EOS

CASE STUDY

ROGERS ARENA

Kicks off the season with EOS™

"SHIFT's EOS™ solution has enabled us to achieve significant operational savings at Rogers Arena – and we're only getting started. In my opinion, Intelligent Live Recommissioning is something all operators must consider. It's a no brainer."

Al Hutchings
Director of Facility Operations and Engineering
Rogers Arena

SHIFT ENERGY
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Summary

About one year ago, SHIFT had a groundbreaking new technological concept called Intelligent Live Recommissioning (ILR), so they began looking for forward-thinking early adopters to help them develop and test the technology for specific building types.

At the same time, the Vancouver Canucks began looking for ways to take control of their energy spend and improve their environmental footprint. After a number of initial planning discussions, they agreed to take part in SHIFT's early adopter program and the creation of a new building energy management paradigm began.

Rogers Arena Energy Environment

475K
Square Feet

80/20
Energy Mix of Electricity/Steam

Located in Vancouver, Canada, Rogers Arena is the 475,000 square foot home to the Vancouver Canucks. The arena was one of the key sites in the 2010 Winter Olympics. In addition to hockey, Rogers Arena hosts a number of live concerts, sporting events and other activities throughout the year.

The energy spending of Rogers Arena is mostly associated with electrical power (approximately 80%) and steam (approximately 20%). The building also uses some natural gas, but its cost is negligible.

The arena building operators are highly skilled building controls users that use four different building controls systems to tune their environment: Johnson Controls (HVAC), Trane (Chillers), Douglas (Lighting) and CIMCO (Ice Plant). As such, one of the key program challenges was integrating with the various controls systems to enable the EOS platform.

Why Rogers Arena Wanted EOS?

SHIFT first approached the Vancouver Canucks in May 2013 about being the “Early Adopter” of our EOS product – the world’s first implementer of Intelligent Live Recommissioning (ILR). Rogers Arena was selected as the ideal development partner because of their passion for innovation and the fact that the arena was already optimized according to traditional approaches. The further optimization opportunity was therefore limited only to what ILR could incrementally deliver, thereby enabling SHIFT to accurately measure the effectiveness of their technology.

With these objectives in mind, SHIFT and the Canucks agreed to build EOS together:

We would use their facility as a test-run for an events facilities solution.

They would feed us requirements from a space, engineering and user standpoint.

Our original joint target was a 15 percent reduction in energy cost. This was later increased to 20 percent.

Since we kicked off the project in June 2013, we have developed and deployed EOS at the Rogers Arena, effectively trimming 20 percent of energy cost from the facility. We are not yet done; however, we consider the project a phenomenal success largely due to strong collaboration from the Vancouver Canucks.

Our joint efforts over the past year can be broken into 3 distinct stages:

6 months

Infrastructure & Development

The first six months of the program were used to fill any infrastructure gaps at the site and build the baseline product that would support the optimization engineering stage. Required infrastructure included controls upgrades, sub-metering and an EOS gateway. At the end of this stage, we were able to view the arena’s energy metrics in real-time in a dashboard and bi-directionally communicate with the existing controls platforms.

3 months

Supervised Optimization

The next 3 months were spent testing various optimization algorithms in a “supervised” mode in the building using a jointly developed plan that minimized possible operational impacts. To maintain ultimate operator control, EOS can be disabled with the click of a button. When this happens, control seamlessly returns to the existing controls.

ongoing

Unsupervised Optimization

Once all were confident with EOS's optimization algorithms and stability, we moved into an unsupervised optimization mode. EOS is now optimizing the Rogers Arena 24x7 and thereby eliminating operational energy waste associated with the systems it controls.

**Based on our experience with the Rogers Arena, we believe EOS could now be deployed into any events facility in six months or less.*

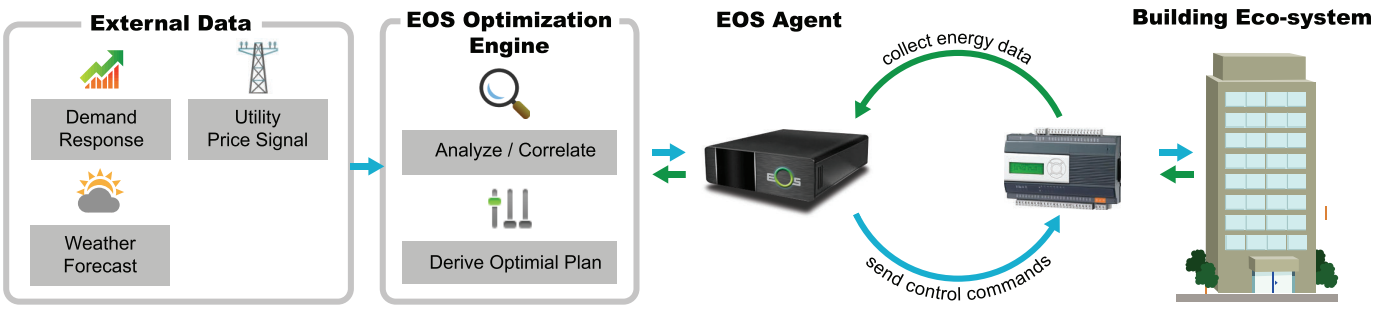
What is ILR?

