COMMUNITY ENERGY reSOURCE

Comment before the
California Air Resources Board (CARB)

regarding the

Draft 2022 Scoping Plan Update

and its

Draft Environmental Assessment

Technical Report

Greg Karras, Community Energy reSource
Prepared for the California Environmental Justice Alliance (CEJA)

22 June 2022 – Revised 24 June 2022

CONTENTS

On 10 May 2022 the California Air Resources Board ("CARB") released the Draft 2022 Scoping Plan Update ("Draft Scoping Plan") and Draft Environmental Analysis for the proposed Draft 2022 Scoping Plan for Achieving Carbon Neutrality ("Environmental Analysis" or "EA") for public review and comment.

This technical report focuses on the adequacy of the Draft Scoping Plan and EA in addressing potential climate, air quality, and environmental health impacts associated with (1) petroleum refining for export, (2) diesel biofuel addition to combustion fuel chains, and (3) the timing of proven measures that can be used to reduce petroleum fuel chain emissions by phasing down California refining rates.

1 Potential emission impacts from unlimited petroleum refining for export.

California hosts the predominant petroleum refining center in Western North America, which has been built and expanded over decades to fuel in-state and cross-border markets.[1] Refining for export is baked into the fuel chain linked to the refineries, reinforced by business imperatives to produce from otherwise idled refining assets and seek returns to scale. Increasing refining for export is strongly linked to decreasing in-state demand for refined fuels by the State's own data.[2] In its Draft Scoping Plan however, CARB relies upon the disproven assertion that reduced in-state fuels demand alone will proportionately reduce in-state refining rates to propose needed petroleum demand reduction measures while rejecting calls for direct curbs on in-state refining. The Draft Scoping Plan could thereby further increase petroleum refining for export, resulting in significant local air quality and global climate impacts.

1.1 <u>State policy has increased California petroleum refining for export</u>.

1.1.1 California climate policies have set no direct refinery emission control standard

California climate policies have set no curbs on in-state refining rates. Standards limiting production rates or "throughput" limit increased refining rates to produce excess fuel for export. This is because oil flow through the petroleum fuel chain—the series of interdependent steps that extract crude, refine it into useable fuels, and burn those fuels for energy in transportation and industry—would be limited by the throughput of the refining link in the fuel chain. Absent such standards, the cap-and-trade program, which does not apply to emissions from burning exported fuels, and Low-Carbon Fuel Standard ("LCFS"), which does not apply to fuel chain emissions associated with exported fuels, cannot curb and have not curbed increasing refining for export.[3]

1.1.2 State policy has at the same time helped to reduce in-state demand for petroleum fuels

The Draft Scoping Plan and EA identify existing measures to reduce emissions by reducing in-state demand for petroleum fuels, including motor vehicle fuel efficiency and zero emission vehicle standards, measures to curb vehicle miles traveled, fuel substitution incentive measures, and others.[4] The Draft Scoping Plan asserts that existing measures contributed to reduced in-state petroleum fuels demand, and projects that they will continue to do so, in its quantitative Reference Scenario modeling.[5] In-state petroleum fuels demand has begun to decline (§§ 1.1.3). Stronger in-state petroleum demand reduction measures are a clearly necessary component of achieving a just transition from oil for climate stabilization. But effective measures upstream and mid-stream in the petroleum fuel chain are needed as well. Indeed, presuming that in-state

---

[1] See CEJA, *Climate Pathways in an Oil State* Prepared by Greg Karras. Feb 2022; and CBE, *Decommissioning California Refineries* Prepared by Greg Karras. Jul 2020.
[2] See CEJA, *supra*; CBE, *supra*; CARB, *Fuel Activity for California's Greenhouse Gas Inventory by Sector & Activity (Fourteenth Ed.: 2000 to 2019)* Jul 2021; and California Energy Commission (CEC), *Refinery Inputs and Production* Jun 2022 (Fuel Watch data). See also Exhibit 1, appended hereto, for the CARB and CEC data.
[3] CBE, *supra*
[4] See Draft Scoping Plan, pages 8, 18, 26–30, 56, 148, 153. 167; and EA Appendix A, pages 13, 33–39, and 56–62.
[5] See Draft Scoping Plan Modeling Information, AB 32 GHG Inventory Sectors Modeling Data Spreadsheet, May 2022. Energy Demand tab.

demand reduction alone will reduce in-state refining rates, and failing on that presumed basis to apply direct control measures to refineries, has backfired.

1.1.3 State data document the resultant dramatic rise of in-state refining for export

California collects, verifies and reports high quality data for refinery production[6] and fuels use[7] in the state, from which net fuels exports can be derived (the State is a net petroleum fuels exporter;[8] its excess refinery production is sold to other states and nations[9]). Decadal volumes for gasoline and petroleum distillate ("PD")[10] from these data are compared in Table 1. These multi-year volumes provide more accurate and reliable information about real structural trends, which can be masked by short-term variability due to factors unrelated to the structural trend, such as economic cycles.[11]

Review of Table 1 reveals first that a long-term structural decline in statewide demand for the major petroleum ground transportation fuels has begun, and second, the resultant increase in the export of those fuels. Consistent with their business imperatives to produce from otherwise idled assets and seek returns to scale, California refiners shifted more of their production to exports as in-state demand for those fuels declined.

As compared with the decade from 2000–2009, during 2010–2019 in-state demand for total gasoline and petroleum distillate (PD) combined fell by approximately 320 million barrels (Mb) or seven percent, while California refinery exports of these fuels rose by ≈423 Mb, or 71 percent. See Table 1. Instead of phasing down their production of petroleum ground transportation fuels when in-state demand for these fuels declined, statewide refiners more than compensated for the in-state decline by refining for export.

California refinery production increased over these decades, and although it shifted among the fuels, this is why refinery exports exceeded the demand decline shown in Table 1. PD production rose by ≈135 Mb during 2010–2019 compared with 2000–2009 (Exhibit 1) as PD demand fell by ≈16 Mb (Table 1), accounting for the ≈151 Mb rise in PD exports shown (135 + 16 = 151).

Expanding State climate efforts did not stop further export growth during 2010–2019. California refiners remained major net exporters of gasoline and PD to other states and nations.[12] Refining for export served the transportation fuels link of their fuel chain in other US states, primarily Arizona, Nevada and Oregon, and other nations, primarily on the Pacific Rim.[13] Refining for export accounted for ≈350 Mb, or 21 percent of total California refined fuels production during 2013–2015, rising to ≈412 Mb, or 24 percent during 2017–2019.[14] Those figures exclude jet fuel and are larger still when jet fuel burned in cross-border flights is included.[15]

---

[6] CEC, *supra;* Exhibit 1 appended hereto.
[7] CARB, *supra;* Exhibit 1 appended hereto.
[8] Energy Information Administration (EIA) *West Coast Transportation Fuels Markets* Sep 2015.
[9] *Id*.
[10] This acronym for petroleum distillate ("PD") is used for brevity as the term is repeated for precision in the text.
[11] Similarly, this analysis generally excludes data that reflect the anomalous transportation energy conditions observed during the COVID-19 pandemic and thus can mask long term structural trends.
[12] EIA, *supra*
[13] *Id*.
[14] CEJA, *supra*
[15] *Id.*

Table 1. California-refined Gasoline and Distillate-diesel: Decadal Changes in California Demand and Exports to Other States and Nations, 2000–2019.

Total volumes reported for ten-year periods

	Volume (millions of barrels)		Decadal Change (%)	
	Demand	Exports	Demand	Exports
Gasoline				
1 Jan 2000 to 31 Dec 2009	3590	358	—	—
1 Jan 2010 to 31 Dec 2019	3270	630	–9 %	+76 %
Distillate-diesel				
1 Jan 2000 to 31 Dec 2009	940	235	—	—
1 Jan 2010 to 31 Dec 2019	924	386	–2 %	+64 %
Gasoline and diesel				
1 Jan 2000 to 31 Dec 2009	4530	593	—	—
1 Jan 2010 to 31 Dec 2019	4190	1020	–7 %	+71 %

Data from CARB, *Fuel Activity Inventory* and CEC *Fuel Watch*. Figures may not add due to rounding.

Compared with 2010 rates, during 2011–2019 statewide PD exports rose by ≈69 Mb on PD production and demand increments of ≈84 Mb and ≈15 Mb, respectively. See Exhibit 1 for data. Volumetric equivalence of these distillate fuel shifts—refiners exported 69 Mb more on a refining increment of 84 Mb after serving 15 Mb more demand—is further confirmed by partial least squares regression analysis on annual data for total distillate use and export from 2010 through 2019.[16]

In an extraordinary omission, however, this crucial information for climate stabilization measures planning is not disclosed or addressed in the Draft Scoping Plan.

1.2 The Draft Scoping Plan could further increase refining for export.

Assuming that refineries here will automatically shrink themselves "in line with demand" for their fuel sales here alone, the Draft Scoping Plan ignores the supply-demand imbalance by which State policy has contributed to increased refining for export. It would establish no direct refinery emission control standard while at the same time worsening that very supply-demand imbalance which increased refining for export.

Though wrong about the resultant impact, CARB itself projects this supply-demand imbalance. Its modeling for its proposed alternative projects that combined in-state demand for gasoline, PD and petroleum jet fuel during 2023–2030 and 2023–2045 would fall by cumulative totals of 14.32 and 24.24 exajoules, respectively, from 2015–2019 levels.[17] Based on CARB fuel energy density data[18] and the analysis of State data described in §§ 1.1.3, this equates to potential export increments of ≈214 Mb by 2030 and ≈953 Mb by 2045.

[16] Partial least squares regression results for analyses of data in Exhibit 1 are appended hereto as Exhibit 2.
[17] CARB *AB32 GHG Inventory Sectors Modeling Data Spreadsheet* May 2022. Energy Demand, *in* California PATHWAYS Model Outputs.
[18] LCFS Regulation Order, Title 17, CCR, §§ 95480–95503.

1.3 The Draft Scoping Plan is likely to result in major greenhouse gas and co-pollutant increases associated with refining for export in communities near California refineries.

This potential for 214 Mb of additional refining for export by 2030 and 953 Mb by 2045 would emit criteria and other toxic air pollutants into communities near California refineries, pollution that would be directly linked to the greenhouse gas ("GHG")[19] combustion emissions exported with the refined fuels. Refinery criteria pollutant emission rates are directly related to refining rates at any given pollutant emission intensity. Some 50 years of State and federal emissions control effort demonstrate this direct relationship, which supports emission standards that are expressed as process rate "throughput" in refinery air permits and CARB's acknowledgment of ongoing elevated health risk in Black and Brown communities near industries like refineries.[20]

Supply-demand imbalances that drive these increased community health risks from refining for export would increase to a greater extent under the Draft Scoping Plan than its no project alternative.[21] Moreover, toxic effects of air pollutants are a function of the duration or repetition of exposure along with the inherent toxicity of the chemicals and their concentration in the air we breathe. Thus, by resulting in new and prolonged exposures to harmful air pollutant emissions associated with prolonged or increased refining for export, the Draft Scoping Plan could result in significant air quality and environmental health risk impacts.

1.4 The Draft Scoping Plan could result in major climate impacts from emission-shifting associated with refining for export in conflict with state climate law.

