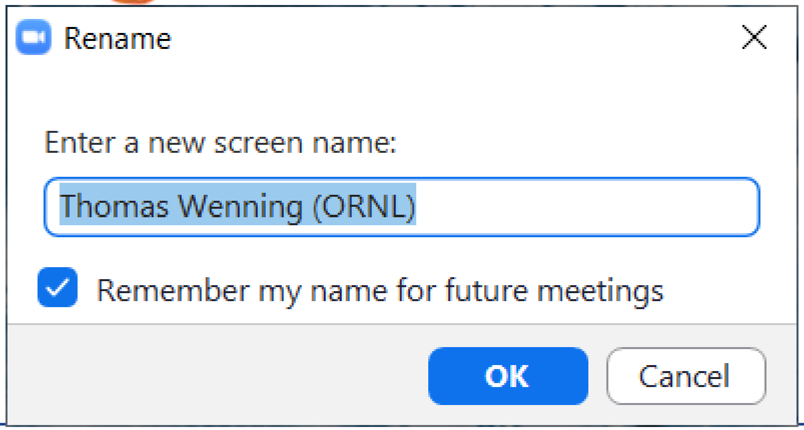
# Rename Yourself to be your <u>Real Name (Company Name)</u>

1. Click on Participant list
2. Go to the right and hover over your name
3. Select “More” & “Rename”
4. Enter your company name in brackets
5. Turn on your camera ☺

# Virtual Training: Onsite Energy Generation and Storage

## Onsite Energy Success Stories and Overview Of Geothermal Systems

Session #4
June 24, 2025
10:00am – 12:00pm EST

# General Information

- Schedule: Every Tuesday (June 3rd – July 8th) morning @ 10am ET
- Sessions will be recorded
- We want these VT to be interactive!
- We're hoping you finish the VT with some big progress
- There will be homework – just try your best!
  - "You'll get out what you put in!"

**Links:**
https://bptraining.ornl.gov/
http://betterbuildingssolutioncenter.energy.gov/better-plants
https://measur.ornl.gov

# Training Overview

1. 06/03: Introduction to Onsite Energy Generation
2. 06/10: Exploring Onsite Energy For Your Facility
3. 06/17: Evaluating an Onsite Energy System
4. **06/24: Onsite Energy Success Stories and Overview Of Geothermal Systems**
5. 07/01: Overview of Combined Heat and Power, Onsite Biomass, and Small Modular Reactors
6. 07/08: Considerations for Onsite Energy and Renewable Energy Supply Options

# Agenda

1. Homework Discussion
2. Geothermal for Onsite Energy
   - *Nicole Harvey, PNNL*
3. Onsite Energy Succes Story: Kingspan Insulated Panels, North America
   - *Kelly Buffey, Kingspan Insulated Panels*
4. Onsite Energy Succes Story: City of Fort Wayne City Utilities
   - *Doug Fasick, City of Fort Wayne*
5. Q&A
6. Homework Assignment

# Review of Homework #3: Evaluate a Solar PV System using REopt

- **Data needed** before running the simulation:

  1- Address of facility or intended location

  Example: 2350 Cherahala Blvd, Knoxville, TN 37932

  2- Electricity rate (Utility Company and Rate Structure/Schedule)

  Example: Industrial/City of Alcoa Utilities, Tennessee: GSA-3

  3- Load Profile (Annual or Monthly kWh of electricity)

  Example: 24/7 Schedule Flat Load (1,845,968 kWh) or use utility bills from Week-1 HW

https://reopt.nrel.gov/tool

- **After completing the simulation, please write below:**

  1- The recommended size of the solar PV system: ________ kW (or MW)

  2- Average Annual PV Energy Production: ___________ kWh (or MWh)

  3- Total $CO_2$ emissions reduced in Year 1: __________ tons

  4- Savings in utility cost in Year 1: $__________

  5- Economics:

  a) Net Present Value (NPV): $______

  b) Payback Period (PBP): _____ years

  c) Internal Rate of Return (IRR):_____%

# Review of Homework #3: Evaluate a Solar PV System using REopt

## Step 1: Select Use Case

- [x] Single Site
- [ ] Portfolio/Sensitivity Analysis

## Step 2: Choose Your Energy Goals

- [x] Cost Savings $
- [ ] Resilience
- [ ] Clean Energy

## Step 3: Select Technologies to Evaluate

- [x] PV
- [ ] Battery
- [x] Grid
- [ ] Wind
- [ ] CHP
- [ ] Prime Generator
- [ ] Chilled Water Storage
- [ ] Geothermal Heat Pump
- [ ] Air-Source Heat Pump (Beta)

## Step 4: Enter Your Site Data

**Site** (required)

* Required field

Evaluation name: 2350 Cherahala Blvd, Knoxville, TN 37932

* Site location: 35.9563692 | -84.152849 — Use sample site

PV & wind space available: ○ Land only ◉ Roofspace only ○ Land & roofspace

Roofspace available (ft²): 15,000 — default = Unlimited

Advanced inputs — Reset to default values

**Utilities** (required)

* Required field

Electricity Rate

* Electricity rate: City of Alcoa Utilities, Tennessee: GSA-3 (1001-50

Rate Details

☐ Use custom electricity rate

Compensation for Exported Electricity

Compensation type: Net metering (full retail rate)

Net Metering Inputs

* Net metering system size limit (kW): 250

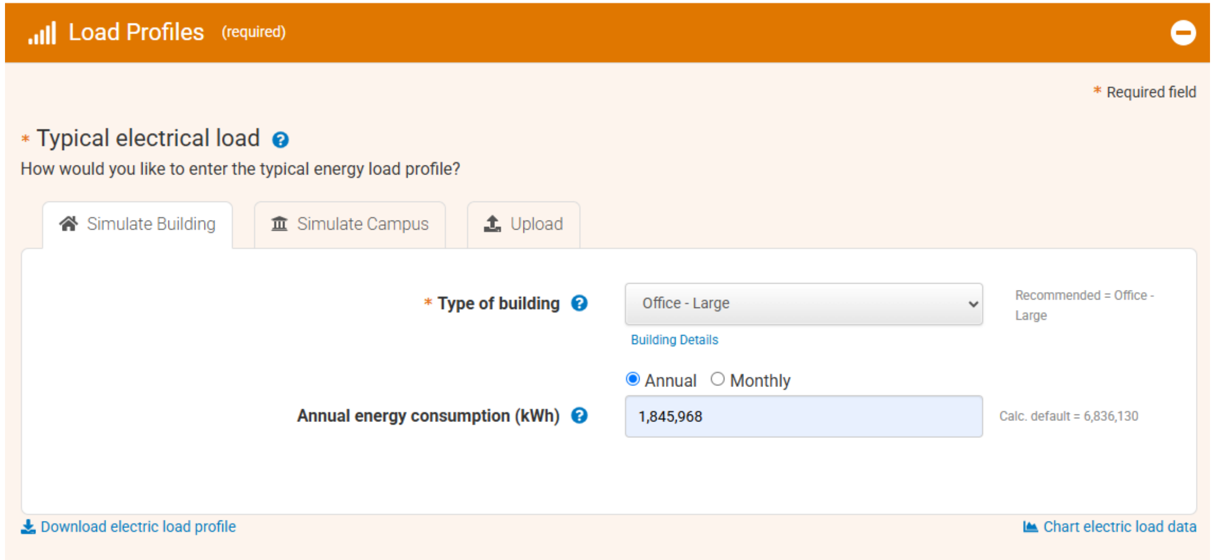
Technologies that can net meter: ☑ PV

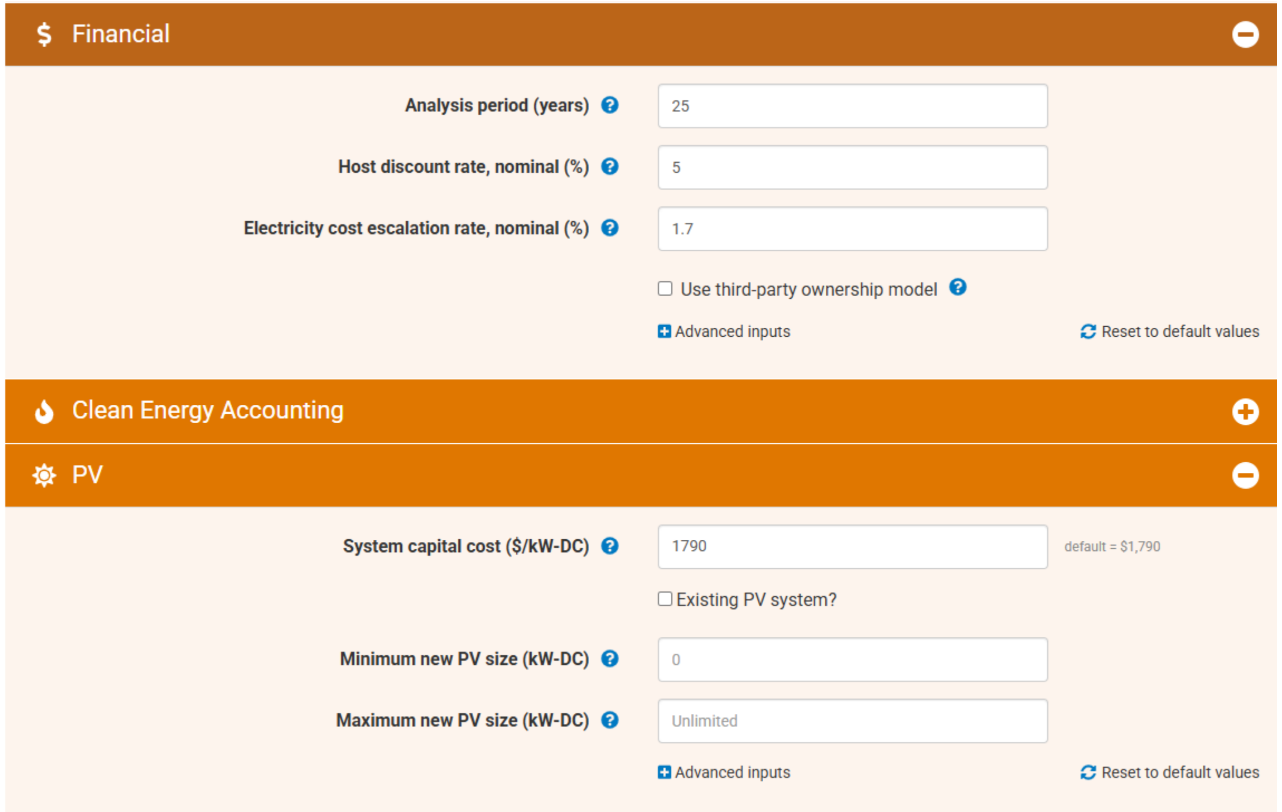
Maximum ratio of grid exports to grid purchases that can receive net metering compensation: 100%

Compensation for excess export beyond annual grid purchases ($/kWh): 0

☐ Include the site's heating load for fuel consumption, cost, and emissions accounting

# Review of Homework #3: Evaluate a Solar PV System using REopt



# Review of Homework #3: Evaluate a Solar PV System using REopt

## Results for Your Site

These results from REopt summarize the economic viability of PV, wind, battery storage, CHP, prime generator and/or GHP at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

Copy | Download PDF

### Your recommended solar installation size

**107 kW**
PV size

Measured in kilowatts (kW) of direct current (DC), this recommended size minimizes the life cycle cost of energy at your site.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

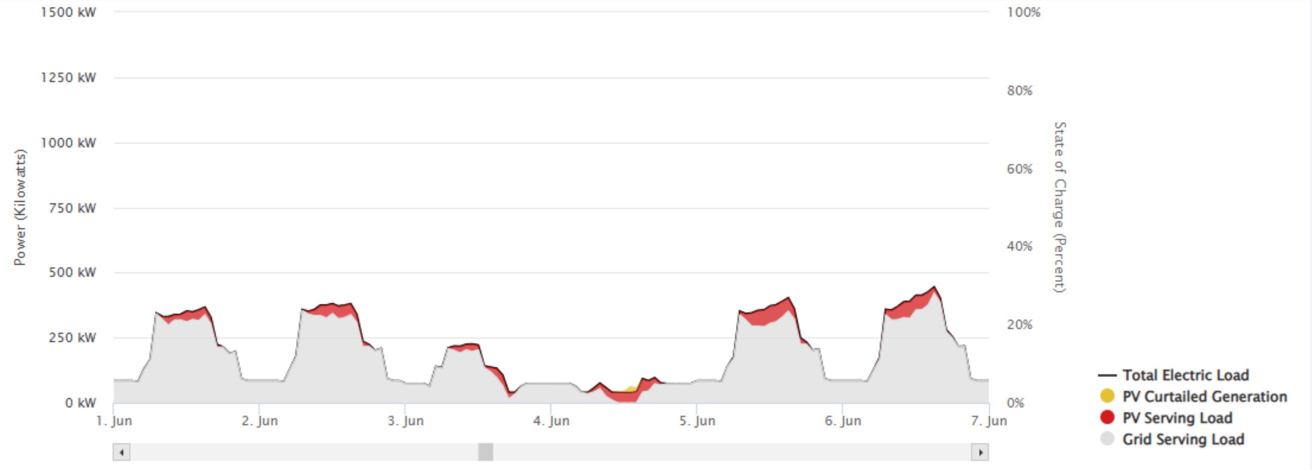
### Your potential life cycle savings (25 years)

This is the net present value of the savings (or costs if negative) realized by the project based on the difference between the total life cycle costs of doing business as usual compared to the optimal case.

**$10,825**

### System Performance Year One

This interactive graph shows the dispatch strategy optimized by REopt for typical operation of the recommended system for every hour of the year. Graphs showing the optimized dispatch strategy during specified outages can be found in the Resilience vs. Financial tab below. To zoom in on a date range, click and drag right in the chart area or use the "Zoom In a Week" button. To zoom out, click and drag left or use the "Zoom Out a Week" button.