The concept of trimming building energy waste by adjusting building automation to meet space requirements (i.e. recommissioning or retro-commissioning) is not new. Recommissioning often offers the best payback of any energy efficiency alternative on the market; however, in more dynamic building eco-systems, operators cannot recommission enough to really align with building needs. As such, they end up with a static system that has very limited waste in 1 or 2 operating scenarios (like, for example, fully occupied or unoccupied). Events-oriented facilities like arenas are one of the most dynamic commercial energy environments. Because of this complexity, recommissioning has limited potential to eliminate energy waste in a way that persists over time.

In smaller facilities, many operators have started leveraging analytics to 'continuously recommission' their buildings. In SHIFT's past life, they repeatedly witnessed firsthand the effectiveness of this constant adjustment of controls in order to optimize according to changing space requirements. Of course, this becomes impossible in large facilities with thousands of inputs to consider when deriving an optimized building plan. This is where Intelligent Live Recommissioning (ILR) comes in – the automation of continuous recommissioning based on cloud computing, big data analytics and real-time machine to machine control.

What is EOS?

The EOS solution puts ILR into action at Rogers Arena. The solution collects 5,000,000 data points a day from the building and a number of external sources. The data is then used to derive an optimal plan for the building. The optimal plan is then actuated through an off-the-shelf integration with multiple pre-existing building controls systems – Johnson Controls, Trane, Douglas and CIMCO.



EOS optimizes the Rogers Arena every one to five minutes depending on what frequency the existing controls network can withstand.

1. Constant, real-time analysis of all of the data points and parameters that influence energy and occupant comfort in buildings.
2. Constant re-adjustment of the parameters impacting equipment and building performance.

In the case of EOS, this adjustment is actuated automatically using the existing Building Automation System (BAS).

EOS Engineering Implementation

EOS is home to 16 core optimization strategies (and growing). These optimization strategies each manifest in a number of associated algorithms – all housed in our cloud-based data center. Since no two sites are alike, EOS cannot simply be implemented without the need for a deep building understanding and a subsequent assessment and mapping of these strategies and their savings potential to the building itself. The EOS solution has been designed so that the product and platform remain unchanged from building to building, but the implementation of the core optimization strategies varies greatly. This means that each EOS customer undergoes an engineering implementation in order to take advantage of the EOS solution.

1 Site Assessment

Before SHIFT can optimize a building with EOS, we must first have a detailed understanding of the equipment and layout of the building. At Rogers Arena, we decided to focus on HVAC first as it was a major component of the energy consumption expense, especially in the wintertime when the optimization stage began.

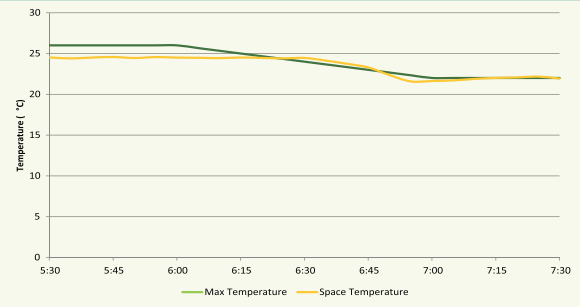
Our engineers initially focused their research on the air handling units (AHUs) – the type and number, which spaces they serve, whether they are constant or variable air volume systems, whether they have heating or cooling coils, what types of terminal units they supply, etc. Through a combination of discussions with operators, review of drawings and site inspections, SHIFT was able to develop a thorough understanding of what optimization strategies made sense at the arena. This understanding would later be programmatically modelled in EOS.

Mapping AHUs to Spaces

The assessment phase identified several Air Handling Units (AHUs) that could be optimized right away by either adjusting their sensor feeds with the help of scheduling data integration or switching them off for unoccupied areas. This drove the development of a number of algorithms related to matching energy use to space needs.

One of these strategies was the implementation of a dynamic calculation of ramp rates to ensure space requirements were met “just-in-time” and only for the minimal required duration.

