Health Impact Review of SSB 5703
Concerning fair treatment of municipal solid waste systems
(2025 Legislative Session)

March 19, 2025

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WASHINGTON STATE BOARD OF HEALTH

HEALTH EQUITY
Governor's Interagency Council on Health Disparities

Full review
The full Health Impact Review report is available at:
https://sboh.wa.gov/sites/default/files/2025-03/HIR-2025-06-SSB5703.pdf

Acknowledgements
We would like to thank the key informants who provided consultation and technical support during this Health Impact Review.

Contents

Executive Summary
SSB 5703, Concerning fair treatment of municipal solid waste systems
(2025 Legislative Session)

Evidence indicates that SSB 5703 may result in Spokane's Waste to Energy Facility (WTEF) assessing emission control technologies, including carbon dioxide (CO_2) capture and storage technologies, and the City of Spokane assessing financing for emission control technologies, allowances, and offset credits. It is unclear how provisions may impact WTEF's ability to meet the Climate Commitment Act's (CCA) Cap-and-Invest Program requirements or WTEF's ability to continue operations.

BILL INFORMATION

Sponsors: Senate Ways & Means Committee (originally sponsored by Senators Holy, Riccelli, Short, Christian, Fortunato, Lovelett, and Nobles)

Summary of Bill:

- Delays the date, from January 1, 2027, to January 1, 2036, that a waste to energy (WTE) facility is a covered entity under the Washington State Climate Commitment Act's (CCA) (Chapter 70A.65 RCW) Cap-and-Invest Program if: 1) the facility reported emissions under RCW 70A.15.2200 or provided emissions data required by this chapter; and 2) the facility's emissions equal or exceed 25,000 metric tons of carbon dioxide equivalent ($MTCO_2e$).
- Exempts emissions from a WTE facility until January 1, 2036.

HEALTH IMPACT REVIEW

Summary of Findings:
This Health Impact Review found the following evidence for SSB 5703:

- **Informed assumption** that delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, may result in WTEF assessing emission control technologies, including CO_2 capture and storage technologies. This assumption is based on current projects related to WTEF and information from key informants.
- **Informed assumption** that delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, may result in the City of Spokane assessing financing for emission control technologies, allowances, and offset credits. This assumption is based on information from key informants.
- **Unclear evidence** how WTEF assessing emission control technologies, including CO_2 capture and storage technologies, may impact WTEF's ability to meet the CCA's Cap-and-Invest Program requirements.

- **Unclear evidence** how the City of Spokane assessing financing for emission control technologies, allowances, and offset credits may impact WTEF's ability to meet the CCA's Cap-and-Invest Program requirements.
- **Unclear evidence** how delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, may impact WTEF's ability to continue operations.

Additional Considerations includes discussion of alternative municipal solid waste (MSW) management options for the City of Spokane and Spokane County.

Introduction and Methods

A Health Impact Review is an analysis of how a proposed legislative or budgetary change will likely impact health and health disparities in Washington State (RCW 43.20.285). For the purpose of this review "health disparities" have been defined as differences in disease, death, and other adverse health conditions that exist between populations (RCW 43.20.025). Differences in health conditions are not intrinsic to a population; rather, inequities are related to social determinants (access to healthcare, economic stability, racism, etc.). This document provides summaries of the evidence analyzed by State Board of Health's Health Impact Review staff during the Health Impact Review of Substitute Senate Bill 5703 (SSB 5703).

Health Impact Review staff analyzed the content of SSB 5703 and created a logic model visually depicting the pathway between bill provisions, social determinants, and health outcomes and equity. The logic model reflects the pathway with the greatest amount and strongest quality of evidence. The logic model is presented both in text and through a flowchart (Figure 1).

We conducted an objective review of published literature for each step in the logic model pathway using databases including PubMed, Google Scholar, and University of Washington Libraries. The annotated references are only a representation of the evidence and provide examples of current research. In some cases, only a few review articles or meta-analyses are referenced. One article may cite or provide analysis of dozens of other articles. Therefore, the number of references included in the bibliography does not necessarily reflect the strength-of-evidence. In addition, some articles provide evidence for more than one research question and are referenced multiple times.

We consulted with people who have content and context expertise about the provisions and potential impacts of the bill. The primary intent of key informant interviews is to ensure staff interpret the bill correctly, accurately portray the pathway to health and equity, and understand different viewpoints, challenges, and impacts of the bill. For this Health Impact Review, we spoke with 22 key informant interviewees, including: 8 state agency staff with expertise in state law related to climate, energy, air quality, toxics, and solid waste; 5 local government staff with expertise in solid waste management and public health; 5 staff from organizations with expertise in environmental topics, including climate, energy, air quality, toxics, and solid waste; 3 staff from an organization with expertise in emission control technologies; and 1 staff from a regional organization with expertise in air quality. More information about key informants and detailed methods is available upon request.

We evaluated evidence using set criteria and determined a strength-of-evidence for each step in the pathway. The logic model includes information on the strength-of-evidence. The strength-of-evidence ratings are summarized as:

- **Very strong evidence:** There is a very large body of robust, published evidence and some qualitative primary research with all or almost all evidence supporting the association. There is consensus between all data sources and types, indicating that the premise is well accepted by the scientific community.

- **Strong evidence:** There is a large body of published evidence and some qualitative primary research with the majority of evidence supporting the association, though some sources may have less robust study design or execution. There is consensus between data sources and types.
- **A fair amount of evidence:** There is some published evidence and some qualitative primary research with the majority of evidence supporting the association. The body of evidence may include sources with less robust design and execution and there may be some level of disagreement between data sources and types.
- **Expert opinion:** There is limited or no published evidence; however, rigorous qualitative primary research is available supporting the association, with an attempt to include viewpoints from multiple types of informants. There is consensus among the majority of informants.
- **Informed assumption:** There is limited or no published evidence; however, some qualitative primary research is available. Rigorous qualitative primary research was not possible due to time or other constraints. There is consensus among the majority of informants.
- **No association:** There is some published evidence and some qualitative primary research with the majority of evidence supporting no association or no relationship. The body of evidence may include sources with less robust design and execution and there may be some level of disagreement between data sources and types.
- **Not well researched:** There is limited or no published evidence and limited or no qualitative primary research and the body of evidence was primarily descriptive in nature and unable to assess association or has inconsistent or mixed findings, with some supporting the association, some disagreeing, and some finding no connection. There is a lack of consensus between data sources and types.
- **Unclear:** There is a lack of consensus between data sources and types, and the directionality of the association is ambiguous due to potential unintended consequences or other variables.

This review was requested during legislative session and was therefore subject to the 10-day turnaround required by law. This review was subject to time constraints, which influenced the scope of work for this review.

Analysis of SSB 5703 and the Scientific Evidence

Summary of relevant background information

Solid waste management, emissions, and energy generation

- Municipal solid waste (MSW), often called garbage or trash, is a mixture of energy-rich materials such as paper, plastics, yard waste, food waste, and products made from wood.[1]
    - The U.S. Energy Information Administration (EIA) estimates that for every 100 pounds of MSW in the U.S., about 85 pounds can be burned to generate electricity.[1]
- The "solid waste management hierarchy" is recommended by the U.S. Environmental Protection Agency (EPA), the European Union (EU), and additional international groups.[2] It recognizes waste to energy (WTE) as an alternative to landfilling to minimize environmental and human health impacts.[2]
- About 12.8% of waste in the U.S. is managed by WTE.[2]
- In the U.S., WTE refers to MSW combustion for the purpose of energy recovery.[2,3] WTE "differs from combustors that are classified as incinerators because of the energy recovery component."[2]
- WTE plants burn MSW to produce steam in a boiler, and the steam is used to power an electric generator turbine.[1]
    - This process can reduce 2,000 pounds of garbage to between 300 and 600 pounds of ash.[1] The volume of waste is reduced by about 87%.[1]
    - The most common WTE system in the U.S. is the mass-burn system,[3,4] in which unprocessed MSW is burned in a large incinerator with a boiler and a generator to produce electricity.[1]
- The EPA has stated that emissions associated with WTE include, "(1) the combustion of waste, i.e., the stack gas (accounting for air pollution controls), (2) the production and use of limestone in the air pollution control technologies (i.e., scrubbers), and (3) the disposal of ash in a landfill."[2]
- Over time, numerous federal regulations that apply to WTE facilities have reduced emissions, including the New Source Performance Standards (reduced WTE emissions of multiple pollutants by more than 90%, including dioxins, mercury, cadmium, lead, and hydrochloric acid); Resource Conservation and Recovery Act (prohibited WTE facilities from burning hazardous waste); Toxic Substance Control Act (prohibited WTE facilities from burning polychlorinated biphenyls [PCBs]); and the Federal Insecticide, Fungicide, and Rodenticide Act (prohibited WTE facilities from burning pesticide waste).[3]
- The EPA and Washington State identify carbon dioxide (CO_2), methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride as greenhouse gases (GHGs) because of their capacity to trap heat in the earth's atmosphere (RCW 70A.45.010).[5]
- Worldwide, the largest source of GHG emissions is electricity generation.[6] However, in Washington State, the largest contributor of GHG emissions is the transportation sector (44.9%), followed by residential, commercial, and industrial heating (23.4%); electricity

(16.3%); and other sources (e.g., agriculture, industrial processes, waste management, natural gas distribution) (15.4%).[6]

- On January 20, 2025, the federal administration issued 3 energy-related executive orders: "Declaring a National Energy Emergency," "Unleashing American Energy," and "Putting America First in International Environmental Agreements".[7] The federal administration also "rescinded several executive orders from prior administrations, including those focused on reducing emissions and expanding clean energy infrastructure."[7]

WTE in Washington State

- Washington State has 1 municipal WTE facility, which is in Spokane.
- Spokane's Waste to Energy Facility (WTEF) began operations in 1991, as part of a solution to manage the community's solid waste by replacing non-compliant, leaking landfills found to be contaminating drinking water.[8]
    - Spokane County is located above the Spokane Valley-Rathdrum Prairie Aquifer (Spokane Valley aquifer),[8,9] which is federally-designated as sole-source drinking water aquifer by the federal Safe Drinking Water Act of 1974.[10]
- The City of Spokane's Solid Waste Disposal Department operates WTEF. The facility is regulated by Spokane Regional Clean Air Agency, Washington State Department of Ecology (Ecology), and Spokane Regional Health District.[8]
- WTEF:
    - Operates 24 hours a day, 7 days a week;
    - Handles up to 800 tons of municipal solid waste per day (250,000 tons per year)[11];
    - Generates approximately 22 megawatts of electricity (3 to 5 megawatts are used to power the facility and the rest is sold to Avista Utilities to power about 13,000 homes); and
    - Earns up to $5 million in power sales annually.[8]
- In 2001, City of Spokane contracted a multi-pathway human health risk assessment to estimate potential health risks associated with long-term exposure to emissions from WTEF.[12] The assessment followed standardized EPA protocols for human health risk assessment, which estimate hypothetical maximum exposure scenarios based on available scientific information, modeling, and risk analyses.[12]
    - Overall, adverse noncancer health effects were not expected.[12] The assessment found that the majority of potential noncancer exposures were attributed to potential ingestion of mercury and inhalation of hydrogen chloride.[12]
    - For all, except 1, cancer risk exposure scenarios, the assessment found that exposures were at or below the low-end regulatory target.[12] However, exposure for adult subsistence farmers was slightly above the low-end regulatory target, with the majority of potential cancer risk exposure due to potential ingestion of dioxins and furans in homegrown chickens, eggs, and dairy products.[12]
    - The assessment also found that "concentrations of lead, nitrogen dioxides, particulate matter, sulfur dioxide, and breast milk dioxins were below their associated target or background levels."[12]

    - Findings from the risk assessment are consistent with other U.S. and international studies of WTE facilities.[2,3]
- In 2016 and 2017, Ecology evaluated atmospheric deposition of PCBs in the Spokane area.[13] Based on modeling of WTEF emissions, Ecology estimated that WTEF accounted for about 2% of PCB bulk deposition at the study sites located northeast of the facility, which represent the "upper bounds of what [WTEF] could contribute to the observed deposition, implying that there must be other contributing PCB sources in the region."[13]
- In 2023, the Washington State Legislature appropriated funds to Ecology to contract a full emissions life cycle assessment (LCA) for solid waste processed at WTEF compared to solid waste processed at 3 landfills within the region where waste may be sent if WTEF were to stop operations.[14] The final report was published in March 2024.
- In 2025, the City of Spokane contracted with CarbonQuest to conduct a feasibility study of the company's CO_2 capture system and options for CO_2 storage to reduce WTEF's CO_2 emissions (personal communications, March 2025). The feasibility study will be completed in June 2025 (personal communications, March 2025).
- In addition to WTEF, there is 1 publicly-owned landfill in the City that is operated when WTEF is down for maintenance (personal communications, March 2025).

