U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Achieving Zero Energy Schools

February 8, 2019

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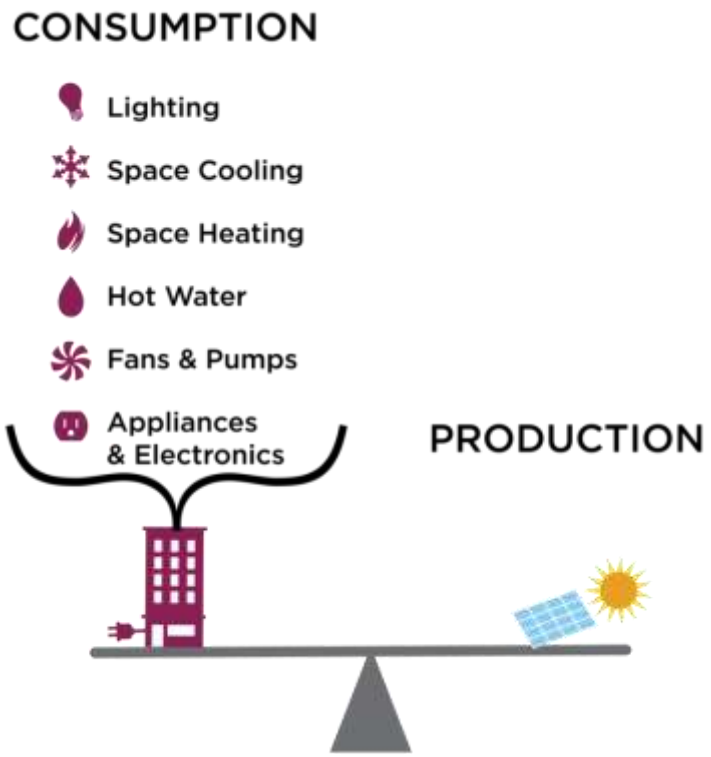
Pathway to Zero Energy Buildings

