EASA
European Union Aviation Safety Agency

EUROPEAN UNION

Welcome to the 14th webinar of the series on

Sustainability - EU/SEA CCCA CORSIA Project

The webinar will start @ 15h Bangkok/Jakarta/Hanoi Time
16h Singapore/Manila Time
10h Brussels/Cologne Time

1977-2022
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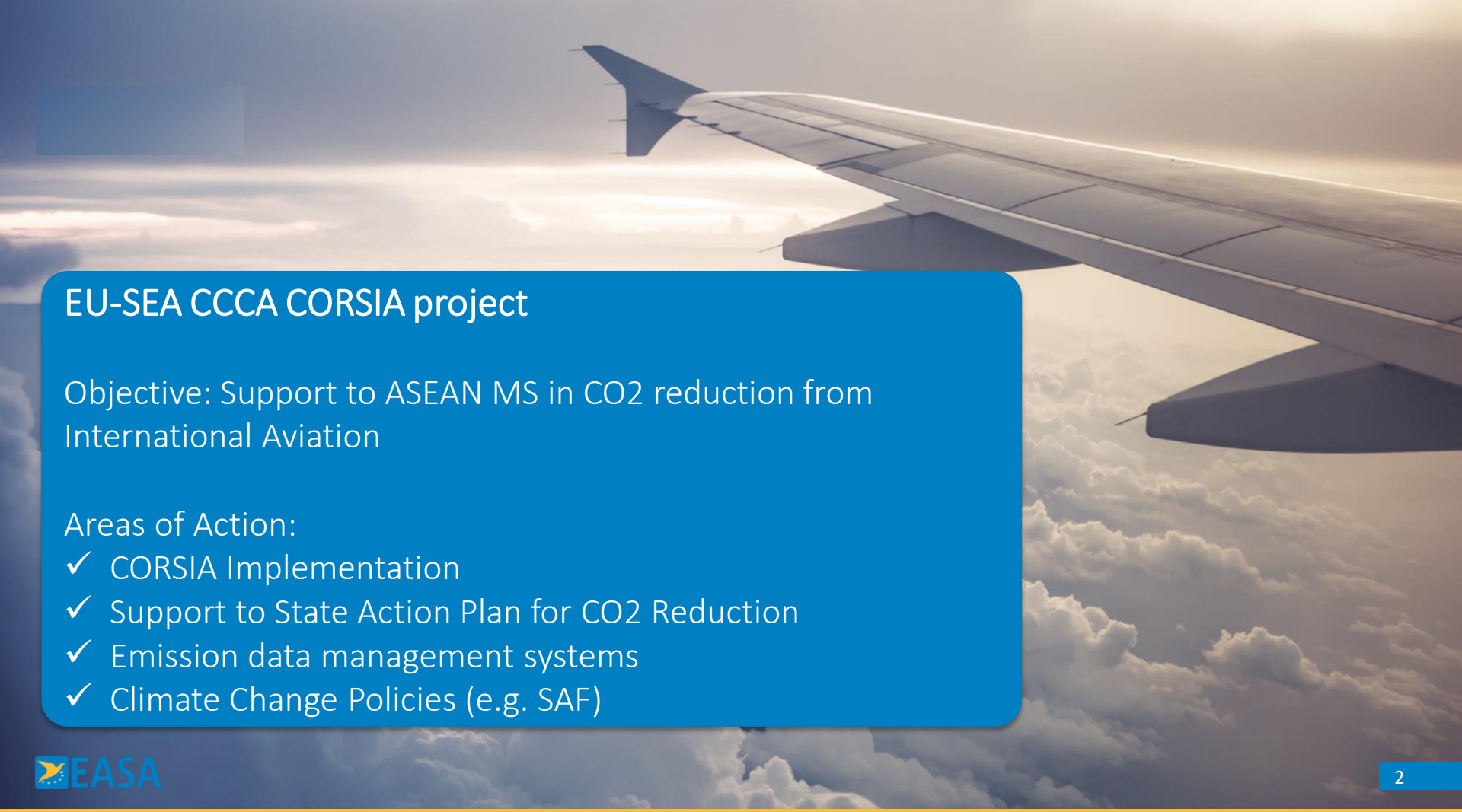

EU-SEA CCCA CORSIA project

Objective: Support to ASEAN MS in CO2 reduction from International Aviation

Areas of Action:

- ✓ CORSIA Implementation
- ✓ Support to State Action Plan for CO2 Reduction
- ✓ Emission data management systems
- ✓ Climate Change Policies (e.g. SAF)

Some practicalities & moderators

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→ **Q&A** after the speaker

→ Use Q&A section (Slido)

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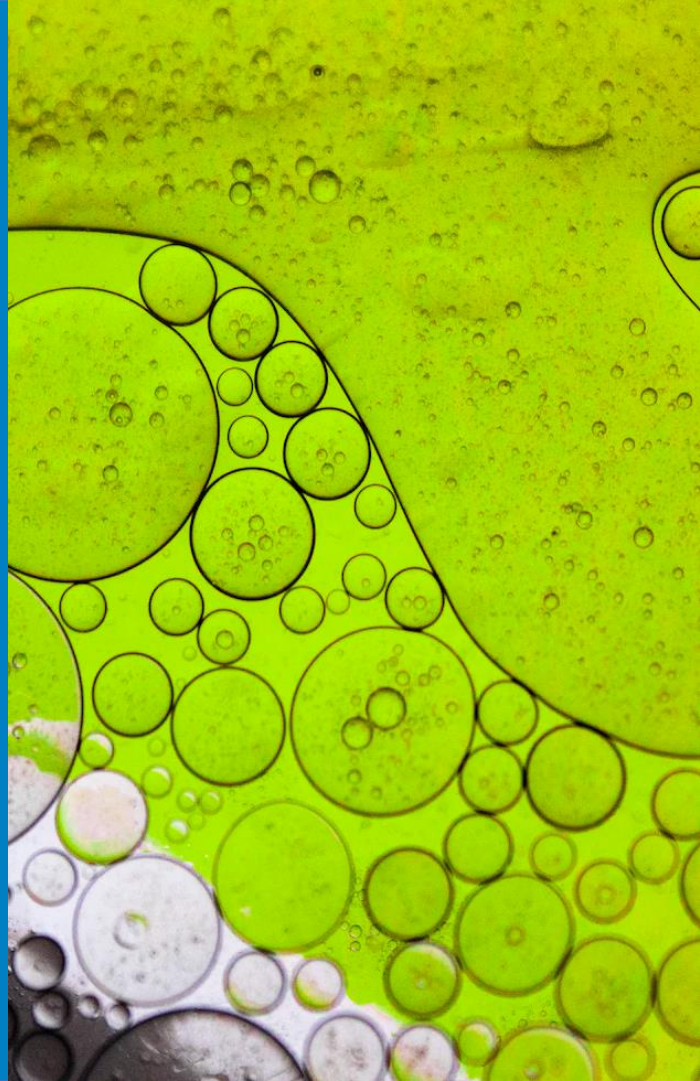
Webinar 14:

Building a Viable Business Case (Plan) for Investability of SAF Projects

Do‘s & Don‘ts when building a SAF business case. Success factors and major drivers of SAF return. Assessing the role and views of different investor types. Lessons learned from building a set of viable techno-economic assumptions: What decides a SAF project’s financial competitiveness and bankability?



Our key speakers for today!

Sebastian Koch

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CBR Consult & Invest GmbH

Senior Finance Expert

Sebastian Koch has over 15 years of experience in the field of corporate finance, analysis of renewable fuel and green chemical projects as well as sustainable risk management. He has experience with strategy development and feasibility studies for various market entries and climate relevant technologies. He is experienced in identifying major business risks, developing financial models and business plans, and conduct in-depth review of financial solidity, risk and sensitivity drivers of renewable fuels projects.

