

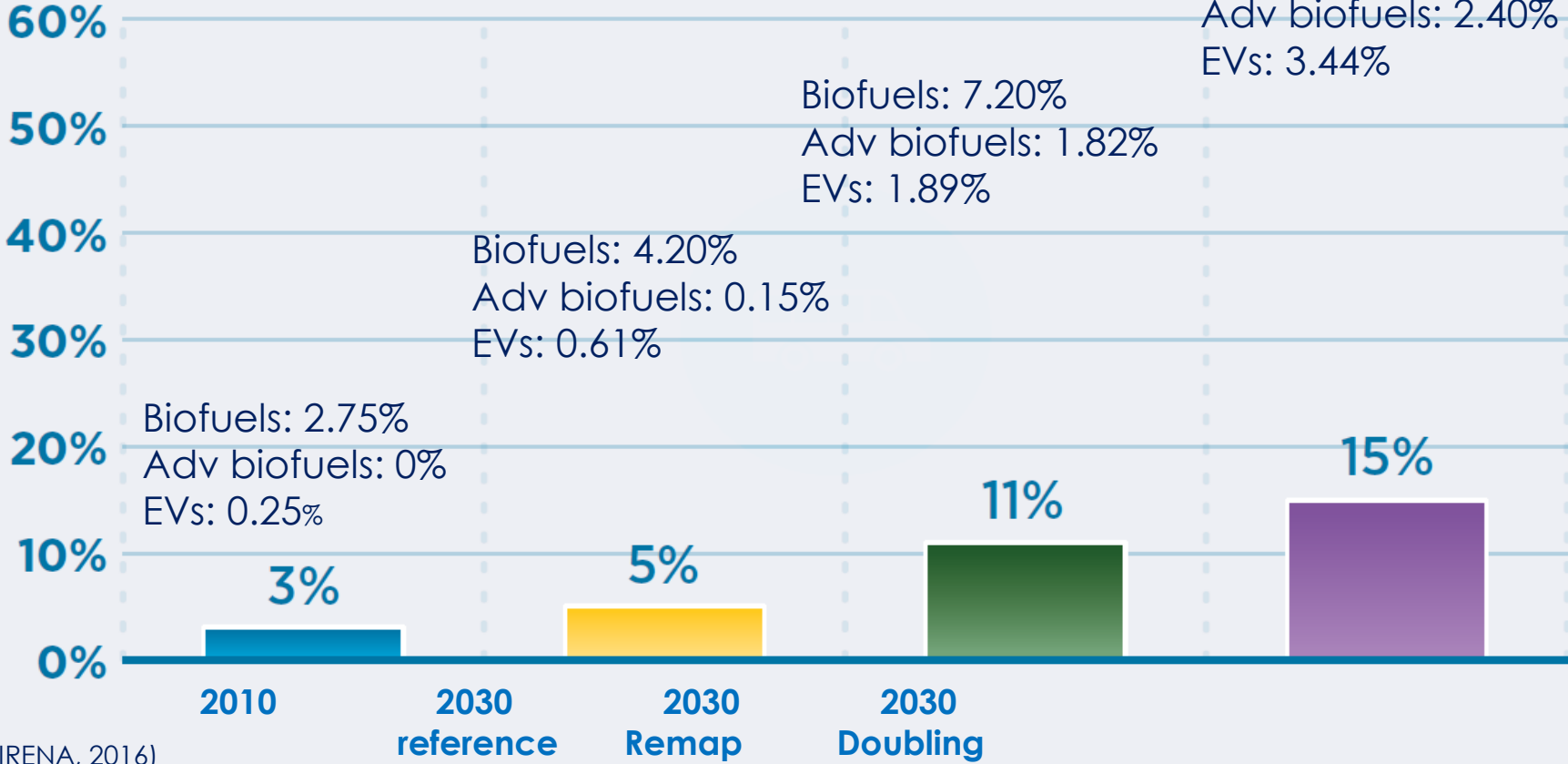
Technology Innovation Outlook for Advanced Liquid Biofuels



Biofuture Platform
IRENA Headquarters, Abu Dhabi
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The Case for Advanced Biofuels

