with Florida agriculture leaders that included citrus, strawberry, and dairy farmers, timber, and ranching interests, along with agricultural extension scientists from the University of Florida, and they advised me that rising temperatures and extreme events are impacting their operations and that they need help adapting.

And they impressed upon me that they also want to be part of the solution to the climate crisis, and they are not alone. As farmers across America increasingly wrestle with the impacts of higher temperatures, they are also looking for opportunities to help solve the climate crisis. Through land management strategies and smart partnerships, they can have an enormous impact. America's farms are uniquely situated to become powerful carbon sinks, all while becoming more resilient to the impacts of severe weather events.

In the United States, agriculture is responsible for nearly 10 percent of annual greenhouse gas emissions which primarily come from nitrogen fertilizer applications and livestock. But through innovative and proven conservation practices that we will hear about today, they can reduce these emissions.

And farmers are already doing a lot to combat the climate crisis, and we must invest in them to do even more. Climate smart agricultural practices such as reducing tillage, planting cover crops, and diversifying crop rotations can increase farmlands' potential to sequester carbon and mitigate climate change. These practices often improve soil health and can also reduce costs, increase yields, and make farms more resilient to the impacts of extreme weather.

One of the most important things we can do to fight the climate crisis is to protect our farmlands. In the last several decades, we have lost millions of acres of agricultural lands to development. Protecting current farmland from development reduces the pressure to convert natural areas to new cropland, leaving intact the forests, the grasslands and wetlands to provide the climate benefits that we discussed last week.

Congress has already taken some steps to incentivize climate smart agricultural practices. Congressionally authorized USDA programs such as the Conservation Stewardship Program and the Environmental Quality Incentives Program offer farmers technical and financial assistance to increase conservation activities.

The Conservation Reserve Program pays farmers to voluntarily retire land from production for less resource-intensive uses, and the Agriculture Conservation Easement Program permanently protects farmlands through agricultural conservation easements.

Congress passed important improvements in the 2018 Farm Bill which increased and expanded upon these initiatives. The USDA also administers the Rural Energy Savings Program and the Renewable Energy for America Program which helps support energy efficiency and renewable energy in rural communities. And, of course, the renewable fuel standards and federal tax incentives for wind and solar have provided sustained economic benefits to farmers in rural counties across the country, but there is more work to do.

We can help the agricultural sector increase their critical role in carbon storage, and we can help farmers maintain and increase their profitability while also helping to solve the climate crisis. So

today we have experts here who are going to help us develop those solutions and help us turn all of these things into reality.

At this time, I will recognize—since Mr. Graves is not here, Mr. Griffith, if you would like to make any opening comments, you are welcome, and Mr. Graves will still get his opportunity when he arrives.

[The statement of Ms. Castor follows:]

Opening Statement (As Prepared for Delivery)

Rep. Kathy Castor (D–FL), Chair
U.S. House Select Committee on the Climate Crisis

"Solving the Climate Crisis: Opportunities in Agriculture"

October 30, 2019

Last week, our committee began exploring natural climate solutions. Nature gives us effective and inexpensive opportunities to keep our air and water clean and to reduce carbon pollution. Today, we will discuss similar opportunities in agriculture and how farmers are contributing to climate solutions—and can do more.

Farmers are on the front lines of the climate crisis. Earlier this year, the Midwest experienced extreme rains followed by severe winds and blizzard conditions across the region. The effects were devastating: the storm decimated livestock, flooded some fields for months, and left millions of acres unable to be planted. Some areas along the Missouri River are still flooded now—seven months later.

Similar stories can be told in other parts of our nation, whether it's fires in the West or hurricanes in the Southeast. In fact, extreme weather conditions made the past year one of the worst for agriculture in decades. The climate crisis is increasingly putting America's agriculture at risk, through harsher floods, longer droughts, unexpected frosts, and other extreme weather events. Anyone who eats should care about the climate crisis.

In August, I visited with Florida agriculture leaders that included citrus, strawberries, dairy, timber and ranching and the University of Florida ag extension scientists. The farmers and ranchers advised me that rising temperatures and extreme events are impacting their operations and they need help adapting, and they impressed upon me that they want to be part of the solution to the climate crisis.

They are not alone. As farmers across America increasingly wrestle with the impacts of higher temperatures, they're also looking for opportunities to help solve the climate crisis. Through land management strategies and smart partnerships, they can have an enormous impact. America's farms are uniquely situated to become powerful carbon sinks, all while becoming more resilient to the impacts of severe weather events.

In the United States, agriculture is responsible for nearly 10 percent of annual greenhouse gas emissions, which primarily come from nitrogen fertilizer application and livestock. But through innovative and proven conservation practices that we'll hear about today, they can reduce these emissions.

Farmers are already doing a lot to combat the climate crisis, and we must invest in them to help them do even more. Climate-smart agricultural practices, such as reducing tillage, planting cover crops, and diversifying crop rotations, can increase farmland's potential to sequester carbon and mitigate climate change. These practices to improve soil health can also reduce costs, increase yields, and make farms more resilient to the impacts of extreme weather.

One of the most important things we can do to fight the climate crisis is protect our farmlands. In the last several decades, we have lost millions of acres of agricultural lands to development. Protecting current farmland from development reduces the pressure to convert natural areas to new cropland, leaving intact the forests, grasslands, and wetlands to provide the climate benefits we discussed last week.

Congress has already taken steps to incentivize climate-smart agricultural practices. Congressionally-authorized USDA programs—such as the Conservation Stewardship Program and the Environmental Quality Incentives Program—offer farmers technical and financial assistance to increase conservation activities. The Conservation Reserve Program pays farmers to voluntarily retire land from production for less resource-intensive uses. And the Agricultural Conservation Easement Program permanently protects farmland through agricultural conservation easements. Con-

gress also passed important improvements in the 2018 Farm Bill, which increased and expanded upon these initiatives.

The USDA also administers the Rural Energy Savings Program and the Renewable Energy for America Program which help support energy efficiency and renewable energy in rural communities. And, of course, the Renewable Fuels Standard and federal tax incentives for wind and solar have provided sustained economic benefits to farmers and rural counties across the country.

But there is still work to do.

We can help the agricultural sector increase their critical role in carbon storage. And we can help farmers maintain and increase their profitability, while also helping solve the climate crisis. Today we'll explore ways Congress can help make this a reality.

Mr. GRIFFITH. Well, I appreciate that, Madam Chair, but I anticipate that Ranking Member Graves will be here shortly.

Ms. CASTOR. Okay. Well, if the witnesses don't mind, when he arrives, we may break in between witnesses and have him give some opening statements, or he might want to just jump right into the questions as well.

So without objection, members who wish to enter opening statements into the record may have 5 business days to do so.

Now we will move on to our terrific panel before us today. I will introduce each of you, and then we will go one by one with testimony.

First is Dr. Jennifer Moore-Kucera. She is the Climate Initiative Director at American Farmland Trust. She oversees their efforts to help states develop innovative policies and programs that can maximize agriculture opportunities to combat the climate crisis. Prior to joining AFT, she served in USDA's Natural Resource Conservation Service as west region soil health team leader and as the co-director for the USDA northwest climate hub.

Next, my good friend, Mr. Fred Yoder, is a fourth generation farmer. He grows corn, soybeans, and wheat in Ohio on his family's farm and operates a retail seed business. He is also the co-chair of Solutions for the Land and advocates for agriculture solutions to sustain productive, enhance climate resilience, and help the United States reach sustainable development goals.

Next, Ms. Tina Owens is the Senior Director of Agriculture Funding and Communication at Danone North America. Her work focuses on regenerative agriculture practices and financing. She has spent 2 decades leading sustainability and strategic sourcing in the food industry.

Next, Mr. Viral Amin is the Vice President of Commercial Development and Strategy at DTE Energy Resources. DTE Energy is a diversified energy company and develops renewable energy services projects, including a dairy-based renewable gas processing facility in Wisconsin.

Before we turn to you, Dr. Moore-Kucera, we want to welcome the ranking member, and if you would like 5 minutes to make opening remarks.

Mr. GRAVES. Thank you for not late shaming me too much. I apologize for being late, but thank you all for being here.

I just very quickly want to say that I appreciate you all being here today. Agriculture is a very important opportunity, very important natural resource managers that have the opportunity, as I indicated, to be significant participants in our efforts to sequester greenhouse gases.

If you look across the globe, approximately, I guess the average for agriculture is emitting about 24 percent of the greenhouse gases in different countries. In the United States, it is about 8 percent, indicating it is a more efficient agricultural practice here in the United States which does support our efforts to export agricultural products because globally, that helps to reduce greenhouse gas emissions when you look at global averages.

It is similar to the policies that we have discussed in this committee in regard to natural gas. U.S. natural gas, according to the National Energy Technology Laboratories, is over 40 percent cleaner than Russian natural gas when supplied to European and Asian countries. So once again, using U.S. gas results in lower greenhouse gas emissions globally.

Do we need to do a better job implementing best management practices and investing in R&D to ensure that we are maximizing opportunities with our farmers with agricultural lands? Absolutely. To figure out how we do a better job enhancing sequestration and do it in a way that is complementary to the objectives of our farming community.

So with that, I am going to yield back, and thank you Madam Chair.

Ms. CASTOR. All right. Dr. Moore-Kucera, you are recognized for 5 minutes.

STATEMENTS OF DR. JENNIFER MOORE-KUCERA, CLIMATE INITIATIVE DIRECTOR, AMERICAN FARMLAND TRUST; FRED YODER, CORD, SOYBEAN, AND WHEAT FARMER, CO-CHAIR, SOLUTIONS FROM THE LAND; TINA OWENS, SR. DIRECTOR, AGRICULTURE FUNDING, AND COMMUNICATION, DANONE NORTH AMERICA; VIRAL AMIN, VICE PRESIDENT, COMMERCIAL DEVELOPMENT AND STRATEGY, DTE ENERGY RESOURCES

STATEMENT OF DR. JENNIFER MOORE-KUCERA

Dr. MOORE-KUCERA. Chair Castor, Ranking Member Graves, and honorable members of the committee, I am Jennifer Moore-Kucera, the Climate Initiative Director for American Farmland Trust. An organization founded 40 years ago to help protect farmland, advance sound farming practices, and keep farmers on the land. I thank you for the opportunity to testify and applaud the committee for exploring the critical issue of agriculture and climate change.

Our nation's crop and ranch lands offer immediately available, low cost, and proven ways to address climate change by sequestering carbon and reducing greenhouse gas emissions. No other option to combat climate change comes with more of the co-benefits we need for a sustainable future. It is imperative we work across the political spectrum to make this opportunity a reality. Our farms and our futures depend upon it.

Climate change threatens lives, livelihoods, our food security, and our economy, and is no longer a distant problem. Record high temperatures, drought, wildfires, storms, and floods are becoming more intense and frequent. Collectively, these events negatively impact our crops, soil, and water. You are probably already seeing one of more of these impacts in your own districts. As we speak, north-

ern California is suffering from intense wildfires in what has become a new normal.

Agriculture contributes to these challenges as a net emitter of more than 580 million metric tons of carbon dioxide equivalents per year. However, these emissions can be substantially reduced or even offset with continued adoption of what are commonly referred to as regenerative climate smart or soil health practices.

Two proven low-cost soil health practices are cover crops and conservation tillage. Working with the USDA colleagues, we estimate that if U.S. farmers adopted cover crops on 25 percent of our cropland and conservation tillage on 100 percent of our tillable acres, we could reduce nearly 150 million metric tons of carbon dioxide equivalents per year or one quarter of the total U.S. agricultural emissions, and there are numerous other practices available that can further reduce these levels which we can discuss during questions.

AFT recently documented the co-benefits of soil health practices on four farms from across the U.S. After implementing new soil practices, they found that in addition to reducing their greenhouse gas emissions by an average of 379 percent, these same farms significantly cut nitrogen, phosphorus, and sediment losses and increased yields. The three row crop farmers increased their average net income by $42 per acre per year.

These gains, however, are not possible unless we keep farmland as farmland. According to USDA, over 25 million acres of farm and ranch land were converted to development between 1982 and 2015. Once land is lost to development, we lose the ability to further sequester carbon, and the remaining lands are subject to increased pressures. Encouraging agricultural easements and compact urban growth are two ways to protect farmland while reducing transportation emissions.

Today I am here as a scientist, not as a policy expert. Nonetheless, I want to share some perspectives from AFT policy experts. We call on Congress to seize the opportunities and make agriculture a key partner in fighting climate change. This could be achieved through a comprehensive climate bill or integrated into a transformational farm bill.

First, Congress should expand upon the successful voluntary Farm Bill conservation programs. Historically, these programs have more demand than available funding.

Second, we encourage Congress to leverage other Federal programs and State-level innovations such as the pilot programs in Iowa and Illinois that offer reductions on crop insurance premiums for cover crop adoption.

Third, we need additional research on practices that help address climate change and quantify their impacts. This knowledge will inform farmers and ensure good, sound public investments.

Lastly, we must find new ways to fund these practices and reward farmers for reducing greenhouse gases. This can include engaging consumers and private companies through environmental markets, supply chain management, and labels.

Producers are struggling to make ends meet. Such efforts are models for encouraging best practices and keeping producers viable. Our nation's farm and ranch lands have numerous scalable op-

portunities to address climate change with the co-benefits we need for our future. We at AFT are excited to continue this conversation and serve as a resource as you move forward.

Thank you once again for the opportunity to testify.

[The statement of Dr. Moore-Kucera follows:]

Testimony of Jennifer Moore-Kucera, Ph.D.
Climate Initiative Director, American Farmland Trust

Before the U.S. House of Representatives Select Committee on the Climate Crisis
"Solving the Climate Crisis: Opportunities in Agriculture"

October 30, 2019

Chair Castor, Ranking Member Graves, and Honorable Members of the House Select Committee on the Climate Crisis. I am Jennifer Moore-Kucera, the Climate Initiative Director for American Farmland Trust. Our nonprofit organization was founded 40 years ago to help protect farmland, advance sound farming practices, and keep farmers on the land.

I thank you for the opportunity to testify and I applaud the committee for exploring the critical issue of agriculture and climate change.

I want to open by saying that addressing climate change by promoting climate-smart, regenerative agricultural practices can be a win-win-win. We can ensure our nation's food security, improve our environment, and enhance economic returns to farmers and ranchers. Moreover, we already have the tools to reduce, or even eliminate, net greenhouse gas (GHG) emissions, and scientists and farmers are coming up with new innovations all the time. Along the way, we can make farmers and ranchers more productive, more profitable, and more resilient to the ups and downs of weather and markets. And finally, all of society will reap numerous additional benefits, including cleaner water, more wildlife habitat, and more productive soils that can keep growing food for generations to come. Not many sectors of the economy have the positive opportunities that we do in agriculture, so we need to work together, across the political spectrum, to seize these opportunities.

CLIMATE RISKS TO AGRICULTURE

There is a lot at stake. Too often we think of climate change as an abstraction, something that will happen in the far-off future. But for America's farmers and ranchers, climate change is already a daily reality. Extreme weather events, including record high temperatures and drought in parts of our country, threaten crop productivity, stress water supplies, and increase wildfire risks, while more frequent and intense storms in other areas wash away the soil and increase flooding. Collectively, these events negatively impact our crops and the soil and water resources we depend on. They also threaten livestock, wildlife, people, national food security, and our economy.

Within just the past 22 years, we have experienced 20 of the hottest years on record (WMO, 2019). **Increased temperatures** are predicted to impact crop yields and germination and harvest timing. These impacts may be positive or negative depending on the crop and location (Roesch-McNally et al., 2019). Whereas some crops might benefit from a longer growing season, the species and varieties of crops grown in an area shift, resulting in the need for new equipment, knowledge, and resources to maintain viability. Other impacts include greater risks of disease, insect, and weed pressures due to higher temperatures, longer growing seasons, and more frost-free days, which will increase dependence on inputs such as fungicides, herbicides, and insecticides.

In addition to higher temperatures, **more extreme weather events** are projected. Some areas will experience increased duration, frequency, and intensity of drought, whereas other areas will be subjected to intense storms, leading to major flooding. So-called 500-year floods have become 100-year floods. This makes planting and harvest more difficult, as seen in the Midwest this year when unusually wet conditions led to one of the latest planting seasons on record (Rippey, 2019). These events also lead to soil loss from erosion and flooding of farm fields, compounding water quality problems.

Other concerns, especially in western states, involve the reduction in snowpack amount and earlier peak flows (snow melt), which would reduce water availability

during the growing season (Roesch-McNally et al., 2019). Heavy and earlier spring rains or flood events will delay planting or force farmers to perform field operations (e.g., tillage, planting) when the soil is susceptible to compaction or erosion. Major flooding also imperils infrastructures such as roads, railroads, barge landings, and buildings necessary for storage and crop processing. Higher temperatures and increased drought increase stress on both livestock and crops, thus requiring greater inputs to maintain their health.

Increased carbon dioxide (CO_2) levels will have both positive and negative effects on agriculture. Additional CO_2 will stimulate growth in some crops, such as soybean and wheat, and may provide some protection against moderate drought. However, increasing CO_2 levels will also stimulate weed growth, potentially increasing herbicide use (Ziska, 2003). In addition, higher CO_2 levels cause plants to take up less nutrients, leading to less nutritious feed in the trough and food on our plate (Myers et al., 2014).

Finally, drought and high temperatures will result in **increased wildfire risk** which threatens homes, fields, livestock, wildlife, and, tragically, human life. Smoke damage for certain susceptible specialty crops (e.g., wine grapes) has resulted in decreased quality and can negatively affect farmers and farm workers exposed to unhealthy air conditions. Farmers and their neighbors in northern California are suffering from intense wildfires at the time of this testimony, in what has unfortunately become a new normal. Chances are that all of you are already seeing one or more of these impacts within your own districts.

AGRICULTURE'S GREENHOUSE GAS EMISSIONS

Agricultural practices, in part, contribute to total greenhouse gas (GHG) emissions in the United States (US). The most recent EPA report indicates that agriculture releases about 582 million metric tons (MMT) of carbon dioxide equivalents (CO_2e), which translates to approximately 9% of total US emissions (USEPA, 2019).[1] In contrast to other production sectors, which are dominated by energy-related CO_2 emission sources, the bulk of agriculture's impact on climate change is due to **nitrous oxide (N_2O) and methane (CH_4) emissions** from fertilizer application, manure handling, and enteric fermentation from livestock (USEPA, 2019).

The following percentages exclude the 40.1 MMT CO_2 from fuel combustion in agriculture to focus on the contribution of agricultural management as reported in the agriculture chapter (Chapter 5) of the US EPA 2019 inventory report:

- **53% of agriculture's GHG contributions are in the form of nitrous oxide (N_2O)** from agricultural soil management (activities such as fertilizer application, growing N-fixing plants), drainage of organic soils and irrigation practices, manure management, and field burning of agricultural residues. Nitrous oxide stays in the atmosphere about 114 years and is almost 300 times more efficient at trapping heat than CO_2 (IPCC, 2007).
- **46% of agricultural emissions are from methane (CH_4)** primarily from enteric fermentation from livestock and manure management, as well as rice cultivation and field burning of agricultural residues. Methane's lifetime in the atmosphere is only 12 years, but it is 25 times more efficient at trapping heat than CO_2 over a 100-year period (IPCC, 2007).
- Unlike other sectors, only 1.5% of agriculture's GHG contributions are from **Carbon Dioxide (CO_2)**, predominantly from urea fertilization and liming.

AGRICULTURE AS A CLIMATE SOLUTION

Although agriculture currently is a net source of GHG emissions, farmers and ranchers can be some of our nation's greatest allies in fighting climate change. There are numerous crop land and grazing land management practices that are known to increase the amount of carbon plants can capture and ultimately store belowground in the soil. This process is called soil carbon sequestration.

In fact, soils store 2–3 times more CO_2 than the atmosphere and 2–5 times more C than that stored in vegetation (IPCC, 2013). Unfortunately, between the late 1880s to 1985, agricultural soils have lost half or more of the soil organic carbon (SOC) that was present prior to industrialization (Lal, 2004). Since 1985, increased yields, reduced tillage intensity, and improved genetics have resulted in many soils beginning to increase soil carbon levels, and there is much more we can do! With more than 900 million acres of agricultural land in the US, we have an enormous opportunity to rebuild soil organic carbon, sequester atmospheric carbon, and reduce N_2O and CH_4 emissions as well. Some estimates suggest that if we were able to ade-

[1] CO_2e refers to the carbon dioxide equivalent, because methane (CH_4) and nitrous oxide (N_2O) are converted to their CO_2 equivalent, in terms of their global warming potential.

quately address economic, social, and technical barriers to implementing best soil management practices, US croplands have the potential to sequester 1.5 billion to 5 billion metric tons of CO_2e per year for 20 years (Sanderman et al., 2017; Zomer et al., 2017). Moreover, the same agronomic practices that increase carbon sequestration also help to mitigate flood events, protect water quality, recharge groundwater, and increase resilience to drought (Lehman et. al, 2015).

Rebuilding soil health is crucial to sustaining agriculture, enhancing the profitability of farmers and ranchers, and combatting climate change. Soil health is defined by USDA–Natural Resource Conservation Service (NRCS) as "the continued capacity of a soil to function as a vital living ecosystem that sustains plants, animals, and humans." Healthy, high-functioning soils:

(1) Produce food, fuel, fiber, and medicinal products using management strategies that maintain or enhance environmental quality;

(2) Store, filter, and release water, and thus protect or improve water quality;

(3) Are resilient to environmental disturbances such as drought, fire, floods, and temperature extremes;

(4) Resist diseases, pests, and pathogens, thus reducing the reliance on pesticides;

(5) Store and cycle nutrients internally, reducing the reliance on external inputs and the potential for off-site movement of nutrients into the air and water;

(6) Store and cycle carbon and modify other greenhouse gases, helping to reduce climate change; and,

(7) Maintain biodiversity and habitat, which is critical to all above functions.

Recently, the USDA–NRCS Soil Health Division has outlined four soil health principles to improve soil function for a variety of ecosystem outcomes, but they also apply to building resilient agricultural systems that sequester C and reduce GHG emissions (Roesch-McNally et al., 2019). The four principles are:

(1) Minimize disturbance (typically physical disturbance is the major focus, with a target to reduce tillage depth, intensity, and frequency);

(2) Maximize soil cover, often through mulching, reduced tillage, residue retention, and cover crops;

(3) Maximize the continuous presence of roots, which is typically achieved through cover crop planting but also longer rotations, forage, and biomass plantings, and incorporation of perennial crops into the rotation; and

(4) Maximize biodiversity through practices similar as those described in #3; but can also include the integration of livestock into the cropping system and diversifying cover crop mix or more diversified crop rotations.

