Beloit USD 273 - BTU CREW

Purpose: This past academic year, our district had two overarching projects in regards to becoming more aware of energy basics and the impact of energy usage in our buildings. These two focus projects can be summarized into the “Building Analytics Project” and the “KidWind Project”. Our steps to becoming more “energy efficient” in our district included 1) learning as much as we could through hands-on activities and real-world application to learning 2) bringing in outside community resources to strengthen our understanding of energy 3) share our learning results and experiences with other school districts and educational leaders.

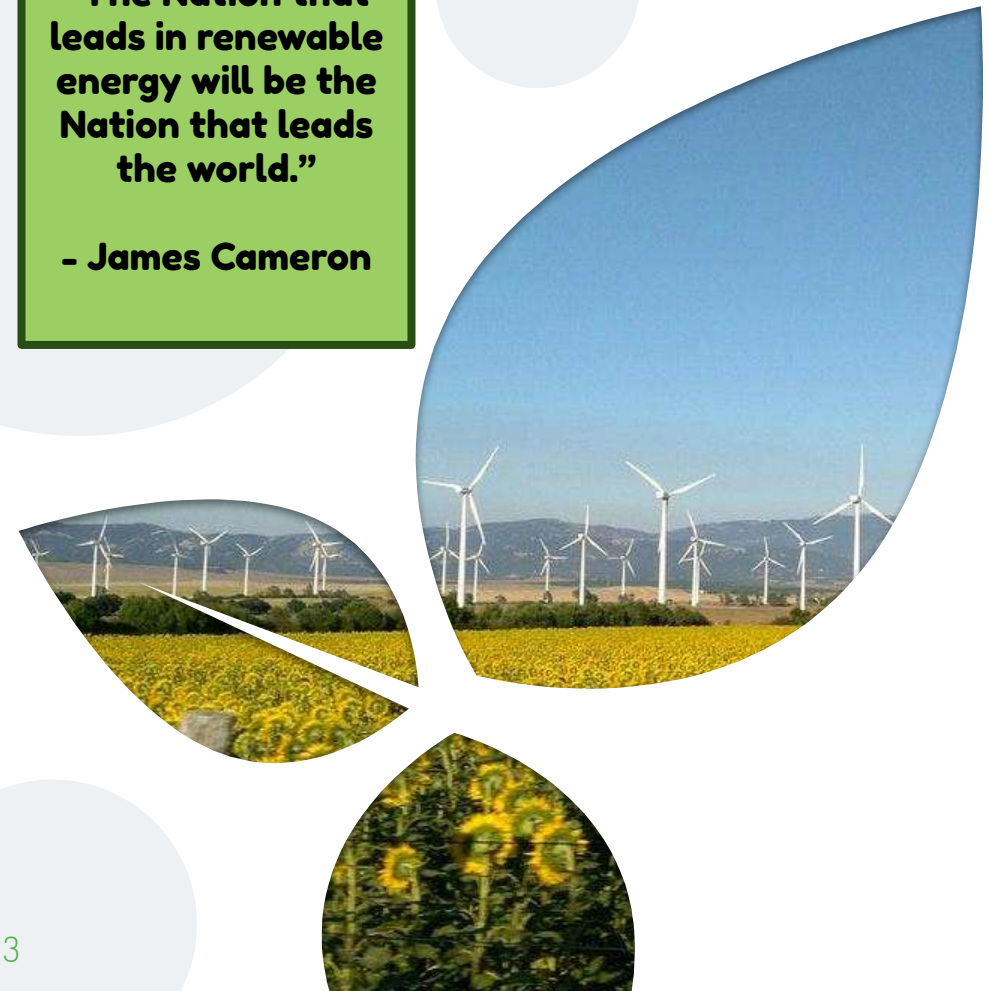
Advisor: Brooke Hemmert
(9th - 12th grade teacher)

BHS Energy Education Goals:

1. Learn more about non-renewable and renewable energy resources, and become more conscious of how we use these resources.
2. Strengthen our understanding of renewable energy through hands-on STEM activities.
3. Explore our school's energy usage through our partnership with Trane and take steps to reach maximum energy efficiency.
4. Share our results and goals with our community and other school districts throughout the state.
5. Utilize community resources to strengthen the students' understanding of energy basics.

