

# The California LCFS and Supporting Science

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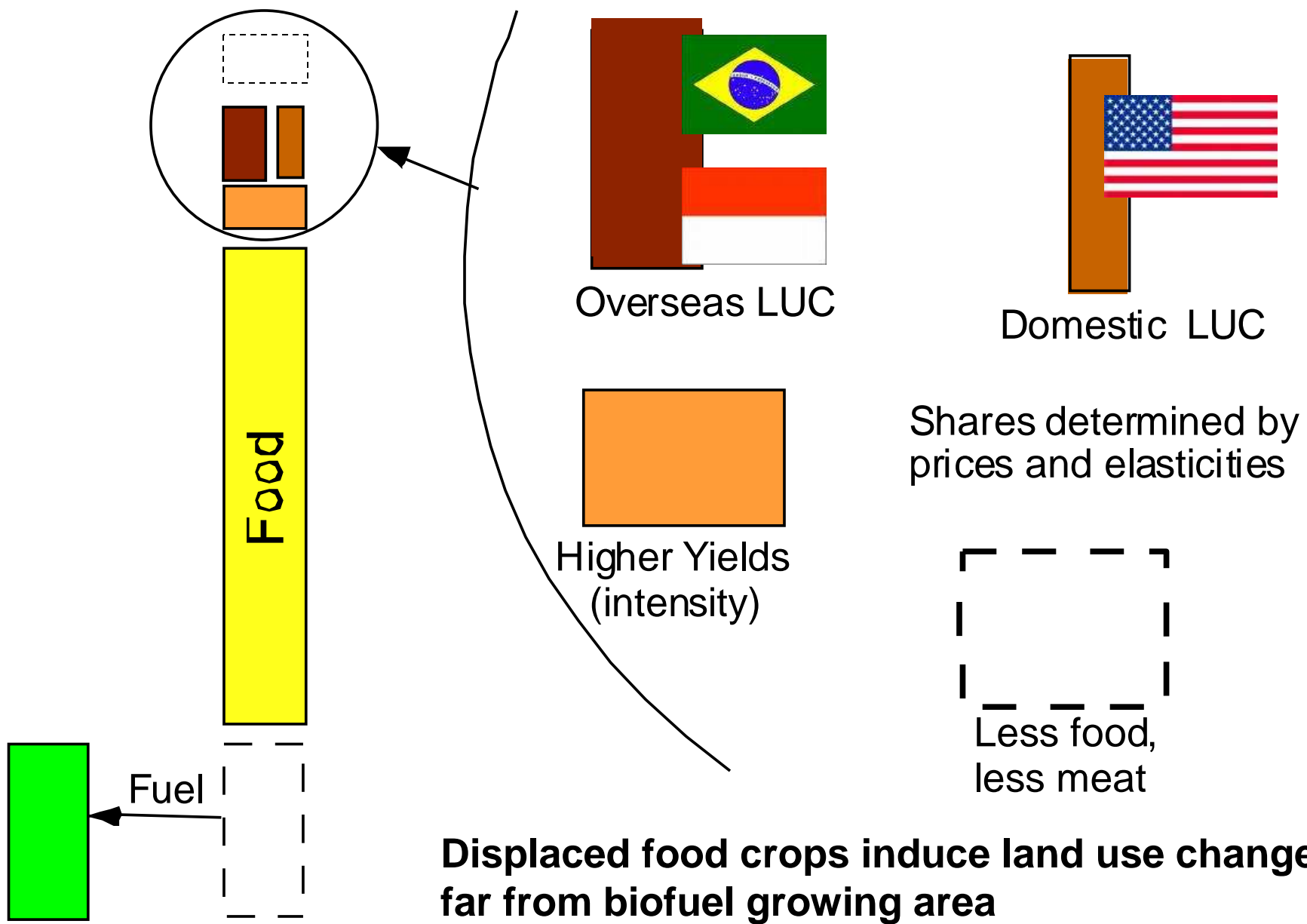
