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REPORT

USE IT WHEN WE HAVE IT:
HOW TO USE MORE CLEAN ENERGY AND DECARBONIZE THE GRID WITH DEMAND FLEXIBILITY

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I. Introduction

The way we consume electricity is problematic. Thanks to an inflexible electric grid and old appliances, we let clean energy go to waste during times of low demand, and we see home electricity bills skyrocket during heat waves and cold snaps. Luckily, recent advances in technology present an opportunity to change the way we use electricity without changing our behavior. Many electric devices in our homes—water heaters, heat pumps, chargers for electric vehicles (EVs), and in-home batteries—could be made "flexible," so that when electricity is expensive and polluting, utilities could temporarily modulate down these devices with signals via the internet until electricity is cheap and clean again or effective price signals could be given to spur technology that will automatically adjust appliance operation without requiring customer action. With modest investment, it is in fact possible for utilities to do this without our noticing, shifting the times of electricity consumption by these devices to save money and maximize the amount of clean energy we use. This is *demand flexibility*.

A man adjusting a digital thermostat at his home.

When that solar energy is available, we should be using it, by precooling our homes, preheating our water, and charging our EVs and in-home batteries.

For example, California produces a huge amount of solar power in the middle of the day.[1] Sometimes so much is generated that solar farms have to shut down, and the clean energy potential is wasted. Demand flexibility doesn't tolerate waste. When that solar energy is available, we should be using it, by precooling our homes, preheating our water, and charging our EVs and in-home batteries.

Demand flexibility also smooths out spikes in electricity demand—especially when using smart devices that can store electricity when it's cheap and feed it back into the grid as needed. To meet unusually high demand, grid operators normally have to turn to fast-response fossil fuel-powered generating plants, but with demand flexibility those electricity peaks are not as high and can be more easily managed. This means we use less fossil fuel and more clean energy.

Changing how our appliances operate is not a new idea. There have been utility programs to incentivize electricity use at smarter times, but these precursors to demand flexibility have been hindered by market failures, rigid policies, outdated technologies, lack of information, and general customer inertia. Successfully implementing demand flexibility will require overcoming these same barriers. This report investigates the challenges facing demand flexibility programs and focuses on the technologies, policies, market mechanisms, and equity strategies that can enable demand flexibility for all communities, leading toward a just method of avoiding harmful carbon emissions, known as decarbonization, from our daily lives. The report focuses on the demand flexibility potential in residential buildings because it is a largely untapped opportunity and a critical pillar of the cost-effective decarbonization of our buildings. However, it is important to note that there are large demand flexibility opportunities in commercial buildings and industrial plants as well; policymakers and utilities must equally implement standards and programs to capitalize on this potential.

II. Benefits of Demand Flexibility

Demand flexibility has the potential to save consumers money and reduce greenhouse gas emissions. In 2018, the Rocky Mountain Institute modeled the impact of employing demand flexibility in the Texas power grid.[2] With demand flexibility programs attached to eight technologies, such as smart (internet-connected) air-conditioning controls and smart water heaters, demand flexibility was able to increase renewable energy usage by 40 percent and decrease emissions by 23 percent.[3] Further, a Brattle Group report shows that investments in cost-effective demand flexibility programs could save electricity customers more than $15 billion per year nationwide by 2030.[4] Those savings are mainly driven by avoided investments in generation capacity, reduced electricity prices and avoided investments in transmission and distribution infrastructure.

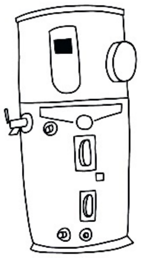
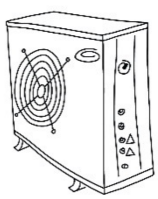
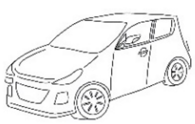
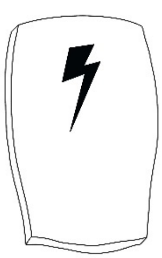
Demand flexibility achieves these savings by using electricity when clean energy is available and low-cost. This simple idea can help reduce our reliance on fossil fuels and mitigate the worst impacts of climate change, all while bringing savings to U.S. consumers.

This simple idea—using clean energy when we have it—can help reduce our reliance on fossil fuels and mitigate the worst impacts of climate change.

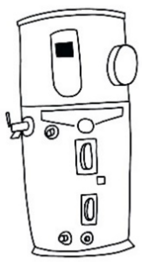
III. Technologies and Capabilities

There are four especially promising smart technologies that can be used to implement demand flexibility: electric heat pump water heaters (HPWH), heat pumps and thermal storage, EVs, and in-home battery storage. Each has unique benefits for the electricity system (Table 1).

