CAAFI Mini-Symposium

bp presentation

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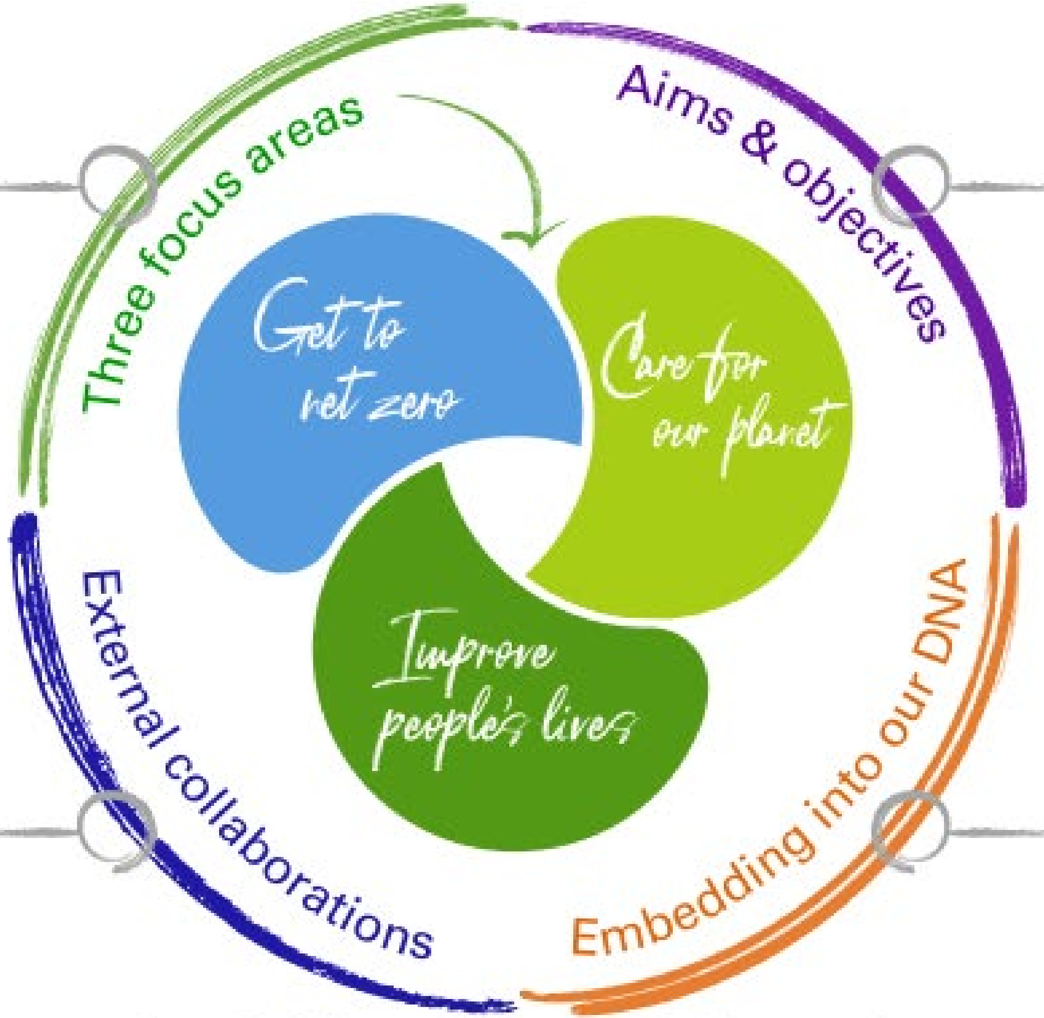
June 2021

