

CITY OF BOULDER FIRE-RESCUE DEPARTMENT'S SUSTAINABILITY AND RESILIENCY RECCOMENDATIONS AND REPORT

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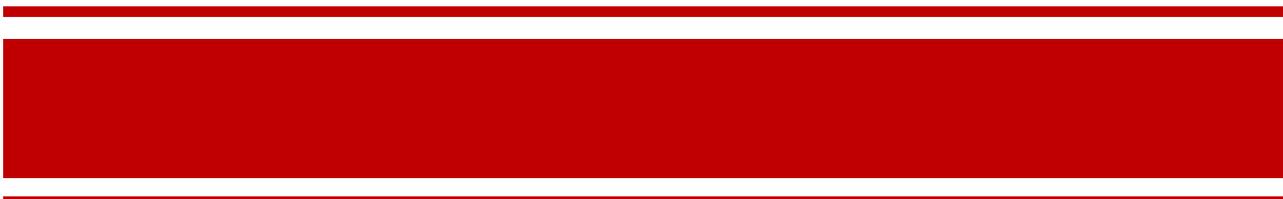
BFRD'S SUSTAINABILITY AND RESILIENCY COMMITTEE

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OCTOBER 30, 2019





Mission Statement:

*We exist to protect lives and property
from harm through effective risk reduction,
emergency response, and recovery assistance.*

Vision Statement:

People first, safety always, excellence in all we do!



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Sustainability and Resiliency Plan

presented by

City of Boulder Fire-Rescue Department's

Sustainability and Resiliency Committee

Boulder, Colorado

Submitted to:

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Introduction

Scope of Plan

This document is a continuation of the department's Sustainability Plan completed in 2013. After a thorough evaluation, the Sustainability and Resiliency Committee has identified additional opportunities and recommendations for Boulder Fire-Rescue Department's (BFRD) to increase its efficiency and reduce its carbon footprint. Furthermore, this report is specifically aimed to identify high priority needs and pinpoint solutions to inefficiencies in the fire stations, emergency operations, training and employee travel to and from work. This revision of the Sustainability and Resiliency Plan intends to build on BFRD's achievements since the 2013 version by establishing new goals related to energy efficiency; explore ways to reduce greenhouse gas (GHG) emissions associated with the department's operations; address the department's role in preparing for and responding effectively to shocks and stressors to enhance the community's resiliency; and continue to serve as a reference when making future decisions and for master planning.



Sustainability and Resiliency Plan Summary

The Boulder Fire-Rescue Department (BFRD) has committed to and made it a priority to become a leader in sustainability for the professional firefighting industry nationwide and its local community. This Sustainability and Resiliency Plan will make recommendations on how the department can continue to stay viable in the future. While BFRD is proficient in providing emergency services that meet national standards and the community's needs, this document is intended to guide the department's long-term planning regarding its sustainable efforts and is designed to be revisited annually to track progress in specific areas to identify how successful the endeavors have been.

The BFRD's Sustainability and Resiliency Plan creates a systematic way to align specific areas of the department with the Boulder Valley Comprehensive Plan's (BVCP) recommendations in order to obtain greater success with its sustainable efforts. The Sustainability Framework features the same sustainability framework utilized in creating the BFRD Master plan and is categorized according to the BVCP's policy areas. Recommendations are to be evaluated against the City of Boulder's program-based budgeting approach. For example, BFRD's day-to-day operations have been assessed to understand what the department is responsible for, how it can make changes to its sustainability goals, what initiatives BFRD has been successful in implementing, and which ones require some additional attention or funding.

Furthermore, the recommendations contained in this document are intended to build a comprehensive and resilient guide for BFRD to use as a compass, and by utilizing the Sustainability Plan as a tool, the organization can aid itself in regulating the community's expectations while still being a flagship for emergency services.



Accomplishments

In support of the Boulder Valley Comprehensive Plan, the Sustainability Committee has set the target of supporting department initiatives that also fit the criteria of the BVCP. Created in 2010, the BFRD Sustainability and Resiliency Committee sought to address action items identified in the Tri-Data produced report. As most items dealt with sustainability, it naturally led to the creation of the original sustainability plan in 2013. Furthermore, BFRD has set the goal of incorporating practical, sustainable initiatives where possible that do not negatively impact its operational mission. In collaboration with the City of Boulder's Facilities, Information Technology and Fire-Rescue Departments, the resulting accomplishments since that time are listed below.

Operations:

- **Schedule for fire field personnel changed to 48 hours on/96 hours off.**
 - Changing the work schedule of the BFRD field personnel cut commuting frequency with the goal of reduced emissions by employees driving in and out of Boulder.
- **Fire Headquarters' staff are allowed to work a 4/10 schedule.**
 - BFRD Headquarters' staff are given the option to work a 4-days a week/10-hours a day schedule. Working this schedule means that personnel commute one less day to work weekly and reduces emissions from their personal vehicles commuting to and from work.
- **Fire Headquarters' staff can telecommute to work.**
 - Fire Headquarters' staff are given the option, if their position allows, to remote into work while not losing the ability to be productive in their assigned role. This reduces emissions from their personal vehicles commuting to and from work.
- **Revised shift start time from 6:50 to 7:00 a.m.**
 - The BFRD shift start time is now at 7:00 a.m. By changing the shift start time for the personnel of BFRD, it allowed for personnel to take alternative modes of transportation to work. Before the change, staff were unable to take RTD (the regional bus and rail transit service) to work because bus arrival times occurred after shift change. However, the goal missed the mark as this mode of transportation is underutilized due to inefficiency for travel to work for prolonged shifts.
- **Supply Works contracted for station's consumable supply delivery.**
 - BFRD brought in Georgia Pacific and Supply Works to assess all fire stations for opportunities to reduce paper waste and to supply environmentally-friendly cleaning chemicals. The result of this assessment was working with Supply Works to deliver and provide all station facilities with high recycled content paper products for restrooms and kitchens, environmentally-friendly chemicals dispensed from a metered dispensing machine and economic savings.



- **Emergency Vehicle Technician added to Fleet Services.**
 - In collaboration with Fleet Services, it was identified that the department required fleet maintenance from an Emergency Vehicle Technician (EVT). The city's Fleet Services hired an EVT who has been fundamental in keeping the fleet in service which reduced emissions caused by taking fire apparatus to the local fire apparatus' dealership or the city yards for repairs.

Technology:

- **BFRD performed a technology needs assessment in 2018.**
 - The results of this assessment will aid in recommending the proper technologies both infrastructure and systems or programs to support the BFRD mission.
- **Changed to cloud-based computing for internal website and data storage.**
 - This change allowed BFRD to improve access and efficiency for internal communication, references, resources and shared data storage. The department, along with the City of Boulder, also migrated to the cloud-based Office 365 which created more resilient access on all devices regardless of the operating system.
- **BFRD rolled out iPhones for front line apparatus.**
 - All fire apparatus have a cell phone as a secondary communication device, and iPhones improve efficiency on scene of emergencies for crews by allowing them to access the internet for research, using fire service-specific apps, or FaceTime for remote communication.
- **iPads for inputting fire inspections.**
 - BFRD purchased a Wi-Fi iPads for each fire apparatus to utilize for preplanning of buildings in the city to note special features, utilities and so on.
- **Automatic vehicle locating hardware and software implemented to dispatch closest fire station crews to a call.**
 - Automatic vehicle locating was implemented by the BFRD to improve response times to emergencies and reduce the distance traveled by apparatus if one happens to be closer to an emergency call.
- **ACTIVE 911 app purchased.**
 - To create a redundant and more robust emergency notification system, BFRD purchased the ACTIVE 911 app for all personnel to use. The app notifies personnel of emergencies and offers mapping to expedite routing to the call which increases the efficiency of vehicle technology and reduces GHG emissions.



- **Telestaff by Kronos purchased as staffing software to manage daily personnel assignments.**
 - This electronic software has been utilized since 2011 and is how staffing, leave usage, and hours worked are tracked for the department. This staffing program has significantly improved efficiency for staffing and reduced staffing errors, and it has also reduced paper consumption by eliminating the need for paper rosters to track personnel.

- **BFRD installed all-in-one printing equipment in its facilities.**
 - All-in-one printing equipment allows personnel to print, scan or copy documents from their facility. In addition to the installation and purchase of these machines, the city contracted for Follow Me Printing to encourage personnel to scan documents or email them before printing. This feature also reduces the number of documents left at the printer, thus, reducing waste throughout the year.

- **BFRD installed LED monitors in every fire station to display mapping and directions to an emergency call.**
 - LED monitors installed in all fire stations display apparatus status, emergency call mapping and weather information. The flat screen monitors are energy efficient and also improves personnel response by displaying directions which allows them to get to the emergency call sooner.

- **BFRD implemented Emergency Medical Dispatching (EMD).**
 - The City of Boulder's communications department oversees the 911 call center and fire dispatching. With the implementation of an EMD program, it cut down on GHG emissions from fire apparatus responding to an emergency medical call versus dispatching only an ambulance to adequately handle the call alone.

