CITY OF MENLO PARK

REGULAR MEETING AGENDA

Date: **7/21/2021**
Time: **6:00 p.m.**
Regular Meeting Location: Zoom.us/join – ID# 915 4675 0502

NOVEL CORONAVIRUS, COVID-19, EMERGENCY ADVISORY NOTICE
On March 19, 2020, the Governor ordered a statewide stay-at-home order calling on all individuals living in the State of California to stay at home or at their place of residence to slow the spread of the COVID-19 virus. Additionally, the Governor has temporarily suspended certain requirements of the Brown Act. For the duration of the shelter in place order, the following public meeting protocols will apply.

Teleconference meeting: All members of the Environmental Quality Commission, city staff, applicants, and members of the public will be participating by teleconference. To promote social distancing while allowing essential governmental functions to continue, the Governor has temporarily waived portions of the open meetings act and rules pertaining to teleconference meetings. This meeting is conducted in compliance with the Governor Executive Order N-25-20 issued March 12, 2020, and supplemental Executive Order N-29-20 issued March 17, 2020.

- How to participate in the meeting
  - Access the special meeting real-time online at:
    Zoom.us/join – Special Meeting ID 915 4675 0502
  - Access the meeting real-time via telephone at:
    (669) 900-6833
    Meeting ID 915 4675 0502
    Press *9 to raise hand to speak

Subject to Change: Given the current public health emergency and the rapidly evolving federal, state, county and local orders, the format of this meeting may be altered or the meeting may be canceled. You may check on the status of the meeting by visiting the City's website www.menlopark.org. The instructions for logging on to the Zoom webinar and/or the access code is subject to change. If you have difficulty accessing the Zoom webinar, please check the latest online edition of the posted agenda for updated information (menlopark.org/agenda).

Regular Session (Zoom.us/join – ID# 915 4675 0502)

A. Call To Order

B. Roll Call – Elkins, Evans, Gaillard, Kabat, London, Payne, Price

C. Public Comment

The public may address the Environmental Quality Commission (EQC) on any subject not listed on the agenda. Each speaker can make public comment for a limit of three minutes once. The EQC cannot act on items not listed on the agenda other than to provide general information.

D. Regular Business

D1. Approve May 19 2021 minutes (Attachment)

D2. Select chair and vice chair

D3. Review and discuss 2030 climate action plan progress report (Staff Report #21-004-EQC)

D4. Review and discuss cost effectiveness and policy options report to electrify existing buildings (climate action plan No. 1 strategy) (Staff Report #21-005-EQC)

E. Reports and Announcements

E1. Reports and Announcements from staff and commissioners

F. Adjournment

At every Regular Meeting of the Commission, in addition to the Public Comment period where the public shall have the right to address the Commission on any matters of public interest not listed on the agenda, members of the public have the right to directly address the Commission on any item listed on the agenda at a time designated by the Chair, either before or during the Commission's consideration of the item.

At every Special Meeting of the Commission, members of the public have the right to directly address the Commission on any item listed on the agenda at a time designated by the Chair, either before or during consideration of the item.

For appeal hearings, appellant and applicant shall each have 10 minutes for presentations.

If you challenge any of the items listed on this agenda in court, you may be limited to raising only those issues you or someone else raised at the public hearing described in this notice, or in written correspondence delivered to the City of Menlo Park at, or prior to, the public hearing.

Any writing that is distributed to a majority of the Commission by any person in connection with an agenda item is a public record (subject to any exemption under the Public Records Act) and is available by request by emailing the city clerk at jaherren@menlopark.org. Persons with disabilities, who require auxiliary aids or services in attending or participating in Commission meetings, may call the City Clerk's Office at 650-330-6620.

Agendas are posted in accordance with Government Code §54954.2(a) or §54956. Members of the public can view electronic agendas and staff reports by accessing the City website at menlopark.org/agenda and can receive email notification of agenda and staff report postings by subscribing to the "Notify Me" service at menlopark.org/notifyme. Agendas and staff reports may also be obtained by contacting City Clerk at 650-330-6620. (Posted:07/16/2021)

REGULAR MEETING MINUTES – DRAFT

Date: 5/19/2021
Time: 6:00 p.m.
Special Meeting Location: Zoom.us/join – ID# 915 4675 0502

A. Call to Order

Vice Chair London called the meeting to order at 6:02 p.m.

B. Roll Call

Present: Elkins, Gaillard, Kabat, London, Martin (exited meeting at 7:06 p.m.), Price (arrived at 6:15 p.m. and exited at 8:06 p.m.), Payne
Absent: None
Staff: Rebecca Lucky- Sustainability Manager

C. Public Comment

None.

D. Regular Business

D1. Approve April 21 2021 minutes

Vice Chair London introduced item.

ACTION: Motion and second (Gaillard/ Elkins) to approve April 21 2021 minutes with correction to report out from Commissioner Elkins, passed (6-0-1, Price absent).

D2. Informational update from Canopy on the tree-planting permit conditions resulting from 1000 El Camino Real Heritage Tree Removal Permit

Christian Bonner introduced the item. Canopy Executive Director Catherine Martineau and Canopy Forestry Manager Maya Briones made the presentation (Attachment).

- Peter Edmonds spoke in support of former Mayor Mueller's coloration with the permit applicant to increase tree replacements.
- Judy Rocchio spoke in support of an increase in more native species planted, support for former Mayor Mueller's efforts, and requested a progress report on the Willow/101 interchange tree-planning project.

D3. Amend the Environmental Quality Commission's work plan to include consideration and recommendation of a gas-powered leaf blower ordinance in 2021.

Sustainability Manager Rebecca Luck introduced the item.

- Judy Rocchio spoke on concerned related to the quality of life and health for labor force, community, and plants and requested a ban of leaf blowers.
- Randy Avalos spoke in support on a ban of leaf blowers.

ACTION: Motion and second (Elkins/ Kabat) to amend work plan as proposed with additional context regarding minimal greenhouse gas emissions reductions associated but leaf blowers activities do increase lung irritants and poor air quality, and create a subcommittee consisting of Commissioner Elkins to review this matter and provide advice to the commission, passed 6-0-1 (Martin absent) (Attachment).

D4. Discuss Climate Action Plan Subcommittee's recommendations for climate action in fiscal year 2021-22

Commissioner Gaillard and Kabat provided a presentation to commission (Attachment).

ACTION: Motion and second (Elkins/ London) to approve forwarding subcommittee's recommendations to the City Council with memo, passed 5-0-2 (Martin and Price absent).

D5. Discuss rescheduling June 16, 2021, Environmental Quality Commission Meeting

Sustainability Manager introduced the item.

ACTION: By acclamation, the Commission reached consensus on two alternative dates: June 10 and June 30, 2021, passed 5-0-2 (Martin and Price absent).

E. Reports and Announcements

E1. Reports and Announcements from staff and commissioners

Commissioner Gaillard shared information about the Department of Motor Vehicles data and reported new electric vehicle registrations are on the rise.

Commissioner Kabat shared information on legislation.

Sustainability Manager Rebecca Lucky provided updates on Climate action plan progress report, climate action plan strategy No. 1 progress, and progress on the request for proposals process for a renewable microgrid at the new community center (Menlo Park Community Campus).

F. Adjournment

Chair Price adjourned the meeting at 8:25 p.m.

Rebecca Lucky, Sustainability Manager

62 Trees for Menlo Park

Canopy Update For EQC - May 19, 2021

CITY OF MENLO PARK

CANOPY

Catherine Martineau, Executive Director
Maya Briones, Community Forestry Manager

JB Matteson

SARES REGIS Northern California

Progress Update

Project Goals: 62 trees

- Twenty-two (22), twenty-four inch (24”) box trees shall be planted at Burgess (Civic Center) and Kelly Park (Belle Haven neighborhood.)
- Forty (40) trees, at a minimum size of number 15 (15 gallon) nursery container, or twenty-four inch boxes, wherever possible, shall be planted in the Belle Haven neighborhood and near vicinity.

Delivered: 33 trees

- 19 24”-box trees planted at Burgess Park and Hamilton Park
- 14 15-gal in the Belle Haven neighborhood

Burgess Park March 27, 2021

- Menlo Park Arbor Day celebration
- Ceremonial Mayor’s tree
  - Valley Oak
- COVID-safe volunteer event
  - 12 24”-box native trees planted
  - 20 community volunteers

Matt Matteson, Christian Bonner, Scott Johnson,
Starla Jerome Robinson, Josie Gaillard, Catherine Martineau,
Mayor Drew Combs

Hamilton Park

February 27 and April 10, 2021

- 7 24”-box trees planted
- 20 community volunteers
- Nice coverage by Susan Erhart, of bellehavennews.com

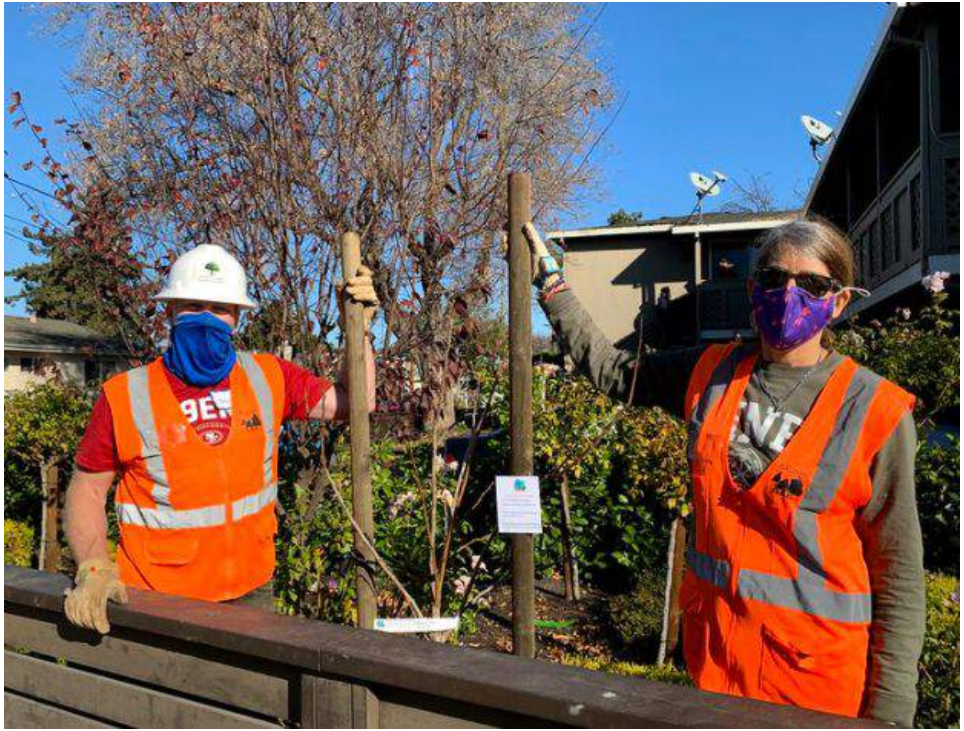

HAMILTON PARK
CITY OF MENLO PARK






Pierce Road
12/19/2020

- In partnership with Menlo Park engineering, Canopy planted trees along the newly renovated Pierce Road
- 14 trees planted
- 12 community volunteers



Completion Plan

- 29 trees
- Obtained extension to 12/31/21
- All trees in Belle Haven
  - Belle Haven Elementary
  - All Five Preschool
  - Street trees
    - Canvass neighborhoods

Questions and Comments

CITY OF MENLO PARK

Commission work plan guidelines

Step 1 Review purpose of Commission as defined by Menlo Park City Council Policy 3-13-01.

Step 2 Develop a mission statement that reflects that purpose.

Step 3 Discuss and outline any priorities established by City Council.

Step 4 Brainstorm goals, projects, or priorities of the Commission and determine the following:

A. Identify priorities, goals, projects, ideas, etc.
B. Determine benefit, if project or item is completed
C. Is it mandated by State of local law or by City Council direction?
D. Would the task or item require a policy change at City Council level?
E. Resources needed for completion? (Support staff, creation of subcommittees, etc.)
F. Completion time? (1-year, 2-year, or longer term?)
G. Measurement criteria? (How will you know you are on track? Is it effective? Etc.)

Step 5 Prioritize projects from urgent to low priority.

Step 6 Prepare final work plan for submission to City Council for review and approval in the following order:

- Work plan cover sheet, listing of members, priority list, work plan worksheet – Steps 1 through 8.

Step 7 Use your "approved" work plan throughout the term of the plan as a guide to focus in on the work at hand.

Step 8 Report out on work plan priorities to the City Council, which should include:

A. List of "approved" priorities or goals
B. Status of each item, including any additional resources required in order to complete
C. If an item that was on the list is not finished, then indicate why it didn't occur and list out any additional time and/or resources that will be needed in order to complete

Mission Statement

The Environmental Quality Commission (EQC) is committed to helping the City of Menlo Park to be a leading sustainable city that is well positioned to manage present and future environmental impacts, including the grave threat of climate change. The Environmental Quality Commission is charged primarily with advising the City Council on matters involving environmental protection, environmental improvement, sustainability and climate change.

Commission members listing

Commissioner (Chair) Ryann Price

Commissioner (Vice Chair) Janelle London

Commissioner Leah Elkins

Commissioner Josie Gaillard

Commissioner Tom Kabat

Commissioner Deborah Martin

Commissioner James Payne

Environmental Commission
Priority List

The Environmental Quality Commission has identified the following priorities during 2021-2022:

1.	**Climate Action Plan (CAP) –** Continue to recommend/advise on implementation of the City's adopted 2030 Climate Action Plan initiatives to achieve or surpass the City's greenhouse gas (GHG) reduction target, which includes: • Adoption of an existing building electrification policy (Action #1) • Promotion of City goals for increasing EVs and decreasing gasoline sales (Action #2) • Implementation of a program or policy to expand access to EV charging for multi-family and commercial properties (Action #3) • Reduction of vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission (Action #4) • Elimination of fossil fuels from municipal operations, including fleet vehicles, gardening equipment, furnaces, water heaters, pool heaters, etc. (Action #5) • Development of a climate adaptation plan to protect the community from sea level rise and flooding (Action #6)
2.	**Urban Canopy Preservation –** Continue to recommend/advise development of a comprehensive urban canopy strategy for Menlo Park, which includes monitoring the effectiveness of the City's Heritage Tree Ordinance, hearing heritage tree appeals and consider establishing an urban canopy inventory.
3.	**Green and Sustainable Initiatives –** Support sustainability initiatives, as needs arise, which may include but not be limited to habitat protection, healthy ecology, environmental health protection, healthy air, surface water runoff quality, water conservation and waste reduction.
4.	**Gas Powered Leaf Blower Ordinance-** Recommend/advise City Council on a gas-powered leaf blower ordinance.

Environmental Quality Commission
Work Plan

Step 1

Review purpose of Commission as defined by Menlo Park City Council Policy 3-13-01	The Environmental Quality Commission is charged with advising the City Council on the following matters: • Mitigating climate change by reducing community-wide greenhouse gas emissions to zero as rapidly as possible and inspiring other cities to follow, • Preparing the community for the effects of climate change, especially the threat of sea level rise, flooding and drought, • Preserving heritage trees, maintaining the urban canopy, making determinations on appeals of heritage tree removal permits and organizing an annual Arbor Day tree planting event, • Advising on programs and policies related to all other areas of environmental sustainability, including protection of natural areas, recycling and solid waste reduction, environmentally sustainable practices, air and water pollution prevention, and water and energy conservation.

Step 2

Develop or review a mission statement that reflects that purpose	The Environmental Quality Commission (EQC) is committed to helping the City of Menlo Park to be a leading sustainable city that is well positioned to manage present and future environmental impacts, including the grave threat of climate change. The Environmental Quality Commission is charged primarily with advising the City Council on matters involving environmental protection, environmental improvement, sustainability and climate change.

Step 3

Discuss any priorities already established by City Council	• Make gains on our Climate Action Plan

Step 4 **The goals and priorities identified below are not listed in order of magnitude.*

*Brainstorm goals, projects or priorities of the Commission	Benefit, if completed	Mandated by State/local law or by City Council direction?	Required policy change at City Council level?	Resources needed for completion? Staff or creation of subcommittees?	Estimated completion time	Measurement criteria How will we know how we are doing?
Climate Action Plan (CAP) – Continue to recommend/advise on implementation of the City's adopted 2030 Climate Action Plan initiatives to achieve or surpass the City's greenhouse gas (GHG) reduction target, which includes: • Action #1: Review and recommend/advise on a policy to phase out the use of fossil fuels of existing buildings • Action #2: Advise on whether to work with BGI for promoting citywide goals of increasing EVs and decreasing gasoline sales • Action #3: Review and recommend/advise on policies and programs to increase access to EV charging for multi family and commercial properties • Action #4: Recommend that Council request CAP action #4 be included on Complete Streets	• Other cities inspired to join us in adopting bold climate action, as happened with City's all-electric Reach Code • Reduced GHG emissions • Reduced air pollution • Reduced traffic congestion • Improved public health • Increased community engagement for emissions reductions • Reduced risk of stranding fossil fuel assets • Increased equity and environmental justice • Increased preparedness for sea level rise and other climate threats • Demonstrated environmental leadership • Improved transparency on city goals and activities to meet GHG targets	Yes ☑ No ☐	Yes ☑ No ☐	• Subcommittees • Possible partnerships with organizations, businesses, other commissions • Staff time • Consultants/contractors	2 years	1. City reports progress on CAP metrics such as gasoline sales, EV registrations, natural gas sales, water heater replacements, etc. 2. City adopts policy for phasing out the use of fossil fuels in existing buildings 3. City launches program to assist multi-family and commercial building owners to install EV charging 4. Complete Streets proposes a VMT reduction goal 5. City makes progress on developing a climate adaptation plan 6. Other cities copy Menlo Park's climate policies and programs

Commission Work Plan (reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission) • Action #5: Continue to advise/recommend ways to electrify municipal buildings, fleet and landscaping equipment • Action #6: Continue to advise/recommend a climate adaptation plan to protect the community from sea level rise and flooding • Recommend 2021-22 Climate Action for Council Adoption • Advise/recommend Council support for State adoption of impactful impactful CALGreen and energy reach codes for the 2022 building code update • Continue to provide recommendations/advice that improves communication with the community about the Climate Action Plan • Recommend City strategy for sharing our policies and analysis with other cities to inspire and help others adopt bold climate action						

Urban canopy preservation – Continue to recommend/ advise development of a comprehensive urban canopy strategy for Menlo Park, which includes monitoring the effectiveness of the new Heritage Tree Ordinance, hearing heritage tree appeals, and consider establishing an urban canopy inventory. • Receive update on implementation and operation of the Heritage Tree Ordinance and recommend adjustments as needed • Research ways other cities measure health of urban forest and make a recommendation to Council	• Improved public awareness and satisfaction with Heritage Tree policies • Efficient functioning of the Heritage Tree policies	Yes ☑ No ☐	Yes ☐ No ☑	• Subcommittee • Staff time budgeted	Ongoing	• Reduction in the number of healthy trees removed • Increase in the diversity and quality of trees within the entire urban canopy • Improved coordination with the planning process • Deliver recommendation on conducting inventory and catalogue of urban tree canopy
Green and sustainable initiatives – Support sustainability initiatives, as needs arise, which may include but not be limited to habitat protection, healthy ecology, environmental health protection, healthy air, surface water runoff quality, water conservation and waste reduction. • Develop recommendation for pesticide posting ordinance • Support initiatives improving air and water quality	• Reduced cases of asthma • Clean air • Clean water • Reduced environmental impacts on health • Reduced exposure to pollutants • More efficient water usage • Critical habitat preserved • Less waste generated	Yes ☑ No ☐	Yes ☑ No ☐	• Create Subcommittee, if needed	Ongoing	• Council and community view Commission as responsive to environmental concerns

• Support initiatives protecting environmental health • Support initiatives that reduce waste • Support initiatives that conserve water • Support initiatives that improve the quality of water runoff in the City						
Gas Powered Leaf Blower Ordinance- Recommend/advise City Council on a gas-powered leaf blower ordinance.	• Clean air • Reduced exposure to pollutants • Improved public health	Yes ☑ No ☐	Yes ☑ No ☐	• Subcommittee	1 year	Recommendation provided to City Council

Step 5

List identified goals, priorities and/or tasks for the Commission	**Prioritize tasks by their significance			
	1 Urgent	2 1-year	3 2-year	4 Long term
Climate Action Plan (CAP) – Continue to recommend/advise on implementation of the City's adopted 2030 Climate Action Plan initiatives to achieve or surpass the City's greenhouse gas (GHG) reduction target.	• Action #1: Review and recommend/advise on policies to phase out the use of fossil fuels of existing buildings • Action #2: Advise on whether to work with BGI to promote citywide goals of increasing EVs and decreasing gasoline sales • Action #4: Recommend that Council request CAP action #4 be included on Complete Streets Commission Work Plan (reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission) • Recommend 2021-22 Climate Action for Council Adoption	• Action #3: Review and recommend/advise on policies and/or programs to increase access to EV charging for multi family and commercial properties • Action #5: Continue to provide recommendations/advice to electrify municipal buildings, fleet and landscaping equipment • Advise/recommend Council support for State adoption of impactful impactful CALGreen and energy reach codes for the 2022 building code update	• Action #6: Continue to provide recommendations/advice in developing a climate adaptation plan to protect the community from sea level rise and flooding • Continue to provide recommendations/advice on new climate actions to be adopted by Council in 2021	• Continue to provide recommendations/advice that improves communication with the community about the Climate Action Plan • Recommend City strategy for sharing our policies and analysis with other cities to inspire and help others adopt bold climate action
	• Track citizen concerns on large	• Receive update on operation and	• Provide advice on developing an urban	

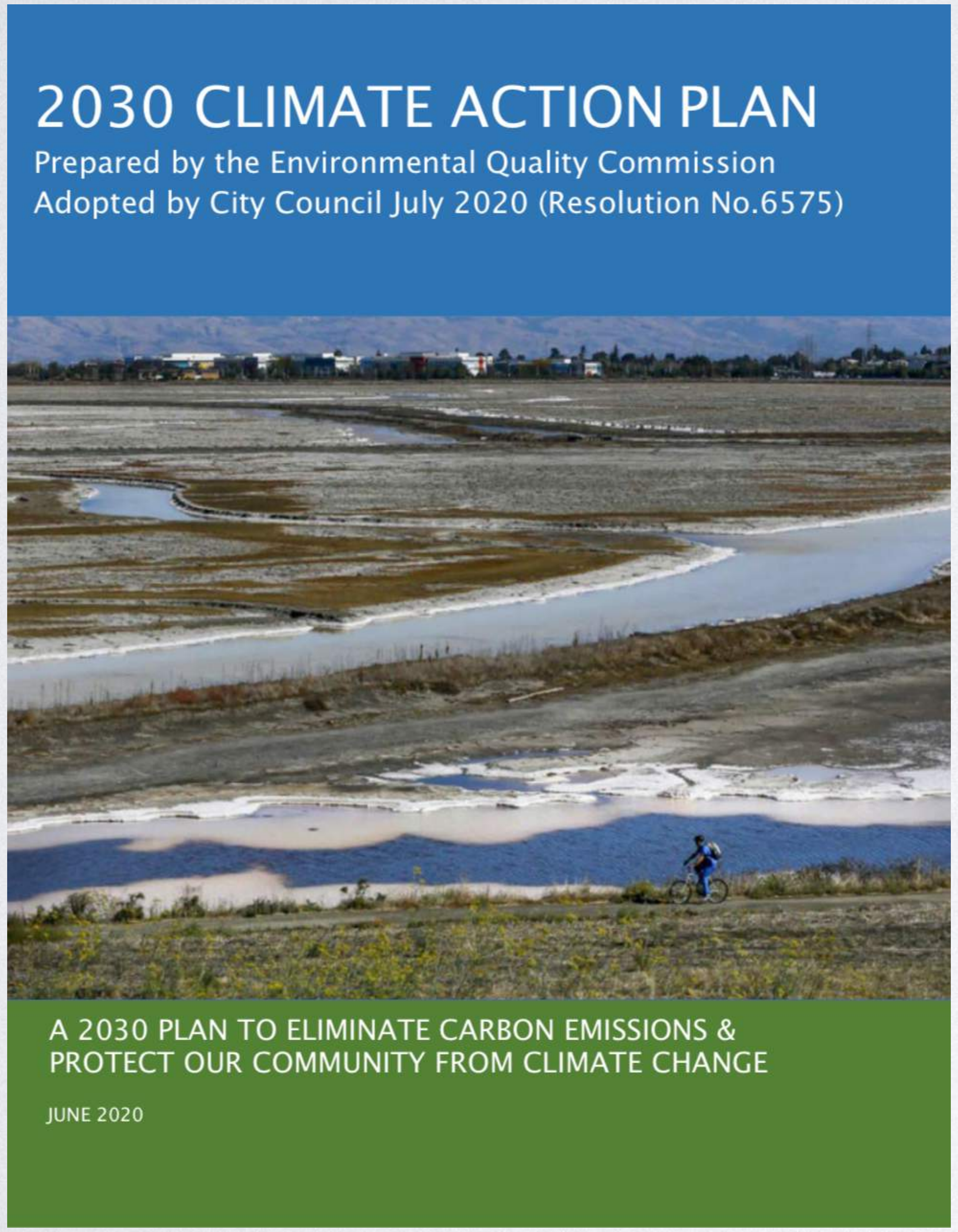
Urban canopy preservation – Continue to recommend/ advise development of a comprehensive urban canopy strategy for Menlo Park, which includes monitoring the effectiveness of the new Heritage Tree Ordinance, hearing heritage tree appeals, and consider establishing an urban canopy inventory.	scale tree removal projects and provide advice on future policy improvements as it relates to tree removals	implementation of the Heritage Tree Ordinance and recommend adjustments as needed	forest master plan to City Council	
Green and sustainable initiatives – Support sustainability initiatives, as needs arise, which may include but not be limited to habitat protection, healthy ecology, environmental health protection, healthy air, surface water runoff quality, water conservation and waste reduction.				• Develop recommendation for pesticide posting ordinance • Support initiatives improving air and water quality • Support initiatives protecting environmental health • Support initiatives that reduce waste • Support initiatives that conserve water • Support initiatives that improve the quality of water runoff in the City
Gas Powered Leaf Blower Ordinance- Recommend/advise City Council on a gas-powered leaf blower ordinance.		• Form a subcommittee • Prepare recommendation to City Council and receive further direction		

Step 6 Prepare final work plan for submission to the City Council for review, possible direction and approval and attach the Worksheets used to determine priorities, resources and time lines.

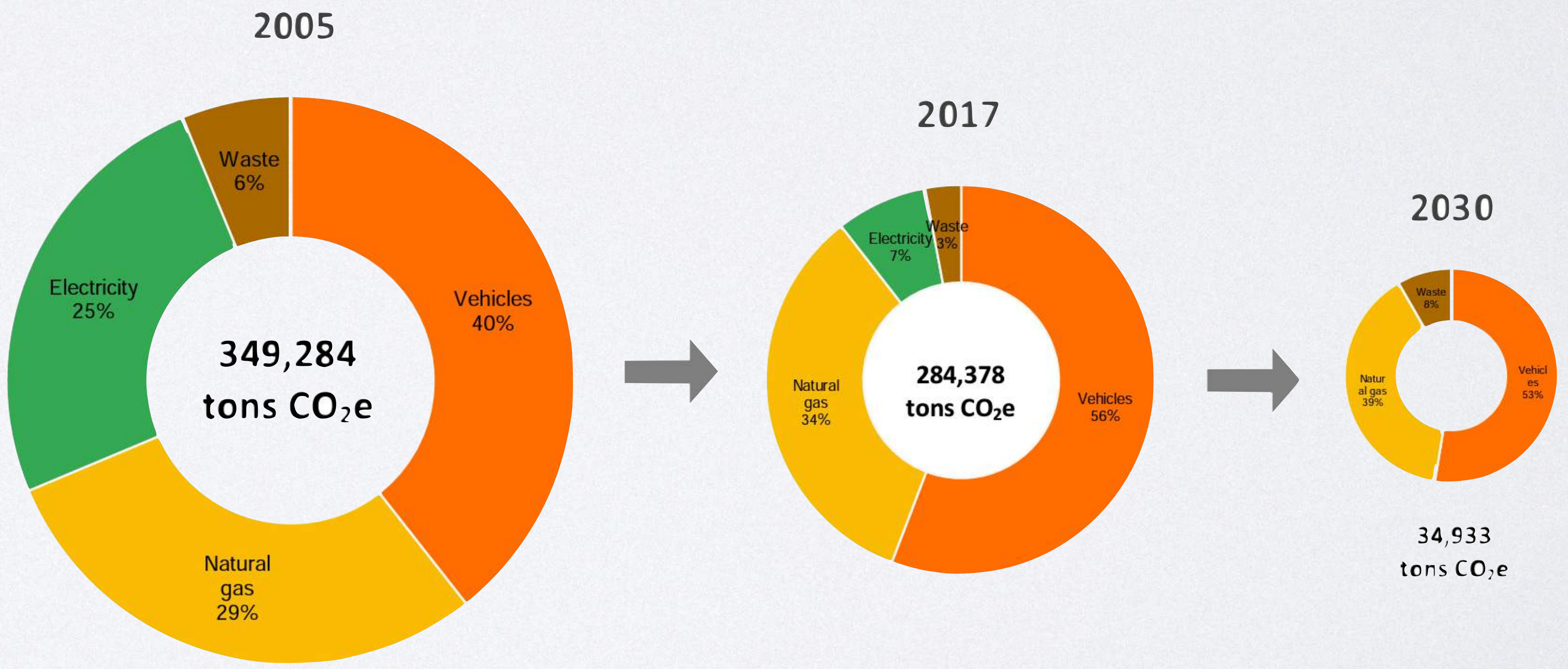
Step 7 Once approved; use this plan as a tool to help guide you in your work as an advisory body.

Step 8 Report out on status of items completed. Provide any information needed regarding additional resources needed or And to indicate items that will need additional time in order to complete.

CLIMATE ACTION PLAN



- Adopted by Menlo Park City Council in July 2020
- Sets a goal of 90% reduction in GHG by 2030 and elimination of the remaining 10% through direct carbon removal
- **Plan paired down due to pandemic budget cuts**

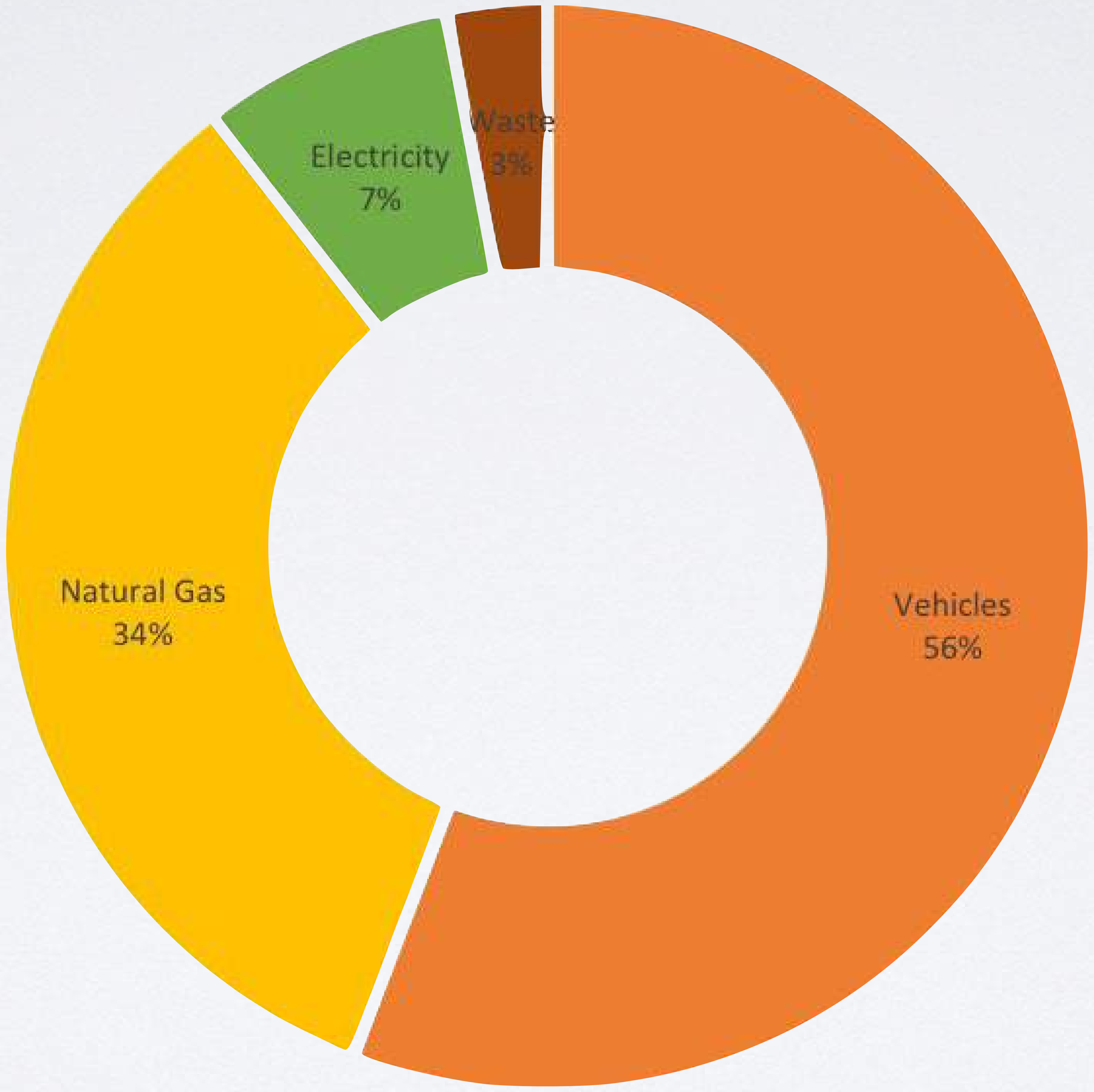


MENLO PARK CAP 2020-21

#	Action	2030 GHG Reduction (tons/yr)
1	Explore policy/program options to convert 95% of existing buildings to all-electric by 2030	1) 86,465 OR 2) 51,636
2	Set citywide goals for increasing EVs and decreasing gasoline sales	7,120
3	Expand access to EV charging	7,370
4	Reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission	31,743
5	Eliminate the use of fossil fuels from municipal operations	879
6	Develop a climate adaptation plan to protect the community from sea level rise and flooding	0
		98,748

GHG EMISSIONS PROFILE

for Menlo Park

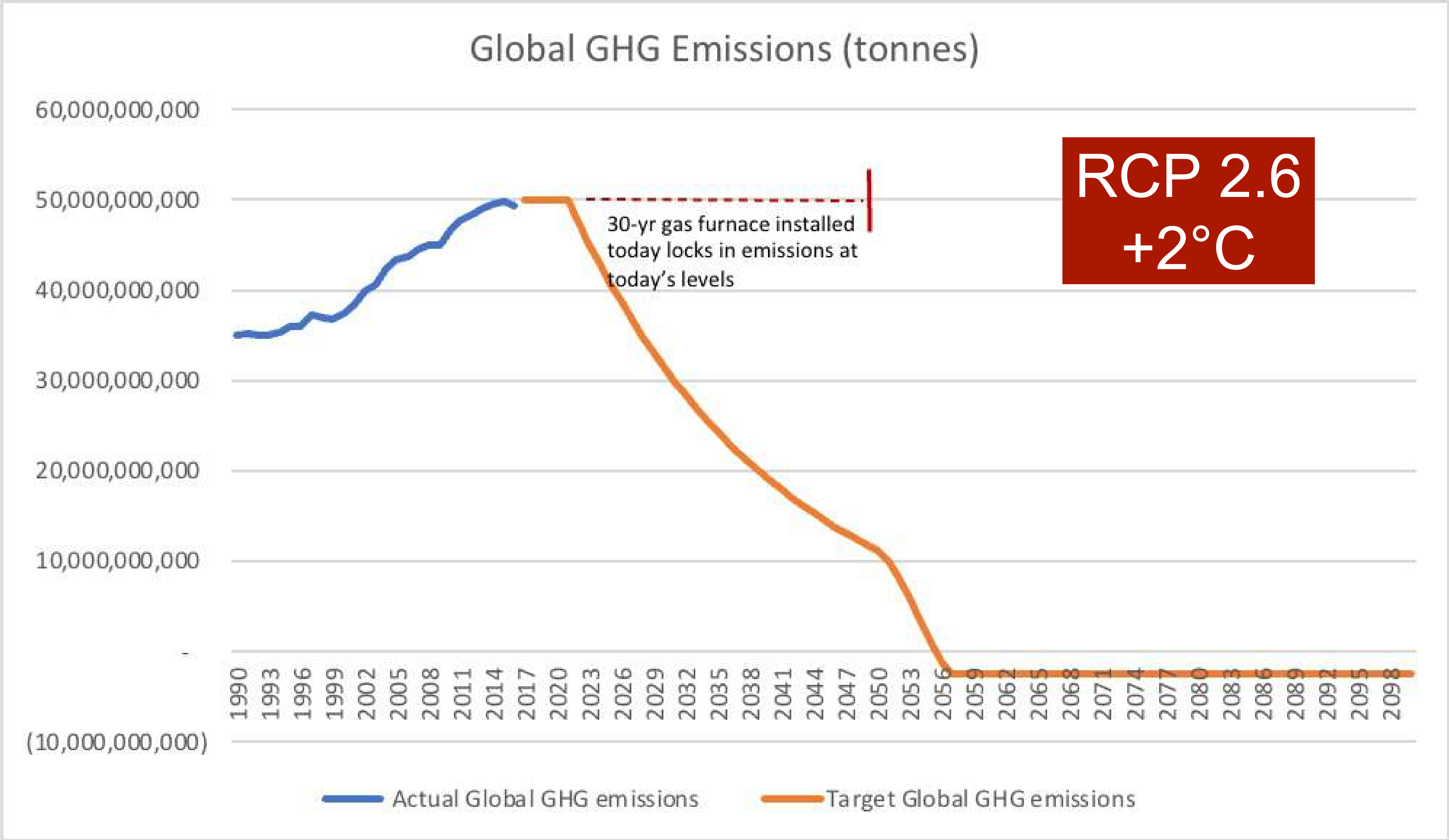


Source: City of Menlo Park December 2019 Staff CAP report

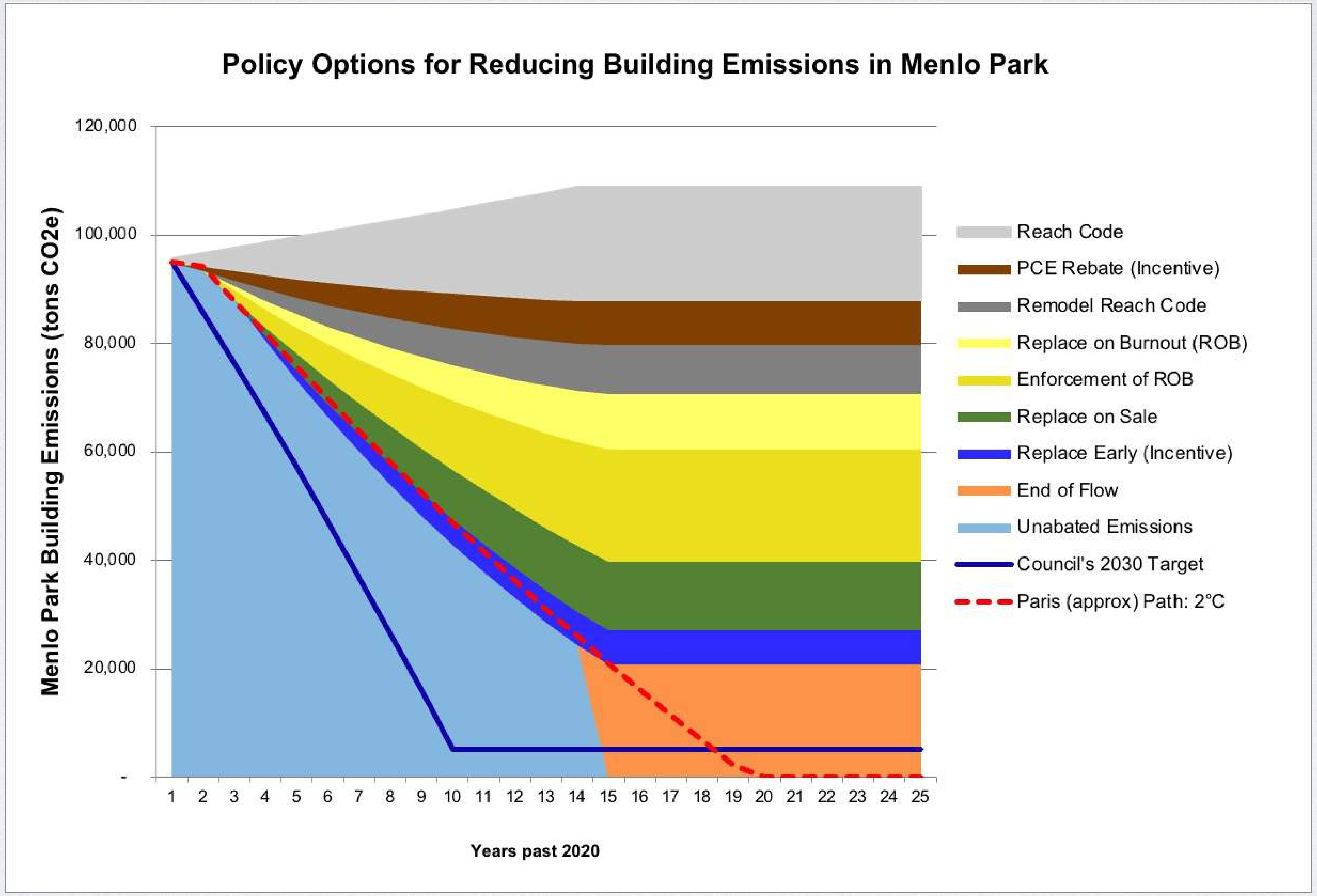
NOT ON TRACK TO MEET GOALS

- Menlo Park is not currently on track to meet adopted climate goals
- Not on track for GHG cuts required for 1.5°C
- Not on track for GHG cuts required for 2.0°C
- Not on track to meet Paris Climate Agreement goals

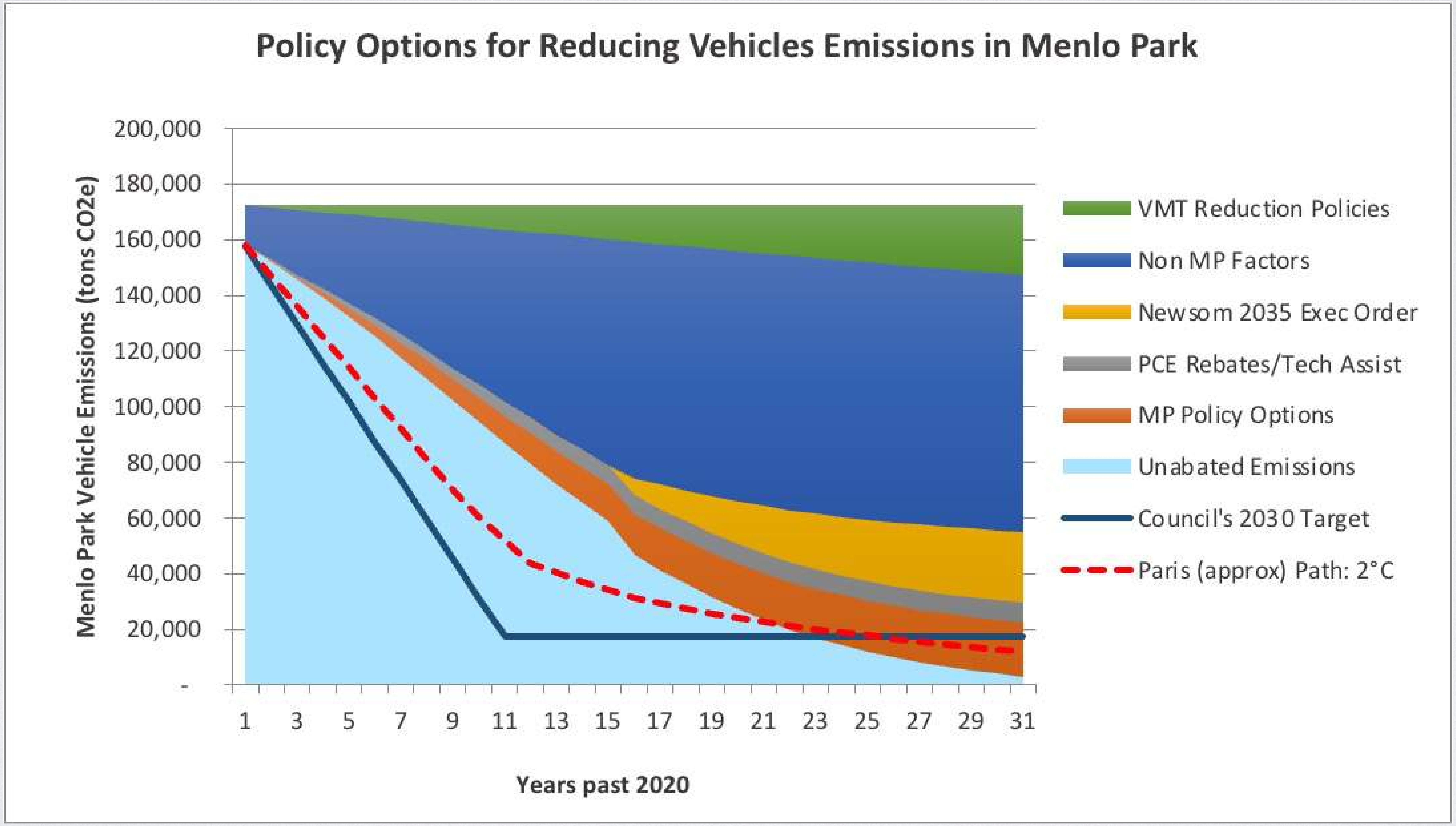
OUR ONLY PATH REMAINING TO 2°C



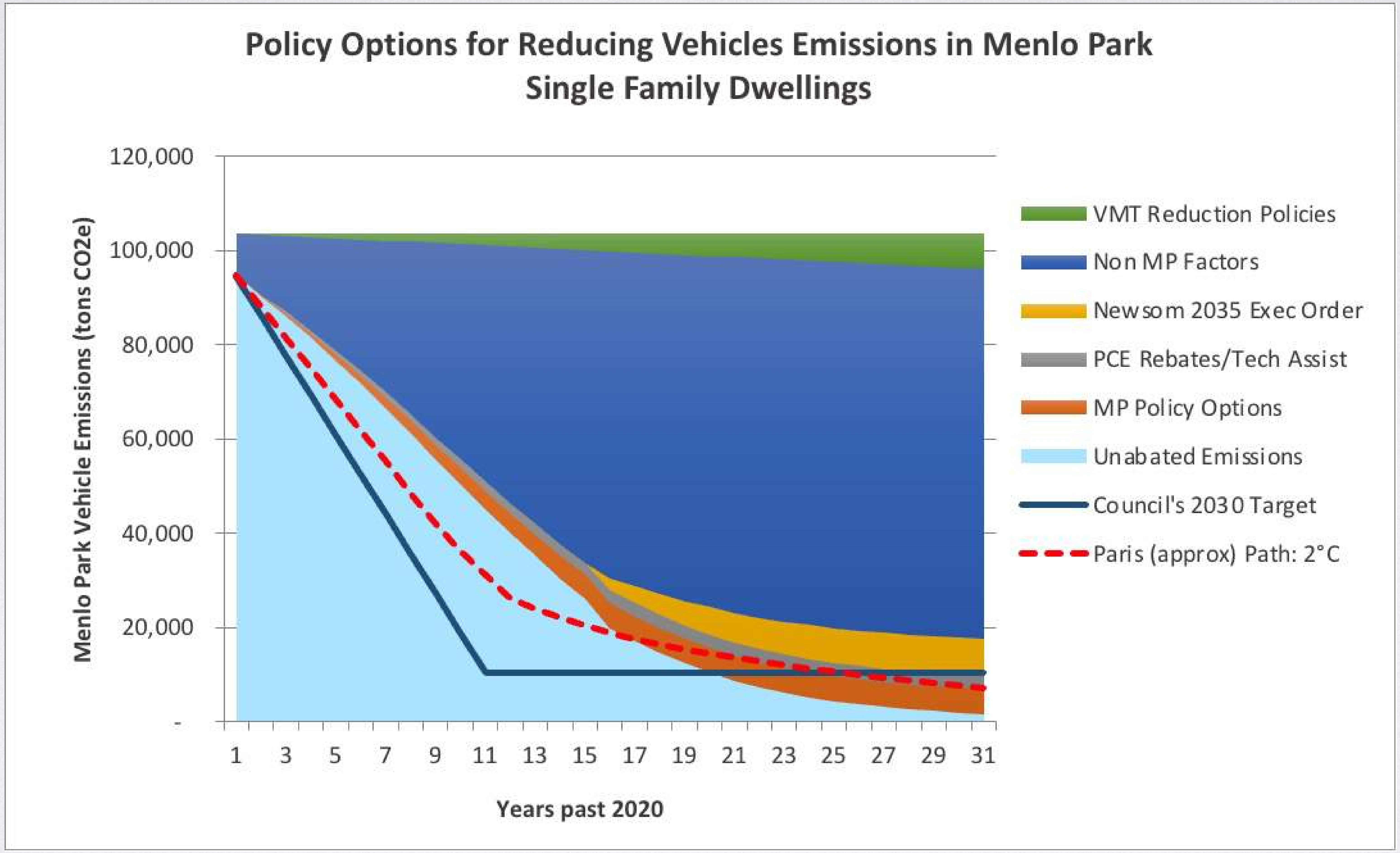
RAPID, BOLD ACTION REQUIRED FOR BUILDINGS



