Text for Revised 40 minute Recorded Presentation Renewable Fuels: What? How? Why?

Slide	Text
1	*.Are you interested in learning about how to reduce our carbon footprint right away? Join us for about 40 minutes to learn about renewable fuels, the kind that are used in planes, trains, automobiles and more.* *I'm Joanne Ivancic, executive director of Advanced Biofuels USA, a nonprofit educational organization. The free online educational package includes a copy of the text of the presentation, along with links to references and a discussion guide.* *So, let's get started with an Introduction to Renewable Fuels: What, How and Why.*
2	*First, some information about Advanced Biofuels USA, a nonprofit educational organization that advocates for understanding, development and use of renewable fuels in the US and around the world for these reasons.*
3	*Before we get into details, I have some questions.* *What do you think of when you hear the word "bioenergy? Or renewable energy?"* *Do you think about energy for transportation? For heating? For cooking?* *We are going to talk about all of these during the next half hour.*
4	*Before we get into the details, What do you think of when you hear the word "biofuel"?* *Many people in the US will answer corn ethanol because in the US about 10% of the gasoline is ethanol molecules that are made from corn.* *In the EU, people might say biodiesel or renewable diesel and think of used cooking oil, soybeans, canola or rapeseed used to make it.* *In Africa, Asia and Brazil, you might say ethanol from sugar cane or from cassava.* *Or, maybe you think of sustainable aviation fuel*
5	*This is what we are going to talk about. We'll go through this pretty quickly. You can always come back to the slides and the notes with links to details later.*

	At the end of the presentation, you should be able to answer these questions and discuss these topics. At least a little bit
6	*First, What are advanced renewable fuels?*
7	*Many people have heard of ethanol used as a fuel, as we talked about earlier.* *Ethanol is not the only fuel that can be made from renewables. These others are, too: Biodiesel, renewable diesel, Sustainable Aviation Fuel (SAF), Bio-isobutanol, renewable natural gas, rDME, Drop-in hydrocarbons, maritime/ marine fuels… and more.*
8	*But let's start with ethanol.* *Many people don't realize that the ethanol that we talk about with regard to fuel is the same molecule as the ethanol or alcohol in wine, beer, whiskey.* *Corn ethanol has long been nick-named "moonshine."*
9	*You will hear people talk about 1st generation and 2nd, 3rd and 4th generation biofuels.* *Generally, the higher the generation, the more sustainable the fuel was thought to be; although we will see that it's a lot more complicated than that.* *This gives you some idea about the factors considered when using generational descriptions.*
10	*Now we know, generally, what advanced renewable fuels are. Next: What are they used for?*
11	*Think about it. In the early days of cars and trucks, there wasn't a system of gas stations or fueling stations. People used horses, oxen, mules and other animals for transportation and work. So, cars and trucks were built to use the fuel that could be made on farms or near where the cars and trucks were used.* *Thus, the first diesel engines used peanut oil and the original Ford Model T ran on ethanol.*

	When gasoline came into use, later Model Ts were the first "flex-fuel" vehicles. They could use ethanol and gasoline. And, eventually, gasoline was sold mixed with ethanol, as we do today.
12	*Today, you buy biofuels at the "gas" or "petrol" station.* *In the US, almost all the regular gasoline is E10—or 10% ethanol, a biofuel; some is 15%, E15. You might also see 30%, E30 or E85, 85% ethanol.* *The more ethanol in the fuel, the higher the octane.* *Ethanol use increased as a replacement for MTBE, a carcinogenic replacement for toxic lead in gasoline that leaked into groundwater from gas station tanks. After many lawsuits, it was banned in about half the US states.* *However, it is still used in gasoline in other parts of the world and could be replaced with safer ethanol that also serves to enhance octane to prevent premature combustion, and avoids sulfur, particulates, etc* .
13	*In other countries like India and Brazil, you might see 20%, 30% and higher ethanol blends.* *Thailand plans to make E20 a standard fuel.* *With flex fuel vehicles, in some countries you might have the opportunity to use close to 100% ethanol.*
14	*If you have a flex fuel vehicle, you can use gasoline with up to 85% ethanol. You can buy E85 conversion kits.* *In the US, you can use E15 or 15% ethanol fuel in vehicles built since 2001. At this time motorcycles in the US may only use up to 10% ethanol fuel, E10, the most common fuel at gas stations in the US.* *Much diesel fuel in the US is 5% renewable biodiesel.*
15	*Some diesel engine manufacturers build for 20% biodiesel use (B20).*

