UP IN THE AIR: WILL CALIFORNIA'S METHANE GAS MITIGATION LAWS AND POLICIES LOWER GLOBAL GREENHOUSE EMISSIONS?

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INTRODUCTION

Anthropogenic climate change is wreaking havoc in California. In recent years, increases in the frequency and intensity of drought,[1] wildfires,[2] rising sea levels,[3] and flooding[4] have devastated California communities and

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1. *See generally* Noah S. Diffenbaugh et al., *Anthropogenic Warming Has Increased Drought Risk in California*, 112 PROC. NAT'L ACAD. SCI. U.S. 3931 (2015) (discussing the increased frequency of drought in California).

2. *See* A.L. Westerling et al., *Climate Change and Growth Scenarios for California Wildfire,* 109 CLIMATIC CHANGE 445, 445–46 (2011) (anticipating increases in wildlife burn area and variability in fire severity); A.L. Westerling & B.P. Bryant, *Climate Change and Wildfire in California*, 87 CLIMATIC CHANGE 231, 231 (2008) (stating wildfire activity in California "has greatly increased in recent years").

3. Kendra L. Garner et al., *Impacts of Sea Level Rise and Climate Change on Coastal Plant Species in the Central California Coas*t, PEERJ, May 12, 2015 at 1–2.

4. *See* Michael Dettinger, *Climate Change, Atmospheric Rivers, and Floods in California – A Multimodel Analysis of Storm Frequency and Magnitude Changes*, 47 J. AM. WATER RESOURCES ASS'N 514, 514 (2011) (anticipating increase in atmospheric river "episodes," leading to more frequent and severe floods).

delivered a cascade of financial consequences.[5] Arguably, the deleterious impacts of climate change in California and elsewhere have only just begun. Aggressive greenhouse gas (GHG) emission mitigation is critical to either reduce the effects of climate change or possibly even reverse its course.[6]

A series of laws enacted in California target 40% and 80% reductions in the state's GHG emissions from 1990 levels by 2030 and 2050, respectively.[7] The laws provide the California Air Resources Board (CARB) with teeth to regulate carbon intensity (CI) to effectuate these goals.[8] County, state, and federal financial incentives complement these Acts to develop renewable and alternative energy technology with lower GHG emissions and environmental impacts than fossil fuels.[9] Ostensibly, California's cadre of laws and policies place the state on a trajectory to accomplish its climate change mitigation goals. From 2004 to 2017 (the most recent year for which data are available), the state's total GHG emissions declined by 14%.[10] And, GHG emissions per capita were reduced by 24% from a 2001 peak.[11] United States net GHG emissions decreased 10% from 2005 to 2018,[12] while the world's carbon

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5. *Id.* at 514–15; *see* Katherine Blunt & Erin Ailworth, *PG&E Reaches $1 Billion Settlement with Paradise, California Governments,* WALL ST. J. (June 18, 2019), https://www.wsj.com/articles/pg-e-settles-with-some-california-communities-on-wildfire-claims-11560894354 (describing PG&E's liability for "deadly wildfires sparked by its equipment" in 2017–18); Faiz Siddiqui, *California's New Normal: Wildfires, Ash and Power Outages Could Last a Decade* (Oct. 26, 2019), https://www.washingtonpost.com/nation/2019/10/26/this-is-new-norm-fire-ravaged-wine-country-rolling-blackouts-become-way-life/ (showing how weather and fire conditions in California are worsening).

6. *See* James Hansen et al., *Target Atmospheric CO_2: Where Should Humanity Aim?*, OPEN ATMOSPHERIC SCI. J., May 2008, at 1–2, 16 (asserting prompt policy changes are necessary to avoid dangerous climate effects).

7. CAL. HEALTH & SAFETY CODE § 38566 (West 2019); Cal. Exec. Order No. S-3-05 (June 1, 2005).

8. *See*, *e.g.*, CAL. HEALTH & SAFETY CODE § 38510 (West 2019) (charging CARB with monitoring and regulating GHG emissions sources); *id*. § 38561 (directing CARB to create a scoping plan to achieve maximum feasible emissions reduction).

9. *See California Laws and Incentives*, U.S. DEP'T OF ENERGY, https://afdc.energy.gov/laws/state_summary?state=CA (last updated Oct. 2019) (listing available incentives in California).

10. CAL. AIR RES. BD., CALIFORNIA GREENHOUSE GAS EMISSIONS FOR 2000 TO 2017 3 (2019).

11. *Id*.; *see also* CAL. AIR RES. BD., CALIFORNIA GREENHOUSE GAS INVENTORY (MILLIONS OF METRIC TONNES OF CO_2 EQUIVALENT)—BY IPCC CATEGORY 22 (2007) (showing that California's total annual GHG emissions actually increased from 430.724 CO_2 equivalent in 1990 to 471.1 CO_2 equivalent in 2000, although GHG emission calculations and Global Warming Potential (GWP) are calculated slightly differently for these two datasets).

