
IBTC
International Biomass
Torrefaction and
Carbonisation Council

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IBTC International Biomass Torrefaction and Carbonisation Council

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What we do for our members

→ Market promotion and networking

→ Standardization and commoditization of products

→ Master permits and certification for handling, logistics and trade

→ Bridging science to industry

→ Member networking

→ Statistics and market analytics

Circular Biocarbon – From Specialities to Commodities

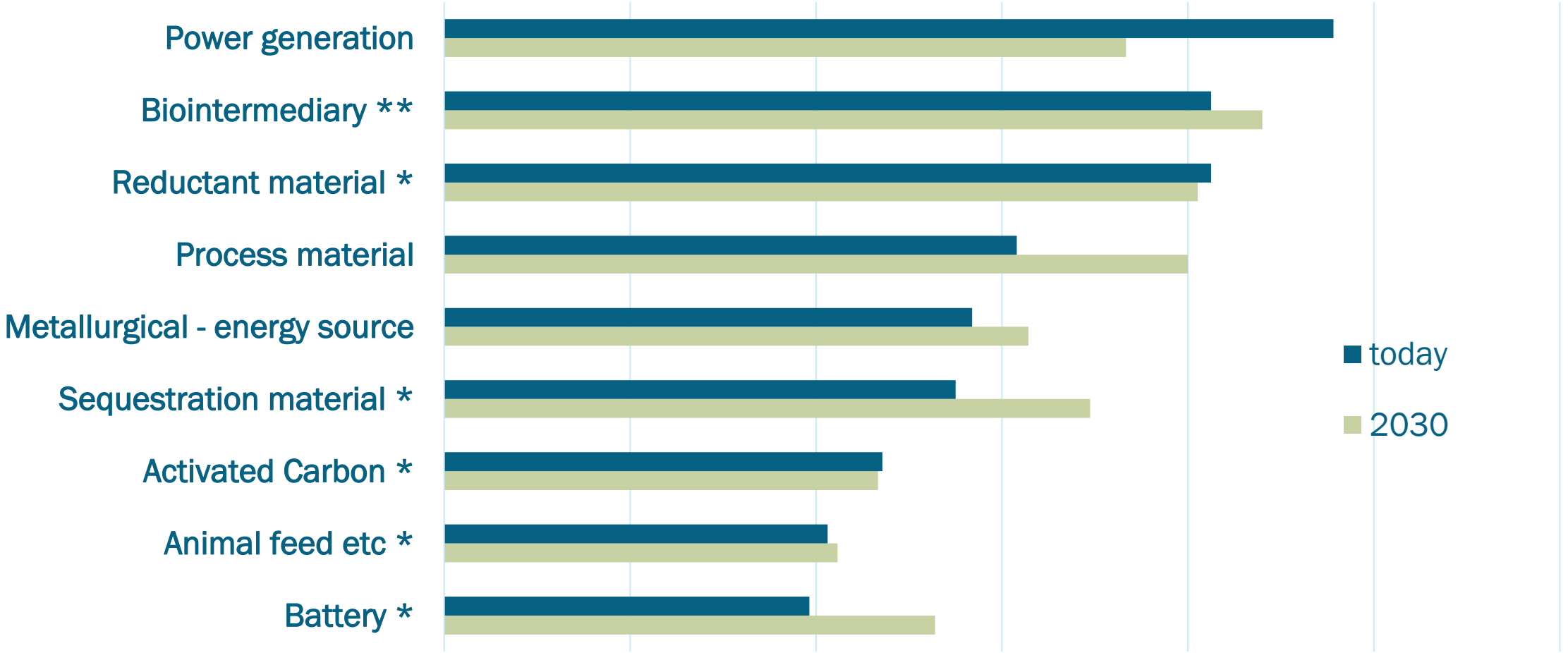
- Circularity needs cooperation:
  Why we need the off takers on board

- Renewable carbon: Is it part of the solution for the defossilization for energy-intensive industries?

- The potential markets for biocarbon from now to 2030

Which application is driving the volumes

as seen by producers and suppliers

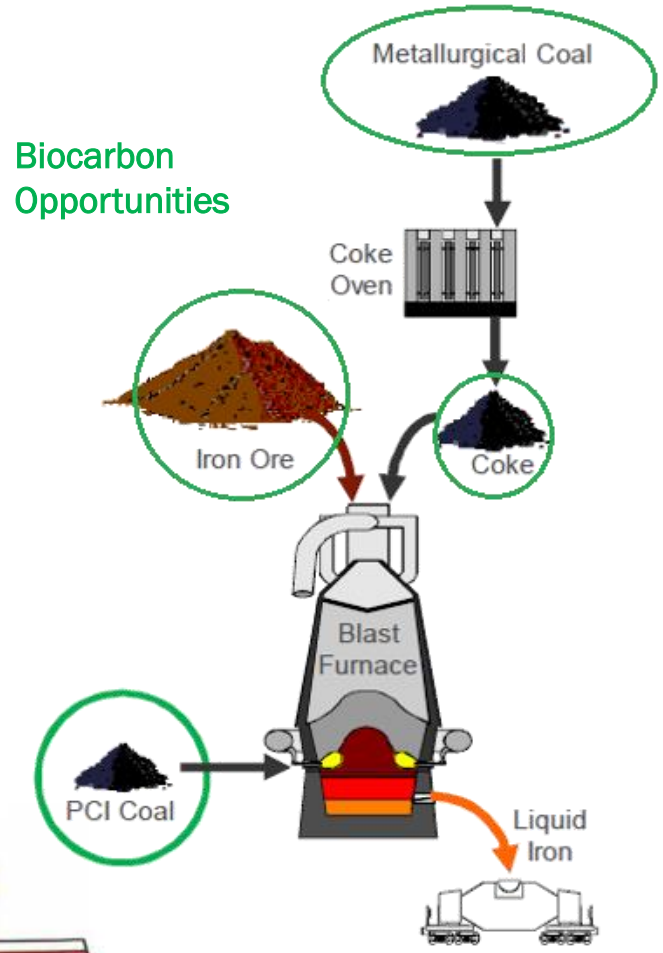


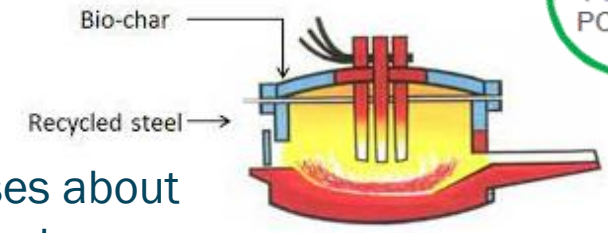
* Increased Carbon Content in product required (Cfix>75%) ** Gasification, SAF, Methanol, Carbonization etc

