2024 ICAO REGIONAL SEMINAR ON ENVIRONMENT

In collaboration with CAAT
สำนักงานการบินพลเรือนแห่งประเทศไทย
The Civil Aviation Authority of Thailand

APAC Region

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Bangkok, Thailand

ICAO
ENVIRONMENT

ACT SAF

CORSIA

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Boeing

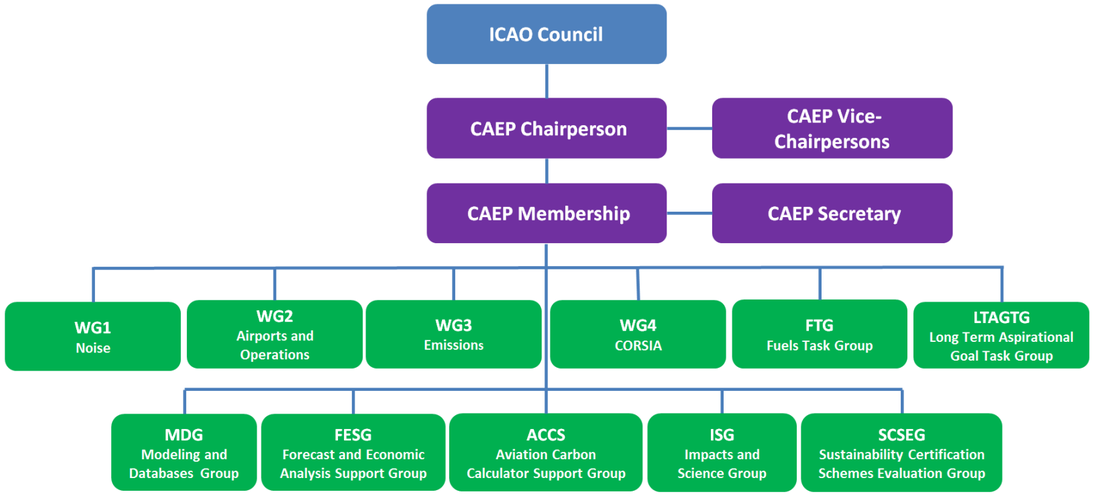
Boeing Asia-Pac Team

- **Kimberly Camrass: Aust/NZ**
- **Alisa Schackmann: Japan**
- **Sharmine Tan: SE Asia**
- Jinjin Xu: China
- Hannah Monaghan: Aust

Boeing and ICAO
Why Asia Pacific?
SAF – Why now?

Roadmaps / feedstock studies inc:
- Australia
- Japan
- SE Asia

Boeing and ICAO Environment



Boeing and Asia Pacific: Why?