12 . Press Release, U.S. Envtl. Prot. Agency, Latest Inventory of U.S. Greenhouse Gas Emissions and Sinks Shows Long-Term Reductions, with Annual Variation (Apr. 13, 2020), https://www.epa.gov/newsreleases/latest-inventory-us-greenhouse-gas-emissions-and-sinks-shows-long-term-reductions-0; *see generally* U.S. ENVTL. PROT. AGENCY, DATA HIGHLIGHTS: INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2018 (2020) (summarizing GHG emissions and sinks nationwide).

dioxide (CO_2) emissions alone increased 46.37% from 2000 to 2014.[13] The contrasts between state, national, and international GHG emissions is potentially indicative of emissions leakages,[14] defined as "any change in emissions from sources not covered by the GHG policy or program that is caused by the GHG emissions policy or program."[15]

As the fifth largest economy in the world, California's market power clearly influences global commerce and the resulting environmental impacts.[16] The state has a large consumer-demand base and is a renowned hub for spinning off technological innovation: when California moves, others respond.[17] However, in order to effectively reduce GHG emissions on a global level that will aggressively curb climate change, transformative interventions with the largest sources of GHG emissions (the agricultural, transportation, and energy generation sectors)[18] cannot be limited to California. In order to truly address climate change, technological advancements must simultaneously mitigate GHG emissions while facilitating economic growth inside and outside of California, and across developed and developing nations.

This article posits that California's emerging dairy biogas supply chain infrastructure exemplifies technological advancement that may have a tractable impact on mitigating worldwide methane emissions that contribute

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13. *See* Tom Boden et al., *Global CO_2 Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751-2014*, CARBON DIOXIDE INFO. ANALYSIS CTR. (Mar. 3, 2017), https://cdiac.ess-dive.lbl.gov/ftp/ndp030/global.1751_2014.ems (listing raw data of CO_2 globally).

14. *See* MEREDITH FOWLIE & DANNY CULLENWARD, INDEP. EMISSIONS MKT. ADVISORY COMM., REPORT ON EMISSIONS LEAKAGE AND RESOURCE SHUFFLING 1 (2018) (discussing how heavily regulated GHG producers can become less competitive than producers in other jurisdictions that are not subject to emissions requirements).

15. *Id.* A rebound, or backfiring, effect may also cause net global GHG emissions to rise through increased consumer consumption attributable to perceived improvements in environmental quality ("My environmental footprint is lower for this product so I can consume more of it"), or increased production in locations where environmental impacts aren't transparent or valued (the invisible impacts of consumption). Kenneth Gillingham et al., *The Rebound Effect is Overplayed*, 493 NATURE 475, 476 (2013). The rebound effect occurs when a policy designed to reduce environmental impacts has the reverse effect, and environmental impacts actually worsen. *Id*. at 475. Energy efficiency and conservation policies present notable rebound effects, in that consumers increase their consumption with improved energy efficiency, although the magnitude of rebound effects is debated. *See id*. at 475–76 (discussing the rebound effect).

16. *California Now has the World's 5th Largest Economy* (May 4, 2018), https://www.cbsnews.com/news/california-now-has-the-worlds-5th-largest-economy/.

17. *See id.* (describing the reasons for California's large economy); Thomas Fuller, *The Pleasure and Pain of Being California, the World's 5th-Largest Economy* (May 7, 2018), https://www.nytimes.com/2018/05/07/us/california-economy-growth.html (explaining Silicon Valley and technology giants are a "big part of California's success").

18. *Global Greenhouse Gas Emissions Data*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data#main-content (last visited Apr. 29, 2020); *see* Hansen et al., *supra* note 6, at 1, 14, 16 (describing prompt policy changes that should be made regarding coal use, agriculture, and other practices to prevent dangerous climate effects).

to global climate change. Whether this will occur is highly dependent upon governmental and market forces. Small-scale anaerobic digesters have been successfully used for some time to transform methane by capturing it from organic waste and converting it into electricity.[19] Recently, the scale and scope of these practices have greatly expanded in California due to a cadre of innovative governmental policies.[20] The federal Renewable Fuel Standard (RFS) Program, promulgated by the Energy Policy Act of 2005[21] and revised as "RFS2"[22] under the Energy Independence and Security Act (EISA) of 2007,[23] and state initiatives turned biogas from dairy manure into a hot commodity for California's transportation sector.[24] California's rapidly expanding statutes, regulations, and financial incentives have provided grants to install new farm anaerobic digesters.[25] The biogas is reconditioned into Renewable Compressed Natural Gas (R-CNG) at regional fuel hubs and transported through newly expanded natural gas pipeline infrastructure to power natural gas vehicles.[26] In addition, fuel-cell technology is converting biogas into electricity without combustion; the electricity is being used to power plug-in electric vehicles (PEV), including state vehicle fleets.[27] Updated carbon offset and international GHG cap-and-trade programs also

19. *See* Catherine Keske, *Anaerobic Digestion Technology: How Agricultural Producers and the Environment Might Profit from Nuisance Lawsuits*, 52 NAT. RESOURCES J. 315, 315, 320 (2012) (explaining that anaerobic digestion systems are built so that microorganisms can break down organic materials in a closed space where there is no oxygen).

20. *See*, *e.g.*, CAL. DEP'T OF FOOD & AGRIC., DAIRY DIGESTER RESEARCH AND DEVELOPMENT PROGRAM: REPORT OF FUNDED PROJECTS (2015-18) 3, 9 (2019) (discussing results of significant legislative funding for 64 dairy digester projects).

21. Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594, 1068 (codified in relevant part at 42 U.S.C. § 7545 (2018)).

22. Clean Air Act, 42 U.S.C. § 7545(a) (2018).

23. Energy Independence and Security Act of 2007, 42 U.S.C. ch. 152 (2018).

24. *See*, *e.g.*, CAL. HEALTH & SAFETY CODE § 38566 (West 2019) (directing the Board to reduce GHG emissions by 40% below 1990 levels by 2030); *Advanced Clean Cars Program*, CAL. AIR RES. BD. (Feb. 8, 2019), https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-cars (describing regulations to control emissions); *DDRDP Demonstration Projects*, CAL. DEPT. OF FOOD & AGRIC., https://www.cdfa.ca.gov/oefi/ddrdp/DemoProject.html (last visited Apr. 29, 2020) (describing grants for dairy digester projects); *California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA)*, CAL. STATE TREASURER, https://www.treasurer.ca.gov/caeatfa/ (last visited Apr. 29, 2020) (describing funding available to assist in reducing GHG emissions).

25. *See*, *e.g.*, CAL. HEALTH & SAFETY CODE § 38501 (West 2019) (directing CARB to design emissions reduction measures); *DDRDP Demonstration Projects*, *supra* note 24 (describing grants for dairy digester projects); *California Laws and Incentives*, *supra* note 9 (listing available incentives).

26. *Natural Gas Basics,* U.S. DEP'T OF ENERGY, https://afdc.energy.gov/fuels/natural_gas_basics.html (last visited Apr. 29, 2020).

27. *See generally* FUEL CELL TODAY, USING FUEL CELLS IN…CONVERTING WASTE TO ENERGY (2012) (describing the use of fuel cells to convert biogas to energy for use in electric vehicles).

support this developing supply chain and infrastructure by creating demand for methane conversion and GHG emission reduction.[28]

As the nation's largest dairy producer and the most populous state, California is highly motivated to cultivate a cost-effective energy supply chain for its transportation sector while striving to fulfill its heavily mandated and regulated GHG targets.[29] However, it is up in the air as to whether California's GHG mitigation programs will expand to a scale so that there are lasting impacts on climate change. It is also unclear whether its infrastructure will eventually buckle due to federal policy changes and GHG emission leakages if dairies and other industries relocate to avoid regulation.

The rest of the article is organized as follows: section I discusses the prevalence of methane GHG emissions from agriculture and the associated implications for global climate change. Section II summarizes the alignment of federal and state laws that facilitate renewable fuel generation. Section III elaborates upon the financial incentives created and explores whether California's expanding methane biogas capture supply chain will endure if the financial incentives taper from this confluence of policies. The conclusion is that the methane biogas supply chain could be scaled outside of California to mitigate climate change in the long term, if it is used in conjunction with other renewable energy sources to displace petroleum-based transportation fuels and methane leakages are effectively mitigated.

I. PREVALENCE OF METHANE GAS EMISSIONS AND IMPACTS ON CLIMATE CHANGE

In spite of relatively aggressive GHG emission reduction policies and an overall state decrease in GHG emissions since 2000, California's annual methane emissions have headed in the opposite direction.[30] The State's methane emissions increased approximately 16% from 2000 to 2017, though California's overall GHG emissions declined by 10% over that same

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28. *See* CAL. HEALTH & SAFETY CODE § 38561 (West 2019) (directing CARB to implement emissions reduction measures); *id.* § 38562 (extending internationally recognized cap-and-trade system, effective 2031); INT'L CARBON ACTION P'SHIP, USA—CALIFORNIA CAP-AND-TRADE PROGRAM 1–6 (2020) (describing California's program, including its interaction with other programs internationally).

29. M. Shahbandeh, *Top U.S. States Based on Milk Production 2016 – 2018* (Apr. 3, 2019), https://www.statista.com/statistics/194968/top-10-us-states-by-milk-production/; Hans Johnson et al., *California's Population,* PUB. POLICY INST. CAL. (Mar. 2017), https://www.ppic.org/publication/californias-population/; *see also* Terence Chea, *California Targets Dairy Cows to Combat Global Warming* (Nov. 29, 2016), https://www.kqed.org/science/1201862/california-targets-dairy-cows-to-combat-global-warming (describing the dairy industry's role in combating GHG emissions).

30. CAL. AIR RES. BD., *supra* note 10, at 1, 3, 15.

period.[31] In contrast, U.S. methane levels decreased by 18.1% between 1990 and 2018.[32]

California's increasing methane emissions are attributed to its bourgeoning dairy industry, which is the state's largest source of anthropogenically created methane.[33] The California dairy industry doubled its milk production from 1970 to 1994,[34] and the state now accounts for approximately 20% of all U.S. milk production.[35] California agriculture contributes approximately 8% of all state-level GHGs, though emissions associated with crop production have generally declined since 2000.[36] In contrast, GHG emissions from dairy manure management and enteric fermentation increased between 2000 and 2007 as the industry expanded, and the levels have remained relatively constant from 2007 onward.[37] Due to the overall decline in GHG emissions, dairies now comprise a larger overall proportion of California's GHG emissions, accounting for roughly 60% of the state's total agricultural emissions.[38] Recognizing the significance of the consistently lingering levels of methane generated by livestock, the California Legislature enacted Senate Bill 1383, which set a goal of reducing methane from 2013 levels by 40% by 2030.[39]

Reducing anthropogenic methane is critical for climate change mitigation. Methane presents a relatively high radiative heating effect per molecule and per unit mass relative to CO_2 over a relatively short (20 to100 years) time horizon, earning it the description as a "short-lived climate pollutant."[40] Though estimates range upon the scientific study methodology and assumptions used, it's generally accepted that methane provides approximately 28–36 times the Global Warming Potential (GWP) of CO_2 during a 100-year time horizon and 84–87 times the GWP of CO_2 over a 20-

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31. *Id*. at 15.