1.4.1 State law requires minimizing GHG emission-shifting to the extent feasible

CARB argues that despite rejecting direct refinery control measures the Draft Scoping Plan demand reduction measures would reduce GHG emissions from petroleum fuels in California. Though correct as to that limited point, CARB's analysis is incomplete; it ignores the resultant emission shifting. GHG emissions impact climate globally wherever GHG emits. Recognizing this, the California Health and Safety Code requires CARB to minimize emission shifting, which the Code defines as "a reduction in emissions of greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside the state." Cal. Health & Safety Code §§ 38505 (j), 38562 (b) (8). But by rejecting feasible direct refinery control, the Draft Scoping Plan would expand an incomplete set of measures which already results in the GHG emission shift defined. This would appear to conflict with State climate law.

1.4.2 The Draft Scoping Plan could increase petroleum emissions outside the state as much or more than its demand-side measures cut petroleum emissions in state

CARB could have used the evidence described in § 1.1 and other available data to estimate the GHG emission shift that could result from its in-state fuels demand cuts without direct curbs on refining under the Draft Scoping Plan. Table 2 provides an example.

---

19 Herein, "GHG" means carbon dioxide equivalents (CO_2e) at the 100-year climate forcing horizon.

20 Draft Scoping Plan at page 15. Numeric emission limits expressed as throughput have long been applied to California refineries in Clean Air Act Title V air permits. This comment incorporates additional information regarding health risks of refining for export in part 3 herein.

21 Compare Alternative 3, Reference Scenario in CARB *AB32 GHG Inventory Sectors Modeling Data Spreadsheet* (*supra*) for potential to induce refining for export.

Table 2. Potential cross-border GHG emission shift due to increased refining for export that could result from Draft Scoping Plan implementation, example estimate [a]

GHG: CO_2e, 100-year GWP **Mb:** million barrels **b:** barrel; 42 U.S. gallons
CI: carbon intensity in kg/b **MMT:** million metric tons

Petroleum shift increments		Baseline [b]	Potential Emission Shift Increments [c]	
		2013–2019	2023–2030	2023–2045
Cross-border fuels exports				
volume	(Mb)	—	214	953
combustion CI	(kg/b)	395.5	395.5	395.5
combustion GHG	(MMT)	—	84.6	377
Crude imports refined for export				
volume	(Mb)	—	190	844
extraction CI	(kg/b)	79.14	79.14	79.14
extraction GHG	(MMT)	—	15.0	66.8
Net GHG increments	(MMT)	—	100	444

a. Estimated shift for gasoline, petroleum distillate and jet fuel only; estimates for all refined fuels may exceed values shown. **b.** Baseline carbon intensity (CI) values estimated from State data for 2013–2019 in CEJA (2022) Table S1. Post-2019 data are excluded from this baseline due to anomalous conditions during COVID. Baseline volumes, from Draft Scoping Plan fuel energy modeling, which was not reported before 2015, are from 2015–2019. **c.** Cumulative volume and mass emission increments from baseline: Fuel volumes are from Draft Scoping Plan fuels energy modeling and fuel energy densities in the CARB LCFS Regulation Order. Crude volumes from fuel volumes and processing volume expansion based on data in CEJA (2022) Table S1. Shift increments estimated at the 1:1 ratio shown from data discussed in §§ 1.1.3 herein, conservatively assuming no increase in the CI or in-state refinery production of crude or fuels. Figures may not add due to rounding.

As shown in § 1.2 CARB projects cumulative in-state petroleum fuels demand cuts that could result from the Draft Scoping Plan, –214 Mb by 2030 and –953 Mb by 2045, on an energy-equivalent volume basis. CARB could have applied the volumetric equivalence of petroleum fuel shifts described by State data (§§ 1.1.3) to estimate the cross-border fuels export shifts shown in Table 2. Similarly, it could have used State refinery crude input and fuels production data[22] to quantify the effect of volume expansion during processing and estimate the slightly lower crude volume increments that would be imported for this refining for export, also shown in Table 2. This is relevant because in-state crude supply has dwindled below that needed to meet in-state fuels demand alone,[23] so that cross-border extraction emissions would occur from crude import increments linked to the refining-for-export increments.

Baseline fuel combustion and imported crude extraction carbon intensity ("CI") values shown in Table 2 are from State data for statewide refining from 2013–2019.[24] Conservatively assuming no further increase in CI or refinery production, CARB could have applied these CI values to the emission shift volumes in Table 2. As shown in the table, these data support potential GHG emission shift increments of ≈100 million metric tons (MMT) by 2030 and ≈444 MMT by 2045.

These 100 MMT and 444 MMT GHG increments outside the state, however, do not include emissions associated with Draft Scoping Plan measures that reduce in-state petroleum fuels demand. In one important example, CARB has estimated GHG emissions associated with

[22] CEJA, *Climate Pathways in an Oil State* Prepared by Greg Karras. Feb 2022. See data in Table S1.
[23] *Id.*
[24] *Id.*

renewable diesel elsewhere,[25] and the Draft Scoping Plan relies upon renewable diesel for in-state petroleum fuels demand reduction to a considerable extent.[26] Had CARB considered all available data and information, it could have found that the Draft Scoping Plan petroleum demand reduction measures—alone, absent direct refinery control measures—have a reasonable potential to increase cross-border GHG emissions by substantially more than these measures would decrease in-state GHG emissions.

1.4.3 A feasible measure the Draft Scoping Plan excludes could minimize emission shifting

CARB can establish standards limiting refinery throughput rates. As explained above, this could limit in-state refining for export because oil flow through the petroleum fuel chain would be limited by the throughput of its in-state refining link. Moreover, this measure may be required to minimize GHG emission shifting and, at a minimum, that requirement further supports its feasibility.

1.5 <u>The Environmental Assessment (EA) is factually incomplete</u>.

Presuming that in-state petroleum refining will phase down in line with demand without any direct refinery emission control measure is an error. The EA does not identify, describe, assess, or analyze mitigation for the air quality, environmental health, or climate impacts associated with refining for export and emission-shifting that could result from the Draft Scoping Plan. A feasible measure could lessen or avoid these impacts.

2 Potential emission impacts from enhanced growth of diesel biofuel that fails to replace petroleum distillate fuel

Outcomes recorded by the State's own data disprove the hypothesis that diesel biofuel use reduces GHG emissions by replacing petroleum distillate-diesel in the combustion fuel chain. Without disclosing or addressing this evidence, the Draft Scoping Plan would expand financial and policy support to further increase diesel biofuel production and combustion in California. This action could result in significant climate, air quality, and health impacts by further shifting petroleum distillate refining to export, increasing emissions from refining for export locally and distillate fuels globally. The EA does not identify or mitigate these potential impacts.

2.1 <u>State policy has increased GHG emissions associated with distillate fuels production and combustion</u>.

2.1.1 State biofuel policy supports diesel biofuel growth financially based on a hypothesis that adding diesel biofuel to the combustion fuel chain reduces GHG emissions by replacing higher-emitting petroleum distillate (PD) fuel globally

As the Draft Scoping Plan states: "The LCFS is a key driver of market development for renewable diesel and its coproducts. While the federal renewable fuel standard (RFS) and blenders tax credit also benefit producers, an analysis of their respective contributions to market

[25] LCFS Regulation Order, Title 17, CCR, §§ 95480–95503.

[26] Draft Scoping Plan at pages 18, 153; Draft Scoping Plan, Appendix H, at page 61.

development, and interviews with industry representatives and independent experts, point to [the] LCFS as a more important factor in market development, at least in recent years."[27]

The LCFS seeks to reduce the carbon intensity ("CI"), not the amount or mass emissions, of transportation fuels through a system of financial credits and debits in which credits are tradeable among companies that supply fuels used in California.[28] It assigns these credits and debits based on the energy equivalent "gallons" supplied, and the calculated CI of each fuel relative to a declining statewide CI standard.[29] Suppliers of California fuels deemed lower-CI than petroleum fuels can thus receive credits based on this energy equivalent gallon-for-gallon comparison. An LCFS credit was worth an average of $17 in 2012, rising to $192 in 2019.[30] Diesel biofuel ("DB")[31] suppliers received ≈25.4 million LCFS credits during 2011–2019.[32]

Apart from its success in reducing the carbon intensity of statewide fuels, however, the LCFS has not confirmed that DB reduced climate impacts of GHG emissions associated with PD by actually *replacing* PD. CARB suggests that DB "displaced" PD.[33] To where, it does not say. Refinery PD production increased.[34] In effect, State policy gave distillate fuel refiners LCFS credits based on the hypothesis that DB replaces PD.

2.1.2 In fact, diesel biofuel additions in California are not replacing, but adding to, petroleum distillate globally

Observed outcomes provide evidence to disprove the hypothesis that DB reduces GHG emissions by replacing PD. Adding DB to the PD refined in California added volume to the total distillate combustion fuel chain.[35] Instead of curtailing otherwise productive assets, California refiners further shifted to refining for export.[36] California PD production increased, and PD combustion increased globally.[37]

/

/

[27] Draft Scoping Plan at page 18.
[28] LCFS Regulation Order, Title 17, CCR, §§ 95480–95503.
[29] *Id.*
[30] CARB *Monthly LCFS Credit Transfer Activity Reports* Accessed Jun 2022.
[31] This acronym for diesel biofuel ("DB") is used for brevity as the term is repeated for precision in the text. DB includes biodiesel and renewable diesel.
[32] CARB *LCFS Quarterly Summary Report* Accessed Jun 2022.
[33] *Id*.
[34] CEC *supra*. The CEC defines petroleum distillate as the mix of No. 1, No.2 and No. 4 diesel and fuel oils. When diesel biofuel substitutes for petroleum distillate in one location, refiners adjust processing to seek the highest-value mix of petroleum distillate component sales across their global fuel chain.
[35] Based on CARB, *Fuel Activity for California's Greenhouse Gas Inventory by Sector & Activity (Fourteenth Ed.: 2000 to 2019)* Jul 2021; and California Energy Commission (CEC), *Refinery Inputs and Production* Jun 2022 (Fuel Watch data); and Exhibit 1, appended hereto, reporting CARB and CEC data.
[36] CARB, *supra;* CEC, *supra;* Exhibit 1.
[37] CEC, *supra;* Exhibit 1 (reporting in-state production and world consumption data).

Moreover, causal mechanisms for these outcomes reflect the resistance to change of established fossil fuel systems and development paths.[38] [39] [40] [41] [42] [43] [44] [45]

2.1.3 State data document the further shift to petroleum distillate refining for export induced by diesel biofuel addition in California

California collects, verifies and reports high quality data for in-state DB use, as well as in-state PD production and use,[46] from which statewide PD export rates are known. See §§ 1.1.3 herein. Analysis of these data demonstrates that the balance between refinery production and demand drives PD exports. *Id*. Direct effects of DB addition to total distillate demand in California are illustrated in Chart 1 based on these State data.

