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House Committee on Environment and Energy
State House
Montpelier, Vermont

Subject: S.5 meeting the mandated greenhouse gas reductions for the thermal sector through efficiency, weatherization measures, electrification and decarbonization.

Dear Committee:

I am Thomas Weiss, a civil engineer whose experience includes energy conservation.

- My master's thesis was on orientation of solar collectors: not the orientation for maximum output. Rather it was on the reduction of intercepted energy with off-peak orientations (meaning the roofs on our existing buildings). My research then found no one who had done that before.
- I have been an energy auditor and a technical assistance analyst.
- I have been an energy conservation engineer who helped a U. S. Army base win the Army's energy conservation prize for most improved base in Europe.

This testimony will do the following:

- Explain the reality behind three of the myths behind the proposed Clean Heat Standards
- Asks why is it OK to buy non-fossil fuels from out of state when it is not OK to buy fossil fuels from of state
- Place S.5 into the context of all actions related to buildings and thermal pathways in the Climate Action Plan.
- Urges that the priority be to reduce thermal loads before anything else
- Suggests other ways to improve S.5 as it has come to you.

The reality behind three of the myths on which the Clean Heat Standard is founded

Myth: S.5 will not force people to do anything.

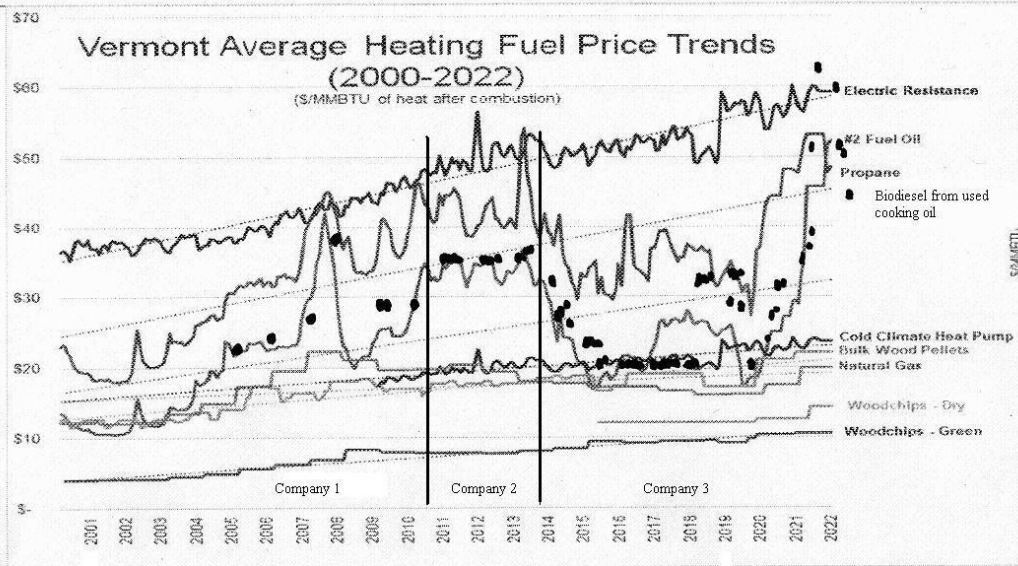
Despite what the overly optimistic supporters of S.5 have told you, S.5 *will* force people to rip out their oil tanks. Will force people to change their heating systems. Or will force people to make massive reductions in the thermal loads of their buildings. Or face whatever prices the market demands because of the competition for limited supplies of liquid fuels, fossil or low intensity non-fossil. Not immediately.

In 2050, the only liquid fuel that will be acceptable for fuel switching will need a carbon intensity less than 20. The only pathways for liquid fuels in Oregon with a carbon intensity less than 20 is *some* biodiesel made from used cooking oil. Not all biodiesel from used cooking oil has a carbon intensity less than 20. There is insufficient used cooking oil to make sufficient biodiesel for everyone who now burns a liquid fuel.