32. *Greenhouse Gas Inventory Data Explorer*, U.S. ENVTL. PROT. AGENCY, https://cfpub.epa.gov/ghgdata/inventoryexplorer/#allsectors/allgas/gas/all (last visited Apr. 29, 2020).

33. CAL. AIR RES. BD., *supra* note 10, at 15.

34. L.J. BUTLER, MAINTAINING THE COMPETITIVE EDGE IN CALIFORNIA'S DAIRY INDUSTRY PART II—CHALLENGES AND OPPORTUNITIES iii (1994).

35. WILLIAM A. MATTHEWS & DANIEL A. SUMNER, UNIV. OF CAL., CONTRIBUTIONS OF THE CALIFORNIA DAIRY INDUSTRY TO THE CALIFORNIA ECONOMY IN 2018: A REPORT FOR THE CALIFORNIA MILK ADVISORY BOARD ES-1 (2019).

36. CAL. AIR RES. BD., *supra* note 10, at 15.

37. *Id*.

38. *Id*.

39. S.B. 1383, 2015-2016 Reg. Sess. (Cal. 2016) (enacted) (requiring adoption of regulations to reduce methane emissions from livestock manure); CAL HEALTH & SAFETY CODE §§ 39730.5, 39730.7 (West 2016).

40. S.B. 1383, 2015-2016 Reg. Sess. (Cal. 2016); *see generally* L.D. Danny Harvey, *A Guide to Global Warming Potentials (GWPs)*, 21 ENERGY POL'Y, 24 (1993) (describing methane as a GHG).

year time horizon.[41] Methane also interacts with other GHGs to create additive impacts depending upon how much is released, how long it remains, and how strongly the gas affects the atmosphere.[42] Methane is a precursor to ozone, another GHG.[43] Eventually, methane oxidizes into CO_2, in which case it may remain in the atmosphere for hundreds of years and its atmospheric concentrations may persist for thousands of years.[44]

Avoiding methane generation altogether is a preferred strategy to converting it into CO_2.[45] However, transforming methane into CO_2 is an opportunistic strategy to reduce GWP and climate change over a "short term" 100-year interval, when methane is clearly a potent GHG. Moreover, methane transformation may combat long-term climate change if the transformed methane displaces fossil-fuel sources for a net decrease in overall CO_2 emissions (essentially "foregone CO_2 emissions"). In sum, if biogas methane is transformed into energy in lieu of petroleum-based fuels without creating additional leakages, there may be a cumulative reduction in GHG emissions. Reductions may occur in both the agriculture and transportation sectors, where the conditioned biogas can fuel natural gas and electric vehicles. Section II summarizes how U.S. laws and policies align to effectuate this scenario.

II. THE ENERGY INDEPENDENCE AND SECURITY ACT OF 2007 (EISA)[46] AND CALIFORNIA LAWS FACILITATE THE USE OF DAIRY METHANE BIOGAS IN THE TRANSPORTATION SECTOR

Biogas generated from methane digesters may be counted as renewable fuel under the national RFS2 program promulgated by EISA, which has been in effect since 2007.[47] EISA requires that transportation fuel sold or

41. *Understanding Global Warming Potentials*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials (last updated Feb. 14, 2017).

42. *See* Ivar S. A. Isaksen et al., *Atmospheric Ozone and Methane in a Changing Climate*, 5 ATMOSPHERE 518, 518, 520, 530 (2014) (showing "climate-chemistry interactions" between methane, ozone, and nitrous oxides).

43. *Understanding Global Warming Potentials*, *supra* note 41.

44. *Id.*; L.D. Danny Harvey, *supra* note 40, at 28.

45. *See* Annika Carlsson-Kanyama & Alejandro D. González, *Potential Contributions of Food Consumption Patterns to Climate Change,* 85 AM. J. CLINICAL NUTRITION 1704, 1706 (2009) (demonstrating that minimizing agriculture-based methane in food production has given rise to food movements calling for low to zero meat and dairy consumption).

