



**DEMON® Installations are bringing
Nutrient Removal in the US to a new
level**

*Presented By
Andrea Nifong*

Clean Water and Energy from Wastewater

Agenda

Section I: INTRODUCTION

Section II: DEMON TECHNOLOGY

Section III: DOCUMENTED RESULTS

Award Winning World-Class Manufacturing

Quality * Safety * Cost * Schedule * Innovation

Headquarters: Oklahoma City, OK USA

- Global Leader in MBBR/DAF Technology
- BNR Specialists
- Advanced R&D Capabilities
- Experienced Process Engineering
- World-wide Delivery Team

WWW is one of the Fastest Growing US Companies

2013

Inc. 500



Top 100
Environmental
Services
Companies

2012

Inc. 500



Top 100
Manufacturing
Companies

Inc. HirePower



Top 100
Oklahoma
Companies



Top 10
Oklahoma
Companies



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Agenda

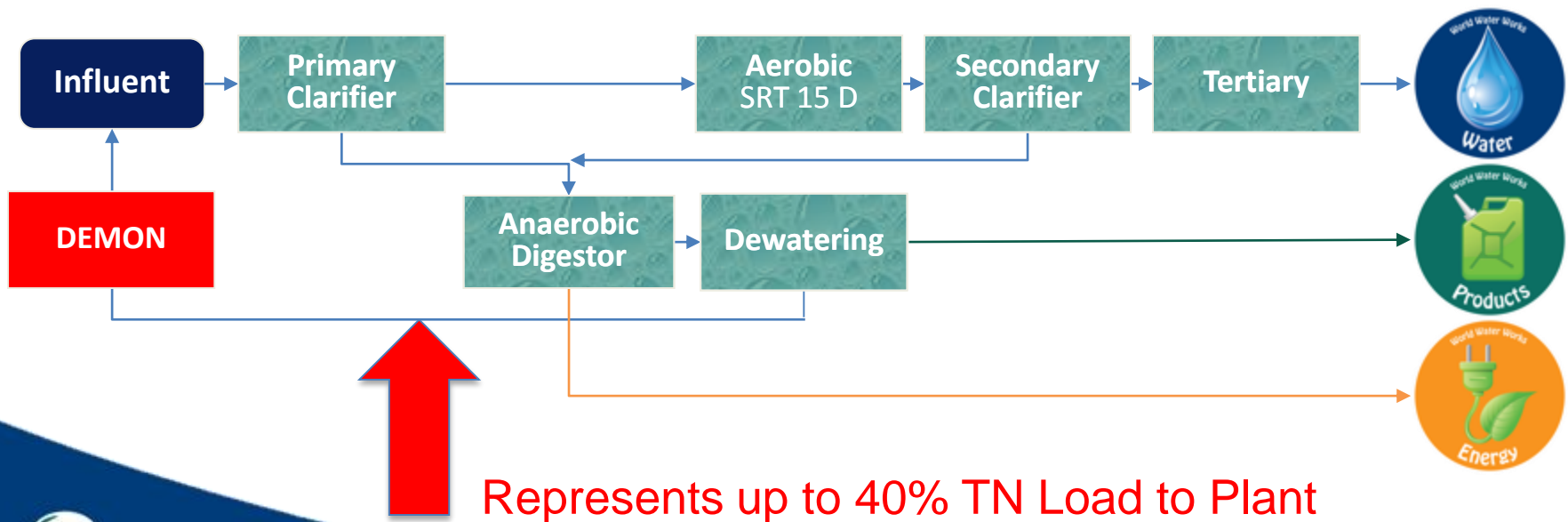
Section I: INTRODUCTION

Section II: DEMON TECHNOLOGY

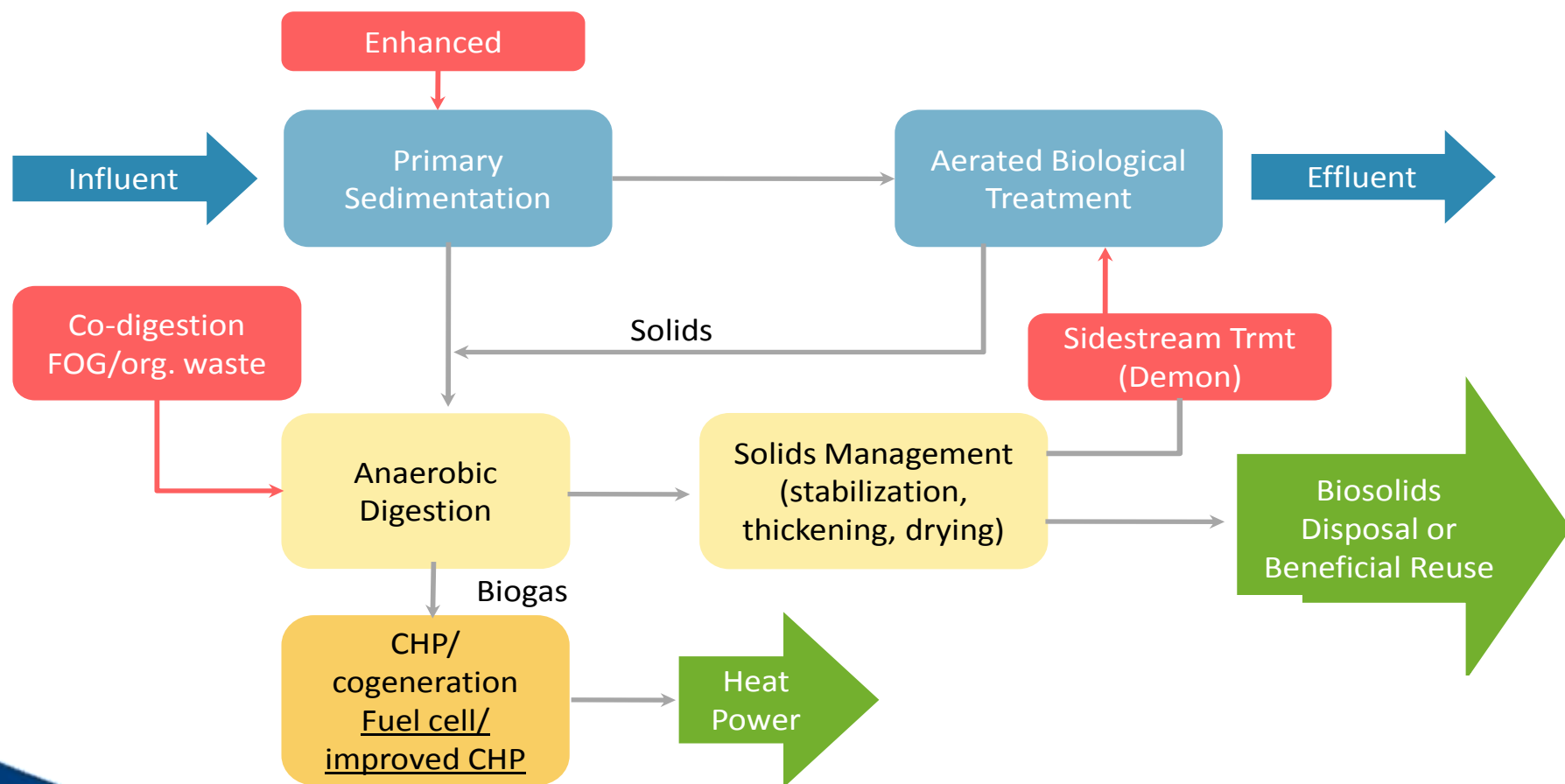
Section III: DOCUMENTED RESULTS

Drivers for Sidestream DEMON®

- ~1% of Total Plant Influent Flow
- ~20-40% of the Total Plant TN load
- NH_4 Concentration between 900 – 1,500 mg/L
- Alkalinity/ NH_4 ratio \approx 3.5-4.0
- Temperature 30 - 38°C
- Alkalinity insufficient for complete nitrification
- Insufficient carbon for denitrification