1st Reduce Consumption

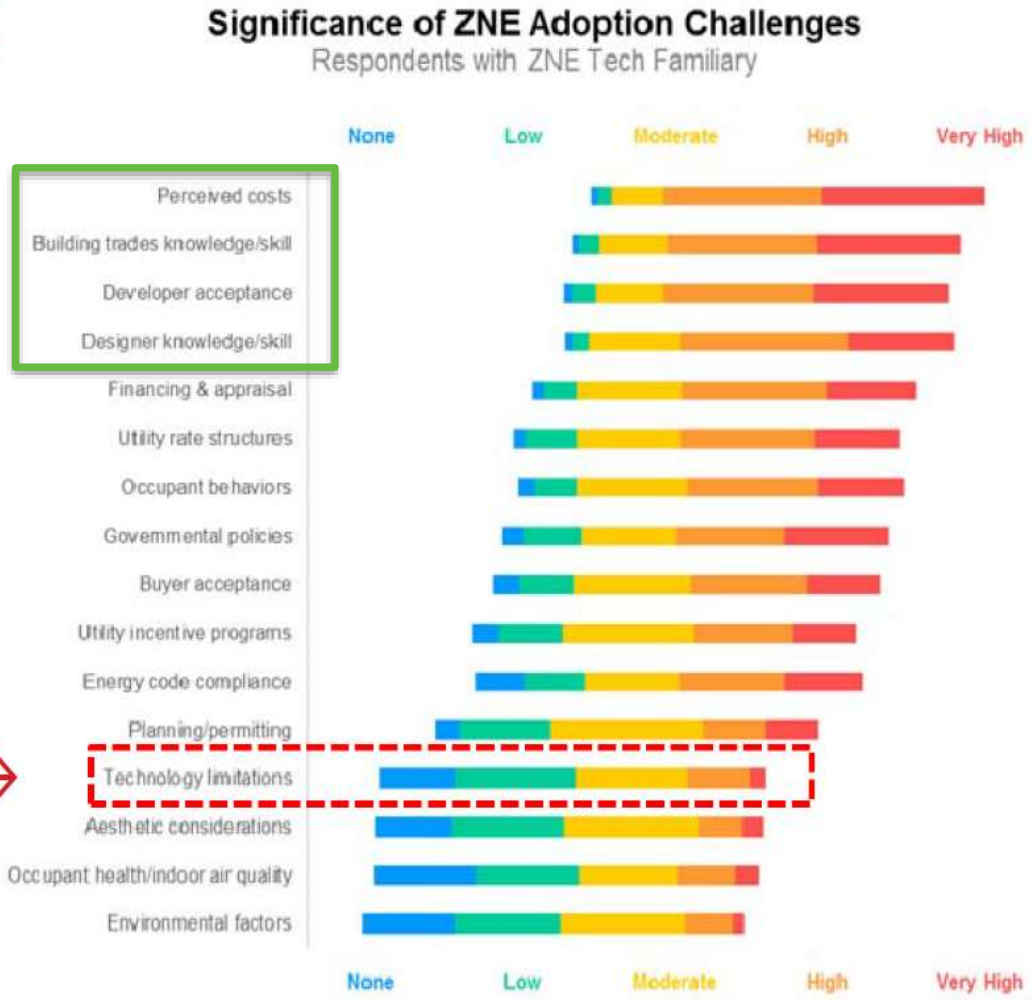
2nd Apply On-site Renewable Energy

BALANCE!



