Nest Renew

The Power of the Smart Home

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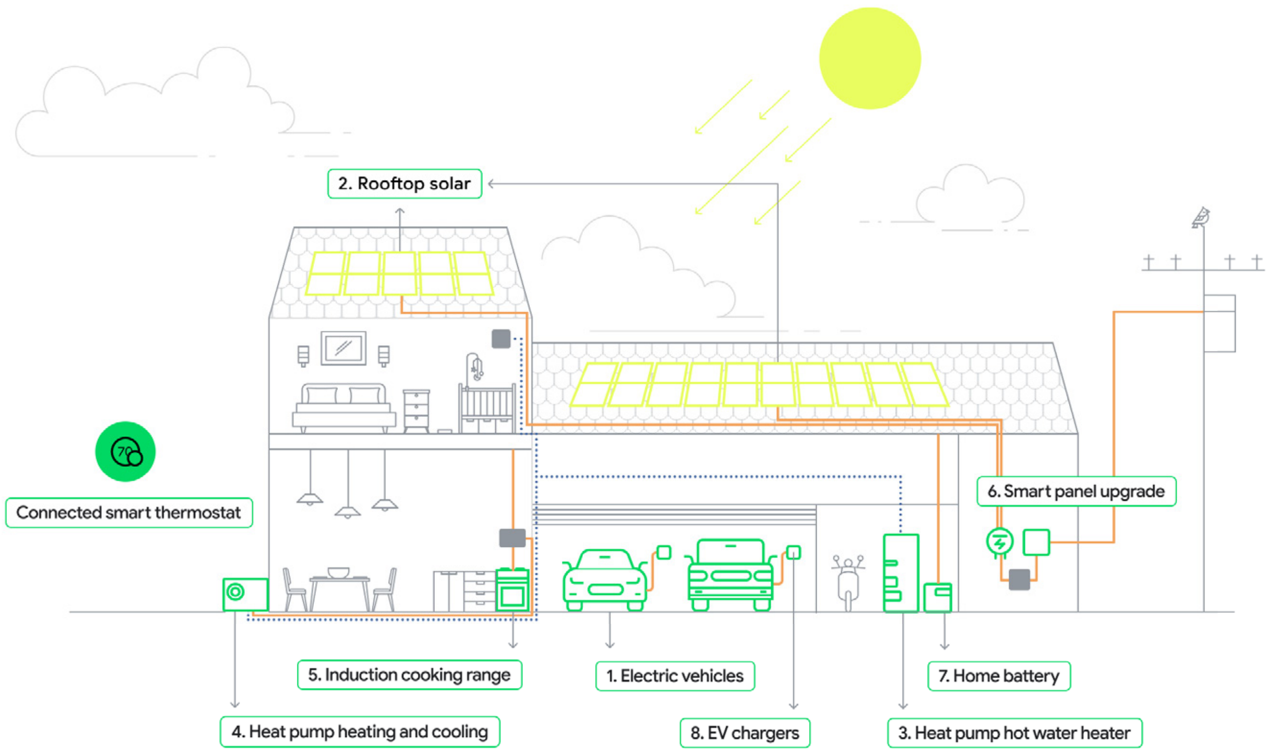
Unprecedented Challenges for an Aging Grid

Our nation's electric grid is facing unprecedented challenges, with many states across the U.S. increasingly at risk for more frequent power outages.[1] A variety of factors including rising electricity usage and extreme weather events have increased stress on the grid, often resulting in outages and higher costs for residents.[2] The impact of these challenges can be staggering, both financially and for the health and wellbeing of residents. The United States Government Accountability Office recently published findings that the total annual cost of utility outages are upwards of $55 billion and that this number, if unchecked, could rise to $480 billion per year by 2080.[3]

