

OPTIMIZATION OF COAL WASTE/BIOMASS GASIFICATION FOR HYDROGEN PRODUCTION

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Introduction



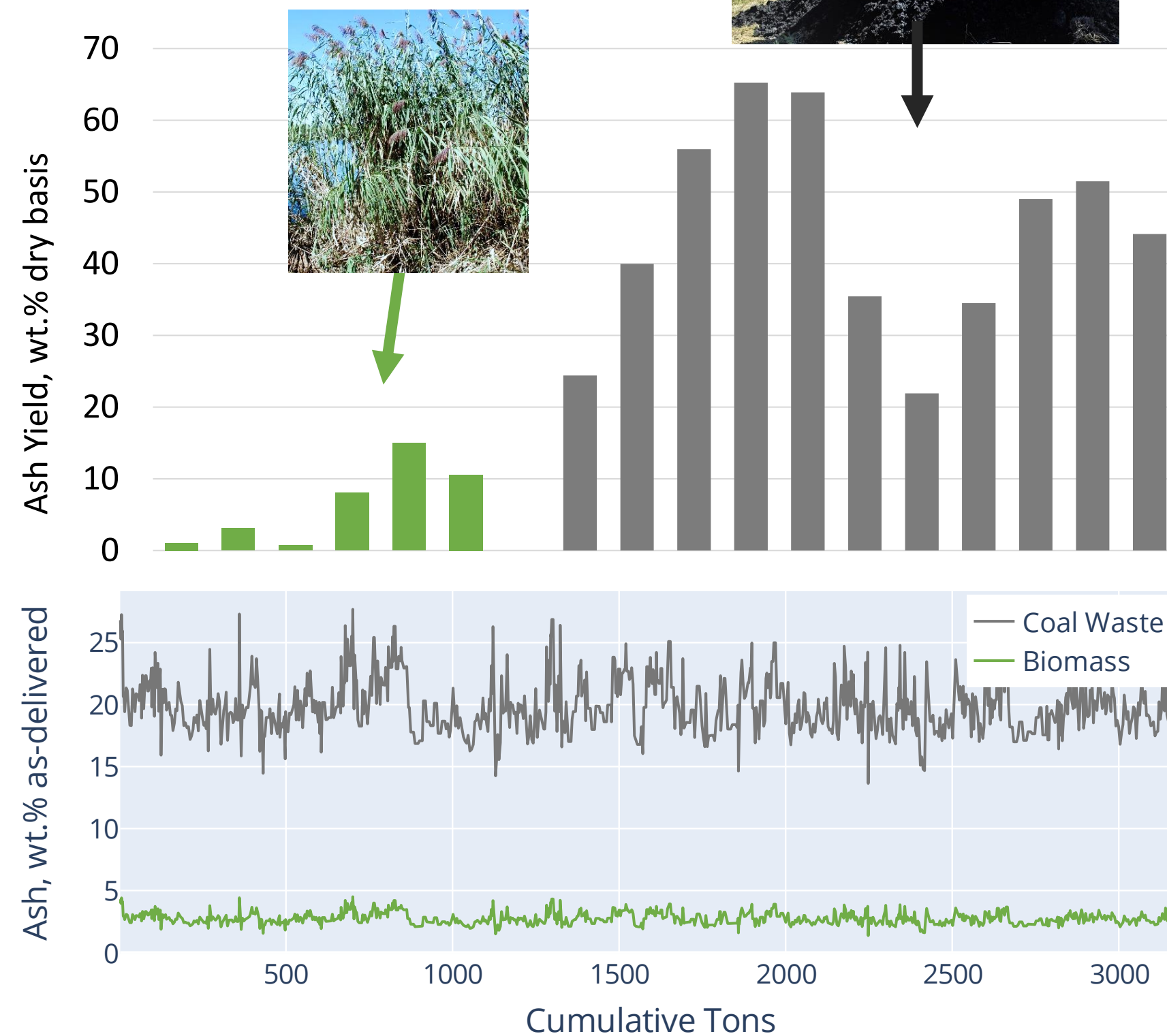
- Drive down the cost of green hydrogen to \$1/kg within 1 decade
- Gasification: Co-utilize biomass with existing coal waste resources
- Physical/chemical properties of biomass/coal waste are highly variable
- Feedstock properties impact plant performance