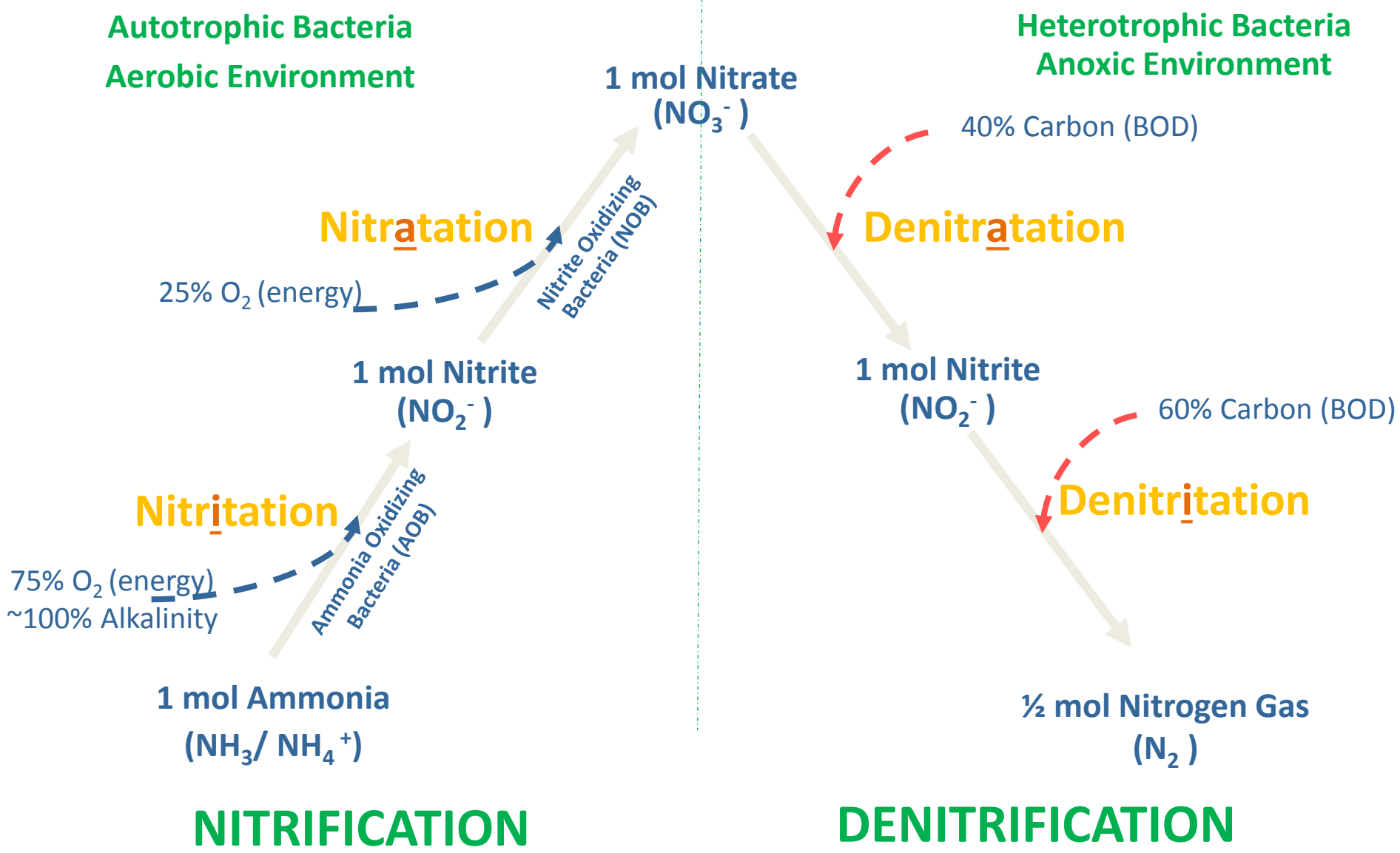


Innovation in Plant Design to Achieve Energy Neutrality

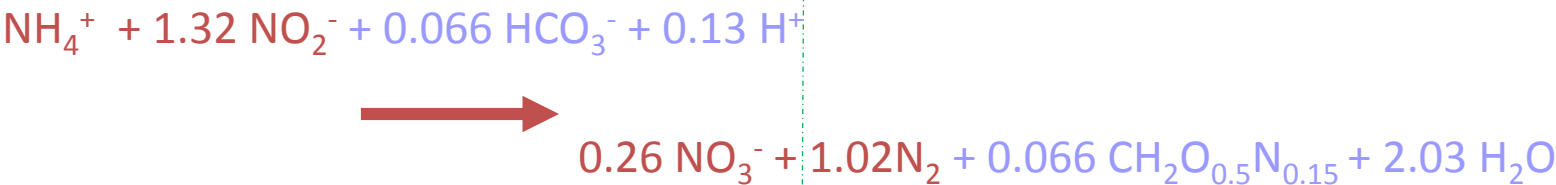


Lauren Filmore.2012. *Roadmap to Energy Neutral Wastewater Treatment*. VWEA Annual Education Seminar. Richmond, VA

Conventional Nitrification-Denitrification



Partial Nitritation + Anammox = Deammonification

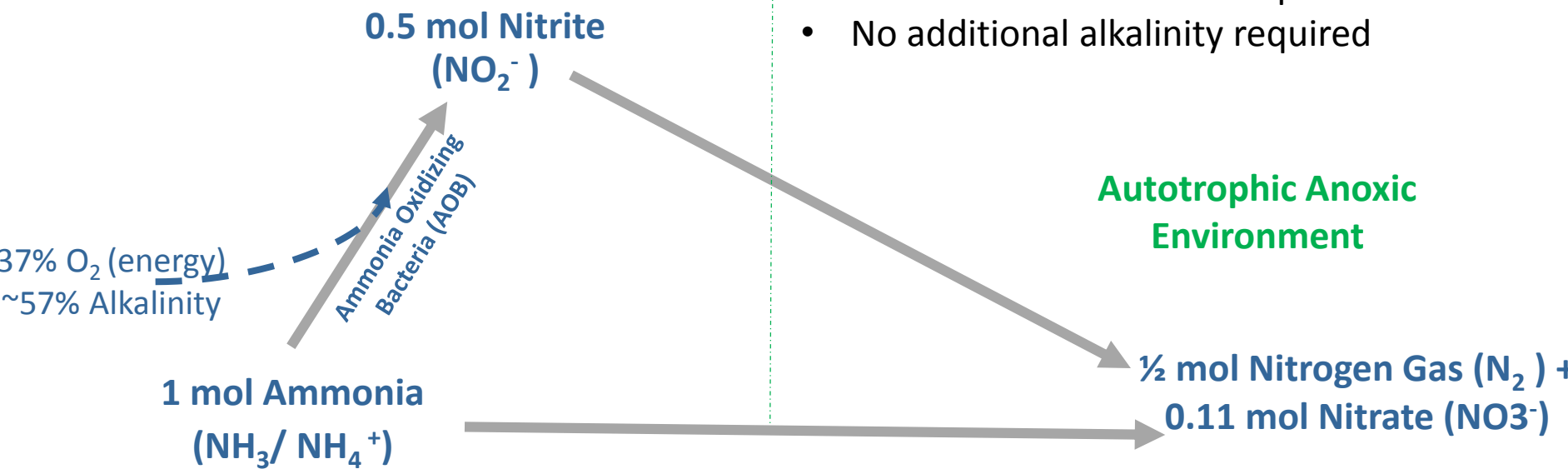


Autotrophic Bacteria
Aerobic Environment

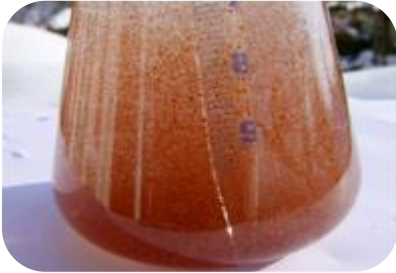
Advantages:

- 63% reduction in oxygen demand (energy)
- Nearly 100% reduction in carbon demand
- 80% reduction in biomass production
- No additional alkalinity required

Autotrophic Anoxic Environment



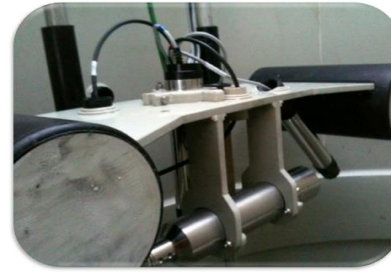
DEMON[®] Process Components



Seed Sludge



Aeration
System



Instruments &
Controls



Tank



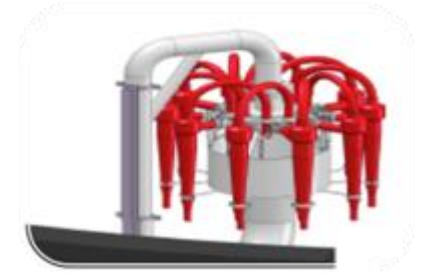
Blowers



Decanter



Mixer



Cyclone

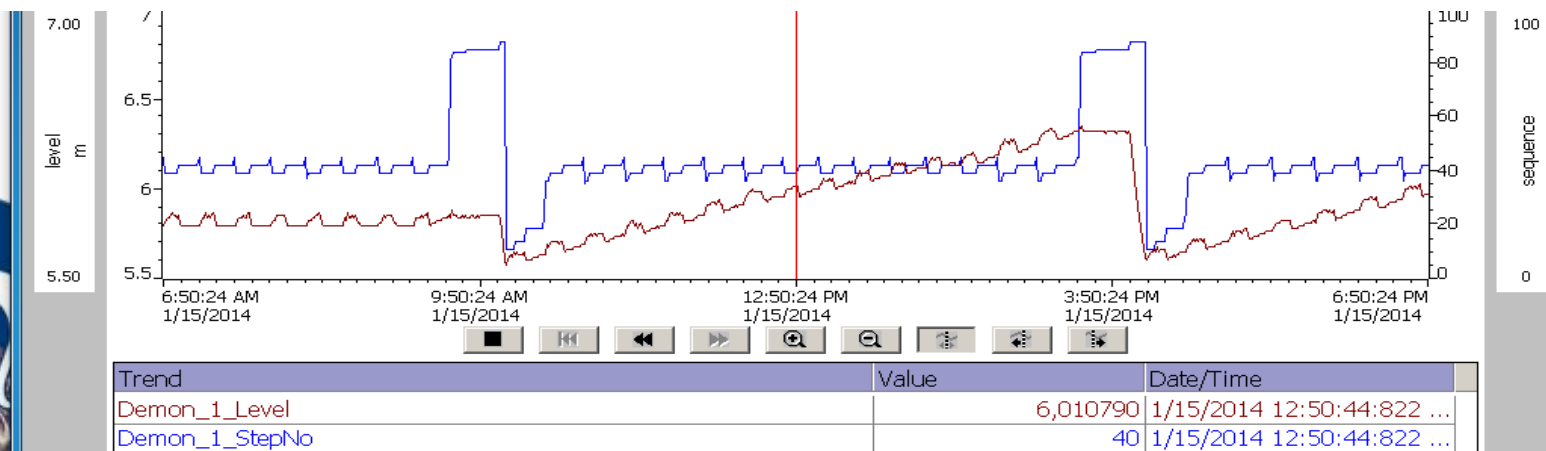
DEMON® Control Strategy - Anammox Enrichment

- Continual enrichment of anammox
 - Large excess of activity
 - Provides stability
- Ability to Washout NOB if proliferation occurs



DEMON® – Control Strategy

- SBR configuration – 6-8 hr/cycles/day
- Last hour of cycle - settle and decant
- Active cycle – Multiple mini-cycles (10-30 mins):
 - Aerate
 - Mix/fill
 - Mix
- Aeration:
 - DO \sim 0.2-0.5 mg/L (PID control or constant airflow)
 - pH based aeration control



DEMON[®] Status in North America

- DEMON – HRSD York River; Started October 2012; **operating**
- DEMON – Industrial Project; started January 2014; **operating**
- DEMON – Alexandria, VA; startup May 2015; **operating**
- DEMON – Philadelphia, PA; 100% design
- DEMON- Guelph, Ontario; starting June 2015; **in construction**
- DEMON – Pierce County, WA; starting 2016; **in construction**
- DEMON – DCWater Blue Plains; starting 2016; **in construction**
- DEMON – Greeley, CO, starting July 2015; **in construction**
- DEMON Mainstream - Alexandria, VA, starting June 2015; **in construction**

