FROM FOUNDATION TO CEILING

A Handbook for Green and Livable ADUs

GLADUR

A PRODUCT OF

HEART OF SAN MATEO COUNTY

GREEN ADU DESIGNS FOR TODAY AND THE FUTURE

HEART's vision for San Mateo County is for all members of our vibrant community to have a place to call home.

Creating more affordable housing options is our passion. We know that everyone benefits when all members in our community have a stable home. Together with the Bay Area Air Quality Management District (BAAQMD), we are thrilled to announce our newest initiative to create more housing an innovative, environmentally-friendly program that makes constructing green and livable Accessory Dwelling Units (ADUs) affordable and streamlined.

Community members benefit from the Green and Livable Accessory Dwelling Unit Resource (GLADUR) program by gaining access to free designs and construction plans; a handbook; and a streamlined and shortened permitting process in our pilot cities and county. Together, these elements will save homeowners thousands of dollars in design fees and expedite the process in obtaining permits to build an ADU. Our environment also benefits as homeowners can utilize some of the savings to invest them in enhanced green and sustainable features.

The designs this program provides were borne from extensive community engagement. Developed with San Mateo communities and aesthetics in mind, each design is customizable, energy efficient, decarbonized, offers sustainability options, and meets the State of California's building codes.

With green features that increase cost efficiency, homeowners are investing in the future of the Bay Area by creating affordable housing that produces less strain on our environment. We see a future where these new homes provide options for essential workers—teachers, healthcare providers, food and grocery store workers—to remain a part of our community.

Finally, we offer this program as a resource for all. While HEART and BAAQMD built this program with San Mateo County in mind, the designs can be utilized anywhere. We know this program provides real solutions for the existing housing crisis, and we are eager for our residents to join us in building toward a better future for our community.

In partnership,

Don Horsley
Chair, Board of Directors

Armando F. Sanchez
Executive Director

HEART
OF SAN MATEO COUNTY
Since 2003 | heartofsmc.org

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A Note About the Images in This Guidebook

Images are provided for visual interest only and do not represent GLADUR designs, unless otherwise noted.

A NOTE ON NEW LAWS

There have been a lot of new state and local laws passed regarding ADUs, and many are frequently being updated. It is recommended that you reach out to your local jurisdiction to find out what new regulations have been passed, as well as what that means for what you can build.

For a summary of the six ADU bills signed into law in 2019, please see this summary provided by the 21 Elements Second Unit website. To learn more about specific ADU regulations in each San Mateo County jurisdiction, please visit the 21 Elements ADU website. For ADU regulations throughout the State and County, please visit the Accessory Dwellings website.

SOURCES Cover, Jack Barnes Architect;
Foreward, Maximillian Conacher on Unsplash;
Left, Mikhail Pavstyuk on Unsplash

GLOSSARY

General ADU and Housing Terms

The following is a list of terms that you may see in this handbook or generally come across during the ADU development process, as well as in choosing green and sustainable features. They may also be helpful in your discussions with architects, contractors, and city officials.

Accessory Dwelling Unit (ADU) A dwelling unit accessory to a main single-family dwelling. Sometimes also referred to as a "secondary unit," "in-law unit," "backyard home," or "granny unit."

Administrative Use Permit Special planning permit or variance use permit that is required for some ADUs (e.g., if they exceed the height limit). It requires a public hearing.

Alley A public or private way which affords secondary access to an abutting property.

Air Quality Management District (AQMD) The local agency charged with controlling air pollution and attaining air quality standards. The Bay Area Air Quality Management District is the regional AQMD that includes Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo and Santa Clara Counties and the southern halves of Solano and Sonoma Counties.

California Building Code The standards and rules related to the different elements of construction of new and existing properties in the state of California. All residential and nonresidential buildings in the state must comply unless they are exempt.

California Climate Zone Climatic boundaries that have unique climatic conditions (e.g., energy use, temperature, weather and other factors) that dictate which minimum efficiency requirements are needed for that specific climate zone. These are incorporated into the Energy Efficiency Standards (Energy Code).

CalGreen The California Green Building Standards Code (CalGreen) is the state-mandated green building code that includes both mandatory and voluntary measures intended to improve public health, safety and general welfare through enhanced design and construction of buildings using concepts that reduce negative impacts and promote those principles that have a positive environmental impact and encourage sustainable construction practices.

Car Share A car rental model where people rent cars for short durations (e.g., hourly) and/or by distance (i.e., miles traveled).

Carbon Dioxide (CO_2) A colorless, odorless gas that is an important contributor to climate change.

Carbon Monoxide (CO) A colorless, odorless, toxic gas produced by the incomplete combustion of carbon-containing substances. It is emitted in large quantities by exhaust of gasoline-powered vehicles.

Carbon Footprint The amount of carbon dioxide and other carbon compounds emitted due to the consumption of fossil fuels by a particular person, group, etc.

Climate Change A change in global or regional climate patterns, in particular a change apparent from the mid- to late-20th century onwards and attributed largely to the increased levels of atmospheric greenhouse gases produced by the use of fossil fuels.

Decarbonize Converting home technologies powered by fossil fuels to electricity that is ideally produced through renewable sources.

Deed Restriction A special condition or requirement pertaining to the property recorded in the public record. The restriction stays with the property unless and until removed by the permitting agency.

Duplex A two-family dwelling or duplex designed or used exclusively as a residence, including two separate dwelling units.

Dwelling A structure or portion thereof including one or more rooms designed or used as a residence by one family or housekeeping unit, with facilities for living, sleeping, eating and food preparation.

Electrify Converting home technologies powered by fossil fuels to electricity.

California Energy Code (Title 24) Part of the California Building Code, it was created to reduce the state's energy consumption and apply to most buildings throughout California. These conservation standards, which can vary by climate zone, are updated periodically by the California Energy Commission.

ENERGY STAR The U.S. government-backed label for energy efficiency that provides simple, credible, and unbiased information that consumers and businesses rely on to make well-informed decisions. The label applies to both consumer products and buildings.

Easement A limited right of one person or class of persons to use real property owned or occupied by another.

Family An individual, or two or more persons living together and occupying a dwelling.

Framing The fitting together of pieces to give a structure support and shape. Framing materials are usually wood, engineered wood, or structural steel.

GLADUR The Green and Livable Accessory Dwelling Unit Resource program overseen by HEART of San Mateo County provides information and designs for green all-electric Accessory Dwelling Units that homeowners can download for free and build on their property.

General Contractor A general building contractor is a contractor whose principal business is in connection with any structure built, being built, or to be built, for the support, shelter and enclosure of persons, animals, chattels or moveable property of any kind requiring in its construction the use of at least two unrelated building trades or crafts, or to do or oversee the whole or any part of the construction process.

Glazing Panes or sheets of glass set in frames of windows and doors.

Global Warming Potential (GWP) The index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emissions of one kilogram of a greenhouse gas to that from emission of one kilogram of carbon dioxide over a period of time (usually 100 years).

Green Building Utilization of environmentally appropriate and resource conserving materials and techniques.

Greenhouse Gas (GHG) Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and hydrofluorocarbons (HFCs).

Heat Transfer The process of thermal exchange between different systems and/or environments (e.g., between the interior and exterior of a building).

Heating, Ventilation and Air Conditioning (HVAC) The equipment that heats, cools and ventilates a structure to keep it at a desirable temperature and humidity.

Heritage Tree Any tree, grove of trees, shrub or group of shrubs, growing on public or private property within a designated city's limits and that has a historical or horticultural significance, is a distinctive size or structure for its species, provides a valuable habitat, or is identified by the municipality as having a significant arboricultural value to the community.

Indoor Air Quality The air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants.

Kilowatt Hour (kWh) A composite unit of energy equal to one kilowatt (kW) of power sustained for one hour and often used as a way to determine energy usage.

Livability As applied to ADUs, livability is the sum of the factors that impact occupants' quality of life including accessibility as well as physical comfort and contentment.

Livable Space The area inside a home where occupants spend their time and that is heated and cooled. Ceiling heights and other factors can determine whether a space is considered livable.

Loft A space directly beneath the roof structure raised above the main floor which opens into interior space.

Lot A piece or parcel of land, occupied or intended to be occupied, by a permitted principal building or a group of such buildings and accessory buildings, together with required open spaces, and having frontage on a dedicated, accepted and improved public street.

Lumen(s) A unit of measurement for the brightness of light.

Methane (CH_4) A colorless, odorless flammable gaseous hydrocarbon that is a product of biological decomposition of organic matter and is often used as a fuel (see natural gas). It has a high global warming potential.

Natural Gas A combustible mixture of methane and other hydrocarbons used chiefly as a fuel (e.g., for heating space and water, cooking).

On-Site Parking A permanently surfaced area for vehicular parking, either within a structure or in the open, and connected to a public street, alley or other public way by a permanently surfaced driveway or access drive.

Owner's Representative The person or company who represents the owner of a building (e.g., during permitting and building processes).

Parcel A lot or plot of land owned or meant to be owned by someone.

Particulate Matter (PM) Particles that are solid or liquid matter including soot, dust, aerosols, fumes and mists. Fine particulate matter, commonly measured as 2.5 or 10 micrometers, are invisible to the human eye and small enough to be inhaled into the lungs.

Passive House A highly energy efficient building standard that uses energy/heat from the sun and other indoor sources to facilitate indoor comfort.

Payback Period The length of time required for an investment to recover its initial outlay in terms of profits or savings.

Permit Written governmental permission issued by an authorized official, empowering the holder thereof to do some act not forbidden by law but not allowed without such authorization.

Plug Load Plug load is the energy used by products that are powered by means of an ordinary AC plug.

Property Line A line of record that divides one lot from another.

Primary Residence A building in which is conducted the principal use of the lot on which it is located. For residentially zoned lots, such a building would be a dwelling.

Public Hearing A meeting in which testimony and arguments are presented publicly before a hearing body.

R-value Used to measure resistance to heat flow for insulation in homogenous materials (e.g., insulation in walls). The higher the R-value, the better its energy efficiency.

Reach Codes A local building code that "reaches" beyond the State's minimum requirements for energy use, water efficiency, green materials, etc. These standards can be "prescriptive", which require one or more specific measures. They could also be "performance-based," which require a building to perform more efficiently overall yet is based on accepted computer modeling that can allow trade-offs between different measures.

Renewable Energy Useful energy that is collected from renewable resources (e.g., sunlight, wind, geothermal heat) and are naturally replenished on a human timescale.

Setback The distance by which any structure (including roof overhangs) is required to be removed from a property line, street or alley, right-of-way line or the like.

Sheathing The board or panel material used in floor, wall and roof assemblies of buildings. The most basic function of sheathing is to form a surface onto which other materials can be applied.

Single-Family Dwelling A building designed or used exclusively as a residence and including only one dwelling unit.

Site Plan A type of drawing which shows existing and proposed conditions for a given area, typically a parcel of land that is to be modified. Sites plan typically show buildings, roads, sidewalks and paths/trails, parking, drainage facilities, sanitary sewer lines, water lines, lighting, and landscaping and garden elements.

Solar Heat Gain The solar radiation admitted through a building's window, door, or skylight. This solar radiation is transmitted directly or absorbed and released as heat inside a home or building.

Studio A home that combines living, dining, and bedroom into one space.

Toxic Air Contaminants (TACs) Air pollutants which cause illness or death in relatively small quantities upon exposure (e.g., ingestion, inhalation).

Transit Stop An area officially marked and designated as a place to wait for a bus, a light rail vehicle, train or any other public transportation vehicle.

U-value Used to measure the rate of heat transfer in products that resemble building systems with more than one type of insulation and complementary materials that stop air flow and moisture (e.g., windows). The lower the U-value, the better the wall or attic can resist heat transfer and save energy.

Universal Design The process of creating products and buildings that are accessible to people with a wide range of abilities, disabilities, and other characteristics.

Variance Use Permit Special planning permit that is required for some ADUs that vary from state or local regulations (e.g., if structure will exceed the height limit). Requires a public hearing.

Volatile Organic Compounds (VOCs) Organic chemicals that have a high vapor pressure at room temperature. These chemicals can be found in a variety of construction and home products, some of which may have direct short- and long-term adverse health effects or contribute to regional air quality problems.

Zero Net Energy (ZNE) A dwelling that produces as much or more energy than it consumes on an annual basis.

Zoning Ordinance A municipally adopted set of laws and regulations governing uses of property located within a jurisdiction.

1 INTRODUCTION

HEART and its Work on ADUs

The Current Situation

The well-known expression that "the Bay Area is suffering from a housing crisis" has been fortified by two decades of rising rents and a near absence of choice when looking for housing. The mismatch of reasonable housing options relative to work locations has made it difficult to attract and retain employees, strained the transportation system with traffic congestion and overcrowding on public transit, and generated more air pollution while gobbling-up undeveloped natural lands. It has contributed to gentrification and resulted in many people being unable to afford homes in the community where they grew up. Housing also impacts individuals' quality of life when they spend hours stuck in congestion – increasing stress and reducing free time that could be spent with friends, family, and community organizations.

How HEART is Helping

HEART is thinking both big and small to address the Bay Area's housing crisis with particular attention focused on San Mateo County. Founded in 2003 as a public/private partnership among the cities, the county, and the business, nonprofit, education, and labor communities, HEART works to create affordable housing stock and increase opportunities for home ownership. Through 2020, HEART has invested over $19 million to fund 1,300 affordable homes. Through its first-time homebuyer program, HEART has provided over $7.6 million in down payment assistance loans, which has enabled 104 families and individuals to stay in their communities as homeowners. HEART is now seeking to help and encourage homeowners to build green and livable ADUs that can ease the regional housing crisis and protect the environment.

RATIO OF JOBS TO HOUSING IN BAY AREA COUNTIES

County	2004-2008	2011-2017
San Francisco	4.27	6.26
Alameda	-0.05	3.86
Contra Costa	0.66	3.04
San Mateo	0.91	8.14
Santa Clara	1.71	4.15
Marin	0.27	4.82
Napa	1.88	8.41
Sonoma	-0.63	5.15
Solano	0.55	4.27

SOURCE SPUR 2020, Figure 2, Page 8

Benefits of ADUs

Financially

ADUs offer a unique opportunity to increase financial security for existing homeowners and renters while reducing environmental impacts from the housing sector. ADUs add to the economic value of the home, while adding a revenue-generating feature through renting. Renters, or family members, benefit from the lower energy cost of smaller unit sizes and lower rents.

Easier to Build

Thanks to State laws allowing ADU construction in almost all Bay Area communities, these units can be built relatively quickly compared to larger housing developments that may require years or even decades for land acquisition and zoning approvals.

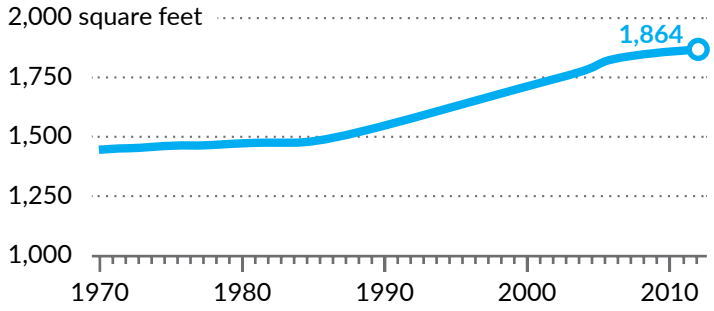
Cost to Build

Unlike many market-rate units that have been growing in square footage to maximize developers' profits, an ADU's size is usually dictated by how they fit on existing lots and how much homeowner builders want to invest upfront. This means ADUs tend to be smaller and require fewer materials to build than larger units in newer market-rate developments. Their per-unit construction cost also tends to be lower than large developers can achieve because individual property owners build ADUs on land they already own.

Cost to Operate

Occupants benefit from lower energy bills because fewer and smaller rooms mean less energy is needed to light, heat and cool an ADU's living space.

AVERAGE U.S. HOME SIZE (ALL HOUSING UNITS)



SOURCE Office of Energy Efficiency & Renewable Energy, U.S. Energy Department

Less Traffic/Commuting

When the supply of available housing in a given area is low and the price of available units increase due to high demand, some people will live farther away from their preferred locations. The longer commutes contribute to increased traffic congestion, more tailpipe emissions and lost free time.

For the Community

The addition of ADUs throughout existing communities increases options for smaller units and overall housing availability. More housing choices in built-out areas helps the housing shortage and allows more people who work in the community to be able to live closer. This helps keep great teachers in our schools, businesses to hire employees, and first responders to live closer in case of emergency.

MORE INFO + RESOURCES

SAN MATEO COUNTY'S HOME FOR ALL WEBSITE

ACCESSORY DWELLINGS WEBSITE

GLADUR
GREEN AND LIVABLE ACCESSORY DWELLING UNIT RESOURCE

Free ADU Designs with a Green Twist

Free Handbook and Designs

HEART wants to build upon the public's increased interest in ADUs by providing resources that encourage more construction of green and livable ADUs. With financial support from a Climate Protection Grant provided by the Bay Area Air Quality Management District (BAAQMD)*, HEART initiated the Green and Livable ADU Resource (GLADUR) program. Through the GLADUR program, HEART is providing ADU designs with construction plans, as well as this handbook, to the public for free!

The Designs

HEART, in collaboration with Architects OpenScope Studio, is currently offering four different GLADUR unit sizes

- 400-SF studio;
- 575-SF 1-bedroom unit, rectangular footprint;
- 745-SF 1-bedroom unit, square footprint; and
- 800-SF 2-bedroom unit.

Green

With the materials used, the designs will be more than just energy efficient and sustainable. They will also be decarbonized – meaning that only electricity will be used to cook, heat water as well as warm and cool the living space.

Customizable

While each plan contains the vital information required by homeowners to obtain a building permit and build their ADU, the designs provide an assortment of green feature options that allow the homeowner to customize their ADU to reach a variety of levels of sustainability and cost-effectiveness.

ELEVATIONS, GLADUR UNITS

1-Bedroom Square, Contemporary Style

Studio, Craftsman Style

* *This report was prepared as a result of work sponsored, paid for, in whole or in part, by the Bay Area Air Quality Management District (District). The opinions, findings, conclusions, and recommendations are those of the author and do not necessarily represent the views of the District. The District, its officers, employees, contractors, and subcontractors make no warranty, expressed or implied, and assume no legal liability for the information in this report.*

Each design also includes multiple architectural styles (post war, craftsman, and modern) and aesthetic variations to fit the homeowner's ADU style preferences. This customization also allows the new ADU to better fit the existing aesthetic of the primary structure and neighborhood.

While fixtures, equipment and finishes are provided in the drawing package, it is always recommended that the homeowner work closely with a general contractor.

Pre-Reviewed

Working with licensed architects, planners, and public officials from San Mateo County, HEART has worked with several jurisdictions to have its GLADUR designs pre-reviewed by city building and planning officials (for a complete and updated list with jurisdiction specific details, please visit HEART's ADU website). This will reduce approval times for homeowners by streamlining the permitting process, and making building an ADU even easier.

Homeowner builders will still need to provide certain documents specific to their property such as a site plan to show where the building will sit on the property, and need to make sure the units comply with all local site-specific requirements. It is always recommended homeowners speak and work with the local building departments. You may also want to consult with an architect to create a site plan for you, or speak with a structural engineer to make sure the GLADUR plan foundation is appropriate for your property's soil and pitch. Speak with city officials who can provide guidance on this.

Can Be Used Anywhere

Although GLADUR designs were developed with San Mateo communities and aesthetics in mind, the designs are freely available to be used in any community. All designs are consistent with the State of California's building codes and meet or exceed Title 24 energy code requirements.

ELEVATIONS, GLADUR UNITS

1-Bedroom Rectangle, Craftsman Style

2-Bedroom, Contemporary Style

Green ADU Handbook

A Helpful Resource

HEART's GLADUR program is also producing the Green ADU handbook to accompany the designs and inspire homeowner builders who want to build or improve an existing ADU. This handbook provides homeowner builders, contractors, and public officials with key information and resources that explain the importance of building environmentally friendly ADUs that improve the living experience for its occupants. It provides readers with a background information on environmental and livability issues that property owners should consider before selecting a design path.

Diving into the Details

Recognizing the balancing act between immediate construction costs relative to longer-term benefits and costs savings, the handbook provides homeowner builders with detailed explanations about the different options that pertain to the green features and technologies most relevant to ADUs. This includes giving an overview of design features' purpose, options, and common variations, etc. The handbook describes the advantages and disadvantages of these design features as well. Additionally, it provides readers with features' financial considerations as well as non-economic benefits (e.g., emission reductions, health benefits, etc.). Overall, understanding industry green feature terms can improve communication between homeowner builders and contractors.

