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Resource Recovery: Biosolids to Biogas at the Piscataway WRRF

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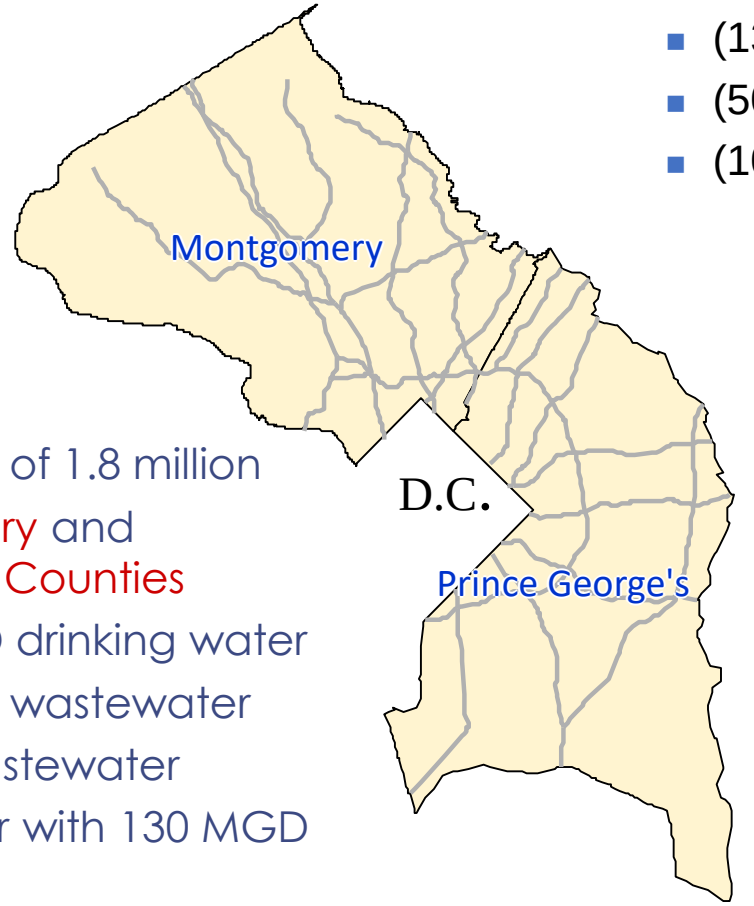
Agenda

- Bio-Energy Project Objectives and Drivers
- Bio-Energy Plant Overview
- Piscataway Renewable Gas Production
- Piscataway and Montgomery County Gas Reqmts
- Projected Bio-Energy Initial Operations
- Renewable Fuel Standard Program and RIN Market
- Projected Cost and Revenue Comparison
- Questions

WSSC Water Service Area (Maryland)

- (2) Water Filtration Plants
- (5) Water Resource Recovery Plants
- (13) Water Pumping Stations
- (50) Wastewater Pumping Stations
- (10) Field Offices/Lab/HQ



- Serves population of 1.8 million
- Serves Montgomery and Prince George's Counties
- Provides 170 MGD drinking water
- Collects 200 MGD wastewater
- Treats 70 MGD wastewater
- Supplies DC Water with 130 MGD wastewater

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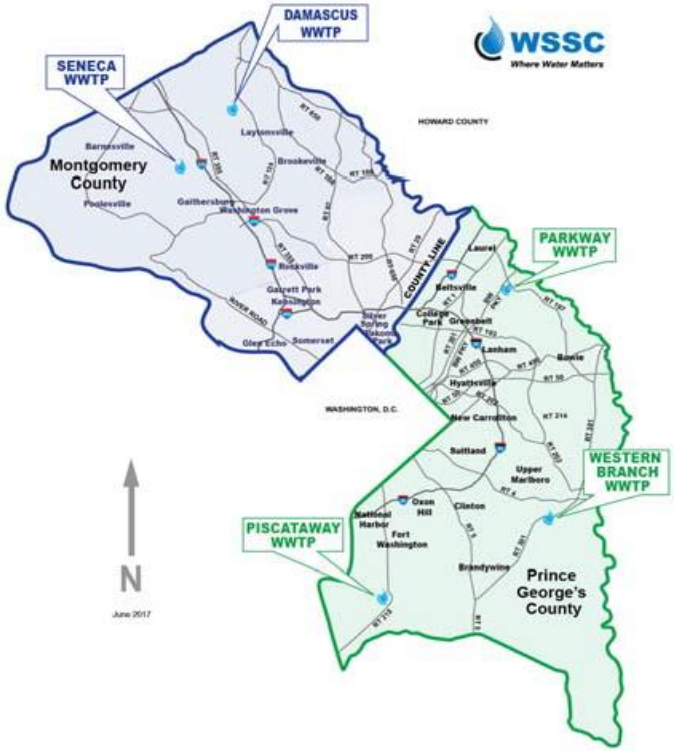
Existing Biosolids Management Practices

