Welcome to... The 2016 Rhode Island High Performance Schools Summit

October 21, 2016
Rhode Island College

Join the conversation by using #RIHPS2016
SUMMIT CO-HOSTS

- RIDE (Rhode Island Department of Education)
- National Grid
- Rhode Island College
- Office of Energy Resources
COMMUNITY PARTNERS & PLANNING COMMITTEE

• Thank you to all our community partners and the RI High Performance Schools Working Group
THANK YOU SPONSORS

- Gilbane
- National Grid
- AMERESCO
- Siemens
- The Apeiron Institute for Sustainable Living
Welcoming Address

Dr. Frank Sánchez – President, Rhode Island College

Dr. Ken Wagner – Commissioner, Rhode Island Department of Education
Governor Gina Raimondo
Looking, Hearing, Feeling – Sensing the Benefits of High Performance Schools

Opening Speaker:
• Dr. Joseph da Silva, RI School Building Authority

Panelists:
• Patti DiCenso, Pawtucket School Department
• Shélynn Riel-Osorio, Rhode Island College
• Chin Lin, HMFH Architects
• Erika Eitland, Harvard University

Facilitator:
• Manuel Cordero, RI School Building Authority

Photo Credit: SMMA Architects
Patti DiCenzo, Pawtucket School District
Looking, Hearing, Feeling: Sensing the Benefits of High Performance Schools

Environmental Implications in Language Development & Acquisition

Shélynn Riel-Osorio
Ambient Noise & Learning

Children are not as well-equipped as adults to cope with cacophony of modern life.

A child’s ability to overcome the sensory demands created by background noise does not reach the adult level until the late teenage years (Johnson, 2000).
Learner Impact

The presence of noise in a learning environment can have cognitive and psychophysiological repercussions on young learners, demonstrated through:

- Delayed reading skills, speech perception, and memory (Maxwell & Evans, 2000).

- Increased cortisol levels and heart rate (Evans, et. al., 1995).

High-Risk Subpopulations

- SES/ Urban dwellers

- Hearing-impaired students, students with learning disabilities, students with language and attention disorders

- Language learners (and not just English learners!)
Creating a learning-conducive environment means catering to the myriad intelligences present in the student body...
Given the prevalence of background noise, it is likely that children rarely experience completely quiet environments when learning. However, even limited listening opportunities in quieter environments may help children overcome the deleterious effects of noisier environments (Fallon, et al., 2000).


A PLATFORM TO DISCUSS, RESEARCH, AND DISSEMINATE INFORMATION ON HOW SCHOOL BUILDINGS IMPACT THE HEALTH OF STUDENTS AND TEACHERS EVERY DAY
“CHILDREN ARE NOT LITTLE ADULTS”
INDOOR ENVIRONMENTAL QUALITY

- Indoor Air Quality
- Lighting & Views
- Noise & Acoustics
- Thermal Health
MORE THAN 60,000 U.S. PUBLIC SCHOOLS EXPERIENCE ENVIRONMENTAL CONDITIONS THAT CAUSE ASTHMA, HEADACHES, NAUSEA, WEIGHT GAIN, COGNITIVE IMPAIRMENT, COUGHING, AND GENERAL EYE, NOSE, AND THROAT IRRITATION.
VISUAL

172 U.S. THIRD GRADE STUDENTS TESTED THE EFFECT OF HIGH INTENSITY GLARE-FREE “FOCUS” LIGHTING

➔ HIGHER % INCREASE IN ORAL READING FLUENCY PERFORMANCE

NON-VISUAL

• ARTIFICIAL DAYLIGHT (6500K)
  — COLOR TEMPERATURE ➔ ALERTNESS, FEWER ERRORS, BETTER COMPUTERIZED TEST SCORES

• SEASONAL DIFFERENCES IN DAYLIGHT EXPOSURE
  — CIRCADIAN RHYTHM NOT STIMULATED ➔ NEED TO SUPPLEMENT WITH ARTIFICIAL LIGHT

SCHOOLS FOR HEALTH

ABSENTEEISM, TEST SCORES, ATTENTION, ADEQUATE SLEEP
Within schools highly exposed to aircraft noise

