AGRIVOLTAICS AS A LIFELINE FOR RURAL FARMERS AND CALIFORNIA'S RENEWABLE ENERGY GOALS

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SUMMARY

Agrivoltaics, the concept of using solar energy systems to enhance agricultural production and generate renewable energy on the same plot of land, offers a lifeline to beleaguered farmers and communities facing water shortages, cost increases, and marginal agricultural profitability. This concept seeks to aid California in its ambitious renewables portfolio standard, and could reduce the impacts of climate change and the toll agricultural operations take on the San Joaquin Valley's groundwater resources. However, agrivoltaics is a novel and emergent concept, and calls for adjusting California's legal framework to better support it. This Article serves to bring greater attention to agrivoltaics and to further identify potential barriers to its application, while suggesting fair and reasoned solutions and identifying paths where its agricultural components provide either meaningful opportunities or unique challenges that could be mitigated.

The San Joaquin Valley is one of California's greatest assets.[1] The Valley has 920,000 acres of agriculturally productive land, which produced one-quarter of the United States' food and $3 billion in agricultural revenue in 2020.[2] As a result of this productivity, some parts of the Valley have subsided, or sunk, by as much as 28 feet because of decades of excessive groundwater pumping.[3] This groundwater pumping has resulted in the California Department of Water Resources designating 83% of the San Joaquin Valley's groundwater basins as critically overdrafted.[4]

At the same time, utility-scale solar has become an attractive option for farmers compared to irrigated agricultural production.[5] Yet this region has vast potential to accommodate both existing agriculture and significant solar energy capacity.[6] The San Joaquin Valley's high solar insolation and temperate climate make it ideal for solar

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1. For the purposes of this Article, the San Joaquin Valley region is composed of 13 counties: San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, Kern, Calaveras, Tuolumne, Mono, Mariposa, and Inyo.
2. San Joaquin Council of Governments, *Agricultural Production*, https://www.sjcog.org/245/Agriculture (last visited Oct. 17, 2023); U.S. Geological Survey California Water Science Center, *California's Central Valley—Regional Characteristics*, https://ca.water.usgs.gov/projects/central-valley/about-central-valley.html (last visited Oct. 17, 2023).
3. National Aeronautics and Space Administration (NASA) Earth Observatory, *San Joaquin Valley Is Still Sinking*, https://earthobservatory.nasa.gov/images/89761/san-joaquin-valley-is-still-sinking (last visited Oct. 17, 2023).
4. California Department of Water Resources, *SGMA Data Viewer*, https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#boundaries (last visited Oct. 17, 2023) (in the lefthand column under "Reference Layers," navigate to the "Groundwater Management" heading and click "SGMA Critically Overdrafted Basins"); California Department of Water Resources, *Critically Overdrafted Basins*, https://water.ca.gov/programs/groundwater-management/bulletin-118/critically-overdrafted-basins (last visited Oct. 25, 2023) ("A basin is subject to critical overdraft when the continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts.").
5. Andrew Ayres et al., Public Policy Institute of California, Solar Energy and Groundwater in the San Joaquin Valley: How Policy Alignment Can Support the Regional Economy (2022), https://www.ppic.org/publication/solar-energy-and-groundwater-in-the-san-joaquin-valley/.
6. Dustin Pearce et al., Berkeley Law Center for Law, Energy, and the Environment, A Path Forward—Identifying Least-Conflict Solar PV Development in California's San Joaquin Valley 2 (2016).

asset development.[7] The California Independent System Operator (CAISO) predicts the region has the capacity for at least an additional 30 gigawatts (GW) of solar photovoltaic (PV) energy systems, which would triple California's current solar energy generation.[8] Hypothetically, if one-half of the San Joaquin Valley's agriculturally productive land is utilized for agrivoltaics systems, and assuming a 50% lower energy density due to a variety of potential configurations, an additional 19.3 GW of solar PV capacity would become available—almost tripling California's current solar production, but only accounting for less than one-half of California's 2040 projected solar needs.[9]

The California Legislature approved, and then-Gov. Jerry Brown signed, Senate Bill (SB) 100 in 2018, which directs the California Public Utilities Commission (CPUC), the California Energy Commission (CEC), and the California Air Resources Board (CARB) to plan for 100% of the total retail sales of electricity in California to come from eligible renewable energy resources and zero-carbon resources by December 31, 2045.[10] This renewables portfolio standard (RPS) is primarily implemented and administered by the CPUC and requires that a certain percentage of the electrical energy delivered by utilities[11] be "renewable." Most of that renewable energy is procured by utilities from independent power producers (IPPs).[12] The state's primary energy policy and planning agency, the CEC, has identified the San Joaquin Valley as a prime location for solar asset development.[13] Additionally, one of the world's largest solar farms is currently in development in the San Joaquin Valley.[14] Thus, agriculture and solar energy generation are yet again pitted against each other for prime real estate.

However, some of these conflicts may be reconciled by a unique dual land use system called agrivoltaics. Agrivoltaics is a synergistic solution to keep the San Joaquin Valley agriculturally productive while helping California meet its renewable energy goals and providing a vital economic lifeline to farmers ruined by limited access to water. This concept is gaining momentum across the nation, and the California Legislature has proposed various bills on the topic.[15] Farmers would not utilize agrivoltaics on already fallowed land in the San Joaquin Valley, but instead on productive farmland bordering on collapse.

This Article demonstrates how agrivoltaics can play a key and vital role in saving farmers in the San Joaquin Valley and in helping California provide enough clean, renewable energy to meet the climate change and energy independence challenges it faces. Part I elucidates the concept of agrivoltaics by discussing a timely study by the National Renewable Energy Laboratory (NREL) dissecting the crucial water, energy, and food production nexus that can be achieved through agrivoltaics. This part also briefly discusses the characteristics of the San Joaquin Valley. Part II then discusses current incentives and opportunities to support agrivoltaics in California, such as incentive provisions of the Inflation Reduction Act of 2022 (IRA), the Climate Catalyst Program of the California Infrastructure and Economic Development Bank (IBank), and the CEC's Electric Program Investment Charge (EPIC) Program.

Part III addresses potential barriers to agrivoltaics generally and as applied to the Valley. This part discusses a range of issues, including local political and regulatory power, the Williamson Act, the California Environmental Quality Act (CEQA), transmission planning, and the interconnection queue, and ends with a brief discussion of power purchase agreements (PPAs). For each of these barriers, I offer palpable, reasoned modifications or improvements that could help agrivoltaics overcome uncertainty barriers as a novel land use concept. Part IV concludes.

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7. *Id*. at 13, 27 ("In sum, the team identified 470,000 acres of least-conflict land, amounting to roughly 5% of the 9.5 million acres in the stakeholder study area." Least-conflict land means "areas not mapped as Prime Farmland, Farmland of Statewide Importance, or Unique Farmland according to FMMP [the Farmland Monitoring and Mapping Program] or areas that were within Westlands Water District drainage impaired lands.").
8. CAISO, 20-Year Transmission Outlook 2-3 (2022) [hereinafter 20-Year Transmission Outlook]; *see also* CAISO, Key Statistics (2022), http://www.caiso.com/Documents/Key-Statistics-Nov-2022.pdf.
9. Solar Energy Industries Association, *Land Use & Solar Development*, https://www.seia.org/initiatives/land-use-solar-development (last visited Oct. 17, 2023) ("a utility-scale solar power plant may require between 5 and 10 acres per megawatt (MW) of generating capacity"). By a conservative estimate, a utility-scale solar operation requires 10 acres per MW of generating capacity. U.S. Environmental Protection Agency (EPA), *San Joaquin Valley*, https://www.epa.gov/sanjoaquinvalley (last updated Aug. 24, 2023); San Joaquin County Agricultural Commission, 2020 Crop Report: Story of Recovery and Resilience, https://www.sjgov.org/docs/default-source/agricultural-commissioner-documents/croprpt-archive/2020to2029/sjc_cr2020.pdf?sfvrsn=5dfb6910_3 (772,762 acres of the San Joaquin Valley are in agricultural production; one-half of 772,762 acres is 386,381 acres, divided by 10 (10 acres per MW of generating capacity) equals 38,638 MW, which is equivalent to 38.6 GW, divided by two for a presumed 50% lower energy density equals 19.3 GW); Jordan Macknick et al., National Renewable Energy Laboratory, The 5 Cs of Agrivoltaic Success Factors in the United States: Lessons From the InSPIRE Research Study 20-27 (2022), https://www.nrel.gov/docs/fy22osti/83566.pdf ("Traditional utility-scale solar installations have minimal spacing between panels. Increasing the space between panels facilitates greater penetration of sunlight to the agricultural area, but leads to a lower energy density."); 20-Year Transmission Outlook, *supra* note 8, at 19 (53,212 MW of utility-scale solar projected for the 2040 Starting Point scenario).
10. 100 Percent Clean Energy Act of 2018, S.B. 100, 2017-2018 Leg. (Cal. 2018) (SB 100 increases the renewables portfolio standard (RPS) requirement established in SB 350 from 50% by 2030 to 60%, and creates the policy of planning to meet all of the state's retail electricity supply with a mix of RPS-eligible and zero-carbon resources by December 31, 2045, for a total of 100% clean energy.).
11. U.S. Energy Information Administration, *Glossary: Electric Utility*, https://www.eia.gov/tools/glossary/index.php?id=Electric+utility (last visited Oct. 17, 2023):

    A corporation, person, agency, authority, or other legal entity or instrumentality aligned with distribution facilities for delivery of electric energy for use primarily by the public. Included are investor-owned electric utilities, municipal and State utilities, Federal electric utilities, and rural electric cooperatives. A few entities that are tariff based and corporately aligned with companies that own distribution facilities are also included.

