Duke

Utility Ownership of Combined Heat & Power Plant At Duke University

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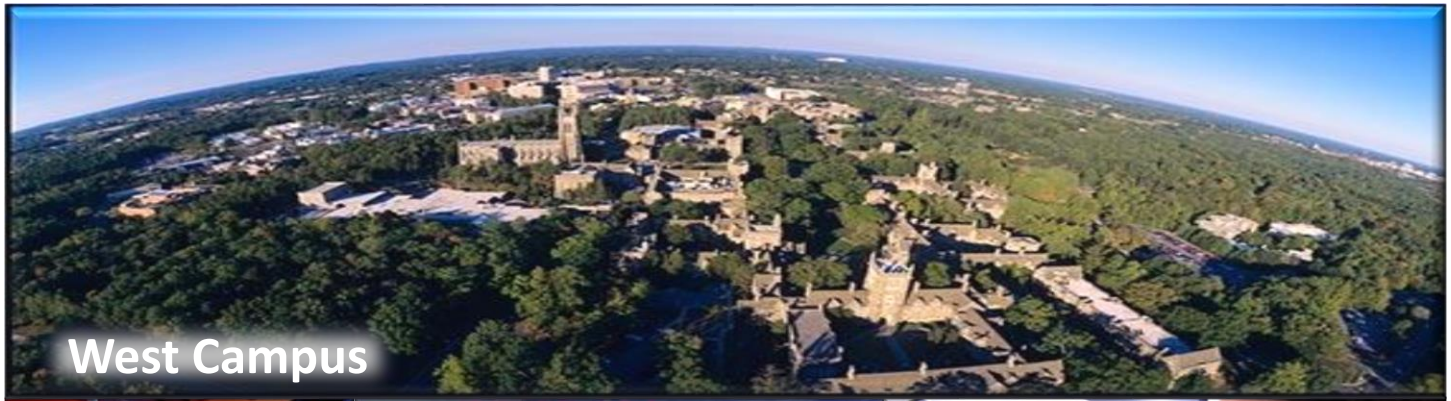
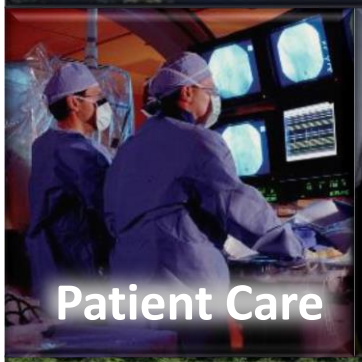
Agenda

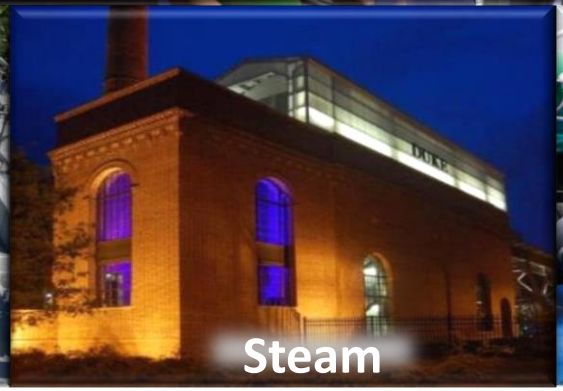
- Energy at Duke University Overview
- CHP Proposal Overview
- Regulatory Challenges
- Terms & Conditions
- The Community Pushback
- Summary

Energy at Duke Overview

Scope and Scale







18 Million:

Gross square feet of over 300 buildings

40,000-50,000:

