Super-Efficient, All-Electric New Homes Pilot: Consumers Energy-NRDC Collaboration

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2021 Midwest Energy Efficiency Alliance Conference

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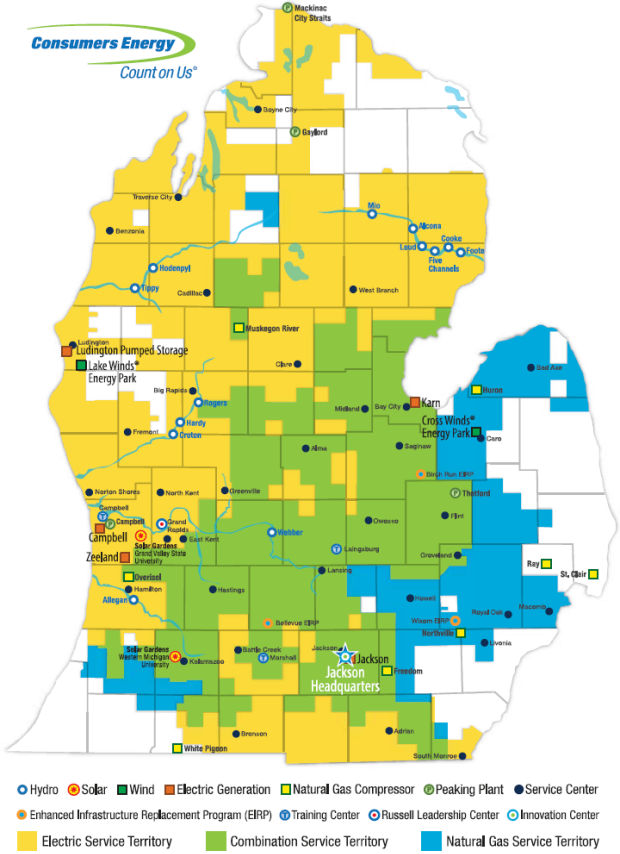
Michigan IOU

- 1.8 million electric customers
- 1.7 million gas customers
- Only partial overlap

Most recent IRP

- 80% CO2 reduction by 2040
- Coal plant retirements
- Capacity replaced w/EE, DR, renewables

Increasing and aggressive EE targets



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Natural Resources Defense Council

Non-profit environmental advocacy group

- Offices in NY, Washington, San Fran, LA, Bozeman, New Delhi & Beijing
- 3 million members; ~600 Staff
- working on climate, energy, water, land, and wildlife issues.

Midwest Office opened in Chicago in 2007

- Importance of Midwest to clean energy future
- 400,000 members in the region

Extensive energy work in Michigan

- Efficiency planning
- Demand response planning
- Integrated resource planning
- Distribution system planning

- *Regulatory proceedings*
- *Legislation*
- *Stakeholder processes*
- *Direct utility engagement*

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Pilot Timeline

- **Phase 1: Affordable Housing Demonstration Projects**
  - Spring 2020 thru Spring 2021
  - $362k design/implementation + $150k incentives
  - Kalamazoo Neighborhood Housing Services partnership
  - 4 single-family homes (completion expected soon)
- **Phase 2: Market Rate + Income Qualified Pilot**
  - 2021 thru 2022
  - Goal of 50 homes
  - $209k implementation + $375k incentives

Evaluation of energy impacts, customer comfort, builder feedback, etc. at applicable points in time

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Pilot Concept

- **Part of solution to climate concerns**
  - Aligns w/Consumers IRP goals for carbon emissions reduction
  - Integration of EE and RE
- **Test performance in MI climate**
  - Energy
  - Comfort
- **Test potential builder interest**
  - Affordable/subsidized housing
  - Market rate housing

Program Requirements

- **HERS efficiency rating of 40 or lower**
- **Certified “cold climate” air source heat pump**
- **PV-ready**
  - DOE ZERH checklist

Recommended Efficiency Measures

Home Component	Recommended Measure
Air-Source Heat Pump or Mini-Split Heat Pump*	Selected from NEEP's ccASHP Product List
Whole-Home Ventilation	HRV or ERV
Heat Pump Water Heater	UEF 2.00+
Infiltration	1.50 ACH or less
Insulation	Ceiling/Attic Insulation R-Value: 60+ Wall Insulation R-Value: 30+ Basement or Slab Insulation R-Value: 20+
ENERGY STAR Certified Windows	U-Value: 0.20 or lower
Cooktop	Induction
ENERGY STAR® Certified Appliances†	CEE Tier II
ENERGY STAR LED	100% LED

*For Non-Ducted systems: HSPF >10, For Ducted systems: HSPF >9, COP @5°F >1.75 (at maximum capacity operation), SEER > 15
†Tier II – This level signifies energy efficiency at 25% above government mandate

HERS 40 is an efficiency performance standard, so these are just recommendations. Builder can use alternative mix of measures.