12. Cal. Pub. Util. Code §399.12(i).
13. CEC, RETI 2.0 Final Plenary Report 41 (2017) (discussing the "abundant solar energy source" with "high resource value and high commercial interest").
14. *Westlands Solar Park, California*, Power Tech. (May 20, 2022), https://www.power-technology.com/projects/westlands-solar-park/ (Westlands Solar Park is a 2.7 GW solar farm planned in the San Joaquin Valley).
15. S.B. 688, 2023-2024 Leg., Reg. Sess. (Cal. 2023) (Sen. Alex Padilla (D-Cal.) introduced SB 688 on February 16, 2023, to provide grant funding for agrivoltaics projects).

I. Background and Significance

A. Agrivoltaics as a Model for Responsible and Sustainable Land Use

The concept of agrivoltaics is more than 40 years old.[16] In 2019, NREL revived agrivoltaics to combat food and energy insecurity in the United States.[17] NREL's ongoing agrivoltaics research project, titled Innovative Solar Practices Integrated With Rural Economies and Ecosystems (InSPIRE), is primarily funded by the U.S. Department of Energy's Solar Energy Technologies Office (SETO). InSPIRE added its 29th research site in June 2022.[18] Agrivoltaics as a "novel ecosystem" demonstrates the benefits of colocated ground-mounted solar PVs with agriculture to "maximize crop yields, minimize water use, and produce resilient, renewable energy," providing mutual benefits and adding value to each sector.[19]

The combined efficiency and value of crops and electricity located together is equal to or higher than either single land use alone, with some studies suggesting as high as 60% more efficient.[20] Agrivoltaics may also present opportunities to lower the soft costs of solar energy and increase overall value.[21] Additionally, agrivoltaics could provide rural farmers with ecological benefits and diversified revenue sources while "reducing land use competition and siting restrictions."[22] With ground-mounted solar PV deployment projected to triple by 2030, stakeholders must consider dual land use systems like agrivoltaics to help avoid local land use competition with agricultural land.[23]

B. Synergies of Agrivoltaics: Energy, Water, and Food Production

Maintaining and improving energy security and food production is critical to building resilience under uncertain climate conditions.[24] Unfortunately, the conventional understanding of land use presupposes a "zero-sum game" of vigorous competition between agriculture and solar PV farms.[25] Rising temperatures and sporadic precipitation threaten productive agricultural land rapidly being converted into other uses. For example, the conversion of more than 20,000 acres of former farmland in southern California to solar farms in a year is mainly attributable to water scarcity in the region, making agriculture noneconomically viable.[26]

A 2019 study represented the first empirical examination of agrivoltaics' positive impacts on each component of the food-energy-water nexus.[27] The food-energy-water nexus is a holistic and integrated approach that emphasizes links among those systems and extends past single-sector approaches to resource management.[28] The results of this study suggested that agrivoltaics could have significant synergistic effects:

> [C]olocating solar and agricultural could yield several significant benefits to multiple ecosystem services, including (1) water: maximizing the efficiency of water used for plant irrigation by decreasing evaporation from soil and transpiration from crop canopies and (2) food: preventing depression in photosynthesis due to heat and light stress thus allowing for greater carbon uptake for growth and reproduction. An additional benefit might be (3) energy: transpirational cooling from the understory crops lowering temperatures on the underside of the panels, which could improve PV efficiency.[29]

California's prolonged and haphazard droughts threaten agriculture and renewable energy production. For example, the impacts of climate change could reduce hydropower capacity by 20% for individual power plants.[30] In California, hydropower averages 15% of the state's electricity generation.[31] Therefore, certain "drought-proof technologies," such as wind and PV that require minimal water for operations, could boost the electricity sector's drought

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16. Adolf Goetzberger & Armin Zastrow, *On the Coexistence of Solar-Energy Conversion and Plant Cultivation*, 1 Int'l J. Solar Energy 55 (1982).
17. *Benefits of Agrivoltaics Across the Food-Energy-Water Nexus*, NREL (Sept. 11, 2019), https://www.nrel.gov/news/program/2019/benefits-of-agrivoltaics-across-the-food-energy-water-nexus.html ("Across the globe, reductions in precipitation and rising air temperatures are increasing vulnerabilities in both the agricultural and energy sectors.") (discussing Greg A. Barron-Gafford et al., *Agrivoltaics Provide Mutual Benefits Across the Food-Energy-Water Nexus in Drylands*, 2 Nature Sustainability 848 (2019)).
18. Harrison Dreves, *Growing Plants, Power, and Partnerships Through Agrivoltaics*, NREL (Aug. 18, 2022), https://www.nrel.gov/news/program/2022/growing-plants-power-and-partnerships.html; Macknick et al., *supra* note 9, at 2 ("The InSPIRE project is the most comprehensive coordinated research effort on agrivoltaics in the United States. The project has examined opportunities and trade-offs at over 25 sites across the country that span crop production, pollinator habitat, ecosystem services, and livestock production.").
19. *Benefits of Agrivoltaics Across the Food-Energy-Water Nexus*, *supra* note 17.
20. Press Release, Fraunhofer Institute for Solar Energy Systems, Harvesting the Sun for Power and Produce—Agrophotovoltaics Increases the Land Use Efficiency by Over 60 Percent (Nov. 23, 2017), https://www.ise.fraunhofer.de/en/press-media/press-releases/2017/harvesting-the-sun-for-power-and-produce-agrophotovoltaics-increases-the-land-use-efficiency-by-over-60-percent.html.
21. U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy, *Solar and Agriculture Co-Location*, https://www.energy.gov/eere/solar/solar-and-agriculture-co-location (last visited Oct. 17, 2023) [hereinafter *Solar and Agriculture Co-Location*]; DOE Office of Energy Efficiency and Renewable Energy, *Solar Soft Costs Basics*, https://www.energy.gov/eere/solar/solar-soft-costs-basics (last visited Oct. 17, 2023) ("Soft costs are the non-hardware costs associated with going solar. These costs include permitting, financing, and installing solar, as well as the expenses solar companies incur to acquire new customers, pay suppliers, and cover their bottom line.").
22. Barron-Gafford et al., *supra* note 17.
23. *Solar and Agriculture Co-Location*, *supra* note 21.
24. Barron-Gafford et al., *supra* note 17, at 850.
25. *Id*. at 852.
26. Dale Kasler, *More California Farmland Could Vanish as Water Shortages Loom Beyond Drought*, Sacramento Bee (Nov. 27, 2015), https://www.sacbee.com/news/california/water-and-drought/article46665960.html.
27. Barron-Gafford et al., *supra* note 17, at 855.
28. *Id*. at 848.
29. *Id*. at 850.
30. *Id*. at 848.
31. Alvar Escriva-Bou et al., *Water and Energy in California*, Pub. Pol'y Inst. Cal. (Dec. 2022) (from 7% in dry years to more than 20% in wet years); Barron-Gafford et al., *supra* note 17, at 848.

resilience by minimizing water use.[32] The Solar Futures Study, initiated by SETO and led by NREL, is "the most comprehensive review to date of the potential role of solar in decarbonizing the U.S. electric grid and broader energy system."[33] In specific decarbonization scenarios projected in the Solar Futures Study, water withdrawals will decline by about 90% by 2050 due to savings from the low water use of drought-proof technologies, such as PV, compared with fossil fuel and nuclear generators.[34] Additionally, this study recognized the potential of agrivoltaics.[35]

Drylands of the southwestern United States, including the San Joaquin Valley, are ideal for PV because of the abundance of sunlight; however, increasing ambient temperatures reduce this potential because of PV panel sensitivity to temperature increases.[36] Additionally, large PV systems can cause a "heat island" effect that indirectly warms the surrounding area, creating a "negative feedback of additional warming."[37] In nature, "vegetation reduces heat gain and storage in soils by creating surface shading, though the degree of shading varies among plant types."[38]

Similarly, one study found that "PV panels in a traditional ground-mounted array were significantly warmer during the day and experienced greater within-day variation than those over an agrivoltaics understory."[39] Additionally, the shade created by PV systems could reduce water demands for crops due to lower evapotranspiration rates, mitigating some water-related challenges and helping clear the way for "dry farming," where no supplemental irrigation is needed.[40] This synergy between water, energy, and food production cannot be understated, and can play a significant role in ensuring the survival of the San Joaquin Valley.

