WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

Industry Agenda

Biorefineries, Biotechnology and Bioenergy in North America

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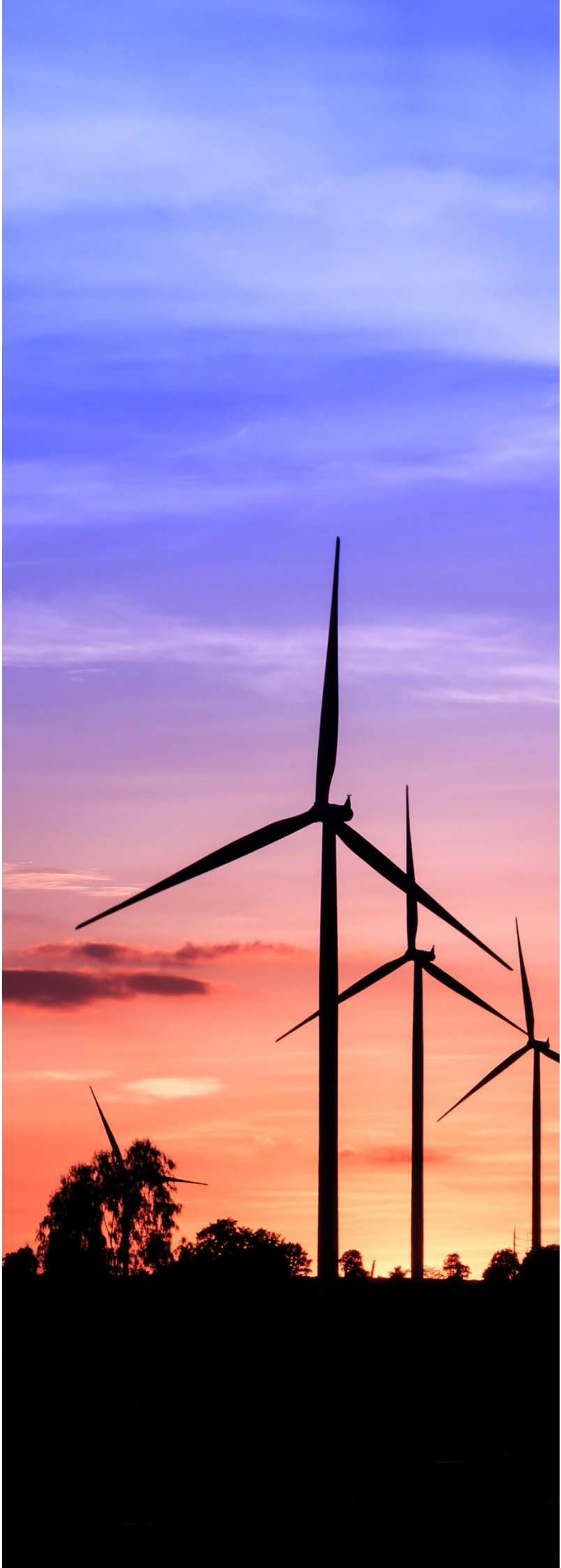
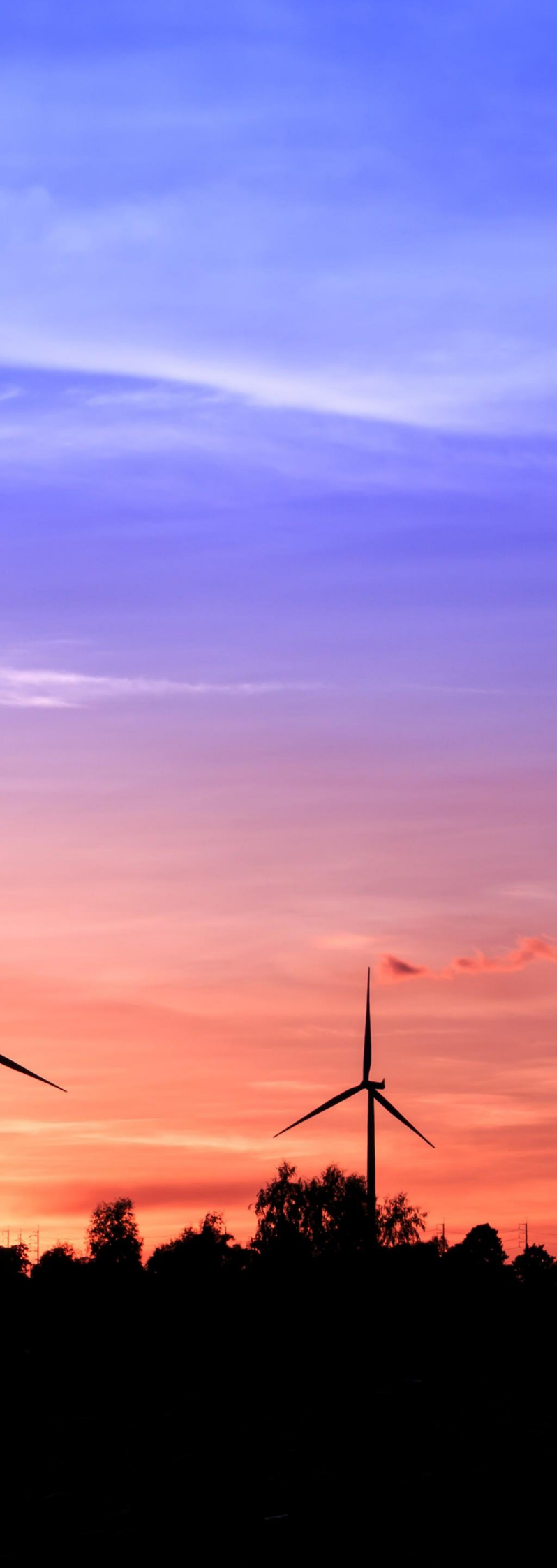
Contents

