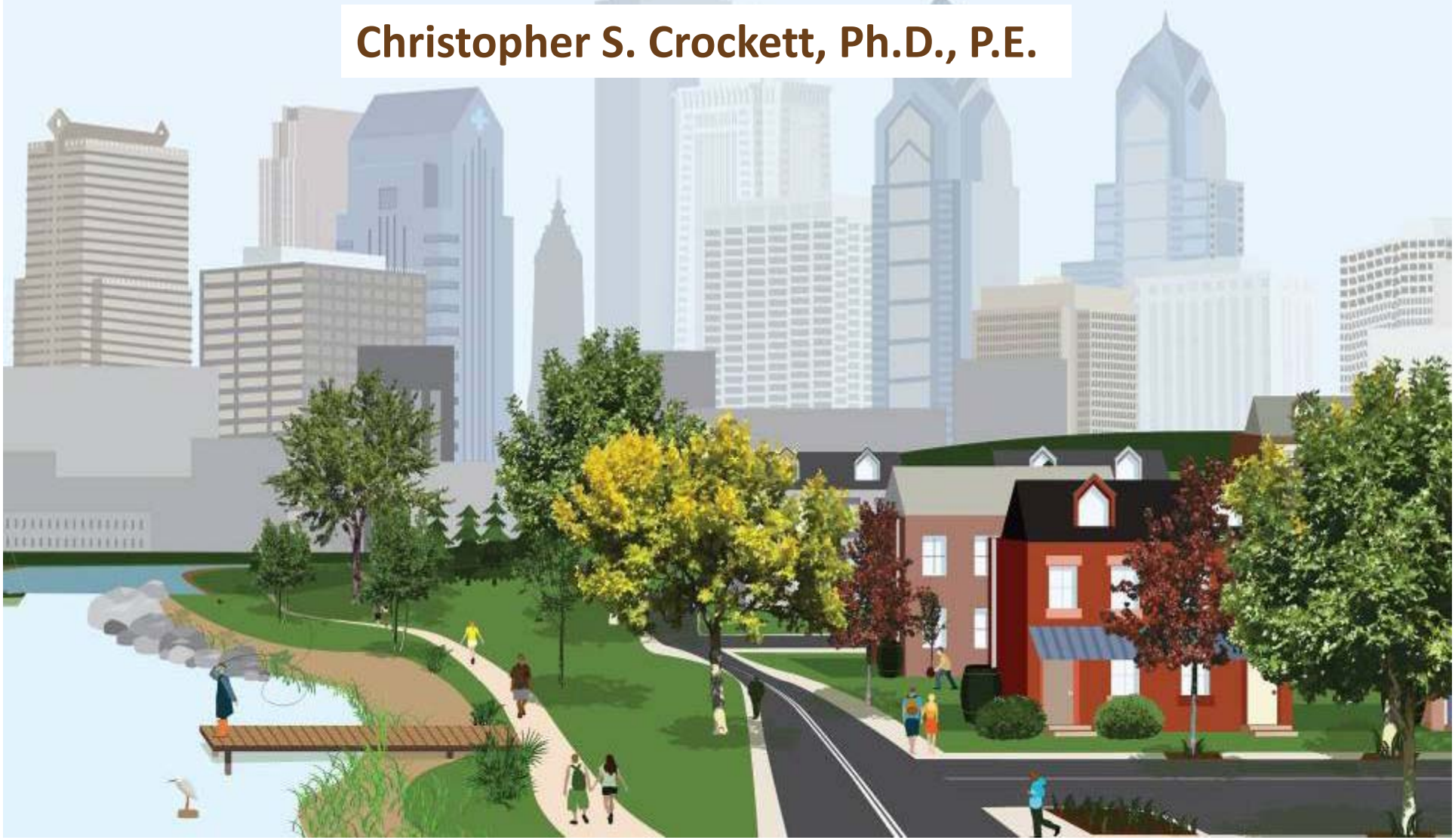
Moving from Wastewater Treatment to Resource Recovery

Christopher S. Crockett, Ph.D., P.E.