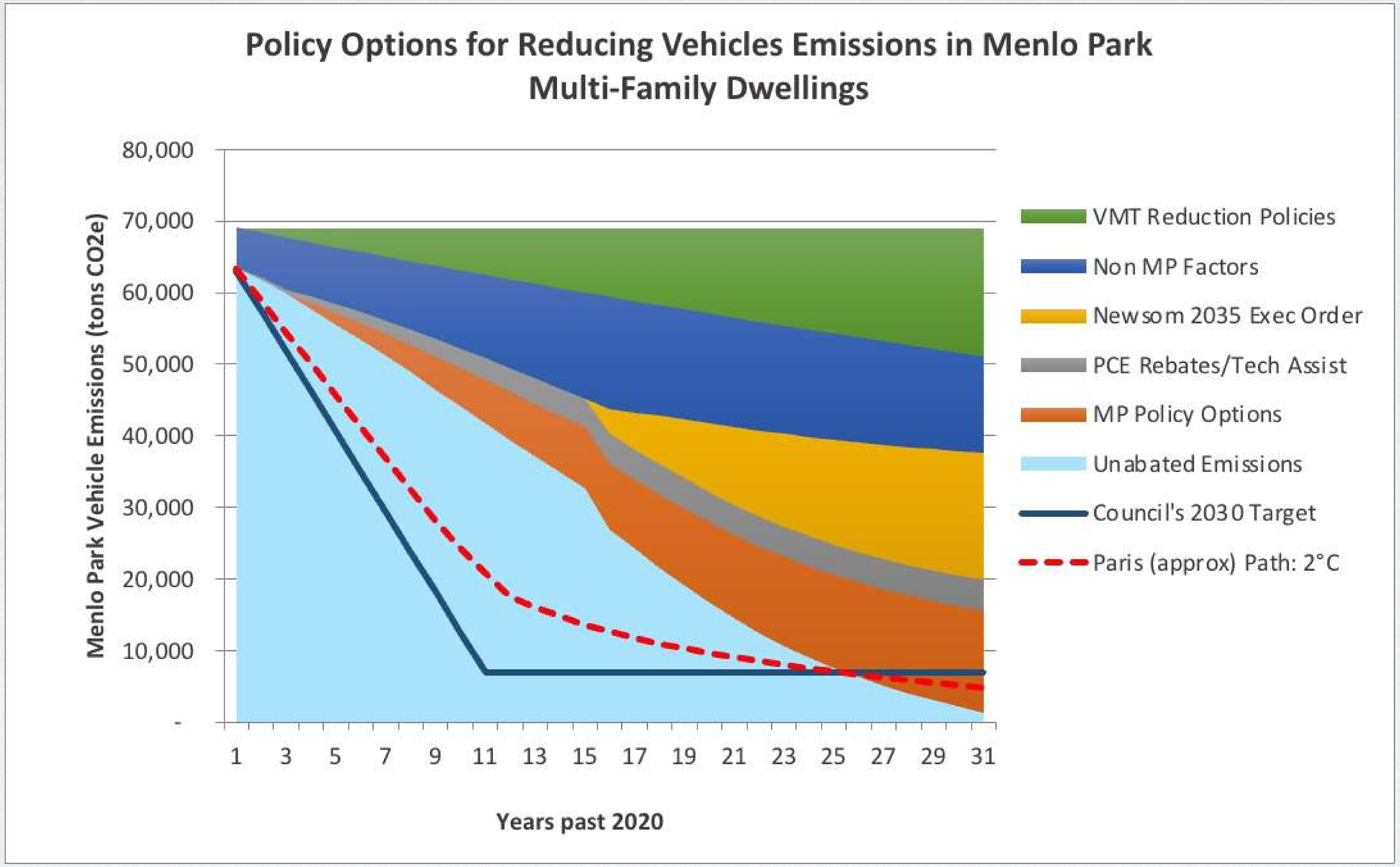
ACTIONS FOR VEHICLE EMISSIONS



SINGLE FAMILY HOMES CONVERTING TO EVS



MULTI-FAMILY DWELLINGS NEED SUPPORT TO CONVERT



PROPOSED GOALS FOR 90X30

- Goal #1: Reduce emissions from buildings by 90% by 2030
- Goal #2: Reduce emissions from vehicles by 90% by 2030
- Goal #3: Reduce emissions from waste by 90% by 2030
- Goal #4: Implement programs to sequester remaining emissions in 2030, equivalent to 10% of 2005 emissions
- Goal #5: Develop climate adaptation plans to protect portions of Menlo Park that are threatened by climate collapse
- Goal #6: Reduce emissions from construction 90% by 2030

NEED A POST-COVID PLAN

CAP Goal	Actions	#	Staff Skills Required	Policy	Legal	Engineering	Building Science	Building Codes	Energy Analytics	Urban Planning/Aboriculture	Finance	Economics	Climate Damage Analysis	Public Relations	Marketing	Stakeholder Engagement	Organizational Design	Process Improvement	Information Technology	Dept	Sustainability	Legal	Public Works	Planning	Public Engagement	Information Technology	Skills Gaps	2020-21	2021-22	Beyond 2022	CAP Goal #
#1 Reduce emissions from buildings by 90% by 2030	Research and analyze CAP #1 policy options	1	Policy, engineering, building science, quantitative analysis, finance	x		x	x		x		x									Sustainability	x						Engineering, building science, quantitative analysis, finance	x			1
	Analyze cost effectiveness of CAP #1 policies	2	Finance, economics, energy analytics, building science, climate damage analysis	x		x	x		x		x	x	x			x				Sustainability	x						Finance, economics, energy analytics, building science, climate damage analysis	x			1
	Analyze legal implications of policies	3	Legal, policy	x	x			x												Legal		x						x			1
	Conduct community outreach for CAP #1 policies	4	Public relations, marketing, market analysis, stakeholder engagement, engineering, finance			x					x			x	x	x				Public Engagement, Sustainability	x				x		Engineering, finance, market analysis		x		1
	Draft policies and related code language	5	Legal, policy, code enforcement, engineering, finance	x	x	x		x			x									Legal, Planning (Building Dept), Sustainability	x	x		x					x		1
	Develop plan for enforcing CAP #1 policies	6	Organizational design, change management, building codes expertise					x									x		x	Planning (Building Dept), Sustainability	x			x			Organizational design, change management		x		1
	Simplify permit application and process for electrification	7	Process improvement, change management, information technology (Accela system design), building codes expertise					x									x	x	x	Planning (Building Dept), Information Technology, Sustainability	x			x		x	Process improvement, change management		x		1
	Create and implement electrification plan for all municipal buildings	8	Engineering, finance, building science, energy analytics			x	x	x	x		x		x	x						Public Works, Sustainability	x		x				Energy analytics, climate damage analysis, economics		x		1

GOAL #2

CAP Goal	Actions	#	Staff Skills Required	Policy	Legal	Engineering	Building Science	Building Codes	Energy Analytics	Urban Planning/Aboriculture	Finance	Economics	Climate Damage Analysis	Public Relations	Marketing	Stakeholder Engagement	Organizational Design	Process Improvement	Information Technology	Dept	Sustainability	Legal	Public Works	Planning	Public Engagement	Information Technology	Skills Gaps	2020-21	2021-22	Beyond 2022	CAP Goal #
#2 Reduce emissions from vehicles by 90% by 2030	Explore and implement policies/programs to increase employer-based EV charging	9	Policy, legal, engineering, urban planning, energy analytics, finance, stakeholder engagement	x	x	x			x	x	x					x				Sustainability, Planning, Legal, Public Engagement	x	x		x	x		Engineering, energy analytics, finance		x		2
	Explore and implement policies/programs to increase EV charging at multi-family buildings	10	Policy, legal, engineering, urban planing, energy analytics, finance, stakeholder engagement	x	x	x			x	x	x					x				Sustainability, Planning, Legal, Public Engagement	x	x		x	x		Engineering, eergy analytics, finance		x		2
	Develop clear network of protected pedestrian/bike paths throughout town in order to reduce VMT	11	Engineering, urban planning, stakeholder engagement			x				x						x				Sustainability, Planning (Transportation), Public Works, Public Engagement	x		x	x	x		Multi-modal transportation engineer			x	2
	Explore and implement policies to both concentrate, and increase the density of, development near transit in order to reduce VMT	12	Engineering, urban planning, stakeholder engagement		x	x				x						x				Sustainability, Legal, Planning (Transportation), Public Engagement	x	x		x	x				x		2
	Explore other policies/ programs to reduce gasoline sales and usage	13	Policy, legal, engineering, finance, stakeholder engagement	x	x	x					x					x				Sustainability, Planning, Legal, Public Engagement	x	x		x	x		Engineering, Finance		x		2
	Explore policies/programs to convert commercial fleet vehicles to EV	14	Policy, legal, engineering, energy analytics, finance, stakeholder engagement	x	x	x			x		x					x				Sustainability, Planning (Transportation), Public Engagement	x			x	x		Engineering, energy analytics, finance			x	2
	Implement municipal fleet vehicle electrification plan	15	Engineering, energy analytics, finance			x			x		x									Public Works, Sustainability, Planning (Transportation)	x		x	x			Engineering, energy analytics, finance		x		2

GOAL #3

CAP Goal	Actions	#	Staff Skills Required	Policy	Legal	Engineering	Building Science	Building Codes	Energy Analytics	Urban Planning/Aboriculture	Finance	Economics	Climate Damage Analysis	Public Relations	Marketing	Stakeholder Engagement	Organizational Design	Process Improvement	Information Technology	Dept	Sustainability	Legal	Public Works	Planning	Public Engagement	Information Technology	Skills Gaps	2020-21	2021-22	Beyond 2022	CAP Goal #
#3 Reduce emissions from waste by 90% by 2030	Explore policies and programs to expand recycling and composting services to multi-family housing dwellers	16	Policy, legal, engineering, stakeholder engagement	x	x	x										x				Sustainability, Legal, Stakeholder Engagement	x	x								x	3
	Identify and tightly manage methane emissions from all local sources, inc. landfills, waste water treatment facility, etc.	17	Engineering, climate damage analysis, finance			x					x		x							Sustainability, Public Works	x		x				Engineering, finance, climate damage analysis			x	3
	Explore policies/programs to promote a circular economy	18	Policy, legal, engineering, finance, stakeholder engagement	x	x	x					x					x				Sustainability, Legal, Public Engagement	x	x			x		Engineering, Finance			x	3
	Explore policies/programs to reduce plastic waste	19	Policy, legal, stakeholder engagement	x	x						x					x				Sustainability, Legal, Public Engagement	x	x			x		Finance			x	3
	Adopt Foodware Ordinance to reduce/ eliminate plastics and singl use disposable foodware	20	Policy, legal, stakeholder engagement	x	x						x					x				Sustainability, Legal, Public Engagement	x	x			x		Finance			x	3
	Update waste requirements in Construction and Demolition Ordinance	21	Policy, legal, stakeholder engagement	x	x						x					x				Sustainability, Legal, Public Engagement	x	x			x		Finance			x	3

GOAL #4

CAP Goal	Actions	#	Staff Skills Required	Policy	Legal	Engineering	Building Science	Building Codes	Energy Analytics	Urban Planning/Aboriculture	Finance	Economics	Climate Damage Analysis	Public Relations	Marketing	Stakeholder Engagement	Organizational Design	Process Improvement	Information Technology	Dept	Sustainability	Legal	Public Works	Planning	Public Engagement	Information Technology	Skills Gaps	2020-21	2021-22	Beyond 2022	CAP Goal #
#4 Implement programs to sequester 10% of emissions by 2030	Explore and implement policies/programs to sequester 35,000 tons/ year of CO2e by 2030	22	Policy, engineering, climate damage analysis, finance	x		x					x		x							Sustainability, Public Works, Public Engagement	x		x		x		Engineering, finance, climate damage analysis		x		4
	Explore partnership w/ local land conservation trusts (e.g. POST) to sequester carbon on local lands with afforestation, regenerative agriculture or biochar generation	23	Policy, engineering, climate damage analysis, finance	x		x					x		x							Sustainability, Public Works, Public Engagement	x		x		x		Engineering, finance, climate damage analysis			x	4
	Explore and implement policies/programs to sequester carbon in building materials, such as concrete	24	Policy, legal, engineering, building science, building codes, climate damage analysis, finance, stakeholder engagement, public relations, marketing, information technology	x	x	x		x			x			x	x	x			x	Sustainability, Legal, Planning, Public Engagement, Information Technology	x	x		x	x	x	Engineering, Finance			x	4

GOAL #5

CAP Goal	Actions	#	Staff Skills Required	Policy	Legal	Engineering	Building Science	Building Codes	Energy Analytics	Urban Planning/Aboriculture	Finance	Economics	Climate Damage Analysis	Public Relations	Marketing	Stakeholder Engagement	Organizational Design	Process Improvement	Information Technology	Dept	Sustainability	Legal	Public Works	Planning	Public Engagement	Information Technology	Skills Gaps	2020-21	2021-22	Beyond 2022	CAP Goal #
#5 Develop adaptation plans to protect people and property threatened by climate collapse	Develop plan for protecting community from sea level rise	25	Policy, legal, engineering, building codes, urban planning, climate damage analysis, stakeholder engagement	x	x	x		x		x			x			x				Sustainability, Legal, Planning Public Works, Public Engagement	x	x	x	x	x		Engineering, climate damage analysis		x		5
	Develop plan for protecting community from drought, extreme heat and wildfires	26	Policy, legal, engineering, building codes, urban planning, climate damage analysis, stakeholder engagement	x	x	x		x		x			x			x				Sustainability, Legal, Planning Public Works, Public Engagement	x	x	x	x	x		Engineering, climate damage analysis		x		5
	Develop plan for adapting urban forest to changing climate	27	Aboriculture, urban planning, climate damage analysis, hydrology, stakeholder engagement							x			x			x				Public Works, Public Engagement			x	x	x		Climate damage analysis		x		5
	Propose building moratorium or other policy to indemnify City against climate related damages on or near flood-prone property being developed on the Bay, inc. release of any obligation to maintain critical infrastructure: roads, sewers, etc.	28	Climate damage analysis, legal, engineering, urban planning, stakeholder engagement, policy	x	x	x				x	x		x			x				Planning, Legal, Public Engagement, Public Works, Finance		x	x	x	x		Engineering, climate damage analysis		x		5

GOAL #6

CAP Goal	Actions	#	Staff Skills Required	Policy	Legal	Engineering	Building Science	Building Codes	Energy Analytics	Urban Planning/Aboriculture	Finance	Economics	Climate Damage Analysis	Public Relations	Marketing	Stakeholder Engagement	Organizational Design	Process Improvement	Information Technology	Dept	Sustainability	Legal	Public Works	Planning	Public Engagement	Information Technology	Skills Gaps	2020-21	2021-22	Beyond 2022	CAP Goal #
#6 Substantially reduce emissions from construction by 2030	Explore policies/programs requiring low embodied carbon building materials for new construction and remodels	29	Policy, legal, engineering, building science, building codes, energy analytics, finance, climate damage analysis, marketing, stakeholder engagement, process improvement, information technology	x	x	x	x	x	x		x		x		x	x			x	Sustainability, Legal, Planning, Public Engagement, Information Technology	x	x	x	x	x	x	Engineering, building science, energy analytics, finance, climate damage analysis		x		6
	Explore policies/programs requiring zero emissions construction equipment for new construction and remodels	30	Policy, legal, engineering, building codes, finance, climate damage analysis, marketing, stakeholder engagement	x	x	x	x				x		x		x	x				Sustainability, Legal, Planning, Public Engagement	x	x	x	x	x		Engineering, building science, finance, climate damage analysis			x	6
			Totals	21	18	23	5	9	8	8	21	1	11	3	4	20	2	1	4		27	17	12	17	20	3		**3**	**16**	**11**	

STAFFING GAPS

Staff Skills Required	Skills Required																Dept	City Department						Skills Gaps
	Policy	Legal	Engineering	Building Science	Building Codes	Energy Analytics	Urban Planning/Aboriculture	Finance	Economics	Climate Damage Analysis	Public Relations	Marketing	Stakeholder Engagement	Organizational Design	Process Improvement	Information Technology		Sustainability	Legal	Public Works	Planning	Public Engagement	Information Technology	
Totals	21	18	23	5	9	8	8	21	1	11	3	4	20	2	1	4		27	17	12	17	20	3	

CURRENT STAFFING INADEQUATE TO ACHIEVE CAP GOALS

- Skills gaps identified in:
  - engineering
  - energy analytics
  - financial analysis
- Hires needed **across departments**:
  - Public works
  - Building department
  - Planning, transportation
  - Public engagement

PROPOSAL

- Adopt CAP Subcommittee recommendation
- Send, along with any EQC edits, to City Council for consideration in upcoming budget deliberations

STAFF REPORT

Environmental Quality Commission
Meeting Date: 7/21/2021
Staff Report Number: 21-004-EQC

Regular Business: Review and discuss 2030 climate action plan progress report

Recommendation
The 2030 Climate Action Plan Progress Report (Attachment A) is scheduled to be presented to the City Council at their August 31 meeting; the commission may want to consider providing feedback to the City Council.

Policy Issues
In 2019, the City Council declared a climate emergency (Resolution No. 6535) committing to catalyze accelerated climate action implementation. In July 2020, the City adopted a new Climate Action Plan with the bold goal to reach carbon neutrality (zero emissions) by 2030.

Background
Every summer, staff aims to provide City Council and the community with a progress update on the Climate Action Plan (CAP). This allows an opportunity for the City Council to review and consider trends in greenhouse gas (GHG) emissions created by the community and provide further direction if desired/needed. In addition, the City aims to measure its progress on GHG reductions for city (municipal) operations every five years.

This year the progress update includes more data and information than from previous years, and is largely due to measuring progress and trends as they relate to the newly adopted 2030 Climate Action Plan.

To summarize progress of the 2030 CAP, a comprehensive interdepartmental Climate Action Progress Report has been compiled (Attachment A). This report includes a summary of 2021 implementation progress to date, selected metrics, and both communitywide and municipal GHG inventories. The centralization of all progress to date can support the community and City Council to make informed decisions on potential next steps for climate action strategies.

The Environmental Quality Commission may want to provide feedback to the City Council before it is presented to them on August 31 (tentatively scheduled).

Some challenges and opportunities were presented when gathering and analyzing data, and are discussed in the analysis section of this report.

Analysis
The comprehensive report on the 2030 CAP progress is included in Attachment A. There were some challenges and opportunities identified in preparing the progress report and are discussed below.

2030 CAP metrics
The Environmental Quality Commission (EQC) included nine metrics to track the progress of the 2030 CAP:

1. Number of gas hot water heaters citywide that are replaced with electric versions
2. Number of gas furnaces citywide that are replaced with electric versions
3. Number of utility natural gas accounts terminated
4. Number of new light-duty vehicles registered that are fossil fuel (gasoline) vs. electric
5. Number of total light-duty vehicles registered that are fossil fuel (gasoline) vs. electric
6. Gallons of gasoline sold in Menlo Park
7. Percentage of municipal assets converted from gas or diesel to electric
8. Vehicle miles traveled, including trips inbound, outbound, and within the City
9. Number of other cities that query and/or copy Menlo Park's climate policies and programs

This is the first year these metrics and related data have been aggregated. While compiling, city staff experienced challenges with both internal and external stakeholders to source the necessary data. This increased staff time to obtain data. Considering adjustments would allow for a more efficient use of resources while capturing the desired data to make informed decisions. Refer to Attachment A for all reported metrics including data limitations and considerations. Staff is currently working on identifying metrics that can help measure progress going forward, and will present these to the commission in August.

Google Environmental Insights Explorer
In addition to the climate action plan metrics and GHG inventories, the EQC has identified the Google Environmental Insights Explorer (EIE) as possible source for tracking climate action progress in Menlo Park. EIE is a free service that uses exclusive Google data sources to estimate activity, emissions, and reduction opportunities. Although this tool is a significant advancement for measuring emissions, there are impacts in using this information going forward. For complete assessment of the EIE tool, including comparison to current GHG calculation methodology, refer to Attachment B.

Greenhouse gas inventory baseline
Measuring GHG emissions year to year can be highly volatile based on external factors (economic, pandemic, state and federal regulation changes). It is difficult to have confidence in trends when measuring on a year-to-year basis. It may be beneficial to consider the use of a rolling average (e.g., most recent 3-years of data) in addition or in place of reductions calculated to a baseline. This approach may also capture trends more accurately at a local level.

Impact on City Resources
Obtaining metric data and departmental data has increased staff time for sustainability and other departments, and this could be streamlined for increased efficiencies. Staff is currently working on a proposal for consideration.

Environmental Review
This action is not a project within the meaning of the California Environmental Quality Act (CEQA) Guidelines § § 15378 and 15061(b) (3) as it will not result in any direct or indirect physical change in the environment.

Public Notice

Public notification was achieved by posting the agenda, with the agenda items being listed, at least 72 hours prior to the meeting.

Attachments

A. Menlo Park Climate Action Plan Progress Report
B. Assessment of Google Environmental Insights Explorer Memorandum

Report prepared by:
Candise Almendral, Sustainability Contractor

Report reviewed by:
Rebecca Lucky, Sustainability Manager

ATTACHMENT A

MENLO PARK CLIMATE ACTION PLAN PROGRESS REPORT

July 2021

Prepared for the City of Menlo Park, Office of Sustainability

Prepared by Municipal Plan Check Services

CONTENTS

EXECUTIVE SUMMARY

Climate Action Plan

The City of Menlo Park adopted its first Climate Action Plan (CAP) in 2009. The goal of this plan was to reduce communitywide greenhouse gas (GHG) emissions 27 percent below 2005 levels by 2020. At the time of adoption, the community, City Council, and staff believed this would be a challenging and costly goal to achieve. Fortunately, due to progressive state policy allowing for the formation of community choice aggregation programs (CCAs), the Menlo Park has achieved the GHG reduction needed to meet this goal. Through CCAs cities and counties can now buy or generate more renewable and/or lower carbon intensive electricity for residents and businesses using Pacific Gas and Electric's transmission and distribution infrastructure. In 2016, Peninsula Clean Energy (PCE) was formed and began delivering carbon-free and renewable energy to San Mateo County and all 20 of its cities and towns, including Menlo Park.

The CCA program, through PCE electricity, is the largest contributing factor in Menlo Park meeting its 2020 GHG emissions reduction goal. Additionally, this measure was and continues to be cost effective for the community and city operations.

This measure emphasizes that while the community, City Council, and staff continue to take great efforts to plan and strategize toward meeting local GHG reduction goals, many reductions also come from regional or state efforts that compliment strategies in the CAP. It also highlights the need for the ability to quickly adapt to new external policies, programs, or technologies that have the potential for greater and/or more cost-effective impact than may have been previously realized in a local climate action plan.

A great example of Menlo Park's nimble adaptability includes amending the building codes (known as reach codes) in 2020 to require new buildings to be all-electric. This allowed the community to capitalize on PCE's carbon-free electricity and eliminate the use of natural gas in new buildings to curb climate change in new construction.

Even though Menlo Park has reached its 2020 GHG reduction goal, the urgency to address climate change remains unchanged. As a result, the community, the Environmental Quality Commission, and the City Council remain committed to addressing climate change. In alignment with the United Nations Intergovernmental Panel on Climate Change's (IPCC) and the City Council declaring a climate emergency in 2019, a new Climate Action Plan was adopted in July 2020. The 2030 Climate Action Plan (CAP) outlines six strategies to achieve carbon neutrality by 2030[1].

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[1] Menlo Park Climate Action Plan: menlopark.org/305/Climate-Action-Plan

Current Climate Action Plan Strategies

1. Explore policy/program options to convert 95% of existing buildings to all-electric by 2030
2. Set citywide goals for increasing electric vehicles to 100% of new vehicles by 2025 and decreasing gasoline sales 10% a year from a 2018 baseline
3. Expand access to electric vehicle (EV) charging for multifamily and commercial properties
4. Reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission
5. Eliminate the use of fossil fuels from municipal operations
6. Develop a climate adaption plan to protect the community from sea level rise and flooding

Current climate action plan metrics

To track the progress of the six adopted strategies and the achievement of carbon neutrality by 2030, the following metrics were selected by the Environmental Quality Commission:

1. Number of gas hot water heaters citywide that are replaced with electric versions
2. Number of gas furnaces citywide that are replaced with electric versions
3. Number of utility natural gas accounts terminated
4. Number of new light-duty vehicles registered that are fossil fuel (gasoline) vs. electric
5. Number of total light-duty vehicles registered that are fossil fuel (gasoline) vs. electric
6. Gallons of gasoline sold in Menlo Park
7. Percentage of municipal assets converted from gas or diesel to electric
8. Vehicle miles traveled, including trips inbound, outbound, and within the City
9. Number of other cities that query and/or copy Menlo Park's climate policies and programs

Community greenhouse gas inventory

Before the climate action plan metrics were selected by the Environmental Quality Commission, the City has historically tracked CAP progress through GHG emissions reductions relative to the 2005 baseline. The inventory does provide value in understanding GHG trends, external influences, and the sectors that contribute most to climate change. Some areas of the inventory are more precise at measuring GHG emissions, such as building emissions, while others may not be accurate or representative of the full GHG impact.

In 2005, the community generated 349,284 tons of GHG emissions [2] in four categories: transportation, solid waste, building energy use: natural gas, and building energy use: electricity. In 2013, the City Council established a GHG reduction goal of 27 percent below 2005 levels by 2020.

The most recent data shows the City has reached this goal even with continued development. Between 2005 and 2019, communitywide greenhouse gas emissions have decreased to 253,371 tons. This reflects a 27.5 percent decrease relative to the 2005 baseline. This can be attributed to reductions from:

[2] The industry standard unit for GHG emissions is metric tons carbon dioxide equivalent (MT CO2e). These terms can be used interchangeably.

- Waste related emissions (-15,723 tons) due to:
  - Installation of gas capture devices at the primary landfill that services Menlo Park, Ox Mountain landfill.
  - Improved sorting and waste diverted from landfill. Note, this is largely due to statewide requirements and regional cooperation.

- Building energy use: electricity related emissions (-64,591 tons) due to:
  - State mandates requiring energy providers, such as Pacific Gas & Electric and Peninsula Clean Energy to obtain power with lower emissions[3] and from renewable sources[4].
  - Menlo Park subscribing all residents and businesses to the community choice aggregate, Peninsula Clean Energy (PCE)[5]. PCE provides Menlo Park with cleaner electricity, from more renewable sources (e.g., solar, wind, and geothermal) to reduce the consumption of fossil fuels (like natural gas). As of 2021, all electricity provided by PCE is 100% carbon-free and is on track to be 100% renewable by 2025. It should be noted this single measure reduced building energy use: electricity related emissions by 24,689 tons in one year (2016-2017).

- Transportation related emissions (-36,657 tons between 2017 and 2019) due to:
  - Increased state mandated fuel efficiency and emission standards.
  - This is also a possible indication of increased zero emission vehicle adoption and/or local trip and vehicle miles traveled reduction measures.

It should be noted, despite recent reduction, the most significant source of emissions continues to be transportation (48.2 percent), followed by building energy use: natural gas (41.2 percent).

Municipal greenhouse gas inventory

In 2016, municipal operations generated 2,812 tons of GHG emissions in six categories[6]: natural gas consumption, electricity use, vehicle fleet, employee commute, waste generation, and emissions from decommissioned Bedwell Bayfront landfill.

The most recent data shows the City has successfully reduced its municipal operations related emissions to 2,178 (22.6 percent) in 2019. This can be attributed to reductions from:

- Building/facility electricity use related emissions (-540 tons) due to:
  - Menlo Park city buildings and facilities being subscribed to the community choice aggregate, PCE. In 2017, Menlo Park took formal action to enroll all municipal

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[3] Assembly Bill 32, the California Global Warming Solutions Act (2006) arb.ca.gov/cc/ab32/ab32.htm
[4] Senate Bill X1-2, Renewables Portfolio Standard (2011) leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.pdf
[5] Peninsula Clean Energy: peninsulacleanenergy.com
[6] Previous municipal inventories calculated emissions in five categories: buildings, vehicle fleet, streetlights, water/storm water, and solid waste.

accounts in ECO100[7] which provides 100% renewable electricity to subscribers. This means, all electricity provided to the City by PCE is Green-e certified; 100% from renewable sources (i.e., solar and wind) and carbon-free.

- Solid waste related emissions (-120 tons) due to:
  - Incremental reduction at Bedwell Bayfront Landfill. Note, this landfill has been decommissioned so emissions will continue to decrease with no intervention.
  - Improved sorting and waste diverted from landfill. Note, this is largely due to statewide requirements and regional cooperation.

[7] Peninsula Clean Energy, ECO100: peninsulacleanenergy.com/opt-up

CLIMATE ACTION PLAN STRATEGIES

2021 scope of work and progress to date

In April, the City Council approved a 2021 scope of work to implement the adopted six CAP strategies. The following is a summary of progress including related projects, initiatives, and/or activities related to the 2030 Climate Action Plan strategy implementation.

Strategy No. 1: Explore policy/program options to convert 95% of existing buildings to all-electric by 2030

Scope of work: Like the reach codes for new construction, Menlo Park is seeking to capitalize on Peninsula Clean Energy's carbon-free and increasingly renewable electricity by developing and implementing all-electric codes and/or programs for existing buildings.

The project is well underway and is considered a top priority[8] of the City Council's 2021 annual work plan. The following is a summary of project milestones:

- May/June 2021: Complete cost effectiveness analysis on various policy/program pathways toward achieving 95% electrification by 2030
- June/July 2021: Environmental Quality Commission provides advice to City Council on cost effectiveness analysis and potential pathways to achieve electrification goals for existing buildings
- August 2021: City Council reviews policy/program

Progress and next steps

This project is anticipated to meet the milestones listed.

Additionally, in 2019, the City adopted local building codes known as reach codes[9] requiring new buildings to be all-electric with limited exceptions. Considering, all Menlo Park residents and businesses receive carbon-free electricity[10], this measure is expected to maintain current levels or even slightly reduce, natural gas consumption emissions in the community.

As of May 2021, 87 new building permits (84 single family residential and 3 mixed use commercial/multifamily residential) have been subject to the provisions of the reach code.

[8] Menlo Park City Council 2021 annual work plan priorities: menlopark.org/DocumentCenter/View/27924/F1-20210420-CC-CC-priorities

[9] Menlo Park reach codes: menlopark.org/1583/Reach-codes

[10] As mandated by the state and through automatic enrollment in Peninsula Clean Energy service.

Strategy No. 2: Set citywide goals for increasing electric vehicles (EVs) to 100% of new vehicles by 2025 and decreasing gasoline sales 10% a year from a 2018 baseline

Scope of work: Implementation deferred to the Beyond Gas Initiative (BGI) under Joint Venture Silicon Valley[11].

Progress and next steps

BGI is currently gathering data on gasoline consumption and electric vehicle adoption at the county, city, and zip code level. BGI also signed a memorandum of understanding with Joint Venture Silicon Valley in September 2020 to promote climate, health & equity by speeding the transition from gasoline to cleaner alternatives in Silicon Valley.

BGI goals:

- Reduce gasoline consumption in Silicon Valley 50% by 2030.
- Shift transportation culture to reject gasoline and embrace cleaner alternatives.

BGI's methods to achieve those goals are:

- Build a coalition of government, business, and organization leaders to advance effective gasoline reduction policies.
- Collect data regarding gasoline use, the adoption of alternative transportation and city and business gasoline reduction policies, and commitments in Silicon Valley in collaboration with Joint Venture's Institute for Regional Studies.
  - Note: city staff has coordinated estimated fossil fuel (e.g., gasoline and diesel) sales and zero-emissions vehicles registration data collection to be shared with local stakeholders, such as Beyond Gas Initiative.
- Partner with cities to adopt gasoline reduction measures such as public fleet electrification, vendor clean delivery requirements, and citywide gasoline sales reduction goals.
  - Note: In addition to the goal outlined in this strategy, in March 2020, Menlo Park adopted the Sustainable Fleet Policy prioritizing the purchase of zero-emission vehicles as a first option and establishing a fossil fuel (e.g., gasoline and diesel) reduction goal of 5 percent annually over 2018 baseline.
- Partner with businesses interested in making gasoline-reduction commitments to take actions such as electrifying corporate fleets, reducing gas-powered deliveries, and enabling employees to avoid using gasoline in connection with work.
- Inspire Silicon Valley elected officials to call publicly for a gasoline-free future; gain news and media coverage of the Beyond Gasoline Initiative; convene performance art and cultural events.
- Publish a gasoline picture book and promote it to elementary school districts and library branches. Launch a Beyond Gasoline website and digital campaign.

[11] Beyond Gasoline Initiative: jointventure.org/initiatives/climate-change/beyond-gasoline

Strategy No. 3: Expand access to electric vehicle (EV) charging for multifamily and commercial properties

Scope of work: To align with Governor Executive Order N-79-20[12] banning the sale of new fossil fuel (e.g., gasoline and diesel) vehicles by 2035 and take advantage of available EV charging incentive programs, the City will:

- Monitor the effectiveness of state and regional charging infrastructure incentives.
- Promote/market the state and regional charging infrastructure incentives to multifamily property owners.
- Offer up to $10,000 in additional incentives to multifamily property owners.

Progress and next steps

In Fall 2020, city staff completed an electric vehicle charging gap analysis to identify barriers to accelerate zero-emission (specifically full battery electric) vehicle adoption[13]. A key finding was adoption rates are closely linked to access to at-home charging. While this is not typically a problem for single-family homes, it is problematic for multifamily properties.

Though there are several public EV charging spaces available in Menlo Park, they are located at a limited number of sites; primarily on the Facebook campus and/or other public locations that are not convenient for overnight charging. This indicates a severe deficiency of on-site EV charging infrastructure at multifamily properties.

The analysis found less than 2.5 percent of existing multifamily properties have EV charging available at or near (within 0.25 miles) their respective locations. Multifamily property residents, roughly 40 percent of Menlo Park's population, do not have ready access to on-site charging. This lack of on-site EV charging infrastructure results in substantial equity and barrier issues for EV ownership and/or use.

The deficiency of on-site charging at multifamily properties will also negatively impact the implementation of CAP strategies No.2 (increase EV purchase/use and decrease gasoline sales) and No. 4 (reduce vehicle miles traveled).

These findings are consistent with analysis[14] performed for East Bay Community Energy, a local community choice energy provider servicing Alameda County and 14 cities (Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, Tracy, and Union City).

The next steps include:

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[12] Executive Order N-79-20: library.ca.gov/Content/pdf/GovernmentPublications/executive-order-proclamation/40-N-79-20.pdf
[13] Menlo Park City Council staff report 20-239-CC, October 27, 2020: menlopark.org/DocumentCenter/View/26523/G4-20201027-CC-EV-charging
[14] Innovations in Electric Vehicle Charging for Multi-unit Dwellings: res.cloudinary.com/diactiwk7/image/upload/v1614128486/FINAL-REPORT_Ecology-Action_Innovation_in_EV_Charging_for_MUDs_kgtbh3.pdf

- Continue to monitor and track incentive penetration for multifamily properties in Menlo Park by tracking:
  - Number of new electric vehicle charging stations installed at multifamily and commercial properties
  - Participation in regional funding programs

To determine the number of new electric vehicle charging stations installed at multifamily and commercial properties, staff evaluated city permit data. Relevant permits were identified as alterations or additions which specified installation of EV charging stations or infrastructure (i.e., electrical upgrades, wiring, etc.).

Data limitation(s) and/or consideration(s): Level 1 charger installation (120v household plug) may not be included if no electrical upgrade (permit) was required.

Table 1 and 2 describes the number of building permits issued to install electric vehicle charging infrastructure in existing multifamily and commercial properties:

Table 1: Electric vehicle charging permits at multifamily properties

Year	Total related permits	Comments
2017	5	4 charging ports installed (dedicated parking spaces). 1 upgrade to electrical service for future EV charging installation.
2018	6	29 charging stations installed (at least 3 in dedicated parking spaces, total port/spaces unknown).
2019	3	2 charging stations installed (total port/spaces unknown). 10 prewired spaces for future EV charging installation.
2020	1	1 charging station installed (total port/spaces unknown).

Table 2: Electric vehicle charging permits at commercial properties

Year	Total related permits	Comments
2017	9	33 charging stations installed (total port/spaces unknown).
2018	13	65 charging stations installed (total port/spaces unknown), and 4 EV chargers relocated. This includes the installation of three 120v household plugs (Level 1) in addition to two Level 2 chargers in one location.
2019	0	None.
2020	3	51 charging stations installed (total port/spaces unknown).

  - Participation in regional funding programs was reported to the City by Peninsula Clean Energy (PCE). Currently, PCE is administrating its EV Ready Program[15] which features $24M in incentives. These incentives are available to all PCE customers. PCE reports five multifamily properties in Menlo Park have applications that are currently under review. The scope of these projects is currently unknown,

[15] Peninsula Clean Energy, EV Ready Program: peninsulacleanenergy.com/ev-ready/

and the properties vary in size from 4 to 41 units. Note, two locations have yet to confirm total units in the building/complex.

- Implement an additional Menlo Park incentive for multifamily properties to install EV charging stations. Work anticipated to begin Fall 2021.
- Market and educate multifamily property owners about EV charging and available incentives. Work anticipated to begin in Fall of 2021.

Strategy No. 4: Reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission

Scope of work: Reduce VMT through the implementation of the Transportation Master Plan, utilization of Senate Bill 2 Housing grant, formation of a Transportation Management Association, and implementation of the VMT guidelines for new development.

Progress and next steps

Transportation Master Plan implementation

In November 2020, the City Council adopted the Transportation Master Plan (TMP)[16]. The 2020-21 Capital Improvement Plan (CIP) has 14 projects in the TMP either underway or programmed. Many of these projects are beneficial to reducing VMT since they will improve bicycle and pedestrian infrastructure by either closing gaps or upgrading existing facilities, encouraging more bicycle and pedestrian usage. One project is also expected improve transit travel times, encouraging more transit use. Table 3 summarizes the status of these projects and describes expected VMT benefit:

[16] Menlo Park Transportation Master Plan: menlopark.org/1147/Transportation-Master-Plan

Table 3: Status of Transportation Master Plan Projects in Capital Improvement Plan			
Project	**TMP Project Number (Priority)**	**VMT Benefit**	**Status**
Active Projects			
Haven Avenue Streetscape	1, 2 (Tier 1)	Close bicycle and pedestrian gap	Construction to start in FY21-22
Middle Avenue Bicycle and Pedestrian Crossing	81 (Tier 1)	Improve bicycle and pedestrian infrastructure	Design phase
Traffic Signal Modifications: Ravenswood/Laurel	74 (Tier 1)	Improve bicycle and pedestrian infrastructure	Construction to start in 2021
Willow Oaks Bike Connector	59 (Tier 1)	Improve bicycle and pedestrian infrastructure	Design phase
Funded/On Hold Projects			
Caltrain Grade Separation	Regional	Provide pedestrian and bicycle infrastructure, Reduce transit travel times	On hold
Future Year Programmed Projects			
El Camino Real Crossings Improvements	85, 91, 92, 95 (Tier 1)	Improve pedestrian and bicycle infrastructure	Not started, programmed for FY 21-22
Middle Avenue Complete Streets	118 (Tier 1)	Provide pedestrian and bicycle infrastructure	Not started, programmed for FY 21-22
Middlefield-Linfield Santa Monica Crosswalk	65 (Tier 1)	Improve pedestrian and bicycle infrastructure	Not started, programmed for FY 21-22
Willow Road and Newbridge Bicycle and Pedestrian Improvements	28, 37 (Tier 2)	Improve pedestrian infrastructure	Not started, programmed for FY 22-23

Note: the named projects may encompass multiple TMP efforts which may result in a single project name having multiple project numbers.

In addition to the 20-21 CIP projects, the following multi-modal transportation projects were funded prior to TMP adoption and are underway or have been completed:

- Chilco Street and Sidewalk Installation
- Oak Grove Safe Routes to School and Green Infrastructure
- Pierce Road sidewalk and San Mateo Drive bike route installation
- Santa Cruz Avenue repaving (including sidewalk and bike lane installation)
- Sharon Road sidewalks
- Sidewalk Repair and Replacement program

Required infrastructure that can also reduce VMT:

- Bayfront Pedestrian and Bicycle Bridge: required condition for the Facebook West Campus project
- Garwood Way bicycle route: required mitigation measure for the 1300 El Camino Real project

Walk audits were added to the TMP as part of the Safe Routes to School program. Due to the most students being remote or partially remote for the 2020 school year, virtual walk audits were performed for most schools in the spring with staff participating in an in-person walk audit for Belle Haven Elementary.

The VMT guidelines in the Transportation Master Plan also call out reducing the VMT per capita and VMT per employee metrics which are aligned with the VMT standards in the City's Transportation Impact Analysis guidelines.

Implementation of vehicle miles traveled (VMT) guidelines for new development:
In June 2020, the City Council adopted new standards and updated the Transportation Impact Analysis[17] (TIA) guidelines[18]. The TIA guidelines have been adopted with the purpose of disclosing potential transportation impacts, such as increased VMT, resultant from new development or capital improvement projects in Menlo Park. TIA guidelines ensure compliance with both state (California Environmental Quality Act) and local (e.g., General Plan, Climate Action Plan, etc.) requirements.

The timing of how often VMT will be measured has not been established. However, development of the methodology, reporting mechanism, and a reduction target are expected to be part of the Complete Streets Commission work plan in 2022-23.

- Note: The VMT standards in TIA guidelines were developed using the City's Travel Demand Model and may have different results than other methodologies (i.e., Google Environmental Insight Explorer, California Department of Transportation Highway Performance Monitoring System, etc.).
- Approved development project subject to new VMT reduction guidelines:
    - 111 Independence Drive[19]
    - Note: project is also subject to the City's Transportation Demand Management Ordinance[20] that requires a 20 percent reduction in trip generation.

Transportation Management Association (TMA)
The goal of a TMA is to coordinate logistics and transportation demand management (TDM) services amongst multiple member businesses. Instead of an individual business providing TDM services (e.g., shuttles, public transportation discount programs, etc.) for their employees, a TMA allows multiple businesses to share resources and creates cost-efficiency, allowing smaller businesses to access services that may otherwise be unaffordable. These services provide customized alternative transportation options to reduce single-vehicle travel amongst commuters.

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[17] The TIA is a tool used for development or capital projects to ensure that a thorough transportation analysis occurs for all projects that might result in impacts under the California Environmental Quality Act and in conformance with the City's General Plan.
[18] Menlo Park Transportation Impact Analysis: menlopark.org/DocumentCenter/View/302/Transportation-Impact-Analysis-Guidelines
[19] 111 Independence Drive: menlopark.org/1571/111-Independence-Drive
[20] Menlo Park Transportation Demand Management Ordinance (Municipal Code Section 16.45.090): codepublishing.com/CA/MenloPark/#!/MenloPark16/MenloPark1645.html#16.45.090

Since the adoption of this CAP strategy there have many external factors which impact commute patterns and the transportation system. Specifically, the COVID-19 pandemic which shifted attitudes toward public transportation and remote work policies, and the formation of the subregional TMA, Manzanita Works[21]. In responses to these factors, the following three TMA objectives were developed[22]:

- Objective 1: Endorse and support regional and sub-regional TDM efforts
- Objective 2: Ensure TDM is available for all businesses
- Objective 3: City can serve as an example of an employer with a robust and collaborative TDM program

The TMA feasibility study to achieve these objectives is nearing completion. A final report and proposed next steps will be presented to City Council in August 2021.

Senate Bill 2 Housing grant
The City was awarded a grant under Senate Bill 2[23] (SB 2) to accelerate/encourage housing production within Menlo Park. These actions are designed to locate additional units in already urban/built-up areas, such as existing single-family neighborhoods that are potentially walkable/bikeable to transit and jobs, or downtown near local and regional transit lines as well as near the commercial core of Menlo Park. This type of infill development reduces dependence on vehicles for everyday activities/errands and vehicle miles traveled.

The City's housing grant application to accelerate/encourage housing production, specifically in urban/built-up areas will be considered part of the 2023-2031 Housing Element Update[24]. The City is currently updating its required Housing Element and Safety Element, and preparing a new Environmental Justice Element.

Strategy No. 5: Eliminate the use of fossil fuels from municipal operations

Scope of work: The City owns, operates, and manages an array of equipment and facilities to provide the community with specialized services. To reduce related emissions in the provision of these services, the following direction was given by City Council:

- Utilize current resources and available budget toward eliminating fossil fuels in building the new Menlo Park Community Campus.
- Replace fossil fuel appliances/assets at the end of life with non-fossil fuel options unless infeasible.
- Pilot program to transition landscaping equipment from gas to electric.

[21] Manzanita Works: manzanita.works
[22] Menlo Park City Council staff report 21-074-CC, April 13, 2021: menlopark.org/DocumentCenter/View/27882/L3-20210413-CC-TMA-update
[23] Senate Bill No. 2 Chapter 364: leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB2
[24] 2023-2031 Housing Element update: menlopark.org/housingelement

Progress and next steps

Menlo Park Community Campus (MPCC)

In collaboration with Facebook, the City is in the process of building a new multigenerational community center and library on the site of the current Onetta Harris Community Center, Menlo Park Senior Center, Belle Haven Youth Center, and Belle Haven Pool (100-110 Terminal Avenue).

To showcase Menlo Park's sustainability leadership, this project aims to achieve:

- LEED Platinum certification
- Full building/facility including pool electrification (no natural gas consumption)
- Installation of a renewable power microgrid system. To support the development of a resilient and cost-effective islandable (off-grid for operation as a Red Cross emergency center), renewable energy project, the system will include:
  - Solar PV (building/facility energy use) and solar water heating (Belle Haven Pool)
  - Battery energy storage systems
  - Microgrid energy management systems (MEMS)
  - Electric vehicle charging stations

A renewable power microgrid feasibility study was completed in 2020 and City Council approved developing a request for proposals to consider the installation of a renewable power microgrid system. Proposals for Solar PV Microgrid and Electric Vehicle Charger Design, Installation, and Operation[25] (renewable power microgrid system) were submitted May 2021 and are currently under review. Contract award will be conducted during a public hearing anticipated in August/September 2021. If approved, this would eliminate the use of fossil fuel consumption at this site (including the Belle Haven Pool which is the largest greenhouse gas contributor).

