San Francisco, California

Summary

This report is part of a series on best-practice municipal energy strategies within Europe and North America. The series is part of a larger project of recommendation on *TransformTO*, with other series' discussing waste, transportation, and buildings. This document highlights strategies & recommendations from San Francisco to improve *TransformTO*. Similar reports are written for Vienna, Munich, Lyon, Manchester, New York City, Portland, and Vancouver. This report is focused on heating/cooling, energy efficiency, renewable energy, electricity, intergovernmental co-operation & utilities. The report concludes that San Francisco has been remarkably successful at reducing its' emissions and although it is a warmer and more affluent city than Toronto, numerous initiatives could be adapted in *Transform TO* to reduce energy-related emissions.

Background on city

In 2020, San Francisco's estimated population was 891 583 (World Population Review, 2020). San Francisco lies on the western edge of the United States and has a mild climate. Average temperatures range from 7.2 °C to 21.1 °C and average hours of daily sunshine range from 5.2 to 10.5 (Weather Atlas, 2020). The city tends to get windier from February to July with average wind speeds at 8.4 miles/hour (Weatherspark, n.d.). In 2017, San Francisco was found to have one of the strongest economies in the United States, largely attributed to its booming technology industry. The typical household income, $96 677 is almost twice as high as the median income in the US, $57 617 (Garfield & Kiersz, 2018).

Energy/Climate Change Plans

Overview

San Francisco has been adapting increasingly stringent emission reduction targets since releasing its first *Sustainability Report* in 1996 and its first climate change plan in 2004, *The San Francisco Climate Action Plan.* In 2002, the city passed the *Greenhouse Gas Emissions Reduction Resolution* in support of The Kyoto Protocol*,* to reduce emissions 20% below 1990 levels by 2012 (SF Environment, 2004). In 2013, the target was adjusted to 40% by 2025 in an update to the Climate Action Plan (SF Environment, 2013). The city had originally committed to an 80% reduction in emissions by 2050 but in 2018 the mayor increased this to 100% (SF Environment, 2019). San Francisco has been tracking emissions since 1990, adhering to a global emissions inventory protocol and each city department is required to complete emissions reports annually (Data SF, 2020; ACEEE, 2020c).

Key Initiatives all from Focus 2030 Report (1990 baseline):

- Reduce citywide emissions: 40% by 2025 and 100% by 2050 (SF Environment, 2019)

- 100% of electricity from renewables by 2030 (SF Environment, 2019)
- 100% of energy from renewables by 2050 (SF Environment, 2019)
- By 2030, all new buildings must be carbon neutral (SF Environment, 2019)
- By 2050, nearly 100% of old buildings should be electrified with enhanced efficiency and a minimum of 3% of buildings should be retrofitted annually (SF Environment, 2019)

Energy

Most of San Francisco's energy is utilized by buildings and electrical vehicle charging stations (Ackerly et al., 2018). Most of the city's emissions originate from transportation related commodities as displayed in Figure 1 (City and County of San Francisco, 2018). Residential and commercial buildings contribute 44% of citywide emissions, mostly through heating & cooling that utilizes natural gas (SF Environment, 2019). In 2013, the city committed to sourcing all residential electricity and 80% of commercial electricity from renewable sources (SF Environment, 2013). Today, the city aims to obtain all electricity from renewable sources (SF Environment, 2019). Figure 2 displays the sources of electricity in San Francisco in 2017. The city is focused on increasing energy efficiency, and electrification of new & old buildings. City operations contribute 3% of the total emissions in San Francisco, mostly from natural gas use as displayed in Figure 3 (SF Environment, n.d. a). Energy in San Francisco is distributed via network infrastructure systems, one third of which lies outside of the city (Ackerly et al., 2018)

Implementation status/key initiatives

San Francisco has reduced emissions by 36% since 1990 and these reductions are displayed in Figure 4 up to 2018 (ACEEE, 2020c). The American Council for an Energy Efficient Economy (ACEEE) rates San Francisco as the second most energy efficient city in the United States and finds it likely that the city will meet all their emission reduction goals (2020c). San Francisco accomplished the sourcing of 50% of the city's energy from renewables three years ahead of schedule and in 2017, 64% of energy came from renewables (ACEEE, 2020c). As of 2017, emissions from buildings decreased 51% below 1990 levels even though the overall number of buildings increased substantially (SF Environment, 2019). The city expressed concern towards meeting carbon neutrality by 2050 in its 2019 report *Focus 2030: A Pathway to Net Zero Emissions*; current plans will lead to a 90% reduction in emissions by 2050 but new and innovative solutions are required to meet the 100% reduction target (SF Environment, 2019).

