

## Overview

On Thursday, November 12, 2020, **PROTEK** and CoolGreenPower hosted their pilot COOLCon 2020 New York virtual roadshow event.

CoolGreenPower is expanding the distribution of the **COOLNOMIX®** compressor controller into NY State. They are starting the process of recruiting channel partners to market, sell, and install **COOLNOMIX®** and related services including HVAC preventative maintenance into the commercial, industrial, and government sectors.



The pilot COOLCon 2020 New York targeted HVAC contractors, project expeditors, and others involved in the HVAC energy efficiency space across NY State.

The virtual event took place from 11AM – 3PM as a sequential set of four 45-minute conversations thought leaders in the New York's energy efficiency industry. The agenda was:

- Opening Remarks and two keynotes: "HVAC energy efficiency: evolution and opportunity" and "How does NY policy enable HVAC energy efficiency growth"
- HVAC energy efficiency opportunities for small commercial businesses in New York State
- Healthy building and energy efficiency: the critical role of HVAC maintenance
- The role of emerging technologies for HVAC energy efficiency

## Session 1 – Opening Remarks and Keynotes

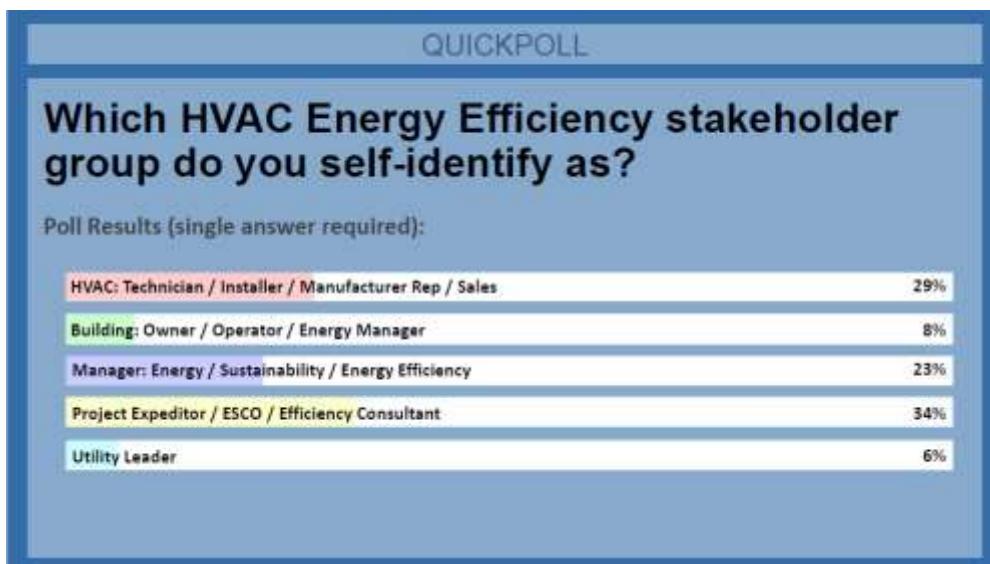


### **Dave Ableman, VP, Operations, Protek Corporation**

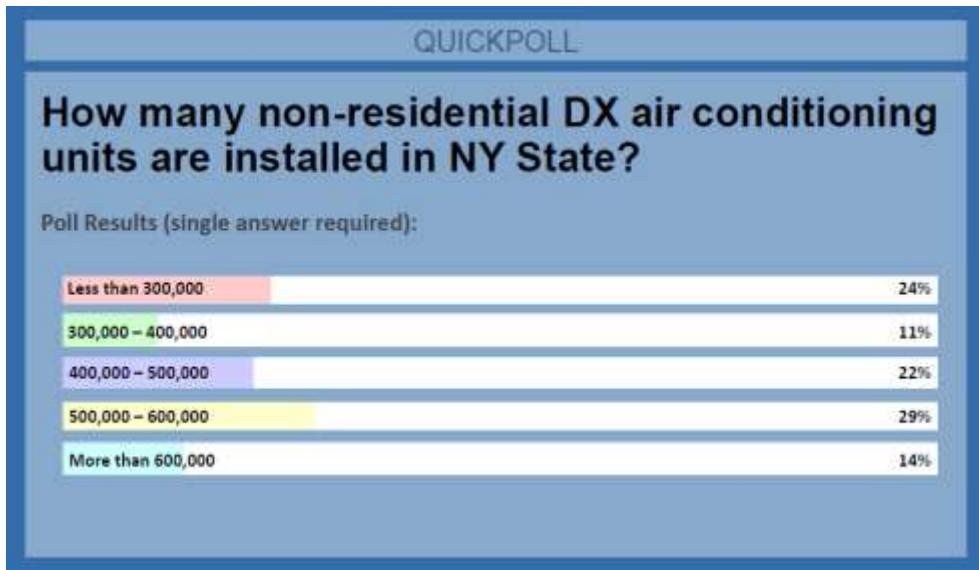
Dave welcomed the audience to Virtual COOLcon New York 2020, the first of a series of planned webinars focused on New York State. Our planned agenda was 4 hours in duration, comprised of 4 sessions. Each session had 30-40 minutes of planned content and 10-15 minutes for Q&A. Each session also included interactive polling questions for audience engagement. There was a short break between each session.

Time	Topics
11-11:50A	Opening Remarks, Keynotes from Dennis Landsberg and Jodi Smits-Anderson
12-12:50P	HVAC Energy Efficiency opportunities for Small Commercial Businesses in New York State. Panel Conversation.
1-1:50P	Healthy Building and Energy Efficiency: The critical role of HVAC Maintenance. Panel Conversation
2-2:50P	The role of Emerging Technologies for HVAC Energy Efficiency: COOLNOMIX will be used to demonstrate the growth potential for the NY State small commercial sector

The first polling question was to get the audience used to using the polling tool and give the audience a sense of the different stakeholders participating.



The second polling question was intended to test the audience knowledge of the number of DX units in New York State.



According to the [NYSERDA Commercial Baseline Study](#) recently published, the number is closer to 700,000 across New York State.

After completing the two polling questions, Dave introduced the first keynotes speaker, [Dr. Dennis Landsberg](#). Dr. Landsberg is the President of [L&S Energy Services](#). Dr. Landsberg shared his insights on how Energy Efficiency in the HVAC industry has evolved and where it is heading in the future for New York State small commercial sector. Dr. Landsberg has over 44 years of experience in energy efficient building technologies, building energy analysis and audits, energy consumption, demand-side management, commissioning and energy conscious building simulation and design. Dr. Landsberg is past chairman of the [ASHRAE](#) Technical Committee TC 7.6, Building Energy Performance. Dr. Landsberg is a voting member of ASHRAE Standards Committees 100 – Energy Efficiency in Existing Buildings, 105 – Measuring and Expressing Building Energy Performance and 211 – Building Energy Audits. He was the lead author of ASHRAE's Energy Efficiency Guides for Existing Buildings and is a member of ASHRAE Standards Committee 228 – Net Zero Buildings. He is also the ASHRAE liaison to ISO 242 Building Energy Management. He is one of 65 inducted into the [AEE Energy Managers Hall of Fame](#).



Exciting things are happening in HVAC Energy Efficiency and it is an exciting time to be an energy consultant in NY State. Policy seems to be driving everything: a drive towards energy efficiency and a drive towards eliminating carbon. Our goal is 50% renewable energy generation by 2030 and a plan to eliminate all fossil fuels in NY State over the next 30 years.

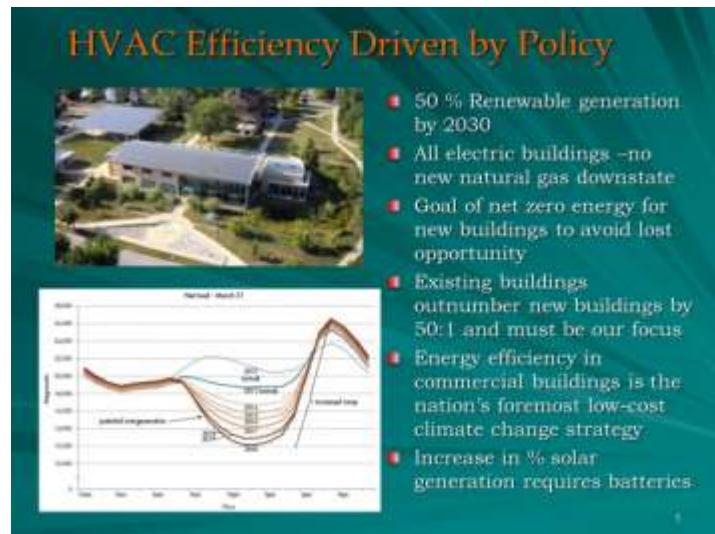
For a new building, the focus should be on Net Zero (i.e., a lost opportunity if you don't). When dealing with existing building, our primary focus for today's webinar, we need to take a different approach. **Existing building are important because**

**there are 50 times more existing buildings than new buildings and more than 50% of the existing stock will be here 35 years from now.** We must achieve net zero with half the buildings we have today.

### **Energy efficiency in commercial buildings is our nation's foremost low-cost climate strategy.**

Right now, the drive is to use solar and wind. We have a fair amount of hydro today but there are some problems with damaging the environment and endangering fish. When you increase solar energy use, you have the "duck curve" (see diagram to the right) as you get more solar (most active Noon – 4PM). This causes a peak of energy use at the end of the day.

#### **To account for this, we must use batteries**



The other problem is with net zero buildings. Most of our buildings are in the cities. **Solutions for cities are not the same as for suburban area.** More of a push for solar farms rather than being on buildings, because net zero building will affect the generation on the site is a building with a low population density and this leads to higher transportation cost. This is a balancing act = transportation and environmental issues.

