# Case study: Biomass export potential of Colombia

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Workshop "Towards a Sustainable European Bioenergy Trade Strategy for 2020 and beyond"

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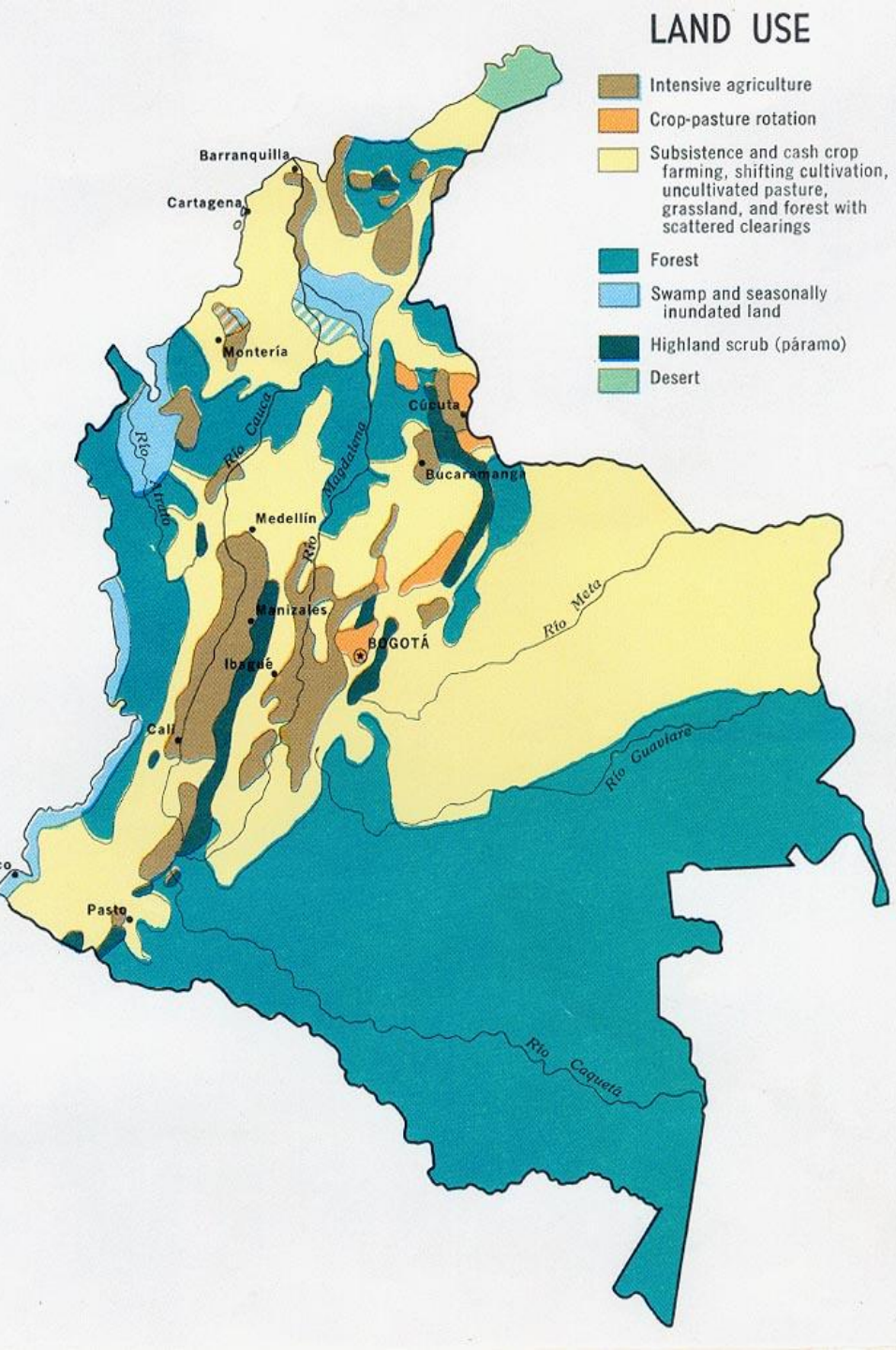
LAND USE
Intensive agriculture
Crop-pasture rotation
Subsistence and cash crop farming, shifting cultivation, uncultivated pasture, grassland, and forest with scattered clearings
Forest
Swamp and seasonally inundated land
Highland scrub (páramo)
Desert
Barranquilla
Cartagena
Montería
Cúcuta
Bucaramanga
Medellín
Manizales
BOGOTÁ
Ibagué
Cali
Pasto
Río Cauca
Río Magdalena
Río Meta
Río Guaviare
Río Caquetá