Consulting Focus @ CBR

- Financial modelling and due diligence for SAF
- M&A transaction advisory and fundraising for asset-heavy SAF project developments (first-of-its kind plants)

Education

Master of Business Administration – Tsinghua University, China, MIT - Massachusetts Institute of Technology, USA
Master of Economics, Ludwig-Maximilians University, Germany

Our key speakers for today!

Raphaela Spielberg

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CBR Consult & Invest GmbH

Senior SAF Consultant

Raphaela Spielberg has over 7 years professional experience in the financial field, and 5 years of experience in strategy development and implementation of impact projects and climate technologies. She has gained experience in thematical investment consulting and climate risk management of ESG compliant projects. She is experienced in assessing and developing business cases in the PtX field, analysing global challenges and opportunities, executing the financial modelling and conducting deep-dive research of risk and sensitivity.

Consulting Focus @ CBR Consult & Invest GmbH

- Project management and business planning, e.g., application support for EU funding programs for the demonstration of innovative low-carbon technologies (EU Innovation Fund)
- ESG and Sustainability (CSR) concept development and implementation (strategy, roadmaps, reporting, labels)

Education

Sustainability & Climate Risk Professional, GARP

Master in Sustainable Finance, NOVA SBE, Lisbon

The financing of SAF market is ambivalent

In just five months, the United Airlines Ventures Sustainable Flight Fund [SM] increased in size to nearly $200 million and welcomes American Express Global Business Travel, Aramco Ventures, Aviation Capital Group, Bank of America, Boston Consulting Group, Groupe ADP, Hawaiian Airlines, and JetBlue Ventures

International: H2Global enables imports of sustainable hydrogen products into Germany and incentivizes investment in green hydrogen outside of the European Union

Shell puts a stop to Singapore biofuels, base oil projects

Repsol to invest more than $130 million to retrofit plant to produce biofuels

RockCreek, a prominent global multi-asset firm specialising in energy transition investments, has successfully concluded its investment in Raven SR, Inc., a company at the forefront of producing high-value renewable transportation fuels from diverse feedstocks, including waste streams.

Shell will spend up to $1bn annually on hydrogen and CCS in 2024 and 2025

Oil giant said it will focus on regions where subsidies exist, and praised the US Inflation Reduction Act

SAF Startup Scores $22M in Development Funding

OXCCU, a new entrant into the sustainable fuel production arena, has earned funding to scale up its novel production process.

The Raven SR investment is part of RockCreek's Smart Aviation Futures fund.

SCA, St1 expand venture to produce SAF from pine oil

Published date: 06 May 2022

Share:

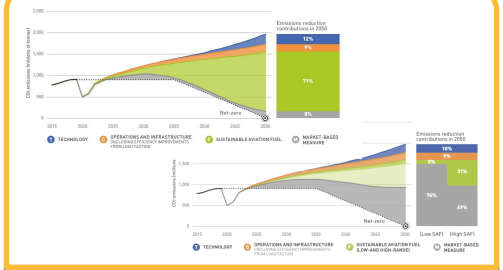
Swedish forestry business SCA and Finnish bioenergy firm St1 will expand their partnership to produce sustainable aviation fuel (SAF) from pine oil for the Swedish market from a new jointly-owned biorefinery, starting from 2023.

Source: Press releases

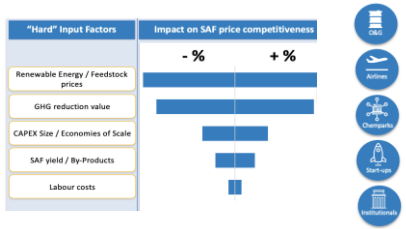
Agenda

Building a Viable Business Case (Plan) for SAF Projects

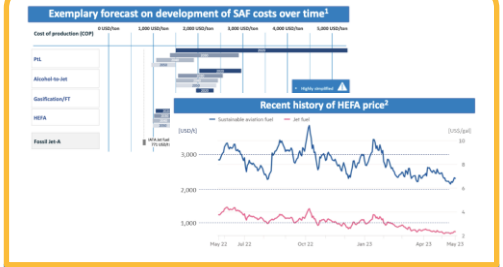
Guiding questions today



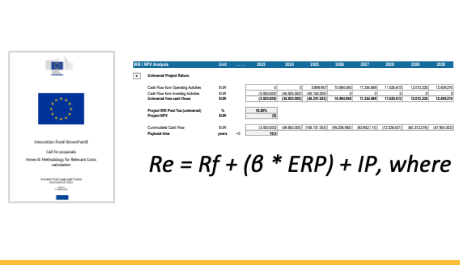
Why is it key to develop solid SAF business cases and to assess the long-term investment opportunity?



What are the key parameters and their sensitivities on the business case?



What SAF business case aspects challenge the financing landscape and how to overcome these?

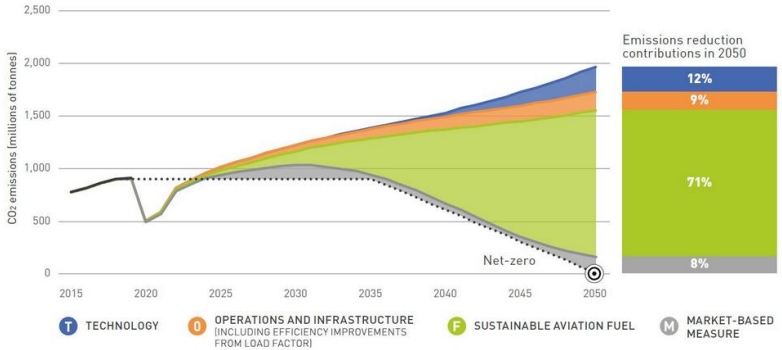


How to assess the competitiveness between projects based on financial modelling?

Huge investment and fuels with high emissions reduction factor needed, to deploy the potential of SAF as key solution to decarbonise aviation

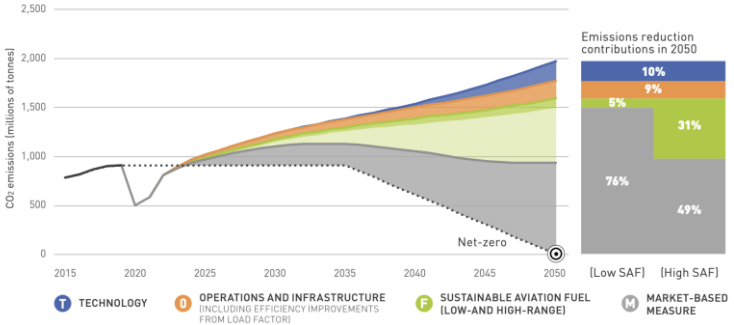
Industry view

SAF has the potential to contribute up to 71% to the emission reduction until 2050…



"Aggressive" sustainable fuel deployment

At the current rate, SAF will only contribute 5-31% to the emissions reduction in aviation.