Our new sustainability frame

Where we can make the most difference

SUSTAINABLE DEVELOPMENT GOALS

Transparent progress against aims aligned with our strategy



Partnerships to drive progress and shape the future together

Integration into governance and decision making

Sustainability at the heart of what we do

Get bp to net zero

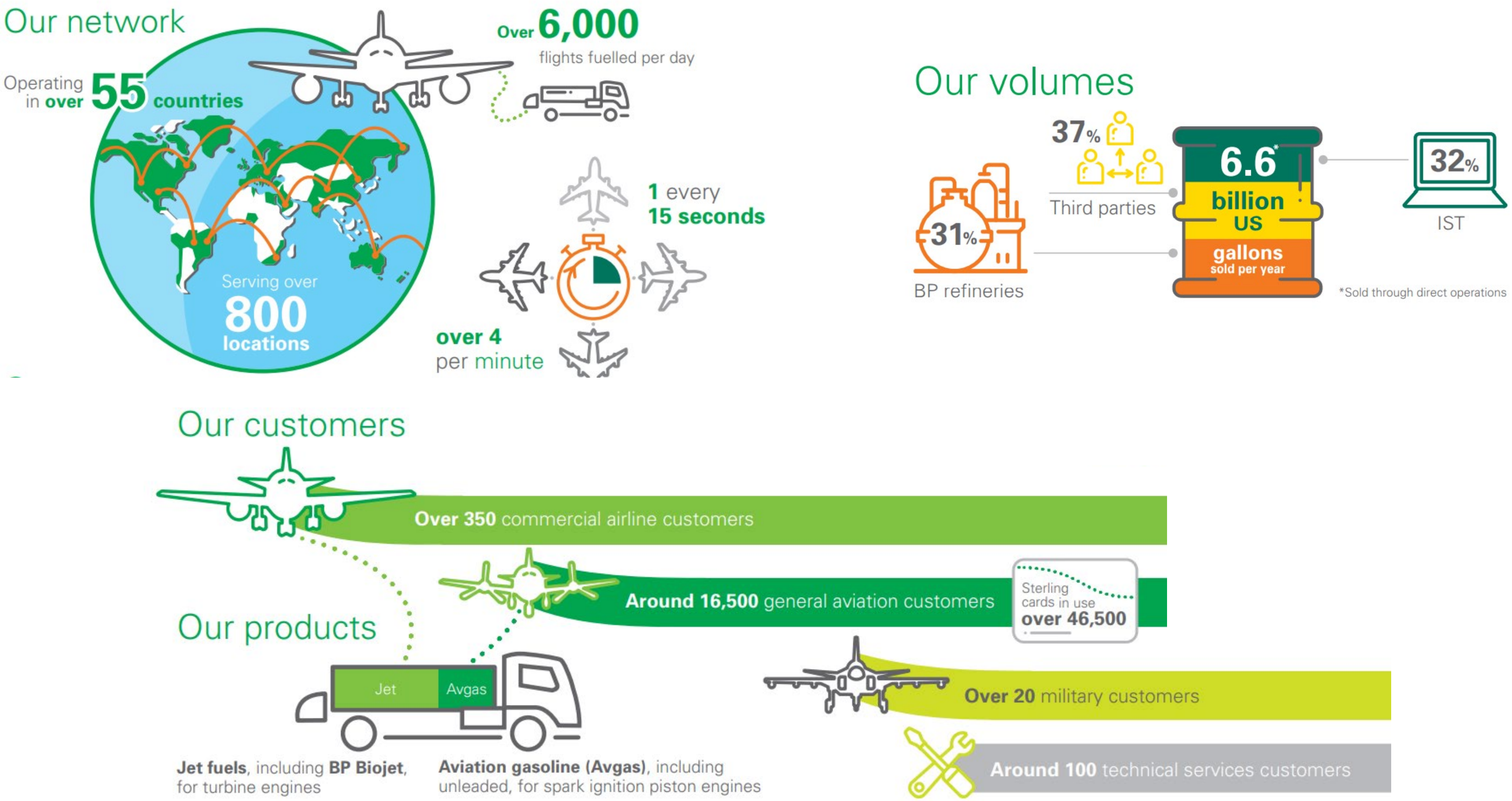
		2025 Targets	2030 Aims	2050, or sooner Aims
Aim 1	Net Zero operations	20%	30-35%	100%[1]
Aim 2	Net Zero oil and gas	20%	35-40%	100%[2]
Aim 3	Halving intensity	5%	>15%	50%
Aim 4	Reducing Methane	0.20% Measurement approach in place by 2023	Timeline to achieve 50% reduction to follow	
Aim 5	More $ for new energies	$3-4bn	~$5bn	⇧

Aims 1–4: Emissions reductions

Aim 5: Low carbon spend[3]

(1) Net zero, gross operated (2) Net zero, bp net equity, excludes Rosneft
(3) Includes: low carbon electricity, bio-energy, electrification, future mobility solutions, CCUS, Hydrogen (incl. mobility) and trading (low carbon)

Air bp is a leading marketeer of aviation



1	**Aviation decarbonisation**	**Why sector must decarbonise?** **What are options to decarbonise?**
2	**Demand side dynamics**	**What will drive SAF demand?** **Who will pay and what is willingness to pay?**
3	**Supply side dynamics**	**What are the SAF technology pathways?** **What are the constraints and adoption implications?**
4	**bp participation**	**What can bp do to advance the aviation decarbonisation agenda** **What are the participation choices in the near term vs. long term?**

