

# Analytical Capabilities at the National Renewable Energy Laboratory

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Edward J. Wolfrum, Ph.D.

Workshop - Leveraging 1<sup>st</sup>

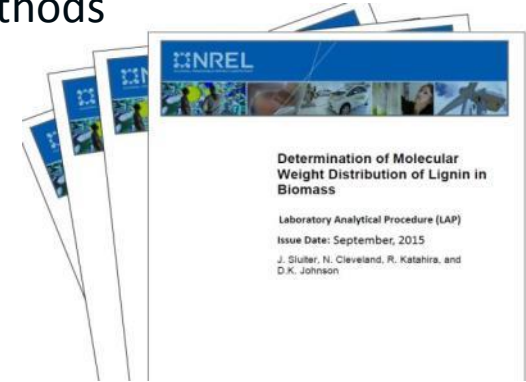
Generation Bioethanol Production

September 2019

# Analytical Development & Support at NREL

## Method Development

Collaborate to implement new analytical methods for improved speciation and mass closure



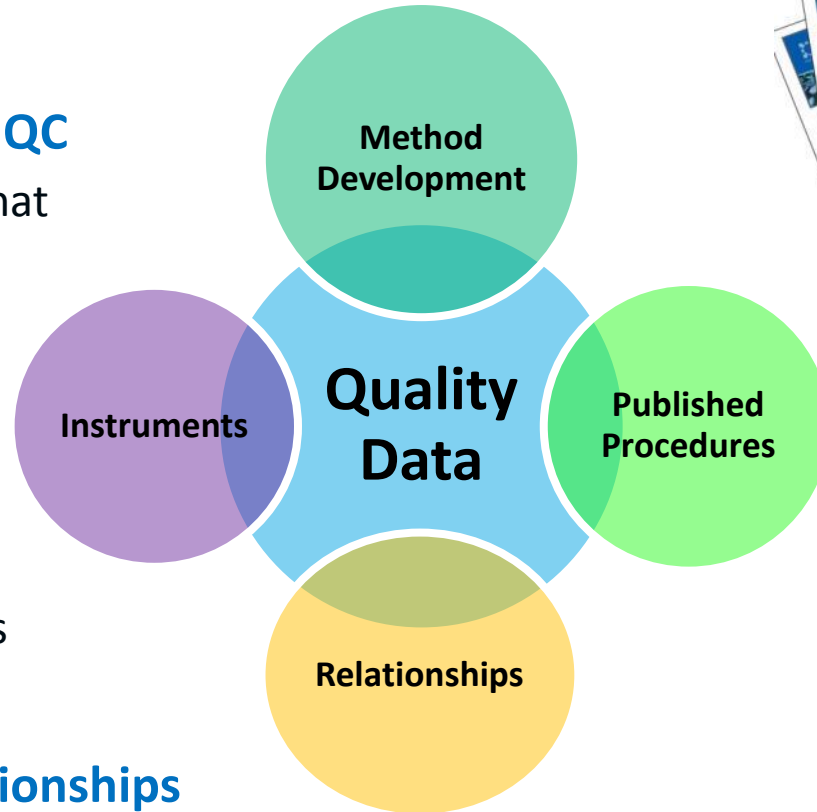