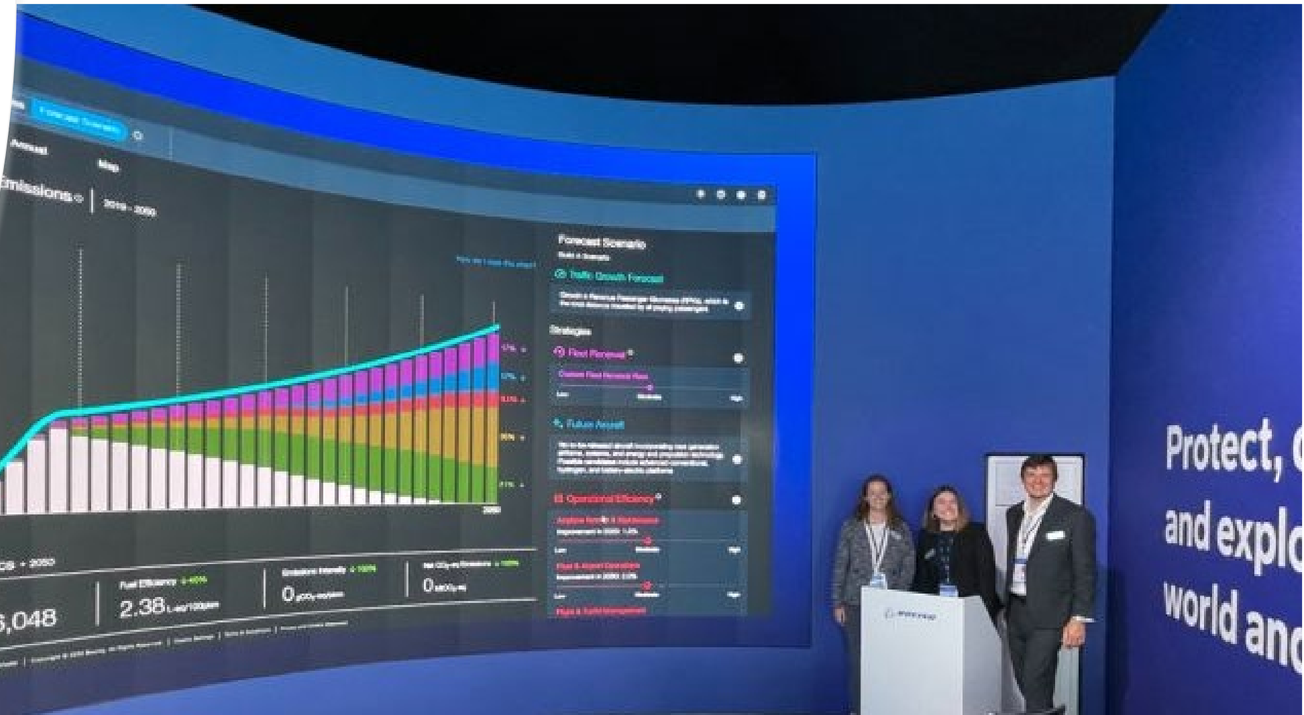
"There is no net zero without Asia-Pacific"

12.8 Million flights	1.7 billion passengers	37% share of global passenger traffic	316 airlines
Aviation supports 47 million jobs in region	$225 billion or 3.1% of GDP In APAC	35 air navigation service providers	22 million tonnes of cargo

- >100 Mt of jet fuel (~130 billion litres)
- 8 of the top 10 busiest airport pairs by number of flights
- 39 ICAO States representing 60% of the world population
- ~40,000 Boeing employees based outside of the United States

SAF: Why now?

- What were you doing in 1998?
- Fast approaching net zero targets
  - Commercial aerospace sector (2021)
  - ICAO Member States (A41: 2022)
- Voluntary commitments
  - ~50 airlines with SAF commitments **(20 from this region)**
- Meeting policy goals or regulations
  - ~17 Mt