Torrefied Biomass in the steel making industry

Millions of tonnes of biomass / biochar will be needed to replace fossil fuel carbon

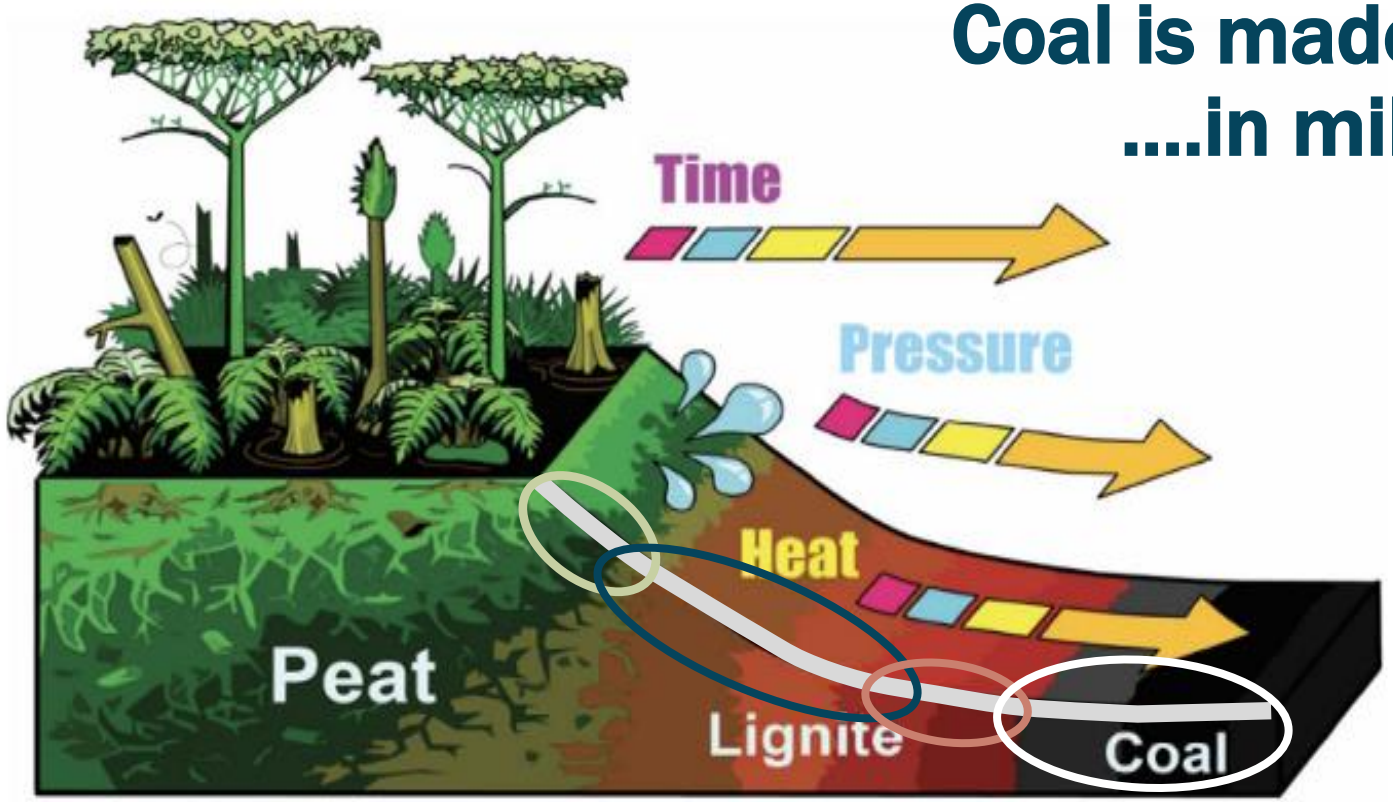
1. **Iron ore briquettes or pellets contain ca. 4% carbon at 580 mil tons market size**
2. **Up to 25% replacement of pulverized coal injection (PCI) in blast furnace ironmaking**
3. Up to 100% replacement of coke breeze for the induration of iron ore pellets
4. 5% substitution of metallurgical coal in coke making (slot ovens)
5. Replacement of coke briquettes by biochar briquettes
6. Up to 100% replacement of injection carbon (for slag foaming) and charge carbon (heat) in electric arc furnace (EAF) steelmaking



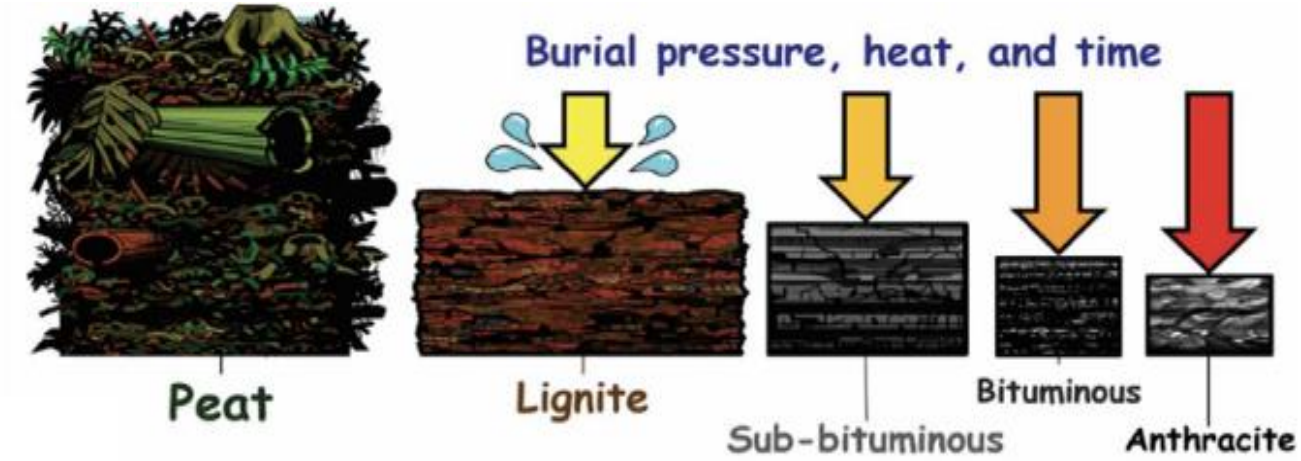


On average, it is estimated that the global steel industry uses about 2 billion tons of iron ore, 1 billion tonnes of metallurgical coal

Coal is made of biomass ....in million of years



	GCV kJ/kg	GCV kcal/kg
Steam Explosion	17000	4057
Torrefaction	21000	5012
Pyrolyses	25000	5967
Carbonisation = Charring	29000	6921
	33000	7876



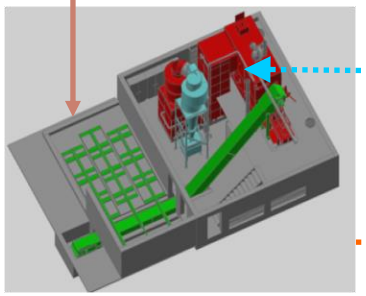
...or within minutes

by technology and temperature

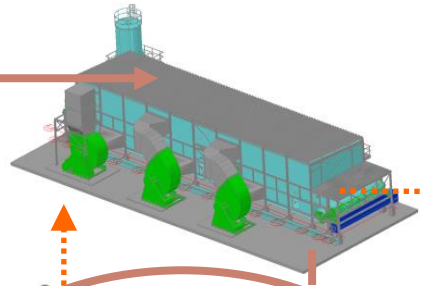
Different Pathways...