Electrification of existing city facilities

The City of Menlo Park currently owns and operates the following city facilities and buildings:

- Menlo Park Civic Center Complex:
  - City Hall & Police Department (701 Laurel Street)
  - City Council Chambers (Laurel Street)
  - Library (800 Alma Street)
  - Arrillaga Family Gymnasium & Burgess Pool (600 Alma Street)
  - Arrillaga Family Gymnastics Center (501 Laurel Street)
  - Arrillaga Family Recreation Center (700 Alma Street)
  - Child Care Center (801 Laurel Street)
- Coporation Yard (333 Burgess Drive)
- Menlo Park Community Campus (100-110 Terminal Ave): the following buildings are currently closed due to development of a new multigenerational facility (MPCC):

[25] Solar PV Microgrid and Electric Vehicle Charger Design, Installation and Operation at Menlo Park Community Campus: pbsystem.planetbids.com/portal/46202/bo/bo-detail/82009

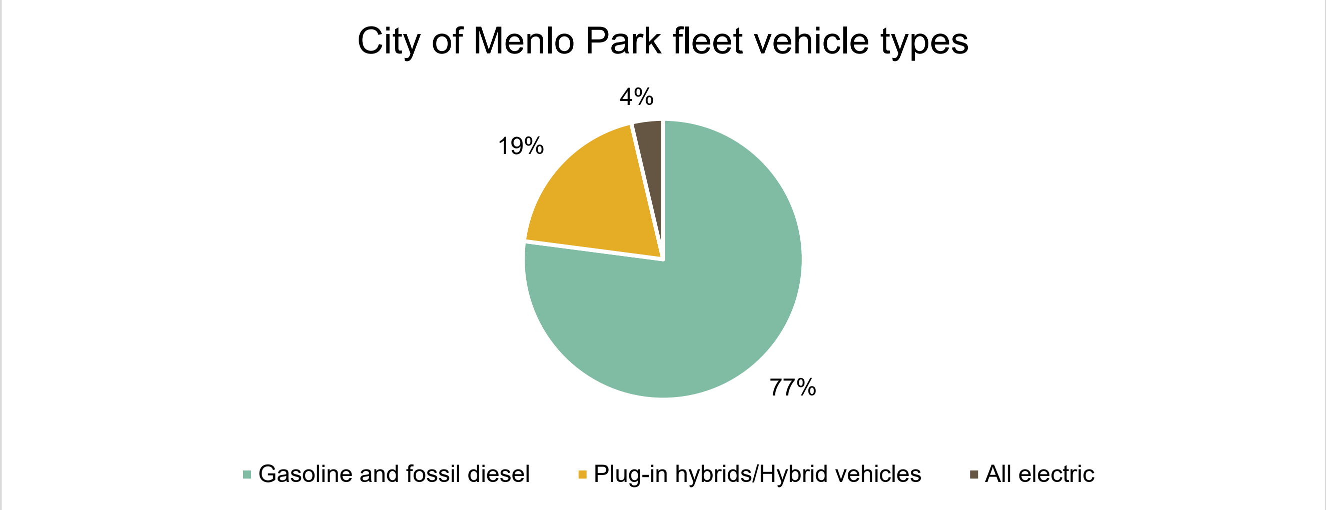
- Onetta Harris Community Center
- Menlo Park Senior Center
- Belle Haven Youth Center
- Belle Haven Pool

In addition to the MPCC project, design projects to replace the HVAC equipment in the Arrillaga Family Recreation Center (700 Alma Street) and Gymnasium (600 Alma Street) buildings are currently underway, and all-electric options are planned. This equipment is likely to be replaced in 2022.

A consultant has also been hired to assist and support Public Works in long-term planning and strategy development to eliminate fossil fuels at city facilities.

Municipal Fleet

Menlo Park's municipal fleet of vehicles and equipment comprise the largest collection of fossil fuel (e.g., gasoline and diesel) assets. The City currently manages 109 fleet vehicles (including light-, medium-, heavy-duty and pursuit-rated vehicles, motorcycles, and parking enforcement). Figure 1 summarizes the characterization by fuel type of the current municipal fleet:



In March 2020, the City Council adopted the Sustainable Fleet Policy to reduce greenhouse gas emissions related to fleet operation[26]. This policy prioritizes the purchase of zero-emission vehicles as a first option. This policy also establishes a purchasing hierarchy to ensure vehicle purchases are the lowest emissions option available and a fossil fuel (e.g., gasoline and diesel) reduction goal of 5 percent annually over 2018 baseline. While the City did achieve a 5.54 percent reduction relative to baseline in 2020, this data is expected to be an outlier due the COVID-19 pandemic and shelter-in-place orders. Staff expects to begin tracking municipal fleet fossil fuel reduction once 2021 data is available.

[26] Menlo Park City Council Sustainable Fleet Policy: menlopark.org/DocumentCenter/View/24571/F3-20200326-CC-Follow-up-grand-jury-response

Given vehicle availability and market trends, city staff estimates approximately 40 percent of the current municipal fleet will have EV options available now or in the next three years. Table 4 summarizes Menlo Park's municipal fleet characterization by vehicle category and EV market availability:

Table 4: Menlo Park fleet vehicle summary

Vehicle category	% of municipal fleet (109 total vehicles)	EV market ready	EV market available in less than three years	EV market available in more than three years
Light-duty passenger vehicles, motorcycle, and parking enforcement	14%	X		
Light-duty trucks and cargo van	26%		X	
Police patrol vehicles	35%			X
Medium and heavy-duty truck	25%			X

It is important to note that much of the City's fleet is specialized, and electrification of specialized fleets are not as readily available as passenger light duty vehicles. For example, there are currently no police pursuit-rated vehicles, and the market lacks medium- and heavy-duty vehicles that are full battery electric. Electric prototypes and vehicle conversion technology exists but using early technologies can run the risk of reduced performance or safety for the community and employees.

Even with this barrier, city staff has continued to seek out GHG reduction strategies for the fleet. For example, the City reserved five full battery electric Ford F-150 light-duty trucks, which are planned to go into production in 2022.

Additionally, in April 2021, the City transitioned to renewable diesel to fuel diesel vehicles and equipment. Unlike conventional fossil fuel diesel, renewable diesel is made from sustainable sources such as animal fats, and plant and cooking oils. Renewable diesel can also be intermixed with conventional fossil fuel diesel; no specialized equipment or infrastructure modifications are required. This means any vehicle or equipment using fossil fuel diesel can begin using renewable diesel immediately. Per the manufacturer, Neste, use of this product can reduce related emissions by up to 80 percent.

Several other County of San Mateo jurisdictions are currently using this fuel including City of San Mateo and Menlo Park Fire Protection District. San Francisco International Airport (SFO) also uses a similar product called sustainable aviation fuel (SAF) to fuel aircraft. SFO is currently working with the California Air Resources board, airlines, and supply chains with a goal of 5 percent SAF by 2025.

Expansion of city-owned electric vehicle (EV) charging infrastructure

The City of Menlo Park currently owns and operates the following electric vehicle charging infrastructure:

- Four public, Level 2 EV charging stations (8 total charging spaces)
  - Two (4 charging spaces) located at City Hall (701 Laurel Street)
  - Two (4 charging spaces) located at Downtown Parking Lot 2 (Crane Street)
- Three Level 2 EV charging stations (6 total space) that are exclusive for municipal fleet charging
  - Two (4 charging spaces) located at City Hall (701 Laurel Street)
  - One (2 charging spaces) located at the Corporation Yard (333 Burgess Drive)
- One Level 1 charging port (120v household plug) is also located at City Hall (701 Laurel Street) for exclusive for parking enforcement vehicle charging

Based on available EV charging infrastructure and best management practices (2:1 vehicle/charging ratio), the City can support 14 electric vehicles (approximately 12 percent of the current municipal fleet). To support the electrification of the municipal fleet for the next 10 years, staff estimates the following infrastructure is needed:

- City Hall (701 Laurel Street):
  - Three modular direct current (DC) fast charging systems
    - One exclusive for police department use
  - Nine Level 2 charging stations for exclusive police department use
- Corporation Yard (333 Burgess Drive)
  - One modular DC fast charging system

In August 2020, an existing System and Load Analysis (load monitoring) of the Civic Center Complex (701 Laurel Street) main switchboard and emergency distribution panel was completed. This analysis found the main switchboard available capacity can accommodate a maximum of four Level 2 EV charging stations (8 charging spaces) and two DC fast charging (2 charging spaces) and the emergency distribution panel available capacity can accommodate a maximum of four Level 2 EV charging stations (8 charging spaces).

Installation of additional EV charging stations at city facilities are currently in the design phase. This includes 12 Level 2 and three DC fast charging stations (27 charging spaces) at MPCC. It is anticipated that additional charging stations will also be added at the civic center where most of the city's vehicle fleet is located.

Electric leaf blower pilot

To maintain all 14 of the City's parks, the Public Works department performs several recurrent tasks each week, including:

- Mowing fields
- Trimming vegetation
- Adjusting and repairing irrigation
- Picking up litter

- Clearing debris (i.e., leaves, small branches, trimmings, etc.) along landscape and hardscape (e.g., walking pathways and parking lots) to ensure public safety

In 2020, the City purchased four full battery electric leaf blowers to pilot their use in the maintenance of city parks. Leaf blowers are used daily to complete approximately 90 percent of the park maintenance tasks throughout all city parks and sports fields. Each city park may require up to eight hours of using the leaf blowers per week during heavy leaf season; this requires up to 40 per week.

Currently the City uses seven gasoline-fueled and four full battery electric leaf blowers. One electric leaf blower (including the equipment, battery fast charger, and battery pack) costs approximately $1,600. On average each battery pack lasts for 1.5 hours and costs $1,100. Typically, two city staff members work together at each park. Therefore, two fully charged electric leaf blower with six extra battery packs would provide the duo team approximately 4.5 hours of leaf blower duties a day: up to 22.5 hours total per week. This is not enough to complete daily responsibilities, especially when considering other recurrent maintenance tasks (mowing, trimming, etc.).

Initial results of the pilot have found that while quieter and less greenhouse gas emitting, the electric leaf blowers are not as powerful as their gas counterparts. They simply cannot move large volumes of debris (i.e., leaves, small branches, trimmings, etc.), especially in the fall when the amount of leaves is greatest.

To fully transition to electric leaf blowers, hand raking and extra work to collect the leaves during the fall season will be required. This will result in a 50 percent increase in work per site/time required to complete daily maintenance duties. If more time is spent collecting debris (i.e., leaves, small branches, etc.), other maintenance tasks/projects may be eliminated or deprioritized. More community engagement would also be required to explain slower response times to maintenance requests, and park and facility beautification efforts.

Also, identification and/or installation of more charging infrastructure (i.e., 120v household plugs, mobile storage solutions, facility upgrades, etc.) to charge the batteries while in the field is needed. City facilities, such as sports field sheds, may require electrical upgrade to meet battery pack charging needs. If charging is limited to facilities with larger capacity (i.e., City Hall, Corporation Yard, etc.), this would increase vehicle miles traveled and related tail pipe emissions until the fleet is transitioned to full battery electric vehicles. Note, a battery pack may take up to two hours to fully charge.

The City will continue to explore the full transition to electric landscaping equipment with a recently hired Public Works consultant working to eliminate city operations’ fossil fuel use.

Strategy No. 6: Develop a climate adaption plan to protect the community from sea level rise and flooding:

Scope of work: To mitigate public safety risk associated with sea level rise and flooding, the following direction was provided by the City Council:

- Update the Safety Element in Menlo Park's General Plan to bring it into compliance with recent changes in General Plan law, including Senate Bill 379 (Climate Adaptation and Resiliency)
- Continue progress on the Menlo Park SAFER Bay grant application
- Continue to participate in and monitor OneShoreline
- Hold a City Council study session by July 2021 on the City's local hazard mitigation plan

Progress and Next Steps

SAFER Bay grant application

In early July 2021, the City was notified by the Federal Emergency Management Agency (FEMA) and California Office of Emergency Services (CalOES) that the application submitted to the Building Resilient Infrastructure and Communities (BRIC) program to design and construct portions of the SAFER Bay sea level rise protection project has been selected for further review[27]. Based on FEMA's provided definition, a subapplication that is Selected for Further Review means a *"subapplication is eligible (or potentially eligible pending some additional information) and there is available funding under the applicable subtotals."* In other words, of the $500M allocated for all proposed BRIC projects, $50M has been set aside for the Menlo Park SAFER Bay Project pending further review. This is not a guarantee of receiving the funding, but it is very significant advancement in the process.

City staff will continue to work with FEMA and CalOES to provide requested information for the project, as well as continuing to work on a memorandum of understanding between the funding and project delivery partners, including Facebook, PG&E, and the San Francisquito Creek Joint Powers Authority. A City Council study session on the project is planned for late August 2021, followed by consideration of the memorandum of understanding in fall 2021.

Continue to participate in and monitor OneShoreline

City staff and the City Council liaison frequently attend OneShoreline board meetings, which are held approximately monthly. In addition, Menlo Park is collaborating with Redwood City, Atherton, San Mateo County, and OneShoreline to develop a diversion structure to mitigate flooding impacts from high/rising tides, up to 25-year storm event, the

[27] BRIC 2020, City of Menlo Park, Menlo Park SAFER bay Project: fema.gov/grants/mitigation/building-resilient-infrastructure-communities/fy2020-subapplication-status#2020-chart

Bayfront Canal and Atherton Channel flood protection and ecosystem restoration project[28].

The City has allocated $1.2M as part of the fiscal year 2020-21 capital improvement program budget and committed to construct by December 2021 to preserve $1.135M Department of Water Resources grant funding.

In fall 2020, the City entered a memorandum of understanding (MOU) and drainage easement agreement for the construction and maintenance of the Bayfront Canal and Atherton Channel Flood Protection project[29]. This MOU establishes terms and responsibilities for cost-sharing related to construction, operation and maintenance (O&M), and mitigation monitoring. OneShoreline will serve as contracting and managing agency for all work funded by MOU, except O&M. Note, MOU expires five years after completion of construction.

Construction began in June 2021 and is expected to continue through the end of 2021.

Local Hazard Mitigation Plan
The Local Hazard Mitigation Plan (LHMP) identifies strategies that would reduce risk or eliminate long-term risk to life and property from a hazard event. Mitigation planning is the systematic process of learning about the hazards that could affect the community, including hazards that are a direct result of climate change, such as extreme heat, fires, and sea level rise. The plan aims to set clear goals, identify appropriate actions, and follow through with an effective mitigation strategy. Mitigation could also protect critical community facilities, reduce exposure to liability, and minimize post-disaster community disruption.

Adopting a LHMP allows jurisdictions to be eligible for various types of pre- and post-disaster grants from the Federal Emergency Management Agency (FEMA) and California Governor's Office of Emergency Services (CalOES), such as the $5M Hazard Mitigation Grant program for the Chrysler Pump Station reconstruction and the $50M Building Resilient Infrastructure and Communities (BRIC) grant pending FEMA review for constructing a portion of the SAFER Bay sea level rise protection project (described above).

To comply with the federal mandates in the Disaster Mitigation Act of 2000 (Public Law 106-390) and Menlo Park Municipal Code Section 2.44.050(5), the local hazard mitigation plan typically gets updated every five years. Menlo Park City Council last adopted Resolution No. 6339 on August 30, 2016 to approve an update to the Menlo Park Local

[28] For the past several decades, high tides have kept flows in the Bayfront Canal from draining to the Bay. Even minor rainfall events have resulted in the flooding with nearby properties experiencing flooding 40 times over the past 70 years – most recently in 2017.
[29] City Council staff report, October 27,2020: menlopark.org/DocumentCenter/View/26509/G1-20201027-CC-Bayfront-Canal-and-Atherton-Channel

Hazard Mitigation Plan Annex to the San Mateo County Hazard Mitigation Plan. The 2021 update is currently underway.

Due to changes in the City Council meeting calendar in summer 2021, an update for the City Council is now tentatively planned for late August 2021. The City Council, along with other agencies and the Board of Supervisors for San Mateo County, will need to adopt the LHMP by the end of 2021.

Once adopted, the LHMP will be used to help update the Safety Element, which is part of the City's General Plan. The Safety Element update is anticipated to be adopted by the end of 2022.

Climate action plan metrics

The following metrics were developed by the Environmental Quality Commission as part of the 2030 Climate Action Plan (CAP) to assess progress of local initiatives, policies, and programs. The CAP was adopted in July 2020, so this is the first year these metrics and related data have been aggregated. While compiling, city staff experienced challenges with both internal and external (e.g., third-party) stakeholders to source the necessary data. Data limitations and/or considerations are listed with each metric.

1. Metric no.1: Number of gas hot water heaters citywide that are replaced with electric versions.

   To determine the number of gas hot water heaters replaced with electric versions in existing buildings, staff evaluated city permit data. Relevant permits were identified as alterations or additions which specified replacement, repair, or relocation of water heaters.

   Data limitation(s) and/or consideration(s):

   Municipal software (formerly TideMark and currently Accela) has limitations. Specifically, the type of water heater is not explicitly and/or consistently reported; there is no notation to define water heater fuel type (natural gas or electric).

   Due to lack of notation, staff used technician notes to glean more insight on relevant projects. However, these notes are entered manually and vary widely; they may simply list "water heater" or include additional details like 30-gallon, tankless, etc.

   Additional comments provide more information about permits that specifically identified electric appliances.

Tables 5, 6, and 7 describe the total number permits issued by Menlo Park related to hot water heaters in existing buildings by type:

Table 5: Climate Action Plan Metric No. 1: commercial properties		
Year	**Total related permits**	**Comments**
2017	1	None.
2018	3	1 permit describes the replacement of electric water heater; note, this may be a like for like replacement and represent no reduction in natural gas consumption.
2019	2	None.
2020	0	None.

Table 6: Climate Action Plan Metric No. 1: multifamily properties		
Year	**Total related permits**	**Comments**
2017	16	None.
2018	12	None.
2019	27	None.
2020	0	None.

Table 7: Climate Action Plan Metric No. 1: single family properties		
Year	**Total related permits**	**Comments**
2017	77	None.
2018	54	None.
2019	56	1 permit describes the removal and replacement of electric water heater; note, this may be a like for like replacement and represent no reduction in natural gas consumption.
2020	8	None.

2. Metric no. 2: Number of gas furnaces citywide that are replaced with electric versions.

   To determine the number of gas furnaces replaced with electric versions in existing buildings, staff evaluated city permit data. Relevant permits were identified as alterations or additions which specified replacement, repair, or relocation of furnaces.

   Data limitation(s) and/or consideration(s):

   Municipal software (formerly TideMark and currently Accela) has limitations. Specifically, the type of furnace is not explicitly or consistently reported; there is no notation to define furnace fuel type (natural gas or electric).

   Due to lack of notation, staff used technician notes to glean more insight on relevant projects. However, these notes are entered manually and vary widely; they may simply list “furnace” or include additional details like 70k BTU, 95%/AFUE/60k BTU, etc.

Additional comments provide more information about permits that specifically identified electric appliances.

Tables 8, 9, and 10 describe the total number permits issued by Menlo Park related to furnaces in existing buildings by type:

Table 8: Climate Action Plan Metric No. 2: commercial properties

Year	Total related permits	Comments
2017	0	None.
2018	2	None.
2019	2	1 permit describes the replacement of a furnace with a heat pump.
2020	3	None.

Table 9: Climate Action Plan Metric No. 2: multifamily properties

Year	Total related permits	Comments
2017	18	None.
2018	19	None.
2019	14	1 permit describes the addition of new heat pump system. Note, may be in addition to existing natural gas infrastructure and represent no reduction in natural gas consumption.
2020	8	1 permit describes the installation of new heat pump system. Note, this may be like for like replacement and represent no reduction in natural gas consumption.

Table 10: Climate Action Plan Metric No. 2: single family properties

Year	Total related permits	Comments
2017	55	None.
2018	77	1 permit describes the replacement of a furnace with a heat pump.
2019	66	3 permits describe the replacement of a furnace with a heat pump. 3 permits describe the replacement of heat pumps. Note, this may be like for like replacement and represent no reduction in natural gas consumption.
2020	31	2 permits describe the installation of new heat pump systems. Note, may be in addition to existing natural gas infrastructure and represent no reduction in natural gas consumption.

3. Metric no. 3: Number of utility natural gas accounts terminated.

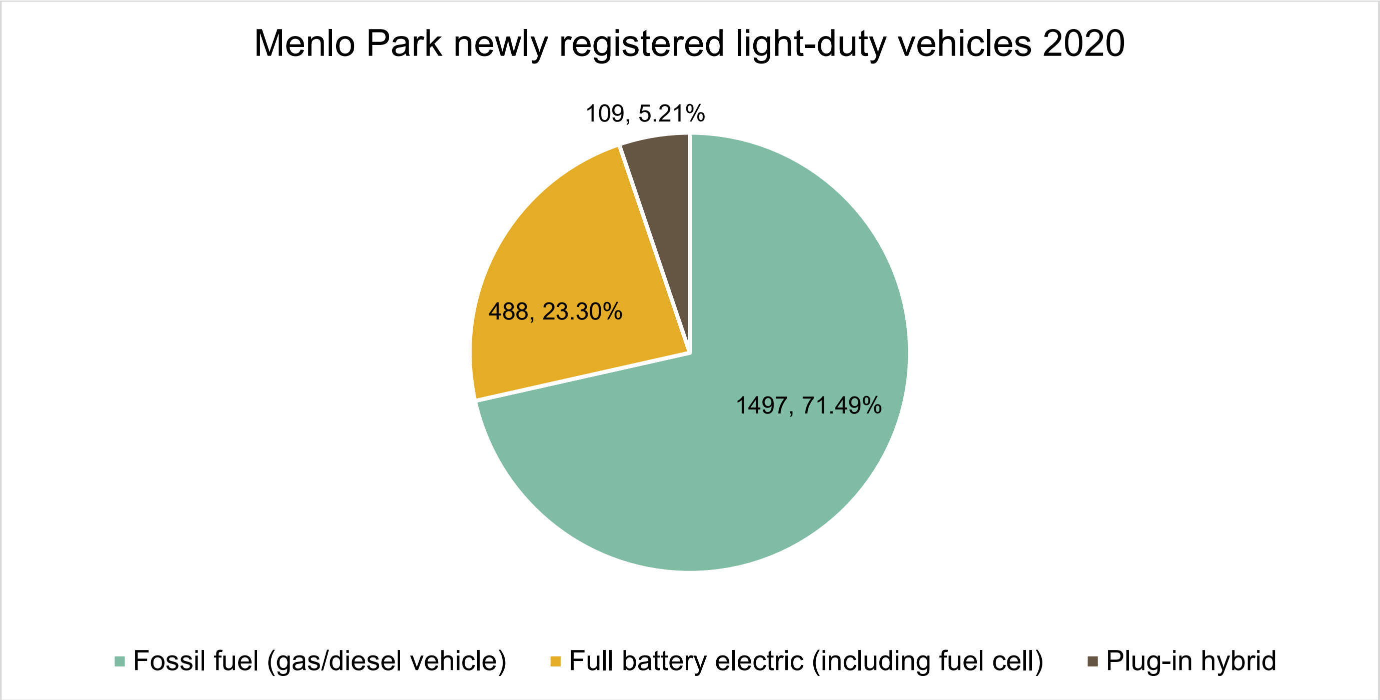
   Data limitation(s) and/or consideration(s): Upon contacting the local natural gas provider, Pacific Gas & Electric, city staff was informed this metric is not currently tracked and is not anticipated to be available to the public in the near future. Therefore, this data is not obtainable.

4. Metric no. 4: Number of light-duty vehicles newly registered that are fossil fuel (e.g., gasoline and diesel) vs. electric.

   Data limitation(s) and/or consideration(s): This is a synthesized data point provided by third party; city staff does not have access to raw or referenced data sets. This number is from a staff member at the California Energy Commission (CEC) using the Department of Motor Vehicles (DMV) Registration Data[30]. CEC staff used the following criteria to determine new registrations:
   - A recent model year (model years 2019+ are be considered "new")
   - The owner took possession of the vehicle within the reporting period
   - A low odometer reading (under 50 miles)
   - No history of prior ownership

   Additionally, provision of this data point is considered a special (not regularly analyzed/reported) request and is not readily available to the public. CEC staff does not currently and has no immediate plans to include city level data (i.e., newly registered light-duty vehicles in Menlo Park) in its regular reporting. For ongoing report of this metric, CEC staff recommends submitting formal requests for information to the DMV. Note, because this is considered a special request, no estimate on availability or timelines for future data requested is currently available.

Figure 2 describes newly registered light-duty vehicles in Menlo Park by fuel type:

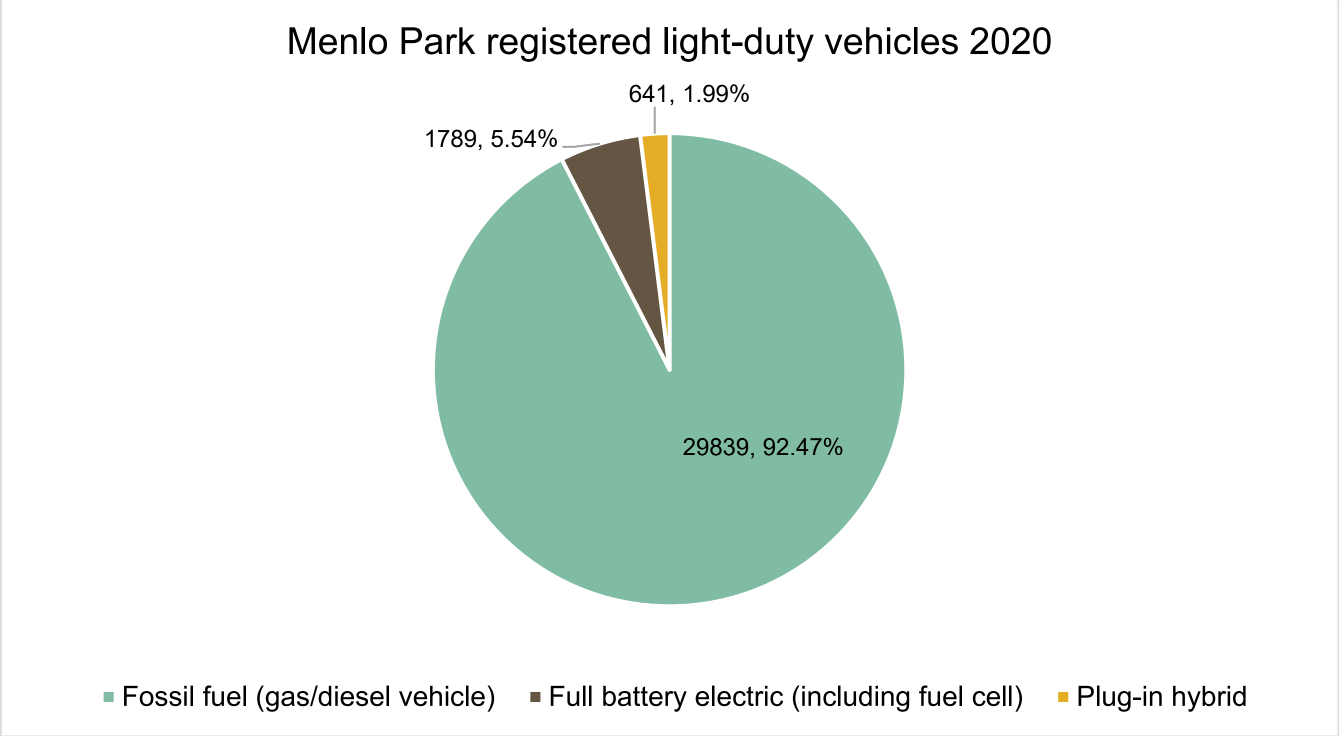


5. Metric no. 5: Number of total light-duty vehicles registered that are fossil fuel (gasoline) vs. electric.

[30] California Energy Commission, Zero Emission Vehicle and Infrastructure Statistics: energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics

Data limitation(s) and/or consideration(s): The Department of Motor Vehicles (DMV) currently reports vehicle counts by zip code, model year, fuel type, make, and duty (light/heavy) of registered vehicles at irregular intervals[31]. This report was last updated on December 14, 2020, but the DMV has provided no estimate on availability or future report updates. Lack of regular reporting intervals may impact future reporting of this metric. City staff has submitted a request to the DMV encouraging regular provision of this report.

Figure 3 describes the total number of light-duty, fully battery electric vehicles registered in Menlo Park:



6. Metric no. 6: Gallons of gasoline sold in Menlo Park.

   Data limitation(s) and/or consideration(s): Per the Climate Action Plan, gallons of fossil fuel (e.g., gasoline and diesel) are estimated using revenue data reported to the California Board of Equalization and average state gas prices.

Table 11 describes the estimated volume of fossil fuel sold in Menlo Park:

[31] California Department of Motor Vehicles, Vehicle Fuel Type Count by Zip Code: data.ca.gov/dataset/vehicle-fuel-type-count-by-zip-code

Table 11: City estimated fossil fuel sales			
Year	Gasoline (g)	Diesel (g)	Total Fuel
2001	16,459,982.14	914,443.45	17,374,425.60
2002	17,328,807.69	962,711.54	18,291,519.23
2003	16,203,111.70	900,172.87	17,103,284.57
2004	14,624,502.30	812,472.35	15,436,974.65
2005	14,239,357.14	791,075.40	15,030,432.54
2006	15,013,421.05	834,078.95	15,847,500.00
2007	14,551,615.38	808,423.08	15,360,038.46
2008	13,837,500.00	768,750.00	14,606,250.00
2009	14,825,472.53	823,637.36	15,649,109.89
2010	15,235,079.62	846,393.31	16,081,472.93
2011	15,437,310.16	857,628.34	16,294,938.50
2012	15,298,218.27	849,901.02	16,148,119.29
2013	15,172,023.26	842,890.18	16,014,913.44
2014	15,491,960.21	860,664.46	16,352,624.67
2015	14,790,242.24	821,680.12	15,611,922.36
2016	16,178,600.72	898,811.15	17,077,411.87
2017	16,730,094.82	929,449.71	17,659,544.53
2018	15,145,466.57	841,414.81	15,986,881.38
2019	13,055,148.55	725,286.03	13,780,434.59
2020	9,584,281.54	532,460.09	10,116,741.62

7. Metric no. 7: Percentage of municipal assets converted from gas or diesel to electric.

   Data limitation(s) and/or consideration(s): To determine percentage, city staff would need to audit all current assets. For the purposes of this metric, staff has defined an asset as city owned property or equipment with a purchase price/value of $5,000 or greater.

   While not represented in a percentage, the following summarizes the addition or replacement of fossil fuel (e.g., gasoline, conventional diesel, and natural gas) assets with electric and lower GHG emitting versions. Note, in July 2021, the City hired a consultant to assist Public Works with a long-term strategy for converting municipal assets from fossil fuel to electric.

   <u>Buildings</u>
   The Menlo Park Community Campus (MPCC) project includes the demolition and replacement of four existing buildings, including the Belle Haven Pool facility (currently the largest greenhouse gas emitter on-site). The new facility will be all-electric (no natural gas consumption), including solar heating for the pool.

Design projects replace the HVAC equipment in the Arrillaga Family Recreation Center (700 Alma Street) and Gymnasium (600 Alma Street) buildings are also currently underway, and all-electric options are planned. This equipment is likely to be replaced in 2022.

Fleet

In alignment with the Sustainable Fleet Policy, city staff proposes the following vehicle replacement for fiscal year 2021-22:

- Seven gasoline hybrid police vehicles; six replacing gasoline vehicles and one would replace an existing gasoline hybrid.
- Five heavy-duty trucks; four renewable diesel and one gasoline. The proposed gasoline truck would replace an older diesel truck due to its inefficiencies and high maintenance costs. One of the four renewable diesel heavy-duty trucks includes a hybrid component; the vehicle would run on renewable diesel to travel to/from job sites but use an electric battery in operation at the jobsite.

City staff continue to strive towards the benchmarks outlined in Sustainable Fleet Policy and research electric options for fleet vehicles as the technology becomes more readily available. For example, the City reserved five full battery electric Ford F-150 light-duty trucks, which are planned to go into production in 2022. Light-duty trucks are used for daily operations, such as carrying tools and small equipment.

Additionally, in 2020, the City added four all-electric leaf blowers to existing equipment to pilot their use for daily maintenance duties.

8. Metric no. 8: Vehicle miles traveled, including trips inbound, outbound, and within the City.

   Data limitation(s) and/or consideration(s): Per the 2030 Climate Action Plan, this metric was sourced from Google Environmental Insights Explorer[32]. Google EIE uses proprietary data derived from Google Maps Location History data to estimate trips taken within a city's boundaries. These estimates are multimodal (passenger vehicle, bus, cycling, rail, and walking) and including vehicles traveling into (inbound), leaving (outbound), and within (in-boundary).

   Note: The vehicle miles traveled standards in Transportation Impact Analysis (TIA) guidelines were developed using the City's Travel Demand Model and may have different results than other methodologies (i.e., Google Environmental Insight Explorer, California Department of Transportation Highway Performance Monitoring System).

Table 12 describes the total vehicle kilometers (approximate miles) traveled:

[32] Google Environmental Insights Explorer: insights.sustainability.google

Table 12: Climate Action Plan Metric No. 8		
Year	Total vehicle km (mi) traveled	% change (year to year)
2018	1,140,000,000 km (~708,363,156 mi)	
2019	1,160,000,000 km (~720,790,580 mi)	1.75%
2020	610,000,000 km (~379,036,425 mi)	-47.41%[33]

9. Metric no. 9: number of other cities that query and/or copy Menlo Park's climate policies and programs

   Data limitation(s) and/or consideration(s): There is currently no tracking system in place to record these queries and/or incidents, especially if policies and/or programs are templated from publish reports which are readily available to the public.

[33] Note: In March 2020, in response to the COVID-19 pandemic the state of California issued a shelter-in-place order.

COMMUNITYWIDE GREENHOUSE GAS INVENTORY

Overview

To track progress of Climate Action Plan strategies and programs, the City calculates and tracks its greenhouse gas (GHG) emissions. The City Council had a GHG reduction goal of 27 percent below 2005 levels by 2020. In 2005, the community generated 349,284 tons of GHG emissions in four categories: transportation, solid waste, building energy use: natural gas consumption, and building energy use: electricity. This means Menlo Park's 2020 GHG emission target is 254,977 tons or a 94,307 ton reduction.

The most recent data shows the City has achieved notable emission reductions in the face of continued development and has successfully achieved its target. Between 2005 and 2019, communitywide greenhouse gas emissions have decreased to 253,371 tons. This reflects a 27.5 percent decrease relative to the 2005 baseline. This can be attributed to reductions from:

- Waste related emissions (-15,723 tons) due to:
  - Installation of gas capture devices at the primary landfill that services Menlo Park, Ox Mountain landfill.
  - Improved sorting and waste diverted from landfill. Note, this is due to statewide requirements and regional cooperation.

- Building energy use: electricity (-64,591 tons) due to:
  - State mandates requiring energy providers, such as Pacific Gas & Electric to obtain power with lower emissions and from renewable sources.
  - Menlo Park subscribing all residents and businesses to the community choice aggregate organization, Peninsula Clean Energy (PCE). PCE provides Menlo Park with cleaner electricity, from more renewable sources (e.g., solar, wind, and geothermal) to reduce the consumption of fossil fuels (like natural gas). As of 2021, all electricity provided by PCE is 100% carbon-free and is on track to be 100% renewable by 2025. It should be noted this single measure reduced electricity related emissions by 24,689 tons in one year (2016-2017).

- Transportation related emissions (-36,657 tons between 2017 and 2019) due to:
  - Increased state mandated fuel efficiency and emission standards.
  - This is also a possible indication of increased zero emission vehicle adoption and/or local trip and vehicle miles traveled reduction measures.

Community greenhouse gas emissions results

A communitywide greenhouse gas emissions inventory involves measuring the energy and fuel consumed, and solid waste generated in the community to calculate the resultant greenhouse gases. The City completed an inventory of its 2005 communitywide greenhouse gas emissions, which serves as its baseline. The initial 2005 inventory was conducted in conjunction with ICLEI-Local Governments for Sustainability, an organization that specializes in climate change and greenhouse gas inventories for cities and counties. To maintain consistency, staff has continued to use the ICLEI methodology. Greenhouse gas emissions in Menlo Park were measured from:

- Estimated fossil fuel (gasoline and diesel) consumption
- Estimated vehicle miles traveled
- Reported solid waste sent to the landfill
- Building energy usage (natural gas and electricity consumption) by account type

Figure 4 describes annual communitywide emissions with percentage by category. Figure 5 summarizes communitywide emissions for the most recent inventory year (2019). As shown in Figures 4 and 5, the most significant source of emissions is transportation (48.2 percent), followed by natural gas consumption (41.2 percent). For comprehensive data summary, refer to Appendix A.

Figure 4-Community greenhouse gas emission 2005-2019 by category

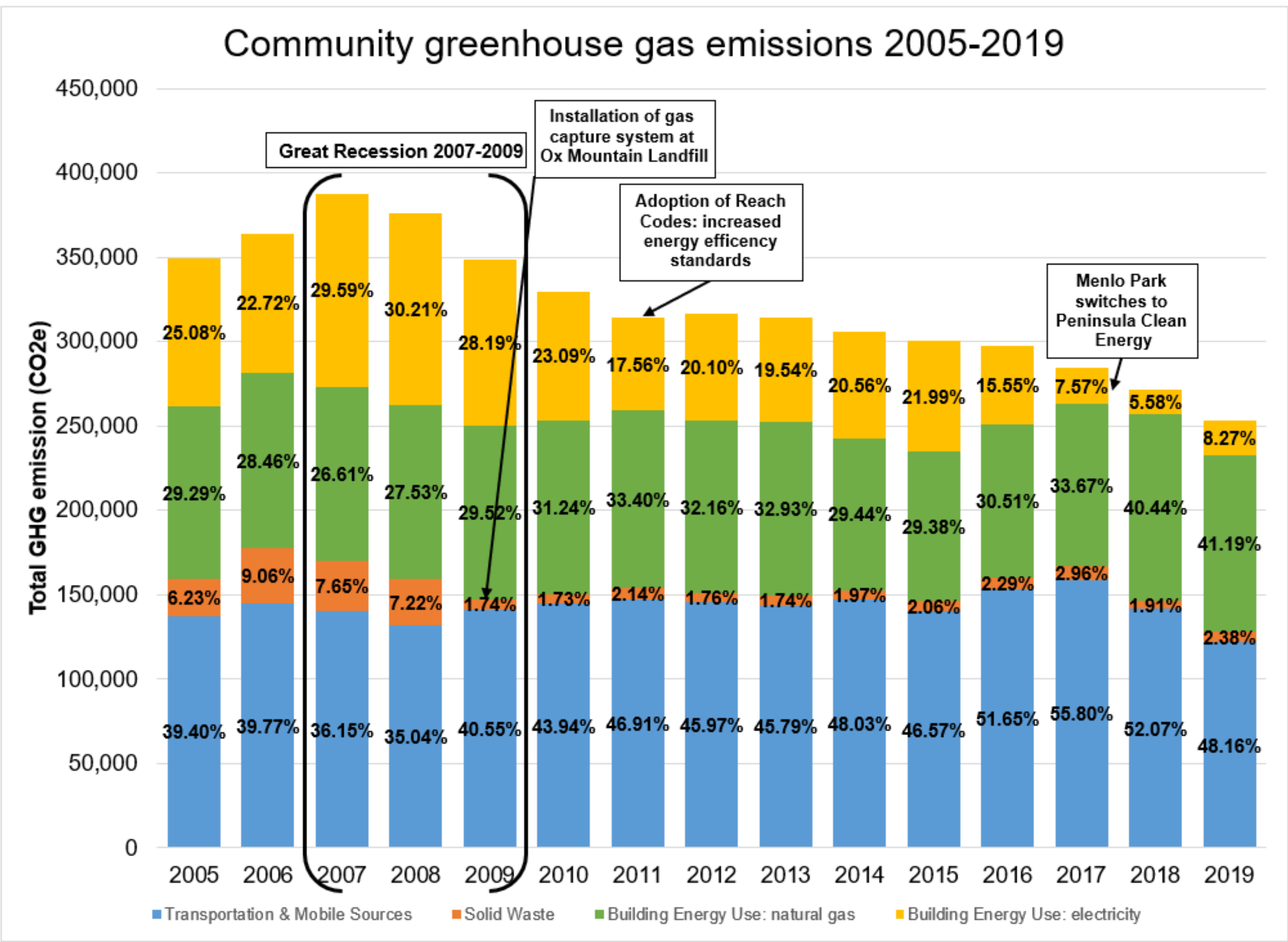


Figure 5-City of Menlo Park communitywide greenhouse gas emissions 2019

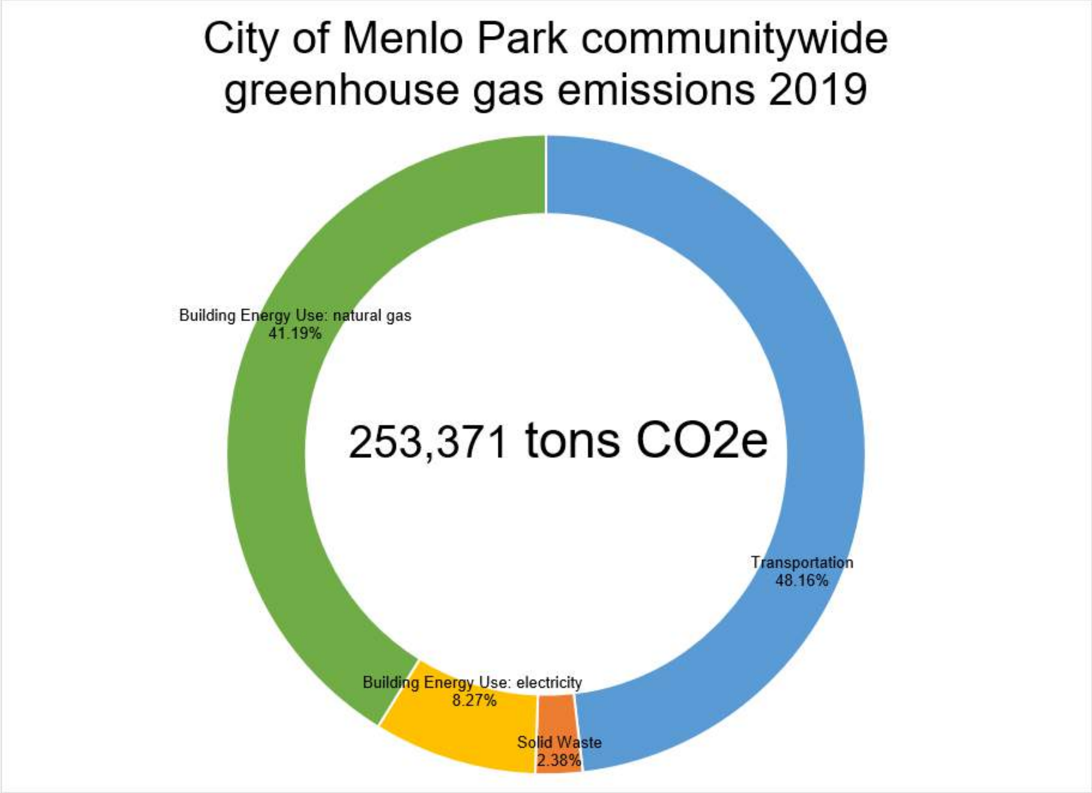
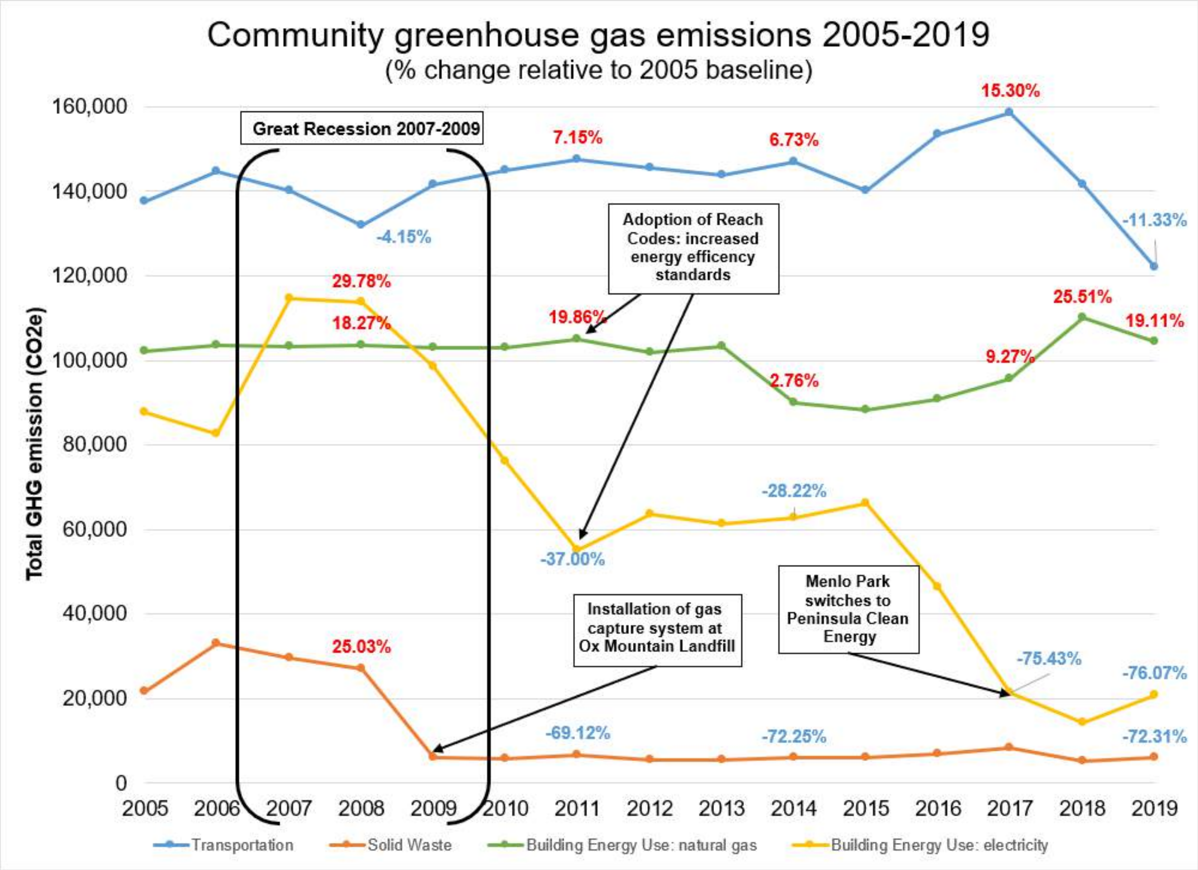


Figure 6 highlights changes in community greenhouse gas emissions by category:



Economic/development events are also noted, such as the Great Recession, installation of gas capture devices at Ox Mountain Landfill (primary landfill that services Menlo Park), and city implemented reduction strategies (adoption of local ordinance, automatic enrollment in Peninsula Clean Energy). These noteworthy events show while local strategies can affect communitywide greenhouse gas emissions, they can also be influenced by factors outside the City's purview (e.g., economic event, state, or regional efforts, etc.).

Methodology/measurement notes and considerations

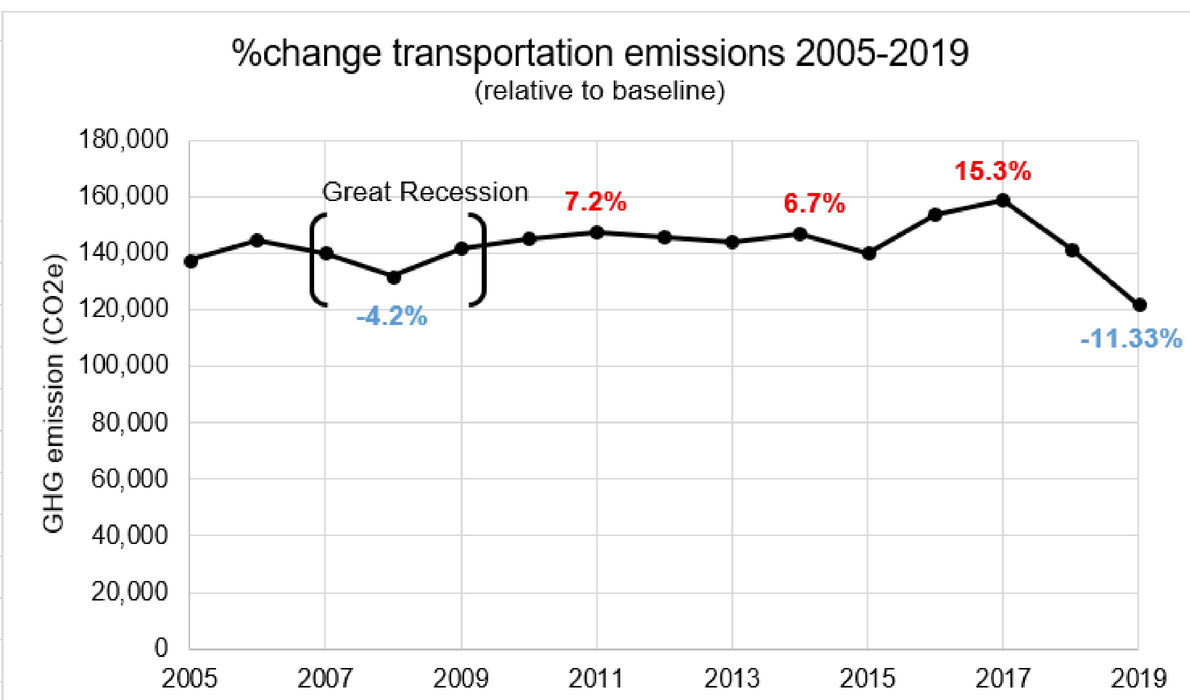
It is important to note that any greenhouse gas emissions inventory represents an estimate using the best available data and calculation methodologies at the time it was conducted. These estimates are subject to change as better data and calculation methodologies become available.

