Council – 225th Session

Subject No. 50: Questions relating to the environment

Analyses in Support of the 2022 CORSIA Periodic Review: Focus on Covid19 impacts on CORSIA and its baseline

Presented by CAEP

February 2022

Questions Addressed at the 225th Council Session

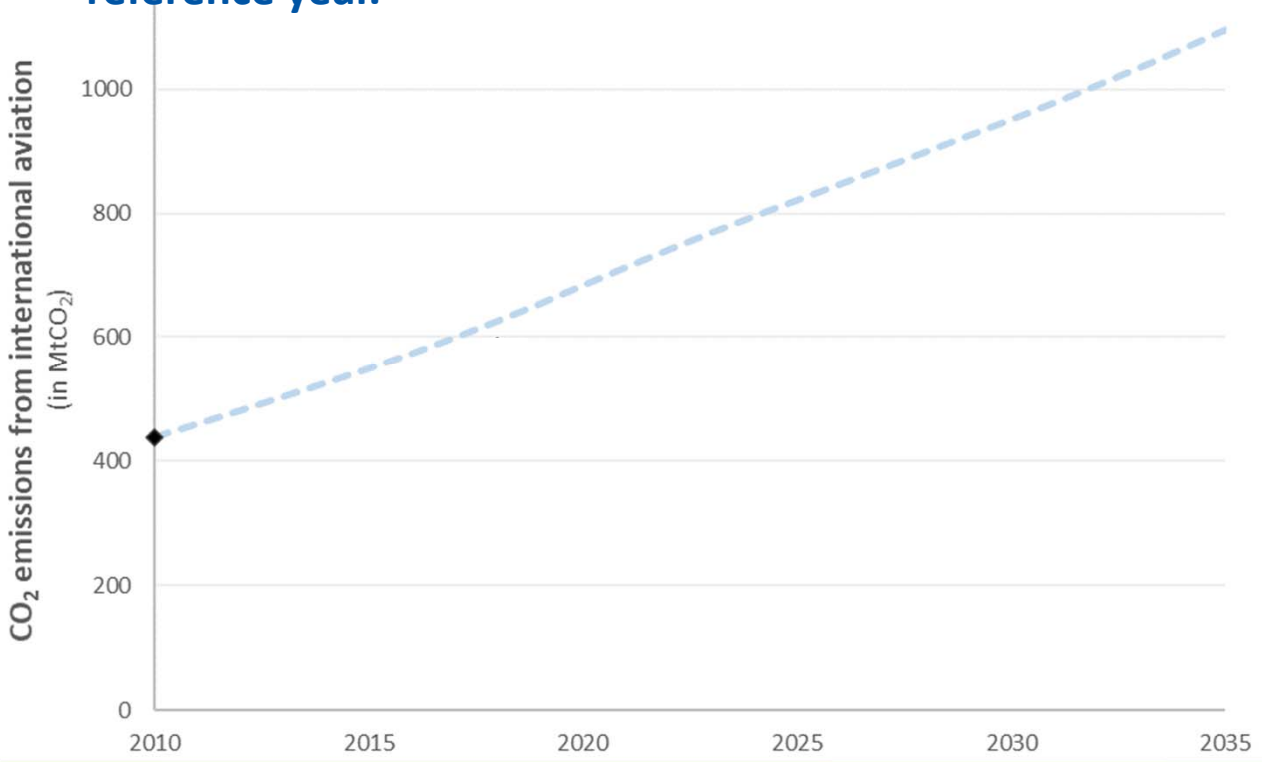
The Council requested CAEP to present the following inputs for the review, as outlined in the C-DEC 222/12 and the CORSIA Periodic Review Terms of Reference:

Excerpt from C-DEC 222/12 reference: 10. f. ii.

Further assessment of the impact of COVID-19 on CORSIA, including inter alia, its impact on the baseline beyond the pilot phase, on the different phases of CORSIA implementation, and on the growth factors, as set out in paragraph 5(e) of C-DEC 220/13, and drawing upon the analysis referenced in paragraph (d) above;

CO_2 Emissions Trends: Background

- **Analyses by CAEP conducted in 2015-2016 towards the decision on CORSIA during Assembly 39 in 2016 were based on CO_2 emissions trends from CAEP/10 using 2010 reference year.**



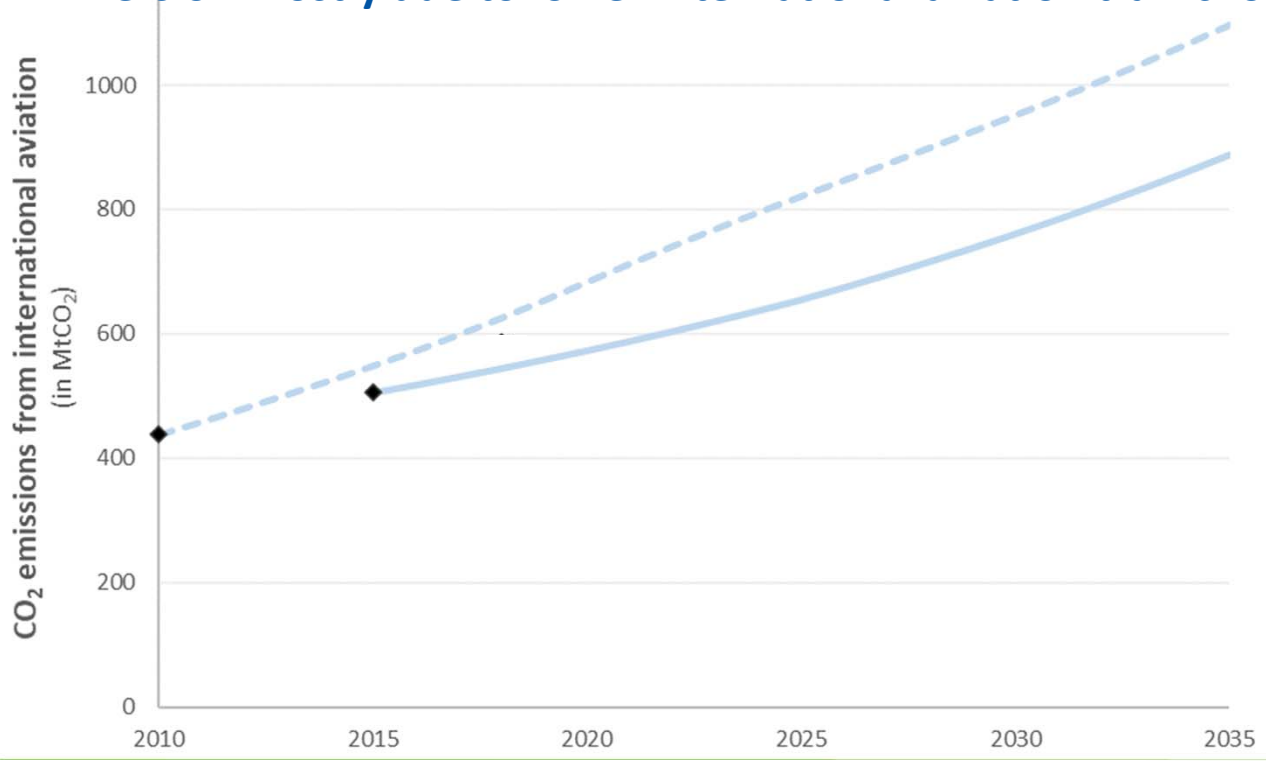
Base (CAEP/10 – ref.2010)*

Information available in 2013 (A38 trends) and confirmed in 2016 (A39 trends)

** Central traffic and optimistic aircraft technology improvement scenario*

CO_2 Emissions Trends: Background

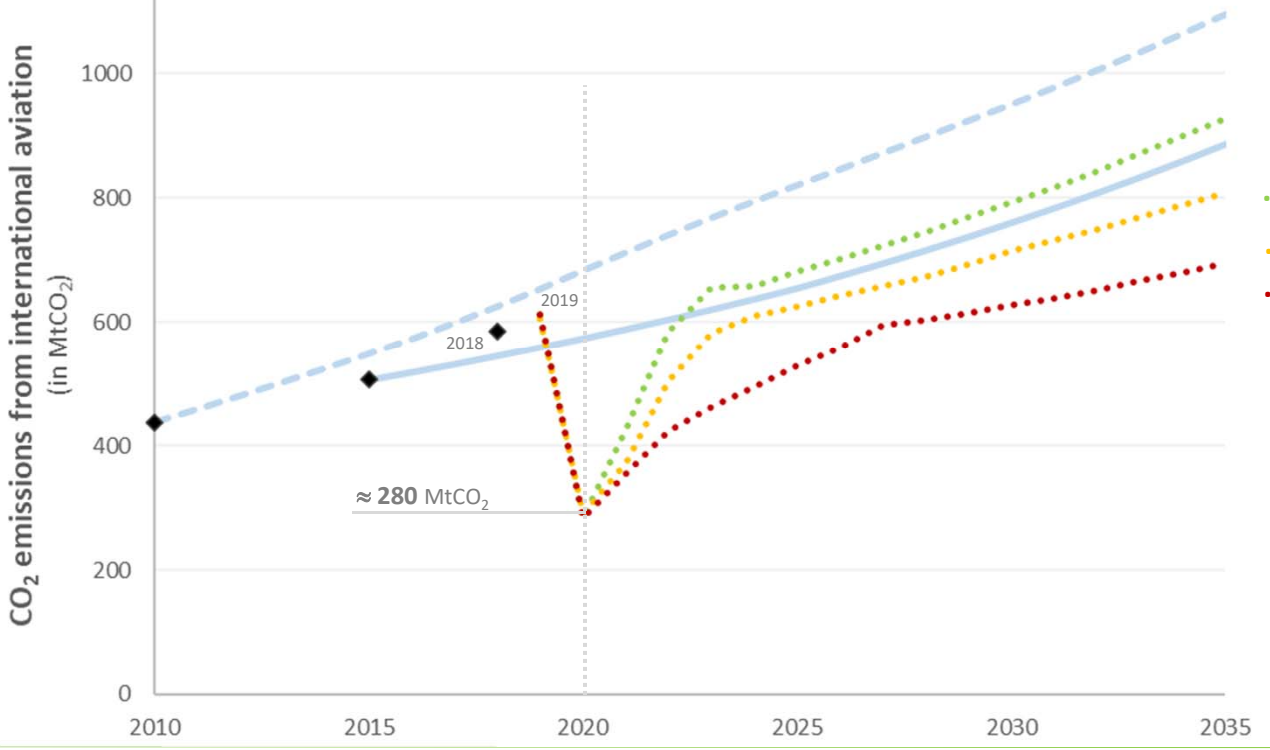
- **After the 39th Assembly, CAEP continued to update its analyses using the CAEP/11 CO_2 emissions trends. Long-term projections of CO_2 emissions were lower than the CAEP/10 version mostly due to lower international aviation traffic forecasts.**