We are seeing many more sophisticated systems in the environment. My focus today is on the smaller commercial buildings. 80% of the buildings in the US are small buildings. Typically, small buildings are maintained by contractors; architects and engineers do not go near them after they are built. We are seeing VRV and geothermal heat pumps. Many are trying to go to high efficiency, all electric buildings. **Heat recovery is important because we need outside air for a healthy environment and this lowers the cost of re-heating the air.**

More of a focus on zone dampers rather than 1 or 2 thermostats for the entire building. **Zone dampers with individual thermostats can control individual spaces more efficiently.**



**We are also seeing a move towards natural refrigerants, such as Carbon Dioxide, Ammonia, and Propylene.** The reason we are moving towards them so if there is a leak there is no damage to the environment

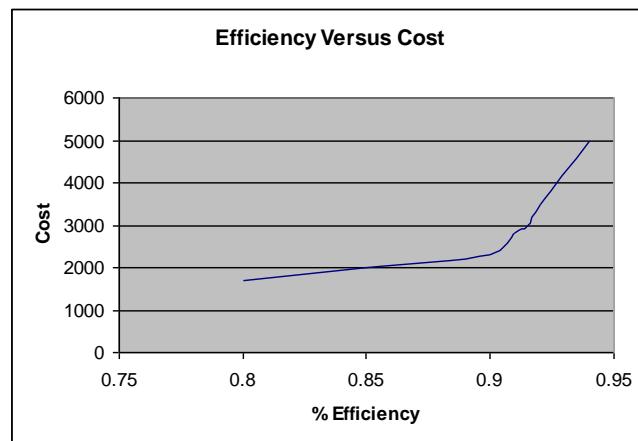
When looking at cutting the energy cost for an existing building, few things to

focus on. **First, there are many low- or no-cost items that result in lowering the cost rather quickly.**

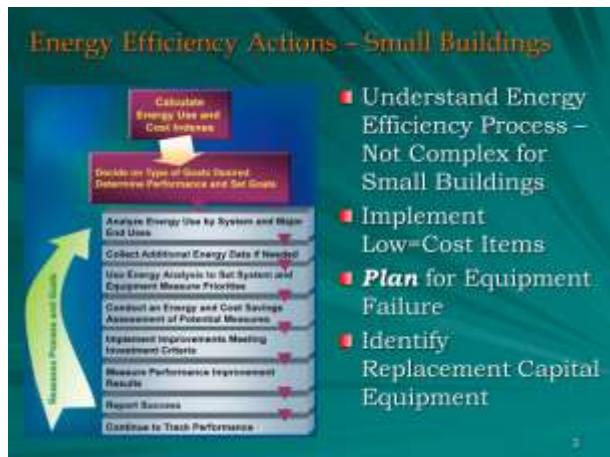
Also, we want to focus on the timing of the replacement of equipment. **If you must replace it anyway, for a little bit more money you can get a more efficient piece of equipment leveraging the opportunity cost of having to replace the piece of equipment.** To take advantage of this opportunity you need a plan. Does not need to be a complicated plan.

For example, you might have a packaged rooftop unit. It will not last more than 20 years, it is already 15 years old, it is going to fail at some point, and you will have to replace it. If you look now and decide what your options are to replace it, you have a plan. If it fails without a plan, you will grab the cheapest available piece of equipment, it is lost opportunity, and you will not save a lot of energy.

One more suggestion. **There is a sweet spot on the payback curve.** Generally, the most energy efficiency equipment has a very long payback, the cheapest equipment is terrible, but **at the knee of the curve, you achieve significant energy savings and is most cost-effective place to be.**



Below is what a full-scale energy plan looks like.



of business until you replace it.

After Dennis' remarks, Dave introduced [Jodi Smits-Anderson](#).

Jodi is the Director of Sustainability Programs for [DASNY](#), an architect, [LEED](#) AP BD+C, AIA member, [NESEA](#) Board Member, wife, mom, hiker, kayaker, knitter, and storyteller. Jodi is working with many state agencies on sustainability implementations in NY



State. Jodi has spoken at conferences in Seattle, Austin, San Diego, Toronto, Boston and throughout NY, is a NY Energy Code trainer and has assisted in research and writing for [Project Drawdown](#), which cites the 100 market-proven ways we already have in our toolkit to reduce CO2 in our atmosphere.



Jodi spoke about the challenge and opportunity that lies ahead for us in NY State. Our BHAG – Big Hairy Audacious Goal – is represented by the NY State climate law which is telling us that we need to reduce GHG by 50% in 2030 and 85% by 2050. This is across all sectors in the state, including buildings, education, transportation, health care, where our food comes, and how we deliver goods. **We need to rethink every system that we created based on fossil fuels and recreate it for the healthy and well-being for the people around us.**

Our status currently is that we are dealing with COVID and situations that have brought equity to the forefront of our awareness. We have seen that the shutdown of the last 10 months has called into high relief all the issues with our economy and how it is structured. Through all of this, we need to pay attention that our climate is changing and be intentional about how we want it to change. We have an opportunity to do the right things with all of these concerns in mind. **We need to invest more thought and awareness into the decisions we make because these are connected issues.** We will make mistakes if we make address our climate concerns without paying attention to equity, our health, or the economy. We need to be smarter and more connected and more genuine about reaching out to other people for their insights to do the right things.

*Recognition and concerns about climate, equity, COVID, economy, and more.  
These are connected issues.*

- OUR STATUS

*What we've done will no longer work for what we need to accomplish.  
Energy efficiency is not enough.*

- OUR REVELATION

circumstances around our built environment and our communities has changed. Our population is higher, the stresses on environmental systems are greater, and we are working in detriment if we do not figure out how to do things differently to achieve the goals we need to achieve. **Energy efficiency is not enough.**

**Energy efficiency with an understanding of how humans behave is an imperative.**

**Energy efficiency while supporting health and well-being and connecting people to nature is an imperative.**

**Energy efficiency while ensuring that access to renewable energy, renewable transportation and walkable communities is available to everyone is an imperative.**

This is a big revelation, our revelation to share, pick apart and figure out.

As a recap, we need innovation, and we need connections. **We need systems that work with nature, work with people, work with buildings.** If there is a consultant or a contractor out there that thinks we are building buildings just to build buildings, they are missing the point.

**Interdependence is strength.** When you are a child, you are dependent on your parents or the people that are raising you. As you emerge into being a teen and a young adult, you staunchly defend your independent. It is only with age and wisdom. No one person, no one building, no one community can do it alone.

*We need systems that:  
work with Nature  
work with People  
work with Buildings*  
**Interdependence is strength.**

- INNOVATION AND CONNECTIONS

Jodi encouraged the audience attending the webinar to **pay attention to broadening thee network you are connected with.** She said that being curious understanding that every single step is a path but one that reveals new answers. That will give us the ability to innovate and not be ashamed we have done poorly because the new information is going to help us do it better.



**Her question to the audience is what will they bring to the work.** She listed a few things on the slide. There has to be much more than the few ideas I am suggesting here. Your perspective will bring light and knowledge to the table. Your curiosity and ability to talk with others is going to help you to do what you have ever done in the past. **Come to the table, bring your ideas, your curiosity, and your willingness to be iterative in the process because there is so much more ahead of us.**

Dave thanked Jodi and recapped several points. He emphasized that when you save money, you should repurpose the dollars you save for ongoing initiatives. Also, the point of increasing education on point of going electric and all that entails

## Q&A

Our first question is for Jodi, from Richard, who asked cooling as a service is most often employed off-shore to address the maintenance issue.

Jodi: I am not familiar with cooling as a service and asked for clarification.

Dennis: There are companies in the US that are doing this now, offering heating or cooling as a service. If you do not want to buy a chiller, you can pay by the month and they will maintain them and everything else.

Jodi: Oh, you mean a lease. I think this is a phenomenal approach. This is like having Solar PV on your roof but owned by the utility. You get a benefit from it but the maintenance is on them. The maintenance has a better chance of being done and that is a really important facet.

Question #2. Due to Covid-19, many are stressing the importance of increasing outdoor air ventilation. While some say that current standards are OK, due to less people in the buildings, what do you see happening to optimize energy and health concerns?

Dennis: In new buildings, we are seeing heat recovery ventilators to bring in more air without spending much money. We are even seeing heat recovery systems in homes that mount in the wall and they give you a turnover of air. COVID-19 has opened our eyes to many different things. I do not think the only solution is to kill virus or bacteria in the air handler. We will see systems in the future to kill the virus or bacteria in the space without harming the people. There are a number of ways of doing it and this will evolve over the next couple of years.

Dennis: Human health and human productivity is extremely important. We hurt ourselves when we only focus on energy. For example, if the windows are high on the wall, you do get more daylighting. If you are building a school, students need to see the horizon, or their eyes do not develop. Having windows only high on the wall is not going to help you. Things are more complicated than they seem. You need an approach where you involve all the designers in coming up with effective solutions and this is a lot harder to do in existing buildings.

Jodi: Regarding ventilation and health, I would recommend looking into a couple of resources. One is a special pilot in the [LEED rating system that informs on COVID-19](#) and air quality in buildings specific to virus transfer. The other is in the [Well Building Standard](#) which is entirely about wellness in the space and they've focused on COVID-19 and strategies in existing buildings and new buildings to address COVID-19 safety.

Jodi: The key point in the question was about the ventilation being adequate because the occupancy is lower. We know as designers that existing buildings often were built at a time when there were no ventilation requirements. Please be careful about making the assumption of any existing building that it is adequate because we have gotten smarter. As we get smarter, we know about the screwups we have made in the past so we should be attentive to those. If there is a way to know the occupancy is low, and the air ventilation is adequate, and ramp up whenever the occupancy ramps up (e.g., CO<sub>2</sub> sensors as a lead), that would be great to do. Ventilation certainly. Filtration certainly. Also, many emerging ultraviolet treatments that would be acceptable as well. All of these will take energy to do and we must use the energy we need to use wisely and not add more waste in our systems.

Question #3. Electrification of small commercial buildings is a growing strategy to reduce Greenhouse Gas Emissions in New York State. What are the implications for HVAC energy efficiency and where are the opportunities?

Jodi: As we move to electric forms of heating and cooling, we just have to be aware and help our occupants understand that if there is a system change and that change has a longer ramp-up and longer dissipation, the feedback loops will be longer. It is not like forced air, which is terribly inefficient, but it is really fast. Once you have used a forced air system, regardless of how that is heated or cooled, you are gonna know that it has changed. As we move to radiant systems, that help with electric heat pumps, they have a longer rise and fall. Our occupants need to be informed about that, so that they can participate and not undermine the system.

Dennis: Exactly. If you have a hot air furnace, you can heat the air to 180 degrees when it is cold out whereas if you have a heat pump, you are heating to 110-115 degrees. Ideally you do a radiant system and only heat conditioning the ventilation air. Then, use the heat recovery systems to reduce the amount of energy to even less. This is harder to do in an existing building, but I can see it being beneficial in some older building. An issue we have is the floor-to-floor height is not adequate for duct work if wanting to use all the heating and cooling using air. For example, the Empire State building. They had to air handlers in closets because not enough room above the ceiling to add ducts. So a combination system is what is going to happen going forward and gonna have to have anticipation because they cannot react instantly. On the other hand, if you have a lot of mass in the building, they will not have to react instantly.