Washington State law and policies

- Washington State has established GHG emission reduction targets in statute (RCW 70A.45.020). Overall, emissions of GHG are to be reduced by 2030 (50 million metric tons; 45% below 1990 levels), 2040 (27 million metric tons; 70% below 1990 levels), and 2050 (5 million metric tons; 95% below 1990 levels).[15]
- In 2019, the Washington State Legislature passed the Clean Energy Transformation Act (CETA) (Chapter 288, Laws of 2019), which requires 80% of electricity used in the state to come from renewable or non-emitting sources by 2030 and allows the remaining 20% to be carbon-neutral via offsets or other compliance mechanisms.[16] By 2045, CETA requires all electricity in Washington State to come from clean energy sources (i.e., an electricity supply free of GHG emissions).[17]
- In 2021, Washington State passed the Climate Commitment Act (CCA) (Chapter 70A.65 RCW), which directed Ecology to design and implement a statewide, market-based cap-and-invest program to reduce GHG emissions by levels set in state law (i.e., by 95% by 2050).[18] The CCA was upheld by Washington State voters in November 2024.
    - Under the Cap-and-Invest Program, covered entities include those that produce annual GHG emissions above 25,000 metric tons of carbon dioxide equivalent ($MTCO_2e$):[19]
        - Effective January 1, 2023: Industrial facilities, certain fuel suppliers, in-state electricity generators, electricity importers, and natural gas distributors; and
        - Effective January 1, 2027: Municipal WTE facilities.
    - Covered entities may reduce emissions, obtain allowances, or purchase offset credits, or some combination of these, to cover remaining emissions.[19]

    - Emissions exempt from coverage include emissions from aviation fuels, certain coal-fired electric generation facilities, combustion of biomass or biofuels, motor vehicle fuel or special fuel used for agricultural purposes, and MSW landfills that are subject to methane emissions regulations.
    - Carbon allowances are offered at auction. An allowance is equal to 1 metric ton of CO_2 or the equivalent in other GHG emissions.[20] On March 5, 2025, allowance prices increased 24% from December 2024, selling at $50 per allowance.[21] The price of allowances has fluctuated over time, from below $30 to about $60 per allowance, and is capped at $95 per allowance under the CCA.[21]
        - The program has generated about $2.8 billion in state revenue since allowance auctions began in 2023.[21]
- In 2022, the Washington State Legislature passed Engrossed Second Substitute House Bill (E2SHB) 1663 (Chapter 179, Laws of 2022), which directed Ecology to adopt regulations requiring MSW landfills to take steps to monitor and capture methane emissions.[22]
    - In May 2024, Ecology adopted Chapter 173-408 WAC, Landfill Methane Emissions.[23] The rules established new requirements for MSW landfills (both active and closed, with some exemptions) that received solid waste after January 1, 1992.[23] The rules address requirements specific to technology and performance, monitoring, reporting and recordkeeping, and others (e.g., civil penalties, maximum methane concentration limits).[23]
    - In 2023, the Legislature appropriated $9.6 million from the CCA to help MSW landfill owners to comply with the new standards.[24]
- In 2022, the state passed the first Organics Management Law (Chapter 180, Laws of 2022), which established state organics management goals and requirements to reduce methane by diverting organic materials from municipal landfills toward beneficial uses (e.g., compost, crop nutrients).[25]
    - In 2024, the Legislature passed (Chapter 341, Laws of 2024) creating funding opportunities and amending some organics management and collection requirements.[26]

Other jurisdictions

- As of 2025, the U.S. has 75 facilities across 25 states that recover energy from the combustion of MSW.[4]
- Adoption of MSW combustion with energy recovery has been greater in regions of the world where populations are dense and land is limited, in part due to space constraints.[4]
    - WTE facilities are prevalent internationally, with about 410 facilities in 23 European countries and more in Asia.[2]
- WTE accounts for a small portion of U.S. waste management for multiple reasons:
    - Availability of land – EPA has stated, "landfilling is often considered a more viable option, especially in the short term, due to the low economic cost of building an MSW landfill versus an MSW combustion facility."[4]

    - Public opposition – Combustion facilities have not always had air emission control equipment, which caused them to gain a reputation as high polluting.[4]
    - Significant economic investment – WTE facilities require a significant upfront investment ($100-$300 million) and economic benefits may take several years to be realized (i.e., from tipping fees, electricity generation, and sale of ferrous metal [iron containing] and non-ferrous scrap metal).[4]
- Some states have called for expansion of WTE facilities, including Florida, Maine, Maryland, and Pennsylvania.[2] For example, Pennsylvania's 2009 Climate Action Plan "calls for the expansion of WTE to help reduce GHG emissions by reducing landfilling and increasing electricity generation."[2]

Summary of SSB 5703

- Delays the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's (Chapter 70A.65 RCW) Cap-and-Invest Program if: 1) the facility reported emissions under RCW 70A.15.2200 or provided emissions data required by this chapter; and 2) the facility's emissions equal or exceed 25,000 $MTCO_2e$.
- Exempts emissions from a WTE facility until January 1, 2036.

Health impact of SSB 5703

Evidence indicates that SSB 5703 may result in WTEF assessing emission control technologies, including CO_2 capture and storage technologies, and City of Spokane assessing financing for emission control technologies, allowances, and offset credits. It is unclear how provisions may impact WTEF's ability to meet the CCA's Cap-and-Invest Program requirements or WTEF's ability to continue operations.

Pathway to health impacts

The potential pathway leading from provisions of SSB 5703 to health and equity are depicted in Figure 1. We made the informed assumptions that delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, may result in WTEF assessing emission control technologies, including CO_2 capture and storage technologies, and the City of Spokane assessing financing for emission control technologies, allowances, and offset credits. These assumptions are based on current projects related to WTEF and information from key informants. It is unclear how WTEF assessing emission control technologies, including CO_2 capture and storage technologies, and the City of Spokane assessing financing for emission control technologies, allowances, and offset credits may impact WTEF's ability to meet the CCA's Cap-and-Invest Program requirements. It is also unclear how bill provisions may impact WTEF's ability to continue operations. Based on these findings, the pathway to health impacts could not be completed.

Scope

Due to time limitations, we only researched the most linear connections between provisions of the bill and health and equity and did not explore the evidence for all possible pathways. For example, we did not evaluate potential impacts related to:

- Ecology rulemaking. If SSB 5703 were to pass, Ecology would need to conduct rulemaking (personal communication, Ecology, March 2025). However, key informants from Ecology stated that the rulemaking process to bring WTE facilities into the CCA by January 1, 2027, as required by existing statute, has already begun. Therefore, if SSB 5703 were to pass, changes to rule would be incorporated by a change to the existing rulemaking process (personal communication, Ecology, March 2025). Therefore, this Health Impact Review did not consider potential impacts of rulemaking.

- Electricity generation. The electricity that is generated by WTEF is used to power the facility (3 to 5 megawatts) and the remaining electricity is provided directly to the power grid through the facility's switching yard to be used by customers of Avista Utilities.[27] The facility generates enough electricity to power roughly 13,000 homes.[8] Researchers have stated that the:

  > relative GHG impact (WTE versus landfills […]) cannot be measured without knowing the energy supply that will be offset. Thus, evaluating WTE in isolation is very misleading as it leaves out the net effect of the environmental energy impacts of landfilling the waste often great distances away from the source of generation.[2]

  This Health Impact Review did not evaluate how the amount of energy generated by WTEF or available to the power grid may change over time.

- Reductions to the Climate Investment Account (CIA). The CIA (RCW 70A.65.250) is used to administer the CCA and for projects that support the transition to clean energy, ecosystem resilience, and carbon sequestration. Auction revenue deposited into the CIA first funds the administration of the Cap-and-Invest Program (maximum 5% of total auction revenue).[28] The remaining funds are distributed to 2 sub-accounts: the Climate Commitment Account (RCW 70A.65.260) (75%) and the Natural Climate Solutions Account (RCW 70A.65.270) (25%).[28] The Climate Commitment Account "focuses on projects that support Washington's transition to a low-carbon economy, improve air quality, and increase access to clean energy for Washington residents."[28] The Natural Climate Solutions Account focuses on "projects that protect fish and wildlife habitats, improve aquatic ecosystems and water quality, and protect against floods."[28] In the fiscal note for the original version of SB 5703, Ecology assumes reductions to the CIA revenue of $4,605,000 per year in State Fiscal Years 2027 through 2031.[29] This Health Impact Review did not evaluate the potential impacts on the CIA and projects funded through either sub-account.

- Potential impacts for communities outside Spokane County. If WTEF were to stop operations, the City of Spokane would need to identify an alternative MSW management option to address the approximately 250,000 short tons per year of MSW produced by people in the City of Spokane and Spokane County (personal communications, March 2025). Information from key informants, as well as evidence presented in recent analyses, indicate MSW would likely need to be transported and disposed of outside of Spokane County. Therefore, communities outside Spokane County may experience health impacts related to additional MSW management and waste disposition. Additionally, communities through which the waste would be transported may be affected by GHG

emissions from transportation (i.e., by truck or rail) (personal communications, March 2025). This Health Impact Review did not evaluate potential impacts for communities outside Spokane County. See Additional Considerations on page 28 for a discussion of alternative MSW management options for the City of Spokane and Spokane County.

- Additional WTEF customers outside Spokane County. WTEF must submit a request to regulating agencies to accept and burn special waste (out of state waste, laboratory waste, pharmaceuticals, etc.), and regulatory agencies may approve or deny the request (personal communications, March 2025). For example, WTEF currently accepts and incinerates drugs and illicit substances seized by law enforcement agencies, and key informants stated that there is not another facility in the state that could accept this waste stream (personal communication, Ecology, March 2025). This Health Impact Review did not evaluate how additional WTEF customers outside Spokane County may be impacted by SSB 5703.

Magnitude of impact

SSB 5703 relates to WTE facilities. Since there is only 1 municipal WTE facility in Washington State, SSB 5703 has the potential to impact Spokane's Waste to Energy Facility (WTEF) and people who live in the City of Spokane and Spokane County.

WTEF

WTEF began operations in 1991, as part of a solution to handle the community's solid waste, replacing non-compliant, leaking landfills found to be contaminating drinking water.[8] WTEF provides solid waste management services to the City of Spokane, nearly all of unincorporated Spokane County, and a few neighboring jurisdictions for a total of approximately 500,000 residents (personal communication, City of Spokane, March 2025). It receives approximately 250,000 short tons per year of waste.[11] In 2024, the City of Spokane (City) represented 75% of the tonnage disposed of at WTEF, and Spokane County (County) represented the remaining 25%.[29]

WTEF processes waste dropped off by people who live in the City and County, waste delivered by truck from residential curbside pickups, and waste from 2 transfer stations[27] (i.e., North County Recycling & Transfer Station and Valley Recycling & Transfer Station). People who drop off their garbage are responsible for organizing it as: yard waste, which is sent to a commercial composting facility; non-burnables, which are sent to local landfills; large appliances or scrap metal, which are sold for recycling; and all other garbage.[27] WTEF also offers recycling and household hazardous waste services onsite.[27]

Garbage not diverted to other facilities is burned as fuel for the WTEF. Heavy equipment operators push garbage from the drop-off point (i.e., the tipping floor) into the pit where a crane operator mixes and fluffs the garbage before feeding measured amounts of garbage into the feed hopper, which funnels the waste into WTEF's 2 boilers.[27] Each boiler has a slanted floor and moving grates which move the garbage through different burning zones where it dries and catches fire.[27] Finished ash falls into a quench tank of water.[27]

Pollution is created inside the boiler as the garbage is burned, and WTEF uses multiple processes to neutralize the various forms of pollution created. The WTE incineration process is designed to thermally destroy pathogens, waste pharmaceuticals, and some hazardous materials and chemicals (personal communication, Ecology, March 2025).[2] Additionally, anhydrous ammonia (NH_3) is sprayed into the boiler to neutralize nitrogen oxides (NO_x) released during incineration into nitrogen (N_2) and water.[27] Next, gases are pulled from the boiler out to where charcoal (carbon) is injected to bind to mercury making it easier to remove.[27] The gases are then moved to an acid scrubber where a lime slurry (i.e., a suspension of calcium hydroxide) is injected to neutralize acid gases.[27] Next, gases are funneled into a baghouse where fine particulate matter (also called fly ash) is filtered out to be mixed with bottom ash to undergo further processing.[27] The U.S. EPA indicates that this process removes more than 99% of particulate matter.[4]

The ash that leaves the boiler is approximately 90% less in volume than the garbage that went into the boiler.[27] Fly ash typically amounts to 10-20% by weight of the total ash.[4] The rest of the ash (80-90% by weight) is called bottom ash, which generally consists of silica (sand and quartz), calcium, iron oxide, and aluminum oxide.[4] The mix of bottom ash and fly ash is treated with lime to bind with heavy metals and render them inert.[27] The ash is then processed to remove iron containing metal (i.e., ferrous metal), and, through this process, WTEF recovers as much as 25 tons of metal daily from the ash to be recycled.[27] Finally, the remaining ash is packed into containers and hauled by truck and rail (227 miles away[11]) to the Roosevelt Landfill in Klickitat County.[27] The final ash takes up less space than the initial garbage and does not generate methane gas or leach into the environment.[27] However, the EPA noted:

> If MSW combustor ash exceeds the toxicity characteristic regulatory limit […] using the Toxicity Characteristic Leaching Procedure (TCLP), it is identified as a hazardous waste due to the risks it poses to groundwater contamination under a worst-case mismanagement scenario. Non-hazardous MSW combustor ash may still present potential risks via other pathways, such as through inhalation, ingestion, or dermal (skin) contact. These risks should also be considered during transport, disposal and/or beneficial reuse of the ash as a non-hazardous secondary material.[4]

WTEF's boilers also produce steam which is used to generate electricity. A fan pulls in air from the pit, feeding the fire with oxygen to increase its temperature and create steam.[27] Each boiler holds approximately 20,000 gallons of water.[27] As the water vaporizes, the steam is funneled through a high-pressure pipe to turn the turbine and a generator creates the electricity.[27] The steam is then released through the exhaust pipe which carries the steam over a series of fans (i.e., an air-cooled condenser) to cool and transition back into water.[27] The water is recirculated through the boiler to be made into steam again.[27]

The electricity generated by WTEF is used to power the facility (3 to 5 megawatts) and the remaining electricity is provided directly to the power grid through the facility's switching yard to be used by customers of Avista Utilities.[27] The facility generates enough electricity to power roughly 13,000 homes.[8]

Air quality

WTEF is regulated by Spokane Regional Clean Air Agency (SRCAA), Washington State Department of Ecology (Ecology), and Spokane Regional Health District (SRHD).[8] Each agency has unique regulatory authority. For example, SRCAA has the authority to enforce all federal, state, and local air quality requirements from the federal and state Clean Air Acts but does not

have regulatory authority for GHG emissions (personal communication, SRCAA, March 2025). Ecology has regulatory authority related to state laws, including the CCA and very limited aspects of CETA (personal communication, Ecology, March 2025). SRHD permits and regulates WTEF's municipal solid waste operations (what type and how much waste they can accept [i.e., waste streams]; waste treatment; facility operations and maintenance; etc.) (personal communication, SRHD, March 2025).

