BIOFUEL NETWORK

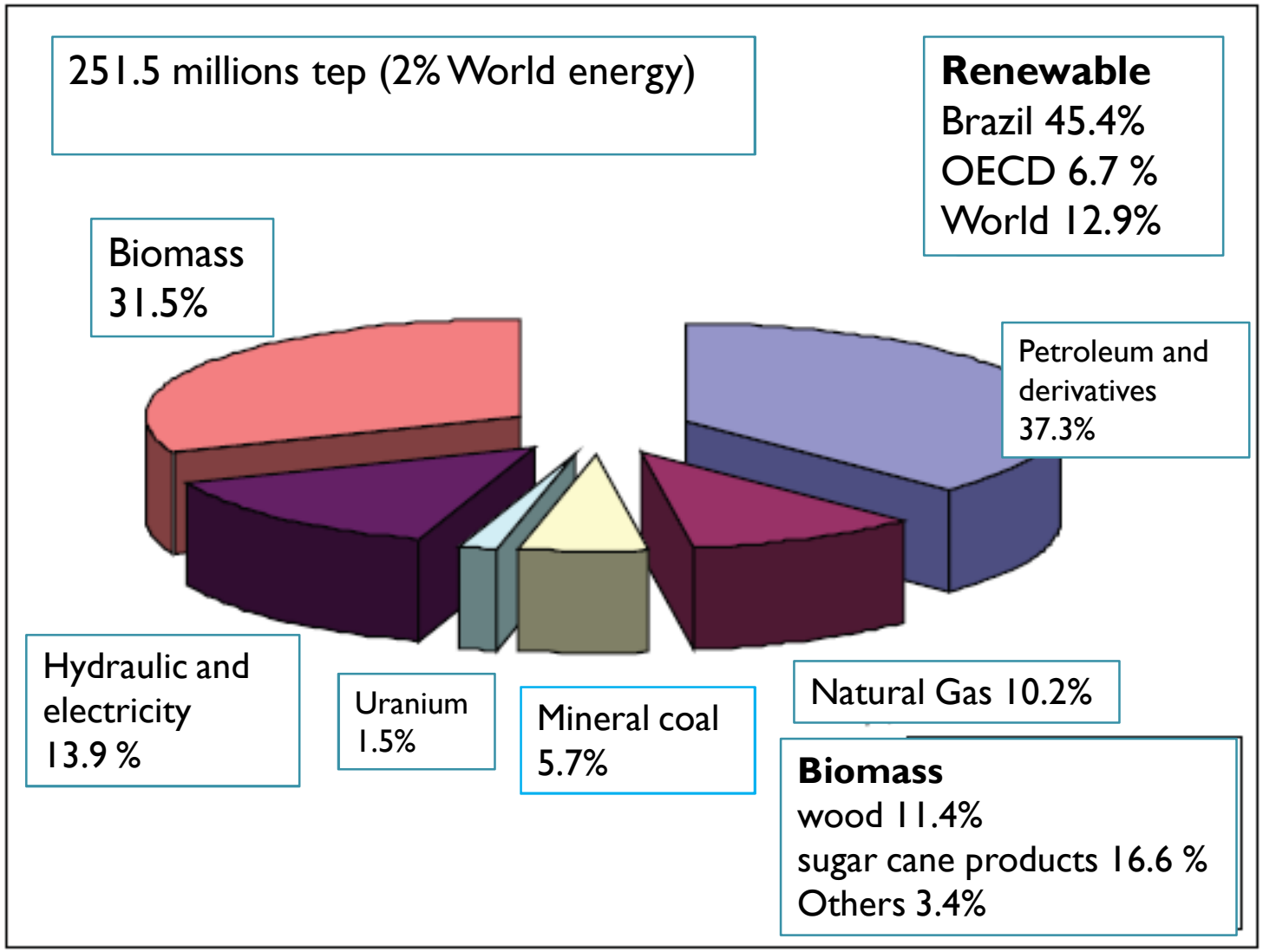
1st Brazil-U.S. Short Course in Biofuels Technology

UNICAMP

Logistics – Sugar Cane Harvest and Transportation

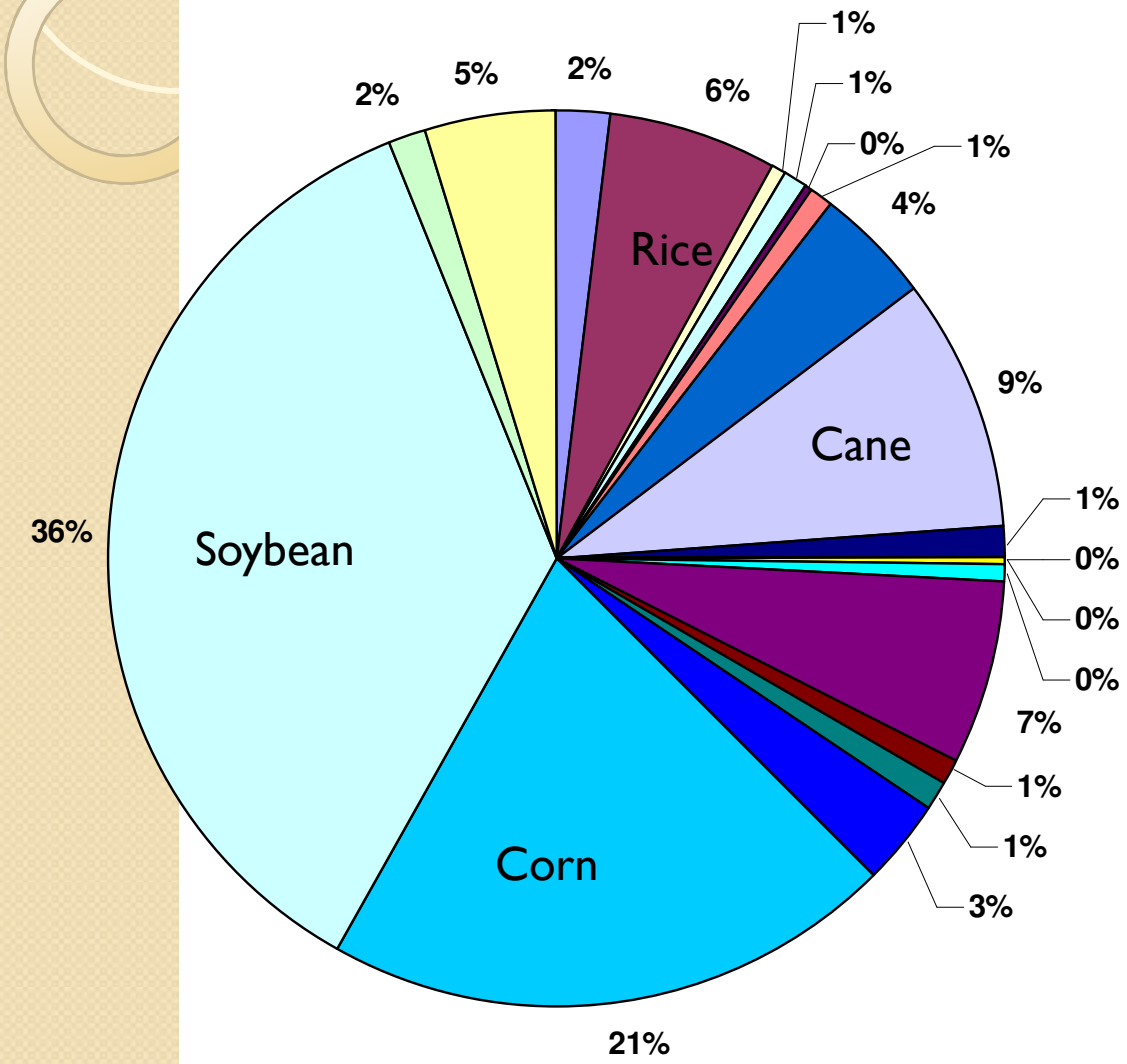
Prof. Paulo **Graziano** Magalhães,
State University of Campinas (UNICAMP)
College of Agricultural Engineering – FEAGRI
NIPE – Núcleo Interdisciplinar de Planejamento Energético

Internal energy supply in Brazil (2008)

