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PTV Talks:
Air Taxi & Hyperloop

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PTV Group, Dubai
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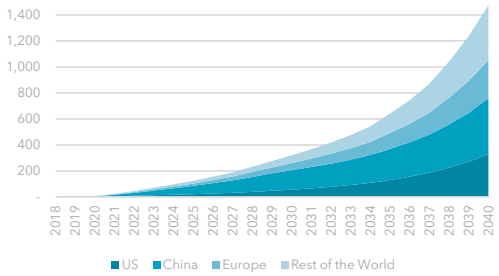
Air Taxi Demand & Hub Locations

How high could VTOLs go?



"Flying cars could initially gain market share from cars on the road, planes and public transportation. However, it could also open up a whole new world of business across multiple sectors. In its base case, these opportunities point to a total addressable market of $1.5 trillion by 2040"

Source: Morgan Stanley Research

Air Taxi Demand & Hub Locations

What demand can we expect for the Air Taxi Service?

What is the optimal distribution of Air Taxi hubs?

What are the optimal service parameters?

Who does demand / revenue / cost / profit depend on service parameters and hubs' location?

Air Taxi
Study Focus

Estimation of the potential demand for air taxi services in urban areas, with particular focus on trips from/to CBD

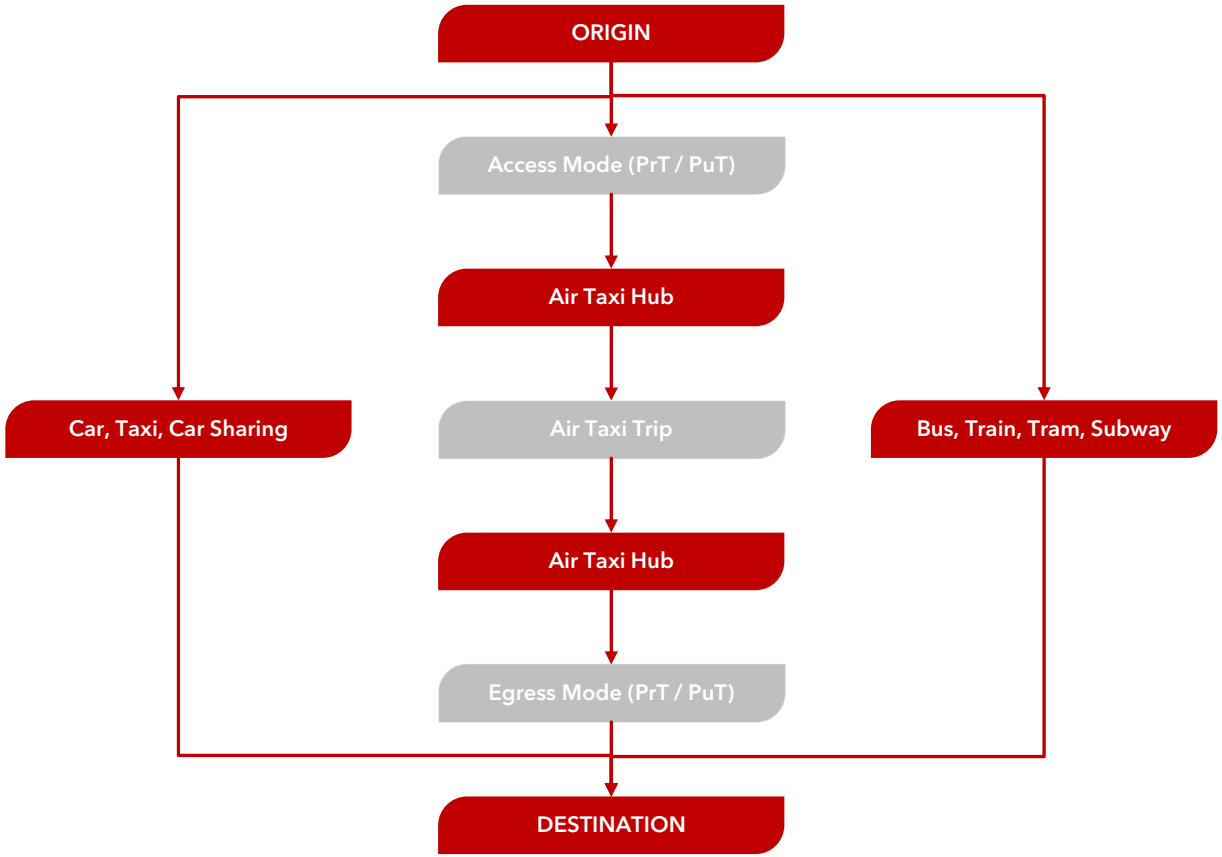
OBJECTIVES

Estimation of demand for air-taxi services

Evaluation of modal shift from existing modes to the new air-taxi mode

Optimization of air-taxi hub locations aimed at maximization of air-taxi demand

Estimation of required fleet size, modal split on access modes and daily distribution of demand



