



Final Deliverable: E2C Expert Match Tama County, IA

Microlearning modules on residential energy efficiency- Module 2

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U.S. DEPARTMENT
of **ENERGY**

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E2C: Technical Assistance Opportunities

EXPERT MATCH

E2C's Expert Match program connects energy experts with local governments, electric utilities, and community-based organizations to provide technical assistance to inform near-term energy decisions.

Expert Match offers:

- **Access to experts from the U.S. Department of Energy's national lab system.**
- **40–60 hours of support over 3 months from the first kickoff call.**
- **Focus on community-driven challenges or goals.**

For more information, visit:
www.nrel.gov/e2c/expertmatch

Scope

ORNL will develop a set of short microlearning modules to help Montour (Tama County) homeowners better understand and manage household energy use. The work focuses on creating clear, practical, and accessible content that guides residents toward cost-effective improvements and available incentives. Activities in this work may include:

- **Content Development:**
ORNL will prepare seven (agreed upon) modules using plain language, relatable examples, and simple step-by-step guidance covering topics on home energy efficiency improvements.
- **Learning Management System on Website:**
ORNL will use a simple WordPress website of learning management system (LMS) to support hosting the above modules and providing instructions for future updates.

Points of Contact

Community POC

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Microlearning modules on residential energy efficiency

Module 2. Home Energy Efficiency

Energy Efficiency Made Easy: Small Changes for Smarter Homes

Welcome to your comprehensive guide to making your home more energy-efficient, comfortable, and cost-effective. Whether you own or rent, these practical strategies will help you take control of your energy usage, reduce your environmental footprint, and save money on your monthly bills.

*All the pictures in this presentation slides are generated through various AI tools and are added here for illustrative purpose. The pictures do not represent technical accuracy.

A guide to discover a roadmap for improving your home's energy performance with options for every budget and skill level

1

DIY Home Energy Audit

Learn how to identify energy waste in your home with simple inspection techniques anyone can do

2

Weatherization Essentials

Discover how proper sealing and insulation can improve comfort while cutting costs

3

Lighting Solutions

Compare lighting technologies and find the best options for every room in your home

4

Smart Thermostat Technology

Explore how intelligent climate control can optimize your heating and cooling automatically

Why Energy Efficiency Matters?

The average American household spends over \$2,000 annually on energy bills, with up to 30% of that energy being wasted due to inefficiencies. Improving your home's energy performance good for your wallet and it creates tangible benefits you'll notice every day:

- **Financial Benefits**

Lower monthly utility bills, protection against rising energy costs, and potential tax incentives or rebates