Goal

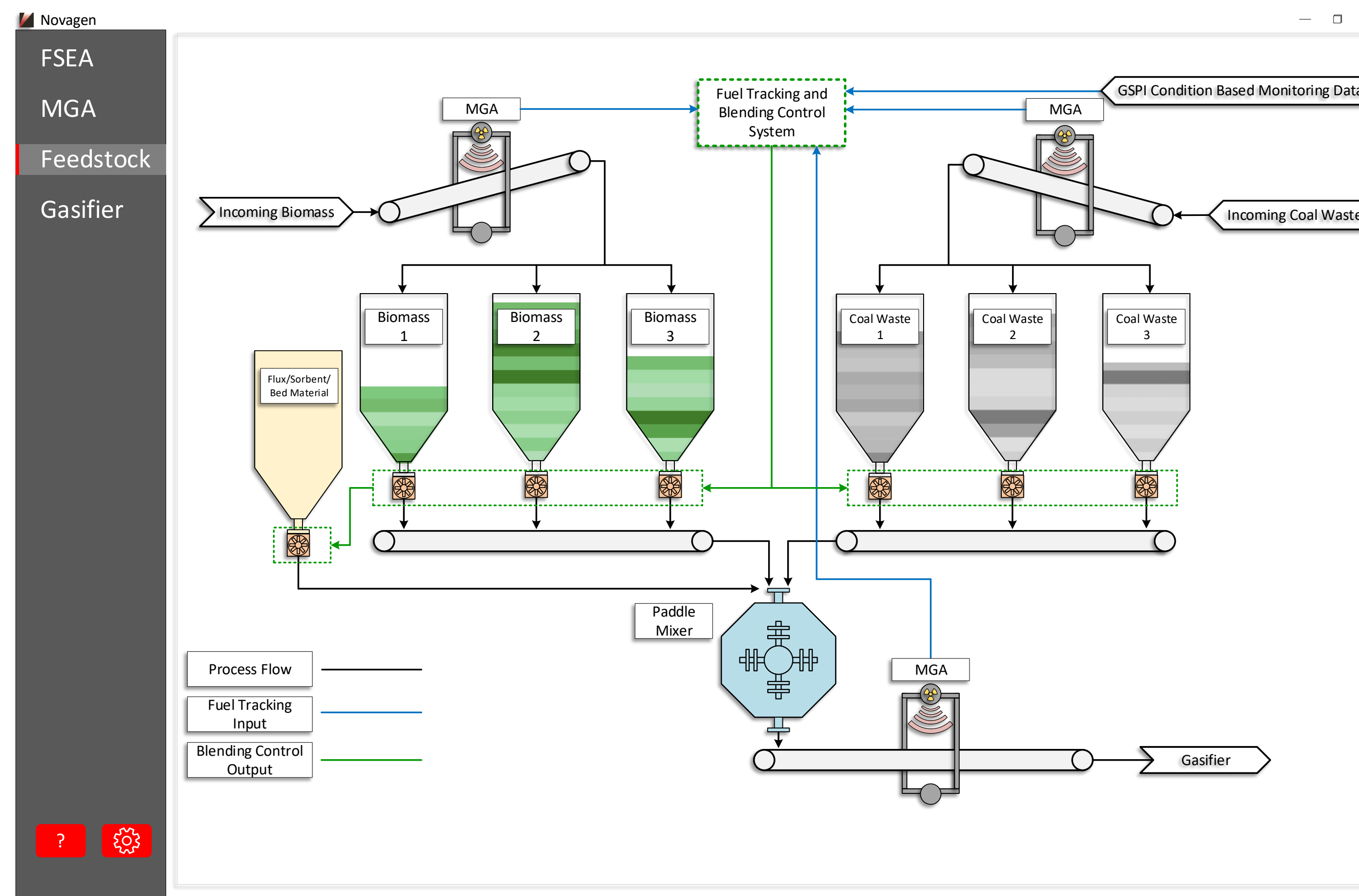
Demonstrate at a bench-scale MTI's Novagen™ software product to manage feedstock properties and to optimize gasifier operations online that will allow for utilization of waste coal and biomass to produce low-cost carbon neutral and carbon-negative hydrogen.

