Presentation to

Wastewater Advisory Committee

Update on the Combined Heat and Power Project for the Deer Island Treatment Plant

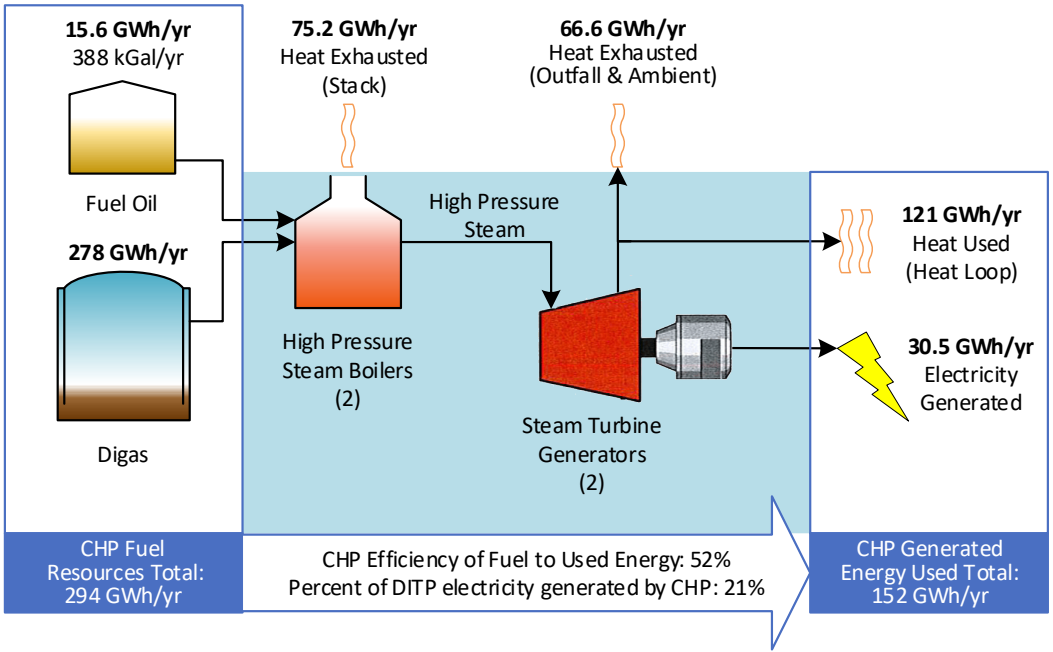
October 7, 2022

Goal of Contract 6963A

Contract 6963A: Part of long term combined heat and power (CHP) system infrastructure planning

- Evaluate DITP's existing CHP system
- Develop recommendation to:
  - Reliably and economically meet energy needs
  - Maximize on-site generation
  - Reduce electricity purchases

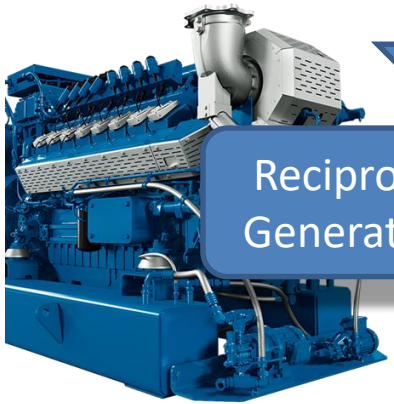
Existing CHP Schematic & Energy Flow



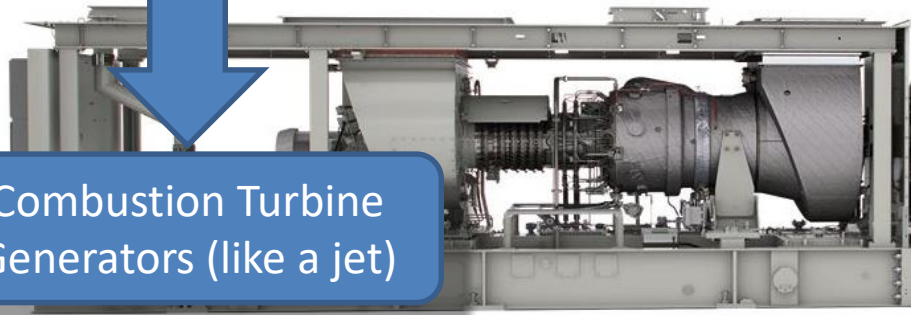
Total Energy Used at DITP (Thermal & Electrical)	Total Energy Generated from On-site Resources	Percent of Energy from On-site Resources
265 GWh/yr	152 GWh/yr	57% by Energy 65% by Cost