** Central traffic and optimistic aircraft technology improvement scenario*

CO_2 Emissions Trends: Background

- **Since March 2020, CAEP has reflected the impacts of Covid19 on international aviation and its potential recovery scenarios. Interim analyses by CAEP presented during the 223rd session of the Council included a range of Low, Mid and High Covid19 recovery scenarios.**



Base (CAEP/10 – ref.2010)* — Information available in 2013 (A38 trends) and confirmed in 2016 (A39 trends)

Base (CAEP/11 – ref.2015)* — Information available in 2019 (A40 trends)

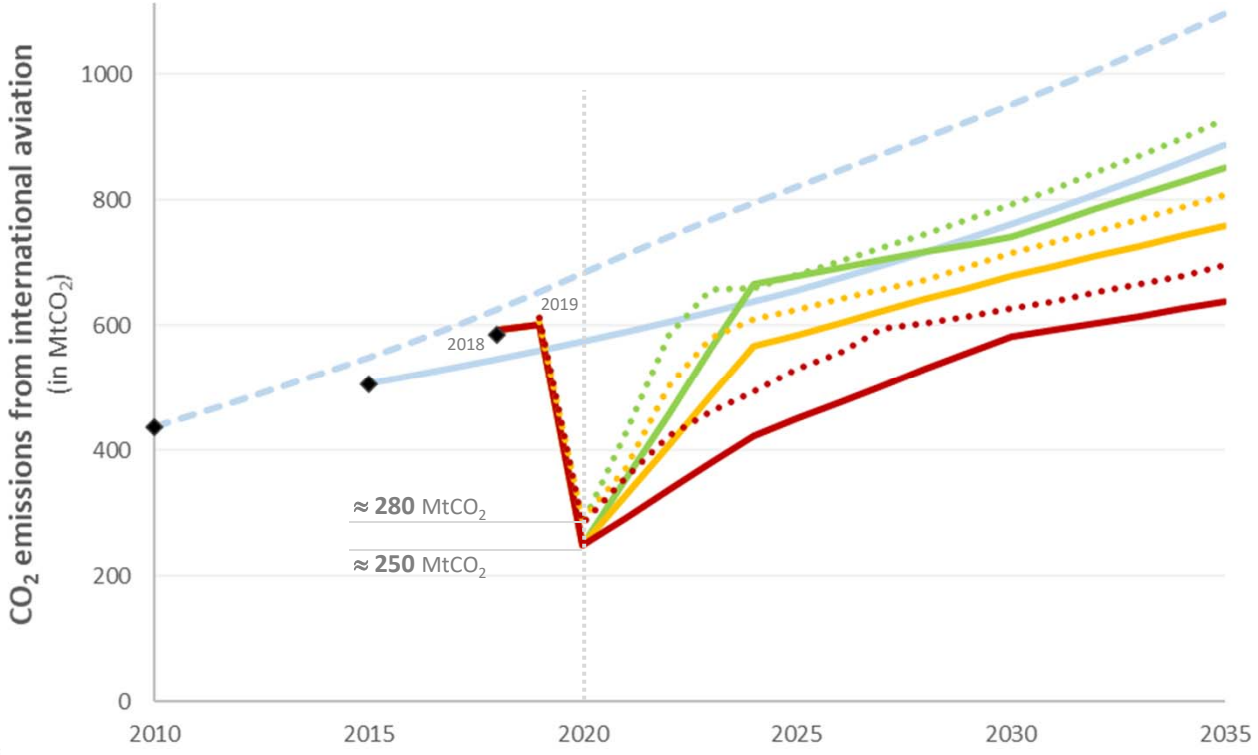
··· **High** Covid19 recovery
··· **Mid** Covid19 recovery
··· **Low** Covid19 recovery

April 2021 version of Covid19 Scenarios

** Central traffic and optimistic aircraft technology improvement scenario*

CO_2 Emissions Trends: Updated Covid19 Scenarios

- **Based on the updated Covid19 scenarios (CAEP/12 Trends), CO_2 emissions in 2020 are expected to be lower than originally anticipated in April 2021** i.e., drop of approximately 59 % from 2019 to 2020 instead of 54%.



Base (CAEP/10 – ref.2010)* — Information available in 2013 (A38 trends) and confirmed in 2016 (A39 trends)

Base (CAEP/11 – ref.2015)* — Information available in 2019 (A40 trends)

April 2021 version of Covid19 Scenarios:
- High Covid19 recovery
- Mid Covid19 recovery
- Low Covid19 recovery

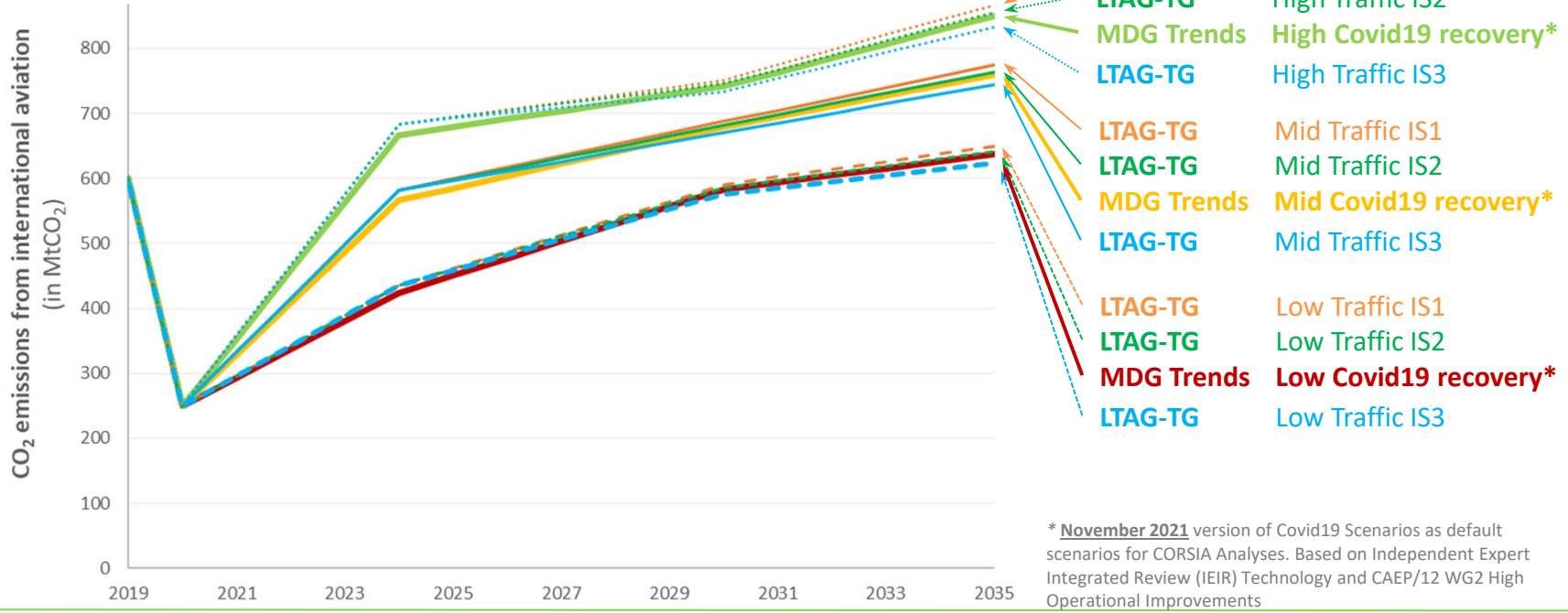
November 2021 version of Covid19 Scenarios:
- High Covid19 recovery
- Mid Covid19 recovery
- Low Covdi19 recovery

◆ **Actual CO_2 emissions** (estimations based on actual international aviation activity)

** Central traffic and optimistic aircraft technology improvement scenario*

Placing the CO_2 Emissions Trends used for CORSIA Analyses in Context of LTAG-TG Trends through 2035

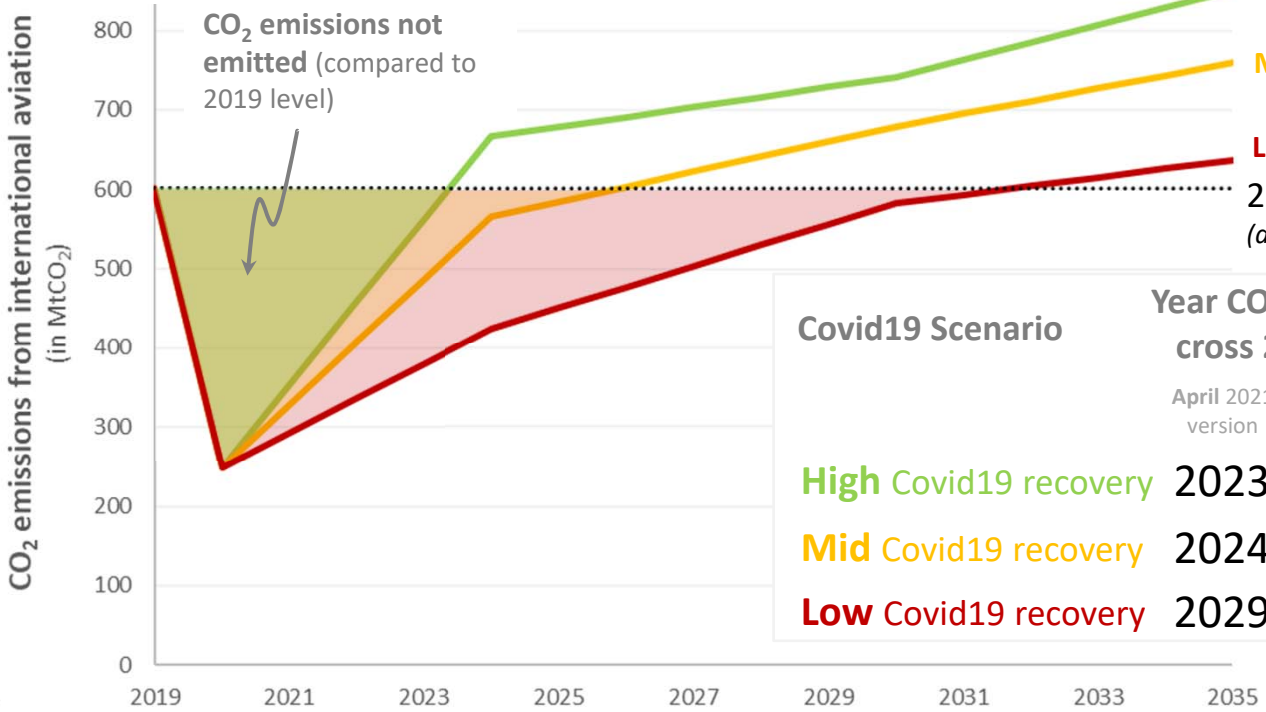
- Trends in CO_2 emissions after technology and operations improvements used as input to CORSIA Analyses (i.e., CAEP/12 Trends) are very close to the LTAG-TG Trends.
- No material impacts in CORSIA Analyses results expected if LTAG-TG scenarios were used instead.



