



From Animals to Plants: Financing Farm Transitions Through Carbon Markets

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Factory farming animals creates a tremendous strain on our environment.

From the methane emissions created by enteric digestion to livestock feed dominating the world's agricultural lands, industrial animal agriculture is a leading and rapidly growing contributor to climate change, already responsible for more than 18% of global greenhouse gas emissions.¹

In recent years, carbon markets have emerged as a promising strategy to help governments and businesses limit greenhouse gas emissions and incentivize better practices. In conjunction with the carbon market, carbon offset programs enable companies to diminish their net contribution to greenhouse gases. **We propose leveraging carbon offset protocols to finance sustainable farming transitions.**



A new idea

When an entity purchases offset credits, it funds a specific project which prevents or reduces the greenhouse gas emissions of another sector in society, thereby neutralizing its own net impact on climate change.

Currently, however, offset projects do not sufficiently or directly address emissions from the livestock sector.

Thinking about farmers

In addition to environmental impacts--which are not limited to greenhouse gas emissions--farmers in the United States who manage concentrated animal feeding operations (CAFOs) **must assume high levels of debt to purchase expensive technical equipment to compete in disadvantageous tournament-based systems.**

The nature of the industry forces them to sign short-term contracts with large companies and operate on low profit margins, rendering their livelihoods extremely vulnerable to any shocks.

Our Proposal

If offset programs begin recognizing projects that help farmers transition from raising animals to growing plants, emissions would be brought down, and farmers would be lifted up. **We propose an exciting intervention opportunity at the intersection of (1) the insufficiency of carbon offset markets to address factory farming and (2) the vulnerability of current CAFO farmers who lack the agency to move away from the system in which they operate.** Under this initiative, the funding from CARB's offset credit program will incentivize a shift from factory farming animals to the production of sustainable crops, providing major benefits to farmers, the environment, and animals.

In addition to promoting the interests of the farm labor force and the environment, *it is imperative that the framework also emphasizes broader environmental concerns as well as the welfare of animals.* Therefore, **the only supported offset projects should be those which specifically move farmers from raising animals to growing plants.** Even though transitioning from raising cattle to breeding chickens may result in a net reduction of greenhouse gas emissions, subsidizing this transition would incentivize another form of factory farming that creates local environmental issues while further entrenching animal exploitation. Additionally, this intervention would not target any specific species of the livestock industry. Any CAFO could qualify for funding through the carbon offsets.

Finally, to streamline the verification process, **regulators should look to calculate the offsets solely from avoided emissions** and not soil sequestration. Conversations with various stakeholders and literary review has revealed that quantification technology around soil carbon has yet to develop. While soil carbon is a promising method to reduce greenhouse gas emissions, obtaining accurate measurements with current soil carbon accounting is currently very challenging and costly, and would negatively intensify the verification process. We are attempting to create a true-cost measurement of proxies that is currently more accurate and stable than soil carbon measurements.

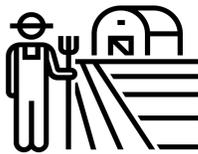
Healthier Planet & Stronger Communities

Environment-based subsidies will incentivize food producers to move from livestock to plant-based meat substitutes, promoting:



Environmental health on multiple indices:

- Avoiding greenhouse gas emissions,
- Reducing animal waste needing to be disposed,
- Mitigating air pollution created by manure spraying,
- Limiting negative land use changes required for growing animal feed,
- And reduced water usage.

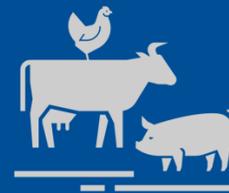


Empower local farmers by providing financial resources outside of contracts and debt

- Although initial funds must be spent on capital for more sustainable practices or alternative production,
- This more stable supplemental income would *not be based* on price fluctuations for meat or the unpredictability of the tournament system. Thus, it could both alleviate financial burdens *and* reduce risk for farmers caught in a chronic debt trap, possibly removing some of the debt all together.



Animal welfare as even a few CAFOs transitioning to plant-based proteins would save thousands of animal lives per year.



Operating within California’s Air Resources Board (CARB)

CARB is tasked with developing programs and regulations that protect the public from the harmful effects of air pollution. One program that CARB operates is California’s Cap-and-Trade Program.ⁱⁱ The program hopes to reduce the greenhouse gases emitted by California companies to 1990 levels by the year 2020.ⁱⁱⁱ To do this, it essentially creates a price signal on the emission of carbon by capping emission levels and allowing for the trade of the capped emission allowances among included business entities.