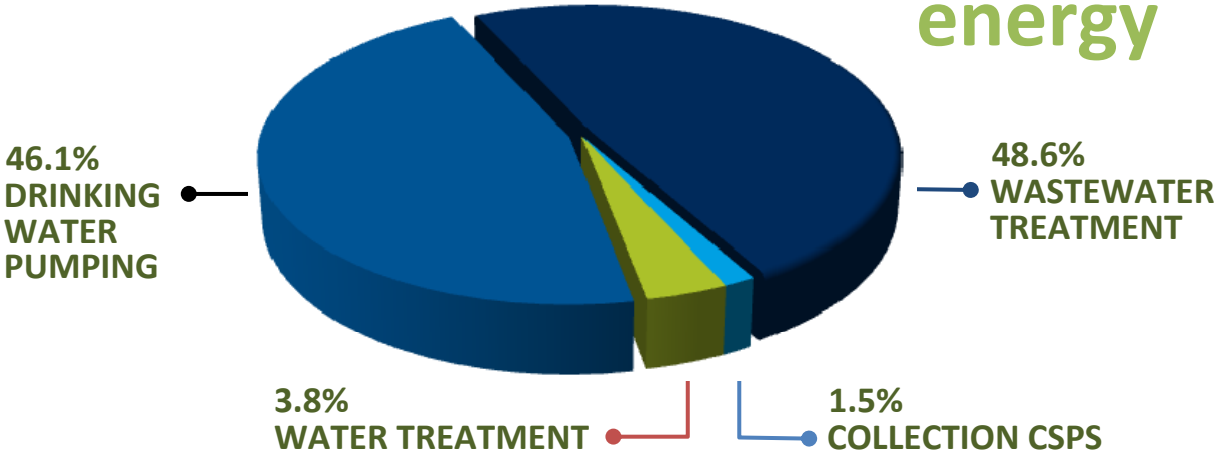


Energy History

- PWD has historically worked to address energy issues
  - Off peak operations
  - Load shedding
  - Efficiency projects

PHILADELPHIA WATER DEPARTMENT'S CHALLENGE

- Annual Energy Consumption – 260 GWh
- Deregulation at end 2010
- Forecast 30+% cost increases energy



Goals

- Organizational
  - Balance core mission and organization management
  - Ensure organizational capacity to sustain energy management
- Business
  - Promote Innovation in Energy Management
  - Integrate renewable energy into overall energy portfolio
  - Establish monitoring programs for energy management
- Technical
  - Promote Energy Conservation and Peak Demand Management
  - Optimize Operational Processes and Practices
  - Implement Capital Initiatives that Positively Impact Energy Conservation
- Financial
  - Define Cost Effective Procurement Options
  - Develop Reliable Energy Cost Forecasting Mechanisms

ORGANIZATIONAL STRUCTURE

ENERGY CHAMPION

ENERGY MANAGEMENT TEAM

- **Finance**
- Officer of Water
- **Water Treatment**
- **Wastewater Treatment**
- Conveyance
- **Collection**
- **Planning & Research**
- Design
- **City Liaison**

ADHOC
WORKING GROUPS

FACILITY LEADERS

- **Baxter WTP**
- Belmont WTP
- **Queen Lane WTP**
- **Northeast WPCP**
- Southeast WPCP
- **Southwest WPCP**
- **Torresdale PS**
- Load Control
- **Flow Control**
- **Bureau of** Laboratory Services