We see four major drivers for SAF volume demand

I Policy & collective action

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- National and regional policy; Norway, Sweden, France, Finland, Netherlands, Denmark, Germany, Spain, UK have implemented SAF mandates. EU planning 5% mandates by 2030
- US proposal for SAF Act aims to boost production through tax credits, grants ($1 billion) and expanding the CA LCFS
- Collective action through international associations, i.e., CORSIA/CSFT
- Allowing SAF to reduce a company's obligations within emissions trading schemes (EU ETS) and CO2 taxes (Norway)
- Private subsidies (Swedavia) or governmental subsidies that allow SAF to opt-in to ground fuel schemes (i.e., LCFS)

II Voluntary Business

- ESG (environment, social and governance) issues are becoming key for investors: 33 of the world's largest institutional investors with $5.1 trillion in assets have committed to achieving net-zero emissions
- The Collective Commitment to Climate Action – global banking sector initiative which includes 38 banks across all continents committed to align their loan portfolios with the global climate goal
- Microsoft, Deloitte, Apple and Amazon have already committed to reducing their corporate travel emissions through SAF purchases via their airline partners

III Voluntary Cargo

- 1% of global freight weight is carried as air cargo, but this accounts for 35% of the value of global freight. Additional cost of SAF is passed to freight customers. DHL, Lufthansa Cargo and AirFrance-KLM Cargo have already committed to purchasing SAF.
- First fully carbon neutral cargo flight (100% SAF Frankfurt-Shanghai – both legs) was achieved in Nov 2020 by Lufthansa Cargo carrying medical goods for Siemens

IV Voluntary Passengers

- Despite the convenience of flying, consumers have said they are increasingly worried about the impact it has on climate change. Public movements, such as #flygskam ("flight shaming") and Fridays for Future, reflect this sentiment, particularly among millennials.
- In a survey of 5,300 fliers in 13 aviation markets on climate change, more than 50 percent of respondents said they were "really worried" about climate change. Those feelings were higher among women than men and most pronounced among people aged 34 and younger

Source: McKinsey, customer interviews, published legislation

3 **KEY MESSAGES:** Supply side dynamics

What are the SAF technology pathways?
What are the constraints and adoption implications?

- **Multiple pathways are needed to meet long-term SAF demand**, viable technology pathways include; HEFA, MSW to Jet, Alcohol to Jet, Biomass pyrolysis and eFuels.
- Feedstock availability may limit some pathways (e.g. HEFA from waste oils), however, i**n aggregate there is enough non-food bioenergy feedstock to meet the demand for jet fuel. Most advanced SAF pathways will be limited by technology readiness, capital intensity, build rate**, and cost.
- **In each market, a different mixture of feedstocks and pathways will provide SAF** according to the available feedstock, societal preferences, and capital availability – this could result in a mixture of different supply scenarios creating differing dynamics by region.
- On a cost of production basis, **HEFA is the most cost advantaged route to SAF with MSW or e-fuels projected to be the marginal route in the mid-long term**
  - The cost of eFuels are 2-3x the cost of HEFA today but will fall over time. MSW to jet will be competitive sooner.
- The technology pathways considered have 60-100% reduced carbon intensity (CI) relative to fossil jet. **eFuels have the lowest CI of the routes considered.**
- Availability of sustainable feedstock for HEFA is constrained to <10-20 Mtpa and there will be competition for demand from road transport sector. Therefore, other pathways are needed to achieve SAF scale beyond 2025-2030.
- The scope of the aviation transition to net zero is not unprecedented in terms of the number of plants. **Roughly 700 plants would be required to provide ~56% SAF in 2050** and this is similar to the number of bioethanol plants in the US/Brazil today.

