IRENA Analysis of Advanced Biofuel Needs and Opportunities

Exchange of Experiences and Opportunities on Advanced Biofuels

GBEP 6th Bioenergy Week Buenos Aires, Argentina
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Economic potential

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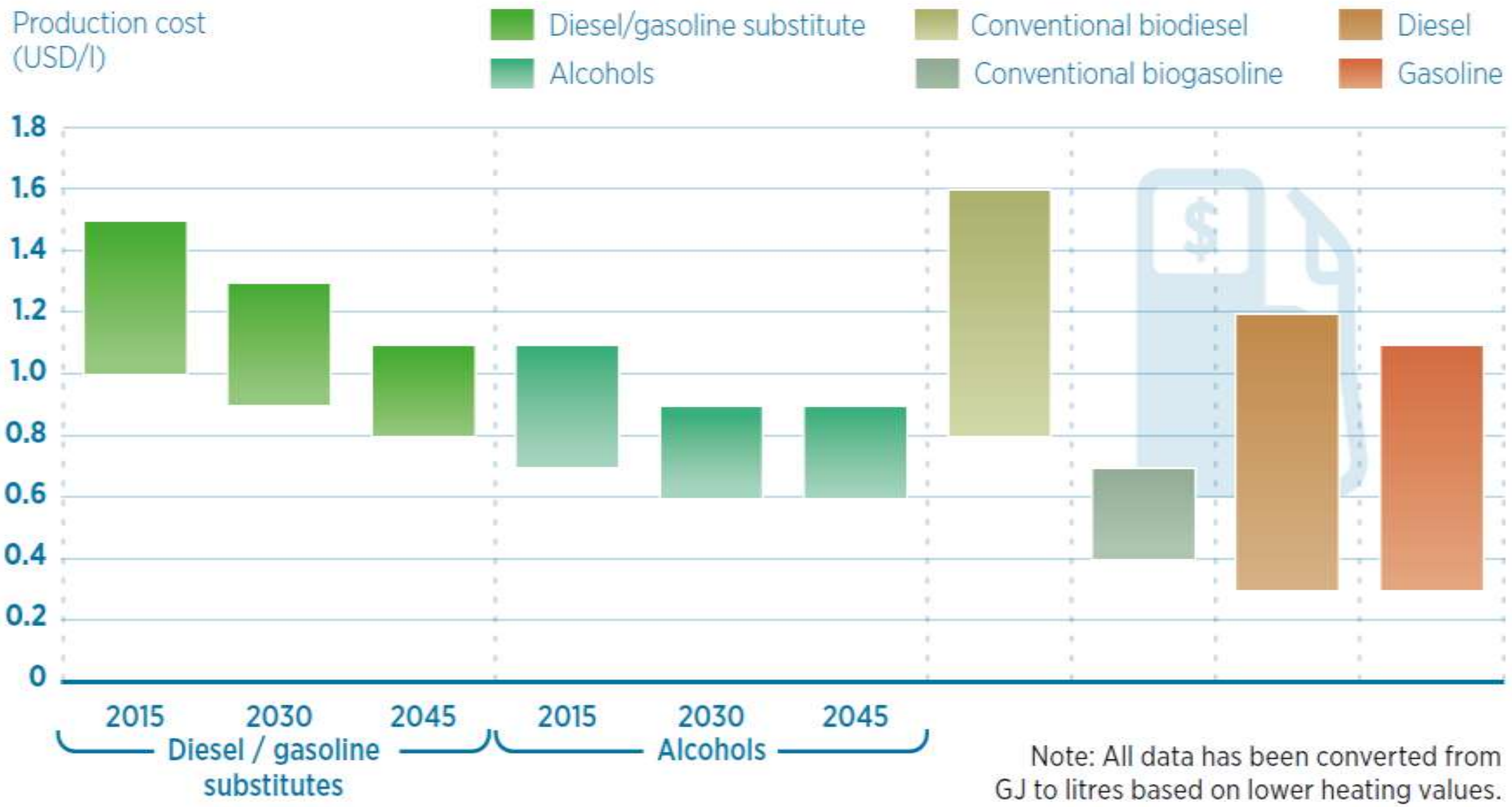
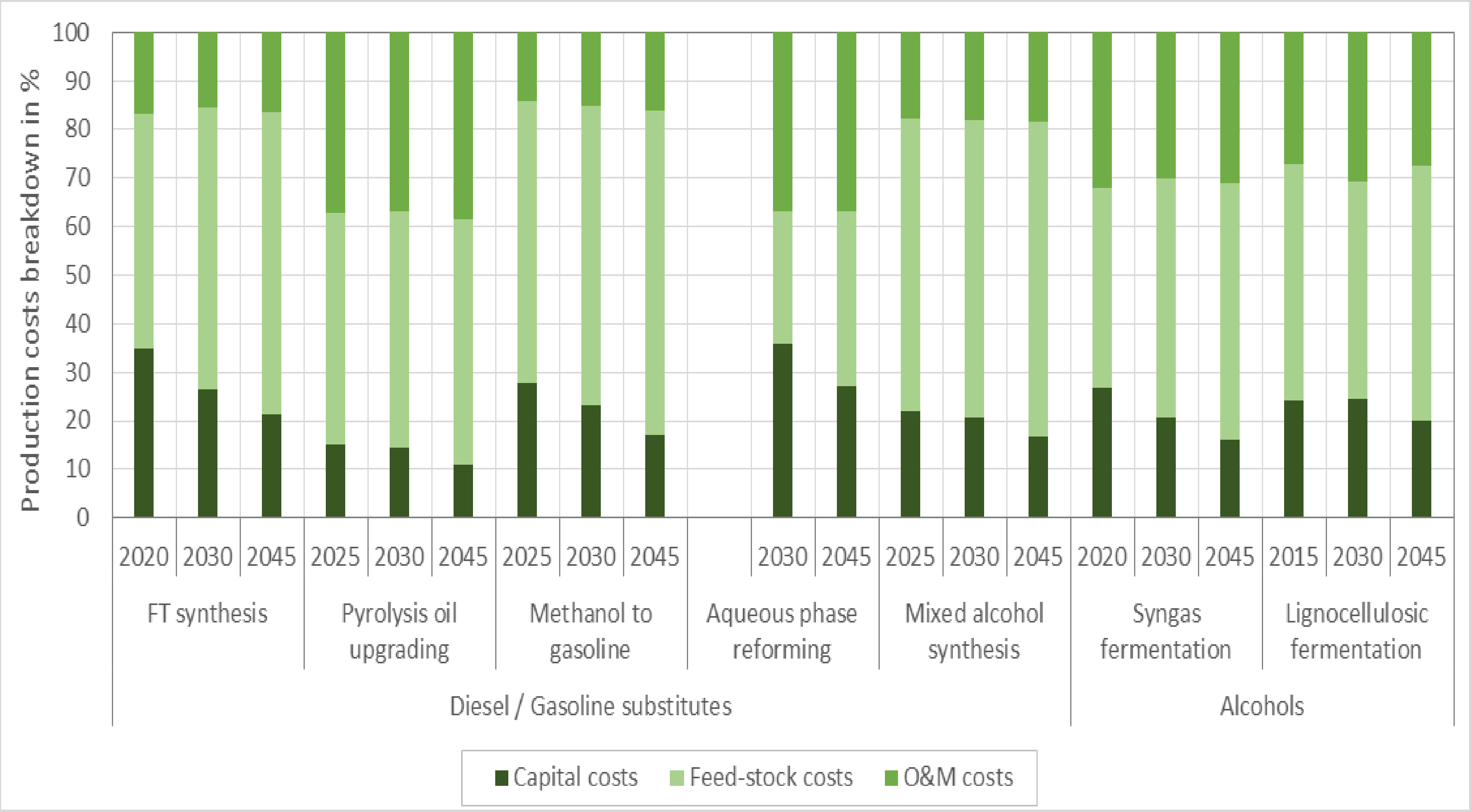
- Advanced biofuels cannot compete with oil prices below $80 per barrel