Heating/Cooling

Most emissions in residential and commercial buildings come from heating and cooling as displayed in Figure 5. San Francisco encourages the decarbonization of space & water heaters by incentivizing the installation of heat pumps (SF Environment, 2019). The city promotes commercial adoption of solar water heating (SWH) which can reduce hot water bills by up to 80%. The state operates *CSI Thermal* which provides rebates and direct financial incentives for the installation of SWH systems of up to $5391 for single family homes or up to $800 000 for multi-family residences to replace gas systems (California Public Utilities Commission, n.d.). *GreenFinance SF* provides loans through a Property Assessed Clean Energy (PACE) funding model where the loan is held against the property rather than the landlord or building owners (SF Environment Factsheet, n.d.).

In 2016, the city conducted a thermal decarbonization assessment to determine the feasibility of installing low carbon heating & cooling systems in city-operated facilities. This assessment was completed at the cost of $30 000 (San Francisco, 2016). This assessment required a municipal heating equipment inventory to be undertaken as displayed in Figure 6 which revealed that hospitals were the largest sources of emissions (San Francisco, 2016). The assessment determined replacement costs to be $21 000 000 (some equipment was reaching end of life anyways) and emissions reductions to be 43 000 tonnes, approximately 25% of the city's overall emissions (San Francisco, 2016). This report is intentionally designed to encourage adaptation by other cities.

Renewables

In 2017, 64% of electricity was sourced from renewables and municipal buildings utilized 100% emissions free electricity (SF Environment, 2019). The city predicts that transitioning to 100% renewable electricity will reduce emissions in the building sector by 24% (SF Environment, 2019). In 2019, a city ordinance ordered non-residential buildings over 50 000 feet to derive all on-site electricity from renewables by 2030 (Shean & Trotz, 2019). The city's municipal facilities have 23 solar PV installations generating 8.6 MWh of energy (SF WaterPowerSewer, 2020). The city's *GoSolarSF* program provides incentives of up to $100/kW for homes, $1000/kW for businesses, and additional incentives for low-income families up to $2000/kW (SFWater, 2020). The *GoSolarSf* program also incentivizes companies to hire city-trained solar installers (ACEEE, 2020c). In the past, the city partnered with a non-profit organization, Grid Alternatives, to provide 75 free rooftop solar installations and weatherization to low-income households (ACEEE, 2020c). San Francisco's water treatment facilities generate and are powered by 3 MW of peak electricity through cogeneration biogas and 5MW of solar power (ACEEE, 2020c).

From 2015 to 2017, the City & County conducted a *Solar and Storage for Resilience Project,* to assess energy resilience and preparedness in the event of a large-scale disaster. The project explored the feasibility of using solar installations & battery storage as a back-up power source in emergency shelters and critical facilities such as hospitals

(City & County of San Francisco, 2017). The project found diesel generators often provide power for only a few days and other sources of energy such as natural gas, could take up to six months to re-establish (City & County of San Francisco, 2017). Electricity was found to be the power source with the quickest recovery time (City & County of San Francisco, 2017). This report found capacity for 8.2 MW solar PV and 12.9 MW of battery storage across 67 potential shelters (City & County of San Francisco, 2017). Financing could be established through a public-private hybrid where private companies cover upfront costs and operate the solar installations for a contractually designated time period to recover costs, eventually handing over the installation to the city (City & County of San Francisco, 2017). This report was intentionally designed to be utilized and adapted by other cities.