TABLE 1: OVERVIEW OF DEMAND FLEXIBILITY WITH RESIDENTIAL APPLIANCES

TECHNOLOGY	HOW TO USE FOR DEMAND FLEXIBILITY
Heat Pump Water Heater 	The water in an HPWH can remain hot enough for customers for 6 to 12 hours and more after heating.[5] HPWHs can reduce emissions by preheating water when renewable energy is available and low-cost.
Heat Pump (for space heating and cooling) 	Buildings with good thermal insulation can hold on to heat or cold and keep an indoor space at a fairly consistent temperature. A heat pump can preheat or precool a space so that the heat pump runs less frequently when fossil-fueled generators are producing power.
Electric Vehicle 	EVs can charge when clean energy is available and stop charging when dirty energy is most available on the grid.
In-Home Battery Storage 	In-home batteries can charge when clean energy is abundant. When electricity is expensive or at times when it is generated from polluting sources, these batteries can provide power to a home.

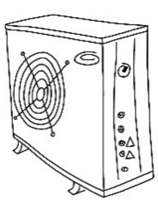
Seattle resident Nikki Mazzel researches energy efficient heat pumps.



A. HEAT PUMP WATER HEATERS

Water heating represents 13 percent of U.S. residential energy use and is well-suited to demand flexibility.[6] Because water retains heat well, water tanks can remain at an appropriate temperature for about 6 to 12 hours and more before customers need the water to be heated again.[7] Demand-flexible water heaters can preheat the water when renewable energy is plentiful on the grid and still provide hot water during peak demand hours without using additional electricity. A study by Ecotope and NRDC found that using an HPWH for demand flexibility can reduce electricity costs by 15 percent for the customer and reduce operating costs 34 percent for the utility.[8]

There are two types of water heaters that could work for demand flexibility. HPWHs should be customers' first choice because they are highly efficient. In fact, they are so efficient that homes with an HPWH save about $182 annually compared to homes that use electric resistance water heaters (ERWH), which are about one-third as efficient.[9] However, because both can use electricity to store hot water throughout the day, both HPWHs and ERWHs can technically be used for demand flexibility.



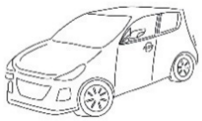
B. HEAT PUMPS AND THERMAL STORAGE FOR SPACE HEATING AND COOLING

Space heating accounts for 45 percent of a home's energy use and is the largest consumer of energy in U.S. households.[10] Heat pump technology, a more efficient alternative to a furnace or air conditioner, can be used to both heat and cool air inside a home.[11]

Similar to hot water heaters, heat pumps can be used for demand flexibility by preheating or precooling homes when renewable energy is available on the grid or when electricity demand is not high. Utilities can use algorithms to program a heat pump to run less often during hours when electricity is expensive. One study found that precooling can reduce electricity costs by about 8 to 10 percent per customer.[12]

However, for preheating or precooling to be effective, the home must also have good thermal insulation. This prevents rapid indoor temperature changes, which in turn allows a comfortable inside temperature to last longer, meaning the heat pump will require less electricity during peak hours.[13] Home weatherization programs as well as a host of emerging technologies (such as ice energy storage and phase-change materials) can improve the thermal insulation of a house, increasing comfort, enabling demand flexibility, and improving the ability of the grid to integrate renewable energy.[14]

In 2030, smart charging could reduce the peak power demand in its territory by nearly a gigawatt, enough to power 700,000 homes.