Ramping for Events

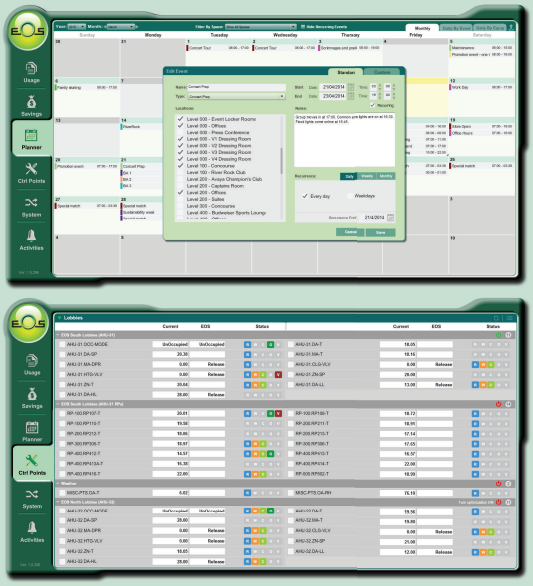


A ramp rate is the speed that an AHU is capable of changing the temperature in a space. It is dynamic based on weather conditions, equipment performance and schedule. Calculating the ramp rates for all spaces allows EOS to turn AHUs on at precisely the required times in order to make the space comfortable in time for an upcoming event.

2 Optimization

EOS started optimizing the AHUs by running each AHU optimally for the events that were taking place in the spaces served by the AHU at any given time. Fresh air was used to help with cooling and (rarely) heating, taking into account outside air humidity and freeze protection issues. Simultaneous heating and cooling; i.e., heating or cooling air at an AHU and then doing the opposite operation at a terminal unit, was largely eliminated.

Location Based Scheduling



Many Build Automation Systems have scheduling capabilities. What sets EOS apart is its location-based scheduling functionality or “Planner”. Instead of having the user schedule AHUs to run at certain times, EOS’s Planner asks only what type of event is happening in which space. It then uses that schedule to derive the proper space requirements (e.g., fresh air, maximum temperature, minimum temperature). For example, AHU-03 serves the Canucks dressing room and a number of other miscellaneous spaces. Since the other spaces are generally unoccupied according to Planner, EOS can allow AHU-03 to only concern itself with the Canucks dressing room.

Ramping Space Conditions

The locations based schedule also helps EOS better ramp space conditions in preparation for upcoming events. If EOS is running an air handler for the sole purpose of cooling the Level 300 Concourse at the Rogers Arena, then it does not need to use any hot outdoor air, nor is there any concern about blowing cold air on people in the concourse. This allows EOS to ramp space conditions faster and more efficiently.

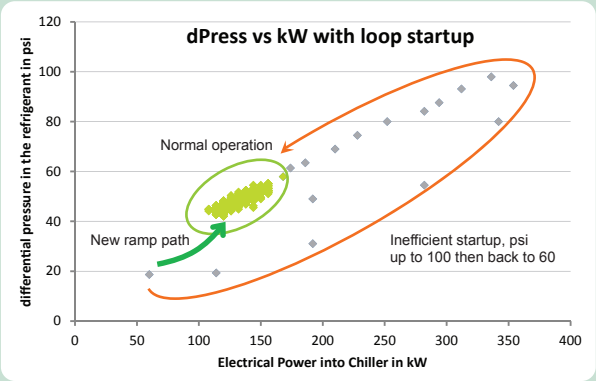
3 Integration

Our engineers then began to focus on integrating different energy systems together in one common building eco-system. This not only enables operators to centrally control all systems, but also results in improved optimization and reduced total energy use.

The first application of this was to have EOS control the arena's chiller plant.

Chiller Optimization

Previously, EOS shuts the chiller off if nothing in the building calls for cooling, regardless of how hot it is outside. It also shuts the chiller off if all of the presently occupied areas will become unoccupied sooner than they will get too hot. Furthermore, EOS coordinates the downstream cooling valves to maintain a part load at the chiller "sweet spot" in terms of efficiency.



Weather Conditions

EOS purges spaces with cool outdoor fresh air at night when it is advantageous. EOS connects to the weather forecast for the Rogers Arena, and uses it along with the schedule for the arena to determine which equipment should run at night to achieve energy savings.

Lighting Optimization

EOS automates the shut down of lighting when not needed. EOS balances daylight and electric lighting in spaces with access to outdoor lighting.

Operations

The Vancouver Canucks operations team was trained on EOS in May 2014. Their day-to-day operations are largely unaffected by EOS. The EOS dashboard is always running in the "control room" so they can verify that the system is meeting their requirements. Scheduled events are automatically uploaded from their central planning function. When an unscheduled space is required on the spot, the operators add the new event in the Planner rather than scheduling each piece of equipment in the building controls directly.