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ANAEROBIC
DIGESTION

DEWATERING

THICKENING

DEMON

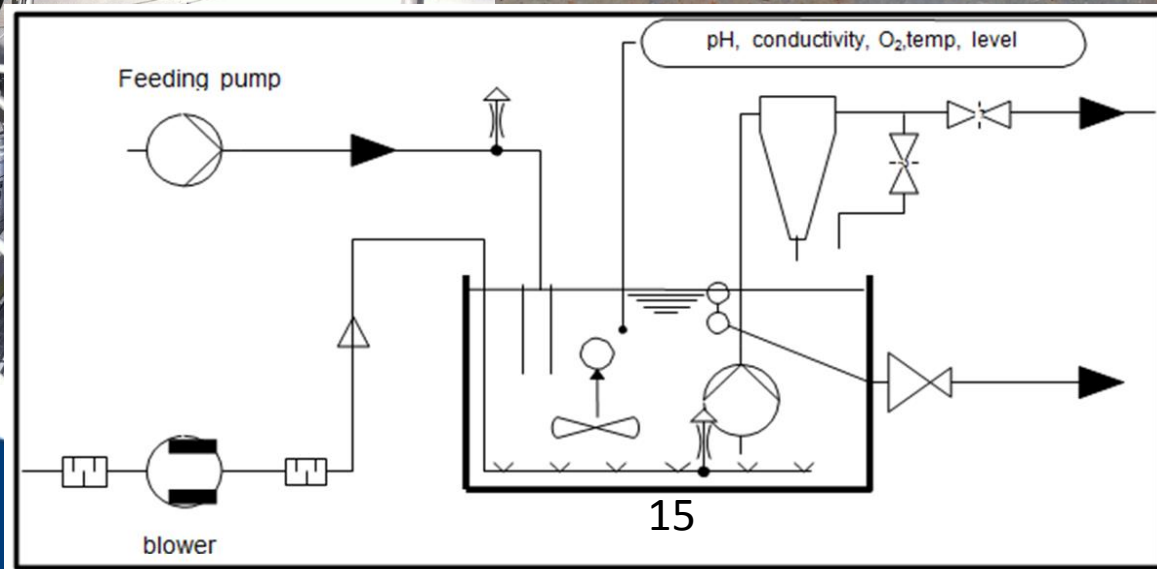
AERATION
BASINS

HEADWORKS

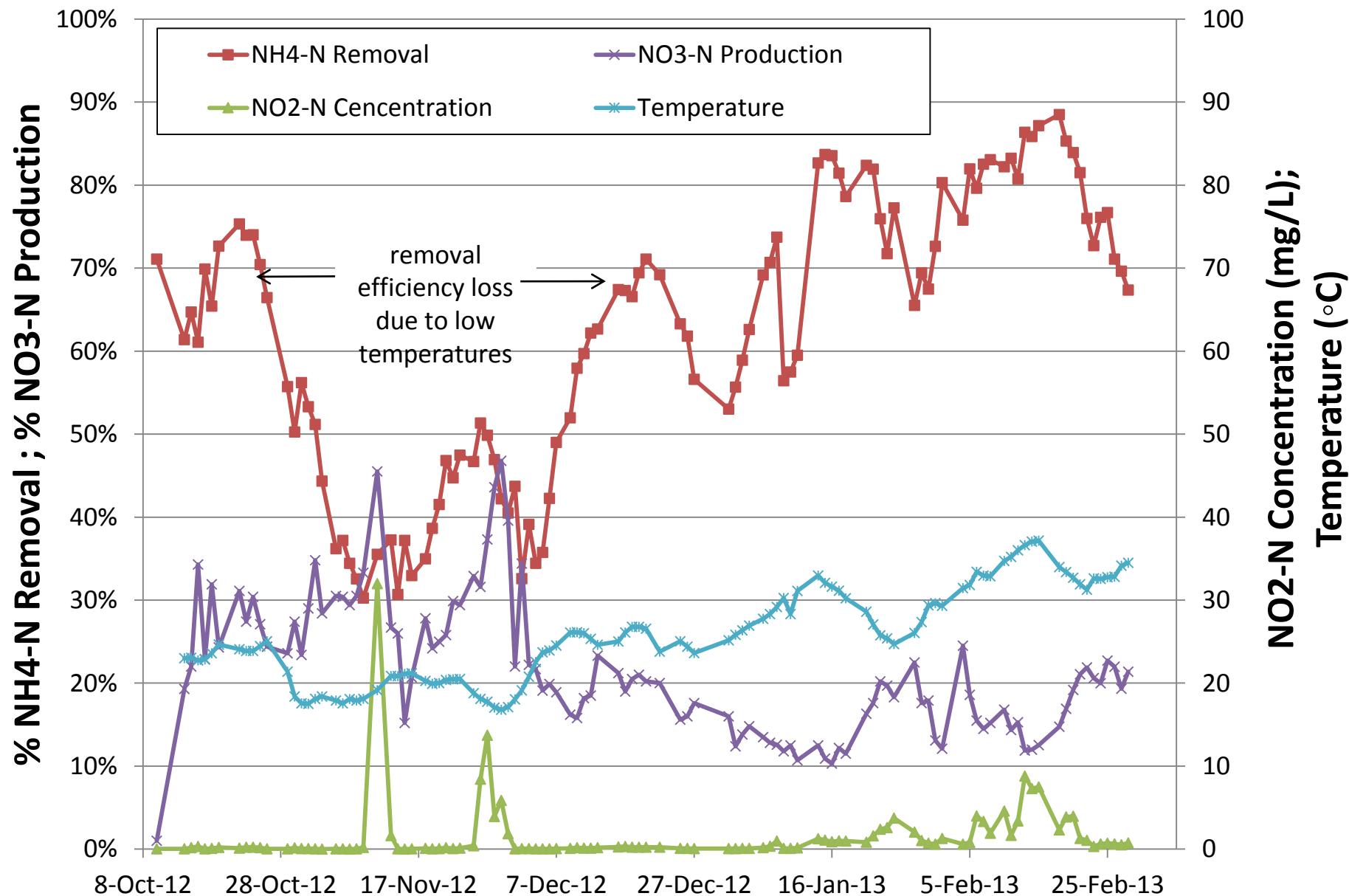
DENITE
FILTERS

DEMON at York River

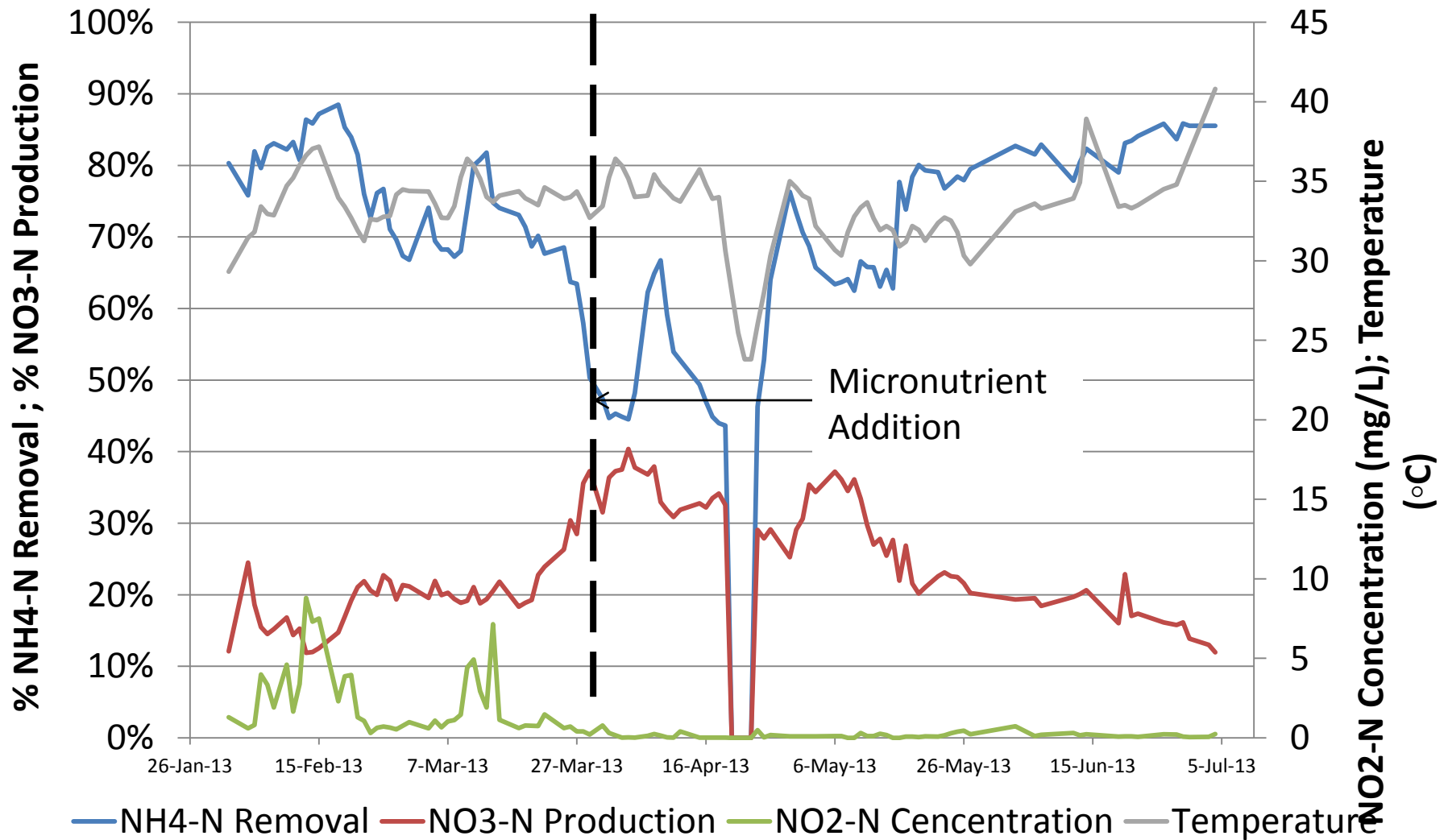
Demon® York River WWTP



NH₄ and TIN Removal Percentages



Micronutrient Deficiency - DEMON®

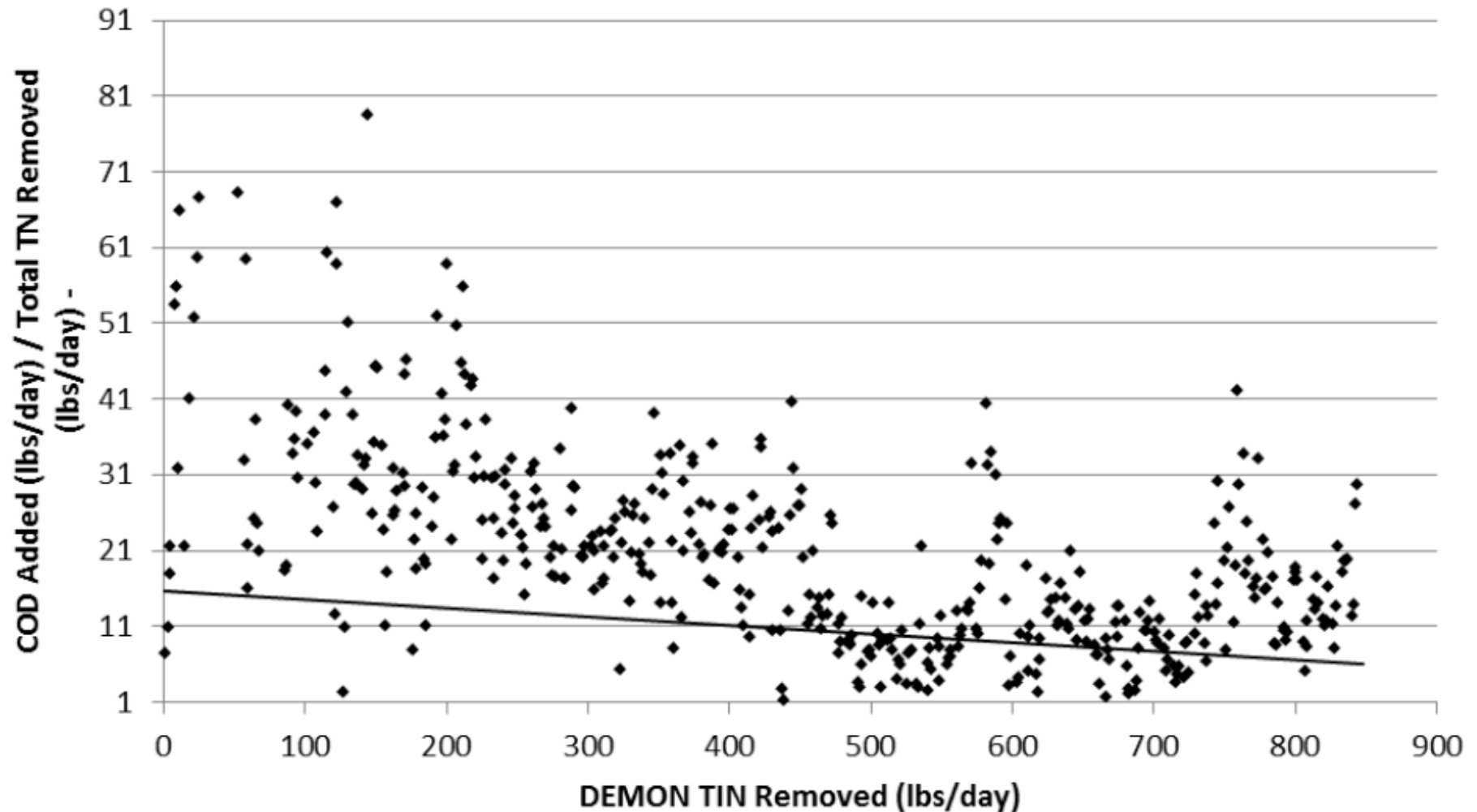


Lessons Learned