	And trucks and buses can be retrofitted to use 100% biodiesel.
16	*In response to the 2026 war in the Middle East, there is enhanced attention to energy security and energy independence.* *Some countries are looking at standard fuels of 30 and 40% biodiesel; Indonesia plans to use 50% biodiesel; the Philippines are moving from B3 to B7; Malaysia from B10-B20. Brazil is moving to E32, India is at E20 and Vietnam has accelerated their transition from E5 to E10.*
17	*There are a number of apps you can download to help you find stations that sell the kind of fuel you need that are near you or along the roads you travel.* *Here's where you can find these fuels and compare costs.* *You see, E15 and E85 are significantly cheaper than regular gasoline.* *The Gas Buddy app lets you search for UNL88 (E15).*
18	*Ethanol does have less energy density, therefore E85 has up to 25% lower mileage per gallon than E10, BUT, it has high octane and better performance.*
19	*Indy Cars use 100% renewable racing fuel with 85% ethanol.* *Cars racing in the old ALMS (American Le Mans Series) used a variety of renewable fuels experimenting with biobutanol, cellulosic E85, E10 and E20.* *NASCAR uses E15.* *Formula 1 plans to increase biofuel use from 10% to 100%.*
20	*Some buses around the world use renewable natural gas or biomethane for fuel in engines that can use compressed natural gas.* *This chart compares the greenhouse gas emissions among different fuels. You can see the greenhouse gas emissions benefit over petroleum diesel that you get RNG.*
21	*School buses can also use renewable natural gas, biomethane, as well as biodiesel, renewable diesel, and hydrogen. Because electric buses are expensive and not appropriate for some places, like mountainous regions, these are good options*

22	*Trucks on the roads today can also use renewable natural gas (RNG), as well as biodiesel blends and renewable diesel, also known as HVO or green diesel which can completely replace petroleum diesel.*
23	*Renewable diesel, HVO or green diesel can completely replace petroleum diesel in trains, too.* *LA's Metrolink and Bay Area's Capitol Corridor Commuter Rail Service Both Invested in New Advanced Diesel Engines Powered with 100% Renewable Diesel.*
24	*The International Maritime Organization's proposed regulations to reduce dangerous sulfur oxide emissions from ships went into effect in 2020 and additional regulations of emissions have been proposed.* *Low sulfur renewable fuels help the shipping industry meet these and European Union requirements.*
25	*Renewable aviation fuel is called "Sustainable Aviation Fuel" or SAF. Not much sustainable aviation fuel (SAF) is yet available, but efforts being made to expand production with some countries having mandates such as the European Union's mandate starting at 2%.*
26	*Military aircraft and ships around the world can use renewable fuels.*
27	*Multi-country military exercises have proved that renewable fuels can be used interchangably with other military spec fossil fuels*
28	*Biofuels can also be used for heating. **Bioheat®** fuel is a blend of cleaner-burning ultra-low-sulfur heating oil and biodiesel.*
29	*In some parts of the world gathering wood or dung for cooking fires can be dangerous and can cause deforestation.* *Also, indoor smoke from wood, charcoal and dung fires is very unhealthy.* *The United Nations and other international organizations support replacing those with cleaner burning stoves such as ethanol stoves.*
30	*For many years, Advanced Biofuels USA has been following the development of Moses Moseray's small ethanol cook stove business in Sierra Leone. A community getting together to make a difference. They design stoves, provide training and market stoves and ethanol fuel.*

