

Decarbonization & SEM: The Human Side of Energy Management

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Abstract

Strategic Energy Management (SEM) is a holistic energy management approach encompassing technical and behavioural strategies for achieving energy and GHG (greenhouse gas) reduction targets. Since 2009, CLEAResult has delivered SEM programs across North America to more than a thousand participant organizations, including more than 200 in Canada. This paper will focus on the six-cohort SEM program, which ran from 2018 to 2021. It is the first of its kind program to be delivered in Alberta, Canada, as it focuses entirely on greenhouse gas emission reduction. The participants belonged to different sectors: health authorities, advanced education, manufacturing sites, oil and gas facilities, retail/hospitality industry, government, property management, and school districts. Whether working with an industrial site or consulting with a school facility to achieve carbon reduction goals, it is crucial to strategize engagement methods to facilitate a supportive collaboration of human behaviour and energy efficiency strategy.

This paper will examine the large dataset from over 250 sites across the 6 SEM cohorts with over 60 participants. The field-tested engagement strategies will be shared in this study to showcase how energy management programs can be significantly enhanced by effectively utilizing human capital as a resource. This paper will share data-based evidence on how behavioural engagement in the SEM program effectively reduced GHG emissions. Findings from this study can help optimize future programming by using human resource capital alongside energy management principles to achieve cost-effective decarbonization.

Introduction & Background

According to the CEE Strategic Energy Management Minimum Elements, "Strategic Energy Management can be defined simply as taking a holistic approach to managing energy use to continuously improve energy performance, by achieving persistent energy and cost savings over the long term. It focuses on business practice change from senior management through shop floor staff, affecting organizational culture to reduce energy waste and improve energy intensity." (CEE 2014).

CLEAResult has helped various organizations in North America to improve and realize their Energy Efficiency potential through Strategic Energy Management (SEM). Since 2009, the organization has served over 1,000 participant organizations, including more than two hundred participants in Canada. SEM is a unique and human-centric approach that fosters a culture of continuous energy improvement by engaging employees on all levels – from top executive management to the frontline workforce.

Offering a carbon-focused SEM program enhanced by engagement strategies has immense potential to help achieve upcoming net-zero goals and reduction targets as energy management is the first tier of the Energy Efficiency Pyramid (Deane and Day 2021). The GHG-focused SEM program empowered energy teams, managers, and staff to reduce overall GHG emissions through behavioural and operational change.

The Alberta GHG-focused SEM program was a first-of-its-kind cohort-based Strategic Energy Management program, a two-year intensive program from December 2018 to May 2021. The first cohort started in December of 2019 with additional five SEM cohorts, which began soon after in different geographical locations within Alberta. This program was initiated by Energy Efficiency Alberta in 2018 but was taken over by Alberta Environment and Parks in September 2020. It provided a holistic approach to the management of energy use by continuously improving energy performance to achieve persistent GHG reductions and cost savings. The participants created specific targets, actionable initiatives, and detailed metrics that resulted in lasting energy, greenhouse gas, and other resource savings. The cohort curriculum was customized to a mix of commercial, institutional, industrial, K-12 and advanced education sectors from different regions of Alberta. The program focused on decarbonization and utilized customized engagement strategies per the participants' needs to achieve GHG reduction goals. This paper will examine the large dataset from 276 sites representing over 60 SEM participants within 6 SEM cohorts. Figure 1 shares the integrated energy management approach and the general SEM cycle deployed for the Alberta SEM Program.