Energy Planning

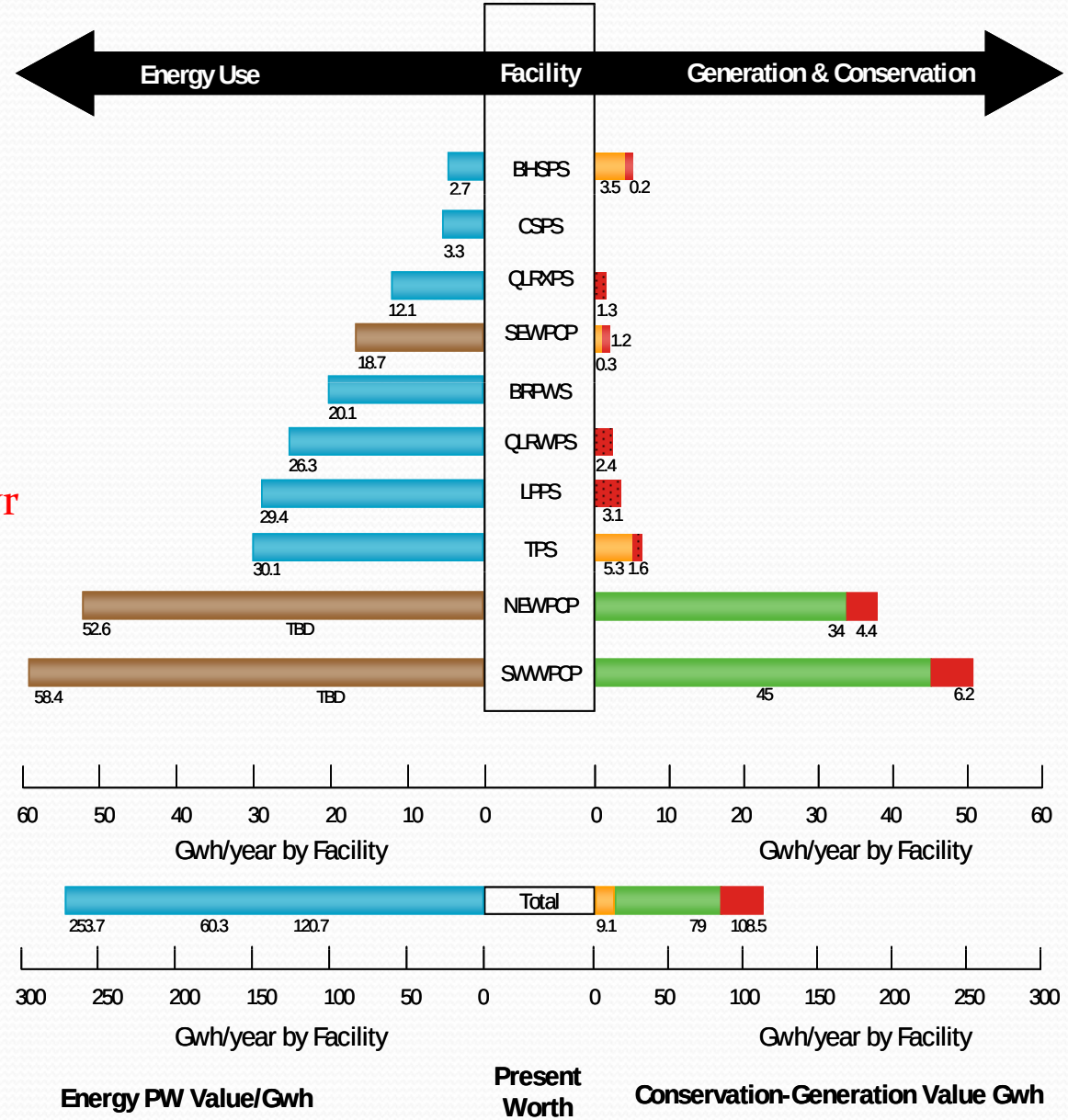
Legend

- Drinking Water Distribution
- Solar Energy*
- Biogas Energy
- Conservation
- Wastewater Treatment and Pumping

*Solar Energy Generation Values are based on information obtained from PWD as of April 2010.

Conservation = 29.5 Gwh/yr

Generation = 79 Gwh/yr



PWD Energy Activities

- Strategic Energy Plan
- Hydroelectric Power – studies & designs
- Airport Deicing Fluid to Biogas - ongoing
- Solar at SE – constructed/operating
- Solar American Cities – Facility solar plan completed
- Sewer Geothermal – constructed/operating
- NE Cogen – 5.6 MW facility under construction
- Food Waste Co-digestion – under study
- Algae Biofuels – research
- Lighting Efficiency Projects
- Load Demand Reduction Programs
- High Efficiency Pumps