Boeing CSIRO SAF Roadmap

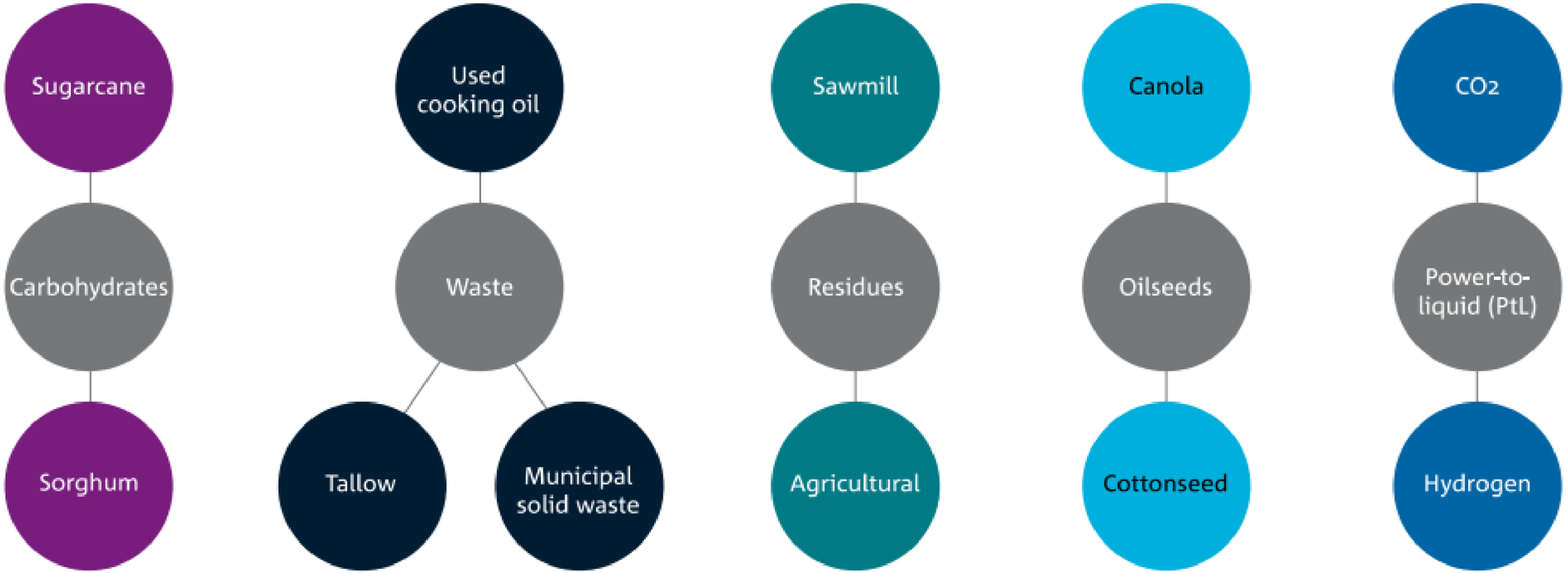
- Domestic aviation emissions tripled between 1990 and 2019
- Jet fuel forecast to increase by 75% from today to 2050
- Onshore refining capacity is lagging feedstock potential
- Report projects that Australia will have enough feedstock to **produce 60% of local jet fuel demand** (using biogenic feedstock) in 2025 and 90% by 2050.
- Between $10B and $19B of opportunity!

Feedstock: What was considered?

- Various **feedstocks considered**, such as oilseeds, carbohydrates, waste products (e.g., tallow, used cooking oil (UCO) and MSW), agricultural and sawmill residues, and hydrogen.
- For each feedstock, the analysis estimates the **current and future availability** and the potential fuel output up to 2050.
- It also considers the **challenges** of reallocating these feedstocks for SAF production, including commercial, sustainability, policy, and social impact considerations.

Boeing CSIRO SAF Roadmap

Potential feedstocks in Australia



- Australia has a significant opportunity to develop a diversified portfolio of feedstocks for a domestic SAF industry

Regional Feedstock availability

- Each Australian State and territory has its own advantages
- Strong correlation with arable land: East and Southwest coast tilted towards biogenic feedstock
- PTL largely universal with significant renewable energy potential

Regional Feedstock availability

Modelling approach:

Growth rates modelled using 4 key parameters:

1. Historical feedstock data:

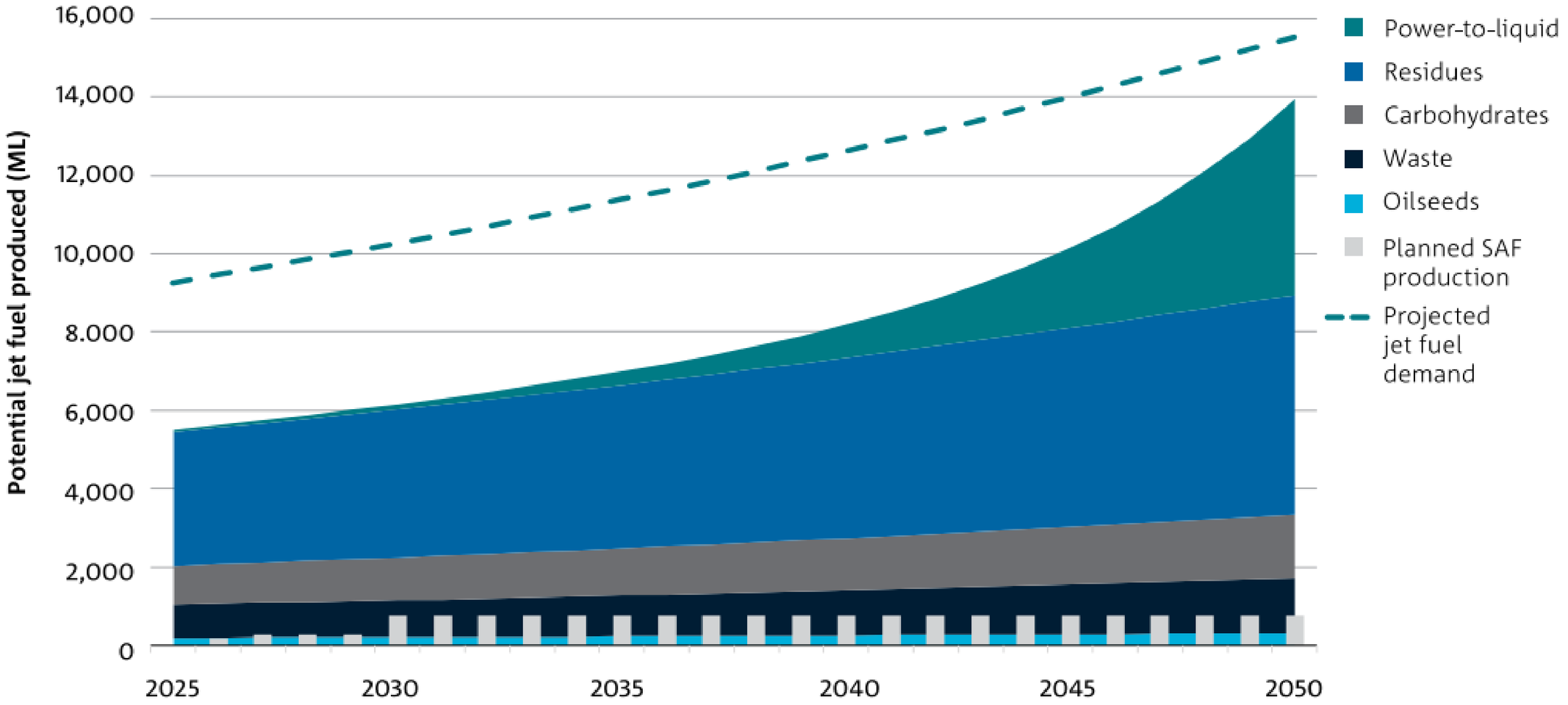
2. Feedstock growth rates: Two feedstock growth rates (0.5% and 2%) H2 (exponential)

3. Jet fuel yield: Two jet fuel yield scenarios (low and high)

4. Feedstock allocated to jet fuel: Two feedstock allocation hypotheticals

Domestic production potential

- In 2025, Australia could have enough feedstocks to produce 60% of local jet fuel demand using biogenic feedstocks



Key roadmap recommendations

IMMEDIATE (2023-2025) | **MEDIUM (2025-2035)** | **LONGER 2035+**

1. **Develop policy tools and frameworks to support industry development**
2. Encourage demand signaling across sectors
3. Educate consumers to build social license
4. Invest in R&D to support emerging technologies and feedstock understanding
5. Scale-up biogenic SAF production

6. Scale up second generation biogenic feedstock and processing
7. Invest in R&D to reduce cost and logistic hurdles and scale up PtL pilots

8. Develop large-scale production of PtL at several hydrogen and CO2 hub locations

Japan – key insights:

Study completed by Boeing / SMBC Capital / MHI and ICF

1. Country has sufficient feedstocks, but…

those with the highest opportunity are complex and difficult to refine.

2. Japanese domestic feedstock is enough to meet targets, but…

Requires support to be directed to aviation.

