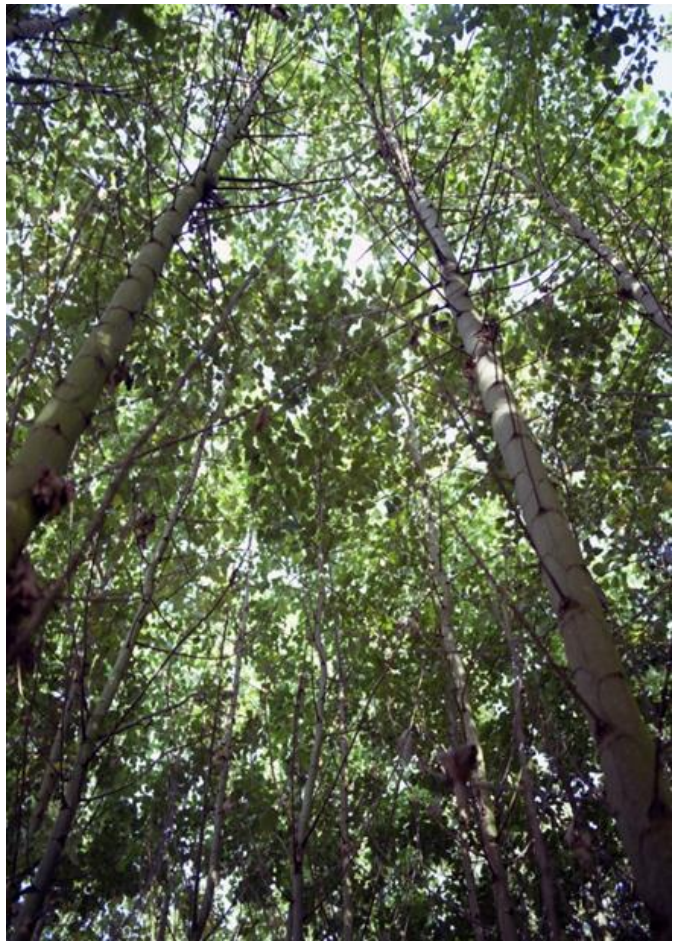
Barriers of biojet deployment



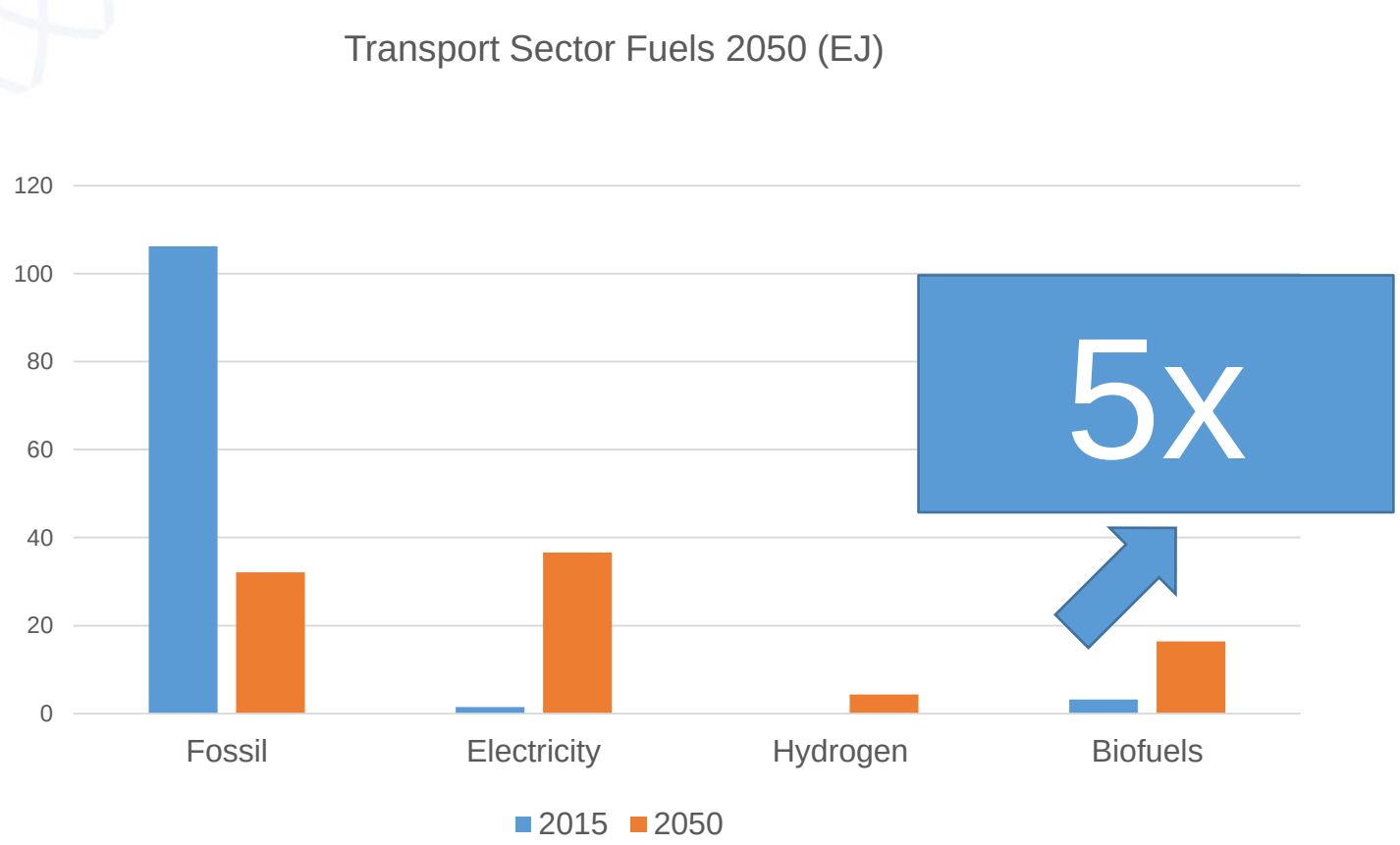
What holds back investments?
We asked the investors

