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Town of Lexington
Select Board Member

LexCAN
Economics of Designing Net Zero Schools
September 10, 2024

Lexington High School Goals

Select Board, School Committee & School Building Committee established the following goals for Lexington High School

- All-Electric HVAC and domestic hot water design
- Achieve 25 kBtu/sf Energy Use Intensity (EUI) Target (Excellent Energy Efficiency)
- Maximize Onsite Renewable Energy Production
- Achieve Net Zero Energy Design
- Utilize Solar + Energy Storage to maximize operational savings
- Achieve Highest Performance Indoor Air Quality Standards
- Compliance with the Integrated Building Design and Construction Policy

Lexington High School designed to these standards will have a lower upfront cost and lower total life cycle cost than a conventionally designed Lexington High School

Hastings School Net Zero Design



Scenario Based Evaluations

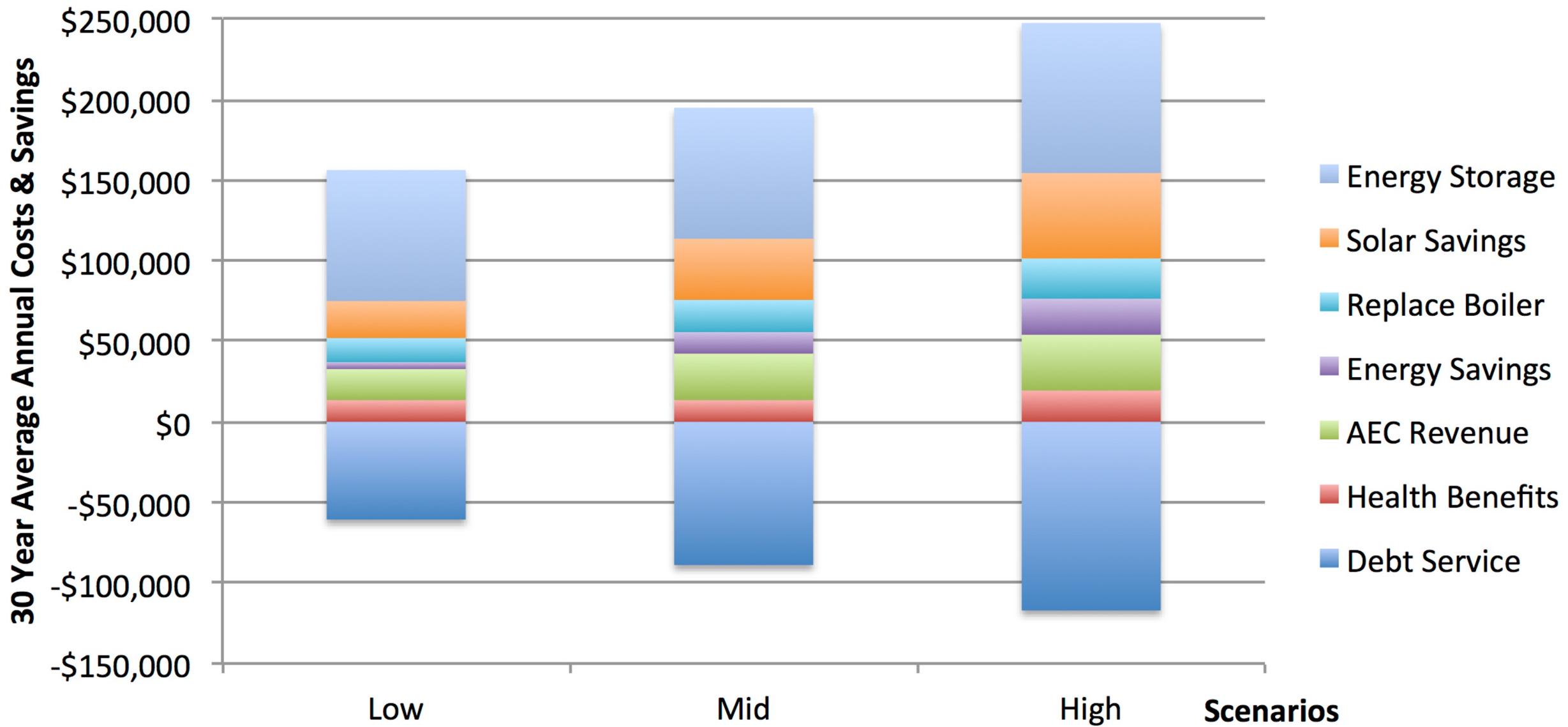
Evaluation conducted by Sector experts

Evaluations consider reasonably probable scenarios

- Capital investments
 - Ongoing operational & maintenance costs