- **Comfort Improvements**

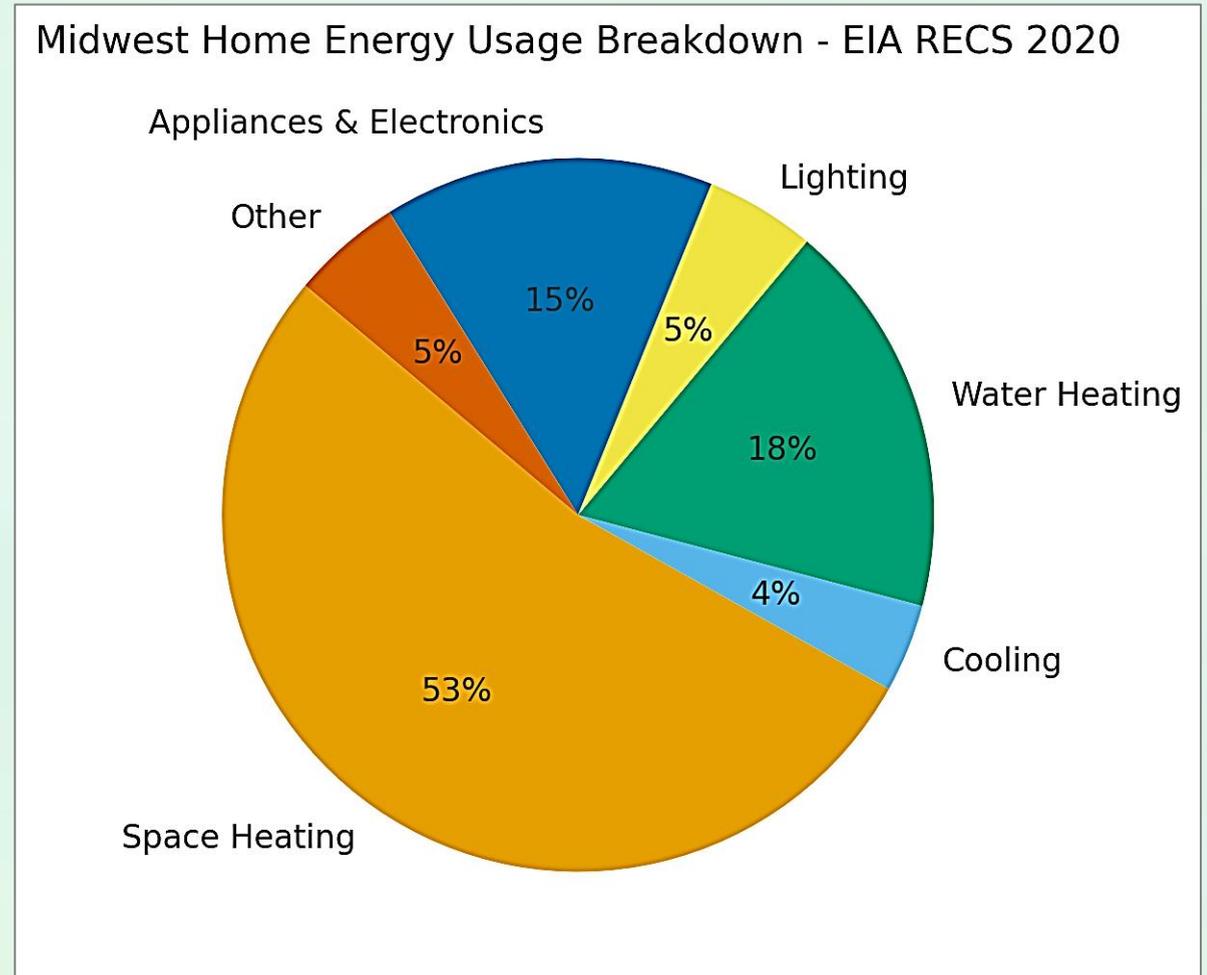
Fewer drafts, more consistent temperatures, reduced humidity issues, and quieter living spaces

- **Health Advantages**

Better indoor air quality, reduced allergens, and improved ventilation

- **Environmental Impact**

Reduction in carbon footprint due to reduced energy use without sacrificing the comfort



Typical home energy usage breakdown

Pie chart based on the data from

1) <https://www.eia.gov/consumption/residential/data/2020/index.php?view=consumption&utm>

2) <https://www.eia.gov/todayinenergy/detail.php?id=57321&utm>

DIY Home Energy Audit: Become Your Own Energy Detective

Before making improvements, it's crucial to identify where your home is losing energy. A professional audit can cost \$300-600, but you can perform a basic assessment yourself with these steps:

Exterior Inspection

- Check all exterior corners, outdoor water faucets, and areas where different building materials meet
- Inspect areas where foundation meets the siding for gaps or cracks
- Examine door and window frames for gaps or deteriorated caulking
- Look for daylight through door edges and ensure weatherstripping is intact

Interior Assessment

- Test for air leaks by closing windows, doors, and dampers, turning off combustion appliances, then using an incense stick to detect drafts
- Check electrical outlets and switch plates for air leaks
- Inspect attic insulation levels (R-49 to R-60 recommended*)
- Examine ductwork for disconnected segments or visible leakage

