Net Zero CO2 Emissions Roadmaps

Yue Huang

Assistant Director, Climate Policy

Bojun Wang

Manager, Net Zero Modelling

IATA Net Zero CO2 Emissions Roadmaps

Policy

- Objective: **guiding policymakers in developing a strategic, effective policy mix supporting air transportation's energy transition**.
- Action-driven policy menu which addresses the order in which to target different objectives and how to tailor policy measures to these

Finance

Objective: **to provide an "in-house" quantitative assessment of the finance needs for the net zero CO2 transition of the air transport industry over immediate-, mid-, and long-term**.

Lessons for aviation from policies that created wind & solar market

Key lessons include:

- **Strategic policy sequencing**: Technology-push policies come first, and demand-pull measures follow.
- The importance of **early and substantial governmental R&D support**, a crucial element in fostering competition and diverse solutions, with market-based policies implemented as technologies mature.
- The necessity for **all supply chain stakeholders to be subjected to predictable, long-term, and as globally harmonized as possible policies**.


IN-DEPTH

A reflection on policies used to support the creation of new renewable energy markets

Lessons for aviation?

25 July 2024

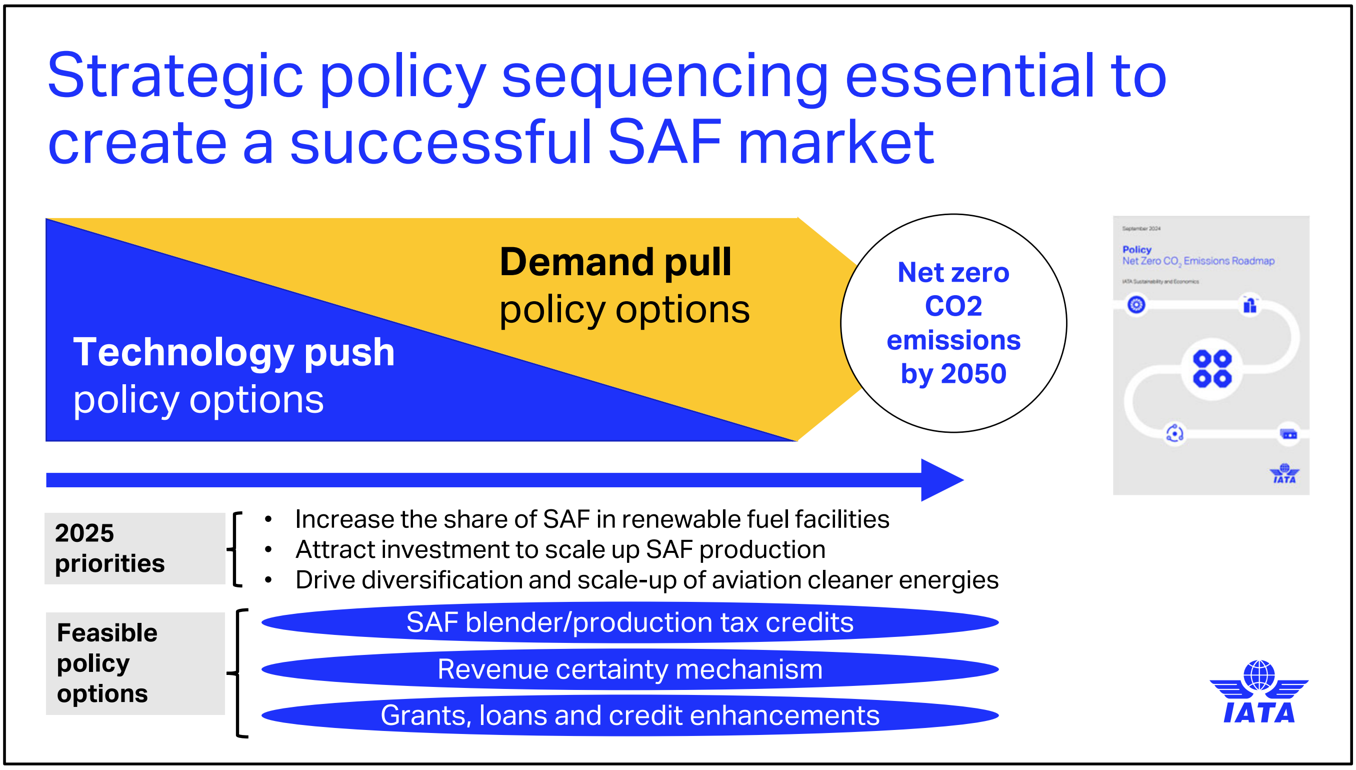
This document provides an analysis of the policies used to create the wind and solar energy markets. The crucial role of governments in supporting the development of new energy markets is a key takeaway for the aviation sector's energy transition. The case studies of the solar and wind energy markets provide insights into important aspects of policy design, sequencing, and choice of instruments.

