Valorizzazione di biomasse residuali nella produzione di intermedi (biofeedstock) per impieghi in ambito energetico e chimico

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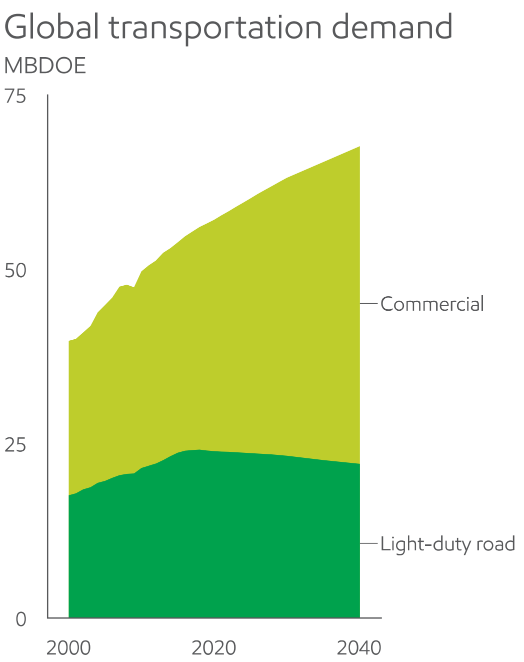
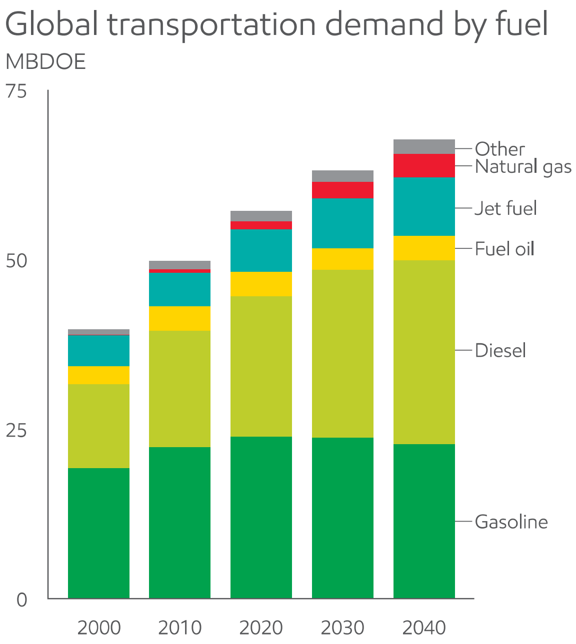
Napoli (Italy)

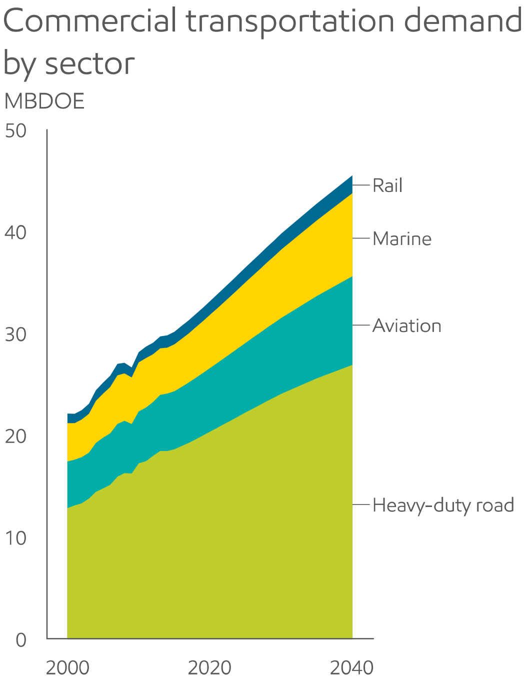
ASSOCIAZIONE ITALIANA PER LA RICERCA INDUSTRIALE

Tecnologie innovative per il recupero e riciclo di prodotti e materiali nell'ambito dell'Economia Circolare – 24 maggio 2018 - ROMA