CHP Technology Evaluation

Several CHP technologies were evaluated
Two primary contenders



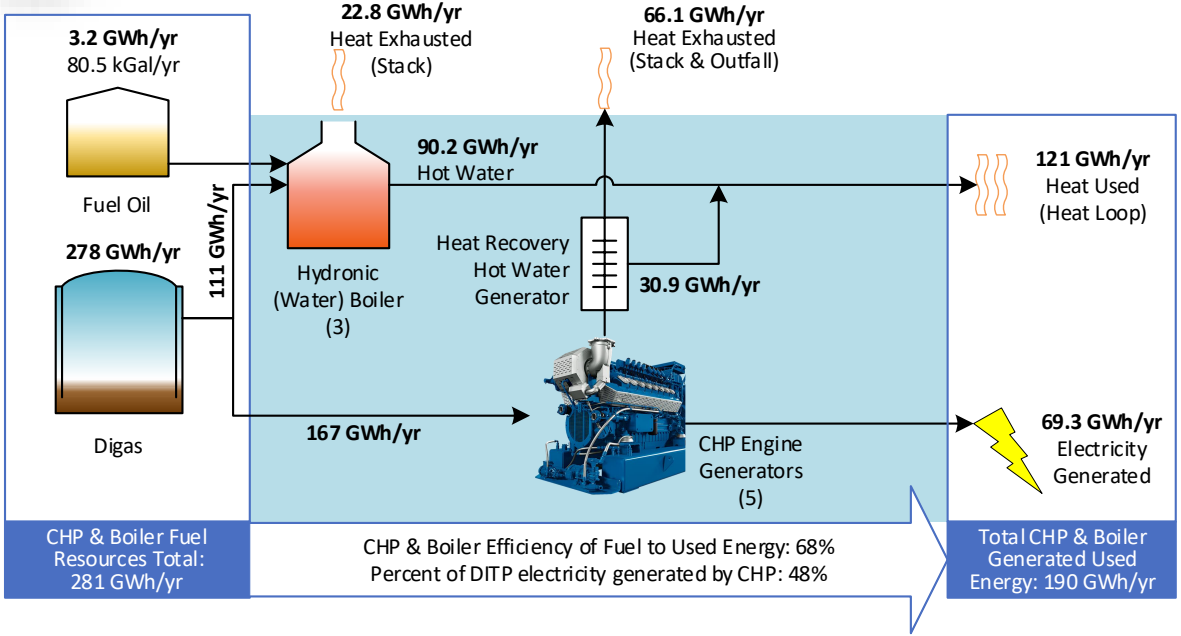
Reciprocating Engine Generators (like a car)



Combustion Turbine Generators (like a jet)

Chosen Technology
Generated more electricity when simulated in DITP system

Consultant Proposed Design - Schematic and Energy Flow*



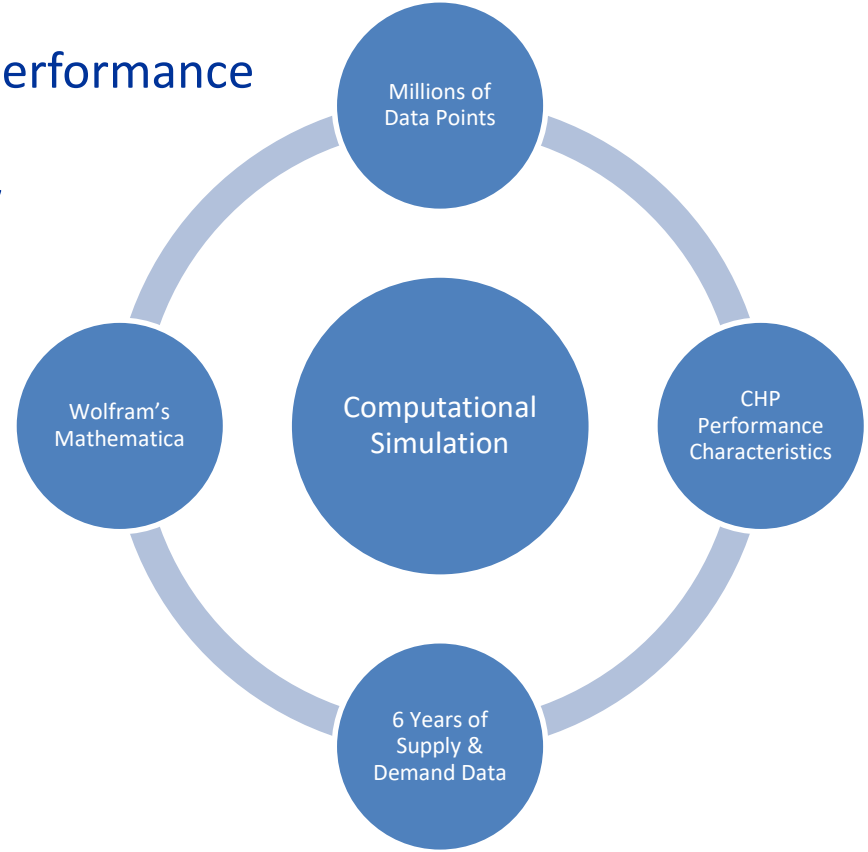
- New building for equipment
- Design and construction cost: $82M