Highlights

- To gain traction at the 2015 Paris Climate Conference COP21, and as part of the broader climate change agenda, the bioindustry needs to provide complete "biosolutions" that consider key business issues such as the supply chain, as opposed to just innovative technologies (see Opening Session).
- The output from previous biotechnology ecosphere meetings is being used to drive tangible change, such as much-needed governmental reforms in Brazil (see Opening Session).
- While the shale revolution is a quintessential American story, all industries and regions can draw lessons from its success. Two key lessons are that innovation frequently comes from unexpected places and that change is often driven by small players (see Feedstock Analysis).
- Selecting an engaging narrative around an example where biofuels are currently being used at scale as part of an existing value chain, such as in the airline industry, can generate buzz and set the table for broader discussions (see Task Force 1 - Mobility).
- Waste to fuel conversion presents a unique value proposition as it addresses two crucial societal issues simultaneously: reducing waste and producing more low-carbon fuels (see Task Force 2 - Waste to Fuels).
- Engaging specialty markets can be a strong starting point for building the bridge between biotech companies and consumer companies and can be a stepping stone to more significant impact driven by biomaterials (see Task Force 3 - Consumers).
- Several concrete steps can be taken to drive action, including finalizing an industry statement for COP21, driving specific policy recommendations, and continuing momentum for this platform at subsequent World Economic Forum meetings (see Next Steps: Opportunities for Action).





Introduction

The Chemicals and Advanced Materials team at the World Economic Forum launched the Biotechnology Ecosphere platform in 2010 to bring leaders in biotechnology together and drive change in the industry. Since then, the platform has held sessions in locations such as Brazil, China and North America while organizing virtual touchpoints to share lessons across regions. Given the challenges currently facing the industry, collaboration and discussion across the biotechnology value chain will be essential in the coming years. As such, the main goals for the platform in 2015 are:

1. Establishing a clear vision on how biotechnology can enable circular economy solutions across industries

2. Gaining the consensus of industry stakeholders around issues and establishing a unified voice for the industry

3. Employing this unified voice to influence policy development and change in key global regions

The 2015 North American gathering for Biotechnology Ecosphere was held on 22 July 2015 in Montreal, Canada. The World Economic Forum convened esteemed participants from leading industry partner companies, innovative start-ups and the public sector to discuss key issues that will impact the future of the industry. The outputs of this meetings will help develop a credible narrative to get biotechnology back on the climate change agenda, inform policy recommendations participants will bring back to their respective governments, and set the stage for further discussions at subsequent gatherings in São Paulo, Geneva and Davos-Klosters.

Discussion Summary

Opening Session

Much discussion has revolved recently around the challenges facing the biotechnology industry, with some going so far as to suggest that biotechnology is currently residing "in the shadow of the valley of death". To remove this shadow requires "lights from a variety of angles", making this gathering with its representation from across the value chain an ideal opportunity to advance on crucial issues and to construct a value-chain-centric approach to influence key decision points, including at the upcoming COP21 climate conference in Paris.

To achieve success at COP21 and in the climate space more broadly, the bioindustry must position itself as providing complete "biosolutions" rather than just a set of interesting technologies. This is because COP21 is looking not just for innovative technologies, but also for companies that have thought through the crucial business issues, such as those related to the supply chain, and that are capable of finding solutions that will have a large-scale impact over a 3-5 year time frame. The bioindustry needs to decide on an approach for its climate value proposition at either the sector or subsector level. The panellists commented that this is an exciting time in the climate space, as organizations like the World Economic Forum have been convening leaders at the chief executive level to discuss cross-cutting issues like policy and messaging, and taking an industry-centric approach to addressing climate change. While this business leadership is exciting, there is also room for personal leadership from senior executives to drive change.

