LJHS+

LISLE JUNIOR HIGH SCHOOL

By **engiNUity**

Northwestern University Education Building | Retrofit

PROJECT SUMMARY

Lisle Junior High School is a public middle school of Lisle Community School District 202, located about 25 miles west of Chicago. The campus was originally built as Lisle's first high school in 1956, and last received renovations in 2003 with the addition of an auditorium, gym, music rooms, and several classrooms. The school continues to be maintained and fixed throughout the years due to its outdated equipment and inefficient building components such as building's envelope and the HVAC system.Through new innovations in the floor plan, envelope, HVAC system, water management, and new incorporation of renewable systems, the improved Lisle Junior High School (LJHS+) aims to serve as a **sustainable** and **feasible** "prototype" for existing schools in the U.S. by prioritizing the needs of our **students** and the surrounding **community**.

PROJECT DATA

Location: Lisle, IL
Climate Zone: 5
Lot Size: 760,000 SF
Building Size: 110,000 SF
Occupancy: 400 people (Grade 6-8)

TECHNICAL SPECIFICATION

ENVELOPE

- **Wall:** R-41
- **Ceiling:** R-44
- **Floor:** R-36

POWER

- **PV:** 950 kW Roof mounted array
- **Geothermal:** 200 kW Boreholes & 80 kW Enerdrapes

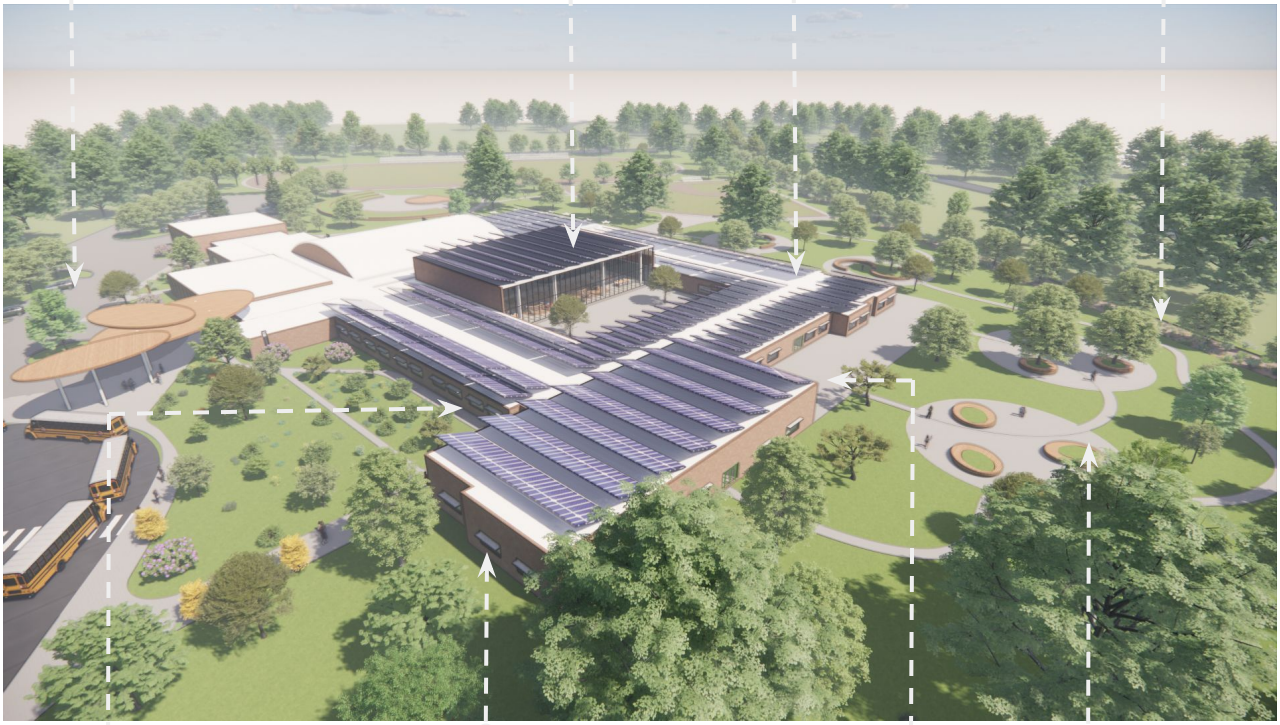
DESIGN STRATEGY

Permeable Car Park
Alleviate flooding to the neighboring houses

Program Separation
Seperate social spaces from learning spaces

Clean Energy On-site
Photovoltaic arrays & biogas digester as clean and renewable energy