A company may also exceed their carbon emission allowances by up to eight percent by purchasing CARB offset credits.^{iv} Because they allow a company to emit an additional metric ton of carbon, each offset credit acts as a carbon allowance. However, instead of purchasing this allowance at an auction or from another business, these offset credits are acquired by funding a project that reduces carbon emissions elsewhere in our society. CARB has approved six types of projects that qualify under the offset credit program. These are known as Carbon Offset Protocols.^v Approved Carbon Offset Protocols include biogas dairy digesters, reforestation, urban forestation, as well as a few others.

We plan to make our initiative--the emissions avoided by transitioning livestock farmers to crop farming--into a new Carbon Offset Protocol. Approving this protocol will require a series of procedural steps, such as extensive research by CARB staff followed by a notice and comment period. The protocol will likely also need, on some level, the approval of the Compliance Offsets Protocol Task Force, which consists of 11 members who represent different stakeholders,^{vi} and the CARB Board, which consists of 16 members ranging from elected officials to appointed stakeholders.^{vii}



A successful CARB offset protocol must be one that reduces emissions in an industry not subject to compliance obligations under Cap-and-Trade, produces direct emission reductions in a confined project boundary, produces permanent emission reductions, reduces emissions in a verifiable and enforceable manner, and the emission reductions must be additional.^{viii}

Our initiative meets the following qualifications:

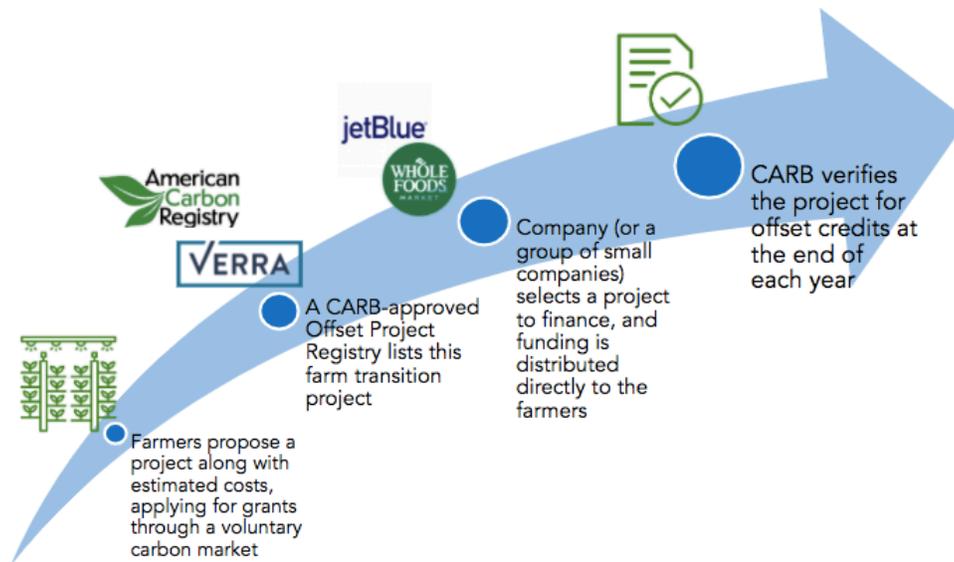
- 1) The agriculture industry is not subject to the compliance obligations of CARB's Cap-and-Trade program.^{ix}
- 2) The initiative aims to directly eliminate the greenhouse gas emissions from the project boundary of the farmer's land.
- 3) By eliminating the animal-related emissions throughout the length of the project timeline, the emissions reductions are permanent.
- 4) The emission reductions are both easily verifiable and enforceable by ensuring that the farm in question has indeed changed from producing livestock to producing plants.
- 5) By eliminating a source of animal agriculture in sectors of the market with suppressed prices, there is very little incentive for business-as-usual approaches to farming elsewhere to increase animal agriculture output by the amount of the project's reduction. Further, there are very few regulations and initiatives incentivizing emission reductions in this sector. This indicates that nearly all emission reductions from this initiative will be additional.

Despite the procedural hurdles associated with creating a new carbon offset protocol, **several opportunities make this initiative worthwhile even beyond the scope of carbon reductions in California.** For instance, California has a partnership with Quebec's cap and trade program, which means there is an additional market within which funds may be distributed to transitioning farms. Another opportunity with this initiative, which may allow for the implementation of its scope without as many procedural hurdles, is by reforming the requirements of the reforestation offset protocol to incorporate farmers transitioning away from CAFOs.