Jodi: Build a building to support energy systems instead of being a problem the energy systems need to fix. That is great

Dave thanked our keynotes speakers Dr. Dennis Landsberg and Jodi-Smits Anderson.

## Session 2 – HVAC Energy Efficiency opportunities for Small Commercial Businesses in New York State



### **Joe Mueller, CEO, CoolGreenPower, US distributor for COOLNOMIX®**

There are multiple programs currently available for the NYS small commercial sector. Joe Mueller from CoolGreenPower moderated a panel of experts who shared their experience with current energy efficiency program adoption in this sector. Before introducing the panel, Joe set the scene by providing an overview of NYS programs and engaging the audience in a series of polling questions.

#### **NYS Utilities offer multiple programs to the small commercial sector**

##### ConEd:

- The Neighborhood Program - free energy assessments and recommendations for lighting and refrigeration improvements for small business customers
- Small Business Equipment Upgrades - free energy audits and incentives to upgrade equipment (HVAC, refrigeration, etc.) for small business customers

##### National Grid:

- Small Business Program - Offers no-cost facility energy assessments with direct install measures and 12 month on-bill financing
- 0% financing approved through Dec 31st
- Prescriptive and Custom Energy Efficiency project incentives for large commercial/industrial businesses
- Small Business Marketplace - E-Commerce Site
- Virtual Assessment tool coming soon!

##### NYSEG:

- Small Business Direct Install - free audits and rebates worth up to 70 percent of the cost of recommended equipment upgrades for small business customers
- Small Savings Rewards - incentives to reduce electricity usage during periods of peak demand for small business customers

whether the audience had taken advantage of any of the New York State utility programs before?

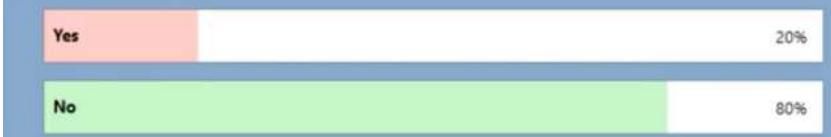
**80% of the audience said No and 20% said Yes.**

Joe started by providing a sample of existing New York State utilities programs including programs from Con Edison, National Grid, and NYSEG. Joe stated that many utilities start with a no-cost audit or technical assistance to help a business understand their opportunities.

Joe asked a polling question as to

#### **Have you taken advantage of a utility program before?**

Poll Results (single answer required):



#### **NYSERDA also offer many programs for the small commercial sector**

- Business Energy Pro
- Clean Heating and Cooling Communities
- Commercial Programs
- Flexible Technical Assistance
- Real-Time Energy Management
- Commercial Tenant Program
- Community Energy Engagement Program
- Contractor Delivery Channel
- Green Jobs Green New York Energy Studies
- Innovative Market Strategies
- Energy Study Aggregation Program
- Small Business and Not-for-Profit Financing

Joe then shared a sample of NYSERDA programs available to the small commercial sector. Flexible Technical Assistance or Green Jobs Green NY Energy studies are a good starting point.

Joe asked a second polling question was whether the audience had taken advantage of any of the NYSERDA programs before?

**60% of the audience said No and 40% said Yes.**



Joe posed a third polling question to the audience asking them about the largest barrier holding them back from taking advantage of either a NYS utility or NYSERDA program.



**50% of the audience said, "Lack of Awareness", 33% indicated "Time or Money Constraints", and the remaining 17% said "Trust".**

Joe said that the upcoming panelists will be discussing these barriers and how they recommend these barriers can be overcome.

Joe then spoke about NYSERDA's recently published [Commercial Statewide Baseline study](#), where they included HVAC energy efficiency trends in NY State.

VRF, HVAC controls, and recommending higher efficiency appliances / technology were highlighted, along with penetration levels for HVAC controls.

### Energy Efficiency Technology Trends NY State

	Table 3.1 Penetration of HVAC Controls		
	HVAC Equipment	Single Zone Cooling	Variable Air Volume
Manual On/Off	10%	95%	8%
Thermostatic	39%	26%	36%
Programmable Thermostat	9.2%	41%	48%
Smart/Wi-Fi Thermostat	5%	4%	4%
Energy Management System (EMS)	3%	2%	2%
Other	2%	1%	1%

Just prior to introducing the panel, Joe asked a fourth polling question to the audience, asking them about the expected growth rate of HVAC jobs (pre-Covid)?



**The polling answers had an equal distribution of answers between 6-15% growth of HVAC jobs.** Joe commented that pre-Covid research indicated a 15% projected growth rate, and post-Covid, the growth rate would be even higher. Joe also commented that there are not enough HVAC trained resources

to meet the demand today, let alone in the future.

Joe introduced the three panelists:

- [Mayra Lujan, NYSERDA](#), Outreach Manager
- [Dan Keating, National Grid](#), Manager, Technical Sales and Support, NY
- [Ron Slosberg, L&S Energy](#), Vice President



Joe posed the first question to the panel: *What programs are successful for the small commercial sector, and why?*

**Mayra:** Mayra told the audience that she had been involved in NYSERDA PROGRAMS outreach for the past 5 years. She highlighted the following programs:

- **Direct Install.** A very popular program offered by both NYSERDA and multiple NYS utilities. Include an energy audit and the cost of all the upgrades, taking into account the incentives from the utilities. Extremely successful with the volume of upgrades they do. Great operating model where they make it easy for vendors and customer to participate. In the 5 borough NYC this program **employs a couple of hundred people.**
- **Statewide Clean Heat Pump program.** \$450M through 2025. Mostly going to the utility company but very interesting for small commercial sector to use
- **Flexible Technical Assistance.** Helps to prove the hypothesis on what could help customer and vendors to drive decisions with the right information at the right time. ASHRAE has recently partnered with Flexible Technical Assistance on Covid-19 measures.
- **Real-time Energy Management program.** Hits the issue of data availability. 800 sites across NY State. Landlords to collect data and make decisions on operations. Provide

- upfront cost for installing equipment, hardware and software. Ongoing commissioning and training
- [Commercial Tenant Program](#). Incentives for the energy experts that we trust to advise tenants and landlords on decision making, with incentives for the advising – benchmarks, design, operations, maintenance plans, and more. Widely successful, expanded to all types of tenants – small, medium, and large. Still funding available

**Mayra: Each of these programs has millions of dollars of funding still available.**  
 Perception in the market is that funding is not available.

**Dan:** Great transition from NYSERDA programs to utilities program and helping with lack of awareness and trust.

- [Small Business Service Program](#), just with electric measures and look to add gas in 2021. Covers 60% of the project cost, and through 2020 and covering 85% of the project cost. Avg 18 cents per kwh saved, and now 25 per kwh saved. 90% is lighting and the next is refrigeration. Not enough HVAC. Also, a 10% lumpsum discount if you pay upfront, or put on bill over 12 months
- [Ecommerce Website](#) to buy wi-fi thermostats, etc.
- Mid-Stream program, just lighting but looking to add unitary HVAC equipment. You buy at the distributor and discount taken off right there when you buy it
- Custom program. Have 0% financing for 24 months, available through end of year

**Ron: The small business sector is a unique sector often overlooked by many energy efficiency consultants and equipment vendors.** Financial opportunity for small business is small. They are owned and operated by the business person focused on their core business (e.g, office) and do not have an energy manager or background in energy technologies, and not aware so do not know about the programs. Unique, overlooked, and they also behave differently than large commercial & industrial customers.

Ron: Programs that are most successful are objective, non-biased information and help them towards implementation. The [NYSERDA Green Jobs - Green NY program](#) through end of the year is offered at no cost to the business. Individuals are not selling equipment or services. Information includes an assessment of energy efficiency opportunities, estimates of implementation cost, payback, energy saving, and then taking the next steps and moving them to energy efficiency programs that are offered to help them implement. **Those that most successful start by providing well rounded unbiased information to small business and move them to successful handoff to an implementation contractor.**

Joe posed the second question to the panel: *How does HVAC Energy Efficiency create jobs?*

**Ron:** The business-as-usual environment creates job by freeing up capital. Expand space, staff. **Now with Covid-19, energy efficiency is more critical because businesses operating on negative margins, sales down, business operations down, critical to free up capital** but how do you get to implementation energy efficiency in these facilities

**Dan:** During Covid-19, controls contractors tweaking controls. Small businesses potentially closing. Tough to figure out the creation of jobs. National Grid, NY State, end users have their

goals to promote energy efficiency and we are hiring to support these goals. Electrifying heat. In the boiler business, looking forward on how to electrify the boiler room. **Contractors on shifting how they retain and new capabilities that are needed. Pushing hard on the HVAC side on the creation of jobs.**

Mayra: NYSERDA to support CLCPA by 85% by 2050. The [Climate Leadership and Community Protection](#) Act (CLCPA), enacted in July 2019, establishes ambitious goals to reduce GHG emissions 40 percent by 2030 and 85 percent by 2050 from 1990 levels. We also have the NYSERDA post-Covid new sources of funding and many new programs getting pumped out to push on energy efficiency. This is a period of great opportunity for energy efficiency on how we design and operate spaces. **We are seeing increasing demand and getting more funding from NY state.** Reach out to customers and show them the path forward. **The best thing we can do is to "Train the trainers' that know their clients and how to reach them.** NYSERDA industry 2019 report "Nearly 159,000 were working in Clean industry" more than biotech and agriculture together". Over 80% trying to hire, have difficult hiring because of skills in the workforce. Initiatives to train 71,000 workers, announced in 2020, Career pathway workshops. Prioritizing the states most underserved populations. Another NYSERDA focus shift from very large commercial buildings who know their incentives and focus our funds resources and staff to those communities that need it the most.

Joe posed the third question to the panel: *What holds back energy efficiency and what can we do differently?*

Dan: Nothing holds us back on the gas side of the business, folks are competing with the other measures electric that are non-HVAC like Lighting. 80% of the projects we incentive are lighting. Great payback and incentives but holds back HVAC. Then, we also **struggle with benefit cost analysis.** We must abide by guidelines to get an expensive piece of equipment to pass the benefit cost analysis.

