



A concurrent design
approach for model-
based technology
roadmapping

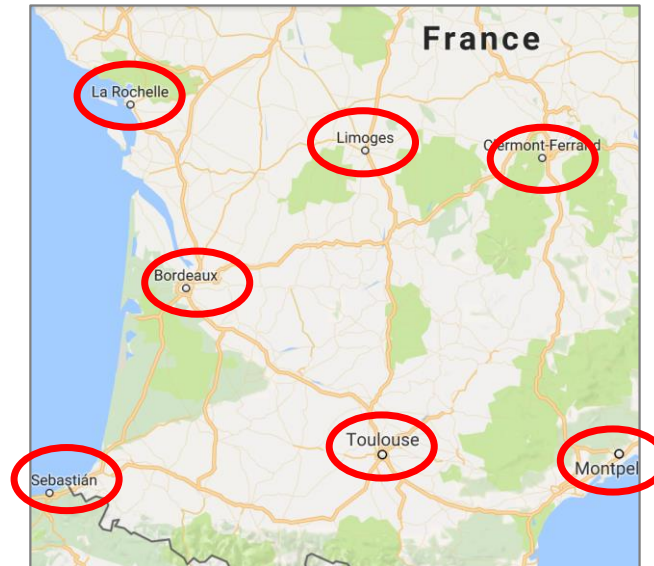
- Roadmapping in general
- Technology infusion assessment
- Concurrent Design approach
- Roadmap modeling
- Use case: Solar Electric Plane
- Outlook

where are we today?



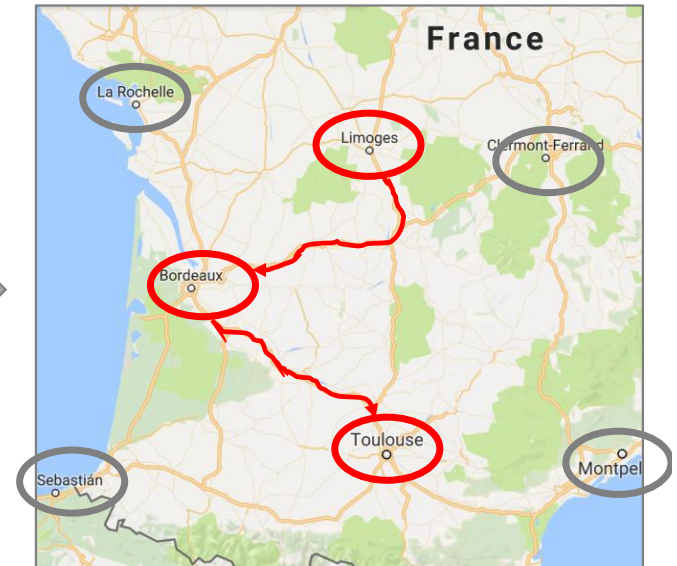
Technology assessment

where could we go?



Technology roadmapping

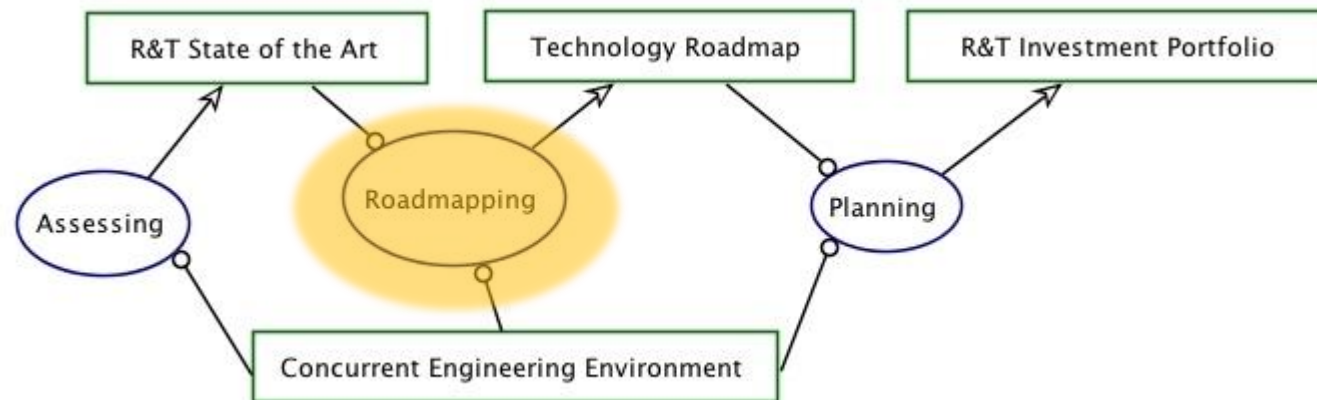
where should we go?



