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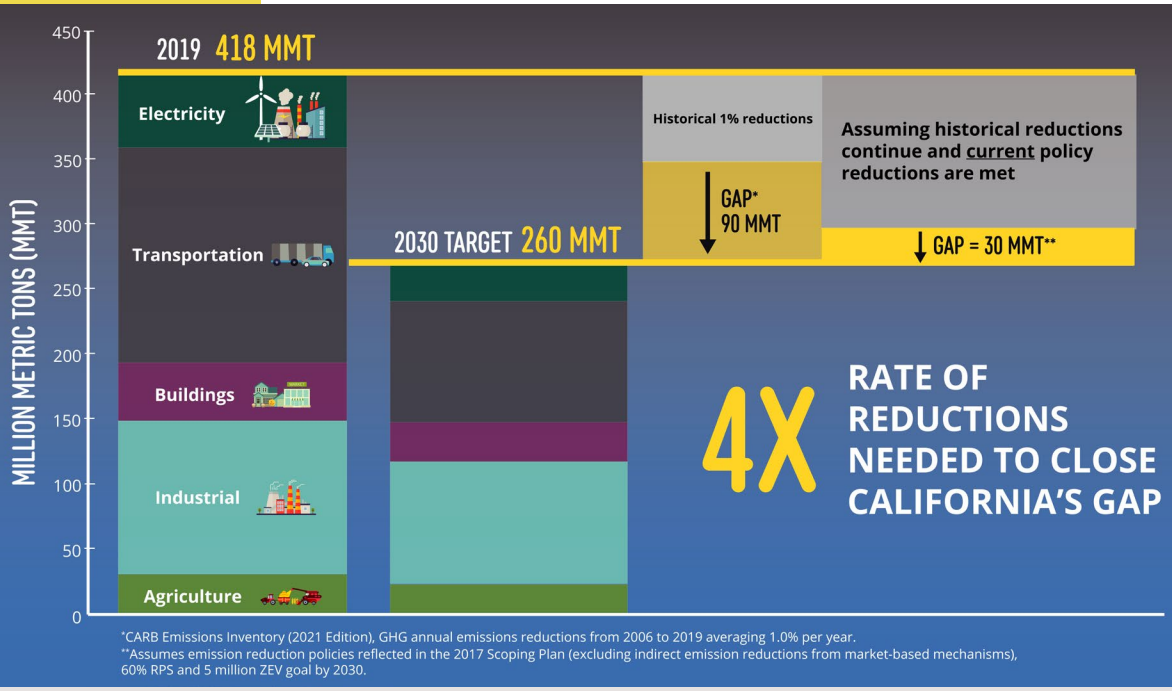
Energy for What's Ahead®

MIND THE GAP

POLICIES FOR CALIFORNIA'S COUNTDOWN TO 2030

September 2021



*CARB Emissions Inventory (2021 Edition), GHG annual emissions reductions from 2006 to 2019 averaging 1.0% per year.
**Assumes emission reduction policies reflected in the 2017 Scoping Plan (excluding indirect emission reductions from market-based mechanisms), 60% RPS and 5 million ZEV goal by 2030.

The nearly 25 years of general global indecision and slow action since the Kyoto Protocol was signed have had catastrophic consequences, visibly accelerating climate change — sooner even than many experts predicted. Everywhere around the world, individuals, families and communities are having to adapt to the effects of climate change happening right now. As a result, societies must reduce emissions at a much faster rate than ever before to mitigate the most severe impacts of climate change. We must pursue carbon neutrality with unprecedented urgency and commitment.

Through a range of policies and proclamations, California leaders have established landmark renewable energy and greenhouse gas (GHG) emissions reduction goals. This effort began in the 1970s with progressive policies to reduce energy consumption and continues with the California Global Warming Solutions Act of 2006, the 100 Percent Clean Energy Act of 2018 and Gov. Gavin Newsom's California Comeback Plan in 2021. However, based on current state and federal policies, gaps in outcomes remain that will prevent California from meeting its 2030 economywide 40% GHG reduction goal. We estimate the range of the emissions gap to be between 30 million metric tons (MMT) and 90 MMT. The lower bound is based on the state fully meeting existing policy goals and funding. The higher bound assumes the continuation of California's average annual reduction rate since the California Global Warming Solutions Act of 2006 was signed into law.

While many GHG emission reduction activities are required across California's economy to meet 2030 goals — including reductions of the most damaging global warming pollutants, continued efficiency gains in internal combustion engines (ICE), reduced vehicle miles traveled and efficiency gains across the diverse industrial sector landscape — this paper focuses on the gaps and actions needed in the electric sector and the efficient electrification of transportation and buildings. Additionally, if these other policy outcomes are not realized, even more electrification of transportation and space and water heating will likely be needed to reduce emissions to meet 2030 goals.

At the 30 MMT gap level, our analysis shows the power sector comprising approximately 10% of the gap, transportation electrification (TE) comprising about 33% of the gap and building electrification (BE) comprising approximately 25% with other sectors and abatement activity accounting for the remainder of the gap.

Against this backdrop, we are sharing our analysis and recommendations for both state and federal policies. At Edison, we have been an early adopter among energy companies as we work to meet the most ambitious set of goals in the nation for reducing GHG emissions.

California needs enabling public policies, funding mechanisms and greater funding overall to transition to the decarbonized reality required for a livable future. This policy paper specifies the policy and funding steps needed now to achieve 2030 emission reduction targets.

INTRODUCTION

The recently published Sixth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) made it clear the climate is in crisis.[1] Here in California, we have seen unprecedented changes in the climate in the past decade, and this rate of change is increasing. As a result, temperatures have increased, drought conditions have deepened and wildfires have intensified. Record-breaking fires are occurring more often, and the total area consumed is growing sharply.[2] Wildfire conditions are fueled by alarmingly low precipitation levels, unprecedented heat waves and increasing development in high-fire-risk areas.

Additionally, these combined conditions have created system reliability concerns with drought decreasing hydroelectric supply and more significant, wider-spread heat waves increasing power demand across the West. These concerns are further exacerbated when import capacity across the region has been reduced by wildfires, as seen in recent Oregon fires. Now is the time to deeply decarbonize California's economy — and create the blueprint for the world to follow.

California's environmental ambitions have often set the standard for other states and the United States overall.* SB 32 continued California's bold environmental leadership by defining a 40% economywide GHG reduction requirement below the 1990 level by 2030 and a subsequent extension of California's Cap-and-Trade Program to 2030 that continues to be a key element in generating funds for emission reduction activities. In 2020, Gov. Newsom directed the California Air Resources Board (CARB)** to develop regulations that mandate 100% of in-state sales of new passenger cars and trucks be zero-emission by 2035.[3] In July 2021, the governor issued his vision for *California's Electricity System of the Future*, which reinforces the criticality of the electric system to decarbonize the broader economy equitably.[4]

Despite meeting the 2020 GHG target four years earlier than mandated by law, the state is at a critical juncture in public policy formation and execution where delay is untenable in resolving broad, systemic societal issues, including inequity, climate change mitigation and climate adaptation. Unparalleled action and improved coordination — starting now — are needed to meet California's 2030 decarbonization goals and put the state in a position to meet potentially more aggressive federal targets. This will set the state on a feasible path to meet the 2045 goals of cleaning the grid and reaching carbon neutrality and prepare our society for a continually changing climate.

Substantial public and private investment will be needed to fund the transition adequately. However, the level and timing of investments are not the only issues. Planning, siting and permitting must evolve to reduce project lead times and forge new social contracts. In addition, public and private institutions must align themselves to help build and maintain public support to sustain the transformation to a decarbonized economy.