Talk with a Professional

While this handbook and other similar resources are a great source of information, it is always recommended that you speak and work with a professional and licensed architect and structural engineer when building your GLADUR ADU.

Helpful Tips

Throughout this handbook, readers are offered a number of tips about behavioral changes that can further reduce their energy consumption, shrink their carbon footprint, lower energy costs, and improve their indoor experience. This includes energy-saving habits/practices, best practices for maintaining healthy indoor air quality, and organization and green cleaning tips.

Other Resources

This handbook complements additional resources that homeowners can use to better inform their decisions related to building a green ADU. Please refer to Chapter 10 for a list and description of some of those resources.

Property owner talking with contractor
SOURCE buildinganadu.com

2 GLADUR'S GREEN FEATURES

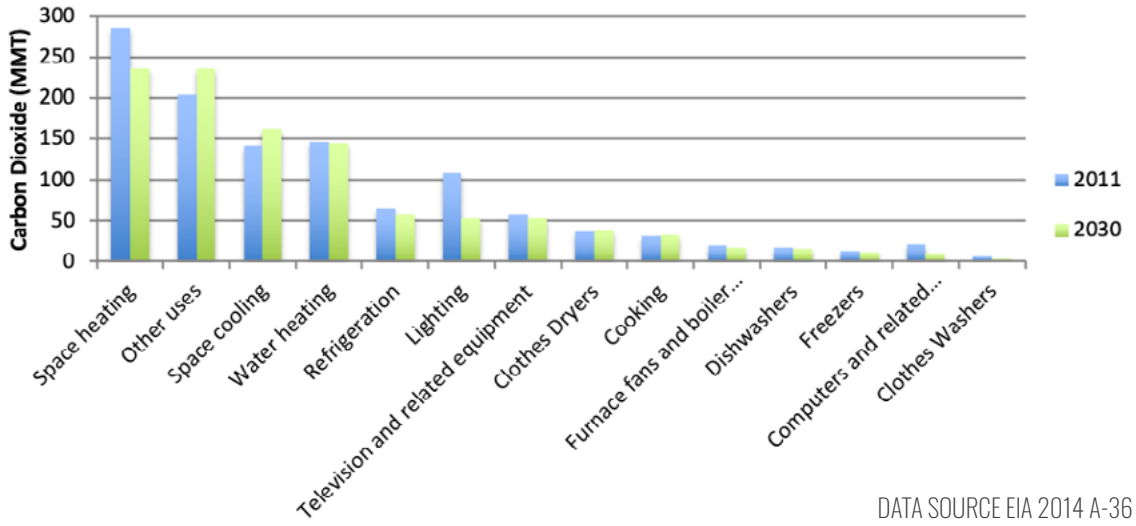
This chapter presents information about the importance of making ADUs greener through different features and how to do so based on the feature's purpose. It is further organized based on whether the feature reduces greenhouse gas (GHG) emissions through operation of the ADU or as part of its construction. The order of the topics is based primarily on the typical level of energy-related GHG emissions generated in a residential household (see chart below); features affecting the maintenance of interior temperature are discussed first. This chapter considers both the use or generation of energy as well health impacts on the occupants from air quality.

Importance of Green ADUs

Climate Change's Effect on Housing

HEART recognizes that housing cannot be separated from the environment in which it is located and its GLADUR units reflect this fact. The Bay Area has had one of the most desirable climates in the world and this has helped attract and retain many world-class businesses and their talented employees for decades. Climate change, however, is threatening the desirability of our region and the wellbeing of its entire population. Bay Area residents already feel its impacts through power outages, droughts and water rationing, longer heatwaves, air pollution, flooding and wildfires. Our new normal has people spending more time sheltering in their homes from hot days or smoky skies, and it is a reality to which our housing stock must adapt.

RESIDENTIAL ENERGY-RELATED CARBON DIOXIDE EMISSIONS BY END USE (U.S..)

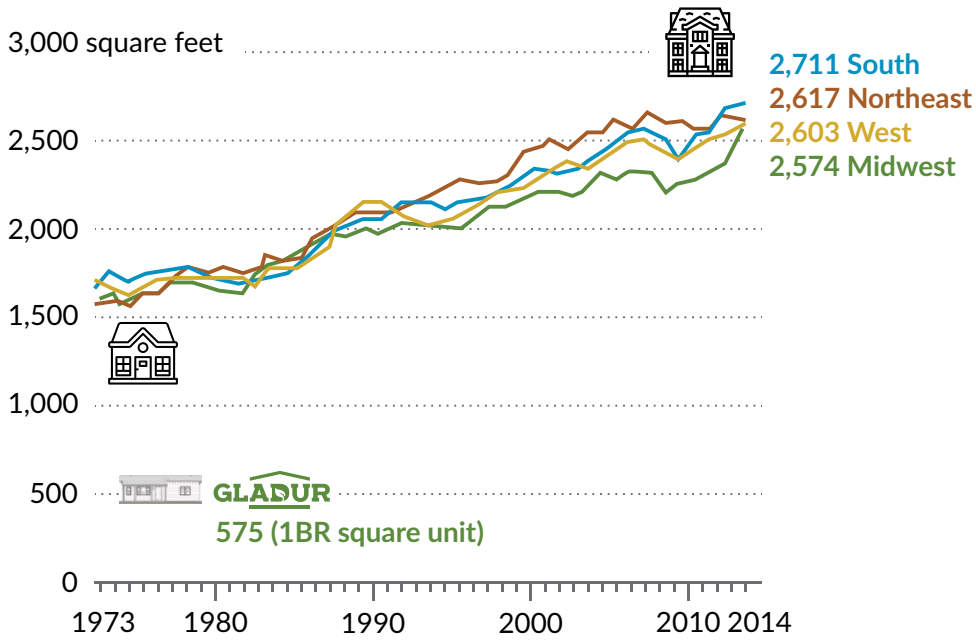


DATA SOURCE EIA 2014 A-36

Housing Emissions

Reducing the emissions from housing can directly combat climate change and associated environmental issues. Housing contributes more than half of building-related GHGs and about 14% of all emissions in the Bay Area. Making improvements in the housing sector that reduce energy consumption and GHGs helps secure this region's comparative advantage and improves the lives of all its residents. The trend towards larger housing units, even if more efficient than older homes, means potential energy savings and emission reductions have been offset by more square footage. When these homes are built in undeveloped areas, they cause loss of natural habitat, lead to more traffic and associated emissions, and spread limited infrastructure maintenance dollars across an even greater area.

AVERAGE SIZE OF NEWLY BUILT SINGLE-FAMILY HOMES, BY REGION



DATA SOURCE Pew Research Center

Natural Gas's Effects

Many homes also continue to rely on natural gas, the more palatable name for the powerful greenhouse gas methane, when there are practical alternatives available to heat living space and water as well as for cooking. Burning natural gas contributes to air pollution and also releases known carcinogens like formaldehyde and polycyclic aromatic hydrocarbons (PAHs) that can harm indoor air quality. Incomplete combustion from natural gas appliances cause thousands of carbon monoxide poisoning cases every year in the U.S. Even if you do not burn a lot of gas, just having methane connected to your home creates the potential for the potent greenhouse gas to leak into the atmosphere and could even pose a safety risk. Continuing these trends is a lost opportunity to protect public health and achieve emission reductions needed to avoid catastrophic climate change.

MORE INFO + RESOURCES

AIR DISTRICT CLIMATE CHANGE WEBSITE

AIR DISTRICT AIR QUALITY WEBSITE

Benefits of Green ADUs

Protecting our communities from climate change and its effects literally begins at home. A well-conceptualized, green ADU will be cheaper and easier to heat, cool and light thanks to its smaller size. Water- and electricity-conserving features can achieve even more savings. Moreover, fitting ADUs in existing neighborhoods provides people with more housing options to shorten their driving commutes and even shift them to other modes like transit, bicycling, walking.

All-Electric ADUs

Decarbonized ADUs provide a counterpoint that illustrates how efficient, environmentally friendly, healthy and comfortable smaller homes can be. In addition to reducing your carbon footprint and air pollution, fuel switching to electricity or solar energy can save you a lot of money. Simply not connecting your ADU to natural gas infrastructure can significantly reduce construction costs while reducing potential methane leaks. Installing solar panels like those on GLADUR units allow you to produce your own energy rather than being dependent on utility companies and fluctuating natural gas prices. A back-up battery that stores your solar energy could keep your home running at night for free and at times when the electricity grid is down. Decarbonizing housing reduces this sector's environmental impact and improves the health of residents, which helps explain why so many local jurisdictions have already banned natural gas in new homes.

Advantages of Eliminating Natural Gas + Wood Burning

Burning a fuel like natural gas or wood to generate heat also releases GHGs like CO_2 directly into the atmosphere. Natural gas (methane) is itself a powerful GHG so even small leaks will have a disproportionately larger effect than CO_2. Smoke from wood burning also generates black carbon, which is a super-GHG. Using electricity will also improve your indoor air quality.

Costs of Building an ADU

HEART recognizes that there are three costs to pay when you build an ADU. You directly pay the first two costs 1) the upfront cost to build it; and 2) the ongoing expenses that keep it running. HEART is providing the GLADUR designs to help offset the first price, initial costs of designing an ADU, so you can invest those savings in the green materials and technologies – thus saving you on the second price. The third price is the environmental externalities such as climate change, habitat loss, and air pollution that is paid by everyone who builds and occupies a home. As discussed further below, this price can be reduced by building ADUs.

Cost Savings of Green Features

As discussed in this chapter, ADUs can include green features that reduce your utility bills, reduce your carbon footprint, and make ADU living more enjoyable. They can reduce the energy you need in the first place through a better building envelope (e.g., advanced framing, insulation, etc.), water

SOURCE buildinganadu.com

and energy-conserving appliances/fixtures, better ventilation, and an increase in natural light without a higher cooling bill. Although these green features may cost more upfront, this chapter's next section will explain how they can save you more money over time while making living in an ADU more enjoyable.

Benefits of Green Building Materials

The final section of this chapter will discuss green building materials that can reduce the embodied energy/carbon footprint of constructing your ADU. Investing in greener building materials will not necessarily cost more and could increase the value of your ADU. More durable products that last longer than cheaper alternatives could save you money on maintenance, repair and replacement. Many of the building materials discussed will also have direct health benefits for you because they do not contaminate indoor air like many conventional products.

California utility customers currently receive above 50% of their electricity from renewable sources and this share continues to grow.

Reducing the Third Price of ADUs

Making your ADU greener will reduce the third price. Like any home, it takes physical resources to build an ADU and the construction process itself generates emissions. When done right, building and maintaining a smaller unit should generate less waste, pollution, as well as savings on energy and materials. You will also use less energy to operate your ADU. Providing co-benefits of creating more housing, which are also affordable to live in, is a win for the entire region's population – whether or not they decide to live in a green ADU themselves. Protecting our region from the adverse effects of climate change requires significant emission reductions across many areas of life and HEART, in collaboration with the Bay Area Air Quality Management District, is proud to offer GLADUR unit designs for free to help you create your dream green ADU.

SOURCE Charlotte May from Pexels

Building more ADUs increases your housing choices so you can choose to live closer to the destination you frequent (e.g., work, school). Reducing travel distances reduces tailpipe emissions and makes walking and biking more attractive options.

Green Features for a Decarbonized Home

Intro

Designing your ADU to reduce Greenhouse Gases

Decarbonized homes that will reduce greenhouse gas ("GHG") emissions and utility bills are the future of new residential development in California, and ADUs can exemplify this movement. Given that decarbonized ADUs rely on electricity, and given that conditioning the interior space is the largest draw for domestic energy use, these units should be as energy efficient as possible using the environment around them as well building materials and technology. It makes little sense to generate renewable energy onsite when it is usually more cost effective to save the necessary energy in the first place. Ideally, you will be able to embrace optional passive-house strategies that allow ADUs to benefit from favorable building orientation, a tightly sealed building envelope, superior insulation, and highly efficient windows and doors.

Energy Generation

Green ADUs should also include onsite energy generation in an effort to make them less dependent on grid energy. This could include harvesting the power of the sun to heat water and generate electricity. Wind power is another way of generating electricity that may work in some locations. This section outlines the options available to homeowner builders.

Other Savings Tools

In addition to reducing electricity consumption and generating its own energy, well-designed ADUs can also protect the environment and your budget in other ways. This includes conserving water, reducing solid waste destined for the landfill, and encouraging alternative modes of transportation.

SOURCE Andrey_Popov on Shutterstock

MORE INFO + RESOURCES

WHAT IS A PASSIVE HOUSE?

Building Orientation and Solar Shading

Immediate and Free Savings

Why pay to heat or cool your ADU when choosing the right building orientation and solar shading options can cover much of these costs for free? Orienting the longest wall of your home to face roughly true south can save up to 85% of heating and cooling costs when combined with other passive-house strategies. Maximizing an ADU's exposure to direct sunlight can also reduce the need for artificial lighting use.

Beware of Too Much Sun

Too much sunlight, however, can cause counterproductive overheating and glare. You can add strategically placed shading, overhangs, or retractable awnings to prevent this.

Working Within Your Lot

It is possible that your parcel was subdivided without considering how a home's orientation could take advantage of the sun. Some lots may be deep but narrow so it is not always possible to orient your preferred ADU design with the sun's path. It may be unconventional but desirable to angle the footprint relative to the sun rather than the fence and main house if possible.

Doors and Windows

Doors and windows offer architectural detail, illumination and ventilation for your ADU. Glazing, which is the industry term for glass found in doors and windows, is one of home's largest sources of heat transfer and can have a significant impact on an ADU's heating and cooling needs. In addition to direct heat transfer, solar radiation penetrating glazing can provide free heat in the winter but can also lead to overheating in the summer. An ADU's small size means doors and windows make up a potentially high share of its building envelope with more potential for unwanted solar heat gain and air leakage.

SOURCE: European Rolling Shutters

When considering how maximize the benefits of windows and doors, consider

- Locating a higher percentage of glazing on the ADU's south side
- Double- or triple-glazed glass filled with a gas that is denser than air (e.g., argon)
- Low-emissivity (Low-e) coatings that reduce infrared and ultraviolet light while still allowing visible light to pass through
- Lower U-values than required
- Wooden storm blinds, curtains and strategic shading strategies
- Energy-efficient doors that fit tight and have magnetic weather striping

MORE INFO + RESOURCES

DOORS + WINDOWS

Solar Heat Gain Coefficient

Solar heat gain through glazing can provide free heat in the winter but can also lead to overheating in the summer. The closer glazing's solar heat gain coefficient (SHGC) is to zero (0), the less solar heat it transmits through the window into the interior. If you live in a temperate climate like San Mateo County, selecting windows with low U-values and moderate SHGCs can maximize energy savings during both cold and hot seasons. As the climate heats up during winter, though, a lower SHGC is more desirable.

Insulation

Insulating an ADU is one of the most cost-effective measures that reduces both heating and cooling expenses. Insulated exterior walls, attics, foundations, and subfloors act as a buffer to heat transfer between these interior spaces and the home's surroundings. This helps maintain desired indoor air temperatures with less energy consumed by heating and cooling systems. Doors and windows have insulation values as well. Insulating hot water pipes and ventilation ducts can also cut energy bills by maintaining their contents' desired temperatures.

R-value for Individual Materials, U-value for Systems

Insulation in homogeneous materials (e.g., insulation in walls) is commonly measured using an R-value, which measures resistance to heat flow. The higher the R-value, the better its energy efficiency. U-values are used to measure the rate of heat transfer in products that resemble building systems with more than one type of insulation and complementary materials that stop air flow and moisture (e.g., windows). The lower the U-value, the better the wall or attic can resist heat transfer and save energy.

Properly Installing the Right Amount

Proper installation by an experienced contractor can help you pass your third-party HERS Quality Insulation Installation (QII), which will verify that the insulation has the correct R-value, is not compressed, has no voids between it and the framing, has needed air barriers, and more. You may be inclined to add more insulation than required to future-proof your ADU like the GLADUR units that have thicker ceiling insulation than required for San Mateo County's climate zone in anticipation of warmer weather to come. Adding too much insulation, though, can actually cost more than it saves in reduced energy bills.

A double-stud wall system showing heat transfer improvement
SOURCE Peter Amerongen

MORE INFO + RESOURCES

INSULATION

Building Envelope and Framing

Building Envelope

An ADU's building envelope can impact heat transfer, moisture levels and the air tightness of a home. The "building envelope" refers to parts of the home that separates the interior from the outdoors including the roof, exterior walls, windows, doors, foundation, openings (e.g., exhaust vents) and framing. Minimizing the number of envelope penetrations and properly sealing around them with supporting materials further improves an ADU's energy performance.

Framing and Heat Transfer

Framing is essentially the skeleton of a building with the design and material choices impacting how heat transfers between the home's inside and exterior. Thicker, wood framed walls will transfer less heat. Strategic use and placement of wood studs and properly sized headers can further reduce potential heat transfer. Using advanced framing techniques can reduce labor and materials costs, while achieving annual heating and cooling cost savings of up to 5%.

Structurally Integrated Panels

A newer building material called structurally integrated panels (SIPs) sandwiches an insulating foam core between two structural facings such as oriented strand board (OSB). Their advantages include reduced labor, less wasted materials and a tighter sealed building envelope.

Choosing the right tree is important. The iTree application provides you with detailed information including about costs and benefits of specific species you can plant around your ADU. Construction time is also a great opportunity to study your soil to see what landscaping will work best around your ADU.

Landscaping

Planting trees and other vegetation in yards not only looks nice but can help reduce your ADU's utility bills thanks to shading and evapotranspiration. Shading alone can reduce home cooling expenses by 15 to 50%. Landscaping can also sequester carbon, prevent rainwater runoff, and retain soil moisture.

Here are some tips for greener landscaping

- Well-placed deciduous trees let winter sun warm your ADU while shading it in the summer
- Avoid tree species and placement that will shade your solar panels or affect power lines
- Landscaping traps dust and can serve as a windbreak that reduces winter heating demand
- Plan your ADU to preserve existing mature trees that sequester more carbon
- Consider selecting native species that have a reduced population and that resist drought, disease and wildfires
- Prioritize species that feed pollinators or your household
- Add a vertical garden to the side of your ADU to absorb solar radiation

SOURCE buildinganadu.com

MORE INFO + RESOURCES

BUILDING ENVELOPE AND FRAMING

LANDSCAPING

Cool Roofs

Benefits

Cool roofs can significantly reduce buildings' cooling demand by reflecting heat-generating solar radiation thanks mostly to a higher rooftop solar reflectance – also known as albedo. Cool roofing technologies, such as lighter or more reflective paint, coatings, membranes, shingles or tiles, can increase a roof's albedo from 10 to 20% to about 50 to 60%. In some cases, cool roofs can look just like conventional ones because their materials reflect light in the near-infrared spectrum.

Reflecting the sun's rays means less of its energy is converted to heat, which means your ADU needs less energy to cool down.

Balancing Pros and Cons

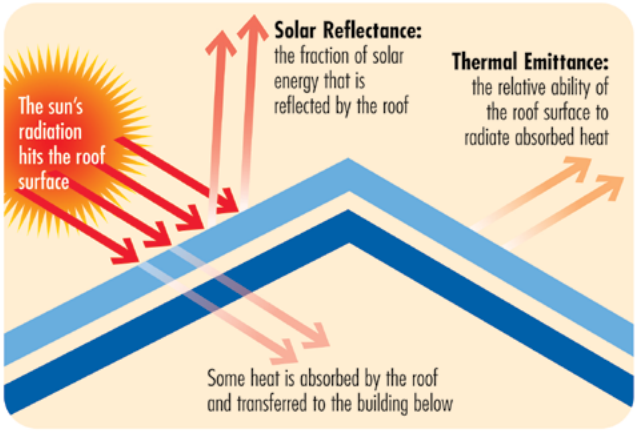
While cool roofing reduces the need for air conditioning on sunny, hot days, it could increase the need to heat your home on cooler winter days by reflecting solar radiation away from the buildings. This could potentially increase heating-related energy use during winter months. In most locations, the balance of these two effects results in a net reduction in energy use. This is not surprising given that we have been experiencing more hot days and hotter temperatures, which is likely to get exacerbated by climate change.

Skylights and Solar Tunnels

Skylights and solar tunnels can cut down on the need to use artificial light. Skylights are essentially rooftop windows, which are available in different shapes and glazing options that reduce heat transfer and solar heat gain. They can include built-in shades and be operable to let air move into and out of the home.

