Exploring Issues in ILUC

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Natural Resources Defense Council

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Project goals

- Develop a very simply but dynamic platform to explore issues impacting the emissions from indirect land-use change
- Educational and directionally correct, but not trying to quantitatively forecast impacts
- Focus on:
  - shedding light on the importance of different variables
  - Exploring non-intuitive interactions that are best understood with a dynamic model

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Our initial exploration

- Endogenous vs exogenous yield changes to biomass crops and to other major crop groups
  - Polar perspectives on yield: Yield will save us vs. all yield improvement is in the baseline
- Four other dynamics emerged:
  - Very different baseline in land constrained world than in world where ag is “freeing up” land
  - Use, abuse, and discarding of land dramatically influences the projected carbon debt of biofuels
  - Projections for energy crop yield are critical to future carbon debt estimates

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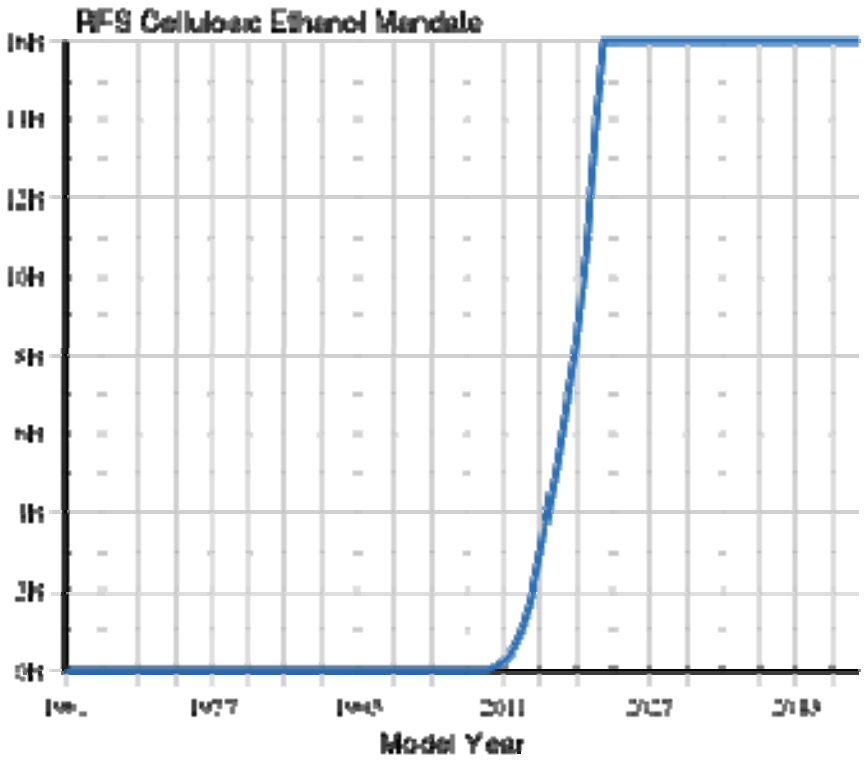
The effect of US cellulosic biofuels mandate



In this analysis, we consider the impact of the cellulosic biofuels mandate under the EISA 2007 RFS

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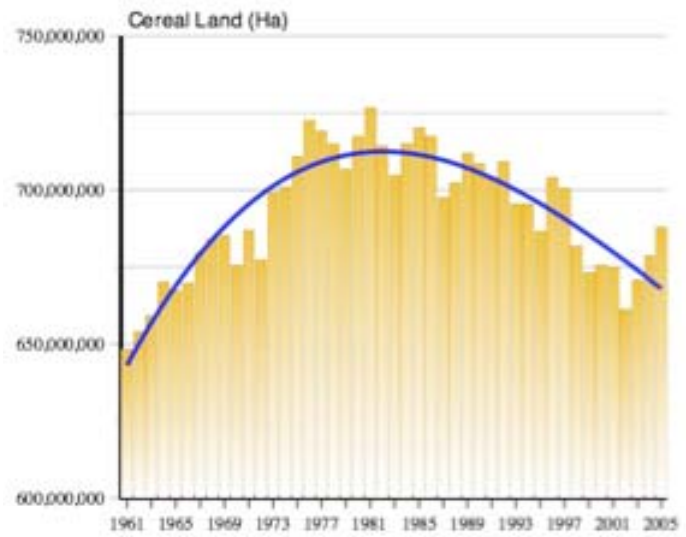
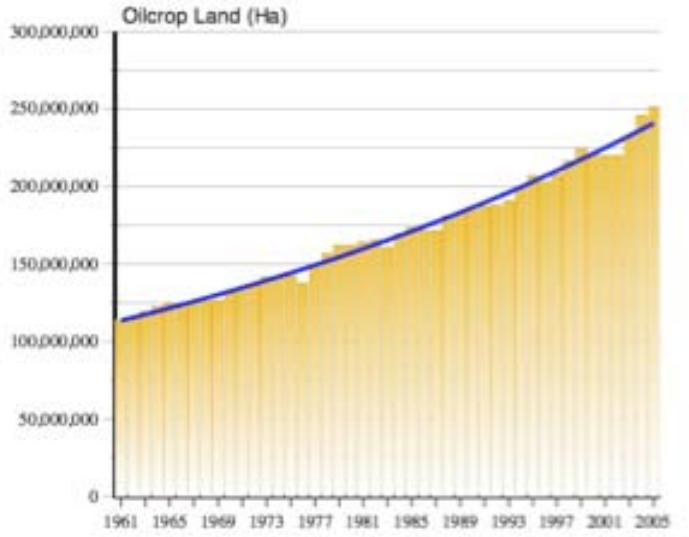
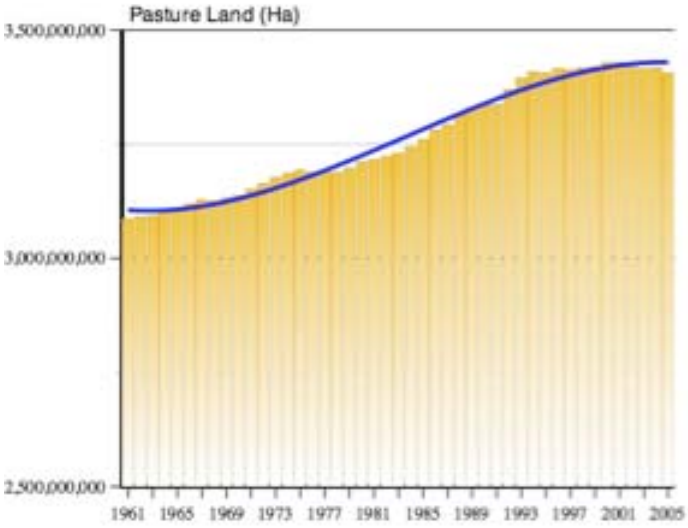
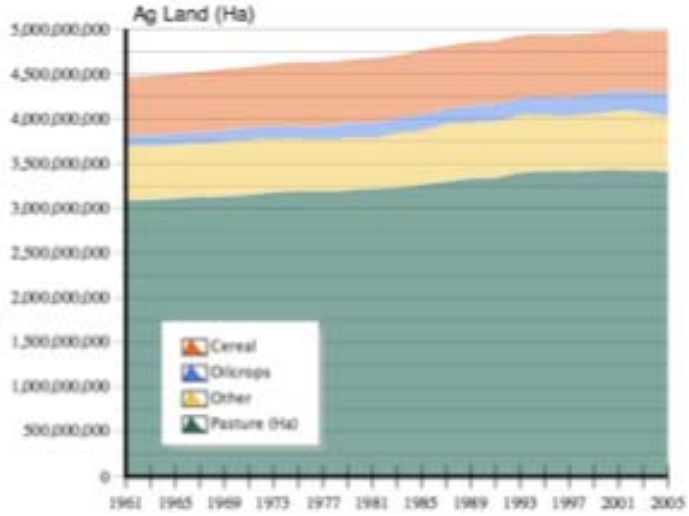
Tuned to historical baseline