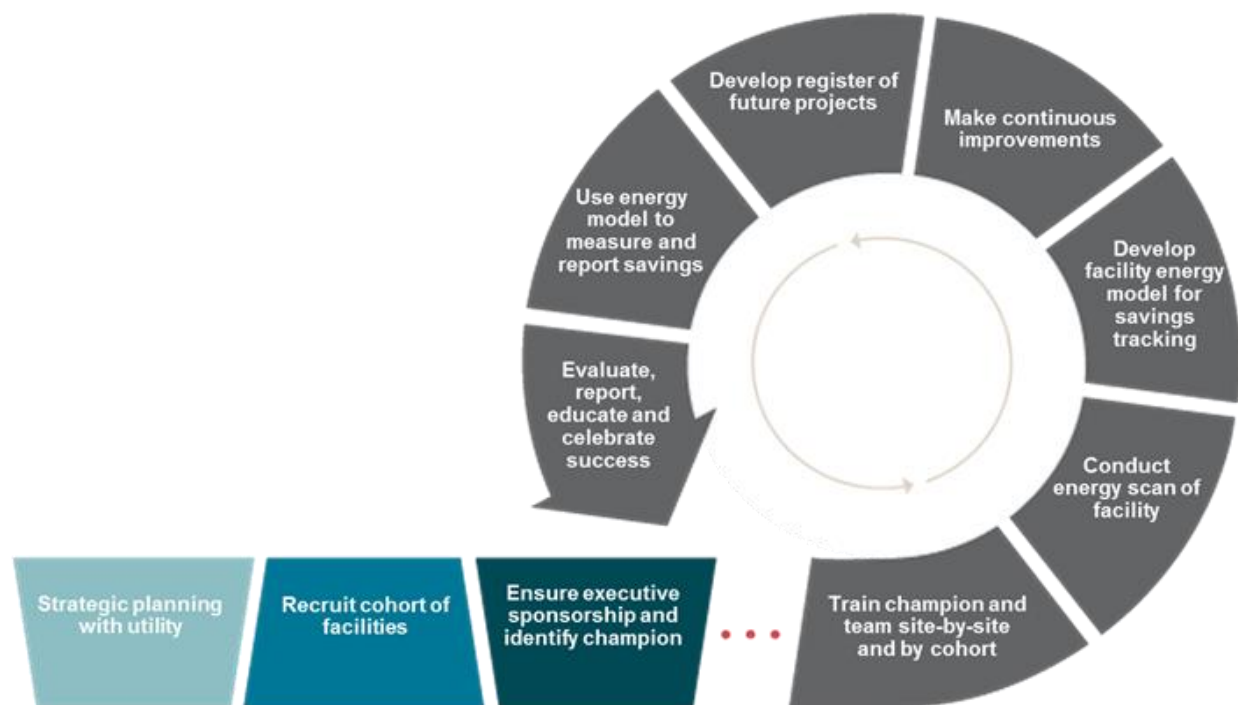


Figure 1. The SEM Cycle.

Goals & Methodology

This paper will explore the human side of the Alberta SEM program by sharing the overall GHG savings and adopted engagement strategies the participants achieved in the program and will conclude with an assessment of the interaction between the two. It will also analyze and compare the effectiveness of adopting behavioural-based Energy Conservation Measures (ECMs) and the success of the SEM program in engaging participants in sustainable energy management and decarbonization. To participate in this program, organizations were required to

meet several criteria, including having a dedicated organizational capacity to support the adoption of SEM and a minimum GHG emissions annual baseline of 2,000 tonnes. Alberta's SEM program quantified GHG savings from O&M (operations and maintenance) and behavioural activities conducted during the two-year SEM engagement. CLEAResult's delivery of the SEM program focused on implementing low and no-cost measures centralized on behaviour-change-based ECMs, which will be referred to as behavioural ECMs in this paper. Unlike traditional ECMs, behavioural ECMs are not implemented at participants' sites once; instead, these ECMs instill a habitual behaviour change in the energy use practices and are, therefore, implemented on a continuous basis. For example, engaging employees to reduce plug load energy usage by turning off computer monitors will require them to change their normal behaviour. Thus, the focus of behavioural ECMs will be on instilling the suggested behaviour change as a standard practice in a participant's workplace, focusing heavily on the human side of SEM.

Conversely, O&M-based ECMs are also implemented with little or no cost. However, they are more technical, usually only implemented once, and are easily quantifiable through engineering-based calculations. Some examples could be adding more insulation during a pre-planned roof maintenance project or reducing hot water temperature setpoints for a manufacturing plant's wash bay. For an industrial setting, both types of ECMs have been claimed to have an Estimated Use Life of 7 years or higher (Energy Trust of Oregon 2020).