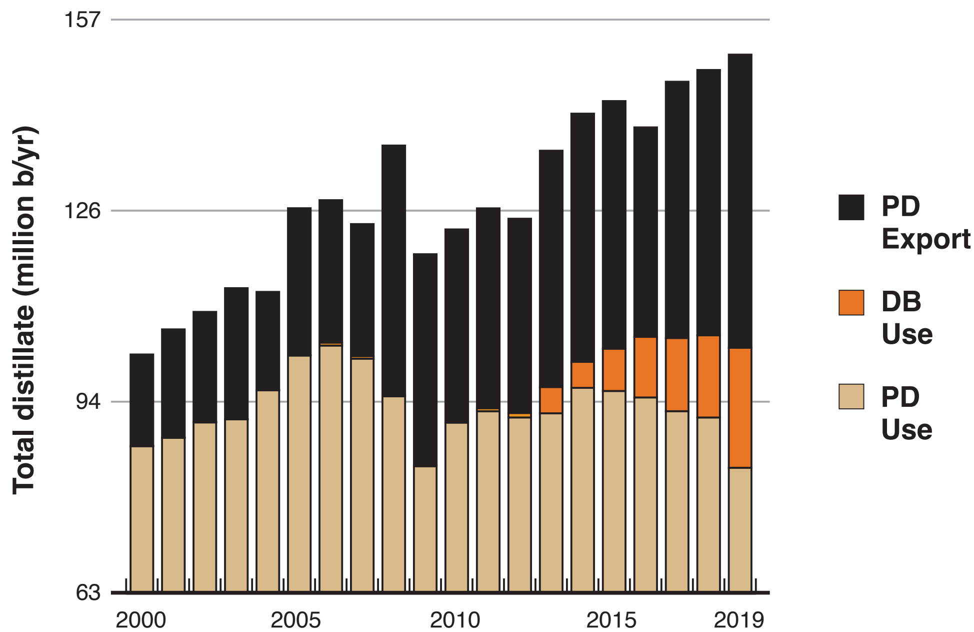
DB use (orange in Chart 1) induced a further shift from PD use here (brown) to PD export (black) from California to other states and nations. DB served increasing shares of total California distillate demand, which reached its previous three-year high during 2016–2018 compared to 2005–2007, increasing the shares of PD refined in the State that shifted to export.

Importantly, statewide refinery production of PD increased from 2010–2019 alongside DB use.[47] Partial least squares regression modeling of the State data from 2010–2019 found that DB use was a stronger factor in PD export than PD production, and both factors together explain 87 to 96 percent of the interannual change in PD export, with the 87 percent estimate due to including a potentially anomalous outlier year in that analysis.[48] PD use was the weaker factor, with effects on PD export that spanned zero (standardized coefficients, 95% confidence) when compared alongside DB use.[49] Modeling results for the 2010–2019 data are illustrated in Chart 2.

DB can account for essentially all of the PD export increment. During 2011 through 2019 as compared with 2010 rates, DB use rose by approximately 70 million barrels (Mb), PD demand rose by ≈15 Mb, in-state refinery production of PD rose by ≈84 Mb, and refinery exports of PD rose by ≈69 Mb.[50]

---

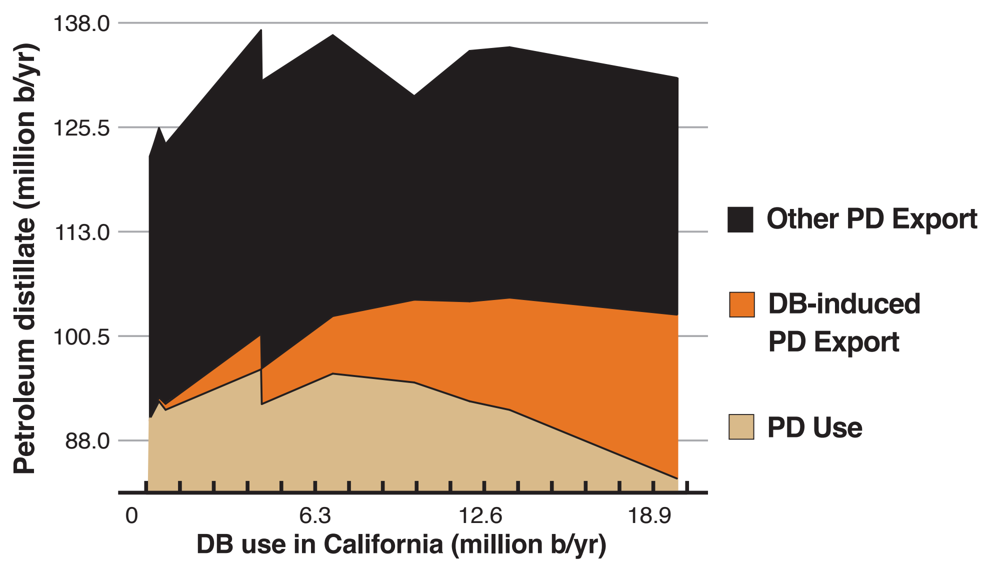
[38] Ha-Duong et al. Influence of socioeconomic inertia and uncertainty on optimal CO_2-emission abatement *Nature* 390:270. Nov 1997.
[39] Unruh. Understanding carbon lock-in *Energy Policy* 28: 817 Mar 2000.
[40] Davis et al. Future CO_2 Emissions and Climate Change from Existing Energy Infrastructure *Science* 329: 1330 Sep 2010.
[41] Davis and Socolow. Commitment accounting of CO_2 emissions *Env. Res. Letters* 9. Aug 2014.
[42] Rozenberg et al. Climate constraints on the carbon intensity of economic growth *Env. Res. Letters* 10. Sep 2015.
[43] Seto et al. Carbon Lock-in: Types, Causes, and Policy Implications *Annu. Rev. Environ. Resour*. 41:425. Sep 2016.
[44] Smith et al. Current fossil fuel infrastructure does not yet commit us to 1.5 ºC warming *Nature comm.*10:101. Jan 2019.
[45] Tong et al. Committed emissions from existing energy infrastructure jeopardize 1.5 ºC climate target *Nature* 572: 373. Jul 2019.
[46] CEC, *supra;* CARB, *supra;* Exhibit 1 appended hereto.
[47] CEC, *supra;* CARB, *supra;* Exhibit 1 appended hereto.
[48] Exhibit 2; Partial least squares regression results for data from CEC, *supra* and CARB, *supra;* appended hereto.
[49] Exhibit 2; Partial least squares regression results for data from CEC, *supra* and CARB, *supra;* appended hereto.
[50] CEC, *supra;* CARB, *supra;* Exhibit 1 appended hereto.



1. Diesel biofuel (DB) added to petroleum distillate (PD) in California

From CARB Fuel Activity Inventory and CEC Fuel Watch. See Exhibit 1 for data.

This PD export increment was caused by DB use that served some of the in-state demand for total distillate, so that the PD demand increment rose less than the PD production increment (84 – 15 = 69). Thus, adding the 70 Mb DB increment shifted an additional 69 Mb of PD refining to export, and each barrel of DB use increased PD export by ≈0.99 barrel, on a volume basis.



2. Diesel biofuel (DB) shifts petroleum distillate (PD) refining to export

Modeling results on California data from 2010–2019 plotted against DB use. See Exhibit 2.

On an energy basis, this 70 Mb DB increment had the energy content of ≈67 Mb of PD,[51] and each DB barrel increased PD export by ≈1.03 barrel. Further accounting for interannual changes via partial least squares regression analysis of all the State distillate use and export data from 2010 through 2019 indicates that each barrel of DB addition increases PD export by 1.00 barrel.[52] Finally, the US Environmental Protection Agency estimates that each energy-weighted barrel of US biofuels changes US petroleum imports by 0.99 barrel.[53] Taken together, available evidence supports DB-induced PD exports of equivalent volume (range, 1:0.99 to 1:1.03).

Downstream impacts of this DB-induced refining for export contributed to increased PD combustion across the global fuel chain linked to California refineries. During 2011–2019 world PD consumption rose from 2010 rates by ≈5,870 Mb for all uses of PD and ≈7,860 Mb for PD use in transportation.[54] These increments exceed the 84 Mb California PD refining and 69 Mb PD export increments, indicating that DB addition here contributed to increased PD combustion globally. Moreover, it may have increased world PD use by more than the 69 Mb export increment observed. A substantial body of peer reviewed work suggests that biofuel-induced petroleum fuel exports to global markets can reduce fuel prices enough to induce further petroleum fuels refining and growth.[55] [56] [57] [58] [59] [60] [61]

Emissions from DB that failed to replace PD added to those from PD that was not replaced, increasing GHG emissions from the total distillate combustion fuel chain.

2.2 <u>The Draft Scoping Plan could further increase GHG emissions associated with subsidized diesel biofuel addition to the petroleum fuel chain</u>.

2.2.1 The Draft Scoping Plan would increase subsidized diesel biofuel addition in California

CARB asserts that its LCFS is "key driver" of renewable diesel growth.[62] The LCFS provides financial support to DB, including biodiesel and renewable diesel, via a mechanism that rewards

---

[51] Based on energy densities of 126.13 MJ/gal. biodiesel, 129.65 MJ/gal. renewable diesel, and 134.47 MJ/gal. ULSD from the LCFS Regulation Order, Title 17, CCR, §§ 95480–95503; a 34%/66% biodiesel/renewable diesel mix of in-state DB use from 2011–2019 from CARB *LCFS Dashboard* Figure 10 data table; and the calculations 0.34 • 126.13 MJ/gal. + 0.66 • 129.65 MJ/gal. ≈ 128.45 MJ/gal. (DB mix) and,
128.45 MJ/gal. (DB mix) ÷ 134.47 MJ/gal. (ULSD) • 70 Mb ≈ 67 Mb (PD energy-equivalent BD added, in Mb).
[52] Exhibit 2; Partial least squares regression results for data from CEC, *supra* and CARB, *supra;* appended hereto.
[53] USEPA *Draft Regulatory Impact Analysis: RFS Annual Rules* EPA-420-D-21-002. Dec 2021.
[54] Energy Information Administration (EIA) *Transportation sector energy consumption by region and fuel* Data table accessed Mar 2022; International Energy Agency *World Production and Final Consumption of Gas/Diesel* IEA Data and Statistics; Data Tables; Oil; accessed Mar 2022; and Exhibit 1, appended hereto, reporting these data.
[55] Drabik and de Gorter. Biofuel Policies and Carbon Leakage *AgBioForum* 14: 3. 2011.
[56] Chen and Khanna. The Market-Mediated Effects of Low Carbon Fuel Policies *AgBioForum* 15:1. 2012.
[57] Grafton et al. US biofuels subsidies and CO_2 emissions: An empirical test for a weak and a strong green paradox *Energy Policy* 68: 550. Dec 2013.
[58] Bento and Klotz. Climate Policy Decisions Require Policy-Based Lifecycle Analysis *Environ. Sci. Technol.* 48: 5379. Apr 2014.
[59] Rajagopal et al. Multi-objective regulations on transportation fuels: Comparing renewable fuel mandates and emission standards *Energy Economics* 49: 359. Mar 2015.
[60] Hill et al. Climate consequences of low-carbon fuels: The United States Renewable Fuel Standard *Energy Policy* 97: 351. Aug 2016.
[61] Abdul-Manan. Lifecycle GHG emissions of palm biodiesel: Unintended market effects negate direct benefits of the Malaysian Economic Transformation Plan *Energy Policy* 104: 56. Jan 2017.
[62] Draft Scoping Plan at page 18.

increasing DB volume (§§ 2.1.1), and gave DB ≈25.4 million credits from 2011–2019[63] as per-credit values rose steeply to $192 by 2019.[64] The Draft Scoping Plan would further expand this financial support by relying on renewable diesel to a considerable extent in its selected suite of petroleum fuels demand reduction measures.[65] In its modeling for the Draft Scoping Plan, CARB projects renewable diesel use would rise from its 2015–2019 mean by a cumulative total of ≈5.394 exajoules,[66] or an energy-equivalent volume of ≈80.4 Mb,[67] during 2023–2045.[68]

2.2.2 Potential diesel biofuel use and petroleum distillate export volume increments

The DB-induced PD export effect of this 80.4 MB DB increment is readily foreseeable, as documented in §§ 2.1.3. Further, CARB could have estimated its extent. For example, CARB could use publicly reported State and federal data to estimate that each barrel of DB shifts 0.99 to 1.03 barrel of PD to export, as described in §§ 2.1.3. CARB could apply this 0.99 to 1.03 range to its modeled DB increment (80.4 Mb) to estimate a potential DB-induced PD export increment of 79.6 Mb to 82.8 Mb through 2045, as shown in Table 3.