 - Cost savings, revenue generation, incentives, and tax credits
 - Synergistic benefits (e.g. geo-thermal, solar and storage)
 - Health and climate benefits
 - Potential risks (e.g. toxics, technology, inaction, opportunity cost)
 - Potential benefits (e.g. noise, resilience, productivity, traffic)
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Ground Source Heat Pump with Solar + Storage

Annual Savings vs. Debt Service



Better Building Recommendations

- Enhance students' health & cognitive performance
 - Clean and healthy air, natural sunlight
 - Thermal comfort, moisture control
 - Fewer sick days, heightens participation, better scores!
 - Higher standards make economic sense
 - Achieving healthy outcomes now common practice
 - 50% lower energy demand & enhanced resilience
 - Cash flow positive from day 1
 - Healthy schools put money back in classrooms
 - Fewer sick days, higher staff productivity and retention
 - Insulate budgets from energy price shocks
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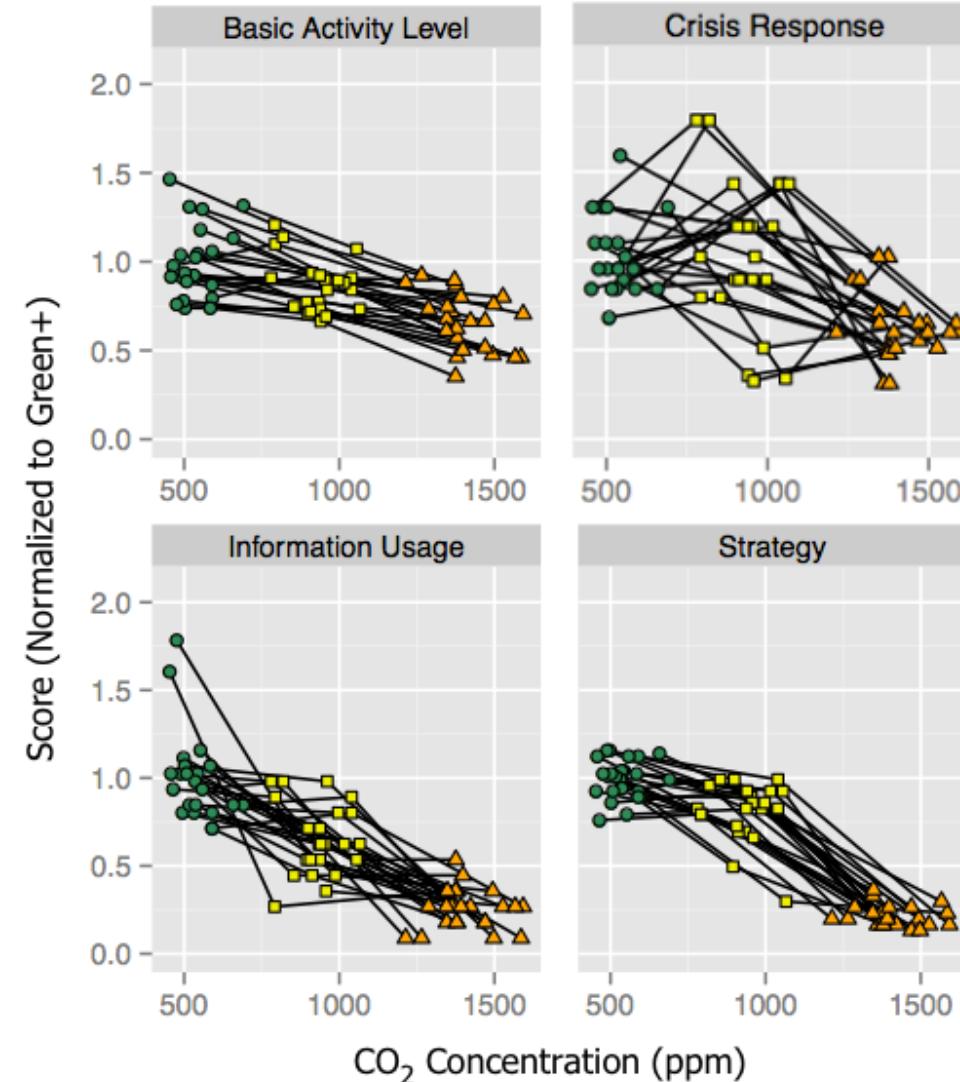
Cognitive Performance Benefits