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Working Together to Build a Better Future

A Scalable / Replicable Model for Accessible Clean Energy Solutions in LMI Communities

Implementation Contractor

ICF

Community Non-Profits Providing Financial Support

KAHP seeks to provide high-quality homes built by HBA members that are both attainable in cost and provide the homeowners with low maintenance costs. KAHP is an umbrella program comprising the Kalamazoo partners. https://www.kalamazoohomepage.com/kahp-information

HBAWMI members build attainable homes in Kalamazoo's underserved neighborhoods. The HBA has developed "house in a box" designs that integrate the most efficient construction possible. By partnering with member suppliers, HBA members can provide high-quality materials at discounted pricing. https://www.kalamazoohomepage.com/

KNHS is the builder fiduciary and pass-through for Consumers Energy incentives. KNHS is a non-profit offering a variety of specialized loan products and financial education services to LMI customers. https://knhs.org/

The Local Initiatives Support Corporation is a Community Development Financial Institution (CDFI) that offers financing during all stages of projects — predevelopment, property acquisition, construction, and permanent. https://www.lisc.org/kalamazoo/

The Foundation for Excellence provides the buy-down subsidy. A unique innovation by the City of Kalamazoo and private donors to address systemic challenges to the prosperity of the city and fund aspirational community projects. https://www.kalamazoocity.org/ffe

Participating Builders & Raters

Landmark Homes of Michigan

Osborne Construction & Maintenance, LLC

Martz Home Builders

Energy Diagnostics

Key Local Contractors

Craft Mechanical
Kalamazoo, MI
Mitsubishi Diamond HVAC Contractor

Home Energy Solutions
Fujitsu Elite HVAC Contractor

Green Panel
Rooftop Solar PV Installer

MARKET TRANSFORMATION OBSERVATION Although Energy Star certification is not a program requirement, the Kalamazoo partners are leveraging this opportunity to pursue certification, which enables them to tap into mortgage funding, strengthen the pipeline of qualified HVAC contractors and bring distinction to their community initiative.

Phase 1 All-Electric Demonstration Homes

AFFORDABLE SINGLE-FAMILY HOMES | SUPER EFFICIENT NEW CONSTRUCTION | 1,440 SQ. FT. | 2-STORY

$16,000 Incentive for Electric Measures & Envelope Upgrades

$24,000 Incentive for Rooftop Solar PV*

Each home features:

- Industry leading cold climate heat pumps by Mitsubishi or Fujitsu
- Intelligently designed 8.45 kW-dc rooftop solar PV system*
- Energy Star® appliances
- Energy Star® triple-pane windows
- Comprehensive air sealing and premium insulation (R-25 wall with 2" spray foam and R-60 ceiling)
- 240V outlet for fast electric vehicle charging
- 3 BR, 2.5 Bath or 4 BR, 3 Bath builds

*Because of its orientation and limited suitable roof space, the solar PV system on the 4th home was limited to 5.2 kW with a $15,500 incentive.

These all-electric spec homes use the same floor plan as their 2019 dual fuel counterparts, providing EM&V opportunities.

Check out a Virtual Tour of the 2019 Dual Fuel Home

Forecast of Near Zero Net Energy Because of PV

- Drive homes as close as feasible to zero net energy (ZNE) on an annual basis
- Set annual solar electricity output at ~ 85% of expected on-site consumption (on first three homes), to avoid over-producing annually in violation of utility tariff rates. Set at lower % on fourth home due to roof orientation and shading.

Image courtesy of Osborne Construction
9/29/2020 Kalamazoo, MI

Images taken
12/29/2020

124 BURR OAK STREET

View of the main living space which includes kitchen with peninsula, powder room, large pantry and 2 closets. This home has 3 bedrooms upstairs and rough plumbing for a basement bathroom. A 2-ton Fuijtsu cold climate ASHP with ERV will be installed in this home.

118 FELLOWS AVENUE

This home has enough suitable roof space to host an 8.45 kWdc solar PV system.

Energy Star triple pane windows help create an efficient envelope. This window header is framed to accommodate insulation. Caulking gaps and spray foam insulation will help create airtight home.

1015 ALBERT AVENUE

This home has since been framed and roofed. Its ready for rough plumbing, mechanical and electrical.

Images taken
12/29/2020

124 BURR OAK STREET

Drywall, finishes and the rooftop PV system are next.

These all-electric spec homes use the same floor plan as their 2019 dual fuel counterparts, providing EM&V opportunities.
Check out a Virtual Tour of the 2019 Dual Fuel Home shown above

Phase 1 Modeled Results

HERS® 43

HERS index dropped 20 points with the planned measures. With the addition of solar PV, these homes can reach a HERS index of 15.