Solar tunnels collect sunlight, often through a convex bubble that is sometimes elevated, which allows it to collect more light without interference from rooflines, vents or solar panels. The light is channeled down a highly reflective tube into the house's interior, even through an attic, and can be offset from the opening on the roof. A diffusing fixture on the ceiling end helps spread the light throughout the room. Certain brands have technology that can customize the amount of light entering the home's living space.

Professional installation is key to enjoying natural light from skylights and solar tunnels. Many people suffer leaks because a skylight is not properly set and sealed with adequate flashings – especially in retrofits projects. Skylights also may require more maintenance, including cleaning and resealing gaps, than a solar tunnel. Their larger and sometimes flatter surface can collect more debris such as leaves around them, which could increase the chances of pooling water that leaks into a home.



Cool roof functionality
SOURCE Cool Roof Rating Council

Solar tunnel and how it directs light into living space through attic
SOURCE EnergySage

MORE INFO + RESOURCES

- COOL ROOFS
- SKYLIGHTS AND SOLAR TUNNELS

Introduction to Heating, Ventilation, and Air Conditioning (HVAC)

Home is where we spend most of our time and it should be a comfortable temperature with safe indoor air quality. A well-designed ADU will be able to minimize temperature fluctuations caused by weather and solar heat gain. As discussed above, it is essential to make sure the unit takes advantage of passive heat and cooling strategies, is well insulated and has a tightly-sealed envelope. There are many days, though, where you will need to actively heat or cool your home. Fortunately, the smaller size of an ADU will make the unit inherently easier and cheaper to heat or cool.

The features in the following pages can also be implemented to enhance indoor comfort and air quality. Smart thermostats, for example, will help you better manage mechanical heating, ventilation, and air conditioning (HVAC) systems. Heat pumps, fans, and energy recovery ventilation are all features that can adjust the indoor temperature while saving energy, cutting GHGs and reducing your utility bills.

Smart thermostat

SOURCE EE Image Database, licensed under CC BY-NC 2.0

Smart Thermostats

The thermostat is the control center for a home's HVAC system. Today's "smart" thermostats are more intuitive than programmable counterparts. They can automatically adjust your home's temperature after learning your household's habits including your typical weekly schedule and preferred temperatures by time of day and even by room and based on ambient outdoor temperatures. Some thermostats capable of "geofencing" can use the location of your smartphones to adjust the temperature when you are away and in anticipation of your arrival back home. You can still override these settings from a smartphone app or the WiFi-enabled unit on the wall.

Using Wisely

Your decisions about temperature can maximize energy savings. Setting a temperature of 68°F during waking hours and adjusting it up or down by 7°-10°F from ambient temperature while asleep can save up to 10% on utility bills while reducing GHGs. You can also download usage and system performance information that can help you optimize energy use as it relates to the HVAC system.

Cost Savings

Although the average cost of $200 is more expensive than conventional programmable thermostats, many local jurisdictions and utilities offer rebates that reduce the upfront cost. Even without a rebate, employing the energy-saving features of a smart thermostat can easily pay for the cost difference in less than a few years.

MORE INFO + RESOURCES

SMART THERMOSTATS

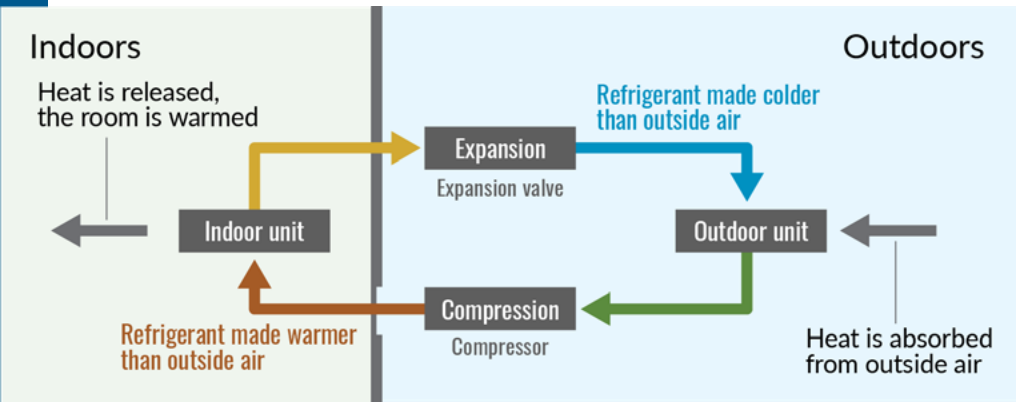
Refrigerants Matter

The refrigerant R32 is replacing R410A because of the latter's high global warming potential (GWP). Some heat pumps even use CO2 (R744), which has the least GWP.

Air Source Heat Pump

Heat pumps have gained popularity as their technology and public understanding about them have improved. Air source heat pumps draw warmth from the air around them. To heat a home, the air source heat pump takes heat from the outside air, even from cold winter air, then pumps that warm air into the home. To cool a home, the system reverses the process by pulling warmth out of the interior air and discharging it outside. The principle is basically the same as a refrigerator that cools by pumping warm air out of its interior.

Ductless split system heat pumps connect an outdoor condenser unit to one or more indoor air handling units via copper tubes that move refrigerant (and heat) between them. A multi-zone installation can condition a home's living spaces in a very targeted way and can eliminate expensive duct work, but its financial justification for an ADU depends on its layout and size.



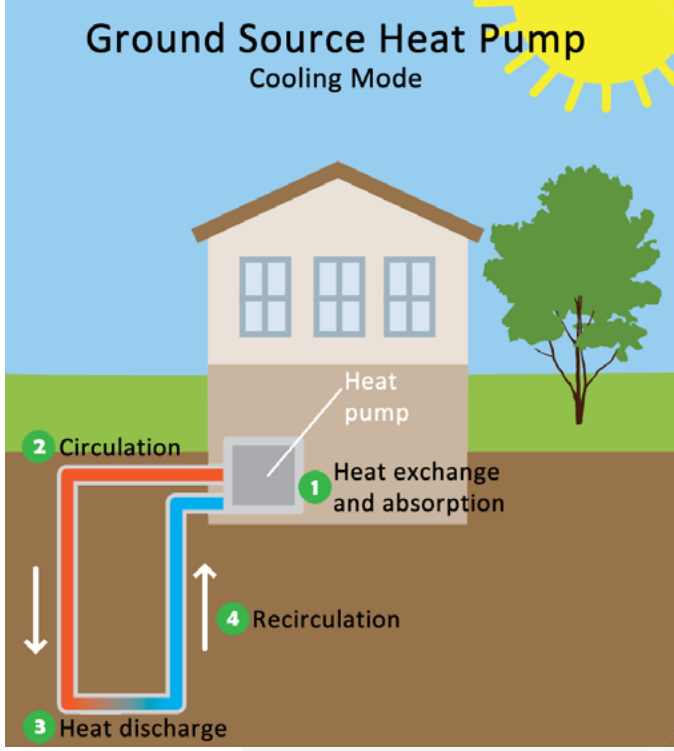
Air source heat pump functionality in heating mode

Benefits

Air source heat pumps offer better efficiency over furnaces and traditional air conditioners – reducing energy use by up to 40%. This is because it uses less energy to transfer heat than it does to produce hot or cool air.

Ground Source Heat Pump

A ground-source heat pump (GSHP) uses the same principle as an air source heat pump except it exchanges heat using underground tubes filled with heat-exchanging fluid (e.g., food-grade propylene glycol). Most Bay Area parcels will need to install these lines vertically due to space constraints. Vertical systems require drilling down hundreds of feet to allow sufficient contact between the lines and soil to let the heat exchanging fluid reach its optimal temperature.



Ground source heat pump functionality in cooling mode

SOURCES U.S. EPA

Costs

Residential systems commonly cost about $30,000 to install. This would only make financial sense if you wanted to connect your primary house to the GSHP well at the same time. While they are more expensive upfront, the underground lines can have a lifespan of over 50 years. When sized correctly, GSHPs are the most efficient HVAC system and the reduction in energy use can save you significant amounts of money over the life of these systems.

MORE INFO + RESOURCES

- AIR SOURCE HEAT PUMPS
- GROUND SOURCE HEAT PUMPS

Energy Recovery Ventilation

Energy recovery ventilation (ERV) systems facilitate air exchanges while exchanging heat and humidity between incoming or outgoing air. ERVs can recuperate up to 80% of the energy in the vented air and transfer it to the incoming air. ERVs work very well in moderate to extreme climates; as Bay Area weather becomes less temperate due to climate change, ERVs will become more beneficial. On some days, ERVs may be enough to condition an ADU's interior space.

Efficiency

In addition, newly constructed homes have such tight building envelopes that they need a mechanical way of exchanging air to protect indoor air quality. Many ERV models also incorporate high-efficiency air filters to clean incoming air. Other options include built-in filters, number of connections in the home, variable speed fans, etc.

A heat recovery ventilation (HRV) system is like an ERV except it does not recover energy in the form of humidity.

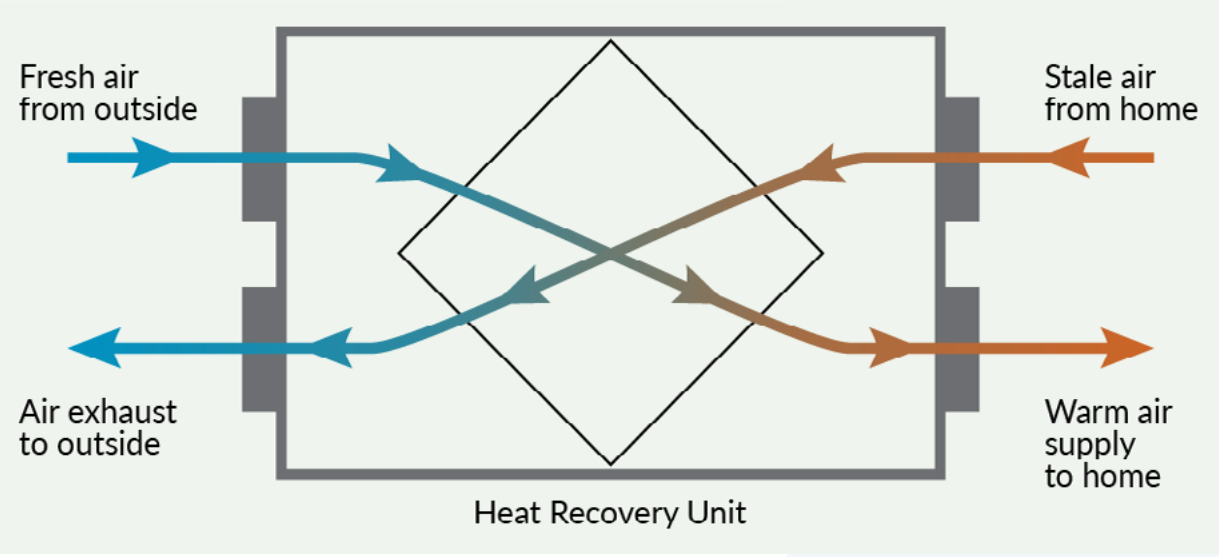
Fans for Ceilings, Attics, and the Whole House

Rather than use an air conditioner to cool down a home, all three fan alternatives below are cheaper to install and operate than an air conditioner.

A ceiling fan, when installed at the proper height, creates a downdraft by efficiently circulating air around a room. This draft creates a wind chill effect that can allow the raising of a thermostat by about 4°F without sacrificing comfort. These fans do not cool a room directly, only the people in them, so you should turn them off when nobody is there. In the winter, many fans can reverse direction to help circulate warm air more efficiently. ENERGY STAR® ceiling fans circulate air about 20% more efficiently than standard models which translates into little to no price premium.

A whole house fan draws air from the inside of the living space and vents it out through the attic and roof. It is a good option for retrofits of buildings that do not have a tight building envelope. Venting the hot air to make room for new, cooler air keeps the home cooler.

An attic fan operates along a similar principle except that it pulls warm air only from the attic and vents it outside via the roof or a gable. This keeps rooms below the attic from warming due to the hot air that would otherwise be trapped above them.



Energy recovery ventilation system functionality

MORE INFO + RESOURCES

ENERGY RECOVERY VENTILATION

FANS

Air Filtration

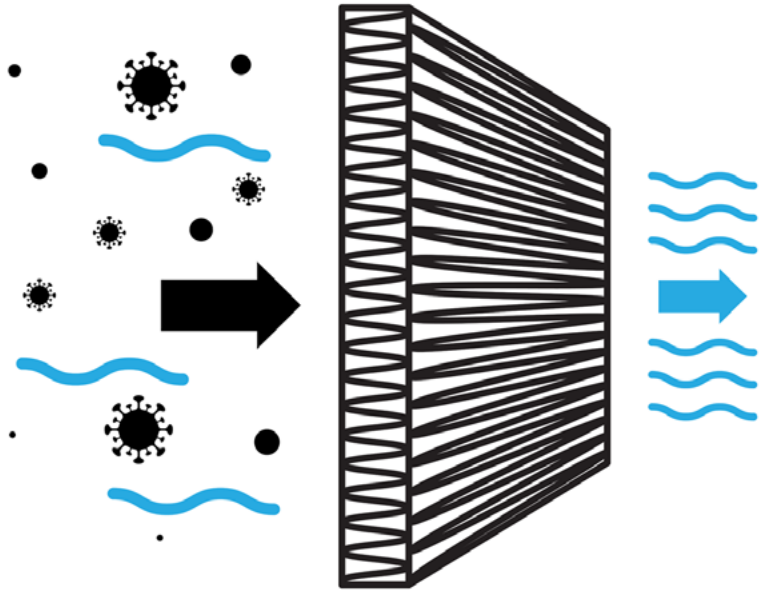
Increasing temperatures and more wildfires leading to dangerous pollution episodes mean you should take extra care to protect your ADU's indoor air quality (IAQ) – particularly for shelter-in-place events. Air filtration can be installed as a standalone system, connected to duct work or integrated into HVAC equipment (e.g., part of an energy recovery ventilation system).

MERV v HEPA

Systems with high efficiency particulate air (HEPA) filters are able to remove at least 99.97% of airborne particles with a size of 0.3 microns (µm) or larger. While having a HEPA filter may sound reassuring, it is not necessary in most cases. A filter with a minimum efficiency reporting value (MERV) 13 can satisfactorily remove particulate matter that poses a threat to human health. These "superior" MERV filters can be used to clean incoming air before it is circulated inside, which is especially important for tightly sealed building envelopes.

Not all air filtration systems are good for you. Ionizing air "purifiers" can actually create ozone and end up being more harmful than helpful to IAQ.

Air filters do cause resistance for the air flowing through them. The thicker they are, the more energy is needed to move the same amount of air. Air filtration systems can compensate with larger ducts that accommodate filters with a greater surface area through which air can move with less resistance.



Air filter functionality
SOURCE Artem Stepanov on Shutterstock

Replacement of Filters

In order to protect air filtering equipment, lower energy bills and protect ADU occupants, you should be aware that air filters need to be replaced periodically.

MORE INFO + RESOURCES

AIR FILTRATION

Heating Water for Your ADU

Heating water represents the second highest use of energy in homes with nearly 30% of residential energy in the U.S. Pacific region being used to produce hot water.

The majority of homes in California rely on natural gas to heat water. Utility companies have often subsidized connecting homes to gas supply lines in order to secure new gas customers. Natural gas water heaters also tend to be relatively easy to find and install during urgent replacements whereas electrically powered water heaters often require a costly electrical system upgrade. Natural gas prices have also been low for many years.

There are strong arguments in favor of avoiding natural gas water heaters – particularly when building a new ADU. Many energy efficient water heaters powered with electricity or the sun are cheaper to operate and can save you money over time. The following sections explain the different options available for heating water in an all-electric ADU.

SOURCE Karolina Grabowska from Pexels

Electric Resistance Water Heating

Consumers can purchase electric tank-storage water heaters even though this technology is more costly to operate in the long run than solar, heat-pump, or tankless water heaters. Electric water heaters use a heating element to warm up cold water in a storage tank. The tank experiences "standby losses," which account for roughly 10% to 20% of a home's water heating expenses just to maintain the water temperature.

An insulating jacket can slow this loss of heat. Insulating the hot water pipes and the first 5 to 10 feet of the cold-water supply line can also reduce heat loss. Ultimately, though, you should strongly consider investing in another decarbonized way to heat your water.

Using cold water to wash hands saves energy and is better for your skin.

Tankless Water Heaters

Electric tankless water heaters, sometimes referred to as instantaneous or on-demand hot water heaters, heat domestic hot water as it is used. Electricity energy powers a heating element that quickly heats water flowing through the heater and avoids storage tank standby losses. Tankless water heaters are known for their durability with many lasting 20+ years and have readily sourced replacement parts. Another advantage of not needing a tank is that they are relatively small – freeing up valuable space for storage.

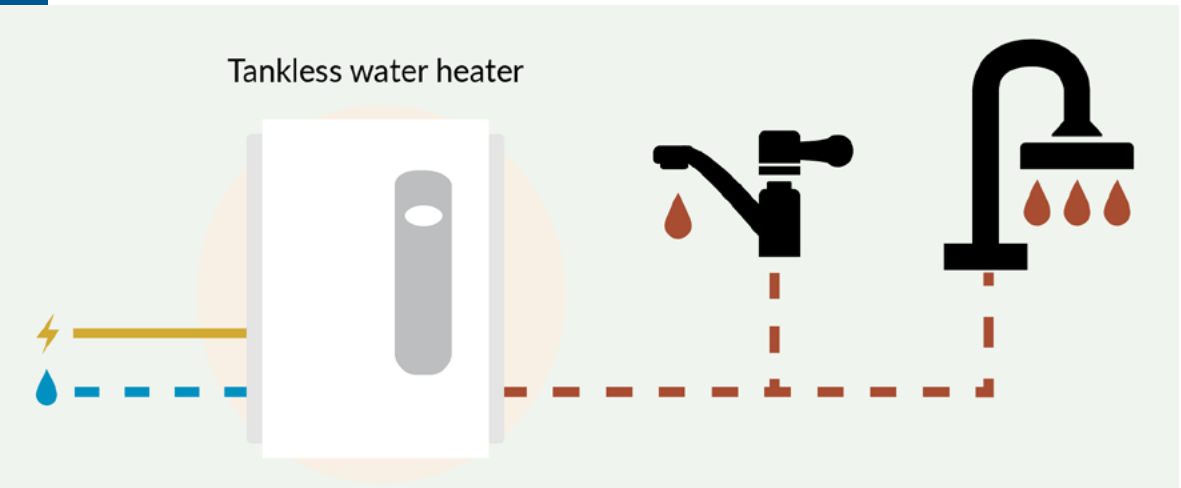
MORE INFO + RESOURCES

WATER HEATING

Electric tankless hot water heaters could consume more energy relative to alternatives depending on whether there are multiple users drawing hot water at the same time, the distance the water needs to travel to faucets, and the efficiency of the water heater. Even under normal conditions, tankless water heaters may also have difficulty warming water to a satisfactory level if they are not sized correctly to keep up with demand. However, if daily household consumption of water is relatively low (< 40 gallons per day) and the tankless heaters are located close to their end uses (i.e., kitchen, bathroom and washer), they could reduce water-heating energy consumption between 25% to 34%.

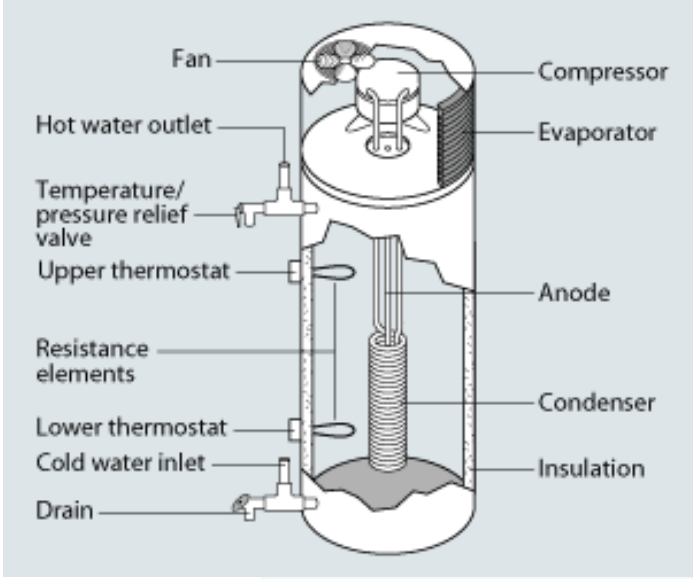
It could be difficult to warm water if electric tankless water heaters are using an energy storage unit during a blackout because the electricity drawn could exceed the amount of power available from the battery.

