

# **Biodiesel Blends in Microturbines**

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**Poster Presentation**

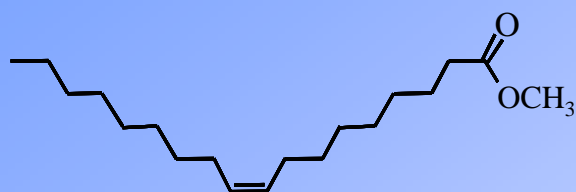
**C.R. Krishna**

**Brookhaven National Laboratory  
Energy Sciences and Technology  
Energy Resources Division**

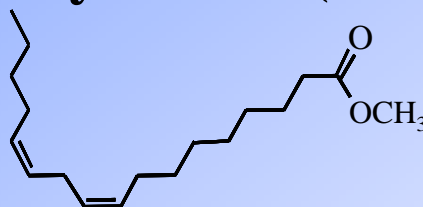
# Biodiesel Blends in Microturbines

## What is Biodiesel?

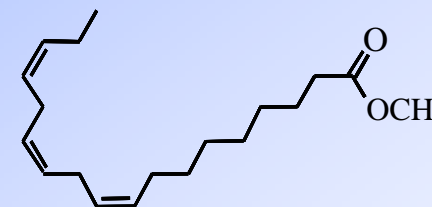
- Mono-alkyl esters of fatty acids (i.e. methyl or ethyl esters),
- Sometimes called soy methyl esters (SME)



