Market-Mediated Land Use Change & Biofuel Policy

Towards An Evaluation of Mitigation Options

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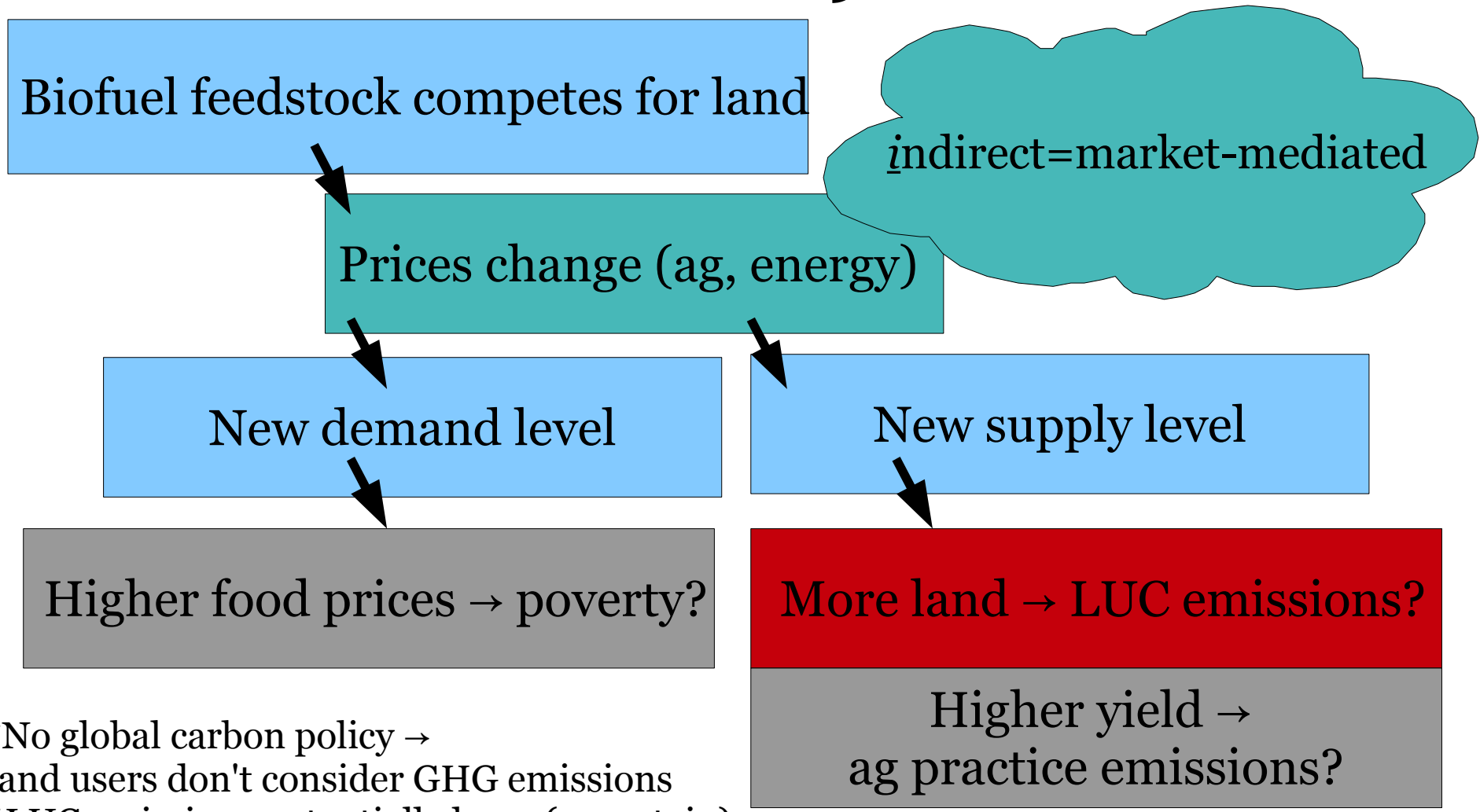
IEA Bioenergy Workshop on Land Use Impacts of Bioenergy

Campinas, Brazil, 20 September 2011

Biofuel LUC - why we care...