- Individual handling at 5 WSSC WRRF (WWTP)
- Class B land application
  - Meet EPA requirements
  - Land sites in VA
- Western Branch
  - Landfills in Virginia

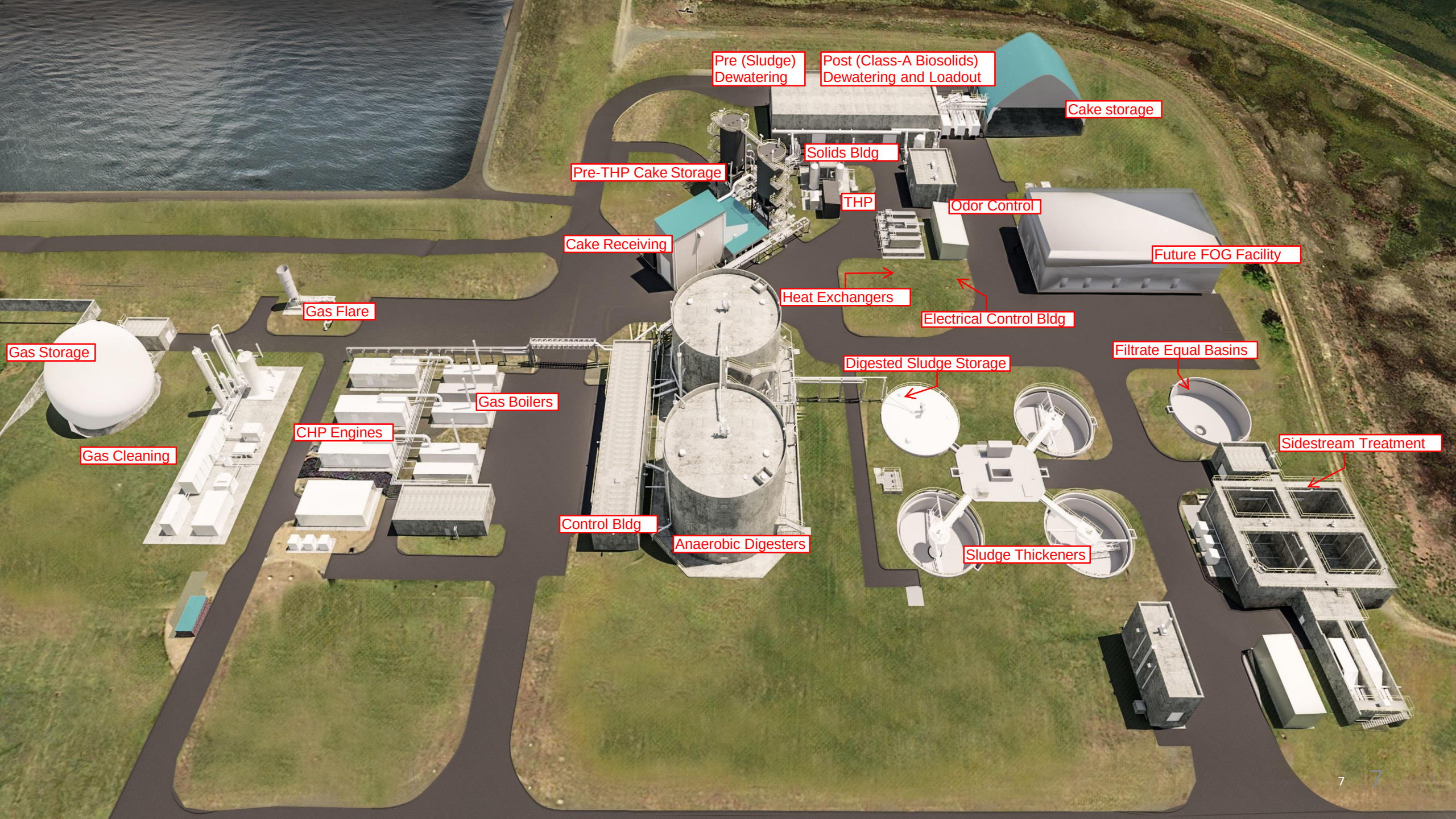


Drivers for Change

- Increased regulations will lead to higher costs for Class B disposal
- Fewer restrictions on more highly treated Class A biosolids (better product)
- Reduced quantity of biosolids to be land applied
- Recovered energy (resource) during the process

Bio-Energy Project- Objectives

- Save rate payer dollars through reduced operating costs
- Minimize the quantity of biosolids material
- Develop Class A (pathogen-free) biosolids material
- Maximize return on investment and energy recovery from biosolids, fats, oils and grease
- Reduce greenhouse gas emissions
- Improve power reliability
- Reduce nutrient loads to Chesapeake Bay