- **BFRD utilizes Fire Priority Dispatching System to improve emergency response.**
 - When an emergency call comes in to a 911 dispatcher, the dispatcher asks questions to ascertain the type and severity of the emergency. Establishing a Fire Priority Dispatching System standardizes a unified format that dispatchers match the emergency response type to the seriousness of the incident. This system ensures that the appropriate number of units are sent to a call and reduces vehicle emissions from extraneous apparatus response.

- **BFRD utilizes teleconferencing to reduce unnecessary traveling for meetings.**
 - After the city replaced its phone system technology, the new phone system featured a meeting place conference call which allowed multiple personnel to meet via phone conferencing. The incorporation of the morning conference call has cut down on face-to-face meetings and reduced GHG emissions by eliminating unnecessary traveling.



Facilities:

- **Professional energy audit of all BFRD facilities providing a baseline of greenhouse gas production and inventory.**
 - The BFRD Sustainability and Resiliency Committee recommended that the department perform a GHG baseline report. Initially performed in 2008, the city contracts to have additional GHG baseline assessments performed annually.
- **Occupancy sensors added to facilities for lighting control.**
 - After adding occupancy sensors to certain locations within BFRD facilities, additional sensors were requested to increase energy efficiency and usability.
- **CFL lighting in place of incandescent.**
 - Lighting in facilities has been changed to CFL where possible.
- **Waste sorting program adopted at BFRD facilities.**
 - BFRD has supported the city's goal of waste reduction through recycling and composting and has implemented this program at BFRD facilities.
- **BFRD facilities assessed for air infiltration.**
 - To mitigate against air infiltration contributing to increased energy use, all BFRD facilities were assessed, and improvements were implemented to reduce energy demand and waste.
- **BFRD apparatus bays were retrofitted with radiant heating.**
 - BFRD fire and emergency response vehicles are kept in heated bays to prevent damage from water lines freezing within the fire pumps in wintertime and keeps the apparatus bays warm which utilizes a large amount of energy. Retrofitting all apparatus bays with radiant heaters lets the objects in the bay to warm-up, not the air. Therefore, when the bay door is opened allowing for the fire apparatus to respond, it takes far less time and energy for the space to recover heat loss.
- **Water-wise devices installed.**
 - Faucets and showerheads at facilities were changed out for water-saving fixtures. Low flow toilets and urinals were installed in new facilities, and older devices are replaced with a water-efficient model when their service life has ended.
- **Renovations use Low VOC and sustainable materials**
 - When renovations and remodels are performed at BFRD facilities, low VOC and sustainable materials are sourced to support the city's sustainability goals and to provide a safer environment for personnel.



- **BFRD installed a station notification system that uses LED lighting to alert personnel of an emergency call.**
 - The BFRD contracted with FirstIn to outfit all fire stations with a modern emergency alerting system to replace the antiquated system. The new system uses LED technology for alerting lighting, hallway lighting and at night changes efficient mode.
- **BFRD built a LEED standard Wildland fire station.**
 - The City of Boulder has identified that there is a high potential for a wildland fire event close to city limits. As part of the commitment to preparing the BFRD to respond to a wildland fire event, the city built a state of the art, LEED Silver Standard fire station staffed by full-time wildland firefighting personnel to support the year-round wildfire threat. By having full-time personnel assist in mitigation and extinguishment of wildland fires, the size and severity of wildfire incidents will be reduced which will, in turn, reduce the GHGs produced from a wildland fire event.

Fire Apparatus:

- **All fire apparatus purchased by BFRD are equipped with a low-emission engine that can also utilize higher percentages of Biodiesel.**
 - Fire apparatus are not commonly perceived as low emission types of vehicles; however, the industry is changing to meet new standards set by the Environmental Protection Agency (EPA). Thus, BFRD fire apparatus are being equipped with technology that allows for better emission control without sacrificing fuel economy which results in a substantial reduction of unburned hydrocarbons, carbon monoxide, and particulate matter compared to emissions from diesel fuel.

Community Risk Reduction:

- **BFRD Community Risk Reduction performs all re-inspections of businesses for fire code violations in place of fire station crews.**
 - The Community Risk Reduction Division now performs re-inspections of businesses for fire code violations. Before 2010, fire station crews would perform a re-inspections of fire code violations of businesses. Once the Community Risk Reduction Division took over these duties, the result was a reduction in fire engine miles driven to conduct re-inspections and a reduction in emissions. This change also benefited the department by increasing the efficiency in completing annual fire inspections.



Training:

- **BFRD's Training Division has constructed a sustainable plan for the department's fire rescue education.**
 - BFRD's Training Division created a sustainable long-range, comprehensive plan for training. Considerations regarding building construction, wildland fire, city infrastructure improvements, increased population and a more dense community all present different areas that require additional planning. The Training Division has addressed the department's needs to develop fire rescue personnel to respond to emergencies with the knowledge skills and abilities required for the modern-day fire service.
- **BFRD training division purchased online textbooks.**
 - The BFRD training division has purchased digital textbooks in addition to traditionally printed textbooks. The goal with the digital copies is to reduce the need of printed copies and associated paper waste and to create greater access to reference resources.
- **BFRD training division utilizes Target Solutions database management software to retain digital copies for proof of certification.**
 - In order to consolidate software and centralize databases for tracking training records, the BFRD Training Division implemented Target Solutions for use. This has significantly decreased the number of paper files needed to track personnel's training records. Furthermore, it supports Insurance Safety Office (ISO) data tracking and allows for video training in lieu of driving to the facility which further reduces GHG emissions.

Miscellaneous:

- **BFRD utilizes reusable shopping bags for department personnel.**
 - To support the city's waste reduction initiative, the Community Risk Reduction Division purchased reusable bags for personnel to use when purchasing items in the city.



GHG Emissions and Energy Use

Emissions by Sector

The Boulder Fire-Rescue Department's Sustainability Plan reassesses the department's energy use and associated greenhouse gas emissions from several sectors as seen in Table 1. These sectors are Buildings, Employee Commute, Vehicle Fleet, Business Travel, Materials, Solid Waste and Water Treatment. This reassessment estimates the potential decrease or increase in energy use or greenhouse gas emissions based on industry standards for emission facts for an energy source.

Part of this reassessment includes comparing the results of a fire department-specific greenhouse emissions inventory conducted in 2008 versus the results of a 2017 study. This comparison shows how emissions related to BFRD activities have changed over time. In some sectors, BFRD has been able to reduce emissions; however, in other areas, emissions have increased. For example, the Buildings sector has seen an increase in emissions of approximately 37% while employee commuting has estimated to have decreased by almost 50%.

During the process of creating the revised BFRD Sustainability Report, it was discovered that some of the methodologies for calculating greenhouse gas emissions might have changed. For example, the initial McKinstry GHG Report analyzing BFRD activities in 2008 estimated 59 mtCO₂e for business travel for the Boulder Fire-Rescue personnel. However, the City of Boulder's inventory estimated 43 mtCO₂e for all city personnel.

For this reason, the BFRD Sustainability and Resiliency Committee recommends that several studies specific to the department's activities need to be conducted to calculate the levels of greenhouse emissions from its activities accurately. Specifically, Consumptions, Business Travel, Solid Waste and Water Treatment sectors need more detailed study.

Table 1

Comparison of BFRD's GHG Emissions from 2008 to 2017

	2017 Emissions (CO ₂ e)	2008 Emissions (CO ₂ e)	Percent Change from 2008 Level	Potential Levels in 2019 due to energy efficient projects
Buildings	548	399	37%	406
Employee Commuting	246	493	-50%	246
Vehicle Fleet	522	392	33%	522
Business Travel *	0.91	59	-98%	1
Consumption *	12	19	-39%	12
Solid Waste *	9.2	5	84%	9
Water Treatment *	0.26	2	-87%	0.26
Total	1338	1369		1196



Fire Facilities' Energy Use

Boulder Fire-Rescue Department's operations are conducted from eight fire stations, a training facility and the fire department's headquarters. The eight fire stations are located strategically throughout the city while the training facility is located at the Boulder Reservoir, and headquarters is housed within an office building shared with other city departments on the east side of Boulder. A majority of BFRD's building energy use and the related emissions come from electricity and natural gas use. For this reason, the section on facilities' energy use is primarily focused on finding ways to minimize that impact.

In 2008, McInstry Construction Company performed an energy use audit for the fire department. The report showed that the total emissions for all buildings were approximately 280 MTCO₂ for electricity and 119 MTCO₂ for natural gas use, for a total of 399 MTCO₂. Since that audit, efforts to minimize energy use were implemented, but there was a 37% increase in the total emissions from facilities energy use alone attributed to the department. This increase is primarily due to the training facility that was built in 2011.

