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Renewable Portfolio Standard 2025

Additional submitted attachment is included below.

28 May 2025

California Energy Commission

Docket Log: 21 RPS 02 Notice of Scoping Meeting on the Draft Renewable Portfolio Standard 10th Edition Guidebook

Hi Staff,

Due to advances in clean generation and storage, significant scaling of clean technologies, Western Energy Imbalance Market, CAISO EDAM, a growing diversity of policies that enable more efficient and resilient management of our resource adequacy, research findings, and record levels of CO2 in our atmosphere, a 10th edition is certainly warranted. These changes allow us to be more selective and therefore effective. Instead of declaring anything that has at least one percent fewer GHG emissions than fossil fuels to be eligible and receive RECs, it is time to select the best of the best of current technologies, while disqualifying technologies that have more, the same amount, or only slightly less GHG emissions than fossil energy. Using only the best will spur technologic innovation and accelerate our progress toward legislation-mandated targets, e.g., SB-1020 Laird 2022.

We would be wise to select technologies with the lowest amount of side effects, opportunity costs, and externalized costs. At present, we have more options than ever which have minimal amounts of these.

The body of this comment explores the current RPS technologies to delete or add. They are presented in their order of appearance in the 9th edition. The term sunset herein means to reach a point of complete disqualification as a RPS generator by 2030 at the latest. Sunsetting is recommended for the botanical-based technologies below as well as hydrogen fuel cells (with certain exceptions). It is recommended that one form of hydro be added as qualifying for RPS status. LCA means lifecycle analysis of GHG emissions - in all three Scopes.

BIODIESEL

There are many cleaner generation technologies with a lower LCA carbon intensity[1]. This is especially true when including net emissions from mining and manufacturing of production plants, land use changes, transportation, fugitive emissions from pipelines, GHG emissions from carbonaceous combustion, toxic air contaminants from combustion [2], diminished CO2

[1] Ecologically informed solar enables a sustainable energy transition in US croplands | PNAS

[2] https://cacondor.substack.com/p/not-just-hot-air

https://cacondor.substack.com/p/the-biomass-boondoggle

sequestration due to harvest of growing botanicals, depletion of soil nutrient density (which requires labor, transport, and soil amendment materials to restore), the inefficiency of.waste heat, and management of industrial waste after production. Each of these inputs must be factored into the calculations of the difference of CO2e intensity between biodiesel and other generation technologies. Due to a diverse heterogeneity of LCA models, assumptions, and variables quantified, the variation in reported LCAs of biodiesel is high. Methane turbine generation was found to be superior to biodiesel generation[3]. A search did not locate LCA research contrasting biodiesel generation with clean generation (geothermal, wave/current/tidal, solar, wind, hydro). This would help to decide upon the duration to continue classification of biodiesel as RPS qualified.

Total emissions and environmental impacts of biofuels depend on feedstock, production processes (e.g., thermochemical, electrochemical, direct combustion), kinds of energy used for production and transport, and effects of waste management [4]. The lowest environmental impact is achieved by using waste feedstocks instead of raising dedicated crops.

Biodiesel production competes with food crops for land, water, pesticides, herbicides, and fertilizers. It may exacerbate global food shortages.The amount of arable land on our planet is dwindling each year. This is due to increased drought and urban development. Policies to divert water use from other industries (e.g. raising livestock in CAFOs and biofuel production) to crop agriculture are recommended. A higher and better use of processed waste biomass is to use it for agriculture instead of biofuels.

NON-WOODY BIOMASS

A search since 2021 did not reveal performance research that included LCA [5]. Peer-reviewed LCA research should be a requirement for any generation technology to be RPS-qualified [6]. Most scientific articles on biomass energy focus on production of fuels. Combustion of woody

[3] https://www.sciencedirect.com/science/article/abs/pii/S0016236121029446

[4] https://www.sciencedirect.com/science/article/abs/pii/S1364032122003197

[5] https://www.research-collection.ethz.ch/bitstream/handle/20.500.11850/518188/Sources_of_Electricity_Supply_Synthesis_Report.pdfhttps://www.research-collection.ethz.ch/bitstream/handle/20.500.11850/518188/Sources_of_Electricity_Supply_Synthesis_Report.pdf

[6] https://pubs.rsc.org/en/content/articlehtml/2024/va/d4va00109e

and non-woody biomass emits airborne toxic co-pollutants [7],[8],[9]. Because many of these have GHG properties, that alone should preclude non-woody biomass from qualifying as an RPS technology. A higher and better use for it is compost and mulch for agricultural and landscaping.