- Insulate or provide heating during startup
- Provide micronutrients or bi-annual micronutrient screening
- Eliminate sources of dilution water
- Sufficient EQ size and settling
- Temperature control if necessary



Resource Savings – Methanol Reduction



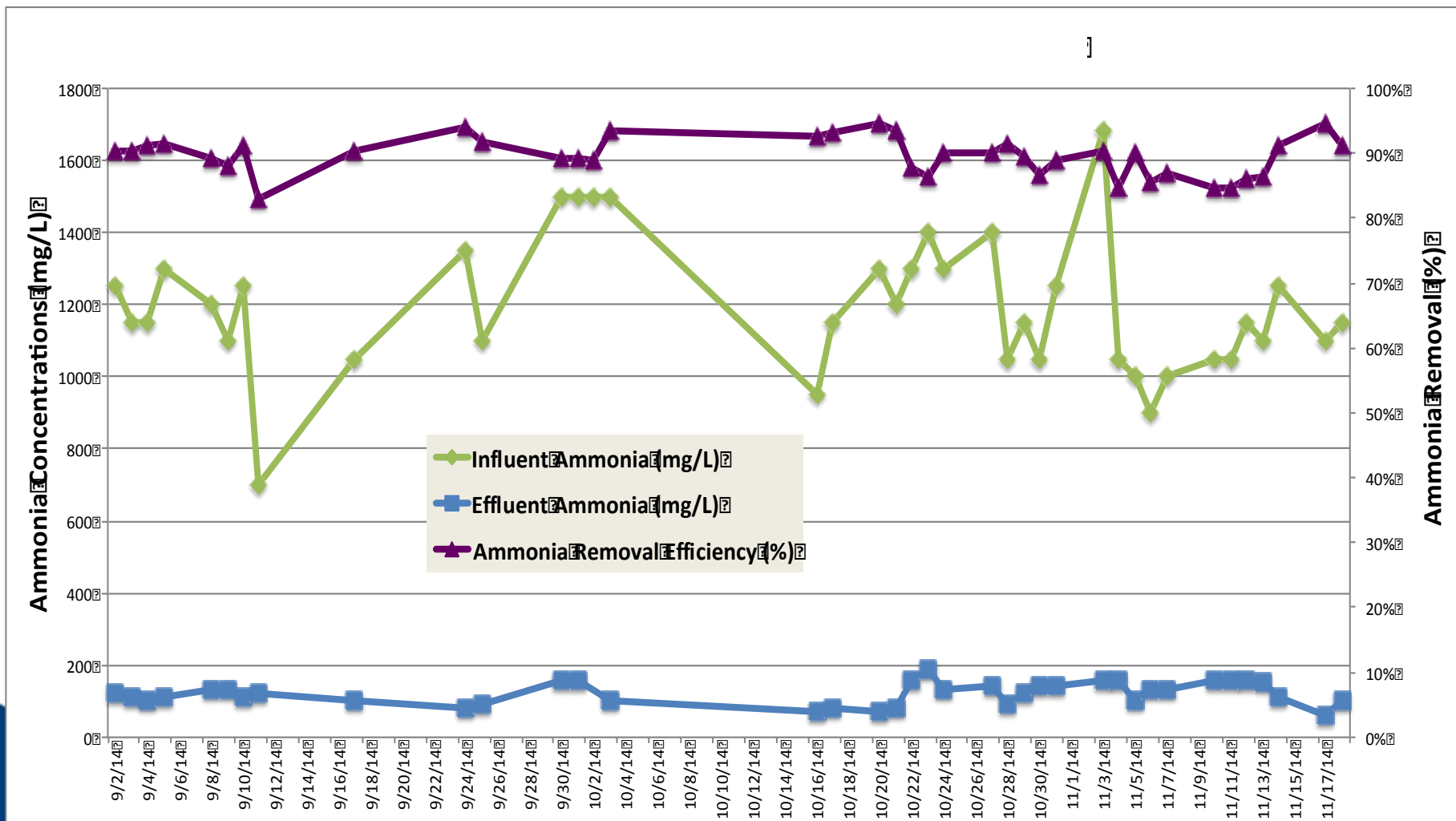
Mean Methanol addition prior to stable DEMON performance was 20.33 ± 0.69 while the mean methanol addition after stable performance was 14.82 ± 0.81 . t-Test provided p values less than .001.