Transportation fuels: fabbisogno attuale e proiezioni

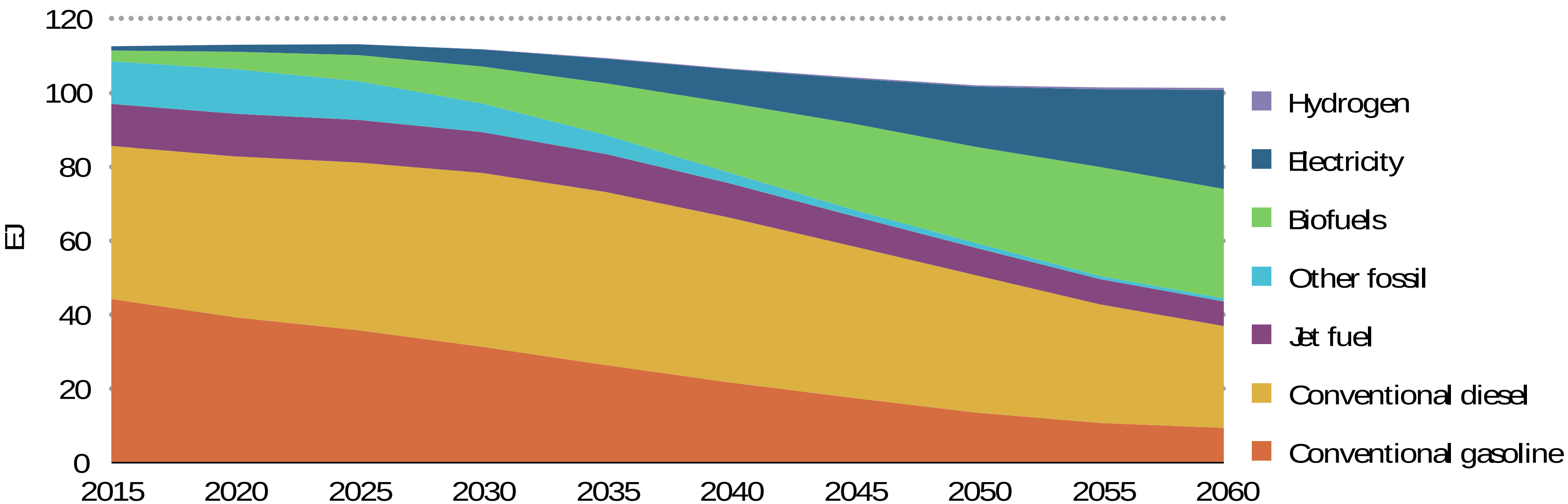






Fonte: Exxon

Figure 9: Transport final energy demand in the 2DS

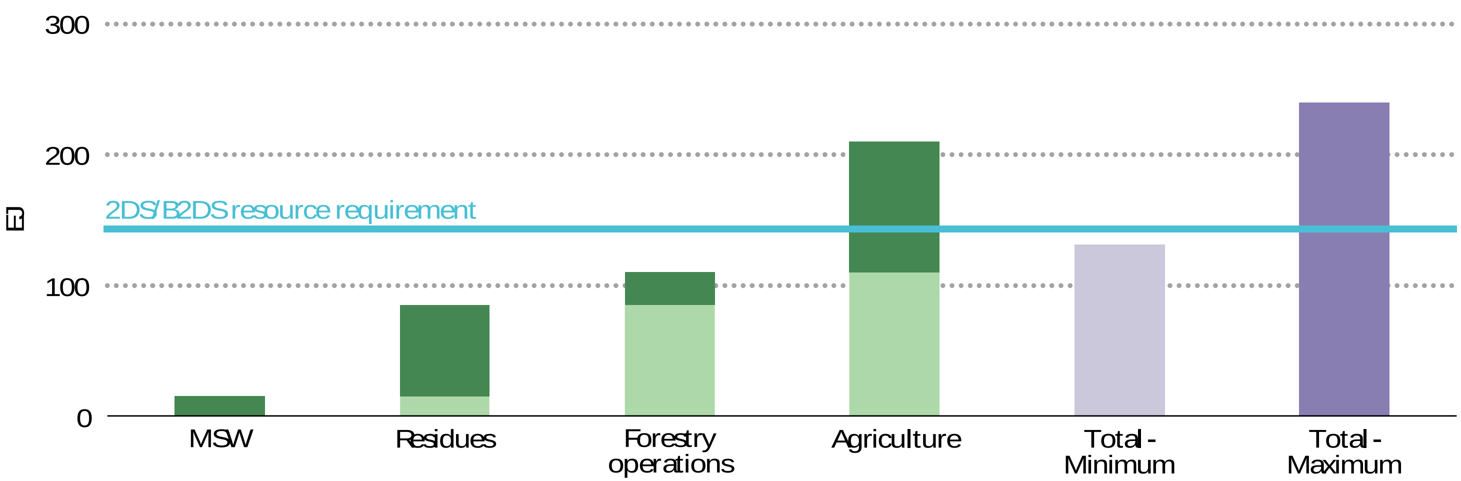


Fonte: IEA

Table 8: Summary of sustainable biomass resources

Bioenergy resource	*Conditions for sustainability*	*Potential in 2060 (EJ)*
Municipal wastes	Taking account of the waste management hierarchy, which favours waste prevention and minimisation and recycling, and evolution of waste management systems in economies as they develop.	10-15
Agricultural wastes, residues and processing residues from wood and agro-industry	Respecting the need to reserve some of the available resource for animal feed and to leave sufficient residues in the field for soil protection, and consistent with other uses.	46-95
Wood harvesting residues co-products	Used within the context of a sustainable forestry plan, which takes carbon aspects fully into account, along with measures to maintain other forest characteristics including biodiversity.	15-30
Agriculture	Produced on land in ways which do not threaten food availability and whose use leads to low land use change emissions, and subject to a positive assessment on other sustainability indicators such as biodiversity and water availability and quality. Crop or forestry production on degraded and derelict land linked to attempts to afforest, reforest or otherwise improve the quality of these areas.	60- 100

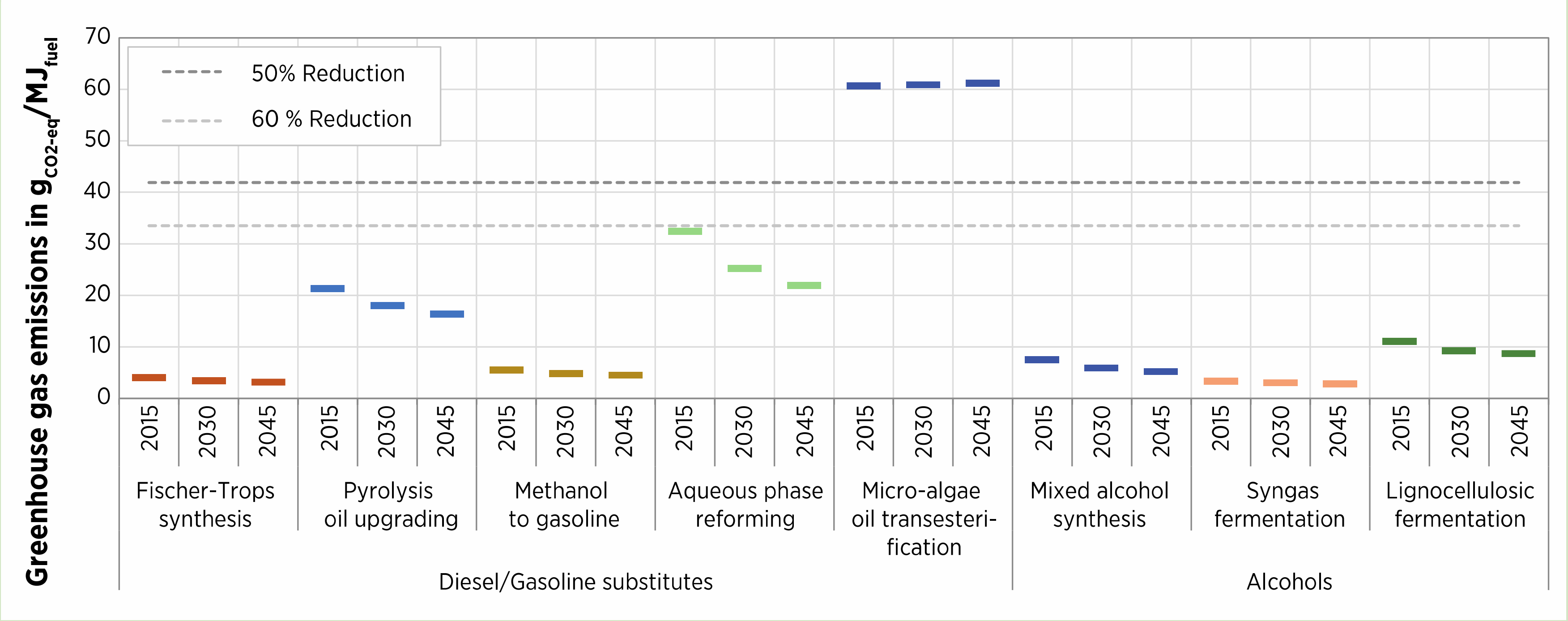
Fonte: IEA


300
200
100
0
2DS/B2DS resource requirement
MSW
Residues
Forestry operations
Agriculture
Total - Minimum
Total - Maximum

