Current Issues in Biofuel Sustainability

And relevance for algal biofuels

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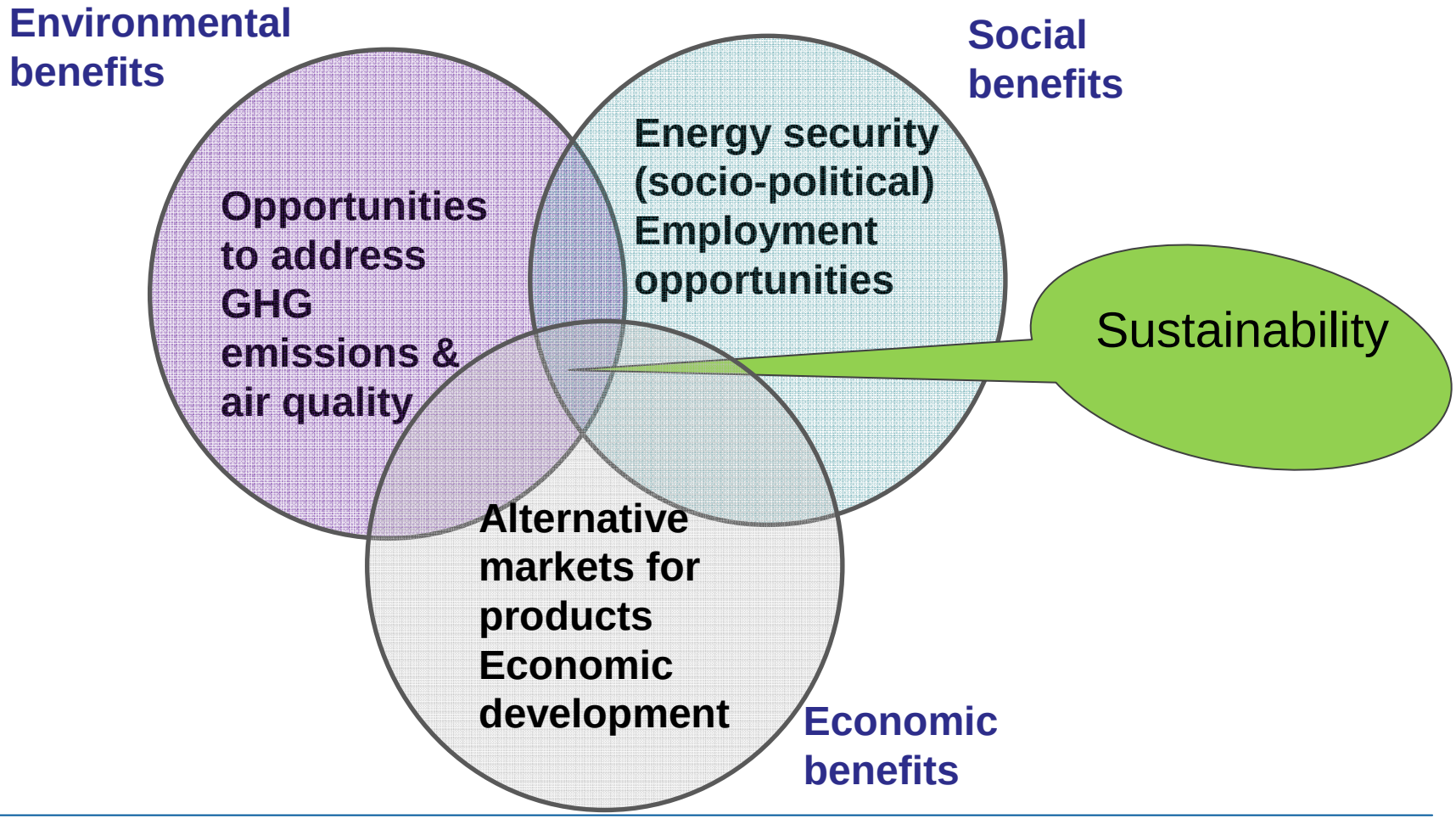
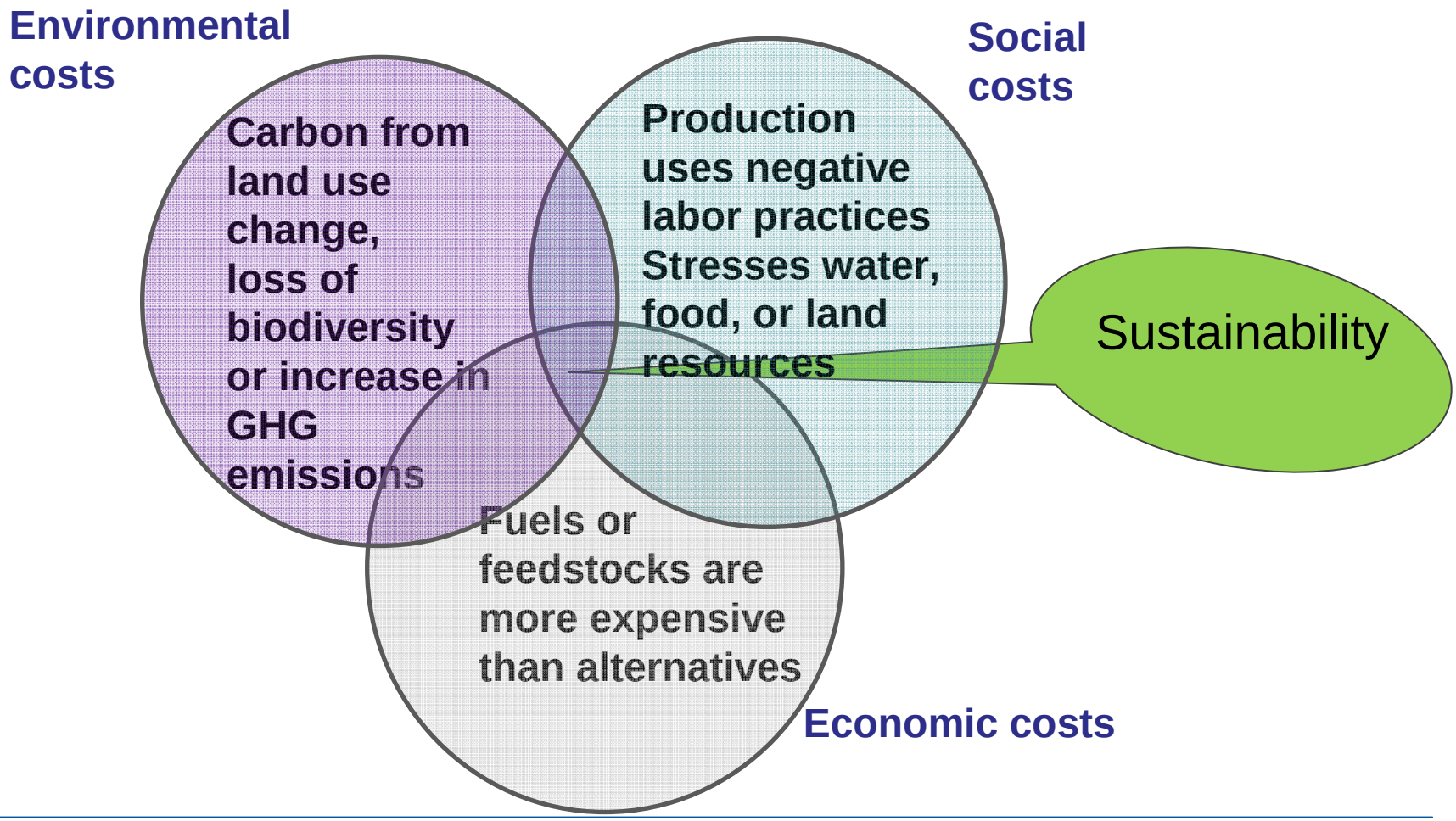
Overview