Current data and calculation methodologies also have limitations, for example solid waste emissions include only the direct emissions due to waste breakdown and do not represent emissions associated with the sourcing, production, or transportation of goods (cradle-to-grave emissions). Limitations such as these may underrepresent related emissions.

Inventory data for 2020 will not be available until Fall 2021.

Transportation

Despite recent overall reductions (11.3 percent relative to 2005 baseline), fossil fuel (gasoline and diesel) vehicle travel continues to be the largest source of greenhouse gas emissions in Menlo Park. In 2019, transportation related emissions were 122,029 tons (48.2 percent of the communitywide total). For comprehensive summary of data, refer to Appendix A. Figure 7 describes the change in transportation related emissions relative to the 2005 baseline:



The transportation category includes emissions related to passenger vehicle travel within (in-boundary) Menlo Park. Emissions are estimated using both vehicle miles travel (VMT) estimates from the California Department of Transportation (Caltrans) Highway Performance Monitoring System data and estimated fuel usage derived from fuel vehicle sales tax reported to State of California Board of Equalization and average gas prices. These data sets (VMT and fuel usage) are used to estimate different transportation related greenhouse gases:

- Estimated vehicle miles traveled are used to calculate methane (CH_4) and nitrous oxide (N_2O) emissions
- Estimated fuel usage is used to calculate carbon dioxide (CO_2) emissions

It should be noted, VMT or fuel usage have been used in past inventories to approximate total transportation related emissions independently to prevent double counting. However, this calculation method allows for the use of both since they calculate different GHG emissions.

Also note, Caltrans Highway Performance Monitoring System vehicle miles travel estimate methodology may differ from City VMT standards for specific development and city capital projects. Thus, estimates may differ.

The Bay Area has experienced a period of increased development. In addition to development completed in 2018 and 2019, the City expects the replacement and rebuild of 100 new homes and the addition of 21 new buildings that include high-rise residential, retail, office, and hotels over the next three years (2020 to 2023). The estimated daytime (resident and employee) population is estimated to be 64,152 by the end of this code cycle (2023).

It is important to note, that while the State has had established vehicle emissions reduction requirements since 2002[34] and in 2012 the California Air Resources Board (CARB) adopted mandates for emissions standards[35], these programs affect new vehicles only. As of 2020, the average age of cars on the road in California is estimated to be 11.9 years[36]. Average car age in the United States has increased since this metric started being tracked and is predicted to increase especially in regions, like the Bay Area, where the cost of living is higher than average.

Furthermore, in September 2020, Governor Gavin Newsom signed Executive Order N-79-20[37], setting a target for all new passenger cars and light truck sales to be zero-emission (ZEV) by 2035. While this may increase the adoption of new ZEVs (i.e., electric vehicles), considering this order relates to new vehicles sales only, it may further increase the average age of cars on the road in Menlo Park.

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[34] California Assembly Bill 1493 Vehicular emissions: greenhouse gas emissions (also known as the Pavely legislation) establishing emissions standards for new passenger vehicles manufactured in 2009-2016

[35] Advanced Clean Car Programs a set of regulations to control emissions from passenger vehicles arb.ca.gov/our-work/programs/advanced-clean-cars-program/about

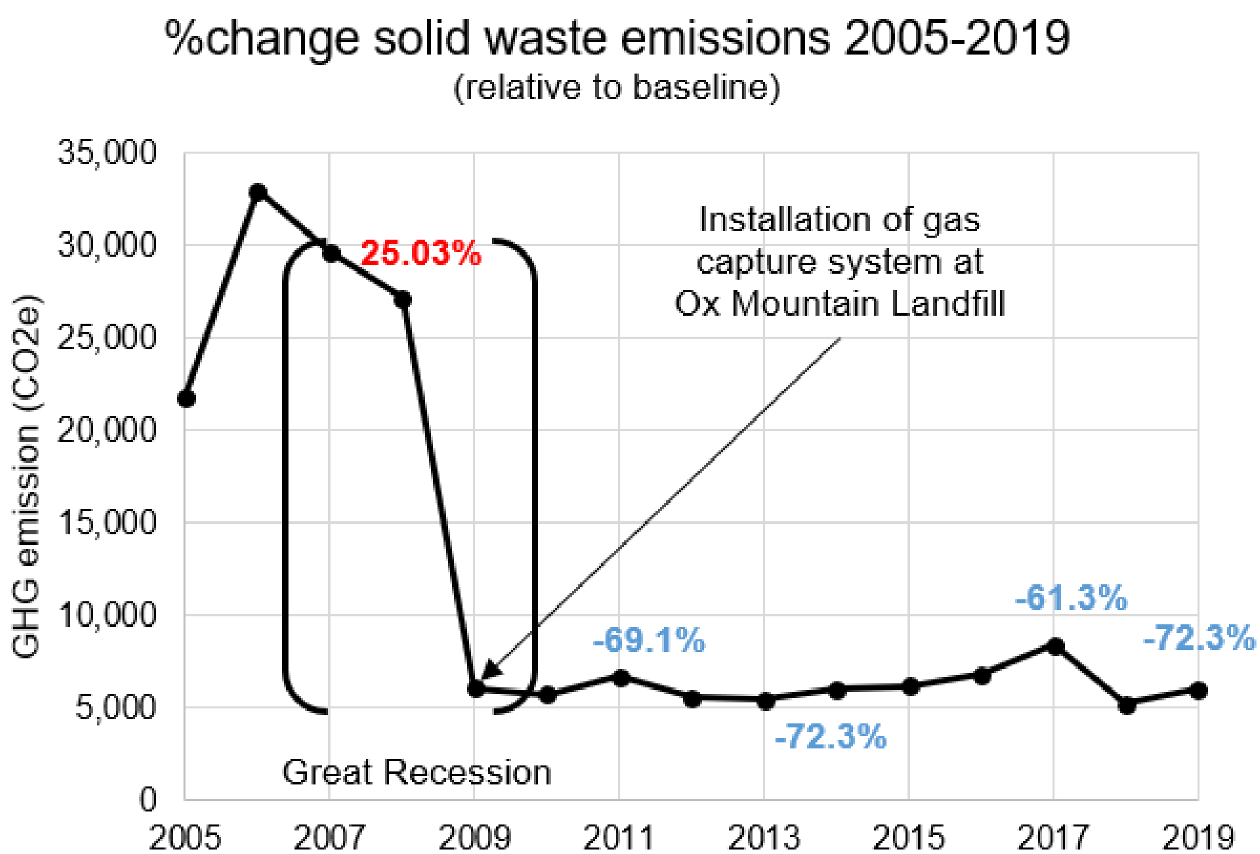
[36] Bureau of Transportation Statistics: bts.gov/content/average-age-automobiles-and-trucks-operation-united-states

[37] Governor Newsom's Zero-Emission by 2035 Executive Order (N-79-20): arb.ca.gov/resources/fact-sheets/governor-newsoms-zero-emission-2035-executive-order-n-79-20

Solid Waste

The current greenhouse emission calculation methodology shows direct emissions from solid waste to be the smallest source of emissions in Menlo Park. However, solid waste emissions include only the direct emissions due to waste breakdown and do not represent emissions associated with the sourcing, production, or transportation of goods (cradle-to-grave emissions). If the cradle-to-grave emissions were accounted for, the emissions associated with waste would be significantly higher.

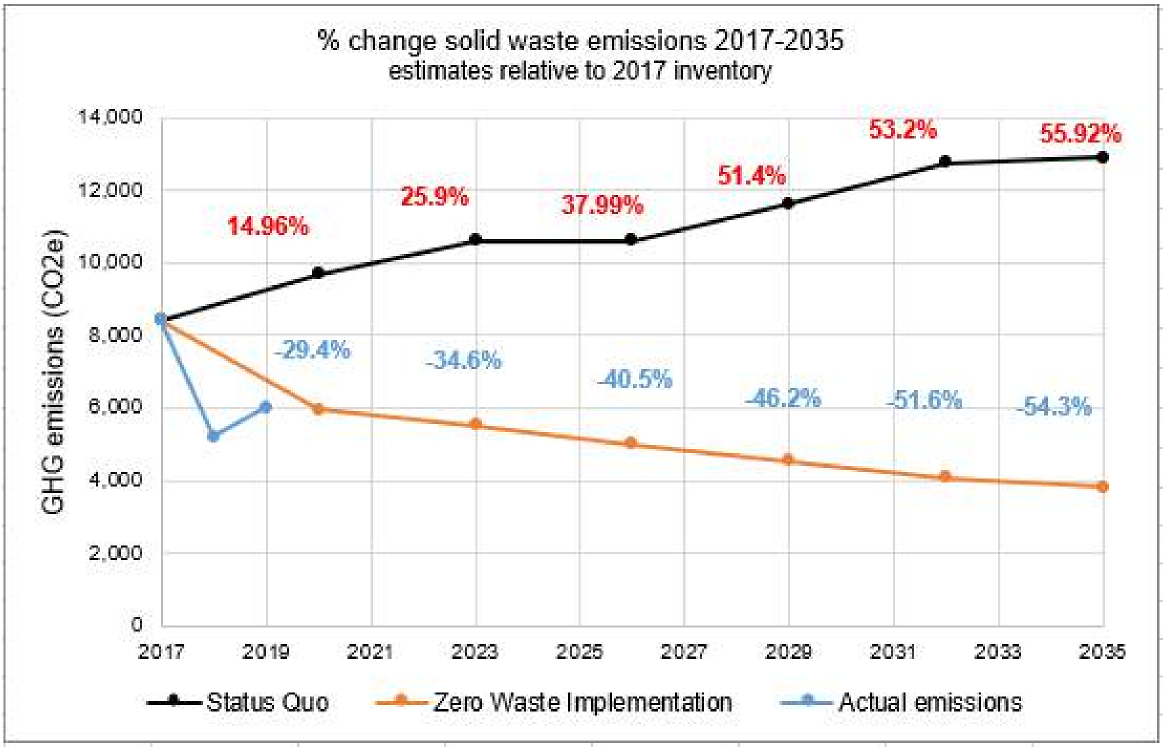
The solid waste category reflects emissions related to total community waste sent to landfill reported to California Department of Resources Recycling and Recovery (CalRecycle). In 2019, solid waste related emissions were 6,022 tons (2.38 percent of the communitywide total). For comprehensive summary of data, refer to Appendix A. Figure 8 describes the change in solid waste related emissions relative to the 2005 baseline:



In 2017, City Council adopted the Community Zero Waste Plan. This plan could reduce waste related emissions by over 50 percent over 2017 levels. The following figure shows emissions forecasts for both status quo (no new measures undertaken) and fully implementation of the Community Zero Waste Plan (reduction of waste per capita from 5.0 to 3.1 pounds per person per day).

As of 2019, solid waste emissions are on trend with zero waste implementation estimates. Reductions in this category may be attributed to improved sorting and waste diverted from landfill. Note, this is due to statewide requirements and regional cooperation

Figure 9-Estimated solid waste related emissions 2017-2035



Building Energy Use: natural gas and electricity

In 2016, all electricity customers in the City of Menlo Park began being automatically enrolled in Peninsula Clean Energy service. This action alone reduced greenhouse gas emissions related to electricity 24,689 tons in a single year (2016-2017).

Due to significant reductions in electricity related emissions, staff has separated building energy use into two distinct categories, building energy use: natural gas and building energy use: electricity. Analysis at this level provides more granular data to support 2030 Climate Action Plan strategies such as existing building electrification (No. 1).

In 2019, building energy use: natural gas was the second largest contributor communitywide emissions, 104,358 tons (41.2 percent of the communitywide total). For comprehensive summary of data, refer to Appendix A.

Figure 10 describes overall building energy use emissions by type (natural gas versus electricity):

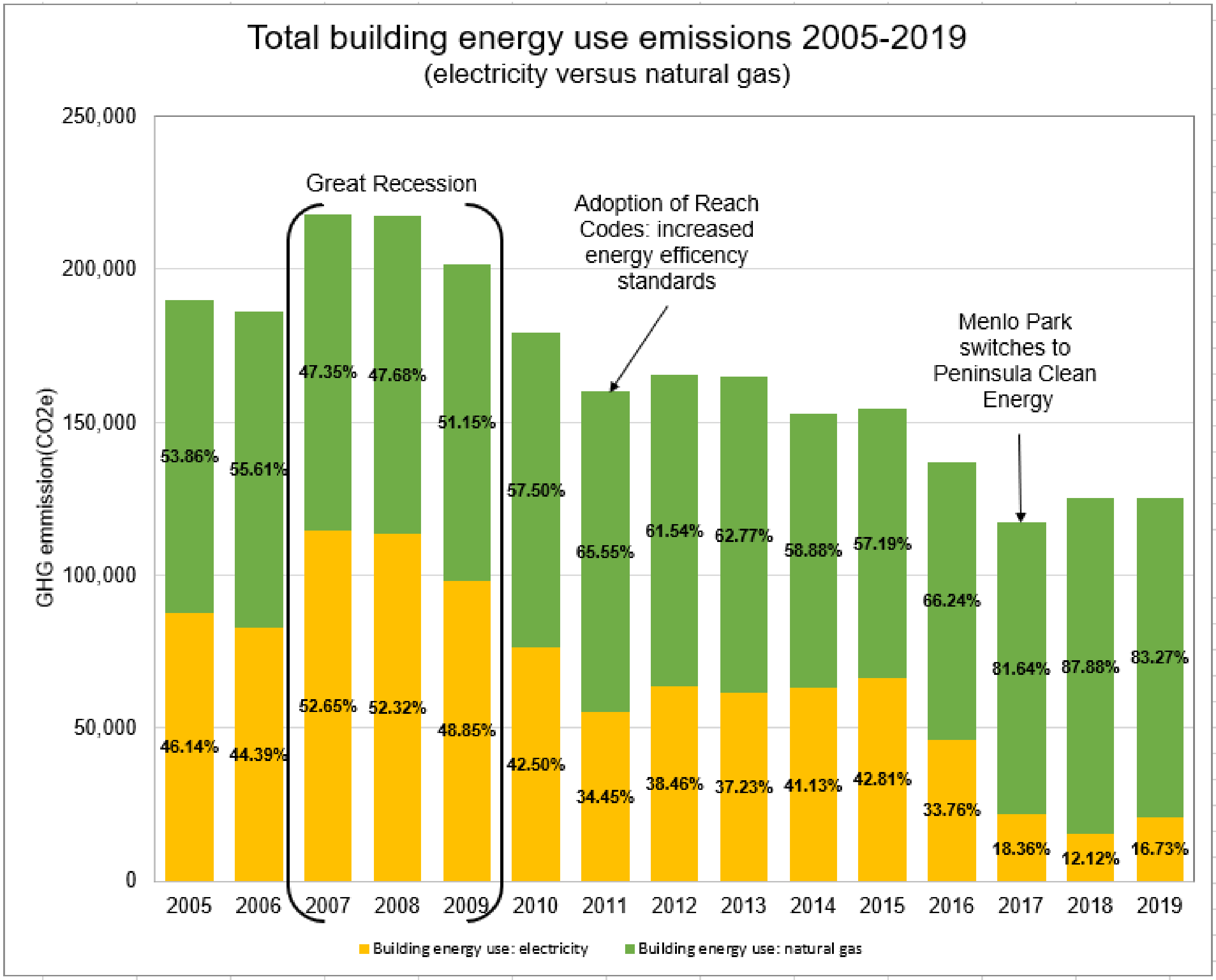
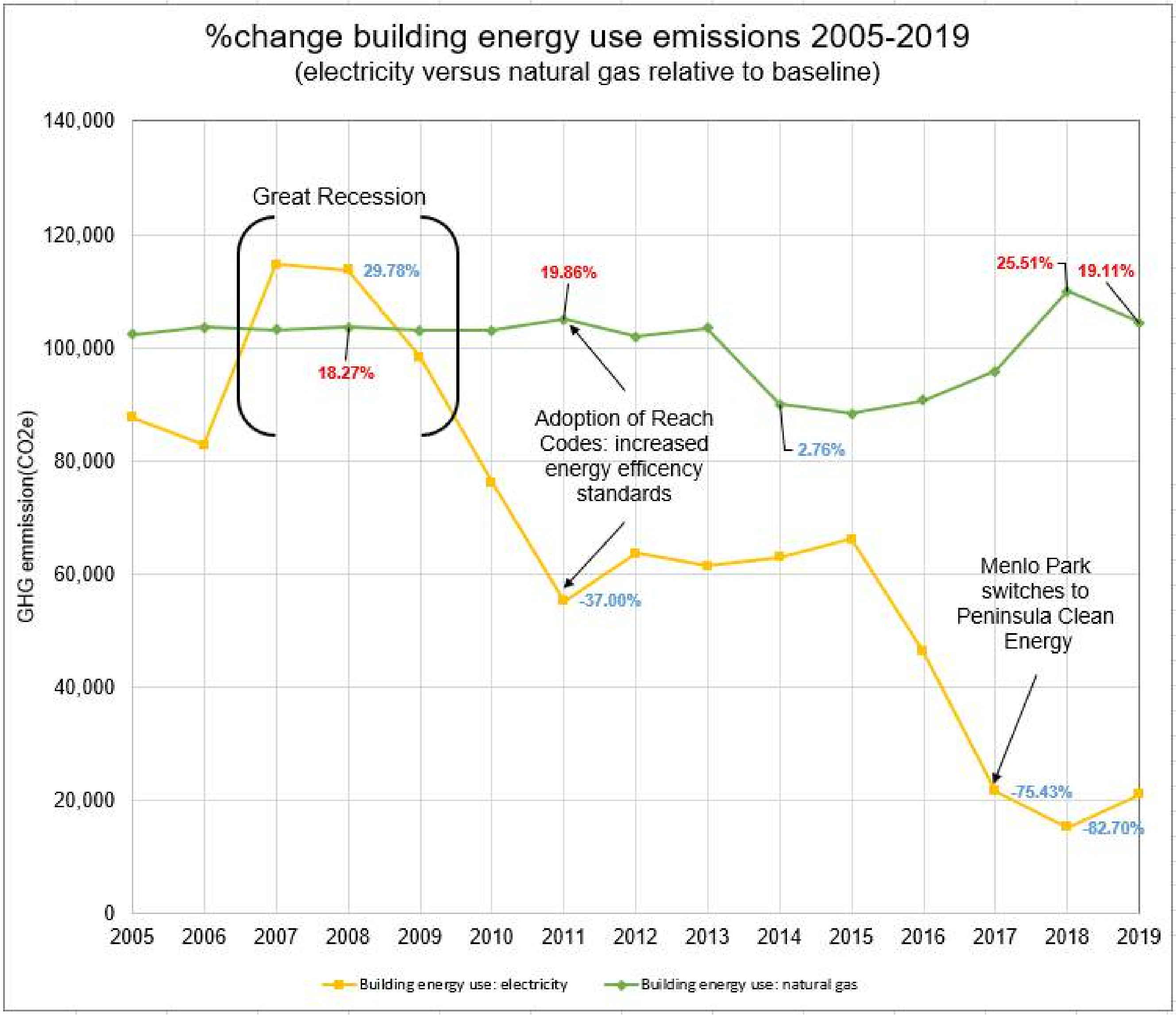


Figure 11 highlights changes in building energy use relative to the 2005 baseline by type (natural gas versus electricity):



The building energy use category includes both natural gas consumption and electricity use reported by Pacific Gas & Electric (PG&E) and Peninsula Clean Energy (PCE). In April 2017, all San Mateo County electricity customers (including Menlo Park) were fully transitioned to PCE service, therefore PCE data is available for 2017 to 2019 inventories only.

Automatic enrollment in PCE service comes with the ability to opt-out (retain PG&E service) if desired. As of May 2021, Peninsula Clean Energy services 98.6 percent of all electricity customers in Menlo Park.

Since launching in 2016, PCE has provided cleaner energy every year; though significantly lower than PG&E, the PCE provided electricity did have associated carbon emissions with the goal of being carbon-free. Emissions related to electricity use are expected to decrease further in 2020 as energy sources increasingly become carbon neutral or free.

In March 2021, Peninsula Clean Energy accomplished its carbon-free goal and reported all electricity provided is 100 percent carbon-free, at least 50 percent renewable, and nonnuclear. Nominal emission related to electricity consumption are expected after 2021 for customers who have opted out of PCE service.

While emissions related building energy use: electricity have and are expected to decreased to near minimal levels, the emissions related to natural gas are likely to remain unchanged or increase until natural gas-powered appliances in existing building stock are replaced.

It should be noted, in Fall 2019, the City adopted building codes eliminating the installation of natural gas infrastructure in new commercial and residential buildings. These codes were implemented in 2020. Building code updates related to existing buildings are currently being explored.

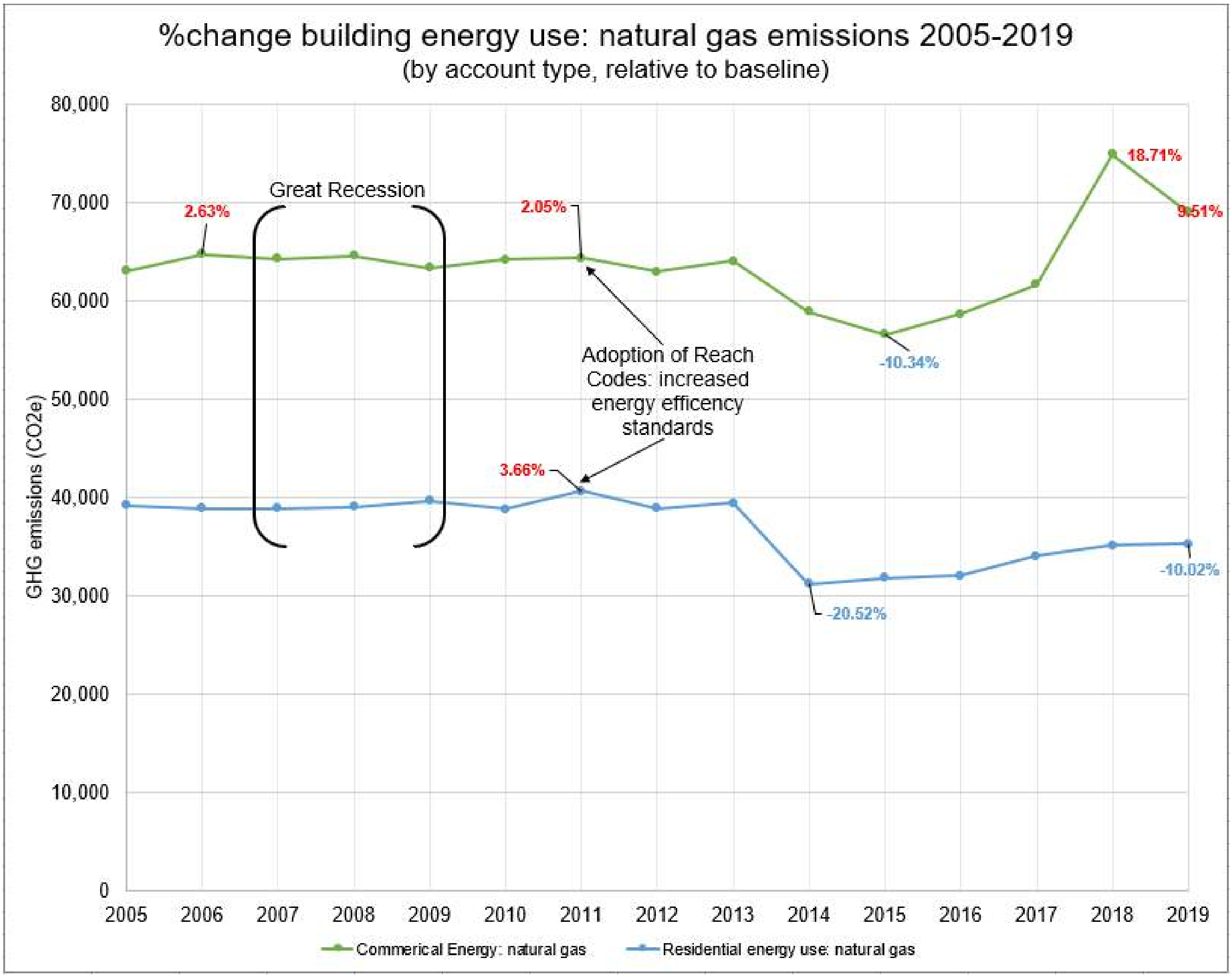
Building energy use by account type

Natural gas is the second largest contributor to communitywide GHG emissions, evaluating natural gas separately by account type can provide insights for future policy and programs around building electrification.

Commercial accounts are the largest GHG contributor in the building natural gas use. In 2019, building natural gas emissions from commercial accounts were 69,049 tons from or approximately 55.1 percent total building natural gas consumption. In 2019, building natural gas use emissions from residential accounts were 35,309 tons or approximately 28.2 percent of natural gas emissions for buildings. For comprehensive summary of data, refer to Appendix A.

The emissions related to natural gas are likely to remain unchanged or increase until natural gas-powered appliances in existing building stock are replaced. Note, all new construction projects are subject to 2020 reach codes prohibiting the installation of natural gas infrastructure (all-electric) with limited exception.

Figure 12 highlights changes in building energy use: natural gas emissions relative to baseline (2005) by account type (commercial and residential):



As of May 2021, Peninsula Clean Energy services 1,727 commercial customers, 1 industrial customer (included in commercial energy category), and 13,766 residential customers. This data also includes usage from customers who opt out (decline) PCE service.

Note, direct access accounts have emissions related to electricity use only. For building energy use related to direct access accounts, refer to Appendix B.

MUNICIPAL GREENHOUSE GAS INVENTORY

Overview

To track progress of Climate Action Plan strategies and programs, the City calculates and tracks its greenhouse gas emissions. In 2016, municipal operations generated 2,812 tons of GHG emissions in six categories: natural gas consumption, electricity use, vehicle fleet, employee commute, waste generation, and emissions from decommissioned Bedwell Bayfront landfill.

The City Council has adopted communitywide GHG reduction goals of 27 percent below 2005 levels by 2020 and zero net emissions by 2030 but does not currently have a specific target for municipal operations. Though there is no specific target, the most recent data shows the City has successfully reduced emissions to 2,178 (22.6 percent relative to 2016 levels) in 2019. This can be attributed to reductions from:

- Building/facility energy use related emissions (-540 tons) due to:
  - Menlo Park city buildings and facilities subscribing to the community choice aggregate, Peninsula Clean Energy (PCE). In 2017, Menlo Park took formal action to enroll all municipal accounts in ECO100 which provides 100% renewable electricity to subscribers. This means, all electricity provided to the City by PCE is Green-e certified; 100% from renewable sources (i.e., solar and wind) and carbon-free.

- Solid was related emissions (-120 tons) due to:
  - Incremental reduction at Bedwell Bayfront Landfill. Note, this landfill has been decommissioned (no new material is being disposed) so emissions will continue to decrease with no intervention.
  - Improved sorting and waste diverted from landfills. Note, this is due to statewide requirements and regional cooperation.

Municipal greenhouse gas emissions inventory results

The City completed an inventory of its municipal greenhouse gas emissions from 2016-2019. The aim is to update the municipal inventories every five years to use resources efficiently. The inventory was conducted in conjunction with ICLEI-Local Governments for Sustainability, an organization that specializes in climate change and greenhouse gas inventories for cities and counties.

Greenhouse gas emissions in Menlo Park were measured from:

- Reported vehicle fleet fuel consumption, vehicles miles traveled, and equipment run time
- Estimated solid waste sent to the landfill (both municipal solid waste/trash and organics)
- Reported gas captured at Bedwell Bayfront Landfill
- Reported energy usage by type (natural gas and electricity)
- Reported commuter program participation with transportation method and vehicle miles traveled estimates

Note, the 2009 inventory included emissions related to water/sewage and excluded emissions related to employee commute and the Bedwell Bayfront Landfill. Also, emissions related to buildings and streetlights are included as separate categories. However, due to the formal action taken in 2017 to enroll all municipal accounts in ECO100, staff now calculates emissions related to natural gas consumption and electricity use separately (regardless of location, i.e., building/facility or streetlight). For previous inventory, refer to Appendix B.

Figure 13 describes annual municipal emissions with percentage by category. Figure 14 is a summary of total municipal emissions from 2019. As shown in Figure 13 and 14, the most significant source of emissions is natural gas consumption (35.35 percent), followed by vehicle fleet (23.46 percent).

Figure 13-Municipal greenhouse gas emission 2016-2019 by category

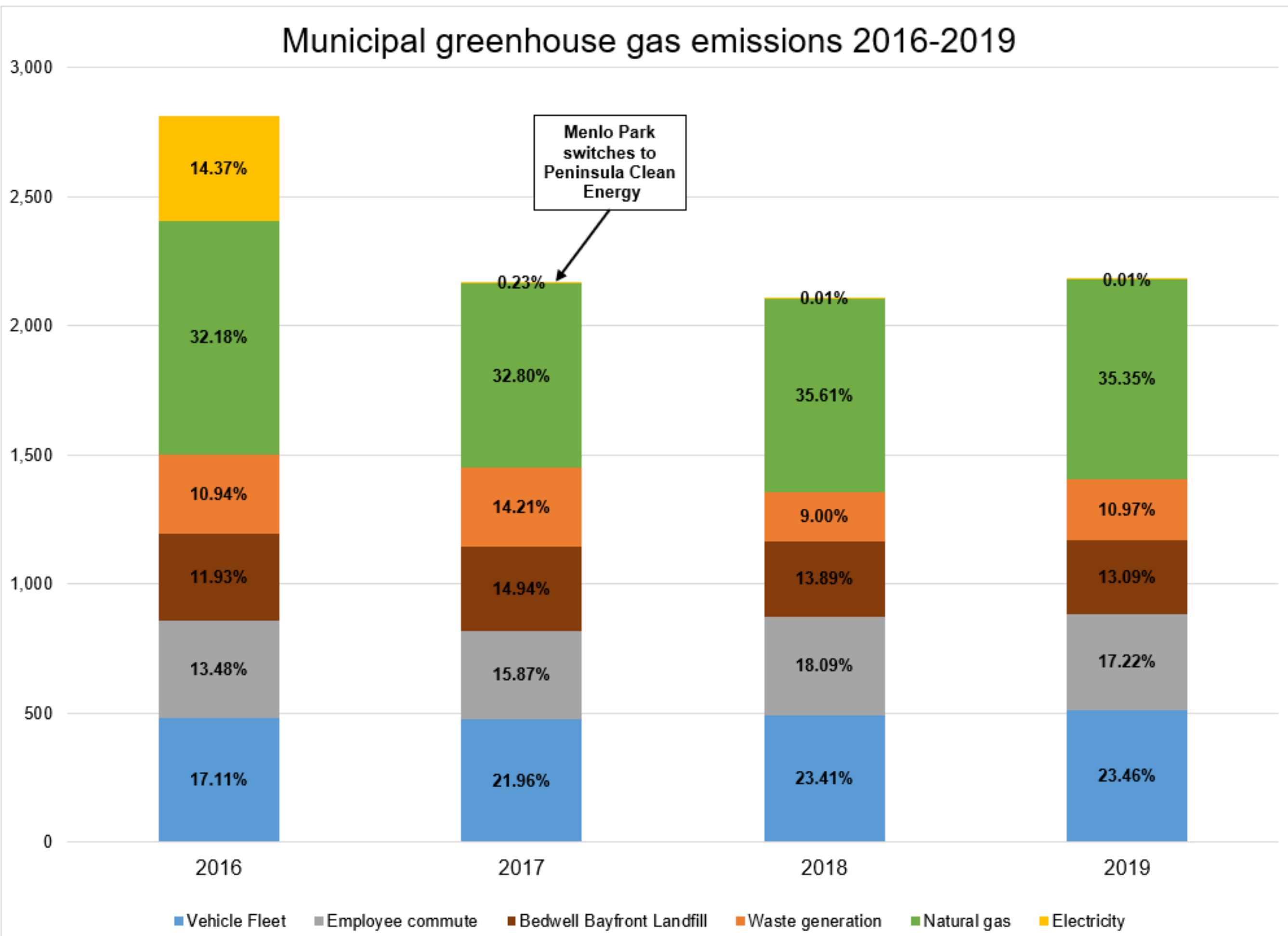


Figure 14-City of Menlo Park municipal greenhouse gas emissions 2019

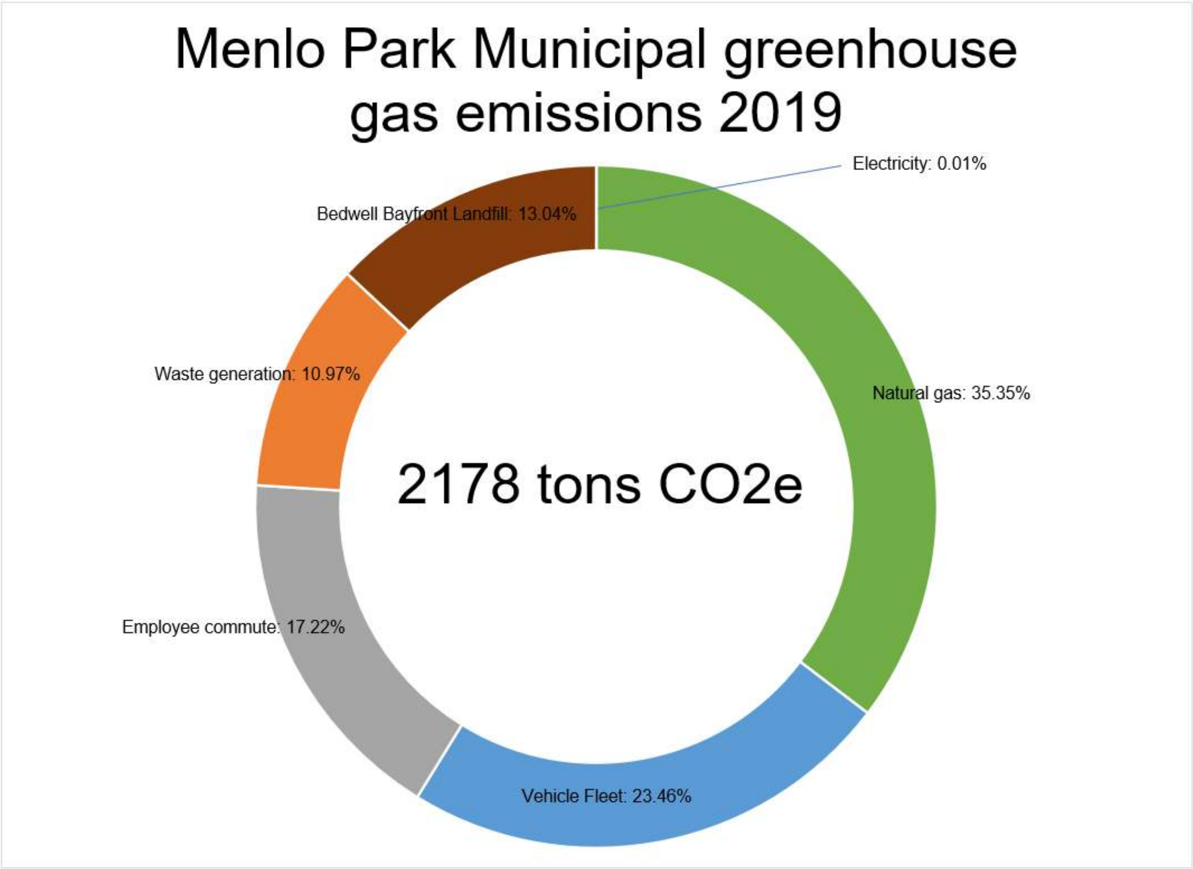
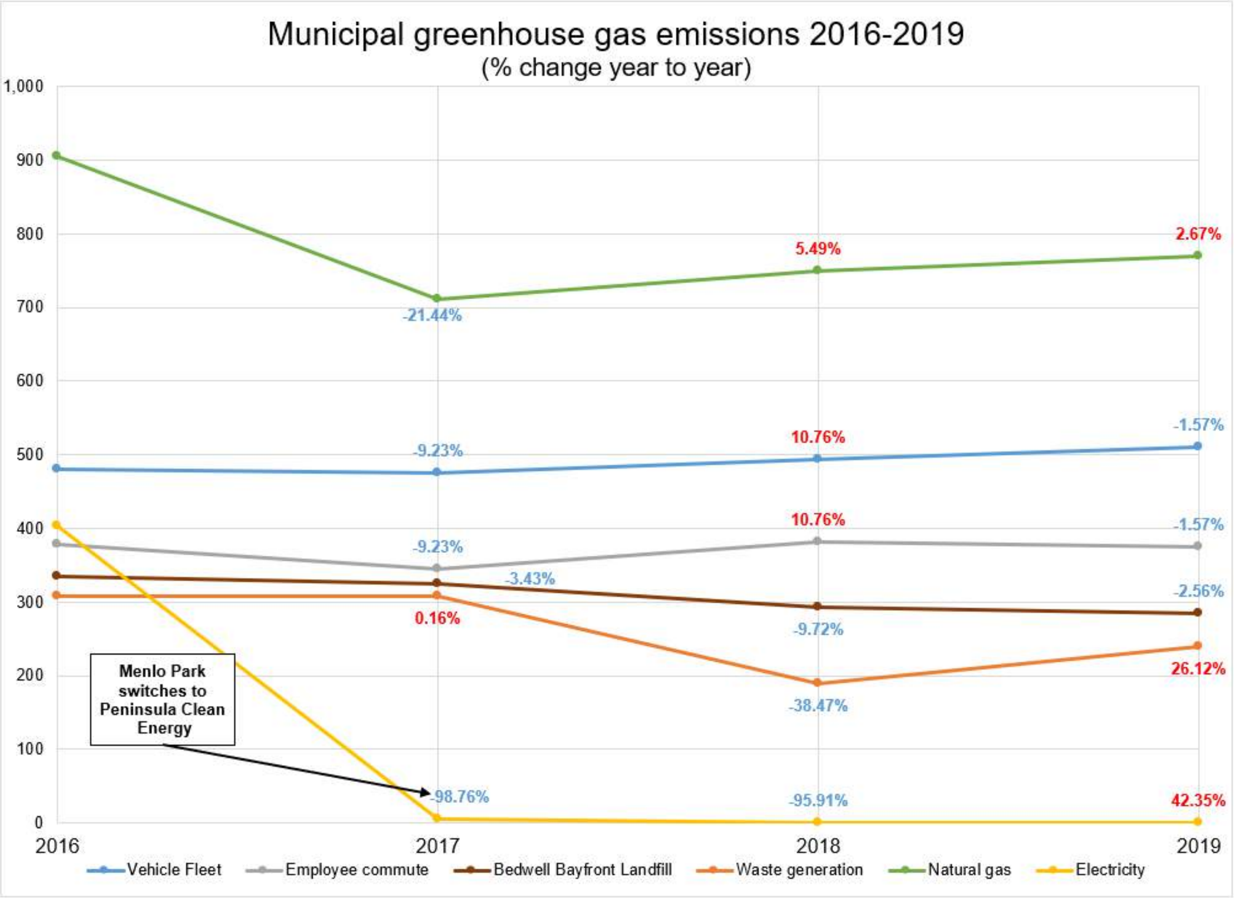


Figure 15 highlights changes in municipal greenhouse gas emission by category:



Methodology and measurement notes

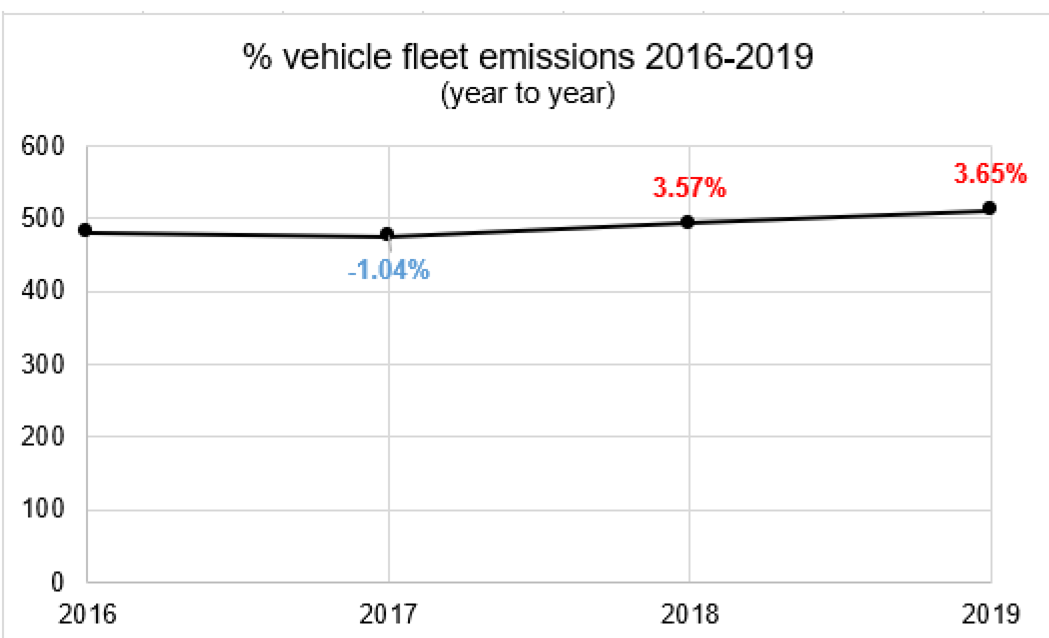
The City can calculate emissions generated by municipal operations related to water and wastewater emissions, fugitive point sources, and more. However, the city has elected to calculate greenhouse gas emissions in six categories (natural gas consumption, electricity use, vehicle fleet, employee commute, waste generation, and emissions from decommissioned Bedwell Bayfront landfill) to provide the most accurate measure of progress in the sectors under the City's purview which will receive the greatest impact from local action.

It is also important to note that any greenhouse gas emissions inventory represents an estimate using the best available data and calculation methodologies at the time it was conducted. These estimates are subject to change as better data and calculation methodologies become available.

Inventory data for 2020 will not be available until Fall 2021.

Vehicle Fleet

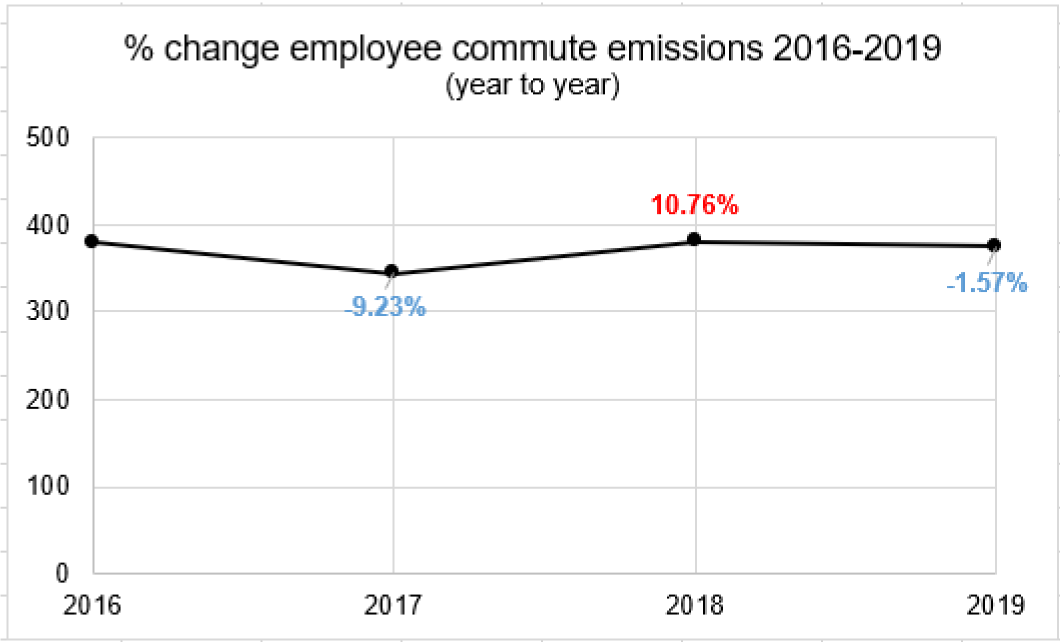
The transportation category includes emissions related to vehicle fleet fuel consumption, vehicles miles traveled, and equipment run time recorded and reported by Menlo Park Public Works, Maintenance Division. As of 2019, vehicle fleet emissions are the second largest contributor to municipal greenhouse gas emissions; 511 tons (23.46 percent of total). Figure 16 highlights the change in emission from 2016 to 2019:



Vehicle fleet related emissions are expected to reduce due to the Sustainable Fleet Policy which prioritizes the purchase of zero-emission vehicles as a first option and establishes a fossil fuel (e.g., gasoline and diesel) reduction goal of 5 percent annually over 2018 baseline.

Employee commute

The employee commute category includes emissions related to commuter program participation reported by Menlo Park Public Works, Transportation Division, and transportation method[38] and vehicle miles traveled[39] estimates derived from regional data reported by the Metropolitan Transportation Commission. As of 2019, vehicle fleet emissions are 375 tons (17.22 percent of total). Figure 17 highlights the change in emission from 2016 to 2019:



Employee commute related emissions are expected to reduce in the near term due to a significant increase in telecommuting/working remote because of the COVID-19 pandemic. At date of publication, though the prevalence of telecommuting/working remote remains, it is unclear if will persist as state, regional, and city restrictions lift.

Considering the previous need for social distancing requirements (COVID-19 prevention measure), if employees do return to office, significant outreach and education must be done to reengage those who previously utilized public transportation and successfully transition more employees away from single vehicle travel.

Natural gas consumption

The natural gas consumption category includes emissions related to natural gas usage reported by Pacific, Gas & Electric. As of 2019, natural gas consumption emissions are the largest contributor to municipal greenhouse gas emissions; 770 tons (35.35 percent of total). Figure 18 highlights the change in emission from 2016 to 2019:

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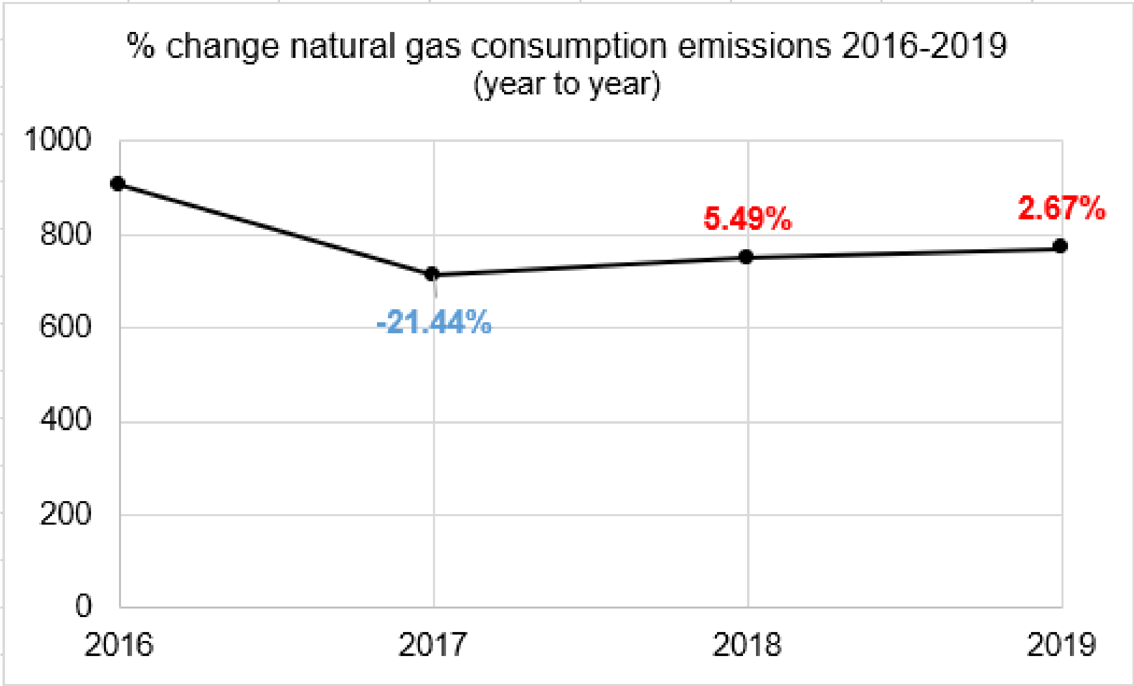
[38] Metropolitan Transportation Commission, Vital Signs: Commute Mode Choice: vitalsigns.mtc.ca.gov/commute-mode-choice

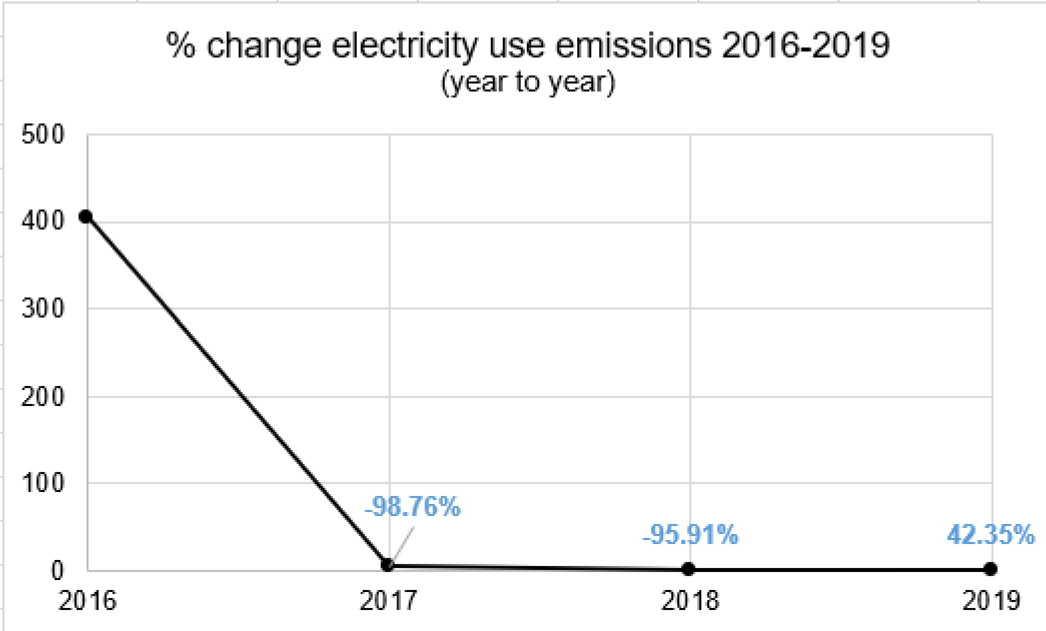
[39] Metropolitan Transportation Commission, Vital Signs: Daily Vehicle Miles Traveled: vitalsigns.mtc.ca.gov/daily-miles-traveled



Natural gas consumption emissions are expected to remain constant or decrease as more municipal assets and facilities are electrified. For example, the City is currently evaluating proposals to install an all-electric, fully islandable (operation off-grid through the use of on-site solar and battery arrays) microgrid system at the new Menlo Park Community Center (100-110 Terminal Avenue). All-electric options for HVAC equipment replacements in the Arrillaga Family Recreation Center (700 Alma Street) and Gymnasium (600 Alma Street) buildings are also planned.