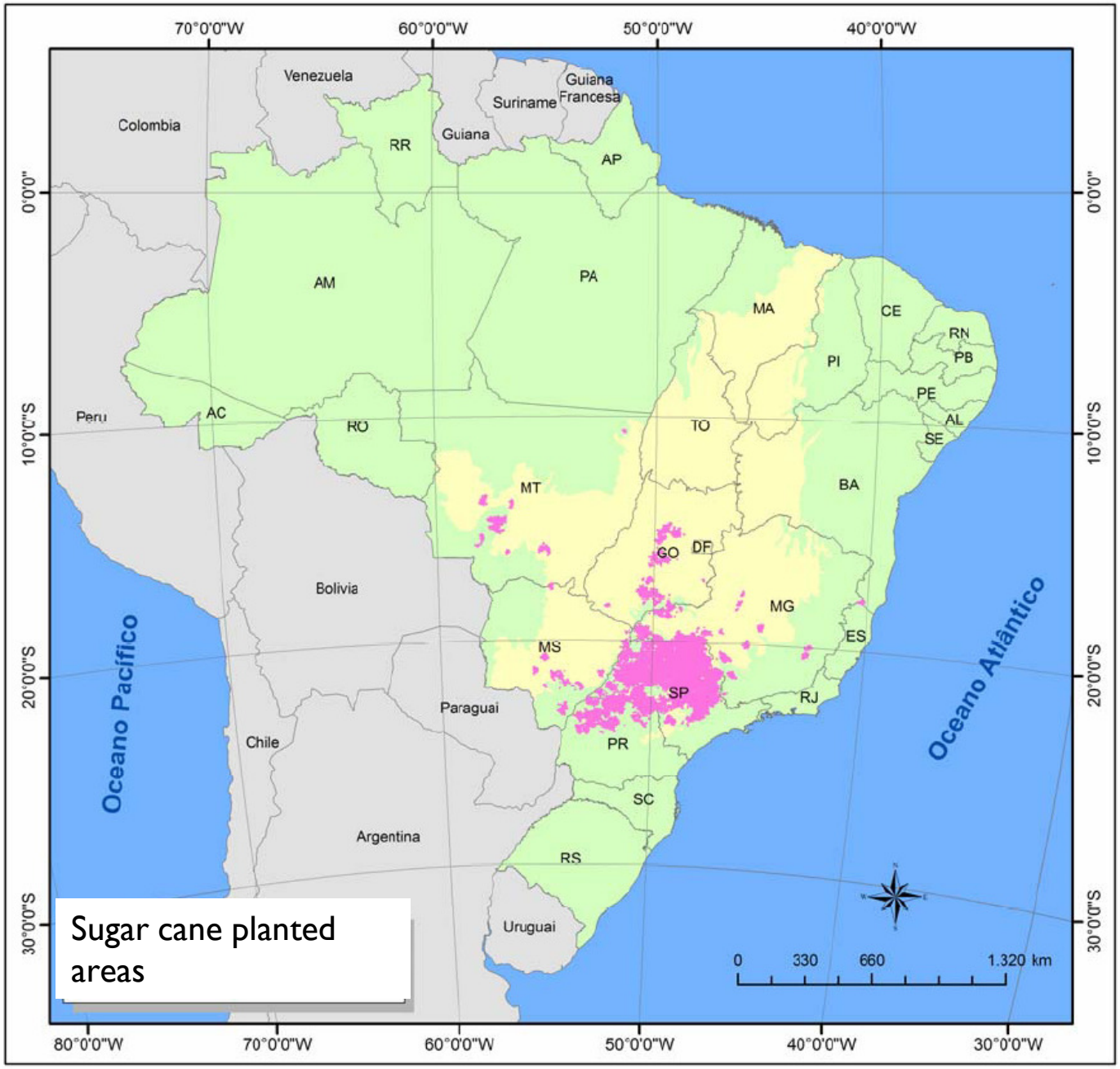


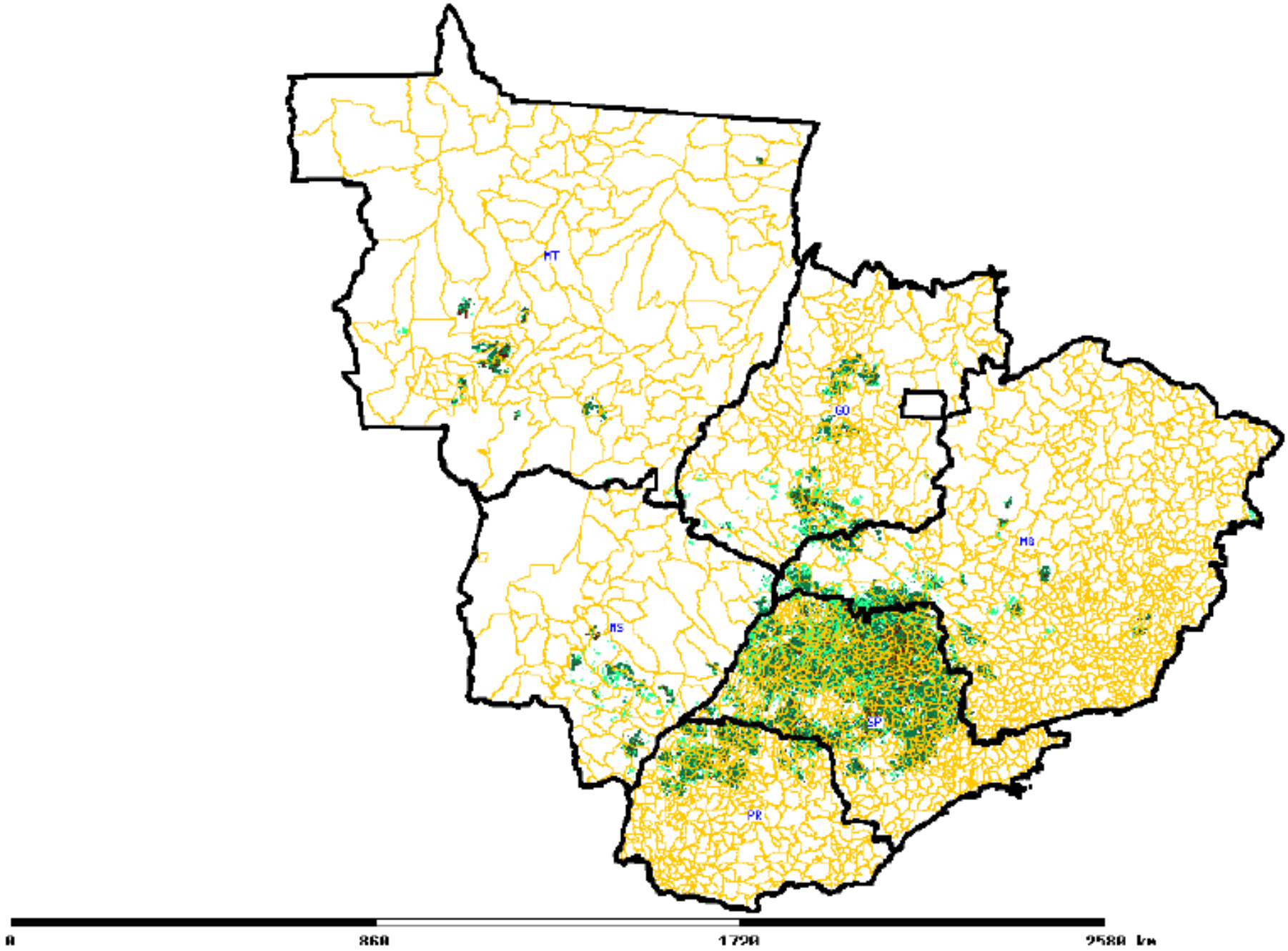
Sugar cane production in Brazil Actual and Potential

Cultivated area in Brazil



- Algodão herbáceo (em caroço) LT
- Arroz (em casca) LT
- Aveia (em grão) LT
- Banana LP
- Batata - inglesa LT
- Cacau (em amêndoa) LP
- Café (em côco) LP
- Cana-de-açúcar LT
- Castanha de caju LP
- Cebola LT
- Cevada (em grão) LT
- Côco-da-baía LP
- Feijão (em grão) LT
- Fumo (em folha) LT
- Laranja LP
- Mandioca LT
- Milho (em grão) LT
- Soja (em grão) LT
- Sorgo granífero (em grão) LT
- Trigo (em grão) LT


70°0'0"W
60°0'0"W
50°0'0"W
40°0'0"W
0°0'0"
10°0'0"S
20°0'0"S
30°0'0"S
80°0'0"W
Venezuela
Colombia
Guiana
Suriname
Guiana Francesa
RR
AP
AM
PA
MA
CE
RN
PB
PI
PE
AL
SE
Peru
AC
RO
TO
BA
MT
GO
DF
MG
ES
Bolivia
MS
SP
RJ
PR
Paraguai
Chile
SC
Argentina
RS
Uruguai
Oceano Pacífico
Oceano Atlântico
0
330
660
1.320 km
Sugar cane planted areas

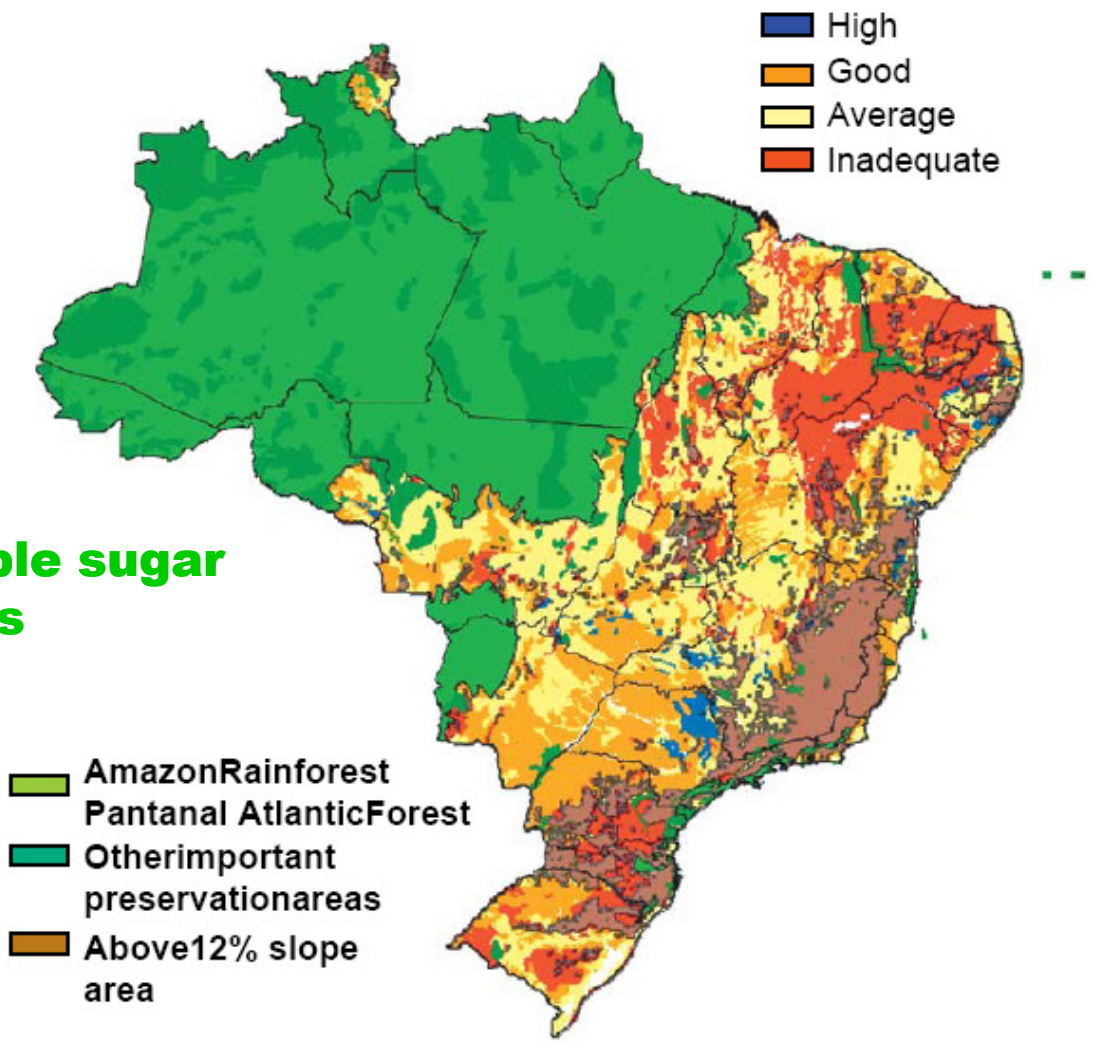

MT
GO
MG
MS
SP
PR
0
860
1720
2580 km

SUGAR CANE (2007-2008)

- **7.0 million hectares**
- **571 million tonnes cane**
  - 246 – sugar
  - 325 - ethanol
- **Yield average – 81.7 tonnes per ha**
  - **26,6 billion litters of alcohol**
  - **32 million tonnes of sugar**