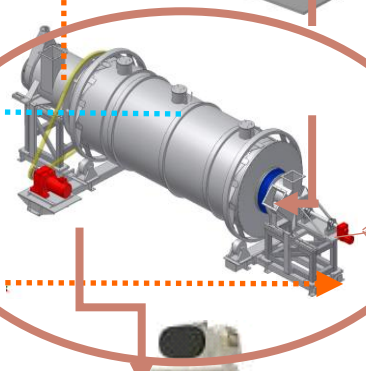
Fresh biomass

Fresh biomass fuel



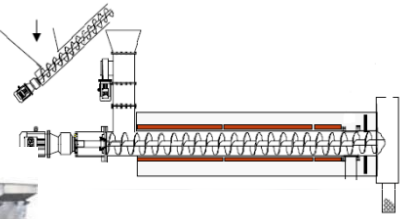
ENERGY SUPPLY
Biomass +
lean gas incineration





Drum drier or calziner

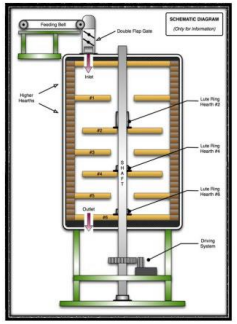
Auger-screw type reactor



Eventually Micro wave supplemented

Vibrating belt

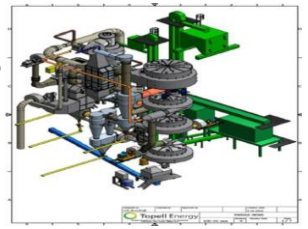
Multiple Hearth

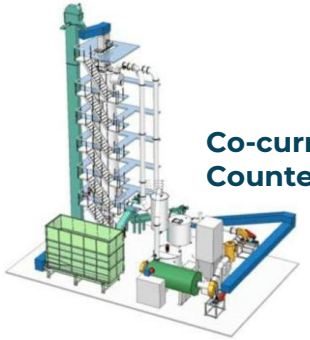


Batch reactor

Moving bed reactor

Cyclone,
Fluidized bed



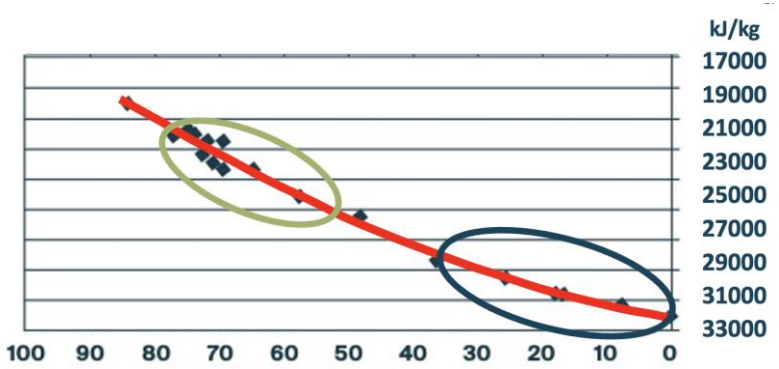


Co-current or
Counter current

Different processing levels – different products

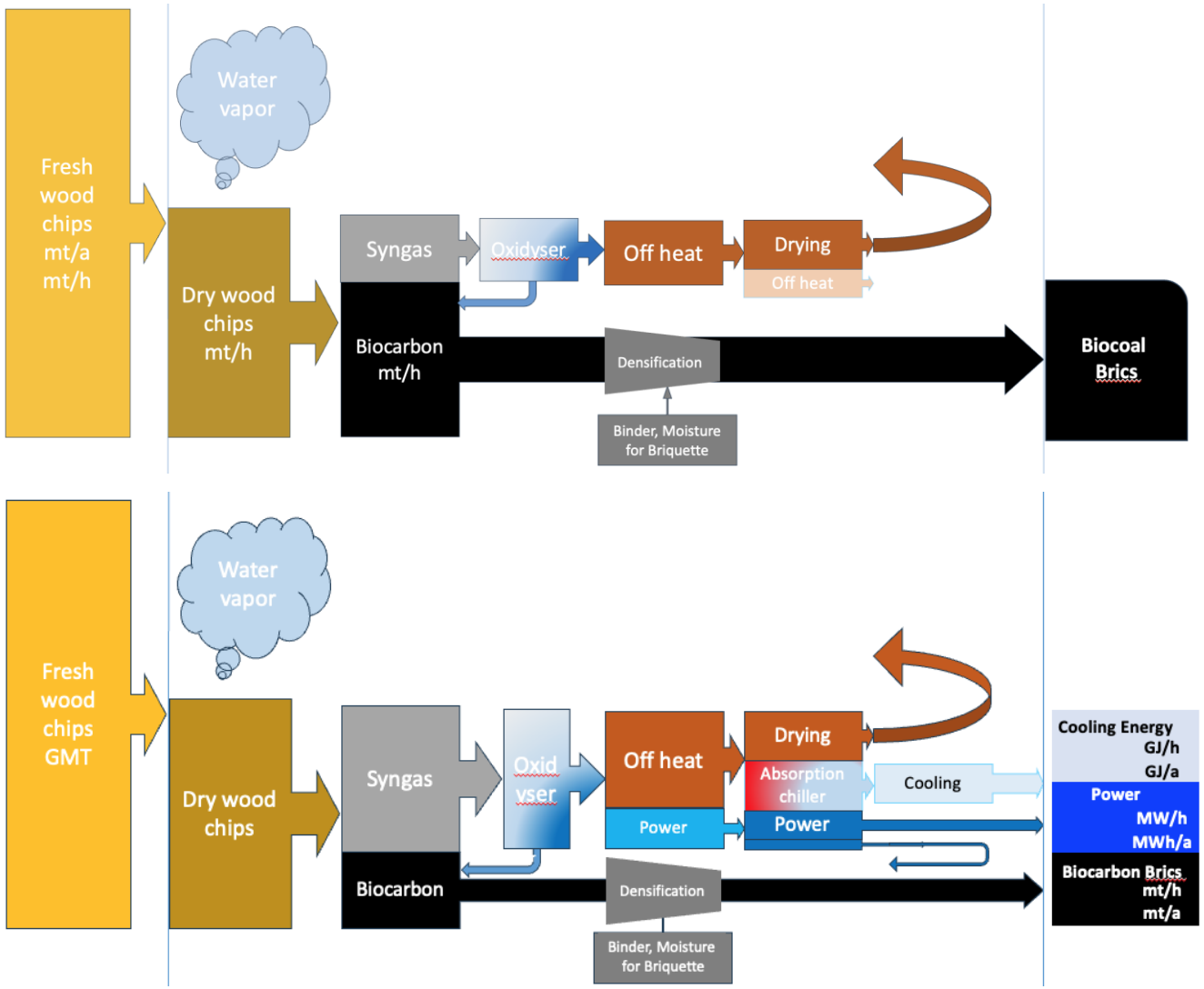
Torrefaction

one semi carbonised material –
Steam coal substitute or biointermediary



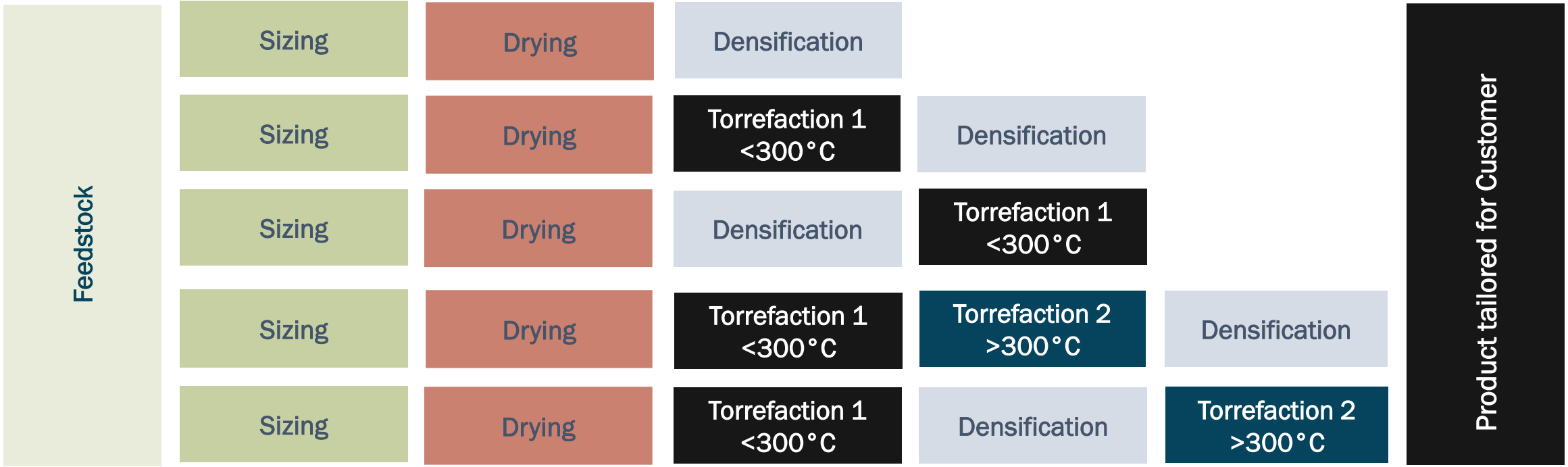
Carbonisation

multiple products –
Biocarbon, Power, Heating,
Cooling, Process heat



Process steps in a torrefaction supply chain

Basically, the value chain is built of up to 5 steps from gate of first processing installation to final delivered product. While it seems logic that first 3 steps are unavoidably located at place of feedstock origin it may be worthwhile analyzing if location of final steps at place of consumption provide advantages



Typical Product Form Factors for Trading

Pellets*
6 - 12 mm

Piston or Extrusion Briquetted
40 - 100mm

Agglomerated

Roller Briquetted
12 - 50mm

Terminology according to ISO working group (ISO TC 238 WG1):

