ARLINGTON RE-GEN

Arlington County Water Pollution Control Plant

Solids Master Plan

Biosolids Advisory Panel

February 8, 2022

ARLINGTON VIRGINIA

Agenda

01	6:00 - 6:05	**Introductions**
02	6:05 - 6:20	**Open Discussion on Background Materials**
03	6:20 – 7:40	**Biogas Utilization Discussion**
04	7:40 – 7:55	**Program Updates**
05	7:55 – 8:00	**Next Steps**

Introductions

Mary Strawn	**Tom Broderick**	**Lisa Racey**	**Mike Collins**	**Peter Golkin**
Arlington County Water Pollution Control Bureau	Arlington County Water Pollution Control Bureau	Arlington County Water Pollution Control Bureau	Arlington County Dept. of Environmental Services	Arlington County Dept. of Environmental Services

Brian Balchunas	**Brian Bakke**	**Stephanie Spalding**	**Rahkia Nance**	**Jessica Host**	**Samantha Villegas**
HDR	HDR	HDR	HDR	HDR	Raftelis

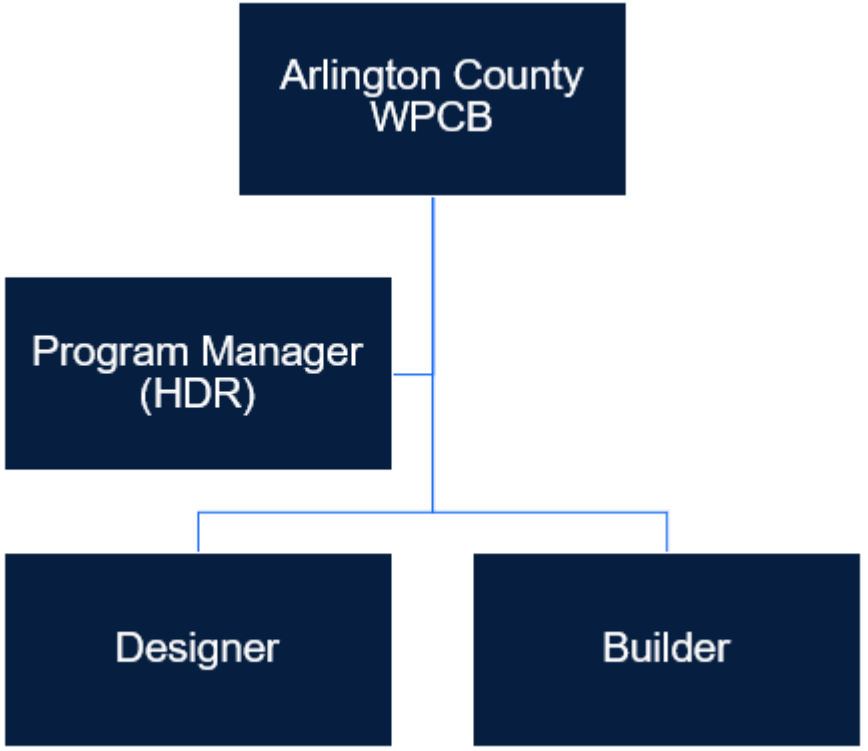
Biosolids Advisory Panel

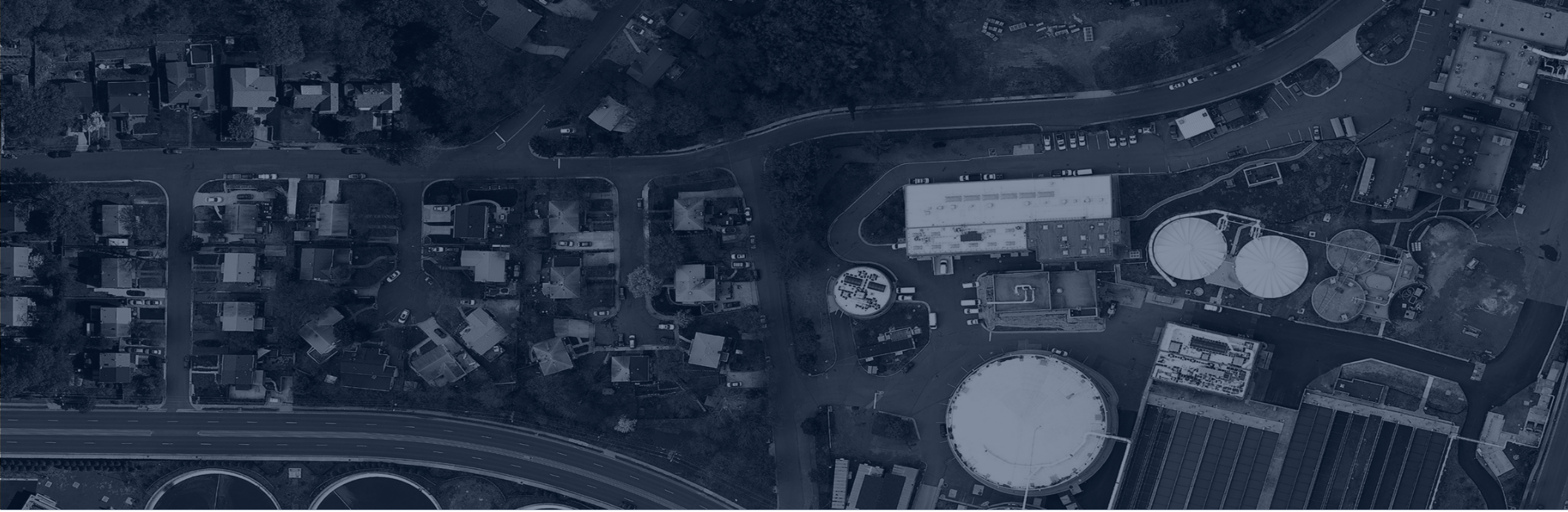
- Purpose: to serve as a focus group that examines and gives feedback as the program develops

- Expectations: to provide thoughtful input and perspective from the groups and people represented

Roles and Responsibilities

- HDR serves as an advisor to Arlington County
- Current phase:
  - Define program scope
  - Define program delivery
- Future phases:
  - Oversee design and construction
  - Assist with start-up and commissioning
- HDR is prohibited from participating in any design and construction



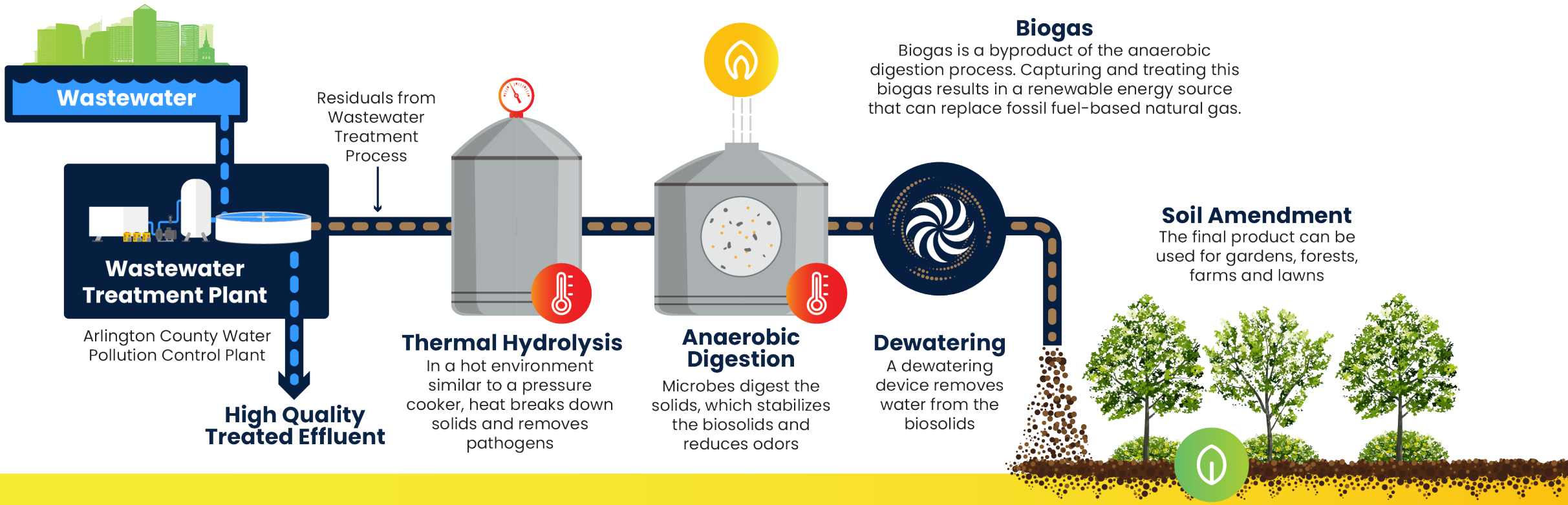


02

Background Materials

Program Overview

Recovering renewable resources from wastewater

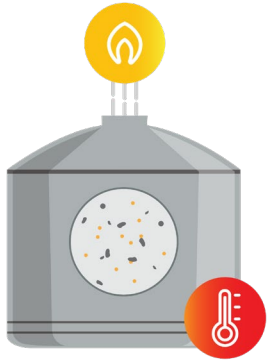


03

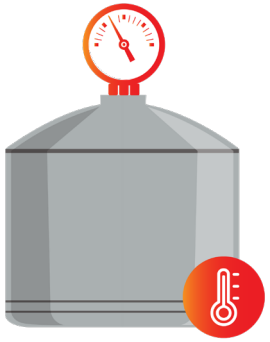
Biogas Utilization Discussion

Key Questions for Biogas Utilization

- **Biogas is a byproduct of anaerobic digestion**



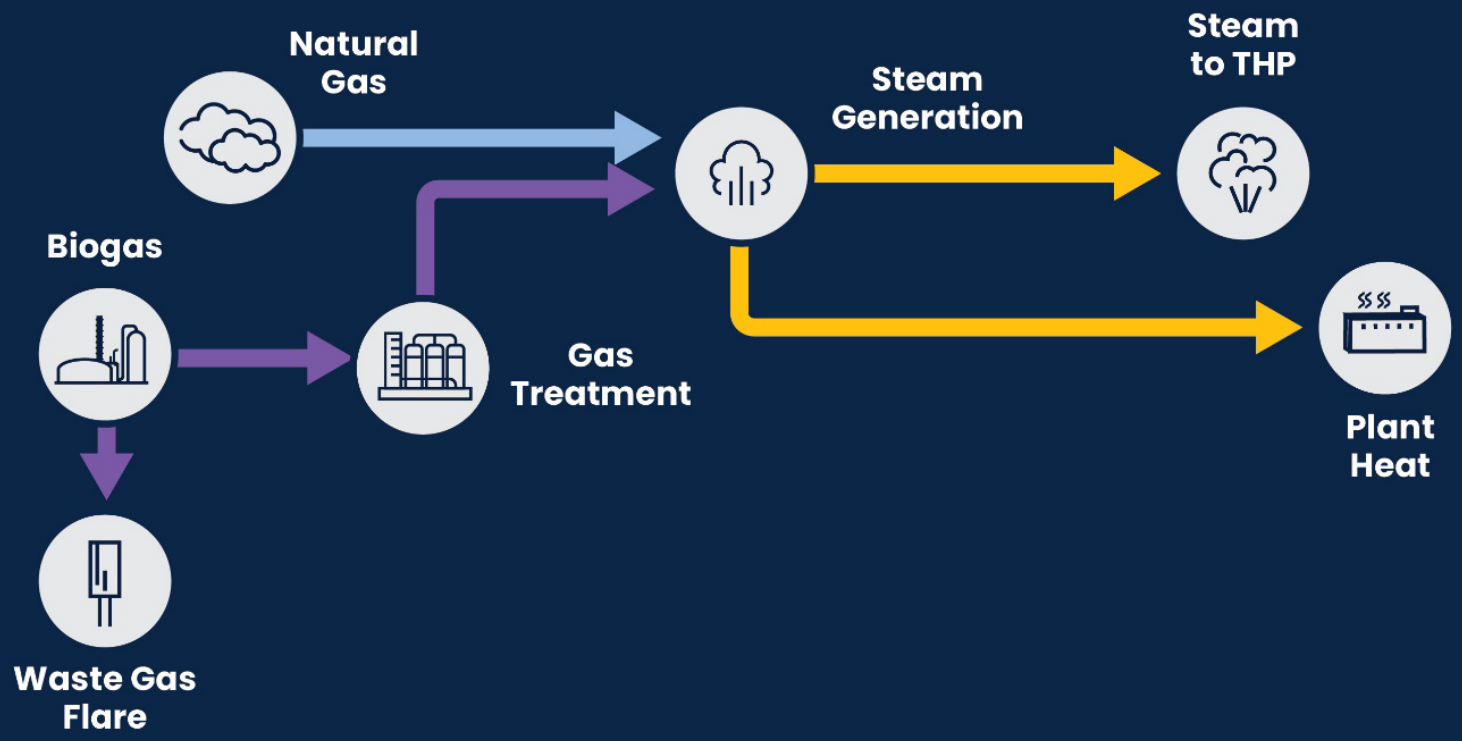
- **Steam is required for thermal hydrolysis**



?