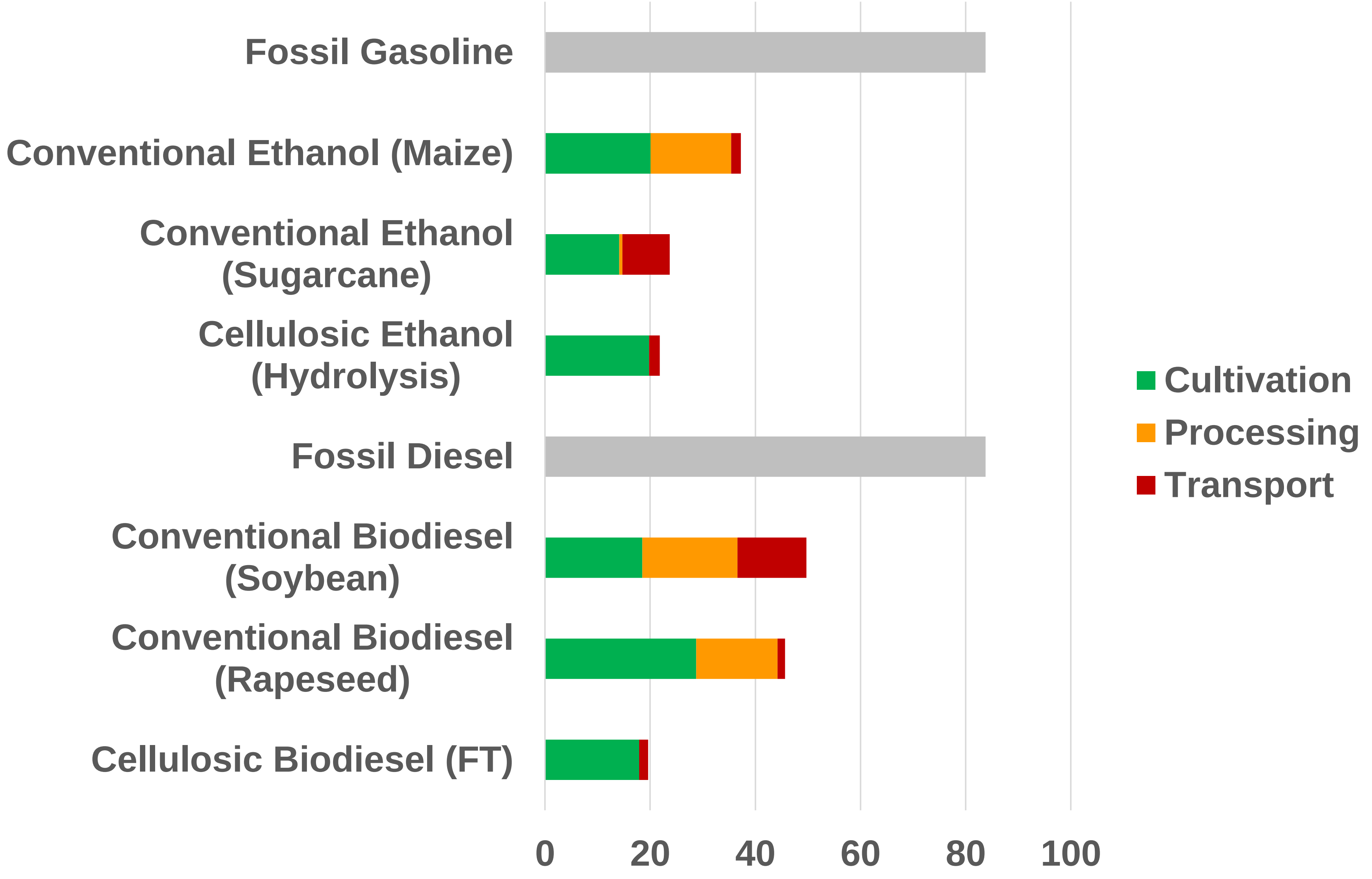


Feedstock cost is key