EUBCE Lisbon, May 28, 2019

Sakari Oksanen
Consultant to IRENA

The climate equation cannot be solved without increasing production of liquid biofuels for the transport sector

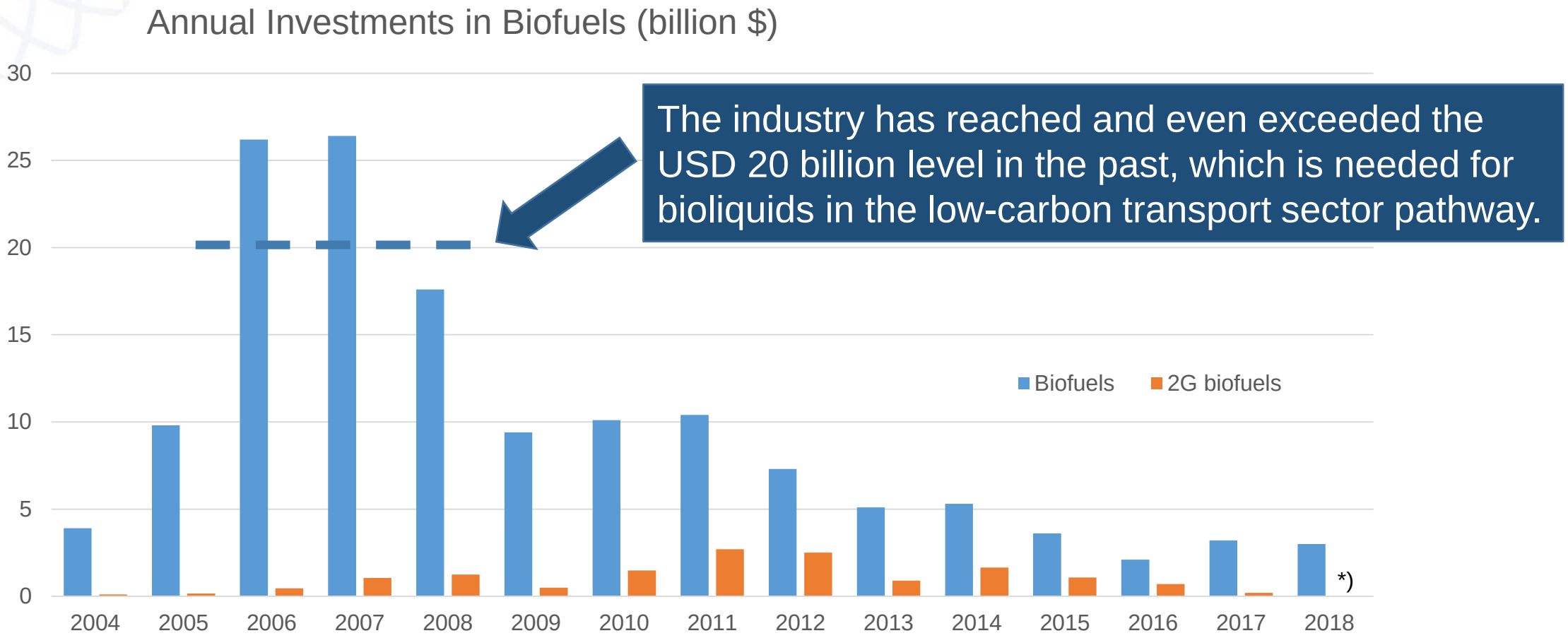
Five-fold production of bioliquids is needed by 2050



Source: IRENA (April 2019), Global energy transformation: A roadmap to 2050 (2019 edition)

Global biofuel investments are on a declining trend

To reach the 2050 climate targets, more than 100 refineries should be developed annually at the investment cost of USD 20+ billion. More than 10% of bioliquids should be allocated for aviation but the buildout of biojet refineries is slow.



Source: BNEF, *) AB 2018 not yet available

Future biojet supply will be based on a thriving biofuels ecosystem

"Importantly, we need to ensure that the output from those (biofuel) facilities is directed to aviation and not road transport which should be transitioning to electricity…" - it'll not be so straightforward!

- The merit order of Government policy measures should be based on ascending price and declining volume of GHG emission reductions.
- Liquid biofuels have a wide ranging role for decades although electricity will become the dominant energy source for road vehicles.
- We need economies of scale to press the unit cost of biofuel production low towards that of traditional fuels.
- Production of biojet through hydrocracking renewable hydrocarbons results in a higher share of lower-value naphta and refinery gas at the cost of higher-value renewable diesel (i.e. HEFA & biocrude pathway processes need to be modified).
- Some ATJ pathways convert ordinary ethanol into advanced biofuels in bolt-on facilities whereby ethanol infrastructure and market remain relevant and beneficial for biojet by-production.