Dan: What can be done differently to respond to New York State Public Services Commission and hope we can have some flexibility in the future with the BCA. Can do it together if we **bundle HVAC with Lighting.** More of a policy thing to get the HVAC measures into the market. Also, **a shift from annual savings to lifetime savings of a measure, which is perfect for HVAC** that have a longer lifespan than other measures we incentive. Midstream program with lighting, and if we can **get a midstream program with HVAC moving.** We are seeing in stock the baseline piece of equipment, buying the least efficient that is in stock. If we can incentive the more efficient based of equipment, and then they stock that item, and buy it down with the distributor.

Mayra: How do we present the benefits? **For tenant, instead of showing annual savings, look at the lease length and how much they will save.** Some leases can be 20 years long. Much bigger scale timelines. Looking at how to present the right information at the right time. Really compares the different options. We also look at incremental cost and savings from the baseline. Just meet the energy code but go a bit more what is the cost and what additional benefit. **A much larger rate of implementation in the programs that are using this kind of information presentation methodology.** Another thing holding us back is the tenant landlord split incentive. Who is going to pay for it and who benefits?

**Mayra:** Thinking about how can we change the leasing terms or start the conversation between landlord and tenants to talk about sharing the benefits. Local law 97 will offer fines based upon carbon emissions, starting to see a lot more dialogue. Who will pay for what? How do I meter / measure report that? Information flow holding us back, but we see more metering coming and more dialogue. Changing environment dialogue about ventilation rates for Covid-10 and this creates opportunity to look at data and talk about energy efficiency.

**Ron:** Awareness. **information on what do I do and then the financial hurdle. Where do they get the money to do the implementation? Getting the money and make it smooth and answer. Business owners are used to thinking about simple payback and changing the conversation to life savings.** Illustrate not just payback but keeps on giving. Information and finances.

**Joe:** Audience question. If dollars for Local Law 97 are not available, will NYSERDA consider offering dollars for projects starting sooner?

**Mayra:** Offering through all the program we mentioned and a link with lease to other programs. Your benchmarking and a growth plan of what you need to do. Certain kinds of improvements will be paid for. Any of these to help make a decision or understand where you are, NYSERDA offering an incentive.

**Dan:** We look at NY State code and incentivize that energy conservation measure

**Joe:** Thank you to our three panelists: Mayra, Dan, and Ron. This was a great opportunity to talk about all the NYSERDA and utility programs available for the small commercial sector.

## Session 3 – Healthy Buildings and Energy Efficiency: The critical role of HVAC Maintenance



**Bob Krell, [Healthy Indoors Magazine](#), Publisher, IAQ Technologies, President, [IAQschool.online](#), Training Director**

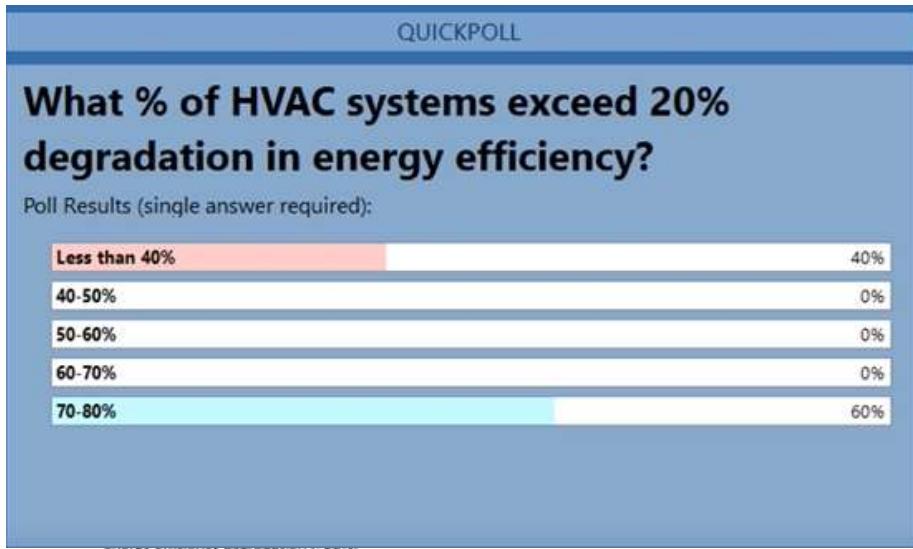
Bob welcomed the virtual audience to Session 3. *What is the greenest kw of energy that you can have?* Really, it is the preface for this entire section.

### The greenest kw is the one we do not need to generate.

First, and foremost if you are trying to achieve energy efficiency, you need to start with a system that is operating as it should be.

The crux of this is preventative maintenance and having a PM type program in place vs. reacting when your hardware breaks is much more effective. That is the way to save money and that is the bottom line. Really do need to address the efficiency of your equipment first and foremost with preventative maintenance. Keeping things clean. Proper filter changes. Keeping coils clean. On and on. We'll be talking about that today.

Polling Question #1 – What % of HVAC systems exceed 20% degradation in energy efficiency?  
What do you think?



- Wood PLC results >200 federal and commercial sites nationwide: 73% of units tested had an average reduced efficiency of 26% due to easily correctable issues
- In some cases, systems were never installed correctly and have never operated optimally, resulting in lower efficiency than implied by the nameplate rating
- In many cases, the performance has degraded over time, either because of faults or improper service, causing the equipment to malfunction or to perform poorly

### Opening Remarks

Why is HVAC Preventative Maintenance (PM) better than Traditional (Reactionary) Maintenance?

- They BOTH ensure safety and comfort; however PM can save you money:
- PM is the MOST important HVAC energy efficiency measure (EEMs)
- PM reduces risks, employee complaints, emergency maintenance and costly interruptions
- PM extends equipment life
- PM enables service teams to anticipate workloads
- PM prevents crisis management – by both owners and service teams

PM is essential to achieve any value from add-on EEMs. If you don't deploy basic PM, you will NOT achieve the manufacturer's energy efficiency specifications. Example:

- Although outside air-side economizers can provide improved indoor air quality and energy savings, many fail within two years. In fact, research indicates that over 75% in the field have failed.
- Problem: If they fail while open, they can draw hot outside air, forcing cooling equipment to work harder than necessary, consuming significantly more energy.

Wow. 40% of our audience, nearly half, thought less than 40%; that is interesting.

A good portion also said 70-80%.

Research shows that the performance of existing HVAC systems is far from optimal.

Multiple studies have shown that 80% of systems have problems.

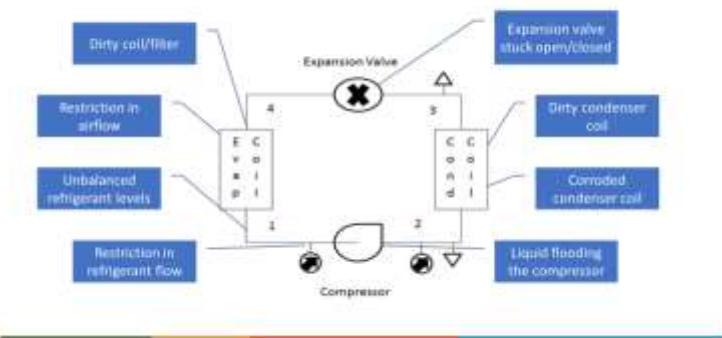
3 different DOD studies showed >80% of the units had significant issues.

This chart shows multiple points where you can have energy degradation. From dirty coils, dirty filters to restrictions in your air flow, both on the evaporator coil and on the condenser coil. Any number of other problems.

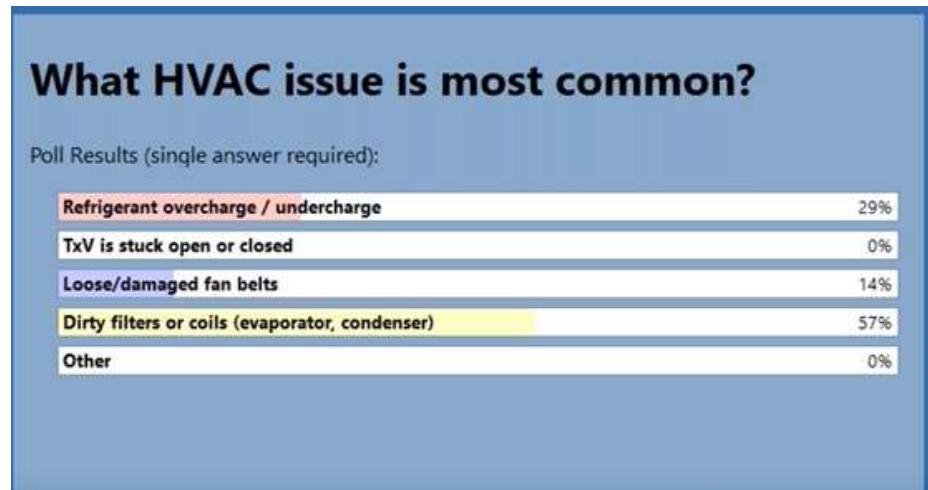
Unbalanced refrigerant. All these things, cumulatively, this means that our building stock's HVAC equipment just not working well.

Polling question #2: What HVAC Issue is most

## Efficiency Degradation



common?



57% said Dirty Filters or Coils, 29% Refrigerant overcharge / undercharge, and the remaining 14% Loose / Damaged Fan Belts.

Caring for Repairs in contrast to contractors' recommendation for regular maintenance

- Two-thirds (66%) of New York businesses have a reactive approach to equipment maintenance, i.e., they service or repair equipment when it breaks.
- About a third of businesses have either a preventative (staying ahead of potential issues before they become more significant) or scheduled (following all manufacturer recommendations) maintenance approach.
- Less than one percent of customers have multiple maintenance approaches.



The data we have from the [NYSERDA Commercial baseline Study](#)

Study is interesting. Businesses tend to wait for their systems to break down before repairing them. Two thirds of NY businesses do have a reactive approach to maintenance currently. That is kind of scary. Just one of those things we tend to put in the back of our mind, as far as

doing regular proactive maintenance.

After his introduction, Bob introduced the panelists:

- [Mark Ditch](#), Sr. Energy Engineer, [National Grid Energy Services](#)
- [Richard Fennelly](#), COO, [CoilPod LLC](#)

- [Carsten Steenberg](#), CEO of [PowerWise Systems](#)



Bob: First question. *How do we get small commercial stakeholders to understand the high cost of doing nothing?* This is a good question. I have been in the AC hygiene industry as an IAQ consultant for 34 years now. With few exceptions, from a HVAC hygiene perspective, it still seems from a HVAC perspective we only get called out when there is a catastrophic problem. How do we get that changed? It seems we are still a reactive industry, how do we become proactive?

