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LIFE CYCLE ASSESSMENT OF POWER-TO-LIQUID FUELS: A LITERATURE REVIEW

POLITECNICO MILANO 1863

AWARE – Assessment on WAste and REsources

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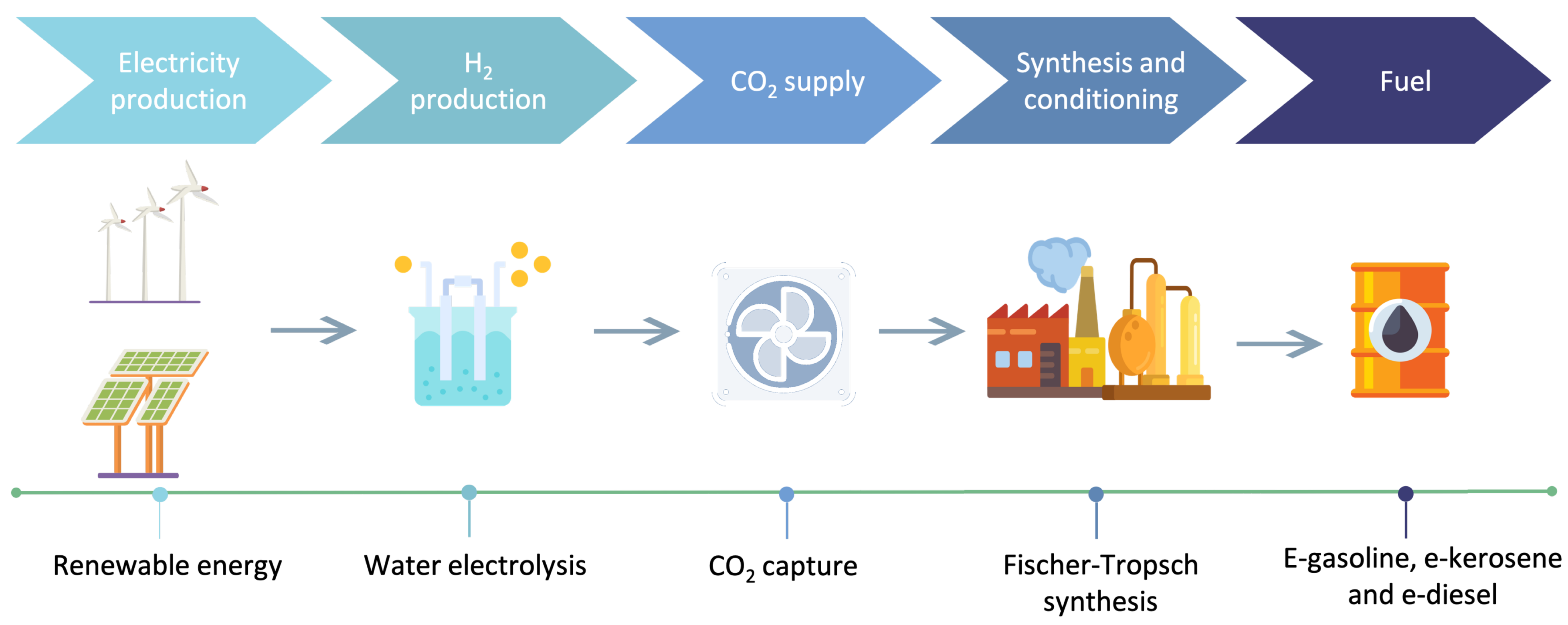
INTRODUCTION AND OBJECTIVE

New promising non-fossil based fuels are emerging: ***e-fuels***.

These show properties similar to their fossil counterparts, but are synthesised by combining H_2 and CO_2 through **highly energy-intensive** processes.

→ *to be a potential decarbonisation solution, the energy used must be renewable*

GOAL: review of LCA studies focusing on **drop-in** e-fuels produced via Fischer-Tropsch synthesis for the **transportation** sector.



MATERIALS AND METHODS

Ref.	Goal	Functional unit (related to)	System boundary	Multi-functionality	LCIA methodology	Impacts (other than CC[d])	Endpoint level impacts	Source of background data	Sensitivity analysis
[1]	evaluation	mass and energy	WtW[a]	allocation	EIO-LCA	no	no	literature	yes
[2]	comparison	mass	CtG[b]	allocation	ReCiPe 2016	yes	yes	ecoinvent v.3.5	no
[3]	comparison	energy	WtW[a]	allocation	ReCiPe 2016	yes	no	ecoinvent v.3.7.1	yes
[4]	comparison	mass	CtG[b]	system expansion	ReCiPe 2016	yes	yes	ecoinvent v.3.5	no
[5]	comparison	energy	WtW[a]	allocation	CML 2001	yes	no	GaBi database	yes
[6]	comparison	energy	WtW[a]	n.s. [c]	GREET	no	no	GREET 2022	no
[7]	evaluation	energy	WtW[a]	allocation	ReCiPe 2016	yes	no	ecoinvent v.3.6	yes

[a] WtW = Well-to-Wheel analysis; [b] CtG = Cradle-to-Gate analysis; [c] n.s. = not specified; [d] CC = climate change impact category.

METHODOLOGICAL CHOICES

TECHNICAL PARAMETERS

			Power source				Electrolysis technology			CO_2 source			
												Air	
Ref.	Product	Location	PV [a]	Wind	Nuclear	Grid mix [b]	AEL [c]	PEMEL [d]	SOEL [e]	Ind [f]	Biog [g]	Ads [h]	Abs [i]
[1]	e-diesel	CA				X	X						X
[2]	e-gasoline	GB		X				X	X	X			
[3]	e-kerosene	SE				X	X	X			X		
[4]	e-diesel	GLO	X	X	X	X		X		X			X
[5]	e-kerosene	DE	X	X		X		X	X			X	X
[6]	FT-fuel	US			X				X		X		
[7]	e-kerosene	GB		X			X					X	

[a] PV = photovoltaic system; [b] Share of renewable energy in the grid mix: [1] = 95%, [3] = 66%, [4] = 25%, [5] = 31%;
[c] AEL = alkaline electrolyser; [d] PEMEL = proton exchange membrane electrolyser;
[e] SOEL = solid oxide electrolyser ; [f] Ind = industrial CO_2 source; [g] Biog = biogenic CO_2 source;
[h] Ads = adsorption-based Direct Air Capture (DAC); [i] Abs = absorption-based DAC.

CONCLUSIONS

E-fuels' potential to reduce climate change is mainly affected by **electricity carbon intensity**

multiple impact categories must be considered to fully understand their effects on human health, ecosystems and resources

→ *overall environmental benefits of e-fuels over fossil fuels can't be unequivocally stated*

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