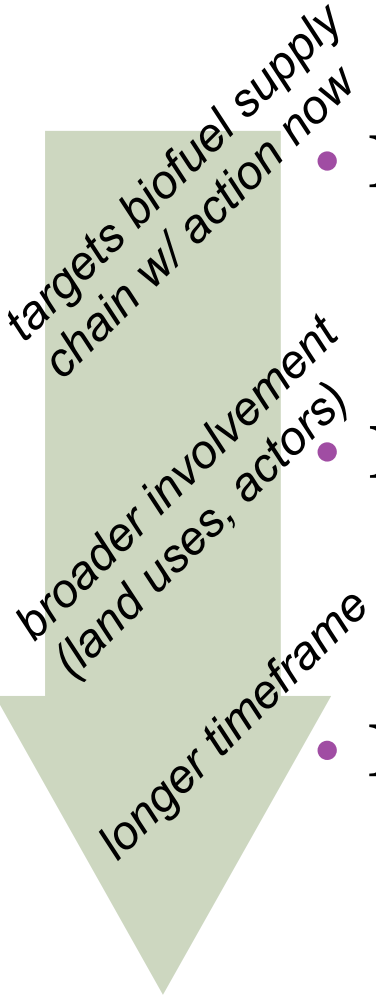
*No global carbon policy →
land users don't consider GHG emissions
*LUC emissions potentially large (uncertain);
can undermine GHG reduction goals of biofuel policy (1st gen & beyond)
*How to manage LUC risk for 21st c. given other policy objectives?

Witcover et al. Campinas 2011

Managing LUC Risk from Biofuel Policy: A Three-Pronged Approach

- Feedstock mix less reliant on land
  - promote low LUC-risk feedstocks (waste, residue, algae)
  - limit use/expansion of high LUC-risk (crop) feedstocks
- Lowered LUC risk for land-using feedstocks
  - reward feedstock-growing conditions that avert displacement or compensate for its effects
- Investments that reduce the scope for LUC
  - land productivity, environmental protection, carbon accounting

A 'Policy Menu' Approach: Cover Transition Timeframe, Both Sides of Productive Frontier



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- Investments that reduce the scope for LUC
  - land productivity, environmental protection, carbon accounting (short- and long-term)

Strategy List as Policy Design 'Menu'

Alter feedstock mix (inside supply chain)

Lower risk from ld-based sources (in/out)

Reduce LUC thru broader investm'ts (beyond)

1. Prioritize Low-Risk LUC Feedstocks: *waste, residue, algae*

- create incentives for low-risk LUC feedstocks (EU-RED double counting; R&D incentives)
- set targets for low-LUC biofuel volumes (US-RFS2 hi volumes for 'advanced' fuels & biodiesel)

2. Discourage Land-Using Feedstocks

- cap biofuel production volumes/feedstock production areas for higher risk feedstocks (US-RFS2 capped volumes for higher carbon 'renewable' fuels)
- exclude high-risk LUC feedstock pathways for meeting policy requirem'ts (regional US prop)
- create disincentives for high-risk feedstocks (via ILUC factor) (US-RFS2, CA-LCFS, 'quantitative' and 'uncertainty factor' proposals)

3. Limit LUC via Controls on Feedstock Production Conditions

- confine feedstock prod'n primarily to more 'marginal' land (little biomass or productive use) (some projections for cellulosics)
- promote use of more 'marginal' land (EU-RED CI bonus for severely degraded land, LIIB certification for 'non-provisioning' land)
- encourage 'additional' feedstock production from areas already under cultivation (LIIB certification for 'additional' output from higher yields or integration w/ existing prod'n systems)

4. Offset LUC with Credits

- allow emissions offsets for LUC effects (link to carbon credit programs – REDD, CDM)
- allow yield offsets for feedstock production (Virtual Yield Bubbles)

5. Take Pressure Off the Land Base

- create incentives for higher land productivity on cleared & 'marginal' land (map/target high-risk LUC areas, support defined local property rights, R&D, extension)
- reduce agricultural supply chain losses (harvest, storage, transport)
- generate land-saving co-products (encourage coproduct development from feedstock production & processing)
- ease demand thru energy efficiency gains (extract more energy from feedstock)