Appliance & System Review

- List the age of major appliances—many older models use 2-3 times more energy than newer ENERGY STAR® certified versions
- Check HVAC filter condition and replace if dirty
- Inspect water heater settings (120°F is typically sufficient)
- Calculate lighting efficiency by counting incandescent bulbs that could be replaced

Documentation

- Create a floor plan noting problem areas
- Take photos of issues for reference
- Gather 12 months of utility bills to establish baseline energy use
- Use the free Home Energy Saver tool (homeenergysaver.lbl.gov) to estimate potential savings

* Source DOE – insulation recommendations by climate zone <https://www.energy.gov/energysaver/insulation?utm>

After Audit Findings, Prioritizing Your Energy Projects

After completing your DIY audit, you'll likely discover multiple opportunities for improvement. Here's how to prioritize your projects for maximum impact:



Start with No-Cost Changes

Adjusting behaviors costs nothing but can yield immediate savings:

- Lowering thermostat 7-10°F for 8 hours daily saves up to 10% annually
- Using cold water for laundry cuts water heating energy by 90%
- Running full loads of dishes and laundry maximizes efficiency
- Closing curtains on sun-facing windows in summer reduces cooling costs



Address Low-Cost, High-Return Projects

These affordable improvements typically pay for themselves within months:

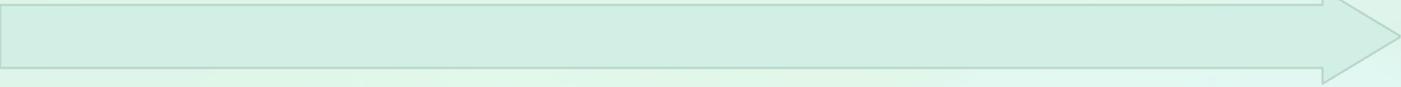
- Sealing air leaks with caulk and weatherstripping (\$20-50 in materials)
- Installing a programmable thermostat (\$25-250)
- Replacing HVAC filters regularly (\$10-30 each)
- Adding attic door insulation (\$20-100)



Plan for Moderate Investments

These projects require some investment but deliver long-term returns:

- Adding insulation to attics, walls, or floors (\$200-1,500+)
- Upgrading to LED lighting throughout home (\$100-300)
- Installing water-efficient fixtures (\$20-300)
- Sealing and insulating ductwork (\$300-500)



Consider Major Upgrades When Appropriate

Reserve these for when existing equipment fails or renovations are planned:

- Replacing windows (\$5,000-20,000)
- Upgrading to high-efficiency HVAC systems (\$3,000-10,000)
- Installing tankless water heaters (\$800-3,000)
- Adding smart home energy management systems (\$200-1,500)

Remember: Focus first on the building envelope (the barrier between conditioned and unconditioned space) before upgrading mechanical systems. A tight envelope maximizes the efficiency of everything else.

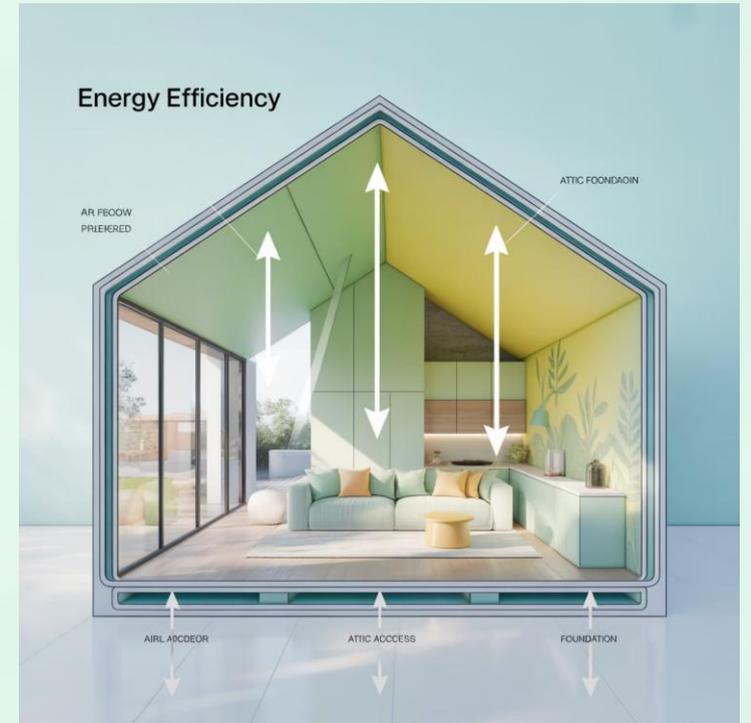
Weatherization 101: Sealing Your Home's Envelope