In addition to sequestering carbon, healthy soils absorb more water during heavy rains, which reduces runoff. They also offer better resilience during periods of drought because the land holds more water. Healthy soils also can help farmers increase yields, increase yield stability, and be more productive in the long term. Ultimately, building soil fertility can reduce farmers' dependence on fertilizers, saving them money and improving their bottom line. Soil health systems also offer a wide range of ecologically important co-benefits (Figure 1).

These practices can be put in place separately, but ideally producers will implement a suite of practices to optimize benefits and co-benefits. For example, the benefits of cover crops were detectable more quickly with no-till management compared with conventional tillage (Olson et al., 2014). Additionally, cover crops have been reported to increase economic gains when farmers transition to no-till practices in both corn and soybeans (Myers et al., 2019).

Estimated GHG Benefit from Cover Cropping and Conservation Tillage

Among the soil health practices promoted by American Farmland Trust, NRCS, Soil and Water Conservation Districts, and numerous other organizations across the nation, **reduced tillage** and **cover cropping** are the two most popular and studied.

According to the 2017 USDA AgCensus, there are ***396 million acres of total cropland and 401 million acres of grazing land*** in the US (www.nass.usda.gov/AgCensus/). Of the total cropland reported, 15.3 million acres have adopted cover cropping, **104 million acres are in no-till** and **97.5 million acres have adopted reduced tillage practices** that disturb the soil less than conventional till.

Although there are many benefits of cover crop and conservation tillage adoption, I would like to focus on their impact on GHG emissions. To estimate the GHG reduction benefit from these key conservation practices, American Farmland Trust—in collaboration with the USDA Agricultural Research Service—used data from the 2017 AgCensus along with estimated GHG reduction coefficients reported in the USDA COMET–Planner tool (www.comet-Planner.com). Based on these data, our preliminary calculations estimate that relative to no cover cropping, **current adop-**

tion of 15.3 million acres of cover cropping have potentially reduced emissions between 4.2 and 6.3 million metric tons (MMT) CO_2e per year.

Recognizing that not all the remaining cropland is suitable or appropriate for cover cropping, adopting cover crops on even 25% of the remaining cropland (e.g., about 95 million acres) can further reduce CO_2e emissions between 22.6 and 31.9 MMT per year. Combining **current cover crop adoptees and this conservative estimate of future adoption would reduce GHG emissions by an estimated 26.8 to 38.2 MMT of CO_2e per year**.

Similarly, we estimate that the **current adoption of conservation tillage on 201.5 million acres has reduced CO_2e between 59.1 and 70.8 MMT per year**. Expanding the current adoption levels and converting the remaining 79.9 million acres that are in intensive till to reduced till or no-till can reduce **an additional 12.6 to 39.4 MMT per year**.

If we add up the **current and projected future adoption of cover crops (25%) with no-till or reduced till practices (100%), our nation could reduce GHG emission by up to 148.5 MMT CO_2e per year.** This translates to approximately 25% of the total ag GHG emissions and that doesn't include what can be achieved through the addition of best practices for grazing land management and livestock/manure management. This 148.5 MMT CO_2e is **equivalent to removing 31.5 million passenger vehicles** from the road each year (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator).

Additional Conservation Practices Provide Further GHG Reductions

Cover crops and conservation tillage are just two of the many conservation practices available on croplands. There are numerous nutrient management options such as replacing synthetic nitrogen fertilizers with composts or manure, switching sources of synthetic nitrogen from anhydrous ammonia to urea, improved timing of fertilizer application, and variable application rates within the field (Fargione et. al., 2018). Other practices include conservation crop rotations, improved manure management, biochar, and mulching. We currently are working on estimating the GHG benefits from many of these practices using the same approach we report on for croplands above.

Many of these practices can be economically beneficial for farmers, but their adoption involves real and perceived risk. AFT has worked on the ground in 18 states to help farmers optimize their fertilizer rates with risk free yield guarantees. Farmers reported high satisfaction with the program and 85% said they have continued to use the approach on their farm.

Grazing lands make up about 45% of all US agricultural lands. Although they typically are less suitable for crop production, they are ideally suited for livestock. These soils store vast amounts of carbon and, when managed properly, provide numerous ecosystem services such as wildlife and pollinator habitat and water storage and drainage. Similar to croplands, there are many conservation practices available for grazing lands. Ensuring sufficient rest periods between grazing events can maximize plant productivity and, hence, the amount of carbon fixed from the atmosphere. In addition, studies have shown that fertilizing California rangeland with compost could sequester large amounts of carbon (Ryals et al., 2015).

Other landscape-level considerations with major GHG reduction potential include establishing trees or shrubs along field borders, riparian forest buffers, hedgerow plantings, alley cropping, and establishing strips of permanent grass and legume covers to absorb rainfall and reduce erosion. All of these practices bring huge co-benefits, including supporting pollinators and other beneficial insects, creating wildlife habitat, and enabling native plant species to thrive. In Iowa, research has shown that planting strips of native prairie plants within existing crop fields can build soil carbon while substantially reducing erosion and nutrient loss and supporting pollinators and grassland birds (Pérez-Suárez et al., 2014; Schulte et al., 2017).

In addition, there are some technological interventions that can target key sources of emissions, such as installing methane digesters to turn stored manure into an energy source, and feed additives that can reduce enteric fermentation emissions from cattle.

As you can see from this testimony, there are numerous options available to support crop and grazing land productivity and environmental services like reduced GHG emissions and increased soil carbon sequestration. Successful implementation, however, requires technical and financial assistance to optimize productivity and GHG reductions.

Healthy Soil Case Studies

The success of these healthy soil practices is not just conceptual. With support from an NRCS Conservation Innovation Grant, American Farmland Trust staff partnered with four farmers in California, Illinois, Ohio and New York to produce easy-to-read, two-page case studies showing the excellent return on investment for healthy soil practices for a variety of crops (https://www.farmlandinfo.org/soil-health-case-studies). These farmers implemented steps such as no-till, nutrient management, cover crops, compost, and mulching. As a result, these farms cut their greenhouse gas emissions by an average of 379% on fields selected for the analysis. This means that these fields transformed from being net emitters to net reducers of greenhouse gases.

These case studies also illustrate the many benefits associated with healthy soil practices. The actions taken by these farmers increased yields and profits, stopped soil erosion problems, and improved water quality. The farmers saw, on average, increased yields of 12%, reduced nitrogen losses of 54%, reduced phosphorus losses of 81%, and reduced sediment losses of 85%. The average net income increase for the three crop farmers was $42 per acre per year. For the California almond grower, his net income increased an average $657 per acre per year, thanks to the soil health practices.

Adopting climate-smart agricultural practices is among the least costly and most immediate actions that can help reduce greenhouse gas emissions on a meaningful scale. Their extensive adoption can serve as an important bridge until new climate-friendly energy and transportation technologies are developed.

Protection of Farmland as a Climate Strategy

None of these gains are possible unless we are able keep farmland as farmland. According to the USDA, over 25 million acres of farmland and ranch land were converted to development between 1982 and 2015. Through our "Farms Under Threat" project, American Farmland Trust is mapping the precise location of this past development, as well as areas with the highest threat in the future. This information will help towns, counties, and states make smart decisions to protect their valuable farmland.

A growing body of research demonstrates the necessity of protecting agricultural lands from development as a key component to any comprehensive GHG reduction strategy. Not only does it protect lands that can function as carbon sinks, it encourages inward and more compact development growth, thereby preventing additional transportation emissions and electrical and heating use. American Farmland Trust's 2018 "Greener Fields" study found that cutting California farmland loss by 75% by 2050 (700,000 acres), while encouraging compact urban growth, would reduce GHG emissions by 33 tons of GHG (per acre per year). That's the equivalent of taking 1.9 million cars off the road each year. Protecting farmland also keeps that land available for flood and fire mitigation.

With every acre of farmland we lose, we not only lose the ability of that land to grow food and sequester carbon, we put more pressure on the remaining land to be farmed more intensely, further reducing environmental benefits. And with 40% of U.S. agricultural land expected to change hands in the next 15 years due to the age of landowners, we need to take full advantage of tools such as easements to ensure that as much remains farmland as possible (NASS, ERS, https://farmland.org/project/farm-legacy).

CONGRESS' ROLE IN HELPING FARMERS AND RANCHERS ADDRESS CLIMATE CHANGE

I am here today as a scientist, not as a policy expert. Nonetheless, I want to share some perspective on these matters from the policy experts at American Farmland Trust.

First, we want to thank Congress for the significant commitments made in the **2018 Farm Bill Conservation Title.** These important programs provide technical assistance and financial incentives for farmers and ranchers to protect soil, water, wildlife, and other natural resources on privately owned lands and offer a strong starting point for how agriculture can be part of the solution to climate change.

Within the 2018 Farm Bill, Congress included critical additional funding for the **Agricultural Conservation Easement Program—Agricultural Land Easements (ACEP–ALE) program,** which provides funds to enable local and state partners to work with farmers to permanently protect their land. This new funding will begin to meet program demand and ensure productive agricultural lands remain available to future generations of farmers and ranchers and for GHG reduction.

We also appreciate the additional funding included for the **Regional Conservation Partnership Program (RCPP).** This program enables public and private conservation agriculture groups to join with farmers in a focused, local area to develop innovative approaches toward shared conservation goals.

Other working lands programs, such as the **Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP),** are vital tools for farmers and ranchers to implement or enhance current conservation practices on their land. They support farmers to plant cover crops, reduce tillage, diversify crop rotations, and improve grazing management, all of which can reduce greenhouse gas emissions. Likewise, studies have shown that land enrolled in the **Conservation Reserve Program (CRP)** rapidly sequesters soil carbon, while also providing benefits for wildlife and water quality (Gebhardt et al., 1994).

Such programs give us a foundation to build from. However, more must be done to help farmers and ranchers protect their land and implement agricultural practices addressing climate change. At a time when the farm economy is suffering, ensuring the widespread adoption of new practices will require additional incentives, training, and capacity.

American Farmland Trust would like to share a few additional ideas on how Congress can help more farmers and ranchers reap the benefits of practices that reduce GHG.

A first step would be to **provide additional funding for existing Farm Bill conservation programs, such as ACEP–ALE, RCPP, EQIP, CSP, CRP, and others.** However, both legislation and agency rulemaking could be strengthened to encourage GHG reductions in addition to other services. Historically, these conservation programs are oversubscribed, meaning there is not enough money to support the farmers who actively want to improve their operations, and not enough for critical technical assistance to help them make changes on their farm. Any farmer or rancher who wants to improve their soil health and reduce GHG emissions should get the support they need.

Another opportunity would be to **leverage other programs, including state soil health efforts.** This includes **incentives for climate-smart practices through the crop insurance program.** Cover crops can help increase resiliency, which reduces risk. As a result, Iowa and Illinois have launched pilot programs offering insurance premium reductions to those taking advantage of cover crops. Such a concept should be explored at the national level. **Expanding low to no-interest loans to help farmers implement practices is another option.**

We must also **increase support for climate-related agricultural research.** We have many different practices at our disposal, but ongoing research is needed to make them work for farmers in all the unique climates, soil types, and production systems where they grow our food. The National Academies' 2018 "Science Breakthroughs to Advance Food and Agricultural Research by 2030" report identifies the soil as one of the frontiers of agricultural science. We are just beginning to understand its immense potential. To unlock this potential, we need further investments in tools and methodologies to quantify and track the impacts of management practices on soil carbon storage. We also need better quantification of how innovative management practices affect emissions of N_2O and CH_4. This knowledge will be critical to ensuring that public investments in agricultural GHG mitigation are sound and provide incentives for the right management practices.

Lastly, we must **find new ways to help fund these crucial changes.** This can include engaging consumers and private companies through environmental markets, supply chain management, and labels. American Farmland Trust has worked across the country to develop markets for carbon and other ecosystem services, such as reductions in nitrogen and phosphorus. Now, many companies are becoming engaged in this work as they aggressively look for ways to reduce their carbon footprint. These local, state, and regional efforts are compelling models for how we can provide future funding that rewards best practices and keep farmers and ranchers viable as they innovate. More must be done to explore how these types of funding models could work nationally.

As policymakers think about how to address agriculture and climate change, we recommend a comprehensive, integrated approach. This could be achieved by fully including agriculture in a major climate bill. In addition, the next Farm Bill, as the piece of legislation that touches on all facets of agriculture, represents a transformational opportunity to enact many of these ideas. The most important objective is to ensure that the vast potential of agriculture is unleashed as part of any broader set of climate solutions.

The opportunities before us are enormous. Every day, farmers, ranchers, and private forest owners make stewardship decisions that impact over 1.4 billion acres of land. This is over 70% of the landmass of the contiguous 48 states (USDA, 2018).

As a society, we must value not only the food our farmers and ranchers produce, we must value all of the environmental services they can produce for our nation.

CONCLUSION

America's farmers and ranchers are an essential and indispensable part of any meaningful plan to address climate change. I thank you once again for this opportunity and for elevating the role agriculture can play in addressing climate change. Our entire team at American Farmland Trust is excited to continue this conversation and to serve as a resource as you move forward with this important work.

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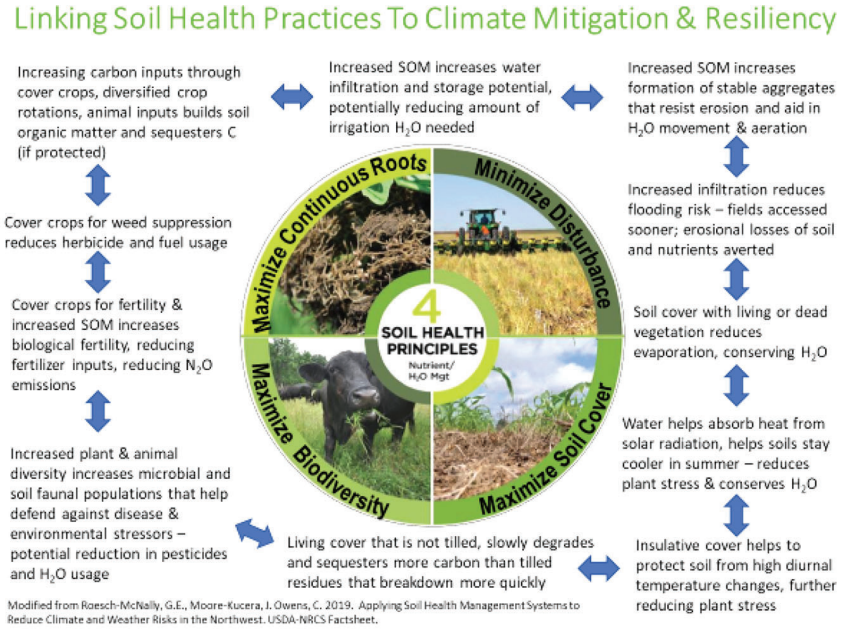

Figure 1. Linking Soil Health Practices to Climate Mitigation & Resiliency.
SOM = soil organic matter

GLOSSARY OF TERMS (NOT A COMPREHENSIVE LIST)

The following terms were as defined in the 2017 Census of Agriculture—Report form guide:

Cover crop—a crop planted primarily to manage soil erosion, soil fertility, soil quality, water, weeds, pests, and diseases on non-CRP acres.

Intensive tillage leaves less than 15% of crop residue of small grain residue. This type of tillage is often referred to as conventional tillage. Intensive tillage often involves multiple operations with implements such as a mold board, disk, and/or chisel plow.

No-till farming practices is cropland used for production from year to year without disturbing the soil through tillage other than planting. Do not include as no-till, land that was not planted in 2017 such as existing orchards, land in berries, nursery stock, or hay harvested from existing grassland or alfalfa that was established prior to 2017. No-till is an agricultural technique which increases the amount of water that infiltrates into the soil and increases organic matter retention. In many agricultural regions it can reduce or eliminate soil erosion. As explained in LaRose and Myers (2019) "no-till, which would include both continuous no-till and rotational no-till (rotational no-till refers to using no tillage after one crop, such as soybeans, but tilling after another crop in the rotation, such as after corn."

Reduced tillage leaves between 15% and 30% residue cover on the soil of small grain residue to conserve moisture and prevent erosion. This may involve the use of a chisel plow, field cultivators, or other implements.

AMERICAN FARMLAND TRUST SOIL CASE STUDIES

These case studies were developed by American Farmland Trust as part of a 2018 USDA Natural Resources Conservation Service Conservation Innovation Grant (CIG) project, "Accelerating Soil Health Adoption by Quantifying Economic and Environmental Outcomes & Overcoming Barriers on Rented Lands," and feature farms in California, Illinois, Ohio and New York. The four case studies can be accessed below:

- MadMax Farms, Ohio (https://www.farmlandinfo.org/sites/default/files/AFT_NRCS_Case%20Niemeyer%20web2.pdf)
- Swede Farm LLC, New York (https://www.farmlandinfo.org/sites/default/files/AFT_NRCS_Case%20Swede%20web2.pdf)
- Okuye Farms, California (https://www.farmlandinfo.org/sites/default/files/AFT_NRCS_Case%20Sauter_web2.pdf)
- Thorndyke Farms, Illinois (https://www.farmlandinfo.org/sites/default/files/AFT_NRCS_Case%20Thorndyke%20web2.pdf)

AMERICAN FARMLAND TRUST CLIMATE EXPERTS

American Farmland Trust (AFT) has a wide range of experts that can serve as a resource on issues related to agriculture and climate change, including:

Jennifer Moore-Kucera, Ph.D., Climate Initiative Director, was hired in late 2018 to provide overall leadership for AFT's climate work and technical assistance to the U.S. Climate Alliance states. Jen is a nationally recognized soil health expert having led NRCS's West Region Soil Health Team and co-directed the USDA Northwest Climate Hub. Before that, Jen was an associate professor in environmental soil microbiology at Texas Tech University.

Tim Fink, Policy Director, was hired in 2019 to develop AFT's overall policy strategies. Tim brings extensive policy experience from both the agriculture and energy sectors to AFT's work on the Farm Bill and work advocating for agriculture to be included in federal and state climate plans.

Jimmy Daukas, Senior Program Officer, has worked on agriculture and climate issues at AFT in various leadership roles for over 20 years. He spearheads AFT's work on smart solar siting. Jimmy also serves on the Steering Committee of the Coalition on Agriculture Greenhouse Gases.

Michelle Perez, Ph.D., Water Initiative Director, leads a companion effort that addresses nonpoint source pollution. An expert in quantifying environmental outcomes, she is working in partnership with the NRCS through a Conservation Innovation Grant on the work entitled "Quantifying Economic and Environmental Outcomes of Soil Health". The first four case studies published outline outcomes that have been shared with this testimony.

Gabrielle Roesch-McNally, Women for the Land Director, leads AFT's national initiative to ensure women landowners have access to the resources and technical advice to lead in building resilient agrifood systems. She is an expert in producer decision-making in the context of climate change adaptation and mitigation and has written or contributed to many publications on climate change. Before AFT she worked at the USDA Northwest Climate Hub.

Brian Brandt, Director of Conservation Innovation, is an expert on environmental markets. He currently manages a project that employs conservation practices in the Ohio River Basin to reduce pollutants contributing to the dead zone in the Gulf of Mexico.

Mitch Hunter, Director of Research, returned to AFT in 2019 to lead its collaborative research program, including 'Farms Under Threat,' a comprehensive data project with multiple connections to climate. He is an expert in sustainable intensification and climate resilience in agriculture.

Ann Sorensen, Ph.D., Research Senior Advisor, is author of more than 70 refereed papers. Ann has had an outsized influence on agricultural policy during three decades at AFT. She currently advises on 'Farms Under Threat,' having led the project and recently taken partial retirement.

Beth Sauerhaft, Ph.D., Vice President who oversees AFT's National Initiatives (including Climate and Water). Just hired in early 2019, Beth brings to AFT experience as an environmental and social sustainability consultant, a sustainability officer at a global food company, and an EPA official. She began her career at NRCS.

David Haight, Vice President who oversees AFT's Regional Offices, where AFT works directly with farmers on conservation practices and with state legislators on agricultural policy. David is spearheading AFT's effort to bring on-the-ground experiences to U.S. Climate Alliance states. This work involves several of AFT's regional directors.

John Piotti, President & CEO, sees climate as the central issue of our times and agriculture as essential to achieving climate goals. As such, he plays a direct role in AFT's Climate Initiative, bringing a wealth of experience in management and program development.

Ms. CASTOR. Thank you very much.

Mr. Yoder, you are recognized for 5 minutes.

STATEMENT OF FRED YODER

Mr. YODER. Well, good afternoon, Chair Castor, Ranking Member Graves, and members of the Select Committee on the Climate Crisis. I thank you for the opportunity to appear before you today to share some of my thoughts and experiences involving opportunities for agriculture to contribute solutions to climate change and challenges.

My name is Fred Yoder, and I am a fourth generation farmer who has lived and farmed near Plain City, Ohio for over 45 years. Along with my wife, Debbie, and our two children and their families, we grow corn, soybeans, and wheat. We have also operated a retail farm seed business for over 40 years and sell all kinds of seed to farmers including biotech, conventional, and also the ones that grow organic crops. We also offer precision technologies to help farmers increase their efficiencies.

I am testifying today as both a working farmer and also co-chair of Solutions for the Land, a farmer-led, non-governmental organization that works to place America's farms, ranches, and forests at the forefront of resolving food system, energy, environmental, and climate challenges and achieving global sustainable development goals.

I want to begin by affirming one important fact. Although the topic we are discussing today can be politically divisive, my personal observations and experiences have taught me there is evidence that climate is, indeed, changing. I see it happening before my very eyes. Science isn't perfect, but it is the very best tool we have to make assessments, and the science on this topic is clear. It is time to stop debating whether the climate is changing because of natural or human activities and come together and advance proven, pragmatic, and innovative agricultural solutions that benefit producers, the public, and the planet.

We as an industry are also uniquely positioned to be the ones that can deliver the solutions. In central Ohio where I farm, we have already experienced one of the most difficult growing seasons I can ever remember in my career. In my written testimony, I discuss the need to utilize the three complementing and interlocking climate smart agriculture, or CSA, to address climate challenges.

First, sustainably increasing agricultural productivity and livelihoods. The second one is enhancing adaptive capacity and improving resilience, especially in our soils. And third, delivering ecosystem services, sequestering carbon, and reducing and/or avoiding greenhouse gas emissions. The reason CSA is an effective strategy for engendering farmer participation and support is the approach

places farmers at the center of all climate discussions and decisions.

