

Net ZERO  
Green Buildings

**New Middle School # 8**

**IRVING**  
*Independent School District*

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**What if...**

*... a school could be designed and built to produce as much energy (on site) as it consumes from the electric grid?*

- No/minimal electricity bill for use of air-conditioning, lighting, or power?
- Limited gas bill for heating, hot water, or cooking of food?
- No water bill for ground irrigation?

**IMPOSSIBLE ???**

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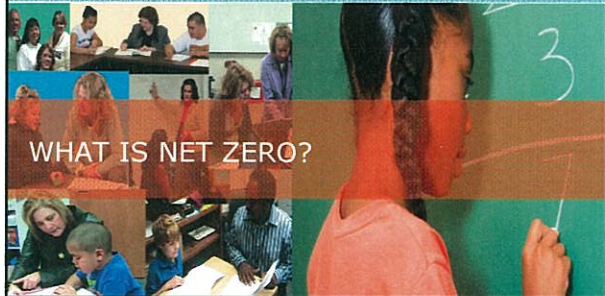
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IRVING ISD

**Net Zero**



**WHAT IS NET ZERO?**

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**What is it?**

- A building that produces as much energy as it consumes through efficiency technologies and on-site power generation
- Integration of state of the art energy efficient construction and renewable energy systems
- Renewable energies are produced through solar, wind, and geothermal applications
- Systems are designed so that over the course of a year, the energy consumed will equal the energy produced; thus net zero
- Building is designed and operated to reduce overall impact of the built environment on human health and natural environment; to use resources more efficiently and to reduce building's negative impact on the environment
- Completely or significantly reduce energy use and green house gas emissions for the life of the building

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**Did you know...**

- ...this will be the **first** net zero public school in the State of Texas
- ...this will be the **first** net zero middle school in the country
- ...this will be the **largest** net zero public school in the country

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**Energy Principles**

**Two Energy Sources**

- **Electricity (kwh)**
  - air-conditioning, lighting, all power needs
  - 1 kwh = 3,413 Btu's
- **Gas (Mcf)**
  - heating, hot water, kitchen equipment
  - 1 Mcf = 1,030,000 Btu's

**Building Efficiency** = Total Number of Btu's / Square Feet (sf)

- » State Average: 57,000 Btu's/sf
- » District Average: 50,000 Btu's/sf

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**How do we get there?**

State Average: 57,000 Btu's/sf  
 50%-70% Reduction: (34,200)  
 Efficient Building Load: 22,800 Btu's/sf

- Cannot produce this much energy on site
- Design building to consume less energy
- Increase building efficiency to a level that can be partially supplemented daily by renewable energy sources
- Produce energy during off hours and sell back to the electric grid

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**Net Zero**



**WHY NET ZERO?**

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**Why Net Zero?**

**Environment**

- Global warming is an international concern
- Emissions in the U.S. have risen by 17 percent from 1990 to 2007
- Scientists project these emissions to continue to rise by one percent per year
- A major source of demand for energy and materials that produce greenhouse gas emissions found in buildings
- By building a net-zero building, we contribute to the reversal of this negative trend

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**Why Net Zero?**

**Economy**

- o Spent \$475 billion on foreign oil in 2008 alone
- o Money taken out of our economy and sent to foreign nations
- o Projected over the next 10 years the cost will be \$10 trillion; greatest transfer of wealth in the history of mankind
- o In 1970, we imported 24% of our oil; Today, it's more than 65%
- o 85 million barrels/day of oil are produced worldwide; 21 million used in the United States
- o America imports 12 million barrels a day; Saudi Arabia only produces 9 million a day

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**Why Net Zero?**

**Education**

- o Future generations must understand and learn the importance of the environment
- o Dependence on foreign oil must end within the next 10 to 20 years
- o Educate the next generation on sustainability and the significance of utilizing renewable energy resources
- o Unless some new "energy source" is discovered, this is the only means to secure a safe and healthy environment
- o Future generations must become stewards of the environment; must learn through our actions

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**Net Zero**



**DESIGN STRATEGIES**

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### Strategies to Reduce



- Increase Wall/Roof Insulation
- High Efficiency Glazing
- Reduction in runoff via permeable paving
- Day Light in Classrooms
- Light Harvesting/Solar Shading
- Rain Water Collection
- Grey Water Harvesting
- Holistic Monitoring of Energy Use
- Energy Star Rated Kitchen
- Laptop Computers /Wireless Network

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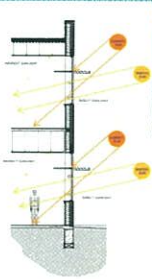

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### Daylighting Technology

**USE OF LIGHT SHELVES**  
Horizontal shelves bounce visible light from the ceiling deeper into the space.

**DAYLIGHT HARVESTING**  
Automatic dimming or switching of light fixtures based on natural light in a space to maintain desirable light levels.




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### Why is Daylighting so important to have in schools?

