National Commission on Innovation & Competitiveness Frontiers


# Competing in the Next Economy

## Adapting to a Changing World

Phase Two of the National Commission on Innovation and Competitiveness Frontiers

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# Adapting to a Changing World

## Call to Action

The U.S. economy faces an inflection point. Multiple technology revolutions are unfolding and converging at a rapid pace, and the nation's ability to swiftly reorganize its economy to capitalize on this creative destruction will dictate whether the United States remains the world's leader in innovation for generations to come. Recent events—including the pandemic, the war in Ukraine, the ongoing effects of climate change, and supply chain disruptions, among many others—have only hastened the pace of change and heightened the importance of rising to the occasion to produce concrete recommendations and action steps for the private and public sectors.

As the world enters this new era of technological transformation, the United States is vying for global leadership in an increasingly multipolar and complex landscape. That includes, most significantly, a rising strategic competitor in China that seeks to build capabilities in science, technology, and innovation to rival the United States and write the global rules of the next economy in its favor. But it also includes many other nations who seek to capitalize on game-changing innovations that can originate anywhere, especially in an increasingly digital world. At the same time, the foundations of U.S. capacity and capability in science and technology have been slowly eroding, and too few people across the entire nation fully participate in and benefit from the innovation economy.

"With a $20 trillion economy [and] a diverse population of over 330 million people, the United States is an incredible incubator of ideas. But it is also a nation of unequal opportunity. What we need is a 'modernization model'—our Commission must be unbelievably creative in re-inventing America. We need to develop national innovation systems, not a single innovation system."

**Dr. Michael M. Crow**
President, Arizona State University, and National Commissioner

To secure U.S. leadership, prosperity, and competitiveness in this evolving world order, the nation must think differently about innovation. It must be willing to play a radically different game with different rules and a different mindset about what it will take to compete and win. It must re-imagine the people, places, and models of the innovation ecosystem. And the nation must more fully tap into the potential that exists in all corners of the U.S. economy and promote an "all-of-nation" approach to ensure that the innovation ecosystem fires on all cylinders.

## The Next Phase of the National Commission

With those considerations in mind, the National Commission on Innovation and Competitiveness Frontiers (the Commission) is launching the next phase of its work to re-envision the U.S. innovation ecosystem, and dramatically increase the nation's innovation capacity and capabilities. Over the course of the coming months, the Commission will initiate a new wave of dialogues that will build on prior work, dive deeper into critical topics, and refresh collective thinking on how the United States can out-innovate and out-compete other nations in the 21st century.

Specifically, this next phase of work will build on the Commission's previous report, *Competing in the Next Economy*, which established the goal of increasing U.S. innovation by tenfold (10X) and included 50 specific recommendations for achieving it. Although many of those recommendations have since been implemented, many of them have not and merit continued attention and advocacy. This next phase will also unpack and explore certain aspects of innovation at a deeper level than was feasible during the first phase, including the future of sustainability, the future of technology, the future of work, and the future of place-based innovation.

Innovation by its very nature is dynamic and so are the externalities that can have an impact on it. Since the National Commission began its work, a new global pandemic, a war in Europe, and generationally high inflation rates have all disrupted national and global innovation capacity. In light of these developments, the Commission's work has only grown in importance and urgency. The United States' ability to make the most of this moment will have far-reaching consequences, affecting everything from the economic opportunities available in local communities to the quality of life of future generations to geopolitical influence on the world stage. The goals and recommendations stemming from this new phase of work will shape the direction and focus of the U.S. innovation agenda and ensure American competitiveness, security, and prosperity for decades to come. The Council invites all of our members and other interested stakeholders to join us in pursuing that mission.

# History of the Commission
## Phase One

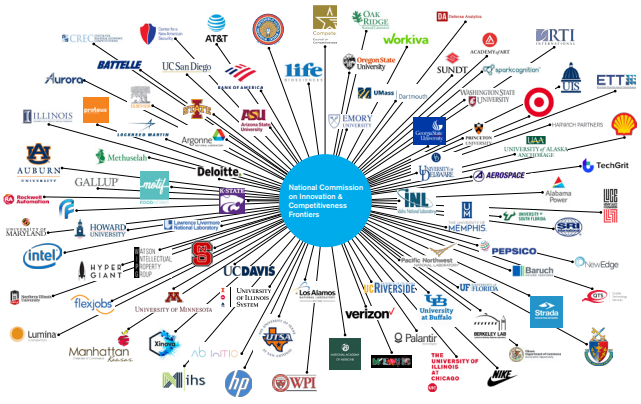

In August 2019, the Council on Competitiveness launches the **National Commission on Innovation and Competitiveness Frontiers** with more than 35 CEOs, university presidents, labor leaders, and national laboratory directors.

The Commission holds a major launch conference at Arizona State University to kick off working group dialogues, research, and reporting that will inform policy recommendations.

The Commission releases the *Competing in the Next Economy* report, laying out 50 priority recommendations from across the four working groups and calling for a 10x boost to U.S. innovation.

2019 2020

The Council builds the multi-hundred "community" of experts to stand up the National Commission Advisors and working groups




The Council focuses on communicating and advancing key recommendations of *Competing in the Next Economy* with the administration, on the Hill, et al.

2021

2022

The Commission hosts three *Competing in the Next Economy* webinars centered on various innovation topics, as well as a virtual summer meeting featuring guest speakers U.S. Secretary of Energy Jennifer M. Granholm and U.S. Secretary of Commerce Gina M. Raimondo.

The Commission convenes the **2021 National Competitiveness Forum**, featuring panels on a variety of technology topics, and announces "phase 2" of working group engagement to articulate a new set of goals.

The Commission meets at the University of Wyoming for the **Mountain West Innovation Summit** to formally kick off a new phase of working group engagement to build on the findings from the *Competing in the Next Economy* report.

Compete. Council on Competitiveness

University of Wyoming

HESS

INL Idaho National Laboratory

Established in 2019, the Commission brings together leaders from business, academia, labor, and national laboratories to examine the emerging economic, technological, and global competitive landscape, and develop key recommendations to address the related challenges facing the United States. The Commission serves as an agile and responsive cross-sectoral leadership network which aims to develop a bold, actionable agenda to boost U.S. innovation and competitiveness. It also builds on previous, groundbreaking work from the Council on Competitiveness—including the "Clusters of Innovation" initiative, the country's first-ever National Innovation Summit at MIT and the following National Innovation Initiative, as well as the Exploring Innovation Frontiers Initiative in partnership with the National Science Foundation—that has positioned innovation as the key driver to U.S. economic prosperity and competitiveness over the past two decades.

The Commission was formed to be bold, to reinvent innovation models, to support U.S. global leadership, and to highlight the tremendous benefits of innovation for all Americans. Over the past several years, Commission members have remained remarkably agile—maintaining focus on the core mission while adapting as needed to respond to a rapid and compressed period of change and address an evergreening series of new innovation challenges.

The Commission's work began in earnest with a launch meeting at Gallup headquarters in August 2019, which set the stage for a public announcement at the December 2019 National Competitiveness Forum. The January 2020 kick-off summit at Arizona State University convened not only the Council's Commissioners but also a broader "community"—a collection of hundreds of advisors, communications specialists, and issue-area experts and leaders nominated by the National Commissioners to drive a series of working groups to develop key policy recommendations. The effort began with identifying four pillars of U.S. innovation and competitiveness around which to orient the Commission's initial phase of work:

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; and
4. Unleashing Capabilities for Work and Entrepreneurship.

These key pillars formed the basis of the Commission's four policy-generating working groups in 2020, which convened experts across industry, academia, and government to develop recommendations for action to accelerate and dramatically increase U.S. innovation. Coming out of the ASU launch event, the Commission quickly pivoted the working group process in light of the pandemic. The working groups convened in nearly 150 virtual, curated meetings between March and October of 2020 to develop many dozens of recommendations—which were narrowed to the 50 that would form the basis of the Commission's 2020 report, *Competing in the Next Economy*.

The Commission found that competing in the next economy will require a radical transformation of the national innovation system, and established the ambitious goal of achieving a tenfold increase in the United States' innovative capacity and capability by:

- Increasing the number of innovations Americans develop, deploy, and scale;
- Increasing the speed of innovation; and
- Increasing the number and diversity of Americans engaged in innovation.

The Commission's recommendations (see pages 8-9) were targeted at strengthening critical aspects of the U.S. innovation system and removing barriers to innovation in pursuit of this 10x goal. Key recommendations included establishing a leadership structure for coordinating national policies that

**National Commission on Innovation and Competitiveness Frontiers, Phase 1: 2019–2022**

## National Commissioners

60+ distinguished leaders from industry, academia, national laboratories and other critical stakeholder groups, including the Council on Competitiveness Board:

**Dr. Mehmood Khan**
Chief Executive Officer
Life Biosciences, Inc.

**Mr. Brian T. Moynihan**
Chairman and Chief Executive Officer
Bank of America

**Dr. Michael M. Crow**
President
Arizona State University

**Mr. Lonnie Stephenson**
International President
IBEW

**Mr. Samuel R. Allen**
Chairman
Deere & Company

**Ms. Deborah L. Wince-Smith**
President & Chief Executive Officer
Council on Competitiveness

**Dr. Thomas Zacharia**
Director
Oak Ridge National Laboratory

## Advisory Committee

Three dozen+ multi-sector innovation leaders supporting the National Commissioners and guiding the Working Group agendas.

## Outreach & Engagement Committee

Two dozen+ strategic communications, media and government affairs leaders supporting the creative education, advocacy and communications plans for the National Commission.

## Working Groups

150+ innovators and leaders—from all sectors of the economy and across the entire country—brainstorming and developing actionable policy recommendations for the National Commission.

1. **Developing and Deploying at Scale Disruptive Technologies**
2. **Exploring the Future of Sustainable Production and Consumption**
3. **Optimizing the Environment for the Nation's Innovation Systems**
4. **Unleashing Capabilities for Work and Entrepreneurship**

affect innovation, restoring federal R&D funding to historic levels, accelerating the movement of new technologies from the laboratory to the marketplace, launching public-private partnerships to expand innovation capacity in communities that are not currently engaged in the innovation economy, and building a coordinated strategy for development and deployment of key emerging technologies.

Since the release of the 2020 report, the Commission has extensively engaged with leaders across the public and private sectors to advocate for the report's key recommendations. The Commission collaborated with congressional leadership to help develop the transformative United States Innovation and Competitiveness Act (USICA), outlined actions to boost university innovation, convened a series of industry-led webinars on cutting-edge innovation topics, and much more. The next phase of work will seek to further shape the national innovation agenda; more deeply explore important issues raised in *Competing in the Next Economy*; and examine new challenges and opportunities created by recent events.

# Key Recommendations from *Competing in the Next Economy*
## A New Innovation Age Calls for a New Innovation Game

### 10x: Leadership and National Strategies for Innovation

1. Establish the White House National Competitiveness and Innovation Council (NCIC)—and parallel State Competitiveness and Innovation Councils—to create a national vision for U.S. competitiveness and innovation in the 21st century global economy, and integrate policy development across federal departments and agencies in this domain.
2. Build a whole-of-nation strategy for developing and deploying critical dual-use technologies that will shape the industries of the future, national security and global grand challenges—including advanced microelectronics, advanced computing (supercomputing, quantum, artificial intelligence), biotechnology, advanced materials, climate, etc.
3. Establish the National Innovation Radar Initiative, a coupling of innovation and intelligence assessment.
4. Establish a new Technology Statecraft Initiative and International Innovation Corps.
5. Secure supply chains critical to U.S. innovation, national security and economy growth.
6. Establish regulations, government procurement policies, and reforms in antitrust and competition policy to support the industries of the future.

### 10x: Increasing the Number of Innovations Developed in and Deployed by the United States

1. Keep the U.S. corporate tax rates competitive with EU and OECD nations, and include corporate pass-through entities in the Section 1202 exclusion, increasing asset limits to $100 million.
2. Restore federal research and development (R&D) investment to 1960 levels of two percent of GDP.
3. Establish a new, non-profit American Innovation Investment Fund with initial public-private capitalization of $100 billion.
4. Expand venture capacity nationwide, extend Treasury small business programs to encompass bank loans and private investors, allow equity investments into federal small business programs, and develop preferential rates for veterans and other underserved populations.
5. Establish new federal and state SBIR phase III grants to bridge the valley of death.

## 10x: Increasing the Speed at Which the United States Innovates

1. Establish the U.S. Digital Infrastructure Access and Inclusion Initiative.
2. Drive deployment—by federal, state and local governments—of new technologies that make infrastructure smarter, safer, more sustainable, more efficient, and more responsive and resilient.
3. Extend the mission of national labs to encompass economic competitiveness and permit co-funding with private sector partners.
4. Expand access to and public-private financing for shared research institutions and industry-led pilot demonstration projects.
5. Establish new sustainability curricula, innovation consortia, the "Patents for Planet" program, and new tax incentives or sustainability investments.

## 10x: Increasing the Number and Diversity of Americans Engaged in Innovation

1. Ensure all federal, state and local programs and investments in innovation capacity and education address the access, diversity and inclusion of minorities and women—with a goal to increasing their participation tenfold.
2. Redesign federal economic development programs to support innovation building capacity, eliminating outdated grant criteria and duplicative funding by adopting innovation metrics and performance standards for new block grant programs.
3. Conduct through State Competitiveness and Innovation Councils regional innovation mapping and assessments for building future innovation capacity.
4. Realign federal, state and local workforce development programs and training to enable a highly skilled, digitally competent, innovation workforce beginning at the junior and high school levels.
5. Launch new community-based public-private partnerships to support students and entrepreneurs, by expanding invention and entrepreneurship curricula in pre-K through higher education—with a goal to retain and grow regional innovation capacity.
6. Establish multidisciplinary engineering innovation centers and ecosystems in communities of dire economic and social need.

# U.S. Innovation & Competitiveness: Opportunities in a Rapidly Shifting Landscape

In the year and a half since the Commission released *Competing in the Next Economy*, the world has experienced one of the most rapid and compressed eras of change in modern history. That change has important implications for the U.S. innovation agenda. Although several recent developments merely accelerated trends the Commission previously identified, others have created or elevated issues that merit the Commission's close and careful attention. Many of these developments pose significant challenges to the existing innovation system, but they also highlight the need, urgency, and opportunity associated with reimagining the contours of a sustainable innovation agenda in the 21st century.

## Accelerating the Pace of Change During the COVID-19 Pandemic

The pandemic has presented the global economy and society with unparalleled challenges and disruptions. In the early months of pandemic lockdowns, America faced widespread unemployment, an economic freefall, and a temporary halt to basic social contact. The pandemic also exposed the vulnerabilities of existing supply chains, as global networks disrupted by lockdowns and reduced industrial activity during the height of the pandemic have struggled to catch up with surging consumer demand for goods that have been in short supply.