I also discuss a number of guiding principles that should be understood and followed as we determine agriculture's response strategies to a changing climate. Science-based decisionmaking should be the foundation for the adoption of climate smart technologies and practices for sustainable agriculture and global food production. There is no silver bullet solution for enhancing the resilience of agriculture. Solution strategies must adopt a systems approach.

While climate change will pose serious changes for the agriculture and forestry sectors, it will also present new opportunities in the form of near-term high value and lower cost mitigation services. These sectors can provide in the form of carbon dioxide captured by crops, grasses, trees, and sequestered in the soil emission reductions from improved agriculture management practices, emissions that are avoided through the production and use of renewable energy and fuels and bio-based products.

So what can you all do to help us? First, you can call for increased federal funding for conservation tillage, cover crop, biogas programs administered through USDA NRCS, environmental quality incentives, conservation stewardship, and regional conservation partnership program. There are very good people in these positions. We just need more of them.

You can call to rebuild the capacity of NRCS state conservation agencies and local conservation districts to provide much-needed technical assistance in writing and implementing CSA plans, providing funding for our nation's land grant universities, and expand CSA research and extension work. We can offset fossil fuel emissions by using biomass to produce renewable energy and bio-based production.

You can restore USDA's ability to conduct agriculture and economic research in support of CSA. You can enable, through proper funding, USDA is network of climate hubs to develop and deliver science-based, regional specific information and technologies to farmers and natural resource managers.

Finally, I thank you for providing a real farmer an opportunity to speak to you on this critically important topic, and I look forward to your questions.

[The statement of Mr. Yoder follows:]

Testimony of Fred Yoder
Corn, Soybean & Wheat Farmer; Co-Chair, Solutions from the Land

Before the U.S. House of Representatives Select Committee on the Climate Crisis
"Solving the Climate Crisis: Opportunities in Agriculture"

October 30, 2019

Good afternoon Chair Castor, Ranking Member Graves, and members of the House Select Committee on the Climate Crisis. Thank you for the opportunity to appear before you today to share some of my thoughts and experiences involving opportunities for agriculture to contribute solutions to climate change challenges.

My name is Fred Yoder, and I am a 4th generation farmer who has lived and farmed near Plain City, Ohio for over 45 years. Along with my wife Debbie and our 2 children and their families, we grow corn, soybeans, and wheat. We have also operated a retail farm seed business for over 40 years and sell seed to all kinds of farmers including those who use biotech varieties, conventional varieties, and those

who grow organic crops. Additionally, we sell precision agriculture equipment to help farmers improve their planting and harvesting operations.

I am testifying today as both a working farmer and as Co-Chair of Solutions from the Land (SfL), a farmer led non-governmental organization that works to place America's farms, ranches and forests at the forefront of resolving food system, energy, environmental and climate challenges and achieving global sustainable development goals. SfL's mission is to identify and facilitate the implementation of integrated policies, practices and projects at a landscape scale that will result in land being sustainably managed to produce food, feed, fiber and energy, while enhancing biodiversity, protecting and improving critical environmental resources and delivering high value solutions to combat climate change.

I want to begin by affirming an important fact. Although the topic we are discussing today can be politically divisive, my personal observations and experiences have taught me there is evidence that the climate is indeed changing. I am a farmer living and working through these climate changes. Climate change is disrupting my operations today and is a major threat multiplier to the future economic viability of my four decade plus family farming operation. As I said in a recent Politico story on this topic, it's absolutely a crying shame that we've politicized climate change. Agriculture is a science-based industry. I make decisions on my farm based on the best science I can find. Science is telling us that the climate is changing. I see it happening before my very eyes. Science isn't perfect, but it's the very best tool we have to make assessments, and the science on this topic is clear.

It's time to stop debating whether or not the climate is changing because of natural or human activities and come together and advance proven, pragmatic and innovative agricultural solutions that benefit producers, the public and the planet. I've devoted much of my life to this cause and that's why I took a day off from my fall harvest to be with you for this very timely and important hearing.

Farmers and ranchers are directly impacted by climate change, and we as an industry are also uniquely positioned to help deliver solutions. Disastrous events due to extreme weather are becoming more frequent, and their cost is enormous. Farmers and ranchers have taken steps to prepare for disasters—but despite their best efforts, the scale of these events has led to widespread crop damage and losses. Weather-related changes make it riskier to raise livestock and produce crops—and require greater resilience. Rising temperatures can reduce the fertility of livestock, reduce their rate of gain, and likewise reduce crop yields. Weather changes have increased the length of the frost-free period (and corresponding growing season), increased precipitation and heavy downpours, and increased frequency of extreme weather events like droughts, floods, fires, and heat waves. These are not things science is telling us will happen. These challenges are happening now and we are struggling mightily to adapt.

In central Ohio where I farm, we have already experienced one of the most difficult growing seasons that I can remember during my farming career. Last year was almost a record wet year, delaying planting by weeks. This was followed by 6 rain events during the growing season of over 2 inches each, and then by a fall that contained virtually no harvest days during the whole month of November. We finally finished field work shortly before Christmas. This year's spring planting was again delayed by weeks because of wet and saturated soils. This was followed by a very dry July and August, greatly restricting plant growth and delaying maturity. As we hopefully finish up harvest this week, yields have been down 20 to 30% from historical numbers. Luckily, this year at least we have so far enjoyed a dry and warm harvest in Ohio, and should finish on time.

Elsewhere, a large swath of the country experienced record winter precipitation in 2019, in some areas up to 200 percent above normal, leading to major flooding. Spring flooding across the Midwest left many fields unplanted, resulting in about $2 billion of losses in uninsured stored crops. Cool, wet springs across the Midwest and Ohio River Valley delayed planting, which meant changes in which crops were planted. The Mississippi River rose to historical levels and left acres of fields in Mississippi inaccessible—even for wildlife. Early fall blizzards and early freezes damaged crops in the Dakotas and Upper Midwest. The 2016 California drought was also devastating, resulting in $247 million loss of farm-gate revenues and up to $600 million in spillover value lost to the rest of the economy. North Carolina farmers and livestock growers experienced more than $1.1 billion in losses from Hurricane Florence in 2018. And the list goes on.

Over the past four years, Solutions from the Land has been facilitating and supporting the North America Climate Smart Agriculture Alliance (NACSAA), a coalition of over 70 farm, ranch, forestry, conservation, academic and government partners. These groups have joined together to create a platform for inspiring, educating, and equipping agricultural partners to innovate effective local adaptations

that sustain productivity, enhance climate resilience, and contribute to local and global goals for sustainable development. The Alliance is producer-led and focused on utilizing climate-smart agriculture (CSA) strategies to enhance the adaptive capacity of North American agriculture. Adaptive management involves responses taken by producers and the value chain to reduce risks and capture opportunities created by changing conditions. These actions range from minor adjustments in existing production systems to major changes in production and marketing practices.

In considering agricultural solutions to climate change, it's important to recognize and respect the fact that CSA is built upon three complementing and interlocking strategies: (1) sustainably increasing agricultural productivity and livelihoods (i.e. sustainable intensification); (2) enhancing adaptive capacity and improving resilience; and (3) delivering ecosystem services, sequestering carbon, and reducing and/or avoiding greenhouse gas emissions (GHGs). This approach has been embraced and successfully deployed by many stakeholders at the state and national level here in the U.S. and on a global scale through FAO and the Global Alliance for Climate Smart Agriculture, of which SfL is an active member. The reason CSA is an effective strategy for engendering farmer participation and support is that the approach places farmers at the center of all climate discussions and decisions. It recognizes that the key to engaging and empowering famers to act is to begin by focusing on economically viable systems and practices that benefit the famer, improve resilience and simultaneously deliver high value ecosystems services that the public seeks. When I talk to fellow farmers about climate change, I don't talk about what they can do or need to do to save the planet; I talk about innovative practices and systems that help their economic and environmental bottom lines. These same practices also provide solutions to climate change.

Farmers and ranchers take great pride in the practices they use on the farm to protect and enhance the environment. Not every practice will work for every farm. There are 20,000 soil types, 28 growing zones, and 18 major watersheds across the United States. What works in one area may or may not work in another.

That brings me to the second topic I want to cover today—the guiding principles that should be understood and followed as we determine agricultural response strategies to a changing climate. We have given this subject a lot of thought. Working with our NACSAA partners, we've adopted a set of Climate Smart Agriculture guiding principles and are advocating for their use at the global level through our involvement in the United Nations Framework Convention on Climate Change, of which SfL is an observer organization and contributor. Guiding principles are needed to establish a framework for expected behavior and decision-making. I urge the House Select Committee to embrace and follow these guiding principles as you develop your recommended agricultural solution pathways to address the climate crisis:

- As affirmed in the communiqué from the 8th Meeting of G20 Agricultural Chief Scientists (MACS), science-based decision making should be the foundation for the adoption of climate smart technologies and practices for sustainable agriculture and global food production.[i]
- Production and production efficiency per unit of land must increase going forward to meet the food needs of the future while incurring no net environmental cost.[ii, iii]
- As reflected in the Sustainable Development Goals (SDGs) of the United Nations, outcomes (rather than means) applicable to any scale of enterprise must be emphasized, without predetermining technologies, production type or design components.[iii]
- Adaptation strategies must be recognized to require system approaches[iv] that utilize a combination of improved efficiency, substitution (e.g. new crop varieties and breeds), and redesign/system transformation to reflexively respond to continuous short- and long-term changes in climate's impacts on cultivated and natural ecosystem conditions.
- Peer reviewed academic, business and farmer climate smart agriculture research and knowledge sharing recommendations should guide decision-making.

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[i] G20 Japan. *8th Meeting of Agricultural Chief Scientists (MACS) Communiqué* [Press Release]. (2019). Retrieved from http://www.affrc.maff.go.jp/docs/press/attach/pdf/190427-3.pdf.

[ii] Pretty, J. (2018). Intensification for redesigned and sustainable agricultural systems. *Science, 362*(6417), eaav0294.

[iii] Campbell, B. M., Thornton, P., Zougmoré, R., Van Asten, P., & Lipper, L. (2014). Sustainable intensification: What is its role in climate smart agriculture? *Current Opinion in Environmental Sustainability, 8,* 39–43.

[iv] Tittonell, P. (2014). Ecological intensification of agriculture—sustainable by nature. *Current Opinion in Environmental Sustainability, 8,* 53–61.

- There is no silver bullet solution for enhancing the resilience of agriculture: solution strategies must embrace a systems approach that recognizes the tremendous diversity of agricultural landscapes and ecosystems and enables producers to utilize the systems and practices that best support their farming operations.
- Farmers must be at the center of all discussions and decision-making; significant input will be needed from a wide range of agricultural stakeholders, including technical agricultural experts drawn from farmer organizations, academia, industry, and international and regional organizations.
- Context-specific priorities and solutions must be aligned with national policies and priorities, be determined based on the social, economic, and environmental conditions at site (including the diversity in type and scale of agricultural activity), and be subject to evaluation of potential synergies, tradeoffs, and net benefits.[v]

In SfL's work facilitating farmer-led, multi-stakeholder CSA collaboratives in North Carolina, Ohio, Missouri, Florida and Iowa, we have found general agreement that agriculture is undergoing transformational change and that climate change is a threat multiplier that requires additional discussion and adaptive management planning. While the types and ways crops and livestock are produced in each state vary, the leaders we have engaged agree that their level of preparedness to adapt to and mitigate the effects of climate change is inadequate. Most forged consensus on the need to conduct comprehensive agricultural vulnerability assessments along the lines of the assessment the state of California just produced. And most agreed on the need to develop and implement comprehensive adaptive management and ecosystem service action plans to enhance the resilience of agriculture and improve the environment.

Federal support to accelerate and scale up work in these areas across the country is needed and could be one of the House Select Committee's primary recommendations to help the agriculture sector deliver climate smart agriculture solutions from the land. Examples of areas of focus for these ecosystem service action plans include:

- Enabling policies which facilitate public and private payments to farmers for the ecosystem services they produce with CSA systems and practices;
- Production systems that improve efficiency and reduce inputs;
- Conservation practices that improve soil organic content, sequester carbon and enhance water storage;
- Reforming crop insurance policies that work at cross purposes with CSA practice adoption, such as those that disincentive the planting of fall cover crops;
- Investments in research and knowledge sharing to give producers confidence to innovate with emerging CSA systems;
- Investments in technology innovation to allow for more widespread adoption of precision agriculture systems such as variable rate fertilizer application technologies;
- Infrastructure investments to allow communities to better manage water challenges from prolonged droughts or intense rain events, ensuring the safe and timely delivery of goods and services necessary to protect the ag economy and national food system; and
- Removal of regulatory barriers which impede the deployment of lower-carbon, high-octane biofuels and new engines that can be optimized to run on these cleaner-burning fuels.

While climate change will pose serious challenges for the agriculture and forestry sectors, it will also present new opportunities in the form of the near-term, high-value, and lower-cost mitigation services these sectors can provide. The potential reductions directly available from these sectors come through three principal mechanisms: carbon dioxide captured by crops, grasses, and trees and sequestered in the soil; emission reductions from improved agricultural management practices; and emissions that are avoided through the production and use of renewable energy and fuels and biobased products.

Fostering the implementation of practices that increase the uptake and storage of carbon into the system will pay dividends for both the climate and food security while delivering multiple ecosystem service co-benefits. For example, increasing soil carbon sequestration for climate increases soil organic matter which can enhance nutrient cycling, water retention and infiltration, support soil biodiversity, and in-

[v] North American Climate Smart Agriculture Alliance (2015). *A platform for knowledge sharing and application of climate science to agriculture* [Report]. Retrieved from: https://www.sfldialogue.net/files/sfl_formation_plan_2015.pdf.

crease crop productivity and climate resilience. These co-benefits are particularly important in Ohio where nutrient leaching from farm fields is contributing to nutrient pollution in Lake Erie.

It is impossible to overstate how important land-based solutions like the ones we have discussed will be to address global climate change going forward into the future. Dr. Rattan Lal, Ohio State University's Nobel Prize-winning expert on soil carbon management and an IPCC report contributor, predicts that properly managed soil, vegetation and animal systems worldwide could achieve 157 parts per million of CO_2 drawdown per year by the next century—nearly 40% of 2018's global atmospheric carbon levels. Enabling policies that address climate change through agriculture and forestry can unlock the huge, untapped potential for America's farms to lead the way towards this goal through both economic and environmental sustainability.

Another important climate solution pathway is offsetting fossil fuel emissions by using biomass to produce renewable energy and biobased products. Because bioenergy emits far fewer GHGs than its petroleum equivalents, broader use can help mitigate climate change. Those benefits were strongly underlined by a USDA study released earlier this year showing that GHGs from corn-based ethanol are about 39 percent lower than from gasoline. The study also states that when ethanol is produced at refineries powered by natural gas, GHGs are even lower, running around 43 percent below gasoline.

The USDA report serves as a reminder of the need for further appropriate policy measures that can optimize the climate benefits offered by bioenergy—an end product of agriculture—to maximize the climate solutions producers can provide from the land. While expanding the opportunity for sales of E15 earlier this year has been a good step, confusion continues to reign over EPA's handling of small-refinery waivers under the Renewable Fuel Standard. The biofuel sector and farmers who grow its feedstocks remain shortchanged under a proposal EPA has deemed to be a resolution of the waiver dispute. It's an issue that must soon be resolved to optimize the contributions our nation's biofuel producers can generate to help stem the ongoing and damaging changes to our climate.

Early action and "big return" steps you could champion to accelerate climate solutions from agriculture include not only improving access to biofuel and other markets for farmers, but also:

- Calling for increased federal funding for conservation tillage, cover crop, and biogas programs administered through the USDA NRCS, Environmental Quality Incentives, Conservation Stewardship and Regional Conservation Partnership Programs;
- Rebuilding the capacity of NRCS, state conservation agencies and local conservation districts to provide much needed technical assistance in writing and implementing CSA plans; providing funding to our nation's land-grant colleges to expand CSA research and extension work;
- Ensuring that rural areas have access to broadband internet service to enable CSA precision agriculture technologies;
- Restoring USDA's ability to conduct agricultural and economic research in support of CSA; and
- Enabling, through proper funding, USDA's network of Climate Hubs to develop and deliver science-based, region-specific information and technologies, with USDA agencies and partners, to agricultural and natural resource managers that enable climate-informed decision-making, and to provide access to assistance to implement those decisions.

Thank you for providing farmers with the opportunity to speak on this topic. Agriculture is a high value and near term solution to climate change challenges and farmers need to be directly involved in the climate change policy development process. We hope you will look to Solutions from the Land as a resource as you move forward in exploring the challenges and opportunities that climate change will present to the agricultural and forestry sectors. I would be pleased to respond to any questions.

Ms. CASTOR. Thank you, Mr. Yoder.

Ms. Owens, you are recognized for 5 minutes.

STATEMENT OF TINA OWENS

Ms. OWENS. Good afternoon, Chair Castor, Ranking Member Graves, and members of the committee. Thank you for holding this

hearing and putting a spotlight on the climate crisis, one of the greatest challenges before us as a society.

My name is Tina Owens, and I am honored to be here on behalf of Danone North America as its Director of U.S. Agriculture. Danone is a global food company that has been in the dairy business for 100 years and employs approximately 5,000 employees in the U.S. We buy directly from more than 700 farms across the country for our most important ingredient, which is milk. You may know us best for our yogurt brands that include Dannon, Oikos, and Activia.

Danone's overarching vision of one planet, one health drives our sense of purpose and responsibility, not only to our shareholders, but also the many other stakeholders of our business including our suppliers, our customers, our consumers, and our farmer partners. My role is to lead and coordinate Danone North America's investment with our farming partners. Simply put, our business cannot exist without the individuals and families who are willing to take on the daily work and personal risk that is farming in America. Their success is our success.

As a major food company, we can plainly see that the climate crisis adds an immense additional layer of risk for our food system. Our farms and food businesses are among the first to feel the impact of this extra volatility. It is clear that to reduce the most extreme risk associated with climate change, agriculture must be a central part of the equation. To meet this challenge, we are actively pursuing new models of working with farmers that incentivize the adoption of new management practices that can address climate change.

Our largest focus is on soil health. In 2018, we launched a 5-year, $6 million soil health initiative aimed at capturing carbon and overcoming common obstacles to building soil health management systems. This program, which targets both economic resilience and environmental impact, is a strong starting point for Congress to develop complimentary policies options.

Our approach has the following three pillars. Pillar number one is about science. While there is ample research on how soil captures carbon, better understanding of regional differences is key. We have worked with several university partners to help provide a scientific baseline, economic analysis, and soil sampling. A coordinated approach between government and research institutions for improving soil health allows all stakeholders to better understand the potential for different farming systems to capture carbon and reduce net greenhouse gas emissions.

Pillar number two is about data. Data is vital for tracking and verifying progress and improving the carbon capture in soil. We partner with the eco practices platform to help us and our farmer partners understand both the return on investment for improving the health of soil and the environmental impacts of soil health practices. When new activities are implemented, farms then have the data to understand the impact of their change in management practices.

Pillar number three is about incentives. We believe that improving soil health can provide a return on investment to farms, but

the short-term cost of implementing these practices can often stand in the way.

Since improving soil health takes a holistic approach, we need to incentivize farms so that the benefits can be realized in the fewest number of crop cycles. We are working with the USDA to incentivize practices for soil health and ideally would create contracts that cover multiple practices over multiple years. In many cases, it takes just three to four core practices to achieve real climate results.

In conclusion, the climate crisis may be felt first by those who are closest to the land, but its impact will eventually touch everyone who produces, sells, buys, and eats food. While there is no single solution when it comes to our complex agriculture landscape, building new and lasting soil health management solutions holds promise for the climate benefits we need as a society.

These systems must be scalable relative to the size of the climate crisis, and they must support the livelihood on farmers on which we all rely. While the work of one company cannot bring all the climate solutions we need, our scale and our partnerships have the power to show that the impact of soil health on the climate crisis is real, measurable, and replicable. We must act together now to scale similar impact through policy and investment in American farms.

Thank you for the opportunity to appear before you today. I would be happy to answer any questions the committee may have.

[The statement of Ms. Owens follows:]

Testimony of Tina Owens
Sr. Director, Agricultural Funding & Communication, Danone North America

Before the U.S. House of Representatives Select Committee on the Climate Crisis
"Solving the Climate Crisis: Opportunities in Agriculture"

October 30, 2019

Chair Castor, Ranking Member Graves, and members of the Committee; thank you for holding this hearing and putting a spotlight on the climate crisis—one of the greatest challenges before us as a society.

My name is Tina Owens and I am honored to be here on behalf of Danone North America as its Director of U.S. Agriculture.

Danone is a global food company that has been in the dairy business for 100 years and employs 100,000 people around the world. As the largest part of that global business, Danone North America employs approximately 5,000 employees in the U.S. and buys directly from more than 700 American farms across the country for our most important ingredient—milk. Most U.S. consumers know us by our yogurt brands: Dannon, Oikos, Activia and Wallaby Organic to name a few. Within our family of brands, we are proud to own one of the original pioneers in organic dairy, Horizon Organic. We are also industry leaders in plant-based brands and products such as Silk (soy, almonds and oat milks), So Delicious (frozen desserts) and Vega (nutritional products). We aim to bring health through food to as many people as possible by providing a wide variety of healthy and affordable everyday food choices.

Danone has a history of thinking differently about the role of business and valuing social progress alongside business growth. We believe that we have a responsibility to use business as a force for good and are proud to be the largest Certified B Corporation® and largest public benefit corporation in the world. Danone's overarching vision of "One Planet. One Health" drives our sense of purpose and responsibility toward not only our shareholders, but also the many other stakeholders of

our business, including our suppliers, our customers, our consumers and our farmer partners.

My role is to lead and coordinate Danone North America's investments with our farming partners who supply the ingredients essential to our products. Simply put, our business cannot exist without the individuals and families who are willing to take on the daily work and personal risk that is farming in America. Their success is our success. Therefore, as we consider the risks and volatility that climate change presents for us and our farming partners, it is not only the right thing to do, it is also good business sense. As you know from your important work on the farm bill, robust policy related to agriculture can make a world of difference in the amount of risk borne by individual farmers on a daily basis. It is precisely for this reason that we come before this Committee today to discuss the potential for new paths forward in advancing agriculture in the face of climate change.

