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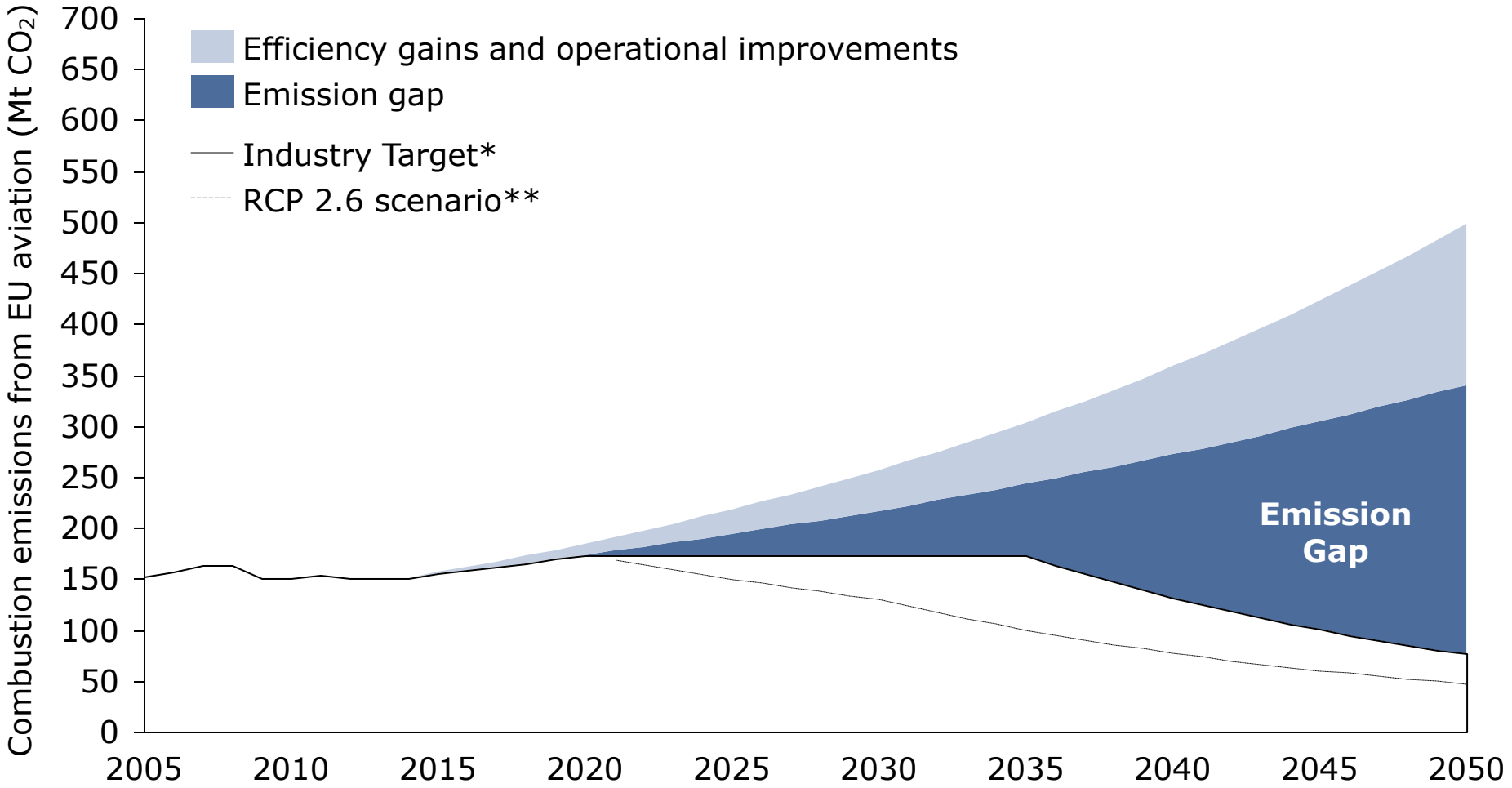
A roadmap for the adoption of renewable jet fuels (RJF) in Europe