Source: UPM photo bank

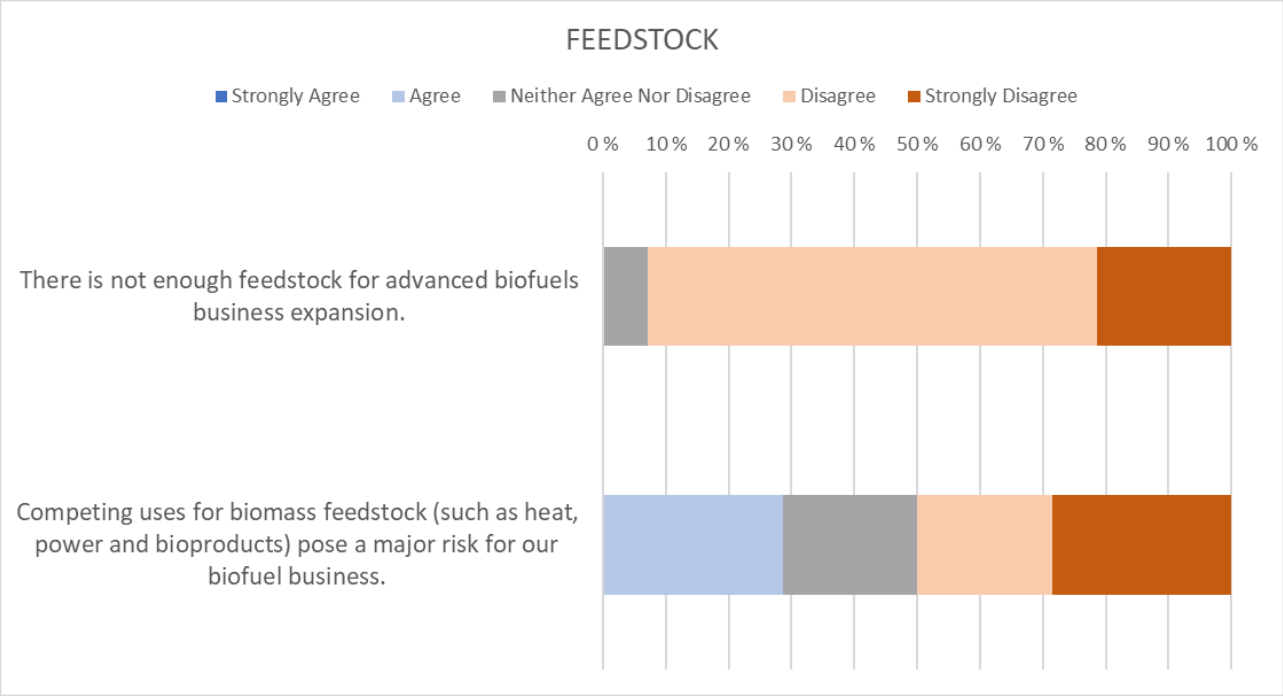
IRENA surveyed barriers to investments

Questionnaire to and interviews of advanced biofuel industry executives

- Industry executives in Europe, Brazil, China and North-America from 14 major advanced biofuel companies.
- Respondents covered key technologies, end-products and a large share of the global market.
- Questions spanned over feedstock, technology, financing, policies, consumer demand and environmental and social issues.
- Analysis sought to distinguish major issues from minor issues.

Feedstock

Two selected issues



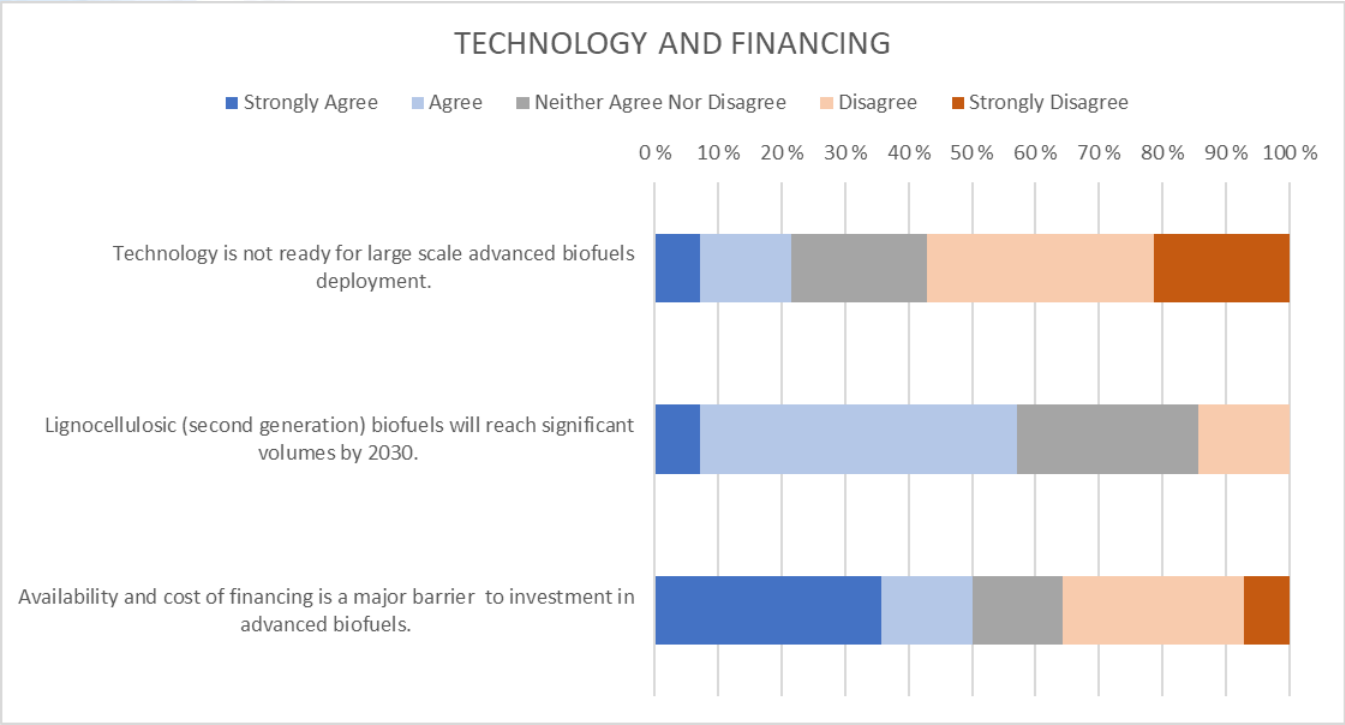
- Feedstock related issues are important but are not the most effectual impediments to investments.
- Opinions in this area are somewhat dependent on technology pathway. Lignocellulosic ethanol producers did not see any major concerns about feedstock quantity, quality and price, and their variation. However, they agreed competing uses may be an issue.

"Building new supply chains is a major part of our work.
This includes R&D, which focuses quite much on issues associated with feedstock."

Studies show there is enough feedstock in the medium term to support all demand sectors (power, buildings, industry, transport, biobased materials) but the surplus will decrease.