WTEF operates in compliance with federal laws and regulations and meets state air quality standards.[11] Staff from SRCAA stated that WTEF is subject to multiple federal and state emission limits (personal communication, SRCAA, March 2025). WTEF is required to meet new source review permitting requirements from when the facility was built (e.g., Prevention of Significant Deterioration permit; Notice of Construction permit) (personal communication, SRCAA, March 2025). In addition, the facility is subject to requirements included in the federal emission guideline for large municipal waste combustors (personal communication, SRCAA, March 2025). Since WTEF is considered a major source of air pollution, the facility is also subject to the federal Air Operating Permit program (also called the Title V permitting program) (personal communication, SRCAA, March 2025). All federal, state, and local air quality requirements that apply to WTEF are contained in their Air Operating Permit, which must be renewed every 5 years (personal communication, SCRAA, March 2025). Per federal regulations, WTE facilities must have Continuous Emission Monitors (CEMs) that continuously monitor (i.e., 24 hours per day/7 days per week) emissions from the 2 exhaust stacks for 4 pollutants: carbon monoxide (CO), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and opacity (proxy for particulate matter emissions) (personal communication, SRCAA, March 2024). WTE facilities must also undergo annual third-party stack testing (i.e., testing of emissions leaving the smokestack of the facility) for particulate matter and a wide range of toxic air pollutants, including dioxin/furans and mercury (personal communication, SRCAA, March 2025). Stack testing only provides a measure of what the facility is burning at the time of the test (personal communication, SRCAA, March 2025). WTEF is required to submit reports to SRCAA monthly and to SRHD throughout the year (personal communication, March 2025). WTEF undergoes routine inspections by regulatory agencies (e.g., SRCAA conducts inspections and full compliance evaluations on an annual basis; SRHD conducts inspections twice a year) (personal communications, March 2025). The facility must also submit a request to regulating agencies to accept and burn special waste (out of state waste, laboratory waste, pharmaceuticals, etc.), and regulatory agencies may approve or deny the request (personal communications, March 2025).

Key informants with regulatory authority stated that emissions from WTEF are consistently below permitted levels for pollutants that are measured (personal communication, March 2025). Key informants noted that WTEF is required to test for pollutants that have a federal or state standard; however, there are other pollutants that do not have a standard and may not be measured (personal communication, SRCAA, March 2025). Some pollutants that do not have a limit are included in tests run by WTEF, including PCBs, additional metals, hydrochloric acid, and other toxics (personal communication, SRCAA, March 2025).

Specific to GHG emissions, WTE facilities do not emit methane (personal communications, March 2025). However, as a byproduct of the combustion process, WTE facilities produce CO_2 emissions. The City of Spokane's 2019 GHG Emissions Inventory Report inventoried emissions

from community activities as well as from everyday government activities.[30] In 2019, the City of Spokane's community activities produced 1,968,982 metric tons of CO_2 equivalent ($MTCO_2e$).[30] WTEF received a total of 276,238 tons of waste in 2019, producing 99,773 $MTCO_2e$ (5% of community-wide emissions).[30] WTEF GHG emissions accounted for 68% of Spokane's Government Operations 2019 GHG emissions.[30] The inventory stated that landfilling the same amount of waste (276,238 tons) would have produced 45% less direct GHG emissions.[30] However, WTEF diverted 9,501 tons of ferrous metals to recycling, avoiding an estimated 16,981 $MTCO_2e$; the facility also produced 505,276 million metric British thermal units (MMBtu) of energy, avoiding 41,219 $MTCO_2e$.[30] Factoring in WTEF's recycling and energy generation in 2019, GHG emissions were 24% less than had the material been landfilled.[30] Similarly, a 2023 Ecology analysis identified WTEF as 1 of 5 facilities in or nearby (i.e., within 3 miles) Spokane and Spokane Valley emitting GHGs.[31] It reported that, in 2021, WTEF emitted 242,787 $MTCO_2e$, of which 141,607 $MTCO_2e$ (about 58%) was identified as biogenic (i.e., emissions from natural organic material, which are not covered under the CCA).[31]

Combustion also causes emission of criteria air pollutants (CAPs), hazardous air pollutants (HAPs), and other toxic pollutants (personal communications, March 2025). EPA identifies 6 air pollutants as CAPs known to cause adverse health effects.[32] The 6 pollutants are: carbon monoxide (CO), lead (Pb), particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and ozone (O_3).[32] CAPs are the only air pollutants regulated by National Ambient Air Quality Standards, which specify the allowable concentrations of these substances in ambient air.[11,32] Ecology's 2023 report, "Improving Air Quality in Overburdened Communities Highly Impacted by Air Pollution", stated that Spokane and Spokane Valley saw an average of 7.33 days per year (2020 through 2022) with recorded unhealthy air quality, with $PM_{2.5}$ and cumulative CAPs (particularly $PM_{2.5}$, O_3, and NO_2) as pollutants of concern.[31] In 2024, a Life Cycle Assessment (LCA) of Spokane Waste Management Options, contracted by Ecology, also assessed CAPs and other pollutants of concern.[11] Specific to CAPs, WTEF had the highest emissions for 4 of the 6 pollutants.[11] Specifically, WTEF emitted between 2 to 8 times more NOx, SO_2, PM_{10}, and $PM_{2.5}$ in comparison to the 3 landfills included in the assessment.[11] It was not possible to compare all pollutants of concern as pollutants produced differ between landfills and WTE facilities.[11] Of the pollutants produced at landfills and WTEF (4 of 8 pollutants), WTEF had the highest emissions.[11] The common pollutants were ammonia (NH_3), hydrogen chloride (HCl), mercury (Hg), and dioxin/furans.[11]

Key informants with regulatory authority stated that there have been no compliance issues with WTEF (personal communications, March 2025). Key informants with regulatory authority also noted that they have not received any complaints related to WTEF from the community in recent years (personal communications, March 2025). However, regulatory agencies do get inquiries from community members (e.g., related to PCBs, per- and polyfluoroalkyl substances [PFAS]), and WTEF is often the first facility people look to when there is an environmental issue in the community because it is visible (personal communications, March 2025).

People who live in the City of Spokane and Spokane County

Key informants stated that, while SSB 5703 pertains to GHG emissions, reduction of co-pollutants is also a goal of the CCA and efforts to reduce GHG emissions also reduce emission of co-pollutants (personal communication, Ecology, March 2025). Section 3 of the CCA requires

agencies to work to measure and reduce air quality impacts to overburdened communities. Under the CCA, Ecology, in collaboration with the Washington State Department of Health (DOH), is required to compile a report that identifies communities disproportionately impacted by CAPs. Ecology identified 16 communities in Washington State, including Spokane and Spokane Valley as disproportionately impacted by CAPs. In its analysis, Ecology stated, "the Spokane area has relatively high particulate matter pollution ($PM_{2.5}$) for Washington [S]tate."[31] In a 2023 report, Ecology identified mobile sources (e.g., a variety of on-road and non-road vehicles, engines, and equipment) as the largest source of GHG emissions in the community (712,131 $MTCO_2e$).[31] Environmental justice screening tools showed:

> central and northeast Spokane, as well as the industrial area in north Spokane Valley, were most likely to be overburdened or disadvantaged. This area includes, or is close to, several sources of pollution like major roadways, railways, and industrial sites. Asthma and chronic obstructive pulmonary disease [COPD] rates, as well as lower life expectancy, are also well-correlated to the identified area.[33]

WTEF is located outside of this area. However, based on air dispersion and deposition modeling of emissions from WTEF conducted in 2001, the "nearest potentially exposed residential populations are located northeast of the [facility]",[12] which may include the area identified as most likely to be overburdened or disadvantaged.[31,33]

Of the 16 communities identified as overburdened and highly impacted by air pollution, 9 are also considered disadvantaged for climate risk, including Spokane and Spokane Valley.[34] Climate risk indicators include: expected agriculture loss rate, expected building loss rate, expected population loss rate, projected flood risk, projected wildfire risk, and low income.[34] Multiple key informants stated that reducing emissions from WTEF may reduce health risk for Spokane communities disproportionately impacted by air pollution and climate (personal communications, March 2025).

Overall, SSB 5703 has the potential to affect WTEF and people who live in the City of Spokane and Spokane County.

Logic Model

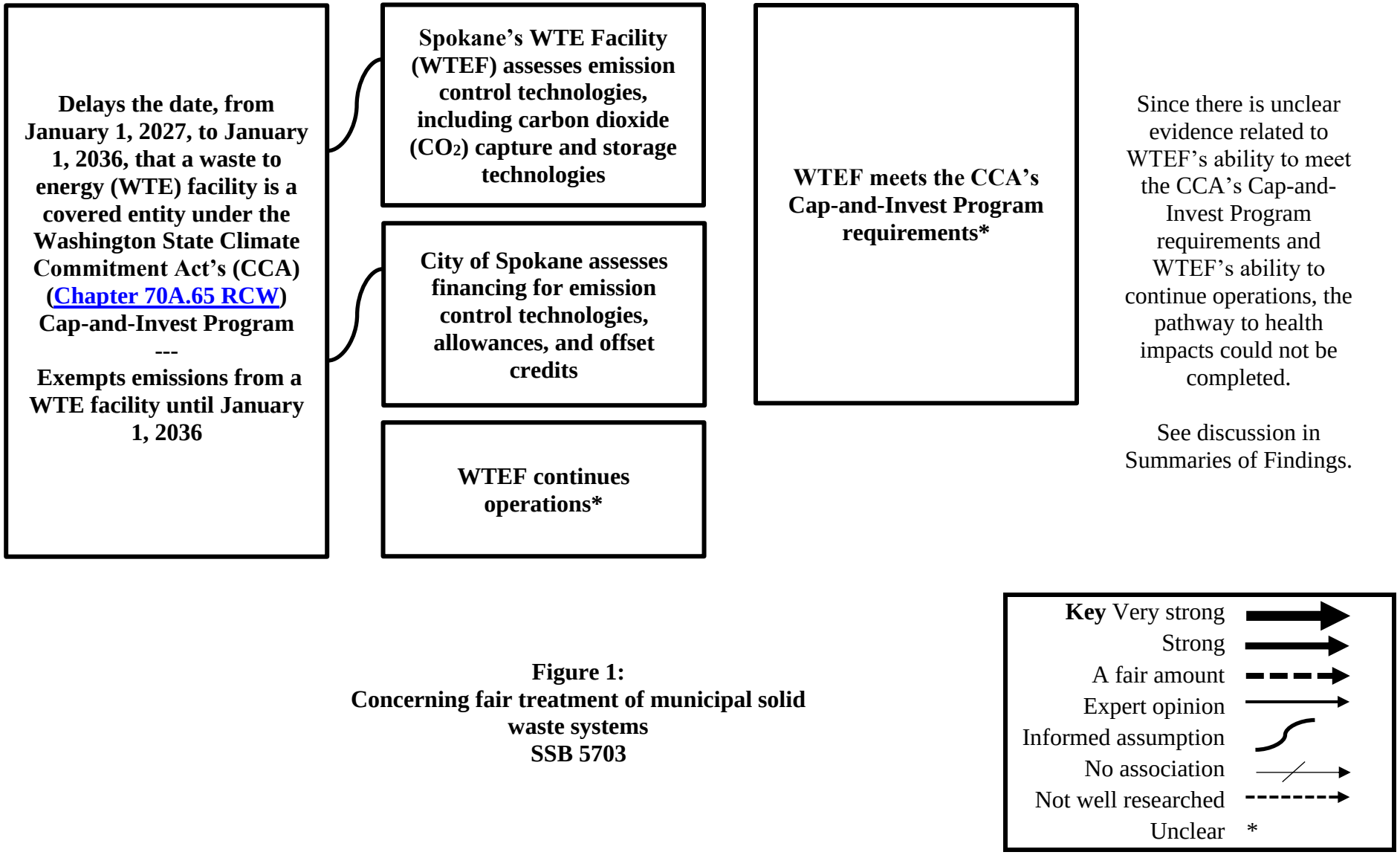

Figure 1:
Concerning fair treatment of municipal solid waste systems
SSB 5703

Summaries of Findings

Would delaying the date, from January 1, 2027, to January 1, 2036, that a waste to energy (WTE) facility is a covered entity under the Washington State Climate Commitment Act's (CCA) (Chapter 70A.65 RCW) Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, result in Spokane's Waste to Energy Facility (WTEF) assessing emission control technologies, including carbon dioxide (CO_2) capture and storage technologies?

We have made the informed assumption that delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, may result in WTEF assessing emission control technologies, including CO_2 capture and storage technologies. This assumption is based on current projects related to WTEF and information from key informants.