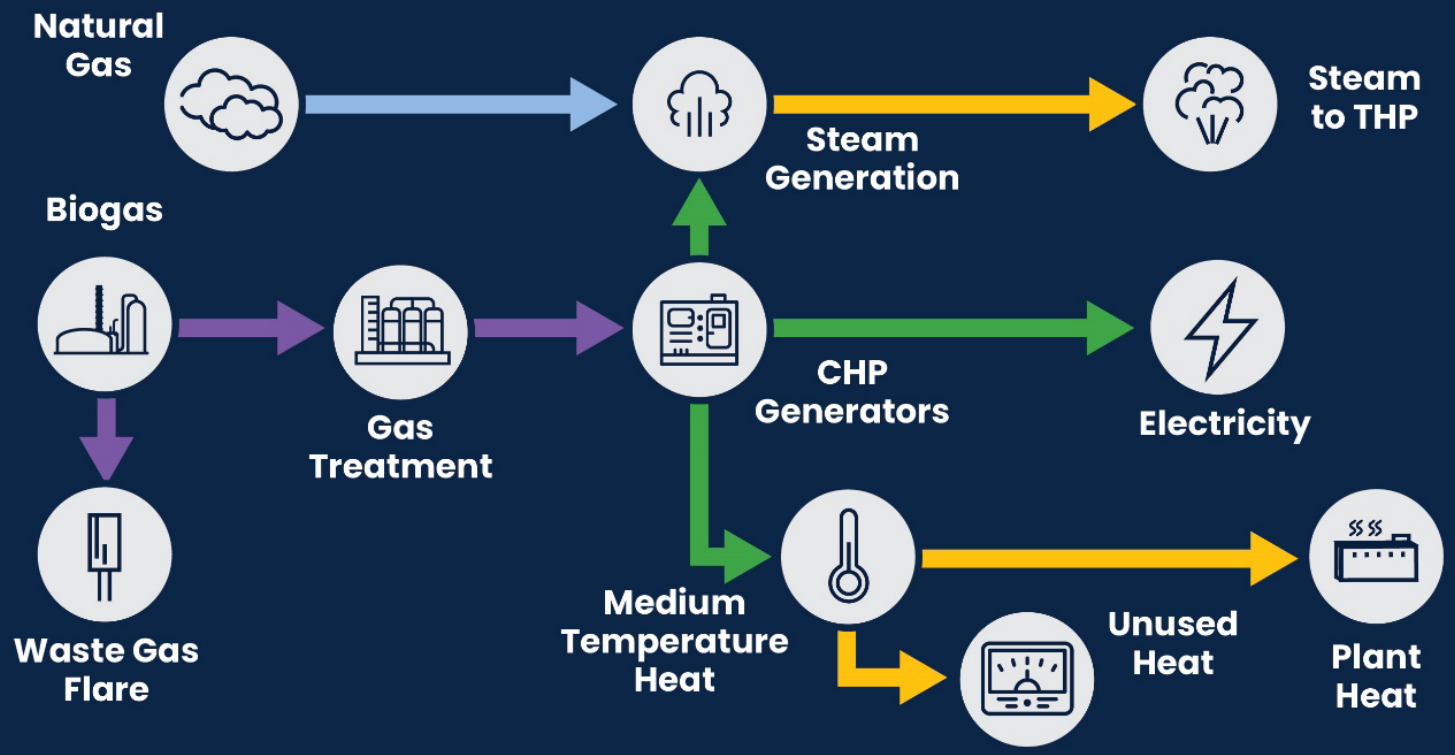
How do we best sustainably use the biogas while also most effectively generate the necessary steam for the process?

Alternative 1
Process and Building Heat



- Steam demand for THP would use ~30% percent of biogas produced, leaving 70% as excess, which would be flared
- Not a viable option – does not meet sustainability goals
- *Used for comparison only*

Alternative 2
Combined Heat and Power



Alternative 2A:
CHP with Engines

- Internal combustion engines would produce more power but recover less heat
- Supplemental heat would be required to meet process needs
- Some biogas would bypass the engines to fire directly in the boiler and provide steam for THP

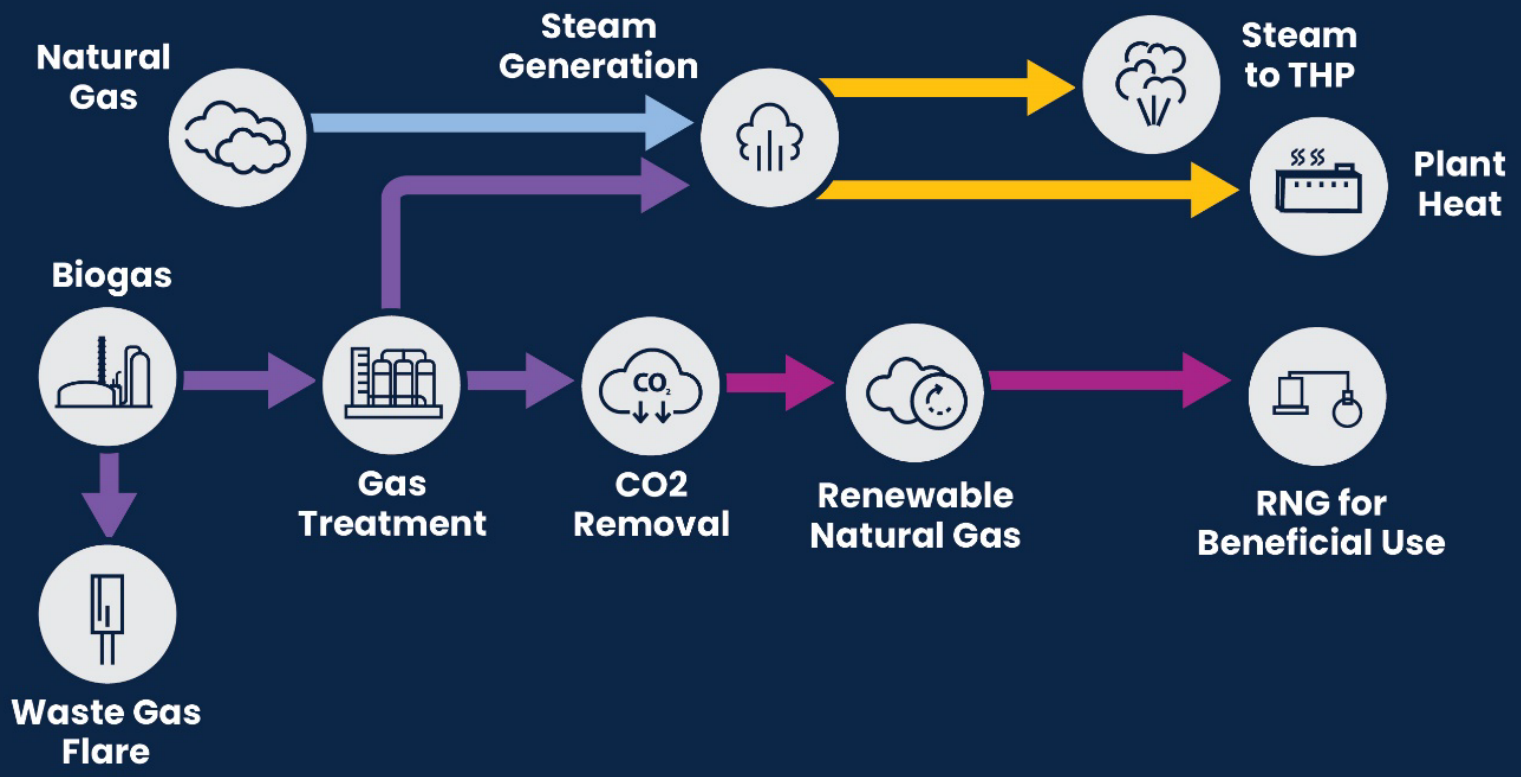
Alternative 2B:
CHP with Gas Turbine

- Gas turbine engine would produce less power but recover more steam
- Heat recovered would satisfy process needs

CHP Considerations

- Generates electricity to offset what is purchased from grid
- Electricity for Arlington County operations expected to be 100% renewable by 2025
- Engines are intensive relative to operations and maintenance
  - Similar to a heavy-duty diesel engine running 24/7
  - Regular engine overhauls required
  - May be difficult to keep online
- Engines generate local emissions

Alternative 3
Renewable Natural Gas



Alternative 3A:
RNG Injected Into Natural Gas Pipeline

- All of the RNG would be injected into the local natural gas pipeline for off-site use

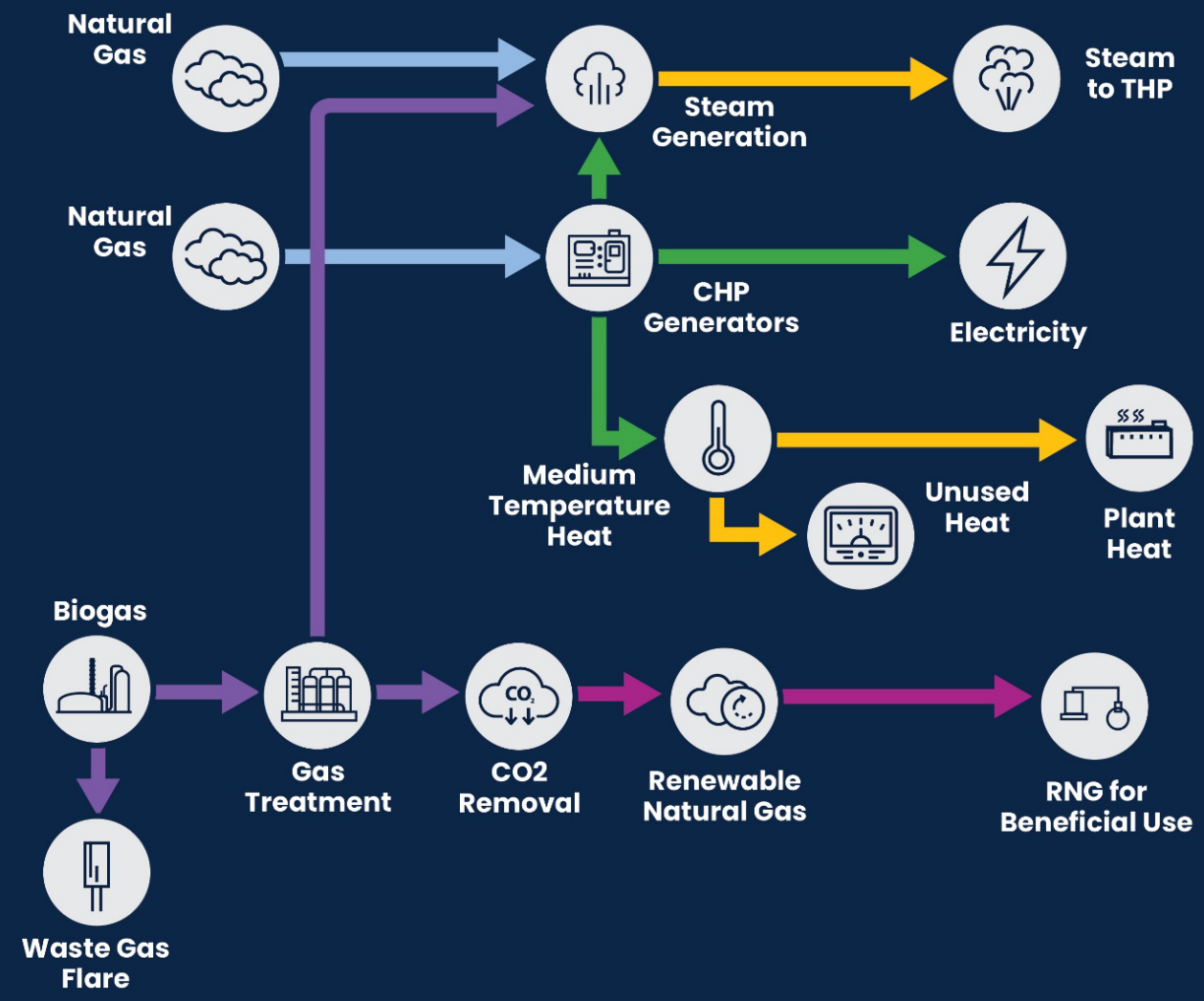
Alternative 3B:
RNG Used as Compressed Natural Gas (CNG)

- RNG would be sent directly to local CNG stations for use
- RNG would be used to fuel CNG buses operated by Arlington Transit and the Washington Metropolitan Area Transit Authority

RNG Considerations

- Generates renewable natural gas that can replace fossil fuel based natural gas
- Financially supported by Federal Renewable Fuel Standard program and renewable identification numbers (RINs) when gas has a pathway to transportation fuel
  - Not a necessity that the transportation fuel use be local
- Requires removal of carbon dioxide from biogas – high pressure treatment systems
- No net impact on localized emissions – similar emission profile to fossil fuel based natural gas it displaces

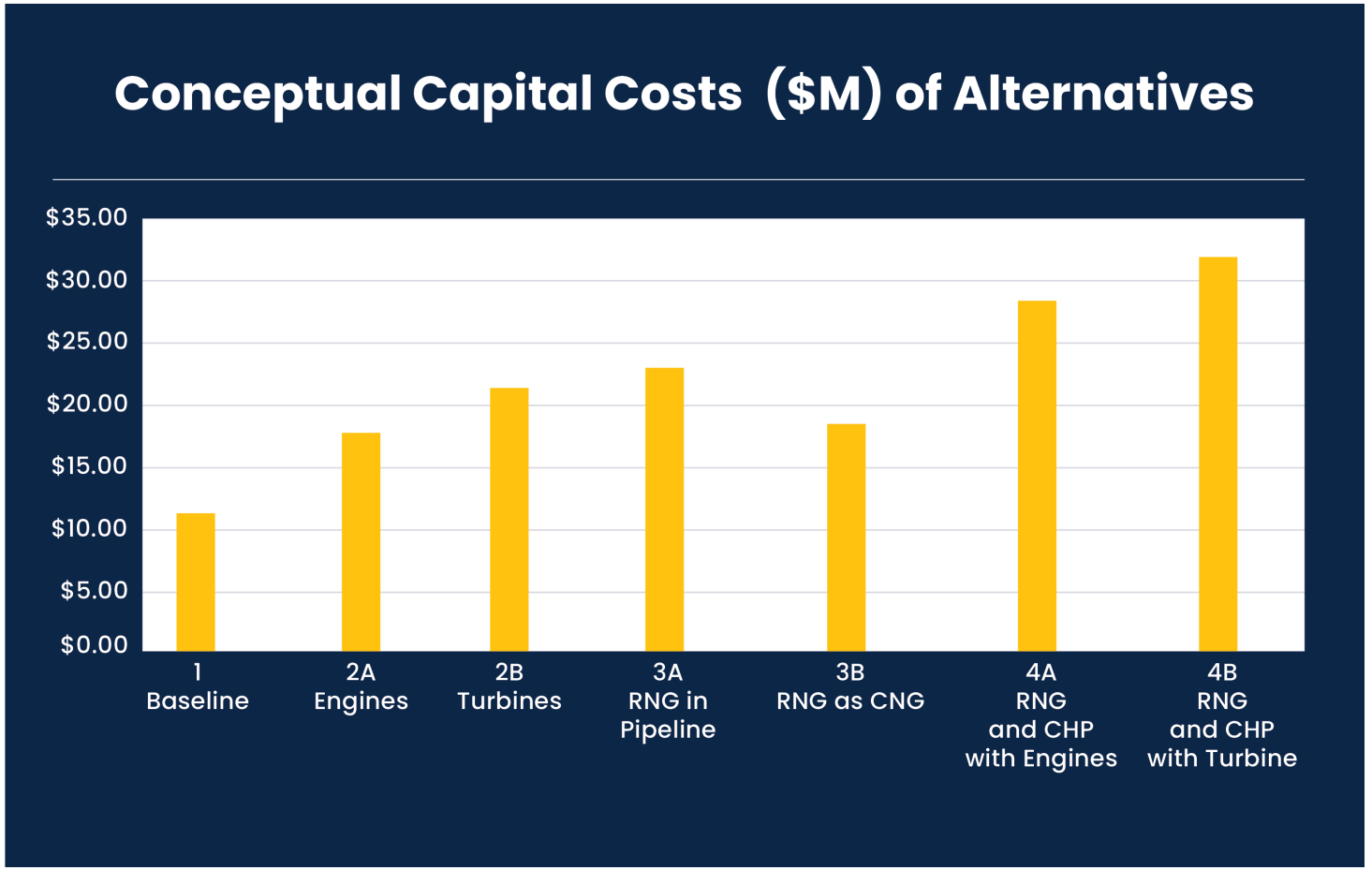
Alternative 4
Renewable Natural Gas and Combined Heat and Power



Alternative 4A:
RNG and CHP with Engines
- Larger internal combustion engines would produce supplemental heat required to provide steam for THP

Alternative 4B:
RNG and CHP with Gas Turbine
- Smaller gas turbine engines would produce less power but recover more steam
- Heat recovered would satisfy process needs.

