Enabling Airports' Energy Resilience – Electric Aviation

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Electric Aviation

Powering Business Worldwide

- What will be the main challenges an airport will face during its electrification process?
- Who is going to pay for it?
- What are the hurdles of electric air mobility?
- What lessons have we learnt from the automotive industry?

The future is now

Charging infrastructure and networks of CPOs for general aviation already in place in Europe

Requirement for Charging Infrastructure, By Aircraft Type

Based on discussions held with customers

General Aviation

(Flight Schools & Private aircraft)

eVTOL

(Cargo & passengers)

Small Commercial Aircraft

(Cargo, Private jets & Up to 20 Passenger Commercial)

Medium Commercial Aircraft

	General Aviation	eVTOL	Small Commercial Aircraft	Medium Commercial Aircraft
Passenger Capacity	1-4	5-8	5-20	20 - 90
Commercialization	Commercial	>2025	>2028	>2030
Charging Power Requirement	**22kW - 250 kW**	**250kW – 2 MW**	**500kW - 3 MW**	**1- 3 MW**

400V

Up to 1000V

1200V

50kW

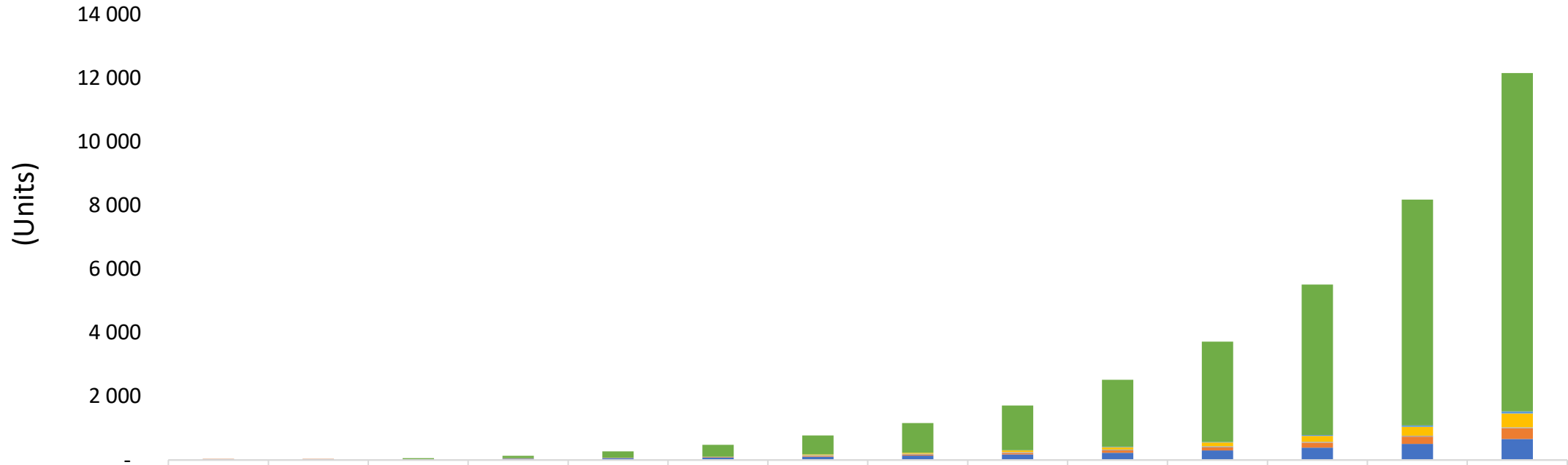
44kW | 150kW | 250kW | 250kW | 500kW | 1MW | 500-750kW | 1MW | 500-1000kW | 1MW

2023 **2024** **2024** **2025** **2024-2025** **2024-2025** **2026**

Global Electrical Aircraft

Global Markets: 2023-2036

Annual Commissioned Aircraft (Units)



