July 10, 2023

Dear Sustainable Equity Strategy Clients and Friends,

When the famously frugal Warren Buffett bought his first private jet in 1986, he wryly apologized by naming it *The Indefensible*. In 2019, 16-year-old Swedish climate activist Greta Thunberg rejected flying for its high carbon footprint and instead hitched a ride on a sailboat from Europe to New York for a UN climate conference.

Buffett was thinking economics, Thunberg impacts. Yet it turns out the two are tightly linked. Combusting fuel is a grossly inefficient way to generate propulsion given that most of the fuel's energy value dissipates as waste heat (electrification avoids this loss, which is partly why most transport modes are transitioning to it). While jet engines are more efficient than car engines,[1] they do not scale optimally to the low seat capacity of private flying, making it an exceptionally costly and high-emitting activity.[2] Wasted money = Excess emissions. Ergo, Buffett = Thunberg.

Well, almost…it turns out that time introduces a wrinkle into our syllogism.

After experiencing what it did to enhance his time productivity, Buffett did a 180 and renamed his plane *The Indispensable*. Then, grasping the wider market for the value proposition he had lived (same as his playbook with Cokes, cheeseburgers, and chocolates) he bought NetJets and dispensed of *The Indispensable* because he now had the world's biggest private jet fleet at his disposal.

Had Thunberg adopted Buffett's productivity calculus, she could have swapped her 14-day sailboat ride for a 5-hour flight and used the found time to appeal personally to more Americans before her UN speech. But her decision to live her beliefs inspired millions in a way more words couldn't have.[3] Moreover, she was focused on a physics equation, one less amenable to time-saving tradeoffs: the finite remaining atmospheric capacity for heat-trapping gases if humanity is to avoid the most dangerous climate impacts, and the closing window to reduce emissions.

It's likely that most readers of this letter are recurring flyers and aware that this activity is a big line item in their personal carbon footprint.[4] Regulators are grappling with this too: the European Union is debating whether investments in the aviation sector can be fairly labelled as "green" in its prescriptive disclosure regime.[5] So we decided it would be timely for us to walk through why we added **Airbus** to the Sustainable Equity Strategy portfolio last December. Its 2023 return puts it near the top third of our portfolio, though we hasten to add that this is not a quarter-to-quarter horse race, and our performance objective is long-term compounding. We are nonetheless pleased to report that in the first half of 2023 the Strategy returned 18.62% gross (18.15% net of fees) and, more relevantly, that our 6.5 year annualized return since inception is 16.41% gross (15.34% net of fees) – well ahead of reference indexes, as noted in the Performance table below. (Past performance does not guarantee future results.)

Airbus Fundamentals: Gaining Share in a Wide-Moated Duopoly as Rival Falters

So first, let's admit that, as Airbus shareholders, we found the Paris Airshow even more glamorous than Paris Fashion Week happening at the same time across town. It's where Airbus announced that IndiGo, India's largest airline,[6] had placed an order for 500 single-aisle planes — the single largest aircraft order in history (boosting Airbus' order book to 7,967 aircraft,[7] or ~10 years of production at current rates). Airbus holds 60+% market share over rival Boeing for the narrow-body aircraft that now dominate the sector, and its 320 family have list prices of $110m and up, though IndiGo's order is assumed to include customary volume discounts.[8] In total, Airbus secured 821 new orders at the show to Boeing's 316.[9] Airplanes are exceptionally difficult to design, build and certify, which makes this an attractive duopolistic industry structure with high barriers to entry.[10]

If we had assessed Airbus' competitive edge as transitory, Boeing might have been the better "value" investment as it sought to recover from a two-year grounding of the 737 MAX after two crashes that killed 346 people across five months in 2018-2019. But we saw deeper cultural problems at Boeing: it had designed an unsound engine placement on the 737 MAX aircraft and then sought to remedy the resulting nose-up tendency with a software fix[11] on which it then neglected to properly train pilots.[12] As Americans, we're rooting for Boeing to recover. As investors, we see enduring culture/quality risks and consequences, not just for its brand equity and market share, but also its balance sheet and reinvestment capacity; it now carries $55.4bn in debt (vs. $13.8bn at Airbus), hindering investment in the next generation of more sustainable aircraft.[13]

