

Capturing the Demand for an Electric-Powered Short-Haul Air Transportation Network

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Short Haul Regional Route Concept

Towards an **environmentally and community-friendly** short-haul air transportation service for door-to-door mobility: the **miniliner**

1. **Microfeeder** service (hub-and-spoke)

- Feeding hub flights: carry people to international airports flying from small aerodromes (minor airports and grassy airstrips) scattered in the neighboring territory



2. **Intercity liner** service (point-to-point)

- Serving **town-to-town commuters: intercity** service replacing car/train, "as easy as a bus"

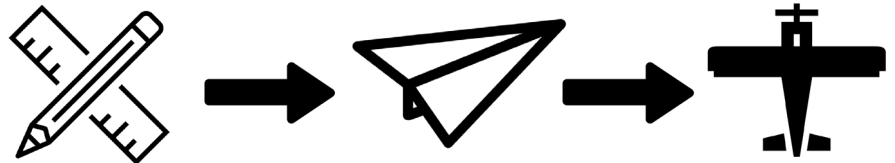
Short Haul Regional Market

Requirements to design the aircraft for these services?

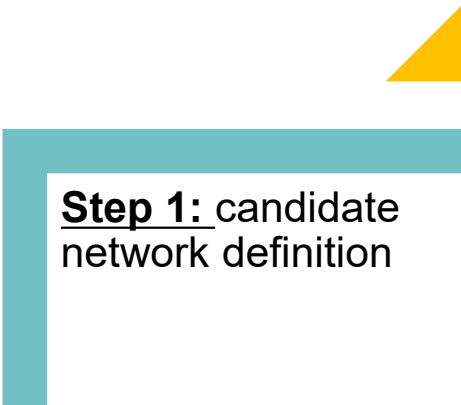
- Typically, requirements come from **market needs**
- Here, the market is not developed today, it must be **predicted**

Preliminary studies encompass several elements in the **future microfeeder and miniliner market definition**

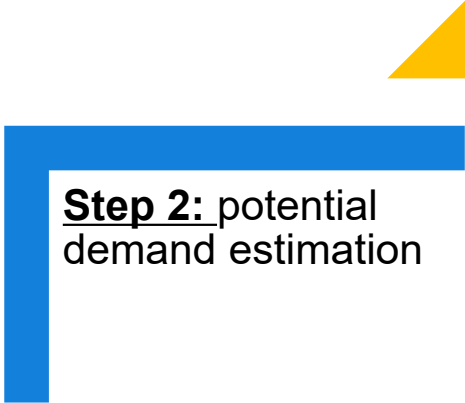
1. Available aerodrome network
2. Mission analysis
3. Potential demand estimation



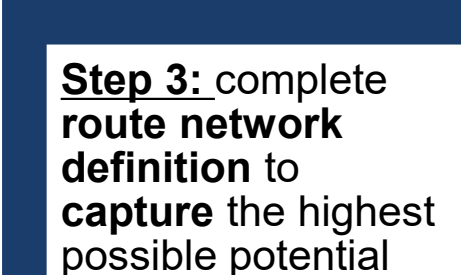
Short-Haul Air Route Optimal Network Assessment



