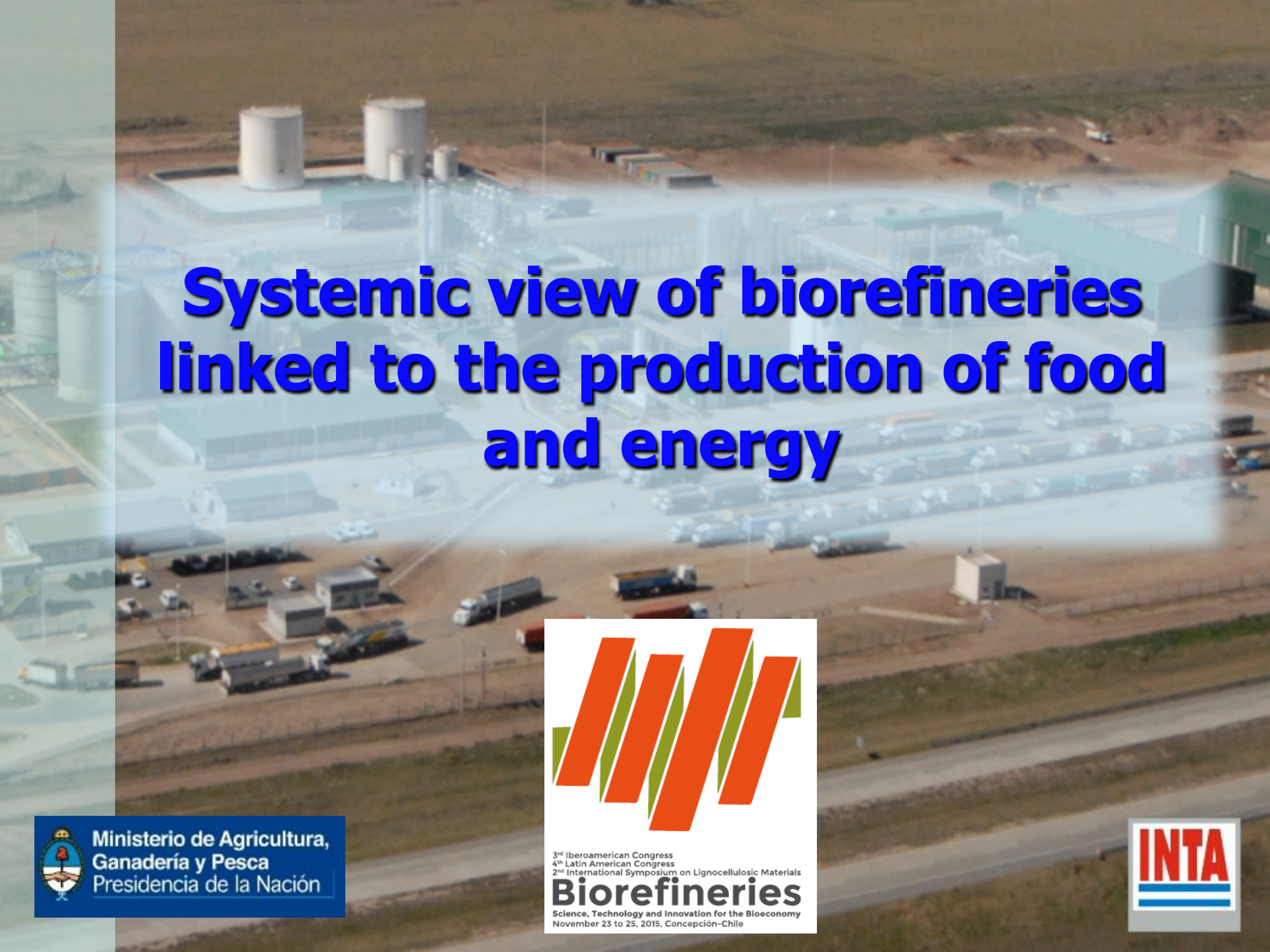
Systemic view of biorefineries linked to the production of food and energy



Ministerio de Agricultura, Ganadería y Pesca
Presidencia de la Nación

3rd Iberoamerican Congress
4th Latin American Congress
2nd International Symposium on Lignocellulosic Materials
Biorefineries
Science, Technology and Innovation for the Bioeconomy
November 23 to 25, 2015, Concepción-Chile

INTA

The study of renewable energy coming from biobased products must analyze and contemplate all the components of a complex transforming chains

Raw material production (feedstocks)

Agroindustrial and biorefinieries transformation

Energy food feed & bioproducts vectors (solids, likieds and gaseoues)

End product target user (people , engines, animals, construction etc.)

Final energy use (mechanical, biological, electric, heat)

BIOMASS ADDED VALUE

Bioproducts
(bioplastics,
biomolecules,
biophármac etc

- MARKET VALUE ++ ++

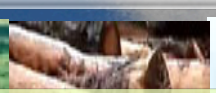
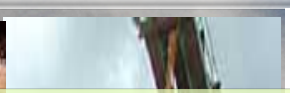
- PRODUCTION VOLUME ++

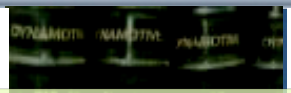
Fodder and animal food

Biofuels - Bioenergy

ADDED VALUE OF THE TRANSFORMING PROCESS

Big scale biofuels are produced in complex multi-product transforming chains

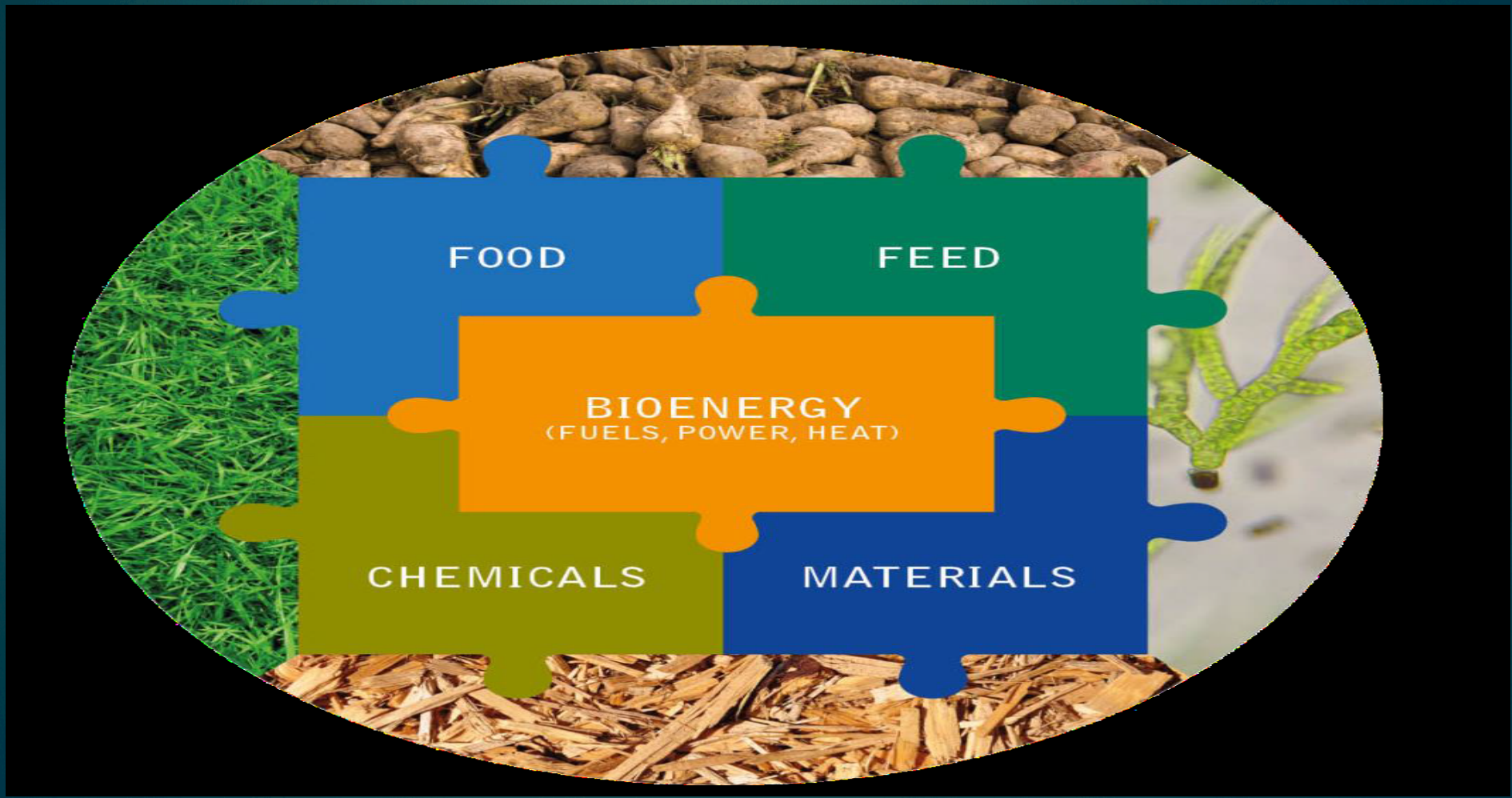






- Derive from a well established transforming chains (food, fiber, feed etc.)
- Produced from coproducts of “flexcrops” production
- Rely on logistics and size economy savings already established.
- Produces multiple impacts in established markets generating new products, price movements, replacements, food feed patterns etc.
- Much affected by policy and administrative changes inside and outside country boundaries
- The industry were feedstock transformation occurs has great plasticity to produce or not the biofuels according to prices profit etc.


CROPS AND RESIDUES
SOIL USE
BIOFUELS
COPRODUCTS
National regulationsnales
INTERNATIONAL RULES
MARKETS
LOGISTICS & TRANSPORT
FOOD DEMAND DIET PATTERNS
NEW TECHNOLOGIES
TARMING TECHNOLOGY
FOSSILE ENERGY
AGROCHEMICALS
CLIMATE CHANGE AND CROP HEALTH
COMPLEX MULTIPLE INTERACTIONS UNKNOWN IN MARKETS HISTORY

Bioenergy is an initial driver force towards a circular **bioeconomy**



ENVIRONMENTAL BALANCE IS A GREAT CHALLENGE FORM I AND II GENERATION BIOFUELS

- Boundaries of the studies
- Alocation critera and factors
- Valorization criteria of each product
- Methodology
- Energy value of each feedstock
- Logistic considerations


SUSTENTABILITY

Sustainability public perception & awareness installation in society and its consequences

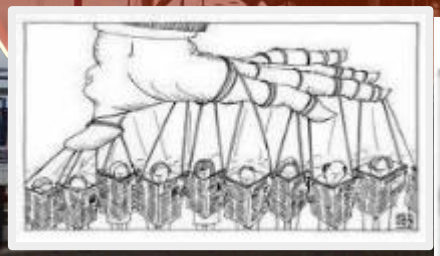
Economic actors
NGO

$$

Instalation through media

"SCIENTIFIC" SUPPORT

Pat Bagley / *Salt Lake Tribune*, de Utah, EE. UU.
La Madre Naturaleza, ante un dilema.



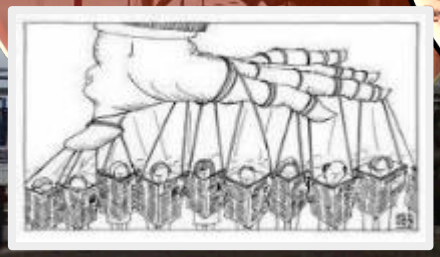
"Klimaschutz geht auch dich was an!"

Sustainability public perception & awareness installation in society and its consequences

Economic actors
NGO

$$

Instalation through media



PUBLIC PERCEPTION CHANGE

Politician Answer

"Klimaschutz geht auch dich was an!"

"SCIENTIFIC" SUPPORT

Sustainability public perception & awareness installation in society and its consequences

Economic actors
NGO

$$

Instalación del tema en los medios

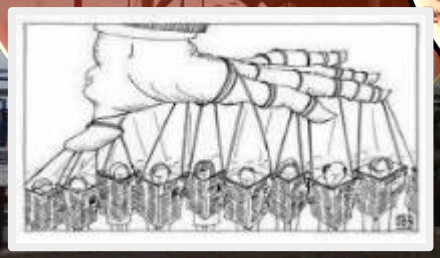
CAMBIO

PERCEPCION PUBLICA

Respuesta política

Regulation and control departments

REQUIREMENTS



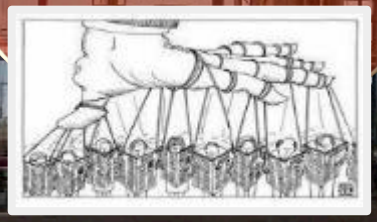
"SCIENCE" SUPPORT

Sustainability public perception & awareness installation in society and its consequences

Economic actors
NGO

$$

Instalation through media



"SCIENTIFIC" SUPPORT

PUBLIC PERCEPTION

CHANGE

Politician Answer

Regulation and control departments

REQUIREMENTS

Search for scientific support of new measures

Universities

Research Institutes

Installed paradigms

- Direct relation between production capacity and food security
- Food competence
- Advantages of non food crops (II generation)
- Superior costs than conventional fuels
- Direct relation between crop use and biofuel production
- Increase crop production altering forest areas
- Relative advantages on GHG savings
- Neutral or low Energy balances

