SL2

Impiego di Biocombustibili nei MCI

Livorno, 7 Luglio 2022

Yanmar R&D Europe
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Sommario

- Obiettivo presentazione
- La transizione ecologica in Yanmar
- Biocombustibili liquidi
- Biocombustibili gassosi
- Conclusioni

Obiettivo presentazione

Il «tema» biocombustibili

- Panorama techologico variegato
- Tema complesso
- L’obiettivo è portare esperienze concrete mie e di Yanmar

La transizione ecologica in Yanmar

Company info

YANMAR HOLDINGS CO., Ltd

Head office	1-32, Chayamachi, Kita-ku, Osaka, Japan YANMAR FLYING-Y BUILDING
Founded	March 1912 Founded as YAMAOKA HATSUDOKI KOSAKUSHO
Employees	20,744 (As of March 31, 2021)

YANMAR R&D Europe s.r.l.

Location: Firenze, Italy

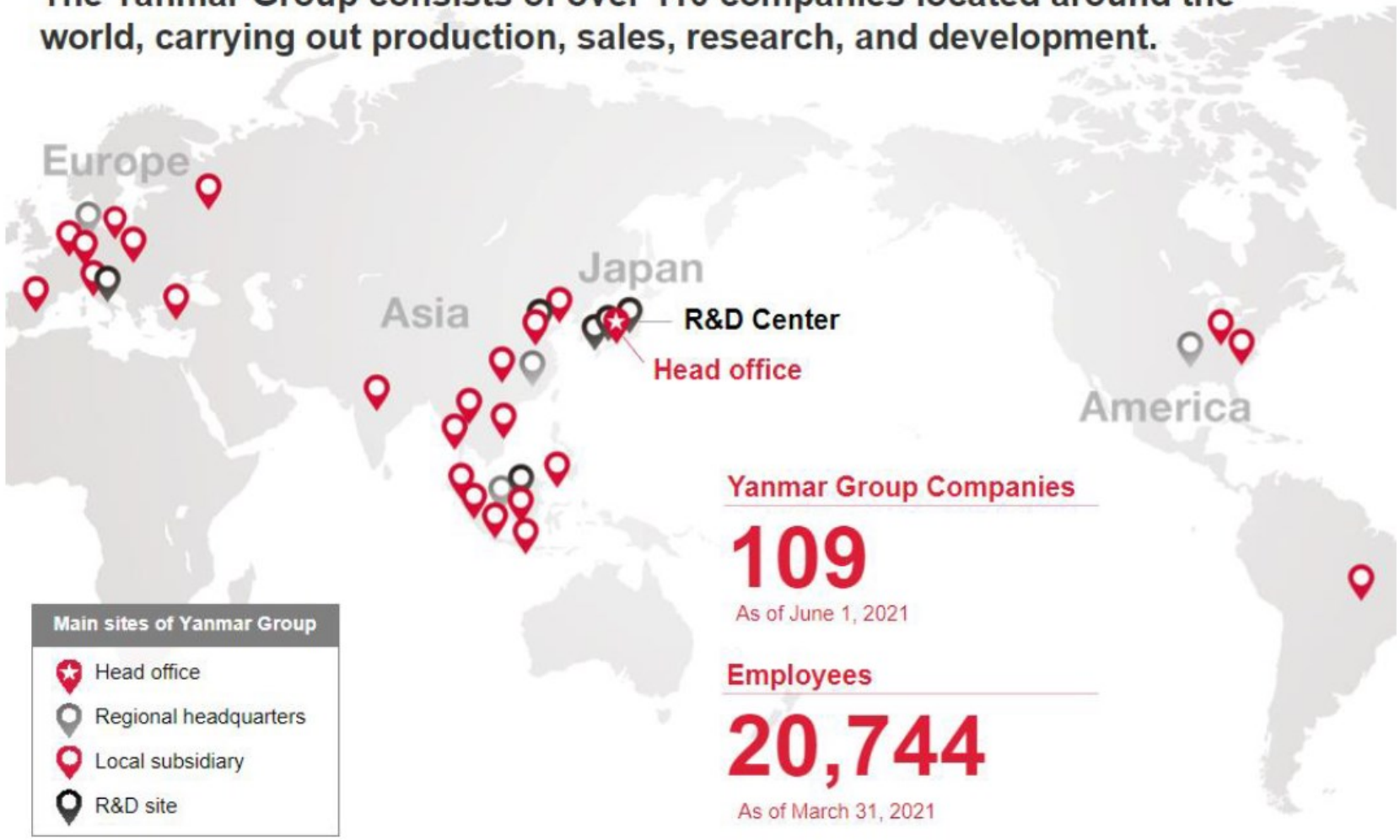
Founded: 28th Jun 2011

Number of Members: 19

- Graduated: 100%
  - ✓ With PhD: 47%
- Average age: 35

Global Network

The Yanmar Group consists of over 110 companies located around the world, carrying out production, sales, research, and development.