Electricity use

The electricity use category includes emissions related to electricity usage reported by Pacific, Gas & Electric (2016 to current) and Peninsula Clean Energy (2017 to current). As of 2019, electricity use emissions are an insignificant contributor to municipal greenhouse gas emissions; 0.2909 tons (0.01 percent of total). Figure 19 highlights the change in emission from 2016 to 2019:



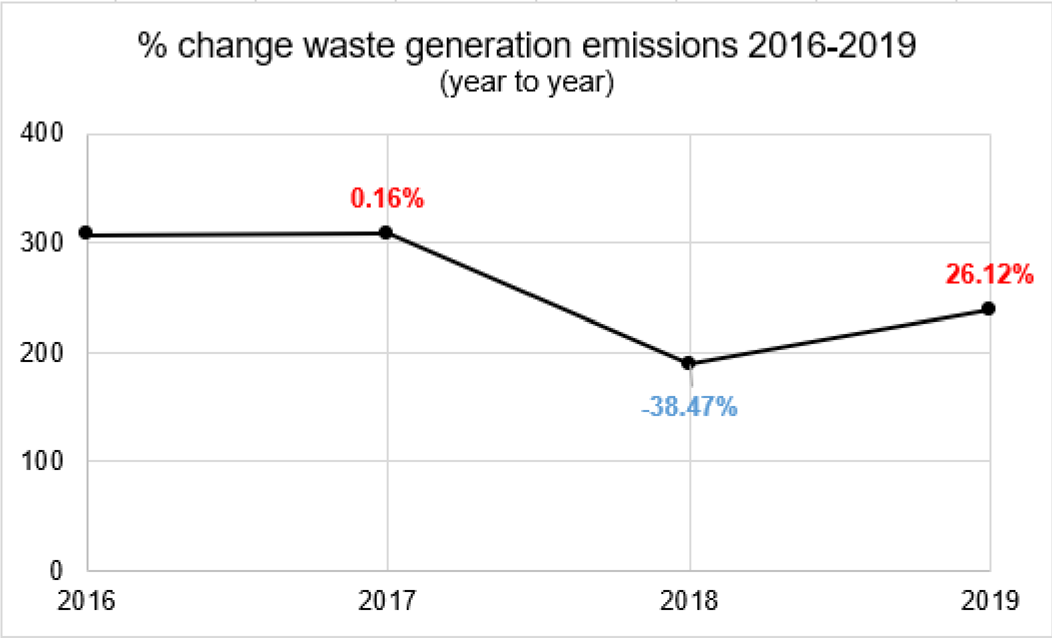
Electricity use emissions were expected to be zero due to the 2017 formal action taken to enroll all municipal accounts in ECO100 (electricity is Green-e certified; 100% from renewable sources (i.e., solar and wind) and carbon-free). However, while staff was performing the municipal inventory, it was discovered that a small amount of electricity from PG&E is still provided to municipal accounts. While it is a very small amount (2706 kWh in 2019) resulting in negligible emissions (0.2909 tons), more investigation is necessary to determine the reason for this discrepancy.

Waste generation

The waste category includes direct emissions related to the breakdown of estimated solid waste (municipal solid/trash waste and organics) sent to the landfill. Estimates were derived service levels for all municipal accounts described in the City's franchise agreement with Recology[40]. Note, any emissions related to the collection and processing of recyclable material or the sourcing, production, or transportations of goods (cradle-to-grave emissions) are not included.

As of 2019, waste generation emissions are 239 tons (10.97 percent of total). Figure 20 highlights the change in emission from 2016 to 2019:

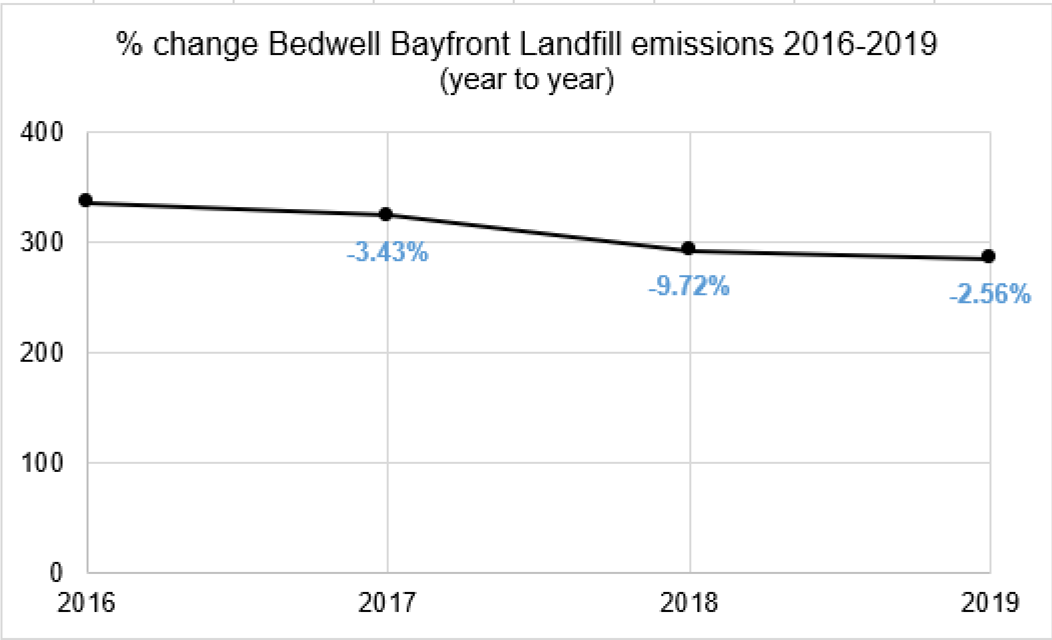
[40] Menlo Park City Council staff report, April 24, 2018: menlopark.org/DocumentCenter/View/17285/I1---Recology-Agreement



If calculation methodology remains the same, waste generation emissions are expected to decrease due improved sorting and waste diverted from landfills. Note, this is due to statewide requirements and regional cooperation. Emissions could be further reduced through the implementation of the Community Zero Waste Plan (2017)[41].

Bedwell Bayfront Landfill

The Bedwell Bayfront Landfill category includes emissions related to captured gas reported by Menlo Park Public Works, Engineering Division. As of 2019, Bedwell Bayfront Landfill emissions are 285 tons (13.09 percent of total). Figure 21 highlights the change in emission from 2016 to 2019:



[41] Menlo Park Community Zero Waste Plan: menlopark.org/1132/Community-Zero-Waste-Plan

Bedwell Bayfront Landfill emissions are expected to continue decreasing because it has been decommissioned (no new material is being introduced).

APPENDIX A: GREENHOUSE GAS EMISSIONS DATA TABLES

The following table summarizes calculated communitywide greenhouse gas emissions from 2005 to 2019.

Table 13-Communitywide greenhouse gas emissions 2005-2019

Table 13: Communitywide greenhouse gas emissions			
Year	GHG emissions (tons)	%change (year to year)	%change (relative to baseline)
2005	349,284		
2006	364,090	4.24%	4.24%
2007	387,731	6.49%	11.01%
2008	376,435	-2.91%	7.77%
2009	348,934	-7.31%	-0.10%
2010	329,777	-5.49%	-5.58%
2011	314,412	-4.66%	-9.98%
2012	316,761	0.75%	-9.31%
2013	313,981	-0.88%	-10.11%
2014	305,845	-2.59%	-12.44%
2015	300,834	-1.64%	-13.87%
2016	297,239	-1.20%	-14.90%
2017	284,378	-4.33%	-18.58%
2018	271,903	-4.39%	-22.42%
2019	253,371	-6.50%	-27.46%

The following tables summarizes calculated greenhouse gas emissions from 2005 to 2019 by category (transportation, solid waste, build energy use: natural gas, and building energy use: electricity).

Table 14-Transportation related emissions 2005-2019

Table 14: Transportation			
Year	GHG emissions (tons)	%change (year to year)	%change (relative to baseline)
2005	137,628		
2006	144,795	5.21%	5.21%
2007	140,176	-3.19%	1.85%
2008	131,917	-5.89%	-4.15%
2009	141,478	7.25%	2.80%
2010	144,892	2.41%	5.28%
2011	147,475	1.78%	7.15%
2012	145,627	-1.25%	5.81%
2013	143,757	-1.28%	4.45%
2014	146,885	2.18%	6.73%
2015	140,111	-4.61%	1.80%
2016	153,518	9.57%	11.55%
2017	158,686	3.37%	15.30%
2018	141,568	-10.79%	2.86%
2019	122,029	-13.80%	-11.33%

Table 15- Building energy use related emissions by type (natural gas and electricity) 2005-2019.

Table 15: Total building energy use: natural gas			
Year	GHG emissions (tons)	%change (year to year)	%change (relative to baseline)
2005	102,295		
2006	103,611	1.29%	1.29%
2007	103,165	-0.43%	0.85%
2008	103,621	0.44%	1.30%
2009	103,012	-0.59%	0.70%
2010	103,027	0.01%	0.72%
2011	105,021	1.94%	2.66%
2012	101,885	-2.99%	-0.40%
2013	103,406	1.49%	1.09%
2014	90,036	-12.93%	-11.98%
2015	88,375	-1.84%	-13.61%
2016	90,689	2.62%	-11.35%
2017	95,742	5.57%	-6.41%
2018	109,971	14.86%	7.50%
2019	104,358	-5.10%	2.02%

Table 15: Total building energy use: electricity			
Year	GHG emissions (tons)	%change (year to year)	%change (relative to baseline)
2005	87,617		
2006	82,715	-5.59%	-5.59%
2007	114,718	38.69%	30.93%
2008	113,712	-0.88%	29.78%
2009	98,368	-13.49%	12.27%
2010	76,142	-22.59%	-13.10%
2011	55,203	-27.50%	-37.00%
2012	63,677	15.35%	-27.32%
2013	61,342	-3.67%	-29.99%
2014	62,891	2.53%	-28.22%
2015	66,150	5.18%	-24.50%
2016	46,217	-30.13%	-47.25%
2017	21,528	-53.42%	-75.43%
2018	15,161	-29.57%	-82.70%
2019	20,963	47.26%	-76.07%

The following tables summarizes calculated greenhouse gas emissions related to building energy use (natural gas and electricity) from 2005 to 2019 by account type (commercial, residential, and direct access). Note, direct access accounts have only electricity related emissions.

Table 16-Commercial energy related emissions 2005-2019

Table 16: Commercial energy use: natural gas			
Year	GHG emissions (tons)	%change (year to year)	%change (relative to baseline)
2005	63,053		
2006	64,709	2.63%	2.63%
2007	64,238	-0.73%	1.88%
2008	64,535	0.46%	2.35%
2009	63,358	-1.82%	0.48%
2010	64,188	1.31%	1.80%
2011	64,344	0.24%	2.05%
2012	62,956	-2.16%	-0.15%
2013	64,000	1.66%	1.50%
2014	58,847	-8.05%	-6.67%
2015	56,533	-3.93%	-10.34%
2016	58,638	3.72%	-7.00%
2017	61,656	5.15%	-2.22%
2018	74,849	21.40%	18.71%
2019	69,049	-7.75%	9.51%

Table 16: Commercial energy use: electricity			
Year	GHG emissions (tons)	%change (year to year)	%change (relative to baseline)
2005	57,508		
2006	54,035	-6.04%	-6.04%
2007	76,323	41.25%	32.72%
2008	76,486	0.21%	33.00%
2009	66,151	-13.51%	15.03%
2010	50,710	-23.34%	-11.82%
2011	34,020	-32.91%	-40.84%
2012	39,856	17.15%	-30.69%
2013	38,765	-2.74%	-32.59%
2014	40,191	3.68%	-30.11%
2015	42,913	6.77%	-25.38%
2016	26,205	-38.93%	-54.43%
2017	13,206	-49.61%	-77.04%
2018	10,297	-22.03%	-82.09%
2019	7,610	-26.09%	-86.77%

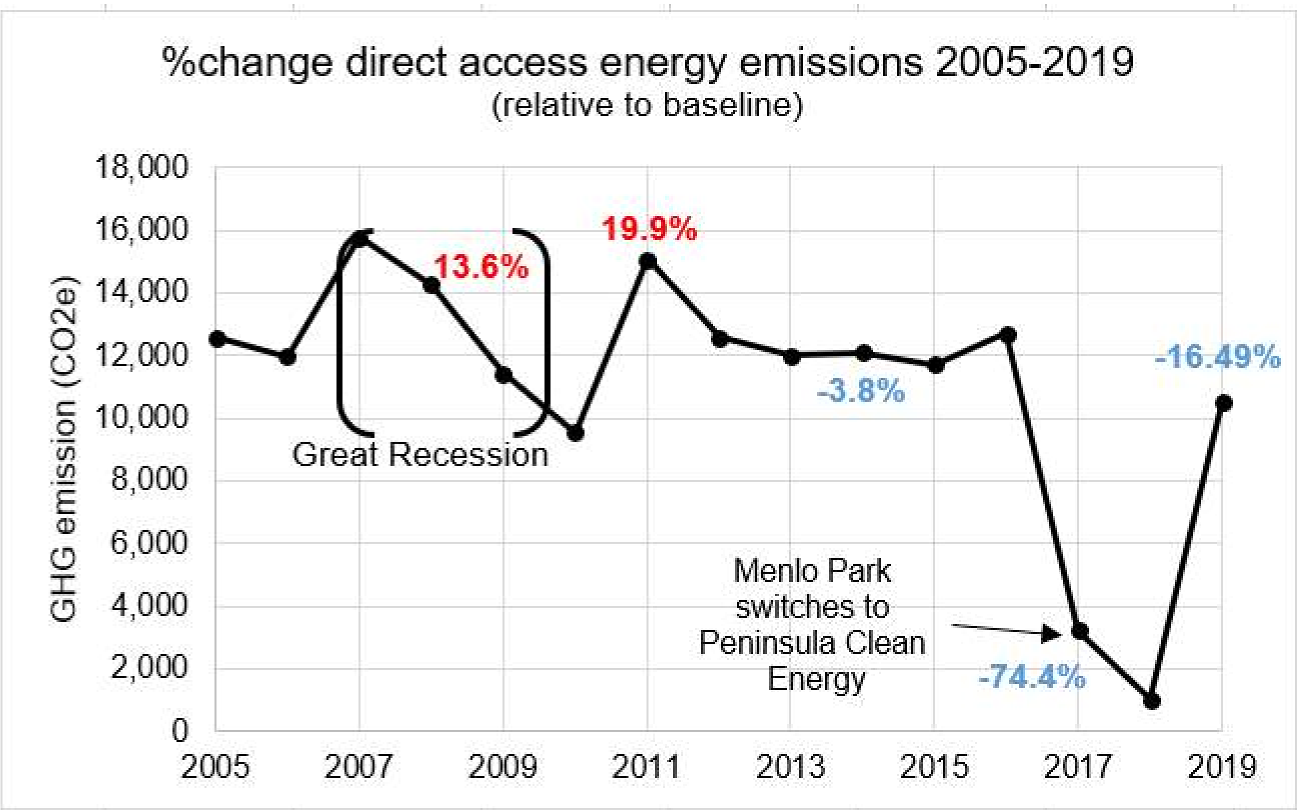
Table 17-Residential energy related emissions 2005-2019

Table 17: Residential energy use: natural gas			
Year	GHG emissions (tons)	%change (year to year)	%change (relative to baseline)
2005	39,242		
2006	38,902	-0.87%	-0.87%
2007	38,927	0.06%	-0.80%
2008	39,086	0.41%	-0.40%
2009	39,654	1.45%	1.05%
2010	38,839	-2.06%	-1.03%
2011	40,677	4.73%	3.66%
2012	38,929	-4.30%	-0.80%
2013	39,406	1.23%	0.42%
2014	31,189	-20.85%	-20.52%
2015	31,842	2.09%	-18.86%
2016	32,051	0.66%	-18.32%
2017	34,086	6.35%	-13.14%
2018	35,122	3.04%	-10.50%
2019	35,309	0.53%	-10.02%

Table 17: Residential energy use: electricity			
Year	GHG emissions (tons)	%change (year to year)	%change (relative to baseline)
2005	17,534		
2006	16,709	-4.71%	-4.71%
2007	22,626	35.41%	29.04%
2008	22,943	1.40%	30.85%
2009	20,789	-9.39%	18.56%
2010	15,895	-23.54%	-9.35%
2011	13,967	-12.13%	-20.34%
2012	15,690	12.34%	-10.52%
2013	14,875	-5.19%	-15.16%
2014	14,636	-1.61%	-16.53%
2015	14,817	1.24%	-15.50%
2016	14,434	-2.58%	-17.68%
2017	5,104	-64.64%	-70.89%
2018	3,837	-24.83%	-78.12%
2019	2,852	-25.67%	-83.74%

APPENDIX B: BUILDING ENERGY USE: DIRECT ACCESS

The current greenhouse emission calculation methodology shows direct access accounts to be the smallest contributor the building energy use category. In 2019, building energy use related emissions from direct access accounts was 10,501 tons (4.14 percent of the communitywide total). Figure 22 highlights changes direct access building energy use related emission 2005-2019:



Note, all PCE provided electricity (irrespective of account type) is tracked by PG&E as direct access energy. To avoid double counting, total electricity use reported by PCE is subtracted from PG&E direct access energy category. This process likely resulted in the abnormal (91.8 percent relative to baseline) emissions reduction in 2018.

The direct access energy category reflects electricity consumption reported by Pacific Gas & Electric (from 2005 inventory to current) and Peninsula Clean Energy (from 2017 inventory to current). As of 2019 emissions related to direct access energy use represent approximately 8.4 percent of building energy use related emissions.

Emissions related to electricity use are expected to continue decreasing as energy sources increasingly become carbon neutral or free.

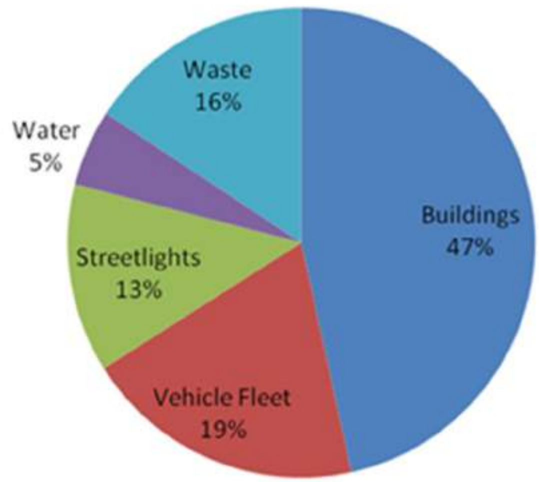
Table 18-Direct access energy related emissions 2005-2019. Note, all PCE provided electricity (irrespective of account type) is tracked by PG&E as direct access energy. To avoid double counting, total electricity use reported by PCE is subtracted from PG&E direct access energy category.

Table 18: Direct Access Energy			
Year	GHG emissions (tons)	% change (year to year)	%change (relative to baseline)
2005	12,575		
2006	11,971	-4.80%	-4.80%
2007	15,769	31.73%	25.40%
2008	14,283	-9.42%	13.58%
2009	11,428	-19.99%	-9.12%
2010	9,537	-16.55%	-24.16%
2011	15,073	58.05%	19.86%
2012	12,580	-16.54%	0.04%
2013	12,020	-4.45%	-4.41%
2014	12,092	0.60%	-3.84%
2015	11,716	-3.11%	-6.83%
2016	12,696	8.36%	0.96%
2017	3,218	-74.65%	-74.41%
2018	1,028	-68.05%	-91.83%
2019	10,501	10195.10%	-16.49%

APPENDIX C: PREVIOUS MUNICIPAL GREENHOUSE GAS INVENTORY

The following is the last published Municipal Greenhouse Gas Inventory (included as part of the 2015 Climate Action Plan update[42].

Municipal Operations Greenhouse Gas Emissions Inventory 2009 By Source (2,889 tons CO_2e)



Emissions from the City are embedded within the community-wide totals. Government operations are therefore a subset of total community emissions. In the year 2009, the City of Menlo Park's municipal operations generated 2,889 tons of CO_2e, which constitutes 0.004% of the community's total greenhouse gas emissions. This is a 25% increase compared to 2005 total emissions (2,305 tons).

Electricity and natural gas use in the City's buildings contributed to 47%, the vehicle fleet contributed 19% of this total, and the remainder of CO_2e came from streetlights, waste, and the electricity for pumping water and storm water.

Municipal Buildings - Electricity and natural gas use in the City's buildings contributed to 47% of CO2e from municipal operations. This is up 14% compared to City buildings contributing 33% of CO2e toward municipal operations in 2005. This increase can be attributed to a couple reasons; PG&E's greenhouse gas CO2 emission rates for electricity increased from KWh x (0.489 lbs/kWh / 2,204.6 lbs/metric ton) in 2005 to KWh x (0.641 lbs/kWh / 2,204.6 lbs/metric ton) in 2009. The increase in emissions rates means that each kWh consumed in 2009 contributed approximately 31.1% more CO2 than in 2005. Another reason for the increase in fuel and electricity consumption from municipal buildings is the construction of new buildings from 2005-2009.

[42] Menlo Park Environmental Quality Commission staff report, August 26, 2015: menlopark.org/DocumentCenter/View/7879/B5---CAP?bidId=

Vehicle Fleet - In 2009, Menlo Park's municipal vehicle fleet is responsible for the second largest share of overall municipal emissions at 19%. Compared to 2005's 28.4%, this is a 9.4% reduction. Menlo Park's vehicle fleet consists of analyzing the fuel consumed by City vehicles and equipment, such as police vehicles, and the tractors used for landscaping

Streetlights - The energy consumed by the City's street lights accounted for 13% of municipal operations greenhouse gas emissions in 2009. This analysis included the energy consumed by streetlights, traffic signals, park lighting, decorative lights, and parking lot lights. Compared to 2005's 11.9%, this is a 1.1% increase. This increase can be attributed to the addition of more streetlights, including signal cameras added throughout the city in 2008.

Water/Sewage - The emissions resulting from the energy used to pump water and waste water remained the same at 5% in 2005 and 2009. This analysis excludes pumping and treatment of wastewater that is carried out by the West Bay Sanitary District (WBSD), East Palo Alto Sanitary District (EPASD), and the South Bayside System Authority (SBSA).

Waste - In 2009, the relative contribution of landfilled waste from municipal operations to greenhouse gas emissions is 16%. Compared to landfilled waste contributing 20.8% to municipal operations in 2005, there is a 4.8% decrease. This decrease can be attributed to the reduction of solid waste sent to the landfill from year to year.

CITY OF MENLO PARK

MEMORANDUM

Date: **7/21/2021**
To: **Environmental Quality Commission**
From: **City Manager's Office: Sustainability Division**
Re: **Assessment of Google Environmental Insights Explorer**

The Environmental Insights Explorer (EIE) is a free service which uses exclusive (Google) data sources and modeling capabilities to produce estimates of activity, emissions, and reduction opportunities to select cities. The Environmental Quality Commission Climate Action Plan subcommittee, learned of this no cost, dynamic tool and requested Menlo Park be added to its list of cities in November 2019.

Google EIE provides building and transportation related emissions estimates. These estimates are modeled from underlying information from the Google Maps application (measurements of activity and infrastructure) and advanced machine learning techniques. While primarily based on the Google Maps information, EIE is anonymous, highly aggregated and combined with other data sources (e.g., building outlines and types, overhead imagery, etc.).

ICLEI performed a technical review[1] of the EIE data for local GHG inventories and acknowledges its strong potential for streamlining GHG inventory processes, while also providing some data advantages for planning and performance measurements. ICLEI reports that the EIE represents the biggest leap forward in new approaches to develop activity data for GHG performance management and climate action planning.

While a leap forward, as noted above, a greenhouse gas emissions inventory represents an estimate and is subject to change as more or different data sources and calculation methodologies, such as EIE, become available. Therefore, EIE estimates differ from the staff calculated emissions. Additionally, there are data limitations and/or considerations for each source.

The following is a summary comparison of the Menlo Park and EIE GHG inventory methodologies and notable data constraints.

Building energy use emissions calculation methodology:

City staff calculates building energy use emissions by applying emissions factors specific to Menlo Park energy providers, Pacific Gas & Electric (PG&E) and Peninsula Clean Energy (PCE) to actual usage data. Energy emissions factors are reported by utilities (PG&E and PCE) to the state and represent actual power mix for electricity generation.

Google EIE calculates building energy use emissions by estimating aggregated floor spaces, location, size, building type (residential or non-residential), and energy type (e.g., electricity, natural gas, etc.).

[1] Technical review of Google Environmental Insights Explorer Data for Local Greenhouse Gas Inventories: insights.sustainability.google/assets/papers/Technical%20Review%20of%20Google%20Environmental%20Insights%20Explorer%20Data%20for%20Local%20Greenhouse%20Gas%20Inventories_ICLEI-USA%20August%202019.pdf

Regional energy intensity factors (not city specific) are then applied to these energy use estimates to estimate related emissions. It should be noted, EIE emissions factors are a blended average of nearest available emissions factors (i.e., may include emissions factors from energy providers that do not deliver energy to Menlo Park). This methodology results in reporting 25.58 percent more than city calculated emissions in 2019.

Considering these factors, the City's current methodology is more accurate as it directly calculates the associated emissions to actual usage reported by the local utilities (PG&E and PCE). Furthermore, by calculating emissions based on actual usage data provided by PG&E and PCE, staff can evaluate building energy use more discreetly (natural gas versus electricity).

<u>Transportation emissions calculation methodology:</u>

City staff calculates transportation related emissions from passenger vehicle travel within (in-boundary) Menlo Park only. These emissions are estimated using both vehicle miles travel estimates from the California Department of Transportation (Caltrans) Highway Performance Monitoring System data and estimated fuel usage derived from fuel vehicle sales tax reported to State of California Board of Equalization- Sales Tax Generator and average gas prices.

Google EIE calculates transportations emissions by using proprietary data derived from Google Maps Location History to estimate trips taken within a city's boundaries. These estimates are multimodal (passenger vehicle, bus, cycling, rail, and walking) and including vehicles traveling into (inbound), leaving (outbound), and within (in-boundary). Please note:

- Cycling, rail, and walking trips do not have related GHG emissions
- This data has been conditioned; a number privacy filters, aggregation/anonymization techniques, and inference models have been applied to estimates

The inclusion of more precise travel data (inbound, outbound, and in-boundary) resulted in EIE emissions estimate to be 44.54 percent more than the city calculated estimate. While more accurate, the EIE data is only available from 2018 to date. The City currently measures progress compared to its 2005 baseline. If the City were to transition to this newer, more accurate transportation data source, it could not compare to baseline older than 2018.

It should also be noted both EIE and Caltrans Highway Performance Monitoring System vehicle miles travel estimate methodology may differ from the method used by city staff as part of a transportation analysis for development or infrastructure projects. Thus, estimates may differ.

CITY OF MENLO PARK

STAFF REPORT

Environmental Quality Commission
Meeting Date: **7/21/2021**
Staff Report Number: **21-005-EQC**

Regular Business: **Review and discuss draft cost effectiveness and policy options report to electrify existing buildings (CAP No.1 strategy)**

Recommendation

City Council requested the commission's review and feedback on cost effectiveness and policy options to electrify existing buildings as envisioned under Climate Action Plan goal No.1: Electrify 95% of existing building by 2030.

Concurrent with the commission's review, staff is conducting its review of the draft report and will transmit feedback to City Council. City Council is scheduled to hold a study session on this matter at their August 31 meeting at which time both staff and the commission's feedback will be considered. The commission can continue discussion at its August meeting if desired/needed to finalize any review and/or feedback prior to the City Council study session.

Policy Issues

In 2019, the City Council declared a climate emergency (Resolution No. 6535) committing to catalyze accelerated climate action implementation. In July 2020, the City adopted a new CAP with the bold goal to reach carbon neutrality (zero emissions) by 2030 that included a goal to electrify 95% of existing buildings by 2030.

Background

A first goal and high priority of the 2030 Climate Action Plan (CAP) is to electrify 95% of Menlo Park's existing buildings by 2030. Electricity consumed in Menlo Park is greenhouse gas free as almost all residents and businesses are subscribed to Peninsula Clean Energy. This provides an opportunity to eliminate the use of natural gas (a fossil fuel) in existing buildings by changing natural gas equipment (such as water heaters and space heating) to electric.

In 2020, new building reach codes were implemented that require all new buildings to be electric. In order to achieve carbon neutrality, eliminating natural gas in existing buildings through electrification will be crucial. However, there are many considerations in electrifying existing buildings, and include but are not limited to, equity, cost effectiveness, overall grid resiliency and capacity, and market readiness.

As a result, the City Council directed a cost effectiveness analysis and policy options report to be completed. In addition, the City Council requested the commission's review and feedback on the report. Attachment A includes a working draft of the cost effectiveness analysis to electrify existing buildings and potential policy options. The report will be finalized next month to meet the City Council timeline to review this matter.

Analysis
The cost effectiveness analysis for Menlo Park was prepared by TRC under a contract with Peninsula Clean Energy. Currently the analysis includes residential buildings. Analysis for nonresidential (commercial) is still underway as data from the state was recently received.

The potential policy options were developed in partnership with city staff, DNV, and PCE. Additional options are still under review.

Impact on City Resources
It is anticipated that a significant amount of resources will be needed to develop and implement the policy options.

Environmental Review
The environmental impacts of existing building electrification policies or programs and any California Environmental Quality Act (CEQA) compliance needs will be identified as they are approved for work by the City Council and analyzed further.

Public Notice
Public notification was achieved by posting the agenda, with the agenda items being listed, at least 72 hours prior to the meeting.

Attachments
A. Draft Cost Effectiveness Results and Potential Policy Options to Electrify Menlo Park's Existing Buildings

Report prepared by:
Rebecca Lucky, Sustainability Manager

7/1/2021

***DRAFT ***
Cost Effectiveness Results and Potential Policy Options to Electrify Menlo Park's Existing Buildings

Prepared by:
TRC, Inc and City Staff in partnership with Peninsula Clean Energy and DNV

Contents

I. INTRODUCTION AND PROBLEM STATEMENT

The City of Menlo Park has set out to achieve an ambitious Climate Action Plan goal to be carbon neutral or greenhouse gas free by 2030. The 2030 Climate Action Plan (CAP) was adopted in 2020, and included six strategies to begin local work in reaching this carbon neutral goal. One of the main strategies involves converting 95% of existing buildings to electric by 2030.

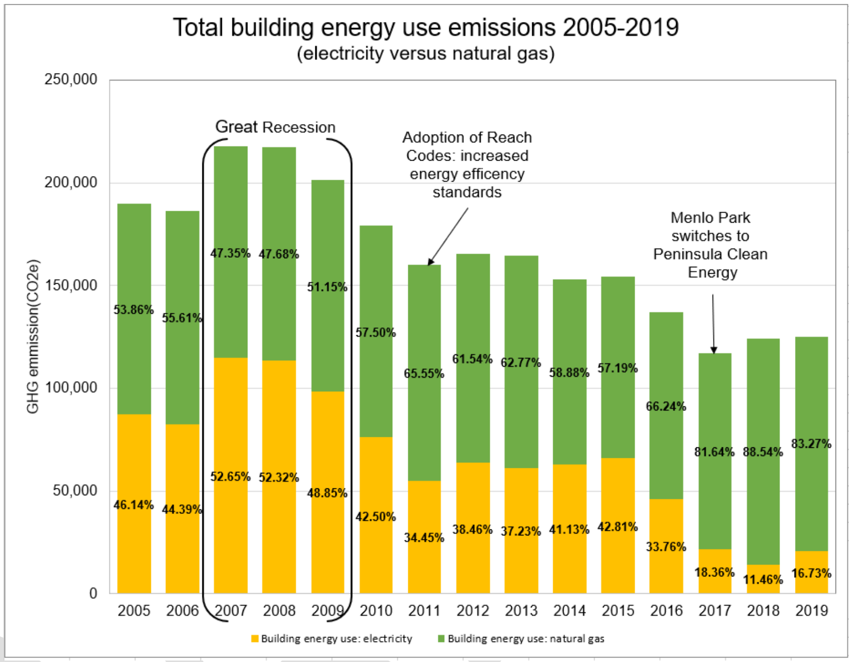


Figure 1 – Menlo Park Annual Building GHG Emissions

This strategy is built upon the fact that Menlo Park procures clean and greenhouse gas free electricity for residents and business through subscribing customers to Peninsula Clean Energy (PCE). All Menlo Park residents and business have access to affordable clean and greenhouse gas free electricity.

However, as noted in the graph in Figure 1 and 2, the remaining building emissions are from natural gas consumption. Natural gas consumption emits about 12 pounds of carbon or GHG emissions per therm.

Many communities with access to greenhouse gas free electricity have an opportunity to maximize their GHG reduction potential by replacing all natural gas appliances and equipment with electric versions (e.g. heat pumps).

However, this transition will take time and consideration. The City has already positioned itself as a leader through being one of the first to implement all-electric requirements for *newly constructed buildings* in 2020. New buildings in Menlo Park will be consuming greenhouse gas free energy, and will not contribute further to local GHG emissions. The next step for Menlo Park is to strategize on how to convert its existing building stock to all-electric.

Designing policies and programs around electrifying *existing* buildings will not be as straight forward as newly constructed buildings. This is largely due to the unique circumstances and building layouts in Menlo Park's existing building stock. Careful consideration and engagement is needed to ensure that policies or programs address existing inequities as well as preventing future inequities, such as increasing debt for low to moderate income community members, existing building leakages and inability to invest in photovoltaics, increasing rental costs because of renovations, and preventing evictions as a result of renovations known as "renovictions."

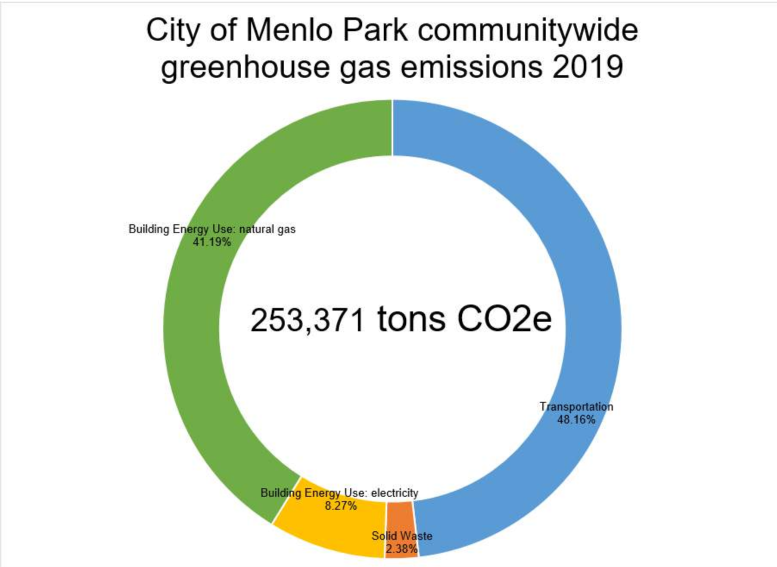


Figure 2 - City of Menlo Park Communitywide Greenhouse Gas Emissions, 2019

The city council has requested that a cost effectiveness analysis be completed and potential policy options be identified for their careful consideration in transitioning Menlo Park into an all-electric building future. This report provides an overview of cost considerations, market readiness, ability to address equity in an all-electric future, and potential policy options.

II. EVIDENCE/DATA AND OTHER CONSIDERATIONS

Cost effectiveness analysis results

The Investor Owned Utilities' (IOUs) Codes & Standards program is funding cost effectiveness analysis for electrification of fossil gas appliance measures in existing buildings.[1] The majority of scenarios across both residential and nonresidential building types have shown limited cost effectiveness for electrification, most notably using on-bill approaches, under the IOUs team assumptions. Assumptions include 15 to 30-year lifecycle periods, long-term fuel escalation rates based on business-as-usual, excluding vehicle electrification from the scope, and including locally available incentives. These assumptions are assumed to be the most realistic and relatively conservative. Other assumptions may lead to different results.

Cost effectiveness metrics that are common across the residential and nonresidential studies include:

- Use of two metrics to identify benefits:
  - Utility Bill Impacts (On-Bill): Values energy based upon estimated site energy usage and customer on-bill impacts using electricity and fossil gas utility rate schedules over a 30-year duration accounting for discount rate and energy inflation.
  - Time Dependent Valuation (TDV): California Energy Commission (CEC) Life Cycle Costs (LCC) methodology, which is intended to capture the "societal value or cost" of energy use including long-term projected costs such as the cost of providing energy during peak

[1] https://localenergycodes.com/

periods of demand and other societal costs such as projected costs for carbon emissions, as well as grid transmission and distribution impacts.

- Cost effectiveness is presented using net present value (NPV) and benefit-to-cost (B/C) ratio metrics.
  - Net Present Value (NPV): Net savings (NPV of benefits minus NPV of costs) as the cost effectiveness metric. If the net savings of a measure or package is positive, it is considered cost effective. Negative savings represent net costs.
  - B/C Ratio: Ratio of the present value of all benefits to the present value of all costs over 15 or 30 years (NPV benefits divided by NPV costs). The criterion for cost effectiveness is a B/C of 1.0 or greater, representing a positive return on investment.
- Three building vintages were evaluated to determine sensitivity of existing building performance on cost effectiveness of upgrades. Vintages were selected based on historical code requirements and construction practices, and represent 1980's, 1990's, and 2000's construction.

Residential

Methodology

The IOUs team examined a single family building and multifamily building with eight dwelling units, testing a variety of scenarios for electrification upon the end of life of existing gas appliances. The IOUs team used the same methodology as in the statewide analysis (*reference*) with Menlo Park-specific exceptions:

- Local Peninsula Clean Energy electric utility tariff (TOU-C) and PG&E (G-1) tariffs are used.
- Current Peninsula Clean Energy and BayREN incentives are considered.
- A single family 2,700 square foot home is used in place of the 1,665 square foot home applied in the statewide study. This larger home better reflects the Menlo Park building stock.
- Only the electrification of fossil gas appliances are evaluated – furnace, water heater, clothes dryer, and range. No efficiency measures.
- Two additional measures are evaluated showing the energy impact of converting a gas dryer and gas range/oven to electric resistance appliances.

Key Results

Key cost effectiveness results include the following. The full cost effectiveness report for nonresidential can be accessed in Attachment A. The values below are drawn from the single-family prototype findings and blended across vintages for simplicity, but results generally align between the single-family and multifamily building prototypes.

- Water heating fuel-substitution measures
  - Heat pump water heaters cost approximately $2,600 more than gas water heaters over a 30 year lifecycle period, including replacements.
  - Heat pump water heaters were found to be cost effective when using the TDV metric that will be used during the 2022 Building Code.
  - On-Bill impacts
    - A baseline efficiency (Uniform Energy Factor, or UEF, of 2.0) heat pump water heater costs approximately $120 per year more to operate than a gas equivalent in Year 1, and $80/year more on average over 30 years. It is important to note that while 2.0 is the federal minimum efficiency, these appliances are not

        available on the market for purchase, but must be included in reach code studies to inform the potential for federal pre-emption.
        - A high efficiency (UEF>3.0) heat pump water heater costs approximately the same to operate as a gas equivalent in Year 1, and saves approximately $15/year on average over 30 years.
        - After BayREN and Peninsula Clean Energy incentives, a high efficiency heat pump water heater is narrowly not cost effective when using the On-Bill metric. It should be noted that the net present value of heat pump water heating is approximately -$200 to -$600 over 30 years, a very small amount considering the lifecycle period.
        - Heat pump water heaters are cost effective On-Bill when combined in a measure package including on-site solar PV.
- Space heating fuel-substitution measures are:
    - Baseline efficiency (14 SEER) heat pump space heaters cost approximately $500 more than baseline combined gas furnaces and air-conditioners over a 30 year lifecycle period, including replacements.
    - High efficiency (21 SEER) heat pump space heaters cost approximately $3,800 more than baseline combined gas furnaces and air-conditioners over a 30 year lifecycle period, including replacements.
    - Heat pump space heaters were found to be cost effective when using the TDV metric that will be used during the 2022 Building Code.
    - On-Bill impacts
        - A baseline efficiency heat pump space heater costs approximately $300/year more to operate than a gas equivalent in Year 1, and $200/year more on average over 30 years.
        - A high efficiency heat pump space heater costs approximately $60/year more to operate as a gas equivalent in Year 1, but costs about the same on average over 30 years due to fuel escalation rate assumptions.
        - After BayREN and Peninsula Clean Energy incentives, a high efficiency heat pump water heater is not cost effective when using the On-Bill metric by approximately -$3,000 over 30 years.
        - Heat pump space heaters are cost effective On-Bill when combined in a measure package including on-site solar PV.
- Clothes drying and cooking measures are not currently cost effective using either TDV or Customer On-Bill metrics.

Results for all appliances, both TDV and On-Bill but excluding incentives, are shown in Figure 1 for a single-family building. Customer On-Bill results including incentives are shown in Figure 2. It is important to note that these results assume replacement at the end of useful life, and that results would become less cost effective upon early replacement.

Measure	Vintage	Measure Cost	Electricity Savings (kWh)	Gas Savings (therm)	GHG Savings (lb CO_2e)	Utility Cost Savings		Customer On-Bill		2019 TDV		2022 TDV	
						Year 1	Avg Annual	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
Heat Pump at HVAC Replacement	Pre-1978	$501	-4,528	451	2,966	-$377	-$249	0	-$8,006	0	-$5,462	9.30	$4,160
	1978-1991		-3,173	309	1,889	-$295	-$200	0	-$6,547	0	-$2,318	5.68	$2,348
	1992-2010		-2,711	278	1,466	-$232	-$154	0	-$5,178	0.32	-$343	6.63	$2,824
SEER 21 Heat Pump at HVAC Replacement	Pre-1978	$3,749	-3,261	451	3,534	-$30	$26	0.19	-$3,290	0.92	-$312	3.17	$8,152
	1978-1991		-2,337	309	2,267	-$66	-$19	0	-$4,637	0.52	-$1,788	1.96	$3,617
	1992-2010		-1,999	278	1,780	-$38	-$1	0	-$4,076	0.98	-$59	1.82	$3,084
Heat Pump at HVAC Replacement + 2.82 kW_{DC} PV	Pre-1978	$9,454	-27	451	3,259	$786	$670	1.92	$9,644	1.33	$3,111	2.00	$9,478
	1978-1991		1,328	309	2,182	$868	$717	2.06	$11,078	1.66	$6,222	1.81	$7,637
	1992-2010		1,790	278	1,759	$931	$764	2.19	$12,464	1.87	$8,221	1.86	$8,132
HPWH at Water Heater Replacement	Pre-1978	$2,594	-1,588	179	1,451	-$114	-$71	0	-$5,032	0	-$4,546	1.20	$522
	1978-1991		-1,593	181	1,462	-$125	-$80	0	-$5,305	0	-$4,486	1.20	$517
	1992-2010		-1,594	181	1,466	-$128	-$83	0	-$5,391	0	-$4,458	1.18	$466
NEEA Tier 3 HPWH at Replacement	Pre-1978	$2,775	-1,146	177	1,584	$5	$22	0.21	-$2,434	0.22	-$2,168	1.87	$2,419
	1978-1991		-1,152	179	1,599	-$6	$13	0.13	-$2,702	0.23	-$2,140	1.87	$2,424
	1992-2010		-1,155	180	1,603	-$9	$10	0.10	-$2,788	0.24	-$2,116	1.85	$2,359
HPWH at Water Heater Replacement + 2.82 kW_{DC} PV	Pre-1978	$11,546	2,913	179	1,744	$1,057	$852	2.00	$12,781	1.36	$4,167	1.52	$6,017
	1978-1991		2,908	181	1,755	$1,046	$843	1.98	$12,500	1.37	$4,218	1.52	$6,003
	1992-2010		2,907	181	1,759	$1,042	$840	1.97	$12,416	1.37	$4,246	1.52	$5,956
2.82 kW_{DC} PV + Electric Ready	Pre-1978	$13,044	4,501	0	293	$1,161	$916	1.90	$12,994	1.34	$4,375	1.09	$1,156
	1978-1991		4,485		292	$1,093	$862	1.79	$11,378	1.33	$4,365	1.08	$1,100
	1992-2010		4,400		287	$1,069	$844	1.75	$10,829	1.33	$4,365	1.07	$848
Electric Clothes Dryer	All	$313	-891	33	118	-$182	-$140	0	-$4,555	0	-$3,770	0	-$2,242
Electric Range/Oven	All	$608	-295	14	59	-$55	-$42	0	-$1,949	0	-$1,692	0	-$1,229

Figure 3. IOU team findings for cost effectiveness of water heating, space heating, clothes drying, and cooking measures in a 2,700 ft2 existing home.

Measure	Vintage	Gross Measure Cost	PCE/ BayREN Incentive	Net Measure Cost	Year 1 Utility Cost Savings	No Incentive		With Incentive	
						On-Bill B/C Ratio	On-Bill NPV	On-Bill B/C Ratio	On-Bill NPV
SEER 21 Heat Pump at HVAC Replacement	Pre-1978	$3,749	$1,000	$2,749	-$30	0.19	-$3,290	0.26	-$2,168
	1978-1991				-$66	0	-$4,637	0	-$3,514
	1992-2010				-$67	0	-$4,820	0	-$3,697
NEEA Tier 3 HPWH at Replacement	Pre-1978	$2,775	$2,000	$775	$5	0.21	-$2,434	0.78	-$188
	1978-1991				-$6	0.13	-$2,702	0.46	-$456
	1992-2010				-$9	0.10	-$2,788	0.36	-$542

Figure 4. IOU team findings for cost effectiveness of water and space heating fuel substitution in a 2,700 ft2 existing home. Even with high efficiency appliances and incentives, fuel substitution measures are barely not cost effective.

Nonresidential

The IOUs Codes & Standards program has not completed the review of the Nonresidential electrification alteration results, but is allowing that TRC share preliminary results to support Menlo Park's policymaking making schedule. As such, these results are TRC's representation rather than the IOUs'.

TRC examined five nonresidential building prototypes, testing a variety of scenarios for electrification at the end of useful life of an existing gas appliance. The report is still in progress and final results are expected to be published in October 2021.

Methodology

TRC used modified versions of the following five Department of Energy building prototypes to evaluate cost effectiveness of measure packages: Medium Office, Stand-alone Retail, Warehouse, Quick-service restaurant (QSR), and Full-service restaurant (FSR). The analysis assumes some equipment replacement over time across three vintages, based primarily on the Senate Bill 350 analysis.[2] The rate of replacement varies by building system and by envelope component. General prototype characteristics are outlined in Figure 3.