Flying is expected to achieve pre-pandemic levels this year.[14] Air traffic has tended to grow at above-GDP rates long-term,[15] and Airbus' IndiGo's massive order reminds us that over 80% of the world's population has never flown in an airplane. Airbus has a final assembly line in Tianjin and this April announced plans to open a second one in China — positioning it to deliver to China's burgeoning fleet, unconstrained by U.S.-China geopolitical tensions, whereas Boeing has been largely shut out.[16] (Our Strategy is global, but we favor market exposure to rising buying power in Asia, by corporations domiciled in the U.S. and EU, where investor protections are better.) The post-pandemic challenge for Airbus has not been finding adequate demand, but overcoming post-COVID supply chain challenges. After a slow start in Q1 2023 deliveries, Airbus is projecting a strong back-end to the year to meet its 720 delivery target. With recovery in volumes and a mix shift toward the higher priced A321neo, we expect operating profit margins of nearly 10% in 2023 and a cumulative +200-300bps progression in the next several years. We are tracking this closely as further verification that Airbus possesses the operational excellence to build on its lead.

Airbus and the Sustainability Conundrum: Positioning for a Changing World

Airbus' contribution to the growing global fleet brings us back to aviation and sustainability. While not as biologically essential as food, water and shelter, the human yearning to connect and explore is core to who we are – and perhaps something to celebrate rather than be ashamed of. If decarbonizing the world means suppressing such drives, it is likely to prove a losing battle.[17] **As with most essential and defining human activities, our conviction is that we need to rethink how we do them in a more sustainable way, not whether we do them.**

Aviation emits about 2-3% of greenhouse gas emissions but more like 3-4% of actual warming given the complex high-altitude effects of water vapor contrails, sulfates and other pollutants.[18] Would the world be safer if heads of state didn't convene in person once a year at the recurring UN climate talks? Given such summits, and the millions of other instances of human connectivity that aviation enables across our global civilization, one could argue that 2-3% is a reasonable emissions "tax" to pay if it ultimately helps us lever emissions reductions in the other 97%.

We often note that our Strategy is not about inserting our own values about the ethics of behaviors like flying, nor about winning "green" labels from the EU or others. Rather it's about conducting our own independent research on how the risks and opportunities associated with environmental sustainability may affect the fundamental performance of companies over our typically long holding periods — including changing **consumer behavior, technology disruption, regulatory progression, and the physical impacts of climate change**. Let's go through each:

1. Consumer Behavior: Some Curb Flying, More Aspire to It: Values are fair game through our fundamental research lens: we study whether and how the sustainability values of consumers are driving their purchase decisions, for example as they grapple with the flying conundrum. Even if most don't stop flying like Thunberg, there is some evidence that some flyers, especially in Europe, are curbing frequency.[19] Even so, flying by the

rising middle class in emerging economies is likely to overwhelm selective restraint in industrial economies. Economics, not just ethics, may weigh on consumers as aviation's CO2 emissions are priced into air tickets. Business travel is likely to remain lower after COVID, given the efficiency of videoconferencing alternatives such as Zoom and **Microsoft** Teams, and company efforts to reduce employee travel to help meet their net zero-by-2030 commitments.[20] After all, the most carbon-efficient mile is the one you don't travel, i.e., the "negamile"[21] (akin to the watt of electricity you don't use, i.e., the "negawatt"). Technology has given us choices about when to move ourselves in the form of bits versus atoms and will continue to improve to the point where immersive virtual meetings become imperceptibly different from in-person ones — **Apple**, among others**,** is on the case.[22]

