New Technologies

CIACA 2025

- History review
- Energy sources
- Commercial problems
- Samples electric vehicels

General comments

- In the 1970'is , we talked about new aircraft technologies, when powered planes were built in composite , the classic engines were still usual in this era
- Some developements of modern engines were started, but not all for use in serial production
- Even we had the worldwide first flight with an electric plane 1973 in Wels/Austria flown by Heino Brditschka for 9 minutes, this concept sleeped for years until new batterytechnology allowed practical use.
- Now electric planes are part of the game, as well as Hybrid or Hydrogenpowered planes with fuelcells
- There are a more than 300 startup companies worldwide developing innovations for flying in the future

ENERGY SOURCES

The Battery-Electric Flight

The technology for electric drives has been largely optimized and exhausted. Electric motors have an efficiency of up to 97%, that of inverters/controllers is almost 99%. Power connections and battery management systems are also optimized. The sticking point of e-mobility is almost exclusively due to the lack of energy density of batteries.

The media is reporting about energy densities of 400 Wh/kg and more. But where are the actually available energy densities in reality?

Here is an overview of the currently actually achieved battery energy densities at the system level. So not just the bare battery cell, but the actual amount of energy in relation to the total weight of the power supply unit. **And only that counts!**

Audi e-tron:	95kWh/700kg	136 Wh/kg
Ford Mustang E:	68kWh/485kg	140 Wh/kg
Audi e-tron GT:	93kWh/630kg	148 Wh/kg
Porsche Tycan:	93kWh/630kg	148 Wh/kg
Jaguar I-pace:	90kWh/599kg	150 Wh/kg
BYD Han EV:	85kWh/568kg	150 Wh/kg
Mercedes EQS:	108 kWh/692kg	156 Wh/kg
Tesla S:	100kWh/625kg	160 Wh/kg
Tesla 3:	75kWh/439kg	171 Wh/kg
Tesla Y:	75kWh/437kg	172 Wh/kg
Rimac:	120kWh/599kg	200 Wh/kg

The average brutto energy density is therefore 157 Wh/kg. And these energy densities are also given without the weight of cooling liquid, pipes, pumps, coolers, etc. The usable energy is normally approx. 5 - 10% less.
Taking all these factors into account, the average actual realized net energy densities that can actually be used for propulsion is below 150 Wh/kg.

The significantly higher requirements of aviation apply to aircraft batteries. In particular, crash safety and fire protection play a much greater role than with cars. Because in the event of a fire it is not possible to stop and exit the aircraft. This further reduces the actually available energy density.

For example the Pipistrel aviation battery: PB345V124E-L

A 10.35 kWh unit weighs 74 kg = 140 Wh/kg energy density. Even that is calculated without cables, hoses, coolant, pump, cooler, crash-proof housing, etc. More information can be found **HERE**.

Airplanes are about 10 times more weight sensitive than cars. Even if the battery-electric drive for road traffic is emerging as the future solution, this is much more difficult for the significantly weight-sensitive aircraft.
The following physical energy consideration is intended to show what performance is currently achievable for cruising with battery-powered aircraft.

Battery (2x Pipistrel PB345V124E-L)	**20kWh**
Losses (motor, inverter, cable, ...)	-10%
Available drive energy	**18kWh**
Acceleration of the aircraft and climb to cruising altitude	-1.2kWh
legal minimum reserve 30 min. (20 kW / 27 hp)	- 10kWh
remaining energy for planned cruise flight	**6.8kWh**

What flight time can be achieved with 6.8 kWh of energy ?

	standard	minimum
Assumed cruising power	**70 hp** (51,5kW)	**41 hp** (30kW)
legally plannable cruise time	8,2 min.	13,6 min.

For comparison:
A full 70-litre gasoline tank including the pump, hoses, etc. weighs around **58 kg,** with which a light aircraft with a take-off weight of 600 kg can be operated for 4 hours with 70 hp!
(51.5 kW x 0.25 kg/kWh (specific consumption) x 4 hours / 0.73 (specific weight of gasoline) = 70 liters)

This results in the well-known weight factor of 1 : 20 (1145/58 kg)

This means that a **battery system is around twenty times heavier than a fuel system** in order to bring the same energy to the propeller. And that even with the best and new batteries currently available.

But as we know, every kilogram counts in aviation!

This clearly shows that there is a long way from replacing piston engines in airplanes with battery electric drives. Only a fraction of the demand can be met with batteries or hydrogen for the next 25-30 years or more.