A panellist noted that the industry's current problems in North America can be traced to changing oil prices, weaker than expected government mandates, and the fact that those who first built biorefineries in the United States could have done better. While the times are challenging, opportunities for bold moves exist, such as seriously discussing carbon pricing, given the current state of oil prices. The importance of getting biotechnology back on the agenda at COP21 was further stressed; the lack of discussion on biotechnology at the recent Bonn Climate Change Conference indicates that the industry "did not do its job". Finally, the panellist noted the tangible results in places like Brazil, where the output from previous sessions has been driving much-needed governmental reforms in the industry, such as creating a fast track for biotech patents and reducing taxes on enzyme imports.

Feedstock Analysis

There is no bigger story in America today than the shale revolution (also known as "fracking"), which has shaken up the oil and gas industry. It has disrupted the global energy industry, generated billions of dollars in economic

01: Bernice Lee, Head of Climate Change and Resource Security Initiatives, World Economic Forum
02: Gregory Zuckerman, The Wall Street Journal, USA
03: Participants break up into task forces to discuss the impact of biotechnology on various markets

output, depressed the global oil price substantially, reduced America's carbon emissions, and influenced America's foreign policy. And it all originated from the least likely of places. A leading journalist and author at the gathering described for participants the history of the shale revolution in the oil and gas industry and the insights that all industries can glean from how it happened.

The history of the shale revolution is a quintessential American success story, involving innovation, perseverance, great wealth, and the triumph of the little guy over long odds. Surprisingly, the shale revolution did not emerge from the oil majors, even though some of them have headquarters that are physically on the Barnett Shale in Texas or had internal research groups dedicated to the type of non-conventional drilling that led to the revolution. Instead, the revolution was sparked by a few key people: (1) George Mitchell, the owner of a gas company in Texas and pioneer of the new fracking techniques; (2) Aubrey McClendon and Tom Ward of Chesapeake Energy, who leased substantial acres of shale gas land across the country for development; (3) Harold Hamm, the pioneer of shale development in the Bakken formation in North Dakota; and (4) Charif Souki of Cheniere Energy, who first realized the potential export market for shale gas and engineered his natural gas terminals to capitalize on this insight. The takeaway from their success story is that innovation frequently comes from the smaller players in the field. The little guys were successful because they didn't have a choice. As noted during the meeting, "When your back is against the wall, you need to innovate."

The participants did address the environmental objections that have been raised as an argument against the continuation of fracking, debunking some while arguing for the prioritization of others. A major concern for citizens is instances of methane seeping into the water supply and causing "flammable water". However, the expert panellist said these fears are unfounded as towns with documented incidents of methane in their water supply have historically had these issues as a result of natural geological occurrences. Also dismissed during the discussion were concerns around man-made earthquakes. However, one issue raised was that the fracking revolution could cause undue "addiction" to fossil fuels because of their depressed prices, which could slow the adoption of renewable energy, the area where the global energy markets should be shifting for a longer-term solution. As an alternative to lambasting "the frackers", an alternative was proposed: put public pressure on the oil and gas companies to maintain well integrity and improve the enforcement of regulations that will make the industry more environmentally friendly. Ultimately, the public should be working with "the frackers" instead of condemning them.

Despite the environmental considerations, the positive effects of the shale revolution seem to outweigh the negative. Today, driven by the shale revolution, America pumps 9.5 billion barrels of oil per day, up from 5 billion in 2006. America will likely achieve energy security in the near future and will rely significantly less on oil producers in the Middle East. In the words of the expert panellist, "America has gone from an energy weakling to an energy powerhouse." Increased oil and gas production will likely play a role in shaping America's foreign policy and potential military involvement in the Middle East, and will facilitate a faster foreign policy pivot to Asia. As for the domestic economy, approximately 2 million jobs have been created from the shale revolution (about the same number lost during the housing crisis) and American consumers have reaped enormous economic benefits at the gas pump from the cheap price of a barrel of oil. Companies are also beginning to relocate operations to the United States to take advantage of the country's lower energy costs relative to the rest of the world. In aggregate, the shale revolution is contributing ~1% to US GDP. Locally, areas home to the shale oil and gas industry, such as North Dakota, are giving young people economic reasons to stay, reversing years of population declines and providing well-paying jobs. The shale revolution has profoundly changed the United States (and the world), and the innovation and perseverance that the key actors displayed in making it happen hold lessons that apply across all industries. As the biotech industry looks to capture market share away from traditional oil & gas, it should look to the fracking revolution and its application of underdog technology for inspiration.

Landscape Definition

Participants were split into three task forces to examine the crucial topics that will be driving change in the industry:

1. Mobility
2. Waste to Fuels
3. Consumers

Each task force considered the potential value in their focus area, the hurdles that need to be overcome in achieving that value, and concrete action steps that can be taken to accelerate progress.