C. *The San Joaquin Valley Is a Continually Threatened, Immensely Valuable Asset*

The San Joaquin Valley is one of the United States' most productive agricultural regions, with more than 3,400 active farms and 772,762 acres in agricultural production, and is also home to four million Californians.[41] This productivity has left parts of the San Joaquin Valley subsided by as much as 28 feet because of decades of farming and excessive groundwater pumping.[42] Prolonged drought exacerbates this pattern when "farmers rely heavily on groundwater to sustain one of the most productive agricultural regions in the United States."[43] The Valley is further complicated by the existence of three irrigation districts that regulate not only water distribution, but also electricity procurement and distribution within their territories.[44] The CPUC does not regulate these irrigation districts, so they have greater autonomy to create efficient processes that could benefit agrivoltaics projects selling electricity to these districts.[45]

Agrivoltaics can potentially increase crop yield for certain crops critical to the San Joaquin Valley region's economy. One study demonstrated that dual land use systems like agrivoltaics could increase particular crop yields as much as twofold when compared to traditional growing environments; specifically, berries, fruits, and fruity vegetables benefited from partial shading.[46] For example, InSPIRE researchers in Oregon explored how certain agrivoltaics configurations can "reduce drought stress and blossom end rot in dry farmed tomatoes, improving fruit quality and yield of marketable tomatoes."[47] These findings are critically important because in 2020, California produced 91% of tomatoes harvested in the United States, and the San Joaquin Valley produced 68% of California's tomatoes.[48] The potential benefits of agrivoltaics on this staple crop cannot be understated.

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32. Escriva-Bou et al., *supra* note 31.
33. Jenny Heeter et al., NREL, Affordable and Accessible Solar for All: Barriers, Solutions, and On-Site Adoption Protentional iv (2021).
34. Office of Energy Efficiency and Renewable Energy, DOE, Solar Futures Study 19 (2021), https://www.energy.gov/sites/default/files/2021-09/Solar%20Futures%20Study.pdf.
35. *Id*. at 17 ("Dual-use applications provide mutual benefits: farms can grow food and produce electricity on the same land, solar building materials do double duty, and PV on waterbodies reduces evaporation loss.").
36. Barron-Gafford et al., *supra* note 17, at 849.
37. Greg A. Barron-Gafford et al., *The Photovoltaic Heat Island Effect: Larger Solar Power Plants Increase Local Temperatures*, 6 Sci. Reps. art. 35070 (2016).
38. David D. Breshears, *The Grassland-Forest Continuum: Trends in Ecosystem Properties for Woody Plant Mosaics?*, 4 Frontiers in Ecology & Env't 96 (2006).
39. Barron-Gafford et al., *supra* note 17, at 851 ("We attribute these lower daytime temperatures in PV panels in the agrivoltaic system to the greater balance of latent heat energy exchange from plant transpiration relative to sensible heat exchange from radiation from bare soil (the typical installation method).").
40. Macknick et al., *supra* note 9, at 16.
41. U.S. EPA, *supra* note 9; San Joaquin County Agricultural Commission, *supra* note 9.
42. NASA Earth Observatory, *supra* note 3.
43. *Id*.
44. CEC, Electric Utility Service Areas: California, 2023, https://cecgis-caenergy.opendata.arcgis.com/documents/CAEnergy::electric-utility-service-areas/explore (the Modesto Irrigation District, Turlock Irrigation District, and Merced Irrigation District); Cal. Water Code §22115; *see also* Nev-Cal Elec. Sec. Co. v. Imperial Irrigation Dist., 85 F.2d 886, 906 (9th Cir. 1936) (upholding as constitutional the statute authorizing the board of directors of the Imperial Irrigation District to use the funds of the irrigation district for power purposes).
45. The CPUC regulated investor-owned utilities. Municipal utilities, like irrigation districts, are self-regulated public agencies. Cal. Water Code §20570 ("districts are state agencies formed and existing for governmental purposes"); *id*. §21385 (general powers of the board); *id*. §22225 (necessary acts); *id*. §22115:

    > Any district heretofore or hereafter formed may purchase or lease electric power from any agency or entity, public or private, and may provide for the acquisition, operation, leasing, and control of plants for the generation, transmission, distribution, sale, and lease of electric power, including sale to municipalities, public utility districts, or persons.

46. Moritz Laub et al., *Contrasting Yield Responses at Varying Levels of Shade Suggest Different Suitability of Crops for Dual Land-Use Systems: A Meta-Analysis*, 42 Agronomy for Sustainable Dev. 6 (2022), https://doi.org/10.1007/s13593-022-00783-7; Macknick et al., *supra* note 9, at 30.
47. Macknick et al., *supra* note 9, at 16 (InSPIRE researchers have hypothesized that the partial shade and wind protection from solar panels could help minimize blossom-end rot in tomatoes by reducing plant drought stress.).
48. National Agricultural Statistics Service, U.S. Department of Agriculture, 2021 California Processing Tomato County Estimates 1 (2022); National Agricultural Statistics Service, U.S. Department of Agriculture, Vegetables 2020 Summary 1 (2021).

The San Joaquin Valley, like many rural agricultural communities, is predominantly composed of low-medium income communities and communities of color.[49] These communities have traditionally been disproportionately harmed by fossil fuel-based energy systems, "as evidenced by the disproportionately poor air quality and health outcomes in under-resourced communities."[50] Replacing fossil fuel-based energy systems with zero-carbon power sources, such as solar, can restore communities' local air quality and mitigate upstream environmental justice issues associated with material extraction.[51] However, topographic features and automotive pollution are the predominant cause of air quality issues in the San Joaquin Valley.[52]

Additionally, solar deployment presents opportunities for job creation and local wealth-building, which could be vital to the San Joaquin Valley.[53] In the United States, the solar industry already employs around 230,000 people, and projections indicate that it could employ 500,000-1,500,000 people by 2035.[54] Therefore, agrivoltaics has the potential to increase agricultural production, reduce water use, and produce energy—but it can also begin to remedy decades of harm caused by the fossil fuel-based energy systems in the San Joaquin Valley.

II. Current Funding Opportunities and Financing Mechanism Incentives

Agrivoltaics has recently garnered bipartisan support in the U.S. Senate with the introduction of the Pollinator Power Act and the Agrivoltaics Research and Demonstration Act.[55] The Pollinator Power Act would help "reverse the decline in pollinator populations by incentivizing pollinator habitats surrounding new solar projects carried out through the Rural Energy for America Program" with grant monies covering up to 55% of the total project cost.[56] The Agrivoltaics Research and Demonstration Act authorizes $75 million in funding for the U.S. Department of Agriculture (USDA) to fund agrivoltaics research and demonstration projects.[57]

Agrivoltaics also gained the attention of the California Legislature in the 2023-2024 legislative session. In February 2023, Sen. Alex Padilla (D-Cal.) introduced SB 688, which primarily sought to provide grant funding for agrivoltaics projects in California.[58] Assemblymember Lori Wilson similarly introduced Assembly Bill (AB) 408, which would have financed a variety of projects that focus on improving agriculture resilience and sustainability, including allocating $20 million to install agrivoltaics projects.[59] Unfortunately, neither bill made it out of committee.

Additionally, closed funding opportunities by SETO indicate that agrivoltaics is gaining traction, such as through the Foundational Agrivoltaic Research for Megawatt Scale funding program that funded six projects examining how agrivoltaics designs affect agriculture production and energy production.[60] These projects also studied how agrivoltaics can integrate into existing solar farms and tried to develop resources to lower entry barriers to agrivoltaics.

The 2020 SETO funding program funded projects to "develop[ ] co-location models that would help overcome soft cost barriers and realize additional value streams, and support research and analysis on the ecological or performance impacts of solar and agriculture co-location."[61] Fortunately, there are still several incentives and opportunities for stimulating agrivoltaics in the San Joaquin Valley. These incentives are essential because uncertainties in operation, business planning, and upfront costs are barriers to farmers adopting an agrivoltaics model.[62] Additionally, small adjustments to configurations necessary for agrivoltaics projects can increase the projects' costs and make them less economically competitive, furthering the need for financial incentive mechanisms.[63] Therefore, reducing uncertainty and risk through financial incentive mechanisms is crucial for the success of agrivoltaics.

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49. California Health Care Foundation, California Regional Markets: San Joaquin Valley (2020), https://www.chcf.org/wp-content/uploads/2020/12/RegionalMarketAlmanac2020SanJoaquinValleyQRG.pdf (56.7% Latinx population, and "[a]cross the region, which spans the counties of Mariposa, Madera, Fresno, Kings, and Tulare, more than 20% of the 1.8 million residents have incomes below 100% of the federal poverty level (FPL)"); U.S. Census Bureau American Community Survey (ACS), *Low Income Community Census Tracts—2016-2020 ACS*, https://www.arcgis.com/home/item.html?id=573b883f8fd1487991a3136759b00d9c# (calculated using Esri ArcGIS data based on the criteria of 26 U.S.C. §45D(e), Low-income community).
50. Sanya Carley & David M. Konisky, *The Justice and Equity Implications of the Clean Energy Transition*, 5 Nature Energy 569 (2020), *available at* https://doi.org/10.1038/s41560-020-0641-6.
51. Office of Energy Efficiency and Renewable Energy, DOE, *supra* note 34, at 98.
52. U.S. EPA, *San Joaquin Valley: EPA Activities for Cleaner Air*, https://www.epa.gov/sanjoaquinvalley/epa-activities-cleaner-air (last updated Aug. 8, 2023).
53. Office of Energy Efficiency and Renewable Energy, DOE, *supra* note 34, at 75.
54. *Id.* at 19.
55. S. 1555, 118th Cong. §1 (2023) (Sen. Jeff Merkley (D-Or.) introduced the Pollinator Power Act of 2023 to the Committee on Agriculture, Nutrition, and Forestry); S. 1778, 118th Cong. §1 (2023) (Sen. Martin Heinrich (D-N.M.) introduced the Agrivoltaics Research and Demonstration Act of 2023 to the Committee on Agriculture, Nutrition, and Forestry).
56. S. 1555, 118th Cong. §1 (2023), https://www.congress.gov/118/bills/s1555/BILLS-118s1555is.pdf.
57. S. 1778, 118th Cong. §1 (2023), https://www.congress.gov/118/bills/s1778/BILLS-118s1778is.pdf.
58. S.B. 688, 2023-2024 Leg., Reg. Sess. (Cal. 2023) (Senator Padilla introduced SB 688 on February 16, 2023, to provide grant funding for agrivoltaics projects. The bill passed unanimously in the Senate and died in the Assembly Appropriations Committee as of the end of the 2023 legislative session.).
59. A.B. 408, 2023-2024 Leg., Reg. Sess. (Cal. 2023) (Assemblymember Wilson introduced AB 408 on February 2, 2023, which authorizes $3.365 billion in general obligation bonds, $20 million of which are proposed to fund agrivoltaics projects. The bill passed in the Assembly, but died in the Senate Appropriations Committee as of the end of the 2023 legislative session.).
60. DOE Office of Energy Efficiency and Renewable Energy, *Foundational Agrivoltaics Research for Megawatt Scale (FARMS) Funding Program*, https://www.energy.gov/eere/solar/foundational-agrivoltaic-research-megawatt-scale-farms-funding-program (last visited Oct. 17, 2023).
61. *Solar and Agriculture Co-Location*, *supra* note 21.
62. Alexis S. Pascaris et al., *A First Investigation of Agriculture Sector Perspectives on the Opportunities and Barriers for Agrivoltaics*, 10 Agronomy 10 (2020).
63. Macknick et al., *supra* note 9, at 22.