Total Energy Used at DITP (Thermal & Electrical)	Total Energy Generated from On-site Resources	Percent of Energy from On-site Resources
265 GWh/yr	197 GWh/yr	74% by Energy 78% by Cost

*Based on preliminary sizing and overall design

Performance Prediction Method

- Simulation predicts energy performance
- Calculates performance of new CHP when run in DITP system
- Accounts for interplay between boilers and CHP engines
- Simulation enables high confidence results

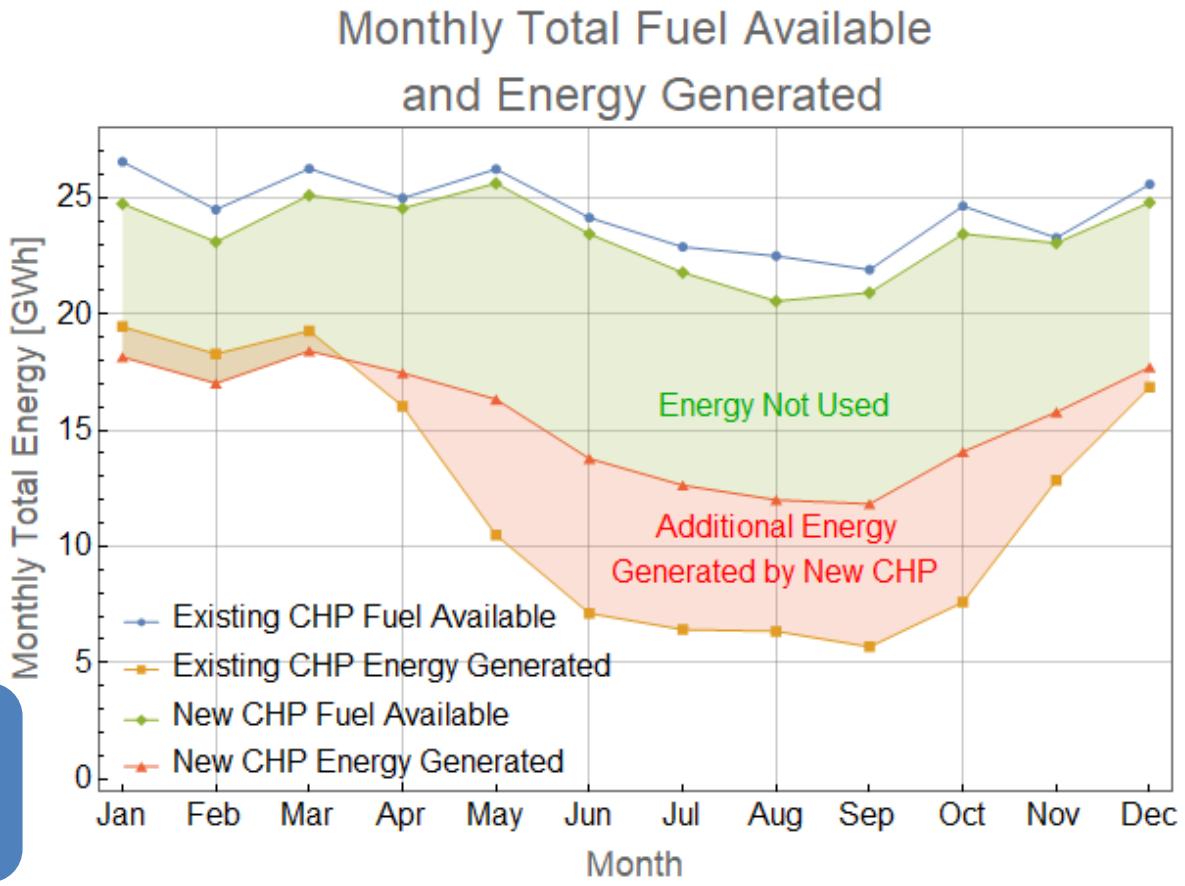


Source of Additional Electricity

Electricity Output Increase
Old CHP: 30 GWh/yr
New CHP: 69 GWh/yr

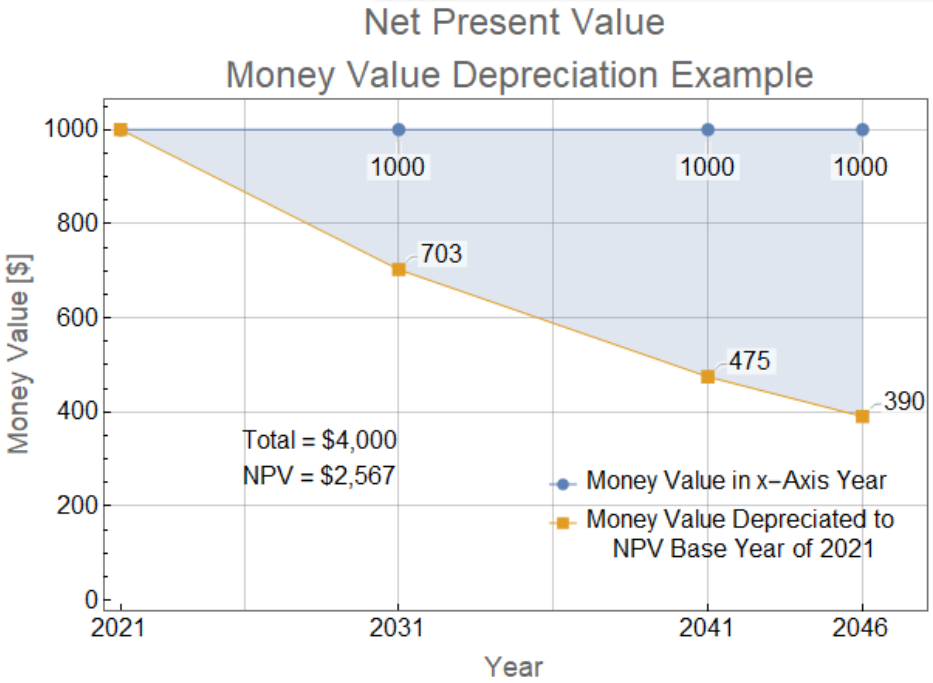
Fuel to Electricity Efficiency
Old CHP: ~10%
New CHP: ~40%

Reduced summer heat demand
=
New CHP receives more fuel



Economic Analysis - Net Present Value Introduction