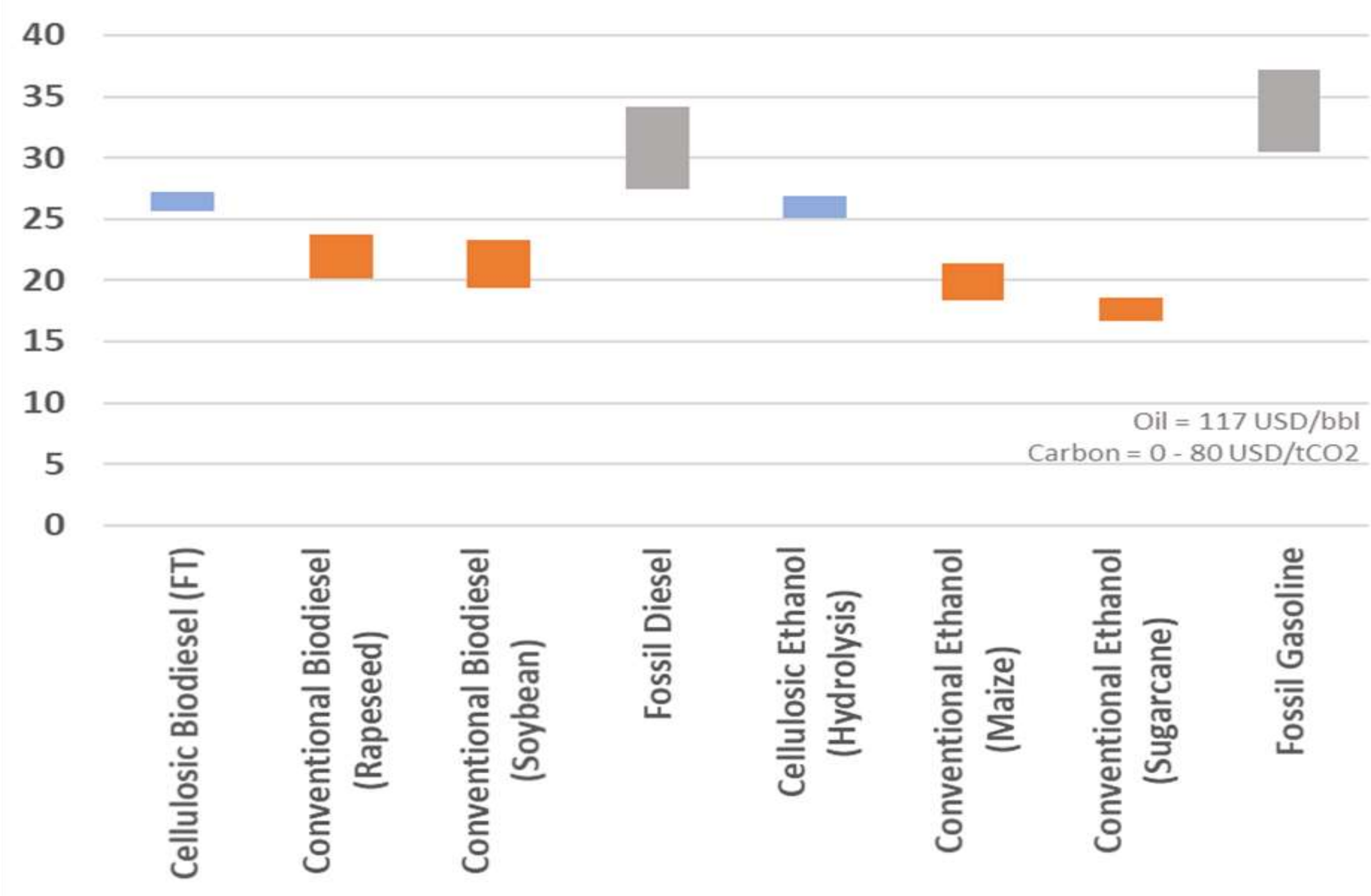
- Feedstock cost represents **40% to 70 %** of production cost