2. Technology Change: Evolution, then Disruption and New Patterns: Airbus's A320neo family is ~20% more efficient than its predecessor.[23] Boeing's MAX aircraft offer similar efficiency gains, but during their two-year grounding they were not flying and replacing older higher-emitting planes, while Airbus' were — a crucial difference.[24] Over 40% of the projected global demand for aircraft over the next 20 years will be to replace aging aircraft,[25] providing business model resilience even if flying demand and fleet growth moderate due to sustainability concerns. Airbus aims to offer hydrogen-powered flight by 2035, though we are skeptical of this strand of its R&D.[26] The best way to avoid the waste heat problem that afflicts all combustion is to electrify. For large aircraft, battery weight makes full electrification impractical, favoring continued efficiency gains, use of Sustainable Aviation Fuel,[27] carbon offsetting and hybrid designs, all of which Airbus is pursuing.[28] But just as the electricity generation paradigm is changing so that Distributed Generation (e.g., solar on roofs) is now competing with centralized utility generators, we believe aviation will stratify as new downscaled solutions come to market, such as Electric Vertical Takeoff and Landing (eVTOL): early models carry only 4-6 passengers for ~150 miles at ~200mph, offering quieter, safer, point-to-point, zero-emissions flight.[29] This won't be a solution for trans-oceanic flight, but for urban, inter-city and new patterns of inter-modal travel, eVTOL will open up a projected $1.5 trillion market by 2040.[30] Joby Aviation, a listed, pure-play eVTOL startup with Toyota's backing, just achieved FAA[31] certification to begin testing of its air taxi.[32] Airbus' eVTOL entry is the CityBus NextGen and it is striking early deals with ITA Airways and Munich Airport,[33] as well as with Japanese partner Hiratagakuen for non-urban eVTOL applications.[34] We avoid risking client capital in pre-revenue companies like Joby, instead favoring legacy companies like Airbus that are reinvesting in embedded growth options like eVTOL, while bringing established advantages to help it win.[35] By contrast, Boeing — with its $55.4bn debt load — pulled the plug on the Boeing NeXt innovation division for eVTOL, though it is a partner in Wisk Aero.[36]

3. Regulatory Progression: Carbon Pricing of Aviation and Beyond: Airbus is domiciled in the EU, where aviation emissions have been subject to carbon pricing in the Emissions Trading System (ETS) since 2012, and this past February the EU got even tougher, saying it will stop granting free allowances to airlines for ETS compliance by 2026, adding a projected $10.70 to the cost of each air ticket (doesn't sound like enough to curb much flying, but prices could go up in this traded market).[37] China's carbon market, launched in 2021, is expected to add aviation in 2025.[38] However there is no guarantee they will, and China has so far rejected participation in the International Civil Aviation Organization's voluntary offsetting framework for aviation, seeing it as an unfair constraint on its turn to embrace air travel.[39] The US EPA finalized a lenient rule that will not drive aviation to introduce emissions-reducing technology, even by 2028, and recently overcame environmentalist appeals to its "do-nothing" rule in court. EPA said it instead favors deference to future international agreements, presumably to avoid disadvantaging Boeing with a technology-forcing domestic rule.[40] France (home of Airbus) actually banned certain short-haul flights this year, but its emissions impact is limited because it only applies where a

time-efficient rail alternative is available.[41] As noted at the beginning of this letter, the EU is now deciding whether to allow investors marketing sustainable products to count, for example, Airbus' revenue from more efficient engines as "green" or exclude it because it consumes fossil fuels.[42] Bottom line: regulatory change is complex, it's happening — and we track it here and in other sectors as part of our continuous research process.

4. Physical Effects: Submerged Airports, Worse Turbulence, Consumer Responses: Many traditional investors still neglect to consider how the physical impacts of climate change, under various scenarios, could influence their investment theses. If we hit 2°C of warming, which the Paris Agreement aims to prevent, 100 airports across the world could be submerged under rising seas in the coming decades, and a further 364 airports put at risk of coastal flooding.[43] This could tilt the future in favor of the more flexible vertical takeoff capabilities of eVTOL that don't require runways. There is also evidence that climate change is causing more wind shear and severe clear-air turbulence, which so far appears within the handling capabilities of Airbus' aircraft but could, over time, be a factor in curbing flying demand.[44] Climate change is exacerbating water stress in China and India[45] and as the gravity of this crisis is progressively grasped, could prompt more Indians, Chinese and others to follow Thunberg or at least curb their rapid growth in flying. Regulators could be similarly provoked by climatic events to progress from the uneven patchwork of action described above to a more consistent and stringent regulatory regime that drives up aviation carbon pricing and compels technology innovation. Heat events in mid-2023 are alarming scientists and it seems to us likely that humanity's determination to act will grow.[46] There is evidence that at least one of the more efficient engine options offered on both the MAX and neo families — Pratt & Whitney's GTF — may be less durable and able to perform in hotter, dustier conditions such as India is experiencing.[47] Corporate leaders like Airbus are systemically exposed to global risks like the loss of runways on which to land their A320neos, and have a compelling economic interest, we believe, in using their considerable leverage to advocate for strong government policy on climate — both on an economy-wide and sector-specific basis. We would like to see Airbus improve its C- performance on climate policy lobbying per InfluenceMap, and will be engaging them to encourage this.[48]