Pyrogenic Biocarbon, the term for Biocarbon utilized in energy or for processes;
Biochar, the term used for Biocarbon that is sequestered

*__Black pellets__ from steam explosion, __Biocarbon pellets__ from thermal processes

CIRCULAR BIOCARBON

Standard	Wood Pellets WWP ISO 17225-2	Steam Exploded Pellets ISO 17225-8	Torrefied Biomass Pellets/Briquettes ISO 17225-8	Bio-Carbon Pellets/Briquettes ISO WG	Biochar undensified WBC cert
Moisture content (% wt)	7–10	03.Jun	2–8	3–8	30% rec
Ash Content (% wt)	0.3–1.5	0.3–3	1,5-5	1,5–8	14 max
Calorific value NCV (MJ /kg)	16–17	19-21	19–23	25–32	
Volatiles (% db)	70–75	70	50–60	10–25	
Fixed carbon (% db)	20–25	20–25	25–50	60–95	>70
Bulk density (kg /m^3)	650–680	700-750	650–700	650–750	150–350
Energy density (GJ/m^3)	10,4–11	15-16	13–17	18,2–24	
Dust	Average	Low	Average	Limited/Average	High
Hydroscopic properties	Hydrophilic	Hydrophobic	Hydrophobic	Hydrophobic	
Biological degradation	Yes	slow	very low	No	No
Milling requirements	Classic/special	HGI 40–45	HGI 40–50	HGI 45–55	
Handling properties	Special/dry	Easy	Easy	Easy	with care
Transport costs	Average	Low	Low	Low	high
EPA PAH					6 g t-1 db
EFSA PAH					1 g t-1 db
PCB					0,2mg/kg db
H/Corg					< 0,7(< 0,4) db

IBTC

Pellets*
6 - 12 mm

Piston or
Extrusion Briquetted
40 - 100mm

Agglomerated

Roller Briquetted
12 - 50mm

Quality – Standardisation

ISO 17225

Solid biofuels – Fuel specifications and classes

ISO TS 17225 - 8:

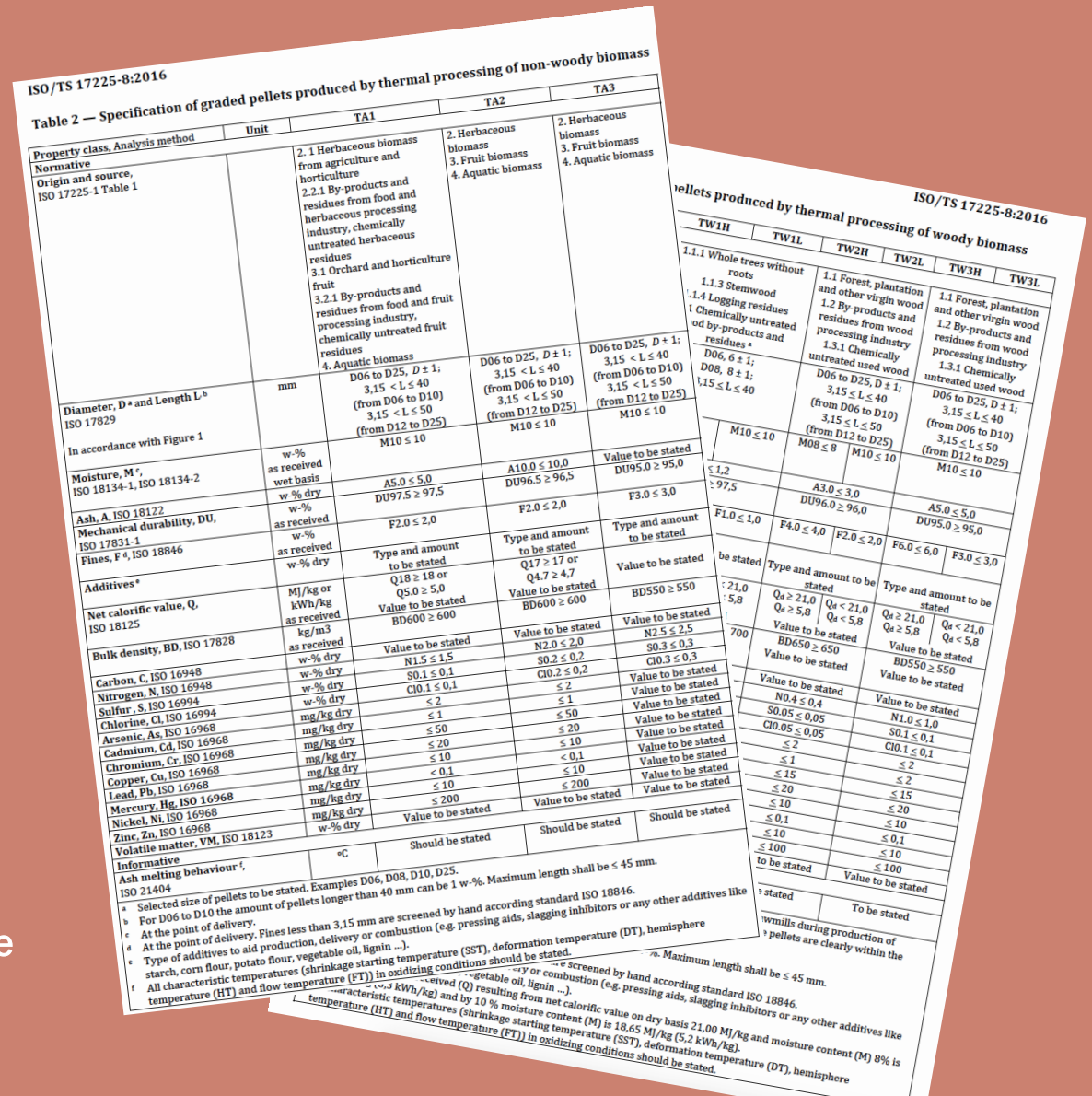
Part 8: Graded thermally treated and densified biomass fuels

Different Classes

1. Wood biomass different classes
2. Herbaceous biomass
3. Fruit biomass
4. Aquatic biomass

Net Calorific Value, Durability, Bulk Density, Volatile Matter, Water sorption, Grindability etc.

ISO working group to analyse need for additional standard for carbonised biomass for different applications, like metallurgical biocarbon



ISO/TS 17225-8:2016

Table 2 — Specification of graded pellets produced by thermal processing of non-woody biomass

Property class, Analysis method	Unit	TA1	TA2	TA3
Normative				
Origin and source, ISO 17225-1 Table 1		2. 1 Herbaceous biomass from agriculture and horticulture 2.2.1 By-products and residues from food and herbaceous processing industry, chemically untreated herbaceous residues 3.1 Orchard and horticulture fruit 3.2.1 By-products and residues from food and fruit processing industry, chemically untreated fruit residues 4. Aquatic biomass	2. Herbaceous biomass 3. Fruit biomass 4. Aquatic biomass	2. Herbaceous biomass 3. Fruit biomass 4. Aquatic biomass
Diameter, D [a] and Length L [b] ISO 17829	mm	D06 to D25, $D \pm 1$; $3{,}15 < L \leq 40$ (from D06 to D10) $3{,}15 < L \leq 50$ (from D12 to D25)	D06 to D25, $D \pm 1$; $3{,}15 < L \leq 40$ (from D06 to D10) $3{,}15 < L \leq 50$ (from D12 to D25)	D06 to D25, $D \pm 1$; $3{,}15 < L \leq 40$ (from D06 to D10) $3{,}15 < L \leq 50$ (from D12 to D25)
In accordance with Figure 1		M10 ≤ 10	M10 ≤ 10	M10 ≤ 10
Moisture, M [c], ISO 18134-1, ISO 18134-2	w-% as received wet basis			Value to be stated
	w-% dry	A5.0 ≤ 5,0 DU97.5 ≥ 97,5	A10.0 ≤ 10,0 DU96.5 ≥ 96,5	DU95.0 ≥ 95,0
Ash, A, ISO 18122	w-% as received			
Mechanical durability, DU, ISO 17831-1	w-% as received	F2.0 ≤ 2,0	F2.0 ≤ 2,0	F3.0 ≤ 3,0
Fines, F [d], ISO 18846	w-% dry	Type and amount to be stated	Type and amount to be stated	Type and amount to be stated
Additives [e]		Q18 ≥ 18 or Q5.0 ≥ 5,0 Value to be stated	Q17 ≥ 17 or Q4.7 ≥ 4,7 Value to be stated	Value to be stated
Net calorific value, Q, ISO 18125	MJ/kg or kWh/kg as received	BD600 ≥ 600	BD600 ≥ 600	BD550 ≥ 550
Bulk density, BD, ISO 17828	kg/m3 as received			
Carbon, C, ISO 16948	w-% dry	Value to be stated	Value to be stated	Value to be stated
Nitrogen, N, ISO 16948	w-% dry	N1.5 ≤ 1,5	N2.0 ≤ 2,0	N2.5 ≤ 2,5
Sulfur, S, ISO 16994	w-% dry	S0.1 ≤ 0,1	S0.2 ≤ 0,2	S0.3 ≤ 0,3
Chlorine, Cl, ISO 16994	w-% dry	Cl0.1 ≤ 0,1	Cl0.2 ≤ 0,2	Cl0.3 ≤ 0,3
Arsenic, As, ISO 16968	mg/kg dry	≤ 2	≤ 2	Value to be stated
Cadmium, Cd, ISO 16968	mg/kg dry	≤ 1	≤ 1	Value to be stated
Chromium, Cr, ISO 16968	mg/kg dry	≤ 50	≤ 50	Value to be stated
Copper, Cu, ISO 16968	mg/kg dry	≤ 20	≤ 20	Value to be stated
Lead, Pb, ISO 16968	mg/kg dry	≤ 10	≤ 10	Value to be stated
Mercury, Hg, ISO 16968	mg/kg dry	< 0,1	< 0,1	Value to be stated
Nickel, Ni, ISO 16968	mg/kg dry	≤ 10	≤ 10	Value to be stated
Zinc, Zn, ISO 16968	mg/kg dry	≤ 200	≤ 200	Value to be stated
Volatile matter, VM, ISO 18123	w-% dry	Value to be stated	Value to be stated	Value to be stated
Informative				
Ash melting behaviour [f], ISO 21404	°C	Should be stated	Should be stated	Should be stated