A. The IRA

The IRA is one of the most significant climate and energy spending packages in the history of the United States, with $369 billion dedicated to renewable energy and climate resilience.[64] Farmers and solar developers may utilize several provisions of the IRA to support agrivoltaics projects in the San Joaquin Valley. The IRA primarily supports solar energy development in two ways, through an investment tax credit (ITC) and a production tax credit (PTC).[65] The ITC provides a 30% tax credit for qualifying investment costs in renewable energy projects, and the PTC provides a 2.6 cents per kilowatt hour tax credit for 10 years.[66] Finally, solar developers can claim an additional 10% bonus tax credit for locating their qualified 5 megawatts (MW) or less solar facility in a low-income community.[67]

A utility-scale solar operation requires 10 acres per MW of generating capacity by a conservative estimate.[68] This means that a 5 MW facility, the maximum size that can obtain the 10% bonus credit, may require 50 acres of land. Presumably, under a colocation model, more acreage would be required since the solar land use efficiency would decline compared to a pure solar, utility-scale project. There are 13,317 farming operations under 50 acres in the San Joaquin Valley that could benefit from this 10% bonus tax credit, or about 35% of all farm operations in the San Joaquin Valley.[69] Additionally, more than 61% of counties in the San Joaquin Valley would qualify for the additional 10% tax credit based on their low-income status.[70]

Generally, farmers may elect to lease portions of their land to utility-scale solar developers or pursue funding and develop the solar assets themselves. If ambitious farmers choose to develop the solar asset themselves, then §22002 of the IRA may prove beneficial. Section 22002 established more than $2 billion for the Rural Energy for America Program (REAP) implemented by USDA.[71] REAP "provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements."[72] Agricultural producers with at least 50% of their gross income from agriculture operations may receive combined grants and loan guarantee funding for up to 75% of the total eligible project costs for small and large solar generation projects.[73]

B. California IBank—Climate Catalyst Program

The California Legislature established the California IBank through the IBank Act to provide financial assistance to eligible projects in California through various financing mechanisms.[74] In 2020, the California Legislature amended the IBank Act to add the Climate Catalyst Program, which provides financial assistance to eligible projects intended to "further California's climate goals, activities that reduce climate risk, and the implementation of low-carbon technology and infrastructure."[75]

The IBank and the California Department of Food and Agriculture (CDFA) identified a non-exhaustive list of eligible projects that could receive funding, including on-farm renewable energy.[76] The IBank and CDFA targeted these eligible projects because they "promote climate-smart technology and practices across the agricultural value chain" and provide "compelling opportunities to support climate resilience in a critical industry while directly reducing global warming pollution."[77] Conceptually, agrivoltaics meets these standards and could benefit from the various financing mechanisms offered through the Climate Catalyst Program.

Depending on the scale and purpose of the agrivoltaics projects, certain solar projects may also benefit from transmission funding provisions of the Climate Catalyst Program. Specifically, the transmission interconnection component of an agrivoltaics project may benefit from financing mechanisms if the applicant meets certain criteria common to a utility-scale solar developer.[78] Most agrivoltaics projects will likely follow a leasing model common in solar development and could benefit from this financing mechanism. Agrivoltaics projects clearly meet the Climate Catalyst Program's objective, and would be great candidates for future funding opportunities.

64. IRA, Pub. L. No. 117-169, 136 Stat. 1818 (2022).
65. *Id*. §§13701-13702 (amending 26 U.S.C. §45) (the traditional PTC and ITC will be replaced with technology-neutral credits: the new clean electricity production tax credit (§45Y), and the clean electricity investment tax credit (§48E), which generally mirror the PTC and ITC).
66. *Id*. (amending 26 U.S.C. §45).
67. *Id*. §13103 (amending 26 U.S.C. §48(e)).
68. Solar Energy Industries Association, *supra* note 9 ("Depending on the specific technology, a utility-scale solar power plant may require between 5 and 10 acres per megawatt (MW) of generating capacity.").
69. USDA National Agricultural Statistics Service, 2017 Census of Agriculture—County Data: California tbl.8, https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/California/st06_2_0008_0008.pdf (calculated using USDA 2017 Census of Agriculture data, the most current data set available at the time of writing; the 2022 Census of Agriculture is scheduled to publish in the summer of 2024).
70. ACS, *supra* note 49 (Tables B17020 and B19113).
71. IRA, Pub. L. No. 117-169, §22002(a), 136 Stat. 2019 (2022).
72. USDA Rural Development, *Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grants*, https://www.rd.usda.gov/programs-services/energy-programs/rural-energy-america-program-renewable-energy-systems-energy-efficiency-improvement-guaranteed-loans (last visited Oct. 17, 2023).
73. Rural Economic Development Loan and Grant Programs, 7 C.F.R. §4280.137(b)(1) ("The amount of any combined grant and guaranteed loan shall not exceed 75 percent of eligible project costs and the grant portion shall not exceed 25 percent of eligible project costs.") ($1 million maximum grant for renewable energy systems may constitute a maximum of 25% of the total project cost).
74. Bergeson-Peace Infrastructure and Economic Development Bank Act (Cal. Gov't Code §§63000 et seq.) (known as the IBank Act).
75. Cal. Gov't Code §63048.92(b).
76. *Id*. §63048.93(f)(2)(A).
77. California IBank, *Climate Catalyst Program*, https://www.ibank.ca.gov/climate-financing/climate-catalyst-program/ (last visited Oct. 17, 2023).
78. Cal. Gov't Code §63048.93(f)(3)(C)-(D).

III. Barriers to Agrivoltaics and Potential Legislative and Regulatory Actions

The success of agrivoltaics projects depends on adapting each project to its climate and context. The ideal configuration will vary with crop type, terrain, and climate conditions. Challenges associated with the additional costs of elevating PV systems to allow for undercanopy food production and difficulties adapting certain forms of mechanized harvesting present obstacles for a farmer interested in the agrivoltaics model.[79] Additionally, InSPIRE's second round of research demonstrated the importance of partnerships, noting that "[a]grivoltaics is not necessarily more expensive than traditional solar development, but it can be more complex."[80] However, potential legal obstacles preventing agrivoltaics from flourishing are equally as formidable as some of these more practical concerns.

A. Precedent for Preemption: Local Government Zoning Laws and Regulations

Cities and counties in California generally have the power to support or hinder agrivoltaics through several mechanisms.[81] The California Supreme Court held that a city's police power is as broad as the police power of the legislature.[82] However, that power may also equally be limited or extinguished by the California Legislature.[83] This preemptive authority has been used sparingly—for example, the California Legislature enacted the Housing Accountability Act in 1982, which preempts a city's discretion to deny certain types of affordable housing projects.[84]

The California Legislature's preemptive authority has also been used to target specific problems in the San Joaquin Valley. For example, in 2004, the Legislature required each city located in the San Joaquin Valley to amend appropriate elements of their general plans to include strategies to improve air quality.[85] Again in 2007, the Legislature required cities in the San Joaquin Valley to amend their general plans to include feasible implementation measures.[86] Cities are thereby forced to amend their zoning ordinances as a result of amending their general plans.[87]

The California Legislature justified these measures because they are "a matter of statewide concern and not a municipal affair."[88] It is fair to argue that California's energy crisis is equally crucial as its housing crisis or the San Joaquin Valley's acute air quality and flood problems. Therefore, new legislation requiring cities in the San Joaquin Valley to amend their general plans to accommodate dual land use systems like agrivoltaics is supported by precedent, and may be politically viable.