Staying Diversified Across the Evolving Transportation Landscape

Airbus is a tougher case for sustainability than holdings like **SolarEdge**, a clear solution provider in the accelerating drive to displace fossil fuels with solar power. Our job in such cases is to integrate fundamental economics and sustainability factors, including interactions between the four drivers above, and then to dive deep with our E-Map and E-Assess tools to refine our thesis and financial model. Airbus met our fundamental criteria convincingly as a well-moated and profitable business with a long backlog. Climate change, however, poses significant risks to its core business, and Airbus may well need to further increase its diverse investments in transformational solutions. While we appreciated Airbus' CDP grade of A- in 2022, and its recently approved short-term greenhouse gas reduction target aligned to a 1.5C pathway,[49] we support the Climate Action 100+ in engaging Airbus to further improve its performance.[50] Integrating fundamental, sustainability and portfolio construction factors led us to a buy decision. As in all cases, we strive to mitigate the consequences of potential error in such individual decisions by staying diversified across nearly all sectors. For example, one way to avoid aviation emissions in inter-city air travel is to shift modes and take the train instead, ideally an electrified bullet train. In January, our holding **Siemens** signed a $3.25 billion contract to supply 1,200 electric locomotives and service them for 35 years to India — the biggest locomotive deal in the company's history (like Airbus, Siemens has been among our stronger equity performers in 2023).[51] In June, India experienced one of its worst-ever transportation disasters, which killed 275 people and injured 1,000.[52] India's 67,000 mile rail network handles 22 million passengers per day and was built under British

rule in the 19th Century; its renovation is urgent and represents a big market opportunity for Siemens Mobility, which achieved all-time-high order intake in Q2, including its India win. Our holding **Aptiv** continues to supply automakers with solutions to transition to EVs; as of Q1 2023, their order book stood at $13.9bn, ~80% of prior year sales, including $5bn in new order wins for its Smart Vehicle Architecture. **Amazon**'s e-commerce model enables millions of households to reduce individual passenger trips (and emissions) to procure their goods, and the company is rapidly electrifying last mile delivery (offset by increased air freight to speed delivery).[53] **Alphabet**'s Waymo remains a leader in autonomous driving which we believe will be a $1 trillion market even sooner than eVTOL. On the freight side of transportation, **Canadian National Railway** remains a leader in intermodal transportation, which optimizes ship-rail-truck transfers to maximize efficiency and reduce emissions.[54] **Trimble** is enabling fuel-efficient routing and higher asset productivity in the trucking sector.[55] Google Maps' eco-friendly routing is a key pillar of **Alphabet**'s goal to support one billion users in making more sustainable choices.[56]

When it comes to flying, each individual needs to assess their resources, responsibilities and objectives and decide for themselves whether they will aspire to a NetJets membership like Buffett[57] or adopt Thunberg's purist model, or land somewhere in between.[58] Our job as investors is to monitor and anticipate the aggregate impacts of billions of such choices over time, and the drivers shaping them, in order to invest our clients' capital prudently in a rapidly changing world. And to selectively engage our portfolio companies and make the business case for them to move more quickly in even more sustainable directions.

Performance:

See below for performance of the Sustainable Equity Strategy from its January 1, 2017 inception through June 30, 2023 (6.5 years). Please note that past performance does not guarantee future results.