Shaping Task Forces and Objectives

Task Force 1 – Mobility

The Mobility task force discussed the distinction between the challenges and opportunities in servicing the two primary end markets for mobility biofuel products: automotive and aviation fuels. In terms of infrastructure and business models, the group concluded that there is an advantage for aviation fuels as airlines can partner directly with fuel providers while automotive companies are reliant on a larger pool of independent consumers at the pump. Additionally, incentives for flex fuel engines in the United States are lacking due to the absence of necessary infrastructure at gas stations. Second-generation ethanol, despite offering greater environmental benefits, has even less of the necessary infrastructure in place to allow for widespread use, which will prolong its adoption. Despite these factors, the automotive industry remains attractive to the biotech industry because of the potential to use bio-based materials in the assembly of cars. The most important takeaway

01: Joost Dubois, Director Branding, DSM Bio-based Products and Services, Royal DSM, Netherlands, moderates the Mobility task force

from this discussion was the need to identify intersections between the airline and automotive supply chains where bioproducts can play an increased role, in order to craft a cohesive message about the bioindustry's potential role in these markets.

Several more general challenges to adopting biofuels for mobility purposes were also discussed. Two frequent challenges that often go hand in hand are public perception of biofuels and government incentives to adopt them. "Food vs fuel" debates engendered by the use of first generation biofuels are being held by governments across the globe and are inhibiting a positive perception of the industry among consumers. Additionally, changes in government incentive policies play a major role in consumer decision-making. For example, in the United States, incentives and funding for flex fuel development have been reduced in favour of other renewable sources of energy, such as electrification, decreasing consumer appetite for biofuels.

It was also noted that the mix of public perception and government incentives with respect to biofuels differs greatly across regions. In some northern European countries, the combination of policies such as carbon taxes and blend mandates has created incentives for the broader adoption of biofuels and has fuelled greater public acceptance and adoption. Another positive example is Brazil, which has clearly delineated a separation between biofuels and fossil-based fuels to inform consumer decision-making. Finally, incentives and perception in the United States are a mixed bag because of the significant differences across the 50 states.

Another key set of interrelated challenges are technology and cost. Given that many biotechnologies are still in the early stages, particularly those associated with second generation feedstocks, they face the technological and commercialization challenges generally associated with early-stage solutions. In the absence of strong government support, this translates into higher end costs for consumers, which can inhibit widespread adoption. In most markets, consumers have proven unwilling to pay a premium for biosolutions, such as in Brazil where they have the possibility to choose between fossil and flex fuels at the pump, but generally just choose the cheapest options. Consumers in some markets, however, such as the Nordic countries, willingly pay higher costs in exchange for the social benefits of biofuels.

This group also focused on crafting an industry approach for getting biotech on the agenda for COP21. To build momentum, the industry should articulate real, high value delivery options for biofuel applications. This will effectively serve as a placeholder strategy to establish a foothold and build broader adoption. While there have been several individual examples of collaboration involving biofuels, such as the partnership between Mercedes and Clariant and the 2012 Olympics fuelled by BP biodiesel, the group decided to focus on the use of biofuels in the airline industry to demonstrate an instance in which biofuels have been implemented at scale as part of a full supply chain solution. Generating buzz around airlines' use of biofuels, punctuated by headlines about flying leaders to Paris on biofueled planes for instance, could serve as an effective way to start the conversation and build towards a road map for solutions in different industries.

Different messaging opportunities that could be tied into the COP21 approach were also identified. Participants noted that over 70 countries globally are promoting renewables and biofuels as a positive economic contributor, creating an opportunity to talk about the jobs created by the biofuels. Stories about the impact of biofuels on small towns, such as Emmetsberg, Iowa, could also be particularly effective as part of the narrative. Ultimately, the solution presented should focus on value chain delivery and scalability so that it is promoted as a complete business solution rather than just a technology.

Task Force 2 – Waste to Fuels

An important first step for the Waste to Fuels task force was defining the key term that will shape this type of biosolution: waste. Participants defined waste as anything that can be used as a feedstock for bioprocessing, which can come from a variety of sources, including forestry, agriculture, and urban and industrial areas. More generally, these types of waste can be organized into two categories: residual

biomass and municipal solid waste. While much of the waste material available through these channels will be in the form of lignocellulosic biomass, other types of biomass can also be considered waste.

When identifying the types of waste available as feedstocks for bioprocessing, the other current uses for biological waste, such as recycling and composting, must also be considered. In many regions, particularly in the United States, biomanufacturing is prohibited from using recyclable material as feedstock and therefore should be regarded as a complementary, not substitute, option to recycling processes. This creates value capture opportunities for biotech applications to use non-recyclable paper and plastics as carbon feedstocks.