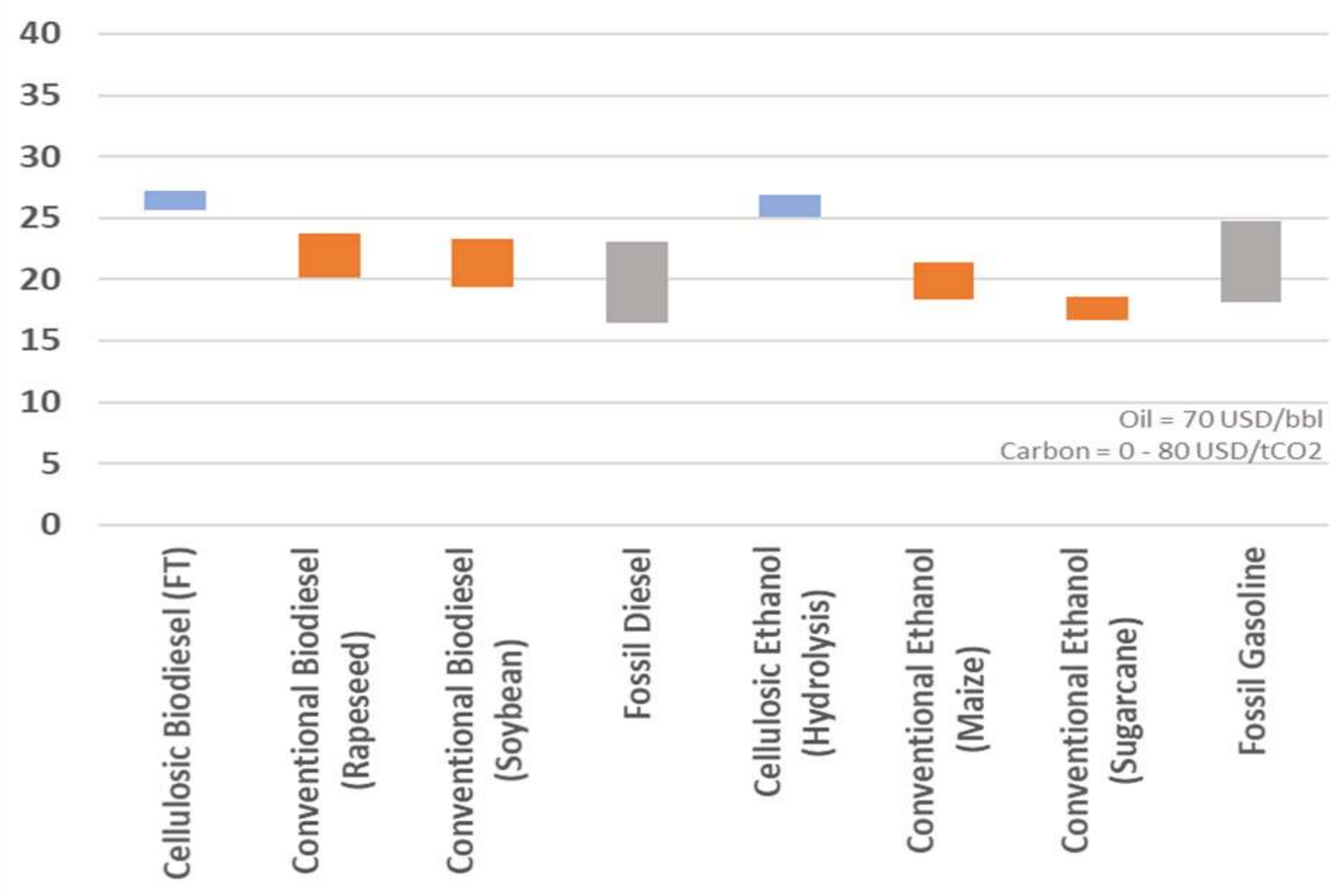
Carbon Benefits of Biofuels (gCO2/MJ)