Lexington Board of Health recommends CO₂ level of 600 ppm or less

Consistent with Mass Dept. of Public Health guidelines

Allen – Harvard School of Public Health
<https://ehp.niehs.nih.gov/doi/10.1289/ehp.1510037>

How CO₂ Levels Affect Human Cognition



Solar Canopies & Net Zero Schools



The motivation for energy storage

Peak demand charges

- Account for about 45% of LHS electricity bills

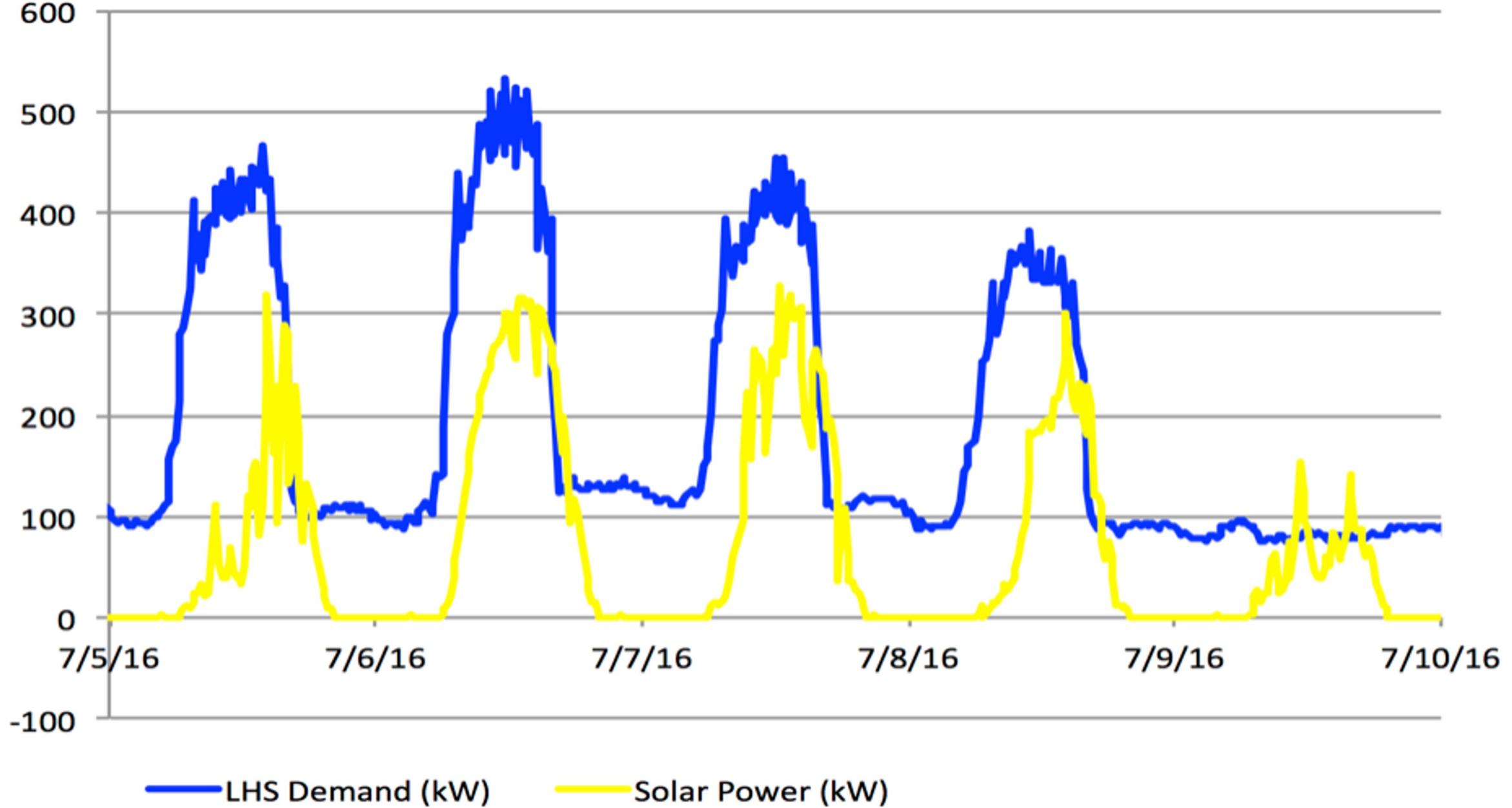
Demand charge reductions from solar are limited

