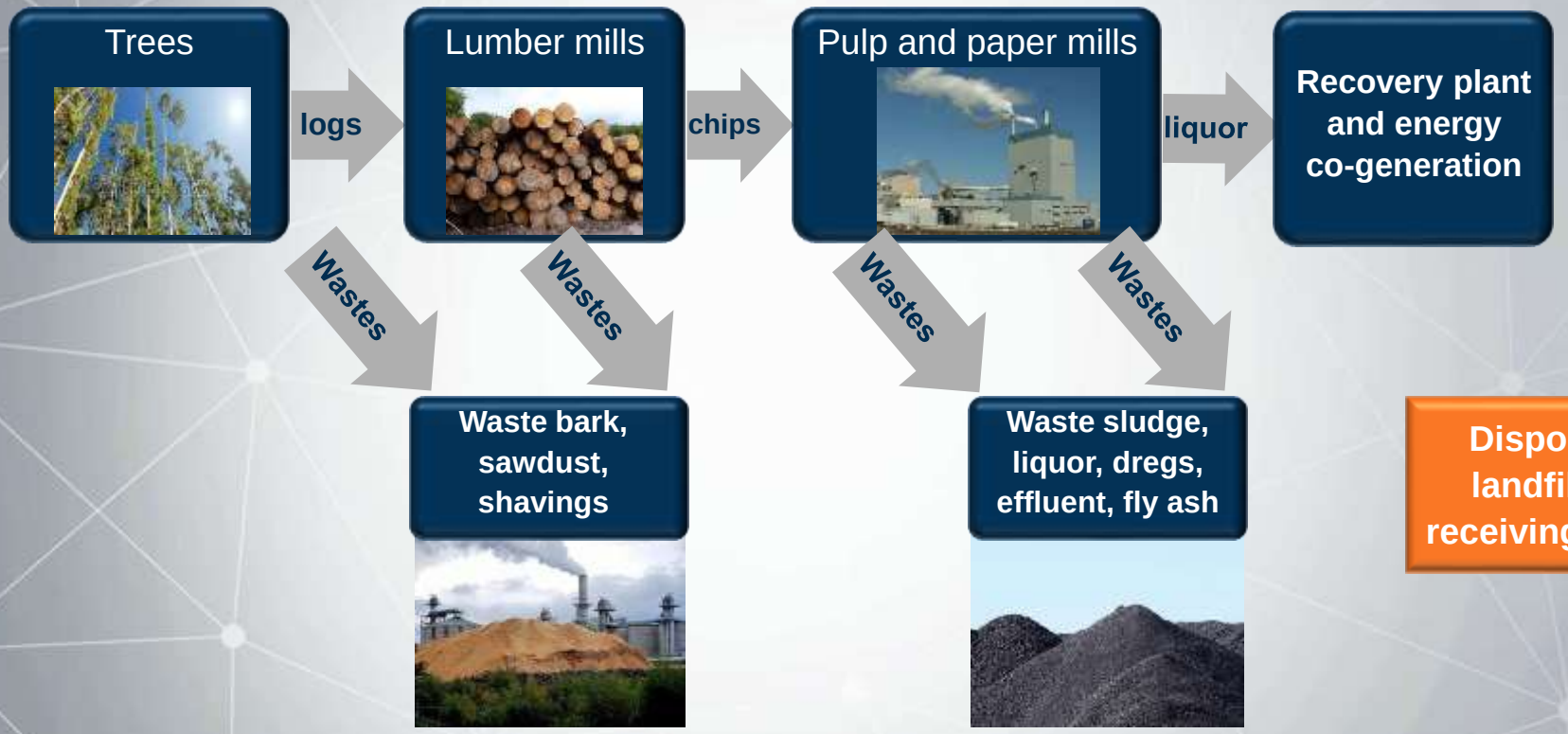
The DST-CSIR Biorefinery Industry Development Facility

