February 24, 2017

By Electronic Mail (climate.strategies@state.ma.us)

Commissioner Martin Suuberg
Department of Environmental Protection
1 Winter Street
Boston, MA 02108

Subj: Comments re: GWSA Section 3(d) Regulations

Dear Commissioner Suuberg,

Please accept the following comments by Conservation Law Foundation (“CLF”) regarding the Department of Environmental Protection’s (“DEP’s”) rulemaking required by Section 3(d) of the Global Warming Solutions Act (“GWSA” or the “Act”)—proposed new and revised regulations 310 CMR 7.72, 310 CMR 7.73, 310 CMR 7.74, 310 CMR 7.75, 310 CMR 60.05, and 310 CMR 60.06—as noticed by DEP on December 16, 2016 (the “Rulemaking”). CLF’s comments, explained in detail herein, can be summarized as follows:

- As currently proposed, the Rulemaking does not comply with the GWSA or the decision in Kain v. Department of Environmental Protection, 474 Mass. 278 (2016) (“Kain”) because it fails to address the significant, documented risk that the Commonwealth’s 2020 emissions will exceed the equivalent of 70.8 million metric tons of CO2 (“MMTCO2e”). As a result, it cannot reasonably be said to “ensure that legally mandated reductions are realized by the 2020 deadline” as ordered by the Supreme Judicial Court.

- In order for the Rulemaking, as currently structured, to comply with the GWSA and the Kain decision, DEP must, at a minimum:
  - Use a viable emissions reduction accounting structure that expressly accounts for known and reasonably foreseeable future emissions-related uncertainties, which is consistent with the analysis in the Massachusetts Clean Energy and Climate Plan for 2020 (“CECP Update”), and which is supported by publicly available, record evidence; and

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1 DEP, Public Hearing Notice re: Proposed Amendments to 310 CMR 7.00 Air Pollution Control, and 310 CMR 60.00, Air Pollution Control for Mobile Sources (Dec. 16, 2016).

As proposed, the Rulemaking fails to comply with Kain.

As currently proposed, the Rulemaking does not comply with the Global Warming Solutions Act (“GWSA” or the “Act”) or the Supreme Judicial Court’s decision in Kain v. Department of Environmental Protection, 474 Mass. 278 (2016) (“Kain”) because its new and revised regulations fail to demonstrate that they are sufficient to “ensure that [the GWSA’s] legally mandated reductions are realized by the 2020 deadline.”3

3 Kain, 474 Mass. at 300.
1. **Kain Requires Declining Volumetric Limits That Ensure 70.8 MMTCO2e in 2020.**

   In *Kain*, the Supreme Judicial Court explicitly described what is required of DEP by Section 3(d) of the GWSA: it must issue regulations of a certain type, and it must design them to achieve a certain purpose.

   Regarding the type of regulations the Act requires, the Court held that the plain language of GWSA Section 3(d) requires DEP to promulgate regulations that “[i] address multiple sources or categories of sources of emissions, [ii] impose a limit on emissions that may be released, [iii] limit the aggregate emissions released from each group of regulated sources or categories of sources, [iv] set emissions limits for each year, and [v] set limits that decline on an annual basis.”

   Regarding their purpose, the Court held that such annually-declining, volumetric emissions caps must “ensure that legally mandated reductions are realized by the 2020 deadline.” That is, and must be, the case the Court explained since “[t]he purpose of [the GWSA] is to attain actual, measurable, and permanent emissions reductions in the Commonwealth,” and “the Legislature included [Section 3(d)] in the statute” as the means to achieve that goal.

   As a matter of law, then, in order to comply with the GWSA and the *Kain* decision, the Rulemaking must not only set annually-declining, volumetric limits on aggregate emissions from one or more greenhouse gas (“GHG”) sources, it must set those limits at levels which will ensure that in 2020, the Commonwealth’s statewide GHG emissions are no more than the equivalent of 70.8 million metric tons of CO2 (“70.8 MMTCO2e”).

2. **To Ensure 70.8 MMTCO2e in 2020, the Rulemaking Must Remove the Risk that Emissions Will Exceed That Amount.**

   In order to ensure that the Commonwealth’s statewide GHG emissions are no

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4 *Id.* at 292; *accord id.* at 280 (“For the reasons discussed herein, we conclude that the unambiguous language of [Section 3(d)] requires the department to promulgate regulations that establish volumetric limits on multiple greenhouse gas emissions sources, expressed in carbon dioxide equivalents, and that such limits must decline on an annual basis.”).

5 *Id.* at 300.

6 *Id.; accord* Executive Order 569, § 2 (“The Department of Environmental Protection shall promulgate final regulations that satisfy the mandate of Section 3(d) of [M.G.L. c. 21N] by August 11, 2017, having designed such regulations to ensure that the Commonwealth meets the 2020 statewide emissions limit mandated by the GWSA[.]” (emphasis added)).

7 2015 CECP at 2-4.
more than 70.8 MMTCO2e in 2020, the Rulemaking must directly address—and successfully mitigate—the “significant risk” identified by the Secretary of Energy and Environmental Affairs just months before the *Kain* decision. In his 2015 update to the state’s *Clean Energy and Climate Plan for 2020*, the Secretary concluded that, based on multi-factored analysis and modeling, an assessment of existing state and federal regulations, and well-known risk factors, there was a significant risk that the Commonwealth’s statewide emissions in 2020 may be as high as 76 MMTCO2e, or about 5% above the GWSA’s required volumetric limit, even with all then-existing programs and policies fully enforced.

This risk exists, according to the Secretary, as a result of a range of well-known factors that are either beyond the Commonwealth’s control, or which lie outside of the existing regulatory structure. Such uncertainty drivers include: the weather, implementation of federal vehicle emissions standards, individual driving habits, national and regional fuel prices, the availability and timing of potential future low-emissions electricity imports, inadequate development of regional electricity transmission infrastructure, non-compliance with the state’s Renewable Portfolio

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8 See id. at 11 (“[T]here is a significant risk that the total amount of reductions realized in 2020 will be less than 25%, compared to the 1990 emissions.”); accord id. at 13-15.

9 *Id.* at 13 (“Discussion of each sector appears below Table 3, along with a projection of a likely outcome that emissions will be reduced by 25% in 2020, relative to 1990, if *policies in this CECP Update are fully implemented.*” (emphasis added)); *id.* (Table 3) (indicating 2020 emissions could be as low as 66 MMTCO2e, i.e., about 5% lower than required, or as high as 76 MMTCO2e, i.e., about 5% higher than required).

10 See *id.* at 13 (Table 3).

11 *Id.* at 14 (building sector “emissions are significantly affected by weather, as illustrated in the variability observed in recent years.”); *id.* at 15 (“[R]isks to fully realizing [electricity sector] emission reductions include: . . . extreme weather increasing electricity demand[,]”)

12 *Id.* (“Between 2015 and 2020, significant improvements in vehicle efficiency will occur as the stringency of vehicle GHG standards increases.”); *id.* at 12 (Table 2) (identifying “Federal and California Vehicle Efficiency and GHG Standards (CAFE/Pavley)” and “Federal Emissions and Fuel Efficiency Standards for Medium and Heavy Duty Vehicles” as responsible for potential 2020 emissions reductions from “vehicle efficiency”).

13 *Id.* at 14 (“[R]ecognizing the historic increase in VMT from 1990 to 2013 of 22%, it remains possible that an increase in [vehicle miles travelled] will offset some or all of [sector-wide] benefits.”)

14 *Id.* (“Fuel prices can also have significant impacts on building sector emissions.”).

15 See *id.* at 14-15 (“The *Clean Energy Imports* policy contributes approximately 17% of the overall 25% reduction goal (or 4.2% of the emissions in 1990) if fully implemented before 2020.”); accord *id.* at 11 (“A review of Table 2 suggests that a particular focus on the Clean Energy Imports policy is appropriate, given the amount of reductions anticipated from this policy and the fact that new legislation (or new regulation like the Clean Energy Standard) is required for implementation. Without this policy, there is a significant risk that the total amount of reductions realized in 2020 will be less than 25%, compared to the 1990 emissions.”)

16 *Id.* at 15 (“[R]isks to fully realizing [electricity sector] emission reductions include: non-compliance with the RPS program, inadequate transmission infrastructure development, extreme weather increasing
Standard (“RPS”) program, and regional gas-system constraints.

A summary of the Secretary’s risk analysis was included in the 2015 CECP and is shown below in Figure 1 which, together with accompanying text, indicates that “if policies in this CECP Update are fully implemented,” 2020 emissions could be as low as 66 MMTCO2e, i.e., about 5% lower than required (a 30% reduction from 1990 levels), or as high as 76 MMTCO2e, i.e., about 5% higher than required (only a 20% reduction from 1990 levels).

To ensure that the Commonwealth’s statewide GHG emissions are no more than 70.8 MMTCO2e in 2020, then, the Rulemaking must either eliminate the “+5%” risk that 2020 emissions will be as high as 76 MMTCO2e, or offset it by securing a comparable volume of new emissions reductions beyond those that can reasonably be expected from existing programs and policies. Conceptually, then, DEP has only two options. It can either:

(i) Impose legally enforceable, annually declining, volumetric emissions caps on electricity demand, or increased oil use for power generation in 2020 as a result of constraints on the gas system.”