[a] Selected size of pellets to be stated. Examples D06, D08, D10, D25.
[b] For D06 to D10 the amount of pellets longer than 40 mm can be 1 w-%. Maximum length shall be ≤ 45 mm.
[c] At the point of delivery.
[d] At the point of delivery. Fines less than 3,15 mm are screened by hand according standard ISO 18846.
[e] Type of additives to aid production, delivery or combustion (e.g. pressing aids, slagging inhibitors or any other additives like starch, corn flour, potato flour, vegetable oil, lignin ...).
[f] All characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT)) in oxidizing conditions should be stated.

ISO/TS 17225-8:2016

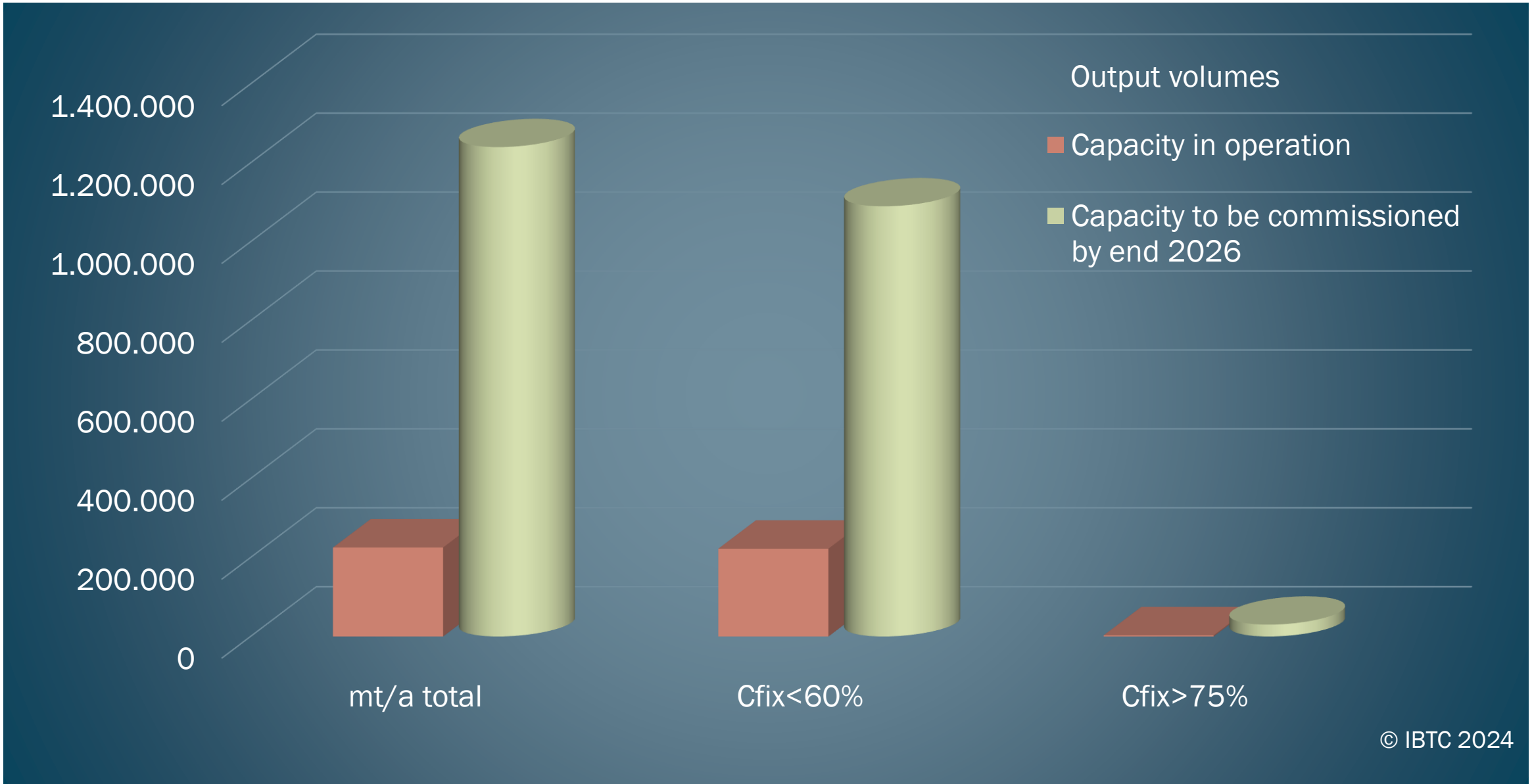
...pellets produced by thermal processing of woody biomass