* **November 2021** version of Covid19 Scenarios as default scenarios for CORSIA Analyses. Based on Independent Expert Integrated Review (IEIR) Technology and CAEP/12 WG2 High Operational Improvements

CO_2 Emissions Not Emitted Compared to 2019 Level

- **Based on the interim updated scenarios, CO_2 emissions not emitted compared to a 2019 level could range from 780 to 1800 $MtCO_2$ depending on the rate of recovery.**
- **For context, in 2016 (pre-Covid19) offsetting requirements from 2021-2035 were estimated at approximately 2,500 $MtCO_2$.**



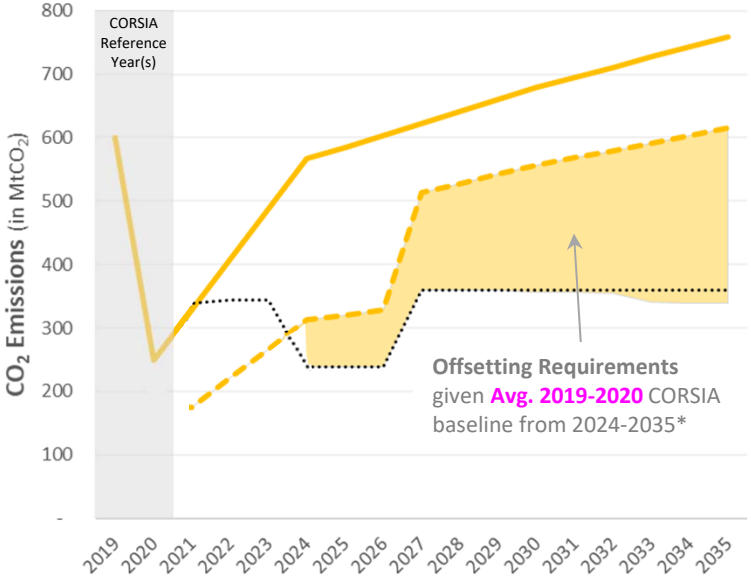
Covid19 Scenario	Year CO_2 emissions cross 2019 level		CO_2 emissions not emitted (vs. 2019 level)	
	April 2021 version	Nov. 2021 version	April 2021 version	Nov. 2021 version
High Covid19 recovery	2023	**2024**	540	**780** $MtCO_2$
Mid Covid19 recovery	2024	**2026**	660	**980** $MtCO_2$
Low Covid19 recovery	2029	**2032**	1200	**1800** $MtCO_2$

Estimation of Offsetting Requirements

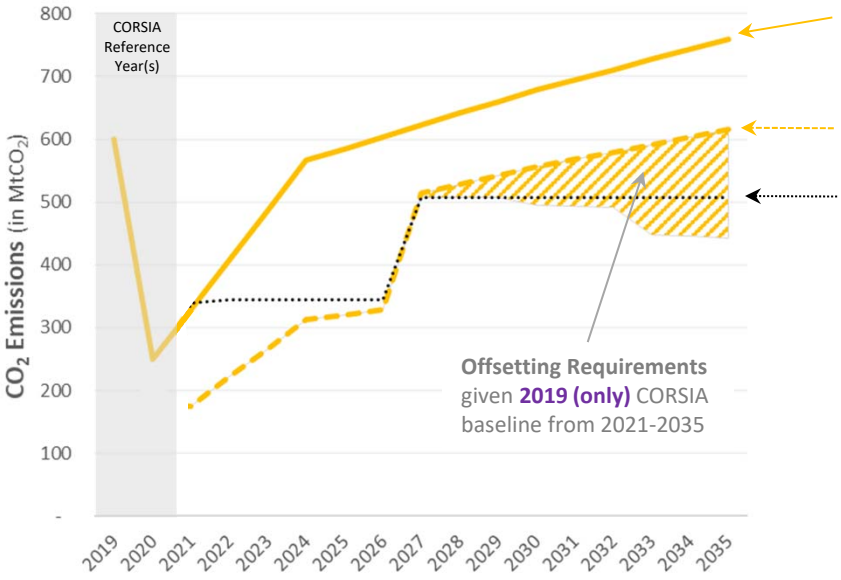
- **Given a recovery scenario for traffic and CO_2 emissions, the definition of the CORSIA baseline (impacted by Covid19 in 2020) will affect offsetting requirements through 2035.**

Illustration: Mid Covid19 recovery

CORSIA Baseline: Avg. 2019-2020 from 2024 to 2035*



CORSIA Baseline: 2019 (only) from 2021 to 2035



CO_2 Emissions from International Aviation (Chapter 2)

CO_2 Emissions subject to Offsetting Requirements (Chapter 3)

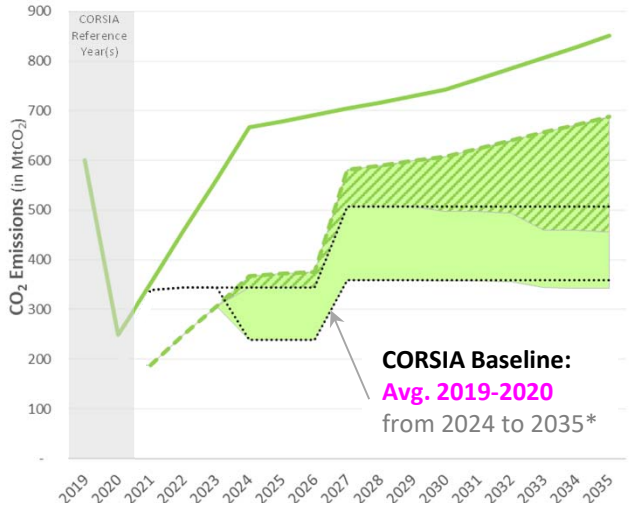
CORSIA sector baseline

* CORSIA baseline from 2021-2023 defined as 2019 (only) based on decision by ICAO Council in June 2020.

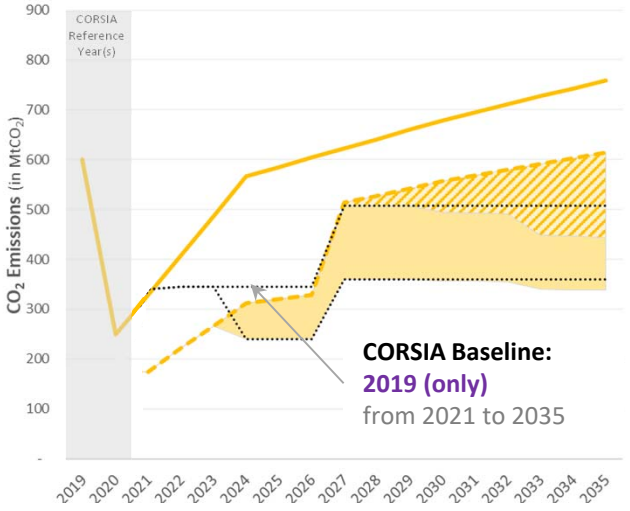
Estimation of Offsetting Requirements

- **Total offsetting requirements across international aviation sector are influenced by the impact of Covid19 (in 2020) and, the rate of recovery in out years along with the CORSIA baseline.**

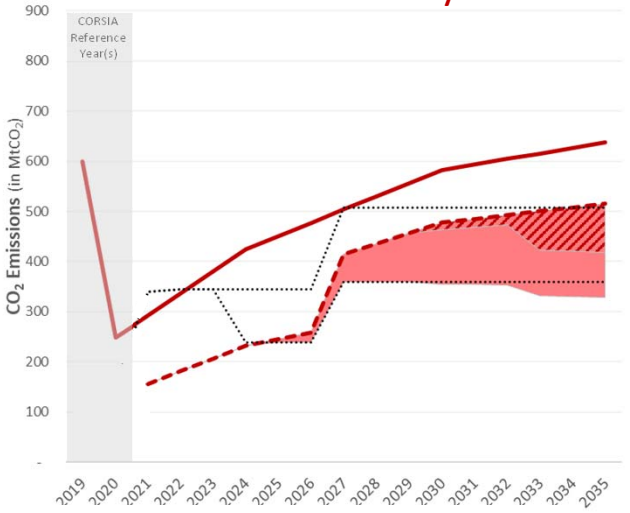
High Covid19 recovery



Mid Covid19 recovery



Low Covid19 recovery



Legend:

Offsetting Requirements given **2019 (only)**
CORSIA baseline from 2021-2035

Offsetting Requirements given **Avg. 2019-2020**
CORSIA baseline from 2024-2035*

Offsetting Requirements given **2019 (only)**
CORSIA baseline from 2021-2035

Offsetting Requirements given **Avg. 2019-2020**
CORSIA baseline from 2024-2035*

Offsetting Requirements given **2019 (only)**
CORSIA baseline from 2021-2035

Offsetting Requirements given **Avg. 2019-2020**
CORSIA baseline from 2024-2035*

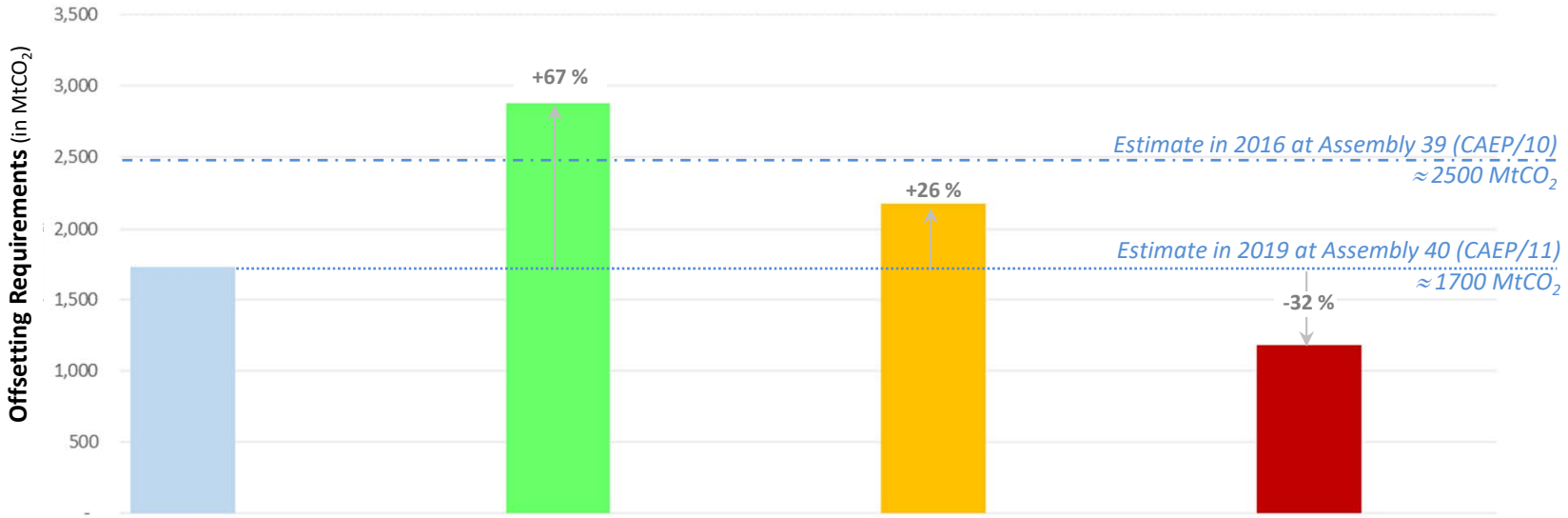
Estimation of Offsetting Requirements

- **Under a scenario of average 2019-2020 baseline for 2024-2035, offsetting requirements (OR) could range from 1200 to 2900 $MtCO_2$.**

All Phases (2021-2035)

Notes:
- Average results from 100 runs of stochastic model.