- What do we mean by biofuel sustainability?
- Recent key issues
- Policy and program responses to ‘sustainable’ biofuels
- Current views on algal biofuel sustainability
- Relevant lessons for algal biofuels

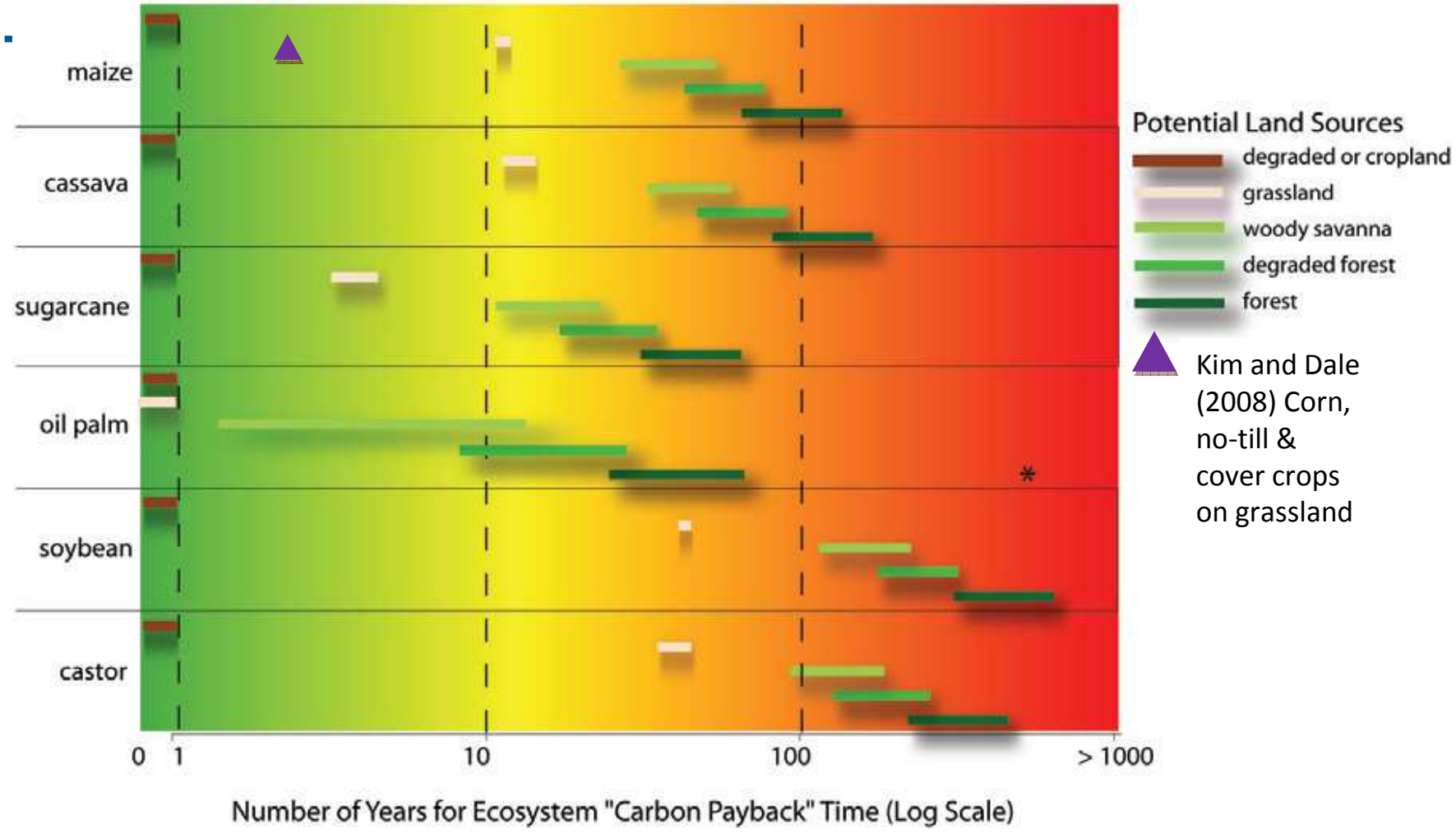
Potential biofuel sustainability benefits