2.2.3 Potential diesel biofuel use and petroleum distillate export emission increments

CARB estimates the full fuel chain "life cycle" carbon intensity ("CI") of both fuels in its LCFS and could have done so for its projected Scoping Plan fuel volume increments. Fuel-specific energy density and default CI values[69] indicate a CI factor of 567.3 kg CO_2e/barrel PD, and CI factors of 245.0 to 353.9 kg CO_2e/barrel renewable diesel, depending on whether it is derived from "residue" or "crop" oil feedstock. CARB could have used these data with the volume increments in Table 3 to estimate potential impacts that could result from the Draft Scoping Plan renewable diesel expansion. These results are shown in Table 3.

Thus, CARB could have estimated cumulative GHG emission increments, during 2023–2045 over 2015–2019 mean rates, that range from 19.7 to 26.4 MMT associated with DB addition in California, and 45.2 to 47.0 MMT associated with DB-induced PD exports from California.

Importantly, since DB fails to replace PD and DB-induced PD exports contribute to increased PD emissions globally (§§ 2.1.3), emission increments from both fuels (64.9 to 75.4 MMT) describe the potential direct contribution of DB-related effects to climate impacts.

---

[63] CARB *LCFS Quarterly Summary Report* Accessed Jun 2022.
[64] CARB *Monthly LCFS Credit Transfer Activity Reports* Accessed Jun 2022.
[65] Draft Scoping Plan at pages 18, 153; Draft Scoping Plan, Appendix H, at page 61.
[66] CARB *AB32 GHG Inventory Sectors Modeling Data Spreadsheet* May 2022. Energy Demand, *in* California PATHWAYS Model Outputs.
[67] Based on CARB fuel energy data from the LCFS Regulation Order, Title 17, CCR, §§ 95480–95503.
[68] The CARB projection may understate potential DB growth in California substantially. Planned renewable diesel feedstock refining capacity expansions by Phillips 66 at Rodeo (29.2 Mb/year), Marathon at Martinez (17.5 Mb/y) and AltAir at Paramount (7.8 Mb/y new capacity) suggest more rapid DB growth than CARB projects. If build as scheduled and run targeting a feasible 68.1% distillate yield on feed, these three California lipids refining projects could add some 37.2 Mb/y of renewable diesel capacity. If all three projects are built, commissioned on schedule and can overcome lipids feedstock supply limitations to operate at capacity, the growth of DB use in California by 2030 could be more than double that which CARB projects. But targets announced by refiners for projects not yet built are uncertain forecasts, and there are good reasons to limit reliance on hydrotreated lipids-based diesel biofuels.
[69] See LCFS Regulation Order, Title 17, CCR, §§ 95480–95503.

Table 3. Potential total distillate fuel shift and GHG emission increments from diesel biofuel expansion in the Draft Scoping Plan, total increments during 2023–2045

GHG: CO_2e, 100-year GWP **Mb:** million barrels **MMT:** million metric tons

		Diesel biofuel addition in CA		Petroleum distillate export induced by biofuel	
		lower bound	upper bound	lower bound	upper bound
Volume [a]	(Mb)	80.4	80.4	79.6	82.8
CI [b]	(kg/b)	245.0	353.9	567.3	567.3
Emissions [c]	(MMT)	19.7	28.4	45.2	47.0

a. Estimated cumulative diesel biofuel increments during 2023–2045 *versus* the time-weighted mean fuel volumes from 2015–2019. DB increment based on renewable diesel increment point estimate from Draft Scoping Plan fuels energy modeling and fuel energy density from CARB LCFS regulation order; PD increment range based on DB use to PD export range of 1:0.99 to 1:1.03 from analysis of State data in this report §§ 2.1.3. **b.** Carbon intensity (CI, in kg/b) values based on fuel energy densities and default fuel chain "life cycle" emission factors in CARB LCFS regulation order; the CI range for DB is based on renewable diesel CI factors for "residue" (lower bound) and "crop" (upper bound) lipids biomass feeds. **c.** CO_2e mass emission increments are calculated from the fuel volumes and CI factors shown for each fuel. Since DB use in California shifts PD to export and the estimated CI of PD is greater than that of DB, most of the resultant total distillate emission increment estimated (64.9 to 75.4 MMT) would shift outside the state. Figures may not add due to rounding.

2.3 The Draft Scoping Plan could result in major air quality and environmental health impacts associated with renewable diesel refining and diesel biofuel-induced petroleum distillate refining for export in communities near California refineries.

This potential for 79.6 to 82.8 Mb of additional PD refining for export through 2045 would emit criteria and other toxic air pollutants in communities near California refineries, pollution that would be directly linked to the GHG emissions exported with the refined fuels. Supply-demand imbalances that drive these increased community health risks from PD refining for export would increase to a greater extent under the Draft Scoping Plan than its no project alternative.[70] [71] BD refining impacts, and in particular the potential for extremely hydrogen-intensive renewable diesel processing to result in acute air pollutant exposures from more frequent flaring,[72] would add new risks in nearby communities. Thus, by resulting in new and prolonged exposures to harmful air pollutant emissions associated with prolonged or increased refining for export and increased biorefining, the Draft Scoping Plan could result in significant air quality and environmental health risk impacts.

2.4 The Draft Scoping Plan could result in major climate impacts from emission shifting caused by biofuel-induced refining for export in apparent conflict with state climate law.

2.4.1 State law requires minimizing GHG emission-shifting to the extent feasible

CARB asserts that the Draft Scoping Plan DB expansion measures would reduce GHG emissions from petroleum fuels in California. Though correct as to that limited point, CARB's analysis is incomplete; it ignores the resultant emission shifting. GHG emissions impact climate globally wherever GHG emits. Recognizing this, the California Health and Safety Code requires CARB

[70] Compare Alternative 3, Reference Scenario in CARB *AB32 GHG Inventory Sectors Modeling Data Spreadsheet* (*supra*) for potential to induce refining for export.
[71] Additional support for this comment specific to refinery emission impact is provided in § 1.3 and part 3 herein.
[72] Karras. *Changing Hydrocarbons Midstream* Aug 2021. Prepared for the NRDC.

to minimize emission shifting, which the Code defines as "a reduction in emissions of greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside the state." Cal. Health & Safety Code §§ 38505 (j), 38562 (b) (8). But by financing increased DB use which shifts PD to export while rejecting feasible direct control measures, the Draft Scoping Plan would result in the GHG emission shift defined. This would appear to conflict with State climate law.

2.4.2 Cross-border GHG emissions associated with petroleum distillate refining for export could exceed in-state GHG emission reduction from diesel biofuel substitution

GHG emissions from DB that fails to replace PD and from that PD would contribute to global climate impacts. However, the Draft Scoping Plan limits its focus to emissions in California alone. It subtracts emissions associated with PD (which would in fact be exported) from emissions associated with DB used in-state to find emission reductions within the State. Results in Table 3 indicate a potential incremental GHG emission reduction *within the state* ranging from ≈16.8 (45.2 – 28.4 = 16.8) to 27.3 (47.0 – 19.7 = 27.3) MMT. PD emissions from the DB-induced PD export increments, however, would exceed this in-state reduction at 45.2 to 47.0 MMT (Table 3). Thus, the smaller GHG emission reduction within the state would be offset by the larger GHG emission increase outside the state.

2.4.3 Feasible measures the Draft Scoping Plan excludes could minimize emission shifting

CARB can establish direct emission control standards expressed as throughput limits to each refinery in California. This measure has proven feasible when implemented on an air quality and environmental health basis and can effectively limit refining for export. See §§ 1.1.1 and § 1.3. Moreover, this measure may be required to minimize GHG emission shifting and, at a minimum, that requirement further supports its feasibility. This measure is further discussed in §§ 1.4.3.

CARB also can establish a numeric cap on statewide DB usage. A lipids-derived DB cap has been suggested by the State's expert advisors on transportation measures to achieve its climate goals,[73] and could lessen or avoid new air quality and climate impacts associated with DB fuel chain emissions and those from DB-induced refining for export. This measure also could support lower-emitting and more scalable non-combustion freight and shipping alternatives.

2.5 The Environmental Assessment (EA) is factually incomplete.

Presuming that diesel biofuel replaces petroleum distillate fuel, when it does not, represents a fatal error in the Draft Scoping Plan *and* the EA. The EA does not identify, describe, assess, or analyze feasible mitigation for air quality, environmental health, or climate impacts associated with refining and burning more total distillate that could result from the Draft Scoping Plan.

/

/

/

---

[73] Brown et al. *Driving California's Transportation Emissions to Zero* Apr 2021. UC Office of the President, ITS reports. See pages 392–396.

3 Potential impacts from delayed refining phase down on the feasibility of climate stabilization pathways

Putting off transition impacts by delaying direct refining phase down measures CARB can take now to transition from oil, the Draft Scoping Plan would lead to a vicious cycle: Cumulative emissions increase faster while time left for cutting them shortens. This forces deeper cuts faster to our climate goal. That increases the severity of transition impacts, reinforcing the vicious cycle. Delay, then, can be a dead-end path to climate disaster. Analysis of high-quality data demonstrates that the Draft Scoping Plan phase down delay could breach clearly foreseeable feasibility tipping points. Major impacts that could result from its rejection of "maximum feasible" measures include conflict with State climate law, prolonged toxic health impacts near refineries, and total cumulative emissions that far exceed the State GHG emissions goal. The Draft Scoping Plan and EA obscure these impacts through a series of errors and omissions.

3.1 <u>The Draft Scoping Plan obscures potential impacts of delayed refinery phase down</u>.

3.1.1 Delayed refining cuts make emissions targets less feasible to achieve

This point is simple and crucial. Suppose one sector in the statewide economy emits 50 percent of total statewide emissions and all other sectors emit the other 50 percent. When we need total emissions to be cut 25 percent, if the super-emitter delays its cuts, all the other sectors must cut their emissions by 50 percent to make the cut. That makes the total cut less feasible than it would be if all sectors did their share. When we need total emissions cut 50 percent, if the super-emitter still delays its cuts, all other sectors must cut their emissions by 100 percent (go to zero) to make the cut. That makes the needed cut much less feasible.

In fact, the petroleum fuel chain linked to California refineries emits up to 65 percent of total GHG linked to all activities in California.[74] Moreover, accounting for the emission shifting enabled by an absence of direct refinery GHG emission standards, which allowed export refining as in-state petroleum demand began to decline, sustained cuts in those refining-linked petroleum fuel chain emissions were, in fact, delayed.[75] The Draft Scoping Plan omits these facts.

3.1.2 The Draft Scoping Plan does not quantify and report any path to the State's direct emissions targets that is known to be feasible based on measures proven in practice

State climate emission reduction targets, expressed in shorthand as –40% by 2030 and –80% by 2050, are direct emission reduction goals, which "carbon neutrality" measures such as industrial or biological carbon sequestration are explicitly meant to supplement but not to replace.[76] The State's "carbon neutrality goal is layered on top of the state's existing commitments to reduce greenhouse gas emissions 40% below 1990 levels by 2030 ... and 80% below 1990 levels by

---

[74] CEJA, *Climate Pathways in an Oil State* Prepared by Greg Karras. Feb 2022.
[75] *Id*.
[76] *Executive Order B-55-18 to Achieve Carbon Neutrality* Edmund G. Brown Sep 2018.