- CORSIA Analyses developed and refined by WG4 based on Monte Carlo runs of stochastic CORSIA Integrated Model (v2022-01a). The model, developed by the United States, includes over 1700 operators across over 8000 State-pairs and is calibrated to match CO_2 emissions across 40 international route groups from the CAEP/12 Trends from 2019 to 2035.

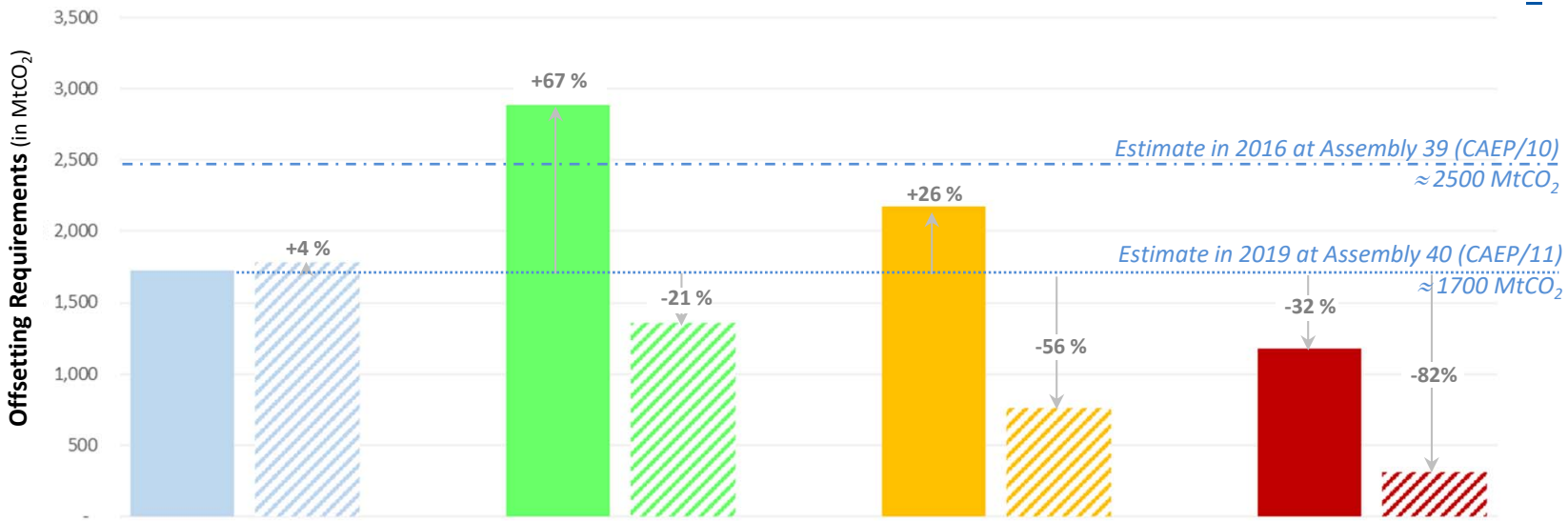


Scenario Assumptions				
CO_2 Emissions Trends	**Base** (CAEP/11 ref. 2015) No Covid19 Scenario	**High** Covid19 Recovery Scenario	**Mid** Covid19 Recovery Scenario	**Low** Covid19 Recovery Scenario
CORSIA Baseline (2021-2023)	2019 (only)	2019 (only)	2019 (only)	2019 (only)
CORSIA Baseline (2024-2035)	Avg 2019 -2020	Avg 2019 -2020	Avg 2019 -2020	Avg 2019 -2020

Estimation of Offsetting Requirements

- **Under a scenario of average 2019-2020 baseline for 2024-2035, offsetting requirements (OR) could range from 1200 to 2900 $MtCO_2$.**
- **If the baseline remains at 2019 level for 2024-2035, OR could range from 310 to 1400 $MtCO_2$.**

All Phases
(2021-2035)



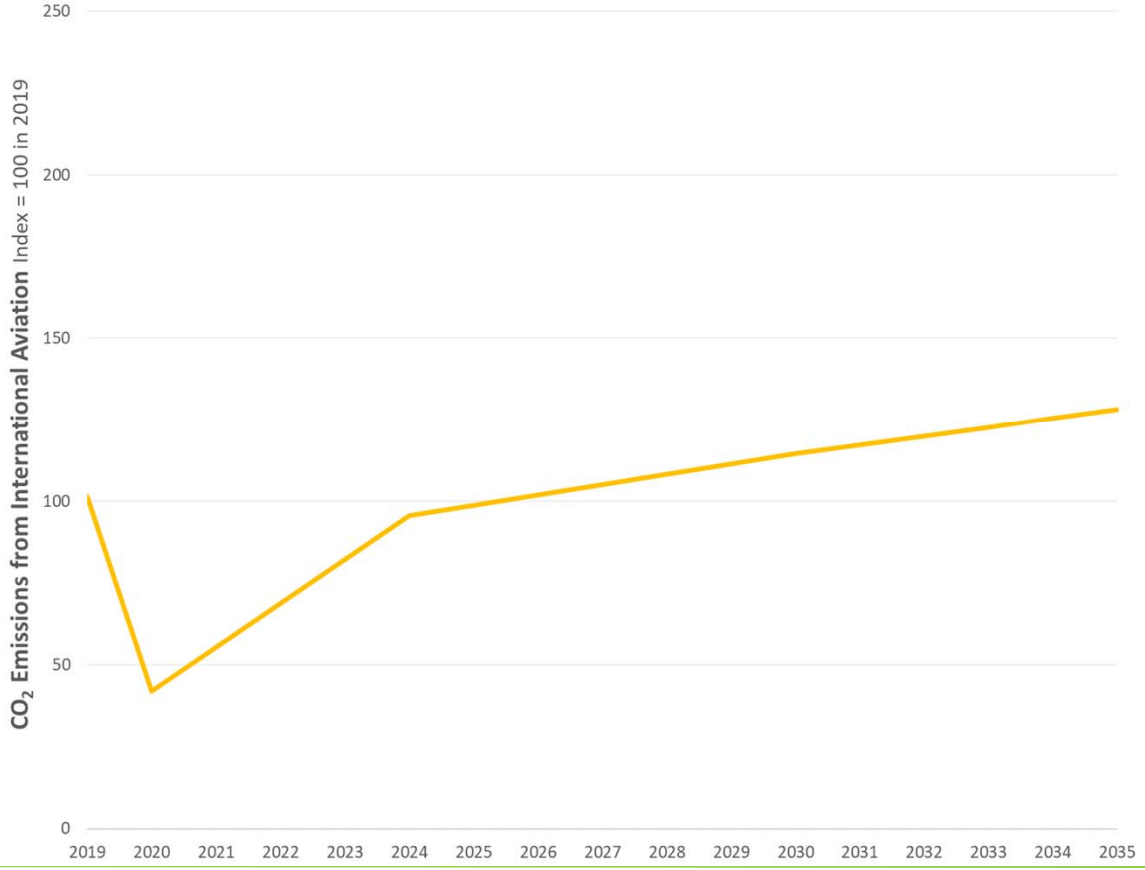
Note. – Slide 25 displays estimates presented to the 223rd session of Council. Updated estimates are slightly lower due to lower CO2 emissions forecasts.

Scenario Assumptions

CO_2 Emissions Trends	**Base** (CAEP/11 ref. 2015) No Covid19 Scenario		**High** Covid19 Recovery Scenario		**Mid** Covid19 Recovery Scenario		**Low** Covid19 Recovery Scenario	
CORSIA Baseline (2021-2023)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)
CORSIA Baseline (2024-2035)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)

CO_2 Emissions from International Aviation

Illustration: **Mid Covid19 Scenario**

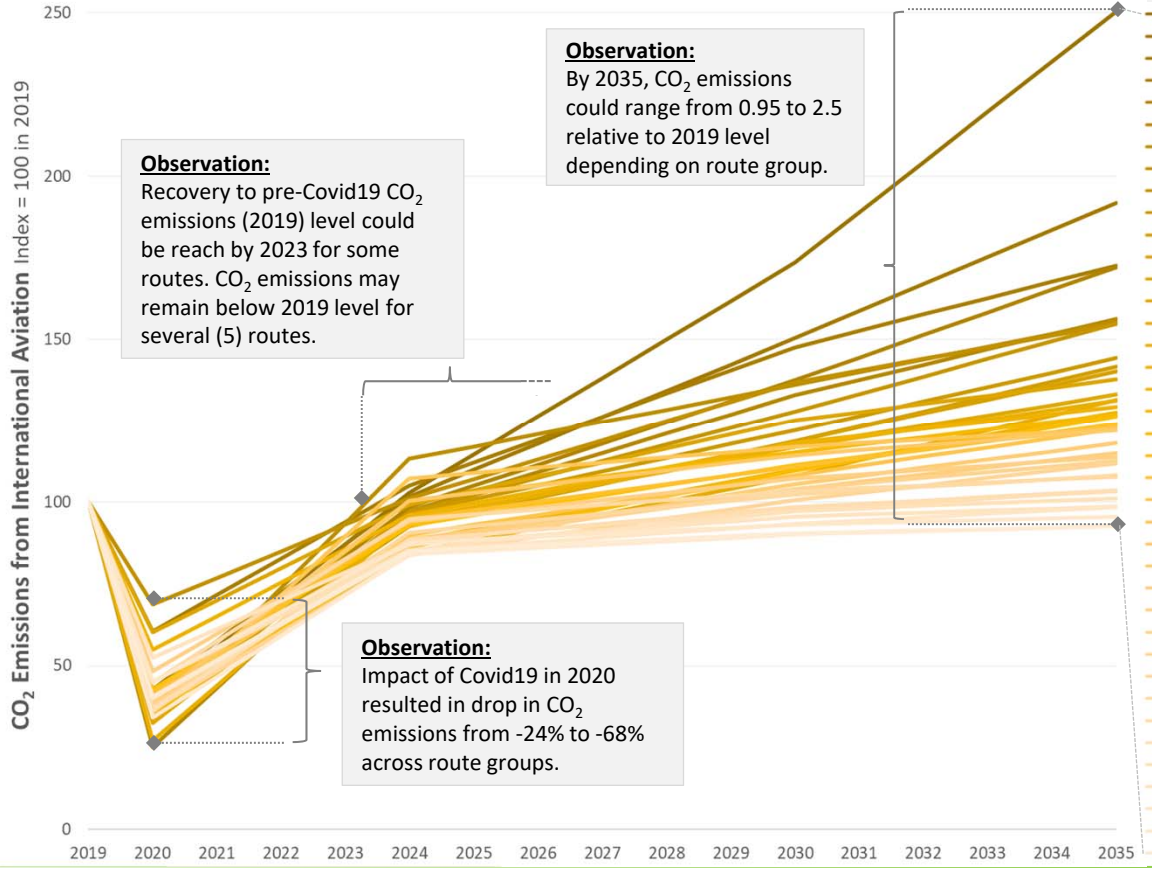


CO_2 Emissions from International Aviation (Chapter 2)