oleic acid



linoleic acid



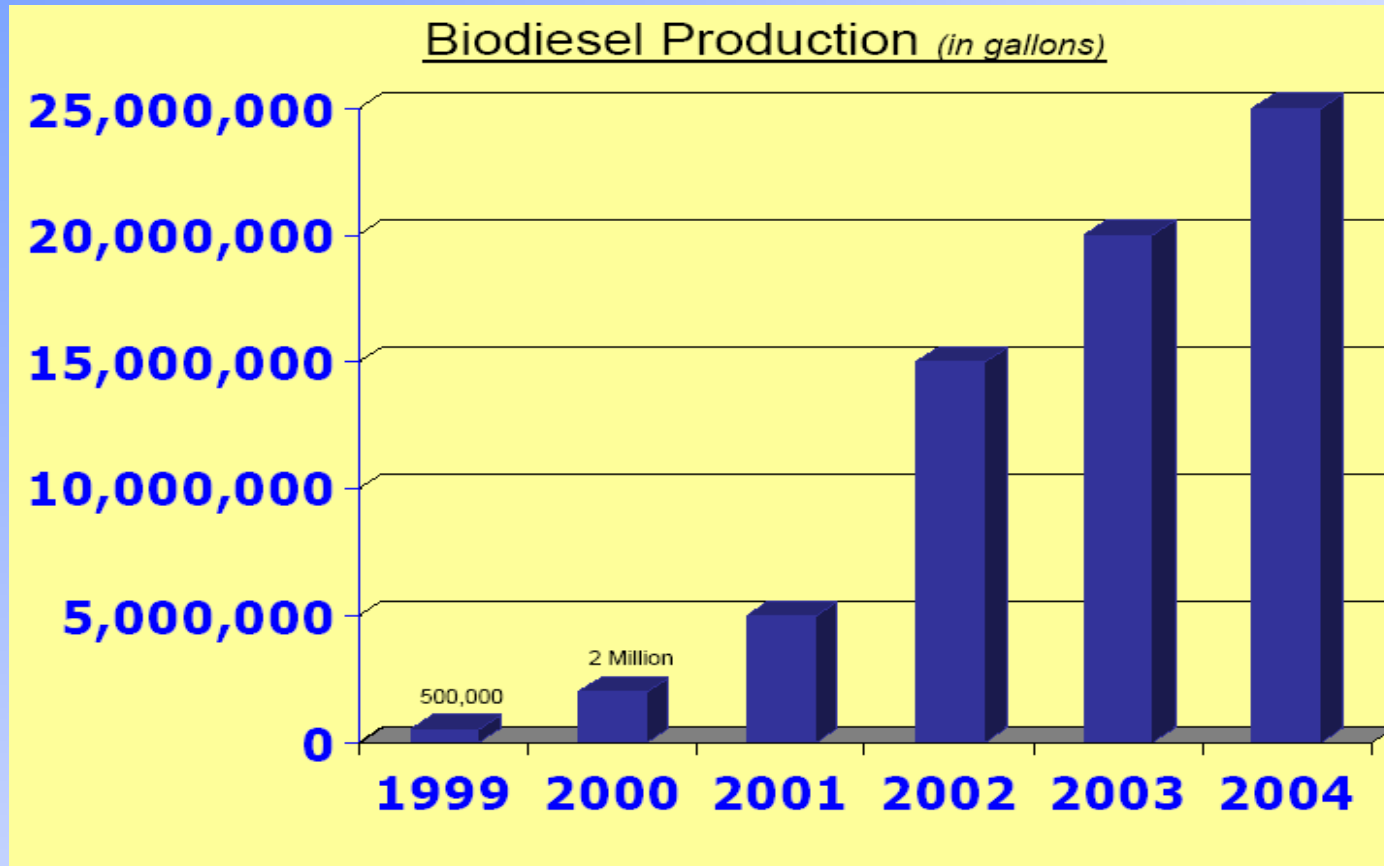
linolenic acid

100 lb triglyceride + 10 lb alcohol = 10 lb glycerine (byproduct) + 100 lb Mono-alkyl ester Biodiesel  
soy oil                      methanol

- In USA, must meet the requirements of ASTM D6751
- Typically used as blend with diesel/heating Oil

# Biodiesel production in the USA

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# **Biodiesel Blends in Microturbines**

## **Goals/Objectives (1)**

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- **Assess the performance of biodiesel blends in a Capstone 30 kW microturbine**
  - **Measure blend properties**
  - **Characterize injector spray with the blends**
    - **Drop size distribution measured with Malvern spray analyzer**

# **Biodiesel Blends in Microturbines**

## **Goals/Objectives (2)**

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- - **Measure Combustion performance**
    - **Efficiency, emissions**
  - **Measure performance in ‘long-term’ test**
    - **Changes in efficiency, emissions**
    - **Changes in internal parts**
      - **Deposits, corrosion, wear**

# Biodiesel Blends in Microturbines

## Biodiesel Blend Properties (1)

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- **Some Fuel Properties of Biodiesel blends in ASTM #2 heating oil**