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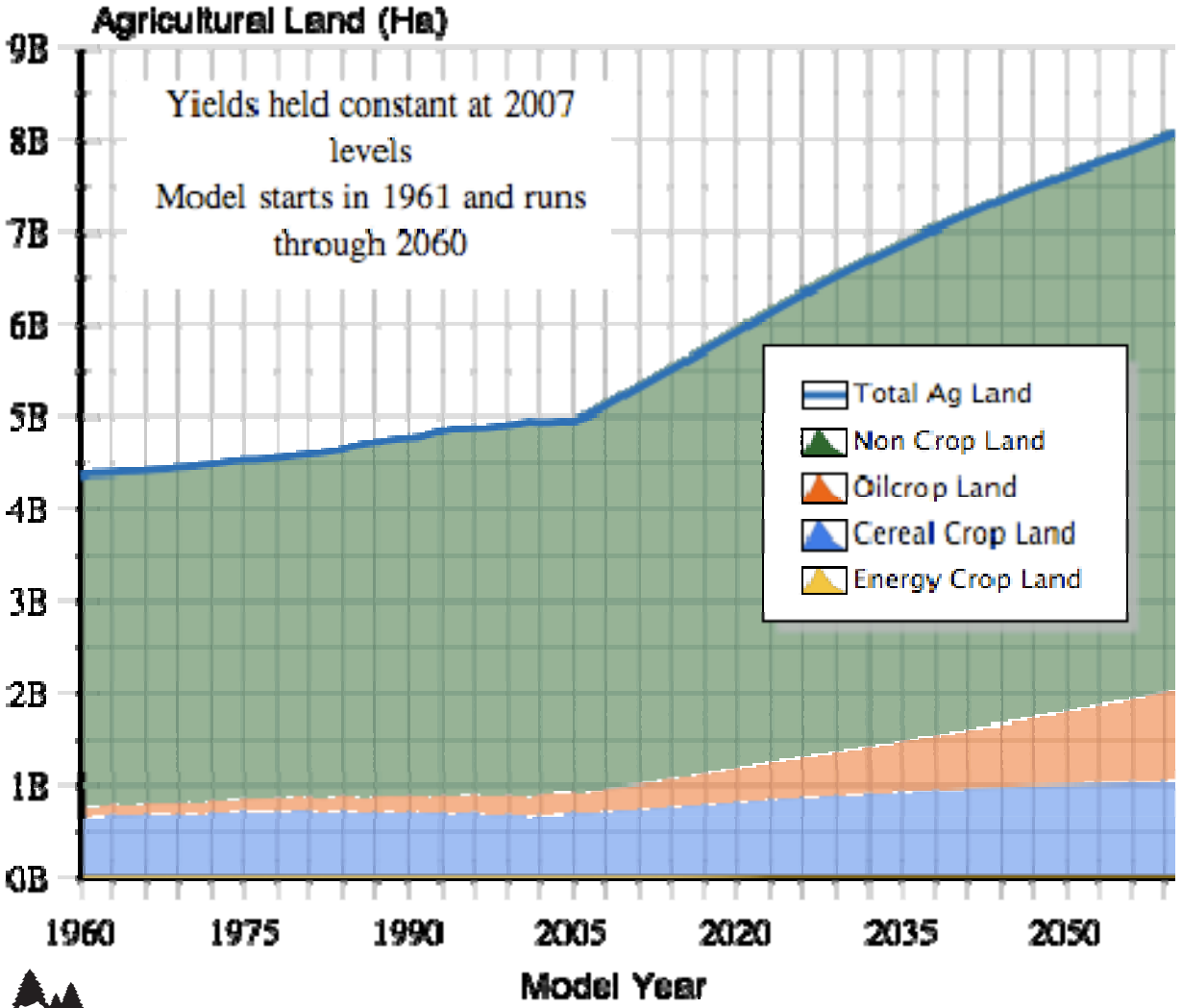

Scenario 2: Worst case assumption of no further yield improvements

Significant jump in land demand relative to historical growth.

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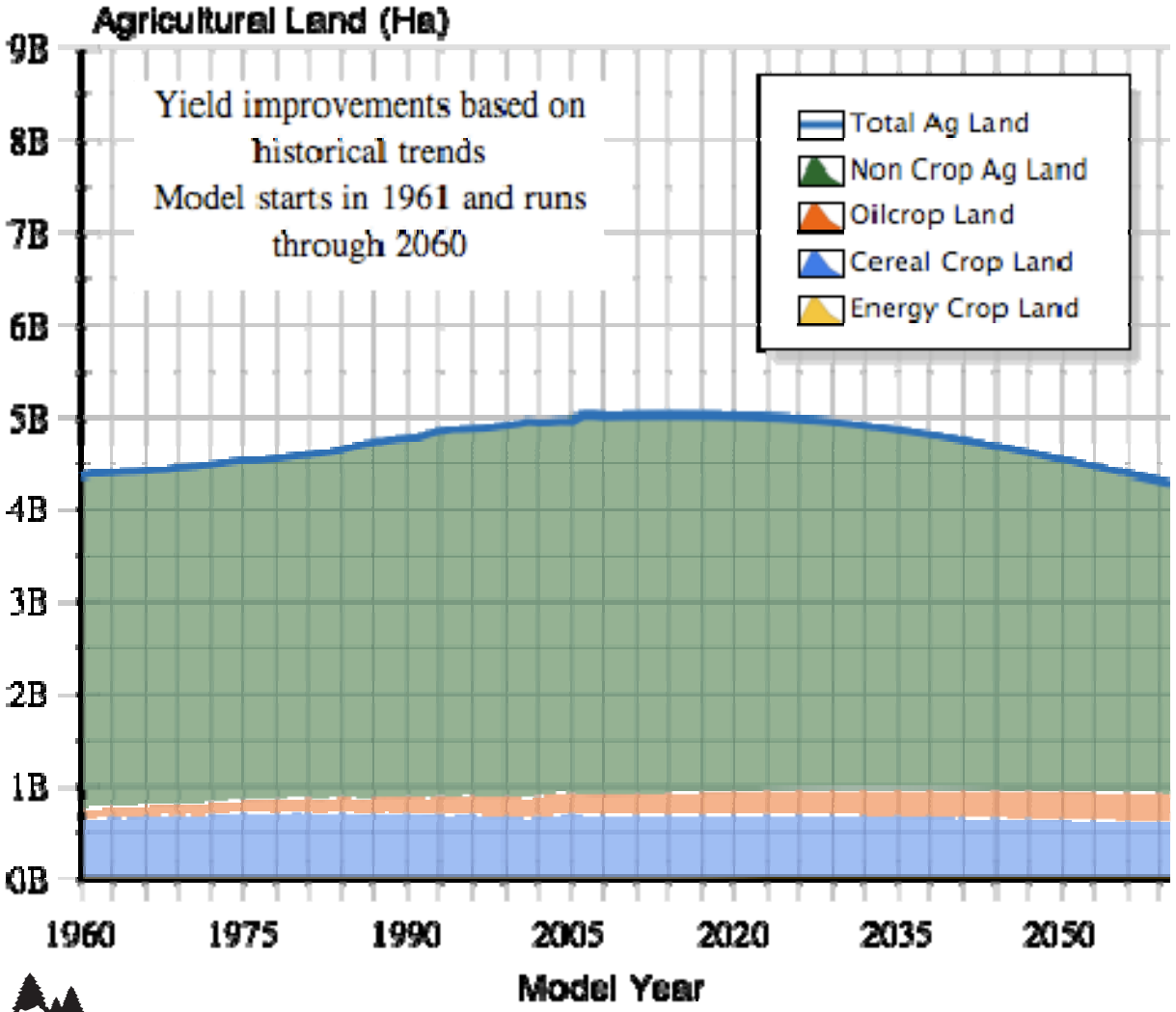

Scenario 1: Extrapolation of historical yields and per capita demand—coupled with UN median population projections