However, as noted in the Commission's 2020 report, the pandemic has also accelerated digitalization and innovation across every industry and sector at an unprecedented pace. Health and economic crises, accompanied by swift changes in consumer demands, have accelerated the adoption of big data, cloud, and IoT capabilities. Although the push towards digitalization was already in motion, the pandemic acted as a major accelerant of technology adoption. Innovations in technology, commerce, and health have been similarly catalyzed by the disruption of COVID-19. Remaining resilient in the face of these disruptive forces will be crucial to competing in a future economy dominated by transformative technologies that are currently being developed and deployed.

These developments have also driven profound changes to the way people work, creating new opportunities and enhanced flexibility in many organizations, while also hastening worker displacement in others. Such changes hold additional implications for city planning, commercial real estate development, and related environmental impacts in communities around the country. In the face of this creative destruction, organizations are rethinking how and where to source workers, opening new possibilities for employers and employees alike. Technologies such as AI and autonomous systems will disrupt many industries, and reskilling and upskilling will be critical to easing worker reallocation, creating potential pathways to high-paying jobs, and capitalizing on

technological advancements. **To secure the benefits of this transformation for all Americans, the United States should arm its workforce with the digital and interdisciplinary skills vital to a thriving innovation ecosystem.**

## Adapting Global Engagement Amid Geopolitical Conflict & Mounting Tensions

Geopolitical tensions have been mounting in recent years as other nations—especially China and Russia—have competed with the United States for technological, economic, and strategic dominance. Calls to decouple with China have escalated as concerns mount over forced technology transfer, intellectual property (IP) theft, and China's growing role in standards-setting bodies. This momentum has prompted a re-evaluation of global alliances and partnerships in consideration of how global engagement can best serve U.S. interests, especially without equipping potential adversaries in the long term.

With the explosive onset of the Russian invasion of Ukraine, these concerns and reassessments have been both accelerated and heightened. New challenges have arisen—including supply chain vulnerabilities in energy, food, and key technology inputs such as rare minerals. Existing challenges have been hastened, including a rapid, unprecedented but necessary reconfiguration of global trade and financial networks. Combating these barriers—including establishing resilient supply chains and ensuring favorable technology standards—will be essential to promoting U.S. and allied technologies worldwide. With careful calibration, the United States can make major strides towards reinforcing its competitive advantage in critical industries during this period of transition, and hopefully do so in a manner that does not simply exchange one set of vulnerabilities now for a new set of vulnerabilities in the future.

## Innovating to Address Climate Instability & Resource Scarcity

The environmental challenges facing the globe continue to grow in urgency and severity with each passing year. The steady march of urbanization and population growth continues to place mounting pressure on food production, clean water, energy resources, and critical infrastructure around the globe. Meanwhile, the energy-intensive systems and processes that the world has relied upon to power the economy and satisfy consumer demands are creating lasting ramifications for the global climate.

The Intergovernmental Panel on Climate Change (IPCC) recently pointed to rapid decarbonization as the only avenue to avoid a multitude of health, safety, and economic risks from global warming.[1] In addition, the world faces growing material footprints coupled with increasingly constrained resources. Competing in the next economy will require targeted efforts to reimagine how societies produce and consume.

1 IPCC (2022), *Climate Change 2022: Impacts, Adaptation and Vulnerability*.

Rapid innovation will be necessary to create, scale, and deploy the critical clean energy technologies which will enable the United States and the world to reach climate goals without compromising economic growth, development in emerging and underdeveloped economies, and quality of life. **The International Energy Agency (IEA) projects that roughly 45 percent of the emissions reductions needed to reach net-zero emissions globally by 2050 will come from technologies that have not yet been commercially deployed.**[2] Significant opportunities exist around clean energy production and energy efficiency improvements, and maintaining the rapid pace of innovation in these fields will be crucial to unlocking widespread commercialization.

To make the most of these opportunities, the United States must find new ways to expand access to financing and drive the widespread deployment of technologies that make sense from both a climate and business perspective. By seizing and maintaining a leadership position in clean energy technology, the United States can not only create its own clean energy economy but also export that technology to the rest of the world and help the global community avoid the worst impacts associated with climate change.

## Overcoming Persistent Social Divisions & Inequities

Despite being a perennial leader in innovation, the United States has not fully tapped into its innovation potential. Many Americans currently do not engage and participate in the innovation economy, with these divisions typically falling along geographic and demographic lines. And as the pace of change accelerates, these divisions are likely to become more severe and amplified.

For instance, automation will disrupt many industries and displace countless workers, both in urban cores and rural communities. Workers who lack digital and technological skills—or the infrastructure to use them—are similarly at risk of being excluded from fully participating and benefitting in the innovation economy.

For decades, U.S. innovative capacity has been primarily concentrated in coastal technology hubs such as Silicon Valley, Boston, Seattle, and New York. While these hubs have proven to be successful innovation centers, they fail to leverage wide swaths of the country and U.S. population—leaving a massive amount of untapped potential and creating an opportunity to expand the playing field when it comes to advancing the nation's innovation agenda.

**To fully tap into that potential, the United States must create a "system of innovation systems" that is tailored to regional assets and, together, constitute a globally competitive national innovation ecosystem.** Innovation is a global game, and the United States can no longer afford to pit cities against cities and states against states in the fight for innovation-based capital and talent. Rather, an innovation ecosystem that is nationally coordinated, regionally focused, and locally driven is needed—thereby enabling all corners of the economy and workers from all walks of life to fully contribute to and participate in the benefits of the innovation economy.

2 IEA (2020), *Energy Technology Perspectives 2020*, p. 310.

# Key Issues the National Commission's Work Must Address Going Forward

The historic events and developments of the past few years have fundamentally altered the U.S. innovation landscape, heightening urgency around several key challenges while also opening the door to countless new opportunities. With a cross-sectoral membership composed of organizations at the forefront of American innovation, the Commission is positioned at the nexus of these critical developments and has a unique perspective to offer on the many imperatives facing the nation. The time has come to refresh and expand on recommendations from the 2020 *Competing in the Next Economy* report to reflect an evolving set of urgent priorities.

The Commission will orient upcoming work around four key issues that the United States must address to bolster its competitive position in a rapidly changing world. To create the world's newest standard for innovation-based competitiveness, the United States must:

1. **Rethink and reshape how people produce and consume for a more sustainable future.** The United States needs to identify new ways to sustainably consume, produce, and power daily life to lead the world in creating a healthier, more abundant world for future generations.
2. **Accelerate development and deployment of disruptive technology at scale in critical emerging sectors.** The United States must step up innovation in critical emerging technologies and accelerate their application and widespread deployment to support competitiveness in key industries of the future.
3. **Adapt to the changing nature of the workforce and workplace.** The United States needs to invest in constant upskilling, reskilling, and broader STEM education efforts to ensure that the national workforce can adapt to automation-driven disruptions, benefit from the digitally-intensive knowledge economy, and keep pace with new modes of work.
4. **Expand the geography and demography of the innovation ecosystem.** The United States must cultivate a more geographically and demographically inclusive innovation ecosystem, leveraging untapped talent in areas around the country and from underrepresented populations.

**By addressing challenges and opportunities across these four critical issue areas, the Commission believes it can build on past success, supercharge the national innovation engine, boldly confront the many challenges facing the nation and the world at large, and help ensure an American future which is more resilient, more secure, more sustainable, more inclusive, more innovative—and more competitive.**

# The Next Phase

The four key issue areas provide the Commission with ample opportunities to initiate discussions and develop targeted recommendations. The process for facilitating these discussions will mirror the approach featured in the 2020 *Competing in the Next Economy* report. Specifically, four distinct working groups will be established, each of which will engage with specific aspects of the Commission's four issue areas.

**Working Group 1**
The Future of Sustainability: Accelerating Innovation in Clean Energy Technology

**Working Group 2**
The Future of Technology: Developing and Deploying Disruptive Technologies at Scale

**Working Group 3**
The Future of Work: Developing, Supporting, and Expanding the Modern Innovation Workforce in an Era of Creative Destruction

**Working Group 4**
The Future of Place-Based Innovation: Broadening the Innovation Ecosystem

Each working group will be comprised of subject matter experts and thought leaders representing industry, academia, labor, and national laboratories. The working groups will convene through a series of moderated dialogues held both virtually and in-person throughout late summer and early fall of 2022. Each working group will be responsible for collaborating around, developing, and honing targeted recommendations specific to their dedicated issue area. These recommendations will then be packaged together and serve as the foundation for the Commission's continued engagement around issues at the forefront of U.S. innovation competitiveness.

The remainder of this document contains charters for each of the four working groups. These charters broadly outline the purpose and focus of each working group as well as key issues and discussion topics which the working groups will be asked to engage around over the coming months.

**Proposed National Commission Phase 2 Working Groups and Key Issues to Address**

**The Future of Sustainability:** Accelerating Innovation in Clean Energy Technology

- Boosting investment in development and deployment of promising clean energy technologies
- Modernizing the U.S. power grid to enable the clean energy transition
- Establishing a supportive domestic policy ecosystem to foster clean energy innovation
- Engaging proactively on the international stage to address trade issues and reinforce global competitiveness in clean energy

**The Future of Technology:** Developing and Deploying Disruptive Technologies at Scale

- Sustaining and properly allocating investments in R&D while removing barriers to commercialization of disruptive technologies
- Reinforcing U.S. innovation leadership through national domestic strategies and international technology statecraft
- Bolstering the security, resiliency, and reliability of critical supply chains
- Leveraging cross-disciplinary partnerships to harness the convergence of disruptive technologies

**The Future of Work:** Developing, Supporting, and Expanding the Modern Innovation Workforce in an Era of Creative Destruction

- Revitalizing U.S. education and training systems to foster a high-skilled future workforce
- Leveraging telework capabilities, digitalization, and emerging technologies to augment conventional work
- Navigating workforce challenges and opportunities created by increased automation
- Adapting to rapid labor force shifts and new models of work organization
- Expanding efforts to increase diversity and inclusion in the innovation workforce

**The Future of Place-Based Innovation:** Broadening the Innovation Ecosystem

- Establishing regional and national strategies to coordinate and support specialized regional innovation hubs
- Investing in expansion and retention of the local talent base
- Promoting inclusive growth and innovation in regional hubs
- Strengthening local innovation ecosystems by enhancing digital infrastructure and local financing

## National Commission on Innovation and Competitiveness Frontiers, Phase 2

### National Commissioners

70+ distinguished leaders from industry, academia, national laboratories and other critical stakeholder groups, including the Council on Competitiveness Board:

**Mr. Brian T. Moynihan**
Chairman and Chief Executive Officer
Bank of America

**Ms. Janet Foutty**
Executive Chair of the Board
Deloitte US

**Ms. Joan Gabel**
President
University of Minnesota

**Mr. Lonnie Stephenson**
International President
IBEW

**Ms. Deborah L. Wince-Smith**
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1. **The Future of Sustainability:** Accelerating Innovation in Clean Energy Technology
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3. **The Future of Work:** Developing, Supporting, and Expanding the Modern Innovation Workforce in an Era of Creative Destruction
4. **The Future of Place-Based Innovation:** Broadening the Innovation Ecosystem

# Working Group 1

# **The Future of Sustainability:** Accelerating Innovation in Clean Energy Technology

"We cannot allow the manufactured goods that will be central to the green economy, such as solar panels, wind turbines, high capacity batteries and electric vehicles, and their connected supply chains, to be dominated by China and other foreign competitors."[1]

**Lonnie Stephenson**
International President
IBEW

## Overview

Global population growth, urbanization, and intensified consumption are increasingly stressing the planet. These impacts are no longer distant or abstract. Consumption is outpacing extraction, the planet continues to warm, and resources like fresh water are becoming increasingly scarce. This dynamic is currently playing out in food production: demand for food is steadily increasing alongside the growth of the middle class, while the land and resources needed to produce this food are increasingly constrained in the face of climate-induced droughts, lack of sustainable water sources, and increased energy use. The global material footprint has increased 70 percent since 2000, and it is expected to approximately double relative to current levels by 2060.[2] Global society will need to fundamentally reshape production and consumption to achieve a more sustainable future.

The Commission initiated and facilitated discussions on sustainability in developing the 2020 *Competing in the Next Economy* report and during the Lockheed Martin-sponsored webinar, *2021 Sustainability: Pursuing Innovation with Purpose*. Key recommendations stemming from these discussions included fostering partnerships between the public and private sector to strengthen deployment and commercialization of key technologies, promoting sustainability-focused education to empower the future workforce, and encouraging metrics to ensure corporate action is grounded in sustainable practices.

But while sustainability can and should be defined very broadly, in this next phase of work, the Commission will narrow its focus on a key element of sustainability: decarbonizing the energy system through accelerated innovation in clean energy technologies. This is an essential and urgent mission for innovators around the world. The IPCC has projected that greenhouse gas emissions must be cut by 43 percent by 2030 and reach net-zero emissions by 2050 to meet the 1.5 °C target.[4] According to McKinsey, annual worldwide capital spending on low-emissions physical assets will need to increase by $3.5 trillion

### Key Recommendations from *Competing in the Next Economy* and National Commission Phase 1

- The federal government in partnership with industry should identify key technologies on which future sustainability is dependent—taking into account factors such as need, sustainability impact, and current market incentives and barriers. The federal government should provide some support to catalyze the formation of sustainability innovation consortia to tackle commercial development of these technologies.
- Academic institutions should prepare all graduating engineers and business students to be literate in systems thinking and the issues of sustainability, as well as prepared with relevant tools to promote environmental responsibility.
- The private sector needs to develop metrics that gauge long-term value across industries to direct capital toward high-performing firms on track to meet sustainability goals.[3]
- Congress should institute incentives for private investment and development of sustainable technologies. Modeled after the Orphan Drug Act, this could include instituting a designation process for sustainable and green technologies and offering a range of incentives for developing technologies that receive such a designation.

1 Testimony of Lonnie R. Stephenson, International President, IBEW. "Building a 100 Percent Clean Economy: Opportunities for an Equitable, Low-Carbon Recovery" before the Subcommittee on Environment and Climate Change, House Committee on Energy and Commerce, U.S. House of Representatives, September 16, 2020.