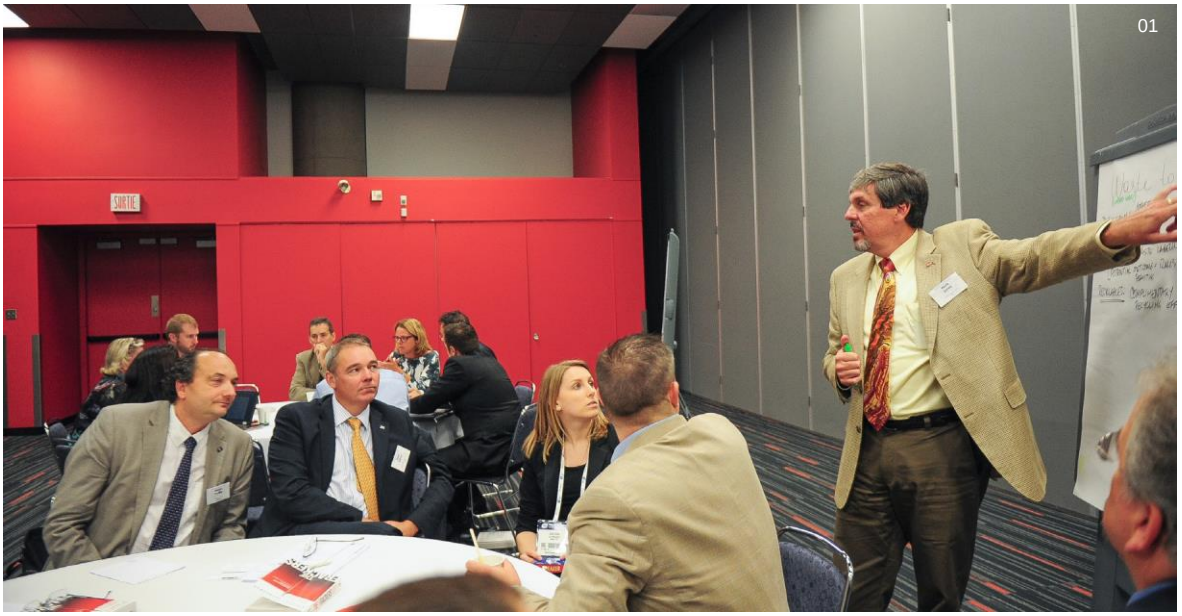
Regulatory considerations also impact how biotech companies should define and categorize waste. For example in the European Union, specific regulations guide how "waste" products must be disposed of, so many biotech companies position the feedstocks they are using as "co-products" instead. Additionally, the chemicals industry in the United States has concerns about classifying feedstock materials as waste given the regulatory requirements of the Toxic Substances Control Act. While using waste materials as feedstocks does raise regulatory concerns, these policies can also provide opportunities, such as in the European Union where biofuels created from second generation feedstocks such as waste material count twice towards fulfilling government mandates.

Defining the exact output of the waste to fuels process is also an important step. In view of the hierarchy of fuel sources used to produce energy, ranging from heat energy to electricity, the group debated whether the output from this technology needs to fit on a particular part of this spectrum. Ultimately, participants agreed that the focus should not just be on "taking a match" to biomass, but rather converting it into higher value fuels. The group also stressed the need to look beyond just fuels when considering the products that could be produced from waste biomass, with one participant noting, "We're not just making fuels, we are making low-carbon products".

The group mentioned several advantages that create strong support for waste to fuel solutions. The waste to fuels story is very compelling because it addresses two significant societal issues – "everyone wants to reduce waste and produce more low-carbon fuels" noted the participants. By both reducing the amount of waste sent to landfills and providing low-carbon feedstock for fuels, waste to fuel technology presents a unique win-win situation. Waste is also better positioned to gain public acceptance than first generation bio feedstocks since it does not carry the same land use or "food vs fuel" concerns as food crops that have traditionally been used as feedstocks. This business model also has built-in economic advantages, such as the tipping fees companies receive to process waste from municipalities. Finally, since waste is generated all over the world, it can easily be sent to local manufacturing centres without the need for vast transportation networks, giving it an advantage over crops that are only grown in specific regions.

While the current strategic advantages for the conversion of waste to fuels are strong, it is still in the early stages of development. A number of crucial challenges that need to be addressed to take full advantage of this technology remain:

- Carbon efficiency – Biomanufacturers need to ensure that the carbon content of the products they create is commensurate with the carbon content of the feedstock by reducing the energy that is used during the conversion process.
- Financing – Bank financing is currently reserved for companies that have already scaled up and have a proven facility that is up and running, with smaller ventures needing to rely purely on capital financing.
- Scale – While the disposal of waste across the globe creates opportunities, it also presents challenges as certain types of waste must be aggregated and collected before being used as feedstock. Manufacturers will also need to be flexible in what types of feedstocks they can receive.



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01: Mark Jones, Executive External Strategy and Communications Fellow, The Dow Chemical Company, USA, moderates the Waste to Fuels task force

– Competition with other business models – Other types of business models that use waste as an input for other end purposes must be considered as they could present competition for biomanufacturers entering this space.