Electricity

In 2017, the electricity supplied to San Francisco was 82% carbon free with 64% derived from wind, solar and hydro as displayed in Figure 2 (SF Environment, 2019). Municipal buildings are supplied with 100% fossil fuel free electricity by the San Francisco Public Utilities Commission (SFPUC) (ACEEE, 2020c). The city found that electrification of buildings could reduce emissions by 22% (SF Environment, 2019). The city is utilizing various strategies to encourage the electrification of older buildings including advocating for the state of California to obtain funding from utility rate payers, providing more flexible utility rates to offset retrofit costs, collaborating with contractors & manufacturers and providing consumer education (SF Environment, 2019). As of March 2020, 97% of the city's streetlights had been transitioned to LED (ACEEE, 2020c). The city requires all new buildings be electrified (SF environment, 2019).

Energy Efficiency

The city's building energy codes for both residential and commercial buildings in the *San Francisco Green Building Code* are more stringent than those set by the state (ACEEE, 2020c). All city operated buildings and non-residential buildings over 10000 sq. feet are subject to benchmarking systems and municipal facilities are 100% compliant (ACEEE, 2020c). 88% of commercial building fall under the benchmarking system with an 80% compliance rate (ACEEE, 2020c). Reductions in energy use of 6.1% have been recorded amongst buildings enrolled in this program (ACEEE, 2020c). The city has focused retrofitting efforts on improving building insulation and the city predicts that improving energy efficiency in buildings will lead to a 10% decrease in overall emissions by 2030 (SF Environment, 2019). The city has 612 buildings meeting LEED certification, 52 of which are municipally owned buildings (SF Environment, 2019).

San Francisco was the first city in the United States to require green roofs, solar hot water or solar PV installations on new buildings under its *Better Roofs Ordinance* which applies to residential, commercial and municipal buildings, where 15% of roof area must be designated for solar (ACEEE, 2020c; SF Environment, 2019; City & County of San

Francisco, 2017). Under *San Francisco's Residential Energy Conservation Ordinance*, residential and commercial buildings must participate in above code energy efficiency actions including energy audits every 5 years, meeting LEED or GreenPoint certifications for new builds and residential properties built before 1978 must complete a specified level for retrofit before they can be sold (ACEEE, 2020c). The city has a full-time staff of 11 people designated to ensure compliance to their green building code (ACEEE, 2020c).

The city facilitates numerous financing, education programs, and incentives for energy efficiency upgrades. *SF Energy Watch* provides free energy assessments and partial funding for upgrades to businesses lighting, refrigeration, and HVAC systems (SF Environment, n.d. b). *The Bay Area Regional Energy Network* (BayREN) provides rebates and financing for homeowners, multifamily property owners, and small & medium-sized businesses to make energy efficiency upgrades (BayREN, 2020). BayREN uses bill financing, where payments for upgrades are added to utility bills but the monthly totals are still lower due to energy savings from upgrades (BayREN, 2020). BayREN and SF Energy Watch have saved 200 GWh of electricity and $3.7 million (SF Environment, 2019). *The San Francisco Green Home Assessment* focuses on energy conservation in the home by creating personalized checklists to improve sustainability (SF Environment, n.d. c). The city assists local, non-profit organizations such as food banks or community outreach centers in improving their energy efficiency with *Environmental Justice Grants* which have led to reduced energy bills and over 100 solar PV installations (SF Environment, n.d. d).

Intergovernmental Relations

The state of California has engaged in progressive policy-making to support San Francisco's climate action including adopting the goals of reducing state emissions 40% by 2030, requiring equitable benefits across communities, deriving 60% of energy from renewable sources by 2030, decarbonizing electricity by 2045, developing microgrid technology, achieving carbon neutrality by 2045 through Senate Bill 100 and adopting a cap-and-trade program (California Energy Commission, 2020). San Francisco requires stricter building energy codes than the state even though California's building codes are already quite stringent as they surpass international and nationally recommended energy codes (ACEEE, 2020c).