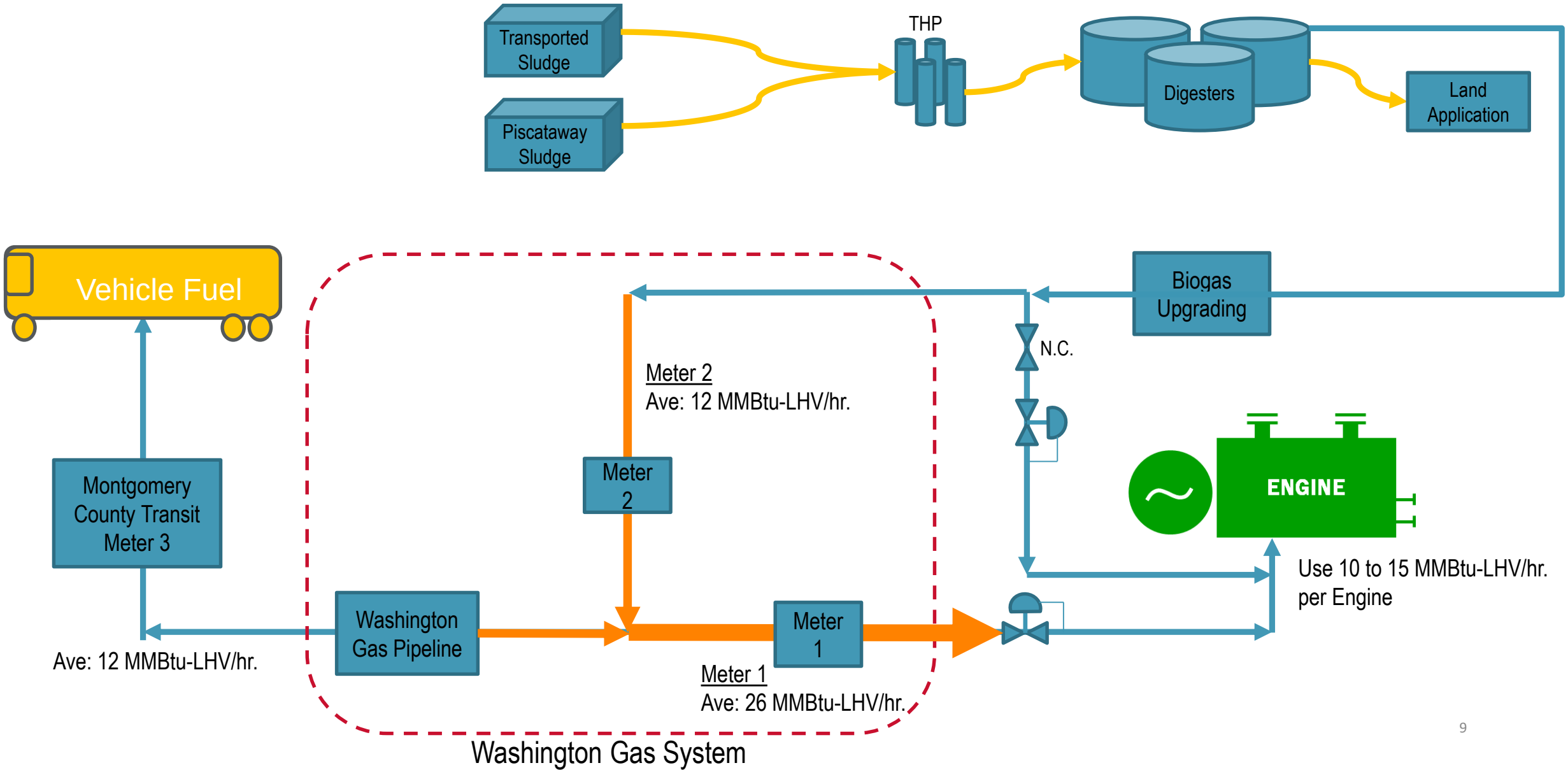

Pre (Sludge) Dewatering
Post (Class-A Biosolids) Dewatering and Loadout
Cake storage
Solids Bldg
Pre-THP Cake Storage
THP
Odor Control
Cake Receiving
Future FOG Facility
Heat Exchangers
Gas Flare
Electrical Control Bldg
Gas Storage
Filtrate Equal Basins
Digested Sludge Storage
Gas Boilers
CHP Engines
Sidestream Treatment
Gas Cleaning
Control Bldg
Anaerobic Digesters
Sludge Thickeners