PRODUCTION DSTUDIES ON BIOFUELS AND COPRODUCTS ON REGINAL PLANTS

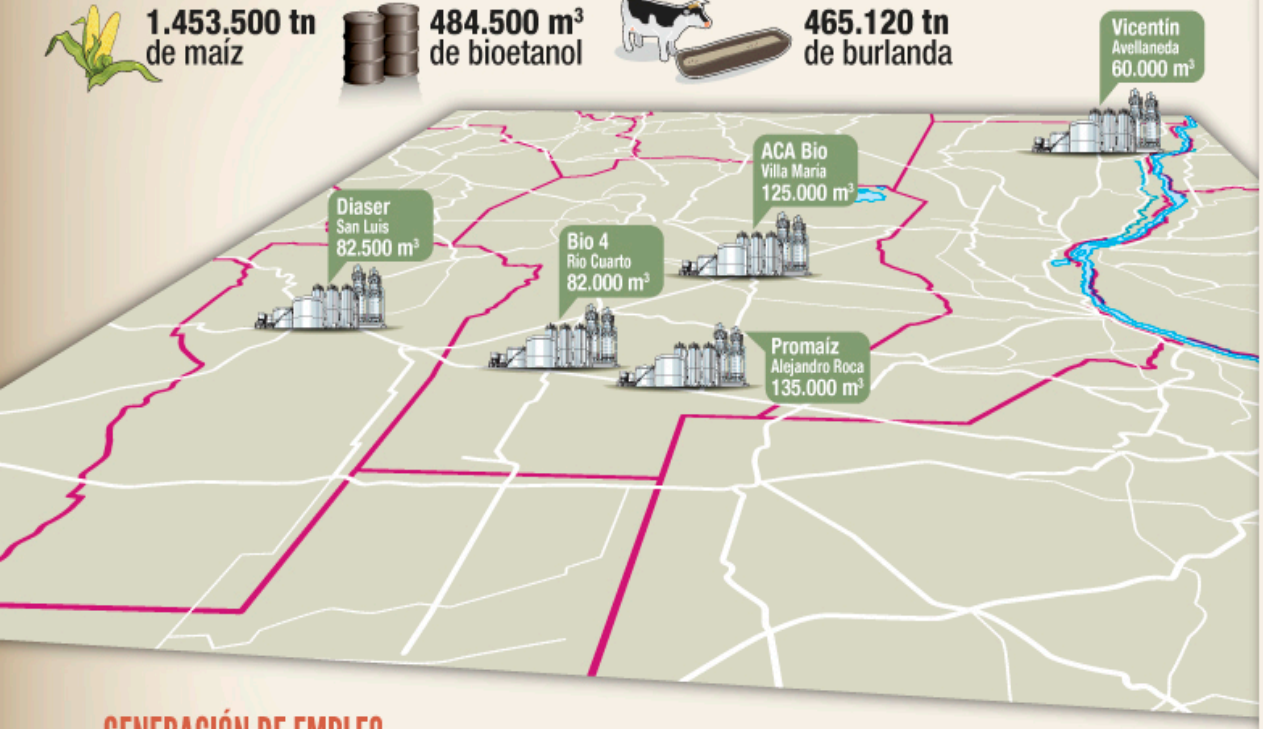
Jorge Antonio Hilbert
Intituto de Ingenierìa Rural
Instituto Nacional de Tecnología Agropecuaria
jorgeantoniohilbert@gmail.com
hilbert.jorge@inta.gob.ar

BIOETANOL DE MAÍZ

CONTRIBUCIÓN IMPOSITIVA, ECONÓMICA Y SOCIAL DE LA CADENA DE VALOR

PRODUCCIÓN (año 2014)

- **1.453.500 tn** de maíz
- **484.500 m³** de bioetanol
- **465.120 tn** de burlanda



GENERACIÓN DE EMPLEO

SECTOR PRIMARIO

GLOBAL **2.310**

SECTOR INDUSTRIAL

DIRECTO **640**

INDIRECTO **1.930**

TOTAL 4.880

INVERSIÓN
(en millones de dólares)

436 MILLONES

AHORRO DE DIVISAS
(en millones de dólares)

420 MILLONES

APORTE FISCAL (en millones de pesos)

Siembra, cosecha y comercialización	242 MILLONES
Elaboración de bioetanol	530 MILLONES
Costo de oportunidad (derechos de exportación no recaudados)	-192 MILLONES
Cadena de valor	**580 MILLONES**

APORTE FISCAL POR TONELADA

El aporte fiscal de la tonelada industrializada es más estable ante reducciones en el precio del maíz

APORTE DE LA CADENA DE VALOR VS. PROGRAMAS DE INTI E INTA (AÑO 2013)

CADENA DE VALOR	INTI	INTA
580 MILLONES	448 MILLONES	1.698 MILLONES
	129% DEL PRESUPUESTO	34% DEL PRESUPUESTO

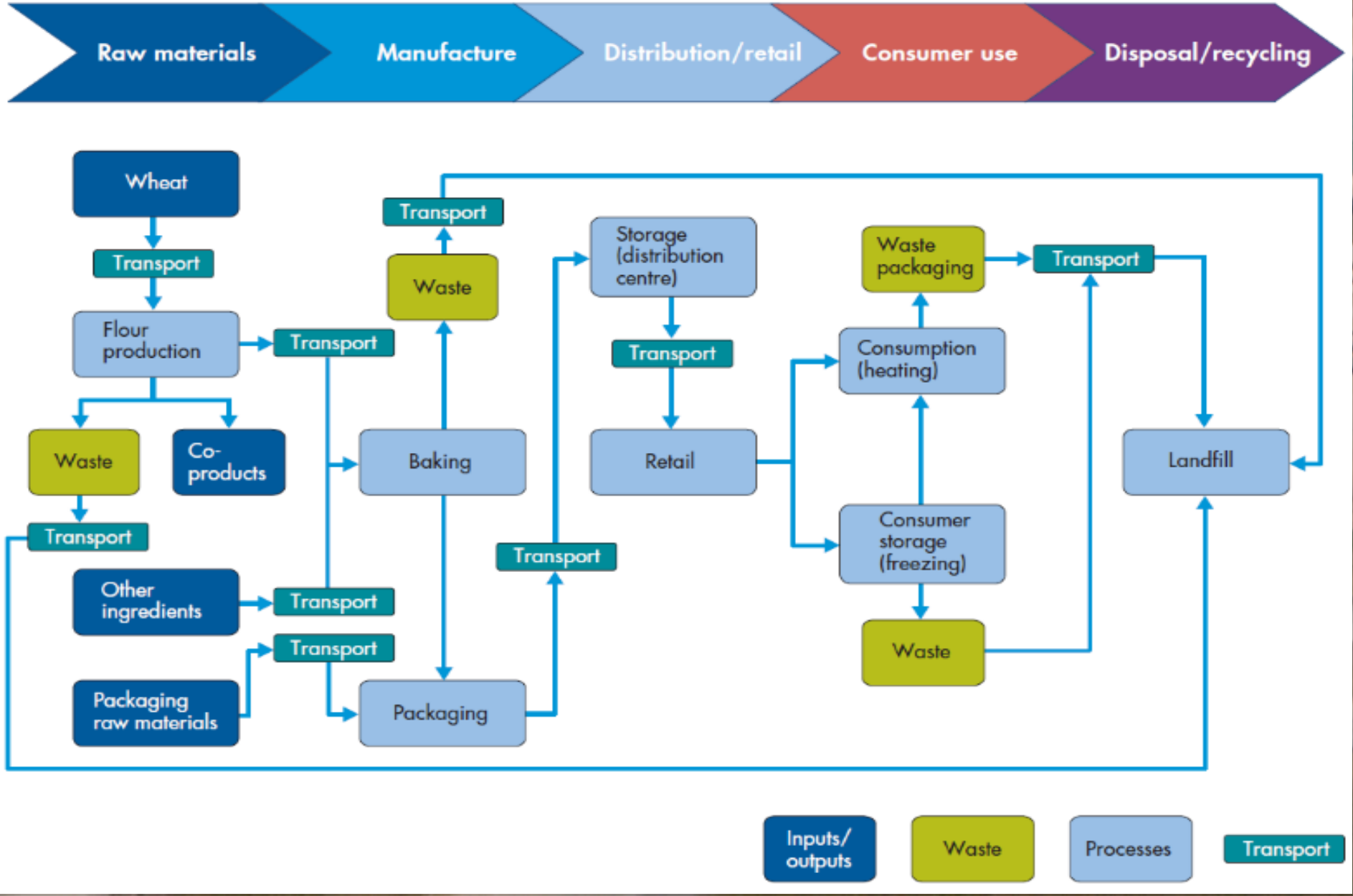
Instituto Nacional de Tecnología Industrial

Proyectos desarrollados

bio4
BIOETANOL RIO CUARTO S.A.

bioelectrica
energia en origen

PRODUCT APPROACH



¿Why do this studies from the business perspective"?

Process efficiencies

- Better knowldge to improve
  - Fuels uso
  - Agrochemicals
  - Transport

Commercial reasons

- Anticipate potential regulatory measures
- Overcome international market requirements
- Promote and position products in local & overseas markets
- Support the implementation of new measures
- Develop marketing strategies

Allocation between products & Co-Products

Mass balance: *Emitions are appropiate according to real yields and mass balance (% weight) in each step.*

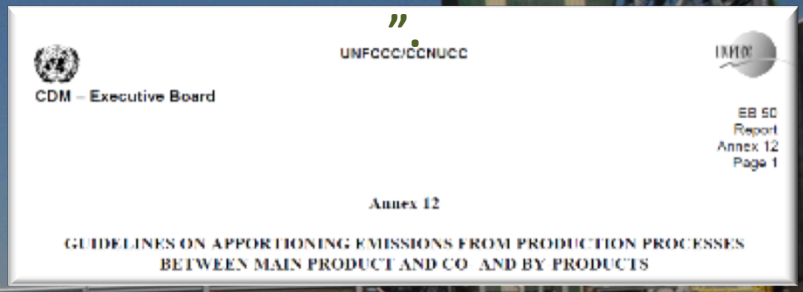
Energy content: *According to the European Union Directive*
Where a fuel production process produces, in combination, the fuel for which emissions are being calculated and one or more other products (co-products), greenhouse gas emissions shall be divided between the fuel or its intermediate product and the co-products in proportion to their energy content (determined by lower heating value in the case of co-products other than electricity). ". Annex V – Point 17.

Market price: *According to EB 50 – the executive board of the Clean Development Mechanism, for assigning of co-products.This methodology is being used for projects that generate cetrtiified emition green bonus.*

Methodological tools

2006 IPCC directives for national GHG inventories

EB 50 – Executive MDL board "Guidelines on apportioning emissions from production processes between main product and co-and by-products ".


UNFCCC/CCNUCC

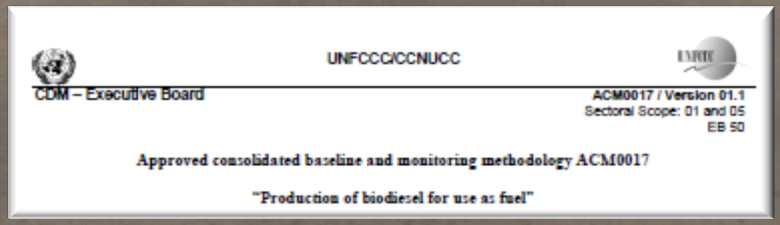
CDM – Executive Board

EB 50
Report
Annex 12
Page 1

Annex 12

GUIDELINES ON APPORTIONING EMISSIONS FROM PRODUCTION PROCESSES BETWEEN MAIN PRODUCT AND CO AND BY PRODUCTS

ACM0017 Methodology "Approved consolidated baseline and monitoring methodology Production of biodiesel for use as fuel".


UNFCCC/CCNUCC

CDM – Executive Board

ACM0017 / Version 01.1
Sectoral Scope: 01 and 05
EB 50

Approved consolidated baseline and monitoring methodology ACM0017

"Production of biodiesel for use as fuel"

DIRECTIVE 2009/28/CE European Union Parliament and council April 23 2009

Annex V concepts included in the studies

	Concepto	Incluido
e_{ec} =	Emissions from the cultivation raw material (soybean);,	Yes
e_{l} =	Annualised emissions from carbon stock changes caused by land-use change,	No Assumption of no change in carbon stoks in soils since January 2008.
e_{p} =	Emissions from processing	Yes
e_{td} =	Emissions from transport and distribution emissions	Yes
e_{u} =	Emissions from the fuel in use	No Europen Directive - Anex V - Páragraph 13:Emissions from the fuel in use, eu, shall be taken to be zero for biofuels and bioliquids
e_{sca} =	Emission savings from soil carbon accumulation via improved agricultural management,	No No changes in carbon stoks due to agricultural practces
e_{ccs} =	Emission saving from carbon capture and geological storage,	No There are not any geological storage in place.
e_{ccr} =	Emission saving from carbon capture and replacement	No No biomass is used for fossile fuel replacement.
e_{ee} =	Emission saving from excess electricity from cogeneration .	No No electricity is generated.