(2019-2020)	(2019-2035)
-59 %	**+28%** (+1.5 % per annum)

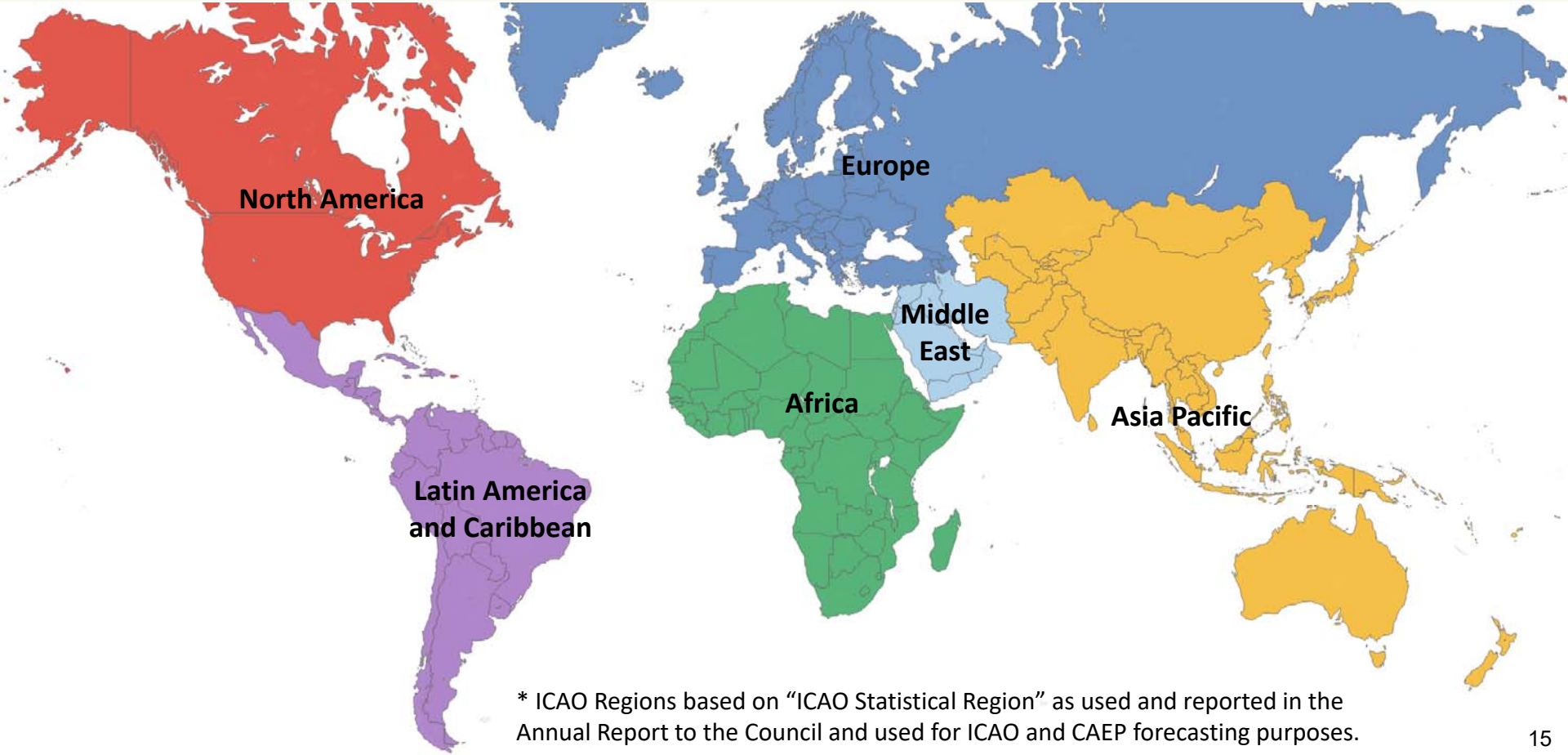
Regional Breakdown of CO_2 Emissions from International Aviation

Illustration: **Mid Covid19 Scenario**



FESG Route Group			Annual Growth Rate (2019-2020)	Annual Growth Rate (2019-2035)
Middle East	<->	South West Asia	-60%	5.9%
China & South West Asia	<->	North Asia	-57%	4.2%
Intra China & South West Asia			-40%	3.5%
China & South West Asia	<->	Pacific South East Asia	-62%	3.5%
Latin America/Caribbean	<->	China	-75%	2.8%
Europe	<->	North Africa	-66%	2.8%
China	<->	Middle East	-31%	2.8%
Intra Pacific South East Asia			-65%	2.8%
Central America/Caribbean	<->	South America	-64%	2.3%
Intra Africa			-60%	2.2%
Europe	<->	South West Asia	-58%	2.1%
China	<->	North America	-40%	2.0%
North Asia	<->	Pacific South East Asia	-68%	1.8%
North America	<->	South West Asia	-63%	1.7%
Latin America/Caribbean	<->	North Asia & Pacific South East Asia	-73%	1.7%
China	<->	Europe	-45%	1.6%
Africa	<->	Middle East	-62%	1.5%
Intra North Asia			-61%	1.5%
Africa	<->	Asia/Pacific	-64%	1.5%
Intra Central America/Caribbean			-57%	1.3%
Central America/Caribbean	<->	North America	-58%	1.3%
Africa & Middle East	<->	South America	-59%	1.3%
Intra Europe			-64%	1.3%
Intra South America			-61%	1.3%
North America	<->	Pacific South East Asia	-62%	1.0%
Central America/Caribbean	<->	Europe	-63%	0.9%
North America	<->	South America	-52%	0.8%
Middle East	<->	North Asia & Pacific South East Asia	-62%	0.7%
Europe	<->	Pacific South East Asia	-63%	0.7%
Intra Middle East			-64%	0.5%
Intra North America			-55%	0.5%
Europe	<->	South America	-64%	0.2%
Europe	<->	Middle East	-63%	0.2%
Middle East	<->	North America	-55%	0.1%
North America	<->	North Asia	-48%	-0.1%
Europe	<->	North America	-60%	-0.1%
Europe	<->	North Asia	-55%	-0.3%
Africa	<->	North America	-66%	-0.5%
Europe	<->	Sub Saharan Africa	-59%	-0.5%

Background on ICAO Regions*



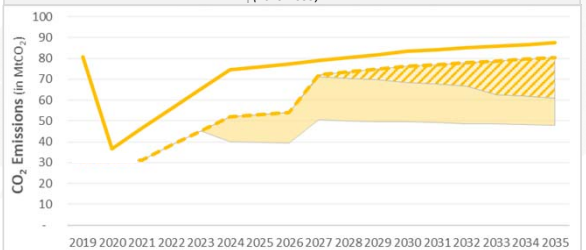
* ICAO Regions based on “ICAO Statistical Region” as used and reported in the Annual Report to the Council and used for ICAO and CAEP forecasting purposes.

Regional Breakdown of Offsetting Requirements by ICAO Regions

North America

Share of total CO_2 emissions (2021-2035)*: **12%**

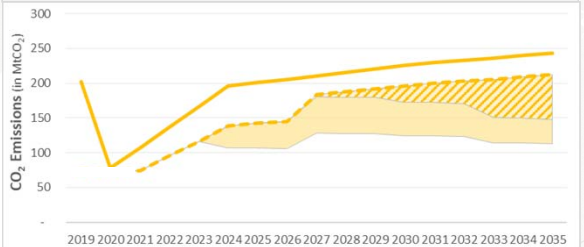
Avg. annual growth rate CO_2 emissions (2019-2035)**: **0.5%**



Europe

Share of total CO_2 emissions (2021-2035)*: **33%**

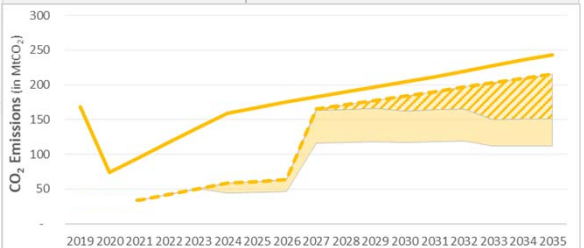
Avg. annual growth rate CO_2 emissions (2019-2035)**: **1.2%**



Asia Pacific

Share of total CO_2 emissions (2021-2035)*: **30%**

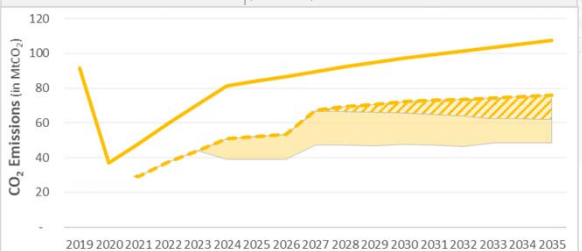
Avg. annual growth rate CO_2 emissions (2019-2035)**: **2.3%**



Middle East

Share of total CO_2 emissions (2021-2035)*: **14%**

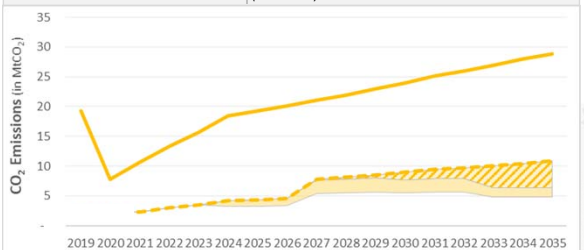
Avg. annual growth rate CO_2 emissions (2019-2035)**: **1.0%**



Latin America and Caribbean

Share of total CO_2 emissions (2021-2035)*: **3%**

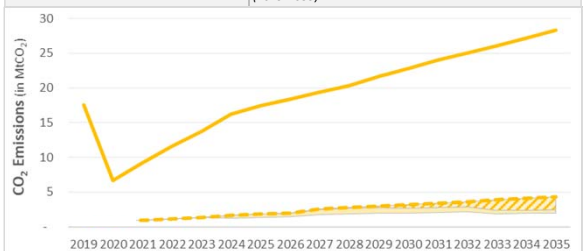
Avg. annual growth rate CO_2 emissions (2019-2035)**: **2.6%**



Africa

Share of total CO_2 emissions (2021-2035)*: **3%**

Avg. annual growth rate CO_2 emissions (2019-2035)**: **3.0%**



Summary of Assumptions:

CORSIA Baseline Ref. Year (Pilot):	2019
CORSIA Baseline Ref. Year (2024-2035):	Avg. 2019-2020 or 2019 (only)
Sectoral/Individual :	80% / 20% in 2030-2032
Sectoral/Individual :	30% / 70% in 2033-2035
States for Chapter 3 State Pairs:	Edition 2 (July 2021)

Illustrative traffic scenario: Mid Covid19 recovery.