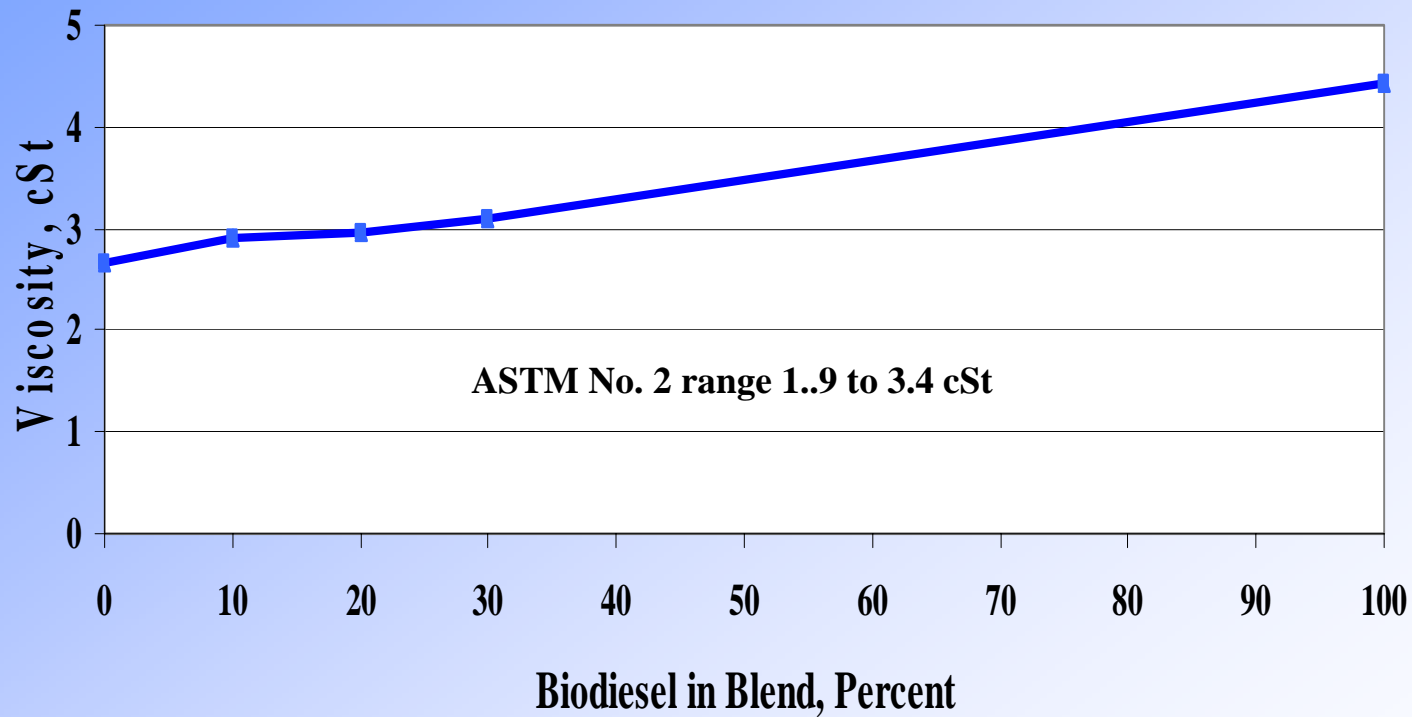
	ASTM	No. 2	B 10	B20	B30	B 100
Flash Point °C	38 min	63	64	66	68	123
Pour Point °C, max	-6	-24	-21	-18	-15	0
Viscosity at 40°C, Mm <sup>2</sup> /s	1.9/3.4	2.67	2.90	2.95	3.1	4.4
Heating Value, Btu/gal	140,000					126,000-130,000
kJ/l	(~39,000)					(35,100- 36,200)
Specific gravity	0.85					0.885

# Biodiesel Blends in Microturbines

## Blend properties (2)

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Viscosity of Biodiesel Blends