BIOMETHANE

The conversion of biogas to biomethane replaces the CO2 in biogas with CH4 (methane), which has a Global Warming Potential (GWP)20 of 84. This increases energy density per volume as well as the GWP of biomethane.

In a search since 2021, LCA models are briefly outlined in the scientific literature and some results are presented [10],[11],[12],[13],[14], [15],[16],[17]. None of the LCA models or methodologies were complete. So, results therefrom incorporate only part of the LCA emissions.

Because biomethane consists of 95% methane, its LCA carbon intensity is probably greater than that of natural (fossil) gas (NG) - which is 70 to 97% methane.

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[7] https://cacondor.substack.com/p/not-just-hot-air

https://cacondor.substack.com/p/the-biomass-boondoggle

[8] https://www.sciencedirect.com/science/article/abs/pii/S1674200123001761

[9] https://www.researchsquare.com/article/rs-5223246/v1

[10] https://chemistry-europe.onlinelibrary.wiley.com/doi/10.1002/cssc.202400779

[11] https://www.sciencedirect.com/science/article/pii/S1364032120308728

[12] https://www.mdpi.com/1996-1073/17/11/2771

[13] https://www.sciencedirect.com/science/article/abs/pii/B9780443184796000090

[14] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4721420

[15] https://www.tandfonline.com/doi/abs/10.1080/15567036.2021.1899341

[16] https://www.sciencedirect.com/science/article/abs/pii/S1364032121004366

[17] https://www.sciencedirect.com/science/article/abs/pii/B9780128228081000155

Fugitive emissions of NG from pipelines vary from 3 to 11% of volume [18], [19]. Ordinarily, fossil methane pipelines are used for biomethane. It is thus likely that fugitive emissions of biomethane are also between 3 and 11% of volume [20].

Research on the LCA of NG reveals that it emits about the same amount of CO2e/kWh as coal [21], [22], [23], [24], [25], [26].

Converting biogas to biomethane is a water-intensive process. Production in drought-prone areas is cautioned. Also, toxic chemicals from production and eutrophication-proliferating organic wastes pollute nearby water resources. As with other biogenic feedstocks for fuels and electricity, there are significant waterborne and airborne toxic co-pollutants and use of residues for feedstocks has a lower environmental impact than use of dedicated crops.

HYDROGEN FUEL CELLS (HFC)

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[18] US methane emissions dwarf EPA's data

[19] New Data Show U.S. Oil & Gas Methane Emissions Over Four Times Higher than EPA Estimates, Eight Times Greater than Industry Target

[20] https://www.sciencedirect.com/science/article/pii/S2590332222002676

[21] https://scijournals.onlinelibrary.wiley.com/doi/pdf/10.1002/ese3.35

[22] https://www.nytimes.com/2023/07/13/climate/natural-gas-leaks-coal-climate-change.html?unlocked_article_code=nsBdgtppgLWo401hYeHEN6kYyZ7Bwq9rtvSUqYOBMeVfDNfVpwSN0re7iHswh-J4Z5WtuitIpFtMaY6uJm8Zgz3sfHvCxi4qVZe-LsXymvsgM6pdoUkqweC5Y1kNBSSka8eSYuc3zvdRZ2kOwUFPI86l7irNpR4CkeMykcNvucKlpf9MNIFjHGvr9rerYw_-Dpib7xB949re0R1QlZYHteL51QvBClFIetY2VSJYLxC5qmue60x9sthykxsexZPxzwHjZUbmJK8aEFaLe5oc_puXPERtKVx96POPnvWFCkdateFdBzKE-k2ognlSNYkgyD0uT7y_rlOii93r0asvRr6w-2alv8rOKXPxQXkinA&smid=url-share

[23] Evaluating net life-cycle greenhouse gas emissions intensities from gas and coal at varying methane leakage rates - IOPscience

[24] Liquefied natural gas carbon footprint is worse than coal | CALS

[25] Calculating Parity Between Gas and Coal Life-cycle Emissions - RMI

[26] Coal vs. Natural Gas | Rocky Mountain Institute

Though HFCs may be used as a power source for buildings, this is rarely found in CA. There are many disadvantages of using HFCs for buildings instead of using electricity. HFCs require a dedicated pipeline that is designed to prevent leaks of tiny hydrogen (H2) molecules. This network does not exist in CA, would cost $billions, and it would be paid for by ratepayers. Building appliances can run on blends of up to 10 or 20% H2.The remaining 80 to 90% is NG. Both are highly flammable and explosive. Combustion of these blends for appliances creates toxic emissions. These cause medical damage [27], [28], [29]. HFCs are not cost competitive with electrification.