IEA Bioenergy workshop, 9 November 2016

Sierk de Jong
Utrecht University and SkyNRG

The Emission Gap of European aviation grows rapidly towards 2030 and beyond

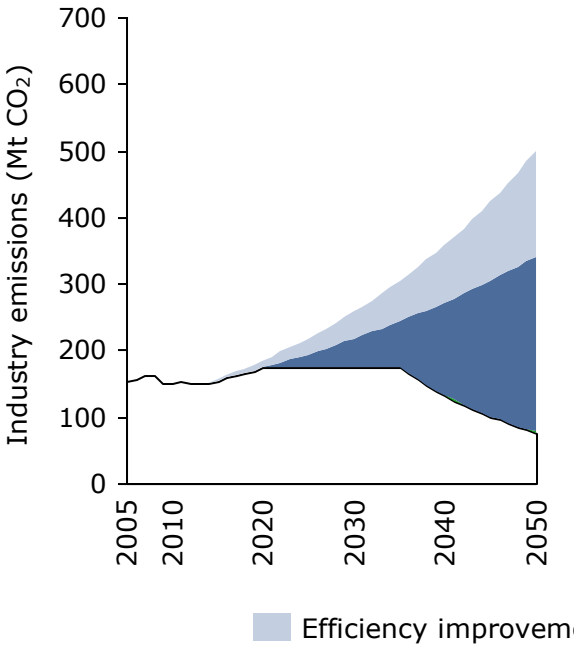


*Carbon neutral growth after 2020 and an emission reduction of 50% in 2050 relative to 2005.
**The Representative Concentration Pathway (RCP) 2.6 represents a pathway likely leading to a temperature rise ranging from 0.9 to 2.3 °C (mean 1.6). The share of global emissions of the aviation sector is kept constant after 2020.

CORSIA offsets and RJF may be used in varying shares to cover the Emission Gap

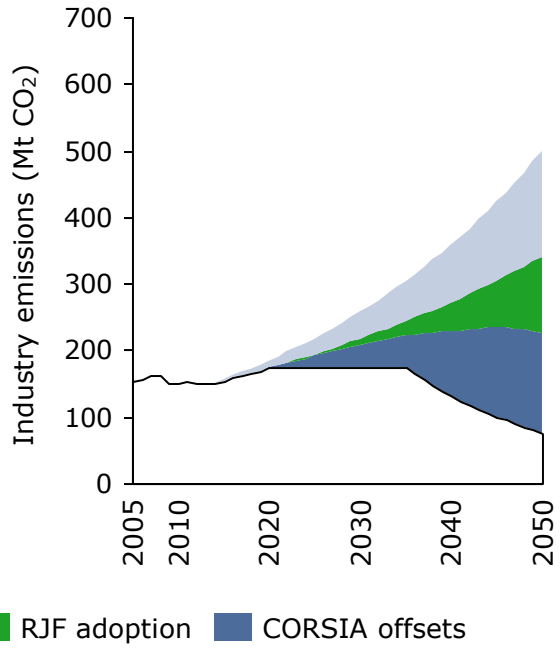
RJF deployment scenarios

Business as Usual (BAU)



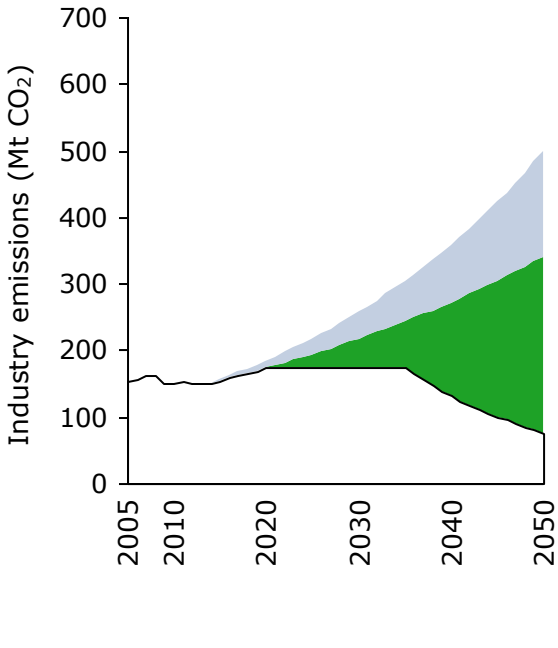
Storyline:
Absence of dedicated policies; premium for RJF is covered by airlines or external funding (0.01% of annual fuel expenses)

Delayed action



Storyline:
Gradual introduction of RJF instigated by policy incentives: 0.5% blend in 2021, growing to 5% in 2030

Full RJF adoption



Storyline:
Aggressive blending targets such that RJF covers the entire Emission Gap