Renewable Biogas - Piscataway

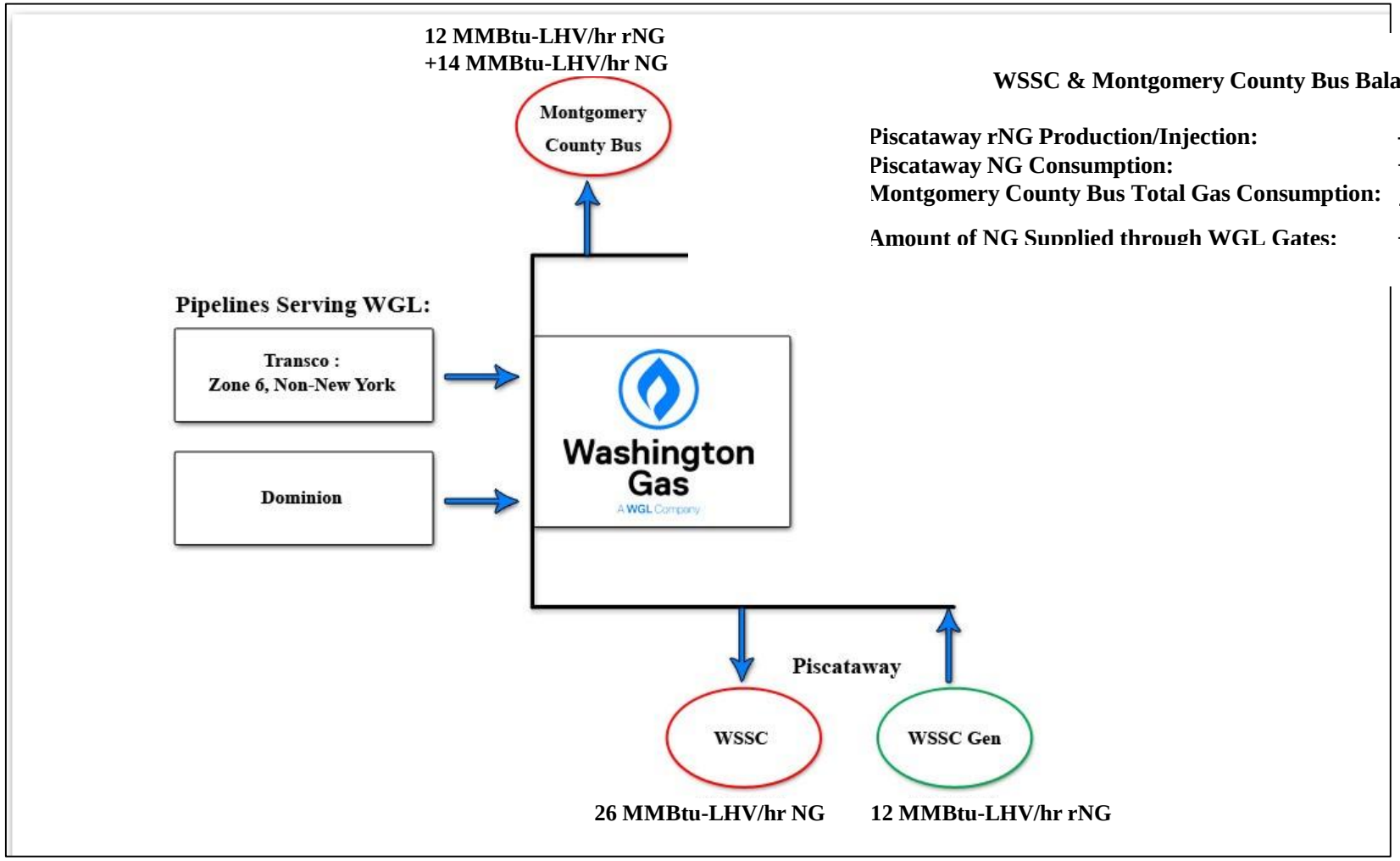
- Biogas production: ~12 MMBtu-LHV/hr in mid-2023
- Site consumption: ~26 MMBtu-LHV/hr, also in mid-2023
- Biogas production qualifies for renewable fuel credit (RIN) if delivered for transportation use
- WGL constructing new gas service that allows Piscataway to sell biogas to other system users
- Any licensed energy supplier can deliver Piscataway renewable gas to any customer

WSSC Piscataway Bioenergy Program
Potential NG Use and rNG Injection Quantities

Projected Initial Operation



Biogas and Natural Gas Delivery – Montgomery County & WSSC



WSSC & Montgomery County Bus Balance (as seen by WGL):

Piscataway rNG Production/Injection:	**- 12 MMBtu-LHV/hr rNG**
Piscataway NG Consumption:	**+26 MMBtu-LHV/hr NG**
Montgomery County Bus Total Gas Consumption:	**+26 MMBtu-LHV/hr NG+rNG**
Amount of NG Supplied through WGL Gates:	**+40 MMBtu-LHV/hr Gas**

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Renewable Fuel Standard (RFS) Program Structure

- Created under the Energy Policy Act of 2005 (EPAct)
- Amended the Clean Air Act (CAA)
- Energy Independence and Security Act of 2007 (EISA) further amended the CAA by expanding RFS program
- EPA implements the program in consultation with the US Department of Agriculture and the Department of Energy

Pathways II Improved on Pathways I

- Pathways I originally classified Biogas (from Landfills, sewage and waste treatment plants, manure digesters) as for D5 (Advanced) RINs

- RFS Pathways II was published on July 18, 2014

- Pathways II added Pathway Q that provided D3-RIN (cellulosic) designation for any:
  - "Renewable Compressed Natural Gas, Renewable Liquefied Natural Gas, Renewable Electricity"
  - produced from "Biogas from landfills, municipal wastewater treatment facility digesters, agricultural digesters, and separated MSW digesters; and biogas from the cellulosic components of biomass processed in other waste digesters."