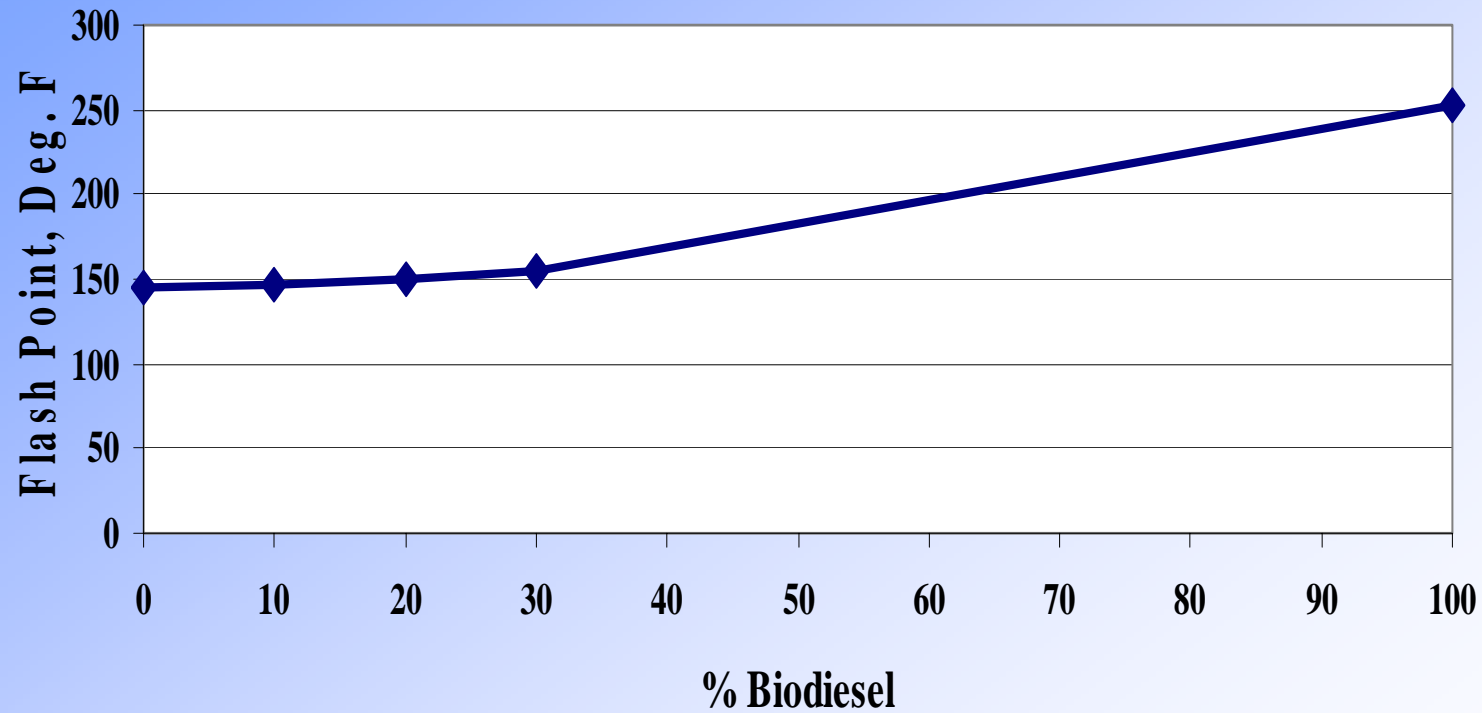


# Biodiesel Blends in Microturbines

## Blend Properties (3)

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Flash Points For Biodiesel





# Biodiesel Blends in Microturbines

## Malvern Spray Analyzer set up (1)

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Brookhaven Science Associates  
U.S. Department of Energy

# Biodiesel Blends in Microturbines

## Malvern Spray Analyzer set up (2)

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Brookhaven Science Associates  
U.S. Department of Energy

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NATIONAL LABORATORY

# Biodiesel Blends in Microturbines

## Major Milestones

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- **Characterize Injector**--- End of second quarter
- **Complete assessment of performance tests**--- End of sixth quarter
- **Deliver final report**--- End of eighth quarter

# **Biodiesel Blends in Microturbines**

## **Team Members and Partners**

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- **Brookhaven National Laboratory**
  - **C.R. Krishna, Yusuf Celebi, Roger McDonald, Toshi Sugama (Corrosion studies), Thomas Butcher**
- **Capstone Corporation**
  - **Steve Gillette, Craig Smugeresky**
    - **Upgraded fuel system and control software**
    - **Will provide injector for spray measurement**
- **Contacts**
  - **Oak Ridge National Laboratory (ORNL)**
    - **John Storey**
      - **Coordinate with ORNL work on opportunity fuels**

# **Biodiesel Blends in Microturbines**

## **Benefits to DE program goals**

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- **Promote the use of biofuels in microturbines**
  - **Obvious green gas reduction benefit**
  - **Potential other emission reductions if demonstrated**
    - **NO<sub>x</sub>, PM**
  - **Could benefit long-term operations due to**
    - **Lower sulfur levels**
    - **Lower flame particulate levels**

