



### Portland Clean Energy Community Benefits Fund (PCEF) Climate Investment Plan Full Draft Public Comment May 16 – June 2, 2023

# Public comment received via online survey & attachments

ID	Stakeholder Group	What feedback do you have to share?	Name	Organization / Business
	Interested	The draft plan misses a huge opportunity to incorporate participatory budgeting (PB) to the plan and into transparent, accountable and equitable allocation of PCEF funds. PCEF has been challenged by critics to allocate available funding with sufficient public accountability and transparency. What better way to demonstrate transparency and accountability than to delegate power, within parameters, directly to the communities served? PB is a highly flexible, proven mechanism for increasing transparency, accountability, and public trust over the use of public funds. It will directly operationalize PCEF's Guiding Principles: Accountable and Community-Powered. De-carbonization criteria could be easily incorporated PB rule books and project development thereby integrating technical knowledge and lived experience/expertise into developing and selecting funding priorities.		
1	member	PB should become a fourth funding pathway applied to all PCEF funds.	Jim Labbe	None
	Interested community	I have noted below the parts of the plan that I am most supportive of and view as critical to the City's commitment to Environmental Justice and Ćlimate Change. I am almost 75 and have lived in Portland my entire life. I am fully supportive of the changes in the City Charter as approved by voters on 11/8/22. One last thought, I believe that a plan for Participatory Budgeting is critical. Therefore, I am supportive of a Mitigation Banking System to achieve this goal. I will attend the Community Listening Session on May 24, 2023. Thank you, Babs Vanelli		
2	community member		Babs Vanelli	None

Stakeholder What feedback do you have to share? **Organization / Business** ID Name Group Interested community I believe that this is awesome I think Great environmental Educational for the 3 member Others who are in nand just want to learn about the P CEF programs Shellice Na Great job incorporating readability improvements since the preliminary draft! I have just one final suggestion along those lines: In Table 1, could you assign a letter ("A" through "L") to each of the 12 items in the first column (titled "Primary Code Category"). Example: "A. Climate jobs, workforce and contractor development." And again on the corresponding description in the document, use the same letter in the header on that page. Example: on p. 18, the header would start with the letter "A" as follows: "A. Climate jobs, workforce and contractor development." The last header would start with an "L" - i.e., "L. Multiple funding categories/other carbon emissions reducing projects." This would greatly help Interested community readers know where they are in the document, and how each section 4 member corresponds with the list in Table 1. Judy Walton None I am excited about improvements to the 82nd corridor and increase in the urban 5 Business Elena Lauterbach Sweaty Betty Tree Care canopy. Excited: to see the allocation for CBO capacity building. Lots of groups who are already doing work could benefit from expanding their impact. Also liked that up to 40% of transportation grants could be used for safety improvements. When you're adding access to things like e-bikes, it needs to be safe for people to use them. Missing: When it comes to decarbonizing transportation, consider efforts to bring resources closer to neighborhood centers. Building community centers, library hubs, and medical facilities in neighborhood centers will help reduce car 6 Community org trips and build resiliency, especially in low income neighborhoods. Annette Stanhope Historic Parkrose

Stakeholder ID What feedback do you have to share? **Organization / Business** Name Group Firstly, thank you for taking care of 82nd, I am very excited to see the infrastructure updates for that area. The main concern I have is the lack of discussion on increasing biking and walking infrastructure. There is a line that says women and biopic feel less vulnerable on ebikes. Anecdotally, I rarely hear from non-bikers that the preventative safety concern is being harassed. The main safety concern is getting hit by a car. Not pairing e-bikes accessibility with building safety measures against cars seems to make biking more dangerous. I'd like to see safety measures- such as protected bike lines that are not just paint (bollards, raises), major street crossings that have buttons for yield/stop lights(such as Burnsidex30th), and more dedicated greenways with clearer signage- get some explicit funding. The only line I see is "Charging infrastructure Interested community that is equitable, convenient, reliable, affordable, safe, and access" which is never member quite expanded on, and has confusing wording. April Ta None

ID	Stakeholder Group	What feedback do you have to share?	Name	Organization / Business
		Hopscotch Foundation has been working with Jefferson High School in building what we believe to be the largest aquaponics tower in the country. All indoors. No soil. Recycled water. LED lighting. Optimal growing conditions allow about 9 harvests a year. All DIY. Holds 7,000 plants at any one time. About as organic as you can get.		
		The Jefferson kids are currently selling produce they grew at the King Elementary farmers market. They built it, grew it, and sold it in their community.		
		We don't care whether it's January or July		
		Videos at hopscotchfoundation.com. Controlled Environment Agriculture (CEA) must be used to help solve food insecurity in our low income communities. Aquaponics is one segment of CEA. There are others.		
		We've already proven this whole method - with our high school kids!!! I'd think you'd really want this in your urban farming plan. Also, please contact me and come out and visit the "farm" in southeast Portland.		
0	Community	Dave Gunderson Hopscotch Foundation	Dava Guadanaan	
8	Community org	503-702-6568	Dave Gunderson	Hopscotch Foundation
		Really great process with many opportunities to provide input. Thank you!		
		Appreciate the focus on moving with clarity and urgency there is a lot of planning at the City and not enough action taken to combat climate change.		
9	Community org	I am a champion of Frog Ferry because of the quick start up time, the community served, and the large impact.	Susan Bladholm	Frog Ferry (note, I will arrive late)

ID	Stakeholder Group	What feedback do you have to share?	Name	Organization / Business
10	Org (Type		Nere	None
10	unknown)	I m very excited to near about the organizational capacity building!	None	None
11	Interested community member	I don't think the outcomes accurately address the smaller minority contractors that will be doing work in the PCEF program. There is a large section of money that will go to single family residential and those outcomes/goals don't kick in unless they are greater than \$350,000 but excludes work less than \$100,000. In my opinion this is a gross oversight of where most of the work will be happening in the residential sector and seems to not address DEI goals for smaller contractors.	None	None
11	member		None	None
12	Government	Overall, I am excited about the CIP. I really appreciate the Strategic program 15: Climate-friendly public schools! I would like to respectfully request that Controlled Environment Agriculture (hydroponics, aquaponics, vertical farming) be included in the Regenerative Agriculture category for Community Responsive Grants. Hopscotch Foundation has proven the effectiveness of this strategy by paying Jefferson HS students to build and work on the urban farm. It continues to reap benefits for the school by feeding families and raising money by selling the produce at Farmer's Markets, and those funds are reinvested in programming for students. PPS has applied to USDA for a grant to expand this to McDaniel HS and Jefferson HS. We don't know if we will be awarded, as this is a national competitive grant, but PCEF could invest in this innovative project right here at home and benefit hundreds of youth and their families in PCEF priority populations. Thank you!	Robyn Faraone	Portland Public Schools
		Lam excited about dimate justice, equity, job creation, and sustainable		
		agriculture methods that are included. An extended tree canony will be to		Portland Baging Grannies
13	Community org	mitigate the urban deserts that exist, primarily in the outer east of our city.	Alice Shapiro	Environmental Team

ID	Stakeholder Group	What feedback do you have to share?	Name	Organization / Business
		Missing from the current CIP draft is vital language regarding Participatory		
		how to spend a portion of a public budget. It's a tool to tap into the lived experience and collective intelligence of residents to exercise their power to		
		shape solutions in their communities. Youth Voice Youth Vote PB fosters and supports youth civic leadership and public health in the process of identifying		
		solutions for unmet needs. There is a need to continue investment in PB so all		
		that meet their needs. And as much data there is to support PB as an equitable		
		tool for justice, I know that l've lived it, l've experienced it first hand. PB		
		and Youth Voice Youth Vote increase opportunities for leadership and civic		
14	Community org	engagement and it has passed the mic to voices which are often silenced.	Karol Wai	Participatory Budgeting Oregon
15	Business	Please see attached	David Burchfied	Burch Energy Services

ID	Stakeholder Group	What feedback do you have to share?	Name	Organization / Business
16	Community org	The current CIP draft does not include electric stoves and induction stoves as one of the clean energy upgrades under the Renewable Energy and Energy Efficiency strategic program. The CIP draft mentions, "None of the clean energy programs allows PCEF funding to be invested in equipment or appliances that use fossil fuels." Gas stoves are fossil fuel appliances that should not be invested in using PCEF funding. The CIP draft should also provide funding for the costs associated with replacing a gas stove with an electric or induction stove, including but not limited to the costs of electric paneling, wiring, and service upgrades. Electric and induction stoves are clean energy upgrades that contribute to a healthier climate, reducing building emissions, and improving air quality. Gas appliance pollution inequitably impacts low-income communities, communities of color, pregnant people, individuals with preexisting health conditions, and the elderly.	Samantha Hernandez	Oregon Physicians for Social Responsibility
		Small Business Utility Advocates offer the following public comment. Though PCEF's CIP plan helps inform readers on metrics possible improvements that could help enhance PCEF's CIP draft include; expanding on the scope in which EV charging stations may play a role in this program. The draft leaves more questions then answers regarding this topic with using vague words such as "may" and "scope" that does not provide substantive takeaways on the role of this topic within the program. If PCEF has intentions to include this aspect for small commercial they should commit to it in the next revision of draft and offer details. PCEF notes in past meetings the reliance of natural gas within this sectors building stock but such observations are absent in the draft. Small commercial transition from this energy source is especially worrisome in older buildings and the effort it will take to accommodate electrical equipment. Strategies to target		
17	Community org	aging buildings would improve the draft.	Guillermo Castillo	Small Business Utility Advocates

ne	I'm in support of the CIP's climate jobs, workforce, and contractor development for people historically marginalized in the workforce. Workforce development is needed in the energy field. Training people could help develop them to jumpstart and/or further their career in this field and help other projects throughout the nation.	April Hasson	None
vernment	See letter.	Guadalupe Guerrero	Portland Public Schools
erested mmunity ember	<ul> <li>I'm very excited about the inclusion of regenerative agriculture in the CIP draft - as it tends to be omitted from these endeavors.</li> <li>There are some considerations that I think are missing from the materials: <ul> <li>How will the plan account for growth in population and long-range planning/UGB restrictions when thinking about available land and food production demands?</li> <li>One of the measures includes an "increase in PCEF households receivinghealthy foods", but what does that measurable look like? What is the starting value and by what percent do we hope to reach? Is there an inclusion for culturally-nourishing foods?</li> <li>Are there funds for assisting in utility payments and taxes for CLT models? Would that be part of the responsive grants?</li> </ul> </li> </ul>	Megan Grzybowski	PSU
er	e ernment rested munity iber	<ul> <li>I'm very excited about the inclusion of regenerative agriculture in the CIP draft - as it tends to be omitted from these endeavors.</li> <li>There are some considerations that I think are missing from the materials:         <ul> <li>How will the plan account for growth in population and long-range planning/UGB restrictions when thinking about available land and food production demands?</li> <li>One of the measures includes an "increase in PCEF households receivinghealthy foods", but what does that measurable look like? What is the starting value and by what percent do we hope to reach? Is there an inclusion for culturally-nourishing foods?</li> <li>Are there funds for assisting in utility payments and taxes for CLT models?</li> </ul> </li> </ul>	Interpretention of the energy field. Training people could help develop them to jumpstart and/or further their career in this field and help other projects throughout the nation.       April Hasson         ernment       See letter.       Guadalupe Guerrero         I'm very excited about the inclusion of regenerative agriculture in the CIP draft - as it tends to be omitted from these endeavors.       Guadalupe Guerrero         There are some considerations that I think are missing from the materials:       - How will the plan account for growth in population and long-range planning/UGB restrictions when thinking about available land and food production demands?         - One of the measures includes an "increase in PCEF households receivinghealthy foods", but what does that measurable look like? What is the starting value and by what percent do we hope to reach? Is there an inclusion for culturally-nourishing foods?         - Are there funds for assisting in utility payments and taxes for CLT models?         Would that be part of the responsive grants?         Megan Grzybowski

ID	Stakeholder Group	What feedback do you have to share?	Name	Organization / Business
		Portlanders - especially lower-income renters really need support to work with their landlords to replace methane gas stoves with electric resistance or (ideally) hyper-efficient and safer induction stoves. This is especially critical for families with small children, because of their body size/more rapid respiration/developing lungs and because nitrogen dioxide is heavier than air, sinking to ground-level and not easily vented. I exchanged emails with someone on the Stanford research team today and they emphasized that carcinogenic benzene, which leaks even when stoves are off, is an even greater concern. A new paper is coming out in a few weeks. So, yes - getting fossil gas cooking equipment out of kitchens is critical - this may require installing a higher amp plug behind the stove and possibly upgrading the electrical panel. Please be sure to include this in your revised draft. Search in Tuesday's NYTimes: "Testing New York Apartments: How Dirty Is That		
21	Community org	Gas Stove, Really?"	Noelle Studer-Spevak	Families for Climate
22	Interested community member	It is exciting to see workforce development programs included. To expand the opportunities available for hands-on training and subsequent careers, it may be worth explicitly citing renewable energy project development (including large, utility-scale projects), an area with significant national demand for talent that can be matched with locally-trained and locally-based staff.	Garrett D.	Emerald Renewable Energy Developers
23	Interested community member	<ol> <li>Liaison and leveraging with Federal, State, Metro and private funds should be a clear goal and criteria for investments.</li> <li>While East Portland has unique issues due to being relatively recently annexed into the City, funding should be made available to all parts of the City, and tracked in such a way that it can be reported on a new City-district level.</li> </ol>	Thomas S Karwaki	None
24	None	None	None	None
25	Community org	None	Hannah Cruz	Energy Trust of Oregon

#### PCEF Full Draft (May 2023) Online Survey Comments

Public Comment Period: May 16 - June 2, 2023

ID	Stakeholder What feedback do you have to share? Group		Name	Organization / Business
		I can offer direct comments for PCEF since I am on the climate team (Lauren Z),		
		but wanted to get this in this channel.		
		SP1: Should include funding for whole building life cycle analysis to support low		
		carbon materials and require low-carbon concrete.		
		SP2: Should include funding for whole building life cycle analysis and support use		
		of low-carbon concrete.		
		Community responsive grants for workforce should include businesses and		
		programs that participate in materials recovery, salvage, recycling, or reuse. This		
		would support the Deconstruction program, reduce the amount of new goods		
		being consumed and produced, and drive innovation in young people to see		
		opportunities for new businesses, products, and programs locally, while reducing		
26	Government	the carbon impacts of consumerism and construction.	Lauren Zimmermann	climate team

### Table of attachments to online survey

ID	Stakeholder Type	Organization	Contact Name
1	Interested		Jim Labbe
	community		
	member		
14	Community org	Participatory Budgeting Oregon	Karol Wai
15	Business	Burch Energy Services	David L Burchfield
16	Community org	Oregon Physicians for Social	Samantha
		Responsibility	Hernandez
19	Education	Portland Public Schools	Guadalupe
			Guerrero
25	Community org	Energy Trust of Oregon	Hannah Cruz

## Impacts of Participatory **Budgeting:** What We Know **Research Brief** · April 2022

This research brief offers a global picture of the current state of research on the short-term outcomes and long-term impacts of participatory budgeting (PB) on people, communities, and governments. Thousands of governments and institutions have implemented PB, giving people the power to decide how to spend part of a public budget. In many cases, PB has been found to positively impact well-being and governance, education and learning, as well as civil society and political participation.

These impacts, however, depend on the design and context of the PB process. Understanding these impacts and how the factors that produce them can help advocates to promote PB more effectively, practitioners to design better PB processes, and researchers to produce more useful data and analysis.