CARB's 2017 Scoping Plan has played a vital planning role in defining how the state can reach the 2030 GHG target. The programs under the 2017 Scoping Plan include the Cap-and-Trade Program, the Low Carbon Fuel Standard, movement toward cleaner vehicles, increasing electricity generation from renewable sources and strategies for significantly reducing short-lived climate pollutants. However, the

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* SB 1087 (2002), SB 107 (2006) and SB X1-2 (2011) established a Renewables Portfolio Standard, 20% by 2010 and then 33% by 2020; Executive Order S-3-05 (2005) established a target of reducing GHG emissions 80% below 1990 levels by 2050; AB 32 (2006) codified a GHG emissions target of 1990 levels by 2020 and created an economywide cap-and-trade program; SB 350 (2015) established a Renewables Portfolio Standard of 50% by 2030 and added new requirements for doubling energy efficiency and for wide-scale TE deployment; SB 32 (2016) codified a GHG target reducing emissions 40% below 1990 levels by 2030; AB 398 (2017) extended the cap-and-trade program to 2030 and defined new offset levels.

** To the extent consistent with state and federal law.

programs and targets found in the 2017 Scoping Plan need further funding and support from other state bodies. In some instances, such as building electrification, state targets need to be defined. The 2022 Scoping Plan update will assess progress toward achieving the 2030 target and specify a path to meet carbon neutrality by midcentury.

Recent analyses have noted the substantial distance between actual emissions and California's 2030 GHG reduction goals.[5,6,] Fewer than nine years remain for California to close this gap, and the challenge becomes greater with each passing day. The rate of transition required to achieve a decarbonized economy is unprecedented but also achievable with clear commitment and action. California must reduce its emissions by an average of 4.1% each year from 2019* to 2030 to meet its 2030 GHG reduction goal.[7]

Since the Global Warming Solutions Act (AB 32) was passed in 2006, California has reduced GHG emissions by an average of 1% per year, which is notable given that California's economy has grown 3% per year over the same period. If California continues the trend of 1% GHG emissions reduction per year, the state will miss the 2030 GHG target of 260 MMT by 90 MMT (35%), making it an even heavier lift to reach the state's 2045 carbon neutrality ambitions.** Even considering known policy commitments, Edison estimates that there could still be a 30 MMT (12%) gap in reaching our state's 2030 decarbonization goals. An opportunity exists to define and further refine targets, programs and actions needed to meet the state's 2030 goals in the 2022 CARB Scoping Plan update. The final 2022 Scoping Plan must be supported by other state bodies through implementation to improve, create and fund existing or additional programs identified in the plan.

SCE's *Pathway 2045* paper, released in November 2019, identified a feasible and economical route to realize California's GHG reduction goals by 2045. This work was predicated on the success and achievement of several existing statutes*** and insights gained from SCE's previous paper, *The Clean Power and Electrification Pathway*. Successfully achieving carbon neutrality in the long term is critically dependent on meeting our 2030 goals in the near term.

Gaps in accomplishment have emerged in many focus areas of the *Pathway 2045* analysis, including BE, TE and energy efficiency. The state has made significant progress in identifying the appropriate targets in the electric sector. Still, more progress is needed to ensure reliability and resilience along with increased electrification, including the recommendations put forth in SCE's *Reimagining the Grid* paper to develop a robust, adaptive and agile grid. The state's course must be adjusted within the next 12 to 18 months for California to have a chance at achieving its 2030 and 2045 decarbonization goals.

The state's cap-and-trade program should also continue to play a vital role to enable these emission reductions, including as a key source of funding alongside other funding sources for enhanced and new electrification policies and programs. Market-based programs like cap-and-trade will act in concert with additional policy and funding actions to ensure California has all the tools it can use to incentivize action and realize our carbon reduction objectives.

What follows is a description of the tasks needed to achieve our 2030 and 2045 goals. These initiatives must be launched as soon as possible and undertaken with priority given to equity, affordability

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* Most recent California GHG emissions inventory data year is 2019 released in the 2021 Edition.

** The average annual decline between 2006 and 2019 is approximately 5 MMT. Using this as the estimate of emission reductions for each year between 2020 and 2030 approximates the 90 MMT gap.

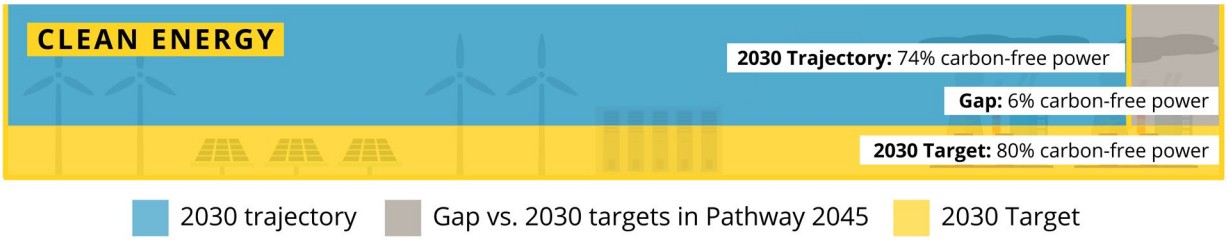
*** The Global Warming Solutions Act of 2006 (AB 32), Clean Energy and Pollution Reduction Act (SB 350), California Renewables Portfolio Standard program (SB 100), mechanisms found in CARB's 2017 Climate Change Scoping Plan.

and climate adaptation requirements. Systems must be made more resilient to a changing climate, actions must be equitable across society and measures taken must be affordable within the context of increasing uncertainty. The sources of funding (e.g., tax revenues, cap-and-trade revenues or utility rates) can affect the equity and affordability of a given policy goal. Therefore, the intersections between public policy goals, funding mechanisms and expected outcomes need to be appropriately analyzed with equity and affordability in mind.

ELECTRIC SECTOR

An immense body of work has noted the most affordable path to decarbonization in the near term includes two primary actions: cleaning the power grid and efficiently electrifying as much of the U.S. as possible.[8,9,10] These actions have significant implications for both generation resources and grid investment.

Reimagining the Grid



The electric sector has been primarily responsible for California's progress in reducing its GHG emissions, with 40% reductions in the electric sector since 2005. Progress must continue to ensure California meets its 2030 and 2045 decarbonization goals. California electric sector planning processes, including the Integrated Resource Plan proceeding at the California Public Utilities Commission (CPUC), have recently moved toward implementing more aggressive GHG targets necessary to meet the 2030 economywide GHG emission reduction goal. However, we still see a 10% gap from SCE's *Pathway 2045* recommendations. Positively, the CPUC has defined clean resource and reliability-based capacity needs through 2026.*[,11] In recent years, much has been done to address mid- and long-term reliability as the power supply decarbonizes.[12] Meanwhile, the increasing effects of climate change, such as hotter temperatures and larger wildfires, and the needed transition away from natural gas are creating new challenges for ensuring grid reliability.

The shift from uses that rely on fossil fuel combustion toward more efficient electrification reduces primary energy use across the economy. This increase in electrification and reliance on clean electricity will have transformational effects on the grid.

The electrification of transportation and buildings (air conditioning, space and water heating) will increase electrical demand on the grid. *Pathway 2045* found grid-served electricity consumption will increase 60% from today's levels, with peak loads increasing 40% by 2045. The *2021 SB 100 Joint Agency Report* also found a significant increase from today's loads, ranging between 22% and 87% by 2045, depending on the scenario.[13] California's load was relatively flat from 2008 to 2020. In *Pathway 2045*,

* This decision addresses the midterm reliability needs of the electricity system within the California Independent System Operator's operating system by requiring at least 11,500 MW of additional net qualifying capacity to be procured by all of the load-serving entities subject to the CPUC's integrated resource planning authority. The capacity requirements are adopted annually, beginning with 2,000 MW by 2023, an additional 6,000 MW by 2024, an additional 1,500 MW by 2025 and an additional 2,000 MW by 2026.

load in 2030 is flat relative to today's levels; however, this assumes that SB 350's energy efficiency doubling goal will be met by 2030 and that recent periods of excessive summer heat are outliers, not the norm.