3. Domestic feedstock types are capable of high emissions reduction (low carbon intensity), but…

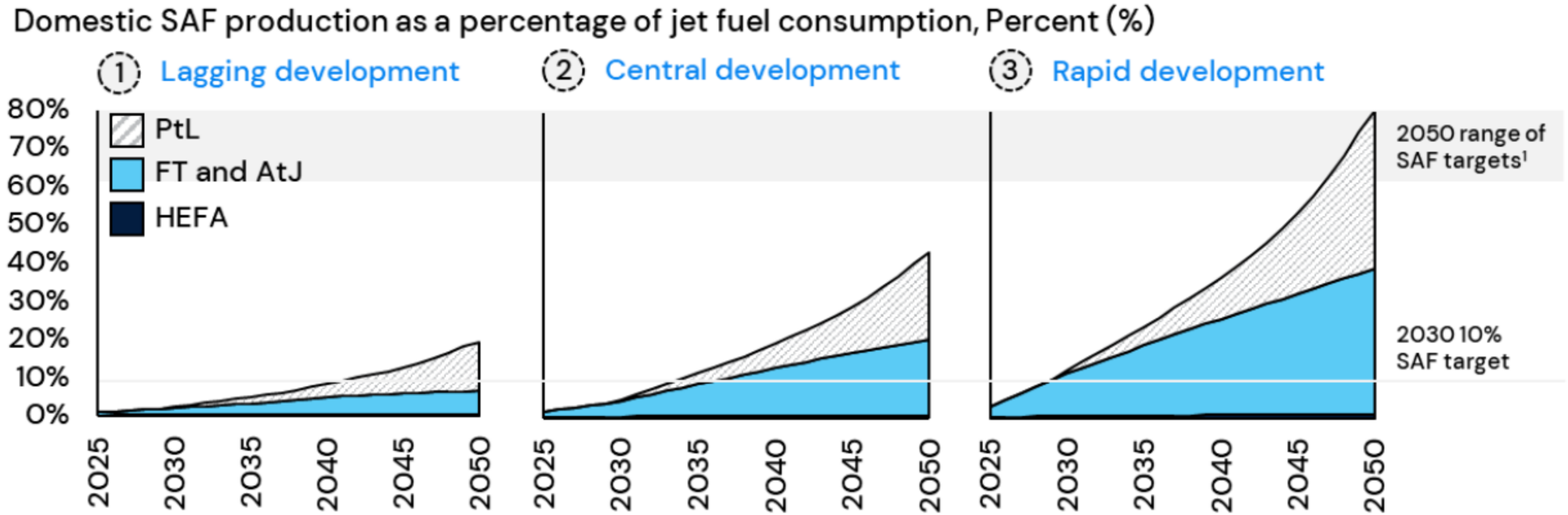
Require new technology to be de-risked to allow widespread production.

Japan: reliant on aviation and still growing

- Air transport expected to grow by 47% over the next 20 years
- Japan is the 5th highest consumer of oil – almost 90% imported
- Japan has introduced a proposal to replace 10% of its jet fuel with SAF by 2030
- Japan has significant domestic feedstock potential (circa 11 billion litres by 2030)
- Available production capacity lagging feedstock potential