Mark: **The best thing we can do is to share statistics.** We have done a good job just in this discussion alone. 20% efficiency impact with over 80% of the systems that are out there. Statistics are one thing, but people do not understand it that unless you put into financial terms. People are paying attention to their bottom line. If they are not, they are probably not in business post COVID. **Use examples of something that they can relate to.**

Mark: When I am out there, I would ask somebody that was obviously not maintaining their system "do you change the oil in your car". They can generally understand where you are going with that. **Either maintain it now or replace it later. Generally, if you show them the financial variance of that, they are gonna listen.**

Bob: One of the problems with indoor air quality and the health of the buildings, that's harder to quantify. Energy saving, we can numerically extract those. We can do analysis over the course of the year, multiple seasons and see what we've got. But **to say we improve employee productivity, that is harder to quantify** and harder to sell that. How do we get less reactive?

Carsten: I agree with Mark. We really need to focus on the dollars and cents. Provide examples of case stories, of a business similar sized of them that they can relate to and this made a difference. Really, it is the dollar that drives it, they are very focused on the savings and cannot take the replacement cost. **Show them the path and find case stories that are similar to their business.**

Richard: I agree. **I think it is not only the industry, but everybody also needs a mindset change. The owners, the industry, the energy efficiency experts, the utilities, everybody needs to move maintenance to the forefront.** The [Carbon Trust](#) in 2018 estimated that with better maintenance of AC and refrigeration globally, we could reduce global emissions at the power plant from 2.6 Gt/yr indirect emissions to 2.1 Gt/yr --- a 19.2% cut – 0.5 Gt/yr CO<sub>2</sub>eq. If you extrapolate that down to NYC, that's 8.5 mt/yr CO<sub>2</sub>eq. That is

20% of NYC's stationary energy emissions due to poorly maintained AC and refrigeration. You get that from doing a GDP extrapolation down from the Carbon Trust global study and nobody is talking about it!

Bob: Why are people not talking about it?

Richard: It is the unsexy thing to talk about. **Folks do not like to do maintenance – its labor.**

Richard: One HVACR person told me "Richard, my clients who are the owners of refrigeration want automatic solutions. Maintenance is not automatic. You need to go in and clean the units 1-4 times a year. A pizza parlor with a refrigeration unit near where they pound out the dough with flour needs to be cleaned every week. It's a problem."

Bob: It makes sense. It is important. As the studies have shown, this is a major impact on our carbon footprint. It's a major impact on our efficiency. We can talk all we want about new technologies to improve efficiencies, but first and foremost, **we have to take care of our existing stock and actually properly servicing it. That is your starting point.**

Mark: **Part of the problem is out of sight out of mind. A good thing to do is providing some means to make it more visual.** Whether using your Building Automation System to trend the energy consumption, so they can go back and see what it was last year this time, even if just your demand. Or whether its putting on that alarm indicator when the static pressure across your filter gets to the point where you are not moving enough air to effectively heat or cool the space, or whatever the issue is.

Bob: The other part of the aspect is organizations. A client that is spending literally tens or hundreds of thousands of dollars on doing proactive system cleaning, but then there **regular PM work that should be done on a regular interval (quarterly, annually), they are not doing it.** But they spend big ticket on the actual big catastrophic cleaning of the impacted coils because they have not changed their filters for 4 years. It makes no sense to me. So, **we do need a paradigm shift.**

Bob: Let's go to another question. *How do ensure Preventative Maintenance is the starting point for ANY energy efficiency project?* How do we as an industry get that to be right on the forefront?

Carsten: To expand what Mark said, I believe in BMS and any kind of monitoring system. There is a famous quote "**You cannot manage what you do not measure**". It's a business quote but it applies to what we are doing here. Yes, we can do a lot by monitoring energy and making sure there are alerts associated with those thresholds. But I also feel, talking about the dollar again, that sometimes the business owner or the maintenance person, **if there is somebody else in charge of the checkbook (CFO), make sure they are involved, they have access to the monitoring, and they can see where we are losing money.** We have had success to make sure there is a financial view on those dashboards.

Bob. That is a key point Carsten. **Often, there is a major disconnect between facilities and finance people on a lot of topics. Finance people are not privy to understand**

**how their facilities work and what those dollars amount to.** They are just counting the beans, making decisions based on numerical values vs really understanding the crux of that.

Richard: **Getting the sustainability folks in corporations involved and highlight the cooling sector as one that they are probably forgetting about might be a strategy.**

The G7 environment ministers met in 2019, and in the section of their communique after they ended their meeting, the section that dealt with energy efficiency, they mentioned only one sector, the cooling sector. But they mentioned it in the context of HFC refrigerant replacement, which is important. **They did not mention maintenance, which is the other thing you need to do.** We look at HFC refrigerant replacement as getting a handle on the emissions problems from refrigerant leakage. The outside the coil solution is to get the junk off the coils so that the coils can throw off the heat. You have to do both things.

Richard: **The maintenance aspect has gotten no traction that we have seen.** We have been after this since 2017 banging on doors.

Richard: One major NY utility approached me about 18 months ago. I shared everything I have on the topic and they never conversed with us. Mark, it was not National Grid.

Bob: That's good. It's true. Not the sexy thing to do. It's not the exciting thing. Its not the new foyer in your corporate headquarters. It is not things that people look at and is demonstrable and say this is so wonderful, look what we have done. **Nobody sees what is happening inside the mechanical equipment**

Mark: If they paid more attention to their Ps and Qs, the money they could save could help pay for that new foyer (or help pay for it). **The most important thing to do to keep at the forefront is to show them by example.**

Mark: I had to do this one time with a school district. They had 38 refrigeration units in the district: their coolers (walk-ins or reach-in) in their cafeterias. They were excited about the opportunity / financial assistance to replace those coolers. I was doing an audit for them and the facility supervisor came into the cafeteria. I pulled the cover off the bottom of the cooler, it looked like the lint in your dryer. It looked like it had a jacket on it. I have a person I am gonna come and show you what the difference is. I put a power meter on it and recorded it for a week. Then one of my employees came and cleaned it, straightened it out, and blew them out. Then we recorded it for another week. That saved between 10-12% across the district per coil for that unit. The program he was excited about (cooler replacement) was a 15% savings based upon the baseline. Well, that is great but that;s going to be in the same condition next year if you do not maintain it. I do not care if it is a new cooler or not; it may be a bit more efficient but **if you do not maintain it, will be just as bad as this.** They started a new program across the district and as far as I know it is ongoing

Richard: Experts say quarterly / 4 times a year, but it varies depends upon the space.

Bob: Depends upon the conditions of the space. What type of debris, what is flying around in the air. In a clean mechanical space, not as often. Depends upon the filtration also, and if they are properly maintained. the coils do not gets as dirty as quickly.

Mark: **Coils are important but there are a lot of other things they should be looking at.** One of the biggest issues we see come up in the industry is steam trap maintenance as far as the ROI. If they were able to maintain their water chemistry and if they were to do a survey. I ask when they did a survey of your steam traps the last time and can I see it. If they do not know where it is in their file, it's been too long. They must investigate their steam traps again because if they have a return if you need to rebuild them of less than a year. There are a lot of other places they need to be looking.

Richard: I have a question for Carsten. *To what extent are people doing monitoring on plug loads cooling equipment contrasted with centralized systems.*

Carsten: Plug load is not that common and not as easy to monitor because the equipment is sometimes more expensive and not that integrated when you do things at an electrical panel level. **We do believe that the majority of loads do not come from plugs but things that are wired directly to the panel.**

Richard: One of our areas of interest to all of the self-contained refrigeration units, display cabinets, reach-in refrigerators and freezers. Each of those, they are connected into a plug somewhere. If you look at a food service establishment running 8 units, (e.g., deli, convenient store), we estimate the loss is about 10,000 kwh a year by not doing coil cleaning.

Carsten: It varies from building to building in terms of the electric panels and how well the circuit breakers are aligned to the outlets. Normally we can almost with trial and error, here is a lot of load, we can use the breakers, and help people that way. If there are a lot of different outlets going to the same breaker, it is expensive to do that.

Richard: The last 4 years I have been running a daily Google Alerts using the search term "coil cleaning". I see every day content for AC but never see refrigeration, just an observation. **I think the AC silo has a certain amount of PM taking place. Refrigeration is the hidden gem; nobody looks at it.** I am highlighting commercial refrigeration in food service and health care.

Richard: One time, I asked a question to a maintenance manager of a major hospital complexes in NY State. How many refrigeration units do you have running in your facility? Multiple buildings. He said 7,000. How often do you do refrigeration coil cleaning? **We don't get involved in that; we leave it up to the individual clinics and departments to do it.**

Bob: **Therefore, it does not get done.** Ironically, terminal filters in a big laboratory complex. We are not dealing with the terminal filters; it is the client's responsibility. We are looking at the filters and they are impacted. They are so black. Obviously, they are not doing that. Their responsibility. **There is a flaw in the system; should be the end client.**

Richard: I want to get back to the numbers from before. We did two calculations, one from global study that says 25% of NYC stationary energy emissions due to dirty AC and refrigeration (commercial and residential). We did another one did where we took individual data with same assumptions and came in at 20%. Anywhere from 7M to 8.5 mT of stationary energy emissions in NYC (burning of fossil fuels) due to cooling not maintained. 25% or 20%. The higher number

is from the global study, the lower number from our local field survey and assumptions. We presented to NYC 18 months ago.

Mark: **The problem that they were putting it back off on to the individual clinics. They are probably not responsible for their utility cost.** Same at school district's; they are notorious each individual school not responsible for their utility cost. Need to push that back more at a local level.

Richard: The individual clinics are caring for patients; they do not have time for maintenance.

Bob: Another question. *With NY State incentive with the [Climate Act](#), to try to reach aggressive goals in the next 5, 10, 30 years, how does this aspect play into that?* I hear a lot in residences to get them away from gas appliances to all electric, **not hearing a lot about maintenance.**

Mark: Unfortunately, most of the sectors that make up the cost, people envision that there is a new technology just around the corner. So why try to fix or repair this when it is easier and more effective to replace it. We need to get rid of that mindset. It may be 5 years until that unit's measured life has been exceeded. 5 years you should be maintaining that and show them the financial impact on that. Not just a simple payback. **People are always looking at the simple payback. They do not understand the life-cycle cost of design.**

Bob: We do not look at life cycle costs at all in the US. We have never been good at that.