We present 19 key research findings and share practical recommendations for advocacy; planning and design; and research, monitoring, and evaluation. You can find more explanation on how different inputs, contexts, and activities lead to these impacts in the PB Theory of Change.



This document is based on findings and recommendations compiled by Brian Wampler, Michael Touchton, Czarina Medina-Guce, Tarson Núñez, Greta Ríos, Carolin Hagelskamp, Celina Su, José María Marín, Manuela Maunier, Eliza Meriabe, Alisa Aliti Vlasic, Daniel Schugurensky, Andrés Falck, Patricia García Leiva, Karla Valverde Viesca, Cintia Pinillos, Gisela Signorelli, Aline Yunery Zunzunegui López, Amala Vattappally, Kanza Fatima, and Xingmiao Ruan.







#### **Key Findings: What We Know**

### Impacts on People 📽 🝙

#### Finding 1: PB participants acquire new civic and political knowledge.

- Porto Alegre (Brazil) and Rosario (Argentina): PB participants reported substantial increases in their knowledge of politics, community needs, and citizens' rights. They also learned about the inner workings of city hall and mechanisms and regulations used to allocate public funds. (Schugurensky 2006 & 2009; Lerner & Schugurensky, 2007; Lerner 2010; Luchman 2010)
- Maribor (Slovenia) and Reykjavík (Iceland): Participants • reported significant knowledge gains from their involvement in PB, including the management, obligations, and work of public enterprises; community needs; the importance of constructive discussion for reaching consensus; city government responsibilities, public funds, and municipal politics; and citizens' rights and duties (Gregorčič & Krašovec, 2016 & 2017).
- Boston (United States): Youth participants reported a better • understanding of government processes and democracy, and of needs in other neighborhoods. (Grillos, 2016)
- Chicago (United States): Participants reported new • knowledge about the needs of their ward, the interests of their neighbors, and the city budgeting process (Crum et al., 2013).
- Similar findings were reported for Guelph (Canada), • Cluj (Romania) and many other cases (Pinnington & Schugurensky, 2010; Brennan, 2015).

#### Finding 2: PB participants develop stronger civic, political, and deliberative skills.

Porto Alegre (Brazil), Montevideo (Uruguay), and Rosario (Argentina): PB participants developed new competencies to monitor government actions, contact government agencies and officials, rank priorities, and develop proposals for local projects. Beyond these instrumental skills, participants gained **analytical skills** like the ability to understand and interpret official documents and to "read" political dynamics in the city.

#### **Practical Recommendations**

#### 🔁 Advocacy:

- Form alliances with civil society organizations focused on civic engagement, electoral democracy and voter turnout.
- Emphasize that PB can build participants' understanding of other civic activities.

#### Research:

 Conduct longitudinal studies to track participant learning over time.

#### 🔁 Advocacy:

• Make the case to politicians and government officials that PB increases the public's ability to engage with government, which can lead to greater support for public decision-making.



### Impacts on People 🖉 🔊

Participants also strengthened their social and leadership skills (working in groups, interacting with neighbors, coordinating teams, organizing meetings, etc.) and **deliberative skills** like listening, speaking in public, negotiating, persuading, making collective decisions, dealing with conflicts, and reaching consensus (Schugurensky, 2002; Lerner & Schugurensky, 2007; Luchman, 2010).

- Maribor (Slovenia) and Reykjavík (Iceland): PB participants reported increases in careful listening and analytical skills and in their ability to **make collective decisions** and engage in teamwork, including intergenerational cooperation and consensus-building. They also reported gains in their ability to organize group work, develop and defend proposals and projects, interpret official documents, seek out relevant social and political information, and social skills and leadership skills (Gregorčič & Krašovec, 2016).
- Boston (United States): Participants reported gaining specific skills including leadership, teamwork, networking, communication, and professionalism (Grillos, 2016).

#### Practical Recommendations

- 🔁 Advocacy:
- Make the case to educational leaders that PB can build skills in a variety of areas used to measure student, teacher, and school performance.
  - Planning & Design:
- Facilitate activities aimed at developing and refining civic and deliberative skills like role-playing and campaigning.

#### Research:

- Investigate how the design of deliberative activities during PB affects decisionmaking and other skills.
- Investigate the impacts of PB on problem-solving, research, critical thinking, math, and communication skills.





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#### Finding 3: PB participants adopt new attitudes, values, and dispositions.

- Studies have found that participation in PB processes promotes tolerance, an orientation towards the common good, and a **disposition to solve conflicts**. (Schugurensky, 2006; Gregorčič & Krašovec, 2017; Albornoz-Manyoma et al., 2020)
- Andalusia (Spain): Participation in diverse primary school • groups led to an increase in positive interactions between participants and gradually reduced negative interactions between participants. The processes increased the group identification of participants, psychological empowerment (Albornoz-Manyoma et al., 2020; Albornoz-Manyoma et al., 2021; García-Leiva et al., 2021), subjective well-being (García-Leiva et al., 2021), group cohesion, and popularity of previously isolated students among their peers (Albornoz-Manyoma et al., under review).
- Greensboro (United States): PB participants reported • increased interest in voting and participating in civic and community life (Jovanovic et al., 2016).
- PB participants reported greater concern for the • problems of the community, stressed higher interest in community participation, and expressed greater responsibility for the preservation of the city and more respect for other community members after the process than before the process (Schugurensky, 2006; Gregorčič & Krašovec, 2017).
- Longitudinal studies show that the acquisition of these traits in childhood and youth has consequences for civic engagement later in life. Children and youth involved in civic activities show more empathy, more democratic interactions with other people and greater civic engagement as adults (Metzger et al., 2019).

#### Practical Recommendations

- Planning & Design:
- Work with participants to reach agreement on the main values guiding the process, so that there is explicit understanding of the values behind PB.
  - Research, Monitoring, & Evaluation:
- Use questionnaires before and after the PB process to measure indicators for variables like learning, empowerment, subjective well-being, and institutional trust. By including a similar non-participating group in pre- and postmeasurements, it's possible to isolate participation as an independent variable.





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## Impacts on People a

#### Finding 4: PB promotes mutual trust between participants, governments, and educational institutions.

- New York City (United States): Residents in city council districts with PB reported feeling that local government was more accessible, and they often viewed government officials more positively. (Swaner, 2017)
- Andalusia (Spain): Participants in primary schools • developed reported gaining trust in government institutions, increased their number of friends, and found a community (García-Leiva et al., 2021).
- Arizona (United States): Students participating in a • pilot project on inclusive school PB reported improved relationships with their teachers and classmates. Project proposals also reflected the priorities of students with disabilities. (Bartlett et al., 2020) In the long run, this increased responsiveness can lead to greater trust.

#### Finding 5: PB can increase voting in regular elections, especially among historically disenfranchised constituents.

- New York City (United States): PB voters' likelihood to vote in ordinary elections increased by 8.4 percentage points, after voting in PB. The effect is stronger for local than for national elections. The effect is strongest for groups who are less likely to vote (people under 30, residents from low-income neighborhoods, ethnic minorities). Even residents who live in a PB district but did not vote in PB were more likely to vote in ordinary elections, after their district introduced PB. (Johnson et al., 2021)
- Prague (Czech Republic): In districts that introduced • PB, voter turnout in local elections increased by 3 percentage points compared to districts without PB. (Kukucková & Bakos, 2019)
- The above findings are comparable in size to research on the effects of referendums/ballot initiatives (Dvorak et al., 2017; Tolbert & Smith, 2005) and jury participation on voting in general elections (Gastil et al., 2008).

#### **Practical Recommendations**

#### 🚯 Advocacy:

• In places where trust in government and public institutions is low or declining, emphasize to decision-makers that PB can improve relationships between community members and institutions.

#### 🔂 Advocacy:

• Make the case to politicians that implementing PB can lead to higher voter turnout.

#### Research:

- Ask PB participants (at meetings or voting stations) to opt in to data collection via email, social media or phone, to better measure longerterm impacts on political participation.
- Collect data on variables that could explain the link between PB and voter turnout, like access to information or membership in informal networks.





### Impacts on People 🔊 🔊



#### Finding 6: PB can enhance non-electoral, individual-level political participation, such as contacting elected officials and proposing solutions to community problems.

PB can change participants' behavior and lead them to perform everyday acts of political participation

- Rosario (Argentina), Montevideo (Uruguay), Porto Alegre (Brazil): PB participants were more likely to engage in new political practices, including monitoring public budgets, attending and speaking at community meetings, contacting elected officials, and proposing solutions for community problems; they also reported gains in deliberative skills and political capital, and in intentions to engage in civic and political participation in the future (Lerner and Schugurensky, 2007; Schugurensky, 2013, 2006, 2005, 2001).
- New York City and Vallejo (United States), Leith (Edinburgh, Scotland), London Borough of Tower Hamlets (United Kingdom): PB participants learn about how governments work and make decisions in ways that facilitate future mobilization. They become more likely to advocate for community needs through other channels, such as local community boards and elected officials. (Johnson 2017).

#### Practical **Recommendations**

#### 🔂 Advocacy:

• Frame the process as inclusive, democratic, and educational to encourage open-minded participation.

#### Planning & Design:

• Use techniques that encourage democratic communication and learning by doing: term limits for delegates, time limits for speakers, and designated facilitators for meetings. (Lerner, 2010).

#### 🕗 Monitoring & **Evaluation:**

• Monitor which other participatory processes and collective action campaigns PB participants take part in, and which they do not.







### Impacts on People 💒



**Finding 7: Different PB designs** and implementation can narrow or widen the civic engagement gap.

- The civic engagement gap refers to the fact that all potential PB participants do not have equal opportunities to participate in civic and political spaces. Historically marginalized groups are often excluded from civic opportunities. When this gap starts from a young age, it can lead to less engagement later in life. (Bartlett et al., 2020)
- Designs that rely on self-selection or the selection of • individuals with leadership experience are more likely to widen the civic engagement gap (Bartlett et al. 2020).
- Designs that emphasize **outreach to marginalized groups** and randomized selection of participants are more likely to narrow the civic engagement gap (Bartlett et al. 2020; García-Leiva et al. 2021) because they reduce selfselection bias.
- Andalusia (Spain): Schools provide an ideal setting for • a cost-efficient, quasi-random selection because they divide students in classrooms. When full class groups are chosen as participants in a PB process, isolated students become better integrated in participatory dynamics and increase their popularity among their peers. (Albornoz-Manyoma et al., under review)
- Rosario (Argentina): Much of the learning that occurs in PB processes happens through informal mechanisms, including repetitive interactions with other participants. (Lerner 2010)
- The impact of informal democratic learning increases significantly when PB is paired with formal learning.
  - Arizona (United States): Citizenship learning is richer when informal learning is complemented with curriculum and pedagogical interventions in the classroom (Cohen et al. 2015).

#### Practical **Recommendations**

- Use random selection to recruit PB participants, to reduce learning gaps. (Process designs can be creative, combining random and volunteer groups of participants.)
- Complement informal learning experiences with formal education interventions.
  - Encourage informal learning by creating spaces for participants to network and build relationships, such as peer mentorship opportunities and social events. (Lerner, 2010)
- Connect the process to curricular content on civics, democracy and government whenever possible



### Impacts on People a

Finding 8: These impacts on knowledge, skills, attitudes, and behaviors depend on participants' prior experiences, roles played in the process, intensity of participation, and duration of engagement.

- Studies have found that learning and change tends to be more significant among participants with fewer prior experiences of civic engagement, political participation, and leadership. In addition, participants who take on leadership roles during the process (e.g. steering committee members, delegates, councilors, change agents) experience more change than participants who take on peripheral roles (e.g. only voting) (Grillos, 2016; Schugurensky, 2006).
- These impacts are also correlated with the intensity of **participation** (e.g. frequency of meetings, opportunities to deliberate and make decisions, support structures, mentorship, development opportunities). More intense participation is associated with greater knowledge of government institutions, self-efficacy, and likelihood to vote, to work with others to solve problems, and to volunteer in community projects (Grillos, 2016).
- The duration of participation also affects learning: the • longer the engagement, the stronger the impact. In Andalusia (Spain), when the process was repeated a second year, psychological empowerment and group identification increased. (Albornoz-Manyoma et al., 2021).



#### Practical **Recommendations**

- 🔁 Advocacy:
- When advocating to renew a PB process, emphasize that sustained engagement over time is associated with greater impacts on learning.

- Work with community partners to recruit potential participants who have less civic and political experience.
- Design the process to include more time for deliberation and teamwork. to increase the impacts on learning.
- Design the process to extend across more weeks and months, to increase the duration of participation
  - Research:
- Investigate the impacts of PB on "second tier" participants, who vote but do not engage deeply.
- Investigate the impacts of PB on organizers and facilitators (government officials, teachers, school and university administrators)



#### Finding 9: PB is associated with lower infant mortality.



Municipalities using PB programs in Brazil have lower infant mortality than comparable municipalities without PB. The effect grows stronger after more than eight years of PB. (Gonçalves, 2014; Touchton and Wampler, 2014)

The strong associations between PB and reductions in infant mortality are likely associated with broader governance shifts. When residents demand more health spending, governments implement new projects, like health clinics and services in poor communities, and increase spending in these communities. Community leaders also gain valuable networking access, including to a broader range of public health officials. These factors, combined, may lead to increases in well-being.

#### Finding 10: PB with "social justice rules" is associated with lower infant mortality.

Municipalities using specific social justice rules in Brazil have lower infant mortality than comparable municipalities that don't use these rules. These rules require more resources to flow to neighborhoods with higher poverty, as identified by the Quality of Life Index. Increased funding motivates lowincome residents to participate, allowing them to prioritize projects that meet their needs. Social justice rules also reduce the ability of wealthier residents to disproportionately influence the PB process. (Wampler and Touchton, 2019; Wampler et al., 2021).

#### Practical **Recommendations**

#### Planning & Design:

 Include spending on health infrastructure and programs as eligible projects, when possible.



- Adopt social justice rules that explicitly allocate more resources to low-income communities.
- Partner with local universities and organizations to identify underserved neighborhoods.



#### Finding 11: Building budget literacy among community leaders has a greater impact on wellbeing than educating all PB participants.

Municipalities with PB that build budget literacy and knowledge by holding informational workshops specifically for PB delegates and leaders are associated with lower infant mortality rates than municipalities that seek to educate all participants. On the other hand, there is no connection between informational workshops for all participants and infant mortality. (Wampler & Touchton, 2019).

#### **Finding 12: Communities that allocated more** money per capita through PB have seen greater community participation.

- United States and Canada: PB processes with larger budgets (per capita) allocated to projects proposed and voted on by residents saw higher voter turnout. The more communities increased their PB budgets from one year to the next, the more voter turnout increased at the same time. (Hagelskamp et al. 2016, A process; Goldfrank & Landes 2018)
- Porto Alegre (Brazil): **Participation rates did not increase** until significant funds were allocated through PB, and participation rates were higher and grew faster in districts that received more resources. (Goldfrank 2011)



#### Practical **Recommendations**

- Planning & Design:
- Target informational workshops to the most active community leaders, particularly budget delegates.
- Support budget delegates to educate other community leaders.

#### 🔁 Advocacy:

• When making the case for PB to decisionmakers, emphasize that communities that allocate more through PB tend to see greater participation.

#### Planning & Design:

 Consider following the Paris example. Start with a significant budget, or if initial funds are limited, commit to investing larger budgets in future years. (Veron 2015).