Solar

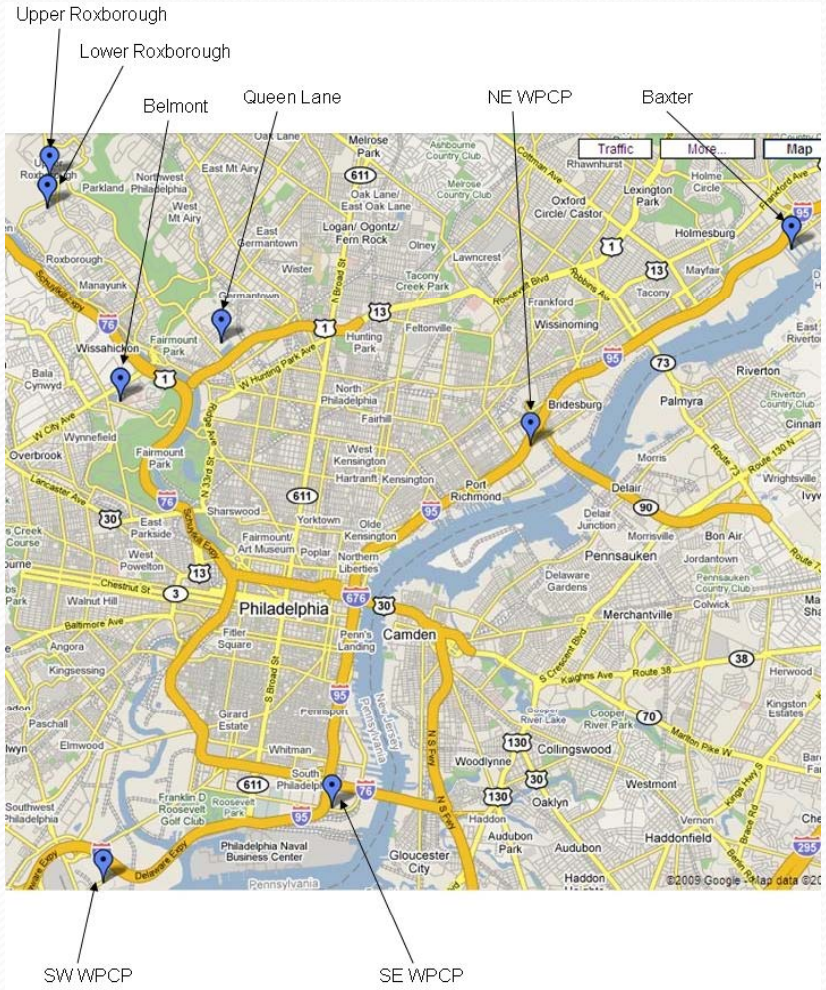
Sewer Thermal

Food Waste

Biogas Cogeneration
De-icing Fluid Recycling

PWD Potential Solar Sites

- Examined Solar at PWD facilities
- Limiting Factors
  - Use behind the meter
  - Rooftop upgrade timing
  - Operational needs



Solar Panel Installation

Southeast WPCP

- PWD's first solar installation
- Installed August 2010
- Medium-sized Photovoltaic System (PV)
  - 1014 panels
  - 250 kWp DC power
  - 300,000 kWh AC power production per year
- $1.5 million project cost
- PWD owns Solar Renewable Energy Certificates (S-RECs) associated with solar energy generated
  - S-RECs earn 12 cents/kWh
- Simple pay back of 8 to 14 years with 25 year life cycle

Solar Panel Installation - Southeast WPCP

Aircraft De-icing Fluid (ADF)

Southwest WPCP

- Aircraft deicing fluid (ADF) runoff from Philadelphia International Airport accepted at Southwest WPCP.
- Adding ADF to plant's anaerobic digesters produces useful methane gas without any negative impacts on process.

- PWD earns revenue from tipping fees paid by Airport:
  - $351/truck
  - $54/1000 gallons
- Each truck delivers between 5,000 and 7,500 gallons of ADF per load.