Air leakage accounts for 25-40% of the energy used for heating and cooling in a typical home. Properly sealing your home's envelope is one of the most cost-effective energy improvements you can make.

Air Sealing Essentials

Target these common leak locations for maximum impact:

- **Door and window frames:** Apply caulk to stationary cracks and weatherstripping to moving components
- **Baseboards and crown molding:** Use clear or paintable caulk for gaps where walls meet floors and ceilings
- **Electrical outlets and switches:** Install foam gaskets behind cover plates (turn off power first!)
- **Plumbing, electrical, and HVAC penetrations:** Seal with expanding foam for larger gaps or silicone caulk for smaller ones
- **Attic hatches and basement doors:** Add weatherstripping and insulation board
- **Recessed lighting:** Use specially designed airtight covers for non-insulation contact rated fixtures
- **Fireplace dampers:** Ensure proper closure and consider a chimney balloon when not in use



Materials Guide

- **Caulk:** Silicone for non-porous surfaces (bath, kitchen); acrylic latex for general use; expandable for larger gaps
- **Weatherstripping:** V-strip for windows; door sweeps for exterior doors; foam tape for irregular gaps
- **Expanding spray foam:** Great for larger holes and odd-shaped gaps
- **Gaskets:** Pre-cut foam for electrical outlets and switch plates

Weatherization 101: Sealing Your Home's Envelope

Materials Guide



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Insulation: Your Home's Thermal Blanket

While air sealing stops the flow of air, insulation slows the transfer of heat.

Together, they're the dynamic duo of energy efficiency.

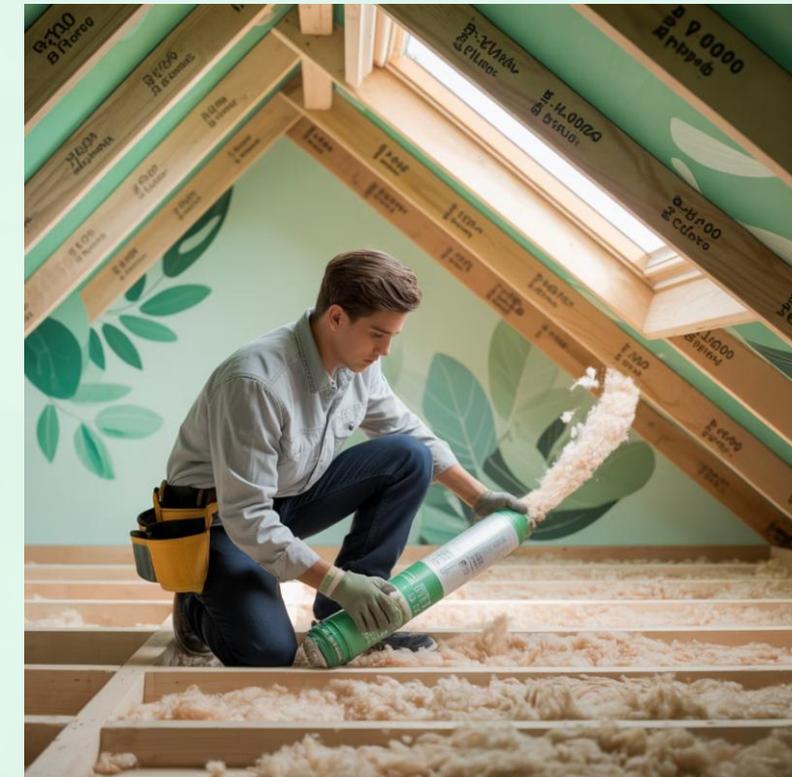
Understanding insulation requires familiarity with R-values—the measure of thermal resistance.