The Growth and Potential of the Smart Home

There is a simple and effective way to help mitigate these costs. Using today's smart, connected, technologies, our homes, offices, and buildings have the potential to work in harmony with the electrical grid to automatically conserve, shift demand, and deploy power how and where it's needed—helping us maximize our existing infrastructure capability and making the grid more reliable and resilient. Connected technologies and appliances (both in homes and attached to the grid) that enable us to more precisely, cheaply and effectively adjust and shift the demand, supply, and small-scale electricity generation technologies are known as distributed energy resources (DERs). Smart thermostats, electric vehicles (EVs) and EV chargers, rooftop solar, and battery storage are all examples of DERs that can be found in millions of homes across the United States today.[4]



However, despite the existence and increasing adoption of these technologies, many homeowners don't have access to programs that incentivize and enable their DERs to respond in real time to the needs of the grid. When the grid experiences high demand for electricity, there are two options to keep the lights on: 1) increase the production of electricity or 2) reduce demand. However, the most common approaches for both of these options are not capable of scaling at the speed and magnitude that we need to ensure grid reliability.

To increase production, utility companies have historically maintained a network of "peaker plants," which are typically fossil-fuel based power plants.[5] As the name suggests, these plants often only run during periods of peak energy demand. In fact, on average, they only run for 3%[6] of the year. However, despite their limited usage, they still incur year-round maintenance and capacity costs, which are paid for by customers.[7] Furthermore, peaker plants are typically gas or oil burning, and are disproportionately located in low-income and minority communities.[8] Due to these factors, it will become increasingly difficult to justify the construction or continued use of many of these plants.

To reduce demand, we have historically relied on blunt tools like remotely shutting off high-demand appliances like air conditioners, curtailing commercial or industrial load, marketing campaigns asking residents to turn off appliances or shift their usage or in extreme cases, directed power outages. While these tools are useful, residential DERs can enable us to more precisely, cheaply and effectively adjust and control the demand, supply, and generation of electricity. Coordinating such a meaningful decrease or shift in electrical demand for a short amount of time across aggregations of DERs is known as "Demand Response."

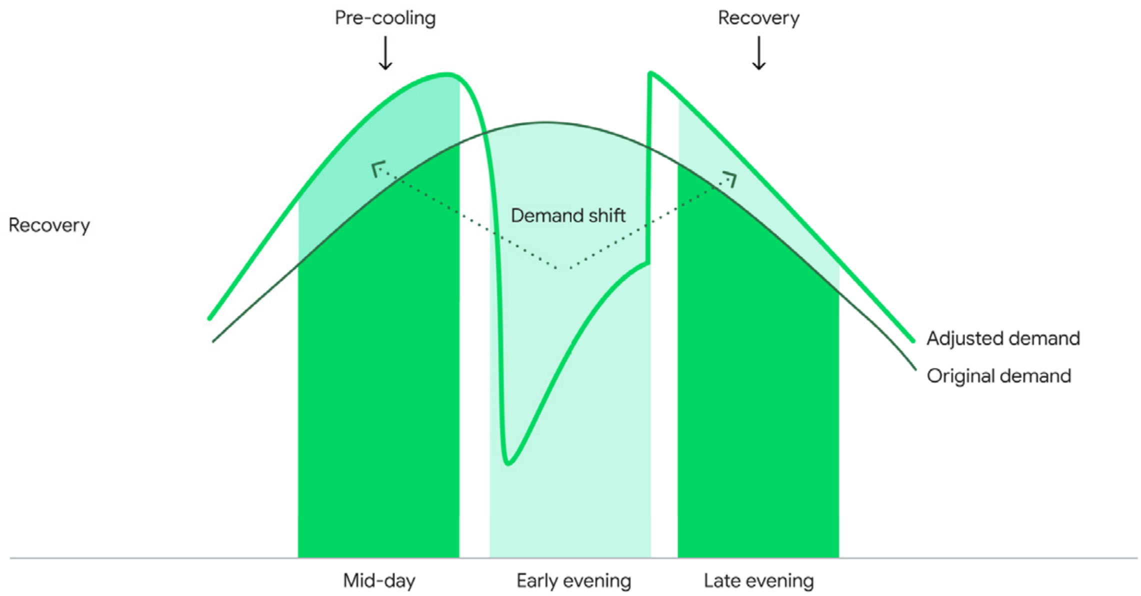
Smart Programs Enable a More Resilient and Efficient Grid