Zoom Out a Week | Zoom In a Week

Download Sys. Performance Dispatch Spreadsheet

# Review of Homework #3: Evaluate a Solar PV System using REopt

## Grid

| Average Annual Dispatch Results | |
|---|---|
| **Grid Serving Load (kWh)** | 1,712,648 |
| **Grid Charging Battery (kWh)** | 0 |
| **Grid Total Electricity Consumed (kWh)** | 1,712,648 |

## PV

| Average Annual Dispatch Results | |
|---|---|
| **PV Serving Load (kWh)** | 133,320 |
| **PV Charging Battery (kWh)** | 0 |
| **PV Exported to Grid (kWh)** | 0 |
| **PV Curtailment (kWh)** | 2,718 |
| **PV Total Electricity Produced (kWh)** | 136,038 |

- Energy Resilience Performance
- Results Comparison
- Renewable Energy & Emissions Metrics
- Inputs
- Defaults
- Caution
- Next Steps

# Review of Homework #3: Evaluate a Solar PV System using REopt

- **After completing the simulation, please write below:**

  1- The recommended size of the solar PV system: 107 kW (or MW)

  2- Average Annual PV Energy Production: 136,038 kWh (or MWh)

  3- Total $CO_2$ emissions reduced in Year 1: 22 tons

  4- Savings in utility cost in Year 1: $10,759

  5- Economics:

  a) Net Present Value (NPV): $10,825

  b) Payback Period (PBP): 12.63 years

  c) Internal Rate of Return (IRR): 5.9%

# Review of Homework #3: Participant Submission

- Automotive Facility in South Carolina
  - 28,000 SM or 300,000 SF of ground area available


**4,200 kWdc System Size**

RESULTS

Print Results

5,803,973 kWh/Year*

*System output may range from 5,604,897 to 5,961,261 kWh per year near this location.*
*Click HERE for more information.*

| Month | Solar Radiation (kWh / m$^2$ / day) | AC Energy (kWh) |
|---|---|---|
| January | 3.80 | 392,827 |
| February | 4.23 | 389,605 |
| March | 5.13 | 505,117 |
| April | 5.93 | 549,827 |
| May | 6.46 | 604,724 |
| June | 5.93 | 528,379 |
| July | 6.36 | 577,907 |
| August | 5.94 | 545,745 |
| September | 5.58 | 505,578 |
| October | 4.99 | 475,822 |
| November | 3.99 | 386,295 |
| December | 3.33 | 342,146 |
| Annual | 5.14 | 5,803,972 |

**Facility Load: 21,000,000 kWh/yr**

# Review of Homework #3: Participant Submission

**Facility Load: 21,000,000 kWh/yr**

- Automotive Facility in South Carolina
  - 28,000 SM or 300,000 SF of ground area available

REopt

Your optimized solar installation size

**1,152 kW**
PV size

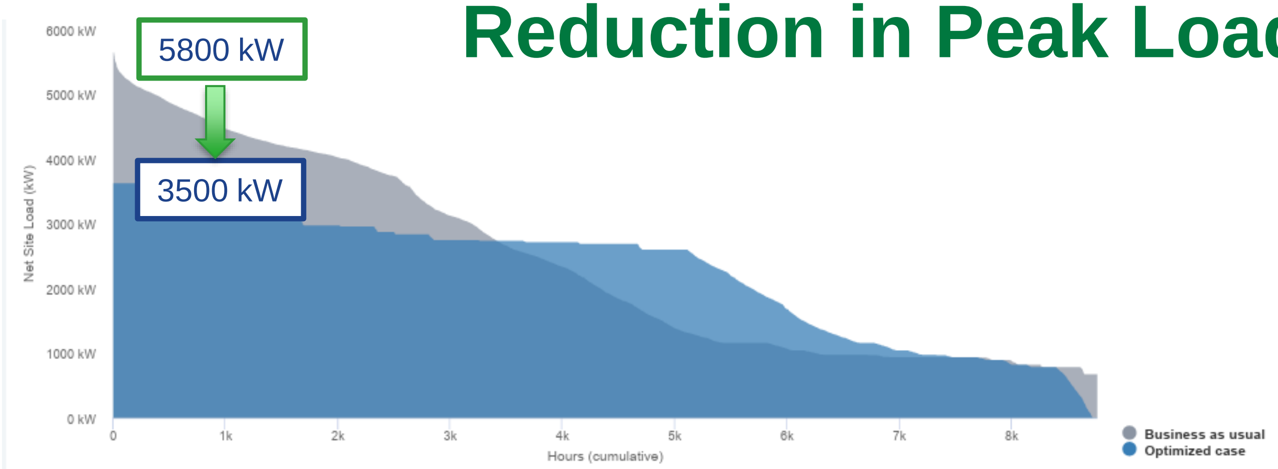
Measured in kilowatts (kW) of direct current (DC), this optimized size minimizes the life cycle cost of energy at your site.

Your optimized battery power and capacity

| **1,905 kW** | **20,209 kWh** |
|---|---|
| battery power | battery capacity |

The battery power (kW-AC) and energy capacity (kWh) are optimized independently for economic performance.

## Reduction in Peak Load



# Review of Homework #3: Participant Submission

REopt

## Grid

| Average Annual Dispatch Results | |
|---|---|
| Grid Serving Load (kWh) | 16,937,971 |
| Grid Charging Battery (kWh) | 2,824,564 |
| Grid Total Electricity Consumed (kWh) | 19,762,534 |

## PV

| Average Annual Dispatch Results | |
|---|---|
| | |
| PV Serving Load (kWh) | 1,512,916 |
| PV Charging Battery (kWh) | 5,928 |
| PV Exported to Grid (kWh) | 0 |
| PV Curtailment (kWh) | 0 |
| PV Total Electricity Produced (kWh) | 1,518,844 |

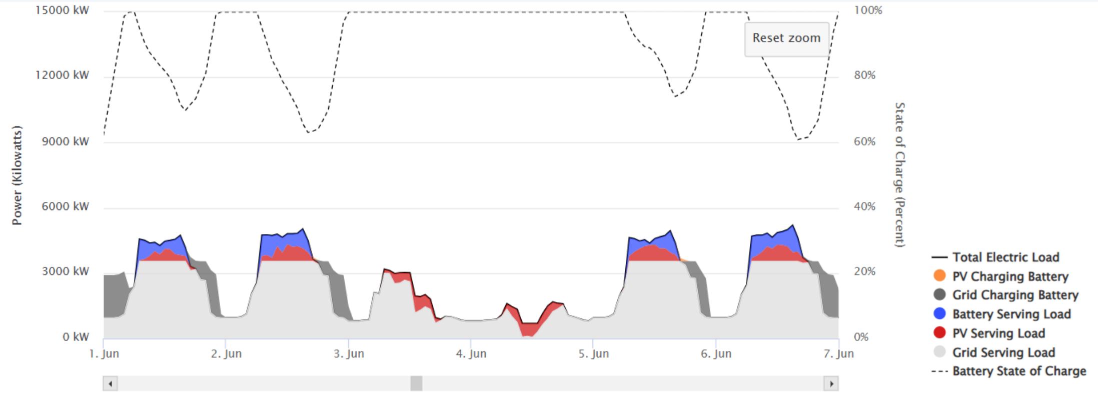
## Battery

| Average Annual Dispatch Results | |
|---|---|
| Battery Serving Load (kWh) | 2,549,114 |

| | Business As Usual | Financial | Difference |
|---|---|---|---|
| **System Size** | | | |
| PV Size | 0 kW | 1,152 kW | 1,152 kW |
| Battery Power | 0 kW | 1,905 kW | 1,905 kW |
| Battery Capacity | 0 kWh | 20,209 kWh | 20,209 kWh |
| **Energy Production and Fuel Use** | | | |
| Average Annual PV Energy Production | 0 kWh | 1,518,844 kWh | 1,518,844 kWh |
| Average Annual Energy Supplied from Grid | 21,000,000 kWh | 19,762,534 kWh | -1,237,466 kWh |

## System Performance Year One

This interactive graph shows the dispatch strategy optimized by REopt for typical operation of the optimized system for every hour of the year. Graphs showing the optimized dispatch strategy during specified outages can be found in the Resilience vs. Financial tab below. To zoom in on a date range, click and drag right in the chart area or use the "Zoom In a Week" button. To zoom out, click and drag left or use the "Zoom Out a Week" button.



# Review of Homework #3: Participant Submission-2

- Dairy Food in Connecticut

**Facility Load: 8,200,000 kWh/yr**

| | |
|---|---|
| PV & wind space available | Land & roofspace |
| Land available (acres) | 3.9 |
| Roofspace available (sq ft) | 9,709 |

| Load Profile | |
|---|---|
| Typical electric load profile type | simulated building |
| Type of building | 24/7 Schedule Flat Load |
| Size class | Large Commercial (101 - 2,000 kW) |

| Utilities | |
|---|---|
| Annual energy charge ($/kWh) | $0.24 |
| Annual demand charge ($/kW/month) | $0.00 |
| Compensation type | Net billing (not full retail rate) |
| Net billing compensation for all exports ($/kWh) | 0.123 |

Your optimized solar installation size

747 kW

PV size

Measured in kilowatts (kW) of direct current (DC), this optimized size minimizes the life cycle cost of energy at your site.

1. The recommended size of the solar PV system: 747 kW
2. Average Annual PV Energy Production: 1,027,269 kWh
3. Savings in utility cost in Year 1: $242,435

Economics:

1. Net Present Value (NPV): $1,600,010
2. Payback Period (PBP): 4.57 years
3. Internal Rate of Return (IRR):19.2%

# Poll Time!

U.S. DEPARTMENT OF ENERGY

# Today’s Speakers

**Nicole Harvey**

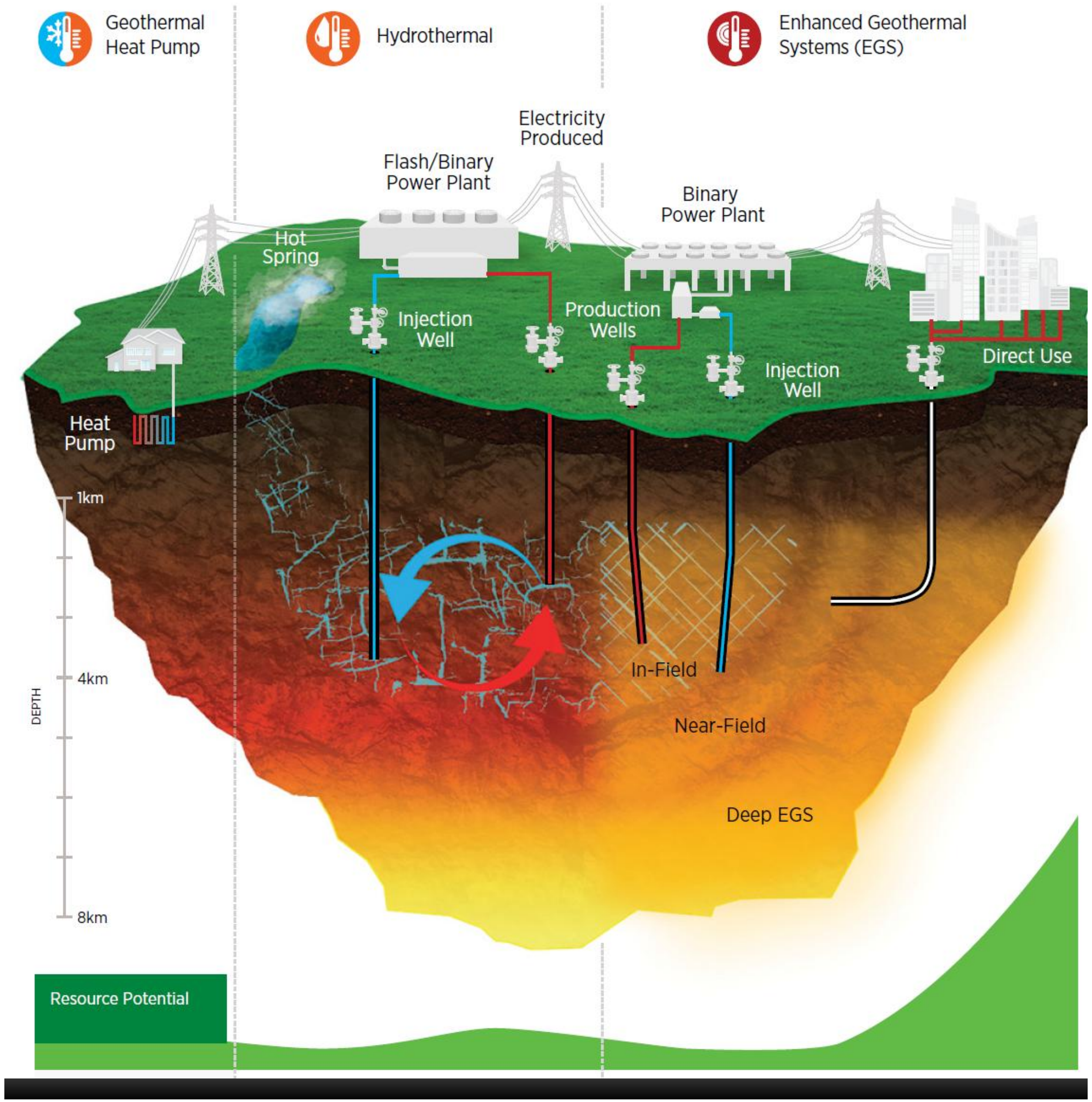
*Mechanical Engineer,*
*Pacific Northwest National Laboratory*

# Geothermal for Manufacturing Facilities

**Nicole Harvey**
Pacific Northwest National Lab

# 3 Types of Geothermal Energy Applications

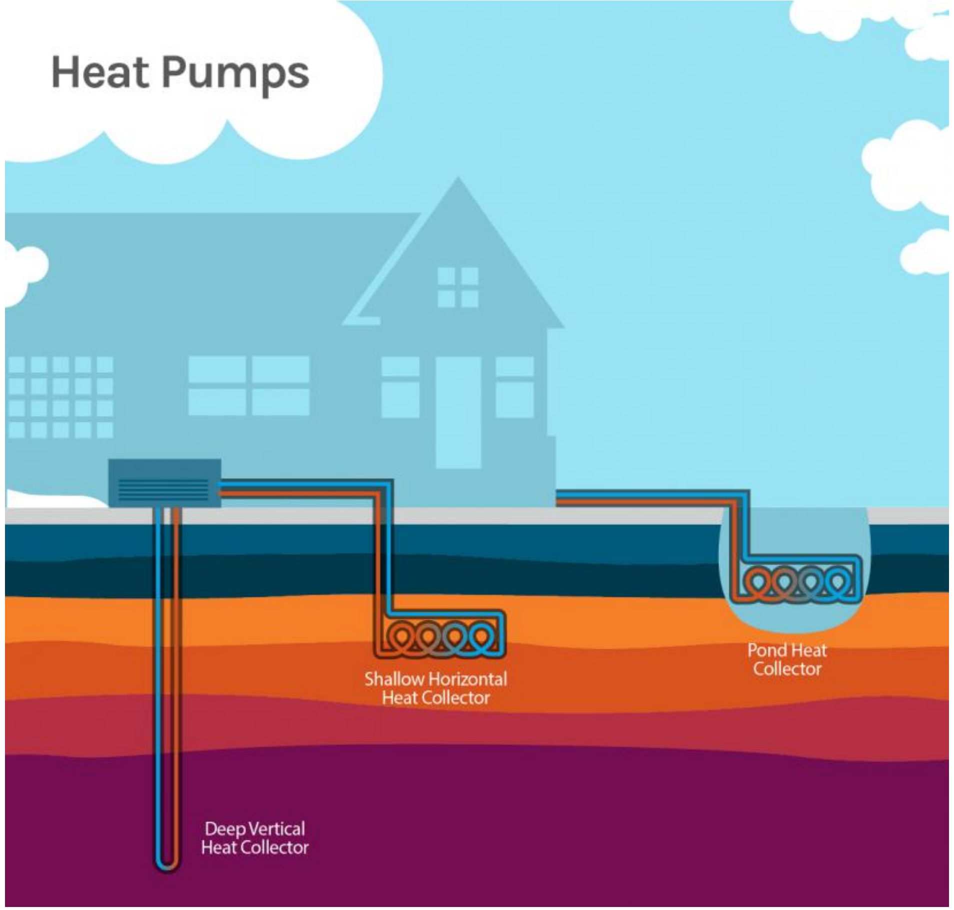
1) Ground source heat pumps (GSHP) for heating/cooling
2) Deep Direct Use (DDU) for heating/cooling
3) Geothermal Electricity Generation