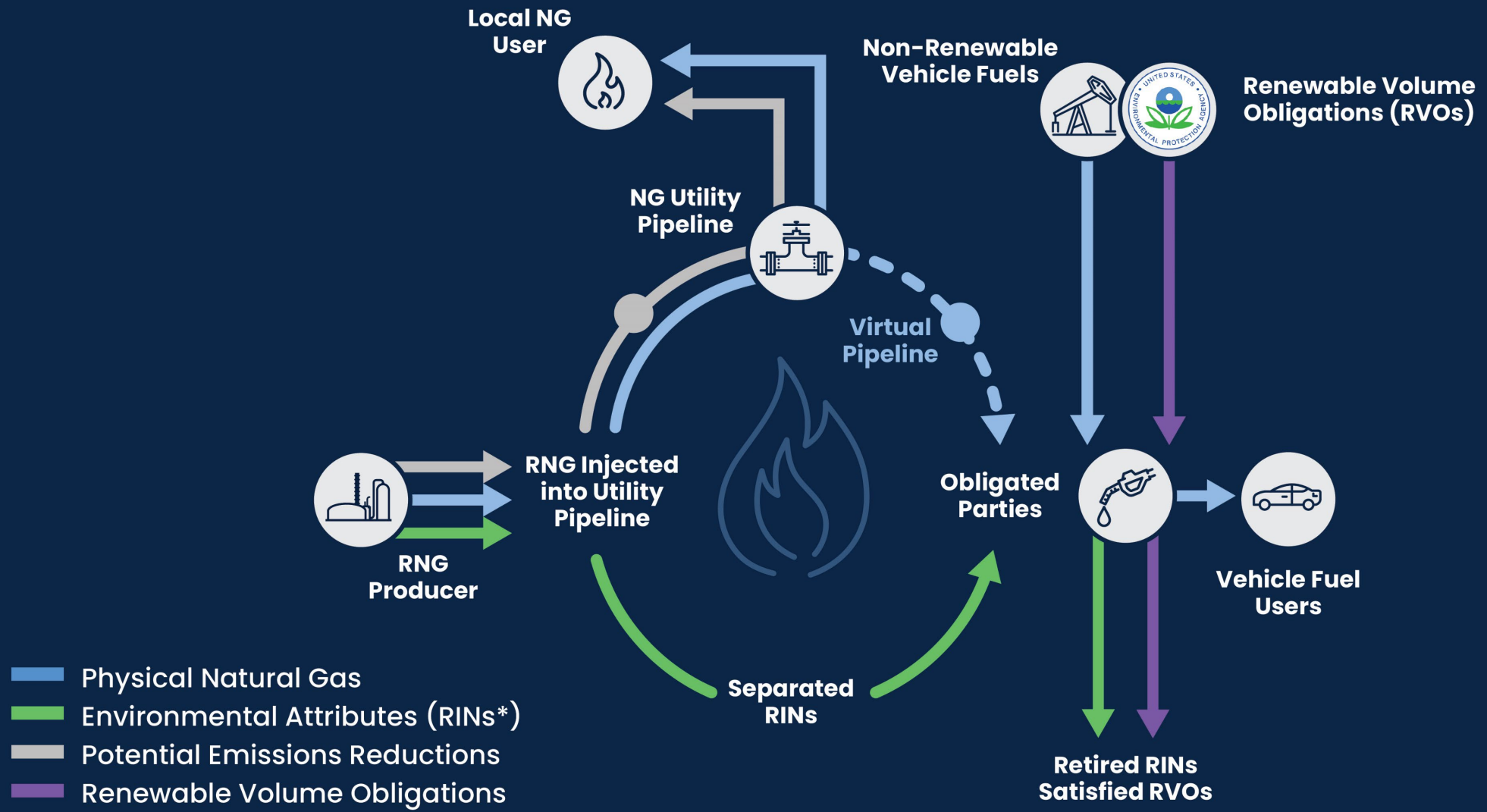
Capital Cost Financial Analysis



Alternatives 4A and 4B eliminated from further consideration due to:

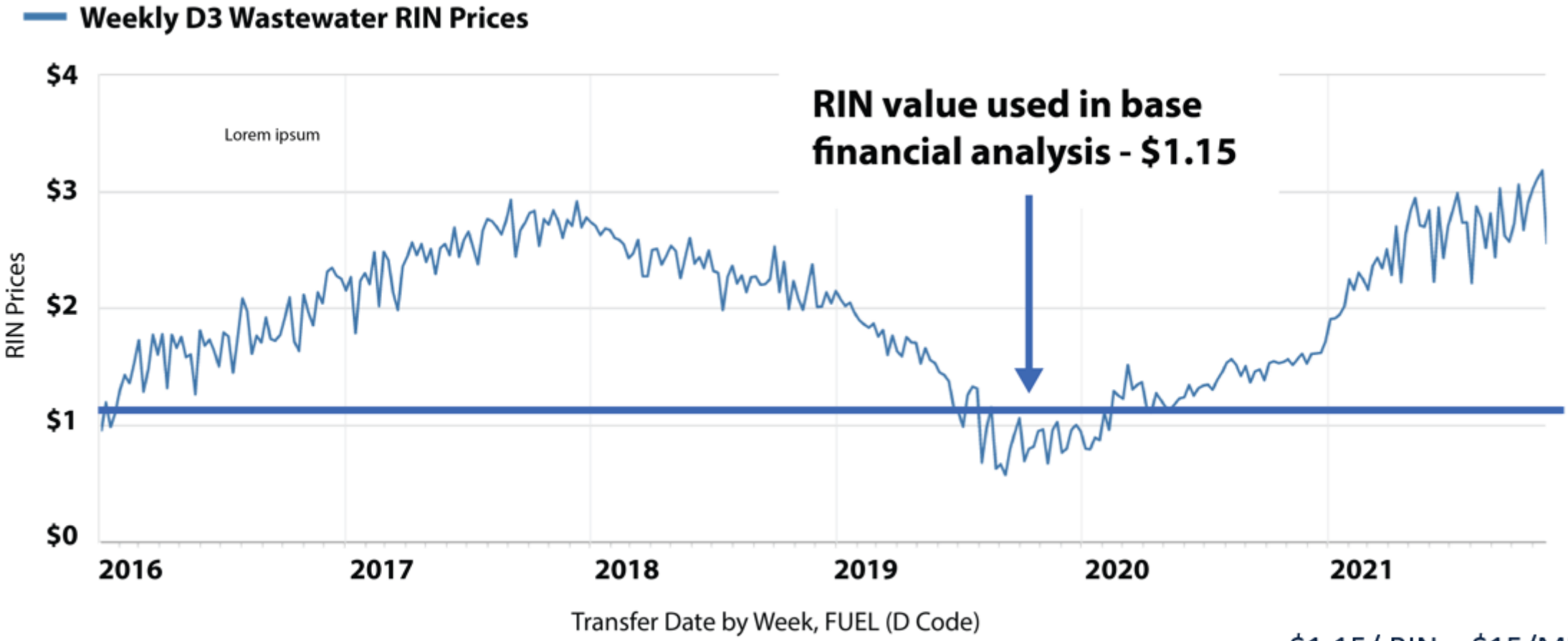
- High capital costs
- High overall complexity
- Significant use of natural gas to run engines
- Operating costs are also high due to purchase of natural gas to run generators

RNG Pathways



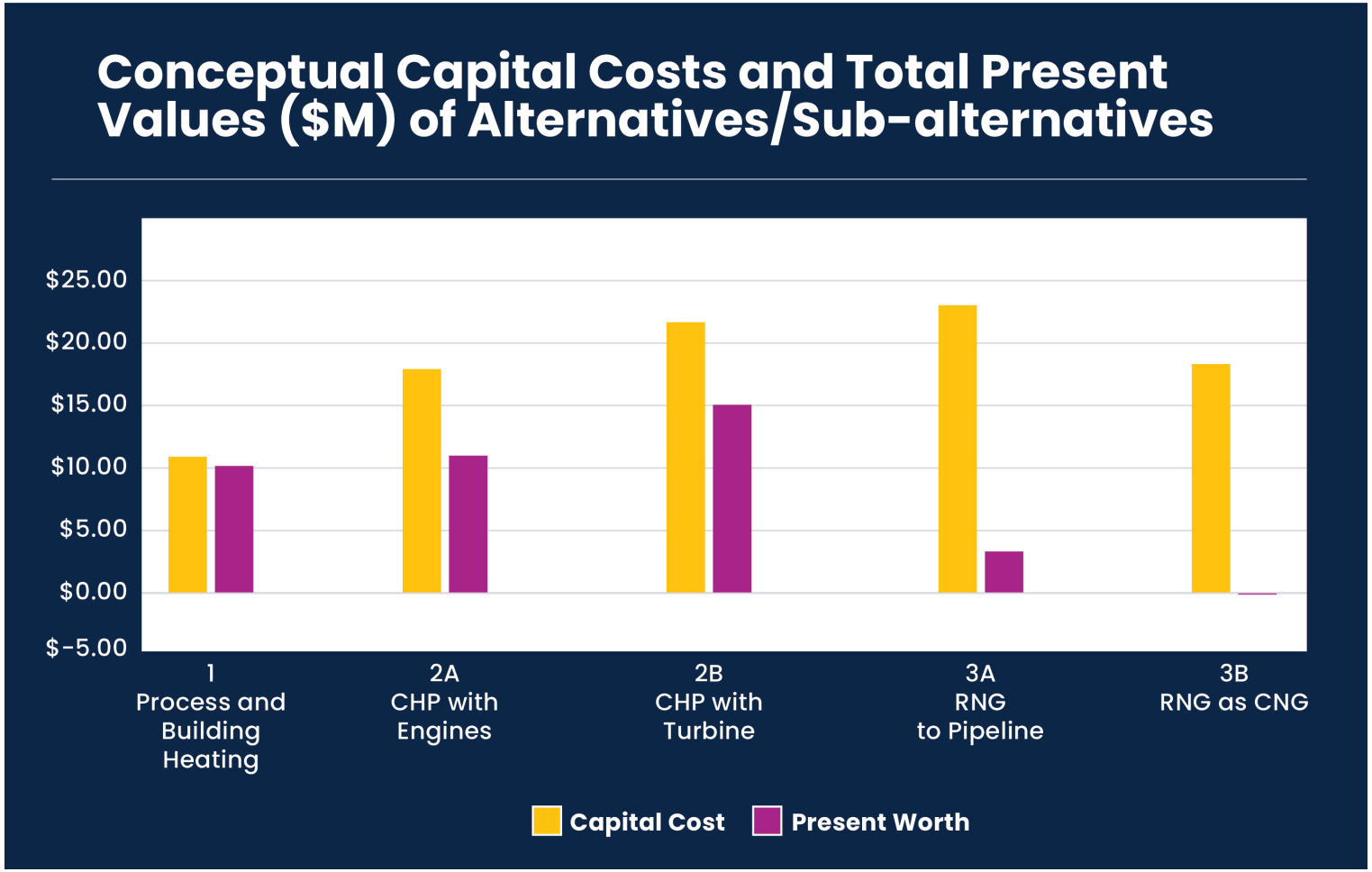
*RIN: Renewable Identification Number, which is a tracking number assigned to biofuels and required by the U.S. EPA Renewable Fuel Standard

Historical RIN Pricing



$1.15/ RIN = $15/MMBtu

Present Value Financial Analysis



Present Value calculations:

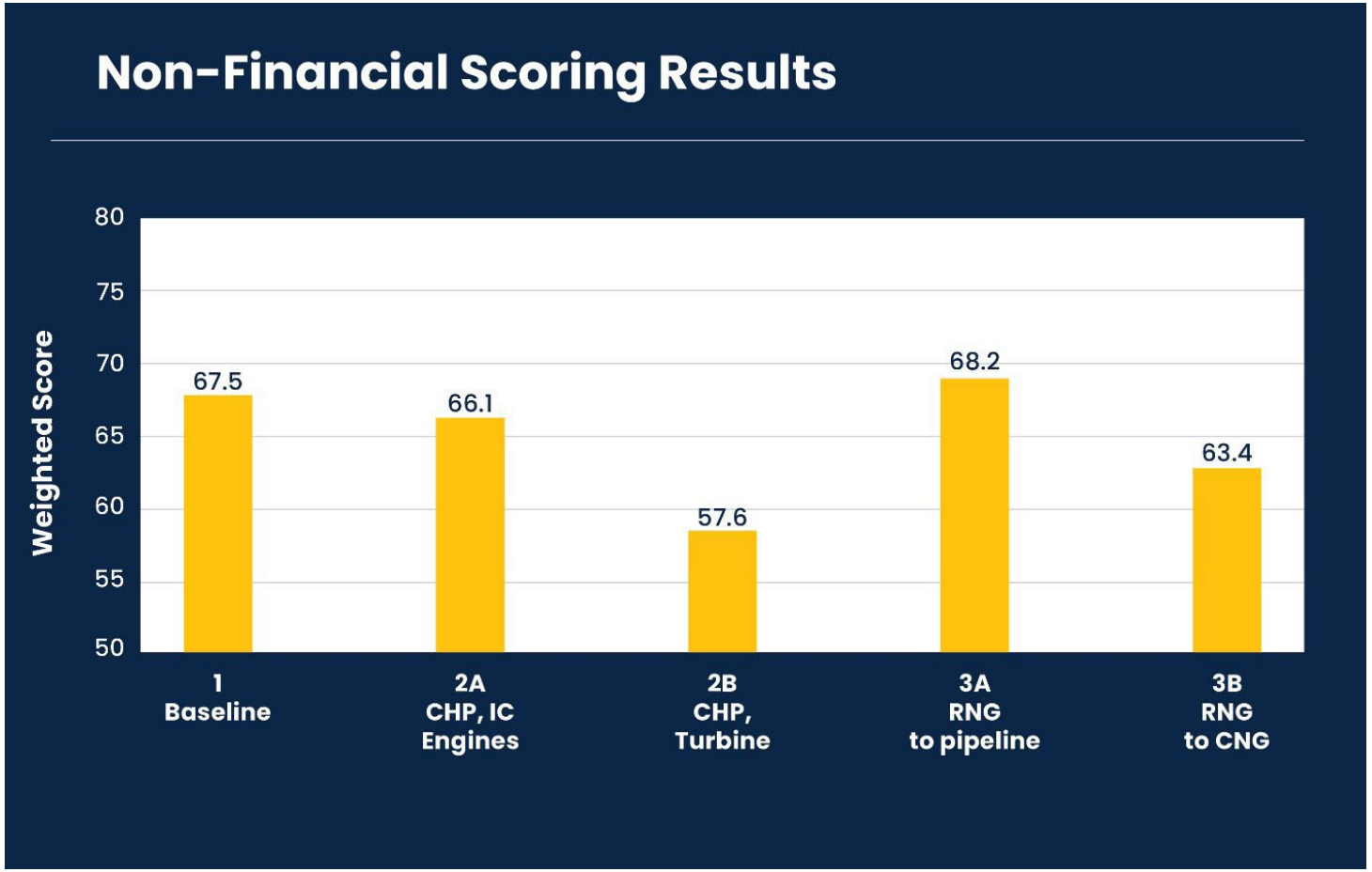
- Capital costs offset over the life cycle of the equipment due to the sale of RINs
- RIN value of $15/MMBtu shown; this value is conservative
- Majority of RIN pricing scenarios are favorable to 3A/3B