46. Energy Independence and Security Act of 2007, 42 U.S.C. ch. 152 (2018).

47. 42 U.S.C. § 7545(o) (2018); *id.* § 17021; *see also* KELSI BRACMORT, CONG. RESEARCH SERV., R44045, THE RENEWABLE FUEL STANDARD (RFS): WAIVER AUTHORITY AND MODIFICATION OF VOLUMES 1 n.2 (2019) ("P.L. 109–58 (Title XV, Subtitle A, Section 1501) established the RFS under Clear Air Act Section 211(o); P.L. 110–140 expanded the RFS partly with the requirement of larger annual volumes and the addition of greenhouse gas accounting requirements, among other things.").

introduced into commerce in the United States on an annual average basis contains a specified amount of renewable fuel.[48] All replacement renewable fuels require reductions in "lifecycle GHG emissions" compared to gasoline or diesel fuel sold or distributed in 2005.[49] Assessing lifecycle GHG emissions involves a scientifically rigorous assessment of the aggregate direct and indirect emissions (e.g. land use changes) at all stages of fuel and feedstock production and distribution.[50] The GHG mass values are adjusted for comparative GWP.[51] Setting mandatory lifecycle GHG emission reduction thresholds compared to average petroleum fuels used in 2005 for four renewable fuel categories facilitates the transition to lower CI, non-petroleum based alternative fuels, and chiefly towards advanced and cellulosic (non-cornstarch ethanol) technology.[52] RFS2 ratchets up the federally required increases in renewable fuel volumes, from nine billion gallons in 2008 to 36 billion gallons in 2022, for the four renewable fuel categories, with D-3 Cellulosic Biofuel targets comprising the largest proportion of the four.[53] The RFS2 requires that volumes for D-3 Cellulosic Biofuels incrementally increase over time through 2022, at which point the EPA will revisit them.[54]

Methane biogas produced from organic matter qualifies as a D-3 Cellulosic Biofuel and reflects an 80% reduction in lifecycle GHG emissions compared to petroleum-based fuels.[55] However, calculating the supply and demand for renewable fuels for RFS2 compliance is highly nuanced and dynamic. Due in part to historically deficient supplies of D-3 Cellulosic

48. 42 U.S.C. 7545(o)(2) (2018).

49. *See id*. § 17022 (requiring the Secretary to award grants "for advanced biofuels with the greatest reduction in lifecycle greenhouse gas emissions compared to the comparable motor vehicle fuel lifecycle emissions during calendar year 2005").

50. PANKAJ BHATLA ET AL., WORLD RES. INST., GREENHOUSE GAS PROTOCOL: PRODUCT LIFE CYCLE ACCOUNTING AND REPORTING STANDARD 72–73 (2011); *see generally* OFFICE OF TRANSP. & AIR QUALITY, ENVTL. PROT. AGENCY, EPA-420-F-09-024, EPA LIFECYCLE ANALYSIS OF GREENHOUSE GAS EMISSIONS FROM RENEWABLE FUELS (2009) (discussing EPA's lifecycle GHG emission calculation protocol).

51. *See* BHATLA ET AL., *supra* note 50, at 85 (discussing appropriate steps for companies to calculate lifecycle GHG emissions, including applying a GWP to emissions data).

52. *See* 42 U.S.C. § 7545(o)(1)(C) (2018) (defining baseline lifecycle GHG emissions as that of gasoline or diesel sold as fuel in 2005); *see generally* STEFAN UNNASCH, LIFE CYCLE ASSOCS., GHG EMISSIONS REDUCTIONS DUE TO THE RFS2: A 2018 UPDATE (2019) (describing the effect of RSF2's lifecycle GHG emissions reductions).

53. 42 U.S.C § 7545 (o)(2)(B)(i); 40 C.F.R. § 80.1425(g)(1) (2019) (designating cellulosic biofuel as D-3 for Renewable Identification Numbers).

54. *See* 42 U.S.C § 7545 (o)(2)(B)(i)(III) (mandating the incremental increase of cellulosic biofuels through 2022).

55. MATTHEN TOMICH & MARIANNE MINTZ, COW POWER: A CASE STUDY OF RENEWABLE COMPRESSED NATURAL GAS AS A TRANSPORTATION FUEL 1, 8 (2017).

Biofuel, the values are subject to annual supplemental notices of EPA rulemaking, as well as periodic exemptions, such as small refineries.[56]

Clearly, there is room to improve methane biogas collection practices to meet the D-3 Cellulosic Biofuel mandates and to reduce GWP. In California, the state's legal infrastructures mandating GHG[57] and methane reduction[58] combined with CARB's regulatory oversight over the transportation sector improve methane biogas collection.[59]

III. WILL CALIFORNIA REDUCE ITS METHANE EMISSIONS BY INNOVATION OR EVACUATION?

The fragile web of federal and California state laws surrounding the use of dairy biogas creates uncertainty about whether California will reduce methane emissions[60] through innovation or evacuation. Will California's rapidly evolving practices to convert methane from dairy biogas to displace petroleum-based vehicles remain financially viable if the EPA significantly reduces RFS2-mandated volumes after 2022?[61] What will happen if federal laws limit California's authority to enact more rigorous state air quality and emissions rules than federal standards?[62] Will dairies eventually relocate outside of California where there are less stringent state regulations leading to methane leakages and increased global methane emissions? Or, will anaerobic digesters generate enough revenue to encourage dairies to remain in the state and add more dairy cows? Understanding this conundrum requires additional discussion of the current federal and state financial incentives to produce dairy biogas.