- 86% of teachers reported keeping the windows closed even in warmer weather
- 38% of them indicated they undertook fewer outdoor activities with their students (Bergstrom et al., 2015)

Hypertension, sleep disturbance, stress, annoyance, cardiovascular disease, higher blood pressure irritability, behavioral changes

- Reductions in reading comprehension, memory & attention
FOR EVERY 1°F INCREASE, TEST SCORES FELL BY 0.2%

TAKING AN EXAM ON A 90°F DAY VERSUS 75°F DAY WOULD HAVE A 12.3% HIGHER LIKELIHOOD OF FAILING

WHY DOES THE EDUCATIONAL ENVIRONMENT MATTER?

Figure 6. Interrelated pathways through which educational attainment affects health.
DISCUSSION

Panelists:
• Patti DiCenso, Pawtucket School Department
• Shélynn Riel-Osorio, Rhode Island College
• Chin Lin, HMFH Architects
• Erika Eitland, Harvard University

Facilitator:
• Manuel Cordero, RI School Building Authority
NETWORKING AND EXHIBITOR BREAK
10:30 – 11:00 AM
THE PATH TO ZERO ENERGY SCHOOLS

Opening Speaker:
- Commissioner Carol Grant, Rhode Island Office of Energy Resources

Panelists:
- Paul Torcellini, National Renewable Energy Laboratory
- Puja Vohra, National Grid
- Nicholas Valls, Jacobs Engineering

Facilitator:
- Becca Trietch, Rhode Island Office of Energy Resources
Designing to the Zero Energy Performance Target
Paul Torcellini, Ph.D., P.E.
National Renewable Energy Laboratory
October 21, 2016
U.S. Building Energy Consumption

The graph shows the annual quads (quadrillion) of energy consumption from 1950 to 2020. The graph distinguishes between residential and commercial energy consumption.

From 1980 to 2014, there was a 72% increase in energy consumption.
Trends of Commercial Sector

- Growth is faster than energy efficiency measures
- Every decision has an energy and environmental impact
- Buildings mortgage the energy futures of the world
What are Zero Energy Buildings?

- Conceptually, a building that has no adverse energy [or environmental] impact [because of its operation]

- Energy consumption has been a long-term surrogate for environmental impact

- Boundaries and metrics
- What energy flows to measure
Zero Energy Building

CONSUMPTION
- Lighting
- Space Cooling
- Space Heating
- Hot Water
- Fans & Pumps
- Appliances & Electronics

PRODUCTION
Adding Renewables

CONSUMPTION
- Lighting
- Space Cooling
- Space Heating
- Hot Water
- Fans & Pumps
- Appliances & Electronics

PRODUCTION
Building on a Diet

CONSUMPTION

- Lighting
- Space Cooling
- Space Heating
- Hot Water
- Fans & Pumps
- Appliances & Electronics

PRODUCTION
Goal 1: Reduce Consumption

Goal 2: Apply On-site Renewable Energy

BALANCE!
An **energy-efficient building**, where on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.
Real Value Added

II

III

Value Added

Costs

Energy Savings

I

IV
How Do We Get There?

• Set measurable goals around energy efficiency
  – Energy Use Intensity Goals
  – Zero Energy Building (even if it is a stretch goal—all projects should state this!)

• While Technology is important—the real solution is in motivating design and contractor teams to make decisions aligned with the project goals.
  – Performance Based Procurement
Questions?
Paul.Torcellini@nrel.gov
Send us zero energy school case studies!
ZEB Pathway to 2035

A Whitepaper of the Rhode Island Zero Net Energy Building Task Force

By
Puja Vohra, National Grid
Mission:
- Define a 20 year pathway for Rhode Island to advance Zero Energy Buildings (ZEB) across all building sectors in support of the Rhode Island Energy Plan 2035.
Rhode Island Specific Issues

- Awareness
- Higher upfront costs
- Cost of ownership
- Valuation and financing
- Technical know-how
- Alternatives for on-site generation
- Need for supportive utility infrastructure
Recommended State Goals

### Suggested State Goals

- New Construction: 100% by 2035
- Existing Buildings: 10% by 2035
- Across all sectors: Residential, Commercial, Public Bldgs

