National Commission on Innovation & Competitiveness Frontiers

A Council Plan to Redefine 21st Century Productivity, Prosperity and Security

Exploring the Future of Sustainable Production and Consumption

Working Group 2 Charter

Setting the Stage for the Commission Working Groups

Despite significant strengths in its innovation capabilities and capacities—documented in the Council on Competitiveness *2018 Clarion Call for Competitiveness*—U.S. competitiveness is dynamic and ever transforming. And our nation's comparative position in the global competitiveness arena can change rapidly.

Now and into the future, U.S. companies, industries and our national and regional economies that expect to compete will have to rise to the challenge of this dynamic, and reorganize for an age of growing technological, economic and political disruption. Our government, communities and our education system must be prepared to support rapid change, and help those who are displaced or negatively affected by technological and competitive change.

When the United States controlled the global direction of technology, we were positioned to control our economic destiny. That is no longer guaranteed.

The United States must take stock. We must assess if our innovation ecosystem and its investments are enough to maintain our global economic and technological leadership. And, as technology seeps into nearly every aspect of American life, our national leaders and our governments at every level must bolster their knowledge and response capabilities to match the strengthening global competition, technological change and coming disruptions.

What will the United States do in the face of challenges at home and coming from abroad?

Will we plan for the long term, transforming challenge to opportunity? Will we put in place the talent, innovation capital and infrastructure necessary for continuing success in the decades to come? Will we recognize the multifaceted nature of today's global innovation race, and come together across all sectors to form a new "innovation compact" for economic growth, productivity and inclusive prosperity?

To confront and overcome critical challenges facing the U.S. innovation engine…

To create momentum in the United States to outpace the rest of the world in innovation capacity, capability and competitiveness…

To build on the Council's history of work in defining, articulating and activating America's innovation movement…

And to develop new partnerships and efforts to launch and scale innovation-based research, businesses and ventures in the United States.

The Board and Executive Committee of the Council has formed the National Commission on Innovation & Competitiveness Frontiers (Commission) to prepare the Nation for a new, unfolding and evolving innovation reality that will shape the Nation's prosperity for the next half century.

In the first year of the Commission's work, the Council will build a powerful set of recommendations with **Working Groups focused on three core pillars:**

1. **Developing and Deploying at Scale Disruptive Technologies.**
2. **Exploring the Future of Sustainable Production and Consumption, and Work.**
3. **Optimizing the Environment for the National Innovation System.**

Working Group 2: Exploring the Future of Sustainable Production and Consumption

Mission

The Exploring the Future of Sustainable Production and Consumption Working Group aims to confront three critical issue sets—and to identify long-term, productivity and prosperity-enhancing recommendations that harness the nation's abundance of natural resources, energy, talent and ingenuity to power and unleash the most productive economy in the world.

First, this Working Group will examine the ever-evolving disruption underway in the production of goods. For example, the physical and digital worlds are converging across numerous dimension through sensors, networks, additive manufacturing and a data tsunami. At the same time, innovators are finding new ways to sustainably produce—moving beyond subtractive and additive manufacturing to the bioengineering production of goods.

Second, the Working Group will explore—coupled with the future of sustainability production—the current issues in the energy economy. Finding strategies to harness and capitalize on the opportunities of innovative energy technologies, investments, manufacturing, infrastructure and talent continue to be a challenge in overcoming barriers for a sustainable, economically viable energy future.

Lastly, the Working Group will investigate the trends regarding consumption, including an assessment of consumer culture and fast-growth markets. In times of economic uncertainty, along with scale of disruptions, consumer behavior is being driven to balance savings, investments, healthcare and basic needs as well as spending on technology and other goods. Near and long term economic impacts will be impacted by these consumption behaviors.

To accomplish these aims, the Working Group will create and prioritize concrete, sector-appropriate (government, industry, academia, national laboratories, workforce) recommendations to bolster sustainable production and consumption of goods in the United States and how to capture global value from this innovative production.