Nonresidential prototypes analyzed for cost-effectiveness				
Building Type (All Vintages)	Conditioned Floor Area (ft2)	# of floors	Baseline HVAC Distribution System	Baseline Hot Water System
Medium Office	53,628	3	Packaged multizone Variable Air Volume (VAV) reheat + boilers	Central Gas Storage
Stand-alone Retail	24,563	1	Packaged single zone (SZ) Constant Air Volume (CAV) + gas furnace	Central Gas Storage
Warehouse	17,548	1	Warehouse: Gas furnace serving 10% of floor area, exhaust-only ventilation Office: Packaged SZ CAV + gas furnace	Central Gas Storage
Quick-service Restaurant (QSR)	2,500	1	Packaged SZ CAV + gas furnace	Central Gas storage
Full-service Restaurant (FSR)	5,000			

Figure 5. Nonresidential prototypes analyzed for cost effectiveness.

TRC electrified appliances with heat pumps for all appliances, except for restaurant cooking appliances which are either induction or resistance technologies. TRC examined the following packages for each prototype:

- Mixed Fuel Code Minimum package: Appliance upgrades on the existing building using code-minimum fossil gas equipment.
- All-electric Code Min: Replace any gas equipment with electric, code-minimum equipment, including HVAC (heating, ventilation and air-conditioning), SHW (service hot water), and cooking appliances (for restaurants only). Upgrade electrical infrastructure as-required. The Baseline for this package is a gas code-minimum equipment replacement, including HVAC, SHW, and appliances.
- All-electric Code Min (2022 TDV): All-electric Code Min, with cost-effectiveness calculations done using 2022 TDV multipliers. The Baseline for this package is the same as the all-electric Code Min Baseline, except with 2022 TDV multipliers.
- Electric HVAC and SHW: This package is specifically for the restaurant prototypes, and replaces gas space and water heating equipment with electric code-minimum equipment.

[2] https://www.cpuc.ca.gov/sb350/

- All-Electric + Efficiency: Adds efficiency measures to the All-Electric Code Min package, except in restaurants where it adds efficiency measures to the Electric HVAC and SHW package.
- All-electric + PV: All-electric Code Min, including a solar PV array, plus battery storage for the Restaurant prototypes only. The solar PV size is customized for each prototype based on either offsetting annual kWh consumption, or the size accommodated by 50 percent of the roof, whichever is smaller. Batteries were sized to offset the majority of peak load hours. The Baseline for this package is the same as the All-electric Code Min Baseline.
- All-electric + PV (2022 TDV): All-electric + PV, with cost-effectiveness calculations done using 2022 TDV multipliers. The Baseline for this package is the same as the All-electric Code Min Baseline, except with 2022 TDV multipliers.

Results

TRC identified the results summarized below. For complete findings, please reference the attached Nonresidential memo.

- Quick-service Restaurants –
  - HVAC and SHW electrification (not cooking appliances) is cost effective using TDV. The net savings
  - HVAC and SHW electrification is cost effective using On-Bill and TDV when coupled with efficiency measures.
  - HVAC and SHW electrification alone is cost effective using TDV.
- Full-service Restaurants – HVAC and SHW electrification (not cooking appliances) is cost effective using TDV when coupled with efficiency measures.
- Stand-alone Retail – electrification retrofits are cost effective using both On-Bill and TDV metrics when combining with either efficiency measures or solar PV.
- Warehouse – electrification retrofits are cost effective using the On-Bill metric when combining with solar PV.
- Medium Office – little-to-no cost-effective electrification retrofit packages identified yet.

For the final draft, TRC plans on finalizing and adding results for two other prototypes – the Small Hotel and High-Rise Multifamily – to have a total of seven analyzed prototypes. TRC also plans on adjusting mechanical equipment cost assumptions based on similar research.

Incentives and on-bill financing

The Team performed an extensive literature review (attached) to identifying financing options for existing building electrification. The literature review lists the currently available incentive programs and financing options for Menlo Park residents and businesses. The review also identified that local jurisdictions could serve in the lead role in providing the following financing pathways:

- Municipal Financing (e.g., Green Bonds and Local Taxes and Fees) – Voter-approved fund generation mechanisms can affirm a community's willingness to invest in decarbonization measures. Bonds can be used for public infrastructure projects, and increased revenues from utility taxes can serve to potentially provide consumer financing.
- Incentive Programs – A jurisdiction may lead the development of incentive programs, likely with funding from a partner organization, such as San Jose and Marin County partnering with BAAQMD. Redwood City has recently started a modest program offering electrification incentives.

Local jurisdictions may also serve educational and advocacy roles for the following mechanisms:

- Electrification as a Service – A local jurisdiction can play a key role in reducing market entry barriers for providers such as BlocPower, or advocate for establishing local programs like NYSERDA's that creates a market for contractors and installers by paying them for projects that deliver metered bill savings.
- Tax Credits, Deductions, and Rebates – Federal tax incentives can be attained for eligible electrofits and stacked with incentive programs, though they are fairly low amounts.
- On-Bill Financing – The IOUs and local Community Choice Aggregation (CCA) programs can offer on-bill financing to their customers for energy efficiency and electrification upgrades. These loans are associated with the utility customer and not the meter, which usually disqualifies renters from being eligible. On-bill financing loans offer low interest rates and can serve customers with low credit history. Peninsula Clean Energy is exploring implementing an on-bill financing program in 2022 for its customers.

The IOUs can also offer *tariffed* on-bill (TOB) financing to its customers. TOB loans are associated with the utility meter and not the customer which allow them to serve a wide market including the harder to reach segments such as renters.

Loan Programs – A suite of loans are available for credit-worthy residential and nonresidential building owners through the California Hub for Energy Efficiency Financing, including programs for residential, affordable multifamily, and small businesses. These programs may fill in gaps where building owners may have insufficient access to incentive programs or tax deductions. Loans are expected to be one of the last options to financing a project, as they carry more risk for the applicant than many of the preceding options listed. They also can increase debt and have equity impacts as it can further exacerbate financial vulnerability for low income communities.

The review also noted the following financing mechanism gaps:

- High investment costs and limited incentives for heat pump space heating as a replacement for a methane gas furnace in a building that doesn't already have air-conditioning.
- Limited precedence for existing building EV financing. A jurisdiction may supplement Peninsula Clean Energy's EV incentive program with additional incentives, or additional loan programs targeted toward EV investment in a similar manner that Boulder partnered with a local credit union.
- Nonresidential buildings are eligible for fewer incentive programs than residential. This may be due to the higher financing needs and access of the nonresidential market.

Market Readiness

Technology

The technology is available for full electrification of all building stock today, with exception in a minority of industrial and process loads. As outlined in the New Building Institute's Building Electrification Technology Roadmap, there are limited technology barriers to building electrification. Key takeaways from the study include:

- Space Heating

    - Various forms of heat pump systems are technically ready and available to address most retrofits, including commercial space heating needs. More difficult buildings include those with large heating loads, such as labs and hospitals, and those with physical constraints that would prevent the footprint and hot water storage necessary for a load-flexible heat pump.
    - Electric resistance boilers and electric reheat coils are technically ready and available to address niche space heating needs but don't offer the high efficiency and GHG reduction benefits that heat pumps do.
- Water heating
    - Heat pump water heaters (HPWH)s are technically ready and available to address some retrofits and multifamily hot water needs with demand control capability.
    - Solar thermal and electric resistance water heaters are technically ready but have drawbacks.
- Cooking
    - Induction cooktops and electric resistance ovens are technically ready and available to address some retrofits and commercial cooking needs.
    - Barriers include consumer desires for charbroiling, low consumer education, and requiring ferrous cookware that is a separate investment from the range. In addition, this can have equity impacts in requiring further investment in new cooking equipment to use induction cooktops. Conversely, there are utility bill impacts in using electric resistance ovens, which have equity impacts on low-income communities.
- Clothes dryers
    - Heat pump dryers and combo washer/dryers (condensing dryers) are the recommended technologies to focus electrification efforts for residential buildings right now.
    - Electric resistance dryers are technically ready and available to address residential new construction and commercial laundry needs.
    - The primary roadblock is the lack of commercial-grade heat pump clothes dryers in the U.S. market, which are more common in Europe and Asia.
- Pool heating
    - Pool heat pumps are widely available in the US.
    - Contractor education will be required in order to make pool heater heat pump installations more common.

Across all these technologies, the primary barrier is the unique site considerations and heightened electrical requirements when replacing gas appliances, and the related challenges posed to contractors. A major barrier specific for HVAC and plumbing contractors has been simple preference for gas-fired equipment to maintain business-as-usual practices.

Contractors

Although used widely throughout the United States and other countries, heat pump water heaters represent the newest technology for contractors in California. This will be a major overhaul in how contractors provide space and water heating services to customers. As mentioned in the previous section, the preferences of contractors to continue to use gas-fired equipment will continue over the next few years, resulting in a limited supply of contractors capable and willing to do this type of work. This is a natural and normal process for any industry or professional grappling with deep trade related changes. It requires a significant time investment for the contractor to learn about the technology, how to expertly install and inform customers about its use and performance, and become efficient at installing and problem solving gas to electric conversions to lower overall labor costs.

Installation in existing buildings can require a different configuration than gas equipment and may require both an electrician as well as a plumber for a task that once required only one trade. The industry will need time to become more educated and align their trade licenses in a way that provides convenient and efficient services.

Mechanical contractors may be already well-suited for installation, as they are accustomed to installing air-conditioner and heat pumps. Electric ranges and dryers do not require special installation, except for an adequately-sized electrical circuit, which can be performed by a licensed electrician.

Property owners can utilize two resources to find contractors that are well versed in electrification technologies:

- Bay Area Regional Energy Network has a database of nearly 100 certified contractors throughout the Bay Area that specialize in residential energy assessments, heat pump HVAC, heat pump water heaters, solar PV, and other building components.
- The Clean Energy Connection has a database of contractors serving single family, multifamily, and commercial properties across California. It also includes information on whether the contractor provides financing, participates in rebate programs, and speaks multiple languages.

Other Bay Area Cities' Progress Toward Existing Building Electrification

Representatives of many other cities have indicated interest in electrifying existing building stocks in order to meet GHG reduction goals. At the time of this report, only the City of Berkeley and Half Moon Bay are directly addressing the electrification of existing buildings.

In April 2021, the City of Berkeley developed a draft Existing Buildings Electrification Strategy. [3] A major conclusion included that before any mandatory measures can be implemented or considered, there are equity issues that need to be addressed in order to make the mandatory policies effective and doable for all members of the community. This has ultimately led to a delayed ability to mandate electrification of existing buildings. Berkeley projects that they will be able to electrify all existing buildings by 2045.

Many foundational policies/activities need to be developed or enhanced to prepare for mandatory requirements such as tenant protections, advocacy at the state level, building set back requirements, and energy efficiency upgrades in the existing housing stock. A road map was prepared that identifies short, medium, and long-term strategies. Below is a table that summarizes their roadmap.

Berkeley's Existing Building Electrification Strategy	
Phase 1: 2021-2025	Demonstrate the benefits and feasibility of electrification through: • Community engagement • Pilot projects • Education campaigns • Well trained job force

[3] https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Draft_Berkeley_Existing_Bldg_Electrification_Strategy_20210415.pdf

	• Additional incentive programs • Larger scale financing programs, such as tariffed on-bill financing. • Collaborate with regional and state partners to ensure the ability to execute Phase 2
Phase 2: 2022-2030	The following would be only implemented after Phase 1 actions have demonstrated feasibility, cost effectiveness and best practices: • Mandating electrification at points of sale, lease, renovation, and part of a building performance standards program. • Neighborhood scale electrification Some Phase 2 actions will need to be implemented only after accessible funding and financing programs is in place or the upfront costs of electrification reach parity with gas infrastructure.
Phase 3: 2027-2045	Bans the use of gas

Figure 6 - Berkeley's Existing Building Electrification Strategy

In April 2021, Half Moon Bay proposed a draft Building Electrification ordinance that includes new construction electrification requirements and prohibits replacing fossil gas appliances with another gas appliance in alteration scenarios.[4] The City is conducting public engagement through September of 2021 before making a final decision.

Equity

Electrification policy must make financial sense for all populations, including lower-to-moderate income (LMI) residents. Ensuring that benefits of electrification, such as health, safety, and affordability, are targeted toward marginalized communities reverses compounding historical injustices, many of which have been created and perpetuated by government action. Peninsula Clean Energy's literature review identified the following findings:

- Without equitable policy development, local building regulations run the risk of doing more harm than good. For example, landlords may evict tenants when making building upgrades, a harmful practice known as "renovictions."
- Partnering directly with local Community Based Organizations (CBOs) can expand city efforts and deepen engagements in the creation of building decarbonization policies. CBOs and community members may initially be skeptical of governmental interventions, but early and regular engagement can lead to honest discussions around climate policy, establish a strong commitment, demonstrate accountability, repair trust, and lead to better overall policy.
- Rental property energy performance standards, coupled with rental housing policies, could reduce the energy cost burden on tenants, eliminate the split incentive, and support cities in meeting climate goals.
- CBOs and community members should be compensated for attending workshops or meetings to cover childcare, food, travel, or other expenses.

[4] https://www.half-moon-bay.ca.us/761/Building-Electrification

The City of Berkeley Existing Buildings Electrification Strategy defines the multiple forms of equity, establishes the intention to design policy around the goal of Targeted Universalism, and will leverage the Greenling Institute's Equitable Building Electrification Framework.[5,6] Berkeley's strategy aims at addressing LMI ability to invest time and access available incentives, avoiding increasing debt in financing programs, and investing in energy efficiency and solar and battery storage to ensure bill impacts are reduced or negligible.

Using the LEAD tool, Figure 4 shows American Community Survey data indicating that there are approximately 1,500 housing units in Menlo Park that are below the 30 percent Area Median Income (AMI).[7] The occupants of these housing units are mostly renters and pay seven to eleven percent of their income on energy (also known as 'Energy Burden'). As one example, an equitable policy would strive to ensure that the energy burden of LMI communities matches that of more affluent populations (see section 3.1.4).

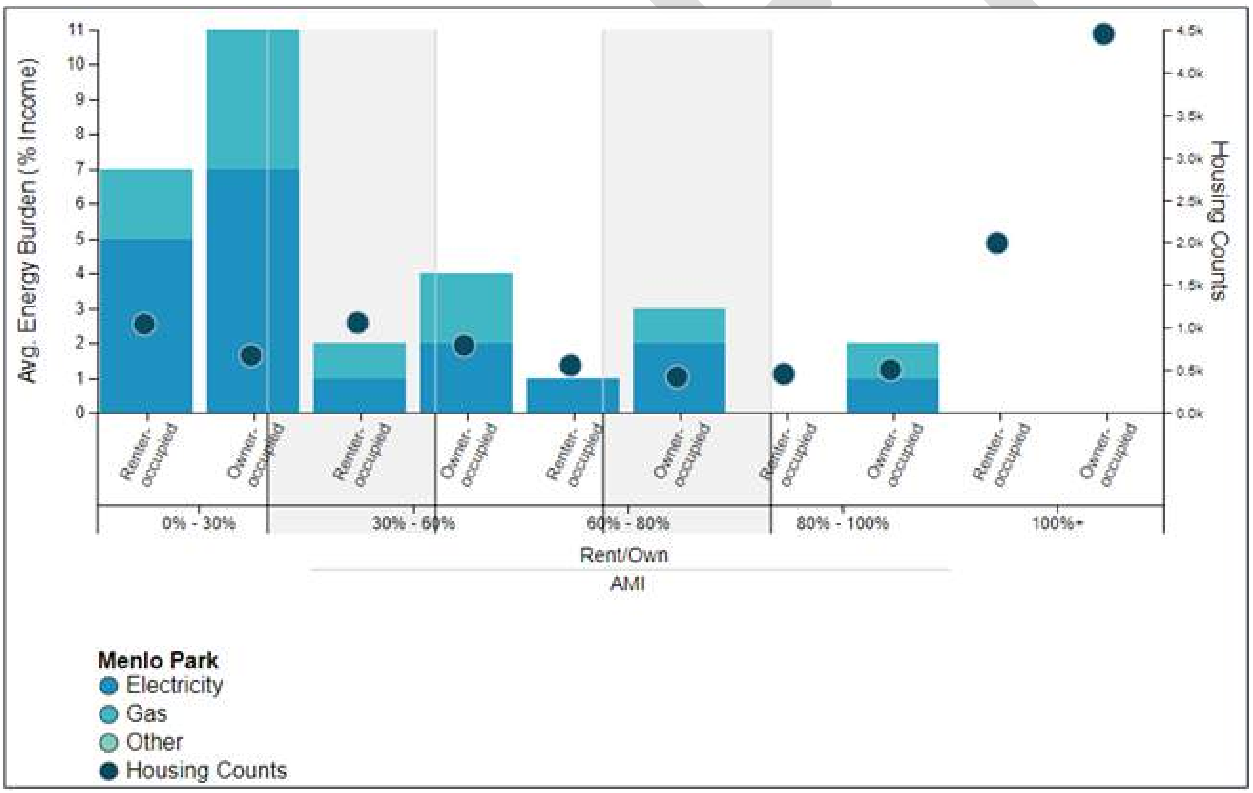


Figure 7. Average Energy Burden (percent of income) for Menlo Park

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[5] https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Draft_Berkeley_Existing_Bldg_Electrification_Strategy_20210415.pdf

[6] https://greenlining.org/wp-content/uploads/2019/10/Greenlining_EquitableElectrification_Report_2019_WEB.pdf

[7] https://www.energy.gov/eere/slsc/maps/lead-tool

III. POLICY OPTIONS

This section provides an overview of possible options that Menlo Park can consider in advancing building electrification of existing buildings. The policy options at this time focus on existing single family and some multifamily electrification opportunities. Nonresidential (commercial) will be added once further the cost effectiveness data is completed. The next section of this report analyzes the GHG reductions for each option. The last section uses criteria to rank policy options for consideration.

There are three important notes to make (1) implementing all of the policy options will only achieve half of the needed GHG reductions by 2030; efforts at the regional, state, and federal government levels will be needed to support Menlo Park in meeting its GHG reduction goal. (2) It will be important to consider the GHG emissions differences between commercial and residential consumption when finalizing an existing building electrification strategy for Menlo Park. See graph below. (3) Similar to Berkeley's findings, significant foundational work may be needed before considering any regulations and/or mandates. Further discussion is provided below.

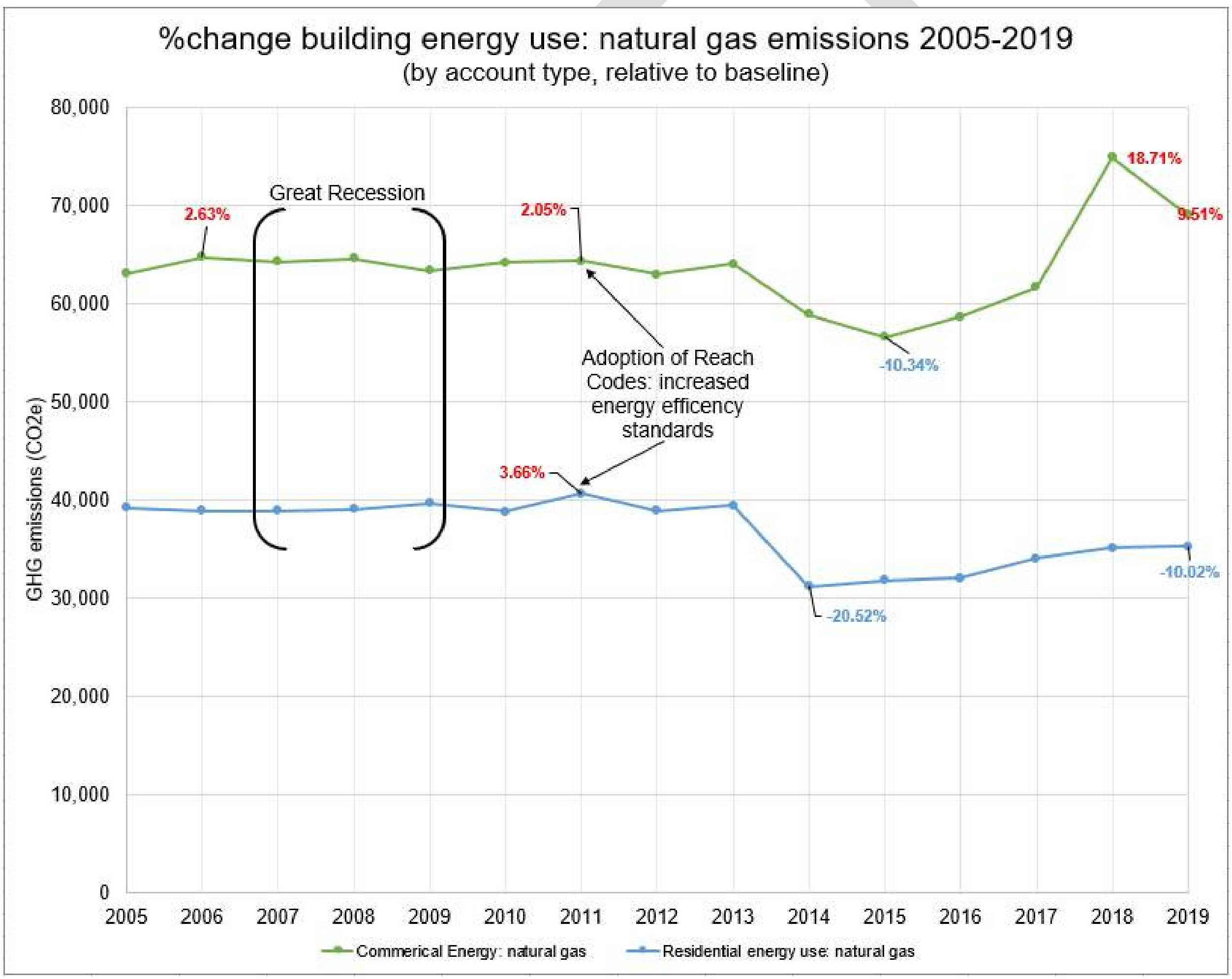


Figure 8 - Natural Gas Emissions by year in Menlo Park

Groundwork to pave the pathway towards electrification mandates

Similar to Berkeley's findings, significant foundational work may be needed before considering mandates, and includes:

- Robust engagement and education to assist residents and business on grid resiliency through solar and battery storage and addressing climate change through all-electric buildings.
- Pilot projects that include solar, energy storage and electrification that support low to moderate-income community members.
- Advocate at regional and state levels to advance electrification for existing buildings.
- Develop additional incentives and financing programs and explore possible funding mechanisms
- Develop rental protections and/or rental license program that would not cause displacement or rent increases because of future electrification mandates.
- Develop or include in housing rehab programs solar installation, energy efficiency upgrades, and building electrification.
- Modify city's noise and building setback regulations to accommodate building electrification needs.

Addressing these areas before mandates are adopted will be key in gaining community buy-in, trust, and support. It will help to identify and problem solve for unusual or unique building layouts or energy needs (e.g. must relocate equipment in setback areas). It will place equity at the forefront in demonstrating/piloting the feasibility of existing building electrification.

Option 1: Public Engagement and Education

Develop a Robust Public Engagement and Education Program

This option involves developing a comprehensive concierge type of service to assist residents and businesses through the electrification process. This can include partnering with Peninsula Clean Energy on projects/programs, piloting projects for electrification in low to moderate-income neighborhoods, providing energy analysis and design services for all members of the community, permit counter education opportunities, large-scale community education forums and outreach for residents and businesses, and assistance with rebate and financing eligibility.

City Resources Required: Additional staff would necessary to perform this work. The amount of staff required could be minimized (but not eliminated) if the City is able to contract with a local nonprofit or company to support the work.

Option 2: Generate Funds to Develop Additional Incentive and Financing Program Offerings

In order to provide additional incentives and financing programs for Menlo Park residents and business, the City may want to consider generating revenues from various sources to support electrification.

Taxes and development fees

There are a variety of ways a local government generate revenue to fund incentives, and use fees as a disincentive to continue to generate GHG emissions. Local governments may incorporate a fee for building projects that generate greenhouse gas (GHG) emissions and use the funding to incentivize future decarbonization offsets throughout the jurisdiction. This also has the added effect of dis-incentivizing generating GHG emissions on site. An example of this includes:

- **City of Watsonville** adopted a Carbon Fund Ordinance in 2015 that charges a fee to all development projects including new construction, additions, and alterations, with the exception of single-family alterations. The additional carbon impact fee is between 30 and 50 percent of the building permit fee. Projects may be refunded the fee if they install on-site renewable generation to offset the average annual electricity load.[102]
- In late 2019, the **City of San Luis Obispo** tentatively proposed a greenhouse gas *in-lieu fee* for new construction projects that installed fossil fuel consuming appliances, ranging from $6,013 for a typical single-family residence up to $89,000 for a 54,000 ft^2 office.[103] This measure has been delayed for adoption due to political pressure.

A utility users' tax (UUT) may be levied by municipalities to provide general fund revenue. The tax may be increased to generate funds for projects and programs that reduce greenhouse gas emissions, and provide catered offerings for income-qualified projects. Menlo Park's current UUT is low and may be able to be increased without a ballot measure. Some examples of other jurisdictions that have generate funds related to energy consumption include:

- **City of Berkeley** proposed Measure HH in 2020 to increase the UUT from 7.5 percent to 10 percent for electricity and 12.5 percent for methane gas.[100] The UUT proposal included special rates for income-qualified residents. Despite strong community support during survey, the ballot measure was ultimately defeated.

- **City of Albany** proposed Measure DD to increase the UUT from 7 percent to 9.5 percent for electricity and gas and apply a tax to water service at 7.5 percent. The measure passed. The measure is estimated to generate an additional $675,600 in new revenues annually for the City.[101]

Financing

A municipality can also use borrowing capacity or loan loss reserve to develop a partnership with a local lender and create a loan program to finance electrification enhancements. A dedicated loan program brings a streamlined funding opportunity and rate certainty to property owners who are considering the prospect of electrification and would benefit from the extra financial line of sight. California has several dedicated loan programs for energy related upgrades through the California Hub for Energy Efficiency Financing, and there are a few examples outside of California of cities partnering with lenders to create customized programs, such as Fort Collins Home Efficiency Loan Program and Boulder's partnership with Elevations Credit Union.

Option 3: Time Certain Building Performance Standards

Building performance standards can alert building owners of citywide, deadline-driven requirements, allowing them to plan upgrades in long-term. They also capture buildings that are not retrofitted, sold, or submitted for permit during an alteration. In some cases, cities require that upgrades be performed within certain time windows or face a penalty. Examples of these policies, and the issues contained, are listed below. Similarly, a jurisdiction may adopt an ordinance requiring that all buildings replace their existing appliances to be all-electric by 2030. To enhance enforceable, cities may need add field inspection programs and penalties for noncompliance.

- **City of Brisbane** requires most owners of buildings larger than 10,000 ft^2 to report energy benchmarking results using ENERGY STAR Portfolio Manager to the city annually on May 15th starting in 2021. Starting in the 2023 reporting cycle, buildings will be required to demonstrate building efficiency performance metrics or conduct an audit to identify and implement savings opportunities.
- Some cities may leverage existing structure from rental policies and business license programs to enforce disclosure programs and require additional upgrades. The **City of El Cerrito** is a California example of a residential rental inspection program, operating since 1997. El Cerrito requires all residential rental units to be registered, obtain a business license, pay an annual license tax, and be inspected every two years. The inspection costs approximately $129 per multifamily unit. The inspector checks for a variety of measures including appliance installation and operation as well as electrical wiring. The cities of Richmond, San Pablo, and San Rafael also include rental inspection programs, though triggers can vary by regular time periods, time of sale, and/or complaints. These programs achieve an average of 80 percent compliance rates.
    - StopWaste has developed key considerations and estimates of carbon impacts to support jurisdictions exploring the idea of a Rental Housing Inspection Programs with energy efficiency requirements.
- **City of Berkeley** may expand their BESO program to include greenhouse gas emissions per square foot estimates and require building owners to limit emissions according to gradually decreasing threshold through 2045. This may be administratively challenging—even under the current BESO program design, a recent evaluation found that the "BESO administrative process [and ensuring compliance] is staff-intensive and time consuming."

- Outside of California, **City of Boulder** adopted the SmartRegs program in 2010, which required that rental properties meet energy efficiency requirements by 2018 or before a rental license application approval. In 2017, 100 percent of the rentals were inspected, and 86 percent were compliant. Similarly, Boulder also requires that commercial and industrial building owners complete one-time lighting upgrades and implement cost-effective retro-commissioning measures by set dates, depending on the size of the building. Failure to perform upgrades can result in fines of $0.0025 per square foot up to $1,000 per day of non-compliance. To support property owners, the City provides a set of resources including a cost estimation tool and a list of service providers.
- Since 2013, the **City of Chicago** has required multifamily and commercial buildings of at least 50,000 ft^2 to report whole-building energy use annually according to a custom energy rating system that went into effect in 2019. The rating is required to be posted in a prominent location on the property, and either the energy rating or ENERGY STAR® score must be listed in any advertisements for sale or lease at the time of listing.
- In May 2021, the **City of Burlington** adopted an ordinance requiring rental units that consume over 90 $kBtu/ft^2$ for space heating purposes to implement energy efficiency measures up to a cost cap of $2,500/unit to complete the initial work, not including incentives. After the initial work is completed, property owners are given a three-year extension to finish the required efficiency improvements with no cost cap.
- **Gainesville, Florida** has a rental unit permit and inspection program that requires rental units apply for permits annually, and demonstrate that they meet a set of energy efficiency requirements.

Time certain building performance standards raise community awareness and allow the opportunity for property owners to comply through our policy pathways, such as permitting (Option 4) or time of property transfer (Option 5). Inspection requirements for rental licensing programs can also be used to achieve equitable outcomes such as adequate living standards and fair leasing practices.

Pros	Cons
• Easy for residents to understand • Reduces 'missed opportunities' with gas replacements during burnout • Can directly tie to time-specific goals • Ability to impact all buildings • Can be integrated well with incentives • Rental license program could be leveraged for many other uses and help create equity.	• Time certain years require enforcement in those years, such as rental license or business license programs, increasing staff responsibilities • Right timing replacements may be difficult, such as emergency replacements • May require a new tracking platform for buildings and residences • Without incentives, can add significant cost to annual operating budgets of constituents • Expected backlash from realtors

Figure 9 - Pros and Cons of Time Certain Ordinance

Option 4: Permitting

California's Title 24, Part 6 Building Energy Efficiency Standards contain various efficiency upgrade requirements that additions and alterations must comply with if the trigger conditions are met. For example, the standards dictate that space-conditioning system replacements (the trigger event) are limited to methane gas, liquefied petroleum gas, or the existing fuel type, except in the case of going from gas or liquefied petroleum gas to heat pumps (the requirement).

Local governments may use the same triggering events, such as the replacement of a mechanical and/or domestic water heating system, and further require electrification measures. In this case, a local code amendment could further require that replacement equipment be heat pump systems, as opposed to the like-for-like replacement currently allowed in Title 24, Part 6.

Encouraging or requiring electrification conversions make most economic sense when coupled with major renovations, because it can be more cost effective and less disruptive to the building owner. Solar photovoltaic (PV) installations have an added benefit of improved operational cost effectiveness.

Pros	Cons
• Easy path to enforcement • Clearly within City of Menlo Park purview • Good opportunity to integrate with incentives	• Without incentives, can add significant cost to some improvement projects • May decrease permit adoption • Permit adoption rates are low, reducing effectiveness of this approach • Expected backlash from contractors

Figure 10 - Pros and Cons of Permitting as Intervention Point

Option 4A-4B: Electrification Ready Upgrades in Minor Alterations and Additions:

The electrification readiness option is intended to start the conversion process for existing residential multi-fuel buildings to all-electric buildings by requiring the installation of the electrical infrastructure needed to allow for the future conversion. This approach requires additional scope of work to a Building permit however it does not add significant cost to the project due to the contractor being hired specifically to work on the building's electrical systems.

The electrification readiness requirements are triggered by building permits with a scope of work that includes:

- The installation of a photovoltaic system or the replacement/upgrade to a main electric panel ; or
- The installation of a reverse cycle air conditioning condensing (heat pump) unit instead of a traditional air conditioning condensing unit.

4A: The Installation of a Reverse Cycle Air Conditioning Condensing (Heat Pump) unit

This option would require a reverse cycle air conditioning condensing (heat pump) unit to be installed instead of a traditional air conditioning condensing unit when a Building permit application is made that includes replacing an existing air conditioning condensing unit is or the installation of an entirely new system.

The reverse cycle condensing unit is the critical piece of the infrastructure needed for the conversion to HPSH system. This option also builds on the electrification provisions of electrification readiness by making the conversion to a HPWH and/or HPSH equipment no more difficult than the replacement of a GFWH and GFSH equipment like in kind.

The number of structures that are made electrification-ready could be increased by including Building permit applications for additions to existing buildings that also include:

- An increase the overall condition space; and
- Modifications to the electrical, plumbing or HVAC systems.

These additional scope of work requirements to trigger of the electrification readiness option are intended to avoid capturing projects such as a roof being added over an existing porch/patio or an increase in the square footage of a garage or carport which do not affect the overall consumption of energy for a structure.

4B: Installation of a photovoltaic system or the replacement/upgrade to a main electric panel

When a permit application is made that includes the installation of a photovoltaic system or the replacement/upgrade to a main electric panel for one- and two- family homes and townhomes, the applicant would also be required to provide:

- The reservation of breaker space in the existing or new electric panel to accommodate anticipated future electrification of single and multifamily buildings' electrical load;
- Wiring to a current water heater location to allow for the installation of a heat pump water heater in an emergency repair situation for single-family buildings;

When a permit application is made that includes the installation of a photovoltaic system or the replacement/upgrade to a main electric panel for all other multi-family buildings, the applicant would also be required to provide:

- Wiring to current water heater location in multi-family buildings that have all of the water heaters serving individual units installed in the same location or in buildings with a centralized building water heater; and
- The reservation of breaker space and electrical capacity to accommodate the additional electrical loads associated with Heat Pump water and space heating, a 120-volt, 30-amp circuit per unit to allow for electric vehicle charging, electric stove, ovens and clothes dryers can potentially necessitate the upsizing of the panel size however this is solely an equipment and wiring cost and shouldn't adversely affect the overall labor cost.

The requirement to add wiring to the current gas fired hot water heater does add both labor and material cost. However, by having the wiring installed allows for a property owner to replace the existing gas fired water heater at the end of its life cycle with a Heat Pump water heater (HPWH) without experiencing any additional time without hot water than would normally be experienced. The requirements do not include wiring for the Heat Pump space heating equipment (HPSH) due to not knowing the desired location for the location of the Heat Pump space heating equipment being based on the City's Zoning Ordinance requirements for required side and rear yards and the City's Noise Ordinance which cannot be determined until the equipment has been selected.

There is the possibility that the installed wiring to the existing water heater location may never be used due to an increase in the HPWH physical size that prohibits the HPWH from being installed in the same location. The rate of recovery for a HPWH being considerable slower than a gas fired water heater and most manufacturers recommend that the storage size be increased for a HPWH to offset the slower rate of recovery. A typical recommendation for a replacement of a 40-gallon gas fired water heater is 60 to 80 gallons for a HPWH. The increase in physical size can potentially cause a conflict with:

- The City's Zoning ordinance requirements if the water heater is located in a garage and the new HPWH encroaches into the required interior clear space for parking cars; or
- Adequate space in an existing water heater closet located in a Single-family buildings or individual dwelling units in multi-family buildings.

However, most HPHW of larger capacities only increase height, resulting in marginal increase to footprint. The height, still being below 7 feet.

Option 4C: Heat Pump Based Equipment Installed Upon Voluntary Replacement

The voluntary replacement option is intended to begin the electrification process by leveraging the educational and electrification readiness ground work for single and multi-family home property owners who are voluntarily replacing existing gas fired water heating and/or space heating equipment prior to the equipment's end of life.

The Voluntary replacement option requirements only address voluntary replacement, upgrade or relocation of the existing GFWH and GFSH. The voluntary only provision of the requirements allows single-family property owners whose structures are electrification ready the flexibility to research and maximize monetary incentives prior to replacing GFWH and/or GFSH equipment. Property owners making incremental improvements to their structures that have not been made electrification have time to research contactors, products and incentives and provides time to coordinate the commencement of the work. The conversion from an existing GFWH to a HPWH in a structure that is not electrification-ready involves a licensed electrical contractor to install the electrical wiring and a licensed plumber to install the HPWH. The conversion from a GFSH to a HPSH equipment only requires a licensed HVAC contractor.

Heat pump based equipment generates condensate water, which must be accounted for by adding a condensate drain. Additionally, heat pump equipment typically generates noise levels above 70 dBa which can potentially cause a conflict with the City's Noise Ordinance for all heat pump equipment located outside.

The Voluntary replacement option also captures hot water replacements in multi-family buildings that have existing electric resistance water heaters located in each unit. While this does potentially add cost to the project, some of those cost can be offset with available incentives. It is difficult to ascertain if additional electrical work will be required to address the electricity requirements for a HPWH and how condensate water will be discharged due to the differing ages and construction of the existing multi-family building stock. However, the requirements would result in an approximate 66 percent reduction in electricity consumption per water heater.

Permits for the replacement of GFWH and GFSH are applied for and issued on-line which poses a challenge in determining since the permit information does not note whether the replacements are voluntary or due to the end of equipment life. Additionally, the 2019 California Building Standards Code allows for emergency replacement or repair to a structure prior to obtaining a building permit. This allows property owners to make repairs in an emergency situation to prevent further damage to a structure and protect life safety. The more likely scenario is that this option will only capture GFWH and GFSH being replaced or relocated as part of an addition and alteration projects.

There is also the potential of the replacement of gas fired equipment like in kind without the benefit of a building permit to avoid significant time without hot water or heat and any additional costs. The lack of permit prevents the inspection to ensure the proper installation of the equipment for the safety of the occupants. Finally, if a permit is issued to a property owner that is aware of the requirements, the occupants could experience a significant amount of time without hot water or heat.

This option could be expanded to include replacement of the existing gas fired equipment at the end of life, however this has some significant associated challenges. The replacement of water heaters and space heating equipment at the end of life falls under this category of emergency repair. In the event that a property owner has GFWH or GFSH replaced like in kind in an emergency situation and then applies for a permit, the expanded requirements would obligate them to remove and replace the new GFWH and/or GFSH equipment with a HPWH and/or HPSH equipment.

Option 4D: Heat Pump Based Equipment Installed during Additions to Single-Family Residential Buildings

This option would require additions to single-family homes that increase the existing conditioned space to convert the existing gas fired water heating or space heating equipment or both to heat pump based equipment depending on the scope of work. Conditioned space is defined in the 2019 California Energy Code as, "*An enclosed space within a building that is directly conditioned or indirectly conditioned*" and is included to avoid capturing projects whose scope of work is unrelated to water or space heating. Additionally, the option requires the structure to be made electrification ready as prescribed in the electrification readiness option.

The electrification requirements of this option would have two exceptions.

1. Additions that do not alter the existing space heating system. This exemption is included to avoid adding the cost associated with the installation of new space heating equipment to a project where the existing system has capacity to heat the new conditioned space. Dedicated wiring for the future electrification of the existing space heating equipment is not required since the location of the HPSH equipment is based on the City's Zoning Ordinance requirements for required side and rear yards and the City's Noise Ordinance which cannot be determined until the equipment has been selected.
2. Additions that do not alter the water supply system and is included to avoid adding the cost associated with new water heating equipment to a project. However, it does require the installation of a dedicated 240-volt, 30-amp branch circuit to be installed within 3 feet from the existing water heater location to prepare the house for future electrification.

As stated in previous option analysis, the requirement to add wiring to the current gas fired hot water heater does add both labor and material cost. However, by having the wiring installed allows for a property owner to replace the existing gas fired water heater at the end of its life cycle with a HPWH without experiencing any additional time without hot water than would normally be experienced. The requirements do not include wiring for the Heat Pump space heating equipment due to not knowing the desired location for the location of the Heat Pump space heating equipment being based on the City's

Zoning Ordinance requirements for required side and rear yards and the City's Noise Ordinance which cannot be determined until the equipment has been selected.

There is the possibility that the installed wiring to the existing water heater location may never be used due to rate of recovery for a HPWH is considerable slower than a gas fired water heater. A water heater's recovery rate is the amount of hot water the water heater is capable of providing in a given period of time. Most manufacturers recommend that the storage size be increased for a HPWH to offset the slower rate of recovery. While the recommended increase in size varies based on demand and rate of recovery, a typical recommendation for a replacement of a 40-gallon gas fired water heater is 60 to 80 gallons for a HPWH. The increase in physical size can potentially cause a conflict with:

- The City's Zoning ordinance requirements if the water heater is located in a garage and the new HPWH encroaches into the required interior clear space for parking cars; or
- Adequate space in an existing water heater closet located in a Single-family buildings or individual dwelling units in multi-family buildings.

A potential resolution to these conflicts is to install the HPWH in a new location however the equipment cannot be located where it is exposed to the elements. Where the HPWH cannot be relocated within the existing single-family buildings footprint, the existing structure would need to have a shelter constructed to accommodate the HPWH. The shelter could not be placed in the required side or rear yards and could potentially add lot coverage and/or floor area. Additionally, heat pump equipment typically generates noise levels above 70 dBa which can potentially cause a conflict with the City's Noise Ordinance for all heat pump equipment located outside. The challenges associated with the relocation to accommodate a HPWH within a dwelling unit in a multi-family building are even more complex.

Option 4E: Heat Pump Water Pool Heating Equipment for New Pools

This option would require the installation of heat pump pool water heating equipment for all new pool construction. Currently all new single-family home development that includes the construction of a new pool are required to use heat pump pool water heating equipment. However a new pool being constructed on a property with an existing single- or multi-family or non-residential building is not required to install heat pump pool water heating equipment.

The requirement for the use of heat pump pool water heating equipment for all newly constructed pools does increase the cost of the direct pool construction cost due to the additional cost associated with using heat pumps rather than gas fired equipment. Additionally, the use of a heat pump could result in the requirement to upgrade the existing electrical panel. A typical heat pump pool water heating equipment requires a 40 to 60 Amp, 240 Volt circuit and greatly depends on the size of the pool. The electrical panel upgrade could potentially trigger the electrification ready requirement for existing Single- or multi-family buildings should those policies be adopted. The additional capital cost associated with the heat pump equipment, upgrade to the panel and electrification ready provisions could add significant cost to the overall project. The noise level would be comparable to a similar sized air conditioning unit and he noise from multiple heat pump sound sources is cumulative.

Option 4F: Electric Appliances and EV Charging in Alterations to Residential Buildings

This option requires alterations to single-family homes to convert the existing gas fired water heating or space heating equipment or both to heat pump based equipment depending on the scope of work.

Additionally, the option requires the structure to be made electrification ready as prescribed in the electrification readiness option. There are two exceptions to the requirements of this option:

- The first exempts alterations that do not alter the existing space heating system. This exemption is included to avoid adding the cost associated with new space heating equipment to a project. Dedicated wiring for the future electrification of the existing space heating equipment is not required since the location of the heat pump space heating equipment is based on the City's Zoning Ordinance requirements for required side and rear yards and the City's Noise Ordinance which cannot be determined until the equipment has been selected.
- The second exception exempts alterations that do not alter the water supply system and is included to avoid adding the cost associated with new water heating equipment to a project. However, it does require the installation of a dedicated 240-volt, 30-amp branch circuit to be installed within 3 feet from the existing water heater location to prepare the house for future electrification.

The requirements also captures alterations to multi-family buildings. Specifically, it requires:

- The main panel serving the units have enough breaker space and electrical capacity to electrify all of appliances in the unit; and a 120-volt, 20-amp circuit per unit to allow for electric vehicle charging but does not require the installation of the outlet;
- The existing space heating equipment be replaced with heat pump space heating equipment when the heating system is altered;
- The existing water heating equipment be replaced with heat pump water heating equipment when the water supply system is altered; and
- A dedicated 240-volt, 30-amp branch circuit be installed within 3 feet from the existing water heater location(s) when there is an existing gas fired water heater in the unit under alteration but the work scope does not include alterations to the existing water supply system.

There are exceptions for multi-family residential buildings where the existing gas fired HVAC and water heating systems are centralized for the entire building(s), the systems are required to be replace with heat pump equipment when 50 percent of the units in the building(s) have been altered. While these requirements do potentially add cost to the project, some of those cost can be offset with currently available incentives. It is difficult to ascertain if additional electrical work will be required to address the electricity requirements for a HPWH due to the differing ages and construction of the existing multi-family building stock.

Alterations are defined in the 2019 California Residential Code as, "Any construction or renovation of a structure other than repair or addition." The term is used specifically in this option as it is a codified term however, it does have the potential of capturing projects where the cost of this option requirements greatly exceeds the cost of the proposed alterations. As an example, the replacement of a window will trigger the requirements to make the building electrification ready consistent with the electrification readiness requirements and install a dedicated 240-volt, 30-amp branch circuit be installed within 3 feet from the existing water heater location(s) when there is an existing gas fired water heater. The reservation of breaker space and electrical capacity to accommodate the additional electrical loads associated with Heat Pump water and space heating, a 120-volt, 20-amp circuit per unit to allow for electric vehicle charging, electric stove, ovens and clothes dryers can potentially necessitate the upsizing of the panel size and the possibility that the installed wiring to the existing water heater location may never be used due to potential conflicts associated with the increase in physical size as discussed in the electrification readiness analysis. There are three possible outcomes in this type of scenario:

1. The property owner moves forward with a permit and complies with the option requirements;
2. The property owner moves forward without the benefit of permit which prevents the inspection of the installation to ensure the proper installation of the equipment for the safety of the occupants; or
3. The property owner elects to not replace the window and the potential energy efficiency gains associated with a new window are lost.

Further consideration of more exceptions need to be explored to avoid the unintended consequence of adding significant cost to small projects is needed.

Number of Buildings Impacted by the Permitting Options:

There are 7,333 single-family homes and 5,669 multifamily units (2 or more units per building) per the 2019 ACS census data. Below are the number of permits issued for additions, alterations and the installation of new electric panels, photovoltaic systems, water heaters and HVAC equipment in single- and Multi-family residential buildings between 2017 and 2020.

Single-Family Average Number of Permits by Use and Work Type							
Year	Electric Panels	PV	Water Heaters	HVAC	Additions	Alterations	Pools
2017	51	76	59	53	59	172	27
2018	34	66	38	86	61	204	16
2019	37	75	49	53	45	195	12
2020	6	125	3	39	37	249	TBD
Average	32	86	37	58	51	205	18

Figure 11 - Single-Family Average Number of Permits by Use and Work Type

Multi-Family Average Number of Permits By Use and Work Type						
Year	Electric Panels	PV	Water Heaters	HVAC	Additions	Alterations
2017	3	0	14	18	0	88
2018	6	1	12	23	0	87
2019	2	2	26	10	1	73
2020	0	3	0	12	1	36
Average	3	2	13	16	1	71

Figure 12 - Multi-Family Average Number of Permits by Use and Work Type

Using the average number of issued permits per year and the 2019 census data the permitting options, the anticipated average number of buildings based on each permitting option are as follows:

Electrification Readiness:

An average of 32 permits were issued specifically for new electric panels and 86 for photovoltaic systems between 2017 and 2020. This data does not include electric panel upgrade/replacement or photovoltaic system installations associated with additions and alterations as accurate data is difficult to ascertain without review of each individual plan set. If the requirements for electrification readiness are implemented, it is anticipated that an average of 118 buildings per year will be electrification ready by 2030. This equates to 1.6 percent of the existing single-family and multi-family structures building stock and does not account for the new all electric buildings that are currently being built in compliance with the City's adopted 2019 Building Codes.

Between 2017 and 2020 an average of 51 permits were issued for additions to single-family structures and 1 permits were issued for additions to multi-family residential structures per year. If the requirements for electrification readiness are expanded to include additions to single-family and multi-family buildings are implemented, it is anticipated that an additional average of 2.3 percent of the existing single-family and multi-family structures building stock will be made electrification ready for a total of 6 percent annually. This does not account for the new all electric buildings that are currently being built in compliance with the City's adopted 2019 Building Codes.

Voluntary Replacement:

The number of voluntary replacements/relocations associated with additions and alterations in single-family buildings is difficult to ascertain without review of each individual plan set. An average of 37 permits were issued specifically for the replacement of water heaters in single-family buildings and 58 for the replacement of HVAC equipment between 2017 and 2020. If the requirements for the voluntary replacement are expanded to include the mandatory replacement of existing gas fired equipment at the end of equipment life with heat pump equipment, it is anticipated that an average of 95 single-family buildings (37 water heater permits and 58 HVAC permits) and 29 multi-family buildings (13 water heater permits and 16 HVAC permits) per year will be electrification ready by 2030 which is approximately 1.7 percent of the existing building stock per year.