DEVELOPED CALCULATOR

- Based on excell spreadsheets
- Book with 32 dinamic tables
- Contains databeses and reference data
- Sensibility and input sheets
- International and national impacts

Inventario actividades ACABIO - Campaña 2014/15

Resumen de contenidos planilla de calculo

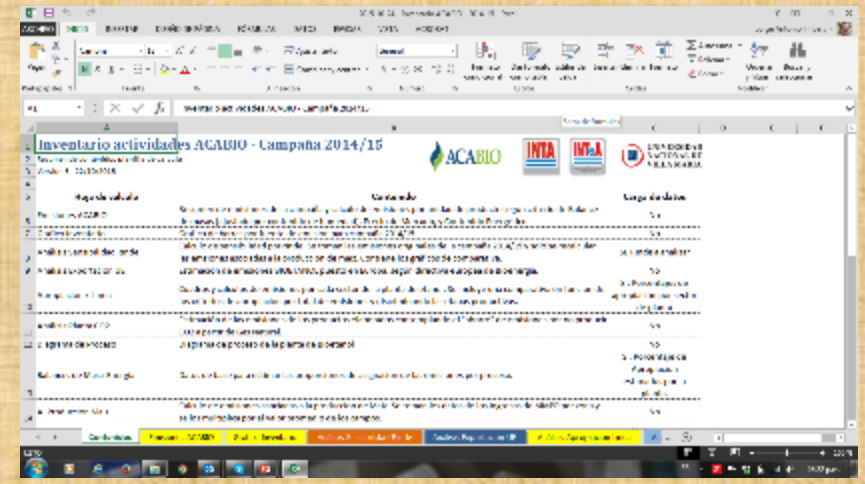
Version 9 - 29/10/2015

Hoja de calculo	Contenido	Carga de datos	Pagina
Emisiones ACABIO	Resumen de emisiones de la campaña y calculo de emisiones por unidad de producto según criterio de Balance de masas (ajustado por contenido de humedad), Precio de Mercado, y Contenido Energético.	No	1
Grafico Inventario	Grafico de barras por fuente de emision para campaña 2014/15	No	2
Análisis Sensibilidad Rinde	Calculo de sensibilidad por rinde. Se toman las emisiones originales de la campaña 2014/15 y solo se recalculan las emsiones asociadas a la produccion de maiz. Contiene los gráficos de comparativa.	Si. Rinde a analizar	3
Análisis Exportacion UE	Estimación de emisiones BIOETANOL puesto en Europa, según directiva europea de Bioenergía.	No	4
Apropiación x Linea	Cuadros y calculos de emisiones por cada sector de la planta de etanol. Se incluye una comparativa en funcion de los criterios de apropiacion por total de emisiones y discriminando las etapas productivas.	Si. Porcentajes de apropiación por sector de planta	5
Análisis Planta CO2	Estimación de las emisiones de los productos elaborados contemplando el "ahorro" de emisiones por no producir CO2 a partir de Gas Natural.	No	6
Diagrama de Proceso	Diagrama de proceso de la planta de Bioetanol	No	7
Balances de Masa-Energia	Datos de base para estimar las proporciones de asignacion de las emisiones por proceso.	Si. Porcentaje de Apropiacion estimados por la planta.	8
A. Produccion Maiz	Calculo de emisiones asociadas a la produccion de Maiz. Se toman los datos de los ingresos de MMPP por zona y se los multiplica por el valor promedio de los campos.	No	9
B. Fletes Maiz	Calculo de emisiones asociadas al transporte según recepciones de Cartas de Porte y calculo de distancia desde campos a Acopio y ACABIO.	Distancias y volumenes según Cartas de porte	10
C. D Planta - Fletes PT	Calculo de emisiones asociadas a la planta de Bioetanol. Calculo de emisiones consumos de energia, fletes de	Datos de consumos y	11

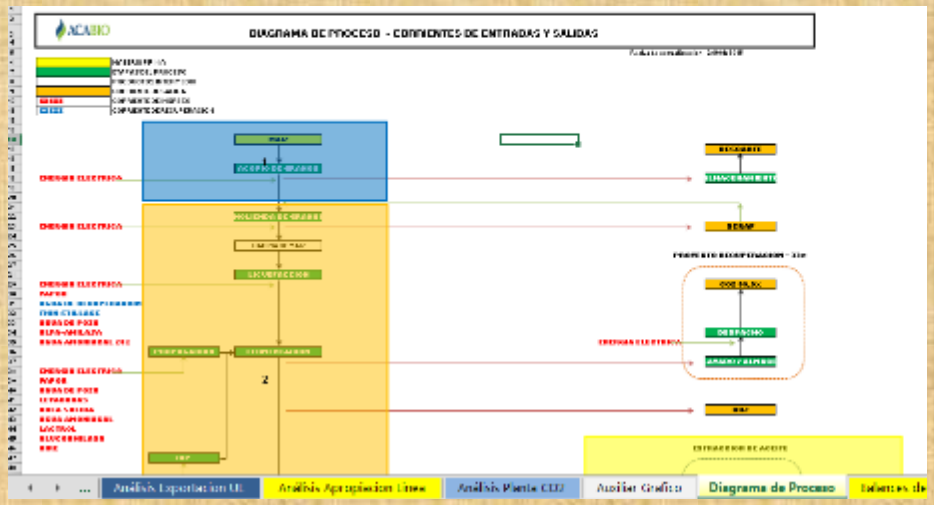
Contenidos | Emisiones ACABIO | Grafico Inventario | Análisis Sensibilidad Rinde | Análisis Exportacion UE | Análisis Apropiacion Linea | An ...