DOE Geovision Report

# Overview: GSHP

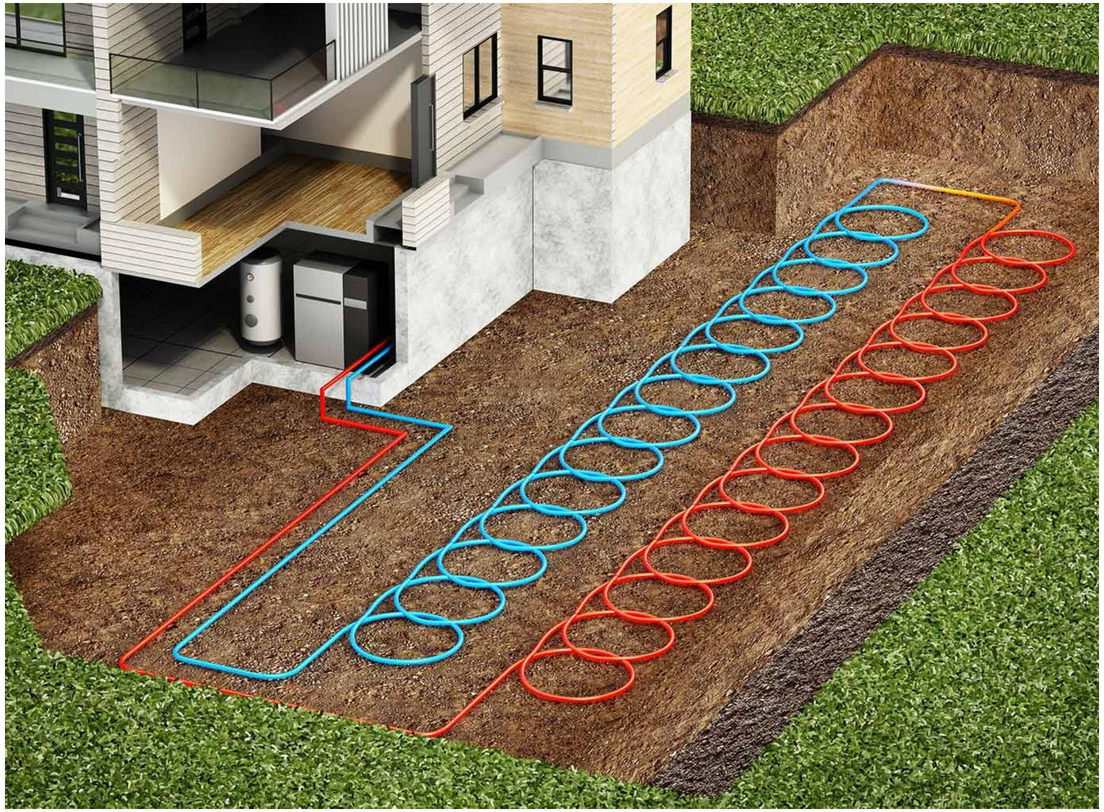
- Also known as geothermal heat pumps. This technology is generally used for low temperature applications <150°F.
- However special circumstances can allow for heat generation up to 300°F (See back up slides)
- Applications include:
  - Space heating and cooling
  - Low temperature process heating
  - Process cooling and refrigeration
  - Greenhouse heating




Department of Energy: Heat Pumps

# Challenges and Considerations: GSHPs

- Challenges
  - Most commonly used and best suited to applications requiring low temperatures (<150°F)
  - High upfront costs compared to traditional HVAC systems
  - Unbalanced heating and cooling loads can lead to thermal interference.



Rocky Mountain Institute

# Case Study – Delta Electronics [1]

- Location: Freemont, CA
- 175,000 sf electronics manufacturing facility
- Shallow horizontal closed loop system
- Installed in 2015
- 580 tons cooling load
- Facility uses 70% less energy on average than a LEED certified building

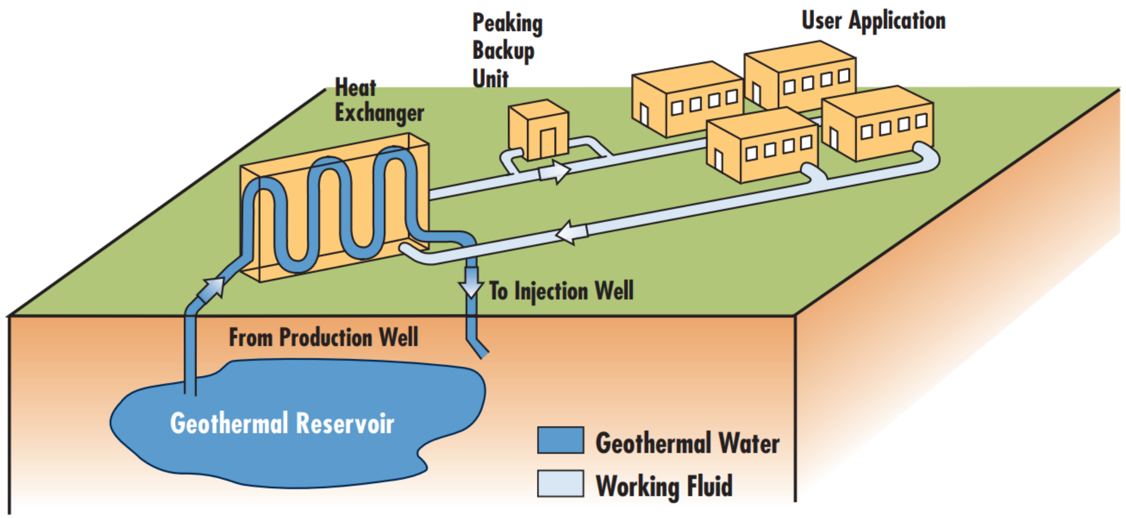
Geothermal Technologies Office: Geothermal Case Studies

# Resources: GSHP

- International Ground Source Heat Pump Association
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- ORNL GSHP Screening Tool
- REopt
- PNNL GSHP Maintenance Guidelines

# Overview: Deep Direct Use (DDU)

- Use hot water from springs or reservoirs near the surface for heating or cooling purposes.
- Resource Requirements:
  - Sufficiently hot rock/fluid: 100-300°F
  - Must have flowing ground water at sufficient flow rotes
  - With in 3-4 km of the surface
- Applications Include:
  - Greenhouse heating
  - Food processing and drying
  - Pulp/paper processing
  - Absorption cooling

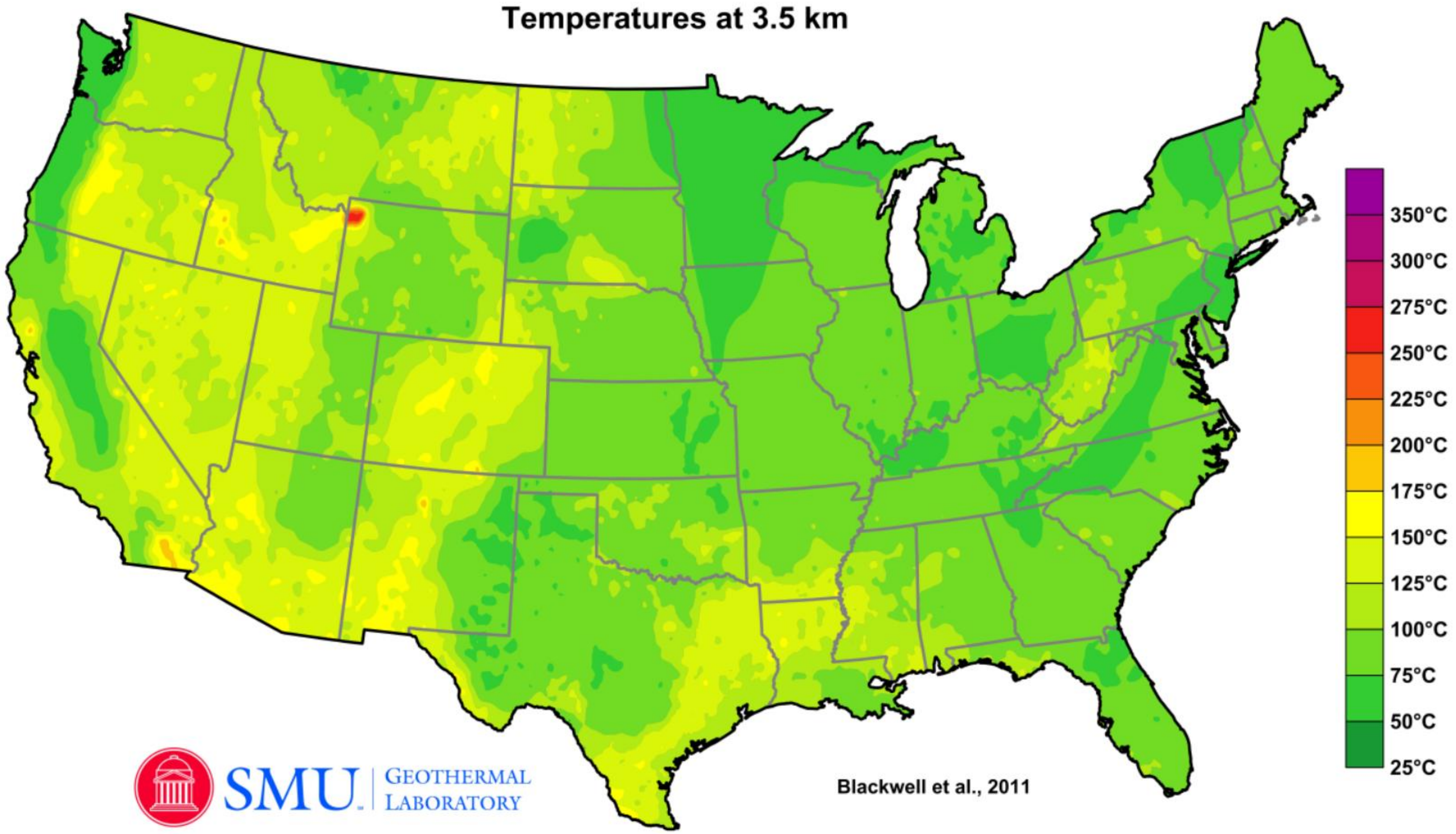



*Graphical representation of a geothermal district-heating system.*

Geothermal Technologies Program: Direct Use

# Challenges and Design Considerations: DDU

- Sufficiently hot geothermal resources with sufficient water flow rates are not available everywhere
- Most resources are concentrated in the western United States and Gulf Coast
- High upfront costs
  - High resource characterization costs



# Case Study - Karsan Cement Plant, Kenya [2]

- Location: Menengai field, Kenya
- Resource: Depths around 2 km with temperatures ranging from 662-752°F (350-400°C) [3]
- The cement plant produces about 1200 tonnes per day
- One 4 MW ORC power plant and one heat powered dyer
- Steam and brine produced from the well. Steam and brine separated with hot brine going to heat the dyer and steam used to generate power
- Drying pozzolanic tuffaceous ash which will be used to replace some of the clinker in the cement

Think Geo Energy

# Case Study - Empire Energy, Nevada [4]

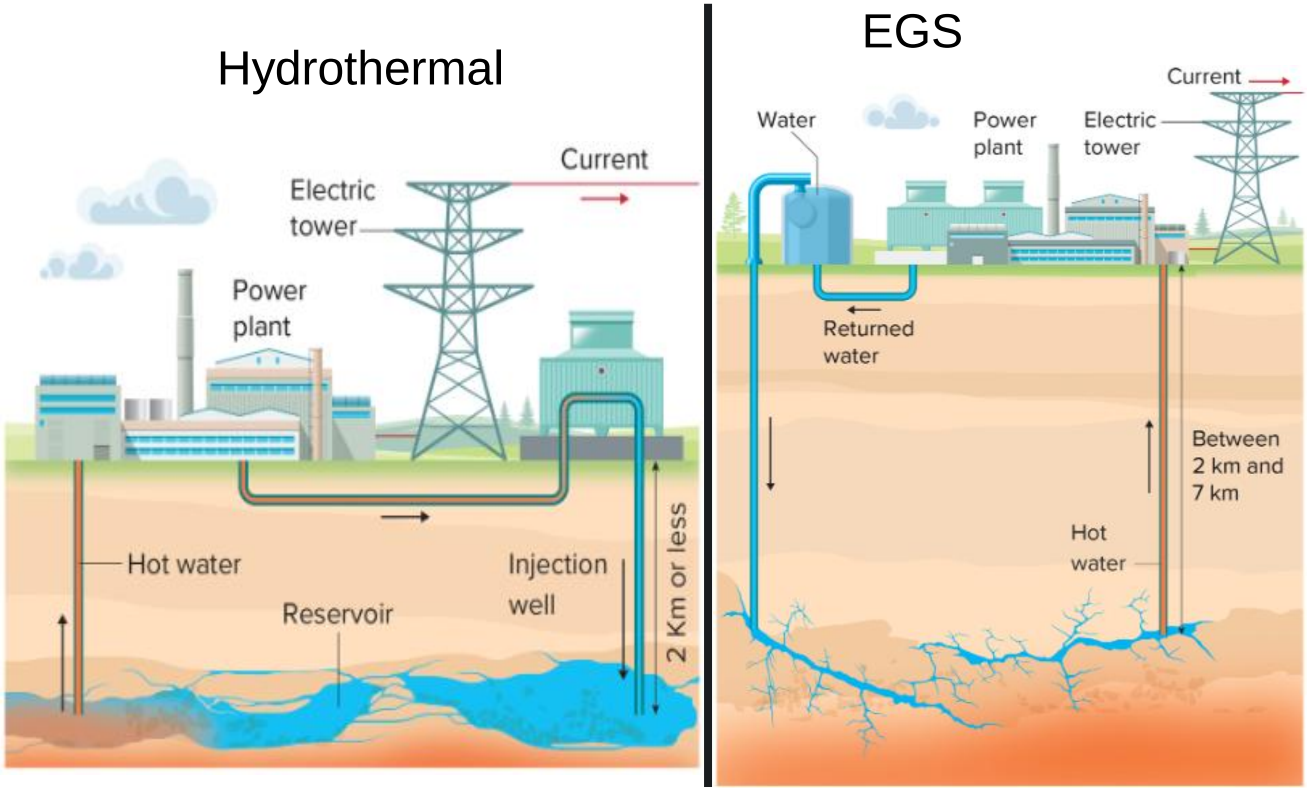
- Location: San Emidio Dessert Nevada
- Resource depths: 12-600 m
- Heat used in dehydration plant
  - 800-1200 gpm at 298°F (148°C) for a four-stage dryer
  - Dehydration plant capacity is 75,000 lbs/day of onion and 85,000 lbs/day garlic
- Dehydrator constructed and began operation in 1994