B. Agrivoltaics Is Consistent With the Purpose of the Williamson Act

1. The Williamson Act's Role in Preserving Prime Agricultural Land

The California Land Conservation Act, better known as the Williamson Act, evolved as a statewide strategic response to farmland disappearing at alarming rates due to conversion to urban uses.[89] The Williamson Act Program allows local governments to contract with private landowners to restrict parcels of land to agricultural or open space uses.[90] In exchange for restricting their property, landowners receive reduced property taxes "based upon generated income as opposed to the potential market value of the property."[91] The contract has a 10-year minimum term and automatically renews each year unless action is taken, effectively making the actual term indefinite.[92]

Generally, one may dissolve a Williamson Act contract through cancellation, nonrenewal, or easement exchange. If the landowner chooses to cancel the contract, likely at the prospect of adapting the parcel's use, they must pay a fee equal to 12.5% of the full market value of their property or 25% for a farmland security zone contract.[93] Suppose the landowner chooses to initiate a notice of nonrenewal. In that case, they must wait nine years until the contract terms expire because the contract renews annually, or 19 years for a farmland security zone contract.[94] However, through an easement exchange, parties contracted under the Williamson Act may mutually agree to rescind their contract to enter into a solar use easement simultaneously and benefit from reduced fees.[95]

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79. Barron-Gafford et al., *supra* note 17, at 853.
80. Dreves, *supra* note 18.
81. Cal. Gov't Code §65103.
82. Candid Enters., Inc. v. Grossmont Union High Sch. Dist., 39 Cal. 3d 878, 885 (Cal. 1985); Cal. Const. art. XI, §7 (under the police power granted by the constitution, counties and cities have plenary authority to govern, subject only to the limitation that they exercise this power within their territorial limits and subordinate to state law).
83. Cal. Const. art. XI, §7 ("A county or city may make and enforce within its limits all local, police, sanitary, and other ordinances and regulations not in conflict with general laws.").
84. Cal. Gov't Code §65589.5.
85. *Id.* §65302.1(b).
86. *Id.* §65302.9(a).
87. *Id.* §65860 ("County or city zoning ordinances shall be consistent with the general plan of the county or city"); *id.* §65860.1 (specifically applying this requirement to the San Joaquin Valley).
88. *Id.* §65302.9(a).
89. California Land Conservation Act of 1965, Cal. Gov't Code §§51200-51297.4 (1965); California Department of Conservation, *Williamson Act Program Overview*, https://www.conservation.ca.gov/dlrp/wa/Pages/wa_overview.aspx (last visited Oct. 17, 2023).
90. Cal. Gov't Code §51240.
91. *Id.* §51243.6; Cal. Const. art. 13, §8; California Department of Conservation, *supra* note 89.
92. California Land Conservation Act of 1965, Cal. Gov't Code §51244-51245.
93. *Id.* §51280-51287; California Department of Conservation, Williamson Act General Cancellation Process Overview (2021), https://www.conservation.ca.gov/dlrp/wa/Documents/WA%20General%20Cancellation%20Process.pdf.
94. Cal. Gov't Code §51245.
95. *Id.* §51255.1(a) ("Notwithstanding any other provision of this chapter, the parties may, upon their mutual agreement, rescind a contract for a parcel or parcels of land that, upon review and approval, are determined by the Department of Conservation to be eligible to be placed into a solar-use ease-

Converting agricultural land into a solar facility would have consequences under any of these scenarios. However, by preserving the agricultural use of the land while simultaneously generating renewable energy, agrivoltaics presents an opportunity to preserve the purpose of the Williamson Act while helping California meet its renewable energy goals. Mitigating these barriers to agrivoltaics is particularly important in the San Joaquin Valley, where Williamson Act contracts cover 75% of irrigated lands.[96]

2. Several Minor Amendments May Benefit Agrivoltaics Projects

The Williamson Act is undoubtedly necessary for preserving California farmland, but amending various provisions of the Williamson Act is equally necessary to reap the benefits of colocated design. A few fair and palatable suggestions are proposed below, including limiting the discretion of local municipalities drafting contract terms and limiting their ability to exclude agrivoltaics as a compatible use, and creating an exception to the requirements of solar use easements for agrivoltaics projects.

The Williamson Act grants local municipalities broad discretion to draft the terms of individual contracts and adopt rules defining compatible uses on property subject to the contract.[97] For example, "electric facilities" is not defined in California Government Code §51201, leading some municipalities to define the term narrowly in order to exclude electric generation facilities. Additionally, counties have discretion to determine if a solar power generation facility is or is not a "compatible use" on Williamson Act contracted parcels.[98] This determination is subject to certain limitations, including that the use will not significantly compromise the long-term productive agricultural capability of the land.[99]

As discussed previously, agrivoltaics enhances the agricultural capability of the land and should not generally violate the compatibility principles used to determine compatible uses.[100] After all, the "overwhelming theme of the legislation is the need to preserve undeveloped lands in the face of development pressure," and colocating two conflicting uses preserves undeveloped agricultural land and that in production.[101] In other words, broad discretion in the hands of local municipalities may prove problematic in advancing a novel and unfamiliar dual land use concept. NIMBYism and other public pressure may dissuade decisionmakers from granting a compatible use in the Williamson Act contract.[102] However, local municipalities have ground to stand on and could argue that agrivoltaics is compatible with the purpose of the Williamson Act.

One option would be to amend the Williamson Act so that dual land use systems like agrivoltaics are presumptively compatible uses, thereby removing the discretion of local authorities to deem an agrivoltaics project incompatible with the terms of the Williamson Act contract.[103] Senator Padilla's proposed SB 688 sought to do just that by specifying that the use of land for an agrivoltaics system under the bill's provision is an "agricultural use" for the purposes of the Williamson Act, but that text was struck during a Senate amendment.[104]

Additionally, whether to convert Williamson Act contracts to solar use easements is at the discretion of the relevant city or county, because a mutual agreement is required to simultaneously rescind their Williamson Act contract and enter into a solar use easement.[105] Either entirely revoking or limiting the consent requirement would prevent local municipalities from vetoing agrivoltaics projects. In order to qualify for a solar use easement, the land must consist of soils determined to be "significantly reduced [in] agricultural productivity for agricultural activities."[106] Additionally, land designated as "prime farmland, unique farmland, or farmland of statewide importance" does not qualify for a solar use easement.[107]

Consistent with the purpose of the Williamson Act, the solar use easement's restrictions ensure that farmers preserve valuable farmland for agricultural uses and not

ment . . . .") (recission fees are set at 6.25% while contract cancellation fees are set at 12.5% (SB 1489, §11 (reenacting Government Code §51255.1))).

96. Annabelle Rosser, *Is SGMA Compatible With Farmland Preservation?*, Pub. Pol'y Inst. Cal. (Aug. 15, 2022), https://www.ppic.org/blog/is-sgma-compatible-with-farmland-preservation/; CEC, *supra* note 13, at 41 ("Extensive acreage under Williamson Act contracts.").

97. Cal. Gov't Code §51201(e) ("Compatible use is any use determined by the county or city administering the preserve pursuant to Section 51231, 51238, or 51238.1 or by this act to be compatible with the agricultural, recreational, or open-space use of land within the preserve and subject to contract."); *id*. §51240.

98. *Id*. §51201(e).

99. *Id*. §51238.1(a)(1).

100. *See* Section I.B.

101. Cleveland Nat'l Forest Found. v. County of San Diego, 37 Cal. App. 5th 1021, 1045 (Cal. Ct. App. 2019).

102. NIMBY stands for "not in my back yard," and represents the opposition to locating something considered undesirable in one's neighborhood. Although some claim the NIMBY movement has weaponized CEQA review, there is conflicting evidence of the true significance or impact of the NIMBY movement hindering solar development in California. *See* Sean B. Hecht, *Anti-CEQA Lobbyists Turn to Empirical Analysis, but Are Their Conclusions Sound?*, LegalPlanet (Sept. 28, 2015), https://legal-planet.org/2015/09/28/anti-ceqa-lobbyists-turn-to-empirical-analysis-but-are-their-conclusions-sound/; Jennifer Hernandez et al., Holland & Knight, In the Name of the Environment (2015), https://issuu.com/hollandknight/docs/ceqa_litigation_abuseissuu. I have decided to omit a discussion of this issue due to conflicting evidence and for the sake of being concise.

103. Cal. Gov't Code §51238(a)(1) (determining agricultural laborer housing is presumptively a compatible use absent the board or council making a finding to the contrary).

104. S.B. 688, 2023-2024 Leg., Reg. Sess. (Cal. 2023) (Senator Padilla introduced SB 688 on February 16, 2023, to provide grant funding for agrivoltaics projects. The original bill text included language seeking to establish agrivoltaics as an "agricultural use" for purposes of the Williamson Act.).

105. Cal. Gov't Code §51255.1(a) ("Notwithstanding any other provision of this chapter, the parties may, upon their mutual agreement, rescind a contract for a parcel or parcels of land that, upon review and approval, are determined by the Department of Conservation to be eligible to be placed into a solar-use easement.").

106. *Id*. §51191(a)(1)(A)-(B) ("The land consists predominately of soils with significantly reduced agricultural productivity for agricultural activities due to chemical or physical limitations, topography, drainage, flooding, adverse soil conditions, or other physical reasons.").