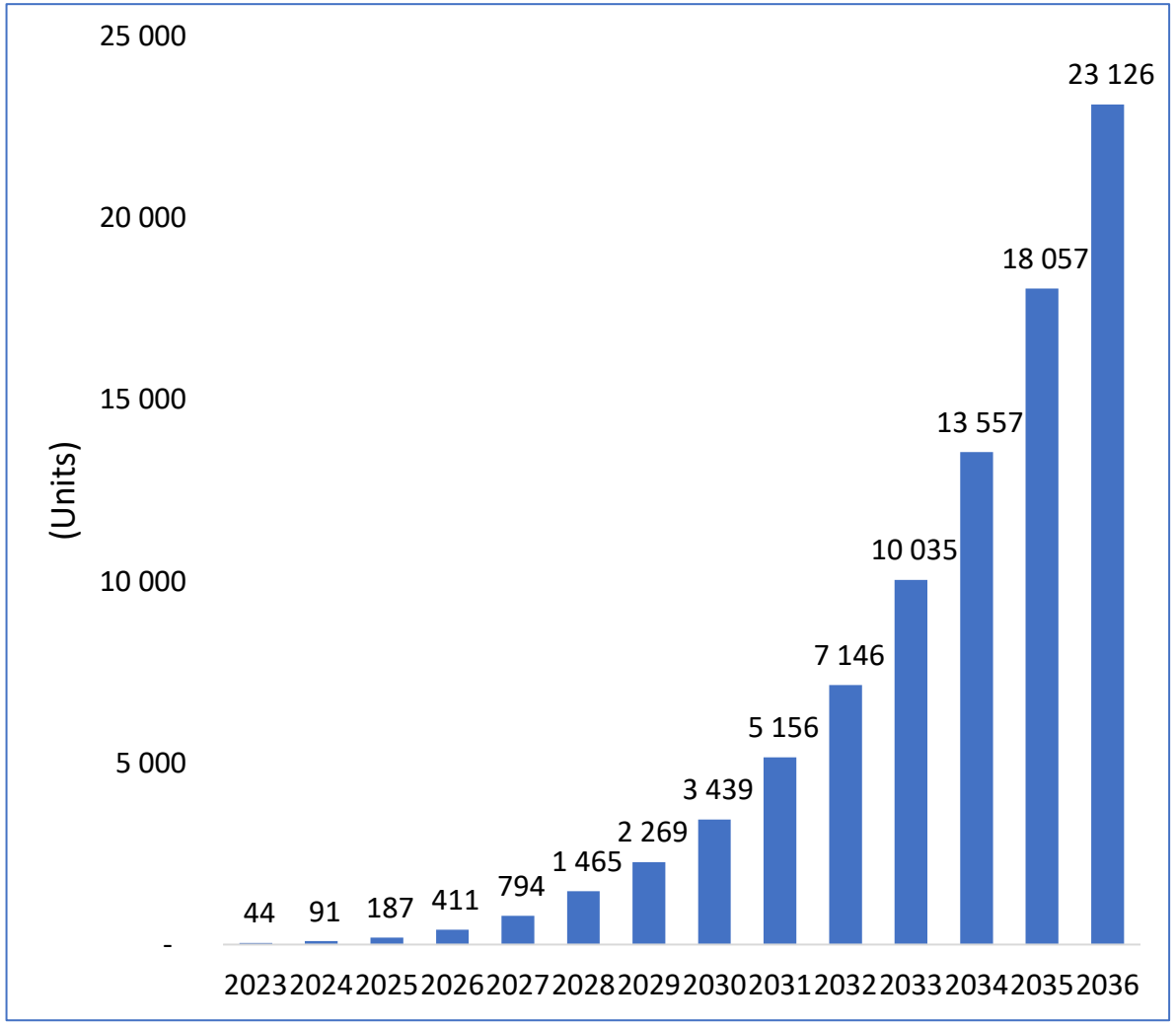
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
eVTOL Aircraft	-	-	25	75	200	375	600	935	1 400	2 100	3 150	4 725	7 088	10 631
21-90 Passengers	-	-	-	-	-	-	-	-	9	14	20	30	46	67
Up to 20 Passengers Commercial	-	-	-	-	-	-	20	32	50	77	118	182	281	432
Private Jets	-	-	-	2	2	6	30	30	30	30	30	30	30	30
Private Small Aircraft	3	3	4	6	8	13	20	30	44	67	100	150	225	337
Flight Schools	30	32	30	48	62	82	105	137	178	232	301	392	509	661

