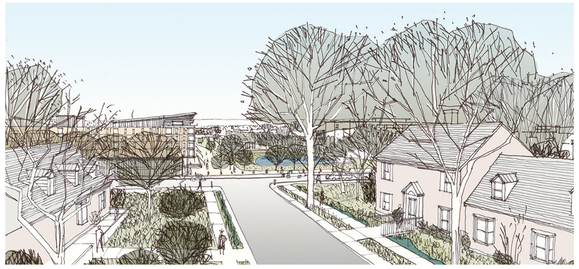
RESILIENT BRIDGEPORT
SOUTH END ENERGY STRATEGY



Submitted to Connecticut Department of Housing

Prepared by **WSP USA**

The South End suffered greatly from flooding caused by Superstorm Sandy and sustains other chronic and acute flooding conditions. To increase confidence that future extreme weather events will not bring a repeat of the impacts of Superstorm Sandy, WSP evaluated the technical and financial performance of various options for achieving higher levels of resilience of electricity and heating energy supplies for the South End.

The figure below shows existing and planned energy assets that were considered for integration into a community-wide energy resilience strategy. In particular, WSP conducted a preliminary investigation into the concept of recovering waste heat from the auxiliary cooling system of the new PSEG combined-cycle power plant (Harbor Unit 5) and using it as a thermal energy resource for the later phases of development of the NuPower thermal loop.

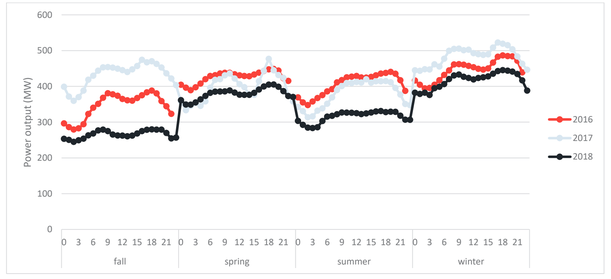
Map of Existing Bridgeport Energy Assets and Assets Currently Under Development

The concept considered here uses heat pump technology to achieve a water temperature that can be effectively used by the NuPower loop. This approach enables the power plant to reject some of its heat to the district heating system, where it can be put to work, rather than rejecting that heat to the atmosphere as a waste product of the electric power generation process.

Estimated amount of heat rejected by PSEG auxiliary cooling system under three ambient air conditions

Case	1	2	3
Ambient Temp (ºF)	20	59	92
Condenser Water Inlet Temp (ºF)	81	84	99
Condenser Water Outlet Temp (ºF)	67	70	85
Condenser Water Flow Rate (gpm)	7,003	7,005	7,015
Heat Rejection (mm Btu/hr)	49	49	49

WSP estimated the hours per typical year that the auxiliary cooling system would have waste heat available. We acquired actual historical hourly power generation data for the Bridgeport Energy combined-cycle plant and used that as a surrogate for the new PSEG plant; both are similarly sized gas-fired combined-cycle plants. The figure below displays the average power generation by the Emera plant for each hour of typical winter, spring, summer, and fall days during 2016, 2017, and 2018. These load shapes inform the hours of the year that can be expected to have waste heat available from the auxiliary cooling system.



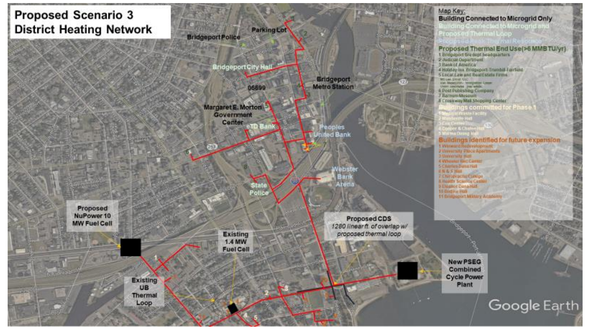
Bridgeport energy plant hourly power output for a typical day by season

Based on the three years of hourly power generation data, WSP estimated the average rate of heat recovery in each season and the number of hours per season that the PSEG auxiliary cooling system could be expected to supply waste heat. While significant waste heat is available during the summer, we took the conservative approach of assuming summertime NuPower loop heat loads were not sufficient to justify operating the heat recovery equipment during that season.

Tapping into waste heat captured from the PSEG combined-cycle power plant would increase the level of heating energy resilience since history suggests that the reliability of that thermal energy source will be very high even in the face of the next Superstorm Sandy.

Estimated Parameters of Heat Recovery Equipment

Parameter	Year 0	Winter	Spring	Summer	Fall	Annual
Average heat recovery rate (mmBtu/hr)		32.5	29.2	26.6	24.6	
Hours of heat recovery		2,160	1,104	0	1,092	4,356
Amount of heat recovery (mmBtu)		70,220	32,227	0	26,843	129,340
Average heat pump electric power input (kW)		2,574	2,315	0	1,947	
Heat pump electricity usage (MWh)		5,561	2,556	0	2,126	10,242
Electricity cost		$403,699	$185,563	0	$154,325	$743,586
Maintenance cost						$20,000
Total installed cost	$2,600,000					
Net GHG emissions reduction (mtCO2e)						2,253



Proposed NuPower Loop, including heat recovery from PSEG combined cycle power plant

MOSCONE CENTER EXPANSION