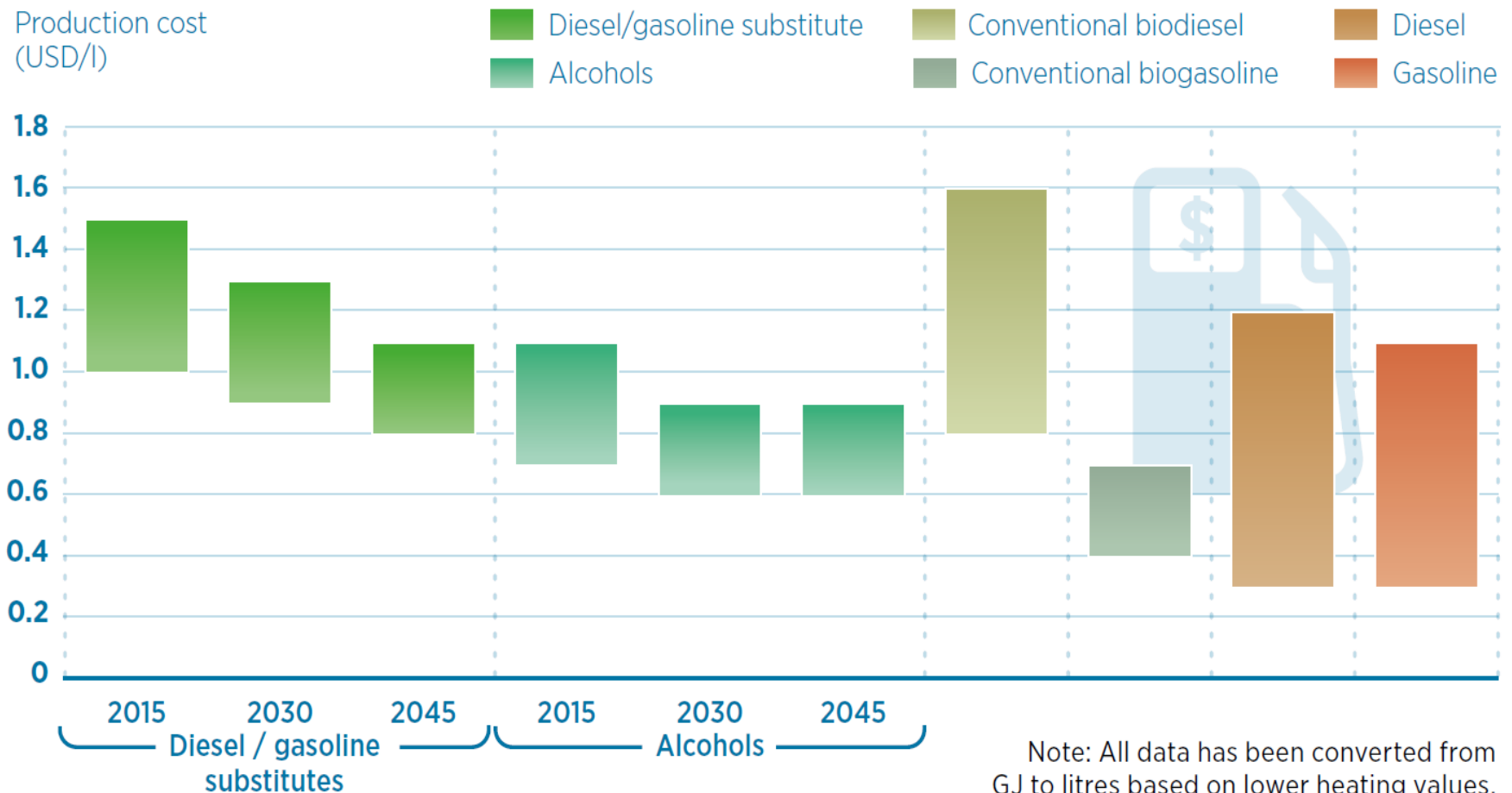
Transport renewable energy shares (incl. renewable electricity use)



Advanced biofuels broaden sustainable feedstock options.