In 2017, the total energy expenditure related to all fire department activities was 558,613 kWh of electricity and 40,887 Therms of natural gas (*See Table 2.*). This roughly equates to a total of 568 MTCO₂. Most of the energy use and the associated emissions were contributed to the fire stations' operations and the training facility. Together, the eight stations utilized 376,623 kWh of electricity and 27,721 Therms of natural gas, or approximately 67% of total electricity and natural gas use (*See Figure 1.*). This equates to around 370 MTCO₂. Many factors contribute to the differences in energy use per station. Some of these factors are the age of the buildings, quality of insulation (specifically bay doors, station windows), heating and cooling efficiency, size of the buildings, number of apparatus and personnel operating in the buildings. The majority of the remaining energy use, 175,987 kWh and 13,166 Therms, was attributed to the training center's operations. This accounts for approximately 32% of total electricity use, 32% of total natural gas use and approximately 174 MTCO₂. A minimal amount of electricity was utilized for the operation of a storage building that houses the reserve fire apparatus, approximately 4000 kWh, or near 1%.

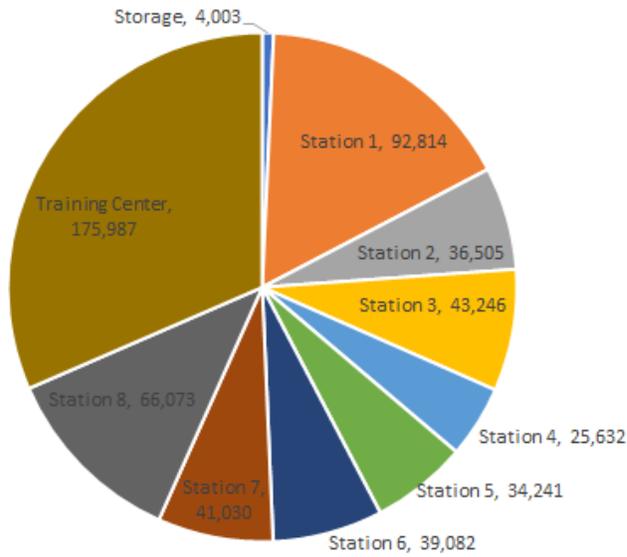
Table 2

Total Energy Expenditure Related to All Fire Department Activities in 2017

Facility	kWh use	Therms
Storage	4,003	-
Station 1	92,814	4,483
Station 2	36,505	2,426
Station 3	43,246	4,350
Station 4	25,632	1,892
Station 5	34,241	2,190
Station 6	39,082	3,227
Station 7	41,030	5,532
Station 8	66,073	3,621
Training Center	175,987	13,166
Total energy consumption	558,613	40,887
MTCO₂	331	237



Electricity Use per Station 2017 (kWh)



Natural Gas Use per Station 2017 (Therms)

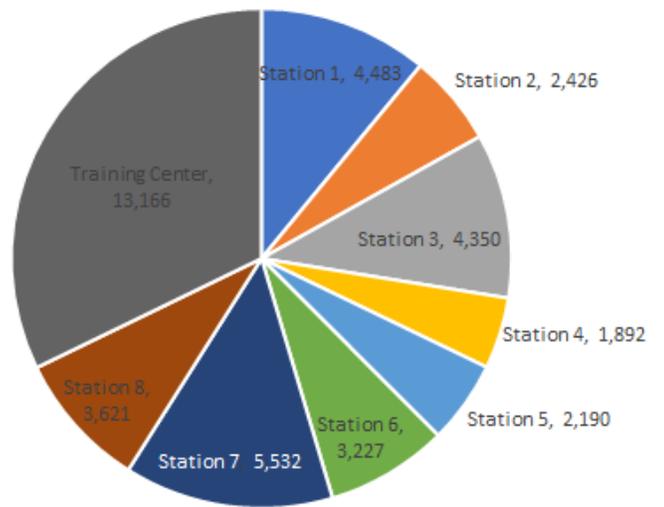


Figure 1. Breakdown of BFRD Facilities' Electricity and Natural Gas Use in 2017



Facilities' Offset Potential of Energy Use

Solar Panel Installation

In 2018, an analysis was made to identify sites throughout the city of Boulder that would be most suitable for installation of additional solar panels to offset some of the electricity usages by the city's facilities. The Boulder County Regional Fire Training Center was identified as one of the sites ideal for such upgrade. Preliminary conversations among the stakeholders indicate that a solar panel site could be installed at this location. Generating approximately 239,000 kWh annually, the site would offset a majority of the electricity usage for Station 8 and the training center. Furthermore, this project could be completed within a relatively short amount of time and potentially bring Boulder Fire-Rescue Department's emissions/energy use numbers back down to 2008 levels.

Station 7 was also identified as an additional site for potential solar panel installation. Preliminary estimates indicate that a 14kW roof-mounted system could generate approximately 20,000 kWh of electricity which could offset about 50% of the station's electricity demand. In addition, this system could be expanded to generate more electricity. Based on the size of Station 7 and the proposed 14 kW system, the new reserve apparatus structure could be large enough to accommodate an additional 10-15kW set of panels. This could have the potential of producing an extra 15,000-22,500 kWh of electricity annually and offset the electricity use of the storage facility and the remaining use of the station. This option would also be more financially sound since larger solar systems generally are less expensive to install.

With the abovementioned systems in place, BFRD would be well on its way to significantly reducing its energy consumption below 2008 levels. Additional sites have been earmarked for future evaluation regarding a potential solar panel installation. These sites include Station 1, 5 and 6. Together with Station 7, these four stations utilize 202,642 kWh of electricity. If solar panel systems are put in place to offset even half of this energy demand, BFRD would significantly reduce its emissions and energy use by about 100,000 kW. This course of action would be in line with a goal established in the 2013 BFRD Sustainability Plan to install solar panels on the highest GHG production stations first.

There are two available options for BFRD to consider for solar power: to buy the panels outright or to lease the solar panels. Currently, the option to lease solar panels from a vendor is being pursued. The power generated from the solar panels would be sold to BFRD at a cheaper cost than the power currently being bought from Xcel Energy. Also, with leasing the panels, BFRD would not be responsible for the installation of the infrastructure of the system but would be merely leasing the roof space or designated space for the panels' installation.

Financial Impact of Solar Project

City of Boulder's Facilities Management is in charge of overseeing the expenditures for the energy use related to the operations of the fire department stations. A line item is added to every budget year estimating the cost for the fire station operations. While the installation of solar panels will not directly impact the BFRD budget, it will most certainly impact the Facilities Management budget when it comes to fire department activities. The proposed solar panel installation at the Boulder County Regional Fire Training Center would save a significant amount of money over a 30-year lifespan. In its first year of



operation, this system could offset approximately \$6,800. It is assumed that with a 4% escalation this return would grow significantly over the 30 years, and in the year 2049, it could offset an estimated \$37,000 for that year. The total savings over the lifespan of the system could be close to \$560,000. If used appropriately, each year's funds that are offset could be utilized to develop additional solar sites throughout the City of Boulder or could be utilized to maintain the established system for optimal operations.

Comparatively, the proposed solar system at Station 7 would not be as profitable as the Training Center system based on the anticipated rates of the power purchase agreement. Moreover, as of right now, if the proposed system was to be installed just on the station itself, it would potentially be at a cost to the City the Boulder even though it would contribute to the offsetting of greenhouse gas emissions. For example, the first year would cost approximately \$1,700, and the accumulative cost over the system's life span would be roughly \$42,000. Even if the proposed system was to be expanded to accommodate an additional 10-15 kW set of solar panels on a yet-to-be-built reserve apparatus storage building, it would not generate enough electricity to provide cost savings.

Overall, installing both systems would still be a benefit to the city financially and in regards to reducing greenhouse gas emissions. With both solar panel systems in operation, the city could save approximately \$520,000 over the 30-year life span.

Alignment with the Boulder Valley Comprehensive Plan

The goal to establish solar energy as one of BFRD's energy sources ties into the Boulder Valley Comprehensive Plan (BVCP) to address the impacts on the natural environment through promoting energy-efficient and climate sound projects and promoting business practices that focus on economic resilience (2015 BVCP, Sections 2, 3, and 5). BFRD believes that its fire stations and facilities should be community landmarks and, as such, should be constructed to reflect community values and embrace sustainability. Inclusion of solar energy technology and other sustainable actions will showcase the fire department as an example of environmentally, fiscally and socially responsible practices.

Other Facilities' Energy Use Mitigation Strategies

While the inclusion of solar panels to offset BFRD's energy demands is a sound approach, this method should not be a "be all, end all" solution to the department's energy dilemma. Alongside implementing solar energy sources, BFRD should consider an extensive investigation into minimizing energy loss from its current buildings.

For instance, some of BFRD's stations are old and have reached the end of their functional life span. Despite being remodeled many times over, this aging infrastructure has many areas that lead to energy loss, particularly regarding heating and cooling. In the wintertime, the station's bay doors do not adequately seal and lead to energy loss. Cold air enters the bay area, causing the heater to cycle on many times more than necessary. During the summer, the apparatus bay cannot adequately let the air that is heated by the fire trucks to escape. This results in the building's thermal mass increasing in temperature, causing the entire building to be a lot warmer resulting in the higher air conditioning use.



