



May 9, 2024

Liane Randolph
Chair, California Air Resources Board

Steven Cliff
Executive Officer, California Air Resources Board
1001 I Street
Sacramento, CA 95814

Comment submitted electronically

RE: Fulcrum Bioenergy’s Comments on Sourcing Low Carbon Intensity Power for Sustainable Aviation Fuel Production Facilities and Federal Funding Issues

Dear Chair Randolph and Executive Officer Cliff:

This comment letter is submitted on behalf of Fulcrum BioEnergy, Inc. (“Fulcrum”) regarding the critical regulatory issue of power sourcing for advanced low carbon fuel production facilities. We sincerely appreciate the time that California Air Resources Board (“CARB”) staff and management has spent with us on this issue over the last several years. During this time, we have been exploring structures designed to maximize real-world carbon intensity (“CI”) reductions while minimizing the risk of resource shuffling. On a parallel track, multiple agencies of the federal government have been exploring these same issues to establish guidelines and requirements under Inflation Reduction Act (“IRA”) section 40B pertaining to sustainable aviation fuel (“SAF”) and section 45V pertaining to hydrogen.

This comment letter provides Fulcrum’s recommendations regarding the optimal Low Carbon Fuel Standard (“LCFS”) policy structure to enable Fulcrum to build planned facilities in the San Francisco and Los Angeles metropolitan areas. The feedstock that Fulcrum utilizes to produce SAF is post-separated municipal solid waste (“MSW”). To convert this feedstock into high-quality SAF, Fulcrum utilizes gasification and other advanced processes that require significant energy inputs. Consistent with current LCFS regulatory requirements under section 95488.8(h), Fulcrum has persistently attempted at multiple planned facility locations to establish a direct connection behind the utility meter to a wind or solar facility. These requirements have proven impossible to meet at Fulcrum’s current 10 MGY facility location near Reno, and similarly impossible at Fulcrum’s 30 MGY facilities under development in the Chicago and Houston areas.

Due to this direct experience, Fulcrum is encouraged by the federal 40B SAF guidance that the SAF Interagency Working Group developed. The 40B structure relies heavily on CARB’s existing LCFS book-and-claim structure for electricity used as a transportation fuel and for the

production of electrolytic hydrogen including hydrogen used to produce a transportation fuel. This existing LCFS regulatory structure coupled with the additionality guardrail imposed by DOE presents a superb opportunity for CARB to establish a similar and consistent policy structure available to SAF Producers like Fulcrum.

Fulcrum’s Next Generation Biofuel Processing Technology

Fulcrum is the parent company of Fulcrum Sierra BioFuels, LLC (“Sierra BioFuels”). Sierra BioFuels owns and operates a commercial scale low carbon fuel production facility comprised of a Feedstock Processing Facility and a biorefinery. The Feedstock Processing Facility has been operational since 2017 and is located adjacent to the Lockwood Regional Landfill near Sparks, Nevada. The Feedstock Processing Facility is located on the truck route to Lockwood and receives diverted MSW that would otherwise be landfilled. A sophisticated feedstock processing system shreds, screens, and sorts the MSW producing an MSW-derived feedstock. The Sierra BioFuels biorefinery pictured below is fully constructed and is located approximately 20 miles east of Reno in the Tahoe-Reno Industrial Center. The biorefinery is now undergoing commissioning and expected to achieve full production in the late summer or early fall of 2024. The biorefinery will ultimately have the capability to convert the MSW-derived feedstock into very low carbon diesel fuel, jet fuel, and bio-crude using a three-step process comprised of steam reforming, Fischer-Tropsch (“FT”) synthesis, and hydroprocessing. Initially, the biorefinery will produce bio-crude which will be co-processed at a conventional refinery into finished fuels.