Washington State University

Washington State University: Dried and processed onions

# Overview: Geothermal Electricity Generation

- <u>**Not typically used in manufacturing, but high potential**</u>
- Two main types: hydrothermal and Enhanced Geothermal Systems (EGS)
- Both require >200°F (90°C) water/ground temperatures within 4.4 mi (7 km) of earth's surface
- Hydrothermal:
  - Established technology
  - Requires specific and unique geology (i.e., not available everywhere)
  - Geology requirements:
    - ✓ Permeable rock (naturally existing factures)
    - ✓ Naturally flowing water
- EGS
  - Seeks to create natural fractures through hydraulic fracturing.
  - Water cycled through hot dry rock to generate electricity
  - Nascent technology



# Challenges and Design Considerations: Geothermal Electric

- Typically, these systems are operated at a utility scale.
- Sizes range from 150 kW to 725 MW[1]
- Very few examples of geothermal electricity at a building/campus level
  - Chena, AK Geothermal Microgrid (680 kW)
  - Fang Geothermal Plant in Chang Mai, Thailand (150-250 kWe)
- Operated at high capacity factors typically greater than 90% (i.e. base load operation) [5]
- Economics
  - Well drilling and resource characterization are the most expensive part
  - Drilling depths can become limiting factor
- Induced Seismicity
  - Drilling and water injection has been known to cause seismic activity
  - Robust analysis and careful consideration required before drilling to reduce risk
- Small footprint compared to other technologies
  - 1.6 acres per MW required [6]

1. The Geysers in CA has a total installed capacity of 725 MW across 13 power plants [https://geysers.com/geothermal]

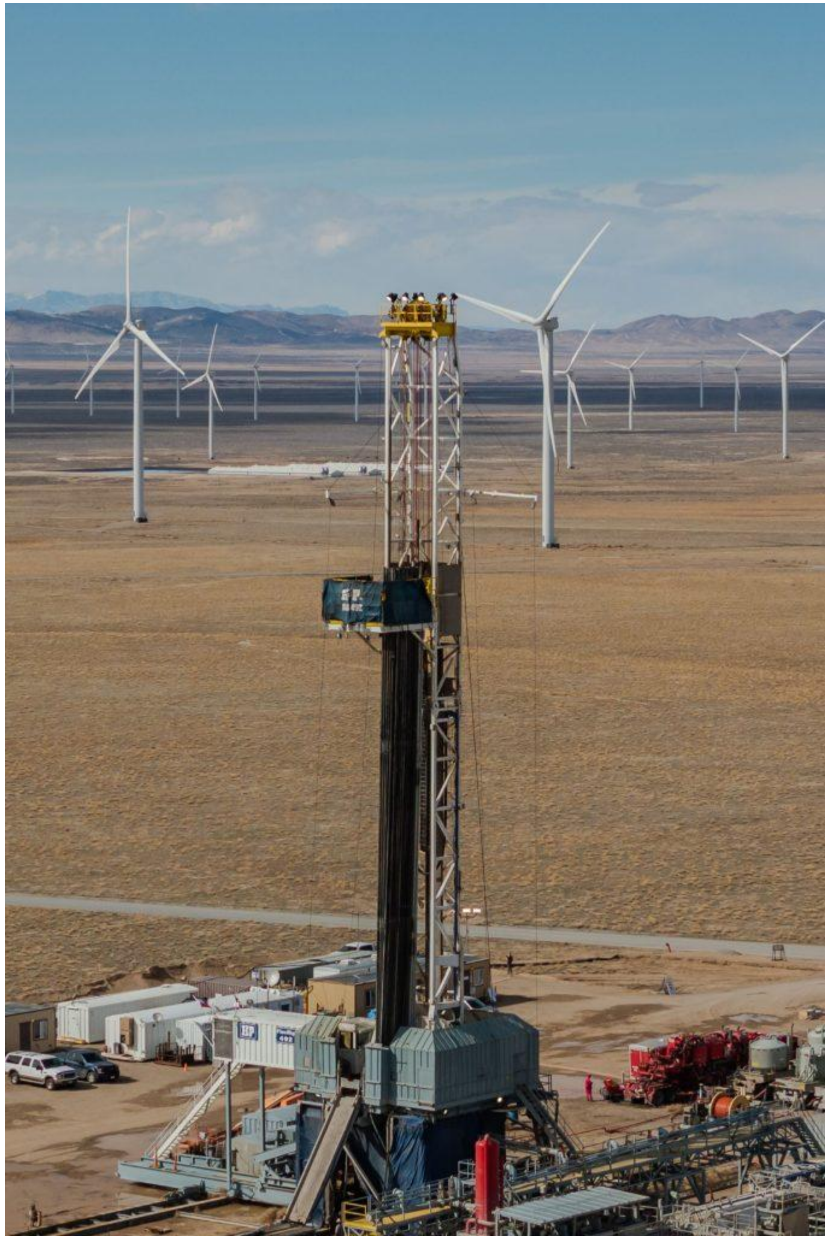
# Case Study – Chena, Microgrid [7]

- Location: Chena, AK
- Began operation in 2006
- Binary power plant (lower temperature needed)
- Lowest temperature geothermal resource in the world at 71°C [6]
- In 2006 400 kW generator cost $2.1M and displaced 150,000 gal diesel annually
- Capacity expanded from 400 kW to 680 kWe in 2008
- Also used for heating baths, swimming pools, and greenhouses.

Chena Hot Springs Resort

# Case Study – Fervo Energy Cape Station [8]

- Location: Cape Station, UT
- 500 MW Capacity
- Resource: >428°F (220°C)
- Enhanced Geothermal System
- Phase one to begin delivering power in 2026



Fervo Energy

# Resources: DDU and Geothermal Electric

DDU

- Geovision report
- SMU Temperature Maps
- Geothermal Technologies Office
- Stanford Temperature Model
-

Geothermal Electric

- Geovision report
- NREL Geothermal Potential Map
- SMU Temperature Maps
- Geothermal Technologies Office
- Stanford Temperature Model
- Renewable Energy Potential Model (reV)
- System Advisory Model (SAM)
- Jobs and Economic Development Impact mode (JEDI)

# New and Upcoming Technologies

- Thermal Storage
- AGS (closed loop geothermal electricity generation)
- High temperature heat pumps ( >150°F)
- Hybrid geothermal
  - Pairing geothermal with other technologies
- Co-produced systems
  - Production of hydrocarbon fluids (existing oil and gas wells)
  - Critical materials from geothermal brines
- Drilling technology enhancements

# Wrap Up Summary

- Many great applications for geothermal energy in the manufacturing space
- GSHP are most suitable for end use applications below 150°F and require electricity to operate
- DDU requires a sufficiently hot resource with flowing water(mostly available in the western US and Gulf coast). Suitable for 100-300°F applications.
- Electricity generation requires a sufficiently hot resource 200°F with in 6 km depth and 1.6 acres/MW open land.

# Thank you

# References:


[1] “Geothermal Heat Pump Case Study: Delta Electronics.” n.d. Energy.Gov. Accessed June 11, 2025.https://www.energy.gov/eere/geothermal/geothermal-heat-pump-case-study-delta-electronics.

[2] Carlo Cariaga. 2024. “World’s 1st Geothermal Direct Use Cement Project Sets Model for Sustainable Industry.” August 22, 2024. https://www.thinkgeoenergy.com/worlds-1st-geothermal-direct-use-cement-project-sets-model-for-sustainable-industry/.

[3] Clean Air Task Force. n.d. “Menengai, Kenya Key Stats.” Clean Air Task Force. https://cdn.catf.us/wp-content/uploads/2022/10/25212940/CATF_SHRProjectFactsheet_MenengaiKenya.pdf.

[4] Bloomquist, R. Gordon. 2004. “Empire Energy LLC - A Case Study.” Washington State University Energy Program. https://www.energy.wsu.edu/Documents/2GeoHeat%20Bulletin_July04.pdf.

[5] “Geothermal FAQs.” n.d. Energy.Gov. Accessed June 11, 2025. https://www.energy.gov/eere/geothermal/geothermal-faqs.

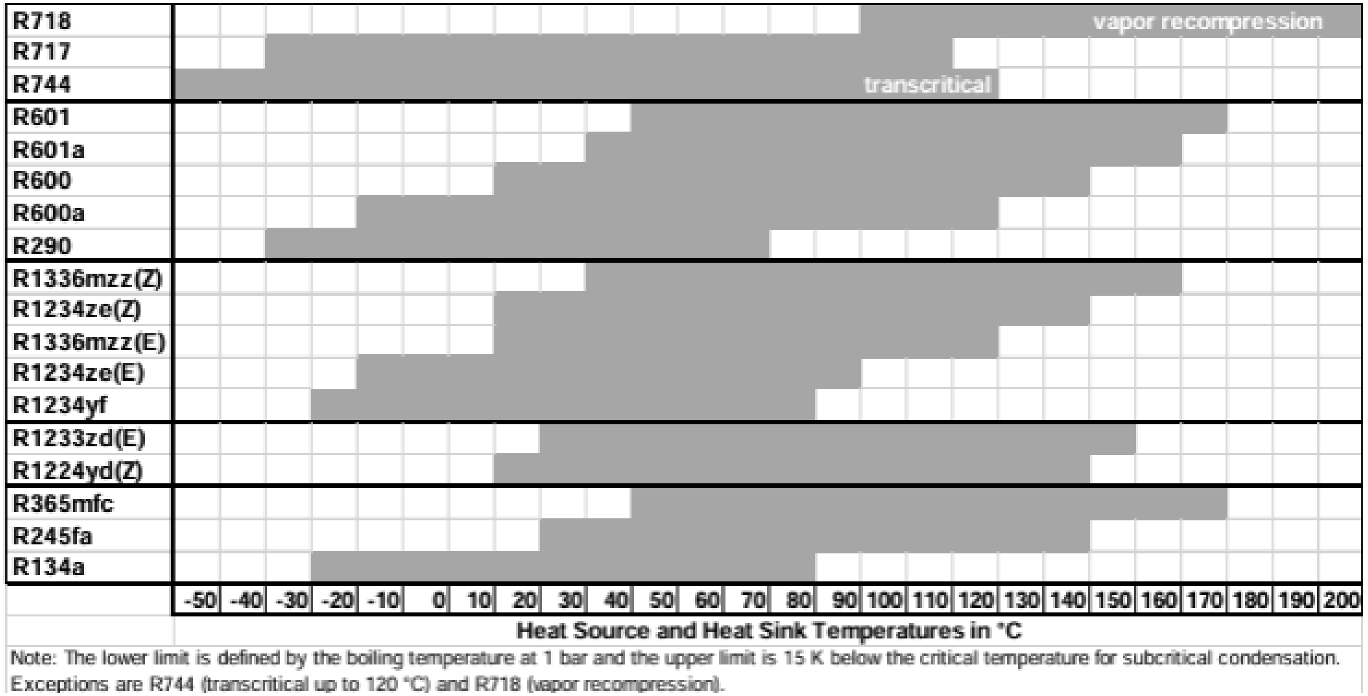
[6] Robins, Jody, Amanda Kolker, Francisco Flores-Espino, Will Pettitt, Brian Schmidt, Koenraad Beckers, Hannah Pauling, and Ben Anderson. 2021. “2021 U.S. Geothermal Power Production and District Heating Market Report.” NREL/TP-5700-78291, 1808679, MainId:32208. https://doi.org/10.2172/1808679.

[7] “Chena Hot Springs, Chena, AK, USA.” n.d. Arctic Council. Accessed June 11, 2025. https://arctic-council.org/about/working-groups/acap/home/projects/arctic-black-carbon-case-studies-platform/chena-hot-springs-chena-ak-usa/.

[8] “Resources - Cape Station.” 2023. June 14, 2023. https://capestation.com/resources/.

# GSHPs Special Applications

- Certain refrigerants and refrigeration cycles can allow for output temperatures up to 300°F.
- Requirements
  - High grade geothermal resource at economical depths (90°C at 2 km depth)
  - Absorption cycle heat pump




International Energy Agency (IEA). (2023). "High-Temperature Heat Pumps Task 1-Technologies.

