Task 39
IEA Bioenergy

Comparison of Biofuel Life Cycle GHG Emissions Assessment Tools

GHGenius

GREET

New EC

VSB

Phase II b: 2G ethanol

May 2019

Background

- Phase I:

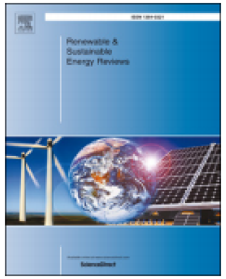
Renewable and Sustainable Energy Reviews 110 (2019) 1–12

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

ELSEVIER



Comparison of biofuel life-cycle GHG emissions assessment tools: The case studies of ethanol produced from sugarcane, corn, and wheat

L.G. Pereira[a,b,*], O. Cavalett[a], A. Bonomi[a,c], Y. Zhang[d], E. Warner[d], H.L. Chum[d]

- Phase II a: Comparison of Biofuel Life Cycle Analysis Tools - FAME and HVO/HEFA (report)
- Phase II b: Comparison of Biofuel Life Cycle Analysis Tools - 2G ethanol (report – under development)

Motivation

Bioenergy plays an important role in the decarbonization of the transportation sector.

Its medium and long-term benefits depend on the reduction of GHG emissions in substitution to their fossil counterparts.

Decarbonization impacts of biofuels can be quantitatively determined through a Life Cycle Analysis (LCA) methodology.

However, discrepant results are often obtained using different LCA tools.

Models

NEW EC

New EC - Biofuels pathways. Input values and GHG emissions.