Technology and costs

Selected issues

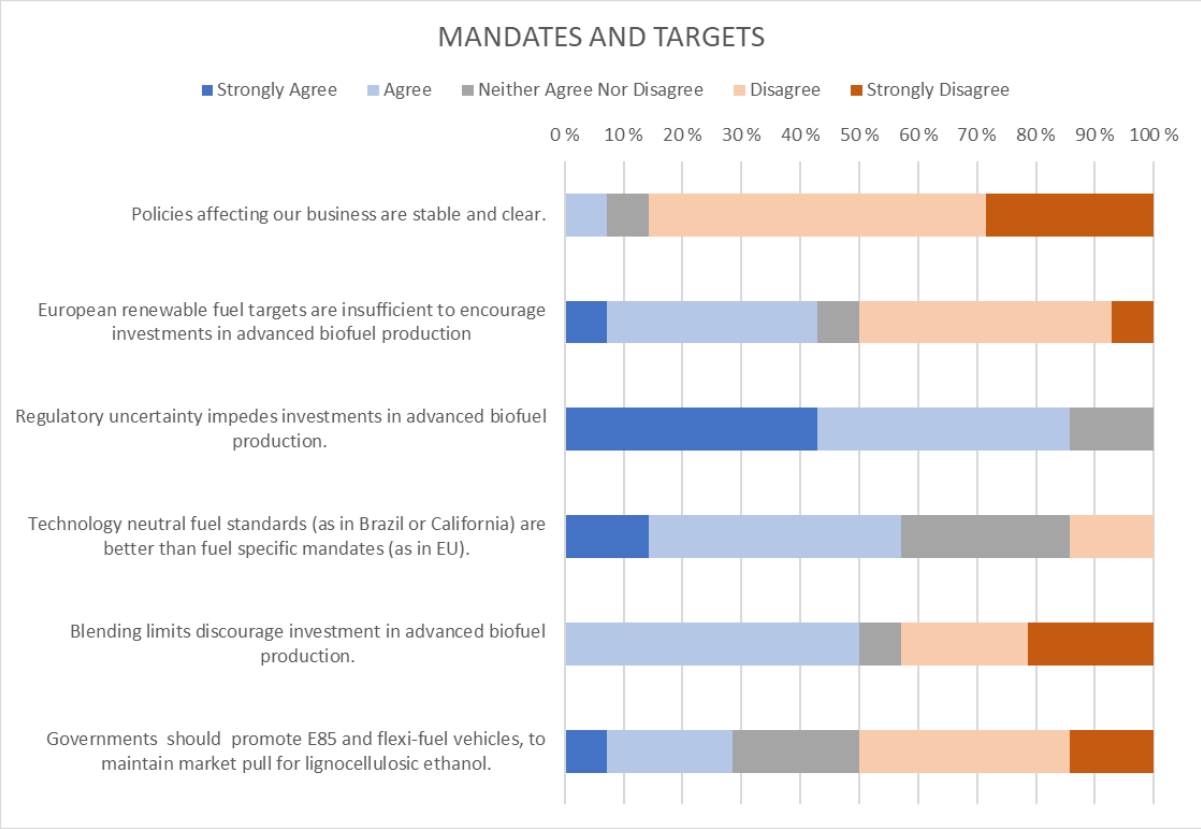


- Technology risk materialised over the last 10-15 years through many early-comers going under liquidation or diverting to other businesses.
- Majority of executives now see less problems with technology and costs.
- Lignocellulosic ethanol and thermo-chemical producers encounter more unresolved technical challenges and financing issues than HVO producers.

"Our processes are efficient and high-yielding – not much room for improvement."
"We haven't been able to make an investment decision for a new one because the plant technology has not been operating continuously stable enough."

Policies and regulation

Selected issues

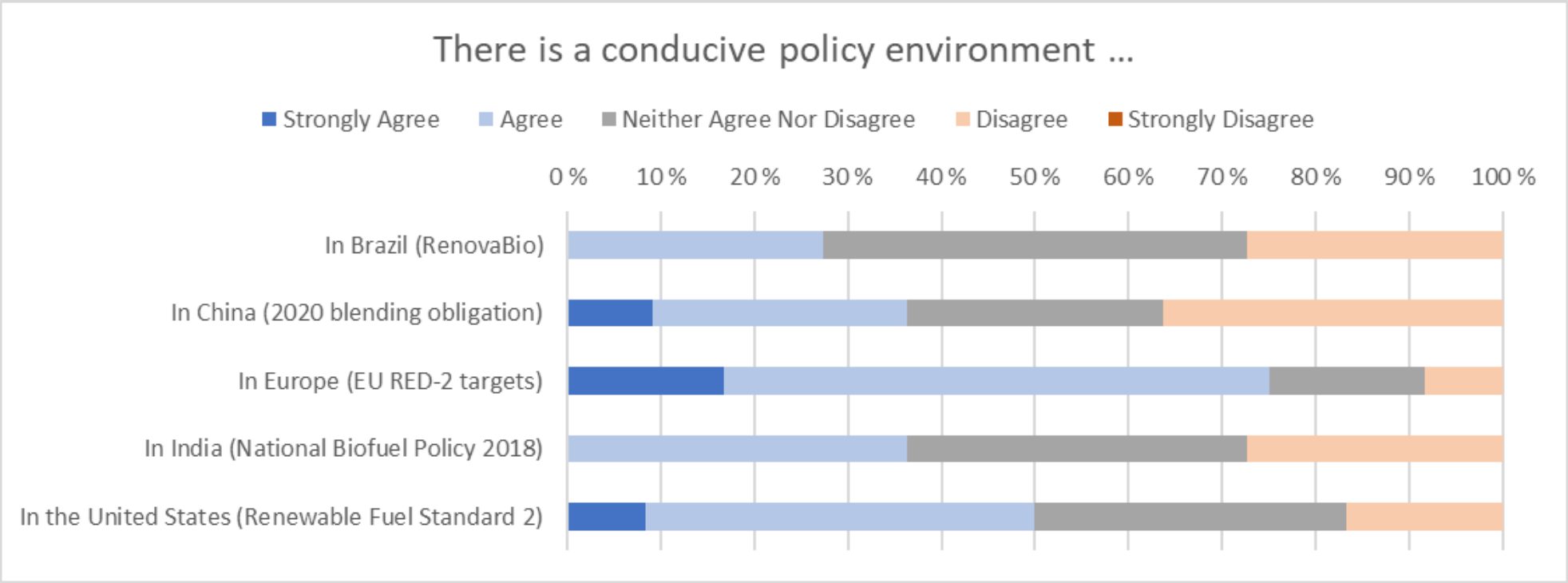


Opinions divide about FFVs, E85 and Blend Wall, which are important for representatives of ethanol pathways.