Lower present financial value is better

Non-Financial Factors

Criterion	Description	Weight
Localized emissions	Produces emissions at Plant site that may negatively impact air permitting requirements, cause neighborhood issues, or impact air quality in immediate area	**8.0%**
Noise	Generates excess noise that may impact neighbors or result in costly noise reduction measures	**8.4%**
Visual aesthetics	Is acceptable to the neighbors and general Arlington County community from a visual aesthetics standpoint	**4.1%**
Footprint	Sufficient space for operations and maintenance; does not take land space from current needs or potential future add-ons	**6.9%**
Potential for flaring	Provides multiple outlets for use of biogas or redundancy options to minimize the amount of biogas sent to the waste flare	**8.4%**
Operational complexity	Complexity of equipment and facilities in operation	**11.8%**
Maintenance complexity and reliability	Reliability of equipment and facilities, ongoing maintenance requirements, annual downtime for maintenance, and number of components that could fail, resulting in failure of system	**11.8%**
Safety	Risks for operation of system, including leaks, pressures, number of components, etc.	**22.5%**
Resilience	Provides for additional resilience benefits for the Plant and solids handling systems	**8.8%**
Future opportunities	Maintains flexibility for modifying approach should market conditions change	**9.3%**

Non-Financial Scoring Results



RNG alternatives had:

- Lower localized emissions
- Reduced noise
- More outlets for beneficial use of the biogas and ability to reduce flaring
- Lower maintenance complexity and reliability
- Ease of adaptability to other gas utilization alternatives in the future

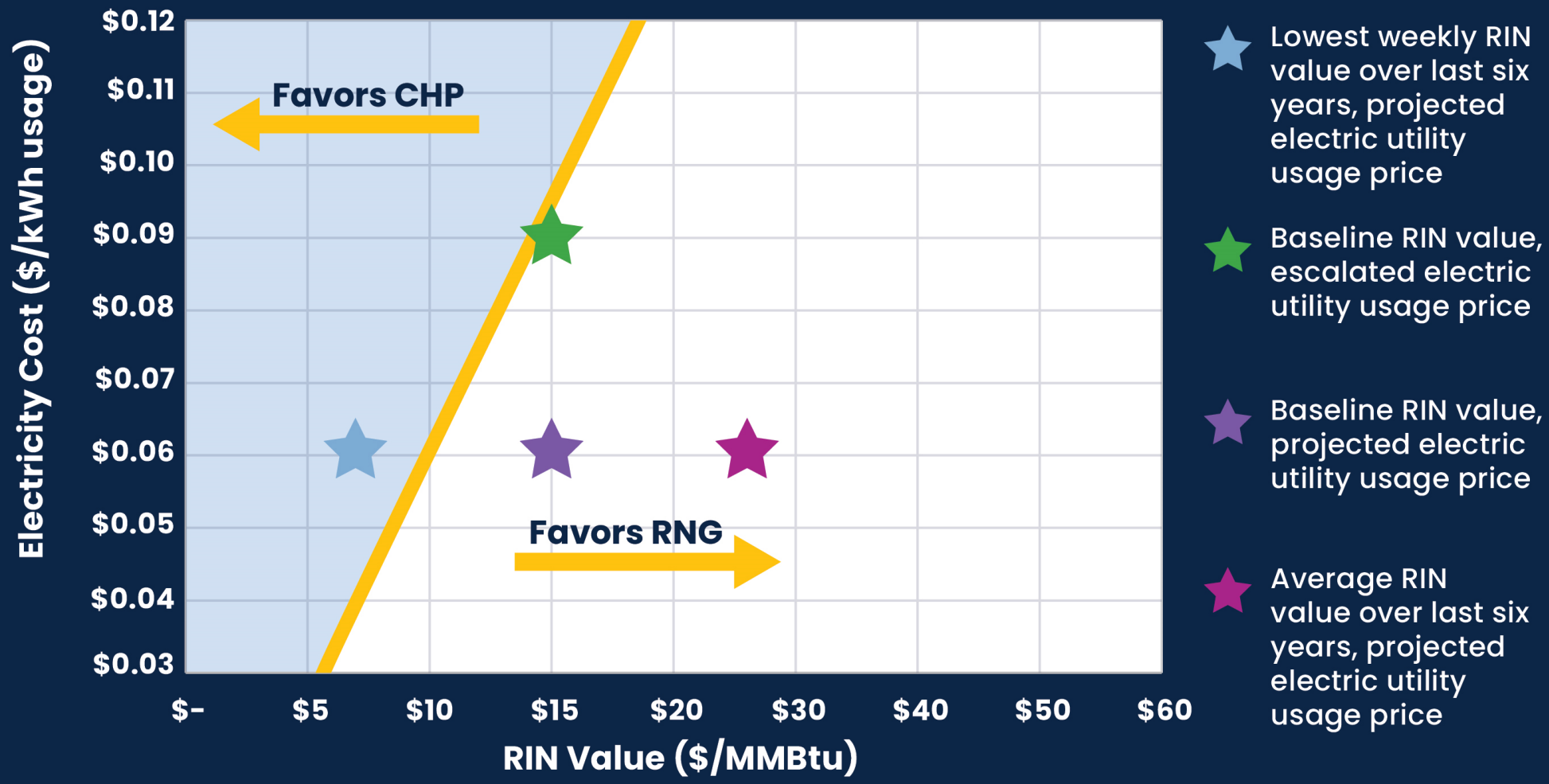
Carbon Footprint for Biogas Utilization

Alternative/ Sub-alternative	Net Electricity Use of Biogas Utilization	Natural Gas Offsets	Natural Gas Purchased	Total Change in Emissions
1: Process and Building Heat	120	-40	0	80
2A: CHP with Engines	-3,390	-40	0	-3,430
2B: CHP with Turbines	-2,370	-40	0	-2,410
3A: RNG to Pipeline	770	-6,240	1,970	-3,500
3B: RNG Used as CNG	770	-6,240	1,970	-3,500

- Arlington County projected to be **100 percent renewable by 2025**, in which case the GHG reduction for net electricity production would be zero.
- The generation of renewable power at the Plant may allow for currently forecasted renewable sources to be used elsewhere.
- Full GHG analysis for the biosolids program is under way and will be shared in future meetings

Sensitivity Analysis

RIN Value vs. Electricity Cost

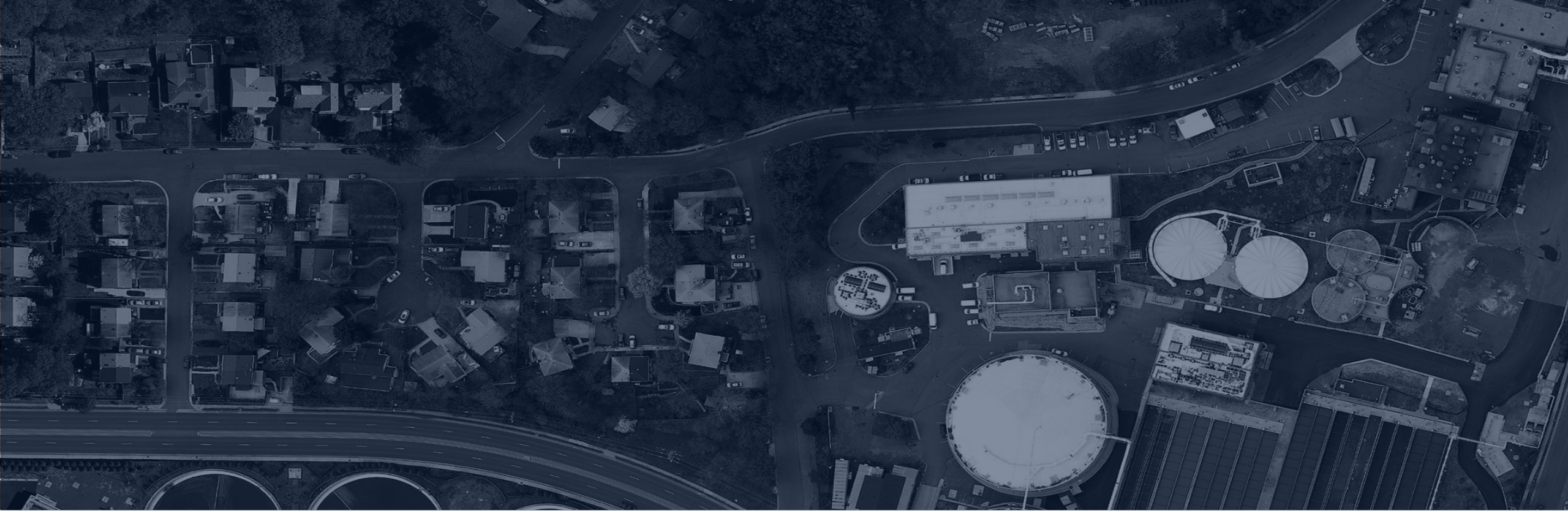


Biogas Recommendations

County staff recommends proceeding with Alternative 3

- Lowest net present value
- Scored the highest in the County's non-financial scoring
- Sensitivity analysis on RIN volatility and changes in electric rates supported Alternative 3
- The County has the ability to retain GHG credits if biogas is used in Arlington County.
- GHG reductions with Alternative 2 may be less as County is projected to be 100% renewable by 2025
- Benefits of CHP onsite are limited

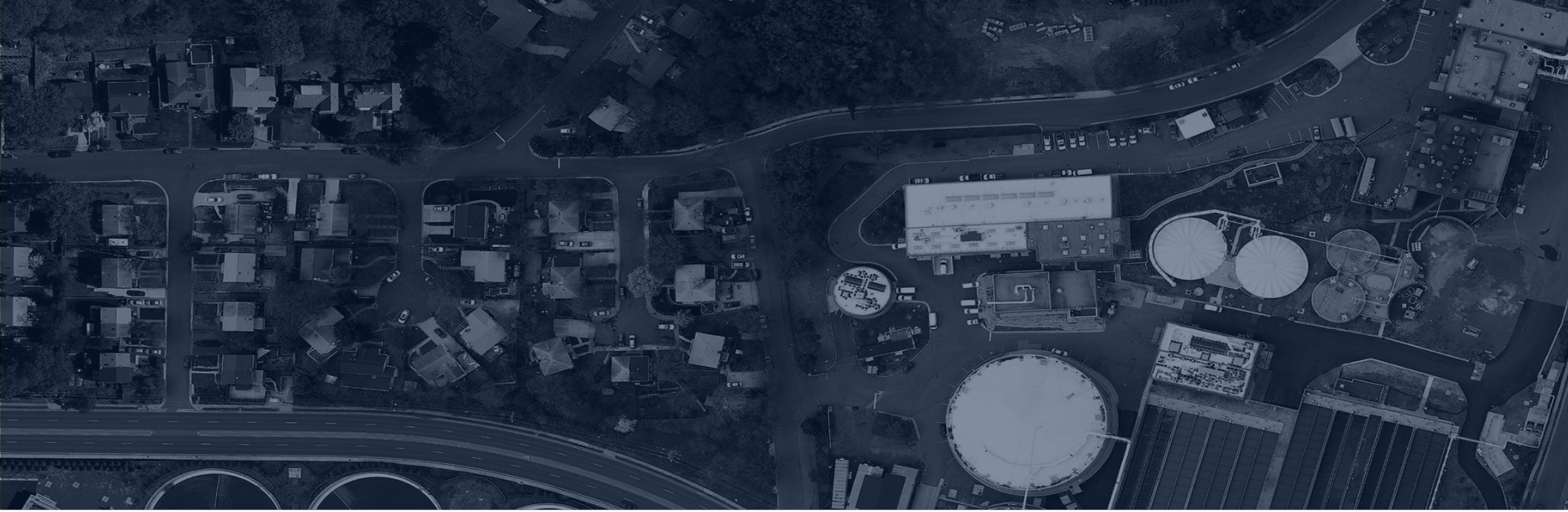
Preference for Alternative 3A (RNG into pipeline) over Alternative 3B (RNG as CNG) due to uncertainty of local RNG transportation use. However, final decision will be made in the future.