Fonte: IEA

Le esternalità ambientali: GHG

Figure 28: GHG emissions of advanced biofuel pathways and their emissions reduction compared to fossil fuel



Fonte: IRENA

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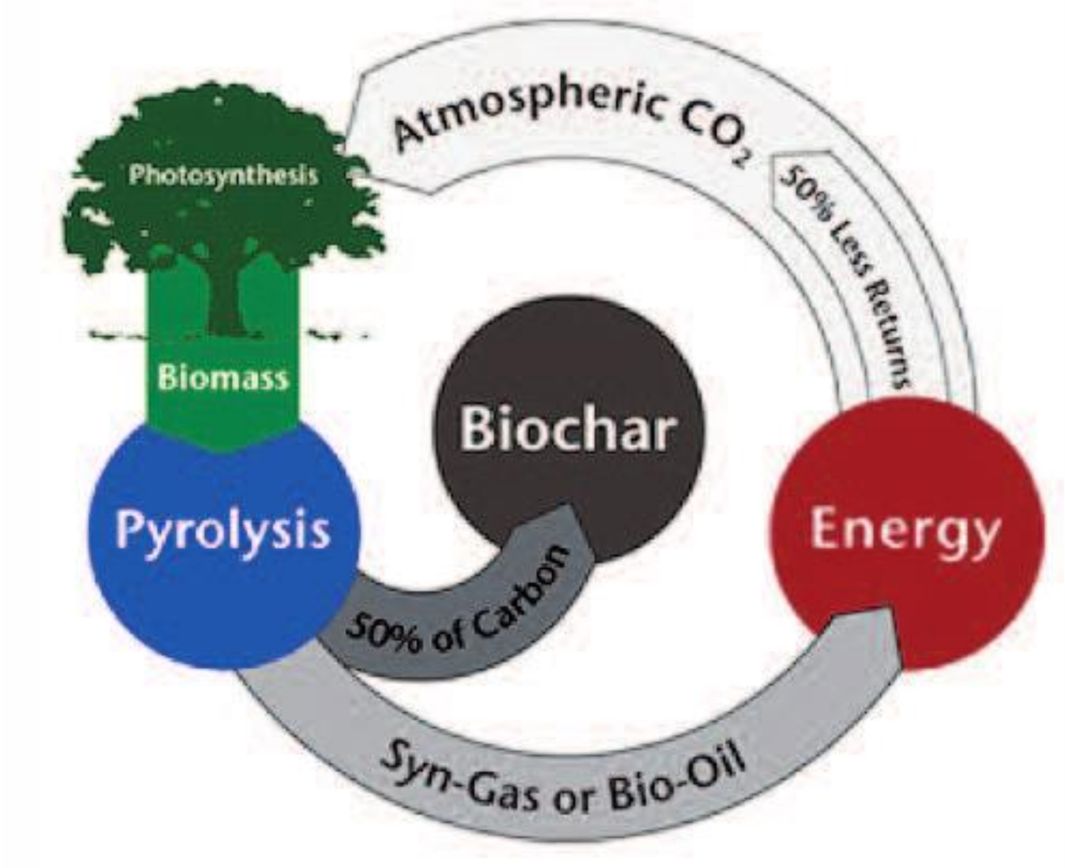
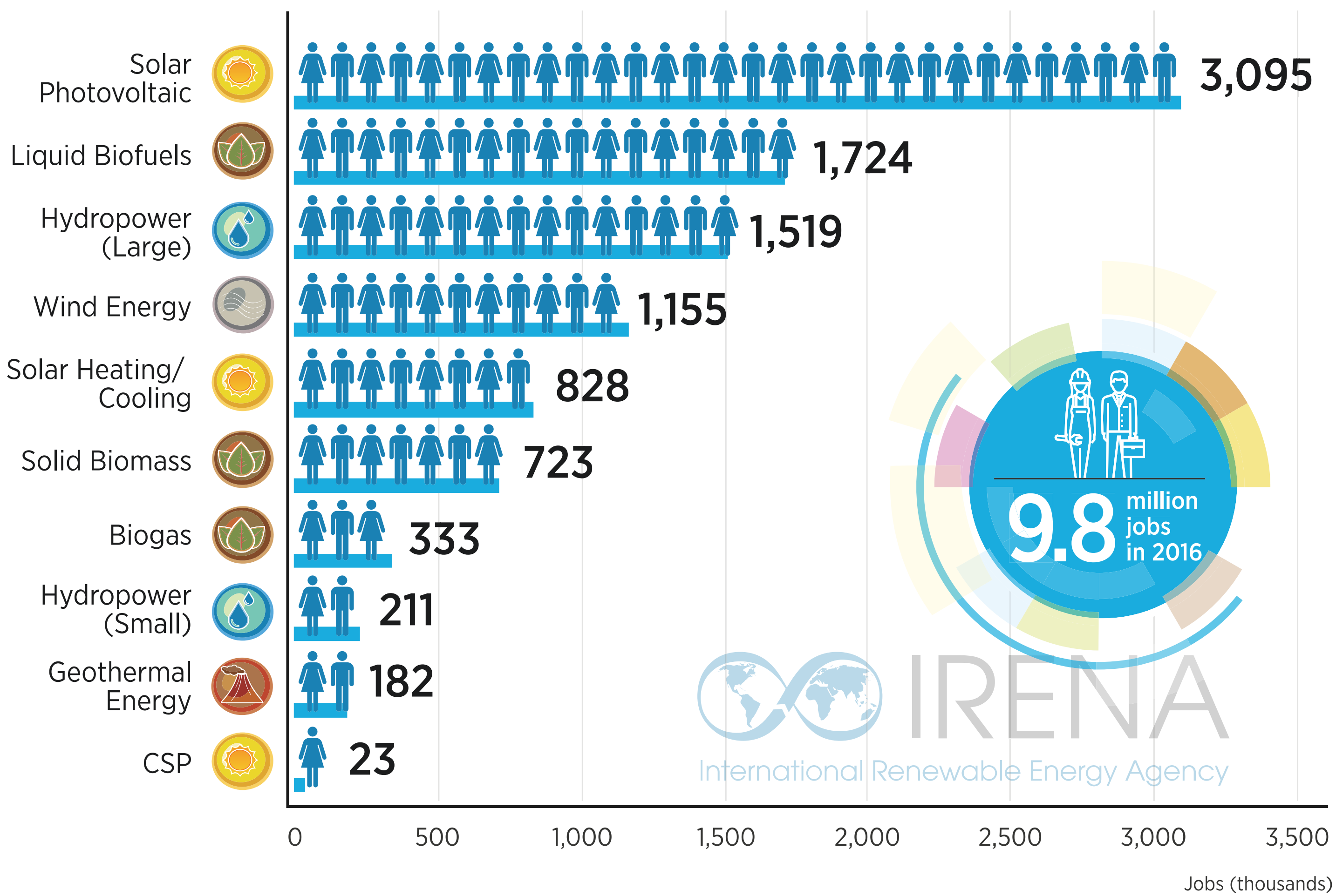
La "circolarità"