Mark: That requires a higher order of economics.

Richard: Mark mentioned the auto industry before, I would love to find out the psychological tricks they use to get us to take our cars in for maintenance. **Maybe you must love your HVAC system and your refrigerator as much as your car.**

Bob: A lot of the initial service is driven by warranty. **You do not get the warranty until you take to it in. That scares people. Hopefully, I am going to do my maintenance. Then they get you in the habit of doing it.**

Bob: Another problem I see Is that **facilities in general are scaling down their O&M capabilities. Less people on staff, trying to do more with less people, still saying they are doing their PM, but they are not. They are not allocating their resources.** Does this require a new paradigm shift?

Richard: We talked with a pharmacy chain running close to 10,000 stores in the US, with 8 coolers per store. They told me two things. **(1) We do not have the manpower to do it (2) we need utility incentives. Utilities by and large do not incentive maintenance, by and large.** This is a company who could afford to buy an insurance company a few years ago. You can figure out who they are. 75,000 refrigeration units in their stores, probably wasting \$12M a year. They are suffering breakage. Another store has suffered 4 coolers going down in a single year; they throw out \$25K of ice cream because they do not maintain the units. **They just run them with dirty coils.**

Bob: That leads to another point. **It is stopping a pre-mature failure of equipment. That's huge.**

Richard: **How about a cancer center that has a \$1m cancer meds in refrigeration in their facility and they are not doing coil cleaning.**

Richard: Covid-19. There is a vaccine developed that needs 70 degrees below refrigeration. **The cold chain is critical for getting the COVID vaccine out there, yet you are running refrigeration where nobody is paying attention to maintenance.** I could go on and on.

Carsten: I love all the things Richard is saying and **scary that more people are not aware.** This is the industry I come in where we can alert about these things, warn, and see the trends. We have done a lot in the food industry where we have alerts if temperature rises in walk-in coolers.

Richard: Two thoughts we used. **We look upon AC and Refrigeration as inefficient vacuums that morph into open electric spigots when they come online. The problem is you need to herd the cats so they do what they should be doing.**

Bob: That is a challenge. Next question. *How do we increase buyers trust of HVAC preventative maintenance services?* It is a tough industry to patrol because it is sight unseen. Even the facilities people do not see what's in their mechanical duct systems so they pay a company to do service work, and what do they actually do? Is somebody going to follow them around and see what they do? They don't. I doubt people are going to into the coolers to check the compressors while service work is being done.

Richard: They need to trust their owner's manual if they don't.

Mark: I was going to recommend they **use the baseline and trend with the energy management system.**

Carsten: I would take it a little bit further. **Have a very simple asset management system,** rate different conditions of your RTUs, so you have an idea, a score of 60, this is critical. There is a very simple checklist that is easy to do. There needs to be a bit of asset management to point the PMs necessary.

Bob: **Without metrics, we don't have data. How do we know anything?**

Bob: **It is critically important to use some form of monitoring, some documentation, some recording what is being done, and what is happening with this equipment.** We do not do a good job of that.

Carsten: We did an asset management system and rolled out to a big fast-food chain, and they changed 150 RTUs within half a year based upon that system because they knew how expensive it was when it failed. Easy when you have 1 CFO who monitoring 300 locations.

Bob: Much easier sell when they can see a substantial pay back line. A standalone smaller facility, especially the one-off facilities that have refrigeration and cooling equipment, they are not going to have that kind of oversight or vision and the numbers are not that big. Not that big scale. If you have 300 facilities and you make just a 1% change, that is still millions of dollars.

Carsten: Plus you can compare to each other because if it is a fast food chain, their layout is similar. They can see ones that are done and ones that are not done.

Bob: I can see how that might be easier to get that information disseminated into large organizations. How do we deal with the stand-alone / one offs? How about small organizations?

Richard: That is a problem.

Richard: Another issue I would like to highlight. **Folks don't believe data unless generated in their own organization, in their own state.** The study I referred to that the Carbon Trust did was based upon a literature survey of everything they could find. Multiple studies found savings between 15-25% and they picked 20% on average. When I bring that study to somebody, one of my targets, you say "you still have to prove it in my organization". In other words, Fido, jump through hoops and then I will listen to you. **Folks are not willing to believe studies done elsewhere.**

Bob: How do we overcome that then?

Richard: I don't know. **More people need to be talking about the issue.**

Carsten: There is also a misunderstanding; everybody that installed monitoring and BKS talked about the ROI of the system. **They normally only think about saving in energy cost, not the equipment to be place**, and therefore, they say they cannot afford it. There is a lot of education required here but often you do not have the time.

Bob: **Just selling on energy is tough, unless there is big scale.**

Mark: **That provides a good opportunity for the some of the ESCOs or performance contractors to include the service and maintenance in their contract.** As long as the owner does not see the increase in total cost, because the savings are guaranteed and paying for their service. There is a lot of mistrust over the performance contracting industry as a whole because everybody remembers ENRON. **That is an opportunity for them to regain the trust by saying we are going to guarantee it, your guarantee pays out by your savings in utilities costs are paying for my services.** A hurdle that can be overcome with good companies that are doing that service.

Richard: Offshore, there is a move movement supply the equipment to the facility by a third-party service provider who owns the equipment. They would have an interest in doing the maintenance. It is happening in several developing countries, not sure about traction here in the US.

Richard: For example, there is a group in Switzerland ([BASE](#)) working with the UN. Also, there is a Bill Gates sponsored organization [Kigali Cooling Efficiency Center](#). The mandate is that they cannot spend bucks in the US but they can do it in the developing world and develop some of these business models with the hopes to align maintenance with the selling of cooling units to an organization or person that needs them. Could be an organization. They have banks involved to front the money. Something like an ESCO install it, own it, and charges cooling units to customers needing the cooling. **That organization has an interest in maintaining the equipment, because of it's maintained, they make more money.**

Dr. Landsberg: There are companies that offer cooling and heating as a service in the US.

Bob: **There seems to be a big disconnect between those tasked with operating our built environments and preventative maintenance. An eversion to that.** This is the overall biggest hurdle. How do we start? From the top down? Carsten mentioned convince / get the CFOs online and that is a great concept. *Is there another way to target this, with more understanding of other paybacks, not just the direct energy payback?*

Mark: Question from Dave Ableman, I mentioned the cooler school district example. What is the actual cost of the PM for that vs. cost of the energy not to do it? That comes down to are you doing it in house or subbing it out. Not to say that that maintenance is the same throughout, generally the time required for somebody already onsite to clean the coil is 10-15 minutes vs. if you hire it out to a company, that really depends on how many units they have to do in a given day and their travel time. **If you were to break it down, 20% of the cost of the savings to do the maintenance.** That goes by my experience with that particular district because I already had that employee and I said go do it and get it done. 25% of the cost to do that.

Bob: **Not factoring in the saving the life of the equipment. That is a potential huge additional saving.**

Richard: Cintas has a business to do PTAC units in hospitality. I saw an invoice that somebody leaked on the Internet; showed \$40 per unit, and also some setup costs, maybe somewhat higher. They would go into a hotel (150 rooms), do 150 PTAC units, coil clean, put them back in, \$40-50 unit charge per unit it looked like. From a few years ago. We sell a cleaning aid, a dust hood. I am leaning to pushing customers to do it themselves. Simple enough for a person to do with reasonable skill to do; a wet dry vac with two hoses. The problem is that there is no service industry for refrigeration.

Bob: Blasting. You just put the hood. Not Wet Cleaning. With small equipment, wet cleaning trying to control water is almost impossible.

Richard: This is for refrigeration units in indoor units where slip and fall is an issue with solvents.

Bob: Last night, we dealt with 29 reheat coils in line on this system. A research lab, .5M sq ft 16 miles of duct work. It's insane, the scale of it, building longer than and wider than a football field with mechanical equipment. A lot of reheat coils, and supplemental coiling coils, 50-year-old hardware. Cannot wet clean it; have to dry blast it. Using HEPA, big capture equipment. **Its challenging; equipment never designed to be easily serviced. Coils are not in an easy place for a technician to service them.**

Richard: Design issue. Nobody paid attention to the fact that. In fact, EnergyStar when they run life cycle cost on refrigeration, they assume a level electric draw. They do not realize that the electric draw runs

Bob: What does 10% savings means

Mark: 10% savings. I would have to go back to my study. Most of them were reach-in coolers. It was around 2,000 kWh per year. That would be about 20 hours in savings. When you have a lot of coolers they add up.

Richard: We saw a survey from California. Reach-in coolers, The savings ranged from 2K-6K. The energy savings averaged 47%, very tightly packed between 40-50%. If you are not cleaning your units, you may see them in that range.

Bob: A quick final thought from each of you.

Carsten: I think **we must educate**. I like Richard's way that we need to **ride on the wave about people being more concerned about the environment**. I think that's a trend. Also, younger people. **Any kind of incentives we can throw at it**. This is been really helpful for me to hear from you guys.

Mark: A throw out to Carsten. **The best thing people can do is trend and watch what they are doing**. Not all small business has an Energy Management System but there are other options. Like for plug loads, you can put in a kilowatt hour meter. Trend, trend, trend. If you do not know where you are spending it, you do not know how to save.

Richard: **You must move maintenance forward. It needs to be talked about by everybody that's a stakeholder.**

Bob: I really want to thank Carsten, Richard, and Mark. Thank you to for the great panel. [Healthy Indoors](#) is a free online monthly publication. You should be looking at it with a lot of great information.

#### Session 4 – The role of Emerging Technologies for HVAC Energy Efficiency



**[Joe Mueller, CEO, CoolGreenPower, US distributor for COOLNOMIX®](#)**

Joe welcomed the virtual audience to Session 4. Blah Blah Blah

Utilities are interested in commercially available technologies that can be offered through customer programs as measures, often with an incentive. Collaborations on emerging technologies projects helps achieve New York State ambitious energy and GHG emissions goals. Emerging technologies are another opportunity for job creation, differentiation of products / services, and multiple benefits for the small commercial.