- Investors send a clear message to policy makers calling for more stable and predictable investment environment for biofuels.
- It takes 5 to 8 years to develop a refinery, and anticipated returns should be yielded in the following 15 years of operation assuming original assumptions remain valid.
- US RFS is the longest standing but EPA waivers and legal processes from many sides against EISA/RFS create uncertainty.
- European regulation brought fundamental changes (e.g. ILUC Directive 2015) to the investment environment in the middle of the 10-year RED I period (2011-2020)

Policies and regulation

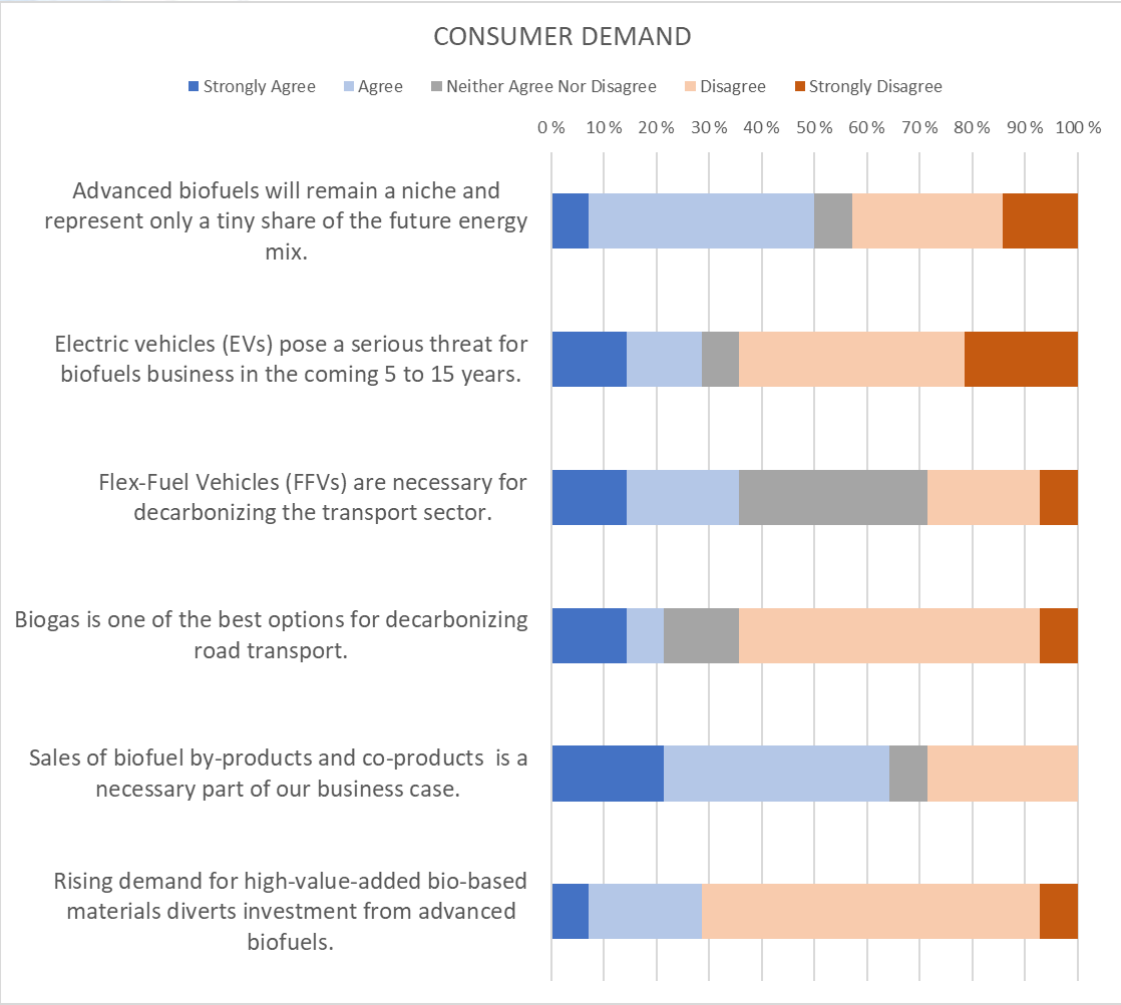
Upcoming regulatory framework



Despite highly critical assessment of the past policy arena, over 70% of the respondents found the European market under RED II (2020-2030) conducive for their business.