MAPA FISICO - POLÍTICO
MAR CARIBE
OCÉANO PACÍFICO
VENEZUELA
PANAMÁ
ECUADOR
PERÚ
BRASIL
Riohacha
Santa Marta
Barranquilla
Cartagena
Montería
Cúcuta
Bucaramanga
Medellín
Manizales
Pereira
Ibagué
Bogotá, D.C.
Cali
Popayán
Neiva
Florencia
Pasto
Villavicencio
San José del Guaviare
Arauca
Puerto Carreño
Inírida
Mitú
Leticia
LA GUAJIRA
ATLÁNTICO
MAGDALENA
CESAR
SUCRE
CÓRDOBA
BOLÍVAR
NORTE DE SANTANDER
SANTANDER
ANTIOQUIA
CHOCÓ
RISARALDA
CALDAS
BOYACÁ
CUNDINAMARCA
CASANARE
ARAUCA
VICHADA
GUAINÍA
VAUPÉS
AMAZONAS
QUINDÍO
VALLE DEL CAUCA
TOLIMA
META
CAUCA
HUILA
NARIÑO
CAQUETÁ
PUTUMAYO
GUAVIARE
CONVENCIONES BÁSICAS
Limite internacional
Limite departamental
Capital de la república
Capital de departamento
Distrito capital
Cabecera municipal
Carretera nacional pavimentada
Carretera nacional sin pavimentar
Carretera nacional en construcción
Linea férrea activa
Linea férrea inactiva
Río
Cuerpo de agua
TICES HIPSOMÉTRICOS (ALTIMETRÍA)
m.s.n.m
4000 m.
3000
2000
1000
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200
100
0
SIGAC
ESCALA 1:5'000000

# Biomass in Colombia

## Field and processing residues:

>72 Million tons (FW)

~20 million ton DM

> 330.000 TJ

| Cultivo | Producción [1] [t/año] | Tipo de residuo | Origen del residuo | Factor de residuo [2] [$t_{residuo}/t_{producto\ principal}$] | Masa de residuo [ t / año] | Potencial energético [TJ / año] |
|---|---|---|---|---|---|---|
| Palma de Aceite | 872.117 | Cuesco | RAI | 0,22 | 189.074 | 2.627,44 |
| | | Fibra | | 0,63 | 546.381 | 6.778,89 |
| | | Raquis de Palma | | 1,06 | 924.618 | 6.607,31 |
| Caña de Azúcar | 2.615.251 | Hojas - Cogollo | RAC | 3,26 | 8.525.718 | 41.707,22 |
| | | Bagazo | RAI | 2,68 | 7.008.873 | 76.871,65 |
| Caña Panelera | 1.514.878 | Bagazo | RAC | 2,53 | 5.680.790 | 62.305,56 |
| | | Hojas - Cogollo | RAI | 3,75 | 3.832.640 | 18.749,01 |
| Café | 942.327 | Pulpa | RAI | 2,13 | 2.008.192 | 7.206,79 |
| | | Cisco | | 0,21 | 193.460 | 3.338,57 |
| | | Tallos | RAC | 3,02 | 2.849.596 | 38.561,52 |
| Maíz | 1.368.996 | Rastrojo | RAC | 0,93 | 1.278.642 | 12.573,18 |
| | | Tusa | | 0,27 | 369.629 | 3.845,88 |
| | | Capacho | | 0,21 | 288.858 | 4.383,73 |
| Arroz | 2.463.689 | Tamo | RAC | 2,35 | 5.789.669 | 20.699,41 |
| | | Cascarilla | RAI | 0,2 | 492.738 | 7.136,53 |
| Banano | 1.878.194 | Raquis de banano | RAC | 1 | 1.878.194 | 806,31 |
| | | Vástago de banano | | 5 | 9.390.968 | 5.294,27 |
| | | Banano de rechazo | RAI | 0,15 | 281.729 | 495,34 |
| Plátano | 3.319.357 | Raquis de plátano | RAC | 1 | 3.319.357 | 1.425,00 |
| | | Vástago de plátano | | 5 | 16.596.783 | 9.356,64 |
| | | Plátano de rechazo | RAI | 0,15 | 497.903 | 875,43 |
| TOTAL | 14.974.807 | | | | 71.943.813 | 331.645,71 |

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Ref: Atlas del Potencial Energético de la Biomasa Residual en Colombia

