<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:30-09:00</td>
<td>Coffee &amp; mingle</td>
</tr>
<tr>
<td>09:00-09:30</td>
<td>Welcome to Elise summit - Anders Forslund</td>
</tr>
<tr>
<td>09:30-09:45</td>
<td>Aircraft Unveil</td>
</tr>
<tr>
<td>09:45-10:15</td>
<td>Elise aircraft-next steps, Mauritz Andersson</td>
</tr>
<tr>
<td>10:15-10:45</td>
<td>Fika</td>
</tr>
<tr>
<td>10:45-12:00</td>
<td>Academic partners presentations</td>
</tr>
<tr>
<td>12:00-13:00</td>
<td>Lunch</td>
</tr>
<tr>
<td>13:00-14:00</td>
<td>Industrial partners presentations</td>
</tr>
<tr>
<td>14:00-14:15</td>
<td>Electric aircraft quiz</td>
</tr>
<tr>
<td>14:15-14:45</td>
<td>Fika</td>
</tr>
<tr>
<td>14:45-15:15</td>
<td>Electric aviation-new perspectives, Robert Gyllroth &amp; Jonas Didoff, Örnsköldsvik airport</td>
</tr>
<tr>
<td>15:15-15:30</td>
<td>General aviation leading the way, Måns Theorin, EcoFlight</td>
</tr>
<tr>
<td>15:30-16:00</td>
<td>Closing Remarks</td>
</tr>
</tbody>
</table>
Elektriska flygplan en växande vandringsmyt

DEBATT Något eldrivet trafikflygplan kommer inte att vara i luften på många år. Eleflyg 2040 kommer att vara obetydligt och nästan allt i luftrummet kommer att vara nu kända flygplanstyper, skriver Arne Karyd, före detta utredare på Luftfartsverket.
Volocopter (Bruchsal, Germany)
Airbus Vahana (San Jose, USA)
Kitty Hawk Cora (USA/New Zealand)
Pipistrel Alpha Electro (Slovenia)
Why is this important?
Aircraft fuel consumption 1970-2020

Source: GKN Aerospace, IATA, Peeters, et al., 2005
Aircraft fuel consumption 1970-2020

Source: GKN Aerospace, IATA, Peeters, et al., 2005

Liters per 100 passenger kilometers

Long-haul aircraft, 5500 km
Short-haul aircraft, 1000 km
Global CO$_2$ emissions from aviation

Global CO₂ emissions from aviation (Percentage of total emissions)

“Only electrical propulsion, demand reduction or offsetting remaining emissions will enable full decarbonization of the aviation sector.”

Kerosene vs. Lithium-ion Battery
Gravimetric Energy Density

1 mass unit Kerosene = 48 mass units Lithium-ion Batteries
World Distances

CPH (1/70 of the distance) 229 km

GOT

ADL

Airbus A350

15294 km

(1/70 of the distance)
World Distances

Adapted from: http://www.martingrandjean.ch/connected-world-air-traffic-network/
Electric aircraft are different!

- Zero operational emissions
- Significantly reduced noise
- Ten times lower energy costs
- Significantly easier to build, maintain and operate
- No need for jet fuel infrastructure
- Easier and cheaper to operate airports
- Limited range
- Smaller aircraft and flexible, decentralised aerial infrastructure
- Disruptive force on aerospace industry

Image by Zunum Aero
ELISE
Elektrisk Lufttransport i Sverige

Project partners:
1. International positioning

Airbus Vahana (USA)

Volocopter (Germany)

Lilium Jet (Germany)

Ehang 184 (China)
Avinor: All flytrafikk i Norge elektrisk innen 2040

Luftfarten skal bli grønnere, og Avinor-sjef Dag Falk-Petersen sier all norsk flytrafikk skal være elektrisk innen 2040.
2. Demand mapping

- Domestic flights
- Medical transport
- Swedavia airports (10)
- Other passenger airports (27)
- Airfields (160)
Nextjet i konkurs – hårt slag mot norr

Efter stora ekonomiska problem tog det definitivt stopp för Nextjet. Flygbolaget går i konkurs och bland de stora förlorarna finns en rad mindre Norrlandskommuner.
– Det här är förödande för oss, säger Arvidsjaurns kommunalråd Lotta Åman (S).
Swedavia airports (10)
Swedavia airports (10)
Other passenger airports (28)
Swedavia airports (10)

Other passenger airports (28)
- Other airfields (160)
3. Inventory of Swedish technology for electric flight

- Blackwing
- SAAB Windex MERA
- Chalmers
- Örnsköldsvik Remote Tower
Goal: Build a full-scale prototype
Three categories of electric aircraft
Category A: Urban Air Mobility
Category C: General Aviation
By what criteria should we select our concept?
1. Reduce CO$_2$ emissions
2. Reduce noise emissions
3. Benefit Swedish Infrastructure

Nextjet i konkurs – hårt slag mot norr

Efter stora ekonomiska problem tog det definitivt stopp för Nextjet. Flygbolaget går i konkurs och bland de stora förlorarna finns en rad mindre Norrlands kommuner.