Demand side

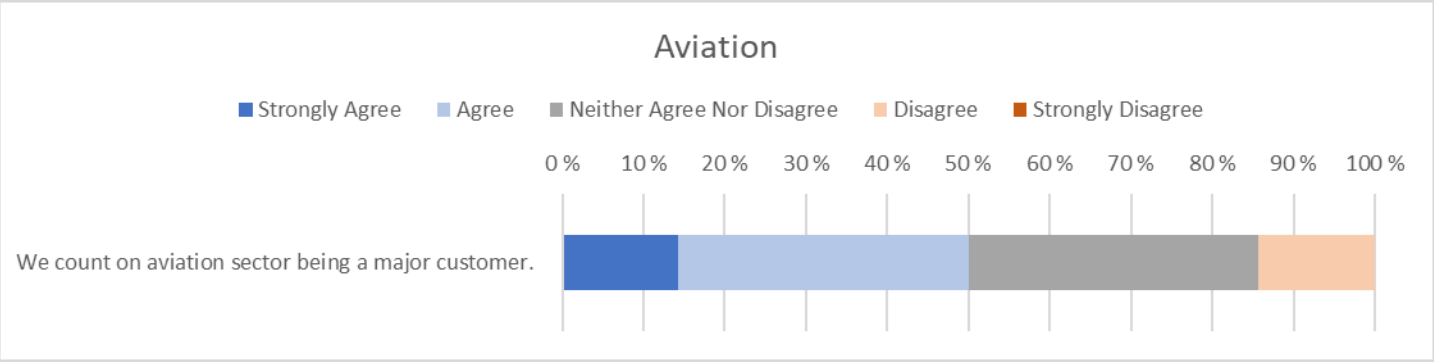
Selected issues



- No hype about the importance of advanced biofuels in the future enery mix.
- There are supporters of EVs and those seeing them as a threat for biofuels, depending on the business objectives of the company represented by the respondent.
- FFVs have some support within the ethanol producers but those focusing on drop-in fuels do not see them as playing an important role in decarbonising transport.
- Co-products are recognised as an essential part the biofuels business.

Aviation

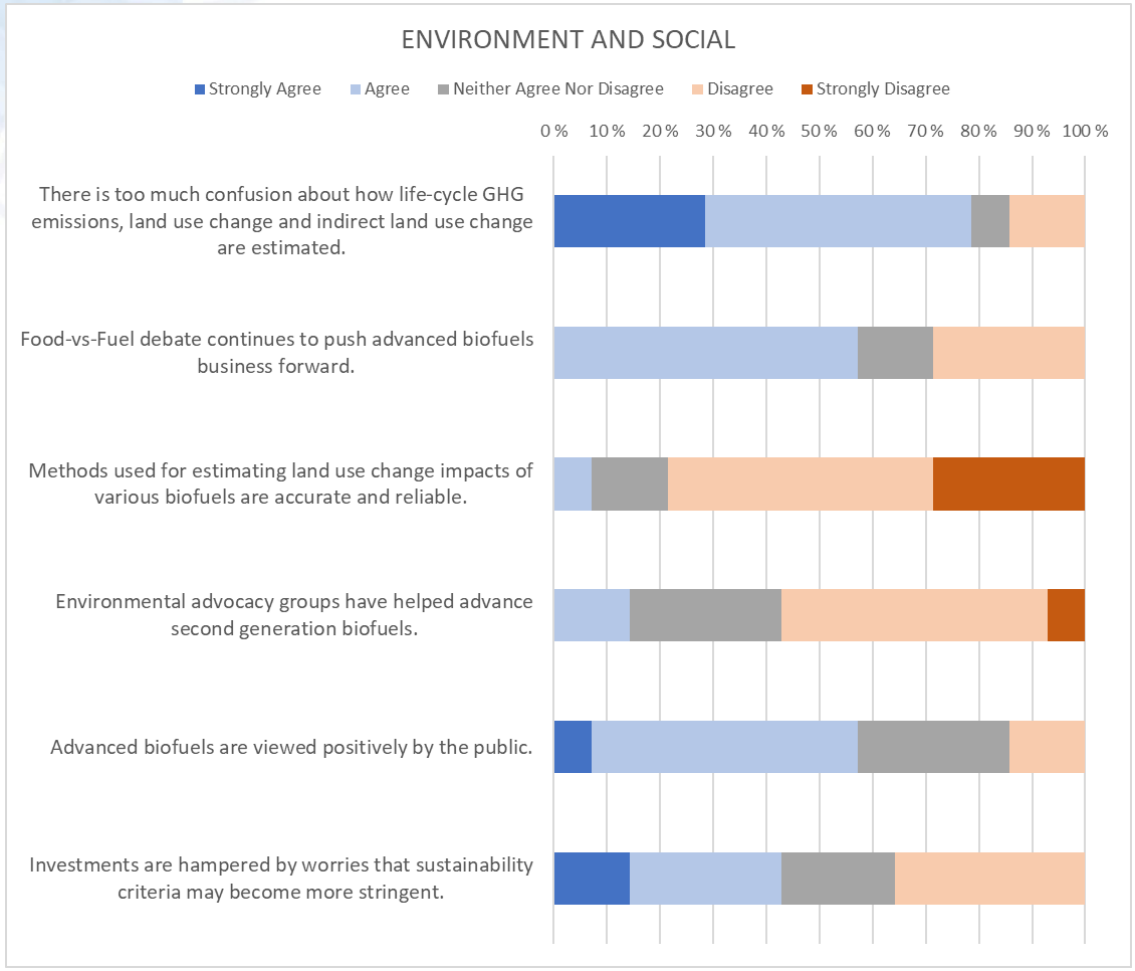
Major consumer of advanced biofuels?



- Producers of HEFA and other drop-in fuels saw potential in the aviation sector.
- The share of aviation fuels was seen between 20% and 30%, and by one ”up to 50%”.
- As long as there is sufficient demand and margin in selling fuel ethanol for blenders, the ethanol to drop-in fuels pathway may not prove attractive to many.