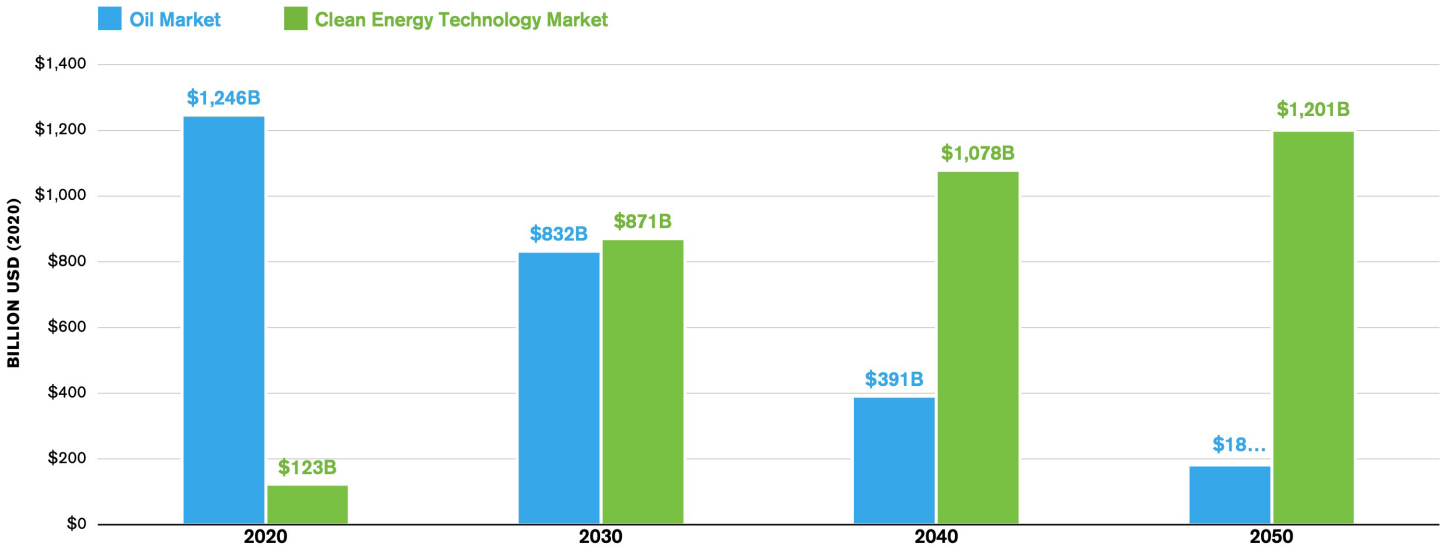
2 UN (2019), "Goal 12: Ensure sustainable consumption and production patterns."

3 Council & Lockheed Martin, *Competing in the Next Economy* 2021 webinar series.

4 IPCC (2022) "IPCC Press Release: Working Group 3."

**Figure 1. Estimated Global Market Sizes of Oil and Selected Clean Energy Technology Equipment in Net Zero Scenario, 2020–2050**

Source: IEA (2021), *World Energy Outlook 2021: Executive Summary*.




in order to achieve these climate goals.[5] Many current models for GHG reduction assume clean energy technology cost declines that will be impossible without sustained and rapid innovation.[6] To reach global climate goals and avert extreme climate impacts, innovation needs to be accelerated and scaled in essential clean energy technologies, including but not limited to:

- Industrial Carbon Capture, Utilization, and Storage (CCUS)
- Zero Carbon / Green Hydrogen and Ammonia Production & Advanced, Low-Emissions Hydrogen Combustion Technology
- Grid-Scale Storage
- Advanced Nuclear & Fusion
- High-Efficiency, Low-Impact Electrical Transmission Technology
- Geothermal Energy

Throughout 2022 and 2023, this Future of Sustainability Working Group will identify and develop recommendations to ensure that the United States continues to invent, commercialize, and manufacture at scale the materials, fuels, machines, and systems that will drive the clean energy transformation. Specifically, the group will explore ways to boost investment in critical technologies, design infrastructure necessary for widespread clean energy use, and develop a supportive domestic and international ecosystem for production and deployment.

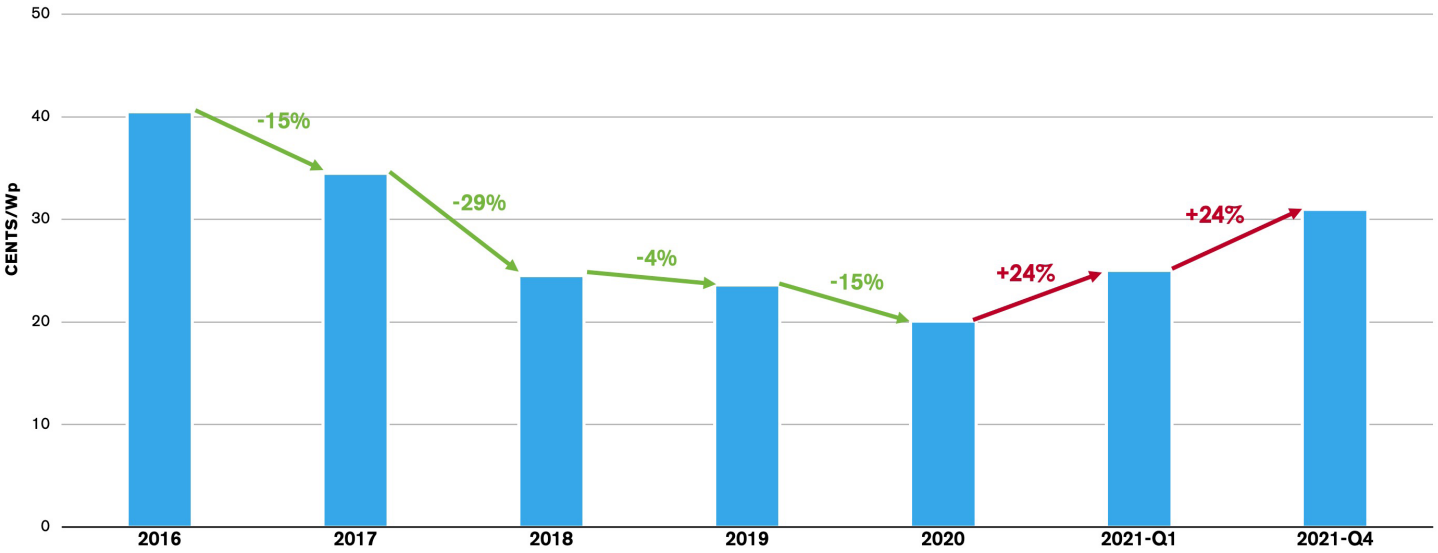
The United States cannot afford to fall behind in clean energy technology. The environmental and social stakes are too high, and the economic reward is too great. In the IEA's net-zero scenario, the size of the global market for clean energy technology will rise from $123 billion to $871 billion by 2030, surpassing the value of the global oil market.[7] Investments in clean energy innovation will position the United States as a leader in this field and increase U.S. economic security and competitiveness for decades to come.

5 McKinsey (2022), *The net-zero transition: What it would cost, what it could bring.*.

6 ITIF (2022), "Continued Innovation in Renewable Energy Is Not a Given: Public Policy Must Push and Pull."

7 IEA (2021) *World Energy Outlook 2021: Executive Summary*.

**Figure 2. Solar PV Module and Shipping Cost, 2016–2021**
Source: Rystad Energy (2021), "Most of 2022's solar PV projects risk delay or cancelation due to soaring material and shipping costs."




## Recent Developments

The COVID-19 pandemic and the war in Ukraine have combined to significantly disrupt global energy markets. Oil markets, in particular, have been thrown into turmoil by supply shocks from the ongoing reconfiguring of global trade networks. The United States is taking active steps to lessen its reliance on unpredictable and often hostile foreign regimes for fossil fuels. For example, the United States recently banned Russian oil, natural gas, and coal in the wake of violence in Europe, and positioned clean energy as a long-term replacement.[8] At the same time, the nation must ensure it does not develop similar dependencies for critical minerals that feed production of clean energy technologies and thereby threaten the resiliency of the U.S. clean energy innovation pipeline.

Ongoing supply chain disruptions have contributed to skyrocketing inflation, which could further hamper clean energy tech innovation as many products and technologies rely upon materials like silicon and copper with surging prices. For example, the price of solar panels increased by more than 50 percent in 2021, and battery prices are increasing for the first time in more than a decade.[9] The advent of higher interest rates intended to tame inflation may also increase the cost of innovative clean technology projects, thereby hampering investment. Higher interest rates increase the cost of loans for borrowers, a dynamic which may uniquely harm the clean energy industry due to its heavy dependence on large loans to finance the major costs of transitioning from fossil fuels and building new projects.[10]

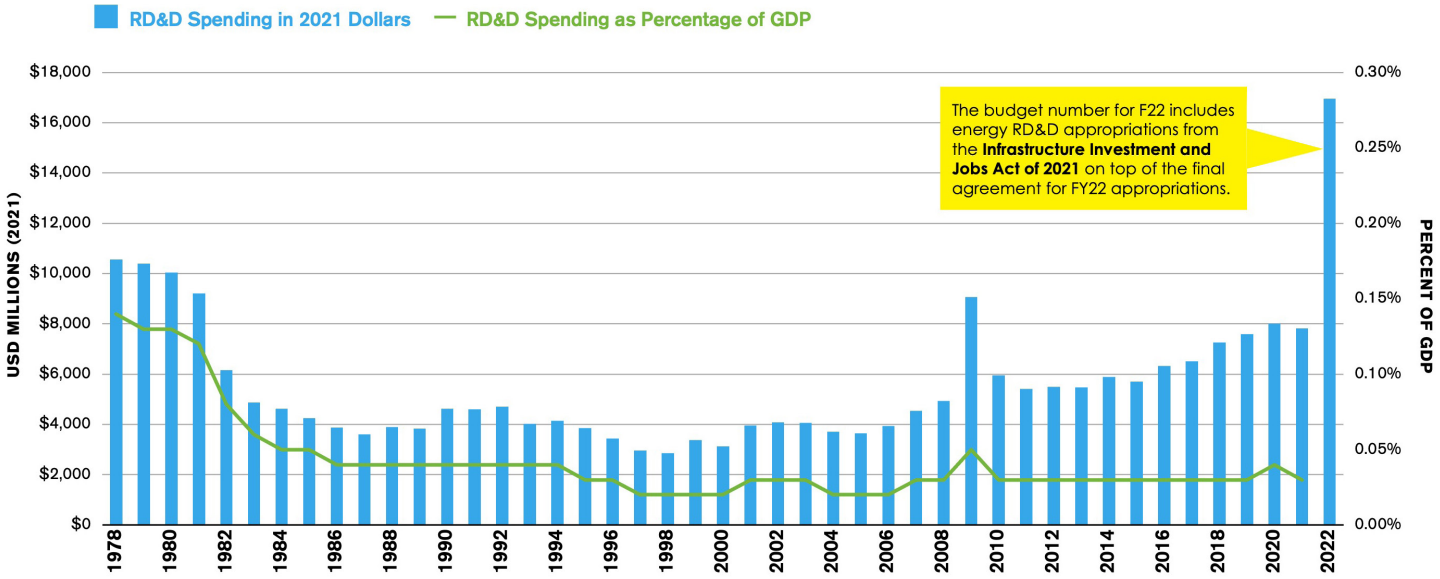
Supply chain disruptions, historic inflation, rising interest rates, and a polarized political environment have complicated the Biden Administration's plans to transition to clean energy. In the short term, higher prices of inputs for clean energy and widespread uncertainty have increased pressure to use more conventional energy sources. In the longer term, higher oil prices may encourage production of alternative energy sources as they grow cheaper by comparison. The United States must develop forward-looking policies to support near-term energy resilience while establishing a supportive ecosystem

8 White House (2022), "United States Bans Imports of Russian Oil, Liquefied Natural Gas, and Coal."

9 Bloomberg (2021), "Global Inflation Ends Era of Ever-Cheaper Clean Energy."

10 E&E News (2022), "Clean energy faces its latest test: Rising interest rates."

**Figure 3. Total DOE Energy RD&D Spending, 1978–2022**
Source: ITIF (2022), *Further Energizing Innovation in Fiscal Year 2023*.




for innovation and competition in clean energy technologies of the future. If the nation waits to invest until these crises are over, precious time will be lost and the challenge will be even greater.

**To achieve net-zero emissions by mid-century, the United States will need to: (1) generate electricity by carbon net-zero sources, (2) electrify as many industries and processes as possible, (3) upgrade energy infrastructure to efficiently store and transfer renewable generation with minimal loss, and (4) address emissions from processes that cannot be electrified through cleaner combustion sources and carbon capture, utilization, and storage (CCUS) efforts.**

To accomplish these goals, the nation must develop and deploy critical clean energy technologies without delay, a transition which will require public policies that drive unprecedented investment and innovation. If successful, the United States has an opportunity to decouple its energy demand from its economic and national security. This is also a unique moment for global leadership—as the United States develops the clean energy technologies that make ambitious climate targets achievable, it can export these technologies to other nations. The United States can demonstrate a model for decoupling economic growth from GHG emissions, positioning itself at the forefront of the global clean energy revolution and leading the world to a healthier, more sustainable future.

## Key Issues + Discussion Questions

To accelerate innovation in clean energy technologies, the United States must address several key issues, including but not limited to the issues identified below. These issues are intended to serve as a jumping-off point for discussion among working group members this summer.

- **Issue 1:** Boosting investment in development and deployment of promising clean energy technologies
- **Issue 2:** Modernizing the U.S. power grid to enable the clean energy transition
- **Issue 3:** Establishing a supportive domestic policy ecosystem to foster clean energy innovation
- **Issue 4:** Engaging proactively on the international stage to address trade issues and reinforce global competitiveness in clean energy

### Issue 1: Boosting investment in development and deployment of promising clean energy technologies

Despite recent increases in federal investment in research and development of clean energy technologies, more will be needed to meet the climate challenge. In 2020, the United States ranked 13th among IEA member nations in terms of investment in public energy RD&D as a share of GDP.[11] The Biden administration has since taken steps to ramp up investments in clean energy RD&D. For example, the administration's FY 2023 budget of $11.9 billion represents a 32 percent increase over FY 2021 funding.[12] However, this funding level still falls short of the estimated $20 billion in annual investments that the United States needs to make to achieve its climate goals, according to the Center for Climate and Energy Solutions (C2ES) report *Getting to Zero*.[13]

Increased early-stage R&D investment will only drive progress if the funded breakthroughs result in commercially viable and scalable clean energy technologies. Much like other disruptive technologies, new clean energy technologies face several barriers along the "lab-to-market" pipeline, including technology transfer gaps and insufficient resources for "de-risking" immature technologies. The United States has relied on China to develop, demonstrate, and de-risk advancements in several clean energy technologies. In turn, China has learned and profited from these innovations. For instance, joint ventures with U.S. solar companies enabled China to access key technologies and value chains and helped support their global dominance in the solar photovoltaic industry.[14] The United States must overcome domestic barriers to commercialization and deployment to be competitive in the growing clean energy industry.

#### Potential questions for this working group to consider include:

- What key areas of R&D in clean energy technology remain unaddressed or underfunded by the Biden budget, the infrastructure bill, USICA/America COMPETES, and other recent reinvestments?
- Are any particular clean energy technologies serially underinvested in R&D? Where could the United States stand to gain the most from targeted investments?
- Should the United States establish a federal "green bank" or similar central financing authority to support demonstration and scaling of promising clean energy technologies?
- How can the lab-to-market pipeline for clean energy technologies be supported, reconfigured, or streamlined to accelerate commercialization of major discoveries?

### Issue 2: Modernizing the U.S. power grid to enable the clean energy transition

Major upgrades are needed across America's energy infrastructure to effectively store and transmit energy from renewable sources. The Biden administration has taken steps to invest in expanding and fortifying the grid, including roughly $15 billion of spending in the Bipartisan Infrastructure Law. However, Princeton's *Net-Zero America* report finds that enabling the renewable energy growth needed to decarbonize the grid by 2035 will require $360 billion in investments by 2030.[15] Grid improvements are particularly critical for transmission and distribution networks, as outdated networks can cause congestion and hinder output from clean energy sources. This reduces the financial viability of prospective projects and, in turn, reduces the appeal for investment in clean tech deployment.[16] The United States should proactively

11 IEA (2021), *Energy Technology RD&D Budgets: Overview*.

12 White House (2022), "The Biden-Harris Administration FY 2023 Budget Makes Historic Investments in Science and Technology."