Yet another opportunity for this initiative lies in a company's ability to benefit from joint regulatory compliance benefits through credit stacking. Credit stacking would enable companies to get both carbon credits alongside other environmental credits, such as those to fulfill water regulations.^x This is especially favorable for an idea with as many environmental benefits as this initiative offers.

Given that CARB often models its offset protocols on the protocols and projects found in the voluntary market, **the successful incorporation of this initiative within the voluntary registries is likely a precondition to its incorporation within CARB.** Although working within CARB would give companies additional incentives to provide funding for farm transition projects, this initiative works perfectly within the broader volunteer carbon market. Without testing the waters in a voluntary market, direct inclusion in existing CARB framework likely requires several burdensome administrative steps and any modifications may be cumbersome. As such, it is crucial to propose this initiative to both CARB and other non-CARB entities, such as the Offset Project Registries.

How it works

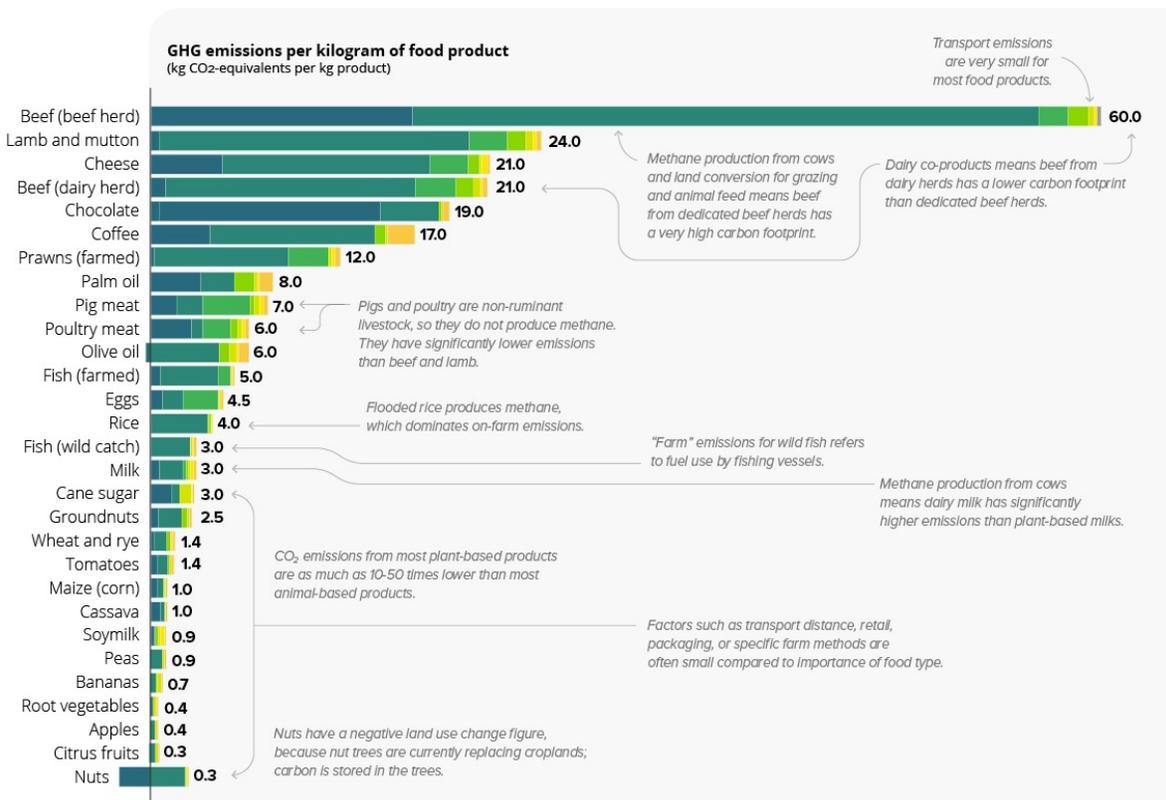
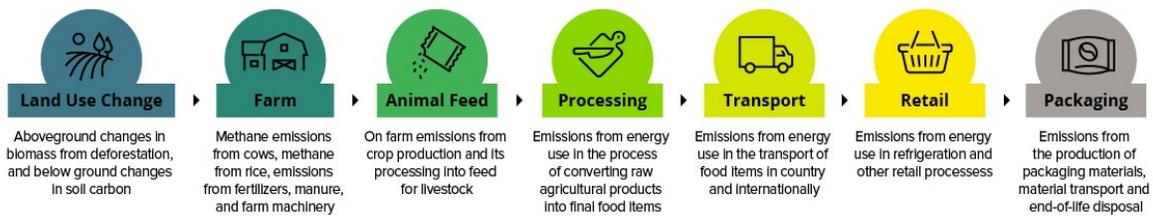