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There exists several SAF technology pathways

    

	HEFA (wasteoil)*	FT (MSW)	1G Ethanol to jet	2nd Generation Biomass***	eFuel****
Time to Market & Current scale	**2020s** **Currently commercial.**	**2025-2030** **Commercial demo.**	**2025-2035** 1G ethanol is mature. Dehydration to ethylene commercial. Ethylene to jet not yet commercial.	**2030-2035** Pyrolysis commercial demo. Pyrolysis oil to jet not yet commercial.	**2030-2040** rWGS not yet commercial. FT demonstrated. Electrolysis is commercial.
Key Opportunities	**Fungible feedstock, Scaleable technology**	**Negative cost feedstock**	**Attractive in areas with existing ethanol capacity (US/Brazil)**	**Significant feedstock availability** Long-term **low-cost potential**	**Progress at pace of renewables** **Societal preference** Highest Sustainability Credentials
Near term Constraints	**Competition with renewable diesel** (HVO) for a highly limited feedstock	**Capital Requirements**	**Opportunity cost to sell ethanol** for road transport is high	**Costs & technology readiness**	**Costs & technology readiness** Improvements Required in Multiple Areas of Technology
Long term constraints	**Feedstock supply is limited** to <1-5% jet demand unless oilseed energy crops emerge post 2035. [rent may migrate to feedstock]	**High capital intensity** MSW access **GHG reduction counts on avoided landfill emissions**	**Opportunity cost to** sell as chemicals may be high	**Build rates** **Biomass aggregation**	**Capital costs** **Build Rates for eFuel and Power/H2**
GHG Reduction vs. fossil jet	65-79%	82-94%**	60-70% sugarcane; <20-30% corn	76-94%	100%

Key take away	HEFA is a near term option that uses fungible feedstock and back-integrates to refineries.	FT MSW provides near-mid term potential in urban areas with tipping fees for waste.	1st generation ATJ is capital lite & produces SAF from existing ethanol markets.	2nd generation biomass technologies have long term, low cost potential.	eFuels potential is increasing due to the pace of renewables and green H2.

*1G food crop vegetable oils could also be used as a feestock for HEFA
**assumes avoided landfill emissions are counted as part of analysis; landfill practice changes pose a risk to this accounting
***multiple other technology routes from 2nd generation biomass to SAF should also be considered including alternate catalytic/fermentative conversions, LC ethanol to jet, etc.
****alternate routes to eFuels also exist including a route through methanol and others at R&D stage

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Achieving the Net Zero scenario in the BP outlook is possible (though not easy) and likely requires a mix of different technology pathways which vary by region.

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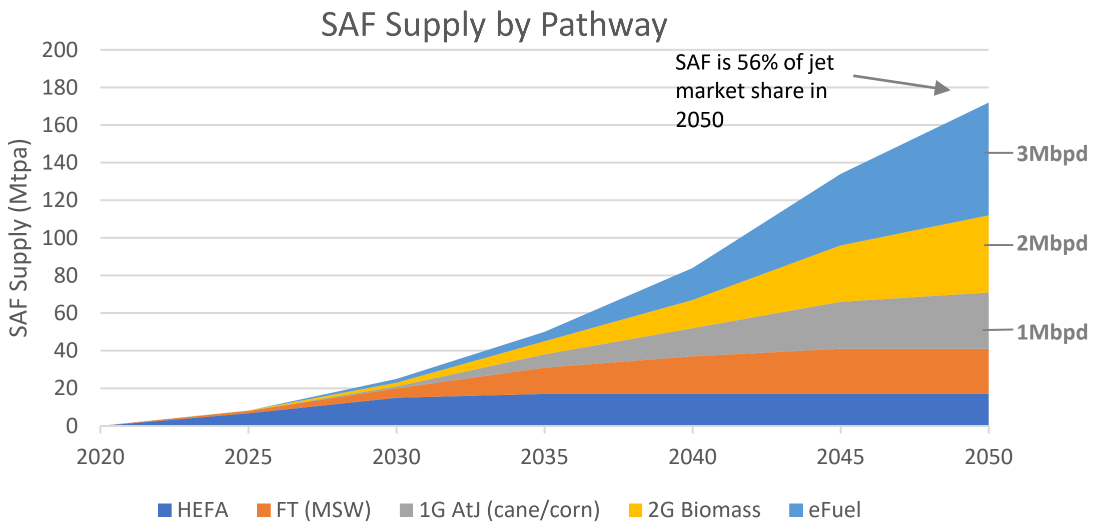
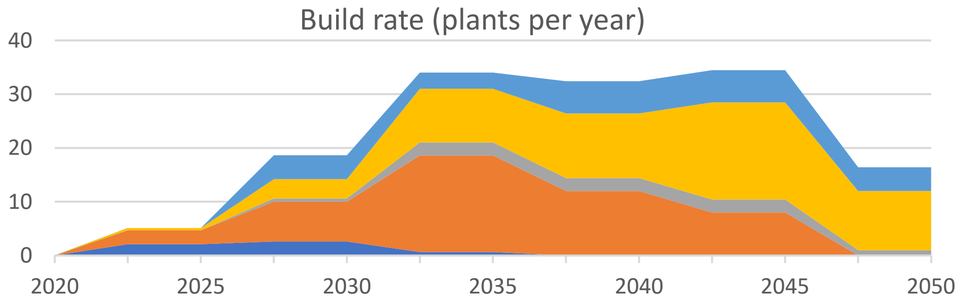
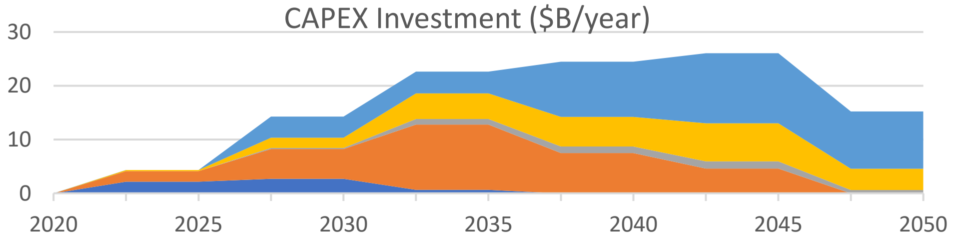
Net Zero Scenario (aligned with IATA targets) – SAF Supply







