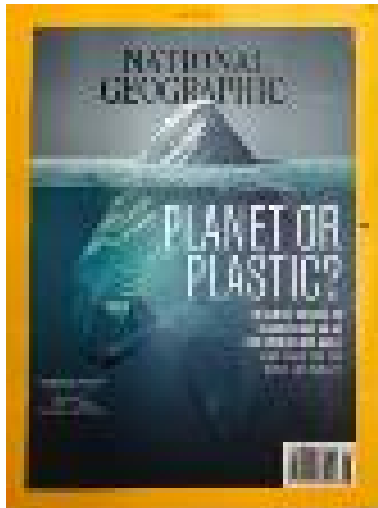


# TECHNOLOGY to CONVERT WASTE to VALUE

Bram van der Drift

8 October 2019, TCBiomass<sup>plus</sup>, Chicago



ever intended to keep. In 1955 *Life* magazine celebrated the liberation of the American housewife from drudgery. Under the headline "nowaway Living," a photograph showed a lady flinging plates, cups, and cutlery into

Production of plastic has come at a breakneck pace: Virtually half of the plastic ever manufactured has been made in the past 15 years.

The items would take 40 hours to clean, the text noted—"except that no housewife need bother." When did plastics start to show their dark side? You might say it was when the junk in their photo hit the ground.

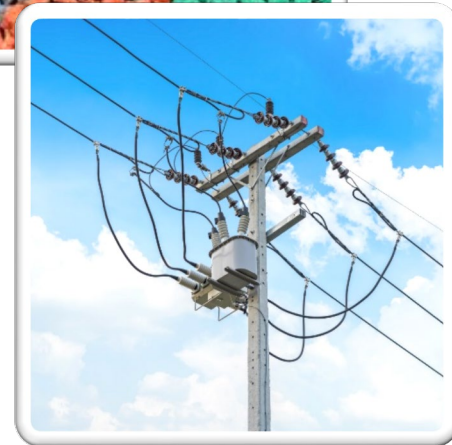
And decades later, roughly 50 percent of the

chemical engineering professor at Michigan University who also works in his native India. "You still would not make a dent on the plastic released into the oceans. If you want to do something about this, you have to go there, to the countries, and deal with the mismanaged waste."

THE PASIG RIVER ONCE FLOWED majestically through downtown Manila, capital of the Philippines, and emptied into pristine Manila Bay. It was a treasured waterway and civic point of pride. It's now listed among the top 10 rivers in the world that convey plastic waste to the sea.