“The Nation that leads in renewable energy will be the Nation that leads the world.”

- James Cameron



Why study energy?

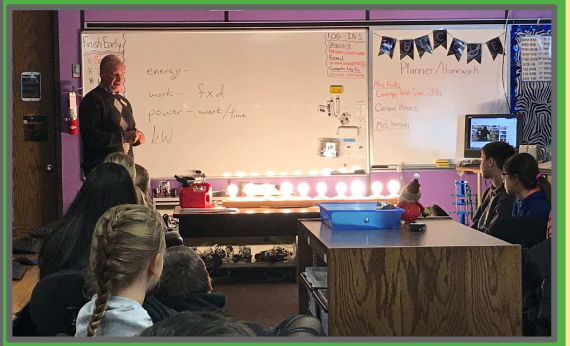
Energy rules the world around us. From powering our cars to heating our homes, the use of energy is what literally gives us the power to live our lives. In the past, fossil fuels and other types of nonrenewable energy have made their statement in the energy world, however, the reliability of these resources cannot be sustained forever. Non-renewable resources have an important place in our world, but without careful conservation, these resources will run out. We therefore have to turn to renewable energy. With sectors such as wind and solar, renewable resources give us hope for more clean, sustainable energy usage. Activities like the BTU Crew and the KidWind Challenge help us learn energy basics and have fun at the same time! It also sparks an interest for our future career options. We are the future leaders of the energy world!

Beginning steps of energy implementation

Our energy implementation all started with a partnership our district developed with a company called Trane in May of 2016. Trane installed sensors in our buildings, and started collecting data at the elementary and junior-senior high school. Our district's long-term goal with this partnership is to save our school money through identifying heating/cooling energy loss, making changes to fix those problems, and implementing renewable energy. Dan Whisler, BTU Crew Energy Education Consultant with Trane, worked closely with us to develop a deeper understanding of how to use building analytics and the importance of renewable energy. He also worked closely with our teachers to help them implement the Trane curriculum into the classroom.

The Trane curriculum and the basics of energy was taught to 26 high school students, through the elective STEM class. The modules of the Trane curriculum includes the forms of energy, energy consumption, career research, interpreting events, and energy audits. This curriculum led us into hands-on activities like the BTU building analytics and the KidWind Challenge. Both of these projects helped us understand energy in a real, applicable way.

Utilizing Community Resources



One of our learning goals was to bring in community resources to further our understanding of energy basics. Our first resource, Dan Whisler, BTU Crew Energy Education Consultant, spoke to us about the unit of a kilowatt hour, importance of renewable energy, and the basics to begin building and designing a wind turbine for the KidWind Challenge. Dan was a great resource to understanding why we need to study energy!

Understanding the implications of non-renewable energy is just as valuable to understanding energy basics. Warren Martin, a Kansas-Strong Petro education consultant, presented valuable information about the use of fossil fuels in our society. We were “wowed” by how much our developed nation relies on Petroleum!