Review of Previous Questions

Biogas Utilization: Next Steps

- C2E2 Meeting – 2/28
- Advisory Panel Meeting – late Spring
  - Review any follow-up questions
- Biogas utilization selection – early Summer
- Brief Board as part of regular May update



04

Program Updates

Technical Updates

"What"

- Data Analysis
- Condition Assessment
- Technology Review
- Process Evaluations
- Gas Utilization
- Air Emissions
- Site Development
- Facilities Plan

Completed

- 17 technical workshops
- 13 lunch and learns
- 4 sustainability workshops
- 15 technical memos to document key recommendations

Upcoming

- Program team working towards Draft Facilities Plan in the next month

Delivery Updates

"How"

- Risk Analysis
- Project Packaging
- Delivery Evaluation
- Procurement of Delivery Teams

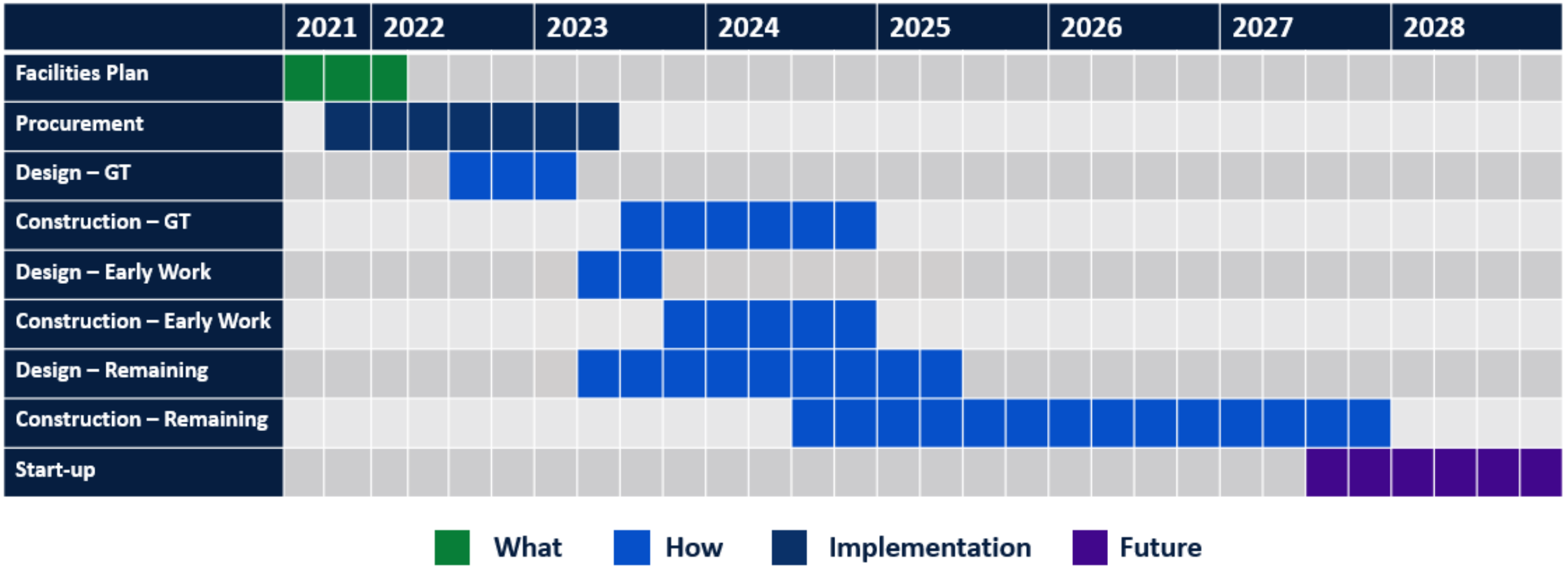
Completed

- 8 delivery workshops and meetings
- 3 risk workshops
- Identified two packages for delivery:
  - Gravity thickeners
  - Remainder of work

Upcoming

- Begin procurement of delivery teams

Schedule Overview



05

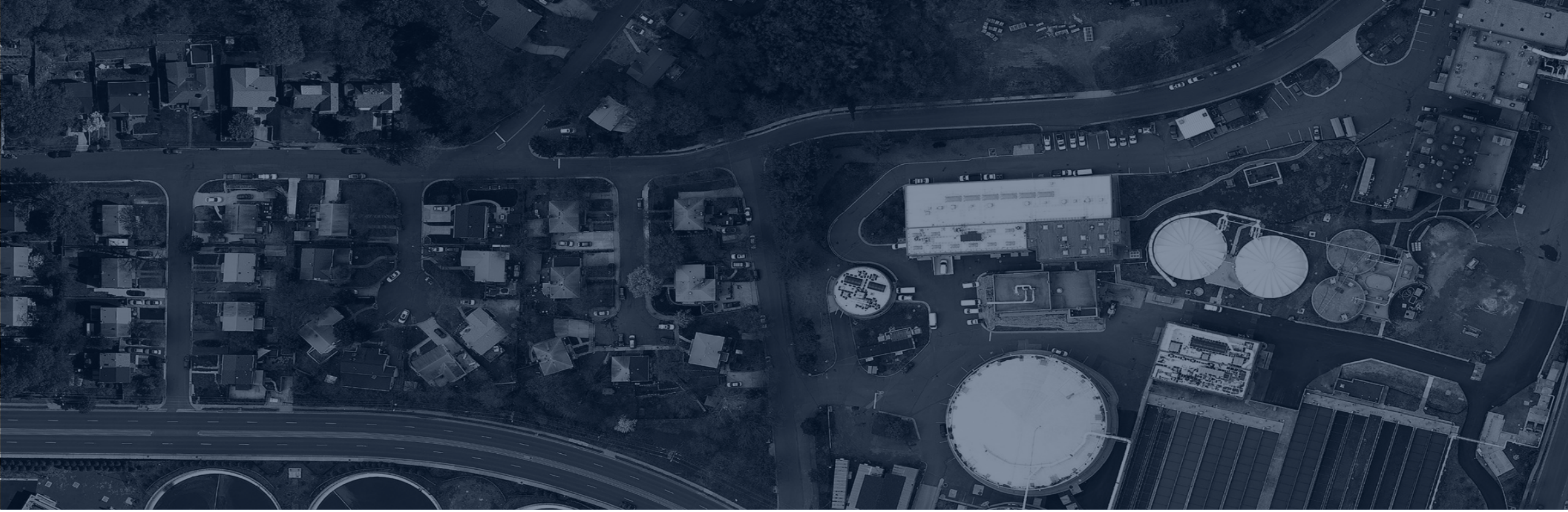
Next Steps

Next Steps

- Next meeting in Spring 2022
- Provide opportunity for Advisory Panel to review and comment on website and branding

Project Contact

Mary Strawn
Chief Engineer
Arlington County Water Pollution Control Bureau
(703) 228-6829
MStrawn@arlingtonva.us

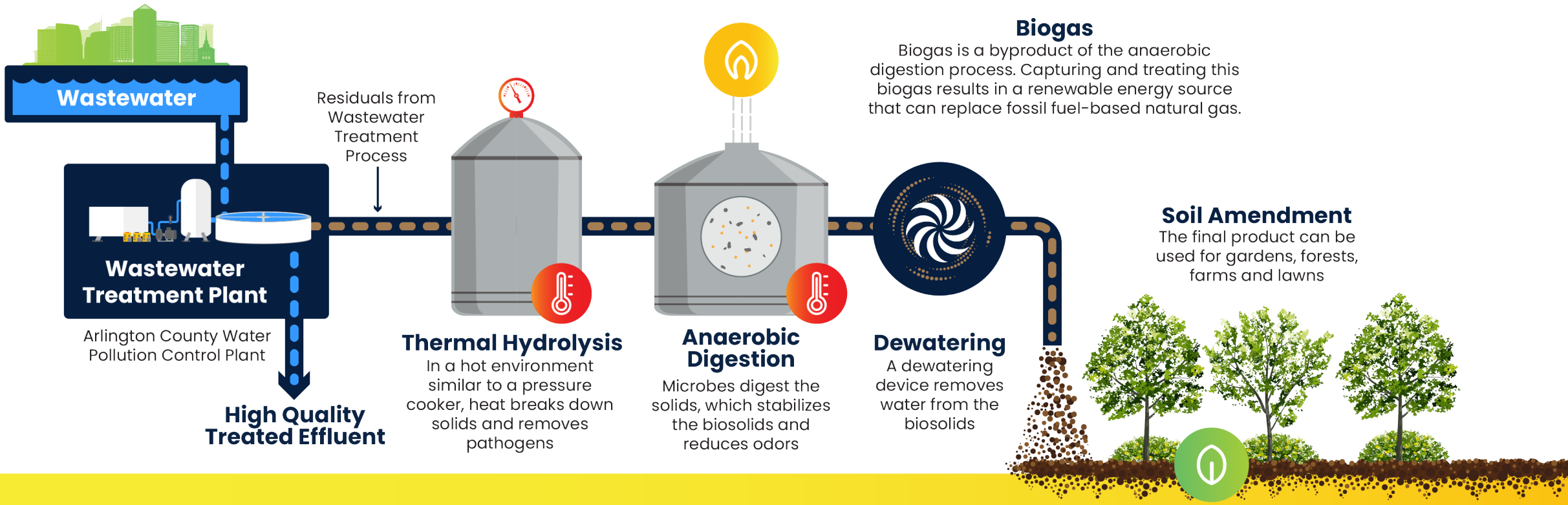


06

Background Materials

Program Overview

Recovering renewable resources from wastewater



What are biosolids?

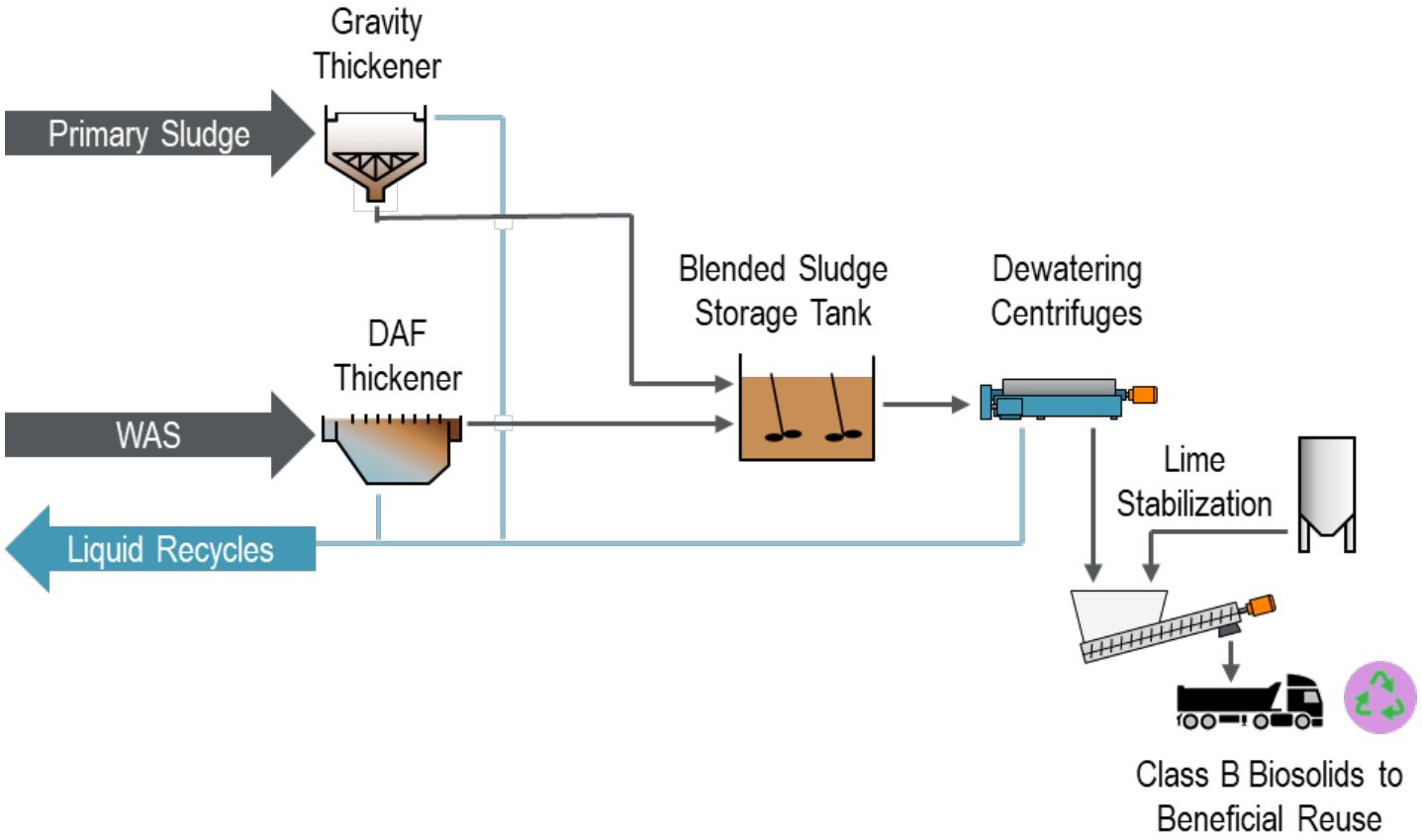
- Product of the wastewater treatment process
- Liquids are separated from the solids
- These solids are physically and chemically treated to produce a semisolid, nutrient-rich product - “biosolids”
- Beneficially used biosolids must meet federal and state requirements for treatment

All wastewater treatment plants must handle and dispose of solids.
Biosolids are a natural and renewable resource that conserves and protects our environment.
Using biosolids reduces waste and recovers natural resources.

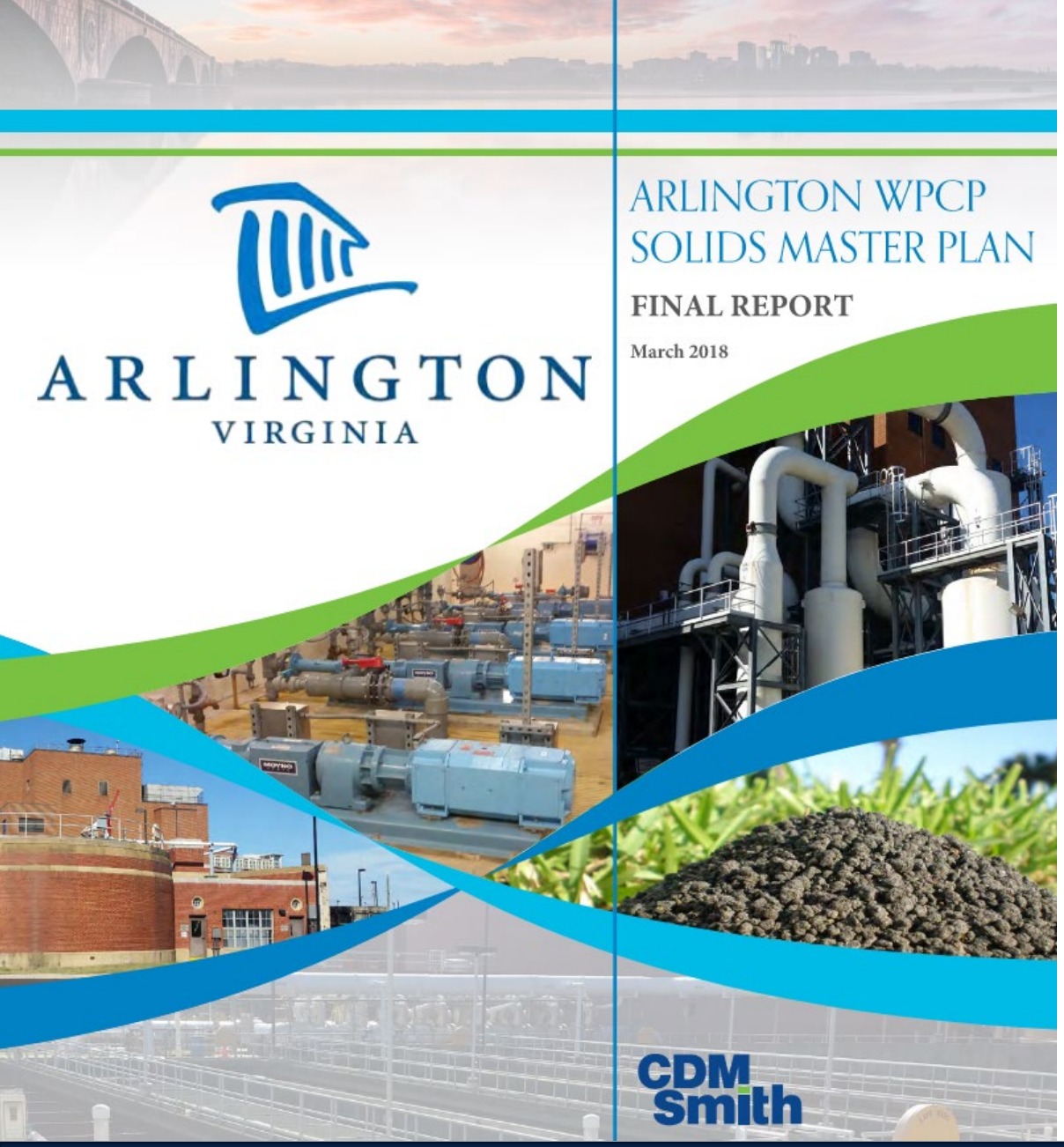
Land Application of Biosolids

- Biosolids are rich in key nutrients and are a proven and effective natural alternative to chemical fertilizers
- Class of biosolids depends on level of pathogen removal
- Class A biosolids
  - Treatment processes proven to eliminate pathogens and viruses
  - No restrictions on use
- Class B biosolids
  - Treatment process to reduce, but not necessarily eliminate, pathogens and viruses
  - Site restrictions on use to allow time for additional pathogen degradation