Timeframe

The Working Group will:

- Regroup summer 2020, following the June meeting with the National Commissioners.
- Convene virtually through 2020 for cross-Working Group engagements on a weekly basis.
- Continue, under the leadership of co-Chairs, virtual engagements through fall 2020 in preparation for the next Commissioner meeting in December 2020.
- Target delivery of final recommendations at the December 2020 Commission meeting.

Background

Following the 2004 release of its Innovate America report, the Council began a concerted effort to explore two emerging megatrends at the heart of long-term competitiveness: How to turbocharge a manufacturing and production renaissance in an unexpected era of energy abundance; and how to work and thrive in an increasingly turbulent, technological and transforming global economy.

These efforts—and key findings captured in Council reports Work (2016) and Accelerate (2018)—document the speed and ease with which a country can reorganize its economy around new disruptive technologies, and how this plays a critical role in the competitive and economic benefits a nation can capture.

Additionally, the Council led two major follow on efforts to the National Innovation Initiative (NII)—which foreshadowed the importance of a renewed, reinvigorated manufacturing capacity in the United States, turbocharged by a changing energy landscape which the US could capitalize on new energy abundance to help bridge toward a more sustainable, clean energy pathway in the nation. The American Energy & Manufacturing Competitiveness Partnership (AEMCP) and the Energy & Manufacturing Competitiveness Partnership (EMCP) were multi-year, nine dialogue, four national summit efforts at the Council to make the conjoined case that energy and manufacturing are inextricably linked.

The reorganization of the economy is a dynamic process undertaken by businesses, government and people and it is inherently disruptive, creating new opportunities for some and pain for others. But it is essential for leveraging new technology to generate the greatest benefits in terms of jobs, economic growth, productivity and wealth.

Issues

Future of sustainable production. Around the world, the pressure to make production more sustainable is growing. Radically different forms of production that answer that challenge are emerging. For example, with sensors, data and intelligent controls in smart manufacturing, producers can optimize production and minimize energy consumption and waste. 3D printing builds objects layer by layer from 3D model data, eliminating scrap. Vertical indoor farms are promising for making some food production more sustainable. They increase harvest productivity, cut water use by 70-95 percent and do not use pesticides. Fresh produce grown in vertical farms travels only a few miles to reach grocery store shelves compared to conventional produce, which can travel thousands of miles by truck or plane.

The world produces 300 million tons of plastic waste ever year. About 80 percent of it ends up in landfills, dumps or the natural environment and can persist in the environment for centuries. One company uses a proprietary process to re-purpose agricultural waste and biomass to produce cost-effective compostable food packaging that performs and feels like plastic.

The packaging breaks down into organic material and can be used again to regenerate soil or other organic matter, creating a fully closed-loop cycle where the food grown creates the input materials for the packaging that carries food to the consumer and then, once used, is used to help grow more food.[1]

Cities and metros have taken steps to enhance sustainability, ranging from banning plastic food containers to adopting renewable energy and building energy efficiency standards. Cities and metros could take advantage of new technologies, investments and trends that could make a significant difference in sustainability: new investment in infrastructure; new building energy efficient designs and technologies; intelligent highways and vehicles that optimize traffic flows and reduce congestion and idling; high levels of internet and computing penetration to support telecommuting; the introduction of autonomous vehicles for transit and deliveries, “lights-out” robotic and autonomous systems, etc. Cities and metros could leverage such opportunities in more integrated, systems approaches to sustainability.

1 Zume.

Figure 1. Recycling as a Percentage of Generation
Source: U.S. Environmental Protection Agency. National Overviews of Materials, Waste and Recycling.

In percentage of total MSW generation, recycling (including composting) did not exceed 15 percent until 1990. Growth in the recycling rate was significant over the next 15 years, spanning until 2005. The recycling rate grew more lowly over the last few years. The 2017 recycling rate was 35.2 percent.

The recycling (as a percentage of generation) of the below materials in MSW has mostly increased over the last 4 years. See the table below for examples.