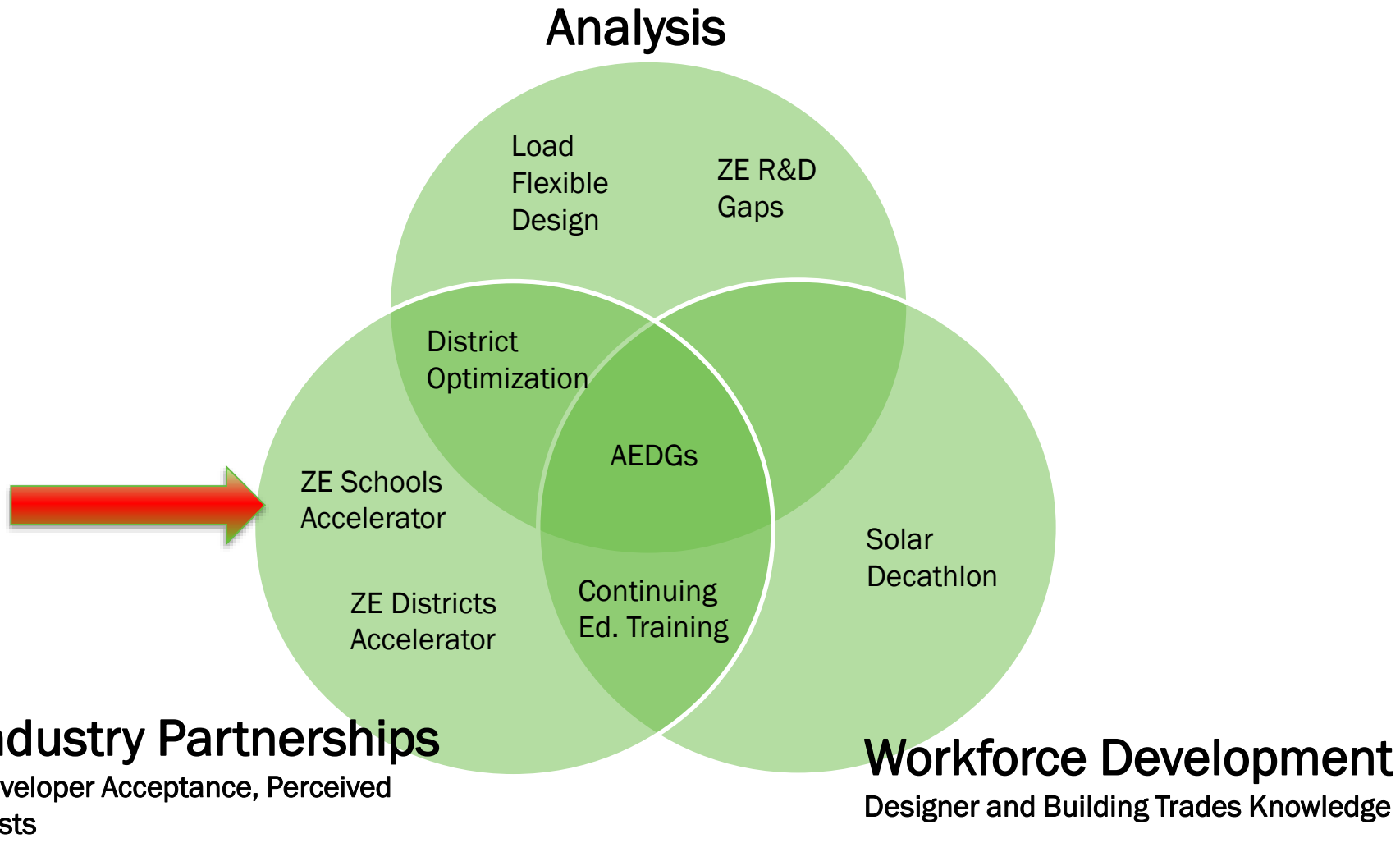
Barriers to Achieving Zero Energy

CHALLENGES TO ZNE



Technology Limitations→

DOE's Work Responding to Barriers



Zero Energy Schools Accelerator

Launched by DOE in the fall of 2016 as a targeted, three-year effort to identify, develop, and share strategies to overcoming barriers to achieving ZE schools.

Why Focus on Schools?