31	*To get an idea of the benefit we see TODAY from all of these kinds of uses of renewable fuels, look at California's Low Carbon Fuel Standard.* *As you can see, biodiesel, renewable diesel, ethanol and biomethane are generating the greatest reduction in greenhouse gas emissions in the transportation sector.* *These benefits exceed those from the electrification of cars, trucks and buses by almost 4:1.* *This demonstrates how today's use of biofuels can provide the greatest amount of carbon footprint reduction in the least amount of time for the lowest price because you can do it with existing vehicles and infrastructure.*
32	*How about in the future?* *In addition to continuing and expanding what works now, even retrofitting existing cars to use higher renewable blends like E85, work is being done to optimize gasoline engines for E30, 30% ethanol.* *Who knows, maybe the other 70% will be green gasoline.*
33	*In the future we can also expect to use renewable hydrogen or ethanol for fuel cell powered cars and trucks as well as in combustion engines.* *(hydrogen fuel cell; hydrogen combustion engine; ethanol fuel cell)*
34	*What about rockets and missiles? Research is being done to use renewable fuels in these, too.*
35	*So, how are these renewable fuels made? That is, how do you store the energy of the sun in plants or other materials and then make it available to move a car, truck, train or plane?*
36	*There are three parts to making renewable fuels:* *-feedstock—the stuff that goes into the recipe;* *-logistics—how do you get the feedstock from where it grows or is produced to the biorefinery;* *-and the technology—how do you convert the feedstock into fuels.*
37	*If we stop using fossil carbon; stop using petroleum and natural gas to make fuels, plastics, chemicals, and all kinds of products; then we will replace those building blocks with products from agriculture, forestry, aquaculture, and waste management.*

	Those will be the foundations of our bio- and circular economies. That way we will recycle and re-use carbon that is already on land and in the air. *Thus, Agriculture, Forestry, Aquaculture and Waste Management are the foundations of our future.*
38	*First, let's look at how we do that with plants. Remember, plants take carbon that is already in the air and use it to grow by a process called photosynthesis. Basically, they recycle carbon and store solar energy.*
39	*Using fuels made from this recycled carbon reduces the need to take old carbon out of deep storage in the Earth.* *Similarly, we can prevent carbon from getting into the atmosphere, for example from industrial waste gases.* *When that is used to make fuels, we recycle carbon instead of taking it out of storage.*
40	*There are many things that store solar energy via photosynthesis that you might use to make renewable fuels. Here's a quick scroll through pictures of just some examples.*
41	Different Kinds of Sorghum
42	*Soybeans Soybeans are grown mostly to make animal feed. The oil needs to be taken out to make the soybean meal digestible. That oil is used to make fuel.*
43	*Corn or Maize Similarly, corn/maize, rice and wheat are fermented into ethanol with high protein animal feed co-products, along with relatively clean CO2 that can be sequestered, used for beverages, medical or industrial purposes or as a "feedstock" for e-fuels*
44	*Oil seed crops like Sunflowers or Jerusalem Artichokes*
45	*Tiny oil seed crops like Canola, Rapeseed, Carinata, Camelina and pennycress which might be grown as winter crops or cover crops in more southern latitudes.*

46	*Grasses like Phragmites, Miscanthus or Arundo, Giant Reed that grow high as houses. Something called lignin is what makes them--and trees-- stand up straight. More about lignin later.*
47	*Switchgrass Not only does switchgrass grow higher than the height of the man, but the root system of the grass grows even longer than that. So, when you talk about sustainability; places that need soil erosion control might be good candidates for growing switchgrass as an energy crop.*
48	*Energy tobacco is being tested in China and also in Virginia as a way to use swine manure for fertilizer in a safe and sustainable way.*
49	*Agave, used to make tequilla, might also become fuel in some parts of the world.*
50	*In some tropical areas, cassava is the choice for ethanol production.*
51	*Jatropha, Moringa, Pongamia, Castor Bean, Jojoba Neem* *These productive legume and oil seed trees can be grown on marginal land with minimal fertilizer inputs in places like Florida, Hawaii, India and Nigeria*
52	*Some feedstocks can be grown in water, like algae, duckweed and seaweed like kelp.* *The top image shows algae being grown to treat wastewater in California, a process also being researched in Spain and New Zealand.* *This is another example of how growing biofuel feedstock can solve other problems, too.*
53	*Agricultural waste and residues can be used to make biofuels: from manure to corn stover and cobs and straw from wheat, barley and other grains.*
54	*Similarly, the sugars in Sugarcane are used to make ethanol, especially in Brazil and other countries with tropical climates. The leftover residue, bagasse, can be burned for electricity or used to make biofuel*
55	*Along those lines, in Europe, sugar beets are used to make ethanol and in the US, research on leftover sugar beet pulp and energy beets indicates they can be used to make fuel.*
56	*Palm oil, also grown in tropical areas, is used to make fuels in places like Malaysia and Indonesia. Some countries ban the use of palm oil-based fuel due to concerns about deforestation and harm to animal habitat.*
57	*You can also get woody biomass from willow and poplar that are coppiced, cut to the ground so that many shoots grow back, increasing the yield per acre over the years.*