Step 1: candidate network definition



Step 2: potential demand estimation

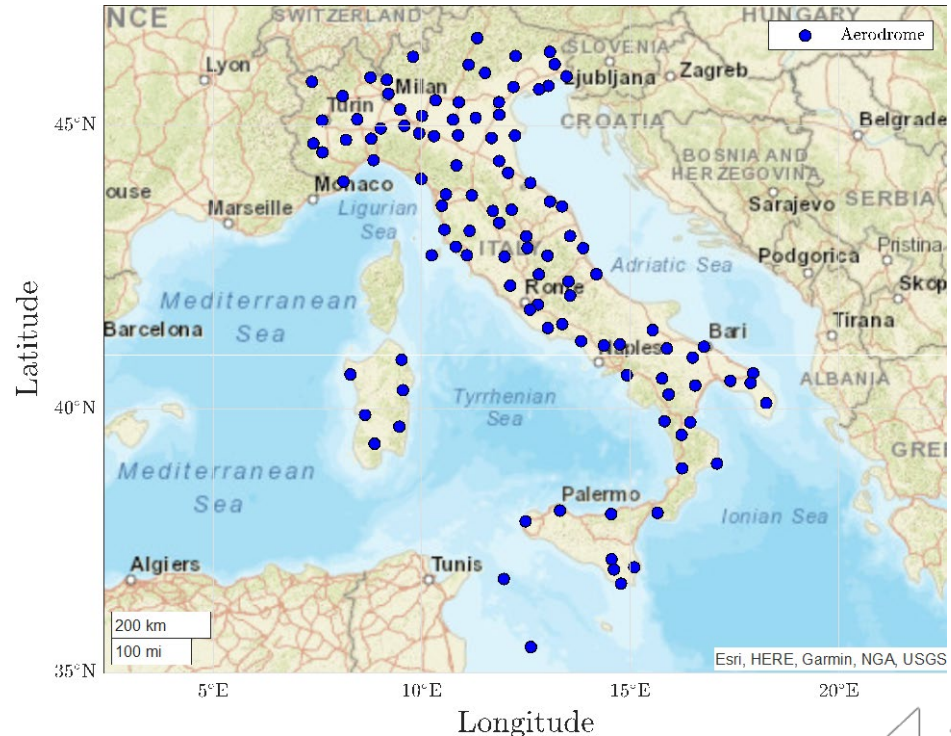


Step 3: complete route network definition to capture the highest possible potential demand, based on a given aircraft fleet.

Candidate network

- Italian territory
- **Secondary Aerodromes:**
 - + airports with less than 5M pax/year
 - + airfields
- Secondary Aerodromes organized in **clusters**
- Cluster max width: **50 km road distance**
- Minimum runway length of 600 m

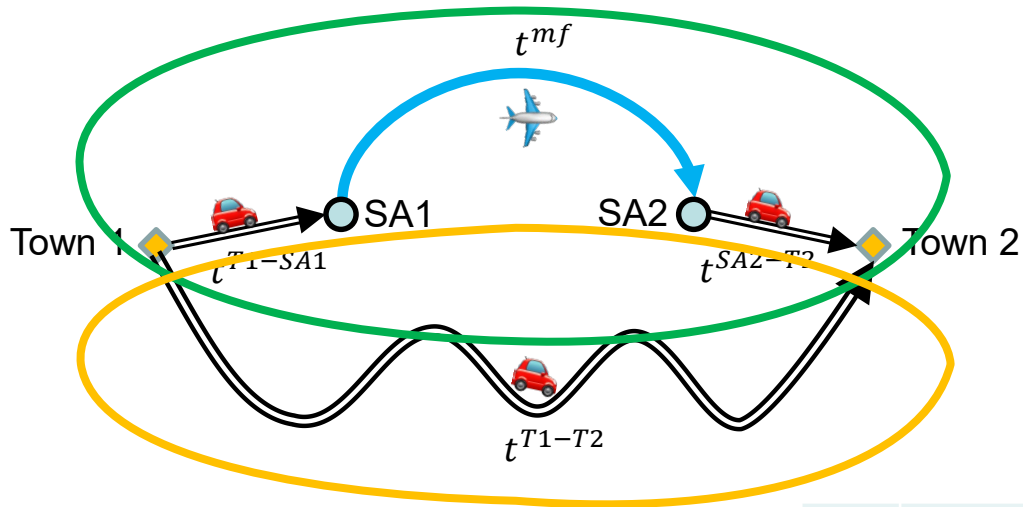
Hubs (pax 2018 >5,000,000)	12
Secondary airports + airfields	602



Catchment area

Route catchment area definition

- The **catchment area** for a route traced between two **secondary aerodromes** (airport or airstrip is defined based on the positive evaluation of the **time advantage**)
- **Flight time** includes the block cruise time and **fixed airport time** to account for check-in operations, security checks, boarding time.