TW1H	TW1L	TW2H	TW2L	TW3H	TW3L
1.1.1 Whole trees without roots 1.1.3 Stemwood 1.1.4 Logging residues 1 Chemically untreated ...od by-products and residues [a]		1.1 Forest, plantation and other virgin wood 1.2 By-products and residues from wood processing industry 1.3.1 Chemically untreated used wood		1.1 Forest, plantation and other virgin wood 1.2 By-products and residues from wood processing industry 1.3.1 Chemically untreated used wood	
D06, 6 ± 1; D08, 8 ± 1; $3{,}15 \leq L \leq 40$		D06 to D25, $D \pm 1$; $3{,}15 \leq L \leq 40$ (from D06 to D10) $3{,}15 \leq L \leq 50$ (from D12 to D25)		D06 to D25, $D \pm 1$; $3{,}15 \leq L \leq 40$ (from D06 to D10) $3{,}15 \leq L \leq 50$ (from D12 to D25)	
M10 ≤ 10		M08 ≤ 8	M10 ≤ 10	M10 ≤ 10	
≤ 1,2		A3.0 ≤ 3,0		A5.0 ≤ 5,0	
≥ 97,5		DU96.0 ≥ 96,0		DU95.0 ≥ 95,0	
F1.0 ≤ 1,0		F4.0 ≤ 4,0	F2.0 ≤ 2,0	F6.0 ≤ 6,0	F3.0 ≤ 3,0
be stated		Type and amount to be stated		Type and amount to be stated	
≥ 21,0 ≥ 5,8		Q4 ≥ 21,0 Q4 ≥ 5,8	Q4 < 21,0 Q4 < 5,8	Q4 ≥ 21,0 Q4 ≥ 5,8	Q4 < 21,0 Q4 < 5,8
700		Value to be stated		Value to be stated	
		BD650 ≥ 650		BD550 ≥ 550	
		Value to be stated		Value to be stated	
		N0.4 ≤ 0,4		N1.0 ≤ 1,0	
		S0.05 ≤ 0,05		S0.1 ≤ 0,1	
		Cl0.05 ≤ 0,05		Cl0.1 ≤ 0,1	
		≤ 2		≤ 2	
		≤ 1		≤ 1	
		≤ 15		≤ 2	
		≤ 20		≤ 15	
		≤ 10		≤ 20	
		≤ 0,1		≤ 10	
		≤ 10		≤ 0,1	
		≤ 100		≤ 10	
		Value to be stated		≤ 100	
				Value to be stated	
		...stated		To be stated	

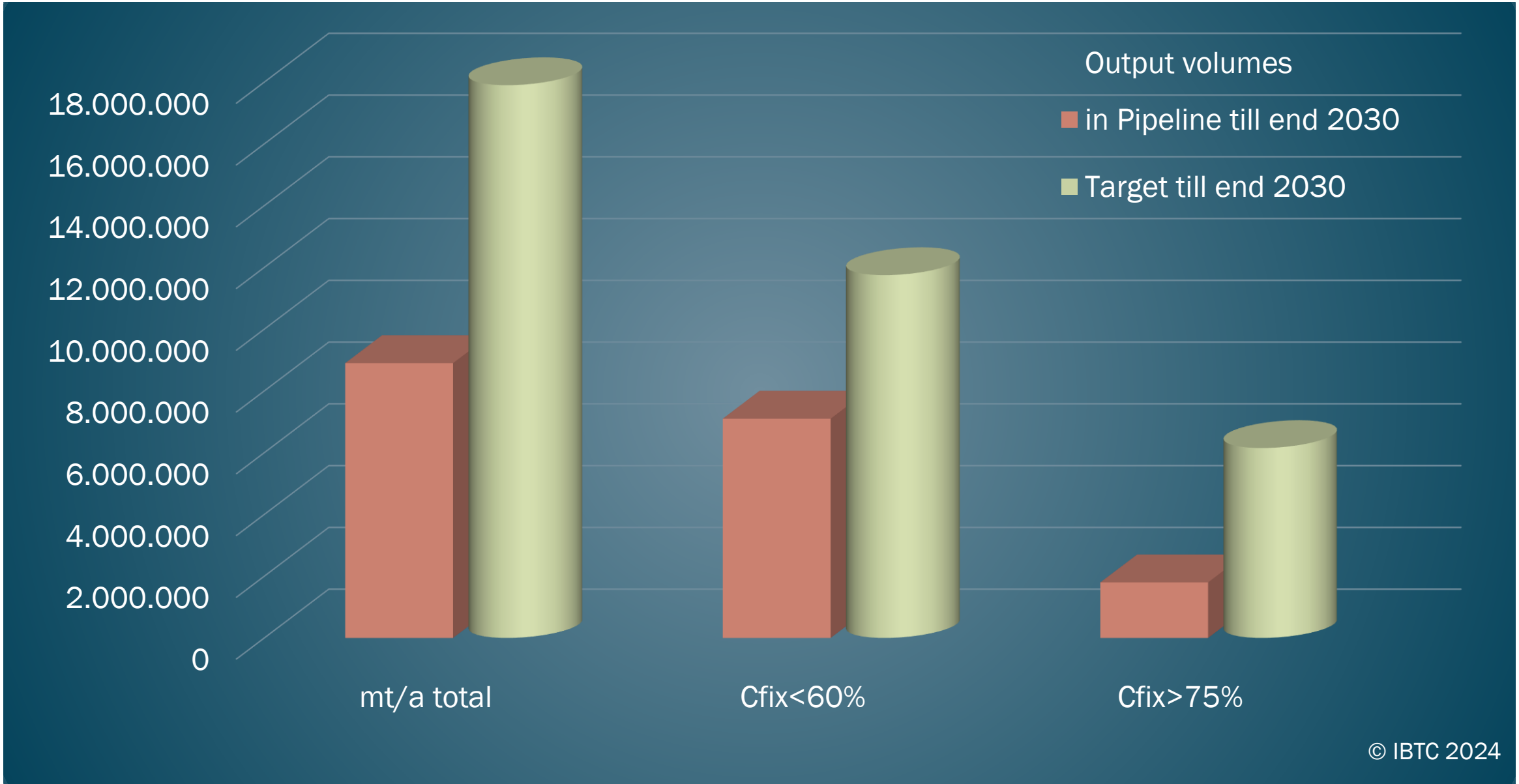
...wmills during production of ...pellets are clearly within the

...e screened by hand according standard ISO 18846. Maximum length shall be ≤ 45 mm.
...ary or combustion (e.g. pressing aids, slagging inhibitors or any other additives like ...vegetable oil, lignin ...).
...erved (Q) resulting from net calorific value on dry basis 21,00 MJ/kg and moisture content (M) 8% is ...,5 kWh/kg) and by 10 % moisture content (M) is 18,65 MJ/kg (5,2 kWh/kg).
...aracteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT)) in oxidizing conditions should be stated.