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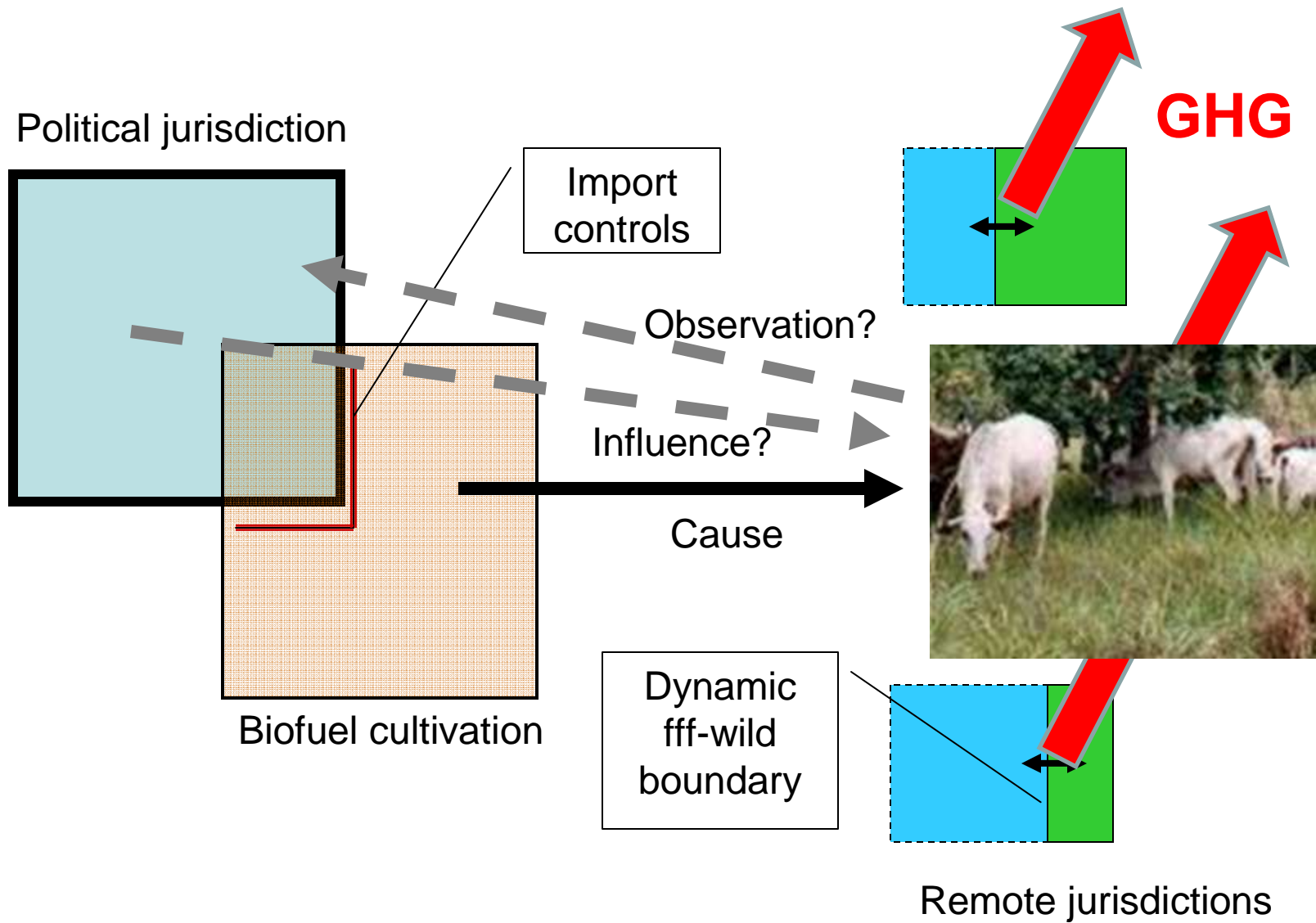
# Biofuels then and now