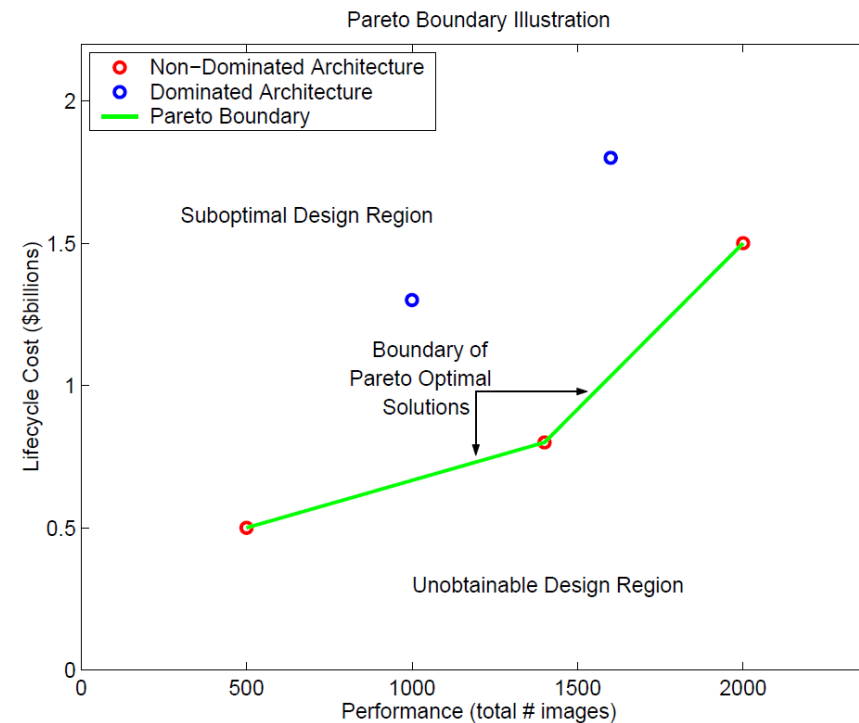
Technology planning

- Strategy Development Process

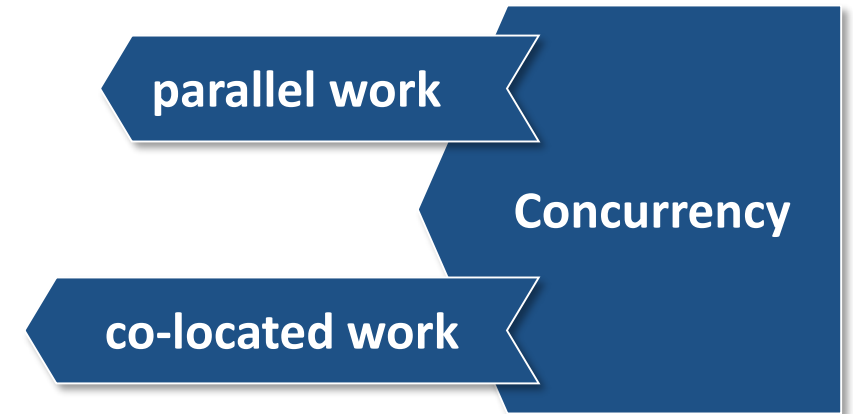
1. Assessment – identifying status and opportunities
2. Roadmapping – evaluating alternative options
3. Planning – choosing possibilities



- Quantitative assessment
→ Figures of Merit
- Multiple Attributes in tension
→ Tradespace exploration
(Ross & Hastings 2005)
- Technological evolution
→ shifts the Pareto front
(de Weck & Chang 2003)