CORSIA offsets and RJF may be used in varying shares to cover the Emission Gap

RJF deployment scenarios

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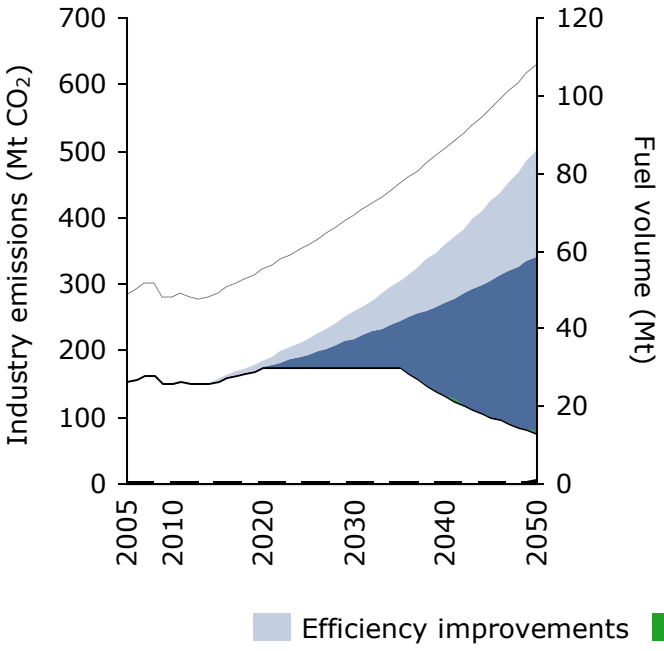

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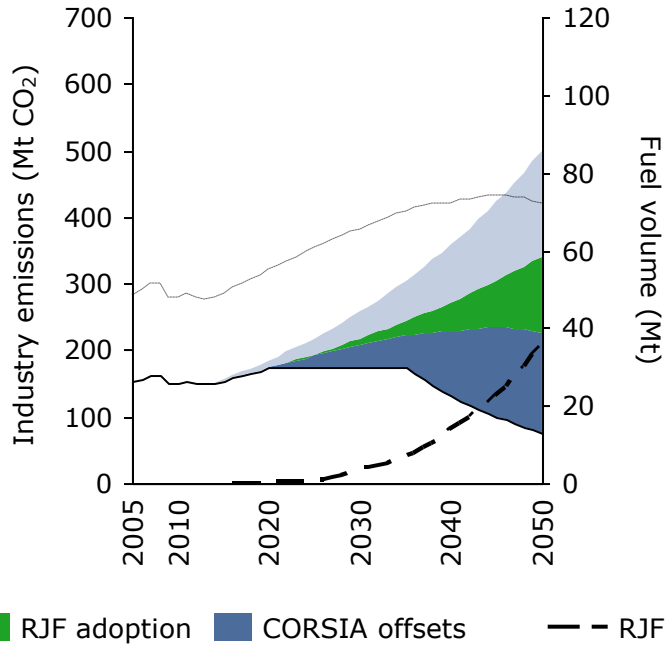

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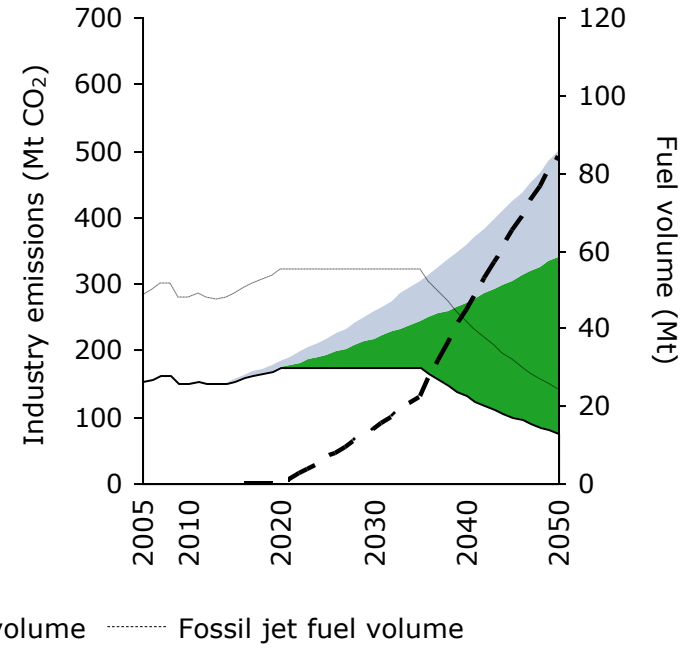

Storyline:
Aggressive blending targets such that RJF covers the entire Emission Gap

A European bioenergy model was used to assess the deployment scenarios up to 2030

Final demand

Included *Future work*

Input data
- Techno-economic data
- Biomass potentials
- Share of renewables in other demand sectors
- Model constraints
- Endogenous learning