Potential sustainability costs of biofuels

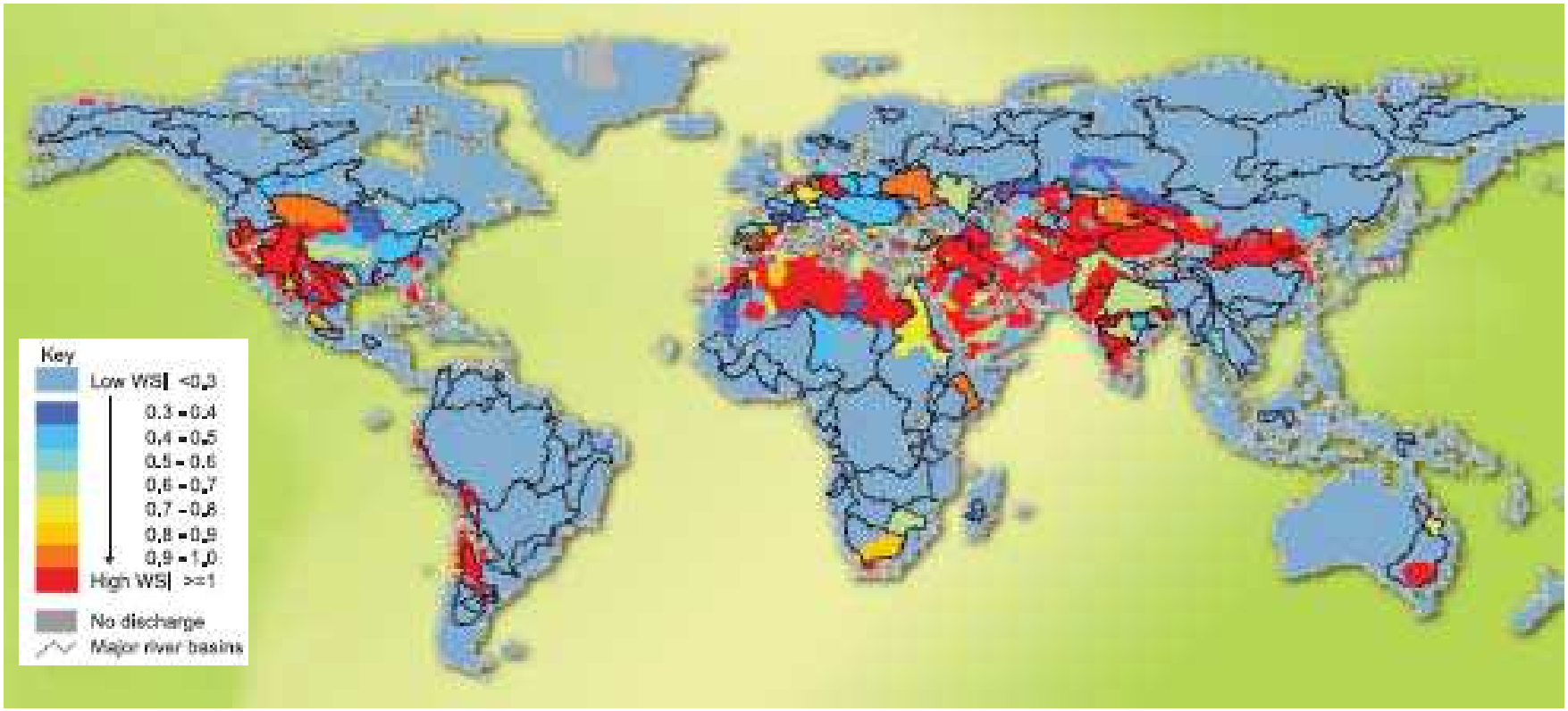


Some land use changes could negate GHG savings from bioenergy but others offer opportunities for sequestration



Source: Gibbs (2008) and Kim & Dale (2008)