The NPV is the sum of all capital and O&M costs over the analysis duration discounted to the base year



- Accounts for time value of money
- Discounts future money to base year of 2021
- Discount rate tied to MWRA cost of money
- Analysis period 25 years

Consultant Results Summary

Consultant NPV Summary Results		
Alternative	**NPV**	**Compare New NPV to Existing (NPVΔ)**
Existing CHP	$ 214M	-
New CHP	$ 227M	**$ +13.1M***

The above numbers are the net present value (NPV) in millions of dollars for a 25 year analysis of operating a new and existing CHP/power plant and purchasing fuel oil and electricity.

Consultant recommended continued use of existing CHP

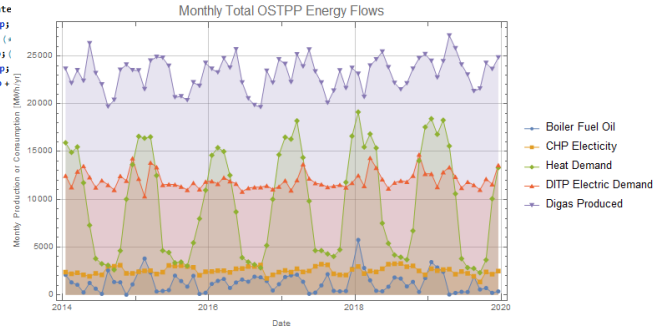
*Based on preliminary CHP sizing and current Eversource incentive as well as a prediction of the variable market driven energy certificate sales revenue.