Data collection process

For the GHG-focused Alberta SEM program, the GHG savings data from 276 sites was compiled, representing sixty organizations across the fifteen NAICS sectors in Alberta. With emissions-focused SEM cohorts, all fuels consumed onsite were analyzed, provided their use was substantive and there was a scope of GHG reduction for that fuel type. Thus, the participants were able to prioritize all savings opportunities for all fuel types in this program (Deane and Day 2021). The GHG savings were calculated using energy reduction changes seen over the two years, mainly using electricity and natural gas-based energy models. For some participants, other fuels such as diesel, propane, or biomass were also included to quantify GHG savings. CLEAResult as an implementer, performed rigorous statistical modelling to quantify energy/GHG savings and created baseline energy models for all cohort participants. Each site's energy model used a minimum of two years of historical data to establish a baseline. When a participant's site failed to obtain a statistically viable model, a bottom-up engineering calculation approach was utilized to quantify GHG savings. It is crucial to note that for all sixty participants, the reported GHG savings are based on total site activity, including behavioural and O&M-based ECMs and were recorded in annual reports.

It should be noted that the engagement strategies were not deployed separately; instead, a multi-modal engagement approach was utilized. The GHG-focused Alberta SEM program's savings are reported as a result of cumulative actions taken by each participant and cannot be broken down by ECM type or engagement strategy type. This quantification is out of scope for this paper as over 1200 ECMs were implemented in this program.

Data analysis process

CLEAResult used digital Strategic Energy Management Plans (SEMP) to keep track of the Energy Conservation Measures (ECMs) conducted at each site for every participant. CLEAResult's SEM coaching team developed detailed annual completion reports based on the SEMP's and energy models. We recorded each participant's activity during their two-year engagement period as per the participating cohort's start date, including all SEM measures, key personnel, employee engagement activities, and other related data from 2018 to 2021. This reporting approach has allowed us to classify the implemented ECMs into two categories: behavioural ECMs and O&M-based ECMs for every participant.

To assess the impact of engagement strategies, 10 SEM participants were selected from a total of 60 participants. The chosen participants could be from any of the 15 NAICS sectors identified in the Results & Discussion section. The sampling unit of this study is a participating organization with one or more sites. An average of 23 SEM measures were implemented for each participant, ranging from 8 to 50 ECMs per site. We categorized each selected participant by differentiating the engagement level (high or low) perceived by the SEM coaching team during the program's implementation. Categorizing a participant as having a high-level vs. low-level engagement was subjective to qualitative assessment from the coaching team. It involved several factors such as completing all program deliverables, holding employee engagement events, participating in cohort workshops, and implementing the SEMP's. SEM measures were classified as:

- **O&M-based ECMs:** implementing Building Automation System-based changes, changing boiler setpoints, lighting improvements, optimizing processes, etc.
- **Behavioral ECMs:** Training staff to operate equipment more efficiently, scheduling staff to do routine leak maintenance, compressed air/ steam leak program, turning off lighting when not in use, etc.

For the ten selected participants, the annual completion reports were reviewed by the coaching team and the ECMs implemented by the participants were classified into the above two categories. According to Energy Trust of Oregon's Industrial O&M persistence study, an estimated seven-year measure life has been assumed for all ECMs implemented by the participants in year 1 and year 2 of the GHG-focused SEM program (Energy Trust Oregon 2020). Please note that none of the ECMs were double counted even if CLEAResult re-engaged a participant to strengthen /renew the ideal behaviour in year 2 of the program.