13 C2ES (2019), Getting to Zero: A U.S. Climate Agenda.

14 IEA (2022), Tracking Clean Energy Innovation: Focus on China.

15 Princeton University (2020), Net-Zero America.

16 WEF (2020), "Why transmission and distribution are the clean energy transition's secret weapons."

address these shortcomings in the power grid by funding and accelerating permits for flexible energy infrastructure that support integration of clean energy technologies.

Modernizing the power grid to support the clean energy transition will also involve development and integration of "smart grid" capabilities. These capabilities, supported by the convergence of advancements in IoT technologies and AI-powered analytics, enable two-way electricity flows and real-time automated decision-making to re-route power around potential disruptions, reduce peak loads, and boost overall grid reliability and resiliency. The United States must take steps to accelerate innovation in these underlying technologies and support their continued integration into the nation's energy infrastructure.

**Potential questions for this working group to consider include:**

- What shortcomings or vulnerabilities exist in the current U.S. power grid which must be addressed to support the clean energy transition?
- How can the public and private sectors collaborate to support grid modernization? Where would investments stretch the furthest?
- What innovations in "smart grid" capabilities show the most promise, and how can innovation in these areas be unlocked?

### Issue 3: Establishing a supportive domestic policy ecosystem to foster clean energy innovation

Private sector investment in development of promising clean energy technologies can be limited by weak or imprecise market signals that undervalue long-term gains from emissions reductions. The U.S. government should respond by using various policy levers to strengthen market signals and incentivize private sector development and deployment of clean energy technologies. Policy options include administering targeted tax credits, establishing patent extension programs, and setting clean electricity standards, and/or carbon pricing to support the flow of capital.

> "The role of government is to create revenue streams or demand signals or even mandates that open up the markets so that the money comes in…If there's a revenue stream, then the funding is infinite."[16]
>
> **Brian Moynihan**
> CEO
> Bank of America

Clean energy innovation requires expertise in many disciplines and across numerous sectors. Policy support for increased collaboration among universities, industry, national labs, and other stakeholders will be crucial for leveraging clean energy discoveries and smoothing the lab-to-market journey. Government-funded cross-disciplinary consortia could be a key component in coordinating efforts from researchers, innovators, investors, and policymakers.

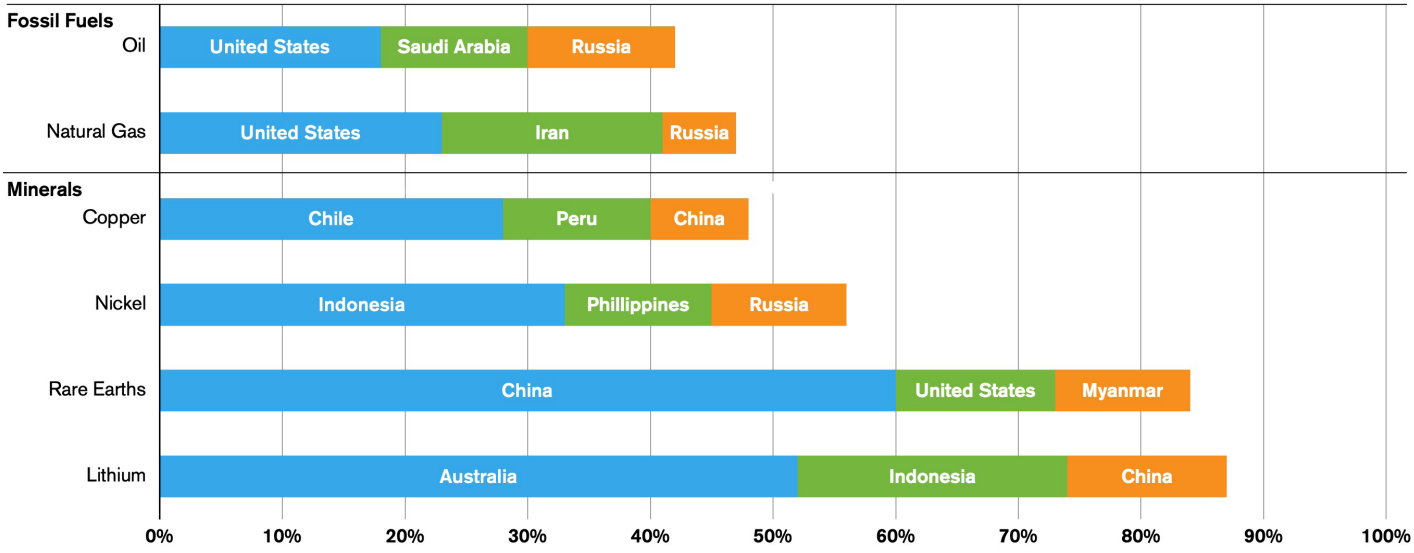
**Potential questions for this working group to consider include:**

- What specific policy levers would be most effective for ramping up development and deployment of clean energy tech?
- In what areas of clean energy technology innovation are market signals currently the weakest, and how can the surrounding policy environment be improved to drive investment in these critical areas?
- What steps need to be taken to encourage the robust and continued investment of venture capital into clean energy technologies?
- Should any new programs or federal bodies be established to coordinate cross-sectoral efforts and support private sector innovation?

17 *The Wall Street Journal*, "Why Financing the Multi-Trillion-Dollar Transition to Net Zero Isn't That Hard."

**Figure 4. Share of Top Three Producing Countries in Extraction of Selected Minerals and Fossil Fuels, 2019**

Source: IEA (2021), "Share of top three producing countries in extraction of selected minerals and fossil fuels, 2019."




**Issue 4: Engaging proactively on the international stage to address trade issues and reinforce global competitiveness in clean energy**

The pandemic and war in Ukraine have revealed vulnerabilities in U.S. energy security. However, they have also accelerated efforts to reduce dependency on unreliable and potentially hostile foreign powers for traditional fuel sources, such as oil and gas, and invigorated the push towards domestic production of clean energy. This shift must be handled thoughtfully and incrementally to avoid trading one set of dependencies in global markets for another, as the United States currently relies on Russia and China for many of the raw materials necessary for clean energy technologies. Several ongoing efforts aim to support continued supply of these key inputs. The Bipartisan Infrastructure Law invested $600 million to develop alternatives to critical materials and to promote their efficient production and use. Meanwhile, the Biden Administration has enacted the Defense Production Act to fund viability studies into domestic production of critical minerals. Effectively

combating these vulnerabilities will require continued engagement and action on both the international and domestic stage.[18,19]

International trade and competition in the clean energy arena can power the global transition towards a net-zero future by increasing the number of game-changing technologies and reducing renewable energy costs worldwide. However, outdated international trade agreements are often misaligned with climate considerations and impede this global transition.[20] Expanded U.S. leadership and collaboration with allies such as the WTO could help to level the playing field for global trade and competition in clean energy technologies. Additionally, increasing exports of these technologies to allies in the EU and other regions could bolster the U.S. clean energy industry while assisting other countries to meet their climate targets.

**Potential questions for this working group to consider include:**

- What can policymakers, the private sector, and other stakeholders do to boost resiliency of supply chains that underpin clean energy technologies?
- How should near-term steps to bolster energy security be balanced with long-term climate objectives?
- What steps can the United States take in international forums and trade organizations to support domestic and global clean energy innovation (e.g., WTO green "exemption")?

18 NY Times (2022), "Biden Invokes Cold War Statute to Boost Critical Mineral Supply."

19 Department of Energy (2021), "Critical Material Innovation, Efficiency, And Alternatives."

20 Capital Monitor (2021), "How outdated trade agreements are undermining climate progress."

# Working Group 2

# **The Future of Technology:** Developing and Deploying Disruptive Technologies at Scale

"The industries of the future—AI, machine learning, 5G, quantum information sciences, advanced manufacturing—these are all areas where we have to continue to be globally competitive in order to ensure that we continue to extend and deepen American prosperity."

**Dr. Thomas Zacharia**
Director
Oak Ridge National Laboratory (ORNL)

## Overview

Disruptive technologies that will reshape society and the global economy are actively being developed and deployed at a rapid pace. These technologies—and the products and services they enable—will transform how people work, live, learn, interact, and experience the world around us. Each of these technologies is groundbreaking on its own. For example, it is estimated that artificial intelligence (AI) systems alone could contribute almost $16 trillion to global GDP by 2030, making AI the largest commercial opportunity in the next economy.[1] However, the ongoing convergence between these numerous disruptive technologies is what will fundamentally revolutionize entire industries and create new competitive advantages for nations that are able to lead the way.

In the 2020 report, *Competing in the Next Economy*, the Commission identified ten critical technologies with the greatest potential to create economic and societal value over the coming decades:

- Advanced Computing
- Microelectronics
- Biotechnology
- Nanotechnology
- Quantum
- Artificial Intelligence
- Autonomous Systems
- Industrialization of Space
- Advanced Aerospace
- Advanced Manufacturing

The Developing and Deploying Disruptive Tech at Scale Working Group will be responsible for building recommendations for how the United States can best harness these technologies and their convergence to expand its global competitiveness in industries of the future. Specifically, the working group

### Key Recommendations from *Competing in the Next Economy* and National Commission Phase 1

- While recognizing that the laboratory system must continue to be mission-driven, the United States should take steps necessary to enhance the contribution the Department of Energy's national laboratories can make to advancing U.S. innovation and competitiveness by adding and integrating this role into their mission.
- The federal government should take steps to expand access to the nation's network of shared research resources and equipment for high-risk, early stage innovation-driven enterprises. Create a federal policy or funding pool to offset the costs of accessing federally-funded research equipment for non-lab affiliated entrepreneurs working on research and development for early stage companies.
- Federal and state governments, and regional partnerships should invest in the infrastructure needed to grow a 21st century economy, such as the development of medical and scientific research parks, laboratories, and incubators, and ensure they are supported by advanced digital infrastructure and platforms.
- With funds from an expanded public investment in R&D, the federal government should co-fund with industry several pilot at-scale initiatives to demonstrate new models of application-oriented R&D efforts. These should be selected based on a rigorous competition taking into account industry commitment, technical capability and capacity, opportunity landscape and potential for economic impact, and adequacy of supporting ecosystem elements.

1 PwC (2017), Sizing the Prize: What's the real value of AI for your business and how can you capitalize?

will not only focus on how to continue to drive homegrown innovations in these areas, but also how to ensure that a domestic ecosystem is in place to go from "lab to market" and deploy critical technologies at scale with minimum dependency on nations who do not share U.S. values—or in strategic partnership with those who do.

## Recent Developments

Since the December 2020 release of *Competing in the Next Economy*, several global developments have had a significant impact on the innovation landscape and increased the urgency for the Commission to further explore this vital issue area. For instance, the pandemic has greatly accelerated the pace of digital transformation, driving rapid innovation in and deployment of critical emerging technologies. As these technologies are increasingly used in combination with each other, traditional boundaries between industries are blurring even more and cross-disciplinary collaboration across formerly siloed science and technology fields is growing more important.

Meanwhile, supply chain disruptions, driven by both the pandemic and the war in Ukraine, have led to shortages of essential components—most prominently in advanced microelectronics and semiconductors, which underpin the development and deployment of a wide range of cutting-edge technologies. These global disruptions have revealed the need for expanded domestic production capabilities where possible, the cultivation of strategic partnerships when needed, and the pursuit of innovations which better shield us from vulnerabilities associated with reliance on foreign suppliers, especially those hostile to U.S. interests.

The war in Ukraine has also escalated geopolitical tensions and accelerated a widespread reconfiguration of long-standing trade and financial relationships. The difficulties imposed by this global transition have underscored the need for the United States to assume a proactive, forward-looking approach to U.S. technology statecraft on the world stage. The United States must set the pace and the standard in the global market by not only continuing to innovate but also collaborating with like-minded nations to ensure that U.S. technologies are adopted and embraced around the world. U.S. leadership must also employ a coordinated approach to supporting the domestic innovation economy by sustaining investments in both basic and applied R&D and working to address consistent barriers to commercialization that cut across emerging technologies.

Finally, the nation continues to face growing competition from other countries in each of these emerging technology areas. The fiercest competitor is China, who is reaping the benefits of decades of heightened R&D investment, absorption and theft of foreign technologies and IP, and expanded geopolitical engagement. Falling behind strategic competitors like China in the global innovation race would severely undermine U.S. competitiveness for decades—perhaps permanently. This growing threat has underscored the need to supercharge the development and deployment of disruptive tech at scale—fortifying the United States' position as an innovation superpower and sustaining its economic and national security for decades to come.

## Key Issues + Discussion Questions

To maintain its leadership role in the development and deployment of critical technologies, the United States must address several key issues. They include but are not limited to the issues identified below, which will provide a jumping-off-point for discussion among working group members this summer.

- **Issue 1:** Sustaining and properly allocating investments in R&D while removing barriers to commercialization of disruptive technologies
- **Issue 2:** Reinforcing U.S. innovation leadership through national domestic strategies and international technology statecraft
- **Issue 3:** Bolstering the security, resiliency, and reliability of critical supply chains
- **Issue 4:** Leveraging cross-disciplinary partnerships to harness the convergence of disruptive technologies

**Issue 1: Sustaining and properly allocating investments in R&D while removing barriers to commercialization of disruptive technologies**

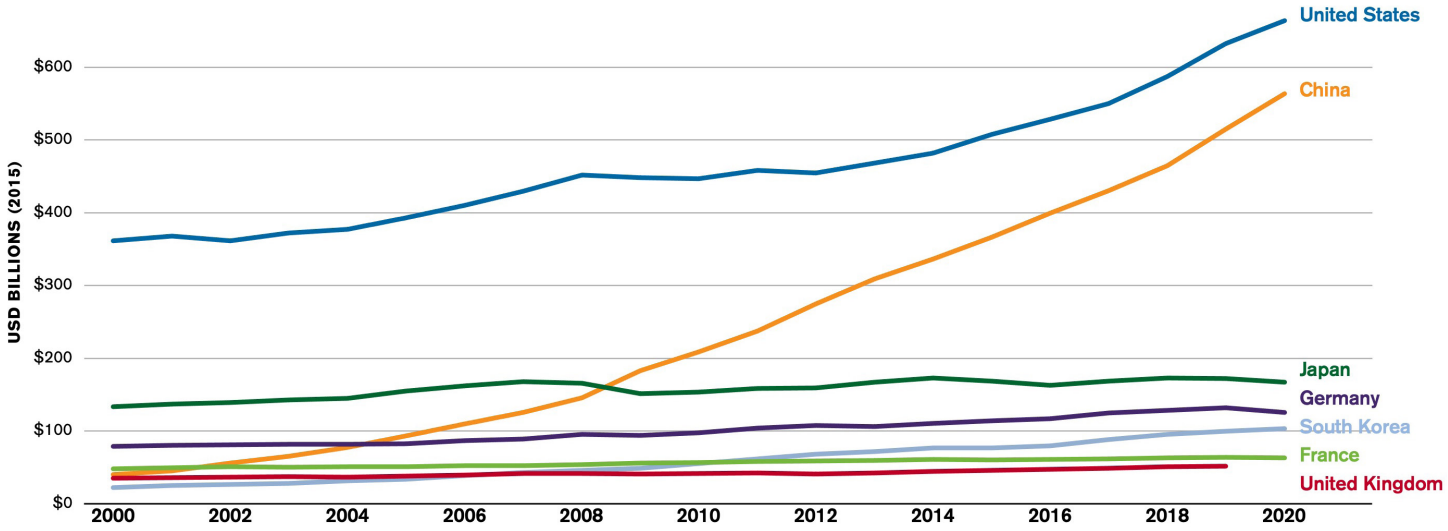
The United States has historically been the global leader in R&D investment, but other countries have steadily gained ground over recent decades and begun to threaten U.S. science and technology leadership.[2] The Biden administration has prioritized reinvestment in R&D in its first term, with major R&D provisions present in the federal budget, the bipartisan infrastructure law, and the separate House and Senate innovation competitiveness bills.[3] However, these investments must be optimally allocated to areas of highest need and sustained across administrations to address long-term challenges in the U.S. innovation ecosystem.