Yanmar Group Companies

109

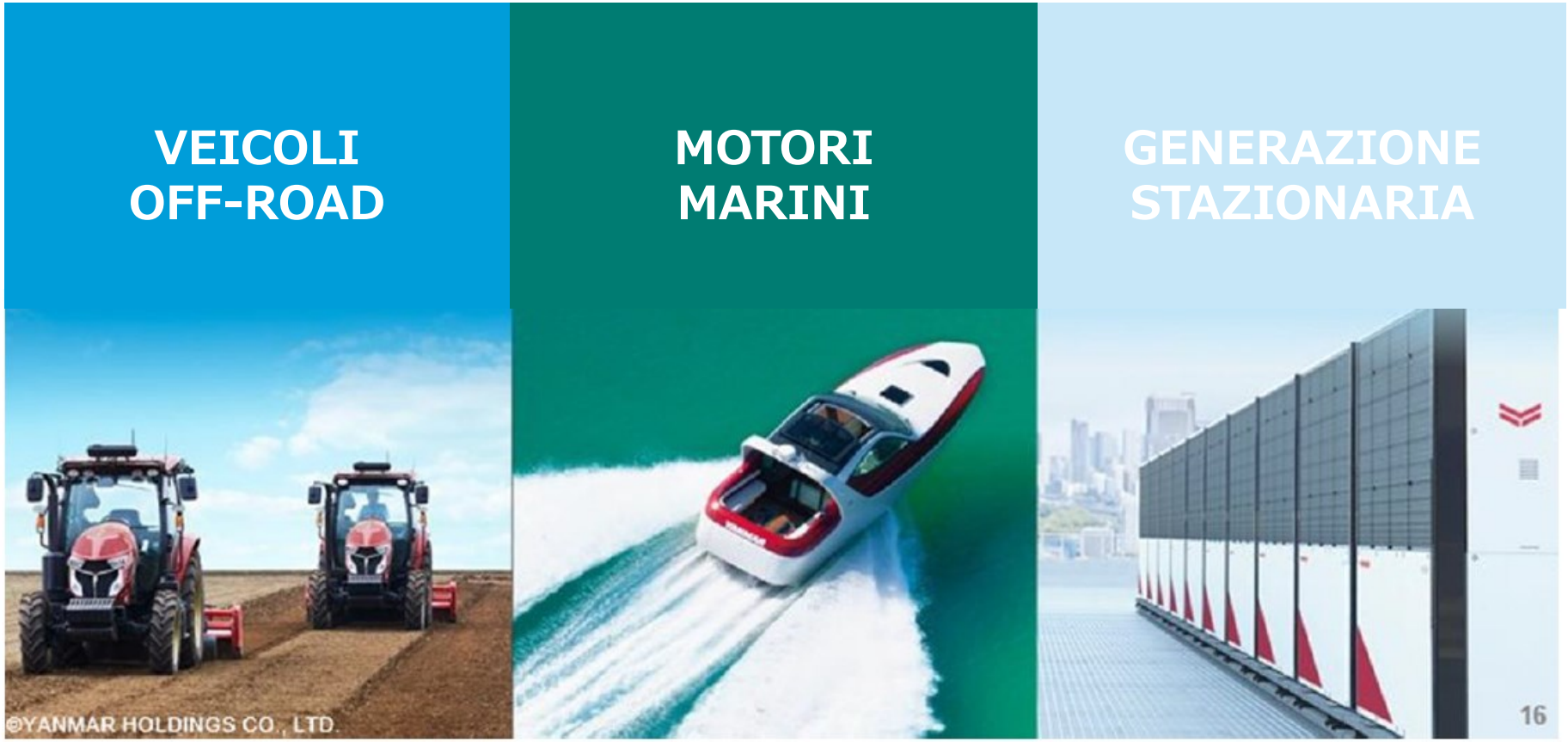
As of June 1, 2021

Employees

20,744

As of March 31, 2021

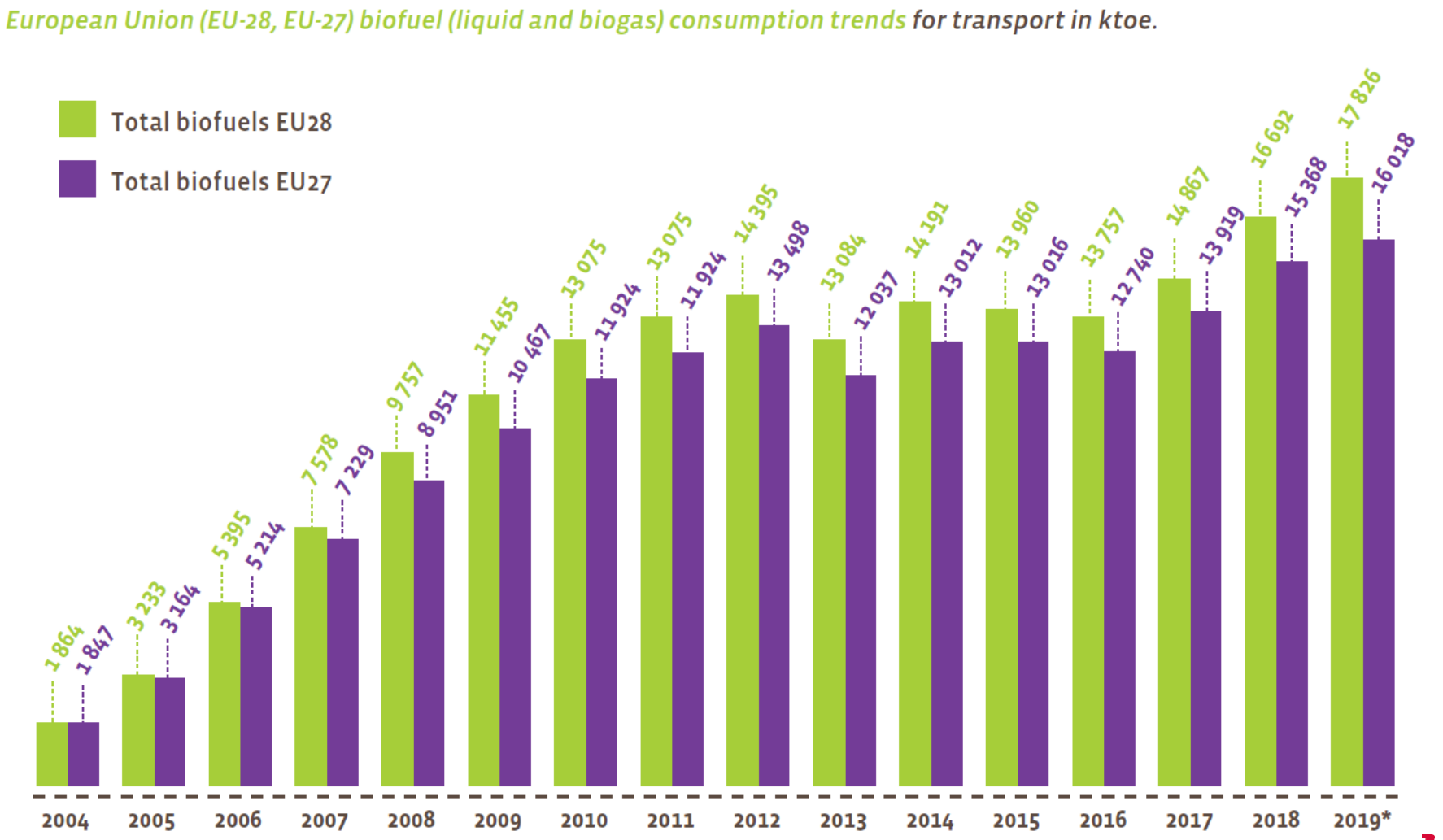
Business domains



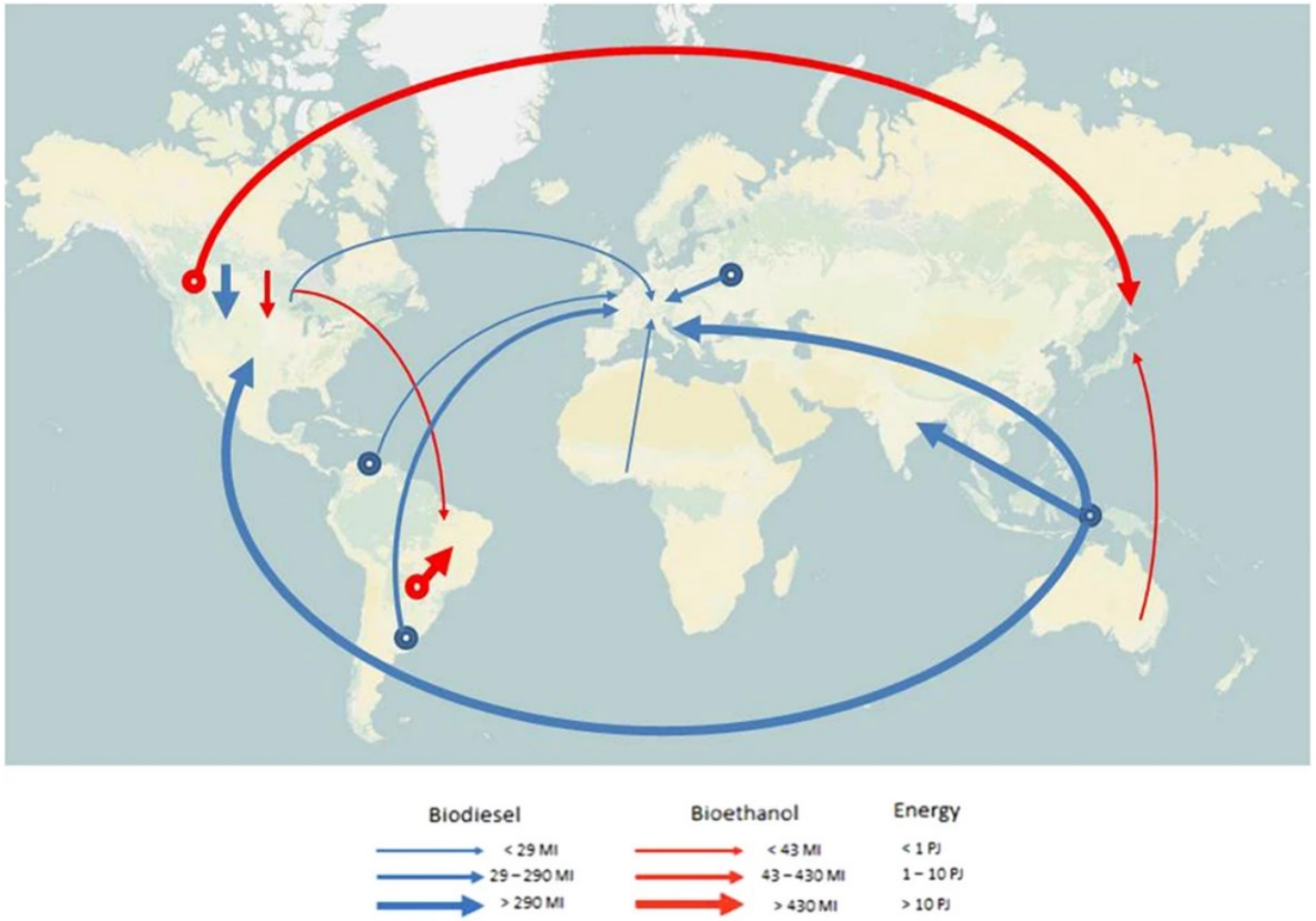
Biocombustibili liquidi

Biofuel

- Biodiesel 80,5%
- Bioetanolo 18%
- Biogas 1,5%



Present picture- Trade



Ref: Nature https://www.nature.com/articles/srep22521, 2016

4 generazioni

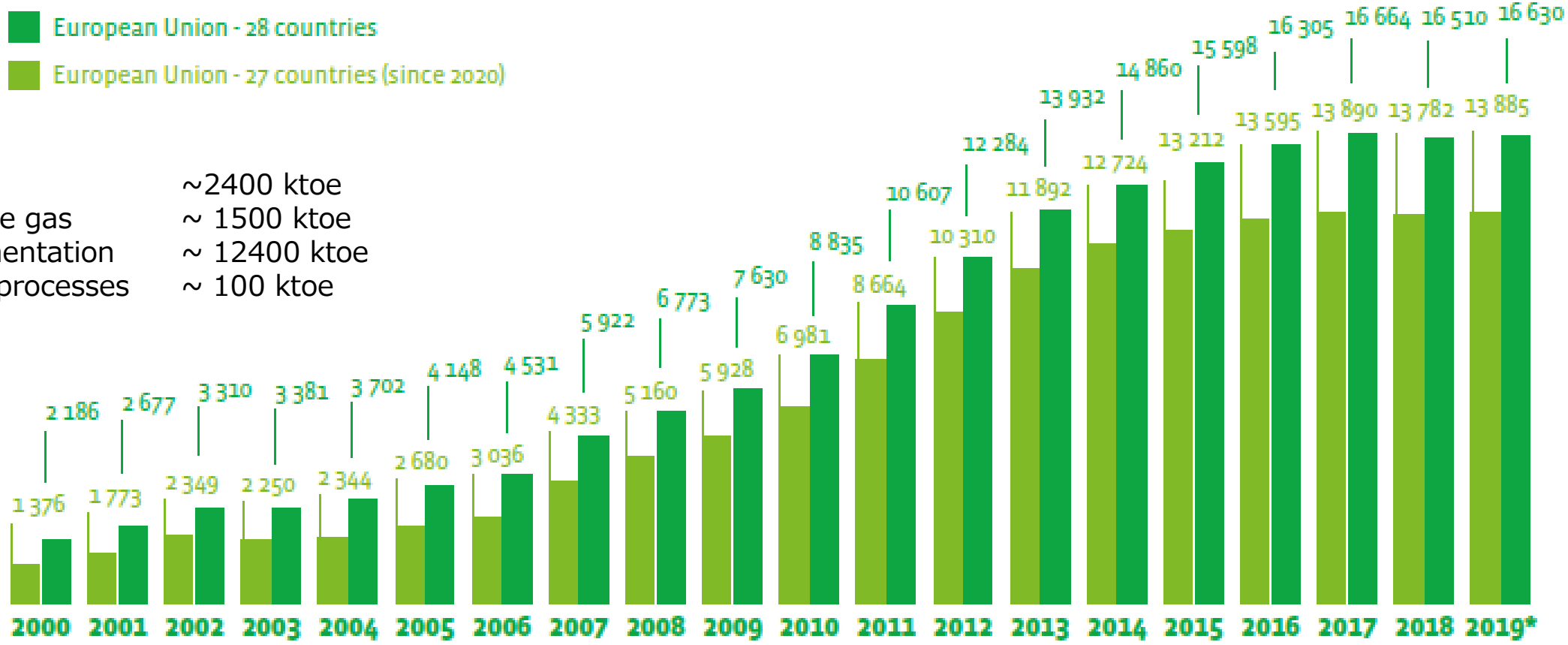
1st GEN	2nd GEN	3rd GEN	4th GEN