Myth: Prices of "clean" fuels will be stable and lower than the fuels they are supplanting

Biodiesel is a commodity whose market-driven price is volatile. I have been buying straight biodiesel, B100, since 2005. I have placed the prices I paid onto one of TJ Poor's slides (March 22). Biodiesel prices are not stable. They are quite volatile. They tend to track the prices of #2 fuel oil. [NOTE: \$1 per / gallon of B100 in my boiler amounts to \$10.1 per MMBtu (million Btu), the units in Poor's slide.]

Thermal Prices



Base chart: Slide 5, presentation of TJ Poor, DPS, to HEE, March 22, 2023

Myth: Heat pump water heaters have lower greenhouse gas emissions than propane water heaters

My heat pump water heater has emitted as much greenhouse gas annually as my previous propane-fired water heater had. Heat pumps contain a refrigerant that is a powerful greenhouse gas. I installed a hybrid, air-source heat pump to heat hot water in 2015 in the boiler room. Having long tracked my energy use and greenhouse gas emissions, I had the plumber install a water meter and the electrician an electric meter, serving only the water heater. After two years I noticed the efficiency was dropping. I had a leaking valve replaced and the refrigerant recharged. I have had the refrigerant recharged twice since then and I haven't bothered to have it replaced a third time. The costs to repair and recharge the heat pump amounted to 40% of the installed cost of the water heater.

The propane water heater had an installation cost, no maintenance cost over 23 years, used no electricity (so I had hot water if the power went out), and had a scrap metal value when I was through with it. In contrast, the heat pump had an installation cost, has ongoing maintenance costs, and will have negative value when its useful life is over because the refrigerant will have to be removed and properly disposed.

Because of the refrigerant in heat pumps, it is likely that replacing electric resistance water heaters with air source heat pump water heaters will actually increase greenhouse gas emissions.

If it's not OK to send money out of state for fossil fuels, why is it OK for non-fossil fuels?

Over the years, we have heard the refrain that sending money out of state for fossil fuels is bad. We should be keeping that money in state. Yet this bill encourages buying non-fossil fuels from out of state. This bill wants us to believe that sending money out of state to buy non-fossil fuels is good. Huh? And many of those non-fossil fuels will never actually get into Vermont. The most that will get to Vermont for much of this fuel is a flimsy piece of paper that says someone else, somewhere else, will burn the real non-fossil fuels as a proxy, while we are still burning fossil fuels. Money going out of state is money going out of state. It seems odd that one is good and the other not. Let's avoid the question by not getting into a credit market. We'll be sending lots of money out of state to buy the materials and equipment needed to meet the required emissions reductions. So let's send our

money out of state for something physical that will actually help us meet our goals instead of a flimsy piece of paper that won't help us meet our goals.

- **Suggestion:** Do not participate in a credit market.

S.5 in the context of actions related to buildings and thermal pathways in the Climate Action Plan.

The Climate Council has nine pathways for reducing greenhouse gas emissions from buildings and thermal loads. S.5 addresses only one of them. You have been asking questions about some other pathways and finding that the answers are hard to come by. Here are the nine actions with a brief description of each and when they Climate Action Plan calls for them to be implemented. (This information is from tables on pages 93 through 97 and 99 through 100.) The actions in bold face might fit well into an expanded S.5