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17 \textit{Id.}
18 \textit{Id.}
19 \textit{Id.} at 13.
all sectors, which in the aggregate total 70.8 MMTCO2e in 2020; or

(ii) It can drive the +/-5% uncertainty under the 70.8 MMTCO2e limit for 2020 by capping fewer than all sectors enough to ensure that, regardless of the uncontrolled/uncontrollable factors identified by the Secretary—weather, individual driving habits, fuel prices, etc.—“worst case” emissions in 2020 are no more than 70.8 MMTCO2e.

3. **The Rulemaking Fails to Address the Significant Risk that 2020 Statewide Emissions Will Exceed 70.8 MMTCO2e.**

Without visible justification, Rulemaking abandons the methodical risk analysis in the 2015 CECP and, as a result, fails to adequately address the significant risk that despite existing programs and policies, the Commonwealth will not achieve its 2020 GWSA emissions limit as the law—and *Kain*—expressly require.

Recognizing that in 2013, the most recent year for which the Commonwealth has complete emissions data, statewide emissions were at a level 19.7% below 1990 levels, the Rulemaking is premised on the assumption that it need only ensure “an additional 5.3% reduction in GHG emissions . . . by the end of the year 2020.” In order to meet that asserted goal, DEP suggests that the Rulemaking will “achieve an estimated 7.2% total reductions in GHG emissions,” resulting in a 1.9% margin that will “help control for variables that could result in additional electric power demand or increases in vehicle miles traveled[.]” But the Rulemaking’s analysis in this regard is fatally flawed and wholly inadequate. It is also unsupported by any visible evidence.

Using the Rulemaking’s own, flawed accounting structure, DEP identifies *less than one-tenth of one percent* (< 0.1%) of new reductions that are reasonably expected to result from new legally enforceable Section 3(d) regulations of the type required by *Kain*, i.e., annually declining, volumetric emissions caps resulting in new/additional

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20 DEP, *Background Document on Proposed New and Amended Regulations, 310 CMR 7.00 & 310 CMR 60.00 Air Pollution Control for Stationary and Mobile Sources* (Dec. 16, 2016) (“Rulemaking”), at 4.
21 *Id.* at 11.
22 See Exhibit 1 (Testimony of Elizabeth A. Stanton, Ph.D.) (“Stanton Test.”)
23 DEP attributes the following emissions reductions to proposed enforceable “Section 3(d)” volumetric emissions limits: 0.05% from new 310 CMR 7.73 regarding “Methane Leaks from Gas Distribution System, see Rulemaking at 8 (Table 1); 0.01% from amended 310 CMR 7.72 regarding “Gas Insulated Switchgear,” id.; and 0.01% from amended 310 CMR 60.05 and new 310 CMR 60.06 regarding MassDOT and state vehicle fleets, id. at 9 (“MassDEP has estimated 0.01% for additional GHG emissions reductions from its two proposed transportation sector regulations in this rule-making”). DEP identifies no emissions reductions that are attributable to the proposed 310 CMR 7.74 cap on in-state power plants. *See infra* n.35.
enforceable reductions of just 0.07%, or about 66,080 metric tons CO2.\textsuperscript{24} And such \textit{de minimis} reductions plainly fail to fulfill the mandate of \textit{Kain} when compared—as they reasonable must be—to the Secretary’s fulsome 2015 CECP analysis published just months before the Court’s decision.

4. \textbf{Anticipated Improvements in Vehicle Emissions Standards Cannot Save the Rulemaking.}

In asserting that the Rulemaking will “achieve an estimated 7.2% total reductions in GHG emissions,”\textsuperscript{25} DEP attempts to rely on 3.1% of anticipated 2013 to 2020 reductions resulting from increases in vehicle efficiency in that period resulting from the application of California emissions standards in Massachusetts as is currently required by 310 CMR 7.40.\textsuperscript{26} But such anticipated emissions reductions—while perhaps reasonably calculated\textsuperscript{27}—cannot be relied on here for at least two important reasons.

First, the reductions fail to meet the requirements of Section 3(d) as detailed by \textit{Kain} because they do not limit aggregate emissions in the transportation sector as a whole, or from a group of regulated sources or categories of sources in the sector, and they do not set volumetric emissions limits that decline on an annual basis.\textsuperscript{28} In this respect they are similar to, and fail for the same reasons as, the Commonwealth’s existing sulfur-hexafluoride regulations as analyzed by the \textit{Kain} court. Although 310 CMR 7.40 mandates increases in vehicle fuel efficiency rates, it does not limit either the number of vehicles in the state, or the number of miles in-state vehicles can be driven in any year. As a result, 310 CMR 7.40 does not work to limit aggregate emissions of any source or category of sources in the transportation sector. Indeed, as was detailed in the 2015 CECP, it is reasonable to expect, based on historic performance data, that a continued increase in vehicle miles travelled between 2013 and 2020 will offset some or all of the tail-pipe emissions reductions resulting from 310 CMR 7.40 emissions standards in that same time-frame.\textsuperscript{29}

Second, the 310 CMR 7.40 reductions referenced in the Rulemaking are part of the pre-\textit{Kain} business as usual: they are included in the 2015 CECP and thus do not represent any new reduction that works to reduce the significant risk identified by the Secretary that the Commonwealth’s statewide GHG emissions may exceed 70.8 MMTCO2e in 2020. Instead, according to the Secretary’s 2015 CECP analysis, even

\begin{footnotesize}
\begin{enumerate}
\item Based on 1990 emissions of 94.4 MMTCO2e, each 1% reduction from 1990 emissions levels equates to 0.944 MMTCO2e or the equivalent of 944,000 metric tons CO2.
\item \textit{Id.} at 11.
\item \textit{Id.} at 9; \textit{id.} (Table 2).
\item Cf. Stanton Test. at 16:3 – 17:14 (identifying likely calculation errors).
\item \textit{Kain}, 474 Mass. at 292.
\item See 2015 CECP at 14.
\end{enumerate}
\end{footnotesize}
with 310 CMR 7.40 in place—and assuming it remains enforceable—transportation sector emissions in 2020 may be as low 29 MMTCO2e as high as 32 MMTCO2e.

5. As Currently Structured, Anticipated Electric Sector Emissions Reductions Cannot Save the Rulemaking.

Of the 7.2% reduction in emissions claimed by the Rulemaking, DEP attributes over half (4.0%) to new and existing programs designed to limit emissions in the Commonwealth’s electricity sector. But for reasons similar to those above regarding anticipated reductions in transportation sector emissions, reductions associated with these energy programs cannot be relied on for purposes of complying with the GWSA and Kain.

As above, the entirety of the claimed 4.0% net reduction in emissions is, according to DEP, the result of programs and policies that do not meet the requirements of Kain. Neither the Commonwealth’s new or existing clean energy purchasing programs nor its existing energy efficiency programs limit the aggregate emissions of, or set declining annual emissions limits for, a source or category of sources. And virtually all are existing “business as usual” programs that are included in the 2015 CECP and thus do not represent any new reduction that works to reduce the significant risk identified by the Secretary that the Commonwealth’s statewide GHG emissions may exceed 70.8 MMTCO2e in 2020: DEP identifies no emissions reductions that are

30 310 CMR 7.40 adopts for the Commonwealth California’s CAFE/Pavely emissions standards issued under federal Clean Air Act authority. Following the 2016 federal election, however, the near-term future those standards is in grave doubt. See, e.g., Evan Halper, Trump’s EPA pick casts doubt on California’s power to regulate auto emissions, LOS ANGELES TIMES (Jan. 18, 2017) (reporting that in his Senate confirmation hearing, EPA Administrator Pruitt would not “commit to keeping in place the current version of a decades-old federal waiver that allows California to set emissions standards stricter than elsewhere in the United States,” and instead “held out the possibility that he might take that power away”), available at: http://www.latimes.com/nation/la-na-pol-epa-confirmation-20170118-story.html.
32 Rulemaking at 10; id. (Table 3).
33 Without differentiation, DEP attributes a 2.0% reduction to the combined effect of existing RPS program and “additional new renewable energy that can likely be procured for the Commonwealth” presumably associated with the proposed 310 CMR 7.75 Clean Energy Standard. Id. While the rulemaking indicates that DEP is still attempting to quantify the “amount of surplus in-region renewables that may be available for use in complying with the clean energy standard,” see id. at 10 n.14, DEP suggests in its Nov. 7, 2016 “GWSA Regulations – Emitting Electricity Generators Stakeholder Meeting” presentation (at slide 7) that 1.3% of these reductions (about 1.3 MMTCO2e) are anticipated to come from the proposed 310 CMR 7.75 Clean Energy Standard.
34 DEP predicts “emissions reductions of at least 2.2% will occur as a result of the ongoing efforts by DPU, the EEAC and the Energy Efficiency Program Administrators to achieve emission reductions through [existing] energy efficiency programs.” Id.
attributable to the proposed 310 CMR 7.74 cap on in-state power plants.\textsuperscript{35}

\textbf{B. TO COMPLY WITH KAIN, THE RULEMAKING MUST BE MEANINGFULLY REVISED.}

In order to comply with the GWSA and the mandate of \textit{Kain}, the Rulemaking must be materially revised such that it is visibly structured to ensure that statewide GHG emissions do not exceed 70.8 MMTCO\textsubscript{2}e in 2020 regardless of a range of known factors beyond the Commonwealth’s control (\textit{see} Part A.2 above).

\textbf{1. The Rulemaking Must Use Valid Accounting That Correlates to the Commonwealth’s GHG Inventory and Be Based on Publicly Available Data.}

Section 3(d) of the GWSA requires DEP to size and structure the Rulemaking so as to “ensure that legally mandated reductions are realized by the 2020 deadline.”\textsuperscript{36} Because those mandated reductions must be “actual, measurable, and permanent emissions reductions,”\textsuperscript{37} the Rulemaking must include and consistently use a valid emissions accounting structure that directly correlates to the Commonwealth’s GHG Inventory, the results of which for 2020 will dictate whether or not the Commonwealth fulfilled its 2020 GWSA obligation.