Investments in early-stage R&D only go so far when the discoveries they support stop short of commercial uptake and thus never materialize into products and services in the marketplace. This persistent gap, or "valley of death," between basic research and

"If you let go of production, that means that you are de-skilling the workforce, and it eventually brings you to the place where you can't do design either. It's a really kind of insidious cycle that needs to be broken…So, all these things—design, production, assembly, packaging and testing—…we all need to have them here at home."[4]

**Victoria Coleman**
Chief Scientist
United States Air Forc

**Figure 1. Gross Domestic Expenditures on R&D, 2000–2020**
Source: OECD (2022), "Gross domestic spending on R&D."




2 Congressional Research Service (2021), *The Global Research and Development Landscape and Implications for the Department of Defense*.

3 White House Press Release (2022), "The Biden-Harris Administration FY 2023 Budget Makes Historic Investments in Science and Technology."

technology commercialization is a major impediment to deploying disruptive technology at scale, hindering the realization of benefits promised by these underlying discoveries. Oftentimes, innovative ideas and designs that are conceived in the United States lack the resources and surrounding production infrastructure to be demonstrated and de-risked here at home, leaving a gap for competitor countries such as China to prove out U.S. innovations and reap the rewards. For example, despite U.S. leadership in early-stage research for microelectronics, domestic demonstration and scaling facilities are insufficient, forcing innovators to turn to fabrication plants in Asia to realize their advancements.[4] To fully leverage American innovative potential, existing barriers to commercialization must be removed and stakeholders must ensure that investments in R&D stretch along the innovation pipeline to support the testing, demonstration, technology transfer, and eventual commercial applications of major breakthroughs.

### Potential questions for this working group to consider include:

- What key areas of R&D in critical technologies remain unaddressed or underfunded by the Biden budget, the infrastructure bill, USICA/America COMPETES, and other recent reinvestments?
- Are any particular disruptive technologies serially underinvested in R&D? Where could the United States stand to gain the most from targeted investments?
- In what ways could the current lab-to-market system be optimized to accelerate commercialization of disruptive technologies? How can the demonstration and scaling of key technologies be supported here at home rather than outsourcing those capabilities?
- How can the United States foster public-private collaboration and partnerships to better facilitate technology development, commercialization, and deployment?
- What new programs or mechanisms could be developed and applied to the innovation pipeline to bridge the gap between early-stage R&D and commercial applications?
- Have the Manufacturing USA institutes served as an effective model for facilitating technology development and deployment? How could this model be enhanced, expanded, or reconfigured?

### Issue 2: Reinforcing U.S. innovation leadership through national domestic strategies and international technology statecraft

The United States currently lacks a cohesive national strategy or dedicated federal body for advancing U.S. innovation and competitiveness. This has resulted in numerous agencies and Congressional committees working independently to address cross-jurisdictional innovation challenges, leading to disjointed efforts at collaboration with industry and academia. To fully unlock its domestic innovation capacity, the U.S. government must coordinate its efforts to assess evolving trends in critical technologies and bolster private sector innovation activity through increased partnership, incentives, and policy support.

Domestic innovation leadership must be coupled with increased engagement on the international stage. Global standards, guidelines, and norms are still in flux for many of these emerging technologies. China and the EU are jockeying for influence in determining the de facto rules of the road on issues such as digital trade and next-generation telecommunications.[5] **Proactive U.S. engagement in standards-setting bodies and global trade and technology will be crucial for leveling the playing field for competition in industries of the future.** Optimal U.S. technology statecraft should be a two-way street. The nation must excel at scanning, identifying, and incorporating innovative ideas and best practices that are developed outside U.S. borders. At the same time, the United States should lead global dialogues and aggressively promote the adoption of U.S. technologies and standards abroad.

4 Department of Defense (2022), "DOD Aims to Close Gap in Bringing U.S. Tech Innovation to Market."

5 Reuters (2021), "European business says technical standards 'new battleground' for China, rest of world."

### Potential questions for this working group to consider include:

- How can the United States leverage or reconfigure existing governance structures to create a coordinated national approach to innovation competitiveness?
- Where and how should the United States ramp up its engagement in global dialogues and standards-setting bodies?
- How should the United States calibrate export controls to promote national security concerns without hampering innovation and competitiveness in key technologies?
- What steps can be taken to better protect U.S. IP integral to critical technology from theft by malicious actors?

**Issue 3: Bolstering the security, resiliency, and reliability of critical supply chains**

The pandemic and geopolitical tensions have disrupted supply chains that support development and deployment of critical technologies. These disruptions have exposed vulnerabilities in sectors vital to national security and competitiveness. The White House notes that offshoring and disruptions of supply chains have led to reduced innovative capacity in four key sectors: semiconductors, large capacity batteries, critical minerals and materials, and Pharmaceuticals.[6] These ongoing shortages have perhaps been most pronounced for semiconductors, where disruptions have threatened production lines for some of America's largest tech firms—including Apple, Google, and Qualcomm—who rely on foreign manufacturers for the majority of their chips.[7]

**Last October, for the first time ever, global CEOs identified supply chain disruptions as the greatest risk to growth for their company and their countries' economies.**[8] This continued turbulence has underscored the need for the United States to renew its efforts to secure essential supply chains that undergird its innovation ecosystem. The security and resiliency of supply chains must be bolstered, where possible, and innovations must be made around vulnerabilities in cases where existing networks cannot be readily adjusted. These efforts will require a variety of tactics—including potential repatriation, increased redundancies, and application of emerging tech capabilities—and will vary across technology areas. By capitalizing on new momentum and opportunities, innovators may obviate these critical supply chain vulnerabilities and create new efficiencies.

### Potential questions for this working group to consider include:

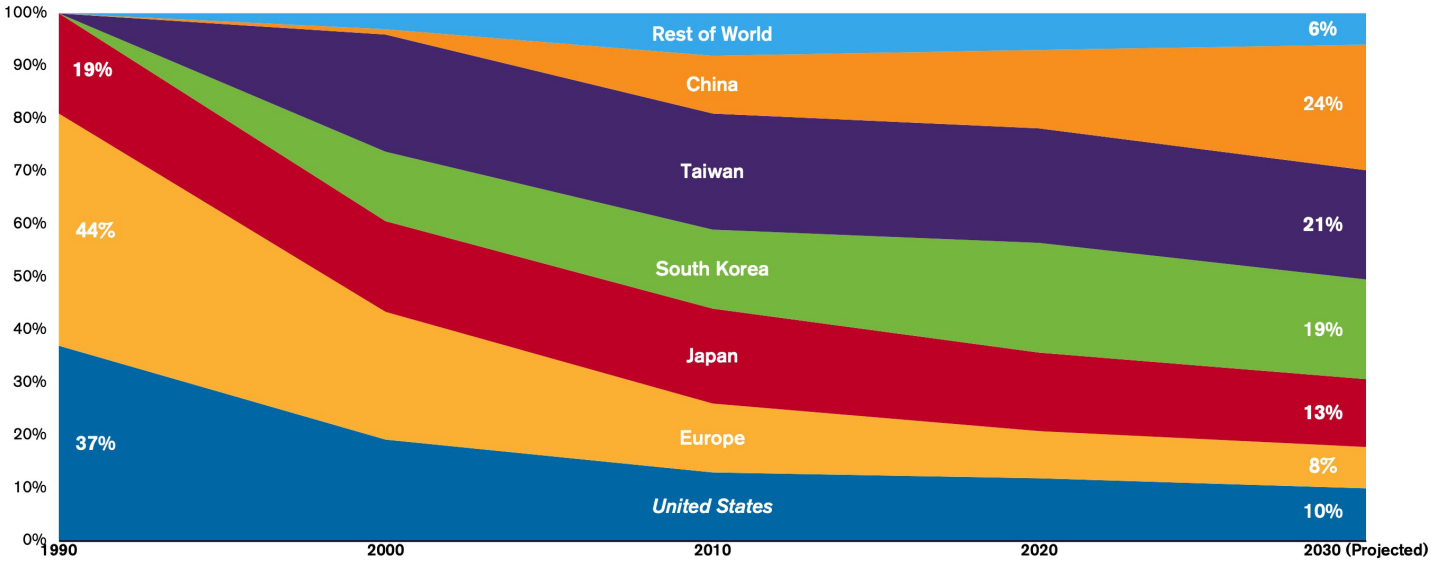
- What disruptive technologies are most at risk from ongoing supply chain challenges?
- How do the implications of supply chain challenges, and the solutions required to confront them, differ from technology to technology?
- What can policymakers, the private sector, and other stakeholders do to boost resiliency of supply chains that underpin key disruptive technologies?
- In what areas can innovation act as a solution to reduce vulnerabilities and/or avert supply chain challenges?

6 White House Report (2021), Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth.

7 Center for Strategic & International Studies (2022), "Taiwan's Semiconductor Dominance: Implications for Cross-Strait Relations and the Prospect of Forceful Unification."

8 McKinsey & Company (2022), "The coronavirus effect on global economic sentiment."

**Figure 2. Global Share of Semiconductor Manufacturing Capacity by Location, 1990–2030**
Source: Boston Consulting Group and Semiconductor Industry Association (2020), *Government Incentives and US Competitiveness in Semiconductor Manufacturing*.




### Issue 4: Leveraging cross-disciplinary partnerships to harness the convergence of disruptive technologies

The convergence of disruptive technologies is reshaping traditional industries, creating new industries, and altering the global competitive landscape. For instance, the convergence of AI, 3D printing, and Internet of Things (IoT) technologies is being harnessed to create self-organizing manufacturing centers and fully unmanned production lines.[9] A recent survey found that 95 percent of businesses believe convergence is already impacting their industry.[10]

This convergence is melding together formerly siloed disciplines and creating a new suite of multi-disciplinary academic fields, professional specializations, and entire industries. The emerging autonomous vehicle (AV) industry is a prime example of such col-

9 MarshMcLennan (2021) *Harnessing technology convergence: Lessons from smart manufacturers*.

10 Altimeter (2021), Understanding Convergence: The Next Wave of Digital Transformation.

laboration, as the traditional auto industry has integrated with technology companies to utilize converging AI and IoT capabilities, transforming automobiles from a simple vehicle to a connective, self-driving computer. This new type of multifaceted collaboration will be necessary to harmonize complementary advancements in various fields and confront complex global innovation challenges. The United States must expand its support for partnerships and programs that nurture cross-disciplinary and cross-sectoral collaboration to capitalize on this unprecedented opportunity.

### Potential questions for this working group to consider include:

- Does the United States need to create any new federal programs/initiatives or strengthen particular federal interagency collaborations to support a cross-disciplinary innovation environment?
- Are new models needed for how key agencies seek to fund or incentivize downstream cross-disciplinary research and collaboration?
- How can the private sector best partner with academia, national labs, federal agencies, etc. to foster cross-sectoral approaches to innovation?
- Does any particular convergence of distinct disruptive technologies (e.g., AI, advanced computing, and biotech) merit a unique cross-disciplinary research approach or program at the federal level?

"The nature of innovation itself has changed. It is dramatically more interconnected, more turbulent, and more transformative, driven by the convergence of the digital, genetic, and cognitive revolutions."

**The Honorable Deborah L. Wince-Smith**
President & CEO
Council on Competitiveness

# Working Group 3

# **The Future of Work:** Developing, Supporting, and Expanding the Modern Innovation Workforce

"How do we create an opportunity across all organizations, across a person's entire life to be engaged in the opportunity for universal learning? That will require all organizations to rethink themselves."[1]

**Dr. Michael M. Crow**
President, Arizona State University, and National Commissioner

## Overview

Talent is the engine of the U.S. innovation economy. A diverse, skilled, equipped, and empowered workforce is the critical ingredient to maintaining the United States' pole position in the global race to innovate and compete. World-class talent in science, technology, engineering, mathematics, finance, management, and a wide range of other fields are necessary to consistently bring innovative products, services, and businesses to fruition, whether it is cultivating a new idea, developing a prototype, demonstrating its viability, producing it at scale, bringing it to market, or maximizing its commercial potential.

U.S. workers are caught up in a turbulent economy shaped by globalization, shifts in economic drivers, hyper global competition to perform the world's work, and rapid technological change. The economy is now driven by ideas, information, and the constant application of new technology, raising the demand for workers with greater knowledge and skills. New technologies make entirely new forms of work possible—work without humans, work in which humans and technologies form teams, work performed in remote locations and, potentially, entirely novel forms of work organization. The United States must find ways to support workers and bring them along through this period of intense, even unprecedented creative destruction in order to maintain global leadership in industries and jobs of the future.

The National Commission on Innovation and Competitiveness Frontiers began to address several of these important issues in developing the 2020 report, *Competing in the Next Economy*. Key recommendations stemming from these efforts included increasing funding for federal workforce development programs, embedding innovation-based curriculum into K-12 education, and broadening the "innovator mindset" beyond technical careers to all fields and industries.

**Key Recommendations from *Competing in the Next Economy* and National Commission Phase 1**

- Triple funding for successful workforce development efforts supported by the U.S. Department of Energy—such as fellowships, career awards, and energy workforce development—and consider scaling best practices and programs to other agencies.
- The education community, supported by government at all levels, should ensure that every student has the opportunity to experience invention and innovation throughout Pre-K-12 and higher education, and interested individuals have accessible pathways to develop their skills and ideas.
- Those leaders and experts involved in innovation-related activities should remove the perception that innovation is limited only to careers in science, engineering, or in "high-technology" companies—and support efforts such as the "Science Is US" campaign in which the Council on Competitiveness is a key leader along with nine other major, national organizations at the forefront of STEM advocacy.
- Create more inclusive paths to support women, underrepresented minorities, and first-time entrepreneurs. Activities should be carried out with a clear equity agenda, focused on underserved geographic areas of the country and populations underrepresented in STEM disciplines, the science and technology ecosystem, and its innovators.