### How do we get there

- State Policies & Legislations
- Utility programs & grid modernization
- Technical, Financial & Education Support
- Marketplace adoption/Implementation
Net-zero Energy Should Start with schools

Studies indicate that schools are a prime market for net-zero energy design and operation, in both new construction and deep energy retrofit projects of existing building. Net zero schools are more beneficial to districts, occupants and the environment.
Zero Energy Schools in Rhode Island

Where we are today
- 2 Zero Energy Ready
- RIDE’s Long-term goals includes ZEBs
- Numerous EE retrofits

What do we need to do next?
- Lead by example
- Demo projects
- Strategic partnerships
The Path to Zero Energy Schools Related to Rhode Island Public Schools

School House

Energy Report Card

October 21, 2016
What We Did

- Surveyed 307 Schools
- 24.435 million ft²
- Derived Utility Cost Data from UCOA Data
- Benchmarked Energy Use for each school
- Assessed the Condition of Energy Consuming Equipment
- Identified Energy Conservation Measures
- Defined Action Plans to Achieve Net Zero Energy for Each School
- Identified Funding Sources & Execution Strategies
Why We Did This

- Significantly Reduce Energy $
- Net Zero Energy Schools
- Avoid Energy Volatility $
- Reduce O&M Costs
- Improve Cognitive Performance
- Improve Student Learning
- Create Living Laboratories
- Demonstrate Institutional Values
- Preserve Current Staff & Academic Programs
How Did We Do It

- 5 Teams Assessed 307 Schools
- Entered Conditions Data into MAPPS® via Handheld PC
- 4 Energy Engineers Filtered UCOA Utility Data
- Utility Consumption Derived from Cost Data based on Assumptions
- Calculated EUI & $/ft² for each School
- Identified Energy Conservation Measures
- Defined Action Plans to Achieve Net Zero Energy
- Estimated Costs, Savings & simple payback period
- Utilized Potential Contractors
- Solicited Incentives & Funding Sources
Findings

- Rhode Island 4th highest AVG. Electric Rate in US 18.69 cents/kWh
- Avg. EUI 45.2 - 60.7 vs. US Avg. 58.2
- Energy Costs $33.6 Million
- Avg. Age of School 62 Years +/- 30
- Avg. School Energy Cost $1.48/ft²
Rhode Island Public Schools Energy Cost ($/SF by LEA)

Rhode Island Dep't of Education Energy Consumption Findings

https://public.tableau.com/profile/paul.mills#!/vizhome/rideenergy/RIDEEnergyFindings
Next Generation of Energy Conservation Measures

- Broader Benefits
- Better for Student Learning
- Longer Pay Back Periods
- Building Automation Systems
- Energy Recovery Ventilation
- LED Lighting Retrofit
- Solar Assisted Domestic Hot Water

## Energy Conservation and Net Zero Energy Measures

<table>
<thead>
<tr>
<th>Energy Conservation Measure</th>
<th>Cost to Implement</th>
<th>Annual Savings (Estimate)</th>
<th>Simple Payback (Years)</th>
<th>System Size</th>
</tr>
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<tbody>
<tr>
<td>Building Automation System</td>
<td>$4,830,000</td>
<td>$149,920</td>
<td>32.22</td>
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<tr>
<td>ERVs/DOAS</td>
<td>$6,855,500</td>
<td>$211,411</td>
<td>32.43</td>
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<tr>
<td>Solar Hot Water</td>
<td>$14,340,000</td>
<td>$345,239</td>
<td>41.54</td>
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<tr>
<td>Solar Photovoltaics</td>
<td>$246,916,430</td>
<td>$13,527,620</td>
<td>18.25</td>
<td>125MW Array generating 150,000 MWH/year</td>
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<tr>
<td>LED Lighting</td>
<td>$64,121,905</td>
<td>$2,796,098</td>
<td>22.93</td>
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</tr>
<tr>
<td>Heat Pumps (Geo)</td>
<td>$389,677,907</td>
<td>$20,186,799</td>
<td>19.30</td>
<td>87,000 Tons of geothermal heat pump</td>
</tr>
</tbody>
</table>
Steps for Going Net Zero Energy