Made from the sugars and vegetable oils found in food crops using standard processing technologies	Production of biofuels manufactured from agricultural and forest residues and from non-food crop feedstocks	Specially engineered crops such as algae as the energy source	Uses genetically modified (GM) algae to enhance biofuel production
Corn, Rapeseed, Soybean, Palm (Ethanol Based Sugar Starch)	Agriculture/food processing waste (e.g. grasses and trees)	Transgenic Materials, Low Lignin Eucalyptus, Poplar Trees and Sorghum e.g. higher yield feedstocks and algae	NOTE: Take into account the carbon capture and storage potential on the crops used to produce the required biomass, as well as the energy efficiency of the processing technology that generates the resulting fuel
Fermentation, Transesterification	Biomass-To-Liquid (BTL), Fischer Tropsch, Fermentation, Gasification	Biomass-To-Liquid (BTL), Fischer Tropsch, Fermentation, Gasification, Algae Processing	
Bio-Alcohols, Biodiesel, Fatty Acid Methyl Ester (FAME), Unprocessed Vegetable Oil	Cellulosic Ethanol, Biogas, Biohydrogen, Fischer Tropsch Diesel	Cellulosic Ethanol, Biogas Biohydrogen, Fischer Tropsch Diesel	

Biocombustibili gassosi

- Inquadramento
- Cosa fa Yanmar su MCI
- Innovazioni da settore automotive

Biogas - Biochemical

- Landfill gas ~2400 ktoe
- Sewadge sludge gas ~ 1500 ktoe
- Anaerobic fermentation ~ 12400 ktoe
- Other thermal processes ~ 100 ktoe