2050."[77] This distinction is important because CARB climate plans and measures are required to achieve the "maximum feasible" GHG emission reductions,[78] and carbon-capture-sequestration has not been proven feasible at the necessary scale.[79]

In essence, State policy calls on CARB to refrain from delaying feasible measures to meet State GHG emission targets in favor of unproven carbon neutrality measures that may not prove feasible and in any case are to be "layered on top" after the State emission targets are met. But that is not what the Draft Scoping Plan does. None of its scenarios include direct refinery phase-down standards. All of them lump proven direct measures and unproven carbon capture measures together, conflate the emission reduction target and carbon neutrality goal analyses, or both. It does not quantify and report any path to the direct emission reduction targets that is known to be feasible based on measures that are proven in practice.

3.1.3 The Draft Scoping Plan obscures climate impacts of delay through failure to disclose and compare cumulative emissions from its scenarios over time

Emitted CO_2 accumulates in the upper atmosphere, where it contributes to climate-forcing "greenhouse" impacts on the climate system for hundreds of years. *Cumulative* emission over time is a direct metric for climate effects of the Draft Scoping Plan. Annual emission snapshots are not. However, the Draft Scoping Plan presents analysis focused on snapshots of annual emission rates. This obscures climate impacts that could result from the Draft Scoping Plan.

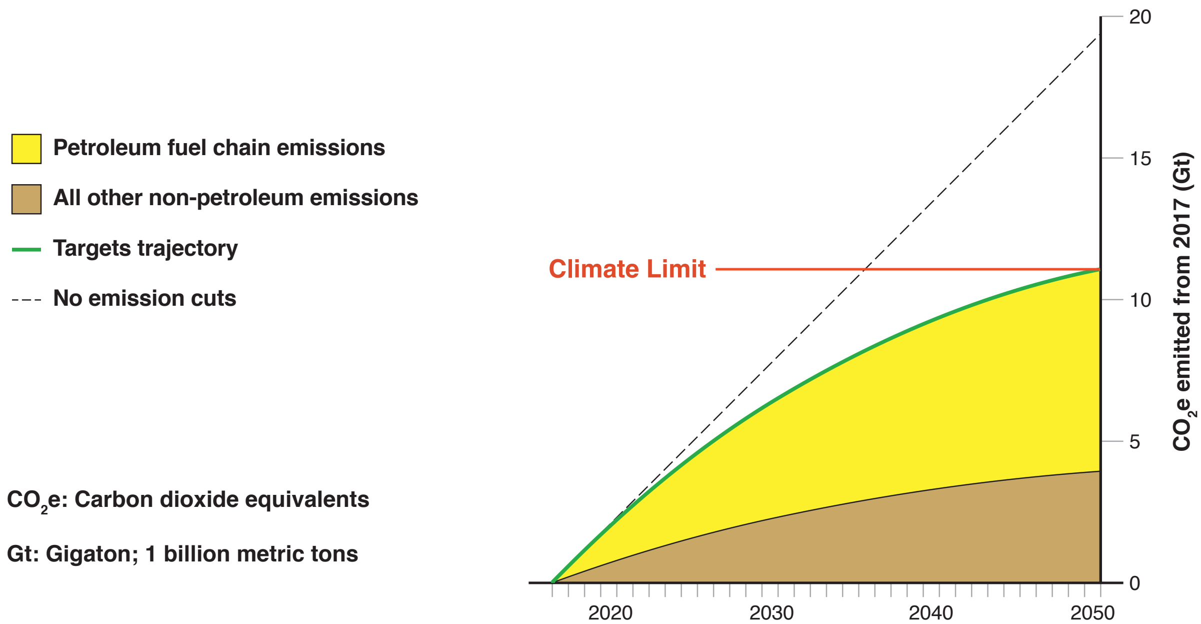
First it obscures impacts of delayed emission cuts on climate. For example, the Draft Scoping Plan (Alternative 3) delays GHG emission cuts from replacing fossil fuels in vehicles, power plants and industry compared with Alternative 1. It presents Alternative 3 as resulting in equivalent GHG emission cuts to Alternative 1 between 2020 and 2045 (–355 MMT), based on its comparison of *annual* emissions between those two years.[80] Adding up the data for all years from 2020 through 2045, however, *cumulative* GHG emissions from the Draft Scoping Plan exceed those from Alternative 1 by ≈1,520 MMT, or ≈26 percent.[81] Sole focus on the annual emissions obscures a 1,520 MMT climate impact of delay that cumulative analysis reveals.

Second, focusing solely on annual emissions obscures impacts of delayed emission cuts on the *feasibility* of climate stabilization. In the example above it missed 1,520 MMT of cumulative emissions that are more feasible to prevent than to suck out of the air after the GHG emits. Both limiting the accumulation of GHG emissions to a climate-forcing impact of 1.5 to 2 ºC global heating, and the feasibility of measures which could do that, have a timing component. Their timing and feasibility are interdependent. Quantifying this interdependence has been a central problem in CARB climate planning. Pairing technology pathways analysis with cumulative emission trajectories analysis can solve this problem.[82] Indeed, this inclusive data analysis method appears necessary to estimate the feasibility of climate pathways accurately.

---

[77] Mahone et al. *Achieving Carbon Neutrality in California: PATHWAYS Scenarios Developed for the California Air Resources Board* Energy and Environmental Economics. Oct 2020. See page 14.
[78] See Cal. Health & Safety Code §§ 38560.5 (c), 38561 (a), (c), 38562 (a).
[79] See Draft Scoping Plan comments of Julia May on behalf of the California Environmental Justice Alliance.
[80] CARB *AB32 GHG Inventory Sectors Modeling Data Spreadsheet* (*supra*)
[81] *Id*.
[82] CBE (2020) *supra;* CEJA (2022) *supra*.

Moreover, the Draft Scoping Plan does not disclose that the State's direct emission targets were developed and timed to limit *cumulative* emission at the State's share of global emission that is consistent with holding climate heating below 2 ºC. Its direct emission targets define this climate limit. The targets seek continuous, proportionate annual cuts in direct emissions during three periods.[83] First, back to the emission rate in 1990 by 2020, then 40 percent below the 1990 rate by 2030, then 80 percent below the 1990 rate by 2050. Now we are past 2020, statewide emissions were close to that first target, and we have reliable and accurate emissions data representative of current pre-COVID conditions from 2013–2019[84] to assess the proportionate annual cuts to the 2030 and 2050 targets. With these cuts, a certain amount of CO_2e will be emitted each year through 2050. The climate limit is simply the sum total of these proportionately declining annual emissions. See Chart 3.



3. State Climate Target: Cumulative emission limit through 2050 defined by state climate targets
For data and details of methods see CEJA (2022) Supporting Material, esp. Table S9.

Chart 3 illustrates cumulative emission trajectories defined by State climate targets. The trajectories start with actual emissions as of 2017 based on high quality State and federal data.[85] Reduced emissions defined by the targets add to cumulative emissions in each subsequent year. The non-petroleum (brown shading), petroleum fuel chain (yellow shading), and total (green curve) trajectories bend downward because of these sustained emission cuts. The climate limit (red line) is the total emissions through 2050, approximately 11.1 gigatons (Gt) or 11,100 MMT. This cumulative emission limit is consistent with State's share of global emission reductions for a 67 percent chance of holding global heating to between 1.5 and 2.0 ºC.[86]

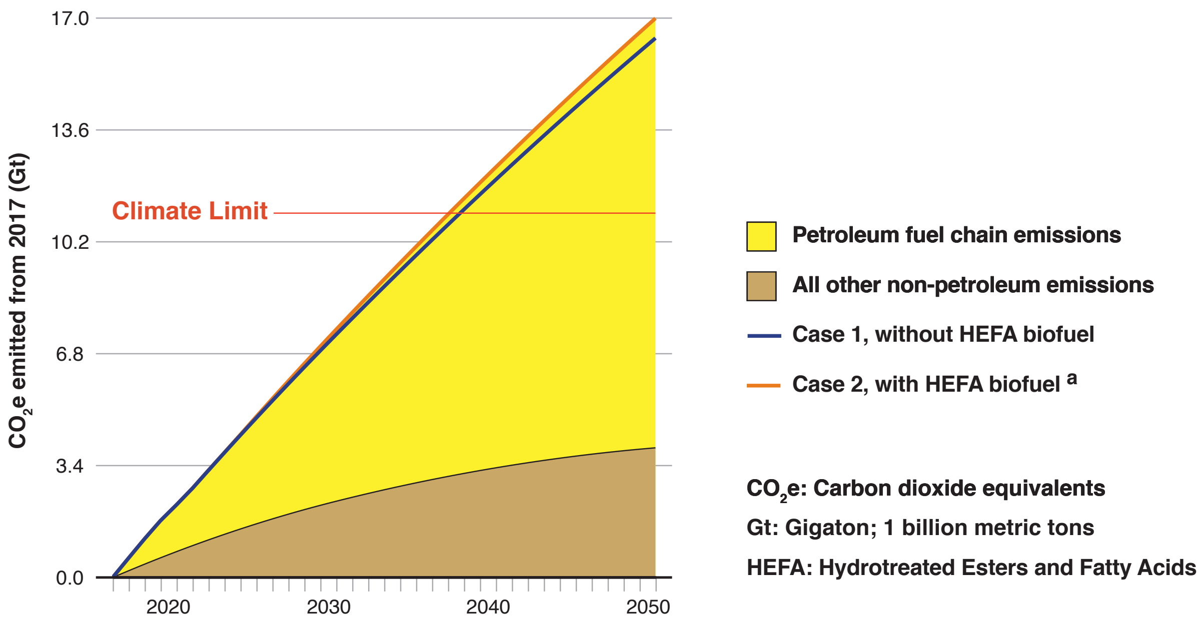
---

[83] See CBE (2020) *supra*
[84] CEJA (2022) *supra*, see Table S1.
[85] *Id*.
[86] CEJA (2022) *supra*, see tables S9, S10.

3.2 Even if all other, non-petroleum emissions are cut to their share of the State direct emissions reduction goal, this goal cannot be achieved without petroleum refining rate cuts.

To assess potential climate impacts, CEJA compared cumulative emissions from the petroleum fuel chain linked to California refineries with the climate limit, along pathways without crude rate reductions. Uncut petroleum emissions would build up more than in the climate limit trajectory illustrated in Chart 3. But how much more? CARB did not say.

Chart 4 illustrates the potential for climate impacts from the petroleum fuel chain alone, by showing emissions associated with all other, non-petroleum activities statewide as they would appear if cuts to their share of the climate limit will be sustained along the entire path from 2017 through 2050. The "all other, non-petroleum" trajectory in Chart 4 is the same as its climate limit trajectory as illustrated in Chart 3 above (brown shading in both charts).



4. Cumulative emission along petroleum fuel chain pathways without refinery crude rate cuts.
Assumes all other non-petroleum emissions are cut to their share of the climate limit. (a) Without refinery crude rate cuts, Case 2 includes only crude-to-biofuel refinery conversions which would not reduce capacity to maintain current refining rates on all climate pathways. For data and details of methods see CEJA (2022) Supporting Material, tables S11, S12.[1]

Uncut petroleum fuel chain emissions without crude rate cuts (yellow shading) drive a dramatic buildup of total cumulative emissions (rising blue and orange curves) to exceed the climate limit (red horizontal line) by a wide margin before 2050. Pathways without crude rate cuts exceed the climate limit trajectory by 13 to 16 percent in 2030, irreversibly exceed the 2050 climate limit by 2038, and exceed the limit by 5,300 to 5,900 MMT, or 48 to 53 percent, by 2050.[87] That vast accumulation of climate forcing GHG would contribute to global climate heating significantly.