People on campus each day

$80 Million: annual utilities cost

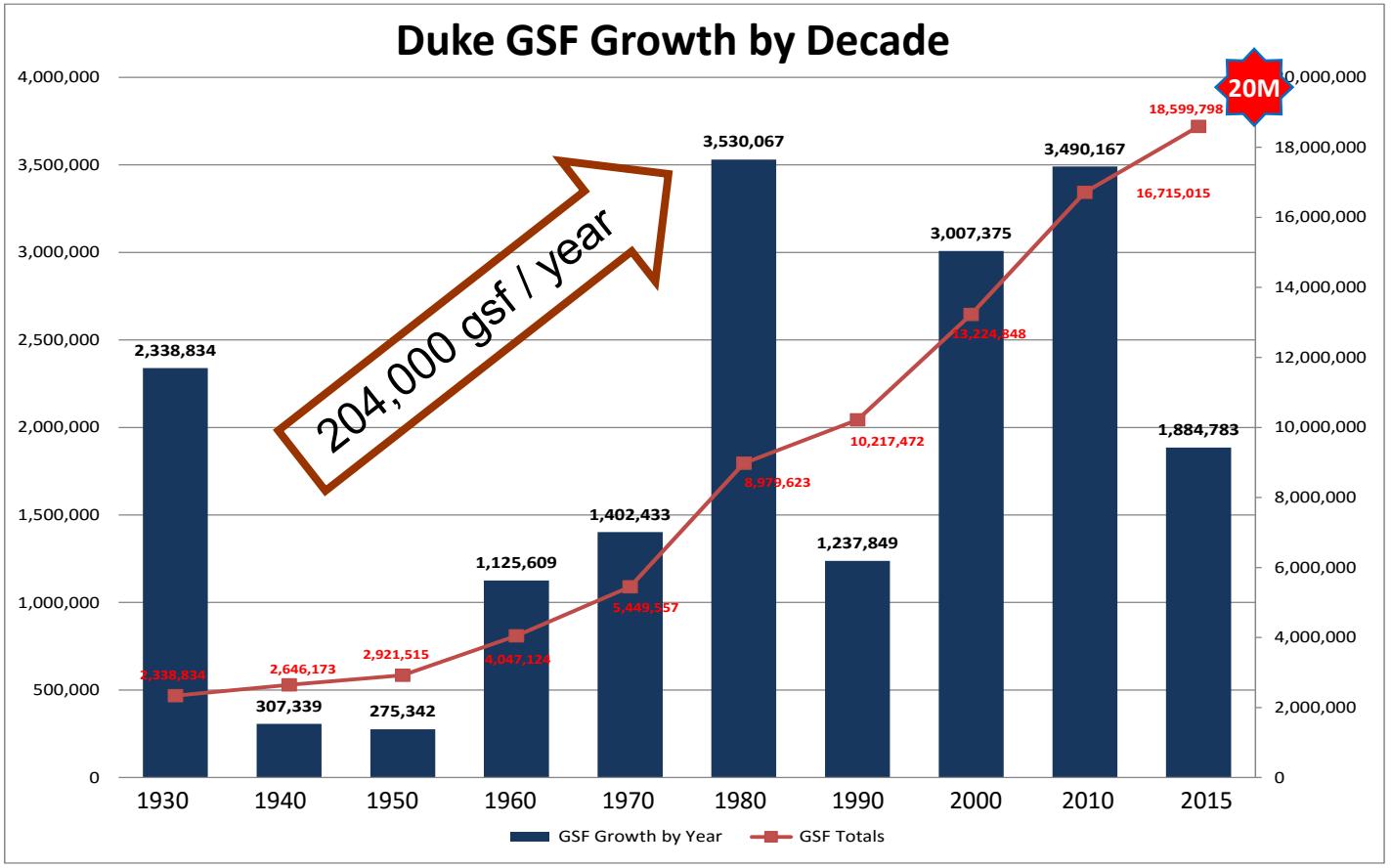
Campus Utilities Overview

- Utility Systems serving both University & Medical Center facilities

- Utility Infrastructure Includes:
  - 2 Chilled water plants
  - 2 Steam plants
  - 1 Solar hot water plant
  - 1 District hot water plant
  - 5 High voltage electrical substations
  - 3 Central emergency generator plants
  - 2 Stormwater “plants”

Utility System	Replacement Value (2016)
Stormwater	$ 116,900,000
Sanitary Sewer	$ 29,600,000
Water	$ 90,100,000
High Voltage	$ 95,200,000
Chilled Water	$ 241,000,000
Steam	$ 214,900,000
Totals	**$ 787,700,000**

Growing Campus Energy Needs



- Duke University uses annually about 1% of the electricity and about 3% of the natural gas sold to the NC commercial sector
- Duke University is among the top 20 electrical consumers in the state of NC