The deployment of connected devices in homes and buildings, such as smart thermostats, smart water heaters, EV chargers, etc., coupled with demand response programs can help to automatically reduce the energy demand placed on the grid. Demand response programs should create choice, energy efficiency savings, and offer participating customers fair incentives like hardware credits, payments, or discounted electrical bills for utility programs, or for market-based programs, direct payments to compensate customers for agreeing to reduce their energy use, just as a generator would be paid to create that electricity, but without the additional transmission or distribution costs. By aggregating these shifts across a region, it is possible to smooth peak load demand and reduce or even eliminate the need for expensive and rarely used peaker power plants.

For example, during the height of summer, the electrical grid often strains to meet the late afternoon energy demand when people are getting home from work and school and turning on their air conditioning.[9] As such, we've historically had to turn on peaker plants or implement rolling power outages.[10] Today, smart thermostats can coordinate to pre-cool some homes or automatically adjust temperature settings by a few degrees.[11] This helps more people to stay cool and comfortable while also temporarily reducing the demand and high stress placed on the grid and reducing our reliance on peaker plants.

FIG. 1

Peak demand response "Event call"



Visual representation of how demand shifts of demand response events can maintain comfort while reducing overall peak demand

More advanced programs provide customer choice by allowing them to enroll into utility or third-party programs, responding to real-time grid conditions automatically making slight temporary adjustments to their settings in order to help decrease or shift demand. Specifically, these demand response programs enable grid operators to 1) automatically shift or reduce demand via customer-enrolled devices (e.g. smart thermostats) for a given amount of time and 2) directly incentivize residents to participate. "Nest customers who participate in these demand response programs can see potential shifts of up to 77% of AC load during peak events, while still maintaining comfort and control." [12]

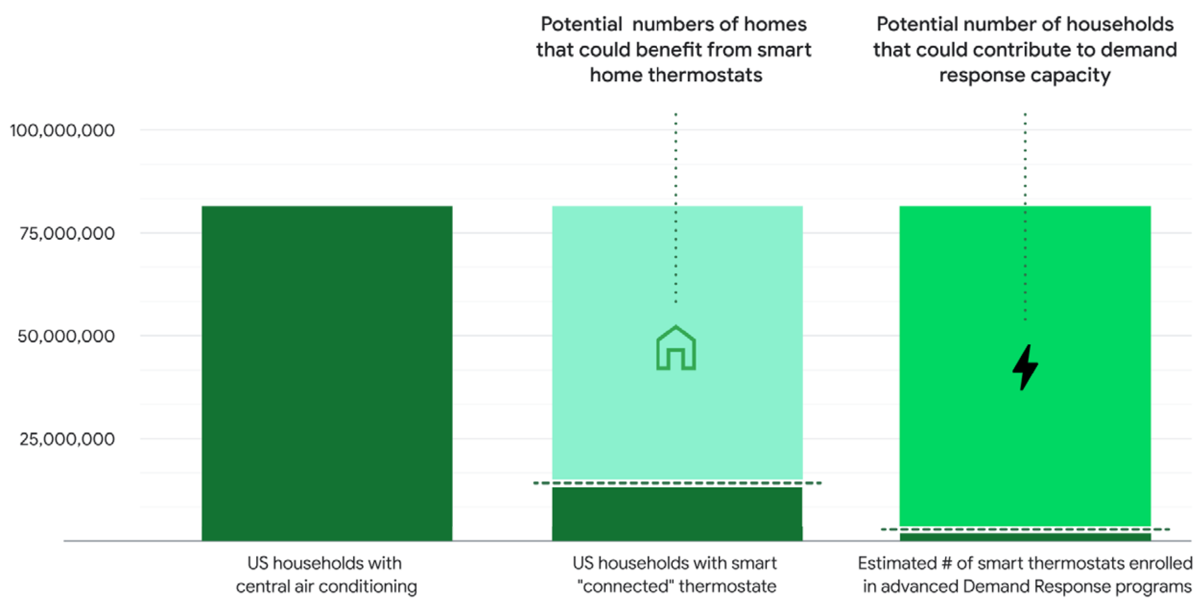
While some programs limit customer adjustments during peak events, Google Nest customers maintain control. We believe this improves customer satisfaction and engagement, and it's the right thing to do for customers.