1 National Competitiveness Forum, 2021.

In this next phase of the Commission, the Future of Work Working Group will be responsible for developing recommendations for how the United States can best overcome the challenges and seize the opportunities associated with creating the workforce of the future. Specifically, the working group will explore the nation's options for leveling-up the workforce, including but not limited to creating new models of universal and lifelong learning and skilling, smoothing the economy's reorganization around new ways of working, and expanding efforts to build a more diverse and inclusive innovation-based workforce.

## Recent Developments

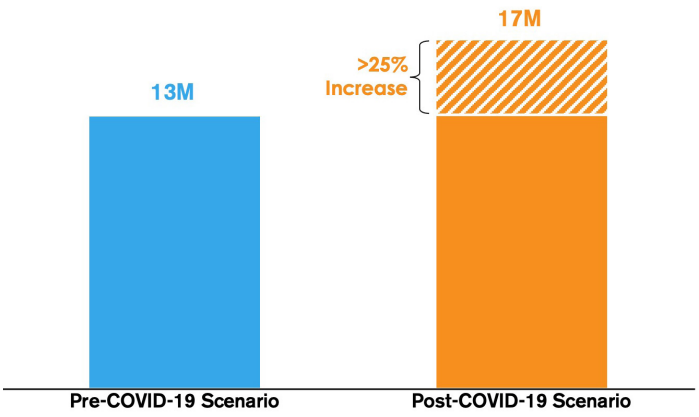
Since the 2020 release of the *Competing in the Next Economy* report, the nature of work, workplaces, and workforces has continued to change dramatically.

Even before the pandemic, the future of work was a topic of intense debate, as disruptive technologies such as automation, artificial intelligence, and advanced robotics were beginning to find their foothold. Since the start of the pandemic, however, those trends have only accelerated. For instance, McKinsey projects that the share of the workforce that may need to transition to jobs in entirely new occupations by 2030 has increased by roughly 25 percent from pre-pandemic estimates to post-pandemic estimates.[2] Meanwhile, two-thirds of senior executives said that they were increasing investments in automation and AI in 2020.[3] Due to the accelerated pace of change over the past two years, many of the workforce-related challenges that were once viewed as "over the horizon" are now firmly at the front door.

Numerous additional labor force trends have been created or accelerated by the pandemic. Expanded telework capabilities have transformed where and when work takes place, with 34.5 percent of business establishments having increased telework for

**Figure 1. Number of U.S. Workers that May Need to Transition to Jobs in New Occupations by 2030, Pre-and-Post-COVID-19 Scenarios**

Source: McKinsey Global Institute (2021), *The future of work after COVID-19*.




some or all their employees due to the pandemic.[4] Since the pandemic began, 28 percent of workers have seriously considered moving to a new community.[5] Meanwhile, workers are increasingly looking to change jobs or enter new career paths. In a survey taken during the height of the pandemic, 66 percent of unemployed adults seriously considered changing their occupation or field of work.[6] Widespread redistribution of labor away from low-wage service jobs has led to persistent worker shortages in sectors such as food service and hospitality.[7] In March 2022, job quits reached a record high of 4.5 million, underscoring the trend that some have termed the "Great Resignation" or the "Great Reassessment."[8]

The United States continues to lag behind other nations in terms of digital literacy and developing the skills that workers will need in a technology-based

2 McKinsey Global Institute (2021), The future of work after COVID-19.

3 ibid.

4 Bureau of Labor Statistics (2021), "2021 Results of the Business Response Survey to the Coronavirus Pandemic."

5 Washington Post (2021), "Nearly a Third of U.S. Workers Under 40 Considered Changing Careers During the Pandemic."

6 Pew Research Center (2021), "Unemployed Americans are Feeling the Emotional Strain of Job Loss; Most have Considered Changing Occupations."

7 U.S. Chamber of Commerce (2022), "Understanding America's Labor Shortage: The Most Impacted Industries."

8 Bureau of Labor Statistics (2022), *Job Openings and Labor Turnover Summary*.

knowledge economy. **The US ranks 29th out of 100 countries for the digital acumen of its workforce in business, technology, and data science.**[9] This comes as the adoption of disruptive technology within industries is accelerating, especially in automation and artificial intelligence.

The pandemic has also only widened the gap between higher-skill and lower-skill works. Lower-skill workers have long been more prone to displacement and disruption from automation and other technological innovations. While automation created a net increase in jobs from 1947-1987, this trend has since reversed; from 1987-2016, automation-driven worker displacement has outpaced new opportunities for low-skill workers, driving declining real wages among this group.[10] The new challenges created by the pandemic have only exacerbated those fundamental issues.

Recent events have highlighted the need to improve diversity, equity, and inclusion in the workplace. Workers representing particular socio-demographic groups remain underrepresented in the high-skilled innovation workforce. Research has found that high-performing children from lower-income or minority families are far less likely to become inventors than their high-income or white counterparts—and only 18 percent of inventors are female.[11] To reach its full potential, the United States must not only draw from the talent of individuals of all genders, colors, and backgrounds—across every corner of the country—but also make sure that they are invested in and benefit from an innovation-based economy.

Perhaps most notably, the pandemic rapidly accelerated a trend toward more flexibility, especially in knowledge-based jobs. Businesses have been forced to not only think differently about when and where work is performed, but also about the role that in-person interaction and collaboration plays in innovation. Data suggests that many of these changes are likely here to stay, both in the United States and abroad. For instance, an OECD survey found that teleworking options are expected to remain available after the pandemic for 70 percent of workforces employed in knowledge-intensive services.[12] **Economies that are able to more swiftly, smoothly, and successfully reorganize their work, workplaces, and workforces around these new modes of operation are more likely to thrive in the next economy.**

## Key Issues + Discussion Questions

To support development of an adaptable, high-skilled workforce of the future, the United States must address several key issues, including but not limited to the issues identified below. These issues are intended to serve as a jumping-off point for discussion among working group members this summer.

- **Issue 1:** Revitalizing U.S. education and training systems to foster a high-skilled future workforce
- **Issue 2:** Leveraging telework capabilities, digitalization, and emerging technologies to augment conventional work
- **Issue 3:** Navigating workforce challenges and opportunities created by increased automation
- **Issue 4:** Adapting to rapid labor force shifts and new models of work organization
- **Issue 5:** Expanding efforts to increase diversity and inclusion in the innovation workforce

### Issue 1: Revitalizing U.S. education and training systems to foster a high-skilled future workforce

The impacts of technological change on the workforce are coming at a rapid pace and likely to accelerate in the years ahead. This means individuals, companies, communities, educators, and trainers have less time to adapt and prepare than they have had in the past when technology life cycles were longer. The demand by employers for digital skills has

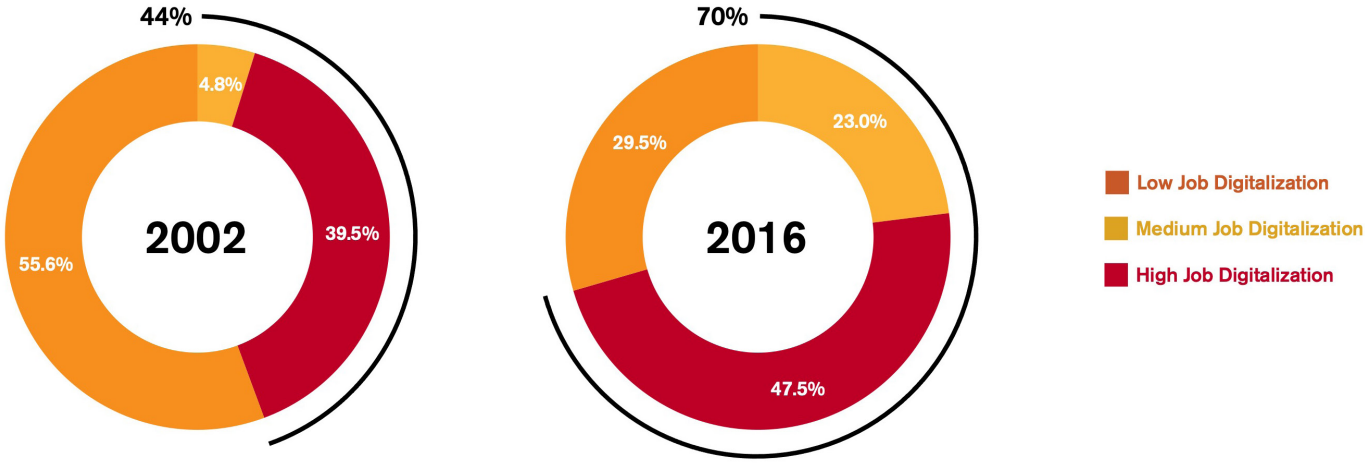
9 Coursera (2021), *Global Skills Report*.

10 MIT News (2020), "Study finds stronger links between automation and inequality."

11 Bell et. al (2017), "Who Becomes an Inventor in America? The Importance of Exposure to Innovation."

12 Criscuolo, C., et al. (2021), "The role of telework for productivity during and post-COVID-19: Results from an OECD survey among managers and workers."

**Figure 2. Employment by Levels of Job Digitalization, 2002 and 2016**
Source: Brookings (2017), Digitalization and the American Workforce, Analysis of O*NET and OES data.




grown markedly in recent decades, with the share of U.S. jobs requiring medium-to-high digital skills increasing from 44 percent in 2002 to 70 percent in 2016.[13] Meanwhile, the U.S. education system continues to lag behind much of the developed world in fields that are critical to innovation. For instance, as recently as 2018, the United States ranked 30th in math and 11th in science among OECD nations according to the Program for International Student Assessment. To ensure that U.S. workers have the skills they need to thrive in a changing labor market, it is more important than ever to adjust education and training programs to fit emerging skill needs and reinvest in development of a high-skilled future workforce.

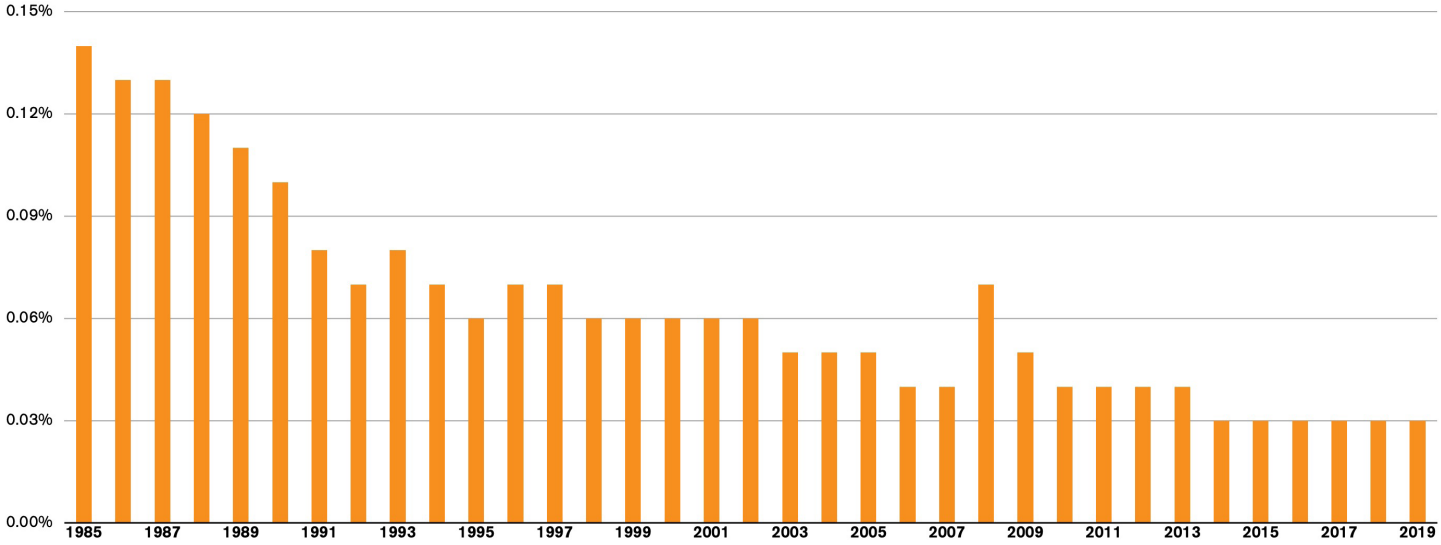
U.S. public spending on labor market training as a percent of GDP has fallen steadily from the mid-1980s to 2019.[14] Increased public and private sector investments, facilitated through a wide variety of programs, partnerships, and tools, will be essential to supporting a future-ready workforce. Approaches might include increased incentives for on-the-job training initiatives and expansion of workforce development programs focused on preparedness for industries of the future. Additionally, the United States should refocus and reinvest in STEM education and innovation-focused curriculum at all levels to prepare students for tech-adjacent roles in future workforce and support broader tech literacy.

In addition to renewed investment, education and training providers need to adjust their models to suit a changing society in which technology is creating greater diversity in education and training options. For example, the demand for training and educated and skilled workers has driven a proliferation of credentials that job applicants include on their resumes and transcripts. While workers benefit from having more choices in the education and training market, employers face a confusing landscape in evaluating credentials to determine what a job candidate knows and can do. This trend carries implications for labor flows and job-skills matching and requires that companies be well-versed in the rapidly shifting education and training landscape.

13 ITIF (2021), "Assessing the State of Digital Skills in the U.S. Economy," Analysis of Brookings report: *Digitalization and the American Workforce.*

14 OECD (2022), *Public spending on labour markets–Training*.

**Figure 3. U.S. Public Spending on Labor Market Training as Percent of GDP, 1985–2019**
Source: OECD (2022), *Public spending on labour markets–Training*.




## Potential questions for this working group to consider include:

- In a world of rapid change with a swiftly increasing digital skill base, what are the new ABCs all students need to know and be able to do?
- What needs to be done to encourage existing higher education institutions to serve a broader base of learners? Are new types of higher education institutions needed?
- Does the United States need to take steps to better inform both employers and workers about the value of credentials, or rationalize credentialing to make job-skills matching more efficient, and hiring faster and more effective for employers and workers alike? If so, how? Are new forms of credentialling needed, and if so, what would they be?
- How can on-line learning be scaled rapidly to reach broader communities and increase access to high-quality education and training?
- How can technologies such as AI, modeling and simulation, gaming, etc., be best used to improve learning?