As a major food company, we can plainly see that the climate crisis adds an immense, additional layer of risk to the network of producers across the country that we rely on for our food system. We have all heard about or felt extreme weather impacting us—be it through record hurricanes, droughts, or heavy spring rains. Our farms and food businesses are among the first to feel the impact of this extra volatility, which also significantly impacts federal budgets. For example, this past year, farmers were unable to plant more than 19 million acres due to severe spring rains—a record number cited by USDA.[1] For a dairy, that may mean higher input costs at a time when farmers already cannot afford any surprises.[2]

Various recent reports are clear that to reduce the most extreme risk associated with climate change, the land sector, including agriculture, must be a central part of the equation.[3] To meet this challenge, Danone North America is actively pursuing new models of working with farmers that incentivize the adoption of new farm management practices that can address climate change. For instance, we have long-term contracts with dairies to help alleviate the short-term volatility of the market and allow farmers to consider new ways of farming, and are searching for new, innovative ways to finance social impact with farms and suppliers. We are encouraged that the Committee is reviewing the potential for agriculture to contribute to climate change mitigation, and we look forward to working with the Committee as it prepares to issue policy recommendations in 2020.

GLOBAL COMMITMENTS

Similar to actions taken by 285 companies, Danone globally has adopted a Science-Based Target which for Danone means a 30% reduction of greenhouse gas (GHG) emissions by 2030.[4] This target includes our entire footprint from our supply-chain at the farm level to the end of life of our packaging.[5]

During Climate Week this year, we were also one of 87 companies that acknowledged the recent science by commiting to carbon neutrality by 2050 in order to help prevent a rise in temperatures of more than 1.5 C degrees.[6]

And to complement these commitments, at the United Nations Climate Action Summit in September, Danone's global CEO, Emmanuel Faber, announced a new business coalition, One Planet Business for Biodiversity—alongside 18 other major agriculture-driven companies with more than $500 billion in total annual revenue. Together these companies will work to develop nature-based solutions for the climate crisis,[7] in three ways: advancing regenerative agriculture and soil health, boosting cultivated biodiversity and resilient food and agriculture models within our product portfolios, and eliminating deforestation in our supply chains.

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[1] https://www.fsa.usda.gov/news-room/news-releases/2019/report-farmers-prevented-from-planting-crops-on-more-than-19-million-acres.

[2] Increased and sustained heat can also exacerbate dairy inefficiencies and costs, for example, see https://www.canr.msu.edu/news/summer-s-hot-weather-will-cause-heat-stress-in-dairy-cattle.

[3] For example, see Intergovernmental Panel on Climate Change (IPCC) latest report acknowledging exacerbated risks to land sector by climate change and the need for the land sector, including agriculture to provide mitigation solutions.

[4] The 30% reduction is based on a 2015 baseline. For a full explanation of science-based targets and what other companies are taking similar action, please see https://sciencebasedtargets.org/companies-taking-action/.

[5] https://www.danone.com/impact/planet/towards-carbon-neutrality.html.

[6] https://www.wemeanbusinesscoalition.org/press-release/87-major-companies-lead-the-way-towards-a-1-5c-future-at-un-climate-action-summit/.

[7] https://op2b.org/.

U.S. SOIL HEALTH INITIATIVE

In 2018 Danone North America launched a five-year, $6 million Soil Health Initiative to help our farmer partners to restore the ability of soil to capture carbon and overcome common obstacles to building soil health management systems. We believe that this program, which targets both economic resilience and environmental impact, is a strong starting point for Congress to develop complementary policy options to incentivize and assist farmers and their partners for lasting impact at a nationwide scale. Our approach has the following pillars:

- *Start with soil science*—While there is ample research on soil and its capacity to capture and sequester carbon, understanding the variables and nuances that come with regional differences in growing regions and farm management is key. Danone North America has worked with university partners from the Ohio State University and Cornell University to help provide a scientific baselines, economic analysis, soil sampling and overall advice as we implement our program. In the U.S., we have arguably the strongest agricultural reseach institutions in the world, including the U.S.D.A. climate hubs. Similarly, a coordinated approach between government and research institutions for improving soil health would allow all stakeholders, particularly the private sector, to better understand the potential and variances for different farming systems to capture carbon and reduce net GHG emissions.
- Improve the use of data in farm planning and measuring results—Data is vital for tracking and verifying progress in improving the ability of soil to capture and sequester carbon. Danone North America partners with Sustainable Environmental Consultants and its EcoPractices platform to help us and our farmer partners understand two main issues: the economic return on investment for the farms of improving the health of their soil, and the environmental impacts of soil health practices using a variety of measurement tools.[8] Working with a trusted third party like EcoPractices also allows us to ensure farmers' privacy in data collection and provides "boots on the ground" to assist farmers with creating a continuous improvement plan for soil health practices. When new activities are implemented, farms then have the data to understand the impact of their change in management practices. We are exploring ways to leverage this work with USDA technical assistance funding so that we can scale-up with additional farms.
- *Provide incentives for most impactful practices*—While we have initial findings that practices to improve soil health can provide a return on investment to farms, the short-term costs of implementing these practices often stand in the way of their adoption. Since improving soil health takes a systems approach, we need to help farms financially to build-in new practices so that the benefits to soil, input efficiency and yields can be developed quickly in the fewest number of crop cycles. We work directly with farms to understand the financial support they need to implement new practices like reducing tillage, adding cover crops, enhancing crop diversity, improved manure management, ensuring irrigation efficiency, and adding vegetative field buffers to help prevent water running off fields. We are also working with USDA to incentivize these practices for soil health and ideally would create contracts that cover multiple practices over multiple years so farmers know they will still be profitable while restoring the soil. It is essential, however, that financial incentives—whether they come from our company or from USDA—be simple, straightforward and have low transaction costs with clear paths of access for the farms. Finally, while there are more than 100 NRCS-approved conservation practice standards, depending on the farming system, we generally need to prioritize fewer than 10 or so practices, and in many cases 3–4 core practices will begin to achieve real benefits.[9]

IMPORTANCE OF PUBLIC POLICY

Public targets and strategies like those that Danone North America has made with our farmer partners are critical to foster U.S. innovation and leadership, but we cannot just tout our own commitments. We also support and advocate for state and federal actions to ensure that as a society, we are able to meet the science-

[8] Danone North America relies on EcoPractices to establish application program interfaces (APIs) with various measurement tools such as Field to Market, COMET–Farm, and Cool Farm Tool. We remain flexible to improve and adjust our measurement tools should any become more widely accepted.

[9] *See* NRCS's description of the four tenants of soil health, https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/mgnt/; and similarly Soil Health Institute, https://soilhealthinstitute.org/resources/best-practices/.

based need to prevent a rise in global temperatures of more than 1.5 degrees. As an example, we have joined forces with three other like-minded food companies to form the Sustainable Food Policy Alliance to advocate for policy action to address challenges such as climate change.[10] We supported policies, for example, in the Farm Bill last year to help food companies deliver conservation with U.S. farmers through programs such as the Regional Conservation Partnership Program. And we will continue to be a voice for how food and agriculture can and must be part of the solution to the climate crisis.

CONCLUSION

The climate crisis may be felt first by those who are closest to the land, but its impact will eventually touch everyone who produces, sells, buys, and eats food. It has already begun. While there is no single solution when it comes to our complex agricultural systems, building new and lasting soil health management systems holds promise for the climate benefits we need as a society. These systems must be scaleable relative to the size of the climate crisis, and they must consider and support the livelihood of the farmers on which we all rely.

Danone North America is committed to combatting climate change for the sake of not just our own business but our entire agriculture and food sector. While we know the work of one company cannot bring all the climate solutions we need, our scale and our partnerships have the power to show that the impact of soil health on the climate crisis is real, measurable, and replicable. We must act together, now, to scale similar impact through policy and investment in American farms.

Thank you for the opportunity to appear before you today. I would be happy to answer any questions you may have.

Ms. CASTOR. Thank you very much.

Mr. Amin, welcome. You have 5 minutes to present your testimony.

STATEMENT OF VIRAL AMIN

Mr. AMIN. Thank you. Chairwoman Castor, Ranking Member Graves, and members of the Select Committee, thank you for the opportunity to testify before you today. My name is Viral Amin, and I am the Vice President of Commercial Development and Strategy for DTE Energy's Power and Industrial Group based in Ann Arbor, Michigan.

At DTE Energy, we believe that climate change is one of the defining public policy issues of our time. We applaud this committee for taking the initiative to understand what can be done.

Today I would like to introduce you to renewable natural gas, a product that is made entirely from waste and has the potential to deliver significant greenhouse gas reductions while also improving air and water quality and creating well-paying jobs.

Renewable natural gas or RNG is exactly what it sounds like. It is natural gas made from renewable resources. Derived from methane creating by the decomposition of organic matter, rather than being extracted from underground fossil-based resources, RNG is chemically identical to the natural gas that most of us use every day. Livestock operations such as dairy and hog farms can be a renewable source of methane.

Manure management practices are a significant source of greenhouse gas emissions in this country. Manure is often stored in uncovered lagoons, leading to the release of methane into the atmosphere which is 25 times more potent than carbon dioxide. RNG projects capture methane by diverting manure to large enclosed storage tanks called anaerobic digesters. The captured methane is

[10] Sustainable Food Policy Alliance has take many policy positions to advocate for policy related to combatting climate change, see https://foodpolicyalliance.org/issue/environment/.

then processed to remove impurities and produce a product that can be transported and delivered anywhere in this country through our existing natural gas pipeline infrastructure and can be utilized by end customers without any limitations or changes to their equipment.

The primary use for RNG today is as a fuel replacement in trucks, buses, and cars that are otherwise powered by traditional fossil-based natural gas. RNG fuel allows for a carbon footprint that is lower than even electric vehicles due to the avoidance of farm-based methane emissions. Furthermore, because RNG is primarily used by medium and heavy duty trucks, emissions of sulfur dioxide, nitrogen oxides, and particulates are significantly lower than those of diesel-fueled vehicles.

DTE is working with 10 dairy farms in Wisconsin to develop RNG projects. We have already committed $140 million and are looking at more opportunities in other states. We like that our investments are driving not only significant greenhouse gas emission reductions but that these projects are creating economic and environmental wins for the agriculture communities in which these projects reside.

The financial challenges currently faced by dairy farms due to low milk prices combined with the additional pressure from local communities to improve water quality and reduce odor can be partially mitigated by RNG projects in several ways.

First, DTE pays dairy farmers a share of the revenues earned from the sale of RNG, allowing these primarily family-owned businesses to realize value from a waste byproduct. Second, we create new, well-paying jobs in order to develop, operate, maintain, and support the complex systems required to produce RNG. Third, the process used to produce RNG can reduce the number of pathogens within the manure and thereby lower the risk of groundwater contamination. And last, but not of least importance to dairy communities, many of the volatile compounds that contribute to odor are destroyed in the RNG production process.

We believe that RNG is a unique solution in the battle against climate change. Harmful methane emissions are captured to fuel vehicles, allowing the transportation sector to significantly lower its carbon footprint. American farmers benefit financially, well-paying jobs are created, and both air and water quality in rural communities can be improved.

In order to encourage investment and expand access to RNG, project developers require stable and transparent policy mechanisms that promote the use of low carbon fuels and clean energy. We ask this committee to understand, support, and help stabilize existing policies that have driven investment to date and to develop new and additional frameworks that enable the market to realize the full potential of RNG. These additional mechanisms could include the allocation of funds for R&D to drive technology advancement, tax incentives that are at parity with other renewable energy sources, and to promote the development of natural gas powered vehicles or other RNG uses.

RNG is a prime opportunity available today to reduce methane emissions economically, decrease reliance on fossil fuels, and support American farmers and rural economies.

I appreciate your attention, and I look forward to answering your questions. Thank you.

[The statement of Mr. Amin follows:]

Testimony of Viral Amin
Vice President, Commercial Development & Strategy, DTE Energy Resources

U.S. House of Representatives Select Committee on the Climate Crisis
"Solving the Climate Crisis: Opportunities in Agriculture"

October 30, 2019

Chairwoman Castor, Ranking Member Graves, and members of the Select Committee, thank you for the opportunity to testify before you today. My name is Viral Amin, and I am the Vice President for Commercial Development & Strategy for DTE Energy's Power and Industrial Group based in Ann Arbor, Michigan. DTE Energy is a diversified energy company with two utility businesses serving Michigan and various non-utility businesses with investments throughout the United States. The Power and Industrial group of DTE Energy focuses primarily on developing renewable energy and industrial energy services projects. At DTE Energy, we believe that climate change is one of the defining public policy issues of our time. We applaud this committee for taking the initiative to understand what can be done.

We are proud to say that DTE Electric, a regulated utility with 2.2 million customers and DTE Gas, a regulated utility with 1.3 million customers have made commitments to customers to reduce carbon and methane emissions, respectively, by more than 80% by 2040, and our goal is to achieve net zero emissions from electric generation by 2050!

Today, I'd like to introduce you to Renewable Natural Gas, a product made entirely from waste with the potential to deliver significant reductions in greenhouse gases, improve air and water quality, and create well-paying jobs.

Renewable Natural Gas, or RNG, is exactly what it sounds like—it is natural gas made from renewable resources. RNG is chemically identical to the natural gas that most of us use every day, except that it is derived from methane created by the decomposition of organic matter, rather than being extracted from fossil-based resources.

Manure management practices are a significant source of greenhouse gas emissions in this country. Manure from livestock operations, such as dairy and hog farms, is often stored in uncovered lagoons leading to the release of methane into the atmosphere. And, as I am sure this committee is aware, methane has a global warming potential that is 25 times more potent than carbon dioxide.[1] Agricultural waste accounts for over 9% of anthropogenic methane emissions in the U.S., according to a 2017 EPA report.[2]

RNG projects capture methane by diverting manure to large, enclosed tanks, called anaerobic digesters. The captured methane is then processed to remove impurities and produce a product that can be transported and delivered anywhere in this country through our existing natural gas pipeline infrastructure and can be utilized by end-customers without any limitations or changes to their equipment. This is the product we refer to as *Renewable Natural Gas*, or RNG.

While today's hearing is particularly concerned with the role of agriculture in addressing climate, it's important to note that the transportation sector is now the leading sector source of CO_2 emissions in the United States and the use of RNG in alternative fuel vehicles provides a proven cost-effective option for reducing the emissions from the heavy-duty transportation fleet. According to Natural Gas Vehicles for America, 32 percent of all on-road fuel used in natural gas vehicles in calendar year 2018 was renewable natural gas (RNG).

DTE and other developers produce RNG from dairy farms for use as a fuel replacement in trucks, buses and cars that are otherwise powered by traditional fossil-based natural gas. The resulting carbon footprint is lower than even electric vehi-

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[1] Global Warming Potential for 100-yr time horizon. Table TS.2. Technical Summary in climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

[2] USEPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990–2017. In 2017, manure management represented 9.4% of anthropogenic methane emissions; landfills accounted for 16.4%.

cles! When compared to diesel fuel, these vehicles have significantly fewer emissions of other air pollutants like sulfur dioxide, nitrogen oxides and particulates. DTE has already committed $140 million to develop ten RNG projects at large dairy farms in Wisconsin which can power approximately 2,000 alternative-fuel trucks every year. Five of these projects are in operation, while the other five are under construction.

The financial challenges currently faced by dairy farms due to low milk prices, combined with the additional pressure from local communities to improve water quality and reduce odor can be partially mitigated by RNG projects in several ways. First, DTE pays dairy farmers a share of the revenues earned from the sale of RNG, allowing these primarily family owned businesses to realize value from a waste by-product. Second, we create new, well-paying construction and full-time jobs in order to develop, operate, maintain, and support the complex systems required to produce RNG. Third, the process used to produce RNG can reduce the number of pathogens within the manure and thereby lower the risk of groundwater contamination.[3] And last, but not of least importance to dairy communities, many of the volatile compounds that contribute to odor are destroyed in the RNG production process.

RNG is a unique solution in the battle against climate change. Harmful methane emissions are captured to fuel vehicles or other beneficial uses, American farmers benefit financially, well-paying jobs are created, and both air and water quality in rural communities can be improved.

In order to encourage investment and expand access to RNG, project developers require stable and transparent policy mechanisms that promote the use of low carbon fuels and clean energy. We ask this committee to understand, support, and help stabilize existing policies that have driven investment to date and to develop new and additional frameworks that enable the market to realize the full potential of RNG. These additional mechanisms could include the allocation of funds for R&D to drive technology advancement, tax incentives that are at parity to those for renewable energy sources, and sensible stimulus designed to promote the development of natural gas-powered vehicles and other RNG uses.

RNG is a prime opportunity—available today, using today's technology—to reduce methane emissions economically, decrease reliance on fossil fuels, and support American farmers. I appreciate your attention, and I look forward to answering any questions you may have. Thank you.

Ms. CASTOR. I want to thank you. A fantastic job from all the witnesses.

At this time I recognize myself for 5 minutes for questions. So the existing Farm Bill has a number of conservation initiatives. They have been crucial in providing technical assistance to farmers and financial incentives to help implement climate smart ag practices such as the Conservation Stewardship Program, Environmental Quality Incentives Program, the Conservation Reserve Program.

They all seem to move us in the right direction, but if agriculture is going to be part of major climate solutions, solutions for the lands and from the lands, it seems like we are nowhere near the scale that we need to be.

Mr. Yoder, give us some advice on the scale, on how significantly we need to scale up these initiatives. Which ones work especially well, and which ones need to be expanded in some way?

Mr. YODER. Well, to be clear, there is some really good programs that you just mentioned that we can utilize, but the problem we have is we just don't have enough boots on the ground. I know farmers that have been waiting for up to 2 years before they get their, like, an interim management plan that they can improvise, you know, as they go through this.

I would like to see a program where—and maybe I am more of an innovator—but I would like to see a program where you can be involved with these programs but also have some sort of safe har-

[3] https://farm-energy.extension.org/pathogen-reduction-in-anaerobic-digestion-of-manure/.

bor provision where, you know, there is farmers out there trying new things and things that we haven't even thought about yet that might be a really, really good solution to some of these things.

And so, again, it is going to have to be—you are going to have to have a lot of research out there and a lot of places where different things work in different watersheds. That is the one thing that we don't have the luxury of doing is a one size fits all. There is plenty of watersheds out there. There is plenty of different volumes of water. There is plenty of different soil types.

There is thousands of different soil types, so we can't find a one size fits all, but we can provide tools for the toolbox that they can all implement on their particular farm. And this is a massive undertaking, but the potential is just enormous. In fact, I look at it as the low hanging fruit for a climate change solution.

Ms. CASTOR. So to speak.

Mr. YODER. Yes.

Ms. CASTOR On our trip to Gainesville and the University of Florida, and then out on the timber ranch in August, I was impressed with the depth and breadth of knowledge by our agricultural extension service through the land grant universities in partnership with State and local officials.

It seems like they are trusted, but they are just skimming the surface right now. Does everyone agree that we would need more scientists and technical help for farmers and agriculture?

Okay. Dr. Moore-Kucera, you have a lot of experience with this. Talk to us about the scale of these current Farm Bill initiatives and then what is not under the Farm Bill rubric that we should be thinking about as well.

Dr. MOORE-KUCERA. Are you referring to the conservation?

Ms. CASTOR. Yeah. Talk to us first about how much we would need to scale those initiatives up.

Dr. MOORE-KUCERA. There is a lot of room for opportunity and scaling, specifically targeting soil health practices that have a lot of co-benefits that I mentioned earlier about improved water quality, air quality, water quantity, and all of these issues to try to bring it back to other mitigation opportunities, reduce floods, and reduced inputs.

So there is a lot of opportunities that we can have and research, and as Mr. Yoder mentioned, increased boots on the ground and resources for our conservation service and extension organizations I think is really critical.

Ms. CASTOR. Ms. Owens, you were specifically focused on soil health and advised us to invest in the science there, technical expertise, and it occurred to me that for the United States of America, we have always been a leader in these type of agricultural scientific initiatives. And you think of the challenge with increasing carbon pollution around the rest of the world, in the developing world and the technical help they are going to need to sequester carbon and implement smart farming practices.

You have an international company here. How important is it that the United States of America is a leader and develops these technologies that we can export to other countries.

Ms. OWENS. Well, thank you, Chair. For our own part, we are an international company headquartered out of Paris. However, the

U.S. is actually our largest single market. So as a company, we are focused on the impact that we can have within the U.S.

You and I have spoken a little bit earlier about the United States' ability to actually position itself as a leader for practices around the world, and I agree that that is an important point.

You had also asked earlier around scale. And while it is important that we align our research institutions and the government towards a single goal such as soil health and climate mitigation, to the point made from some of the other witnesses, I would like to add that boots on the ground is actually a very clear need. And one of the ways that we could offer a new partnership to do that is actually utilizing the scale of international food companies or others that are operating within the U.S. and utilize the supply chain that we have for additional implementation with those farms with which we partner.

Today that is not the model that is used. It is state by state, farm by farm, and we would open the door to having a conversation about a new day where the existing model of the Farm Bill and the way that payouts happen is used but at a different scale than farm by farm, county by county, state by state.

Ms. CASTOR. Thank you.

Mr. Graves, you are recognized for 5 minutes.

Mr. GRAVES. Thank you, Madam Chair.

Ms. Owens, if the U.S. is your largest market, we welcome your headquarters being relocated here. We have French speakers in Louisiana, so——

Dr. Moore-Kucera, I wanted to make sure I understood some of your comments earlier. Right now under the Farm Bill we did last Congress, we have about $2 billion invested in conservation programs, voluntary programs. You indicated, and I want to make—I don't want to put words in your mouth. I want to make sure I am understanding. You indicated basically building upon those, or recalibrating those, or introducing new ones, or all of the above. Could you clarify?

Dr. MOORE-KUCERA. Well, actually, that gets more into the policy component of AFT. I am here as a scientific technical expert, and I would have to defer to our policy team to further expand on those questions.

Mr. GRAVES. Okay. If you could do that in writing after the hearing——

Dr. MOORE-KUCERA. Absolutely.

Mr. GRAVES [continuing]. That would be helpful. I want to understand if you believe that some of the existing conservation programs, or if your organization does, if those are sufficient; if they were expanded, more dollars invested; or if you are talking about new types of incentives or voluntary programs, just a better understanding.

Dr. MOORE-KUCERA. I think we need both opportunities, actually.

Mr. Graves. So expanding on existing programs and also adding new. Okay. Thank you.

Mr. Yoder, in your testimony, and also according to some of the folks that we have met with, I understand that NRCS technical staff may be insufficient to address the demand. Could you expand upon that a little bit and where you see that as being a problem?