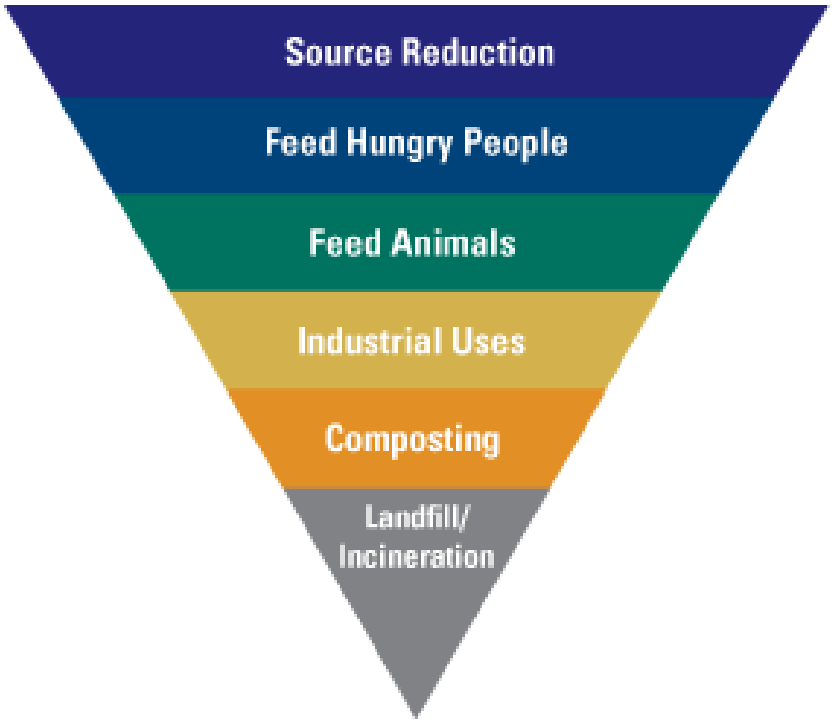
Aircraft De-icing Fluid

Revenue from Tipping Fees

FY	ADF Load (MG)	Revenue ($)
09	1.9	$100,000
10	3.5	$190,000
11	2.9	$160,000
12	0.7	$42,000
Total	9.0	$490,000

Sustainable Food Waste Management

- **EPA Hierarchy for Managing FW Effectively**
  - Improving upstream production and distribution systems
  - Smart purchasing and use of food
  - Feeding people with leftover food
  - **Using a food waste disposer (FWD)**
  - Composting in the backyard, using green bins and maintaining community gardens



Clean Kitchen, Green Community

- Installation of 100 FWDs throughout West Oak Lane and Point Breeze neighborhoods
- **Purpose of Program: To divert FW from landfills and to assess how FWDs can help the City reach its Greenworks Philadelphia sustainability goals**
- Collaboration between the Streets Dept, PWD and InSinkErator
- Streets Dept will conduct focused MSW study for West Oak Lane and Point Breeze neighborhoods

Biogas Cogeneration Facility

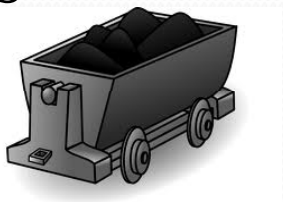
- NE WPCP uses 51.5 million kWh/year
- FY 13 energy budget ~$5 million
- Facility will meet 85% of current NE WPCP demand

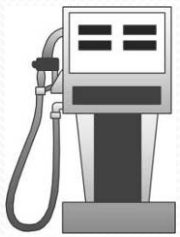
- PWD uses 270 million kWh/year
- Facility will meet 15% of total PWD demand
- Facility will reduce greenhouse gas emissions by ~28,000 tons CO_2/year

Biogas Cogeneration Facility

Environmental Metrics

- Facility will produce 4 x 1.44 MW = 5.67 MW electricity
- Off-set: 27,870 tons of CO_2 / year
- This is equivalent to
  - 4,833 passenger vehicles
  - 5,390 acres of pine or fir forests
  - 132 railcars of coal
  - 2,843,487 gallons of gasoline





Biogas Cogeneration Facility

Northeast WPCP

- The PWD is using a unique business approach to accomplish Biogas Cogeneration project.
  - Capital limitations prohibit PWD from commissioning contract of required size.
  - Federal tax incentives require that energy projects be owned by taxable entities.
- Developer will finance, install, build, commission, own, and maintain facility.
- City will lease facility from Developer for sixteen year term and use generated electricity and thermal heat.
- Project also qualifies for $3.9 million in State Act 129 funding "PECO's Smart Ideas."