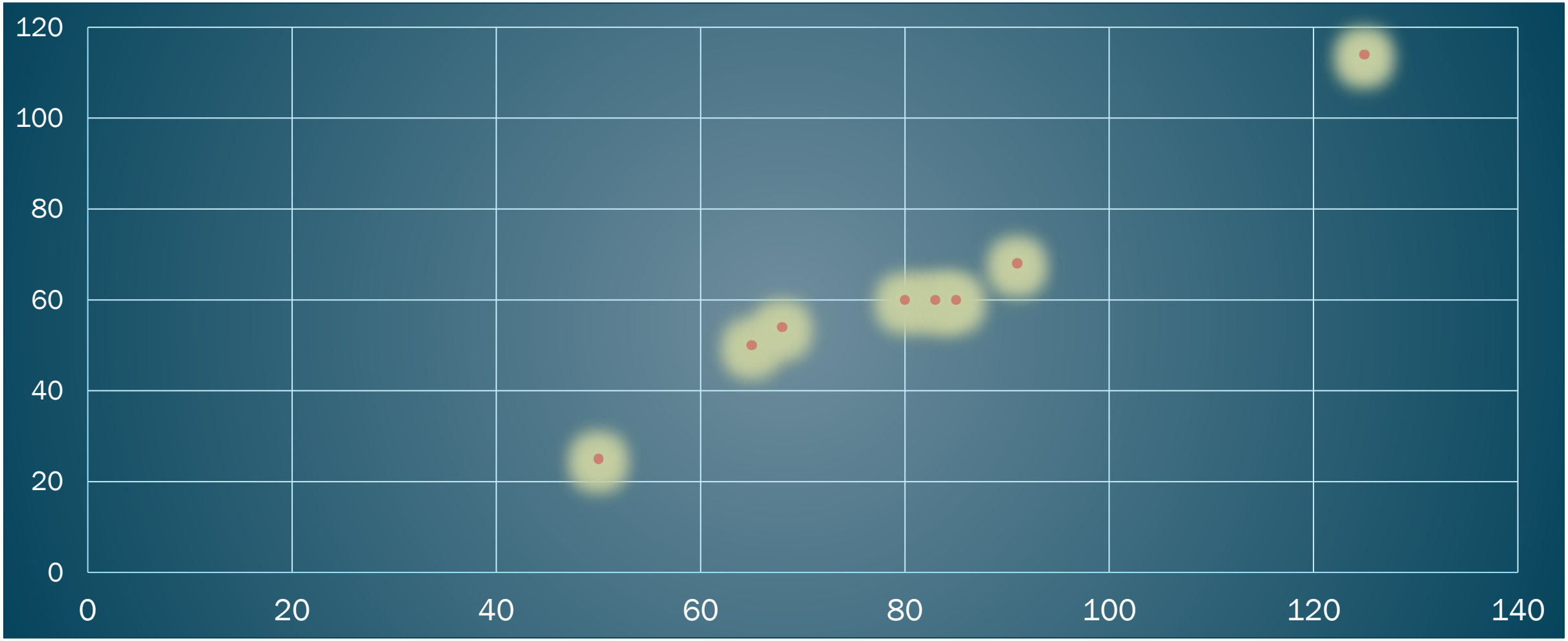
Capacity active and under Construction mt/a



Capacities outlook mt/a

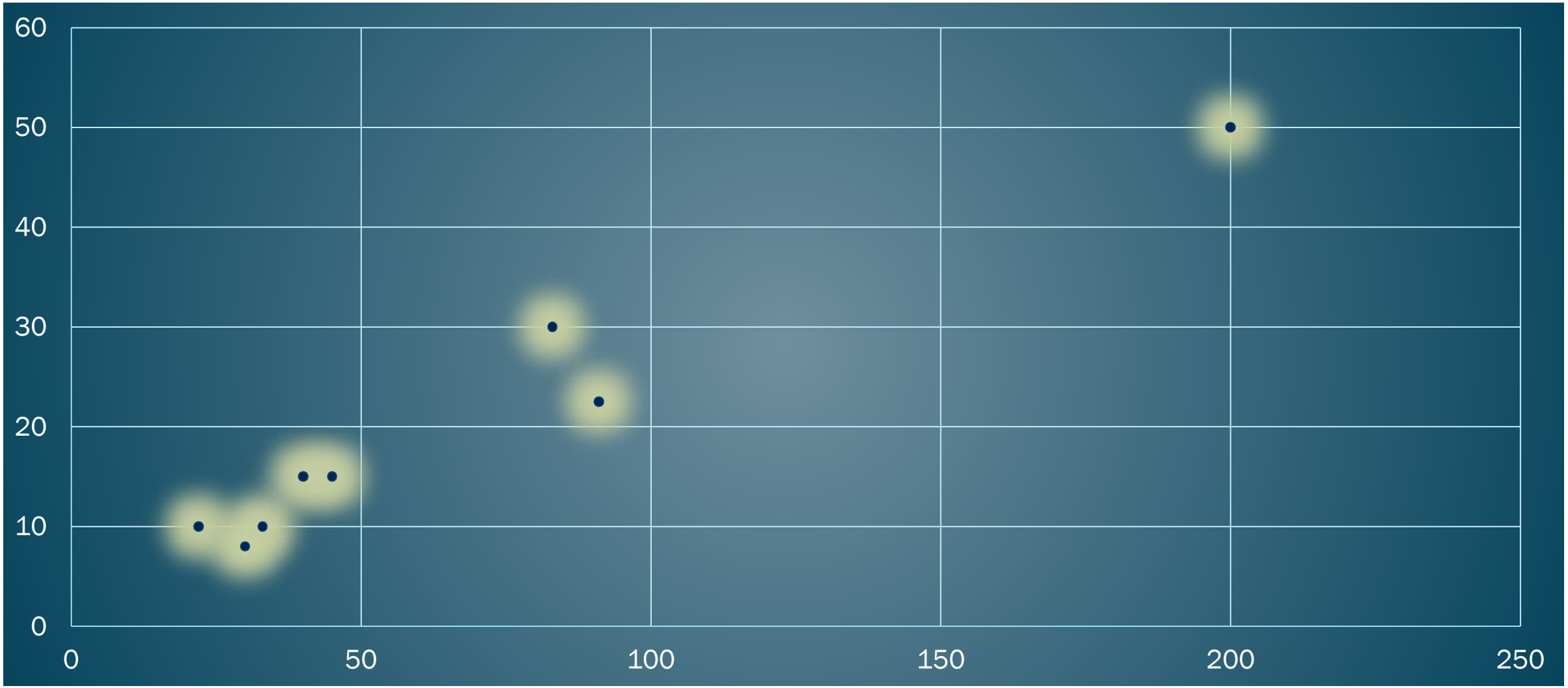


Capacity of Torrefaction lines offered
(input bd/output in 000mt)



Capacity of Carbonisation lines offered

(input bd/output in 000mt)



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Circular Biocarbon – From Specialities to Commodities

- The potential markets for biocarbon are various and the volumes demanded are staggering
- Circularity needs cooperation – new collaborative business models are needed to speed up, scale and enable further research to reduce emissions in time

  and for the joint development of final product parameters and value chain set up
- Circular Biocarbon is part of the solution to defossilise energy-intensive industries

How can we make that work? Together!

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Shaping the Future of Circular Biocarbon.

Together.

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