# **Biodiesel Blends in Microturbines**

## **Technology Transfer and/or outreach activities**

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- **None so far**

# **Biodiesel Blends in Microturbines**

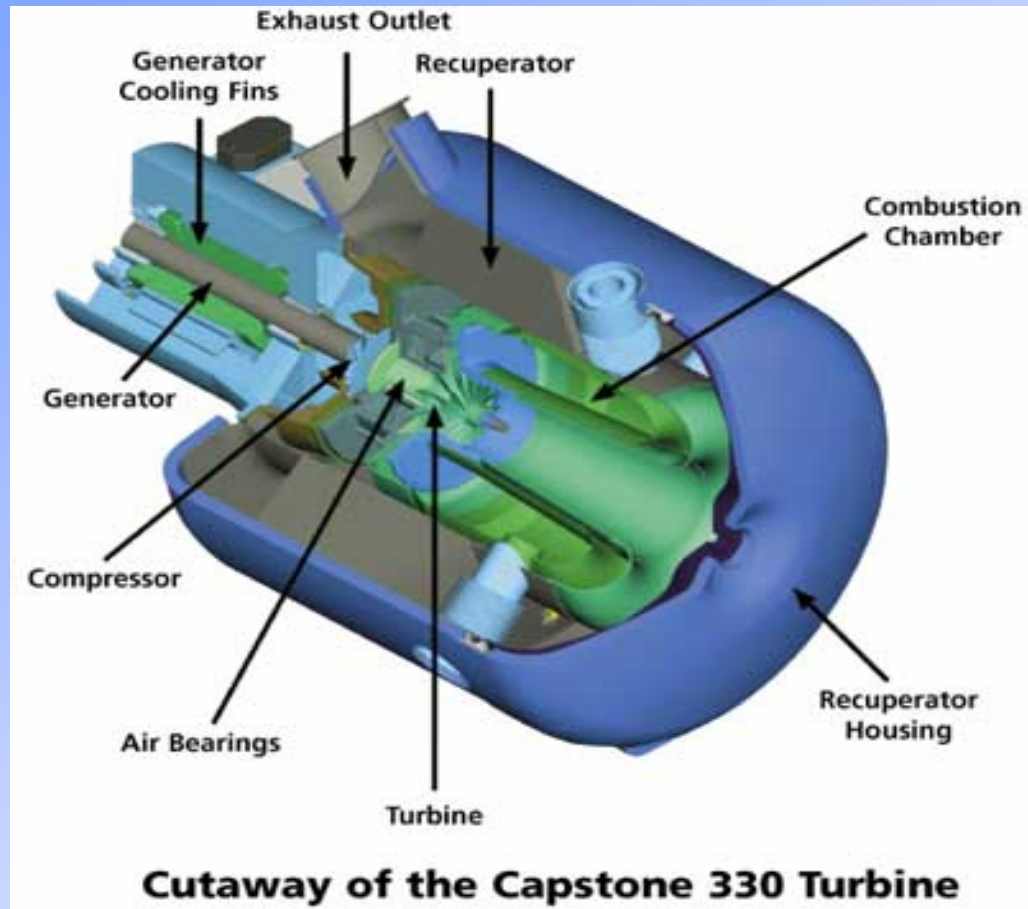
## **Preliminary results**

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- **Only preliminary test results available at this time**
  - **Base line and blends of B 5 and B 20 tested**
    - **Limited measurements of combustion performance**
  - **Following slide gives a sample of the results**