- **Weatherization** (Pathway 1, Strategy 1, Action 1). Adopt legislative or administrative recommendations consistent with those set out by the Weatherization at Scale Working Group (WWG) with the goal of weatherizing 90,000 additional homes by 2030 and allocate the funding needed to achieve the goal. Implement by December 2022.
- **Weatherization workforce development** (P1, S1, A2). Administration co-ordination to ensure the scaling up of the workforce necessary to weatherize 90,000 additional homes by 2030 and co-ordinate weatherization training among the wide variety of public and private entities involved in workforce training. Implement by 1st quarter 2022.
- **Energy and coaching financial services** (P1, S1, A3). Provide a plan for energy and financial coaching services for Vermonters with low and moderate incomes who could benefit from the State's energy savings programs. Implement by 1st quarter 2022.
- On-bill financing tariffs for electric and gas utilities (P1, S1, A4). Encourage electric and gas utilities to do this. Implement by May 2021.
- **Rental Property Efficiency Standard** (P1, S2, A1). Authorize adoption of efficiency standards for rental property, beginning with expanding the definition of "fit for human habitation". and bring rental units up to those standards by December 31, 2030. Implement the plan by May 2022.
- **Update residential building energy code** to Zero Energy Ready by 2030 (P1, S3, A1). The 2023 Residential Building Energy Standards are in the final stages of approval. The Standards are scheduled to be updated again in 2026 and 2029.
- **Energy Code Circuit Rider** (P1, S3, A2). Provide an Energy Code Circuit Rider to provide code training and enforcement assistance to municipalities, to ensure awareness and compliance with building energy codes. Implement by September 2023.
- **Authorize PUC to create a Clean Heat Standard (P2, S1, A1).** This is what S.5 is addressing. Implement by May 2024.
- Require electric water heaters to be utility-connected and -controllable (P2, S2, A1). Require new electric water heaters to have a modular demand response communications port. Implement by July 2022.

The Climate Council's annual report does not relate its achievements to these actions. The report merely gives what they've done without stating which action each achievement addresses.

- **Suggestion:** Find that the Climate Council's 2023 annual report to the General Assembly is insufficient. Direct the Climate Council to provide additional information for each action in the Plan. The person with contact information responsible for implementing or overseeing the action. When the action was supposed to be implemented and when it actually was implemented. What progress has been made in meeting the overall progress. I suggest something along the lines of the following.

Weatherization workforce development. Name and contact information of the administration's coordinator. The number of workers we need in each category (weatherizing, heat pump servicing, solar installers and service people, and more). The agencies or organizations which are developing the workforce. What each is doing. The amount of money being spent. The success rate of the training: how many begin; how many complete; how many are employed. And probably more that I haven't thought of.

Reduce thermal loads before anything else

You have heard that the single most effective measure is reducing thermal loads. And that the reductions assigned to a measure depend on the order in which measures are implemented. Both are true.

The first step in energy conservation (and for reducing greenhouse gas emissions) should always be reducing the amount of energy used: fewer square feet; more insulation; less infiltration, improved ventilation). This should be done no matter what energy is used. Unnecessary thermal load is wasteful, no matter the energy source. Emissions-free energy has costs, too. If we have not reduced thermal load, we are cutting too many trees. Covering too many fields with solar panels. Damming too many streams and rivers. Destroying too many mountain tops. Diverting too much farmland away from food crops.

- Suggestions for reducing thermal loads:

- Set a cap on the thermal load of residences that are larger than a certain size. Better yet, require zero emissions for all new buildings and additions.
- Require reduction of thermal load before giving credit to measures that require installation of equipment.
- Change the priorities of the energy measures. Require that weatherization and heat loads be reduced before credit is given to other measures. I suggest the following.

(d) List of eligible measures.

(1) Existing buildings. Eligible ~~clean~~ heat measures delivered to or installed in existing buildings in Vermont shall include:

(A) thermal energy efficiency improvements and weatherization;

(B) nonresidential buildings with a thermal load less than ___ Btu / (hr · ft²) or residences with a thermal load less than the smaller of either ___ Btu / (hr · ft²) or ___ Btu / (hr · ___ ft²). The Public Utilities Commission shall determine the conditions under which the following measures delivered to or installed in Vermont shall be eligible as clean heat measures:

(i)(2) cold-climate air, ground source, and other heat pumps, including district, network, grid, microgrid, and building geothermal systems;

(ii)(3) heat pump water heaters if they are not supplanting an electric water heater;

(iii)(4) utility-controlled electric water heaters;

(iv)(5) solar hot water systems;

(v)(6) electric appliances providing thermal end uses,

(vi)(7) advanced wood heating; only if it is supplanting less efficient wood heating;

(vii)(8) noncombustion or renewable energy-based district heating services;

(9) the supply of sustainably sourced biofuels; and

(viii)(10) the supply of green hydrogen.

(ix)(H) the replacement of a manufactured home with a high efficiency manufactured home.