In order to identify how/what government policies could help creating the renewable energy market, we look back into the ones used to create and scale up the wind and solar market;

Caveat: understanding the different nature of wind and solar vs. SAF, we are not suggesting to copy/paste the policy options, but to withdraw the lessons learnt for aviation decarbonization and energy transition.

Most important lessons learned:

- Policy sequencing: feed in tariff first (incentivize the supply), followed by renewable portfolio standard (demand pull)
- Long-term, predictability and global harmonization are key to achieve success.



The role of effective policymaking in this transition can hardly be exaggerated—it holds the key to success in all endeavors, from R&D to commercialization of new technologies, from nascent markets to globally well-balanced supply and demand, and of course, from using fossil fuels to renewable energy sources in global aviation.

When we apply the lessons learned in wind and solar, we found out that strategic policy sequencing is essential to create a successful SAF market.

As of today, we do not have a functional SAF market: no robust supply and demand to generate market liquidity, and no established price transparency.

In order to scale up the SAF supply, we strongly believe technology push policy options should be first introduced.

For example, from now to 2025, the most immediate policy objects are:

- Increase the share of SAF in renewable fuel facilities (+ explanation: why production of SAF is uneconomic now)
- Attract investment to scale up SAF production
- Drive diversification and scale-up of aviation cleaner energies

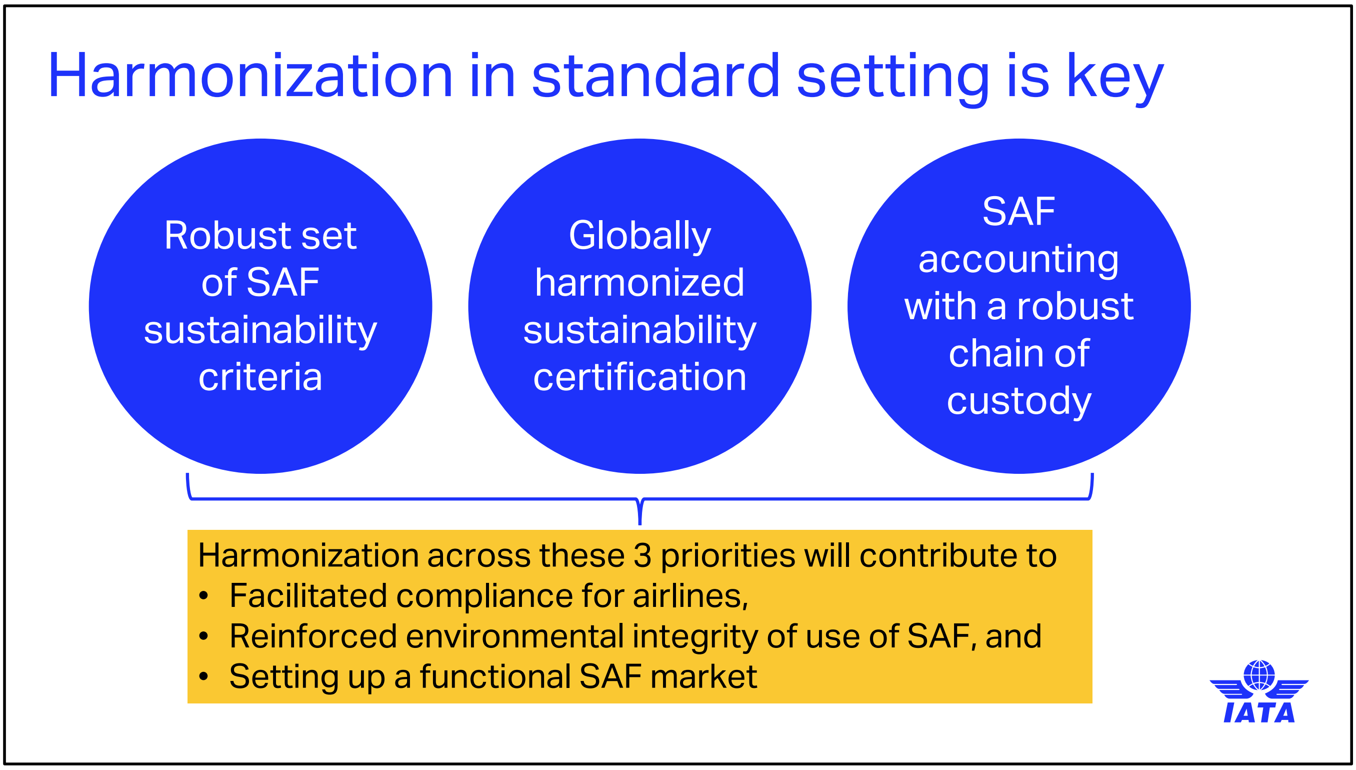
And which policy options can assist to achieve the above listed objectives?

