January 19, 2022

MEMORANDUM TO: **Residential Ratepayers Advisory Board**

FROM: **Donald M. Kreis, Consumer Advocate**

SUBJECT: **Benefit/Cost Screening in the NHSaves Programs**

I. Introduction

As you know, on November 12, 2021 the Public Utilities Commission issued an Order that essentially amounted to a complete reversal of the state's public policy with respect to ratepayer-funded energy efficiency. One key aspect of the Commission's decision was its criticism of the benefit-cost test – known as the Granite State Test -- that the PUC itself had approved at the end of 2019. The Commission criticized the Granite State Test as "overly dependent on subjective factors such that any desired outcome could potentially be obtained." Additionally, the Commission complained that ratepayers are entitled to, but were presumably not getting, "a fully objective and understandable measure" of cost-effectiveness.

In my judgment, these criticisms of the Granite State Test were – and still are -- entirely unwarranted. I said as much, in a recent edition of my "Power to the People" column published on InDepthNH.org. In that column, I attempted to explain in succinct fashion how the Granite State Test works. Then I stated: "[V]ia its blithe dismissal of the Granite State test as too subjective and too hard to understand, the PUC has insulted not just us at the Office of the Consumer Advocate (by implying we have cast our lot with a bunch of nonsense) but also you by deeming customers too clueless to grasp what I have just explained to you."

This in turn prompted a request from a member of the Advisory Board for "actual examples of the calculations using the Granite State Test that justify their support from the energy efficient programs."

"I want to make sure I am not 'clueless,'" added this Board member.

This struck me as an entirely reasonable request, particularly in aid of the deliberations of the body whose statutory tasks include advising me in my capacity as Consumer Advocate. Though I stand by my column as a succinct explanation, and a refutation of the PUC's claim of subjectivity, I must concede that the claim of simplicity is only true at a certain level of generality. If one wants to understand precisely how a particular measure is deemed to be cost-effective, and thus worthy of ratepayer subsidy via the NHSaves program, a fairly elaborate analytical trip becomes necessary.

Specifically, it first becomes necessary to understand what truly 'counts' as the energy saved via the installation of an energy efficiency measure. Unfortunately this is not just a matter of considering the technical performance of a particular measure versus whatever that measure replaces. Rather, those technical specifications must be assessed, as fully as possible, in light of

the actual conditions that prevail in New Hampshire – our energy costs, our weather conditions, our demographics, the attributes of our state's economy, etc. I believe that you will be impressed by the degree to which this information is objectively ascertained.

Then there is the benefit-cost test itself. What counts as a benefit? Are those benefits limited to reductions in the consumption of energy, or should other effects be considered? Similarly, what costs do we consider? The "cost" question is, admittedly, somewhat simpler as it tends to come down to whether to include costs charged to all ratepayers (via the energy efficiency charges on their bills) and/or the additional costs paid by the customers on whose premises the measures are actually installed. Note that the latter costs are always significantly greater than the former.

Finally, there's a fair amount of math involved in all of this. If the objective is to understand how three specific measures find their way into the NHSaves program because they are cost-effective, there is not any way to avoid the math – so, the calculations (with explanations) appear in the final section of this memorandum.

I majored in English as an undergraduate and ultimately went to law school in part because math is not my strong suit. More significantly for present purposes, I am not involved on a day-to-day basis in making benefit-cost determinations for the NHSaves program. That responsibility falls to employees of the utilities that administer the program, with oversight from a working group overseen by the PUC. Therefore, I enlisted the help of analysts from the utilities, three of whom (James Butler of Eversource, Mary Downes of Unitil, and Eric Stanley of Liberty) are planning to join me for the Advisory Board's January 24 meeting. I am sure you will have questions that I they (as opposed to I) can answer. Though this memorandum was thus a collaborative effort, responsibility for it (particularly for any errors) belongs to me exclusively.

I. Avoided Energy Supply Component Study

The process of determining the cost effectiveness of a ratepayer-funded energy efficiency measure begins with the Avoided Energy Supply Component (AESC) Study. The AESC Study is conducted on a region-wide basis and is funded by the program administrators around New England. In New Hampshire, that means the four electric and two natural gas utilities. The most recent AESC Study, 427 pages long, was finalized in May 2021. The previous one was finalized in 2018. Given that the Triennial Energy Efficiency Plan submitted to the PUC in DE 20-092 was finalized in 2020, the 2018 AESC Study was the edition that informed the Plan.