#### Research:

• Use publicly available records or reports to estimate correlations between per capita allocations and voter turnout in PB across and within different countries and over time.



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#### Finding 13: Outreach strategies and collaboration with civil society organizations also impact participation.

- Brazil: A large experiment involving over 40,000 PB voters found that a **get-out-the-vote campaign** (text messages) and email) can increase participation in PB voting by 4.7 percentage points, without biasing voting preferences. (Peixoto et al. 2020)
- Canada and the United States: Districts that worked with CSOs in the design and implementation of PB saw greater voter turnout from traditionally underrepresented groups. Lower-income residents and communities of color were more likely than white and higher-income residents to report they heard about PB from a CSO. Person-to-person outreach was associated with greater turnout of lowerincome residents and people of color (Kasdan & Markman 2015; Hagelskamp et al., 2016, Public spending)

#### Practical **Recommendations**

#### Planning & Design:

 Invest in participant outreach and training: Include a get-outthe-vote campaign to increase participation, using different modes of communication to reach community members.





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#### Finding 14: PB can mobilize and lead to more civil society organizations and more collaborations by such organizations, if it includes certain institutional design features.

- Brazil: Municipalities with PB have a greater number of CSOs than those without PB. This number expands as PB is sustained over time. Touchton and Wampler find that PB is associated with an 8% increase in the number of CSOs in a municipality, holding other variables constant. There is evidence of not just correlation but causation, in that the number of CSOs is not a significant predictor of PB. The institutional rules of PB encourage collective action. (Touchton & Wampler, 2014)
- New York City and Vallejo (United States), Leith (Edinburgh, • Scotland), London Borough of Tower Hamlets (United Kingdom): In localities with PB, there was some evidence of more CSOs collaborating with government, as well as more collaborations between groups. 13% of 418 organizations that participated in PB reported starting new collaborations with other groups as a direct result of their involvement in the process. Johnson suggests that these connections are additional ones, not a crowding out of existing organizations or relationships. Design features make a difference, e.g. the festive environment of a community fair and the requirement that participants vote on all projects. (Johnson, 2017) In New York, good facilitation and a focus on equity helped to encourage greater participation and discouraged domination by well-organized groups. (Su, 2017)

#### Without the right design features, PB can also be vulnerable to domination by elite groups.

- Spain: PB that doesn't engage CSOs can lead to participatory frustration. This is a vicious cycle, in which CSOs tuned out or burned out, the local governments lost legitimacy, and PB ended in 4 of the 6 cities studied. (Fernández-Martinez et al., 2019)
- Mexico City (Mexico): Without a strong civil society, local authorities could forward their ideas to make them look like citizens' proposals, and winning projects can go unimplemented. A strong civil society can punish governments that organize weak PB processes by voting out officials or through protest. However, weak PB can also exacerbate a weak civil society, in a vicious cycle. (Rumbul et al., 2018)

#### **Practical Recommendations**

- · Design the process to facilitate citizen engagement and the formation of CSOs.
- Include a preferential bias in favor of poor groups, such as weighted voting or quality of life or equity index, to encourage participation of poor communities that are not already well represented.
- Include multiple channels for participation so that different CSOs can engage in PB, e.g. additional issuespecific forums
  - Research:
- Investigate what types of CSOs are involved in PB processes, to better understand the influence of government and which interests are over- or underrepresented.



#### Finding 15: PB can also facilitate less formal collective action, outside of CSOs.

- Philippines: Local PB processes formally engaged existing housing rights and organized tenants groups of the urban poor. Youth and workers in informal sectors felt left out, but ended up engaging in less formal collective action through PB. One PB project brought different factions of senior citizens in town to work together. By making the municipal meetings social events, as well as incentivising perfect attendance with free groceries, local fisherman groups succeeded in implementing PB projects to reach poorer communities that were otherwise neglected. (Maravilla and Grayman, 2020)
- South Africa: In contexts where PB is not implemented well, or where one political party dominates, such as the African National Congress in South Africa, PB can still facilitate alternative modes of collective action. PB allows migrant workers and refugees from other African countries, HIV-positive residents, and residents of informal settlements to relay concerns, access information, and advocate for neighborhood projects without formal membership or via CSOs. (Piper & von Lieres, 2016)

#### Practical **Recommendations**

- Build in flexibility (and some fun!) into the process, and allow communities to make each PB process their own, even in informal ways.
- Facilitate both top-down, institutionalized spaces and assemblies for PB and bottom-up, informal popup spaces where people might gather as well.





## Impacts on Governments

#### Finding 16: Municipalities using PB generate more local tax revenues.

In Brazil, there was a 30% increase in local taxes in municipalities using PB compared to comparable municipalities without PB. Extra amounts collected are roughly the same as the amounts dedicated to PB. (Touchton et al., 2020 and 2019)

Residents in municipalities using PB may be more willing to pay taxes because they believe that the government is working on their behalf and can be held accountable - even if they don't participate directly in the participatory process. The government is incentivized to collect more taxes in order to fulfill its public spending commitments. It then dedicates more revenue to areas that benefit the public, advancing a virtuous circle.

#### Finding 17: PB programs tend to spend money differently.

Studies show that districts and cities using PB allocate resources to different issues than places without PB, confirming step 1 of the theory of change

- New York City (United States): PB is associated with increased spending on schools, public housing, and streets and traffic improvements, and decreased spending on parks & recreation, and middle income housing preservation and development. (Hagelskamp et al., 2020)
- Porto Alegre (Brazil): PB is associated with greater • spending on water and sewage infrastructure. (World Bank, 2010)
- Brazil: Adopting PB leads municipalities to allocate more • resources to health care (Touchton & Wampler, 2014) and education (Boulding & Wampler, 2010)

Some PB processes, however, do not shift spending, especially when there is little government capacity, political commitment, or mobilization of low-income residents to participate. For example, evidence from Peru suggests no impact of PB on water coverage or service continuity.

#### **Practical Recommendations**

- 🔂 Advocacy:
- · Make the case to decisionmakers that PB can help to raise tax revenues, keeping in mind that the effect may not be immediate.



#### 🔂 Advocacy, Planning & Design:

 Mobilize residents, especially low-income residents, so that the new budget will align with their interests.





## Impacts on Governments

#### Finding 18: PB redirects spending to low-income communities, when it uses equity criteria.

Several studies show that PB shifts funding toward communities with the greatest needs, when cities use equity criteria for determining what projects go on the ballot and how funds are distributed across districts. These criteria may be incorporated into formulas that determine points for each project, into deliberation processes, or into determining the pot of money available in different areas.

- Porto Alegre and Belo Horizonte (Brazil): PB generated • greater levels of spending per capita in poorer districts. (Marquetti 2003 and 2008; Pires 2008; Wampler 2015)
- New York City (United States): PB shifted spending from the • top 50% income neighborhoods to the lower 50% income neighborhoods. (Shybalkina & Bifulco 2018)
- Seoul (South Korea): PB shifted spending to poorer neighborhoods. (Hong and Cho, 2018; Cho et al., 2020)

When governments do not use equity criteria, however, funds are not consistently directed to lower income **communities** at a greater rate through PB.

#### Finding 19: These impacts differ across locations.

The outcomes above depend on local circumstances and context.

#### **Government responsibilities**

- Depending on the country, different levels of government have control over different policies, e.g. health policy in Germany.
- In some countries, increased tax collection doesn't work as an incentive to local governments because other levels of government control most tax revenue, e.g. in Argentina.

#### Practical **Recommendations**

- Planning & Design:
- Use equity criteria for selecting projects and distributing funds across districts.
  - P Research:
- Use georeferenced data to track which neighborhoods PB funding goes to.
- Investigate the impact of PB investments on reducing territorial inequalities. Does PB better reduce territorial inequalities than other non-participatory policies?

#### 🔁 Advocacy:

• When making the case for PB, explain that you can expect different impacts in different places, depending on local economic and political factors.







## Impacts on Governments 🛃



#### **State capacity**

- When governments can mobilize local state capacity, they are more likely to be able to implement projects selected through PB.
- As state capacity diminishes, there is likely going to be a lower rate of project implementation, which will in turn lower the PB's impact on well-being.

#### **Resources**

When governments dedicate greater resources to PB programs, they are more likely to generate broader impacts.

#### Scope of PB projects:

In places where PB is limited to investments in certain • types of urban infrastructure (like parks and streets), impacts on health outcomes may be harder to measure. Example: Quebec.

#### **Practical Recommendations**

Research:

Investigate the effects of a range of contextual variables, including political systems, economic systems, level of government centralization, and state capacity. Key research questions and areas for investigation include:

- Can PB be effective in authoritarian or hybrid regimes?
- Is PB effective when mandated by national governments or promoted by international donors?
- As PB moves from mostly local or municipal spaces into more rural areas and villages, what impacts will it generate?
- Where local governments have little influence over certain policies or limited capacity, how does PB impact well-being?
- What are the impacts of specific models and features of national PB laws?





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My name is Karol Wai, I am a first generation Burmese-Karen immigrant, and nearly a lifelong Oregonian after my family moved to Portland from the nation of Burma which has long fought for democracy against a Military dictatorship. To even provide this feedback is an honor for me considering that voices of my immigrant and refugee community have historically been neglected, and to experience what it's like to be treated as an option on the menu, to share my voice through participatory budgeting, holds immense value to me. Today, I'm here to support Youth Voice Youth Vote - Oregon's first Participatory Budgeting process.

Participatory Budgeting (PB) is a democratic process in which community members directly decide how to spend a portion of a public budget. It's a tool to tap into the lived experience and collective intelligence of residents to exercise their power to shape solutions in their communities. Youth Voice Youth Vote PB fosters and supports youth civic leadership and public health in the process of identifying community-driven COVID-19 relief and recovery projects funded by \$500,000 in the American Rescue Plan Act (ARPA). These ARPA funds were committed by State Legislators Kayse Jama, Chris Gorsek, and Ricki Ruiz. Cycle 1 of this youth-led participatory budgeting process is occurring within Senate Districts 24 and 25 and House District 50 in East Multnomah and North Clackamas Counties and is focused on youth ages 13 - 25 years old.

As a steering committee member and process facilitator of Youth Voice, Youth Vote (YV<sup>2</sup>), I have helped facilitate workshops where youth, especially youth from historically marginalized communities, develop Covid-19 relief and recovery projects in the places they live, learn, pray, or play in. It has been an honor to share about PB as a longstanding process in other parts of the world and now knocking on Oregon's door, as a tool to deepen and diversify our democracy.

Youth Voice Youth Vote is only the beginning of PB in our communities. There is a need to continue investment in PB so all communities across our state can make decisions about public dollars in ways that meet their needs. And as much data there is to support PB as an equitable tool for justice, I know that I've lived it, I've experienced it first hand. PB and Youth Voice Youth Vote increase opportunities for leadership and civic engagement and it has passed the mic to voices which are often silenced.

I sincerely thank you all for your time, and I urge PCEF to continue Oregon's investment in Youth Voice Youth Vote, which will further amplify youth voices and choices to improve our communities. When we invest in our youth, we invest in our futures.

#### Subject: Feedback on Portland Clean Energy Fund's Climate Investment Plan

To the Portland Clean Energy Fund,

I am pleased to share reflections and recommendations on the draft Climate Investment Plan presented by the Portland Clean Energy Fund (PCEF). We appreciate the plan's comprehensiveness and the clear effort to prioritize and value the experiences and input of frontline communities.

1. \*\*Page 3- "Led by Those Who Live It":\*\* The sentiment behind this phrase strongly resonates with us. Furthermore, educators and guides for these communities should reflect the communities themselves, fostering trust and understanding. Additional support, such as substantial educational resources, technical training, and capacity building for CBOs, should be provided to enhance their role in this journey.

2. \*\*Private Businesses & Fair Wage:\*\* Community-based organizations (CBOs) must be informed about the realistic costs for energy efficiency and contracting work. To ensure that work done by the BIPOC community is not undervalued, a standardized rate structure should be agreed upon by the City of Portland, accepted by the CBOs, and agreed upon by private businesses engaging with the PCEF. The dynamics of institutions are different; hence these rate structures will bridge the gap between CBOs and private businesses, providing a fair and equitable financial framework for all involved parties.

3. \*\*Investment in Infrastructure:\*\* While we noticed an approximately \$150 million fund hold for 2027-2028, we suggest some sums be utilized. Instead, a portion (perhaps 5-10%) should be dedicated to enhancing infrastructure for the climate investment program. Improving throughput is critical in achieving our retrofitting goals and realizing our 2050 targets. Allocating funds for external consultants with experience in managing such programs could help the City of Portland operate an efficient program. A modest annual investment could result in substantial future savings. 4. \*\*Strategic Plan #4:\*\* Emphasizing the importance of energy efficiency, we stress the need for ongoing operation and maintenance of these systems. Building managers and operators should have the skills or the ability to obtain the resources to maintain these systems to ensure safety and maximum efficiency.

5. \*\*Strategic Plan #5:\*\* Incorporating disaster preparedness training for communities could be highly beneficial, given the increasing unpredictability of weather patterns due to climate change.

6. \*\*Strategic Program #10 and #11:\*\* Extra time and effort should be allocated for these communities' training, education, and trust-building. Recognizing the historical injustices they have endured, an empathetic perspective must be taken, meeting these communities where they are and working together for mutual growth and development.

8. \*\*Strategic Program #14:\*\* We endorse Community Development Financial Institutions (CDFIs) and Capital Providers. Ensuring these institutions have an aligned mission with the fund's goals and a proven track record of serving marginalized communities would further strengthen this strategic program.

9. \*\*Appendix 1- Draft PCEF Diverse Contractor and Workforce Utilization Goals:\*\* We commend the goals and believe these are achievable, contributing substantially towards a more equitable Portland.

Thank you for your consideration and for providing the opportunity to contribute to the shaping of our city's clean energy future.

Sincerely,

Janil 1 Buchfild

David L. Burchfield, PE

20225- Gas Stove Emissions Are a Public Health Concern: Exposure to Indoor Nitrogen Dioxide Increases Risk of Illness in Children, Older Adults, and People with Underlying Health Conditions

## Gas Stove Emissions Are a Public Health Concern: Exposure to Indoor Nitrogen Dioxide Increases Risk of Illness in Children, Older Adults, and People with Underlying Health Conditions

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8 Abstract

9 "Natural" gas stoves generate a number of harmful air pollutants, with nitrogen dioxide (NO<sub>2</sub>) most 10 consistently identified in the scientific literature. Multiple high-quality scientific studies have shown that 11 NO<sub>2</sub> concentrations are higher in homes that use gas stoves and that cooking with gas stoves without 12 ventilation can result in home  $NO_2$  concentrations that are above the ambient air quality standards of the 13 Environmental Protection Agency (EPA). The EPA has determined that NO2 is "causal" of more severe 14 respiratory symptoms in people with asthma and that long-term exposure to NO<sub>2</sub> is "likely causal" of 15 respiratory illnesses such as asthma. Furthermore, epidemiological studies have shown that gas stoves are 16 associated with an increased risk of asthma in children as well as more severe asthma symptoms. Despite 17 this evidence, few safeguards are in place to protect the health of the public from gas stove emissions, 18 particularly in overburdened and underserved communities. While comprehensive federal law regulates 19 outdoor air quality in the United States, there are no federal indoor air quality guidelines, and few state or 20 local policies address indoor air pollution. Those living in smaller, older, less ventilated homes are at 21 higher risk of the effects of indoor air pollutants from a variety of sources, introducing a disproportionate 22 risk of illness among lower-income populations and people of color. Along with other healthy home 23 improvements, health experts should advocate for an equitable, multipronged approach to combat indoor 24 air pollution from gas stoves, including policy change, program development, education about emission 25 mitigation, and investment. 26 27 Relationship to Existing APHA Policy Statements

28 The following existing APHA policy statements support this proposed policy statement by addressing 29 issues and topics related to air pollution, respiratory disease, gas, energy policy, climate change, and 30 health equity.