Future Fuel Costs in 2050 ($/GJ) with $117/bbl Oil and $0-80/tCO2-eq



Future Fuel Costs in 2050 ($/GJ) with $70/bbl Oil and $0-80/tCO2-eq



Global Investment in Liquid Biofuels

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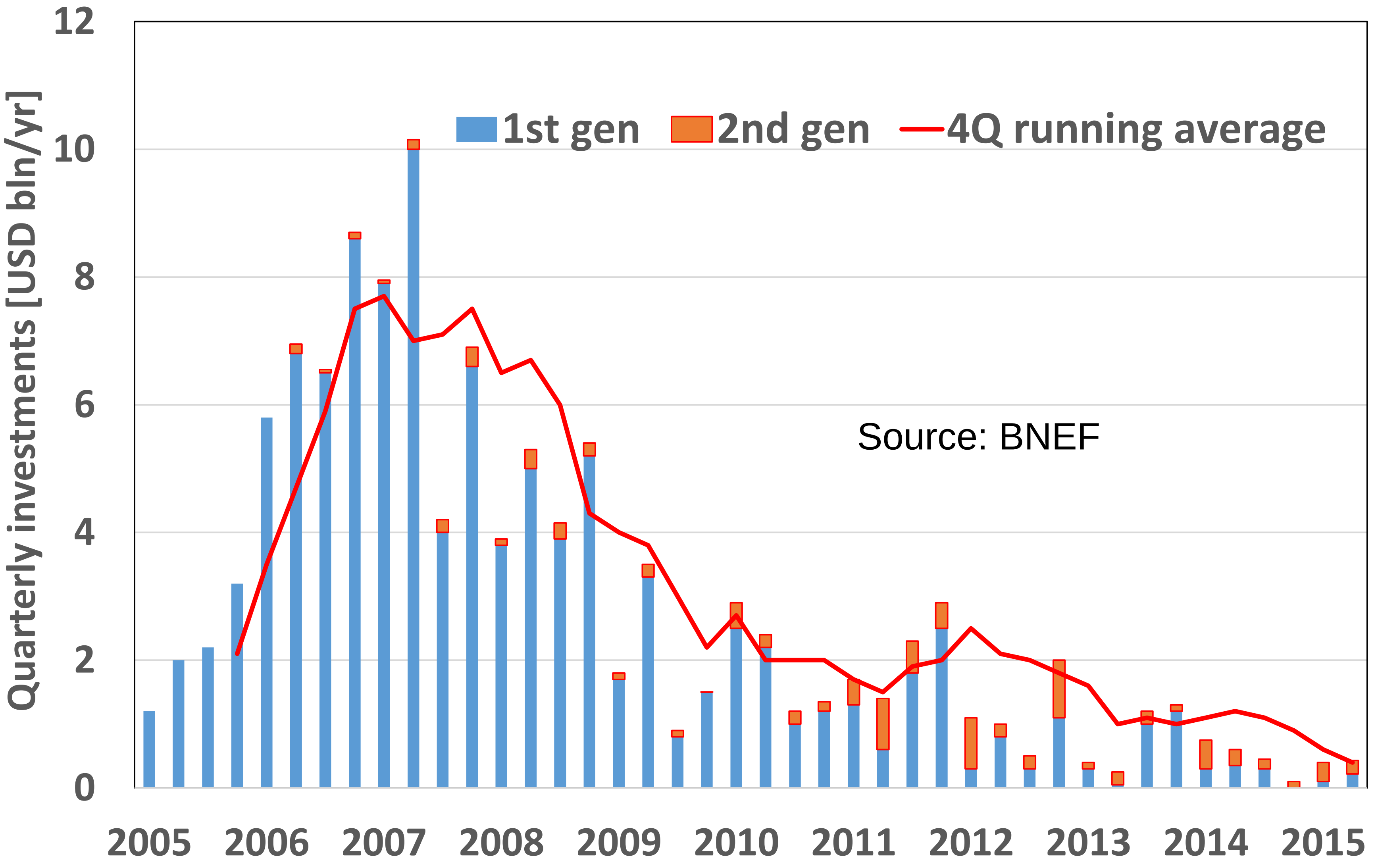