The AESC Study "provides estimates of avoided costs associated with energy efficiency measures" by considering "a hypothetical future in which the New England program administrators do not install any new demand-side measures in 2021 or later years." AESC 2021 at 1. Analyzed are the avoided costs of energy, capacity, natural gas, fuel oil, other fuels, other environmental costs, and demand reduction induced price effects (AESC). The ultimate goal is to determine on a region-wide basis the net present value of energy savings over the useful lives of the measures in question.

II. Technical Reference Manual

Estimates of avoided costs from the AESC Study, in turn, inform the analysis contained in the New Hampshire Technical Reference Manual (TRM) for Estimating Savings from Energy Efficiency Measures. Over 300 pages in length, the TRM is a measure-by-measure guide to the "methods, formulas, and default assumptions for estimating energy, peak demand and other resource impacts" for each measure. TRM at 6.[1]

As to each measure, the TRM relies on algorithms to estimate the annual energy and peak demand impacts as well as, if appropriate, non-energy impacts (e.g., water savings). Inputs and assumptions are based on New Hampshire-specific evaluations or data where available. Other factors being equal, New Hampshire jurisdiction-specific results are favored over results from other jurisdictions in order to account for differences in climate, hours of use, program design and delivery, market conditions, and evaluation frameworks. However, when relevant results exist both from New Hampshire and from other states, it may be necessary to balance the desirable attributes of state-specificity and data reliability. When considering whether to apply results from a study originating in another jurisdiction to New Hampshire programs, the EM&V Working Group (with support from independent evaluation firms as needed), will make the determination based on (1) the similarity of evaluated program/measures to those offered in NH; (2) the similarity of relevant markets and customers base; (3) the recency of the study relative to the recency of any applicable NH results; and (4) the quality of the study's methodology and sample size. In addition to third-party evaluations, inputs may also be based on sources including manufacturer and industry data, data from government agencies such as the U.S. Department of Energy or Environmental Protection Agency, or credible and realistic factors developed using engineering judgment.

The TRM does not simply take the energy and peak demand impacts and equate that with the impact of the applicable measure. The TRM accounts for measure life (i.e., how long a particular measure provides useful savings above the baseline product or measure available to customers) and "impact factors." Impact factors consist of each measure's in-service rate, its realization rate, its coincidence factors, and in some cases net-to-gross ratios.

The in-service rate is the actual portion of efficient units that are installed. The in-service rate accounts for the fact that some measures are purchased as replacement units and not immediately installed.

The realization rate adjusts the gross savings (as calculated by the savings algorithms) based on impact evaluation studies. The realization rate is equal to the ratio of measure savings developed from an impact evaluation to the estimated measure savings derived from the savings algorithms.

The coincidence factor accounts for the extent to which measure-related demand reductions occur at defined system peaks, which yields additional value. The applicable system peaks for New Hampshire are from 1:00 to 5:00 p.m. on non-holiday weekdays in June, July, and August – and from 5:00 to 7:00 p.m. on non-holiday weekdays in December and January.

[1] The most recent edition of the TRM is dated December 2021 and is available here : https://etrm.anbetrack.com/#/workarea/home?token=294a255e6c37343b615e

The net-to-gross ratio converts adjusted gross savings (after the application of realization rates) to net savings, considering "free-ridership" and "spillover" effects. A free-rider is a customer who participates in an energy efficiency program (and takes advantage of a ratepayer-funded incentive) but would have opted for the measure anyway, without the incentive. Free ridership is defined as, "program savings attributable to free riders."[2] Spillover is defined as, "additional reductions in energy consumption or demand that are due to program influences beyond those directly associated with program participation" and may include participant and/or non-participant spillover.[3] Note that in New Hampshire, net-to-ross ratios only apply to midstream and upstream offerings (i.e., programs offering rebates to retailers and distributors, as opposed to rebates provided directly to end-use customers), which are known to have greater levels of free-ridership than other programs as an inherent part of their program design.