– End consumers – Ensuring that end consumers have the will to participate is important in promoting the reuse of waste for bioproducts.

– Technological challenges – Based on current technologies, waste to fuel conversion faces economic competitiveness issues. Additionally, most waste is currently directed to lower technology solutions like composting. While clearly of less economic value than converting the waste to fuels, it is difficult to judge the relative societal benefits of these uses.

– Tipping fees – While companies currently receive fees from municipalities to process their waste, a market-based price for waste could emerge if waste begins to be viewed as a feedstock rather than a problem of disposal.

– Uncertainty on biofuel standards – Government mandates for biofuels, such as the renewable fuel standard in the United States, have been weaker than expected as governments have decreased support for first generation biofuels. There still appears to be political will to promote second generation biofuels, however, which may lead to more nuanced policy support.

– Local vs global solutions – It is necessary to "optimize across the value chain" and keep in mind that solutions that benefit one region might not work in others. Whether a global consensus on how to drive waste to fuel solutions forward is needed or whether a variety of different local solutions is sufficient is still open to debate.

– Waste use hierarchy – In the waste use hierarchy, biomanufacturing is currently positioned below other uses of waste, such as recycling and composting, but it should be positioned as complementing these other uses rather than competing with them.

Despite a number of challenges to be considered and addressed, participants agreed the future for the use of waste materials in the biotechnology industry is exciting. This technology can unlock a significant amount of value, it addresses two major societal issues, and it allows the world to "see waste as an opportunity rather than a problem". The recommended next step is to engage governments and communities across the different areas of this broad and compelling topic.

Task Force 3 – Consumers

The Consumers task force's objective was to discuss how producing and consuming companies within the biotech industry could form effective partnerships and identify concrete steps to be taken to support the industry going forward. The group was composed of top industry experts from around the world from only biotech producers. As a result, the consumer perspective was absent, but the challenges discussed and ideas put forward are applicable across the entire biotech value chain.

Overall, very few partnerships within the biotech industry were able to be identified. The one concrete example came from a participant who described a previous employer (a chemical company) that formed a long-term partnership with a crop protection company. It seems that even obvious partnerships are not being formed: companies looking to make bio-based clothing have never thought to partner with the producers of polymers. Companies will not look to change until there is final pressure from the end consumer, and with generation Y coming of age, that demand might be around the corner. Brand owners who have sustainability built into their public image may also drive some of these partnerships. So what is preventing consumer companies from partnering with producers? The answer can be found in the discussion surrounding the major challenges facing the biotech industry and how they are acting as a barrier to potential partnerships. These challenges include:

4. Ensuring the performance of the biotech product delivers sufficient value to guarantee its economic viability
5. Developing the right technological solutions to market problems
6. Mitigating the risk associated with developing new biotech solutions
7. Providing a large enough supply of bio-based products to meet market needs
8. Overcoming volatility in the prices of commodities and competing products

In the words of one participant, the economics do not seem to support biotech products. In the biofuel industry, fracking has caused the price of fuel to plummet and few businesses are willing to pay up for ethanol. Another participant noted that only niche examples of biofuels, such as those with high ethanol concentrations that can deliver superior performance, can be economically viable. Although no solution was directly proposed to address this challenge, suggestions put forward to address other challenges could indirectly help the economic case of the biotech industry.

Although many biotech solutions currently exist in the marketplace, there is also a technological gap. After biotech companies produce more products and raw materials, intermediate companies can ask their scientists to formulate new applications for those materials. More applications lead to growth in the production of the material, which makes it more widely available for companies to experiment with. As one participant put it, "You have a classic chicken and egg problem." The risk biotech companies take in developing these biotech solutions can be very high, possibly high enough to prevent their initial development. One participant noted that certain companies are making agreements with biotech companies to guarantee the market for their bio-based products, thus de-risking biotech R&D and possibly addressing the technology gap challenge.

Another major challenge for bio-based products, especially when trying to penetrate certain large industries such as aviation and defence, is the current lack of supply of bio-based products to make them viable. Penetrating these industries would also demand significant cost savings that could only be delivered through economies of scale. One

participant noted that being a jet-fuel salesman is a terrible job because the margins are razor thin and there's no money to be made. The biotech industry in its current form will find it difficult to compete in that market. Unfortunately, these large industries provide the greatest opportunities to compare the environmental impact of bio-based products to burning fossil fuels, which as jet fuel is a major contributor to global warming. The solution discussed was to focus on specialty or niche markets and use them as a stepping stone to effectively compete in these larger industries.

Volatility in commodities markets and the significant risk it creates for the biotech industry is another major challenge. The group discussed the global sugar market in the context of Coca-Cola replacing sugar in its beverages with an alternative sugar product.