Sector is not developing as needed for energy transition

Liquid Biofuels in RE transport vision

- ***Half of 2050 transport demand could well be electric:***
  - Around 2 billion electric vehicles
  - Tens of millions of electric delivery trucks
  - High-speed electric trains for long-distance travel.
- ***But global demand for liquid biofuels will still increase:***
  - EVs will take 20-30 years to displace ICEs in developed countries since it takes time for fleets to turn over.
  - Auto population will grow fast in developing countries that do not yet have mature electric grids.
  - Brazil is a case where ethanol economy is so well developed that there is no imperative to electrify (cars with electric drives could run on ethanol fuel cells)

Where will we get our biojet?,

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- ***Feedstocks and technologies to consider:***
  - Oilseed crops on restored land (upgrade biodiesel)
    - Europe (rapeseed), China, Americas.
  - Farm and forest residues (thermochemical and biochemical route for processing lignocellulose)
    - Logging residues (Europe, North America)
  - Carbohydrate crops (1G+2G ethanol plus conversion)
    - Sugar/energy cane (Brazil, S. Africa, Caribbean)
    - Maize (Americas)

Supporting biojet takeoff

- ***Policy supports to consider:***
  - RD&D support for pilot plants w lignocellulosic feedstock
  - Significant market value for carbon and methane
  - Volumetric renewable fuel mandates
  - Limits on jetfuel carbon per person-km, tonne-km