Feedstock Properties

- Collected and analyzed biomass and coal waste samples
- Biomass: low ash (0.7-10%), high levels P and K in leafy biomass, high quartz
- Coal Waste: high ash (20-60%), aluminosilicate and pyrite-based material
- Simulated fluctuations in biomass and coal waste from analysis database
- As-delivered mixed biomass and coal waste properties over time



Novagen™ Feedstock Blend Optimization

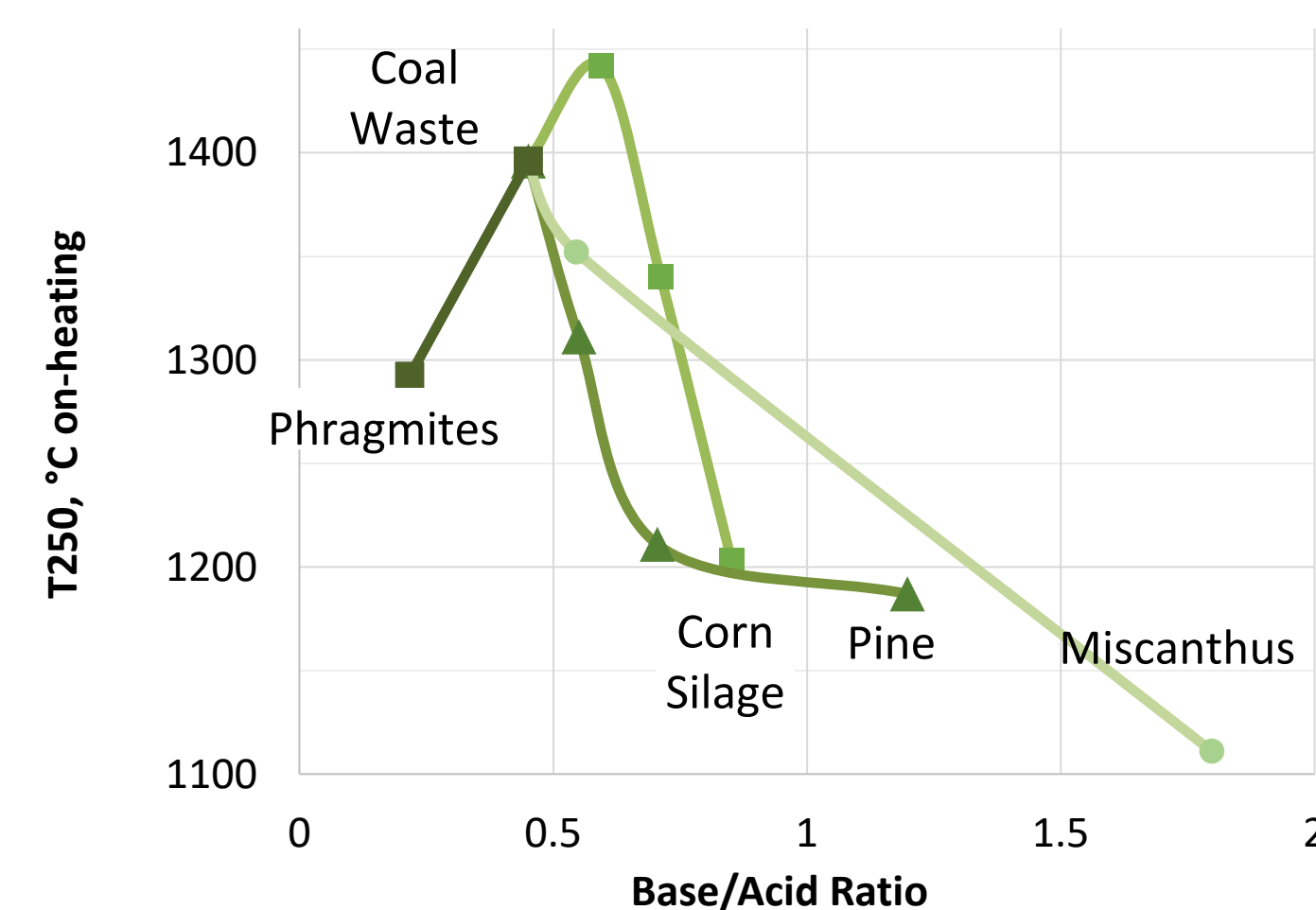


- **Tracking and Monitoring Feedstock Properties:** visual displays of feedstock properties through feedstock handling systems alerts operations personnel to changes in feedstock properties and aids in root cause analysis of unit disruptions.
- **Additive Control:** controlling additive feed rates based on measured feedstock properties and simulated plant performance.
- **Sorting and Blending Feedstocks:** simultaneously controlling sorting and blending operations to achieve target fuel properties and plant performance indices (performed as part of the Phase I effort). Extends gasifier unit life through fine-tuned control of blended fuel properties