Fonte: Ontario Federation of Agriculture

Le esternalità sociali: occupazione

FIGURE 2: RENEWABLE ENERGY EMPLOYMENT BY TECHNOLOGY



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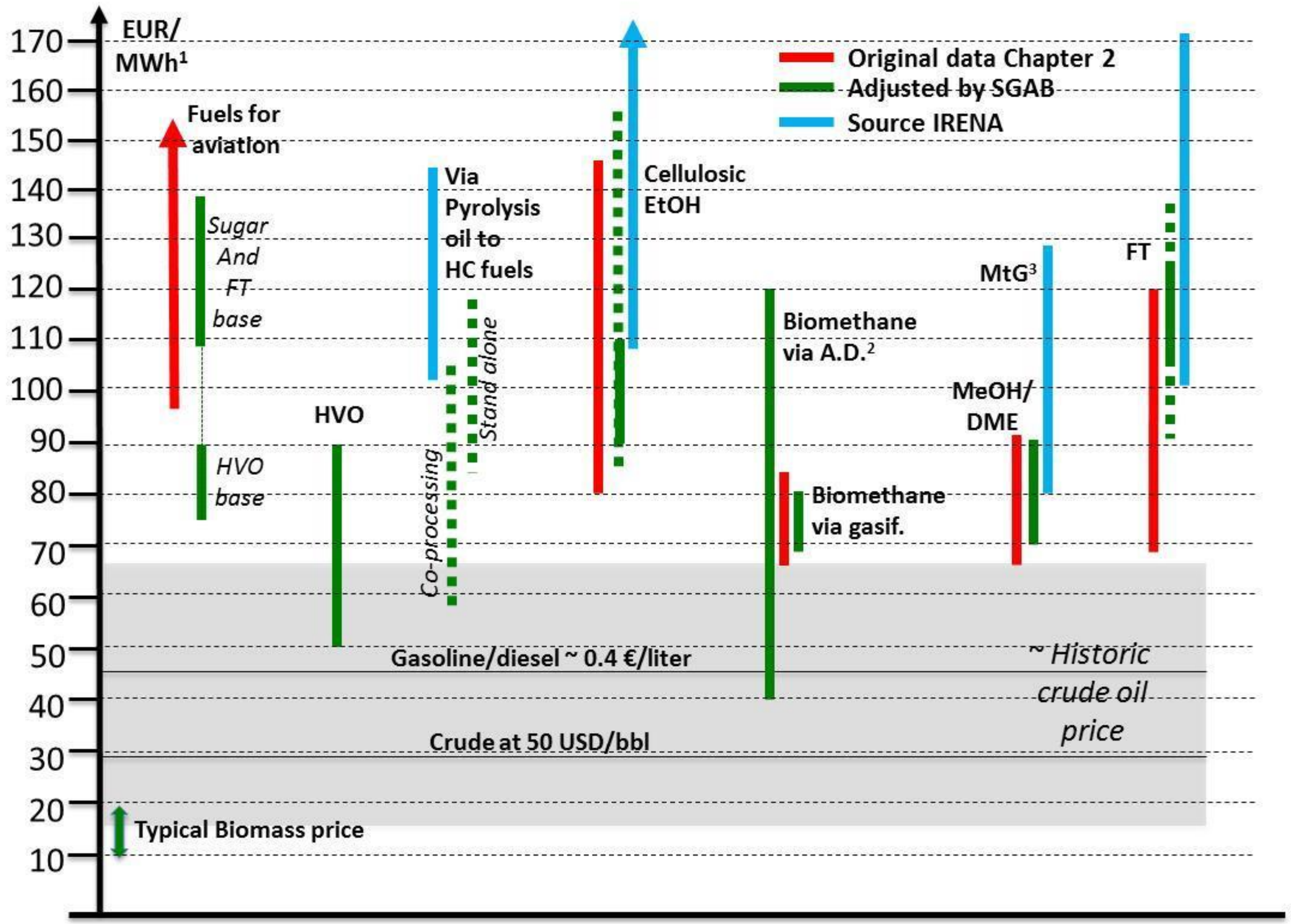
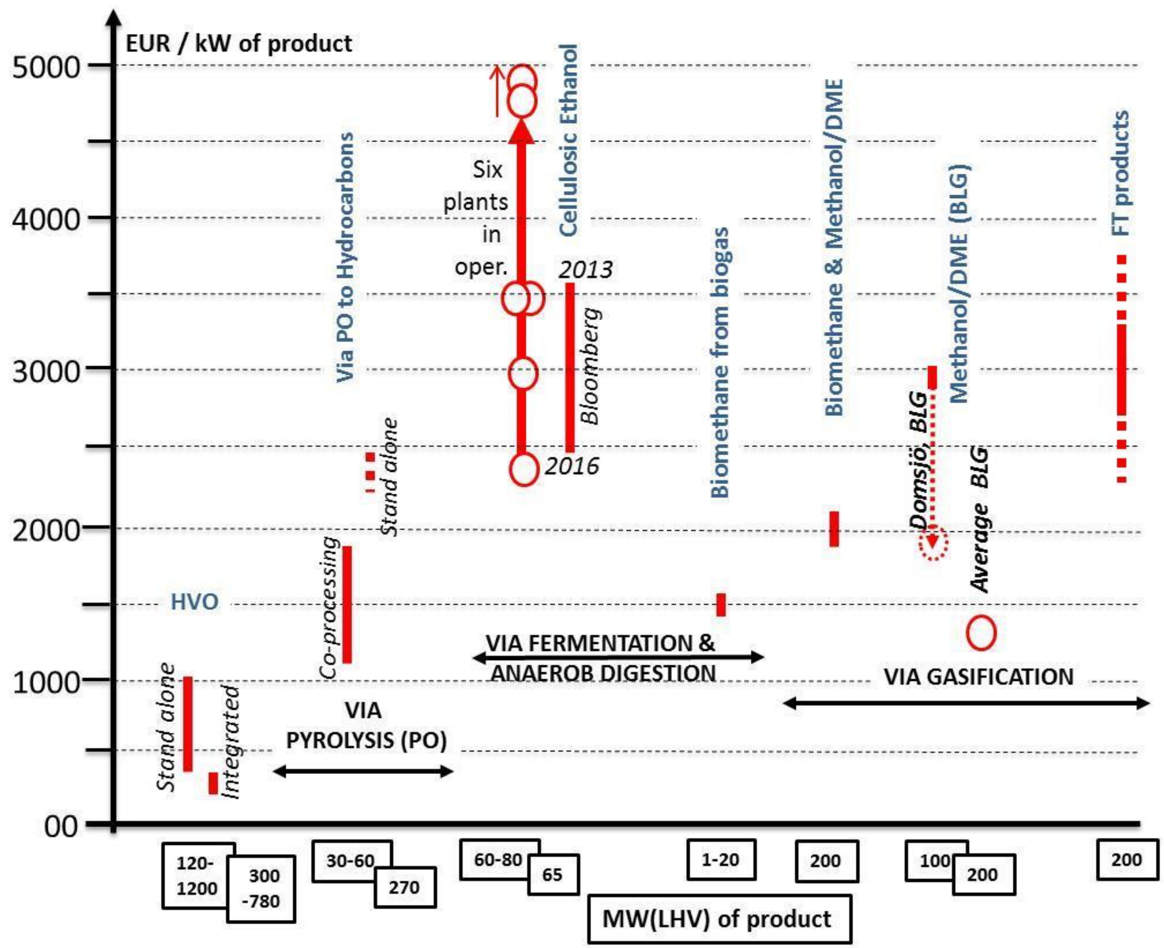