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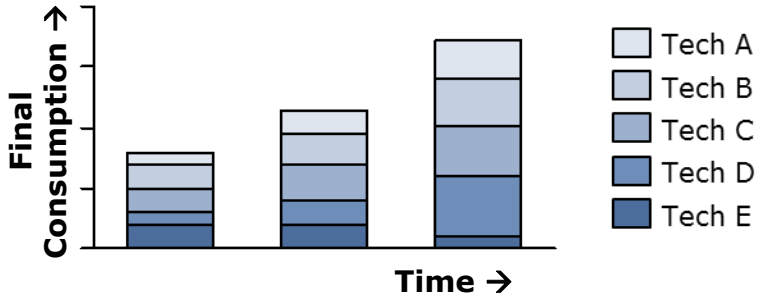
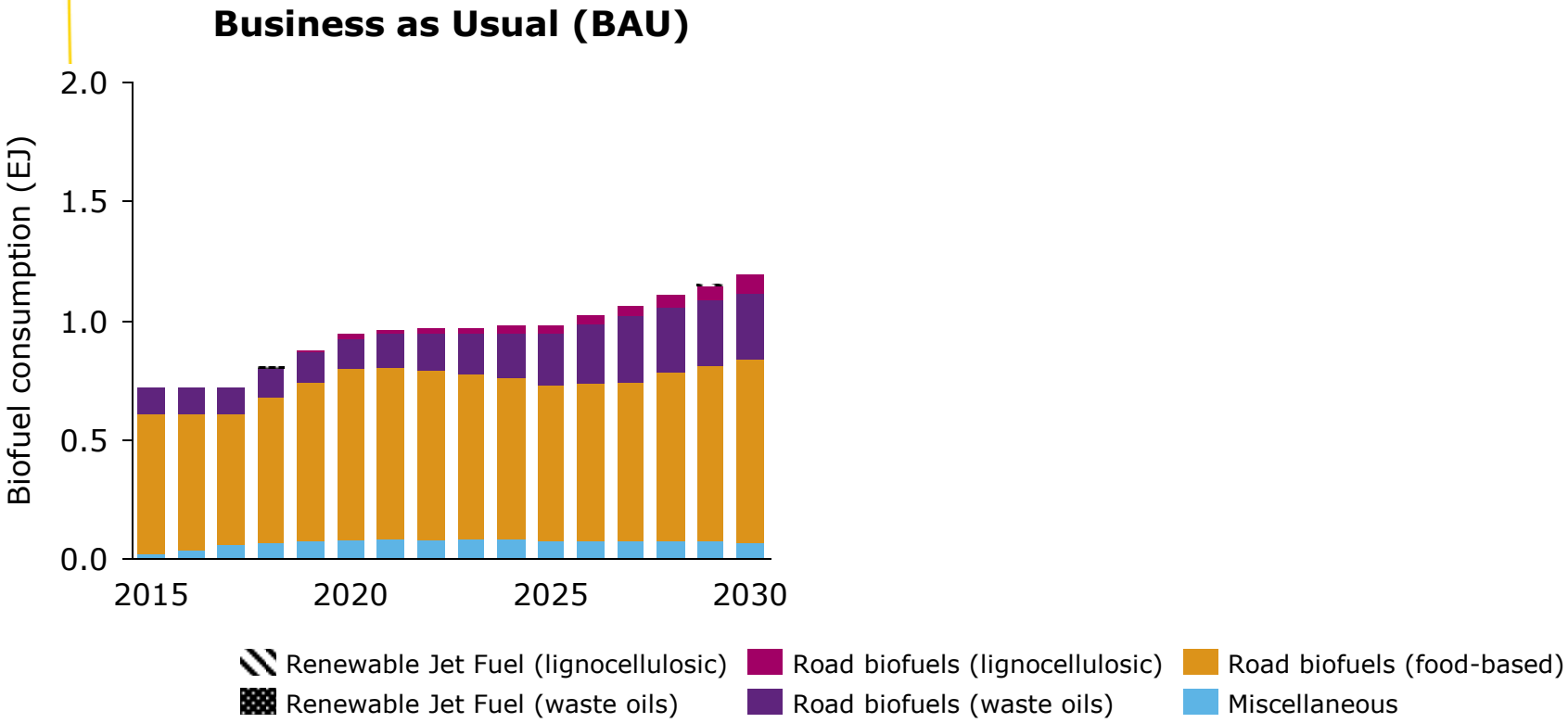
RESolve-Biomass model
Cost optimization model for EU-28 from 2005-2030 developed by Energy Centre Netherlands (ECN)

Deployment scenarios
- Business as Usual (BAU)
- Delayed action
- Full RJF adoption