SAF blender/production tax credits (US IRA; the effect of which would be maximized if the federal level credits can be stacked with the states' level ones)

Revenue certainty mechanism (like Feed-in-tariff, gov underwrite to provide revenue generation certainty. Source of revenue is key. i.e., UK ETS)

Grants, low-interest loans, etc.

Feasible policy options, however need to be on a case by case basis and we cannot be too prescriptive because local circumstances matter and countries need to run impact assessments to define which work best for them. While there is no universal set of policies/one size fits all solution to ensure decarbonization globally, by examining different policy instruments and their impacts on the wind and solar energy sectors, valuable lessons emerge for the aviation industry's energy transition. These include the need to strive for overall energy policy frameworks that are tailored to local contexts and supported by international standards.

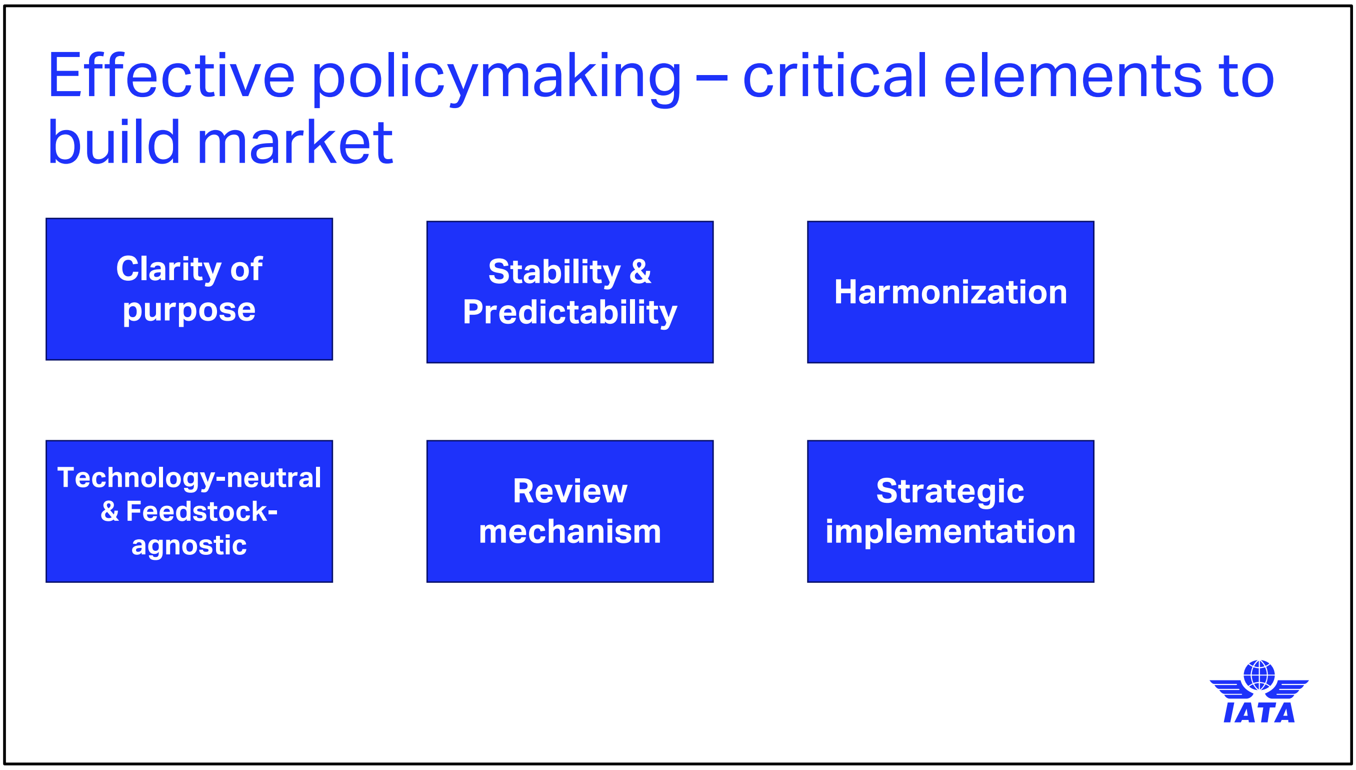


While earlier we talked about, there is no one-size-fits-all solution; we do want to emphasize on the other end, the importance of harmonization in the standard setting to facilitate the creation of SAF market.

Scaling up renewable energy production to unprecedented levels is essential to reduce our dependence on fossil fuels. Every industry, including aviation, requires a fair allocation of this uncertain future renewable energy production. The aviation sector's goal of achieving net-zero carbon emissions by 2050 is ambitious and demands coordinated efforts on multiple fronts for successful implementation, notably on harmonization.

Standard setting is key to the creation of a global SAF market, notably for:

- A robust set of SAF sustainability criteria-further illustration: SAF starts with S, sustainable, to ensure the robust portfolio of SAF, a set of globally recognized sustainability criteria is key. i.e., feedstock which does not compete with food in land use. Sustainability criteria apply to the full supply chain of SAF.
- Certification mirrors criteria and reflects the sustainability credentials of SAF in proof of sustainability.
- SAF accounting with a robust chain of custody: ensure proper track of environmental attributes of SAF; clarity in ownership, no double claiming/counting; facilitate the end user claim of SAF environmental benefits; i.e., airlines for their scope 1 (direct emissions) emissions reductions and corporate customers' claim of scope 3 (indirect emissions that occur in a company's value chain, both upstream and downstream).