Under this scenario, the model predicts flat demand through 2020, followed by a steady decline

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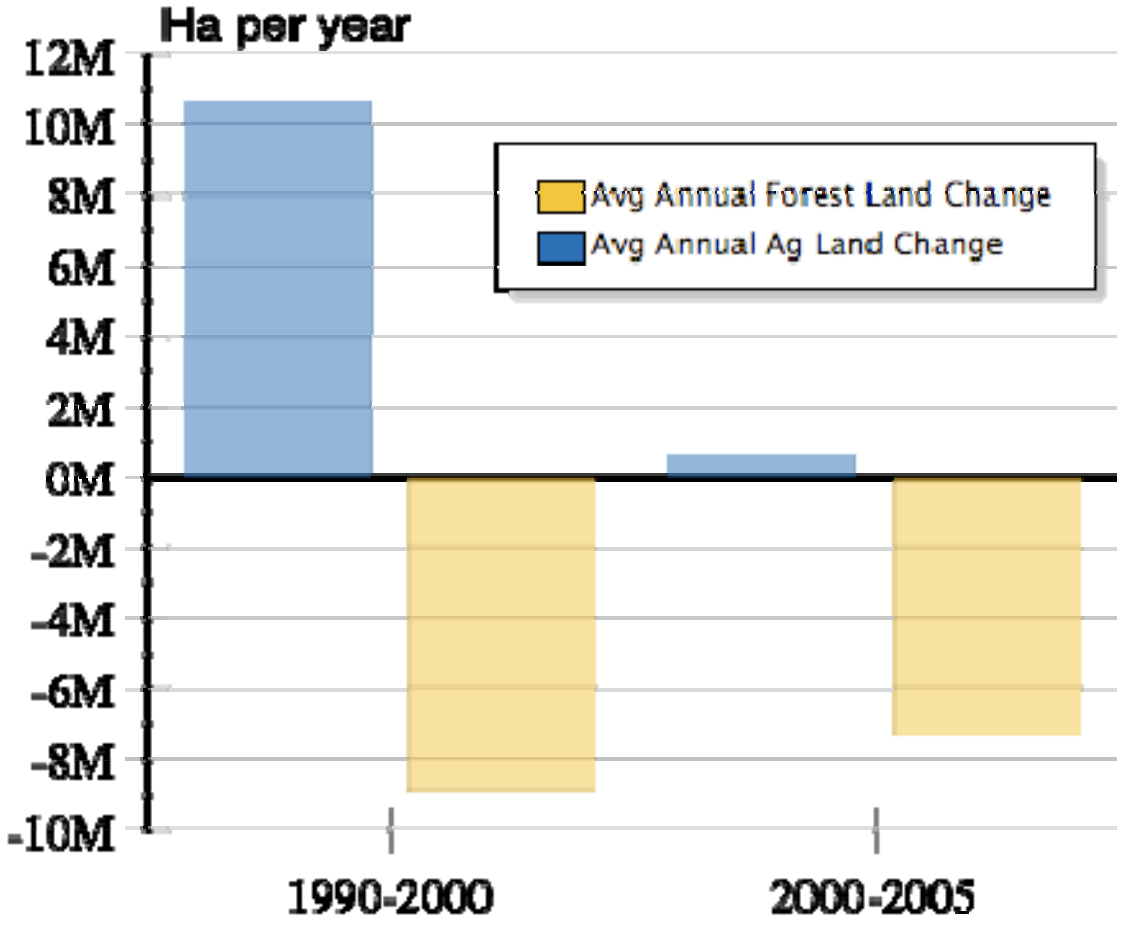
Change in total ag land < total land change

- Forest clearing is not correlated to growth in ag land demand
- Many other contributing factors, such
  - Unsustainable logging
  - “Slash and burn crop shifting”
  - Land degradation



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Change in total ag land < total land change

- "Permanent loss of farmland due to human-induced land degradation [is] estimated to be 5–6 million ha per year."
  - Ian Coxhead and Ragnar Øygard. "Land Degradation." Draft (8 April 2007) submitted for Copenhagen Consensus 2008.

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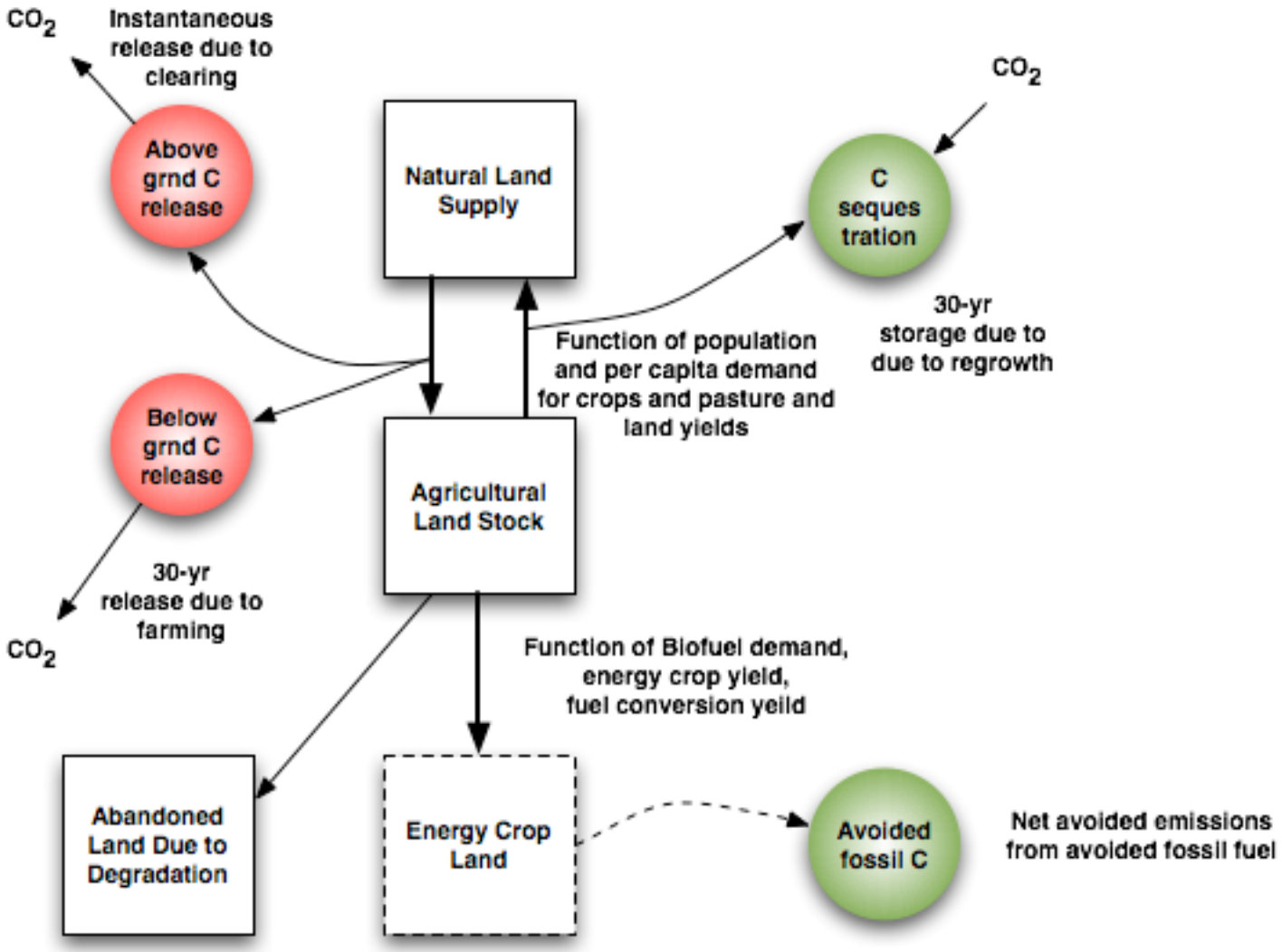
Our very simple Stella model