# Questions?

U.S. DEPARTMENT OF ENERGY

# 5 Minute Break

U.S. DEPARTMENT OF ENERGY

# Today's Speakers

**Kelly Buffey**

*Sustainability Manager,*
*Kingspan Insulated Panels, North America*

U.S. DEPARTMENT OF ENERGY

# Kingspan Insulated Metal Panels

## Department of Energy

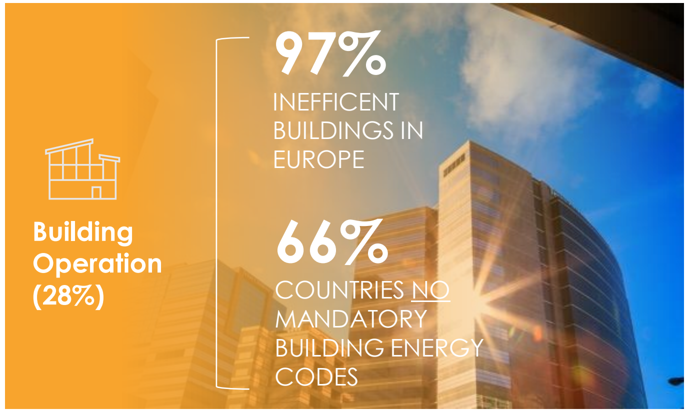
**2025**

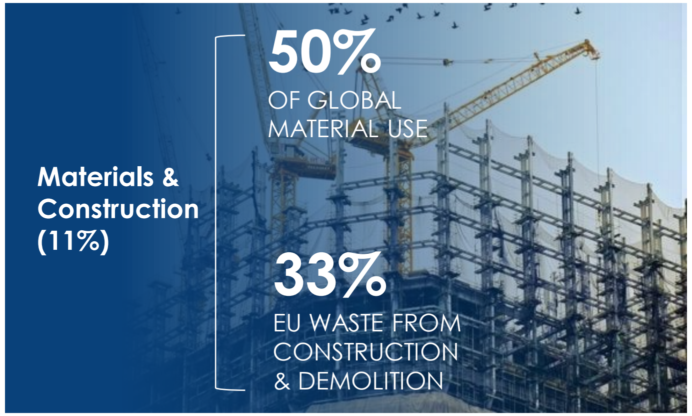
PLANET PASSIONATE

# BUILT ENVIRONMENT OPPORTUNITY

2020 - 2050

## 2020




New build

Renovation

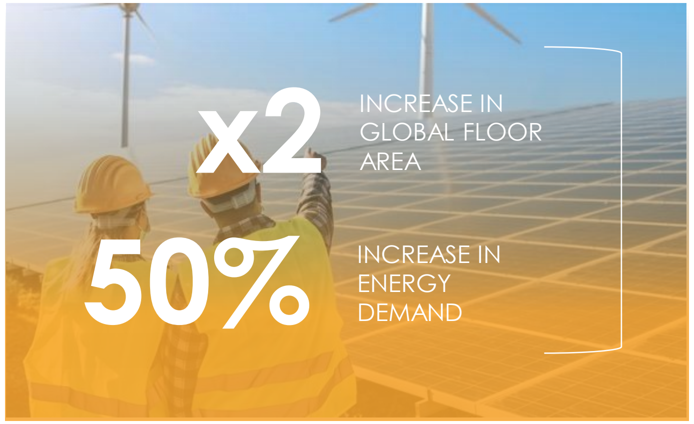
PLANET PASSIONATE BUILDING SOLUTIONS

Market

Regulation

Drivers

## 2050




MISSION AND IMPACT

PLANET PASSIONATE

Our mission is to accelerate a net zero emissions built environment with planet and people at its heart.

## Insulation products


**172m** $tCO_2e$

Estimated lifetime carbon savings from insulation systems sold in 2024

## Kingspan 2024 Carbon footprint

**7.3m** $tCO_2e$

Kingspan 2024 value chain carbon footprint

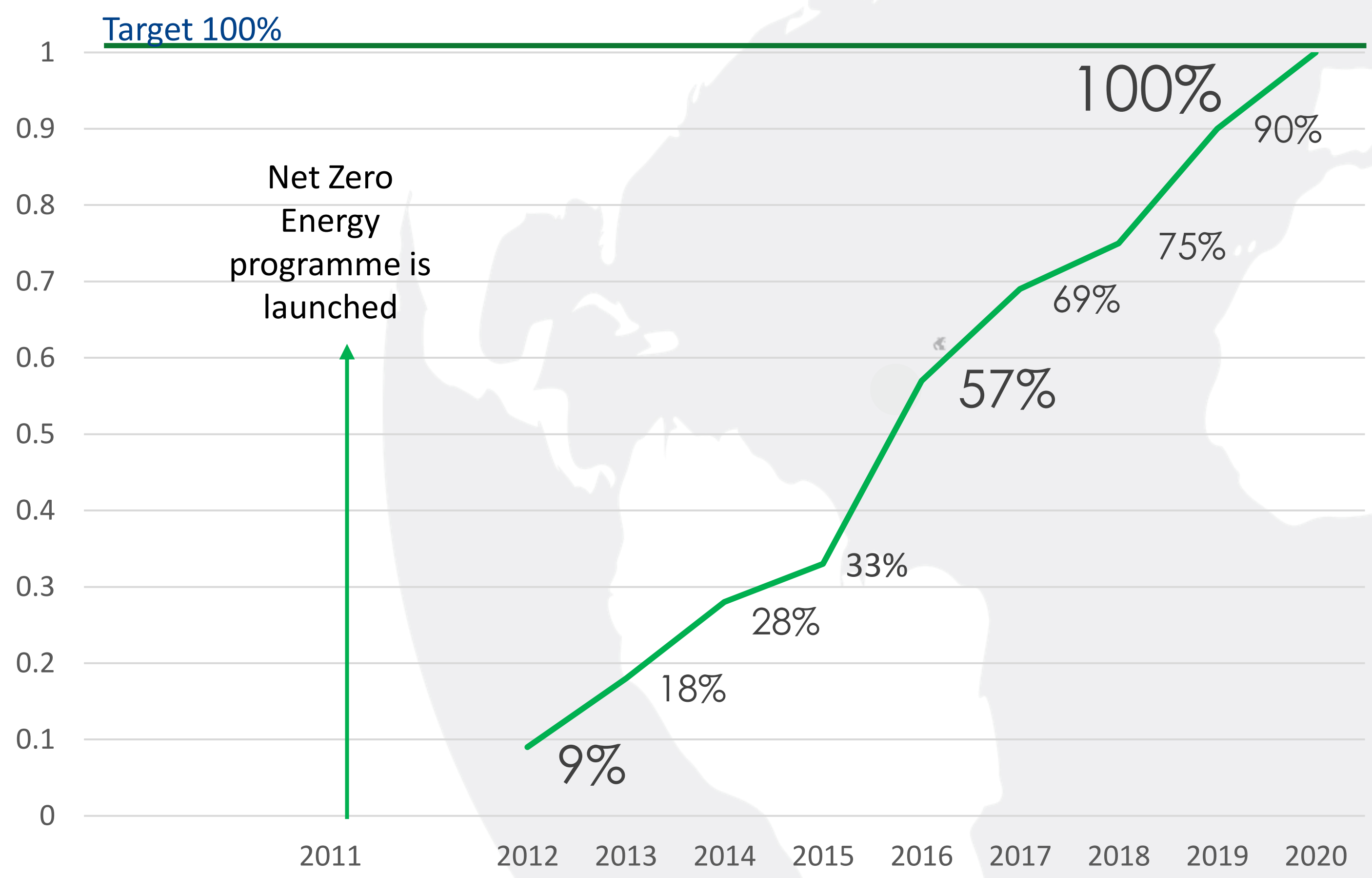
**x 24**

# Kingspan Net Zero Energy 1.0- Looking Back 2011-2020

# OUR NET ZERO ENERGY* 2020 GOAL:

- To match 100% of our operational energy with renewable energy and the purchase of renewable energy certificates to offset any remaining non-renewable energy use.

Renewable Energy%

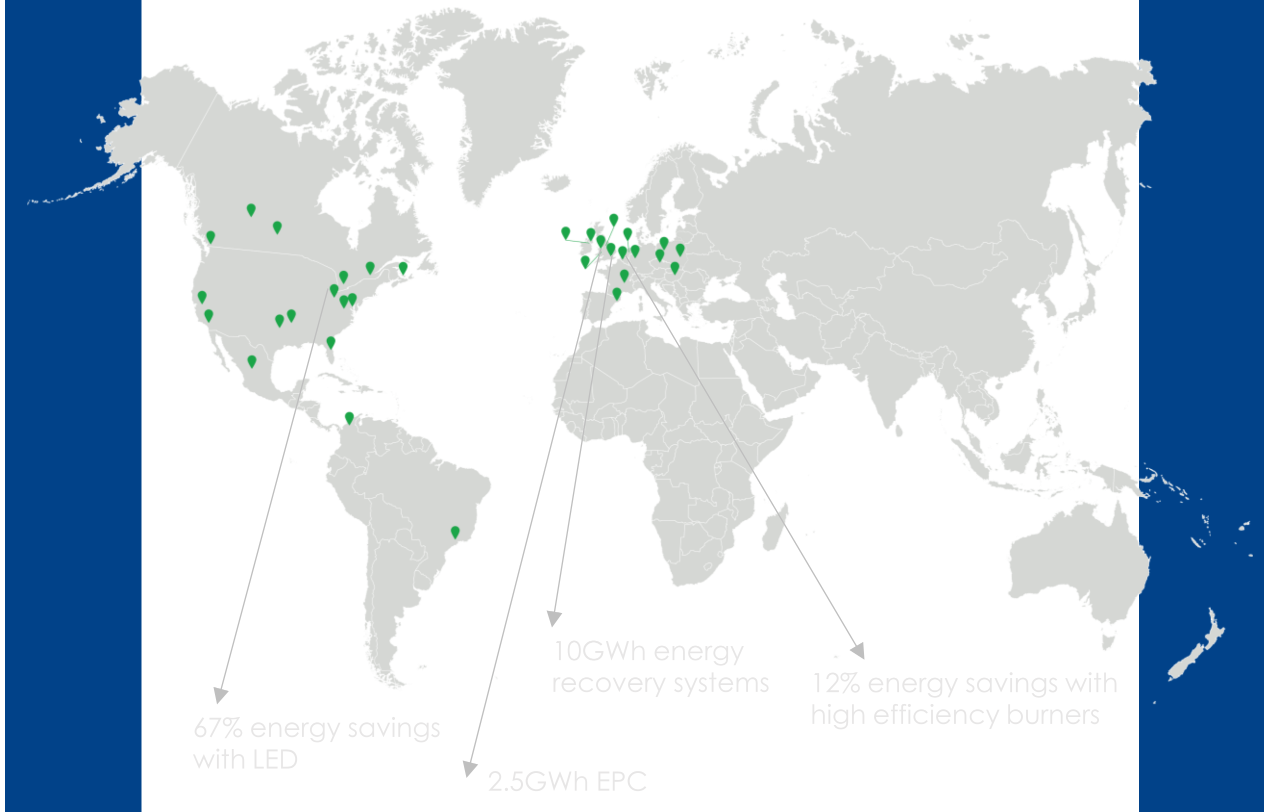


# HOW DID WE ACHIEVE THIS?

## •1.

## Save More

- We have implemented significant energy-saving projects in manufacturing sites across the world.



# HOW DID WE ACHIEVE THIS?

## •2.

## Generate More

- In 2018, 5.9% of our total energy use was generated from renewable sources on our own manufacturing sites.

Kingspan

## HOW DID WE ACHIEVE THIS?

# •3.

# Buy More

- In 2018, in addition to the 5.9% generated on our sites, we bought approximately 21% renewable energy directly from the grid and matched the remainder with renewable energy certificates.

Kingspan

# Planet Passionate- Kingspan Looking Forward- 2020 through 2030

Kingspan

PLANET PASSIONATE

# GROUP PROGRESS 2020 – 2024

| | Metric | | Underlying Business | | Whole Business |
|---|---|---|---|---|---|
| CARBON | 90% GHG emissions reduction | 2030 | 80% | 90% | 61% |
| | 50% raw material $CO_2$e intensity reduction | 2030 | 3.9% | 50% | 3.9% |
| | Zero emission cars annual conversion | 2025 | 89% | 100% | 86% |
| ENERGY | 60% direct renewable energy | 2030 | 43% | 60% | 59% |
| | 20% on-site renewable energy generation | 2030 | 10.2% | 20% | 30% |
| | Wholly owned facilities with rooftop solar PV | 2030 | 61% | 100% | 57% |
| CIRCULARITY | Zero company waste to landfill | 2030 | 62% | 100% | 33% |
| | 1B PET bottles recycled into our processes | 2025 | 100% | 100% | 100% |
| | QuadCore™ utilising recycled PET | 2025 | 75% | 100% | 75% |
| WATER | 100ML rainwater harvested annually | 2030 | 62% | 100% | 63% |
| | 5 ocean clean up project supported | 2025 | 100% | 100% | 100% |

# TARGETS


## Carbon

- **65% reduction** in scope 1 and 2 GHG emissions by 2030
- **15% carbon intensity reduction** for key raw materials by 2030
- **>90% Zero emission** company funded cars- annual replacements by 2030

## Energy

- **60%** direct renewable energy by 2030
- **ISO 50001** energy management system for **large sites*** NEW
- Install solar PV systems on **all owned facilities** by 2030

## Circularity

- **Zero company waste** to landfill by 2030
- **1.5 Million tonnes of** recycled and renewable raw materials used annually by 2030 NEW
- **Facilitate 20** product takeback and recycling schemes by 2030 NEW

## Water

- **100 million** litres of rainwater harvested annually by 2030

*Large sites: >5GWh annual energy use

## PLANET PASSIONATE
PROGRESS IN NUMBERS

PLANET PASSIONATE

# 400+
## PROJECTS SINCE 2020

### GHG EMISSIONS[1]

w/ acquisitions | underlying

**61%** | **80%**

Absolute reduction in Scope 1 & 2 GHG emissions since 2020 (including acquisitions)

**14%**

Absolute reduction in scope 3 GHG emissions since 2020 (including acquisitions)

### ON-SITE GENERATI

TARGET ACHIEVED

**30%**

On-site renewable energy generation

**57%**

Wholly-owned sites have solar PV systems installed

### PET BOTTLES*

TARGET ACHIEVED

**4b+** Recycled since 2020

**1.1b** Recycled since 2024

### PRODUCTS & BRANDS

**19** LEC & BioKor products to date

**2** New brands launched to date

### COMMUNITY PROJECTS

**250+** Planet Passionate Communities projects to date

### OCEAN CLEAN UP

TARGET ACHIEVED

**5** Ocean clean-up projects supported since 2020

[1]: Scope 1&2 GHG emissions. Excluding biogenic emissions. Scope 2 GHG emissions calculated using market-based methodology.
*equivalent no. of PET bottles by weight

PLANET PASSIONATE

# PLANET PASSIONATE IS DEEPLY EMBEDDED INTO OUR BUSINESS

**1.5ºC**
aligned strategy

Strategic business pillar

**100+**
global team

**200+**
annual projects

ESG performance embedded into remuneration

Quarterly progress management reporting

Acquisition screening procedure

Supplier engagement & collaboration programme

**€750m**
Green private placement

**€70**
Internal carbon price

Champions network & education programme

Planet Passionate communities

# Planet Passionate

**Our global environmental sustainability programme aims to help tackle three big global challenges:**

- Climate Change
- Circularity
- Protection of the natural world



## OWN OPERATIONS DECARBONISATION LEVERS

We aim to continue our reduction in Scope 1 and 2 GHG emissions by furthering our energy process emissions reduction through initiatives under the below levers.

Further details on our Scope 1 and 2 decarbonisation levers, along with our project map and key 2024 projects are highlighted in the following section.

### ENERGY EFFICIENCY

Focusing on efficient energy management through measurement and continuous improvements.

### FUEL SWITCHING AND PROCESS ELECTRIFICATION

Transitioning to renewable energy use via conversion of processes and space heating.

### RENEWABLE ENERGY CONTRACTS

Conversion of purchased non-renewable energy to renewable alternatives such as renewable electricity contracts.