Outcome: Feedstock/technology portfolio and associated costs



The BAU scenario shows no RJF growth

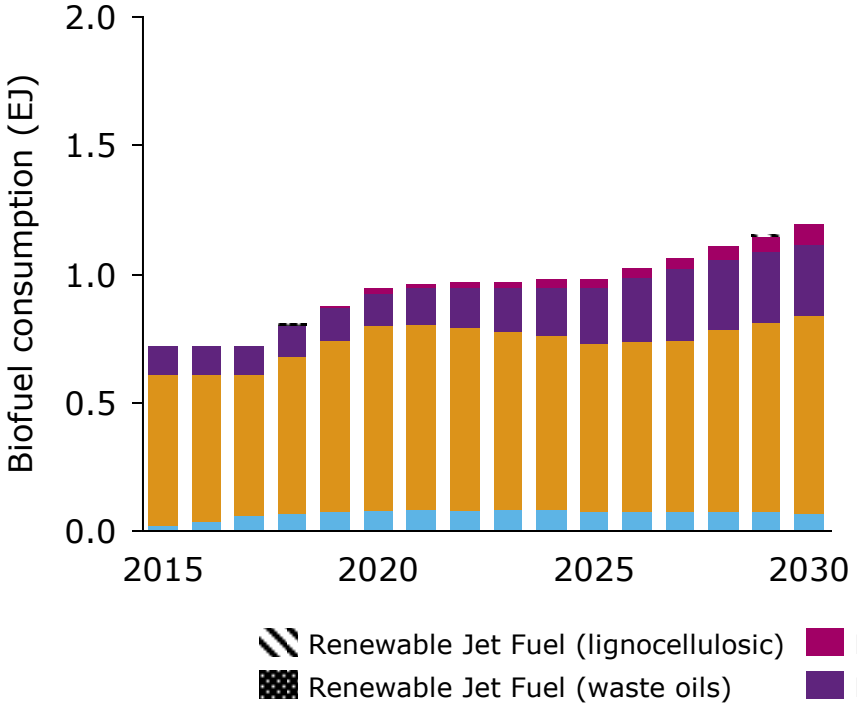


Observations:

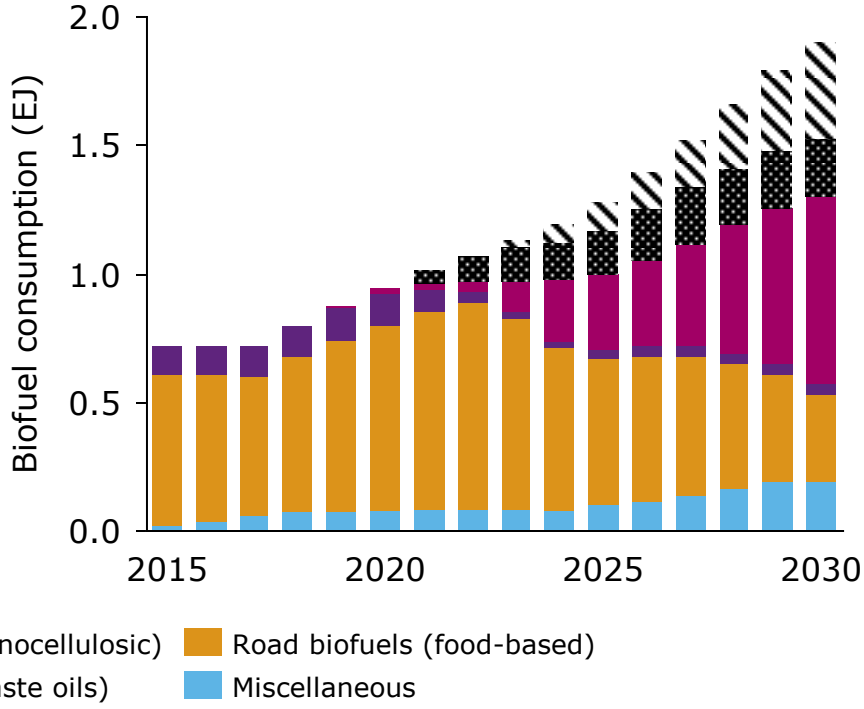
- No action means RJF volumes remain negligible up to 2030
- No stimulation of development activities to produce RJF

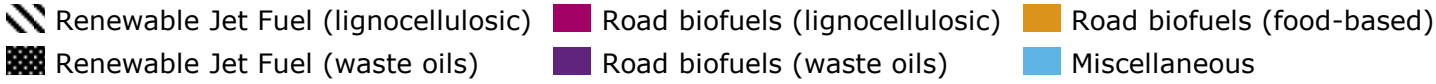
The BAU scenario shows no RJF growth, Full RJF Adoption requires unprecedented growth

Business as Usual (BAU)