Recommended R-Values by Climate Zone

Home Area	Midwest, US
Attic	R-49 to R-60
Walls	R-13 to R-21
Floors	R-25 to R-30
Crawlspaces	R-13 to R-19

Common Insulation Types

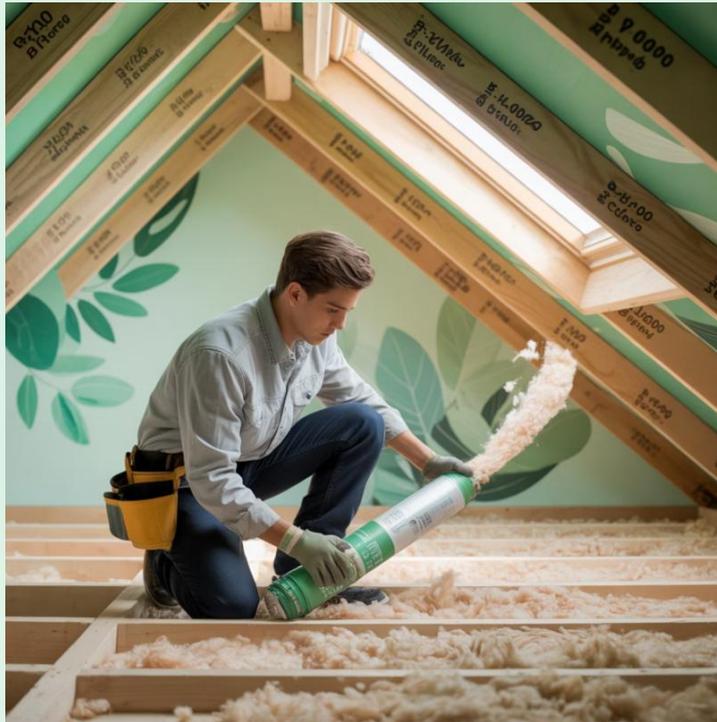
- **Fiberglass batts:** Most common, DIY-friendly, R-2.9 to R-3.8 per inch
- **Cellulose:** Made from recycled paper, excellent for retrofits, R-3.1 to R-3.8 per inch
- **Mineral wool:** Fire resistant, excellent soundproofing, R-3.0 to R-3.3 per inch
- **Spray foam:** Highest R-value (R-3.7 to R-6.5 per inch) and air sealing in one, professional installation
- **Rigid foam board:** Great for basements and continuous insulation, R-3.8 to R-6.5 per inch
- **Reflective/radiant barriers:** Excellent for hot climates, not commonly recommended for the Midwest



Insulation: Your Home's Thermal Blanket

DIY-Friendly Insulation Projects

- **Attic floor insulation:** Typically, the highest ROI project with payback periods of 1-3 years
- **Rim joist insulation:** Sealing and insulating the perimeter of your basement ceiling prevents significant heat loss
- **Water heater blanket:** Insulating older water heaters can reduce standby heat losses by 25-45%
- **Pipe insulation:** Foam sleeves for hot water pipes improve efficiency and prevent freezing



When to Hire Professionals

- Wall cavity insulation (dense-pack or injection foam)
- Spray foam applications
- Crawlspace or basement insulation with moisture concerns
- Attics with complicated electrical or ventilation issues

Window Wisdom: Options for Every Budget

Windows typically account for 25-30% of residential heating and cooling energy use.