Once CARB approves this Carbon Offset Protocol concept, the funding of farm transitions will function much like any other carbon offset project. Here are the general steps:

- 1) **First, farmers will produce a project proposal under the confines of the CARB Offset Protocol concept envisioned in this whitepaper.** Details from the farmer's project proposal will have a direct influence on the level of funding they would likely receive. For example, attributes such as farm size, livestock type, the crop they are opting to grow, and the length of time the farmer expects to grow this new crop will all influence the price point at which they will be able to list their transition project. Of course, as mentioned in previous sections, these details will all have to work within and will be influenced by the confines of the Carbon Offset Protocol created by CARB.
- 2) **Second, CARB-approved Offset Project Registries will list the farm transition project through their respective platforms.** The farmer, in this instance known as the Offset Project Operator, must list their offset project with an approved Offset Project Registry to be eligible for CARB offset credits. There are three Offset Project Registries (OPR), and their role is to help in the listing and verification of offset projects. The OPR can even grant Offset Registry Credits, which CARB can then convert into Air Resources Board Offset Credits.
- 3) **Any company, such as JetBlue or Whole Foods, may then choose to finance the offset project and ultimately distribute the petitioned funds to the farmers.** Although the details require further research, an exciting possibility for these companies may be to source some of their food from these transitioned farmers. This would benefit the farmer in their ability to secure business and would also help the offset-purchasing company by allowing the company to show consumers their dedication to sustainability efforts.
- 4) **To receive CARB Offset Credits, the project will then require verification of GHG emission reductions by a CARB-accredited verification body.** Once the verification is complete, CARB is authorized to grant the offset credits to the appropriate company.

Livestock Emissions

Numerous studies have run comparisons of the climate impact of different foods, from animal-based proteins to fruits and oils, demonstrating the outsized-impact of the livestock industry. For example, a widely-cited 2018 Science Magazine study featured a meta-analysis of 40 major food types representing around 90% of calories consumed globally, covering data from 38,700 farms.^{xi} **The analysis found that beef led the way in emissions, with 60 kg of CO₂ equivalent emitted per kilogram of product**, followed by lamb and mutton, at a much lower 24 kg of CO₂ per kg of product.^{xii} **Most fruits and vegetables were found to emit around 1 kg of CO₂ per kg of food product**, emphasizing the wide emissions gap between animal and plant products. These impacts are visualized in the chart below.



Note: Greenhouse gas emissions are given as global average values based on data across 38,700 commercially viable farms in 119 countries. Data source: Poore and Nemecek (2018). Reducing food's environmental impacts through producers and consumers. Science. Images sourced from the Noun Project. OurWorldInData.org - Research and data to make progress against the world's largest problems.



Source: Neufeld, Dorothy. "The Carbon Footprint of the Food Supply Chain."

More on Livestock Impacts

While our proposal aims to leverage the climate benefits of livestock-to-plant transformations, it is essential to recall environmental impacts in other sectors.

Concentrated livestock cultivation can contribute to additional challenges from eutrophication to loss of biodiversity to degraded air quality. Some of these impact categories may be more closely linked to feed cultivation, but the **inefficient trophic efficiency [about 10% of livestock feed calories are converted into what can eventually be consumed by humans]^{xiii} intensifies these harms.**

In another study on animal versus plant-based proteins, beef led the way in greenhouse gas emissions, while pork required more freshwater withdrawals per kilogram.^{xiv} Each livestock sector will be worth considering concerning its unique environmental harms and the potential benefits and regulatory credits that transforming each type of farm would bring.

Across categories - climate emissions, freshwater withdrawal, and land use - soy-based plant proteins had less impact than beef, pork, and chicken. **Our proposal would incentivize transitions that would substantially reduce environmental pressures such as those on freshwater withdrawal, which is particularly salient in California.**

What This Project Can Achieve

Our team ran a rough calculation on the greenhouse gas emissions that could be avoided from a single project.

We used a US-based estimate of 26.45 kg of CO₂ equivalent emitted per kilogram of beef,^{xv} which was more conservative than the values cited in the other studies. We estimated the emissions of a large CAFO (minimum threshold herd size of 1,000 heads) with a herd size of 1,000 cattle.