The Untapped Potential of Smart Thermostats and Residential Demand Response

The best part is that these benefits aren't theoretical. In fact, Google Nest thermostats have already helped millions of residents around the world to save over 100 billion kWh, which is enough electricity to light up the entire planet for 10 days.[13] However, despite the tremendous promise of these programs, the nation faces two primary issues: 1) many residents still don't have smart appliances such as smart thermostats installed in their homes and 2) most communities currently do not offer demand response programs to residents.[14]

FIG. 2

2020 U.S. Households with Central AC. Smart Thermostats and Demand Response



Data is based on 2020 EIA housing data. SEPA 2019 Demand Response Market adjusted for 12% YOY growth based on FERC 2021 Assessment of Demand Response and Advanced Metering

Based on a 2019 analysis by The Brattle Group, planning and policies could unlock roughly 200GW of cost-effective load flexibility potential by 2030 with nearly $15B in annual benefits. For context, 200 GW of capacity is roughly equivalent to the peak summer capacity for the entire state of Texas and California combined.[15] The majority of potential is in new emerging load flexibility programs, which will be enabled primarily by smart thermostats and Auto-DR —gateways to accessing electrified building load.[16] Smart thermostats alone account for approximately one third of that value, representing an incredible opportunity for impact. And though, most households still don't have smart thermostats, simply enrolling all of the homes that already had them installed as of 2020 in demand response programs we could save consumers money and deliver nearly 10 GW of reliable, carbon-free, consumer saving capacity[17]. That is more than 3,500 utility scale wind turbines[18], or the electricity demand of the entire State of New Mexico, on the hottest day of the year.[19] Furthermore, if we were to equip all central heating and cooling homes with smart thermostats and enroll them in demand response programs, we could see more than 70 GW of additional peak capacity potential[20], nearly the entire peak capacity of California on the hottest day of the year.

Building Consumer Empowered Products

To begin addressing this issue, in October of 2021, Google unveiled Nest Renew, which is a service for compatible Nest thermostats that makes it easier for customers to enroll in existing demand response programs to support peak load reduction. But we need to do more. DERs will continue to proliferate across the U.S., with the market for these enabling technologies forecasted to grow to $110 billion by 2025.[21] As the number of smart and connected devices in the home continues to increase, there is a tremendous opportunity for states, grid operators and utilities to enable policies that help reduce customer bills and provide load flexibility and reliability services. To mitigate the threat of future grid failures at the lowest cost possible, we must develop pathways to empower these households to participate in grid services that will improve the reliability of the grid. By shifting our focus to unlocking the full value in these existing technologies we can reduce the need to invest in and continue supporting high-cost, low-utilization infrastructure projects that produce only 3% of the year and get more out of our existing transmission wires. Furthermore, we can empower customers with tools to respond to high energy demand periods, save energy, reduce stress on the grid and reduce costs.

Policies To Support Consumer Empowerment

Policy is an essential tool to market development by creating the necessary incentives to increase consumer awareness of the benefits of products designed to manage in-home electricity and gas usage. These policies include:

- **Develop rewarding programs that maximize participation of residential demand-side resources** by ensuring funding for energy efficiency programs, expanding residential demand response programs, ensuring that customers share in the value, and streamlining customer participation.
- **Match residential incentives, programs, and rates with decarbonization objectives and household benefits** by aligning the methodologies for cost-effectiveness tests with grid and carbon benefits, expanding dynamic rates, and properly valuing the entire stack of services residential households which DERs can provide.
- **Empower customers to access and share their energy data** through standardized sharing processes that are minimally burdensome to customers and their chosen energy management providers and the provision of real-time pricing and emissions data accessible to customers and authorized solution providers.