- APHA Policy Statement 201711: Public Health Opportunities to Address the Health Effects of
   Air Pollution
- APHA Policy Statement 20183: The Public Health Impacts of Energy Policy in the United States
- 34 APHA Policy Statement 20197: Addressing Environmental Justice to Achieve Health Equity 35 APHA Policy Statement 20157: Public Health Opportunities to Address the Health Effects of • 36 Climate Change 37 • APHA Policy Statement 20125: The Environmental and Occupational Health Impacts of High-38 Volume Hydraulic Fracturing of Unconventional Gas Reserves 39 APHA Policy Statement 20046: Affirming the Necessity of a Secure, Sustainable and Health 40 Protective Energy Policy 41 This proposed policy statement is also consistent with several archived policy statements: 200017 42 (Confirming Need for Protective National Health Based Air Quality Standards), 200012 (Reducing the 43 Rising Rates of Asthma), and 8912 (Public Health Control of Hazardous Air Pollutants). 44 45 In addition, APHA is a signatory on the U.S. Call to Action on Climate, Health, and Equity: A Policy 46 Action Agenda (2019), which calls for a "transition away from wood burning, oil, and natural gas use for 47 home heating and cooking." 48 **Problem Statement** 49 Gas stoves (gas cooktop and oven combinations, interchangeably called gas ranges) are common 50 household appliances across the United States. However, burning gas (i.e., combustion) creates harmful 51 nitrogen dioxide (NO<sub>2</sub>), particulate matter ( $PM_{2.5}$ ), carbon monoxide (CO), formaldehyde (CH<sub>2</sub>O), and 52 methane (CH<sub>4</sub>) pollution and has been increasingly linked to poor health outcomes at lower 53 concentrations over the past 10 years.[1] The Environmental Protection Agency (EPA),[2] Health 54 Canada, [3] and the World Health Organization (WHO)[4] have all revised their assessments of NO<sub>2</sub>'s 55 health impacts in the last decade. Despite these revised health assessments, routine exposure from gas 56 stoves remains an underrecognized health threat to residents.[5] 57 58 The most consistent evidence of gas stove pollution in the literature regards NO<sub>2</sub> emissions because 59 electric stoves do not emit NO<sub>2</sub>, which is an established marker for gas combustion.[6] Indoor NO<sub>2</sub> 60 emissions from gas stoves can exceed indoor/outdoor concentration guidelines set by WHO and outdoor 61 standards set by the EPA.[7] According to EPA estimates, households where gas stoves are used for 62 cooking have between 50% and 400% higher levels of NO<sub>2</sub> than those with electric stoves.[8] Higher 63 concentrations of  $NO_2$  from gas stoves are associated with longer cooking times, [9,10] pilot 64 lights, [9,11,12] and lack of ventilation. [9,13,14] A Lawrence Berkeley National Laboratory modeling 65 study of homes in southern California estimated that during the winter, when ventilation in homes is 66 lowest, 51% to 64% of homes using gas cooking stoves regularly experience indoor NO<sub>2</sub> levels that
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- 67 exceed health-based outdoor air standards.[15] A study of in-home cooking practices in nine homes
- 68 produced findings consistent with these modeling results, with four of the nine homes exceeding the
- 69 National Ambient Air Quality Standards (NAAQS) for NO<sub>2</sub> when cooking without ventilation.[13]
- 70

71 Gas stoves are an important source of personal NO<sub>2</sub> exposure. People in the United States spend about 72 65% of their time in their place of residence and about 90% of their time indoors.[16] In a study of 18 73 cities and 15 countries, including Boston in the United States, NO<sub>2</sub> concentrations were measured in 74 indoor and outdoor environments and compared with personal exposures. Personal exposures to  $NO_2$ 75 were more strongly correlated with indoor  $NO_2$  concentrations than with outdoor concentrations. The 76 most influential activity affecting personal exposure was using a gas stove in the home, with a 67% 77 increase in mean personal NO<sub>2</sub> exposure.[17] In another study in which pediatric asthma patients were 78 equipped with home-based NO<sub>2</sub> sensors, researchers found that patients in homes with gas stoves had a 79 higher frequency of acute  $NO_2$  exposures than patients in homes without gas stoves and that these acute 80 exposures were positively correlated with hospital admissions.[18] 81 In 2020, about a third of Americans cooked primarily with gas.[19] The prevalence of gas stoves varied 82 across incomes nationally; the prevalence was highest among the highest-earning households and lowest 83 among households earning less than \$20,000.[19] There is also variability by region. Gas stove

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84 prevalence rates are higher in California, the Northeast, and the Midwest than in the South.[19] While

85 lower-income households are less likely to use gas stoves on a national scale, a study conducted in

86 Baltimore revealed a gas stove prevalence rate of 83% in homes occupied by low-income

87 populations.[20]

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89 NO<sub>2</sub> exposure from gas stove emissions and health risks to children: The EPA has long recognized that 90  $NO_2$  is associated with respiratory illnesses such as asthma, but in 2016 the agency changed the 91 classification of short-term NO<sub>2</sub> exposure from "likely causal" to "causal" of asthma attacks and long-92 term NO<sub>2</sub> exposure to "likely causal" of the development of asthma.[2] A 2013 meta-analysis conducted 93 by Lin et al. showed that children residing in homes with gas stoves have a 42% higher risk of current 94 asthma and a 24% higher lifetime risk of asthma than children living in homes with electric stoves.[21] 95 This is a comparable risk to a child living with a smoker in the home.[22] In the meta-analysis, 11 studies 96 were included in the assessment of gas stoves and risk of current asthma, three of which were from North 97 America. The results varied only minimally between regions, suggesting that the findings are externally 98 valid for North America.[21]

99

100 The association between gas stoves and increased asthma incidence in children is consistent with  $NO_2$ 's

101 physiological effects. Biologically, children are more susceptible to air pollution because of developing

102 lungs and immune systems, higher breathing rates, and propensity to breathe through their mouths.[23]

103 Exposure to  $NO_2$  in children is negatively correlated with healthy lung function.[23] Cooking with gas 104 has also been shown to reduce lung function up to 3.4% in children.[24] Controlled human exposure

105 studies in healthy adults (not available for children) show development of an allergic phenotype and

106 increased airway responsiveness at high levels of NO<sub>2</sub> (1,000 parts per billion [ppb]), both of which are

associated with the development of asthma.[2]

107 108

109 Indoor NO<sub>2</sub> at concentrations well below EPA outdoor health standards are associated with an increased 110 risk of asthma symptoms in asthmatic children. A prospective study of young children (2–6 years of age) 111 with an asthma diagnosis reported a dose-dependent increase in asthma symptoms among children in 112 Baltimore. A 20-ppb increase in NO<sub>2</sub> levels was associated with statistically significant increases in 113 asthma symptoms after adjustment for confounders (including age, sex, race, caregiver educational level, 114 season of sampling,  $PM_{2.5}$  exposure, and secondhand smoke exposure). Additional analyses were done to 115 ensure that the effects of indoor NO<sub>2</sub> were independent of ambient NO<sub>2</sub> levels.[20] A prospective study of 116 more than 1,000 asthmatic children (5-10 years of age) conducted in Massachusetts and Connecticut also 117 revealed a dose-response relationship above a 6-ppb threshold; every 5-ppb increase in NO<sub>2</sub> levels was 118 associated with a dose-dependent increase in the risk of asthma severity. Models were adjusted for age, 119 sex, atopy, season of monitoring, race/ethnicity, mother's education, smoking in the home, and 120 sensitization and exposure to indoor allergens.[12] Similarly, the 2013 Lin et al. meta-analysis showed 121 that higher levels of indoor NO<sub>2</sub> (20 ppb) were associated with a 15% increased risk of wheezing in 122 children (the meta-analysis results were adjusted for confounding factors, including smoking in the 123 family).[21]

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125 While no studies have yet explored the impact of the removal of gas stoves on asthma severity or asthma 126 incidence, reductions in NO<sub>2</sub> in ambient air in Los Angeles were assessed in a multilevel longitudinal 127 cohort drawn from the Southern California Children's Health Study. More than 4,000 children with no 128 history of asthma were included in the study. The authors reported that with an annual median NO<sub>2</sub> 129 reduction of 4.3 ppb, the incidence rate declined by 0.83 cases per 100 person-years. [25] In addition, a 130 randomized study showed that when gas stoves were replaced with electric stoves, median NO<sub>2</sub> levels were 51% lower, falling from a median concentration of 19.7 ppb in homes with a gas stove to 9.7 ppb in 131 132 homes that received an electric stove.[11] Further research is currently being conducted to build evidence

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133 for the health co-benefits of gas stove removal in affordable housing units. The community group WE

134 ACT for Environmental Justice is leading a pilot study, Out of Gas, In with Justice, that is replacing gas

135 stoves with induction stoves and measuring health benefits in 20 affordable housing homes in New

136 York.[26] Also, the California Energy Commission is funding a \$4 million randomized control trial to

137 investigate the impact of gas stove interventions on children with asthma.[27]

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139 NO<sub>2</sub> exposure from gas stove emissions and health risks to older adults: Negative health effects from gas 140 stoves among healthy adults have been inconsistently reported. This conforms with studies of the effects 141 of air pollution; children are more biologically sensitive to air pollution than healthy adults. There are 142 currently no studies of the health effects of cooking with gas stoves among older adults (typically 143 considered those 65 years or older). However, older adults are more sensitive than younger adults to NO<sub>2</sub>. 144 Increased age is associated with a greater risk of weakened immune function, impaired healing, 145 decrements in pulmonary and cardiovascular function, and a higher prevalence of chronic disease. The 146 EPA found that older adults had more NO<sub>2</sub>-related asthma hospital admissions and emergency department 147 visits and concluded that "older adults are at increased risk for NO<sub>2</sub>-related health effects."[2] Short-term 148 NO<sub>2</sub> exposure, as well as long-term exposure to low levels of NO<sub>2</sub>, is correlated with higher overall 149 mortality rates among older adults.[2,28]

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151 NO<sub>2</sub> exposure from gas stove emissions and environmental justice concerns: Low-income communities 152 and communities of color are at much greater risk of harm from indoor pollution caused by gas stoves. A 153 recent study conducted by the National Center for Healthy Housing (NCHH) and Enterprise Community 154 Partners revealed that 90% of rental homes did not have adequate ventilation to remove gas stove 155 emissions and recommended removing gas stoves.[14] Another study showed that gas stove pollution was 156 highest in multi-unit buildings.[10] Because of the long history of housing discrimination, communities of 157 color are disproportionately renters living in smaller spaces. Renters often have little or no control over 158 the fuel type or quality of their appliances and frequently lack the financial means or property owner 159 permission to choose an electric stove and ensure high-quality ventilation. This combination of 160 circumstances means that low-income renters are often using older stoves that are not adequately 161 ventilated, resulting in a higher concentration of pollutants indoors.[29] In addition, individuals have 162 greater exposure to gas combustion pollutants when they use gas ovens to supplement their home 163 heating.[30] Low-income communities and communities of color are already living with higher levels of 164 outdoor air pollution[31]; their consequent health disparities may be further exacerbated by cumulative 165 exposures to pollution from indoor sources such as gas stoves.

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167 Lack of policies and programs addressing gas stoves and indoor air quality: While outdoor air pollution 168 has received much policy attention, indoor air pollution—including that caused by gas appliances—is 169 entirely unregulated at the federal level. Unlike Canada and WHO, the EPA does not establish health 170 standards or guidelines for indoor air quality. While the EPA does not currently issue air quality 171 guidelines, it does recommend American National Standards Institute (ANSI)/American Society of 172 Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 62.2 (which details whole-173 home ventilation guidelines for acceptable indoor air quality[32]) in a number of its guidelines for 174 construction, including Indoor AirPLUS construction specifications[33] and single-family[34] and 175 multifamily renovations.[35] Similar to the EPA, the U.S. Department of Housing and Urban 176 Development (HUD) does not regulate indoor air quality in its buildings, although it recommends using 177 ANSI/ASHRAE Standard 62.2. It also establishes smoke-free policies in public housing and multifamily 178 properties funded by HUD.[36] The U.S. Air Force does indoor air quality building inspections and 179 recognizes that combustion can cause NO<sub>2</sub> pollution. It recommends venting combustion appliances if 180  $NO_2$  levels are above the NAAQS.[37] In contrast to other gas appliances, which must be externally 181 vented according to building codes, there is a lack of consistent regulation of gas stove ventilation. Some 182 state and local new construction building codes may require more ventilation through the adoption of 183 voluntary ANSI/ASHRAE standards that can reduce gas stove pollution but do not eliminate it.[14] Some 184 jurisdictions (Washington State, New York City, the District of Columbia, and 60 cities in California and 185 towns in Oregon and Colorado) have also recently established building codes that require installation of 186 electric appliances in new construction, [38] but otherwise indoor air pollution is not regulated at the state 187 or local level.

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189 Several existing healthy homes programs address ventilation of gas stoves but do not warn people about

190 gas stove emissions and their association with respiratory illnesses or provide emission reduction

191 strategies beyond ventilation. Examples include HUD's Healthy Homes Principles,[39] the EPA's

Asthma Home Environment Checklist, [40] and the CDC's Healthy Housing Reference Manual. [41]

193 These interventions depend on people understanding the health risks gas stoves pose and regularly using

an exhaust hood vented outdoors. However, building codes do not uniformly require adequate

ventilation,[14] and current data suggest that most people do not use ventilation regularly.[11,42,43]

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197 The costs of transitioning to electric stoves, both at a household and a national level, will require large-

scale policy changes and government investments to ensure a just transition away from gas cooking.

199 Stoves are a crucial piece of kitchen equipment that support household nutrition, and given that many

200 households lack the financial means or property owner permission to choose an electric stove, we must

201 simultaneously advocate for and ensure access to other lower-cost, shorter-term solutions that help

202 mitigate indoor cooking pollution. Additional research on the health harms of gas stoves and assessments

203 of the available health interventions will help support this advocacy and policy change.

204

205 Evidence-Based Strategies to Address the Problem

206 As with successful public health programs and policies that have reduced exposure to household

smoke[44] and radon,[45] reducing exposure to gas stove pollution will require a multipronged approach

208 that includes indoor air quality guidelines, education of consumers and the public health and medical

209 community, uptake of exposure reduction strategies, and creation of new policies and programs.

