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# "Sustainable" Development, Energy, Land-Use Change, Assessment

*"Tryin' to make it real, compared to what?"*

**Collaborators include:**
- Gbadebo Oladosu and Paul Leiby (Economic modeling)
- Allen McBride (analysis - international LUC)
- Rebecca Efroymson (risk assessment)
- Virginia Dale (ecological modeling)
- Nagendra Singh, Esther Parish, Shujiang Kang (GIS, SWAT, EPIC)
- Lee Lynd (Dartmouth), Luis Cortez (Brazil) – Global Sust. Bioenergy
- Tom Wilbanks (climate change, vulnerability and adaptation)
- Alfred Nakatsuma-Vaca (USAID)

US Department of Energy

# Efforts to define Biofuel Sustainability

OBP/ORNL Contributions

**Regional Initiatives**

EU Directive

**National* Initiatives**

**International Bodies' Initiatives**

FAO | G8+5 | OECD | IDB | *IEA* | IFC | UNEP | *ISO*

**International Bodies' Initiatives**

PC 248 & TC 28/SC 7

***What land is available for agricultural expansion without affecting HCVAs?***

***Comparing empirical data to modeling***

***Data and models for improved assessments***

Balanced Scorecard

**National**

**Global**

Equator Principles

Rainforest Alliance

Renewable Transport

Environmental Institute (SEI)

Global Bioenergy Partnership (GBEP)

Task 39-Liquid Biofuels from Biomass

Sugarcane Discussion Group (SDG)

Roundtable on Sustainable Biofuels (RSB)

Renewable Fuel Standard (RFS)

Green Ethanol

Sugarcane Zoning

Sistema de Verificação, da Atividade Agropecuaria (IB)

Roundtable on Sustainable Palm Oil (RSPO)

European Committee for Standardization (CEN)

Low Carbon Fuel Standard (LCFS) Sub-national, CA

Council on Sustainable Biomass Production (CSBP)

Roundtable on Sustainable Soy (RTRS)

Better Sugarcane Initiative (BSI)

Certification System)

Bioenergy and Food Security Criteria & Indicators (BEFCSI)

Brazilian Biofuels Certification Program (PBCB)

National Commitment for the Improvement of Labor Conditions in Sugarcane

World Wildlife Fund (WWF)

* Australia Subnational, NSW

Source: NREL (Chum, Warner), UNICA

## Contributions:

- Field experiences applying concepts of "sustainability"

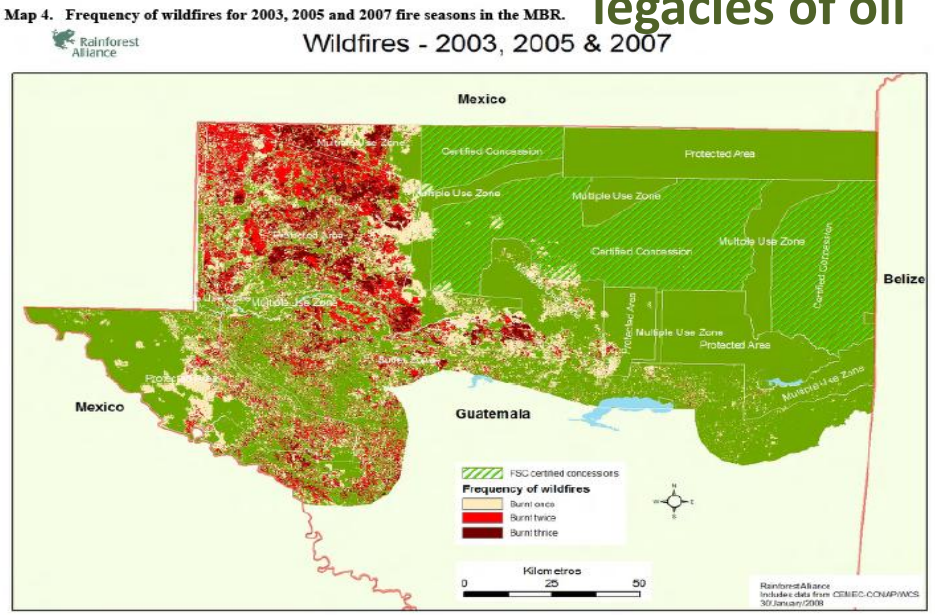
## Take aways:

- Expand collaborations to test indicators and conceptual frameworks
- Explore systems approaches to optimize for defined socio-economic & ecologic targets

## Questions/challenges:

- Attributions among multiple, complex interactions (causal analysis)
- How to address trade-offs among multiple goals

## Maya Biosphere Reserve: habitat loss, fires, water and soil contamination… legacies of oil




| Environment | Indicator | Units |
|---|---|---|
| **Water quality and quantity** | 5. Nitrate concentration in streams (and export) | concentration: mg/L; export: kg/ha/yr |
| | 6. Total phosphorus (P) concentration in streams (and export) | concentration: mg/L; export: kg/ha/yr |
| | 7. Suspended sediment concentration in streams (and export) | concentration: mg/L; export: kg/ha/yr |
| | 8. Herbicide concentration in streams (and export) | concentration: mg/L; export: kg/ha/yr |
| | 9. storm flow | L/s |
| | 10. Minimum base flow | L/s |
| | 11. Consumptive water use (incorporates base flow) | feedstock production: $m^3$/ha/day; biorefinery: $m^3$/day |

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### Indicators to support environmental sustainability of bioenergy systems

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