The behavioural activities used during the program have been categorized by following the taxonomy of the critical strategies shared by Sussman and Chikumbo's 2016 report on "Behavior change programs: Status and Impact." The behavioural activities performed include:

- Persuasive messages and information sharing
- One-on-one communication (In-person & Virtual)
- Energy champions
- Guided group discussion
- Education & training

Results & Discussion

In a recent report, IEA stated that "it is ultimately people who drive demand for energy-related goods and services, and societal norms and personal choices will play a pivotal role in steering the energy system onto a sustainable path." IEA conveys that energy efficiency and behavioural changes are the critical pillars for decarbonization as nearly two-thirds (over 60%) of the energy reduction needed to reach the net-zero goal will require people to change their behaviour with a shift in consumer decisions or lifestyles (IEA 2021). Thus, education and training-based programs, like SEM, are crucial for decarbonization and employing behavioural science-based strategies will help achieve net-zero and climate-based targets.

Previous studies have noted that program administrators frequently combine multiple programs and strategies into more extensive campaigns (Sussman and Chikumbo 2016). The Alberta SEM program also utilized a multi-modal approach for engaging behavioural aspects to increase the program's overall impact.

The following is a list of engagement strategies that were employed by CLEAResult's SEM coaching team to utilize human capital successfully:

Persuasive messages and information sharing: The Alberta SEM program cohorts were a mix of commercial, industrial, and institutional facilities. Most participants were at the beginning of their energy management journey, making behavioural changes related to energy efficiency a bit more challenging to adopt. Thus, the Alberta SEM program focused on sharing information on energy usage, expected cost savings in utility billing, and highlighting non-energy benefits such as updating health and safety messages to add energy efficiency and environmental aspects of GHG reduction. One of the critical messages that helped increase engagement was the utilization of carbon tax projections, demonstrating the added cost if participants chose not to reduce their GHG emissions.

One-on-one communication: The core of the Alberta SEM program focussed on one-on-one coaching with various in-person activities between the SEM coach and the energy team. It has been noted that humans naturally crave social interactions and in-person communication, leading to increased engagement (Sussman and Chikumbo 2016). During COVID, all in-person activities were converted to virtual engagement, with exceptions for some participants. The coaching team utilized the following in-person strategies to retain the element of personal connection:

- Establishing and empowering an energy team and an engaged executive sponsor
- Instituting public commitment by creating energy policies with specific energy and GHG reduction targets
- Continuously tracking energy efficiency projects from identification to completion, using a Strategic Energy Management Plan
- Customized one-on-one coaching and technical (engineering/modelling/change management) support customized to each participant's Energy Management Plan
- Conducting an Energy Management Assessment (EMA) to assess the current state of the energy management program by concentrating on people and processes rather than energy projects. Figure 2 represents the spider web graph of EMA for a sample organization. A customized action plan was provided to participants based on the

weaknesses and strengths of each organization. Progress on the EMA's action plan was tracked periodically.

- Coaching participants to organize structured employee engagement events using Prosci's ADKAR model