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211 Indoor air quality guidelines: More policy attention should focus on indoor air pollutant guidelines. While 212 the Clean Air Act requires the EPA to set NAAOS for common air pollutants outdoors.[46] there are no 213 similar standards or guidelines for indoor air, resulting in less regulation and consequent unsafe levels of 214 indoor pollution. The Clean Air Act has successfully reduced levels of U.S. outdoor air pollution and 215 prevented hundreds of thousands of early deaths and millions of cases of health effects, [47] 216 demonstrating the benefits of such standards. Although EPA indoor air quality guidelines would not have 217 the same legal force under the Clean Air Act as EPA's NAAOS, they would play a valuable role in 218 informing consumers about risks related to indoor air pollution and helping state regulators and voluntary 219 standard-setting bodies assess these risks. Similarly, the EPA develops criteria for determining 220 when surface water is unsafe for people and wildlife. State and tribal governments can use these criteria to 221 develop their own guidance and regulations. [48] Health Canada [3] and WHO [4] have both set indoor air 222 quality guidelines to guide health-based assessments. States do not regulate indoor air quality but can set 223 indoor air quality guidelines. The California Air Resources Board (CARB) passed a resolution in 2020 224 supporting the electrification of appliances and citing the "urgent need to update CARB's indoor air 225 pollution guidelines to provide agencies, researchers, and the public guidance on safe levels for indoor air 226 pollutant exposures."[49]

227

228 Exposure reduction strategies: Replacing existing gas stoves with electric or induction stoves is the most

effective strategy for gas stove emissions mitigation. In a randomized study that explored the intervention

230 options of ventilation, running an air purifier, or switching to electric stoves, electric stoves improved air

231 quality the most, reducing the median kitchen concentration of  $NO_2$  by 51% and the bedroom

232 concentration by 42%.[11] The switch to an electric stove is often most feasible in new construction and 233 at the end of existing gas stoves' life, when replacement is already needed, although some households 234 (i.e., those with the financial means and control over their environment) may choose to replace sooner 235 than that for immediate benefits to their indoor air. There are cases in which a complete replacement is 236 not feasible, such as lack of financial means or property owner permission or structural limitations posed 237 by limited electrical panel capacity. In these cases, households may choose to shift some of their cooking 238 from a gas stove to other small electric appliances they already own, such as microwave ovens, electric 239 kettles, and toaster ovens.

240

When implemented correctly, filtration may be an effective and lower-cost strategy to mitigate indoor air pollution from gas appliances already present in homes across the nation.[50] In the same randomized interventional study described above, installing a ventilation hood was not shown to significantly change NO<sub>2</sub> concentrations from gas stove use. However, high-efficiency particulate absorbing air purifiers with carbon filters placed in kitchens with gas stoves resulted in a 27% reduction in median kitchen NO<sub>2</sub> levels and a 20% reduction over 3 months.[11]

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248 Ventilation may be a strategy to reduce gas emissions, but it has limitations. There are two types of 249 ventilation: whole-home/whole-building ventilation and source ventilation (e.g., exhaust hood). 250 ANSI/ASHRAE Standard 62.2 details whole-home ventilation guidelines for acceptable indoor air 251 quality.[32] In an NCHH study of ANSI/ASHRAE Standard 62.2 in comparison with standard 252 ventilation, whole-building ventilation was shown to reduce PM<sub>2.5</sub> and carbon monoxide from gas stoves. 253 However, it was inadequate to expel NO<sub>2</sub> pollution. The researchers concluded that, to ensure healthy 254 indoor air quality, gas stoves should be removed from homes.[14] Source ventilation can remove gas 255 stove emissions but is not as effective as whole-home ventilation. Many people do not frequently use 256 source ventilation; one survey revealed that respondents used their exhaust hoods only a third of the time, 257 citing noise and forgetfulness.[42] The hoods currently on the market also vary in effectiveness. Many 258 hoods do not vent to the outdoors and simply circulate pollutants around the home, and most fail to 259 capture more than 75% of pollutants.[43] In a study of households that reported using ventilation, 260 children had better lung function and lower odds of respiratory symptoms.[30] Residents with gas stoves 261 and without proper exhaust ventilation can ventilate naturally by opening doors and windows while 262 cooking if weather, outdoor air quality conditions, and window operability permit. Considering the 263 NCHH observation that ventilation is not sufficient to remove NO<sub>2</sub>,[14] whole-home and source 264 ventilation should be paired with other strategies that remove gas stoves or reduce their use.

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Education: An effective way to inform the public of the risk of gas stove emissions and effective
remediation strategies is to require disclosures at the point of sale or when rental and lease agreements are
signed. Thirty-seven states require the presence of radon to be disclosed during real estate transactions,
and four states require tenant disclosures.[51] HUD requires information about radon be provided for all
Federal Housing Administration insured forward mortgages. This requirement is estimated to reach
millions of people buying homes. When HUD-acquired single-family properties are sold, buyers receive
information about the health harms of radon and mold as part of a release agreement and receive
information about home repairs that can help minimize them. The home repairs suggested to mitigate
radon are recommendations without associated funding to make the repairs.[52]
Education and recommendations on gas stove emissions control strategies beyond ventilation could be
added to the outreach materials created by the EPA, HUD, and the CDC. Similarly, health profession
curricula could better address environmental health risks such as gas stoves. Together, these education
strategies could play a role in public education about gas stove emissions and mitigation.
CDC's EXHALE program recommends implementing six strategies to reduce asthma symptoms and uses
health care visits in a home-based program to educate people caring for children with asthma about
multiple asthma triggers. The Community Preventive Services Task Force recommends home-based
multitrigger, multicomponent interventions with environmental remediation because they reduce
symptoms and medical care needs and because they are cost effective.[53] These programs cover
information on issues such as secondhand smoke and pest management.[54] Outreach workers could also
provide information about unventilated gas stoves and offer low-cost remediation strategies that pair
ventilation with source control based on individual household resources (e.g., presence of ventilation,
operational windows, other electric appliances).

Other policy levers: Another policy lever is to better regulate gas stoves and ventilation. The Institute for
Policy Integrity at the New York University School of Law, citing health-harming emissions of gas

stoves, recently called upon the Consumer Product Safety Commission (CPSC) to develop mandatory

294 performance standards for gas stoves and range hoods, require warning labels for gas stoves, and educate

the public about the harms of gas stove emissions. These actions are within the agency's existing statutory

authority.[55]

297

298 Air quality guidelines and nongovernmental standards, such as the internationally recognized

ANSI/ASHRAE Standards 62.1 and 62.2,[32] can also be used to guide state and local building codes.

300 Building codes can establish indoor pollutant concentration limits based on air quality guidelines and

301 require effective ventilation aligned with ANSI/ASHRAE standards. The 2020 ASHRAE Position

302 Document on Unvented Combustion Devices and Indoor Air Quality[56] specifically called for more

303 research to investigate the effects of gas cooking combustion on indoor air quality in residential and

304 commercial buildings, especially concerning NO<sub>2</sub>, as well as a review and update of appliance standards

- 305 and a revision of product information to include the risk of extended use.
- 306

307 Government-funded new construction and retrofits: The Boston Department of Neighborhood 308 Development requires developers receiving funds from the city for new construction affordable housing 309 projects to build to a zero emissions standard with respect to electric appliances.[57] Electrification 310 programs focusing on retrofitting existing buildings are also becoming more popular across the United 311 States.[58] and the replacement of gas stoves could potentially be an additional element of these 312 programs. California and Philadelphia combined a variety of government funding sources to address the 313 core components of a healthy home into one program. "One-stop-shop" models such as these provide 314 funding for whole-home retrofits and address four key components: health and safety, weatherization and 315 energy efficiency, appliance electrification, and energy assistance. [59] Maine has a successful heat pump 316 adoption program that covers the cost of heat pumps for low-income residents and provides tiered rebate 317 financing. Maine's program resulted in 25% to 30% growth in uptake of heat pumps in each of the past 3 318 years.[60] This model could be applied to electric stoves, prioritizing installation in low-income homes. 319 To minimize displacement that may result from building upgrades, government agencies can protect 320 renters by including stipulations on electrification funding. A recent report focused on Los Angeles 321 identified several housing policies that can be used to minimize the impact of building electrification and 322 efficiency programs on renters. These policies included prohibiting pass-through costs for 323 decarbonization retrofits to affordable housing tenants and targeting decarbonization subsidies to low-324 income communities. In addition, local municipalities can strengthen tenant's rights laws.[61] 325 326 Other programs: ENERGY STAR, a national program administered by the EPA, rates the efficiency of 327 appliances and has been successful in reducing energy consumption from appliances.[62] Some states 328 provide rebates for ENERGY STAR rated appliances, and ENERGY STAR appliances are required for 329 several green building certification programs, including the U.S. Green Building Council's Leadership in

330 Energy and Environmental Design (LEED) certification program. Electric stoves and induction stoves are

- 331 more efficient than gas stoves,[63] and adding electric and induction stoves to the ENERGY STAR
- 332 program may help create a preference for them. Some governments, as part of local zoning laws or
- 333 building codes, require LEED certification for building permits, suggesting that providing ENERGY
- 334 STAR ratings could help with the uptake of electric stoves in new building construction.
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- 336 Opposing Arguments/Evidence
- 337 One opposing argument is that there are no stated risks to respiratory health from regulatory and advisory
- 338 agencies and organizations responsible for consumer health and safety. On the contrary, the EPA and
- 339 CPSC have been aware of and have publicized health risks of combustion appliances in buildings for
- 340 more than 35 years.[64] The EPA currently recommends source control for gas stoves (i.e., proper
- 341 adjustment) and ventilation to the outdoors to reduce exposure to indoor air pollution.[65] Through its
- 342 indoor air quality guidelines, the agency recommends whole-home ventilation according to
- 343 ANSI/ASHRAE Standard 62.2 and further recommends that occupants be educated about the importance
- of using ventilation in the kitchen and bathroom. One of the leading medical associations in the United
- 345 States, the American Medical Association, passed a resolution in 2022 recognizing the associations
- among gas stoves, indoor NO<sub>2</sub> concentrations, and pediatric asthma.[66]
- 347

348 A small number of studies and reports also refute the evidence on the health risks of gas stoves. In one 349 global survey study, no association was found between gas cooking and lifetime or current asthma among 350 children.[67] However, this single study was not based on measured concentrations of NO<sub>2</sub> in the home; 351 rather, it was based on a self-reported global survey of household cooking fuels and asthma symptoms in 352 which the respondents were children 13-14 years of age and parents of children 6-7 years of age. 353 Because the study combined data from 31 countries, differences across countries in housing 354 characteristics, ambient temperatures, ventilation, and other factors may have masked the association 355 between gas cooking and asthma. Without better isolation among geographies, types of housing, and

- ventilation, it is problematic to assume that this study's global findings are applicable to the United
- 357 States.
- 358

A 2021 report sponsored by the California Restaurant Association (CRA) critiqued a 2020 report by the

360 University of California, Los Angeles (UCLA), on indoor and outdoor pollution from gas appliances.[68]

- 361 The CRA's arguments primarily addressed the UCLA study's modeling assumptions and scenarios as
- 362 opposed to the actual public health impacts reported. The UCLA study was not included in this policy
- 363 statement, but a few CRA assertions are discussed here because they have been raised elsewhere. In

364 addition to arguments around the cost and effectiveness of ventilation, the CRA report asserts that indoor 365 air pollution is more a function of what is being cooked than what fuel is used. In response to that claim, 366 there are several pollutants emitted from gas that are not emitted from cooking food or from using electric 367 stoves, namely  $NO_2$ , carbon monoxide, and formaldehyde. Cooking food inevitably produces  $PM_{2.5}$ , 368 which is why ventilation is still recommended even when an electric stove is used. However, replacing a 369 gas stove with an electric stove will remove the source of  $NO_2$  and other health-harming combustion 370 pollutants. It will also remove some PM<sub>2.5</sub>, as research shows that gas stoves can produce twice as much 371  $PM_{2.5}$  as electric stoves. [69] In addition, gas stoves produce higher concentrations of ultrafine particles 372 even when no cooking activities take place.[70]

373

374 Concerns about consumer costs of replacing gas stoves and installing ventilation or filtration are often 375 raised as reasons why the public health implications of gas stoves cannot be prioritized. The priority of a 376 public health program is to recognize a problem. Funding for secondhand smoke education programs 377 followed the medical and scientific community's recognition of health harms. As with radon programs, 378 information can be given to consumers about the health effects of gas stoves without the obligation to 379 replace every gas stove in use. The cost of replacing a gas stove with an electric stove (a \$650 average 380 cost plus an installation cost of \$100-\$200)[71] is similar to average radon remediation costs (\$771-381 \$1,179).[72] However, the upfront cost of the stove, ventilation, and filtration technology, as well as the 382 operating costs (including utility bills), can be minimized. In new buildings, all-electric homes are often 383 less expensive to construct than all-gas homes or homes with a mix of fuels.[73] In the case of existing 384 homes, state or local programs can offer point-of-purchase rebates for electric or induction stoves and 385 ventilation and filtration devices through energy efficiency programs. For example, MassSave offers 386 rebates for ENERGY STAR rated appliances.[74] While rebate programs are least effective for renters, 387 they do meet the needs of middle-income homeowners. State-funded electrification programs could offer 388 electric or induction stoves and ventilation and filtration devices according to a means-tested benefits 389 scale, as Maine has done with heat pumps.[60] Although electricity currently costs more than gas for 390 many consumers, electric stoves are more efficient than gas stoves, meaning that once the electric stove 391 has been installed, the annual energy cost differential of operating an electric stove is minimal and should 392 not burden low-income households.[63] In contrast, the average cost of an asthma diagnosis in a 393 household is estimated to be more than \$3,000 a year, illustrating the importance of quantifying the health 394 care costs of gas stoves.[75]

395

396 Concerns that tenants could be displaced after upgrades have been made to homes are not unique to

397 replacing gas stoves. They are legitimate concerns for all building improvement programs, including

398 energy efficiency and electrification programs. States and municipalities should be encouraged to develop

399 a suite of anti-displacement policies to complement funding for building upgrades and include

400 stipulations on funding to minimize displacement.[61]

401

402 Consumer preference for gas stoves has been suggested as a reason not to adopt electric stoves. However, 403 consumer preference is largely driven by advertising. Surveys have shown that people have no preference 404 for whether gas or electricity heats their home, so the gas industry has focused on marketing gas stoves to 405 sell more gas for entire homes. [76] While marketing campaigns may claim that gas stoves provide a 406 better cooking experience, Consumer Reports compared various gas and electric stove models and found 407 that electric stoves outperformed gas.[77] A study that considered the efficiency of gas stoves in 408 comparison with electric and induction stoves revealed that gas stoves were least efficient.[63] Recent 409 polling data show that gas stove interest has declined by 5%.[78]

410

411 For people in substandard housing, replacing a gas stove may not be a household priority. None of the 412 recommended interventions require anyone to prioritize switching out a gas stove over radon, mold, or 413 lead abatement or other household priorities. As with national radon education programs, educating 414 consumers about gas stove emissions allows some people (i.e., those who have the financial means and 415 control over their environment) to make choices based on their specific circumstances. Many mitigation 416 strategies do not require any investment, including using other appliances or opening windows, or require 417 minimal investment, such as using induction burners that plug into existing electrical outlets (estimated to 418 cost less than \$100).