(2) New buildings. Credits will not be available for buildings not occupied, built, permitted, permit applied for [NOTE to committee: choose whichever is appropriate] before July 1, 2023.

Energy codes

Buildings built to the energy codes are the most energy-*inefficient* buildings it is legally permitted to build. Generally codes are determined by consensus. That is why codes generally do not require the best available technology. In order to comply with the Global Warming Solutions Act, we need the best available technology. Our existing energy standards are insufficient for our needs. Because we are not using best available technology, we are creating buildings with a life of 100 or 200 years that will be considered energy wastrels in 2050.

I suggest a cap on the thermal load of residential structures. This cap would be equivalent to a certain thermal load. One of the examples used by the RBES and its handbook is a three-story building (including heated cellar) that is 20' x 40'. The thermal load of such a building using the stretch code is about 24,000 Btu/hr for a building with a total heated floor area of 2400 ft². One might set the cap for larger buildings at 24,000 Btu/hr. I am presenting this for the concept; numbers should be looked at more carefully to ensure that the standard is low

enough so that emissions from new construction are significantly lower than reductions from weatherization. A cap will require larger residences, those 3,000 or 4,000, or 5,000 ft² to be extremely energy efficient.

The Climate Council recommends that the 2029 Residential Building Energy Standards go to net-zero homes by 2030. That is too little, too late. It does not cover commercial buildings. Net-zero is inadequate. We need to go to a standard at least as efficient as the Passive House standard. The 2023 revisions are nearing completion. Subsequent revisions are due in 2026 and 2029. The 2023 commercial standards has an optional appendix CC, Zero Energy Commercial Buildings. The 2023 residential standards do not mention zero energy.

Compliance with the RBES is reported to be 54% and with the CBES is 87%, both declining. The larger compliance with the CBES is likely because many of those buildings need to receive permits through the Fire Safety Division of the Public Safety Department. Many residential buildings need no permit.

The Vermont Housing Finance Authority suggests we'll need 30,000 to 40,000 new housing units by 2030 to ease our housing shortage. That is composed of 16,000 units to end our current shortage. And 14,000 to 24,000 new full-time units for increased population between now and 2030. VHFA also states that the existing housing stock is about 330,000 units, of which 270,000 are occupied full time. 40,000 new units will increase our fulltime housing stock 15%. That is a lot of potential thermal load to be accounted for.

- **Suggestion:** Direct that the Zero Energy Commercial Building Provisions be required in the 2023 CBES. These standards actually are rules that go through the Legislative Committee on Administrative Rules (LCAR).

If it is not feasible for 2023, then require that the CBES require Zero Energy provisions in the 2026 revisions.

- **Suggestion:** Direct that the 2023 residential stretch code provisions be required in the 2023 RBES. Direct that the RBES be brought up to Passive House standards or better no later than the 2026 edition.

- **Suggestion:** Add H.332 to S.5. This is the bill that the Senate added onto the housing bill it passed Friday. Putting it here is insurance in case something happens to prevent or delay the housing bill, S.100.

- **Suggestion:** Find out from the Climate Council if their modeling accounts for all these new homes and additional people.

Existing buildings - weatherization

Weatherization does not seem to be specifically called out in any bills being worked on now.

The budget bill, H.494, contains funds for weatherization in two locations. E.700 creates the Clean heat Homes Program and provides it with \$3,000,000. Weatherization is only one of many allowed uses. B.1100 provides a one-time appropriation of \$10,000,000 to the Vermont Rental Housing improvement Program. Weatherization is only one of many allowed uses for this program.

Nothing in the housing bill, S.100 requires training for weatherization. It had \$20,000,000 for the Vermont Rental Housing Improvement Program. Weatherization is only one of many allowed uses.

It appears that no bills require workforce training for weatherization, specifically. One bill addresses outreach for a wide range of training without mentioning anything that could be interpreted as weatherization.

My limited experience with the weatherization program is that humidity control was not part of the work. The most I have seen is leaving a hygrometer (instrument to measure relative humidity) and telling the occupant to run a dehumidifier when the humidity is too high. As many of you likely are aware, running a dehumidifier uses a lot of electricity. We do not want to weatherize 90,000 homes only to lose them to mold.