Existing Solids Handling at the WPCP



- Existing solids process was implemented in the 1990s as incineration was phased out
- Equipment is nearing end of useful life
- New processes that look to more beneficially use resources have been developed since the solids processes were last upgraded



Solids Master Plan

- Development of the Solids Master Plan began in 2015 and was completed in 2018
- Master planning goals:
  - Replacing failing and end of life equipment
  - Mitigating the risk of potential future regulatory changes to the current practice of recycling Class B biosolids through application to agricultural land
  - Providing a solution that reduces the energy and greenhouse gas footprint of the WPCP
  - Achieving additional County-wide sustainability goals
  - Developing a solids management strategy that offers long-term reliability
  - Establishing an implementation plan compatible with County CIP funding

Master Planning Process

- Initially screened over 50 technologies
- From these technologies, developed 12 viable alternatives
- Further screened the 12 alternatives to 4 for detailed evaluation

1. **Lime Stabilization** *(similar to existing)*
   Class B
2. **Anaerobic digestion**
   Class B
3. **Thermal hydrolysis + anaerobic digestion**
   Class A
4. **Anaerobic digestion + heat drying**
   Class A

SELECTED THERMAL HYDROLYSIS + ANAEROBIC DIGESTION FOR IMPLEMENTATION

LIME STABILIZATION

CLASS B
PRODUCT

BIOSOLIDS TRUCKS
4/DAY

LIME
5 tons/day

POLYMER
0.2 tons/day

NATURAL GAS USE
0.1 MMBtu/hr

POWER USE
2.0 MMBtu/hr

BIOGAS GENERATED
0 MMBtu/hr

NET ENERGY USAGE
2.1 MMBtu/hr

– +

THERMAL HYDROLYSIS + ANAEROBIC DIGESTION

CLASS A
PRODUCT

BIOSOLIDS TRUCKS
2/DAY

LIME
0 tons/day

POLYMER
0.3 tons/day

NATURAL GAS USE
4.2 MMBtu/hr

POWER USE
4.5 MMBtu/hr

BIOGAS GENERATED
13.4 MMBtu/hr

NET ENERGY USAGE
-4.7 MMBtu/hr

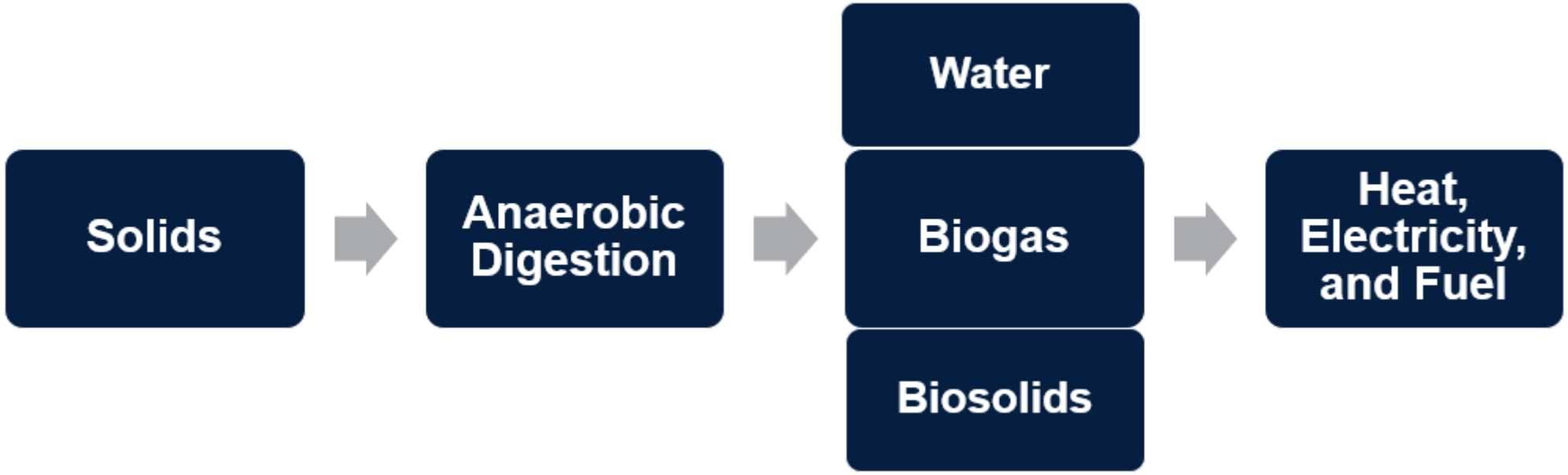
– +

What is Thermal Hydrolysis?

- A high-temperature process– similar to a pressure-cooker– that sterilizes biosolids.
- The high-temperature process removes pathogens, resulting in a Class A Exceptional Quality biosolids product

What is Anaerobic Digestion?

- Process to break down biodegradable material to produce biogas, water and stabilized biosolids



What is Biogas Utilization?

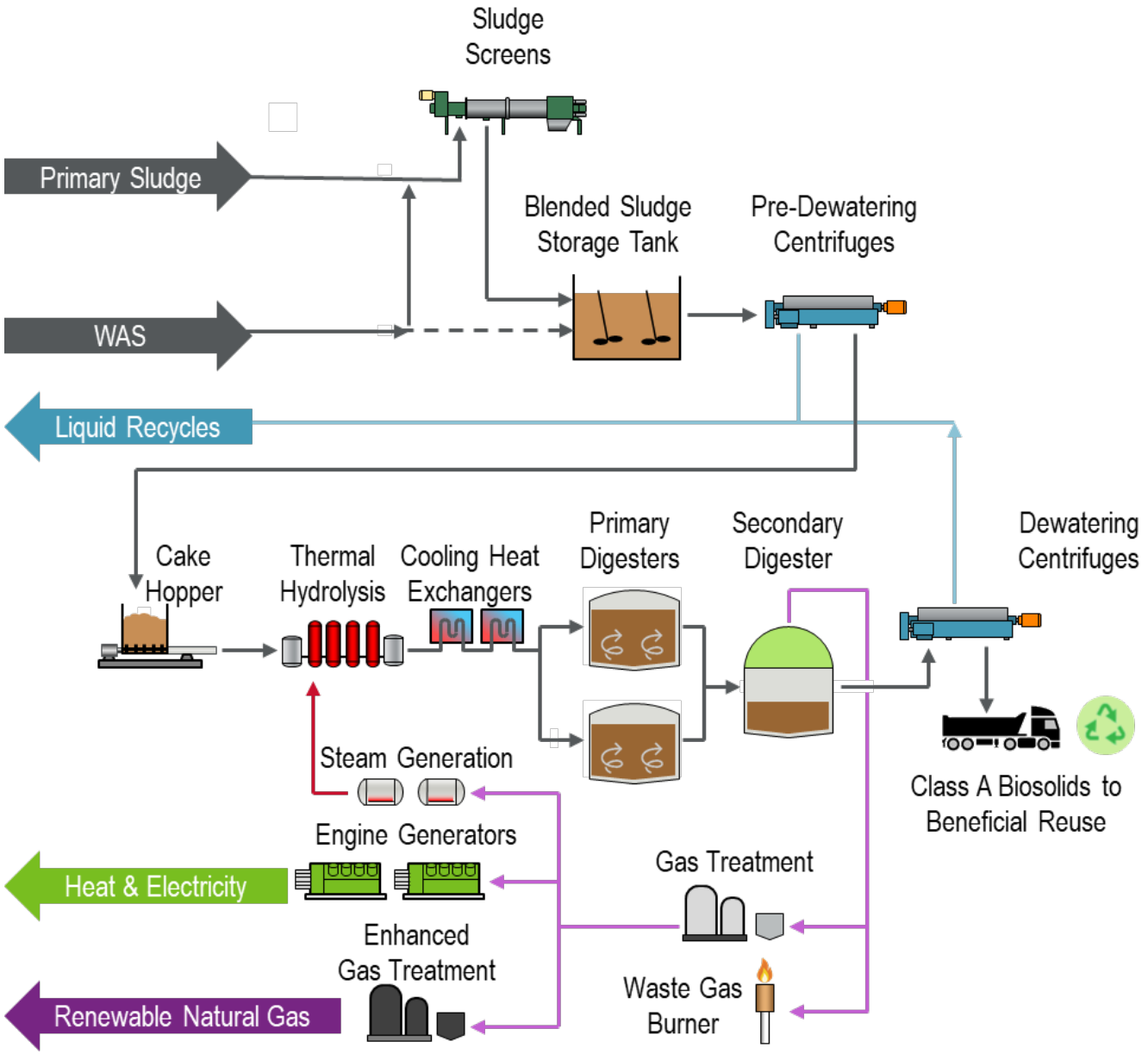
- Biogas generated in the digesters is cleaned through a treatment process.
- The cleaned biogas can be used to generate electricity, fuel natural gas buses or injected into the Washington Gas Pipeline
- Biogas contains biogenic carbon – combustion of biogas does not result in new CO_2 emissions

What are Class A Exceptional Quality Biosolids?

- Highly treated biosolids that do not have detectable levels of pathogens. Class A Exceptional Quality (EQ) biosolids can be used as fertilizer on areas such as lawns, parks, gardens, etc.

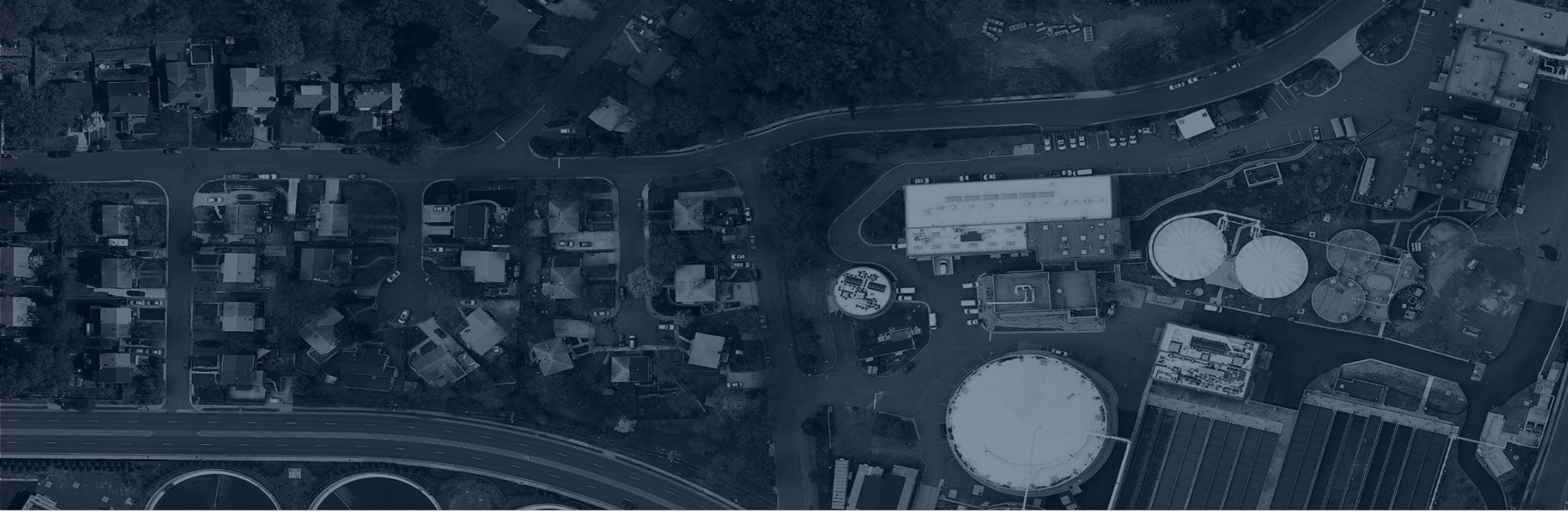
Benefits of Upgrades

New Solids Handling Process



Program Funding

- All projects in the WPCB are funded through the Utilities Fund
- The Utilities Fund is an Enterprise Fund
  - Enterprise funds are self-sufficient
  - Revenues generated within the fund must sustain all activities with appropriate reserves
  - Water-sewer rate set at level which will fully fund activities
- Projects in the WPCB can impact water-sewer rates but not the General Fund