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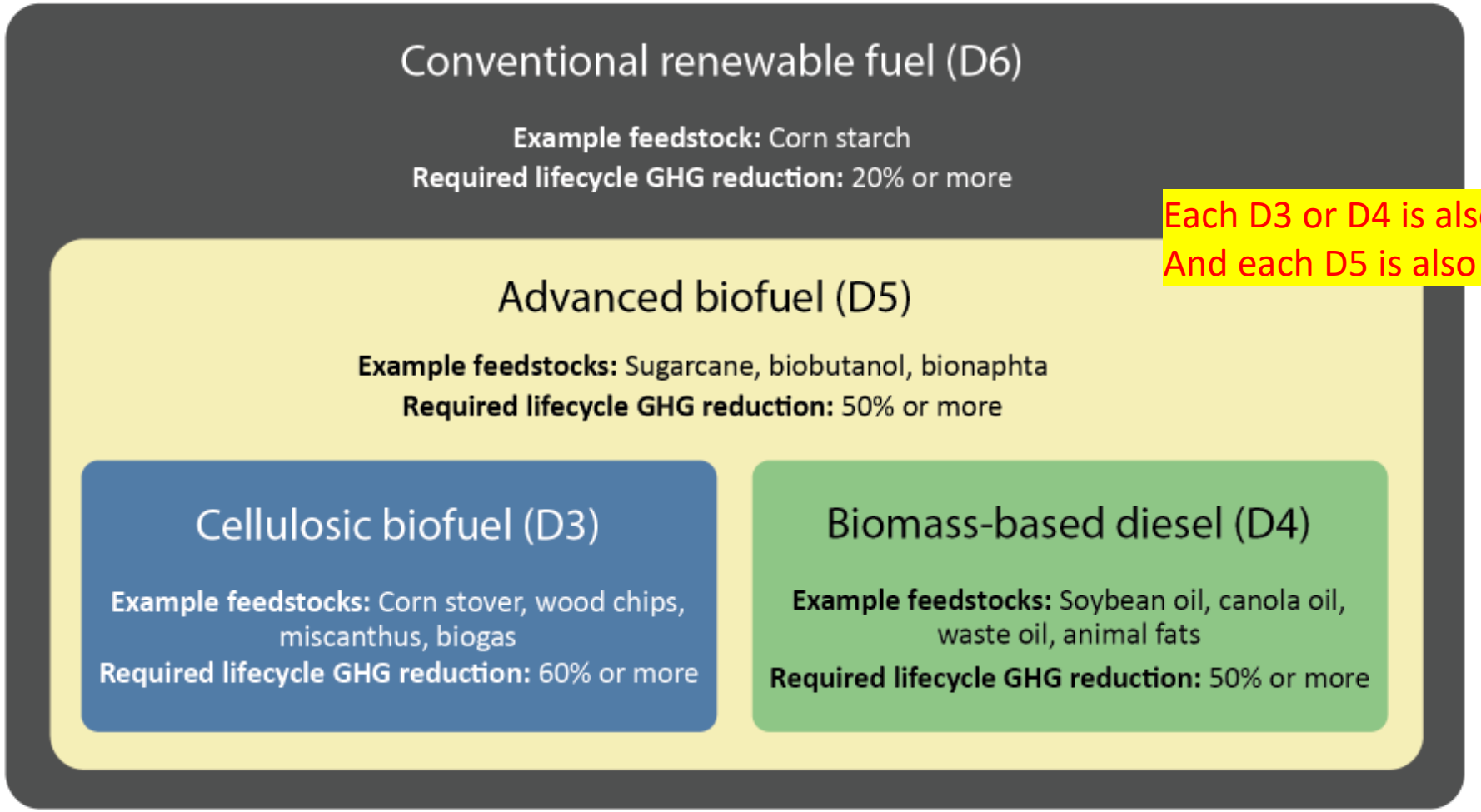
