

Estimating Chilled Investment for Advanced Biofuels Due to RFS Uncertainty

- **Cellulosic and advanced biofuel biorefineries have now reached commercial status and additional ones can be built at lower capital costs.**
- **Policy instability and delays in EPA rulemakings are responsible for the majority of an estimated \$13.7 billion shortfall in necessary investments for capacity to meet the RFS goals.**
- **EPA's delays in rulemaking have undercut the industry's ability to create new employment opportunities by more than 80,000 direct jobs.**

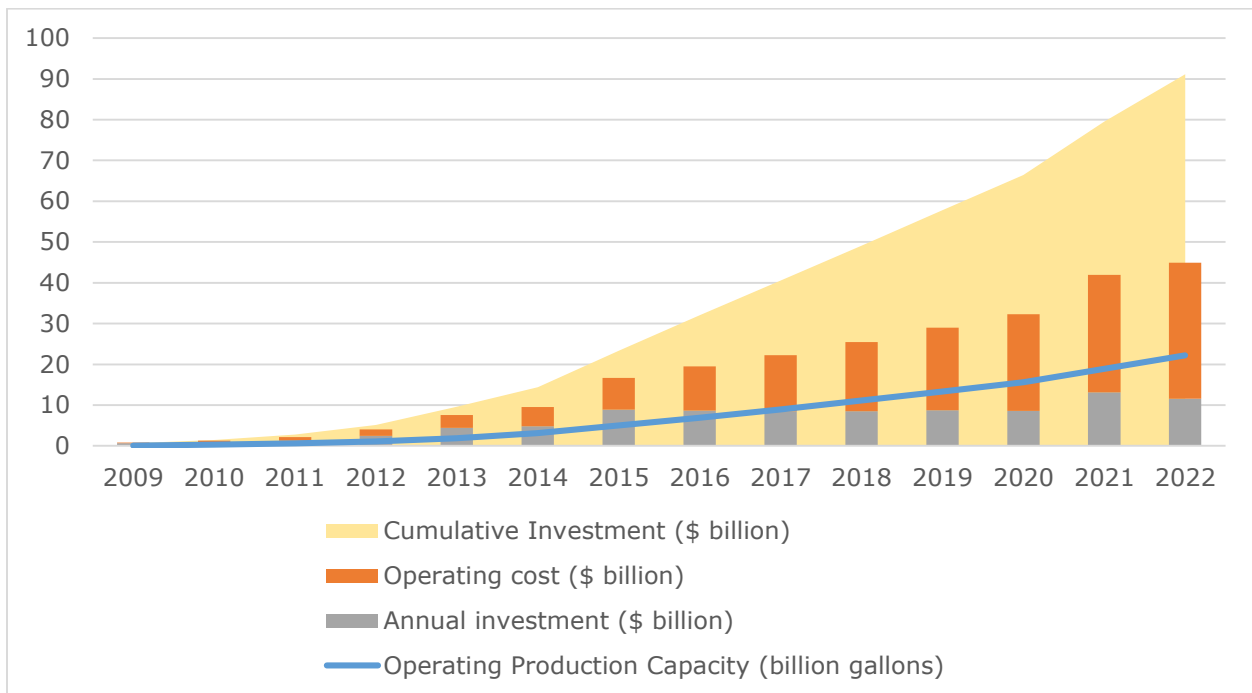
The advanced biofuel industry has invested billions of dollars since 2009 to build first-of-a-kind demonstration and commercial-scale biorefineries around the world, even during a global economic recession. Cellulosic biofuels have reached commercial status, though not at the volumes envisioned in the Renewable Fuel Standard (RFS); at the same time, overall advanced biofuels have met the RFS goals every year (2010 through 2013) that annual volume obligations have been established, primarily through existing capacity for proven biofuel technologies. Instability in the administration of the RFS has hampered investment in new advanced biofuel technology and new feedstocks within the United States. Separating the investment impact of policy instability from the general economic recession and challenges of scaling up new technologies is the goal of this white paper.