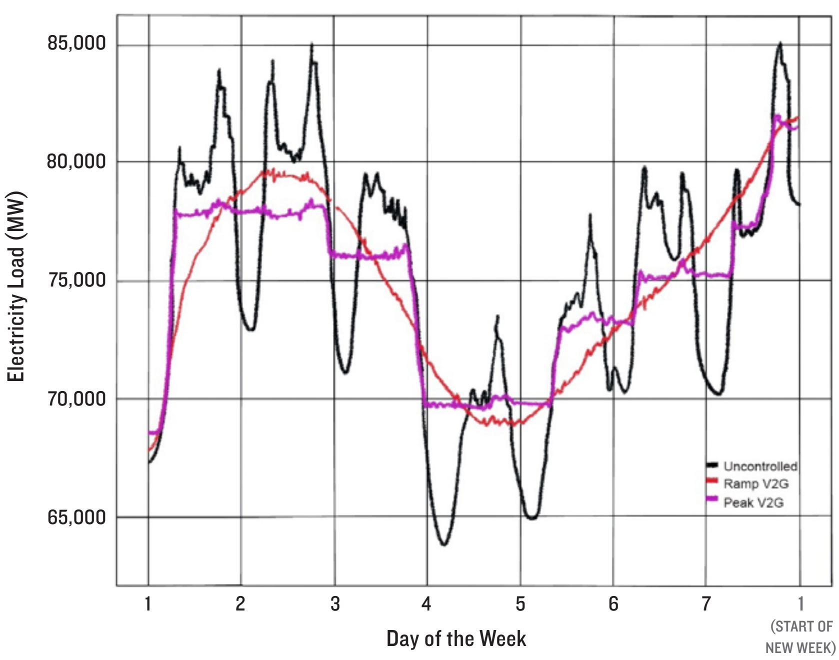
C. ELECTRIC VEHICLES

To avert a climate disaster, according to the Intergovernmental Panel on Climate Change, the increase in global warming must not exceed 1.5 degrees Celsius. To prevent this, approximately 40 percent of passenger cars and trucks in the United States will have to be electric by 2030.[15] Adding electric vehicles to the road will increase electricity usage. To avoid exacerbating the existing problems with peak electricity demand, it is essential for policymakers to be proactive in considering EV charging. If used correctly, EVs could provide the grid with increased flexibility and reduce the need for fast-responding fossil-fuel generators to manage spikes in demand.

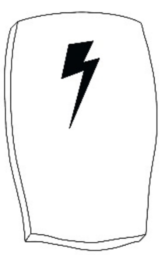
EVs can provide demand flexibility through smart charging, or charging at optimal times.[16] Most EV charging takes place at the home after working hours, which is also often a time of peak electricity demand.[17] In reality, most EV owners just need their car to be charged before morning. Whether EV charging starts right after work or is delayed a few hours makes little difference to the owner but a big difference to the grid. A study from Pacific Gas & Electric (PG&E) projected that in 2030, smart charging could reduce the peak power demand in its territory by nearly a gigawatt, enough to power 700,000 homes.[18]

EVs can also provide demand flexibility by storing electricity during times of low demand and injecting it back into the grid when demand is high. As shown in Figure 1, unmanaged electricity demand (the black line) dips and spikes as EVs are plugged in and unplugged, which is difficult for grid operators to handle.[19] However, in the future, EVs could inject electricity into the grid (known as vehicle-to-grid, or V2G); the red and purple lines show how V2G could help smooth out the peaks and valleys in electricity demand. Grid operators can save money this way, because they can use customers' EVs to manage electricity demand instead of turning to fossil-fuel generators.

FIGURE 1: CHARGING LARGE NUMBERS OF EVS CREATES PEAKS AND VALLEYS IN ELECTRIC LOAD BUT THESE CAN BE SMOOTHED WITH VARIOUS VEHICLE-TO-GRID STRATEGIES[20]



Electric Vehicle charging station.



D. IN-HOME BATTERY STORAGE

In-home batteries can also be used for demand flexibility. Like EVs, they can be charged during hours of low demand and discharged into the grid during hours of high demand, when electricity is more expensive.[21] This helps both customers and grid operators save money.

In 2018 Green Mountain Power, a Vermont utility, saved about $500,000 thanks to its customers' batteries. The utility's incentive program gave rebates to customers who purchased in-home batteries and then gave the utility control of the batteries a few times a year. During a heat wave, the utility was able to avoid purchasing expensive, dirty power by using their customers' batteries to provide electricity.[22]

In-home batteries can help the grid outside of extreme weather events too. They can help every day, by slightly increasing or decreasing their output to balance supply and demand on the grid. Utilities typically draw on energy from fossil fuel generators for this balancing function, also known as *ancillary services*, but a sizeable fleet of in-home batteries can provide this same service, only cleaner.[23]

VI. How Policymakers Can "Unlock" Demand Flexibility

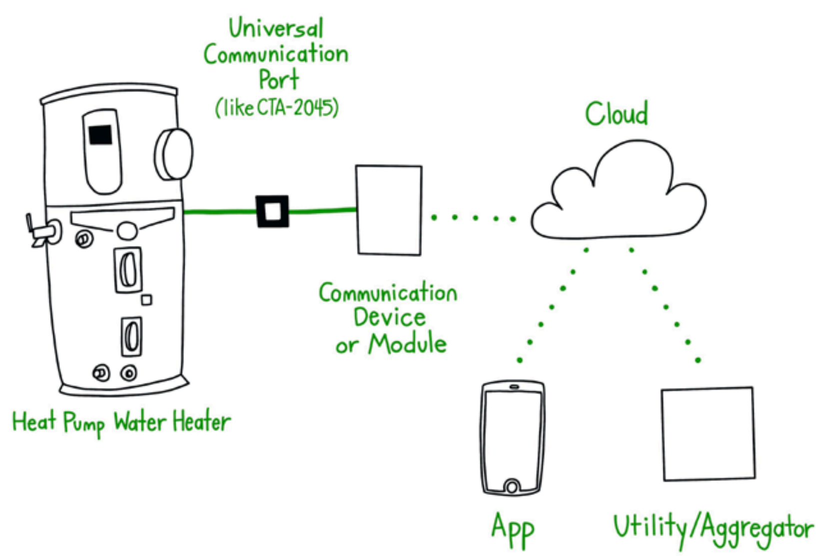
Enabling and promoting demand flexibility will require policymakers to take concrete actions and make real changes in regard to appliances and the electric grid. Many stakeholders have a role to play in demand flexibility, including customers, appliance manufacturers, electricity market designers, supervisory utility commissions, and utilities themselves. The measures below constitute essential elements of a roadmap to unlock the full potential and benefits of demand flexibility. While the first two measures focus on direct utility control of customer devices to enable their flexible operation, successful demand flexibility programs should also prioritize customer empowerment to better manage their own power consumption.