			Reference Indexes		
	DWA Sustainable Equity (gross)	DWA Sustainable Equity (net)	MSCI SRI TR Index	S&P 500 Total Return Index	MSCI World TR USD Index
Annualized Returns					
1Yr	21.14%	20.15%	20.96%	19.59%	18.51%
3Yr	12.99%	12.02%	12.73%	14.60%	12.18%
5Yr	15.05%	14.03%	11.02%	12.31%	9.07%
Inception	16.41%	15.34%	12.16%	13.17%	10.36%
Cumulative Returns					
1Yr	21.14%	20.15%	20.96%	19.59%	18.51%
3Yr	44.27%	40.57%	43.25%	50.51%	41.16%
5Yr	101.55%	92.79%	68.64%	78.66%	54.36%
Inception	168.34%	152.80%	110.77%	123.43%	89.75%

Much was made this quarter about the narrow participation in the market's surge, driven largely by AI-exposed tech companies. We have a robust thesis on how AI is enabling sustainability across sectors, and our portfolio benefitted from this market move, including through **Microsoft**, which added $10bn to its stake in ChatGPT pioneer OpenAI in January[59] and **Amazon**, which is resolutely incorporating AI into its market-leading cloud services.[60] Our two dominant semiconductor suppliers **ASML** and **Taiwan Semiconductor** have also been among our top performers in 2023. **S&P Global** and **Moody**'s were particularly strong in Q2, poised to benefit from an expected recovery in debt issuance as the end of the Fed's hike cycle began to come into view. Each has been incorporating physical climate risk factors into their ratings and data products such as Moody's *Climate on Demand Pro*; both are also using AI to generate new insights from formerly disparate datasets, S&P building on their 2018 acquisition of financial AI innovator Kensho[61] and Moody's with its new AI partnership with Microsoft to use large language models in Moody's Co-Pilot and beyond.[62]

This has been a rewarding first half of the year in terms of equity appreciation, driven principally by re-rating of valuation multiples. Economic growth has defied recessionary expectations so far, but we cautiously note that the year-over-year change in "M2" money supply has gone deeply and unusually negative;[63] while this should help bring inflation down, it also presents continuing risks to growth. More volatility likely lies ahead, but we have strong conviction in the long-term prospects for our portfolio of high-quality companies, as well as the meaningful impact they will have on some of the world's most pressing problems. Thank you, as always, for your confidence in us to steward your capital. Please reach out to Dan Abbasi (dan@douglasswinthrop.com) if you would like to set up a call for any reason, and also kindly let us know if you think of others who might be interested in hearing about our Sustainable Equity Strategy.

Best regards,

The Douglass Winthrop Team

Please see endnotes below and important disclosures at the end of this document.

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[1] Internal combustion engines using gasoline typically run in the 20% range in terms of thermal efficiency (diesel engines are closer to 40%), while jet turbofan engines have typically ranged 35-40% with the most efficient commercial engines now over 50%. See: https://lambdageeks.com/efficiency-of-internal-combustion-engine/ and https://nap.nationalacademies.org/read/23490/chapter/6.

[2] https://www.reuters.com/business/sustainable-business/comment-whats-sustainable-about-soaring-private-jet-use-2022-07-04/

[3] Later in 2019, Time Magazine made Greta Thunberg its Person of the Year. See: https://time.com/magazine/us/5748137/december-23rd-2019-vol-194-no-27-u-s/

[4] Interestingly, an estimated half of Americans don't fly at all, while another one-third of Americans fly up to 5x per year and account for one-third of U.S. emissions. See: https://www.nytimes.com/interactive/2019/10/17/climate/flying-shame-emissions.html

[5] https://www.euronews.com/next/2023/02/01/europe-regulation-green-aviation and https://www.transportenvironment.org/discover/eu-investment-rules-will-greenwash-90-of-airbus-polluting-planes/

[6] IndiGo is India's largest airline and the biggest in Asia outside China. It plans to carry more than 100 million passengers in fiscal 2024, compared with 86 million last year. Southwest Airlines carried 127 million last year.