Bruce Sithole

Sasol discussions

our future through science

Challenge: Current forestry sector technology is wasteful and has limited products



- Extracting only 47% value from trees
- A highly inefficient use of a natural resource

Biorefinery technologies

Biomass waste

CO2

CARBON NEUTRAL

BIOREFINING PROCESSES

THERMAL CHEMICAL BIOCHEMICAL

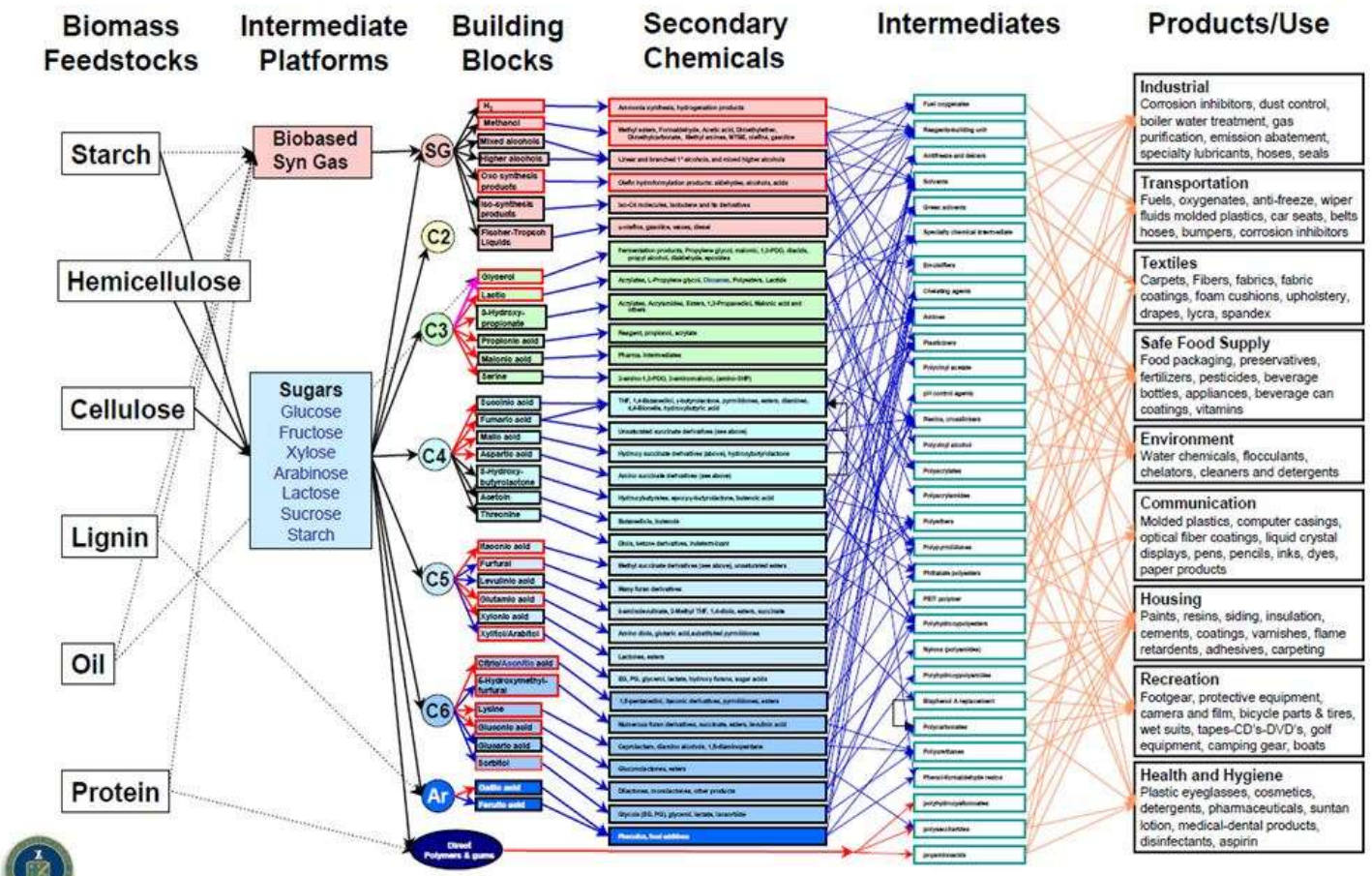
PRODUCTS

ENERGY CHEMICALS BIOMATERIALS FOOD/FEED

BIDF FOCUSSED ON CHEMICAL AND BIOCHEMICAL PROCESSES

Biorefinery products

Analogous model of a biobased product flow-chart for biomass feedstocks.



IBSS
Southeastern Partnership for Integrated Biomass Supply Systems

From Top value-added chemicals from biomass report - http://www1.eere.energy.gov/biomass/pdfs/35523.pdf

Highlights: Develop new value streams from saw dust

Xylitol
(R150/kg)

Eucalyptus

Xylose

Saw dust

Cellulose nanocrystals
($1000/kg)

Pine

Pine oil
(R40-60/kg)

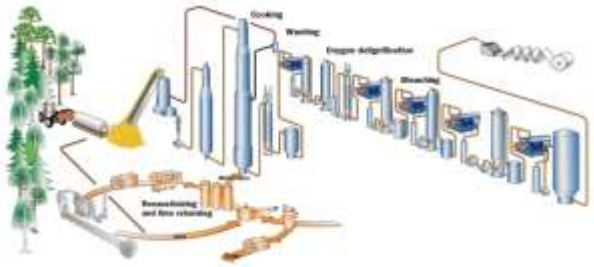
Juices

Plastics

Adhesives
Binders

Chewing gum

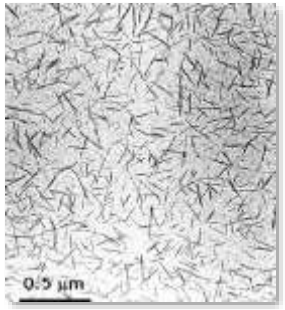
Conventional methods



Dissolving wood pulp mill
(>R20 billion)

Pulp

($1200/ton)