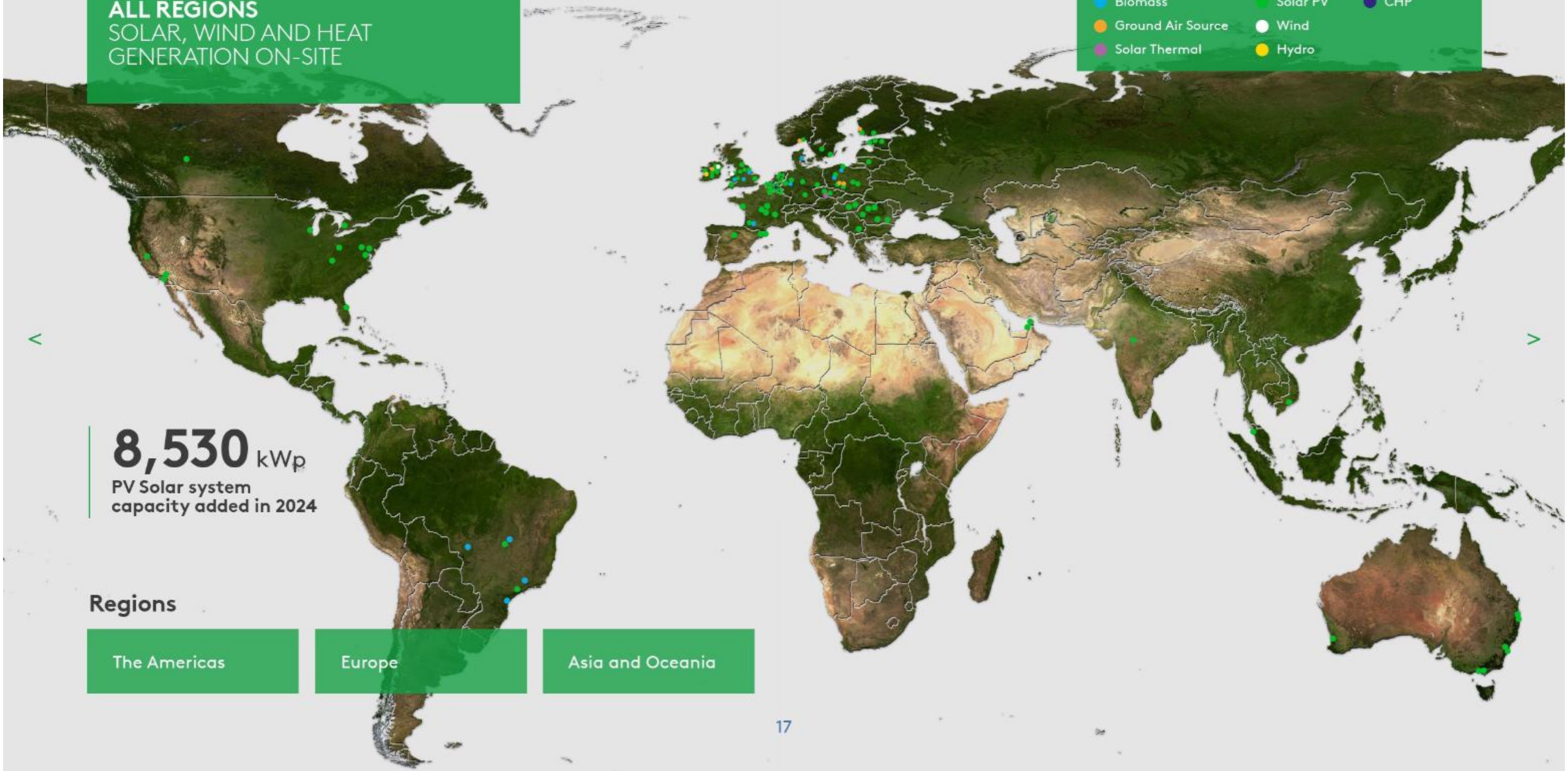
### ON-SITE RENEWABLE ENERGY GENERATION

Development of additional solar PV systems at our facilities, increasing our on-site renewable energy generation.

### LOWER GWP RAW MATERIALS

Phasing out of high GWP blowing agents.

# ALL REGIONS
## SOLAR, WIND AND HEAT GENERATION ON-SITE




**8,530** kWp

**PV Solar system capacity added in 2024**

## Regions

The Americas | Europe | Asia and Oceania

PLANET PASSIONATE

# GROUP EMISSIONS FOOTPRINT

## Upstream processes

**Scope 3**

- Goods & Services for purchase
- Capital goods
- Activities related to fuel & energy
- Transport & delivery
- Waste generated in business activities
- Business trips
- Employee commuting
- Leased assets

**91.2%**

## Internal processes

**Scope 1+2**

- Purchased power, etc.
- Direct emissions from internal industrial processes

**5%**

## Downstream processes

**Scope 3**

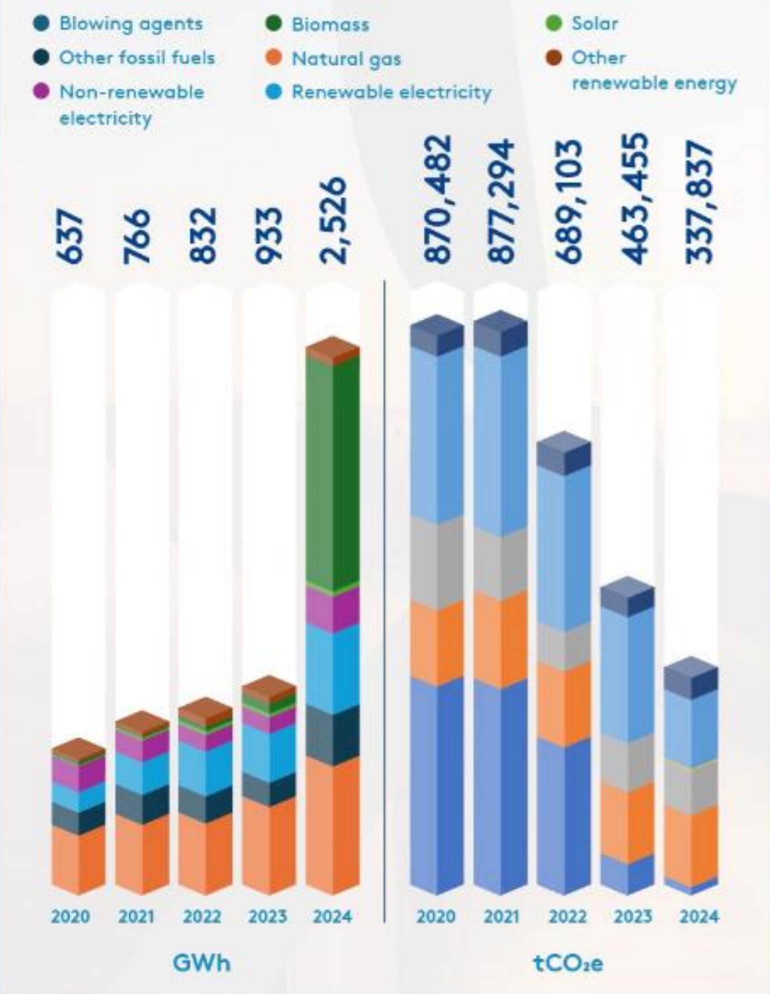
- Transport & delivery
- Use of sold products
- Disposal of sold products

**3.8%**

= **7.3 million tonnes $CO_2e$**

# CARBON AND ENERGY – 2024 KEY METRICS AND HIGHLIGHTS

## ENERGY USE AND SCOPE 1 & 2 GHG EMISSIONS BY SOURCE[1]




## SOLAR PV CAPACITY (MW)

| 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|
| 16.3 | 27.1 | 38.9 | 47.4 | 57.4 |

## KEY RAW MATERIALS CARBON INTENSITY ($tCO_2e/T$)

| 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|
| 2.54 | 2.50 | 2.46 | 2.44 | 2.44 |

## RENEWABLE ENERGY USE PER REGION 2024 (GWh)

| Europe | Americas | APAC |
|---|---|---|
| 1,401.9 | 84.0 | 14.0 |

## CARBON FOOTPRINT 2024[1] ($tCO_2e$)


## RENEWABLE ON-SITE GENERATION BREAKDOWN 2024 (GWh)

| Biomass | Solar | Biofuels | Other |
|---|---|---|---|
| 713.0 | 39.8 | 8.1 | 3.8 |

## SCOPE 3 EMISSIONS 2024

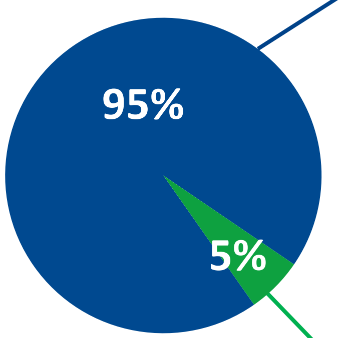
| Purchased goods & services | Fuel & energy-related activities | Upstream transport & distribution | Other |
|---|---|---|---|
| 91.2% | 2.0% | 3.2% | 3.6% |

[1] Excluding biogenic emissions. Scope 2 GHG emissions calculated using market-based methodology.

PLANET PASSIONATE

# DECARBONISATION PATHWAY

**2020** → **2030**




## Scope 3 (95%)

Supplier engagement, collaboration & investment

Supplier data tracking & analysis

## Scope 1 & 2 (5%)

Energy Efficiency

Process Improvements

Renewable Energy

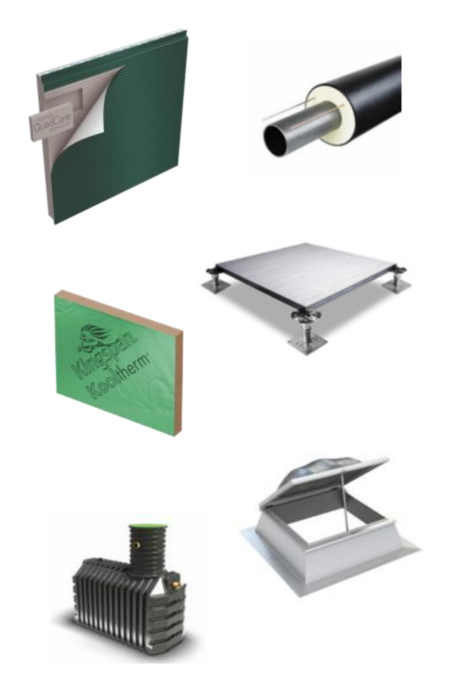
Electrification

Carbon Capture

## LOWER EMBODIED CARBON MATERIALS

## DECARBONISING OUR OPERATIONS


## LOWER EMBODIED CARBON PRODUCTS



PLANET PASSIONATE

## OWN OPERATIONS - DECARBONISATION LEVER:
FUEL SWITCHING AND PROCESS ELECTRIFICATION (cont'd)

### ELECTRIC FORKLIFTS
**INSULATED PANELS, CEME**


In 2024, Insulated Panels, CEME division took a big step forward in its fleet electrification journey with the delivery of 14 new electric forklifts. Production teams are already noticing the benefits in terms of lower emissions and quieter, more efficient handling.

*"Electric forklifts are the future of our operations, they are clean, quiet and powerful. In addition to their environmental benefits, we expect savings in the years ahead due to simpler and cheaper maintenance requirements. While there are challenges to overcome, we are fully committed to our goal of fleet electrification."*
**Lukas Macoun, Logistics Manager, Insulated Panels, CEME**

New Electric Forklifts:
**14**

### FUEL SWITCHING
**SAINT CARADEC AND LEMPDES, FRANCE JORIS IDE**

Carbon Savings:
**143** $tCO_2e$/year

In 2024, the French sites of our Joris Ide division started procuring BioLPG as a renewable alternative to fossil fuels.

Two new contracts were signed during the year, in the Lempdes and Saint Caradec sites.

*"In 2023, Joris Ide's French sites contributed 9% to the division's total carbon footprint. In 2024, by transitioning to renewable electricity and through the adoption of bio propane at the remaining sites, we have significantly reduced emissions."*
**Hanne Vandenbroucke, Divisional Sustainability Graduate, Joris Ide**

### NET ZERO SITE
**VILNIUS, LITHUANIA JORIS IDE**

Vilinus a Balex Metal site in Lithuania is one of our net-zero sites meaning scope 1 and 2 emissions are zero. The site has a 99 kWp Solar PV system installed on the roof of the factory. The solar PV energy is complemented with renewable electricity from the grid.

Solar PV Capacity:
**99** kWp

## OWN OPERATIONS - DECARBONISATION LEVER: RENEWABLE ENERGY CONTRACTS

Renewable electricity is becoming more widely available and where possible, we are procuring renewable electricity directly from our utility providers. In 2024, we expanded our procurement of direct renewable electricity in North America and Australia, regions which have previously had limited availability of such electricity products.

We are also investigating Power Purchase Agreements (PPAs) for both renewable electricity and fuels, particularly in regions where other renewable energy procurement options are not yet available or do not meet our standards. There are a variety of PPA options available, which we are reviewing to determine if they are suitable to support our targets.

## OWN OPERATIONS - DECARBONISATION LEVER: LOWER GWP RAW MATERIALS

Process GHG emissions are from the use of blowing agents for the insulation production. We have ongoing mitigation plans in place and aim to continually reduce, substitute, or where possible eliminate the use of high GWP blowing agents.

### RENEWABLE ELECTRICITY

**LITTLE ROCK, UNITED STATES AWIP**

Our Little Rock facility is now using 100% renewable electricity which has been sourced directly via the energy provider. Switching from non-renewable to renewable electricity helps us save approximately 350 tCO2e per year.

**Carbon Savings:** **350** $tCO_2e$/year

### RENEWABLE ELECTRICITY

**ROOFING + WATERPROOFING**

In 2024, our Roofing + Waterproofing division converted nine non-renewable contracts to 100% renewable electricity across five countries namely Germany, Malaysia, Poland, Spain and Turkey.

**Carbon Savings:** **10,203** $tCO_2e$/year

### RENEWABLE ELECTRICITY

**STEICO**

Since July 2024 the STEICO manufacturing sites in Poland have been using 100% renewable electricity.

**Carbon Savings:** **158,000** $tCO_2e$/year

PLANET PASSIONATE

## OWN OPERATIONS - DECARBONISATION LEVER:
ON-SITE RENEWABLE ENERGY GENERATION

Increasing on-site renewable energy generation capacity is a priority for our business as we seek to increase our energy self-reliance, and reduce both direct GHG emissions and long-term operational costs. We are deploying solutions to generate both renewable electricity and heat.

**Electricity**
As we have multiple manufacturing processes across our Group, we must assess each site individually and investigate the feasibility of potential onsite electricity generation options based on location, cost and viable technologies.

**Renewable fuels**
We are actively investigating options for on-site generation of heat and electricity such as heat pumps, combined heat and power plants and other ways of utilising biofuels on-site.