The CCA created a Cap-and-Invest Program, which is a market-based system to limit and lower climate pollution while generating revenue for climate and air quality projects.[20] The Cap-and-Invest Program sets an annual cap on greenhouse gas (GHG) emissions that declines over time (i.e., by 95% by 2050).[20] Covered entities may reduce emissions, obtain allowances, or purchase offset credits, or some combination of these, to cover remaining emissions above the level set in state law.[18,19] Under the CCA, the cost of emitting GHGs is internalized as a business operations cost (personal communication, Ecology, March 2025). Internalizing the cost of emissions functions as a market signal for covered entities to lower GHG emissions to lower the cost of operations to remain competitive (personal communication, Ecology, March 2025).

Based on provisions of SSB 5703, the date WTE facilities would become a covered entity under the CCA would be delayed from January 1, 2027, to January 1, 2036. On that date, as a covered entity, WTEF may reduce emissions, obtain allowances, or purchase offset credits, or some combination of these, to cover remaining GHG emissions above the level set in state law.[18,19] Key informants stated that lowering GHG emissions at WTEF would lower the cost for the facility to comply with the CCA (personal communications, March 2025), but is not required under the CCA.

WTE plants burn municipal solid waste (MSW) to produce steam in a boiler, and CO_2 is generated as part of this combustion process. Since CO_2 is produced as part of the WTE process, key informants stated that WTEF would need to use emission control technologies if the facility chose to reduce CO_2 emissions (personal communications, March 2025). Key informants stated that CO_2 capture and storage technologies would be the most appropriate option, and this class of technologies is still emerging both for WTE and industry generally (personal communications, March 2025).

In 2025, the City of Spokane (City) contracted with CarbonQuest to conduct a feasibility study of the company's CO_2 capture system and options for CO_2 storage to reduce WTEF's CO_2 emissions (personal communications, March 2025). The feasibility study will be completed in June 2025 (personal communications, March 2025). The study will evaluate the cost and viability of installing a CO_2 capture and storage system, including determining what may work with WTEF's existing incineration system and requirements for sizing, electricity, and resources

(personal communications, CarbonQuest, March 2025). Key informants stated that, while technologies would need to be scaled, CO_2 capture and storage technologies should functionally work to reduce CO_2 emissions for municipal WTE facilities (personal communications, March 2025). Key informants stated that SSB 5703 would provide time for the City of Spokane to evaluate the information from the feasibility study and determine a path forward (personal communications, March 2025).

However, key informants suggested that the larger challenge to implementing a CO_2 capture and storage system at WTEF would be accounting for the GHG emission lifecycle (personal communication, Washington State Department of Commerce [Commerce], March 2025). Specifically, in addition to CO_2 capture, the feasibility study would examine options to dispose of the CO_2 (personal communication, CarbonQuest, March 2025). While CarbonQuest would likely partner with other companies that work on CO_2 storage and disposal, CarbonQuest may examine options as part of the feasibility study, including options such as geological mineralization, selling CO_2 gas to industries (e.g., beverage industry, dry ice industry), or putting CO_2 below ground (personal communication, CarbonQuest, March 2025). There are also new industries putting CO_2 into building materials (e.g., concrete, decking) (personal communication, Commerce, March 2025). Key informants stated that some disposition options delay, rather than prevent, the release of CO_2 into the atmosphere (personal communications, March 2025). For example, key informants stated that CO_2 has very little value currently in Washington State because the market is new (personal communication, Commerce, March 2025). One of the most readily available disposition options in the state is to sell CO_2 to the beverage industry for use in carbonated beverages (personal communication, Commerce, March 2025). Use of CO_2 by the beverage industry delays, but does not prevent, the release of CO_2 into the atmosphere (personal communication, Commerce, March 2025).

While CarbonQuest and other companies have installed CO_2 capture and storage systems in buildings, there are no examples of municipal WTE facilities in the U.S. that have adopted CO_2 capture and storage technologies (personal communications, March 2025). However, there are examples of pilot programs internationally. In 2019, a CO_2 capture and storage system was successfully piloted at the Klemetsrud WTE plant in Oslo, Norway.[35,36] The Klemetsrud pilot operated for 9 months with an initial 2,000-hour test (March 1, 2019, to May 31, 2019) to assess operational stability followed by an extended phase until December 1, 2019.[35,36] While the technology had previously been proven at 2 facilities, the Klemetsrud pilot was necessary to test CO_2 capture on flue gas from waste incineration as well as to test the capture efficiency, energy requirements, solvent degradation, and solvent emissions.[35] The pilot showed that CO_2 capture efficiency of more than 90% can be maintained.[36] The project aims to capture 90% of total CO_2 emissions when the plant is operating at full capacity.[35,36]

Since CarbonQuest is currently conducting a feasibility study of CO_2 capture and storage technologies related to WTEF's operations, we have made the informed assumption that delaying the date WTEF would become a covered entity under the CCA to January 1, 2036, would allow time for WTEF to assess emission control technologies, including CO_2 capture and storage technologies.

Would delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, result in the City of Spokane assessing financing for emission control technologies, allowances, and offset credits?

We have made the informed assumption that delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, may result in the City of Spokane assessing financing for emission control technologies, allowances, and offset credits. This informed assumption is based on information from key informants.

The CCA created the Cap-and-Invest Program, a market-based system to limit and lower climate pollution while generating revenue for climate and air quality projects.[20] The Cap-and-Invest Program sets an annual cap on GHG emissions that declines over time (i.e., by 95% by 2050).[20] Washington State facilities with higher emissions are generally "required to buy 'allowances' to cover their annual emissions."[20] Since biogenic emissions (i.e., emissions from natural organic material) are generally not covered emissions under the CCA, facilities may purchase allowances to cover non-biogenic emissions (personal communication, Ecology, March 2025). An allowance is equal to 1 metric ton of CO_2 or the equivalent in other GHG emissions.[20] Ecology holds quarterly auctions where it sells allowances, and Cap-and-Invest Program participants can also buy from or sell to each other (on a secondary market).[20,37] As fewer GHG emissions are allowed over time, Ecology issues fewer allowances each year, which requires covered entities to choose the most cost-effective strategy for complying with the CCA: compete for a shrinking supply of allowances, take steps to reduce GHG emissions, or a combination of both.[20] Facilities must acquire allowances for 30% of their emissions annually; at the end of each 4-year compliance period, facilities must provide the balance of all allowances (personal communication, Ecology, March 2025).[37]

Currently, Cap-and-Invest Program participants may also purchase offset credits instead of allowances to cover up to 8% of GHG emissions during the first compliance period (2023-2026).[20,37] Offset credits will be limited to cover 6% of GHG emissions for all subsequent compliance periods (personal communications, Ecology, March 2025). As fewer GHG emissions are allowed over time, the percentage of GHG emissions that may be covered by offset credits also decreases (personal communication, Ecology, March 2025). Offset credits allow facilities to fund projects outside of their own operations that remove GHG emissions from the atmosphere.[20] The CCA requires that offset projects directly benefit Washington State's environment, and Ecology verifies that emission reductions or removals are real and permanent.[20] Washington State's offset credit market is still new (personal communication, Ecology, March 2025).

In the fiscal note for the original version of SB 5703, which would have granted WTEF an exemption from the CCA, Spokane County estimated total cost savings between $1 million to $2 million for county ratepayers annually.[29] Based on December 2024's Auction #8 allowance price of $40.26, the City of Spokane estimated a cost savings of $4,000,000 annually if the original version of SB 5703 were to pass.[29] However, under the provisions of SSB 5703, while both the City and County may expect cost savings associated with the Cap-and-Invest Program while WTEF is exempt (i.e., through 2035), the City of Spokane may incur other costs if it pursues

options to meet emission reductions outlined in the CCA (personal communications, March 2024).

Key informants stated that WTEF becoming a covered entity under the CCA will create a cost to the City of Spokane (personal communications, March 2025). As the owner and operator of WTEF, the City is responsible for purchasing any allowances under the state's Cap-and-Invest Program.[29] Key informants stated that, based on information provided in the fiscal note for the original version of SB 5703, if SSB 5703 were to pass, the City of Spokane may need to purchase allowances or offset credits in the amount of $4,000,000 per year, or more, once WTEF becomes a covered entity (personal communications, March 2025). At the Cap-and-Invest Program Auction #9 (March 5, 2025), allowances sold for $50 each.[38] Ecology offered 4,600,000 allowances, and an additional 2,746,096 allowances were offered through entity consignment (i.e., facilities selling to and buying from each other).[38] All allowances offered for sale were sold.[38] Therefore, depending on future WTEF emissions levels and future prices of allowances, costs to the City of Spokane may be higher or lower than estimated.

Key informants working for the City of Spokane stated that delaying the date WTEF would become a covered entity under the CCA would allow the City to assess financing for emission control technologies and for purchasing allowances and offset credits (personal communication, City of Spokane, March 2025). For example, the City of Spokane could determine how much CO_2 capture and storage technologies may cost and consider financing options (e.g., selling bonds, seeking grants) should they decide to pursue technology options to reduce GHG emissions (personal communication, City of Spokane, March 2025). Installing CO_2 capture and storage technologies at WTEF would likely also require facility upgrades to accommodate the technology (personal communications, March 2025). Delaying the date WTEF becomes a covered entity under the CCA may allow the City of Spokane to evaluate additional costs.

Key informants stated that CO_2 capture and storage technologies may not reduce 100% of CO_2 emissions because there are inefficiencies in the process (personal communication, Commerce, March 2025). Therefore, the City of Spokane may still need to purchase some allowances, even if WTEF were to install CO_2 capture and storage technologies to reduce emissions (personal communications, March 2025). However, if WTEF were to install emission control technologies, the facility would likely decrease emissions and therefore decrease the number of allowances the City of Spokane may need to purchase (i.e., lowering the cost) (personal communications, March 2025).

Lastly, key informants from the City of Spokane noted that funding for emission control technologies or to purchase allowances or offset credits may require multiple years to navigate, and any financing option would need to be approved by City Council (personal communication, City of Spokane, March 2025). Therefore, we have made the informed assumption that delaying the date WTEF would become a covered entity under the CCA to January 1, 2036, would allow time for the City of Spokane to assess financing for emission control technologies, allowances, and offsets credits.

Would WTEF assessing emission control technologies, including CO_2 capture and storage technologies, result in WTEF meeting the CCA's Cap-and-Invest Program requirements?
There is unclear evidence how WTEF assessing emission control technologies, including CO_2 capture and storage technologies, may impact WTEF's ability to meet the CCA's Cap-and-Invest Program requirements.

The CCA requires that offset projects directly benefit Washington State's environment, and Ecology verifies that emission reductions or removals are real and permanent.[20] Under state law (RCW 70A.45.010), carbon sequestration is defined as the process of capturing and storing atmospheric CO_2 through biologic, chemical, geological, or physical processes. In the 2024 Supplemental Operating Budget, the Washington State Legislature provided $300,000 for Ecology, in consultation with Commerce, to contract a study of the extent to which CO_2 removal is needed to meet GHG emissions reductions established in state law (RCW 70A.45.020).[39] The final report is due to the Legislature by June 30, 2025, and must include ways in which CO_2 removal might integrate with existing compliance programs; strategies to support industry sectors in integrating CO_2 removal; recommendations for monitoring, reporting, and verifying standards to ensure CO_2 removal technologies can be compared; and consideration of CO_2 removal accounting mechanisms that account for the durability of various approaches.[39]

Ecology's November 2024 Interim Progress Report noted that quantifying the CO_2 storage potential durability over time would rely on the definition of "permanent sequestration".[39] WAC 173-407-110 states that permanent sequestration means the retention of GHG in a containment system, using a method approved by Ecology, that creates a high degree of confidence that 99% of GHGs will remain contained for at least 1,000 years. Ecology has not made a determination under CCA if any carbon removal method, including CO_2 capture and storage technologies that CarbonQuest may be investigating related to WTEF, would meet obligations under CCA's Cap-and-Invest Program (personal communications, March 2025). Ecology staff noted that, to make a determination, the agency must have enough evidence or a clear threshold to make an affirmative and defendable decision, since the CCA requires assurance under the law that there will be a reduction in GHG emissions (personal communication, Ecology, March 2025). The final report (due to the Legislature by June 30, 2025) may provide additional information for WTEF and the City of Spokane to review as they consider options to meet the requirements of the CCA's Cap-and-Invest Program.

Additionally, the timeline for designing, developing, approving, financing, and implementing CO_2 capture and storage technologies at WTEF is unknown. While staff from CarbonQuest suggested that CO_2 capture and storage technologies may be operational in 2 to 3 years (personal communication, CarbonQuest, March 2025), this timeline is uncertain. For example, key informants at Ecology stated that, after a determination of whether CO_2 capture and storage technologies meet obligations under the CCA, the agency may need to conduct rulemaking (personal communication, Ecology, March 2025). The 2024 Interim Progress Report states that Ecology would need to establish "[m]onitoring, reporting, and verification protocols [to] ensure the credibility and accountability of efforts to sequester carbon, including [CO_2] removal, by providing a systematic approach to accurately measure, verify, and report the amount of [GHG] removed from the atmosphere."[39] Key informants explained that part of this effort will be to develop a process to report CO_2 captured and how it is stored, disposed, or distributed in order to

meet federal EPA requirements (personal communication, Commerce, March 2025). Key informants also stated that any technology installation at WTEF may need to go through additional state review processes, such as State Environmental Protection Act (SEPA) and Healthy Environment for All Act (HEAL) requirements (personal communication, Commerce, March 2025).