Bioswales
Control stormwater from flooding



Efficient Envelope
Reduce energy lost & Environmental comfort. Maintain 90% of structure to reduce on-site waste and embodied carbon

Coherent HVAC System
Geothermal heat pump, radiant floor heating & Enerdrape Increase occupancy comfort

Water Efficiency
Incorporate greywater system and efficient plumbing appliances

Open-Air Pavilion
Encourage students' interactions

ARCHITECTURE

LJHS+ will incorporate efficient passive design strategies and centralize programming that maximize the educational experience both during and outside of class-time. The massing is altered to enhance the aesthetics and to maximize the solar gains from the south. Underutilized spaces, such as the courtyard, are repurposed to bring new life and introduce new activities through the school's landscape that enhance educational and community experience.

MARKET ANALYSIS

The retrofit of the building will reuse the materials of the original building in order to reduce cost, and incorporate more sustainable features to achieve long-term energy cost savings and that will allow **LJHS+** to be self-sustain. More efficient windows are added to the building to allow more natural sunlight throughout which further reduce the overall cost of the retrofit. The ESS iron flow battery stores excess energy from the PVs, and can be exported to the grid (ComEd) for revenue, which reduce the payback period.

OCCUPANT EXPERIENCE

Natural daylighting in classrooms increases concentration and overall mood in an educational environment. Within the boundary of **LJHS+**, both the occupants and the surrounding community can take advantage of the spaces' elements during and outside of school-hours, which aim to increase community interactions, and bring awareness to the importance of diversity and inclusivity. Through these improvements, the community of **LJHS+** can maintain and cultivate an enriched school culture.

COMFORT AND ENVIRONMENTAL QUALITY

LJHS+ aims to meet the recommended R-values for Chicago's climate and to optimize indoor comfort and quality. Additional windows increase exposure to natural lighting, which decreases the needs for artificial lightings, while also introducing natural heating throughout the building. An improved HVAC system will address existing noise concerns, while simultaneously addressing individual comfort through personalized control. The building materials meet Indoor AirPlus air quality standards and have strong acoustic performance to create a healthy learning environment.

ENGINEERING

LJHS+ will utilize a system of highly sophisticated Monocrystalline silicon solar panels to support its energy and mechanical system. ESS Iron Flow battery store energy generated from PVs and export excess to the grid when school is not utilised during vacation. Geothermal boreholes and Enerdrape are integrated into VRF ceiling concealed indoor units and radiant floor heating to reduce HVAC loads, with the addition of electric boiler during peak heating loads. Greywater treatment treats greywater from sinks to be used for flushing toilets, and irrigation, which helps to reduce water consumption by 33.5%. Bioswales, rain gardens, and pervious pavements work to prevent flooding in the surrounding neighborhood.

DURABILITY AND RESILIENCE

LJHS+ will be equipped to withstand extreme weather accelerated by climate change, employing improved insulation. A newly installed ventilated facade will reduce the envelope transmittance. In the case of more extreme weather events, the redesigned **LJHS+** will be supplied with backup energy generators, which would not only keep the internal electrical systems of the school running. During extreme storm, the stormwater systems work to collect runoff and prevent flooding. Security measures are taken to ensure student and staffs' safety with security cameras, security doors for preventative procedures.

EMBODIED ENVIRONMENTAL IMPACT

LJHS+ has 20 kg CO_2 emitted per m^2, an A grade on the Carbon Heroes Benchmark. Reusing materials wherever possible and working with local contractors will reduce initial embodied carbon, while renewable energy systems and carbon sequestration through mycelium insulation and vegetation will ensure carbon neutral status.

ENERGY PERFORMANCE

A system of PV arrays will be used to supply the geothermal heat pumps and enerdrape with energy. While heat pumps draw heating and cooling, minimization of energy consumption by the building's HVAC system can largely improve the building's energy performance. The improvement of the building's system and the incorporation of renewable generations allows **LJHS+** to be net positive with an EUI of -3.

INTEGRATED PERFORMANCE

A biogas installation will generate electricity and heat for high-traffic areas such as the cafeteria. This will work in conjunction with the central garden, which will be fertilized with biogas residues. **LJHS+** will also use an electric radiant heating system, which allows for decreased operating costs and completely eliminates maintenance and replacement costs. Additionally, heat flow will be controlled using predictive algorithms to ensure efficient and effective heat dissipation.