Ash Behavior Testing

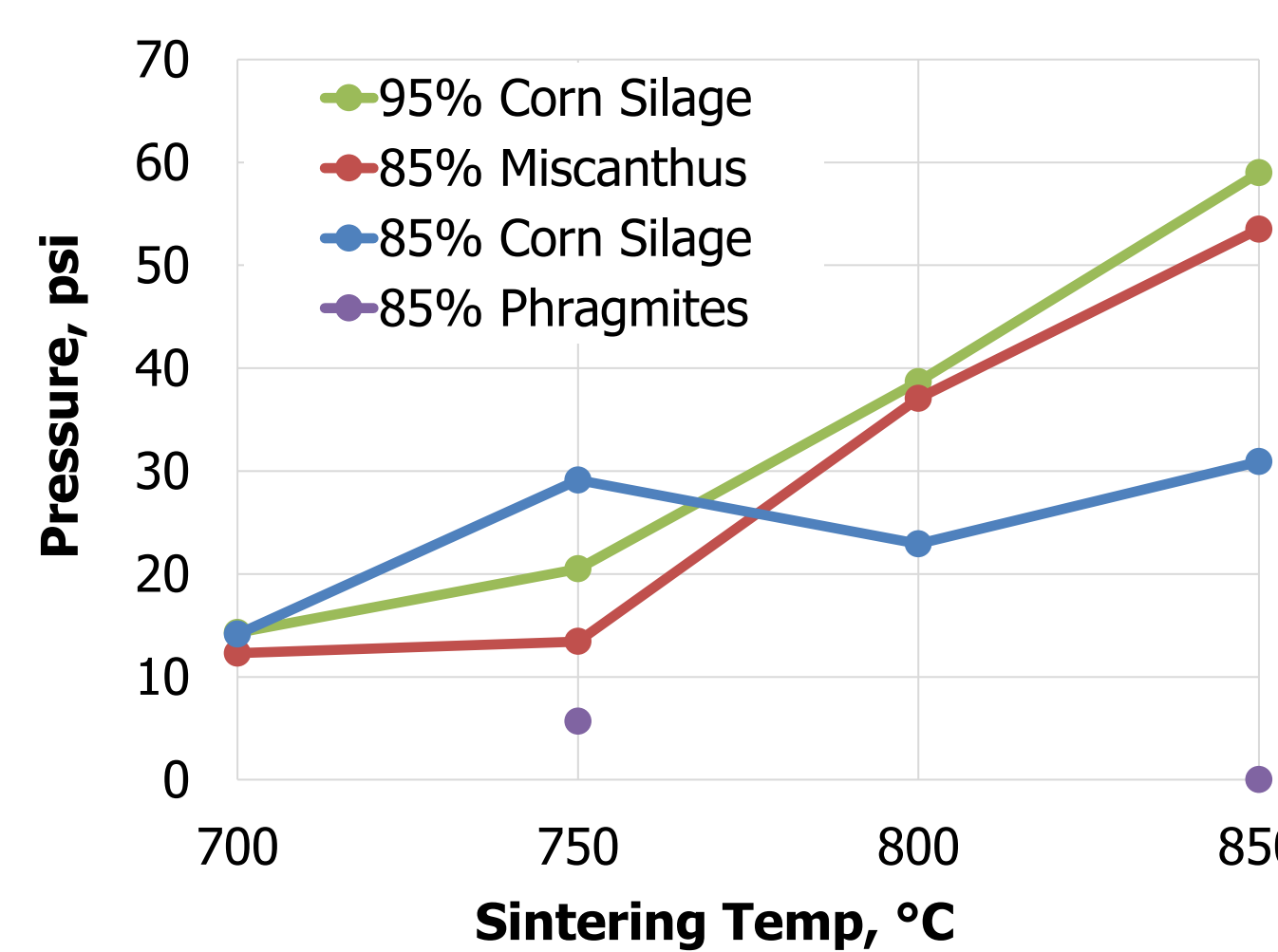
Viscosity-Temperature Relationship

- Coal waste: higher viscosity ash
- Pure biomass: more agglomeration
- T₂₅₀ responds non-linearly to blend ratio between biomass and coal waste depending upon biomass type