Biogas Installations

- Organics management and renewable energy facility
- Converts organic waste into renewable biogas and natural fertilizers
- Full Capacity:
 - 130,000 ton/yr of organic material
 - 3.2 MW of energy
 - 5.4 MW of combined heat and power
 - BioFuel Sources:
 - Food
 - Biosolids
 - FOG

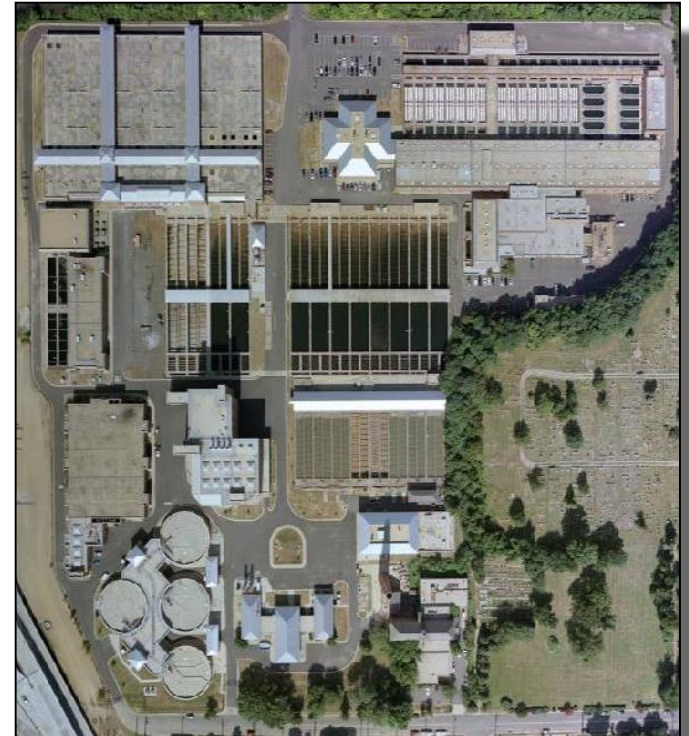


Ammonia Removal Efficiency



AlexRenew Upgrades toward Energy Efficiency

- State-of-the-Art Nitrogen Upgrade Program (SANUP)



AlexRenew – Sidestream DEMON®

- Seeded May 2015
- During startup Achieving 85% Ammonia Removal
- Current Treatment Volume: 85,000 gal/day
- Design Treatment Volume: 276,000 gal/day @ 1,100 mg/L NH₄-N

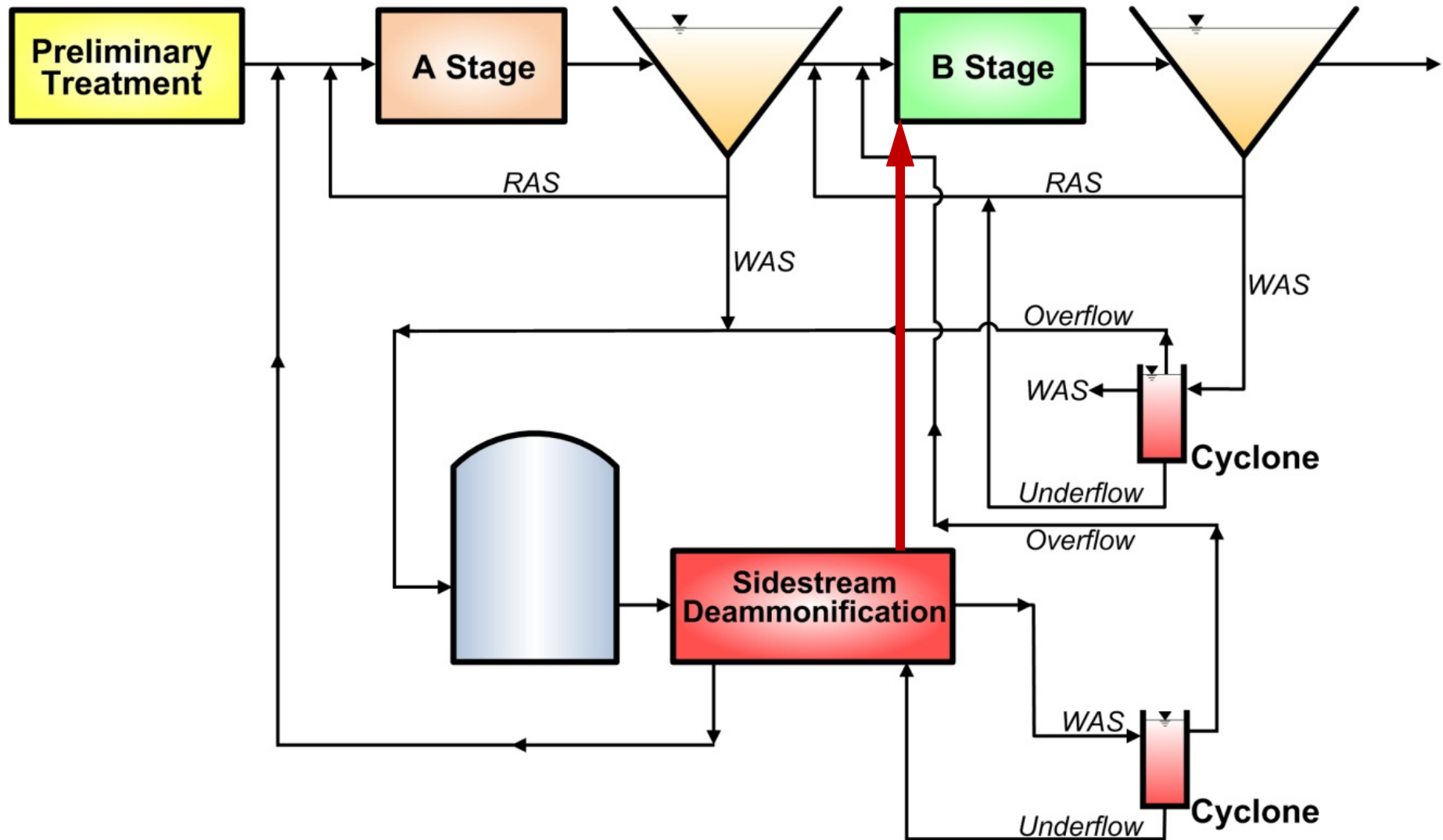


AIZ (ACHENTAL-INNTAL-ZILLERTAL) Innsbruck, Austria – Strass WWTP

- Net energy positive plant
- Mainstream treatment by an A/B process
- Sidestream by DEMON deammonification process
- Co-digestion Facility since 2001
- 10 MGD Winter, 5 MGD Summer
- Equipment selection based on power consumption
- BioFuel Sources:
 - Trap Grease
 - Glycerol from Biodeisel
 - Industrial Biological Processing Waste
 - Food Waste

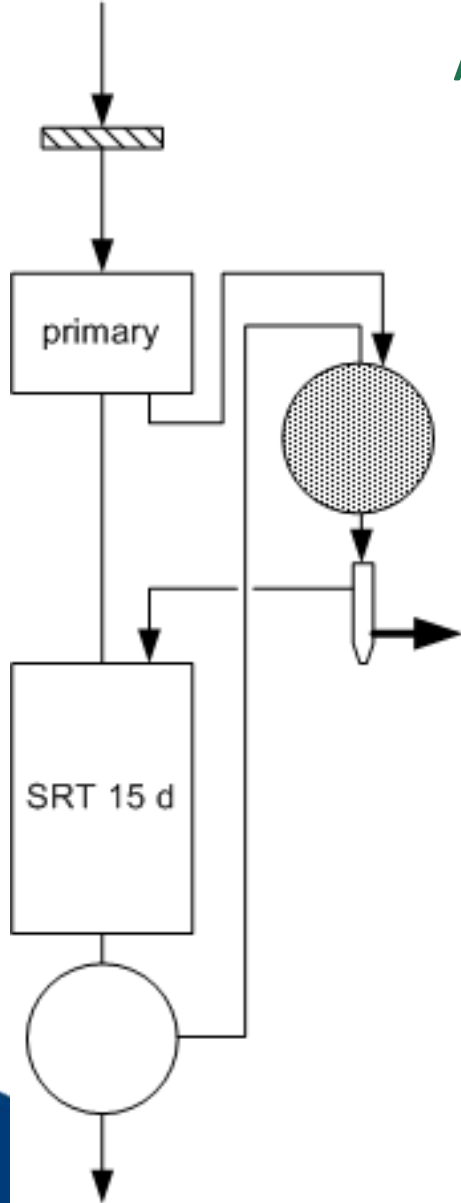


STRASS WWTP DEMONSTRATION (Full-Scale)