GHGenius

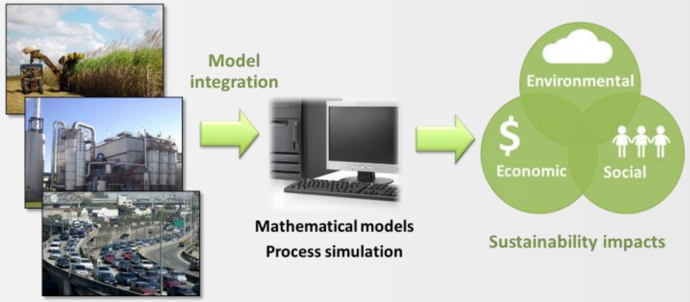
(S&T)² Consultants Inc

GHGenius

GREET LIFE-CYCLE MODEL

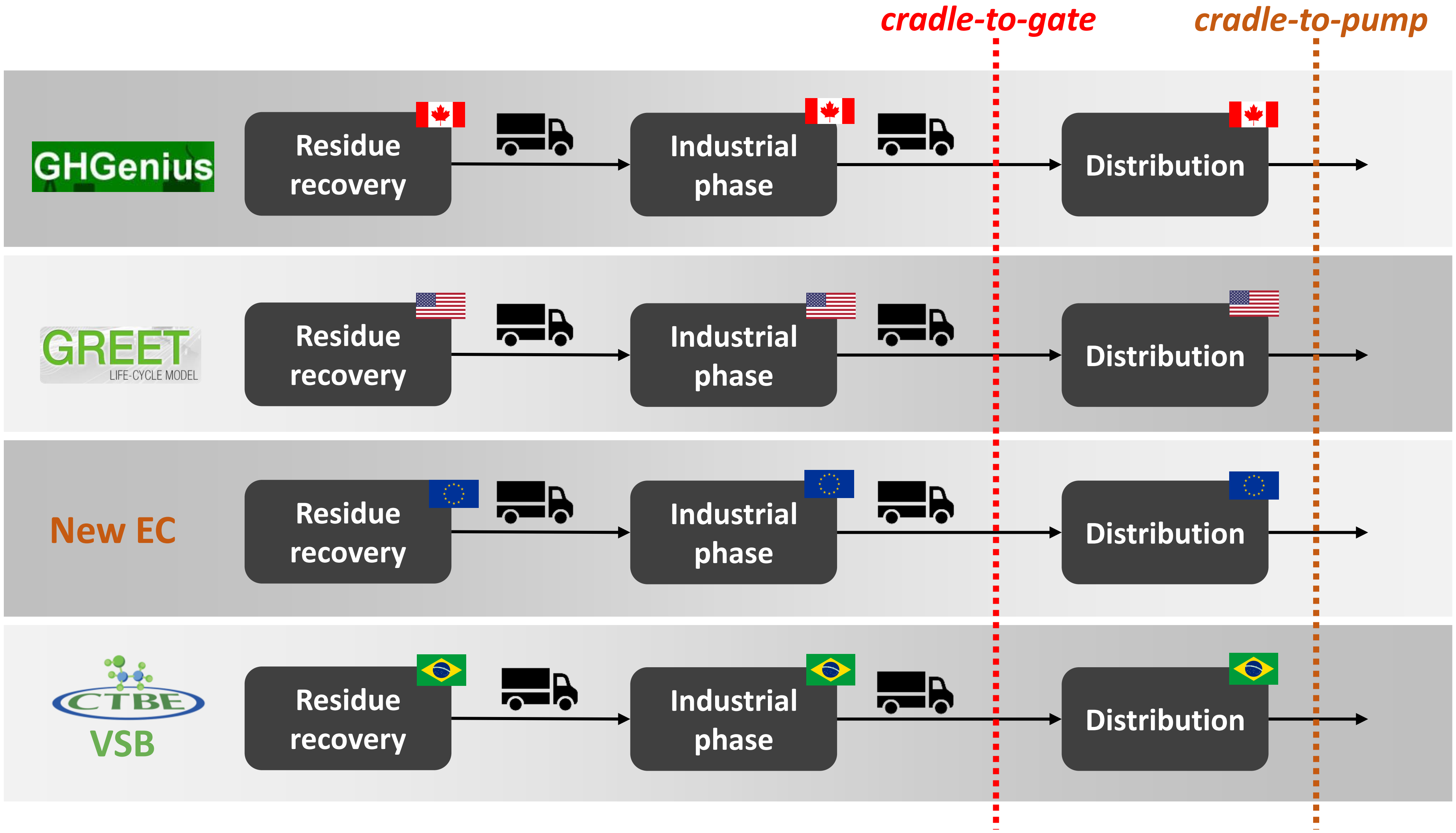
Argonne NATIONAL LABORATORY

The Greenhouse Gases. Regulated Emissions and Energy in Transportation



Virtual Sugarcane Biorefinery (VSB)

System boundaries: standalone 2G ethanol



Particularities: standalone 2G ethanol

- All four models consider:
  - Ethanol as main product and electricity as a co-product
  - Co-generation system
  - Lignin for combined heat and power generation

- GHGenius and GREET consider substitution procedure (electricity)