Utilities

San Francisco's electricity and natural gas are supplied by the investor-owned utility, Pacific Gas & Electric (PG&E) which provides energy to approximately 83% of the city (SFPUC, 2011). PG&E reported savings of 1,287,988 MWh in electricity and 29.97 MMtherm in natural gas in 2018 and offers customers various efficiency incentives (ACEEE, 2020c). The city works with PG&E through the *San Francisco Energy Watch Program*, offering incentives and upgrade programs (ACEEE, 2020c). PG&E has spent over $16 million on solar installations, has provided numerous incentives for single and

multi-family homes, and has proposed a 567.5 MW battery project (PG&E, 2018; ACEEE, 2020c).

San Francisco owns the San Francisco Public Utilities Commission (SFPUC) which provides electricity to city departments and water to businesses and city residents. In 2011, SFPUC provided 17% of the total energy used in the city (ACEEE, 2020c; SFPUC, 2011). In 2016, San Francisco initiated a Community Choice Aggregation Program (CCA), *Clean Power SF* which provides residents with the option to opt into either 48% or 100% renewably sourced energy at no extra cost and has 376 000 customers enrolled (ACEEE, 2020c). The CCA sources renewable power through SFPUC using PG&E's transmission infrastructure. The city attempted to purchase PG&E's distributions networks when the company declared bankruptcy, but this bid was rejected (ACEEE, 2020c).

Discussion

San Francisco has made the most significant progress towards reducing emissions out of the North American cities in this series through increased energy efficiency of city-owned facilities, residential & commercial buildings and integrating renewables into its electricity grid. San Francisco has released numerous reports which other cities can adapt to undertake similar energy resilience or decarbonization initiatives. Although San Francisco has a warmer climate and more affluent population than Toronto, many of its initiatives are still relevant to Toronto and may be useful to integrate into *Transform TO.*

Recommendations

- City departments should submit annual emissions reports to identify high emitters
- Increase requirements for buildings to derive on-site electricity from renewables and municipal buildings should lead by example
- Promote installation of solar water heaters on facilities with high daily hot water consumption
- Conduct a *Thermal Decarbonization Study* to assess the feasibility of transitioning municipal facilities to low carbon heating and cooling utilizing San Francisco's strategy including a *municipal heating equipment inventory* as displayed in Figure 6
- Conduct an energy resilience study to determine Toronto's energy security capacity in the event of a large-scale disaster and to identify potential sites to establish emergency sources of renewable energy potentially financed by private-public model
- Increase incentives and funding for building retrofits and expand benchmarking program to buildings over 10000 sq. feet

- Adopt more stringent building codes requiring installation of solar PV and battery storage
- Consider establishing city-owned utility to provide energy for municipal operations like SFPUC
- Consider Community Choice Aggregation Program to allow consumers to affordably opt-in to renewably sourced energy potentially partnering with already established renewable energy companies such as Bullfrog Power

Appendix

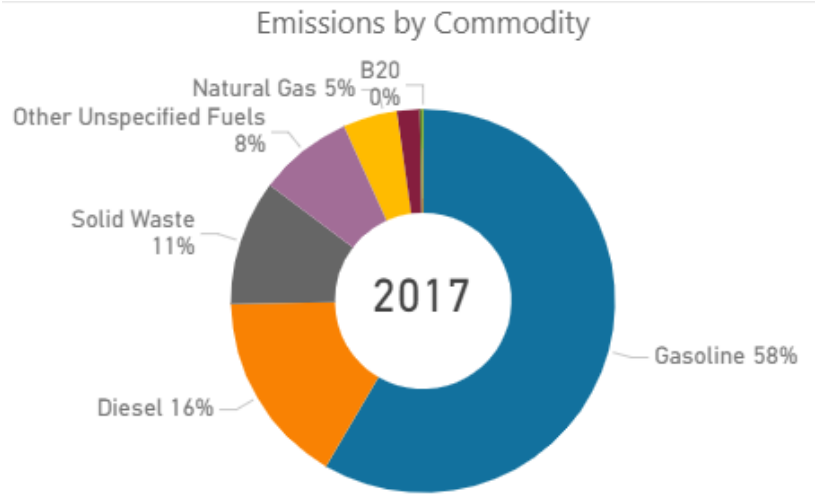

Figure 1: Emissions by Commodity (City and County of San Francisco, 2018)