CNC

Yield of CNC = 15%

BIDF technology

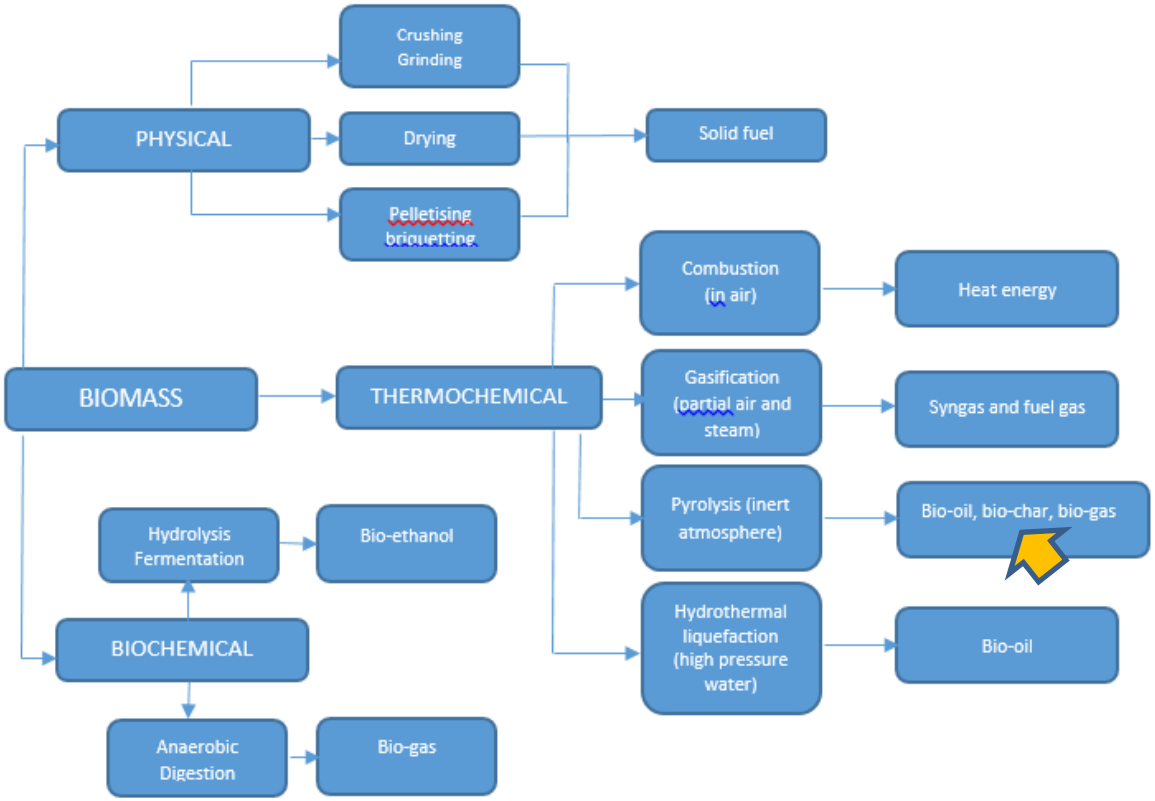
Waste

(Free)

Biomass waste

Yield of CNC = 40%

Biochar production is an advanced science



Schematic of biomass to bio-energy conversion pathways (Sharma et al. 2015)

Production of Biochar