Additional Analysis by Staff

Staff built upon Consultant's analysis by modifying the following parameters:

- Adjusting the O&M costs
- Lowering the discount rate
- Using a standard boiler life

```
(*Creates the time series for the Table*)
ts1Temp = TimeSeriesAggregate[TimeSeries[elecTotCHPMWh, {timeAr}], "Year", Total];(*OSTPP Electricity Generated*)
ts2Temp = TimeSeriesAggregate[TimeSeries[elecTotDemandMWh, {timeAr}], "Year", Total];
ts3Temp = ts1Temp / ts2Temp(*Percent total Elec Demand*);
ts4Temp = ts1Temp * elecUtilAveRate (*Electricity revenue avoided*);
ts5Temp = TimeSeriesAggregate[TimeSeries[foBoilerAllMWh, {timeAr}], "Year", Total]; (*Fuel Oil Used in OSTPP Boilers*)
ts6Temp = ts5Temp * foRateMWh; (*Fuel Oil Cost*)
ts7Temp = TimeSeriesAggregate[TimeSeries[(boilTotSuperSteamEn - totHeatDemand), {timeAr}], "Year", Total]; (*Wasted Energy*)
ts8Temp = TimeSeriesAggregate[TimeSeries[totHeatDemand, {timeAr}], "Year", Total]; (*Total Heat demand*)
ts9Temp = ts7Temp / ts8Temp; (*Ratio of wasted to total heat demand*)
ts10Temp = TimeSeriesAggregate[TimeSeries[digasFlaredMWh, {timeAr}], "Year", Total];(*Wasted digas*)
ts11Temp = TimeSeriesAggregate
ts12Temp = ts10Temp / ts11Temp;
ts13Temp = ts1Temp + ts8Temp;(*
ts14Temp = ts5Temp + ts11Temp;(
ts15Temp = ts13Temp / ts14Temp;
ts16Temp = (ts1Temp + ts7Temp +
```



Results Summary

	Consultant NPV Results	Staff Preliminary NPV Results		
Alternative		**O&M**	**Discount Rate 4%**	**Boiler Replacement**
Existing CHP NPV	$ 214M	$ 233M	$ 290M	$ 328M
New CHP NPV	$ 227M	$ 239M	$ 284M	$ 284M
NPVΔ	**$ +13.1M**	**$ +5.8M**	**$ -6.5M***	**$ -43.1M****

*Includes O&M

**Includes Discount rate and O&M

New CHP outperforms existing CHP

Beyond NPV Considerations – GHG Emissions Reduction

Fuel Oil 300k Gal/yr

3,000 Metric Tons GHG

8M Car miles

+

Electricity 40 GWh/yr*

13,800 Metric Tons GHG**

34M Car Miles

→

16,800 Metric Tons GHG

42M Car Miles

Social Cost of Carbon: $775k/yr

*Does not include Renewable Energy Certificate (REC) Purchases/Sales

** Based on actual GHG profile provided from the electrical supplier

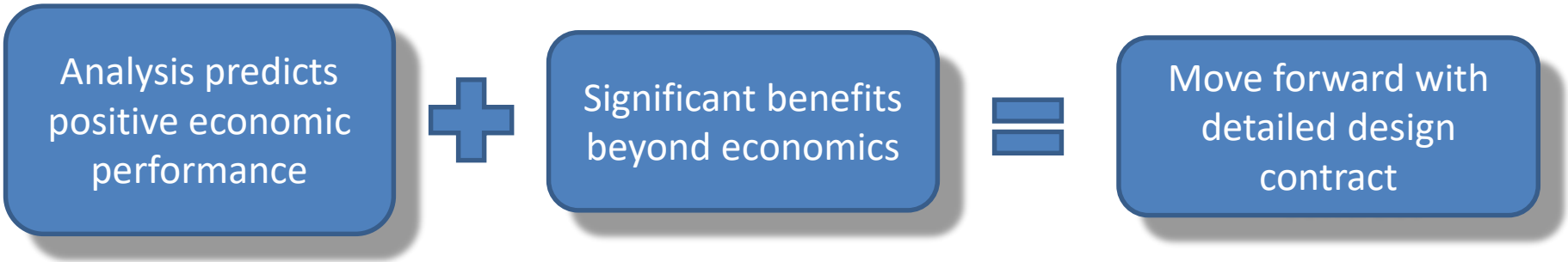
Beyond NPV Considerations

- Increase on site generation
  - From: 57% by Energy; 65% by Cost
  - To: 74% by Energy; 78% by Cost

Percent of total energy demand (thermal and electrical) met by on-site renewable generation

- Eliminate 30 fuel oil truck deliveries per year
- Eliminate high pressure steam system hazards

New CHP Next Steps



Thank you!

Questions?