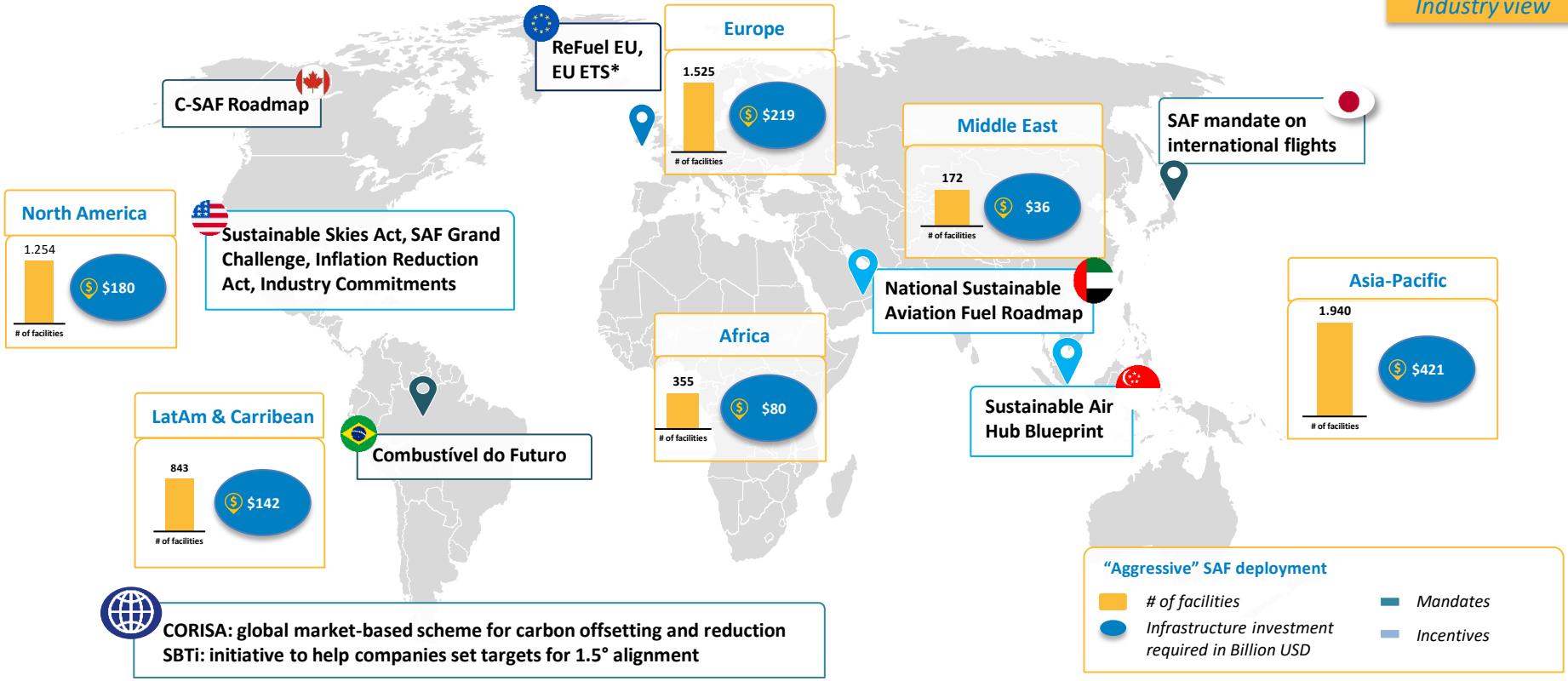
Continuation of current trends

- The BAU (business-as-usual) scenario would result in **approximately 30 to 195 million tonnes in 2050.**
- In this case, SAFs will only **contribute to 5-31%**, leaving the major part **to market-based measures**.

Source: ATAG, Waypoint 2050 report. ATAG: Airports Council International (ACI), Civil Air Navigation Services Organisation (CANSO), International Air Transport Association (IATA), International Business Aviation Council (IBAC), Airlines for America (A4A), Association of Asia-Pacific Airlines (AAPA), Airbus, Boeing, CFM International, GE Aviation, Pratt & Whitney, Rolls-Royce and Safran.

An investment of approx. $1 - 1.45 trn will be necessary to build sufficient SAF capacity, urging for viable business cases

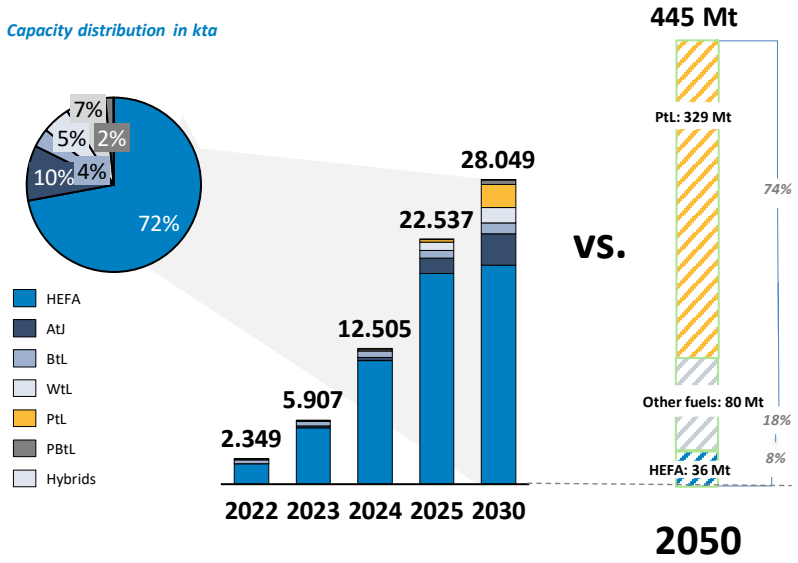
Industry view



Source: ATAG, Waypoint 2050 report. Assumes small production close to the source of feedstock (consolidation, and smaller number of larger facilities possible).

Amongst the myriad of business case options, it is important to assess their long-term value creation potentials

2030: project announcements evolve around HEFA projects
2050: PtL is projected to contribute most to emission reductions



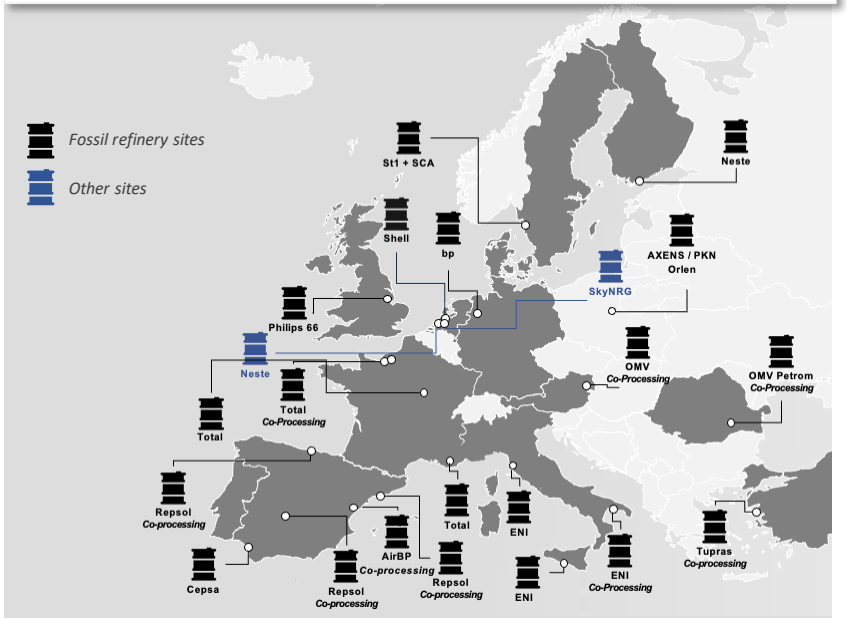
Yet, only 1% of PtL projects currently reach Final Investment Decision.