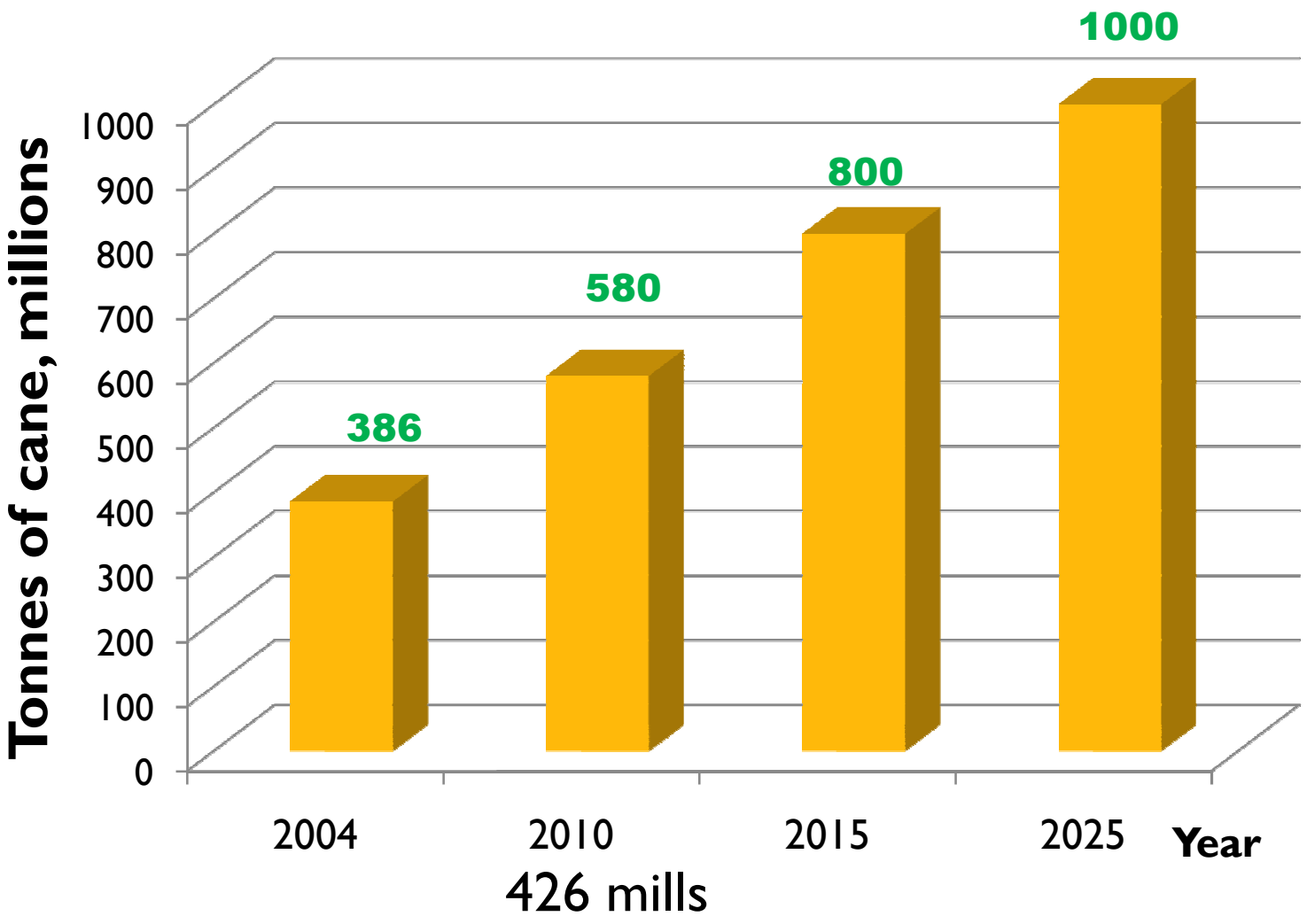
MAPA (2009)

Potential for sugarcane production without irrigation.



Potential area available sugar cane or other biomass 90 million ha.

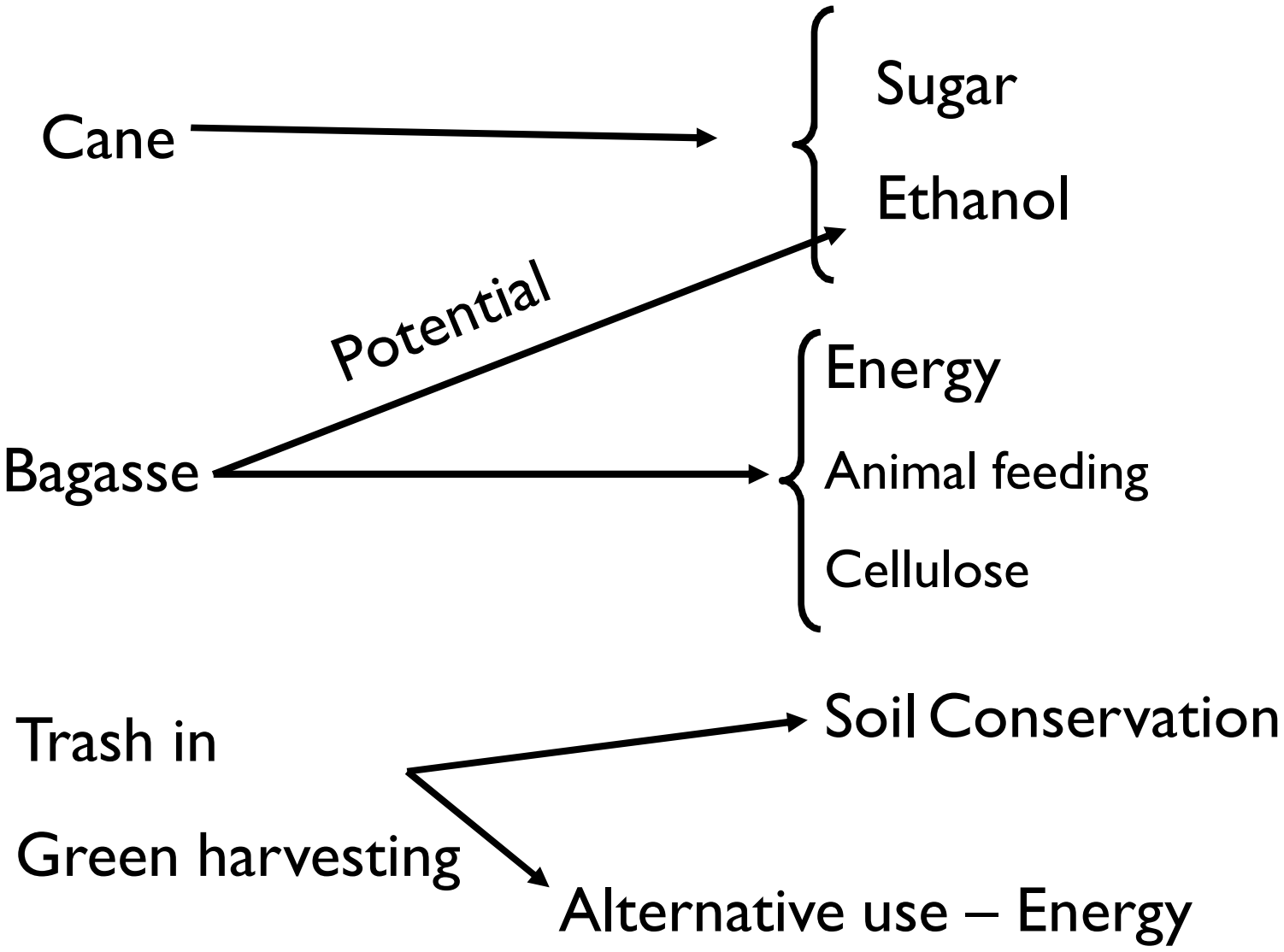
Sugar cane production



SUGAR CANE

Leaves

1/3


Cane
Sugar
Ethanol
Potential
Bagasse
Energy
Animal feeding
Cellulose
Trash in
Green harvesting
Soil Conservation
Alternative use – Energy

Energy from sugar cane

• 1 Ton of cane	• Energy MJ
• 90 litres of ethanol	• 2.300
• 280 kg of bagasse (50% mc)	• 2.600
• 280 kg of trash (50% mc)	• 2.600
• Total	• 7.500 (0.165 TEP)
571 millions tonnes of sugar cane	• 94 millions of TEP

HARVESTING

Pre-harvesting cleaning process
Trash burning

In São Paulo 50% of the area still been burned and 30% manual harvested.

Advantages – Eliminate the leaves

Facilitate the harvesting process

Reduce vegetal impurities

Reduces harvesting cost per ton

Allows manual harvesting

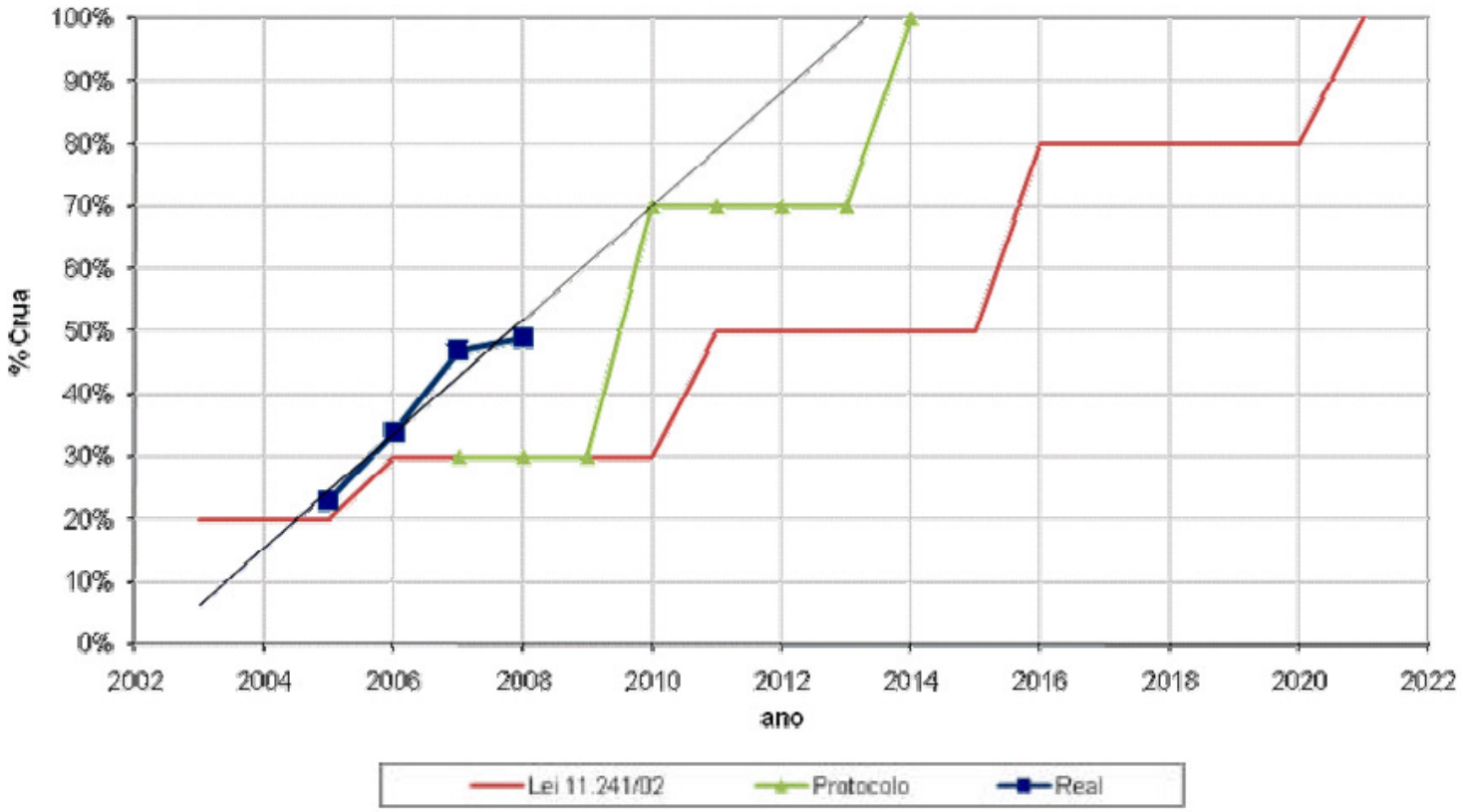
Green harvesting

Why green harvesting ?