Proposed Duke Energy Combined Heat & Power Plant

Proposal Overview

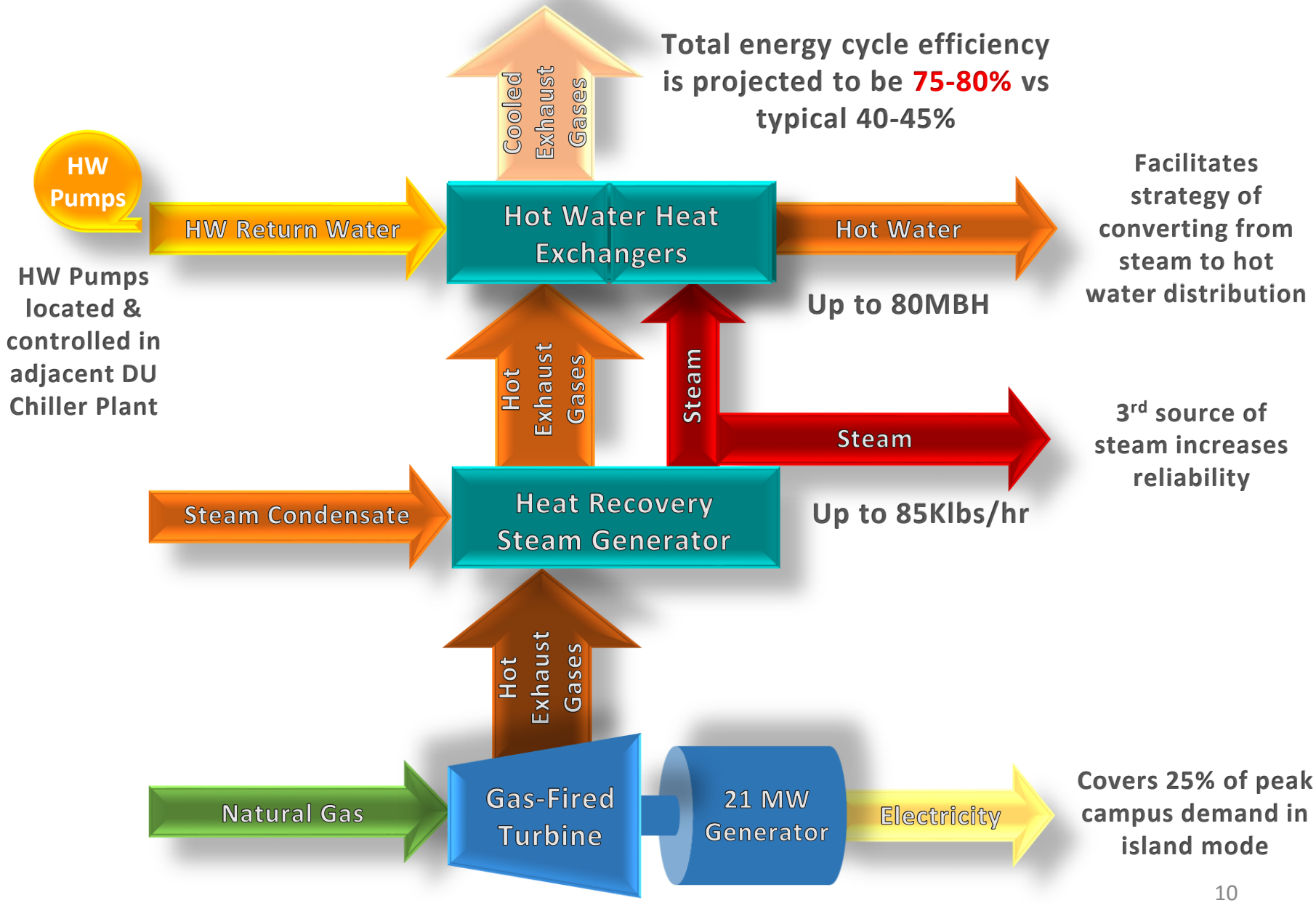
- Duke Energy (DE) will build, own and operate a 21MW Combined Heat and Power (CHP) plant on property leased from Duke University
- Duke Energy will send electricity back onto the their grid and the University would continue to purchase electricity as we always have
- The University will buy the “waste” heat generated in the process at a rate that is significantly less than it costs us to generate steam and hot water at our plants.
  - Total of 85Klbs/hr in a combination of steam and hot water that will vary over the year
- The system will be constructed to allow Duke University to “island” in cases of a power grid outage.
- Duke University will pay to connect the plant to the university’s utility systems