1	HEFA	Fully integrated, most mature but feedstock limitations in future
2	Power-to-Liquid	Unlimited renewable energy, with demanding regulation (i.e., additionality)
3	Waste-to-Liquid	Commercialized technology, influenced by local existence waste disposal fees
4	Biomass-to-Liquid	Leveraging renewable feedstocks but various evolution of regulation
5	Alcohol-to-Jet	Highly regulated to avoid food crop competition
6	Hybrid fuels & Others, incl. PBtL	Potential of carbon efficiency gains, yet RDD needed to mature technology

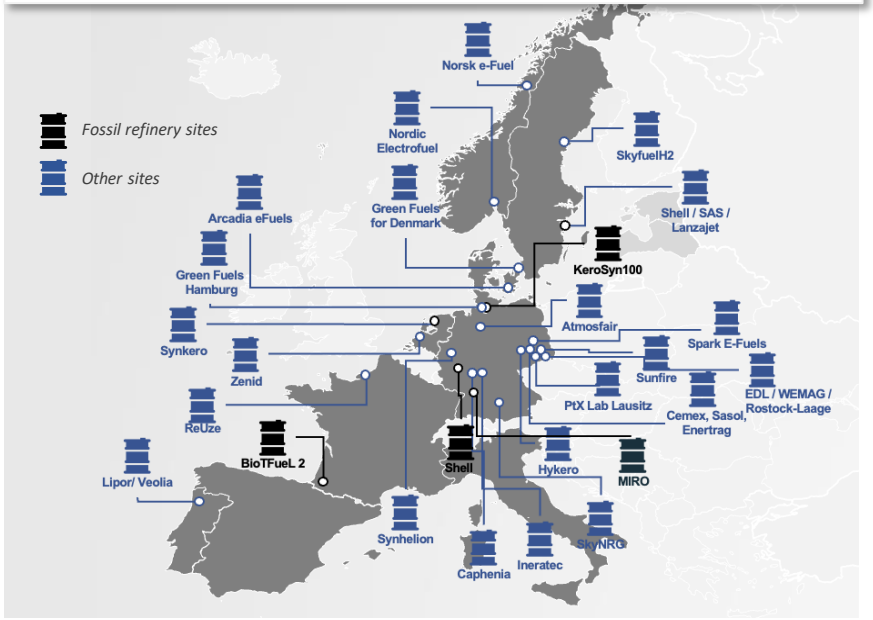
Source: Illustrative depiction based on 1. ATAG, "Aggressive" SAF deployment scenario; 2. CBR 2023 Research; 3. Mission Possible Partnership, Making net-zero aviation possible, 2022

Trend towards decentralized project environment driven by new players to leverage the most competitive site selection criteria

Selected HEFA projects and plants: central driven by Oil & Gas companies



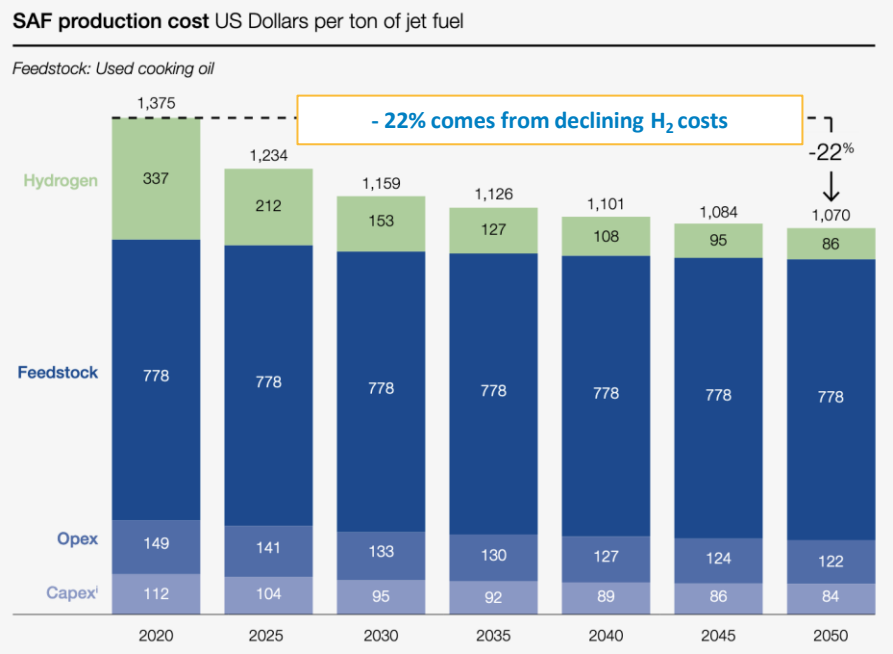
Selected PtL/PBtL projects: decentral, driven by new players



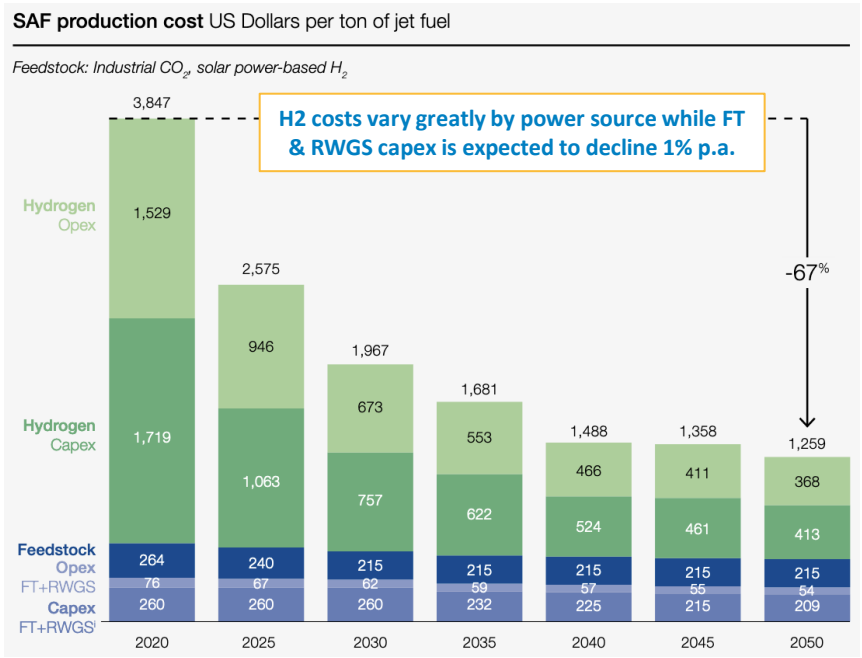
Source: Argus, ICAO, CBR research. O&G = Oil and Gas

Main cost drivers and their development over time need to be estimated and monitored, to reach the SAF scale up by factor 1300 until 2040.