As not all departmental facilities received the same efficiency improvements in 2011, the BFRD Sustainability and Resiliency Committee recommends that BFRD or Facilities Management implement the CIF for the remaining facilities' to make improvements that can be implemented. This improvements should include, but not be limited to:

1. Energy-efficient lighting
2. Motion sensor lighting controls
3. Thermo sealing of buildings
4. High-efficiency heating ventilation air-conditioning systems
5. High-efficiency water heaters
6. Low flow faucet aerators in kitchens bathrooms and low flow showerheads
7. Level of light-activated/temperature regulated blinds
8. Smart thermostats
9. Level of light-activated lights

Other Alternative Energy Sources

BFRD should investigate the use of other sources of energy production for its facilities, such as wind turbines. This could be purchased either by utilizing wind credits for the electricity produced or installing small-capacity turbines in suitable areas. Wind turbines are inexpensive and require less maintenance than other alternative energy sources. One drawback to wind turbines is the height needed for a turbine to maximize its efficiency. There are small wind turbines that can be installed at lower elevations, but they will not generate enough electricity to justify the cost.

In addition, the BFRD Sustainability and Resiliency Committee recommends that the department should participate in a carbon offset program. By purchasing carbon offsets, it would decrease the total GHG emissions for BFRD and bring the department closer to being a net-zero department.

Employee Commute and Business Travel

The city has been tracking energy use for City of Boulder related operations since 2008. This tracking system shows the overall greenhouse gas emissions and energy use for various sectors (e.g., buildings and facilities, materials, employee commute, etc.). Since 2008, several sectors have managed to reduce their energy use and GHGs. However, some sectors have maintained the same emission levels for several years now. Among those is the employee commute sector.

In 2008, a fire department-specific greenhouse emissions inventory was conducted. Part of the process included a survey to evaluate the commuting habits of BFRD personnel. This survey indicated that, on average, their minimum one-way commute was 28 miles and that 90% of employees commuted to work alone utilizing a vehicle with 20.4 miles per gallon range. This process concluded that employee commuting emissions totaled 493 metric tons of CO₂e (MTCO₂e) and comprised the most substantial portion of total BFRD emissions (36%). The commute-related emissions were based on a work schedule that was quite different than what is currently implemented.



Before 2009, BFRD operated on a 24hr-on/24hr-off, 24hr-on/24hr-off, 24hr-on/96hr-off work schedule. In 2009, BFRD switched to a new operating schedule of 48hr-on/96hr-off. This, in essence, cut the commute times in half and theoretically cut the emissions related to the employee commute in half as well. Assuming that the average commute distance, the vehicle efficiency and fuel type mix has remained the same, the total emissions related to employee commute could be estimated at approximately 246 MTCO_{2e} for the year 2018. In essence, BFRD was able to reduce its emissions by half just by altering the work schedule. However, the 2008 inventory assumed some of the estimates based on a 53% employee response rate to a survey. Therefore, the sustainability and resiliency committee believes that the BFRD needs to conduct an internal study specifically for the BFRD employees to accurately evaluate the impact of commuting on the department's emissions from home address. This study should include accurate distance, fuel type and efficiency of the vehicles. Additionally, increased employee participation should provide more accurate numbers to help determine the true impact of BFRD driving to work. A recommendation to investigate a residency requirement or distance from work should be looked into as an employment requirement for all n employees.

Commute-to-Work Alternatives

Alternative modes of transportation (e.g. bus, bike, vanpool, carpool, etc) that employees could utilize are available, and some employees can take advantage of these options. However, this number is quite low. Several reasons exist for the inability or inefficiency of using alternative modes of transportation:

- Distance to work: BFRD employees live on average 28 miles away from the city of Boulder. Some live even further away. It is difficult to find a bus service that runs a direct route for that distance.
- Schedule alignment with shift change: The Regional Transportation District's bus schedule does not align with the BFRD shift change well. It is quite easy for the arriving employee to miss the shift change and be late to work due to bus schedules not aligning.
- Carpooling difficulties: Many of the employees do not live close to each other. Some that do live near each other may not work on the same shift. Scheduled vacation or sick days are also a consideration. Another complication is if an employee has to leave work in case of a family emergency. That individual is stuck at work if they used their colleague's car to get to work, or the other individual is stranded at work if the driver has to leave early.
- Bike to work: On average, BFRD employees live 28 miles away from work. This is too great of a distance for someone to ride to work and then physically perform other strenuous work when they arrive at the fire station. Also, the amount of gear that each employee carries to work for a 48-hour shift is too cumbersome to haul on a bicycle.
- Position at work necessitates a personal vehicle: Many of the employees are "rovers." This position requires the individual to move to a different station every shift. In some instances, these individuals are required to move to different stations several times in the same 48-hour period. Rarely do rovers work at the same station for consecutive shifts to call it a "home station." Additionally, this position also requires the rovers to carry their fire protective gear, food and personal clothes wherever they go. Bringing this on to a bus or a bicycle is not feasible. Potential for losing an essential piece of



equipment is quite high and the task of lugging this much equipment every time a person goes to work would be too strenuous.

- Live closer or move to the City of Boulder: This option is appealing to many but the cost of living close to or within the City of Boulder is too high to consider. A large amount of income would be spent on trying to afford to live close to work.
- Electric Vehicles: Use of electric vehicles could reduce the emissions associated with work commute by a significant amount. The amount of emission reduction would depend on the source of electricity for those electric vehicles. Greenhouse gas emissions could be even further reduced if the electricity was produced by solar panels. However, the cost of electric vehicles and solar panel systems prohibits many from purchasing either. While the federal government and the State of Colorado provide incentives for purchase of electric vehicles and solar panels, for many the incentive does not bring the cost down significantly to commit to a purchase. Currently, only two BFR employees drive an electric vehicle to work. An incentive for others to invest in an electric vehicle could be an installation of solar powered charging stations at each fire station. These charging stations would allow an employee to top off their vehicle battery while at work and not worry about vehicle range on the way home.

While many employees would love to consider an alternative to their work commute, some of those alternatives would not be feasible for a long period of time due to complexity and difficulty while others would not work due to cost of implementation.

Vehicle Fleet

Boulder Fire-Rescue utilizes a variety of vehicles for emergency operations and administrative work. The operations division vehicles utilize both diesel and gasoline, while the administrative vehicles are primarily gasoline vehicles. The smaller vehicles such as the battalion trucks and Type 6 wildland trucks run on gasoline. All but one of the fire trucks run on diesel. Currently, there is no engine type in the industry that can provide the same level of performance than a diesel engine. Over the years, diesel engines have been upgraded with additional technologies such as turbochargers, selective catalytic convertors and diesel exhaust fluid (DEF). Some of the elements added improved the fuel economy while others targeted a reduction of greenhouse gases. Boulder Fire-Rescue replaces its vehicles based on a rotation schedule with the oldest truck usually being replaced first. For this reason, the current age of the fire trucks ranges from early 2000s to the most recent purchase in 2019. Only the newer trucks have the emission-reducing technologies such as diesel emissions fluid (DEF). DEF targets nitrogen oxide particulates (NOx) and prevents them from being emitted into the air.

In 2017 BFRD utilized a total of 57,661 gallons of fuel for day-to-day emergency operations and administrative work (*see Figure 2*). This fuel usage equates to approximately 522 MTCO_{2e} (*see Figure 3*). This number includes emissions from gasoline, diesel, biodiesel, and ethanol (E-85). The 2008 GHG inventory estimated the BFR greenhouse gas emissions from the fire department's fleet to be approximately 392 MTCO_{2e}. While the variety of fuels used has changed since 2008 to include biodiesel, the overall emissions have increased by approximately 33%. As in 2008, the majority of 2017 emissions, roughly 91%, from fuel use came from the use of diesel fuel which powers the fire trucks (*see Figure 4*).



The 2008 inventory approximated that the entire BFRD vehicle fleet had driven about 240,000 miles. The 2017 inventory indicates that the entire fleet has recorded around 258,000 miles. The increase in miles driven between 2008 and 2017 is only 8% or 18,000 miles. Assuming that the 18,000 miles was attributed to a diesel fire truck, the emission equivalent to travel this distance would be approximately 41 MTCO₂e. If mileage was to be used for emissions calculations, the 2017 emissions should only equate to 433 MTCO₂e. This difference uncovers a discrepancy between the original and current inventory and potentially the accounting methods.