¹(EUR / MWh)/3.6 = €/GJ ²Anaerobe Digestion (large span due to very different feedstock costs) ³Methanol to Gasoline

Fonte: IEA


EUR / kW of product
5000
4000
3000
2000
1000
00
HVO
Stand alone
Integrated
VIA PYROLYSIS (PO)
Co-processing
Stand alone
Via PO to Hydrocarbons
Six plants in oper.
Cellulosic Ethanol
2013
Bloomberg
2016
VIA FERMENTATION & ANAEROB DIGESTION
Biomethane from biogas
Biomethane & Methanol/DME
Domsjö BLG
Methanol/DME (BLG)
Average BLG
FT products
VIA GASIFICATION
120-1200
300 -780
30-60
270
60-80
65
1-20
200
100
200
200
MW(LHV) of product

Fonte: IEA

Bioenergy is the only renewable energy source that is continuously available and versatile: on the product side; it can contribute to replace fossil fuels in all energy markets, heat, electricity with base load and flexible capabilities, allowing the integration of high renewables share (wind, solar) into electricity grid, as well as fuels for transport, including for aviation.

On the supply side it may benefit from large availability and wide variety of potential feedstock such as energy crops and wooden biomass, but also residues from both agriculture and forestry, the organic fraction of municipal and industrial solid waste, as well as algae and aquatic biomasses. Feedstock flexibility is an important requirement for future plants as it is important for cost reduction.

SET-Plan – Declaration of Intent on "Strategic Targets for bioenergy and renewable fuels needed for sustainable transport solutions in the context of an Initiative for Global Leadership in Bioenergy" - 16 novembre 2016

On the path from resources to the final energy product there are many technologies used for feedstock preparation on one hand and for the conversion into the final product, being electricity, heat or transport fuel.

It is due to this versatility that an integrated approach is followed here to enhance the synergies and economies of scale, to achieve economic benefits in the value chain to ultimately reduce the production costs and to optimise the greenhouse-gas performance of all bioenergy-products through technology and feedstock upgrading. Although cost structure is heavily influenced by feedstock cost, this document focuses on R&I needs and targets solely for the conversion step.

SET-Plan – Declaration of Intent on "Strategic Targets for bioenergy and renewable fuels needed for sustainable transport solutions in the context of an Initiative for Global Leadership in Bioenergy" - 16 novembre 2016

…For overcoming the barriers of feedstock and economics of bioenergy production … it is necessary to improve the performance of the biomass conversion to intermediate bioenergy carriers analogous to coal, oil and gaseous fossil energy carriers and thus create the crude energy feedstock basis that could be further refined to final bioenergy products or directly used for heat and power generation.

The further processing of intermediate bioenergy carriers to advanced biofuels for transport purposes and the development of heat and power from biomass have additional particular challenges, related to performance concerning necessary technological development for improving the conversion and energy efficiency and reduce the production cost of the end product, but also to sustainability.

On the other hand, sustainability in terms of environmental and social impacts is essential for increasing public acceptance of bioenergy production and enabling bioenergy deployment.

SET-Plan – Declaration of Intent on "Strategic Targets for bioenergy and renewable fuels needed for sustainable transport solutions in the context of an Initiative for Global Leadership in Bioenergy" - 16 novembre 2016

Agreed Strategic Targets in Renewable Fuels for Sustainable Transport

1. Improve production performance

1.1. *Advanced Biofuels*

- By 2030, improve net process efficiency of conversion to end biofuels products of at least 30% compared to present levels, with simultaneously reducing the conversion process costs
- By 2020, obtain total production of 25 TWh (2.15 Mtoe) advanced biofuels[9]

1.2. *Other renewable liquid and gaseous fuels*

- By 2030, improve net process efficiency of various production pathways of advanced renewable liquid and gaseous fuels[10] of at least 30% compared to present levels
- By 2030, for renewable hydrogen production by electrolysis improve net process efficiency to reach 70% [11]

2. Improve GHG savings

Total GHG savings through use of advanced biofuels and renewable fuels will be at least that required in Directive (EU) 2015/1513 where Article 7b (amended) states that greenhouse gas emissions saving from the use of advanced renewable fuels shall be at least 60%. The greenhouse gas emission saving from the use of biofuels shall be calculated in accordance with Article 7d(1) of the same Directive and should be at least 60% of the 40% target in 2030.