$$t^{T1-SA1} + t^{mf} + t^{SA2-T2} \leq \frac{t^{T1-T2}}{k}$$
$$t^{T1-T2} - (t^{T1-SA1} + t^{mf} + t^{SA2-T2}) \geq t_{ref}$$

k	1.3
t_{ref}	30 min

Potential demand estimation – 1

Italian scenario

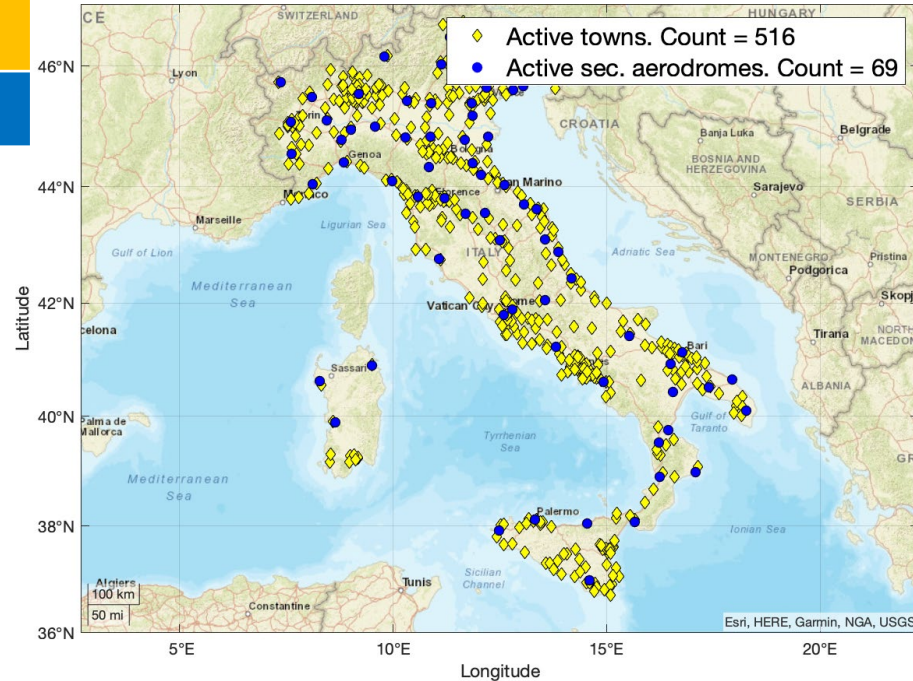
Framework:

- Entire Italian territory
- Commuter matrix from 2011 census
- Only towns with more than 20,000 inhabitants involved

99 parametric studies:

- Trip distance from 100 to 600 km
- Cruising speed from 150 to 250 KTAS
- Cruising altitude 4,000 ft (when possible)
- Runway length from 600 to 1,000 m

Towns	521
Total commuters	13,644,740

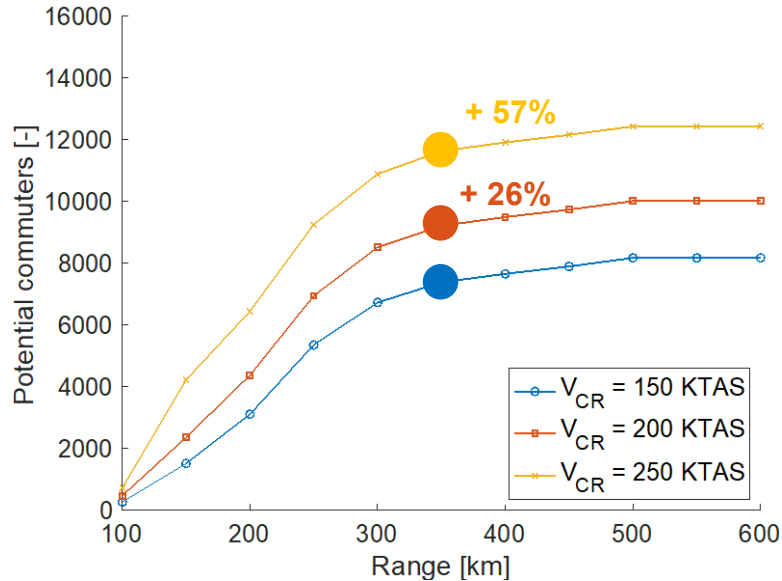


Italian scenario example.