HFC-powered backup emergency generators are a significant improvement over diesel generators. HFCs may be fueled with canisters of compressed hydrogen (H2). However, disadvantages of using HFCs as a primary power source in buildings also apply to HFC generators. Again, electrification has many advantages. HFC generators are more costly than diesel generators and any of the following. Emergency electricity may be generated by discharging solar-charged batteries, using portable solar panels that generate electricity without using batteries, and by using EV batteries. The latter is called Vehicle to Grid (V2G) and is performed by plugging one's EV into a building's circuitry.

In order to solve climate change, only green hydrogen (GH) should be used. The minimum standards determined by the US Treasury Department for GH are[30].

Production from water using electrolyzers

Use of clean energy (geothermal, solar, wind, or hydro) from sources that are constructed after completion of a new H2 plant and dedicated to H2 production

Electricity supplied by nearby power plants within CA - preferably in the same county

Energy to be provided continuously during each hour of production

GH is not currently being produced in CA, though so-called "clean" production is estimated to begin later this year. Some of these projects plan to use electrolyzers. However, it is unknown whether any of these will use the above standards for GH. If not, imports would be required - increasing the cost and LCA of GH. Globally, GH is not cost-competitive with direct use of electricity, fossil fuels, and other colors of H2. Other colors have more carbon dioxide emissions per kg produced [31].

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[27] National Building Pollution Report | Physicians for Social Responsibility

[28] Gas stove health concerns were subject to government scrutiny in the 1980s | Vox

[29] https://www.sfbaypsr.org/our-work/hydrogen-in-homes-harms-climate-health/

[30] STATEMENT: U.S. Treasury Department Rules that Cleanest Hydrogen Projects to Receive Top Tax Credits | World Resources Institute

[31] https://climate.mit.edu/ask-mit/how-clean-green-hydrogen Production of GH emits <1 kg.CO2 per kg. H2 produced. In contrast, a company planning to produce "clean" H2 in CA this year is aiming for 2 kg. CO2 per kg.H2 within 5 years.

Fugitive emissions of H2 have a GWP20 up to 28 times higher than the GWP of carbon dioxide due to interactions in the atmosphere with methane, ozone, and water vapor. Including leaks in LCAs indicate that the carbon dioxide equivalent emissions of H2 are one-third of the emissions of methane (i.e., 84) [32],[33]. A 4% leak rate is common and this increases the warming effect of H2 to a level equal to that of methane, while presenting higher risk of explosion.

There are no advantages or proven benefits of using blends instead of using undiluted CH4. If GH is used, the cost of blends is much higher than that of plain CH4. Ratepayers should not be forced to pay for health-harming fossil energy [34].

GH-fueled HFCs are more effective than biofuels for decarbonizing transportation, but are not as effective as EVs. Hydrogen fuel cell vehicles (FCVs) have an overall electrical efficiency of 7 - 29% (well to wheel) whereas EVs have an overall efficiency of 77%[35],[36] . Hydrogen FCVs have lower lifecycle emissions if they use GH. Due to the cost and inefficiency of hydrogen production, hydrogen is best used only for applications that are difficult to decarbonize. This includes aviation, marine transport, long-haul heavy duty trucks, steel production, and ammonia for fertilizers. Only such applications should receive tax incentives for using green hydrogen, and only until direct electrification and efficiency alternatives can be found for these uses.

HYDROPOWER - RUN OF THE RIVER (ROR)

In the 9th Ed. of the RPS Guidebook, Conduit Hydroelectricity is mentioned as qualifying if it meets certain specifications. This appears to be synonymous with Run-of-the-River [37]. It is here

[32] Frontiers | On the chemistry of the global warming potential of hydrogen

[33] The “deeply concerning” climate impacts of hydrogen leaks - New Statesman

[34] National Building Pollution Report | Physicians for Social Responsibility

[35] https://www.sciencedirect.com/science/article/abs/pii/S0360544222016346

[36] https://electroverse.com/community/ev-blogs-and-guides/how-efficient-are-electric-vehicles

[37] https://en.wikipedia.org/wiki/Run-of-the-river_hydroelectricity

proposed that construction of new ROR be qualified as an RPS generation technology up to a capacity of 100 MWh.