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56. *See* 42 U.S.C. § 7545(o)(9) (providing small refiner exemption); BRACMORT, *supra* note 47, at 4–5 (describing cellulosic biofuel waivers); KELSEY BRACMORT, CONG. RES. SERV., R43325, THE RENEWABLE FUEL STANDARD (RFS): AN OVERVIEW 1 (2020) (noting a historic lack of cellulosic biofuel production causing difficulty in meeting total volume requirement); *Overview for Renewable Fuel Standard*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-fuel-standard (last updated June 7, 2017) (noting additional flexibility for cellulosic biofuel standard).

57. CAL. HEALTH & SAFETY CODE § 38566 (West 2019).

58. CAL. HEALTH & SAFETY CODE § 39730.5 (West 2019).

59. *See* CAL. HEALTH & SAFETY CODE § 38510 (West 2019) (charging CARB with monitoring and regulating GHG emissions sources); *see generally* CAL. AIR RES. BD, *supra* note 10 (providing overview of CARB's management of the transportation sector).

60. *See*, *e.g.*, CAL. HEALTH & SAFETY CODE § 39730.5(a) (West 2019) (setting goal to reduce state methane emissions by 40% from 2013 levels by 2030).

61. BRACMORT, *supra* note 47, at 1.

62. *See* 49 C.F.R. §§ 531.7, 533.7 (2019) (demonstrating that this would repeal California's waiver to create more rigorous state air emissions standards than the federal standards for vehicles, including fuel efficiency). Though California and other states have filed lawsuits to challenge the ruling, this exemplifies the federal tensions with California, who exercises its discretion to enact state laws and regulations that address climate change and that are more rigorous than federal standards. Ostensibly, federal restrictions on California's autonomy may continue and erode CARB's regulatory authority.

Under RFS2, the EPA announces annual renewable fuel percentage standards that are used to calculate the number of gallons each Obligated Party (OP) must blend into their fuel every year.[63] Renewable Identification Numbers (RIN) demonstrate compliance.[64] One RIN is roughly equal to one gallon of ethanol.[65] Notably, the EPA requires OPs to demonstrate both feedstock (supply) and transportation (end-use demand) to generate a RIN.[66]

On the demand side, OPs have a Renewable Volume Obligation (RVO) to purchase renewable biofuels.[67] In 2020, D-3 Cellulosic RVO increased to 540 million RIN, 29% higher than the 2019 RVO.[68] Supplies, however, are expected to fall considerably short of meeting the demand, as has historically been the case.[69] Because meeting the D-3 Cellulosic Renewable Fuel volume demand has been consistently difficult due to inadequate supply, Congress gives the EPA Administrator waiver authority to adjust the renewable fuel volumes.[70] This is an option that the EPA Administrator has consistently exercised.[71] Waivers provide the OP with formulaically derived Cellulosic Waiver Credits (CWC)[72] that can be nested and combined with RINs from other biofuel categories,[73] creating a highly lucrative fuel portfolio for the OP.

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63. 42 U.S.C § 7545(o)(3)(B) (2018).

64. *See* 40 C.F.R. § 80.1127(a) (2019) (requiring obligated parties to demonstrate ownership of sufficient, time-limited RINs to meet the Renewable Volume Obligation for the compliance period).

65. *See id*. § 80.1106(b) (2019) (requiring obligated parties to demonstrate satisfaction of the Renewable Volume Obligation for the compliance period).

66. *Id.* §§ 80.1106(b), 80.1107.

67. *See id.* § 80.1106(b) (2019) (requiring obligated parties to demonstrate satisfaction of the Renewable Volume Obligation for the compliance period); COVINGTON & BURLING LLP, AN ANALYSIS OF THE RENEWABLE FUEL STANDARD'S RIN MARKET 5–6 (2019).

68. *Proposed Volume Standards for 2020, and the Biomass-Based Diesel Volume for 2021*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/renewable-fuel-standard-program/proposed-volume-standards-2020-and-biomass-based-diesel-volume-2021 (last updated Sept. 12, 2019).

69. *See Proposed Volumes for 2020 and Biomass-Based Diesel Volume for 2021: Supplemental Notice*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/renewable-fuel-standard-program/proposed-volumes-2020-and-biomass-based-diesel-volume-2021 (last updated Nov. 7, 2019) (reviewing how RVOs are being calculated).

70. *See* 42 U.S.C § 7545 (o)(7)(D) (2018) (establishing procedures for the Administrator to reduce the minimum volume requirements for cellulosic biofuel based on supply estimates).

71. U.S. ENVTL. PROT. AGENCY, CELLULOSIC WAIVER CREDIT PRICE CALCULATION FOR 2019 1 (2018) ("For any calendar year for which the projected volume of cellulosic biofuel production is less than the applicable volume of cellulosic biofuel set forth in Clean Air Act (CAA) section 211(o)(2)(B)(III), EPA must reduce the required volume of cellulosic biofuel for that year to the projected volume, and must provide obligated parties the opportunity to purchase cellulosic waiver credits (CWC). The price of these credits is determined using a formula specified in the CAA."); BRACMORT *supra* note 47, at 5–6.

72. *Id.* at 5.

73. 42 U.S.C. § 7545(o)(1)(B) (2018); BRACMORT, *supra* note 47, at 5.