- Solar production is not correlated with building energy demand
- Passing clouds can cause solar generation to drop, setting that month's peak.

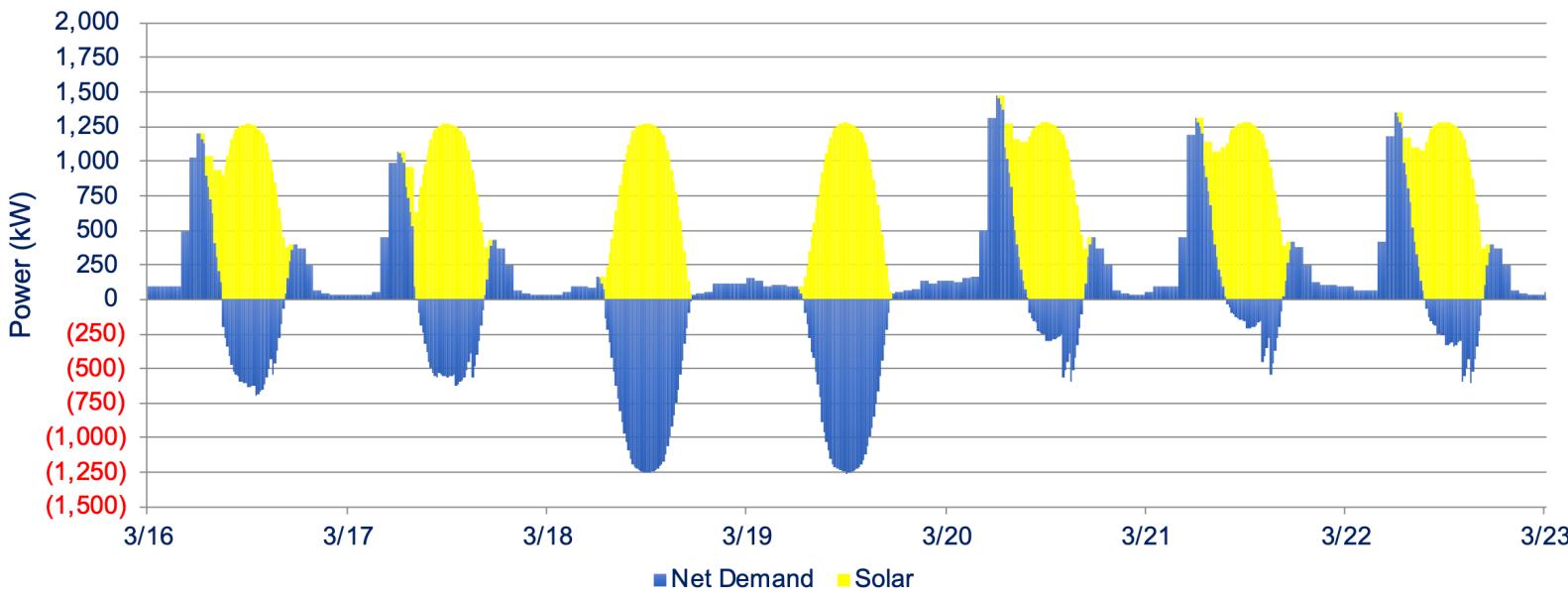
Demand charges increasing rapidly

Enabling utility interconnection approvals

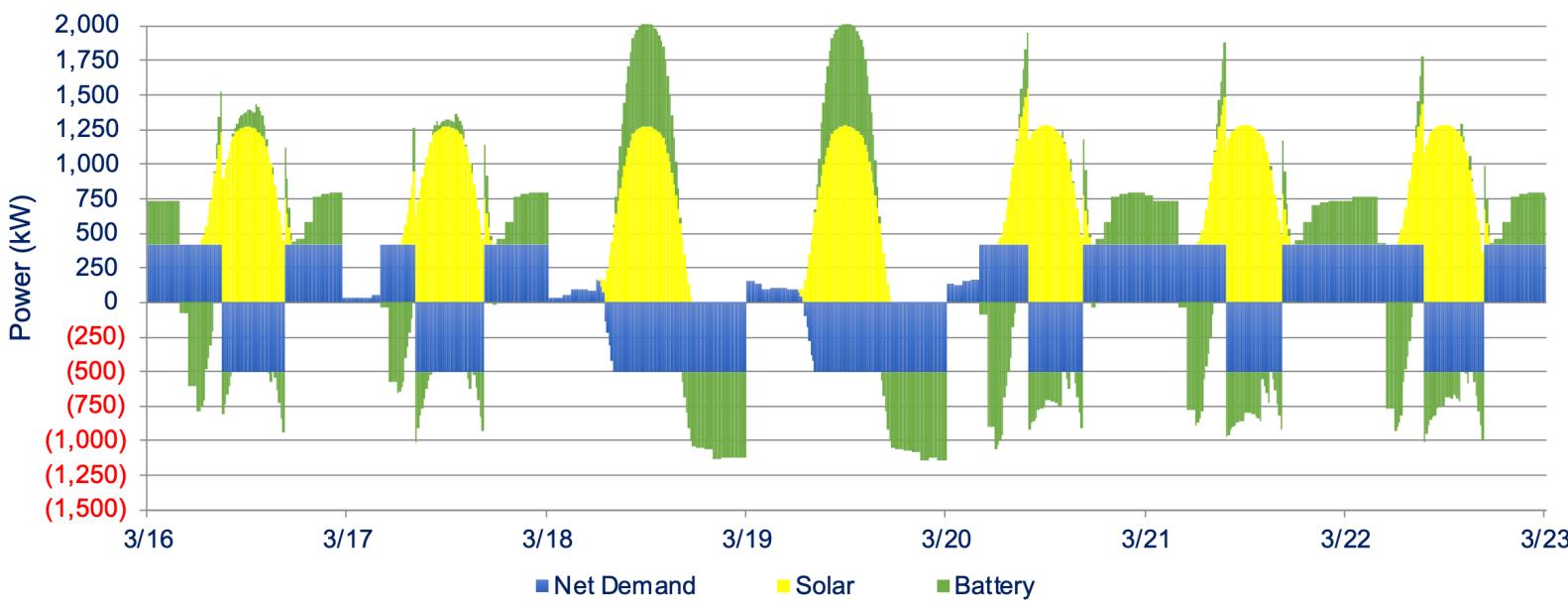
LHS Peak Demand with Solar



LHS Net Demand w Solar