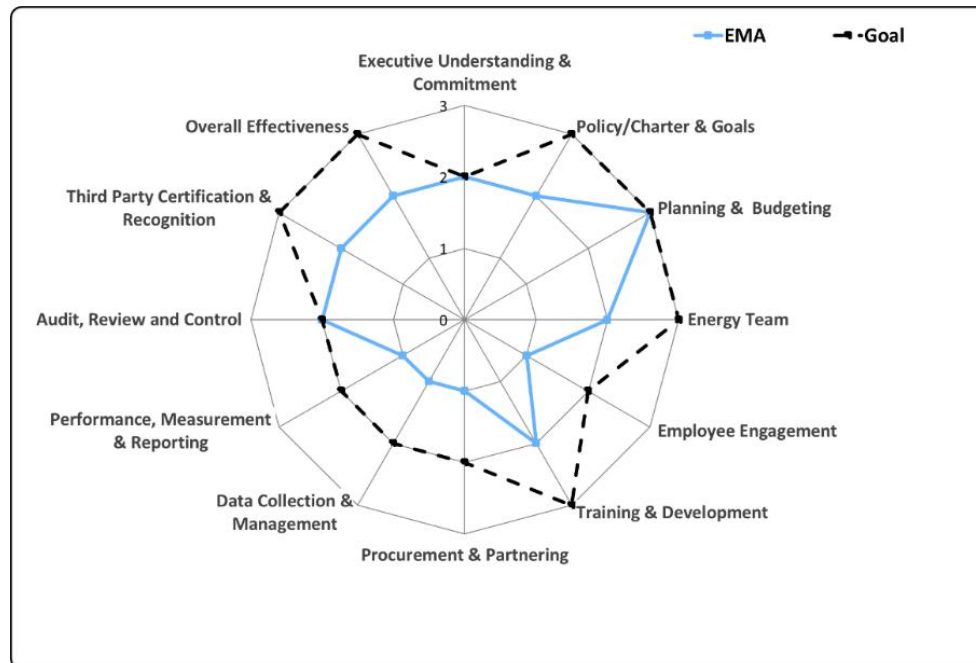


Figure 2. Spider web graph for Energy Management Assessment

Energy champions: Designating specific energy champions was one of the critical engagement strategies implemented for all participants. An energy champion's role is to take ownership of the organization's energy management and be the primary lead in project implementation. An engaged energy champion significantly increased the program's success, promoting an energy efficiency culture and achieving GHG savings. The energy champion also acted as a cheerleader for the energy team and took a lead role in drafting an energy management team charter detailing the monthly meeting schedules, energy team members and specific energy goals and targets

Guided group discussions: The cohort program was established on peer-to-peer learning principles and guided group discussions to create high engagement in participants from diverse sectors. Since none of the six cohorts had sector homogeneity, it allowed participants to learn from peers within and outside their business. CLEAResult facilitated multiple group workshops to keep engagement momentum and continue peer-to-peer learning. The following workshops were held in Year 1:

- Workshop 1: Establishing SEM Program
- Workshop 2: Energy modelling and tracking
- Workshop 3: Change Management and Employee engagement
- Workshop 4: Keeping up the momentum

Education & training: The SEM program incorporated hands-on training in energy audits, energy modelling, progress tracking, and technical webinars. The SEM program customized the offerings of technology and employee engagement webinars per different sectors. For example, a technical webinar on BMS optimization, demand response and monitoring, and deep dives into increasing operational efficiencies of HVAC and Boiler systems.

Customized employee engagement events: Highly engaged participants requested support from the CLEAResult's coaching team to organize employee engagement events at their sites. The customized support was tailored to the participants' organizational structure and stakeholder makeup, such as employees, tenants, students, and custodial staff.

One example of such engagement was directed toward the K-12 school sector, where CLEAResult's team worked with the participants to organize student-focused workshops and energy treasure hunt activities. These student-focused engagement activities helped orient the participants toward energy efficiency. They created awareness regarding the pivotal role school staff and students can play in making their school greener and more energy-efficient. Upon completion of these engagements, there were many instances of students correcting the teacher's energy use behaviour in the classroom, with some even extending to non-energy benefits like paper and water use reduction.

Another example of a successful engagement campaign was with a participant from the transportation sector. CLEAResult's coaching team facilitated a tenant engagement event for employees in the organization's office to inspire energy efficiency awareness among them. This led to the company's energy team being contacted by several employees expressing their interest in supporting the effort. This directly impacted the organization's energy management success by allowing them to adopt behavioural-based ECMs at their workplaces.

A participating organization from the plastics manufacturing sector struggled to find more O&M-based ECMs and opposed behavioural ECMs as they were perceived as a question of their staff's use of time and work credibility. The energy team at this participating organization only saw value in implementing technical improvements in their plant operation. CLEAResult organized a deep dive into their manufacturing process to re-engage their interest in behavioural ECMs but with a nudge approach. An SME from CLEAResult with over ten years of experience in the plastic industry helped the participant create a strong SEMP focusing on process-based improvements allowing for technological improvements. During the energy scan, the SME provided examples of non-energy benefits of energy efficiency that could help the employees and gently nudged them towards the behavioural-based ECMs by providing data on estimated energy savings. It took time for the participant to recognize the benefits of employee engagement, but they are continuing to implement the principles of SEM beyond the program completion.