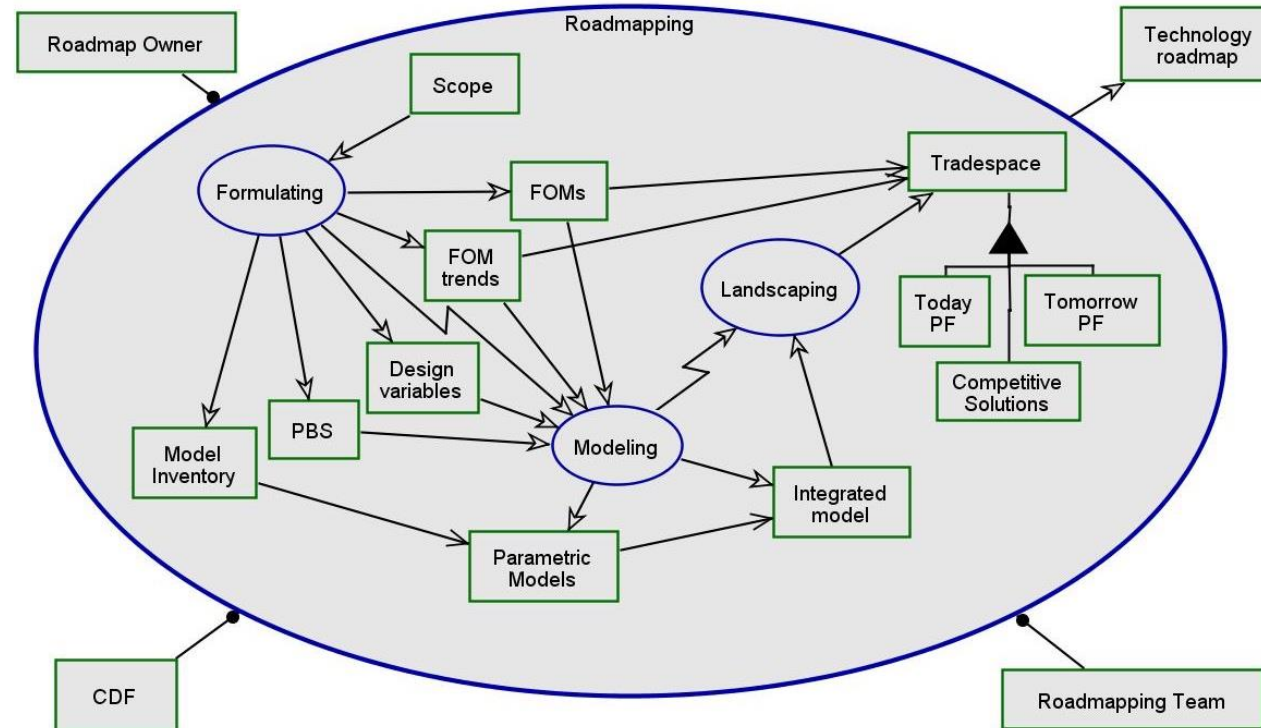


- Used for space mission feasibility studies (Bandecchi et. al., 2000; Braukhane & Romberg, 2010)
 - + Encode knowledge in models where possible
 - + Include multiple disciplines
 - + Value human expertise and in-person discussion
 - + Collaboration supported by tools and process