Fulcrum is also in the development stage of two comparable facilities, including Fulcrum Centerpoint in Gary, Indiana and Fulcrum Trinity in Texas. Centerpoint will have triple the production capacity of the Sierra BioFuels Plant, with an estimated annual output of over 30 million gallons. Two Feedstock Processing Facilities will divert 750,000 annual tons of MSW from the Greater Chicago area to be converted into SAF at the biorefinery. This project is in development with operations targeted to start in 2027. Fulcrum plans to build an additional 12+ similar plants across the United States. Two of the planned facilities are to be located in California with the others located at other major cities in the U.S. Fulcrum also has international affiliates that are developing facilities outside the U.S. The following rendering depicts the planned 30 MGY Fulcrum plants with the large warehouses being utilized for the sorting of 2,000 tons of MSW per day per facility.



Why Carbon Intensity Matters to the Future of Fulcrum and Other Advanced Processing Technologies

As CARB is well-aware, a contentious topic in this rulemaking has been the amount of sustainable biomass feedstock that is available to displace petroleum and to enable California to meet its goals of carbon neutrality, 80% petroleum displacement, and 80% SAF market penetration by 2045. Post-separated MSW is an abundant and cheap feedstock that Fulcrum can secure in the vicinity of all major metropolitan areas. Diverting MSW reduces the expansion of landfills that occupy land, release methane emissions, and adversely impact soil, water and air. Through the conversion of post-separated MSW into SAF, Fulcrum is providing multiple environmental services.

The focus of the LCFS program structure is to reduce the CI of transportation fuels in California. Fulcrum's Sierra Biofuels facility has not yet been in steady-state operation for three months so does not have the necessary data to support a provisional pathway application. However, Fulcrum successfully secured a prospective fuel pathway in 2016, that was subsequently certified

with the modified version of CA-GREET 2.0 in September 2016 and that pathway remains listed on CARB's pathway chart.¹ Fulcrum's prior CI analysis is referenced here for illustrative purposes and to avoid the release of confidential business information. The Summary of the Re-Certification of Fulcrum's Fuel Pathway is attached as **Exhibit A**.

A review of Exhibit A reveals that the most important components of Fulcrum's CI score in terms of GHG emissions are the process emissions at 197.94, the tailpipe emissions at 70.97 and the electricity use at 36.72. The primary GHG benefit that Fulcrum's facilities will deliver is the avoidance of landfill methane emissions by keeping hundreds of thousands of tons of post-separated waste out of the landfill resulting in 303.77 gCO_{2e}/MJ in reductions. These major emission factors coupled with various minor factors resulted in a net prospective CI score for the Fulcrum facility of 14.78 gCO_{2e}/MJ. The electricity usage is based on the average CI of eGrid Subregion NWPP as determined by the U.S. Environmental Protection Agency ("EPA").²

With this context, it is possible to evaluate the importance of the electricity input to the facility from a carbon intensity standpoint. Like all of the subregions of the US transmission grid, significant fossil fuel resources persist on the Nevada grid which is part of the eGrid Subregion NWPP. Under the current LCFS regulation, there is no viable option for Fulcrum to choose to source zero carbon intensity power, even if Fulcrum is willing to pay a premium for that power and seeks to secure that zero-CI power consistent with Fulcrum's mission: *To produce renewable, drop-in aviation fuel at scale from an abundant and low-cost source that doesn't need to be grown or pulled from a well: household garbage.*³ By aligning SAF book-and-claim within the LCFS with the guidelines developed by the U.S. Department of Energy ("DOE") for section 40B, CARB would grant Fulcrum the ability to source zero carbon intensity power that would be recognized for LCFS CI pathway determination purposes thereby lowering Fulcrum's CI score by 36.72 points to -21.94 gCO_{2e}/MJ. This change would not just enable Fulcrum to better fulfill its environmental mission but also allow Fulcrum to provide a better return on investment to its investors which would unlock additional investments and facilities.