The TRM considers so-called non-energy impacts, but only for measures installed under the Home Energy Assistance program (HEA) offered only to income-eligible customers. The relevant non-energy impacts are increased comfort, decreased noise, and health-related impacts. This very limited use of non-energy impacts is explicitly contemplated in the PUC-approved Granite State Test, i.e., the primary test to determine the cost-effectiveness of each program.

III. The Granite State Test

Armed with objective data as to the lifetime savings that are achieved by a particular energy efficiency measure, the next step is to apply the appropriate benefit/cost test. Ultimately, the math is straightforward – if the lifetime savings exceeds the amount of money spent by NHSaves on the measure (a benefit/cost ratio greater than 1) then the measure is cost-effective and worthy of inclusion in the program.

The PUC approved new and improved benefit/cost methodology in Order No. 26,322, issued on December 30, 2019. The new framework replaced one that was nearly 20 years old, adopted at the outset of statewide utility-provided energy efficiency programs.

Under the new framework, there are actually three tests – a primary test and two secondary ones. But in my view, it's the primary test that really 'counts.' The secondary tests merely "help inform future resource allocation decisions, as well as treatment of marginally cost-effective programs." Order No. 26,322 at 4. To my knowledge, NHSaves has never resorted to either of the secondary tests to justify inclusion of a program that is otherwise "marginally cost-effective." To be frank, I believe the secondary tests were included because (1) the framework was developed by a working group convened by the PUC, and (2) some working group members were somewhat skeptical about the new primary test and wanted reassurance in the form of the secondary tests.

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[2] National Renewable Energy Laboratory, Uniform Methods Project, Chapter 17: Estimating Net Savings: Common Practices. September 2014. Available at https://www.energy.gov/sites/prod/files/2015/01/f19/UMPChapter17-Estimating-Net-Savings.pdf

[3] *Id.*

The primary test is known as the "Granite State Test," to reflect that it is not generic but was tailored to advance our state's public policy. But the Granite State Test is basically a version of a generic benefit/cost screen known as the "Utility Cost Test." *Here we get to what is, in my judgment, the most important fact to grasp about this entire subject.* The Granite State Test does *not* compare the overall benefits of energy efficiency measures to their overall costs -- that's exactly what we stopped doing on January 1, 2020. Rather, the Granite State Test compares the *utility's* costs – which means the costs ultimately paid by customers via the SBC and LDAC charges (along with the other program revenue sources, which are also ultimately contributed by customers) – to the benefits that are generated through those investments. Included are benefit 'streams' that accrue to all customers. Participant benefits count as well, as noted in the following paragraph.[4]

In the case of savings associated with "delivered" or "unregulated" fuels (i.e., fuels other than electricity and utility-provided natural gas), the benefits of reducing the use of such fuels are included even though almost all of those benefits accrue to the NHSaves participants as opposed to customers in general. Likewise, the Granite State Test credits participant benefits achieved via reduced water usage, avoided fossil fuel emissions, and benefits achieved by income eligible participants." *See* Order No. 26,322 at 3. Fossil fuel emissions" refers to "environmental impacts from fossil fuel end-uses," with the dollar-per-ton value of carbon dioxide adopted by the Regional Greenhouse Gas Initiative used as a proxy." Erin Malone *et al*., "New Hampshire Cost Effectiveness Review" (2019) at 24.

The reference to income-eligible participants includes both the benefits to customers participating in the NHSaves "Home Energy Assistance" program as well as societal impacts related to impoverished citizens (poverty alleviation, community strength and resiliency, fewer home foreclosures, reduced Medicaid payments, etc.). *Id*. This is a concession to the reality that many energy efficiency projects geared specifically to low-income customers would not pass a benefit-cost screen that only takes benefits on *all* customers into account. The working group that developed the Granite State Test deemed this consistent with public policy in New Hampshire. Indeed, to the extent that participant benefits are included in the Granite State Test, it is because New Hampshire public policy deems these benefits to be in the public interest.

In assessing how all of this works, it is important to understand that the program administrators ultimately apply the Granite State Test at the *program* level. Within a program, some specific measures may not have a benefit/cost ratio larger than one. If so, this must be made up by an even better ratio for other measures within the program. The program administrators are required to offer programs with an overall benefit/cost ratio of 1.0 or higher and to justify continuation of any program that does not consistently achieve cost-effectiveness.