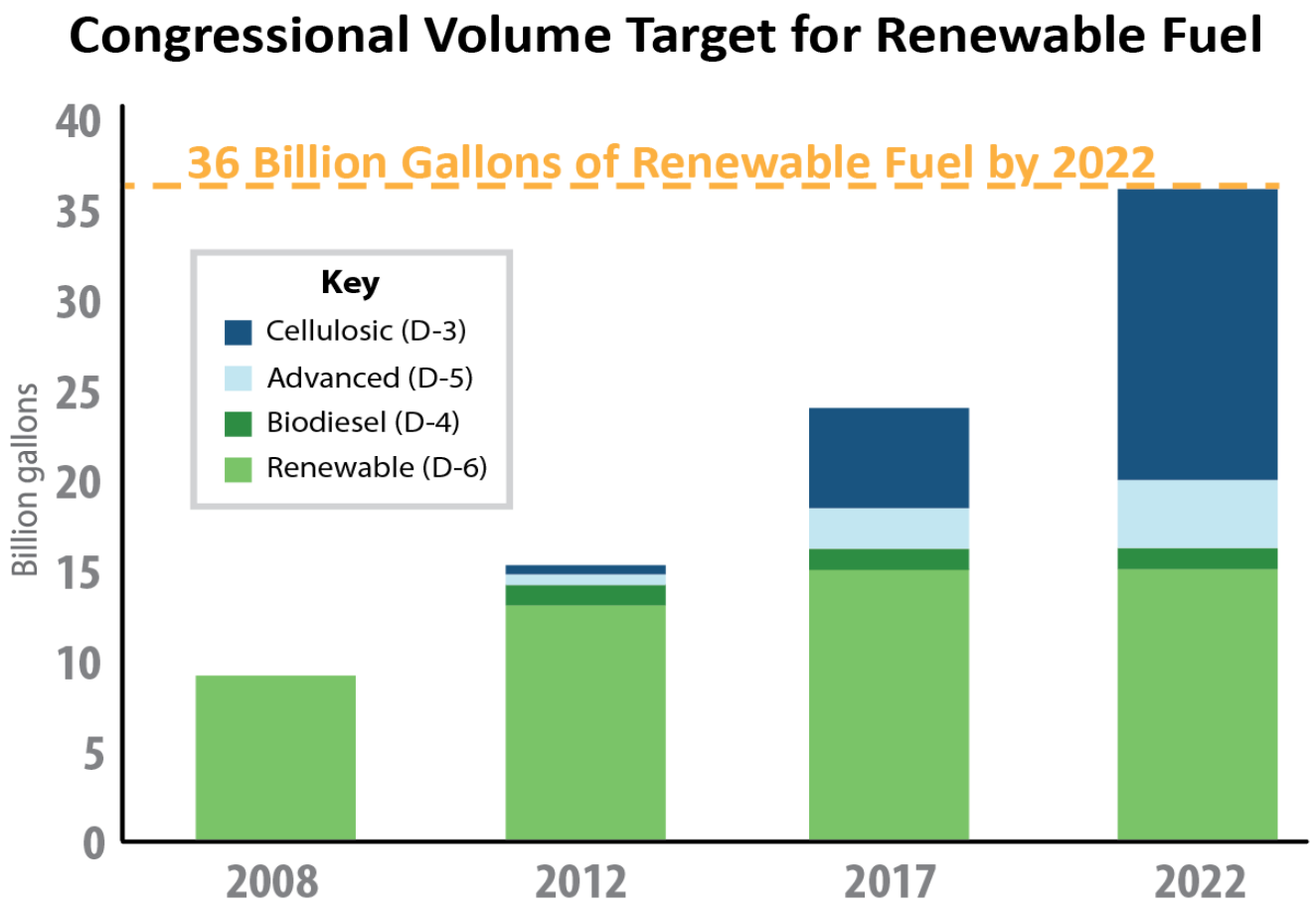
Fuel Nesting Summary for RFS