Social and environment

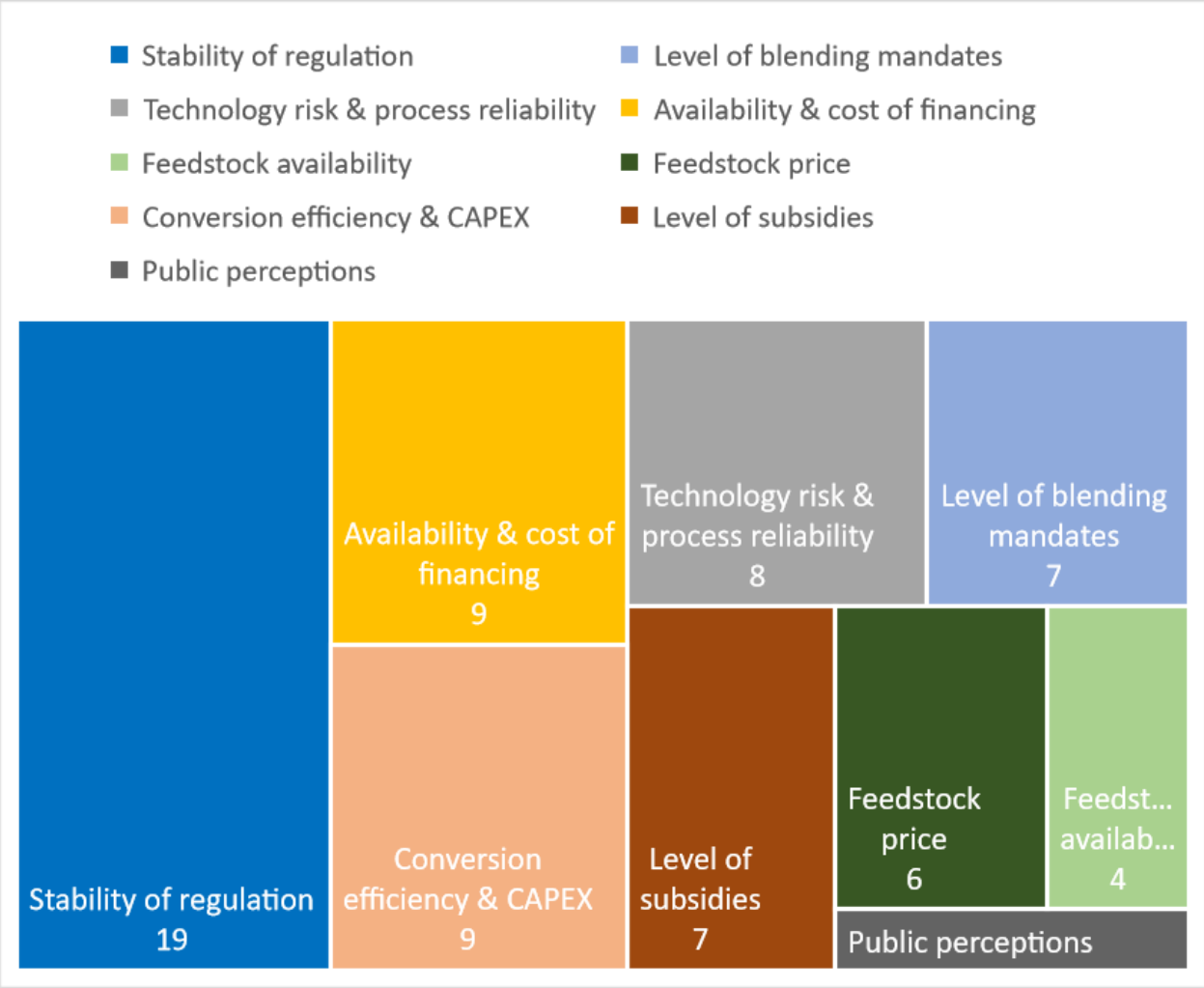
Selected issues



- General public was seen as having poor knowledge but generally positive views on biofuels, This tallies with the results of several opinion polls.
- Low confidence in emissions and ILUC estimation methodologies.
- The role of environmental advocacy groups seen counterproductive. Yet, many see that Food-vs-Fuel debate has helped advance biofuels deployment.
- Risks perceived in midst of changing landscape around sustainability criteria.

What really matters?

Ranking the barriers



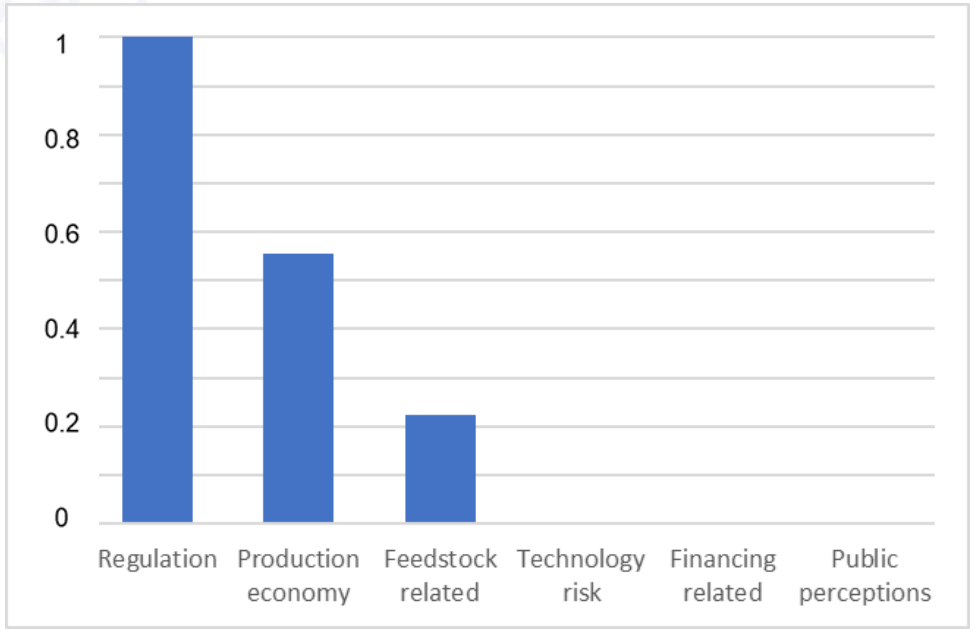
Area is in relation to perceived importance.

- ***Stability of regulation*** is clearly the most important barrier to investments followed by the cost and availability of **financing** and level of **conversion efficiency & capex**.
- The three issues of policy stability, mandates and subsidies (46%) are all dependent on regulation and thus subject to societal preferences and political control.
- The second largest ”block” relates to cost competitiveness of advanced biofuels production, formed jointly by ”conversion efficiency&CAPEX” and ”feedstock price”.