58	*With medical and recreational marijuana and CBD oil made from hemp using only the buds of the plants, the residue leaves and stems or seeds might be used for biofuels.*
59	*Much is being done with Woody Biomass, and Forest Waste and Residues especially in the Northwest US and upper New York state and in Finland and other Nordic countries with large forest-based industries*
60	*What else? Agricultural and food processing residues like nut shells, cotton seeds and hulls, rice hulls and husks, rice and wheat straw, might also make good biofuel. India is a hub for some of this research.*
61	*Did you know that for every cashew, there is a cashew apple residue? In tropical areas, Cashew Apple, Sisal Bole, Date Palm Pits/Seeds are being looked at as potential biofuel feedstock.*
62	*The organic portions of Municipal Solid Waste, Food Waste and Distillers and Brewers Waste are being used to make biofuels.*
63	*All over the world, biofuels like biodiesel, renewable diesel and jetfuel are being made from used cooking oil, grease and tallow or animal fat from food processing.* *The additional benefit from this is to prevent people from dumping grease into sewer systems causing backups known in England as "fatbergs"* *It also keeps unhealthy, contaminated used cooking oil from being re-used, a serious problem in some countries.*
64	*Landfill Gas and Biogas from food and animal waste can be used to make electricity or transportation fuel.*
65	*Not all renewable fuels are made from plants. Some can be made from other carbon sources such as industrial waste gas, hard-to-recycle plastics, old tires..*
66	*Other examples of renewable fuels not made from plants: Renewable hydrogen from electrolysis of water could replace the fossil hydrogen in the recipe for renewable diesel and jetfuel, or could be mixed with carbon dioxide to make methanol. Hydrogen and methanol can be used as fuel on their own or as building blocks to make other fuels and products.*
67	*You might have noticed that the renewable feedstocks we have talked about are not just grown for fuel alone. Many are grown for other purposes and the leftovers or co-products are used to make fuel. Also, fuels made from plant-based materials have co-products such as animal feed, dry ice, fertilizer or other healthy soil amendments.*

68	*When thinking of sustainability and feedstock, you can think of life cycle greenhouse gas reduction compared to fossil fuels. You can also think of the co-products and the additional benefits they provide such as avoiding burning agricultural waste in fields, preventing fatbergs or helping prevent erosion.*
69	*A list of the kinds of jobs involved with the feedstock part of renewable fuels.*
70	*Now let's take a quick look at logistics—how do you get the feedstock from where it grows or is produced to the biorefinery.*
71	*As more research has been done, practical problems became apparent.* *For example, unwanted rocks and dirt got harvested along with agricultural residues that used to be left on the field or burned on the field.* *Engineers and farmers got together to figure out better ways to harvest.*
72	*Similarly, the new feedstock product needed to be stored without spoiling or bursting into flames. And it had to be chopped to the proper size.*
73	*The feedstock and the finished renewable fuel have to be transported to their destinations by appropriate rail, truck and pipelines. Some adjustments were needed in these areas, too.*
74	*At ethanol refineries, logistics may also include capturing and using or sequestering the fermentation co-product, carbon dioxide (CO2). The positive environmental attributes of this may be measured and applied to carbon credits that can be used to meet regulations and for trading in carbon credit markets.*
75	*These are some of the companies that currently capture and use or sequester carbon dioxide as a co-product of fermentation.*
76	*On to Technology: A much more difficult challenge, converting the feedstock into fuels, requires new technologies--or old technologies used in new ways.* *Technologies that recycle the carbon that is already above ground, already out of deep storage.*
77	*These are the names of some of the processes that take the feedstock and make it into renewable fuels or the building blocks for fuels and chemicals.* *Different approaches are needed, depending on the feedstock.* *For example, Fermentation works well with starches and sugars.*