# LOW-VALUE FEEDSTOCK to HIGH-VALUE PRODUCTS



RNG  
Chemicals  
Liquids  
Power



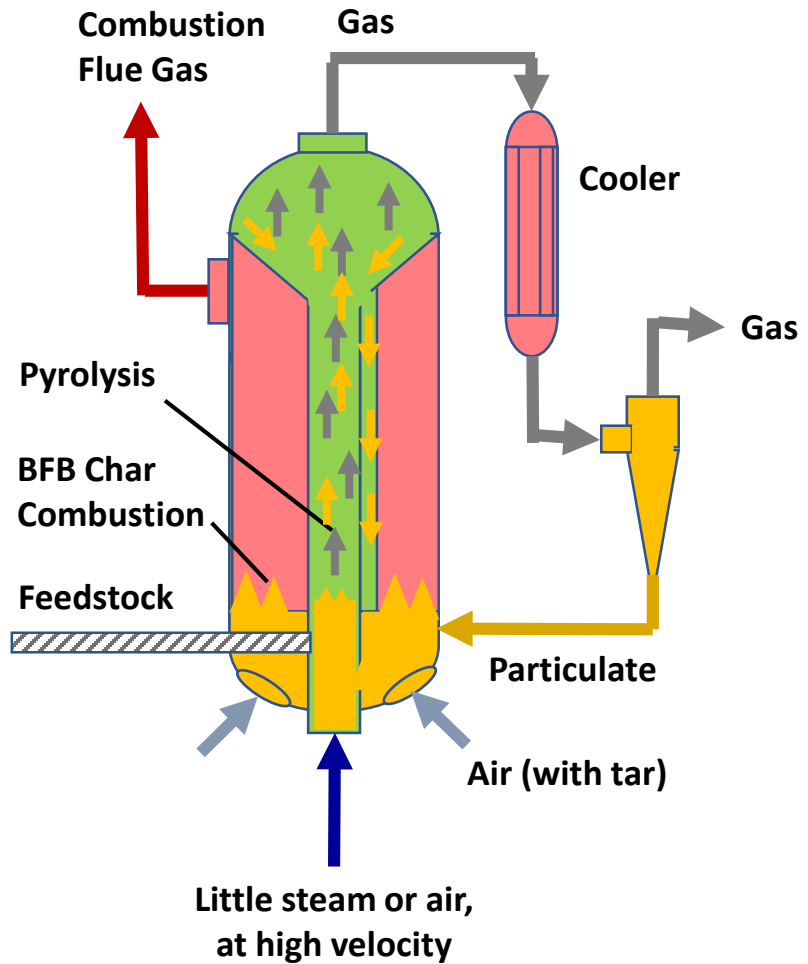
# THE PROCESS



- Devolatilization/depolymerization
- Gas is rich in hydrocarbons
- Efficient removal of tars
- Gas suitable for:
  - Boiler/kiln/furnace
  - Electricity
  - RNG via methanation
  - Chemicals without synthesis



# THE PROCESS – STEP 1



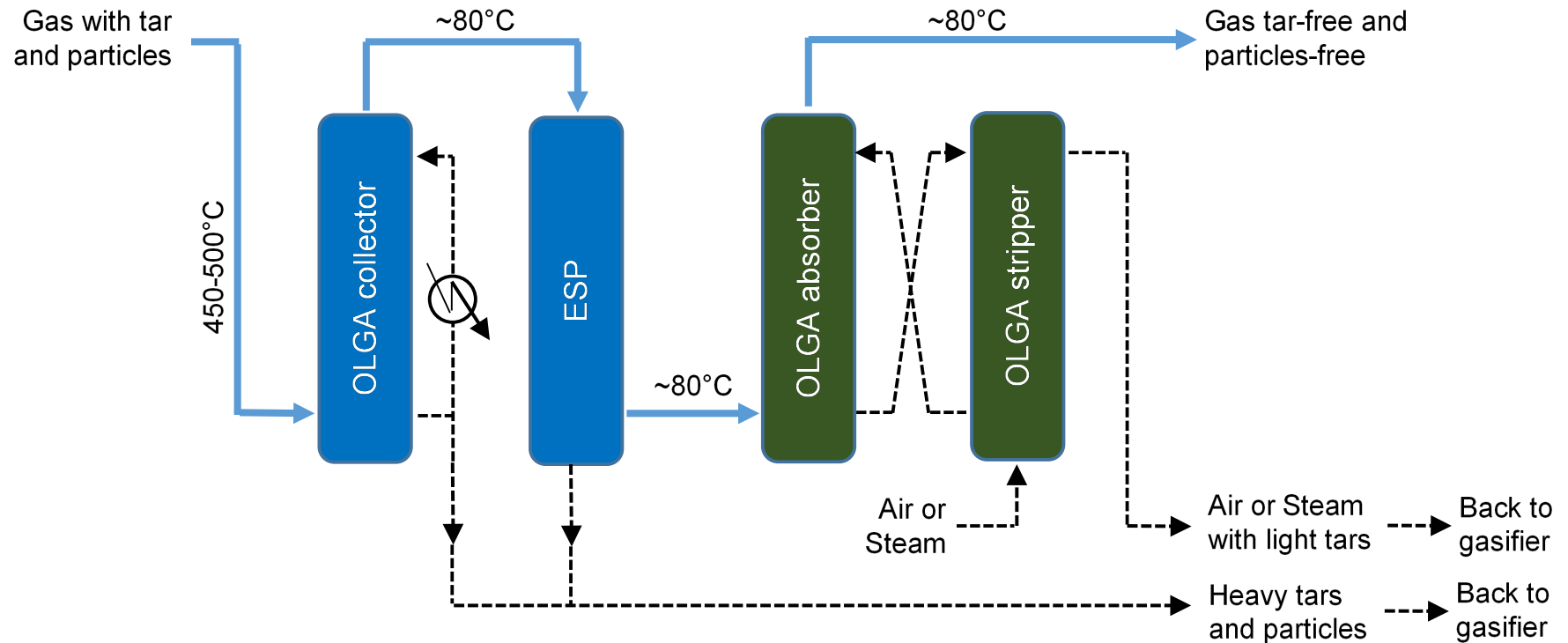
## Step 1: Solid to gas

- Devolatilization/depolymerization
- Feedstock is heated by hot sand
- Sand is heated by burning char and tar
- Gas is essentially free of  $N_2$
- Without oxygen plant