For the following calculations to determine the impact of zero-CI electricity on the value of LCFS credit generation, we will use Fulcrum's current CI score of 15 gCO_{2e}/MJ and compare that with a 40B/zero-CI electricity CI score of -22 gCO_{2e}/MJ. CARB's LCFS Dashboard provides a credit calculator that is an excellent tool for determining the value of LCFS credits based on user inputted values for compliance year, LCFS credit price, CI score, vehicle utilized, fuel displaced, and other factors.⁴ Fulcrum plans to focus solely on the SAF market so the following chart showing values determined by the CARB credit calculator is based on: the

¹ See CARB, "Certified Fuel Pathway Table" landing page at <https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities>, Current Fuel Pathways available for download at

https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/fuelpathways/current-pathways_all.xlsx

² U.S. Environmental Protection Agency, eGrid Maps, available at <https://www.epa.gov/egrid/maps>

³ See Fulcrum BioEnergy, Environmental Benefits: The Garbage-to-Clean Fuels Opportunity," at <https://www.fulcrum-bioenergy.com/environmental-benefits>

⁴ CARB, "LCFS Data Dashboard," Credit Value Calculator available for download via Figure 7 link, at <https://ww2.arb.ca.gov/resources/documents/lcfs-data-dashboard>

compliance year of 2025, the reference fuel of conventional jet fuel, a vehicle-fuel EER of 1, and fuel equivalency of: dollars per gallon of jet fuel. The LCFS credit prices used are low (\$50/MT), medium (\$150/MT), and high (\$250/MT) credit market scenarios. Utilizing these parameters yields the following credit values per gallon fuel, supplemental revenue for lower CI fuel, and increased revenues per year and over 15-year return on investment period.⁵

CI Score	\$50/MT	\$150/MT	\$250/MT
15	\$.45	\$ 1.36	\$ 2.26
-22	\$.69	\$ 2.06	\$ 3.43
Premium Value	\$.24/gallon	\$.70/gallon	\$ 1.17/gallon
Annual Premium Value @ 30 MGY	\$7,200,000	\$21,000,000	\$35,100,000
Premium Over 15 Year Return on Investment Period	\$108,000,000	\$315,000,000	\$526,500,000

Harmonization of California and Federal Policy
Will Maximize Federal Funding to California and Speed Decarbonization

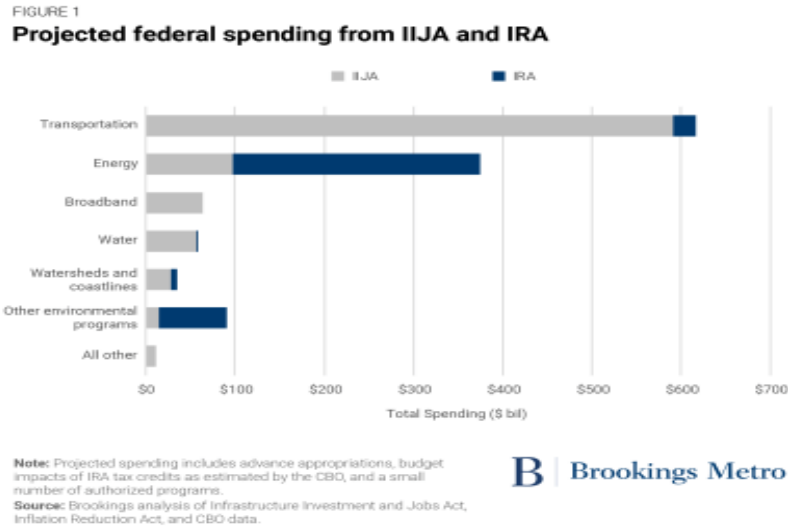
In this LCFS rulemaking, CARB can and should harmonize the life cycle analysis (“LCA”) methodology that underlies LCFS crediting for SAF with the federal LCA methodology for SAF. By establishing an LCA methodology within the LCFS regulation for SAF that is consistent the 40B LCA methodology, CARB will facilitate greater development of this vitally important fuel source for the hard to abate aviation sector. Through this regulatory strategy, CARB will also achieve upstream emission reductions and stimulate expansion of Low-CI power generation capacity, storage and transmission during the peak spending period of IRA and Infrastructure Investment and Jobs Act (“IIJA”).

As stated in a Brookings Institute Report issued on February 1, 2023:

Between the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA), the 117th Congress invested \$1.25 trillion across the transportation, energy, water resources, and broadband sectors for the next five to 10 years. It’s now the Biden administration’s responsibility to get that historic amount of money out the door—yet the bulk of it is still sitting in federal coffers or unrealized tax credits on the federal balance sheet. (...)