Water scarcity



Source: International Water Management Institute

Food security

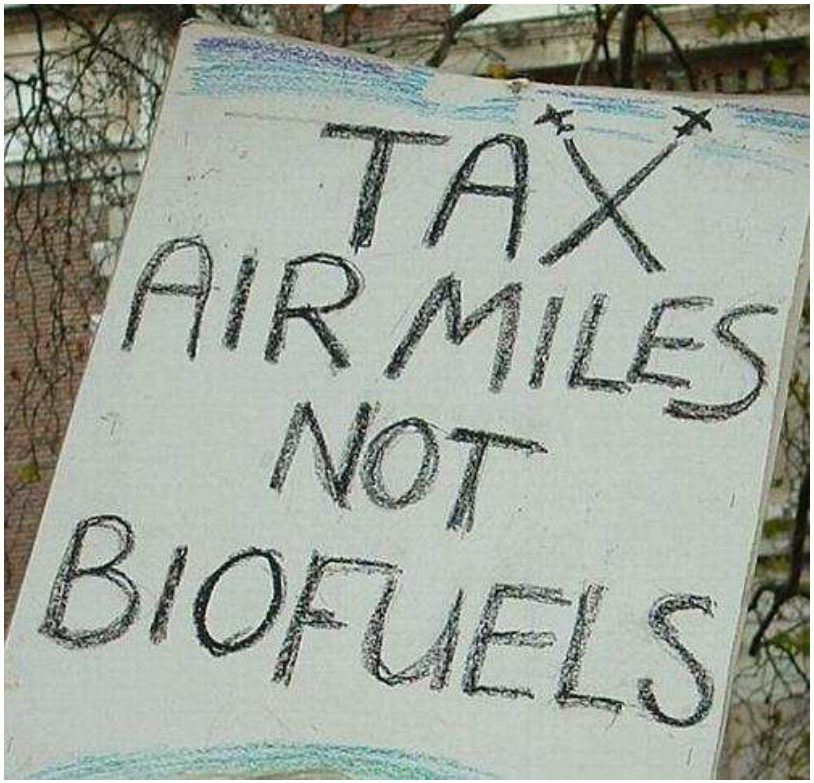
Risks

- Diverting resources from crops for food and feed
- Increasing water stress
- Increased prices for food and feed

Opportunities

- Increased income for producers
- Reduced reliance on (expensive) fossil fuels

Support for biofuels has changed to criticism in some regions and continues today



2006

2008

2010 APEC Sustainable Biofuel Policies, Programs and Practices Report

- There are a number of current policies and programs in APEC economies to encourage biofuels to be developed sustainably.
- Most are in response to realization of a specific negative impact.

Sustainability Criteria in Regulations

- US Renewable Fuel Standard:
  - Cellulosic and advanced biofuels must reduce GHG emissions 50-60% and provide 21 billion gallons
  - Conventional biofuels must reduce GHG emissions 20%, up to 15 billion gallons
- California Low Carbon Fuel Standard:
  - Performance based standard to reduce GHG emissions in transport fuel by 10% by 2020
- EU RED:
  - Must be at least 35% GHG emission reduction compared to fossil fuel (50% from 2017)
  - No raw material from lands with high biodiversity or high carbon stocks