Hydrogen

Hydrogen as an energy carrier is associated with difficult-to-solve challenges in General Aviation:

Infrastructure

- the majority of general aviation aircraft are flown at small airports, very often in club operations. It is unlikely that airports and clubs would invest around €1 million per hydrogen filling station if they can buy 3-6 brand new aircraft for it. The question also arises as to whether investing in a hydrogen filling station will ever pay off.

Technology

- enormous weight and extensive technology of the components (tanks, fuel cell, lines, technology, etc.)
- large volume of hydrogen tanks
- Converting existing aircraft is very difficult. This means that new aircraft for hydrogen propulsion would have to be developed, produced and purchased.

It can be assumed that it would therefore take decades before the switch to hydrogen-powered aircraft would have any impact on environmental protection, which urgently needs to be promoted.

Hydrogen would therefore have to be produced for the most part in sunny and windy regions around the world. However, hydrogen is not so easy to transport across the oceans in large tankers. This requires tankers with very well insulated pressure vessels that can transport the hydrogen in liquefied form, i.e. cooled down to minus 253.

The latest and largest hydrogen tanker model was developed by Dutch energy company LH2 Europe. It will not be operational until 2027.

The 142 meter long liquid hydrogen tanker holds 37,500 m^3. However, liquefied hydrogen is also very light at only 71 kg/m^3, which means that this largest pressure tank tanker can only transport 2,660 tons of liquefied hydrogen. A proportion of around 15 - 20% of this is also lost through boil-off while driving. This means that only around 2,260 tons of hydrogen arrive at the port of destination, which corresponds to energy of around 75 million kWh.

In comparison, a medium-sized oil tanker, which can also be used to transport eFuels, holds around 250,000 tons, which corresponds to an energy of 3 billion kWh.

So, 40 hydrogen tankers can transport as much energy as one tanker for eFuels!

Synthetic Fuels - eFuel/SAF (sustainable aviation fuel)

Synthetic fuels are made from CO2 from the air, water and solar or wind energy. Exactly as much CO2 is absorbed from the air during production as is later released again during combustion. Therefore, with synthetic fuels, so-called eFuels, a CO2-neutral operation of aircraft is possible.

The efficiency in the production of eFuels is lower than in the production of hydrogen, since hydrogen is the starting point for the production of eFuels. However, liquid fuels have the advantage that transport is much easier and cheaper than that of hydrogen and the infrastructure required for transport to refueling at the airport is already available. This means that the transport of eFuels over long distances is cost-effective and much more energy-efficient.

Synthetic fuels can therefore be produced where there is an abundance of regenerative energy, i.e. in sunny and windy regions around the world. With the same investment, installing a solar system in a desert region produces around three times the amount of green energy compared to systems in central Europe, for example. This more than compensates for the non-optimal efficiency in the production of eFuels. Transport ships can also be operated CO2-neutrally with eFuels.

CONCLUSION

Developing new aircraft for battery-electric or hydrogen-based propulsion would take many decades. It would take another decade before the new aircraft are actually in operation and the first noticeable effects in terms of CO2-reducing operation become apparent. Quite independently of this, the question arises as to whether the required ranges and requirements of aviation can ever be achieved with these technologies.

eFuels do not make sense where battery electric solutions are applicable. With eFuels, however, air and ship traffic can be converted to CO2-neutral operation in the foreseeable future. This is possible with the existing ship and aircraft fleets. The entire infrastructure network is also available for this. As a result, appropriate measures can be taken with regard to the urgently needed environmental protection in a much shorter period of time.

Hard times for Companies developing sustainable aircraft concepts

- After insolvency Liliumjet and Volocopter,
- now the APUS-company , which developed the promising Hydrogenpowered family Apus 1-2 , is looking for investors due to insolvency

APUS i-2

THE ZERO EMISSION GA AIRCRAFT

PERFORMANCE	
Cruise	160 KTAS
Payload	400 kg
PAX	1 + 3
Range	500 NM
Service Ceiling	16,000 ft