Additional state financial incentives are available through California Low Carbon Fuel Standard (LCFS)[74] credits,[75] which count additional GHG emission reductions if both the supply source and the user are in California. For example, dairies may convert methane into electricity for on-farm use to cool and store milk.[76] This situation provides farmers with electricity cost savings and LCFS credits.[77] In another example, nitrous oxide emissions (NOx), which have approximately 265-298 times greater GWP compared to CO_2 over a 100-year period,[78] can be reduced 90% when dairy biogas is used to offset petroleum-based fuels in California's transportation sector.[79] Biogas converted into electricity to power vehicles does not qualify for federal RIN, but California LCFS incentives still apply.[80]

This nexus of federal and state incentives has created several emergent supply chain processes for supplying reconditioned dairy biogas to the transportation sector.[81] Biogas may be treated at regional facilities that serve multiple anerobic digesters and farms, collected, and injected into the natural gas grid for R-CNG transportation filling stations.[82] The reconditioned gas may also be exported outside the state as liquified natural gas (LNG).[83] Alternatively, the methane captured by the digesters may be converted into electricity by fuel cells connected to the electrical grid and purchased by electric vehicle (EV) charging stations to power EVs, for virtually GHG-free fuel.[84]

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74. As part of its Scoping Plan, CARB identified the Low Carbon Fuel Standard as an early action to reduce GHG emissions. *Low Carbon Fuel Standard*, CAL. AIR RES. BD., https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/about (last visited Apr. 28, 2020). The Low-Carbon Fuel Standard (LCFS) is a key AB 32 measure and part of a portfolio of evolving GHG policies in California over the past decade. *Id*.

75. *Id.*

76. Lydia Noyes, *Using Methane Power on a Dairy Farm* (Oct. 2018) https://www.motherearthnews.com/renewable-energy/other-renewables/using-methane-power-on-dairy-farm-zm0z18onzsphe.

77. PYE RUSSELL ET AL., RENEWABLE NATURAL GAS: THE RNG OPPORTUNITY FOR NATURAL GAS UTILITIES 1–3, 5 (2017).

78. *Understanding Global Warming Potentials*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials (last updated Feb. 14, 2017).

79. RUSSELL ET AL., *supra* note 77, at 15.

80. Letter from Robert E. Cleaves IV, President & CEO, Biomass Power Ass'n, to Hon. Andrew R. Wheeler, Acting Adm'r, U.S. Envtl. Prot. Agency (Oct. 24, 2018).

81. *See* MARGARET SMITH & JOHN GONZALEZ, U.S. DEP'T OF ENERGY, COSTS ASSOCIATED WITH COMPRESSED NATURAL GAS VEHICLE FUELING INFRASTRUCTURE 2, 9 (2014) (highlighting different methods of supplying natural gas to the transportation sector).

82. *See Renewable Natural Gas Production*, U.S. DEP'T OF ENERGY, https://afdc.energy.gov/fuels/natural_gas_renewable.html (last visited May 2, 2020) (explaining how biogas can be refined for use as a source of fuel).

83. *Id.*

84. *See* Michael J. McAnulty et al., *Electricity from Methane by Reversing Methanogenesis*, NAT. COMM., May 2017, at 1, 2–4.

These complex and evolving initiatives are rapidly expanding California's infrastructure and demand for biogas-generated renewable fuels.[85] This has prompted many dairy farmers to rely on consultants to determine how they can maximize their financial benefits by facilitating GHG reduction while ensuring they remain compliant with legal and regulatory standards.[86] On one hand, this infrastructure creates an efficient mechanism for dairy methane gas capture in California. This is an issue with which the state has struggled[87] and has global implications for climate change mitigation.

However, this emergent dairy biogas supply infrastructure also creates perverse incentives for farmers to raise more dairy cows. This would allow farmers to generate more methane and thus more revenue. Will the dairy industry continue to grow in California? It may if: (1) the RFS2 volumes for D-3 Cellulosic Biofuels are not impinged upon following the 2022 Reset; (2) RFS2 federal financial incentives continue; and (3) California continues to provide policy and financial incentives to offset petroleum-based fuels in its transportation sector. The third will be predicated upon whether California's authority to implement more rigorous regulations of GHG emission reductions is upheld, though it will add an additional layer of complexity and uncertainty for the dairy industry.

In the face of considerable legal and regulatory uncertainty, there is concern that dairies, particularly small ones, may relocate outside of California where methane regulation is less stringent, and water is of greater abundance.[88] The "evacuation" of dairies outside of California would presumably generate methane leakages unless Congress extends the Clean Air Act to include GHG emissions such as methane. In this case, other states could replicate California's model.

In sum, California's emerging system of capturing dairy biogas to reduce transportation sector fossil fuels is critically important to lowering the state's level of methane and overall GHG emissions. However, it remains unknown whether California's innovative practices that have spurned technological

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85. *See* Christopher Yang et al., *Meeting an 80% Reduction in Greenhouse Gas Emissions from Transportation by 2050: A Case Study in California*, 14 TRANSP. RES. PART D 147, 151–52 (2009) (showing how improvements in efficiency and increased reliance on alternative fuels can reduce transportation emissions); CAL. DAIRY CAMPAIGN, ECONOMIC FEASIBILITY OF DAIRY DIGESTER CLUSTERS IN CALIFORNIA: A CASE STUDY 11–15, 25 (2013) (discussing state laws and regulations supporting the development of dairy digesters and biogas projects).

