# Net Zero Energy: Pipedream to Reality

Friday – October 4 Concurrent Sessions 2:00 – 3:00 pm EQUITABLE & HEALTHY COMMUNITIES TRACK

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#### Agenda

- What is Net Zero?
- A survey of Net Zero policies nationally
- A review of the current and potential Net Zero market
- Engagement (Opportunities and Barriers in your local community)
- Impacts urban design decisions can have on net zero energy buildings.
- Practical things planners can do to encourage Net Zero to benefit their communities.
- Case Study City of Eau Claire, WI

#### What is Net Zero Energy?

# What is Net Zero Energy?

The most common definition is: Energy

"A building that produces at least as much renewable energy as it uses in a year"



Graphic Source: Red Car Analytics

#### WHY Build Net Zero Energy Buildings?

"Zero energy has done more to define our brand than any other strategy we have used. Various programs that incrementally reduce energy consumption lack the impact of zero energy. We call it the Power of Zero." - Gene Myers, CEO of Thrive Home Builders



Source: Rocky Mountain Institute

#### How is Net Zero Energy Achieved?



Graphic Source: City of Cambridge

# The Importance of Energy Efficiency

**Exploration of value potential – Elk River City Hall** 

Renewable Energy Study Based on Existing EUI Net Zero Savings: -\$310,000 Net Zero Ready Savings: \$0



# The Importance of Energy Efficiency

**Exploration of value potential – Elk River City Hall** 

Renewable Energy Study ASHRAE 90.1 EUI Net Zero Savings: \$12,150 Net Zero Ready: \$243,000



Elk River City Hall Area: 45,195 Existing EUI: 95 Annual Electrical: \$40,500

#### Renewable Energy Payback EUI 30% Reduced

Need: 236,880 kwh annually Solar panels required: 15,983 sf System size: 224 kw System cost: \$783,167 Simple payback: 19.3 years Life-time Savings: **\$12,150** 

# The Importance of Energy Efficiency

**Exploration of value potential – Elk River City Hall** 

Renewable Energy Study High Performance EUI Lifetime Savings: \$417,150 Net Zero Ready: \$526,500



Elk River City Hall Area: 45,195 Existing EUI: 95 Annual Electrical: \$40,500

#### Renewable Energy Payback High Performance EUI

Need: 118,440 kwh annually Solar panels required: 8,002 sf System size: 112 kw System cost: \$391,655 Simple payback: 9.7 years Life-time Savings: **\$417,150** 





Source: Rocky Mountain Institute

Return on Investment: 10-12 years



Projected future costs: Premium: 50-55% reduction by 2030

Return on Investment: 5-6 years







Annual bill for a net-zero energy home.

A net-zero energy house produces as much energy as it consumes over the course of a year. Residences consume 21 percent of energy in the U.S. and produce 16 percent of the country's greenhouse gas emissions.

Source: BNP Media



Increase in net-zero energy housing units in the U.S. in 2017.

In contrast, 2016 showed a 33 percent increase over the previous year.





Number of net-zero energy single-family homes in the U.S.

There are also over 7,000 net-zero energy multifamily units. California is the leader by volume, followed by Arizona. Other strong regions in North America include the Pacific Northwest and western Canada, the rest of the U.S. Sun Belt, the Northeast through the Great Lakes region, Hawaii, and Florida. The Heartland, Alaska, and far-northern Canada have the least amount of activity in residential net-zero energy construction.

Source: BNP Media

Savings over 30 years, per an estimate by California commissioners, once the California mandate goes into effect.

Added upfront cost is estimated at \$9,500, but the 30-year average works out to a savings of \$80/month.