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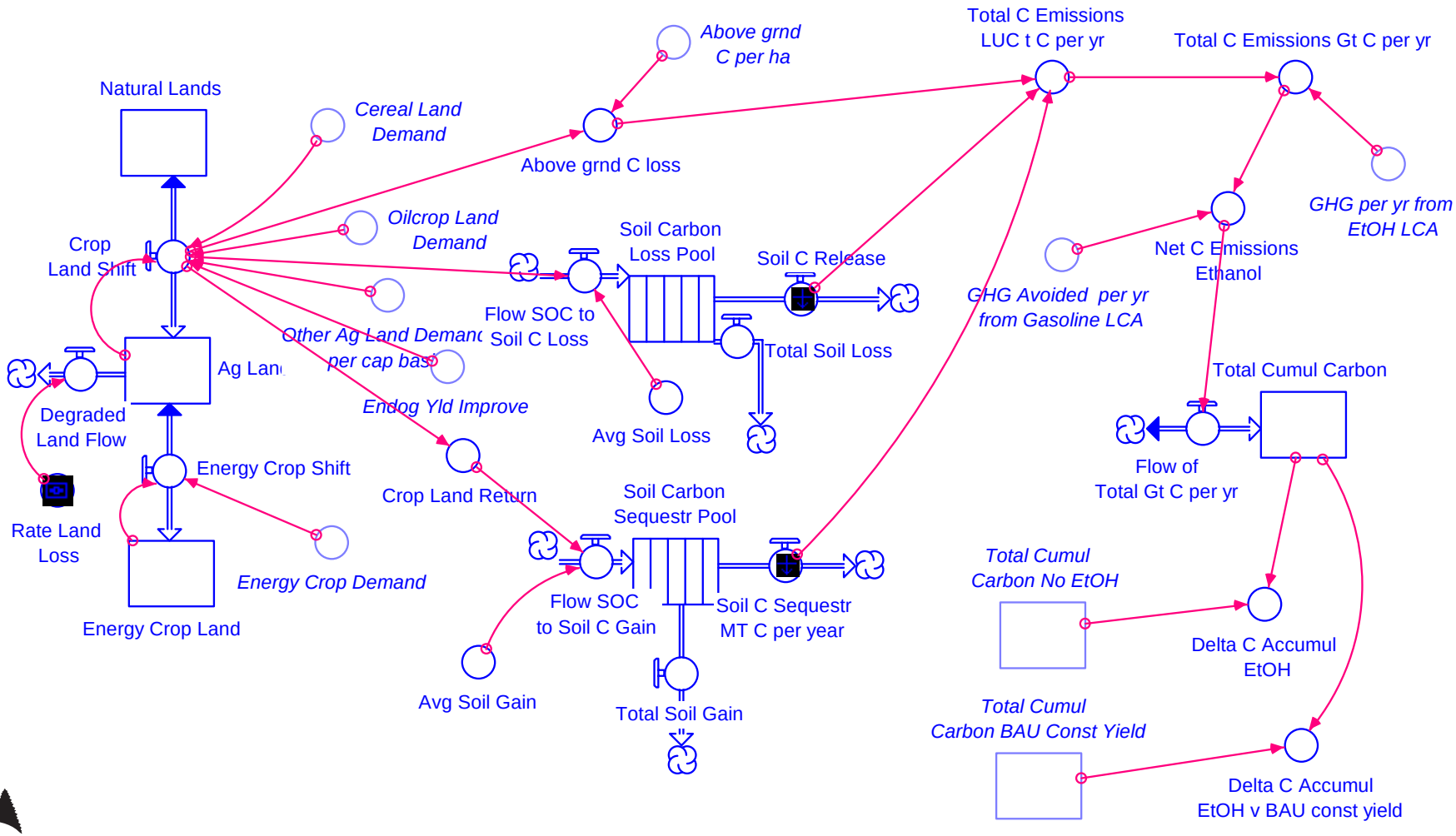
Our very “simple” Stella model

Overall Land Flows



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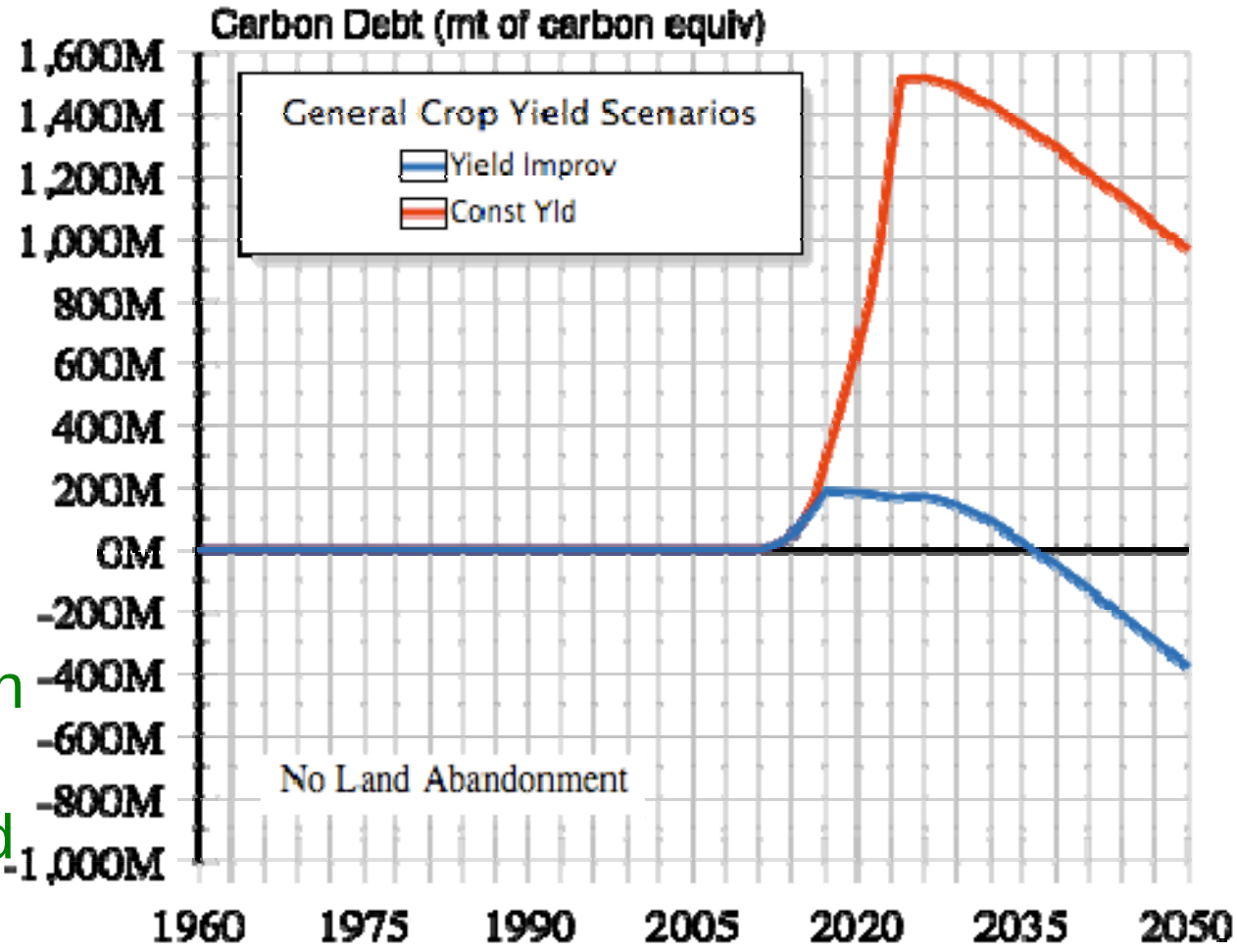
The effect of overall agricultural yields on biofuels carbon debt

- Two extremes of future yield progress show dramatically different impacts on the time to payoff the carbon debt
- Difference between a constrained and unconstrained land supply