- ASHRAE Level 2 & 3 Audits
- Bundle ECMs
  - Building Automation System
  - Energy Recovery Ventilation
  - LED Lighting Retrofits
- Utilize RIIB Efficient Buildings Fund
- Bundle Net Zero Energy Measures
  - Solar Assisted Domestic Hot Water Heaters
  - Geothermal Heat Pumps
  - Solar PV
- Prepare RFQs
- Get Projects Shovel Ready
- Prepare RFPs
- Obtain Approvals
- Execute, Monitor, Inspect, Cx, Train

Understand Financing & Incentive Options

- Federal Incentives
- State Incentives & Financing
- Utility Incentives & Financing
- Other Public Financing (Bonds)
- Qualified Energy Conservation Bonds (QECBs)
- Tax Except Lease- Purchase
- Third Party Ownership (PPA)
- Private Financing Options (Bond-PPA Hybrid or Morris Model)
- ESPCs (Energy Service Performance Contracts)
- Renewable Energy Credits (RECs)
- National Grid Energy Efficiency Rebates & Incentives
Panelists:
- Paul Torcellini, National Renewable Energy Laboratory
- Puja Vohra, National Grid
- Nicholas Valls, Jacobs Engineering

Facilitator:
- Becca Trietch, Rhode Island Office of Energy Resources
ENJOY LUNCH SPONSORED BY:

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HERE WITH YOU. HERE FOR YOU.
FUNDING YOUR SCHOOL ENERGY EFFICIENCY IMPROVEMENT PROJECT

Opening Speaker:
• Treasurer Seth Magaziner, State of Rhode Island

Panelists:
• John McNamee, North Providence School Department
• Jeff Diehl, RI Infrastructure Bank
• Bob Donovan, RI Health and Educational Building Corporation
• Jerry Drummond, National Grid

Facilitator:
• Rachel Sholly, Rhode Island Office of Energy Resources
RHODE ISLAND HIGH PERFORMANCE SCHOOL AWARDS

• Celebrating the success of creating high quality, sustainable learning environments in Rhode Island
SCHOOLHOUSE ENERGY REPORT CARD
RI High Performance School Summit

Michael McAteer
Director Strategic Business, Policy and Evaluation - Rhode Island
Overview

- Changing landscape in Energy and Utility
- Where we are today in Rhode Island
- How do we get to the future
Our world is changing….fast!

National Grid’s blueprint to drive advances in America’s natural gas and electricity infrastructure:
creating a more customer-centric, resilient, responsive, efficient and environmentally sound energy network to meet the needs of the 21st century.

1. Energy Efficiency
2. Gas Growth
3. Distributed Generation & Storage
4. Grid Modernization
5. Vehicles
National Grid has spent $1.96 Billion on Energy Efficiency since 2009

What we’ve saved:

- 4,173 GWh
- 11,855 dth
- 525,205 kW

Our states lead ACEEE policy rankings, 2014:

- MA: #1
- NY: #7
- RI: #3
- VT: #3
- CT: #6

statewide since 2009
Future for Schools in Rhode Island

Towards Zero Emission (or net positive) with High Performance Indoor Environment

Photo credit: http://blog.usa.skanska.com/
Where we are Today in RI: New Construction

- High performance building design assistance for integrated energy efficiency in lighting and mechanical systems

Claiborne Pell Elementary School

Paul W. Crowley East Bay Met Center
Net – zero ready
Where we are Today in RI: Deep Energy Retrofits

Edgewood Highland School Cranston RI

Deep EE Retrofit including maximizing air ventilation for improved indoor air quality
Ongoing Leadership in Rhode Island to Support High Performance Schools

- RIDE’s mission towards net zero and improved IAQ, based on recently released energy report card.
- National Grid EE Programs providing technical services, trainings and incentives/financing for high performance schools
- Rhode Island Infrastructure Bank
- Policy & program development with State Energy Office for pathways to Zero Energy Buildings by 2035!
THANK YOU!

Rhode Island Department of Education

National Grid
Here with you. Here for you.

Rhode Island College

Office of Energy Resources

State of Rhode Island

High Performance Schools Summit