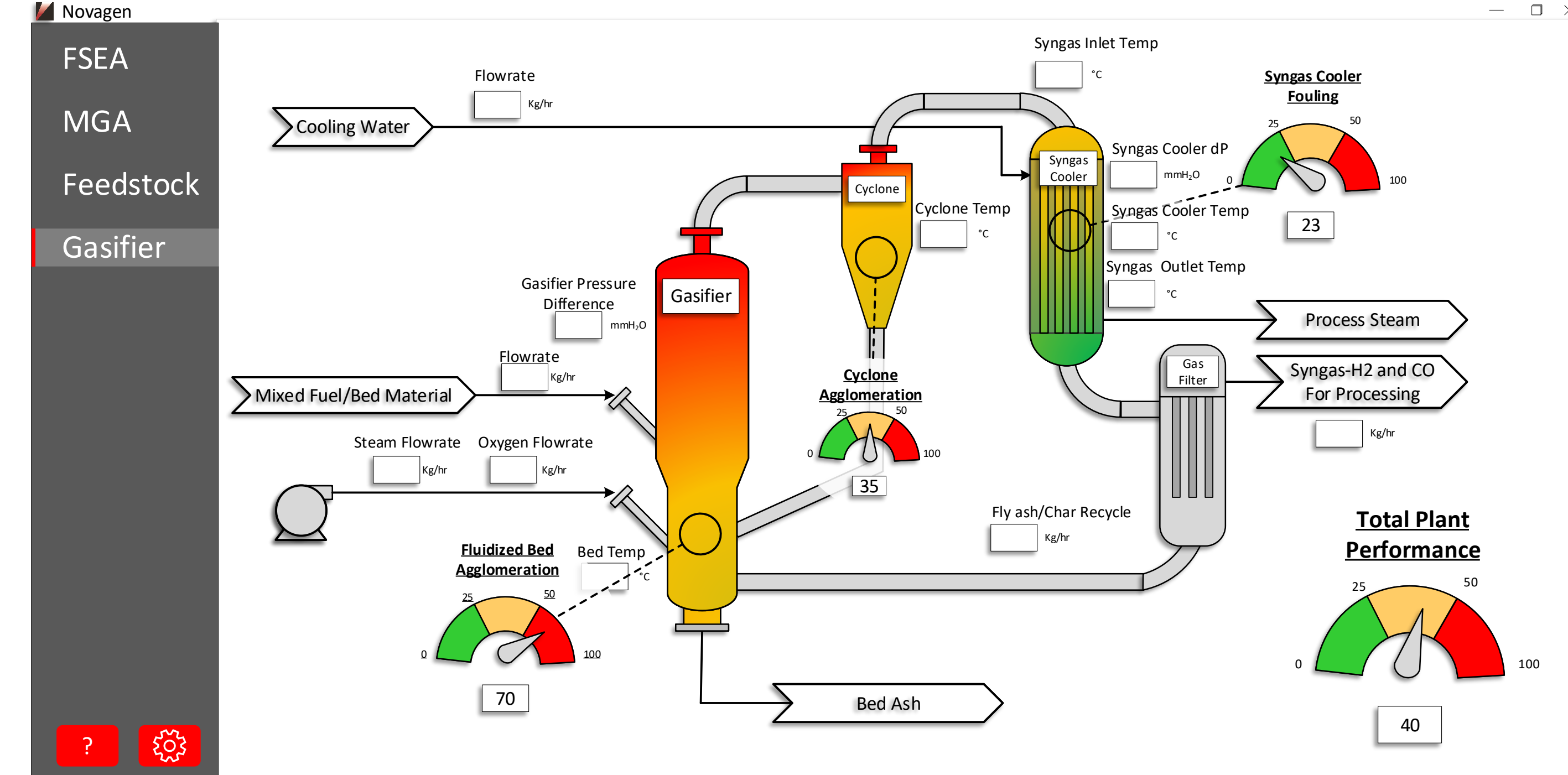


Sintered Ash Strength

- Coal waste dilutes bonding phases
- Potassium levels dictate sintered strength
- Aluminosilicate-based biomasses exhibit low strength development



Novagen™ Gasifier Performance Optimization



- **Predicting Plant Performance:** calculate indicators of plant performance to improve operations (performed as part of the Phase I effort). Prevents deterioration of component performance by alerting operators to component performance in real time.
- **Forecasting Plant Performance:** project future plant performance using neural networks. Aids in longer term decision-making on the order of days and weeks. Lowers risk of operating, enabling longer run time and more efficient operations.

Gasifier Performance Simulations

- Sorted, blended, and gasified biomass/coal waste feedstocks using Novagen™ blending tool
- Compared Novagen™ blended scenario to biomass and coal waste baseline scenarios
- Simulated gasifier performance: unit shuts down once bed agglomeration or syngas cooler fouling is too severe
- Biomass: syngas cooler fouls rapidly
- Coal waste: bed agglomeration due to rapid buildup of ash
- Novagen™ blended scenario optimized gasifier performance; 10-30% availability improvement
- Estimated 5% improvement in levelized cost of hydrogen from use of Novagen™ to optimize feedstocks and plant performance