## Sample Coordination and QC

More than 14,600 analyses that support NREL researchers

## Laboratory Support

Maintain four analytical laboratories

Maintain existing instrumentation and identify and validate new instruments



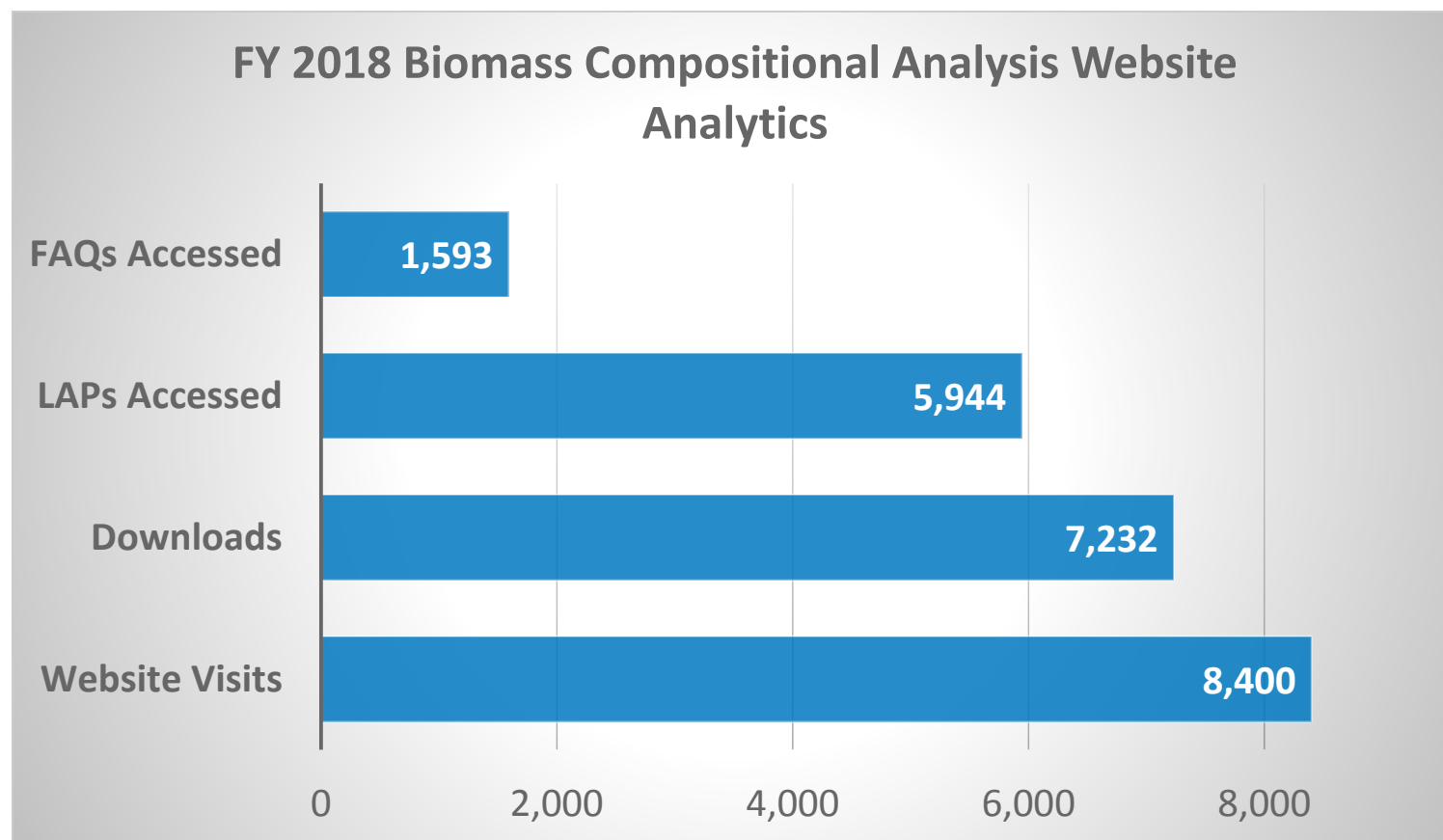
## Relationships

Cultivate relationships with industry, academia, and other laboratories

Maintain NIR calibration models for licensing to partners

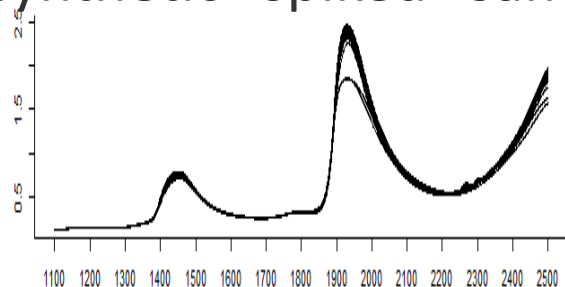
# Laboratory Analytical Procedures (LAPs)