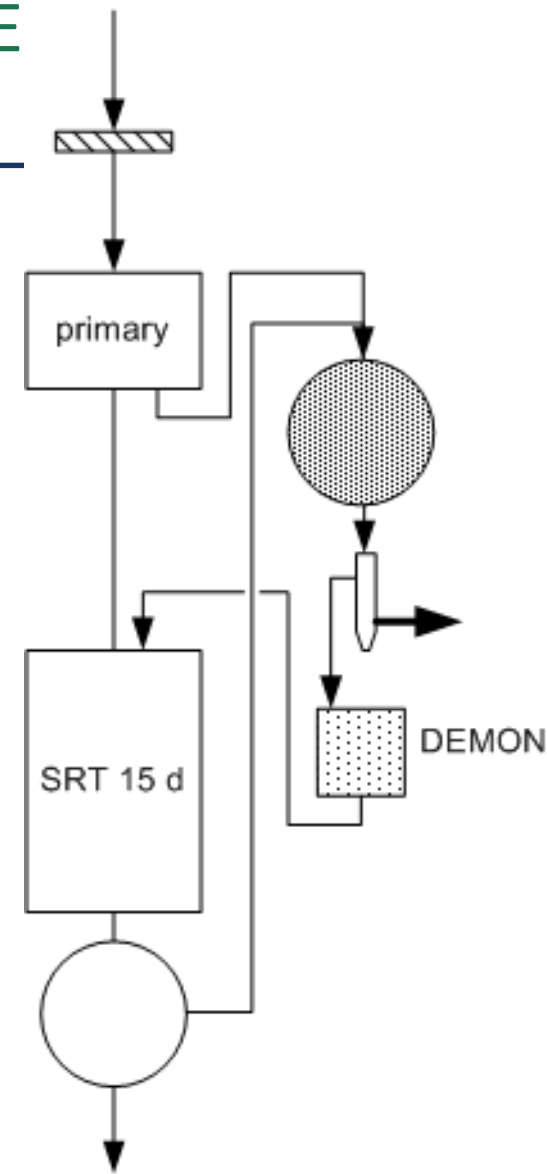


A LOOK TOWARD THE FUTURE

Energy self-sufficient WWTP

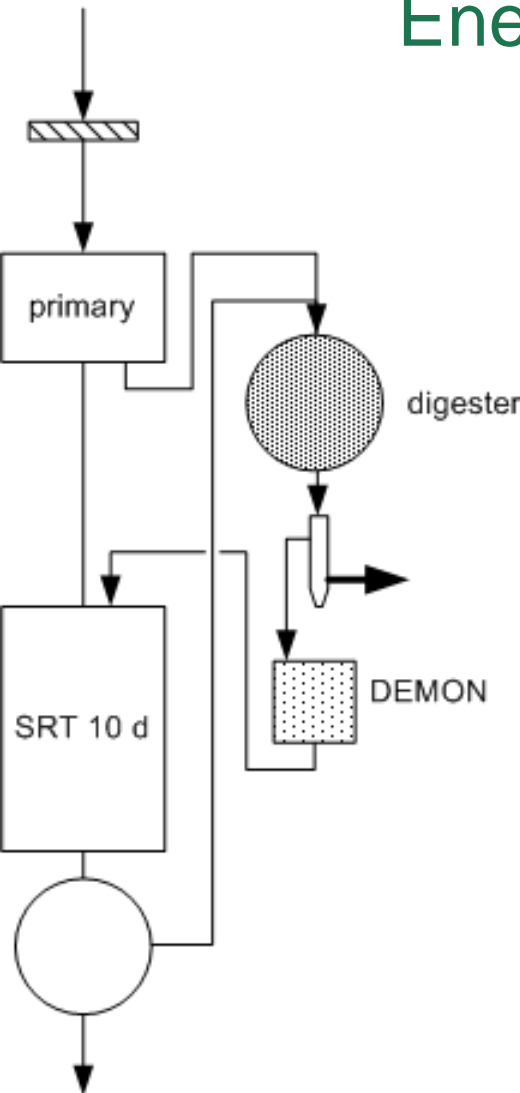


Conventional N-removal	DEMON [®] in side stream DEMON[®]
Aeration +39,3 Wh /pe d	Aeration +37,2 Wh /pe d
Total +56,5 Wh /pe d	Total +54,1 Wh /pe d
Gas el. -42,0 Wh /pe d	Gas el. -42,0 Wh /pe d
Balance +14,5 Wh /pe d	Balance +12,2 Wh /pe d 15 % reduction