– Det här är förödande för oss, säger Arvidsjurs kommunalråd Lotta Åman (S).
4. Improve user experience
5. Short time to market
Five selection criteria

1. Reduce CO\textsubscript{2} emissions
2. Reduce noise emissions
3. Benefit Swedish infrastructure
4. Improve user experience
5. Short time to market
Category A: Urban Air Mobility

- Reduce CO$_2$ emissions: ✗
- Reduce noise emissions: ✗
- Benefit Swedish infrastructure: ✗
- Improve user experience: ✓
- Short time to market: ✗
Category B: Airliners

Reduce CO$_2$ emissions: ✓
Reduce noise emissions: ✗
Benefit Swedish infrastructure: ✗
Improve user experience: ✗
Short time to market: ✗
Category C: General Aviation (for private aviation)

- Reduce CO₂ emissions: ✓
- Reduce noise emissions: ✓
- Benefit Swedish infrastructure: ✓
- Improve user experience: ✓
- Short time to market: ✓
Category C: General Aviation

- Reduce CO$_2$ emissions: ✗
- Reduce noise emissions: ✗
- Benefit Swedish infrastructure: ✗
- Improve user experience: -
- Short time to market: ✓
<table>
<thead>
<tr>
<th>Feature</th>
<th>Urban air mobility</th>
<th>Airliners</th>
<th>General aviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce CO$_2$ emissions:</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Reduce noise emissions:</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Benefit Swedish infrastructure:</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Improve user experience:</td>
<td>✓</td>
<td>✗</td>
<td>-</td>
</tr>
<tr>
<td>Short time to market:</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Feature</td>
<td>Urban air mobility</td>
<td>Airliners</td>
<td>General aviation</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>------------------</td>
</tr>
<tr>
<td>Reduce CO₂ emissions:</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Reduce noise emissions:</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Benefit Swedish infrastructure:</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Improve user experience:</td>
<td>✓</td>
<td>✗</td>
<td>-</td>
</tr>
<tr>
<td>Short time to market:</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
</tbody>
</table>
ELISE concept

Length: 11 m
Wingspan: 11 m
MTOW: 4500 kg
Passengers: 8+1 pilot
Battery: 1000 kg (250 kWh)
Motors: 2 x 525 kW
Pack density: 250 Wh/kg
Range: 400 km
Cruise speed: 500 km/h
Takeoff: 600 m
Elise concept

Reduce CO$_2$ emissions: ✓
Reduce noise emissions:
Benefit Swedish infrastructure:
Improve user experience:
Short time to market:
Elise concept

Reduce CO$_2$ emissions: ✓
Reduce noise emissions: ✓
Benefit Swedish infrastructure:
Improve user experience:
Short time to market:
Elise concept

Reduce CO$_2$ emissions: ✓
Reduce noise emissions: ✓
Benefit Swedish infrastructure: ✓
Improve user experience:
Short time to market:
Elise concept

Reduce CO$_2$ emissions: ✓
Reduce noise emissions: ✓
Benefit Swedish infrastructure: ✓
Improve user experience: ✓
Short time to market:
Elise concept

Reduce CO$_2$ emissions: ✓
Reduce noise emissions: ✓
Benefit Swedish infrastructure: ✓
Improve user experience: ✓
Short time to market: ✓
Would a plane of this range have an impact?
Cumulative domestic passenger trips by range covered, 2010-2017

Source: Thanh Bui (RISE), Eurostat
How many of these planes would you need to build?
Cumulative passenger trips by range covered, 2010-2018

Source: Thanh Bui (RISE), Eurostat
How many of these planes would you need to build?

Answer: 273
1000 cars made at Volvo Torslanda every year for each aircraft
16,000 electric cars needed to decarbonize road traffic for each aircraft
Some back-of-envelope calculations

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planes needed:</td>
<td>250</td>
</tr>
<tr>
<td>Unit cost:</td>
<td>20 million SEK</td>
</tr>
<tr>
<td>Total cost:</td>
<td>5 billion SEK</td>
</tr>
<tr>
<td>Passengers per year:</td>
<td>5 million</td>
</tr>
<tr>
<td>Twenty-year service:</td>
<td>50 kr/flight</td>
</tr>
</tbody>
</table>
Timeline

Dec 6th, 2018  ELISE summit
Jan. 7th, 2019  Elise final report due (draft today)
Jan. 29th, 2019  ELISE stage 2 application, 10 MSEK (50% support level)
Spring 2019:  Apply for more money (Energimyndigheten, Nordic Energy, Etc)
April 25th, 2019  Project start
April, 2021:  ELISE stage 3, 20-30 MSEK (30% support level)
## Deliverables

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>Preliminary design</td>
</tr>
<tr>
<td></td>
<td>Flying scale models</td>
</tr>
<tr>
<td></td>
<td>Interior model</td>
</tr>
<tr>
<td></td>
<td>First electric drivetrain tests</td>
</tr>
<tr>
<td>2020</td>
<td>Detail design</td>
</tr>
<tr>
<td>April 2021</td>
<td>Full-scale unmanned prototype</td>
</tr>
<tr>
<td>2021-2025</td>
<td>Work towards certified production aircraft</td>
</tr>
</tbody>
</table>
Who’s going to make this happen?
Elise consortium

Phase 1:

CHALMERS  RISE  QRTECH  LFV
Consortium Additions
Agenda for Elise Summit

09:40-10:00  Mauritz Andersson, Uppsala University
10:15-10:45  Fika
10:45-11:00  Alejandro Sobrón Rueda, Linköping University
11:00-11:15  Johan Jansson, KTH, Icarus Simulation
11:15-11:30  Christoforos Kanellakis, Luleå University of Technology
11:30-11:45  Mauritz Andersson, Uppsala University
11:45-12:00  Tomas Grönstedt, Chalmers
12:00-13:00  Lunch
13:00-13:15  Erik Kullgren, Elitkomposit
13:15-13:30  Pavel Calderon, Abtery
13:30-13:45  Anders Lundbladh, GKN Aerospace
13:45-14:00  Gustav Wiberg, Katla Aero
14:00-14:15  Electric Aircraft Quiz
14:15-14:45  Fika
14:45-15:15  Robert Gyllroth & Jonas Didoff, Örnsköldsvik airport
15:15-15:30  Måns Theorin, EcoFlight
15:30-16:00  Closing Remarks