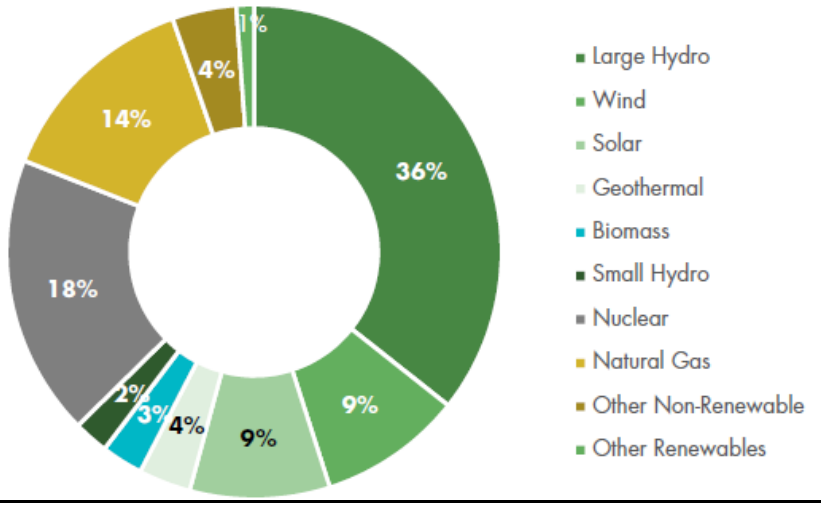

Figure 2: 2017 Electricity Grid Mix (SF Environment, 2019)

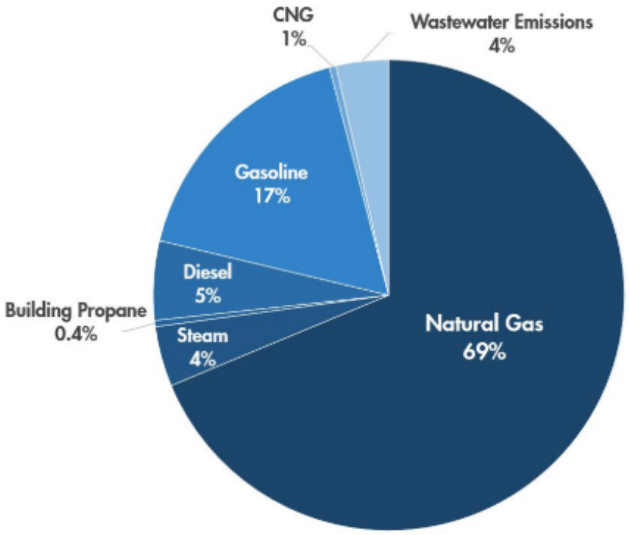

Figure 3: Emissions from City Operations (SF Environment, n.d. a)

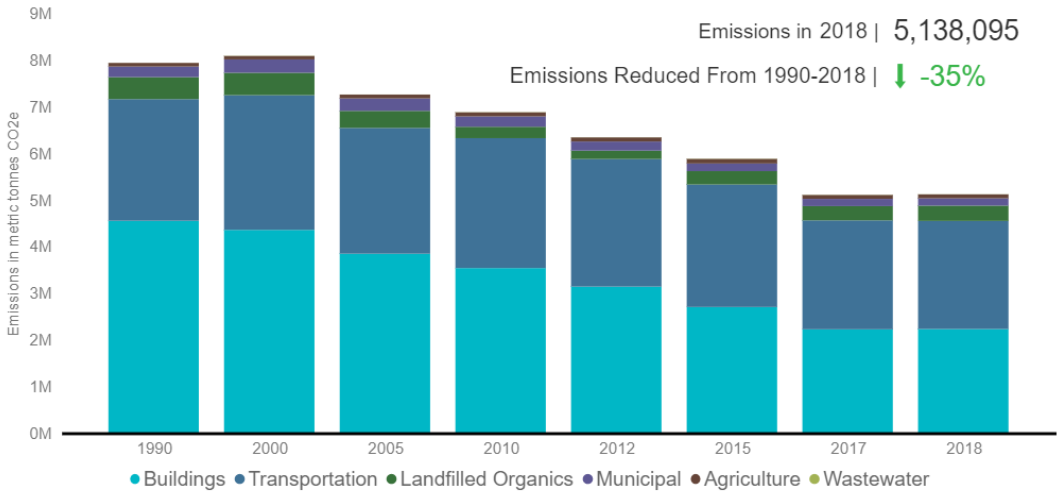

Figure 4: San Francisco's Emissions 1990-2018 (SF Environment, 2018)