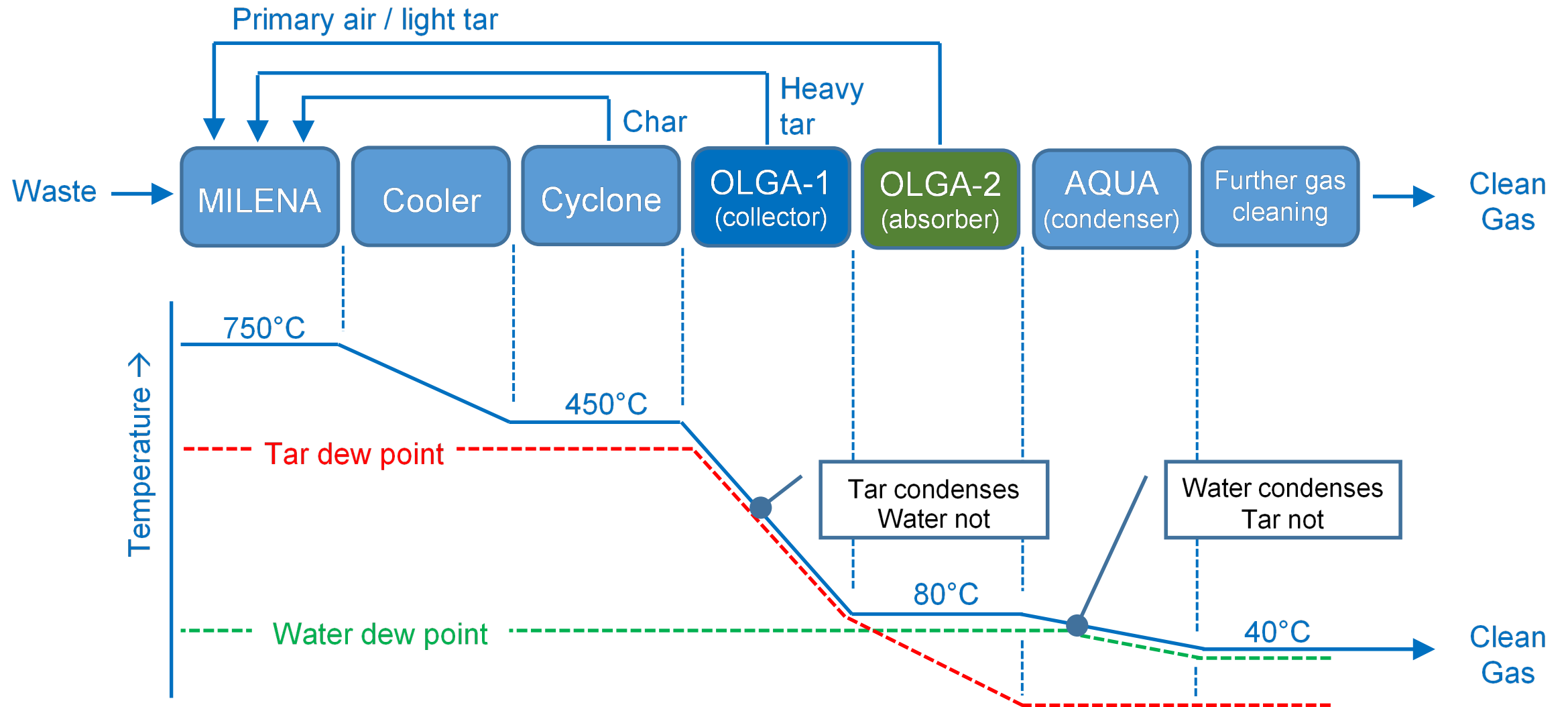
# THE PROCESS – STEP 2

## Step 2: Cleaning the gas