Volatility in the price of sugar is considerable and, according to one participant, creating a financial hedge against the changes in the price of sugar would be incredibly difficult and unprecedented. If a company like Coca-Cola were able to make long-term supply agreements, it would de-risk sugar alternatives. The price of sugar is also heavily correlated to the oil market and decoupling the price of its inputs from the oil market could leave Coca-Cola uncompetitive if oil prices fall (as they currently have done. However, this volatility in the sugar market may be preventing large consumer companies from forming long-term agreements with biotech companies to supply alternatives to sugar, which might expose these consumer companies to the risk of being uncompetitive if the price of sugar drops. This challenge can be extended to other commodity markets where bio-based products might compete. However, as with the aforementioned supply challenge, the volatility challenge largely disappears when moving the focus from commodities markets to specialty or niche markets. All of these challenges might matter less if consumer preferences shift from sugar. If consumers demand less sugar in their drinks for health purposes, then Coca-Cola will have no choice but to find sugar alternatives, regardless of cost.

The group discussed the focus on specialty or niche markets as a means for biotech companies to address several of the previously mentioned challenges. Higher margins in specialty markets make biotech R&D more attractive, potentially addressing technology gaps. Specialty markets do not need the huge supply base of larger markets, which potentially addresses the supply challenge. And in specialty markets, the price of inputs is less important, which potentially addresses the challenge of volatile commodities markets.

This was contrasted with the example of the sugar industry, where long-term supply contracts and the ability to hedge prices are almost non-existent. Specialty markets can also serve as a testing ground for refining product performance. Once the biotech solution has been developed for one industry and the materials are put into production, companies can immediately start testing those materials in applications. Organic industry growth will then occur as the biotech solution can be used in more applications. Ultimately, these specialty markets should act as a stepping stone to larger industries, such as aviation and defence. One participant offered the example of French farmers, who are more willing to sign long-term contracts with biotech companies in several specialty industries. And some specialty markets are worth billions of dollars a year, which is good news for biotech companies looking to scale up. An example put forward was pharma-biotech companies that start very small, prove their performance, and then get acquired by the larger companies in the industry. The participants noted that "innovation comes from small places". A major conclusion from this discussion was that biotech companies should target these specialty markets, but ultimately only use them as a stepping stone to larger markets where the size will allow them to achieve economies of scale and make a real environmental impact. The biotech industry should emulate the oil industry and start with small wells, and then scale up once use is proven.

Given all of these challenges, what are the most promising value chains for partnerships and collaboration within the biotech industry? The first opportunity discussed was between vehicle producers (aviation, auto, etc.) and ethanol producers. Mercedes was given as a good example. In addition to collaborating on biofuels, these companies can look beyond their engines and form partnerships related to the production of other components, such as bio-based upholstery. Another example of a value chain ripe for a biotech partnership is between clothing producers and distributive/additive manufacturers who might use bio-based

01: Alan Hiltner, Vice-President, Business Development, GranBio Investimentos, Brazil, moderates the Consumers task force

ingredients for customized clothing. The last example put forward was of beverage producers forming partnerships to develop sugar from bio-based products. Coca-Cola is already making investments in citric acid. The impetus for this may come from changing consumer preferences away from sugar and/or from regulatory pressure to reduce sugar content in food and beverages. A policy suggestion raised to incentivize these producer-consumer partnerships could be to extend R&D tax breaks for the large consumer companies that invest in early biotech producers.

The participants brainstormed ideas for concrete next steps that can be taken to push the biotech industry forward in this area. The main suggestion was to extend the US government support currently given to biofuels to all bio-based products. This would include the bio-based products in the US Department of Agriculture's BioPreferred programme, which essentially created a market for biofuels. In addition, R&D grants should be extended to bio-based product development, biorefinery assistance should be extended from just including ethanol to including bio-based products, and the Loan Guarantee Program for biochemicals should be expanded. Biotech companies should also drive to get more consumer companies to build biotech into their brands. In addition, biotech companies should explore new markets & manufacturing methods.

Aligning Task Forces and Objectives

Following the in-depth discussions among the individual task forces, the participants reconvened to discuss the main takeaways and seek input from the larger group.

The Mobility task force presented its ideas for a cohesive COP21 statement to the group and suggested using the example of biofuels in the airline industry as a lead-in for broader discussions. While the larger group was supportive of this idea, it was decided that the messaging would need to be more balanced to recognize the issues facing biofuels in aviation, such as pricing and profitability. The focus should be on stressing that this is an example that has proven to be scalable, that has been integrated into an existing value chain and that has concrete targets to which the airline industry has committed. The group also discussed where the funding for biofuel mobility solutions would come from, as people are largely supportive of the idea but do not want to commit initial funding. Yet positive examples from aviation in Nordic countries show additional costs can been shared across the value chain by producers, airlines and consumers who are willing to pay higher prices to fly on planes using biofuels.