Calculator description

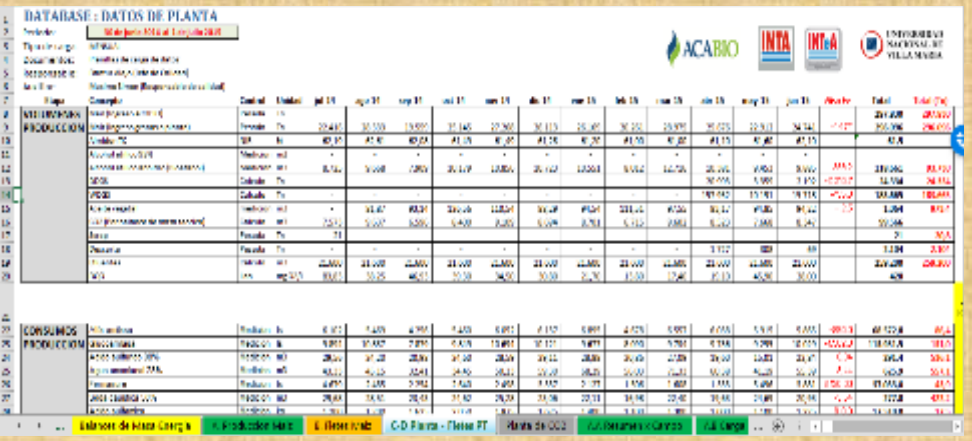
General index



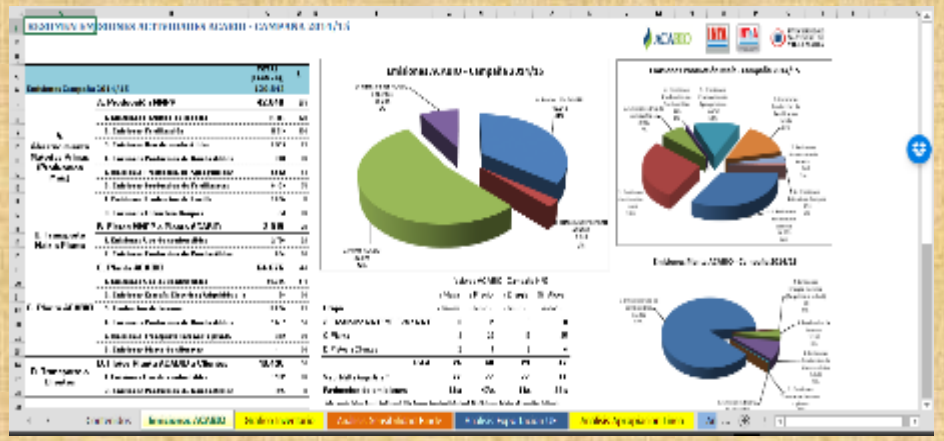
Process descriptions



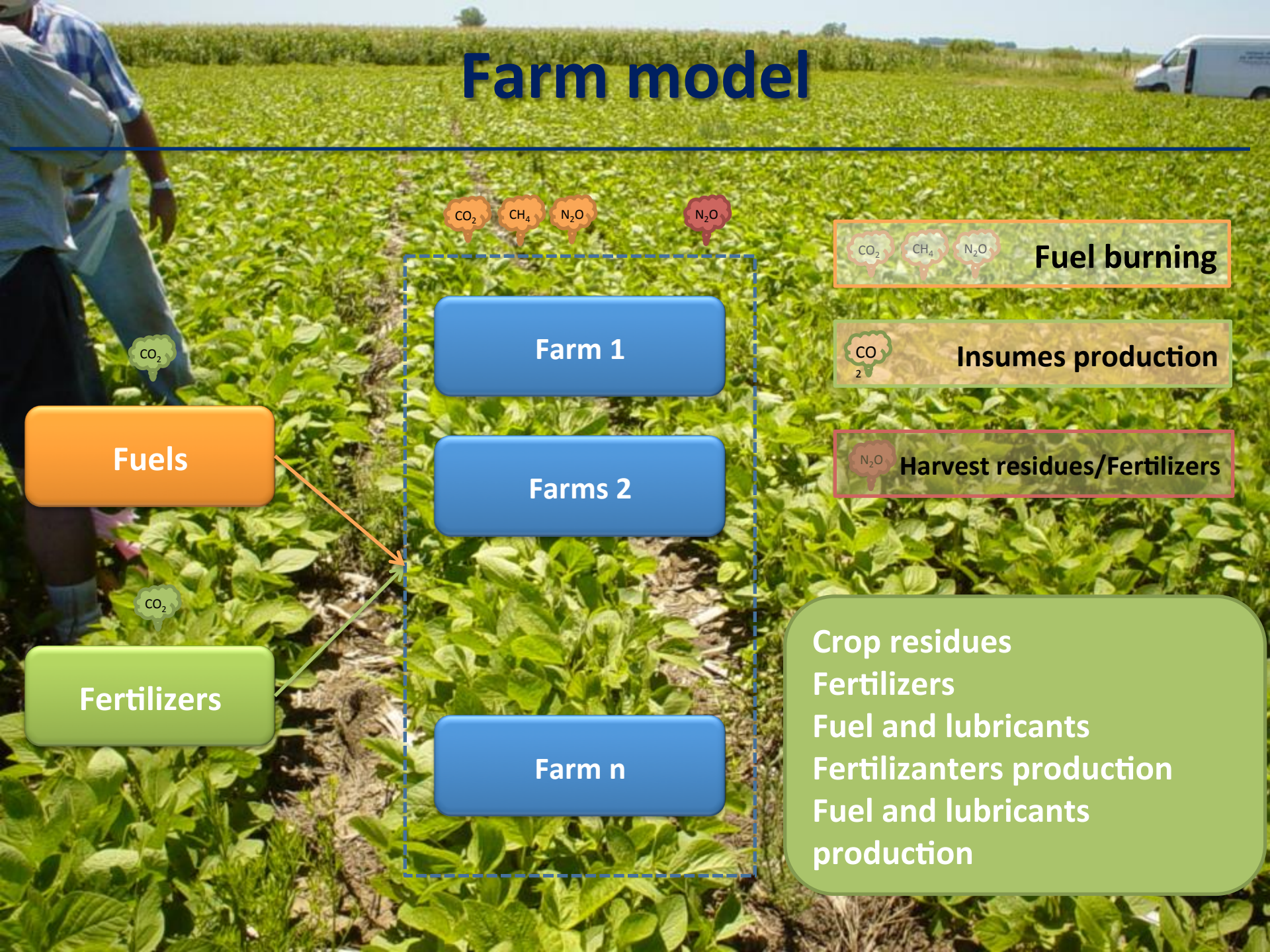
Loading data sheets



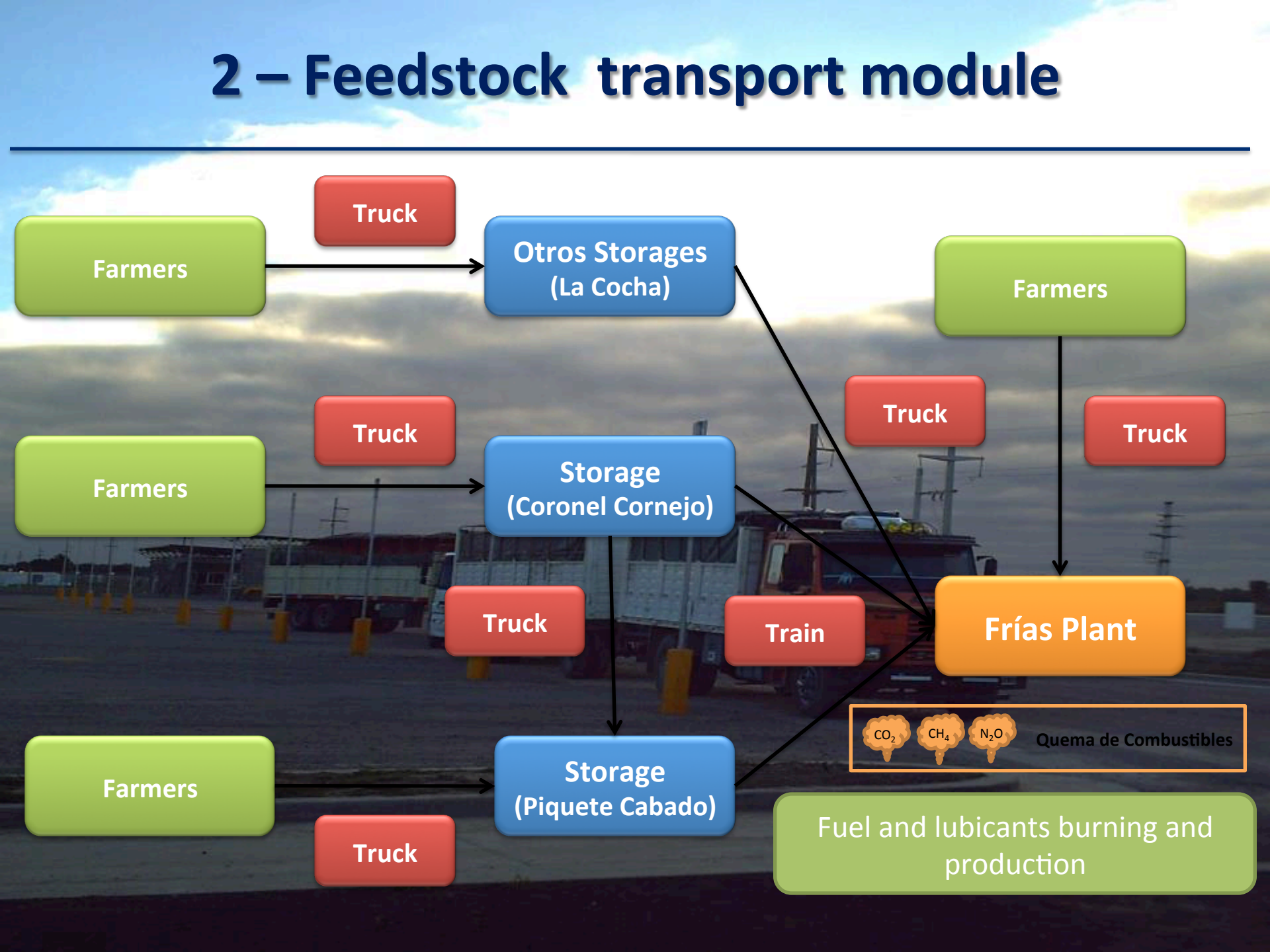
Results graphs and sensibility analysis



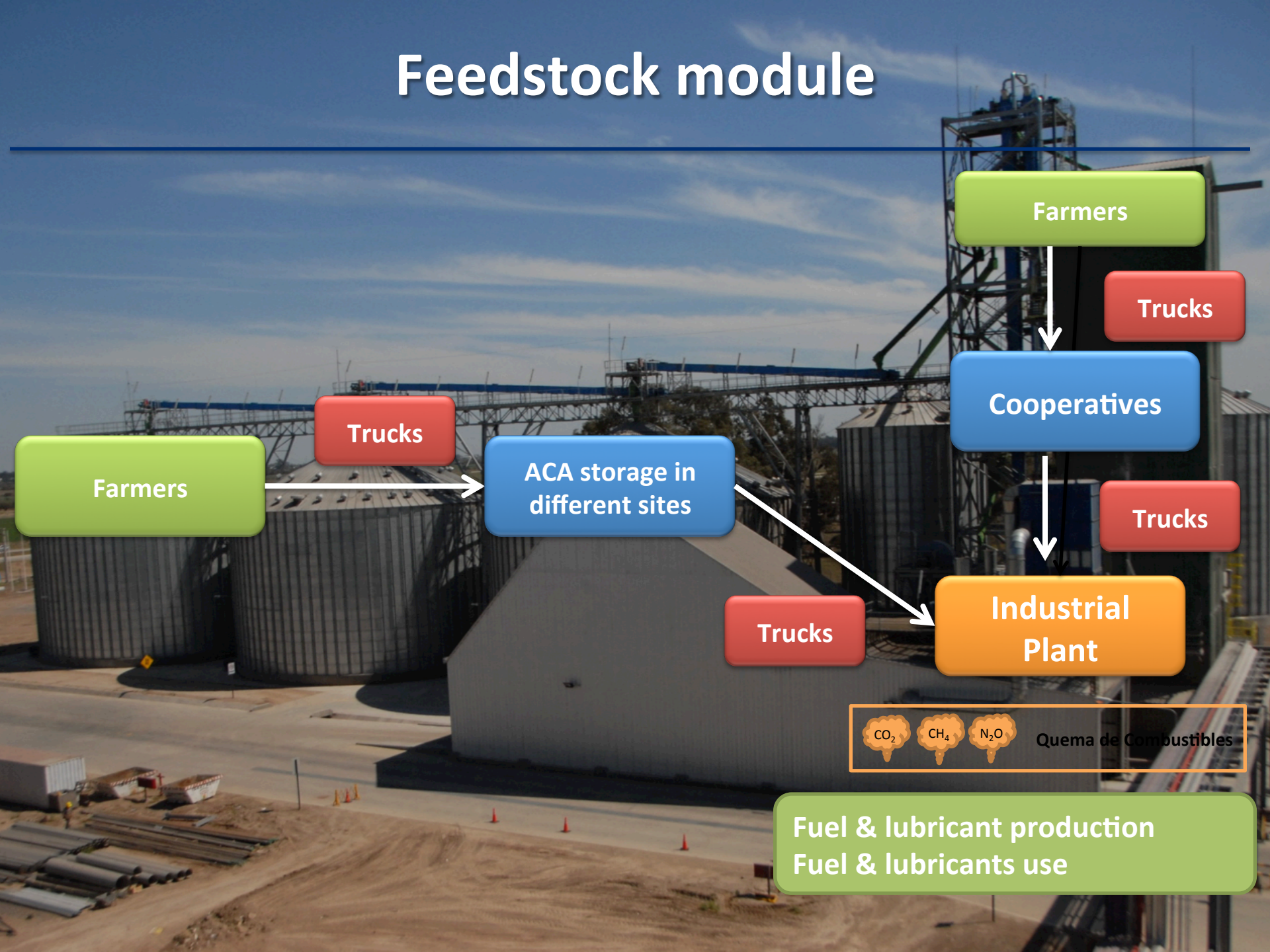
Farm model


CO_2
CH_4
N_2O
N_2O
Farm 1
Farms 2
Farm n
Fuels
Fertilizers
CO_2
CO_2
Fuel burning
CO_2
Insumes production
N_2O
Harvest residues/Fertilizers
Crop residues
Fertilizers
Fuel and lubricants
Fertilizanters production
Fuel and lubricants production