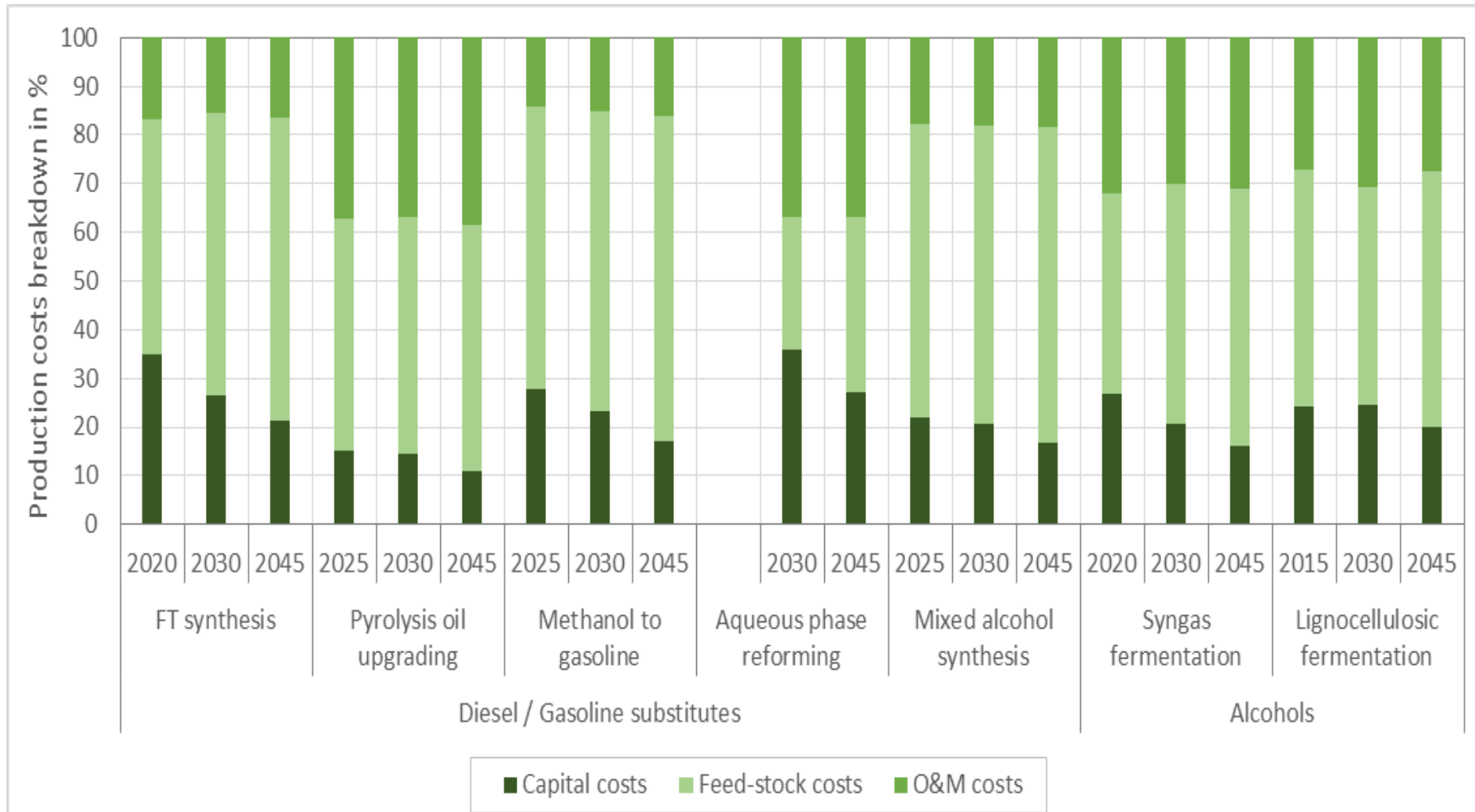
Economic potential

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

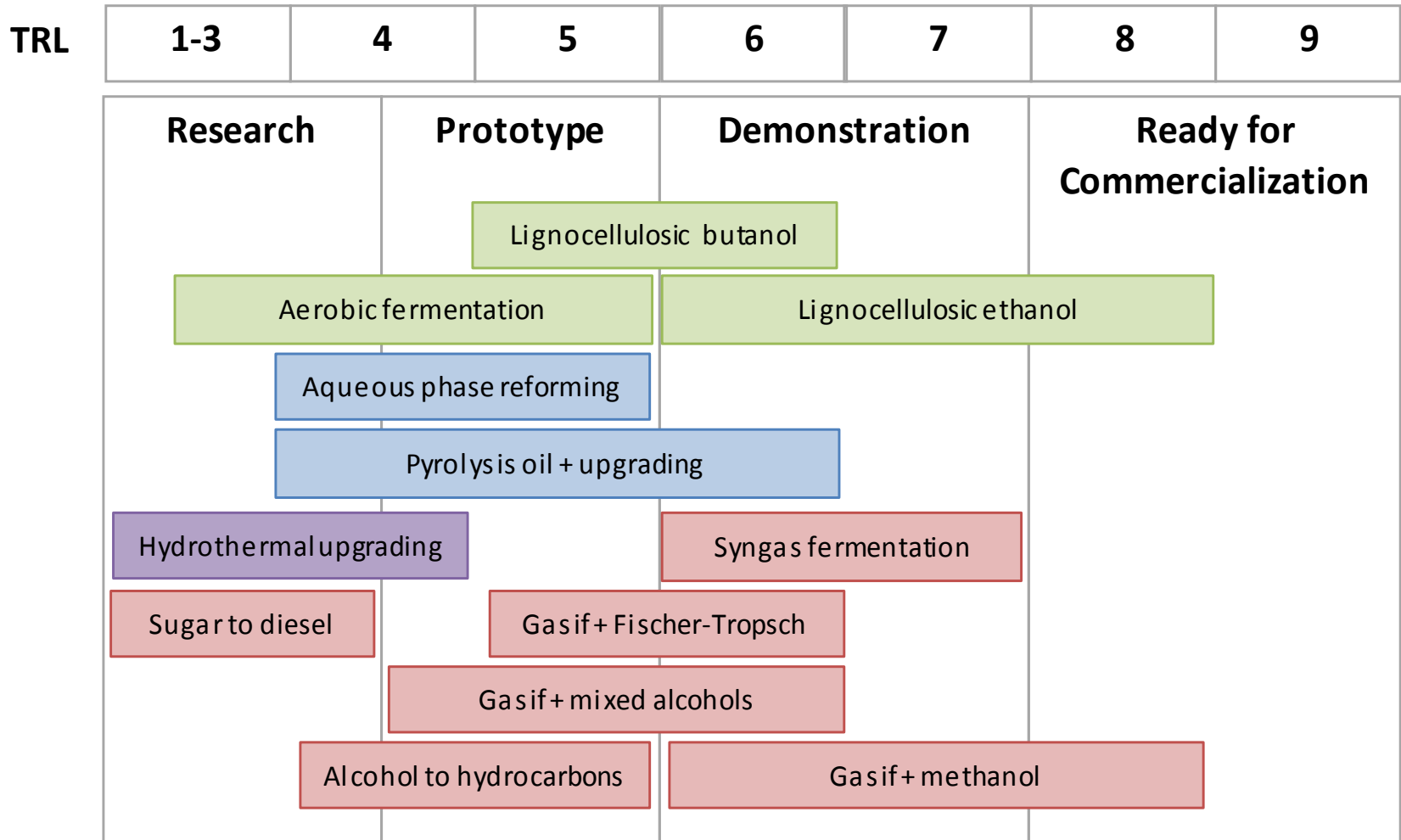


Feedstock cost is key

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



Advanced biofuels pathways



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)



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)