We find that EPA's delays in rulemaking over the past two years have chilled necessary investment in advanced and cellulosic biofuels just as they reached commercial deployment. The industry has experienced an estimated \$13.7 billion shortfall in investment as a result.

In 2009, Bio Economic Research Associates (bio-era) modeled the expected U.S. economic impact of building an advanced biofuel industry from the ground up to

meet the goals of the (RFS).¹ Drawing on available pre-commercial biorefinery engineering and design studies, bio-era estimated that more than \$95 billion in cumulative capital investments would be needed by 2022 for construction of nearly 400 advanced biofuel biorefineries with the capacity to produce 23 billion gallons of advanced biofuel. Figure 1 below shows bio-era’s estimated annual and cumulative capital investments needed to build enough biorefineries to maintain the production ramp up envisioned in the RFS. Added to the annual investment for construction costs is the annual operating costs for that new capacity.

Figure 1: Projected Annual and Cumulative Investments Needed to Build RFS Advanced Biofuel Capacity



In 2009, bio-era estimated construction costs of \$5.50 per gallon and operating costs of \$1.60 per gallon for the first advanced biofuel biorefineries. Given the challenges of simultaneously constructing biorefineries and building supply chains for new energy crops, the actual capital requirements for some first-of-a-kind

¹ Bio-Economic Research Associates. U.S. Economic Impact of Advanced Biofuels Production: Perspectives to 2030. Washington, DC: bio-era, Feb. 2009.

cellulosic and advanced biorefineries have been higher than originally projected. Some companies have built first-of-a-kind biorefineries to deploy new advanced biofuel technologies; others have retrofit existing biorefineries or oil refineries to use new technologies and feedstocks, requiring much lower capital costs. The advanced biofuel industry has now reached a commercial stage where additional biorefineries can be built and operated based on existing designs and optimized processes, which will rapidly lower the capital cost.

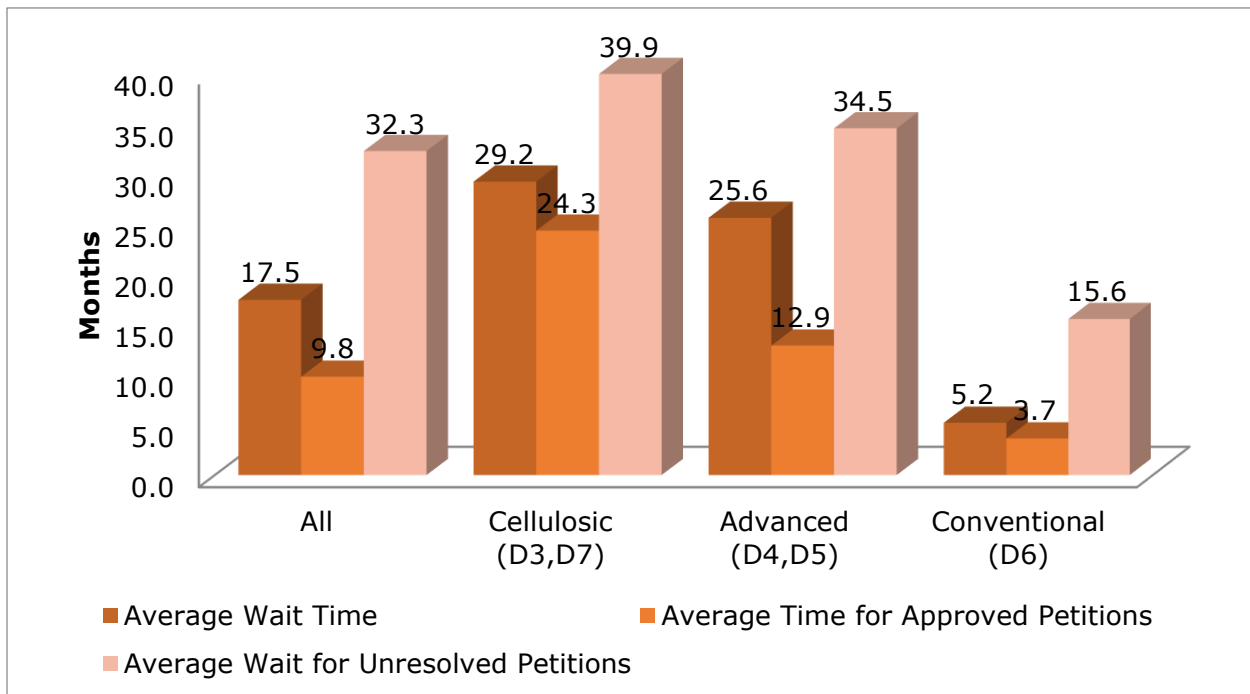
To reach the 2015 RFS goal of producing 5.5 billion gallons of advanced biofuels (including 3 billion gallons of cellulosic and 2.5 billion gallons of advanced biofuel or biodiesel), bio-era estimated the need for 110 operating plants requiring \$20.34 billion dollars in cumulative investment. The U.S. advanced biofuel industry (including biodiesel producers, renewable diesel producers, and advanced ethanol producers) has proven capacity to meet the 2015 requirement. The chill in investment has had the heaviest impact on the cellulosic biofuel industry.