Tankless water heater functionality



Heat-Pump Water Heaters

Heat-pump water heaters operate much like air source heat pumps used to warm an ADU except they use electricity to transfer heat from the surrounding air to warm the water in their storage tank. The resulting cold air is then vented either directly into the space surrounding the heat pump condensing unit or to ducts that move the colder air outside the home. If considered in the design phase, it may be desirable to have an option to redirect vented air into the ADU's living space to cool it without using any extra energy.



Heat-pump water heater schematic
SOURCE U.S. Department of Energy

Benefits

Although a heat pump water heater costs about $800 more than a conventional electric water heater, their efficiency can translate into significantly lower energy bills. This is because it is cheaper to transfer heat than it is to create it. For a two-person household, it is estimated an ENERGY STAR heat-pump water heater will have a payback period of 3 years and offer a net lifetime savings of about $2,700.

MORE INFO + RESOURCES

TANKLESS WATER HEATERS

HEAT-PUMP WATER HEATERS

Solar Hot Water Systems

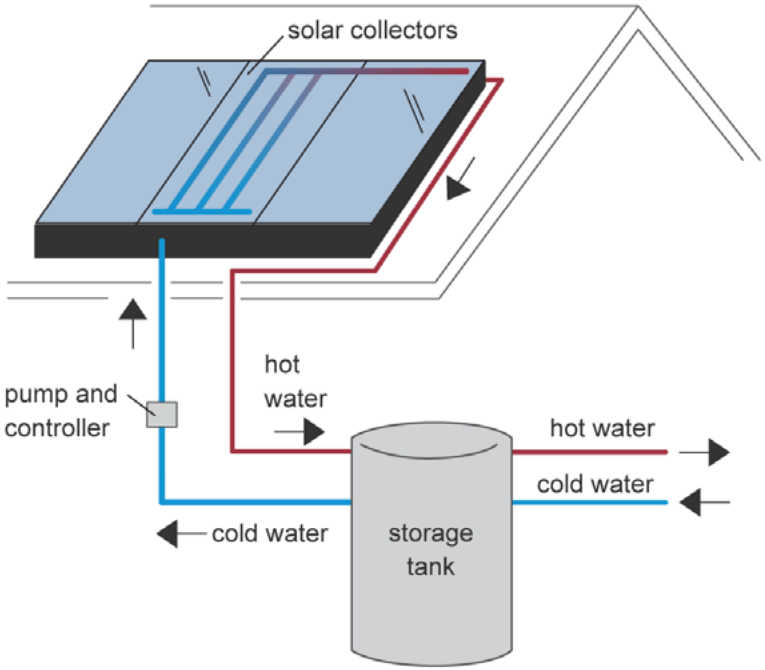
Types of Systems

You can also tap into the power of the sun to generate hot water for domestic uses with a solar water heater. Passive heating systems use heat to move water from rooftop collectors to storage tanks. Active solar water heaters use mechanical pumps and can be further differentiated into direct and indirect systems. Direct systems circulate water in collectors before it is stored in a tank. Indirect systems use a non-freezing liquid that moves via a conduit from the collector and through a storage tank where it transfers its heat to the water.

Aesthetics and efficiency may also play into your choice of solar water heater's collectors. Flat-panel collectors blend in more with a sloped roof while more-efficient evacuated tube collectors tend to be more conspicuous. Batch collectors stand out even more because they store water on the roof in a tank. The solar collectors are more forgiving than solar PV panels but occupants may still need a supplemental electric water heating system for winter and cloudy days.

Costs and Savings

The average 50-gallon solar water heater system for two people plus installation would cost about $4,000 before any incentives. United States Environmental Protection Agency (U.S. EPA) estimates, however, that solar water heaters can reduce energy expenses by 50% compared to a standard electric water heater – resulting in a payback period of 6 years. Since solar water heaters have a relatively long life expectancy of 20 or more years, you can expect to have a net savings of roughly $6,650 over the life of the system.



Basic components of a solar water heating system

SOURCE U.S. Energy Information Administration

MORE INFO + RESOURCES

SOLAR WATER HEATERS

Appliances and Electronics Overview

Appliances and electronics together with lighting use more electricity than either HVAC or water heating in California homes. Its relative increasing share of home energy use is unsurprising given the number of new electrically powered housewares while the efficiency of water heaters and HVAC systems have improved.

Many traditional home appliances have achieved significant improvements in energy efficiency. Perhaps the largest influence has been the ENERGY STAR program, which independently certifies whether certain classes of products meet stricter energy efficiency standards set by the U.S. EPA. This voluntary program allows manufacturers who meet those standards to use the ENERGY STAR label so that consumers recognize them as energy-efficient products. The ENERGY STAR website even has a product search page to assist you when deciding which appliance to purchase.

SOURCE Disabled and Here

Refrigeration

Refrigeration is one of the largest-drawing home appliances and is responsible for approximately 5% of residential energy use in our region. This is unsurprising given that refrigerators and freezers stay on all the time to pump warm air out of their conditioned spaces. Proper sizing a refrigerator, though, can save space and energy. A typical refrigerator for a household of two people is between 12 and 14 cubic feet. Selecting an ENERGY STAR fridge will further reduce energy use thanks to better insulation and improved compressors. Although these fridges cost a little more upfront, they will recover this cost in under three years and save you a lot over the remaining years of their useful life.

Temperatures in the refrigerator should be kept to between 35° to 38°F for the fresh food compartment and 0°F for freezers. Regularly test the temperature with a reliable thermometer placed in a glass of water in the center of the fridge.

Avoid food waste in fridge and freezer through visibility, organization and labeling. This saves money, time cleaning and reduces methane from food waste.

Freezers

Although a dedicated freezer makes sense for some households, relying on the freezer that comes with your refrigerator makes more sense for an ADU. If you are in the market for a stand-alone freezer, the ones that have the Energy Star label use 10% less electricity than conventional models.

MORE INFO + RESOURCES

APPLIANCES AND ELECTRONICS

REFRIGERATION

Cooking Appliances

Essential cooking appliances are responsible for about 2% of home energy use, but their common use of natural gas has a disproportionate impact on many household's carbon footprints. Fortunately, substituting electricity for gas in a new ADU reduces cooking's GHG impact and saves you a lot of money in material and labor.

Types of Electric Cooktops

You can choose from three types of electric cooktops. Cooktops using electric resistance come with either exposed coil burner tops or smooth glass tops covering the coils. Exposed coils' direct contact with cookware makes them more efficient than smooth-top ranges where the coils lie beneath poorly conductive glass. Coil burner cooktops are usually cheaper than ceramic/glass to fix but the advantage of the latter is they are easier to clean.

The third electric option, induction cooktops, look like smooth-top ranges, but they warm food using a magnetic field that interacts with a compatible pot or pan. Currents in the conductive cookware generate heat that is focused inside the cookware with very little lost outside the pot or pan. This is why water boils 50% more quickly using induction and you can more accurately control the heat. Induction ranges cost more than electric resistance but offer better performance.

Unplug small appliances when not in use (e.g., hairdryers, toasters, microwaves, etc.) to reduce your utility bill by $100 to $200 per year.

SOURCE Energy.gov

Other Features

You should also choose an electric convection oven that uses a fan to evenly circulate air around the food, which can shorten cooking times and allows multiple dishes to be cooked well at the same time. Select an oven that has a self-cleaning feature because it will have a better sealed door and more insulation that retains heat during cooking.

Use a range hood that removes air from above the stove and vents it outside to protect your indoor air quality. The quieter ENERGY STAR hoods have more efficient fans and many hoods also come with energy-saving LED bulbs that illuminate the range.

Induction-compatible cookware usually has a  symbol but a good test is to see if a magnet sticks to its bottom.

Activate the self-cleaning feature when the oven is still hot after cooking to save energy.

Convection Oven Microwaves

Although they are not suitable for all types of cooking, smaller convection oven microwaves can be more cost effective relative to a full-sized oven. Some manufacturers make smaller, more energy-efficient convection oven/microwave combinations that may even be able to replace a large oven if you do not cook that much.

MORE INFO + RESOURCES

COOKING APPLIANCES

Dishwashing

Although dishwashers account for about 1% of household energy use, you can save a lot of time and water compared to washing dishes under a running faucet. Unless you use the "two-basin" method, where you wash dishes in a basin full of warm soapy water and rinse them in a second basin of cold water, a dishwasher will likely reduce GHGs and save water.

There are ways to save even more electricity. An ENERGY STAR dishwasher will save both electricity and water thanks to soil sensors that can adjust washes based on how dirty the dishes are, improves water filtration and better distributes water with its pumps and jets. You can also wait to run the dishwasher until it is full, skip pre-rinsing, deactivate the heated drying cycle and avoid the "heavy wash" mode unless necessary.

Compared to washing by hand, an ENERGY STAR dishwasher will reduce the use of municipal water by about 5,000 gallons per year and reduce electricity The payback period for the cost difference with a conventional model will be under five years – even without incentives.

Extend the life of your dishwasher by cleaning out the food trap of debris so the pump does not have to work as hard to evacuate the water – a common reason why dishwashers break.

Size

If you have a small household, you may decide to install an 18-inch, compact ENERGY STAR dishwasher instead of a full-size 24-inch version. This will free up space for more kitchen storage in your ADU and save even more energy and water. This can further reduce GHG by reducing electricity consumption, treatment and pumping of potable water, and the treatment of wastewater.

SOURCE RODNAE Productions from Pexels

You can save a lot of energy by using the cold or warm cycles instead of hot water.

Clothes Washing

Washing clothes accounts for roughly 1% of household energy use and a sizable amount of water. Opting for an ENERGY STAR washer will reduce electricity and water and also eliminates the machine's central agitator to give you more room for additional articles of clothing. These washers also better protect your clothing thanks to gentler washing that gets all parts of your clothes to pass through water jets using flip and turn mechanisms.

MORE INFO + RESOURCES

- DISHWASHING
- CLOTHES WASHING

Types

You can choose between two variations. Top-loading models vibrate less, are gentler on clothes, and are also more ergonomic because you don't have to bend down so much to collect clothes. Front-loading washers tend to use less electricity and have a more efficient spinning cycle to remove excess moisture, which reduces drying times. They also offer space advantages for ADUs because many models can be stacked with a dryer on top.

Size

Properly sizing the washing machine can also save you energy. Although 4 cubic feet is a more common size, a 3.5 cubic feet washing machine that fits a queen-sized comforter will meet the needs of most 2-person households. To properly and efficiently clean clothes, make sure that each load you wash is neither too empty nor too full.

An ENERGY STAR washer is a solid investment with a payback period under 2 years. You'll save even more money and shrink your carbon footprint if you use the graywater from the machine to irrigate your garden.

If you are going to do a lot of outdoor drying, invest in metal clothes pins that withstand the moisture and the sun's ultraviolet rays.

Use sensor drying and longer low-heat drying cycles to reduce your dryer's energy consumption.

Clothes Drying

Drying your clothes is the second fundamental step of laundry and clothes dryers account for roughly 5% of residential energy use.

SOURCE Jack Barnes Architect

Drying racks and clothes lines can reduce this energy use. Thanks to California's fair weather and its "right to dry" laws, you can use the sun's energy to dry your clothes for free. You can use drying racks both indoors and outside, which gives you the option of using them throughout the year no matter the weather. Another advantage of air drying clothes is that it can extend the life of both your dryer and clothes.

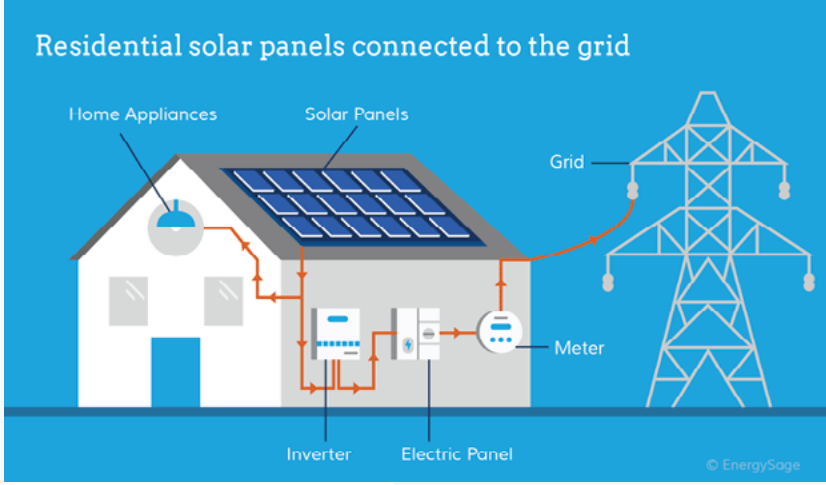
A clothes dryer is often a necessary convenience, though, and an ENERGY STAR model with moisture sensors and low-heat settings can save energy over a conventional model. Advanced ENERGY STAR efficient dryers improve efficiency even more by using heat-pump technology to recycle heat as it removes moisture from the clothes. Proper dryer sizing and loading can also save energy because if you run a dryer too full or too empty, it can be an inefficient use of electricity. You will pay more initially for a heat-pump dryer but likely recuperate this difference in less than two years compared to a conventional model.

MORE INFO + RESOURCES

CLOTHES DRYING

Renewable Energy Overview

Even after you have minimized your ADU's electricity consumption through all the measures and tips mentioned above, you can further reduce your utility bills and carbon footprint by generating your own electricity. You can do this either through solar photovoltaic (PV) systems or wind power. Although you may decide to send some or all of this electricity back to the utility provider via the grid, as this section discusses, you could invest in an energy storage solution that lets you choose when to use this electricity.



How solar panels connect to the grid
SOURCE EnergySage

Solar Photovoltaic Systems and Solar Roofs

Solar photovoltaic (PV) panels have been used for decades with increasing efficiency to turn sunlight into energy, which you could use in your ADU or sell to a utility company. In electrified ADUs like GLADUR units, PV systems with an energy storage system can significantly reduce your reliance on utility-provided electricity.

SOURCE William Mead from Pexels

Configurations and Options

There are many PV system configurations and options. Most PV systems use roof-mounted panels that are available in either polycrystalline and more efficient monocrystalline versions. PV panels send the solar energy they collect to an inverter that turns it into alternating current (AC). Setups could use either a single inverter for the whole system or microinverters connected to each panel. Microinverters have the advantage of allowing each panel to generate electricity independently of the others so that if dirt or shade reduce its ability to collect sunlight, the rest of the system continues to function optimally. Microinverters also allow greater flexibility to expand the system later.

Companies have also begun to offer solar roofs where PV is integrated directly into roofing components (i.e., tiles) to better match a home's design. This can be particularly advantageous if the home needs a new roof.

MORE INFO + RESOURCES

SOLAR SYSTEMS

Given that an ADU's roof space is more limited than a larger house, you may want to invest in higher-performing PV systems that maximize the efficient production of energy. Consult with an expert to determine proper PV system sizing, materials and placement location/angle based on building orientation to achieve your energy goals.

Government rebates and tax credits could offset solar system's upfront costs for property owners. You may even be able to exclude the system's investment cost from property taxes for a certain period of time, which every year could save you about the same amount as a monthly utility bill. In addition, studies have found adding solar panels increases a home's market value.

PV panels lose efficiency with age, during hotter weather, and as dust and dirt accumulate. A cool roof may increase efficiency during high temperatures. Experts also advise to clean PV panels often with soapy water and a sponge – ideally fitted onto an extension to be used safely from the ground.

Wind Turbines

When wind turns the rotors (fan blades) of small wind turbines, it spins a shaft inside a generator to produce electricity. It may be a more cost-effective alternative than solar in places with more wind and less sun or can be combined with photovoltaic systems. Like solar panels, wind-generated electricity needs to be used at the time or it is lost without an energy storage system.

Types

Small wind turbines have different design options. Horizontal axis rotor blades spin around an axis that is parallel to the ground and resemble mechanical windmills. A vertical axis wind turbine's rotor blades revolve around an axis perpendicular to the ground, which can easily fit in urban environments. While vertical systems will operate regardless of wind direction, a horizontal design can be more efficient if optimally oriented to catch the wind.

A vertical wind turbine
SOURCE Anders Sandberg, licensed under CC BY 2.0

Height as well as the rotor blade size and configuration greatly affect their performance. Higher turbines produce more as winds tend to be exponentially stronger with elevation. In addition, a rotor with more and larger blades increases the production of electricity.

Site Specific

Deciding whether to install a small wind turbine will depend on weather conditions, wind obstacles, space constraints as well as local ordinances. Experts recommend carefully researching a site to ensure there are consistent wind resources that average at least 10 miles per hour. Wind turbines should be installed by a professional who can connect them to the electrical system, maximize their efficiency and ensure that the turbine is properly secured to

MORE INFO + RESOURCES

WIND TURBINES

resist storms. Experts usually recommend using a pole-based installation rather than directly mounting a wind turbine on a roof. Wind turbines will likely need a special building permit with regulations varying by jurisdictions.

Energy Storage Systems

Cheaper, better performing batteries has increased the appeal of storing electricity for when onsite energy systems are not generating electricity. Energy storage systems can also be used during peak demand periods to save money where utilities have implemented tiered demand-based or time-of-day pricing. They can also power your ADU during blackouts. Having power all year long is obviously important for any residents in an all-electric home, but particularly when they work from home or depend on medical equipment. Even grid-connected solar-equipped homes need battery back-up systems to continue using electricity generated onsite during a power outage since the systems will otherwise shut off to protect line workers who may be repairing the electrical grid.

Size

Sizing the energy storage system to meet the needs of the ADU is a crucial step. Back-up batteries are measured both in terms of their ability to power electrical devices at any given moment (measured in kW) and their energy storage capacity (measured in kWh). A battery system should ideally be able to power lights, the refrigerator, laptop computer, wifi, and water heater at the same time. Adding an induction range's burner or the split-system heat pump along with a TV will require a larger system. Understanding the loads of different appliances, will better allow you to choose which ones to operate at the same time during a blackout.

Types

The type of batteries is another key decision. Lithium-ion batteries have become preferred to lead-acid batteries because they have a longer life and could generate less waste. Lithium iron phosphate (LiFePO4) batteries are made with a newer, safer chemical composition that does not require any rare earth elements. All lithium-ion battery systems are lighter and more compact than lead-acid batteries, which increases the places in a home they can be installed.

Cost

Cost is a big barrier to these systems. A typical system that powers a home for 24 hours can cost upwards of $11,000. These systems might not make sense for you if your goal is purely saving money and your utility company offers cheap electricity. You should consider the price-per-unit of power ($/kW) and the price-per-unit of usable energy capacity ($/kWh) in order to compare different systems.

Federal and state incentives can reduce the investment cost. The Federal government is currently offering a 30% tax credit for solar-charged battery storage. California also has state and local rebate programs.

MORE INFO + RESOURCES

ENERGY STORAGE SYSTEMS

Water Conservation Overview

Drought combined with heat spells have led to water restrictions throughout California many times in recent years. Respecting those bans is important but doing the right thing is small comfort when you watch your favorite plants die. Increasing water self-sufficiency will be key to avoiding this outcome and reducing GHGs too.

Conservation measures should be the first approach taken to address water shortages. This includes replacing municipal water with rainwater and greywater coming from washing machines. You can save water both inside and outside your ADU for better water security and lower water bills. These measures will also reduce GHGs from energy used to pump, transport and treat potable water as well as for treating waste water.

SOURCE Public Domain Pictures

Water Conservation and High-Efficiency Fixtures

Choosing the right indoor plumbing fixtures in your new ADU is a great way to reduce your water bill and carbon footprint. California standards for the maximum amount of water they can use are 1.8 gallons per minute (gpm) for a kitchen faucet, 1.2 gpm for a bathroom sink and 1.8 gpm for a shower head.

You can save even more water without sacrificing comfort with shower heads that can reduce the flow down to 1.25 gpm while maintaining comfortable pressure. Reducing by just ½ gallon per minute can reduce your water use by an average 1,300 gallons of water per person annually. You can save even more by using better-than-code aerators with the kitchen and bathroom faucets.

The U.S. Environmental Protection Agency's WaterSense program is a rich resource for learning more about water conservation and finding water-saving products.

Although low-flush toilets with a maximum use of 1.28 gallons per flush (gpf) have made it into mainstream building code, ultra-high efficiency toilets (UHET) that use 0.8 gpf would reduce household consumption by about 1,000 gallons per year. Some UHET are even more efficient – resulting in greater savings that could not only pay for the difference but the cost of the entire toilet over its expected life.