Increasing Energy Efficiency Regulation Federal Buildings

# Energy Independence and Security Act of 2007, Section 433(a)

"Federal buildings must reduce fossil fuel-generated energy consumption by increasing percentages reaching 100% reduction in 2030"

#### Executive Order 13693, Section 3(h)(i) – Issued 2015

"Beginning in fiscal year 2020 and thereafter,...all new construction of Federal buildings greater than 5,000 gross square feet must be designed to achieve Net Zero Energy by 2030"

Increasing Energy Efficiency Regulation Federal Buildings

#### GSA

30% Energy Reduction by 2025 100% Net Zero by 2030 **Army** 

25 Installations Net Zero by 2030

#### Navy

50% Shore-based Installations Net Zero by 2020

#### Marines

50% Shore-based Installations Net Zero by 2020







Increasing Energy Efficiency Regulation State Buildings

**48** states with efficiency requirements on State portfolio

**41** require **P**ortfolio efficiency Planning/Monitoring

34 Require >20% reduction

**6** Require 50-100% reduction in 10 years

**6** with program funding totaling \$1.4B to be spent through 2020

Requirements for State Buildings

 None

 Energy Requirements

 Performance Targets

 Increasing Targets

 Very High (50-100% efficiency)



Increasing Energy Efficiency Regulation <b>Private Buildings</b>	<b>Arizona:</b> n	Tucson and Pima County's Net Zero Energy Standard code includes a prescriptive residential section and a prescriptive commercial section covering apartments, office and retail
	<b>California</b> :	Requiring net zero residential construction starting 2020, commercial starting 2030
	Massachusetts:	allows net zero stretch building codes by local
	Minnesota:	jurisdictions, currently considering requiring net zero residential construction SB 2030 requires state buildings to progressively reduce emissions to an 80% reduction by 2030 as well as requiring on-site renewable where fiscally feasible. Push to allow Cities to implement stretch codes
	New York	Requiring 100% renewable energy state-wide by 2050
	Oregon	Requirement for State buildings to achieve Net Zero ready status





Mexico

Mazatlán <sup>e</sup>

Source: Buildingrating.org

Policy

Dominican

Havana •

Zero Energy Building Growth



Source: New Buildings Institute



ZE Growth by Building Sector

Commercial 400 Private **Evenly** split 46% Public Count between public and 300 private ownership Building 200 54% 100 0 © New Buildings Institute 2008 2010 2012 2014 2016 2018 2000 2002 2004 2006 **Completion Year** Fig 9. ZE Verified and ZE Emerging projects by ownership. Projects with

missing ownership data are excluded

Source: New Buildings Institute

700% increase since 2012

Market:

Residential Market:



Net Zero in WI:

Outagamie County Regional Airport



#### Net Zero in WI:

Outagamie County Regional Airport

Great Lakes Energy Education Center Green Bay WI



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Red Fox Crossing (First Net Zero Subdivision) New Berlin WI



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Gunderson Health System (Targeting NZE Portfolio) Measured Energy Stats

141	- 109	= 32
BUILDING'S	RENEWABLE PRODUCTION RPI	BUILDING'S

Site Energy Use Index (EUI) kBtu/SF/year

The Energy Equation: **the building energy use** *minus* **the renewables production** *equals* **the net energy of the building**. Buildings may be 'Getting to Zero' and have a net EUI above zero. If renewable production exceeds energy use its net EUI is below zero (negative) and it is creating surplus energy.



Photos: AECOM

#### What is the FUTURE Market for NZE?



(Source: Navigant Research)

#### What is the FUTURE Market for NZE?

In North America alone, the market is projected to increase annually at a rate of 38.4% during that timeframe, reaching more than \$127 billion in 2035.



(Source: Navigant Research)

# What barriers or opportunities do you see for NZE in your communities?

Since the majority of our future buildings will be built in cities, it becomes very important that proper conditions for these buildings are assured during the urban planning process.

### APA's Climate Change Policy

- Finding 16: Few communities regulate and evaluate development in a way that accounts for or reduces GHG emissions. Planning, regulations and development reviews should directly address climate factors. New or revised standards, regulations, practices and technologies are needed to reduce GHG and prepare communities to adapt to the effects of climate change.
- Energy Policy 9: Integration of Renewable Energy into Codes
  - Revise building codes and architectural design guidelines to allow for, encourage, or require integration of passive solar design, green roofs, active solar and other renewable energy sources.
- Land Use Policy 10: Zoning and Development Standards Reform
  - New zoning and development standards should incorporate climate change impacts and implications in required environmental reviews and decision-making.