High energy expenses

Teaching tools

Replicable

Community assets

Abundant roof space

Kids deserve the best

Owner-occupied

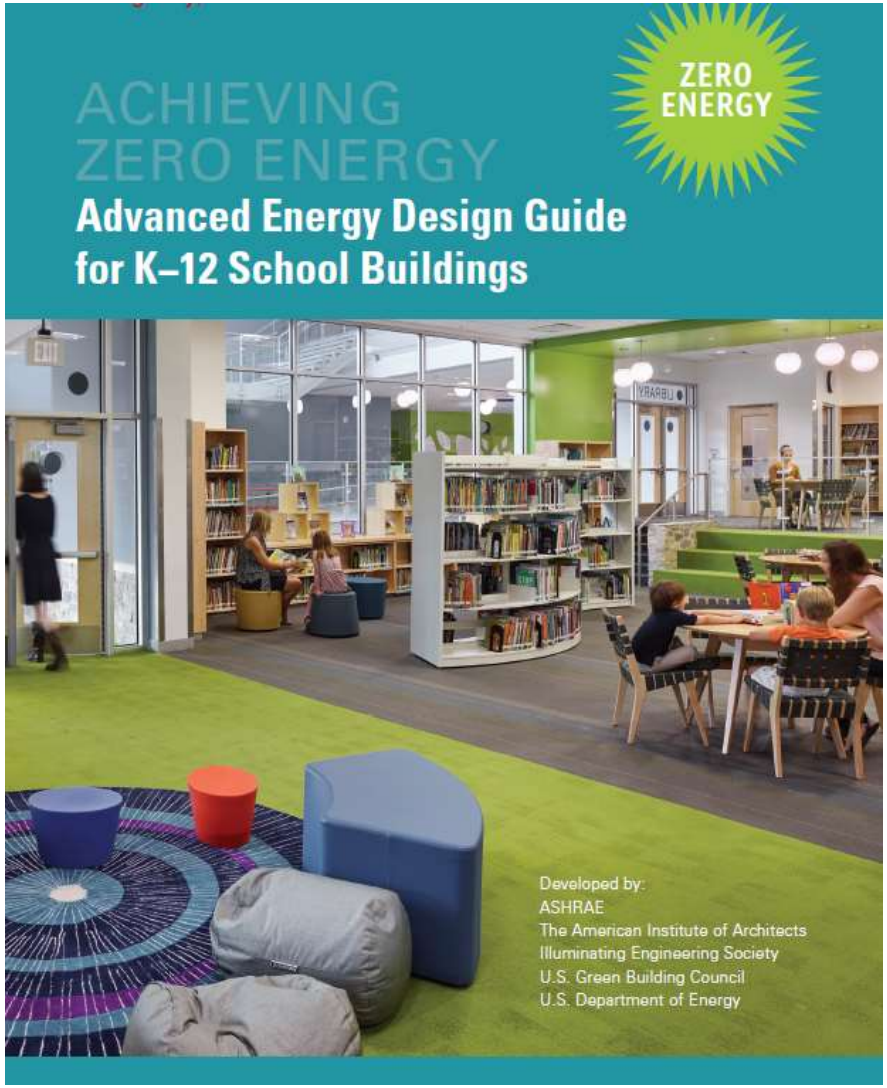
Cost-effective Zero Energy Schools

Arlington Public Schools completed the ZE Discovery Elementary within their normal construction budget, which is now saving the district $100,000 a year on utility bills.

The ZE Jennings Creek Elementary in Bowling Green, Kentucky, cost $1.5 million less to build than the average Kentucky school and is expected to save more than $165,000 a year in energy costs.

Image by Sherman Carter Barnhart Architects

Recipe for Zero Energy Schools



Written for Multiple Audiences

- School Owners (Board, Facilities, Administration)
- Engineers and Architects

Chapter 1 – Introduction

Chapter 2 – Rationale for Zero Energy

Chapter 3 – Keys to Success

Chapter 4 – Building Simulation

Chapter 5 – How to Strategies

In-depth explanation of various strategies to help move toward zero, including specific recommendations around:

- Building and Site Planning
- Envelope
- Lighting (daylighting and electric lighting)
- Plug Loads and Power Distribution
- Kitchen Equipment
- Service Water Heating
- HVAC Systems
- Renewable Energy

Energy Use Intensity Targets for ZE Schools

	Climate Zone	Site Energy		Source Energy	
		Primary School EUI, kBtu/ft^2·yr	Secondary School EUI, kBtu/ft^2·yr	Primary School EUI, kBtu/ft^2·yr	Secondary School EUI, kBtu/ft^2·yr
	0A	22.5	22.9	69.1	70.5
	0B	23.1	23.2	71.4	71.6
Miami, FL	1A	21.3	21.1	65.5	65.0
	1B	21.7	21.6	66.6	66.6
Houston, TX	2A	20.9	21.3	63.8	65.1
Phoenix, AS	2B	19.6	19.9	59.7	60.8
Memphis, TN	3A	18.8	19.1	56.7	57.7
El Paso, TX	3B	19.0	19.4	57.3	58.8
San Fran, CA	3C	17.5	17.6	52.6	52.8
Baltimore, MD	4A	18.8	18.9	56.3	56.7
Albuquerque, NM	4B	18.4	18.5	55.1	55.5
Salem, OR	4C	17.5	17.6	51.9	52.3
Chicago, IL	5A	19.2	19.1	57.1	56.9
Boise, ID	5B	18.7	19.0	55.6	56.6
	5C	17.4	17.6	49.7	52.3
Burlington, VT	6A	21.1	20.6	62.8	61.2
Helena, MT	6B	19.5	19.5	57.9	57.9
Duluth, MN	7	22.3	21.5	66.2	63.7
Fairbanks, AL	8	25.2	23.8	71.1	70.7