Responsibilities

- Duke Energy responsible for:
  - Building and Related Infrastructure
  - CHP Plant and Related Equipment
  - Natural Gas line and compressor
  - Power connection to Duke Energy grid
  - Black start electrical connection to Duke Uni. switchgear
  - Interconnection to Duke University utility systems (5-10ft outside of facility)

- Duke University responsible for interconnection to CHP plant:
  - Steam – including condensate
  - Hot Water – Supply & Return
  - Domestic Water
  - Sewer
  - Storm
  - Connection path to Internet
  - Connection path to Duke University SCADA system

Duke Combined Heat and Power Plant System Diagram



CHP Impact

- Emissions
  - On campus: ~10,000 – 47,000 MTCO2e depending on accounting
  - Off campus: ~100,000 – 150,000 MTCO2e depending which coal plant is turned down based on Duke Energy's production model
  - With future biogas, could reduce campus energy-related carbon footprint by 60%

- Economics
  - $1.0M to $4.0M savings per year depending on price of natural gas
  - Requires Duke University investment of $5.0M – $7.0M to connect plant
  - Requires Duke Energy investment of ~$55.0M
  - Potential to be the lowest cost generator in DE's fleet thus helping to keep rates low
  - Potential to defer or eliminate future Duke University capital investments

- Energy Security
  - 20MW CHP electricity production equivalent to 25% of University's peak demand
  - Represents a 50% increase in on-campus electricity production
  - Provides the ability to direct the power to whatever building we deem necessary unlike building-specific generators
  - Able to power all critical Medical Center & University buildings on campus

Biogas Roadmap to Carbon Neutrality

- $65M in renovation & conversion of steam plants done with biogas as future fuel source
- Duke continues to dedicate resources to developing a robust biogas market in NC
- We expect Duke Energy to assist in pursuing biogas to cover the CHP's CO2 output

1928 — 2011 — 2019? — 2024?