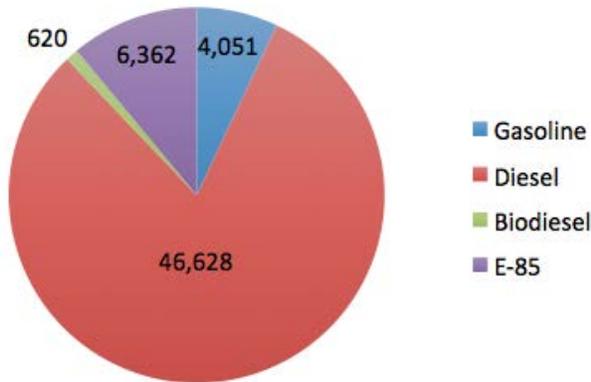


Figure 2. Boulder Fire-Rescue's 2017 Vehicle Fleet Fuel Use in Gallons

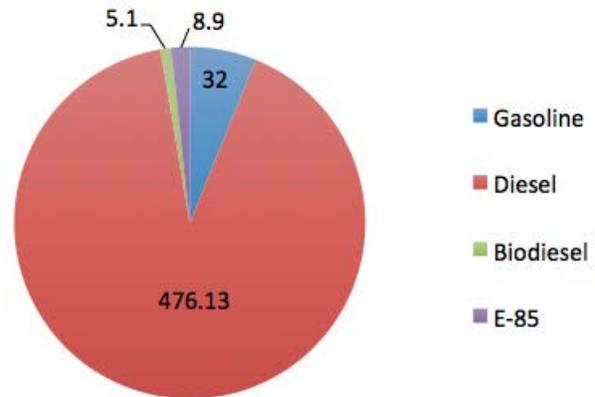


Figure 3. Boulder Fire-Rescue's 2017 Vehicle Fleet Fuel Use Emissions in MTCO₂e

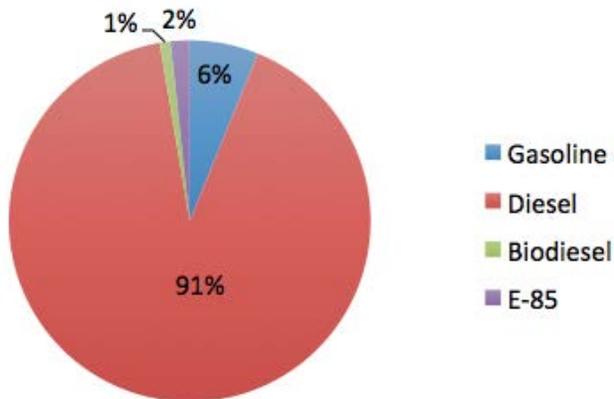


Figure 4. Boulder Fire-Rescue's 2017 Vehicle Fleet Fuel Use as Percentage of Emissions

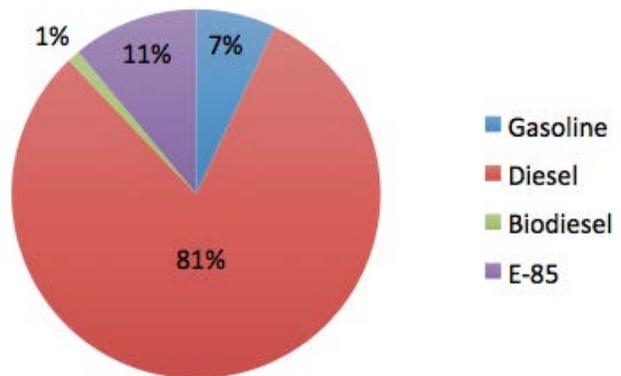


Figure 5. Boulder Fire-Rescue's Vehicle Fleet Fuel Use as Percentage of Total Gallons



Solid Waste, Consumptions and Wastewater Treatment

Estimates for greenhouse gas emissions from solid waste, consumptions and wastewater treatment were made using the 2008 levels of use and then extrapolated for 2017. Presently, BFRD does not have specific data for these sectors. Further studies are recommended to evaluate the true impact of these sectors.

At this time, it is estimated that solid waste sector contributes about 9 MTCO₂e, consumptions 12 MTCO₂e, and wastewater treatment 0.26 MTCO₂e. The combined emissions from these three sources are not a great contributor to the overall emissions from BFRD activities. After an accurate assessment is completed, mitigation strategies can be developed and implemented.



Facilities and Resiliency

As stated previously in the Facility Energy Use section of this document, Boulder Fire-Rescue operates out of seven primary fire stations within the city as well as the Wildland Station 8 and the Boulder Regional Training facility located at the Boulder reservoir. These facilities represent the bulk of the department's energy use and emissions as well as our resiliency exposures. Of the seven primary stations, two are less than 30 years old. The others range from 40 – 62 years of service and have not had any major remodels. Station 3 is in the process of being replaced so it is not included in these recommendations. Assessing sustainable options and resiliency as it pertains to BFRD facilities, the remaining four stations represent the greatest area for improvement. Due to their advanced ages, updating or replacing these facilities would have the most impact in meeting the department's goals for sustainability and resiliency. Compared to modern fire station designs, the current BFRD fire stations present an opportunity to construct facilities that support the department's mission, showcase the sustainable and resilient goals, and be a point of pride for the community.

Station Information

Station #1 – Built in 1957 – 62 Years old - 7,941 Square Feet



Station #2 – Built in 1959 – 60 Years old - 4,757 Square Feet





Station #3 – Built in 1964 – 55 Years old - 6,160 Square Feet



Station #4 – Built in 1967 – 52 Years old - 3,498 Square Feet



Station #5 – Built in 1992 – 27 Years old - 3,716 Square Feet





Station #6 – Built in 1979 – 40 Years old - 3,435 Square Feet



Station #7 – Built in 2000 – 19 Years old - 5,081 Square Feet



The City of Boulder's Resiliency Strategy

According to the 100 Resilient Cities group, of which Boulder is a member, it is estimated that half of the infrastructure cities will have by 2070 has not been built yet. This presents a huge opportunity to begin long-term planning of major infrastructure needed within the next 50 years. This planning should include reducing stressors (i.e. shock multipliers such as an aging infrastructure) and preparing for shock events (unexpected or unpredictable events such as a fire, flood, or terror attack).

Three Strategic Elements

There are three strategic elements the City of Boulder's resiliency strategy focuses on which are:

- Connect and prepare – Prepare city and community for uncertainty
- Partner and innovate – collaborate to leverage assets and capacities



- Transform and integrate – embed resilience into city operations and systems

City of Boulder’s Sustainability and Resilience Framework Objectives

The Boulder Fire-Rescue Departments supports the city’s sustainability and resiliency objectives which are outlined below.

- **Safe** – Foster personal and community safety during emergencies and natural disasters
- **Healthy and Socially Thriving** – Supports the physical and mental well being of its community members
- **Livable** - High-performing, safe, well-maintained and attractive buildings and infrastructure
- **Accessible and Connected** – Safe, accessible transportation system
- **Environmentally Sustainable** – Preserve and responsibly use the earth’s resources
- **Responsibly Governed** – Excellent customer experience, responsibly manages the city’s assets
- **Economically Vital** – Promote a healthy and sustainable economy



Recommendations:

The following recommendations provide options for increasing our department resiliency by reducing stressors and preparing for shocks.

1) BFRD should incorporate a Life Cycle Funding Plan for CIF on all department facilities.

The BFRD Sustainability and Resiliency Committee recommends that a Life Cycle Funding Plan be incorporated in the departments budget to plan for Capital Improvement Funding for remodel and replacement at the end of life for the building. This solution is more sustainable and allows for long term planning to ensure the facilities support the departments mission and employees.

2) BFRD should perform a Life Cycle Assessment on all new fire station construction.

The BFRD Sustainability and Resiliency Committee recommends that a Life Cycle Assessment, or LCA, should be used in conjunction with designing sustainable, “green” fire stations. The American Institute of Architects recommends LCAs as



one of the best mechanisms for allowing architects and other building professionals to understand the energy use and other environmental impact associated with all the phases of a building's life cycle: procurement, construction, operation, and decommissioning. The output of an LCA can be thought of as a wide-ranging environmental footprint of a building — including aspects such as energy use, global warming potential, habitat destruction, resource depletion, and toxic emissions.

3) BFRD should set 72 benchmark for stand alone capabilities for all facilities and personnel.

The BFRD Sustainability and Resiliency Committee recommends that the department work to support its facilities and personnel for a minimum of 72 hours in the event of a natural disaster. This planning for resiliency is needed because emergency services can not experience an interruption in service delivery to the citizens of Boulder during a high impact event or natural disaster. The department should produce a self evaluation of its facilities and determine any improvements needed to make sure utilities would be able to stand alone for the minimum benchmark of 72 hours. The self evaluation should also include plan for locally sourcing resources to minimize shock to the system and stock anything that is not readily available locally.

4) BFRD should add to Standards of Cover Mobile Fuel contracts during natural disasters.

The BFRD Sustainability and Resiliency Committee recommends that the department add mobile fuel contracts to standards of cover to plan for natural disaster or large scale events. Currently fire apparatus fuel up at either the city yards, which is not geographically efficient for all stations, or at regular gas stations using a city fuel purchasing credit card. The apparatus are large vehicles and not always easy to maneuver into gas stations, especially during high traffic hours. This process also leaves BFRD vulnerable to shock events that could interrupt the usual delivery of fuel to gas stations. On-site fuel delivery during natural disasters would be more efficient and provide resilience to the stations in the event of a significant disaster and prolonged fuel shortages occur.