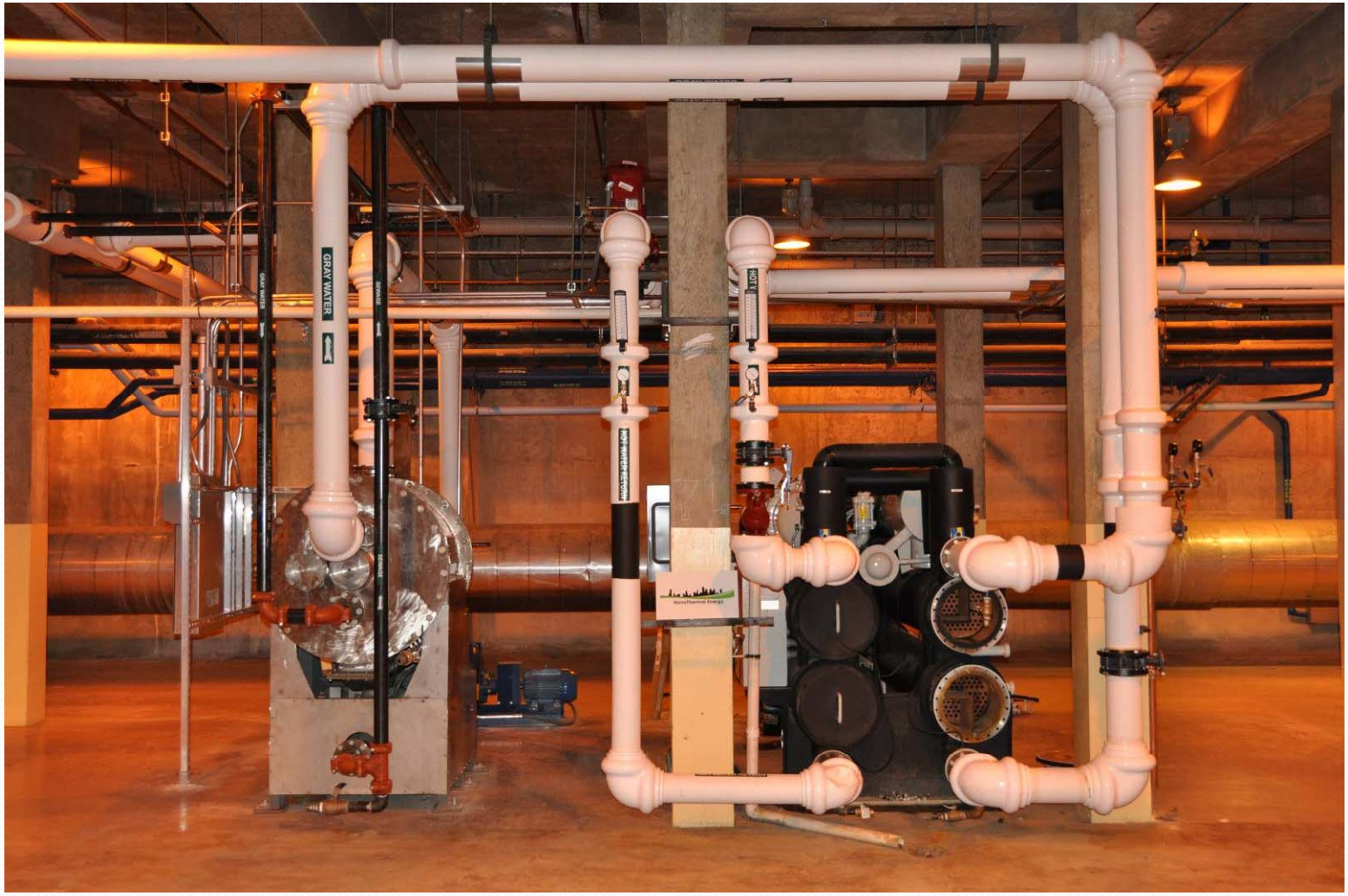
Biogas Cogeneration Facility

Northeast WPCP

- Contract signed with Ameresco 12/23/2011.
- NTP issued 2/92012.
- Construction in progress.
- Mechanical Completion 5/1/2013.
- Final Completion 12/31/2013.

Sewage Geothermal Installation

Southeast WPCP



Sewage Geothermal Installation

Southeast WPCP

- NovaThermal Energy awarded Greenworks Pilot Energy Technology Grant to demonstrate its unique patented geothermal technology.
- System extracts thermal energy in sewage to provide 40% of energy needed to heat Compressor Building at Southeast WPCP.
  - Heat pump operates at 60 cooling tons/978,000 BTUs/hr.
  - 10°C temperature differential between inlet and outlet streams.