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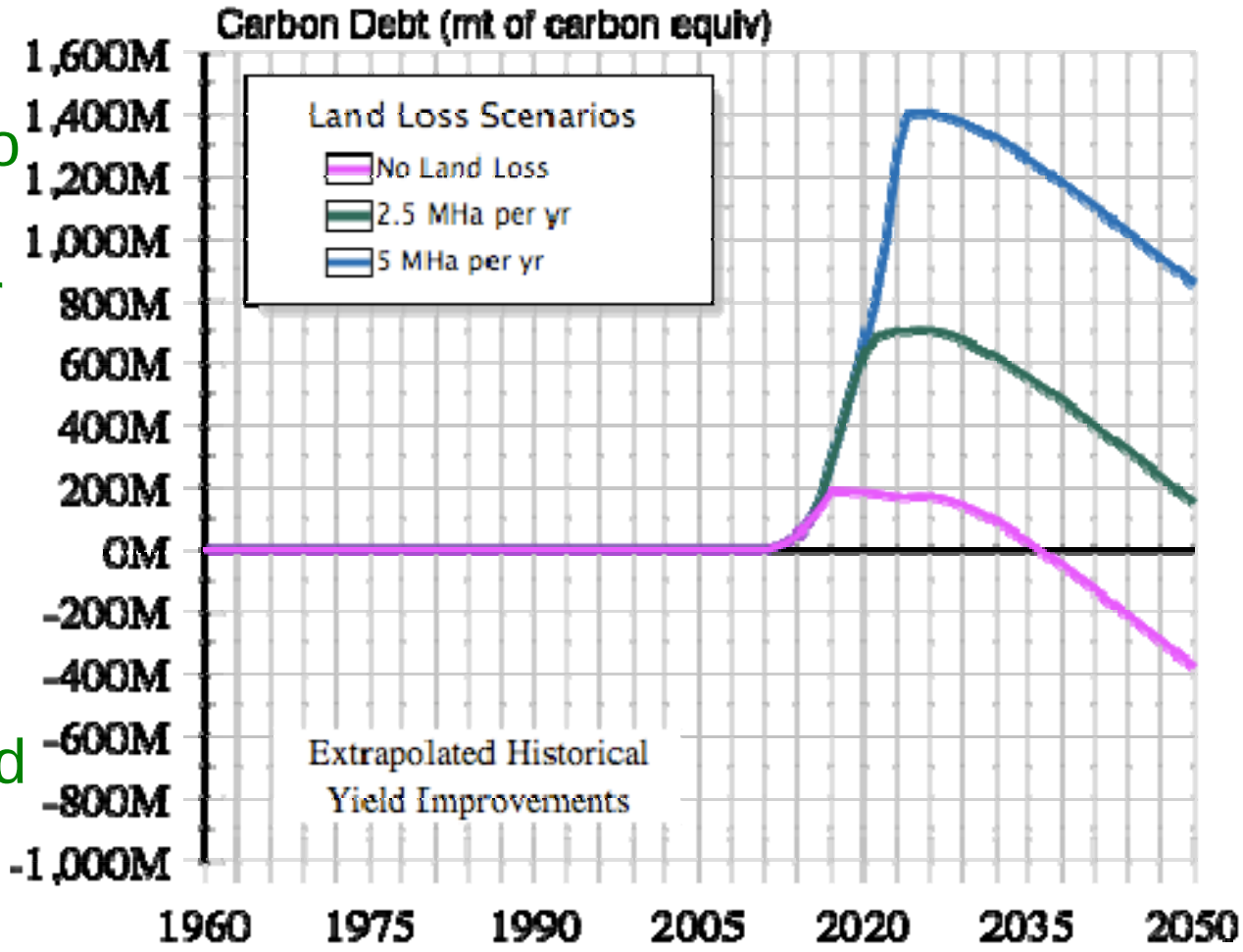
The effect of land degradation on biofuels carbon debt

- The default value for land loss due to degradation is 5 million ha per year
- Reductions in this land loss dramatically change the time time pay off the carbon debt of land clearing



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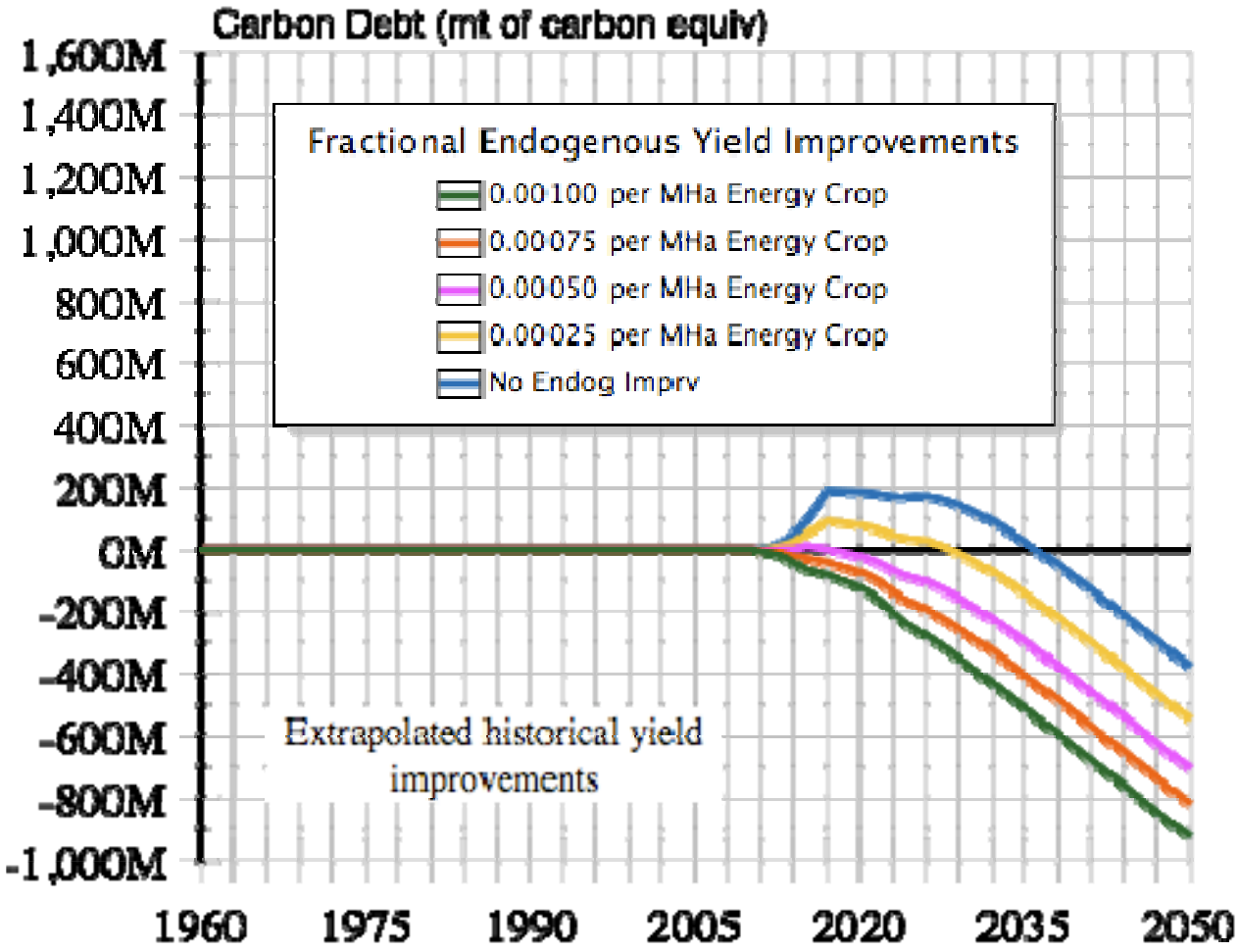
The effect of endogenous yield response to land demand for biofuels on carbon debt

- Increasing endogenous response of crop yields to energy crop land demand reduce the payment time for carbon debt associated with land clearing