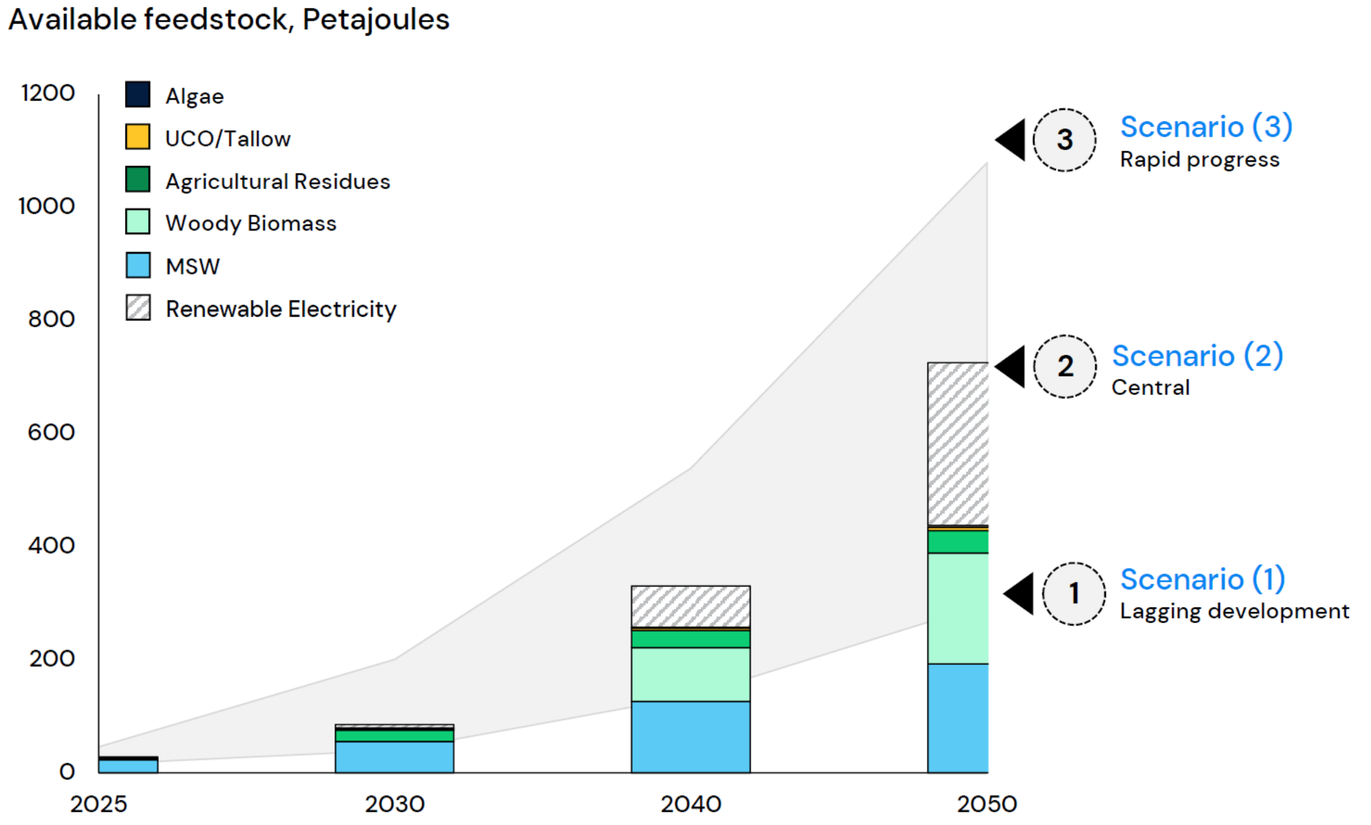
Policy support is the most significant variable

ICF estimates that domestic feedstock is sufficient to meet up to 80% of jet fuel demand with policy support



Source: ICF Analysis, [1] SAF targets in 2050 include the US (100% SAF), the EU (70% SAF), and individual airlines

Key roadmap recommendations



Source: ICF Analysis

Conclusion:

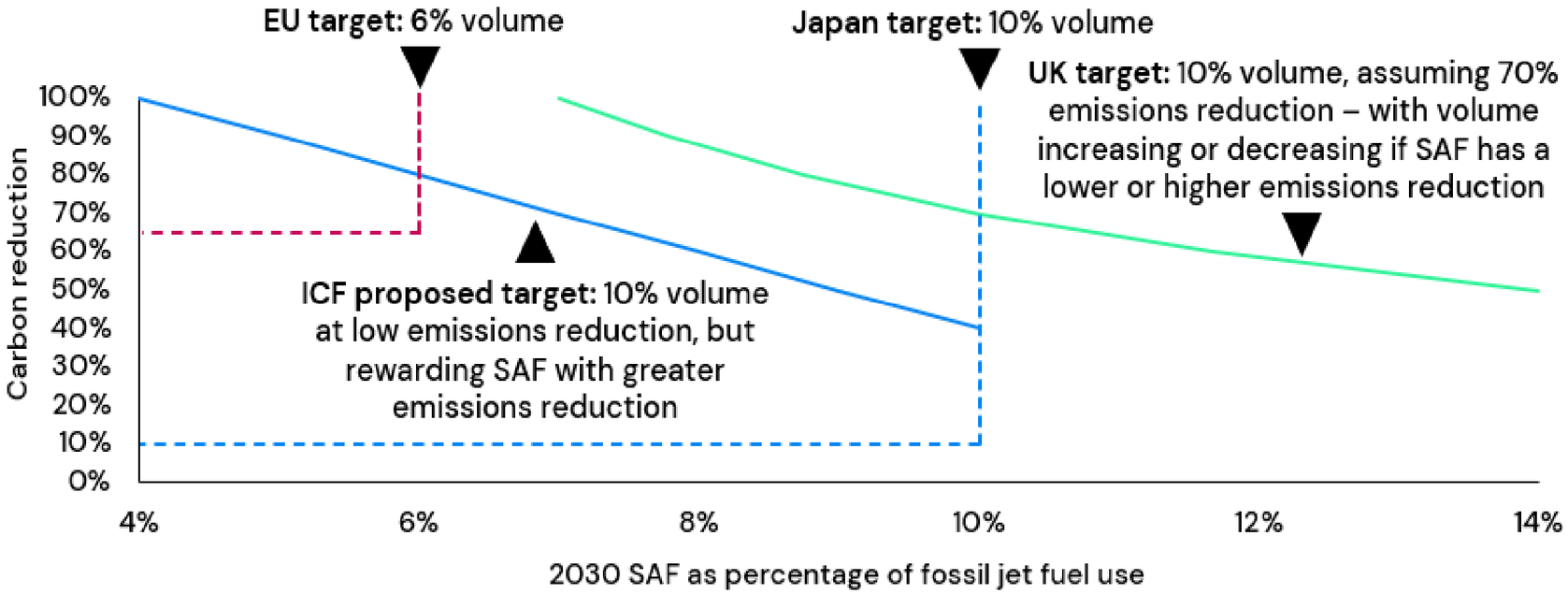
Japanese domestic feedstock is:

- Reasonably plentiful
- Requires support to transition to aviation
- Capable of high emissions reduction (Low CI)
- Requires new technologies to be de-risked to allow widespread production

- Reward SAF with higher emissions reduction (+0.25 beyond 40% CI reduction)
- Establish targets for 2040 and 2050

Rewarding better CI reduction in policy design

This assessment proposes an adjustment to reward SAF offering greater emissions reduction with a higher contribution to the 10% target



Source: ICF Analysis

- Reward SAF with higher emissions reduction (+0.25 beyond 40% CI reduction)
- Establish targets for 2040 and 2050

SE Asia:
A study to assess the most available and sustainable feedstock

RSB
www.rsb.org

Supported by: BOEING Standard Chartered

What it is

Review of available literature on feedstock availability

Regional sustainability analysis using RSB's sustainability framework and tools – addressing relevant social and environmental risks

Insights and guidance for future research

What it is not

Granular information on feedstock availability

How to use the report:

Policymakers: use the insights to shape policies and frameworks that address sustainability risks.

Investors: help inform potential investment decisions in SAF infrastructure and projects.

Researchers: Focusing on addressing data gaps and develop further studies to enhance the understanding of all feedstock, particularly with higher sustainability risks