Key Considerations: Solar Protecting Solar Access =



Key Considerations:

Solar

#### Protecting Solar Access = Daylight Envelope

protecting natural daylight



Key Considerations:

Solar

Protecting Solar Access = Daylight Envelope

protecting natural daylight

#### Solar Envelope

Protecting Solar PV potential



Key Considerations:

Solar

Protecting Solar Access = Daylight Envelope protecting natural daylight

Solar Envelope Protecting Solar PV potential

Climactic Envelope

The intersection of both



Graphic Source: GreenVision Studio, School of Architecture, Univ. of Tennessee

Key Considerations:

Solar

**Urban Cooling** 

**Consider Wind Patterns** 

**Reduce Heat Island** 

Increase green infrastructure (trees, greenroofs, etc)

Decrease dark impervious surfaces

Increase shading

Key Considerations:

Solar

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Equitable Breeze Distribution

Upslope Forest Drainage



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**Breeze Channels** 



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# Equitable Breeze Distribution

Upslope Forest Drainage

Breeze Channels

Interweave buildings and plantings



Key Considerations:

Solar

**Urban Cooling** 

**Consider Wind Patterns** 

**Reduce Heat Island** 

Equitable Breeze Distribution

Upslope Forest Drainage

Breeze Channels

Interweave buildings and plantings

Utilize Landscape Redirection



#### **Environmental Responsiveness**



https://www.energy.gov/eere/downloads/university-california-davis-west-village-largest-planned-net-zero-energy-community

#### UC Davis West Village





#### Site Plan

Village Square

- Mixed-Use (45,000 sf retail + apartment units above)
- Community College (60,000 sf)
- For-sale Faculty/Staff Housing (343 homes)
- Site for Day Care/Preschool
- Student Housing (1,980 beds)
- Water management & open space
- Recreation fields and parks

https://www.energy.gov/eere/downloads/university-california-davis-west-village-largest-planned-net-zero-energy-community

#### Bicycles & Buses



https://www.energy.gov/eere/downloads/university-california-davis-west-village-largest-planned-net-zero-energy-community

#### **EcoBlock** Industrial Consortium

IMPLEMENTING URBAN CLIMATE CHANGE ADAPTATION BY MEANS OF APPLIED, INTEGRATED DESIGN SOLUTIONS

#### EcoBlock – Oakland, CA



https://rael.berkeley.edu/project/the-eco-block-project/



# Practical things planners can do to encourage NZE

#### Approaches

- Edu. Community & Builders
- DOE Zero Ready
- ZeroCode by Architecture 2030
- NZE Guides
- Voluntary Stretch codes
- Solar access ordinance
- Planned Unit Development
- Tax Increment Financing
- Pilot homes
- Awards

#### Grow Selar Solar Toolkit Summary

#### Planning, Zoning, and Permitting

As part of the Grow Solar Partnership, toolkits have been assembled to equip local governments in Minnesota, Wisconsin, and Illinois with information regarding solar development as it relates to



planning, zoning, and permitting. The purpose of these toolkits is to provide resources that will assist communities in addressing barriers to solar energy installations in a manner tailored to each community's needs. The following is a summary of materials that can be found in each of the toolkits.

#### Solar Overview

#### State Solar Policy Summary

Solar policy plays an important role in the development of solar energy. This document includes highlights from each state in both the regulatory arena as well as financial incentives that are available to support solar. Additionally, the State Solar Policy Summary includes statutes that enable local governments to regulate solar in planning, zoning, and permitting. This document can be used as reference guide specific to each state.





#### Case study – Eau Claire, WI

#### Policy goals drive planning

PARIS OBJECTIVE 1: Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels

PARIS OBJECTIVE 2: Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production.