419

420 Instead of asking households to prioritize, the recommendation is that electrification be included in a suite 421 of healthy home upgrades. Electrifying appliances are often excluded from typical weatherization and 422 energy efficiency programs. One solution (as noted) is to create one-stop-shop models for whole-home 423 retrofits that address health and safety, weatherization and energy efficiency, appliance electrification, 424 and energy assistance. This solution is being successfully modeled in California and Philadelphia, where 425 unique funding sources are combined.[59]

426

427 Action Steps

428 Based on this evidence, APHA:

13

429	1.	Calls upon the EPA, HUD, and the CDC to formally recognize the links among gas stove
430		emissions, NO <sub>2</sub> pollution, and increased risk of illness in children, older adults, people with
431		underlying conditions, and environmental justice communities. Furthermore, the public and
432		health care practitioners should be educated on the health harms of gas stove emissions and
433		promotion of mitigation solutions should be expedited.
434	2.	Calls upon the EPA to set health-protective indoor air quality guidelines for all indoor residential
435		settings, drawing on the Clean Air Act and the current EPA recommendations to utilize
436		ANSI/ASHRAE Standard 62.2 in indoor air quality guidance in new construction specifications
437		and renovations.
438	3.	Calls upon the EPA to support the 2020 ASHRAE position document, which recommended
439		additional research on gas stove emissions, review of appliance standards, and revision of product
440		information.
441	4.	Calls upon the CPSC to set mandatory or voluntary performance standards for gas stoves and
442		range hoods and to launch a public awareness campaign.
443	5.	Calls upon state legislatures and HUD to require disclosure during real estate transactions and
444		tenant disclosures that gas stoves emit harmful levels of pollutants without proper ventilation and
445		to provide source control and mitigation strategies for improving air quality (similar to the
446		approach for radon education programs).
447	6.	Calls upon HUD to adopt policies with preferences for the installation of electric appliances in
448		new and retrofitted buildings that are federally funded. Furthermore, HUD should update its
449		Healthy Homes program to provide educational information about gas stove emissions and
450		mitigation strategies, including source control and ventilation.
451	7.	Calls upon public and affordable housing agencies and providers, including those receiving HUD
452		funding, to develop and implement strategies to ensure that residents do not experience unsafe
453		levels of gas stove pollution. New units and retrofitted units can be fitted with appropriate
454		ventilation, filtration, and electric stoves.
455	8.	Calls upon state and local authorities responsible for building codes to legislate the inclusion of
456		whole-home ventilation and outdoor-venting exhaust hoods in all new buildings and remodels,
457		adhering to ANSI/ASHRAE Standard 62.2.
458	9.	Calls upon local and state legislative and regulatory bodies to adopt residential building codes
459		with preferences for installing electric appliances and to require electric appliances for building
460		projects receiving municipal or state funding. Funding for retrofits or building upgrades should
461		include stipulations that minimize displacement.

462 10. Calls upon ENERGY STAR to provide ratings for electric and electric induction cooking stoves. 463 11. Calls upon health care practitioners (including physicians, nurses, public health nurses, 464 community health workers, and many others) to inform patients of the risks of gas stove 465 emissions and the measures they can take to mitigate exposure, similar to the approach to home 466 exposures to tobacco. This workforce will be best prepared to address risks such as gas stoves if 467 health professions increase the amount of environmental health content in curricula. 468 12. Calls upon CDC's National Asthma Control Program to add gas stove emission education, source 469 control, and ventilation strategies to its EXHALE program. 470 13. Calls upon researchers and funders to broaden the scope of health impacts and populations 471 studied in relation to gas stove pollution and assess the risks to households cooking with gas. 472 Other research priorities include identifying the most effective intervention options and 473 monetizing the health costs and benefits of interventions. 474 475 References 476 1. Seals BA, Krasner A. Health effects from gas stove pollution. Available at: https://rmi.org/insight/gas-477 stoves-pollution-health. Accessed November 12, 2021. 478 2. US Environmental Protection Agency. Integrated science assessment for oxides of nitrogen: health 479 criteria (final report, 2016). Available at: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=310879. 480 Accessed November 12, 2021. 481 3. Health Canada. Residential indoor air quality guideline: nitrogen dioxide. Available at: 482 https://www.canada.ca/en/health-canada/services/publications/healthy-living/residential-indoor-air-483 quality-guideline-nitrogen-dioxide.html. Accessed July 28, 2022. 484 4. World Health Organization. WHO global air quality guidelines: particulate matter (PM2.5 and PM10), 485 ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Available at: 486 https://apps.who.int/iris/handle/10665/345329. Accessed July 28, 2022. 487 5. Krasner A, Jones TS, LaRocque R. Cooking with gas, household air pollution, and asthma: little 488 recognized risk for children. J Environ Health. 2021;83(8):14-18. 489 6. Jarvis DJ, Adamkiewicz G, Heroux ME, Rapp R, Kelly FJ. Nitrogen dioxide. Available at: 490 https://www.ncbi.nlm.nih.gov/books/NBK138707/. Accessed July 28, 2022. 491 7. Lebel ED, Finnegan CJ, Ouyang Z, Jackson RB. Methane and NOx emissions from natural gas stoves, 492 cooktops, and ovens in residential homes. Environ Sci Technol. 2022;56(4):2529-2539.

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# **A Review of the Evidence** Public Health and Gas Stoves

November 2022



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### Introduction

Awareness that outdoor air pollution can impact health is prevalent, but less well known is that indoor air pollution can also have significant and harmful health effects. While air indoors can be safer during times of high outdoor pollution events (like wildfire), indoor air pollution has consistently been ranked among the top five environmental risks to public health from comparative risk studies performed by EPA's Science Advisory Board (SAB). In recent years, news media have broadened awareness of decades of research demonstrating that gas appliances, especially for cooking, are a health risk. Research described in this report shows that gas appliances contribute to both indoor air pollution and climate change. While outdoor air pollution and some of its most common pollutants have been regulated for decades through various means in the United States, no federal standards or guidelines govern indoor air pollution. This report summarizes some of the most recent health evidence on gas stoves and their impact on health, reviews case studies of policy action, and offers public health recommendations.



## **Executive Summary**

- Gas appliances contribute to indoor air pollution and are a health hazard, increasing the risk of childhood asthma and asthma severity.
- BIPOC and low-income families experience disproportionate exposure to ambient air pollution and as a result suffer a higher burden from indoor air pollution.
- Gas appliances use methane gas, almost always a fossil fuel, that can contribute to outdoor air pollution levels and climate change.
- Gas cooking activities cause pollutants, including nitrogen dioxide (NO<sub>2</sub>), carbon monoxide (CO) and particulate matter (PM), which can reach levels that affect human health.
- Multnomah County Public Health recommends against indoor combustion appliances, including gas and wood-burning appliances.
- When a non-combustion appliance is available, health officials recommend prioritizing their use.
- When combustion appliances reach the end of their service life, health officials recommend replacing them with a non-combustion appliance.



### Background

Indoor air pollution levels are often two to five times, and occasionally more than 100 times, higher than outdoor levels.<sup>1</sup> With our outdoor environments undergoing changes due to climate change (wildfires/urbanization), indoor spaces where people spend the majority of their time are further impacted in ways that scientists are still trying to understand. The National Academy of Sciences published a 2022 report which emphasized that environmental conditions and indoor chemistry can vary between buildings.<sup>2</sup> They highlighted that researchers know very little about how humans are exposed to indoor chemicals across different pathways and exposure routes. This is also true of cumulative and long-term exposures on human health. This report summarizes some of the most recent health evidence on gas stoves and their impact on health, reviews case studies of policy action, and offers public health recommendations. Gas stoves are of concern because they are a proximate source of indoor air pollution, and ventilation practices vary widely.

- 1 U.S. Environmental Protection Agency. 1987. The total exposure assessment methodology (TEAM) study: Summary and analysis. EPA/600/6-87/002a. Washington, DC.
- 2 National Academies of Sciences, Engineering, and Medicine 2022. Why Indoor Chemistry Matters. Washington, DC: The National Academies Press. https://doi.org/10.17226/26228

#### Pollutants of Concern from Gas Stoves<sup>3</sup>

Gas stoves are a source of combustion (burning) pollution inside the home, occurring during ignition, extinguishment, and even when the appliance is off.<sup>4</sup> Gas used in homes produces pollutants through leaks and combustion. Gas is made up primarily of methane (CH<sub>4</sub>). It also releases carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO) and volatile organic chemicals (VOCs, e.g. formaldehyde). VOCs can also form secondary pollutants, such as particulate matter (PM) and ozone (O<sub>3</sub>).<sup>5</sup> When lit, gas-burning appliances also produce nitric oxides such as nitrogen dioxide (NO<sub>2</sub>) as a by-product.

#### **Health Impacts**

Most gas stove owners are already aware of the burn risks of open flames, the fire hazard of gas leaks, and perhaps even carbon monoxide poisoning. However, many are likely less familiar with the health risks associated with other pollutants emitted from gas stoves and combustion that affect indoor air pollution. Homes and buildings can trap pollutants that are emitted from indoor sources, exposing occupants to pollutants for longer durations. In addition, personal activities (like cooking) happen close to sources, increasing inhalation of pollutants. Indoor air pollution can cause and worsen respiratory illness, including asthma, alongside other non-respiratory health issues such as heart disease, cancer and premature death.<sup>6</sup>

#### Sensitive Groups<sup>7</sup>

Some populations are more susceptible to the risks of indoor air and gas stove pollution. The risk to children is heightened due to their increased breathing rate, higher lung-to-body ratios, and smaller bodies. Aging adults are at increased risk because of the likelihood of pre-existing conditions. People with respiratory and heart conditions are more likely to be affected by air pollution.

#### **Environmental Justice**

Racism and classism shape the choices people have about where to live and work, and thus their exposure to air pollution. Home environments are an important determinant of health. Although there is a knowledge gap on inequities with indoor air pollution, research shows that low-income and BIPOC populations are disproportionately burdened by most types of pollution.<sup>8</sup>

- 3 California Air Resources Board. Combustion pollutants and indoor air quality. https://ww2.arb.ca.gov/resources/ documents/combustion-pollutants-indoor-air-quality.
- 4 Lebel ED, Finnegan CJ, Ouyang Z, Jackson RB. Methane and NOx Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes. Environ Sci Technol. 2022 Feb 15;56(4):2529-2539. doi: 10.1021/acs.est.1c04707. Epub 2022 Jan 27. Erratum in: Environ Sci Technol. 2022 May 17;56(10):6791. PMID: 35081712.
- 5 U.S. Environmental Protection Agency. Controlling Air Pollution from the Oil and Natural Gas Industry. https://www. epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/basic-information-about-oil-and-natural-gas
- 6 U.S. Environmental Protection Agency. Indoor Air Quality: Effects on Human Health. https://www.epa.gov/reportenvironment/indoor-air-quality#:~:text=Health%20effects%20associated%20with%20indoor,%2C%20heart%20 disease%2C%20and%20cancer.
- 7 U.S. Environmental Protection Agency and the U.S. Consumer Product Safety Commission. The inside story: a guide to indoor air quality. Washington, DC: U.S. Environmental Protection Agency and the U.S. Consumer Product Safety Commission, Office of Radiation and Indoor Air; 1995. Document #402-K-93-007. Available from URL: http://www. epa.gov/iaq/pubs/insidest.html
- 8 Tessum, C.W., Paolella, D.A., Chambliss, S.E., Apte, J. S., Hill, J. D., & Marshall, J. D. (2021). PM2. 5 polluters disproportionately and systemically affect people of color in the United States. Science Advances, 7(18), eabf4491.

Data show outdoor air pollution is not spread evenly across our communities and demographic groups.<sup>9</sup> There are documented disproportionate impacts.<sup>10</sup> Historically, low-income people<sup>11</sup> and people of color<sup>12</sup> have experienced disproportionate exposure to ambient air pollution. People of color are 1.5 times more likely to live in an area with poor air quality compared to white people.<sup>13</sup> The CDC reports asthma rates to be much higher among Black children.<sup>14</sup>

Lower-income households have an increased risk of illness from air pollution because they are more likely to be in areas with higher concentrations of outdoor pollutants.<sup>15</sup> They also are more likely to use gas stoves as supplemental heat.<sup>16</sup> Cumulative effects from combined exposure to outdoor and indoor pollution can lead to poor health outcomes. Environmental injustices worsen the adverse health impacts of gas stove emissions.

Across Multnomah County, 50% of households rely on gas heat appliances (primarily using gas to heat their homes, including gas furnaces, boilers, wall units and stoves).<sup>17</sup> Many but not all of these households use gas stoves; the proportion is unknown.

- 9 Multnomah County Health Department. 2014 Report Card on Racial and Ethnic Disparities. https://multco-web7psh-files-usw2.s3-us-west-2.amazonaws.com/s3fs-public/2014%20Report%20Card%20on%20Racial%20and%20 Ethnic%20Disparities%20-%20Full%20Report%20-%20v121214.pdf
- 10 Multnomah County Environmental Health Services. Analysis from the National Air Toxics Release Inventory, 2014. Retrieved from: https://multco.maps.arcgis.com/apps/MapJournal/index. html?appid=886de8737ec84c3d99382a69d4f93853
- 11 Hajat, A., Hsia, C. & O'Neill, M.S. Socioeconomic Disparities and Air Pollution Exposure: a Global Review. Curr Envir Health Rpt 2, 440–450 (2015). https://doi.org/10.1007/s40572-015-0069-5
- 12 J. Liu, L. P. Clark, M. Bechle, A. Hajat, S.-Y. Kim, A. Robinson, L. Sheppard, A. A. Szpiro, J. D. Marshall, Disparities in Air Pollution Exposure in the United States by Race-Ethnicity and Income, 1990–2010. ChemRxiv. Preprint. 10.26434/chemrxiv.13814711.v1; P. Mohai, D. Pellow, J. T. Roberts, Environmental justice. Annu. Rev. Env. Resour. 34, 405–430 (2009)
- 13 American Lung Association. State of the Air Report, 2020.
- 14 CDC. NHIS 2018. Analysis by the American Lung Association Epidemiology and Statistics Unit. Retrieved from: https://www.lung.org/research/trends-in-lung-disease/asthma-trends-brief/current-demographics
- 15 Institute of Medicine. Toward Environmental Justice: Research, Education, and Health Policy Needs. Washington, DC: National Academy Press, 1999
- 16 Coker ES, Smit E, Harding AK, Molitor J, Kile ML. A cross sectional analysis of behaviors related to operating gas stoves and pneumonia in U.S. children under the age of 5. BMC Public Health. 2015 Feb 4;15:77. doi: 10.1186/ s12889-015-1425-y. PMID: 25648867; PMCID: PMC4321321.
- 17 Oregon Department of Energy's 2020 Biennial Energy Report. Accessed from: https://www.oregon.gov/energy/Dataand-Reports/Documents/2020-BER-County-Profiles-Supplement.pdf

## **Health Impacts**

### Health Outcomes Related to Air Quality in Multnomah County

When looking at the burden of disease, indoor and outdoor air pollution are important risk factors. Researchers estimate 350,000 premature deaths from air pollution in the United States annually and an average of two years off the global average life expectancy.<sup>18</sup> The Energy Policy Institute states that breathing polluted air is more dangerous than smoking cigarettes or drinking alcohol.<sup>19</sup> Exposure to air pollution affects health across the lifecourse, from low birth weight to premature death. In Multnomah County, life expectancy ranges neighborhood by neighborhood from 72 to 90 years of age. Air pollution is just one environmental exposure contributing to life expectancy variations. Major health effects include asthma, heart attacks and stroke, Alzheimer's disease, and increased cancer risk. Air pollution causes or contributes to many of the leading causes of death in Multnomah County, including cancer, heart disease, stroke, chronic lower respiratory disease, and diabetes (Table 2).

Multnomah County prevalence of conditions related to air quality are shown in Table 1, tabulated by poverty status. Asthma is among the most prevalent chronic diseases, with one in 10 Multnomah County adults reporting a diagnosis. Socioeconomic disparities are apparent for heart attacks, low birthweight, preterm birth, diabetes and asthma. Adults living at or below the federal poverty level have a higher prevalence of these conditions compared to those not living in poverty.