A. PRIORITIZE APPLIANCE STANDARDS

One of the potential approaches to running an effective demand flexibility program is for the utility to be able to communicate with customers' electric appliances in real time over the internet or via some other form of wireless communication. This is simple enough on a small scale, but utilities will need to connect to tens or hundreds of thousands of heat pumps, EVs and batteries. They could accomplish this by shipping a communication device, or module to the customer, and the customer would plug it into the equipment. Once the module is plugged into the customer's water heater, for instance, the utility will have access to the heater and be able to use it for demand flexibility as described earlier. Other types of demand response programs that do not exclusively rely on the direct utility control of customer appliances could also be an important element of an effective strategy. Those include time-varying electricity rates and utility communication with informed customers in real time to delay or alter their electricity consumption based electricity prices, enabling them to better manage their consumption.

FIGURE 2: REMOTE CONTROL OF A HEAT PUMP WATER HEATER

Once the communication device, or module, from the utility is plugged into the water heater, the utility or third-party aggregator (described in section C) will have access to the heater operations and will be able to modulate it.
The customer will also have access to the heater on their smart phones and laptops.



However, there needs to be a standardized port for the module to plug into, and flexible appliances currently use a variety of ports. As part of its study of remote control of water heaters, Lawrence Berkeley National Laboratory noted the many different communication standards currently used in water heaters and the difficulty that presents in using them for demand flexibility.[24]

Washington State has already recognized this problem and passed a statewide appliance standard that calls for all new electric and heat pump water heaters to come with a universal communication port called CTA-2045, which functions like a USB port.[25] States and the federal government should similarly promote a universal port like CTA-2045, not just for water heaters but also for heat pumps, EVs, and in-home batteries. This is a critical step for enabling widespread demand flexibility programs.

BARRIERS	SOLUTION
Utilities need an easy way to connect to thousands of water heaters (and other appliances) for demand flexibility and remain connected to them for their entire life. Many connectivity protocols are proprietary and do not guarantee lifetime access, which makes utility programs more expensive and less effective.	State legislatures and the federal government should adopt equipment standards that require a universal, standardized communication protocol (like CTA-2045) in electric and heat pump water heaters, as well as in heat pumps, EVs, and in-home batteries.

B. DEVELOP STANDARDS TO ENABLE "OPT OUT" PROGRAMS RATHER THAN "OPT IN"

Passing appliances standards that specify a communication port would overcome a major technological hurdle for demand flexibility. The next step is to help utilities enroll as many customers as possible in demand flexibility programs.

Enrolling customers can be challenging and expensive. Despite noteworthy education efforts from utilities across the country, customers give utilities just about 10 minutes of their attention each year.[26] Policymakers can help by developing standards so that smart appliances can be installed in demand flexible mode by default and flexibility programs can be made opt-out. Standards should guarantee that customers would see utility bill savings from the demand flexibility program without any change in behavior or impact to delivered service.

In opt-out programs, customers are automatically enrolled unless they deliberately choose not to participate. This has an advantage over opt-in programs, since many customers who would otherwise be happy to participate may be unwilling to take the extra steps to actively enroll or may not be aware of the opportunity. Moreover, since customers are automatically enrolled in opt-out programs, program operators reduce the marketing costs associated with acquiring participants.

The opt-out model has been successfully used before. In 2017, the Arizona Corporation Commission granted permission for one of the state's utilities to automatically enroll its customers in a program to upgrade to advanced metering, unless customers chose to opt out.[27] This allowed the utility to quickly and efficiently upgrade its technology and it gave customers who did not want to participate a path to opt out. Using a thoughtful and carefully implemented opt-out model for demand flexibility programs after developing appropriate standards to ensure customer benefits is the quickest and least costly way to jump-start demand flexibility across the country.