# Biomass in Colombia

**Residues:**

Oil Palm

Sugar cane

Coffee: Pulp+wood

Maize: Corn stover

Rice: Straw/husk

Banana: Field

Plantain: Field

Bamboo

Wood residues

# Biomass in Colombia

**Residues:**

Oil Palm

Sugar cane

Too Dispersed
Too Wet
Low Quality
Too valuable in the field
Too far away
Already used

Biomass analysis focus:

Sugar cane residues:

1 Cauca valley

Palm oil residues:

2 Northern palm oil area

3 Central palm oil area


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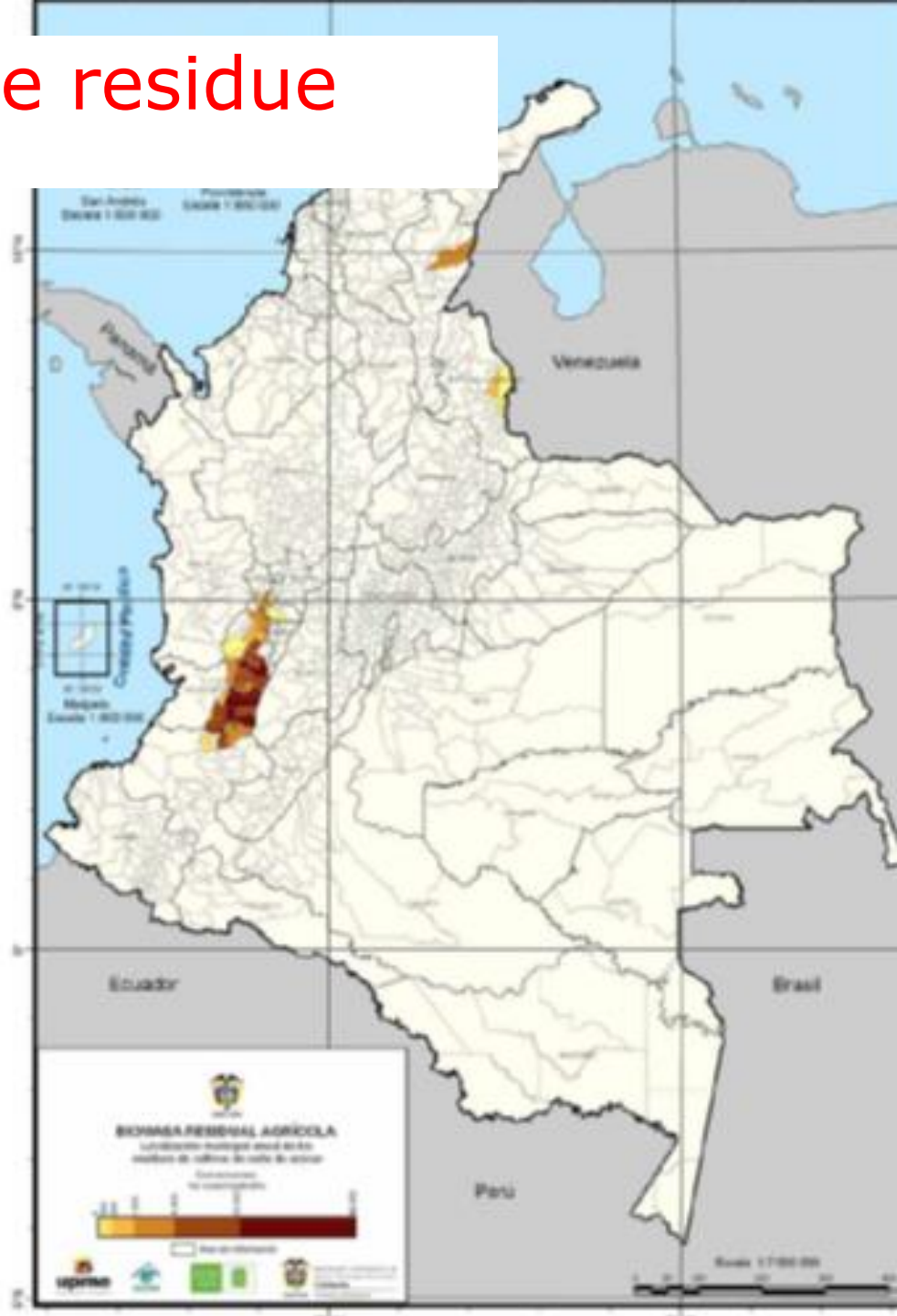
# Sugar cane residue