Source: EurObserv'ER 2020

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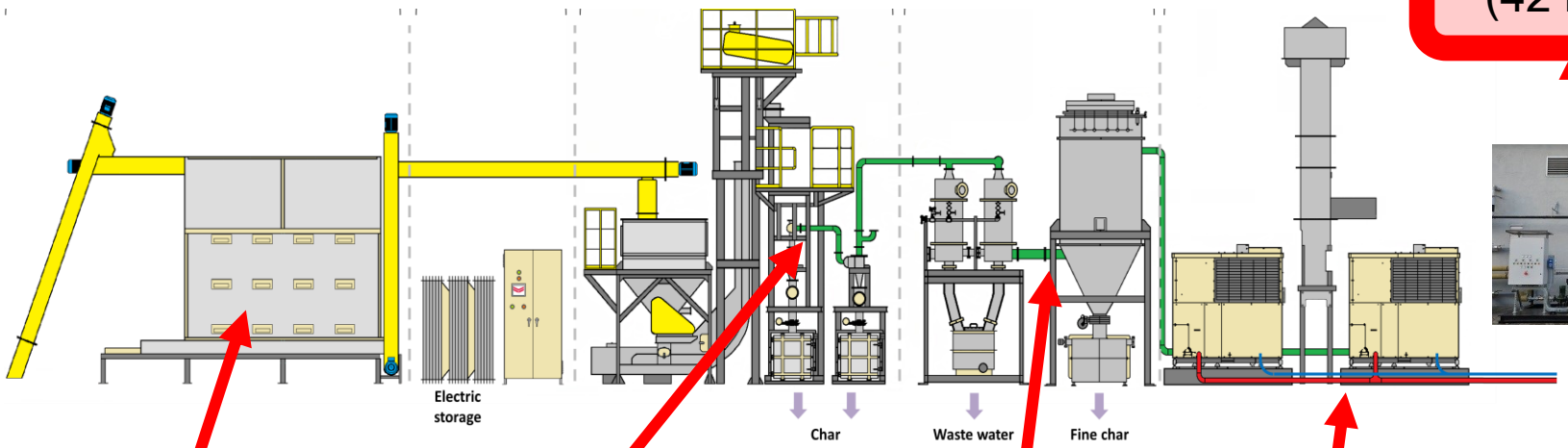
Gassificatore in Yanmar Italy (Varese)



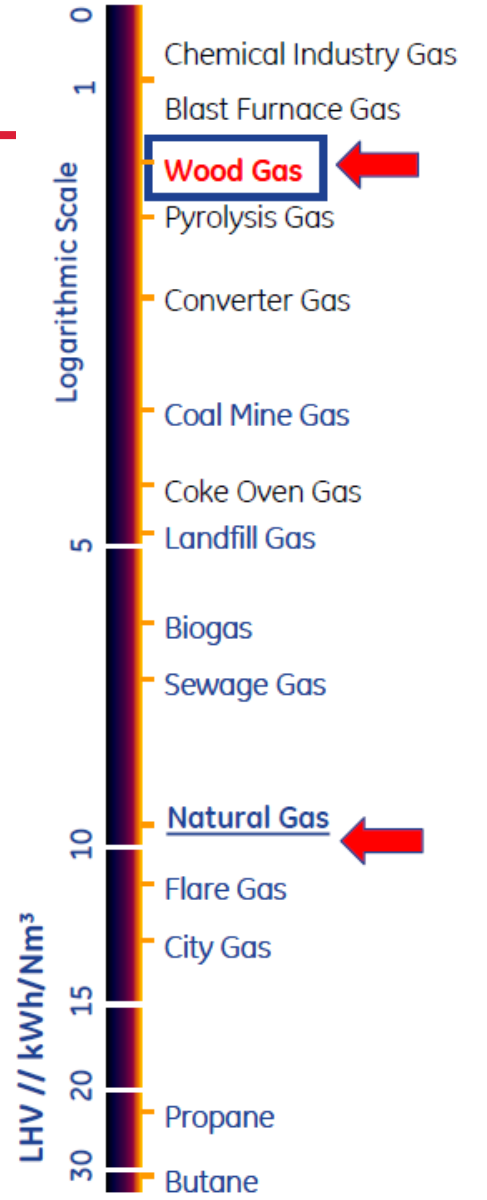
Absorption chiller (42 kW_f)