- 2006 (Farrell et al)
  - Energy independence, somewhat climate-friendly, generally green, compliance path for LCFS and EISA, “need to look at land use”.
- 2008 (Searchinger et al, Fargione et al)
  - Energy independence, but
  - Corn ethanol much worse for climate than gasoline
  - Other biofuels at least need another look
- 2009 (Various)
  - Land use change estimates accumulating
  - Conservative (biofuel favorable) estimates for LCFS:
    - Production period
    - Residence time
    - Food effects

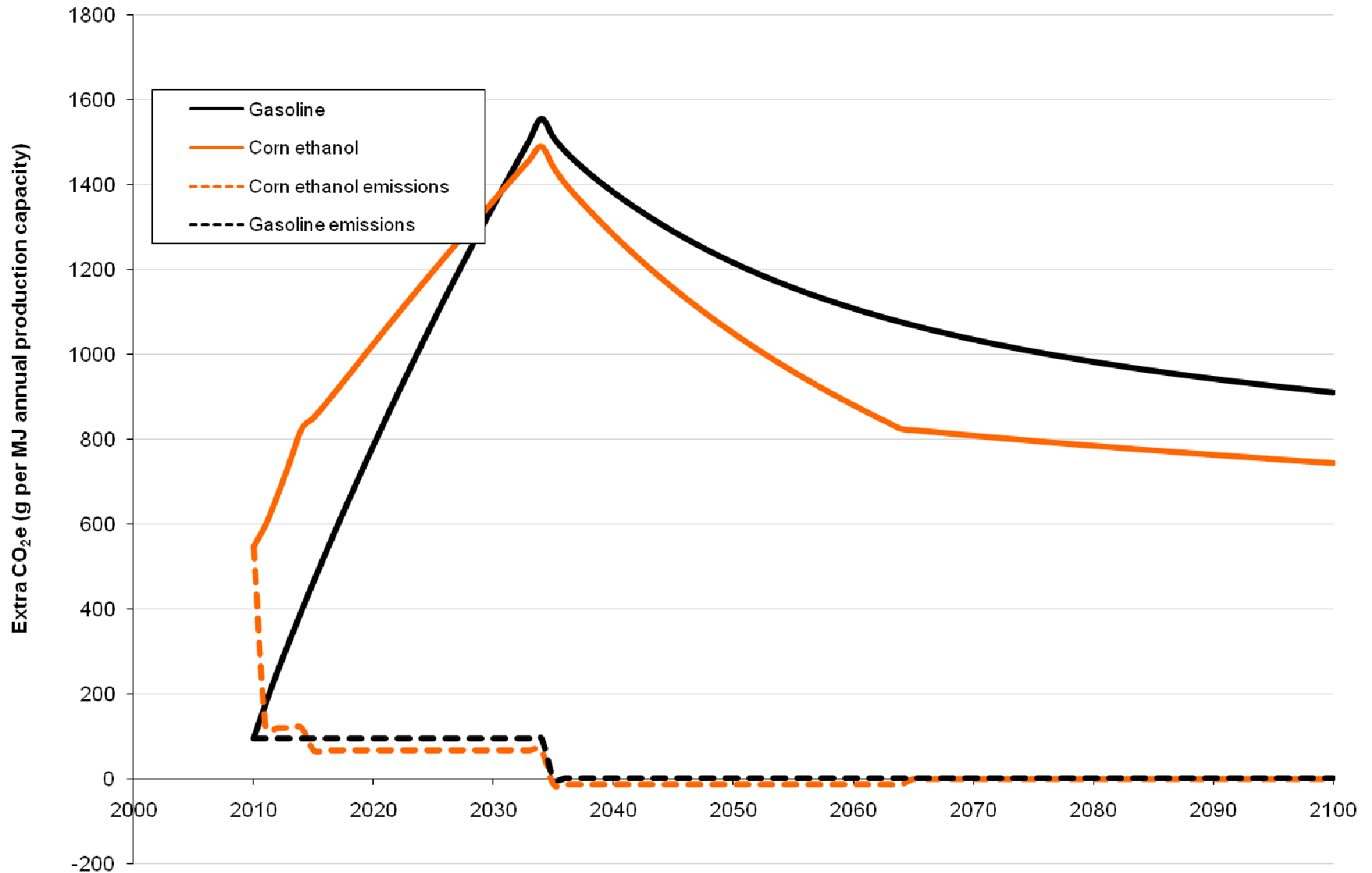
# Three big issues for ARB

- Should California have an LCFS?
  - What would it mean in practice to wait until uncertainty in economically consequential estimates is “low enough”?
- If so, should it use the best available estimates of indirect GW discharges?
  - Government owes its citizens the truth
  - Prices and regulatory practices are informative and consequential
- Should GW indices be adjusted over time to reflect accumulating science?