### HEAT PUMP

**TATE, BELGIUM**
**DATA SOLUTIONS**

In 2024, our manufacturing site in Genk underwent an extension, to increase its production capacity.

During the extension six 3.5kW Air Source Heat Pumps were fitted to replace natural gas space heating.

*"Planet Passionate is key for our organisation. We want to reduce our reliance on carbon-based fossil fuels and in particular natural gas, moving to renewable energy sources. For this reason, we installed state of the art electrical heat pumps in our new production halls. This project serves as a pilot project helping us to decide on future heating solutions in our existing hall."*
**Luc Vanhees, COO Tate Belgium, Data Solutions**

### SOLAR PV

**WINCHESTER, UNITED STATES**
**INSULATION**

In 2024, our Winchester site installed a solar PV system with a generation capacity of 1,365 kWp. It provides price stability and energy security in a long-term Power Purchase Agreement (PPA). The Winchester site during busy production shifts consumes the majority of electricity generated, during low production and down-time hours the energy is exported to the grid.

"We are proud to be the first Insulation Division USA plant to commission a large on-site renewable energy generation project, in support of our sustainability ambitions and Planet Passionate Targets."
**Chris Davis,**
**Senior OPEX Manager,**
**Kingspan Insulation**

**Generation Capacity:**
**1,365** kWp

### SOLAR PV

**LEUZE, BELGIUM**
**INSULATED PANELS, EAA**

**Generation Capacity:**
**495** kWp

## OWN OPERATIONS – DECARBONISATION LEVER:
ON-SITE RENEWABLE ENERGY GENERATION (cont'd)

### SOLAR PV

**BURGOS, SPAIN**
**INSULATED PANELS, EAA**

The rooftop PV installation completed by the Teczone Team in Burgos is projected to generate 1.7GWh of electricity every year. It is estimated that 0.787 GWh will be used in the factory, providing 44% of the total electricity requirement for the site.

Generation Capacity:
**1,435** kWp

### SOLAR PV

**PHU MY, VIETNAM**
**INSULATED PANELS, EAA**

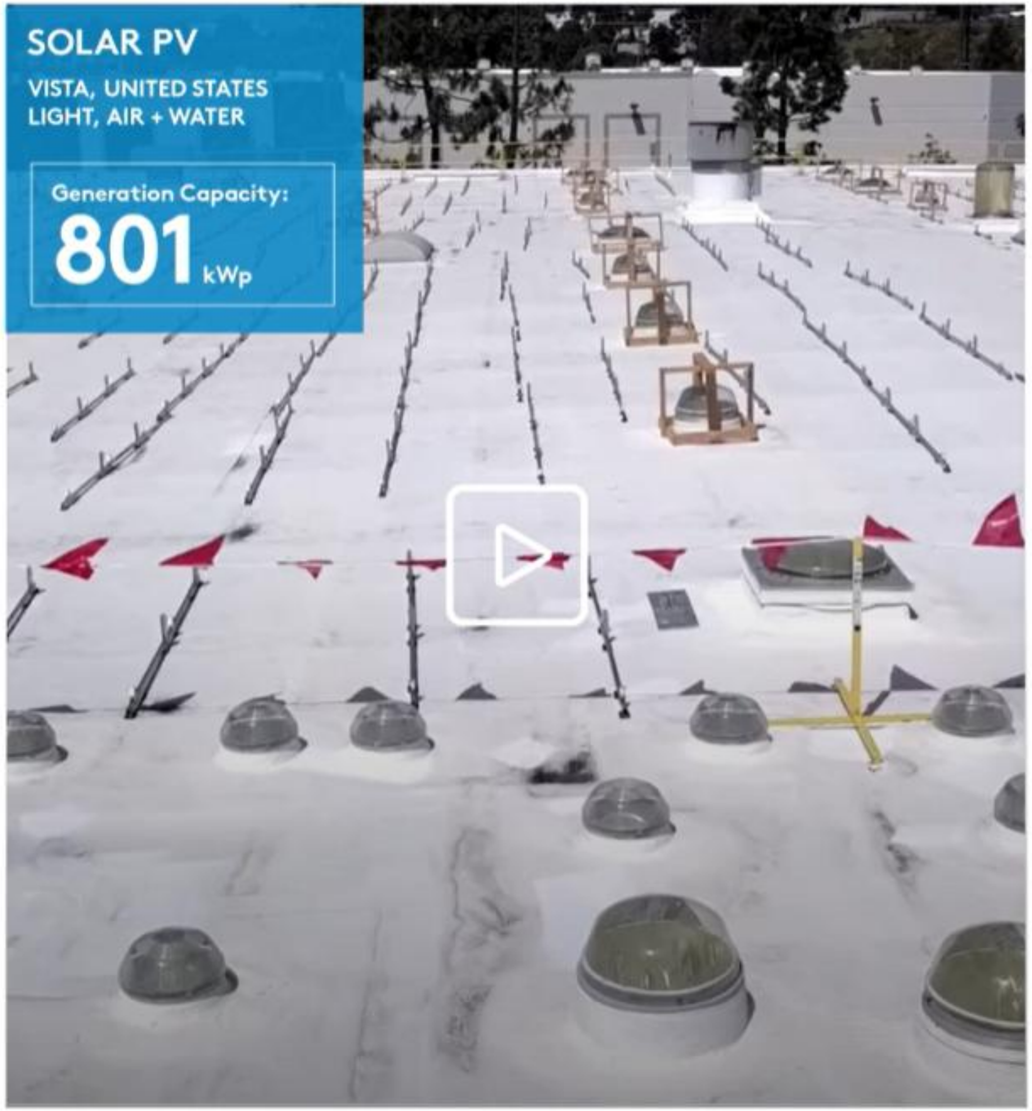
Generation Capacity:
**1,250** kWp

Kingspan Insulated Panels EAA installed a 1.25 MWp solar PV system to drive the Group's carbon reduction efforts as part of Kingspan's Planet Passionate environmental programme. The system's key components are Kingspan QuadCore® RW roof panels in combination with our PoweRail RW Solar PV mounting solution using Longi PV solar modules.

### SOLAR PV

**VISTA, UNITED STATES**
**LIGHT, AIR + WATER**

Generation Capacity:
**801** kWp



# Kingspan Insulated Metal Panels- North America

Kingspan Insulated Panels North America

Sustainability Report 2023



# Progress On Our Targets

| | Target | Target Year | 2020 | 2021 | 2022 | 2023 | Progress Toward Target |
|---|---|---|---|---|---|---|---|
| CARBON | Net zero carbon manufacturing (Scope 1 & 2 GHG emissions—$tCO_2e$)[1] | 2030 | 3,211 | 3,434 | 3,399 | 3,037 | 5% |
| | 50% reduction in product $CO_2e$ intensity from primary supply partners (%) | 2030 | — | — | — | — | The responsibility for this target's monitoring is held by Kingspan Group. Please see the 2023 Planet Passionate Report. |
| | Zero emissions company funded cars — annual replacement (%) | 2025 | 0 | 0 | 70 | 100 | 100% |
| ENERGY | 60% direct renewable energy (%) | 2030 | 3.8 | 4.4 | 8.7 | 30 | 50% |
| | 20% on site renewable energy generation (%) | 2030 | 0 | 0 | 7 | 8.4 | 42% |
| | Solar PV systems on all wholly owned sites (%) | 2030 | 0 | 0 | 50 | 100 | 100% |
| CIRCULARITY | Zero company waste to landfill (tonnes)[2] | 2030 | 3,306 | 2,766 | 1,879 | 2,035 | 38% |
| | Recycle 1 billion PET bottles into our manufacturing processes annually (million bottles) | 2025 | — | — | — | — | The responsibility for this target's monitoring is held by Kingspan Group. Please see the 2023 Planet Passionate Report. |
| | QuadCore® products utilizing recycled PET by 2025 (no. of sites) | 2025 | 0 | 0 | 1 | 1 | Kingspan Panels North America currently has 4 sites producing QuadCore. Our goal is to have all 4 sites producing QuadCore with recycled PET. |
| WATER | Harvest 100 million liters of rainwater annually (million liters) | 2030 | 0 | 0 | 0 | 0.7 | The responsibility for this target's monitoring is held by Kingspan Group. Please see the 2023 Planet Passionate Report. Our division contribution is listed in this table. |
| | Support 5 ocean clean-up projects (no. of projects) | 2025 | 1 | 2 | 3 | 4 | The responsibility for this target's monitoring is held by Kingspan Group. Please see the 2023 Planet Passionate Report. |

1 Excluding biogenic emissions. Scope 2 GHG emissions calculated using market-based methodology. Our definition of Net-Zero Carbon Manufacturing is to remove GHG emissions from our Scope 1 & 2 emissions.

2 Historical data has been revised based on identified conversion error.

Kingspan | PLANET PASSIONATE



## SPOTLIGHT:

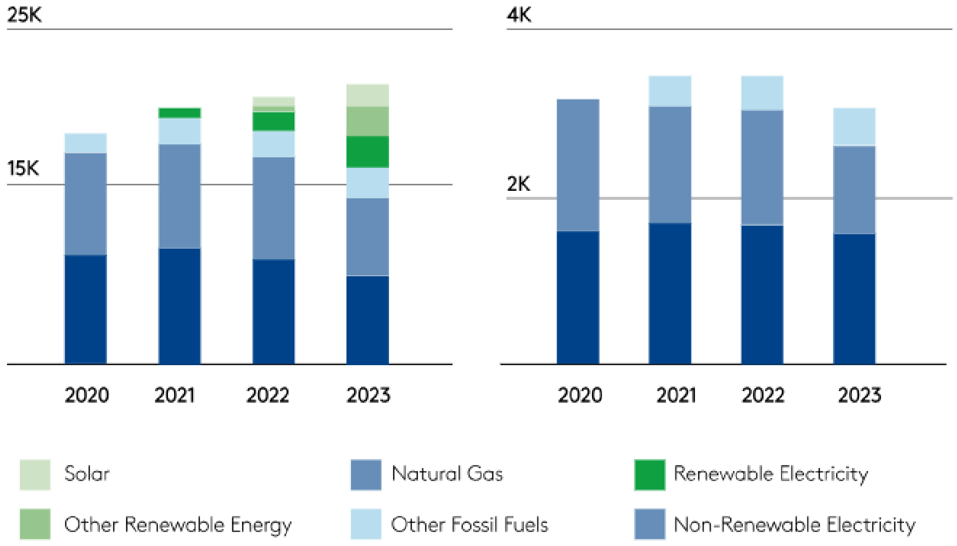
## Photovoltaics (PV) in DeLand

**Damon Reece**
*DeLand Plant Manager*

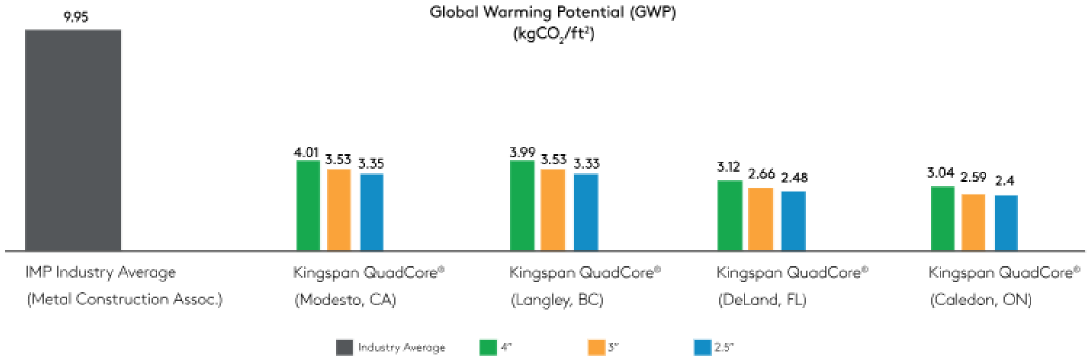
PLANET PASSIONATE

Energy Sources & Consumption (MWh)

Energy Sources & GHG Emissions (tonnes $CO_2e$)




# Carbon



Year: Multipl... | Quarter: All | Month: All | Year on Year: On

Non-Renewable | Renewable | Scope 1 | Scope 2

Acquisition | Sub_Div. | Building | Country | Fuel Type | Activity | Carbon Intensity | Scope | Energy | Process