Full RJF Adoption





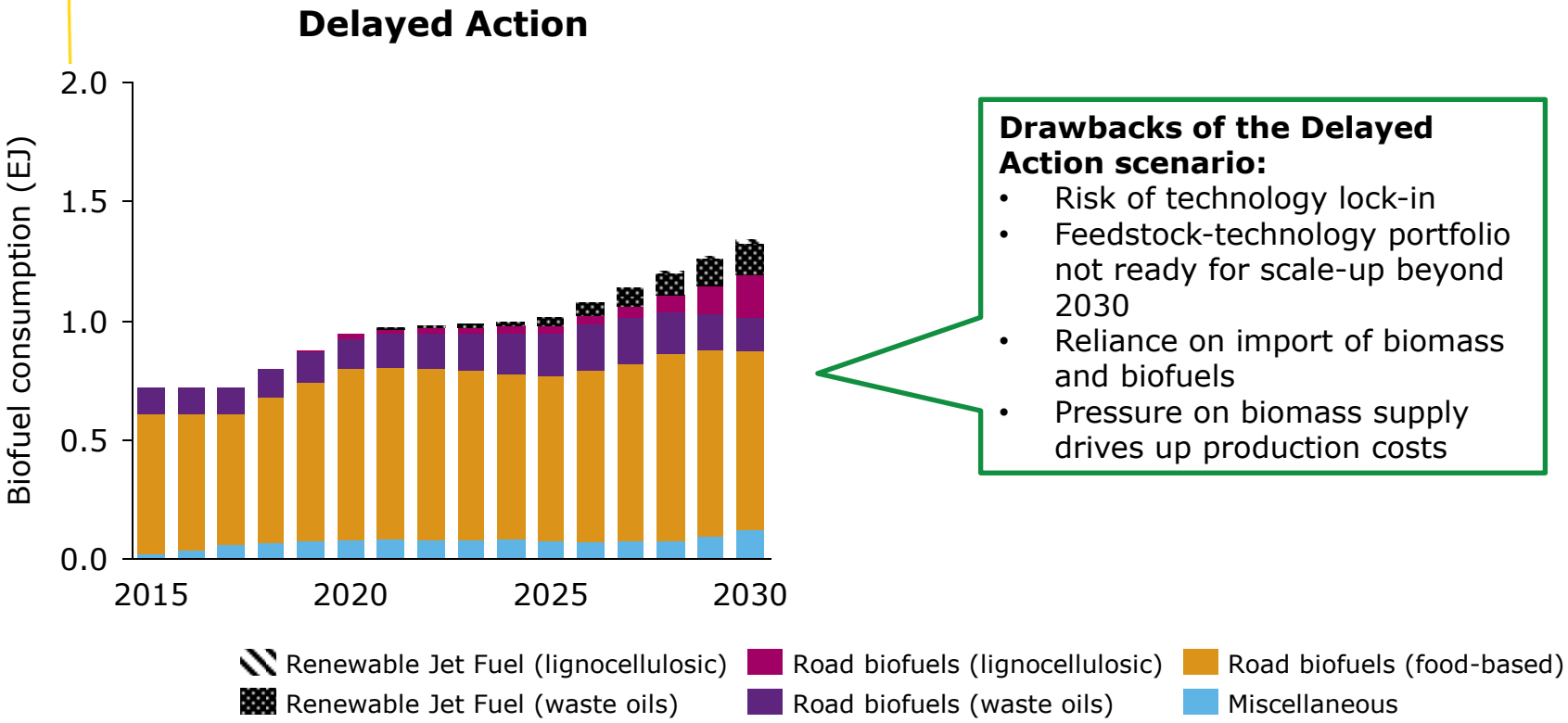
Observations:

- No action means RJF volumes remain negligible up to 2030
- No stimulation of development activities to produce RJF

Observations:

- Rapid upscaling causes a disruptive shift in the feedstock-technology portfolio
- This scenario requires unprecedented increase in feedstock mobilization rate and deployment rate of advanced biofuel production capacity

The Delayed action scenario gradually integrates RJF in the feedstock-technology portfolio