### Issue 2: Leveraging telework capabilities, digitalization, and emerging technologies to augment conventional work

The pandemic reshaped the nature of work in many industries, greatly expanding remote work capabilities and leading businesses to rethink how individuals can and should connect, convene, collaborate, and communicate. This shift has been dramatic for many industries. **A recent Pew survey found that nearly 60 percent of workers with jobs that can be done from home said they would like to work from home all or most of the time given the choice.** Of those currently working from home all or most of the time, 78 percent say they would like to continue to do so.[15] A Gallup survey showed 91 percent desired at least some remote work.[16]

For workers, new models of work—such as telecommuting, working from remote locations, freelancing, and more flexible work schedules—can help people integrate work more seamlessly into their personal lives as well as access jobs outside of their geographic regions. For employers, more flexible patterns of work allow them to tap a wider

15 Pew Research Center (2022), *COVID-19 Pandemic Continues to Reshape Work in America*.

16 Gallup (2021), "Remote Work Persisting and Trending Permanent."

range of workers with knowledge and skills that can contribute value to the organization or business. However, as the scale and scope of virtual work has expanded dramatically, the challenges of distance and non-physical presence are amplified. For example, communications in real-time is harder, scheduling more complex, and managerial oversight and control are severely diminished. Companies must remain agile and responsive to capitalize on the opportunities presented by teleworking while accounting for new challenges.

Additionally, the pandemic accelerated the development, adoption, and use of a wide range of technologies—including augmented reality, virtual reality, virtual worlds, and AI-based tools—that have the potential to boost productivity, create new jobs, and fundamentally alter the way that people think about and perform work. Intelligent systems could reduce the cognitive burden on humans and improve overall performance through human-machine collaboration, while robotics can relieve human workers of dangerous and physically demanding tasks. With intelligent assistants and augmented and virtual (AR/VR) reality, workers at different skill levels can be trained to perform complex work, while expertise focuses around the most complicated problems and tasks. The United States should capitalize on this changing nature of work by supporting adaptation of workforce to new tech-enabled roles and fostering innovation in technologies that are shaping the future of work.

### Potential questions for this working group to consider include:

- Will telework stick? If there is a permanent expansion of telework, what are the implications for organizational structure?
- How can employers be encouraged to use telework to expand the geographic scope of recruiting, for example, to rural areas, distant areas, and globally?
- What is needed in the area of taxation and labor laws to reduce barriers to cross-state remote work in the United States? Cross-border remote work?
- What do technologies such as AI, autonomous systems and robots, human-machine teaming, and AR/VR/3-D displays mean for people and their roles in the workforce? How big will the disruptions be, and how can the downsides be mitigated?
- What kinds of new corporate and government policy issues will arise with increased use of AI and robot/human teaming in the workplace, in areas such as risk, safety, liability, performance evaluation, cybersecurity, etc.
- Is a new multidisciplinary field in work engineering needed—the convergence of automation, cognitive and behavioral science, organizational development, job design, systems integration, etc.?

**Issue 3: Navigating workforce challenges and opportunities created by increased automation**

Automation—robots, machines, devices, sensors, and software—is increasingly capable of doing routine tasks that have made up jobs for millions of workers. The price of automation has fallen significantly in the past few decades, both in absolute terms and relative to the cost of labor.[17] As the cost of labor rises, and the cost of automation declines, it becomes more attractive to automate work and eliminate some jobs. The pandemic added impetus to the scaling of automation and AI. In a recent survey, 68 percent of business and company executives said the pandemic has accelerated their adoption of automation and artificial intelligence.[18]

The impacts of automation on worker displacement are stratified along the skills spectrum. Many lower skill workers perform tasks that are easier to automate or tend to use technology that reduces

17 Federal Reserve Bank of St. Louis (2013), "Job Polarization Leaves Middle-Skill Workers Out in the Cold."

18 Federal Reserve Bank of Richmond (2021), "Cost Pressures Mount Amid Widespread Supply Disruption and Labor Shortages."

the skills needed on the job.[19] In contrast, the labor market is rewarding well-educated workers who can perform non-routine work and complex tasks. This phenomenon has been a driver in labor market polarization—into high-skill/high-paying jobs on one end and low-skill/low-paying jobs on the other, and fewer middle skill jobs—a trend seen across the advanced nations.[20] Policymakers, businesses, and educators should take a forward-looking approach to these trends to help displaced workers retool their skills and find new roles or careers in an increasingly automated workplace.

While automation will eliminate some jobs, it creates others. In manufacturing, most of the new jobs are expected to be for higher skilled workers such as managers, business and financial operations personnel, computer workers, and engineers. Similarly, there will be more jobs for computer workers due to the continued sweep of digital technologies across the economy. The United States should capitalize on growth in these tech-adjacent roles by investing in training and digital literacy in the broader workforce to ensure that workers have the skills to participate in the future economy.

**Potential questions for this working group to consider include:**

- As AI, autonomous systems, and robots increasingly perform routine tasks, will the skill/wage gap grow—and if so, by how much? Will rungs on lower/middle levels of career ladders disappear, closing-off traditional pathways to upward mobility? Does this present new kinds of challenges in reducing economic inequality?
- As machines increasingly perform routine work, does the public have a grasp on the potentially sharp upward trajectory of the economy's knowledge and skill requirements? What role must policymakers play in educating and supporting this shift?
- What are the most important ways to support the rapid reallocation of labor displaced through automation? Where are policies and programming adequate, and where are they weak?

**Issue 4: Adapting to rapid labor force shifts and new models of work organization**

As the United States emerges from the COVID-19 pandemic, several trends are converging to drive major shifts in the labor force. Telework has transformed the nature of where and when work is performed, workers are increasingly considering new career paths and moving to new communities around the country, and new business formation is surging, up from 234,838 in April 2020 to 423,153 in April 2022.[21] Meanwhile, evidence suggests that the pandemic may have accelerated retirements among the Baby Boomer generation, with one study showing 2.4 million "excess" retirements due to COVID-19 as of August 2021.[22] These converging shifts in the labor force will require policymakers and business leaders to be nimble and tailor new employment, management, and policy approaches to keep pace with these major trends.

Meanwhile, recent technology advancements have enabled entirely new models of work and work organization. For example, digital technologies have made it easier to connect customers that need work performed with those able to perform it on a freelance basis. Uber, Lyft, Mechanical Turk, TaskRabbit and the Gig economy have established new models of worker independence and flexibility. New technologies could continue to support entirely new forms of people-centered, rather than employer-centered, and self-organized forms of work that optimize human capital and human capacity.

19 MIT and Harvard University (2005), *How Computerized Work and Globalization Shape Human Skill Demands*.

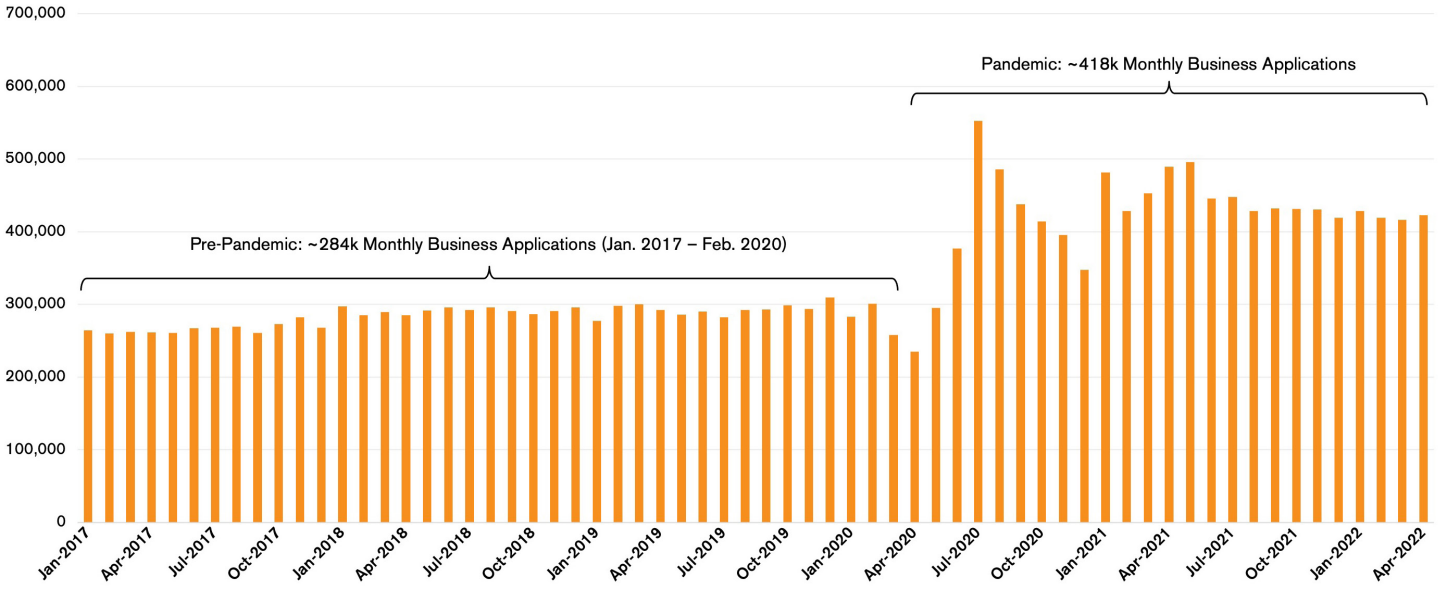
20 OECD Employment Outlook (2017), "How Technology and Globalisation are Transforming the Labour Market."

21 U.S. Census Bureau (2022), *Business Formation Statistics, Total for All NAICS: U.S. Total-Seasonally Adjusted Business Applications*.

22 Federal Reserve Bank of St. Louis (2021), "Excess Retirements During the COVID-19 Pandemic."

**Figure 4. Total U.S. Monthly Business Applications, 2017–2022**

Source: U.S. Census Bureau (2022), *Business Formation Statistics, Total for All NAICS: U.S. Total-Seasonally Adjusted Business Applications*.




Today, the changes brought about by advancements in technology, globalization, hyper-competition and new models of business and work enabled by technology are coming at a fast pace, requiring businesses to adapt much faster than ever before. The COVID-19 pandemic demonstrated that such swift adaptation in corporate organizations is possible. The rapid move to telework was an organizational shift without precedent, the kind of transformation in the economy that would normally take decades to unfold. Work processes had to be rapidly re-engineered, communications reworked, and management and work team operations reconfigured. This kind of agility and reinvention of organizations and work will be a defining competitiveness dimension of a future shaped by disruption and rapid change.

### Potential questions for this working group to consider include:

- What kind of ecosystem and infrastructure would be needed to support a people-based (vs. employer-based) economy?
- What kinds of new knowledge, skills, and support systems are needed for those working outside of traditional employer organizations?
- What kinds of new regulations or policies are needed to address the challenges of worker benefits and income security in a workforce of freelancers?
- What are the biggest barriers to fundamental change in organizations? How can these be overcome?
- What are the implications of this apparent shifting and reorganization of the U.S. workforce?
- From a macroeconomic perspective, how can creative-destruction be eased, and the reallocation of labor resources be more efficient?

**Issue 5: Expanding efforts to increase diversity and inclusion in the innovation workforce**

Women and members of racial or ethnic minority groups are serially underrepresented in the U.S. innovation ecosystem. While the share of women and individuals from minority groups with STEM degrees has increased in recent decades, there has not been a corresponding increase in patenting activity, leaving these groups serially underrepresented in the innovation economy.[23] **Meanwhile, some estimate that closing the gender gap alone in U.S. innovation could increase GDP per capita by 2.7 percent.[24]**

The future U.S. innovation workforce must reflect America in terms of gender, race, background, geography, and a range of other critical factors to not only maximize the nation's economic potential, but to ensure that a broader swath of Americans participate in and benefit from innovation. This will not only require expanding workforce development programs to support access for individuals from these underrepresented communities, but also tailoring programs to help underrepresented groups succeed.

**Potential questions for this working group to consider include:**

- What steps must be taken in order to increase participation of individuals underrepresented groups in U.S. innovation?
- In what industries or fields are disparities the starkest? How can public and private sector entities work together to confront these challenges?
- What partnerships between government, academia, and industry could be formulated to drive diversity and inclusion in the U.S. innovation ecosystem?

23 Washington Center for Equitable Growth (2019), The implications of U.S. gender and racial disparities in income and wealth inequality at each stage of the innovation process.

24 ibid.

# Working Group 4

# **The Future of Place-Based Innovation:** Broadening the Innovation Ecosystem

"Too many across the United States are disconnected from our national innovation ecosystem…We are leaving people behind and, in turn, holding ourselves back collectively—and economically—as a nation."[1]

**The Honorable Deborah L. Wince-Smith**
President & CEO
Council on Competitiveness

## Overview

As competition in the global innovation landscape intensifies, there is a growing urgency to capitalize on untapped talent across America. Innovators in Silicon Valley and other coastal hubs have helped position the United States as a science and technology leader, but many communities and regions have yet to fully join, engage in, and benefit from the country's innovation economy. The innovation workforce is highly concentrated in major metropolitan areas, with the top five metro areas—Boston, San Francisco, San Jose, Seattle, and San Diego—accounting for more than 90 percent of the nation's innovation-sector growth from 2005 to 2017.[2] The costs of this hyper-concentration are playing out in real time. Coastal technology clusters are increasingly facing congested transportation, skyrocketing costs of living, and constrained housing, while lagging regions are excluded from participating in or benefiting from American innovation.[3]

The National Commission on Innovation and Competitiveness Frontiers began to explore this critical issue in the 2020 report, *Competing in the Next Economy*. Key recommendations included restructuring economic development to focus on regional innovation, fostering local talent by increasing exposure and access to innovation tools, and connecting communities of need to funding and mentoring opportunities.

In the next phase of work, the Commission will focus on expanding and deepening both the demography and geography of innovation in the United States: broadening the innovation workforce, and capitalizing on untapped innovative potential and assets in regions across the country. The Future of Place-Based Innovation working group will define anew for stakeholders and policymakers the future of place-based innovation systems within the larger national

**Key Recommendations from *Competing in the Next Economy* and National Commission Phase 1**

- Congress should restructure federal economic development, community assistance, and related training programs into a performance and block-grant-based program to eliminate fragmentation and suboptimal approaches, in favor of strategic and integrated efforts with critical mass.
- Partnerships of high school math and science department chairs, companies in the information technology and science fields, and corporate volunteers should identify talented high school math and science students from low-income areas and provide assistance, coaching, and mentoring to them from high school through college to STEM careers.
- Within communities of dire social and economic need, a coalition of stakeholders—universities, community colleges, community organizations, State and local governments, NGOs, industry, K-12 schools, and small and medium size enterprises—should establish multidisciplinary engineering innovation centers and ecosystems.
- The NCIC, federal departments and agencies, universities with significant populations from groups underrepresented in STEM, state and regional economic development entities, and organizations focused on advancing minority-owned small and start-up businesses should take further steps to connect these communities to the federal research and development funding pipeline.

1 NASDAQ (2022), The Roadmap to a Competitive America.

2 Brookings (2019), "The case for growth centers: How to spread tech innovation across America."

3 Kenan Institute of Private Enterprise (2021), "Is Big Tech Headed for a Big Tumble?"

innovation ecosystem—moving beyond past nomenclature and understanding of "clusters of innovation" (created by the Council in the late 1980s and early 1990s) and regional innovation hubs. Specifically, the Commission will explore the need for a coordinated national strategy for place-based innovation systems, opportunities to develop and retain local talent, and approaches to broaden participation and drive more inclusive economic growth and prosperity.