Standards for sustainable bioenergy

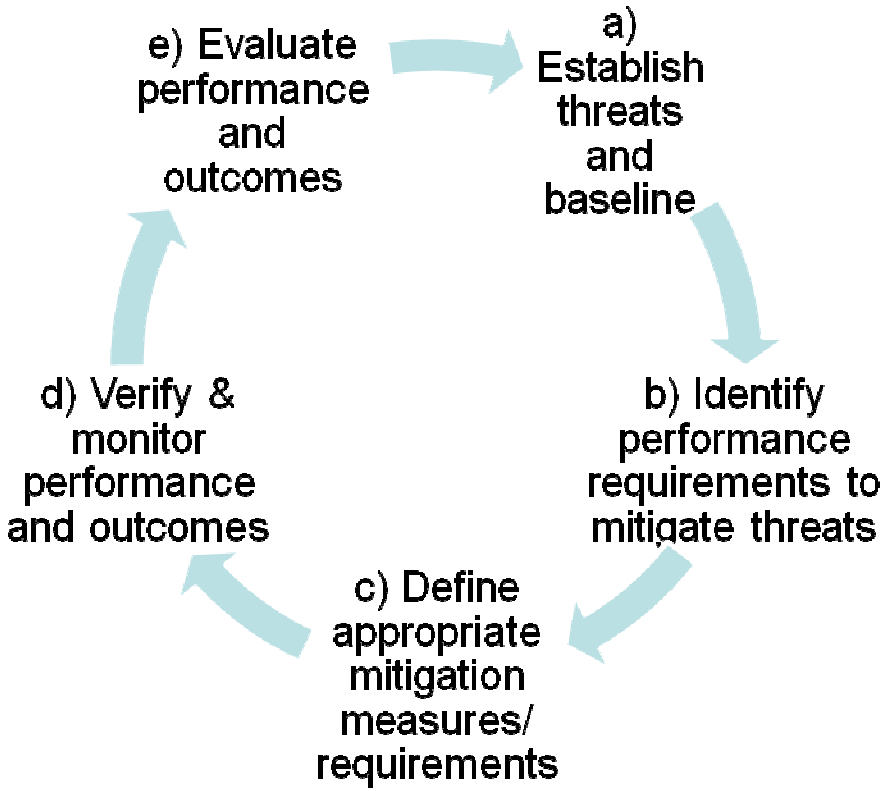
- Many entities have taken up the challenge to develop standards.
- Some attempt to be comprehensive, e.g. GBEP and RSB
- Others are feedstock oriented, e.g. BSI (sugar cane), RSPO (palm oil), RTRS (soy)
- Issues covered varies
- Only a handful are currently implemented

2010 APEC Sustainable Biofuel Policies, Programs and Practices Report

- Key concept 1:
  - There is no single feedstock, production process, or activity that can be promoted as a universally-sustainable solution.
  - Everything is location and situation specific

2010 APEC Sustainable Biofuel Policies, Programs and Practices Report

- Key concept 2:
  - *Planning* for and *Monitoring* a comprehensive range of *Impacts* to ensure that sustainability outcomes are achieved is critical.



Algal Biofuel Sustainability

- Currently promoted as fuel with sustainability outcomes, such as:
  - Do not require fresh water resources
  - Do not require pesticides, may not require fertilizers
  - Relatively lower GHG emissions
  - Lower land requirements
  - Do not compete with food or other uses of agriculture commodities
  - Recycle CO2 streams
  - Potential to treat contaminated water

Algal Biofuel Sustainability

- Potential sustainability concerns:
  - Inputs: fertilizers, methanol, electricity, thermal energy, water
    - Competition with other uses
    - Associated GHG emissions,
  - Safety of hydrogen by products
  - Biodiversity impacts and water contamination
  - Uncertainty of economic sustainability

Studies on algal biofuel sustainability

- Catie Ryan of Terrapin Bright Green, LLC – *The Promise of Algae Biofuels*
  - Look at environmental impacts of different production pathways at commercial scales
- Campbell, Beere and Batten – *Life Cycle Assessment of Biodiesel Production from Microalgae in Ponds*
  - Potential environmental impacts and economic viability of producing algae in ponds
  - LCA of notional production systems
- Pfromm, Amanor-Boadu, and Nelson – *Sustainability of Algae Derived Biodiesel: a Mass Balance Approach*
  - Use an carbon mass-balance approach instead of LCA
- Nexant – *Algae: Emerging Options for Sustainable Biofuels*
  - Addresses species diversity and risks of genetically modified algae species release, land use, carbon trading, etc.
- Williams, Innman, Aden, and Heath – *Environmental and Sustainability Factors Associated with Next Generation Biofuels in the US: What do we really know?*
  - Consider GHG emissions, air pollution, soil health and quality, water use and water quality, solid waste streams, biodiversity and land use changes

Relevant Lessons for Algal Biofuels

- Focusing on single issues for biofuels, could result in unintended consequences on others.
- Sustainability outcomes are not achieved by a single activity. Sustainable biofuels outcomes are achieved through a holistic, integrated approach that takes a wide range of impacts into consideration.
- Biofuels can deliver positive outcomes with the right framework to ensure sustainable outcomes are delivered
  - Sustainability in production process
  - Sustainability in implementation

Questions?

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