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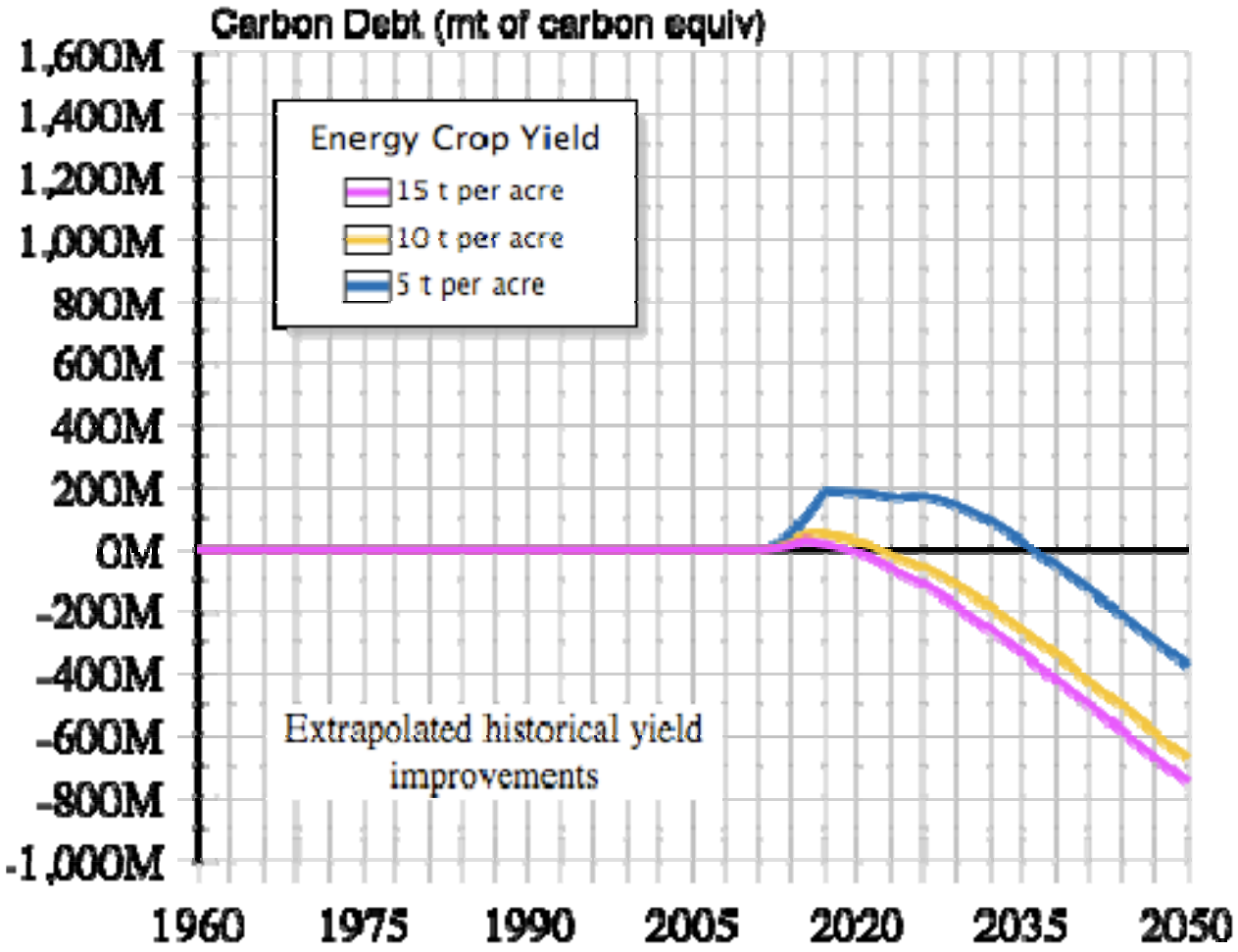
The effect of energy crop yield on biofuels carbon debt

- Energy crop yields are important
- Next step is to make this endogenous



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Conclusions and comments

- The long-term benefits of biofuels are heavily influenced by our global land-use patterns
  - More sustainable overall ag land-use practices plus yield would make it easier to integrate biofuels
  - Ultimately, we need to focus on the entire global land management system
- Elements of biofuels production also strongly influence the outcome of any estimate of carbon debt
  - Actual yield performance of biofuels
  - Endogenous effects of biofuels on overall crop yields could be important, but are not necessarily the most important factor

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Next steps for platform

- Continue to verify inputs especially use, abuse, and discard dynamic
- Customize platform to explore other variables and dynamics
  - Different treatments of emissions over time
  - Food and feedstock coproduction
  - Role of existing “degraded lands” (reforestation or afforestation)
  - More detailed comparison of using “freed-up” ag land for biofuels vs allowing it to return to “natural condition”
  - Regionalization of model
  - Economic response within regions

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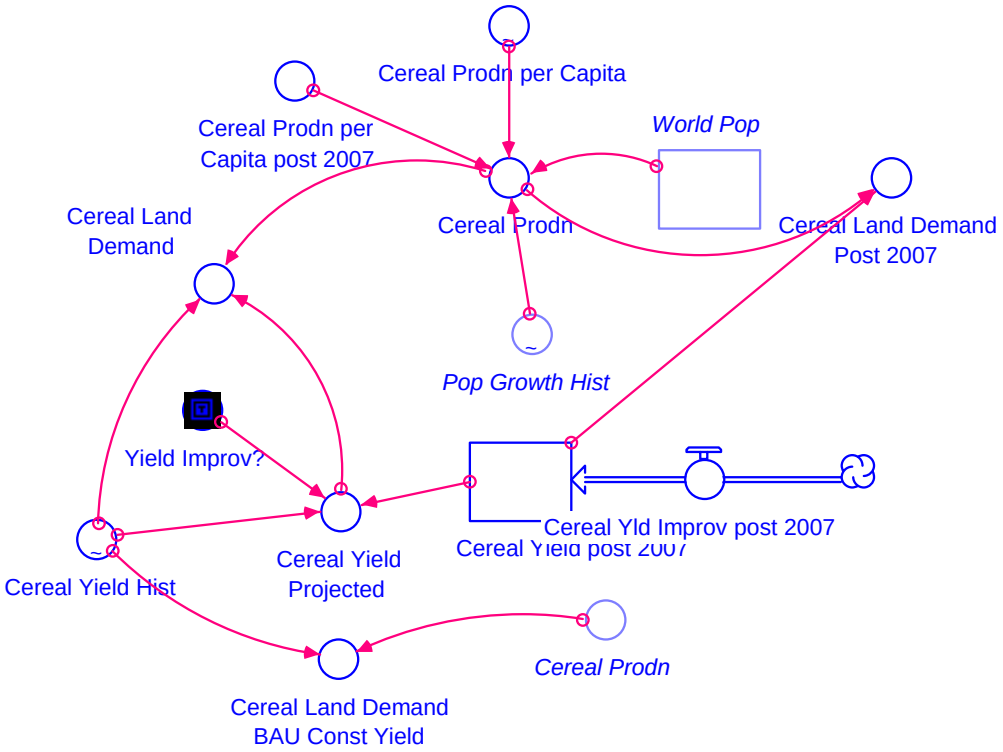
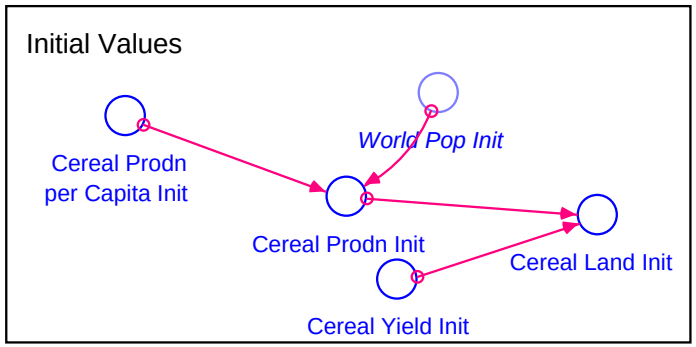
Our very “simple” Stella model