Being more aware of your water consumption and altering your behavior can also save water. Many domestic water providers pay for installing new smart meter technology that provides real-time information about water consumption. They can even

MORE INFO + RESOURCES

WATER CONSERVATION

detect leaks so that you can quickly intervene before they cost you lots of money. You can also conserve water by turning off your shower as you lather up. A thermostatic shower valve will maintain your water temperature. Shaving a minute off each shower can add up over the years.

The best time to water in the Bay Area is between 2am and 6am when less wind and sunlight would cause evaporation.

Water Conserving Landscaping

Gardens with native plants and trees adapted to a drier California climate can save water and support local biodiversity. Choosing landscaping that also works with an even warmer, drier future will save you water, time and money. Many water districts offer free classes with expert landscapers on how to create and maintain a drought-tolerant garden.

Lawns

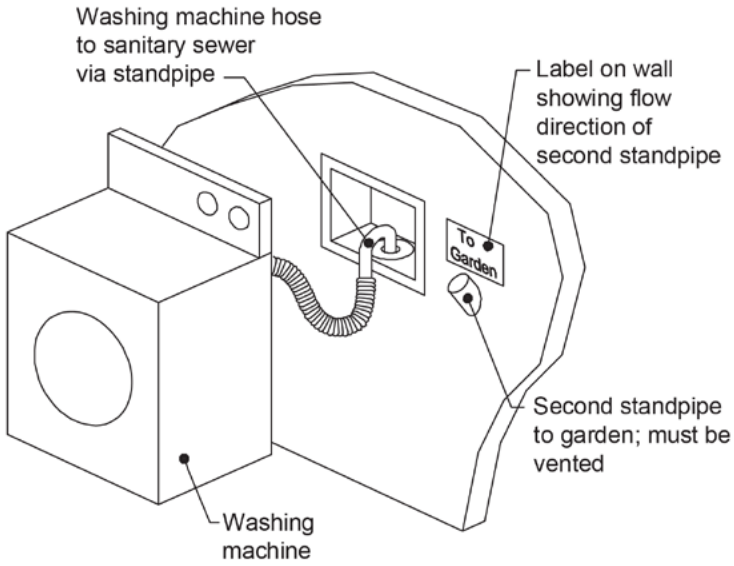
Avoiding installation of a lawn and associated sprinklers or replacing an existing lawn can be the biggest water saver. Some Bay Area water districts offer a "Lawn Be Gone" rebate up to $4 per square foot to convert your lawn to a beautiful, drought-tolerant landscape.

Irrigation

You can make your Bay-friendly garden even more efficient with drip irrigation that precisely targets your plants to avoid waste and runoff. They also save you time better spent weeding and pruning. Weather-based irrigation controllers can detect or anticipate rain so that you do not overwater your plants. Some water districts offer rebates towards the purchase of these controllers.

Compost and Mulch

Another way you can conserve water is to add mulch or compost around the base of plants and trees. The mulch retains moisture and creates a healthy environment around your plants. Making your own compost can save you money and improve the health of your plants while reducing GHGs. You can also use a soil moisture meter to measure soil humidity – a practice that can save water and improve the health of your plants and soil.



SOURCE City of Berkeley, San Francisco Graywater Design Manual for Outdoor Irrigation

Graywater Systems

What is it?

You can also avoid consuming municipal drinking water by using "graywater" – the wastewater from your washing machine, shower and bathroom sink. Despite having some impurities, graywater can still safely be used to irrigate your garden provided it is not stored.

In addition to conserving potable water for other uses and saving money, graywater also reduces the need to treat wastewater that is perfectly safe to use in your garden. Diverting waste water away from treatment plants could reduce GHGs from less chemical and energy use.

MORE INFO + RESOURCES

WATER-CONSERVING LANDSCAPING

Graywater differs from recycled water, which is highly treated wastewater from a centralized treatment facility. Recycled water could be used for such purposes as landscape irrigation and toilet flushing. It requires a separate plumbing system, often called purple piping due to its color, that needs to be connected to a municipal system. Consult with your municipality to see if they have plans in the foreseeable future to supply recycled water to homes in your neighborhood.

Types

The most common graywater systems use the water from a washing machine because in most cases it does not require a permit and is relatively cheap and easy to install. A 3-way diverter allows you to send water either out to the garden or to your ADU's drainage system (e.g., when using bleach or when the soil is too wet). The water then runs underground via a pipe until it reaches a "mulch basin" where the water can create a moisture plume for nearby plants.

Costs

Laundry retrofit kits cost about $100 and the outside infrastructure will vary depending on the pipe's length, which means that it could pay for itself in about three to four years. Planning for and installing a system during the ADU construction process could reduce these costs.

If you want to conserve indoor water using rainwater harvesting, check to see if your local government has already approved the use of rainwater to supply toilets or even clothes washers.

Rainwater Harvesting

An ADU's roof space provides another opportunity to recuperate rainfall for watering the surrounding landscape and other non-potable purposes. You can collect rain water diverted via the downspouts to one or more rain barrels placed on a level and compacted surface (e.g., crushed rock) that enhance stability. A number of downspout diverter options exist that should be researched to match your preferred rain barrel. Adding screens to gutters and downspouts can prevent leaves and debris from entering the rain barrel and reduce maintenance. To protect the foundation, any overflow pipes should be directed away from the ADU. Aesthetic considerations and placement that allows easy access of the water using the spigots are further considerations when purchasing a rain barrel.

A typical rain barrel

SOURCE Aqua.mech, licensed under CC BY 2.0

Size

Probably the most important factor, though, is the size. Calculating the maximum capacity required for an ADU's rooftop catchment area and irrigation needs ensure a cost-effective rain barrel investment. A number of jurisdictions offer rebates of $100 to $200 for the purchase of a rain barrel, which may mean you won't have any upfront costs and can use free water much of the year. Speak with your contractor about installing a water diverter at the same time as the downspouts.

MORE INFO + RESOURCES

GRAYWATER SYSTEMS

RAINWATER HARVESTING

Solid Waste and Composting

Diverting solid waste from landfills can greatly reduce GHGs. Recycling saves both energy and water by reducing the need to produce virgin packaging materials. Composting avoids the production of potent GHGs when organic waste is buried in a landfill and decomposes anaerobically. Home composting can cut 80% of this waste or roughly 275 pounds per person each year while reducing more refuse truck trips.

Even though an ADU has a smaller footprint than a house, you can readily allocate space that encourages recycling and composting – such as under the kitchen sink. No matter where they are located, though, the traditional trashcan should be smaller relative to the volume of recycling and compost bins to encourage more waste diversion.

SOURCE Eva Elijas from Pexels

Options

While the backyard may have enough space for a compost pile, you also can compost on the porch or even inside. One way is with worm composting using a vermicomposter, where red wiggler (Eisenia fetida) worms eat a wide variety of fruits, vegetables and natural paper products (e.g., unlaminated cardboard). A purchased vermicomposter often comes with stackable trays that allow you to add more scraps to higher layers while retrieving worm castings (i.e., poop) from lower levels. Worm castings make an excellent soil amendment for the garden and planter boxes. A spigot also helps collect the "compost tea" – a powerful liquid fertilizer valued by gardeners.

Bokasi composting is an alternative indoor method that uses anaerobic fermentation to accelerate the composting process. Using an air-tight container and some natural additives to facilitate the 10-day fermentation process, the left-over food waste (that can include meats) will need to be placed in an outdoor compost pile or buried for another six weeks to completely breakdown. Yet unlike landfill anaerobic decomposition, the low PH (acidic) levels reduce methane-generating bacteria and associated emissions. It also generates liquid tea fertilizer like a worm composter.

The Berkeley Hot Composting Method lets you create high-quality compost in just 18 days. The high sustained temperatures will destroy pathogens as well as weed seeds and unlike colder methods, will yield roughly the same volume of compost as the amount of materials you put into the pile.

If you prefer more traditional outdoor composting, organic waste can also be temporarily stored indoors in special pails that are usually designed to seal well to reduce the chance that flies or bad smells bother occupants. Some even have filters to stop odors. Many indoor compost pails come in decorative designs that allow them to remain visible on the counter or floor rather before transferring their contents to your outdoor compost pile or municipal green waste bin if they accept food scraps.

Applying the finished compost in your garden can directly decrease GHG emissions by increasing the carbon content and healthy microbial activity of the soil as well as indirectly by enhancing plant growth that sequesters carbon. In addition, compost reduces the need to water plants, and these water savings reduce utility bills and indirectly reduce carbon emissions.

MORE INFO + RESOURCES

SOLID WASTE AND COMPOSTING

Transportation

Encouraging occupants of ADUs to take public transit is one of the reasons for relaxing the parking requirements for units built within 1/2 mile of a transit stop. Ideally, you will find the nearby public transit service suitable for at least some of your travel needs. The inclusion of ADUs into the existing built environment can support soft modes such as bicycling and walking by encouraging decision makers to improve the nearby infrastructure for these modes and supporting local businesses that can be accessed without a car.

SOURCE Anne Nygård on Unsplash

A bicycle can meet your short- and medium-range travel needs if you are physically capable of using and are comfortable on a bike. The design of an ADU can accommodate bicycle storage. A rack fitted to the wall that stands the bicycle up on its rear tire or lets the bicycle rest on its frame horizontally can make the bicycle less of a tripping hazard. If you use an electric-assist bike, you may want to consider locating an outlet near where you will store it. Ideally, the storage will also protect the bicycle from the elements. It may be possible to fit a bicycle on an ADU porch. A pulley system could also lift the bicycle out of the way. You may also consider installing a bicycle locker/shed since ADUs are small and many occupants will likely prefer to store their bicycle outside so long as the infrastructure prevents bicycle theft and reduces their potential as a tripping hazard.

MORE INFO + RESOURCES

TRANSPORTATION

Greener ADU Structures

Significant environmental impacts occur during manufacturing of building materials and the process of constructing structures. You can significantly reduce those impacts by choosing environmentally sustainable materials. This is not always easy because there are many different ways materials could be considered "green" including whether they are renewable, their durability, the distance required to transport them and whether they have any constituents harmful to nature or people. Cost is understandably important too because it may mean compromising on another material.

Doing more research can better inform your choices and avoid products that are merely "greenwashed" or pushing unsubstantiated green marketing claims. It can be overwhelming, though, when you read conflicting information about whether or not a product is truly green. This is normal because of the many ways to measure a product's environmental impact. Remember that a good overarching goal is to reduce your ADU's environmental impact relative to the status quo. You can use the table to the right, outlining qualities that affect whether or not a product is green, to help guide your decision.

The rest of this section discusses green options for common building elements as well as how the construction process itself can minimize environmental impacts. This includes providing terms and resources that you can use to narrow down your search and ask the right questions of manufacturers and suppliers.

QUALITIES AFFECTING PRODUCT "GREEN-NESS"

Product Quality	Considerations
Natural, renewable materials	Favor products made from natural materials that will be renewed rather than non-renewable materials (e.g., petroleum-based products).
Recycled, reusable, and recyclable content	Reuse materials and purchase products with recycled content to lower the amount ofs virgin materials needed – saving energy and reducing emissions. Choose recyclable or reusable materials.
Energy demand	Select products that take less energy and chemicals to produce whenever possible as this will help reduce greenhouse gases and other toxic byproducts.
Impacts on occupant health	Avoid building materials that have finishes that adversely affect indoor and outdoor air quality. Of particular concern are volatile organic compounds (VOCs) and toxic air contaminants (TACs) emitted by products such as plywood or furniture due to glues used to make the composite woods, caulking as well as paints or stains.
Durability and longevity	Select durable products that need less maintenance and have a longer expected life because, generally speaking, they will have less environmental impact.
Local products	Favoring local sources, particularly for heavy products, to reduce the amount of fossil fuels needed to get them to your site. Buying domestic products, and California products in particular, also increases the likelihood they were made in factories with more protective regulations that protect the environment and people.

Deconstruction and Reusing Onsite Materials

Reusing materials rather than purchasing new ones can significantly reduce your ADU's environmental footprint and save you money. A lot of fossil fuels are required to extract and transform raw materials into finished building products that are then transported to their final destination. Many products also require chemical finishes that have byproducts that could contaminate soil, air and water. Reusing materials keeps them out of the landfill and reduces the resources needed to recycle products.

You may be able to reuse lumber, interior doors and other hardware in your ADU. Old concrete can also be broken down onsite and used as the aggregate for your new ADU's concrete foundation.

If you are removing a building to make way for the ADU, ask your contractor whether they can deconstruct it so you can reuse as many materials as possible. Many local governments even require deconstruction rather than demolition. If you do not have any onsite materials, visit your local reuse center and check websites such as Craigslist or Freecycle where people offer surplus and salvaged building materials – sometimes for free.

Click here for a list of reuse centers in the Bay Area where you can find salvaged materials.

If removing a tree or other vegetation cannot be avoided, consider onsite mulching.

For more information on construction mitigation measures, please visit the Air District's CEQA Guidelines.

Reducing the Impacts of Construction Process

Building your ADU can generate a lot of one-time emissions from the transportation of construction materials, site preparation, construction equipment and waste disposal. Fortunately, you can take steps to reduce the dust, toxic air contaminants, ozone-creating criteria pollutants, and GHGs.

Careful planning and coordination with the construction crew can reduce a significant number of vehicle trips. For example, ordering the right amount of materials and allocating sufficient onsite storage space can cut vehicle trips and save time.

You can also reduce emissions asking building crews to power equipment with onsite outlets rather than a portable generator and to turn off idling vehicles and equipment if not in use for more than a few minutes. Watering down your site twice a day, preferably with your own harvested rainwater from your main home, will reduce fugitive dust. Care should be taken to prevent soil from running off the site and into the storm drains. Construction workers will likely know these mitigation measures from larger construction projects where they are required.

SOURCE buildinganadu.com

MORE INFO + RESOURCES

DECONSTRUCTION & REUSING ONSITE MATERIALS

Concrete

An ADU's foundation is one of the most carbon-intensive elements of the structure due to the cement that binds mineral aggregate to form concrete. Producing cement requires heating up its constituent substances in a kiln to around 1,800° Celsius (~3,300° Fahrenheit). These intense temperatures, not to mention the mining needed to extract the raw ingredients, generate significant emissions.

Fortunately, it is possible to reduce the carbon-intensiveness of cement without affecting its strength. You can substitute some cement with one or several supplementary cementitious materials, such as fly ash, slag, or natural pozzolans (e.g., rice hull ash). Some companies offer concrete that embeds carbon in it (e.g., CarbonCure). Many ready-mix concrete companies offer low-carbon concrete products. You can even break apart and reuse an existing concrete foundation as aggregate for your new foundation.

Be sure to verify the concrete strength and curing time needed for your ADU's foundation and footings. GLADUR units, for example, specify that the concrete slab foundation must have a 2,500 pounds per square inch (PSI) rating at 28 days curing time. Some jurisdictions, such as Marin County, have approved extended curing times in order to allow the use of less cement, which reduces the carbon intensiveness of the concrete and ultimately has the same strength.

When ordering ready-mix concrete, be sure to carefully calculate the amount you need to not waste too much but not to order too little or you will have to have a second cement truck.

Wood for Framing and Siding

The wood products used in your ADU can greatly impact its environmental footprint because it makes up one of the most significant construction materials. Most ADUs have wood rather than metal structural framing as it is cheaper, but it is also more environmentally friendly to process the wood into lumber. Selecting wood products certified by the independent Forest Stewardship Council (FSC) means that it has met certain standards that better ensure wood is grown and harvested in a sustainable manner. There is also the Sustainable Forestry Initiative (SFI), which is an industry-led standard. Selecting wood originating closer to your site because this wood will most likely generate fewer transportation-related emissions.

Choosing durable wood that resists decay and termites can prolong the life of your structure. You could use certain species (e.g., redwood, cedar) to replace pressure-treated wood. Wood treated with

SOURCES Top, Rodolfo Quirós from Pexels; Bottom, U.S. EPA

MORE INFO + RESOURCES

- REDUCING THE IMPACTS OF CONSTRUCTION
- CONCRETE
- WOOD FOR FRAMING & SIDING

heavy metals and chemicals (e.g., alkaline copper quaternary) require more energy to produce, can degrade metal fasteners and have byproducts that pose a hazard to the natural environment. However, be sure to verify that the naturally durable woods come from sustainable sources.

Insulation Materials

Your insulating materials choice can impact your ADU's energy performance, durability, and overall carbon footprint. Although many types of insulation have similar R-value performance levels, their composition can offer other advantages. These include resistance to humidity and mold, sound-proofing, use of recycled content and recyclability, and fire resistance. Cost and product availability can also vary significantly by insulation.

Keep in mind that insulation can also directly impact your health. Some insulation materials have the potential to off-gas VOCs and toxic substances due to binders, flame retardants and anti-mold biocide treatments. Formaldehyde, in particular, has been used as a binder and should be avoided. Be sure to research product specifications about the make-up of the insulation or consult an expert.

Whether you're choosing blanket, batt, loose-fill or blown-in insulation, it is important to remember that proper installation is key to performance in whichever material you choose. Hiring a contractor who has experience installing your chosen insulation can help make sure this investment pays off.

INSULATION OPTIONS

Insulation Type	Advantages	Disadvantages
Fiberglass	Relatively cheap; made from abundant materials and some recycled content	Energy intensive; Potential of some to off-gas formaldehyde; Physical irritants
Mineral/stone wool	High recycled content, acoustic performance; Fire resistant; Moisture resistant; No indoor air quality impact	Physical irritants
Wood fiber	Recycled content; carbon sink, acoustic performance; No indoor air quality impact	Cost; Limited distribution
Hemp	Moisture resistant; renewable source; No indoor air quality impact	Cost; Some plastic content; Limited distribution
Cork	Renewable source; Fire resistant; Moisture resistant; No indoor air quality impact	Cost; Limited distribution
Cellulose	High recycled content; No indoor air quality impact	Can absorb moisture
Cotton	High recycled content; renewable source	Can absorb moisture; water and pesticide use in farming
Natural wool	Renewable source; No indoor air quality impact	Cost
Expanded Polystyrene (EPS)	Recyclable; Relative to other foam panels, lower GWP, Low potential for indoor air quality impact	Petroleum-based; Contains toxic fire retardants
Extruded Polystyrene (XPS)	Recyclable	Petroleum-based; Contains toxic fire retardants
Polyisocyanurate (Polysio)	Low potential for indoor air quality impact	Petroleum-based; Not recyclable

Flooring Materials

The environmental price tag of flooring materials is almost as variable as the options available to you. Even for similar flooring materials, some products can have a high environmental cost while others are relatively green. You need to research product's green claims that include impacts on the climate, ADU occupants' health (e.g., off-gassing), biodiversity, use of recycled materials, etc.

Types

Certain products, including natural linoleum, cork, and wood flooring, are considered more sustainable than others. Yet within certain types of materials, the green qualities could be less clear. Wood flooring, for example, could come from nearby sustainable forests or they could be unsustainably harvested from tropical rainforests. Bamboo is a natural and easily renewable flooring material, but not all manufacturers use formaldehyde-free adhesives. Although some carpeting products are now made with all-natural products, it easily traps dust and other allergens – decreasing indoor air quality if not well cleaned.

Drywall

What is it?

The most common bulk building material used to finish the inside of modern homes is drywall, also known as wallboard or sheetrock. These panel boards come in standard sizes and typically consist of gypsum, either mined from natural sources or synthetically made from power plant residues, and possibly some additives sandwiched between two paper sides (facer and backer). A panel's thickness is usually dictated by fire code and other goals such as soundproofing and weatherization.

Synthetic and even natural gypsum can contain low amounts of mercury, which can off-gas. Flame retardants and anti-mold biocides could also bother people who are sensitive. Some additives designed to resist mold, though, could have a positive environmental impact if it avoids replacing the drywall. Ultimately, though, it is important to construct and maintain your ADU well so that you do not develop mold issues. Many manufacturers offer products that have modest off-gassing of VOCs. Research the types of additives included in your preferred panels.

Gypsum is recyclable and many companies already use some recycled gypsum in their products – particularly synthetic gypsum. The paper facing on either side is often made of 100% recycled paper but fiberglass can be used as well.

Alternatives to conventional drywall include gypsum-fiber that has some recycled cellulose mixed with gypsum. This improves breathability to resist mold and gives it a dense consistency that improves sound insulation as well as durability that resists dents. Another strong type of panel are magnesium oxide (MgO) boards, which are highly flame resistant, recyclable/compostable and do not contain toxic, off-gassing materials.

Cork flooring uses sustainable materials and allows you to easily remove dust, dirt, or pet hair.
SOURCE Solutions2050

MORE INFO + RESOURCES

INSULATION MATERIALS
FLOORING MATERIALS
DRYWALL

Structurally Integrated Panels (SIPs)

Structurally integrated panels (SIPs), which are used for both the exterior walls and the roof, are made of a rigid foam insulation core sandwiched between two wood structural panels (e.g., OSB).