HEFA production costs driven by feedstock price.
Capex: 15% decline by 2030 and about 12% more by 2050



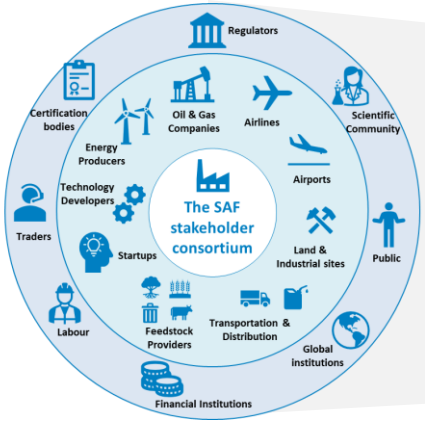
PtL (Water electrolysis and RWGS) is driven by H2 cost
with potential of decline of close to 70% by 2050

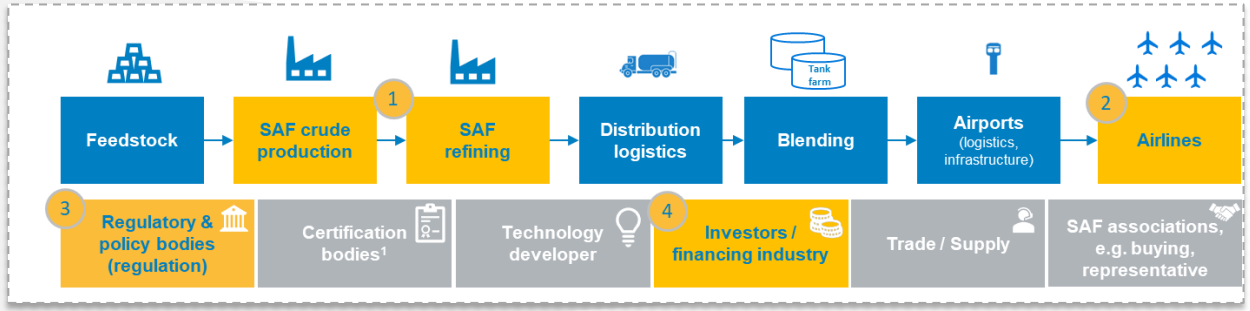


Source: WEF, McKinsey, Clean Skies for Tomorrow, 2021

Opex: operational expenses (i.e., personnel, maintenance, insurance…)
Capex: capital Expenditures (i.e. direct costs, EPC, Owner's Costs, …)

Complex SAF funding due to diverse roles and views of SAF stakeholders & investor types





1

- Strong push from **O&G companies** required
- **Competition** on **feedstocks** (e.g., hydrogen, HVO) mitigated
- Current **start-ups** and **project developers as drivers**

2

- **Price commitments** in **offtake agreements** pivotal for bankability
- Becoming **more involved** in the **provision of SAF**
- Creating **awareness** about **SAF**

3

- **Government support** to scale SAF production rapidly to minimize the risks associated to SAF investments of utmost importance
- **Policies** must be **reliable** to create a **level playing field**

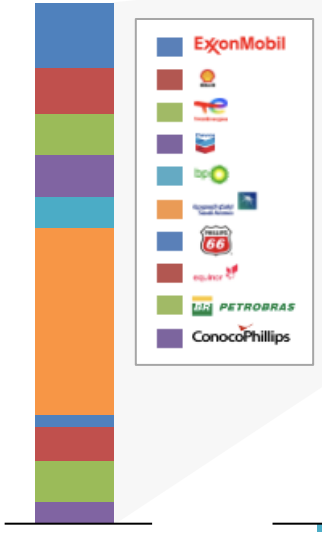
4

- Provision of **project financing** under increased risk exposure
- Increased involvement of **development banks** and **non-refundable loans,** accessible **funds**, etc. by **non-private financing institutions**

O&G = Oil and Gas, DEVEX = Development Expenditures

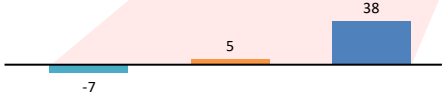
Shifting roles: There is an ambivalence across investor profiles, their motivations and means

$ 450 billion USD
Oil & Gas profits



10 global energy companies

$ -6.9 billion USD airline losses



290 global airlines

Expected profits (2023)

Highest ever annual profit (2017)

Established players

O&G

Current: Focus on HEFA
(+) Leverage strategic momentum and defossilize their current business
(-) High capex, threat of product cannibalization

Airlines

Current: Shifting role from offtaker to strategic equity shareholder
(+) Influence on project bankability through long-term offtakes
(-) Green premium of SAF impairs their businesses margin

New stakeholders

Chemparks

Current: Upside potential, decarbonization and expertise of by-products
(+) Allocation of product slate into other industries
(-) Traditional industry, not willing to take on the innovation risk

Start-ups

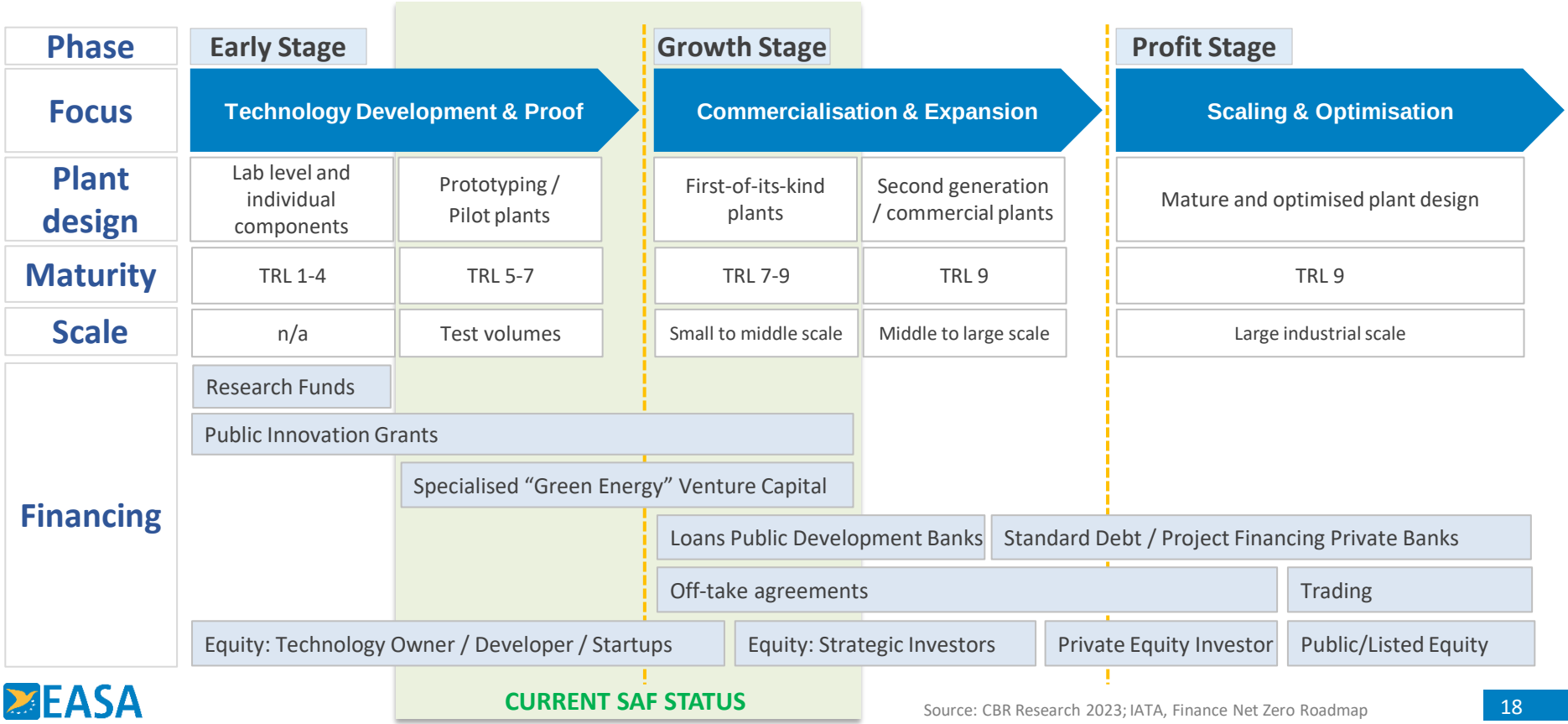
Current: Building up an ecosystem to accelerate venture capital
(+) Will to move faster than the industry taking early technology bets
(-) High initial costs, project risks, business model risks

Institutionals

Current: Risk-return profile not yet matching investment philosophy
(+) Interested in aligning portfolios with ESG criteria
(-) "Wait and See" attitude until regulation undermines business case