3 Steps

- 1) Formulation
- 2) Modeling,
- 3) Landscaping



Object Process Methodology
(OPM) ISO/PAS 19450

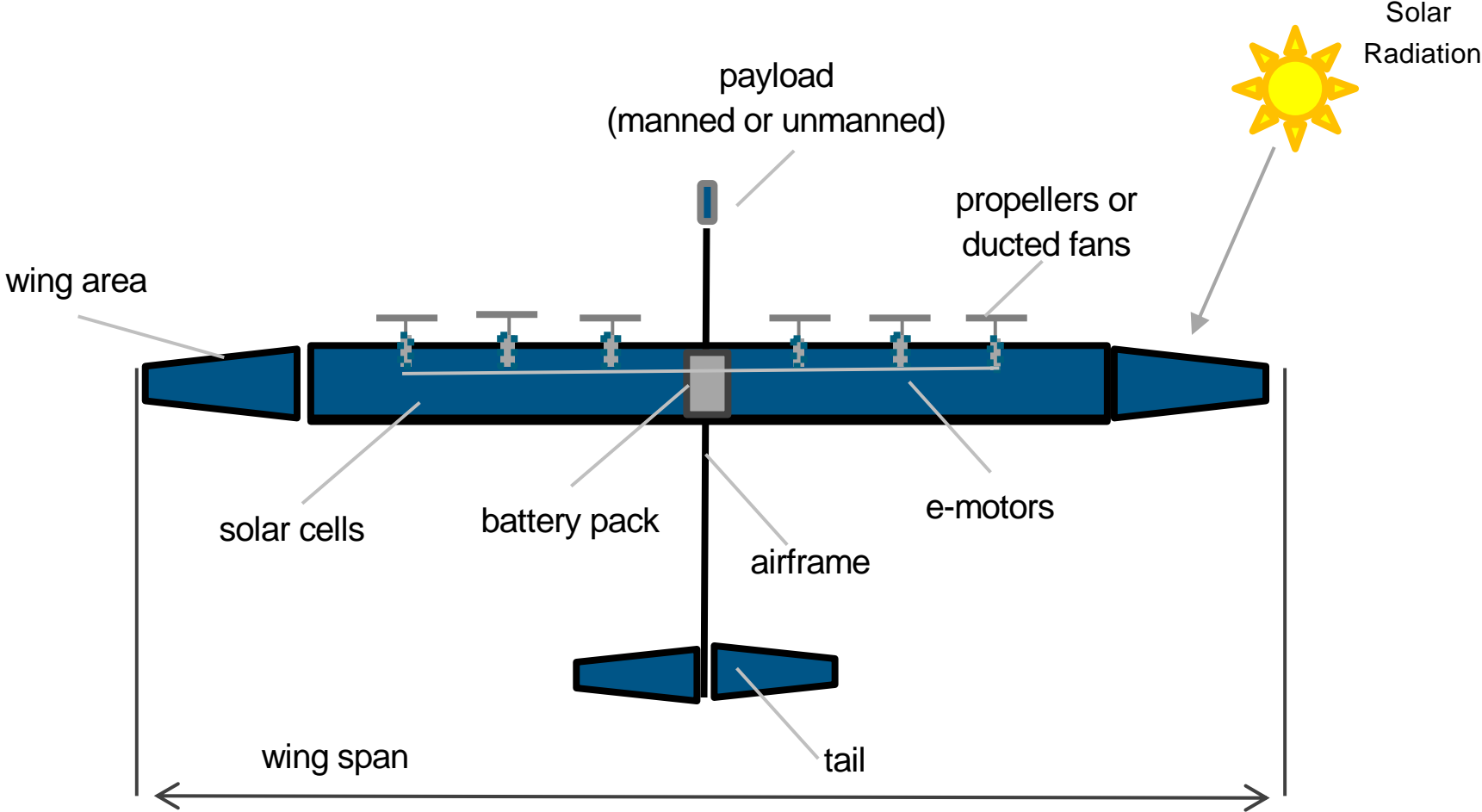
- Documenting technology assessment
- Enabling reliable and repeatable evaluation
- Providing data for technology investment
 - 1) Contextual data
 - 2) Descriptive Model (in OPM)
 - 3) Analytic (parametric) Model
 - 4) Resulting Tradespace data