The *2021 SB 100 Joint Agency Report* found that the average 25-year renewable power build rates must be 2,800 megawatt (MW) solar, 900 MW wind and 2,000 MW storage each year to meet the 2045 SB 100 carbon-free electric sector goal.[14] These levels are greater than the historical maximum single-year build of clean energy in California.* The state's finding is consistent with the *Pathway 2045* analysis, which called for the annual resource development rate to be two to three times higher than historical levels,[15] and is similar to recent findings at the national level.[16] California must continue to ensure that the state's resource planning and procurement policies support the scale of carbon-free resource procurement and development required to meet clean energy needs and evolve to address changing grid reliability requirements.

Pathway 2045 also found that transmission upgrades will be needed for generation interconnections within the state and for an expected significant increase in the ability of the California Independent System Operator (CAISO) to import renewable power. Further, the 2021 SB 100 Joint Agency Report highlighted the need for offshore wind, long-duration storage and resources dependent on new transmission, such as out-of-state wind.[17] The transmission resources and upgrades needed to interconnect clean energy and support reliability will take more than 10 years to complete if the status quo is maintained. SCE's recent transmission development activity shows a 10-plus year completion cycle:

PUBLIC-PRIVATE PARTNERSHIP IN GRID PLANNING

The federal government should consider leveraging models it has used in the past to build large interstate transmission lines via public-private partnerships. For example, the Pacific DC Intertie (PDCI) is a nearly 900-mile-long facility capable of exchanging more than 3 gigawatts (GW) of power between the Pacific Northwest and Southern California. It was built in the 1960s and brought together the Bonneville Power Administration, Southern California Edison, Los Angeles Department of Water and Power and other Southern California municipalities. The PDCI has benefitted the entire Western U.S. for decades. More long-distance power lines between major resource areas and load centers across the nation are required to achieve our goals through regional cooperation. Using this model allows for public and private investment and could help streamline licensing and permitting, thus maximizing the value of federal government participation.

* Over the previous decade, California has built an average of 1,000 MW of utility-scale solar and 300 MW of wind annually. The maximum annual build was 2,700 MW of utility-scale solar and 1,000 MW of wind. *See* California Energy Commission, *2021 SB 100 Joint Agency Report.* Issued: March 15, 2021, pp. 17, https://www.energy.ca.gov/sb100#anchor_report

Transmission Development Activity	Years to Complete
Clean energy needs/generation identified through the Integrated Resource Planning process triggering transmission study needs	2+
Transmission studies (CAISO Transmission Planning Process or Generation Interconnection Studies)	2
CPUC Permit to Construct or Proponents Environmental Assessment creation (Certificate of Public Convenience and Necessity for larger projects can take longer)	2+
Licensing	2+
Construction	2+
Total time	***10+***

Distribution grid upgrades will also be required to meet increased demand and peak loads, even as distributed energy resources are expected to offset some upgrades.[18]

SCE's *Reimagining the Grid* provided a long-term vision of how the electric grid must change to achieve California's ambitious GHG reduction goals. In addition to the required transmission and distribution upgrades mentioned above, the grid will require the ability to sense, communicate, analyze and act, providing a targeted, real-time response to load and equipment condition changes. As a result, advances in sensors, high-speed/high-volume communications, edge computing, predictive analytics and artificial intelligence are needed.

Transmission and distribution planning, design, construction and operations must evolve to remove barriers to decarbonization and support customer adoption of new technologies and renewable resource development. In a future with mounting challenges to achieve decarbonization while meeting ever-growing customer expectations for reliability and resiliency, the uncertainty and complexity the grid faces will only increase, requiring an adaptive and agile grid to respond to different scenarios. Planning, integrated design and accelerated project timelines to build this reimagined grid will not only help California make effective, affordable infrastructure investments but will help utilities expand the availability of new, high-paying, higher-skill job opportunities in their communities.

MODERNIZING DEMAND RESPONSE

- Demand response (DR) plays a critical role in ensuring continued safe and reliable service during the transition from the current state to a decarbonized resource supply mix.
- Gov. Newsom issued an emergency proclamation on July 30, 2021, to establish a new DR program and accelerate permitting approvals for new battery storage projects to improve grid reliability for 2021 and 2022. Customer compensation for the new DR program is more than twice the amount for existing programs, with a goal to attract more participation to avoid grid emergencies.
- While these efforts are needed for near-term grid reliability, they should not continue indefinitely. Asking customers to turn off their power multiple times during the year, even if compensated, will lead to the perception that the grid is unreliable. With this perception, customers may not adopt the building and vehicle electrification technologies needed to decarbonize society.
- Today's technologies can add to the current mix of DR programs, focused solely on emergency grid shutoff responses, to help mitigate peak demand while also not affecting customers' comfort. Traditional DR programs can be retained for infrequent use for true system emergencies.

Fundamental principles to enhance the use of smart grid technologies to ensure greater customer comfort and bolster confidence in grid reliability:

MINIMIZE CUSTOMER IMPACT

Utility-level demand balancing programs focus on achieving net peak reduction across applicable hours while minimizing customer fatigue and capitalizing on technology and automation.

- Increase the number of participating customers through automated programs at scale to minimize the impact on individual customers, increasing program success and decreasing the risk of customer attrition. Customers can set levels of comfort and not have to take proactive steps during grid emergencies.
- Maximize participation for residential and small-business customers with the addition of smaller in-home connected devices, with negligible impacts on customers.
- While minimizing customer impact is critical, the state, utilities and other stakeholders should continue to educate customers on the benefits of conservation so that they can take meaningful action in their lives beyond DR programs.

KEEP IT SIMPLE

Over the past six to seven years, DR programs have moved toward wholesale market integration, but this has meant treating customers like generators and calling for events that last multiple hours, increasing customer discomfort. To simplify and facilitate customer ease, we should modify and diversify the DR portfolio to include some programs not linked to the market, including programs shorter than the current, typical multihour event.

FOCUS ON NEW TECHNOLOGIES

DR programs should focus on technologies that make incremental changes to energy consumption, like smart thermostats, rather than on/off technologies. In addition, as discussed in SCE's *Reimagining the Grid* paper, the integration of informational and operational technologies into a common, shared operating platform deployed across the system, including the grid and customer devices, is paramount to manage load at a more granular level without a noticeable impact on customers.

Following are our state and federal policy recommendations for closing accomplishment gaps in critical areas: decarbonizing the power supply, preparing the grid for shifts in usage and increasing demands and electrifying transportation and buildings, including increasing energy efficiency.

Policy Recommendations to Close the Gap

The electric sector is essential for achieving economywide decarbonization. Yet uncertainty exists in where, when and how much demand and clean resource development will materialize on our path to a high-electrification, high-renewables future. The current deterministic planning standards increase the probability of load not being served or expensive overbuilds. Further, other aspects of grid planning must be based on multiple scenarios that span a broader time horizon, greater than 10 years, rather than a deterministic base-case view. For example, the CAISO has recently embarked on a 20-year outlook transmission study. This is precisely the type of scenario planning the state needs.

As we plan transmission and distribution capacity expansion projects, we need to transition from conventional concepts that stop at supply and grid reliability and include customer-centric reliability and resilience, e.g., deploying behind-the-meter storage. This will allow the grid to accommodate and anticipate growing electrification, changing use patterns, climate change and other economic drivers. Moreover, with additional retirements of fossil-fueled resources and increased dependence on inverter-based renewables, maintaining system inertia will be critical for adequate grid reliability and stability.

State policies that acknowledge these significant needs and ensure that the energy planning and procurement processes are efficient would enable flexible ongoing procurement and accelerate the necessary buildout. Additionally, reliability policies will need to evolve as the grid decarbonizes and regional impacts from climate change grow.