- Environmental and legal restriction
- Potential of using trash as energy source
- Soil protection against erosion
- Improve water availability
- Carbon sequestration

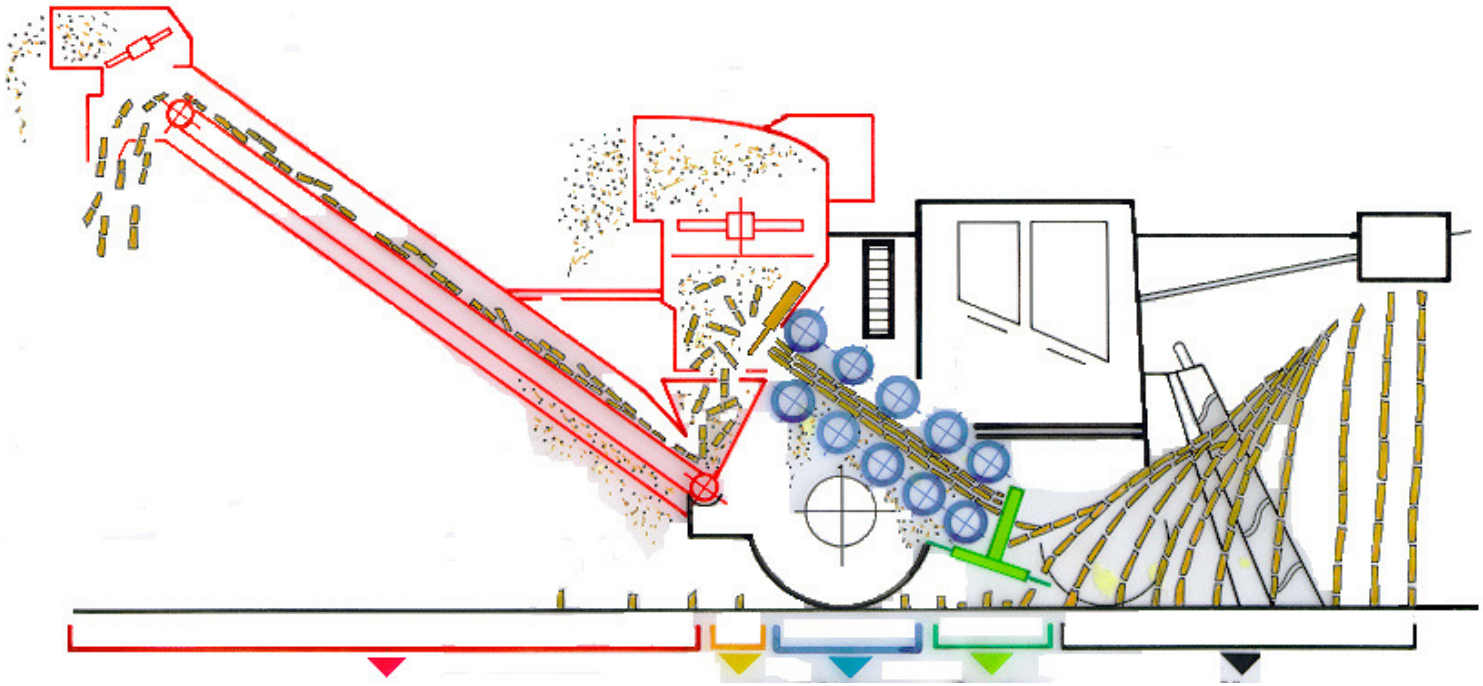
UNICA - signed a protocol of intentions in which its associates (individually and voluntarily) may accept to phase out trash burning practice until 2014, in mechanized areas, and 2017, in non-mechanizable areas

Green cane harvesting schedule



INPE - 2009

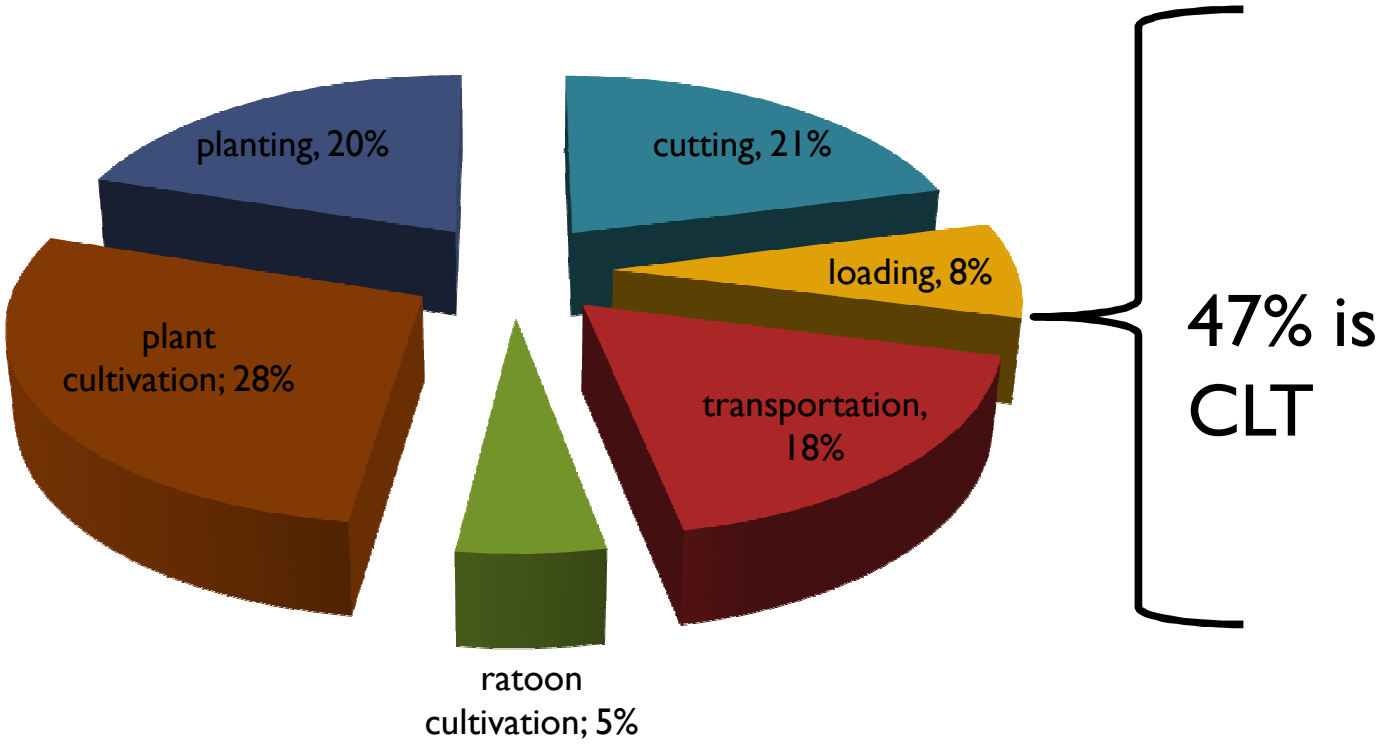
The harvester



Sectional view of cane harvest

All the harvesters present the same principle of operation

60% of the ethanol production cost is associated to the agricultural sector



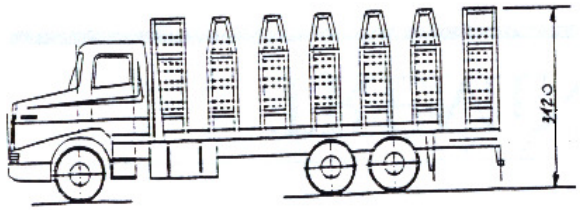
Logistic for mechanized sugar cane harvesting CLT