Replacing traditional wood framing with SIPs saves a lot of labor and reduces construction waste because every panel is made to order off-site. A SIP's rigid foam core is usually made of expanded polystyrene (EPS) in a variety of thicknesses that offer insulation values capable of meeting California energy code requirements. They are transported to the construction site where they can be unloaded, even by hand if necessary, and assembled together to create the structure's airtight envelope on an already prepared foundation. SIPs can incorporate chases (conduits) to simplify wiring.

It is important that your ADU contractor has the knowhow and experience to properly assemble SIPs. Installing SIP panels takes specialized tools that many contractors do not normally possess. Safety, comfort and energy efficiency are all affected because SIPs are the structure itself and need to be properly assembled.

Some people who want to build an ADU with all-natural materials will not like the EPS foam, which is made from petroleum products and may have some initial off-gassing after manufacturing. Another downside to SIPs is that there is currently not a lot of manufacturing capacity and so the cost could be higher than traditional building materials. However, the labor saved putting the envelope together could more than compensate for higher material costs. A properly trained installer can cut the framing time by more than 50%.

Roofing Materials

Options

When it comes to green roofing materials, you have plenty of options metal, wood, rubber, clay tiles, and recycled shingles made from wood, rubber, and plastic. You could even opt for glass solar tiles that will generate electricity while protecting your ADU from the elements.

A standing seam metal roof offers a long useful life (about 50 years), resistance to wildfires and extreme weather events (e.g., hail, strong winds) and easy recyclability. A clay tile roof is also extremely long-lived and recyclable. Composite or recycled shingles offer you another green approach because they keep materials out of landfills and many can be recycled again at the end of their useful life. Keep in mind that recycled wood shingles and rubber shingles may not be the best choice if you live in a fire-prone area.

As noted in the previous section, cool roofing materials that prevent you ADU from absorbing solar radiation can reduce the cooling-related electricity

SOURCE brizmaker from Shutterstock

MORE INFO + RESOURCES

STRUCTURALLY INTEGRATED PANELS

ROOFING MATERIALS

and could boost the performance of solar panels. Cool roofing can be made from most of the material options listed above.

A green or living roof also allows vegetation to grow on your roof – reducing excess water runoff during storms and insulating your ADU during warm weather. These roofs require technical considerations including designing for the weight of the garden, the method of watering the roof during the dry season and the necessary underlayment to protect the ADU from roots and moisture.

Don't forget to choose metal gutters and downspouts over vinyl options. They last longer, are not made from fossil fuels and are recyclable.

Paints and Finishes

Choosing the right type of finish for your ADU's walls, ceilings and other interior features is almost as important as choosing the right type of color. Almost all interior paints start with a low VOC formula that have pigments added to it. Pigments add more VOCs to base paints with darker colors off-gassing more.

Latex paints are preferable to oil-based paints because they can be easily cleaned up using water rather than VOC-emitting chemical solvents. Unlike oil-based paints, latex can also be recycled. Stains and sealers used on wood and concrete should be water-soluble whenever possible.

Natural paints (e.g., milk-based) and sealers (e.g., linseed oil) are less energy-intensive and toxic solutions. Some products, though, may be harder to apply and have variable consistency. You may also choose to decorate your ADU with environmentally friendly wallpaper that uses water-based inks on recycled paper and is applied with a natural paste.

Some paint additives could be less green than you like. The ingredient titanium dioxide can fight smog-causing air pollutants, but the substance is relatively energy intensive. Biocides, which are used to combat mold, could pose a health risk to ADU occupants and may not be listed on the ingredients list.

The materials used to complement finishing materials could also have an impact on the environment and your health. Seek out low-VOC caulking that is frequently used during the painting process. Use recycled paper or canvas drop cloths instead of plastic drop cloths.

Taking a break from painting? Wrap your wet paintbrush in saran wrap and put it in the fridge to keep it from drying out.

MORE INFO + RESOURCES

PAINTS & FINISHES

WINDOWS & DOORS

Windows and Doors

Many homeowners usually select windows and doors based on aesthetics, cost and energy efficiency (e.g., ENERGY STAR), but a few extra considerations can make your choices even better for the environment and your health.

Options

One of the harder decisions concerns the material of a door or window, which usually comes down to vinyl, wood, or metal. Vinyl can reduce the need to maintain the frame relative to wood, but they can bow and crack. Since vinyl cannot be painted, its color can never be changed to match a new paint job on your ADU. Foam-filled vinyl frames insulate well, however vinyl is made from petroleum-based products and cannot be easily recycled.

Wood is more expensive initially but is relatively durable and can outlast vinyl doors and windows when properly maintained. The wood's color can be repeatedly changed to match the interior and exterior color scheme of the ADU. Wood is also a relatively effective insulator. While it is susceptible to rot and pests when not maintained, unlike vinyl, it can also breakdown naturally at the end of its useful life. A FSC-certified label ensures the wood was sustainably grown and harvested.

Aluminum window frames are not good insulators and you will lose more energy than alternatives. They can be color customized after installation with metal paint and easily recycled whenever replaced.

Composite window frames are made largely from post-production recycled materials (e.g., sawdust, plastic). Like vinyl windows, they are more durable and require less maintenance since, but they cannot be easily painted.

SOURCE Fabio Mazzarotto from Shutterstock

Lighting Overview

Well-placed indoor lighting and supporting infrastructure are critical to the functioning of ADUs and their energy consumption. Lighting is responsible for about 10% of residential electricity use. Reducing the electrical demand of lighting allows onsite solar energy to be used for other uses and shrinks utility bills. Energy-saving lights use less electricity for the same output of light (lumens). Modern bulbs can also last much longer than the traditional incandescent bulbs, which is also a boon to your pocketbook.

In this section, you will also learn about light switches that can save energy and improve the home lighting experience. A discussion of the different types of bulbs and lamps follows so you can make the best decisions for the initial purchase and replacement of lighting for your ADU.

Bulbs and Lamps

Lighting technology can have a direct impact on the environment. There are many lighting types that can be used instead of the traditional incandescent bulb.

MORE INFO + RESOURCES

LIGHTING

BULBS & LAMPS

Compact-florescent lamps or light bulbs (CFL) are a version of florescent lighting meant to replace incandescent light bulbs. They last significantly longer and use much less energy than incandescent bulbs. A disadvantage to these bulbs is that they contain mercury and must be disposed of properly. Unfortunately, even when brought to a recycling drop-off location that accepts them, they are often so fragile that they can break before ever making it to a proper waste handling facility.

Light-emitting diodes (LEDs) is an energy-efficient lighting technology that dramatically reduces electricity use and heat. They use less electricity than CFLs and do not contain mercury. With typical use, an LED light bulb can last three times longer than CFL bulbs.

Whenever possible, it is advisable to purchase fixtures that have LED bulbs that can be easily replaced rather than having to throw away a fixture with integrated LED lights that stop working – either because it cannot be repaired or would cost less to just replace.

Reducing lighting-related energy use can be as simple as keeping your curtains or shades open to use natural light instead of turning on lighting fixtures. Light-colored and loose-weave curtains can maintain privacy to allow daylighting while maintaining your privacy.

LED bulb prices have dropped significantly over the years. This makes their long lifespan and lower operating costs a significant budget saver. See the comparison chart below for 60-watt, 800 lumen equivalent bulbs.

COMPARISON BETWEEN LED, CFL, AND INCANDESCENT LIGHT BULBS

	LED	CFL	Incandescent
Lifespan in hours	10,000	9,000	1,000
Watts (equivalent 60 watts)	10	14	60
Cost per bulb	$2.50	$2.40	$1.25
Daily cost* **	$0.005	$0.007	$0.03
Annual cost* **	$1.83	$2.56	$10.95
Cost for 50k hours*	$50	$70	$300
Bulbs needed for 50k hours*	5	5.5	50
Total cost for 50k hours, with bulb price	$62.50	$83.20	$362.50

** Assuming $0.10/kWh, ** Assuming 5 hours/day of usage*

SOURCE Energy Use Calculator

Light Switches

The switches used to turn lights on and off can reduce energy use in your ADU. Dimmer switches, for instance, give users more control over the amount of light that bulbs emit. They reduce energy by sending only enough electricity to power the energy-efficient bulb at your desired setting.

California's Energy Code mandates vacancy/occupancy switches that use a motion sensor to automatically turn off lights based on the presence of people in certain home spaces including bathrooms, laundry rooms and garages. You could choose to also install them for hallways, closets or kitchen task lights to save even more energy.

Outdoor Features

Use Environmentally Sustainable Materials

The area immediately outside the ADU can also benefit from environmentally sustainable materials. Fencing, decking and other wood features should be made from FSC-certified products and treated with natural finishes and sealers. Natural walkway materials like decomposed granite or mulch, particularly if they are locally sourced, have lower carbon footprints than poured concrete walkways or manufactured pavers. If you prefer pavers, consider permeable pavers that allow rain to percolate into the ground to help avoid run-off and foster a microclimate around your ADU.

Perhaps the best practice to adopt is to reuse salvaged products in your landscaping. Bricks, stones, wood and even broken concrete are salvage items commonly used for raised garden beds and other features.

SOURCE Top, joe.oconnell is licensed under CC BY-SA 2.0; Bottom, Douglas Sacha from Shutterstock

MORE INFO + RESOURCES

LIGHT SWITCHES

3 GLADUR'S LIVABILITY FEATURES

Importance of Livable ADUs

You can improve an ADU's livability by incorporating many features and qualities into their design. We spend a lot of time at home, even more so when sheltering-in-place from heat waves, wildfires and COVID-19, so it should be a comfortable place. Natural light, good ventilation, convenient storage and a flexible floorplan with room to work and relax can greatly improve your wellbeing. An ADU's compact nature means careful consideration should be given to design features that can adapt to the needs of whoever is using this space.

Accessible features can improve livability for occupants of all physical abilities – including those who have physical or sensory deficits. These features would support your ADU as an aging-in-place solution for you or your loved ones. Many homeowners also have a relative or friend with a disability who they would like to keep close while still providing maximum independence. Features that improve accessibility do not necessarily cost more than conventional features that are more difficult to use and would save money by avoiding future modifications.

GLADUR units encourage incorporating features that adhere to universal design principles – to the benefit of everyone. GLADUR units also aim to reduce the number of modifications needed to make them accessible to occupants with more disabilities.

Universal Design

Making an ADU comfortable and accessible to people without requiring further modification later can save money and improve livability. Universal design strives to make the built environment and products accessible to as many occupants and visitors as possible – regardless of their individual abilities. Architect Ronald Mace coined the term "universal design" and collaborated with a working group of professionals to develop 7 defining principles. These universal design principles and how they relate to ADUs are explained on the following page.

SOURCE Jack Barnes Architect

MORE INFO + RESOURCES

UNIVERSAL DESIGN

UNIVERSAL DESIGN PRINCIPLES FOR ADUS

Principle	Description
1 **Equitable Use**	Features can be used by people of all abilities – whether they have a permanent or temporary disability, limited strength, etc. A no-step entry, for example, could be used by people who use a walker or wheelchair as well as by individuals with no disability who want to easily move their belongings in and out of the home.
2 **Flexibility in Use**	Features that accommodate a broad range of preferences and abilities. Providing a shower bench, for example, could be used by someone who needs to sit while bathing but could serve as useful space to store shampoo bottles, soap, etc. Towel racks that double as grab bars are another example of a flexible amenity.
3 **Simple and Intuitive Use**	Features should be easy to understand regardless of your experience, knowledge, language skills, or ability to concentrate. One example is having kitchen cabinets with transparent fronts that allow people to readily see the contents without needing to open them.
4 **Perceptible Information**	A feature's design clearly communicates how to use it regardless of ambient conditions or a person's sensory abilities. This means clear and sometimes redundant signaling. For example, faucets can indicate "hot" in both words and using the color red.
5 **Tolerance for Error**	Reducing or eliminating the risk of hazards caused by accidental or unintended actions. Storing sharp knives in a container that needs to be opened manually to prevent accidental cuts is one example and temperature-limiting features for faucets (e.g., thermostatic valves) is another.
6 **Low Physical Effort**	Features that minimize the amount of energy and strength to accomplish a task. You could install lever-style door handles as well as dimmer switches with larger sliding controls so they can also be used by people with less effort.
7 **Size and Space for Approach and Use**	Appropriate sizing and providing enough room for people to maneuver around an ADU and use its features regardless of their body size or physical abilities. For example, a cooktop with user controls on its front rather than behind the burners will be easier and safer for people to use.

SOURCES Top, mwms1916, licensed under CC BY-NC-ND 2.0; Middle, Michael R. Shaughnessy, licensed under CC BY-NC-SA 3.0; Bottom, buildinganadu.com

Design Features that Improve Livability

Your ADU can incorporate many features that will enhance livability and accessibility. Some of these will improve functionality and ease of use, while others improve comfort. Features that enhance security and peace of mind also make an ADU more livable. These features are organized by where you can add them or common points that can apply to multiple spaces.

Accessing Your ADU

When constructing an ADU, you should consider that anybody can suffer a bad fall from tripping and that people who visit will have different physical abilities and possible visual impairments. This means that the ideal pathway leading to your ADU will be

- Relatively flat and straight
- Free of obstructions and tripping hazards (e.g., hoses, potted plants)
- Lit with (solar) path lighting fixtures that illuminate automatically at night and are spaced at roughly six-foot intervals just off the path
- Made of materials that are not slippery when wet, permeable to avoid water pooling, easily maintained and sustainable (e.g., decomposed granite)

At the entrance(s) to the ADU, consider having

- A timed, motion-activated light with a daylight sensor that lights up only when needed
- Light fixtures that minimize light pollution to protect night views and wildlife
- Handrails on both sides of any steps leading along your path to your doorstep
- A bench and/or table outside the front entrance that serves as a place to leave packages as well as rest and relax outside
- A step-free main entrance and/or compressible thresholds to avoid lips
- Dedicated space for planter boxes, pots or a green wall that do not pose a tripping hazard

General Features Enhancing Your ADU's Experience

There are certain features that will improve the livability throughout your ADU. These features enhance the experience and wellbeing of occupants including many that follow the principles of universal design so that people of all abilities can use them.

A Good Grip

Round door knobs and cabinet pulls can be more difficult for some people to manipulate. Lever-style door handles and D-shaped cabinet pulls are

Decomposed granite walkway with solar lights on the side

SOURCE Towse, licensed under CC BY NC-ND 2.0

MORE INFO + RESOURCES

ACCESSING YOUR ADU

attractive alternatives that can increase ease of use for everyone – especially people who have problems manipulating these objects with their hands.

Natural Lighting

Whenever possible, maximize natural lighting opportunities rather than use lighting fixtures. In addition to saving energy, studies have shown it improves the physical and mental wellbeing of occupants. Mirrors can help direct natural light and make rooms look larger. Low-emissivity (Low-e) coatings on windows, skylights, solar tubes and doors can reduce heat transfer and protect a home's contents (e.g., furniture, decorations, floors) from UV damage.

Ventilation

Consider windows that open easily for natural ventilation thanks to locking/unlocking and latching devices that can be operated with one hand and don't require tight grasping, pinching or twisting. Invest in bug screens for your windows and doors to keep out pesky insects.

Color Selection

A room's window exposure can influence your choice of paint color for certain rooms. Experts often recommend cool colors and neutrals with blue, green or purple undertones for sunnier rooms with southern exposure windows. Darker spaces with northern exposure windows could benefit from warm colors and neutrals with pink or gold undertones.

Flooring

Non-skid flooring can help avoid hazardous falls – particularly in areas which are likely to get wet (i.e., kitchen, bathroom, entry). A wet coefficient of 0.6 or greater is recommended to reduce the risk of slipping in these areas.

Noise

Reducing the noise in and around your ADU can help reduce your stress. Whenever possible, opt for quieter appliances and choose quality doors and windows that minimize the sound transfer with the outside world. Interior walls can also be insulated to save energy and reduce interior noise transfer.

Electrical and Lighting

Having the right type and number of plugs, switches, and lights can greatly improve your ADU's livability and safety profile. The previous chapter discussed the environmental considerations for lighting but there are additional considerations for comfort and safety. Below are some tips that when considered in advance can save you money, time and dust from making modifications after the fact.

Plugs and switch options

- Adequate plugs can avoid the need for extension cords and power strips that cause tripping hazards or visual clutter
- Rocker panel switches are easier to use than traditional toggle light switches

SOURCES buildinganadu.com

MORE INFO + RESOURCES

GENERAL FEATURES ENHANCING YOUR ADU'S EXPERIENCE

ELECTRICAL & LIGHTING

- Dimmer switches should be easily operable by people of all abilities (e.g., large levers)
- Illuminated rocker panel switches allow occupants to more easily find a room's main lights in the dark

Lighting considerations

- Specialized LED lighting such as task lighting and closet lights can better illuminate locations where a larger ceiling light cannot provide sufficient lighting (e.g., above a stove or sink)
- Automatic, light-sensing LED night-lights in hallways and rooms can improve safety
- Choose LEDs with a correlated color temperature (CCT) that do not exceed 3,000 Kelvin

Although the science on the effect of blue light is not yet settled, some studies have found that blue light that make LEDs look whiter could have an impact on human health by disrupting sleep patterns. It is recommended that LEDs used in the evening have no more than 3,000 Kelvin correlated color temperature (CCT), which is a warmer light. Some smart LED bulbs can even automatically adjust the lights' color based on the time of day.

Low-voltage considerations

- Locating phone, internet/video, and speaker plugs to accommodate alternative room layouts can reduce wires that create tripping hazards and visual clutter
- In-wall conduits can facilitate future replacement of damaged or obsolete wires
- A centralized enclosure can better manage home networks and wiring systems

Lofts

Although you might like the idea of living in an ADU, perhaps you'd prefer to have a bit more storage and livable space than its footprint would allow – which is where a loft design could help.

Lofts can be habitable or used as storage space depending on their dimensions, access and intended use. In some cases, a loft bed can be a spare bedroom and allow you to shrink the size of your ADU's footprint – increasing the placement options on your lot and reducing the amount of concrete needed. It could also be useful as recreational space or, if harder to access, as storage for items you need only a few times per year or off-season clothing.

Color temperature spectrum SOURCE California Lighting Technology Center, UC Davis

SOURCE Jack Barnes Architect

No matter the use, you should consult with an expert on the loft design. They may need to support heavy loads. To install a loft, your ADU's ceiling heights will have to be tall enough to accommodate the type you would like. Check to see if that height would be consistent with the limits of your jurisdiction. If a loft space meets a minimum height from their floor to ceiling, for example, it would count as habitable space. This could affect property valuations or square footage regulations.

GLADUR's initial four designs do not include this option. However, you can consult with an architect to modify the plans to include a loft if you so choose.

Kitchens

Kitchens are one of people's favorite rooms in a home that can be greatly enhanced to make them welcoming for users of all abilities.

Features that increase accessibility include

- Doors and cabinet hardware that use easily operable levers and D-shaped pulls
- Lever-, touch- or sensor-operated water faucets that can be used with one hand
- Accessible storage (e.g., under counter, pull-out cabinetry and Lazy Susans in corners)
- Pull-out or pull-down water faucets that allow you to fill a pot without having to lift it out of the sink

Optimized, flexible kitchen space

- Multi-level counter space and pull-out work surfaces that can be used while seated
- Accessible storage (e.g., drawers that pull out for easier loading and unloading)
- Layout that allows interaction with other people
- Ability to install wheelchair accessible features

Safety is another key feature of the kitchen that can be improved with

- An induction stove so a burner that is accidentally started cannot generate any heat without compatible cookware on it
- Easily accessible storage for a fire extinguisher
- Slip-resistant flooring – particularly around the sink
- Child-lock safety features if you have small children
- Opening windows or turning on the range hood to evacuate unpleasant smells and harmful particulates created when cooking
- Cooktop controls located in front rather than behind the burners and that are easily read for people with poor eyesight

SOURCE buildinganadu.com

MORE INFO + RESOURCES

LOFTS

KITCHENS

Electrostatic shower valves provide consistent hot water temperatures – helping avoid accidental burns.

SOURCE wuestenigel, licensed under CC BY 2.0

Bathrooms

Bathrooms should be safe and enjoyable to use. Features that employ universal design can increase independence for many occupants – including children, elderly adults and people with disabilities.