State Level

- **Redesign the CPUC Integrated Resource Plan (IRP) process.** The IRP is California's central proceeding for reliability planning and clean resource procurement. However, the IRP would be more effective if the CPUC provided a more stable procurement and project development framework, clarifying expectations among stakeholders through timely, regular and rigorous analysis for resource planning.*
  - Adopt a flexible, clean resource procurement framework that minimizes barriers and delays and provides load-serving entities (LSEs) the option to hold annual solicitations for clean energy and reliability resources.
  - Formalize the adoption of a 2030 target of reducing GHG emissions by 38 MMT to help California reach its decarbonization goals.
  - Move toward ensuring the IRP process bases system need determination and procurement authorizations on system reliability and GHG reduction needs rather than simplified stacking analysis.
  - Maintain an efficient proceeding cycle time to have sufficient opportunities to assess progress toward meeting California's 2030 goals and ensure system reliability.
  - Require all LSEs to plan and procure resources that meet California's decarbonization and system reliability needs fairly across LSEs.

* While the IRP has issued two critical reliability-based procurement orders (procurement for 2021-2023 in D.19-11-016 and procurement for 2024-2026 in D.21-06-035) since its inception, those orders emanated from separate analyses and not through the more detailed resource modeling processes in the proceeding.

- **Revise reliability planning standards and policies.** The CPUC and California Energy Commission (CEC) should ensure that frequent, California-wide reliability studies are conducted to form the basis of planning standards, such as planning reserve margins. As stated in the joint agency report, it is critical that the CPUC adopt resource adequacy planning standards that appropriately count the contributions of renewables in the early evening hours. The joint agencies can ensure that all LSEs in California use a common set of updated planning standards to enable sufficient resources to be equitably added to the system.

- **Enhance resource planning coordination across the Western Interconnection.** Uncertainty in resource adequacy imports from California's neighbors increases challenges to reliability planning as California and Western states decarbonize. To reduce the uncertainty that hinders planning, California's energy planning and regulatory agencies and the CAISO should work in closer partnership with California's neighbors to facilitate a structured process that enables more frequent and transparent information exchange about the available generation capacity that can be shared regionally and agree on resource adequacy and planning standards.

- **Increase the pace of generation interconnection.** The generation interconnection process requires significant improvement, and recent actions by the Federal Energy Regulatory Commission (FERC)[19] to address its challenges are a good first step for the longer term. However, the CAISO faces interconnection superclusters* creating a backlog of projects in the near term, likely causing delays in commercial operation for many new developers. For example, projects applying this year will need three to four years to complete the study process. Therefore, we urge the CAISO to consider the benefits of preapproved policy transmission projects that can spur the development of generation facilities and remove barriers to integrating renewable generation. Similarly, the CPUC and CEC should work together to create prelicensed corridors for transmission construction to reduce permitting and licensing time.

- **Increase the 50 kilovolt (kV) threshold for licensing new electric transmission lines within California.** Many transmission lines will be needed for the increased volume of resources on the system. Replacing the 50 kV threshold with a higher one, such as a 150 kV threshold, would significantly accelerate the construction of needed subtransmission facilities. These facilities will help interconnect moderately sized resources in the range of 10 to 200 MW and larger electrification loads, such as those for transportation depots and fleets.

- **Streamline the review and approval requests of utility infrastructure upgrades and grid capability** through trusted partnerships with utilities and agencies. As the pace of transmission build-out and major distribution upgrades increases, project lifecycles, including permitting and licensing timelines, should be reduced by at least four years.

Federal Level

The combination of federal and state policies has been a catalyst for advancing renewable energy technologies, including renewables portfolio standards at the state level and tax incentives at the federal level. However, a May 2021 analysis, assuming current state and federal policies, high oil and gas prices and low clean-tech costs, found the U.S. is not on track to hit 50%-52% economywide GHG emissions reductions by 2030.[20] Thus, aggressive federal policies and funding mechanisms are essential for the transition to a net-zero economy to occur on the time scale needed to avoid the most devastating effects of climate change.*

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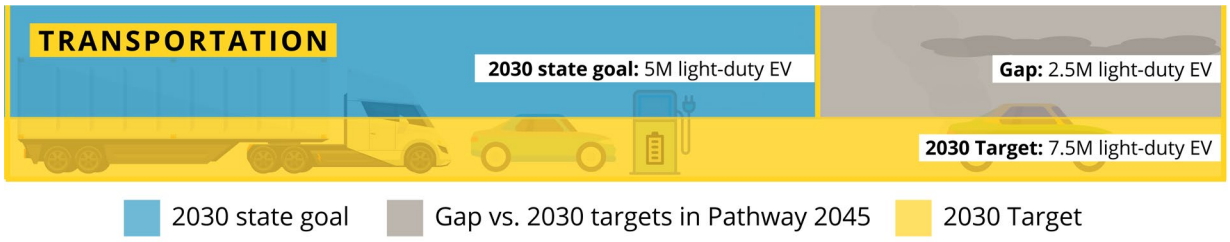
* An interconnection supercluster is a queue of generator interconnection requests significantly higher than historical averages. For example, the CAISO has received a 300% increase in interconnection requests in 2021 relative to historical annual averages.

- **Provide federal incentives,** including cash grants and tax credits, to support increased utility-scale energy storage along with commercial- and residential-customer energy storage.
- **Provide federal incentives,** including cash grants and tax credits, to support increased utility-scale renewable energy deployment.
- **Designate new National Interest Electric Transmission Corridors via FERC** and license and permit interstate transmission lines expeditiously sited within them. Corridor designation should maximize adding clean electricity resources while considering effects on lands, wildlife, cultural resources and communities.
- **Issue a new transmission planning rule to improve interregional project planning via FERC,** clarify cost allocation and facilitate larger high-voltage transmission lines to access regions rich in renewable resources.
- **Provide funding to enable states, tribes, local governments and disproportionately burdened communities to conduct and participate in interregional generation and transmission planning** that identifies optimal generation zones and transmission corridors, accounting for important environmental, social and cultural features.

TRANSPORTATION ELECTRIFICATION

Vehicle Adoption



In aggregate, while GHG emissions have been decreasing in recent years due to the increasing share of renewable power, transportation emissions have increased since 2013 and remain California's biggest decarbonization challenge.[21]

The transportation sector remains the largest source of GHG emissions in California, responsible for 50% of the state's climate-altering pollution.** Vehicle exhaust accounts for 80% of smog-forming gases and other air pollutants linked to premature respiratory and heart disease deaths.[22] Reaching California's goal to reduce GHG emissions 40% by 2030 requires a significant portion of vehicles to be zero emission. Edison's analysis shows transportation electrification comprises a third of the emissions gap, assuming existing policies and funding are met.

Pathway 2045 makes it clear that 7.5 million light-duty electric vehicles (EVs) are needed by 2030 for the state to meet its decarbonization target. The CARB's Revised Draft 2020 Mobile Source Strategy*** confirmed this with its own estimate that 7.9 million light-duty, zero-emission vehicles (ZEVs) are needed

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* The priority policy recommendations identified in this section also align with a broad set of policy initiatives to support new energy sector technology development in 2030 and beyond to enable the ultimate transformation to a carbon-free U.S. power supply, proposed by the multi-stakeholder Carbon Free Technology Initiative, found at www.carbonfreetech.org.

** When including emissions associated with production and refining of fossil fuels for transportation.

*** While CARB's Draft 2020 Mobile Source Strategy is illustrative and not an actionable document, the levels of ZEVs put forward in that document align with the levels Edison believes should be included in the 2022 Scoping Plan as it relates to ZEVs and associated infrastructure.

by 2030.[23] California's recent goal for all new cars and passenger trucks sold to produce zero emissions by 2035 sets a critical target.[24] But it is uncertain how the ZEV transition will be realized.

The CEC's current Integrated Energy Policy Report (IEPR) mid-case 2030 ZEV forecast, used for electric grid planning purposes, comes in 60% short by 2030, at 3.3 million light-duty ZEVs, compared to CARB's 2030 defined need of 7.9 million light-duty ZEVs.[25] Additionally, a gap of 100,000 ZEV trucks and buses exists between CARB's Mobile Source Strategy and the CEC IEPR mid forecast in 2030. A 260,000 ZEV gap exists between the CEC IEPR mid forecast and the 2030 ZEV need noted in *Pathway 2045*. Robust, market-transforming policies and incentives are needed.