Full replacement is expensive, but there are multiple options depending on budget:

Budget-Friendly Solutions

Mid-Range Improvements

Replacement Options

Window Wisdom: Budget-Friendly Solutions

Budget-Friendly Solutions



- **Weatherstripping:** \$5-10 per window to seal air leaks around movable parts
- **Caulking:** \$3-5 per window to seal fixed components
- **Window film:** \$15-25 per window for heat-shrink plastic film (winter) or solar control film (summer)
- **Cellular shades:** \$40-120 per window, create insulating air pockets
- **Thermal curtains:** \$30-150 per window, can reduce heat loss by up to 25%

Window Wisdom: Mid-Range Improvements

Mid-Range Improvements

- **Interior storm windows:** \$100-300 per window, removable panels that add insulation value
- **Exterior storm windows:** \$150-400 per window, permanent additions that protect and insulate
- **Window inserts:** \$100-400 per window, custom-made acrylic panels that press into place
- **Solar screens:** \$50-150 per window, reduce solar heat gain by up to 70%
- **Awnings:** \$200-500 per window, can reduce solar heat gain by up to 77%



Window Wisdom: Replacement Options

Replacement Options



- **Sash replacement:** \$300-800 per window, keeps existing frame but updates operational parts
- **Insert windows:** \$400-1,000 per window, new window within existing frame
- **Full-frame replacement:** \$600-2,000+ per window, complete removal and replacement

Energy-Efficient Window Features:

- Double or triple glazing with insulating gas fill
- Low-E coatings to reflect infrared light
- Warm edge spacers to reduce heat transfer
- Look for ENERGY STAR® certification and low U-factor (typically 0.30 or less)

Lighting Efficiency: Bright Ideas for Energy Savings

Lighting accounts for approximately 15% of a typical home's electricity use. Upgrading to efficient lighting is one of the easiest and most cost-effective energy improvements available.

Lighting Technology Comparison

Feature	Incandescent	CFL	LED
Energy Efficiency	Very Poor	Good	Excellent
Lifespan (hours)	750-1,000	8,000-10,000	15,000-25,000+
Annual Operating Cost*	\$6.60	\$1.60	\$1.00
Upfront Cost	\$0.50-1.50	\$2-5	\$2-8
Contains Mercury	No	Yes (trace)	No
Instant On	Yes	No	Yes
Dimmable	All	Some	Most

*Per bulb, 3 hours/day at \$0.12/kWh for equivalent 60W brightness



Lighting Efficiency: Light and Color Guide

Light Brightness Guide

Lumens measure brightness, while watts measure energy consumption. When replacing incandescent bulbs, use this conversion chart:

- 40W incandescent = 450 lumens
- 60W incandescent = 800 lumens
- 75W incandescent = 1,100 lumens
- 100W incandescent = 1,600 lumens

Color Temperature Guide

Measured in Kelvins (K), color temperature affects mood and functionality:

- **2700K (Warm White):** Cozy, relaxing spaces like bedrooms and living rooms
- **3000K (Soft White):** Versatile, good for kitchens and bathrooms
- **4000K (Cool White):** Energizing, ideal for workspaces and offices
- **5000K+ (Daylight):** Maximum alertness, best for detail work

Lighting Efficiency: Bright Ideas for Energy Savings



Smart Lighting Options

- Motion sensors for seldom-used spaces (15-40% savings)
- Dimmers to reduce energy use when full brightness isn't needed (5-15% savings)
- Smart bulbs with scheduling, remote control, and occupancy sensing (25-60% savings)
- Light zoning to ensure only needed areas are illuminated