The following recommendations provide options for increasing our sustainability, both fiscally and environmentally as well.

5) BFRD should update the fire stations' exterior appearance when rebuilding or replacing facilities.

The BFRD Sustainability and Resiliency Committee recommends that the department works with FAM (Facilities and Asset Management department) to update the exterior of the fire stations in Boulder. Many of the BFRD stations are dated and/or repurposed residential structures. As can be seen in the station images above, several of the stations do not meet the "Livable" objective of the city's Sustainability and Resilience Framework.

By updating these facilities, BFRD is provided an opportunity to showcase what sustainable design and functional community buildings can be. Making sustainable improvements to the exteriors of the fire stations should be focused on impacting energy consumption with renewable resources, creating a resilient, weather tight barrier from the elements and improving facility appearance. Standardized exterior station signs have already been installed to give the community easily identifiable landmarks for its fire stations and to create a professional and accessible image of



Boulder for the public. These updates were just a first step and updates should continue to be added to strengthen the identity of the community fire stations.

6) Adapt continuous improvement model to include Sustainability and Resiliency

A continuous improvement model adapts to changing demands for the department and keeps the department continually assessing how it will meet the current and future expectations of sustainability and resiliency in all aspects of the emergency service business. Current CIM does not include Sustainability and Resiliency planning.

7) Adopt sustainable and resilient building principles.

Sustainable and resilient building principles should be adopted in addition to requiring all new construction to meet LEED standards. Whenever possible, these principles should also be incorporated into remodels. This will move the department towards meeting the framework objectives of being safe, livable, environmentally sustainable, responsibly governed and economically vital.

8) Design future facilities' construction with a "room to grow" concept.

Without being wasteful, future station construction will be more cost-effective over the lifespan of the station if designing some room for expansion was part of the planning phase, even with the upfront investment, versus having to go back and remodel.

9) Replace facility windows with higher efficiency products on all BFRD facilities.

The BFRD Sustainability and Resiliency Committee recommends that the department replace its windows on all facilities with a higher efficiency product. Windows are a common area for facilities to lose energy efficiency while increasing GHG production through utility costs. The fire stations are occupied twenty-four hours a day, seven days a week, and would benefit the most from window replacement. Many of the aging stations have old windows that are not as efficient as current products on the market. Not only do new windows seal better and lower heat/cold transfer, they create a more comfortable working environment for employees. Since replacement of windows is a high cost to take on, this could be phased into the fire stations first and then to any other facilities needing the upgrade.

10) Consider window film installation as an alternative to window replacement.

The BFRD Sustainability and Resiliency Committee recommends installing high-efficiency window films as an alternative to window replacements. Window films are relatively inexpensive compared to the cost of replacing an entire window assembly and a reasonable option to improve the current windows while increasing energy-efficiency.

11) Improve insulation values where possible.

It is recommended that the department improve insulation in its facilities where possible. Improved insulation will not only keep out excessive heat or cold; it also helps maintain a more even temperature between and across rooms inside the home. Improving the insulation in the BFRD facilities would create a more comfortable environment inside the facility while using less energy.



If the facilities are better insulated and sealed from the outside temperatures, it would lessen the GHG produced from the HVAC system needing to recover either the heat or cold loss.

12) Install Solar Tubes in BFRD facilities to increase natural lighting to encourage energy saving.

The BFRD Sustainability and Resiliency Committee recommends that the department increase the natural lighting in its facilities by using solar tubes to decrease artificial lighting's energy consumption. Solar tubes are an inexpensive way to direct light into facilities to reduce energy consumption due to lighting and improve the overall atmosphere for personnel at work.

13) Install LED lighting in BFRD facilities.

The BFRD Sustainability and Resiliency Committee recommends that the department install LED lighting in its facilities in place of incandescent or compact fluorescent light (CFL) bulbs. LED lighting emits more light per watt than incandescent bulbs or CFL bulbs. LEDs also can last up to 10 times longer than a CFL bulb and are much more durable. The installation of LED lighting in BFRD facilities would reduce the energy demands from the current lighting that is installed and would lower GHG production related to energy at the facility.

14) Install foyers or airlocks in all facilities.

It is recommended that the department install airlocks in its facilities. Installing foyers or air locks in the BFRD facilities would cut down on air-infiltration and air-exfiltration due to entry or exit from a facility. With the proper design, an airlock would decrease the amount of heat loss or cooling loss that would need to be recovered by the HVAC system.

15) Design and install a sustainable landscaping plan for all BFRD facilities.

The BFRD Sustainability and Resiliency Committee recommends that the department design and install sustainable landscapes for its facilities. The current landscapes at the BFRD facilities were designed without the thought of sustainability or being environmentally friendly. Working with the City of Boulder's Parks and Recreation Department, BFRD could design a landscaping plan for its facilities that cuts down on maintenance and lowers emissions from mowing equipment and 2cycle engine trimmers. A new design could also incorporate produce gardens for personnel to use for cooking while on shift and better utilize the landscape's natural resources. A more efficient irrigation system that has less sod area and uses drip irrigation would lessen water consumption and improve the outside appearance of the facilities as well. These design concepts should be applied to all future construction for BFRD.

16) Consider a compartmentalized approach to station design.

The BFRD Sustainability and Resiliency Committee recommends that the department take a compartmentalized approach to station design. Since there are many working parts to a fire station and it is open for business 24 hours a day, year round, different areas of the station will be impacted by the environment differently. By breaking the floorplan up into smaller compartments when designing a fire station, it can aid in reducing air infiltration or ex-filtration and increase building energy efficiency.

**17) Install a heat recovery system for station low pressure exhaust system.**

It is recommended that the department install a heat recovery system to reduce energy waste created by the apparatus bay's low-pressure exhaust system. The low-pressure exhaust system is designed to run constantly to remove or exhaust any hazardous output from fire apparatus at the stations. The health and safety of personnel take precedence over energy savings, but with an added component, some of the heat generated in fire apparatus bays could be recovered by conditioning the fresh air coming in to replace it.

18) Purchase only Energy Star rated appliances.

The BFRD Sustainability and Resiliency Committee recommends that the department purchase only energy star appliances for its facilities to lower energy consumption from kitchen appliances. As many of the BFRD facilities have kitchens, the higher the Energy Star rating, the less energy the appliance will utilize compared to similar appliances.

19) Install high-efficiency industrial grade washing machines in all fire stations for laundry needs.

Currently the BFRD has some station's laundry picked up and taken to a local laundry service to be cleaned. The BFRD Sustainability and Resiliency Committee recommends that the department install high-efficiency, industrial grade washing machines in those stations thus eliminating the need to send out laundry. Fire department staff work for 48 hours when on duty, and the ability to launder dirty linens in the station would lower the department's carbon footprint from sending laundry out. There is also a hygiene benefit to having the washing machines in the stations and allowing fire personnel to launder their work uniforms in the station and not taking potentially contaminated garments home.

20) Install air blade hand driers in BFRD facilities to replace paper towels.

Currently there are hand driers available that can dry 22 pairs of hands for the cost of a single paper towel. Another advantage to an air blade hand drier is that it dries hands faster than conventional hand driers while using less energy. Hygiene is another reason to install the air blade hand drier in BFRD facilities because of how frequently emergency medical personnel wash and dry their hands. Also, an air blade hand drier emits seventy percent less carbon in an average day than paper towels.

21) Develop a comprehensive Hygiene plan

The BFRD Sustainability and Resiliency Committee recommends that the department develop a comprehensive Hygiene plan to prevent the spread of disease and airborne contaminants within its facilities. Based on the conditions encountered through the line of work performed by the BFRD, there are many things the department can do to limit the spread of contagious diseases and airborne contaminants in its facilities. Using a healthcare facility model, the BFRD could develop a plan that incorporates sustainable products that are environmentally healthy for the employees and environment.

22) Install water-efficient fixtures in BFRD facilities.

The BFRD Sustainability and Resiliency Committee recommends that the department install water-efficient water fixtures in all BFRD facilities. For example, at the kitchen sink, foot pedals could be installed to turn on and off the faucet when needed, lessening the water wasted from being left



on. In the bathrooms, waterless urinals and dual flush toilets are both options that should be considered to lower water consumption. Motion sensing faucets would only use water when your hands are under the faucet which would use less water than conventional faucets. Another consideration is to install automated handwashing stations in BFRD facilities. These devices are fast, use low volumes of water, and increase hygiene.

23) Consider water recovery system for toilet flushing.

By utilizing greywater in toilet flushing, the department can save on potable water consumption and waste.

24) BFRD should encourage personnel to reduce their laundry needs.

Since the BFRD has moved to the 48/96 schedule, personnel have been doing less laundry due to being at work for a consecutive 48 hours. Before the schedule change, personnel would not reuse bath towels and would need fresh bed linens every time they came to work. The BFRD Sustainability and Resiliency Committee recommends that the department should continue to encourage personnel to be mindful of their laundry needs and use only what is needed when at work.

25) Install gear lockers at fire stations for roving firefighters to store gear.