Within that complex matrix of moving parts, there is a set of characteristics that is often shared across successful policymaking experiences, and that can be thought of as best practices. With respect to air transportation's energy transition, we note the following:

- Clarity of purpose: Create an energy policy framework that states policy objectives clearly and within a specific timeframe, and that is tailored to local conditions as well as supported by international cooperation.
- Stability and predictability: Policies need to be stable and predictable to allow economic actors sufficient certainty and foster investments.
- Harmonization: The harmonization of all rules and regulations, such as sustainability criteria, certification requirements, reporting and accounting rules, across government initiatives, across countries and regions, and as far as possible globally, greatly facilitates innovation and market development.
- Strategic sequencing: Aims to optimize outcomes over the target horizon and generally involves leading with technology push policies, followed by demand-pull measures and market-based policies as technologies mature.
- Technology-neutral and feedstock-agnostic: Policy should be technology-neutral and feedstock agnostic to avoid taking early bets on immature solutions. This promotes the diversification and multiplication of production pathways and feedstock supply chains and fosters competition.
- Review mechanism: Incorporate periodic reviews to ensure that policy remains fit for purpose and to address any unintended consequences in a timely manner. "Exit" strategies need to be considered for when markets are mature enough.

3 key elements in the Finance Roadmap (2024 to 2050)

CAPEX TO INVESTORS

New renewable fuel plants needed		Capital investment (capex) needed
Best-case scenario: **minimum** number of plants needed **3,096**	→	Best-case scenario: **minimum** capex needed **$3.9 trillion**
Worst-case scenario: **maximum** number of plants needed **6,658**	→	Worst-case scenario: **maximum** capex needed **$8.1 trillion**

COST TO AIRLINES

Transition Cost

$4.7 trillion additional cost to airlines for using:

0VDI

0R iivhwwlqj yld FRUVID

0K|gurjhq irudlufudiw

0Fduerq uhp rydo

IATA

Now we are moving to the Finance Roadmap. In the Finance Roadmap, we provided our in-house estimates on the financing needs of the net-zero transition between 2024 and 2050. The financing needs cover two broad aspects, the capital investments by investors in building new plants, and the additional cost to airlines for transitioning to net zero, this is what we call the transition cost.