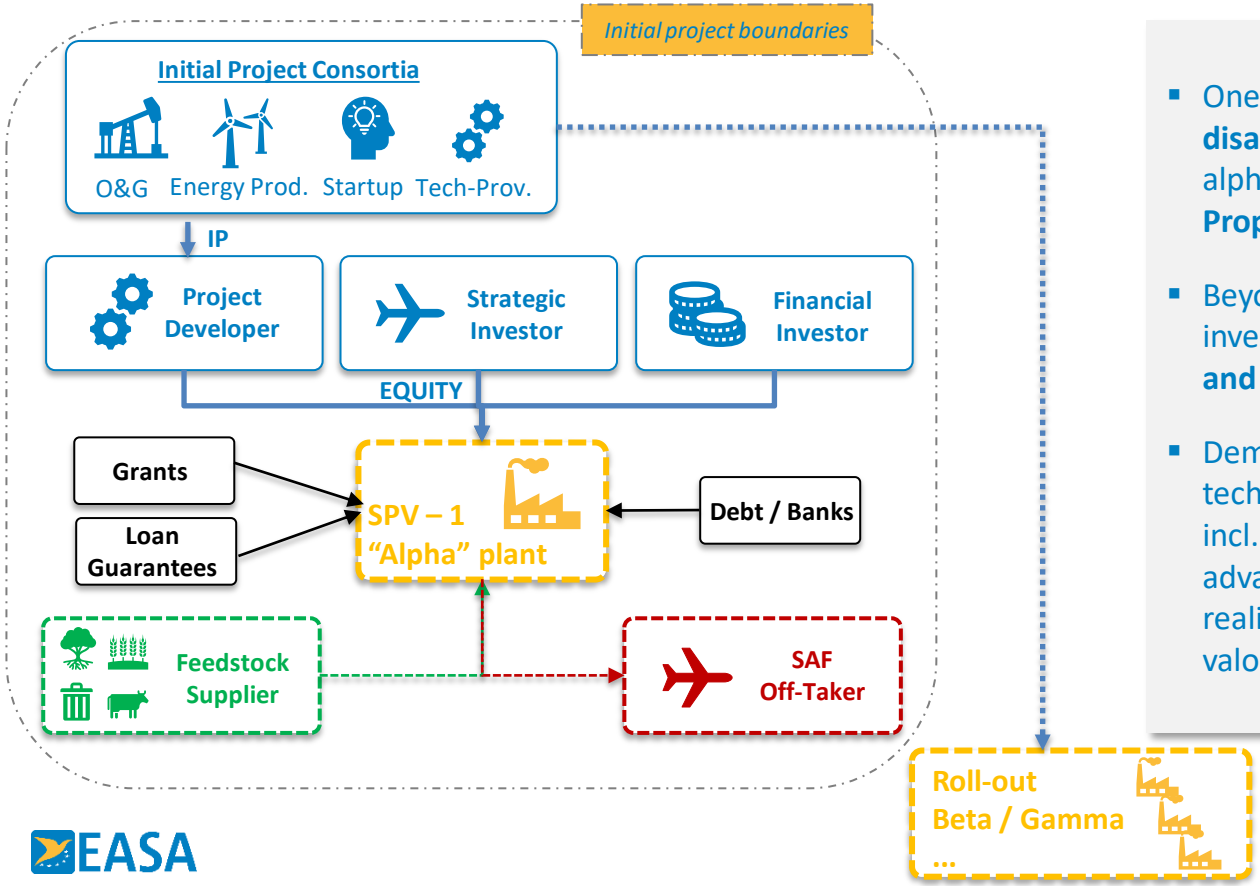
Source: ATAG 2023, "Financing net zero: banks and institutional investor"

Current projects being First-Of-Its-Kind plants are a challenge for SAF business cases to transition into the growth stage



Source: CBR Research 2023; IATA, Finance Net Zero Roadmap

The first movers of today invest with the perspective on being invested into all consecutive plants



- One key aspect of the **first-mover disadvantage** is to have shares of the alpha plant: this is where the **Intellectual Property** is allocated.
- Beyond the mere equity returns, investors should understand the **quality and complex value of the product.**
- Demonstrating the maturity of a technology **lays the blueprint for scaling**, incl. **efficiency gains and cost reductions**, advancement of **expertise in market**, realisation of **added value measures** (i.e., valorisation of side products).

Multitude of SAF pathways reduce comparability of business cases and consequently the predictability of investment returns

Feedstock	Biogas	Energy Crops	Residues	MSW	Oil/Fat
Renewable Energy	Wind	Solar	Water	Geothermic	
CO_2	Biogenic	CCU	CCS	DAC	
Technology	HEFA	PtL	WtL	BtL	AtJ
Maturity	Lab Level	Pilot Plant	First-of-its-kind	Commercial plant	
Project Partner	O&G	Energy Prod.	Tech. Dev.	Startup	Off-taker
Refinery	Central	De-Central			
Region & Land	Africa	Asia	Americas	Europe	
Regulation	Mandates	Incentives	Tax benefits	Certificates	

- **Number of parameter** are a challenge for **project assessment**
- Future **cash flows** and investment **returns** are **less predictable**
- **High risk profiles increase cost of capital** and **ROI requirements**
- Solid **knowledge** (technology, feedstocks, regulatory, emissions, R&D/ engineering) **needed to assess SAF business cases**
- **Enabling Sectors** like in **ASEAN Sustainable Finance Taxonomy** are very important

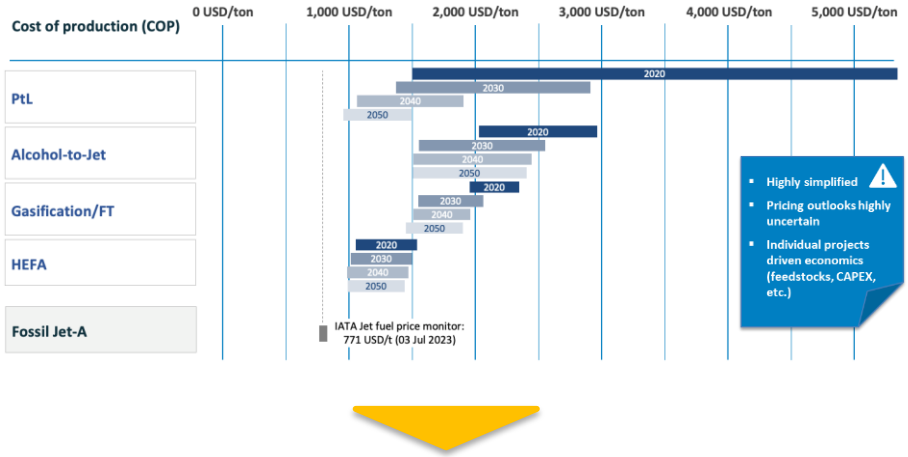
Enabling sectors

EASA

Source: CBR research 2023; ASEAN Sustainable Finance Taxonomy, 2023

Assessment of technology and business proposition competitiveness over time is complex and dependent on many variables

Exemplary forecast on development of SAF costs over time[1]



Recent history of HEFA price[2]

- Most studies forecast **drop of production costs over time** suggesting corresponding drop of SAF prices
- **HEFA** seems to be **most competitive**
- Ultimately, **PtL could become cheaper** than SAF from Alcohol-to-Jet and via biomass gasification + Fischer-Tropsch

- **Real SAF prices** can be much **higher than predicted**
- **Volatility in feedstock prices** (in case of HEFA: Used Cooking or Vegetable oils) can have **a significant impact**
- **Costs for project development and realisation** (CAPEX) are often **underestimated**
- **Cost of production** isn't always a good predictor for **market prices**

Source: [1] World Economic Forum, 2020, amended by CBR, 2023; [2] Argus, 2023, amended by CBR, 2023

Financial modelling principles: how to achieve comparability?