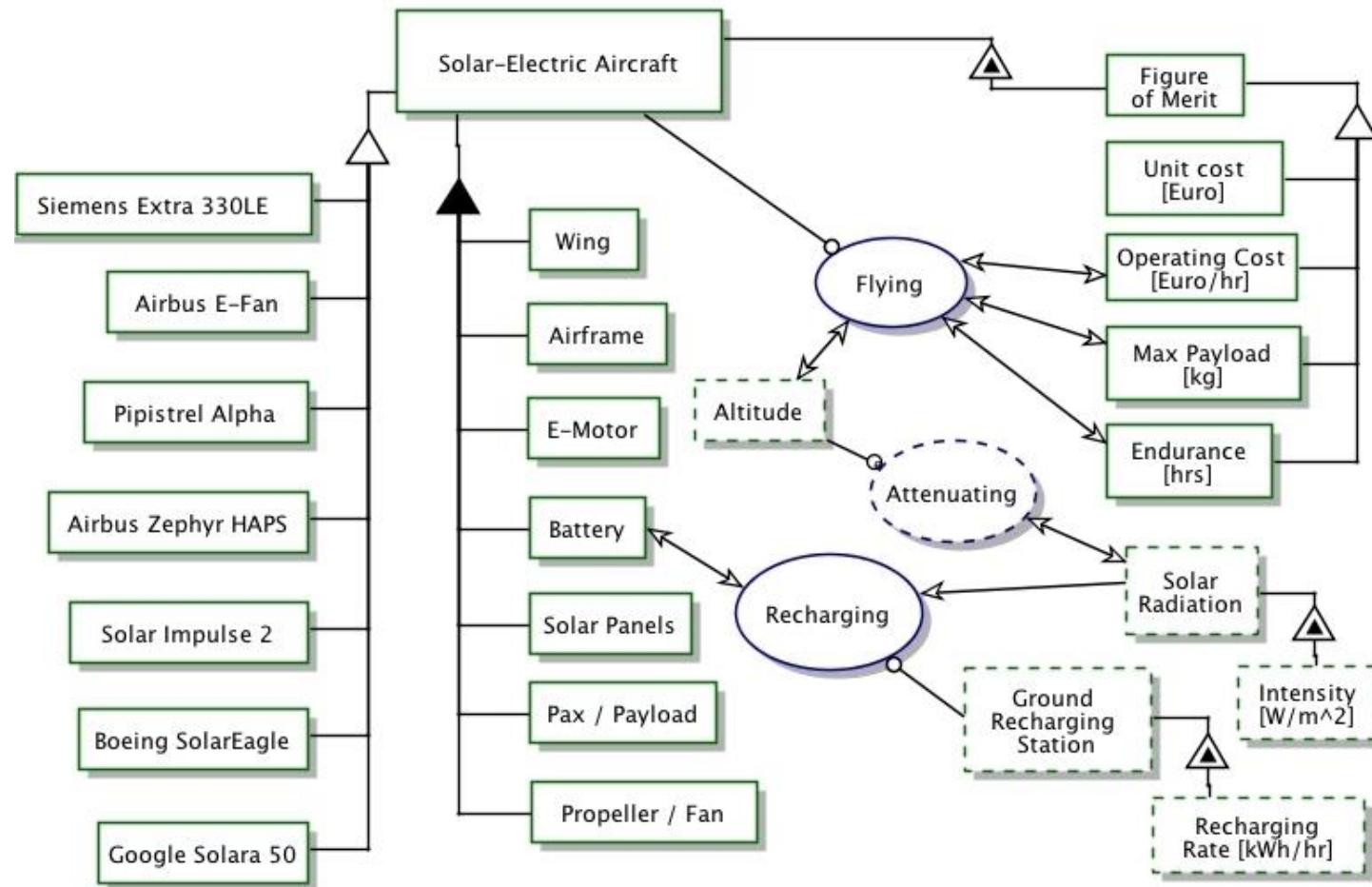
As Object Process Diagram

- Visual representation for quick understanding of roadmap content
- Formalization for comparison
 - Product instances
 - System breakdown structure
 - Functions
 - Figures of Merit

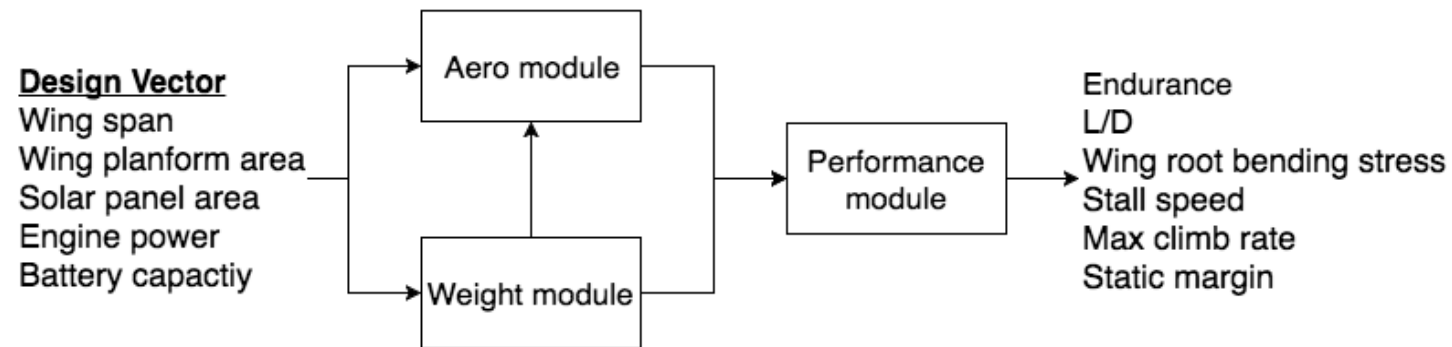
- Decomposition of System into Subsystems / Disciplines
- Technology models: mapping design variables to figures of merit
 - a) Transfer Function – Physics based first principles
 - b) Response Surface – Data from prototypes / tests
 - c) Expert Heuristics – Empirical relationships
- Collaborative tradespace exploration through iterative design session