The BFRD Sustainability and Resiliency Committee recommends that the department install, or make available, gear lockers at its fire stations for roving firefighters to store gear. Many of the fire stations have gear lockers that are adequate for the personnel that staff those stations during shifts. However, roving firefighter personnel can be assigned to a station to fill a vacancy due to sickness or illness and are responsible to transport their gear with them. Many of the roving firefighters take their gear home with them from work after their shift due to not having any place to store it at a station while they are off duty. Since there is so much gear for a roving firefighter to transport, a smaller vehicle for commuting is not practical. Having a locker to store their gear in would allow roving firefighters to consider more efficient transportation when commuting to and from work. The decreased weight in their vehicles would also improve fuel economy.

26) Use only environmentally friendly cleaning products in BFRD facilities.

The BFRD Sustainability and Resiliency Committee recommends that the department only use environmentally friendly cleaning products in its facilities. Eco-responsible packaging, reusability, natural ingredients and materials are all things that are considered before a product is given the Green Seal. The department should consider making it policy to only purchase Green cleaning products for its facilities to show its commitment to a more sustainable environment.

27) BFRD facilities should be furnished with sustainable products that are free of Volatile Organic Chemicals (VOCs).

The BFRD Sustainability and Resiliency Committee recommends that BFRD facilities be furnished with sustainable products that are free of VOCs. Flooring, furniture and permanent fixtures should be reviewed prior to installation to ensure that the products are sustainable. Committing to sustainable products for the BFRD facilities will be another way the department can show how environmental sustainability is a priority.



28) BFRD should perform an assessment of its facilities in coordination with FAM to improve efficiency.

The BFRD Sustainability and Resiliency Committee recommends that the department performs a facility assessment in coordination with FAM to identify areas for efficiency improvements. FAM can provide professional insight into what effect specific efficiency efforts would have on the facilities. BFRD personnel that use the facilities daily would also have helpful recommendations to offer in a collaborative effort.

29) BFRD should purchase three-in-one waste stations for its facilities.

The BFRD Sustainability and Resiliency Committee recommends that the BFRD purchase three-in-one waste stations for its facilities to replace current waste receptacles. The COB has committed to purchasing composting receptacles for the COB and did distribute them to all BFRD facilities. However, the BFRD hasn't been as effective with its composting effort due to the inefficiency of the current receptacles in the BFRD facilities. When effort was taken into consideration, a three-in-one waste station makes more sense for the BFRD facilities in moving towards the BFRD goal of a Zero Waste department. A three-in-one waste station would be divided into trash, recycle and composting bins all as part of the same unit. The three-in-one waste station is a more sustainable solution than the current system for the BFRD.

30) BFRD should build a storage facility or design added bays into new stations for reserve fire apparatus.

The BFRD needs storage space to house its reserve fire apparatus and a supply cache. The current storage facility is not a sustainable model and should be relocated to a more centralized location. When the building is designed it should meet LEED standards and the roof of the facility should be outfitted with solar panels to reduce the greenhouse gas emissions from utilities.

31) BFRD Facilities should have landscape assessment performed.

The BFRD Sustainability and Resiliency Committee recommends that the department performs a landscape assessment to develop landscape designs that support both aesthetic and functional landscape design concepts. Reducing turf square footage and incorporating more native species of plants should be priorities.

32) BFRD should install smart irrigation clocks at all fire stations.

BFRD Sustainability and Resiliency Committee recommends that the department installs Smart Irrigation clocks that reduce water waste for turf irrigation.



Department Assessment

Operations

The Boulder Fire-Rescue Department is working to become an all hazards-response department, meaning the department will have the ability to respond to all hazards when called to service. To support this mission, the department needs to be looking at sustainable hardware and software technology. Recently the department completed a technology needs assessment which identified many actionable items the department can address to improve its ability to respond to the evolving challenges faced by first responders. If these items are implemented, the City of Boulder Fire-Rescue Department can become a progressive model for other departments with sustainable planning and support from the city.

Recommendations:

1) BFRD should explore ways to utilize available technology to assist in emergency services.

The BFRD Sustainability and Resiliency Committee recommends that the BFRD follow the department's vision statement, as its measurement in assessing its own utilization of technology to support its mission.

2) BFRD should assess purchasing new hardware to replace mobile data terminals in fire apparatus.

BFRD currently is currently utilizing mobile data terminals as its information source in fire apparatus. This MDT is utilized by dispatch to communicate computer aided dispatch notes, updates and emergency call information. The MDT also is used for mapping and reference access while responding or on scene of an emergency call. As technology has improved, the current implementation of MDTs is not effectively meeting the needs of the department operationally and creates inefficiencies. Thus, it is recommended to move towards portable tablets which can be utilized during site inspections, incidents, and will contribute to the resiliency of department operations as this hardware is not a permanent fixture on the engine.

3) BFRD should increase staffing to support public safety's information technology.

The BFRD Sustainability and Resiliency Committee recommends that the department increase personnel staffing to support public safety's information technology division. With an increased commitment to technology implementation and utilization comes a need for personnel that can maintain the systems. Currently BFRD has one IT Analyst that oversees the department's fire information systems. As the department works towards a paperless work environment and needs to implement a more resilient records management software database, this one IT staff member will become more heavily utilized in the organization and will need additional internal support. This staffing addition will also increase the department's resiliency in terms of technological support during extended emergency operational incidents when the city's IT staff is unavailable or overextended.



4) BFRD should increase budgeting for technology improvements in the future.

The BFRD Sustainability and Resiliency Committee recommends that the department increase annual budgeting for sustainable technology in the future. The City of Boulder is very committed to exploring new technology and funding it for its departments, and the fire-rescue department is no exception and has been able to increase its technology usage annually. However, technology is everchanging, and the department should formally allot a portion of its budget for exploring and implementing new technological tools which can increase sustainability and begin to set the standards for more progressive fire service.

5) BFRD should utilize drone programs to support emergency operations.

BFRD should utilize local drone programs to support its operations for emergency operations. Drones can be utilized on scene of a structure fire, wildland fire or other hazard need. This technology would give better support to safety of operations on scene giving a greater view of the emergency call which would allow command staff to deploy the appropriate resources to the scene.

6) BFRD should explore collaboration opportunities with local companies.

The City of Boulder is home to businesses across the spectrum that can support BFRD in its daily operations. The BFRD should identify these opportunities and work to collaborate with local businesses to support the community served.

7) BFRD should set minimum standards for the technology implemented.

When evaluating or purchasing technology for the department, BFRD should set minimum standards that will optimally support the department in its operations. There are many devices that specifically support fire rescue and EMS operations that incorporate the latest technology and the BFRD should be ensuring the technology purchased supports the need.

8) BFRD should utilize cloud-based software.

The BFRD Sustainability and Resiliency Committee recommends that the department look for cloud-based programs vs software based. This gives personnel the ability to access information or programs from any device in any location.

9) BFRD should purchase a barcoding inventory software to track department supplies and inventory.

The BFRD Sustainability and Resiliency Committee recommends that the department purchase a barcoding inventory software to track supplies and inventory for the department. Having barcoding inventory tracking software would eliminate paper tracking forms and increase the efficiency of how the department keeps track of inventory or supplies, their location and quantity.

10) BFRD should purchase software for vehicle inspection and maintenance.

BFRD inspects fire apparatus every 48 hours at the beginning of shift and a more detailed inspection weekly. To support Insurance Safety Office (ISO) and national accreditation requirements, the department should purchase software to support data tracking. Currently the department utilizes a paper tracking system so converting the process to a software-based system which can be backed up on a cloud-based server will be more environmentally sustainable and resilient.



11) BFRD should evaluate carbon credits concept from fire stop in residential and commercial fires.

New Zealand conducted a study to identify how much carbon was emitted during a normal residential structure fire. Using the numbers from that report, a fire department could estimate the total tons of carbon that would be produced by a structure fire in an occupancy with normal furnishings. Using that data, a fire department could then determine how much carbon was saved based on where a fire was stopped. There is a potential for a carbon credit presented by the New Zealand study but would require further research and investigation. The BFRD Sustainability and Resiliency Committee recommends that the department evaluate if carbon credits from fire stop in commercial and residential occupancies is quantifiable.

12) BFRD should collaborate with NIST regarding fire-based technology and carbon offsetting.

The BFRD Sustainability and Resiliency Committee recommends investigating collaborating with NIST to explore opportunities to work together addressing fire-based technology and carbon offsetting to increase sustainability within emergency services.

Fire Apparatus Fleet

1) Internal ambulance transport service should be considered an option by COB.

BFRD contracts with a private company, AMR, to provide ambulance transport for emergency medical service in the COB. Should COB take over ambulance transport, it would give the department the ability to deploy a smaller response vehicle to medical emergencies versus placing a fire engine in service unless needed. This is a more fuel-efficient and carbon emission option as well.

2) Explore a more fuel-efficient response vehicle for Battalion Chiefs.

The typical model and design for the Battalion Chief's emergency response vehicle has been a large pickup truck. The department should explore more fuel-efficient vehicle options that do not impact operations or affect the department's mission.