	1960	1970	1980	1990	2000	2005	2010	2015	2016	2017
Paper and Paperboard	17%	15%	21%	28%	43%	50%	63%	67%	68%	66%
Glass	2%	1%	5%	20%	23%	21%	27%	28%	28%	27%
Plastics	Neg.	Neg.	<1%	2%	6%	6%	8%	9%	9%	8%
Yard Trimmings	Neg.	Neg.	Neg.	12%	52%	62%	58%	61%	66%	69%
Lead-acid Batteries	Neg.	76%	70%	97%	93%	96%	99%	99%	99%	99%

While most Americans are concerned about the environment (75 percent), fewer (20 percent) say they make consistent efforts to help the environment as they go about their daily lives. Americans 65 and older are more likely to make an effort all the time vs. millennials and those under 23 years old.[2]

Potential questions for the Working Group to consider:

- How can we encourage companies to think about sustainability in systematic ways across the product life cycle—materials sourcing, production, packaging, distribution and warehousing, delivery to customer, customer use and final disposition?
- Has the business case for greater sustainability been made?
- How can companies influence the decisions suppliers and other actors across the product value chain make with respect to the sustainability of their practices and purchases?
- How can major corporations encourage and help their suppliers become more sustainable? What is the degree to which these efforts are global, deploying in countries that are growing contributors to environmental degradation?

2 For Earth Day, Here's How Americans View Environmental Issues, Fact Tank, Pew Research Center, April 20, 2017.

- What is a good balance between market-generated solutions vs. regulation?
- Does the total quality movement or circular economy concept offer a model for change?
- How can we convert public concern into more sustainable daily decision making (that would also have the benefit of driving market change)? Do we need a movement?
- What are the challenges in harnessing American innovation to meet the need for low carbon energy across the board, at every scale, and around the world? Where is more investment needed? Will market-based approaches meet the challenge?

Energy and advanced manufacturing. Energy is at the crossroads of economic growth, technology innovation and prosperity. In its abundance, low-cost, efficient energy can create a technological revolution and competitive advantage for the United States, enabling increased productivity and efficiency across industries. The country's commitment to energy efficiency has helped not only to reduce the negative environmental impacts associated with heavy industrial and consumer reliance on energy, traditionally in the form of coal and other fossil fuels, but also to reduce costs and drive innovation and competitiveness.

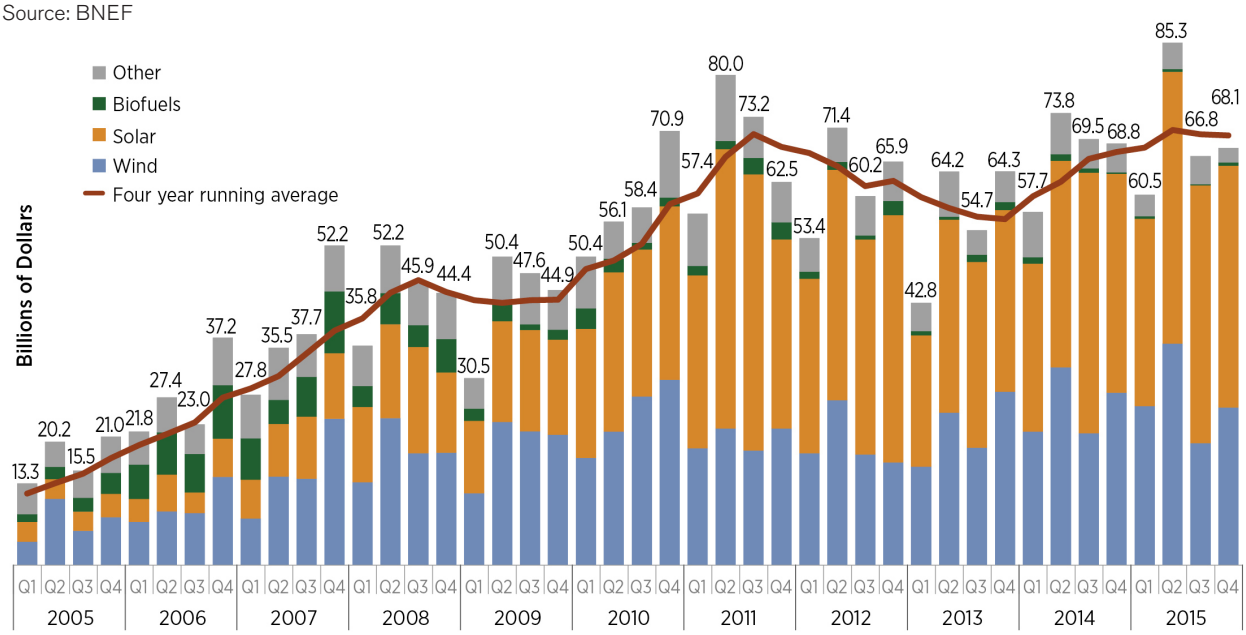
The changing manufacturing landscape has been shaped by many innovations in energy and sustainability were shaped ultimately by global consumer demands for higher precision, higher value products that are manufactured faster, cheaper and safer, making far better use of materials and energy with less environmental impact. Powering this production revolution and subsequent demand for smart manufacturing is the confluence of multiple factors including:

- Slack in manufacturing productivity, precision and performance that, if made more efficient, could tap significant value from supply chain operations and process operations;
- The digitalization of the manufacturing industry with advanced sensing, controls and modeling technologies and digital infrastructure; and

Figure 2. New Investment in Clean Energy by Technology—Global

Published by Department of Energy: Investment in Renewable Energy Continues to Increase. November 2016.

Source: BNEF

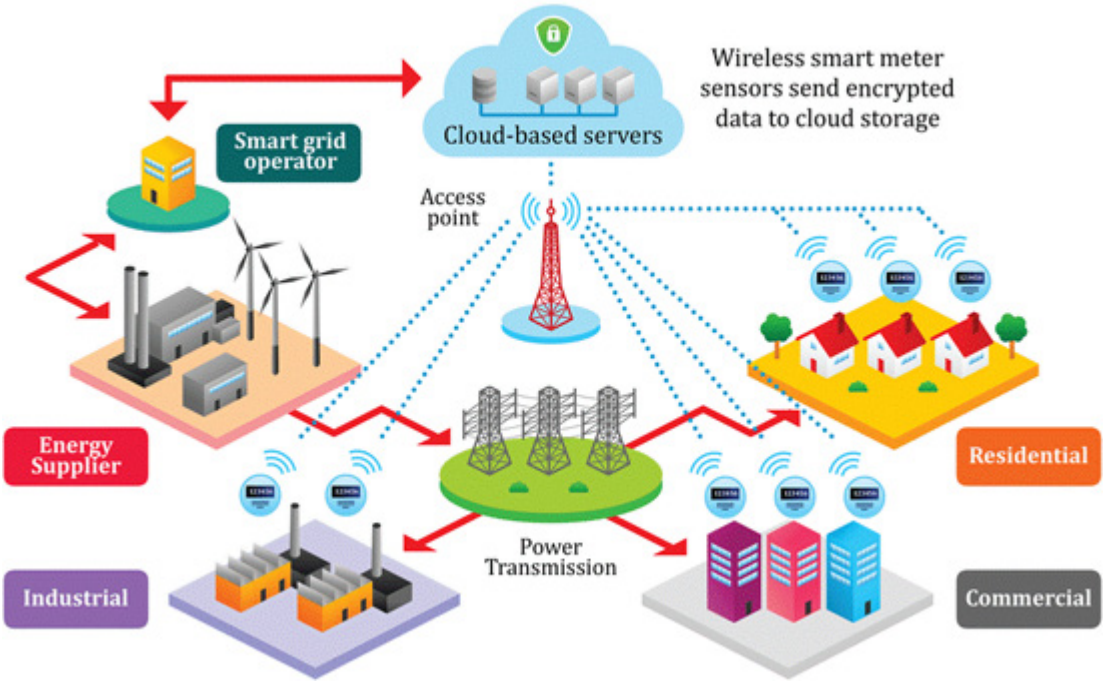


Source: BNEF

Reported values may vary from those included in previous versions of the Data Book due to retroactive changes in source data.