Additionally, key informants from CarbonQuest suggested that some CO_2 storage technologies (e.g., injecting CO_2 below ground to create geologic stone) could allow WTEF to claim and potentially sell carbon removal credits (personal communication, CarbonQuest, March 2025). However, Ecology has not made a determination of whether CO_2 capture and storage technologies meet obligations under the CCA (personal communications, March 2025), which could impact whether CO_2 stored in this manner would meet requirements in state law. Moreover, key informants at Ecology stated that it may take 1 to 5 years to develop a CO_2 removal project that could generate offset credits, and Washington State's offset credit market is still new (personal communication, Ecology, March 2025).

A CO_2 capture and storage system designed for the Klemetsrud WTE plant in Oslo, Norway, also provides an example of potential project timelines. The Klemetsrud project was expected to be the world's first WTE plant with full-scale CO_2 capture and storage system initially opening in 2024.[35] Although successfully piloted in 2019, the project was delayed until 2026,[40] likely due in part to the COVID-19 pandemic. However, the project was then paused in 2023 to reassess and reduce development costs.[41] In January 2025, it was announced that the project had been redesigned, the new cost structure had been approved by the city council, and the facility is expected to be operational in the third quarter of 2029.[41] The complexity and scale of systems may result in unanticipated delays which could affect WTEF's ability to meet the CCA's Cap-and-Invest Program requirements.

Therefore, since consideration of CO_2 capture and storage technologies in state law is ongoing and Ecology has not made a determination on whether emission control technologies may meet obligations under CCA's Cap-and-Invest Program and since any potential project timeline is uncertain, it is unclear whether WTEF assessing emission control technologies may impact WTEF's ability to meet Cap-and-Invest program requirements.

Would the City of Spokane assessing financing for emission control technologies, allowances, and offset credits result in WTEF meeting the CCA's Cap-and-Invest Program requirements?

There is unclear evidence how the City of Spokane assessing financing for emission control technologies, allowances, and offset credits may impact WTEF's ability to meet the CCA's Cap-and-Invest Program requirements. Key informants suggested the financial viability of WTEF and financing options that may be available to the facility and the City of Spokane, may impact WTEF's ability to meet requirements of the CCA's Cap-and-Invest Program (personal communications, March 2025).

Once WTEF becomes a covered entity under the CCA, WTEF may reduce emissions, obtain allowances, or purchase offset credits, or some combination of these, to cover remaining GHG emissions above the level set in state law.[18,19] It is unknown how much emission control

technologies, allowances, and offset credits may cost the City of Spokane. Key informants generally stated that paying for allowances and offset credits would likely be the most expensive (and therefore cost prohibitive) option for the City (personal communications, March 2025). However, it is difficult to predict how many allowances and offset credits the City would need to purchase, and at what cost.

Key informants stated that it is challenging to calculate by what percentage WTEF would reduce emissions if they chose to pursue emission control technologies once the facility is a covered entity under the CCA (personal communications, March 2025). Biogenic emissions are not covered emissions under the CCA, and WTEF could use emission control technologies to reduce only non-biogenic emissions (personal communication, Ecology, March 2025). While WTEF monitors its biogenic and non-biogenic emissions, key informants stated that there is no selective technology that separates biogenic and non-biogenic emissions (personal communications, March 2025). Regulatory agencies would need to address how to account for both types of emissions (personal communications, City of Spokane, March 2025), especially as facilities may choose to reduce GHG emissions under the CCA. Generally, key informants stated that some percentage of WTEF's emissions would be subject to the CCA's Cap-and-Invest Program, and WTEF may reduce emissions by some percentage if they pursue emission control technologies as a covered entity (personal communications, March 2025). Key informants suggested that the amount of reduction may partially depend on financing options available to the City of Spokane (personal communications, March 2025).

The costs and/or savings for the City of Spokane would also vary annually as the number of allowances are reduced under the CCA and the price of allowances and offset credits fluctuates.[29] Specifically, the price of allowances has fluctuated over time, from below $30 to about $60 per allowance, and is capped at $95 per allowance under the CCA.[21] On March 5, 2025, allowance prices increased 24% from December 2024, selling at $50 per allowance.[21] Additionally, key informants working for the City of Spokane stated obtaining offset credits may require City Council approval (personal communication, City of Spokane, March 2025). Staff from the City of Spokane stated that the City may not be able to pay as high a price or compete for offset credits with industry (personal communication, City of Spokane, March 2025). Key informants from Ecology stated that, generally, offset credits are sold at a lower price than allowances (personal communication, Ecology, March 2025).

Key informants speculated that emission control technologies may be less expensive than allowances and offset credits (personal communications, March 2025). However, it is unknown how much it may cost to develop and install CO_2 capture and storage technologies (personal communications, March 2025). While the feasibility study would likely include cost estimates, the project would need to go out for competitive bid (personal communication, CarbonQuest, March 2025), which would determine the company to complete the project as well as the final project costs. Moreover, there would likely be additional costs associated with installing CO_2 capture and storage technologies (upgrading the facility, disposition of CO_2, etc.) (personal communications, March 2025).

Lastly, key informants speculated that if it becomes too expensive to dispose of waste at WTEF (i.e., due to increased costs from emission control technologies or purchasing allowances or

offset credits), the City of Spokane may close WTEF, even though it may also be expensive to transport MSW outside Spokane County (personal communications, March 2025). Key informants suggested that the City of Spokane would need to conduct cost-benefit analyses to determine the most appropriate and viable way to move forward (personal communications, March 2025). For discussion of alternative MSW management options for the City of Spokane and Spokane County, see Additional Considerations on page 28.

Key informants also stated there may be limited financing options for the City of Spokane to invest in emission control technologies. Ecology's 2024 Interim Progress Report related to CO_2 removal included descriptions of a number of federal grants that may be available for the study and application of CO_2 capture and storage technologies.[39] Additionally, key informants discussed federal tax credits that have previously been available for projects (personal communication, CarbonQuest, March 2025). However, under the current federal administration, there are no known federal grant opportunities for WTE facilities (personal communications, March 2025). Specifically, on January 20, 2025, the federal administration issued 3 energy-related executive orders: "Declaring a National Energy Emergency," "Unleashing American Energy," and "Putting America First in International Environmental Agreements".[7] These orders include actions to: accelerate approvals for fossil fuel infrastructure with reduced environmental review requirements under the Clean Water Act and National Environmental Policy Act (NEPA); heighten emphasis on fossil fuel expansion; and pause disbursement of funds for renewable energy projects under the federal legislation.[7] The federal administration also "rescinded several executive orders from prior administrations, including those focused on reducing emissions and expanding clean energy infrastructure."[7] Generally, key informants expressed doubts about whether federal funding opportunities may become available for WTE facilities in the near term (personal communications, March 2025).

Key informants disagreed about whether the CCA provides state financial opportunities for WTEF to pursue emission control technologies. Some key informants stated that the CCA did not provide a funding stream or mechanism to support WTE (personal communication, City of Spokane, March 2025). However, other key informants stated that, under the CCA, lower emissions may reduce necessary allowances for covered entities, which could result in cost-savings for a facility to further invest in lowering emissions (personal communications, March 2025). Other key informants stated that there may be competitive funding options available at the state level through CCA-related account funding (personal communication, Commerce, March 2025).

At the municipal level, key informants stated it may not be possible to raise the rate for MSW management in the City of Spokane or Spokane County to finance emission control technologies or to pay for allowances or offset credits (personal communication, City of Spokane, March 2025). WTE is a more expensive way to dispose of MSW compared to other options (e.g., landfilling), and key informants stated that people who live in the City of Spokane and Spokane County already pay more for solid waste management than other areas of Washington State (personal communications, March 2025). Key informants explained that ratepayers are price sensitive and, since the City of Spokane and Spokane County have lower median household income compared to the state, a rate increase would negatively impact people in the City and County (personal communication, City of Spokane, March 2025).

For example, people who live in the City of Spokane are required to use municipal MSW management and can only decrease their rate by choosing a smaller trash receptacle (personal communication, City of Spokane, March 2025). The City of Spokane recently passed a 2-year rate structure that included a 7% rate increase (personal communication, City of Spokane, March 2025). The structure narrowly passed City Council (4-3), in part due to concerns about costs for people in Spokane (personal communication, City of Spokane, March 2025). In addition, if rates were increased for wholesale customers in the County, these customers could choose not to use Spokane's solid waste services (personal communication, City of Spokane, March 2025). If wholesale consumers changed their service, WTEF may not receive enough trash to operate (personal communication, City of Spokane, March 2025). Lastly, the City of Spokane anticipates additional rate increases in the coming years as different policies take effect (e.g., mandatory curbside collection of organic waste required in state law by 2030) (personal communication, City of Spokane, March 2025).

Purchase of allowances or offset credits under the CCA would likely not improve MSW management services for people who live in the City of Spokane and Spokane County, which may make it challenging for people to accept rate increases for this purpose (personal communication, City of Spokane, March 2025). Key informants stated the City of Spokane may explore other potential options (e.g., selling bonds, levies) to finance emission control technologies, allowances, or offset credits that may have less impact on ratepayers (personal communications, March 2025). However, other key informants stated that any municipal financing option may increase rates for ratepayers (personal communications, Commerce, March 2025). If waste disposal becomes a financial burden, it could increase sanitation concerns and illegal dumping within the County and region (personal communication, SRHD, March 2025).

Overall, there is unclear evidence how financing options may impact WTEF's ability to meet the CCA's Cap-and-Invest Program requirements.

Would delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, result in WTEF continuing operations?

There is unclear evidence how delaying the date, from January 1, 2027, to January 1, 2036, that a WTE facility is a covered entity under the CCA's Cap-and-Invest Program and exempting emissions from a WTE facility until January 1, 2036, may impact WTEF's ability to continue operations. Key informants expressed different viewpoints about how delaying the date WTEF would become a covered entity under the CCA may impact WTEF's operations due to uncertainties about the impacts of Washington State policy implementation, findings of the CO_2 capture and storage feasibility study, and financing opportunities available to the City of Spokane.

Generally, key informants stated that delaying the date WTEF would become a covered entity under the CCA from January 1, 2027, to January 1, 2036, would likely result in the facility continuing operations (personal communications, March 2025). In this scenario, key informants stated that the facility would likely continue GHG emissions at the current level (personal communications, March 2025).

However, some key informants also stated that it was unknown how long the facility may continue to operate or whether the facility would remain financially viable past January 1, 2036, if it were to become a covered entity under the CCA (personal communications, March 2025). Key informants noted that, over time, allowance availability under the CCA becomes tighter and so the cost of allowances will increase as the number of allowances decreases, which some key informants speculated may make it less financially viable for WTEF to remain in operation (personal communications, March 2025). Additionally, key informants stated that the life of the plant is unknown, though the typical lifespan of WTE facilities is 20 to 40 years and WTEF has been in operation for over 30 years (personal communications, March 2025). If WTEF were to close, key informants stated there would be a reduction in GHG emissions and emissions of CAPs and other toxic pollutants from the facility (personal communications, March 2025). Some key informants stated that diversion of waste from WTEF to alternative MSW management options would result in GHG emissions elsewhere in the system (personal communications, March 2025). For discussion of alternative MSW management options for the City of Spokane and Spokane County, see Additional Considerations on page 28.

WTEF's operations are also impacted by CETA, which requires 80% of electricity used in the state to come from renewable or non-emitting sources by 2030 and allows the remaining 20% to be carbon-neutral via off-sets or other compliance mechanisms.[16] By 2045, CETA requires all electricity in Washington State to come from clean energy sources (i.e., an electricity supply free of GHG emissions).[17] Key informants from Ecology and Commerce stated that a determination has not been requested or made about whether WTEF emits fewer GHGs than other alternatives (landfilling) should it cease operations based on a life cycle assessment under CETA (personal communications, March 2025). If MSW is not designated a clean energy source, WTEF could potentially still generate electricity but may need to sell the power it generates outside of Washington State (e.g., to a neighboring state or jurisdiction) (personal communication, Commerce, March 2025). Potential impacts to WTEF's sale of electricity (i.e., as a revenue stream) could also impact WTEF's ability to remain financially viable and in operation.

Overall, there is unclear evidence whether Spokane's WTEF may continue to operate, how long WTEF may continue to operate, or whether WTEF may cease operations.

Additional considerations

This Health Impact Review focused on the most linear pathway between provisions in the bill and health outcomes and equity. Evidence related to alternative MSW management options for the City of Spokane and Spokane County is discussed below.

Some key informants stated that obligations of state law and the CCA's Cap-and-Invest Program requirements may make it less financially viable for WTEF to remain in operation (personal communications, March 2025). If WTEF were to stop operations, the City of Spokane would need to identify an alternative MSW management option to address the approximately 250,000 short tons per year of MSW produced by people in the City of Spokane and Spokane County. Key informants stated there is not an identified or secured alternative MSW management option for the City of Spokane and Spokane County (personal communications, March 2025).

In 2023, the Washington State Legislature directed Ecology to contract a report to study the full emissions life cycle (LCA) for managing Spokane's MSW at WTEF compared to 3 area landfills

that Spokane may send waste, should WTEF cease operating.[11] The report stated "landfilling was determined to be the only available best management practice alternative for managing the current waste stream going to WTEF."[11] While there is 1 publicly-owned landfill in the City that is operated when WTEF is down for maintenance, it may not be an alternative to WTEF if the facility were to close (personal communications, March 2025). Since Spokane is located above a federally-designated, sole-source drinking water aquifer by the federal Safe Drinking Water Act of 1974,[10] there are concerns about siting and constructing a new landfill to handle all the waste currently disposed of at WTEF (personal communications, March 2025).