**NREL is a leader in biofuels analysis and our methods let the world-wide community “speak the same language”**



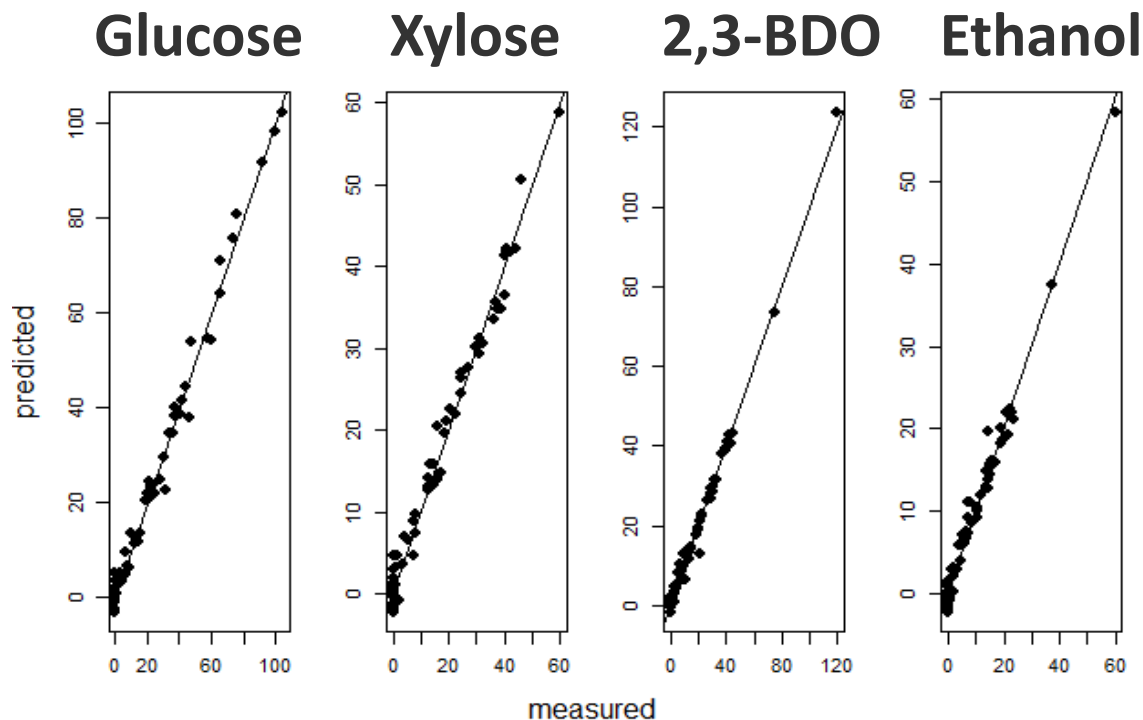
# Rapid Analysis using Near-Infrared Spectroscopy

- At-line measurement of glucose, xylose, ethanol, and 2,3-butanediol (BDO)
- Model used a combination of fermentation broth samples and synthetic “spiked” samples to build a robust calibration model



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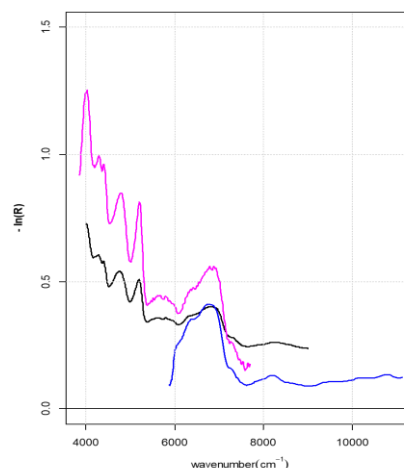
Glucose	Xylose	Ethanol	BDO
0	0	0	37.5
0	0	0	60
33.7	12.7	22.5	10.5
24.7	8.2	3	14.2
6	4.5	12	17.2
25.5	12	0	12
18.7	30.7	21	13.5
6.7	7.5	39	15
21	15	28.5	15



# Low-cost NIR Spectrometers for Biomass Analysis

- Low-cost portable NIR spectrometers to reduce the time and cost for obtaining quality analytical results – ubiquitous hand-held sensors

Currently a cost-shared TCF project



Constituent	Parameter	Thermo-Antaris FT-NIR	TI NIRSCAN Nano EVM	Si-Ware NeoSpectra
	Spectral Range (nm)		1111-2500	900-1700
	# PCs	6	9	4
Glucan	R <sup>2</sup> -calibration	0.97	0.89	0.86
	RMSEC (g/L)	<b>0.30</b>	<b>0.60</b>	<b>0.70</b>
	R <sup>2</sup> -LOO CV	0.95	0.78	0.73
	RMSECV (g/L)	<b>0.50</b>	<b>0.90</b>	<b>1.00</b>
Xylan	R <sup>2</sup> -calibration	0.91	0.73	0.74
	RMSEC (g/L)	0.20	0.40	0.40
	R <sup>2</sup> -LOO CV	0.85	0.47	0.58
	RMSECV (g/L)	0.30	0.50	0.50
Lignin	R <sup>2</sup> -calibration	0.98	0.91	0.93
	RMSEC (g/L)	0.20	0.40	0.40
	R <sup>2</sup> -LOO CV	0.96	0.65	0.84
	RMSECV (g/L)	0.30	0.90	0.60