Source : Internal Analysis

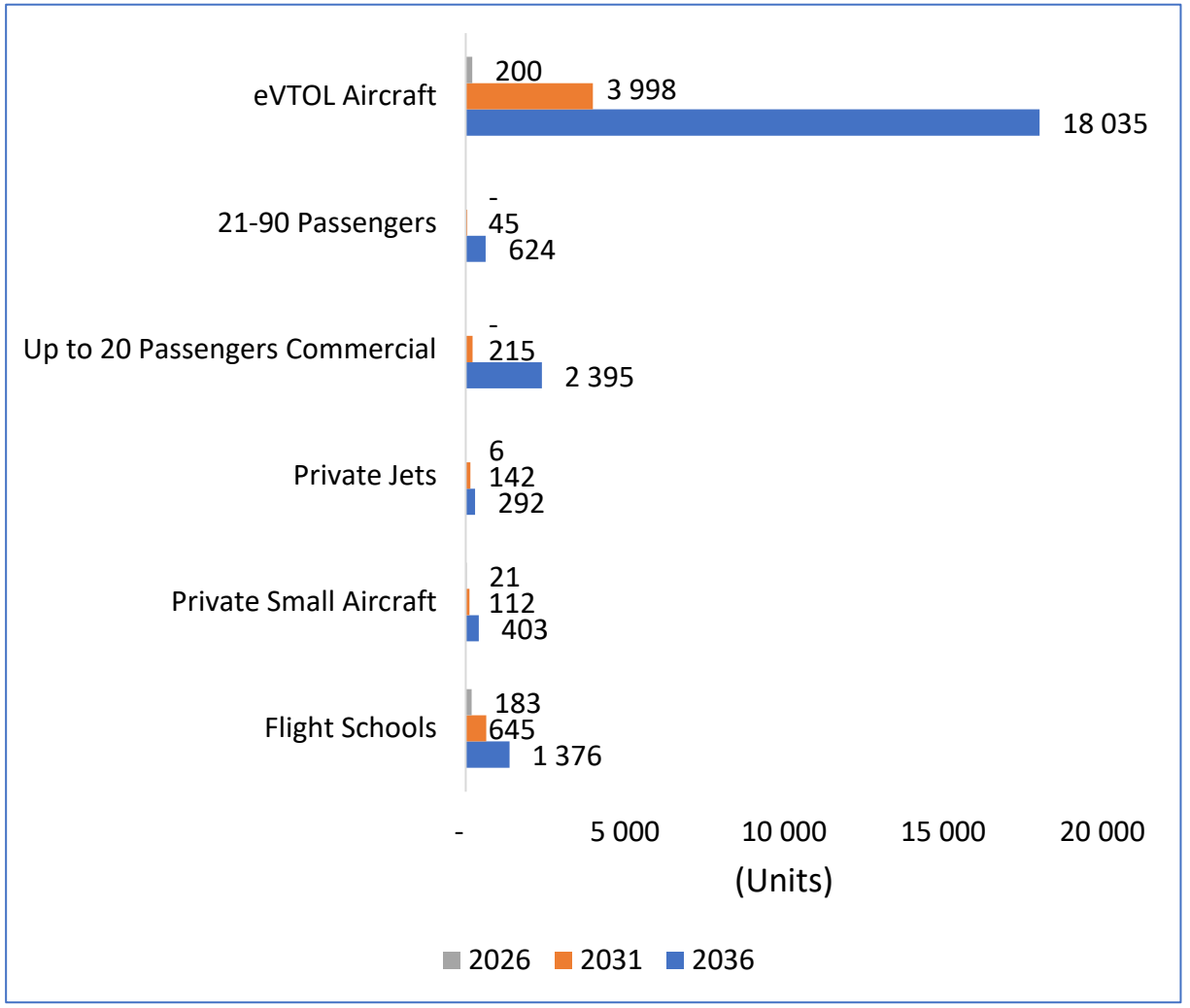
Global Aircraft Chargers Market

Global Markets: 2023-2036 – Cumulative Opportunity

Cumulative Aircrafts Chargers (Units)



Cumulative Aircrafts Chargers, By Aircraft Type (Units)



Source : Internal Analysis

Average Chargers Installed, by Aircraft type (Units)

Average New Chargers Installed per, New Aircraft type (Units)														
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Flight Schools	1.34	1.34	1.34	1.25	1.14	1.01	0.88	0.75	0.64	0.54	0.45	0.37	0.31	0.25
Private Small Aircraft	1.34	1.34	1.34	1.25	1.14	1.01	0.88	0.75	0.64	0.54	0.45	0.37	0.31	0.25
Private Jets	-	-	-	3.00	2.00	2.00	1.50	1.50	1.00	1.00	1.00	1.00	1.00	1.00
Up to 20 Passengers Commercial	-	-	-	-	-	-	3.00	3.00	2.50	2.50	2.00	2.00	2.00	2.00
21-90 Passengers	-	-	-	-	-	-	-	-	5.00	5.00	4.00	3.00	3.00	3.00
eVTOL Aircraft	-	-	2.00	2.00	1.50	1.50	1.00	1.00	1.00	0.75	0.75	0.60	0.50	0.35
Source : Internal Assumptions														