As is detailed in the testimony of Dr. Elizabeth Stanton, attached hereto as Exhibit 1, in order to ensure the Commonwealth obtains a 25\% reduction from 1990 levels by 2020, a valid emissions accounting framework must, at a minimum: (i) be conducted and presented consistently in terms of 2020 metric ton volumetric emissions limits, (ii) account for uncertainty in future emissions and require the high end of the range of expected future emissions to be no greater than the 2020 metric ton limit; and (iii) be based on assumptions, methods, and data that have been made sufficiently available for public, third-party review.\textsuperscript{38}

As proposed, however, the Rulemaking fails to meet this standard: It does not present net emission levels in metric tons, instead using a mix of “percent of required” and volumetric program-only reduction estimates. It does not present a range of

\textsuperscript{35} In Table 3 and accompanying text, the Rulemaking specifies that the entirety of the anticipated 4.0\% reduction in electricity sector emissions will come from the procurement of new and existing RPS-quality power and implementation of existing energy efficiency programs. \textit{See} Rulemaking at 10; accord \textit{id.} at 34 (suggesting that 310 CMR 7.74 merely “complement[s] existing policies and the proposed Clean Energy Standard, by ensuring that an appropriate” but unspecified “portion of these reductions occur in Massachusetts”).

\textsuperscript{36} \textit{Kain}, 474 Mass. at 300.

\textsuperscript{37} \textit{Id.}

\textsuperscript{38} Stanton Test. at 6:12 – 11:11.
uncertain future emissions and does not demonstrate that the high end of a reasonably expected range of 2020 emissions is at or below the required 2020 metric ton limit. And it does not present detailed evidence sufficient for public, third-party review of key assumptions it relies on in asserting that the Rulemaking will ensure a 25 percent reduction from 1990 emission levels by 2020.\textsuperscript{39}

Thus, because an agency action such as the Rulemaking will be set aside if it is either unsupported by substantial evidence—that is, “such evidence as a reasonable mind might accept as adequate to support a conclusion”\textsuperscript{40}—or if it is unwarranted by the facts in the record,\textsuperscript{41} the Rulemaking must be revised to demonstrate that its proposed new and revised regulations are based on a valid accounting framework that is supported by publicly available, record evidence.

2. **Proposed 310 CMR 7.74 Must Be Modified to Ensure Actual 2020 Emissions are No Greater Than 70.8 MMTCO2e.**

As detailed in Parts A.2 and A.3 above, in order to comply with the GWSA and the court order in Kain, the Rulemaking must ensure that the Commonwealth’s statewide emissions in 2020 are no more than 70.8 MMTCO2e, and must do so in the face of the Secretary’s reasonable estimate a year ago that there is a significant risk that emissions in 2020 may exceed that amount by as much as 4.2 MMTCO2e despite full enforcement of all existing programs and policies.\textsuperscript{42} It is possible that can be achieved using the general structure of the Rulemaking—i.e., without the addition of other proposed programs or regulations—but only if the 2020 emissions of in-state power plants is limited to no more than about 7 MMTCO2e.

Within the current structure of the Rulemaking, only the proposed cap on in-state electricity generating units has the potential to achieve enforceable reductions on the order needed to ensure 2020 emissions of 70.8 MMTCO2e.\textsuperscript{43} As shown above, the Rulemaking’s proposed new reductions in other sectors are extremely small—less than 0.1% or about 66,360 metric tons CO2,\textsuperscript{44} and DEP has assessed that the electricity sector could deliver about 4 MMTCO2e in additional reductions by 2020.\textsuperscript{45} In order for 310 CMR 7.74 to play that role, however, DEP must expressly attribute enforceable emissions reductions to the regulation (even if it intends other policies to help the sector meet those emissions levels) and structure it to ensure such reductions are actually

\textsuperscript{39} Id. at 11:12 – 18:2.
\textsuperscript{40} G.L. c. 30A, § 1(6).
\textsuperscript{41} Id. at § 14(7)(e)-(f).
\textsuperscript{42} Accord Stanton Test. at 6:14 – 14:8.
\textsuperscript{43} Accord id. at 11:12 – 14:8.
\textsuperscript{44} See Part A.3 above; accord Stanton Test. at 11:12 – 12:7.
\textsuperscript{45} See Rulemaking at 24.
achieved in 2020. In order to achieve both, the size of the aggregate emissions cap allowed in 2020 must be set in order to ensure 2020 emissions of 70.8 MMTCO2e despite potential increases or variations in the rest of the effectively un-capped emissions sectors.46

In setting that limit, DEP must account for the meaningful risk identified by the Secretary that, based on factors largely beyond the state’s control, non-electricity sector emissions in 2020 could be as high as 62 MMTCO2e.47 Based on that analysis, the electricity sector as a whole can emit no more than 8.8 MMTCO2e in order to ensure total statewide emissions do not exceed 70.8 MMTCO2e. And because emissions from in-state power plants now account for only about 80% of total electricity sector emissions in the state’s GHG Inventory (see Figure 2 below), in order to ensure sector-wide emissions of no more than 8.8 MMTCO2e, the proposed 310 CMR 7.74 aggregate cap for 2020 cannot exceed about 7.0 MMTCO2e.48, 49

Thus, in order for proposed 310 CMR 7.74 “ensure that legally mandated reductions are realized by the 2020 deadline” in accordance with Kain,51 DEP must at a minimum:

46 Accord Stanton Test. at 11:12 – 14:8.
47 See Fig. 1 above, indicating Building sector emissions as high as 24 MMTCO2e, Transportation sector emissions as 32 MMTCO2e, and Other emissions of 6 MMTCO2e in 2020. Accord Stanton Test. at 12:16 – 14:2.
48 The percentage of total electricity sector emissions coming from in-state power plants has dropped from a five-year high of 89% in 2010 to a five-year low of 81% in 2014. Absent evidence suggesting a reversal of that trend, DEP should conservatively assume—given ISO-NE’s prediction of flat-to-declining in-state electricity demand though 2025 (see Comments of ISO New England, Inc. (Feb. 20, 2016) (“ISO-NE Comments”), Encl. (“Evaluation of Proposed MA DEP Regulations Capping CO2 Emissions in the Electricity Sector”) at 23 (“MA State, Annual Energy (GWh), Gross-PV-PRD”))—that through 2020, emissions from in-state power plants will remain approximately where it is now, at about 80-81%.
49 Although the 2015 CECP estimates in Table 3 that 2020 “Other” emissions will be 6 MMTCO2e, if emissions in that sector remain at 2013 levels, 2020 “Other” emissions can be expected to be slightly less than that: 5.7 MMTCO2e. See Stanton Test. at 12:19 – 13:2. If so, the GWSA and Kain would likely permit electricity sector emissions in 2020 of 9.1 MMTCO2e, and a 2020 310 CMR 7.74 aggregate cap of at least 7.3 MMTCO2e.
51 Kain, 474 Mass. at 300.
(a) Revise the “Total Aggregate GHG Emissions Limit” for 2020 in 310 CMR 7.74(5)(a) Table A, reducing it by just over 1.6 million metric tons: from 8,663,170 metric tons to no more than approximately 7,000,000 metric tons;\(^{52}\)

and

(b) Prohibit the submission in 2020 of 310 CMR 7.74(3) “Over Compliance Credits (OCCs)” generated in 2018 or 2019 in order to ensure that actual volumetric limit is achieved.

C. **THE PUBLIC INTEREST REQUIRES ADDITIONAL REVISIONS TO THE RULEMAKING.**

In addition to the minimum revisions required for the Rulemaking to comply with the GWSA and the court’s order in *Kain* (see Part B above), the public interest dictates that DEP should further revise the Rulemaking as follows to avoid unnecessary cost and waste, and to ensure the Rulemaking directly furthers the longer-term requirements of the GWSA.

1. **310 CMR 7.74 Emissions Credits Should Be Allocated By Auction and Compliance Should Be Tied to the Operation of the ISO-NE Energy and Forward Capacity Markets.**

   In addition to a “Total Aggregate GHG Emissions Limit” for 2020 that is too high to ensure the Rulemaking complies with the GWSA and *Kain*, several substantial technical problems exist with proposed 310 CMR 7.74 relating to the method by which emissions rights are allocated and the proposed method for demonstrating compliance with the regulation. The majority of these problems can be cured by allocating emissions to in-state power plants using a priced auction as discussed below; the balance can be solved by tying compliance to a transparent price and coordinating it with the ISO-NE energy and capacity markets.

\(^{52}\) Regarding the amount of reduction required to achieve *Kain*-compliance, the analysis herein replaces that contained in CLF’s “Initial Comments re: GWSA Section 3(d) Regulations - Electric Power Sector” (Nov. 21, 2016), at p.3. Additionally, the 2020 in-state aggregate limit could potentially be higher than about 7.0 MMTCO2e—potentially as high as about 8.0 MMTCO2e—while continuing to comply with *Kain* if, and to the extent that, DEP can revise the Rulemaking to: (a) include analysis and evidence substantiating the amount of Renewable Energy Credits (“RECs”) that proposed 310 CMR 7.75 could deliver in addition to those required by the state’s RPS, (b) attribute to those RECs, an avoided per-megawatt-hour emissions rate, and (c) prohibit the use of either “banked attributes” or Alternative Compliance Payments in 2020 pursuant to proposed 310 CMR 7.75(5)(b)-(c).
a. The Proposed Administrative Allocation and Allowance of Over Compliance Credits Is Seriously Flawed.