6. Protect Carbon Stocks/Encourage Carbon Sequestration

- target hi-carbon areas for protection (EU-RED 'no-go', US-RFS2 'go' areas, peatl'd, forests)
- promote GHG accounting in land use (EU-RED unilateral agreements)
- add carbon value for land use (carbon tax on ld, emissions tax on ld-based prod'ts, cap-&-trade for land-based emissions)
- add carbon value in all sectors (carbon tax, cap-&-trade)

Managing LUC Risk from Biofuel Policy: 'Menu' Item Promising Examples

targets biofuel supply chain w/ action now

broader involvement

longer timeframe

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Risk-based approach **e.g., 'ILUC Factor'**

e.g., 'Low Indirect Impact Fuels', offset schemes (need developm't, rigorous monitoring framework)

e.g., higher global yields, protected areas (uncertainty on magnitude/timing of payoff, scope w/in biofuel policy)

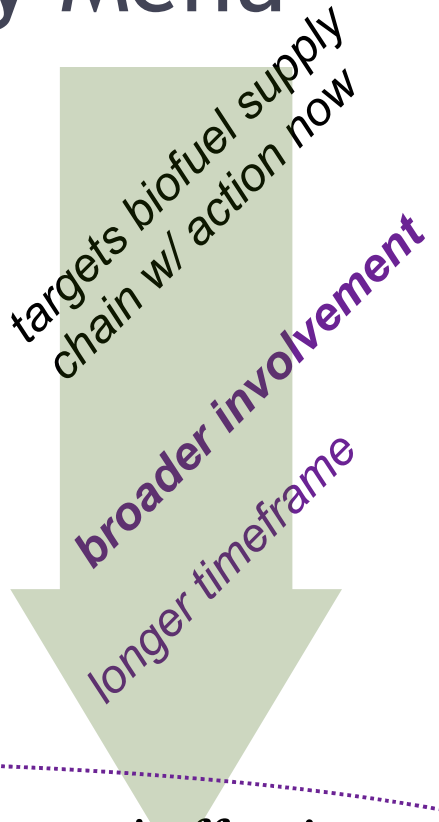
Source: Witcover & Yeh 2011 on LUC policy options for NLCFS

Moving from Concepts to Policy

- Evaluation Criteria
  - effectiveness (and robustness)
  - efficiency
  - implementability
  - enforceability
  - equity
- Evaluation Tools
  - modeling, data work to assess effectiveness, efficiency of outcomes, *unintended consequences (e.g., leakage)*
  - stakeholder participation and consultation (streamlined & workable processes, proper accountability)

Evaluation & 'Policy Menu'

- Evaluation Criteria
  - effectiveness (and robustness)
  - efficiency
  - **implementability**
  - **enforceability**
  - **equity**
- Evaluation Tools
  - modeling, data work to assess outcomes' effectiveness, efficiency, *unintended consequences (e.g., leakage)* as a valuable input for…
  - stakeholder participation and consultation (streamlined & workable processes, proper accountability)



Model-Based Evaluation of LUC *Policy Design*: An Illustration

- From collaborative research on a US National Low Carbon Fuel Standard (directed from ITS-UCDavis)
  - LCFS incentivizes alternative fuel use based on carbon intensities (v. volumetric mandates)
  - economic analysis for US (Madhu Khanna, Hayri Önal, Haixiao Huang, University of Illinois at Urbana-Champaign)
  - rest of world LUC effects (Siwa Msangi, Miroslav Batka, International Food Policy Research Institute)
- Approach – 'soft' link between 2 economic (partial) equilibrium models
  - BEPAM model responds to US biofuel policies by adjusting supply & demand in US ag, energy markets → SHIFTS in exports of key commodities (U of Illinois team)
  - IMPACT model depicts RoW response to US trade changes by adjusting production/consumption & **crop area** (IFPRI team)

Model-Based Evaluation of LUC Policy Design: Two Examples

targets biofuel supply chain w/ action now

broader involvement

longer timeframe

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1. LCFS, 'ILUC Factor' in US Policy