# Sugar cane


- 50% of the area is covered with 220,000 ha
- Year-round production
- 15 mills
- Sugar: 2.3 million tons
- Ethanol: 400 million liters of ethanol
- Electricity Cogeneration : 400 MW capacity
- 15% of bagasse is used for pulp


125
125


PELIGRO
VEHICULO
EXTRA LARGO

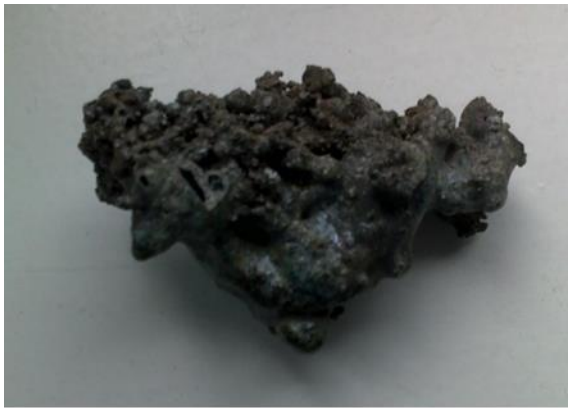

PELIGRO

# Cane residues

- Per ton sugar cane:
- 130 kg sugar
- 140 kg bagasse (DM)
  - Energy
  - Co-generation
  - Sold for pulp (replaced by coal)
- 140 kg trash (DM)
  - 50% is burned pre-harvest
- **15 tons DM per hectare trash**

| | | Current |
|---|---|---|
| **Area** | ha | 200,000 |
| **Sugar cane production** | Ton per hectare | 120 |
| **Bagasse per ton of cane** | | 140 |
| **Trash per ton cane** | kg DM | 140 |
| **Machanical harvest** | % | 50% |
| **Harvestable %** | % | 50% |
| **Local use** | % | 0% |
| **Technical potential (trash + bagasse)** | | 5,040,000 |
| **Technical Trash potential** | ton DM per year | 1,680,000 |
| **Sustainable potential** | ton DM per year | 840,000 |
| **Export potential** | ton DM per year | **840,000** |
| **Export potential** | GJ per year | **14,616,000** |

# Trash vs Bagasse quality



| | | Trash | Bagasse |
|---|---|---|---|
| | % dry | 7.72 | 3.99 |
| LHV | MJ/kg daf | 17.38 | 18.17 |
| HHV | MJ/kg daf | 18.69 | 19.37 |
| C | wt% (daf) | 47.49 | 49.03 |
| H | wt% (daf) | 6.09 | 5.98 |
| N | wt% (daf) | 0.54 | 0.46 |
| S | wt% (daf) | 0.09 | 0.07 |
| O | wt% (daf) | 45.81 | 44.47 |
| **Cl** | **mg/kg (daf)** | **3596** | **368.9** |
| **Ash IDT** | **°C** | **1025** | **1272** |
| **Ash SOT** | **°C** | **1200** | **1321** |

# Problem:

Trash may be available but has low quality

Bagasse has good quality but will be replaced by coal

Biomass for soil is an issue (0 to 100% should be left in field)

First estimate of trash cost is $US 32,-  (Hristov, 2016)

- 16$ US for collection
- 16$ US for nutrients removed

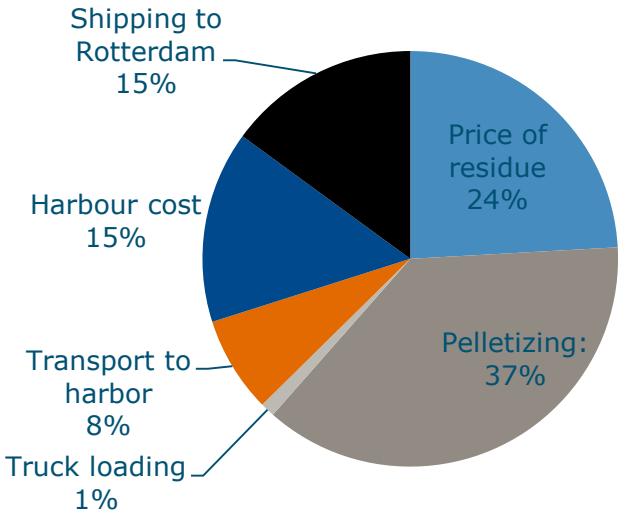
# Solution: Replace basasse with trash

| | Fresh Matter | Dry Matter | Moisture | N | K | P | Ca | Mg | S |
|---|---|---|---|---|---|---|---|---|---|
| | --------- ton/ha --------- | | ----%---- | ---------- g/kg DM ---------- | | | | | |
| **Tops** | 12.8 | 4.9 | 62 | 7.5 | 12.4 | 0.86 | 6.8 | 1.7 | 1.5 |
| **Dry Leaves** | 6.3 | 5.8 | 9.2 | 3.4 | 1.8 | 0.17 | 5.3 | 2.5 | 1.5 |

Use bagasse for pellets/ pyrolysis / 2$^{e}$ gen biofuel, etc.