A participant in the Cement sector had one of the highest reductions in greenhouse gas emissions throughout the program. Their energy champion was highly engaged and involved CLEAResult's coaching team in several successful employee engagement events to leverage the implementation of ECMs. This participant placed a high value on increasing the visibility of energy consumption and providing evidence of the organization's commitment to improved energy efficiency. Some of the employee engagement events organized by this participant are listed below:

- Piggybacking on safety meetings to engage on non-energy benefits of SEM

- Public recognition awards for individuals contributing to energy efficiency and SEM program implementation
- Use of stickers and awareness posters to create general efficiency awareness, such as reducing plug loads through the "Turn off monitors campaign," posting reminders to minimize the unnecessary operation of conveyor belts, and keeping bay doors closed
- Earth Day BBQ for employees and sharing energy efficiency tip sheets
- Knowledge sharing webinar on how to achieve substantial energy savings with no energy budget
- Marketing success stories to the public, top management, and staff

The success of the GHG-focused Alberta SEM program was highly enhanced through the use of these engagement strategies. Figure 3 shows the overall GHG savings achieved from the Alberta SEM program.

The program savings indicate that a customized engagement approach for coaching participants leads to successful decarbonization. The Alberta SEM program successfully created impressive GHG savings and organizational culture change. It is evident from Figure 3 that savings ranged from 0.7% to 16.3%, giving average savings for the Alberta SEM program of 5.6% for the two-year participation. A harmony between behavioural and operational energy conservation measures must exist for effective decarbonization.

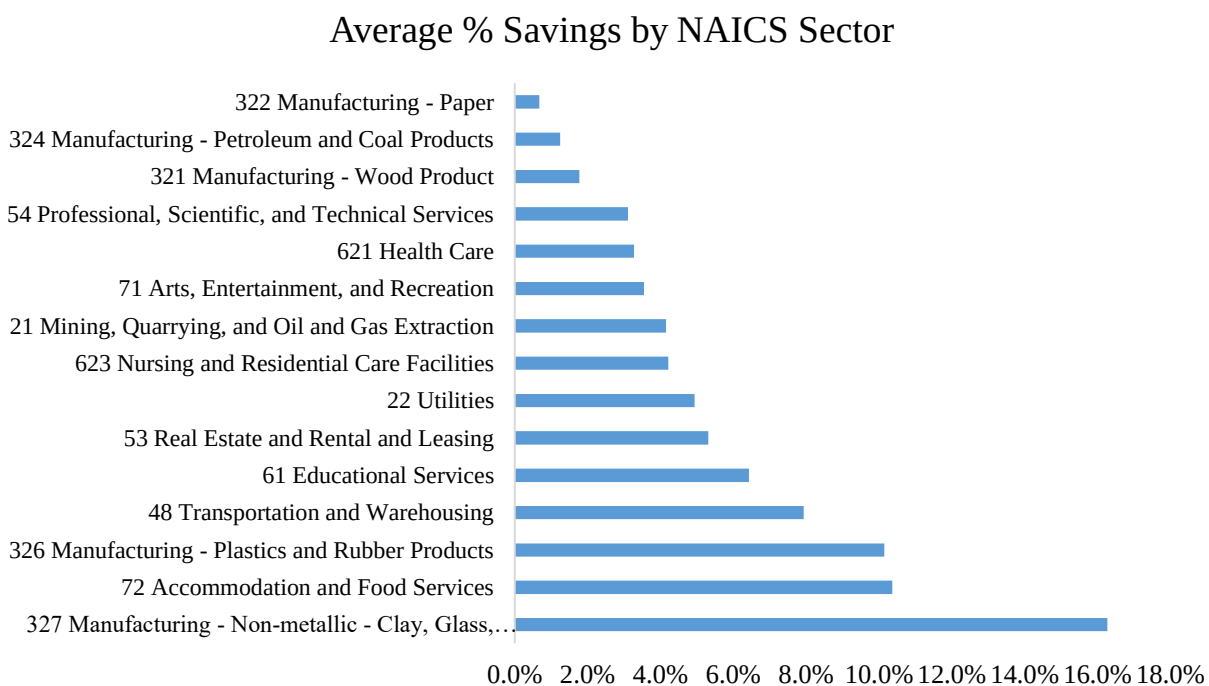


Figure 3. Average % GHG Savings by NAICS Sector for Alberta SEM cohort program

Figure 4 shows the GHG savings and number of Behavioral ECMs (%) adopted by the participants representing different NAICS sectors in the 6 Alberta SEM cohorts and their associated engagement levels. The level of engagement was based on the qualitative assessment from the SEM coaching team. It involved several factors, such as the number of employee engagement events conducted and their customized energy management plan progress.