The overall cost to airlines for transitioning to net zero could be an additional $4.7 trillion to airlines between now and 2050

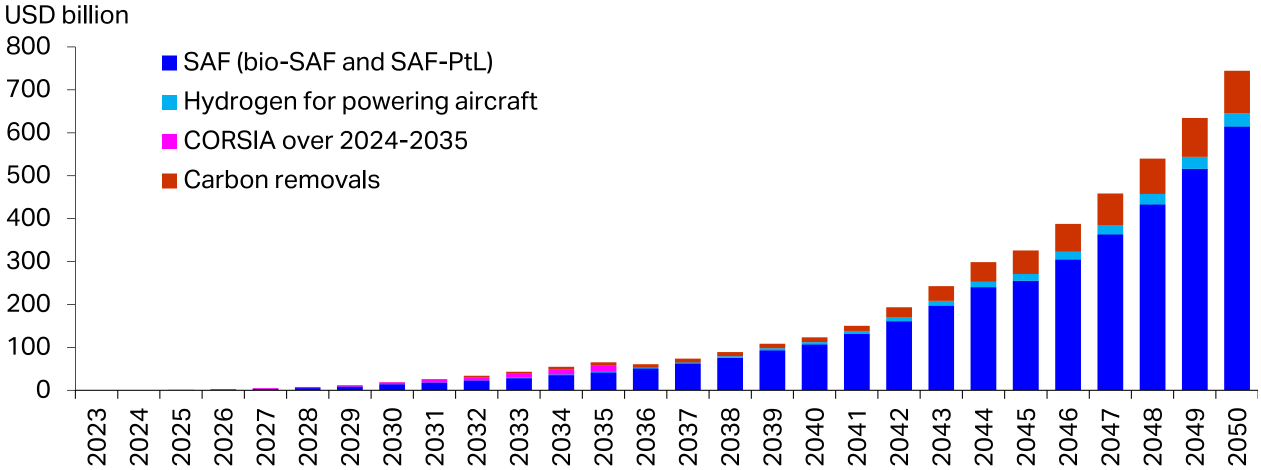
- That includes SAF – the biggest lever (price difference between conventional jet fuel);
- The cost of offsets via CORSIA
- The use of Hydrogen on new aircraft
- The use of Carbon removals to address residual emissions.

Obviously, investments in building the new plants need to take place first so that airlines can use SAF produced from the new plants. Depending on the % of SAF produced from the product mix of a plant and if we can have SAF produced from co-processing, we would need between three thousand and six-and-a-half thousand new renewable fuel plants, and you can see the corresponding capex is around $4 trillion to $8 trillion for the two cases.

Importantly, the development of these renewable fuel facilities is for multiple sectors and their net zero journey - it is not just for aviation.

Transition costs will increase significantly over time, dominated by that of using SAF over 2023-2050

Annual transition cost to increase from USD 1 billion in 2025 to USD 744 billion in 2050



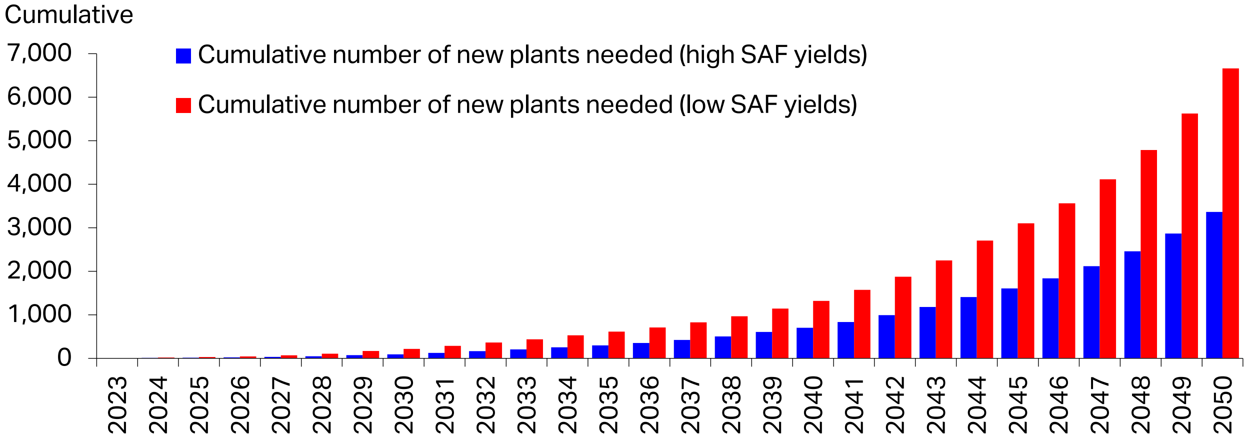
Source: IATA Sustainability and Economics