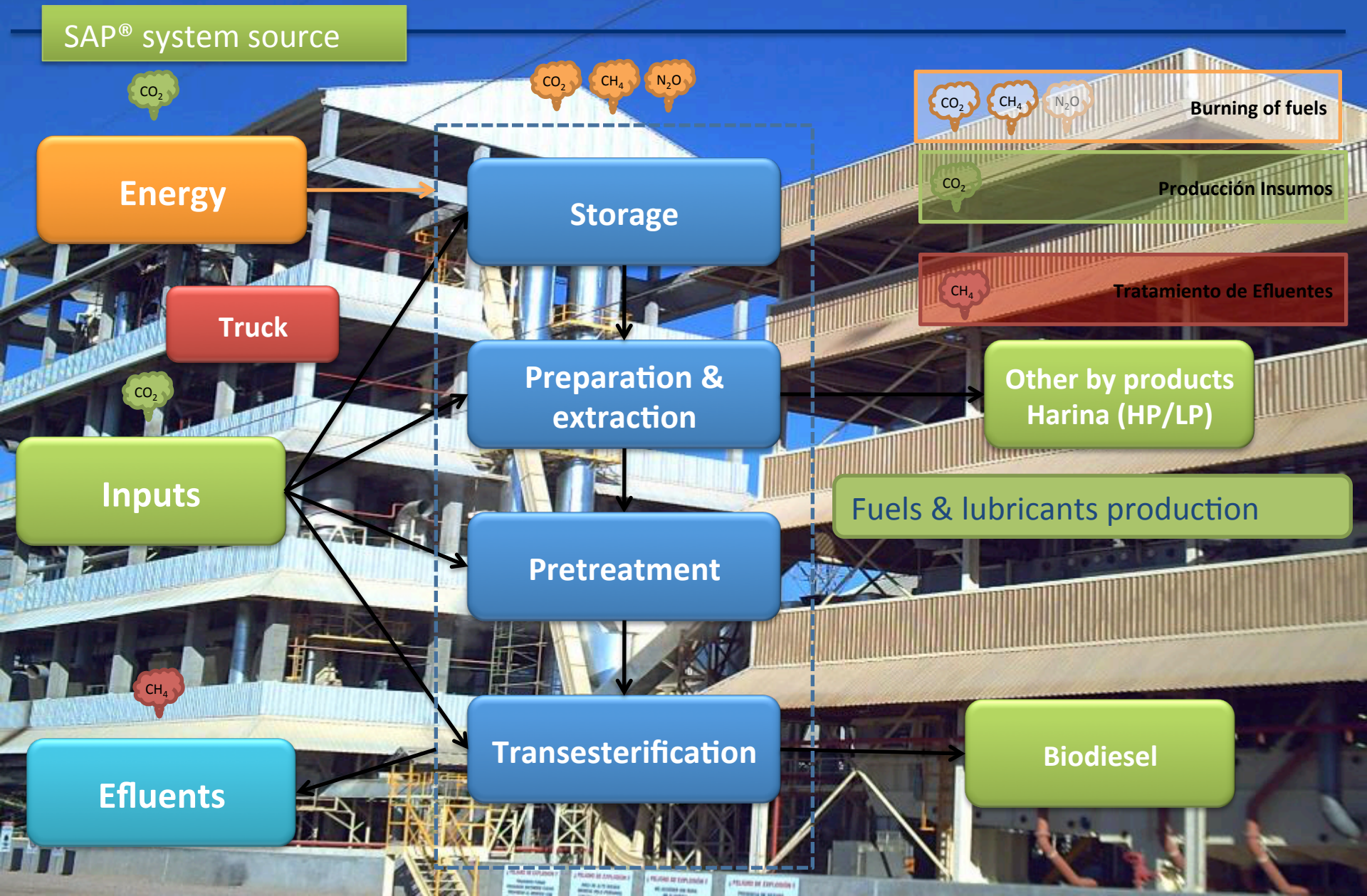
2 – Feedstock transport module



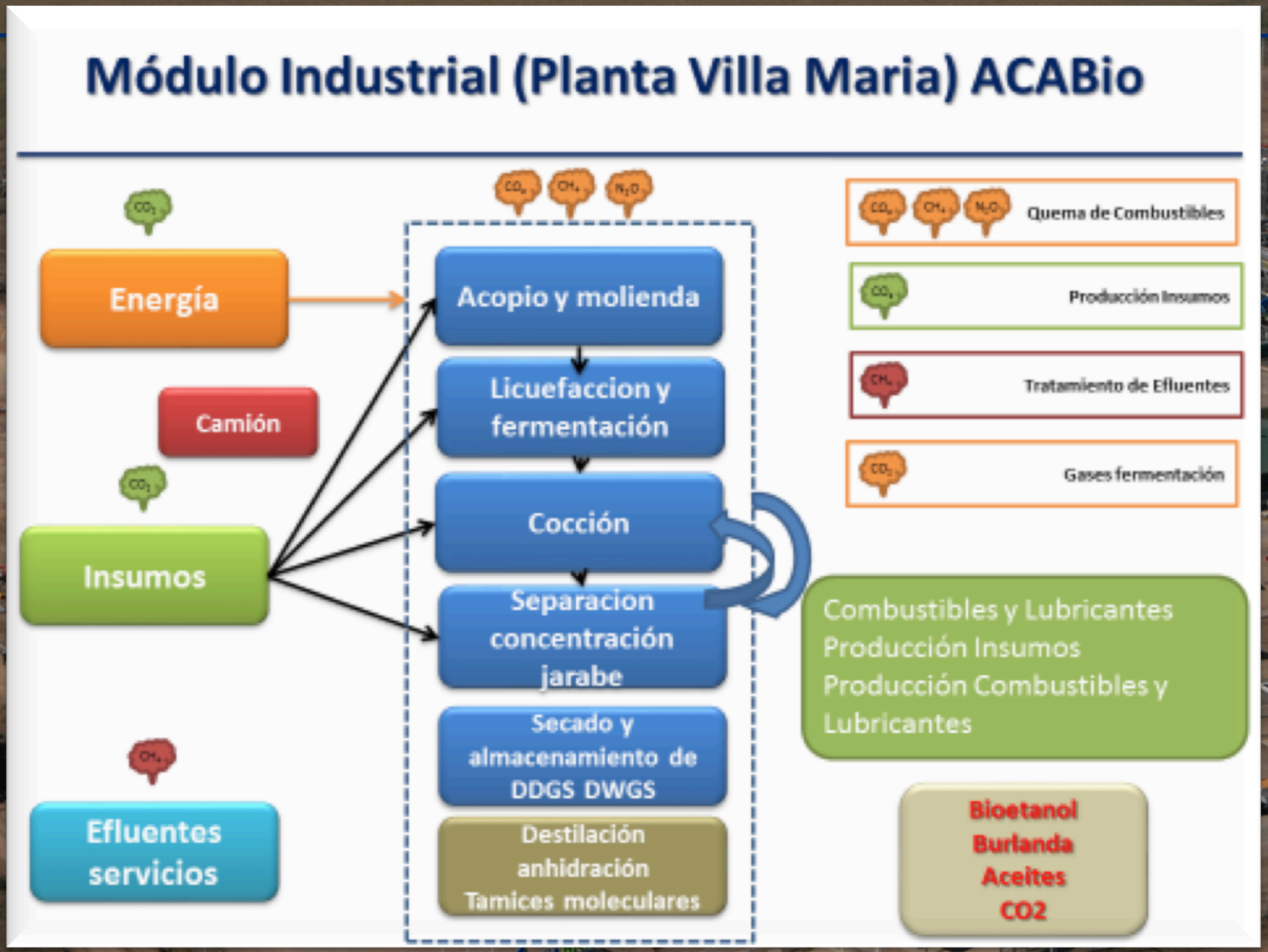
Feedstock module



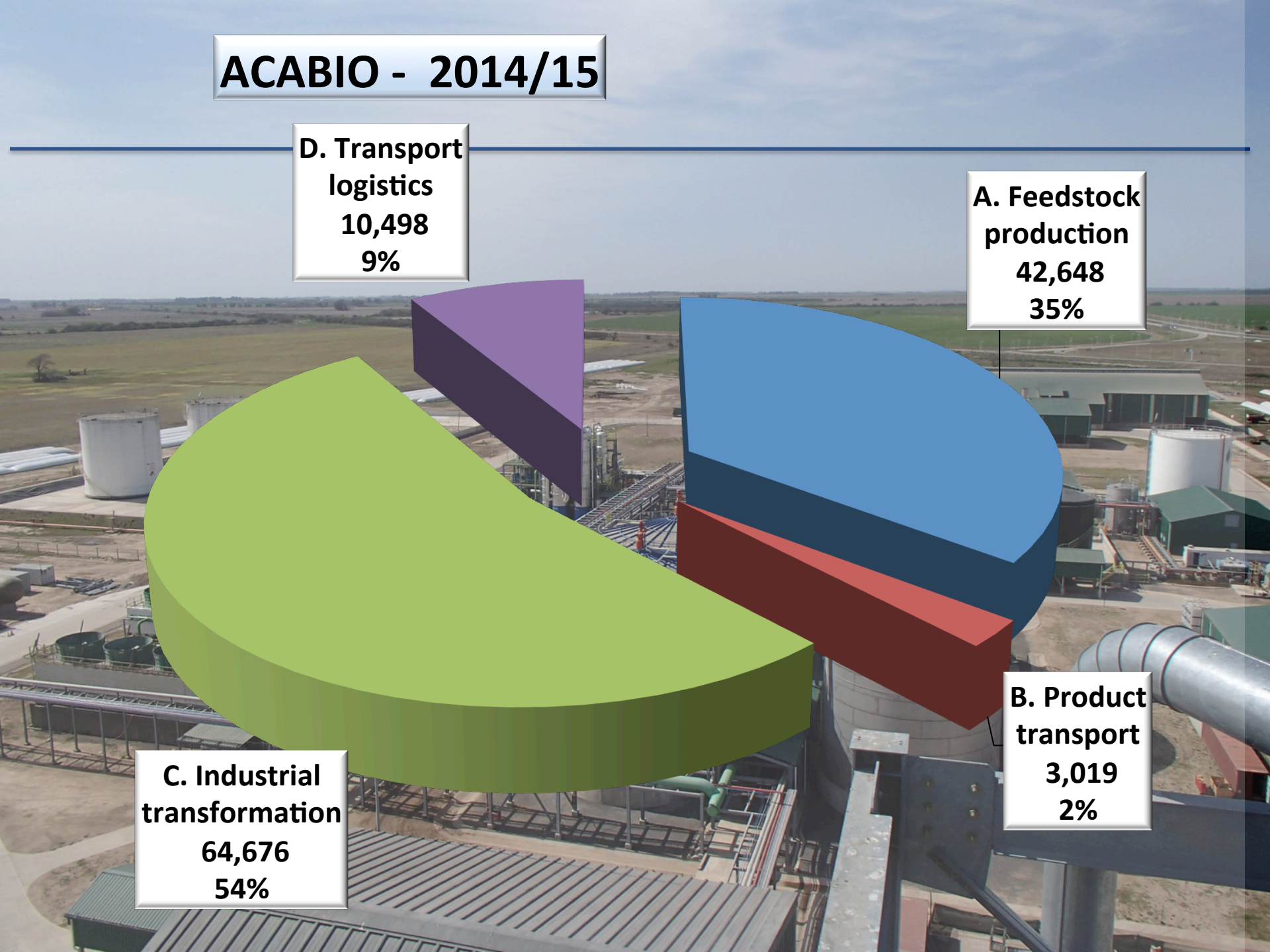
Industrial module (Frías Plant)



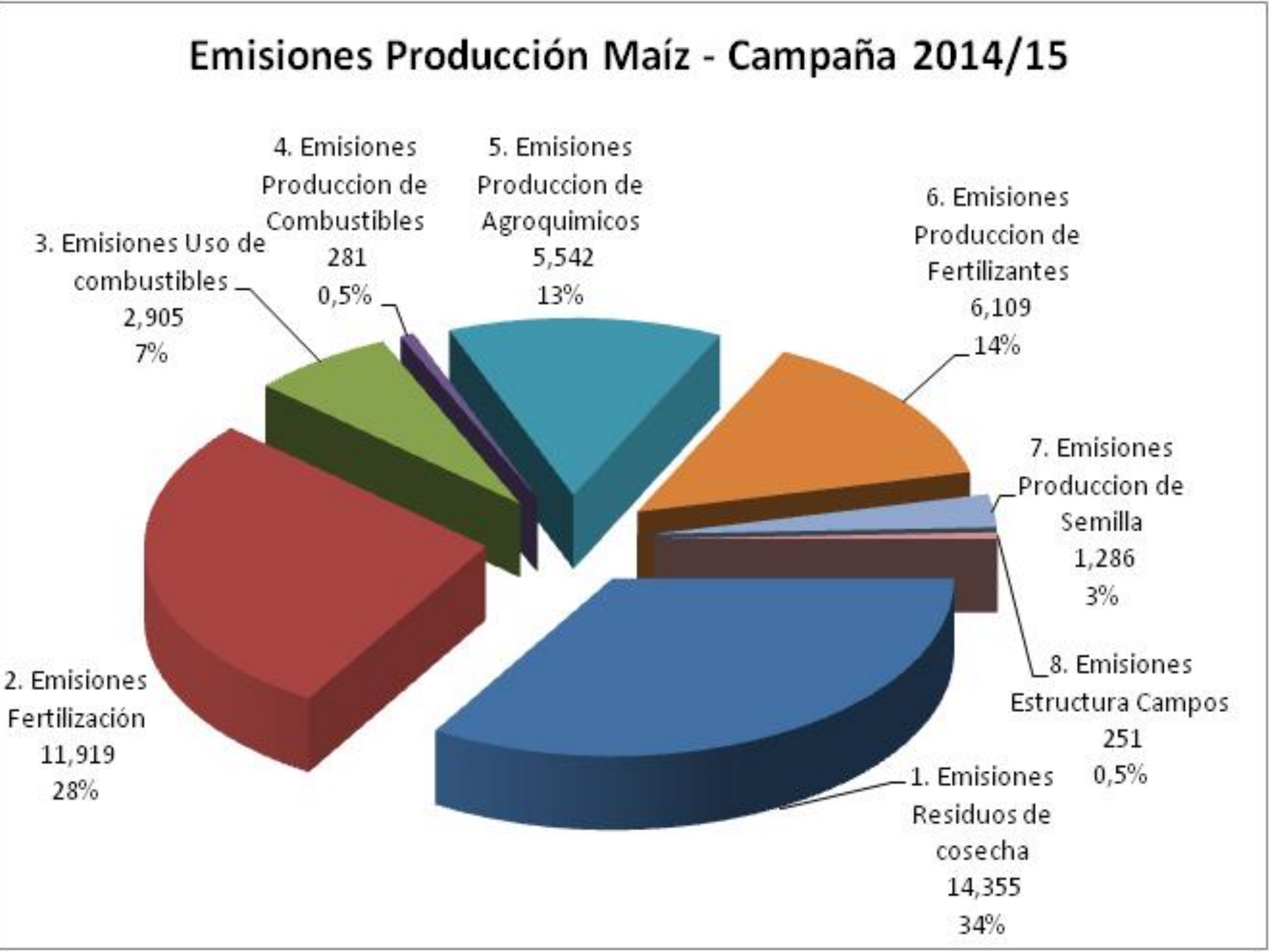
CORN TRANSFORMATION PLANT STEPS AND PRODUCTS



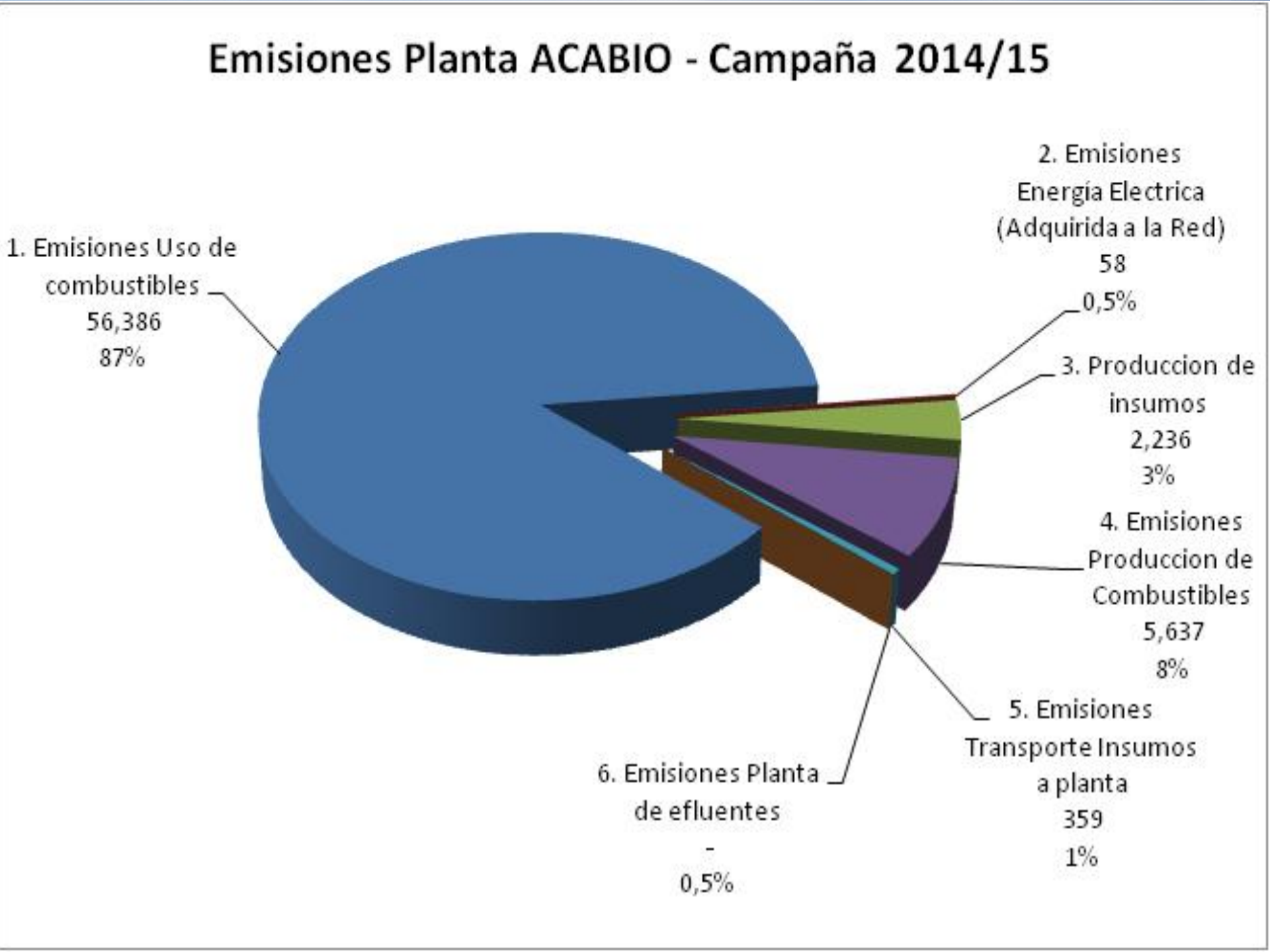
ACABIO - 2014/15



Emisiones Producción Maíz - Campaña 2014/15



Emisiones Planta ACABIO - Campaña 2014/15



DIFFERENT PROCUT CONTRIBUTION

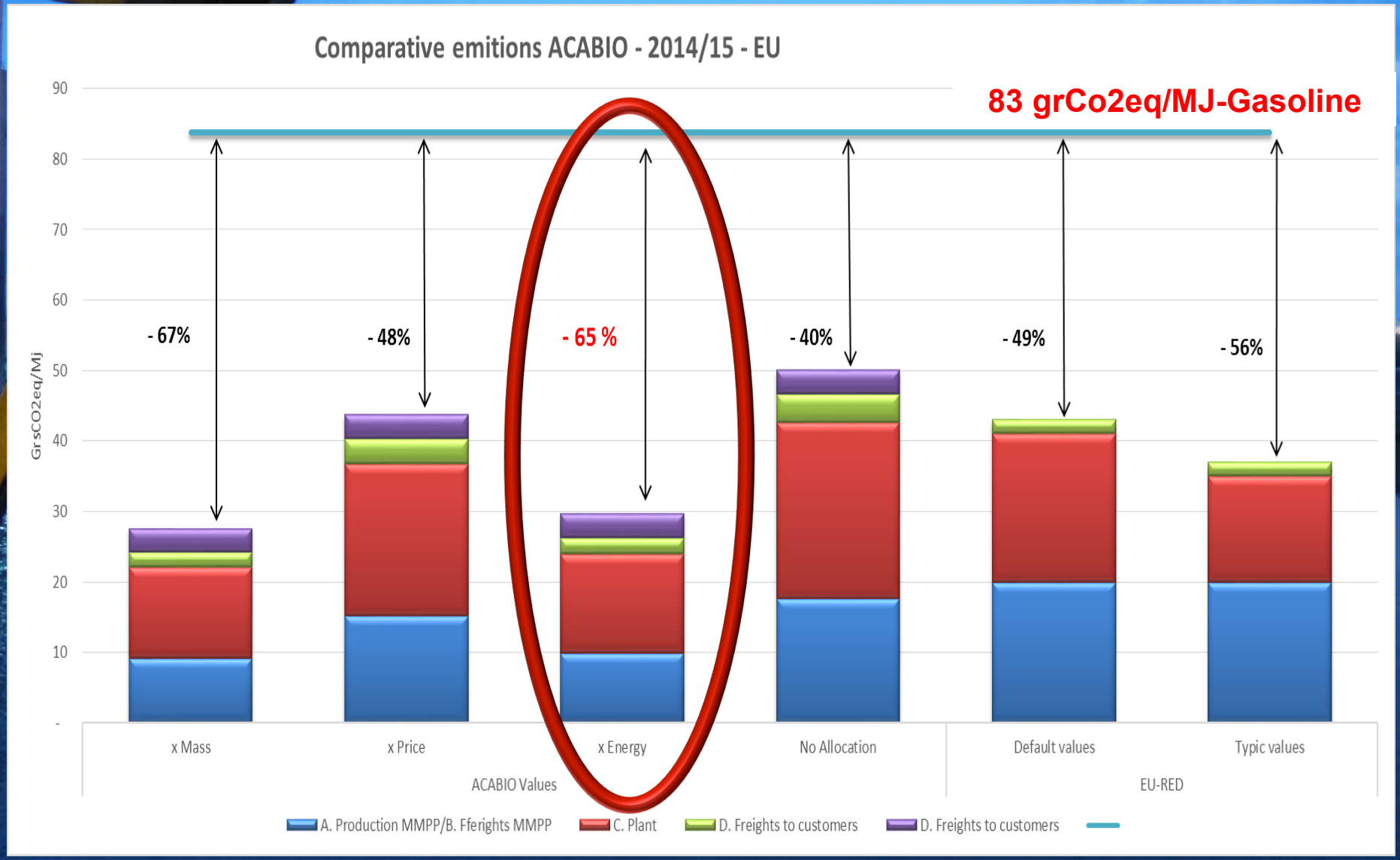
	Energy criteria				
	Production		Emissions	Emission/unit	
Product	Tn	%	TnCO2eq	KgCO2eq/Tn	grsCO2eq/Mj
Bioetanol	93729,99214	0,56193101	63179,23613	674,0557071	24,4081907
DDGS	24334,23	0,10933435	12292,71993	505,1616563	
WDGS	183665,31	0,32091623	36081,37252	196,4517552	
Vegetable oil	973,3587	0,00781842	879,0432168	903,1030563	
Total	302702,8908	100%	112432,3718	371,4281403	