As currently proposed, 310 CMR 7.74 would administratively allocate annual emissions rights to existing and new facilities, by facility and pursuant to separate “Existing Facility” and “New Facility” aggregate caps and allow the creation and trading of OCCs. Doing so, however, is inefficient, ineffective, and administratively burdensome.

**Inefficient** – The proposed method of allocation based on the past performance of existing facilities and the anticipated performance of new facilities is economically and environmentally inefficient in at least three meaningful ways. First, because it is impossible as a practical matter to forecast the future performance of the ISO-NE energy markets with sufficient accuracy to ensure that DEP has allocated the correct annual volume of emissions to each existing and each new facility, the proposed method of allocation is likely to result in a misallocation that lowers the efficiency of the in-state generating fleet, or raises the price of fleet compliance, or both. Second, although in theory (e.g., in the economic “long run”) any such deficiency in allocation might be cured by inter-facility trading of OCCs, in the short term—and almost certainly through 2020—uncertainty regarding the implementation of the new restrictions (by DEP and by ISO-NE) and regarding price and availability of OCCs in a small, newly formed market for them is likely to create an incentive for each generator to hold any OCCs it generates to ensure its own ability to comply with the law. If such rational hording were to occur, it would exacerbate the economic and emissions inefficiencies of any sub-optimal allocation. Finally, because the proposed regulation neither establishes a value of an OCC nor a public market which would visibly price such value, the proposed allocation method would allow in-state power plants to rationally game their ISO-NE energy market bid prices (via privately priced “emissions allowance prices” and “opportunity costs” as defined by and permitted via ISO-NE Market Rule 1, § III.A.7.5.1) to maximize their individual gain at the expense of economic and emissions efficiency.

**Ineffective** – The proposed method of allocation will have at least three effects that run counter to the goal of the proposed regulation, and which could severely limit its effectiveness. First, together with provisions allowing facilities to generate and trade OCCs, such an allocation will create a windfall for the least efficient in-state power plants by giving them a new valuable market asset, the OCC, while providing an incentive to remain operational so as to continue receiving similar valuable allocations in the future. Second, the proposed administrative allocation will grant emissions rights to the least efficient in-state power plants at the direct expense (since all are ultimately subject to a single “Total Aggregate GHG Emissions Limit” each year) of the most

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53 ISO-NE Market Rule 1 is a public document of record, incorporated in relevant part hereto by this reference, and is available at: https://www.iso-ne.com/participate/rules-procedures/tariff/market-rule-1.
efficient in-state plants, both new and existing. Doing so will necessarily limit the ability of more efficient plants to provide power to the Commonwealth more than is necessary to achieve the required level of emissions reductions.\textsuperscript{54} Finally, allowing OCCs to be banked and used for program compliance without restriction in future years (see proposed 310 CMR 7.74(6)(b)) threatens the ability of the program—regardless of the size of the total aggregate cap—to ensure the Commonwealth meets its 2020 or any future GWSA emissions limit: as Kain made clear,\textsuperscript{55} the GWSA requires the Commonwealth to “attain actual, measurable, and permanent emissions reductions” with no provision allowing for the Commonwealth to exceed the Act’s “legally mandated reductions” as long as it collects a sufficient quantity of OCCs.

**Administratively Burdensome** – The proposed method of allocation would necessarily impose—annually through 2050—significant new administrative duties on DEP\textsuperscript{56} and would do so without providing any additional funds or personnel to carry them out.

### b. **Allocation By Auction Is More Efficient—Economically and Environmentally—and Easier to Administer.**

Allocating permissible in-state emissions by priced auction, as DEP may,\textsuperscript{57} would avoid the inefficiencies, detrimental effects, and administrative burdens inherent in the proposed administrative allocation.

Using an auction to allocate emissions would “allow market participants to reflect their private valuation for emissions credits while accounting for expected production, potential capital investments that could reduce emissions, future market conditions, and their risk tolerance” resulting in the efficient allocation of “credits to the set of market

\textsuperscript{54} See, e.g., ISO-NE Comments at 2 (“[E]fficient allocation does not occur under an administrative process where the credits are not allocated to the resources that value them most, and instead uses an alternate framework such as historical emissions, which may not be indicative of emissions going forward. To the extent that the trading of permits between resources is limited (either because of poor information about their market value or market power that limits the set of counterparties), the most cost effective set of resources would not be able to deliver energy, which would increase total costs and emissions relative to an efficient distribution of permits.”

\textsuperscript{55} See Kain, 474 Mass. at 300.

\textsuperscript{56} As proposed, 310 CMR 7.74 would require DEP to regularly, and in detail, determine individual emissions allocations for all generating facilities in state, constantly monitoring and managing changing emissions levels as older plants retire and new plants are proposed, if/as needed, to replace them. It would also require, in order to allow DEP to track program compliance, the establishment and maintenance of an OCC registry capable of tracking and verifying private trades.

\textsuperscript{57} The GWSA expressly authorizes the Secretary to use market-based mechanisms, such as auctioned emissions allocations, to reduce GHG emissions. See G.L. c. 21N, § 7 (authorizing the use of “market-based compliance mechanisms . . . to the extent feasible and in furtherance of achieving [a] statewide greenhouse gas emissions limit”)
participants who value them most.”58 It would also provide price transparency alleviating concerns regarding the formation of ISO-NE energy market bid prices.59

And critically, because such an efficient allocation would be expected to deliver in-state emissions credits as needed to the most efficient plants—for whom the per-megawatt-hour cost of compliance is lowest—allocation by auction (with participation limited to only to covered entities)60 can deliver the same amount of electricity that 310 CMR 7.74 anticipates61 for, on average, about 700,000 tons fewer CO2 each year.62 In doing so, an auction will ensure that little or no in-state generation is “displaced” to less efficient generators outside the state eliminating the risk that regional emissions might rise slightly as a result of achieving permanent volumetric emissions reductions for the Commonwealth, as the GWSA requires.63

Finally, allocation by auction would be easier for both DEP and ISO-NE to administer. Numerous professional vendors exist who could design and annually administer a public, priced emissions credit auction for DEP—in a manner similar to that held annually for RGGI, Inc. At a cost estimated to be less than 1% of anticipated

58 ISO-NE Comments at 2, 5.
59 See note 53 above and accompanying text; accord ISO-NE Comments at 2, 6.
60 CLF recommends that DEP utilize an auction that is virtually identical to that used for the Regional Greenhouse Gas Initiative (“RGGI”), except with auction participation limited to entities regulated by 310 CMR 7.74. Allowing non-covered entities into what will be a relatively small auction risks market disruption in excess of any expected or theoretical economic benefit, including unnecessary curtailment of in-state generators which could lead to an undesirable increase in out-of-state emissions. See ISO-NE Comments at 4-6 (sub-optimal allocation of in-state emissions allowances can lead to an increase in regional emissions).
61 About 19.2 TWh annually, see Rulemaking, Appx. C.
62 See Appendix A to these Comments. Appendix A shows the results of auction modeling by CLF assuming that the 310 CMR 7.74 “Total Aggregate GHG Emissions Limit” for 2020 is set no higher than 8.0 MMTCO2e as might be permitted in accordance with n.39 above.
63 Analysis by ISO-NE suggests that if 310 CMR 7.74 emissions credits are allocated administratively, annual regional emissions in 2025 might be between 0.1% - 0.3% higher with the proposed regulation than without it. See ISO-NE Comments, Encl. at 5 (predicting a potential increase in total New England emissions in 2025 of between 34,000 and 136,000 tons); see also ISO-NE, 2015 ISO New England Electric Generator Air Emissions Report (Jan. 2017) at 18 (indicating ISO-NE aggregate CO2 emissions of 40,312,000 tons). ISO-NE attributes that potential for increased regional emissions to the possibility that, as proposed, 310 CMR 7.74 would “shift[] electricity production from power plants in Massachusetts to other states.” ISO-NE Comments at 1; id. at 4-5 (“Under this proposed regulation, Massachusetts seeks to meet emissions goals by limiting in-state generation which in turn shifts generation to resources in other states to make up the energy shortfall. Our modeling results show that when this occurs, relatively efficient clean burning facilities in Massachussets are operated less, and relatively inefficient and less clean resources in other states are run more.”). Because allocation by auction would allow a more efficient mix of Massachusetts plants to produce the same amount of power with the cap in place as would be expected from Massachusetts plants without the cap in place, there is no “energy shortfall” that might be “shift[ed] . . . to resources in other states.”
auction revenues, such an auction would be revenue and (virtually) resource neutral for DEP. It would also facilitate program integration by ISO-NE by allow program compliance costs to be transparently priced for purposes of energy market bid formation by regulated generators.


Regardless of whether DEP chooses to implement an auction to allocate emissions, it can and should tie program compliance to the operation of ISO-NE’s energy and forward capacity markets. As suggested by ISO-NE, the proposed 310 CMR 7.74 “compliance year” can, and should, mirror ISO-NE’s June-to-June capacity supply obligation period. And in order to ensure that in-state facilities are available if needed to maintain system reliability, and so that facilities with existing Capacity Supply Obligations (“CSOs”) can meet their CSO requirements without penalty, DEP should not include proposed 310 CMR 7.74 emissions limits in facility air plans/permits but instead require in place of 310 CMR 7.74(10)(b), the payment of a defined dollar amount per ton of CO2 emitted without being in possession of valid emissions credits.