- Many **grant programs**, i.e., the EU Innovation Fund, **provide modelling and general assumption guidelines** specific to climate-tech projects
- Those **criteria allow side-by-side comparison of different projects** (esp. during grant application processes)

The key data inputs are based on standard financial indicators that would typically form the basis of a project financing model.

- Capacity of the project
- Project lifetime
- CAPEX
- Variable annual OPEX
- Fixed annual OPEX
- Maintenance CAPEX
- Decommissioning costs
- Timing inputs (for example, construction start/end date, commercial operational date, financial close)
- Expected Annual production (tpa, MWh/annum, tCO2 stored/annum, etc.)
- Operational Benefits

Source: EU Grants: InnovFund Relevant cost methodology, 2022

Financial modelling principles: how to gauge minimum rate of return?

- For investment decisions, the **expected return** should be at least as high as the **opportunity cost of funding**.
- Hence **revenues and costs of a project are discounted by means of a financial discount rate**. The WACC is commonly used as hurdle rate to gauge the desirability of a project.

Equity share * Equity cost + Debt share * Debt costs *(-) Tax shield from debt costs

WACC = E/V * Re + D/V*Rd * (1-Td)

- Re = cost of equity
- Rd = cost of debt
- E/V = equity portion of total capital (Equity over total Value), as expected at financial close, and which must exclude public funding sources
- D/V = debt portion of total capital (Debt over total Value), as expected at financial close
- Td = marginal tax rate

Source: EU Grants: InnovFund Relevant cost methodology, 2022

Financial modelling principles: how to assess a project's profitability?

- The cost of equity refers to two separate concepts; for the investor, it is the rate of return required on an investment in equity. For the project, the cost of equity determines the required rate of return.
- **It is the return that a company requires to decide if an investment meets capital return requirements**.

$$Re = Rf + (\beta * ERP) + IP, \text{ where}$$

Parameter	Explanation
Risk Free rate *(Rf)*	Risk-Free Rate is the theoretical interest rate that a zero-risk investment will achieve
Equity risk premium *(ERP)*	Premium over the risk-free rate demanded by investors for investing the average risk stock.
Beta of the sector *(β)*	If a project increases its debt to the point where its levered beta is greater than 1, the project stock is more volatile than the benchmarked market.
Innovation Premium *(Technology Risk Premium…)*	Additional premium to reflect the high degree of innovation on risks that go beyond the conventional sector WACC.

Source: EU Grants: InnovFund Relevant cost methodology, 2022

Financial modelling principles: different valuations and their results

- **DCF-Valuation** models and **Levelized Cost of Production models (LCOP)** lead to the **target SAF price** that satisfies the project's **cost of production (COP)** including its specific **costs of capital** (equity & debt).
- The levelized unit cost (LCOP) is the **cost of one unit of production** and is defined as the **price** at which the product should be sold for the model to **break even at the end of its lifetime**.

$$LCOP\left[\frac{€}{Product}\right] = \frac{CAPEX + \sum_n^N \frac{O\&M cost}{(1+r)^n} + \sum_n^N \frac{Fuel\ cost, Materials\ cost\ etc.}{(1+r)^n}}{\sum_n^N \frac{Units_{Produced}}{(1+r)^n}}$$

- CAPEX = capital expenditure
- O&M cost = Operations & Maintenance cost (Fixed and Variable, net of Operational Benefits)
- r = discount rate (WACC)
- n = the year
- N = project lifetime

Cost Item	EUR/t
CAPEX	0,12
Feedstock	2,87
OPEX	0,28
Returns (By-Products)	(0,08)
Returns (Utilities)	(0,01)
Returns (CO2)	(1,15)
Tax	0,03
Interests	0,00
LCOP	2,07

Source: EU Grants: InnovFund Relevant cost methodology, 2022

Financial business case modelling implications (1/3)

- Financial **SAF models** need to **predict future cash flows** and **return on investment**. Those cash flows are then **discounted via the WACC** to today's value reflecting **time value of money** and **project specific risk profiles.**

IRR / NPV Analysis	… …	2023	2024	2025	2026	2027	2028	2029	2030
x **Unlevered Project Return**									
Cash Flow from Operating Activities		0	0	4.000.000	12.000.000	13.000.000	14.000.000	15.000.000	16.000.000
Cash Flow from Investing Activities		(4.000.000)	(55.000.000)	(55.000.000)	0	0	0	0	0
Unlevered free cash flows		**(4.000.000)**	**(55.000.000)**	**(51.000.000)**	**12.000.000**	**13.000.000**	**14.000.000**	**15.000.000**	**16.000.000**
Project IRR Post Tax (unlevered)		**10,79%**							
Project NPV		**3.785.095**							
Cummulated Cash Flow		(4.000.000)	(59.000.000)	(110.000.000)	(98.000.000)	(85.000.000)	(71.000.000)	(56.000.000)	(40.000.000)
Payback time	<0	**10,5**							

…20 years project lifetime

Weighted Average Cost of Capital (WACC)

- "Interest" factor used to **discount future cash flows** to today's value
- Reflects the **time value of money** and the **uncertainty of future cash flows (risk profile)**
- **Unlevered** = w/o costs of debt financing, Equity costs only **/ Levered** = incl. costs of Debt Financing
- **Project Return** = better for pure project performance comparison
- **Equity Return** would in a next calculation step reflect payback to Equity holders

Source: CBR, 2023

Financial business case modelling implications (2/3)

- Financial **SAF models** need to **predict future cash flows** and **return on investment**. Those cash flows are then **discounted via the WACC** to today's value reflecting **time value of money** and **project specific risk profiles.**

IRR / NPV Analysis	… …	2023	2024	2025	2026	2027	2028	2029	2030
x **Unlevered Project Return**									
Cash Flow from Operating Activities		0	0	4.000.000	12.000.000	13.000.000	14.000.000	15.000.000	16.000.000
Cash Flow from Investing Activities		(4.000.000)	(55.000.000)	(55.000.000)	0	0	0	0	0
Unlevered free cash flows		**(4.000.000)**	**(55.000.000)**	**(51.000.000)**	**12.000.000**	**13.000.000**	**14.000.000**	**15.000.000**	**16.000.000**
Project IRR Post Tax (unlevered)		**10,79%**							
Project NPV		**3.785.095**							
Cummulated Cash Flow		(4.000.000)	(59.000.000)	(110.000.000)	(98.000.000)	(85.000.000)	(71.000.000)	(56.000.000)	(40.000.000)
Payback time	<0	**10,5**							

…20 years project lifetime

Net Present Value (NPV) of future cash flows

- If **NPV = 0**, then **project return (IRR) equals** the **Weighted Average Cost of Capital (WACC)**
- **Payback time in years** = 100/IRR (10% = 10 years, 25% = 4 years)

Source: CBR, 2023

Financial business case modelling implications (3/3)

- Financial **SAF models** need to **predict future cash flows** and **return on investment**. Those cash flows are then **discounted via the WACC** to today's value reflecting **time value of money** and **project specific risk profiles.**

IRR / NPV Analysis	… …	2023	2024	2025	2026	2027	2028	2029	2030
x **Unlevered Project Return**									
Cash Flow from Operating Activities		0	0	4.000.000	12.000.000	13.000.000	14.000.000	15.000.000	16.000.000
Cash Flow from Investing Activities		(4.000.000)	(55.000.000)	(55.000.000)	0	0	0	0	0
Unlevered free cash flows		**(4.000.000)**	**(55.000.000)**	**(51.000.000)**	**12.000.000**	**13.000.000**	**14.000.000**	**15.000.000**	**16.000.000**
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Payback time	<0	**10,5**							