DIMENSIONS	
Wing Span	13.2 m
Length	8.86 m
Height	2.88 m
MTOM	2,200 kg

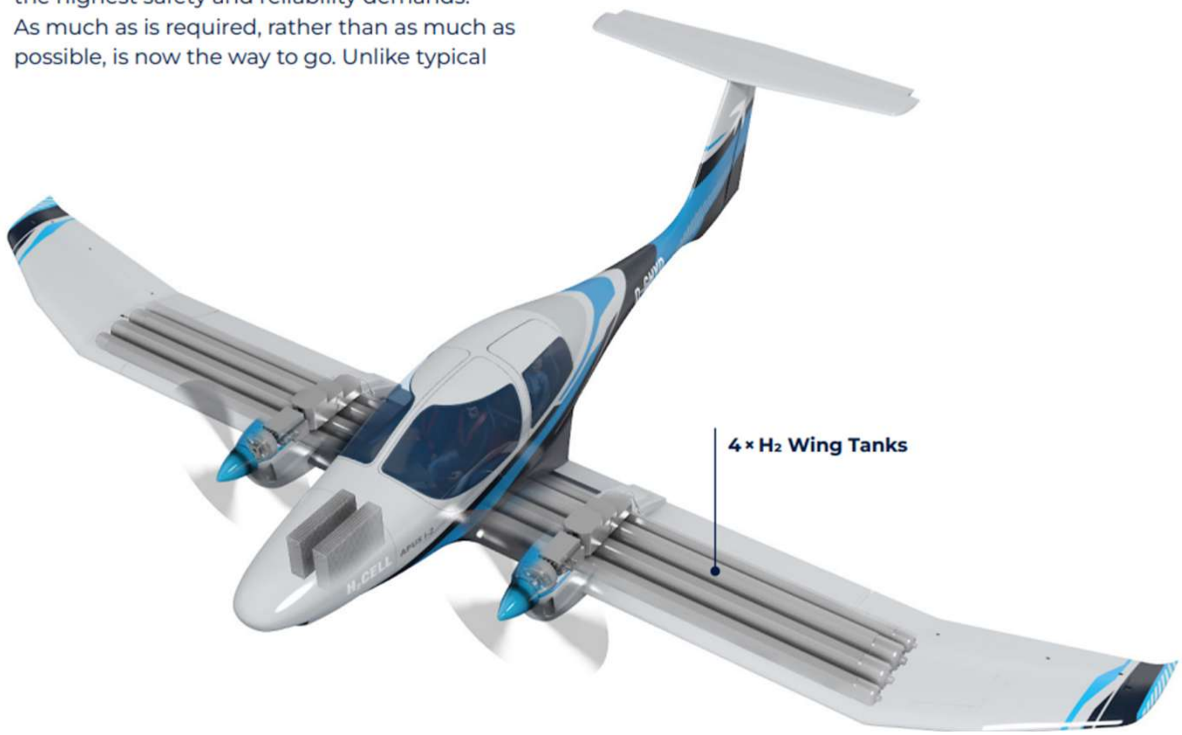
APUS i-2 is the first emission-free aircraft for daily use. It is a four-seat normal-category (CS-23) aircraft with 2,200 kg MTOM, a range of 500 NM and a maximum cruise speed of 160 KTAS – competitive performance data comparable to most modern four-seat aircraft.

Employing a hydrogen fuel-cell as its primary source of energy makes APUS i-2 100 % emission-free, i. e. zero CO_2, zero NOx, zero noise – nothing less than a revolution in emission-free flying! This is achieved through APUS's patented structurally integrated hydrogen storage system.

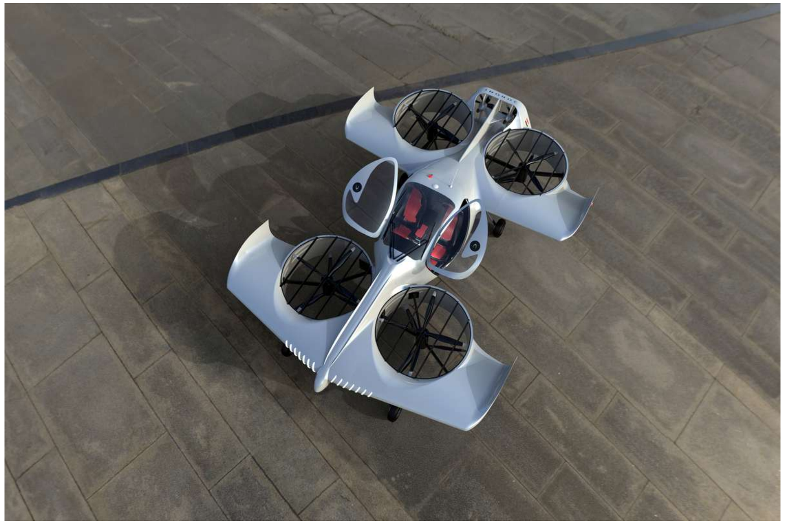
It permits up to 25 % higher specific energy density compared with standard hydrogen fuel tanks and ten times better energy density than battery-electric aircraft, all while avoiding the use of rare minerals that batteries employ.