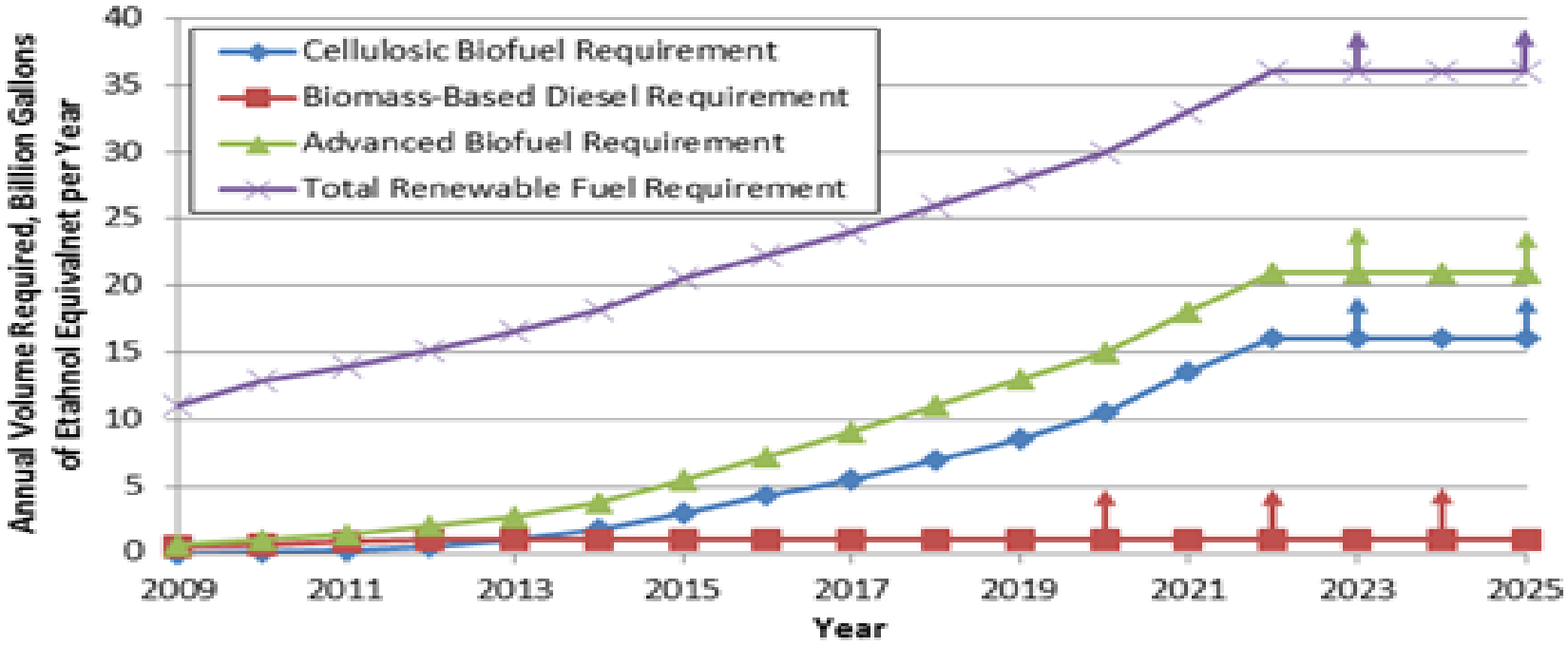


Each D3 or D4 is also counted as a D5
And each D5 is also counted as a D6

Renewable Fuel Volume Obligations (RVO)



Required Volumes of RINs



Data presented are taken from Table I.A.1-1 of the RFS2 Rule, 2009

Requirements for Biodiesel beyond 2013 and other renewable fuels beyond 2022 will be determined by EPA rulemaking but must be greater or equal to the last numeric quantity.

Proposed, Final, and Originally-Legislated D3/D5/D6 RIN Volumes (in millions); with Downturn Starting in 2018

RIN Class	Volume Basis	2012	2013	2014	2015	2016	2017	2018	2019	2020
D3 Cellulosic	Proposed	3 to 16	14	8 to 30	none	none	312	238	381	540
	Final	0	6	33	123	230	311	288	418	590
	Legislated	500	1,000	1,750	3,000	4,250	5,500	7,000	8,500	10,500
D5 Advanced	Proposed	2,000	2,750	2,200 to 2,510	none	none	4,000	4,240	4,880	5,040
	Final	2,000	2,750	2,670	2,880	3,610	4,280	4,290	4,920	5,090
	Legislated	2,000	2,750	3,750	5,500	7,250	9,000	11,000	16,000	15,000
D6 Total Renewable	Proposed	15,200	16,550	15,000 to 15,500	none	none	18,800	19,240	19,880	20,040
	Final	15,200	16,550	16,280	16,930	18,110	19,280	19,290	19,920	20,090
	Legislated	15,200	16,550	18,150	20,500	22,250	24,000	26,000	28,000	30,000

Summary Table from Multiple Proposed and Final EPA RFS Rules on EPA Website at:
https://www.epa.gov/renewable-fuel-standard-program/regulations-and-volume-standards-renewable-fuel-standards (Compiled on 9-15-2019)

What Happens After 2022?

- The statutorily-prescribed phase-in period ends in 2012 for biomass-based diesel and in 2022 for cellulosic biofuel, advanced biofuel, and total renewable fuel.

- Beyond these years, EISA requires EPA to determine the applicable volumes.

- However, the statute requires that the biomass-based diesel volume in 2013 and beyond must be no less than 1.0 billion gallons, and that advanced biofuels (which include Cellulosic) in 2023 and beyond must represent at a minimum the same percentage of total renewable fuel as it does in 2022.