Policy Recommendations to Close the Gap

While EV sales in California have outpaced the national average, vehicle sales are overwhelmingly traditional ICE vehicles. Trends point to increasingly favorable economics for EVs, but their purchase prices are still more expensive than their ICE counterparts. Funding included in the 2021 California state budget represents significant progress in helping spur EV adoption, however, more funding is needed.[26] Assuming favorable cost trends, an estimated funding gap of $3 billion* remains between ICE and EV costs.[27,28] In addition, California's incentives for EV adoption have had a meaningful impact through programs such as the Clean Vehicle Rebate Project, the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project and those funded by the Low Carbon Fuel Standard (e.g., California Clean Fuel Reward). Still, more durable funding is required to transform the transportation market and achieve sales of 7.9 million ZEVs by 2030.

State Level

We recommend policies that:

- **Develop a plan for achieving 2030 EV targets, including vehicle funding and infrastructure.** Gov. Newsom's Executive Order N-79-20 sets an important goal calling for 100% light-duty vehicle sales by 2035 and 100% of medium- and heavy-duty vehicles in operation to be emission-free by 2035, where feasible, and significantly earlier for some segments.[29] CARB estimates that to reach these goals by 2030, the state needs 7.9 million ZEVs, a significant expansion from Gov. Brown's prior target of 5 million ZEVs by 2030.[30] These new vehicle targets should be adopted in state policies and agency actions, especially funding and infrastructure planning. The CEC and CARB should jointly develop a funding plan assessing the needs over the next 10 years for both vehicles and infrastructure to be on pace with achieving the governor's EO goals.

- **Increase incentives and make incentives multiyear for market certainty.** CARB estimates an annual funding need over the next three years of $475 million to $1 billion for the medium- and heavy-duty sector[31] and an estimated need for $4.3 billion in light-duty vehicle incentives to achieve the 5 million ZEVs by 2030 state goal.[32] The need is even higher to reach the steep ramp in adoption required to achieve the state goal of 100% ZEV sales by 2035. California's investments in incentives for EV adoption through various programs** have had a meaningful impact, and recent California

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* SCE's estimated gap to fund light-duty vehicles is about $2.5B, which represents the total amount needed to address the price difference between BEV/PHEV and ICE vehicles. The need for medium- and heavy-duty vehicles is about $0.5B, calculated by addressing the difference in total cost of ownership for BEV and ICE vehicles. Both scenarios assume favorable cost trends and robust landscape of continuing and anticipated incentive levels. To the extent that California will need to reduce upfront costs for the medium- and heavy-duty sector as well, that would significantly increase the funding gap.

** Programs such as the Clean Vehicle Rebate Project, the Low Carbon Fuel Standard, the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project and the Clean Off-Road Equipment Voucher Incentive Project

state budget investments will help continue the trend of increasing adoption. However, far more is needed to accelerate the momentum required to transform the market and achieve 7.9 million ZEVs by 2030. Reliable and adequate funding levels send solid and consistent signals to the market, reducing uncertainty and allowing manufacturers, dealers, consumers, fleet owners and operators to confidently plan their transition from ICE vehicles to zero-emission ones. Multiyear funding addresses the stops and starts in the availability of funds that leave incentive levels uncertain from year to year.

- **Make vehicle incentives redeemable at the point of sale.** Consumers and fleets currently have to navigate a patchwork of disparate incentives with differing timelines in availability, reporting and application requirements and obtaining funds – often after purchasing. Simplifying the incentives landscape by offering a unified rebate program at the point of sale would promote accessibility and enable additional lower- and middle-income buyers to purchase ZEVs.[33]

Federal Level

National policies that support and incentivize ZEV adoption are also critical to driving adoption in California. In addition to the U.S. Environmental Protection Agency's (EPA) and National Highway Traffic Safety Administration's proposed reinstatement of increased vehicle GHG and Corporate Average Fuel Economy standards that align with substantial growth in ZEV adoption, effective policies would:

- **Lift the plug-in EV tax credit cap and make it refundable to incentivize new EV sales.**[34] Purchase incentives, such as the $7,500 new passenger vehicle tax credit, are needed to lower the cost of EVs for consumers. The 200,000 vehicle cap per vehicle manufacturer needs to be removed to encourage more EV purchases. Making it refundable will significantly improve its effectiveness and directly support low- and middle-income buyers with tax burdens smaller than the credit.*

- **Create incentives for medium- and heavy-duty EVs.** Many medium- and heavy-duty EV segments are competitive with diesel today based on the total cost of ownership. However, the high upfront cost is still a significant barrier in the absence of financing or incentives, such as point-of-sale rebates or tax credits. A point-of-sale incentive of at least 30% of a vehicle's purchase price** is needed to provide necessary market certainty for fleets to plan their transition away from diesel vehicles, the most polluting ones on the road. As medium- and heavy-duty EVs move closer to cost parity with ICE vehicles over time, the incentive could be ramped down or directed toward funding infrastructure.

- **Create incentives to increase purchases and leases of used light-duty EVs by low-income customers.** A federal used-EV grant or refundable tax credit is needed to complement the new vehicle purchase incentive, helping ensure more equitable access to ZEVs.

- **Establish national ZEV targets similar to California targets.** To match California targets, these would include:
  - 100% of sales of new passenger cars and light-duty trucks will be ZEVs by 2035.
  - 100% zero-emission medium- and heavy-duty vehicles will be in operation by 2045, where feasible, and by 2035 for drayage trucks.
  - 100% zero-emission, off-road vehicles and equipment will be in operation by 2035, where feasible.

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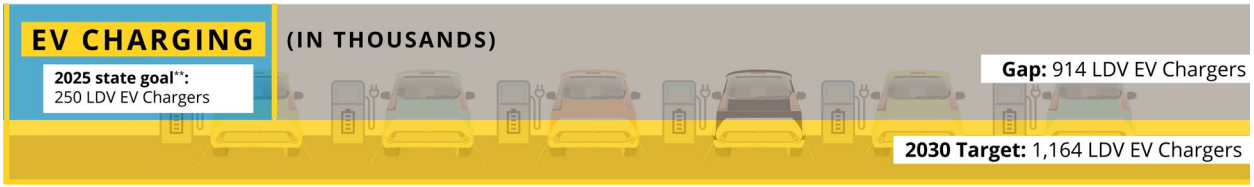
* Given that 50% of light-duty vehicles sold in the U.S. (~8 million annually) need to be electric by 2030, significant incentives are needed in the near term to close the EV adoption gap across the U.S.

** An approximation of the upfront cost difference for most medium- and heavy-duty vehicles as compared to internal combustion vehicles.

- **Accelerate the turnover of ICE vehicles.** In addition to policies supporting new vehicle sales, paired policies that accelerate turnover can provide an essential clean air benefit to priority communities facing disproportionate effects of air pollution. Examples include incentives for recycling vehicles (e.g., up to $1 billion could be accessed for a cash-for-clunkers program*) and regulations (e.g., in-use regulations, zero-emissions zones, fleet rules).

EV Charging Infrastructure



While California is on track to surpass its goal of 1.5 million ZEVs on state roadways by 2025, the state is behind in enabling the charging infrastructure needed to support the growing segment.[35] This may hinder progress toward the 5 million ZEV goal and CARB's estimated need of 7.9 million ZEVs by 2030.[36]

The projected chargers needed to support intraregional travel for 7.9 million light-duty ZEVs in 2030, according to the CEC's *Electric Vehicle Charging Infrastructure Assessment*, include:[37]

TYPE	NUMBER
Multifamily Dwellings	330,000
Workplace	327,000
Public	470,000
Direct Current Fast Charging Intraregional	30,600
Direct Current Fast Charging Interregional	4,700
Direct Current Fast Charging Transportation Network Companies (ride-sharing)	2,100
Total	1,164,400

California will need approximately 1.16 million shared chargers to support the intraregional travel demands of 7.9 million ZEVs in 2030. The CEC's *Electric Vehicle Charging Infrastructure Assessment* leverages the CARB's 7.9 million ZEV determination to estimate the 1.16 million chargers needed. However, the CEC IEPR scenarios depict much lower EV deployment by 2030. This misalignment prevents electric utilities from properly preparing for and building out infrastructure at this scale because grid planning processes rely on the lower IEPR forecasts.