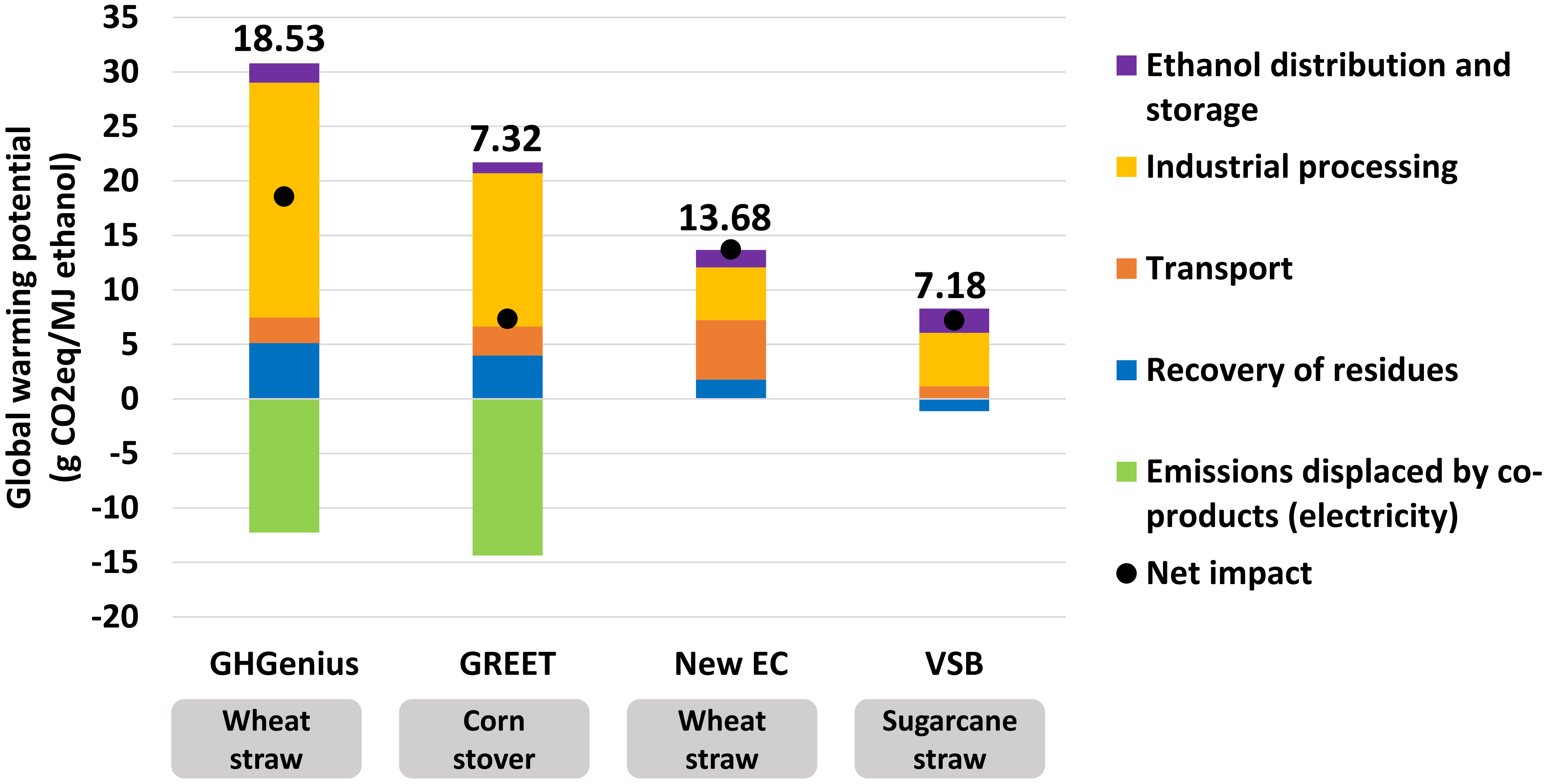
- New EC considers energy allocation

- VSB
  - Considers economic allocation
  - Considers cells recycle for fermentation