Anyone can produce charcoal or biochar but need to use kilns that use after-burning to reduce emissions

- The US EPA states that afterburning is estimated to reduce PM, CO and Volatile Organic Compounds (VOC) emissions by at least 80%.

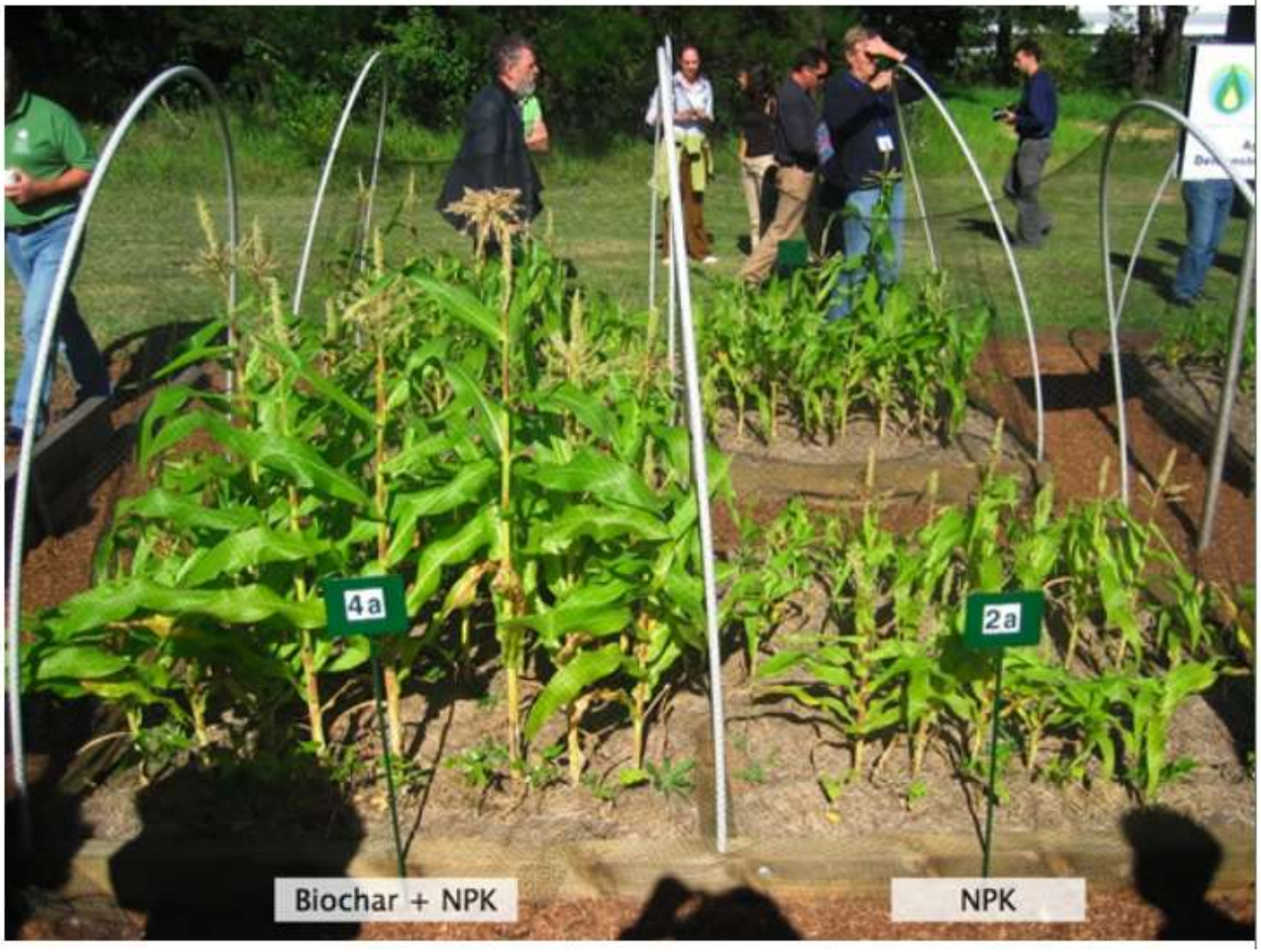
For small scale it is more important to:

- Keep pyrolysis activities away from neighbour
- Pay attention to the predominant wind direction
- Ensure that there are firebreaks

Effect of Biochar

Biochar with NPK fertilizer compared to plain soil.

Effect of Biochar



Effect of Biochar

Biochar without fertilizer compared with plain soil.

Positive effects of biochar

Vita Soil Trials 2018				Maize R/Ton		
					R2 000	
Farmer		Yield	Yield Inc	% Control	Value	ROI
Williamson	Surface	8,337	1,2	116,5%	R2 361	3,3
	Buried	8,188	1,0	114,4%	R2 065	2,9
	Control	7,156	0,0	100,0%	R0	0,0
Mortlock	Surface	12,55	0,6	105,2%	R1 230	1,7
	Control	11,93	0,0	100,0%	R0	0,0
Hope	Surface	8,67	1,7	124,1%	R3 371	4,7
	Buried	8,677	1,7	124,2%	R3 384	4,7
	Control	6,985	0,0	100,0%	R0	0,0
Stein	Surface	13,2	0,7	105,6%	R1 400	1,9
	Buried	14	1,5	112,0%	R3 000	4,2
	Control	12,5	0,0	100,0%	R0	0,0
Combined	Surface	10,69	1,05	112,8%	R2 090	2,90
	Buried	10,29	1,41	116,9%	R2 816	3,91
	Control	9,64	0,00	100,0%	R0	0,00

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Effect of biochar

Left = 10 years HPG
Right = Conventional

- Effective Soil Depth 3-4 x deeper
- Soil Fertility (Most Nutrients >50% higher)
- Carbon = 413% higher at 30-40cm
- Water Holding Capacity (WHC) Double+
- Water Infiltration Rate 10-16x faster
- Rainfall Effectiveness 90-95%+ vs ?50%
- Water Reservoir
  - 2x WHC
  - x 2-3x deeper
  - X 2x RF effectiveness
  - = 8-12x larger

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Thank you!