Wood chips dryer

Fixed bed Reactor - ≈47 kg/h

Gas purification unit - 126 Nm^3/h

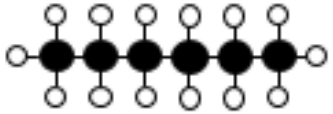
2 X YANMAR CP25VB3Z (40 kW_e, 66 kW_{th})



Il tar (catrame)

WHAT

Tar is a mixture of more that 100,000 hydrocarbons. All hydrocarbon with molecular mass higher than Benzene (C_6H_6) are included in tar



Example of long chain Hydrocarbon

WHEN

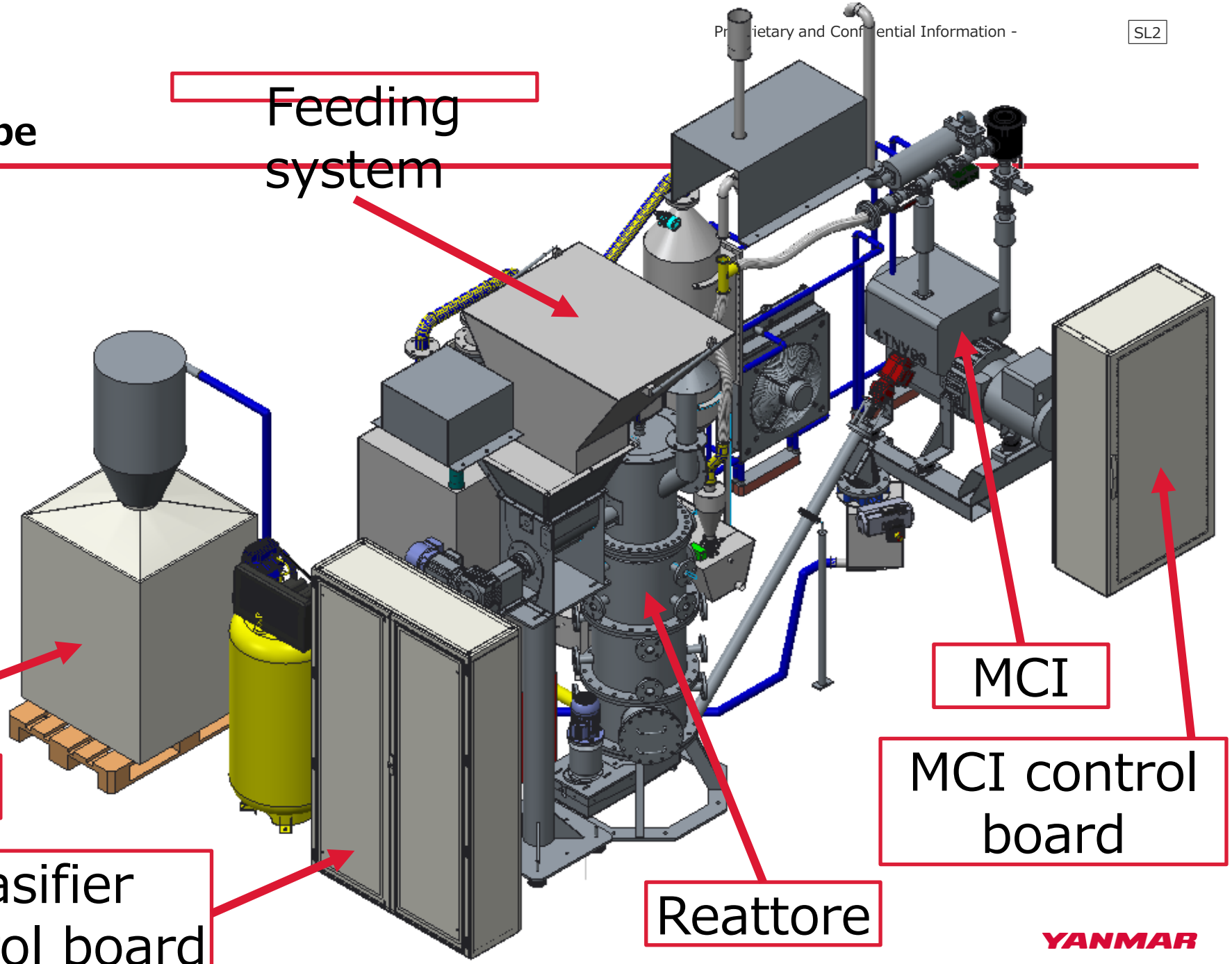
Tar is **unavoidable** in wood gas from gasifiers (always present)