* $1 billion represents a $2,500 incentive on 400,000 vehicles, i.e., roughly 20% of light-duty vehicles that are more than 20 years old.
** California does not yet have a 2030 charging plug goal.

Accelerating the large-scale adoption of EVs creates significant growth in transportation-related electricity demand and associated needs for utility infrastructure upgrades, additional system-level planning and customer-side charging infrastructure.

The following actions can help identify specific needs and enable infrastructure expansion so that the grid serves as an enabler and not a barrier.

Policy Recommendations to Close the Gap

State Level

State policies to accelerate infrastructure deployment would:

- **Increase funding for supportive infrastructure to reach state EV targets.** To provide supporting infrastructure for 7.9 million ZEVs by 2030, a funding gap of $10 billion exists for the remaining 900,000 chargers.* Additional public and private funding streams, including utility investments, are needed to help close the gap for adequate infrastructure deployment to reach 2030 goals. The state should allow utility investments that address harder-to-reach locations such as multifamily buildings. Utility investments could cover up to one-third of the market gap, and the remaining gap could be handled by a joint state funding plan via CARB and CEC, as noted above. Due to technological advancements, funding programs will also need to adapt to changing infrastructure needs, e.g., extended vehicle range, faster charging speeds, greater vehicle grid integration and shifting vehicle use cases, e.g., ride-hailing, prolonged work from home.

- **Adopt infrastructure targets of 1.16 million chargers to support 7.9 million ZEVs by 2030 in state policies and agency decisions related to infrastructure and system planning.** The AB 2127 report critically assesses the statewide infrastructure needed to achieve deep decarbonization, improve air quality and realize 2030 ZEV goals. However, there is additional room to adopt the assessment among state agency decisions, primarily in CEC and CPUC infrastructure and system planning processes.** Currently, electric system planning processes do not appropriately account for the scale or, more importantly, the timeline needed to meet the state's ambitious TE goals.*** The utility transmission and distribution planning processes must use the CEC's IEPR TE forecasts to plan for and invest in future transmission and distribution assets. The most recent 2020 IEPR TE demand forecast estimates only 3.3 million to 4.2 million EVs[38] in the state by 2030. The CEC is developing a scenario to reflect the level of electrification necessary to meet the state's climate and environmental goals. This policy scenario should be central to IEPR TE demand planning targets, so state goals and planning targets are not out of sync. Subsequently, utilities will be able to better plan for the necessary grid infrastructure to support large-scale decarbonization.

- **Provide funding for governments and communities to identify infrastructure needs.** Expand the current CEC EV Ready Communities Phase I (blueprint development) and Phase II (blueprint implementation) grant opportunities. Add funding of at least $15 million to increase staff support to help local governments streamline permitting. Actions include dedicating state agency personnel and funding to help cities and counties comply with AB 1236 (EV charging infrastructure permit streamlining) in partnership with existing metropolitan planning organization efforts.

- **Develop a state-level plan of total funding to cover the infrastructure gap.** The AB 2127 assessment provides a critical estimate of EV charging infrastructure needs statewide. The state

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* The infrastructure funding gap estimate relates only to the light-duty sector and is based on a proportional charger need of approximately 1.1M chargers from the CEC AB 2127 *Electric Vehicle Charging Infrastructure Assessment* to support 7.9M vehicles. The costs of L2 and DC fast chargers were obtained from the CALeVIP program, at levels of approximately $9K for L2 and $100K for DC fast chargers.

** Relevant CEC and CPUC processes include the TE Framework, IEPR, IRP, Transmission Planning Process, Distributed Resource Plan, Grid Needs Assessment.

*** The IEPR mid and high cases for Transportation Electrification are not aligned with needs examined in the AB 2127 Assessment and CARB's Draft Mobile Source Strategy.

should conduct a similar evaluation on the total funding needed to deploy the necessary supportive infrastructure.

- **Streamline and prioritize infrastructure buildout** for transportation-related electric system enhancements, including new substations. In some concentrated areas, increased electricity demand will trigger long lead times for building new grid infrastructure and upgrades. Reforming current system planning processes could help initiate these future builds and upgrades well before the demand materializes. Additionally, once a need is known, the development timeline could be reduced. Priority infrastructure could be identified in partnership with agencies and fast-tracked by streamlining permitting and licensing processes.

Federal Level

Federal policies to accelerate infrastructure deployment would:

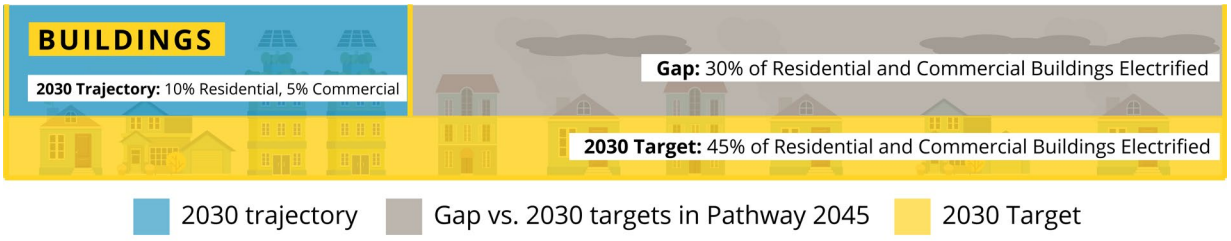
- **Provide EV infrastructure rebates to consumers and businesses.** Provide rebates of 75% of purchase and installation cost up to $1,000 for non-networked Level 2 charging stations, $4,000 for network-capable charging stations and up to $100,000 for direct current fast charging (DCFC) stations.

- **Create a national network of high-speed direct current fast chargers along interstate corridors to serve passenger EVs and commercial heavy-duty electric trucks.** Where private-market chargers are not expected to be built, install DCFCs to form a reliable national charging network.

BUILDINGS

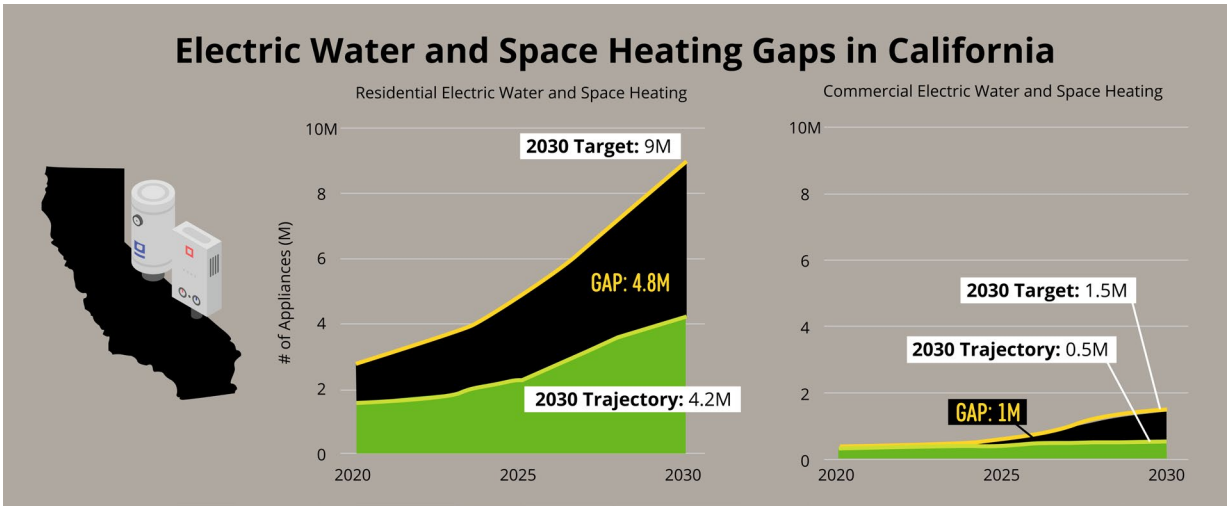
Buildings are served by multiple energy sources, including electricity, natural gas, propane, wood, etc., with California buildings primarily served by electricity and natural gas. GHG emissions from buildings can be reduced in many ways, including improving the building envelope's energy efficiency (better insulation, energy-efficient windows, shade structures), efficient lighting, appliance efficiency gains using the same fuel source and energy efficiency through fuel switching. Other mitigation options include the decarbonization of the fuel source itself. The pathway to substantially decarbonize electricity is known, feasible and codified in SB 100. The decarbonization of natural gas is less understood and poses significant cost barriers today.[39] Meaningful natural gas decarbonization requires further research and technology development, including carbon capture and sequestration.[40] Therefore, codes and standards, incentive structures and consumer and installer-education programs must support further electrification of buildings. Assuming current efficiency and BE policies and funding, efficient BE represents 25% of the emissions gap in 2030.

