



# Shaping the Future of Flight

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# Overview

- Who is Harbour Air and Why Electrification Works for Harbour Air Now
- What We Have Done
- Lessons Learned
- What's Next
  - Short Term
  - Long Term Vision
- Challenges
- What Can You Do?



# SCHEDULED FLIGHTS



We are uniquely positioned to be a leader in commercial electric flight.

- Short flight missions – average 30 minutes
- Typically low altitude flights
- Results in low energy requirements of our aircraft
- Don't need to build an aircraft around technology, just have to change the propulsion system

Never a question of *if* we would do this, but *how*.



## Baseline Aircraft

**Pilots:** 1  
**Passengers:** 6  
**MTOW:** 5,600 lb

**Dimensions:** 10m x 15m x 3m  
**Cruise:** 180 km/h (~100 KTS)  
**PowerPlant:** P&W R985  
**Max rated power:** 450 hp

**First Flight:** August 16<sup>th</sup>, 1947  
**Production:** 1947 – 1965

# Experimental Development Vehicle



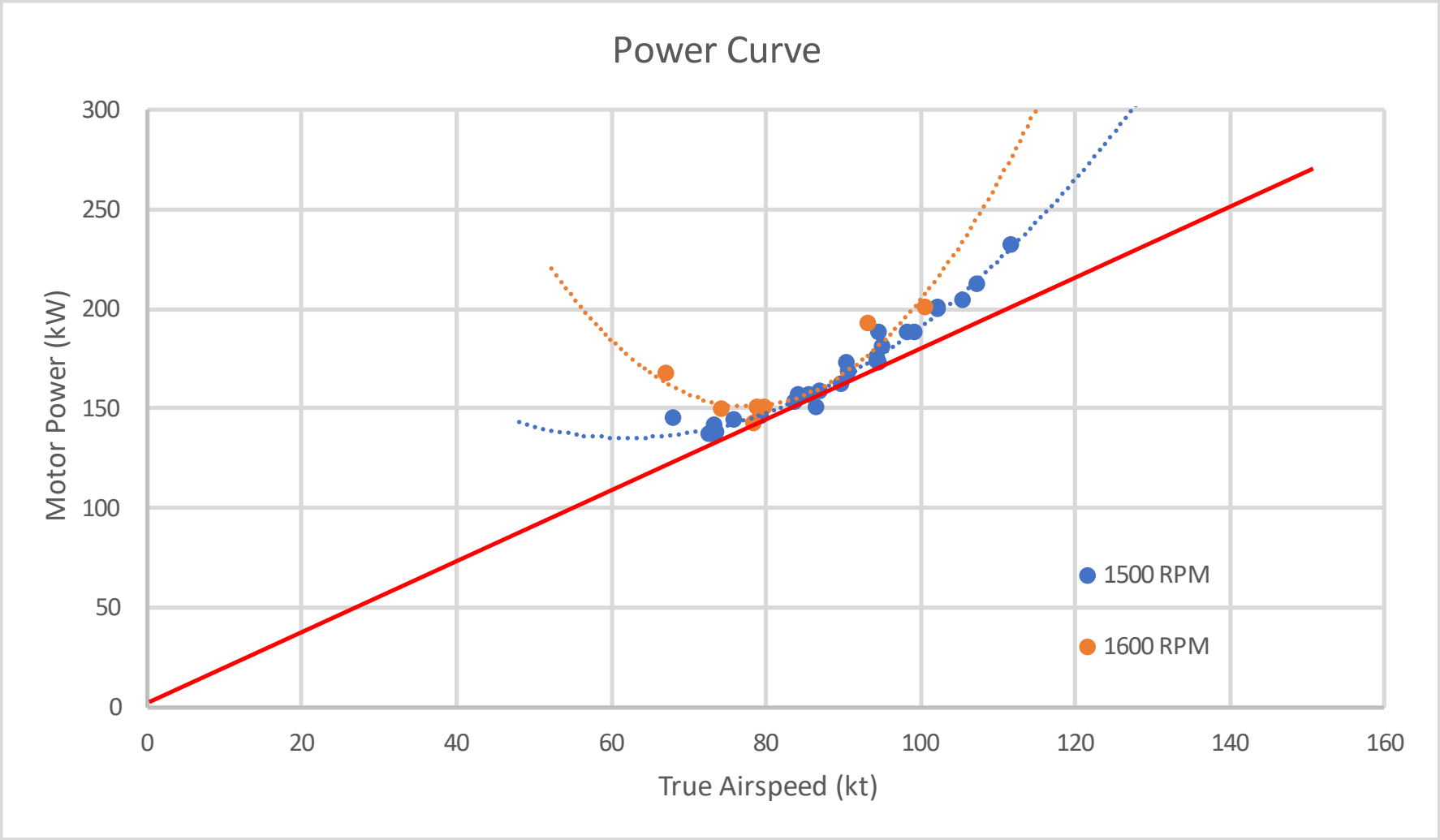
# Flight Testing to Date

Since December 2019 Harbour Air has performed 78 flights exploring:

- Take-off performance
- Cruise performance
- Range / Endurance
- Climb performance
- Noise testing
- Cooling system performance
- Balked landing performance
- Loss of power simulations



# Flight Testing to Date - PLF



Note:

PLF for the original piston Beaver was 62%.

PLF for the eBeaver is 41%.

# Operational Point-to-Point Flights YVR to Vancouver YVR to Saltspring Saltspring to Victoria

## Purpose:

- To test the aircraft under operational conditions
- Show scheduled points can be accomplished
- Test charging capabilities/challenges at various locations
- Evaluation of overall reliability







# Lessons Learned: Charging Infrastructure

- Power source carbon free?
- Charging protocol standardization
- Lack of power at scheduled points, BYOC, wire in 220 service
- Energy storage – we need to think about energy differently
- Nonlinear charge rates



## Lessons Learned: Miscellaneous

- Commonality of markings, placards, cable colours
- Take-off vs. landing weight