…20 years project lifetime

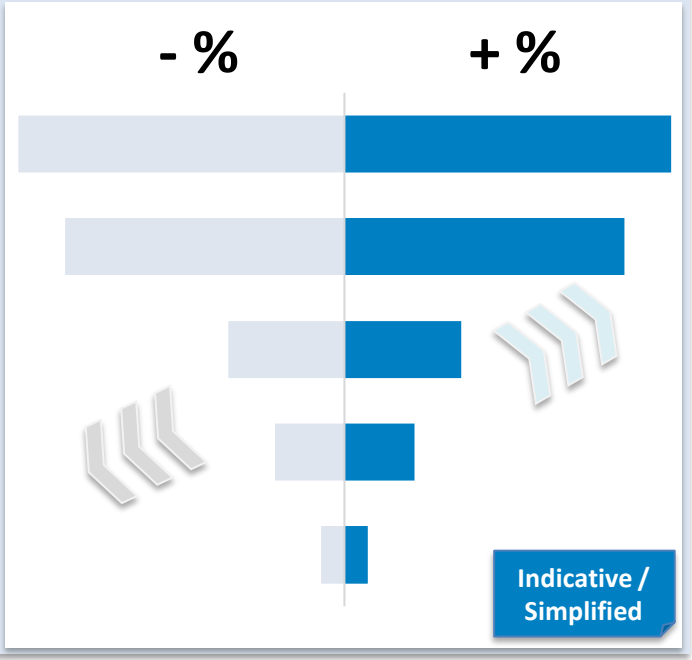
Questions to be answered

- Does an IRR of 10% satisfy a financial investor (taking SAF technology risk into account and considering their investment alternatives)?
- What would happen to SAF prices if return expectations are substantially higher – what happens to bankable off-take agreements?
- What is the valuation of a SAF investment if time to market could be more than 5 years? (of a first-of-its-kind plant only!)

Source: CBR, 2023

Access to price competitive feedstocks and renewable energy are one of the most important success factors of SAF business cases

"Hard" Input Factors	Impact on SAF-Price
Renewable Energy and Feedstock prices	
GHG reduction value	
CAPEX Size and Economies of Scale	
SAF yield and By-Products	
Labour costs	



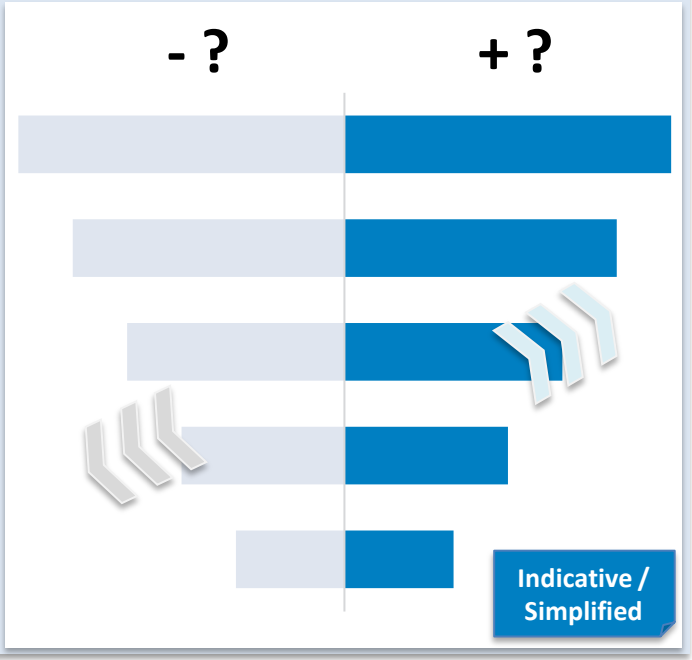
- **Access to abundant feedstocks** and **renewable energy at favourable prices** has the highest sensitivity.
- Several geographies get the opportunity to position themselves as **SAF producer regions. Regulation** of applicable feedstocks and "green" energy will **directly impact the business cases.**
- **Green premium** needs to be closed through GHG reduction incentives, to **level SAF and fossil fuel prices**.
- CAPEX related **economies of scale** over time **challenge** the long-term competitiveness of current **smaller first-of-its-kind SAF plants.**

Source: CBR Research 2023

CAPEX: Capital Expenditures (i.e. direct costs, EPC, Owner's Costs, …)
NPV: Net Present Value

Soft factors factors are equally important to reduce project risk and enhance the likelihood of matching expected business case returns

"Soft" Input Factors	Impact on Success Likelihood
Experience of project developers (technology contributors)	
Maturity of technology	
Established / existent value chain	
Binding Commitments: off-take, energy & feedstock supply	
Availability of skilled labour	



- **Experience** in **technology development, integration of production setup and plant engineering** are often underestimated.
- **Maturity of the individual technical components (TRL)** decreases the tech-risks and enhances the probability of reaching **time to market** of current SAF projects.
- **The integration into an existing value chain** (transportation, logistics, site infrastructure…) and their impact on certification processes are key.
- **Binding commitments** increase **bankability** and funding likelihood.

Source: CBR Research 2023

CAPEX: Capital Expenditures (i.e. direct costs, EPC, Owner's Costs, …)
NPV: Net Present Value

Key messages – SAF business case modelling

1 **Role of SAF**	➢ **In BAU** (business-as-usual) scenario SAFs **will only contribute up to 31% of GHG reduction.** If we achieve to successfully roll out SAF projects via solid business cases, the contribution can go **up to 70%.**
2 **Global SAF ramp-up**	➢ **An investment of approx. $1 - 1.45 trn will be necessary** to build sufficient SAF capacity. ➢ It is important to **assess the business cases' long-term value-creation potential.**
3 **Diverse SAF business cases**	➢ Today's project announcements **evolve around HEFA,** yet the **highest potential for GHG emission reduction.** (with "infinite" feedstock potential) **lies in PtL.** This is why **new tech-business cases need to be developed.**
4 **Multiple Stakeholders**	➢ **Interplay in multi-stakeholder environment** and need for solid value chain step juxtaposition**.** ➢ **Slow positioning of lead investor:** airlines "forced" to step-in as SAF producers, without "deep-pockets".
5 **Early stage of SAF**	➢ **Technological novelty** increase **project risks** and expected **time to market.** ➢ The **first movers** of today **invest with the perspective** on being invested **into all consecutive plants.**
6 **Business case implications**	➢ **Grant programs** provide **modelling** and **general assumption guidelines** specific to climate-tech projects to **allow side-by-side comparison** (especially in investment opportunity assessment). ➢ **Financial investors** usually expect **Internal Rates of Return (IRR) larger than WACC applied in SAF projects.** ➢ **Lack of pure economic business case** calls for **regulator activity / incentives** and **access to public funding.**

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Thanks for joining!

… stay tuned for the upcoming sessions:

- **Hydrogen in the de-carbonisation of aviation – The Manufacturer's Perspective.**
- **Financing SAF Production – Available funds (private and public)**
- **Partnerships along the SAF value chain – Showcasing the collaboration of leaders**
- **Sustainable Aviation Fuel – The Producer's Perspective.**
- **Sustainability Certification of SAF - How does the deployment currently look like?**
- **Book and Claim – What is it and how it will contribute to the scaling up of SAF?**
- **CO2 Emission Reduction Potentials - Levers to achieve Net-Zero aviation in 2050.**

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