Efficient Electrification



Most building decarbonization assessments confirm the electrification of buildings represents a significant, cost-effective opportunity to reduce GHG emissions both in the near term and long term. For example, in *Pathway 2045*, SCE identified BE as critical to meeting California's GHG emissions reduction targets, with the electrification of nearly one-third of residential and commercial space and water heaters by 2030 and 70% by 2045.

To meet these ambitious goals, there is an urgent need to increase heat pump adoption substantially. Edison's internal analysis concludes that the current trajectory of programs and policies supporting BE is insufficient to achieve California's GHG emissions target, resulting in only 47% of the residential 2030 milestone and 30% of the commercial 2030 milestone being achieved. Therefore, near-term programs and long-term policies are needed to achieve the necessary, rapid move to heat pumps.



The graph above shows SCE's assessment of the residential and commercial electric water and space heating gap between California's current trajectory, optimistic assumptions about future codes and current programs scaling to 2030 and the state's 2030 milestone goal. Note: The number of commercial heat pumps is based on converting commercial heating capacity to the average heating capacity of a residential heat pump.

In 2021, the CEC took significant steps toward supporting the state's greenhouse gas reduction goals by issuing the draft Building Decarbonization Assessment to analyze scenarios and strategies to reduce buildings' GHG emissions by at least 40% by 2030, and the 2022 Energy Code, which establishes prescriptive heat pump baselines, electric readiness requirements for residential buildings and expanded solar and battery requirements for nonresidential buildings. However, California currently lacks a defined quantitative target for emissions reduction through building electrification, critical for achieving the 2030 overall GHG emissions reduction goals. In addition, California does not provide widespread funding or market support to incentivize the adoption of heat pump-based equipment. Setting electric heat pump targets, similar to EV goals, would spur state agencies to develop a clear and coordinated transition plan and support policies to electrify buildings efficiently.

The CPUC has recently authorized or is deliberating the authorization of heat pump incentive programs (totaling $435 million through 2024) to stimulate the clean building technologies market.[41] But even with these programs, SCE estimates California will only achieve about half of the heat pump installations needed to meet the 2030 GHG emissions reduction targets.

Indoor combustion from gas appliances raises indoor NO_2 and CO to levels that pose significant health risks, including elevated risks of asthma in children.[42] This is particularly likely to affect renters, low-income households and environmental justice communities.[43] Transitioning to electric end uses would likely have health benefits concentrated in low-income households and environmental justice

communities. Efforts to electrify residential buildings are complicated in rental residences because landlords are not incentivized to make property improvements that benefit tenants' health unless they can raise the rent. Careful program design is needed to mitigate the potential for cost increases borne by low-income renters.

Policy Recommendations to Close the Gap

State Level

State policies to accelerate building electrification would:

- **Adopt statewide heat pump targets** to achieve the electrification of one-third of all space and water heating by 2030.
- **Eliminate fossil fuels from new buildings** no later than 2025 for all residential and targeted commercial segments and remaining commercial segments by 2028 through updates to Title 24 and other related codes and standards.
- **Eliminate fossil fuel appliance incentives** that, while encouraging customers to buy relatively more efficient fossil fuel appliances, result in replacements that will be operating well into the next decade or longer. Moreover, these incentives will lock in fossil fuel equipment for years, just as California must aggressively increase electrification technologies to meet its 2045 carbon neutrality goal.
- **Update California's Residential Building Energy Efficiency Standards** (Title 24, Part 6) to establish stricter indoor air quality standards to reduce adverse health outcomes associated with indoor combustion.
- **Expand retrofit requirements** to install electric alternatives when replacing fossil-fueled appliances by certain dates to provide an orderly transition toward electrification.
- **Dedicate cap-and-trade funds** through 2030 to efficient building electrification appliance incentives, matching transportation electrification levels of investment.
- **Dedicate state general budget funds** through 2030 to efficient building electrification infrastructure funding, matching vehicle electrification levels of investment.

Federal Level

Federal policies should:

- **Direct the Department of Energy (DOE) to establish a national zero-emission appliance manufacturing standard** covering all GHG-emitting uses. This should be modeled after the ZEV vehicle standards and achieve full electrification by 2050, following the recommendations in the *National Academy of Sciences, Engineering and Medicine* (NAS) report.[44]
- **Direct DOE to expand its building asset labeling standards** to focus on emissions as well as efficiency.[45]
- **By 2025, establish minimum energy performance standards** and indoor pollution emission standards for cooling and heating systems that can be met through the use of zero-emission technology, with an exception for optional control packages that allow systems to be paired with a fossil-fueled furnace for retrofit or in freezing climates.

- **Reform the DOE Weatherization Assistance Program**[46] to constrict eligible measures to install only nonfossil-fueled space and water heating.

- **Direct the Environmental Protection Agency (EPA) to promulgate new rules under the Clean Air Act** to regulate emissions from combustion appliances. EPA should also remove gas appliances from ENERGY STAR listings and remove them from incentive finders,[47] following the recommendations in the *NAS* report.[48]

- **Create a federal BE block grant** to cities, communities, states, U.S. territories and Native American tribes to develop, promote, implement and manage energy efficiency and conservation projects, similar to the DOE's 2008-2009 Energy Efficiency and Conservation Block Grant Program.[49] For example, block grants should be used for programs that increase the share of electric heat pumps of heating and hot water to 25% of residential and 15% of commercial buildings and replace fossil furnaces and boilers, with a focus on stock turnover and new buildings in climate zones 1-5 (planning for 100% of sales by 2030), following the recommendations in the *NAS* report.[50]

- **Improve federal homeowner, builder and contractor tax incentives:**
  - $500/unit tax credit for the installation of an electric heat pump water heater.
  - $1,000/unit tax credit for the installation of an electric air-source heat pump.
  - $2,000/unit tax credit for the installation of a home electric panel or smart panel with at least 200-amp capacity and associated wiring upgrades.
  - Remove section 25(c) tax credits for fossil-fueled equipment (water heaters and boilers).
  - Provide a $2,000 per unit incentive to builders for building all-electric homes.
  - Provide one-time $1,000 tax credit for licensed plumbers who purchase a heat pump water heater.
  - Provide $100 per dwelling unit for the permanent elimination of gas service to residential units. The existing gas line must be capped and the service permanently disconnected.

- **Provide federal incentives to restaurant owners:**
  - $2,500/unit tax credit for the purchase of industrial induction cooktops.

Energy Efficiency

California has long been a leader in energy efficiency, yielding significant environmental and economic benefits. As a result, the state is a model for energy efficiency policies across the country and around the world. However, California's SB 350 goals, which seek a doubling of energy efficiency by 2030, are in jeopardy of not being met. Therefore, California must develop a clear and actionable plan on how to meet current energy-efficiency targets.