Therefore, the study compared emission impacts of managing 250,000 tons of waste per year at WTEF to 3 area landfills: Waste Management's (WM) Greater Wenatchee Landfill (Chelan County), Republic Services' Roosevelt Regional Landfill (Klickitat County), or Waste Connections' Finely-Buttes Landfill (Oregon).[11] Since the LCA study, a new landfill has opened in Washtucna (Adams County) closer to Spokane (personal communication, Ecology, March 2025). However, key informants noted that landfills may not have capacity to accept additional waste (approximately 800 tons per day) or agree to accept waste from Spokane (personal communications, March 2025). For example, WTEF currently accepts and incinerates drugs and illicit substances seized by law enforcement agencies, and key informants stated that there is not another facility in the state that could accept this waste stream (personal communication, Ecology, March 2025). The City of Spokane would also have to go out for bid to determine which landfill could offer the lowest cost per ton, including transportation costs (personal communications, March 2025). The City of Spokane would need to determine how to transport waste to landfill sites and would likely need to contract trucking and rail services for this purpose (personal communication, City of Spokane, March 2025).

The LCA focused on impacts from GHG emissions to address CETA's requirement that "a utility may only use electricity from an energy recovery facility if [Commerce and Ecology] determine that electricity generation at the facility provides a net reduction in [GHG] emissions compared to any other available waste management best practice."[11,14] WTE facilities do not emit methane (personal communications, March 2025). However, as a byproduct of the combustion process, WTE facilities produce CO_2 emissions. As an MSW management option, landfills produce methane. Global warming potentials (GWP) are used to compare the relative impact of different GHGs (e.g., CO_2 and methane) on climate by converting emissions into 'CO2 equivalent'.[42]

The LCA suggests that, using a 20-year GWP for methane (81 times more potent than CO_2 over this time period), Spokane WTEF had fewer GHG emissions than the 3 landfills.[11] When using a 100-year GWP for methane (28 times more potent than CO_2 over this time period), WTEF had the highest emissions.[11] Authors of the report recommended using the 20-year GWP due to the urgency of climate change and the need to reduce GHG emissions.[11] However, the recommended use of the 20-year GWP does not align with how methane's climate changing potential is typically measured (personal communications, Ecology, March 2025). The U.S. primarily uses the 100-year GWP as a measure of relative impacts of different GHGs.[43] The EPA states, "the 20-year GWP prioritizes gases with shorter lifetimes, because it does not consider impacts that happen more than 20 years after the emissions occur."[43] Methane is estimated to remain in the atmosphere for 10 to 12 years, while some CO_2 is expected to remain in the atmosphere for

hundreds to thousands of years.[11] Authors of the LCA recommended 20-year GWP as results "stress the importance of addressing potent GHGs, such as [methane], in the urgent need to curb climate change."[11] The United Nations Environment Programme has stated:

> Without action[,] global anthropogenic methane emissions are projected to rise by up to 13% between 2020 and 2030. Global methane emissions must be reduced by 30-60% below 2020 levels by 2030 to be consistent with least-cost pathways of limiting global warming to 1.5°C this century.[44]

Meanwhile, researchers who assessed a variety of climate metrics as well as metric selection on technology preference have stated, "it is not advisable or conservative to use only a short time horizon, e.g., 20 years, which disregards the long-term impacts of CO_2 emissions and is thus detrimental to achieving eventual climate [stabilization]."[42] Rather, researchers recommend, "[testing] any GHG estimates with high and low equivalency values to ensure that we are not simply replacing long-term climate forcing with short-term, or *vice versa*."[42]

Some key informants stated that, because the LCA was completed prior to implementation of Washington State's laws regulating methane emissions at and diverting organics from MSW landfills, the findings are not applicable to the current solid waste management policy landscape (personal communications, March 2025). Specifically, in 2022, the Legislature directed Ecology (Chapter 170, Laws of 2022; Chapter 70A.540 RCW) to adopt regulations requiring MSW landfills to take steps to monitor and capture methane emissions.[22] In May 2024, Ecology adopted rules (Chapter 173-408 WAC), which established new requirements for MSW landfills (both active and closed, with some exemptions) that received solid waste after January 1, 1992.[23] The rules became effective June 13, 2024, and address requirements specific to technology and performance, monitoring, reporting and recordkeeping, and others (e.g., civil penalties, maximum methane concentration limits).[23] In 2022, the state also passed the first Organics Management Law (Chapter 180, Laws of 2022), which established state organics management goals and requirements to reduce methane by diverting organic materials from municipal landfills toward beneficial uses (e.g., compost, crop nutrients).[25] In 2024, the Legislature created funding opportunities and amended some organics management and collection requirements (Chapter 341, Laws of 2024).[26]

Key informants noted that closing WTEF and using an alternative MSW management option would result in additional costs and infrastructure changes (personal communications, March 2025). Key informants stated that the City of Spokane would either need to retrofit WTEF or develop a new transfer station to collect waste for transport (personal communications, March 2025). The City of Spokane would likely need to decommission part of the existing WTE infrastructure and may explore the sale of the facility (personal communications, March 2025). Other key informants suggested that WTEF could also consider changing the type of feedstock it receives (e.g., wood) to continue to produce energy (personal communications, Ecology, March 2025). Since WTEF functions as part of a larger MSW management system, there may be impacts to other aspects of MSW operations (recycling operations, household hazardous waste collection, wholesale customers, law enforcement agencies, etc.) (personal communications, March 2025). There would also be impacts to approximately 70 city employees who work directly and exclusively with WTEF operations (personal communications, City of Spokane, March 2025).

Key informants stated different perspectives about alternative MSW management options. Generally, key informants had differing priorities and concerns based on consideration of climate, MSW management, air quality, and drinking water quality (personal communications, March 2025). Some key informants stated that closing WTEF would be beneficial to human health and the environment as it would reduce CAPs, HAPs, and other toxic pollutants as well as GHG emissions, which may reduce health risk for Spokane communities disproportionately impacted by air pollution and climate (personal communications, March 2025). Some key informants stated that landfilling (and potentially trucking or transporting MSW by rail) may be more harmful to health and the environment than WTEF since landfilling and transportation options also negatively impact air pollution, climate, and drinking water quality (personal communications, March 2025). Key informants also expressed differing opinions about whether WTEF's generation of electricity had beneficial or harmful climate impacts compared to landfilling MSW (personal communications, March 2025). Some key informants also stated that, if WTEF were to close without an alternative MSW management option in place, there may be negative impacts for people who live in the City of Spokane and Spokane County. For example, key informants from SRHD stated that illegal dumping is already a concern in the City and County (personal communication, SRHD, March 2025). Without an identified and planned transition of MSW management from WTEF, the City and County could experience an increase in illegal dumping or waste pile-up, which could result in drinking water contamination or other adverse health impacts due to exposure to MSW (personal communication, SRHD, March 2025).

SSB 5703 does not relate to alternative MSW management options, and this pathway was not included in the logic model.

Annotated References

1. **Biomass explained Waste-to-Energy (Municipal Solid Waste). 2024; Available at: https://www.eia.gov/energyexplained/biomass/waste-to-energy.php. Accessed 10 March 2025.**

This Independent Statistics Analysis U.S. Energy Information Administration webpage provides an overview of Waste-to-Energy Municipal Solid Waste plants. The basics page discusses use of these systems in the U.S., and the in depth page explains how waste-to-energy plants work.

2. **Castaldi M. Scientific Truth About Waste-to-Energy. City University of New York (CUNY);2021.**

In this report, Castaldi provided some background information and summarized some literature related to waste-to-energy facilities, including WTE impacts on greenhouse gas emissions and health. In the U.S., WTE refers to municipal solid waste combustion. About 12.8% of waste is managed by WTE. WTE "differs from combustors that are classified as incinerators because of the energy recovery component." For example, "only WTE captures the energy released from combustion to produce power and steam while recovering additional materials for recycling. On the other hand, energy released from hazardous and medical waste incinerators is not recovered and no additional material is recovered for recycling but goes directly to landfill." The author states that the "relative GHG impact (WTE versus landfills […]) cannot be measured without knowing the energy supply that will be offset. Thus, evaluating WTE in isolation is very misleading as it leave out the net effect of the environmental energy impacts of landfilling the waste often great distances away from the source of generation." The author also cites background information from the U.S. Environmental Protection Agency that emissions associated with WTE include, "(1) the combustion of waste, i.e., the stack gas (accounting for air pollution controls), (2) the production and use of limestone in the air pollution control technologies (i.e., scrubbers), and (3) the disposal of ash in a landfill." Moreover, while decay of municipal solid waste in a landfill is typically projected over 100 years, "emissions from WTE and conventional electricity-generating technologies are instantaneous." Lastly, the authors state that , generally, research has shown that "human health effects cannot be directly connected to properly operating WTE facilities."

3. **Chrostowski P. Municipal Waste-to-Energy has very little public health impact. *Natural Gas & Electricity.* 2007;October:17-21.**

Chrostowski provides some background information about Waste to Energy as a process to manage municipal solid waste in the U.S. In 2000, a study by the National Research Council "concluded that emissions from, well-run facilities were expected to contribute little to environmental concentrations of toxic pollutants or to human health risks." The National Research Council stated that the implementation of numerous federal regulations that apply to WTE facilities reduced emissions, including the New Source Performance Standards (reduced WTE emissions of multiple pollutants by more than 90%, including dioxins, mercury, cadmium, lead, and hydrochloric acid), Resource Conservation and Recovery Act (prohibited WTE facilities from burning hazardous waste), Toxic Substance Control Act (prohibited WTE facilities from burning polychlorinated biphenyls [PCBs]), and the Federal Insecticide, Fungicide, and Rodenticide Act (prohibited WTE facilities from burning pesticide waste). Chrostowski summarizes results from public health risk assessments completed for 3 WTE

facilities in the U.S., including Spokane's WTE facility. Together, the studies found that the probability of a person contracting cancer from exposure to emissions from all exposure pathways was lower than the background rate of cancer in the U.S.

4. **Energy Recovery from the Combustion of Municipal Solid Waste (MSW). 2024; Available at: https://www.epa.gov/smm/energy-recovery-combustion-municipal-solid-waste-msw. Accessed 10 March 2025.**
This U.S. EPA webpage provides an overview of energy recovery from the combustion of municipal solid waste (MSW).

5. **Overview of Greenhouse Gases. 2025; Available at: https://www.epa.gov/ghgemissions/overview-greenhouse-gases. Accessed 3/18/2025.**
This U.S. Environmental Protection Agency (EPA) webpage provides a definition and overview of greenhouse gases.

6. **Ecology Washington State Department of. 2018 Greenhouse gas data.2021.**
Washington State Department of Ecology compiles an annual greenhouse gas (GHG) emissions inventory that estimates the combined emissions from all sources in the state. Worldwide, the largest source of carbon emissions is electricity generation. However, in Washington State, the largest contributor of GHG emissions is the transportation sector (44.9%), followed by residential, commercial, and industrial heating (23.4%), electricity (16.3%), and other sources (e.g. agriculture, industrial processes, waste management, natural gas distribution) (15.4%). Transportation emissions include on-road gasoline and diesel vehicles, marine vessels, jet fuel and aviation gasoline, railroads, and natural gas used in transportation. Emissions from personal cars and trucks contribute to 50% of transportation emissions. Data from 2018 suggest that GHG emissions increased by 1.3% between 2017 and 2018. Emissions from electricity generation decreased 2.5% from 2017 to 2018 due to the 2019 Clean Energy Transformation Act, which requires Washington utilities to stop using coal power by 2025. These reductions in the electricity sector were offset by an increase in emissions of 3.3% in the transportation sector. Ecology also noted that, "the effects of the COVID-19 pandemic are expected to significantly reduce emissions in 2020. However, these reductions are not expected to last as our state and nation recover from the pandemic."

7. **Climate and Energy Executive Orders: Implications for Corporate Sustainability. 2025; 2/19/2025:Available at: https://corpgov.law.harvard.edu/2025/02/19/climate-and-energy-executive-orders-implications-for-corporate-sustainability/. Accessed 13 March 2025.**
This Harvard Law School Forum on Corporate Governance post is based on the authors Conference Board memorandum. The article analyzes the key provisions of three federal executive orders (EO) (i.e., "Declaring a National Energy Emergency," "Unleashing American Energy," and "Putting America First in International Environmental Agreements") and their potential impact on corporate sustainability practices. The first EO, Declaring a National Energy Emergency, "invokes emergency provisions to accelerate domestic fossil fuel production and infrastructure expansion, citing energy reliability, affordability, and national security as critical objectives. It suspends key environmental regulations and redirects federal resources to bolster fossil fuel supply chains. An accompanying memorandum also directs federal agencies to halt

new offshore wind leases." The second EO, Unleashing American Energy, "prioritizes deregulation of domestic fossil fuel production, reverses prior climate-focused mandates, and emphasizes energy affordability, national security, and market-driven energy policies. It reduces federal support for renewable energy, eliminates environmental justice programs, and streamlines permitting for fossil fuel infrastructure." The third EO, Putting America First in International Environmental Agreements, "prioritizes domestic economic and energy interests over multilateral climate commitments, directing the US withdrawal from international climate agreements and reducing federal involvement in global climate finance. This reflects a strategic shift in US climate diplomacy, focusing on perceived economic disadvantages of multilateral commitments while reframing global environmental agreements around energy security and trade interests." Summaries include a list of key actions specified in each EO, and well as a description of potential implications for corporate sustainability efforts.

8. **Solid Waste Services Waste to Energy Facility. Available at: https://my.spokanecity.org/solidwaste/waste-to-energy/. Accessed 10 March 2025.**
This City of Spokane webpage provides an overview of the city-owned and -operated Waste to Energy Facility.