In order to maintain the ability of 310 CMR 7.74 as a GWSA/Kain-compliant regulation—that is, to act as a volumetric cap that cannot be avoided/exceeded by monetary payments—DEP must set such a non-compliance payment at a dollar value high enough to ensure that when facilities bid into the ISO-NE energy markets without being in possession of sufficient 310 CMR 7.74 emissions credits, they will not be dispatched except in a true reliability event as is the case for generators who have cleared the ISO-NE Forward Reserve Market (“FRM”). Based on historical pricing associated with ISO-NE FRM assets and winter fuel prices over the past three years, a revised 310 CMR 7.74(10)(b) non-compliance payment must be at least $500 per ton of CO2.

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64 A confidential market survey performed by CLF indicates that a Massachusetts auction “piggy-backed” on the RGGI auction (i.e., using the same registration information and the same auction platform) could be designed and administered for between $50,000 and $150,000 a year. At ISO-NE’s estimated price of $2/ton, a 310 CMR 7.74 auction as indicated in Appendix A would gross about $16.35 million annually 2018-2020.
65 Although the GWSA requires calendar year emissions accounting, half-year aggregate in-state emissions limits sufficient to meet required annual electric sector aggregate limits could be readily and accurately calculated.
66 In order to hold FRM assets in reserve, ISO-NE modifies an asset’s Market Rule 1, § III.A.7.5.1 Incremental Energy Cost to include an “incremental heat rate” of about 19,935 BTU/kWh. Based Algonquin City Gates gas prices on the average of the 15 highest days over the past three years, a non-compliance price of $500/ton or more will ensure the same result or facilities that would be subject to 310 CMR 7.74(10) if dispatched via inclusion in its Incremental Energy Cost as either an “emissions allowance cost” or an “opportunity cost.”
2. **310 CMR 7.75 Should Be Revised to Prohibit the Use of Banked Credits and Alternative Compliance Payments In 2020, and to Allow Only Zero Emission Energy to Qualify Absent New Analysis.**

Proposed 310 CMR 7.75 (“Clean Energy Standard”) requires two revisions in order to, in the near-term, meaningfully contribute to DEP’s Section 3(d) obligations pursuant to *Kain* and, in the longer-term, be consistent with the GWSA:

In order for DEP to rely on emissions reductions that can be reasonably expected to result from implementing the proposed Clean Energy Standard for purposes of ensuring GWSA/Kain-compliance in 2020, proposed 310 CMR 7.75 must be revised to prohibit the use of both “banked attributes” or Alternative Compliance Payments (“ACPs”) (see proposed 310 CMR 7.75(5)(b)-(c)) either altogether or, at a minimum, for purposes of demonstrating compliance during/for the 2020 compliance year. While potentially valuable from an economic perspective, the use of both banking and ACPs are unacceptable in the context of ensuring compliance with volumetric emissions limits, as data from the Commonwealth’s RPS program indicates. While compliance by ACP has been relatively small as a percentage of the total of the life of the program, between 2010 and 2014, it has followed no easily discernable pattern (e.g., either continually trending up or down) with, at times, a significant emissions impact: in 2013 and 2014, approximately 500,000 tons of expected RPS emissions reductions failed to be realized as a result of ACP payments made in place of about 1.2 million mega-watt-hours (“MWh”) of otherwise required RECs. Given DEP’s assessment (with DOER) that proposed 310 CMR 7.75 has the potential to procure about 3 million MWh of new clean energy in 2020, for purposes of GWSA/Kain-compliance it cannot risk potentially reducing that number by a third.

Second, as was indicated in CLF’s initial comments regarding proposed 310 CMR 7.75 (filed November 21, 2016), the Clean Energy Standard should allow as qualified, only generators with emissions levels that have been determined by DEP to be acceptable in all years through 2050. Based on recent submission to the state’s Energy Facility Siting Board, generation built in 2018 is reasonably expected to remain in operation.

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67 See note 39 above.
69 Alternately, historical RPS data suggests that if the use of banked credits and ACP payments in 2020 is allowed, DEP must assume for purposes of calculating expected 2020 emissions levels that proposed 310 CMR 7.75 will produce on the order of a third fewer emissions reductions.
through at least 2058. As a result, generation built to satisfy the proposed Clean Energy Standard must have an emissions limit consistent with 2050 emissions levels consistent with the GWSA’s emissions reduction requirement for that year, which best-available science indicates is a level about three times lower than the “50% of gas-fired combined cycle plant” emissions level proposed by DEP. As a result, unless and until DEP adopts an evidence-based 2050-compliant positive emissions rate for Massachusetts, the CES should define qualifying “clean energy” as energy with zero GHG emissions, that is, RPS-eligible or nuclear generation only.


As noted in CLF’s initial comments (p.4) regarding proposed 310 CMR 7.73 (filed November 16, 2016), because methane is a potently destructive GHG and because recent peer-reviewed studies indicate that Massachusetts’ aging distribution infrastructure is leaking at a rate well in excess of the national average, it is imperative that DEP establish declining annual emissions limits that will limit actual volumetric emissions from the Commonwealth’s gas distribution system. But in order to achieve that end—as the GWSA requires the reduction of actual volumetric emissions—DEP must re-examine, and update according to best-available science, the Commonwealth’s existing, flawed method of estimating gas distribution system GHG emissions for the years 1990 to present.

70 See Exelon West Medway II, EFSB 15-01 (Response to Information Request CLF-1-8) (expected operational life of 40 years); accord NRG Canal Unit 3, EFSB 15-06 (Response to Information Request CLF-1-27) (same).
72 This definition would allow low-impact/run-of-river hydropower to generate CES credits but would generally prohibit power from large newly-flooded boreal reservoir hydropower, which has average lifetime emissions of between 160 and 250 lbs.CO2/MWh. See, e.g., Steinhurst et al., Hydropower Greenhouse Gas Emissions: State of the Research (Feb. 14, 2012), at 2, from doing so. As the CES is designed to provide an incentive for the construction and procurement of new generation beyond that which is already expected, there is no conflict between this definition and H.4568 (July 31, 2016).
73 Any subsequent determination by DEP qualifying an electricity source or category of electricity sources as “clean energy” for purposes of the CES should be conducted as part of an open and transparent public rulemaking proceeding pursuant to G.L. c. 30A.
74 See Kain, 474 Mass. at 300.
75 CLF supports and joins in the “Comments of Environmental Defense Fund on Massachusetts DEP’s GWSA Section 3(d) Proposed Regulations” filed by Environmental Defense Fund on Feb. 24, 2017.
Accordingly, proposed 310 CMR 7.73 should be revised to require DEP to, by December 31, 2020: (i) commission or conduct a study that establishes for the Commonwealth a revised method of estimating gas distribution system GHG emissions based on best-available science, including updated emission factors and activity factors as well as methodologies that measure emissions from known leaks in Massachusetts, and (ii) complete a rulemaking that adopts and incorporates the recommendations of the study, including revising the statewide GHG Inventory and 310 CMR 7.7.3 as necessary and appropriate in light of the study’s findings, to ensure the Commonwealth’s methodologies for estimating and controlling methane emissions are based on the best available science.

4. 310 CMR 60.05 Should Be Revised to Make the Proposed Annual Limits on Aggregate Transportation GHG Emissions Enforceable.

As stated in CLF’s initial comments (pp.2-4) regarding proposed revision to 310 CMR 60.05 (filed November 16, 2016), it is imperative that the achievement of meaningful, permanent reductions in the transportation sector, now the largest source of statewide GHG emissions, become a main focus of the state’s GWSA compliance effort without further delay. Accordingly, proposed revisions to 310 CMR 60.05 should include an enforcement provision regarding the “Maximum Annual Aggregate Transportation GHG Emissions” listed in proposed Table 310 CMR 60.05(7) comparable (if not identical) to the one provided (in proposed 310 CMR 60.05(6)(a)(3)) to enforce the “Maximum Annual Aggregate MassDOT Transportation GHG Emissions” required in proposed Table 310 CMR 60.05(6).

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5. **310 CMR 60.06 Should Include a Requirement that Executive Offices Purchase or Lease Only 100% Zero-Emission Passenger Vehicles.**

As stated in CLF’s initial comments (p.4) regarding proposed 310 CMR 60.06 (filed November 16, 2016), it is important for the Commonwealth to show strong, nation-leading leadership-by-example regarding the technical and commercial viability of zero-emissions vehicles (ZEVs). Accordingly, in support of the Commonwealth’s on-going commitment to foster the adoption of ZEVs as a critical component of meeting long-term GWSA emissions reduction requirements, as well as the Commonwealth’s commitment to 300,000 ZEVs on Massachusetts roadways by 2025, proposed 310 CMR 60.06 should be revised to include and reflect a requirement that, in order to facilitate each Executive Office meeting the individual office CO2 limits in proposed 310 CMR 60.06(6), each Passenger Vehicle (as defined therein) newly purchased, leased, or otherwise acquired by any Executive Office after December 31, 2018 shall be a ZEV.