EU targets compliance

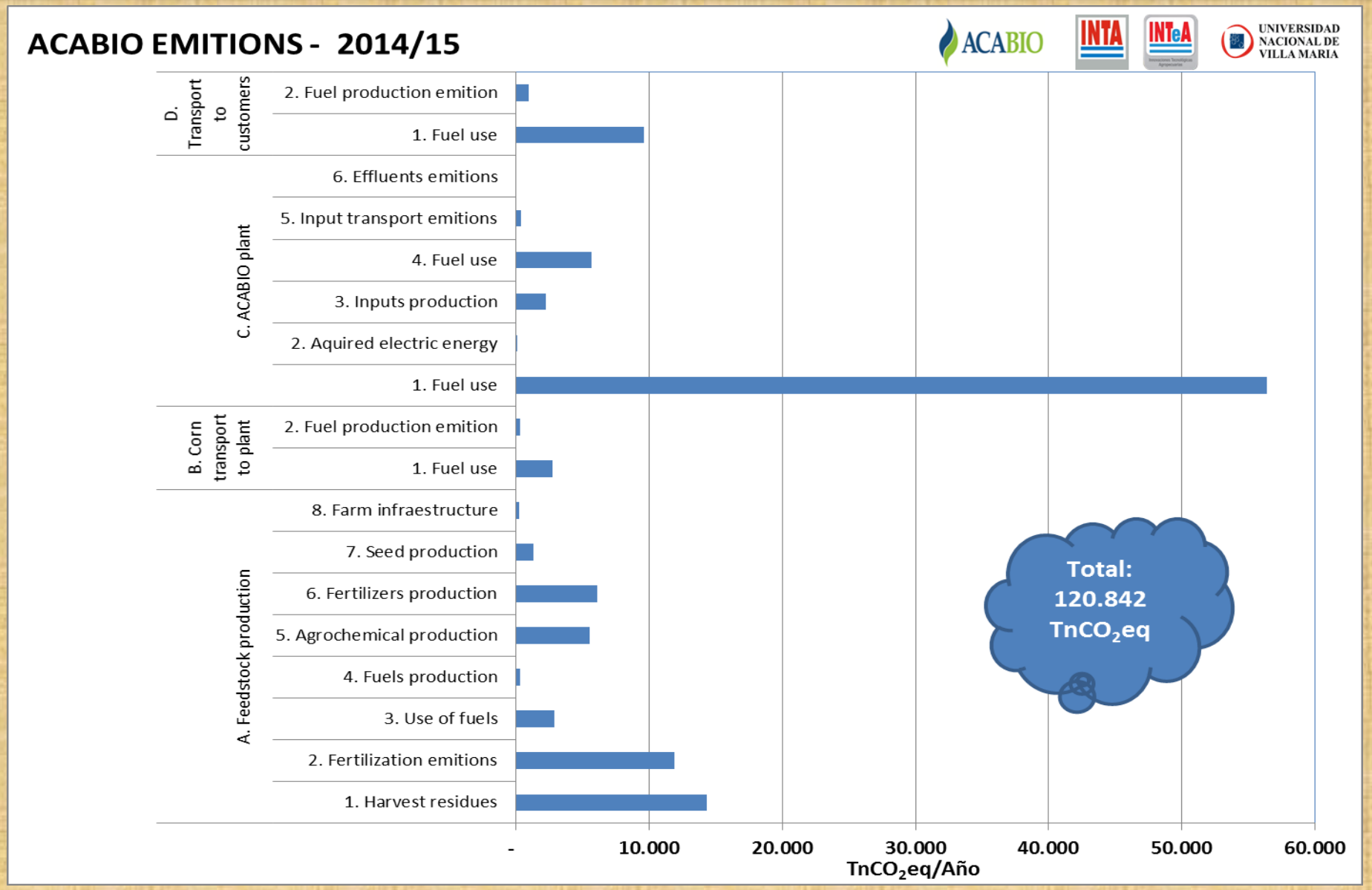
EXPORT REQUIREMENTS ANALYSIS TO THE EU

		ACABIO Values				EU-RED	
Emitions (Grs CO2eq/MJ)		x Mass	x Price	x Energy	No Allocation	Default values	Typic values
eec	A. Production MMPP/B. Fferights MMPP	9	15	10	18	20	20
ep	C. Plant	13	22	14	25	21	15
etd	D. Freights to customers	2	4	2	4	2	2
etd2	E. Ocena transport to Rotterdam	3	3	3	3	-	-
EB	Production emitions (g CO2eq/Mj)	28	44	30	50	43	37
EF	Emitions	83,8	83,8	83,8	83,8	83,8	83,8
RED	Reduction =(EF-EB)/EF	**67%**	**48%**	**65%**	**40%**	**49%**	**56%**
	31 de December de 2016 limit	35%	35%	35%	35%	35%	35%
	Compliance			Yes	Yes	Yes	Yes
	31 de December de 2017 limit	50%	50%	50%	50%	50%	50%
	Cumplimiento	Yes		Yes	No		Yes
	1 de January 2018 limit	60%	60%	60%	60%	60%	60%
	Complience	Yes		Yes	No		

International analysis



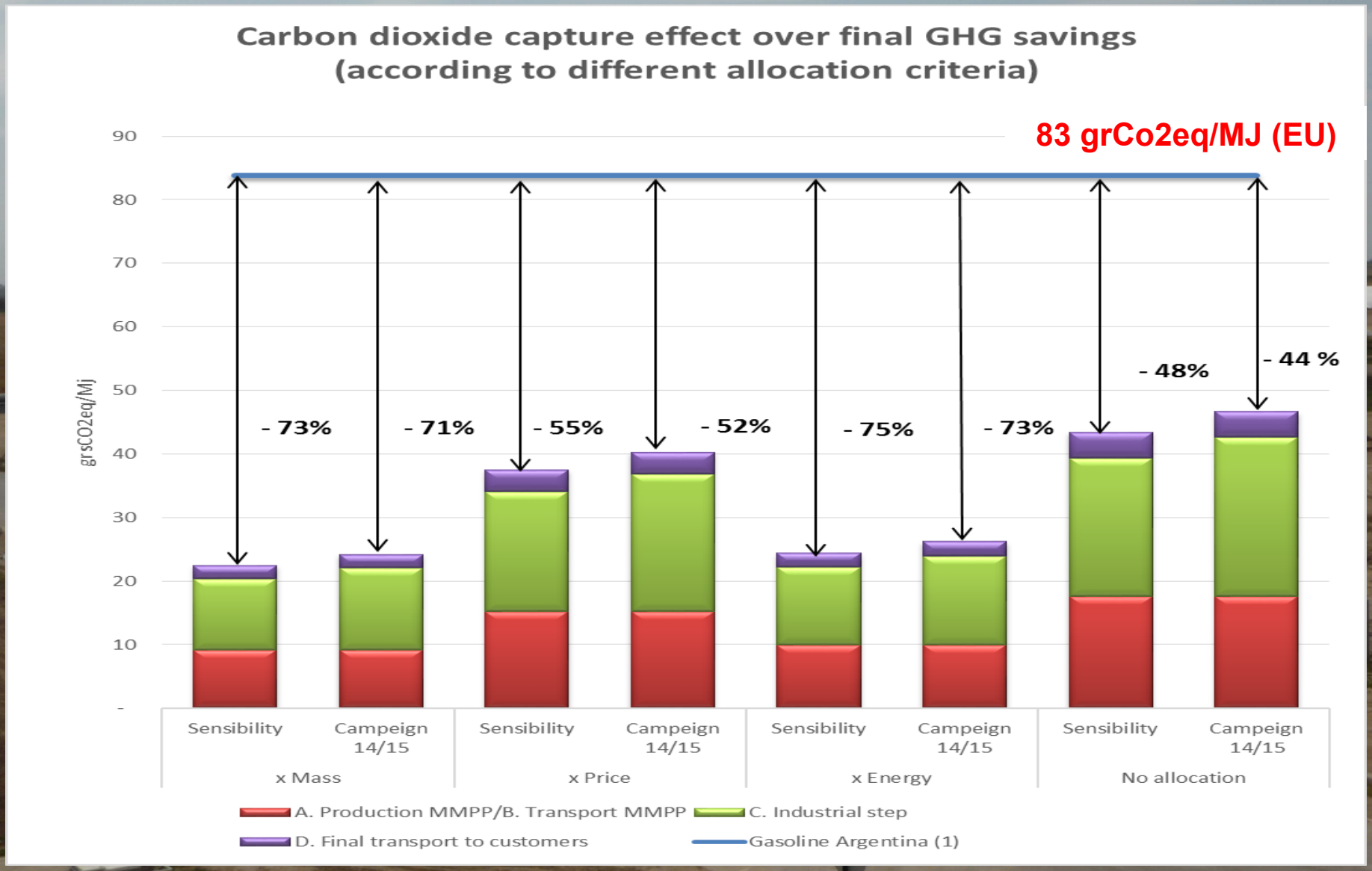
Emition distribution



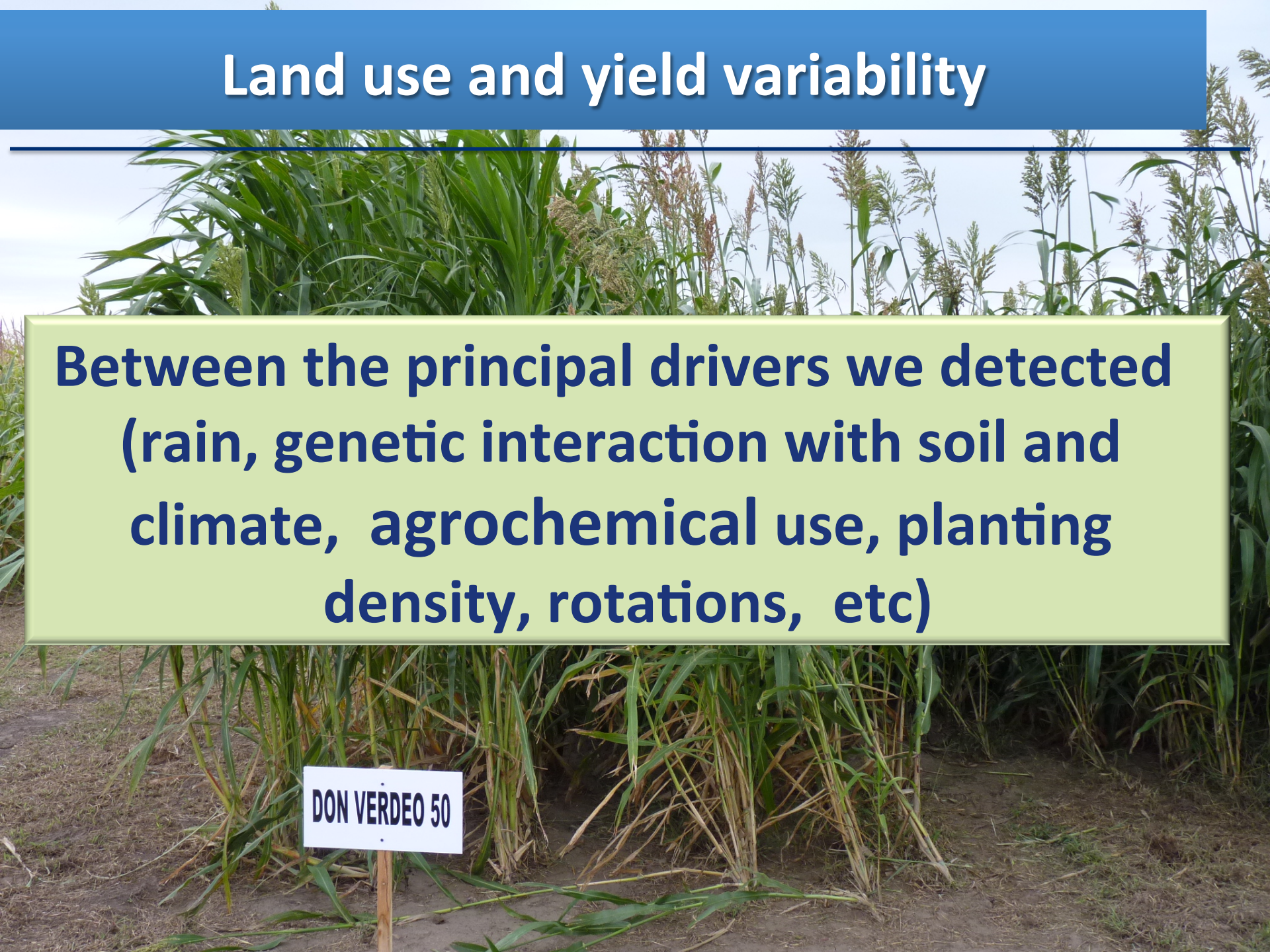
Incorporation of carbón dioxide plant

- Analysis was based on the sustitution of CO2 obtained by burning natural gas in an existingplant.
- Estimation on the additional energy reuiremoent of the new facilities
- According to theallocation methodology the overall impact on GHG savings of different products varies between 2 and 4 %