[7] https://simpleflying.com/airbus-8000-aircraft-backlog-91-single-aisle/ Note that there are about 25,000 aircraft in global fleet today. Airbus in June 2023 raised its projection for new jet deliveries (including Airbus, Boeing, others) to 40,850 over the next 20 years (up from 39,490 last year, of which 58% would serve to grow the global fleet and 42% to replace aging aircraft (driven partly by greenhouse gas regulations). This means the pre-COVID global fleet of 22,880 units would increase to 46,560 in 2042. See: https://finance.yahoo.com/news/airbus-raises-20-delivery-forecast-060222156.html

[8] https://www.forbes.com/sites/mollybohannon/2023/06/19/airbus-wins-largest-commercial-aircraft-order-in-history-with-indigos-500-plane-order/?sh=6cf1dafe39a3 and https://www.airbus.com/en/newsroom/press-releases/2023-06-indias-indigo-places-record-order-for-500-a320-family-aircraft and on pricing and volume discounts: https://simpleflying.com/how-much-do-airbus-aircraft-cost/

[9] https://simpleflying.com/boeing-vs-airbus-paris-air-show-2023/

[10] In this structure, even ordinarily unattractive features such as a negative cash conversion cycle (Airbus must invest upfront to generate revenues later) can further entrench the two leaders' moat by deterring new upstarts.

[11] https://www.forbes.com/sites/petercohan/2019/04/02/mit-expert-highlights-divergent-condition-caused-by-737-max-engine-placement/?sh=6f7f3ccf40aa

[12] Research on the crashes also cited as a contributor to the crashes Boeing's success in "capturing" and rendering compliant the Federal Aviation Agency https://www.seattletimes.com/business/boeing-aerospace/final-report-on-boeing-737-max-crash-disputed-agencies-note-pilot-error-as-a-factor/#:~:text=Both%20the%20NTSB%20and%20France's,major%20cause%20of%20the%20accident and https://www.newyorker.com/news/our-columnists/how-boeing-and-the-faa-created-the-737-max-catastrophe and https://www.vox.com/business-and-finance/2019/3/29/18281270/737-max-faa-scandal-explained

[13] Boeing was previously a holding in the Sustainable Equity Strategy and we sold the position entirely in 2020.

[14] https://news.un.org/en/story/2023/02/1133347

[15] https://transportgeography.org/contents/chapter5/air-transport/air-transport-economic-growth/

[16] https://www.cnn.com/2023/04/06/business/airbus-china-boeing-lockout/index.html#:~:text=Soured%20trade%20relations,2%2C100%20are%20in%20service%20already. China's air traffic growth is expected to be 50% higher than worldwide. It is expected to grow at a 5.3% Compound Annual Growth Rate over the next two decades, outstripping the global average of 3.6%.

[17]https://www.smithsonianmag.com/air-space-magazine/call-new-world-180977307/. Path dependence should also be acknowledged: aviation has led all forms of human organization from families to corporations to distribute themselves across much wider geographies. Abruptly foregoing flying would rupture these connections. Our civilization is now built on the radically adjusted time/space relationships that aviation has wrought, and it's hard to imagine putting this genie back in the bottle.

[18]See: https://aviationweek.com/air-transport/safety-ops-regulation/eu-institutions-close-deal-cut-aviations-emissions and update note at bottom of: https://www.eesi.org/papers/view/fact-sheet-the-growth-in-greenhouse-gas-emissions-from-commercial-aviation. Aviation emissions are also expected to triple by 2050, per the International Civil Aviation Organization – see: https://climate.ec.europa.eu/eu-action/transport-emissions/reducing-emissions-aviation_en

[19] https://www.vox.com/the-highlight/2019/7/25/8881364/greta-thunberg-climate-change-flying-airline and https://www.reuters.com/article/us-travel-flying-climate/flight-shaming-hits-air-travel-as-greta-effect-takes-off-idUSKBN1WH23G and https://www.eib.org/en/infographics/when-it-comes-to-air-transportation and https://www.eib.org/en/infographics/when-it-comes-to-air-transportation and https://www.hindustantimes.com/travel/flight-shaming-hits-air-travel-as-greta-effect-takes-off/story-OZcQPjvETsEcQVU4cZuEZM.html

[20] https://fortune.com/2023/04/26/business-travel-never-going-back-to-pre-covid-normal-deloitte-report-says/

[21] https://www.vermontpublic.org/programs/2017-10-26/watts-the-mile-not-traveled

[22] Our holding **Apple** introduced its first Augmented Reality headset, ApplePro, in June, with immersive visual clarity that reviewers found stunning. Given Apple's massive ~$26bn R&D budget in 2022 alone[22], how long will it be before its increasingly ubiquitous devices render virtual business meetings almost imperceptibly similar to in-person ones? https://fortune.com/2023/06/06/apple-vision-pro-virtual-reality-goggles-first-impression/