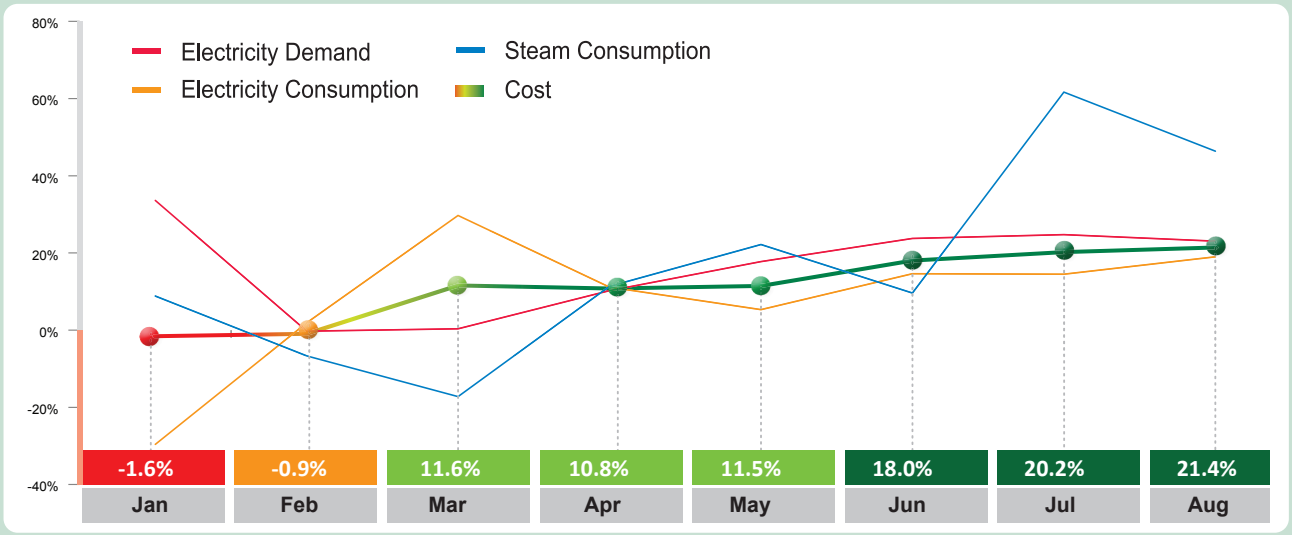
EOS running building 24x7

Operators now trained on EOS

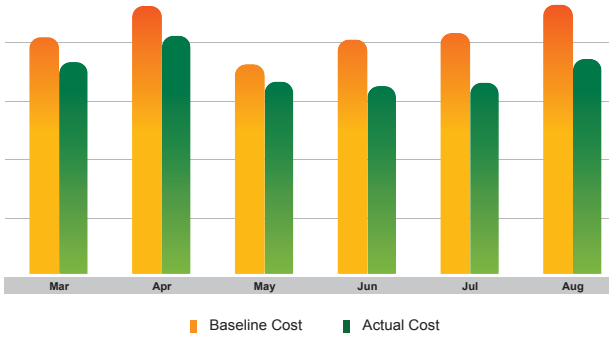
Savings

EOS started running unsupervised in April, 2014. At the time, the weather was still cold enough in Vancouver for EOS to generate significant savings on steam, mostly by eliminating simultaneous heating and cooling and tailoring fresh air to space requirements.
The graphs below shows the savings results.

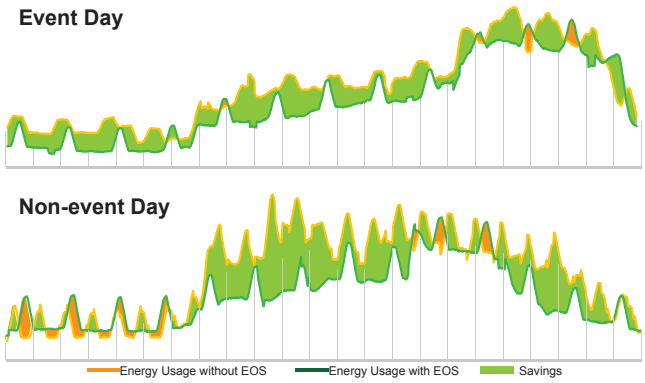
Incremental Savings



Actual vs Baseline



Daily Comparison



More recently, EOS has continued to save energy by reducing the work required by the chiller through more efficient ramping and integrating the chiller plant controls with weather forecasts and the requirements of every AHU.

In May 2014, considerable demand savings were also introduced by implementing EOS's demand control strategies. These demand control strategies were then deployed throughout the arena. By June, EOS was humming and trimming about 20 percent of energy cost out of the building.

In September, EOS was mainly turned off while the Canucks upgraded their Johnson Controls system and integrated a construction project. This was reflected in the savings. The Daily Comparison graph here shows comparable days in terms of space use and outdoor air temperature with EOS on and off.

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