The i-2 will outperform competition from both established conventional aircraft as well as competitors with new hydrogen electric powertrains. New hydrogen electric competitors struggle with payload and volume. Competition is less cost-efficient.

The H_2 technology is currently not available as commercial of the shelf on the aviation market. Therefore, the technology is derived from other sectors than aeronautics, and initially it is challenging to convert highly featured, complex devices into ones that comply with the highest safety and reliability demands. As much as is required, rather than as much as possible, is now the way to go. Unlike typical implementations in the automotive sector, the fine granular, overall controlled approach is replaced by one with minimal complexity in order to gain reliability.



HS1 VTOL



HS1 received its type certificate a year ago

According to Doroni, the mission of its eVTOLs is to transform intracity transportation by offering an environmentally friendly alternative to automobile transport. Archer Aviation is another of the players in the eVTOL market which also aims to transform urban travel. Archer hopes to do so by replacing the one-hour commute by car with around 15 minutes of air-taxi flight.

Unlike Archer which aims to deploy its eVTOLs as air-taxi's or offer them for ridesharing, Doroni's aims to mobilize the H1 as a personal mobility vehicle. It aspires the HS1 to fit into your garage and be intuitive enough for four-year-olds to fly them.

When it was certified in 2023, it was also dubbed the first company "to test manned flights with a 2-seater flying electric car in the US". After the HS1 received its FAA certification, Doron Merdinger, CEO of Doroni Aerospace, was quite buoyant, as he was quoted to have said:

“Receiving the FAA’s Airworthiness Certification is not just a milestone for our company, but a leap forward for the entire field of personal air mobility. The Doroni H1 is poised to redefine urban transportation, offering an eco-friendly, efficient, and exhilarating way to travel. This achievement brings us one step closer to our vision of making personal flight accessible to everyone.”

Specifications of the Doroni Aerospace HS1 Hummingbird

Payload: 500 lbs (227 kg)

Cruise Speed: 100 miles/hour (160 km/h)

Top Speed: 140 miles/hour (225 km/hr)