[23] https://aircraft.airbus.com/en/aircraft/a320-the-most-successful-aircraft-family-ever/a320neo-creating-higher-customer-value#efficiency

[24] "Since entry-into-service in 2016, Airbus has delivered over 2000 A320neo Family aircraft, contributing to 10 million tons of CO2 saving." See: https://aircraft.airbus.com/en/aircraft/a320-the-most-successful-aircraft-family-ever/a320neo-creating-higher-customer-value#efficiency

[25] https://finance.yahoo.com/news/airbus-raises-20-delivery-forecast-060222156.html

[26] We are skeptical of both given that hydrogen's volumetric demands (storing it on board will displace too many paying seats) and challenges of fueling infrastructure. See: https://about.bnef.com/blog/liebreich-the-unbearable-lightness-of-hydrogen/ and https://www.rechargenews.com/energy-transition/liebreich-oil-sector-is-lobbying-for-inefficient-hydrogen-cars-because-it-wants-to-delay-electrification-/2-1-1033226

[27] Airbus joined the First Mover's Coalition to collaborate in driving down the price of Sustainable Aviation Fuel – see: https://www3.weforum.org/docs/WEF_FMC_Aviation_2022.pdf. Our concern with this "solution" is that crop-derived biofuels offer problematic Energy Return on Investment (EROI) and ecosystem risks such as contributing to nutrient runoff and aquatic dead zones. Technologies like electro-fuels are deeply out of the money with significant energy penalties weighing down the different production stages: using electricity to drive electrolysis + Direct Air Capture to secure carbon + additional energy to synthesize these into hydrocarbons.

[28] Airbus is on the case: https://www.airbus.com/en/innovation/low-carbon-aviation/hybrid-and-electric-flight and see also NASA's work, suggesting the efficiency gains from downsizing the jet engine turbine as part of a hybrid format; https://www.nasa.gov/feature/glenn/2020/fantasy-to-reality-nasa-pushes-electric-flight-envelope and https://www.nasa.gov/feature/glenn/2021/smaller-is-better-for-jet-engines.
[29] https://robbreport.com/motors/aviation/gallery/eVTOLs-certified-two-years-1234835345/vertical-aerospace-2/
[30] See: https://verticalmag.com/news/morgan-stanley-shifts-timeline-stays-bullish-eVTOL-urban-air-mobility/ Downscaled electric flight will free us from fixed road and rail routes for many uses cases, and even alter real estate patterns and values over time (admittedly presenting new development risks for ecosystems). An instructive podcast series on this space: https://theverticalspace.net/.
[31] Federal Aviation Agency
[32] https://www.reuters.com/business/aerospace-defense/joby-receives-faa-nod-begin-flight-testing-its-first-built-aircraft-2023-06-28/#:~:text=Joby%20said%20the%20Federal%20Aviation,aircraft%20'Maker'%20in%202021. Archer and Lillium are other pure-play eVTOL startups.
[33] Here is Airbus' activity on electric propulsion including eVTOL (better on safety, noise, emissions than helicopters): https://www.airbus.com/en/innovation/low-carbon-aviation/hybrid-and-electric-flight and https://www.futureflight.aero/news-article/2021-10-22/how-cityairbus-nextgen-could-be-just-first-movement-advanced-air-mobility