*Studies have shown that daylighting—an integral part of making schools energy-efficient—has a positive effect on student attitudes and a direct correlation to improved student performance.*

**Here's the Research**

*Students attending daylight schools for two or more years scored 14 percent better on tests than students in non-daylit schools.*

*Students in classrooms featuring daylighting strategies, large windows, or well-designed skylights performed 19 to 26 percent better on standardized reading tests than students in classrooms without these features.*

*These students also performed 15 to 20 percent better on standardized math tests.*

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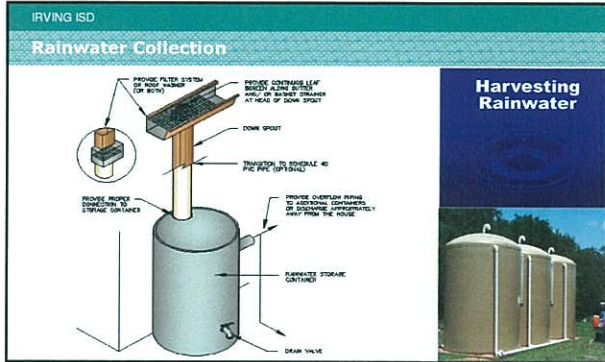
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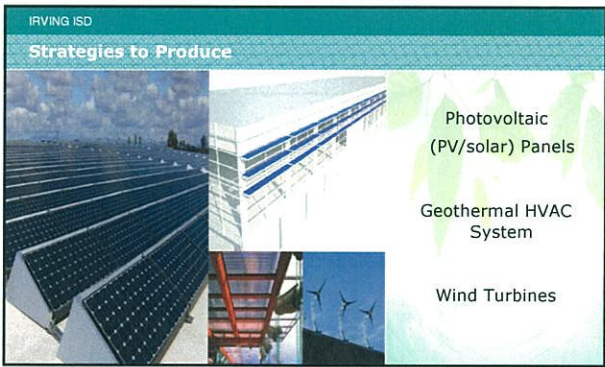
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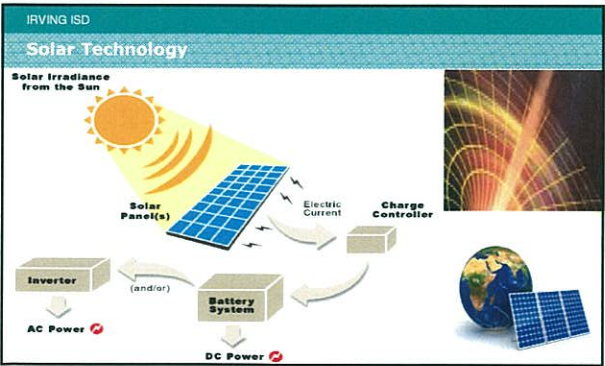
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### Geothermal Technology

The ground loop maintains ground temperature and provides a refrigerant in the heat pump.

Increasing the pressure raises the temperature. Heat is transferred to the heating coils.

Heat is transferred to the room by radiators or underfloor heating.

The refrigerant expands, causing it to cool.

**Geothermal Heat Pump Efficiency**

1 kWh of energy from the grid

Yield: 4 to 5 kWh of energy for the building

Plus: 3-6 kWh of energy from the earth

400-600% Efficient (COP of 4-6)

**Geothermal Energy for the Home**

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**The Earth is an Efficient Place to Reject Heat in Summer...**

Outdoor air design temperature: 98°F in summer

Delta T = 5° to operate!!!

Insulating layer of earth

74°F

72°F

A geothermal heat pump cools the building in summer by rejecting heat into the earth.

**...and is the Source of Stored Heat in Winter...**

Outdoor air design temperature: 35°F in winter

Delta T = 5° to operate!!!

Insulating layer of earth

72°F

60°F

A geothermal heat pump takes heat from the earth during winter and transfers it into the building.

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### Wind Turbine Technology

*How does a wind turbine work?*

1 Inflow of wind

2

3

Blades & blades with the main shaft (C) and gearbox (G) which spins the generator (G), resulting in electrical output.

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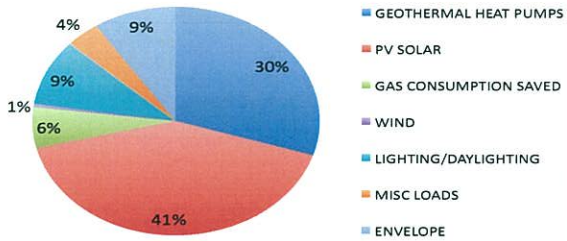
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### ANATOMY OF NET ZERO - ENERGY REDUCTION