CO2 production influente(ACA BIO& Chiantore)

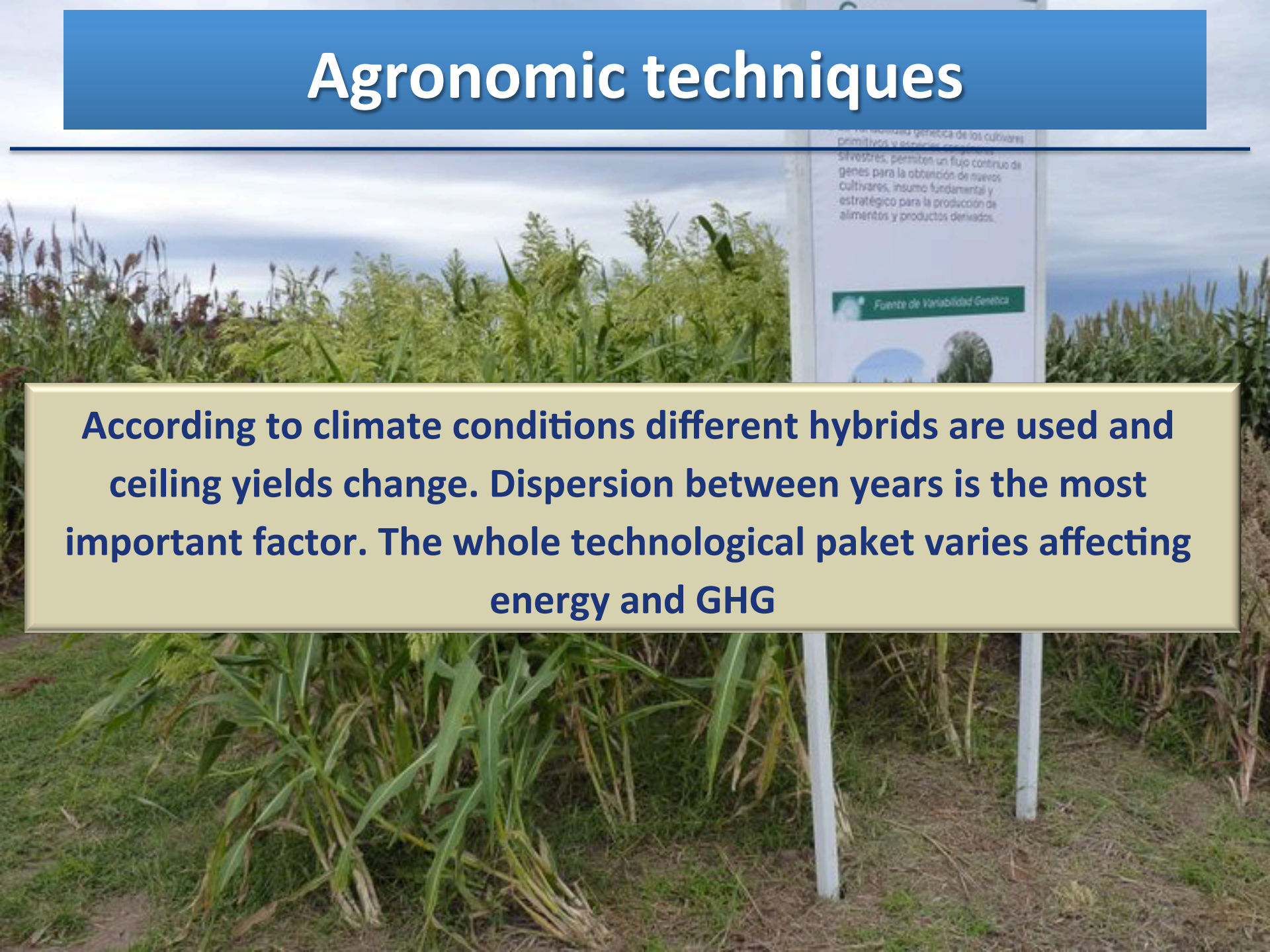


Land use and yield variability



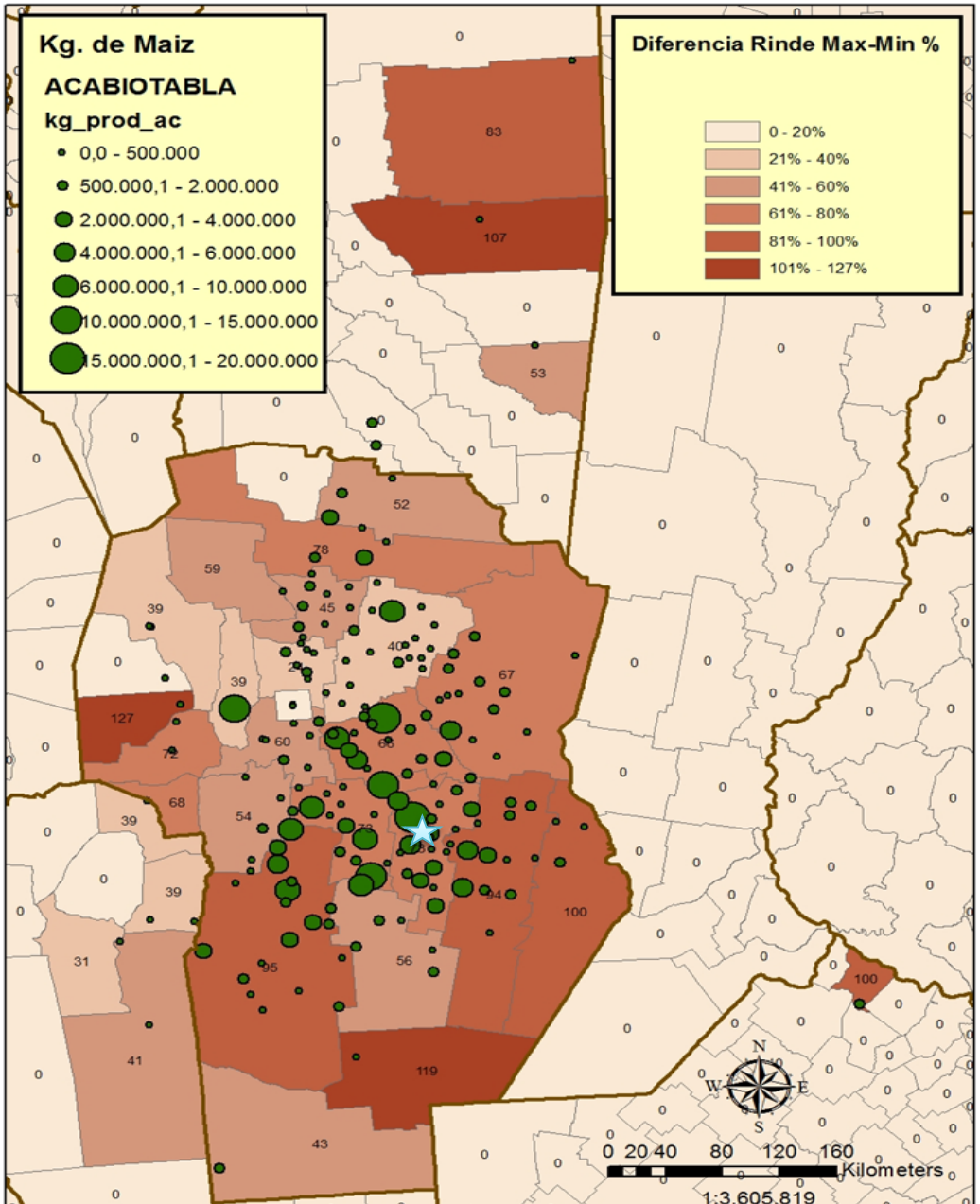
Between the principal drivers we detected (rain, genetic interaction with soil and climate, agrochemical use, planting density, rotations, etc)

Agronomic techniques

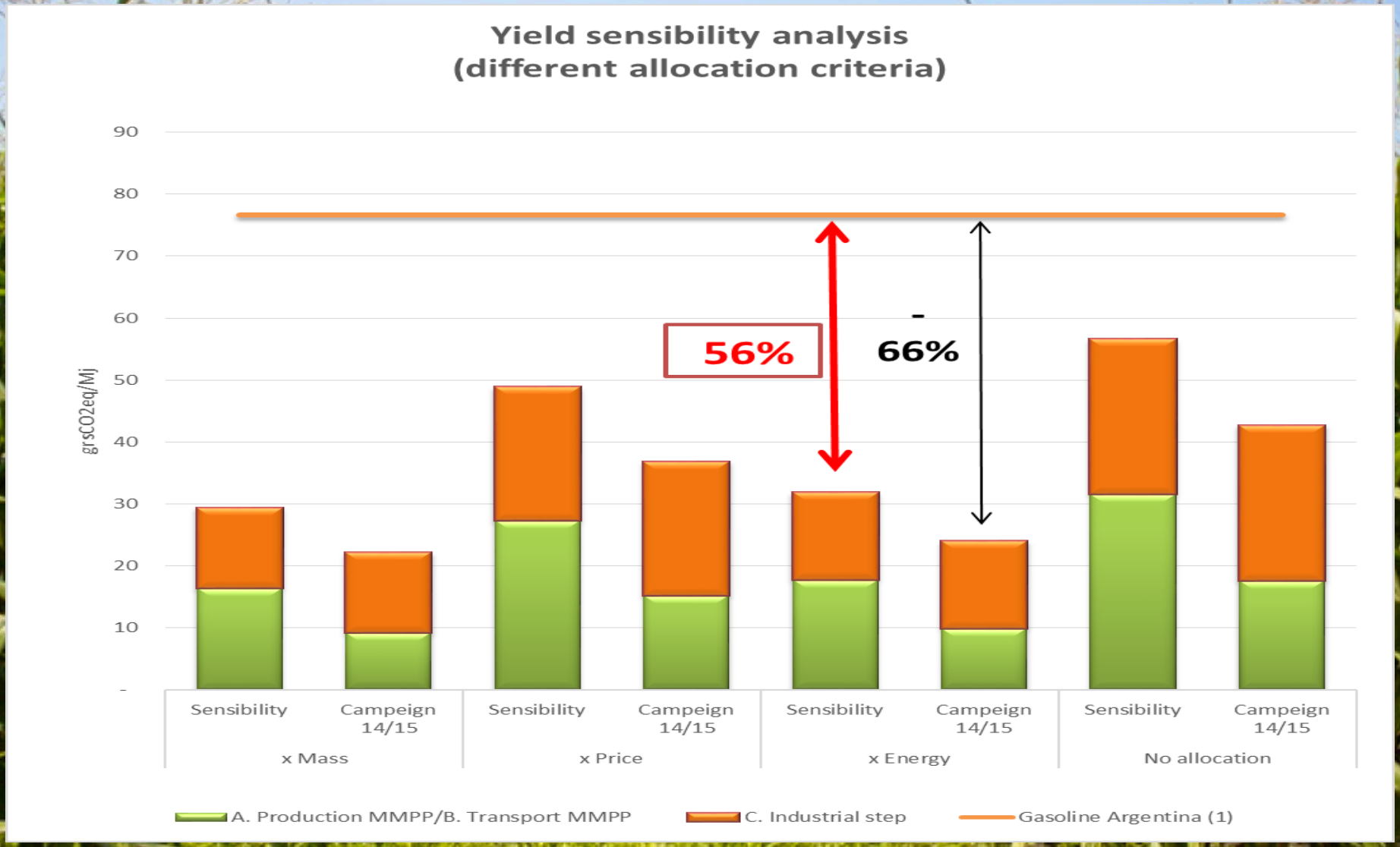


According to climate conditions different hybrids are used and ceiling yields change. Dispersion between years is the most important factor. The whole technological paket varies affecting energy and GHG