With apologies for such a long explanation of how this all works generally – necessary to lay it all out accurately – we can now move into the requested analytical specifics.

[4] Reductions in the individual energy bills of NHSaves participants as the result of energy efficiency measures installed on their premises are not reflected in any benefit/cost test used anywhere for energy efficiency purposes, including the Granite State Test.

IV. The Magic Number = 1

In their capacities as administrators of the NHSaves programs, the utilities consider the cost-effectiveness of each energy efficiency activity or installation, generally referred to as a "measure." The benefit/cost test generally requires projects to be at least 1.0 (i.e., when benefits from installation over its useful life exceed the costs of installation). The PUC requires the utilities to propose programs that operate at a benefit-cost ratio of 1.0 or higher, with minor exceptions. For standard measures that are similar in nature (such as light bulbs by type, heating and water heating equipment, food service equipment, etc.), prescribed or deemed average savings assumptions, or algorithms for calculating savings are used. These average savings assumptions are derived from third party evaluations, and referenced in detail in the Technical Reference Manual (TRM)[5]. The TRM is reviewed and revised periodically with third party consultants and stakeholders. The TRM houses and tracks savings assumptions including, for example, baselines, adjusted measure lives, realization rates, coincidence factors, and (where appliable) net-to-gross ratios.

Below is a summary of the most significant benefits and costs used in benefit-cost calculations. As noted above, the Granite State Test only considers the utility's costs, not the cost born by the program participant when purchasing and installing new equipment.

V. Significant Benefits and Costs

Benefits

- **Avoided cost of energy and generating capacity**. Money utilities do not spend on energy and new power plant investments they do not need to make.
- **Avoided cost of distribution and transmission.** Money utilities do not spend on poles and wires needed to deliver energy to homes and businesses.
- **Avoided value of greenhouse gas emissions (GHGs).** The value of reduced GHG emissions is also called an "environmental benefit." New Hampshire uses the value of carbon set by Regional Greenhouse Gas Initiative (RGGI). Avoided cost is calculated by: carbon intensity of the fuel (tons of carbon per quantity of fuel) multiplied by the carbon price (dollar per ton of carbon).
- **Income-eligible participant impacts.** The monetary value of benefits associated with improvements to the home related to improved health outcomes, indoor air quality, comfort, indoor and outdoor noise, etc.

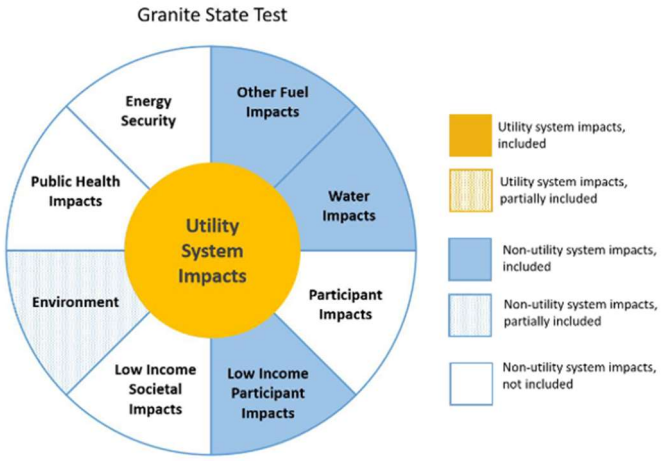
Costs

- **Utility incentive cost**. Value of the utility rebate to the customer or made on their behalf to contractors and vendors.
- **Program administrative and implementation costs.** Utility staff and facilities costs allocated to managing and delivering energy efficiency incentives and other program aspects like managing contact with installers, marketing, technical support and regulatory compliance.
- **Evaluation, Measurement and Verification ("EM&V").** The methods and processes used to track and assess the performance of energy efficiency activities so that results are

[5] https://etrm.anbetrack.com/#/workarea/home?token=294a255e6c37343b615e

achieved and reported with greater transparency and accuracy and future activities can be more cost-effective and impactful[6].