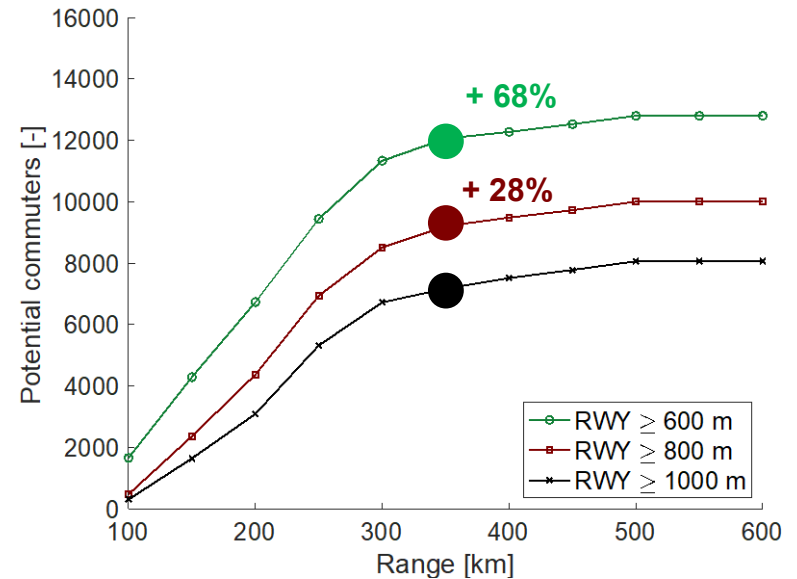
Trip distance 300 km, cruising speed 200 KTAS and RWY
≥800 m

Potential demand estimation – 2

- Potential commuters as a function of range, cruising speed and runway length

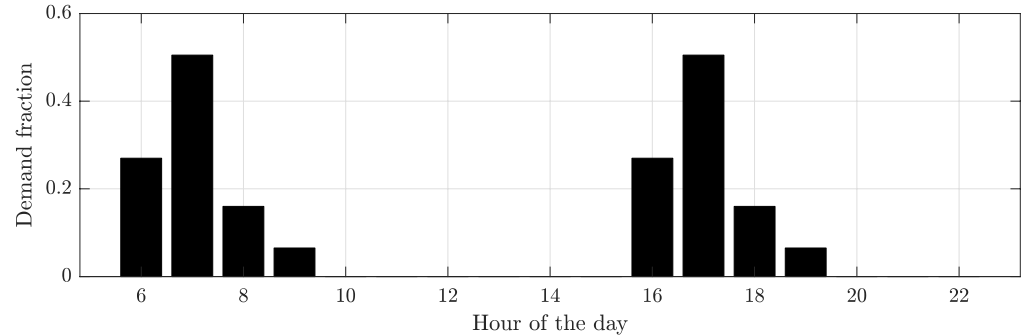
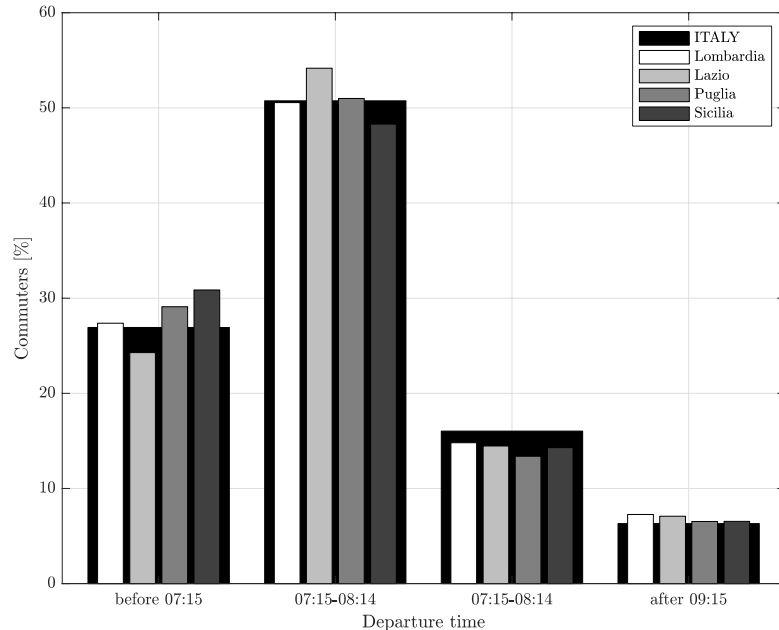