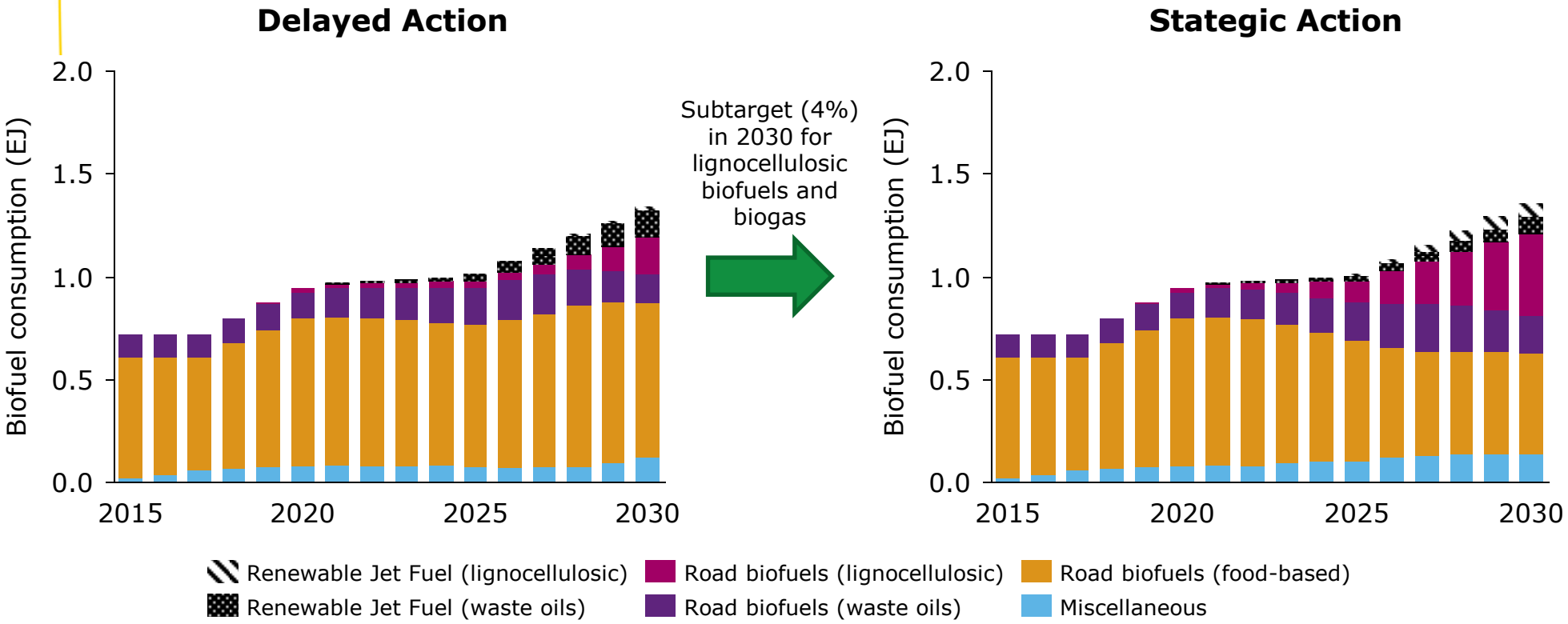
Drawbacks of the Delayed Action scenario:

- Risk of technology lock-in
- Feedstock-technology portfolio not ready for scale-up beyond 2030
- Reliance on import of biomass and biofuels
- Pressure on biomass supply drives up production costs

Observations:

- HEFA RJF represents nearly 90% of the total RJF supply
- Little development of technologies able to unlock lignocellulosic biomass

The Strategic Action scenario paves the way for sustainable biofuel scale-up beyond 2030