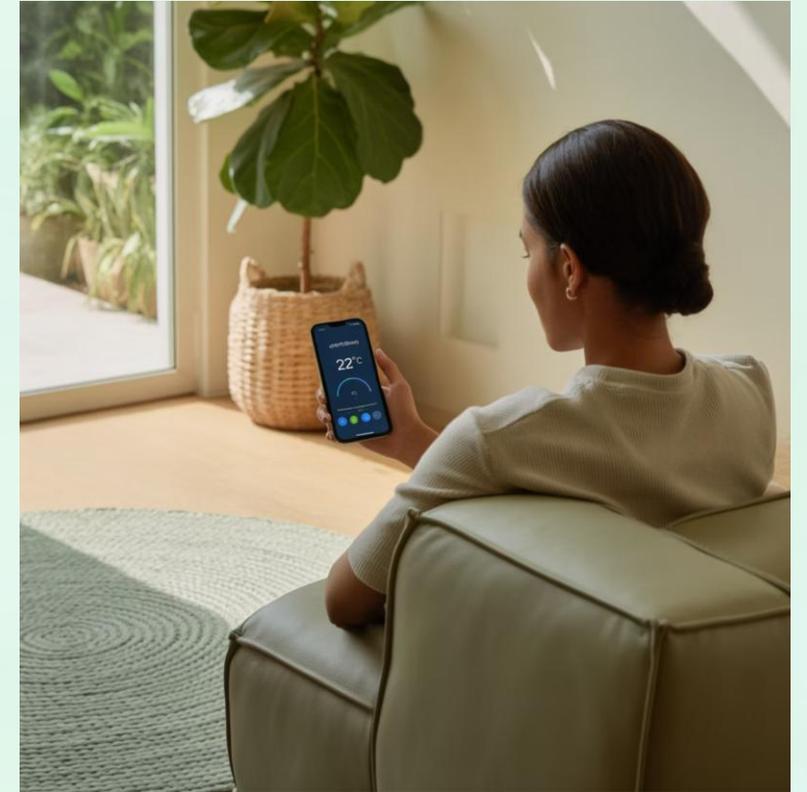
Smart Thermostats: Climate Control Gets Intelligent

Heating and cooling typically represents 40-50% of a home's energy consumption. Smart thermostats can reduce this by 8-15% on heating and about 6-10% on cooling, saving the average household \$50-200 annually.

How Smart Thermostats Work

Unlike basic programmable thermostats, smart models offer advanced features that maximize comfort while minimizing energy use:

- **Learning algorithms** that adapt to your schedule and preferences automatically
- **Occupancy sensing** to detect when the home is empty and adjust accordingly
- **Geofencing** that tracks your smartphone location to know when you're heading home
- **Weather-responsive operation** that adjusts based on outside conditions and forecasts
- **Remote control** via smartphone apps for adjustments from anywhere
- **Energy usage reports** with personalized recommendations for further savings
- **System monitoring** to detect inefficiencies or maintenance needs
- **Voice control** through integration with smart home ecosystems



Smart Thermostats: Optimizing and Installation

Optimizing Your Smart Thermostat

- Enable all energy-saving features during setup
- Use the "away" or "vacation" mode when traveling
- Review energy reports monthly and adjust habits accordingly
- Consider seasonal adjustments to temperature preferences
- Integrate with utility demand response programs for additional savings

Installation Considerations

Most smart thermostats can be installed as a DIY project in 30-60 minutes, but there are important compatibility factors to check:

- **C-Wire requirement:** Most smart thermostats need a common wire for constant power. Some homes built before 2000 may not have this wire.
- **System compatibility:** Verify your HVAC system type is supported (conventional, heat pump, multi-stage, etc.)
- **Voltage:** Most smart thermostats work with standard 24V systems but not with high-voltage systems used in some baseboard heating
- **Zone systems:** Homes with multiple heating/cooling zones need multiple thermostats or a compatible zoned solution
- **Wi-Fi connectivity:** The thermostat location needs reliable Wi-Fi signal

Beyond The Basics: Advanced Energy-Saving Upgrades

Once you've tackled the essentials, consider these higher-impact improvements for even greater energy efficiency and comfort:

Water Heating Optimization

Water heating accounts for approx. 18% of home energy use. Consider:

- Tankless water heaters (30-50% more efficient)
- Heat pump water heaters (2-3 times more efficient)
- Tank insulation blankets for existing heaters
- Hot water recirculation systems to reduce water waste
- Drain water heat recovery systems