Sewage Geothermal Installation

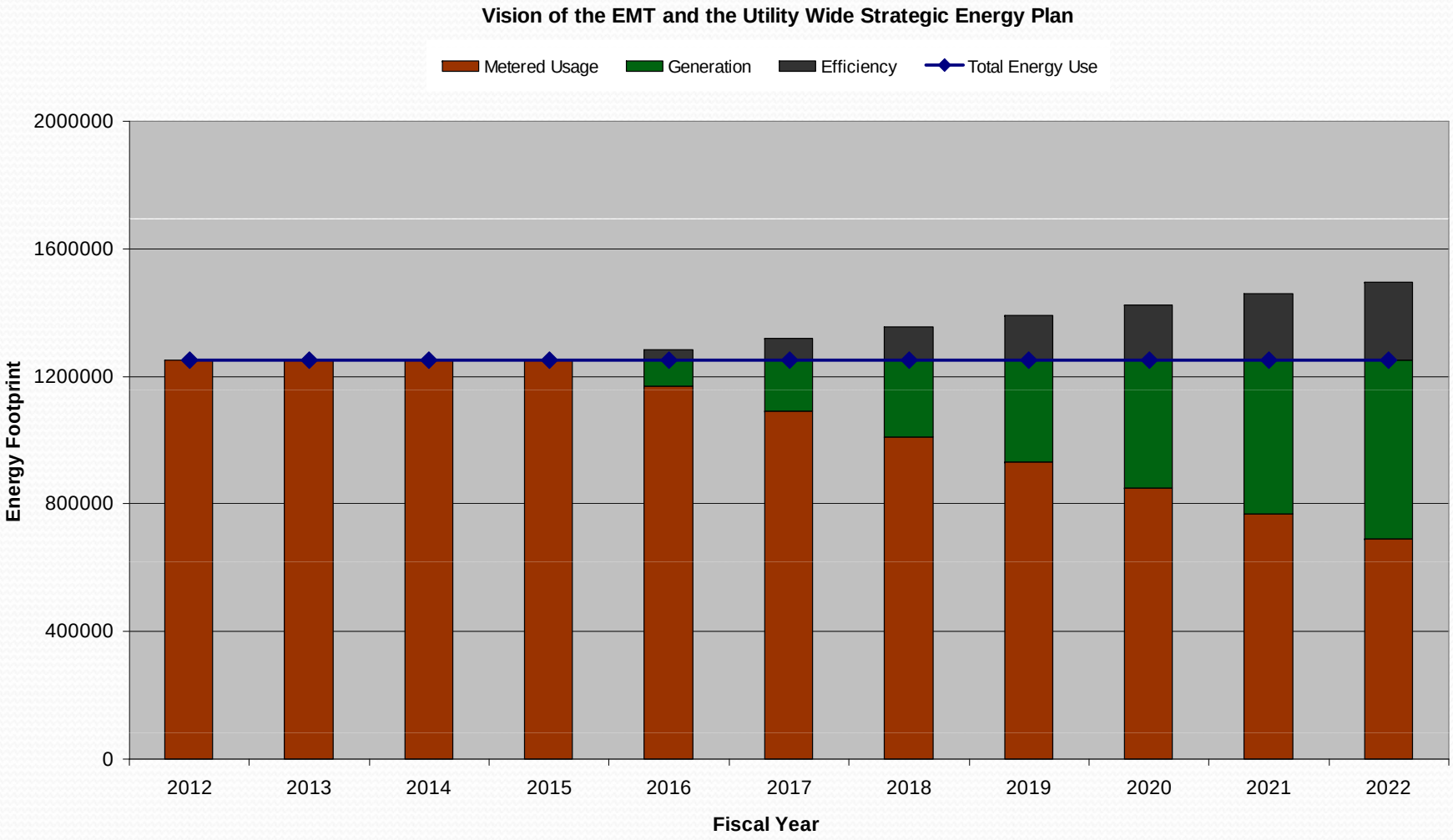
Southeast WPCP

- System operational in February 2012.
- **First use of sewage for heating purposes in the United States.**
- **Important step forward for establishing energy neutral wastewater treatment plant operations.**
- Generating renewable energy to substitute purchased power reduces City's exposure to volatile energy market.

Hydropower

- Flat Rock Dam
- 20 foot elevation change
- PWD maintains walls and Manayunk Canal
- Potential for way to offset maintenance cost
- Accommodating hydropower development in wall repair design
- Construction 2014-2015

10 Year Vision



Conclusions

- Energy independence vs. net energy producer depends on market and operational issues
- Be prepared for opportunities and new technologies
- Be flexible and responsive to changing markets and technologies
- Organizational capacity, processes, and commitment are needed to make progress
- Think beyond their facility when it comes to energy

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