Mr. YODER. Sure. In my State, Mr. Terry Cosby is the leader of the NRCS in our State. And one of the things that he is hampered with is there is not even a member of NRCS staff in every county, and so there is a lot of demand, and these people are fantastic. It is just they had a hiring freeze on for a while. I guess now they can hire again.

Mr. GRAVES. So how does that impede our ability to advance conservation initiatives?

Mr. YODER. Well, one of the things that you find out here in the countryside is the culture of agriculture, you know, the thing that is sort of difficult is all productivity is not created equal.

So you could have very productive farms, and in some ways, it is almost—I don't want to blame the land grant universities, but we were always told you add this, this, this, and this, and you will get, you know, a crop, and it is true. But we haven't been paying a lot of attention to the soil health, you know.

When you look at the amount of top soil we burned through in the last 60 years, it is terrible. And if we burn through the same amount of top soil in the next 60 years, we won't have any left.

Mr. GRAVES. Do you participate in any of the conservation programs?

Mr. YODER. I don't participate in any of those programs, but every bit of my farm, my 1,500 acres, is all no-till, and we raise cover crops on every single acre.

Mr. GRAVES. That is great. That is great. The last question for you, Mr. Yoder. As you know, over the last few decades, there have been substantial changes in ethanol policies that have had an impact on crops grown, including proliferation of corn.

How have you viewed that as having an impact on kind of the land use, soil conservation, and health?

Mr. YODER. Well, data will tell you that you can actually build soil by raising corn, and one of the things that you hear in the media and other places and some NGOs, you know, is that, you know, big bad corn is tearing our soil away, and that is not true, if it is done no-till.

The other thing too is, say, for instance, bio ethanol. The way we weighed bio ethanol 15, 20 years ago is nothing like it is today. So today, if you do it with conservation practices, you can actually—I mean, even with conventional bio ethanol, you are at 35 percent better than petroleum gasoline, but you can get up to actually qualify—I mean, statistics wise, that is advanced biofuels. So it is different today, the improvements we made with bio ethanol performance.

Also, biodiesel is phenomenal. So as it keeps getting better and better, we have to be recognizing that it is not the same as it was just a few years ago, so we are much more efficient today than we ever were.

Mr. GRAVES. Thank you. I am trying to get our chair down to Louisiana so she can see our green diesel facility in Louisiana.

The last question very quickly, Mr. Amin. You mentioned the renewable natural gas. You mentioned the need to transport it. Obviously to the extent we move to more natural gas vehicles, renewable natural gas vehicles, you are going to change sort of the transportation routes that they would go.

So I assume that means that we are going to need natural gas or renewable natural gas infrastructure to be able to transport that gas to the right locations. Is that fair?

Mr. AMIN. That is very fair. We absolutely depend on natural gas infrastructure, and as this market grows, we see continued development of that infrastructure as necessary.

Mr. GRAVES. So we would need to build new natural gas pipelines in order to transport the gas to places where it is needed?

Mr. AMIN. Absolutely.

Mr. GRAVES. Thank you. I yield back.

Ms. CASTOR. Next is Ms. Brownley, but I want to say when I was able to visit Ventura County, you wouldn't think of it out there in the west as being a big farming community, but more strawberries than just about anywhere else. But Congresswoman Brownley took me to a tomato grower who has a very sustainable practice, and the community model was very impressive. So you are recognized for 5 minutes.

Ms. BROWNLEY. Thank you, Madam Chair, and I thank the panel for being here.

Dr. Moore-Kucera, I wanted to ask a question. I know that the University of California at Davis has been doing some research around composting and that composting mixed with cover crops is a better solution than just cover crops in terms of reducing the carbon footprint. At least that is what their study is saying, and certainly now in California, there is a law now called California's Healthy Soils Program which farmers who are doing this can get some assistance for continuing to do it.

So I think you stated in your testimony that you have been doing some research around composting as a greenhouse gas reduction tool. Could you share with us a little bit about that research?

Dr. MOORE-KUCERA. Well, we haven't been doing research specifically on that topic, but it is one of the practices that we are looking at to address the contribution of greenhouse gas reduction and carbon sequestration potential across the U.S., coupling comet planter, the USDA tool for that, and so compost, there have been very successful programs in California applying that waste stream on range lands with significant increases to soil carbon contents, and so that is a very encouraging program.

And then as you mentioned, coupling compost. As we add conservation practices together, they often become more synergistic, so coupling compost with cover cropping then enhances that cover crop to perform the functions that it is designed to do. So the synergies are really important, and then also taking that waste out of that stream is a significant reduction.

Ms. BROWNLEY. Mr. Yoder, you said you have no till cover crops. Do you use composting also?

Mr. YODER. I sure do. I love chicken litter too.

Ms. BROWNLEY. Very good.

Mr. YODER. My neighbors don't exactly like it when I put it on, but we also use a product called Com-Til which is basically composted bio solids. It doesn't smell at all. You put that soil amendment with additional cover crops, and I can't believe how my soil has improved over the last 15 years. I mean, you know, it sounds kind of old and goofy, but my dad said, you know, all I ask

when you take the farm is you leave it in better shape. It is the most productive it has ever been, and it is because of some of these practices.

Ms. BROWNLEY. I have also been told that, you know, one way to collect more carbon in the soil is to begin to manipulate the seeds so that the seeds are producing longer roots into the soil. Has there been any research that anybody is aware of around that piece?

Mr. YODER. Well, there certainly is. There is certainly a lot of research and selection for genetics. In fact, one of the things that really aids the deep penetration of roots is actually no till because as you have a crop and you have roots that decay, the porosity of the soil is greatly increased.

One of the greatest things that ever happened to me, this was years ago—I went to a field day, and they opened up a field tile that had been—this farm had been no-till for many years. And I thought well, because everybody thought—I mean, conventional wisdom says well, the ground is obviously hard and can't get—they put a smoke bomb in that tile, and all over the field, the smoke came out, and it just told me the porosity of that soil was better than any kind of conventional soil than I have ever had. That is when I decided I am doing something wrong, and that is when I decided to switch to no-till.

Ms. BROWNLEY. Very good. And, Mr. Yoder, in terms of all the good things that you are doing on your farm, would a carbon credit or a carbon fee be something that you would want to take advantage of?

Mr. YODER. You betcha. I would love to see—I would love to see us—you know, this is a great example of this year in Ohio. About 50 percent of the crops did not get planted, and luckily, we are in the retail business. We sold a lot of cover crop seed to get on those bare fields.

And there was some help from NRCS as well as the whole market facilitation program, and to get farmers to just put their toe in the water and see what a cover crop will do. There is such a thing called a fallow degree where the ground is fallow, and you don't have anything growing. The microbes all dry up and go away and die. So it is important for me, no matter what, to have something growing on that farm, that field, at all times, and that way, it is ready for the next crop.

Ms. BROWNLEY. Thank you so much. My time is up, and I yield back to the chair.

Ms. CASTOR. Mr. Carter, you are recognized for 5 minutes.

Mr. CARTER. Thank you, Madam Chair. I appreciate that.

Thank you all for being here. This is extremely important. I have always said as we address climate change, we cannot leave rural America behind. We have got to make sure that we include it. I have the honor and privilege of representing a very rural area, and particularly in the western part of my district in south Georgia, we have a lot of agriculture, and it is extremely important to our economy. The number one economy and the number one industry in the State of Georgia is agriculture.

I am very proud of that, but, you know, the American farmer literally feeds the world. We have to remember that, and we have to

make sure that we do everything we can. A lot of people take it for granted. You ask people a lot of times, where do you get your groceries from? They say from the grocery store.

You know, they don't understand where it comes from, and that is why I am just such a great fan of the farmers and particularly in our area.

Precision agriculture. Ms. Owens, are you familiar with that?

Ms. OWENS. Yes.

Mr. CARTER. Ok. And that is certainly something over the last decade that we have really stressed, and I just wanted to ask you. Do you think that prescision agriculture can be a way that we can bring down carbon emissions as well as save money for farmers?

Ms. OWENS. That is a great question. Thank you, Congressman Carter. The answer is definitely yes, and I talk about data in my opening statement, and we have partnered with a platform called Eco Practices which is part of Sustainable Environmental Consultants, and they are actually working on aggregating all of the different data points from farms, but bundling it in a way that the farmer can actually make sense of it and make really detailed decisions based off of it.

So whether it is the data from their combine, you know, from my John Deere, or the economic system that they use to track what is happening on their farm or how they are tracking yield. What we are working on now is actually how you use that precision ag information to project for the farmer as they adopt soil-friendly practices——

Mr. CARTER. Sure.

Ms. OWENS [continuing]. How it actually contributes to their profitability over time and how it projects to help with their resilience related to climate change.

Mr. CARTER. How important is broadband to rural areas and precision agriculture?

Ms. OWENS. Well, you would need broadband in order to have the farm have access to all the different tools that are available today.

Mr. CARTER. How can we help? I serve on the Energy and Commerce Committee, and this is something we talk about, getting broadband to the rural areas. You know, what can we do?

Ms. OWENS. I think it would be interesting to have a policy that broadband is actually a requirement. I myself have always lived in a rural area. I have always had terrible internet, so I would love it if the committee would make a recommendation around broadband related to agriculture because it would affect me as well.

Mr. CARTER. Would it help you, Mr. Yoder?

Mr. YODER. Thank you for bringing up broadband. You bet it would because all these new technologies that we are enjoying today, whether it is, you know, integrated with the machinery itself, it is all dependent on signals either from internet or satellites or from the phone lines or whatever. It is absolutely crucial.

The problem we have is lack of capacity. We are pretty good where I am at right now from just out of Columbus, Ohio, but I talk to my friends out in the bare spots. It is terrible.

Mr. CARTER. It is awful in south Georgia.

Mr. YODER. It is absolutely awful. That is a big part—data is a big part of precision. We are precision ag dealers as well, and my goodness. I will give you an example of how important data precision is. We put a high speed planting kit on our planter, and we literally saved 3 days of planting.

Mr. CARTER. Absolutely.

Mr. YODER. And this year, you know, we had a minimum of 10 days, that was it, that we had to plant, and we got it planted.

Mr. CARTER. All right. Let me get to one other thing that I want to mention. Tier 4 engines. Are you familiar with that, the tier 4 engines? The EPA has gone to—now they are requiring tier 4 engines.

We had a problem with this with our bar pilots, our harbor pilots. They couldn't actually build the boat the size they needed it to in order to fit the tier 4 engines. Now I have got the farmers coming to me and saying they are requiring me to have a tier 4 engine. I can't buy wheels that will get through the rows and the crops.

And the thing about the tier 4 engines is that the environmental benefit you get from going from a 3 to a 4 is just not as good as it was going from a 2 to a 3.

Ms. Owens or Mr. Yoder, any of you all have any experience with that?

Mr. YODER. We experience it every day. We have the transition to tier four, which are fine. That is like a big giant catalytic converter. But with our tier four semis and big tractor, you got to have the DEF—diesel emissions fluid or whatever, and anyway, it is a pain in the rear end.

Mr. CARTER. Sure it is. Well, thank you all. Ag is extremely important. I know that is why we are here. But just out of curiosity, you all know what the number one forestry state in the nation is? It is the State of Georgia. Thank you very much.

And I yield back, Madam Chair.

Chairwoman CASTOR. I have heard this. I have heard this.

Next is Mr. Huffman, and I do want to say, Mr. Huffman, we have all been thinking about you in your district with raging wildfires in northern California, so it is good that you came back for the hearing. You are recognized for 5 minutes.

Mr. HUFFMAN. Thank you very much, Madam Chair, and appreciate all the concern many of my colleagues have expressed. My district just got through the last of a particularly harrowing windy night with pretty limited damage, so we think we are in a better place today. The last exchange between Mr. Carter and Mr. Yoder and others about broadband, and much of the conversation we are having here today, really highlights the fact that there are aspects of this problem-solving exercise when it comes to agriculture that really can bring us together and I think there are so many things that we share common interest in, but before we go further into that, this is the obligatory point where I have to push back on Mr. Graves for his pep rally on behalf of natural gas, okay. Those of us that believe we are in the middle of a climate crisis, I think, also have to accept that we just don't have time for fake solutions, and the idea that somehow U.S. natural gas if it outcompetes Russian natural gas is somehow going to make us better in the face of this

climate crisis is a little bit like the captain of the Titanic saying our only choice is to steer the ship into a U.S. iceberg or a Russian iceberg. I think we have got to change course here folks, and we know that at some where between 3 and 3 and a half percent loss from the wellhead to the point of combustion, natural gas is just as bad for the climate as coal.

So let's stop pretending that promoting U.S. or any other natural gas is a solution to this climate crisis. It is just not. It is actually going to make it worse. But Mr. Amin, I do want to believe that renewable natural gas as part of our portfolio of solutions for making agriculture part of the solution instead of a 10 percent net emitter could be something that we can do. I want to give you a chance to address that potential friction, though. If we believe from a policy perspective we need less reliance on fossil fuels and natural gases that are not renewable, but we think you are on to something that could be a good idea, is there a way to reconcile those two or is the success of your industry absolutely dependent on continuing to build out this fossil fuel infrastructure that, frankly, takes us in the wrong direction on the climate crisis?

Mr. AMIN. So we believe that renewable natural gas is a near-term and immediate solution that is available today commercially to help resolve the climate crisis. There are other carbon mitigating solutions out there; electrification gets discussed quite a bit. That is a longer-term solution and it is not applicable to every end use. And particularly——

Mr. HUFFMAN. I guess what I am asking specifically is if we want to support renewable natural gas, do we necessarily have to support the bigger play on natural gas infrastructure and natural gas dependency that includes an awful lot of nonrenewable?

Mr. AMIN. We certainly depend on natural gas infrastructure. We need pipelines.

Mr. HUFFMAN. I think that unfortunately answered the question. To the rest of you, I am wondering when we talk about all of these exciting practices, no-till practices and cover crops and there were less specific references to other practices that can make a tremendous difference. Ms. Owens, you talked about some of that.

I have people in my district, like the Marin Carbon Project, that are doing a lot of research on this and they believe it shows a lot of potential, but I am really wondering if we are told that agriculture is 10 percent of our greenhouse gas emissions in this country, what would it take to make agriculture part of the solution to either get to zero or net positive? Have any of you run the numbers? Is there a set of specific practices that could be scaled up to specific levels that you can recommend to us? I would just open that up to any of you that want to elaborate.

Dr. MOORE-KUCERA. So that is some of the research that we are working on today. I mentioned that was current and projected adoption of cover crop in conservation tillage we can get to about a quarter of the total ag emissions, and if we couple that with various practices that target nutrient management, renewer management has already been mentioned, conservation crop rotations, mulching, compost, etc., there are lots of different ways to get there, so we are making progress——

Mr. HUFFMAN. Do you have some metrics? Like if we did this much of it, we would get there? Are we able to make those kind of calculations?

Dr. MOORE-KUCERA. We are in progress doing that right now, yeah. I think it is important to mention that different—the best management or the best practice that has the greatest greenhouse gas reduction isn't the same across the country or even across the states, so it is important to have that regionalization that we mentioned earlier.

Mr. HUFFMAN. If the chair allows, I would certainly welcome any other answers.

Chairwoman CASTOR. Sure.

Mr. YODER. Well, it comes down to economics, for sure and that is how you get a farmer to invest in a new practice. One of the things that we participated earlier with was the study from Environmental Defense Fund where do cover crops actually pay for themselves, and we went through where our farmers one of about four in the whole Midwest and we went through the whole thing, not necessarily about what it actually contributes to greenhouse gas sequestration, but what is the dollar value for putting those cover crops in place, and we found out from our numbers on our particular farm that the cover crops more than paid for themselves and had a 2 to 5 percent increase in yield, but—that may seem small, but over the time, over many, you know, more years, your soil becomes much, much better and more resilient so you actually build a lot of risk management by doing that over time. I look at my soil as my 401(k), that if, you know—and that is the problem with bankers. They look at things on a return on investment for 6 months. You need to look at this—give it 5 years, you will get your money back.

Chairwoman CASTOR. Mr. Griffith, you are recognized for 5 minutes.

Mr. GRIFFITH. Thank you, Madam Chair. I yield to Mr. Graves.

Mr. HUFFMAN. Oh, here we go.

Mr. GRAVES. My friend who just got an extra minute and a half, is he the one that is objecting? Thank you, Madam Chair. Thank you, Mr. Griffith, for yielding the time. Number 1, Madam Chair, I want to point to the IPCC report specifically. The supplement AR5 that refers to the migration to natural gas as a cleaner energy solution, reminding my friends that often cite the IPCC report. Number 2, Madam Chair, I would like to submit for the record a graphic demonstrating the United States has reduced emissions more than the next 12 emissions-reducing countries combined. Number 3, I want to submit a graph showing that the State of California under their aggressive green energy solutions have increased their dependence upon Saudi Arabian imports of oil. Number 4, I would like to submit for the record a news report showing that in the northeast their aggressive greenhouse gas reducing policies resulted in increasing the utilization of home heating oil and becoming dependent upon Russian natural gas. Lastly, in response to my friend from Georgia, I would like to submit week 10, the AP top 25 that shows LSU is number 1. And my friend from Georgia is down to number 8.

I yield back.

Chairwoman CASTOR. We will review those documents and then handle the UC at the end of it.

Mr. HUFFMAN. Madam Chair, would you submit all the usual rebuttal documents?

Chairwoman CASTOR. Yes.

Mr. GRIFFITH. Reclaiming my time.

Chairwoman CASTOR. Mr. Griffith.

Mr. GRIFFITH. Thank you. Let me just say that coal is not dead either and that what we have to do is have parity in our research on all of our fuels because coal and natural gas are great, but we have to make sure that we are not increasing our carbon footprint and/or, in fact, reducing that—and a lot of research and you can see clips from Energy and Commerce and you will see me talking about all kinds of great research that is going on. That being said, Mr. Amin, how many cows do you need to make it feasible to have one of your anaerobic digesters on your property if you are a farmer, because most of my farmers are relatively small?

Mr. AMIN. Size can vary quite a bit, and these projects are scalable. So there is no precise formula, per se. I can tell you the farms that we have cited at have been anywhere between 1,500 cows per farm to 10,000 cows per farm.

Mr. GRIFFITH. And so the problem is, I don't have that many cows on any single farm in my district and so that creates a problem. Now, let me ask this, because I do think the concept is one that is worthy, how do you get it to the pipe? How do you get your RNG to the pipe?

Mr. AMIN. So we can transport RNG by pipeline through a direct interconnect with a major interstate pipeline or we can truck the gas there.

Mr. GRIFFITH. Practically, you would have to be close enough to a pipeline to make that work?

Mr. AMIN. Practically speaking, yes.

Mr. GRIFFITH. Okay. Now when you finish getting the methane out of the manure, what do you do with it?

Mr. AMIN. So we take that manure—we don't take the manure, the farmer takes that manure and applies it to the land as fertilizer when the farmer needs it.

Mr. GRIFFITH. So Mr. Yoder could buy some of that if he wanted to to put on his property because I heard him talking about using chicken litter and other types of manure on his property?

Mr. AMIN. I think.

Mr. GRIFFITH. All right. That works. Good. We found a way to marry these two and that is good. Let me get into the broadband discussion with the time that I have left. I represent the most rural parts of the Commonwealth of Virginia, so don't think of my district as being like Northern Virginia and all that traffic. We have got lots of traffic issues on I–81, but once you get off of 81, you don't have that and we have lots of places, including Montgomery County, home of Virginia Tech, where because of the way of the lay of the mountains go, we don't have service. We don't have broadband. You can be three miles outside of Blacksburg, Virginia, one of the most wired communities in the country and not have any service. There is new technology coming for our rural areas. We are working hard to get mapping that is proper, but we have—there is

some white space technology out there that I think Microsoft has been working on. There are two or three companies working on low altitude satellite service. I think within the next few years we are going to have a lot more broadband available so that our farmers, even on the small farms that don't have a thousand cows, we can use modern technologies and go forward with that. I do appreciate that as well.

Ms. Owens, let's talk soil, because the problem with the federal government often is, is that we get into these discussions and we come up with one or two or five sizes and Mr. Yoder said there are thousands of kinds of soils, and I learned that as a young lawyer when I had a case that I thought was a clear winner because somebody had diverted water on somebody else's property, it broke the foundation in their house, and then I found out that the soil around that particular house held water to such an extent that it was the natural soil, the water in the soil, and not the diversion, that popped the foundation. So how do we get a policy when we have thousands of soils? How do we have a policy that everyone can apply?

Ms. OWENS. Well, I am not the scientist on soil. We are working with folks who are scientists on soil, and I think what you have seen is consensus from this panel and the fact that soil is central to the entire equation as well as the fact that we need a systems approach that is unique to each region of the country.

Mr. GRIFFITH. Well, in this case, it was not only each region; it was like neighborhood to neighborhood. Some neighborhoods have radon, some don't. I mean it changes. Madam Chair, this is important discussion and I think there is a lot of common ground not withstanding our good-natured poking back and forth. There is a lot of common ground where we can make a positive difference using common sense approaches particularly in agriculture to solve some of these problems.

I yield back.

Chairwoman CASTOR. I agree. Mr. Casten, you are recognized for 5 minutes.

Mr. CASTEN. Thank you, Madam Chair. Thank you all so much. So my colleagues have heard me say this before, my view is that its super easy to solve the climate crisis. We only have to do three things: We have to cut our energy use per dollar GDP in half which would take us to where our best in class trading partners are. We have to invent whole new technologies to figure out how to decarbonize industries that we have no idea how to decarbonize, like fertilizer manufacturing. And then we have to take about a hundred parts per million out of the atmosphere to get back to a stable level. If we do all those three things, we are set. The first of those is economically acreative, the second one is potentially acreative because we will invent whole new industries, the third is really, really hard. Except in the agricultural space where at least, theoretically, by increasing soil carbon content and picking on the last, we can increase productivity and there is some interesting data on how do that. And so I want to focus on that and I would like to start with you, Dr. Moore-Kucera; is it my understanding that most of the programs that encourage various agriculture practices from no-till to cover crops, et cetera, are essentially practice

based rather than performance based? You don't get a differential incentive to do something that is going to raise more carbon? It is do this, do this, do this, do this? Is that a fair characterization?

Dr. MOORE-KUCERA. I am sorry. I don't totally understand your question.

Mr. CASTEN. Well, let me maybe ask it a different way. Congresswoman Brownley had asked whether a carbon tax or fee or something like that would be appropriate. Do we actually have a way to understand this changing agricultural practice will lead to this much quantifiable precise change in the carbon absorption in the soil?