Figure 1: Costs and benefits included in the NH Granite State Test



Source: Synapse Energy Economics, "New Hampshire Cost-Effectiveness Review"

VI. Example Calculations

The following are examples of cost-benefit calculations for illustrative purposes, using measures that are included in the New Hampshire TRM. The benefits recognized under the Granite State Test, as associated with each measure, are shown in the following categories: electric energy benefits, electric DRIPE benefits, electric capacity benefits, non-electric resource benefits associated with fossil fuel and water savings, income eligible non-energy impacts, and environmental fossil fuel impacts.

A. ENERGY STAR Clothes Dryer

The TRM documents that an ENERGY STAR Clothes Dryer saves a deemed 160.4 kWh annually, based on EPA ENERGY STAR list and Northwest Energy Efficiency Alliance lab testing results. Capacity savings of 0.047 kW are derived from the Navigant Demand Impact Model. Over a 12-year effective useful life, an ENERGY STAR Clothes Dryer will save 1,924.8 lifetime kWh (160.4 annual kWh x 12 years). "Deemed" accounts for the fact that, although individual units will have different savings based on specific model and user behavior, the average savings per unit have been estimated within reasonable statistical confidence.

- Benefits are calculated by taking the deemed lifetime kWh and demand savings and multiplying by discounted energy and demand avoided costs. The Benefit-Cost models display these calculations in detail, and are shown below in summary for an ENERGY STAR Clothes Dryer, broken out by benefit category.

Electric Energy Benefits	Electric DRIPE Benefits	Electric Capacity Benefits	Non-electric Resource Benefits	Income-eligible Non-energy Impacts	Environmental Fossil Fuel Impacts	**Total Benefits**
$128.42	$9.61	$63.57	$0.00	$0.00	$0.00	**$201.60**

[6] https://www.energy.gov/sites/prod/files/2014/05/f16/what_is_emv.pdf

- The NHSaves incentive for ENERGY STAR Clothes Dryers is currently $40.00. The Granite State Test includes additional costs to the utility, including administration, marketing, and evaluation – which for this example have been estimated to include 20 percent in additional costs (actual non-rebate related costs differ by program, utility and other factors). The total cost to the utility to incentivize an ENERGY STAR Clothes Dryer is estimated to be $48.00.

  The Benefit-Cost Ratio for an ENERGY STAR Clothes Dryer is calculated to be 4.2, with the benefit of $201.60 being 4.2 times the cost of $48.00

B. Furnace in Senior's Home

A high-efficiency furnace is about 95 percent efficient or greater, meaning it converts 95 percent or more of the heat from natural gas into warming up the inside of a senior's home. Based on the New Hampshire Potential Study Statewide Assessment of Energy Efficiency and Active Demand Opportunities, 2021-2023, Volume III: Residential Market Baseline Study, June 11, 2020, at 3-14, an old furnace in New Hampshire is typically about 83 percent efficient, though it depends on how old the furnace is and how well it has been maintained. Therefore, replacing an old furnace with a more efficient unit saves about 12 percent of the natural gas originally consumed to heat a home.

For a furnace incentivized through the ENERGY STAR Products program, savings for a 95 percent AFUE furnace are estimated to be 9.8 MMBtus per year, based on deemed inputs from a blended Early Retirement/Replace on Failure baseline that reflects the historical mix of projects performed. The ENERGY STAR Products program requires all units to include an electrically commutated motor, which produce ancillary electric savings of 104.2 kWh per year and .07 kW per year, based on the New Hampshire ENERGY STAR Products Program evaluation report (2018). The effective measure life is 17 years, which is based on a 2020 Massachusetts study completed by the consulting firm Guidehouse.

- Natural Gas benefits are calculated by taking the deemed lifetime MMbtus savings and multiplying by discounted natural gas and demand avoided costs. Electric benefits are calculated by taking the deemed lifetime kWh savings and multiplying by discounted electric energy and demand avoided costs. Below are the calculated benefits for a furnace incentivized through the ENERGY STAR Products program, broken out by benefit category.
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Natural Gas Benefits	Natural Gas DRIPE Benefits	Electric Capacity Benefits	Electric Energy Benefits	Income-eligible Non-energy Impacts	Environmental Fossil Fuel Impacts	**Total Benefits**
$1,361.93	$29.16	$0.00	$119.14	$0.00	$204.46	**$1,714.69**

- The typical incentive for a furnace incentivized through the ENERGY STAR Products program is $300. The Granite State Test accounts for all costs to the utility, which include administration, marketing, and evaluation – which typically add up to 20 percent

in additional costs. The total cost to the utility to incentivize furnace through the ENERGY STAR Products program is estimated to be $360.