50 MMBtu

Annual energy savings per home before the addition of solar PV when compared to baseline dual fuel home.

59%↓

Reduction in gross energy consumption before addition of solar PV system when compared to baseline dual fuel home.

78%↓

Reduction in annual energy costs to the customer with the addition of a rooftop solar PV system.

COVID Challenges and How Addressed

Challenge	Steps taken	Outcome to date
In-Person Builder Engagement	Held cameras-on video conferences and frequent communications via email and phone.	• Strong interest in building all-electric. KNHS intends to commit to 8 IQ homes. • HBA-WMI raised interest in another 8 units with other developers for 2021. • Electric homes featured on HBA-WMI website and in podcasts.
Permitting & Inspection Delays Due to Disruption in Municipal Functions	Implemented flexible incentive structure for Phase 1 • Initial payment at builder signing. • Final at CofO contingent on QA/QC.	KNHS has worked with us to meet payment requirements through timeline shifts and granted us access to the homes for QA/QC to stay on track.
Material Cost Increases	Allocated15% additional budget to cover prices increases in Phase 1.	Not used to date on incentive measures.
Supply Chain Disruptions	Worked with builders to source alternatives and revise schedules as needed.	No meaningful impact to home performance • Swapped new tech thin-triple pane windows for Energy Star triple-pane windows. • Fujitsu ccHP condenser units delayed until January due to availability. • HPWH was initially slated for a 3-month delay. Arrived within weeks of order and stored by builder.

Recruiting Effort

Tier 1

- Homebuilders and rating companies currently participating in Residential New Construction program

Tier 2

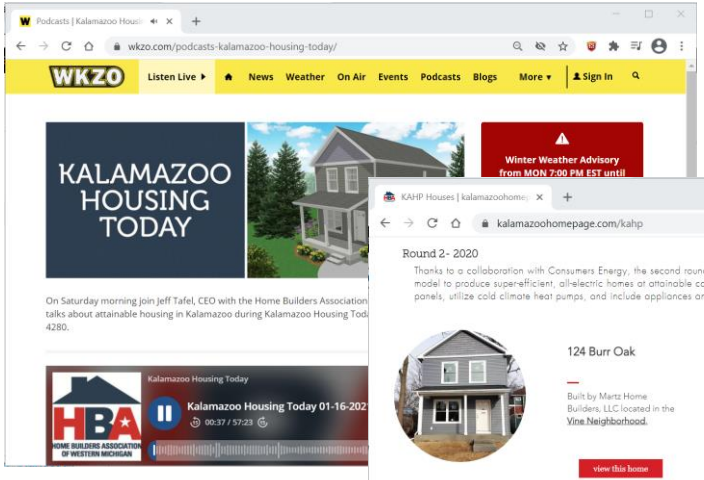
- Collaboration with Stakeholder Groups (Green Home Institute)
- Outreach through HBA's

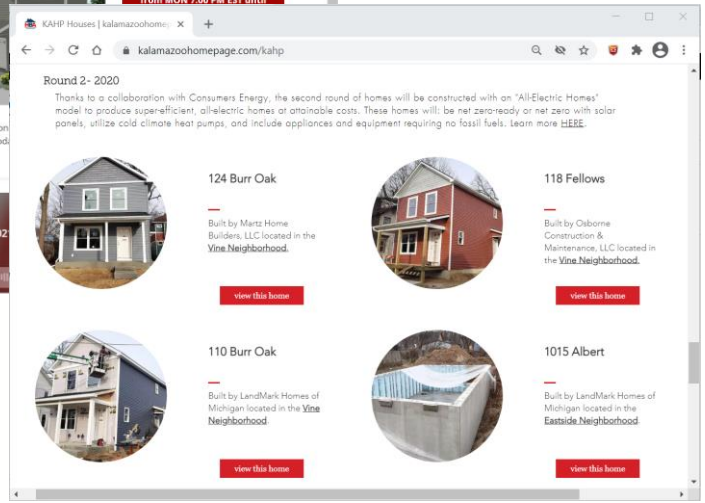
Tier 3

- Contractors & Distributors (e.g., Mitsubishi, Fujitsu)
- Webinar opportunities

Receptivity and Excitement of Builders

Podcast Saturdays @9am





HBA Website Features All-Electric Homes

Myself, Dan Martz and Kevin Osborne were excited to learn and work with new technology to us on these four Pilot Project homes. None of us had experience with an all electric home or a home with solar power. The Consumers /ICF team has been great to work with providing coaching, organization and structure allowing us to build and learn effectively. All of us have learned about new systems and building better, more energy efficient homes that will be comfortable and save the homeowners money every month. We all look forward to continued learning and working with Consumers/ICF on future projects.

Aaron Hovestadt
Managing Partner, LandMark Homes of Michigan
President, HBA of Western Michigan

What's Next?