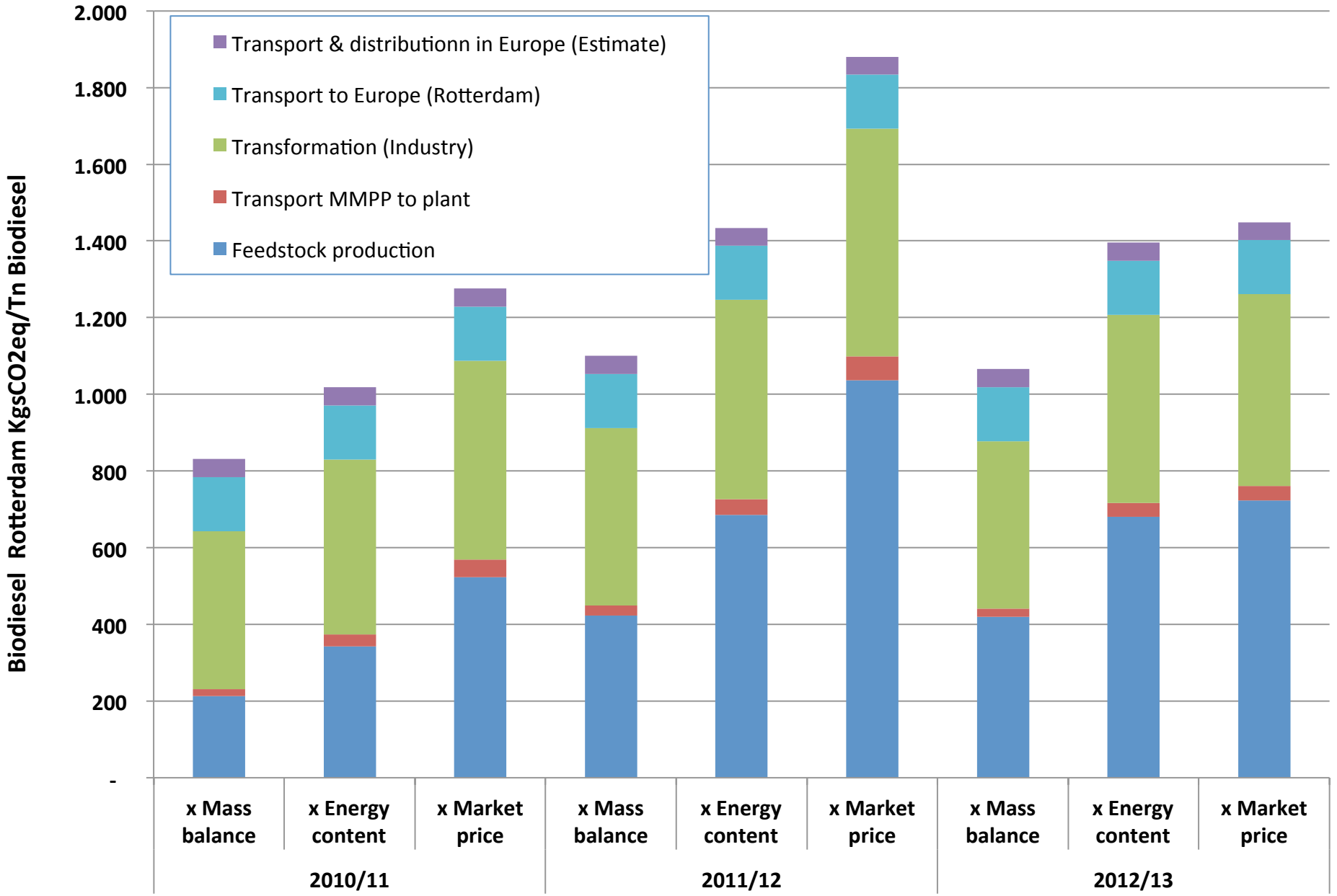
Yield variability



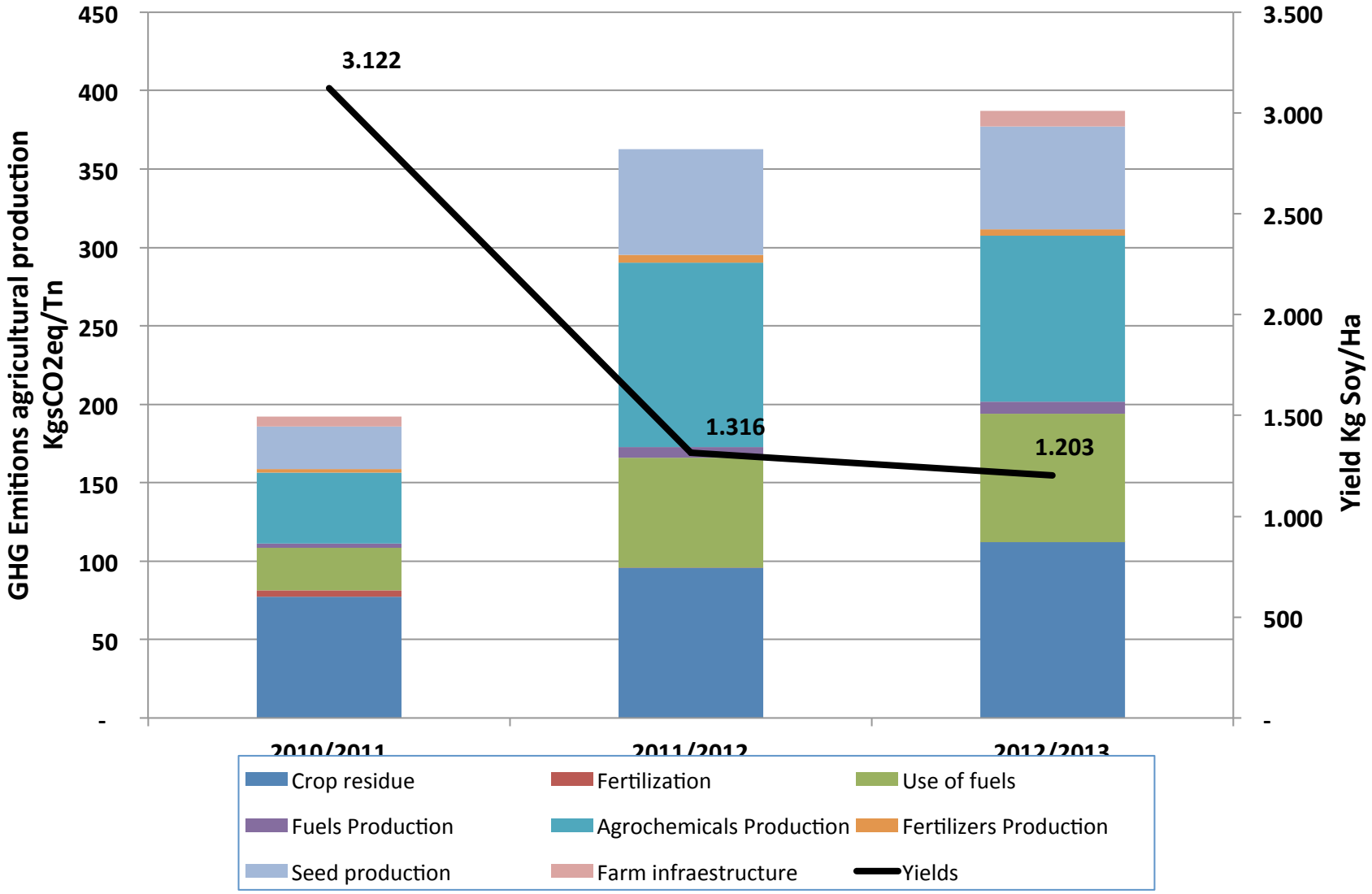
Effect of a 50 % decrease in farm corn yields



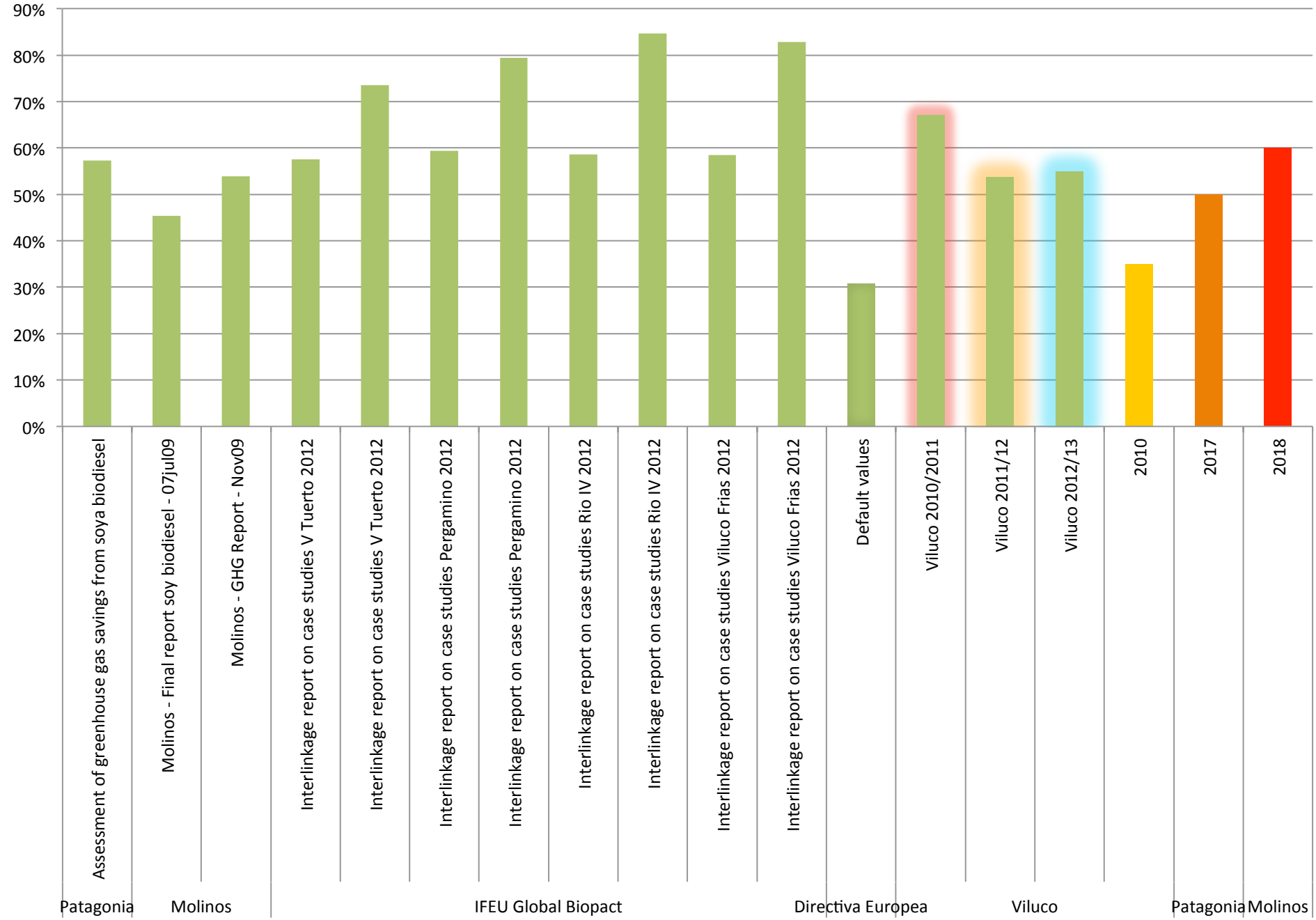
Interanual variation



Yield effect over relative contribution



GHG REDUCTIONS



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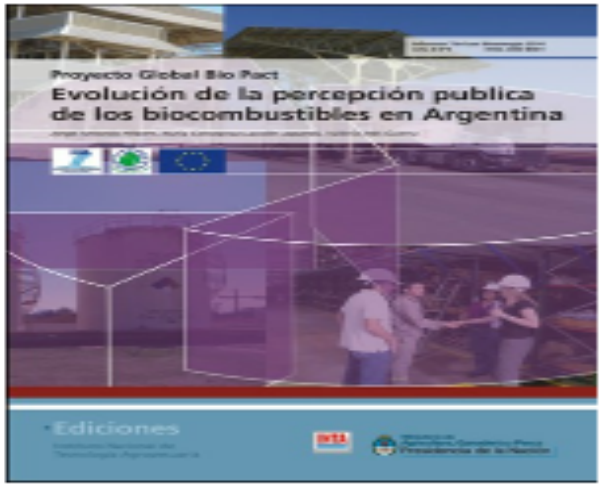

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Taller Nacional del Programa AGSTAR de biogás organizado por la Agencia de Medio ambiente EPA de los Estados Unidos.

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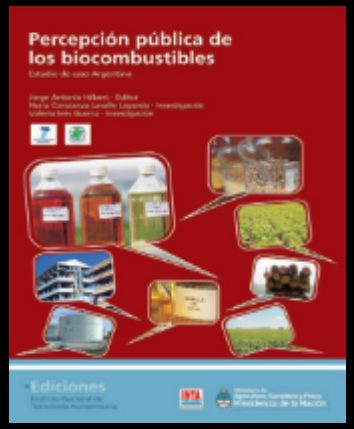
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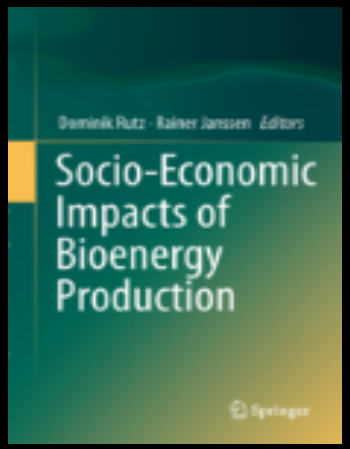
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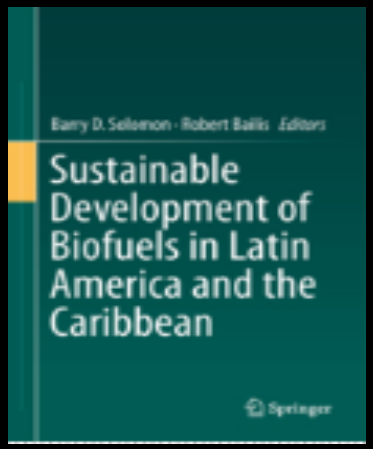
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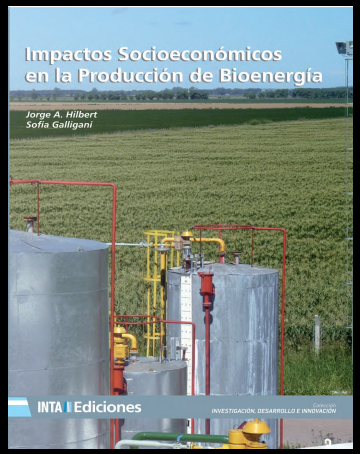
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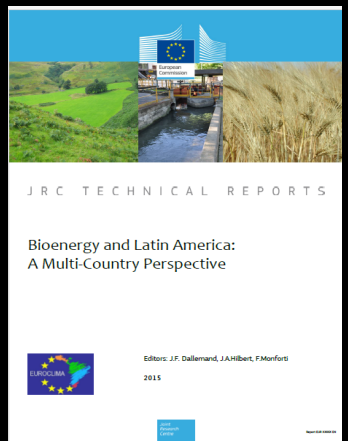
JRC TECHNICAL REPORTS
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Muchas Gracias!

Ing. Jorge A. Hilbert
hilbert.jorge@inta.gob.ar

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