Common Characteristics of ZE Schools

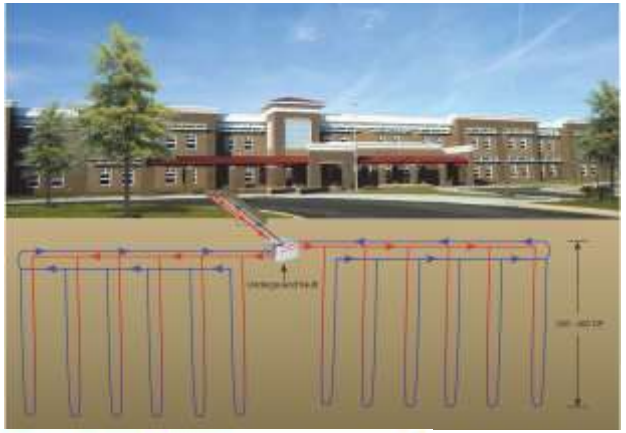
Process

- Energy champion
- Firm EUI goal throughout
- Integrated design
- Iterative energy modeling
- Commissioning

Technology

- Daylighting
- High performance envelope
- Ground source heat pumps
- Dedicated outdoor air system
- Plug load management

Photo: Paul Brokering Photography



	Recommendations by Climate Zone								
Component	0	1	2	3	4	5	6	7	8
Roof U-factor	0.039	0.048	0.039	0.039	0.030	0.030	0.030	0.027	0.027
Walls above ground U-factor	0.124	0.077	0.077	0.064	0.061	0.052	0.047	0.047	0.035
Slab F-factor	0.730	0.730	0.730	0.730	0.494	0.494	0.485	0.400	0.400
Doors U-factor	0.370	0.370	0.370	0.370	0.352	0.352	0.352	0.352	0.352

Source: K-12 ZE AEDG

Scaling the Impact

May 2, 2018 at NREL – ZE schools convening of 60+ school sustainability leaders from 35+ school districts, collectively representing more than 3.4 million students.

July 9, 2019 at Discovery Elementary – Workshop for school, state, and local leaders for achieving zero energy schools.

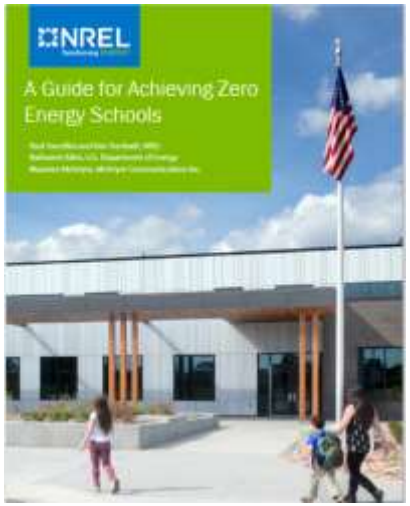
Horry County, South Carolina

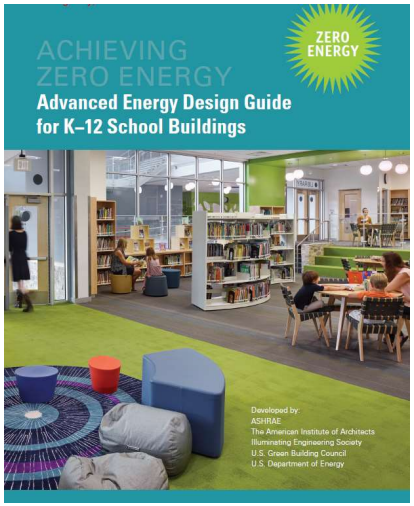
St. James Intermediate School in Myrtle Beach, South Carolina, which opened in August 2017, serves 5th and 6th grades and has a goal of producing 10% more energy than it uses.

Photo: Horry County Schools

Available Resources

- Guide to Achieving Zero Energy Schools
- Zero Energy Advanced Energy Design Guide for K-12 School Buildings
- Video case study – Discovery Elementary
- Database of online case studies





In-process:

- Cost resource
- Procurement guidance

Looking Forward

Kindergarten students work on a model of their new zero energy school in Baltimore

Photo: Grimm + Parker Architects