3. Reduce Costs *(excluding taxes and feedstock cost)*

In conclusion, the target price in 2020 and 2030 for advanced biofuels and renewable fuels should be within a reasonable margin from parity with the fossil based fuels. Nevertheless, when policy incentives for CO_2 reduction are taken into account, they should aim to be in parity with fossil fuel prices in 2030. This will require in particular improvements in process efficiency and energy balance through the application of innovative practices[12].

3.1. Reduce cost for end biofuel products

- Liquid or gaseous advanced biofuels by thermochemical or biochemical processing: <50 €/MWh in 2020 and <35 €/MWh in 2030 e.g. at least by 30% from 2020 levels
- Algae based advanced biofuels <70 €/MWh in 2020 and <35 €/MWh in 2030 e.g. at least by 50% from 2020 levels

3.2. Reduce cost for renewable liquid and gaseous fuels

- Other renewable liquid and gaseous fuels excluding renewable hydrogen: at least by 50% from 2020 levels (<50 €/MWh)
- Renewable hydrogen: <7 €/kg.by 2020 <4 €/kg.by 2030 (electrolysis, reforming,..)

Agreed Strategic Targets Bioenergy:

1. Reduce conversion system costs for high efficiency (>70% based on net calorific value of which >30% electrical) large scale biomass cogeneration of heat and power by 20% in 2020 and 50%

2. Improve performance and reduce GHG emissions by increasing efficiency: Obtain net efficiency[13] of biomass conversion to intermediate bioenergy carriers of at least 75% by 2030 with GHG emissions reduction of 60% from use of all types of intermediate bioenergy carrier products [14] resulting to a contribution to at least 4% reduction of the EU GHG emissions from the 1990 levels.

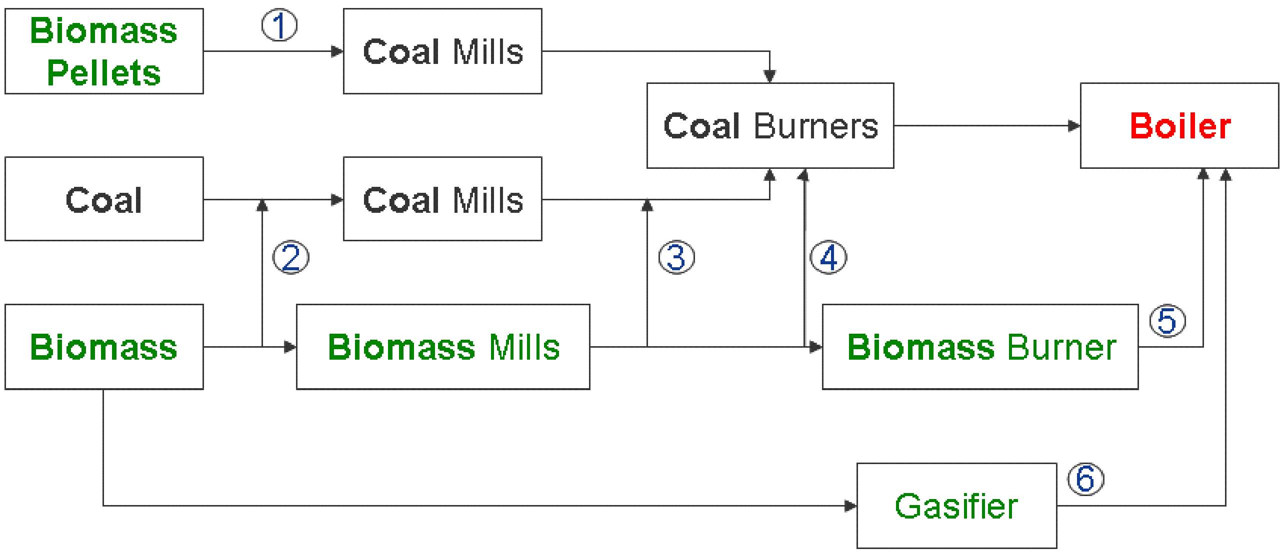
Agreed Strategic Intermediate Bioenergy Carriers[15]

Improve performance and reduce cost (excluding taxes and feedstock cost)[16] **for intermediate bioenergy carriers** (before further processing to final bioenergy products)

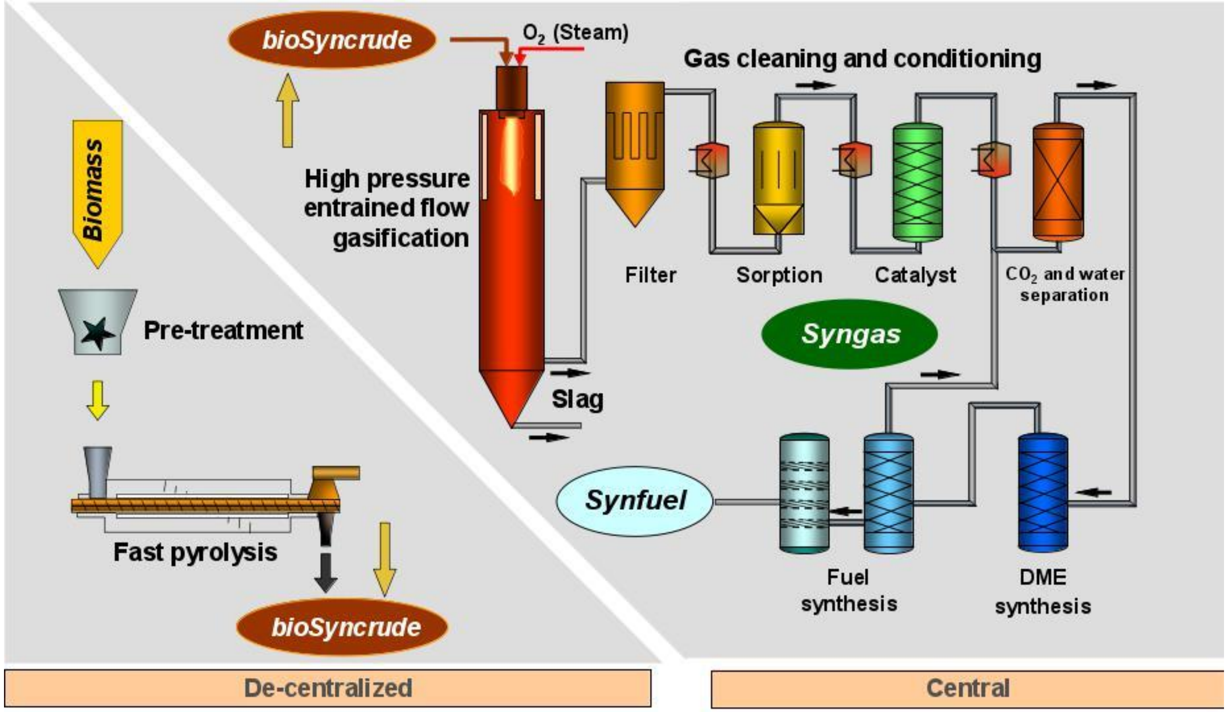
A. Liquid and gaseous intermediate bioenergy carriers by thermochemical or biochemical processing: <20 €/MWh in 2020 and <10 €/MWh in 2030 for e.g. pyrolysis oil; <40 €/MWh in 2020 and <30 €/MWh in 2030 for higher quality, e.g. microbial oils