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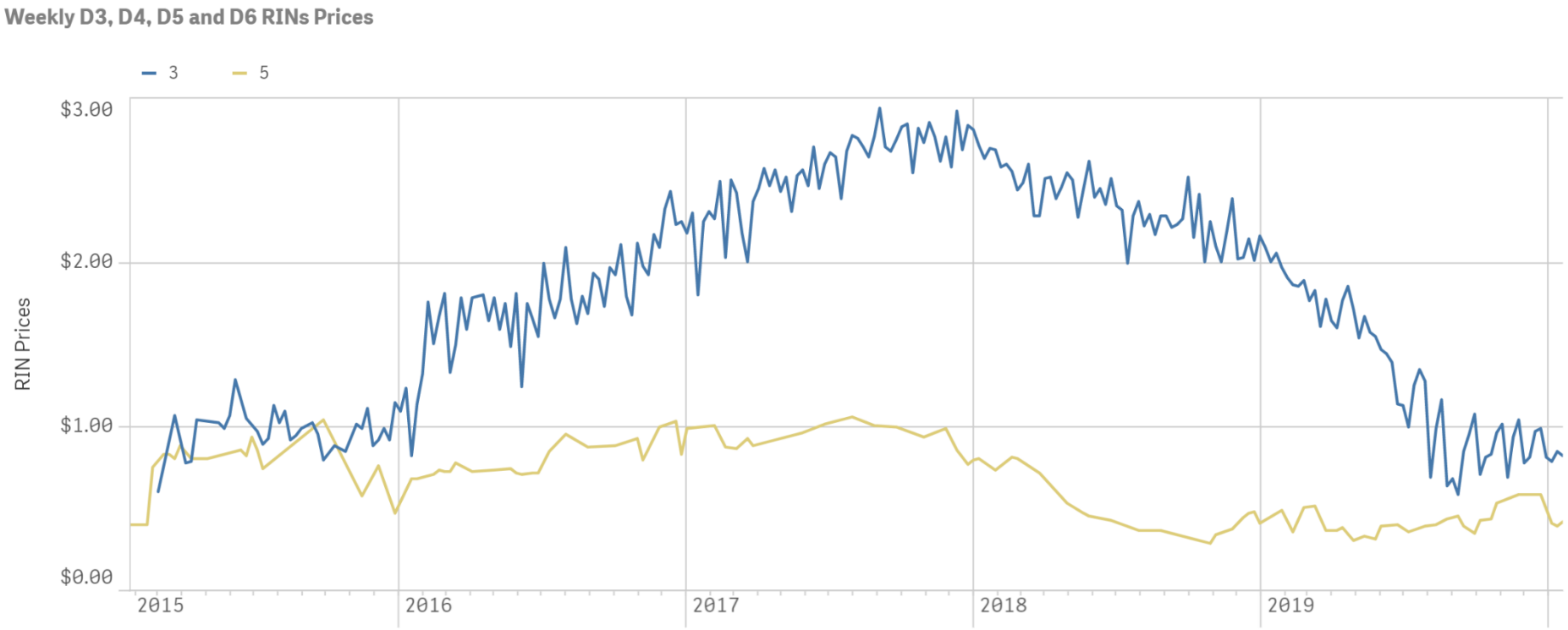
Value of RINS (contrast between D3 and D5)

- D3s have historically been worth 2 to 4 times D5s



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Comparison of Biogas CHP and NG CHP + rNG Export: Operating Parameters

Description	Units	Biogas CHP	NG CHP + rNG Export
Biogas Production	MMBtu-LHV/hr	12	12
Biogas Treatment Recovery	% of Biogas	99%	98%
Renewable Fuel	MMBtu-LHV/hr	11.9	11.8
D3 (Cellulosic) RIN Production	D3-RINs/Day		3,665*
NG LHV Purchases	MMBtu-LHV/hr	4.6	26.0
NG HHV Purchases	MMBtu-HHV/hr	5.1	28.9
Net Electric Efficiency	% of Fuel	38.2%	38.2%
Net Power Production	MW, avg	1.33	2.62

* D3-RINs/Day = $\frac{\text{MMBtu-LHV/hr. x 24}}{\text{77000 Btu/RIN}}$

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Comparison of Biogas CHP and NG CHP + rNG Export: Unit Costs, Revenues, and Savings

Description	Units	Biogas CHP	NG CHP + rNG Export
Net RNG Sale (energy rev. & injection cost)	$/MMBtu-HHV		$2.10
Net NG Purchase (energy & delivery costs)	$/MMbtu-HHV	-$4.00	-$4.00
Net Electric Savings (energy savings, REC rev., & CHP O&M cost	$/kWh	$.105	$.09
Full D3-RIN Value	$/D3-RIN		$1.00
RIN Revenue Recovery	% Full Value		85%

Comparison of Biogas CHP and NG CHP + rNG Export: Annual Savings or Revenues (>0) and Costs (<0)

Description	Biogas CHP	NG CHP + rNG Export
Net RIN Revenue	$0	$1,140,000
Net RNG Revenue	$0	$240,000
Net NG Costs	-$180,000	-$1,010,000
Net Electric Savings	$1,220,000	$2,060,000
Total Annual Savings	**$1,040,000**	**$2,430,000**

$1,390,000

Questions?

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