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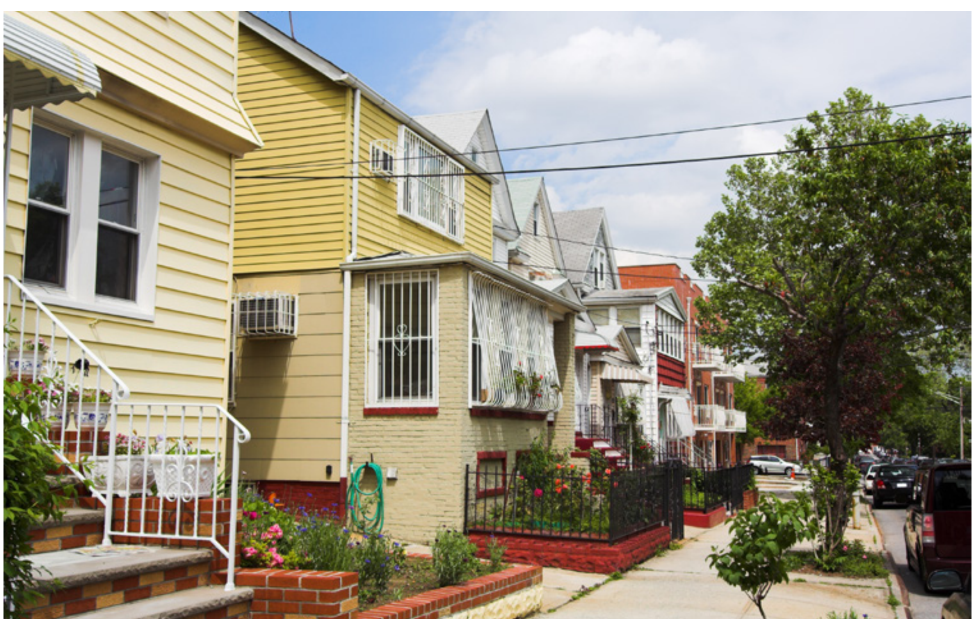


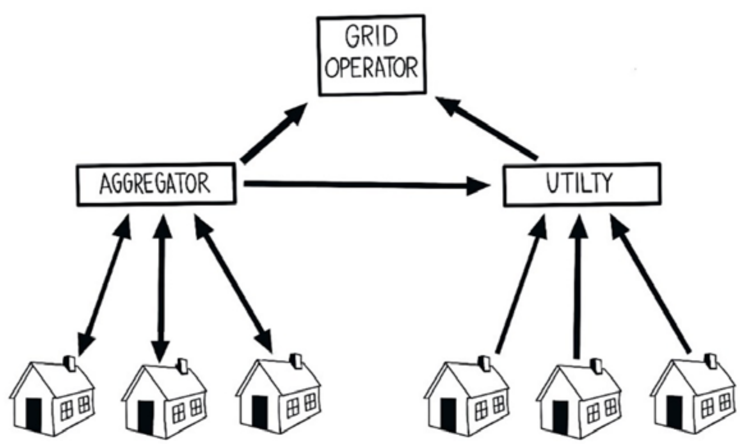
Single and multi-family homes in Queens, NY.

BARRIER	SOLUTION
Most people have limited knowledge about energy programs because they spend very little time engaging with their utility and many of those who are aware may not make it a priority to take action.	State utilities and the commissions that oversee them should make demand flexibility programs opt-out, not opt-in as long as standards are developed to ensure that customers would reap savings on their bills and service delivery is not reduced.

C. CONSIDER THE BENEFITS OF THIRD-PARTY AGGREGATORS

If appliance communication standards and opt-out programs successfully increase customer enrollment in demand flexibility, third-party aggregators can help manage all those participating homes. An aggregator would collect electricity demand data from customers' appliances, decides when to initiate a demand flexibility event, and informs the utility and grid operator when that will happen (Figure 3). In addition to playing the role of a managing entity, aggregators may be necessary to achieve the economies of scale and affordability that are needed for individual customers—especially residential and small commercial and industrial customers—to participate in flexibility programs.

FIGURE 3: ONE POSSIBLE MODEL OF HOW AN AGGREGATOR CAN OPERATE ALONGSIDE A UTILITY THAT DOES NOT MANAGE DEMAND FLEXIBILITY. THE AGGREGATOR BOTH SENDS AND RECEIVES INFORMATION TO AND FROM THE HOUSEHOLDS, WHEREAS THE UTILITY ONLY RECEIVES SIGNALS (TO TRACK ELECTRICITY CONSUMPTION). THE AGGREGATOR IS ALSO IN CONSTANT COMMUNICATION WITH THE UTILITY AND THE GRID OPERATOR.



An aggregator can be either a utility or a third party, depending on state law. While it is not altogether clear that one model is better than the other, allowing third parties to serve as aggregators introduces an element of competition that can be beneficial. For example, a survey of energy markets around the world found that third-party providers were a consistent source of technical and marketing innovation.[28]

Innovation and competition can improve the efficiency of the market, but many states have banned third-party aggregators. For instance, of the 15 member states of the Midwestern Interconnection System Operator, Illinois is the only one that allows third-party aggregation.[29] It is possible that bans on aggregators are preventing competition that could improve efficiency and lower costs. Utility commissions should reconsider whether aggregator bans are best serving the public interest and consider implementing structures to encourage and facilitate aggregation.

BARRIER	SOLUTION
Bans on third-party aggregators may be limiting competition, resulting in higher costs and slowing program growth.	States and utility commissions should reexamine their bans on third-party aggregators and consider whether the ban best serves the public interest.