The CEC estimates that the state will fall about 20% short of the 2030 doubling goal for combined electricity and natural gas savings and 44% short of the 2030 doubling goal for electricity savings unless additional action is taken.[51] However, since efficient electrification of buildings can save up to 70% of annual site energy compared to a mixed-fuel home, efficient electrification of buildings, as made clear in *Pathway 2045*, can close a significant portion of the gap in meeting SB 350's doubling goal. Therefore, we propose the CEC and CPUC rationalize the total energy savings goals and programs across electrical energy efficiency, natural gas efficiency and efficient electrification. This will chart an optimal and viable path to reach both California's GHG emissions reductions goals codified in SB 32 and the energy savings goals of SB 350.

We recommend that the state develop a clear, holistic set of goals across electric energy efficiency, natural gas efficiency and efficient electrification to meet the SB 350 and SB 32 decarbonization objectives. Without such a roadmap and a set of supporting policies, programs and funding, the gap in

meeting SB 350 could continue to grow and California risks missing its 2030 and 2045 decarbonization objectives.

Policy Recommendations to Close the Gap

State Level

State policies to accelerate energy efficiency would:

- **Establish an ambitious statewide target** for efficient building electrification that is sufficient to meet SB 32 and that also helps to achieve SB 350 energy-efficiency goals.
- **Close existing fossil-fueled appliance incentives** and prohibit the creation of new ones.
- **Fund more heat-pump technology research and development** with a focus on U.S.-specific implementation and cost reductions.
- **Extend the CPUC's Self-Generation Incentive Program** common infrastructure handling to include energy efficiency.

Federal Level

Federal policies should:

- **Direct the DOE to develop labeling standards** or rating systems for energy and GHG emissions aligned with building energy codes and incorporate ENERGY STAR as an "operational rating."
- **Strengthen the DOE Building Energy Codes Program**[52] by increasing funding to its three code processes: development, adoption and compliance.
- **Raise the maximum tax credits** from $500/lifetime to $5,000 per year so that, under section 25(c) of the IRS' Internal Revenue Code, a homeowner can receive credits for investing in high-efficiency heating, cooling and water-heating appliances, as well as energy-efficient windows and doors.[53]

CROSS-CUTTING CONSIDERATIONS

Climate Adaptation

California is already experiencing the accelerating and compounding effects of climate change. Meeting the state's goals requires scientifically informed, flexible and adaptive strategies that increase energy sector resilience to climate stressors. Future investments in electric generation, storage, distribution and transmission must be designed and operated for the changing climate.[54] In particular, planning for and developing these facilities requires understanding the challenges posed by increasing wildfire risk, extreme heat, prolonged drought, sea-level rise and other climate change effects. This planning is essential to ensure electricity remains affordable for all customers as the electric grid expands to serve growth in such uses as electrified transportation and space and water heating.[55]

Reliability and resilience of the electric grid become paramount as more areas of the economy are electrified and as more cooling demand is required to maintain the habitability of hot regions. Additionally, regions that have not traditionally needed air conditioning will likely need it in the future to manage hotter and more frequent heat-wave events. The Pacific Northwest heat dome in late June 2021 is an example of these more frequent, extreme heat events. Therefore, incorporating the full range of potential climate change impacts in planning and processes throughout the electric sector and interdependent sectors, such as telecommunications, is necessary to continue reliable operations.

As the climate continues to change in California, throughout the West and across the U.S., local, state and federal governments will increasingly experience the impacts of a harsher climate. Long-term planning amid growing climate uncertainty will be challenging and more costly when compared to a counterfactual future with a stable climate.

Equity

Programs and funding related to clean energy and GHG emissions reductions have often been inadequate to match the ambition of public policy goals. In some cases, these have exacerbated systemic inequities including programs that have subsidized wealthier customers to make discretionary investments in clean technologies at the expense of other customers.* More recently, some programs and funding have begun to address the inequities by benefiting lower-income customers, customers in disadvantaged communities and others who have historically not participated.** Additionally, the realized impacts of climate change have already contributed to inequity across the globe.[56] Socioeconomically and environmentally disadvantaged communities in the U.S. bear disproportionate burdens, and these will be worsened in the future without specific, proportional interventions.[57,58]

Incentives for clean energy technologies should be structured to enable an equitable transition to a clean energy economy where all Californians can participate. The communities currently and historically most affected by air pollution and climate change must remain a focus. Policy design and implementation are where many of these systemic inequities are exacerbated. An opportunity exists to correct these inequities through procedural fairness during policy construction throughout all the policies recommended in this paper. Equity groups should be priority partners during the policymaking process. California must keep electricity affordable for vulnerable populations and households that spend a disproportionate share of their household income on energy; reduce air pollution across varied emission sources, particularly in disadvantaged communities; and strengthen communities' resilience in the changing climate.

Affordability

Substantial capital must be deployed throughout the country if the U.S. is going to meet the Nationally Determined Contribution (NDC) goal of 50%–52% economywide emission reductions by 2030.[59] The decarbonization actions needed for California to meet its 2030 goals are no exception to this capital need. However, these capital investments in renewable electricity, efficient buildings and EVs offset substantial annual fossil fuels and maintenance costs. For example, *Pathway 2045* found total energy expenditures for an average household were reduced 30% for adopters of efficient, electric technologies versus non-adopters.[60]

Decarbonizing the economy requires a significant and sustained capital infusion through 2030 and beyond, including public and private resources. The CPUC faces multiple intersecting policy mandates that require careful balance to avoid unintended consequences. Clean energy, storage development and grid advancements to meet reliability requirements, and climate adaptation and safety expenditures (e.g., wildfire mitigation) are among the current near-term actions that place upward pressure on rates and bills. In contrast, electrification of transportation and buildings puts downward pressure on rates and household energy costs over the long term. As electricity starts to power more of society, the line items and underlying structure that comprise a customer's bill must be carefully examined to ensure equity across customer classes, regulatory objectives are met and desired policy outcomes are funded appropriately (e.g., progressively or proportionately). Investor-owned utilities are critical partners with the state in charting a course to achieve the vital objectives of reliability, climate adaptation and decarbonization while maintaining energy affordability.

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* As of July 2021, cost recovery for behind-the-meter solar photovoltaic adoption is disproportionately shifted onto the bills of solar non-adopters.

** One example is that the California Legislature has allocated over 50% of cap-and-trade auction revenues to benefit disadvantaged communities.

CONCLUSION

While California continues to lead the U.S. — and indeed the world — in the policymaking needed to achieve meaningful GHG emissions reductions, it's essential that steps be taken now to improve current policies so that goals set for 2030 and 2045 can be met. There is also a crucial role for the federal government to play, especially in helping create functioning markets that support the electrification of key sectors. Looking further ahead, the journey after 2030 will surely be only more challenging. The reductions needed after 2030 are expected to require more effort to achieve, as they may have higher marginal costs or be in harder-to-abate areas. In addition, we anticipate the need for a broader range of technologies and policies to meet these needs, and early investments in research or testing may be needed soon. In aiming to achieve California's 2030 goals, the state and the electric sector must keep this in mind — that work done to meet more immediate milestones must also lay the needed foundations for the post-2030 future.

Here at Edison, we remain optimistic that reaching California's goals, and by extension, those of the nation, remains possible. We want to work in close partnership with our state's policymakers and regulatory bodies to develop and implement the necessary structures and conditions to support the successful, equitable and affordable transition to a clean-energy economy. This will require improving, clarifying and harmonizing goals, standards, planning and approaches to how the transition takes place and how quickly. All of this should account for changes in how customers use electricity and the impacts of climate change. It's crucial that we — the electric sector, state agencies and legislators — combine our vast expertise to bring about the practical, actionable and wise policies and actions that will result in rapidly lowering GHG emissions. We must do this now and bear in mind that meeting the goals of 2030 and 2045 is necessary to have a future where we can all thrive.

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