Sincerely,

**CONSERVATION LAW FOUNDATION**

By its Senior Attorney

David Ismay

Enclosure (Testimony of Elizabeth A. Stanton)
In order to simulate the results of an allocation by auction, 2013-2015 actual emissions rates and capacity factors were calculated for all generating units in all existing in-state facilities included for regulation in proposed 310 CMR 7.74; for proposed new facilities, emissions rates and capacity factors included in permit applications and related filings were used. Units were then ranked by emissions rate, lowest to highest, and emissions were allocated to each unit, beginning with the most efficient and in a volume consistent with the average actual/expected generation level for that unit, until the allowed state-wide aggregate emissions level was reached in each year. The allowed state-wide aggregate emissions levels used for simulating an auction reflect total emissions declining by approximately 5% between 2018 and 2020 by about 1.6% 2018-19 and about 3.4% 2019-20, while delivering at least 19.1 TWh of electricity in 2020 with total GHG emissions under 8 MMTCO2e.
Testimony of Elizabeth A. Stanton, PhD

1. INTRODUCTION AND QUALIFICATIONS

Q: Please state your name, title, and employer.

A: My name is Elizabeth A. Stanton. I am a Research Fellow at and direct the Applied Economics Clinic at the Global Development and Environment Institute at Tufts University, and I am an independent consultant using the business name Liz Stanton Consulting.

Q: Please describe the Applied Economics Clinic at Tufts University and Liz Stanton Consulting.

A: The Applied Economics Clinic is a new program that I am in the process of founding at the Global Development and Environment Institute at Tufts University. The Applied Economics Clinic provides expert testimony, analysis, modeling, policy briefs, and reports to public interest groups on the topics of environment, consumer protection, and equity. The Clinic also serves to train the next generation of expert technical witnesses and analysts by providing applied, on-the-job training to graduate students in related fields and working proactively to support diversity among both student workers and professional staff. The Applied Economics Clinic began operations in February 2017.

Liz Stanton Consulting is a private, for-profit consulting business founded in August 2016 located in Arlington, Massachusetts. Through this business I provide economics and other analytical services primarily for environmental and consumer advocates.

Q: Please summarize your professional and educational experience.

A: I am a researcher and analyst with more than 16 years of professional experience as a political and environmental economist. I have authored more than 120 reports, policy studies, white papers, journal articles, and book chapters on topics related to energy, the economy, and the environment. I am currently in the process of moving the base of my work from the private consulting firm Liz
Stanton Consulting to a newly created Applied Economics Clinic at the Global Development and Environment Institute at Tufts University.

In my previous position as a principal economist at Synapse Energy Economics, I led studies examining environmental regulation, cost-benefit analyses, and the economics of energy efficiency and renewable energy. I have submitted expert testimony and comments in Illinois, Vermont, New Hampshire, Massachusetts, and several federal dockets. My recent work includes extensive analysis of the EPA’s proposed Clean Power Plan, critiquing the analyses used to support a flawed valuation method for nuclear power plants, developing testimony on Global Warming Solutions Act (GWSA) compliance for the Massachusetts Departments of Energy Resources and Environmental Protection, and analysis of the need for new gas pipelines in New England and the U.S. Southeast.

Prior to joining Synapse, I was a senior economist with the Stockholm Environment Institute’s (SEI’s) Climate Economics Group, where I was responsible for leading the organization’s work on the Consumption-Based Emissions Inventory (CBEI) model and on water issues and climate change in the western United States. While at SEI, I led domestic and international studies commissioned by the United Nations Development Programme, Friends of the Earth-U.K., and Environmental Defense.

My articles have been published in Ecological Economics, Renewable Climatic Change, Environmental and Resource Economics, Environmental Science & Technology, and other journals. I have also published books, including *Climate Change and Global Equity* (Anthem Press, 2014) and *Climate Economics: The State of the Art* (Routledge, 2013), which I co-wrote with Frank Ackerman. I am also coauthor of *Environment for the People* (Political Economy Research Institute, 2005, with James K. Boyce) and co-editor of *Reclaiming Nature: Worldwide Strategies for Building Natural Assets* (Anthem Press, 2007, with Boyce and Sunita Narain).
I earned my Ph.D. in economics at the University of Massachusetts-Amherst, and have taught economics at Tufts University, the University of Massachusetts-Amherst, and the College of New Rochelle, among others.

My professional resume is attached as Exhibit A to this testimony.

Q: On whose behalf are you testifying in this case?
A: I am testifying on behalf of Conservation Law Foundation.

Q: Have you testified previously regarding Massachusetts’ Global Warming Solutions Act?
A: Yes. In 2014 and 2015 I provided written and oral testimony regarding the cost of compliance with Massachusetts’ Global Warming Solutions Act to the Commonwealth of Massachusetts Department of Public Utilities in Docket No. DPU 14-86 on behalf of the Massachusetts Department of Energy Resources and Department of Environmental Protection.

Q: What is the purpose of your testimony?
A: The purpose of my testimony is:

(1) To describe the characteristics of a sound methodology for the emissions accounting necessary to ensure a 25 percent reduction from 1990 emission levels by 2020, and

(2) To assess, in light of those characteristics, the accounting methodology used by MassDEP in its December 16, 2016 Background Document on Proposed New and Amended Regulations.

Q: Please summarize your findings.
A: In this testimony I propose three characteristics for a sound emissions accounting methodology necessary to ensure a 25 percent reduction from 1990 emission levels by 2020 and find that the accounting methodology used by MassDEP in its December 16, 2016 Background Document on Proposed New and Amended Regulations (the “Rulemaking”) does not meet this standard, as follows:
• It must be conducted and presented in terms of 2020 metric ton volumetric emissions limits: The Rulemaking does not present net emission levels in metric tons, instead using a mix of “percent of required” and volumetric program-only reduction estimates.

• It must account for uncertainty in future emissions and require the high end of the range of expected future emissions to be no greater than the 2020 metric ton limit: The Rulemaking does not present a range of uncertain future emissions and does not demonstrate that the high end of a reasonably expected range of 2020 emissions is at or below the required 2020 metric ton limit.

• It must make available evidence of its assumptions and methods sufficient for public, third-party review: The Rulemaking does not present detailed evidence sufficient for public, third-party review of key assumptions it relies on in asserting that the Rulemaking will ensure a 25 percent reduction from 1990 emission levels by 2020. In particular, the Rulemaking suggests that its calculations include revisions to important 2015 Update to the Clean Energy and Climate Plan for 2020 (2015 CECP) assumptions and/or methods but does not make these revisions available for public review.

As a result, I conclude that MassDEP’s Rulemaking fails to ensure a 25 percent reduction from 1990 emission levels by 2020. The Rulemaking’s assertion of gross reductions from specific policies is not sufficient to demonstrate net reductions or the achievement of required 2020 emission levels. In addition, the Rulemaking fails to present emissions outcomes, which are necessarily uncertain, as an expected range, with the high end of this range indicating at least a 25 percent reduction from 1990 emission levels by 2020.

Q: How is your testimony organized?

A: My testimony is organized in the following sections:

1. Introduction and Qualifications
2. Background on Global Warming Solutions Act and Kain v. MassDEP
3. Sound Accounting Methodology for Documenting Compliance with Legal Emission Limits

4. Emissions Accounting Methodology Used in MassDEP December 16, 2016 Background Document on Proposed New and Amended Regulations

2. BACKGROUND ON GLOBAL WARMING SOLUTIONS ACT AND KAIN v. MASSDEP

Q: What is the Global Warming Solution Act?

A: Relevant to this testimony, the Massachusetts’ 2008 Global Warming Solutions Act (GWSA) requires (1) a reduction in greenhouse gas emissions to “a 2050 statewide emissions limit that is at least 80 per cent below the 1990 level” and (2) that the Secretary of the Office of Environmental and Energy Affairs (EEA) adopt a 2020 limit on statewide emissions between 10 and 25 percent below the 1990 level together with a plan for achieving that limit. In 2010, the Secretary set a 2020 limit of 25 percent below 1990 emissions level and issued the Clean Energy and Climate Plan for 2020 (2010 CECP). EEA released an updated version of this plan in 2015 (2015 CECP).

Q: What are the legal limits on Massachusetts' 2020 greenhouse gas emissions?

A: In 2020, Massachusetts’ statewide emissions may not exceed 75 percent of 1990 levels (that is, a 25 percent reduction from 1990 levels). Because Massachusetts emitted 94.4 million metric tons of carbon-dioxide equivalents (CO$_2$-e) in 1990, the 2020 limit on Massachusetts’ statewide emissions is 70.8 million metric tons.

Q: What is Kain v. MassDEP?

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1 While 2015 CECP notes that “2015: MassDEP published an updated 1990 GHG Emissions Baseline and 2020 Business as Usual (BAU) Projection for public comment, including complete emissions data from 1990 through 2012, and partial data for 2013.5 The estimate of 1990 emissions was revised slightly to 94.5 MMTCO2e”(p.2), MassDEP’s most recent Greenhouse Gas Emissions Inventory published July 2016 still reports 94.4 million metric tons in total statewide emissions in 1990. For consistency with the official inventory, throughout this testimony I use the 94.4 million metric ton value.
A: The Massachusetts Supreme Judicial Court’s May 2016 decision in Kain v. Department of Environmental Protection (MassDEP) clarifies the intent and requirements of the GWSA.

Q: What standards are required by the Kain v. MassDEP?

A: My understanding of the decision comports with that outlined by MassDEP in the Rulemaking and by Governor Baker in Executive Order 569: It requires MassDEP to issue regulations that “address multiple sources or categories of sources of greenhouse gas emissions, impose a limit on emissions that may be released, limit the aggregate emissions released from each group of regulated sources or categories of sources, set emission limits for each year, and set limits that decline on an annual basis” and it requires that those regulations be “designed . . . to ensure that the Commonwealth meets the 2020 statewide emissions limit mandated by the GWSA”. That is, the regulations must ensure that Commonwealth’s emissions in 2020 are no greater than 70.8 million metric tons CO2-e.