Considering that an average of 430lb of beef, or around 195 kg, is acquired per cow and beef cattle typically live for 1.5 years, we project that substituting a large CAFO could lead to about 3,500 metric tons of avoided emissions per year. *Transitioning five farms would lead to around 17,200 metric tons of permanently avoided emissions, equivalent to taking 3,716 cars off the road in a year.^{xvi}*

*Importantly, these carbon market-financed projects will have long lifespans. **If just five of these projects remain as plant-based operations for ten years, an estimated 172,000 metric tons of CO₂ equivalent can be permanently avoided.*** Considering the long-term nature and co-benefits of these transitions (benefits in water quality, avoided land needs for feed cultivation, etc.), our proposal can incentivize meaningful changes.

Challenges and Next Steps

A significant reality with which this intervention must contend is the inertia of the status quo of environmental initiatives in California, including lobbying efforts on behalf of industrial animal agriculture. For example, CARB's 2018 Dairy and Livestock Greenhouse Gas Emissions Working Group conducted a state-funded study that recommended reinforcing the dairy industry's attempts at sustainability through both non-digester practices and digester technology.^{xvii} In a further demonstration of CARB's priorities, CARB's FARMER (Funding Agricultural Replacement Measures for Emission Reductions) Program channels resources towards Big Ag by prioritizing equipment distribution rather than any fundamental shifts in food production systems.^{xviii}

Further, there are important ethical considerations brought up by this framework. *Because cattle emissions dramatically overshadow those of other species, could this model be used to entrench the production of other livestock?* Non-cattle animal agriculture industries such as chicken CAFOs could co-opt this idea to justify transitions to their product model. Given the immense environmental and welfare concerns with animal-to-animal transitions, enabling such transitions through the carbon market would have enormous negative consequences. Though this initiative explicitly rules out animal-to-animal transitions, future activities in offset registries could arise with different stipulations. Ultimately, however, because the agriculture sector will likely eventually get included within carbon markets, our team wants to proactively ensure such integration happens with deliberate attention paid to animal welfare.

Another element that should be considered with this proposal is **how to create market linkages for the emerging plant products supported by this framework**. We anticipate that our model could be an opportunity for companies that offer consumers goods. A company that has funded a transition project could then market these products--such as salad lettuce that comes from a carbon-neutral operation, funded by Google and served at a conference--both showcasing their investment and creating a market for new goods.

The question of leakage is another important consideration. *That is, if one CAFO closes, what is to prevent another one from taking its place?* In order to evaluate the potential impact of leakage and how to mitigate its occurrence, we have several next steps planned. First, we plan to conduct additional research around how leakage is measured and understand how this might apply to our proposal. We also plan to conduct interviews with CAFO farmers and ask them what may prevent them from expanding their operation. If they say they're limited by the size of their nearby slaughterhouse, then perhaps we have a local leakage problem to consider. If they are instead limited by market pressures surrounding the price of their commodity or labor or capital, then leakage may be less of a concern.

All in all, given the ever-decreasing number of people opting to own factory farms, unless the limiting factor for the expansion by most farmers is the size of their local slaughterhouse, we do not anticipate that closing down a substantial number of the CAFOs in California would create the sort of upward trend in prices that would incentivize farmers elsewhere to join the market.

We look forward to continuing to develop this proposal. **We are confident this project offers a creative approach to help the climate, farmers, and animals through the use of established incentive systems.**