Dr. MOORE-KUCERA. There are a variety of tools. The quantification and verification steps with soil carbon is very critical and a lot more research needs to go in that direction. There is a lot of new novel ways that we can measure carbon quickly and so developing a platform that is consistent and can be validated across various regions is a critical component. We currently have the ability to do that now, it is just very expensive.

Mr. CASTEN. So this was my point about practice based because it is really hard if we can't quantify the baseline in a consistent way, then it is hard to know what the change is, but I agree we should do it.

Mr. Yoder, can you just help us understand, and if anybody else has insight, Ms. Owens, I know you and I talked about this a little bit yesterday as well, what is the range before we get to the actual hard numbers on a percentage basis, seasonal changes, slope changes, weather changes, soil type changes, what are we talking about with all these various agricultural practices? How wide is the error band, if you will?

Mr. YODER. It can be very wide. One of the things we are going to have to eventually get to is outcome based rather than just practice based because Dr. Rutan Lao from Ohio State University has done a lot of work on this and where we can sequester particular amounts in my soils. If you go to Nebraska under sandy soils, it doesn't work the same. So the same practice has the different results, so that is why we have to really come down and understand each and every soil type and custom create a program that is going to work for that particular soil. It is, again, a one size fits all, you are not going to get to where you need to be. If we are going to really make a difference in the climate, we need to have a metric that we can count on that you do this—this can be counted on to do this much in this particular area, but you can't do that until we finally get a metric that we can count on.

Mr. CASTEN. Maybe we have to stay with a more practiced based system, too. So help me—do any of you have any estimates of on an absolute basis, what could we do? If we have got to get 100 parts per million down, that is roughly, if I am doing my math right, 400 billion tons of CO_2 out of the atmosphere. If we are looking at the absolute best possible scenario for changing agricultural practices that we think would increase soil health, are we talking 1 percent of the way there, we talking 50 percent of the way there? How big is this relative to what we have to do?

Mr. YODER. Remember I said earlier you have to look at it on a systems basis because you are talking about—there is not a silver

bullet, there are several different ways—for instance, you can reduce greenhouse gas emissions by reducing your tillage or your trips over the field or you can reduce your fertilizer use by going on more of a type that you only fertilize those spots in the field that need it. You can also, depending on what crop you do, you know, whether you are growing hay or whether you are growing corn, it all has to be system based because it is not—we can't have——

Mr. CASTEN. I am out of time and I take your point, but I would welcome if any of you have a way because we have to ultimately figure out how to prioritize the different things we can do and I think there is something really important here in this panel, but it is really hard to understand like, yes, all those things individually are good, but if we are going to spend the time as maybe we should to say what is the variance by soil type, I think it would be helpful for us to understand in the best possible scenario, how big an opportunity is this so that we can look about that that the other things are competing resources for and I am way over, so thank you.

I yield back.

Chairwoman CASTOR. Mrs. Miller, you are recognized for 5 minutes.

Mrs. MILLER. Thank you, Chairman Castor. For over 20 years, my family and I have owned and operated a bison farm in southern West Virginia. We bought our first bull and five females from Medford, Ohio, Mr. Yoder. His name was Buster. Alpha female was Flossy and they are both long gone. I have spent many years at farmers markets selling meats and countless hours on the farm caring for the land, for the animals, and one of the most important things I learned was protecting our land to keep it for generations to come. Probably another important thing I learned was, don't hit an animal on the hind end and expect it to move in the direction you want, because I have to wear this thing for 6 weeks.

We have seen farming evolve across the generations. We have seen farming practices, government suggestions, government programs, even in the 20th centuries, that haven't worked, like planting multiflora rose. That is a mess and it takes years to clean up. We now see farmers utilizing technology in a precision agriculture. Farmers are also instituting sustainable farming practices that are not only benefiting their crop yield, but also the environment. As we move forward in considering ways to address climate change, it is important that we do not become too prescriptive. Farmers know best how to care for their land without cumbersome government mandates. Most of you know that the average age in America of a farmer is 58 years old. For organic farmers, it is 52 years old. For beginning farmers with less than 5 years of experience, it is 47 years old. So we need to keep that in mind as we move forward.

Mr. Amin, is the pipeline infrastructure in the United States adequate to meet the needs of the DTE now and for the expansion of renewable natural gas?

Mr. AMIN. The infrastructure that is in place today is sufficient for what we are doing today. That is correct.

Mrs. MILLER. That is good. Are you selling most of your renewable natural gas to particular states?

Mr. AMIN. Most of our renewable natural gas that we produce in Wisconsin is being sold into the State of California.

Mrs. MILLER. How are you getting it there?

Mr. AMIN. We are getting there by pipeline.

Mrs. MILLER. Okay. Do you think renewable natural gas can help overcome the intermittency problems of other renewable energy sources like wind and solar power?

Mr. AMIN. I do believe so because renewable natural gas is a dispatchable resource. You can use it when you need it most.

Mrs. MILLER. What are the biggest roadblocks in instituting your renewable natural gas technology around the United States?

Mr. AMIN. There are several roadblocks. I would say, number 1, is being able to access the source, the methane source. Generally, we need to be relatively close to a pipeline to be able to make that project work. The farther it is from a pipeline, it is more difficult to access that particular project. So that is probably our number 1 roadblock.

Mrs. MILLER. Thank you. Mr. Yoder, can you describe some of the innovations and advancements in technology that you have seen to assist the farmers?

Mr. YODER. Sure. One of the things that we first adopted several years ago was variable rate technology on fertilizer. We grid sample all of our fields on, actually, acre grids; so for every acre we get an actual reading of what that is and so when we fertilize, we found out because—we did it originally to cut cost. We found out there was hot spots in the field that didn't need any fertilizer at all. We found other spots that were very low. So we spent the last several years evening things up to try to have more of a uniform field. The problem you also have though, that you can't do anything about, is the soil types. We saw that this year with our yields. This year, we are not quite done yet. Actually, I came out of the field yesterday—from the corn field—to be here today, but we found lower yields this year because we had a real wet spring and then we had a very dry July and August, but surprisingly the way we are farming today, our farm still produced much better than what our neighbors did because of the tilled.

The other thing that we have used in our farm is we put precision parts on our planter. It is actually a high-speed kit that we put on and so we can go now—we have got a 40-foot planter that we put—the high speed which we can go up to 10 miles per hour instead of the normal five. We don't go that fast, but we basically turned our 40-foot planter into the same amount of capacity as a 60-foot and we actually cut 3 to 4 days off of our planting. And what my neighbors did because they had to wait until they could get to it, they didn't get their planting done. We got everything planted except for about 150 acres, so the technology—but the other thing too, is, we got all this technology on the planter, we can plant 24 hours in a row because it has got all the readouts. We can understand the seed to soil contact, exactly how much seed we are putting on, the varieties of seed, so we are no longer hampered by day light. In the old days if you plant after dark, you are going to have trouble. Not anymore because you know—you are making a map. Every time you make a trip over the field, you are making a map of what you have done. And so those two things—farmers

love technology, too, and that is the thing. Data is going to be the next big thing that we need to do. If we could get our hands on the data and just like Tina was talking about, the data that each farm generates is wonderful, but just think if we could get the data that our own U.S. Government or USDA has, what if we could put that together and actually have something that we could get some correlations and actually see the trends on a big scale. That would be wonderful.

Mrs. MILLER. Thank you.

I yield back my time.

Chairwoman CASTOR. Thank you.

Ms. Bonamici, you are recognized for 5 minutes.

Ms. BONAMICI. Thank you so much, Madam Chair. Thank you to all the witnesses. I just want to briefly follow-up on Mr. Carter's comment that Mr. Huffman followed up on about the rural broadband and how important that is. There is a little farm Seeley Mint up in Columbia County, Oregon, where they sustainably harvest spearmint and peppermint. The last time I visited, they said, see the tracks down the road? You have to go over the tracks and then you have internet, so it is a real challenge with the growing business. But I also wanted to mention we heard about the importance of small farms in agriculture. Summit foods in Cornelius, Oregon, which is pretty far west of Portland. We grow grape blueberries in Oregon, and Summit Foods dries them, sells them nationally/internationally. They take the processing waste, which is fermented and sent to their sister company, Summit Natural Energy, where they make Thunderbolt Racing Fuel, which the race car drivers like because not only is it 100 percent renewable, it also is high-octane and smells like blueberries. So we are doing creative things doing our part with agriculture. I just wanted to mention on the same day in August when the IPCC released its special report on land degradation and sustainable land management, I was visiting 46 North Farm in Astoria, Oregon. 46 North is participating in a dry farming project with partners at Oregon State University's extension service. People think, well, it rains all the time in Oregon, but they really don't need to irrigate, even during a dry season, because they work to conserve soil moisture through dry strategies like the use of cover crops, which then help them access water and nutrients in the soil later in the growing season. So these practices have allowed them to restore a significant portion of their land, which is heavily degraded from the previously land owner. It is kind of a great example of sustainable agriculture, which, of course, on a large scale could help reduce emissions, restore carbon, and preserve natural habitats, but also providing tasty vegetables and beautiful flowers. Many of our ecosystems have been pushed to the brink with their ability to naturally adapt, but farmers are natural stewards of the land and have direct experience with conserving natural resources, and I know their perspectives are really valuable.

Dr. Moore-Kucera, variable precipitation and rising temperatures are intensifying droughts in some places and increasing heavy downpours in others reducing snow pack, especially in the Pacific Northwest, and leading to significant differences in supply and demand, and it really has changed our crop productivity. So in your

testimony, you outlined the substantial greenhouse gas emission reductions from cover crop and conservation tillage and you noted that the real and perceived risks that farmers face when considering how to adopt strategies. So as water supply changes in the Northwest in the face of the climate crisis, how can we effectively incentivize and encourage more farmers to transition to no-till dry farming and cover cropping practices?

Dr. MOORE-KUCERA. Yes. Thank you for that question. Climate discussions must also include discussions around water, not only water quality like I mentioned, but water quantity and availability. And so all of the soil health practices that I mentioned earlier help to get water into the ground and that water is then available later for the plants, so that is a win-win for sure. You asked about how we can help promote those different practices and break down the barriers. I think it was alluded to earlier, but the relationship building is critical between farmers and conservationists and so communicating that, getting workshops, hearing where the farmers are, where they are in their success, where they are in their challenges, is critical to help move some of those programs forward.

Ms. BONAMICI. Thank you. And to you and also Mr. Yoder, we know that smart agriculture practices have other benefits like reducing fertilizer runoff. I am the co-chair of the Oceans Caucus and the Estuaries Caucus. I've been concerned about runoff and pollution from human activities increasing the presence of harmful algal blooms or habs in marine, coastal, estuary, and freshwater systems, and that has happened in every state.

So I wonder about how healthy soils, reducing dependents on fertilizers; I worked on pesticide reductions programs when I was in state legislature. What are some other benefits and how can healthy soil stewardship practices and how can we effectively reduce those pollutant inputs to maximize the benefits to our soil?

Mr. YODER. Again, I go back to the economic reasoning. Okay. For instance, I am from Ohio and we have—we had some challenges with algal blooms in the lake area basin because of the northwest Ohio—that has been blamed for a lot of it. We have a lot of dissolved reactive phosphorus moving which we never thought we would ever. When I was in college and you talked about phosphors, it never moved more than two inches forever. Well, dissolved reactive phosphorus does.

So what we are trying do is figure out soil amendments to stabilize those nutrients, and the best way you can do that is a cover crop because it just basically takes up all the unused nutrients and waits for the next crop. But it does that, but it also, in economic reasons, you can actually lose. And I use this argument all the time with farmers. Over $100 an acre of some of the nutrients worth that you see go off your farm, that is money—a dollar saved is better than a dollar on a gross. So farmers are saying, hey, you know, if I can save this—so what you do is, you know, these farmers that put on the nitrogen and the phosphorus in the fall and they know half of its going to be gone—that doesn't make sense. And so we have moved to an as-needed basis. Basically, you feed the crop as you take it and you do tissue test and you find out what is it needing instead of just putting it all on and get it out of the way. We have to change our thinking about it. You have to really stress the

economic value of that, and when farmers see the economic values they will change. But they are not interested—that is why I said before, there is also controversy. They don't want to talk about climate change, but they will sure talk about weather pattern changes so that is what they do.

Ms. BONAMICI. Thank you. I am out of time.

I yield back.

Chairwoman CASTOR. Mr. Palmer, you are recognized for 5 minutes.

Mr. PALMER. Mr. Yoder, I am interested in your no-till farming. I own timberland and we have grain fields for wildlife and we did no-till this time, but are you doing corn no-till?

Mr. YODER. We are. We are 100 percent no-till.

Mr. PALMER. How do you do that when your seed has to be at a certain depth, soil depth?

Mr. YODER. There are so many new tools in technology. Our planters got the latest——

Mr. PALMER. You are doing drilling or——

Mr. YODER. No. It is actually a planter, but we control the down force. We call Delta Force; that is our brand name. We can literally put enormous amount of pressure to get it down to where we used to have just springs keeping it down and then you get a tough spot, it rises up, and then you wouldn't get your depth. This guarantees it is going to be a certain depth. And the other thing too about no-till is after continuous no-till, your ground actually gets looser and so you can be more precise. And we also—we have indications of seed to soil contact, we have indications of dropping doubles or skips and things like that. So when we go through with the planter, we can actually do way more than we did when we used to have to stop and dig it out and see what it is like. So technology has been a tremendous tool for our efficiency.

Mr. PALMER. All right. I was—I didn't think you were just throwing seed on top of the ground, so I knew you had to penetrate the soil in some fashion. I just want to share something with you and just get your response to it. The statement was that the greenhouse effect would be desolating the heartlands of North America and Eurasia with horrific drought causing crop failures and food riots. The Platte River in Nebraska would be dry while a continent-wide black blizzard of prairie topsoil will stop traffic on the interstate, strip paint from houses, and shutdown computers. Do you anticipate that?

Mr. YODER. I hope not.

Mr. PALMER. I am asking.

Mr. YODER. Well, this is what I am stressing——

Mr. PALMER. Any of you?

Mr. YODER. I think you are going to be more effective with, instead of scare tactics like what you have been hearing, to show farmers the economic value of changing their practices of what they have been doing, not only cutting their cost but increasing their yields. And if that is going to be a way to a solution for climate change, then that will just help things along.

Mr. PALMER. My question is, and to the entire panel, Dr. Moore-Kucera, is that a reasonable expectation as an outcome for failing to eliminate all carbon emissions?

Dr. MOORE-KUCERA. I just think that there is a lot of hope and there is a lot of opportunity——

Mr. PALMER. I am asking, is this a reasonable expectation? That is a yes or no. Okay. You won't answer. How about you, Ms. Owens.

Ms. OWENS. I would say that we should reasonably expect to see some of our societal fabric breakdown if we continue on this path of extreme climate change.

Mr. PALMER. Mr. Amin.

Mr. AMIN. So this is not an area of my expertise per se, so I will defer that question.

Mr. PALMER. Okay. Thank you. That was from Michael Oppenheimer who is a climate scientist in the Albert G. Milbank professor of Geoscience and International Affairs at the Woodrow Wilson School of Public and International Affairs at Princeton University and he said that in 1990. And he predicted that by 1995, he also said that Mexican police will round up illegal American migrants surging into Mexico seeking work as field hands. A lot of my problem with this and we—I understand the climate's changing, the geologic record shows that, and we are so wrapped around the axle about carbon when I think there were three scientists were all witnesses called by the majority that admitted if we completely eliminated all carbon emissions, went to zero emissions, it would not stop climate change. That was an accurate answer. It will not stop it. The geologic record shows that the climate is changing, it will continue to change, and to some of what you have talked about, Mr. Yoder, in regard to the technology and Mr. Amin, the science behind renewable natural gas is I think how we ought to be approaching this. We need to be looking for adaptation and mitigation solutions because it is coming no matter what we do. But all we are doing is talking about eliminating CO_2 and I am for reducing carbon emissions, I am for—we have done a tremendous job in the last 34 years in regard to the six criteria pollutants that the EPA tracks in reducing that.

In terms of farming, I mean, we basically have an agricultural miracle that has played out over the last 50 years. So my point is, is that, I want us to get serious about being prepared for the climate change that is coming and not buy in to a lot of the fake science.

With that, Madam Chairman, I yield back.

Chairwoman CASTOR. Perfect. Next Ms. Pingree, we are going to recognize you for 5 minutes. Thank you for your interest in this hearing. Ms. Pingree's a farmer herself and one of the members of Congress we look to for expertise in this area. You are recognized for 5 minutes.

Ms. PINGREE. Thank you so much, Madam Chair. Thanks to you and the ranking member and the members of the committee for letting me sit in on what has been a very interesting hearing. Thank you to the panel for really great testimony and really to the committee for such good questions and truly some bipartisan areas of agreement, so it has been a pleasure to be able to be in here with all of you.

I am particularly interested in this. I have been an organic farmer since the 1970s and I have seen a huge transition of when that

was, sort of, a funny back to the land idea to $50 billion industry and so many practices that happen in organic agriculture are the things you are talking about today particularly cover crops and composting. I am working on myself, on a bill related to agriculture and climate change, and so many of the pieces that people have been talking about today are a part of that. I have sort of a five-part strategy, which is support soil health, promote pasture-based livestock, preserve farmland, support unfarm and renewable energy, and reduce food waste, so you all have kind of covered it a little bit. Food waste didn't come up, but just to mention to the committee, in Maine, we have one big bio digester that collects from a dairy farm, but also collects a tremendous amount of food waste as well and bio digests together and then produces electricity on site so there is actually no transportation. I also am very, very interested in some of the questions that came up around the metrics of understanding how much carbon is sequestered in the soil and that is one area that got talked about a little bit, but not developed as much today and I have certainly met with a lot of different organizations and university people who are trying to crack this nut of, you know, how do we look at the outcomes and then how do we pay farmers for the performance. And I am interested just for any of you who want to answer—I mean, one idea is that farmers could participate in carbon markets. I come from actually the most forested state in the nation, so we have been able to take advantage—so I did mention it to my friend from Georgia as well—but we have been able to take advantage a lot of the offsets because we have that, but we also have hundreds of years of developing an understanding of how much carbon is produced in a tree. So a lot of this is new, but we would like to see farmers take advantage of that. So if you were able to participate in a carbon market, if there were some metrics that we could all agree on, either developed through the USDA or one of these many programs, what do you see as the benefit of that, and also, I would say, there is also some talk of a tax credit on this? We give a tax credit to wind and solar, what about a tax credit on carbon produced? So that is just an area of interest, and go ahead and add in whatever you think.

Mr. YODER. Well, I thank you for that question. One of the things that we deal with a lot is what is good for the land and what is good for the farmer. We also have to get buy-in from the land owner, and one of the problems we have is an awful lot of land is leased on a yearly basis and how do you—for the most you can get—money you can get for that land, how do you convince the land owner that these practices, which may be different than what the farmer's been doing, that it is worth it and so that is why I think a tax credit or something like that would be really helpful.

The other thing, too, is, I would like to see us develop some different programs just as a starter, just to get farmers to stick their toe in the water and try something. I have never taken any money to try to these due practices. I actually started a no-till to save money, but today I would never go back to farming like I used to because I have seen the value and the resilience of my soil. For every 1 percent organic matter that you increase in your soil, 20 to 25,000-gallon more capacity for holding water. And so if you look

at it that way, and that is how you get to farmers is managing that risk. It is making your stuff more resilient that they can actually have an economic gain for it, but things—we've got to figure out a way to get all farmers interested in looking at different ways to do things.

Ms. PINGREE. Ms. Owens.

Ms. OWENS. I would like to add a bit to that. So Mr. Yoder actually talked very well about some of the practices that lead to economic resiliency within farms and I think that that is a much more immediate approach that we can take given what we have available using the NRCS resources, and the Farm Bill, and other things at our disposable. We are actually as a company at the table having the conversation around an eventual carbon market, we are supporters of it, and there is a lot of consensus that needs to happen in order for that to get off the ground. What we can show farmers today is a way to use existing tools, data, and the practices that we have talked about several times as a panel on how they can actually impact their profitability starting within, you know, 2, 3 or less years, that they actually can really move the needle. There is some great case studies that we like to point to. AFT actually published some using funding from NRCS. There is a company called Day Two Research that also has open case studies that very specifically shows in states like Illinois, Ohio, and other midwestern states that there is a very real profitability model here for farmers to adopt and that is much more tangible, real, and been demonstrated by farmers such as Mr. Yoder.

Ms. PINGREE. Great. Well, thank you very much. I am out of time. Thank you so much for letting me sit in.

Chairwoman CASTOR. Thank you for your interest. I would like to thank our witnesses for your testimony today. It has been very helpful. The committee is currently accepting policy proposals if anyone has a policy proposal beyond the ones addressed today. Please go to our website at House.climatecrisis.gov. We have a request for information, the due date is November 22nd. So if you have some other institutions or advocates or interested parties, other farmers who would like to submit some ideas to the committee, please pass that along.

At this time I would like to ask unanimous consent to add to the hearing record, number 1, a letter from the Defenders of Wildlife with their policy recommendations and, number 2, a policy paper from the Breakthrough Institute. And any additional questions for the witnesses, the members will have 10 business days within which to submit those and I ask all of the witnesses to respond. Did you have——

Mr. GRAVES. I just wanted to make sure that our pile of documents was submitted and also I left out a letter by Senators—this is Mr. Huffman's favorite—letter by Senator Schumer, Menendez, Markey, and Cantwell asking that we increase global oil production. Sometimes the truth hurts.

Chairwoman CASTOR. They did over a year ago. Okay. So without objection, those being incorporated into the record, thanks again, everyone. The hearing is adjourned.

[Whereupon, at 4:13 p.m., the committee was adjourned.]

Submission for the Record
Representative Kathy Castor
Select Committee on the Climate Crisis
October 30, 2019

OCTOBER 30, 2019.

Hon. KATHY CASTOR,
Chairwoman.
Hon. GARRET GRAVES,
Ranking Member House Select Committee on the Climate Crisis,
Washington, DC.

DEAR CHAIRWOMAN CASTOR AND RANKING MEMBER GRAVES: Defenders of Wildlife (Defenders) is pleased to offer testimony for the record for the hearing, "Solving the Climate Crisis: Opportunities in Agriculture," conducted by the Select Committee on the Climate Crisis on October 30, 2019.