The Waste to Fuels task force outlined the dual benefits of reducing waste and producing additional low-carbon fuels that this technology promises and the hurdles that must be cleared for more widespread adoption. The group discussed the need for a new word to replace "waste", given the implications of that term and the desire to frame waste materials as a valuable feedstock. Global vs local solutions were also considered as participants noted the need to consider nuanced approaches to take into account the differences across regions. All agreed this is a multifaceted topic that requires broad engagement across governments and communities.

The Consumers task force discussed the need to include consumer companies in future meetings, identified major hurdles and potential solutions for the industry in this area, and discussed ideas for policy solutions to support the adoption of biochemicals and biomaterials in consumer products. Some participants in the broader group expressed concern that focusing on specialty markets could ultimately limit impact, but the group agreed that the initial focus on these smaller markets should be positioned as a stepping stone towards more substantial impact. Significant discussion took place on the complexity of value chains for consumer products and how this can make identifying the role of biomaterials particularly complex for this sector. This difficulty can make it more difficult to craft government policies to incentivize the inclusion of biomaterials in value chains and for end buyers to make conscious decisions about buying products made with biomaterials. Consequently, current government initiatives, such as the US BioPreferred programme, should focus on government purchasing and adding value by labelling products made with renewable chemicals to provide information to buyers.

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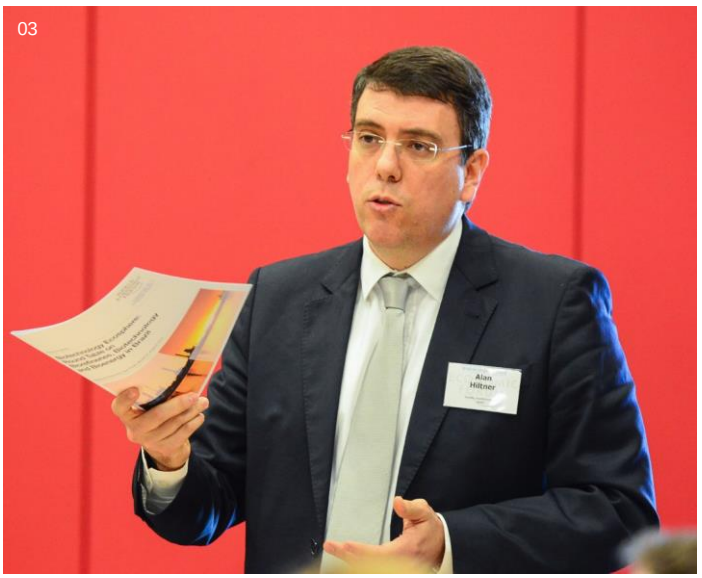
01: Compostable coffee cups were used to reinforce the applicability of biotechnology



01: Participants assemble to discuss North America's biotechnology ecosphere
02: Andrew Hagan, Head of Chemistry and Advanced Materials Industry, World Economic Forum
03: Alan Hiltner, Vice-President, Business Development, GranBio Investimentos, Brazil

Next Steps: Opportunities for Action

At the conclusion of the session, the panellists acknowledged a variety of opportunities to take concrete actions to help advance the topics discussed. The most pressing is to finalize a statement to get on the agenda for COP21. The foundation for this statement was laid during the session in Montreal and participants suggested it should be finalized during the upcoming World Economic Forum Industry Strategy Meeting in Geneva. They agreed a compelling case can be made for using biotechnology to address climate issues and they want to use the statement to present that case.

To further support the case, participants suggested developing a narrative around a particular example in which biotechnology is successfully being deployed at scale in order to engage with key stakeholder and generate broader attention. All agreed to advance the use of biotechnology in airline fuels as such an example. While portraying the benefits of using biofuels as part of this narrative, the industry should present a balanced case and show both the positive and negative aspects of using biofuels in the airline industry to ensure transparency. Finally, this story could be strengthened by ensuring commitments from participants at COP21 and the World Economic Forum Annual Meeting in Davos-Klosters to fly to those meeting using biofuels.

Another proposal was to identify policy recommendations participants can take back to their respective governments. For example, in the United States, policies and incentives have been geared towards promoting biofuels; these same benefits could be extended to promote biochemicals as well. Additional policy initiatives, such as the renewable loan programme or the US BioPreferred programme, could be extended or enhanced to support the industry. These are promising solutions because using the biotechnology ecosphere platform as a driver for policy change can produce tangible results, as seen in Brazil.

Finally, participants decided on several next steps to take at subsequent World Economic Forum meetings. All concurred that consumer companies should be invited to subsequent biotechnology ecosphere sessions, along with other key stakeholders, such as those from the American Chemical Society. Additionally, the takeaways from this session should be discussed at subsequent World Economic Forum meetings in Brazil, China and Switzerland to maintain the momentum generated during the gathering in Montreal.

List of Participants

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