Consider the following features and strategies

- A roll-in (no-step) shower that eliminates tripping hazards or, if necessary, a low-sided bathtub that is easier to get in and out of
- Nonslip strips or nonskid mat on floor of shower or tub
- Enough space for a shower seat so people with disabilities can bath on their own
- A hand-held, adjustable shower head that has the option of being placed on a fixed mount that allows users to wash more effectively and comfortably while sitting or standing
- Lever-, touch- or sensor-operated water faucets that can be used with one hand
- Shower heads with a "pause/stop" feature that temporarily halts water flow without turning off the fixtures, maintains the desired pressure and can save water
- A thermostatic shower valve allows a temperature to be preset so water comes out at consistent, desired temperature without any guesswork – saving time and water
- Grab bars fixed to blocking in frame to help avoid accidental falls or transition between standing and sitting
- Round bowl toilets that save space
- Attachable bidet seat/smart toilet for improved hygiene and less toilet paper use
- Slip-resistant bathroom floor with a wet coefficient of ≥ 0.6 to prevent falls
- Doors and cabinet hardware that use easily operable levers and D-shaped pulls

Plants

Experts often recommend having plants in and around your home to improve your mental wellbeing. Landscaping can also have more practical uses including trapping particulate matter pollution, reducing noise and creating a pleasant microclimate.

A vertical garden planted with herbs could save you a trip to the supermarket and reduces food waste if you use only what you need.

SOURCE wiccahwang, licensed under CC BY 2.0

MORE INFO + RESOURCES

BATHROOMS

PLANTS

Consider the following features and strategies

- Dedicate space for plants in and around your ADU (e.g., living wall, planter boxes)
- Grow herbs and other edible plants
- Locate plants where they are easy to water
- Native plants around your ADU that resist wildfire
- Plants that help clean the air inside your home
- Easily accessible gardening equipment
- Plants with thorns could help secure areas under windows but should be avoided along pathways

Storage and Organization

With little square footage to spare, organizing your ADU is key to avoiding clutter and stress. There are many clever ways to organize space and maximize your storage opportunities.

Storage requirements will vary by person so choosing flexible designs that adapt to changing needs can improve your experience. Book shelves are handy for many personal items beyond just books. Drawers that slide out allow for better visibility than shelves.

If you often work from home, consider dedicating space within a room by setting up special lighting, movable paper or glass screen, a curtain, or even a different wall color or flooring type. A rolling storage cabinet kept in this space can be used to store your work-related items if you do not have a dedicated desk.

Multi-purpose furniture
SOURCE buildinganadu.com

MORE INFO + RESOURCES

STORAGE & ORGANIZATION

You can also make better use of your space by selecting furniture that can convert to other uses or can be put away to make more room in your ADU. Murphy beds that can be pulled down from the wall, lift-top coffee tables that store items and transform into higher working space, wall-desks, and many other creative ideas can be found online.

Safety and Security Features

Feeling safe in your ADU is crucial for livability for all users. You can minimize potential hazards and increase security through both your ADU's design and features. Some of these are mandated through building codes, but optional improvements recommended below can further improve safety. Keep in mind that some features, particularly child safety measures, could reduce the accessibility for some users and are perhaps better implemented temporarily.

Features that improve security and safety on the outside of your ADU include

- Motion-activated lights
- Security cameras and/or smart doorbell camera
- Safety or screen door
- Hose reel for storing hoses
- Plants with thorns under windows

Features/measures that improve security on the inside of your ADU

- Deadbolt, door brace or other measures to reinforce exterior entries
- Peephole or viewing panel on your front door
- Slide-latch or chain on the front door
- Security system that monitors unauthorized entry on doors and windows
- Tempered safety glass used in furniture and cabinets
- Secure tall furniture and objects in case of earthquakes
- Water-leak detectors – particularly around water heater tanks
- Soft-close drawers and doorjamb protectors prevent pinched fingers
- Disaster preparedness and first-aid kit
- Password protected wireless network
- Fireproof safe bolted to the frame or ground

Child safety measures (temporary)

- Strap-down all furniture (good for earthquakes)
- Outlet covers
- Mechanisms that prevent young kids from opening drawers, cabinets, etc.

SOURCE gmstockstudio on Shutterstock

MORE INFO + RESOURCES

SAFETY & SECURITY FEATURES

Fire Prevention

Taking steps to prevent your ADU from catching fire from internal and external sources is important for safety and peace of mind. “Fire-hardening” strategies that protect your ADU and its occupants, especially if you are in a rural or Wildland Urban Interface (WUI), are especially important with increasingly frequent and intense wildfires. Although some strategies can increase construction costs, they could save your ADU or even your life.

Strategies that reduce the risk from a wildfire’s flying embers, hot gases or flames include

- Using non-combustible building materials like tile or metal roofing
- Selecting a roof design that eliminates dormers and other areas where debris collect
- Regularly clearing debris from your roof and gutters
- Installing ember-resistant vents or even metal mesh over vent openings
- Choosing fire-resistant landscaping and maintaining defensible space around your ADU
- Using non-combustible siding (e.g., stucco, brick), flame-retardant wood/lumber and special coatings or paints
- Installing an exterior water spray system or having hoses long enough to reach all parts of your ADU

Make a plan to safely escape in the event of a wildfire or fire in your ADU – including by making sure all household members know where your designated safe meeting place is. Do not waste time saving belongings – simply get out and stay out.

Ways to minimize a fire starting from inside your home include

- Having a fire extinguisher in the kitchen
- Making sure all hard-wired smoke detectors are properly installed and maintained
- Placement of hooks for mitts, potholders, and aprons away from the cooktop
- Install a fire sprinkler system if not already required by your local jurisdiction

MORE INFO + RESOURCES

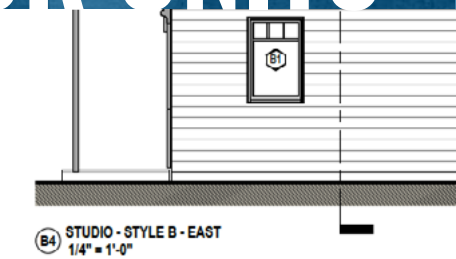
FIRE PREVENTION

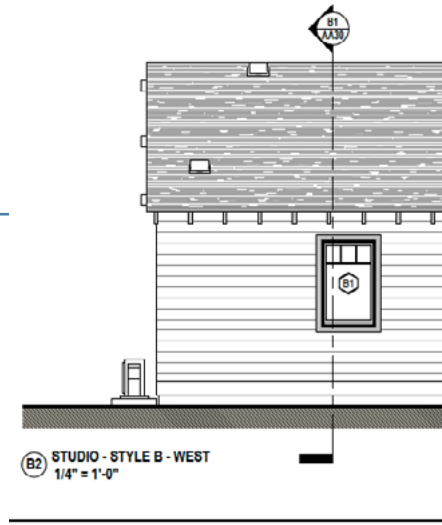
SOURCE Andrey_Popov on Shutterstock

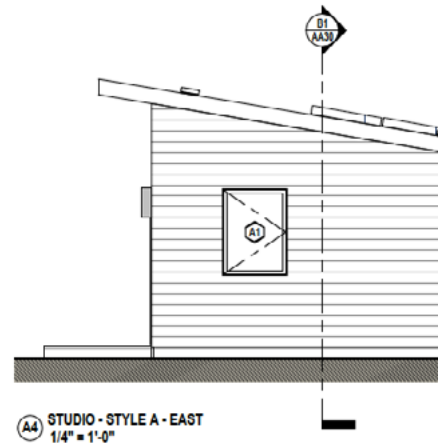
4 THE PROCESS OF BUILDING GLADUR UNITS

This chapter provides an overview of the process of developing a GLADUR unit. Much of the general process of building an ADU is well explained in other resources and workbooks, such as San Mateo County's Second Unit Resource Center or this great infographic from 21 Elements, so please review those as well.

As always, it is highly recommended that you speak and work with a licensed professional throughout the process, which will help you during the development as well as help prevent issues in the future.







Gather Information

The first step in the process of building an ADU is for homeowners to gather the pertinent information regarding their property to ascertain what is allowed to be built.

State and Local Laws and Requirements

To find out what you can build, you need to make sure that you follow all of the laws passed by the State and your local jurisdiction. Additionally, some cities have guidelines intended to help maintain the character of a place that can include guidelines on color, material, details and style, among other things. Homeowners should contact their local city to gather information about their property. For San Mateo County, city specific ADU standards or design guidelines can be found on the 21 Elements ADU website.

Other Key Information

Some of the important information to gather would be

Assessor's Parcel Number (APN)

Available from property deed or contacting the local jurisdiction directly. Also available from the County Assessor's office. For San Mateo County, it is searchable by map or address at Property Maps Portal website.

Property Zoning

Find out whether the zone is permitted for ADUs, as well as the zone's lot coverage. Available by contacting the local jurisdiction directly or from the County Assessor's maps. For San Mateo County, it is available at https//planning.smcgov.org/maps.

Lot Size

This goes to whether the lot meets the minimum size for an ADU. Available from a property survey or property deed. The County Assessor's maps are the best resource for this information.

Maximum Permitted Floor Area Ratio (FAR)

Floor Area Ratio limits how many square feet of building are allowed on a lot by establishing maximum FAR or using other formulas.

FAR is a ratio of the number of square feet of built space (the floor area) compared to the size of the lot. For example, a 2,000-SF home on a 4,000-SF lot would have a FAR of 0.5 (2,000 divided by 4,000).

In this example, if your site's zoning permits a FAR greater than 0.5, and assuming you meet all the other rules, you can build an ADU. If your site's FAR is 0.5 or less, the only option would be to convert existing space to an ADU.

Unfortunately, FAR is not a simple yes/no calculation. It may also limit the maximum size of your ADU. Using the above example, if the maximum permitted FAR were 0.7, your ADU could not be more than 800-SF (see below for details).

FAR x Lot Size = Max Floor Area
0.7 x 4,000 = 2,800

Max Floor Area - Existing Floor Area = Allowable ADU Size
2,800 - 2,000 = 800

Ask the City Every city will stipulate how to calculate floor area. Some measure from the interior walls and some measure from the exterior walls. Most include all living space and finished basements or attics. Some include garages, porches, unfinished attics, basements, and sheds. It is simplest to ask your city

Example of a San Mateo County Assessor map

if they have an official record of your existing floor area. If they do not, ask them what spaces to include in your calculations.

Lot Coverage

Lot Coverage means how much of your lot is covered by a building. As with floor area ratio, it compares your current building footprint with the maximum that is allowed according to the zoning code. Most cities include garages in the lot coverage calculations. Some include overhangs and porches.

Example if your building is 40 feet wide and 50 feet long, it has a footprint of 2,000. If your lot was 4,000-SF, your lot coverage would be 50% (2,000 divided by 4,000).

In this example, if the zoning allows a lot coverage of greater than 50%, assuming you meet all the other rules, you could build a new ADU. If not, you might be limited to converting existing space or building a second story although some cities do not allow new additions for sites over their lot coverage.

Lot coverage, like FAR, is not a simple yes/no calculation but may also limit how much you can build. For example, if the lot coverage limit for your lot is 60%, your ADU would be limited to 400-SF.

Parking

Review the parking requirements on the ADU standards sheet for your city (available at www.21elements.com/secondunits). Some cities will require homeowners to add parking when they add an ADU and/or replace lost parking if they convert a garage. It's also important to determine if your existing home meets parking requirements because some homeowners may be required to bring the entire property up to current parking standards.

SOURCE Neal E. Johnson on Unsplash

Budget

If you have not already, after you have gathered all of the necessary information, the next step is to develop your budget. Knowing what you can afford will help you and your team determine the size and design of the ADU.

Talk to a professional who has experience with similar ADUs to figure out the current complete costs, as well as how certain green features will fit it for short term costs vs long term savings. For an estimate on costs in San Mateo County, San Mateo County's Second Unit Resources Center has a free ADU Calculator.

As ADUs can cost up to $300,000 to build, most homeowners will have to look at financing it. The next chapter will provide an overview of some financing options.

SOURCE NORTHFOLK on Unsplash

Project Manager/Owner's Representative

The Project Manager, or sometimes called the Owner's Representative, is someone who is hired by the homeowner to manage the permitting and/or the construction process. As they represent the homeowner, there is no conflict as with a contractor or architect whose self-interest might be different from yours.

A Helping Hand

For most people, this will be the very first time that they design and build an ADU, and for many, the process can be daunting.

If you hire a design/build firm, you will not need to hire a separate person or company when you get to the construction phase. If not, you'll either need to hire a general contractor or manage the project yourself.

Underestimating the Project

Often, people who are their own general contractors have a difficult and unpleasant time. Many people believe that because they have experience managing a kitchen renovation or adding an addition, they will be able to save money by being their own general contractor. But it's important to recognize that building a second unit is more akin to building an entire house than a renovation. Further, there are many more possibilities for costly and time-consuming mistakes and delays. The process is challenging and best left to those with extensive experience. The "Getting Bids" and "Hiring a Contractor" sections of this chapter will take you through the process of finding and hiring a general contractor.

Some homeowners choose to retain the services of their designer during construction or they hire a construction manager or owner's representative who represents and advocates for the homeowner through the process. Though it may cost more upfront, some homeowners will come out ahead because their project was better managed and/or because of the rental income they would have lost to a delayed project.

Local Options

There are a variety of organizations, and some local ones, who offer such services, and it is recommended to speak with several to compare, read reviews, and talk to homeowners who have used any of them. Some local organizations include Hello Housing's Hello Bright Program, Manzanita Works' Housing Program, and Acton ADU.

SOURCE: Pexels

Design

The next step is to take all of the information gathered and use it to select the desired ADU size and architectural style. You should consider not only how many bedrooms are desired, but livable features that would make the ADU a home as well as privacy, views, sunlight, comfort, etc. Additionally, remember to view the ADU from your neighbor's perspective.

You will then incorporate the project and site-specific information into the Construction Documents, discussed in the next section.

Design Upgrades

While the GLADUR drawing sets provided contain the vital information required by homeowners to permit and build their second unit, such as floor plans, elevations, and Title 24 reports, there are many additional design upgrades that can be performed.

Finish package

While fixtures, equipment, and finishes are provided in the drawing package, these can be replaced with equivalents of the homeowner's choice. By working with the general contractor for the package, any additional features and finishes can be easily tailored for.

As discussed in previous chapters, there are a variety of green and sustainable features that can not only add value to the ADU, but provide long term cost savings. Please note that as these are all-electric plans, so in choosing to use them, certain features may not be added or removed (i.e. cannot add a fireplace or any appliance fueled by natural gas). Additionally, depending on who you will have living in the ADU, discuss adding accessibility features and what you would need if you plan on following ADA requirements and guidelines.

SOURCE Jack Barnes Architect

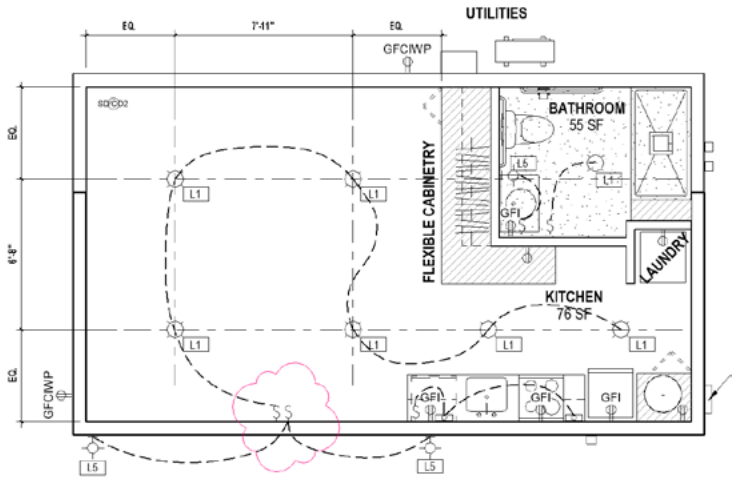
Flexibility and Customization

There is a lot of flexibility afforded to the homeowner allowing them to take control and customize the features of their new ADU as desired. By using these plans as a base point and working closely with a general contractor, a multitude of customizations are available.

No matter the features or upgrades you choose, there are some factors to consider

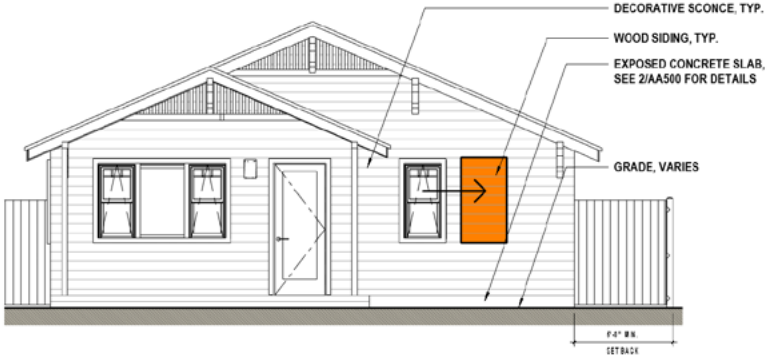
Equipment / Fixture / Outlet Positioning

Plumbing and Electrical codes provide some flexibility in the exact location of switches, outlets, equipment, and fixtures. The Homeowner should review the locations of these items with the Contractor before they are installed, adjust locations if necessary, and verify the items are still code-compliant.



Opening Positions

By using the architectural and structural details provided the Door and Window openings shown in the drawings can be adjusted to the homeowners needs.



Construction Drawing Checklists

Below are some items found in the construction drawing checklist.

Title Sheet

The Title Sheet of the Construction Drawings must be completed by the owner prior to submitting for permit.

Project Directory

Provide the name, address, phone number and email address for the Owner, Contractor, Architect, Engineer(s) and other professionals responsible for the project.

Project Information

Fill out the required information on the Drawing Title Sheet (see right).

DRAWING TITLE SHEET REQUIRED INFORMATION

Field	Required Information
Project Address	Street Address, City, State, ZIP
Parcels (Block/Lot)	Check local parcel maps for property Block / Lot
Parcel Area	In square feet, use the area from local parcel maps
Existing Building Area	In square feet, use the area from local parcel maps
Stories & Building Height	No Additional Information Required
Building Use/Occupancy Group	No Additional Information Required
New Residential SF	No Additional Information Required
Sprinklers	Describe the proposed fire sprinkler system, if required

Site Plan

This is the most essential step in completing the Construction Drawings for permit submission. While the ADU drawings and specifications are drawn generally, the Site Plan information is site specific.

The Site Plan shows your property lines and key information such as buildings, setbacks, lot lines, utilities etc. which are key to attain city approvals.

Site Plan Checklist

- ☐ Site Plan must be drawn to an architectural scale.
- ☐ Indicate which direction is True North (North Arrow).
- ☐ Provide a Site Plan showing the entire property, including property lines and all existing buildings (including sheds / garages etc.)
- ☐ Identify existing and proposed utility lines to and from the new unit and main home (work with project engineers to identify).
- ☐ Clearly identify the proposed Accessory Dwelling Unit.
- ☐ Provide dimensions of decks, terraces and yards detailing the usable open space.
- ☐ Provide dimensions from the proposed ADU to the property lines and existing structures on the lot. Include the width of sidewalk from the front property line to curb.
- ☐ Indicate the exit path from the proposed ADU to the sidewalk – The path of travel to the public right of way must be illuminated and comply with the local city code requirements.
- ☐ Show adjacent lots, both sides, with full outlines of buildings on those adjacent properties.
- ☐ Show all Landscape and permeable surfaces.
- ☐ Fire Hydrants – show the location of (E) hydrants and the distance from the proposed ADU.
- ☐ Fire Sprinklers (If applicable) – show the location of the proposed underground service connection, backflow preventer and sprinkler riser.
- ☐ Water Flow Information – This information should be requested directly from the City Waterflow department and a screenshot attached to the Permit Submittal.
- ☐ Indicate existing street trees and check with the local city jurisdictions and ordinances regarding street tree protection & removal.