# Time and early discharges change GW estimation



# Conclusions

- ARB is well positioned to implement a Low Carbon Fuel Standard with the rule proposed
- Proper management of the LCFS will continuously incorporate new science
- The LCFS will provide accurate green incentives for new technology in CA and other jurisdictions that are watching us.





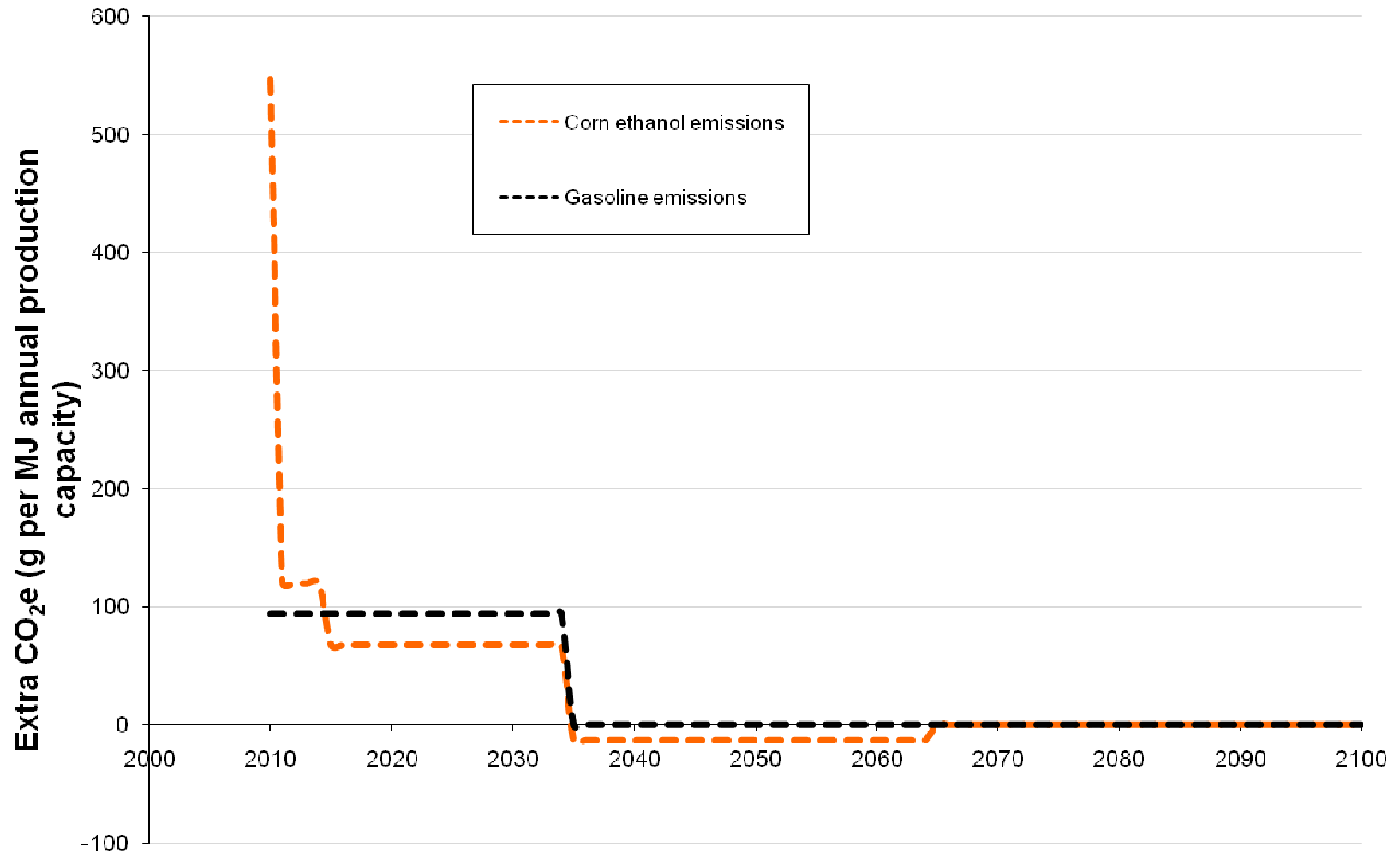
# Time and “counting” GHG

- A unit of GHG discharge now is much worse than a unit twenty years from now
  - Residence time
  - Irreversibilities: probability of a calamity such as collapse of a large grounded ice cap or stopping of the Gulf Stream that would vitiate further GHG reduction.
  - Stern-Nordhaus debate on discounting