More learning opportunities with the community

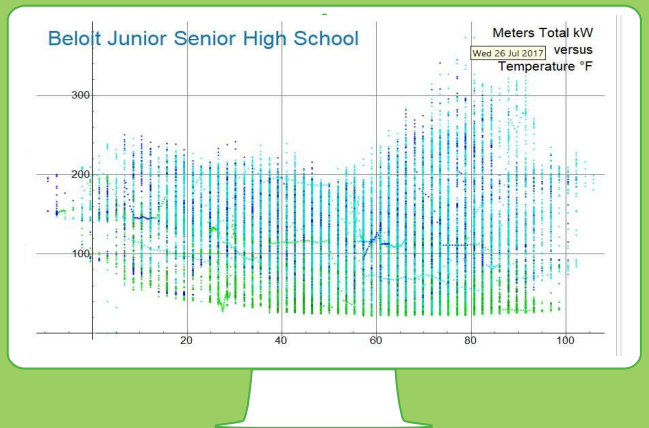
"Miss Hemmert you will be proud of me - I am taking a wind energy course next year in college!" - Jeremy Mosher, senior at BHS

Our district is fortunate to have a wind and solar energy program just down the road, at Cloud County Community College in Concordia. We got the opportunity to tour a wind and solar farm, looking up close at the mechanisms behind the building process and how the farms function throughout the day. We learned about many potential career opportunities as well!

After learning our city has plans to implement renewable energy in the future, we met with our city manager, Jason Rabe, to discuss how the school can be involved in the implementation process. Jason Rabe and the city's electricity consultant, Scott Scheiben, talked to us about where the city buys its electricity and shared their goals to implementing renewable energy for the city of Beloit. We are excited our city has these plans, as our school district is also on board to implementing renewable energy in the future! Our goal is to partner with the city to start incorporating renewable energy into the city and school.

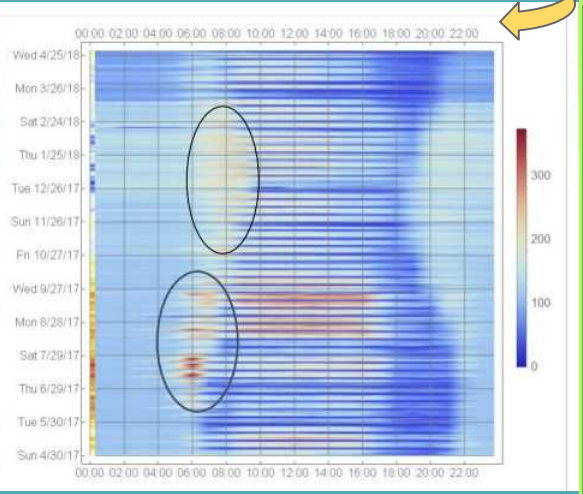
Building Analytics Exploration

- One of our overarching goals for our energy implementation is to analyze our building energy usage to identify problems and make changes. Through our partnership with Trane, we have live access to our school's energy usage on a day to day basis.
- Trane installed sensors in our buildings in May of 2016. The sensors track the energy usage, then displays the information through an accessible online platform. The data is collected every fifteen minutes on a 24-hour basis.
- We analyzed the data that was collected to understand how heating and cooling a building works. We used the data to identify problem areas, and used critical thinking skills to understand why these problems exist, and brainstormed effective solutions.
- The control of the HVAC system our school has installed is mostly managed by our lead janitor. We had a conversation with him to understand more about how the HVAC system works, the kind of light bulbs our school has installed, and other information in regards to heating and cooling our building.

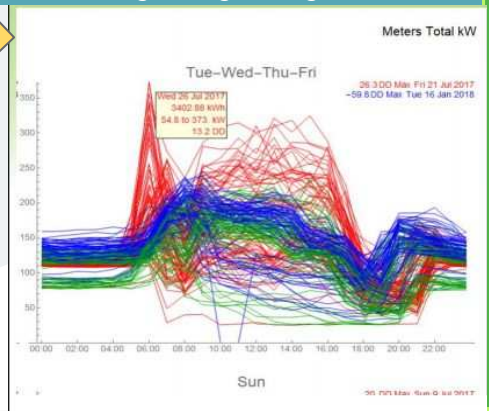


Building Analytics Project

Example of an identified problem - spike of energy around 6am!