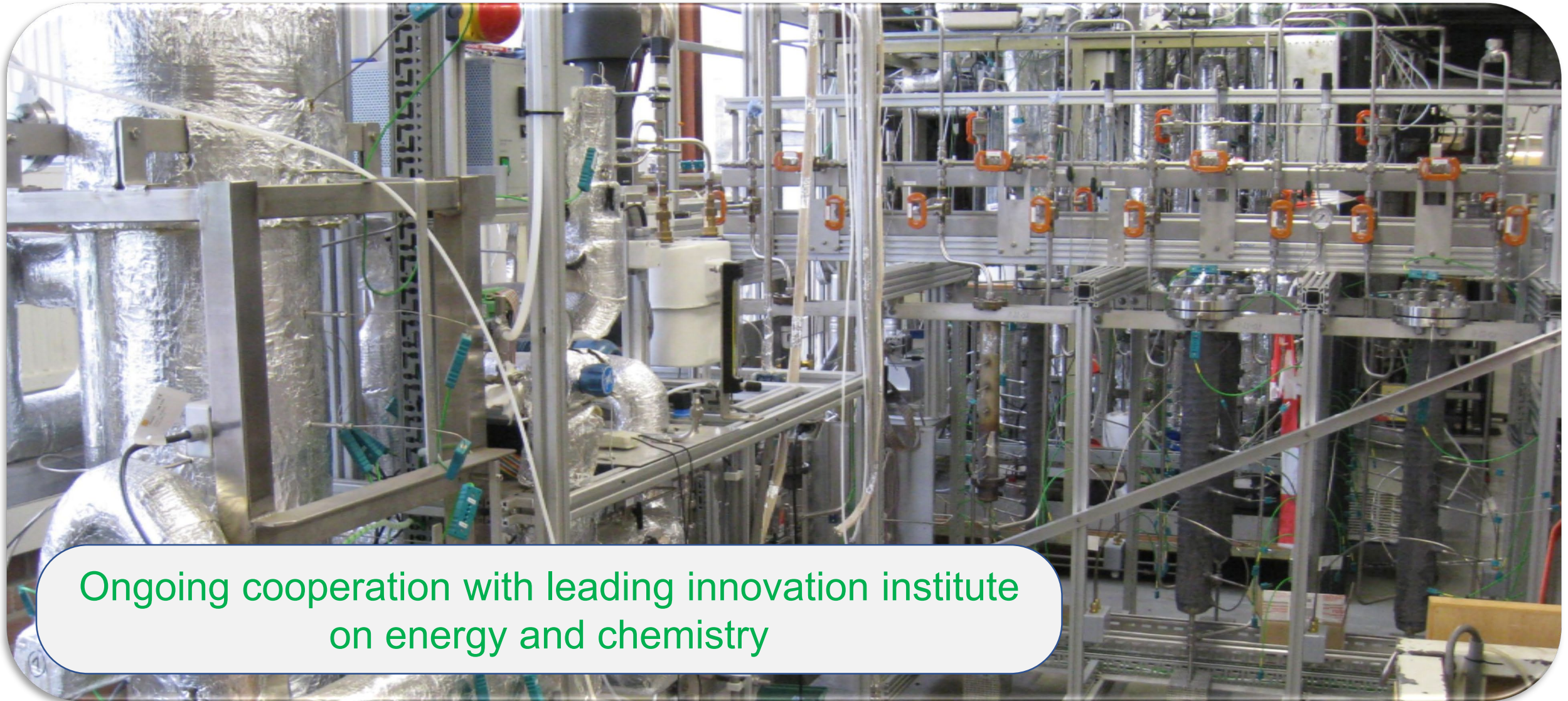
- Condensation of heavy tar
- Absorption of light tar
- Chemicals can be harvested