RWY >= 800 m with varying range and cruising speed



Cruising speed 200 KTAS with varying range and runway length

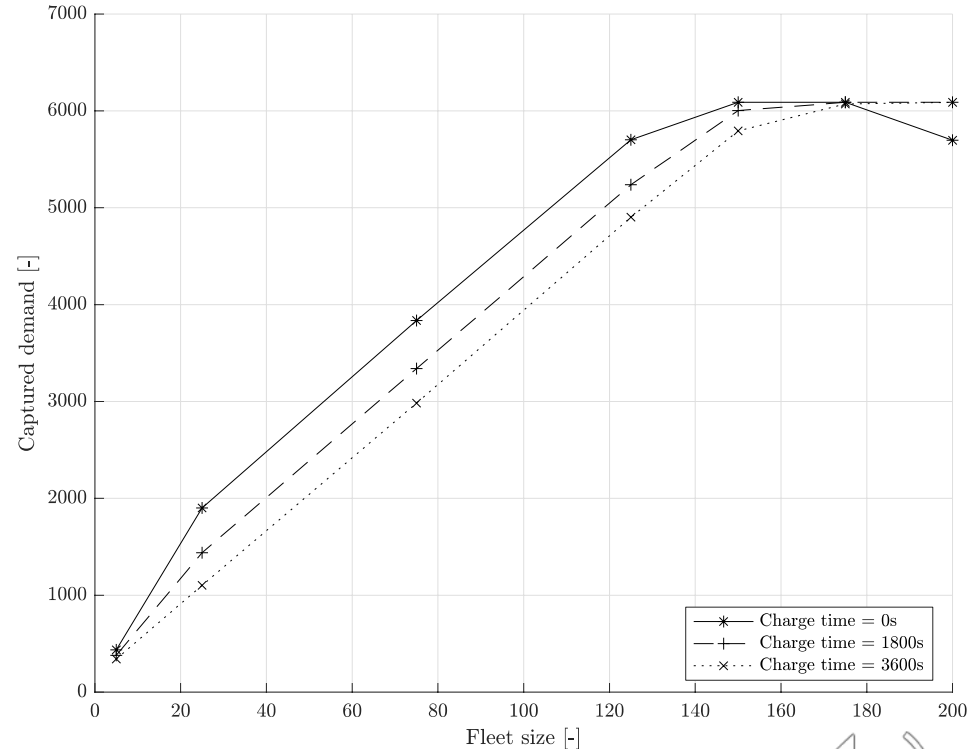
Capture the potential demand – scheduling



- Distribution of potential demand during the day
- Dedicated optimization algorithm
- **Goal: determine the minimum network of aerodromes to capture the highest travel demand**

Capture the potential demand

Parameter	Nominal value
Aircraft capacity	19 passengers
Aircraft range	300 km
Aircraft cruising airspeed	200 KTAS
Minimum trip distance	40 km
Airport times (without battery charging)	40 min
Minimum passenger load factor	0.8
Maximum battery discharge	80%
Time frame	06:00 a.m. -- 08:00 p.m.
Time slot	30 min



➤ 37% of the total potential demand

Conclusion

- Serving **town-to-town commuters: intercity miniliner** service replacing car/train, "as easy as a bus"
- **Candidate network** of 109 **Secondary Aerodromes, Italian** scenario
- **New market** → NO past data → **potential demand** estimation:
 - Reducing the **runway length** can double the potential demand. **Cruise speed** has a **moderate effect**. **Saturation** of the potential demand at high **trip distances**.
 - Cutting airport times **can bring more than 10x travelers**
- **Optimal network** can capture up to **37%** of the potential demand
- **Potential users** for the **intercity miniliner service** can go **far beyond** everyday commuters (**irregular travelers are not included** in this study)

Closing



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➤ **Thank you!**

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