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**

Ongoing R&D Focus

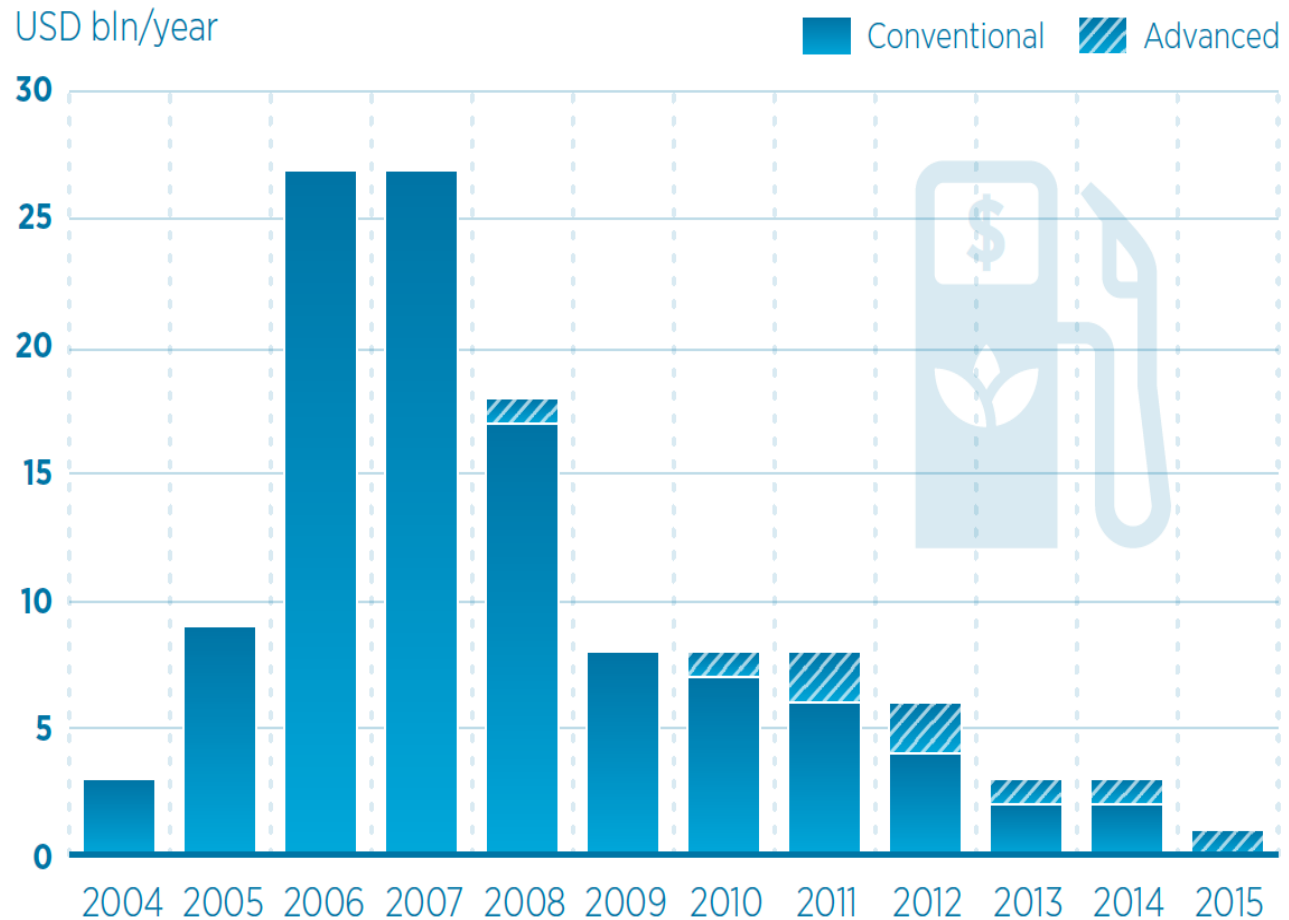
- More effective **catalytic upgrading** processes needed.
- Petrobras and Ensyn have demonstrated the **co-cracking of refinery-ready pyrolysis oil**

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



Investment Stagnating

Liquid biofuel investments have dried up in recent years.