Expected Initial Price: $300,000-$400,000

Range: 60 miles

Charging: 20%-80% in less than 20 minutes

Electric Hoverbike Scorpion3

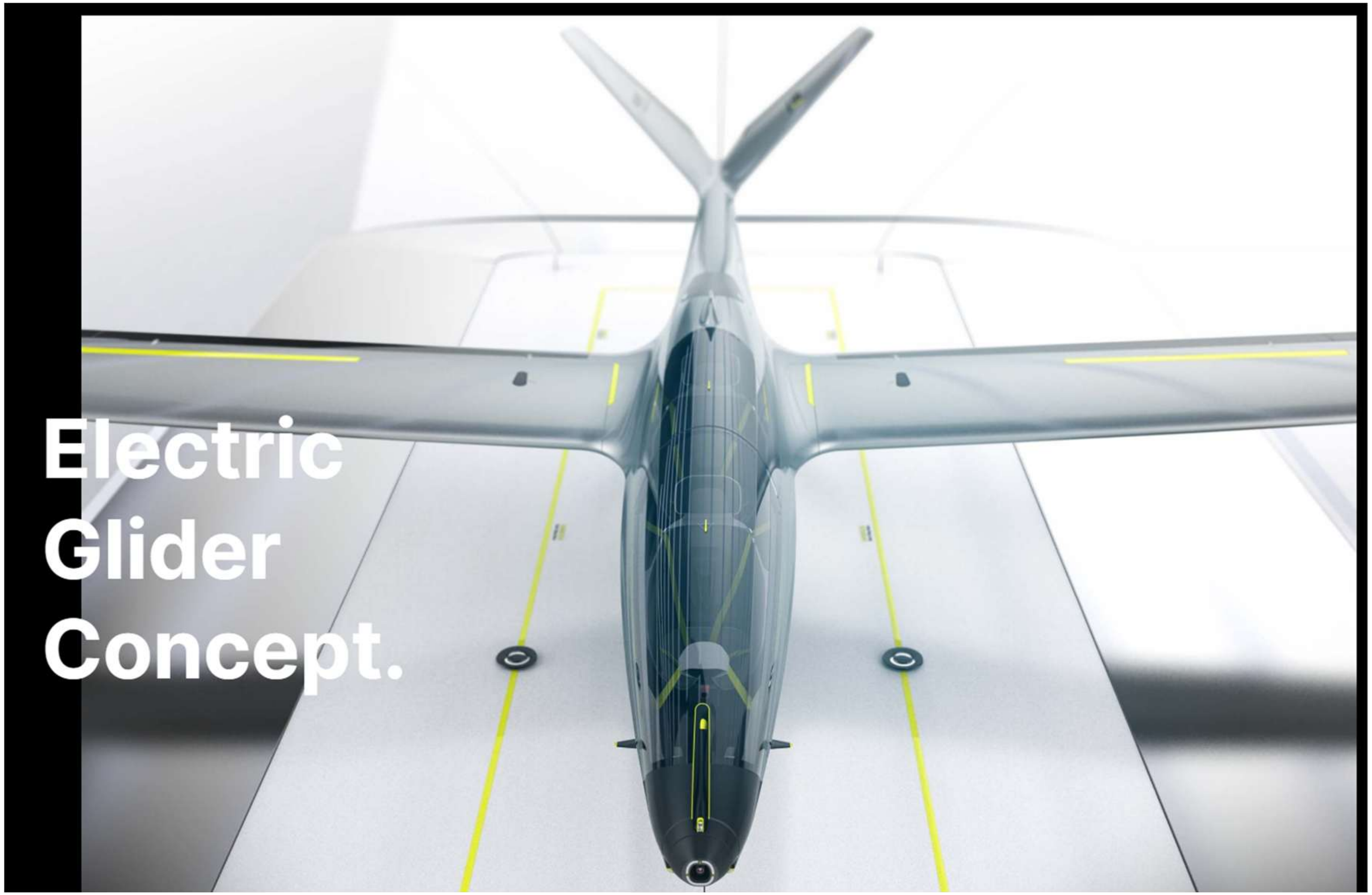
- Bing Videos

Aston Martin race to the skies

https://youtu.be/RuT-fOGleZ8?si=0j2smhoz3ZnaDO3O

- **Volante Vision Concept design to explore luxury personal air mobility**
- **Aston Martin working with partners Cranfield University, Cranfield Aerospace Solutions, and Rolls-Royce**

Electric glider



[Aircraft Norte Electric Glider Future Concept Amazing Inventions - YouTube]

Rethinking the UX and architecture of gliders.

Norte is a two-seater sailplane designed for a sharing system that supports independent pilots and gliding clubs. Norte has a self-starting glider with an electric engine for propulsion and a taildragger undercarriage, making it easy to operate without additional help.

First FAA-certified electric aircraft arrives at Santa Monica Airport and we got to fly it

by Scott Snowden — October 2, 2024 in Business

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In fact, it has an empty weight of 428 kg (944 lbs) and a maximum take-off weight of 600 kg (1,320 lbs), offering a payload of 172 kg (379 lbs). It is powered by a 58 kW (76 hp) liquid-cooled, E-811 electric engine driving a three-bladed, fixed-pitch composite propeller at a cruising speed of 90 knots (105 mph).

And while all that sounds impressive, it's not much use if you can't shoehorn yourself into the cockpit. I faced a similar problem with my previous flight, heck, I face a similar problem every time I fly economy. I'm a 6'1″ former rugby-playing 220 lbs, so some friendly assistance was needed to manhandle me into my seat.

ES30 Hybrid – commercial use

Before making its first flight in 2025, the Heart X1 demonstrator, which has a wingspan of 105 feet (32 meters), will go through extensive ground testing. After that, the Heart X2, which will use the lessons learned from X1, will fly hybrid-electric in 2026. By 2028, Heart Aerospace hopes to have the ES-30 in commercial use.

By blending environmental benefits with practical travel solutions, the ES-30 promises to redefine regional aviation, reduce carbon emissions, and provide quieter, more cost-efficient flights. Its development signals a bright future for sustainable air travel, benefiting passengers, communities, and the planet.

Electric racer (Rolls Royce)

Electric record flight 2021

- **Average over 3km 555,9 km/h, Topspeed 623km/h,**
- **Climbing 202 sec to 3000m**
- **400KW Rolls Royce propulsion system. Based on Siemens (overtaken by RR)**

Rolls royce electric racer you tube - Google Suche

Was New Technology more than 40 Years ago…

The End