⁵ This calculation is not adjusted to reflect the compliance costs associated with sourcing Low-CI Power that is compliant with the LCFS book-and-claim program requirements as this information is not publicly available. Compliance does represent a significant cost that offsets a portion of the additional revenues.

After years of false starts and empty promises from Congress, the IRA is the first major federal spending response to climate change.(...) Using the same methodology as our Federal Infrastructure Hub, we can see the combined reach of the two bills.(...)⁶



As demonstrated in the prior analysis, the LCFS regulatory structure pertaining to Low-CI power sourcing has a material impact on the financial performance of a Fulcrum facility by altering the revenue stream that the LCFS programs provides to low carbon fuel production facilities that supply qualifying transportation fuels to California including SAF. While the total amount of revenue varies across the low, medium and high market scenarios, all three scenarios are highly significant in a commodity fuel market that trades fuel on basis points rather than pennies. An additional revenue stream of \$0.24 to \$1.17 per gallon of fuel produced can swing a marginal project to profitably thereby attracting debt and equity investment that would otherwise not participate. Fulcrum’s 30 MGY facilities are highly capital intensive requiring hundreds of millions of dollars to construct from start to finish. These facilities are long-term investments that typically will not provide a return on investment for at least a 15-year period. However, once the capital expenditure for the facility is recovered, the opportunity to make fuel from garbage is a highly attractive one. Over that 15-year period, the ability of a Fulcrum plant to source zero-CI power will deliver \$315 million in additional revenue in a medium LCFS market, over \$100 million in a low LCFS market, and over half a billion dollars in a high LCFS market. It is for this reason that low carbon fuel producers like Fulcrum are keen to access the Low-CI power market.

⁶ Adie Tomer, Caroline George and Joseph W. Kane for Brookings Research, “The start of America’s infrastructure decade: How macroeconomic factors may shape local strategies,” at <https://www.brookings.edu/articles/the-start-of-americas-infrastructure-decade-how-macroeconomic-factors-may-shape-local-strategies/>

Can an LCFS Regulatory Change Increase California's Access to Federal Funding?

As highlighted by the Brookings Institute Report, taken as a whole, the IJIA and IRA will deliver well over a trillion dollars to the U.S. economy over the period of a decade. It is a substantial undertaking for the federal government to establish the necessary programs, program structures, eligibility requirements, application process, and oversight for the programs. The IJIA was signed into law on November 15, 2021,⁷ and the IRA was signed into law on August 16, 2022.⁸ However, according to a comprehensive analysis released on May 8th by Politico, only a small slice of the funds have been spent. According to Politico:

- *Less than 17 percent of the \$1.1 trillion those laws provided for direct investments on climate, energy and infrastructure has been spent as of April, nearly two years after Biden signed the last of the statutes.*
- *Out of \$145 billion in direct spending on energy and climate programs in the Inflation Reduction Act, the biggest climate law in U.S. history, the administration has announced roughly \$60 billion in tentative funding decisions as of April 11. (...)*
- *And only \$125 billion has been spent from the \$884 billion provided by the infrastructure law and the pandemic law, both of which Biden signed in 2021. Roughly \$300 billion of that won't be legally available to spend until the next two fiscal years. (...)*
- *The IRA also unleashed a gusher of private company investments in clean energy and manufacturing by offering a series of tax breaks that, based on recent estimates, are worth at least \$525 billion.*

As noted by Politico, “Now time is running short for these efforts to show results before voters decide whether to bring back Trump, who has denounced the climate and infrastructure laws, mocked wind power and electric cars and inaccurately described the IRA as the “**biggest tax hike in history.**”⁹

⁷ U.S. Department of Transportation, “Bipartisan Infrastructure Law/Infrastructure Investment and Jobs Act,” at <https://www.phmsa.dot.gov/legislative-mandates/bipartisan-infrastructure-law-bil-infrastructure-investment-and-jobs-act-ijja>