1) Harvesting and load transfer to infield wagon

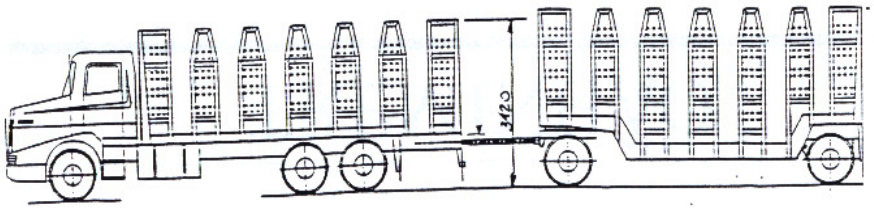
2) Load transfer to trucks

TRANSPORTATION

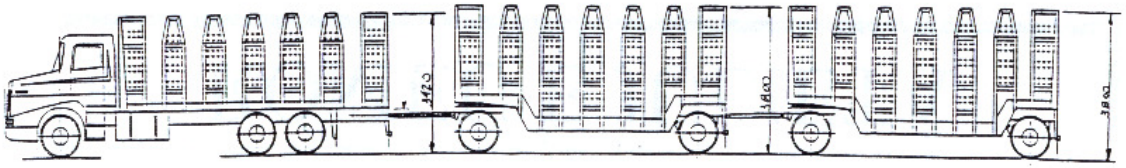
- Truck - single



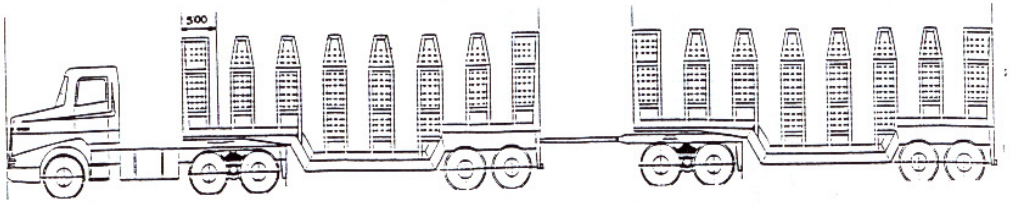
- Romeu-julieta



- Treminhão



- Rodotrem



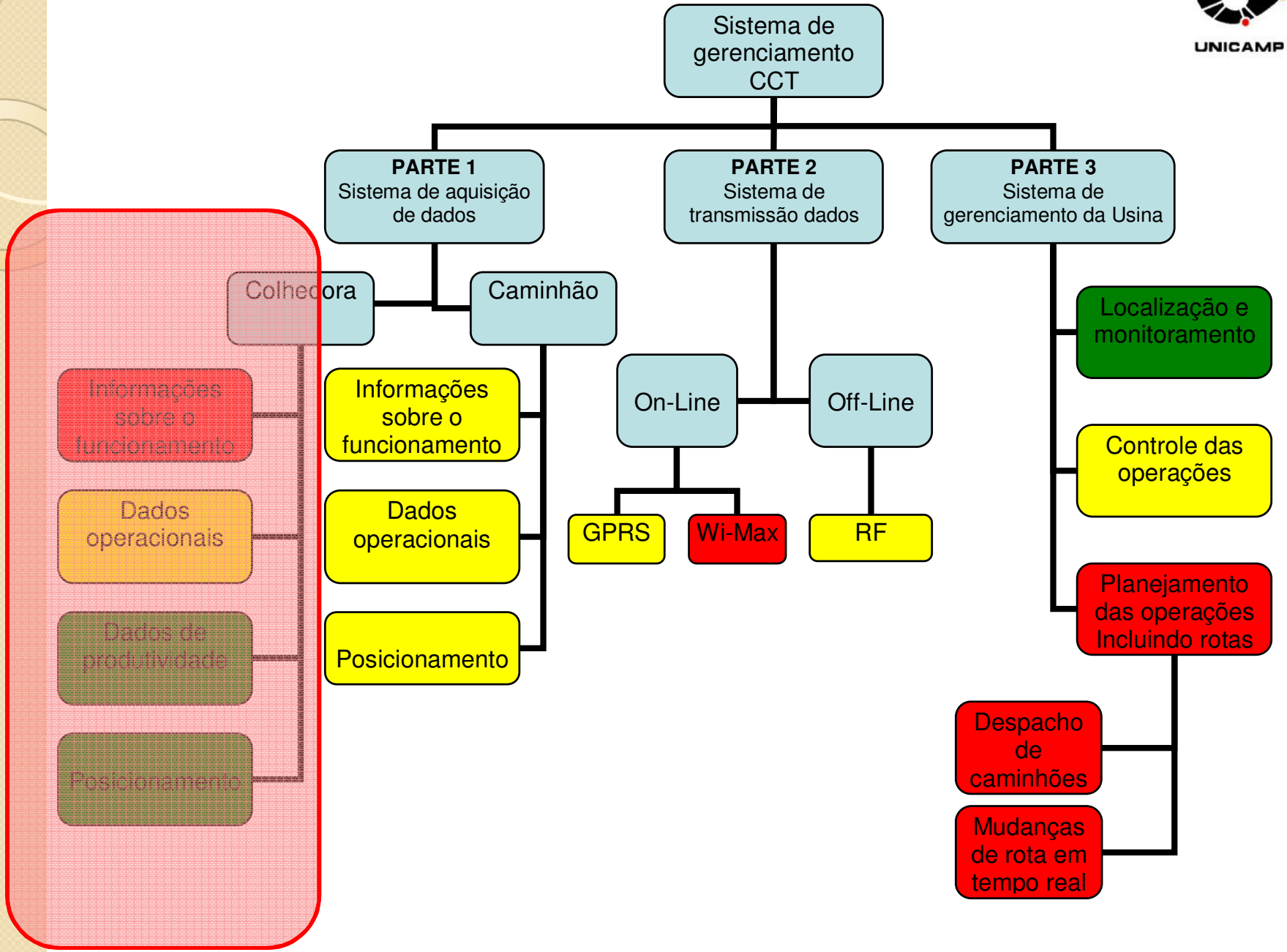

RANDON

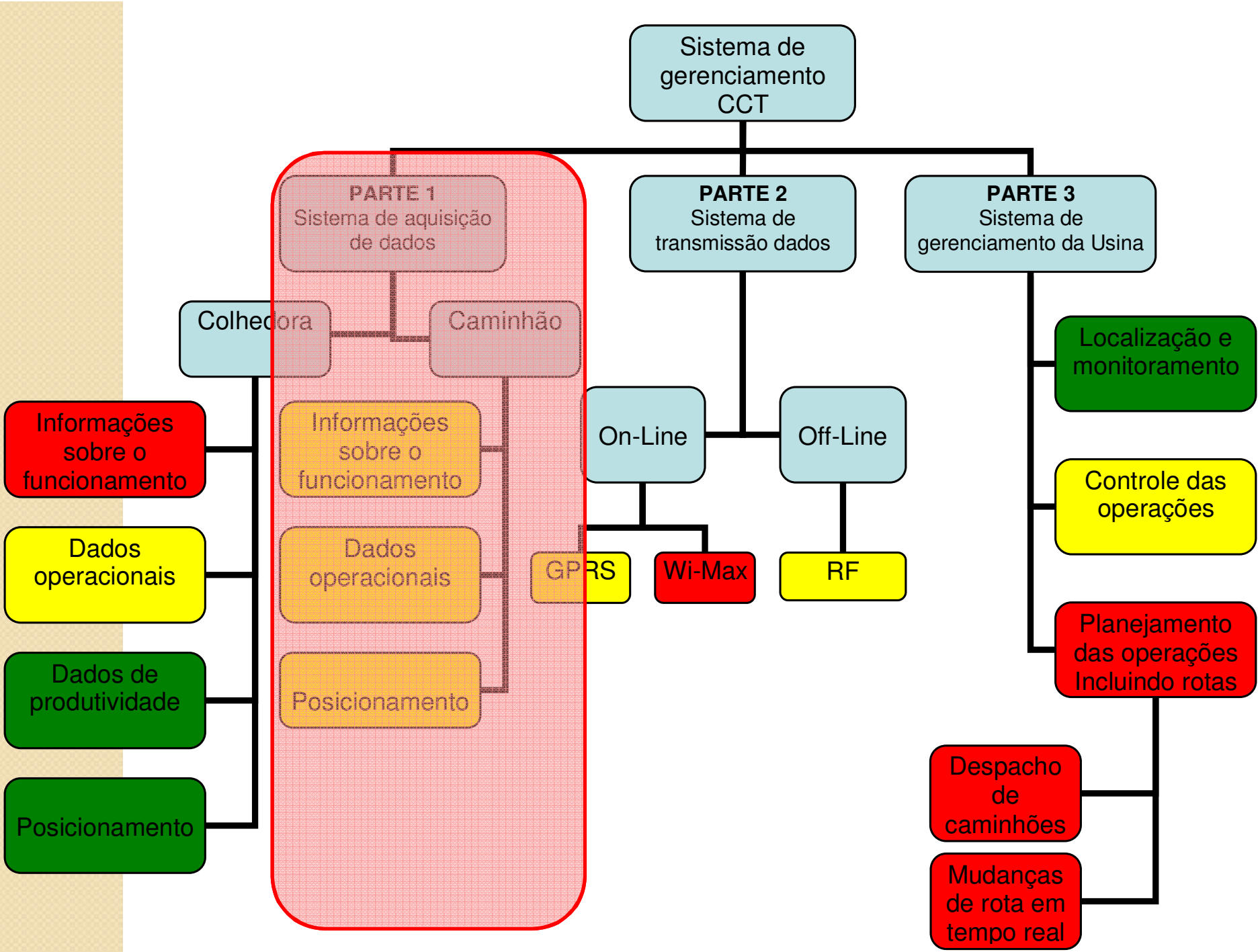
Transportation


3055

Reception at mill

FIELD MANAGEMENT OF HARVESTING LOADING AND TRANSPORTATION SYSTEM (CLT)


Sistema de gerenciamento CCT
PARTE 1
Sistema de aquisição de dados
PARTE 2
Sistema de transmissão dados
PARTE 3
Sistema de gerenciamento da Usina
Colhedora
Caminhão
Informações sobre o funcionamento
Dados operacionais
Dados de produtividade
Posicionamento
Informações sobre o funcionamento
Dados operacionais
Posicionamento
On-Line
Off-Line
GPRS
Wi-Max
RF
Localização e monitoramento
Controle das operações
Planejamento das operações Incluindo rotas
Despacho de caminhões
Mudanças de rota em tempo real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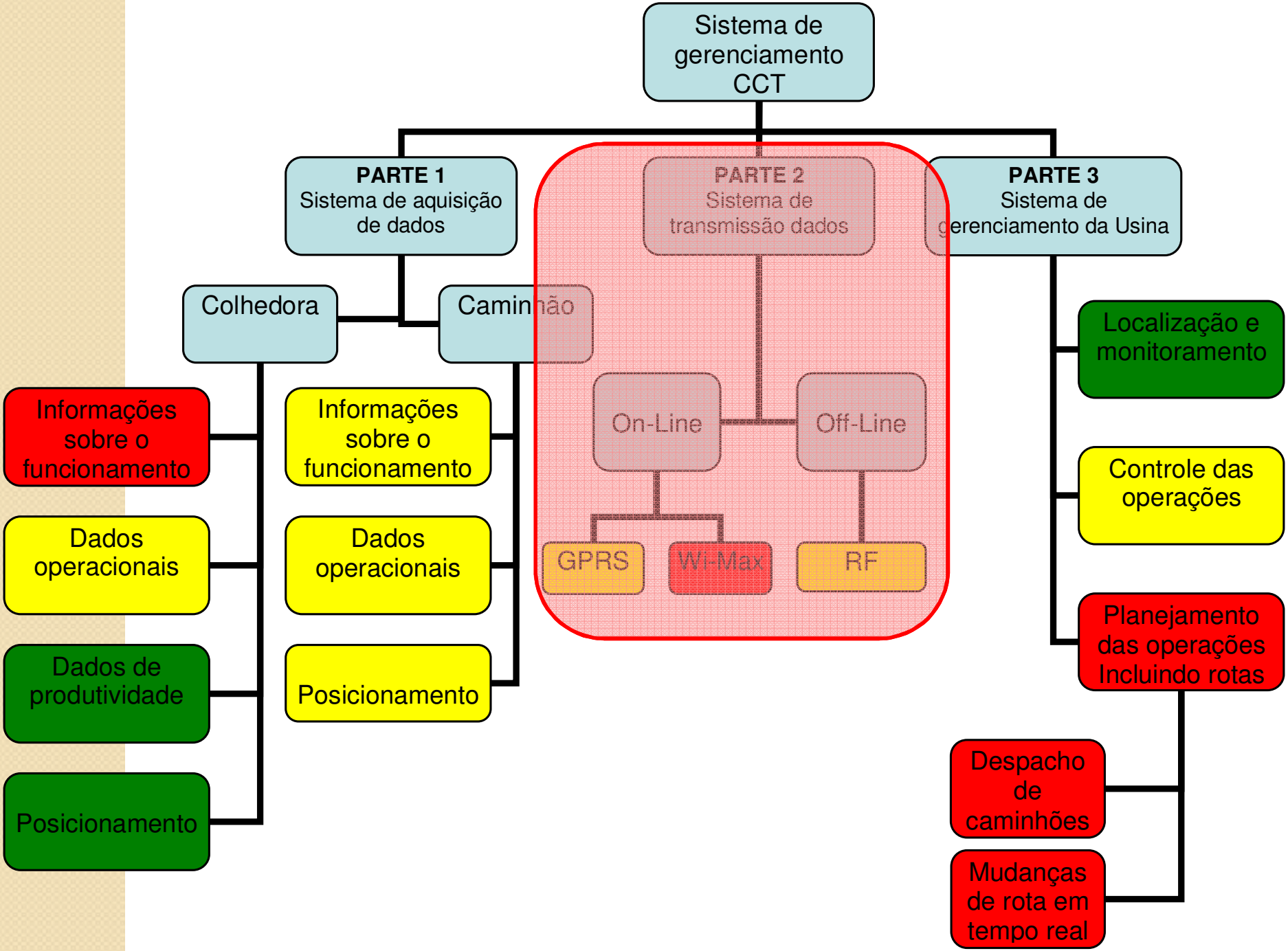
CDA 1000
ENALTA
SGA
Antena RF e Coletor
Antenas:
GPS / GPRS
Sensores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Mudanças de rota em tempo real