Correlation of outside temperature with building energy usage



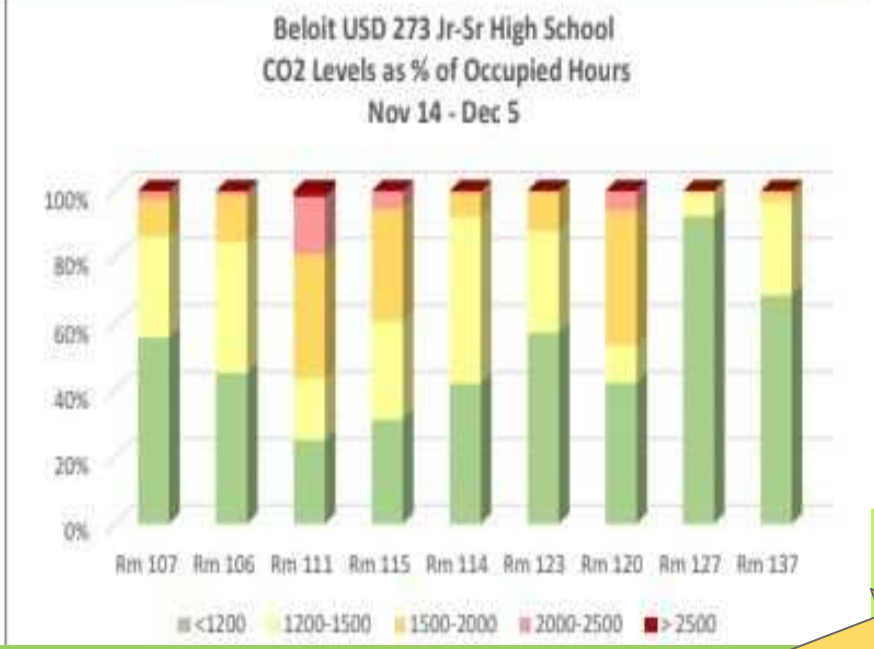
As part of our building analytics exploration, we worked on an independent project with the data collection to explore problem areas and potential solutions to save the school money. The individual project included identifying two target areas from the data analytics, two short-term goals for implementation, and one long-term goal for implementation. After completion of the individual project, each class had a conversation on the target areas and condensed their findings into two short-term goals and one long-term goal overall. Based on the results of their findings, the overall goals of the high school included:

2 Short Term Goals:

- Automatic Lighting systems in classrooms/hallways
  - First use sensors from Kansas Strong to test the lighting of areas around the school
- Increment the start up/shut down with heating/cooling the building
  - Graphs showed a big spike around 6am when the whole system turns on
  - Would staging the start up time be more energy efficient?

1 Long Term Goal:

- Implement renewable energy into the building
  - Solar energy seems to be the best option
  - City is also hoping to incorporate solar energy in the future
  - Use the energy during the day when the sun is out



CO_2 results from Trane sensors

Trane engineers installed sensors in our buildings in October 2018 that tracked temperature, CO_2, and the humidity in individual classrooms. The results from the sensors were obtained and the collected data was analyzed to identify problem areas throughout the building. These results led us to identify why high levels of carbon dioxide can be dangerous in a classroom setting.

Survey Results & School Mapping

Presenting school map results at the Kansas Career & Technical Conference

- After we gathered the results from the Trane sensors, we put together a survey to ask teachers information about room temperatures and energy usage such as shutting off the lights and running the fans. The survey was emailed to all teachers in the building.
- We took the results from the teachers and created a school map marking what each teacher said about their room temperatures. Then we mapped the results from the Trane sensors to find patterns with how our energy is distributed throughout the building.
- The survey gave us qualitative data to compare to the quantitative data of the building sensors to discover any correlations or potential problems.