Additions to Single-Family Residential Buildings:

An average of 51 permits were issued specifically for additions to single-family homes between 2017 and 2020. It is difficult to ascertain the number of these permits that would have triggered the Option's requirements without review of each individual plan set. Assuming that an annual average of 51 permits for additions to single-family homes trigger at least one of the requirements, this would equate to .7 percent of the existing single-family home building stock having some form of heat pump equipment installed and made electrification ready annually if implemented. This is in addition to the new all electric buildings that are currently being built in compliance with the City's adopted 2019 Building Codes.

Alterations to Single-Family Residential Buildings:

An average of 205 permits were issued specifically for alterations to single-family homes and 71 for multi-family homes between 2017 and 2020 that would have triggered the requirements. It is difficult to ascertain how many individual dwelling units are associated with of the multi-family permits without review of each individual plan set. If the requirements are implemented, it is anticipated that an average of 2.7 percent of the existing single-family home building stock would have some form of heat pump equipment installed and made electrification ready annually. Assuming each permit issued for a multi-family building was for a single dwelling unit, an average of 1 percent of the existing multi-family building stock would have some form of heat pump equipment installed and made electrification ready annually. This is in addition to the new all electric buildings that are currently being built in compliance with the City's adopted 2019 Building Codes.

Impacts to State Building Codes or City Ordinances

The permitting options will require local amendments be made to the California Building Standards Code (CBSC) and possibly the City's Zoning, Noise and Heritage tree Ordinances. The CBSC allows for local jurisdictions to establish more restrictive and reasonably necessary to the CBSC. The local amendments are required to be based on climatic, topographic or geographical conditions and approved by City Council. All of the proposed permitting policy options will require going through the local amendment process.

Several aspects of the permitting options could require amendment to the City's Zoning and Noise ordinance. As mentioned earlier, a new HPWH may not fit into the existing GFWH location or could encroach into the required clear space for covered parking. Where the HPWH cannot be relocated within the existing buildings footprint, the existing structure would need to have a shelter constructed to accommodate the HPWH. The shelter could not be placed in the required side or rear yards and could potentially add lot coverage and/or floor area. Additionally, heat pump equipment typically generates noise levels above 70 dBa which can potentially cause a conflict with the City's Noise Ordinance for all heat pump equipment located outside. Similarly, the location of the Heat Pump space heating equipment being based on the City's Zoning Ordinance requirements for required side and rear yards and the City's Noise Ordinance. The challenges associated with the relocation of existing water and space heating equipment to accommodate a heat pump equipment in multi-family buildings are even more complex.

The Heritage Tree ordinance prohibits installation or storage of equipment under a heritage tree. Specifically, any person who owns, controls, or has custody or possession of any real property within the city shall use reasonable efforts to maintain and preserve all heritage trees located thereon in a state of good health. This requirement can pose limits on possible heat pump equipment location.

Amending the City's Zoning, Noise and Heritage Tree ordinances could be undertaken to exempt heat pump equipment in some capacity to encourage its installation. The process would require a comprehensive study of allowing possible equipment location to be closer to property lines and/or heritage trees then currently allowed but still maintains a distance that does not cause a nuisance for the adjoining properties. At a minimum, the process would require:

- Studying typical equipment size, weight, noise levels and installation requirements:
- Analysis of each Zoning District's typical lot dimensions and size for determination of allowable distance to property line for the equipment;
- Analysis of the attenuation of sound over distance to ensure noise levels are not increased to a nuisance level by reducing the allowable proximity to property lines.
- Analysis of potential harm to heritage trees if equipment is allowed to be located under them;
- Drafting of revised Ordinance language;
- Potential public outreach for feedback;
- Presentation to and recommendation from the Planning Commission; and
- Presentation to and approval by the City Council.

City Resources Necessary for Permit Requirements

The permitting options potentially impact the Building Official and City Attorney during the code adoption process for the selected options as well as the time associated with permit processing, plan review and inspection for the Building and Planning Divisions. The time impacts are cumulative with respect to each option that is adopted and to the potential number of permits each option captures. Additionally, there is the time impact associated with staff providing written and verbal educational information to the public which is very difficult to quantify.

The permitting options that are chosen to be implemented are adopted as amendments to the California Building Standards Code. The California Building Standards Code is adopted in three year cycles with local amendments to the code typically adopted at the same time. This does not preclude the adoption of an amendment in a non-code adoption year. In order for an amendment to brought forward for adoption, The Building Official will have to determine which sections of the code that is required to be amended, determine that the new code language does create conflict with any other code sections and write the code language for the amendment. The amendments are reviewed by the City Attorney and ultimately brought to the City Council for approval. A considerable amount of time is required to write an amendment to ensure that the amendment captures the intended structures and uses and does not create any unintended consequences.

The impact associated with the electrification readiness option beyond the educational component will be the additional Building Division plan check and inspection time associated with the electrification readiness requirements. Specifically, the permit application will have to be accompanied by electrical load calculations for the structure to demonstrate compliance to both the California Electric Code requirements and the requirements of this option. The plan checker will have to then review the load calculations prior to issuance of the permit. Likewise, the Building Inspectors will have to confirm that the requirements of the option are incorporated into the new electric panel and the wiring installed to the existing water heater location.

The anticipated impact to staff associated with voluntary replacement option will be the additional plan check and inspection time associated with the plan checker determining whether or not the existing GFWH is being replaced, upgraded or relocated in order to apply the requirements. Additionally, if the equipment is being relocated or placed outside of the building, a Planning Division staff member will have to review the plans for compliance with the City's Zoning and Noise ordinances. Likewise, the Building Inspectors will have to confirm that the existing GFHW has not been replaced, upgraded or relocated during the construction of the project. If the scope of work has been increased during construction, the plans will be required to be updated to show the increased scope of work and compliance with the option requirements, the revisions submitted for plan review, the revised pans issued and re-inspected for compliance.

The anticipated impact to staff associated with the additions and alterations to existing buildings options will be the additional plan check and inspection time associated with this option's requirements. Specifically, the Building Division plan checker will have to determine whether or not the existing water supply and/or space heating systems are being altered in order to apply the requirements. Likewise, the Building Inspectors will have to confirm that the existing water supply and/or space heating systems are being altered during the construction of the project. If there are alterations made during construction that are not shown on the plans, the plans will be required to be updated to show the increased scope of work and compliance with the option requirements, the revisions submitted for plan review, the revised pans issued and re-inspected for compliance.

Option 5: Electrification Ready at Time of Sale

A jurisdiction may encourage or require electrification upgrades at time of real estate sales. The City could consider electrification ready at the time of sale. Existing examples require some energy assessment and/or label and disclosure policies, with no explicit link to electrification. Notable instances include:

- Since 2015, **City of Berkeley** Building Emissions Savings Ordinance (BESO) has required an energy efficiency assessment for all single family, commercial, and multifamily buildings at time of listing, and/or annual benchmarking, using either the Department of Energy Home Energy Score or ENERGY STAR Portfolio Manager. Exemptions are allowed for new construction, extensive renovations, or financial hardship (such as participation in income-qualified or tax-postponement programs). A 2020 evaluation of the program states that while the program helped the City attain energy consumption information that is useful for shaping policy, it has also been challenging for the city to track conversion rates from assessment to energy upgrade, due to privacy protections of utility program data and a lack of granular building permit data.
- The **City of Berkeley** also has a Real Property Transfer Tax that is imposed on all property transfers, and ranges from 1.5 percent - 2.5 percent of the property value. Up to 1/3 of the base 1.5 percent transfer tax rate is eligible for a Seismic Transfer Tax Refund, if the property owner performs voluntary seismic upgrades within one year of the transfer. [74] Historically, an average of 13 percent of eligible homeowners have received the refund between 2014 and 2019.[75] The City is considering updates to expand the Seismic Tax Refund Program include resilience, energy efficiency, electrification measures for commercial and mixed-used buildings.[76]
- **City of Davis'** Resale Program, implemented in 1976, requires a building inspection to certify that the building meets local ordinance requirements as part of a residential property transaction. The inspected items include various health and safety measures including air conditioner disconnect, furnace combustion air, laundry outlet voltage, energy standards compliance with retrofit, and pipe insulation. As of 2018, the cost for the inspection was $426. The City inspects approximately three to four percent of its housing stock annually, and since 2014, only five percent of resale inspections have found unpermitted heating, ventilation, and air conditioning (HVAC) installations.
- **City of Piedmont** requires that at point of listing for sale of a property, a report from a Home Energy Audit or Home Energy Score (homeowner's choice) must be provided to potential buyers and submitted to the City—unless the residential building was constructed in the past 10 years. This requirement was implemented in early 2021, and there is limited compliance and implementation data at this time.
- Since 1982, the **City of San Francisco** has required energy and water conservation measures for all residential dwellings that undergo a property transfer or major improvements (e.g., $20,000 of estimated improvements for a single-family home). Measures include a minimum of R-11 attic insulation, water heater insulation, weatherization, and duct insulation, and must be inspected for compliance. Costs are capped at $1,300 per single-family dwelling, and for multifamily buildings:

- 1% of the assessed value of the building if improvements are performed prior to property transfer
- 1% of the purchase price as stated in the real estate sales contract

Pros	Cons
• Ability to create total electrification of homes and buildings • May provide incentive for property owners to consider electrification ahead of property sales • Relatively high GHG impact	• Without incentives, can add significant cost to property transfer • Limited total number of buildings that can be impacted • Expected backlash from realtors

Figure 13 - Pros and Cons of Time of Sale Ordinance

IV. PROJECTED GHG REDUCTION OUTCOMES

GHG savings opportunity of proposed policy options

In order to determine the effectiveness of each proposed policy pathway, DNV quantified Greenhouse Gas (GHG) savings potential in terms of annual reduction of Metric Tons Carbon Dioxide equivalent (MT CO2e) on an annual basis. This specifically answers the question "how much will annual emissions be reduced if we enact this policy on January 1st 2023 and it impacts buildings through December 31st 2030."

The total emissions savings of all policies listed below is not expected to meet the target outlined in the Climate Action Plan.

Intervention Point	Methodology	GHG Savings w/o leakage (MT CO2e yr)
If we meet 2030 goal (95% of buildings)	95% x comm & res natural gas use from Climate Action Plan	51,636[8]
Business and Usual	Assumes 10% of Menlo Park residents will electrify their home by 2030 without incentive or mandate.	5,164
Marketing and Education	Assumes 10% of Menlo Park residents will be inspired to perform total electrification by 2030 by Marketing and Education Efforts	5,164
HVAC Permit	Assumes every HVAC permit with existing gas equipment results in electrification.	653
Water Heating Permit	Assumes every water heating permit with existing gas equipment results in electrification.	894

[8] The table above has yet to compare the GHG savings methodology against the methodology used by the Climate Action Plan (CAP.) In order to provide and apples-to-apples GHG reduction comparison, it is critical to square up against the numbers used in the CAP

Single Family Additions	Assumes every addition results in total electrification	1,006
Single Family Alterations	Assumes every alteration results in total electrification	3,652
Single Family Repair	Assumes every repair results in total electrification	2,708
Panel Upgrade Electrification Readiness	Assumes that 10% of panel upgrade permits results in electrification of two end uses.	2,661
Solar PV Permit	Assumes every PV installation permit receives total electrification.	359
Pool Permit	Assumes every new pool is heated with heat pumps instead of natural gas	193
Point of Sale	Assumes every home sale results in total electrification.	6,874
Total		29,246

Figure 14 - GHG Savings of Policy Options

The waterfall chart below[9] outlines the GHG savings opportunity (excluding the gas grids fugitive methane emissions,) if each policy is selected. A corresponding dashboard is available in excel which allows users to select or de-select each measure

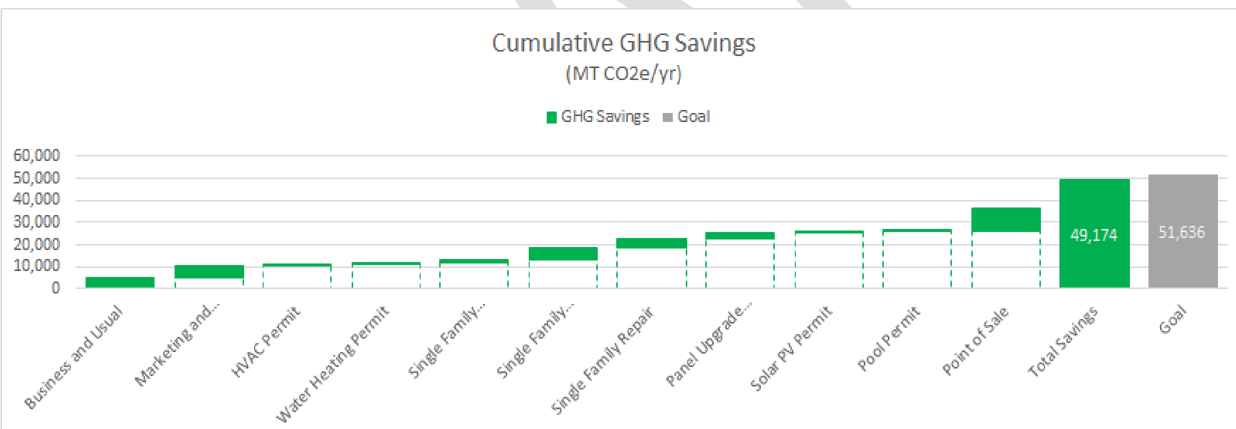


Figure 15 - Cumulative GHG Savings of Proposed Options

Permits as intervention points cannot alone meet the 2030 goal

There appears to be a low permit capture rate within Menlo Park, which aligns with DNV's findings in a 2017 study for the California Public Utilities Commission. The chart below outlines the differences between the GHG savings of capturing every equipment replacement, as compared to the GHG savings of capturing equipment only when HVAC or water heating permits are pulled. Based on these findings, it may benefit Menlo Park to consider alternative policy pathways to meet the 2030 GHG savings goal outlined in the CAP.

[9] Waterfall chart does not include the impact of fugitive methane emissions

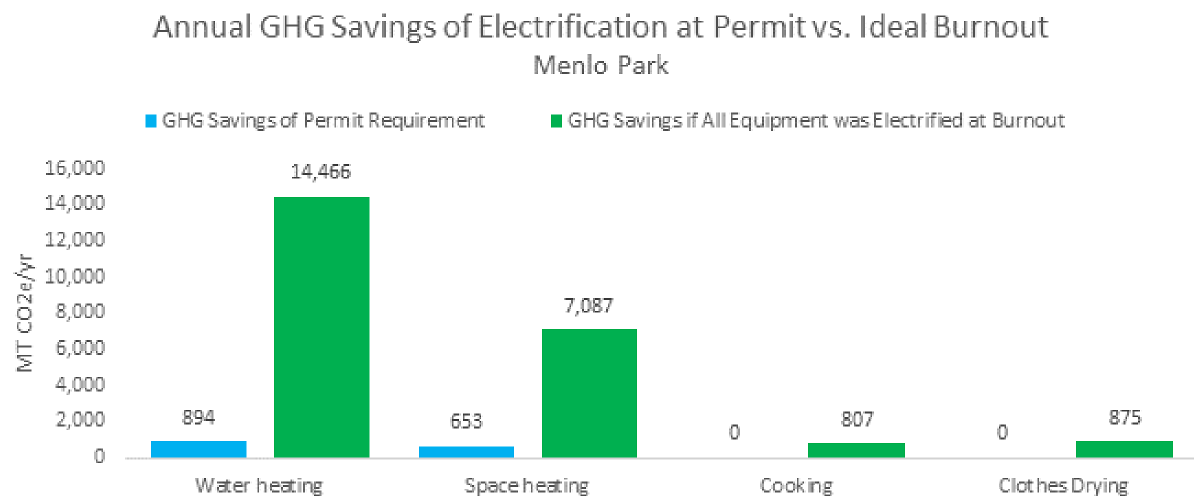


Figure 16 - Annual FHG Savings of Electrification - Permit vs. Ideal Burnout

State and federal action is needed to meet our carbon neutral goal

Since not all projects go through the permit process, and some buildings may find a way to keep old, gas-fired equipment running long-past its life expectancy – state or federal action will needed to help reach local climate goals. Environmental health risks have long been the bedrock or local, state, and federal mandates on the reduction or end of use of certain equipment. Asbestos has been heavily regulated under many uses since 1970s Clean Air Act, Lead Paint has been banned for residential use since 1978, and the Montreal Protocol represented a global effort to save the planet's ozone layer by ending the use of CFCs[10].

If the state or federal government bans the sale of gas-fired equipment, it could significantly help Menlo Park meet its ambitious climate goals. This may be the only path, which enables the world to meet its global climate goals and avoid catastrophic global warming.

V. CRITERIA USED IN MAKING EVALUATION

Each of the options above were scored according to the following criteria to inform recommendations in the next section. Other criteria or characterizations of the criteria can be included in future versions of this report.

a. Ease of Implementation/Process – 1) There is a low level of engagement necessary during the adoption process, 2) does not require long term-staff resources, 3) does not require coordination with other agencies.

[10] The Montreal protocol may be the closest example to efforts to stave off global warming today. Ozone depletion due to CFCs was a known issue since the 1970s, but slowly phased out through the 1990s with some older HVAC equipment still using CFCs today. While the ozone layer has been largely preserved, a thinning of the ozone layer over the Southern Hemisphere occurred. As a result, skin cancer rates are the highest in countries in the region – Australia and New Zealand.

b. Convenience – 1) Does not increase scope beyond the original plan, 2) does not increase project timeline or cause a physical impact to the property, 3) skilled workforce for the required upgrade is available
c. Equitable – 1) Tenant protections exist, 2) there are income-qualified exemptions, incentives, and financing available, 3) there is community engagement on policy design and workforce development and training
d. Cost effectiveness – 1) Demonstrates on-bill savings, 2) does not increase upfront costs, 3) incentive programs are available or forth-coming
e. Effectiveness – 1) Is an enforceable mandate, 2) transforms the market, 3) is scalable

The options have been ranked based on the three elements contained within each criteria. Each element is worth either 0 or 1 points, and with three elements per criteria, each policy option could achieve a maximum of 12 points. This is a coarse scale, and also assumes equal weighting across each element. This scale serves as a starting point by which to rank these policy options and can be improved upon in future iterations.

The Policy Options are listed in the table by option number and have scores ranging from 4 -10. The two highest ranking options include:

- Option 2 Generate Funds - scored highly because it is the most convenient policy because it doesn't directly impact project work, provides incentives, can be designed to generate and redistribute funds equitably, and may be implemented by city staff relatively easily.
- Option 4A Heat Pump at A/C installation – scored highly because it is minimally intrusive, does not add cost to a project where air-conditioning equipment is already being replaced.

Options 1 Public Engagement and Education, 4B Electric Ready due to PV Installation or Panel Upgrade, 4E Heat Pump Pool Heater Installed for New Equipment, 4F Electric Appliances and EV Charging in Alterations to Residential Buildings and 5 Electrification Ready at Time of Sale all tied in 3rd place with a score of 6.

The three lowest ranking options include Options 4C Heat Pump Installed Upon Voluntary Replacement, 4D Heat Pump Installed During Additions to SF Buildings and 3 Time Certain Building Performance Standards. All of these require a high level of engagement, and either new staff resources or coordination with outside agencies. They can all increase a project's scope of work, budget, timeline and while it can be difficult to initially find skilled workforce for heat pump water heat installations, the market can adapt quickly . Incentives for panel upgrades, heat pump water heaters and heat pump space heaters are available, but they may not be enough to cover the increased upfront costs associated with these upgrades. Options 4Cand 4D are also susceptible to permit dodging, reducing effectiveness. Option 3 would need a disclosure program to become an enforceable mandate. However all three options can lead to market transformation.

It is important to note none of the policies listed ranked highly for equity using the criteria listed above as currently constructed.

LEGEND		
0	1-2	3
🔴	🟡	🟢

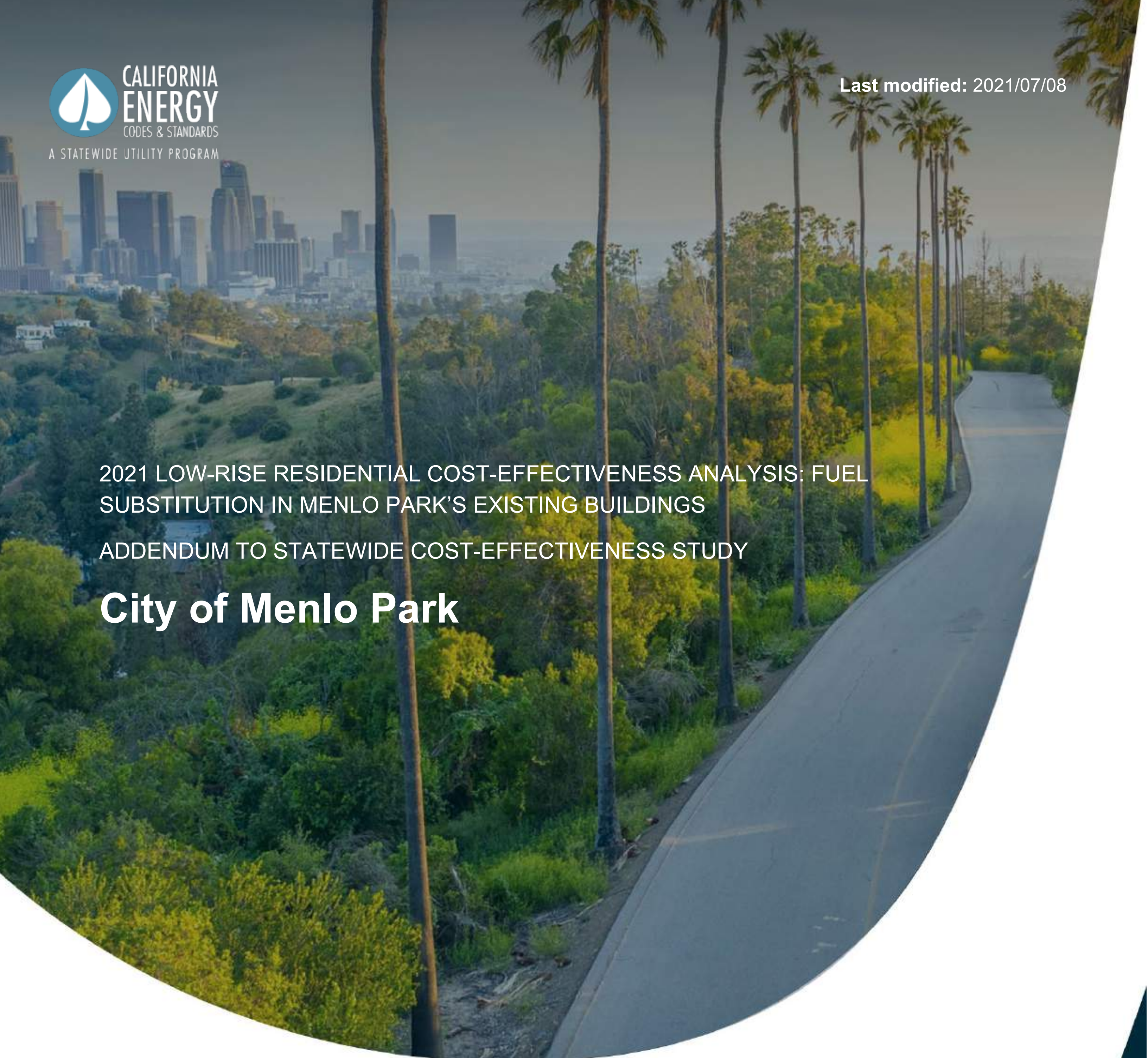
Policy Option and Requirement		Ease of Implementation	Convenience	Equitable	Cost Effective	Effective	Total Score
Option 1: Public Engagement and Education		🟡	🟢	🔴	🔴	🟡	6
Option 2: Generate funds to Develop Additional Incentive and Financing Program Offerings		🟢	🟢	🟡	🟡	🟡	10
Option 3: Time Certain Building Performance Standards		🔴	🟡	🟡	🟡	🟡	5
Option 4: Permit Desk	Option 4A: Heat Pump at A/C Installation	🟢	🟡	🔴	🟡	🟢	9
	Option 4B: Electric Ready Due to PV Installation or Panel Upgrade	🟡	🟡	🔴	🟡	🟢	6
	Option 4C: Heat Pump Installed Upon Voluntary Replacement	🟡	🔴	🔴	🟡	🟡	4
	Option 4D: Heat Pump Installed During Additions to SF Buildings	🟡	🔴	🔴	🟡	🟡	4
	Option 4E: Heat Pump Pool Heater Installed for New Equipment	🟡	🟡	🔴	🟡	🟡	6
	Option 4F: Electric Appliances and EV Charging in Alterations to Residential Buildings	🟡	🟡	🔴	🟡	🟢	6
Option 5: Electrification Ready at Time of Sale		🔴	🟡	🔴	🟡	🟢	6

Figure 17 - Rubric Comparing Measures

VI. ATTACHMENTS

Attachment A- 2019 Residential Cost Effectiveness Analysis

Attachment B- Memorandum on preliminary cost effectiveness analysis for non-residential.



CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Last modified: 2021/07/08

2021 LOW-RISE RESIDENTIAL COST-EFFECTIVENESS ANALYSIS: FUEL SUBSTITUTION IN MENLO PARK'S EXISTING BUILDINGS

ADDENDUM TO STATEWIDE COST-EFFECTIVENESS STUDY

City of Menlo Park

Prepared by:
Frontier Energy, Inc.
Misti Bruceri & Associates, LLC

Prepared for:
Kelly Cunningham, Codes and Standards Program, Pacific Gas and Electric Company

SDGE A Sempra Energy utility · SoCalGas A Sempra Energy utility · Southern California Edison · Pacific Gas and Electric Company

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Acronym List

B/C – Benefit-to-Cost Ratio

BayREN – Bay Area Regional Energy Network

CBECC – California Building Energy Code Compliance

CBSC – California Building Standards Commission

CEC – California Energy Commission

CZ – Climate Zone

GHG – Greenhouse Gas

IOU – Investor-Owned Utility

PCE – Peninsula Clean Energy

POU – Publicly Owned Utility

PG&E – Pacific Gas & Electric (utility)

SCE – Southern California Edison (utility)

SCG – Southern California Gas (utility)

SDG&E – San Diego Gas & Electric (utility)

CPAU – City of Palo Alto Utilities

SMUD – Sacramento Municipal Utility District

LADWP – Los Angeles Department of Water and Power

kWh – Kilowatt Hour

NPV – Net Present Value

PV - Solar Photovoltaic

TDV - Time Dependent Valuation

Title 24 – California Code of Regulations Title 24, Part 6

TOU – Time of Use

Summary of Revisions		
Date	**Description**	**Reference (page or section)**
4/22/2021	Original Release	NA
6/23/2021	Update to include multifamily analysis; include additional detail on incremental costs.	NA
7/8/2021	Update to PCE HPWH incentive, GHG savings, and 1992-2010 HP results. Add cost details on electric ready measures.	NA

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1 Introduction

The California Codes and Standards Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy and greenhouse gas reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation. Local jurisdictions that are considering adopting ordinances may contact the program for support through its website, LocalEnergyCodes.com.

The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (California Energy Commission, 2018) is maintained and updated every three years by two state agencies: the California Energy Commission (the Energy Commission) and the Building Standards Commission (BSC). In addition to enforcing the code, local jurisdictions have the authority to adopt local energy efficiency ordinances—or reach codes—that exceed the minimum standards defined by Title 24 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards). Local jurisdictions must demonstrate that the requirements of the proposed ordinance are cost-effective and do not result in buildings consuming more energy than is permitted by Title 24. In addition, the jurisdiction must obtain approval from the Energy Commission and file the ordinance with the BSC for the ordinance to be legally enforceable.

This analysis is an update to the statewide cost-effectiveness study for existing building upgrades completed in March 2021 (Statewide Reach Code Team, 2021) which evaluates the feasibility and cost-effectiveness of retrofit measures in existing single family homes built before 2010. This report presents results from analysis conducted in response to a request from the City of Menlo Park to evaluate the fuel substitution measures with revisions that more accurately reflect local conditions. Cost-effectiveness is reported for California Climate Zone 3 based on Peninsula Clean Energy (PCE) electric tariffs for both single family and low-rise multifamily buildings. This report was developed in coordination with the California Statewide Investor Owned Utilities (IOUs) Codes and Standards Program, key consultants, and engaged cities—collectively known as the Reach Code Team.

The Department of Energy (DOE) sets minimum efficiency standards for equipment and appliances that are federally regulated under the National Appliance Energy Conservation Act, including heating, cooling, and water heating equipment (E-CFR, 2020). Since state and local governments are prohibited from adopting higher minimum efficiencies than the federal standards require, the focus of this study is to identify and evaluate cost-effective packages that do not include high efficiency heating, cooling, and water heating equipment. High efficiency appliances are often the easiest and most affordable measures to increase energy performance. While federal preemption limits reach code mandatory requirements for covered appliances, in practice, builders may install any package of compliant measures to achieve the performance requirements.

2 Methodology and Assumptions

The same methodology used in the statewide analysis (Statewide Reach Code Team, 2021) is applied to this analysis with the following exceptions:

- Local PCE electric utility tariffs are used in place of PG&E tariffs.
- PCE and BayREN incentives are considered.
- A single family 2,700 square foot home is used in place of the 1,665 square foot home applied in the statewide study. This larger home better reflects the Menlo Park building stock.
- A two-story multifamily apartment building was also evaluated. The eight-unit building has four one-bedroom 780 square foot units and four two-bedroom 960 square foot units.
- Only the fuel substitution measures are evaluated.
- Two additional measures are evaluated showing the energy impact of converting a gas dryer and gas range/oven to electric resistance appliances.

Key components of the methodology are repeated below. Refer to the statewide study for further details.

2.1 Measures and Costs

In addition to the fuel substitution measures for space heating and water heating the Statewide Reach Code Team also evaluated fuel substitution for clothes drying and cooking. Standard and high efficiency heat pumps were considered in this analysis. For space conditioning, the study assumes that an existing AC and natural gas furnace is replaced with a heat pump. It is assumed there is no incremental labor except in providing new 240 V electrical service to the air handler location. In mild climates, where AC may not be installed, there will be additional costs for installing an outdoor unit, refrigerant lines, and condensate drain pan. A 21 SEER, 11 HSPF variable capacity heat pump was modeled for the high efficiency space conditioning heat pump.

The heat pump water heater (HPWH) measures are based on replacement of a natural gas storage water heater with a HPWH, assuming the existing water heater is located in the garage for single family buildings and an exterior closet for multifamily buildings. Costs include all material and installation labor including providing new 240 V electrical service to the water heater location.

Incremental costs for these fuel substitution measures are presented in Table 1, Table 2, and Table 3. All equipment is assumed to be replaced at end-of-life and incremental costs are relative to comparable gas equipment. The lifetime for the heat pump, furnace, and air conditioner are based on the Database for Energy Efficient Resources (DEER) (California Public Utilities Commission, 2021). In DEER heat pump and air conditioner measures are assigned an effective useful lifetime (EUL) of 15 years and a furnace an EUL of 20 years. The heating and cooling system components are typically replaced at the same time when one reaches the end of its life and the other is near it. Therefore, it is assumed that both the furnace and air conditioner are replaced at the same time at year 17.5, halfway between 15 and 20 years. Future replacement costs for the heat pumps are reduced by 20% to account for cost reductions as a result of a maturing market. The HVAC single family costs reflect a 3-ton heat pump or air conditioner and a 60,000 Btu/h furnace. The multifamily costs are slightly lower as they reflect a 2-ton heat pump or air conditioner and a 40,000 Btu/h furnace. Incremental costs for electric ready measures are presented in Table 4.

Table 1: HVAC Measure Cost Assumptions – Electric Replacements

	Single Family (3-ton HP/AC, 60kBtu/h furnace)			Multifamily (2-ton HP/AC, 40kBtu/h furnace)			Notes
	Gas Furnace /AC	14 SEER Heat Pump	21 SEER Heat Pump	Gas Furnace /AC	14 SEER Heat Pump	21 SEER Heat Pump	
First Cost	$8,738	$9,101	$11,247	$8,545	$8,731	$10,725	Equipment costs from on-line sources and HVAC contractors. Other supply and labor costs from 2019 report on residential building electrification in California (Energy & Environmental Economics, 2019). First cost includes disposal, electrical upgrade, and labor costs.
Replacement Cost (Future Value)	$8,738	$6,729	$8,445	$8,545	$6,433	$8,028	Future total replacement costs for the heat pumps are reduced by 20% to account for cost reductions because of a maturing market and electrical upgrade costs are removed.
Replacement Cost (Present Value)	$5,209	$4,319	$5,421	$5,094	$4,129	$5,153	Based on 17.5-year lifetime for gas furnace/AC, 15-year lifetime for heat pumps, 3% discount rate.
Remaining Value at Year 30	($1,029)	$0	$0	($1,006)	$0	$0	Residual value of the gas furnace/AC to account for the remaining life at end of 30-year analysis period.
Total Lifecycle Cost	$12,918	$13,419	$16,667	$12,633	$12,859	$15,878	
Incremental Cost	**-**	**$501**	**$3,749**	**-**	**$227**	**$3,245**	

Table 2: Water Heating Measure Cost Assumptions – Electric Replacements

	Single Family & Multifamily			Notes
	Gas Storage Water Heater	2.0 UEF HPWH	NEEA Tier 3 HPWH	
First Cost	$1,600	$4,018	$4,155	First cost based on 2018-2020 costs from SMUD incentive program for NEEA Tier 3 HPWH (Sacramento Municipal Utility District, 2020). 2.0 UEF first cost assumes 90% of equipment cost compared to NEEA Tier 3 unit based on on-line product research. Includes equipment cost, electrical upgrade, permitting, and labor.
Replacement Cost (Future Value)	$1,600	$1,874	$1,943	Future replacement cost assumes the same labor for the gas and HPWH case. HPWH replacement equipment costs are reduced by 50% to account for cost reductions because of a maturing market.
Replacement Cost (Present Value)	$1,027	$1,203	$1,247	Based on 15-year lifetime and 3% discount rate.
Remaining Value at Year 30	$0	$0	$0	
Total Lifecycle Cost	$2,627	$5,221	$5,402	
Incremental Cost	**-**	**$2,594**	**$2,775**	

Table 3: Cooking and Clothes Dryer Measure Cost Assumptions – Electric Replacements

	Single Family & Multifamily				Notes
	Gas Range	Electric Resistance Range	Gas Dryer	Electric Resistance Dryer	
First Cost	$1,510	$2,118	$1,805	$2,118	Costs from E3 study for Climate Zone 3 (Energy & Environmental Economics, 2019). No incremental replacement costs assumed.
Incremental Cost	**-**	**$608**		**$313**	

Table 4: Electric Ready Cost Assumptions

	Incremental Cost	Notes
Appliance pre-wire	$455 per appliance. $910 total for space and water heating	$125 parts, $330 labor. (Energy & Environmental Economics, 2019).
Main service panel upgrade	$3,181	Upgrade 100A to 200A (TRC, 2016)

A PV system is evaluated in combination with select fuel substitution measures. The PV system size presented in Table 5 was based on the sizing methodology of the 2019 new construction standards in Climate Zone 3. It was evaluated in CBECC-Res according to the California Flexible Installation (CFI) assumptions. Table 5 also presents incremental costs.

Table 5: PV System Capacity & Costs

	PV Size	Total Lifecycle Cost	Notes
Single Family	2.82 kW-DC	$3.18/kW-DC ($8,953 total)	First costs are from LBNL's Tracking the Sun 2019 costs (Barbose, 2019) and represent costs for the first half of 2019 of $3.70/WDC for residential systems and $3.10/WDC for small commercial systems. These costs were reduced by 26% for the solar ITC, which is the average credit over years 2021-2022. Inverter replacement cost of $0.14/WDC present value includes replacements at year 11 at $0.15/WDC (nominal) and at year 21 at $0.12/WDC (nominal) per the 2019 PV CASE Report (California Energy Commission, 2017). System maintenance costs of $0.31/WDC present value assume $0.02/WDC (nominal) annually per the 2019 PV CASE Report (California Energy Commission, 2017).
Multifamily	13.33 kW-DC total (1.67 kW-DC per dwelling unit)	$2.74/kW-DC ($4,559 per dwelling unit)	

2.2 Cost-effectiveness

This analysis uses two different metrics to assess cost-effectiveness. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with energy efficiency measures as compared to the 2019 prescriptive Title 24 requirements. The main difference between the methodologies is the way they value energy and thus the cost savings of reduced or avoided energy use.

- **Utility Bill Impacts (On-Bill)**: Customer-based Lifecycle Cost (LCC) approach that values energy based upon estimated site energy usage and customer on-bill impacts using electricity and natural gas utility rate schedules over a 30-year duration accounting for discount rate and energy inflation.
- **Time Dependent Valuation (TDV)**: Energy Commission LCC methodology, which is intended to capture the "societal value or cost" of energy use including long-term projected costs such as the cost of providing energy during peak periods of demand and other societal costs such as projected costs for carbon emissions, as well as grid transmission and distribution impacts. This metric values energy uses differently depending on the fuel source (gas, electricity, and propane), time of day, and season. Electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods (Horii, Cutter, Kapur, Arent, & Conotyannis, 2014). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in Title 24, Part 6. Analysis based on both 2019 and 2022 TDV is presented in this report.

On-Bill analysis was completed using the utility rates described in Table 6. PCE's TOU-C rate is similar to PG&E's TOU-C rate except with a lower generation rate and additional credit for solar PV generation. Rates reflect PCE's most recent updates on April 1, 2021 and PG&E's March 1, 2021 updates. Monthly net energy production is credited at $0.01/kWh in addition to the retail rate. See 5.1 Utility Tariff Details in the Appendix for details.

Table 6: Utility Tariffs Applied in Analysis

Electricity	Natural Gas
PCE TOU-C	PG&E G-1

Source: Utility websites, see 5.1 Utility Tariff Details in the Appendix for details on the tariffs applied.

Utility rates are assumed to escalate over time, using assumptions from research conducted by Energy and Environmental Economics (E3) in the 2019 study Residential Building Electrification in California (Energy & Environmental Economics, 2019). Escalation of electric utility rates for PCE was not available and the assumptions used in this analysis are based on those from the statewide studies (Statewide Reach Code Team, 2019).

Results are presented as a lifecycle benefit-to-cost (B/C) ratio, a net present value (NPV) metric which represents the cost-effectiveness of a measure over a 30-year lifetime considering discounting of future savings and costs and financing of incremental first costs. A value of one indicates the NPV of the savings over the life of the measure is equivalent to the NPV of the lifetime incremental cost of that measure. A value greater than one represents a positive return on investment.

3 Results and Discussion

Table 7 through Table 10 summarize cost-effectiveness of the fuel substitution measures evaluated. Cost-effectiveness analysis was evaluated using both On-Bill and TDV cost-effectiveness criteria. Site energy savings, cost savings, measure cost, and cost effectiveness including lifecycle B/C ratio and NPV of savings are provided. Where measures are dependent on building vintage (envelope efficiency measures), cost effectiveness is reported for each vintage. The electric clothes dryer and electric cooking measure results do not differ by vintage.

3.1 On-Bill Cost Effectiveness

The fuel substitution measures are not cost-effective on their own based on the On-Bill approach. When coupled with PV both the heat pump at HVAC replacement and HPWH at water heater replacement are cost-effective across all vintages. PCE[1] and BayREN[2] each offer a $1,000 incentive for a combined $2,000 incentive for installing a HPWH with a Uniform Energy Factor (UEF) of 3.1 or greater that replaces a gas water heater. These incentives reduce the first incremental cost substantially but not enough to make this measure cost-effective across the three vintages for either single family or multifamily. Because the incentives only apply to HPWHs with UEFs higher than the federal minimum standard, the cost-effectiveness results for single family cannot be used as the basis of an ordinance. Higher efficiency HPWHs can be installed as an option to an ordinance that is based on minimum efficiency equipment.

BayREN also offers a $1,000 incentive for a space conditioning heat pump with a minimum SEER of 17 and HSPF of 9.4. While this incentive improves cost effectiveness for the high efficiency heat pump measure, it is not enough to result in a positive On-Bill NPV over the lifetime.

The electric dryer and range measures are not cost-effective on their own. They may be cost effective if evaluated as a package with PV measures or if incentives were available.

For multifamily buildings, this study assumed the water heater is located in an outdoor closet. Performance of a HPWH will be slightly better if the existing water heater is located inside the unit (in conditioned space) but would create potential sound and comfort issues. Cost to install a HPWH inside the apartment would also be higher and most likely require ducting to properly vent the unit.

3.2 TDV Cost Effectiveness

Cost effectiveness improves for the fuel substitution measures based on the 2019 and 2022 TDV metric and all the measures except for the high efficiency heat pump for multifamily and the electric clothes dryer and range/oven are cost effective based on 2022 TDV. The measures are cost-effective under 2019 TDV when combined with a PV system. PV systems are more cost-effective On-Bill than with the TDV metrics, but the PV packages are all cost-effective based on all metrics.

[1] PCE incentive is currently $1,500 but will be reduced later in 2021 to $1,000.
https://www.peninsulacleanenergy.com/heat-pump-water-heater/
[2] https://bayrenresidential.org/sites/default/files/2021-01/BayREN_Home+_Measures_10292020.pdf

Table 7: Single Family Equipment Fuel Substitution Cost-Effectiveness Results – No Incentives

Measure	Vintage	Measure Cost	Electricity Savings (kWh)	Gas Savings (therm)	GHG Savings (lb CO_2e)	Utility Cost Savings		Customer On-Bill		2019 TDV		2022 TDV	
						Year 1	Avg Annual	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
Heat Pump at HVAC Replacement	Pre-1978	$501	-4,528	451	2,409	-$377	-$249	0	-$8,006	0	-$5,462	9.30	$4,160
	1978-1991		-3,173	309	1,606	-$295	-$200	0	-$6,547	0	-$2,318	5.68	$2,348
	1992-2010		-2,722	265	1,398	-$262	-$179	0	-$5,922	0	-$1,109	4.96	$1,984
SEER 21 Heat Pump at HVAC Replacement	Pre-1978	$3,749	-3,261	451	2,977	-$30	$26	0.19	-$3,290	0.92	-$312	3.17	$8,152
	1978-1991		-2,337	309	1,984	-$66	-$19	0	-$4,637	0.52	-$1,788	1.96	$3,617
	1992-2010		-2,011	265	1,713	-$67	-$25	0	-$4,820	0.78	-$825	1.60	$2,244
Heat Pump at HVAC Replacement + 2.82 kW_{DC} PV	Pre-1978	$9,454	-27	451	2,702	$786	$670	1.92	$9,644	1.33	$3,111	2.00	$9,478
	1978-1991		1,328	309	1,899	$868	$717	2.06	$11,078	1.66	$6,222	1.81	$7,637
	1992-2010		1,779	265	1,691	$901	$739	2.12	$11,720	1.79	$7,455	1.77	$7,292
HPWH at Water Heater Replacement	Pre-1978	$2,594	-1,588	179	1,358	-$114	-$71	0	-$5,032	0	-$4,546	1.20	$522
	1978-1991		-1,593	181	1,369	-125	-80	0	-$5,305	0	-$4,486	1.20	$517
	1992-2010		-1,594	181	1,372	-128	-83	0	-$5,391	0	-$4,458	1.18	$466
NEEA Tier 3 HPWH at Replacement	Pre-1978	$2,775	-1,146	177	1,491	$5	$22	0.21	-$2,434	0.22	-$2,168	1.87	$2,419
	1978-1991		-1,152	179	1,505	-$6	$13	0.13	-$2,702	0.23	-$2,140	1.87	$2,424
	1992-2010		-1,155	180	1,510	-$9	$10	0.10	-$2,788	0.24	-$2,116	1.85	$2,359
HPWH at Water Heater Replacement + 2.82 kW_{DC} PV	Pre-1978	$11,546	2,913	179	1,651	$1,057	$852	2.00	$12,781	1.36	$4,167	1.52	$6,017
	1978-1991		2,908	181	1,662	$1,046	$843	1.98	$12,500	1.37	$4,218	1.52	$6,003
	1992-2010		2,907	181	1,666	$1,042	$840	1.97	$12,416	1.37	$4,246	1.52	$5,956
2.82 kW_{DC} PV + Electric Ready	Pre-1978	$13,044	4,501	0	293	$1,161	$916	1.90	$12,994	1.34	$4,375	1.09	$1,156
	1978-1991		4,485		292	$1,093	$862	1.79	$11,378	1.33	$4,365	1.08	$1,100
	1992-2010		4,400		287	$1,069	$844	1.75	$10,829	1.33	$4,365	1.07	$848
Electric Clothes Dryer	All	$313	-891	33	118	-$182	-$140	0	-$4,555	0	-$3,770	0	-$2,242
Electric Range/Oven	All	$608	-295	14	59	-$55	-$42	0	-$1,949	0	-$1,692	0	-$1,229

Note: Values shaded in **red** indicate option is not cost-effective with B/C ratio less than 1. Values shaded in **green** indicate option is cost-effective with B/C ratio greater than or equal to 1. Cells with "n/a" reflect cases where cost effectiveness was not evaluated.

Table 8: Single Family On-Bill Cost-Effectiveness Comparison with Incentives

Measure	Vintage	Gross Measure Cost	PCE/ BayREN Incentive	Net Measure Cost	Year 1 Utility Cost Savings	No Incentive		With Incentive	
						On-Bill B/C Ratio	On-Bill NPV	On-Bill B/C Ratio	On-Bill NPV
SEER 21 Heat Pump at HVAC Replacement	Pre-1978	$3,749	$1,000	$2,749	-$30	0.19	-$3,290	0.26	-$2,168
	1978-1991				-$66	0	-$4,637	0	-$3,514
	1992-2010				-$67	0	-$4,820	0	-$3,697
NEEA Tier 3 HPWH at Replacement	Pre-1978	$2,775	$2,000	$775	$5	0.21	-$2,434	0.78	-$188
	1978-1991				-$6	0.13	-$2,702	0.46	-$456
	1992-2010				-$9	0.10	-$2,788	0.36	-$542

Note: Values shaded in **red** indicate option is not cost-effective with B/C ratio less than 1. Values shaded in **green** indicate option is cost-effective with B/C ratio greater than or equal to 1. Cells with “n/a” reflect cases where cost effectiveness was not evaluated.

Table 9: Multifamily Equipment Fuel Substitution Cost-Effectiveness Results Per Dwelling Unit – No Incentives

Measure	Vintage	Measure Cost	Electricity Savings (kWh)	Gas Savings (therm)	GHG Savings (lb CO_2e)	Utility Cost Savings		Customer On-Bill		2019 TDV		2022 TDV	
						Year 1	Avg Annual	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
Heat Pump at HVAC Replacement	Pre-1978	$227	-615	61	2,508	-$71	-$50	0	-$1,755	0	-$851	2.60	$363
	1978-1991		-402	40	1,585	-$47	-$34	0	-$1,261	0	-$678	1.53	$119
	1992-2010		-337	34	1,378	-$39	-$28	0	-$1,087	0	-$590	1.40	$91
SEER 21 Heat Pump at HVAC Replacement	Pre-1978	$3,245	-453	61	3,084	-$26	-$15	0	-$3,959	0.20	-$2,585	0.60	-$1,311
	1978-1991		-294	40	1,972	-$17	-$10	0	-$3,813	0.14	-$2,782	0.41	-$1,900
	1992-2010		-254	34	1,683	-$16	-$10	0	-$3,809	0.02	-$3,191	0.33	-$2,184
Heat Pump at HVAC Replacement + 1.67 kW_{DC} PV	Pre-1978	$4,785	2,044	61	3,894	$616	$492	2.80	$9,484	2.03	$4,909	1.88	$4,224
	1978-1991		2,257	40	2,971	$640	$508	2.89	$9,973	2.06	$5,075	1.83	$3,974
	1992-2010		2,322	34	2,764	$598	$475	2.70	$8,980	2.08	$5,163	1.82	$3,941
HPWH at Water Heater Replacement	Pre-1978	$2,594	-1,037	141	8,868	-$74	-$46	0	-$4,277	0	-$3,042	1.29	$753
	1978-1991		-1,037	141	8,868	-$74	-$46	0	-$4,284	0	-$3,042	1.29	$753
	1992-2010		-1,037	141	8,868	-$74	-$46	0	-$4,284	0	-$3,042	1.29	$753
NEEA Tier 3 HPWH at Replacement	Pre-1978	$2,775	-842	141	9,561	-$20	-$3	0	-$3,194	0.29	-$1,961	1.57	$1,591
	1978-1991		-842	141	9,561	-$20	-$4	0	-$3,201	0.29	-$1,961	1.57	$1,591
	1992-2010		-842	141	9,561	-$20	-$4	0	-$3,201	0.29	-$1,961	1.57	$1,591
HPWH at Water Heater Replacement + 1.67 kW_{DC} PV	Pre-1978	$7,152	1,623	141	10,254	$621	$502	1.90	$7,137	1.41	$2,905	1.67	$4,806
	1978-1991		1,623	141	10,254	$620	$502	1.90	$7,127	1.41	$2,902	1.67	$4,803
	1992-2010		1,623	141	10,254	$620	$501	1.90	$7,122	1.41	$2,899	1.67	$4,797
1.67 kW_{DC} PV + Electric Ready	Pre-1978	$8,650	2,660	0	1,386	$608	$480	1.50	$4,771	1.19	$1,650	0.97	-$239
	1978-1991		2,655		1,384	$600	$473	1.48	$4,573	1.18	$1,573	0.97	-$257
	1992-2010		2,578		1,343	$578	$456	1.42	$4,064	1.16	$1,392	0.94	-$493
Electric Clothes Dryer	All	$313	-671	25	898	-$148	-$114	0	-$3,782	0	-$2,888	0	-$1,764
Electric Range/Oven	All	$608	-232	11	395	-$48	-$37	0	-$1,786	0	-$1,737	0	-$1,073

Note: Values shaded in **red** indicate option is not cost-effective with B/C ratio less than 1. Values shaded in **green** indicate option is cost-effective with B/C ratio greater than or equal to 1. Cells with "n/a" reflect cases where cost effectiveness was not evaluated.