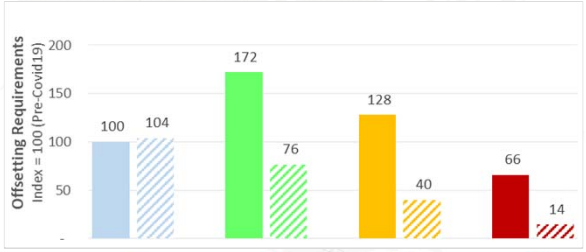
** Share of total international aviation CO_2 emissions (A16V4 Chapter 2) from 2021 to 2035. Shares very similar across Covid19 scenarios.*

*** Average annual growth of CO_2 emissions from international aviation (A16V4 Chapter 2) from 2019 to 2035.*

Regional Breakdown of Offsetting Requirements by ICAO Regions

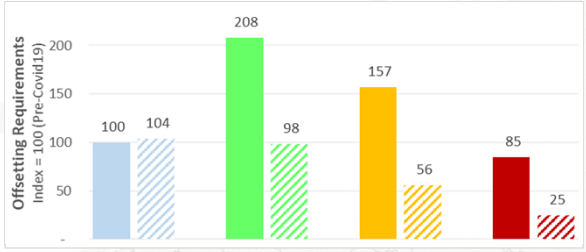
Offsetting Requirements Index = 100 for pre-Covid 19 (Base) scenario

North America

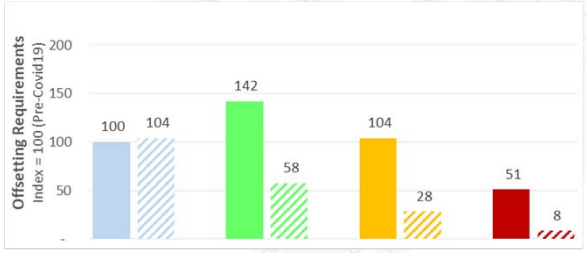


CO_2 Emissions Trends	Base		High		Mid		Low	
CORSIA Baseline (2021-2023)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)
CORSIA Baseline (2024-2035)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)

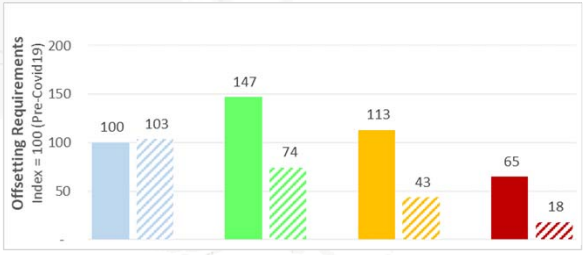
Europe



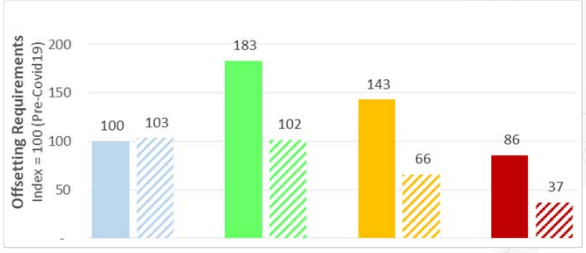
Middle East



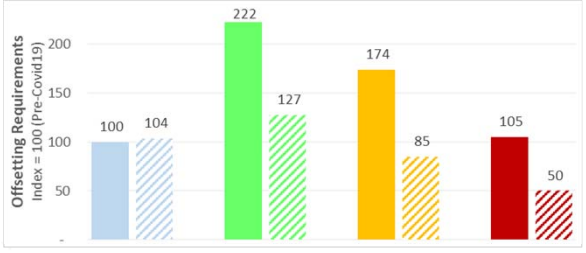
Asia Pacific



Latin America and Caribbean



Africa



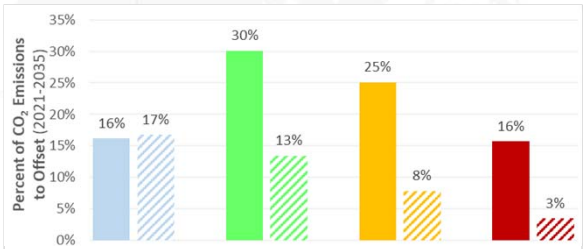
Summary of Assumptions:

CORSIA Baseline Ref. Year (Pilot):	2019
CORSIA Baseline Ref. Year (2024-2035):	Avg. 2019-2020 or **2019 (only)**
Sectoral/Individual :	80% / 20% in 2030-2032
Sectoral/Individual :	30% / 70% in 2033-2035
States for Chapter 3 State Pairs:	Edition 2 (July 2021)

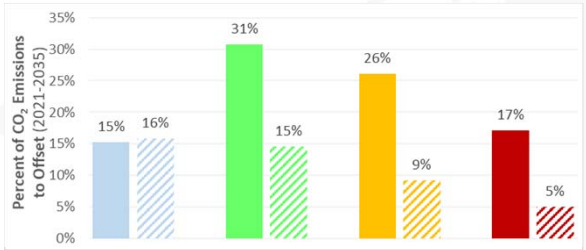
Percent CO_2 emissions to Offset by ICAO Regions

Percent CO_2 emissions to offset based on **total international aviation CO_2 emissions** (A16V4 Chapter 2).*

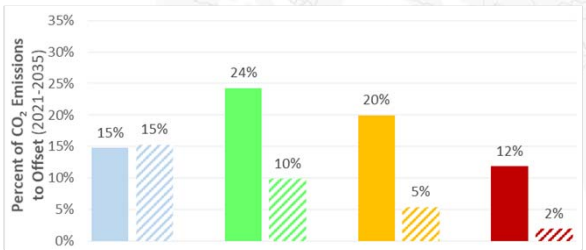
North America



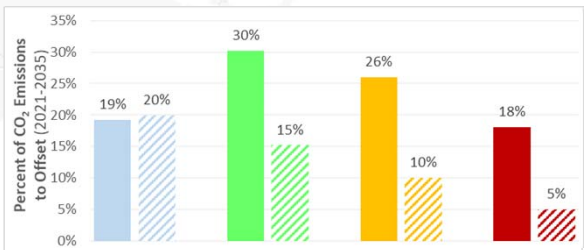
Europe



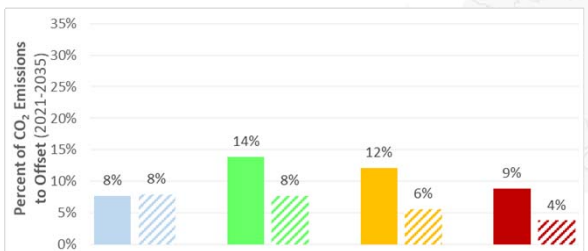
Middle East



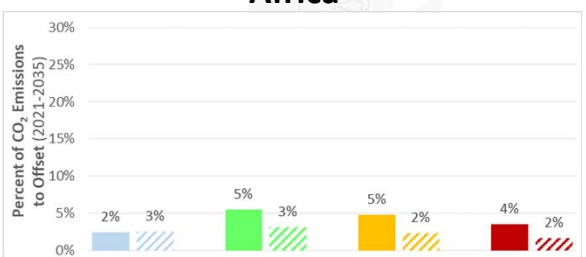
Asia Pacific



Latin America and Caribbean



Africa



* *Percent CO_2 emissions to offset calculated as: total offsetting requirements (2021-2035) divided by total CO_2 emissions from international aviation (A16V4 Chapter 2) from 2021 to 2035.*

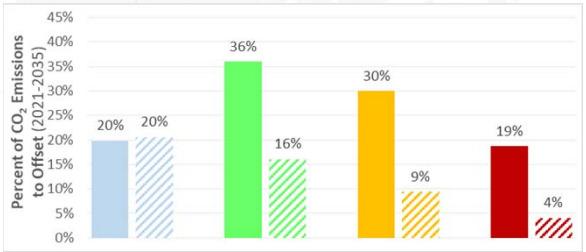
Summary of Assumptions:

CORSIA Baseline Ref. Year (Pilot):	2019
CORSIA Baseline Ref. Year (2024-2035):	Avg. 2019-2020 or **2019 (only)**
Sectoral/Individual :	80% / 20% in 2030-2032
Sectoral/Individual :	30% / 70% in 2033-2035
States for Chapter 3 State Pairs:	Edition 2 (July 2021)

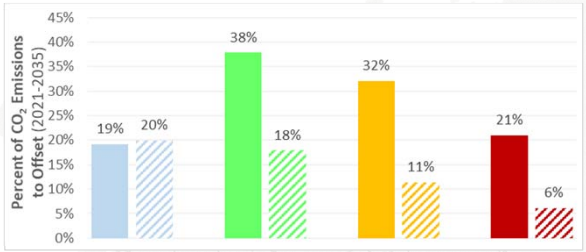
Percent CO_2 emissions to Offset by ICAO Regions (cont.)