3) When possible, fire apparatus should be shut down during an emergency call.

After arriving on scene of some emergency calls, fire apparatus could be shut down rather than being left idling. The BFRD Sustainability and Resiliency Committee recommends that the department create a policy that outlines when it is appropriate and when it is not appropriate to shut down a fire apparatus on calls. The purpose of shutting down a fire apparatus when possible is to lower emissions and save on fuel consumption when the vehicle is left idling. New technology does exist to support this function and should be explored for feasibility on upcoming vehicle replacements.



Training

The City of Boulder Fire-Rescue's Training Division supports front line personnel through hands on training, lecture, certification management support, professional development and succession training. The Training Division has many important tasks to manage along with tracking hours of training for the Insurance Safety Office (ISO) and hours of training for national accreditation. As the department moves into an all hazards emergency response, the demand and expectation put on the Training Division will increase. Technology will become vital in supporting BFRD's Training Division as a means of providing education remotely through different modes of learning and supporting the everchanging environment of emergency services.

The Boulder County Regional Fire Training Center (BCRFTC) is where the department's Training Division is based. The training facility has received a LEED Gold Certification and several architectural awards for its sustainable design. The entire training center is comprised of classrooms, administrative offices, a live fire training building, training tower, driver training area, fire pump training area, and many skill specific props related to all hazards training.

Recommendations:

1) BFRD should include solar panels at the BCRFTC.

Solar should be assessed for the BCRFTC to produce clean power and offset the site's energy consumption.

2) BFRD should work with the Boulder County Regional Fire Training Center (BCRFTC) Board to create a training site plan and prop for energy-efficient products.

The BFRD Sustainability and Resiliency Committee recommends that the BFRD work with the BCRFTC board to develop a comprehensive training site plan for training props of energy-efficient products. The City of Boulder and Boulder County are changing; many residential and commercial occupancy are outfitting themselves with energy-efficient products. Having the proper training props to simulate how to deal with these products, like solar panels, is a genuine need.

3) BFRD should work with the Boulder County Regional Fire Training Center (BCRFTC) Board to create a mock power grid prop.

As the city is pursuing the municipalization of local electric utilities, the department should construct a mock power grid on the training grounds. The purpose of this is to simulate real-life conditions and hazards created by an electric grid when mitigating emergencies that have overhead power lines and underground power vaults.

4) BFRD's Training Division should incorporate video conference training to reduce commuting by station crews driving to the training center.

The BFRD Sustainability and Resiliency Committee recommends incorporating video conferencing for some training to reduce fire apparatus emissions due to being driven to the fire training center. Using video conference technology would reduce the miles driven by fire apparatus annually and allow for faster emergency response since fire station crews will be attending the



training from their stations. This recommendation should be applied to classes where hands-on training is not necessary and when it is deemed appropriate by the instructor and training officer.

5) BFRD should collaborate with Channel 8 to produce training videos.

There are many advantages of watching a pre-recorded video when being used as a training tool. Videos can be paused for interruptions, rewind to replay a topic or segment and be distributed in electronic format. Reducing the need to have a face to face training will reduce the BFRD's carbon emissions while still maintaining social sustainability for the department.

Alternatively, the BFRD Sustainability and Resiliency Committee recommends that the BFRD explore constructing a video production studio to produce training videos for both internal and external training.

6) BFRD should provide all line personnel a laptop or tablet.

BFRD should provide all personnel with a laptop or tablet to be used for training, report writing and records management. Many trainings can be offered in digital or video format being pushed out to personnel to view on their individual device. Keeping more accurate records and getting things entered in a timely manner would also be supported by issuing individual devices.

Community Risk Reduction

Recommendations:

1) BFRD should have a department-specific Public Information Officer.

The BFRD Sustainability and Resiliency Committee recommends that the department hire a dedicated Public Information Officer to publish and disseminate relevant department activities and life safety information to the community. Currently this position is shared with the police department which is not the most efficient or effective utilization of this role. During large scale events or natural disasters, the community should be provide with the most current information available so they can stay informed.

2) BFRD should develop a pre-plan system uploaded to its database.

BFRD pre-plans occupancies currently utilize a paper-based system which is inefficient, not updated frequently, and that knowledge is not easily shared. The department should work to develop a digital pre-plan program to support planning for emergencies before they happen, developing knowledge of special occupancies in the city and uploading documents to a database that can be easily accessed on scene of emergencies.

3) BFRD Community Risk Reduction should perform all COB fire code inspections.

The BFRD Sustainability and Resiliency Committee recommends that the Community Risk Reduction Division perform all city fire code inspections. To accomplish this task, BFRD Community Risk Reduction Division would need to assess its staffing to determine the number of personnel required to handle all COB fire inspections. The recommendation to have BFRD's CRR perform all COB fire code inspections is to reduce emissions from fire apparatus being driven in the city to perform fire code inspections as the Community Risk Reduction Division also drives



smaller vehicles and would have better fuel economy than a fire engine. This recommendation also better aligns fire operations with its mission, however, it would require hiring additional employees.

4) BFRD should develop public service announcement videos.

In collaboration with Channel 8, Community Risk Reduction should produce public service announcement videos to educate citizens of life safety precautions with renewable energy sources and their homes. These videos should also be multilingual to reflect the diverse population of the community.



Zero Waste

Recommendations:

1) BFRD should have more training on composting and recycling.

The BFRD Sustainability and Resiliency Committee recommends that the department have more training on composting and recycling to inform personnel of how to properly sort waste. Many BFRD personnel do not understand the "do's and do not's" of composting and recycling and for the department to be effective in its zero waste efforts, it must have the personnel's support. An annual training refresher would be a good way to keep personnel up to date with any changes in composting and recycling and the effects it is having for the BFRD in reducing its waste production.

2) BFRD should expand its recycling efforts.

The BFRD Sustainability and Resiliency Committee recommends that the department should expand its recycle efforts to include disposable items that are hazardous to the environment. Items such as CFL bulbs, printer cartages and batteries should be recycled in coordination with the local waste pick up company for Boulder. There are many items that can be recycled just have to be sorted from the normal single stream recycling bins.

3) BFRD should expand support of the City of Boulder's Target Environmental Procurement Purchasing Policy.

The BFRD Sustainability and Resiliency Committee recommends that the department increase its support of the city's Target Environmental Procurement Policy for Purchasing. The city's goal is to encourage and increase the use of recycled and environmentally preferable products. The BFRD should not only meet the minimum requirement but exceed it whenever possible.



Paperless

Recommendations:

1) Set a date to go paperless.

The BFRD Sustainability and Resiliency Committee recommends that the department set a date of when it is possible as a department to go paperless. There are phases involved in getting an entire organization to go paperless, and the first step is setting a date. Having a timeline that sets a goal to go paperless will hold the BFRD accountable in achieving its goal on time and be a more effective way to go paperless.

2) BFRD should develop an outline for how digital documents will be named and stored.

The BFRD Sustainability and Resiliency Committee recommends that the department develop an outline for how the department wants to name and store digital documents. Having a clear outline will maintain consistency and efficiency for personnel to create, save and store their digital documents.

3) BFRD should inform all vendors that BFRD is going paperless.

It is recommended that the department inform all vendors that the BFRD is going paperless and request that normal paper items be sent to the department in digital form. Committing to going paperless as a department will reduce paper waste and by informing vendors of the BFRD going paperless will reduce paper waste from outside the department. This is also an environmentally friendly practice as it reduces the amount of paper that must be recycled annually.

4) BFRD should consult the Colorado State Archives Division for what documents must be kept in paper form.

The BFRD Sustainability and Resiliency Committee recommends that the department consult the Colorado State Archives Division for information about what documents have to be kept in paper form. After finding out what documents have to be kept in paper form, the BFRD can go paperless and begin making digital copies of current paper documents to eliminate the need to store paper. This is also an environmentally friendly practice as it reduces the amount of paper that must be recycled annually.

5) BFRD Sustainability and Resiliency Committee member should join with department's IT division participation in citywide paperless project.

It is recommended that a member of the BFRD Sustainability and Resiliency Committee join with the department's IT division in its participation on the citywide paperless project. The participation of the BFRD Sustainability and Resiliency Committee in the citywide paperless project will show the department's commitment to going paperless and allow the BFRD Sustainability and Resiliency Committee to make recommendations that will be more in line with the rest of city departments.



Conclusion

In conclusion, this document has outlined sustainable and resilient accomplishments made by the City of Boulder Fire-Rescue Department. The Sustainability and Resiliency Committee identified areas of improvement the department can make and outlined recommendations. BFRD will continue to use the Sustainability and Resiliency Plan to establish new goals that support the initiatives and values of the City of Boulder and Boulder Valley Comprehensive Plan. As BFRD moves forward in the future, there will be new challenges, and opportunities to become more sustainable and resilient as an organization. Proper planning, strategic implementation and continuous evaluation will be what allows the department to set the standard for sustainability and resiliency for the fire service.