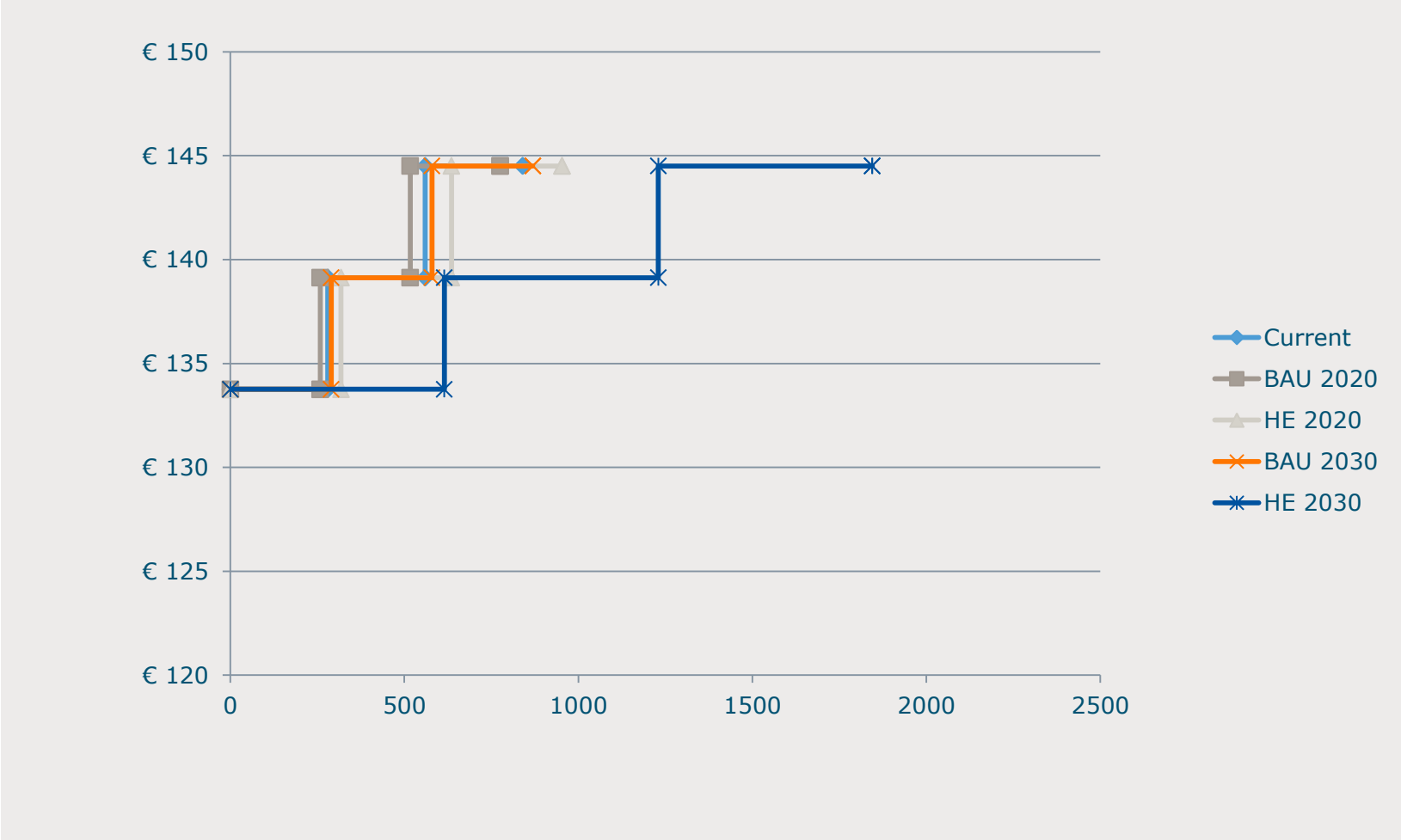
Replace bagasse in boilers trash dry leaves fraction of with pre-treated trash