2. regional yield gains, protecting hi-Cstock areas

Witcover et al. Campinas 2011

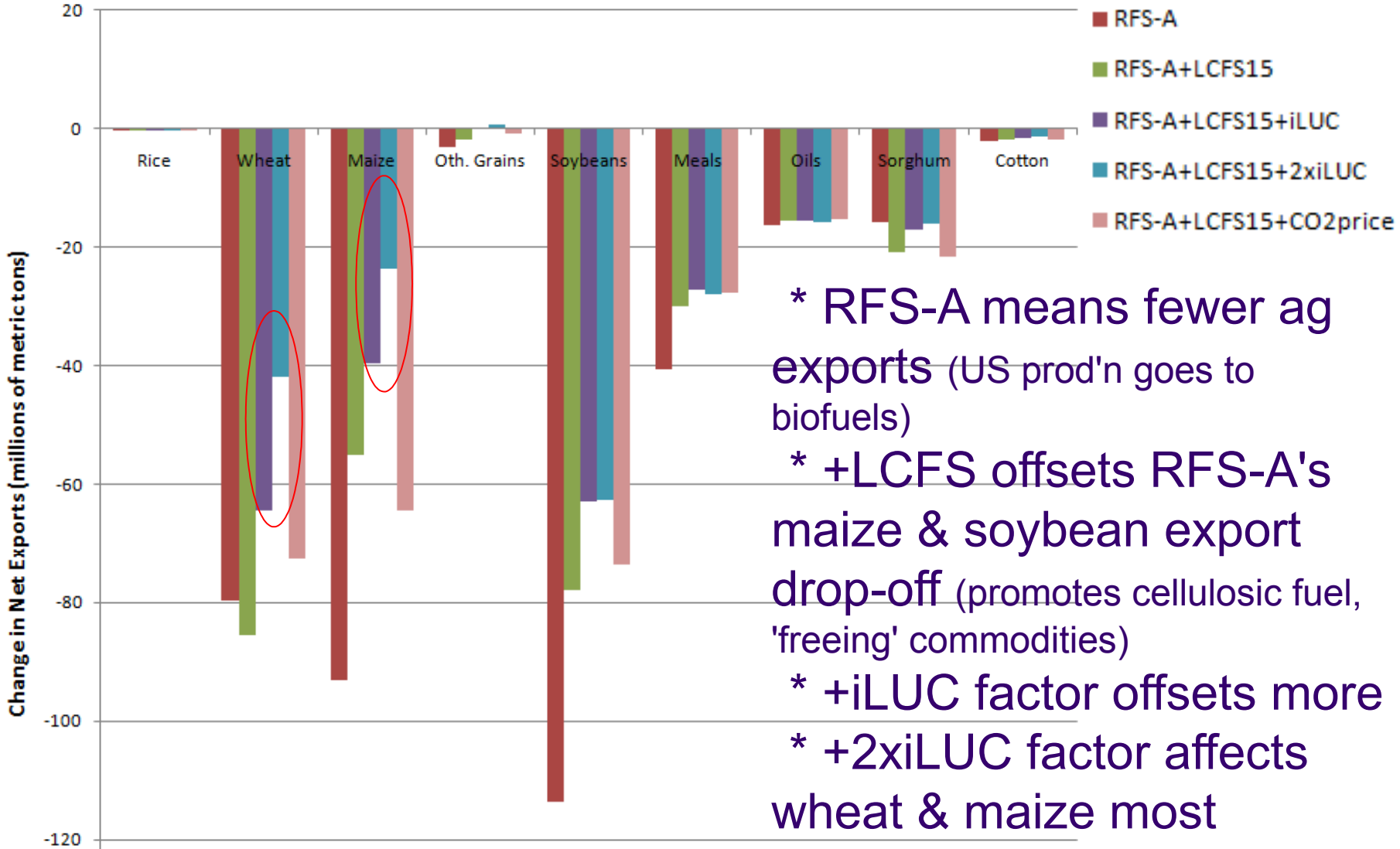
Modeling Example 1: US Policy Scenarios

(compared to BAU, no policy, AEO-informed, to 2030*)