My limited experience with the weatherization program is that it has difficulty dealing with vermiculite. Some vermiculite was made from stone containing asbestos. If the weatherization cannot be completed merely because vermiculite is present, then I suggest that the weatherization program could test the vermiculite for asbestos and give the test results to the building's owner. Then, if the vermiculite does not contain asbestos, the weatherization program would weatherize the residence. If the vermiculite does have asbestos and needs to be

removed to adequately weatherize the building, then that would become part of the weatherization project by the weatherization program.

- **Suggestion:** Add funds specifically for weatherization.
- **Suggestion:** Ask the administration's weatherization workforce co-ordinator what is needed (money, training programs) to build the workforce to meet the goal of weatherized homes by 2030 and add that to S.5.
- **Suggestion:** Make sure that the weatherization program does provide proper heat-exchange ventilation. And do not allow credits for weatherization without proper ventilation.
- **Suggestion:** Make sure that the weatherization program can complete weatherization in buildings containing vermiculite.
- **Suggestion:** Work with the committees whose jurisdiction is workforce development to ensure that weatherization receives sufficient attention to meet our demand for trained weatherizers.
- **Suggestion:** Give priority to weatherizing residences of recipients of LIHEAP or other funding programs designated for those with low or moderate incomes.

Other comments on ways to improve S.5

Clean heat measures and credits. The whole system seems overly complex.

Clean heat measures should not include changing from one fuel to another unless there is a significant reduction in emissions. Let's look at heating with wood. When one cuts down a 100-year-old tree for heating, the carbon dioxide is released in one heating season. And it takes 100 years to get another tree storing that much carbon. Yes, one can play games by planting faster growing trees and more of them. The conversion of carbon dioxide to wood is slow in the first years, the seedlings are so small. Switching to wood will not reach a steady state in the 27 years left until 2050.

As far as I have been able to determine, the carbon intensity of cord wood is the same as that of wood pellets. Thus a change from a wood stove to a pellet stove only reduces greenhouse gas emissions if a pellet stove is more efficient than a wood stove. If there is little difference in efficiency, then converting from a wood stove to a pellet stove should not create credits.

- **Suggestion:** Amend § 8123(3) to state that clean heat measures shall not include switching from one fuel to another unless there is a significant lowering of the carbon intensity of the new fuel.

Redefining "heating fuel" as "fossil-based heating fuel", seems intended to mislead people.

- **Suggestion:** Remove §8123(11) and make corresponding changes throughout the text of the bill.

Ownership and application of credits

My fuel dealer should not get credits because I burn biodiesel. I began burning it many years ago; many years before my biodiesel was supplied by my present fuel dealer.. If annual credits are to be issued for my biodiesel, then I should be the owner of the credits.

Credits created before the start of the program should only be allowed for capital improvements. And credits would begin to be retired beginning in the year equipment is installed. For example, suppose equipment is installed in October 2023. The equipment has a life of 25 years and creates a total of 50 credits over those 25 years. The program begins in 2026. In this case, the first credits likely would be generated in 2023 and last through 2047. Credits applicable to the three years before the start of the program could not be saved for application after the start of the program. Otherwise, applying those credits later would be a paper exercise showing more reductions than actually occur. The person with the credits can start claiming them at the rate of 2 per year beginning in 2026. Only twenty-two years of credits could be applied, in the years 2026 through 2047.

- **Suggestion:** §8124(c). Change early action credits to the following.

(c) Early action credits. Beginning on January 1, 2023, clean heat measures involving capital improvements that are installed and provide emission reductions are creditable. Upon the establishment of the clean heat credit system, entities may register credits for actions taken starting in 2023. Credits shall begin to be retired when the improvement is made, as if the system had been in existence then. Only those credits remaining at the start of the program shall be allowed to be retired during the program. The life of the capital improvement shall be calculated from the date of installation.