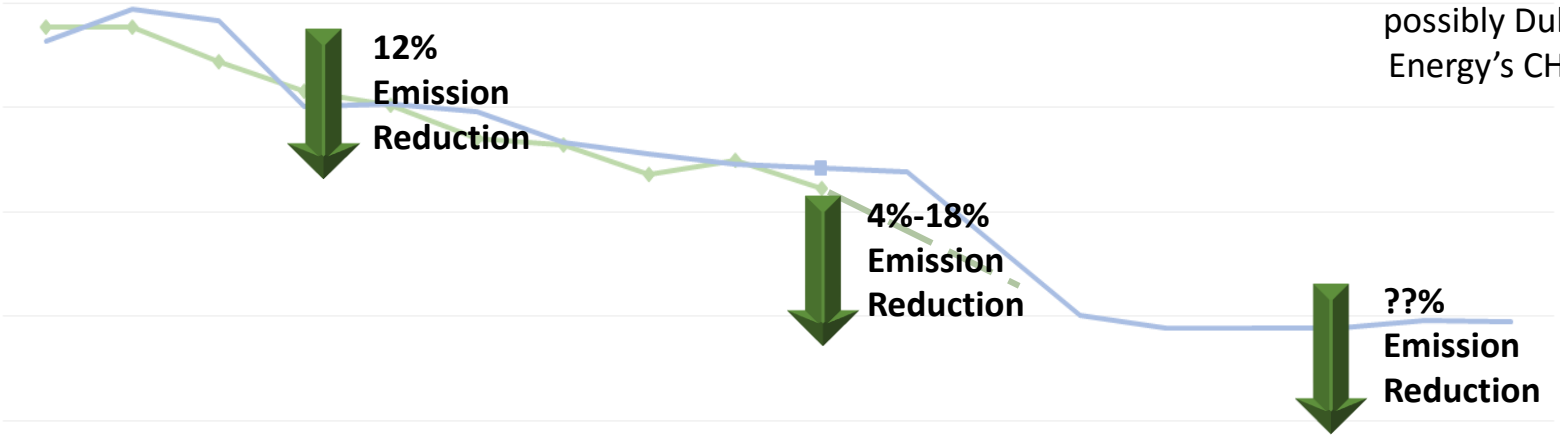
Duke burned coal for 83 years

Conversion & renovation of both steam plants to burn natural gas

Proposed CHP provides campus with steam & hot water from waste heat

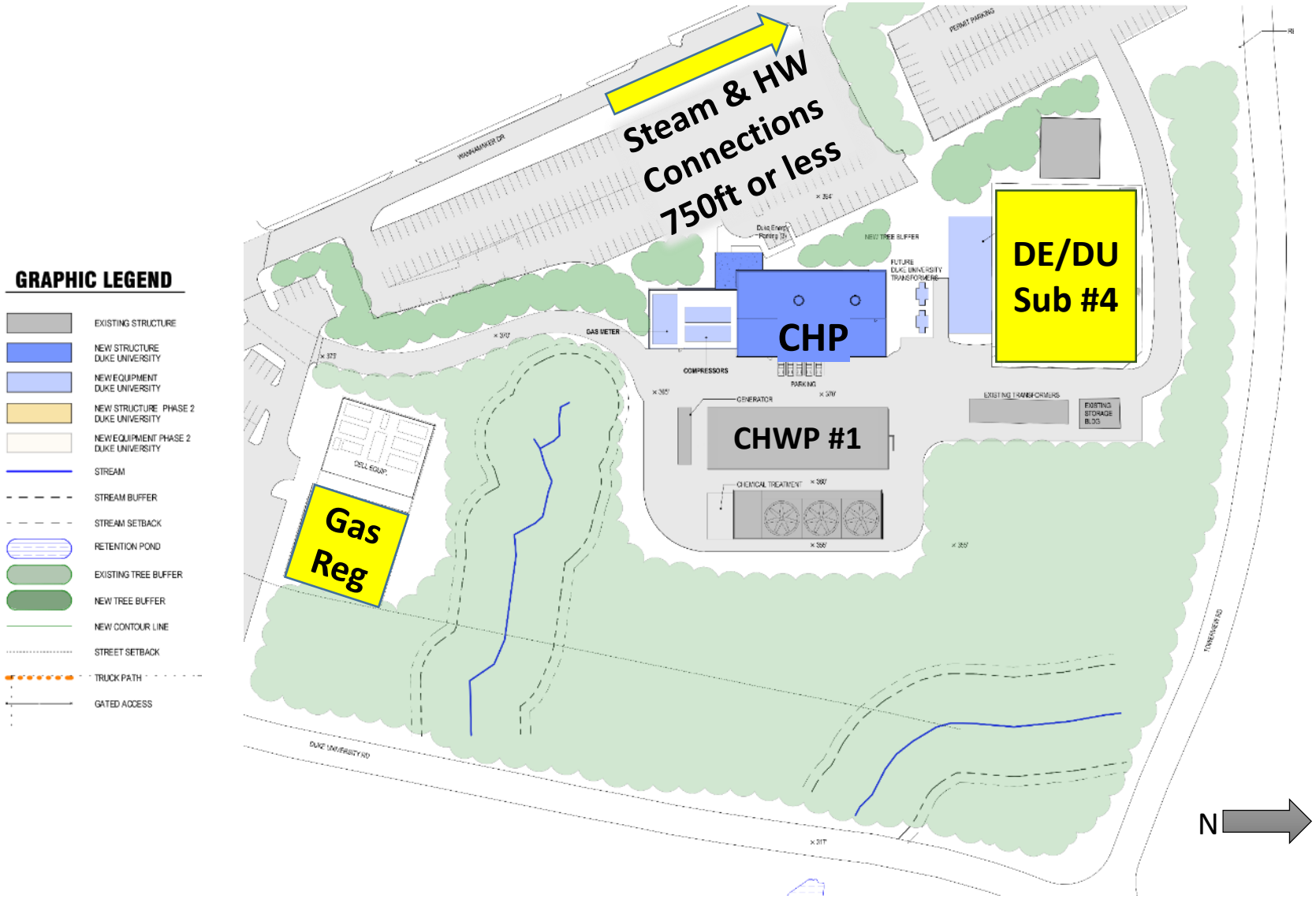
Swine Waste-to-Energy

Biogas used to fuel existing steam plant gas boilers and possibly Duke Energy's CHP