WHERE

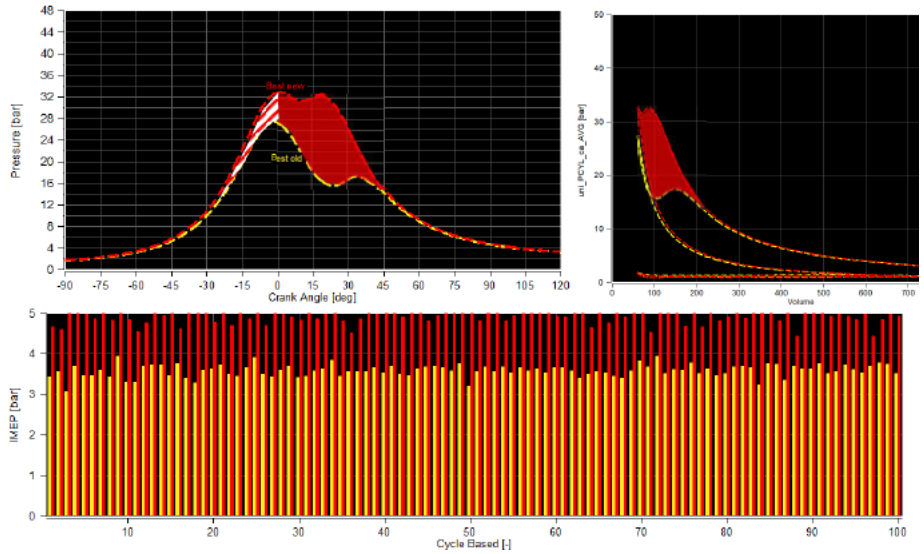
Tar condenses at very high Temperatures (~350°C) and damage all **cold surfaces** of the system (decrease system reliability)

Gassificatore prototype

- 20kg/h
- 20kWe/40kWth
- Biocombustibile solido legnoso



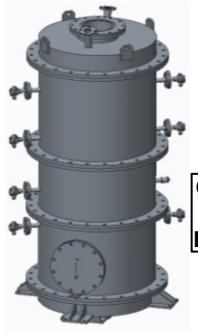
Modifiche al Yanmar 4TNV98-IGECS



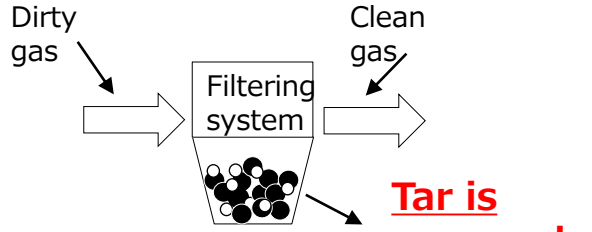
Indicated efficiency +38%

Come sfruttare in maniera innovativa il know how automotive?

STATE OF ART

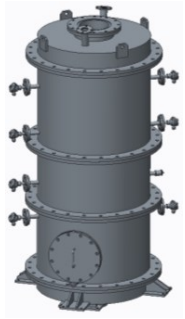


CYCLONE DUST REMOVAL → COOLER → BAG FILTER → SCRUBBER → BIOFILTER → BAG FILTER → ***POWER PRODUCTION***



Tar is removed physically

MIT IDEA

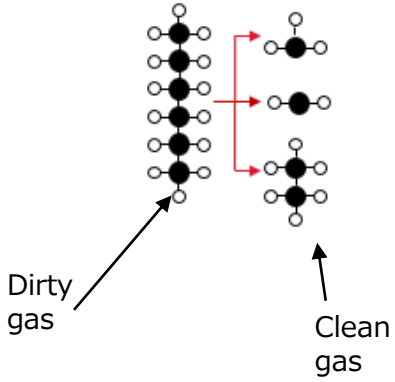


CYCLONE DUST REMOVAL → CLEAN UP GAS → COOLER TBD → ***POWER PRODUCTION***

MCI per pulizia gas

Catalizzatore automotive

MCI per produzione potenza



Tar is broke down into smaller chains (permanent gas)

Conclusioni

Conclusioni

- Non ancora chiara la via maestra
- Limiting factor (comune a tutti I biocombustibili)
- Molte opportunità