Billion-Dollar Disaster Event Types by Year (CPI-Adjusted)



#### Tornado that hit western Wisconsin classified as EF3

Homes were damaged and trees downed in Wheaton and Elk Mound.

By Tim Harlow Star Tribune SEPTEMBER 25, 2019 – 11:03PM



DAN REILAND - ASSOCIATED PRESS





What climates today are most similar to the projected future climate of my location?



Climate analog: 2046-2065, mid emission scenario (A1B)

http://www.wicci.wisc.edu/climate-map.php



Climate analog: 2081-2100, mid emission scenario (A1B)



https://climatewisconsin.org/story/temperature-change

### Policy goals drive planning

City & Community 100% Carbon Neutral Goal by 2050		
4% annually over 2041 – 2050 (40% drop)	100%	
<b>3% annually over 2031 – 2040</b> (30% drop)	Renewable	
2.5% annually over 2021 – 2030 (25% drop)	Energy	
<b>1% annually over 2015 – 2020</b> (5% drop)	by	
Community/City Emission Baseline 2015	2050	

#### Carbon Drop Down Goals



#### Renewable Energy Action Plan

The REAP community planning project seeks to address how Eau Claire will meet its 100% renewable energy and carbon neutrality goals by 2050.

Background	>
Workshops	~
Workshop #1 <u>Agenda, Notes</u> & <u>Slides</u>	
Workshop #2 Agenda, Notes, Slides, Strategy Summaries	
Workshop #3 <u>Agenda</u> , <u>Notes</u> , <u>Slides</u>	
Workshop #4 <u>Agenda</u>	
Future meeting agendas and notes will be posted here.	
Data	>

https://www.eauclairewi.gov/government/our-divisions/renewable-energy-action-plan



#### Average Energy Costs (2018)

Xcel Energy\*
 PARTNERS IN ENERGY
 An Xcel Energy Community Collaboration

Sector	Average Costs Per Premise	
Residential	\$1,376	
Commercial and Industrial	\$17,484	
Municipal	\$10,719	

#### Total spent on energy: \$108 Million

#### **Plan Structure & Focus Areas**





#### NZE Approach & Process

- Built from solar access ordinance
- Considered external and internal factors
  - Education and encouragement route
- State Office of Energy Innovation Grant for NZE to help implement 2050 goals
- Hired paleBlueDot, LLC
- Community input meeting & survey
- Drafted solar access checklist
- Drafting NZE guide
- Approvals in early 2020 (part of REAP plan)
- Trainings afterwards
- Seeking a pilot house demonstration and a certain # NZE bldgs. by 2030.
- If you want final version give me your email.

### Samples of document

- NZE Guide
  - Commercial, Institutional and Residential
  - Intro\Why with Technical section with strategies
- Scoring metric
  - Calculators to account for Bldg. EUI & Renewable goals and carbon pre and post development scenarios





		Net Zero Construction Recommended Range	
	State of Wisconsin Energy Code Insulation Requirements	Minimum High Performance Insulation Recommendations	Passive Net Zero Insulation Recommendations
	0.35 U-Factor	0.27 U-Factor	0.12 U-Factor
	0.60 U-Factor	0.50 U-Factor	0.12 U-Factor
Irade	R-10 to 4' from perimeter	R-20 to 4' from perimeter	R-20 to 4' from perimeter
Walls	R-15 (R-19 when insulation is interior)	R-15 <u>c.i</u>	R-20 to 4' from perimeter
	R-30	P_20	P_20

Windows

Skylights

Slabs-on-o

Basement

#### Key takeaways – closer to reality

- Trend is growing as costs come down and people want greater control over energy and expenses
- Technology is enabling the practice
- NZE buildings save money over time
  - Onsite PV makes you money!
- Mind set change about values and upfront \$ vs. mid-term \$
- Mass implementation is going to be a journey
- Lessons can be learned from leaders
- State Codes are a hinderance to go above and beyond
- Planners have a key role in shaping NZE urban design
- NZE are better buildings for occupants and tax base

#### Contacts

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