CLT System

•Harvester data
•Truck data
•driver
•occurrence

Wi-Max / GPRS

RF

PIMS
SIG-CLT

•Harvester data
•Tractor data
•Truck data
•Driver
•occurrence

Wi-Max / GPRS

RF

•Harvester data
•driver
•Occurrence

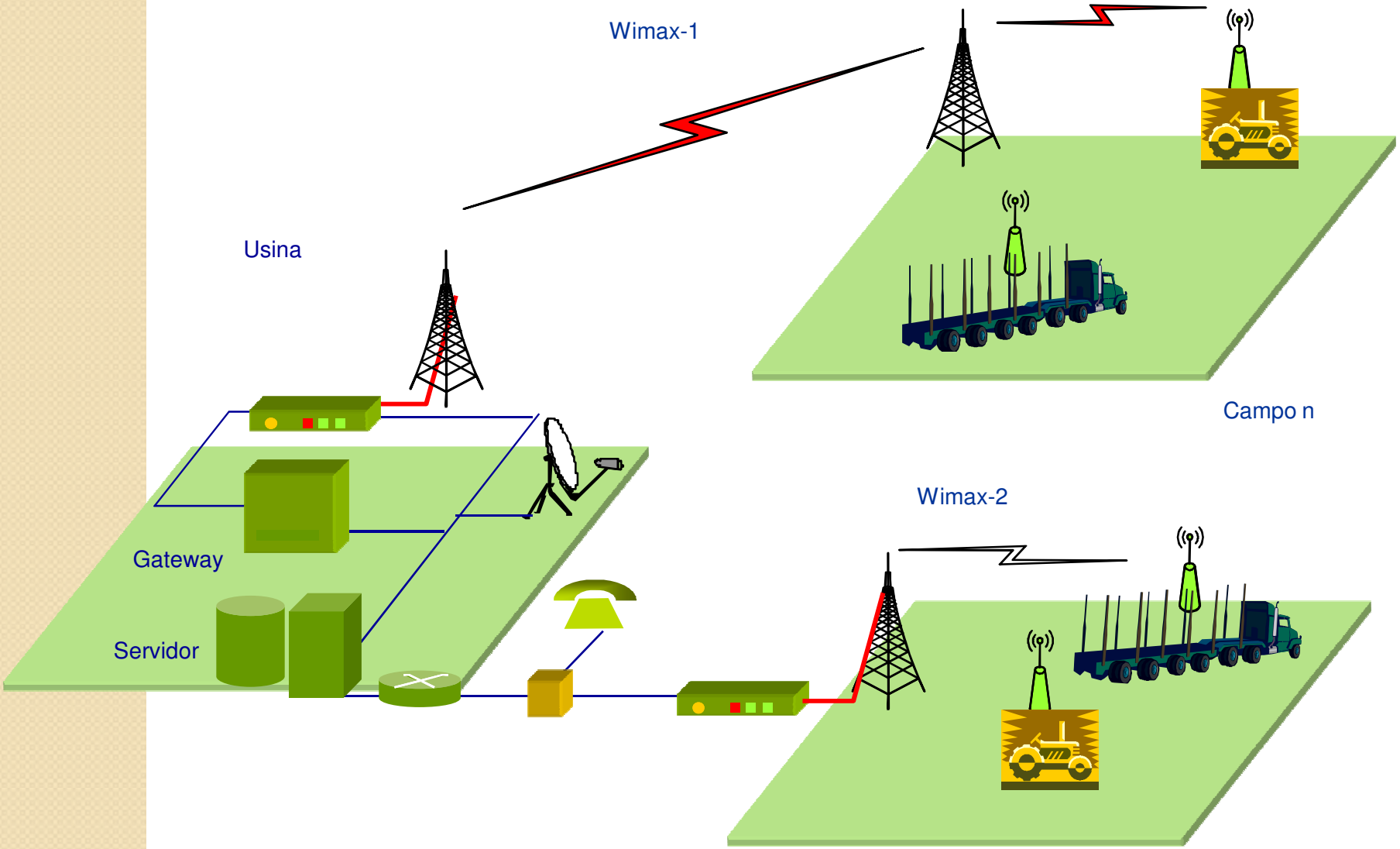
Wi-Max / GPRS

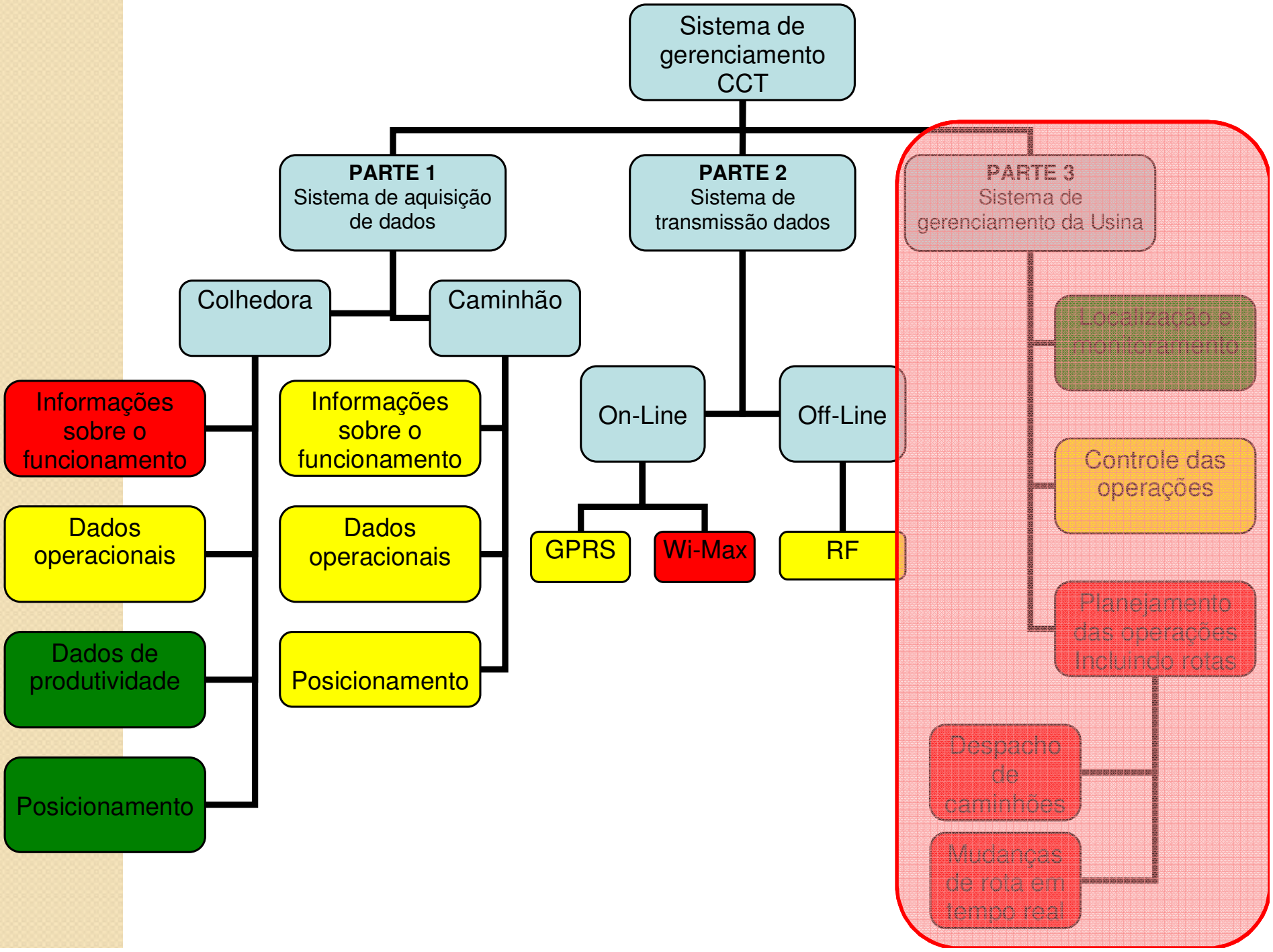
RF

RF

Operational data for each wagon

Wimax

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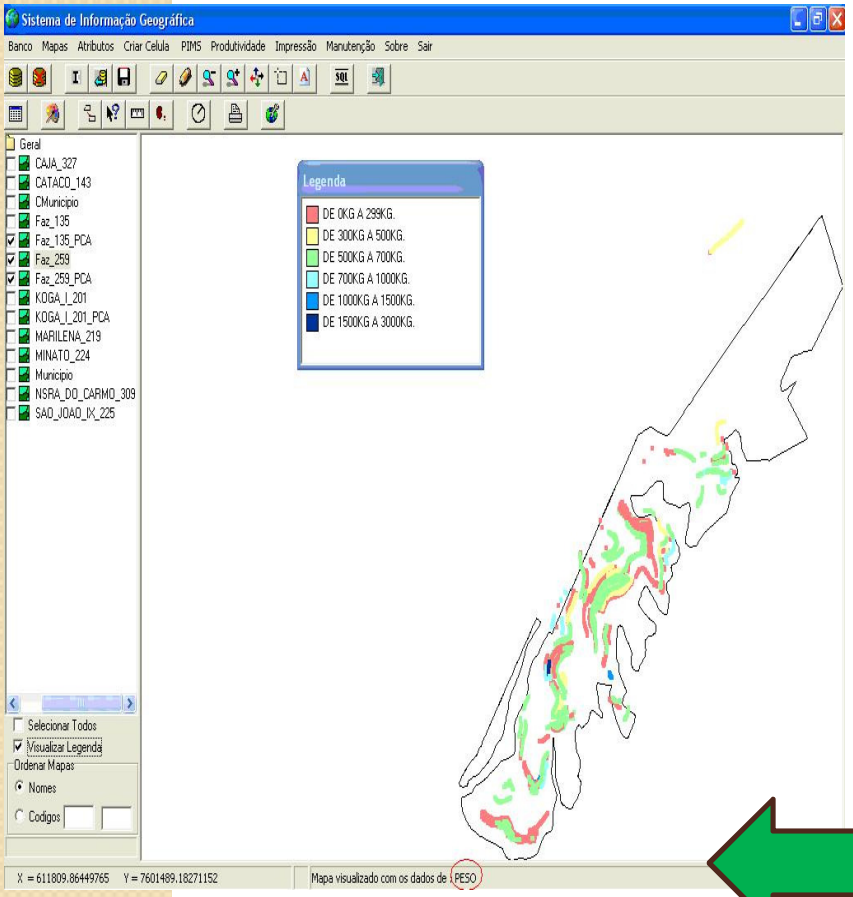
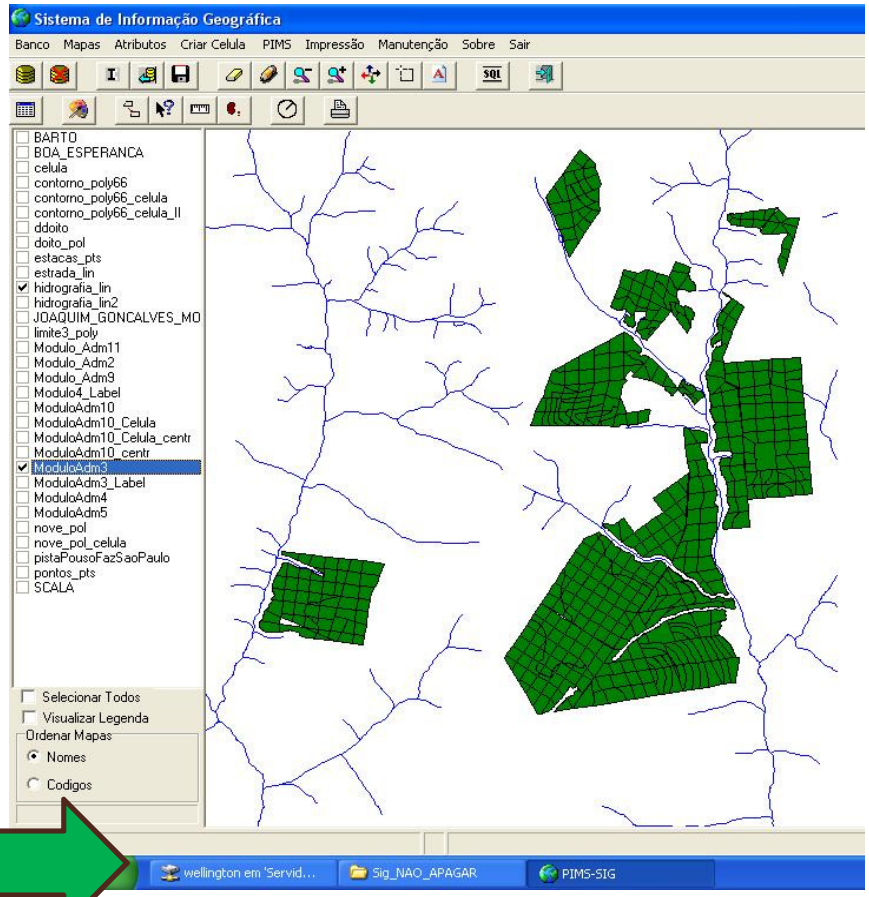
PIMS-GIS-Agriculture