Total values include estimates for undisclosed deals; includes corporate and government R&D and spending for digital energy and energy storage projects (not reported in quarterly statistics).

Figure 3. Smart Grid Cloud Integration Landscape
Source: IEEE Smart Grid. The Cyber-Physical Security of the Power Grid. 2019.



- The generational re-emergence of advanced and highly productive manufacturing capacity on U.S. soil.[3]

As the world sits on the precipice of a clean energy revolution, energy resides as an attractive investment that both supports preserving the nation's existing zero emission technologies and enables new technologies and innovative strategies to reduce the carbon footprint and remain sustainable for generations to come.

America's energy security is also an issue of national security. As we continue to advance and modernize America's energy systems, it is important to ensure grid modernization does not occur at the expense of security. Monitoring cyber activity and guarding against infiltrations of America's grid and nuclear plants are a significant concern, and grid security is a national security risk of the highest order.

Potential questions for the Working Group to consider:

- How soon will alternative power generation technologies be available? What will the market adoption rate of these technologies be?
- What technologies are on the horizon?
- What are the challenges and opportunities in the area of energy storage?
- What will our cities look like in 10, 20, 50 years? And what will be the energy needs in these areas?
- What will be the social impact of future changes in the energy sector?

3 Smart Manufacturing: Leveraging the Democratization of Innovation. Council on Competitiveness (Council) and UCLA, home to CESMII—The Smart Manufacturing Institute. June 2019.

- What is the future of solar or alternative energy in regard to its cost effectiveness and ability to compete with conventional fuels?
- Which utilities' models will be disrupted and which will succeed?
- What resources will be needed to protect and secure energy facilities and infrastructure?
- How do we connect communities across America to modern, efficient energy sources?
- Most of the world's power still comes from burning carbon—how can we substantially decarbonize?
- How does the US keep the cost of energy low enough to sustain economic growth?
- What will be the social impact of future changes in the energy sector?
- What can be done to meet America's demand for electricity while also making the right choices to protect the environment?

Consumption. Consumption patterns can change rapidly as a result of many events—pandemic, natural disaster or economic uncertainty to name a few. With investments and accelerating change in the future of sustainable production and energy resources, consumer behaviors will be significantly impacted by these resulting innovations.

For the first time since agriculture-based civilization began 10 millennia ago, the majority of the world's population—just over half—could be considered middle class or richer. By 2030, the global middle class could reach 5.3B—1.7B more than today. Reaching middle class is transformative as a life experience. These new middle class consumers will want a wide range of products and services.

As we enter the Fourth Industrial Revolution,[4] distribution of goods and consumption behaviors will provide opportunities for value creation through the adoption of disruptive technologies and greater inclusivity. The advancement of inclusive growth strategies will be further prioritized.

With increasing development and rising income around the world, consumption is on an upward trajectory. For example, according to the UN, the per capita "material footprint" of developing countries increased from 5 metric tons in 2000 to 9 metric tons in 2017. In high income countries, the per capita material footprint is 27 metric tons.

U.S. per capita municipal solid waste (MSW) generation is 4.5 pounds per person per day (EPA). Total MSM generated in 2017 (latest data) was 267M tons, of which 67M tons were recycled and 27M composted—equivalent to a 35 percent recycling and composting rate. Fifty-two percent ended up in a landfill. Paper and paperboard products made up the largest percentage of all materials in MSW (one-quarter), followed by food (15 percent), plastics (13 percent), and yard trimmings (13 percent). Seventy-five percent of food that could be composted ends up in a landfill.