107. *Id*. §51191(a)(2) ("for placement into a solar-use easement if the following criteria are met: . . . The parcel or parcels are not located on lands designated as prime farmland, unique farmland, or farmland of statewide importance . . . .").

develop into other uses without penalty.[108] However, this requirement is inconsistent with the application of agrivoltaics principles because agriculturally productive land is essential to achieving the food-energy-water nexus and because the application of agrivoltaics is not exclusive to farming, but instead enhances and preserves it. Therefore, the solar use easement restrictions should be modified to include an exception for agrivoltaics because the agrivoltaics model preserves the agricultural use of the land and thus conforms to the purpose of the solar use easement and the Williamson Act.

Overall, the Williamson Act remains a popular program. However, adjustments could help preserve the purpose of the Act while partially mitigating the dynamic effects of prolonged agricultural productivity and helping California meet its renewable energy goals. The proposed suggestions further the objectives of the Williamson Act while supporting the development of a novel land use configuration that remedies the impacts of two conflicting land uses.

C. Minor Amendments to CEQA May Be Necessary

CEQA is California's response to the National Environmental Policy Act (NEPA)[109] that requires "projects" involving governmental action to readily study and disclose potential environmental impacts associated with the project.[110] Solar power generation facilities almost always trigger CEQA because they require discretionary permits and approval based on their scale and from multiple governmental agencies throughout development. The CEC offers an opt-in permitting authority for larger renewable projects through a streamlined CEQA process that avoids potential local resistance and may benefit larger agrivoltaics projects, but the CEC process can be equal to a local process as to environmental factors.[111]

The CEQA process is necessary for informed decision-making and environmental protection, but it is time-consuming, expensive, and provides a powerful tool to those who oppose projects.[112] The California Legislature has made targeted improvements to CEQA over the years to remedy some of these issues because more widespread reform has major political consequences.[113] Structural CEQA reform is a complex and formidable policy issue beyond the scope of this Article, but targeted amendments such as expedited review processes or categorical exemptions may be appropriate for agrivoltaics projects.

CEQA exemptions are not uncommon and can either completely or partially mitigate a requirement to comply with CEQA.[114] Additionally, CEQA exemptions may either be statutory or categorical. Statutory exemptions are projects the California Legislature has determined are exempt from CEQA regardless of their environmental impact.[115] Categorical exemptions are projects defined in the CEQA guidelines that generally do not significantly affect the environment and are exempt from CEQA unless an exception applies.[116]

For example, a categorical exemption exists for the renewal of Williamson Act contracts, but not for their cancellation.[117] However, Department of Conservation determinations relating to solar use easements are statutorily exempt from CEQA.[118] This statutory exemption is an excellent example of how the legislature can target an acute issue without disrupting or frustrating the purpose of CEQA and its meaningful application. This exemption is crucial for agrivoltaics projects, but the application of agrivoltaics in the San Joaquin Valley may have a significant enough policy justification to warrant its own categorical exemption.[119]

A categorical exemption for dual land use concepts like agrivoltaics could, in some ways, be modeled after the Class 32 infill development project exemption.[120] Similarly, a categorical exemption for agrivoltaics could exempt projects meeting certain conditions, including: (1) the project is consistent with the applicable general plan designation and all applicable general plan policies, as well as with applicable zoning designation and regulations; (2) the proposed development occurs on a parcel substantially surrounded by agricultural uses, and is no larger than 5 MW; (3) the project site has no value as habitat for endangered, rare, or threatened species; and (4) approval of the project would

108. S.B. 618, 2011-2012 Leg. §1(g) (Cal. 2011) (codified at Cal. Gov't Code §§51190-51192.2), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201120120SB618 ("Encouraging utility-scale photovoltaic energy facilities on marginally productive or physically impaired land by providing expedited termination of Williamson Act contracts, without penalty, will protect the many statewide benefits of the program while providing significant economic incentives for new solar power development.").
109. 42 U.S.C. §§4321-4370h, ELR Stat. NEPA §§2-209.
110. *See generally* Cal. Code Regs. tit. 14, §15002.
111. *Id.* tit. 20, §1879; Cal. Pub. Res. Code §25545(a)(1) (solar PV projects with a generating capacity of 50 MW or more may utilize the opt-in streamlined permitting process with the CEC as the designated lead agency for CEQA purposes).
112. Rigel Robinson, *When a Statute Loses Its Way: Fulfilling the Original Intent of the California Environmental Quality Act*, 41 Yale L. & Pol'y Rev. 280, 284 (2022); Elisa Barbour & Michael Teitz, Public Policy Institute of California, CEQA Reform: Issues and Options iii (2005); Jennifer Hernandez, *New CEQA Study Reveals Widespread Abuse of Legal Process by "Non-Environmentalists*,*"* Plan. Rep. (Dec. 21, 2015), https://www.plannin-greport.com/2015/12/21/new-ceqa-study-reveals-widespread-abuse-legal-process-non-environmentalists ("Only 13 percent of CEQA lawsuits were filed by groups with a track record of prior environmental advocacy, such as the Sierra Club and more local organizations like SCOPE and EPIC."); Lisa Halverstadt, *Union Used CEQA Against Solar Projects, Too*, Voice San Diego (Oct. 19, 2015), https://voiceofsandiego.org/2015/10/19/union-used-ceqa-against-solar-projects-too/; Brian Troxler, *Stifling the Wind: California Environmental Quality Act and Local Permitting*, 38 Colum J. Env't L. 176 (2013).
113. Robinson, *supra* note 112, at 292-93.
114. Cal. Code Regs. tit. 14, §15260; California Governor's Office of Planning and Research, Technical Advisory: CEQA Exemptions Outside of the CEQA Statute (2018), https://opr.ca.gov/docs/20180606-Tech_Advisory_CEQA_Exemptions.pdf (there are more than 50 listed CEQA exemptions to date).
115. Cal. Pub. Res. Code §§21080 et seq.
116. Cal. Code Regs. tit. 14, §153001; *id.* §15300.2.
117. *Id.* §15317 (Class 17: open space contracts or easements).
118. Cal. Gov't Code §51191(d).
119. *See* Part I.
120. Cal. Code Regs. tit. 14, §15332.

not result in any significant effects relating to traffic, noise, air quality, or water quality.

A narrow categorical exemption, as discussed above, could allow small farmers to implement agrivoltaics projects with higher probability of success given the reduced costs and time associated with the CEQA review process. The California Legislature's willingness to exempt solar use easements from CEQA review supports the notion that the state is willing to allow solar development on agricultural land so long as it does not harm the land's agricultural productivity.

If a categorical exemption is not politically viable, streamlining mechanisms provide valuable procedural assistance without compromising the underlying purpose of CEQA. Streamlining review is an example of a partial exemption, where the project is exempt from certain CEQA requirements, but not from the entire review process.[121] For example, proposed projects that are consistent with existing zoning, the community plan, or the general plan where an environmental impact report has already been certified may be subject to environmental review for only those impacts that are peculiar to the proposed project or the site where it is located.[122] Additionally, certain projects on infill sites within transit priority areas are exempt from evaluating aesthetic and parking impacts because they are not considered to impact the environment significantly.[123]

Specific narrow streamlining mechanisms could also be used for agrivoltaics projects in the San Joaquin Valley. For example, agrivoltaics projects in the San Joaquin Valley could be exempt from evaluating aesthetics, a commonly challenged aspect of CEQA litigation from NIMBY groups.

D. Transmission and Interconnection: The Most Prominent Impediments to California's Renewable Energy Goals

Transmission planning and interconnection management are core responsibilities of CAISO.[124] Simply put, transmission planning is the CAISO process of identifying and planning the development of solutions to meet the future capacity needs of the CAISO-controlled grid, including in the San Joaquin Valley area.[125] The interconnection process involves studying generation projects to plan for their connection to the grid and potential impacts on grid capacity, in addition to the technical aspects and equipment required to connect generators to the transmission system.[126]

Currently, the primary policy directive of the CAISO planning cycle is meeting the 2030 greenhouse gas reduction targets established by CARB as directed by SB 350, which establishes a trajectory to meet California's RPS goals.[127] CAISO formulates the public policy-related resource portfolios in collaboration with the CPUC and with input from other state agencies, such as the CEC and the municipal utilities within the CAISO balancing authority area.[128] These agencies' combined influence can either resolve or exacerbate two of the most practical impediments to California's renewable energy goals: transmission and interconnection.