Cereal Land





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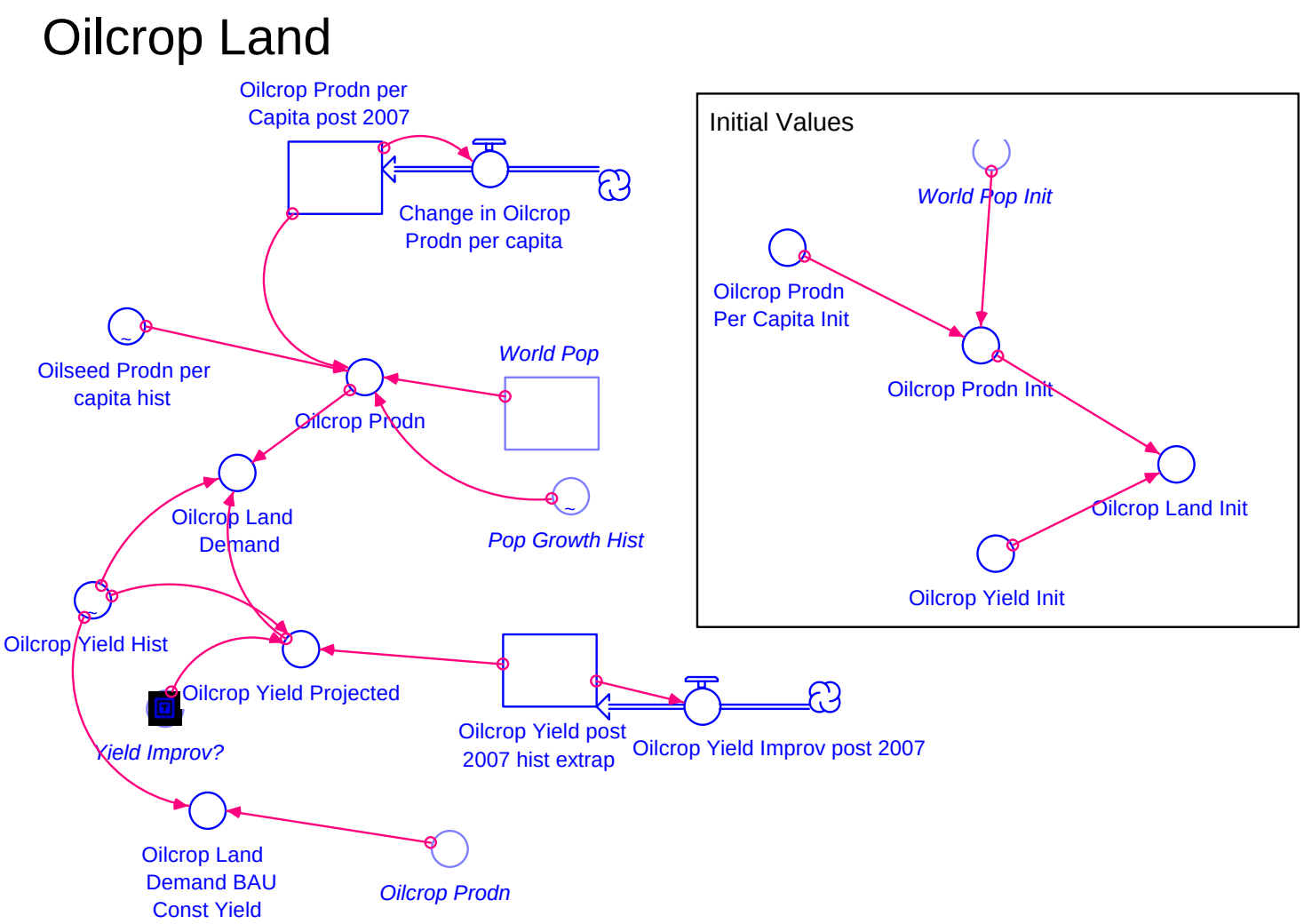

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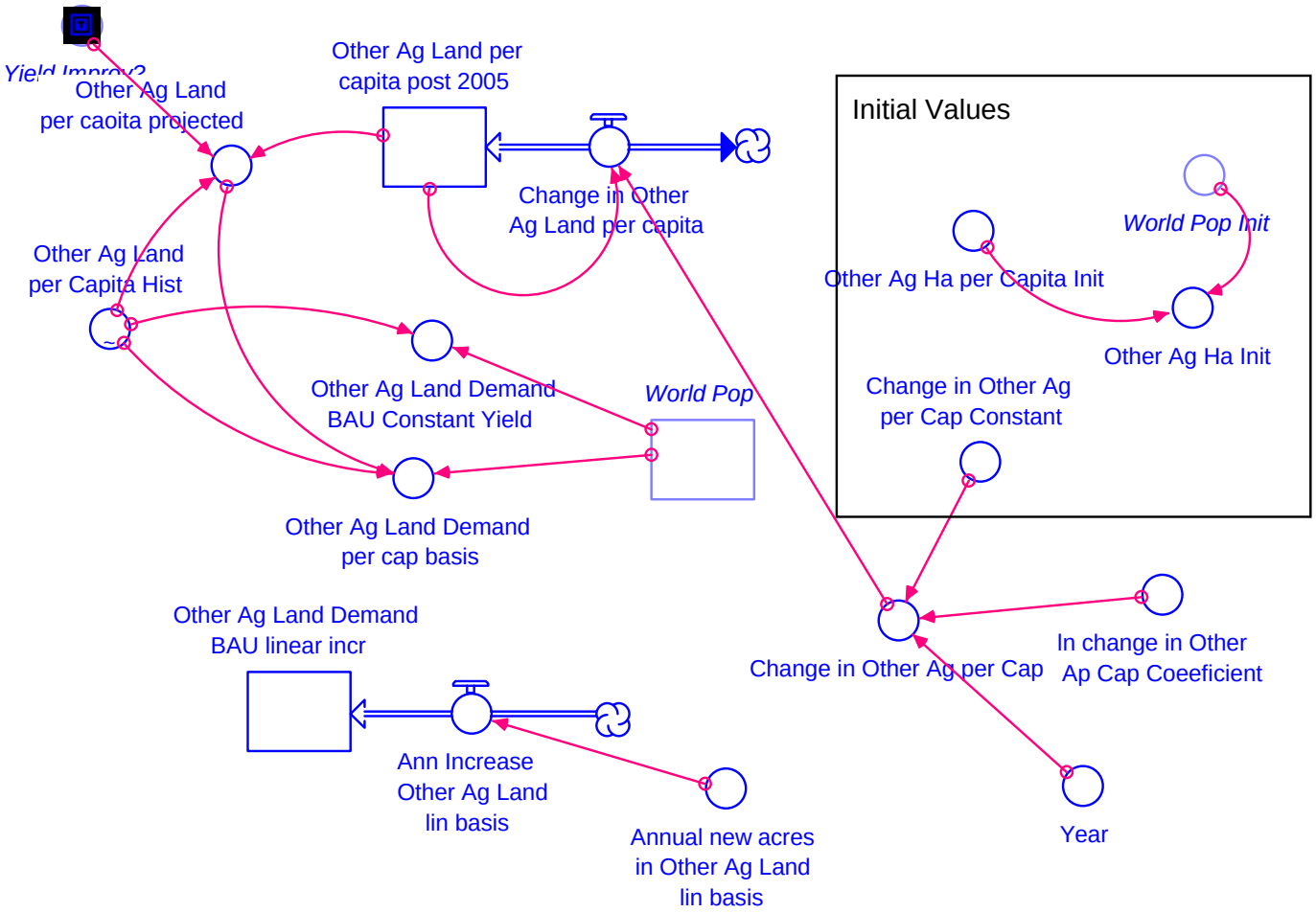
Non Primary Food Crop Ag Lands