Appliance Upgrades

When replacing appliances, look for:

- ENERGY STAR® certification (typically 10-50% more efficient)
- High MEF (Modified Energy Factor) for washers
- Low EF (Energy Factor) for dryers
- Induction cooktops (25% more efficient than electric resistance)
- Heat pump clothes dryers (20-60% more efficient)

HVAC Optimization

Beyond your thermostat:

- Duct sealing (can improve efficiency by 20%)
- Regular professional maintenance
- Zoning systems for multi-level homes
- Variable speed air handlers
- Smart vents for room-by-room control
- Ceiling fans for improved air circulation

Phantom Load Reduction

Standby power can account for 10% of home electricity use:

- Advanced power strips that cut power to idle devices
- Home energy monitors to identify energy vampires
- Smart plugs and outlets with scheduling capabilities
- Whole-house switches for vacation mode

Renewable Energy: The Energy Upgrade

After optimizing your home's efficiency, consider renewable energy systems to further reduce your carbon footprint and potentially eliminate your energy bills entirely.

Residential Solar Power Systems

Solar photovoltaic (PV) systems have become increasingly affordable, with costs dropping over 70% in the past decade. A typical residential system:

- Costs \$15,000-25,000 before incentives (\$10,000-15,000 after federal tax credit)
- Provides 5-8 kilowatts of generation capacity
- Produces 7,000-12,000 kWh annually (region dependent)
- Has a payback period of 7-12 years in most areas
- Carries warranties of 25+ years with minimal maintenance
- Increases home value by approximately \$15,000-20,000



Renewable Energy: Options

Financing Options

- **Cash purchase:** Highest return on investment
- **Solar loans:** Many solar-specific loan products with low interest rates
- **Power Purchase Agreements (PPAs):** No upfront cost, pay only for electricity produced
- **Leases:** Fixed monthly payment regardless of production
- **Community solar:** Subscribe to a shared solar farm if your property isn't suitable



Other Renewable Options

Solar Water Heating

60-80% more efficient than electric water heating
\$4,000-8,000 installed cost before incentives
3-8 year payback period

Geothermal Heat Pumps

300-500% efficient compared to conventional heating/cooling
\$10,000-30,000 installed cost before incentives
50+ year ground loop lifespan
30-60% reduction in heating and cooling costs

Your Energy Efficiency Action Plan

Follow these steps to transform your home into an energy-saving, comfort-enhancing environment.
Time to create a personalized action plan -

1

Assess Your Current Situation

- Complete the DIY energy audit outlined earlier
- Review 12 months of utility bills to identify seasonal patterns
- Consider professional audit for detailed analysis
- Document problem areas with photos and notes

2

Set Clear Goals

- Define your priorities: cost savings, comfort, environmental impact
- Establish a realistic budget for improvements
- Set target energy reduction percentage (15-30% is achievable for most homes)
- Create a timeline with short and long-term objectives

3

Start With Quick Wins

- Implement no-cost behavioral changes immediately
- Complete low-cost air sealing and insulation projects
- Install programmable or smart thermostat
- Replace most frequently used light bulbs with LEDs
- Add weatherstripping to doors and windows

4

Plan Larger Investments

- Research available incentives and financing options
- Get multiple quotes for major improvements
- Coordinate upgrades with existing renovation plans
- Consider the sequencing of projects for maximum effectiveness
- Evaluate renewable energy options after efficiency improvements



Your Energy Efficiency Tracking Plan



Track and Celebrate Progress

Monitoring your energy usage helps maintain motivation and identify additional opportunities:

- Compare utility bills year-over-year to quantify savings
- Use energy monitoring tools to track real-time consumption
- Document improvements in comfort and indoor air quality
- Calculate your reduced carbon footprint
- Share your success stories to inspire others

✔ Remember

Every step you take toward energy efficiency, no matter how small, makes a difference—for your wallet and your comfort. Start where you can and build momentum toward a more efficient home.