86. *See*, *e.g.*, *Dairies*, CAL. BIOENERGY, https://calbioenergy.com/dairies/ (describing how one company helps dairies develop and finance biogas projects) (last visited Mar. 28, 2020).

87. *See* CAL. AIR RES. BD., *supra* note 10 at 15 (describing the trends in dairy GHG emissions between 2000 and 2017).

88. Adam Ashton & Andrew Sheeler, *Turning Poop into Power: California Dairies Appeal for More State Climate Change Money* (May 29, 2019), https://www.fresnobee.com/news/business/agriculture/article230869984.html.

innovation can be replicated elsewhere in a cost-effective manner. This is critical in facilitating global climate change mitigation.

CONCLUSION

In conclusion, there is indeed potential for dairy methane biogas capture to have a tractable impact on GHG and climate change mitigation. For California's methane reduction policies to reduce GHG emissions that contribute to global climate change, the GHG emission reduction efficiencies between the state's agriculture and transportation sectors must expand in California and replicate elsewhere in a cost-effective manner. Otherwise, leakages will raise GHG levels nationally and internationally as industries relocate outside of California, seeking lighter regulations.[89]

Using dairy methane biogas as a D-3 Cellulosic Biofuel has shown to effectuate a net reduction in lifecycle GHGs emissions,[90] though the adoption of these practices on a larger scale relies upon the expanded use of EV and R-CNG vehicles.[91] Demand from states like California, with large governmental vehicle fleets, may drive the development of EV charging infrastructure, which has been significantly and positively correlated with EV adoption.[92] The expanded infrastructure necessary to support government fleets may propel private sector EV demand.[93] However, until the EV charging infrastructure matures, it will also be important for the State to continue providing financial incentives[94] both to grow EV infrastructure and demand and support R-CNG vehicles. Moreover, though reconditioned biogas provides one source of renewable biofuel, energy generation from non-fossil fuel technology (e.g. solar energy) is paramount for EVs to have larger scale GHG emission reductions that will affect global climate change.[95]

Though multiple, diverse sources of renewable energy are necessary to grow and support the emerging infrastructure for EVs, cultivating California's agriculture-based methane emissions is a significant step in

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89. Thomas D. Peterson & Adam Z. Rose, *Reducing Conflicts Between Climate Policy and Energy Policy in the US: The Important Role of the States*, 34 ENERGY POL'Y 619, 620 (2006).

90. OFFICE OF TRANSP. & AIR QUALITY, *supra* note 50, at 2 (2009); TOMICH & MINTZ, *supra* note 55, at 1, 17.

91. AMY MYERS JAFFE, THE FEASIBILITY OF RENEWABLE NATURAL GAS AS A LARGE-SCALE, LOW CARBON SUBSTITUTE CONTRACT NO. 13-307 1, 4 (2016).

92. William Sierzchula et al., *The Influence of Financial Incentives and Other Socio-Economic Factors on Electric Vehicle Adoption*, 68 ENERGY POL'Y 183, 184 (2014).

93. *Id.* at 184, 192.

94. U.S. DEP'T OF ENERGY, *supra* note 9.

95. *Life Cycle Assessment Harmonization*, NAT'L RENEWABLE ENERGY LAB., https://www.nrel.gov/analysis/life-cycle-assessment.html (last visited May 2, 2020).

expanding renewable biofuel technologies that will reduce GHG emissions and mitigate global climate change. As California's supply chain model for R-CNG and EVs matures and becomes increasingly efficient, other states and countries may adopt a similar supply chain infrastructure for biogas capture and EVs. This may be true particularly if it becomes cost-effective to do so. California, an early adopter of EV infrastructure, shoulders the innovation costs and may leverage its market power to reduce costs so that technology may be replicated elsewhere.[96] For some time, small-scale anaerobic digesters have demonstrated to be economically feasible at the farm level.[97] Moreover, advancements in the use of biogas as a renewable fuel for transportation may enhance economic feasibility. It will be interesting to see whether this remains the case after the federal RFS2 volumes are reset in 2022.

The problem of anthropogenic climate change requires more resources and attention than strictly manure management. Methane biogas capture, however, is a good place to begin. Technological innovations that reduce environmental impacts and create efficiencies through a systems approach may simultaneously drive economic development and mitigate GHG emissions.[98] Small improvements in these innovations add up.

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96. *See* NEXT 10, POWERING INNOVATION: CALIFORNIA IS LEADING THE SHIFT TO ELECTRIC VEHICLES FROM R&D TO EARLY ADOPTION 4-5, 26 (2011) (explaining California's role in the adoption of EV technologies). It is well established that California is known as being a hub for innovation, and that its market power facilitates adoption of these innovations elsewhere.

97. KESKE, *supra* note 19, at 315.

98. Another hypothetical example is capturing CO_2 emissions at the smokestack, transporting, and injecting the emissions into the ground. *See* José D., Figueroa et al., *Advances in CO_2 Capture Technology—the US Department of Energy's Carbon Sequestration Program*, 2 INT'L J. GREENHOUSE GAS CONTROL 9, 9-10 (2008) (identifying new technologies associated with injecting CO_2 into the ground).