PIMS-GIS-Logistics



PIMS-GIS-CLT

Output from the system

a) Operational time;
b) Harvester performance parameters
c) Total harvested area
d) Performance of the all harversting team;
e) Operator performance t/day
f) Reasons for machinery stop and interruptions
g) Average time for loading;

LOGISTICS FOR TRASH RECOVERY

Biomass: ethanol (sugar) + bagasse + trash

Sustainability - No tillage

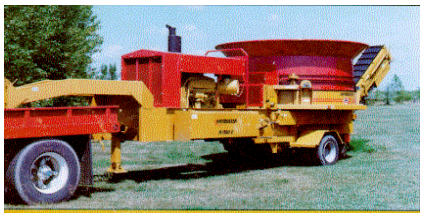
- Lower cost
- Soil Conservation
- Moisture Conservation
- Nutrient Conservation
- Reduction of CO_2 emission

Technological solution


Ripoli 2005

Cost of Baled Trash

	US$ / t_{MS}
Windrowing	0,5 a 1
Bailing	4 a 6
Grab loading	0,8 a 1,5
Transport (20 km)	5 a 7
Unloading	0,5 a 1
Grinding	0,5 a 1
TOTAL	12 a 18



Integral harvesting

INTEGRAL

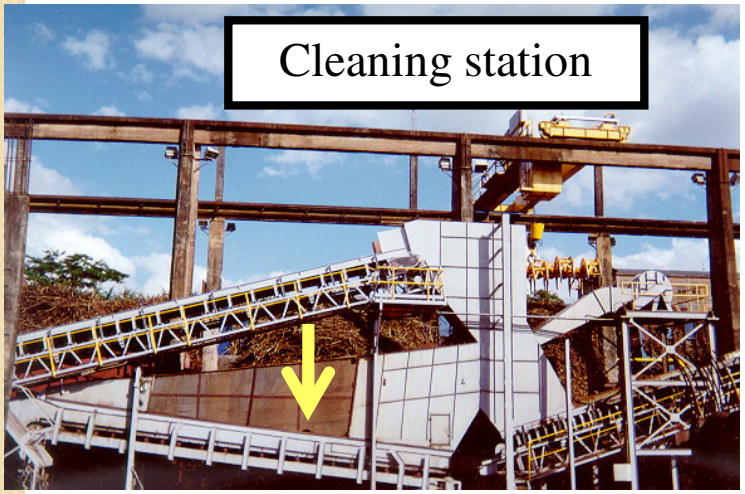
Handling

Harvester

Self tipping wagon
(billets + trash)

Transportation

Cleaning station



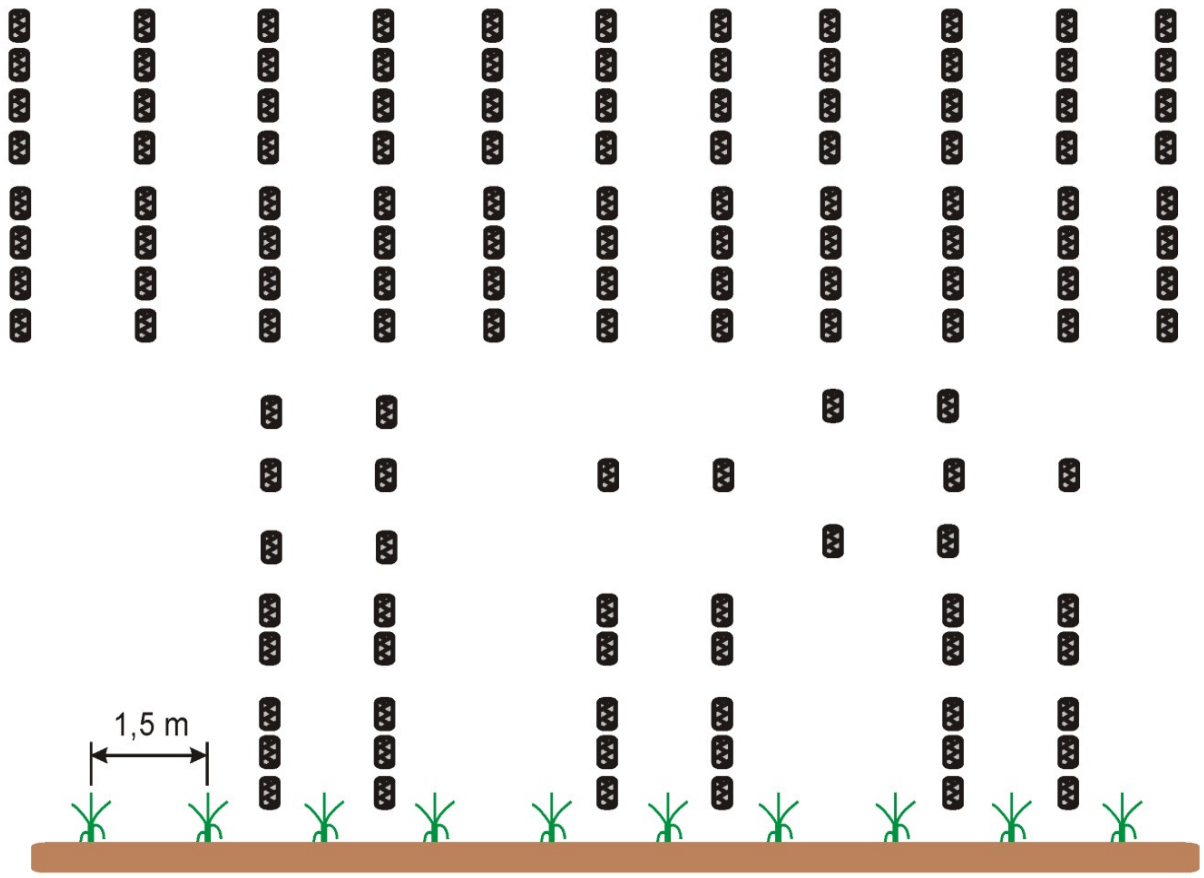
Fotos: Coopersucar

LOGISTICS FOR FIELD OPERATIONS

Controlled Traffic

- Sugar cane are planted with at 1.5 m uniform row space.
- With this system in each row there is a 16 pass of tires with different loads.
  - Harvester – 18 t – 4 wheels – 4.5 t each wheel
  - Tractor – 10 t – 4 wheels – 2.5 t each wheel
  - Wagon (2) – 14 t each – 4 wheel – 3.5 t each wheel