# THE THING with DEW POINTS



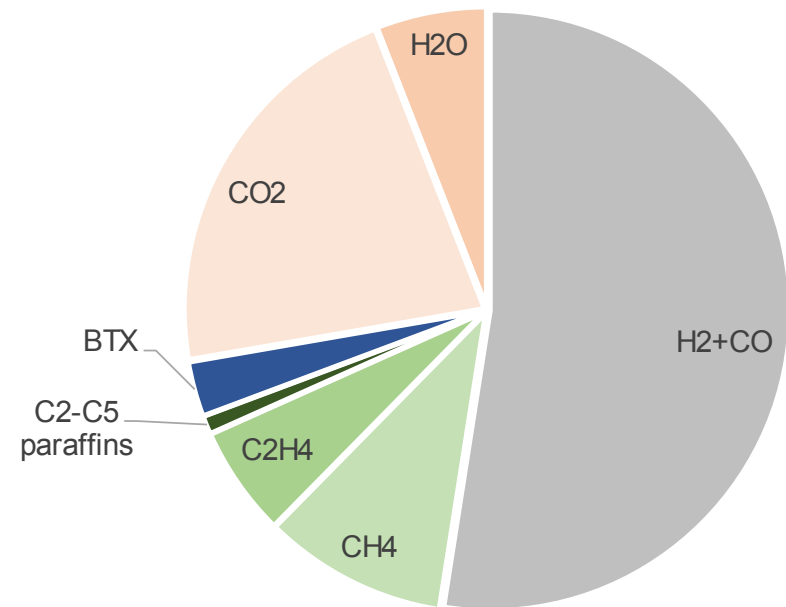




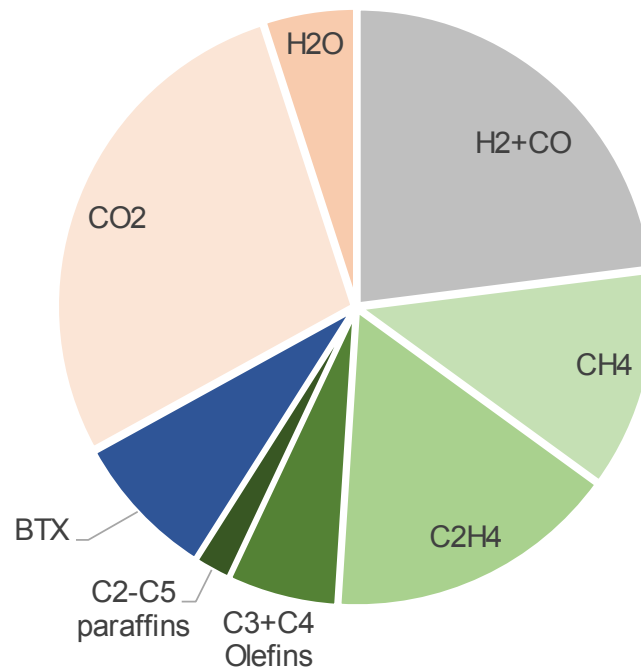
Ongoing cooperation with leading innovation institute  
on energy and chemistry

# THE GAS (mass%)

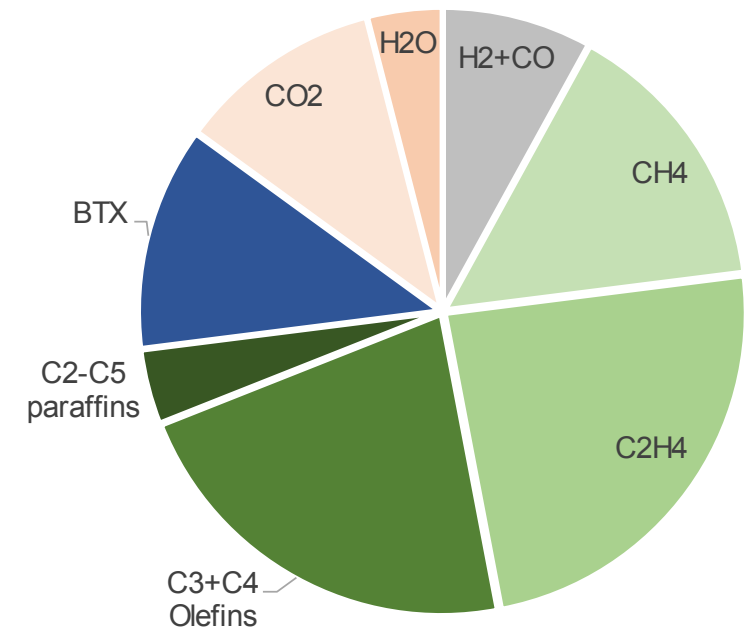
WOOD [wt%]



RDF (WOOD/PLASTIC) [wt%]