  - No fuel burn, landing loads would be based on take-off weight
- Electric aircraft heavier than OEM when 'empty"
  - Ground infrastructure not designed for this condition
- High capital cost, low operating cost
- Emergency response considerations



# Lessons Learned: Battery Considerations

- Non-linear discharge rate, in particular at low states of charge
- Approach to thermal management
  - Additive heat
  - Temperature differentials, battery conditioning
- Battery Life
  - SOC vs. SOH vs. Cycle Life
  - String replacement – mix of full SOH and depleted SOH. Larger impact on design than failure condition
- Battery cell, module, and string balancing logic

# Program Next Steps

## Short Term

- Experimental Development Vehicle
  - Developing test points to aid in determining certification basis
  - De-risk validation flight tests
  - Multiple flights in one day
- Certification build
  - Second build underway – airframe is ready
  - Testing to date has determined we need to revisit our planned architecture





# Program Next Steps

## Long Term Vision

- Phase 1/2 – Certify the electric DHC-2 Mkl Beaver
- Phase 3 – Convert the entire Harbour Air fleet of Beavers
- Phase 4 – Certify the next aircraft type, depending on technology
- Phase N – Convert the entire Harbour Air fleet

# Challenges

- Technology readiness level, rapidly changing technology
- Dispatch changes/reliability, operator education
- Infrastructure
- Industry funding
  - Viability of Programs
  - Sustainability Policies
  - Public Interest
- Certification – resources
  - Government budgets
  - High quantity of submissions





# What Can You Do?

- Join the transportation industry!
- Evaluate the opportunities
  - What technology can work for you now?
  - Not just vehicles, production of alternate fuels, energy storage & delivery, infrastructure
- Join a committee to help develop standards such as SAE or ASTM
  - New technologies need support
  - Collaborative – industry, technology, certification & the regulators
- Talk to your government officials
  - Let them know this is a priority

Questions?