The Benefit-Cost Ratio for a furnace incentivized through the ENERGY STAR Products program is calculated to be $1,714.69, with the benefit of $1,714.69 being 4.8 times the cost of $360.

C. Manufacturing Process (Air Compressor)

Air compressors are frequently used in manufacturing processes and are a source of significant energy use (and waste). A typical compressor in an existing manufacturing facility is likely a load/unload modulating compressor that performs relatively poorly. By assisting the manufacturer-customer in identifying the opportunity and facilitating the selection of a suitable high-efficiency replacement, the NHSaves programs can overcome the lack of time and information about how to proceed that often prevent key decisionmakers at manufacturing facilities from green-lighting such initiatives The rebate helps to overcome the first cost barrier of replacing the equipment with something more expensive given that operational cost savings will be spread over time.

The algorithm to calculate the savings associated with an air compressor is provided in the TRM and are applied by the installation vendor based on the site's specific conditions. The formula multiplies the nominal rated horsepower of the high efficiency unit by the kW reduction per motor horsepower, and then multiplies the resulting kW by the motor's annual operating hours. Typical nominal horsepower of a high efficiency air compressor is between 15 and 75; the example given here assumes 50 horsepower. The TRM provides that the kW reduction per motor horsepower is 0.189. Operating a 1-shift schedule (e.g., 2,000 hours per year) will result in a savings of 18,900 annual kWh (50 HP x 0.189 kW/HP x 2,000 hours), or 283,500 kWh over the 15-year lifetime of the air compressor.

- Benefits are calculated by taking the calculated lifetime kWh and demand savings and multiplying by discounted energy and demand avoided costs. The Benefit-Cost models display these calculations in detail, which are summarized below for the commercial air compressor described above, broken out by benefit category.

Electric Energy Benefits	Electric DRIPE Benefits	Electric Capacity Benefits	Non-electric Resource Benefits	Income-eligible Non-energy Impacts	Environmental Fossil Fuel Impacts	**Total GST Benefits**
$17,810.39	$1,079.30	$19,869.10	$0.00	$0.00	$0.00	**$38,758.79**

- A typical compressor incentive offered though the Small Business program will be around $4,000.00. The Granite State Test includes all costs to the utility, which include administration, marketing, and evaluation – which for this example have been estimated to include 20 percent in additional costs (actual non-rebate related costs differ by

program, utility and other factors) The total cost to the utility to incentivize the air compressor in this example is estimated to be $4,800.00.

- The Benefit-Cost Ratio for the commercial air compressor is calculated to be 8.1, with the benefit of $38,758,79 being 8.1 times the cost of $4,800.00.

VII. Conclusion

The benefit-cost calculations detailed above, along with all of the other measures offered by each program offered by NHSaves, form the basis for the budget for each such program on a utility-by-utility basis. The utilities make reasoned predictions about how much of each measure they will be able to deploy among their eligible customers, and thereby arrive at program-wide projections of benefits and costs. As already noted, the PUC does not review each specific measure for its cost effectiveness; the regulators' concern is the overall cost-effectiveness of each program. But the utilities, the EM&V Working Group, and the analysts at the Department of Energy most assuredly do care about cost-effectiveness at the level of detail offered here.

Moreover, these experts evaluate cost-effectiveness not just prospectively (i.e., when developing plans for Commission approval) but retrospectively via regular reports filed with the Public Utilities Commission and the Department of Energy. The EM&V Working Group authorizes an ongoing program of impact and process evaluations; as new and more accurate assessments of measure benefits become available, they are incorporated into the TRM and thus the benefit-cost process itself. In this way, the ratepayers of New Hampshire are assured in ongoing fashion that they are receiving a verifiable degree of net benefits via the energy efficiency charges that are included in their monthly bills.