B. Solid intermediate bioenergy carriers by thermochemical or biochemical processing (e.g., bio-char, torrefied biomass, lignin pellets): <10 €/MWh in 2020 and <5 €/MWh in 2030 compared to present levels.

L'impiego in "filiera corta"



Un esempio di integrazione in filiera lunga: Bioliq®



1 ton/hr gasifier of the bioliq® Process at Karlsruhe Institute of Technology operated at 30 bar for subsequent FT synthesis or at 80 bar for DME synthesis

http://www.bioliq.de/english/55.php

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Il progetto "Biofeedstock"

Sviluppo di Piattaforme Tecnologiche Integrate per la Valorizzazione di Biomasse Residuali

Il progetto "Biofeedstock"

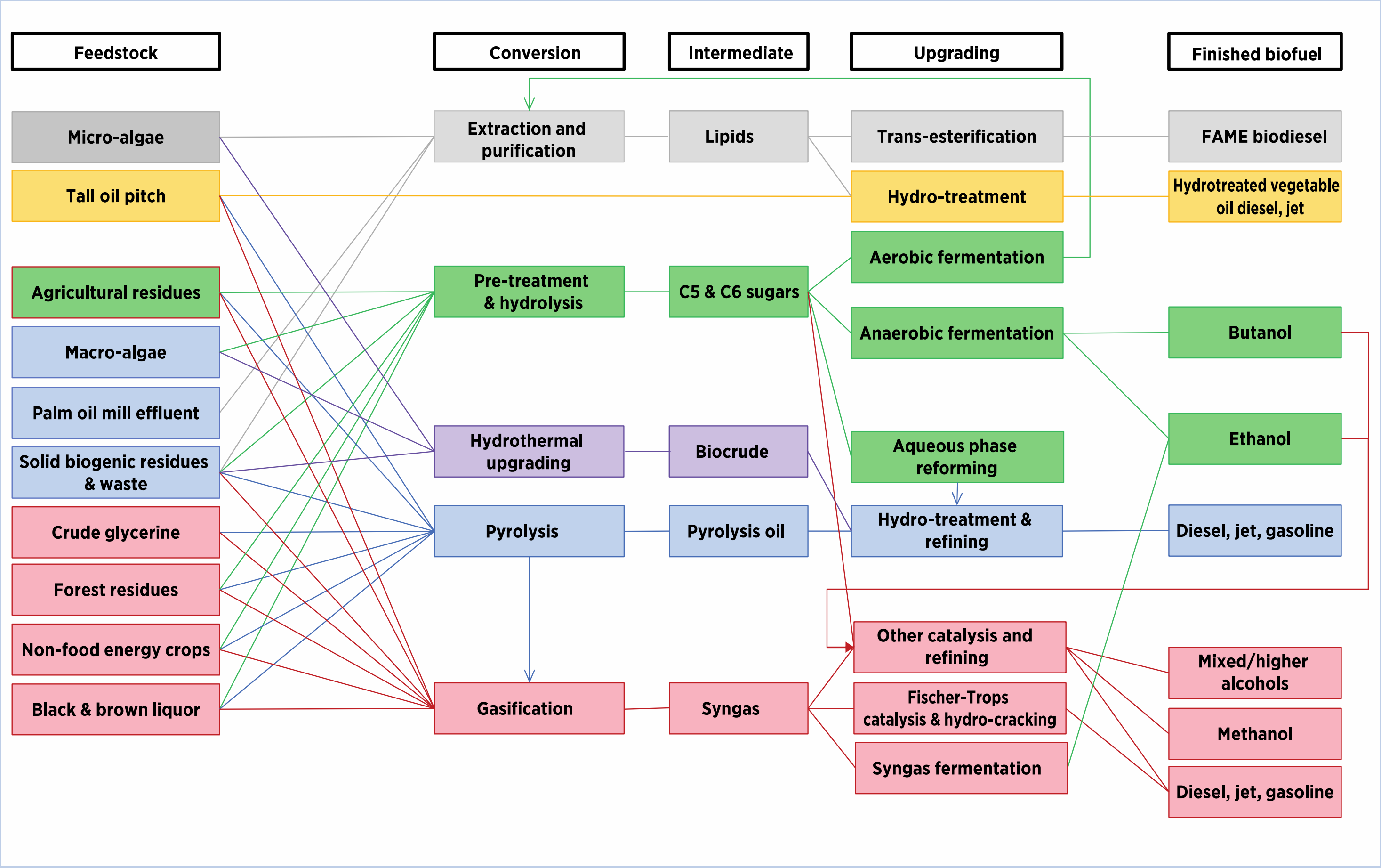
Esplorazione di processi a "filiera lunga": **produzione decentralizzata** di vettori bioenergetici mediante semplici pretrattamenti della biomassa (meccanici, chimico-fisici, fermentativi), di norma condotti nei siti locali di produzione o di raccolta, **valorizzazione finale** del biofeedstock attraverso l'upgrade e processi di bioraffineria.

La logica delocalizzata/centralizzata presenta numerosi vantaggi:

- possibilità di trarre vantaggio dalle **economie di scala** nella valorizzazione finale dei prodotti;
- **disaccoppiamento** della fase di produzione dei biofeedstock dalla fase di valorizzazione finale;
- possibilità di conciliare la **semplicità delle operazioni delocalizzate** (senza ricorso a personale altamente specializzato e apparecchiature complesse) con l'efficiente valorizzazione energetica;
- **flessibilizzazione dei processi di trasformazione** complessiva in relazione ai fabbisogni ed alle opportunità di mercato: in prospettiva i biofeedstock possono essere scambiati sui mercati come autentiche "commodities";
- **integrazione** della valorizzazione delle biomasse residuali **in processi convenzionali**, in un'ottica di progressivo affiancamento della "bioeconomia" alle produzioni industriali convenzionali.