# Sugar cane pellet delivery cost




| Cost item | Value | Dimension |
|---|---|---|
| **Delivered price of coal in Colombia:** | € 42 | € per ton |
| **Energy content of coal** | 25 | MJ/kg |
| **Energy content of bagasse** | 8 | MJ/kg as is |
| **Moisture content of bagasse** | 50% | |
| **Cost of bagasse (based on price of coal)** | € 13.44 | €/ton wet |
| **Cost of bagasse?** | € 26.88 | €/ton DM |
| **Premium if bagasse is replaced by trash:** | 20% | Premium increases from 20% to 40% to 60%. |
| **Energy content of pellets** | 17.5 | €/ton DM |
| **Biomass cost incl cleaning of trash** | € 32 | €/ton DM pellet |
| **Price of bagasse including premium** | € 32.26 | €/tonne DM pellet |
| **Pelletizing** | € 50.00 | €/ton pellet |
| **Loading** | € 1.50 | €/ton |
| **Transport to Buenaventura:** | € 10.00 | $12.41 per track truck |
| **Harbour cost, incl. storage and unloading/loading** | € 20.00 | €/ton |
| **Transport by ship Buenaventura to Rotterdam** | € 20.00 | €/ton Transport 5194 nautical miles including Panama Canal. |
| **Cost per GJ** | **€ 133.76** | €/tonne pellet delivered to Rotterdam |
| **Cost per GJ** | **€ 7.64** | €/GJ |

# Sugar cane bagasse pellet delivery cost € per ton Rotterdam: Current, BAU and High Export



Biomass analysis focus:

Sugar cane residues:

1 Cauca valley

Palm oil residues:

2 Northern palm oil area

3 Central palm oil area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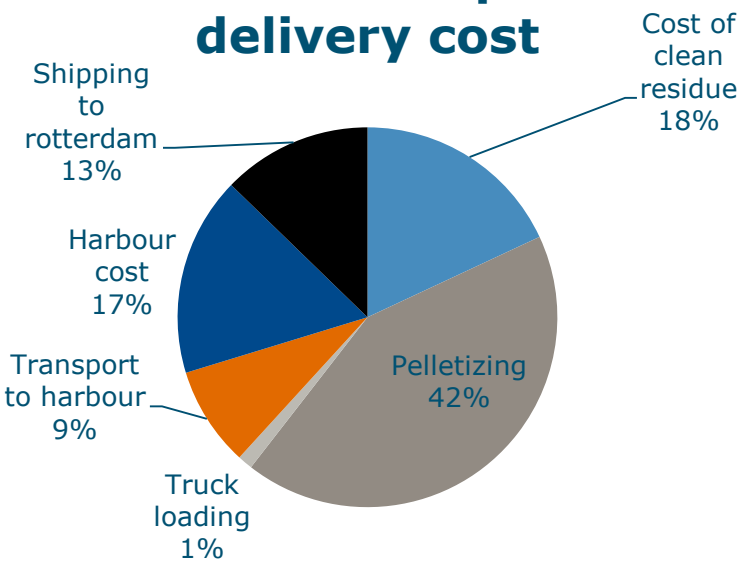
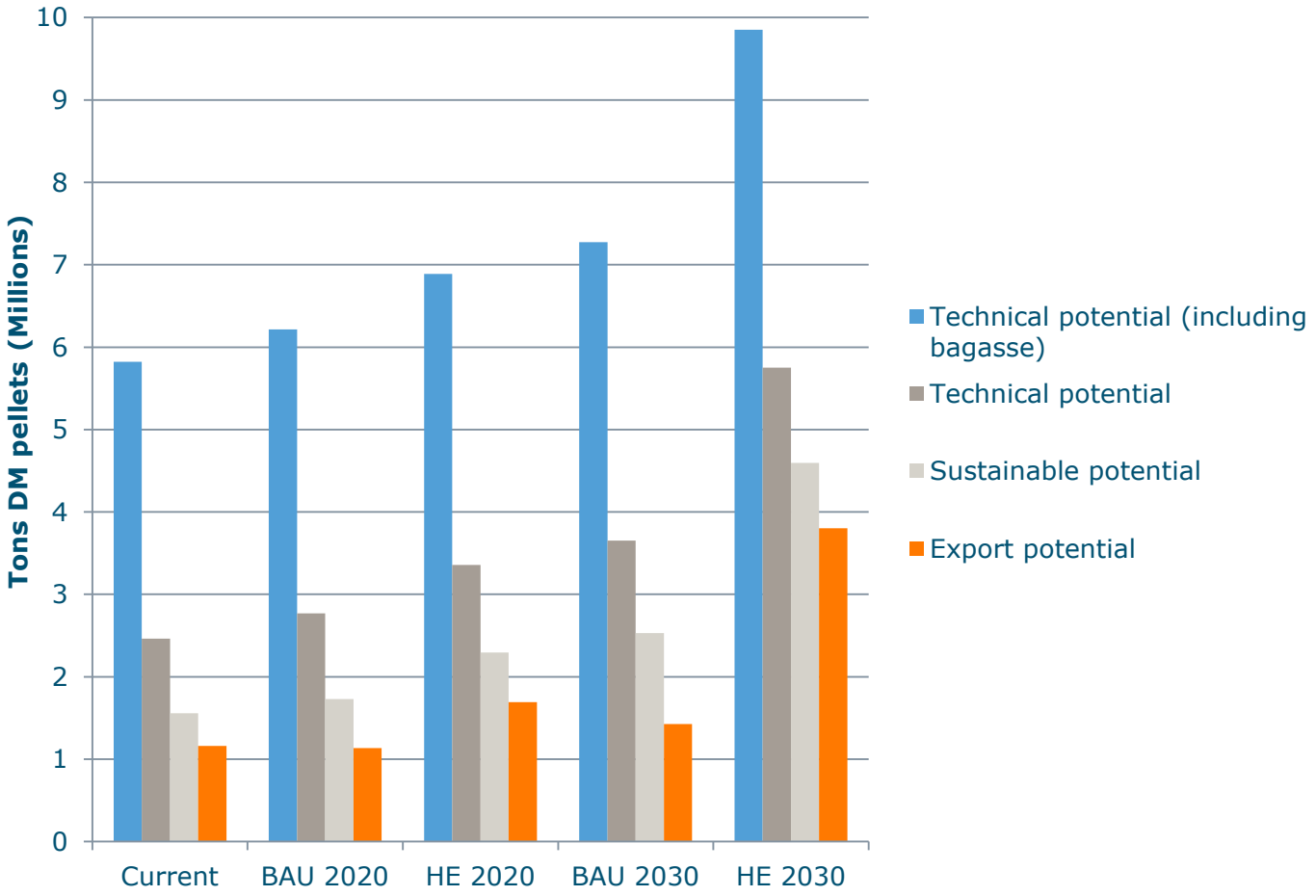
## Palm residue pellet delivery cost