D. RETHINK COST-BENEFIT TESTS

Before a utility can launch a demand flexibility program, regulators often require proof that the benefits of the program will exceed the costs. However, many of the most important benefits of these programs are hard to quantify, including 1) the avoided cost of complying with state policy goals like a renewable portfolio standard that requires a certain percentage of electricity to be generated from renewable resources such as wind and solar, 2) participant benefits, including lower energy bills and potentially, increased comfort and productivity, 3) environmental benefits, and 4) economic development and job benefits. As a result, evaluators often omit these kinds of benefits from the cost-benefit calculation while including all of the costs.[30]

A national survey found that only 13 states try to include hard-to-quantify benefits in their calculations, and only 10 include benefits from avoiding carbon pollution.[31] However, since cost-benefit tests include all the costs of energy efficiency programs, they should also include all the benefits. Many utilities can begin by including environmental benefits in their analyses. Some states use advanced computational methods, while others use "environmental adders" that increase benefits by a certain percentage to account for positive environmental effects.[32]

BARRIER	SOLUTION
Cost-benefit tests usually include all the costs but not all the benefits.	Utility commissions should require the utilities to include environmental benefits, health benefits, and other hard-to-quantify benefits of demand flexibility programs in cost-benefit analyses.

E. ENSURE THAT ENERGY STORAGE DOES NOT FACE DOUBLE RULES AND UNFAIR CHARGES

Bi-directional energy storage resources like EVs and in-home batteries—i.e. storage resources that can both consume power and inject it into the grid—play an important role in demand flexibility, but they often fall into a jurisdictional gray area. They are unlike traditional appliances because they can inject power into the grid, and they are unlike traditional generators because they also draw electricity from the grid. Because energy storage resources can both consume and supply power, they are often governed by two sets of rules, requiring two sets of applications and in the case of in-home batteries, review processes for permitting.[33] This adds additional cost and time. States should recognize the unique features of EVs and in-home batteries and consolidate rules specific to their capabilities, so they can be evaluated and issued permits in one streamlined process.

In addition to complying with two sets of rules, energy storage is sometimes also hit with fees that other resources don't have to pay. In New York City, energy storage resources are actually charged a toll for injecting electricity into the grid, which can amount to as much as 70 to 80 percent of an aggregator's revenue.[34] This fee doesn't apply to other electricity sources, like solar and fossil-fueled power plants.[35] This uneven application of the charge makes energy storage reduces the competitiveness of energy storage resources compared to other electricity sources, even though it can help the state meet its greenhouse gas reduction target. Utility commissions should review these tariffs, and make sure they are applied fairly to both energy storage and traditional electricity generators.

BARRIERS	SOLUTIONS
Because they can both draw electricity from the grid and inject electricity into it, energy storage resources must often comply with duplicate applications and review processes. Energy storage resources are sometimes charged a toll for injecting electricity into the grid (which other resources don't have to pay), making it difficult for aggregators to be profitable.	States should consolidate their permitting rules for energy storage so they can be evaluated in one process. Utility commissions should reexamine their tariffs on energy storage resources and ensure they are applied fairly.

F. REQUIRE ELECTRICITY MARKETS TO SEND ACCURATE PRICE SIGNALS IN REAL TIME

The purpose of demand flexibility is to use electricity when clean and low-cost energy is abundant and use less of it when renewable energy is scarce. This can only work via *accurate* real-time price signals in the electricity markets.[36] When prices are low, aggregators will turn customers' appliances on remotely, and when prices are high, they will modulate them down (or have them discharge their electricity into the grid, if possible).

However, in many markets, electricity prices do not accurately reflect real-time supply and demand. The *capacity market*, a separate electricity market designed to ensure grid reliability, gives retainer payments to generators to be on call in case of emergency shortages (although this is increasingly recognized as a suboptimal approach).[37] Where capacity markets exist, the cost of electricity is split between two markets, so real-time electricity prices reflect only part of the true value of electricity.

Demand flexibility will work best in areas where capacity markets do not operate and cannot blunt real-time price signals. The Electric Reliability Council of Texas (ERCOT) system, for example, doesn't use a capacity market.[38] As a result, real-time electricity prices capture the full value of electricity and provide the appropriate price signals to guide investment in demand flexibility. Policymakers and grid operators can maximize the benefits from demand flexibility by encouraging market designs that send precise and accurate prices signals in real time, like the ERCOT model.

BARRIER	SOLUTION
Capacity markets blunt the price signals in the real time energy market that are necessary for demand flexibility to perform same-day load shifting, i.e. modulating customer appliances up and down based on electricity prices.	States and independent system operators should encourage market design that sends precise and accurate price signals, like the ERCOT model.