With the expected increasing demand for adopting the transition measures, the transition cost will increase significantly over time, from $1 billion in 2025 to $744 billion in 2050. As shown in the chart, the annual transition cost is dominated by the cost of using SAF. In fact, SAF accounts for 81% of the $4.7 trillion total transition cost.

$744 in 2050 is a very big number, and I'll put this number into perspective in my later slides. But clearly this is a huge challenge that airlines cannot possibly take on themselves. We need strong policy support in the transition.

More SAF output per plant = fewer new plants
Capex savings of up to USD 4 trillion

Cumulative number of new renewable fuel facilities over 2023-2050: High SAF yields versus low SAF yields



Source: IATA Sustainability and Economics

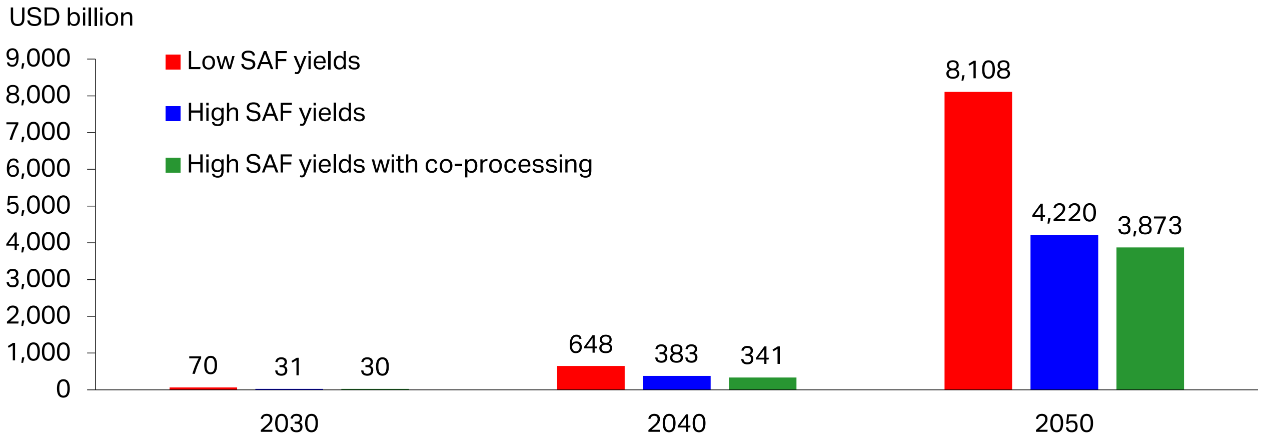
One crucial support that government policy can offer is to incentivize more SAF production per plant, which means higher SAF yields in the product mix. When more SAF is produced per plant, fewer new plants will be needed, and therefore, lower Capex needs to be financed.

Here you can see the number of new renewable fuel facilities needed to serve aviation's SAF needs is dramatically reduced if the output of SAF is maximized. Unfortunately, this is not what is happening today. Refineries make more money from producing renewable diesel than SAF because of a favored policy incentive. We need at least the same level of policy support on SAF production - the needs of aviation cannot and must not be forgotten.

If we had policy support as such to optimize the SAF yields, the number of new plants needed by 2050 would reduce from 6700 to 3400, with up to $4 trillion savings in capital investment.

Producing SAF at existing petroleum refineries (i.e., co-processing) can provide further capex savings

Cumulative capex required per scenario: low SAF yields, high SAF yields, and high SAF yields with co-processing



Source: IATA Sustainability and Economics

While new facilities take time to construct, we have an immediate way of producing SAF with the minimum investment: co-processing. Co-processing allows a certain amount of bio-based intermediate to be blended into the existing petroleum refineries and produce SAF along with other petroleum products simultaneously. By producing SAF from existing facilities, we can avoid building 266 new plants by 2050, which would save around $350 billion in total.