Assumption :

- *During the initial years, the number of new chargers installed will be higher as compared to the number of new aircraft, in order to create a favorable infrastructure. However, as the infrastructure develops, the average number of new chargers required per new aircraft will be lower over the period.*

Source : Internal Analysis

Solar, Storage & EA Charging: The Holy Trinity of Building Energy Management

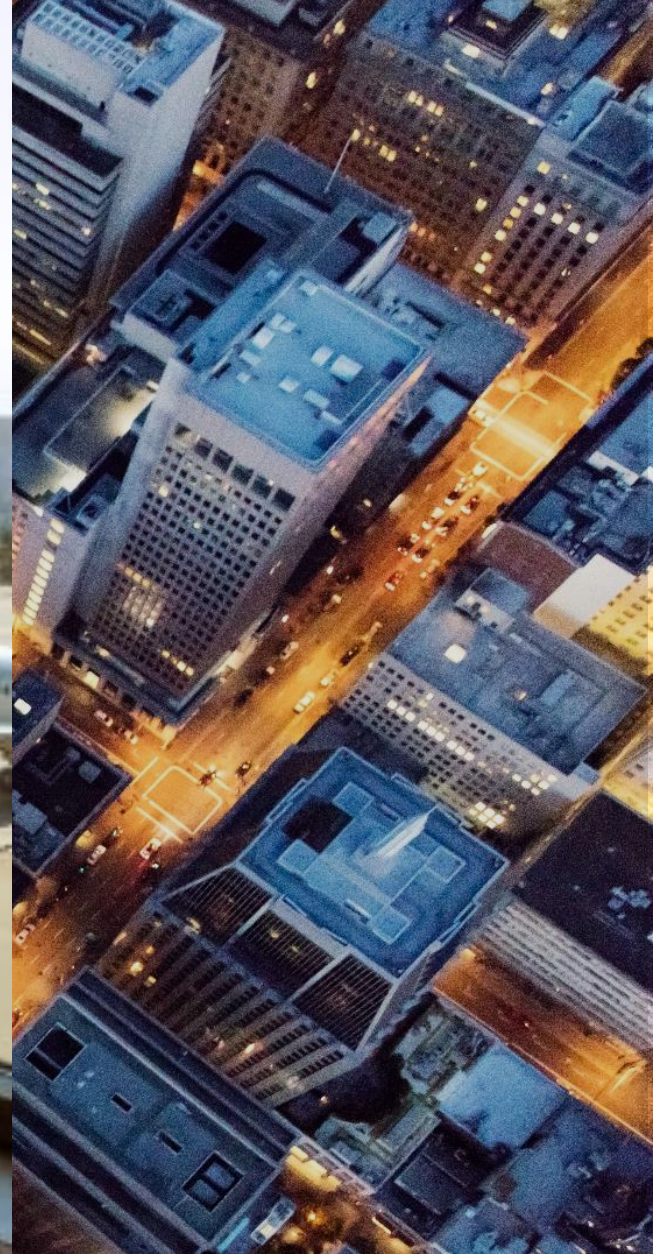
- Electrification of mobility happens in the context of already very loaded electrical grids
- As electrical experts, we have learned from the deployments of charging infrastructures that there are challenges tied to the multiplication of electric vehicles, both going on road and in the sky
- For small and for bigger airports, charging aircraft is likely to result in a substantial overload of the electrical infrastructure of the airport

We need to foster a holistic view: to provide the charging capacity to an airport, managing the various loads, local production (PV) and storage ***to balance availability of energy.***

Powering Business Worldwide

Airport as a Grid

Converting airports into energy hubs (microgrids) where self generated energy can be utilised to its maximum with the help of energy storage, energy management and highly efficient charging of vehicles and airplanes.



Airport as a Grid:

Energy Storage System

Solar Power Generation

Charging System (EV & EA)

AC DC

Energystorage

Electric Vehicle and E-Aircraft Charging Infrastructure

EMS

Energy Management Software

(Measure – Optimize – Manage)

Power Distribution Backbone

- To be ready in time, TCO
- Subsidies
- Certification, Standardisation
- Chicken-egg dilemma

Thank you!

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