RFS-A	RFS-AEO – RFS falls short of EISA blending goals (as per AEO 2010 outlook)
RFS-A+**LCFS15**	RFS-AEO + **LCFS requiring 15% decline in fuel carbon intensity**
RFS-A+LCFS15+**iLUC**	RFS-AEO with LCFS15 + EPA **'international LUC'** values
RFS-A+LCFS15+**2x**iLUC	RFS-AEO with LCFS15 + **2x**EPA 'international LUC' values
RFS-A+LCFS15+**CO2price**	RFS-AEO with LCFS+**CO2 price** (EIA assessment of US ACES cap-&-trade)

*details of BAU & scenarios in Khanna et al. (2011)

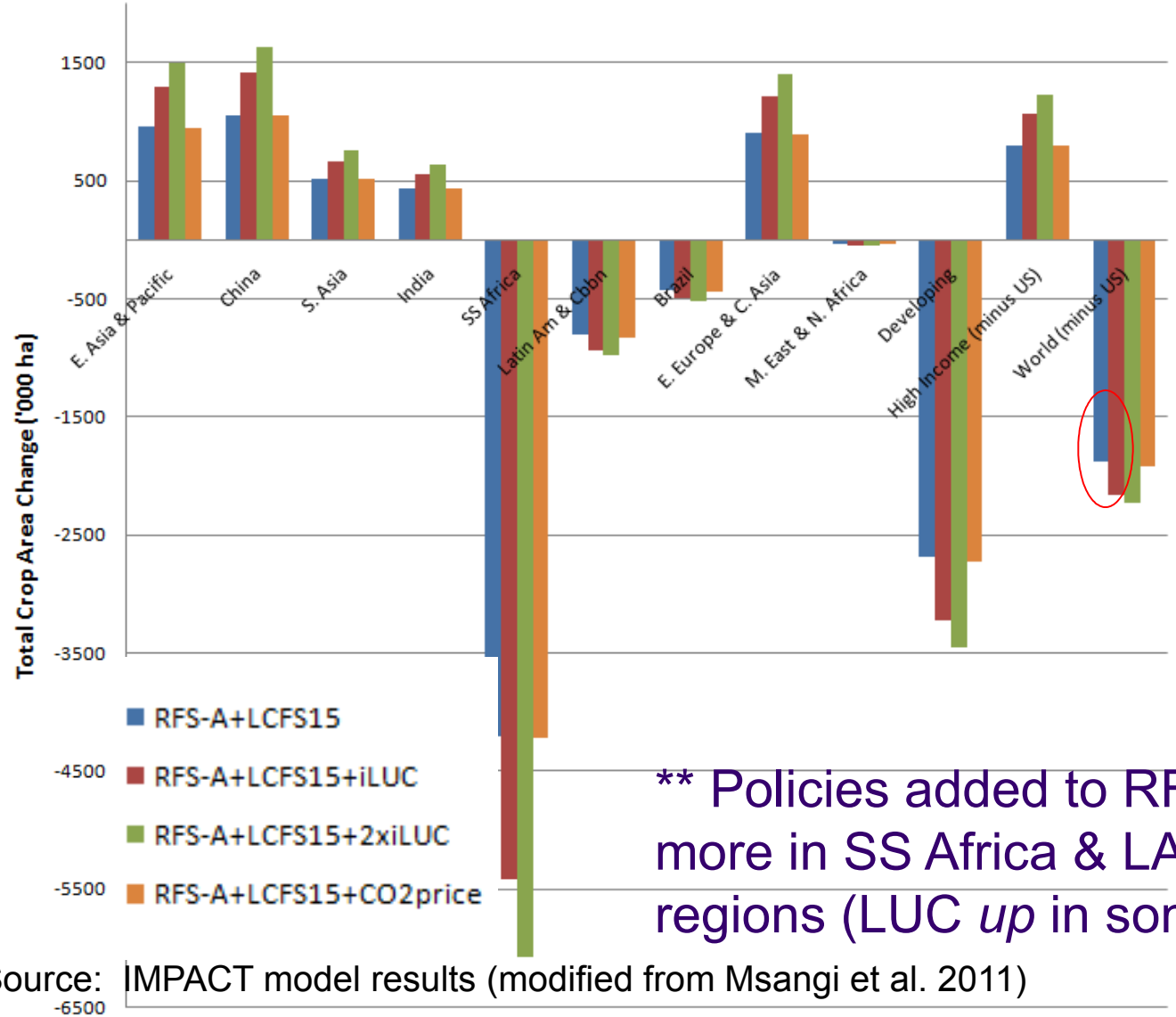
Ex 1: US Policies change US exports relative to BAU (2030)