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References

- ⁱ Steinfeld, Henning, et al. "Livestock's Long Shadow: Environmental Issues and Options." Food and Agriculture Organization of the United Nations, United Nations, 29 Nov. 2006, www.fao.org/3/a0701e/a0701e.pdf.
- ⁱⁱ California Air Resources Board. "Cap-and-Trade Program." California Air Resources Board, California Environmental Protection Agency, 2019, ww3.arb.ca.gov/cc/capandtrade/capandtrade.htm.
- ⁱⁱⁱ California Air Resources Board. "Overview of ARB Emissions Trading Program." California Air Resources Board, California Environmental Protection Agency, 9 Feb. 2015, ww3.arb.ca.gov/cc/capandtrade/guidance/cap_trade_overview.pdf.
- ^{iv} California Air Resources Board. "Chapter 1: How Does The Cap-And-Trade Program Work?" California Air Resources Board, California Environmental Protection Agency, Sept. 2012, ww3.arb.ca.gov/cc/capandtrade/guidance/chapter1.pdf.
- ^v California Air Resources Board. "Compliance Offset Program." California Air Resources Board, California Environmental Protection Agency, 2019, ww3.arb.ca.gov/cc/capandtrade/offsets/offsets.htm.
- ^{vi} California Air Resources Board. "Compliance Offsets Protocol Task Force." California Air Resources Board, California Environmental Protection Agency, 2019, ww3.arb.ca.gov/cc/capandtrade/offsets/taskforce.htm.
- ^{vii} California Air Resources Board. "Leadership." California Air Resources Board, California Environmental Protection Agency, 2020, ww2.arb.ca.gov/about/leadership.
- ^{viii} California Air Resources Board. "California Air Resources Board's Process for the Review and Approval of Compliance Offset Protocols in Support of the Cap-and-Trade Regulation." California Air Resources Board, California Environmental Protection Agency, May 2013, ww3.arb.ca.gov/cc/capandtrade/compliance-offset-protocol-process.pdf.
- ^{ix} 17 CCR § 95852.2 Emissions Without a Compliance Obligation. 17 CA ADC § 95852.2 BARCLAYS OFFICIAL CALIFORNIA CODE OF REGULATIONS.
- ^x California Air Resources Board. "California Air Resources Board's Process for the Review And Approval of Compliance Offset Protocols in Support of the Cap-and-Trade Regulation." California Air Resources Board, California Environmental Protection Agency, May 2013, ww3.arb.ca.gov/cc/capandtrade/compliance-offset-protocol-process.pdf.
- ^{xi} Neufeld, Dorothy. "The Carbon Footprint of the Food Supply Chain." *Visual Capitalist*, Visual Capitalist, 10 Feb. 2020, www.visualcapitalist.com/visualising-the-greenhouse-gas-impact-of-each-food/.
- ^{xii} Poore, J., and T. Nemecek. "Reducing Food's Environmental Impacts through Producers and Consumers." *Science*, vol. 360, no. 6392, 2018, pp. 987–992., doi:10.1126/science.aag0216.
- ^{xiii} Shepon, A, et al. "Energy and Protein Feed-to-Food Conversion Efficiencies in the US and Potential Food Security Gains from Dietary Changes." *Environmental Research Letters*, vol. 11, no. 10, 4 Oct. 2016, doi:10.1088/1748-9326/11/10/105002.
- ^{xiv} "How Much Would Giving up Meat Help the Environment?" *The Economist*, The Economist Newspaper, 5 Nov. 2019, www.economist.com/graphic-detail/2019/11/15/how-much-would-giving-up-meat-help-the-environment.

- ^{xv} "Less Beef, Less Carbon." *Natural Resources Defense Council*. Issue Brief. March 2017.
<https://www.nrdc.org/sites/default/files/less-beef-less-carbon-ip.pdf>
- ^{xvi} "Greenhouse Gas Equivalencies Calculator." *EPA*, Environmental Protection Agency, 15 Oct. 2018, www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.
- ^{xvii} Dairy and Livestock Greenhouse Gas Reduction Working Group . "Recommendations to the State of California's Dairy and Livestock Greenhouse Gas Reduction Working Group ." *California Air Resources Board*, California Environmental Protection Agency, 26 Nov. 2018, ww3.arb.ca.gov/cc/dairy/dairy_subgroup_recommendations_to_wg_11-26-18.pdf.
- ^{xviii} FARMER Program." *California Air Resources Board*, California Environmental Protection Agency, 2020, ww2.arb.ca.gov/our-work/programs/farmer-program/about.

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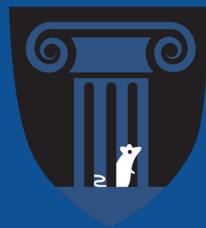
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- **Page 3 and 4:** environment by Flatart from the Noun Project
- **Page 3 and 4:** farm animal by Laymik from the Noun Project
- **Page 6:** approval by Gem Designs from the Noun Project
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This report was researched and written in spring 2020 by a team of Yale graduate and professional school students in the **Climate, Animal, Food & Environmental Law & Policy Lab (“CAFE Lab”)**, an initiative of the **Law, Ethics & Animals Program at Yale Law School**.

The CAFE Lab’s mission is to develop novel strategies to compel industrial food producers to pay the currently uncounted, externalized costs of industrial agriculture for people, animals, and the environment. For more information about the Program and the CAFE Lab and to access its publications, please visit: law.yale.edu/animals.



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