LHS Net Demand w Solar + Storage



The motivation for energy storage

LHS Pre-solar annual electricity bill ~\$1,175,000

3.5 million kWh annual usage

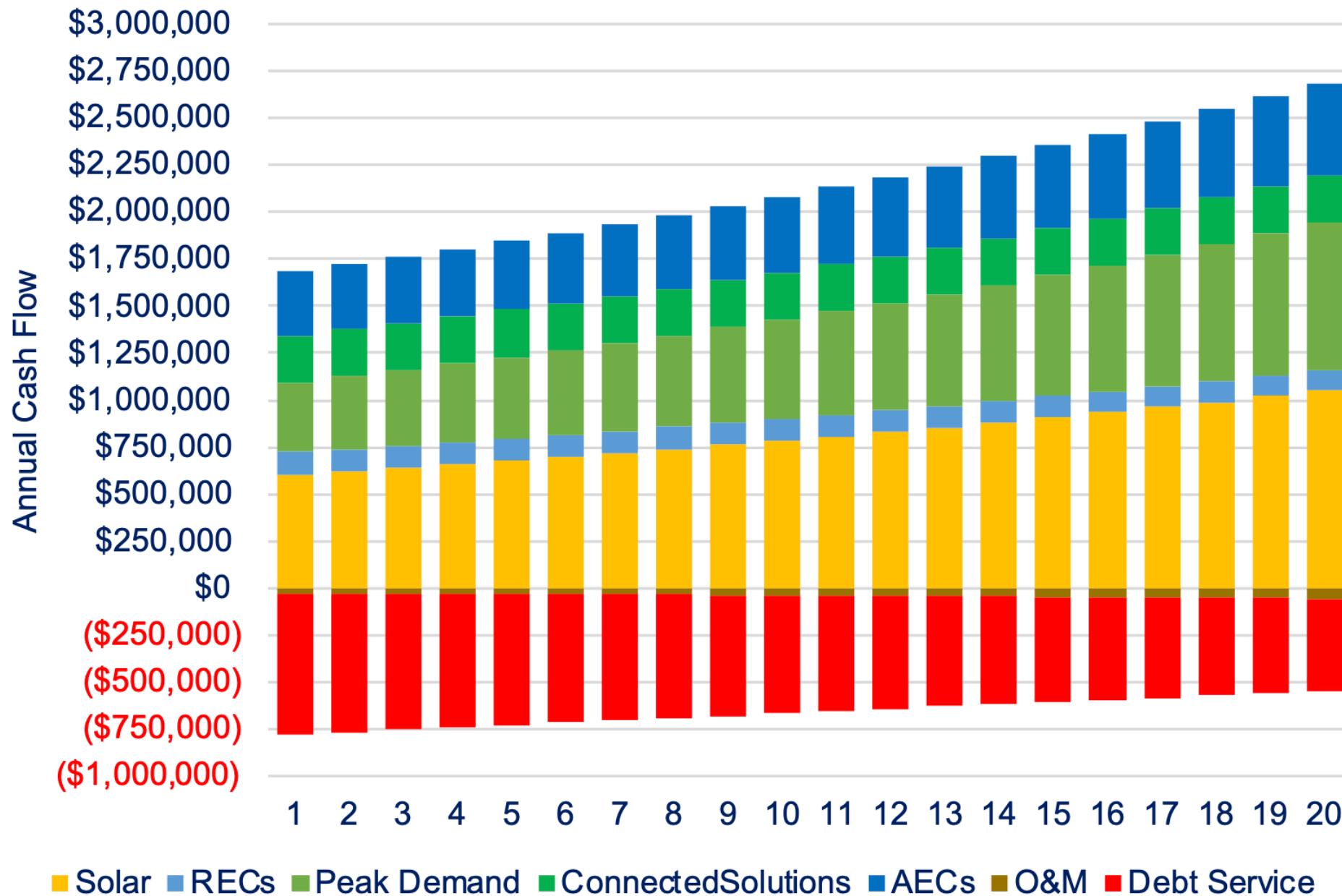
- \$600,000 annual usage charges
- \$575,000 peak demand charges

3.5 million kWh solar + 1,150 kW peak demand reduction

- \$600,000 solar energy production annual savings
- \$122,500 REC annual revenue
- \$425,000 energy storage peak demand annual savings
- \$250,000 ConnectedSolutions energy storage annual revenue
- \$337,000 Alternative Portfolio Standard annual revenue
- \$1,734,500 Year 1 Positive Cash Flow + \$210,000 health benefits

\$55 million in Positive Cash Flow over 30 years

LHS Solar + Storage Cash Flow (4 MWh)