G. PRIORITIZE UNDER-RESOURCED COMMUNITIES

Compared to the average U.S. resident, low-income families often live in less energy-efficient housing.[39] For some families, energy bills can approach 20 percent of their income.[40] Further, many low-income earners work multiple jobs and don't have the time or resources to engage with utility programs or participate in complex regulatory proceedings. However, these are the very families who would benefit the most from the reduced energy bills that accompany demand flexibility. Building an equitable demand flexibility program will require utilities to take concrete steps to prioritize these communities.

1. ENGAGE THE COMMUNITY

The utility should engage with under-resourced (low-income) customers via community-based organizations (CBOs) to provide education, outreach, and targeted programs. CBOs are usually relatively small nonprofits with a narrow focus on a particular issue in a community.[41] They're also often staffed by members of the community they serve.

Utilities should produce outreach materials in multiple languages, but CBOs can further bridge language gaps for non-English speakers. CBOs and utilities can come together at community events like block parties, farmers markets, and town halls to educate each other about utility programs and the needs of the community. Utilities can host webinars, with supporting materials left behind.[42] These outreach efforts can help customers realize the savings they can unlock not just with demand flexibility but with multiple energy-saving programs and they can help the utility understand how best to design those programs.

BARRIERS	SOLUTIONS
It is difficult for low-income communities to engage in time-consuming regulatory procedures.	Utilities should partner with CBOs to learn about communities and identify needs and shared objectives.
Meetings are often held at times when residents can't attend, due to childcare needs, multiple job responsibilities, or difficulty accessing the location.	Utility partners (like CBOs and other nonprofits) should attend community events to engage with and educate residents and enroll them in energy programs.
Program details may be described in jargon, making them inaccessible.	Utilities should make meetings more inclusive by hosting at multiple times, both online and in person, and make supporting materials for education and enrollment easy to access, both online and in flyers at local businesses.

2. DIRECT NEW FUNDING TOWARD LOW-INCOME COMMUNITIES, AND MAKE EXISTING FUNDS MORE ACCESSIBLE

One source of funding for low-income demand flexibility programs can be the utilities themselves. Many utilities have specific targets for saving energy in low-income households.[43] Each year these utilities are legally required to either save a certain amount of energy in these households or allocate a certain percentage of their program funds to that end.

Even without a specific spending mandate, utilities can still launch targeted low-income demand flexibility programs. Unfortunately, for a utility to spend money on a program, it usually must pass a cost-benefit test, and the math often leaves low-income communities behind.[44] To address this, some states require utilities to include extra benefits in their calculation for serving low-income customers. Other states, including Michigan, Illinois, and Iowa, have eliminated cost-benefit tests for low-income programs altogether.[45] These changes can overcome barriers and unlock funding streams from the utility. While utilities should continue to calculate the costs and benefits of programs (for information and planning purposes), passing a particular threshold should not be required for low-income programs. Instead, program objectives, metrics, and a reasonable budget should be determined collaboratively to ensure that money is prudently spent and that there is sufficient funding to reach all eligible customers.

Many states and municipalities already provide funding for communities to reduce greenhouse gas emissions through programs like demand flexibility. However, these funds can be unintentionally held in separate jurisdictional silos, making them complicated for customers to reach. Customers who simply want to lower their energy bills may not be prepared to enter this complicated landscape. For example, customers could participate in a demand response program, or they might be eligible for equipment upgrades through their utility's energy efficiency program, or perhaps they qualify for federal weatherization funds. All of these programs may have different requirements and deadlines, complicating the process greatly. These funding sources should be streamlined, and states should direct them toward low-income communities.

For example, local governments in California are overcoming the issue of program integration through the Transformative Climate Communities program.[46] Using funds from California's cap-and-trade mechanism, the program awards local governments a lump sum of money to implement sustainable growth plans at the neighborhood level.[47] Communities can apply the funds to a wide array of projects, deciding how to improve their health and well-being while also reducing greenhouse gas emissions.

Also in California, the Association of Bay Area Governments (ABAG) provides another example of how to integrate funding streams. Its project, the Bay Area Multifamily Building Enhancement Program, coordinates local governments in the Bay Area to support energy efficiency upgrades. Funded by utility customers and monitored by the California Public Utilities Commission, ABAG provides free energy efficiency consultation, rebates, and financing for energy upgrades to homes in multifamily buildings.[48] It also provides a local point of contact for people who wish to get involved.

When integrating funding streams from multiple programs, customers should also have a single point of contact (SPOC) to help guide them through their options. A SPOC is a behind-the-scenes connector who explains procedures, connects customers to contractors and financing opportunities, and simplifies the process so that customers have to fill out only one application and contact one person. A SPOC can increase the participation rate of energy efficiency programs sevenfold and triple energy savings compared with programs without a SPOC.[49]

BARRIERS	SOLUTIONS
Cost-benefit tests often leave out many hard-to-quantify benefits and can limit the accessibility of demand flexibility in low-income neighborhoods.	Utilities should work with communities to establish key objectives and collaboratively determine a reasonable budget rather than rely on traditional cost-effectiveness calculations to approve programs.
Funding is hard to access, because programs from different agencies have different deadlines and requirements.	Local governments should help coordinate multiple funding streams to ensure that customers from under-resourced single-family and multifamily households are served. They should also make sure each customer gets a comprehensive upgrade to his or her home, improving energy efficiency and installing efficient, flexible appliances. Utilities and states should establish a single point of contact to help customers navigate multiple energy-saving program opportunities, including demand flexibility programs.