Customer income. It is not clear what customer income data will be collected and how. S.5 doesn't describe that. I see no need to collect specific income data. I have a feeling that fuel dealers know very well the approximate income levels of their customers: low, moderate, or higher than low or moderate.

Recipients of certain programs should automatically be eligible for this program. Those programs might include LIHEAP, section 8 subsidies, SNAP, and others that have income requirements that are the same as or similar to the requirements now in S.5.

This section aligns S.5 with the Climate Action Plan's action to "Authorize implementation of a plan for coordinating and enhancing energy and financial coaching services for Vermonters with low and moderate incomes who could benefit from the State's energy savings programs that is consistent with recommendations from the Energy Counseling Savings Work Group and their legislative report and allocate the funding to achieve the plan goals and objectives."

The coaching service would work through the existing programs mentioned above and others. The programs would certify to the fuel dealers that a customer meets the criteria of low income or moderate income and that would be sufficient for the fuel dealer to provide the measures to the customer.

- **Suggestion:** Do not require those with low or moderate incomes to disclose their incomes under this program. Amend §8124(d)(6) along the following lines.

(6) A clean heat measure delivered to a customer receiving assistance from any of the following programs shall qualify for clean heat credits required by subdivision (2) of this subsection. The customer may choose to have the agency implementing the assistance program certify that the customer is low-income or moderate-income.

(A) LIHEAP

(B) section 8 housing vouchers

(C) SNAP

(D) _____ [NOTE: This and perhaps more would be any other suitable programs assisting those with low or moderate incomes. The correct references to all programs would need to be used, I suppose.]

- **Suggestion:** Establish a program with funding for energy coaching and financial services.

Rulemaking. It is not clear to me that the Public Utilities Commission has sufficient time to complete the development of this complex program to the check-back point in the time allotted. I acknowledge the statements of the Commission to your committee last week. I acknowledge that the bill provides the ability to hire three more staff. Sometimes having more people work on a project doesn't make things go faster. There are inherent durations for various steps in the process. Those can't be shortened. I base my concern on the development of the rule called net metering 2 (2 1/4 years) and on the revision to that rule presently underway (4 years and counting). I have been involved with the development of both of them. I am not faulting the PUC. I hear from other sources that the PUC is overwhelmed by all its other work, including solar photovoltaics.

- **Suggestion:** I have none. We'll see how the rulemaking progresses.

Manure gas and landfill gas and sewer gas. The most efficient and least emitting use of these gases is to burn them where generated to generate electricity. One of the major goals of the Global Warming Solutions Act and the Climate Action Plan is to electrify everything. These gases need some processing to make them suitable for burning to generate electricity. In order to be placed into a natural gas pipeline, these gases need additional

processing: more complex, more energy intense. In addition to the energy costs from the additional processing, the pipelines and gas facilities leak gas. Credits should only be available if these gases are used to generate electricity.

All of our natural gas comes through Canada. There is no direct, all U. S. route to bring natural gas from somewhere else in the U. S. to Vermont. This is different from the analogy often made to renewable energy certificates for electricity. Only those gases that are actually delivered to Vermont should count as measures that can earn credits.

- **Suggestion:** Change § 8127(e) to read something like:

(e) Digester gas and landfill gas. In order to achieve credits, these gases must be used to generate electricity at or adjacent to the location where the gas is generated and collected.

Technical Advisory Group. The Technical Advisory Group's work needs to be open and accessible to the public. needs to be subject to the APA and the open meeting laws. The meetings must have a physical location at which the members must be present. Members of the public may attend remotely or in person.

- **Suggestion:** Add a subdivision §8128 (e) along the following lines.

(e) The Technical Advisory Group shall comply with the requirements of open meeting laws and the Administrative Procedures Act. All materials of the Technical Advisory Group shall be considered public documents.

Equity Advisory Group

- **Suggestion:** Add a subdivision §8129(c) with the same requirements as for the Technical Advisory Group.

Thank you for reading this testimony. My suggestions are placed throughout this letter. I hope you agree that these suggestions are necessary to an improved approach.

Sincerely,
Thomas Weiss