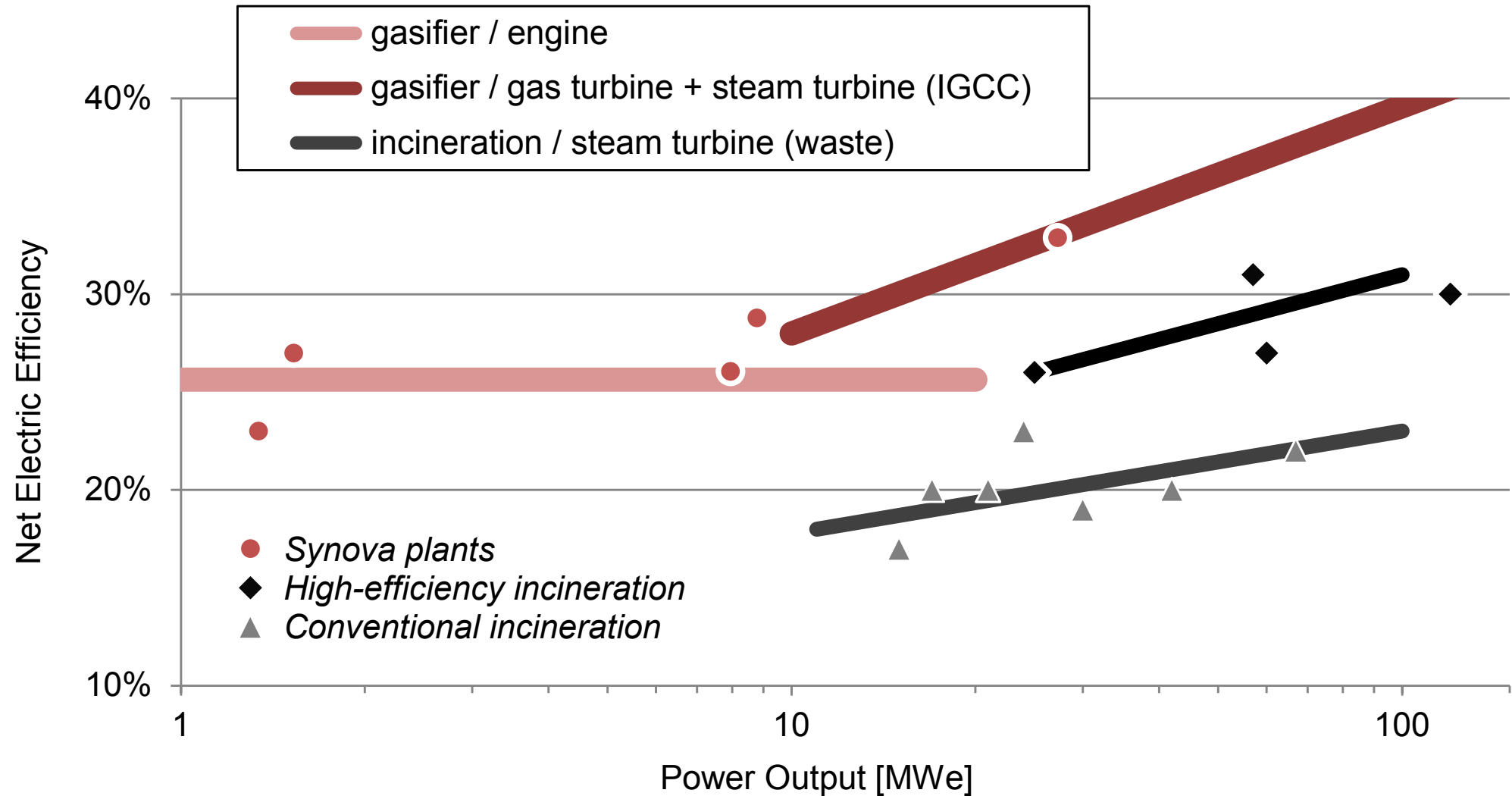


MIXED PLASTICS [wt%]





# ELECTRICITY with HIGH EFFICIENCY



# HIGH EFFICIENCY – SMALL FOOTPRINT

- Modularized unit for 25-30 tonnes/day
- Pre-assembled
- Footprint <1000 m<sup>2</sup>
- Short delivery time
- Larger units developed for 160 and 400 tonnes/day
- Efficiency and output to power:
  - 1.5 MWe net power output
  - >24% net efficiency