This climate protection failure would occur despite cutting all other non-petroleum emissions to their share of the climate limit. See Chart 4. It would occur despite falling in-state demand for petroleum fuels. See §§ 1 and 2 herein. Ongoing refiner efforts to protect their otherwise

[87] CEJA (2022) *supra*, see table S11 and S12.

stranded assets and seek returns to scale by increasing refining for export across the global fuel chain in response to decreasing in-state demand would be among its proximate causes. *Id.* A root cause would be State failure, despite clearly foreseeable and significant local and global impacts of this emission shifting, to directly control and phase down petroleum refining in-state. By rejecting this measure the Draft Scoping Plan could result in this climate protection failure.

> **THE EFFECT OF DELAY ON ANNUAL REFINERY CUTS IS SIMPLE MATH.**
>
> Suppose a polluter emits ten tons per year, and its climate limit for the next three years is a cumulative total of 24 tons.
>
> What happens if it starts the cuts now? It could cut emissions by 1 ton per year for three years to meet the 24 ton limit. That would emit 9 tons this year, 8 tons next year, and 7 tons the third year. Here's the math: 9 tons + 8 tons + 7 tons = 24 tons.
>
> What if it waits a year? After emitting 10 tons this year it could cut emissions by 2 tons per year in each of the next two years to meet the limit: 10 tons + 8 tons + 6 tons = 24 tons. But that 2 tons per year is twice the pace of the 1 ton per year cut if it starts now.
>
> What if it waits two years? It would emit 20 tons during those two years. Only 4 tons would be left out of its total limit of 24 tons. To meet the limit it must cut 6 tons in the third year: 10 tons + 10 tons + 4 tons = 24 tons. But cutting 6 tons in a year after waiting two years is **six times** the one-ton-per-year pace if it starts now.

Box: CBE (2020)

3.3 <u>By rejecting gradual implementation of direct refinery phase down measures that can be in effect before 2031, the Draft Scoping Plan could result in a significant climate impact through failure to include the "maximum feasible" measures, contrary to state climate law</u>.

Cuts to zero emissions "will not happen overnight."[88] Even with deep non-zero cuts, cumulative emission keeps rising, as shown for the "all other, non-petroleum" emissions in Chart 4. This shows waiting for emissions to approach the climate limit can delay action until it is too late.

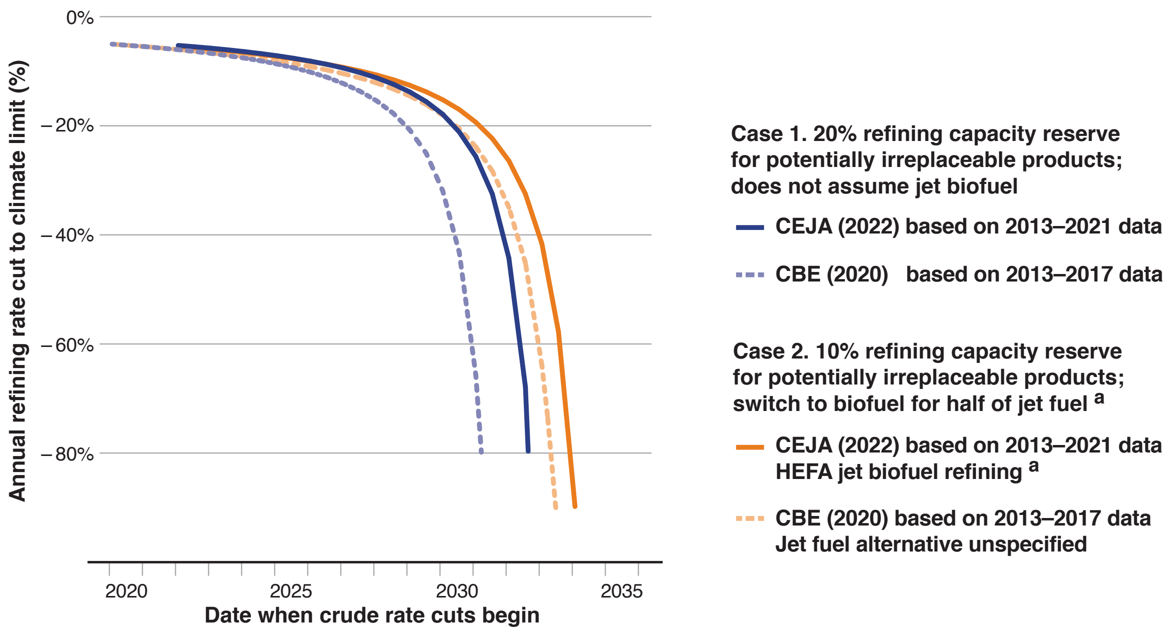
Tipping points in the feasibility of meeting our climate limit, as measured by refining capacity lost annually along climate pathways, are different from tipping points in the climate system. Compared with the complexity and uncertainty of climate system tipping points, these feasibility tipping points are certain to occur with delay, and predictable based on simple math. See Box.

Tipping points can be quantified based on available data[89] that CARB could have analyzed in its Draft Scoping Plan feasibility analysis. However, the Draft Scoping Plan fails to disclose clearly foreseeable tipping points in the feasibility of achieving State emission targets that are directly linked to the timing of refinery phase downs. Chart 5 illustrates the deeply diving downward curves of annual refining capacity losses that would be caused by delays in starting crude rate cuts along 91 pathways to the climate limit.

---

[88] CARB itself makes this point. See Draft Scoping Plan at pages vii, 78, 152.

[89] See CEJA (2022) *supra.* Charts 3, 4 and 5 and discussions of them herein draw on exhaustive analysis of high-quality primary data from CARB and other State and federal agencies in CBE (2020) *supra* and CEJA (2022) *supra*, which updates the CBE (2020) analysis to include more recent new and revised data. The Box above is from CBE.



5. Effect of delay on annual refinery crude rate cuts to the State climate limit.
Assumes non-petroleum emission cuts to their share of the climate limit. (a) Case 2, in this report, assumes repurposing refining capacity lost along climate pathways with HEFA refining up to the 50/50 biofuel/petroleum jet fuel blending limit. HEFA: Hydrotreated esters and fatty acids; type of biofuel. For data and details of methods see CEJA (2022) Tables 11, 12.

Pathways to the climate limit that decommission refinery capacity gradually at five to seven percent per year (Chart 5, left) would be foreclosed by delaying the start date for sustained crude rate cuts in the petroleum fuel chain from left to right in the chart. Delay until 2032 (Case 1) or 2034 (Case 2) would force refining capacity losses of 80 to 90 percent in a single year to meet the climate limit (chart, right). That enormous increase in sudden statewide refinery closures, hence worsening of transition impacts, would substantially and irreversibly impair the social feasibility of meeting the State climate limit. But the tipping point would come sooner.

Tipping points for the feasibility of meeting the climate limit, after which delay drives these transition impacts over a cliff, from around 20 percent to 80 or 90 percent refinery capacity losses per year to meet the limit, would arrive by 2031 at the latest (orange curve) and could trigger irreversible impairment of state climate limit feasibility by 2030 (blue curve).

Worse, it can take years from official proposal to actual enforcement of refinery emission cuts.[90] Refinery rulemaking to avoid the feasibility "cliff" illustrated in Chart 5 must start right away. The Draft Scoping Plan would delay direct refinery phase down measure rulemaking.

California climate law requires CARB climate measures and plans to achieve the "maximum feasible" GHG emission reductions.[91] Instead, the Draft Scoping Plan would reject planning for, and thereby foreclose via delay, a feasible measure that is needed to meet State GHG emission reduction targets and depends upon starting sooner for its feasibility. That would appear contrary to State climate law and could result in a significant climate impact.

[90] CEJA (2022) *supra*, page 15.
[91] Cal. Health & Safety Code §§ 38560.5 (c), 38561 (a), (c), 38562 (a).

3.4 <u>Significant air quality, health, and environmental justice impacts could result from the failure of the Draft Scoping Plan to include a direct refining phase down measure</u>.

As shown throughout this report, climate, air quality and health impacts that could result from the Draft Scoping Plan are linked to increased refining for export and could be lessened or avoided by a feasible measure to phase down oil refining. This measure, facility-level direct standards expressed as refinery throughput that decline over time, was further shown to be justified on an air quality and environmental health basis, which further supports its feasibility. This subsection (3.4) incorporates §§ 1.3, 1.5, 2.3, 2.5 herein by reference and further supports that measure.

Low income Black and Brown populations in California communities that host refineries have long been shown[92] to face disparately worsened exposures to harmful refinery emissions of CO_2e co-pollutants, such as particulate matter, nitrogen oxides, sulfur oxides, and other criteria and toxic air pollutants. Doubling down on this toxic racism, a substantial and potentially growing portion of that disparately severe exposure is being caused by refining for export of fuels that Californians do not need or use.[93]

The same refinery-specific direct control measures needed to reduce crude rates before our most feasible pathways to the State climate limit are foreclosed would reduce these emissions from refineries as well. These direct control measures would benefit environmental justice communities, further enhancing the feasibility of least-impact pathways to the climate limit. Conversely, further delaying them would prolong and worsen an acute social injustice in California communities that host refineries, further impairing the feasibility of delayed action pathways to the climate limit. For example, consider Table 4.

Table 4. Refining for export community emission impacts avoidable by the least-impact climate pathway starting crude rate reductions in January 2023

t (ton): metric ton **Mt** (Megaton): 1 million tons **No CCR:** no crude rate reduction

	CO_2e emitted by refining for export (Mt/y) [a]			Co-pollutant emissions from refining for export (t/y) [b]			
Year	No CRR	Climate path	Export refining	PM	NOx	SOx	Subtotal
2022	35.64	35.64	0.00	0	0	0	0
2023	35.64	33.58	2.06	129	457	263	848
2025	35.64	29.81	5.83	364	1,290	744	2,400
2030	35.64	22.13	13.51	843	3,000	1,720	5,560
2035	35.64	16.43	19.21	1,200	4,260	2,450	7,910
2040	35.64	12.20	23.44	1,460	5,200	2,990	9,650
2045	35.64	9.06	26.58	1,660	5,900	3,390	10,900
2050	35.64	7.14	28.50	1,780	6,330	3,630	11,700

PM: particulate matter; PM_{10} including $PM_{2.5}$ **NOx:** oxides of nitrogen **SOx:** oxides of sulfur
a. CO_2e emissions from refining for export without crude rate cuts are the difference of No CRR and climate path emissions from the least-impact pathway starting CRR in Jan 2023. **b.** CO_2e co-pollutant emissions from refining for export were based on co-emission factors (e.g., t PM/Mt CO_2e) derived from state refinery emissions data. For data and details of methods see CEJA (2022) tables S11, S13. The table shows only new, post-2022, refining for export impacts. Table adapted from CEJA (2022). Figures may not add due to rounding.

[92] Pastor et al. *Minding the Climate Gap: What's at stake if California's climate law isn't done right and right away* U. Cal. Berkeley and U. Southern California. Apr 2010.
[93] See §§ 1.1, 1.2, 1.3 and 3.2 herein.