3. SOUND ACCOUNTING METHODOLOGY FOR DOCUMENTING COMPLIANCE WITH LEGAL EMISSION LIMITS

Q: What characteristics of a sound methodology for accounting for greenhouse gas emissions are necessary to ensure a 25 percent reduction from 1990 emission levels by 2020?

A: In order to ensure a 25 percent reduction from 1990 emission levels by 2020, an emissions accounting methodology must (1) consistently account for present and future emissions and emissions reductions in terms of metric tons; (2) account for uncertainty when estimating future emissions and require the high end of the range of expected future emissions to be no greater than the 2020 metric ton limit; and (3) make available for public, third-party review the data, assumptions and methods that support such estimations.

Q: Please explain what it means for an emissions accounting methodology to be conducted and presented in terms of 2020 metric ton limits.
A: An emissions accounting methodology conducted and presented in terms of 2020 metric tons demonstrates compliance with the Massachusetts allowable emissions level with direct reference to the 70.8 million metric ton limit. Projected emissions inventories are conducted in terms of the metric tons expected in each future year using energy and emission modeling techniques sufficient to account for likely future economic and climatic conditions, interactions between energy sectors, and interactions among various emissions reduction policies.

Goals, targets or limits presented in metric tons of policy-specific emissions reduced and/or percentage reductions are partial and gross, and therefore insufficient to ensuring net emissions reductions result in required 2020 emission limits.

Q: What are the consequences of using an accounting methodology that conducts and presents emissions in terms other than 2020 metric ton limits?

A: An accounting methodology that relies on policy-specific metric ton emissions reductions or percent emissions reductions cannot and does not ensure a 25 percent reduction from 1990 emission levels by 2020. Such reduction-based emissions accounting is partial and gross in accounting terms. A sum of expected policy reductions cannot, and does not, provide a complete accounting of expected volumetric emission changes for the state. Expected policy reductions do not include future economic and climatic conditions, interactions between energy sectors, and interactions among various emissions reduction policies, all of which will necessarily impact, and in certain cases have the potential to negate, expected policy-level reductions.

In contrast, emissions accounting based on final limits in metric tons is complete and, from an accounting perspective, net. Modeling of the expected emissions inventory in 2020 takes into consideration not just the direct impacts of planned policies but also unrelated or indirect changes to emissions, both positive and negative.
Q: Please explain what it means for an emissions accounting methodology to account for uncertainty and require the high end of the range of expected future emissions to be no greater than the 2020 metric ton limit.

A: Any complete and net accounting of expected future limits must take into consideration uncertainty. Future emissions cannot be known or be predicted with certainty. Instead, a range of likely future emissions must be estimated based on a likely range of future circumstances including fuel prices, economic growth, federal environmental policy enforcement, weather and climate, and human behavior (including, e.g., electric demand, vehicle miles travelled, energy efficiency adoption, etc.).

For an estimated range of expected future emissions to then satisfy the requirement of ensuring a 25 percent reduction from 1990 emission levels by 2020, it is necessary that the high end of the reasonably expected range of future emissions be no greater than the 2020 limit. For Massachusetts this means that the high end of the reasonably expected range of future emissions in 2020 must be no greater than 70.8 million metric tons. Figure 1 below depicts the relationship between actual 1990 emissions (94.4 million metric tons), actual 2013 emissions (75.8 million metric tons), and the 2020 legally mandated limit (70.8 million metric tons).

Figure 1. Total Massachusetts CO₂-e emissions: 1990 and 2013 actual; 2020 legal limit
Q: What are the consequences of using an accounting methodology that does not account for uncertainty and/or does not require the high end of the range of expected future emissions to be no greater than the 2020 metric ton limit?

A: An accounting methodology that does not account for uncertainty is unrealistic and necessarily inaccurate because as a technical matter, future emissions can never be known with absolute certainty, particularly years into the future. Only an emissions accounting methodology that accounts for this uncertainty can be understood to ensure a 25 percent reduction from 1990 emission levels by 2020.

In addition, a high end of expected future emissions that is greater than the legal limit—that is, greater than 70.8 million metric tons in 2020—does not ensure a 25 percent reduction from 1990 emission levels by 2020. That is the meaning of the expected range: that emissions are expected to fall somewhere within its boundaries. A high end of the projected range above the 70.8 million metric tons is equivalent to a reasonable expectation that no assurance exists that 2020 emissions reductions will be achieved.

Q: What range of emissions is acceptable for the purpose of ensuring a 25 percent reduction from 1990 emission levels by 2020?

A: To ensure a 25 percent reduction from 1990 emission levels by 2020, the high end of that range of must be no greater than 75 percent of the Commonwealth’s 1990 levels, or 70.8 million metric tons. The low end of the range can be any value lower than 70.8 million metric tons. The 2015 CECP suggests a range of 2020 emissions of 10 percent surrounding the 2020 limit—that is, a +/- 5 percent variance where 2020 emissions may be as high as 80 percent of 1990 emission levels (only a 20% reduction), or as low as 70 percent (as much as a 30% reduction). The 2010 CECP presented a range of 2020 emissions of 15 percent surrounding the 2020 limit, suggesting that emissions reductions may be 7 percent below or 8 percent above the 25 percent required reduction. To my knowledge, no other
assessments of the expected range of 2020 emissions have been presented by MassDEP or EEA.

Based on EEA’s estimated +/- 5 percent uncertainty range regarding 2020 emission levels presented in the 2015 CECP, and the legal requirement that a 25 percent reduction from 1990 emission levels be achieved by 2020, 2020 emissions as high as 70.8 million metric tons, and as low as 61.4 million metric tons, would be consistent with ensuring compliance with GWSA.

Q: Please explain what it means to make evidence of an emissions accounting methodology’s assumptions and methods sufficiently available for public, third-party review.

A: Providing evidence sufficient for public, third-party review is the basic standard necessary when asserting the accuracy of analysis in a public proceeding. To meet that standard, evidence (the underlying data, or references to data otherwise publicly-available) must be provided sufficient to enable a third-party reviewer (that is, a reviewer who is entirely independent of state agencies and/or the petitioner in a utility commission proceeding) to replicate the calculations presented and arrive at the same result. This type of review allows for protection of the public interest and is a critical quality assurance when performed by experts not involved in conducting the analysis at issue.

Q: What are the consequences of using an emissions accounting methodology that does not make available evidence of its assumptions and methods sufficient to public, third-party review?

A: An emissions accounting methodology that does not make available evidence of its assumptions and methods sufficient for public, third-party review cannot reasonably be assumed to be accurate. Review by experts who did not perform the analysis provides quality assurance necessary to any analytical exercise. In particular, review by experts who are answerable only to the public interest is a critical basic standard for the unbiased analyses on which public policy decisions rely.

Q: Is it sufficient for DEP to set a single emission limit for the state as a whole for purposes of meeting the standards for compliance set by the GWSA and Kain v. MassDEP?
A: No. According to the Court in the Kain case, MassDEP must “impose a limit on emissions that may be released, limit the aggregate emissions released from each group of regulated sources or categories of sources, set emission limits for each year, and set limits that decline on an annual basis”. This language requires more than setting a single limit for the state as a whole. Instead, it requires multiple annual emission limits be set that are in the aggregate sufficient to ensure the 2020 statewide limit is achieved. While the GWSA does not specify what these groups of regulated sources or categories of sources must be, MassDEP has historically reported both its emissions inventory and its expected emissions reductions grouped in the following sectors: waste; agriculture; land use; industrial processes; natural gas systems; electricity consumption; buildings, non-electric (often further disaggregated into residential, commercial, and industrial buildings); and transportation (sometimes called mobile combustion).

Q: What emission levels for each of the major sectors would be consistent with the range of 2020 emissions necessary to ensure a 25 percent reduction from 1990 emission levels by 2020?

A: Determining emissions levels needed to meet the 2020 statewide limit requires an analysis of anticipated volumetric reductions in the context of total statewide emissions in 2020 incorporating a likely range of future circumstances including fuel prices, economic growth, federal environmental policy enforcement, weather and climate, and human behavior.

Regarding anticipated volumetric reductions, the Rulemaking includes the following expected programmatic emissions reductions by sector for the 2013 to 2020 period:

- **Waste**: no reduction
- **Agriculture**: no reduction
- **Land use**: no reduction
- **Industrial processes**: 0.01 percent of 1990 levels, or 0.01 million metric tons
- **Natural gas systems**: 0.05 percent of 1990 levels, or 0.05 million metric tons
- **Electric consumption**: 4.0 percent of 1990 levels, or 3.8 million metric tons
- **Buildings, non-electric**: no reduction
- **Transportation**: 3.1 percent of 1990 levels, or 2.9 million metric tons

According to the Rulemaking only two sectors—electric consumption and transportation—are expected to have reductions equal to or greater than 0.1 million metric tons in the 2013 to 2020 period.

The Rulemaking, however, fails to assess the ability of these potential reductions to affect the reasonable range of expected future aggregate emissions reductions or the statewide 2020 emissions limit.

That such a range of expected future emissions exists has been explicitly acknowledged by EEA: The 2015 CECP, for example, presents an expected range of 2020 emissions for the electricity consumption, buildings, and transportation sectors based on various uncertainties. The Rulemaking does not present any information describing the expected future range of 2020 emissions that modifies or supersedes the information on emission uncertainty presented in the 2015 CECP.