	HTL is useful to convert wet biomass such as food waste and sewage sludge. *Gasification and pyrolysis are good for feedstock high in lignin which is hard to convert by enzymes or yeast.* *Current research is improving enzymatic conversion of woody biomass, agricultural wastes like straw or nut shells or municipal solid waste.*
78	*Starches, sugars and fats have been easy to convert to make fuels.* *Agricultural and forest waste and residues--can be burned to used the stored energy.* *They can also be converted into liquid fuels that have more uses. The challenge is known as 'biomass recalcitrance.'* *One reason that some biomass is hard to convert is lignin--the stuff that makes trees and grasses stand tall. It is very hard to break down to make it more useful.* *It does break down in nature—think of rotting wood or digested food.* *So, we look to nature for ideas. What animals eat wood? Maybe the enzymes that break down that wood to fuel them can be used to break down that wood to fuel our mobility, too.*
79	*A summary of technologies that take feedstock to fuels and other finished bioproducts--starting with some plant or biomass, converting that to chemical building blocks that will then be converted to fuels and other products that can substitute for or replace those made with petroleum or natural gas fossil carbon.*
80	*As we have seen, some fuels are made from things that are not necessarily "bio"; not necessarily made from recently living things, for example, industrial waste gases or municipal solid waste (MSW).* *LanzaTech has developed a biological process to take gasified MSW or gases from steel mills and other industries to make ethanol and jetfuel.*
81	*Yara has started a pilot plant for making renewable ammonia fuel for maritime use by combining nitrogen which has been obtained from air, with renewable hydrogen.*
82	*More about hydrogen.*

	Using lots of energy, using a process called electrolysis, water can be split into oxygen and hydrogen. The hydrogen can be used as a fuel itself. *Also, in addition to combining with nitrogen to make ammonia; hydrogen can be synthesized with carbon dioxide to make methanol, methane and also other fuels via the Fischer-Tropsch process. Here's a diagram that depicts that.* *Sometimes fuels made without using biomass are called e-fuels or electro fuels or 'Power-to-gas' or 'Power-to-Liquid" fuels, emphasizing that they require a lot of energy for the conversion process and that can come from renewable power.*
83	*Note that all feedstock conversion processes can use renewable energy to reduce their greenhouse gas footprint.* *Also, this illustrates that hydrogen, whether obtained from splitting water or from other processes, has many uses related to renewable or low-carbon fuels.* *It can be used as a fuel itself; it can be used in oil refineries and biorefineries, for example, to enhance fuel stability and energy density.* *The oxygen from electrolysis might also be used in gasification.*
84	*Here are illustrations of some different ways to obtain low-carbon hydrogen. Electrolysis has been mentioned before.* *It is also possible to obtain hydrogen from further processing of a co-product of biodiesel production, from biomass gasification and from microbes breaking down organic matter like biomass or wastewater.*
85	*Once obtained, hydrogen has many competing uses: as a chemical, fuel for transportation or power generation and for energy storage. And, for now, low-carbon hydrogen is very expensive.*
86	*Here are some of the jobs involved with converting the feedstock to renewable fuels.*
87	*So, why are renewable fuels important?*

88	*We are in the process of making choices about our energy resources. This is what we have with fossil fuels.*
89	*This is what we could have.* *Renewable fuels can help make this our future reality.*
90	*If our goal is to replace imported oil and petroleum-based fossil fuels, then transportation fuel is the way to go.* *Only about 1% of electricity is produced from petroleum.* *Although there is work on electrifying short flights in small planes, even renewable electricity won't power large jet planes for a very long time.*
91	*Before oil runs out, it becomes more difficult and dangerous to extract. These are images of boreal forest and what it looks like when turned into oil sands petroleum extraction. Similar images illustrate mining of minerals needed to make batteries for EVs.*
92	*Remember the oil spill in the Gulf of Mexico in 2010?—drilling for oil very, very deep wells.* *These are the people working 10 hour shifts for $10/hour in stifling heat wearing plastic protection to clean it up on the beaches. These don't have to be the jobs of the future.* *And don't forget the 11 people who died in that oil rig explosion and the terrible loss for their families and friends.*
93	*There are also geo-political reasons to replace fossil fuel.* *The oil embargo in the 1970s, showed us the vulnerability of relying of imports for energy.* *These days, the closing of the Strait of Hormuz reinforces this vulnerability.* *If done right, every country should be able to minimize its reliance on imported energy, increase their energy security and energy independence.*
94	*Carcinogenic MTBE enters the water supply from leaking underground storage tank systems including those at gas stations.* *MTBE is highly water soluble, not easily absorbed into soil, and sticks around for a long time.*