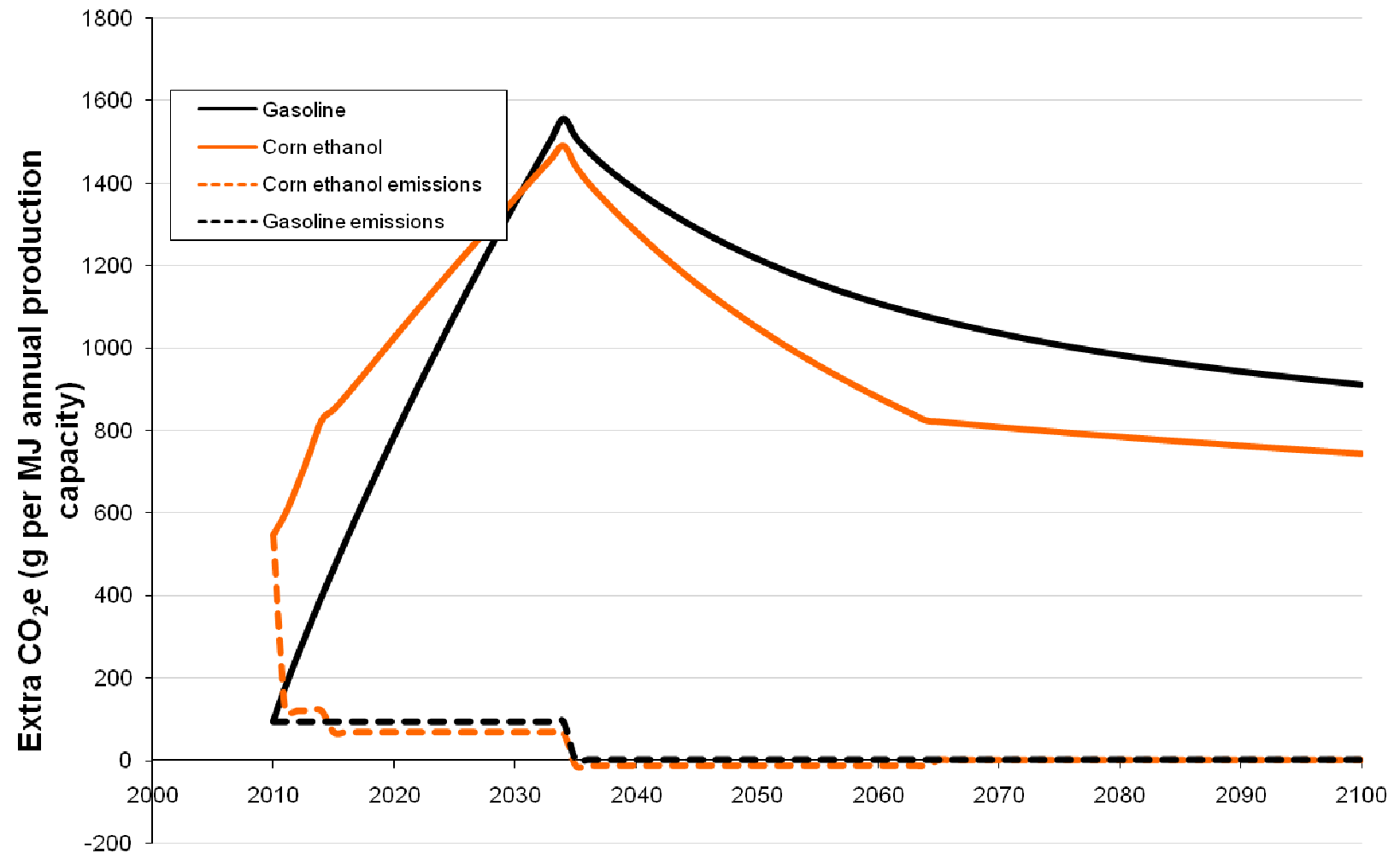
# Key time issues

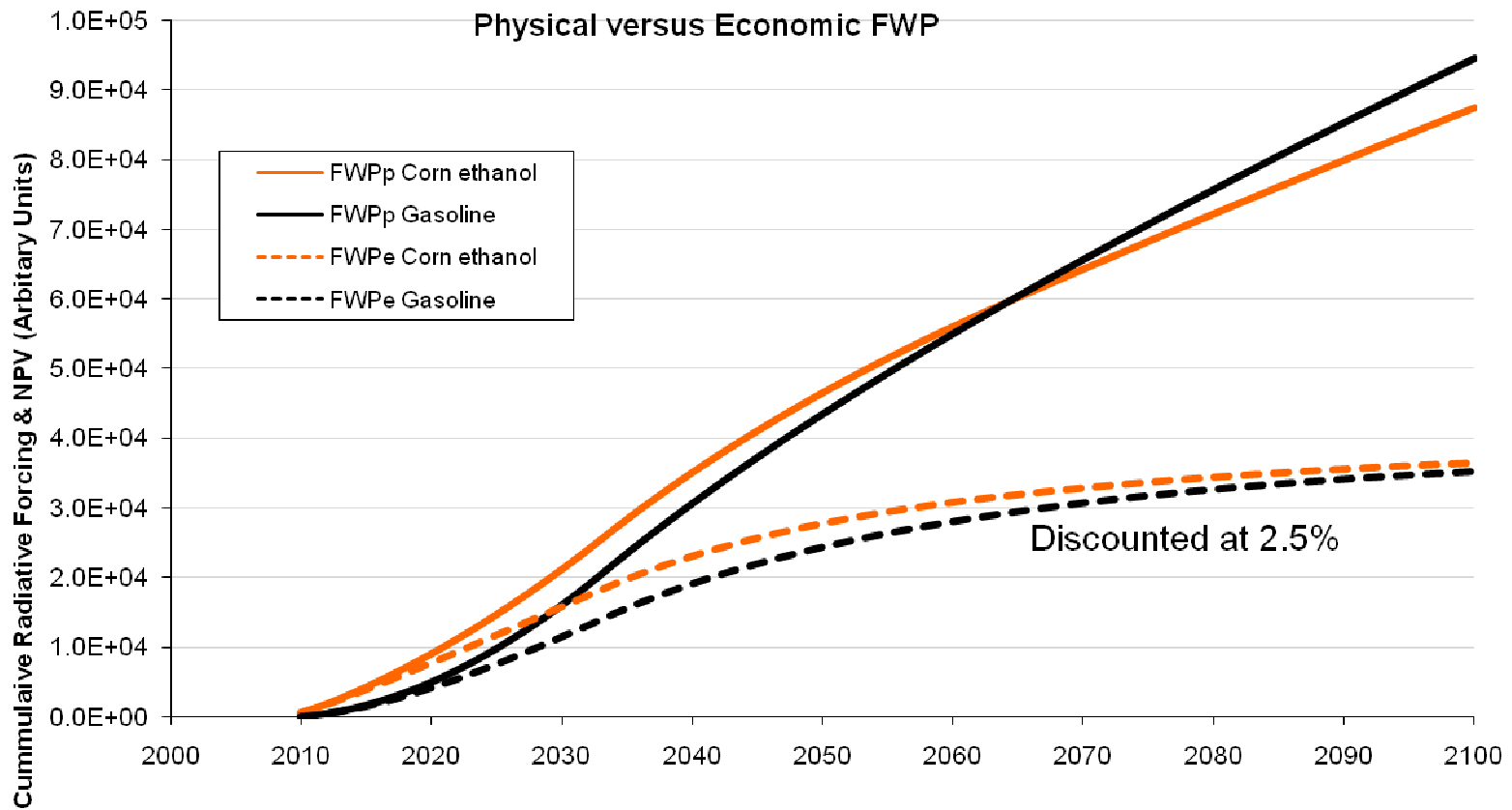
- Production period
- Analytic horizon
- Policy horizon
- Policy criterion:
  - Fuel carbon content
  - Atmospheric carbon at target time
  - Integral of carbon release
  - Warming
  - Social cost