Family in Pennsylvania.

3. PLAN FOR A SUSTAINABLE FUTURE

Energy programs often prioritize quantitative metrics, such as energy savings, to judge success. However, these metrics neglect qualitative measures that might be more meaningful to the community, such as boosting customers' confidence in their ability to pay their energy bills, or increasing their comfort during extreme weather days.[50] To be successful, low-income demand flexibility programs should develop thoughtful goals and metrics to measure their progress during and after program implementation. The metrics should be developed in an open dialogue with members of the community so each community's specific needs are addressed. Each community will have different goals, but generally, program metrics might include recording how many local jobs are created as a result of the program, or how many members of the community the program serves, in addition to the energy and money saved.

Demand flexibility programs involve investments and new technologies that offer great energy-savings potential. These investments also have the potential to drive up property values and rents in low-income neighborhoods. People who live in a community should be allowed to stay there, and this can be achieved through forward-looking, equity-focused programs.[51] Policymakers should roll out demand flexibility programs in conjunction with robust policies that support the community and protect against gentrification. Such policies might include introducing real estate transfer taxes and "just cause" eviction regulations, maintaining affordable and subsidized housing, requiring a certain percentage of local hiring, and enforcing strong building codes.[52] Leading with equity ensures that program benefits are not reaped just by privileged people and that investment in low-income communities leads to revitalization, not gentrification.[53]

BARRIERS	SOLUTIONS
Program metrics often prioritize quantitative energy savings and neglect qualitative metrics like customer comfort and confidence in being able to pay energy bills. Improvements to buildings and communities lead to rising rents, which can lead to resident displacement.	Utilities and regulators should work with communities to ensure that regulators develop appropriate metrics to track program success. These should include both quantitative energy- and money-saving goals and also qualitative goals like increased comfort and financial security. Local governments should establish tenant protections such as just-cause eviction policies, affordability agreements to protect against large and sudden rent increases, local hiring quotas, affordable-housing preservation, and real estate transfer taxes to ensure that community investments do not ultimately displace residents.

*People who live in a community should be allowed to stay there,
and this can be achieved through forward-looking, equity-focused programs.*

V. Conclusion and Summary of Actions for Policymakers

Demand flexibility helps us use the clean energy that we have when we have it. Removing the barriers facing demand flexibility is key to unlocking a decarbonized future. We hope this report serves as an introduction to this issue and inspires policymakers to further pursue demand flexibility.

SUMMARY OF ACTIONS FOR POLICYMAKERS

	U.S. Department of Energy (DOE)	U.S. Federal Energy Regulatory Commission (FERC)	State Legislatures	Utility Commissions	Utility Companies	Grid Operators	Research Organizations and Others
PRIORITIZE APPLIANCE STANDARDS. State legislatures should explore equipment standards that require uniform communication ports (like CTA-2045) **in devices capable of demand flexibility**.	●		●				
DEVELOP STANDARDS TO ENABLE "OPT OUT" PROGRAMS RATHER THAN "OPT IN." An opt-out model reduces costs and, increases participation.			●	●	●		
CONSIDER THE BENEFITS OF THIRD-PARTY AGGREGATORS. States and utility commissions should consider whether third-party aggregators can increase innovation and lower the costs of their demand flexibility programs.			●	●	●		
RETHINK COST-BENEFIT TESTS. Regulators should instruct utilities to consider the environmental, health, and other hard-to-quantify benefits of demand flexibility in cost-benefit analysis.				●	●		
ENSURE THAT ENERGY STORAGE DOES NOT FACE DOUBLE RULES AND UNFAIR CHARGES. Make sure permitting procedures and utility rules have explicit and fair processes for energy storage.		●				●	
REQUIRE ELECTRICITY MARKETS TO SEND ACCURATE PRICE SIGNALS IN REAL TIME. States and grid operators should structure their electricity markets so that real-time energy prices reflect the true value of energy.			●			●	
PRIORITIZE UNDER-RESOURCED COMMUNITIES. Utilities should improve communication with underserved communities by partnering with community-based organizations. States should create single points contact and work with them to unlock and coordinate funding from utilities as well as from federal and state energy programs. State and local governments should plan ahead for the effects of investment in under-resourced communities.	●	●	●	●	●	●	●
ADDRESS DATA GAPS. Utilities and research organizations should work to address data gaps related to the potential costs and benefits of achieving high participation rates in demand flexibility programs. This is necessary to appropriately assess the role and impact of demand flexibility in decarbonization.					●		●

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