# Carbon Report

Data Position: May/2025

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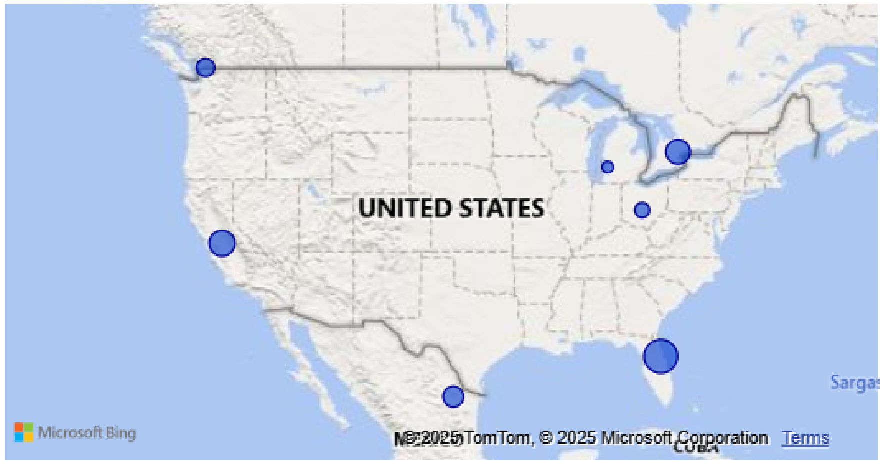
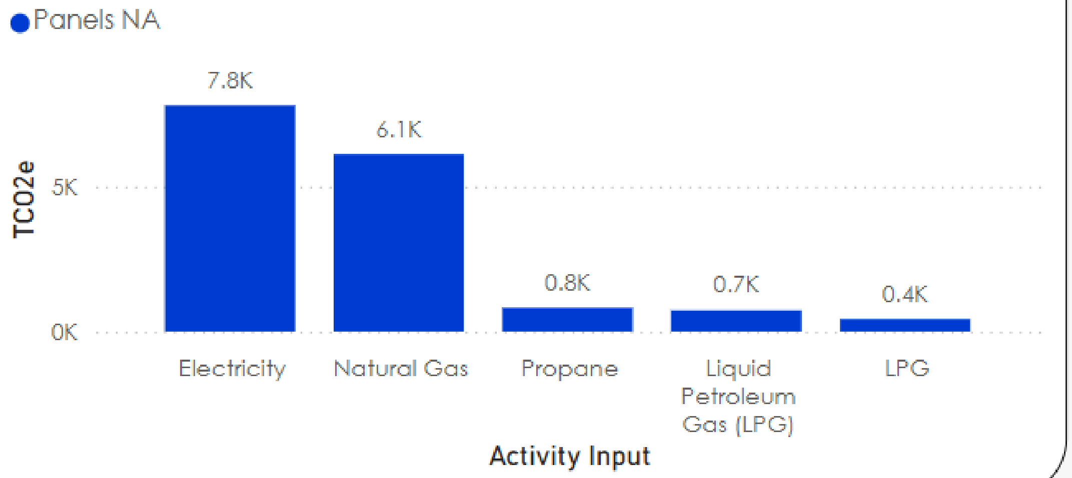
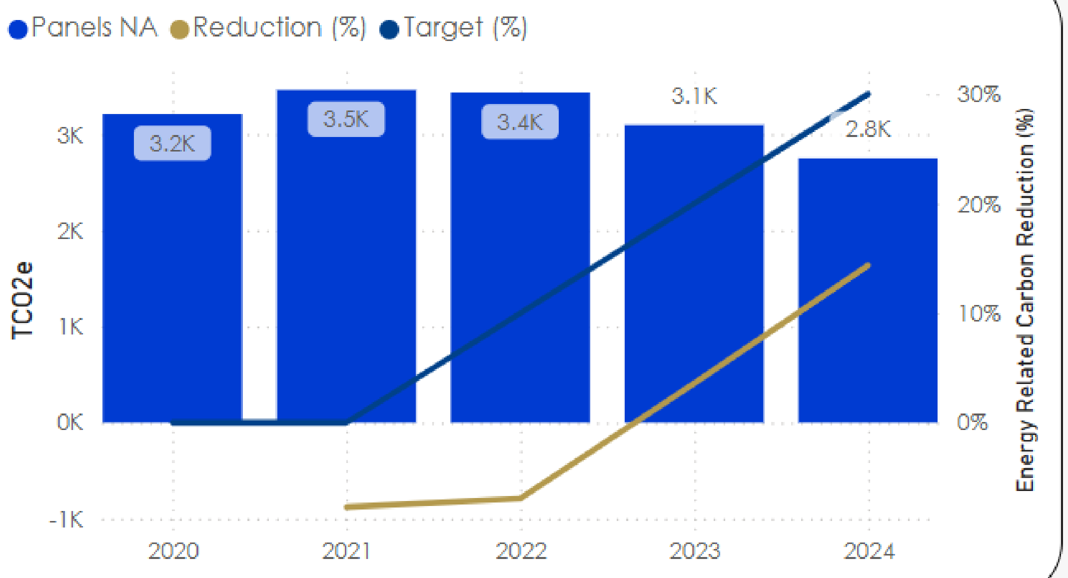



## Top 5 GHG Emissions by Fuel Type




| Division | 2020 | 2021 | 2022 | 2023 | 2024 | Total |
|---|---|---|---|---|---|---|
| Panels NA | 3,212 | 3,460 | 3,435 | 3,097 | 2,751 | **15,954** |
| **Total** | **3,212** | **3,460** | **3,435** | **3,097** | **2,751** | **15,954** |



Year | Quarter | Month | Year on Year
Multiple sel... | All | All | On

Non-Renewable | Renewable

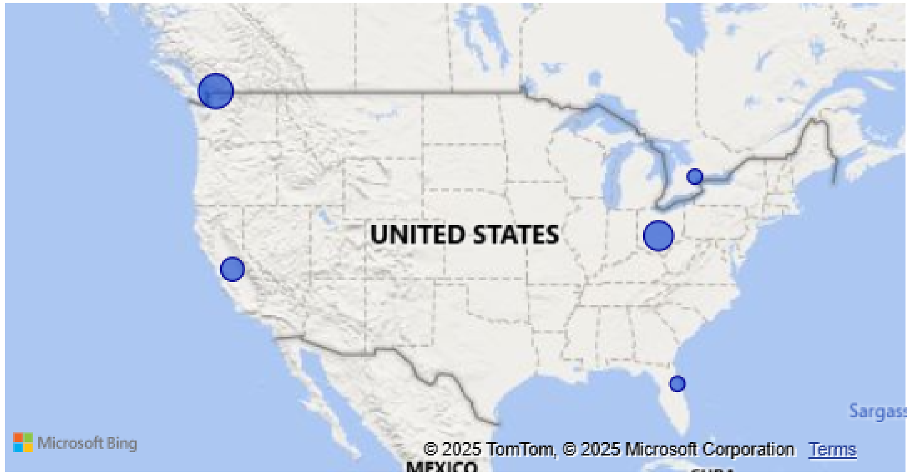
Sub_Div. | Building | Country | Fuel Type | Activity | Energy Use... | Direct... | Onsite...

# Energy Report

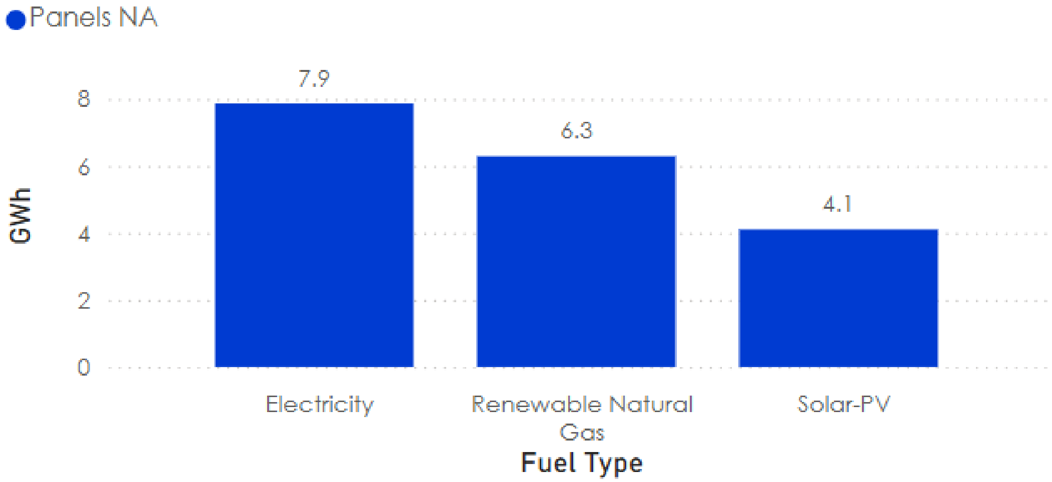
Data Position: May/20...

PLANET PASSIONATE

Panels NA

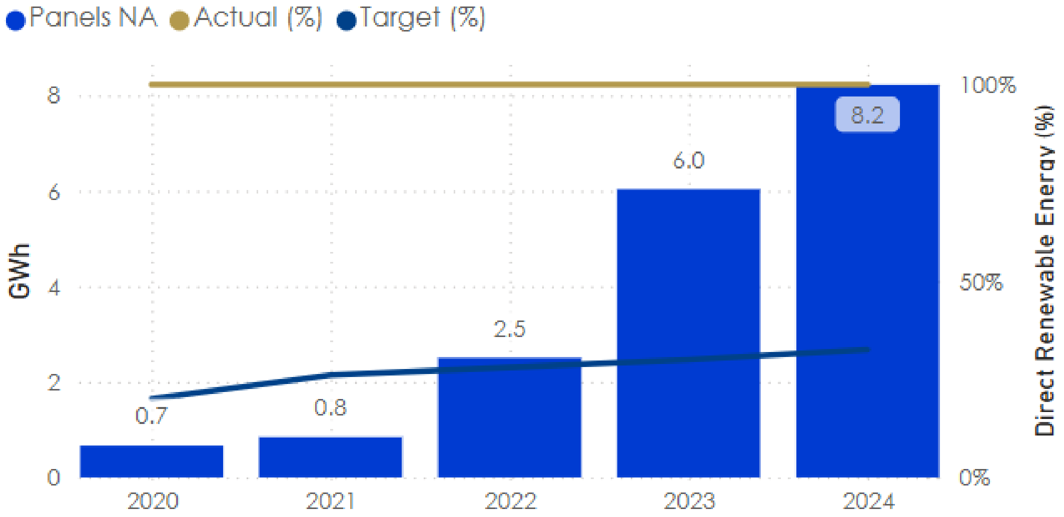



## Top 5 Energy Use by Fuel Type




| Divisions | 2020 | 2021 | 2022 | 2023 | 2024 | Total |
|---|---|---|---|---|---|---|
| ⊟ **Panels NA** | **0.66** | **0.84** | **2.50** | **6.03** | **8.22** | **18.27** |
| ⊞ Panels NA | 0.66 | 0.84 | 2.50 | 6.03 | 8.22 | **18.27** |
| **Total** | **0.66** | **0.84** | **2.50** | **6.03** | **8.22** | **18.27** |

## Total Energy Use



Kingspan Insulated Panels
DeLand, Florida

Kelly Buffey, Sustainability Manager
Email: Kelly.Buffey@Kingspan.com
**www.kingspan.com**

# Questions?

# Today’s Speakers

**Doug Fasick**

*Cheif Sustainability Officer,*
*City of Fort Wayne City Utilities*

# Fort Wayne City Utilities Sustainability & Resilience Initiatives

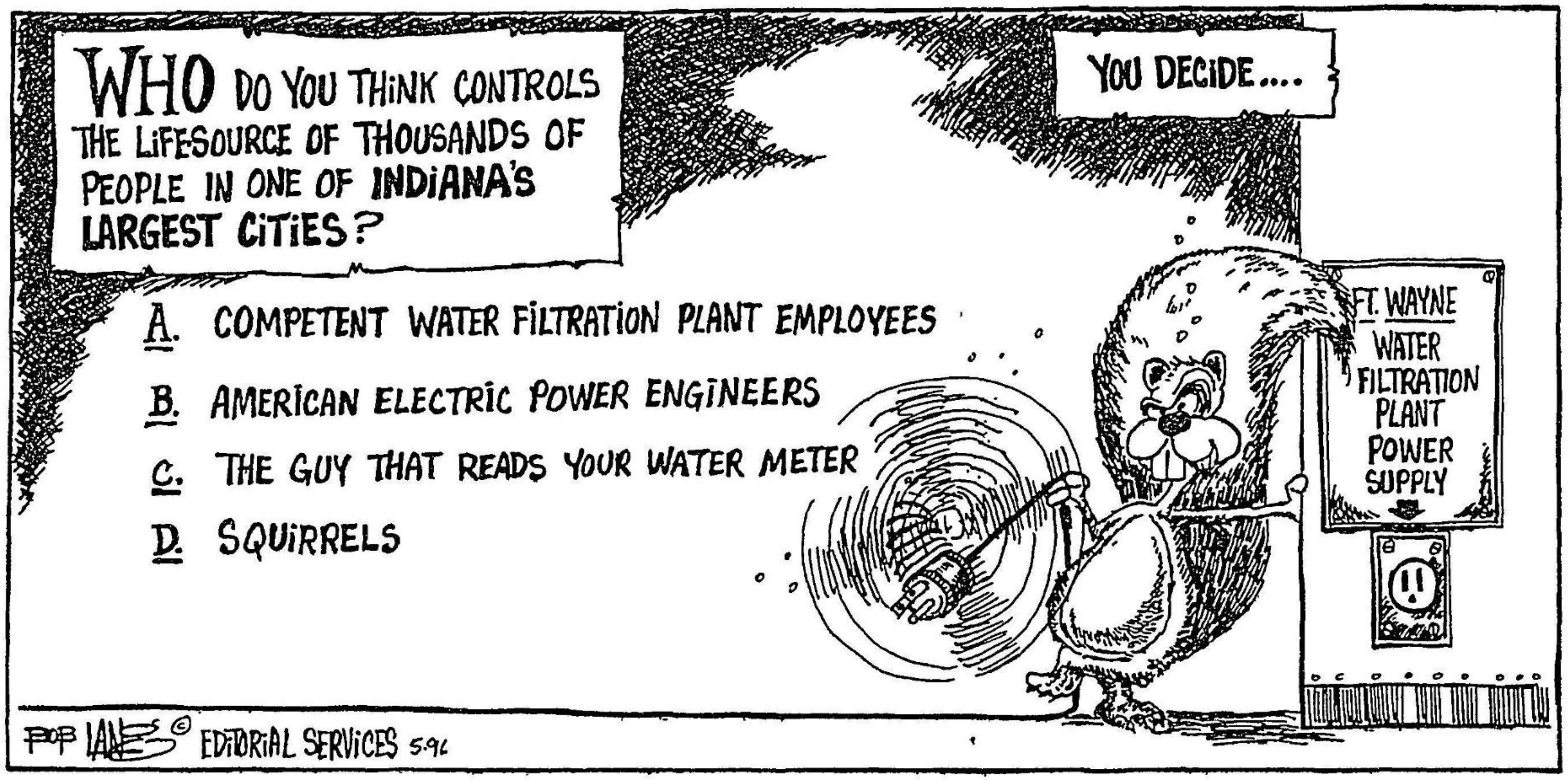
CITY UTILITIES
WATER THAT WORKS

## Onsite Generation Program

# Importance of Resiliency

CITY UTILITIES
WATER THAT WORKS

**ILLUSTRATION TO THE EDITOR:** *Bob Lang is a free-lance editorial cartoonist.*



# Our Facilities

# Combined Heat and Power

CITY UTILITIES
WATER THAT WORKS

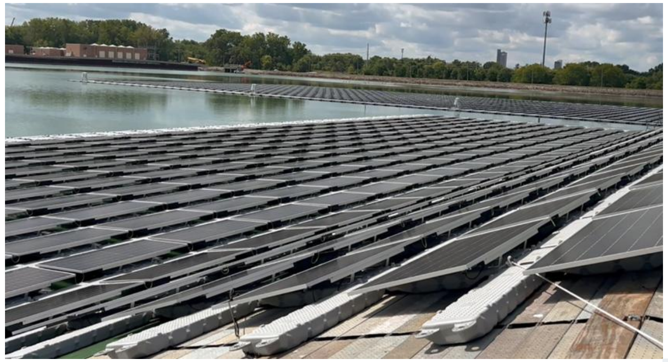
- 800 kW Biogas Fueled Engine Generators
- Connected November 2015
- Produced over 55.5M kilowatt-hours
- Providing 28% of our WWTP electrical needs
- $4.2M Avoided Electric Utility Energy Costs

# Renewable Energy Solutions Project

CITY UTILITIES
WATER THAT WORKS

- 5 MW Floating Solar Array
  - 12,470 PV Solar Panels
- 1 MW Energy Storage Batteries
- 3MW NG/Biogas Generation

# Questions?



Douglas J Fasick
Chief Sustainability Officer, Mayor's Office
Fort Wayne City Utilities Engineering

doug.fasick@cityoffortwayne.org

260-427-5235

# Questions?

U.S. DEPARTMENT OF
ENERGY