Notional Roadmap Example: Solar Electric Airplane SEA

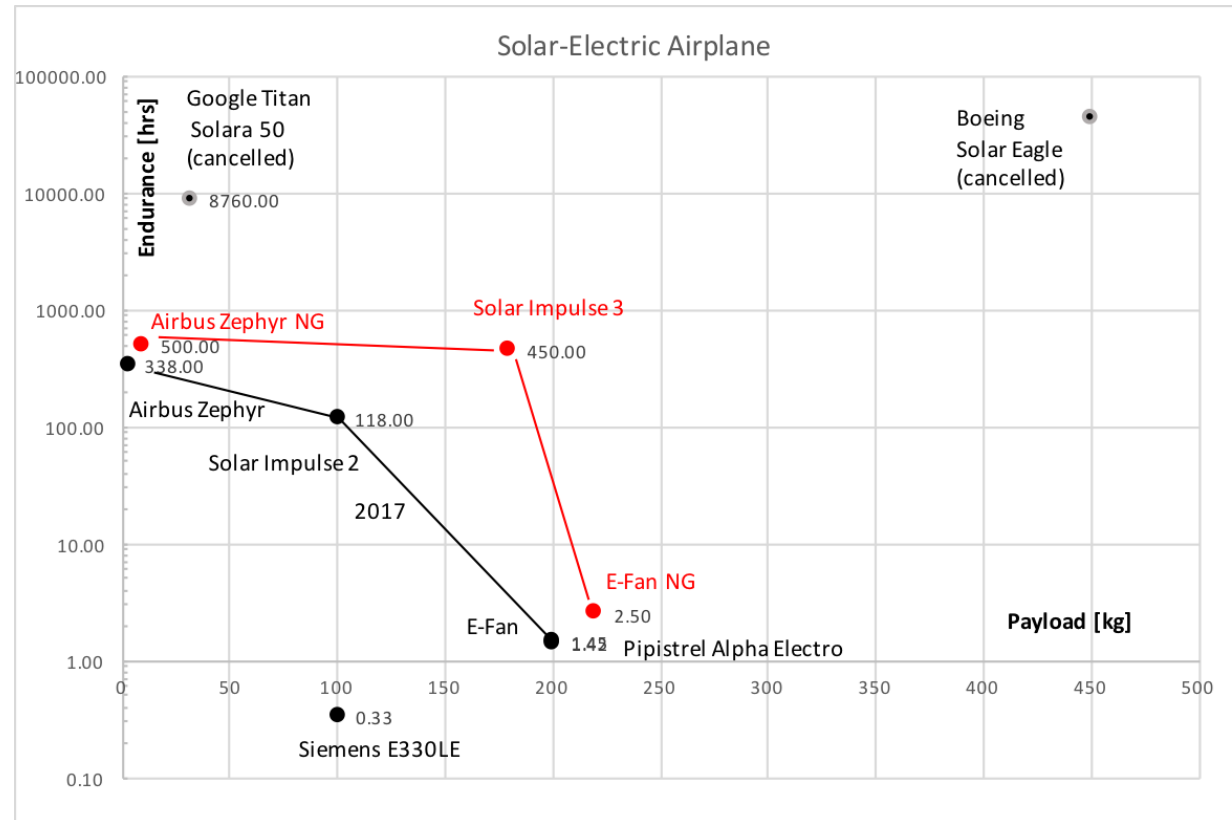




Integrated analytic model: Sizing parameters map to performance characteristics



Payload mass vs. Endurance



Future Pareto front in red.

Current Pareto front in black

- ++ Model-based roadmaps provide reliable data for decision support
- - Building models for new technologies remains challenging

- Forecasting of future evolution Figures of Merit
- Taking into account market competitors
- Expert opinion elicitation with Delphi method



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