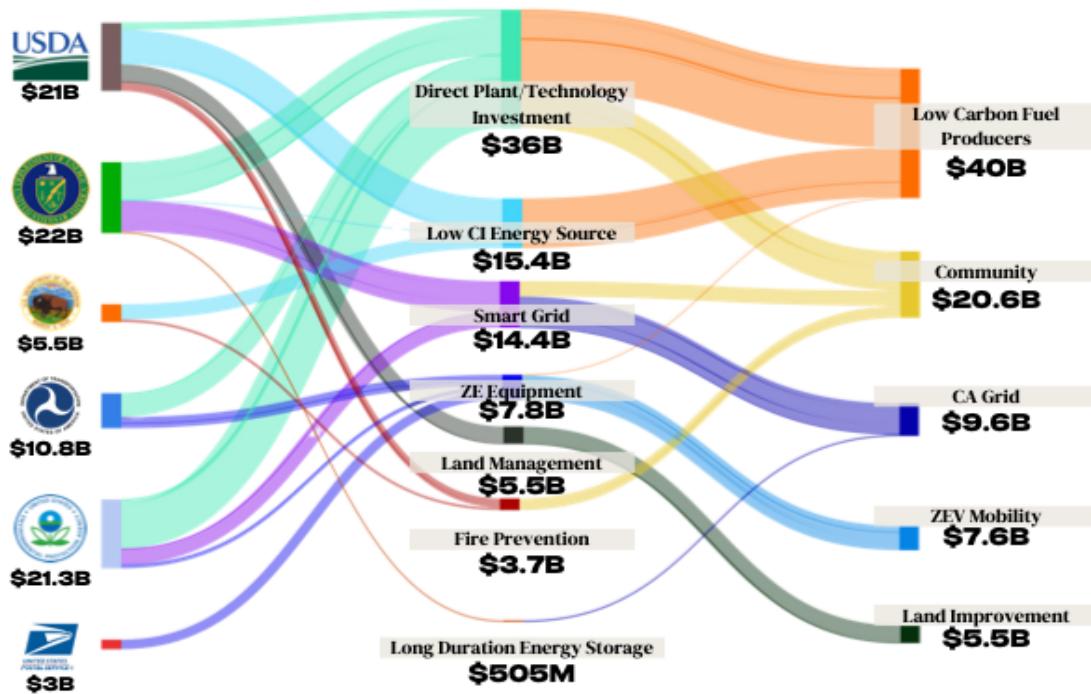
⁸ U.S. Department of the Treasury, “Inflation Reduction Act, at <https://home.treasury.gov/policy-issues/inflation-reduction-act#:~:text=On%20August%2016%2C%202022%2C%20President,made%20in%20the%20nation's%20history>.

⁹ POLITICO, “Biden’s big bet hits reality,” by Jessie Blaeser, Benjamin Storrow, Kelsey Tamborrino, Zack Colman and David Ferris, at <https://www.politico.com/interactives/2024/biden-trillion-dollar-spending-tracker/> (emphasis in original).

Establishing an LCFS Book-and-Claim System that is
Consistent with the 40B SAF Tax Credit will
Harmonize Policies, Increase SAF Project Viability and
Drive Federal Dollars To California

Based on the direct nexus between LCFS credit revenues and the economic viability of projects that low carbon fuel developers seek to finance and build, a group of low carbon fuel production companies has been funding a comprehensive analysis by Zero Emission Advisors and directed by NLC. This analysis has focused on the funding components contained in the IIJA and IRA that are most relevant to low carbon fuels and low carbon energy including funding designated for land restoration, feedstock development, wildfire risk management, energy generation, energy storage, large scale transmission, microgrids, waste and sanitation, advanced fuel technologies, hydrogen, SAF, hydrogen fuel cell and battery electric vehicles, alternative fuel and charging stations, and community assistance. This analysis has been anchored by the specific types of low carbon fuel facilities that currently supply or seek to supply low carbon transportation fuels to California under the LCFS including a wide range of liquid and gaseous low carbon fuel producers and developers. The overall universe of funding identified as relevant and available is \$83 billion depicted in the following diagram and categorized by 1) agency; 2) targeted sector (e.g., feedstock, energy, fuel, vehicle); and 3) targeted recipient.