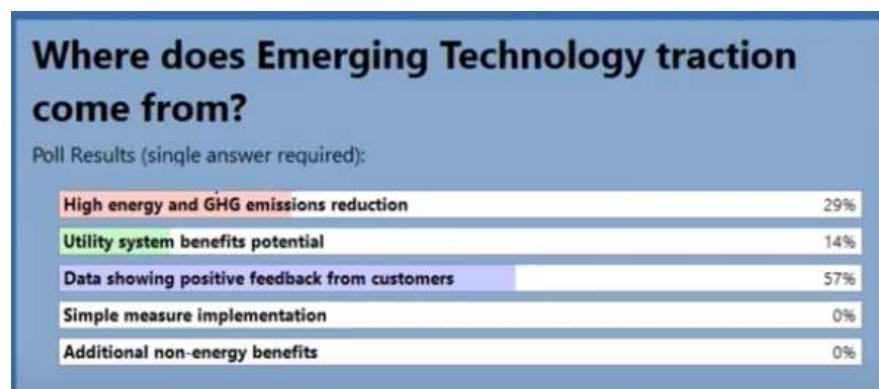
After spending 30 years in the business and technology consulting industry helping companies change to be more successful, Joe Mueller started CoolGreenPower to deploy solutions to address climate change. He wanted to focus on technologies with a low upfront cost with multiple benefits so that even the smallest business could afford it. Joe had significant experience curating emerging technologies in his consulting career and thought he could apply those skills to be a curator of underutilized emerging technologies. Joe described how emerging technologies are another pathway for significant growth, job creation, and differentiation for the HVAC energy efficiency industry. Joe raised awareness of a US Department of Energy projection that **emerging technologies will generate 50% of future building energy savings**.

Joe described four federal programs that fund or support in other ways emerging technologies:

- US ESTCP (<https://www.serdp-estcp.org/About-SERDP-and-ESTCP/About-ESTCP>): Focuses on emerging technologies relevant for military bases
- GSA's Green Proving Ground (<https://www.gsa.gov/governmentwide-initiatives/sustainability/emerging-building-technologies/about-gsas-proving-ground-gpg>): focuses on office buildings more broadly.
- Better Buildings (<https://betterbuildingssolutioncenter.energy.gov/>): a program for sharing best practices across federal buildings
- Energy Exchange (<https://www.energy.gov/eere/femp/energy-exchange>): a similar program for military bases.

Joe shared NYSERDA research that 80 percent of NY State commercial buildings were constructed before energy codes emerged in the 1970s and that they were not designed to be energy efficient. **NYSERDA offers multiple emerging technologies funding opportunities, including the Advanced Buildings program** that is helping laboratories and startups working on business models and technology to lower buildings' emissions and energy use. Joe highlighted NYSERDA's Next Generation HVAC Innovation Challenge that supports clean energy companies that want to develop, commercialize, and demonstrate new technologies for HVAC systems. The program aims to improve the performance of advanced HVAC systems and create new economically viable opportunities for energy efficiency in buildings. Joe pointed out that small buildings are a key focus.

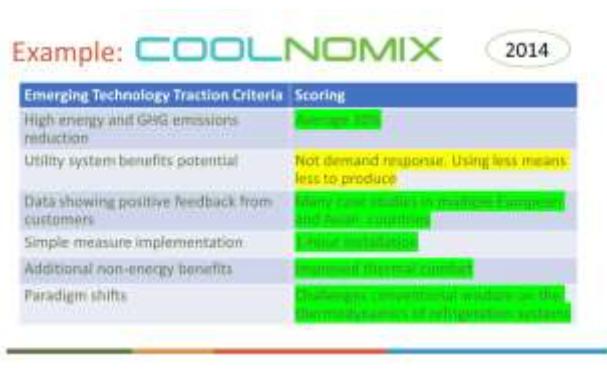
Joe posed a question to audience "Where does Emerging Technology traction come from?



57% opted for "Data showing positive feedback from customers", 29% opted for "High energy and GHG emissions reduction", and 14% opted for "Utility system benefits potential".

Joe shared with the audience that he used six

Emerging Technology Traction criteria to search and evaluate proven low-cost add-on technology for existing cooling systems that had not yet been introduced to the US.



It was 2014 when CoolGreenPower first learned about **COOLNOMIX®** significant traction in Europe and Asia. There were cases studies with prominent brands such Marriott, McDonalds, 7-11, Sanofi, and Kimberly-Clarke. JLL had implemented **COOLNOMIX®** in 90 bank branches across 5 Asian countries to achieve \$3M of

savings as part of a performance contract with HSBC Bank. There were government incentives in the UK and New Zealand. **COOLNOMIX®** checked all the boxes.

CoolGreenPower is the US distributor for the **COOLNOMIX®** technology. Commercial products have been available since mid-May 2015. CoolGreenPower have pursued emerging technology programs to both demonstrate the technology and identify areas for improvement to address any differences in the US market. Although **COOLNOMIX®** had been installed extensively in Europe and Asia on head pump and split systems, packaged rooftop units are unique to the US market. During the US ESTCP demonstration projects, CoolGreenPower learned that the **COOLNOMIX®** installation methods and software needed some revision to address packaged rooftop units.

**COOLNOMIX® has not been widely marketed in the US** as CoolGreenPower has been focused on building up local US case studies with independent / third party performance validation. There are currently **COOLNOMIX®** installations in 6 US states: California, Texas, Florida, Washington DC, New Jersey, and Massachusetts. **CoolGreenPower are entering NY with the initial intent to build out their channel partner network and to conduct demonstration projects in the small commercial sector over the next two cooling seasons (2021 and 2022)**. Given the uncertainty of Covid-19, their focus for the 2021 cooling season will be small businesses they know will be open: convenience, grocery, full-service restaurants, and fast-food restaurants.

Joe described the **COOLNOMIX®** technology, starting with the intentional minimalist industrial design. As a non-residential product, there is an enclosed side panel that only an installer gets access to and no externals buttons or knobs for people to touch. Typically, one person makes the thermal comfort decisions for both the occupied and unoccupied times for the business or government agency.



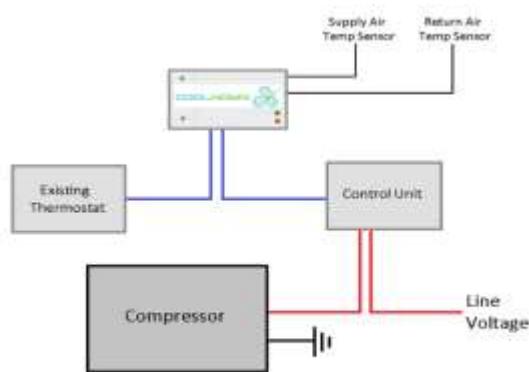
Joe asked the audience to think about **COOLNOMIX®** as a thermostat's new best friend, helping them to avoid unintended consequences from their decisions. Both the thermostat and building automation systems unintentionally call for compressor run-time during part-load, full-load, and peak-load conditions. For example, during part-load conditions, most office space is over-cooled. During peak-demand, many units run all day long because the thermostat cannot achieve the setpoint.

**COOLNOMIX®** has two wired temperature sensors that get placed in a different location than where the thermostat is located. This allows COOLNOMIX to independently take two measurements, that can be used to determine thermal comfort as the #1 priority, and after that, look for energy savings opportunities from reduced compressor run-time. **COOLNOMIX®** is a self-contained solution requiring no connection to the Internet to operate and no upgrade to existing infrastructure

**COOLNOMIX®** claims significant energy consumption reduction of 30% on average while maintaining or improving indoor thermal comfort. **CoolGreenPower have observed a wide range of COOLNOMIX® energy consumption reduction results from 20-70%,** based upon differences in climate, property type, internal heat load, thermostat settings, and ventilation strategies. In general, the more variable demand the use case, the higher the % reduction. Cost reduction is immediate and is a direct result of kWh electricity consumption reductions. However, a 30% reduction in kWh will not always result in the same decrease in the electricity bill, because many commercial bills have a kW peak demand component to their utility bill in addition to the kWh consumption component.

**COOLNOMIX®** offers a full 3-year product warranty and the effective useful life is 15+ years. For heat pumps, **COOLNOMIX®** only operates during the cooling cycle.

**COOLNOMIX®** for Refrigeration claims a similar ~30% energy consumption reduction. There is an additional benefit for refrigeration in that **COOLNOMIX®** prevents icing up of the evaporator coil. 50% of the existing install base have defrost heaters and most are operated by timers. These consume significant electricity and are not efficient. The other 50% of the install base lack a defrost heater and to resolve the icing up of the evaporator coil requires a hair dryer to melt the ice and free up the air flow. Note that **COOLNOMIX®** is not yet currently available for freezers (sub 32 degrees F).



**COOLNOMIX®** is installed in series between the thermostat and the compressor control unit. **COOLNOMIX® is a supplemental control and does not take over control from the thermostat or Building Automation System.** Installing **COOLNOMIX®** is just like changing a thermostat; non-invasive and therefore should not affect the existing equipment warranty. Joe stated that only a small fraction of installed DX cooling systems are within the warranty period. Joe told the audience to not install **COOLNOMIX®** if their DX

unit is still within the warranty period and they are concerned about this.

Joe then shared photos from inside the **COOLNOMIX®** installation area that are accessible to installers:

- **AC Power Terminal:** **COOLNOMIX®** does not have its own power supply; it can accept between 90-240V. On some larger rooftop units that are 408V or 460V, a step-down transformer is needed to create 90-240V circuit if not already available.
- **Control Terminal Relay:** Normally closed. Remains closed unless **COOLNOMIX®** decides the compressor should be held off and the relay opens. The duration of relay open and close times has certain minimums for compressor safety.
- **Setpoint DIP Switches:** This is the **COOLNOMIX®** setpoint, that is normally above the thermostat setpoint and is determined during the installation process.

- **COOLNOMIX® CONNECT:** Once **COOLNOMIX®** is powered up for the first time, installers can use the CONNECT Android application to verify **COOLNOMIX®** has been installed properly and can do a step-by-step commissioning process.