Compared with the least-impact climate pathway, in which direct measures launch a gradual phase down of refining in 2023, delaying the phase-down start date could foreclose annual criteria air pollution cuts from statewide refineries of approximately 5,560 metric tons by 2030, 9,650 tons by 2040, and 11,700 tons by 2050 from refining for export alone. Table 4.[94] Applying enhanced direct throughput reduction standards to California refineries is therefore strongly supported on the basis of need, authority and obligation to cure air quality, health, and equity impacts in communities in the shadows of refinery emission stacks.

But despite the consequent climate impacts and emission shifting contrary to State climate law,[95] the Draft Scoping Plan proposes to reject this feasible, needed climate and health measure. This proposed action would arbitrarily expose disparately pollutant-burdened communities to more harmful air pollution, to which people in communities near refineries would be exposed routinely and episodically for an unnecessarily prolonged period. The Draft Scoping Plan could thus result in significant air quality and environmental health impacts.

This evidence further supports refinery-specific phase down standards for climate justice.

3.5 <u>The Environmental Assessment (EA) is factually incomplete</u>.

California's Final Scoping Plan can apply throughput standards to phase down refineries before the rising carbon flow through their combustion fuel chain overwhelms its all-source emission reduction targets, further poisons nearby Black and Brown communities, and blows through our share of cumulative global GHG emission to hold climate heating below 2 ºC. This measure is feasible given the gradual refining phase down schedule that is still available now, and appears essential to ensure statewide all-source emission targets can be met. Instead, the Draft Scoping Plan would exempt refineries from this measure now, while there is still time for gradual refinery phase downs, and could thereby foreclose this now-feasible measure through delay.[96]

The EA does not identify, describe, assess, or analyze feasible mitigation for air quality, health, or climate impacts associated with foreclosing feasible refining rate reductions through delay. which could result from the Draft Scoping Plan.

---

[94] Table 4 was adapted from CEJA (2022), *supra*

[95] See §§ 1.4, 2.1, 2.2, 2.4, 3.2 and 3.3 herein.

[96] As stated, CARB's rationale for this oil industry exemption fails on the facts. Refiners have not phased down in line with in-state petroleum demand; they increased production on increased exports across the Pacific Rim. Diesel biofuel did not replace or reduce petroleum distillate refining or combustion; refiners exported petroleum distillate and boosted its production. Refining is not a separate, small, or fungible part of the statewide GHG equation; it enables fuel chain carbon flow that emits more than half of total statewide GHG. There is no evidence for rejecting a proven measure like refining rate control based on the presumed cost-effectiveness of an unproven measure like carbon capture and storage; cost "effectiveness" of unproven measures cannot be known until they prove effective. It is not valid to compare climate effects of deploying different arrays of measures over time ("scenarios," "trajectories" or "pathways") based on annual emissions in their final year alone; the pathway that delays measures may cut to the same emission rate in that final year but emit much more along the way—and cumulative emissions over time, not 'blips' in any one year, drive climate heating. This list of relevant errors and omissions in the Draft Scoping Plan and EA is not necessarily exhaustive.

4 List of Exhibits and Attachments Provided with this Report

Exhibits

Exhibit 1. Distillate Fuels Data, California and World, page 27.

Exhibit 2. Partial Least Squares Regression Results, page 28.

Attachments

Abdul-Manan, A. F.N. Lifecycle GHG emissions of palm biodiesel: Unintended market effects negate direct benefits of the Malaysian Economic Transformation Plan (ETP). *Energy Policy* **2017.** 104: 56–65. http://dx.doi.org/10.1016/j.enpol.2017.01.041. Attachment file label: Abdul-Manan_*Lifecycle GHG emissions of palm biodiesel*_Jan_2017

Bento, A. M.; Klotz, R. Climate Policy Decisions Require Policy-Based Lifecycle Analysis. *Environ. Sci. Technol.* **2014.** 48: 5379-5387. dx.doi.org/10.1021/es405164g Attachment file label: Bento and Klotz_*Climate Policy Decisions Require Policy-Based Lifecycle Analysis*_Apr 2014

Brown, A. L.; Sperling, D; Austin, B et al. *Driving California's Transportation Emissions to Zero;* University of California Office of the President, ITS reports. **2021.** DOI: 10.7922/G2MC8X9X. https://escholarship.org/uc/item/3np3p2t0. Attachment file label: Brown et al_*Driving California's Transportation Emissions to Zero*_Apr_2021

CARB *AB32 GHG Inventory Sectors Modeling Data Spreadsheet;* E3, California PATHWAYS Model Outputs. 2 May 2022. Excerpt includes Emissions and Energy Demand sheets. California Air Resources Board: Sacramento, CA. Attachment file label: CARB_AB32 Modeling Excerpts_May_2022.

CARB *Fuel Activity for California's Greenhouse Gas Inventory by Sector & Activity (Fourteenth Edition: 2000 to 2019);* California Air Resources Board: Sacramento, CA. Fuel Combustion and Heat Content; https://ww2.arb.ca.gov/ghg-inventory-data. Attachment file label: CARB_*Fuel Activity 2000–2019*_Jul_2021

CARB *LCFS Data Dashboard Figure 10, Data Table "DMAggregatedFuelVolumes";* Accessed Jun 2022. California Air Resources Board: Sacramento, CA. https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm. Attachment file label: CARB_*LCFS Dashboard*_Jun_2022 CARB_

CARB *Low Carbon Fuel Standard Reporting Tool Quarterly Summaries;* Spreadsheet; Fuels Tab. Accessed June 2022 from: https://ww2.arb.ca.gov/resources/documents/low-carbon-fuel-standard-reporting-tool-quarterly-summaries. Attachment file label: CARB_*LCFS Quarterly Summary Report* _Jun_2022

CARB *Monthly LCFS Credit Transfer Activity Reports;* Accessed Jun 2022 from https://ww2.arb.ca.gov/resources/documents/monthly-lcfs-credit-transfer-activity-reports. Annual average credit prices from December reports. California Air Resources Board: Sacramento, CA. Attachment file label: CARB_LCFS Credit Transfer Activity_Jun_2022

CBE *Decommissioning California Refineries: Climate and Health Paths in an Oil State;* **2020.** A report by Communities for a Better Environment. Karras, G., Author. Includes Supporting Material Appendix. Available at www.energy-re-source.com Attachment file label: CBE_*Decommissioning California Refineries*_Jul_2020

CEC *Refinery Inputs and Production;* Fuel Watch. California Energy Commission: Sacramento, CA. https://www.energy.ca.gov/data-reports/reports/weekly-fuels-watch/refinery-inputs-and-production. Attachment file label: CEC_ *Refinery Inputs and Production*_Accessed_Jun_2022

CEJA, 2022. *Climate Pathways in an Oil State – 2022;* **2022.** A California Environmental Justice Alliance Report. Includes Supporting Material Appendix. Prepared by Greg Karras, Community Energy reSource; www.energy-re-source.com Attachment file label: CEJA_Climate Pathways in an Oil State_Mar_2022

Chen, X.; Khanna, M. The Market-Mediated Effects of Low Carbon Fuel Policies. *AgBioForum* **2012.** 15(1): 89–105. Attachment file label: Chen and Khanna_*Market-Mediated Effects Low Carbon Fuel*_2012

Davis, S. J.; Socolow, R. H. Commitment accounting of CO_2 emissions. *Environ. Res. Lett.* **2014**. 9. https://doi.org/10.1088/1748-9326/9/8/084018. Attachment file label: Davis and Socolow_*Commitment accounting of* CO_2 *emissions*_Aug_2014

Davis, S. J.; Caldeira, K.; Matthews, D. Future CO_2 Emissions and Climate Change from Existing Energy Infrastructure. *Science* **2010**. 329: 1330. https://doi.org/10.1126/science.1188566 Attachment file label: Davis et al_*Future* CO_2 *Emissions and Climate Change from Existing Energy Infrastructure*_Sep_2010

Drabik, D.; de Gorter, H. Biofuel Policies and Carbon Leakage. *AgBioForum* **2011.** 14(3): 104–110. Attachment file label: Drabik and de Gorter_*Biofuel Policies and Carbon Leakage*_2011

EIA *Transportation sector energy consumption by region and fuel;* US Energy Information Administration: Washington, D.C. Report downloaded 29 March 2022 from: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=49-IEO2021&region=0-0&cases=Reference&start=2010&end=2050&f=A&linechart=Reference-d210719.3-49-IEO2021&ctype=linechart&sourcekey=0 Attachment file label: EIA_*Transport sector energy cons by region and fuel*_Mar_2022

EIA *West Coast Transportation Fuels Markets;* **2015.** PADD 5 Transportation Fuels Markets. US Energy Information Administration: Washington, D.C. Attachment file label: EIA_West Coast Transportation Fuel Markets_Sep_2015

EPA *Draft Regulatory Impact Analysis: RFS Annual Rules.* EPA-420-D-21-002. **2021.** Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency: Washington, D.C. Attachment file label: EPA_*Draft Regulatory Analysis*_Dec_2021

Executive Order EO B-55-18 to Achieve Carbon Neutrality. California Governor Edmund G. Brown. **2018.** Attachment file label: EO B-55-18_*to Achieve Carbon Neutrality*_Sep_2018

Grafton, Q. R.; Kompas, T.; Long, N. V.; To, H. US biofuels subsidies and CO_2 emissions: An empirical test for a weak and a strong green paradox. *Energy Policy* **2014.** 68: 550–555. http://dx.doi.org/10.1016/j.enpol.2013.11.006. Attachment file label: Grafton et al_*US biofuels subsidies and CO_2 emissions*_Dec 2013

Ha-Duong, M.; Grubb, M. J.; Hourcade, J.-C. Influence of socioeconomic inertia and uncertainty on optimal CO_2-emission abatement. *Nature* **1997**. 390: 270–273. Attachment file label: Ha Duong et al_*Influence socioeconomic inertia emission abatement*_Nov_1997

Hill, J.; Tajibaeva, L.; Polasky, S. Climate consequences of low-carbon fuels: The United States Renewable Fuel Standard. *Energy Policy* **2016.** 97: 351-353. http://dx.doi.org/10.1016/j.enpol.2016.07.035 Attachment file label: Hill et al_*Climate consequences of low-carbon fuels*_Aug 2016

IEA *World Production and Final Consumption of Gas/Diesel* Accessed Mar 2022 from IEA Data and Statistics, Data Tables, Oil; International Energy Agency: Paris FR. https://www.iea.org/data-and-statistics/data-tables?country=WORLD&energy=Oil&year=2010. Attachment file label: IEA_World Prod and Final Cons Gas/Diesel_2010_to_2019

Karras, G. Changing Hydrocarbons Midstream: Fuel chain lock-in potential of crude-to-biofuel petroleum refinery repurposing. **2021.** Prepared for the Natural Resources Defense Council. Available at www.energy-re-source.com/publications Attachment file label: Karras_Changing Hydrocarbons Midstream_Aug_2021

Low Carbon Fuel Standard Regulation Order (excerpts). **2020.** Title 17, CCR, §§ 95480–95503. Unofficial electronic version. Excerpts include tables 4, 7-1, 8. Attachment file label: LCFS Reg Order_*Excerpts*_May_2020

Mahone et al. Achieving Carbon Neutrality in California: PATHWAYS Scenarios Developed for the California Air Resources Board. **2020.** California Air Resources Board: Sacramento, CA. Energy and Environmental Economics, Inc: San Francisco, CA. Attachment file label: Mahone et al_*Achieving Carbon Neutrality in California*_Oct_2020