# RNG: RENEWABLE NATURAL GAS (or as CNG or LNG)

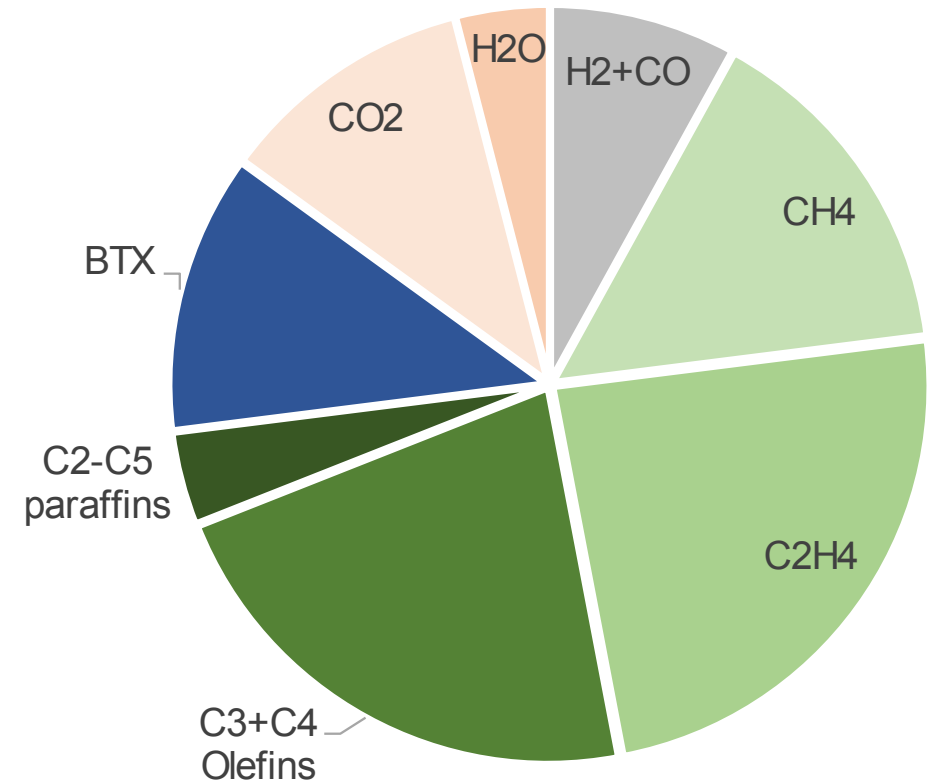


- 65-70% efficiency
- 1 tonne biomass → 350 m<sup>3</sup> RNG
- Process proven at ECN
- Validated by methanation partners

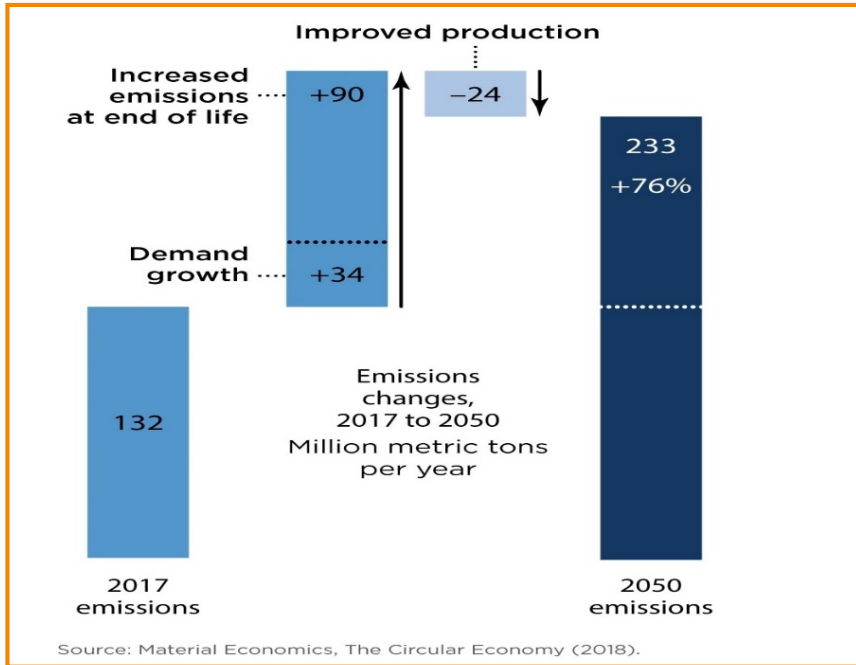


# VALUABLE CHEMICALS WITHOUT SYNTHESIS

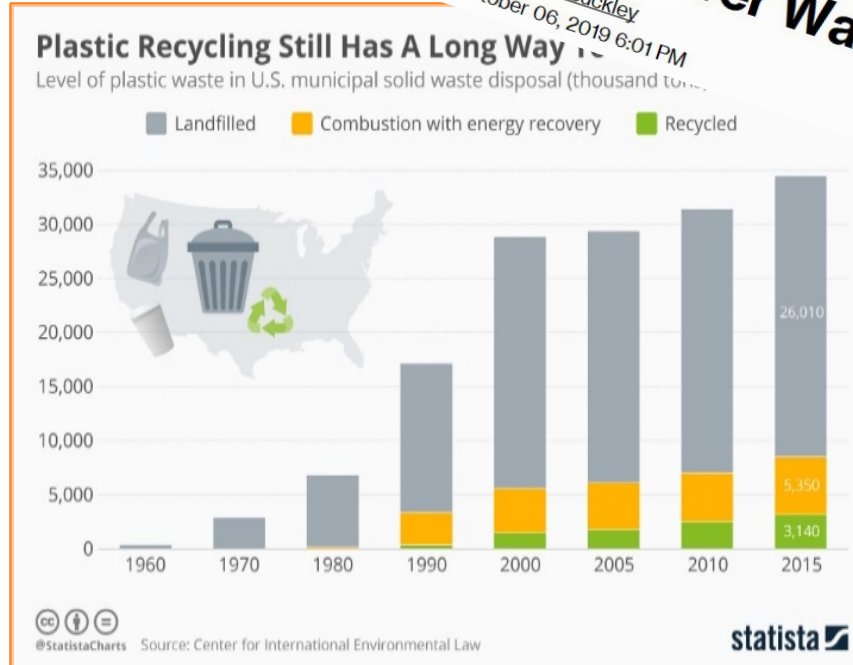
- No synthesis means cost-effective at smaller scale
- Ethylene, propylene, BTX
- Olefin aromatization for boosting BTX yield
- Plastics circularity via chemical recycling
- Adding biomass provides “renewability”