Il quadro di riferimento tecnologico

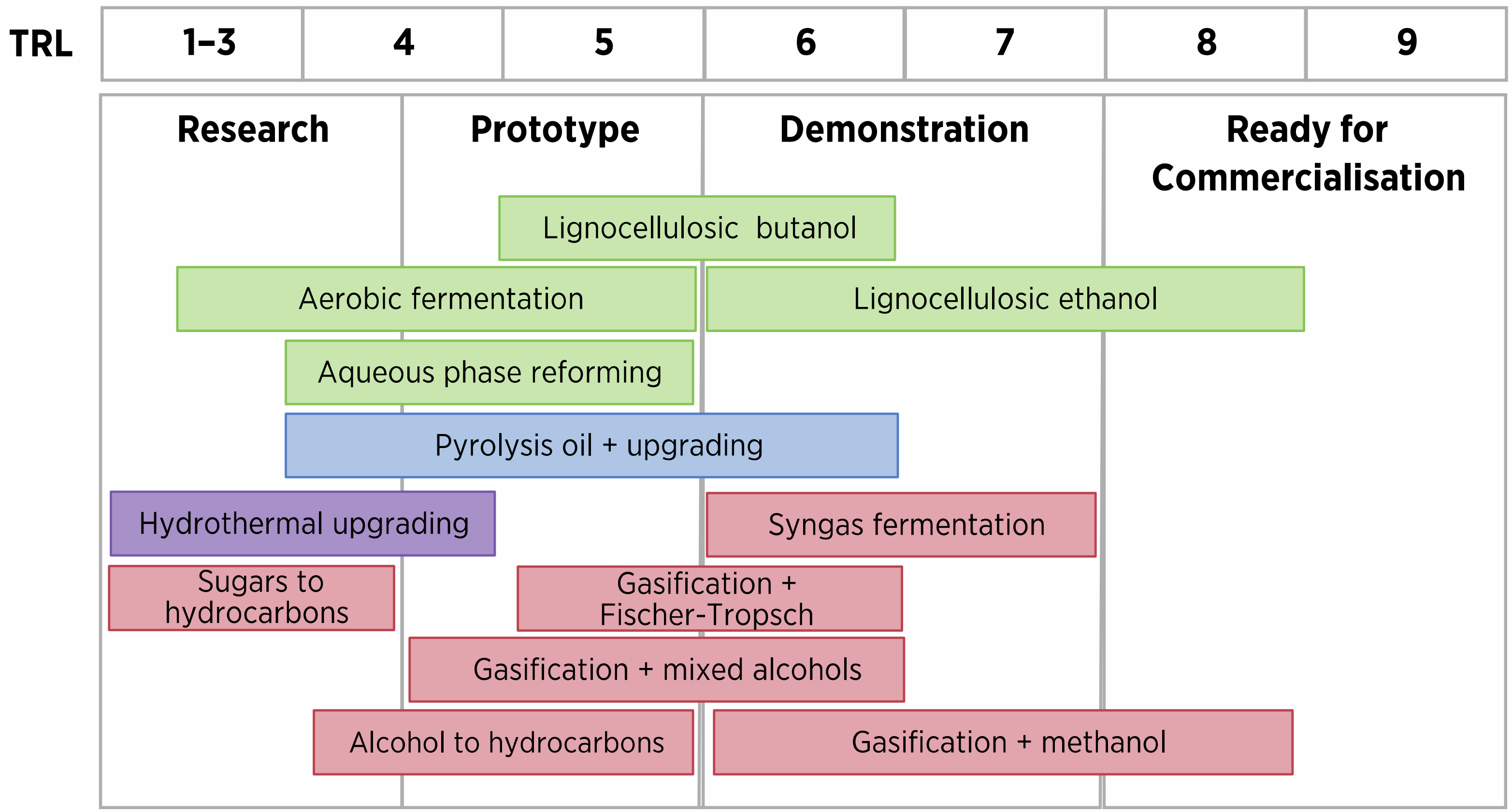
Figure 3: Advanced biofuels pathways



Note: Colours represent the principal conversion processes.

Fonte: IRENA

Figure 6: Commercialisation status of various advanced biofuel pathways



Note: Colours represent the principal conversion process, hydrolysis (green), pyrolysis (blue), hydrothermal upgrading (purple) and gasification (red).

Fonte: IRENA

Biofeedstock: la struttura del progetto

OR	TITOLO
OR1	Valutazione dei bacini di potenziale approvvigionamento di biomasse residuali
OR2	Definizione di logistiche di approvvigionamento di biomasse residuali e di processi di pretrattamento delocalizzato funzionali all'allungamento della filiera
OR3	Valutazione di tecnologie per l'"upgrade" e la valorizzazione finale dei biofeedstocks
OR4	Valutazione del potenziale di valorizzazione dei sottoprodotti
OR5	Realizzazione di una matrice di correlazione tra proprietà delle biomasse residuali, le proprietà dei "biofeedstock" ed i prodotti finali
OR6	Analisi delle opzioni di valorizzazione di biomasse residuali in filiera lunga in ottica di system analysis
OR7	Attività di integrazione di progetto e di disseminazione

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La matrice di correlazione: raw biomass > biofeedstock > end product

La matrice di correlazione, partendo da una categorizzazione di massima delle biomasse residuali sulla base della individuazione di macrocomponenti (ad es., contenuto di grassi, lipidi, cellulosa, emicellulosa, lignina etc.), consente di individuare:

- percorsi più vantaggiosi sia per il trattamento delocalizzato di specifiche biomasse residuali che per la valorizzazione finale,
- analogie di comportamento nella trasformazione e valorizzazione di biomasse residuali di natura e provenienza diverse,
- potenziali strategie sinergiche di “blending” o di co-valorizzazione di “biofeedstock” di origine e natura diverse,
- destino di specifici componenti (eteroatomi, frazioni inorganiche …) lungo la catena di trasformazione
- valorizzazione/smaltimento di sottoprodotti della lavorazione delle biomasse residuali.

Grazie per l'attenzione

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