Pastor et al. Minding the Climate Gap: What's at stake if California's climate law isn't done right and right away. **2010.** College of Natural Resources, Department of Environmental Science, Policy and Management, University of California, Berkeley: Bekeley, CA; and Program for Environmental and Regional Equity, University of Southern California: Los Angeles, CA. Attachment file label: Pastor et al_*Minding the Climate Gap*_Apr_2010

Rajagopal, D.; Plevin, R.; Hochman, G.; Zilberman, D. Multi-objective regulations on transportation fuels: Comparing renewable fuel mandates and emission standards. *Energy Economics* **2015.** 49: 359–369. https://doi.org/10.1016/j.eneco.2015.02.020 Attachment file label: Rajagopal et al_*Multi-objective regulations on transportation fuels*_Mar_2015

Rozenberg, J.; Davis, S. J.; Narloch, U.; Hallegatte, S. Climate constraints on the carbon intensity of economic growth. *Environ. Res. Lett*. **2015**. 10. https://doi.org/10.1088/1748-9326/10/9/095006 Attachment file label: Rozenberg et al_*Climate constraints on the carbon intensity of economic growth*_Sep_2015

Seto, K. C.; Davis, S. J.; Mitchell, R. B.; Stokes, E. C.; Unruh, G.; Urge-Vorsatz, D. Carbon Lock-in: Types, Causes, and Policy Implications. *Annu. Rev. Environ. Resour*. **2016**. 41: 425. https://doi.org/10.1146/annurev-environ-110615-085934 Attachment file label: Seto et al_*Carbon Lock-in*_Sep_2016

Smith, C. J.; Forster, P. M.; Allen, M.; Fuglestvedt, J.; Millar, R. J.; Rogelj, J.; Zickfeld, K. Current fossil fuel infrastructure does not yet commit us to 1.5ºC warming. *Nature Communications* **2019**. 10:101 https://doi.org/10/1038/s41467-018-07999-w. Attachment file label: Smith et al_*Current fossil fuel infrastructure does not yet commit us to 1.5 ºC warming*_Jan_2019

Tong, D.; Jhang, Q.; Zheng, Y.; Caldeira, K.; Shearer, C.; Hong, C.; Qin, U.; Davis, S. J. Committed emissions from existing energy infrastructure jeopardize 1.5ºC climate target. *Nature* **2019**. 572, 373. https://www.nature.com/articles/s41586-019-1364-3. Attachment file label: Tong et al_*Committed emissions from existing energy infrastructure jeopardize 1.5 ºC climate target*_Jul_2019

Unruh, G. C. Understanding carbon lock-in. *Energy Policy* **2000**. 28: 817–830. www.elsevier.com/locate/enpol. Attachment file label: Unruh_*Understanding carbon lock-in*_Mar_2000

EXHIBIT 1. Distillate Fuels Data, California and World

All data in millions of barrels (Mb)

PD: petroleum distillate **DB:** diesel biofuel; biodiesel and renewable diesel **b:** (barrel); 42 U.S. gallons

California	DB use [a]	PD use (demand) [a]	PD production [b]	PD net export [c]
2000	0.0476	87.0246	102.0795	15.0549
2001	0.0595	88.4041	106.2020	17.7979
2002	0.0952	90.9339	109.0410	18.1071
2003	0.0214	91.4559	113.0250	21.5691
2004	0.0333	96.2476	112.3970	16.1494
2005	0.0612	101.9456	126.1429	24.1972
2006	0.4669	103.5919	127.0643	23.4723
2007	0.4157	101.4276	123.1786	21.7509
2008	0.2786	95.2376	136.2452	41.0076
2009	0.1648	83.7293	118.4643	34.7349
2010	0.1754	90.9053	122.5405	31.6351
2011	0.4765	92.7767	125.7095	32.9328
2012	0.7219	91.7536	123.7548	32.0011
2013	4.3051	92.4435	131.3690	38.9256
2014	4.2772	96.6300	137.4976	40.8676
2015	6.9430	96.1149	136.9000	40.7851
2016	9.9767	95.0480	129.5357	34.4878
2017	12.0350	92.7873	134.9905	42.2032
2018	13.5250	91.7491	135.4357	43.6866
2019	19.7508	83.4752	131.7381	48.2629

World	World consumption of PD for all uses [d]	World use of PD in transportation [e]
2010	8,497.76	6,706.22
2011	8,659.04	6,935.68
2012	8,815.78	7,105.51
2013	8,943.98	7,236.73
2014	9,114.00	7,425.49
2015	9,273.51	7,612.81
2016	9,227.47	7,736.16
2017	9,414.91	7,903.35
2018	9,475.86	8,096.96
2019	9,420.83	8,161.30

a. Data from *Fuel Activity for California's Greenhouse Gas Inventory by Sector & Activity (Fourteenth Edition: 2000 to 2019);* California Air Resources Board: Sacramento, CA. Fuel Combustion and Heat Content; https://ww2.arb.ca.gov/ghg-inventory-data

b. Data from *Refinery Inputs and Production;* California Energy Commission: Sacramento, CA. Fuel Watch. https://www.energy.ca.gov/data-reports/reports/weekly-fuels-watch/refinery-inputs-and-production

c. PD net export is PD production minus PD use. California refiners export PD to other states and nations.

d. Data converted to volume at an assumed energy density of 134.47 MJ/gal. from energy data in *Transportation sector energy consumption by region and fuel;* US Energy Information Administration: Washington, D.C. Report downloaded 29 March 2022 from: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=49-IEO2021&region=0-0&cases=Reference&start=2010&end=2050&f=A&linechart=Reference-d210719.3-49-IEO2021&ctype=linechart&sourcekey=0

e. Data converted to volume at an assumed energy density of 134.47 MJ/gal. from energy data in *World Production and Final Consumption of Gas/Diesel;* International Energy Agency: Paris, FR. Downloaded 29 March 2022 from IEA Data and Statistics, Data Tables, Oil; https://www.iea.org/data-and-statistics/data-tables/?country=WORLD&energy=Oil

EXHIBIT 2. Partial Least Squares Regression Results

DB: diesel biofuel **PD:** petroleum distillate **LB (UB):** lower bound (upper bound) of 95% confidence interval

A. PD Export v. DB use and PD production

California (N, 10)

Model: PD Export ≈ 0.478 • DB use + 0.521 • PD production – 5.268

R-squared 0.869

Standardized coefficients (y variable PD export)

x variable	Coefficient	95% Confidence LB	95% Confidence UB
DB use	0.555	0.301	0.809
PD production	0.507	0.368	0.645

Residuals tests	**p-value (two-tailed)**	**alpha**
Shapiro-Wilk	0.147	0.05
Anderson-Darling	0.084	0.05
Lilliefors	0.079	0.05
Jarque-Bera	0.351	0.05

California (N, 9)

Model: PD Export ≈ 0.505 • DB use + 0.505 • PD production – 4.869

R-squared 0.957

Standardized coefficients (y variable PD export)

x variable	Coefficient	95% Confidence LB	95% Confidence UB
DB use	0.601	0.363	0.838
PD production	0.505	0.400	0.610

Residuals tests	**p-value (two-tailed)**	**alpha**
Shapiro-Wilk	0.411	0.05
Anderson-Darling	0.431	0.05
Lilliefors	0.484	0.05
Jarque-Bera	0.597	0.05

B. PD Export v. DB use and PD use

California (N, 10)

Model: PD Export ≈ 0.769 • DB use + 0.119 • PD use + 3.509

R-squared 0.734

Standardized coefficients (y variable PD export)

x variable	Coefficient	95% Confidence LB	95% Confidence UB
DB use	0.893	0.254	1.532
PD use	0.078	–0.589	0.745

Residuals tests	**p-value (two-tailed)**	**alpha**
Shapiro-Wilk	0.396	0.05
Anderson-Darling	0.401	0.05
Lilliefors	0.301	0.05
Jarque-Bera	0.424	0.05

California (N, 9)

Model: PD Export ≈ 0.926 • DB use + 0.450 • PD use – 1.399

R-squared 0.931

Standardized coefficients (y variable PD export)

x variable	Coefficient	95% Confidence LB	95% Confidence UB
DB use	1.100	0.516	1.684
PD use	0.295	–0.041	0.631

Residuals tests	**p-value (two-tailed)**	**alpha**
Shapiro-Wilk	0.281	0.05
Anderson-Darling	0.301	0.05
Lilliefors	0.440	0.05
Jarque-Bera	0.649	0.05

continued next page

EXHIBIT 2. Partial Least Squares Regression Results *continued*

DB: diesel biofuel **PD:** petroleum distillate **LB (UB):** lower bound (upper bound) of 95% confidence interval

C. Total Distillate v. PD use, DB use and PD export

California (N, 10)

Model: Total Distillate ≈ 1.000 • PD use + 1.000 • DB use + 1.000 • PD export + 0.000
R-squared ≈ 1.000
Standardized coefficients (y variable Total Distillate)

x variable	Coefficient	95% Confidence LB	95% Confidence UB
PD use	0.350	–0.012	0.712
DB use	0.620	0.349	0.891
PD export	0.534	0.380	0.687

CA input data tests	**p-value (two-tailed)**	**alpha**
PD use data		
Shapiro-Wilk	0.043	0.05
Anderson-Darling	0.055	0.05
Lilliefors	0.089	0.05
Jarque-Bera	0.138	0.05
DB use data		
Shapiro-Wilk	0.360	0.05
Anderson-Darling	0.462	0.05
Lilliefors	0.543	0.05
Jarque-Bera	0.678	0.05
PD export		
Shapiro-Wilk	0.444	0.05
Anderson-Darling	0.443	0.05
Lilliefors	0.596	0.05
Jarque-Bera	0.758	0.05

Notes: California data from Exhibit 1 for 2010 through 2019. PLS regressions and normality tests by XLSTAT (2022). Input data and residuals test p-values that exceed the alpha value of 0.05 suggest normal distributions of PLS residuals and, separately, PLS input data sets.

A. Results for the main drivers of PD export, DB use and PD production. Standardized coefficients and R-squared values indicate the strength of BD use influence, PD production influence, and the combined influence of these two factors on PD export.

B. The 95% confidence intervals of the standardized coefficients for PD use span zero, indicating the weak influence of PD use, relative to DB use and PD production, on PD export.

C. Modeled values approach unity (and PLS residuals could not be distinguished from zero), due to the inclusion of observations for all distillate fuels in the model. Given this very tight fit to the data, the standardized coefficient confidence interval for PD use that spans zero in this analysis reflects the rise and fall of California PD use as its DB use and PD exports continued to rise (Exhibit 1). Results thus describe the expected conservation of fuel volume in shifts among distillate components.

"N, 9" results for models in **A** and **B** help to inform possible effects of a potential input data anomaly. "N,10" results reflect the inclusion of a potentially anomalous outlier year (2016), when hydrocracking capacity may have shifted from distillate to gasoline production after an explosion idled substantial in-state gasoline production for 17 months.* This may have affected results from analyses A and/or B, which did not intrinsically balance all distillate data. Results of those analyses including *and* excluding the suspect data are shown for comparison.

* See *West Coast Transportation Fuels Markets;* U.S. Energy Information Administration: Washington, D.C. PADD 5 Transportation Fuels Markets. September 2015. www.eia.gov/analysis/transportationfuels/padd5; and Schremp, G. *Transportation Fuels Trends, Jet Fuel Overview, Fuel Market Changes & Potential Refinery Closure Impacts;* BAAQMD Board of Directors Special Meeting. 5 May 2021. Gordon Schremp, Energy Assessments Division, California Energy Commission: Sacramento, CA. Virtual meeting report presentation.