## EU Plastics Lifecycle emissions



## US Recycling



**Unilever to Halve Use of New Plastic as Upward Proclamation**

By Thomas Buckley  
October 06, 2019 6:01 PM

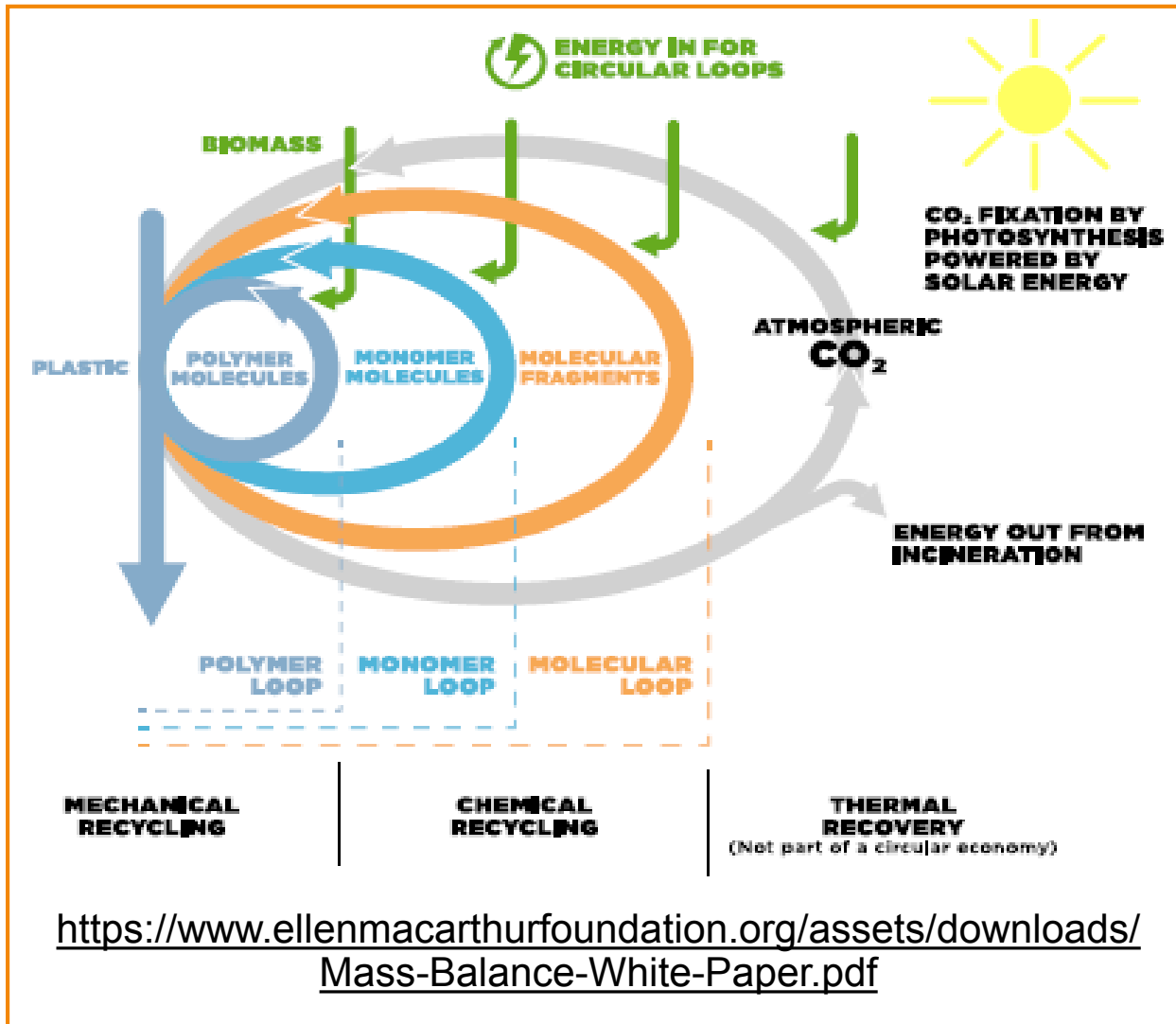
Technology

Bloomberg

Photographer: Jas

Global waste converted to chemicals, would equal 45% of all plastics production

# CONTACT



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