- Continue to evaluate opportunities to scale:
  - Decrease administrative costs
  - Decrease incentive amounts
  - Increase participation
- Measurement & Validation
  - Energy bill impacts
  - Heat pump performance
  - Customer comfort
  - Builder barriers
  - Cost-effectiveness
  - Builder & Customer Interviews
- Collaboration with Renewables Team or C&I Offering
- Expanding Pilot to a Second Phase

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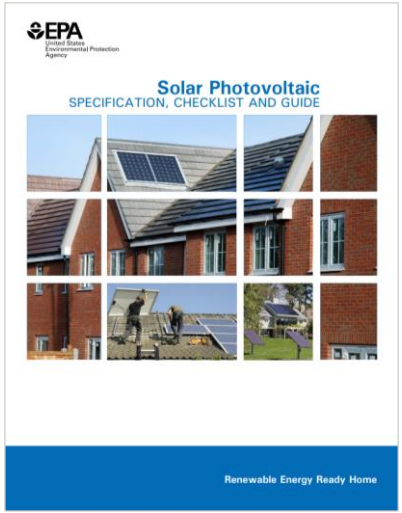
DOE Zero Energy Ready Home PV-Ready Checklist

These requirements were adapted from the EPA's Renewable Energy Ready Home Solar Photovoltaic Specification Guide. This guide can be accessed on the DOE Zero Energy Home program website.



DOE Zero Energy Ready Home PV-Ready Checklist

ZERO ENERGY READY HOME U.S. DEPARTMENT OF ENERGY

DOE Zero Energy Ready Home National Program Requirements Mandatory Requirement 7 (Renewable Ready) shall be met by any home certified under the DOE Zero Energy Ready Home program, only where **all three conditions** of the following conditions are met. If any of these three conditions is not met, the home is exempt from requirements contained in the PV-Ready checklist.

1. Location, based on zip code has at least 5 kWh/m^2/day average daily solar radiation based on annual solar insolation using PVWatts online tool: http://gisatnrel.nrel.gov/PVWatts_Viewer/index.html **AND**;
2. Location does not have significant natural shading (e.g., trees, tall buildings on the south-facing roof, **AND**;
3. Home as designed has adequate free roof area within +/-45° of true south as noted in the table below.

Conditioned Floor Area of the House (sq. ft.)	Minimum Roof Area within +/- 45° of True South for PV-Ready Checklist to Apply (ft^2)
≤ 2000	110
≤ 4000	220
≤ 6000	330
> 6000	440

Note:
- If a solar photovoltaic system is included with the home, then compliance with the Consolidated RERH checklist is not required.

These requirements were adapted from the EPA's Renewable Energy Ready Home Solar Photovoltaic Specification Guide (RERHPV Guide). For further guidance on any of the above items, this checklist notes the section of the guide. This guide can be accessed on the DOE Zero Energy Home program website at http://www1.eere.energy.gov/buildings/residential/pdfs/rerh_pv_guide.pdf

Designate a proposed array location and square footage on architectural diagram: **PV** _____ sq.ft. *(RERHPV Guide 1.1)*	☐
Identify orientation (Azimuth) of proposed array location: **PV** _____ degrees. *(RERHPV Guide 1.2)*	☐
Identify Inclination of proposed array location: **PV**_____ degrees. *(RERHPV Guide 1.3)*	☐
Provide code-compliant documentation of the maximum allowable dead load and live load ratings of the existing roof; recommended: allowable dead load rating can support an additional 6 lbs/sq. ft. for future solar system. *(RERHPV Guide 2.1)*	☐
Provide architectural drawing of solar PV system components. *(RERHPV Guide 3.5)* **Alternative**: Provide home buyer with the following information: ➢ List of renewable-ready features ➢ Available free roof area within +/- 45° of true south ➢ Location of panel or blocking for future mounting of PV system components ➢ Location of Breaker or slot for future breaker in electrical service panel ➢ Copy of the PV-Ready Checklist ➢ A copy of the RERH Solar PV Specification Guide	☐
Install a 1" metal conduit for the DC wire run from the designated array location to the designated inverter location (cap and label both ends). *(RERHPV Guide 3.2)*	☐
Install a 1" metal conduit from designated inverter location to electrical service panel (cap and label both ends). *(RERHPV Guide 3.3)*	☐
Install and label a 4' x 4' plywood panel area for mounting an inverter and balance of system components. *(RERHPV Guide 3.1)* **Alternative:** Blocking is permitted to be used as an alternative to the 4' x 4' panel. The area designated for the future panel to mount PV components shall be clearly noted in the system documentation.	☐
Install a 70-amp dual pole circuit breaker in the electrical service panel for use by the PV system (label the service panel) *(RERHPV Guide 3.4)* **Alternative:** Provide a labeled slot for a double-pole breaker in the electrical service.	☐