Key Conclusions:

Multiple Pathways Required

- The low-cost solution to aviation decarbonization will invest in technology development for **multiple pathways today** and scale those technologies in various waves as they become competitive with other types of SAF (at <$2500/te).
- The required investment, build rates, or subsidies are not unprecedented on their own if compared to other sizeable transitions, but the combination of these factors will be the primary challenge for achieving net zero in aviation.

Regional variations:

- Some regions will **prioritize specific pathways** with a strong focus on land use and sustainability resulting in growth of **eFuels** and **2G biomass**
- Other regions could favour **domestic supply** resulting in production of **ATJ** from ethanol or biojet from MSW.

Transition Scenario for Aviation Decarbonization is Similar to Historical Precedents

705 plants built (23/year average)
equivalent to the **US/Brazilian bioethanol** sector (~680 plants)

$535B capital invested over 30 years (~$17B/yr average)
new refinery investment was ~$45B/yr the last 5 yrs (Statista)

 Source: Statista. IRENA

Participation: scaling up bio-distillates through advantaged portfolio of projects, including long term feedstock security and supply & marketing integration

Secure feedstock

Licensing and R&D

Supply and Offtake

Copro | JV/consortia | Stand-alone assets

Coalitions | Advocacy | Partnerships

bp to drive a focused advocacy strategy to promote SAF availability, accessibility and affordability at pace in order to help deliver the aviation sector ambitions

Overview of bp's "5As" advocacy position for decarbonizing aviation:

Availability

- **Multiple SAF pathways are required, and all should be allowed to compete on their own merits within societal preference**
- Offsets will play a role in reducing GHG, but cannot replace the need for SAF
- Support Hydrogen and Electric technologies in aviation, but they are not going to replace the need for SAF in the next 3 decades
- Feedstock access for aviation should be promoted/supported by policy

Accessibility

- **Promote a global market with global logistics movements of SAF to ensure access and affordability**
- Mass balancing throughout the supply chain to enable bulking up volume/sustainability
- Flexibility on blending point
- Support book and claim programs where physical volume and paper claims are separated

Accountability

- **Support feedstocks that avoid the creation of additional demand for food and feed crops and excludes feedstocks with high risk of ILUC**
- E-fuels solutions should allow blue and biogas derived H2, as well as industrial sources of CO2
- Limits/targets should be placed on GHG profile, rather than volume of SAF (not all pathways and feedstocks are equal)
- Transparent accounting allows for all parties to claim their contribution to reducing GHG in the appropriate scope

Affordability

- **Support economy-wide carbon pricing but recognizes that aviation needs disproportionate price support because cost per ton of carbon abated is higher than other sectors**
- Pathways with higher abatement costs should be given additional policy support e.g., buyout levels must be at a level that promotes production
- Support policy and collective including mandates, cap & trade, blenders tax credits, low carbon fuels standards, government funding for R&D

Acceleration

- **Pace of policy and collective action must be prompt in order to deliver the industry ambitions**
- Suppliers need quick, clear and sustained demand signal in order to launch the investments needed for Rapid and Net Zero scenarios

Thank you!

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