07

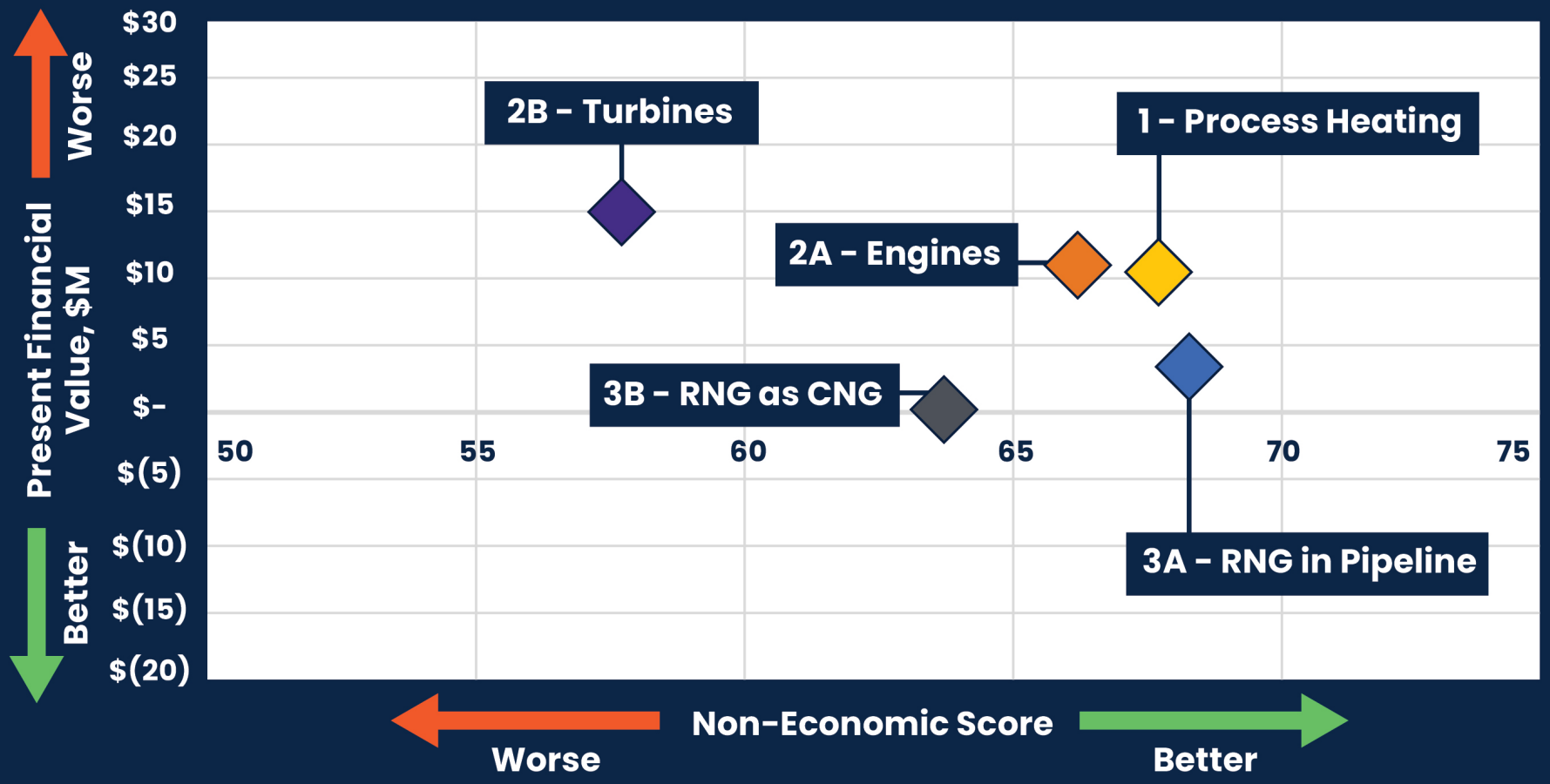
Details of Financial and Non-Economic Scenario Results

Non-Economic Scoring

Criterion	1 – Process	2A – Engines	2B – Turbine	3A – RNG	3B – CNG
Localized emissions	2	3	3	4	4
Noise	5	3	3	4	4
Visual aesthetics	4	4	4	4	4
Footprint	5	4	4	4	4
Potential for flaring	1	3	2	4	3
Operational complexity	4	3	2	2	3
Maintenance complexity and reliability	4	2	2	4	4
Safety	4	4	3	2	2
Resilience	2	4	4	4	2
Future opportunities	2	3	3	5	4

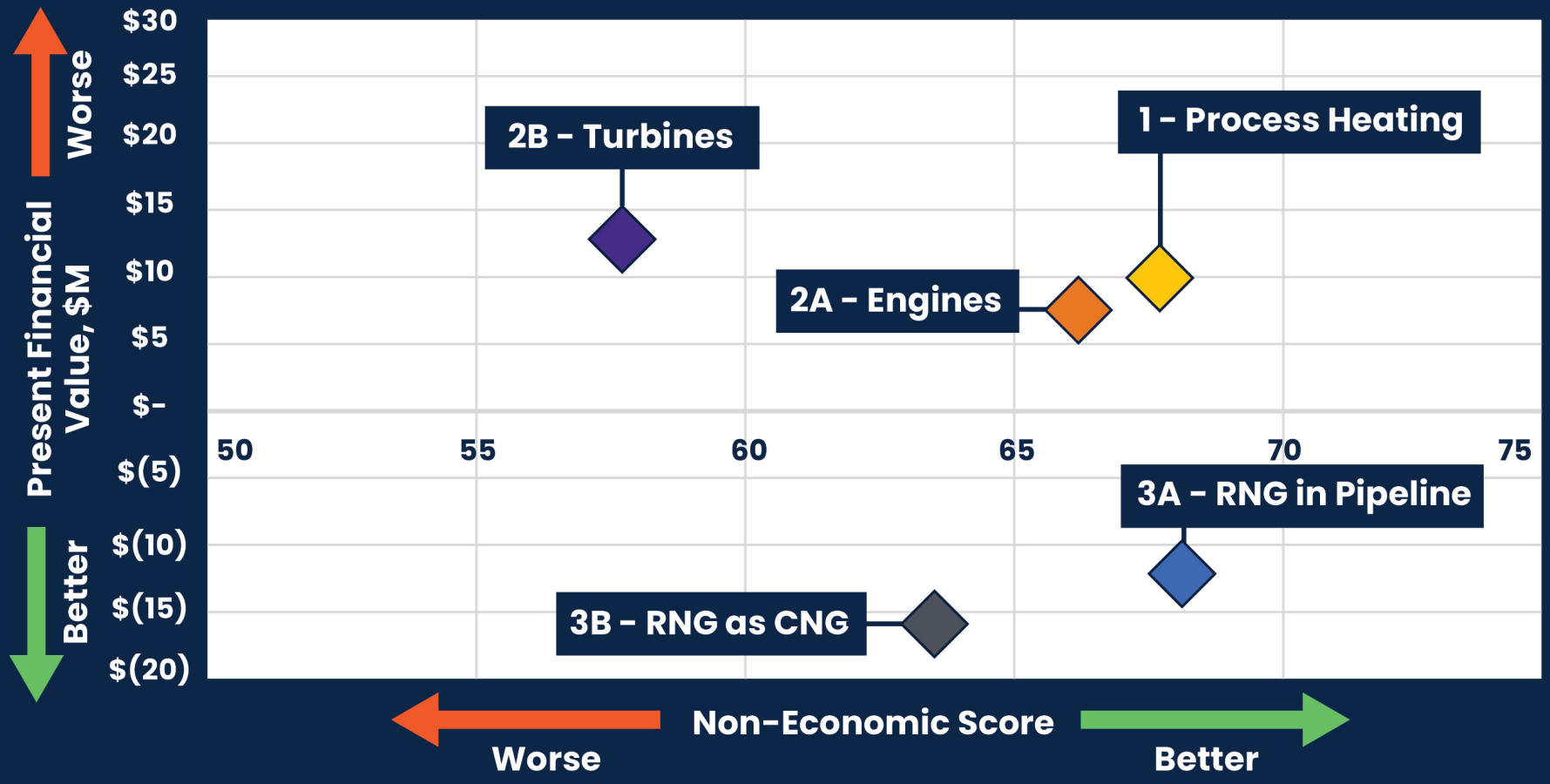
Base Scenario

($0.06/kWh, No social cost of GHG, RIN = $15/MMBtu)



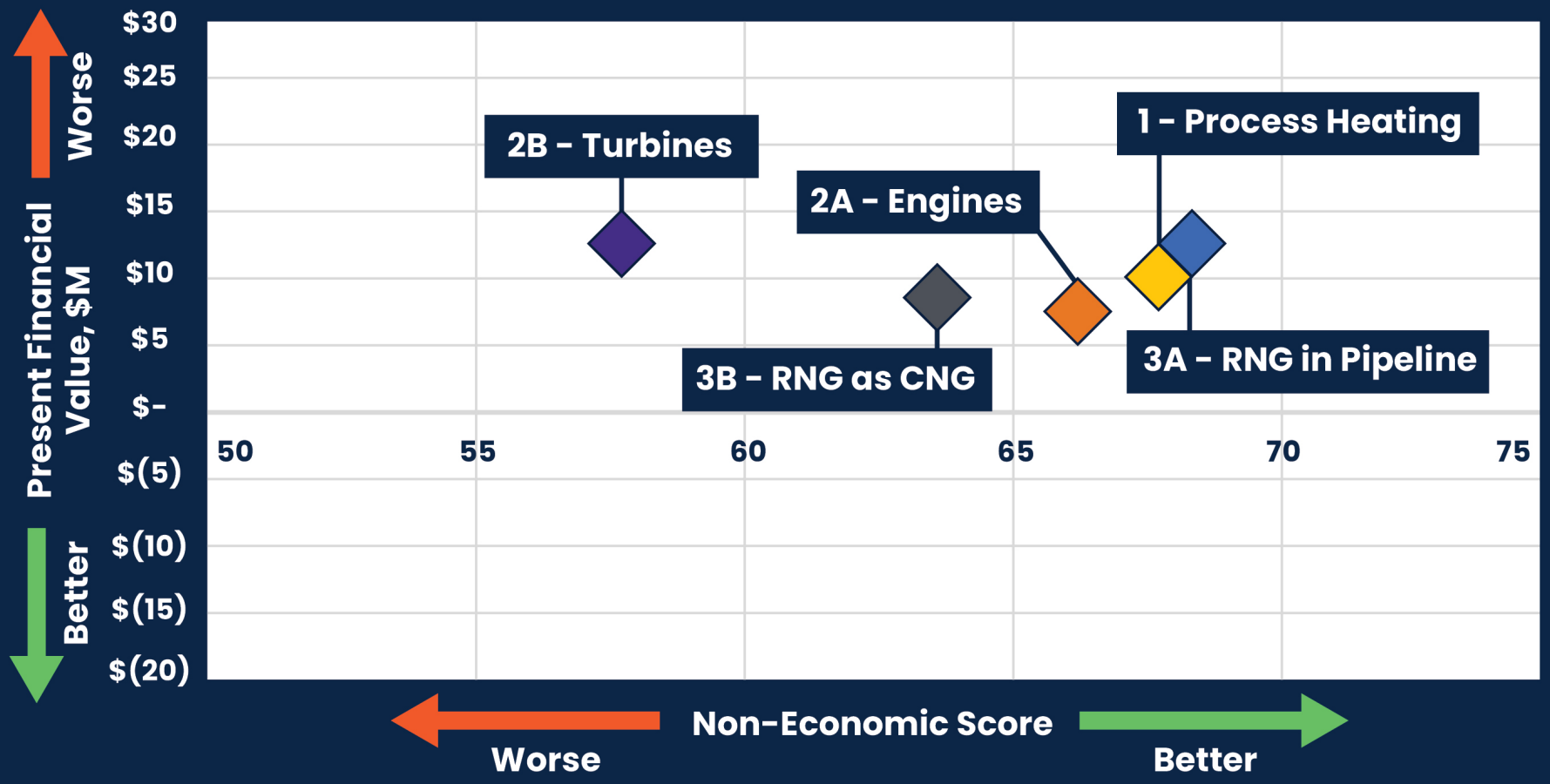
Average RIN Scenario

($0.06/kWh, Includes social cost of GHG, RIN = $23.35/MMBtu)