FEDERAL FUNDING AVAILABLE



Fulcrum Specific Federal Funding Opportunities

Subsequent to the identification of all of the remaining relevant funding opportunities that have a sufficient nexus with the low carbon fuel sector, the focus of the IRA/IIJA project has been to identify the highest value potential sources of funding for specific companies given that company's feedstock, fuel, technology, and its possible ancillary benefits, e.g. Fulcrum's potential to divert MSW and reduce air, water and soil pollution. For Fulcrum, the following were the highest value identified programs.

Site Development \$8.25B:

The Environmental Protection Agency's Brownfields and Superfund programs provide essential funding for the cleanup and redevelopment of contaminated sites. Fulcrum recognizes the potential of these sites as ideal locations for its state-of-the-art biorefineries. By transforming these once-blighted areas into thriving centers of sustainable fuel production, Fulcrum not only addresses environmental challenges but also creates jobs and revitalizes communities.

Utility Development \$10.7B:

To support its biorefinery operations, Fulcrum requires reliable and sustainable utility infrastructure. The Powering Affordable Clean Energy (PACE) and Empowering Rural America (New ERA) programs provide the necessary funding to develop and upgrade electric distribution, transmission, and generation facilities in rural. Through collaboration with electric cooperatives and utility providers, Fulcrum can establish a robust and sustainable utility network that not only supports its own operations but also contributes to the broader transition to clean energy in rural areas.

Plant Development \$7.8B:

Fulcrum's success in transforming MSW into low-carbon biofuels relies on the development of advanced biorefinery facilities. The Biofuel Infrastructure and Agriculture Product Market Expansion program and the Advanced Industrial Facilities Deployment Program provide critical funding to scale up Fulcrum's production capabilities.

For details of these highlighted federal funding programs and other programs with strong potential to provide funding with a nexus to a Fulcrum biorefinery, please see **Exhibit B**.

Conclusion

Fulcrum appreciates the opportunity to provide this LCFS comment and to share the results of our analysis regarding federal funding opportunities that would be enhanced by the availability of book-and claim power sourcing for SAF. Our recommended revisions to the LCFS Regulation to effectuate this proposal are set forth in **Exhibit C**.

Sincerely,

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Graham Noyes
Noyes Law Corporation

Exhibit B

Agency	Program	Program Description	Funding Amount
Department of Agriculture	Biofuel Infrastructure and Agriculture Product Market Expansion (Higher Blend Infrastructure Incentive Program)	To provide grants through the Higher Blend Infrastructure Incentive Program, which has the goal of significantly increasing the sales and use of higher blends of ethanol and biodiesel.	\$500,000,000
Department of Agriculture	Powering Affordable Clean Energy (PACE)	To provide partially forgivable loans to renewable-energy developers and electric service providers.	\$1,000,000,000
Department of Agriculture	Empowering Rural America (New ERA)	To fund the construction of electric distribution, transmission, and generation facilities for rural electric cooperatives	\$9,700,000,000
Department of Energy	Advanced Industrial Facilities Deployment Program	To provide competitive financial support to owners and operators of facilities engaged in energy intensive industrial processes to complete demonstration and deployment projects that reduce a facility's greenhouse gas emissions.	\$5,812,000,000
Department of Energy	Clean Hydrogen Manufacturing Recycling Research, Development, and Demonstration Program	To provide Federal financial assistance to advance new clean hydrogen production, processing, delivery, storage, and use equipment manufacturing technologies and techniques.	\$500,000,000