In response to critics' concerns over interagency coordination, the CPUC, CEC, and CAISO have specifically collaborated on studying transmission-related implications of large-scale renewable energy projects across California. The Renewable Energy Transmission Initiative (RETI) was a scoping-level, nonregulatory review of utility-scale renewable energy potential in California.[129] RETI resulted in identifying and refining competitive renewable energy zones that hold the greatest potential for cost-effective and environmentally responsible renewable energy and transmission development.[130]

In 2017, the CEC, CPUC, and CAISO initiated RETI 2.0 to facilitate electric transmission coordination and planning.[131] RETI 2.0 focused on identifying transmission assessment focus areas and testing the hypothetical implications of various renewable energy development scenarios.[132] Notably, RETI 2.0 specifically acknowledged the need for "substantial upgrades" in the San Joaquin region.[133]

1. Cumbersome Transmission Planning and Opportunities for Improvement

Although long-term transmission planning and complex studies provide optimistic outlooks, the reality of transmission development tells a different story. Studying transmission capacity, planning for upgrades or new construction, and implementing those upgrades or new construction is highly fact-sensitive, complex, time-consuming, and expensive, requiring interagency coordination, costing hundreds of millions of dollars, and upwards of 10 years to accomplish.[134] Additionally, although preempted from local review, larger transmission projects are still potentially subject to CEQA, which can be rightfully burdensome on the applicant.[135] A problematic reality is

121. *See*, *e.g.*, Cal. Pub. Res. Code §21093 (encouraging "tiering" from previous environmental reports).
122. *Id.* §21083.3.
123. *Id.* §21155.4.
124. CAISO, *Transmission Planning*, http://www.caiso.com/planning/Pages/TransmissionPlanning/Default.aspx (last visited Oct. 17, 2023); CAISO, *Generation Interconnection*, http://www.caiso.com/planning/Pages/GeneratorInterconnection/Default.aspx (last visited Oct. 17, 2023).
125. CAISO, 2022-2023 Transmission Plan 11 (2023).
126. CAISO, Interconnection Basics (2014), http://www.caiso.com/documents/interconnectionoptionsbasics.pdf.
127. CAISO, *supra* note 125, at 19.
128. *Id.* at 19.
129. CEC, *supra* note 13, at 1.
130. David Olsen et al., *Collaborative Transmission Planning: California's Renewable Energy Transmission Initiative*, 3 IEEE Transactions on Sustainable Energy 837 (2012).
131. CEC, *supra* note 13, at 1.
132. *Id.* at 3.
133. *Id.* at 56.
134. Patrick Welch, California Municipal Utilities Association, Powering California's Future With Clean, Affordable, and Reliable Energy 11-12 (2022).
135. CPUC General Order No. 131-D, §XIV; Cal. Pub. Res. Code §§21000 et seq.

emerging in the San Joaquin Valley: inadequate transmission capacity has become a fundamental bottleneck to renewable energy deployment.[136] The lack of transmission capacity has become a "primary limiting factor to large-scale [solar] expansion."[137]

The final report of RETI 2.0 stated that an additional 5,000 MW of utility-scale solar in the San Joaquin Valley would not require a new transmission line, but would require significant updates costing upwards of $500 million.[138] The original high end of the hypothetical study range for the Valley was 10,000 MW of new solar development, but the Transmission Technical Input Group (TTIG) reported that "it would not be possible to establish the transmission implications of such a large amount of additional generation because it is far beyond any level that has been studied."[139]

CAISO has initiated several studies and policy initiatives aimed at improving the transmission planning process. The Transmission Planning Process Enhancements initiative identified several improvements, including extending the transmission planning timeline to effectively account for increased complexity and interagency coordination in approving "major long lead time transmission projects needed beyond the current 10-year planning horizon."[140] In 2022, CAISO released the 20-Year Transmission Outlook study to "explore the longer-term grid requirements and options for meeting the State's greenhouse gas reduction and renewable energy objectives reliably and cost-effectively."[141] The study estimated that transmission development needed to integrate resources of the SB 100 Starting Point scenario would cost approximately $30 billion.[142]

The potentially vast application of agrivoltaics coupled with the already vast solar potential in the San Joaquin Valley indicate that the region will need to be well-equipped for transmitting this energy throughout California.[143] In response to this growing concern, CAISO recommended the Manning 500 kilovolt (kV) substation in 2022, aimed at aiding the development of solar assets in the San Joaquin Valley.[144] The report suggests this substation will be enough to "defer the needs for upgrades to transmission lines" in the area, but another, more formidable problem remains.[145]

2. The Never-Ending Queue: Optimizing Transmission Interconnection

All electricity generation projects must receive approval from CAISO before they can interconnect. However, there is a fast-track process for projects smaller than 5 MW.[146] Generally, CAISO has an interconnection queue problem: as of 2022, 605 projects totaling 236,225 MW are waiting in the transmission interconnection queue.[147] In recent years, the median number of months from an interconnection request to the project's commercial operation date has exceeded eight years.[148] This "hyper-competition" creates significant barriers to managing the queue efficiently, and has resulted in significant delays in processing time.[149] This excessive wait time causes many projects to withdraw from the queue.[150]

CAISO is well aware of this problem, and has pursued a significant generator Interconnection Process Enhancements (IPE) program over the past few decades, including integrating the transmission planning and generator interconnection processes,[151] incorporating a cluster process focused on efficiency,[152] and extending deliverable periods to allow more time for application corrections.[153] Because of the complexity of the issues, the IPE targets the immediate needs for interconnection requests already in the study process.[154] More recently, the 2021 initiative improved the interconnection process by allowing flexibility in downsizing and site location, and the incorporation of an emergency interconnection process to preserve system reliability.[155] The 2023 IPE seeks to "revise interconnection procedures to prioritize interconnection requests that are aligned with priority zones."[156] At the time of writing, Track 2 of the

136. Ayres et al., *supra* note 5, at 3 ("Project planning and financing has already become more difficult in the past few years due to uncertainty about access to scarce grid capacity.").
137. *Id*. at 7.
138. CEC, *supra* note 13, at 7, 56.
139. *Id*. (The TTIG was composed of all North American Electric Reliability Corporation (NERC)-registered transmission planning entities within California, including staff from each major private and public utility and balancing area. CAISO led the process in coordination with the RETI 2.0 agency staff.).
140. CAISO, ISO Transmission Planning Process Enhancements—Straw Proposal (2022), http://www.caiso.com/InitiativeDocuments/StrawProposal-TransmissionPlanningProcessEnhancements.pdf.
141. 20-Year Transmission Outlook, *supra* note 8, at 5.
142. *Id*. at 2-3:

> The Starting Point scenario was developed by taking the 2040 SB 100 Core scenario and increasing assumed natural gas power plant retirements to 15,000 MW. . . . [T]he Starting Point called for 37 GW of battery energy storage, 4 GW of long-duration storage, over 53 GW of utility scale solar, over 2 GW of geothermal, and over 24 GW of wind generation—the latter split between out-of-state and in-state resources.

see supra note 10 for an explanation of SB 100.
143. Solar Energy Industries Association, *supra* note 9; Pearce et al., *supra* note 6, at 62.
144. CAISO, 2021-2022 Transmission Plan 199 (2022) (This new substation will not be online until 2028, and will cost approximately $400 million.).
145. *Id*.
146. CAISO, Fifth Replacement Tariff—Appendix DD 26 (2013), http://www.caiso.com/Documents/AppendixDDGeneratorInterconnectionAndDeliverabiltyAllocationProcessJul12013.pdf.
147. CAISO, *supra* note 144, at 12.
148. Joseph Rand et al., Lawrence Berkeley National Laboratory, Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection as of the End of 2021, at 24 (2022), https://emp.lbl.gov/sites/default/files/queued_up_2021_04-13-2022.pdf.
149. CAISO, *supra* note 144, at 12; Rand et al., *supra* note 148, at 6.
150. Rand et al., *supra* note 148, at 3.
151. CAISO, 140 FERC ¶ 61070 (2012).
152. CAISO, 124 FERC ¶ 61292 (2008).
153. CAISO, 162 FERC ¶ 61207 (2018).
154. *Interconnection Queue Reforms Going to ISO Board*, CAISO (Oct. 6, 2022), http://www.caiso.com/about/Pages/Blog/Posts/Interconnection-queue-reforms-going-to-ISO-Board.aspx.
155. CAISO, 180 FERC ¶ 61143 (2022).
156. CAISO, 2023 Interconnection Process Enhancements—Track 1 Final Proposal 4 (2023), http://www.caiso.com/InitiativeDocuments/Final-Proposal-Interconnecton-Process-Enhancements-2023-Track1-Apr13-2023.pdf.

IPE is forthcoming, and will target modifications to the interconnection process.[157]

The considerable attention and action paid to generator interconnection and transmission planning issues is encouraging, but it is too early to say whether these improvements will drastically cut down the average queue time. However, the California Legislature has also taken notice and proposed numerous bills aimed at solving these problems. Several assemblymembers and senators have proposed legislation, including CEQA exemptions,[158] streamlining for battery storage,[159] targeted priority approvals that skip the queue,[160] studying alternative ownership and financing models for new transmission facilities,[161] streamlining transmission infrastructure construction,[162] and even creating a new state agency.[163] Generator interconnection and transmission planning undoubtedly affect the proliferation of agrivoltaics projects. Fortunately, this issue is highly prioritized by regulators and legislators alike, and will hopefully see relief soon.

157. *Id*. at 4.

158. A.B. 914, 2023-2024 Leg., Reg. Sess. (Cal. 2023) (Assemblymember Laura Friedman introduced AB 914 to exempt certain transmission projects associated with transportation electrification, building electrification, distributed energy, energy storage, or interconnection of a renewable energy source.).

159. A.B. 1623, 2023-2024 Leg., Reg. Sess. (Cal. 2023) (Assemblymember Al Muratsuchi originally introduced AB 1263 to provide an accelerated electric interconnection timeline for all clean energy projects, but it has since been narrowed to include only battery storage.).

160. Accelerating Renewable Energy Delivery Act, Stats. 2022 ch. 358 (SB 887) (codified at Cal. Pub. Util. Code §454.57) (requiring the CPUC, CEC, and CAISO to jointly identify high-priority transmission projects and approve them as part of CAISO's 2022-2023 transmission planning process).

161. A.B. 2696, 2021-2022 Leg., Reg. Sess. (Cal. 2022) (Assemblymember Eduardo Garcia introduced AB 2696 intending to study whether the current transmission ownership and financing mechanisms are adequate to achieve California's climate goals. The bill did not make it out of committee with further action, and is currently inactive.).