Corn ethanol: 25 yrs production, 60g direct emissions, 776 g LUC, 30 yrs recovery of 50% of LUC

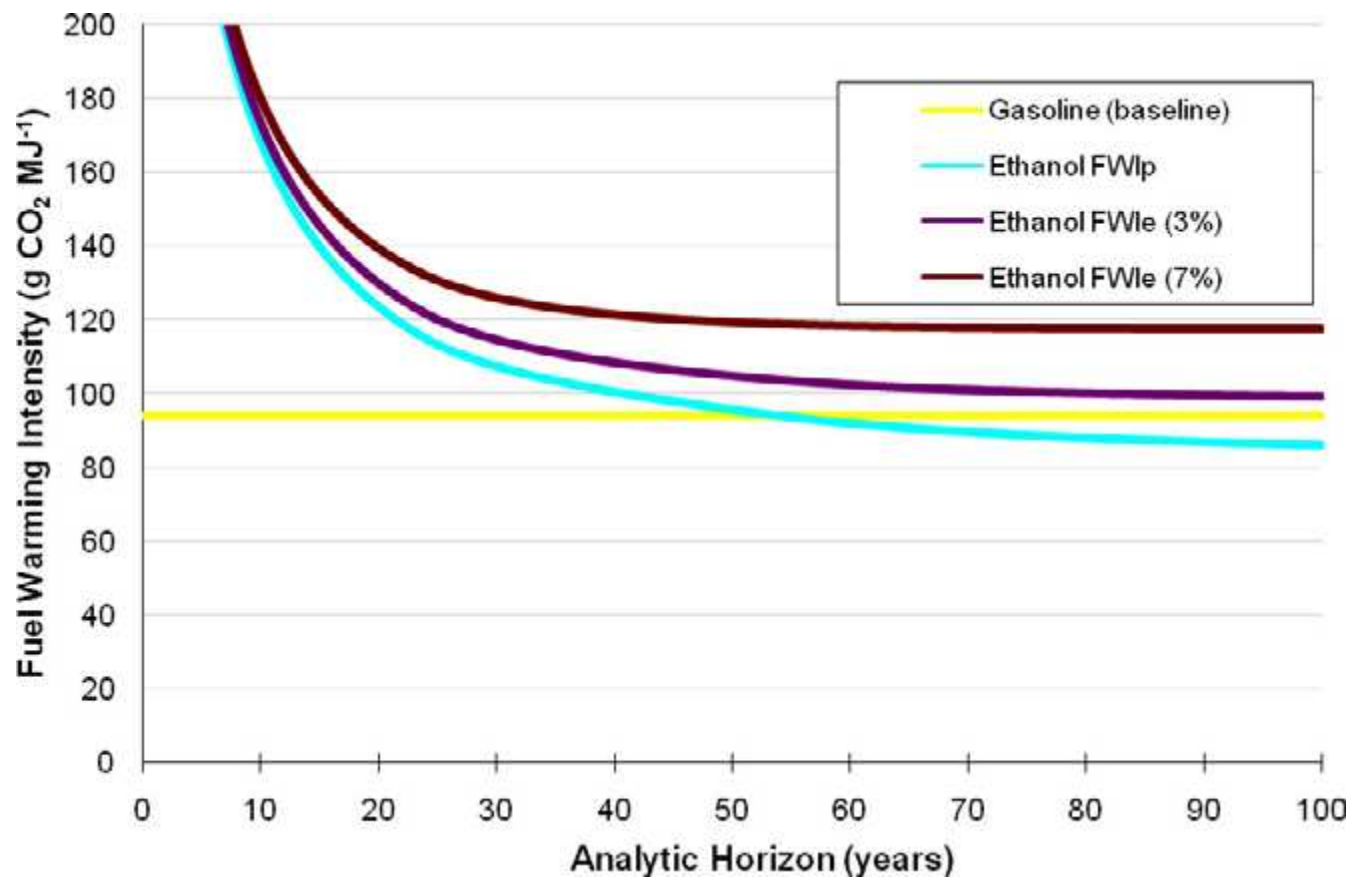


Corn ethanol: 25 yrs production, 60g direct emissions, 776 g LUC, 30 yrs recovery of 50% of LUC





FWP(t) is total warming up to time t



# Alternative model (NERA '09)

- Assume:
  - Flat amortization over any production period
  - Very long analytic horizon
  - 3% discount rate
  - -3% social cost of carbon (SCC) (increasing)
  - - 0.5% cost of GHG reduction
- Implies:
  - Never reduce GHG!



# How might these LUC AFCl results be too high/low?

- Higher yields of all crops
- Different allocations of “makeup” to different natural lands
- Better C stock & land use data
- Coproduct accounting
- Counting C recapture after production
- Albedo changes (eg, snow on former boreal/temperate forest land)
- Nitrogen cycle (yield increase from fertilizer)
- Other greenhouse gases (eg, cattle, rice methane)
- Extremely low-AFCl biofuel crops (e.g mixed perennials for biomass conversion)
- More conversion from lower-C land types (pasture)
- Increased cattle intensity/better practice
- Better elasticity estimates (price and converted land productivity)
- Food effects
- Production period amortization

*This is a research program for LCFS implementation*



# Brasil is important

- “Far end” of iLUC causal chain
- Is cane ethanol a good LCFS compliance path if we don't have corn ethanol?
- What about biodiesel?
- LUC is critical (CARB: 25 & 45 g)
- Local policy is critical
- Experience instructive for ROW

**Kenyan courts halt \$370 million sugarcane, ethanol project over environmental concerns**

July 14, 2008