	When it was banned in many states, ethanol replaced it.
95	*Ethanol fuel has a lot of other benefits, too. It burns clean, has high octane, replaces harmful chemicals in gasoline and can be used in fuel cells.*
96	*When the oil wells start running low, oil becomes more expensive to obtain The economics of extracting the oil mean that it stays in the ground.*
97	*Renewable fuels recycle the carbon that is already on land and in the air. We won't have to take fossil carbon out of deep storage and add it to the atmosphere.*
98	*Renewable fuels aren't important just for their use as fuels; there are these and other ancillary benefits along the renewable fuels' value chains and supply chains.*
99	*There's a lot of talk about a transition from liquid and gas fueled vehicles to electric ones. Certainly, it will take a long time for liquid- and gas-fueled vehicles to be off the roads. Even when we get to half of on-road vehicles being EVs, that means half still need liquid and gas fuels. So someone needs to make sure those fuels are as clean and green as possible.* *Thus, the question is how to make and deploy the most sustainable renewable fuels NOW so they can be used in these trains, buses, trucks and cars.*
100	*Here's an illustration of the current EV-related emissions in Frederick, Maryland, at the Advanced Biofuels USA main office. Not much of the power for EVs is from renewable sources. In addition, demand for electricity from many new data centers in this area is exploding.*
101	*Using vehicles powered by renewable fuels will help alleviate some of the pressure on electrical power generation, transmission and use.* *So, until EVs are affordable, available, powered by renewable sources and use fair trade batteries, vehicles fueled with advanced biofuels look like a responsible option to reduce the greatest amount of our transportation carbon footprint as quickly as possible for the least expense.*
102	*We've already talked a lot about sustainability. Let's spend a couple of minutes more.*

103	*What does "sustainable" mean? Move to the 3 principles slide here Endurance? Lasts for a long time? Or, something you can keep doing over and over without it degrading? It can mean all these things and more.* *With regard to renewable fuels, people talk about the three-legged stool of sustainability with the fuels being economically, environmentally and socially sustainable. If any leg is missing, the stool falls over.* *So, when we talk about sustainability and fuels, we mean that they have to have economic viability over a long term; have to allow or enable the environment to be unharmed or helped; and have to have social acceptance, fit into the fabric of a culture.* *Let's look at each briefly.*
104	*Here are some concepts that might be considered when talking about economic aspects of sustainability.* *Everyone in the value chain from "seed to wheel" making a living from a financially stable operation because the price of the product is competitive.*
105	*Here are some questions with regard to the economic leg of the sustainability stool.*
106	*When thinking of the Environmental aspects of fuel and climate change, we aspire to carbon neutrality; that the fuel production and use does not contribute to an increase in greenhouse gases. And, we consider other aspects of environmental sustainability- air and water pollution; energy use; feedstock benefits.*
107	*A successful sustainable renewable fuels project must fit into the culture of a society. For example, it needs government policies as well as public opinion support. It must fit into social infrastructures. It helps if education systems (formal and informal) enhance understanding of it.*
108	*Here are some specific social aspects that influence renewable fuels understanding, development and use.*
109	*Let's look at how this might appear in real life. Here's a company, GEVO, that combined all three aspects of sustainability in what they called a Net-Zero Framework.* *Environmental: They produce energy dense liquid hydrocarbons using renewable energy (photosynthetic, wind, renewable natural gas, biogas) with the potential to achieve net-zero greenhouse gas emissions across the*