9. **Aquifers / Groundwater. Available at: https://www.spokanecounty.org/1203/Aquifers-Groundwater. Accessed 10 March 2025.**
This Spokane County Public Works webpage describes what an aquifer is and that the Spokane Valley-Rathdrum Prairie Aquifer is the sole-source of drinking water for more than 500,000 people.

10. **Overview of the Drinking Water Sole Source Aquifer Program. 2024; Available at: https://www.epa.gov/dwssa/overview-drinking-water-sole-source-aquifer-program#What_Is_SSA. Accessed 3/18/2025.**
This U.S. Environmental Protection Agency (EPA) webpage provides information about federally-designated, sole source aquifers. Under the federal Safe Drinking Water Act of 1974, the U.S. EPA may designate an aquifer as sole source if the aquifer "is the sole or princial dirnking water source the area and, if contaminated, would create a significant hazard to public health."

11. **Smith CDM. Life Cycle Assessment of Spokane Waste Management Options. March 2024 2024.**
In 2023, the Washington State Legislature appropriated funds to The Washington State Department of Ecology (Ecology) to contract with a consultant to conduct a full emissions life cycle assessment for solid waste processed at Spokane's Waste to Energy Facility (WTEF) compared to solid waste processed at 3 landfills within the region where waste may be sent if WTEF stopped operations. Ecology hired CDM Smith to conduct a life cycle assessment (LCA) of WTEF to determine its eligibility as an alternative compliance option under the Washington Clean Energy Transformation Act (CETA) of 2019. CETA requires that electricity sold to Washington State residents be greenhouse gas (GHG) neutral by January 1, 2030. A utility can provide up to 20% of its electricity through alternative compliance options, which includes electricity from an energy recovery facility using municipal solid waste (MSW) as the principal fuel source if the facility meets specified criteria, through December 31, 2044. An electric utility

may only use electricity from an energy recovery facility if the facility complies with federal laws and regulations, meets air quality standards, and results in a net reduction in GHG compared to other available waste management best practices. This LCA compared WTEF qualifies as an alternative compliance option to 3 MSW landfills in the region: the Republic Services Roosevelt Regional Landfill (Roosevelt), the Waste Connections Finley Buttes Landfill (Finley Buttes), and WM Greater Wenatchee Regional Landfill (Wenatchee). The assessment assumed a period of 30 years (i.e., typical operational period of an active landfill) with 250,000 short tons per year of waste (i.e., approximate annual amount of waste processed at WTEF). The assessment included impacts from GHGs emissions (primary focus), criteria air pollutants (CAPs), and other pollutants of concern. The study assumed that all recycling, organic waste, household hazardous waste diversion programs, and curbside trash pickup would remain the same regardless of where the MSW was sent for processing and disposal. Emission impacts from these activities were not included. Using a 20-year global warming potential (GPW) (81 times more potent than CO2) for methane, Spokane WTEF had less GHG emissions than the 3 landfills, and Wenatchee had the highest. However, using a 100-year GWP for methane (28 times more potent than CO2), Roosevelt had the least GHG emissions, and WTEF had the highest. Specific to CAPs, WTEF had the highest emissions for 4 of the 6 pollutants (NOx, SO2, PM10, PM2.5). Since landfills and WTEF produce different pollutants, it was not possible to compare all pollutants of concern (8). For the 4 pollutants (NH3, HCL, Hg, and dioxins/furans) common to all facilities, WTEF generates larger quantities than the 3 landfills. The LCA found the largest sources of GHG emissions for Spokane's WTEF are: 1) anthropogenic direct emissions including N2O emissions and CO2 emissions (i.e., from burning plastics, carpeting, tires, asphalt shingles, vinyl flooring, and electronic device components); 2) biogenic direct emissions including biogenic CO2 (i.e., combustion of tree products); 3) hauling emissions; and 4) emission for fuel (i.e., natural gas), materials, and electricity consumption. The largest emissions offset for WTEF was electricity generation (8 times greater per ton than landfills). Additional offsets include source reduction and recycling resulting from ferrous metals recovery. For landfills, the largest emissions offsets were for carbon storage. GHG emissions related to hauling were 3-14 times higher than emissions hauling to WTEF due to landfills being further away from waste generators.

12. **Corporation Pioneer Technologies. Final Spokane Waste-to-Energy Facility Human Health Risk Assessment.2001.**

In 2001, the City of Spokane contracted a multi-pathway (soil, air, water) human health risk assessment to estimate potential human health risks associated with long-term exposure to emissions from Spokane's Waste to Energy facility (WTEF). The risk assessment was completed to meet the grant requirements to establish WTEF, and followed standardized EPA protocols for risk assessment. Human Health Risks Assessments do not measure actual health outcomes; rather, risk assessments rely on hypothetical maximum exposure estimates for adults, children, and infants for residential, subsistence farmer, and subsistence fisher scenarios. The assessment include estimation of emission rates; air dispersion and deposition modeling; surface water runoff modeling; identification of toxicity; risk characterization; and uncertainty and sensitivity analysis. The assessment included potential exposures within 31 miles of WTEF. The assessment used emissions data from 1991 through the time to assessment was completed, and identified 77 chemicals of potential concern. The assessment noted that, based on land use zoning, there are no residential locations located at the site of maximum deposition outside the

facility. For noncancer hazards, the majority of the noncancer hazard index was attributed to ingestion of mercury and inhalation of hydrogen chloride. However, the assessment found that all noncancer hazard indices for all exposure scenarios were below 1, indicating that adverse noncancer effects are not expected. For cancer hazards, all cancer risk estimates for all exposure scenarios were at or below the low-end regulatory target, except the subsistence farmer scenario. For adult subsistence farmers, the cancer risk was slightly above the low-end regulatory target, but well below the upper-end target. For adult subsistence farmers, the majority of cancer risk was due to ingestion of dioxins and furans in homegrown chicken, eggs, and dairy products. The assessment found that "concentrations of lead, nitrogen dioxides, particulate matter, sulfur dioxide, and breast milk dioxins were below their associated target or background levels." The assessment notes, "risk presented in this assessment are conditional estimates based on scientific information, EPA policy decisions, standard risk assessment practices, and a number of assumptions about exposure and toxicity given a particular land-use scenario. Uncertainties are inhere in the risk assessment process"; however, "more conservative […] values were generally chosen for each parameter."

13. **Ecology Washington State Department of. Atmospheric Deposition of PCBs in the Spokane River Watershed.2019. 19-03-003.**

In 2016 and 2017, Washington State Department of Ecology (Ecology) evaluated atmospheric deposition of polychlorinated biphenyls (PCBs) in the Spokane area. The evaluation was conducted as part of state clean-up site efforts related to the Spokane River. As part of this work, Ecology conducted modeling of Spokane's Waste-to-Energy facility (WTEF) emissions to determine potential PCB emissions and depositions. The study noted that environmental conditions have a large impact on atmospheric deposition, including variables such as precipitation, temperature, wind direction, wind speed, particulate matter in teh air, landscape, and land use. Ecology stated that the" wind direction and wind speed in the Spokane area varies throughout the year, though wind direction is predominately from teh southwest." Overall, Ecology estimated that WTEF accounted for about 2% of PCB bulk deposition at the study sites located northeast of the facility, which represent the "upper bounds of what the Spokane WTE facility could contribute to the observed deposition, implying that there must be other contributing PCB sources in the region."

14. **ESSB 5187 Operating Budget, Chapter 475, Laws of 2023 (2023).**

Section 302(43) of the 2023 Operating Budget appropriated $200,000 for the Department of Ecology to contract for the development of a life cycle assessment of the solid waste processed at the Spokane Waste to Energy Facility.

15. **Greenhouse gas emissions reductions—Reporting requirements., RCW 70A.45.020 (2020).**

This Washington state statute sets limits on anthropogenic emissions of GHG to achieve emission reductions for the state.

16. **Commission Washington Utitilies and Transportation. Issue Brief 2: Climate Legislation in Washington State. Lacey, WA2022.**

This issue brief from the Washington Utilities and Transportation Commission describes state legislation that addresses climate change by prioritizing decarbonization.

17. **Clean Energy Transformation Act. 2023; Available at: https://www.commerce.wa.gov/growing-the-economy/energy/ceta/. Accessed 12/1/2023.**
This Washington State Department of Commerce webpage provides an overview of the Clean Energy Transformation Act (CETA).

18. **Climate Commitment Act. no date; Available at: https://ecology.wa.gov/Air-Climate/Climate-Commitment-Act. Accessed 3/10/2025.**
This Washington State Department of Ecology webpage provides information about the Climate Committment Act (CCA).

19. **Services Senate Committee. Senate Bill Report, SB 5703, Concerning fair treatment of municipal solid waste systems. 2025.**
This Bill Report provides a summary of the first substitute version of SB 5703, relevant background information, and public testimony.

20. **Ecology Washington State Department of. Climate Commitment Act 101.**
This fact sheet from the Washington State Department of Ecology provides an overview of the state's Climate Commitment Act (CCA), its Cap-and-Invest Program, and uses of CCA revenues.

21. **Lucia B. Washington carbon auction prices rise again. *Washington State Standard*2025.**
On March 12, 2025, the Washington State Standard reported results from the Washington State carbon allowance auction.

22. **E2SHB 1663 Landfills—Methane Emissions, Revised Code of Washington (2022).**
Chapter 70A.540 established regulations for methane emissions at landfills to include a gas collection and control system, concentration limits, monitoring, records and reporting requirements, measurements and test methods, capping or removal, alternative compliance measures, civil penalty, and fees.

23. **Chapter 173-408 WAC - Landfill Methan Emissions. 2024; Available at: https://ecology.wa.gov/regulations-permits/laws-rules-rulemaking/closed-rulemaking/wac-173-408. Accessed 13 March 2025.**
This Department of Ecology webpage provides an overview of the agency's rulemaking to implement Chapter 70A.540 RCW.

24. **Ecology Washington State Department of. Focus on: Grants to Reduce Methane Emissions from Landfills. Updated ed2025.**
This Department of Ecology document outlines the CCA grant funds available to reduce methane emissions from landfills.

25. **Ecology Washington State Department of. 2022 Organics Management Law. February 2023 ed2023.**
This Department of Ecology fact sheet provides an overview of the 2022 Organics Management Law (ESSHB 1799).

26. **Ecology Washington State Department of. 2024 Organics Management Laws. July 2024 ed2024.**
This Department of Ecology fact sheet provides an overview of Washington's updated Organics Management Laws (E2SHB 2301; Chapter 341, Laws of 2024).

27. **Spokane's Waste to Energy Facility, 360 Virtual Tour. Spokane City.**
This video tour guides the viewer on a walk through Spokane's Waste to Energy Facility. Filmed with a GoPro360, viewers can look around the facility while listening to the staff member describe how things work.

28. **Cap-and-Invest auction revenue. Available at: https://ecology.wa.gov/air-climate/climate-commitment-act/auction-revenue. Accessed 10 March 2025.**
This Department of Ecology webpage documents: revenue forecasts and investments funded from Washington State's Cap-and-Invest Program; details the account structure (i.e., the Carbon Emissions Reduction Account, Climate Investment Account, and Air Quality & Health Disparities Improvement Account); and project types eligible for funding.

29. **Multiple Agency Fiscal Note SB 5703. 2/25/2025 ed2025.**
This Multiple Agency Fiscal Note for Senate Bill 5703 (Municipal solid waste) documented the Department of Ecology (Ecology) and Local Government (the City and County of Spokane) anticipated costs and cost savings were the original bill (i.e., creating an exemption that the Spokane Waste to Energy Facility would be eligible for) to pass. Ecology anticipated a decrease in revenue to the Climate Commitment Acounts. Ecology assumed: 1) the approximate expected covered emissions to be 100,000 MT CO2e (metric tons carbon dioxide equivalent) and 2) approximate allowance auction settlement price (based on Cap-and-Invest Program Allowance Auction Revenue Forecast Summary - December 2024 forecast price for June 2026) - $46.05 per allowance. Under these assumptions, the WTEF's approximate estimated compliance obligation would be $4,605,000 each year. Loss of revenue would depend on emissions in 2027 and the price of allowances when purchased. The decrease in CCA aution revenue would affect funds in the Climate Investment Account which funds both the Climate Commitment Account and Natural Climate Solutions Account. The Local Government fiscal note indicated that Spokane County estimates a $1 million to $2 million savings for county rate payers annually. The City of Spokane estimated a cost savings of $4,000,000 annually if the bill passed. The cost savings would vary annually as the number of allowanced were reduced and price of credits fluctuates. The price of credits cannot be estimated.

30. **Spokane City of. City of Spokane 2019 Community and Local Government Operations Greenhouse Gas Emissions Inventory Report.**
This City of Spokane 2019 Greenhouse Gas Emissions Inventory Report inventoried emissions from community activities as well as from everyday government activities. The City of Spokane has committed to reducing GHG emissions within its community and governmental operations. As part of that effort, the City completed GHG emission inventories to help set targets and goals, measure progress over time, and inform which actions will have the greatest GHG emissions reduction benefits. This inventory focused on anthropogenic GHG emissions, as a direct result of human activities ore resulting from natural processes that have been affected by human activities.