Characteristics of Foundational Program Design

Programs that utilize DER technology should strive to incorporate these policies to unlock the full benefit to residential customers and the grid. An ideal program would have, at a minimum, the following characteristics:

Up-front incentives to customers for the DER technology that reflect the full energy efficiency value of the resource. The value should incorporate the forecasted energy reduction over the life of the resource and the avoided cost to the grid of not needing to build out additional infrastructure.

Ongoing incentives to customers for participation in demand response programs. These incentives should incorporate the capacity value that the resource brings, the value of the energy reduction that the resource provides during an event, deferred costs for infrastructure upgrades, and avoided costs of substantial power failures.

Simple customer enrollment processes. Residential customers should encounter minimal barriers to purchase a subsidized DER or sign up for a demand response program. The enrollment process should not require hard-to-find pieces of information like a utility account number. And, when a customer purchases a subsidized DER, they should have the option to pre-enroll that DER into an eligible demand response program at the point-of-sale.

Cost-effectiveness tests that consider grid and carbon benefits. Cost-effectiveness tests should capture the host of benefits a DER can provide, such as avoided costs and time-varying emission reductions. A program that is able to avoid the build out of costly infrastructure or is designed to reduce load when emissions on the grid are at the highest should have those capabilities properly accounted for.

Easy pathways to deliver customer data access to authorized entities. Customers should be able to share their energy data with their authorized third parties. Access to this data will enable customer-chosen third parties to coordinate a DER, or a suite of DERs, within a customer's household and optimize based on the meter data on the customer's behalf.

Trends like the growing market for DERs and customers seeking ways to reduce their energy consumption and increase their savings, are unlikely to slow down anytime soon. By shifting our focus to unlocking existing technologies we can empower customers with the tools to respond to high energy demand periods, save energy, reduce stress on the grid, drastically reduce costs, and minimize health impacts potentially saving lives.[22] The ability for our states and communities to reap these benefits will be determined by the policies created today.

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Appendix

1 May 2022 “”2022 Summer Reliability Assessment”, available at https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SRA_2022.pdf.

2
1. Rising usage, https://www.eia.gov/outlooks/steo/report/electricity.php
2. Extreme weather, https://www.gao.gov/assets/gao-21-423t.pdf
3. Peak events/blackouts, https://www.gao.gov/assets/gao-21-423t.pdf

3 See March 10, 2021 “Climate Change Is Expected to Have Far-reaching Effects and DOE and FERC Should Take Actions,” available at https://www.gao.gov/assets/gao-21-423t.pdf

4 https://www.seia.org/news/united-states-surpasses-2-million-solar-installationsw

5 https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php

6&7 https://www.cleanegroup.org/ceg-projects/phase-out-peakers/
https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php
https://www.nrel.gov/docs/fy17osti/67645.pdf

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17 Rush Hour Rewards Studies
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2. Massachusetts, Eversource, 2019, https://ma-eeac.org/wp-content/uploads/2019-Residential-Wi-Fi-Thermostat-DLC-Evaluation-Report-2020-04-01-with-Infographic.pdf
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4. Michigan, Consumers Energy, 2020, https://mi-psc.force.com/s/filing/a00t000000O8ypAAAR/u210800001
5. Missouri, Ameren, 2020, https://efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936362928
6. Oregon, Portland General Electric, 2020, https://edocs.puc.state.or.us/efdocs/HAD/um1708had165015.pdf "

Appendix

18 | https://www.energy.gov/eere/articles/how-much-power-1-gigawatt

19 | https://www.eia.gov/electricity/state/

20 | ~82 million US households with central heating and cooling x 0.89kW (see note 17) > 70GW

21 | https://www.greentechmedia.com/articles/read/5-takeaways-on-the-future-of-the-u.s-distributed-energy-resources-market

22 | https://www.epa.gov/airmarkets/power-plants-and-neighboring-communities
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