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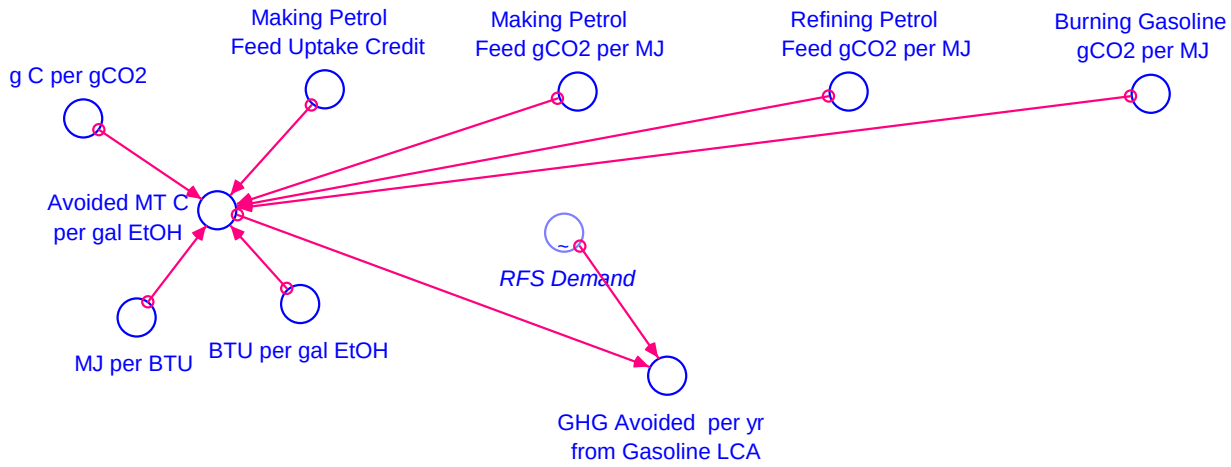
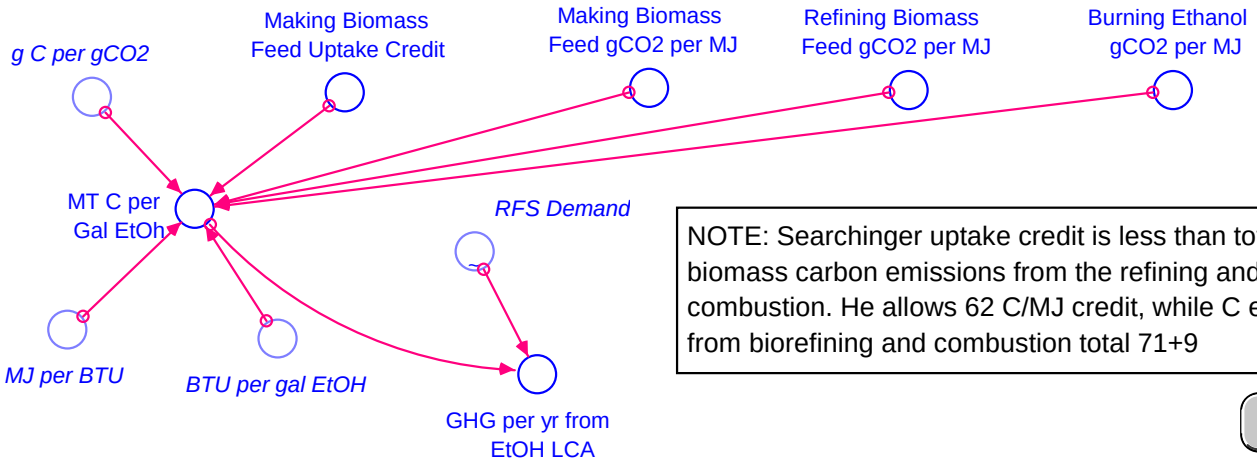
Gasoline Life Cycle Carbon Emissions



Ethanol Life Cycle Carbon Emissions (Non-Land)



NOTE: Searchinger uptake credit is less than total biomass carbon emissions from the refining and combustion. He allows 62 C/MJ credit, while C emissions from biorefining and combustion total 71+9

Overall Land

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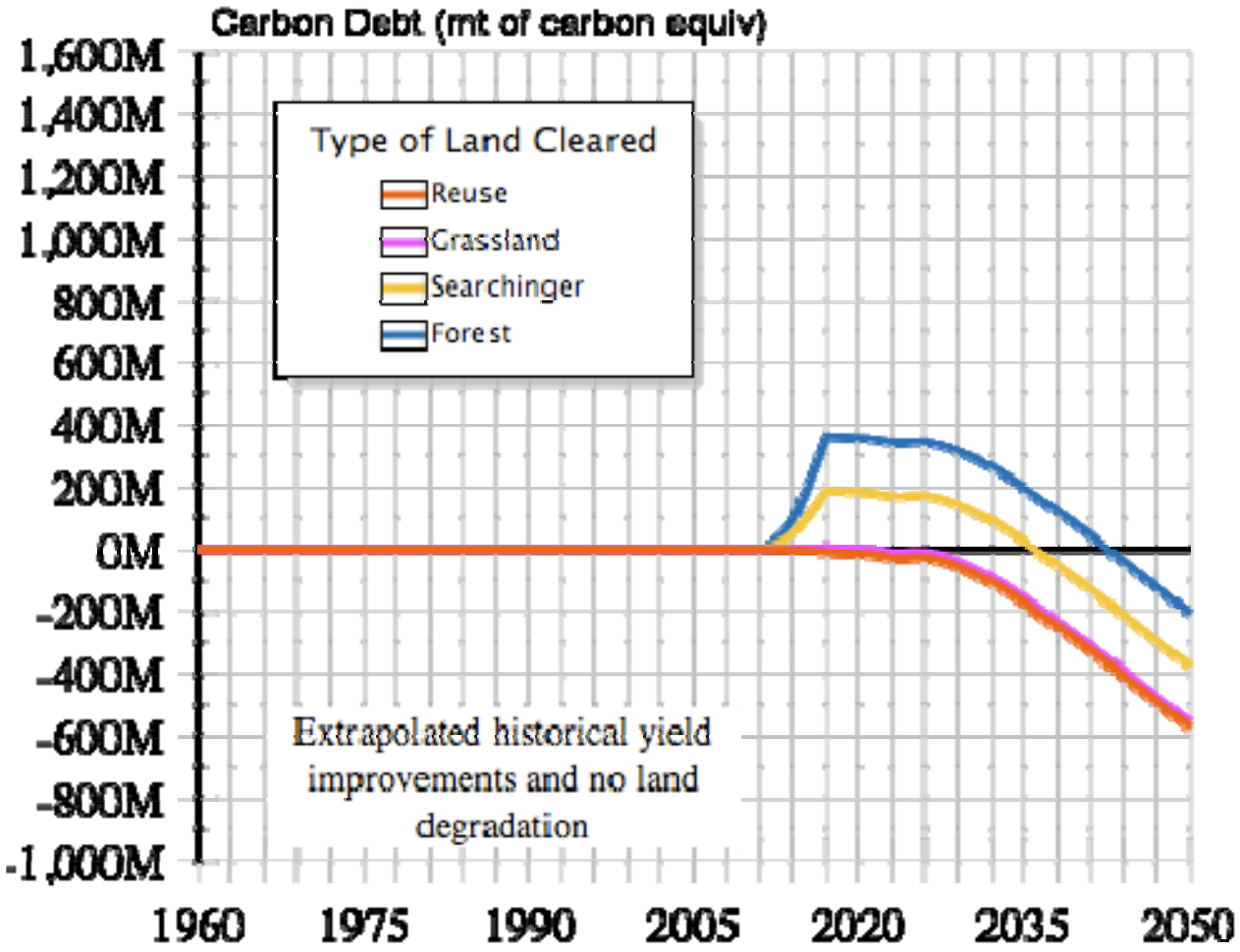
The effect of land type cleared on biofuels carbon debt

- Above ground carbon levels of carbon is major effect on carbon debt



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