As of April 2015, there are five commercial cellulosic biorefineries with a combined capacity of more than 50 million gallons within the United States and registered to meet the goals of the RFS, along with several pilot and demonstration plants. Additionally, there are 28 biorefineries generating cellulosic biogas with a combined annual capacity of approximately 80 million gallons. Taking into account additional renewable diesel producers deploying novel technologies, such as Altair, REG, and Diamond Green, the industry has reached the level of investment (roughly \$3 billion) and production capacity (600 million gallons per year) that bio-era originally projected for 2011. We therefore estimate that the industry has a cumulative delay of four years, corresponding to a shortfall in investment of more than \$20.6 billion, which can be attributed to policy instability, the general economic recession and the challenges of scaling up new technologies.

The Environmental Protection Agency (EPA) issued rules on time in both 2011 and 2012. Therefore, the shortfall in cumulative investment for 2011 and 2012 of \$6.9 billion should be attributed solely to the recession and to challenges in commercializing new technology. Nevertheless, the agency was nine months late

issuing the 2013 RVOs and is more than 17 months late in issuing the 2014 rule. Further, the agency has made cellulosic biofuel producers wait an average of 29 months (more than two years) for approval of production pathways, as shown in Figure 2. The graph shows the average time in months that companies filing new biofuel production pathway petitions under CFR §80.1416 have waited for approval from EPA. Currently, 29 companies have unresolved petitions filed with EPA and they have been waiting on average more than 32 months for resolution. At least two companies abandoned plans for cellulosic biorefineries while waiting for EPA approval of pathways.

Figure 2: Average Time for EPA to Approve New RFS Biofuel Pathways



A majority of the remaining \$13.7 billion shortfall in investment for cellulosic and new advanced technologies should therefore be attributed to EPA's delays in issuing timely rules.

The delay has also had an impact on the industry's ability to create new jobs. Bio Economic Research Associates projected that investment in new advanced biofuel biorefineries would create both 94,000 direct employment opportunities in



construction and operation and 289,000 indirect opportunities in agriculture, transportation, research and development by 2016.

BIO has tracked the development and construction of advanced biofuel and renewable chemical facilities within the United States since 2008. Currently, biorefineries employ 5,125 scientists, engineers and operations personnel. Construction of these facilities has created an additional 8,600 fulltime positions over the past five years. BIO estimates that EPA's delays in rulemaking have undercut the industry's ability to create jobs by more than 80,000 direct jobs in operations and construction, and an additional 228,000 indirect jobs within the rural economy.

It is well worth noting that more than \$600 million dollars has been invested overseas in biorefineries that commercialized new technologies researched and developed here in the United States. Additional commercial biorefineries originally planned for the United States are now looking for locations overseas or have simply been put on hold indefinitely. With commercialization of cellulosic and advanced technologies, companies will continue to seek economic opportunities to deploy them. With policy instability in the United States, those companies are likely to continue deployment in other countries.