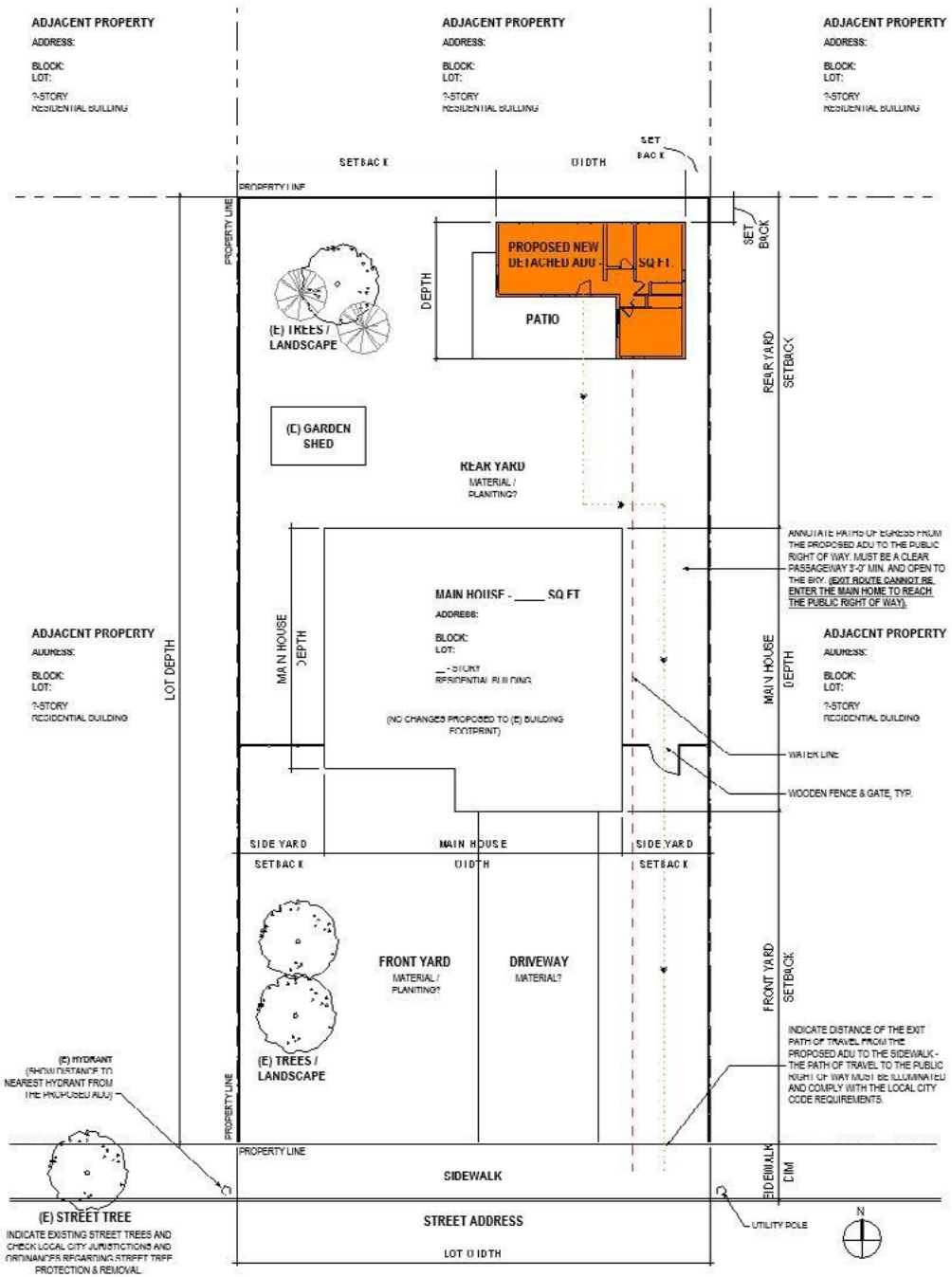
Means of Egress

The means of egress shall provide a continuous and unobstructed path of vertical and horizontal egress travel from all portions of the dwelling to the required egress door without requiring travel through a garage. The required egress door shall open directly into a public way or to a yard or court that opens to a public way.

Example A 3'-0" access pathway that is unobstructed to the sky and illuminated per the local city requirements must be provided to egress from the proposed ADU to the public right of way.

This portion of the Site Plan drawing must not be overlooked and is one of the most important key factors in reviewing the feasibility of your proposed ADU and attaining a building permit.

EXAMPLE SITE PLAN



Vicinity Map

Insert a screenshot of the area from an online map provider. Make sure the street names are legible, and that north is indicated. Locate and identify the project address and location on the map (example below)

Fire Flow Test

Water Flow Information should be requested directly from the City Waterflow department and a screen-shot attached to supplement the Permit Submittal. An example of this form from the Central County Fire Department is shown below (this form and the requested information and pricing will change per each City jurisdiction)

Central County Fire Department

Serving the communities of Burlingame, Hillsborough and Millbrae

John Kammeyer
Fire Chief

Submit your application via email or fax: info@ccfd.org or (650) 344-9950

Fire Flow Test Application

TEST ADDRESS: _____

Water Department: _____

Applicant Name: _____

Applicant Phone Number: _____

Applicant Fax Number: _____

Email Address: _____

Date of Request: _____

Fee per hydrant: *(cash/check only)*

$242 Burlingame
$506 Hillsborough
$234 Hillsborough non-flow
$270 Millbrae – Must submit at Millbrae City Hall

Date Paid: _____

For Office Use Only

Date of Test: _____

Hydrant Number/Location: _____

Static: _____

Residual: _____

Hydrant Number/Location: _____

GPM Flow: _____

Tested By: _____

Date Faxed/Emailed to Applicant: _____

1399 Rollins Road | Burlingame, CA 94010
(650) 558-7600 | www.ccfdonline.org | @centralcountyfd

Architectural Styles and Details

With the different architectural styles available in the GLADUR designs, included are also a variety of architectural plans, elevations, sections and details. This is by design and gives homeowners the flexibility to use the drawing set to build their second unit to their desired specifications.

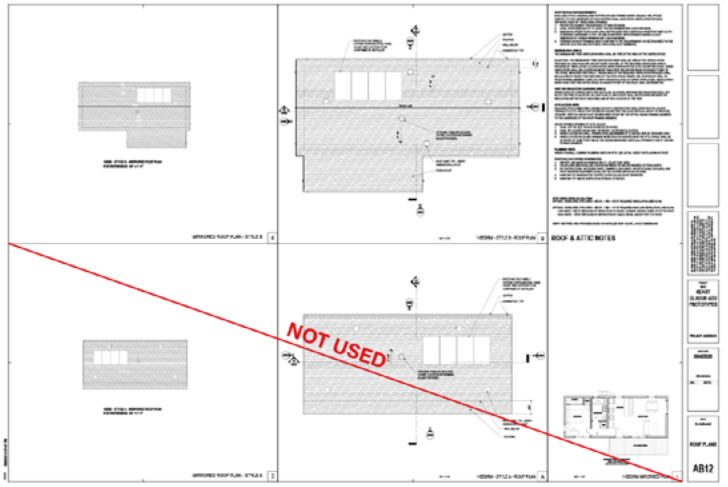
For example, the 400-SF drawing set can be built in a variety of different ways ranging from a gabled roof craftsman, to a shed roof post war. The plans and details for each are included in each set, however it is important that homeowners identify the style and layout that they want to pursue prior to submitting for permit.

By working with your general contractor, homeowners will be able to identify the details that fit their specifications and in turn cross out the details that are no longer applicable. This will streamline the Permit process as plan check personnel will not need to spend time reviewing plans, elevations, sections or details that are not relevant to what is being proposed for approval.

See examples that follow.

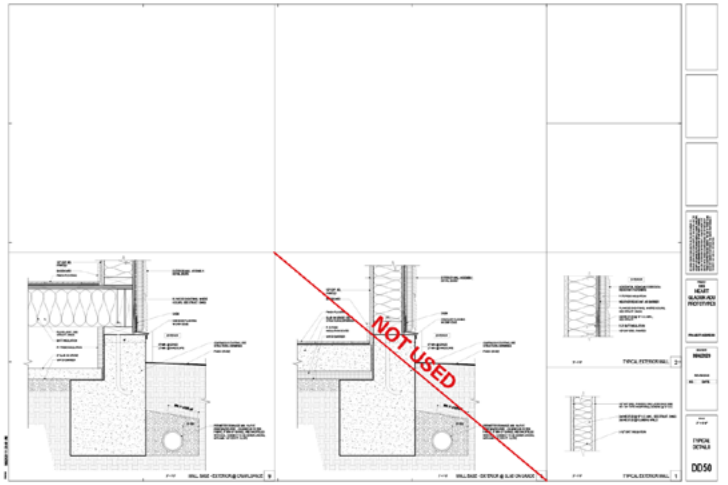
Example 1 – Page not used

In this example, the homeowner is opting to propose the gabled roof in the craftsman style. This renders the shed roof drawings not applicable, and it has clearly been marked “NOT USED”.



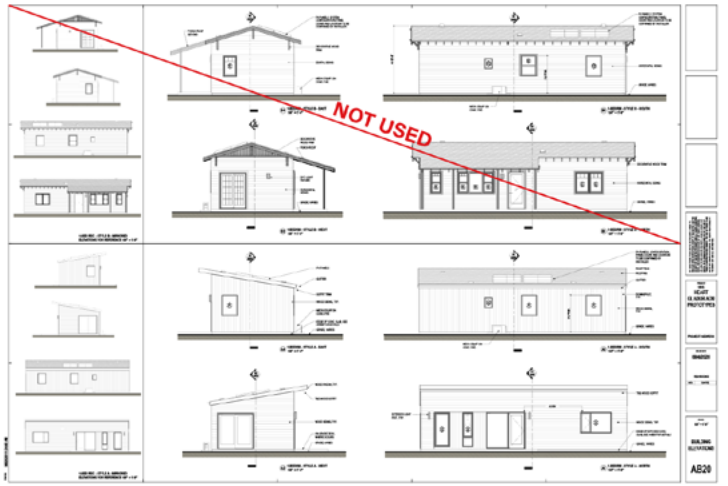
Example 2 – Detail not used

In this example, the homeowner is opting to propose a slab on grade floor detail for the second unit. This renders the raised floor plans and details not applicable so they have been marked “NOT USED”.



Example 3 – Elevations not used

Similar to example 1, as the homeowner is proposing to build in the modern style, the associated roof plan, elevations and details are no longer applicable and should be indicated as “NOT USED”.



Permitting

Once you have chosen your design, and completed the required steps above, you are ready to submit the materials to your City for approval.

The permit review process ensures homes meet code requirements, are habitable, environmentally friendly, and most importantly, safe places to live and work. The permit application, review, and approval process can often be daunting for homeowners who do not have experience with the process. That is why it is recommended that a homeowner work with licensed professionals as well as a project manager.

As mentioned in Chapter 3, some jurisdictions within San Mateo County have pre-reviewed the GLADUR plans. If your jurisdiction has pre-reviewed the GLADUR plans, much of this process is made easier as the City has previously reviewed the drawing sets you are submitting which will expedite the review. However, please note that making major changes to the plans will negate the pre-review benefit, so talk to your jurisdiction throughout the process. For a complete and updated list of all jurisdictions that have pre-reviewed the GLADUR plans, as well as jurisdiction specific details, please visit HEART's ADU website.

The Process

Generally, the permit process can be broken down into the following steps

Step 1 – Submit application

Each city has a different permitting process, but generally you will submit one application with several components and the city will send it out to various departments to review. The first step will be for the city to sign-off that your application is complete. That will initiate the staff's internal review. Typically, several city departments will review your application, including planning, building, and fire departments.

Step 2 – City Review / Comments

The city will collect all internal review comments on the application and then will send them back to you. Assuming changes are needed, which is usually the case, you will then resubmit your revised plans in response to the comments or provide additional information as part of your application. This step is repeated until all the comments are addressed, which might take a few rounds.

Step 3 – Pay Fees

Before receiving the final permits, homeowners will have to pay all the associated fees, including fees required by other agencies like school districts or water districts. The city will give you a list of where you need to go to pay and obtain proof of payment for the various fees required.

Step 4 – Permit approval / pickup

The homeowner or contractor, if they are identified on the application, may then pick up the building permit to commence construction.

SOURCE Yaroslav Shuraev from Pexels

5 FINANCING OPTIONS

This chapter will mention the most common options available to homeowners looking to finance an ADU. There are a variety of other resources available that discuss these options in more detail. While some homeowners have experience with loan products, it is always recommended to talk to a professional.

Please note that commercial lenders are conservative in their underwriting of loans and provide as much financing as they believe you can afford – it may not be enough to help you finance the entire project. Therefore, you might have a gap that you will have to fill. Additionally, while most lenders will not include the future rental income of the ADU in their calculations of what you can afford, it is still an important factor to include in your personal budget.

Keep in mind is that you do not have to use only one financing option. It is often necessary to fill gaps with personal and alternate sources.

The San Mateo County Second Unit Workbook also has a useful table which shows the financing options to consider based on your income and the amount of equity you have in your home.

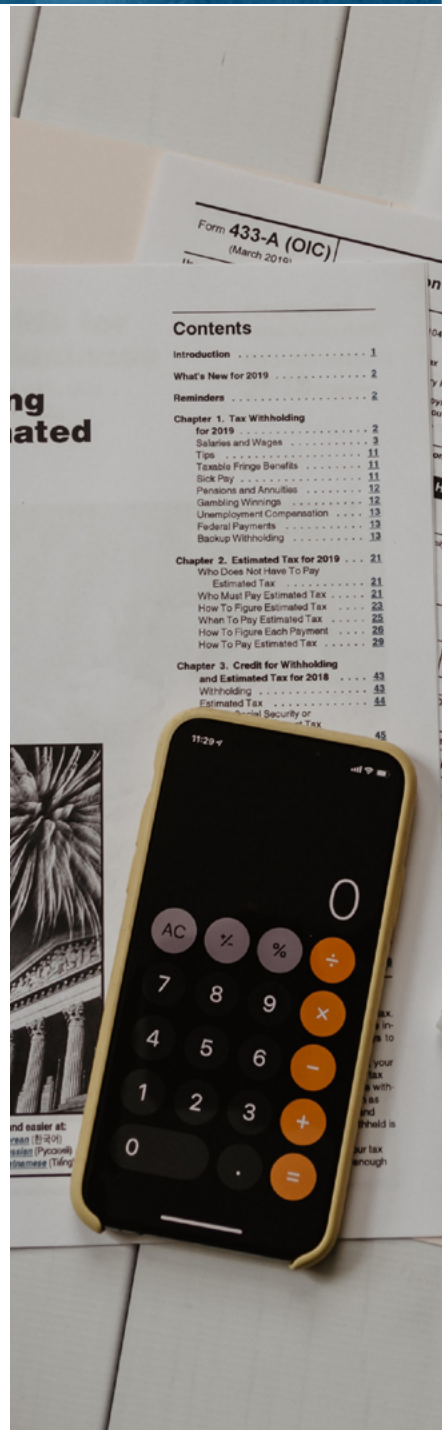
Cash-Out Refinance

Homeowners who have built up enough equity in their home, typically at least 15%, can refinance their mortgage – thus exchanging equity for cash. This replaces the first mortgage with a new mortgage and rate. If this is not the right time for you, it is advisable to wait until mortgage rates are lower or at least closer to your current rate. As with most refinancing options, take into consideration the typical fees into your budget.

Second Mortgage Home Equity Loan or Home Equity Line of Credit (HELOC)

Homeowners who have built up enough equity in their home, typically at least 15% to 20%, can take out a second loan or line of credit. The home equity loan is like a first mortgage you borrow against the equity in your home in exchange for a lump-sum at a fixed interest rate for a set period of time. Once drawn, you will have monthly installment payments.

A HELOC is a type of second mortgage that gives you continuous access to funds at a variable rate. There will be draw periods, during which time you can usually spend up to your credit limit without having to make any payment other than the accumulated interest. You then pay back the principal balance and interest in monthly installments after the draw period ends. Additionally, the homeowner does not start paying interest until funds are drawn.



SOURCE Kelly Sikkema on Unsplash

Just like with a first mortgage, to qualify for a second mortgage you will need to be able to have enough income to cover the cost of the new debt.

Construction or Renovation Loans

Homeowners who do not have enough equity in their home for a cash-out refinance or a second mortgage can consider a construction or renovation loan. This type of loan is based on the future assessed value of the home once the ADU is completed. A lender will typically let you borrow an amount equal to 80% to 95% of the completed value of the ADU. Construction and renovation loans are for a shorter term and typically have higher than average interest rates.

Lenders also often offer this loan with an option to convert it into a permanent 30-year fixed rate mortgage loan after the ADU project is completed, all for one set of closing costs. Without equity to secure the loan, , a homeowner's income will need to have a steady and high salary to qualify for these types of loans.

Please note that for such loans, the lender plays a larger role such as approving the General Contractor selected by the homeowner. The lender also releases funds in a series of draws as construction progresses, which might involve an inspector verifying the progress.

Local Lenders

There are a variety of lenders offering loan products, and it is recommended to speak with several to compare, read reviews, talk to homeowners who have used any of the products, as well as speaking with professional advisors. Some of the more known local lenders developing loan products for ADUs include San Mateo Credit Union and Umpqua Bank.

Retirement Accounts

Homeowners, who are of a certain age and are eligible to take distributions from their retirement accounts, might consider taking a lump sum as an option. Additionally, it may be possible to withdraw from your retirement account before you reach a certain age. Usually this will incur a penalty.

Another option may be to borrow from your retirement account. Some retirement accounts allow you to borrow up to 50% of the amount in the account, although with certain maximum limits. Please make sure to have a repayment plan to prevent any tax penalties.

If you are considering using a retirement account to construct and ADU, please consult with a financial advisor, CPA, or tax expert to understand any tax liabilities and how this could impact your future retirement.

Financing Solar

With the new California energy code requiring solar panels for new detached units, thus applying to all GLADUR units, homeowners might want to finance them as well. There are a variety of finance products for solar. If the main home does not have solar panels, the homeowner could combine the solar panels on the principal home with the ADU panels, thus getting more savings as a bundle purchase and more long-term cost savings. For more information about solar and financing options, please visit the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE).

Personal Savings, Liquid Assets and Loans from Family or Friends

Many homeowners will have planned for their ADU for years and have either built up savings or have "liquid" assets, such as stock, that could be converted to cash to pay for some or all of the costs. Family and friends may also be able to help you build your ADU. Before pursuing these options, please consult a financial advisor and a legal advisor when borrowing funds from family and friends.

SOURCE Karolina Grabowska from Pexels

6 HOME VALUE AND TAXES

New Home Value

A common question is how much would adding an ADU affect the value of the home. While an ADU will most likely add to the overall value of the home, the exact amount is difficult to estimate. Since all of the GLADUR designs are for detached ADUs, it would be for similar ADUs. It is recommended to speak to a professional about future value. However, for rough estimation, some people add 100 times the estimated monthly rental value. Therefore, if the ADU will rent for $2,000, it should add about $200,000 to the overall value of the home.

Property Taxes

Another common question is whether adding an ADU will affect the property taxes. Luckily, the primary house will not be reassessed, and the property taxes will only increase based on the added value of the new ADU. Additionally, homeowners, who have owned their home for a long time and have lower property taxes, need not be concerned as the base assessment will not be affected. The assessor will only review the value of the improvement (the ADU).

Other ADUs

Other ADUs, such as interior conversion or a junior second unit (JADU), might have a smaller impact on the value of the home.

Income Taxes

Please be aware that adding an ADU may affect income taxes. While the rental income received from the ADU is taxable, homeowners can depreciate the cost of construction and maintenance. This can reduce taxes overall. Additionally, when a homeowner sells their property, there might also be capital gains tax related to the increased value. It is highly recommended that everyone speak with a tax advisor or accountant to confirm how everything applies to their situation.

INDEX

OTHER RESOURCES

There are a variety of sources about ADUs and the ADU development process. Most cities and Counties have either their own resources or can direct you to places that do.

For Homeowners in San Mateo County

The County's Second Unit Resources Center is a program created by its Home for All Initiative to provide information and tools to make it easier for homeowners to build second units and to help increase the housing supply in the County. It offers homeowner builders valuable information to navigate the entire process and challenges of building an ADU including

- An online calculator to estimate the cost and potential rental revenue of an ADU by San Mateo County jurisdiction;
- The *Second Unit Design Idea Book* that provides readers with inspiration and information about ADUs that have already been built in San Mateo County; and
- The *Second Unit Workbook* that explains the ADU development process from start to finish.

21 Elements is a great resource for ADU information and tools. It was created by the San Mateo County Department of Housing (DOH) and the City/County Association of Governments of San Mateo County (C/CAG). It is a collaborative planning project that helps all the 21 jurisdictions in San Mateo County address their housing needs and assists them with everything from RHNA to inclusionary housing to ADUs.

Homeowners Outside of San Mateo County

Homeowners outside of San Mateo County can still benefit from the information provided to the left, but can also go to the California Department of Housing and Community Development's (HCD) ADU website as well as AccessoryDwellings.org and BuildinganADU.com, all of which have great general tools and information.

For Seniors or Homeowners Thinking About Aging-in-Place

AARP created a Future of Housing Initiative to develop strategies to address the senior housing crisis. They also created two ADU workbooks a general guide and a step-by-step guide to design and development.

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