<http://biofuelsdigest.com/blog2/2008/07/14/kenyan-courts-halt-370-million-sugarcane-ethanol-project-over-environmental-concerns/>

**FAZENDA ECOLÓGICA – N<sup>a</sup> S<sup>a</sup> DO LIVRAMENTO – MT  
PASTAGEM DEGRADADA – MORRO DA CAIXA D'ÁGUA - (1.994)**



**1 animal/ha**

# PASTOREIO RACIONAL VOISIN

Formalizado por André Voisin (1.957)

SISTEMA DE MANEJO QUE PERMITE  
O EQUÍLBRIO DO TRINÔMIO

**SOLO**

**PASTO**

**GADO**

ONDE CADA ELEMENTO TEM UM  
EFEITO POSITIVO SOBRE OS  
OUTROS DOIS



# Gado em Pastoreio Voisin na Pastagem Ecológica Fazenda Ecológica - Nossa Senhora do Livramento - MT



# GW effects from cane

- *Possible* (cattle intensification absorbs cane land use) vs. *likely* (cattle expand into natural land).
- Direct cane GHG is very low (Goldemberg et al 2008, Macedo et al 2004,2008)
- LUC is critical
- At 20% blend, LCFS target requires 45g ethanol
- WTO rules will matter for policy use

Do we want to make liquid fuel out of biomass anyway?

*...or just burn it to make electricity and displace coal!*



# Non-climate issues

- Biofuel crops are mostly
  - Low labor input
  - Industrial monocrop agriculture
  - Land-hungry
  - Water-thirsty
- Next issues will be “sustainability” considerations
  - Species diversity
  - Rural sociology and economics
  - Etc.

# **“Sustainability” is another whole can of worms!**

Assessment of effects and association with  
‘batches’ of fuel

Local enforcement capacity

Commensuration (dimensions & prices)

Application in a regulatory environment with  
real \$ consequences and court  
oversight

WTO rules

“Goal creep”: LCFS and EISA are GW  
(energy security) policies, not  
‘every good thing’ policies

Your  
thoughts?