KidWind Challenge

"Your first plan isn't always your final plan!" - Laney Clark & Keighlee Armstrong (BHS students)

- The KidWind Project is a hands-on learning experience and real-life application classroom activity with Wind Energy.
- We learned about energy basics through the Trane curriculum and applied what we learned to the KidWind Challenge
- We purchased Vernier KidWind Kits at the beginning of this year so that all the students could have an opportunity to test various blade designs.
- We used a wireless Voltmeter to record and analyze the data collected. We tested different blade pitches, blade shapes, and number of blades used to figure out what was the best energy output.
- We also rented the Wind Tunnel from the Kansas Energy Program in Manhattan, KS so that we could test our designs in the wind tunnel used for competition.
- We made a TON of changes to our designs including building our own bases, figuring out our own gear ratios, designing blades that work best in the tunnel, and figuring out our perfect pitch!
- **We don't just study science, we "do" science!!!**

KidWind Challenge Results

Above: JH boys team (1st place) and HS girls team (5th place) at the STATE level & below: Judge's Choice Award at Regional level!

Manhattan, KS Regional Results

1st place: 4th-8th division boys team

2nd Place: 9th-12th division girls team

Judge's Choice Award: 9th-12th girls team

Topeka, KS State Results

1st place: Junior High Boys team

5th place: 9th-12th division girls team

Nationals Event

4th-8th division boys team is headed to NATIONALS in Houston, TX!

Above: team of boys headed to nationals & Below: team of girls that got 5th at state!

Community Showcase

Through our partnership with Trane, we have had the opportunity to share on multiple occasions what we have been learning and implementing through the Trane curriculum and the KidWind Challenge. We had fun leading the presentations through explaining the results of our building analytics information and results of the KidWind challenge. Our list of presentations include:

- Board of Education presentation - February 11th
- CTE Conference presentation - February 12th
- ZOOM Meeting with Kansas Superintendents - February 27th
- KASB Leadership for Tomorrow - March 21st
- SHESC Superintendents Conference - April 16th
- OVT Visit - April 17th
- …. Many more to come!!

Overall Timeline of Events

May 2016:
Partnership with Trane established & sensors installed in buildings

October 2018:
Teachers: planning meeting with Dan
Students: introduction to energy curriculum

November 2018:
Students:
Continued learning about Wind Energy
&
Kansas Strong-Petro Presentation by Warren Martin

January 2019:
CCCC Tour
&
Dan Whisler presents on Energy and Wind Turbines

January 2019:
Google Survey sent out to teachers and map of school was created

Overall Timeline of Events-Continued

February 2019:
KidWind Teams created and building begins

Rented Manhattan Wind Tunnel for testing

KidWind Regional Challenge

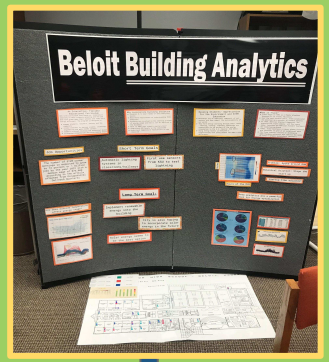
February 2019:
Students present to the USD 273 Board and at the CTE Conference
Jason Rabe, Beloit City Manager and Scott Schreiben, Beloit Energy Consultant come to speak to the BTU Crew

March 2019:
State KidWind Competition

Presentation to KASB Leadership for Tomorrow team

April 2019:
Presentation to SHESC Superintendents Conference and OVT Visit

KidWind JH Team preparing for Nationals



May 2019:
Plan to have an Energy Expo for the Community on May 9th

National KidWind Challenge

What's next? The future of our projects....

- Host an community Energy Expo at our school project fair on May 9th
- Repair our wind turbine at our Special Education Building and track the economics
- Dive deeper into building analytics for year 2 and learning more about Energy through the Trane Curriculum
- Building analytics class has been added at the high school as an elective
- Work with the city to figure out the best way to add renewable energy into our school building.
- Start researching funding and writing possible grants if we decide to build a solar farm at our school
- Possibly partner with NCK Technical or CCCC for the building process