* RFS-A means fewer ag exports (US prod'n goes to biofuels)
* +LCFS offsets RFS-A's maize & soybean export drop-off (promotes cellulosic fuel, 'freeing' commodities)
* +iLUC factor offsets more
* +2xiLUC factor affects wheat & maize most

Source: BEPAM model results

Ex 1: Policies change non-US LUC relative to RFS-AEO (net, by 2030)



* RFS-A prompts LUC outside US

* Adding LCFS lowers LUC (by ~ half)

* Adding iLUC factor lowers LUC more (smaller effect)

* 2xiLUC factor lowers LUC more (smaller incremental effect)

** Policies added to RFS lower LUC more in SS Africa & LAC than in other regions (LUC *up* in some places)

Source: IMPACT model results (modified from Msangi et al. 2011)

Witcover et al. Campinas 2011

Ex 1: US biofuel policy design matters to LUC in RoW

- Adding LCFS to RFS (encouraging lower carbon intensities in US) lowers LUC in RoW, especially SSAfrica and Latin America/Caribbean
- Adding an iLUC factor on top of an LCFS further reduces LUC in RoW, again with strongest effects in SSAfrica and LAC
- A higher iLUC factor continues to reduce LUC, but at a declining rate

Modeling Example 2: Productivity gain scenarios for SSA & LAC

selected crop	productivity gain (additional percent gain per year)	Target region
soybeans	0.15 %	Latin America
cereals/grains[1]	0.10 %	Sub-Saharan Africa
cotton	0.20 %	Sub-Saharan Africa
roots & tuber crops[2]	0.25 %	Sub-Saharan Africa

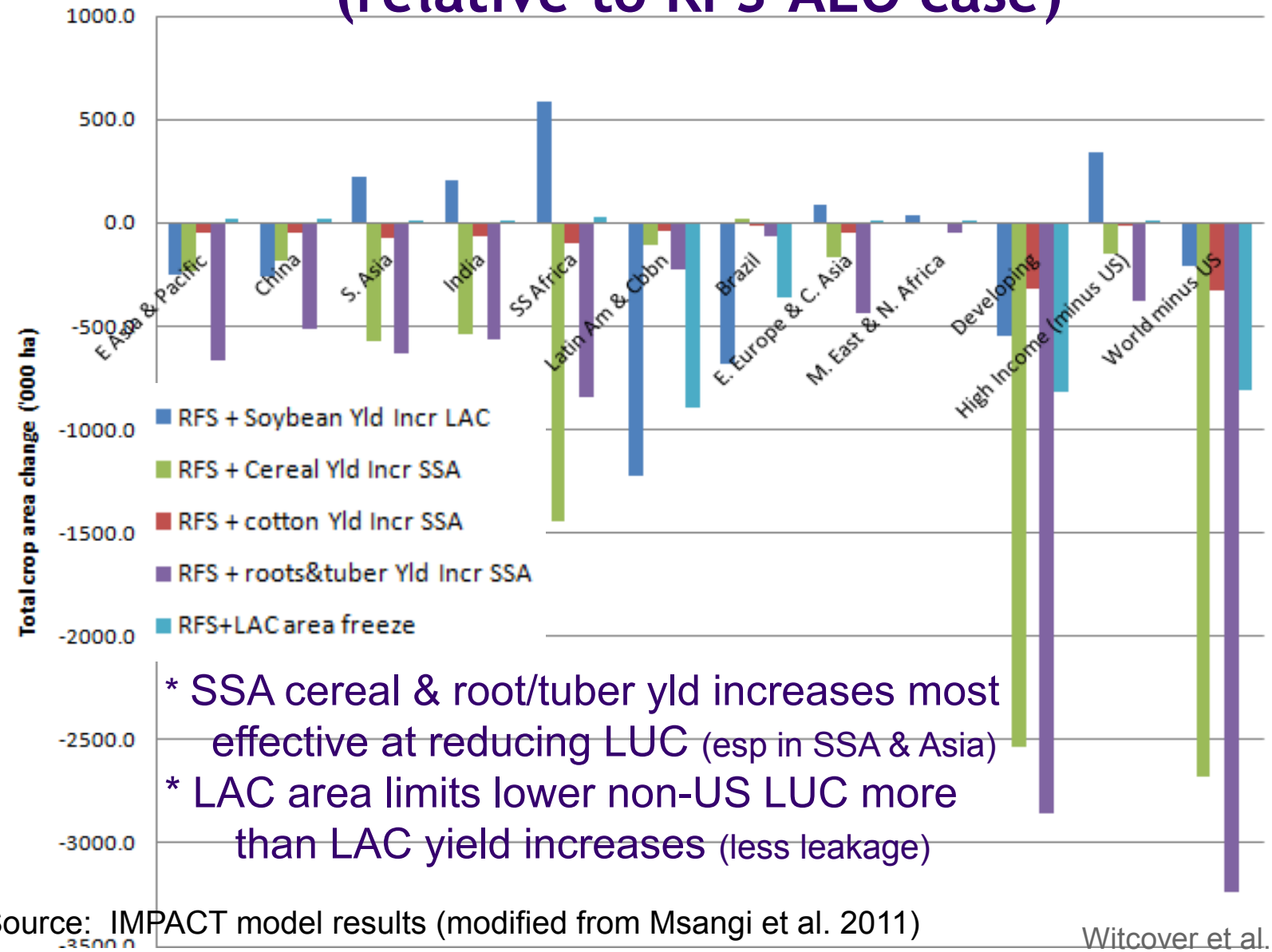
Note: (1) including rice, wheat, maize, sorghum, millet and other coarse grains; (2) including potatoes, sweet potatoes, yams and cassava