Table 10: Multifamily On-Bill Cost-Effectiveness Comparison with Incentives

Measure	Vintage	Gross Measure Cost	PCE/ BayREN Incentive	Net Measure Cost	Year 1 Utility Cost Savings	No Incentive		With Incentive	
						On-Bill B/C Ratio	On-Bill NPV	On-Bill B/C Ratio	On-Bill NPV
SEER 21 Heat Pump at HVAC Replacement	Pre-1978	$3,245	$1,000	$2,245	-$26	0	-$3,959	0	-$2,836
	1978-1991				-$17	0	-$3,813	0	-$2,691
	1992-2010				-$16	0	-$3,809	0	-$2,686
NEEA Tier 3 HPWH at Replacement	Pre-1978	$2,775	$2,000	$775	-$20	0	-$3,194	0	-$948
	1978-1991				-$20	0	-$3,201	0	-$955
	1992-2010				-$20	0	-$3,201	0	-$955

Note: Values shaded in **red** indicate option is not cost-effective with B/C ratio less than 1. Values shaded in **green** indicate option is cost-effective with B/C ratio greater than or equal to 1. Cells with “n/a” reflect cases where cost effectiveness was not evaluated.

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5 Appendices

5.1 Utility Tariff Details

5.1.1 PCE

Following are the PCE electricity tariffs applied in this study. The "Rate with PG&E Surchages" was used in place of PG&E's generation rate. PG&E's net energy metering (NEM) rules are applied. Additionally, monthly net energy production is credited at $0.01/kWh in addition to the retail rate at the hour of generation.

RESIDENTIAL CUSTOMER RATES

Rates Effective April 1, 2021

PENINSULA CLEAN ENERGY

RATE SCHEDULE	SCHEDULE TIMES	ENERGY CHARGE $/kWh		
		GENERATION RATE	RATE WITH PG&E SURCHARGES[1]	3.1.21 PG&E GENERATION RATE
E-TOU-C (PG&E equivalent: E-TOU-C)				
SUMMER - June 1 through September 30				
PEAK	4 pm to 9 pm every day	$ 0.10773	$ 0.15577	$ 0.16397
OFF-PEAK	All other hours	$ 0.05696	$ 0.10500	$ 0.11053
WINTER - October 1 through May 31				
PEAK	4 pm to 9 pm every day	$ 0.06141	$ 0.10945	$ 0.11521
OFF-PEAK	All other hours	$ 0.04713	$ 0.09517	$ 0.10018

5.1.2 PG&E

Following are the PG&E electricity tariffs applied in this study for non-generation rates. The electricity baseline territory used for Climate Zone 3 is T.

ELECTRIC SCHEDULE E-TOU-C Sheet 3
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

RATES: (Cont'd.)

UNBUNDLING OF E-TOU-C TOTAL RATES

Energy Rates by Component ($ per kWh)	PEAK		OFF-PEAK	
Generation:				
Summer (all usage)	$0.16397	(I)	$0.11053	(I)
Winter (all usage)	$0.11521	(I)	$0.10018	(I)
Distribution:**				
Summer (all usage)	$0.14292	(I)	$0.13292	(I)
Winter (all usage)	$0.09459	(I)	$0.09229	(I)

Conservation Incentive Adjustment (Baseline Usage)	($0.02659)	(R)
Conservation Incentive Adjustment (Over Baseline Usage)	$0.04925	(I)
Transmission* (all usage)	$0.03704	
Transmission Rate Adjustments* (all usage)	($0.00248)	(R)
Reliability Services* (all usage)	$0.00017	
Public Purpose Programs (all usage)	$0.01575	(I)
Nuclear Decommissioning (all usage)	$0.00093	
Competition Transition Charges (all usage)	$0.00004	
Energy Cost Recovery Amount (all usage)	$0.00032	
Wildfire Fund Charge (all usage)	$0.00580	
New System Generation Charge (all usage)**	$0.00442	

* Transmission, Transmission Rate Adjustments and Reliability Service charges are combined for presentation on customer bills.
** Distribution and New System Generation Charges are combined for presentation on customer bills.

(Continued)

Advice	6090-E-A	*Issued by*	*Submitted*	February 26, 2021
Decision		***Robert S. Kenney***	*Effective*	March 1, 2021
		Vice President, Regulatory Affairs	*Resolution*	

ELECTRIC SCHEDULE E-TOU-C Sheet 4 (T)
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

SPECIAL CONDITIONS:

1. BASELINE (TIER 1) QUANTITIES: The following quantities of electricity are to be used to define usage eligible for the baseline credit (also see Rule 19 for additional allowances for medical needs):

BASELINE QUANTITIES (kWh PER DAY)

Baseline Territory*	Code B - Basic Quantities		Code H - All-Electric Quantities	
	Summer Tier I	Winter Tier I	Summer Tier I	Winter Tier I
P	14.2	12.0	16.0	27.4
Q	10.3	12.0	8.9	27.4
R	18.6	11.3	20.9	28.1
S	15.8	11.1	18.7	24.9
T	6.8	8.2	7.5	13.6
V	7.5	8.8	10.9	16.9
W	20.2	10.7	23.6	20.0
X	10.3	10.5	8.9	15.4
Y	11.0	12.1	12.6	25.3
Z	6.2	8.1	7.0	16.5

2. TIME PERIODS FOR **E-TOU-C**: Times of the year and times of the day are defined as follows: (T)

Summer (service from June 1 through September 30):

Peak: 4:00 p.m. to 9:00 p.m. All days

Off-Peak: All other times

Winter (service from October 1 through May 31):

Peak: 4:00 p.m. to 9:00 p.m. All days

Off-Peak: All other times

* The applicable baseline territory is described in Part A of the Preliminary Statement

(Continued)

Advice	5759-E	*Issued by*	*Submitted*	February 14, 2020
Decision	D.19-07-004	***Robert S. Kenney***	*Effective*	March 1, 2020
		Vice President, Regulatory Affairs	*Resolution*	

The following provide details on the PG&E natural gas tariffs applied in this study. The PG&E monthly gas rate in $/therm was applied on a monthly basis for the 12-month period ending March 2021 according to the rates shown in Table 11. The natural gas baseline territory used for Climate Zone 3 is T.

Table 11: PG&E Monthly Gas Rate ($/therm)

Month	Procurement Charge	Transportation Charge		Total Charge	
		Baseline	Excess	Baseline	Excess
Jan 2021	$0.49332	$1.09586	$1.53752	$1.58918	$2.03084
Feb 2021	$0.49073	$1.09586	$1.53752	$1.58659	$2.02825
Mar 2021	$0.42316	$1.19868	$1.68034	$1.62184	$2.1035
Apr 2020	$0.23856	$1.13126	$1.64861	$1.36982	$1.88717
May 2020	$0.23187	$1.13126	$1.64861	$1.36313	$1.88048
June 2020	$0.24614	$1.13126	$1.64861	$1.3774	$1.89475
July 2020	$0.23892	$1.13126	$1.64861	$1.37018	$1.88753
Aug 2020	$0.28328	$1.13126	$1.64861	$1.41454	$1.93189
Sept 2020	$0.41891	$1.13126	$1.64861	$1.55017	$2.06752
Oct 2020	$0.38068	$1.13416	$1.65280	$1.51484	$2.03348
Nov 2020	$0.46046	$1.13416	$1.65280	$1.59462	$2.11326
Dec 2020	$0.48474	$1.13416	$1.65280	$1.6189	$2.13754

GAS SCHEDULE G-1 Sheet 2
RESIDENTIAL SERVICE

BASELINE QUANTITIES: The delivered quantities of gas shown below are billed at the rates for baseline use.

BASELINE QUANTITIES (Therms Per Day Per Dwelling Unit)

Baseline Territories ***	Summer (April-October) Effective Apr. 1, 2020		Winter Off-Peak (Nov,Feb,Mar) Effective Nov. 1, 2019		Winter On-Peak (Dec, Jan) Effective Dec. 1, 2019		(T) | (T)
P	0.39	(R)	1.88	(R)	2.16	(I)	
Q	0.59	(R)	1.55	(R)	2.16	(I)	
R	0.36	(R)	1.28	(R)	1.97	(I)	
S	0.39	(R)	1.38	(R)	2.06	(I)	
T	0.59	(R)	1.38	(R)	1.81	(I)	
V	0.62	(R)	1.51	(R)	1.84	(I)	
W	0.39	(R)	1.18	(R)	1.84	(I)	
X	0.49	(R)	1.55	(R)	2.16	(I)	
Y	0.69	(R)	2.15	(R)	2.65	(I)	

SEASONAL CHANGES: The summer season is April-October, the winter off-peak season is November, February and March, and the winter on-peak season is December and January. Baseline quantities for bills that include the April 1, November 1 and December 1 seasonal changeover dates will be calculated by multiplying the applicable daily baseline quantity for each season by the number of days in each season for the billing period.

Get In Touch

The adoption of reach codes can differentiate jurisdictions as efficiency leaders and help accelerate the adoption of new equipment, technologies, code compliance, and energy savings strategies.

As part of the Statewide Codes & Standards Program, the Reach Codes Subprogram is a resource available to any local jurisdiction located throughout the state of California.

Our experts develop robust toolkits as well as provide specific technical assistance to local jurisdictions (cities and counties) considering adopting energy reach codes. These include cost-effectiveness research and analysis, model ordinance language and other code development and implementation tools, and specific technical assistance throughout the code adoption process.

If you are interested in finding out more about local energy reach codes, the Reach Codes Team stands ready to assist jurisdictions at any stage of a reach code project.

Visit LocalEnergyCodes.com to access our resources and sign up for newsletters

Contact info@localenergycodes.com for no-charge assistance from expert Reach Code advisors

Follow us on Twitter

436 14th Street
Oakland, CA 94612
Farhad Farahmand
510.473.8421

MEMORANDUM

July 16, 2021

To: Rebecca Lucky (Menlo Park)

CC: Shraddha Mutyal (Peninsula Clean Energy), Kelly Cunningham (Pacific Gas & Electric Company), Christopher Kuch (Southern California Edison)

From: Farhad Farahmand (TRC)

Re: Preliminary Cost Effectiveness Results for Nonresidential Electrofits in Climate Zone 3

OVERVIEW

TRC is providing preliminary cost-effectiveness results for nonresidential alterations in Menlo Park (California Climate Zone 3), based on work we are performing on behalf of the Statewide Utility Reach Codes Program. These preliminary results are to inform near-term decision-making toward achieving Menlo Park's existing building electrification goals, and to allow Menlo Park to provide feedback on methodology and assumptions. These results are not yet final nor approved by the Statewide Utility Team, and represent solely represent TRC's work to date. There are several next steps TRC will be performing over the next few weeks, including:

- Finalizing and adding the Small Hotel and High-Rise Multifamily results.
- Adjusting cost assumptions based on similar research.

We anticipate that the statewide report will be published by the third quarter of 2021.

Introduction

This memo documents preliminary cost-effectiveness analysis of measures that exceed the minimum state requirements, the 2019 Building Energy Efficiency Standards, effective January 1, 2020, for nonresidential alterations. Measures include energy efficiency, electrification, solar photovoltaics (PV), and battery storage.

The Department of Energy (DOE) sets minimum efficiency standards for equipment and appliances that are federally regulated under the National Appliance Energy Conservation Act, including heating, cooling, and water heating equipment (E-CFR, 2020). Since state and local governments are prohibited from adopting higher minimum efficiencies than the federal standards require, the focus of this study is to identify and evaluate cost-effective packages that do not include high efficiency heating, cooling, and water heating equipment.

Methodology

The Reach Codes Team used the following cost effectiveness methodology to analyze prototype alteration measures.

Cost-Effectiveness

This section describes the approach to calculating cost effectiveness including benefits, costs, metrics, and utility rate selection.

Benefits

This analysis used both *on-bill* and *time dependent valuation* (*TDV*) *energy* based approaches to evaluate cost-effectiveness. Both on-bill and TDV require estimating and quantifying the energy savings and costs associated with energy measures. The primary difference of on-bill and TDV is how energy is valuated:

- **On-Bill**: Customer-based lifecycle cost approach that values energy based upon estimated site energy usage and customer on-bill savings using electricity and natural gas utility rate schedules over a 15-year duration for nonresidential buildings, accounting for a 3 percent discount rate and energy cost inflation.
- **TDV**: TDV is developed by the Energy Commission to reflect the time dependent value of energy including long-term projected costs of energy such as the cost of providing energy during peak periods of demand and other societal costs including projected costs for carbon emissions and grid transmission impacts. With the TDV approach, electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods. This metric values energy use differently depending on the fuel source (gas, electricity, and propane), time of day, and season. Electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods.

TRC performed energy simulations using the most recent software available for 2019 Title 24 code compliance analysis, CBECC-Com 2019.1.3. The Team also simulated packages in 2022 research version software to test the impact of 2022 TDV multipliers and weather files on cost-effectiveness.

Costs

TRC assessed the incremental costs and savings of the energy packages over the 15 years for nonresidential prototypes. Incremental costs represent the equipment, installation, replacements, and maintenance costs of the proposed measure relative to the 2019 Title 24 Standards minimum requirements. Where applicable we accounted for demolition costs. TRC obtained measure costs from engineering cost estimators, manufacturer distributors, contractors, literature review, and online sources such as Home Depot and RS Means. Taxes and contractor markups were added as appropriate.

Metrics

Cost effectiveness is presented using net present value (NPV) and benefit-to-cost (B/C) ratio metrics.

- **NPV**: TRC uses net savings (NPV benefits *minus* NPV costs) as the cost effectiveness metric. If the net savings of a measure or package is positive, it is considered cost effective. Negative savings represent net costs. A measure that has negative energy cost benefits (energy cost *increase*) can still be cost effective if the costs to implement the measure are even more negative (i.e., construction and maintenance cost *savings*).
- **B/C Ratio**: Ratio of the present value of all benefits to the present value of all costs over 15 or 30 years (NPV benefits *divided by* NPV costs). The criterion for cost effectiveness is a B/C greater than 1.0, representing a positive return on investment. A value of one indicates the savings over the life of the measure are equivalent to the incremental cost of that measure.

Improving the energy performance of a building often requires an initial investment. In most cases the benefit is represented by annual on-bill utility or TDV savings, and the cost by incremental first cost and replacement costs. However, some packages result in initial construction cost savings (negative incremental cost), and either energy cost savings (positive benefits), or increased energy costs (negative benefits). In cases where both construction costs and energy-related savings are negative, the construction cost savings are treated as the *benefit* while the increased energy costs are the *cost*.

Utility Rates

TRC determined appropriate utility rates for each prototype and package based on the annual load profile of each prototype and the corresponding package, the most prevalent rate in each territory. For some prototypes there are multiple options for rates because of the varying load profiles of mixed-fuel buildings versus all-electric buildings. If more than one rate schedule is applicable for a particular load profile, TRC did not attempt to compare or test a variety of tariffs to determine their impact on cost effectiveness. TRC used Peninsula Clean Energy electric utility rates B-1 and B-10 depending on the prototype, and PG&E gas rate G-NR1 for Climate Zone 3.

TRC's analysis assumes utility rates escalate over time using General Rate Case (GRC) filings and historical escalation rates. Escalation of natural gas rates between 2020 and 2022 is based on the currently filed General Rate Cases for PG&E. From 2023 through 2025, gas rates are assumed to escalate at 4 percent per year above inflation, which reflects historical rate increases between 2013 and 2018. Escalation of electricity rates from 2020 through 2025 is assumed to be 4 percent per year above inflation, based on electric utility estimates. After 2025, escalation rates for both natural gas and electric rates are assumed to drop to a more conservative 1 percent escalation per year above inflation for long-term rate trajectories beginning in 2026 through 2050. As stated by E3, this latter assumption "does not presuppose specific new investments, changes in load and gas throughput, or other measures associated with complying with California's climate policy goals" (i.e., business-as-usual).

Prototype Characteristics

TRC used modified versions of the following five DOE building prototypes to evaluate cost effectiveness of measure packages:

- Medium Office
- Stand-alone Retail
- Warehouse
- Quick-service restaurant (QSR) and Full-service restaurant (FSR)

The Team created three vintages of prototypes by leveraging data and methodologies from IOU studies, Senate Bill 350 (SB350) analysis, and Commercial Building Energy Consumption Survey (CBECS) to identify appropriate characteristics.[1,2,3] These datasets include estimates of retrofits/upgrades to older buildings as well as field data on existing conditions. The three vintages that TRC analyzed include:

- 1980's – represents buildings built prior to 1990 (reference year 1982).
- 1990's – represents buildings built during the 1990 era (reference year 1992).
- 2000's – represents buildings built during the 2000 era (reference year 2006).

The analysis presented in this report assumes a certain set of existing conditions within each prototype, and that buildings operate as intended. Real building existing conditions are often a variety of old and new components, and equipment performance degrades over time. The analysis assumes some equipment replacement over time, based primarily on the SB350 analysis. The rate of replacement varies by building system and by envelope component.

TRC's prototypes and cost effectiveness results represent a range of vintages in an attempt to account for the variety of existing conditions in real buildings in a simplified way. Jurisdictions should consider how TRC's measure-specific findings would apply to the existing conditions in the jurisdictions' building stock, and in what instances they would be applicable.

Figure 1 summarizes the baseline prototype characteristics.

[1] http://capabilities.itron.com/WO024/Docs/California%20Commercial%20Saturation%20Study_Report_Final.pdf
[2] https://efiling.energy.ca.gov/getdocument.aspx?tn=221631
[3] https://www.eia.gov/consumption/commercial/

Figure 1. Prototype Summaries

Building Type (All Vintages)	Conditioned Floor Area (ft^2)	# of floors	Baseline HVAC Distribution System	Baseline Hot Water System
Medium Office	53,628	3	Packaged multizone Variable Air Volume (VAV) reheat + boilers	Central Gas Storage
Stand-alone Retail	24,563	1	Packaged single zone (SZ) Constant Air Volume (CAV) + gas furnace	Central Gas Storage
Warehouse	17,548	1	<u>Warehouse:</u> Gas furnace serving 10% of floor area, exhaust-only ventilation <u>Office:</u> Packaged SZ CAV + gas furnace	Central Gas Storage
Quick-service Restaurant (QSR)	2,500	1	Packaged SZ CAV + gas furnace	Central Gas storage
Full-service Restaurant (FSR)	5,000			

Greenhouse Gas Emissions

The analysis uses the greenhouse gas (GHG) emission multipliers developed by E3.[4] The multipliers have been developed to support development of compliance metrics for use in the 2022 California Energy Code. There are 8760 hourly multipliers accounting for time dependent energy use and carbon emissions based on source emissions, including renewable portfolio standard projections. For the 2022 code cycle, the multipliers also incorporate greenhouse gas emissions from methane and refrigerant leakage, which are two significant sources of greenhouse gas emissions.[5] There are 32 strings of multipliers – strings differ by the California climate zone and fuel type (electricity or natural gas).

Measure Packages and Costs

TRC analyzed the electrification retrofit (*electrofits*), efficiency, solar photovoltaics (PV), and battery measures described in this section.

Electrofit

TRC examined the potential for electrofits of HVAC, hot water, cooking, and clothes drying end-uses where applicable. In some scenarios, partial electrofits were considered.

TRC received cost estimates from Western Allied Mechanical, a San Francisco Bay Area mechanical contractor for the HVAC and water heating systems, for all packages. The mechanical contractor gave labor costs for typical new installations and noted that retrofit labor costs are highly variable. Building-specific considerations such as tight conditions, prepping surfaces, elevated work, material handling, specialty rigging, and protecting existing finishes

[4] https://efiling.energy.ca.gov/GetDocument.aspx?tn=233260&DocumentContentId=65748

[5] Energy and Environmental Economics, Inc. 2020. "Time Dependent Valuation of Energy for Developing Building Efficiency Standards." https://efiling.energy.ca.gov/GetDocument.aspx?tn=233257&DocumentContentId=65743

can vary building to building. These details can have a large labor cost impact, and it is difficult to define a typical condition. Because of this variation, TRC used multipliers typically ranging from 25 to 50 percent on the new construction labor cost.

For each electrofit, the Team considered the mechanical equipment impact at the central system, distribution, and zone levels. The Team assigned a retrofit labor multiplier separately to the central system equipment, distribution equipment, and zonal equipment based on challenges the installers are likely to encounter. The Team estimated a different multiplier for the mixed fuel retrofit as well as the electrofit for each prototype. The final multipliers range widely, with lower multipliers typical of like-for-like replacements such as replacing a packaged SZ unit, and higher multipliers where additional demolition, physical space, and coordination may be needed.

The Team determined electrical upgrades required for each electrofit and the cost of the upgrade through design engineering coordination with P2S Engineers and costs from RSMeans. The team intended to capture all components of electrical upgrades, from receptacles to transformers. Costs for utility service upgrades were out of the scope of this study.

The Team assumed that all HVAC and SHW equipment has a 15-year useful life and therefore did not consider replacements in either the mixed-fuel or the all-electric scenario for all nonresidential building types. The Team assumed that the maintenance requirements would be the same in the mixed-fuel and all-electric scenarios, and therefore did not consider any incremental maintenance costs, except as noted.

Medium Office

The existing HVAC system is a VAV reheat system which includes one gas hot water boiler, one packaged rooftop unit per floor, and VAV hot water reheat boxes. The existing SHW design includes one gas storage water heater.

To replace the incumbent gas-fired boiler for the Medium Office electrofit, TRC selected a central heat pump water heater with a storage tank and electric resistance booster only to be used during peak heating demand periods. This approach utilizes the existing hydronic plumbing infrastructure and VAV terminals, and supply lower water temperature except during peak heating demand periods. To replace the existing gas storage SHW heater for the electrofit, the Team selected a central heat pump with storage tank. The HVAC and SHW electrofit systems present higher costs compared to the mixed-fuel replacements due to the increased equipment costs and electrical infrastructure needs.

For a mixed-fuel retrofit baseline, the Team assumed the gas boiler and gas water heater replacements are a one-to-one replacement of equipment at the system level, with no demolition required, and a labor retrofit multiplier of 25 percent. For the electrofit, the Team assumed a labor retrofit multiplier of 35 percent for both HVAC and SHW to account for installation of additional components and floor area required for the heat pump and storage tank. No distribution or zonal equipment changes are required as part of the electrofit.

Figure 2 shows the costs for Medium Office averaged across all climate zones for the 1980’s vintage.

Figure 2. Medium Office Electrofit Costs

Mixed-fuel measure	Mixed-fuel cost	Electrofit measure	All-Electric cost	All-electric incremental cost	Source
Boilers	$45,508	Central heat pump water heater with electric resistance booster	$157,070	$111,562	Cost estimator
Service water heater	$73,479	Central heat pump water heater	$88,762	$15,283	Cost estimator
Electrical upgrades	$0	Wiring, distribution boards, and transformers to serve central HVAC and SHW systems	$31,233	$31,233	Design engineer, RSMeans
Total	$118,987		$277,065	$158,078	

Stand-Alone Retail

The existing HVAC system includes four packaged single zone rooftop ACs with gas furnaces. The existing SHW design includes one gas storage water heater.

To replace the existing packaged rooftop units for the Stand-alone Retail electrofit, the Reach Codes Team selected packaged heat pumps to replace the packaged ACs with gas furnaces. To replace the existing gas storage water heater for the electrofit, the Team selected one electric resistance point of use water heater for each of the three sinks.

The team assumed a labor retrofit multiplier of 25 percent for both the mixed fuel and the all-electric HVAC retrofits. This is the low end of retrofit labor multipliers because in both the mixed fuel case and the all-electric case, the packaged units are drop-in replacements at the system level, with no demolition required. No HVAC distribution or zonal equipment changes are required as part of the electrofit. For a mixed-fuel SHW retrofit baseline, the team assumed a labor retrofit multiplier of 25 percent because the water heater is a drop-in replacement of the existing water heater. For the SHW electrofit, the team assumed a labor retrofit multiplier of 35 percent to account for installing equipment in three different locations.

Figure 3 shows the cost data for Stand-alone Retail averaged across all climate zones for the 1980’s vintage.

Figure 3. Standalone Retail Electrofit Costs

Mixed-fuel measure	Mixed-fuel cost	Electrofit measure	All-Electric cost	All-electric incremental cost	Source
HVAC: Packaged SZ AC + gas furnace	$176,229	Packaged SZ Heat Pump	$173,617	($2,612)	Cost estimator
SWH: Gas storage	$1,255	Point of use electric resistance	$1,723	$468	Cost estimator
Electrical upgrades	$0	Wiring for SHW	$2,007	$2,007	Design engineer, RSMeans
Total	$177,484		$177,347	($137)	

Warehouse

The baseline HVAC system includes one packaged single zone rooftop AC with gas furnace which serves the office. The warehouse space does not have cooling, but approximately 10% of the floor area is heated by a ceiling suspended gas unit heater. Exhaust fans provide stand-alone ventilation and are not considered as part of any measure packages. The existing SHW design includes one gas storage water heater.

To replace the existing packaged rooftop unit for the office space, the Reach Codes Team selected a packaged heat pump. For the warehouse space, where 10% of the floor area is heated, the team selected an electric radiant heater to replace the gas unit heater. To replace the existing gas storage water heater for the electrofit, the Team selected one electric resistance point of use water heater for the sink.

The team assumed a labor retrofit multiplier of 25 percent for both the mixed fuel and the all-electric office HVAC retrofits, as well as the warehouse space mixed fuel retrofit. Similar to the Retail prototype, the equipment represents drop-in replacements without significant demolition. For the all-electric warehouse space HVAC retrofit the Team also assumed 25 percent because the electrofit requires little space and only requires hanging equipment in an open area. For a mixed-fuel SHW retrofit baseline, the Team assumed a labor retrofit multiplier of 25 percent because the water heater is a drop-in replacement of the existing water heater. For the SHW electrofit, the Team assumed a labor retrofit multiplier of 35 percent to account for installing equipment in a different location than the existing water heater.

Figure 4 shows the cost data for Warehouse averaged across all Climate Zones for vintage 1.

Figure 4. Warehouse Electrofit Costs

Mixed-fuel measure	Mixed-fuel cost	Electrofit measure	All-Electric cost	All-electric incremental cost	Source
Office HVAC: Packaged SZ AC + gas furnace	$56,013	Packaged SZ Heat Pump	$60,462	$4,449	Cost estimator
Warehouse HVAC: Gas heaters. Exhaust only ventilation	$6,529	Electric radiant heaters. Exhaust only ventilation	$10,958	$4,429	Cost estimator
SWH: Gas storage	$1,255	Point of use electric resistance	$1,149	-$106	Cost estimator
Electrical upgrades	$0	Wiring for warehouse HVAC and SHW	$6,231	$6,231	Design engineer, RSMeans
Total	$63,797		$78,800	$15,003	

Quick-Service and Full-Service Restaurants

TRC analyzed two prototypes, QSR and FSR, to discern the variance in analysis results depending on the type of restaurant. TRC developed a basis-of-design (BOD) for kitchen cooking equipment, HVAC, and service water heating (SWH) for mixed-fuel kitchens and all-electric kitchens. The BOD served as the foundation for modeling inputs and cost assumptions for the cost effectiveness analysis. None of the cooking appliances examined in this study are subject to federal energy efficiency requirements.

The Team determined cost estimates for kitchen appliances from online retailers. Whenever possible, the Team gathered costs from three different appliance retailers and used the average for the analysis. The Team adjusted material and labor costs for each climate zone based on weighting factors from RS Means.

The Reach Codes Team compared the incremental differences in equipment selection and associated costs from a mixed-fuel baseline to all-electric restaurants for HVAC, SWH, kitchen process equipment, and gas/electrical infrastructure.

For replacement and maintenance costs, the Team assumed all cooking appliance replacement at year 10. Based on interviews of subject matter experts, kitchens with all-electric cooking appliances would call for maintenance five times a year, while a typical mixed-fuel kitchen would need regular maintenance 10 times a year, with each visit costing $150.

Figure 5 shows the costs for QSR averaged across all climate zones for the 1980’s vintage.

Figure 5. QSR All-Electric Construction Costs

Mixed-fuel measure	Mixed-fuel cost	All-electric measure	All-electric cost	All-electric incremental cost
Mechanical Equipment				
HVAC: Packaged furnace, DX A/C	$120,811	HVAC: Packaged heat pump	$128,154	$7,343
SWH: Gas storage water heater - One 150 kBtu/hr heater - One 100-gallon tank	$21,860	SWH: Heat pump water heaters with storage tank - A.O. Smith CHP-120 - One 120-gallon tank	$27,963	$6,103
Kitchen Appliances				
Gas appliances: - French Fryer (4) - Griddle, single sided (2) Electric appliances: - Half-size electric convection oven (1)	$21,291	French Fryer (4) Griddle, single sided (2) Half-size electric convection oven (1)	$42,815	$21,524
Infrastructure Upgrades				
n/a	$0	Electrical	$25,832	$25,832
Total	**$163,962**		**$224,763**	**$60,801**

Solar PV

TRC estimated 50 percent of the roof area is available to install PV and has solar access, with a capacity of 15 W/ft^2. This approach assumes that the other 50 percent of the roof is for skylights, mechanical equipment, and walking paths. PV energy output is built into CBECC-Com and is based on the National Renewable Energy Lab's PVWatts calculator, which includes long-term performance degradation estimates.[6]

The costs for PV include first cost to purchase and install the system, inverter replacement costs, and annual maintenance costs, summarized in Figure 6. Upfront solar PV system costs are reduced by the federal income tax credit (ITC), approximately 26 percent due to a phased reduction in the credit through the year 2022.[7]

[6] More information available at: https://pvwatts.nrel.gov/downloads/pvwattsv5.pdf

[7] The federal credit drops to 26% in 2020, and 26% in 2021 before dropping permanently to 10% for commercial projects. More information on federal Investment Tax Credits available at: https://www.seia.org/initiatives/solar-investment-tax-credit-itc; https://www.seia.org/sites/default/files/2021-01/SEIA-ITC-Factsheet-2021-Jan.pdf

Figure 6. PV Construction Costs

		Unit Cost	Useful Life (yrs.)	Source
Solar PV System	Small NR <100kW (QSR, FSR, Warehouse)	$3.20 / Wdc	30	LBNL – Tracking the Sun
	Large NR >100kW (Medium Office, Retail)	$2.50 / Wdc		
Inverter Replacement (at year 11)		$0.15 / Wdc	10	E3 Rooftop Solar PV System Report
Annual Maintenance Costs		$0.02 / Wdc	1	

Battery

This measure includes installation of batteries to allow energy generated through PV to be stored and used later, providing utility cost benefits. TRC applied battery measures to only the QSR and FSR prototypes because these prototypes have significant electrical loads during peak periods (i.e., 4p-9p).

TRC ran test simulations to assess the impact of battery sizes and control algorithms on TDV savings. The battery size is optimized for each prototype to offset the majority of the peak period load. The team used the 'Ranked Day Demand Response' control method, which assumes batteries are charged anytime PV generation is greater than the building load but discharges to the electric grid beginning on the highest priced hour of the day. This control algorithm uses the relative ranking of the highest TDV for a day to determine its rank instead of a specific TDV value as threshold. This control option is not reflective of the current products on the market and represents an ideally controlled condition where there is real-time pricing of electricity. While this control strategy is being used in the analysis, there would be no mandate on the control strategy used in practice. The current simulation software has approximations of performance characteristics changes due to environmental conditions, charge/discharge rates, and degradation with age and use.

TRC used costs of $1,000 kWh based on preliminary findings from concurrent research by the IOU Codes and Standards Program, using data from the Self Generation Incentive Program (Itron, 2019). Batteries are also eligible for the ITC if they are installed at the same time as the renewable generation source and at least 75 percent of the energy used to charge the battery comes from a renewable source. Thus, TRC applied a 26 percent cost reduction to battery costs.

Efficiency Measures

In some prototypes, TRC packaged efficiency measures with the Electrofit packages. The efficiency measures and their applications are listed in the Figure 7

Figure 7. Efficiency Measures Analyzed

Efficiency Measure Description	Retail	Full Service Restaurant	Quick Service Restaurant
Window film: This measure reduces window SHGC of existing windows to 0.39 by adding window film.	•	•	•
Lighting retrofit: This measure replaces the existing light fixtures to reduce the existing LPD in select areas to the following, representing 2019 code-minimum upgrades: • Standalone Retail: Reduces LPD to 0.95 W/ft^2 • Restaurants: Reduces LPD for dining spaces to 0.45 W/ ft^2; Reduces LPD for kitchen space to 0.95 W/ ft^2	•	•	•
Transfer air for commercial kitchens: This measure expands the Title 24 Part 6 Section 140.9 (b)2 requirements kitchen ventilation per the following: • Reduces the transfer air requirement for kitchens with exhaust hoods to air flows greater than 2,000 ft^3/min from 5,000 ft^3/min. For exhaust hood with air flow rate greater than 2000 ft^3/min but lower than 5000 ft^3/min, this measure would require at least 15 percent of all replacement air come from transfer air in the dining space, which would otherwise be exhausted. This measure only applies to the Quick Service Restaurant. • For exhaust hoods with an air flow rate greater than 5,000 ft3/min for Full Service Restaurant: 1. Use transfer air for at least 25 percent of all replacement air that would otherwise be exhausted; and 2. Install demand ventilation systems meeting Title 24 Section 140.9 (b)2.B.ii.		•	•

Measure Packaging

TRC examined the following packages for each prototype

- Mixed Fuel Code Minimum package: Appliance upgrades on the existing building using code-minimum fossil gas equipment.
- All-electric Code Min: Replace any gas equipment with electric, code-minimum equipment, including HVAC, SHW, and appliances. Upgrade electrical infrastructure as-required. The Baseline for this package is a gas code-minimum equipment replacement, including HVAC, SHW, and appliances.

- All-electric Code Min (2022 TDV): All-electric Code Min, with cost-effectiveness calculations done using 2022 TDV multipliers. The Baseline for this package is the same as the all-electric Code Min Baseline, except with 2022 TDV multipliers.
- Electric HVAC and SHW: This package is specifically for the restaurant prototypes, and replaces gas space and water heating equipment with electric code-minimum equipment.
- All-Electric + Efficiency: Adds efficiency measures to the All-Electric Code Min package, except in restaurants where it adds efficiency measures to the Electric HVAC and SHW package.
- All-electric + PV: All-electric Code Min, including a solar PV array, plus battery storage for FSR and QSR only. The Baseline for this package is the same as the All-electric Code Min Baseline.
- All-electric + PV (2022 TDV): All-electric + PV, with cost-effectiveness calculations done using 2022 TDV multipliers. The Baseline for this package is the same as the All-electric Code Min Baseline, except with 2022 TDV multipliers.

COST EFFECTIVENESS RESULTS

Figure 7 through Figure 11 present the preliminary cost effectiveness results for Climate Zone 3 using Peninsula Clean Energy electric rates and PG&E gas rates. TRC did not compare a variety of tariffs to determine their impact on cost effectiveness, and utility rate updates can affect cost effectiveness results.

For the Mixed Fuel Code Minimum package, the baseline is the existing building. For all other packages, the baseline is the Mixed Fuel Code Minimum package.

Figure 8. FSR Cost Effectiveness Results

Full Service Restaurant (FSR)	Vintage	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel Code Minimum	80's	100,806	(2,809)	2	$330,367	$299,196	$209,903	0.9	0.6	($31,171)	($120,463)
	90's	79,955	(2,380)	1	$330,367	$234,916	$161,006	0.7	0.5	($95,451)	($169,361)
	00's	60,077	(1,963)	0	$330,367	$174,202	$113,857	0.5	0.3	($156,165)	($216,510)
All-electric code minimum	80's	(311,520)	24,813	78	$248,591	($565,274)	($505,496)	-2.3	-2.0	($813,865)	($754,087)
	90's	(310,227)	24,636	77	$248,591	($564,529)	($505,670)	-2.3	-2.0	($813,120)	($754,260)
	00's	(312,028)	24,885	78	$248,591	($567,192)	($506,162)	-2.3	-2.0	($815,782)	($754,752)
All-electric code minimum + PV + Battery	80's	(248,537)	24,813	85	$559,032	($423,104)	($197,436)	-0.8	-0.4	($982,137)	($756,468)
	90's	(247,243)	24,636	84	$559,032	($422,358)	($197,608)	-0.8	-0.4	($981,390)	($756,640)
	00's	(249,052)	24,885	85	$559,032	($424,719)	($198,118)	-0.8	-0.4	($983,751)	($757,150)
Electric HVAC and SHW + Efficiency	80's	(55,145)	10,886	48	$51,753	($13,066)	$62,953	-0.3	1.2	($64,819)	$11,200
	90's	(53,658)	10,709	47	$50,784	($10,795)	$62,698	-0.2	1.2	($61,579)	$11,914
	00's	(58,995)	10,958	48	$49,860	($24,745)	$52,444	-0.5	1.1	($74,606)	$2,583
All-electric code minimum (2022 TDV)	80's	(301,073)	23,131	70	$248,591	($553,942)	($98,842)	-2.2	-0.4	($802,532)	($347,433)
	90's	(299,969)	22,972	70	$248,591	($552,873)	($99,966)	-2.2	-0.4	($801,464)	($348,556)
	00's	(301,427)	23,184	71	$248,591	($556,043)	($98,422)	-2.2	-0.4	($804,633)	($347,012)
All-electric code minimum + PV + Battery (2022TDV)	80's	(241,504)	23,131	87	$559,032	($432,119)	($2,266)	-0.8	0.0	($991,151)	($561,298)
	90's	(240,399)	22,972	87	$559,032	($431,089)	($3,389)	-0.8	0.0	($990,121)	($562,421)
	00's	(241,858)	23,184	88	$559,032	($434,203)	($1,845)	-0.8	0.0	($993,235)	($560,877)

Figure 9. QSR Cost Effectiveness Results

Quick Service Restaurant (QSR)	Vintage	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel Code Minimum	80's	42,633	(306)	5	$239,352	$142,294	$106,511	0.6	0.4	($97,059)	($132,841)
	90's	32,497	(560)	3	$239,352	$102,520	$74,531	0.4	0.3	($136,832)	($164,822)
	00's	27,574	(284)	3	$239,352	$90,488	$65,358	0.4	0.3	($148,864)	($173,994)
All-electric code minimum	80's	(142,624)	12,065	39	$38,200	($297,750)	($211,832)	-7.8	-5.5	($335,950)	($250,032)
	90's	(141,190)	11,921	38	$38,200	($295,262)	($210,671)	-7.7	-5.5	($333,462)	($248,871)
	00's	(142,618)	12,011	38	$38,200	($298,517)	($212,228)	-7.8	-5.6	($336,717)	($250,428)
All-electric code minimum + PV + Battery	80's	(113,575)	12,065	41	$202,277	($201,817)	($84,836)	-1.0	-0.4	($404,094)	($287,113)
	90's	(112,141)	11,921	41	$202,277	($199,329)	($83,675)	-1.0	-0.4	($401,606)	($285,952)
	00's	(113,571)	12,011	41	$202,277	($202,595)	($85,236)	-1.0	-0.4	($404,871)	($287,513)
Electric HVAC and SHW	80's	(41,151)	4,610	17	($49,129)	($57,971)	($19,603)	0.8	2.5	($8,842)	$29,527
	90's	(39,679)	4,466	16	($49,129)	($55,191)	($18,388)	0.9	2.7	($6,062)	$30,741
	00's	(40,768)	4,556	17	($49,129)	($57,981)	($19,416)	0.8	2.5	($8,851)	$29,714
Electric HVAC and SHW + Efficiency	80's	(24,501)	4,610	20	($42,495)	($2,282)	$24,478	18.6	>1	$40,213	$66,973
	90's	(22,913)	4,466	19	($43,463)	$881	$25,819	>1	>1	$44,344	$69,283
	00's	(26,071)	4,556	19	($43,973)	($8,664)	$18,494	5.1	>1	$35,309	$62,468
All-electric code minimum (2022 TDV)	80's	(138,948)	12,051	39	$38,200	($282,468)	($116,366)	-7.4	-3.0	($320,668)	($154,566)
	90's	(137,848)	11,870	38	$38,200	($281,988)	($118,794)	-7.4	-3.1	($320,188)	($156,994)
	00's	(138,946)	12,006	39	$38,200	($283,528)	($116,892)	-7.4	-3.1	($321,728)	($155,092)
All-electric code minimum + PV +Battery (2022TDV)	80's	(109,879)	12,051	43	$202,277	($210,425)	($7,988)	-1.0	0.0	($412,702)	($210,265)
	90's	(108,780)	11,870	42	$202,277	($210,193)	($10,418)	-1.0	-0.1	($412,469)	($212,694)
	00's	(109,880)	12,006	42	$202,277	($211,722)	($8,522)	-1.0	0.0	($413,999)	($210,799)

Figure 10. Medium Office Cost Effectiveness Results

Medium Office (MO)	Vintage	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel Code Minimum	80's	0	3,092	17	$147,638	$52,833	$50,700	0.4	0.3	($94,806)	($96,938)
	90's	0	162	1	$147,638	$2,574	$2,677	0.0	0.0	($145,064)	($144,961)
	00's	0	100	1	$147,638	$1,607	$1,686	0.0	0.0	($146,031)	($145,953)
All-electric code minimum	80's	(87,716)	14,697	3	$184,316	$19,902	$29,069	0.1	0.2	($164,413)	($155,247)
	90's	(57,558)	9,573	1	$184,316	$10,355	$18,378	0.1	0.1	($173,961)	($165,937)
	00's	(63,627)	6,120	2	$184,316	($65,531)	($50,394)	-0.4	-0.3	($249,846)	($234,710)
All-electric code minimum + PV	80's	122,607	14,697	13	$561,038	$544,833	$479,348	1.0	0.9	($16,205)	($81,690)
	90's	152,765	9,573	11	$561,038	$539,417	$468,658	1.0	0.8	($21,621)	($92,380)
	00's	146,697	6,120	11	$561,038	$458,643	$399,885	0.8	0.7	($102,395)	($161,153)
All-electric code minimum (2022 TDV)	80's	(89,850)	15,572	3	$184,316	($46,654)	$107,868	-0.3	0.6	($230,969)	($76,448)
	90's	(58,665)	9,480	1	$184,316	($61,046)	$56,742	-0.3	0.3	($245,362)	($127,573)
	00's	(64,256)	6,195	2	$184,316	($147,193)	($28,522)	-0.8	-0.2	($331,509)	($212,838)
All-electric code minimum + PV (2022TDV)	80's	124,181	15,572	13	$561,038	$548,033	$593,215	1.0	1.1	($13,005)	$32,177
	90's	155,366	9,480	10	$561,038	$544,533	$542,089	1.0	1.0	($16,505)	($18,948)
	00's	149,775	6,195	11	$561,038	$452,935	$456,825	0.8	0.8	($108,103)	($104,213)

Figure 11. Warehouse Cost Effectiveness Results

Warehouse	Vintage	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed fuel code minimum	80's	3,638	120	1	$66,020	$13,368	$10,054	0.2	0.2	($52,652)	($55,966)
	90's	1,127	54	0	$66,020	$4,480	$3,402	0.1	0.1	($61,540)	($62,618)
	00's	1,085	33	0	$66,020	$3,993	$2,919	0.1	0.0	($62,027)	($63,101)
All-electric code minimum	80's	(24,313)	1,283	2	$79,404	($54,221)	($32,214)	-0.7	-0.4	($133,625)	($111,619)
	90's	(15,201)	832	2	$79,404	($32,722)	($18,925)	-0.4	-0.2	($112,126)	($98,329)
	00's	(19,212)	1,042	2	$79,404	($41,921)	($24,153)	-0.5	-0.3	($121,326)	($103,557)
All-electric code minimum + PV	80's	85,475	1,283	7	$290,200	$259,721	$202,831	0.9	0.7	($30,480)	($87,370)
	90's	94,587	832	7	$245,243	$258,195	$216,120	1.1	0.9	$12,951	($29,123)
	00's	90,576	1,042	7	$247,535	$247,553	$210,892	1.0	0.9	$18	($36,642)
All-electric code minimum (2022 TDV)	80's	(21,393)	1,131	2	$71,108	($45,278)	($4,999)	-0.6	-0.1	($116,385)	($76,107)
	90's	(13,321)	735	1	$79,404	($27,529)	$3,448	-0.3	0.0	($106,933)	($75,957)
	00's	(16,777)	914	2	$79,404	($34,860)	($848)	-0.4	0.0	($114,265)	($80,252)
All-electric code minimum + PV (2022TDV)	80's	90,302	1,131	7	$290,200	$277,578	$182,015	1.0	0.6	($12,622)	($108,185)
	90's	98,375	735	6	$253,540	$272,957	$190,462	1.1	0.8	$19,417	($63,078)
	00's	94,918	914	7	$255,832	$263,751	$186,167	1.0	0.7	$7,919	($69,665)

Figure 12. Retail Cost Effectiveness Results

Retail (RE)	Vintage	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel Code Minimum	80's	157,836	(1,497)	13	$178,825	$406,306	$400,298	2.3	2.2	$227,481	$221,473
	90's	128,627	(1,132)	12	$178,825	$332,597	$330,867	1.9	1.9	$153,772	$152,043
	00's	111,283	(1,345)	8	$178,825	$275,336	$275,690	1.5	1.5	$96,512	$96,865
All-electric code minimum	80's	(39,706)	3,832	14	$3,471	($65,048)	($30,431)	-18.7	-8.8	($68,519)	($33,902)
	90's	(31,545)	2,809	10	$3,471	($46,311)	($29,294)	-13.3	-8.4	($49,782)	($32,765)
	00's	(35,483)	3,339	12	$3,471	($57,648)	($29,469)	-16.6	-8.5	($61,119)	($32,940)
All-electric code minimum + PV	80's	249,195	3,832	27	$520,937	$520,384	$588,085	1.0	1.1	($553)	$67,148
	90's	257,355	2,809	23	$520,938	$541,336	$589,221	1.0	1.1	$20,399	$68,284
	00's	253,417	3,339	25	$520,938	$625,548	$589,025	1.2	1.1	$104,610	$68,087
All-electric + Efficiency Measures	80's	54,910	3,832	25	$93,821	$234,286	$220,386	2.5	2.3	$140,466	$126,565
	90's	44,824	2,809	19	$80,533	$190,327	$172,392	2.4	2.1	$109,793	$91,858
	00's	17,844	3,339	18	$79,043	$121,655	$111,385	1.5	1.4	$42,613	$32,342
All-electric code minimum (2022 TDV)	80's	(35,499)	3,348	12	$3,471	($56,640)	($11,127)	-16.3	-3.2	($60,111)	($14,599)
	90's	(28,570)	2,452	8	$3,471	($39,794)	($14,997)	-11.5	-4.3	($43,266)	($18,468)
	00's	(31,865)	2,910	10	$3,471	($49,531)	($11,871)	-14.3	-3.4	($53,002)	($15,342)
All-electric code minimum + PV (2022 TDV)	80's	258,421	3,348	24	$520,938	$523,330	$481,009	1.0	0.9	$2,392	($39,928)
	90's	265,350	2,452	21	$520,938	$543,543	$477,118	1.0	0.9	$22,605	($43,820)
	00's	262,055	2,910	23	$520,938	$539,406	$480,244	1.0	0.9	$18,468	($40,694)