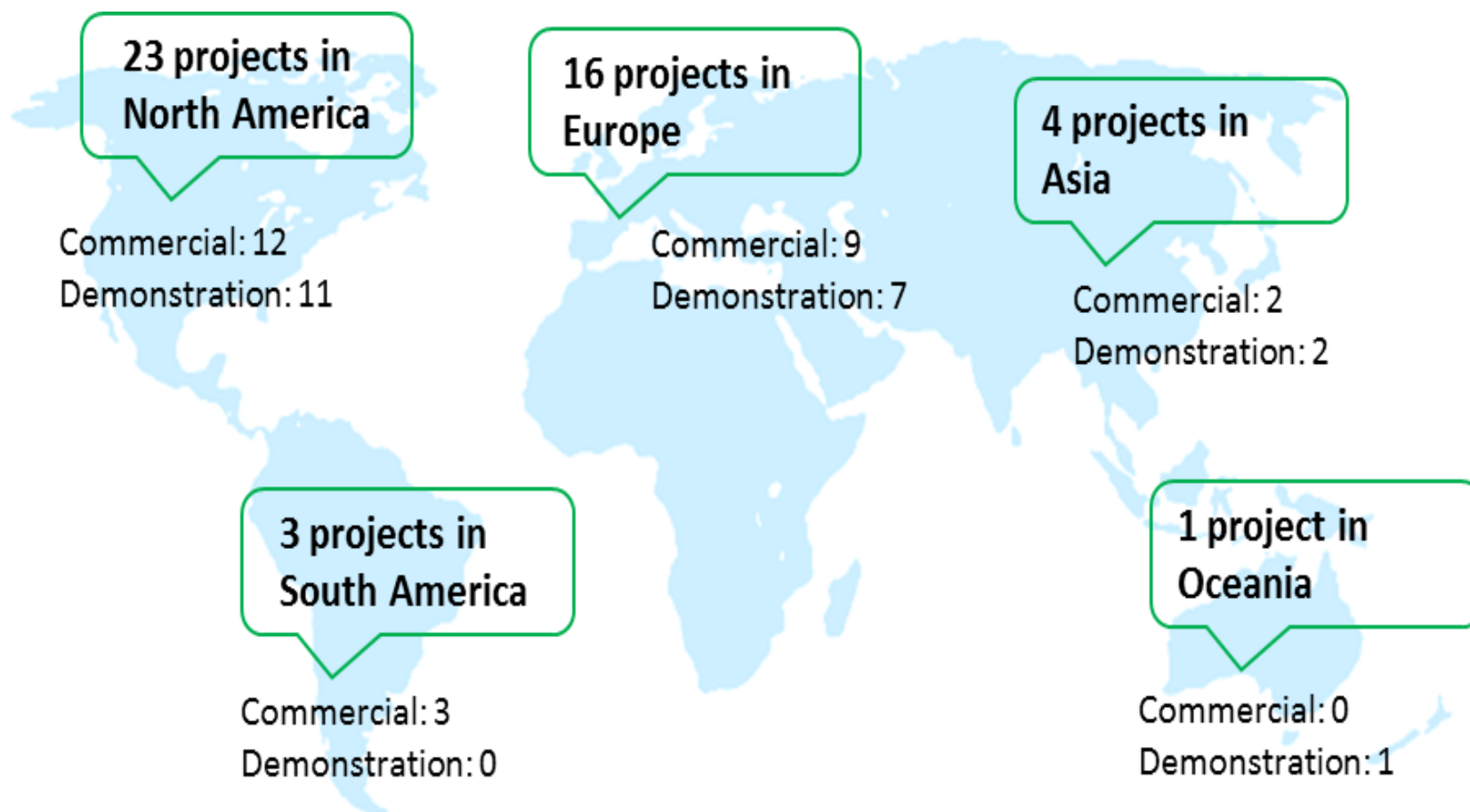


IRENA analysis based on BNEF (2015)

investments have stagnated with lower oil prices and weakened policy support

Current implementation activity

- Present: 1 billion l/year production capacity
- Actual production -> ???
- Efforts centralized in Europe and North America



TECHNOLOGY DEVELOPMENT

- Support for first of a kind commercial-scale pilot plants
- Risk mitigation for other early pilot plants: getting to the Nth.

MARKET FORMATION

- Bio-refineries
- Policy incentives, targets or mandates
- Internalisation of carbon cost
- Public procurement
- Niche markets

ENTERPRISE FORMATION

- Support start-ups
- Strategic partnerships
- Sharing successful business models
- Harness potential socio-economic benefits

Thank you very much for your attention

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