	whole lifecycle of the liquid fuel and produce extensive high protein animal feed co-products. *Social: The fuel fits the current culture and is for use in traditional engines (cars, planes, trucks, and ships).* *Economic: Citigroup is investing and GEVO has designed the program to enhance the local economies and provide a range of green job opportunities in rural areas.*
110	*We have mentioned policy influence on renewable fuels a few times. The topic is vast and complex. Here are a few items to watch for.*
111	*In 2007, the Renewable Fuel Standard was passed with the intent to wean the US off of petroleum fuel by requiring oil refiners or importers to sell specific kinds of renewable fuels in increasing amounts over time. The amounts set for corn ethanol have been met and exceeded. Although oil refiners have fought hard against giving up any market share, in the US gasoline is more than 10% ethanol.* *Yet, overall, as of 2025, only about 6% of US transportation fuel was renewable.* *Some other countries are doing even better. India has reached 20% ethanol in its gasoline market.*
112	*The other key US policy is California's Low Carbon Fuel Standard which, instead of volume-based is criteria-based and linked to a carbon credit trading scheme. Thus, fuels are credited for the amount of fossil carbon for which they substitute according to strict multi-factor "seed-to-wheel" or "well-to-wheel" calculations called "carbon intensity". Oregon, Washington and New Mexico have adopted a version of this and the US Congress and a number of state legislatures are considering it.* *States like California, Oregon and Washington have especially high levels of biodiesel and renewable diesel use.* *Canada is in the process of implementing a Clean Fuel Standard.*
113	*The main policy in the European Union is the Renewable Energy Directive which targets greenhouse gas reduction for all types of energy use, including transportation with targets for renewable transportation fuel at 14% by 2030. The EU is now revising targets as part of its Green Deal.*

114	*Some other key renewable fuels policies appear as mandates. Although well-intentioned, many mandates have proven in practice to be more aspirational than enforceable. To address these challenges, India and Brazil have taken the lead in creating and promoting the Global Biofuels Alliance.*
115	*What other policies might work? Here are some more ideas being implemented and considered.*
116	*Jobs that help us better understand and make informed decisions about renewable fuels have are crucial to all aspects of transitioning from fossil fuels to renewables. Teaching, advocating, funding and more. Communicating the benefits of renewable fuels to the general public, consumers, decision-makers and making sure that policies around the world support thoughtful transportation options.*
117	*You can help make a difference. All the jobs, all the feedstock, all the technologies we have talked about today will help us transition to a truly renewal sustainable energy future.* *It is up to us to build on the foundations that have been created over the past 20 years or more. There is growing understanding of the importance of sustainable renewable fuels not only to mitigate climate change, but to reduce air and water pollution and to be a significant solution to many other problems.*
118	*We all can do it*
119	*What do we have now? What could we have?* *Demands for more power are resulting in greater use of fossil fuels, thus increasing greenhouse gas emissions and exacerbating the dangers of climate change.* *We've seen oil spills—and worse, leading to destruction of ecosystems.* *Demand for fuels continues to increase, with the same negative connections, along with higher fuel prices, leading to economic crises and war.* *Food waste also leads to higher prices and is part of a global waste crisis from plastics in the oceans to uncaptured methane from manure and landfills; from agricultural waste and residues left rotting in fields; from*

	forest waste and un-managed forests leading to wildfires and more ecosystem destruction.
120	*What can we do about it?* *What we've been talking about here, today.* *Biofuels, renewable fuels. These can help meet power and fuel demand. In doing so, by recycling carbon, by capturing carbon and storing or using it in ways that replace petroleum and natural gas, we decrease greenhouse gases and mitigate climate change.* *We lessen the potential for oil spills and eco system destruction.* *Especially in the US, we lower fuel prices because ethanol is less expensive to make than gasoline. Supportive policies can also encourage use of renewables and discourage use of fossil fuels by lowering renewable fuel prices. Then, this can lessen economic crises that lead to violence and wars.* *Renewable fuels present new opportunities all along the value and supply chains, encouraging economically feasible waste management and strong local businesses—not just in the US, but around the world where waste management is sorely lacking.* *When we treat waste and residues like resources, we can address the global waste crisis. We also lessen harmful methane emissions and with better management of forest waste and residues, we reduce the threat of wildfires.*
121	*Advanced Biofuels USA's resources are here for you to use--free.*
	A nonprofit educational organization, Advanced Biofuels USA promotes understanding, development and use of renewable fuels in the US and around the world for these reasons.
122	*Our key tool for accomplishing this is our web site with resources for you to use--free.*
123	*Just some examples.*
124	*Also, don't hesitate to contact us with questions about the world of renewable fuels.*