Defenders is a national nonprofit conservation organization dedicated to the protection of all native plants and animals in their natural communities. For more than 70 years, Defenders has protected and restored imperiled species throughout North America by securing and strengthening state, national, and international conservation policies; working on the ground at the state and local level; and upholding legal safeguards for wildlife and habitat in the courts. We represent more than 1.8 million members and supporters nationwide.

Defenders has led efforts to develop and implement climate change policies for wildlife for more than a decade. Our work on climate change has two main foci: 1) ensuring that wildlife and habitat are managed in a manner that promotes resilience to climate change impacts; and 2) supporting emissions reduction through wildlife-responsible renewable energy development nationwide. We believe it is critical that Congress and the administration provide for wildlife, habitats and ecosystems as part of a climate change policy agenda.

Following are policy recommendations for bolstering current agricultural conservation programs and establishing new initiatives to support wildlife conservation and climate change mitigation and adaptation on our nation's working lands.

Increase Annual Appropriations for Farm Bill Conservation Programs for Landowners to Adopt Climate Stewardship and Wildlife Conservation Practices

Farm Bill conservation programs help farmers and ranchers implement conservation practices on their lands, including wildlife conservation and climate stewardship practices. Congress should avoid using Changes in Mandatory Program Spending (CHIMPS) in annual appropriations processes to raid mandatory Farm Bill conservation programs in order to fill discretionary spending gaps elsewhere in the federal budget.

Increase Funding for Farm Bill Working Lands Programs to Assist Farmers, Ranchers, and Natural Resource Managers to Adapt to Climate Change Impacts

Farm Bill working lands programs, including the Environmental Quality Incentives Program and the Conservation Stewardship Program, provide financial and technical assistance to landowners to implement conservation practices on their agricultural lands, including climate stewardship practices. Supporting climate stewardship on over 100 million acres of farmland would reduce or offset agricultural emissions by one-third by 2025. Dedicated funding would support practices such as rotational grazing, improved fertilizer efficiency, and use of cover crops to retain and improve soils and carbon sequestration.

Example legislation: Climate Stewardship Act (S. 2452) (https://www.congress.gov/bill/116th-congress/senate-bill/2452)

Increase Acreage Enrolled for the Benefit of Wildlife under the Conservation Stewardship Program

The Conservation Stewardship Program is a Farm Bill working lands program that supports farmers and ranchers to adopt conservation practices on their agricultural lands, including climate stewardship practices. Defenders recommends that a minimum of 10 percent of the acreage annually enrolled in each state under the program directly support wildlife conservation. Targeting a minimum amount of the program's funds to wildlife conservation will help support landowners to implement practices that benefit wildlife, reduce emissions, and respond to climate change.

Increase Funding for Conservation Easements on Private Agricultural Lands to Prevent Conversion of Agricultural Land to Development

The Agricultural Conservation Easement Program is a Farm Bill program that that helps landowners protect, restore, and enhance wetlands, grasslands, and working farms and ranches through conservation easements. The conservation of privately held agricultural land helps prevent conversion to development, so that they can continue to actively sequester carbon rather than contribute to greenhouse gas emissions that results from other land uses. Strategic land conservation can also support habitat connectivity and ecosystem resilience against climate change impacts.

Increase Funding for Restoration and Conservation Easements on Private Forestlands to Support Carbon Sequestration

Preserving forests as forests helps prevent their conversion to development and allow them to continue absorbing greenhouse gases. The 2018 Farm Bill reauthorizes three programs that support habitat acquisition and/or conservation easements on privately held forests. The Healthy Forests Reserve Program (HFRP), administered by the Natural Resources Conservation Service, provides landowners with 10-year restoration agreements and 30-year or permanent conservation easements for the purpose of recovering species listed under the Endangered Species Act, improving biodiversity, and enhancing carbon sequestration. The program should be improved by allowing land that has already been restored and is providing wildlife benefits to be eligible for long-term or permanent easements. Like HFRP, the Community Forest Program, administered by the U.S. Forest Service, and the Forest Legacy Program, administered by the U.S. Fish and Wildlife Service, protect forests that are threatened with conversion to non-forest uses.

Support Enrollment in the Conservation Reserve Program that Creates or Enhances Wildlife Conservation and Habitat Connectivity

The Conservation Reserve Program conserves and improves soil and water quality and creates and maintains wildlife habitat by providing cost-share and rental payments for farmers to establish long-term vegetative cover on highly erodible or environmentally sensitive land that has usually previously been converted to crops. For grasslands enrolled in the program, the 2018 Farm Bill directs the Farm Service Agency to prioritize land of ecological significance, including land that would conserve habitat connectivity or federally protected species and/or species of conservation concern. We recommend that the Farm Service Agency prioritize properties that simultaneously serve both of those purposes.

Authorize Perpetual Easements for Land Enrolled in U.S. Department of Agriculture Habitat Conservation Programs

To increase cost savings and the effectiveness of U.S. Department of Agriculture conservation programs, we recommend authorizing perpetual easements for land enrolled in any of the Conservation Reserve Program or Natural Resources Conservation Service habitat initiatives. These new permanent easements should be particularly targeted at land enrolled in the Conservation Reserve Program that exceeds an erodibility index of greater than 15 or is adjacent to riparian areas that should be protected as conservation buffers in perpetuity. Perpetual easements extend the conservation investment and prevent agricultural land from being converted to development at the end of the contract.

Prioritize Enrollment of State Acres for Wildlife Enhancement in the Conservation Reserve Program

The Farm Bill's Conservation Reserve Program includes a State Acres for Wildlife Enhancement initiative, which allows states to design and implement practices that conserve soil and water and also benefit high priority wildlife species. However, and despite the success and popularity of the initiative, the Farm Service Agency has not made these practices available for sign-ups on a nationwide basis since 2017. We recommend that Congress urge the U.S. Department of Agriculture to prioritize enrollment and implementation of this initiative.

Increase Acreage Enrolled under the Conservation Reserve Enhancement Program and Compensate Participants for the Full Cost of Riparian Buffer Protection

The Conservation Reserve Enhancement Program is part of the Farm Bill's Conservation Reserve Program that targets high-priority conservation concerns identified by a state. Farmers and ranchers are paid an annual rental rate along with other incentives to remove environmentally sensitive land from production and establishing permanent resource-conserving plant species. The 2018 Farm Bill codified

the program and incentivizes enrollment of riparian buffers, including forested riparian buffers, by authorizing the U.S. Department of Agriculture to make cost-share payments for forested riparian buffer maintenance throughout the term of the agreement, and to cover up to 100 percent of the cost incurred by the owner or operator for maintenance activities. Now the Department must follow through on this authorization to compensate program participants for the full cost of riparian buffer establishment and maintenance as authorized by Congress.

Increase Funding for Natural Resources Conservation Service's Conservation Technical Assistance Program

The Natural Resources Conservation Service's Conservation Technical Assistance program provides land users with proven conservation technologies and the delivery systems needed to achieve conservation benefits on working lands, such as reducing soil loss from erosion, reducing potential damage from natural disasters, and enhancing the quality of fish and wildlife habitat. The long-standing shortage in funding for technical assistance hampers delivery of conservation programs, a problem that will be exacerbated by the need to implement new climate stewardship conservation practices on private lands nationwide.

Example legislation: Climate Stewardship Act (S. 2452) (https://www.congress.gov/bill/116th-congress/senate-bill/2452)

Increase Annual Appropriations for the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program for Landowners to Adopt Climate Stewardship and Wildlife Conservation Practices

The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program provides financial and technical assistance to private landowners interested in improving habitat for migratory birds, and endangered, threatened, and at-risk species on their working lands.

Expand the Farm Bill Sodsaver Provision Nationwide to Support Carbon Sequestration

The Sodsaver provision in the Farm Bill limits the loss of native grasslands by reducing federal subsidies for crop insurance premiums on acres that are converted from prairie to cropland. Currently the provision only applies to the six states of the Prairie Pothole region. Extending the provision to the entire country would help prevent conversion in other areas, such as Texas and Kansas, that are experiencing some of the highest rates of grassland loss. Preserving grasslands allows them to continue to actively sequester carbon rather than contribute to greenhouse gas emissions that results from agricultural conversion.

Example legislation: American Prairie Conservation Act (S. 1913/H.R. 3939) (https://www.congress.gov/bill/115th-congress/senate-bill/1913)

Authorize a Program for Measuring Outcomes of Farm Bill Conservation Programs

Measuring outcomes helps ensure that investment in Farm Bill conservation programs is achieving conservation goals, helping to reduce greenhouse gas emissions and increasing terrestrial carbon sequestration.

Example legislation: Healthy Fields and Farm Economies Act (H.R. 4751) (https://www.congress.gov/bill/115th-congress/house-bill/4751)

Thank you for providing the opportunity to provide testimony for the record that will help to address our current climate crisis. We commend the Select Committee on its vital work.

Sincerely,

MARY PFAFFKO,
Private Lands Policy Analyst.

Submission for the Record
Representative Kathy Castor
Select Committee on the Climate Crisis
October 30, 2019

CLIMATE MITIGATION THROUGH AGRICULTURAL PRODUCTIVITY, INNOVATION, AND TRADE

THE BREAKTHROUGH INSTITUTE

Despite calls for radical transformation of American agriculture from many critics, American farmers are currently some of the most productive and environmentally friendly producers in the world. Congress should double down on the many existing

strengths of the US agricultural system, most notably by seeking to increase productivity, research and development (R&D) funding, and global exports.

Farmers are America's unsung environmental and climate stewards. Increases in farm productivity over the past half-century have made American producers some of the highest yielding in the world. US corn farmers, for example, produce roughly 4.9 tons of corn per acre, whereas French farmers produce about 3.9 tons, and Chinese farmers produce 2.75 tons.[1]

Due in large part to farmers' high yields and the efficiency with which they use resources, the US uses less land and produces less greenhouse gas (GHG) emissions per unit of food or beverage than most other countries. For example, the US emits roughly 25% and 50% less GHG emissions per pound of beef produced than the UK and Mexico, respectively.[2]

Considering US agriculture and policy options from a global perspective reveals that American farmers have not only been reducing domestic, but also international emissions. The US is the number one agricultural exporter in the world, exporting more than 20% of its production. These exports cut global emissions by reducing the amount of food that would be produced in other countries with less efficient production systems.[3] For example, the US exported almost 72,000 tons of beef to the Republic of Korea in 2017. If that beef was produced locally in Korea—where beef production is 25% more emissions intensive than in the US—it would release an additional 300,000 tons of CO2 equivalent.[4] If the US were to increase agricultural exports to regions with less efficient farm systems, the impact on global emissions could be even higher.

US public R&D is what makes the farm sector's productivity and global environmental benefits possible.[5] USDA economists estimate that investing in agricultural R&D has reduced GHG emissions at a cost of $8–13 per ton of CO2 equivalent. For reference, conservation programs such as the Environmental Quality Incentives Program have reduced emissions at an estimated cost of $14 to $75 per ton.[6] Our preliminary research, in partnership with Purdue University, indicates that doubling R&D funding would reduce global emissions from crop production by more than 100 million metric tons of CO2 equivalent per year by 2050.[7] That is equivalent to cutting current US enteric fermentation from cattle—or cow burps—by two-thirds.[8]

Increasing US R&D funding can also help other countries make their agricultural sectors more environmentally friendly. Our research indicates that sharing US agricultural knowledge and innovations internationally, as the US has done for decades, can approximately double the climate benefits of increasing R&D.[9] By maintaining a trade and IP regime that increases exports not just of food, but also agricultural knowledge and technology, the US could become a global leader for environmentally beneficial and highly productive agriculture.

On top of its environmental potential, investing in R&D benefits American farmers and consumers across the globe. Increasing R&D funding would help American farmers cut their production costs and compete in an increasingly challenging global market. Moreover, by reducing global food prices, investments in R&D improve the nutrition and health of millions of urban poor.[10]

Taking a global perspective to mitigating agricultural emissions also leads to new and creative ideas. For instance, as corn producers are discontented with current ethanol demand, instead of subsidizing ethanol production, the US government could incentivize those farmers to sell surplus corn to foreign markets.

Historic growth in farm productivity has curbed emissions from US agriculture. To continue this overly positive trend, Congress should not attempt to reorganize a system from scratch. Instead, the US government ought to prioritize the factors

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[1] FAOSTAT (2019).

[2] FAOSTAT (2019).

[3] USDA ERS (2018). FAQ. https://www.ers.usda.gov/faqs/

[4] FAOSTAT (2019).

[5] Wang, S. L., Heisey, P., Schimmelpfennig, D., & Ball, V. E. (2015). Agricultural productivity growth in the United States: Measurement, trends, and drivers. Economic Research Service, Paper No. ERR–189. https://www.ers.usda.gov/webdocs/publications/45387/53416_err189_summary.pdf?v=42212.

[6] Jones, C. A., Nickerson, C. J., & Heisey, P. W. (2013). New uses of old tools? Greenhouse gas mitigation with agriculture sector policies. *Applied Economic Perspectives and Policy,* 35(3), 398–434. Note: CO2eq are in metric tons.

[7] Working paper available upon request.

[8] US EPA. (2019). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2017 https://www.epa.gov/sites/production/files/2018-01/documents/2018_chapter_5_agriculture.pdf.

[9] Working paper available upon request.

[10] Baldos, U. L. C., & Hertel, T. W. (2016). Debunking the 'new normal': Why world food prices are expected to resume their long run downward trend. Global Food Security, 8, 27–38.

responsible for past environmental improvements, namely, innovation driven by public R&D and global exports.

For More Information:

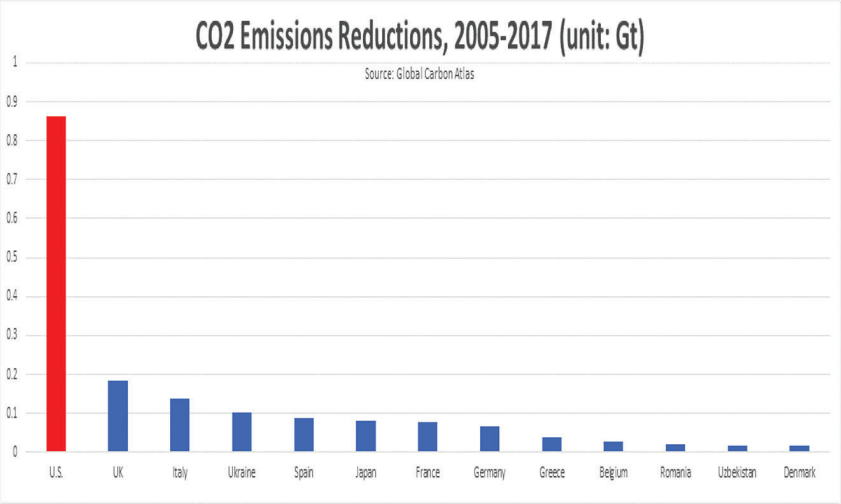
Dan Rejto, Associate Director of Food and Agriculture, daniel@thebreakthrough.org.

Submissions for the Record
Representative Garret Graves
Select Committee on the Climate Crisis
October 30, 2019

ATTACHMENT: *IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

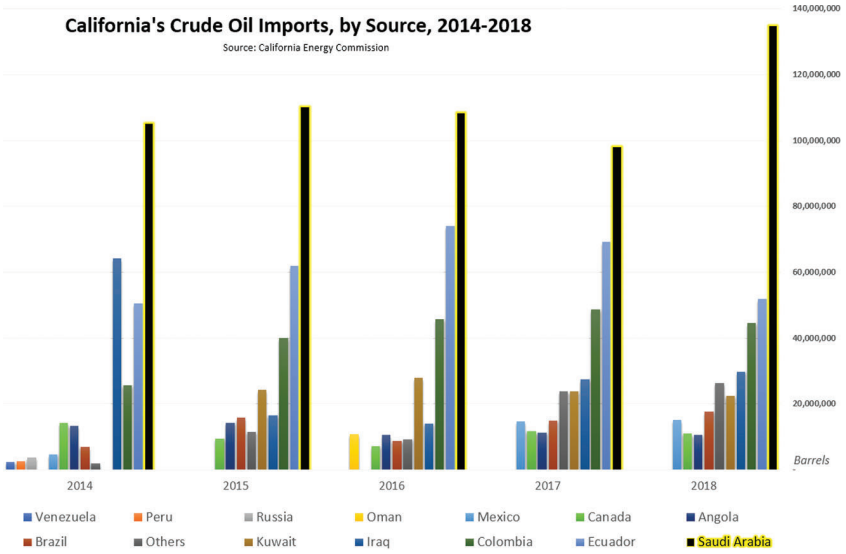
The submission for the record reference can be found on Page 100 of the report; the full report is retained in the committee files and available at: https://archive.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf

ATTACHMENT:



This graphic is retained in the committee files.

ATTACHMENT:



The chart is retained in the committee files. The data for this chart (2014–2017) was compiled from a 2018 report; the report from which the data was pulled is retained in committee files and available at: https://ww2.energy.ca.gov/almanac/petroleum_data/statistics/2018_foreign_crude_sources.html.

ATTACHMENT: Everly, Steve. "Why Natural Gas from Putin's Russia Has to Be Imported to New England." *Washington Examiner*, 24 March 2018.

The article is retained in the committee files and available at: https://www.washingtonexaminer.com/opinion/op-eds/why-natural-gas-from-putins-russia-has-to-be-imported-to-new-england.

ATTACHMENT: Letter from Sens. Maria Cantwell, Robert Menendez, Chuck Schumer, and Ed Markey to President Trump, 23 May 2018.

This letter is retained in the committee files and available at: https://www.democrats.senate.gov/imo/media/doc/Oil.pdf.

United States House of Representatives
Select Committee on the Climate Crisis

Hearing on October 30, 2019
"Solving the Climate Crisis: Opportunities in Agriculture"

Questions for the Record

Jennifer Moore-Kucera, Ph.D.
Climate Initiative Director
American Farmland Trust

THE HONORABLE KATHY CASTOR

1. Currently, most agricultural conservation programs that can help sequester carbon are practice-based, meaning that funding is provided based on the adoption of certain techniques as opposed to the achievement of specific performance metrics. How could we move from a practice-based to a performance-based system to ensure that the estimated carbon drawdown is occurring at predicted levels?

While the scientific community has consistently demonstrated the carbon sequestration benefits of various soil practices, additional research is needed to ensure that anticipated outcomes more fully align with actual performance. Shifting to a per-

formance-based system would require additional data and data standardization as well as improvements in modeling and testing technology.

A crucial step towards these goals could be the establishment of a national agricultural sequestration quantification program. Models of such programs exist from other countries such as Australia and Canada (see Paustian et al., 2019 for details) and could be used as a template for the US to modify and improve upon. A national sequestration quantification program would strengthen the ability of our nation to project outcomes, inform recommended practices, and provide policymakers with a greater understanding of how to maximize limited public dollars. Coordinated through current USDA agencies (primarily NRCS and ARS), this program would develop the necessary components for assessment, interpretation, and implementation as outlined below.

Assessment

- Develop standardized methodology for both soil sampling and carbon measurements. Currently, the most accepted approach is to monitor changes in soil carbon stocks (Paustian et al., 2019). A standardized methodology should include a focus on using appropriate tools to evaluate management impacts on soil carbon stocks and dynamics at different scales (e.g., field, farm, and region).
- Establish a standardized approach for fully evaluating and cataloguing management history. This step is critical for proper interpretation.
- Support research into the development of new, inexpensive, novel, in situ (on-site) soil carbon measurement tools that reduce assessment costs and labor.

Interpretation

- Regionally parametrize acquired data with historical management data to provide greater context and identify baselines to enable better assessment of changes (Manter, Delgado, & Moore-Kucera, 2018).
- Provide additional or programmatic support of on-farm research and grower-driven demonstration programs.
- Increase staffing capability and technical training of NRCS field staff dedicated to soil sampling, carbon evaluation, carbon farm planning, and collection of standardized management history information. These data could be preserved in public databases such as the current ARS–AgCROS (Agricultural Collaborative Research Outcomes System) database system (Delgado et al., 2019).
- Develop a soil sample repository that can facilitate cutting-edge soil carbon quantification tools. These tools will ultimately save time and money from field-collected samples sent for typical soil carbon estimation. This effort could be expanded to include soil health measurements (Manter et al., 2017).

Implementation

- Provide dedicated resources and programmatic funding to enhance coordination between government agencies within the USDA (e.g., between NRCS and ARS). A national network of on-farm demonstration sites or long-term monitoring sites could be established in conjunction with the development of national soil laboratories dedicated to providing consistent and standardized protocols that leverage current databases (e.g., SSURGO and AgCROS) and provide open-source, crowd-sourcing capabilities to expand the knowledge base of practices and quantifiable outcomes.
- Enhance/secure regionally specific technical assistance to develop monitoring and evaluation strategies to determine how conservation practice adoption impacts soil carbon stocks.
- Develop an approach to reward early adopters who have paved the way for wider-spread adoption of carbon sequestration practices. For instance, programs could reward producers for maintaining practices (to avoid negative reversals), establish mentoring programs (for example, farmer-to-farmer learning networks where early adopters are paid to train the next wave of adopters), develop payment incentives for soil sampling prioritization on sites where long-term adoption has occurred, etc.

Additionally, we need to identify other approaches to help sequester carbon. More resources are needed for research into novel carbon reducing practices such as biochar and increasing deep-rooted plants. Support is also need for plant breeding efforts that increase productivity with fewer inputs and produce perennial plants that could replace annuals (e.g., Kernza), as well as other cutting-edge approaches.

Other important considerations are the co-benefits of supporting agricultural systems for climate mitigation and adaptation to ensure food security and address other issues such as flood mitigation and buffering temperature extremes. Many soil sequestration practices also cut GHG emissions indirectly via reductions to fuel (e.g., fewer passes with the tractor with no-till), reduced synthetic fertilizer applications (via increased soil organic matter, a natural warehouse of nutrients and addi-

tions of animal and plant waste via composts and through extraction of nutrients via cover crops), and water savings (via increased water storage capacity with improved soil organic matter).

2. What is the current state of knowledge on the potential of agriculture to reduce U.S. greenhouse gas emissions?

Agricultural practices, in part, contribute to total greenhouse gas (GHG) emissions in the United States (US). The most recent EPA report indicates that agriculture releases about 582 million metric tons (MMT) of carbon dioxide equivalents (CO_2e)0F,[1] which translates to approximately 9% of total US emissions (USEPA, 2019). In contrast to other production sectors, which are dominated by energy-related CO_2 emission sources, the bulk of agriculture's impact on climate change is due to nitrous oxide (N_2O) and methane (CH_4) emissions from fertilizer application, manure handling, and enteric fermentation from livestock (USEPA, 2019).