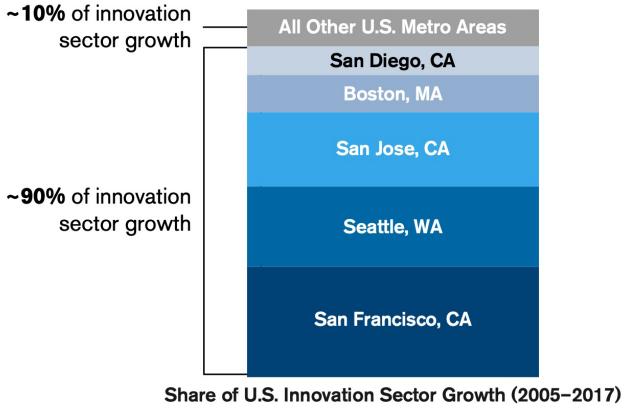
To remain competitive in the next economy, the United States must expand its innovation footprint. Broadening the U.S. innovation ecosystem—which is a system of systems, rather than monolith—will require targeted efforts that meaningfully engage different communities and diverse populations as beneficiaries, workers, innovators, and entrepreneurs. Effective place-based innovation strategies that involve and engage a much broader swath of Americans in the innovation future can help to support U.S. science and technology leadership for decades to come.

## Recent Developments

Leading innovation hubs, such as Silicon Valley, New York, and Boston, have propelled the United States to become the premier global innovation destination. While these areas continue to produce and benefit from technology breakthroughs, many other regions of the nation are not as fully engaged in the country's innovation economy. **From 2010 to 2018, the top ten metro areas with the highest shares of the nation's digital services industry captured 48 percent of new technology jobs.[4] In contrast, the share of nationwide jobs in the technology sector within 63 of the top 100 largest metro regions declined over the same timeframe.[5]** These trends have bifurcated America into high-technology centers that promote creativity and continued growth and isolated rural and rust-belt communities that continue to fall further behind.

**Figure 1. Share of Innovation-Sector Growth in the Top Five Fastest Growing U.S. Metro Areas (2005–2017)**

Source: Brookings (2019), "The case for growth centers: How to spread tech innovation across America."




The United States has recently increased investments in broadening the innovation footprint. For example, the American Rescue Plan established a $1 billion Build Back Better Regional Challenge to invest in local economies and regional industry clusters.[6] The United States Innovation and Competition Act (USICA), if passed, would invest $10 billion in at least 20 new regional technology hubs comprised of universities, industry, state and local governments, and labor representatives, among others.[7] Investments like these will be critical to engaging more Americans in innovation and increasing regional competitiveness. Additional coordination and support can enable even more communities to more swiftly and smoothly integrate into the national innovation ecosystem.

The onset of the COVID-19 pandemic has reduced the physical connection between workers and the workplace. As remote work becomes more prevalent, employees are increasingly untethered from their job location and from the large metro areas where many of these jobs exist. A recent study found that 9.3 percent of Americans—approximately 20 million people—are planning to relocate due to

4 Brookings (2020), "No matter which way you look at it, tech jobs are still concentrating in just a few cities."

5 ibid.

6 Economic Development Administration (2021) "$1B Build Back Better Regional Challenge."

7 S.1260—United States Innovation and Competition Act of 2021.

remote work. Among them, 28 percent say they are moving more than four hours away, while 13 percent say they are moving between two and four hours away.[8] **These dynamics warrant reconsideration of what "place" means in the context of place-based innovation. Newfound worker mobility and increasing digital interconnectedness of the innovation economy could transform how and where regional assets and talent collaborate, and spur new opportunities for cross-regional partnerships.**

Meanwhile, there is growing momentum to re-shore supply chains supporting critical industries. Many business leaders have indicated that the pandemic and supply chain disruptions have compelled them to onshore manufacturing in industries such as semi-conductors, advanced microelectronics, battery production, and EVs.[9] This shift aligns with efforts by the Biden Administration to strengthen domestic manufacturing through its "Made in America" policies.[10]

The nexus of these trends—migration away from urban cores and revitalization of domestic manufacturing—provides a unique opportunity to engage underutilized regions of the country. By strengthening and leveraging regional specialties, these communities can attract both workers and employers who are searching for new opportunities. Workers can bring new skills and opportunities while benefitting from lower living expenses. Companies can spur economic growth and innovation while avoiding the high costs of operating in a major metro area. If regions across the country can capitalize on these converging trends, the nation can greatly increase the geography and demography of its place-based innovation system, unlocking new opportunities for communities and unleashing American innovative capacity.

## Key Issues + Discussion Questions

To broaden the innovation ecosystem, the United States must address several key issues, including but not limited to the issues identified below. These issues are intended to serve as a jumping-off point for discussion among working group members this summer.

- **Issue 1:** Establishing regional and national strategies to define, coordinate, and support specialized regional innovation hubs
- **Issue 2:** Investing in expansion and retention of the local talent base
- **Issue 3:** Promoting inclusive growth and innovation in regional hubs
- **Issue 4:** Strengthening local innovation ecosystems by enhancing digital infrastructure and local financing

### Issue 1: Establishing regional and national strategies to define, coordinate, and support specialized innovation hubs

The challenges and barriers facing the innovation landscape differ by geography, as do the unique opportunities presented by distinct assets, knowledge, and resources in each region. "One-size-fits-all" approaches to supporting regional innovation ignore these crucial geographic distinctions and fail to capitalize on different regions' core competencies and advantages. Meanwhile, communities in certain regions often lack the resources and strategic guidance needed to gear up local innovation and ultimately compete against each other for talent and capital. Finally, research has found that traditional place-based policies often create a zero-sum game that merely shift workers and firms from one area to another without increasing overall economic activity.[11]

8 Upwork (2022), "The New Geography of Remote Work."

9 NY Times (2022), "Supply Chain Woes Prompt a New Push to Revive U.S. Factories."

10 White House (2022), *Made-In-America*.

11 Washington Center for Equitable Growth (2021), "Place-conscious federal policies to reduce regional economic disparities in the United States."

**The United States must recognize the unique capabilities, resources, and competitive advantages present in every region and take active steps to include all corners of the country in its innovation future.** To do so, the nation needs a coordinated national strategy for place-based innovation to help leadership in underutilized regions identify and leverage their local niche. Part of that strategy should include establishing regional centers dedicated to innovation fields that align with the specialized expertise, capabilities, or natural resources specific to the area. For example, one promising approach could involve creating "net-zero innovation hubs" in areas that have been traditionally dependent on the fossil fuel industry to help transition the local workforce to clean energy jobs.[12] These communities are often located in regions with resources and topography conducive to renewable energy buildout, making this approach a valuable model for the kind of place-based innovation that could be promoted through thoughtful national planning and coordination.[13]

Many regions across the country are already experimenting with novel place-based innovation strategies that seek to develop regional assets and leverage competitive advantages. For example, Oak Ridge National Laboratory—partnering with key regional stakeholders, including industry and universities—is finding new ways to turbocharge its regional economy, to provide students access to unique laboratory resources, and attract top-tier talent. This experimental evolution in place-based policies is likely to grow as regions coordinate and collaborate across longer distances in an increasingly digitized national innovation ecosystem.

**Potential questions for this working group to consider include:**

- Are current models for place-based innovation antiquated and/or broken? If so, what can be done to improve these models? Should entirely new methods or approaches be employed?
- Has the meaning of "place" within place-based innovation shifted dramatically? If so, what does this imply for regional coordination and differentiation?
- Which experimental place-based innovation policies have been impactful or successful, and what lessons can they provide for future action?
- Why are some areas particularly uninvolved in American innovation? What barriers are inhibiting innovation-based growth in many areas?
- What regions, states, or metropolitan areas present the clearest opportunities for specialized place-based innovation efforts? How can these areas best be supported?
- What kinds of organizations, programs, or partnerships should be established to develop and support national place-based innovation strategies?

### Issue 2: Investing in expansion and retention of the local talent base

Increased access to talent is needed to boost regional innovative capacity. Investments in local facilities, programs, and surrounding infrastructure are futile without a local talent pool capable of assuming the high-skill roles that fuel innovation. The shift to hybrid and remote work has created opportunities to capitalize on the redistribution of talent around the county, and several cities have designed

12 Brookings (2022), "Net-zero innovation hubs: 3 priorities to drive America's clean energy future."

13 Brookings (2021), "How renewable energy jobs can uplift fossil fuel communities and remake climate politics."

programs to attract remote workers. For example, Tulsa Remote was estimated to add $62 million in new local earnings and create one new job for every two remote workers who relocated to Tulsa in 2021.[14] These workers could be valuable additions to the local innovation ecosystem. Nearly half of remote workers in Tulsa are in the knowledge-intensive professional, scientific, and technical services sector or the information sector, and 37 percent of these workers have considered starting a business in Tulsa in the near future.[15] While efforts like Tulsa Remote which attract talent to local communities can spur economic benefits, regions may no longer need to physically connect with their innovation workforce. Novel place-based policies may leverage newfound digital interconnectedness to access talent and assets across the country, potentially signaling a shift in what will be considered a "place"—a region, a long-distance research partnership, a connected industry, or some other form of virtual collaboration.

While access to outside talent, whether through physical relocation or digital connectedness, can provide a boost to local innovation, investments in homegrown talent are often critical for long-term success. In many cases, local schools, businesses, and community organizations lack the resources to provide residents with the education and skills necessary to participate in the innovation economy. These shortcomings can feed the phenomenon of "brain drain," where high-performing young adults leave their hometowns to pursue educational and employment opportunities elsewhere.[16] Efforts to invest in local K-12 school systems, community colleges, mentorship opportunities, and apprenticeship programs with local businesses can help to cultivate direct connections to the innovation ecosystem for young people. Additionally, incentives such as tuition rebates or scholarships that encourage students to remain close to home could help to combat the effects of "brain drain" and increase retention of local talent.

**Potential questions for this working group to consider include:**

- What kinds of investments or incentives are necessary to expand and retain the talent base in regional innovation hubs?
- Does the pandemic-driven remote work shift present new opportunities to capitalize on a redistribution of talent, or are these changes likely to be temporary?
- What are the primary factors motivating "brain drain" in rural communities across the country? How can these factors be mitigated to retain local talent?
- What types of innovation demand physical proximity, and how can the co-location of assets, talent, and infrastructure be coordinated?

### Issue 3: Promoting inclusive growth and innovation in regional hubs

The innovation economy suffers from a lack of socioeconomic and racial diversity. White children are three times more likely to become inventors than black children, and children with parents in the top 1 percent of the income distribution are ten times more likely to file a patent than children with below-median income parents.[17] While these disparities indicate an extreme challenge, they also present a real opportunity. **Research finds that if women, minorities, and children from low-income families could innovate at the same rate as white men from families in the top 20 percent of income, the number of inventors in America would increase fourfold.[18]**

14 Economic Innovation Group (2021), *How Tulsa Remote is Harnessing the Remote Work Revolution to Spur Local Economic Growth*.

15 ibid.

16 Social Capital Project (2019), Losing our Minds: Brain Drain across the United States.

17 Bell et al., (2017), "Who Becomes an Inventor in America?: The Importance of Exposure to Innovation."

18 ibid.

The United States should engage underserved communities in its efforts to establish new centers of regional innovation and economic growth. Research shows that exposure to innovation is the greatest driver of innovative capacity, but many of these communities lack this crucial exposure.[19] Embedding innovation in local school curricula, business skills training, and community programs will be a key step towards inspiring future innovators and revitalizing struggling communities. By offering educational and employment opportunities to community members, America can activate enormous untapped innovation potential.

### Potential questions for this working group to consider include:

- What are the largest barriers that currently exist to increasing inclusion of underserved communities and populations in U.S. innovation?
- How can leadership in local communities promote innovation/economic growth while ensuring that underserved communities/populations participate equitably in this growth?
- In what areas can investments stretch the farthest to support diversity and inclusion in local innovation ecosystems?
- What kinds of partnerships between community groups, industry, academia, and other organizations could help to support inclusive growth and innovation?

19 ibid.

### Issue 4: Strengthening local innovation ecosystems by enhancing digital infrastructure and local financing

Innovation capacity in rural or distressed communities can be limited by shortcomings in digital infrastructure. A 2019 FCC report found that roughly 30 percent of Americans living in rural areas—or 21 million people—lacked broadband connectivity.[20] The workforce payoffs from increasing broadband access in these areas would be substantial. Deloitte has estimated that a 10 percentage-point increase in broadband penetration in 2016 would have created an average of 270,000 jobs per year over a three-year period.[21] **Recognizing the need to expand digital access in isolated communities, the bipartisan infrastructure law allocated $65 billion towards broadband infrastructure deployment.[22] However, some estimates project that at least $240B is needed to expand broadband access to every household.[23]**

Regional innovative potential can also be hindered by lack of local funding and financing options. Venture capital continues to be highly concentrated in coastal hubs, with three states—California, Massachusetts, and New York—accounting for 84 percent of total

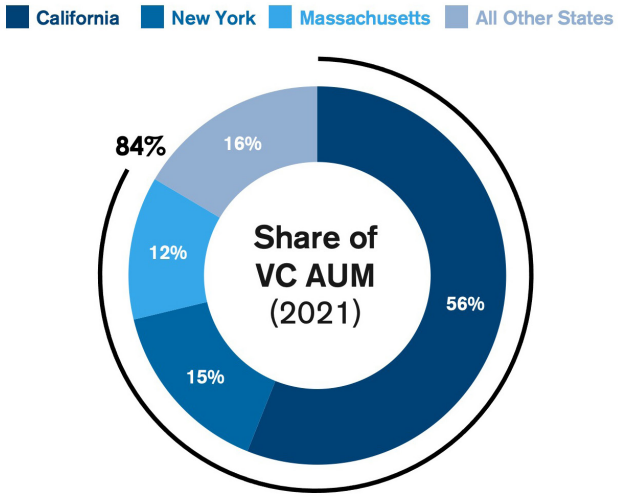
20 FCC (2019), *Broadband Deployment Report*.

21 Deloitte (2021), Quantifying the Economic Impact of Closing the Digital Divide.

22 White House (2021), President Biden's Bipartisan Infrastructure Law.

23 Tufts Fletcher School (2021), *Turning America's Digital Divide into Digital Dividends: Policy Recommendations for the Biden Administration*.

**Figure 2. Share of U.S. Venture Capital Assets Under Management by State**
Source: National Venture Capital Association (2022), 2022 Yearbook.




U.S. VC assets under management in 2021.[24] This hyper-concentration limits access to early-stage funding for promising companies in other parts of the country and reinforces ongoing regional innovation disparities. Expansion of venture capital investment capacity and other public and private financing sources will be necessary to support innovative industries in diverse regions and expand the U.S. innovation footprint.

### Potential questions for this working group to consider include:

- What steps can be taken to enhance digital infrastructure in promising innovation hotspots around the country?
- Is the United States investing enough in broadband buildout or should more be done to close the digital divide?
- What programs, incentives, or funding mechanisms should be established to support innovation in new regional hubs?
- How can policymakers support and incentivize the spread of venture capital capacity to underfunded regions of the country?

24 National Venture Capital Association (2022), 2022 Yearbook.

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