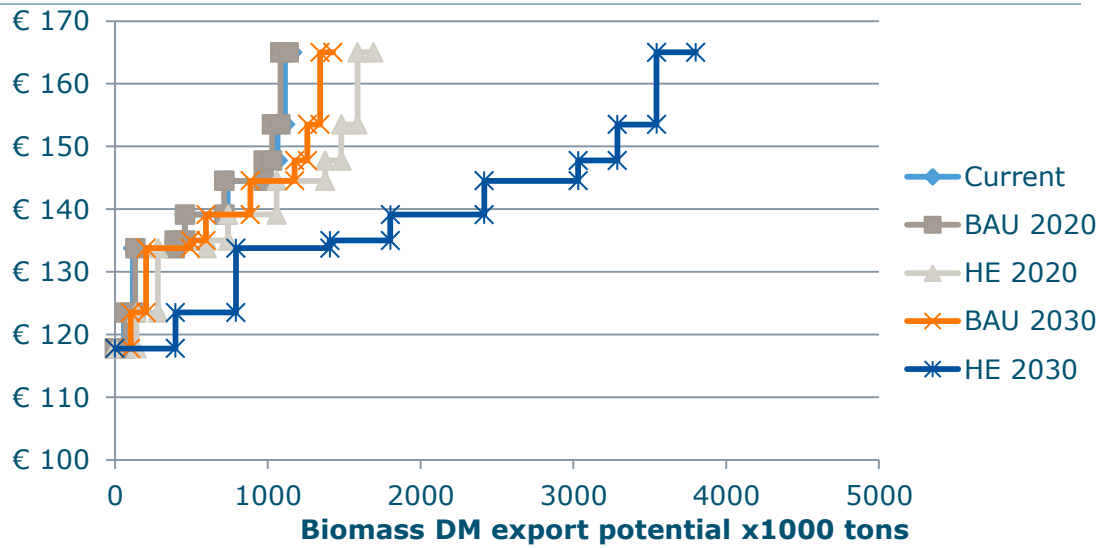

| Item | | |
|---|---|---|
| **Price of pressed EFB** | € 2.5 | €/ton FW |
| **Price of EFB?** | € 5.0 | €/ton DM |
| **Cost of cleaning EFB** | € 10.0 | €/ton DM |
| **Cost of transport to plant** | € 4.0 | €/ton DM |
| **Energy content of pressed EFB** | 18.0 | GJ/ton LHV |
| **Energy cost of drying** | 15% | % |
| **Cost of EFB including washing** | € 21.25 | €/ton DM |
| **Pelletizing:** | € 50 | €/ton DM pellet |
| **Loading 1.5 €/ton** | € 1.5 | €/ton |
| **Transport to harbour** | €10 | €/ton |
| **Harbour cost** | €20 | €/ton |
| **Transport to harbour** | € 11.0 | |
| **Sea transport to Rotterdam** | € 15.0 | Panamax bulk, current prices |
| **Cost per ton pellet delivered** | **€ 117.75** | €/ton pellet delivered Rotterdam |
| **Cost per GJ** | **€ 6.54** | GJ/ton LHV |

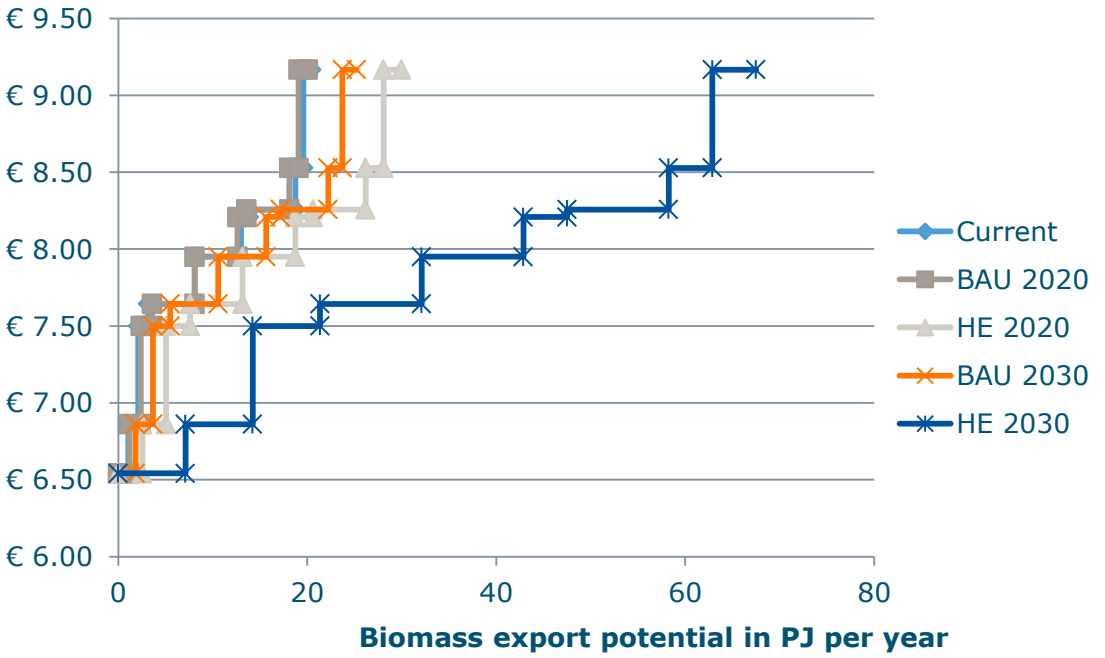
# Sugar cane and palm oil sustainable export potential



# Export potential of palm and sugar cane residue

Export potential palm and sugar cane residues = 1.5 to 4 million tons

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# END

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Luisa Fernanda Arango Londoño

# "To be or not to be a commodity"

| A full commodity | Not a commodity |
|---|---|
| **Easily transportable and storable** → high energy content, low moisture, low volume | **Not easily transportable or storable** |
| **Quality standardized** | **No standards** (quality, sustainability, safety, etc.) |
| **Fungible** (= "exchangeable") Standard transport, contracting, insurance, safety, etc. Standard processing, etc. | **No exchange markets** No market price No financial instruments (futures) |
| **Functioning market** Trade system → Price formation Financial instruments (futures, etc.) High "tradability" | **No sustainability standards** |
| **Sustainability** Standard certification systems exist | **Transaction costs higher** |
| | **Security of supply becomes very important/difficult** |
| | **Long term relationships needed** One on One and Case by Case relations |
| | **Vertical chain integration needed** |