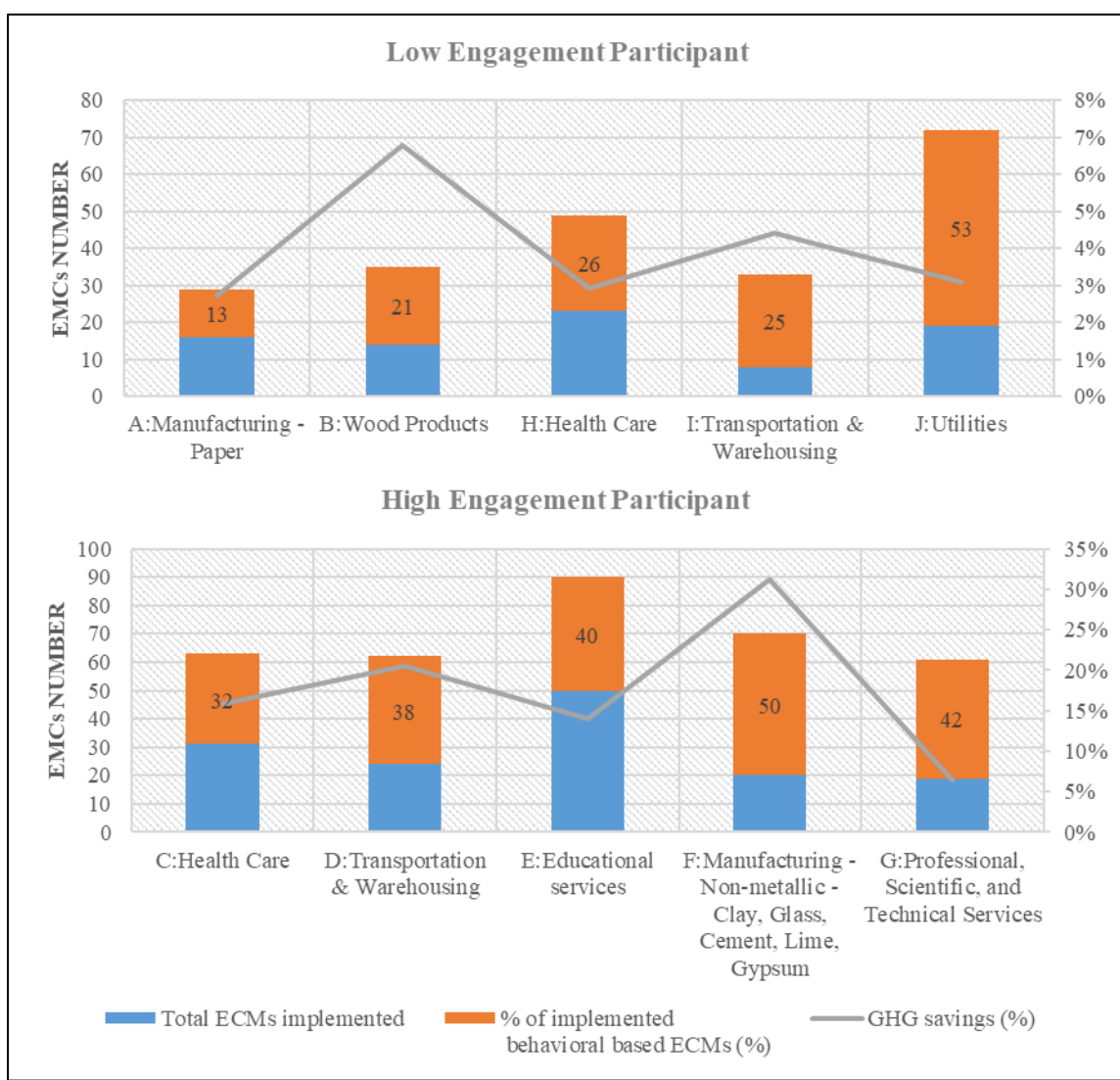


Figure 4. Behavioral ECMs conducted by the selected participants with their respective GHG savings