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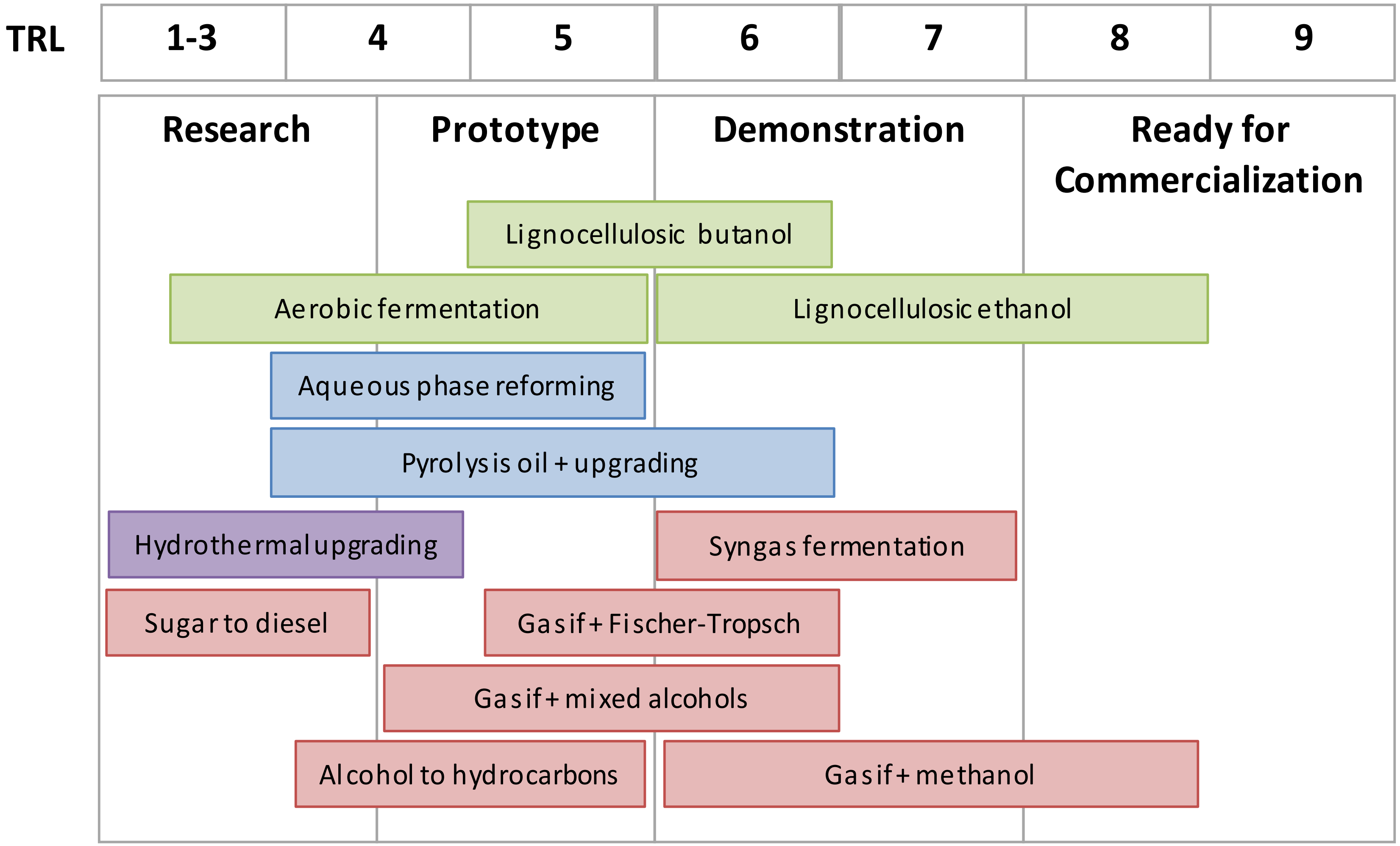
Technology Pathways

- Fermentation
- Gasification
- Pyrolysis

Advanced biofuels pathways



Fermentation

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Status: Depends on Feedstock

- Fermentation plants using ***agricultural residues*** or energy crops are at an ***early commercial*** phase
- Fermentation plants using ***woody biomass*** are still at an early ***demonstration*** stage.
- Fermentation of ethanol from ***municipal solid waste*** is still under ***development***

Ongoing R&D Approaches

- ***Integrating the hydrolysis and fermentation*** processes could reduce production costs by as much as 80%.
- *In-situ removal of butanol*, with ***membrane separation*** instead of distillation, can reduce energy use by half. (Principle of ButaNext project.)

Fermentation: Dupont Nevada (114ML/y)

Pyrolysis

Status

- Can use a ***changing mix of feedstocks*** over time.
- ***Agricultural residues, wood residues and wastes*** have all been used in ***pilot and demonstration plants***

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Ongoing R&D Focus

- More effective ***catalytic upgrading*** processes needed.
- Petrobras and Ensyn have demonstrated the ***co-cracking of refinery-ready pyrolysis oil***

Pyrolysis: Ensyn, Renfew, Ontario (12 ML/y)

Gasification

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Status: Technology Demonstration

- Gasification can use a ***variety of feedstocks.***
- Gasification with ***catalytic synthesis***: many demonstration projects using ***forestry residues***
- Gasification followed by ***syngas fermentation to ethanol*** is being demonstrated, nearly commercial.

Ongoing R&D Objectives

- Gasification still needs to prove ***reliable long-term operation with feedstock contaminants***
- Alter-NRG is working on ***enhanced pre-treatment and ash removal*** using plasma gasification or torches
- Process optimisation is also needed to achieve ***target syngas composition with sufficient hydrogen content.***

Gasification: Enerkem Alberta (38 ML/y)