Percent Chapter 3 CO_2 emissions to offset based on* ***total international aviation CO_2 emissions subject to offsetting requirements*** *(A16V4 Chapter 3).*

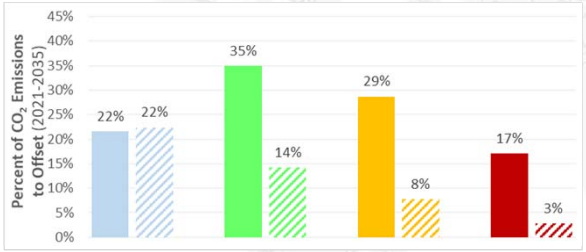
North America



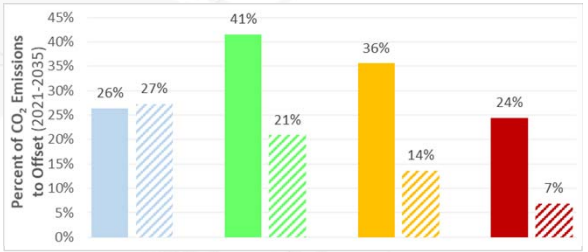
Europe



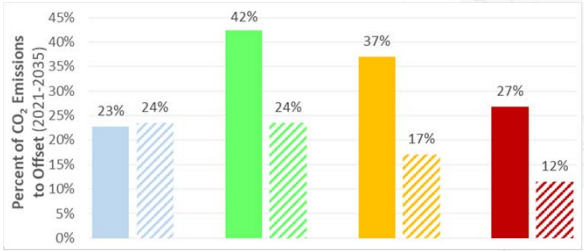
Middle East



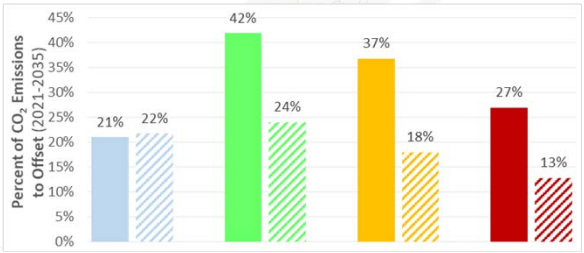
Asia Pacific



Latin America and Caribbean



Africa



Summary of Assumptions:

CORSIA Baseline Ref. Year (Pilot):	2019
CORSIA Baseline Ref. Year (2024-2035):	Avg. 2019-2020 or **2019 (only)**
Sectoral/Individual :	80% / 20% in 2030-2032
Sectoral/Individual :	30% / 70% in 2033-2035
States for Chapter 3 State Pairs:	Edition 2 (July 2021)

** Percent Chapter 3 CO_2 emissions to offset calculated as: total offsetting requirements (2021-2035) divided by total international aviation CO_2 emissions subject to offsetting requirements (A16V4 Chapter 3) from 2021 to 2035.*

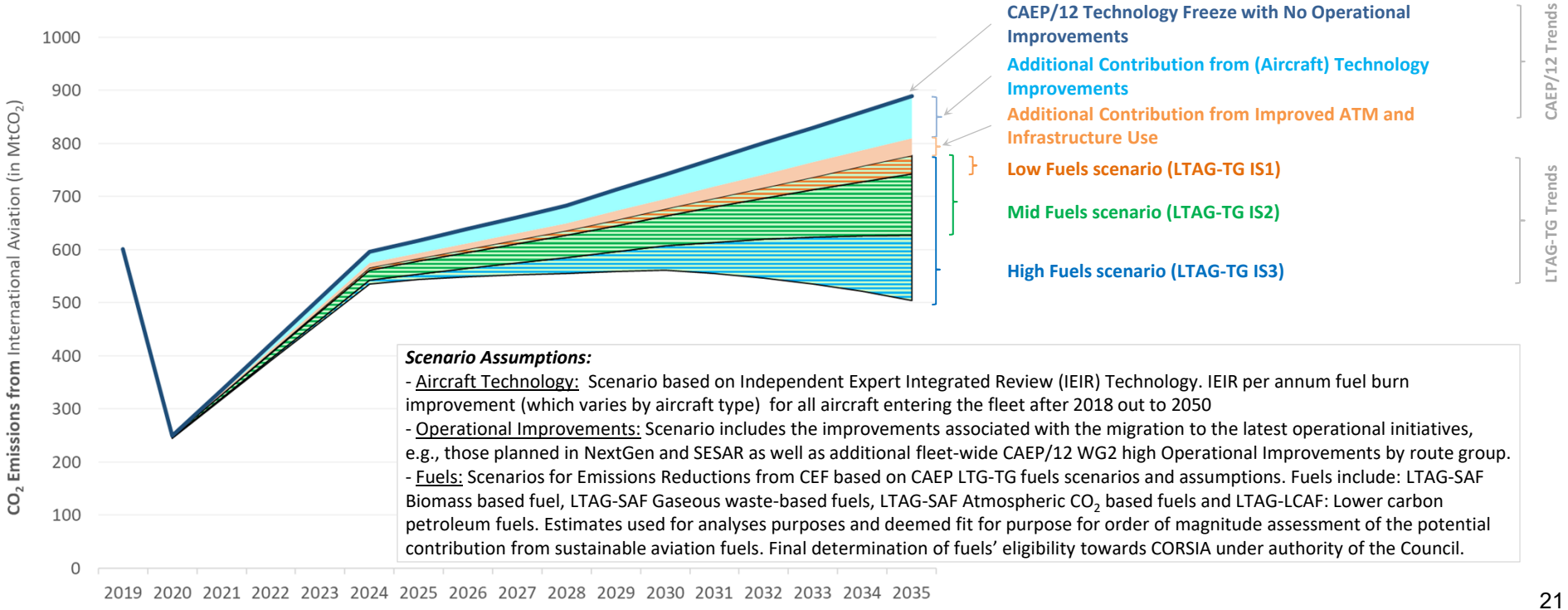
Summary on Regional Breakdown of Offsetting Requirements by ICAO Regions

- **Results of regional breakdown of offsetting requirements by ICAO Region show similar relative changes in offsetting requirements between 2021 and 2035 compared to their expected quantities of offsetting requirements before COVID-19 in all regions**
  (i.e., all regions are expected to be affected by COVID-19 in a similar manner).

- **The percent of CO_2 emissions offset is driven by the participation of States in CORSIA and this is also similar across all regions, except certain regions where there is a relatively higher number of States that are exempted and not voluntarily participating.**

Contribution from Fuels (e.g., SAF) towards Emissions Reductions

- **Future emissions reductions expected from aircraft technology improvements, operational improvements and sustainable aviation fuels.**

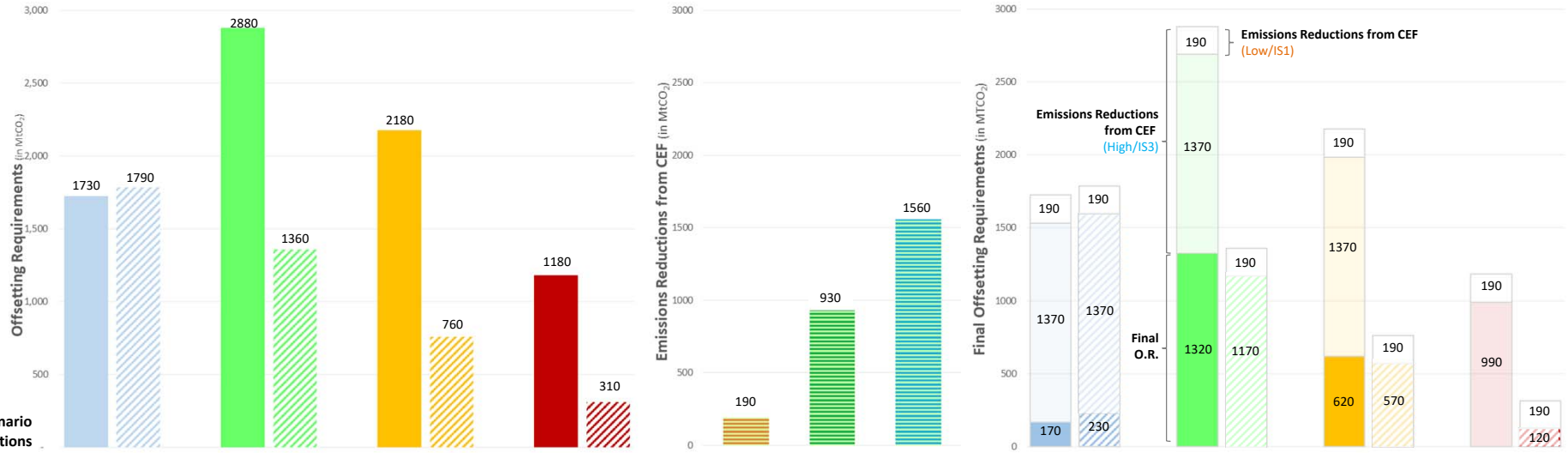


Scenario Assumptions:

- Aircraft Technology: Scenario based on Independent Expert Integrated Review (IEIR) Technology. IEIR per annum fuel burn improvement (which varies by aircraft type) for all aircraft entering the fleet after 2018 out to 2050
- Operational Improvements: Scenario includes the improvements associated with the migration to the latest operational initiatives, e.g., those planned in NextGen and SESAR as well as additional fleet-wide CAEP/12 WG2 high Operational Improvements by route group.
- Fuels: Scenarios for Emissions Reductions from CEF based on CAEP LTG-TG fuels scenarios and assumptions. Fuels include: LTAG-SAF Biomass based fuel, LTAG-SAF Gaseous waste-based fuels, LTAG-SAF Atmospheric CO_2 based fuels and LTAG-LCAF: Lower carbon petroleum fuels. Estimates used for analyses purposes and deemed fit for purpose for order of magnitude assessment of the potential contribution from sustainable aviation fuels. Final determination of fuels' eligibility towards CORSIA under authority of the Council.

Final Offsetting Requirements: Consideration of Emissions Reductions from CORSIA Eligible Fuels

Offsetting Requirements *(per Annex 16 Volume IV, section 3.2)* **– Emissions Reductions from CEF** *(per Annex 16 Volume IV, section 3.3)* **= Final Offsetting Requirements** *(per Annex 16 Volume IV, section 3.4)*



Scenario Assumptions																				
CO_2 Emissions Trends	**Base** No Covid19 Scenario				**High** Covid19 Recovery Scenario				**Mid** Covid19 Recovery Scenario				**Low** Covid19 Recovery Scenario				**Base** No Covid19 Scenario		**High**		**Mid**		**Low**	
CORSIA Baseline (2021-2023)	2019 (only)	2019 (only)			2019 (only)	2019 (only)			2019 (only)	2019 (only)			2019 (only)	2019 (only)			2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)
CORSIA Baseline (2024-2035)	Avg. 2019 -2020	2019 (only)			Avg. 2019 -2020	2019 (only)			Avg. 2019 -2020	2019 (only)			Avg. 2019 -2020	2019 (only)			Avg. 2019 -2020	2019 (only)	Avg. 2019 -2020	2019 (only)	Avg. 2019 -2020	2019 (only)	Avg. 2019 -2020	2019 (only)
Proxy for CORSIA Eligible Fuels (CEF)											Low (IS1)		Mid (IS2)		High (IS3)									

Scenarios for Emissions Reductions from CEF based on CAEP LTG-TG fuels scenarios and assumptions. Fuels include: LTAG-SAF Biomass based fuel, LTAG-SAF Gaseous waste-based fuels, LTAG-SAF Atmospheric CO2 based fuels and LTAG-LCAF: Lower carbon petroleum fuels. Estimates used for analyses purposes and deemed fit for purpose for order of magnitude assessment of the potential contribution from sustainable aviation fuels. Final determination of fuels' eligibility towards CORSIA under authority of the Council.