Conventional system



wagon 2
wagon 1
tractor
harvester

wagon 2
wagon 1
tractor
harvester

Herbicides application

Cultivation

Herbicides application

Planting

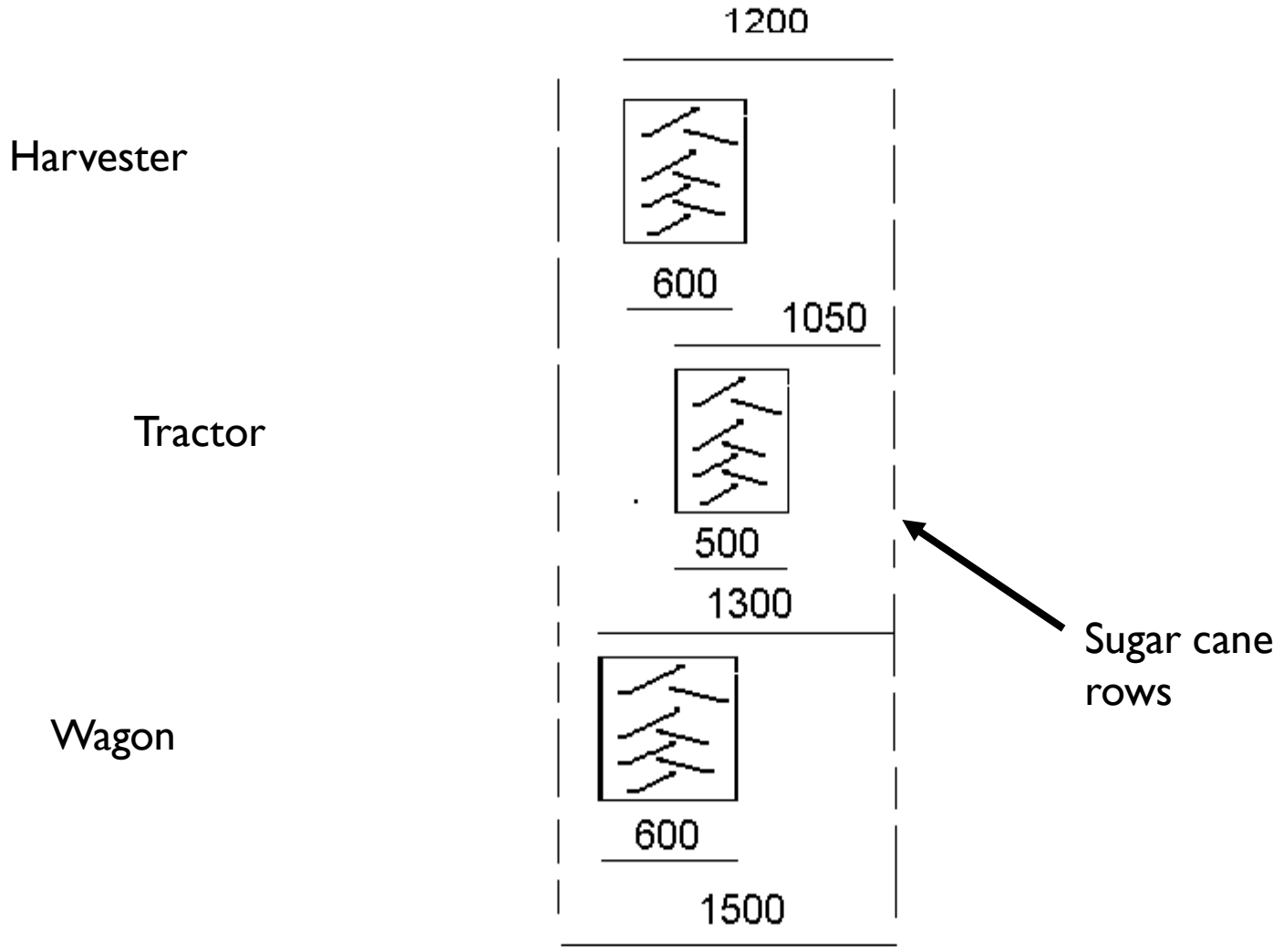
Raton elimination

Number of pass during the first year

Controlled traffic

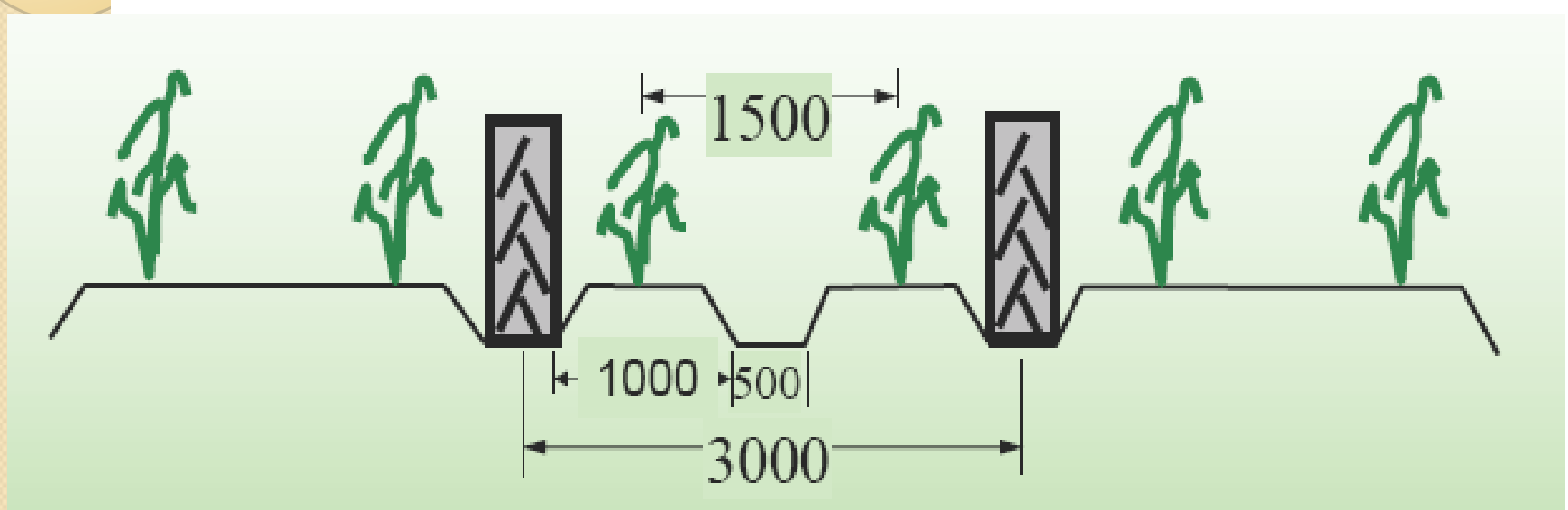
–Total – 56 t – average of 116 kN/m^2

Controlled Traffic



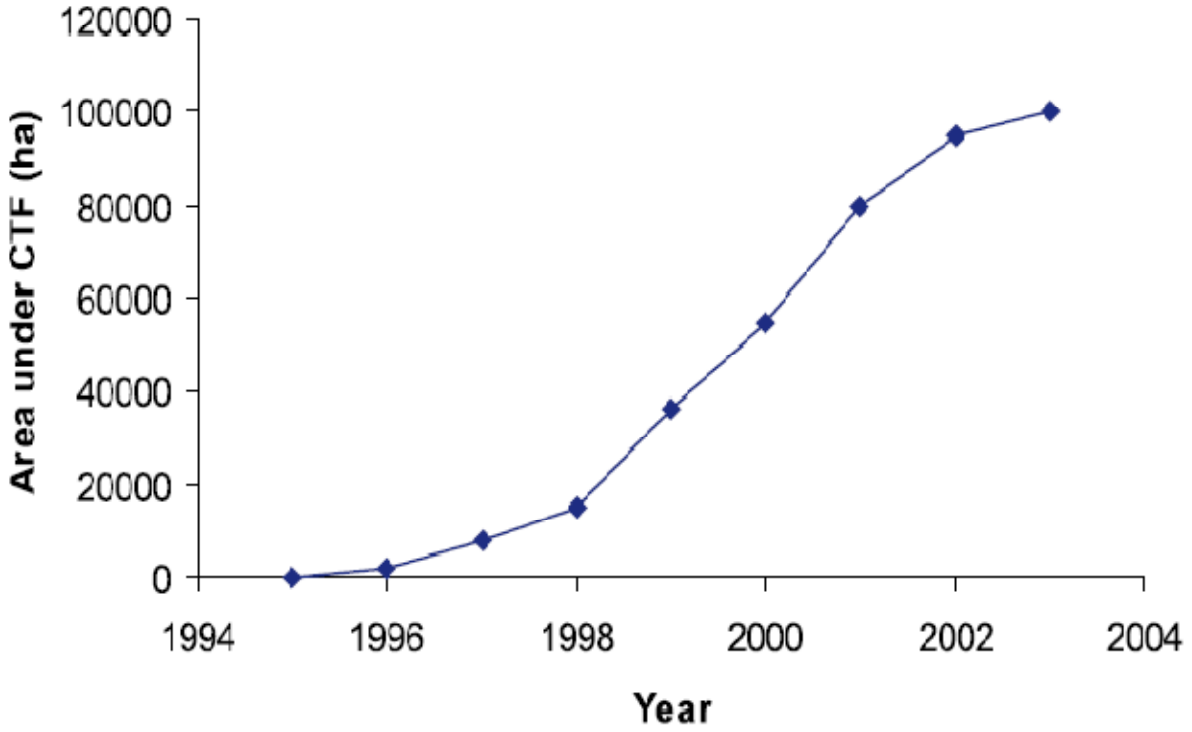
Some mills are adopting a controlled traffic at same extend

increasing wheel spacing




892
1037
TAC 13000

Australia experience in traffic control



Controlled Traffic

Reduces soil Compaction

Israel

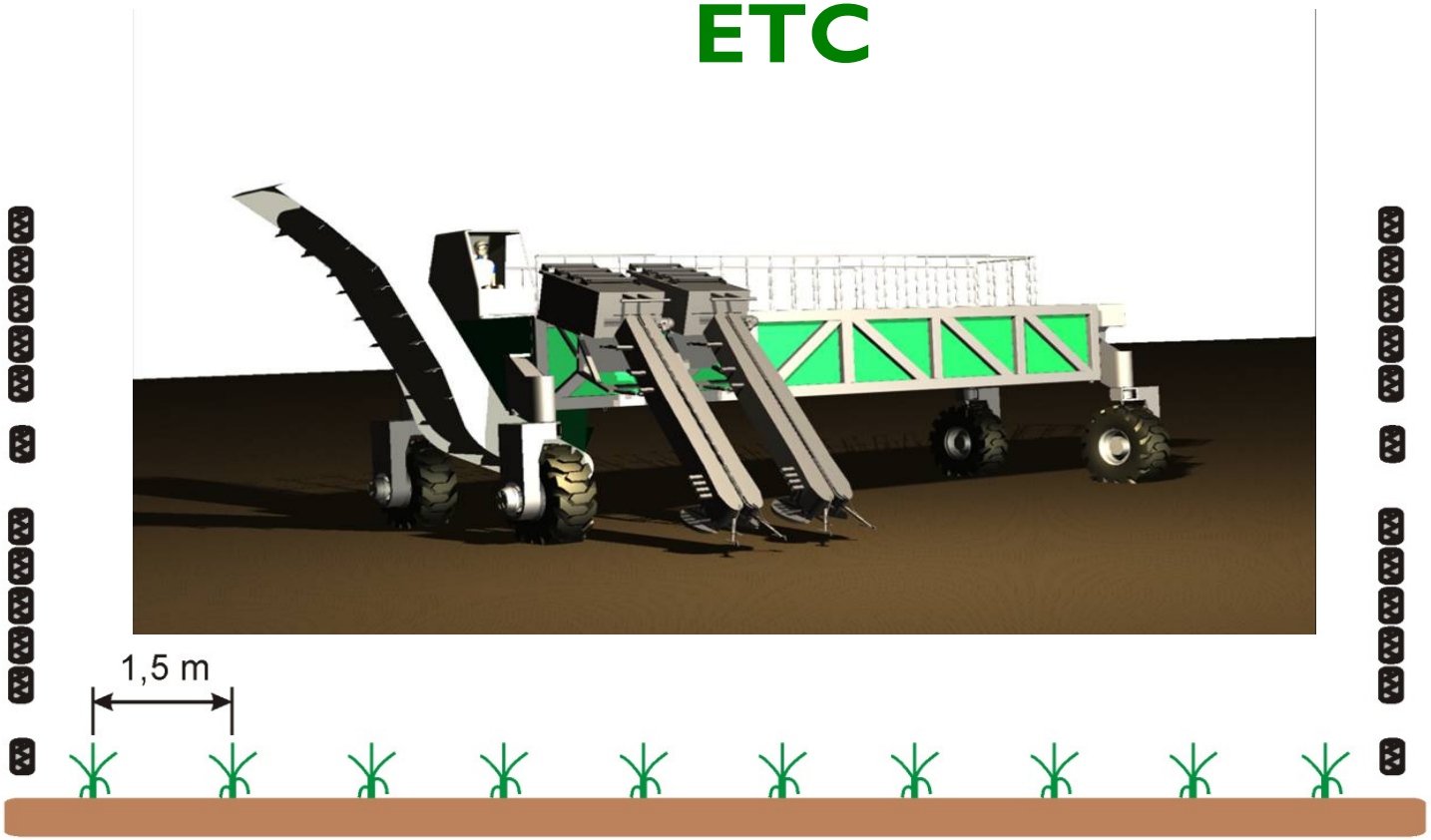
USA

Canada

Australia

No tillage and controlled traffic

ETC



CTBE - Project

Conventional mechanization and with ETC 's cost

Operation	Conventional (5 cuts)	ETC (5 cuts)	ETC (10 cuts)
	Plant-cane [R$/ ha]		
Subsoiling	88,3	0,0	0,0
Ploughing	79,6	0,0	0,0
harrowing	34,0	0,0	0,0
planting	243,7	214,8	214,8
harvesting	451,0	270,1	270,1
In-field transport	282,6	39,8	39,8
	100%	44%	44%
	Ratoon cane		
harvester	1807,6	1.080,5	2.431,2
In-field transport	1.130,3	159,3	358,4
	100%	72%	65%
Total [R$/ ha]	4117,1	1764,5	3314,3
Total [R$/ tc]	21,2	15,3	13,8

Final remarks

1. Sugar cane cultivated area will increase considerably in the next 10 years, mainly in pasture land.
2. Large cane expansion requires use of mechanical harvesting
3. Sugar cane will be 100% mechanically green harvested by the year 2020 (areas which are feasible of mechanization).
4. Sugar cane trash will be introduced in the biomass energy chain
5. No-tillage in sugarcane can reduce costs and contribute for soil, water and fertilizer conservation.

Final remarks

6. A new approach for cane harvester is required to make two row harvesters feasible.
7. Green cane harvesting and trash recovery require a mechanization system designed specifically for that purpose; both from the stand point of quality and cost.
8. With the use of PA and information technologies logistics cost for CLT will reduce, reducing the final ethanol cost
9. ETC will be a revolutionary system for large scale sugar cane production, reducing production cost with environmental benefits.

FEAGRI

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Thank you for your attention

graziano@agr.unicamp.br
NIPE – FEAGRI UNICAMP
019 – 3521 1053

nipe