# Biodiesel Blends in Microturbines

## Capstone Turbine

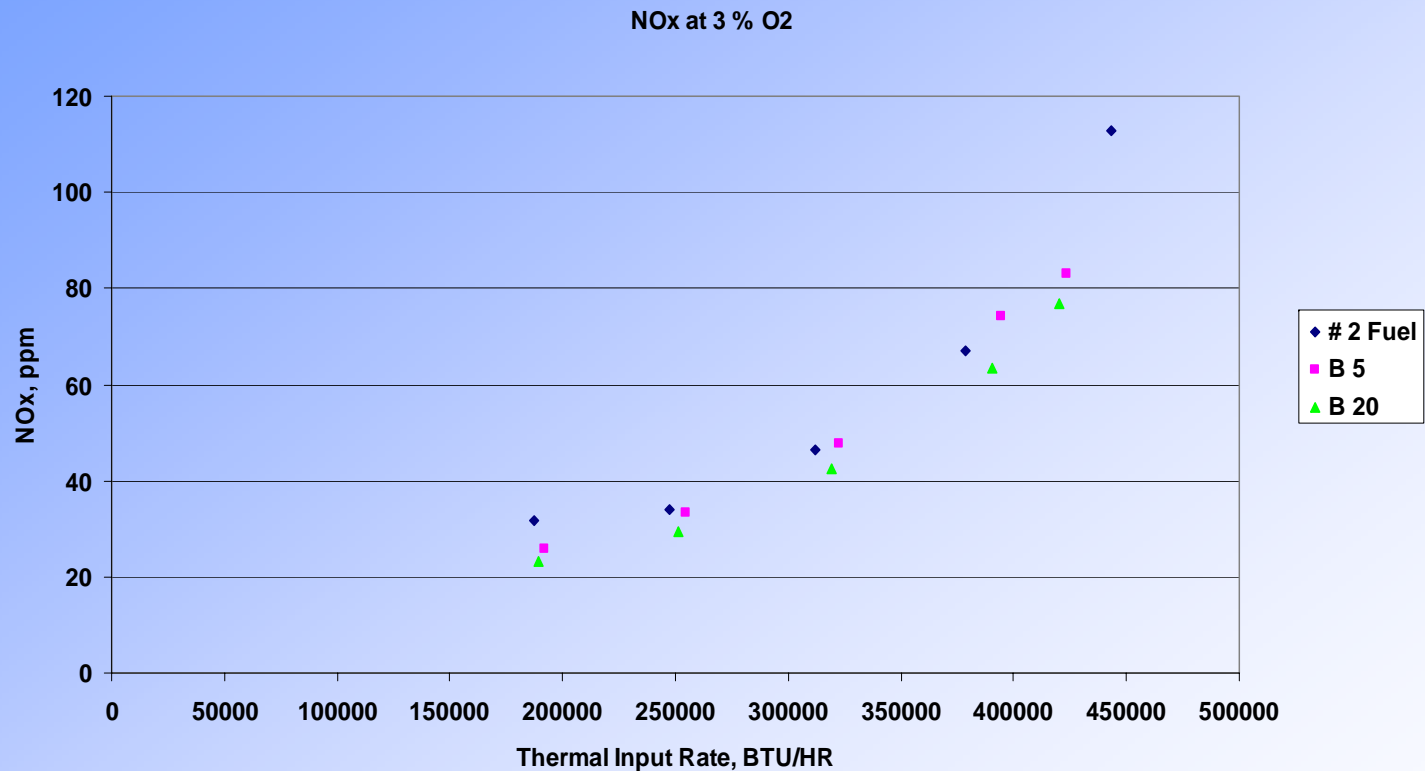


From <http://www.microturbine.com/>



# Biodiesel Blends in Microturbines

## Preliminary NO<sub>x</sub> emission data



# **Biodiesel Blends in Microturbines**

## **Possible Barriers to successful performance**

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- **‘Lubricity’ effects if found**
- **Viscosity limits at high biodiesel blends**
- **Flash point limits at high blends**
- **Effects on non-metallic materials in contact with blends**
- **‘Unexpected’ corrosion**

# **Biodiesel Blends in Microturbines**

## **FY 2006 and 2007 plans**

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- **Measure injector spray characteristics**
- **Complete combustion tests**
- **Complete long-term tests**