First, communitywide emissions included those that "occurred within City of Spokane's geopolitical boundaries across the residential, commercial, municipal, and industrial sectors. Spokane's city boundary covers approximately 69.5 square miles." Second, local government operations included "emissions that resulted from the City's governmental operations. Includes sources under the City's operational control (City has full authority to introduce and implement operating policies at facility), regardless of geographic location." Inventories included emissions which were direct (i.e., from owned/controlled sources or sources occurring within the community's geographic boundary) and indirect emission from purchased energy consumed by the community or government. The inventories did not include the majority of "upstream and downstream emissions associated with consumed goods and services." In 2019, the City of Spokane's community produced 1,968,982 metric tons of carbon dioxide equivalent (MTCO2e). Inventories in 2019 relevant to Spokane's solid waste managment system include: 1) Solid waste activities produced 111,569 MTCO2e in 2019 (6% of total 2019 communitywide emissions); 2) Spokane's Government Operations produced 147,357 metric tons of carbon dioxide equivalent (MTCO2e); 3) Solid Waste Operations contributed 108,134 MT CO2e (73% of total 2019 government operations emissions); 4) WTEF received a total of 276,238 tons of waste, producing 99,773 MTCO2e (5% of communitywide emissions and 92% of total solid waste emissions); 5) WTEF emissions accounted for 68% of Spokane's Government Operations total 2019 emissions [99,773 MTCO2e produced by WTEF / 147,357 produced by Government Operations; this was incorrectly listed as 73% in the report]. The analysis found that landfilling the same amount of waste (276,238 tons) would have produced 45% less direct emissions. However, WTEF diverted 9,501 tons of ferrous metals to recycling, avoiding an estimated 16,981 MTCO2e, and the facility produced 505,276 MMBtu of energy, avoiding 41,219 MTCO2e. Factoring in WTEF's recycling and energy generation, emissions were 24% less than had the material been landfilled.

31. **Ecology Washington State Department of. Improving Air Quality in Overburdened Communities Highly Impacted by Air Pollution.Olympia, WA2023.**

This report from the Washington State Department of Ecology (Ecology) was required by the Climate Commitment Act (CCA). As the first required report, "it outlines and provides a baseline for what [the agency] already know[s] about criteria air pollution, certain health impacts, and greenhouse gas emissions in overburdened communities highly impacted by air pollution in Washington." Ecology states that Tribal communities which are highly impacted by air pollution were not included in this report, and the agency is "consulting with Tribal governments and looking forward to adding Tribal communities in future reports." Ecology's Air Quality Program identified 16 areas across Washington State as overburdened and highly impacted by air pollution as of March 1, 2023. Areas include Ellensburg, Everett, George and West Grant County, South King County, Mattawa, Moxee Valley, Northeast Puyallup, North Seattle and Shoreline, South Seattle, Spokane and Spokane Valley, South and East Tacoma, Tri-Cities to Wallula, Vancouver, Wenatchee and East Wenatchee, East Yakima, and Lower Yakima Valley. Specific to Spokane and Spokane Valley communities, Ecology identified PM2.5 (long-term/annual and short-term/24-hour) and cumulative criteria air pollution (primarily driven by levels of PM2.5, O3, and NO2) as the main pollutants of concern. The report stated, "[p]revious modeling or air emissions inventory results have shown that concentrations of other criteria air pollutants (CO, lead, SO2) are likely to be low in this area." Some of the sources of pollution within Spokane and Spokane Valley include wildfire; residential wood burning; mobile sources

like cars, trucks, trains; and dust from construction and agriculture. In 2021 and 2022, the Spokane area was in attainment with the national ambient air quality standards. However, annual 98th percentile concentrations for PM2.5 were 25-33 µg/m3 (with and without wildfire excluded). The analysis noted, "[w]hile below the national air quality standard of 35 µg/m3, these are higher than Ecology's healthy air goal of 20 µg/m3." Ecology stated that "particle pollution in Washington varies seasonally" and is generally dependent on wildfire smoke and smoke from home heating. The report estimated GHG emissions from mobile sources (a variety of vehicles, engines, and equipment, that can be categorized as either on-road [e.g., passenger cars, trucks, buses, and motorcycles] or non-road [e.g., marine vessels, aircraft, locomotives, equipment used for lawn and agriculture, construction, recreation, etc.]). GHG emissions from mobile sources in Spokane and Spokane Valley were estimated as 712,131 MT CO2e (i.e. 4.8 MT CO2e per capita). Additionally, the WTEF was identified as 1 of 5 facilities in, or nearby (i.e., within 3 miles), Spokane and Spokane Valley that collectively emitted a 411,237 metric tons of carbon dioxide equivalents (MT CO2e) in 2020. In 2021, these facilities collectively emitted 434,028 MT CO2e of which 159,308 MTCO2e was deemed biogenic CO2. Emissions are in units used AR4 global warming potentials as specified in WAC 173-441. In 2021, WTEF was responsible for 242,787 MT CO2e, with biogenic carbon accounting for 141,607 MT CO2e of those emissions.

32. **NAAQS [National Ambient Air Quality Standards] Table. 2024; Available at: https://www.epa.gov/criteria-air-pollutants/naaqs-table. Accessed 3/15/2025.**
This U.S. Environmental Protection Agency (EPA) webpage provides an overview of the National Ambient Air Quality Standards (NAAQS) (40 CRF part 50) for 6 principal pollutants (i.e., criteria air pollutants) which can be harmful to public health and the environment. The criteria air pollutants are: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO2), Ozone (O3), particulate matter (i.e., PM2.5 and PM10), and sulfur dioxide (SO2). It states, "[p]rimary standards provide public health protection, including protecting the health of 'sensitive' populations such as [people with asthma], children, and the elderly" and "[s]econdary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings." The webpage details each pollutant's standards, averaging time, level, and form.

33. **Washington State Department of Ecology. Overburdened Communities Highly Impacted by Air Pollution. 2025; Available at: https://storymaps.arcgis.com/stories/c10bdbfc69984a9d85346be1a23f6338. Accessed 3/15/2025.**
This Department of Ecology webpage provides an overview of the 16 communities in Washington State identified as overburdened communities highly impacted by air pollution. These communities have been identified for Ecology's new Environmental Justice initiative under the Climate Commitment Act. Spokane and Spokane Valley were identified among those communities highly impacted by air pollution.

34. **Ecology Washington State Department of. Air Quality in Overburdened Communities Grant Program: An Environmental Justice Assessment (per RCW 70A.02.060). 2024.**

Washington State Department of Ecology (Ecology) completed an Environmental Justice Assessment (as required in RCW 70A.02.060) related to the implementation of grant program to reduce non-regulated sources of criterial air pollutant emissions in communities overburdened and highly impacted by air pollution.

35. **Institute of Chemical Engineers. CCS pilot phase successfully completed on Norwegian waste-to-energy plant. 2020; 20 May 2020:Available at: https://www.thechemicalengineer.com/news/ccs-pilot-phase-successfully-completed-on-norwegian-waste-to-energy-plant/. Accessed 3/13/2025.**
This news article by a staff reporter at The Chemical Engineer provides an overview of the successfully validated carbon capture technology at the Fortum Oslo Varme's Klemetsrud wate-to-energy site in Oslo, Norway. The article stated, "The pilot started a 2,000 hour test on 1 March 2019 which was completed on 31 May, and then ran an extended phase until 1 December." The technology had prvoiusly been tested and proven at 2 facilities: the SaskPower Boundary Dam Capture Project in Canada and Lanxess CISA CO2 capture plant in South Africa. The Klemetsrud pilot tested the carbon capture technique on flue gas from waste incineration as well as "the capture efficiency, energy requirements, solvent degradation, and solvent emissions." At the time of publication, "The Norwegian Government is due to make a final investment decision this year on the entire project, with full scale operation expected in 2024."

36. **Jemtland T. E. A. . Positive test results fomr the carbon capture and storage pilot in Oslo. In: Fortum, ed. *ForTheDoers Blog*. 13 December 2019 ed: Fortum; 2019.**
This blog post written by the Communications Manager at Fortum Oslo Varme, a Nordic energy company, discusses the company's carbon capture and storage (CCS) project at its waste-to-engergy plant in Oslo, Norway. The post stated, "during the 5,500-hour test that we conducted, the test facility has proven that the technology can provide the intended capture rate of 90[%]" from the flue gas. Specifically, the pilot began capturing CO2 on 26 February 2019 and completed its 24-hour performance test on 1 March 2019. A 2000-hour test to prove operational stability was completed 31 May 2019. The test foced on emissions and degradation. The plant received its Technology Qualification certificate in July 2019. The pilot found that Amine emissions were below the target and a CO2 capture efficiency of above 90% can be maintained. Finally, it showed low solvent degradation, indicating suitability of Klemetsrud WtE-plant flue gas for carbon capture.

37. **Ecology Washington State Department of. Focus on the Cap-and-Invest Program. Vol Publication 24-14-0072024.**
This fact sheet from the Department of Ecology addresses the Cap-and-Invest Program's design, auctions, offsets, compliance, exemptions, and use of auction proceeds.

38. **Ecology Washington State Department of. Washington Cap-and-Invest Program Auction #9 March 2025 Summary Report 2025.**
This report from the Department of Ecology provides background and results for the March 5, 2025, Cap-and-Invest Program's Auction #9. It includes the number of allowances offered, sold, the settlement price, and list of qualified bidders.

39. **Ecology Washington State Department of. Report to the Legislature: Use of Carbon Dioxide Removal to Meet Washington State's Emissions Reductions Limits, Interim Progress Report.2024.**
In the 2024 Supplemental Operating Budget, the Washington State Legislature provided $300,000 for the Washington State Department of Ecology, in consultation with the Department of Commerce, to contract a study of the extent to which CO2 removal is needed to meet greenhouse gas reductions established in state law (RCW 70A.45.020). This Interim report describes the project approach and work to date. The final report is due to the Legislature by June 30, 2025.

40. **Bellona Environmental Foundation Oslo leading by example: world's first CO2 capture and storage on waste incinerator to become reality in 2026. 2022; Available at: https://bellona.org/news/industry/2022-03-oslo-leading-by-example-worlds-first-co2-capture-and-storage-on-waste-incinerator-to-become-reality-in-2026. Accessed 3/13/2025.**
The Bellona Environmental Foundation is an international science-based non-profit organization headquartered in Norway. The article stated that the Bellona Foundation has worked on the Klemetsrud CO2 capture and storage (CCS) project since 2015. The article states, the Klemetsrud waste-to-energy (WTE) plant in Oslo was expected to come online as the world's first WTE with full-scale CCS in 2026.

41. **Norway restarts work on Oslo Waste Carbon Capture Project. *Reuters.* 27 January 2025, 2025.**
This news article from Reuters described Norway's carbon capture project planned for Oslo's Klemetsrud waste to energy facility, which went on hiatus in April 203 due to reduce development costs. Based on new projections, "The facility is expected to be operational by the third quarter of 2029 and will remove 350,000 tonnes of CO2 annually, cutting nearly 20% of the city's remaining fossil emissions."

42. **Balcombe P. , Speirs J. F. , Brandon N. P. , et al. Methane emissions: choosing the right climate metric and time horizon. *Environmental Science: Processes & Impacts.* 2018;20:1323-1339.**
Balcombe et al. conducted a review of various climate metrics to assess each metric's key attributes and limitations with respect to methane emissions. They stated, CO2 equivalences for methane range from 4 to 199 across metrics, time horizons, and end-point metrics, with most estimates between 20 and 80. "Therefore, the selection of metric and time horizon for technology evaluations is likely to change the rank order of preference," stated authors. They cautioned against using "only a short time horizon, e.g. 20 years, which disregards the long-term impacts of CO2 emissions and is thus detrimental to achieving eventual climate stabilisation." Based on their analysis, authors stated, "[t]here is no single metric or time horizon that is appropriate for all applications and situations." To avoid undervaluing the long-term impact of CO2, a number of studies suggested a two-value approach, "which indicates the effect over two different time horizons." However, "even use of [Global Warming Potential]-100 may cause and underestimation of the contribution of methane, for example to impacts related to sea level rise." The authors' overarching recommendation was to present emission results with transparency (e.g., report methane and CO2 emissions separately, summarize the magnitude and type of metric used, if the equivalency value has a significant impact on results include both high and

low values to assess the impact). Metric applications can be categorized as: 1) short-term (e.g., annual) emissions estimates of processes, facilities, or regions; 2) multi-year technology assessments or life cycle assessments; and 3) long-term modelling of energy systems and decarbonization pathways. Authors made recommendations for each category. Authors concluded, “[i]t is vital to test any GHG estimates with high and low equivalency values to ensure that we are not simply replacing long-term climate forcing with short-term, or vice versa.”

43. **Understanding Global Warming Potentials. 2025; Available at: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials#GWPalternatives. Accessed, 17 March 2025.**
This U.S. EPA webpage provides an overview of Global Warming Potentials. Among the answers presented for frequently asked questions, it discusses alternatives to the 100-year GWP for comparing GHGs. While the U.S. "primarily uses the 100-year GWP as a measure of the relative impact of different GHGs [...] the scientific community has developed a number of other metrics that could be used for comparing one GHG to another. These metrics may differ based on timeframe, the climate endpoint measured, or the method of calculation." For example, while the "100-year GWP is based on the energy absorbed by a gas over 100 years, the 20-year GWP is based on the energy absorbed over 20 years." The 20-year GWP "prioritizes gases with shorter lifetimes, because it does not consider impacts that happen more than 20 years after the emissions occur." All GWPs are calculated relative to CO2, therefore "GWPs based on a shorter timeframe will be larger for gases with lifetimes shorter than that of CO2, and smaller for gases with lifetimes longer than CO2." For example, methane (CH4) has a short lifetime, therefore the "100-year GWP of 27–30 is much less than the 20-year GWP of 81–83."

44. **Facts about Methane. Available at: https://www.unep.org/explore-topics/energy/facts-about-methane. Accessed 3/17/2025.**
This UN Environment Programme webpage provides an overview of methane and methane mitigation as a strategy to meet the 1.5 degree celcius global warming limit outlined in the Paris Climate Agreement.