With over 396 million acres of cropland and 440 million acres of pastureland in the US, there are numerous practices that have the potential to reduce US GHG emissions and sequester carbon. Based on current adoption of cover cropping and conservation tillage practices (no-till or reduced till), it is estimated that US cropland has reduced GHG emissions between 64.5 to 78.5 million metric tons (tonnes) of CO_2e per year with much more potential with widespread adoption of these practices. Adoption of other conservation practices, already established and promoted by NRCS, can lead to even greater reductions.

Table 1 (below) summarizes GHG reduction potential estimates of key NRCS conservation practices as calculated using the Carbon Reduction Potential Evaluation (CaRPE) Tool developed by me in collaboration with USDA–ARS scientist, Dr. Daniel Manter. To calculate these values, we coupled data from the 2017 USDA AgCensus with county-level emission reduction values provided by the COMET Planner Tool (developed by Colorado State University and USDA–NRCS) and scaled to a national level. By combining practices such as conservation tillage with cover cropping, US croplands have the potential to reduce emissions by 338 million metric tons CO_2e per year. If nutrient management is added, these lands could reduce emissions by 508 million metric tons CO_2e per year.1F[2] While this number assumes the highly unlikely case of universal practice adoption, it nonetheless underscores the vast potential of our croplands to serve as carbon sinks since removing 508 million metric tons of CO_2e per year is equivalent to eliminating 87 percent of US agriculture's GHG footprint.

Moreover, there are numerous management practices that can be implemented on grazing lands as well as restoration of degraded lands that can contribute to further reductions. For example, combining prescribed grazing and nutrient management practices on grazing lands can reduce GHG emissions up to 56 million metric tons CO_2e per year with substantially more potential with rangeland plantings (Table 1). Again, these estimates assume complete adoption on all agricultural lands, and thus, a plan that projects phased-in adoption rates should be considered to hit targets along the way (e.g., see Chambers, Lal, & Paustian, 2016).

In summary, if the best carbon sequestering practices for croplands and grazing land are implemented, US agriculture would be significantly closer to Carbon neutral and could even have a net negative Carbon footprint.

TABLE 1.—EXAMPLES OF CROPLAND AND GRAZING LAND CONSERVATION PRACTICES AND GREENHOUSE GAS (GHG) EMISSION REDUCTION POTENTIAL FOR US AGRICULTURAL LANDS

[Based off 2017 AgCensus data and emission coefficients from USDA COMET-planner]

Conservation practice	GHG Reduction Potential (million metric tons CO_2e per year)
Single Cropland Practices:	
Conservation tillage practices	63–197
Cover cropping	99–140
Conservation crop rotation	91
Stripcropping	82
Nutrient management	23–145

[1] CO_2e refers to the carbon dioxide equivalent, because methane (CH_4) and nitrous oxide (N_2O) are converted to their CO_2 equivalent, in terms of their global warming potential.

[2] Our estimates are in accordance with an earlier report by Lal et al. (1998) who estimated approximately 360 million metric tons CO_2e per year on US croplands.

TABLE 1.—EXAMPLES OF CROPLAND AND GRAZING LAND CONSERVATION PRACTICES AND GREENHOUSE GAS (GHG) EMISSION REDUCTION POTENTIAL FOR US AGRICULTURAL LANDS—Continued

[Based off 2017 AgCensus data and emission coefficients from USDA COMET-planner]

Conservation practice	GHG Reduction Potential (million metric tons CO_2e per year)
Combined Cropland Practices:	
Conservation tillage plus cover cropping	266–338
Conservation tillage plus cover crop plus compost	367–508
Grazing Land Practices:	
Prescribed grazing	6.2
Nutrient management	10.2–55.5
Range planting	147
Silvopasture	324

REFERENCE PAGE

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Manter, D K, Delgado, J. A., & Moore-Kucera, J. (2018). Integrated soil health management: a framework for soil conservation and regeneration. In D. C. Reicosky (Ed.), *Managing Soil Health for Sustainable Agriculture* (1st ed., Vol. 1, p. 352). https://doi.org/https://doi.org/10.1201/9781351114530

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Questions for the Record
Tina Owens
Sr. Director, Agriculture Funding & Communication
Danone North America

DEAR CHAIR CASTOR AND RANKING MEMBER GRAVES: Attached is our response to the follow up question from the 10/30 Select Committee Question for the Record. Please note that we have collaborated with Scientist Steven Apfelbaum via our mutual collaboration with Green America to provide the scientific basis for the responses submitted in the attached letter, and would like to note these associations in the record.

Sincerely,

TINA OWENS,
Sr. Director, Agriculture Funding & Communication,
Danone North America.

THE HONORABLE KATHY CASTOR

1. If the agricultural sector currently contributes approximately 9% of total greenhouse gas emissions in the United States, how much, or under what scenarios, can agriculture potentially turn into a carbon sink and contribute to climate mitigation?

Ecosystem carbon sampling modeled by Steven Apfelbaum/Applied Ecological Solutions demonstrates:

1. A number of scientific studies have concluded that, with its abundance of crop and pasture land, ***US agricultural land has significant potential to contribute to our overall goal of sequestering carbon.[i]***

2. With over 1.04 billion acres of cropland and pastureland, the US has the potential to sequester anywhere from 25 billion tons of carbon to 50 billion tons by 2050.[ii] The range depends on how quickly we scale and could go even higher if the rate of adoption increases for stacks of soil health practices, sometimes called regenerative agriculture. ***Thus, the U.S. can play a leadership role, by owning a significant percentage of the total drawdown goal.***

3. That soil-carbon in cropland and pastureland is durable across time and weather conditions.[iii] Meaning that ***the carbon remains in the soil once sequestration is achieved.***

There is broad consensus regarding which best management practices (BMPs) are the most important to optimize. These practices are also central to the USDA's 5 Principles of Soil Health:

Recommendations for Prioritization

1. Prioritize soil health as the key focus in the carbon sequestration "pillar" of climate solutions.
2. Align policy and public programs to support farmers going 'all-in' for soil health, specifically the rapid transition to best management practices for soil health.
3. Support outcomes-based measurements some of which are already underway and supported by farmers, soil scientists, and supply chains. Examples of these would include the approved VERRA VM0021 and the Soil Carbon Index standard currently in its pilot stage.
4. Simultaneously support research to help speed climate and economic benefits along with implementation of a nationwide shift to 'all-in' soil health.

THE HONORABLE GARRET GRAVES

1. Ms. Owens, I really appreciate you coming in today because it helps us remember what the end state of agriculture looks like after going through the supply chain. You mentioned in your testimony the need for continued U.S. leadership and innovation in climate sustainability in agriculture.

a. Your company is a global one, so can you give some insight as to how important these farming practices are for your company when selecting suppliers?

Danone North America buys directly from more than 700 American farms across the country for our most important ingredient—milk. Rather than categorizing these farms as suppliers we view them as farmer partners, and as such we work hand-in-hand to provide them with unique financial tools and opportunities to convert their practices to impact soil health.

In 2018 Danone North America launched a five-year, $6 million Soil Health Initiative to help our farmer partners to restore the ability of soil to capture carbon and overcome common obstacles to building soil health management systems. We are currently tracking over 50,000 acres with plans to expand to 100,000 acres by 2022.

While we believe this program to be impactful, we are not able to scale full adoption of these practices for the future without challenging the current systems of agriculture that reward practices from the past. This program, which targets both economic resilience and environmental impact, is a strong starting point for Congress to develop complementary policy options to incentivize and assist farmers and their partners for lasting impact at a nationwide scale.

b. Are developing countries like China and India prioritizing long term soil health and carbon sequestration?

While other countries will have to do their part as well, especially countries with large tracts of agricultural cropland such as Russia, Brazil and China, the US

should move quickly to get 'first mover advantage' and scale the adoption of stacks of soil health practices.

2. Do you think showing that the farming practices we adopt here are low-cost, highly-productive, and improve long-term soil health can be a good model for other nations?

By moving quickly we will ensure economic advantages for our farmers, rural revitalization, weather protection and resiliency and secure our domestic food production. This will, in turn, become a model for other nations.

Thank you for the opportunity to address the questions of the Committee. We will continue our work hand-in-hand with our farmer partners and welcome continued collaboration with the Committee on the significant policy and implementation potential at hand.

DECEMBER 20, 2019.

DEAR CHAIR CASTOR AND RANKING MEMBER GRAVES: Thank you again for the opportunity to present our points of view at the recent hearing "Solving the Climate Crisis: Opportunities in Agriculture" on October 30, 2019. In addition to our testimony, we are responding to the questions of the Committee regarding the size of the opportunity for carbon sequestration in soil, under what scenarios could agriculture become a 'carbon sink', where we are now relative to that opportunity and how to prioritize this opportunity given America's economic interests and environmental interests.

Simply put, the size of the opportunity is enormous. Globally, agriculture as a whole could remove at least 400 billion tons of carbon dioxide (CO_2) over thirty years.[i] This is roughly the equivalent of 100 parts per million (ppm) of atmospheric carbon, which currently stands at roughly 415 ppm (NOAA).

SIZE OF THE OPPORTUNITY

Rigorous soil carbon studies clearly and conservatively document that all cropland and pastureland can increase soil carbon by at least 2% over baseline conditions under improved land management practices optimized for soil health. These practices simultaneously save farmers and ranchers money, provide flood and drought protection, reduce erosion, improve water quality for rivers, lakes, and coastal zones, and improve overall resiliency.[ii] Further ecosystem carbon sampling modeled by Steven Apfelbaum/Applied Ecological Solutions shows that soil-carbon in cropland and pastureland is durable across time and weather conditions.[iii] This means that significant carbon remains in the soil once sequestration in healthy soil is achieved through improved land management practices optimized for soil health.

A number of scientific studies have concluded that US agricultural land, with its abundance of crop and pasture land, has the greatest potential to contribute to our overall goal of sequestering carbon.[iv]

With over 1.04 billion acres of cropland and pastureland, the US has the potential to sequester anywhere from 25 billion tons of carbon to 50 billion tons by 2050.[v] The range depends on how quickly we scale and could go even higher if the rate of adoption increases with robust soil health practices optim. Thus, the U.S. can play a leadership role, by owning a significant percentage of the total drawdown goal.

By moving quickly we will ensure economic advantages for our farmers, rural revitalization, weather protection and resiliency and secure our domestic food production.

There is increasing momentum among global food brands to secure their supply chains, to identify suppliers that have addressed their own climate risk and who align with the corporate ESG (Environmental, Social, and Governance) targets. US farmers have the size, the skill, the technology, and the infrastructure to dominate an emerging climate positive commodity market.

FARMER ECONOMIC RESILIENCY AND OPPORTUNITY

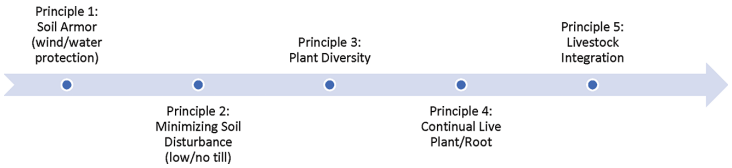
Beyond scientific studies, farmers using robust soil management practices experience even greater rates of soil carbon accumulation. Case studies collected from numerous farmers and ranchers across the U.S. who go 'all-in' on soil health, achieve

significant climate, environmental, farming economics and rural community results in as short as 3–4 years.[vi] Furthermore, farmers practicing these principles increase net profit on average by $100–$150/acre.[vii]

With much of U.S. agricultural soils coming in at 1% or less soil carbon, recent sampling studies conducted by both scientists and companies found that among farmers practicing robust soil health practices, a stacking of best management practices for soil health, soils presented with between 3 to 6% soil carbon. (Williams, Indigo).

WHICH AGRICULTURE PRACTICES DO WE NEED TO ENCOURAGE?

There is broad consensus regarding which best management practices (BMPs) are the most important to optimize. These practices are also central to the USDA's 5 Principles of Soil Health:



RECOMMENDATIONS FOR PRIORITIZATION

1. Prioritize soil health as the key focus in the carbon sequestration "pillar" of climate solutions.
2. Align policy and public programs to support farmers going 'all-in' for soil health, specifically the rapid transition to best management practices for soil health.
3. Support outcomes-based measurements some of which are already underway and supported by farmers, soil scientists, and supply chains. Examples of these would include the approved VERRA VM0021 and the Soil Carbon Index standard currently in its pilot stage.
4. Simultaneously support research to help speed climate and economic benefits along with implementation of a nationwide shift to 'all-in' soil health.

It is abundantly clear, based on what we already know about improved soil health management, we can continue to optimize for better and faster results as the research brings new data forward.

The urgency of the climate crisis calls us to get started now. The economic benefits and weather protections for our farmers and rural communities calls us to accelerate our efforts immediately.

We are honored to follow up with the Committee on the question of potential rates of carbon sequestration. We welcome any and all follow up relative to the size of the soil-carbon opportunity, the speed of scale-up, and the positive farm economic impacts.

Sincerely,

CHRIS ADAMO,
Vice President, Federal & Industry Affairs, Danone North America.
ALISA GRAVITZ,
President and CEO, Green America.
STEVEN APFELBAUM, PH.D.,
Scientist, Author & Chair, Applied Ecological Services, Inc.

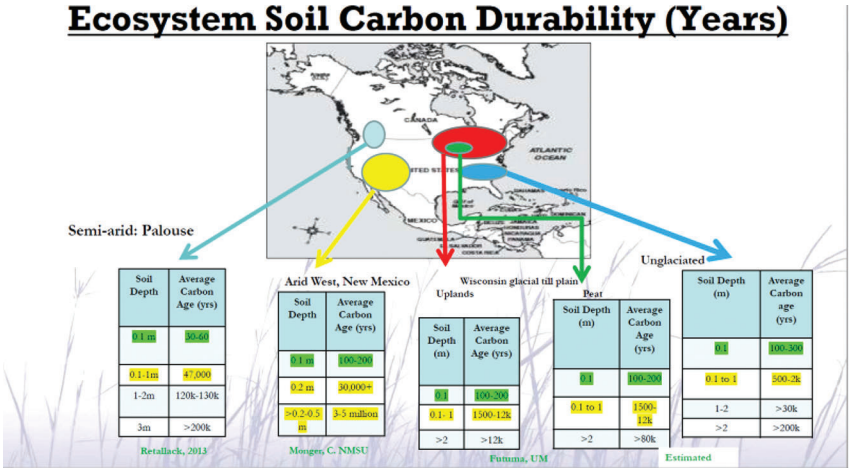


Figure 3
Comparison of current fixed and integrative-adaptive agricultural production systems.

Fixed management (scenarios 1 and 2)		Adaptive management (scenarios 3 through 5)	
Approach	**Effect**	**Approach**	**Effect**
Cropping system		**Integrated cropping and grazing system**	
Annual tillage of large areas	Extended periods of bare soil, increased runoff, soil erosion Loss of soil carbon (C) to atmosphere (as GHG)	Minimal or zero-till cropping	No or minimal periods of exposed soils, less runoff, and soil erosion
Monocultures of non-nitrogen (N)-fixing plants High volume/cost fertilizer, herbicide, pesticide inputs	Decline in soil N/organic C, microbial diversity, and fungal diversity Loss of excess N to water resources and atmosphere as (GHG)	Multi-crop rotations include N-fixing plants and cover crops Targeted micro-nutrient fertilizer inputs only	Build up in soil N/organic C, microbial diversity, and fungal diversity
Grazing system		High intensity regenerative grazing, regrowth-rate related recovery times Improved grazing with periodic fire or targeted treatment of woody plant expansion	Higher C sequestration, improved soil structure, increased nutrient cycling, improved plant species, and soil microbial and fungal function
Continuous grazing, no post-grazing recovery Fire suppression policies	Degraded soil function, reduced ground cover Increased unpalatable plants, woody plant expansion		

viii

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[vi] Case Studies on Soil Health Practices, Farmers Rick Clark (IN), Will Harris (GA), Adam Chappell (AR), compiled by Green America.

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Questions for the Record

Fred Yoder
Corn, Soybean & Wheat Farmer
Co-Chair, Solutions from the Land

THE HONORABLE GARRET GRAVES

1. As a farmer, you have the EQIP and CSP farm bill programs, co-ops, and other ways to get help and funding for conservation purposes on your land, so I'm curious as to why more farmers aren't participating.

a. What are the biggest barriers?

A big challenge is the shortage of staff at NRCS, which are charged to put these plans together for the farmer. They are the only ones at USDA who actually have to visit the farms themselves. Here in Ohio, at least, are counties that don't even have a representative from NRCS to facilitate applications. I have heard of wait times for an NRCS rep to be as long as 2 years for a nutrient management plan, or a wetland designation. Perhaps using contract representatives such as Certified Crop Advisors could alleviate the backlog of requests for help. Also, it depends on what outcome you are looking for. For instance, the adoption of cover crops are not emphasized much at all, nor is there a specific program to incentivize adoption, as well as no-till practices. Also, why tie everything up with NRCS? How about considering offering discounts to those who use Federal Crop Insurance that use practices that make them less of a risk than status quo? It happens all of the time in the insurance world, granting discounts if the client demonstrates a reduction of risk by performing various tasks.

b. Can you talk a bit more about the importance of precision ag technology, and then discuss the barriers to this technology being deployed? (like lack of broadband)

Today, most new technologies coming with the newest precision tools are tied directly to access to broadband services as well as satellite and/or phone service. There are places in rural America that don't even have cell phone coverage. This can put farmers at a tremendous disadvantage based on where their farm is located. This can mean the difference of staying in business or being forced out of farming.

c. What have you heard from other farmers about their issues with broadband and internet access?

I have visited with farmers in places like rural Iowa, where the soils are rich and productive who complain they can't even purchase certain technologies because of lack of access of broadband or satellite coverage. If the US is to be the breadbasket of the world, and the leader in technology, this is embarrassing.

I would be glad to answer any other questions that the committee may have. Please let me know what those questions may be and I will answer them as best as I can.

Best regards,

FRED YODER.

Questions for the Record

Viral Amin
Vice President, Commercial Development & Strategy
DTE Energy Resources

THE HONORABLE GARRET GRAVES

1. Can you elaborate on the environmental benefits that RNG can deliver today?

First and foremost, renewable natural gas (RNG) projects capture methane that would otherwise be released into the atmosphere or flared. RNG can be used as a fuel replacement in trucks, buses and cars that are otherwise fueled by traditional fossil fuels. When compared to diesel fuel, these vehicles have substantially fewer emissions of other air pollutants like sulfur dioxide, nitrogen oxides and particulates. Moreover, the transportation sector is now the leading sector source of CO_2 emissions in the U.S., and the use of RNG is alternative fuel vehicles provides a proven, cost-effective option for lowering the carbon footprint of the heavy-duty transportation fleet. Finally, the process used to produce dairy RNG can significantly reduce odor and the number of pathogens within the manure.

2. Can you describe why you believe RNG can be a long-term solution for reducing emissions from the transportation sector, even for those who are seeking deep decarbonization?

RNG provides both an immediate-term and a long-term solution for reducing transportation emissions when it is used to power Natural gas vehicles. As electric vehicle battery technology continues to mature, heavy duty CNG/LNG trucks running on RNG are achieving cost-effective emission reductions today. RNG produced from DTE's agricultural projects, when used as a vehicle fuel, results in *a lower carbon footprint than using electric vehicles*. This is due to the fact that these projects don't just provide lower-carbon energy by displacing fossil fuels, they also prevent methane from entering our atmosphere.

3. Is it possible for you to partner with small and medium farms?

Although there is no precise formula for how big or small a farm must be to support an RNG project, DTE has developed projects in partnership with farms between 1,500 to 10,000 cows. Even smaller farms could be viable if they are located in close proximity to an existing RNG project, digester, or the necessary pipeline infrastructure.

Also, if several small farms were located adjacent to one another, a large digester might be constructed to serve them all.

4. Can you think of ways USDA and EPA can assist dairy operators and swine producers to move toward RNG through the use of anaerobic digesters?

Congress should work closely with the EPA and USDA to demonstrate continued support for the cellulosic biofuels category under the Renewable Fuels Standard (RFS). RNG production has grown at more than 30% per year since qualifying as cellulosic fuel under the RFS, and there remains considerable untapped potential to create RNG with the waste produced by dairy and swine farms. Creating RNG from waste materials is a real success story of the RFS. It helps farmers and results in substantial reductions in greenhouse gases.

Additional ways that the EPA and USDA could support dairy and swine RNG projects include:

- Providing additional incentives for the use of low-carbon fuels and the deployment of natural gas-powered vehicles
- Invest research funding to support the advancement of RNG technologies
- Promoting the installation and adoption of anaerobic digester and nutrient recovery technologies through new or existing grant programs.

5. Infrastructure, specifically natural gas pipelines, are a necessary component for getting renewable natural gas into the gas stream.

a. Can you elaborate on the necessity of these pipelines in order for RNG?

DTE transports RNG from farms in two ways: Directly, via a pipeline lateral connecting to the interstate pipeline system, and by trucking the RNG to an existing pipeline interconnect. There are limits to the distance RNG can be trucked before

it becomes uneconomic. Therefore, proximity to pipeline infrastructure is often critical to the successful development of an RNG project.

b. What are the biggest barriers you are experiencing in the context of infrastructure?

DTE continues to see growth opportunities in the RNG market using the existing pipeline infrastructure. However, pipelines are a more efficient and a less carbon intensive means of moving the RNG to market.

The existence of a nearby pipeline is often necessary to make an RNG project economically viable. Therefore, additional pipeline infrastructure would likely increase the number of RNG projects and increase the volume of RNG brought to market.

6. In your testimony you mentioned that using RNG as a fuel replacement in vehicles results in a lower carbon footprint than using electric vehicles. Will you elaborate on this?

The use of RNG as a vehicle fuel, and especially RNG from agricultural waste, can result in a lower carbon footprint than using electric vehicles. This is due largely to the fact that agricultural waste-to-RNG projects can capture and destroy methane that would have otherwise been emitted to the atmosphere. According to the Intergovernmental Panel on Climate Change, methane has a global warming potential that is 25 times more potent than CO_2.

An RNG project's Carbon Intensity (CI) score can provide a more specific comparison. CI is a metric used by the State of California's Air Resources Board (CARB) to measure the lifecycle greenhouse gas emissions for a fuel, per unit of transportation energy delivered. The lowest overall CI scores granted by CARB have been for dairy and hog waste-to-RNG projects, which have *negative carbon footprints* and substantially lower CI scores than electric vehicle pathways scored by CARB.

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