Agency	Program	Program Description	Funding Amount
Department of Energy	Clean Hydrogen Electrolysis Program	To establish a research, development, demonstration, and deployment program for purposes of commercialization to improve the efficiency, increase the durability, and reduce the cost of producing clean hydrogen using electrolyzers.	\$1,000,000,000
Department of Energy	Long-Duration Energy Storage Demonstration Initiative and Joint Program	To establish a demonstration initiative composed of demonstration projects focused on the development of long-duration energy storage technologies.	\$150,000,000
Department of Energy	Energy Storage Demonstration and Pilot Grant Program	To enter into agreements to carry out 3 energy storage system demonstration projects.	\$355,000,000
Department of the Interior	Water Recycling	Projects that reclaim and/or reuse municipal, industrial, and agricultural wastewater; or impaired ground and surface waters. Large Scale Water Recycling Program is defined in the Bipartisan Infrastructure Law as projects that reclaim and reuse municipal, industrial, domestic, or agricultural wastewater; or impaired groundwater or surface water with a total project cost of \$500 million or more and located in a Reclamation State.	\$1,000,000,000

Agency	Program	Program Description	Funding Amount
Department of Transportation	Fueling Aviation’s Sustainable Transition through Sustainable Aviation Fuels (FAST-SAF)	To provide grant funding for eligible entities to carry out projects relating to the production, transportation, blending, or storage of sustainable aviation fuel (SAF	\$244,530,000
Environmental Protection Agency	Climate Pollution Reduction Grants: Implementation Grants	To provide grants to Tribes, states, air pollution control agencies, and local governments to develop and implement plans for reducing greenhouse gas emissions.	\$4,750,000,000
Environmental Protection Agency	Superfund	The Environmental Protection Agency’s Superfund program is responsible for cleaning up some of the nation’s most contaminated land.	\$3,500,000,000
Environmental Protection Agency	Brownfields Projects	The Environmental Protection Agency’s Brownfields Program provides funds to empower States, communities, Tribes, and nonprofit organizations to prevent, inventory, assess, clean up, and reuse brownfield sites.	\$1,200,000,000

Exhibit C

Recommended new regulatory language is underlined.

Section 95488.8 (existing LCFS regulation)

(i) Indirect Accounting for Renewable or Low-CI Electricity and Biomethane.

(1) *Book-and-Claim Accounting for Renewable or Low-CI Electricity Supplied as a Transportation Fuel or Used to Produce Hydrogen.(...)*

(...)

(2) *Book-and-Claim Accounting for Pipeline-Injected Biomethane Used as a Transportation Fuel or to Produce Hydrogen. (...)*

(...)

Add:

(3) *Book-and-Claim Accounting for Renewable or Low-CI Electricity Used to make Alternative Jet Fuel. Reporting entities may use indirect accounting mechanisms for low-CI electricity supplied for Alternative Jet Fuel production, provided the conditions set forth below are met:*

(A) Reporting entities may report low-CI electricity supplied for Alternative Jet Fuel production delivered through the grid without regard to physical traceability if it meets all requirements of this subarticle. The low-CI electricity must be supplied to the grid within a California Balancing Authority (or local balancing authority for Alternative Jet Fuel produced outside of California) or alternatively, meet the requirements of California Public Utilities Code section 399.16, subdivision (b)(1). Such book-and-claim accounting for low-CI electricity may span only three quarters. The low CI electricity source must have a commercial operation date that is no earlier than thirty-six months before the Alternative Jet Fuel production facility begins commissioning. If a low-CI electricity quantity (and all associated environmental attributes, including a beneficial CI) is supplied to the grid in the first calendar quarter, the quantity claimed for LCFS reporting must be matched to grid electricity for alternative jet fuel production no later than the end of the third calendar quarter. After that period is over, any unmatched low-CI electricity quantities expire for the purpose of LCFS reporting;

(B) All electricity procured by any LSE for the purpose of claiming a lower CI must be in addition to that required for compliance with the California Renewables Portfolio Standard (described in California Public Utilities Code sections 399.11-399.32) or, for Alternative Jet Fuel produced outside of California, in addition to local renewable portfolio requirements;

- (C) Renewable energy certificates or other environmental attributes associated with the electricity, if any, are retired and not claimed under any other program with the exception of the federal RFS, and the market-based compliance mechanism set forth in title 17, California Code of Regulations Chapter 1, Subchapter 10, article 5 (commencing with section 95800).