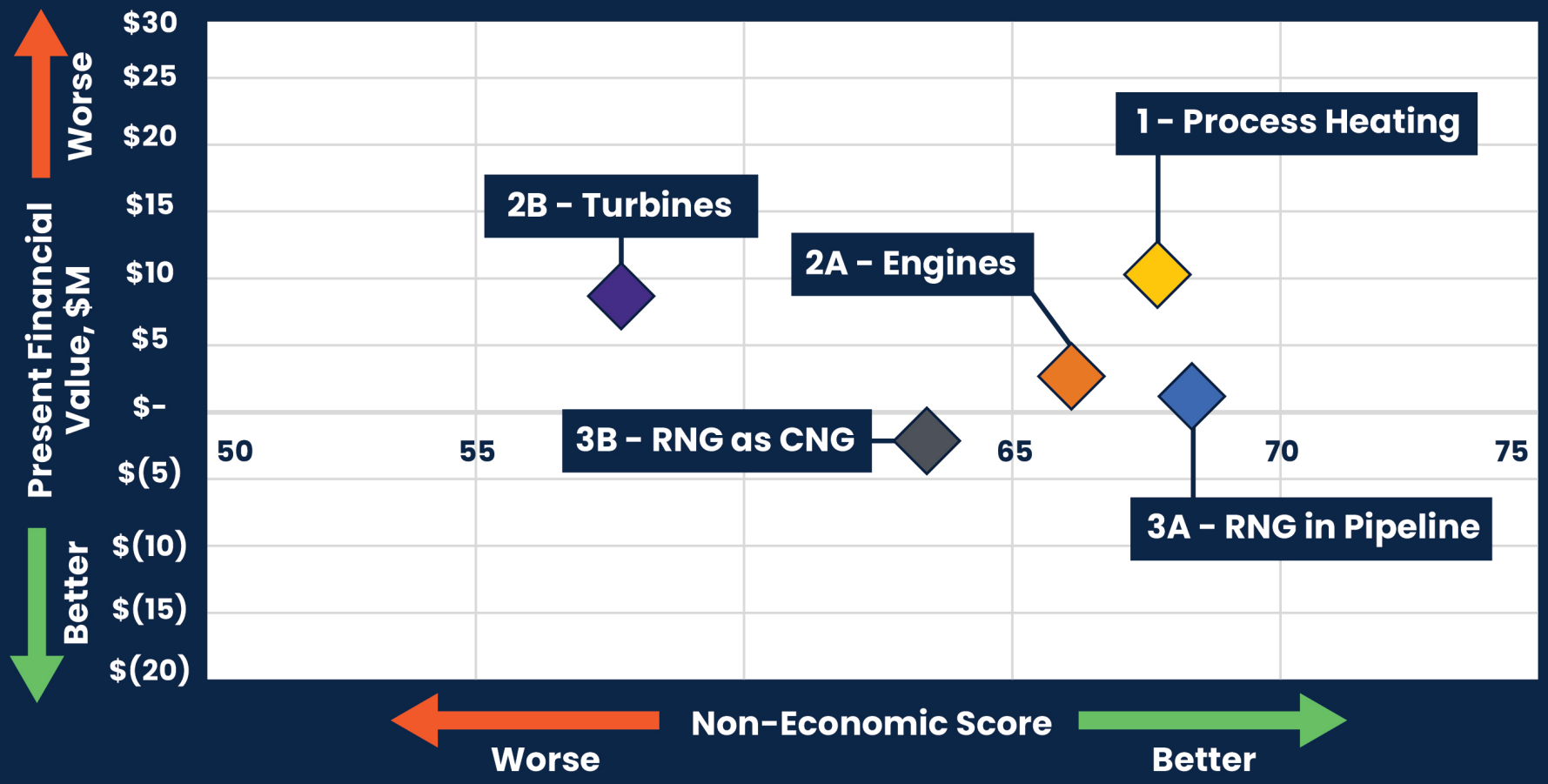
Lowest RIN Scenario

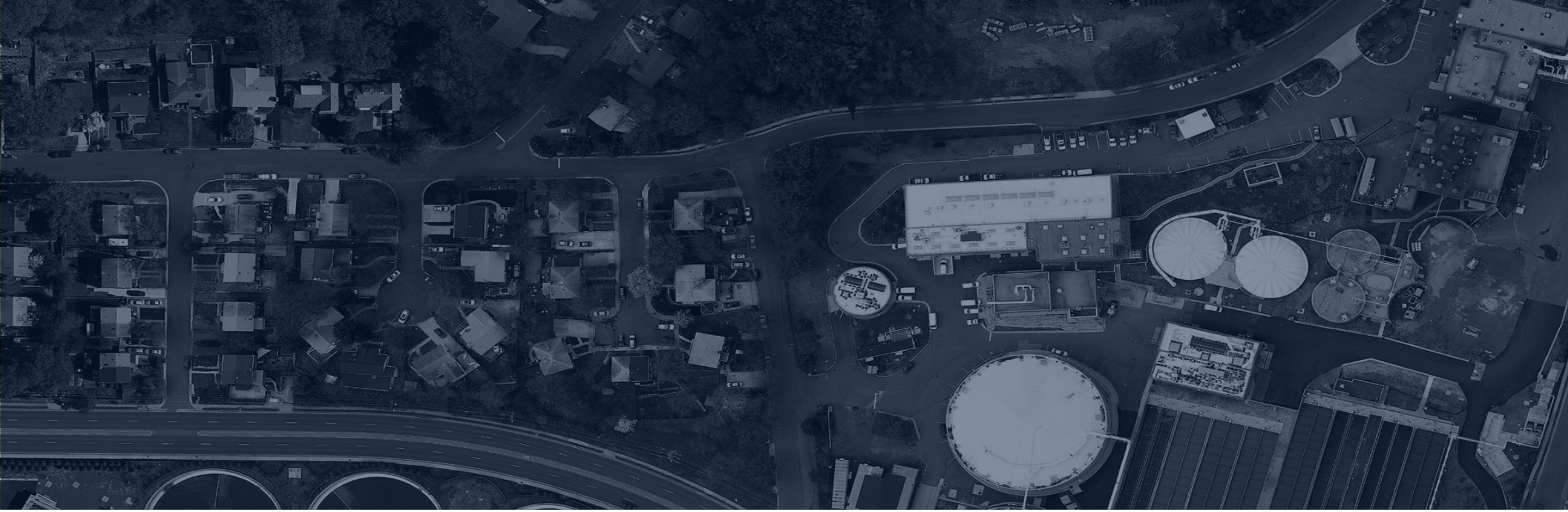
($0.06/kWh, Includes social cost of GHG, RIN = $6.38/MMBtu)



High Electrical Cost Scenario

($0.09/kWh, Includes social cost of GHG, RIN = $15/MMBtu)





08

Questions from Advisory Panel and County Commissions

Q **It appears the proposal is both to sell the "GHG reduction benefits" and "count" the GHG benefits in the financial calculations using the current value of social cost of carbon used by the federal government. This appears to be a form of double-counting.**

A

- See previous discussion on RNG pathways and reference p. 7-9 of the Biogas Utilization Executive Summary.
- The GHG reduction benefit would remain in Arlington County if the gas is used within the County.
- Social cost of carbon is not a true financial value, rather a monetization of the social impacts of the GHG emissions based on economic loss over time.
- Social cost of carbon impacted Alternatives 2A and 3A similarly (similar base GHG reductions). Excluding this would not have impacted the recommendations.

Q **Is there a sense in which the availability of the County's RNG might compete with, and tempt Arlington and WMATA to delay, the needed transition to electric buses? If so, is this an optimal use of the gas?**

A

- The recommendation of RNG is not dependent on use of the RNG in ART or WMATA bus fleets.
- The Transit Bureau is currently completing a study for the bus fleets, including electrification and resiliency alternatives.

Q **Is there a sense of what kind of terms and prices WGL might offer for the RNG and how that compares to transportation use?**

A

- Prices have not yet been discussed.
- The expectation is that the value for the physical gas (without the environmental attributes) would be comparable to the commodity value of natural gas independent of the buyer.

Q **If the “transportation market” loses its viability due to electrification or regulatory changes, will WGL likely be our only practical buyer? If so, how would we be guaranteed a competitive price?**

A No, WGL would not be the only buyer available to the County. There are national and international voluntary markets that operate on a book and claim basis* that would still offer a competitive value for the RNG. This could be other customers within or outside of Arlington County.

*sustainability claim separated from the physical pathway

Q **How would it affect the calculations if Arlington decided to sell the gas without claiming it as "RNG" – i.e. to "retire the environmental credits so that we can claim them ourselves rather than selling them? Would WGL be a willing buyer if we did not sell the gas as "RNG"?**

A

- See previous discussion about RNG pathways and RIN values and reference p. 7-9 of the Biogas Utilization Executive Summary.
- The GHG reduction benefit would remain in Arlington County if the gas is used within the County.
- WGL would be a willing buyer of the physical gas regardless of credits or environmental attributes. However, if no dollar value was received for RINs, the financial benefit would be less, and the financial analysis would favor CHP over RNG. The non-monetary analysis still favors RNG.

Q **What would the approximate cost per kWh of the electricity generated in Option 2?**

A $0.06/kWh which equates for both current County usage and demand charges.

Q **Have there been significant discussions of possible emergency uses for the electricity generating capacity under Option 2? Do resilience concerns justify a higher value for the electricity?**

A There have been such discussions. The WPCP is currently fully protected by two independent Dominion feeds and three generators onsite. New generation would provide some resiliency as it would be on the north side of the campus, but generation would only be approximately 35% of total WPCP power consumption.

Q **What are the “Base Assumptions” made in generating the estimates of capital costs and O&M costs?**

A The analysis was completed over a 25-year time frame with conservative metrics. Additional details on assumptions are provided in the Biogas Utilization Report.

Q **Can we have more information about how the “non-economic criteria” were calculated?**

A Additional details were provided with the Executive Summary and in the Biogas Utilization Report.

Q **Can the anaerobic process be designed for both option 2 and 3 to rely solely on the produced biogas onsite and eliminate the need to purchase natural gas?**

A Although we will not be able to fully disconnect the facility from natural gas, the system will be designed to allow for biogas to be used onsite to the greatest extent desired by the County (i.e., to fire boilers in lieu of natural gas). Please note, with the RNG options, the economics favor selling all of the biogas as RNG and utilizing purchased natural gas onsite. The net natural gas usage would be the same (RNG produced minus either biogas or natural gas used onsite).

Q **Can staff provide more details on the assessment of the localized emissions? How does the expected emission compare with state and federal emissions and air quality requirements and with the present process? What will be the impact on air quality for the surrounding residents?**

A The emissions models are being revised to include all air emitting units onsite (initial model runs were done just for the new facilities). Preliminary results indicate that plant emissions will not result in the local neighborhood air quality exceeding National Ambient Air Quality Standards (NAAQS) for the recommended RNG alternative. Should a CHP alternative be selected, additional air pollution mitigation measures may be required to ensure that the NAAQS are not exceeded.

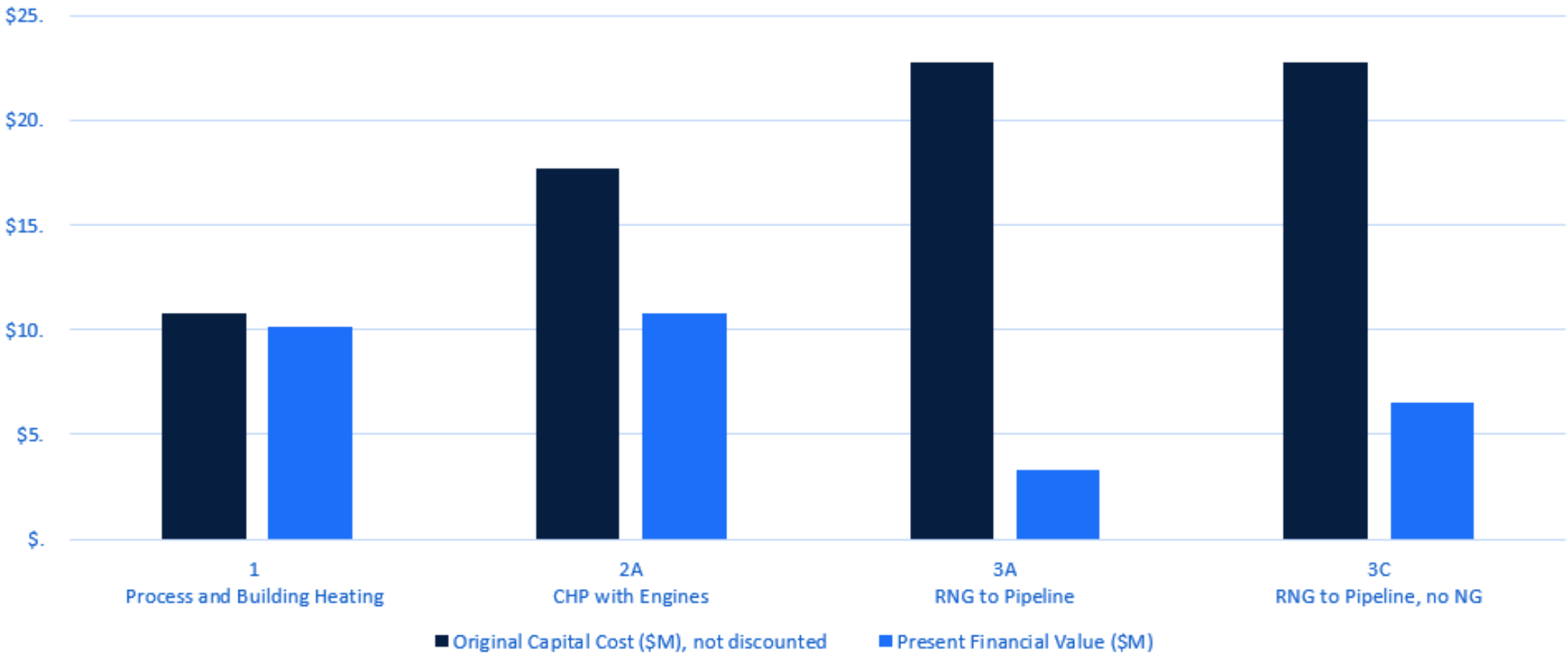
Q **For full comparison of the emission impact, what are the emissions from use of RNG when used for ART buses and what impact will they have on air quality within the County as well as resulting health impacts?**

A These factors were not considered in the WPCP analysis. It is assumed that the RNG will displace fossil-fuel-based natural gas. There is no marked difference between the emissions from combusting RNG or fossil fuel-based natural gas, so the emission impacts are expected to be neutral to current practices.

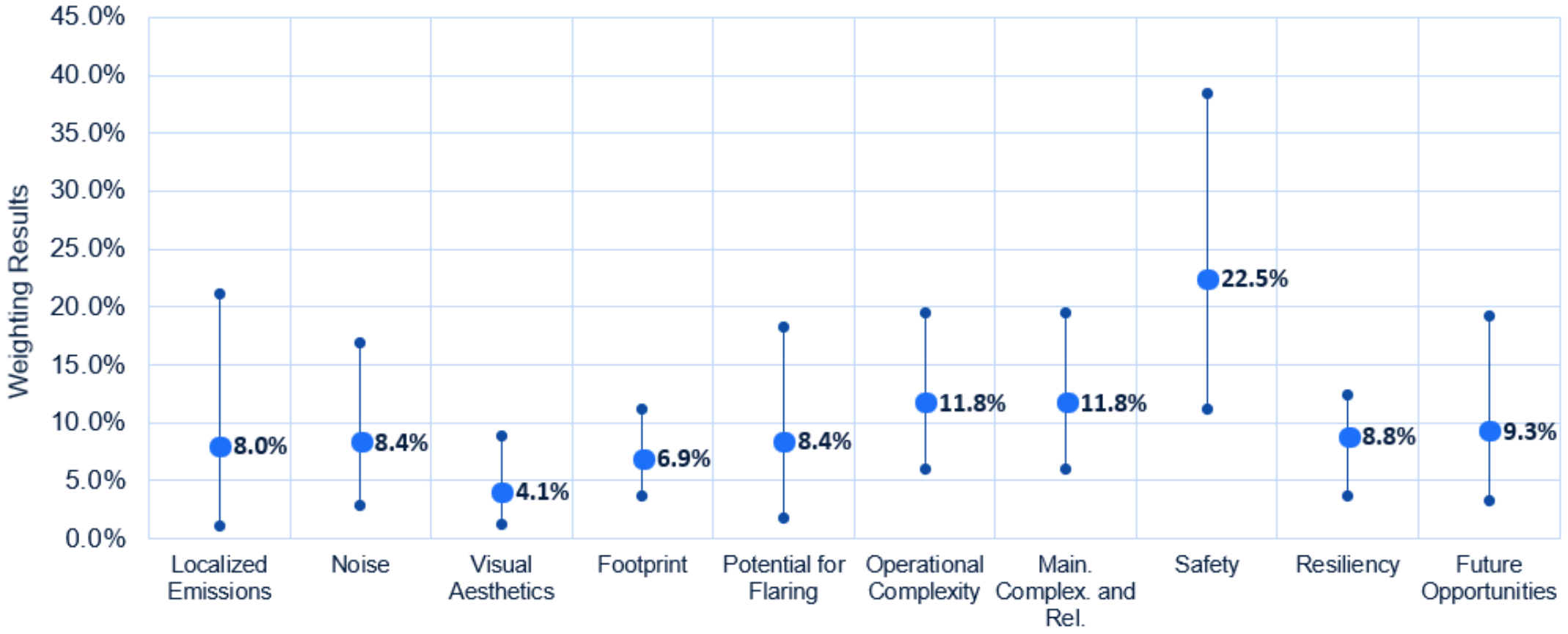
Alternative 3 with Biogas in Boiler

Alternative	1 Process and Building Heating	2A CHP with Engines	3A RNG into the NG Pipeline	3C RNG into the Pipeline, no NG
Conceptual construction cost, $M	$10.75	$17.68	$22.72	$22.72
	Present Financial Value ($M)			
Capital cost	$9.3	$15.3	$19.6	$19.6
Equipment O&M	$0.8	$5.9	$4.9	$3.6
NG cost	$0.0	$0.0	$4.2	$0.0
Electrical offset	$0.0	($10.4)	$0.0	$0.0
RNG revenue	$0.0	$0.0	($25.5)	($16.8)
Total present value	$10.10	$10.81	$3.31	$6.50

Alternative 3 with Biogas in Boiler



County Weighting of Non-Economic Criteria



Scenarios and Probability Models

- Modeled for different electricity and value of environmental attributes (Renewable Identification Numbers)
- Performed statistical analysis for sensitivity analysis
  - Alternative 3 had lower financial and environmental cost for 97% of scenarios
  - In 80% of scenarios, there was a negative cost (revenue generation) to Arlington County