The percentage of behavioural ECMs adopted by a highly engaged participant "F" from the cement sector is 50% signifying an equal distribution of behavioural-based ECMs and O&M-based ECMs, yielding significant GHG savings of 31.2%. GHG savings from highly engaged participants ranged from 6.5% to 31.2%, with 38% of implemented measures being behavioural ECMs. Alternatively, less engaged participants who adopted a lower number of behavioural ECMs (i.e., behavioural-based ECMs comprised of 26% or less of the total ECMs) saved 2.7% to 6% in GHG emissions.

Participant J from the utility sector adopted many behavioural ECMs at their sites in Year 1. However, this did not result in the expected level of savings. Due to COVID, the program shifted to virtual delivery, and high importance was placed on implementing safety protocols. In-person reinforcement from this participant's energy team lacked the required engagement for the facilities team to make sustainable behavioural change, resulting in low energy savings. Also, Participant J joined the SEM program six months after the cohort start date, limiting the number of ECMs they could implement in the first program year.

Energy management programs have a human side, and a strong focus is needed within the energy management program to capture the effect. This concept, partnered with a correlation between behavioural ECMs adopted and GHG savings, makes it clear that a customized engagement approach enhanced the GHG savings realized by the participants in the Alberta SEM program.

Challenges and gaps in creating engagement in the SEM program

A challenge which appeared commonly throughout the 2-year SEM engagement was participating organizations placing a higher priority on the everyday duties of energy team members, resulting in a diminished program impact. One example of such a scenario comes from a sizeable retail-based organization in the real estate sector. They had a prominent brand identity which unified all tenants under them. The core services team would distribute the tenant's utility bills providing the energy team with an excellent opportunity to leverage tenant engagement to create energy savings. However, executive management prioritized retaining the brand image and chose not to encourage the tenants to decrease their energy use. The focus of the SEM program remained on providing effective operations under the core facilities team, which was seen as a function of their everyday job.

The presence of COVID-19 resulted in changes to program delivery methods. This required the coaching team to create effective engagement through virtual delivery methods. Some participants did not have the technical expertise to use virtual engagement software, so the program was delivered in person by following strict precautions and safety protocols. Though it proved a challenge, engagement through virtual methods was ultimately successful. This relationship should be studied further to analyze the success of SEM programs run in-person vs. virtually.

It is noted that every organization functions differently, and engagement around creating energy savings needs to happen within those operational parameters. As SEM implementers, we must align energy management and decarbonization with the organization's overall vision and executive management goals. Thus, it is recommended to research how different organizational cultures impact employee behaviour and related expectations, specifically in SEM programs.

Due to the indirect energy impact of behavioural ECMs, rigorous quantification is required to assess their impact accurately. Sometimes measures may be too difficult or small to quantify. Therefore, when designing a carbon-based SEM program, it is recommended that the implementor focuses on data collection and systematic evaluation to quantify the impact of engagement strategies.

Conclusion

Carbon-focused SEM programs that leverage behavioural changes are critical for successful decarbonization. Alberta's six-cohort SEM program ran from 2018 to 2021 and successfully strategized engagement methods to facilitate a supportive collaboration of human behaviour and energy efficiency strategy. This paper shared the GHG savings from 276 sites representing over 60 SEM participants after completing an engagement-focused SEM program. The central finding was that behavioural-based programming enhanced energy and GHG savings. Utilizing a customized engagement approach was critical for successful decarbonization and establishing a resilient energy efficiency culture.

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