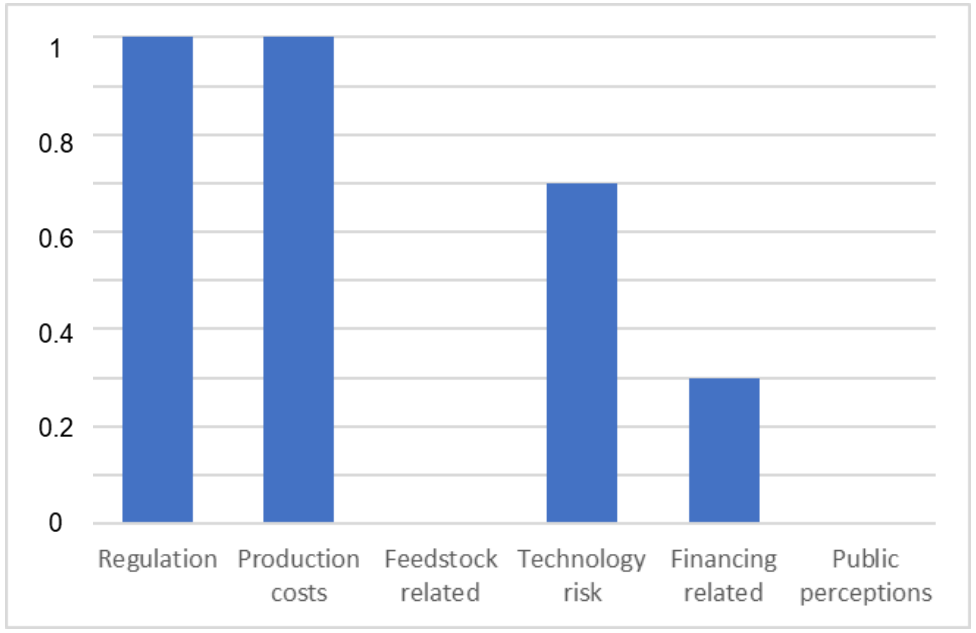
What really matters?

Ranking the barriers (2)

HEFA – drop-in fuels



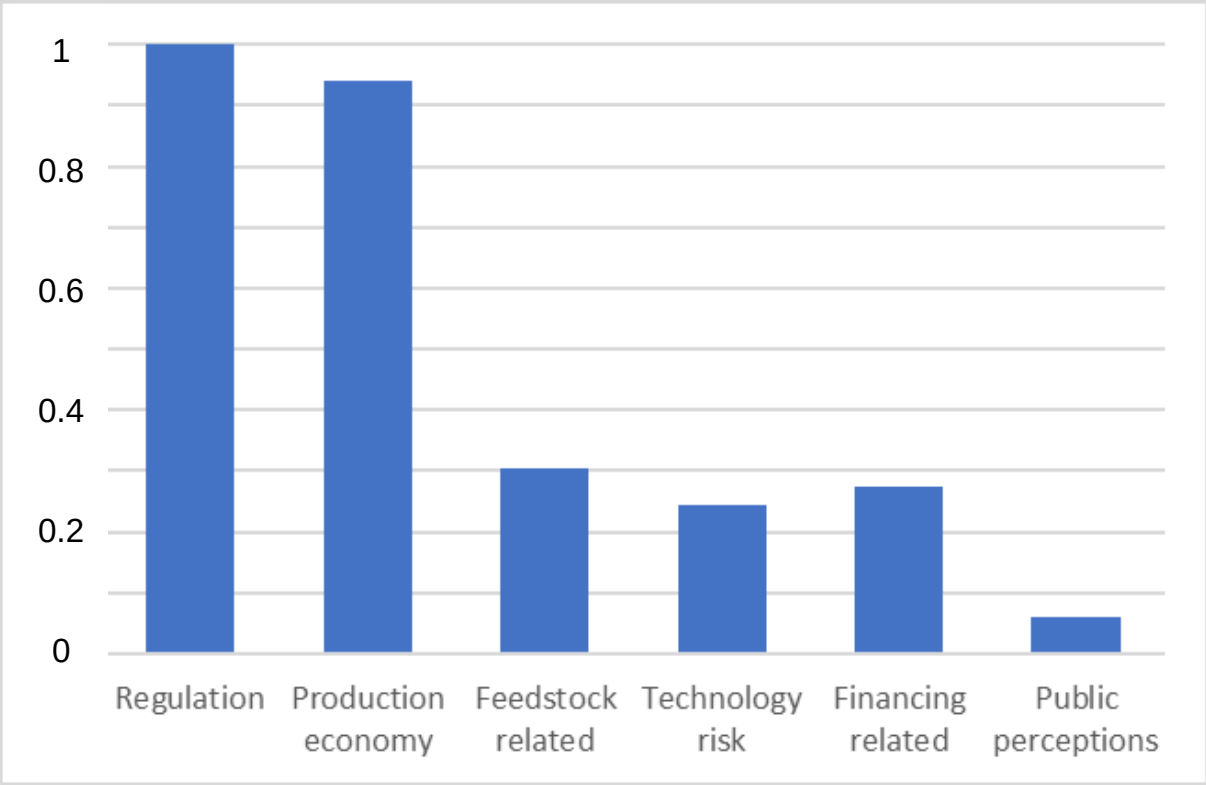
Lignocellulosic ethanol



Technological maturity of hydroprocessing of fats and oils is reflected in the responses where regulation and production economy and feedstock dominate. For lignocellulosic ethanol and thermal processes (pyrolysis, F-T) production costs, technology and financing related barriers continue hamper their businesses.

What really matters?

Ranking the barriers for all (3)



Feedstock cost was counted in both ”feedstock related” and ”production cost”.
The most important barrier was given weight 3, the second most important 2, and the third 1, and rankings then normalised against the highest ranked.

- The oft-mentioned technology risk, whilst important, does not rank among the highest. Many producers already operate successfully in the market. It promises the industry’s ability to scale-up to meet the targets set for the sector should there be enabling policies in place.
- The respondents did not rank the following potential barriers at all:
  - Feedstock quality
  - Innovation & future cost reduction
  - Environmental performance (LUC/ILUC)
  - Transport sector trends (EVs, stringent aviation fuel requirements, etc.)

Thank you!

IRENA

International Renewable Energy Agency