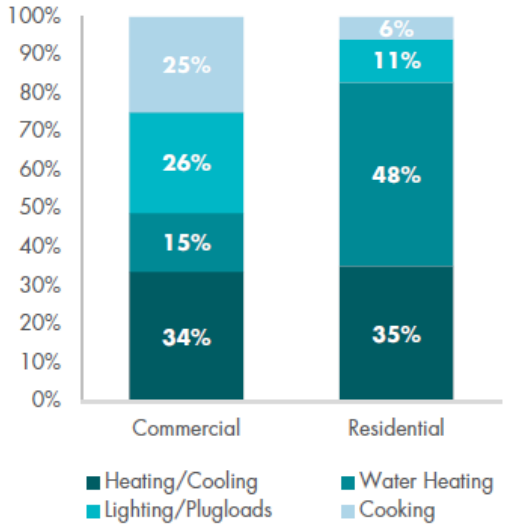

Figure 5: Building Emissions End-Use (SF Environment, 2019)

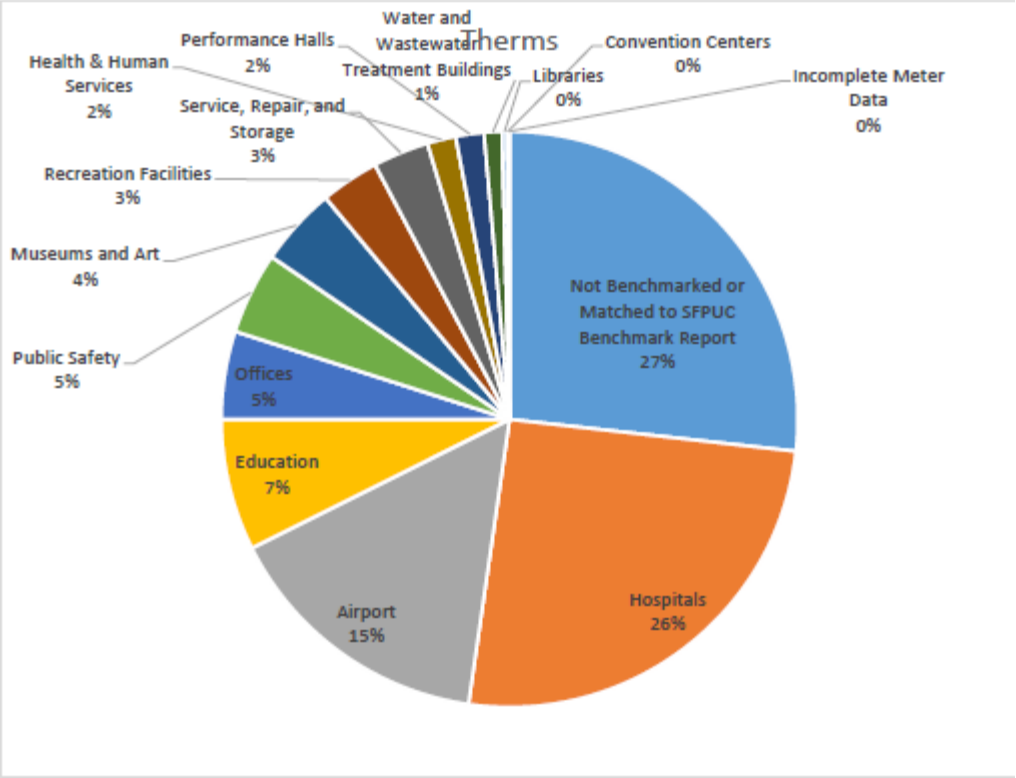

Figure 6: Municipal Heating Equipment Inventory (San Francisco, 2016)

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