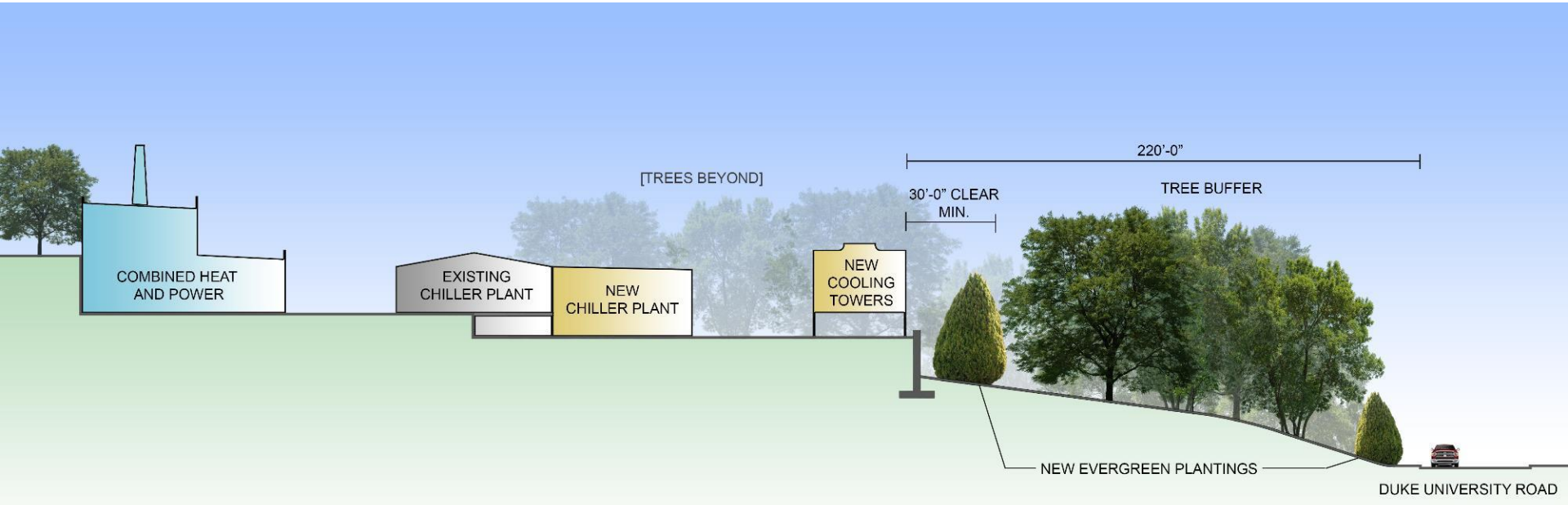
Duke Combined Heat & Power Plant – Campus Context

Duke Combined Heat & Power Plant – Site Plan



CHP – Section

Sectional Diagram



CHP – Front Elevation

Regulatory Challenges

Regulatory Challenges

- Termination
- Option to purchase
- Land lease
- Force majeure - must repair in 1st ten years
- Steam tax
- Transmission vs Generation
- DE reluctance to discuss with commission

Terms & Conditions

Contracts & Agreements

- Services Agreement
- Lease Agreement
- Easement Agreement
- First Amendment to Substation Lease Agreement
- Construction Staging Area Agreement

Terms & Conditions

- Pricing – floats with NYMEX
  - Flat fee for total output of heat with credits for excess downtime
- DU provides make-up water at no cost, maximizes condensate flow to plant
- Architectural control – DU has full approval
- Island Mode - DE would continue to provide this service as long as it operates the CHP Plant
- Operator assignment - a third party operator would be subject to DU's prior written consent
- Changes in Law – aggregate changes before DU pays
- Termination
  - If another technology with lower (or zero) emissions factor becomes economically feasible, the University will have the ability to exit the CHP contract
  - Option to buy

The “Community” Pushback

The "Community" Pushback

- The new mantra: No new gas
- Some contend that natural gas leak rates can make gas as bad as coal
- Four students with a website can create issues
- Environmental groups are willing to say anything, true or not, to stop the project
- Currently conducting a review of the CHP proposal with a committee of students, faculty, & staff

Summary

Summary

PROS

- Leverage their capital
- Able to use their system for transport
- Stable company
- Less staffing
- Expertise
- Keeps utility's revenue stream

CONS

- Less control
- Lots of lawyers
- Lots of time with lawyers
- Long term contract
- Utility perception
- NDA's makes for less transparency