One important support that policy can offer in co-processing SAF is to lift the blend ratio limit. The potential of co-processing SAF is currently limited by the artificial certification constraint, where only up to 5% bio-based intermediate can be blended in the feeds now. What you see from this chart is our analysis based on the 5% blend ratio limit, but if the blend ratio limit is lifted, we can have even more SAF produced from co-processing.

Capex needed for new renewable fuel plants is comparable to investment in wind & solar

Cumulative investments in solar and wind (2004-2022) versus IATA estimated capex on new renewable fuel plants (2020-2050)

	Capex needed for renewable fuel plants	of which capex based on SAF yields	Wind	Solar	Wind & Solar
Amount	USD 3.9 – 8.1 tr	USD 2.0 –2.8 tr	USD 2.4 tr	USD 2.9 tr	USD 5.3 tr
Time span	**30y (2020-49)**		**19y (2004-2022)**		
Min Annual average capex	**USD 128 bn / year**		**USD 280 bn / year**		
Includes	- Plant capex	- The portion of capex directly relating to SAF production	- R&D costs - plant cost - policy and incentives costs		
Feedstock costs	Not included	Not included	None		
Perspective	Cost to supplier	Cost to customer	Cost to supplier		

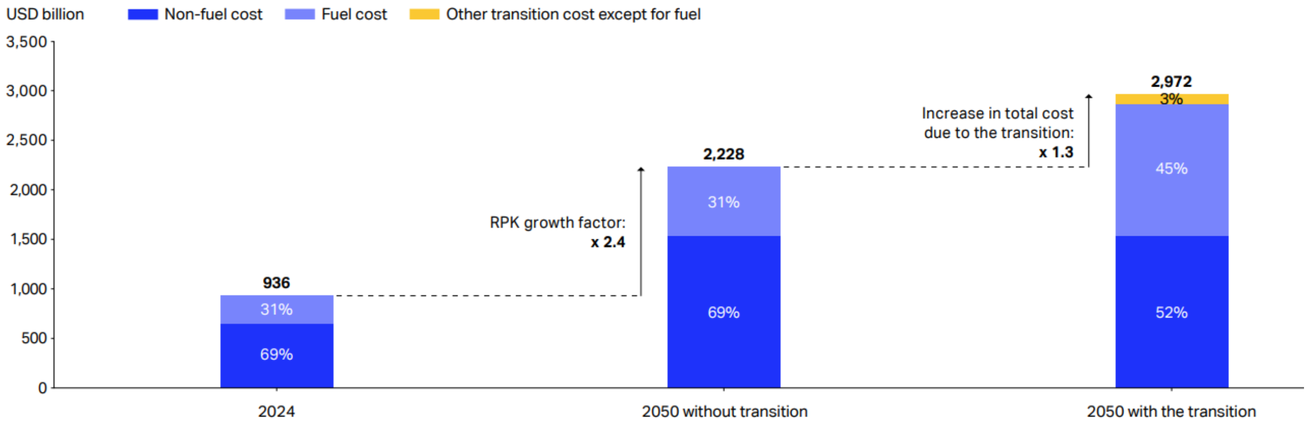
Source: IATA Sustainability and Economics

By improving SAF yields per plant and co-processing SAF, we could potentially achieve significant capex savings for SAF production. Actually in our best-case scenario, the investment needed for building new renewable fuel plants in the next 30 years is much lower than the investment in the wind and solar sector in the past 19 years.

While it is not a hundred percent apple-to-apple comparison, this helps us to understand the relative magnitude of the capex required for the transition.

Without policy action, the transition cost would double airlines' fuel cost in 2050

Potential impact of the net zero transition to airlines' total cost and cost structure in 2050



Source: IATA Sustainability and Economics

Let's now take a step back and put the transition cost into perspective: and this is just for illustration!

Fuel today is just over 30% of airlines total cost.

Projections show RPK could grow by a factor of 2.4 between now and 2050. If for illustration we add the transition cost in 2050 (remember the 744 bn) that would raise the fuel cost component to 45%, and the airline total cost will increase by 30% compared with a 'without transition' case.

All other things being equal, a 30% increase in cost versus a 3% net profit margin of our industry means that this is not financially feasible – not for aviation, not for any industry. We and policy makers all need to work together in such a way that the costs decline, if airlines are to be successful in the net zero transition.

Thank you!