Based, then, on the programmatic reductions the Rulemaking identifies, and the range of expected future aggregate emissions by sector established by the 2015 CECP, the following may reasonably be assumed about expected emissions in 2020:

- **Waste, Agriculture, Land Use, Industrial Processes, and Natural Gas Systems**: The 2015 CECP does not present information regarding emission uncertainty for these sectors, nor am I aware of another source of MassDEP or EEA information on uncertainty in these sectors. In addition, the Rulemaking describes either no emissions reductions or reductions less than 0.1 million metric tons during the 2013 to 2020 period for these sectors. Thus the sum of these sectors’ emissions in
2020 is expected to be identical to the sum of their 2013 inventory levels, i.e., 5.7 million metric tons.

- **Buildings, non-electric**: The 2015 CECP presents a range of expected 2020 emissions for the residential, commercial, and industrial buildings non-electric sectors totaling 20 to 24 million metric tons. The Rulemaking describes no 2013 to 2020 emissions reductions for this sector. Thus for purposes of ensuring a 2020 statewide limit of 70.8 million metric tons, these sectors’ 2020 emissions are expected to be as high as 24 million metric tons.

- **Transportation**: The 2015 CECP presents a range of expected 2020 emissions for the transportation sector of 29 to 32 million metric tons that already includes the 2.9 million metric tons of expected emissions reductions in the transportation sector from 2013 to 2020 identified in the Rulemaking. The 2015 CECP recognizes the risk that some or all of the emissions reductions identified in the Rulemaking may be offset by increases to vehicle miles traveled:

  *Between 2015 and 2020, significant improvements in vehicle efficiency will occur as the stringency of vehicle GHG standards increases...However, recognizing the historic increase in VMT from 1990 to 2013 of 22%, it remains possible that an increase in VMT will offset some or all of these benefits. Therefore, accounting for these trends and recent emission data, 29–32 MMTCO2e appears to be a robust range for 2020[.]*

Accordingly, for purposes of ensuring a 2020 statewide limit of 70.8 million metric tons, this sector’s 2020 emissions are expected to be as high as 32.0 million metric tons.

- **Electricity consumption**: Given these various expectations regarding emissions in the other sectors, emissions from electricity consumption can be no higher than 9.1 million metric tons in order to ensure a 25 percent reduction from 1990 emission levels by 2020. The Rulemaking describes only a 3.8 million metric ton reduction from 2013-2020, which if achieved would
reduce the high end of the 2015 CECP’s 2020 emissions range for this sector from 14 million metric tons to 10.2 million metric tons.

This assessment of the programmatic reductions the Rulemaking identifies in the context of the range of expected future aggregate emissions by sector established by the 2015 CECP, indicates that the Rulemaking does not reasonably ensure a 25 percent reduction from 1990 emissions levels by 2020. It identifies reductions that would result in emissions from electricity consumption as high as 10.2 million metric tons when such emissions can be no higher than 9.1 million metric tons in order to ensure that 2020 emissions limit is achieved.

4. EMISSIONS ACCOUNTING METHODOLOGY USED IN MASSDEP DECEMBER 16, 2016 BACKGROUND DOCUMENT ON PROPOSED NEW AND AMENDED REGULATIONS

Q: Please describe the emissions accounting methodology used in the Rulemaking.

A: The emissions accounting methodology used in the Rulemaking adds gross percentage emissions reductions from specific emissions reductions policies (7.2 percent) to percentage emissions reductions that it asserts have been achieved through 2013 (19.7 percent) to sum to a percentage reduction greater than 25 percent below 1990 levels. Figure 2 below depicts total Massachusetts CO₂-e emissions in 2013, the 2020 emissions level implied by the percentage reductions presented in the Rulemaking, and the 2020 legally mandated emissions limit.
Q: Is the emissions accounting methodology in the Rulemaking conducted and presented in terms of 2020 metric ton limits?

A: No. The emissions accounting methodology in the Rulemaking is not conducted in net terms and is not presented in terms of a 2020 metric ton limit. This method is partial and gross (in the manner explained above) and, therefore, cannot ensure a 25 percent reduction from 1990 emission levels by 2020.

Q: Does the emissions accounting methodology in the Rulemaking result in a high end of the range of expected future emissions no greater than the 2020 metric ton limit?

A: No. The Rulemaking fails to estimate the expected range of likely future emissions. Its only discussion of uncertainty is its unsupported assertion (p.11) that the 7.2 percent in aggregate expected reductions from 1990 emission levels identified by the Rulemaking should be sufficient to achieve the necessary 5.3 percent reduction (from 2013 actual levels) by 2020 by “help[ing to] control for
variables that could result in additional electric power demand or increases in vehicle miles traveled.”

But the Rulemaking presents no estimate of emissions uncertainty in 2020 that substantiates this assertion or demonstrates that this implied range of expected emissions reductions (1.9 percent) will result in a net 2020 emissions level no higher than 70.8 million metric tons.

**Q:** Does the Rulemaking substantiate its emissions reduction projections with evidence sufficient to public, third-party review?

**A:** No, the Rulemaking does not substantiate its emissions reduction projections with evidence sufficient to public, third-party review. The Rulemaking does not present the assumptions or methods used in calculating expected emissions reductions or in arriving at the assertion that these reductions will result in emissions lower than the legally mandated limit. The Rulemaking notes twice (p.9 and 10) that MassDEP has “refined calculations” developed for the 2015 CECP, but does not elaborate on what particular assumptions or methods have been updated or how they have been updated.

**Q:** Do you have confidence in the Rulemaking’s assertion that emissions equivalent to a 7.2 percent of 1990 level reduction will be achieved between 2013 and 2020?

**A:** No, I do not. In addition to the reasons stated above, I lack confidence in that assertion because of how the Rulemaking addresses transportation sector emissions. In asserting that a 7.2 percent reduction will occur statewide, the Rulemaking relies on expected emissions reductions in the transportation sector equal to 3.1 percent of 1990 levels or 2.9 million metric tons between 2013 to 2020. These reductions are composed of reductions smaller than 0.1 million metric tons from requirements for MassDOT and the State Vehicle Fleet, together with a reduction of 3.1 percent of 1990 levels from existing vehicle greenhouse gas standards. To be clear, the Rulemaking does not include any new or amended regulations regarding the reduction of 3.1 percent of 1990 levels from vehicle greenhouse gas standards.
Q: Why does that affect your confidence in the Rulemaking’s 7.2 percent reduction claim?

A: This affects my confidence in the Rulemaking’s 7.2 percent reduction claim because it is contradicted by the state’s own previous 2015 CECP analysis with no new corroborating evidence provided. The Rulemaking states (p.9) that, “MassDEP has refined calculations developed for the 2020 CECP Update and expects that GHG emissions reductions from its LEV program regulations after 2013 through 2020 will be approximately 3.1%.” In contrast, however, the 2015 CECP, published less than a year before the Rulemaking was issued, projects a 4.4 percent reduction from 1990 levels as a result of vehicle greenhouse gas standards over a much longer, 30-year period: 1990 to 2020, indicating the following reductions:

- Federal and California Vehicle Efficiency and Greenhouse Gas Standards (CAFE/Pavley) (3.9 percent of 1990 levels)
- Federal Emissions and Fuel Efficiency Standards for Medium and Heavy Duty Vehicles (0.4 percent of 1990 levels)
- Federal Renewable Fuel Standard (RFS) and Regional Clean Fuel Standard (CFS) (0.1 percent of 1990 levels)

And even these reductions claimed in the 2015 CECP appear unreliable as MassDEP’s GWSA greenhouse gas emissions inventory indicates that Massachusetts’ transportation sector emissions have increased from 30.5 million metric tons in 1990 to 30.9 million metric tons in 2013. In light of such actual recorded program performance, and in the absence of additional new evidence, it is unreasonable for the Rulemaking to assert or assume that transportation sector emissions will fall by 2.9 million metric tons from 2013 to 2020.

Indeed, despite programmatic reduction estimates identified in the 2015 CECP, the document acknowledges (p.14) the real possibility that no major reductions in the transportation sector will
occur between 2013 and 2020 due to historic and potential continuing increased in vehicle miles traveled.

Q. Is it reasonable to rely on the estimates in the 2015 CECP for purposes of this Rulemaking?

A. Not entirely. The 2015 CECP includes two distinct projections of emissions reductions and levels in 2020 in its Table 2 and Table 3:

- Table 2 is insufficient because it presents partial and gross (per above) emission reductions, fails to present a range of uncertain future emissions, and lacks supporting sufficient evidence. And although the assumptions used to develop Table 2 are discussed throughout the 2015 CECP, they cannot be verified by public, third-party review because MassDEP has never made the spreadsheets used to calculate these reductions available to the public. MassDEP’s practice of making its greenhouse gas emissions inventory spreadsheets available to the public in machine-readable form with formulae intact is an excellent precedent in this regard.

- Table 3 appears to be complete and net, and presents a range of uncertain future emissions, but like Table 2, is not supported by publicly available evidence regarding its assumptions, methodology, or constituent data.

For purposes of projecting future emissions in net, volumetric terms and estimating an uncertainty range of future emissions, however, Table 3 of the 2015 CECP is currently the only information made available by EEA and MassDEP. For this reason, I rely on it above to illustrate the possible range of emissions in 2020.
I declare under penalty of perjury, pursuant to the laws of the United States and the Commonwealth of Massachusetts, that the foregoing is true and correct. Executed this 24th day of February, 2017, at Boston, Massachusetts.

[Signature]

Elizabeth A. Stanton