From food to fuel, consumption is concentrated in cities and metros. Cities have taken steps to enhance sustainability, ranging from banning plastic food containers to adopting building energy efficiency standards. Other technologies and designs could make a significant difference in city sustainability including energy efficient building designs and technologies; intelligent highways and vehicles that optimize traffic flows, reducing congestion and idling; high levels of Internet and computing penetration to support telecommuting; autonomous vehicles for transit and deliveries, "lights-out" robotic and autonomous systems, etc. Widespread adoption of existing energy-efficient building technologies—and the introduction and use of new technologies—could eventually reduce energy use in homes and commercial buildings by 50 percent.[5]

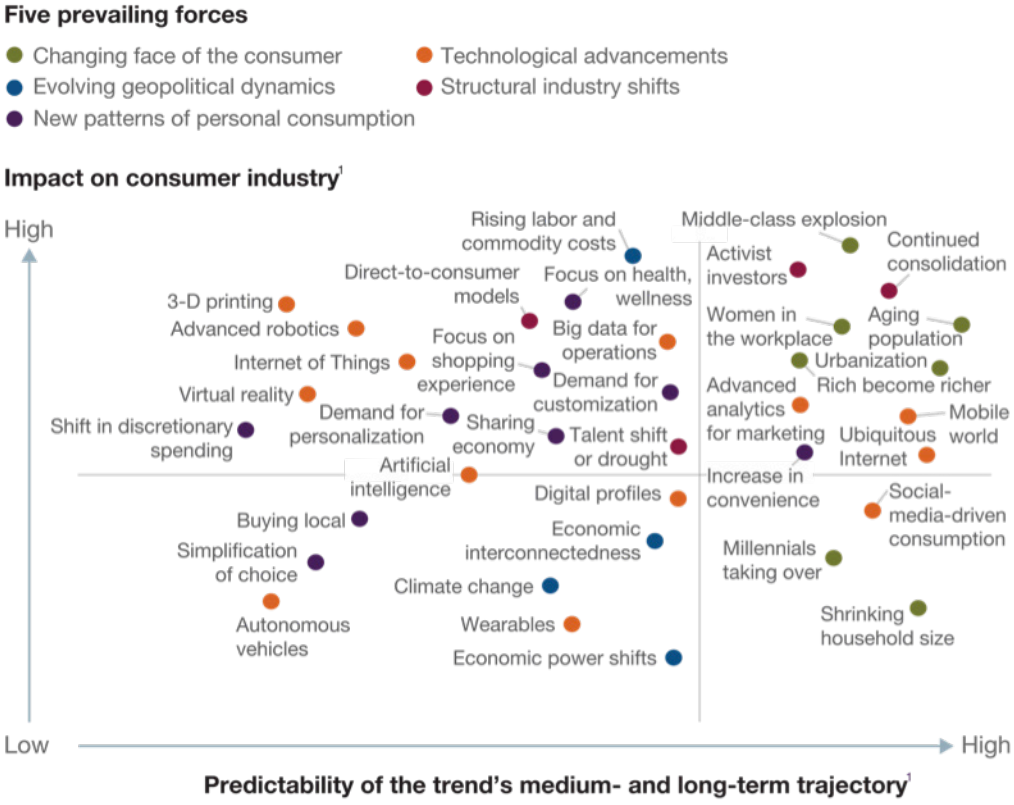
4 The 4th industrial revolution is key to getting the global economy, and our lives, back on track. VentureBeat. April 11, 2020.

5 Quadrennial Technology Review: An Assessment of Energy Technologies and Research Opportunities. U.S. Department of Energy. September 2015.

Figure 4. Which Trends Could Most Affect Consumer Companies

Source: The consumer sector in 2030: Trends and questions to consider. McKinsey. December 2015.

This conceptual matrix will differ for each company depending on the company's specific product categories, geographic markets, and business context.



[1]Based on analysis of third-party projections, publicly available reports, and expert opinions.

Potential questions for the Working Group to consider:

- How will consumers respond post-Coronavirus Disease 2019 (COVID-19)? Will consumers save more, return to 'normal' or will their consumption/ expenditures increase?
- How will business models change as a result of the Fourth Industrial Revolution?
- In what ways will digital technologies and online shopping impact consumer behaviors?
- How much responsibility can we expect consumers to take in changing their consumption behavior and practices to make them more sustainable? How can we make sustainable consumption easier for consumers?
- Who is responsible for making consumer consumption more sustainable?
- Are there societal implications for varying consumption models? To what extent will urban-rural divides impact consumption models?

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