Air Source vs Ground Source Heat Pump Economics

Ground Source Heat Pump

\$14.8 million lower upfront cost after incentives than ASHP

\$10.8 million lower upfront cost than conventional FF HVAC system

Total Life Cycle Cost (30 Yrs)

\$27 million in GSHP savings

- \$22 M in debt service
- \$ 5 M in electricity savings

	SMMA	
ASHP v GSHP Comparison	ASHP	GSHP
HVAC Cost	\$65,000,000	\$81,000,000
<25 EUI Target Cost	\$7,000,000	\$7,000,000
Total	\$72,000,000	\$88,000,000
Mass Save		
<25 EUI		\$1,662,500
Ground Source Heat Pumps		\$4,809,375
Inflation Reduction Act		
Ground Source Heat Pumps (30%)		\$24,300,000
Upfront HVAC Cost after Incentives	\$72,000,000	\$57,228,125
Upfront Savings after Incentives		\$14,771,875
Debt Service Savings		\$22,088,647
30 Year Electricity Savings		\$5,213,890
Total Life Cycle Cost Savings (30 Years)		\$27,302,538

MSBA Green Schools Program

MSBA Green Schools Additional Funding Potential

3% Additional for Specialized Code compliance

1% Additional for Indoor Air Quality

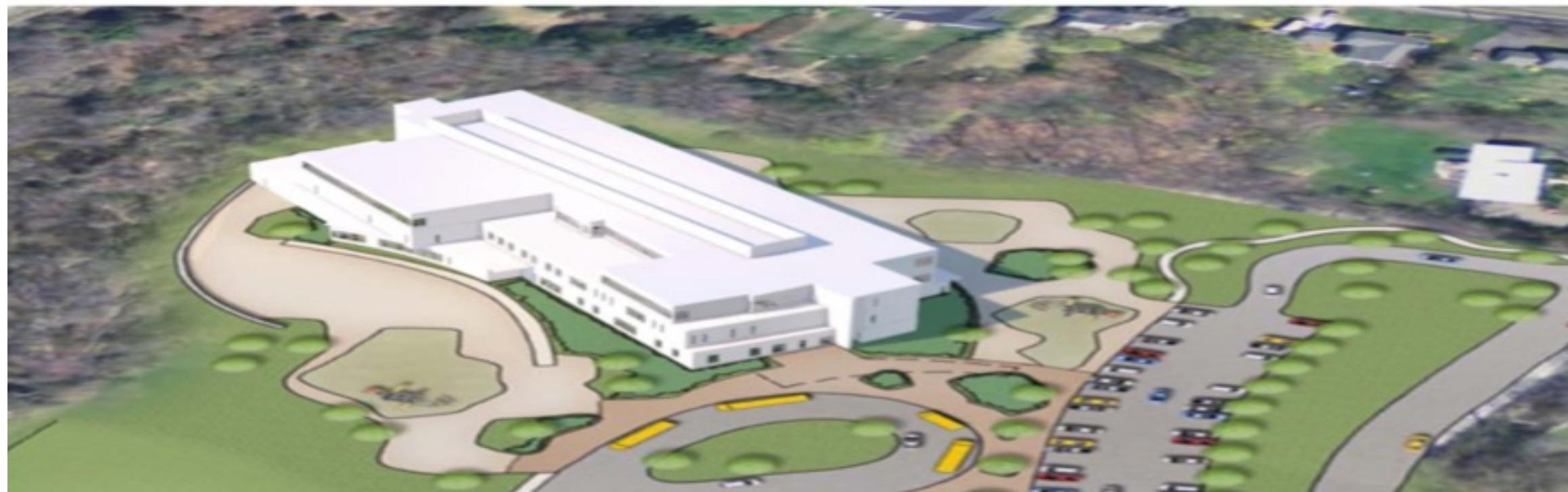
\$19.4 million for Specialized Code compliance

\$ 6.5 million for Indoor Air Quality

\$25.9 million total MSBA Green Schools potential

The Healthiest LHS at the Lowest Cost

Higher design standards for all-electric, healthy buildings with high indoor air quality, exceptional resilience, better cognitive performance can deliver over \$100 million in lower total cost of ownership at LHS!





Questions?