162. S.B. 420, 2023-2024 Leg., Reg. Sess. (Cal. 2023) (The bill sought to exempt construction of a new electrical transmission facility, or other modification, including lines and substations, by an electrical corporation from the requirement to obtain discretionary permit from the CPUC, if the electrical transmission facility meets certain requirements. Unfortunately, this bill was vetoed by Gov. Gavin Newsom, reasoning that the bill "compounds existing permitting complexity for these projects by devolving permitting authority of mid-sized electric transmission projects from a single state agency to local agencies." Press Release, Officer of the Governor, To the Members of the California State Senate (Oct. 7, 2023), https://www.gov.ca.gov/wp-content/uploads/2023/10/SB-420-Veto.pdf).

See also S.B. 619, 2023-2024 Leg., Reg. Sess. (Cal. 2023) (The bill sought to authorize an electrical corporation that applies to the CPUC to authorize a construction of a high-voltage electrical transmission line, rated at 138 kV or greater, to apply to the CEC for certification of the facility pursuant to CEQA, instead of the CPUC conducting the CEQA review. Unfortunately, this bill was vetoed by Governor Newsom, reasoning that "decentralizing permitting between two agencies creates new coordination challenges, requires duplicative staffing, disrupts the sequencing of permitting workstreams and impedes the ability of either agency to consider the full scope of an electric transmission project." Press Release, Office of the Governor, To the Members of the California State Senate (Oct. 7, 2023), https://www.gov.ca.gov/wp-content/uploads/2023/10/SB-619-Veto.pdf).

163. S.B. 1032, 2021-2022 Leg., Reg. Sess. (Cal. 2022) (Senator Josh Becker introduced SB 1032, which originally proposed the creation of a Clean Energy Infrastructure Authority, but the bill was amended several times and the Clean Energy Infrastructure Authority was eventually struck.).

E. Selling Electrical Energy

Some farmers may be driven by environmental concerns to install agrivoltaics projects on their land, but everyone will need to monetize their investment and sell the energy their agrivoltaics produce. There are multiple ways to sell their energy. However, it will most likely be through a traditional PPA with either an investor-owned utility (IOU), a community choice aggregator, or a municipal utility like one of the three irrigation districts in the San Joaquin Valley. A PPA is a foundational contract for all power generation projects, and in California is regulated by the CPUC when it involves an IOU.[164]

Simply put, a PPA is a contract allowing a solar generation developer, as an IPP, to sell the energy their project generates to a utility. Long-term stability in these contracts is essential in infrastructure industries, like energy, that tend to be "capital intensive, require long-term planning horizons, involve high sunk-cost outlays, and are heavily affected by perceptions of the public interest."[165] PPAs can be cumbersome and complex negotiations that may prevent smaller generators from capitalizing on their investments. This has led California to develop other mechanisms, such as the Net-Energy Metering (NEM) and Feed-In-Tariff (FIT) programs, that help smaller generators sell their electricity to utilities.

NEM programs are most appropriate for distributed energy resources like rooftop solar, where the primary objective is to allow customers to generate their own energy, but also allows them to receive financial credit for surplus generated.[166] FITs are guaranteed, long-term, standardized contracts that enable smaller generators to sell their energy to utilities.[167] FIT programs "provided a simple mechanism for small renewable generators to sell power to the utility at predefined terms and conditions, without engaging in timely contract negotiations."[168] FIT programs, unlike NEM programs, are designed for smaller utility-scale solar projects, with an eligible project size capped at 3 MW.[169] California's FIT program has been amended and improved over the years to increase the eligible project size, clarify market pricing mechanisms, increase statewide procurement requirements, and target specific types of renewable energy such as biogas.[170]

The Bioenergy Market Adjusting Tariff (BioMAT) program was created in 2012, and modified California's RPS to require utilities to procure 250 MW of electricity from

164. Cal. Pub. Util. Code §2826.

165. Stephen L. Teichler & Ilia Levitine, *Long-Term Power Purchase Agreements in a Restructured Electricity Industry*, 40 Wake Forest L. Rev. 677 (2005).

166. CPUC, *Customer-Sited Renewable Energy Generation*, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/net-energy-metering (last visited Oct. 17, 2023).

167. Cal. Pub. Util. Code §399.20(d)(1).

168. CPUC, *FIT Program Background*, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/rps/rps-procurement-programs/rps-renewable-fit-program/rps-fit-program-background (last visited Oct. 17, 2023).

169. Cal. Pub. Util. Code §399.20(b)(1).

170. CPUC, *supra* note 168.

bioenergy programs.[171] The BioMAT program is aimed to help achieve "statewide air quality, climate, waste diversion, and public safety goals."[172] In order for agrivoltaics projects to take hold in California and the San Joaquin Valley, mandatory procurement measures similar to the BioMAT program may be appropriate to help "lower barriers to entry to wholesale power production" and provide "market certainty for developers."[173] An agrivoltaics procurement program modeled after BioMAT, in conjunction with a FIT-like program ensuring guaranteed, above-market price for producers, may be very useful in incentivizing utilities and energy developers to support agrivoltaics in California.

IV. Conclusion

Agrivoltaics provides a potent remedy for two conflicting land uses while generating significant synergistic effects between energy, water, and food production. This concept also seeks to aid California in its very ambitious RPS, and seemingly to provide a lifeline solution to the San Joaquin Valley and its teetering agricultural mecca. Climate change and prolonged agricultural productivity have placed the Valley on the brink of collapse. While agrivoltaics cannot single-handedly save the Valley, its widespread application to compatible crop types could reduce the impacts of climate change and the toll agricultural operations take on the Valley's precious groundwater resources.

However, agrivoltaics is a novel and emergent concept that has yet to have significant testing in industrial agriculture scenarios. This unfamiliarity means regulators and farmers alike may have difficulty implementing the concept in modern frameworks, and highlights the need to adjust California's legal framework to better support agrivoltaics.

This Article aims to bring greater attention to the novel concept of agrivoltaics and its seemingly great potential, and to further identify potential impediments to its application while suggesting fair and reasoned solutions. It is no surprise that many of the barriers to agrivoltaics are shared with ordinary solar PV projects. However, I have identified divergent paths throughout where the agricultural components of agrivoltaics can provide either meaningful opportunities or present unique challenges that should be mitigated.

Several funding and financing mechanisms that could hedge against uncertainty and provide incentives for utility-scale solar energy developers to work with farmers in implementing this novel concept are available. These include not only federal sources focused on renewable energy generally, such as the IRA, but also programs focused explicitly on California's innovative spirit, such as the Climate Catalyst Program. While financial incentives serve to induce developers, they are meaningless unless individual projects can actually surpass regulatory and sociopolitical barriers. The solutions to these barriers often lie in legislation, but in an effort not to suggest the perfect yet impracticable solution, the Article emphasizes palpable and reasoned improvements that may muster a majority vote.

Because most environmental and economic impacts and permitting are at the local level, solar PV projects thrive or die at the will of local politicians. Matters of statewide concern, such as housing and energy, have garnered legislative support in the past for preemptive solutions. State legislation like the Williamson Act also conflicts with solar PV projects. The California Legislature has tried to remedy this conflict with the use of solar use easements, but the statutory language limits these easements to agriculturally unproductive lands. Agrivoltaics projects retain the agricultural productivity component of the land, and thus are not in conflict with the purpose of the Williamson Act and should be "compatible uses" within the Act. Alternatively, an exception for agrivoltaics could be incorporated into the solar use easements provisions of the Williamson Act.

Other state legislation such as CEQA is equally necessary for environmental protection, but sometimes conflicts with solar PV projects. Given the environmental benefits of agrivoltaics projects when compared to traditional solar PV projects, a categorical exemption for agrivoltaics projects may be appropriate, and it could be modeled after the existing Class 32 permit. Alternatively, narrow CEQA streamlining mechanisms may prove beneficial to agrivoltaics projects if categorical exemptions are not supported.

The two final but major barriers to agrivoltaics are transmission planning and the interconnection process. If solar PV development on fallowed land and agrivoltaics on productive land catch on in the San Joaquin Valley, then significant upgrades to transmission capacity will be needed. Promising agrivoltaics projects will be at the mercy of the cumbersome transmission planning process as well as the notoriously lengthy interconnection queue. Fortunately, both issues have gained considerable attention since California's ambitious RPS goals in regulatory initiatives, rulemakings, and the California Legislature.

Agrivoltaics has the potential to conserve groundwater in critically overdrafted basins while generating renewable energy for California's RPS goals, improving efficiency of solar PV panels, and potentially increasing crop yields. These benefits cannot be fully realized unless regulators and legislators can support the concept through minor modifications to existing law.

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171. Cal. Pub. Util. Code §399.20 (formerly SB 1122 (Rubio)).
172. CPUC Decision No. 20-08-043, at 13 (Aug. 27, 2020), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M346/K112/346112503.PDF.
173. J.R. DeShazo & Ryan Matulka, UCLA Luskin Center for Innovation, Implementing Feed-In-Tariff Programs: Comparative Analyses and Lessons Learned 3 (2013); Sadie Cox & Sean Esterly, NREL, Feed-In Tariffs: Good Practices and Design Considerations—A Clean Energy Regulators Initiative Report 1 (2016).