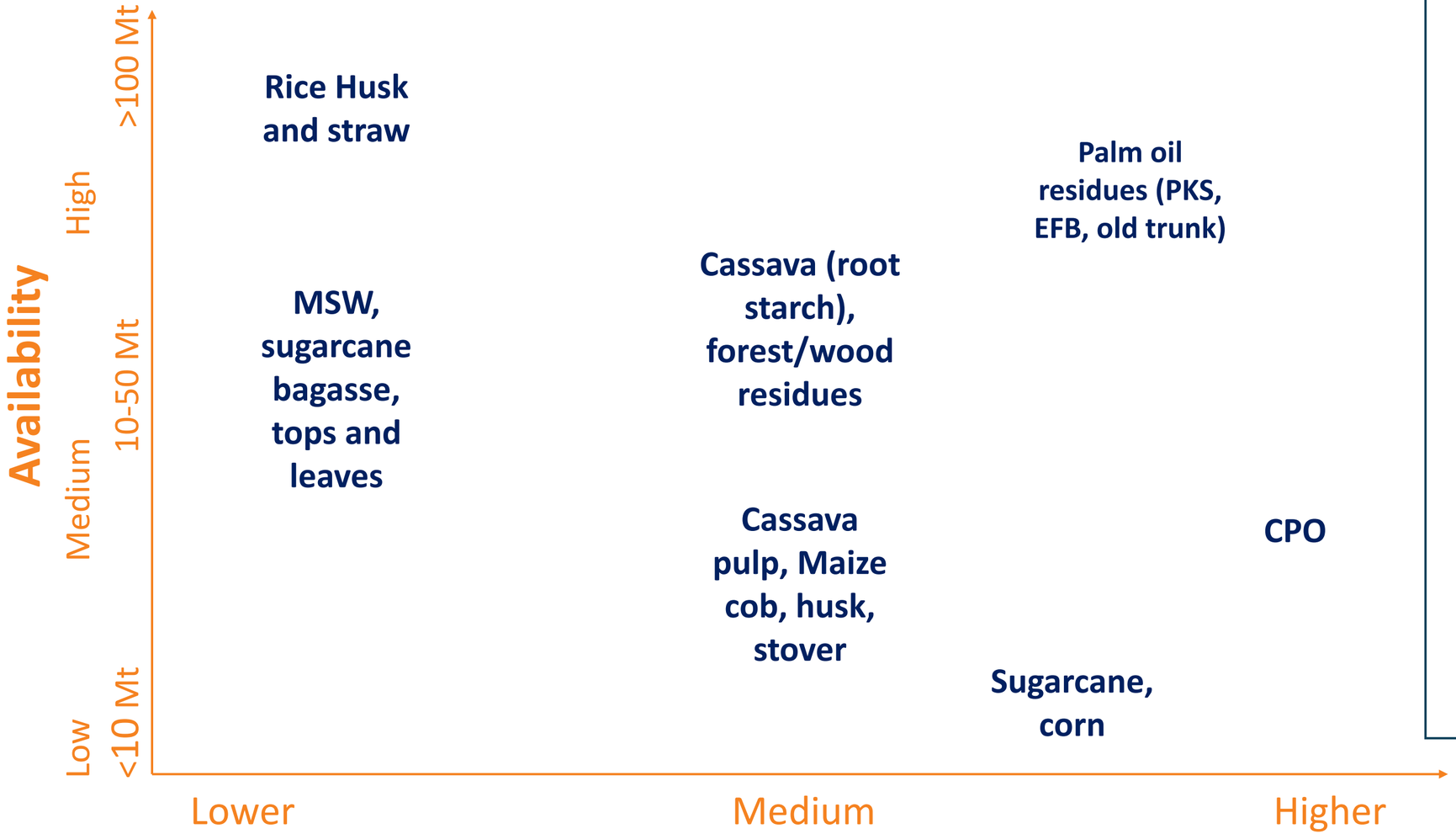
SE Asia – methodology and results sneak peak

SE Asia: Results sneak peak

Pathway	SAF potential production in ASEAN (Mt/year)		
	2025	2030	2050
HEFA	6.3	6.7	7.1
FT	22.3	23.5	24.9
ATJ	12.3	12.9	13.7
Total	40.9	43.1	45.7

Potential improvement scope Important

Feedstock-level risks:
Where are the opportunities to improve? Aim is the <u>top left quadrant</u>



Feedstock plus Techno Economic report expected to be published on 3 September 2024

Thank You

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