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THANK YOU

CAEP/12 COVID-19 Scenarios (Traffic Forecasts)

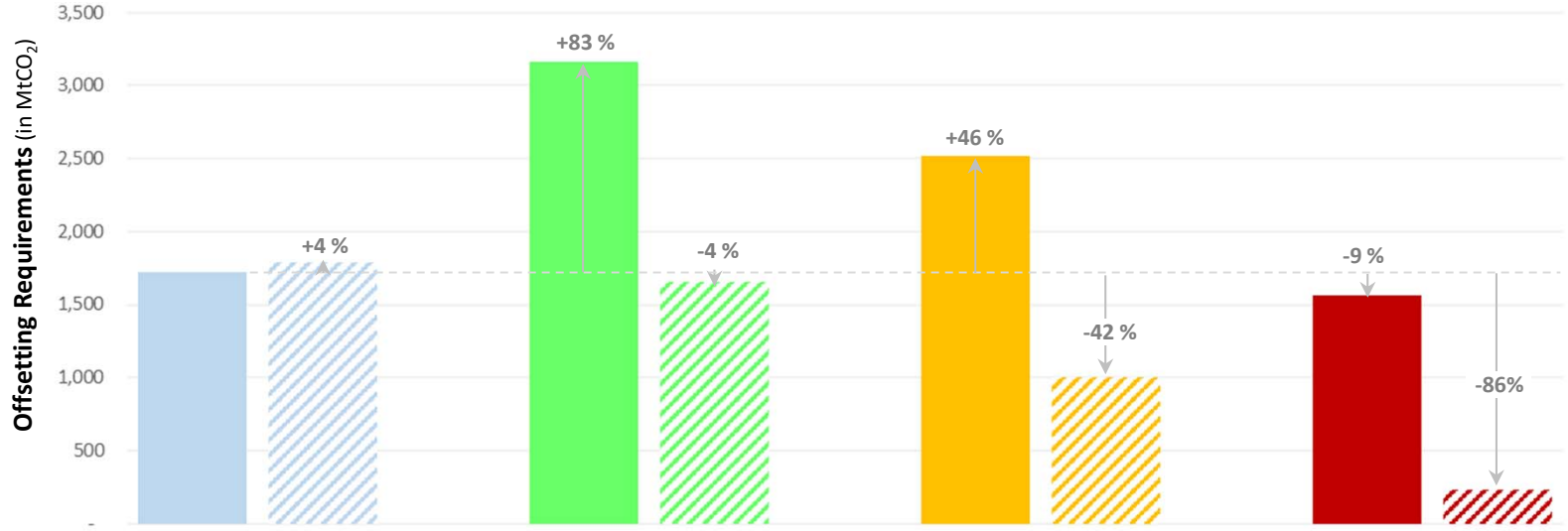
Scenario	Description of Assumptions and Drivers Underlying the Traffic Forecasts
High Covid19 Recovery	Regulatory approval of vaccine takes place in early 2021 with availability and wide-spread use in mid/late 2021. The global economic activity follows a V-shaped recovery (back to 2019 levels in early 2021). *Passenger market:* RPKs are expected to return to 2019 level in 2023 and return to pre-crisis trend (level) around 2030. Business Travel growth resumes late 2021 and returns to normal levels in 2022. This drives solid recovery in both markets (B2B and conferences). Solid and sustained global recovery with Asia (China) pick-up quickly in 2021. Recovery in traffic tracks economic growth (NA/EUR follow Asia). *Freighter market:* RTKs are expected to return to 2019 level in 2021 and return to pre-crisis trend (level). Regional variation will depend upon differences in regional economic activity. Pacific/Asia & Asia/Middle East will lead, followed by North America/Europe.
Mid Covid19 Recovery	Regulatory approval of vaccine takes place in mid 2021 with availability and wide-spread use in early/late 2022. The global economic activity return to 2019 levels in late 2021/2022 (running behind the optimistic outlook). *Passenger market:* RPKs are expected to return to 2019 level in 2024. RPKs do not return to pre-crisis level and a permanent shift remains due to substitution of online technologies for business and changes in household vacation/travel patterns. Business Travel growth resumes in late 2022/2023, but never fully returns to normal levels (i.e., some permanent reduction due to substitutes -- Zoom, etc.). Recovery lags economic growth (some behavioral changes/lower incomes). Resumption in domestic traffic first. International lags. China/Asia leads the recovery, followed by NA and EUR. *Freighter market:* RTKs are expected to return to 2019 level in 2022 and return to pre-crisis trend (level). Regional variation will depend upon differences in regional economic activity. Pacific/Asia & Asia/Middle East will lead, followed by North America/Europe.
Low Covid19 Recovery	Regulatory approval of vaccine takes place in early 2022 with availability and wide-spread use in late 2022/early 2023. The global economic activity return to 2019 levels in late 2023/2024. *Passenger market:* RPKs are expected to return to 2019 level in 2027. RPKs do not return to pre-crisis level and a permanent shift remains due to substitution of online technologies for business and changes in household vacation/travel patterns. Business travel does not fully recover and resulting in a permanent and sustained loss in domestic/international travel. Recovery lags economic growth (more prevalent behavior changes/lower incomes). Resumption in domestic traffic slow to gain traction. International lags further behind. China/Asia and developing nations lead recovery. NA and EUR lag. *Freighter market:* RTKs are expected to return to 2019 level in 2023 and may not return to pre-crisis trend (level) depending on economic forecast. Regional variation will depend upon differences in regional economic activity. Pacific/Asia & Asia/Middle East will lead, followed by North America/Europe.

Source: CAEP-FESG, “COVID-19 Forecast Scenario Development”, CAEP-SG/20213-IP/01 Appendix D.

Estimation of Offsetting Requirements

- Under a scenario of average 2019-2020 baseline for 2024-2035, offsetting requirements (OR) could range from 1600 to 3200 $MtCO_2$.
- If the baseline remains at 2019 level for 2024-2035, OR could range from 230 to 1700 $MtCO_2$.

All Phases
(2021-2035)



Scenario Assumptions

CO_2 Emissions Trends	**Base** (CAEP/11 ref. 2015) No Covid19 Scenario		**High** Covid19 Recovery Scenario		**Mid** Covid19 Recovery Scenario		**Low** Covid19 Recovery Scenario	
CORSIA Baseline (2021-2023)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)	2019 (only)
CORSIA Baseline (2024-2035)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)	Avg 2019 -2020	2019 (only)

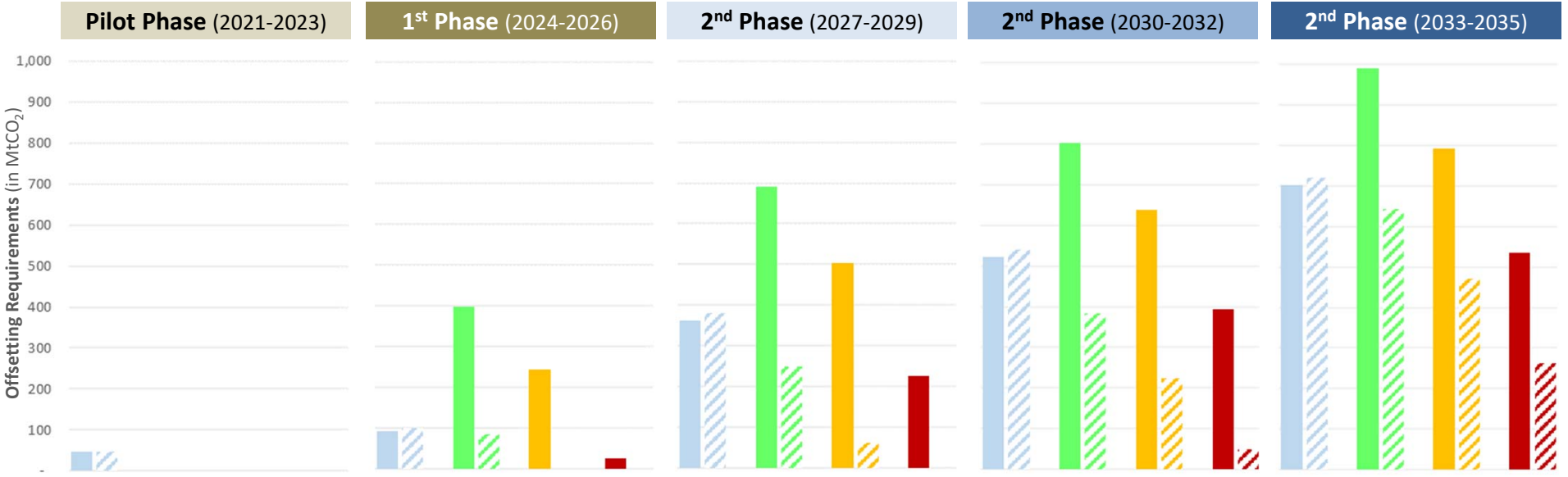
Offsetting Requirements by Phases

- **Offsetting requirements over time (across compliance cycles) influenced by Sector Growth Factor (driven by recovery scenarios) and choice of the CORSIA baseline.**

Legend:

CORSIA Baseline (2024-2035)	CO_2 Emissions Trends
Avg 2019-2020 / 2019 (only)	**Base** (CAEP/11 ref. 2015) No Covid19 Scenario
Avg 2019-2020 / 2019 (only)	**High** Covid19 Recovery Scenario
Avg 2019-2020 / 2019 (only)	**Mid** Covid19 Recovery Scenario
Avg 2019-2020 / 2019 (only)	**Low** Covid19 Recovery Scenario

Compliance Cycles:



Assumptions: Traffic and Emissions Profile (Mid Covid19 Scenario), CORSIA Baseline Ref. Year (2019 for 2021-2023 and average 2019-2020 for 2024-2035), Sectoral/Individual (80% / 20% in 2030-2032, 30% / 70% in 2033-2035), States for Chapter 3 State Pairs (Edition 2 - July 2021), New Entrant baseline option D.

Summary of Sector Growth Factors (SGF)

When the Sector Growth Factor (SGF) was negative for a given year, it was assumed to be zero for the purpose of calculation of offsetting requirements.

Covid19 Recovery Scenario	CORSIA Baseline Scenario	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
High Covid19 Recovery	**Avg. 2019-2020**	0.0%	0.0%	0.0%	34.9%	35.7%	36.4%	38.1%	39.1%	39.9%	40.8%	42.3%	43.8%	45.2%	46.5%	47.8%
	2019 (only)	0.0%	0.0%	0.0%	6.4%	7.5%	8.5%	12.8%	14.1%	15.3%	16.6%	18.7%	20.8%	22.7%	24.6%	26.4%
Mid Covid19 Recovery	**Avg. 2019-2020**	0.0%	0.0%	0.0%	23.3%	25.3%	27.1%	30.0%	31.9%	33.7%	35.4%	36.7%	38.0%	39.2%	40.4%	41.5%
	2019 (only)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	4.0%	6.5%	8.9%	10.7%	12.5%	14.3%	15.9%	17.6%
Low Covid19 Recovery	**Avg. 2019-2020**	0.0%	0.0%	0.0%	0.0%	2.6%	7.4%	13.2%	17.4%	21.2%	24.7%	25.9%	27.0%	28.1%	29.2%	30.2%
	2019 (only)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	1.6%

Note. – Summary results for 100 runs of stochastic CORSIA Integrated Model.