[34] https://www.airbus.com/en/newsroom/press-releases/2022-09-airbus-partners-with-hiratagakuen-to-test-future-eVTOL-flight
[35] Airbus's advantages for eVTOL include: cashflow to fund development and enable resilience to uncertain adoption timing; expertise in certifying new aircraft; established relationships and trust with airline buyers; global facilities for production and aftermarket service.
[36] See: https://wisk.aero/ and https://wisk.aero/news/press-release/wisk-aero-secures-450-million-from-boeing/
[37] https://simpleflying.com/eu-emissions-rules-raise-airline-ticket-fees/ and https://www.wsgr.com/en/insights/european-council-adopts-new-fit-for-55-laws.html
[38] https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/011223-chinas-carbon-market-to-slow-in-2023-as-energy-security-economy-take-priority#:~:text=Currently%2C%20China's%20compliance%20market%20only,metals%2C%20paper%2C%20and%20aviation and https://www.forbes.com/sites/energyinnovation/2022/04/18/chinas-emissions-trading-system-will-be-the-worlds-biggest-climate-policy-heres-what-comes-next/?sh=3a9a0bab2d59
[39] The plan is called the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and first industry-specific offsetting system. See Reuters on China's decision not to proceed: https://www.reuters.com/article/us-un-aviation-china/china-denounces-u-n-aviation-emissions-plan-in-blow-to-industry-efforts-idUSKBN1W938W
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[45] https://www.cnbc.com/2023/06/13/water-scarcity-china-and-india-look-the-most-threatened-from-shortages.html
[46] https://www.washingtonpost.com/weather/2023/07/06/earth-record-heat-climate-extremes/
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[49] https://www.linkedin.com/pulse/airbus-decarbonisation-targets-validated-science-based-initiative-/
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[52] https://www.washingtonpost.com/world/2023/06/04/india-train-crash-cause-railways-safety/
[53] https://www.freightwaves.com/news/in-last-mile-electrification-amazon-sees-another-opportunity-to-dominate and see page 11 of Amazon's sustainability report: https://sustainability.aboutamazon.com/pdfBuilderDownload?name=amazon-sustainability-2020-report and also on air freight: https://www.wired.com/story/amazon-air-quest-to-seize-the-skies/ and https://retailwire.com/discussion/will-amazons-air-cargo-investments-take-off/ and https://www.freightwaves.com/news/amazon-airs-new-reliance-on-hub-airports-increases-efficiency
[54] Rail is nearly 4x more fuel-efficient (and lower emitting) than trucks, and Canadian National Railway is a best-in-class operator among Tier 1 North American railroads, with 15% less fuel used per gross ton mile than the industry average. See: https://www.cn.ca/en/delivering-responsibly/environment/

See CNI's defense of its intermodal growth strategy to divert truck freight to rail despite adverse effects on its operating ratio: https://www.trains.com/trn/news-reviews/news-wire/canadian-national-defends-intermodal-growth-strategy/

[55] https://transportation.trimble.com/products/optimization-tools

[56] https://blog.google/around-the-globe/google-europe/eco-friendly-routing-in-europe/ and https://blog.google/outreach-initiatives/sustainability/sustainability-2021/

[57] Private flying soared in the pandemic but has reportedly begun to normalize. See: https://www.cnbc.com/2023/03/30/private-jet-flights-in-europe-soar-to-record-levels-stoking-climate-fears.html and https://www.forbes.com/sites/brianfoley1/2022/12/19/why-private-aviation-popularity-is-coming-back-down-to-earth/?sh=5e6404182cb4

[58] You can also choose trains and get an EV or, if in a gas-powered car, idle your car less during pickups or waits (idling of personal vehicles wastes 3 billion gallons of fuel and emits 30 million tons of co2 each year. See: https://afdc.energy.gov/files/u/publication/idling_personal_vehicles.pdf

[59] https://www.bloomberg.com/news/articles/2023-01-23/microsoft-makes-multibillion-dollar-investment-in-openai

[60] https://thenewstack.io/generative-ai-cloud-services-aws-azure-or-google-cloud/ and https://fortune.com/2023/06/23/amazon-aws-adam-selipsky-google-microsoft-long-term-ai-plan/

[61] https://investor.spglobal.com/news-releases/news-details/2018/SP-Global-to-Acquire-Kensho-Bolsters-Core-Capabilities-in-Artificial-Intelligence-Natural-Language-Processing-and-Data-Analytics-2018-3-6/default.aspx

[62] https://venturebeat.com/ai/microsoft-weaves-generative-ai-fabric-for-moodys/

[63] M2 year-over-year is at -4% right now. It went to -12% in 1932. For Colonial times to 1959, see https://www.census.gov/library/publications/1975/compendia/hist_stats_colonial-1970.html. For 1960-today, see Federal Reserve Bank of St. Louis https://fred.stlouisfed.org/graph/?graph_id=248494. Continuous chart also here: https://www.longtermtrends.net/m2-money-supply-vs-inflation/