Standalone 2G ethanol

Ethanol production emissions

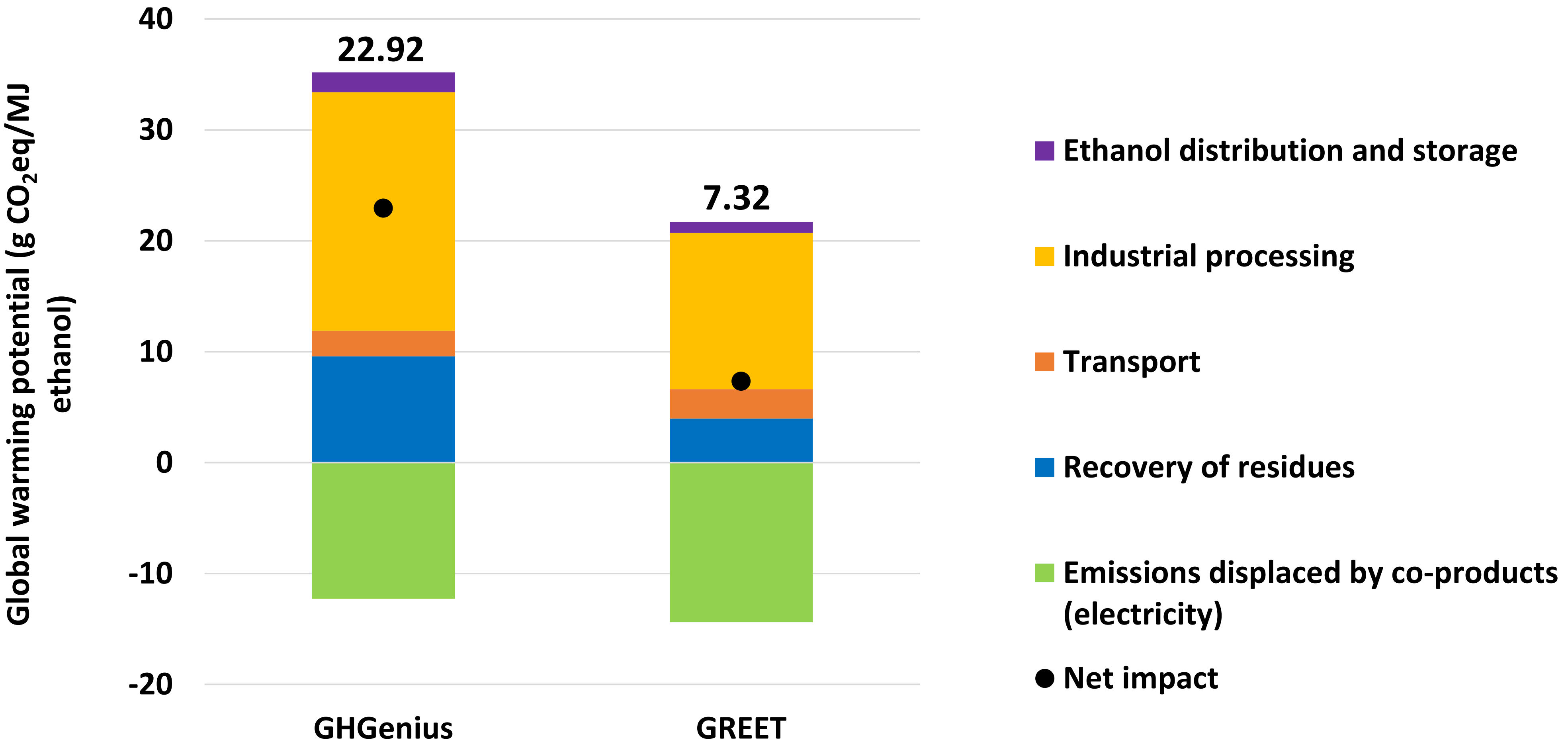
Cradle-to-pump: g CO_2eq/MJ Ethanol



Corn stover 2G ethanol

Ethanol production emissions

Cradle-to-pump: g CO_2eq/MJ Ethanol



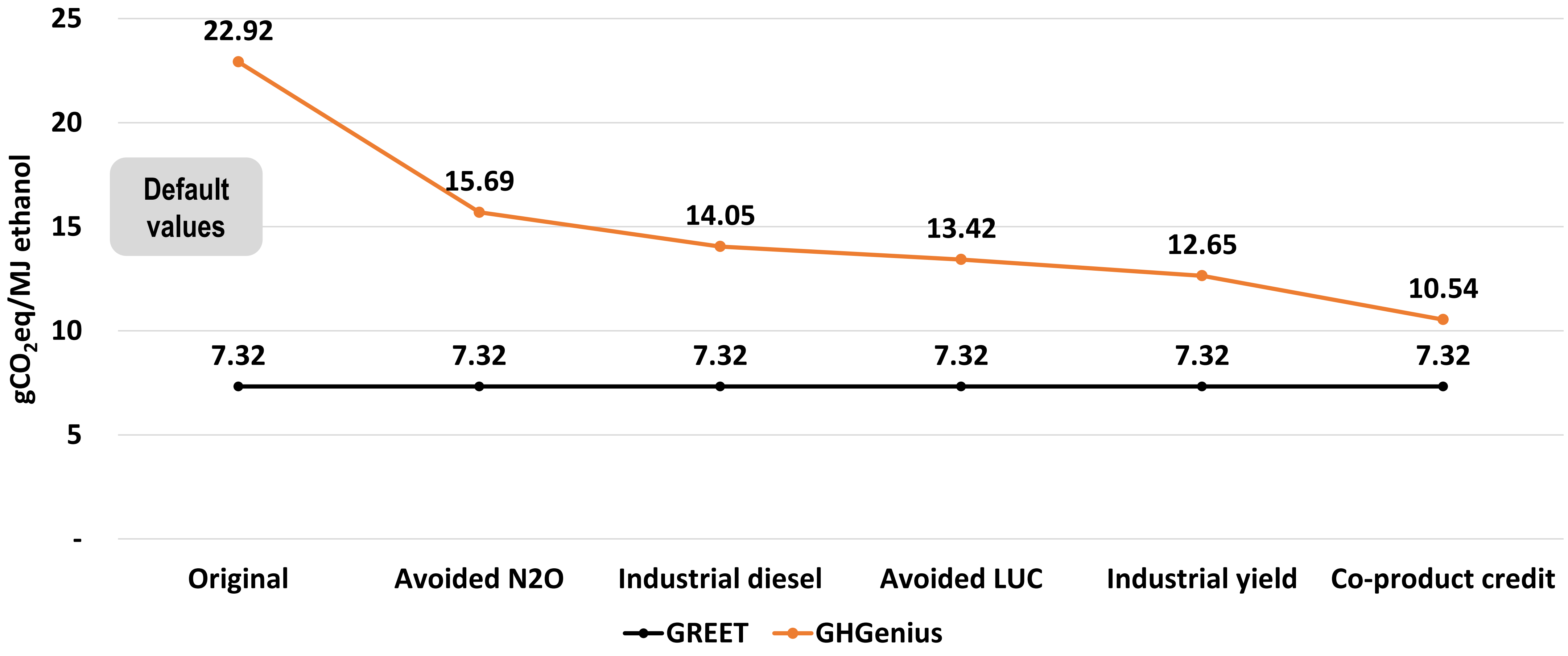
Corn stover 2G ethanol: Major differences

	GHGenius	GREET
Residue recovery	• No credit or debit for carbon changes are considered, neither avoided emissions (N_2O) due to biomass removal	• Considers N_2O and NOx avoided emissions on the field, due to biomass removal
Industrial production	• High energy inputs • No enzyme (cellulase) input	• Low energy inputs • Considers avoided LUC emissions and only lignin for combined heat and power generation
Ethanol distribution	• Local consumption	• Local consumption

Corn stover 2G ethanol

Harmonization of corn stover ethanol emissions

Cradle-to-pump: g CO_2eq/MJ Ethanol



CTBE

CNPEM

CNPEM
Centro Nacional de Pesquisa
em Energia e Materiais

Antonio Bonomi
Otávio Cavalett
Bruno C. Klein
Mateus F. Chagas
Nariê Rinke D. Souza

antonio.bonomi@ctbe.cnpem.br

MINISTÉRIO DA
CIÊNCIA, TECNOLOGIA,
INOVAÇÕES E COMUNICAÇÕES

GOVERNO
FEDERAL