Age-adjusted prevalence (95% Confidence Interval)					
Illness type	Total Population	At or below poverty*	Above poverty*		
Adults who have had a stroke	2.6% (2.2-3.1%)	6.1% (3.7-9.6%)	2.1% (1.7-2.6%)		
Adults who have had a heart attack	3.2% (2.7-3.7%)	6.1% (3.9-9.3%)	2.5% (2.1-3.1%)		
Low birthweight (<2,500 grams)	6.9% (6.6-7.2%)	8.1% (7.6-8.5%)	6.1% (5.8-6.4%)		
Adults who have had cancer	7.3% (6.7-8.0%)	8.5% (6.1-11.7%)	7.3% (6.6-8.1%)		
Preterm birth (< 37 weeks)	8.2% (7.9-8.5%)	9.7% (9.3-10.3%)	7.3% (6.9-7.6%)		
Adults with diabetes	7.6% (6.9-8.4%)	14.2% (10.7-18.5%)	6.8% (6.0-7.6%)		
Adults with asthma	9.7% (8.9-10.6%)	14.7% (11.2-17.7%)	9.3% (8.3-10.3%)		

#### Table 1. Illness related to air quality by poverty status in Multnomah County, 2016-2019

Sources: BRFSS 2016-2019, Oregon Birth Certificates 2016-2019. "Confidence interval" means that there is a 95% chance that the true value is within the range.

\*For birth outcomes, at or below poverty reflects births paid by Medicaid/OHP; above poverty reflects births paid by private insurance.

- 18 K. Vohra, A. Vodonos, J. Schwartz, E.A. Marais, M.P. Sulprizo, L.J. Mickley. Global mortality from outdoor fine pollution generated by fossil fuel combustion: Results from GEOS-Chem. Env Research. 2021;195; AQLI. 2022. https://aqli.epic.uchicago.edu/reports/
- 19 AQLI. 2022. https://aqli.epic.uchicago.edu/reports/

#### Table 2: Death rates from health conditions associated with air pollution in Multnomah County, 2016-2020

Cause of death	Rate per 100,000 population (95% CI)
Major cardiovascular diseases (including stroke)	195.6 (191.3 - 199.9)
Chronic lower respiratory disease	33.7 (31.9 - 35.5)
Lung cancer (including cancers of the trachea and bronchus)	33.6 (31.8 - 35.4)
Alzheimer's disease	33.2 (31.5 - 35.0)
Diabetes	24.7 (23.2 - 26.2)

All conditions are leading causes of death in Multnomah County, 2016-2020 Source: CDC WONDER

#### Air Pollution and COVID-19

Emerging evidence shows there are multiple pathways by which air pollution may interact with COVID-19. First is long-term exposure to pollution, which increases the likelihood of diseases such as asthma, chronic obstructive pulmonary disease (COPD), heart disease and diabetes – all conditions that make cases of COVID-19 more likely to be severe.<sup>20</sup> Second is short-term exposure to air pollution, which is thought to injure and inflame lungs, contributing to a greater susceptibility to infection.<sup>21</sup> There are differences in COVID-19 infection rates by race and ethnicity. Additionally, some scientists think air pollution affects the transmission of COVID-19 infection and its ability to move and survive in the air.<sup>22</sup>

<sup>20</sup> Wu, X., Nethery, R. C., Sabath, B. M., Braun, D., & Dominici, F. (2020). Exposure to air pollution and COVID-19 mortality in the United States. medRxiv.

<sup>21</sup> Y. Zhu, J. Xie, F. Huang, L. Cao. Association between short-term exposure to air pollution and COVID-19 infection: evidence from China Sci. Total Environ., 727 (2020), p. 138704, 10.1016/j.scitotenv.2020.138704

<sup>22</sup> S. Comunian, D. Dongo, C. Milani, P. Palestini. (2020). Air Pollution and COVID-19: The Role of Particulate Matter in the Spread and Increase of COVID-19's Morbidity and Mortality. Int J Environ Res Public Health. 22;17(12):4487. doi: 10.3390/ijerph17124487. PMID: 32580440; PMCID: PMC7345938.

### Review of Health Impacts by Gas Stove Pollutants

Gas stoves release a number of pollutants (like VOCs) through leaks, while also generating nitrogen oxides (most notable  $NO_2$ ), carbon dioxide, carbon monoxide and particulate matter when in use. To date, the majority of research concerning gas stove emissions has focused on their effect on indoor air quality. The findings of gas stoves' impact on outdoor environments is limited.

#### Methods

We searched PubMed, Google Scholar and documents from authoritative sources (EPA, CDC, WHO, ALA, etc.) for systematic reviews or meta-analyses. Systematic reviews are defined as peer-reviewed journal articles that summarize findings of a body of literature on a specific topic, applying inclusion criteria for search terms, date of publication and study design. Meta-analyses are peer-reviewed journal articles that gather data from multiple studies and re-analyze them to determine the strength of findings and relationships across multiple studies.

Study design guides our assessment of the strength of scientific evidence. We view systematic reviews and meta-analyses as a strong study design. For this report, we consider a single highquality systematic review or meta-analysis, or a report from an authoritative source to be sufficient for drawing conclusions about associations between risk factors and health outcomes. This is especially true if it summarizes many studies, finding consistent results and a large effect size. We emphasize recent reviews on the assumption that they encompass older ones and are most likely to represent the current state of scientific understanding. When no systematic review is available, we rely on review articles that are non-systematic reviews and employ less robust search strategies but nevertheless synthesize a body of literature rather than a small number of studies. As a guiding principle, we avoid making claims based on a single study, case studies, or gray literature. Individual well-known studies with larger sample size are mentioned to provide additional evidence, if they were not part of a review article, but are not considered sufficient on their own for drawing conclusions about associations and are viewed as low to moderate in strength of evidence. For more details on the rating of the evidence and review of the studies used, see Appendix.

#### Nitrogen Dioxide (NO<sub>2</sub>)

EHS found strong evidence from systematic reviews and authoritative sources that Nitrogen dioxide  $(NO_2)$  from gas stoves adversely impacts health.  $NO_2$  is a reactive gas released from the combustion of methane gas.  $NO_2$  is the component of greatest concern and is used as the indicator for the larger group of NOx.  $NO_2$  irritates eyes, nose and throat, and causes shortness of breath.

The EPA's Integrated Science Assessment for Oxides of Nitrogen found NO<sub>2</sub> is present in homes with gas stoves at concentrations that are 50% to over 400% higher than those in homes with electric stoves.<sup>23</sup> Cooking with gas can produce levels that exceed outdoor EPA health standards and World Health Organization (WHO) guidelines. A meta-analysis of 26 years of research provides evidence that children living in homes with gas stoves have an increased risk of asthma, and that indoor NO<sub>2</sub> increases the risk of current wheeze in children.<sup>24</sup> The analysis found that, compared to homes without gas stoves, children in homes with gas stoves are 42% more likely to experience symptoms associated with asthma, and 24% more likely to be diagnosed with lifetime asthma due to NO<sub>2</sub> emissions in the home.

<sup>23</sup> U.S. Environmental Protection Agency. Integrated Science Assessment for Oxides of Nitrogen—Health Criteria 2-38 (2008) https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=194645.

<sup>24</sup> Weiwei Lin, Bert Brunekreef, Ulrike Gehring.Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children. International Journal of Epidemiology, Volume 42, Issue 6, December 2013, Pages 1724–1737, https://doi.org/10.1093/ije/dyt150

EPA's Integrated Science Assessment has identified a causal relationship between short-term exposure to NO<sub>2</sub> concentrations within the range generated by gas stoves and adverse respiratory effects, including asthma exacerbation.<sup>25</sup> A causal link between short- and long-term exposure to NO<sub>2</sub> and a variety of other health harms, such as heart rate variability, systemic inflammation of other organs, adverse birth outcomes, cancer, and death has also been cited by EPA and Health Canada in their Human Health Risk Assessment for Ambient Nitrogen Dioxide.<sup>26</sup> A 2020 systematic review on indoor exposure to air pollutants in the home environment notes that the most important predictors of indoor NO<sub>2</sub> concentrations were gas stove use, followed by ventilation and outdoor NO<sub>2</sub> levels.<sup>27</sup>

#### Particulate Matter (PM)

The National Academy of Sciences reports that particulate matter emissions from gas stoves can vary depending on the type of cooking (i.e., frying vs. simmering), foods cooked, temperature, and other factors.<sup>28</sup> The report identified this exposure as a health risk, though it pointed to other research on specific health outcomes as examples, not as a comprehensive or systematic review of health impacts. Particulate matter emissions occur indoors when cooking, no matter the fuel type used. However, the open flame of a gas stove does produce particulate matter (PM) even when there is no cooking happening on the stove.

Particulate matter consists of a complex mixture of organic and inorganic substances, with a diameter of less than 10µm suspended in the air. These particles can be so small that they bypass a body's natural defense mechanisms. Lungs are not always able to filter the smallest of these particles (diameter of less than 2.5 µm), landing the health-damaging particles in our bloodstream and multiple organs. The health effects of breathing in  $PM_{2.5}$  are well documented by authoritative sources, with mounting scientific evidence showing that there is no known risk-free level of  $PM_{2.5}$  exposure.<sup>29</sup>

PM poses serious health risks, such as premature death, heart attacks, aggravated asthma, decreased lung function, and increased respiratory symptoms such as irritation of the airways, coughing or difficulty breathing.<sup>30</sup> WHO has stated that there is a close relationship between exposure to high concentrations of small particulates ( $PM_{10}$  and  $PM_{2.5}$ ) and increased mortality or morbidity, both daily and over time. All-cause daily mortality is estimated to increase by 0.2–0.6% per 10 µg/m<sup>3</sup> of PM<sub>10</sub> while long-term exposure to PM<sub>2.5</sub> is associated with an increase in the long-term risk of cardiopulmonary mortality by 6–13% per 10 µg/m<sup>3</sup> of PM<sub>2.5</sub>.<sup>31</sup>

Research is less developed on outdoor combustion of natural gas, contributing to a lack of certainty in outdoor impacts from gas. One high-profile modeling study suggests that among fuels used in residential buildings, gas is second only to biomass in attributable mortality in Oregon. The same

- 25 U.S. Environmental Protection Agency. Integrated Science Assessment for Oxides of Nitrogen (2016). https://www. epa.gov/isa/integrated-science-assessment-isa-nitrogen-dioxide-health-criteria.
- 26 Health Canada, Human Health Risk Assessment for Ambient Nitrogen Dioxide (2016), https://perma.cc/G2CN-D4F2
- 27 Vardoulakis et al. Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review. Int. J. Environ. Res. Public Health 2020, 17(23), 8972
- 28 National Academies of Sciences, Engineering, and Medicine 2022. Why Indoor Chemistry Matters. Washington, DC: The National Academies Press. https://doi.org/10.17226/26228
- 29 U.S. Environmental Protection Agency. Integrated Science Assessment for Particulate Matter. 2019; WHO. September 2021. https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health
- 30 U.S. Environmental Protection Agency. Health and Environmental Effects of Particulate Matter (PM). Retrieved from: https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm
- 31 World Health Organization. Health Effects of particulate matter: Policy implications for countries in eastern Europe, Caucasus and central Asia. 2013. Retrieved from: //efaidnbmnnnibpcajpcglclefindmkaj/https://www.euro.who.int/\_\_ data/assets/pdf\_file/0006/189051/Health-effects-of-particulate-matter-final-Eng.pdf

study, using 2017 modeled results for the United States, reported that burning gas for any purpose in buildings (residential and commercial) was responsible for an estimated 3,860 to 5,800 deaths annually nationwide (860 to 1,600 for commercial buildings and 3,000 to 4,200 residential).<sup>32</sup> This is a conservative estimate because it includes only health impacts from outdoor PM<sub>2.5</sub> and precursor pollution; it also does not include pollution from upstream extraction. A single modeling study is not sufficient for strong conclusions but suggests the extent of impacts.

#### **Carbon Monoxide (CO)**

Carbon monoxide (CO) is colorless, odorless and is produced by the incomplete combustion of gas and other fuels. Breathing in CO reduces the amount of oxygen that can be transported in the bloodstream to organs like the heart and brain. It can cause dizziness, confusion, fatigue, unconsciousness, heart problems and death.<sup>33</sup> Carbon monoxide poisoning can be fatal in just minutes if concentrations are high enough indoors. WHO, in its review of the scientific evidence, notes exposure to carbon monoxide can also reduce maximum exercise ability in healthy young individuals, while the EPA concludes a causal relationship is likely to exist between short term exposures to CO and cardiovascular morbidity.<sup>34</sup> Gas stoves can be a source of low level carbon monoxide emissions. Patterns of use and appliance maintenance can affect emission levels and impacts. While this exposure pathway is a possibility, evidence is lacking on typical levels of exposure from gas stove emissions.

#### Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOCs) can be emitted through leaks in gas lines and gas stoves inside the home. The VOCs in gas can include formaldehyde and benzene. Many VOCs are ozone precursors, are possible carcinogens and have been reported to be significant risk factors for asthma. A 2020 systematic review found that indoor VOC concentrations were negatively correlated with ventilation.<sup>35</sup> The degree to which VOCs are present indoors from gas stoves is not well researched. However, a recent and widely cited study from Harvard found that natural gas used in homes throughout the Greater Boston area contained varying levels of volatile organic chemicals even when the stove was off.<sup>36</sup> When leaked, these VOCs are known to be toxic and linked to cancer. They also can form secondary health-damaging pollutants such as particulate matter and ozone. While this exposure pathway is a possibility, evidence is lacking on typical levels of exposure from gas stove emissions.

- 32 These values are based on additional analysis from Jonathan Buonocore, Sc.D, the study's lead author; RMI used median estimates from the results of 3 reduced complexity models used in: J Buonocore (Harvard T.H. Chan School of Public Health) et al, "A decade of the U.S. energy mix transitioning away from coal: historical reconstruction of the reductions in the public health burden of energy," 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c. (Table 2 & Figure 16)
- 33 U.S. Environmental Protection Agency. Retrieved from https://www.epa.gov/indoor-air-quality-iaq/carbonmonoxides-impact-indoor-air-quality
- 34 World Health Organization, 2010. https://www.ncbi.nlm.nih.gov/books/NBK138710/; CO ISA, EPA, 2010
- 35 Sotiris et al. Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review. Int. J. Environ. Res. Public Health 2020, 17(23), 8972; https://doi.org/10.3390/ijerph17238972
- 36 Harvard T.H. Chan School of Public Health. "Natural gas used in homes contains hazardous air pollutants: Policymakers and individuals can act to mitigate potential health risks from natural gas." ScienceDaily. ScienceDaily, 28 June 2022. www.sciencedaily.com/releases/2022/06/220628083239.htm

## **Climate Impacts**

The specific role of gas stoves as a contributor to climate change is not well-researched to date, but we felt it important to discuss, given that climate change is a threat multiplier for public health. Climate change has various serious health impacts in Oregon and Multnomah County.<sup>37</sup> Impacts include respiratory illness from deteriorating air quality, heat-related illness and death from warmer summer temperatures, changing patterns of vector-borne disease, threats to food and water quality, and accompanying economic and social stressors. For these reasons, mitigating climate change would contribute to protecting Multnomah County residents from these health hazards.

Combustion of fossil fuels contributes to climate change and harms health.<sup>38</sup> Leaked methane or carbon dioxide and carbon monoxide from gas extraction and combustion can cause climate-related health harms.<sup>39</sup> In the past, gas has been seen as a "cleaner" energy source when compared to other dirtier fossil fuels such as coal, but gas is a large contributor to greenhouse gas emissions. The residential sector plays a critical role in emission reduction, as a source of greenhouse gas (GHG) emissions.