Source: Vosti *et al.* (2011)

Area Targeted for Halt on Agricultural Area Expansion

Ex 2: We also impose a halt to crop area expansion in tropical regions of LAC

Ex 2: LUC from interventions in LAC/SSA (relative to RFS-AEO case)



* SSA cereal & root/tuber yld increases most effective at reducing LUC (esp in SSA & Asia)
* LAC area limits lower non-US LUC more than LAC yield increases (less leakage)

Source: IMPACT model results (modified from Msangi et al. 2011)

Ex 2: Effects of policies to reduce the scope for biofuel LUC vary by region

- Boosting staple yields in SSAfrica has high payoffs in lowering biofuel policy-induced LUC, with contributions from most regions ('low-hanging' fruit in terms of relatively low yields → avoided land expansion, SSA net importer → 'transmits' land-saving elsewhere)

- Limiting tropical Latin American land expansion is a better option than higher LAC yields for reducing LUC, but not as good as adjusting SSA yields (adjusting yields in exporting region → offsetting land expansion elsewhere; less leakage with land limits)

- Challenges – uncertain location of LUC? enforcing land expansion limits? yield investment mechanisms & timing /magnitude of payoffs? (can biofuel policy design contribute?)

Recap: Strategy List & Evaluation Structure

- Three-pronged approach → fleshed out strategy list → policy menu
  - less land-reliant feedstock mix, lower risk from land-based feedstocks, broader investments to reduce the scope for LUC
  - grouping strategies by policy targets vis-à-vis biofuel supply chain highlights combinations to cover transition timeframe and both sides of productive frontier (ease of implementation/enforcement; need for greater coordination; longer timeframes; choice of evaluation tools)
- Model-based evaluation (examples)
  - LUC *outcomes* varied by region, magnitude due to policy design choices for LUC strategies from two 'prongs'
    - 'ILUC factor' (*inside* US biofuel policy) strengthens move toward cellulosics of an LCFS, reducing LUC outside US
    - yield improvements targeted toward staples in SSAfrica outperform LAC-directed strategies in terms of non-US LUC reductions (difficult to incentivise within US biofuel policy)
- From here: more systematic evaluation framework, mix of qualitative & quantitative tools needed for policy design and monitoring (effective LUC policy *combinations* for 21st c. needs)

Thank You!

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