**COOLNOMIX®** is typically installed inside the DX unit electronics area. In the left photo, you can see **COOLNOMIX®** installed in a packaged rooftop unit. **COOLNOMIX®** two sensor wires are extended into the duct work where they can accurately read cold air supply and return air

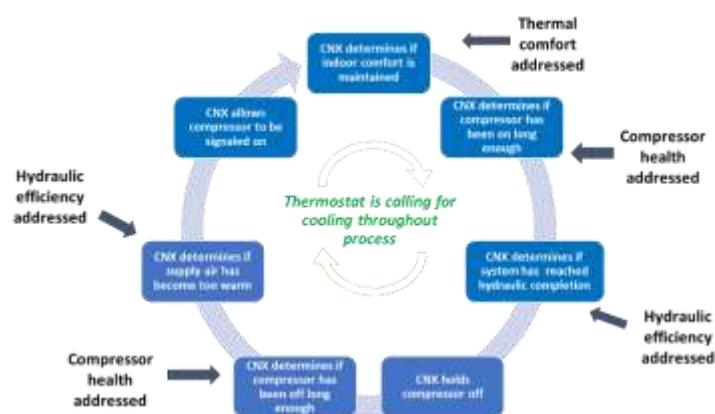


temperatures. In the right photo, you can see **COOLNOMIX®** installed in a walk-in refrigeration electronics area. **COOLNOMIX®** may also be installed indoors.

The 'secret' of **COOLNOMIX®** success lies in a design imperfection inherent in existing DX based systems. The compressor is only doing useful work while, in combination with its associated evaporator and condenser it is cooling the room down to a desired temperature and filling a space up with high pressure refrigerant liquid in the space between the condenser and the expansion valve.

**COOLNOMIX® US patent is based upon using a combination of thermodynamic and hydraulic control to manage the on and off state of the compressor**, which is the main energy consuming component.

Thermodynamics is used to manage comfort levels with the room or space being cooled. Hydraulic control is used to determine when the compressor has completed its efficient work in delivering a supply of high-pressure liquid refrigerant. Once temperature and hydraulic conditions are satisfied the compressor can be held off, thereby delivering a significant reduction in running costs.



**COOLNOMIX®** reduces costs differently depending upon part-load, normal-load, and peak-load conditions.

Joe shared results from two case studies, the first from 2016-2017 and the second from 2018. In 2015, the US Department of Defense ESTCP program awarded a grant to Fraunhofer USA to independently verify **COOLNOMIX®** performance at two US military bases. One of the AC case studies from that project is a military building that operates 24 hour a day at Fort Bliss in El Paso, Texas. **COOLNOMIX®** achieved a modest 17% reduction in energy consumption, just slightly above the target. Payback was ~4 years, driven largely by the low cost of electricity (6

cents per kWh). Thermal comfort was maintained throughout. At that time, the **COOLNOMIX®** software algorithms and installation procedures had not yet been adapted to packaged rooftop units, a type of DX unit that is only common in the USA.

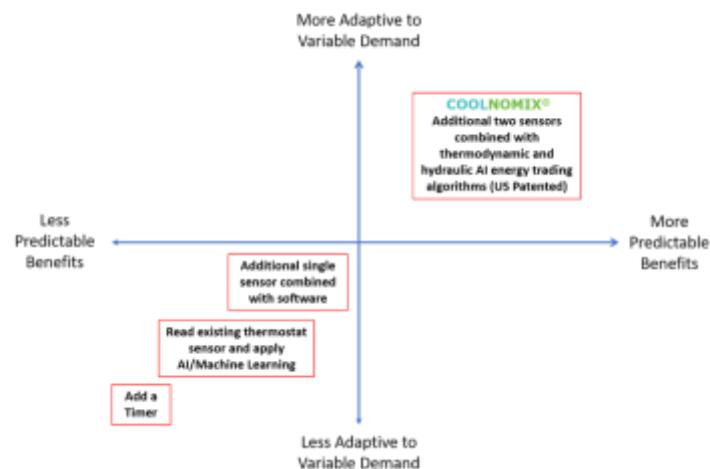
Massachusetts has a climate like New York State. CoolGreenPower has completed multiple demonstration projects in Massachusetts for both air conditioning and refrigeration including Hanover, Medford, Winthrop, and Chelsea. For example, the Chelsea Public Library is a historic building served by 1 large, packaged rooftop unit with 2 scroll compressors, an economizer, and a variable frequency drive. Prior to Covid-19, they served citizens 5 days a week and sometimes on weekends. In 2018, Dynamic Control Technologies performed an independent performance validation of COOLNOMIX as part of a Massachusetts Clean Energy Center DeployMass grant. The client was the Energy Manager for the City of Chelsea who together with other stakeholders were seeking significant energy and GHG emissions reductions along with cost savings. **The projected annual energy consumption reduction of ~8,000 kWh (27% less electricity consumption) is substantial** and close to the manufacturer's performance claim. Projected annual cost savings are ~\$900 and a simple payback less than 2 years.

Joe then described the competitive landscape for **COOLNOMIX®**. He suggested that biggest competitor is a business or government agency "Doing Nothing". Beyond that, CoolGreenPower segment the competition into three categories:

- Other HVAC EEMs
- Other low cost EEMs that target the compressor
- Other non-HVAC Building EEMs

Preventative maintenance is the most important HVAC energy efficiency measure. Programmable thermostats are very helpful as they help with adjustments for unoccupied time. Ventilation operates year-round in NY climates, so economizers and variable frequency drives are important energy efficiency opportunities. **COOLNOMIX®** targets the cooling systems largest energy consuming component – the compressor - but so are other technologies.

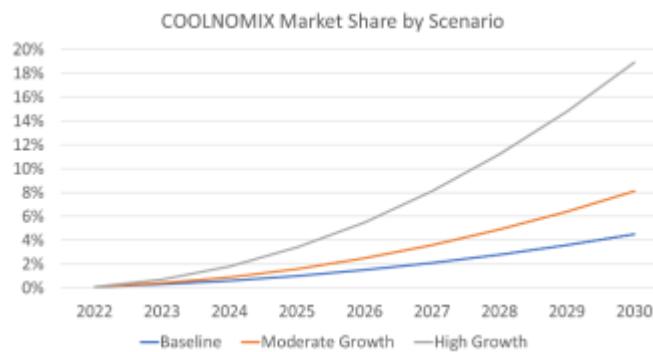
If we think back 20 years, the industry tried using timers to reduce compressor run-time but was unable to achieve predictable results. Technologies later emerged that attached to an existing thermostat, read the sensor readings, and applied AI. That helped a bit but was limited to the information from the thermostat sensor only and historical data. There are other technologies now available that offer a single additional sensor and AI; those offer some benefits but still do not deliver predictable results.



**COOLNOMIX®** dual sensors with artificial intelligence energy trading algorithms uniquely adapts rapidly to variable demand and delivers more predictable benefits than other options. The reason there is a US patent on a dual sensor system with AI is that is the threshold where you have enough additional sensors to measure the changing demand in the space and can apply AI to respond to rapid demand changes and deliver predictable results. In fact, the inventor tried adding more sensors than 2 but adding more sensors did not deliver better results.

Depending upon a small building use cases, non-HVAC EEMs may be competing for the same budget as might be spent on **COOLNOMIX®**. The most popular non-HVAC EEMs in recent years has been LED lighting and this represents immediate and sustainable cost reductions for businesses that use significant lighting. As you heard earlier from Dennis, it is important to evaluate the opportunities to understand which opportunities to prioritize first and their relative cost / benefit. For example, there is a retail banking company that achieved 3 times more energy cost reduction from **COOLNOMIX®** than they did from LED lighting. In their situation, they actually installed both LED lighting and **COOLNOMIX®**.

According to recently published date from NYSERDA, **the opportunity for COOLNOMIX® in NY state is significant, with ~600,000 existing units that are compatible**, including ~400,000 in the small commercial sector. The **COOLNOMIX®** technical potential for NY State is substantial - 3,671 gWh electricity reduction and 2.60 MMTCO<sub>2</sub>e

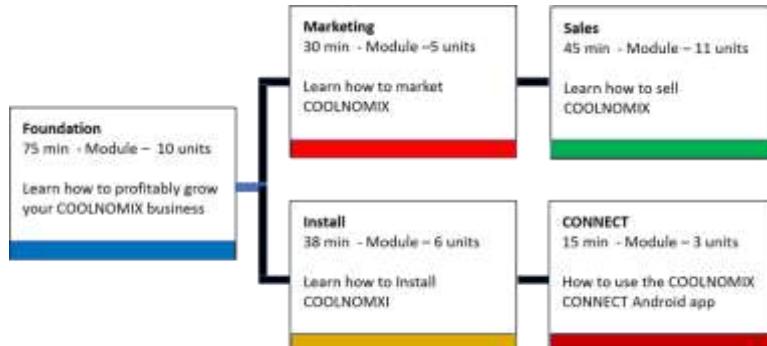


Market adoption takes time. CoolGreenPower have studied adoption rates in NY state and have initial baseline, moderate growth, and high growth rates. Joe said that as they start to work with NYS partners and utilities, they will get a better idea of how these projections can be accelerated. Joe emphasized the **tremendous market opportunity for COOLNOMIX® installers, project expeditors, and other market players.**

## expeditors, and other market players.

Joe described CoolGreenPower's integrated market entry approach for NY State. Joe emphasized the need for multiple market pathways and to develop the HVAC workforce that can market, sell, install, and support **COOLNOMIX®**.

CoolGreenPower offers a full training curriculum available on demand or live.



CoolGreenPower are researching how to offer Continuing Education Units (CEUs) and/or certificates.

Joe concluded the conversation by summarizing CoolGreenPower's current NY activities:

- Establishing NYS physical presence
- Starting to recruit and train channel partners
  - o Marketing, Sales, Installation, Training (Workforce Development)
- Multiple COOLCon events, to be monthly starting in 2021
- Planning for demonstration projects with third party performance validation during Summer 2021 for businesses we know will be open
- Engaging NYS utilities to build **COOLNOMIX®** awareness and to review demonstration project key deliverables
- Planning for **COOLNOMIX®** market surveys
- Participation in NY State Market Awareness events

Joe asked if there were any audience questions. The first question was about getting a deeper understanding of the AI algorithms. Joe said that the AI was not based upon creating patterns through machine learning; rather, the **COOLNOMIX®** AI algorithms are more dynamic to adjust to real-time changes.

The second audience question asked was about who they should contact if they want to be become a **COOLNOMIX®** partner. Joe answered by saying that they should contact **PROTEK** at [COOLNOMIX@protekcorporation.com](mailto:COOLNOMIX@protekcorporation.com) .

Joe finished the fourth session by asking the audience to complete our post event survey. This was a pilot virtual COOLCon New York event and we are asking for feedback on how we can improve.