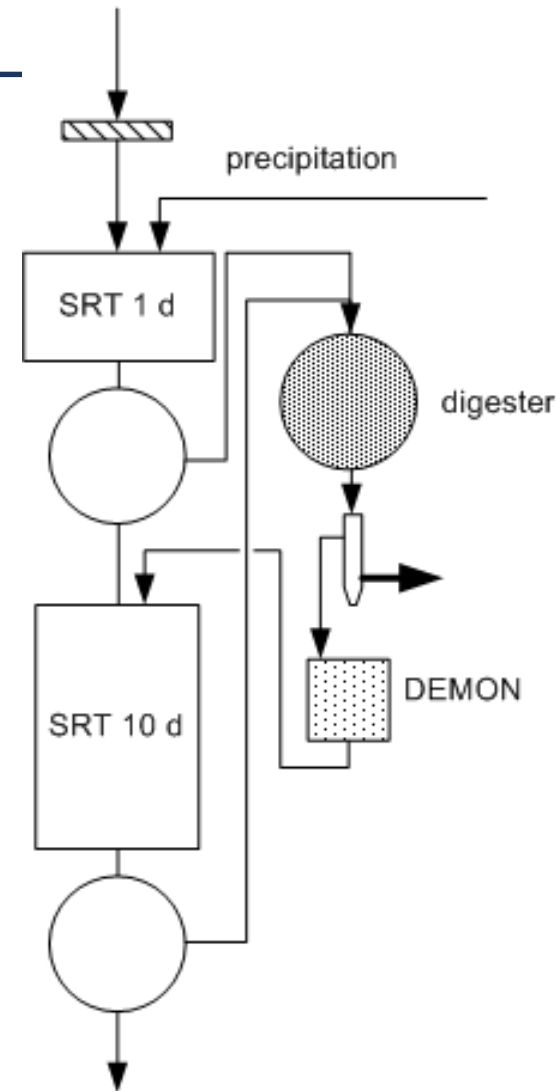


A LOOK TOWARD THE FUTURE

Energy self-sufficient WWTP

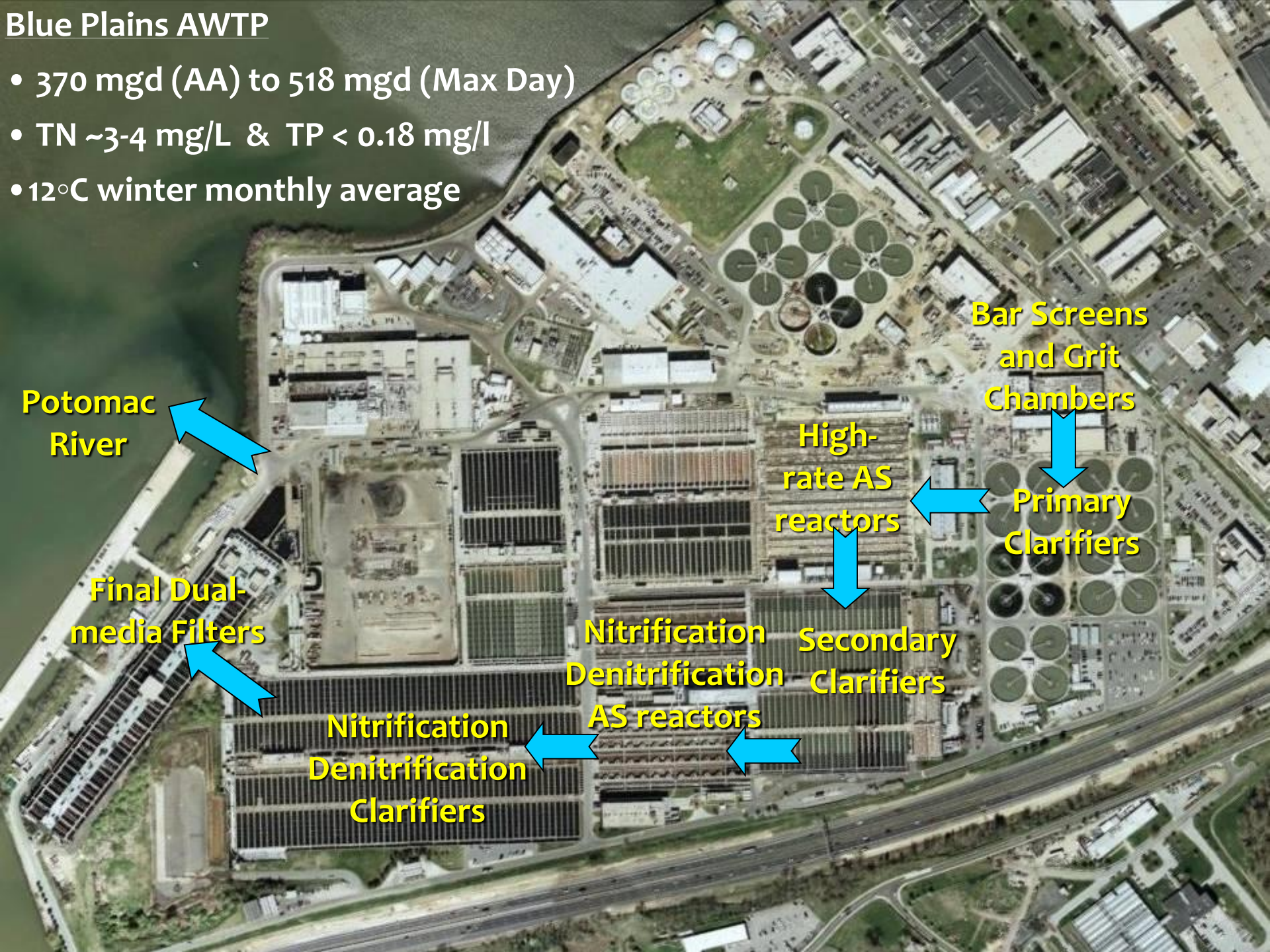


DEMON® in side- and main stream DEMON®+	A & B Step DEMON® & Demon®+ EssDe®
Aeration +31,5 Wh/pe d	Aeration +16,4 Wh /pe d
Total +48,4 Wh /pe d	Total +33,3 Wh /pe d
Gas el. -42,0 Wh /pe d	Gas el. -64,7 Wh /pe d
Balance +6,4 Wh /pe d 56 % reduction	Balance -31,4Wh /pe d



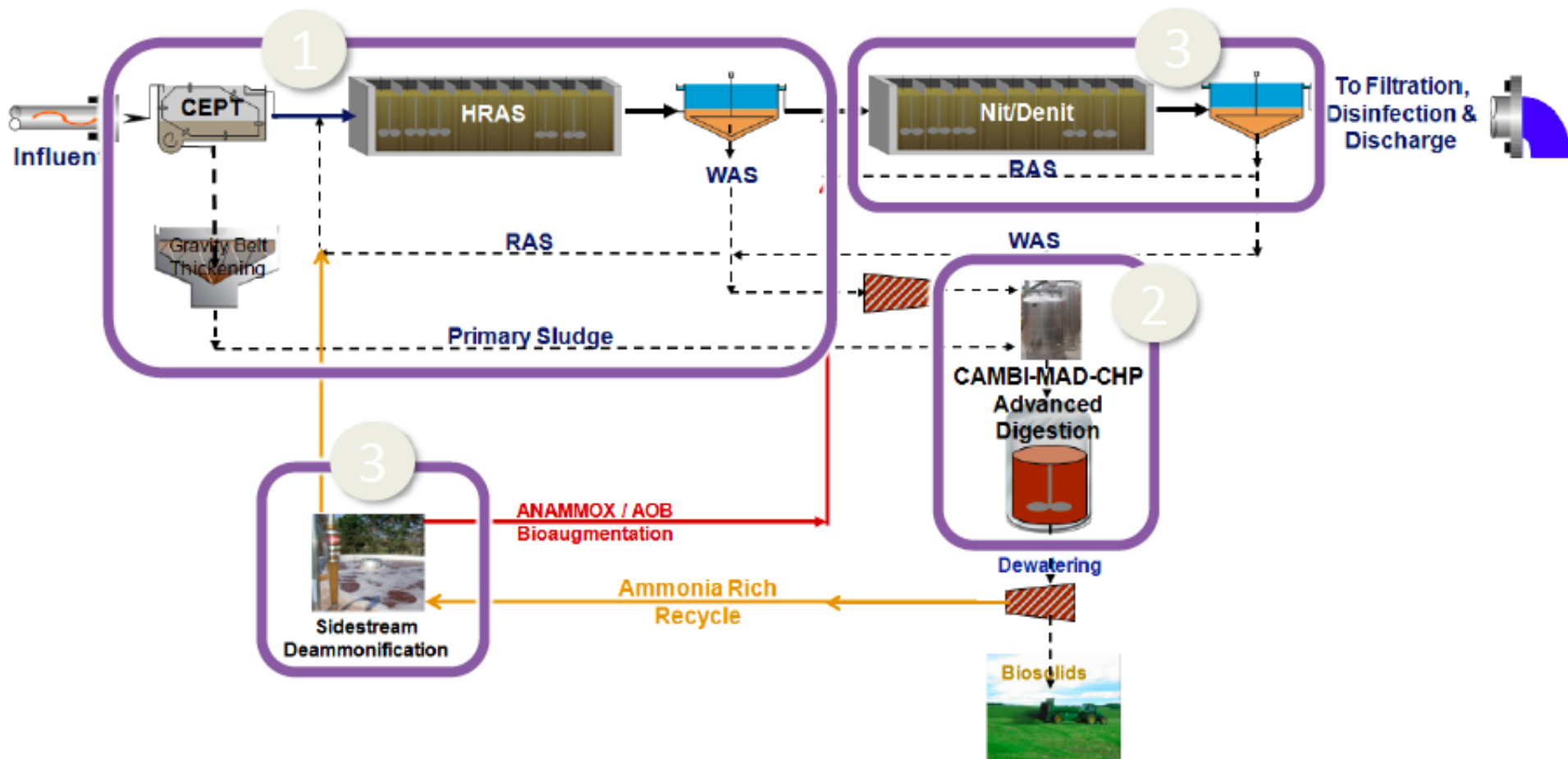
Blue Plains AWTP

- 370 mgd (AA) to 518 mgd (Max Day)
- TN ~3-4 mg/L & TP < 0.18 mg/l
- 12°C winter monthly average



DC Water Upgrades

1. **A-Stage** – Maximize carbon capture
2. **Biosolids** – Maximize energy recovery
3. **B-Stage** – Minimize carbon & energy demand for N & P removal





World water works.com

Thank you

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