Design options are plentiful [38], [39], output to input efficiency is high [40], maintenance requirements are low, and operation does not emit GHGs or toxics. Ponds may be added along conduits to provide storage. However, little or no electricity may be generated during periods of drought. Climate change is anticipated to decrease generation [41], [42], [43]. LCAs show that lifecycle emissions are very low and the levelized cost per MWh is competitive with wind and solar generation [44], [45].

COMBINATIONS OF CLEAN GENERATION AND STORAGE

Please review scientific literature on combinations of RPS-qualified storage and generation. Determine what combinations provide the greatest benefits, least externalized costs, lowest LCA toxic emissions, lowest LCA GHG emission, and lowest Levelized Cost of Electricity per MWh. Point out suitable applications for each, e.g., marine, residential, industrial, large city microgrids, etc. Include comments about the following storage technologies: concentrated solar power, gravity, compressed air, flywheels, green hydrogen, pumped hydro, ground-sourced pumped heat, electric batteries, and thermal batteries. Announce its release and make your report available on the CEC website.

CONCLUSION

The RPS is probably our most effective policy for decarbonizing the grid. It is almost certainly more effective than Cap & Trade for GHG reductions, does not impose tax-like fees on industry, and incentivizes prompt innovation. The latter decreases externalized costs (e.g. Social Cost of Carbon - SCC) of dirty energy more rapidly. Due in part to the low price of allowances, which are

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[38] https://link.springer.com/article/10.1186/s40807-023-00072-1

[39] https://www.sciencedirect.com/science/article/abs/pii/S1364032122002271

[40] https://www.sciencedirect.com/science/article/abs/pii/S0960148121014786

[41] https://iopscience.iop.org/article/10.1088/1755-1315/899/1/012026/meta

[42] https://www.sciencedirect.com/science/article/abs/pii/S136403212201022X

[43] https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2023WR035713

[44] https://aiche.onlinelibrary.wiley.com/doi/abs/10.1002/ep.13716

[45] https://www.mdpi.com/1996-1073/15/20/7507

trading at about 12% of the SCC [46], RPS policy may provide more economic benefits to society than revenue from the sale of allowances.

All of the above botanical-based energy technologies share certain characteristics a) depletion of the stratospheric ozone layer, b) acidification of land and water resources, c) fugitive emissions of GHGs during production and when distributed via pipelines, d) eutrophication of water resources, e) the environmental impact of using organic waste residues is less than using dedicated crops (and other living botanicals) as feedstocks, f) LCA research has a broad variation of emissions profiles due to diverse models, g) fugitive emissions of PM (from dust) and other toxics, h) increased level of ozone in the troposphere, g) and high volume of water consumption. Each of these technologies should be sunsetted. One option for phasing these out is to allow use of both dedicated crops and residues for bioenergy until a certain year, e.g. 2027. Thereafter allow only residues to be used until Dec. 2029 and disqualify all organic feedstocks thereafter.

Using biogenic feedstocks as mulch and aerobic compost for agriculture is a higher and better use than producing electricity and fuels. This increases CO2 sequestration and soil carbon storage by botanicals.

Instead of using land for dedicated bioenergy crops, about 10 times the electricity may be obtained by erecting solar farms [47]. Alternatively, one may generate the same amount of electricity by using only one-tenth of the acreage. The remaining 9/10ths of acreage could be used for planting crops dedicated to human nutrition, new forest, other botanicals that increase CO2 sequestration, or agrivoltaics. The efficiency and efficacy of botanical sequestration is far greater than that of energy-dependent sequestration technologies [48], [49], [50]. And botanical sequestration is dirt cheap.

With the exception of certain applications, the inclusion of hydrogen fuel cells should be sunsetted. New ROR technology should be added to the 10th edition as a qualifying RPS generation source. Please collaborate with other agencies, if necessary, to accomplish the above recommendations.

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[46] Synthesis of evidence yields high social cost of carbon due to structural model variation and uncertainties | PNAS

[47] Ecologically informed solar enables a sustainable energy transition in US croplands | PNAS

[48] Climeworks' capture fails to cover its own emissions - Heimildin

[49] Swiss CO_2 removal firm Climeworks to downsize - SWI swissinfo.ch

[50] The best technologies for effective climate action | SGR: Responsible Science

Sincerely,

David Bezanson

David Bezanson, Ph.D.
CA voter and resident