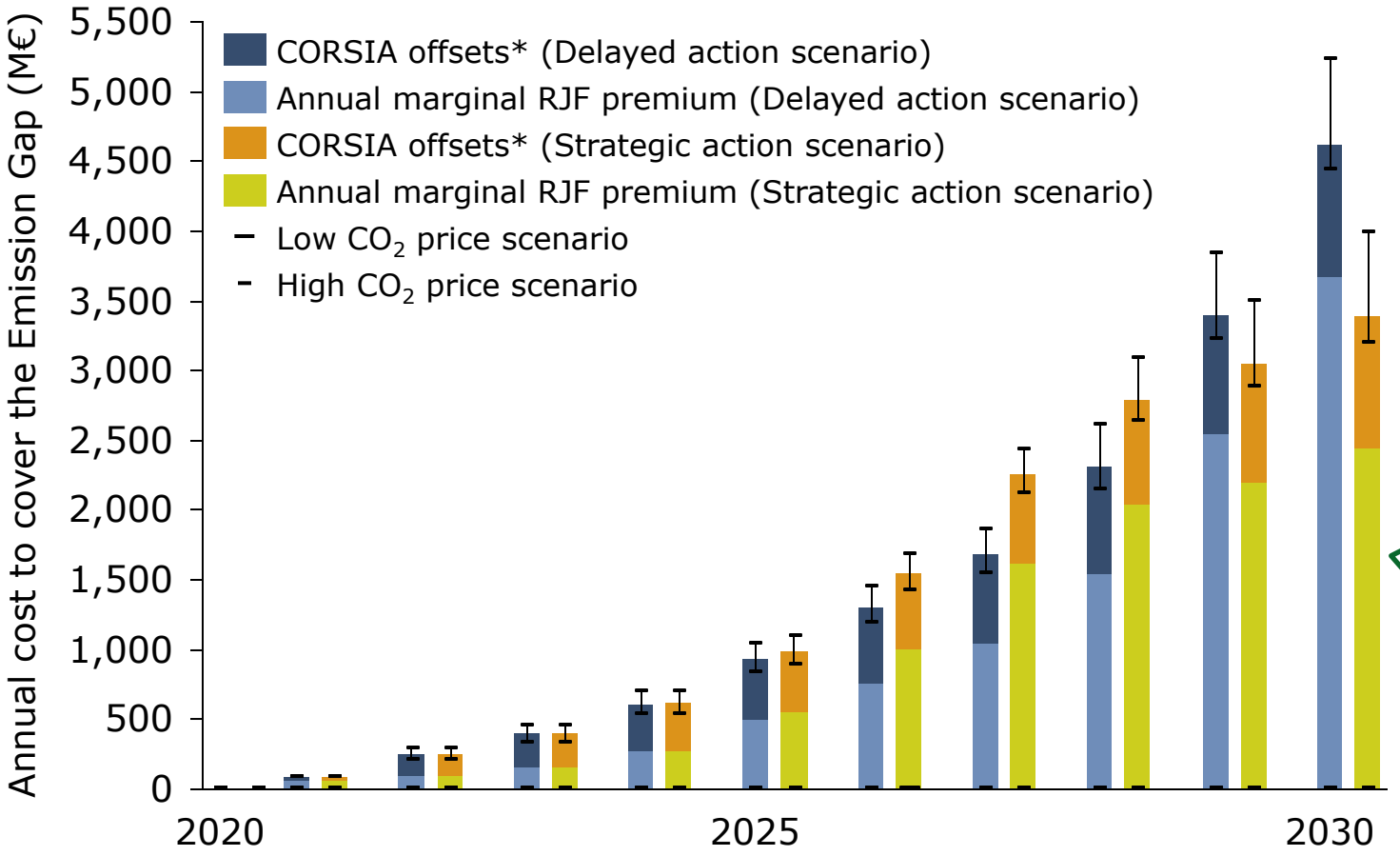
Observations:

- HEFA RJF represents nearly 90% of the total RJF supply
- Little development of technologies able to unlock lignocellulosic biomass

Observations:

- Gradual increase of lignocellulosic biofuels and natural phase out of food-based biofuels
- Diversified feedstock-technology portfolio
- Synergies between road and aviation biofuels

Towards 2030 the Strategic action scenario shows a cost benefit over the delayed action scenario



RJF premium in 2030:
- 2.4 B€/yr
- 700 €/t RJF
- 220 €/t CO_2
- 2 €/departing passenger from an EU airport

*The annual cost of CORSIA offsets were calculated using an increasing CO_2 price of 10 to 29 €/t CO_2 over 2020-2030. The low and high CO_2 price scenario use 10-23 €/t CO_2 and 10-47 €/t CO_2, respectively (Source: Synapse, 2016).

Recommendations

General findings

- Aviation should be addressed in (inter)national decarbonization strategies
- Significant effort and funding is required
- Growing a biofuel industry takes multiple decades and hence a long-term vision
- Strategic (policy) choices need to be made now to achieve climate targets

Recommendations for policy makers

- Stimulate feedstock mobilization and technology development:
  - Short term: de-risk technologies and cover the price premium (on a local level)
  - Long term: incorporate the price premium in the service (on a global/EU level)
- Stimulate the adoption of other renewable energy sources in sectors which have an alternative to bioenergy (e.g. road transport or electricity)

Recommendations for the aviation industry

- Actively support the development of RJF, use offsets to buy time
- Develop consumer programmes on an airline (e.g. Fly Green Fund) or airport level (e.g. Airport Initiative) to cover the price premium and gain experience with RJF

Recommendations for research institutes

- Aid technology R&D
- Assess biofuel deployment scenarios (post 2030) including aviation, chemicals & marine
- Keep improving the knowledge on sustainability impacts of RJF (e.g. land use change, carbon debt, non-CO_2 effects)

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Outputs RENJET project

- De Jong et al. "The feasibility of short-term production strategies for renewable jet fuels – A comprehensive techno-economic comparison". Biofuel, Bioprod. Bioref. 9:778–800 (2015), DOI: 10.1002/bbb.1613
- Mawhood et al. "Establishing a European renewable jet fuel supply chain: the techno-economic potential of biomass conversion technologies". Report (2014)
- Mawhood et al. "Production pathways for renewable jet fuel: a review of commercialization status and future prospects". (2016) DOI: 10.1002/bbb.1644
- De Jong et al. "Greenhouse gas performance of renewable jet fuel conversion pathways". (forthcoming)
- De Jong et al. "Renewable jet fuel in the EU28 – a quantified roadmap to 2030". (forthcoming)