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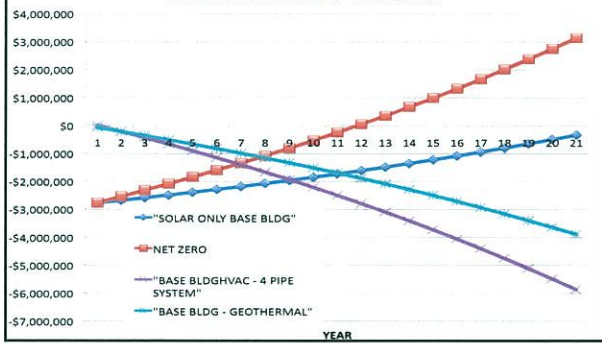
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### CUMMULATIVE CASH FLOW COMPARISONS




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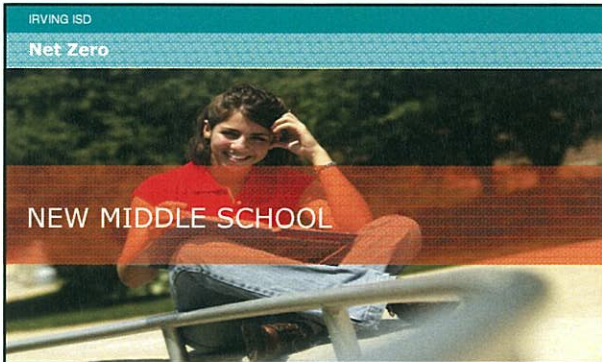
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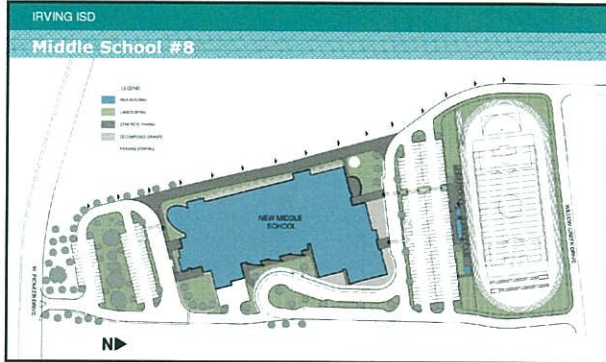
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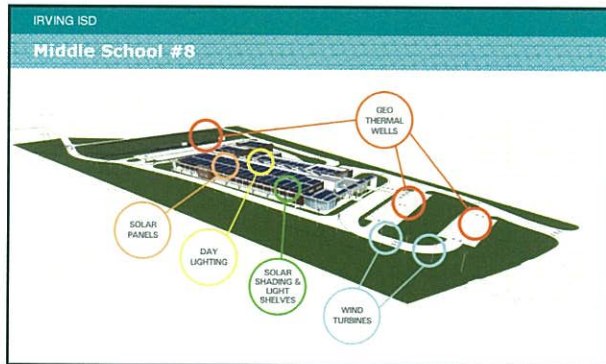
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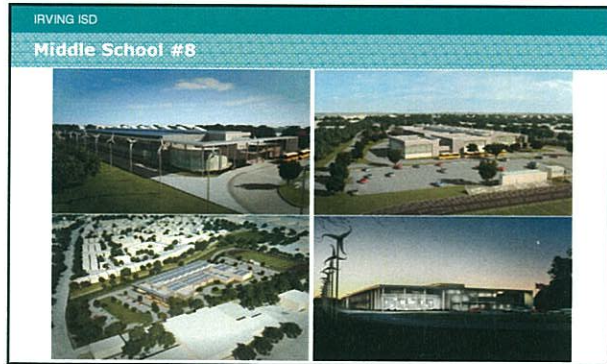
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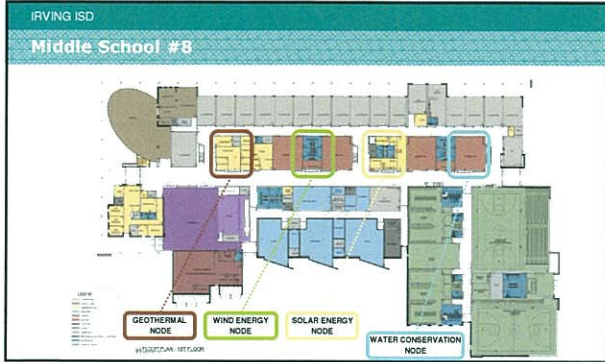
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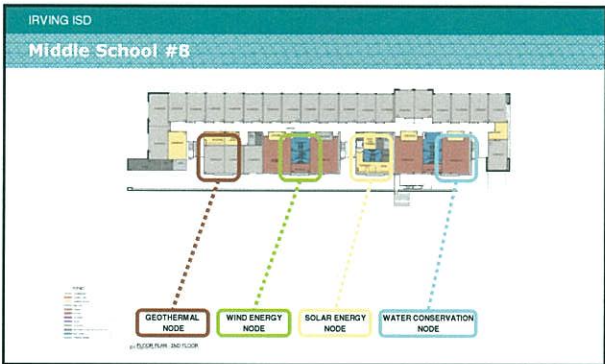
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