There are upstream outdoor emissions associated with gas extraction and distribution. Methane is a potent greenhouse gas that is released at all stages of the gas system, from drilling and production to pipeline distribution and eventually in homes with gas lines. Localized health impacts from hazardous air pollution emissions from fuel extraction processes have been noted by governmental bodies and researchers. The United Nations found methane to be over 80 times more powerful than carbon dioxide as a warming gas over a 20-year timeframe in addition to being an ozone precursor.<sup>40</sup> A newer but small study from Stanford University earlier this year concluded that using a 20-year timeframe for methane, annual methane emissions from all gas stoves in U.S. homes have a climate impact comparable to the annual carbon dioxide emissions of 500,000 cars.<sup>41</sup> While meta-analyses on the impacts of gas stoves to outdoor environmental impacts are lacking, this individual study suggests the extent of impacts. Additionally, evidence reviewed by the EPA concludes that a causal relationship exists between current atmospheric concentrations of CO (not CO<sub>2</sub>) and effects on climate.<sup>42</sup>

- 37 Oregon Health Authority (OHA). Climate and Health in Oregon 2020. December 2020.
- 38 K. Vohra, A. Vodonos, J. Schwartz, E.A. Marais, M.P. Sulprizo, L.J. Mickley. Global mortality from outdoor fine pollution generated by fossil fuel combustion: Results from GEOS-Chem. Env Research. 2021;195
- 39 Jiaxin Fu, Yingqi Liu, FeiHong Sun. (2021)Identifying and Regulating the Environmental Risks in the Development and Utilization of Natural Gas as a Low-Carbon Energy Source. Front. Energy Res., 9.
- 40 United Nations Economic Commission for Europe. Retrieved from https://unece.org/challenge August 10,2022
- 41 Eric D. Lebel, Colin J. Finnegan, Zutao Ouyang, and Robert B. Jackson. Methane and NOx Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes Environmental Science & Technology 2022 56 (4), 2529-2539 DOI: 10.1021/acs.est.1c04707
- 42 CO ISA, EPA
# Health Based Regulation & Policy

Motivated by the information presented above, findings that removing indoor fossil fuel combustion reduces exposure to harmful pollution, and the lack of federal oversight over gas stove emissions, some states and local authorities have developed their own standards or policies to protect their constituents.<sup>43</sup> They include:

### Resolutions

- California Air Resources Board (CARB): In November 2021, CARB adopted a resolution in support of updating building codes to improve ventilation standards and move toward electrification of appliances—making California the first state to issue official guidance to address the health impacts of gas stoves and other appliances.
- American Medical Association (AMA): This national group representing physicians has recognized the association between use of gas stoves, indoor nitrogen dioxide levels, and asthma health risk through the introduction of Resolution 439 (A-22), informing physician, health-care providers and the public that cooking with a gas stove increases household air pollution and the risk of childhood asthma.

## **Indoor Air Quality Guidelines**

- Canada: Continues to update outdoor and indoor guidelines to better protect health. Canada has a maximum NO<sub>2</sub> residential exposure limit of 90 parts per billion (ppb) over a one-hour exposure and 11 ppb over the long-term (>24 h), which is lower than the EPA's outdoor standards of 100 ppb for 1hr exposure and 53 ppb annual.
- CARB Recommendations: Indoor air quality guidelines for pollutants including nitrogen dioxide (NO<sub>2</sub>), formaldehyde, carbon monoxide (CO), particulate matter (PM<sub>10</sub>, PM<sub>2.5</sub>), polycyclic aromatic hydrocarbons (PAHs) and chlorinated hydrocarbons.

### **Other Policy Actions**

- Financial Incentives: Sacramento Municipal Utility District (SMUD) provides financial incentives to switch from gas to electric.
- Gas Bans: At least 77 cities in 10 U.S. states have been working to phase out gas. Berkeley, CA first banned gas hookups in new multi-family construction, setting the stage for other big cities to follow, including <u>New York City</u>, <u>San Francisco</u> and <u>Seattle</u> which allow no gas in new buildings. San Diego and Denver are also taking action. In Oregon, Eugene most recently voted to direct city staff to draft ordinance language that would prohibit natural gas hookups for new residential buildings, which if passed would make Eugene the first city in Oregon to ban gas.

<sup>43 &</sup>quot;David E. Jacobs and Andrea Baeder, "Housing Interventions and Health: A Review of the Evidence," National Center for Healthy Housing, January 2009, http://nchharchive.org/LinkClick. aspx?fileticket=2lvaEDNBIdU%3D&tabid=229"



## Recommendations



Public Health recommends against combustion appliances, including gas stove appliances, to protect public health, improve indoor and outdoor air, reduce emissions and mitigate climate change.



When a non-combustion appliance is available, health officials recommend prioritizing their use to benefit occupants' respiratory health and reduce asthma morbidity in children.



If a non-combustion appliance is not available, adequate ventilation to the outdoors must be required and in working order. Ventilation should be used whenever the appliance is in use.



When replacing combustion devices, health officials recommend replacing them with non-combustion appliances.

# Appendix

Evidence ratings generally follow guidelines used by CDC.

Evidence review ratings adapted from What Works for Health.

Rating	Amount of evidence	Quality of evidence
Strong evidence	1 or more systematic reviews, multiple experimental studies; Authoritative sources (e.g. government and international bodies, non-governmental institutions)	Strong designs, statistically significant positive findings consistent across studies, large effect size
Moderate evidence	1 or more systematic reviews, 2 experimental studies, 3 studies with unmatched comparisons or pre-post measures	Less rigorous designs, some statistically significant positive findings but inconsistency across studies
Insufficient evidence	No more than 1 experimental study, 2 or fewer studies with unmatched comparisons or pre- post measures	Study quality varies/often low, inconclusive findings

<b>Evidence revi</b>	ewed: exposure	to	pollutants
Gas stove use, c	ombustion		

Pollutant	Quality	Description	Count	Reference List
<b>NO</b> <sub>2</sub> There is strong evidence that indoor NO <sub>2</sub> concentrations from gas stove combustion harm health.	High	Systematic review & authoritative sources	5	WeiWei et al. 2013; Vardoulakis et al. 2020; EPA 2008; EPA 2016; HealthCanada 2016
<b>PM</b> There is strong evidence that exposure to particulate matter harms health. Excluding cooking, the evidence suggests that PM levels from gas stove combustion may harm health, but the evidence is undeveloped and considered insufficient.	High	Authoritative sources	2	EPA 2019; WHO 2021
	Low	Modeling study	1	Buonocore et al. 2021

## Evidence reviewed: exposure to pollutants (continued) Gas stove use, combustion

Pollutant	Quality	Description	Count	Reference List
<b>CO</b> Evidence is lacking on typical levels of exposure from gas stove emissions and associated health impacts.	Medium	Authoritative source	1	EPA 2010

Note: There are several other pollutants related to gas combustion. This review focuses on criteria pollutants, which are known to have health effects and have been most publicly studied.

Evidence reviewed: exposure to pollutants Gas stove use, fugitive emissions				
Pollutant	Quality	Description	Count	Reference List
<b>VOCs</b> The evidence is lacking on typical levels of VOCs emitted from gas stoves and their direct health impacts.	Medium	Systematic review	1	Sotiris et al. 2020
	Low	Observational study	1	Harvard 2022
<b>CH4</b> Gas stoves as contributors to climate change are not well- researched to date. However, the climate-related harms from leaked methane from production and transport are.	High	Authoritative source	1	UNECE 2022
	Low	Modeling study	1	Lebel et al. 2022



## **PORTLAND PUBLIC SCHOOLS** OFFICE OF THE SUPERINTENDENT

501 North Dixon Street / Portland, OR 97227 Telephone: (503) 916-3200 Mailing Address: P. O. Box 3107 / 97208-3107

June 2, 2023

Mr. Sam Baraso Program Manager, Portland Clean Energy Fund 1810 SW 5th Avenue, Suite 710 Portland, OR 97201

Dear Mr. Baraso,

As Superintendent of Portland's largest PK-12 education system, I am thrilled that the Portland Clean Energy Fund recognizes the central role of students and schools in fighting climate change. If I had just one comment on the Climate Investment Plan, it would be that both areas of investment – schools and students – are critical.

Investments in schools offer a distinct opportunity to both reduce the region's emissions and to make the threats of climate change visible in every Portland neighborhood. Through the generous support of Portlanders, our Bond-funded projects have made specific buildings more efficient – but only a fraction of our over-ninety properties. The proposed \$16,930,833 investment in our buildings, and the \$50 million you will invest across the city's schools, will accelerate our ability to reduce our carbon footprint. After all, schools anchor every Portland neighborhood. Physical changes to those buildings will be seen by all Portlanders, and will afford another opportunity to educate Portland's children and youth about climate change.

But I am most grateful for your direct investments in our students. Portland Public Schools students, including many from frontline communities, have long advocated for climate justice. They have varying levels of direct experience with climate change, but some students understand intimately how inequality exacerbates the severity of environmental injustices. They see clearly how the climate crisis compounds individual and systemic injustices, and they have rightly demanded that adults in their lives respond with clear action and real urgency. And you are responding with the overall Climate Investment Plan – but also by investing directly in their ideas, dreams, and solutions.

In our own <u>Climate Crisis Response Policy</u>, and in our other climate-related work, we've always tried to center students. We've supported student climate activism through our Climate Justice Youth Advisory and our civic engagement toolkit. We're also developing curricular materials that empower youth to analyze data and create solutions to sustainability and climate justice issues in their community. But your \$3-million investment in student-led projects is bold, courageous, and

appropriate. It recognizes what we know: that our students are capable and deserve to play an active role in building a better, more climate resilient future.

I see great potential for our district to collaborate on other aspects of the Climate Investment Plan but, from my perspective within the city, I am most grateful for your critical investments in students and in schools. Thank you for seeing us and our students as partners in your work. Our shared commitments – to racial equity and social justice, to centering students, and to urgently addressing the climate crisis – will carry us forward together.

Sincerely,

JUU 7 Guadalupe Guerrero

Portland Public Schools



June 2, 2023

421 SW Oak St., Suite 300 Portland, OR 97204 1.866.368.7878 energytrust.org

Sam Baraso Portland Clean Energy Community Benefits Fund 1810 SW 5<sup>th</sup> Ave, Suite 710 Portland, OR 97201

#### Re: Comments on Full Draft Climate Investment Plan for 2023-2028

Energy Trust of Oregon appreciates the opportunity to offer follow-on comments to the Portland Clean Energy Community Benefits Fund's Climate Investment Plan. We appreciate staff's efforts to consider and incorporate various pieces of our feedback on the preliminary draft — feedback provided with a lens as to how we can better work together in our program administration roles, improving our joint community partners' effectiveness and delivering more benefits to our mutual customers. The strategic programs and community responsive grants detailed within the plan will propel vital energy, climate and equity investments into households, small businesses and community-gathering buildings for the benefit of PCEF's priority populations.

Energy Trust is an independent, non-advocacy, nonprofit organization working through a grant agreement with the Oregon Public Utility Commission to serve Portland residents and businesses who receive electricity and natural gas service from Portland General Electric, Pacific Power and NW Natural. We also serve customers of those utilities, plus those of Cascade Natural Gas and Avista, elsewhere in Oregon and Southwest Washington.

Within the five-year plan, the clean energy, workforce and contractor development, and community capacity building programs and grant opportunities are closely aligned with Energy Trust's purpose and our vision of clean and affordable energy for all.

We have been serving Portlanders since 2002 with information, technical assistance and cash incentives to help them invest in cost-effective energy efficiency and small-scale renewable power projects. Over time, those projects have provided clean power, energy savings and utility bill savings of \$98 million to 174,000 homes and 13,600 businesses. However, we have not served or met the energy needs of all Portlanders. For much of our existence, our prescribed goals and objectives were to save or generate the greatest volume of energy at least cost to participants and the utility system. This resulted in system-wide benefits for everyone but the direct benefits—like lower monthly bills, comfortable homes no matter the weather and more attractive business places to work and invest in—went to customers who were most resourced to make investments, leaving many customers underserved by Energy Trust.

To fulfill our core purpose of delivering cost-effective energy efficiency and small-scale renewable energy to all our customers in Portland and beyond, Energy Trust must do a better job connecting to and with customers of color, people experiencing low to moderate incomes; customers living in rural areas; small businesses; Black, Indigenous and people of color

(BIPOC) owned businesses; and woman-owned businesses—the Portlanders PCEF was created to serve.

At Energy Trust, we are committed to working alongside PCEF as you bring forward these new strategic programs and continue your community responsive grant programs. For example:

- Our residential, small commercial, multifamily, new commercial construction and new affordable multifamily construction services and incentives can help PCEF dollars go further to serve more Portlanders with deep home retrofits, energy-efficient affordable housing retrofits, and energy-efficient commercial and school building improvements. And in some instances, our incentives can support the building owner in providing their project investment match.
- Our solar and battery storage incentives and technical assistance can similarly be combined with PCEF funding in homes, commercial buildings and community severe weather response facilities.
- We can bring to the table our technical knowledge of equipment efficiency and reliability, solar+storage systems, new construction and existing building characteristics, project finances and technical analysis, and market channels and contractor networks.
- We understand that to reach people of color and customers experiencing low incomes, our role in projects will be to support community partners—some of them PCEF grantees already—in serving them. PCEF's investments in mini grants and the innovative community-based organization (CBO) capacity building program will be critical resources for community organizations. By leveraging those investments, we may be able to provide higher incentive amounts to homeowner-occupied and rental properties that are directly served by a community partner. We also offer a modest grant opportunity to community-based organizations to help them learn about the energy industry and Energy Trust.

As we prepare our 2024-2025 budget and action plan, we value ongoing discussion with PCEF staff and the broader PCEF community about how we can better align our approaches with the actions and grant programs that will flow from the Climate Investment Plan. While Energy Trust has some limits on what incentives we can offer to customers, we are exploring new partnerships models, fielding pilots to explore no-cost investments for customers experiencing energy burdens and offering enhanced incentives alongside our standard incentives in Portland.

We view the following as areas where Energy Trust and PCEF can work together through planning and sharing information, aligning program requirements, conducting joint outreach and marketing, or combining funding and supporting implementation partners:

- Preserving efficiency and renewable energy investments in multifamily construction and major retrofits so that these long-term investments aren't value-engineered out of projects, including by working with regulated affordable housing providers and developers
- Working to overcome the owner/renter split incentive in residential and commercial settings
- Finding pathways to deep home retrofits and solar installations for homeowners and renters experiencing lower incomes, aided by PCEF's decision to invest in home health, safety and pre-retrofit repairs

- Addressing small businesses' financial hardships, which have been significantly exacerbated by the COVID-19 pandemic, by investing in businesses and the buildings they occupy
- Preparing community gathering places to provide shelter during extreme weather events and reducing or eliminating the costs of efficiency and solar+storage investments required to make these safe spaces climate resilient
- Co-investing in CBO capacity building, workforce development and ongoing training and education

While we can draw from our experience delivering clean energy programs, we are committed to new approaches and offers that center racial equity and environmental justice in order to meet the energy needs of the customers we serve.

Thank you for the opportunity to provide our feedback through the Climate Investment Plan process and for staff's openness to ongoing discussions. At Energy Trust, we are eager to work with PCEF and to achieve clean and affordable energy for all.

Sincerely,

Tracy Scott Director of Energy Programs tracy.scott@energytrust.org