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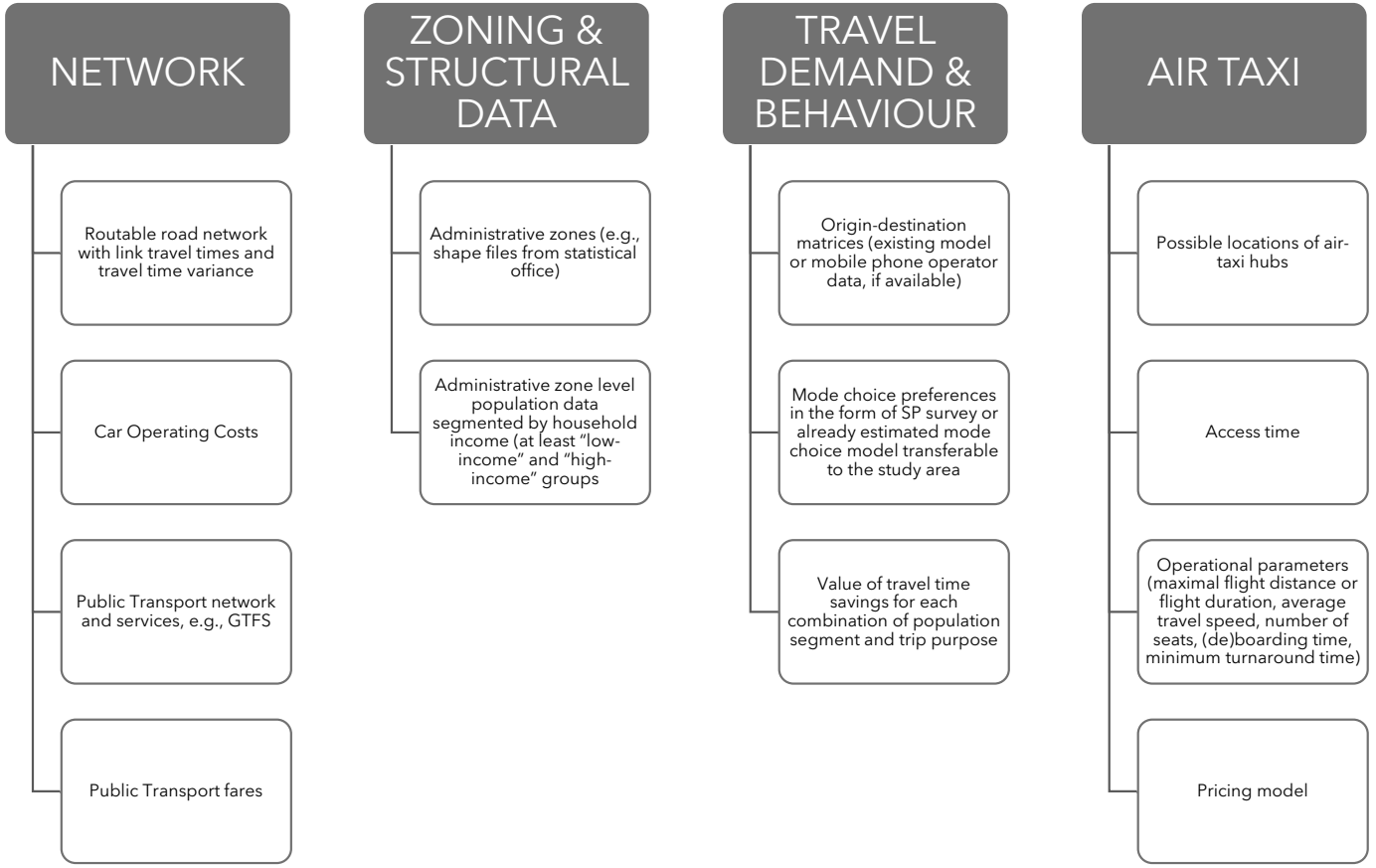
Data Collection

Minimum requirements for

SUPPLY MODEL



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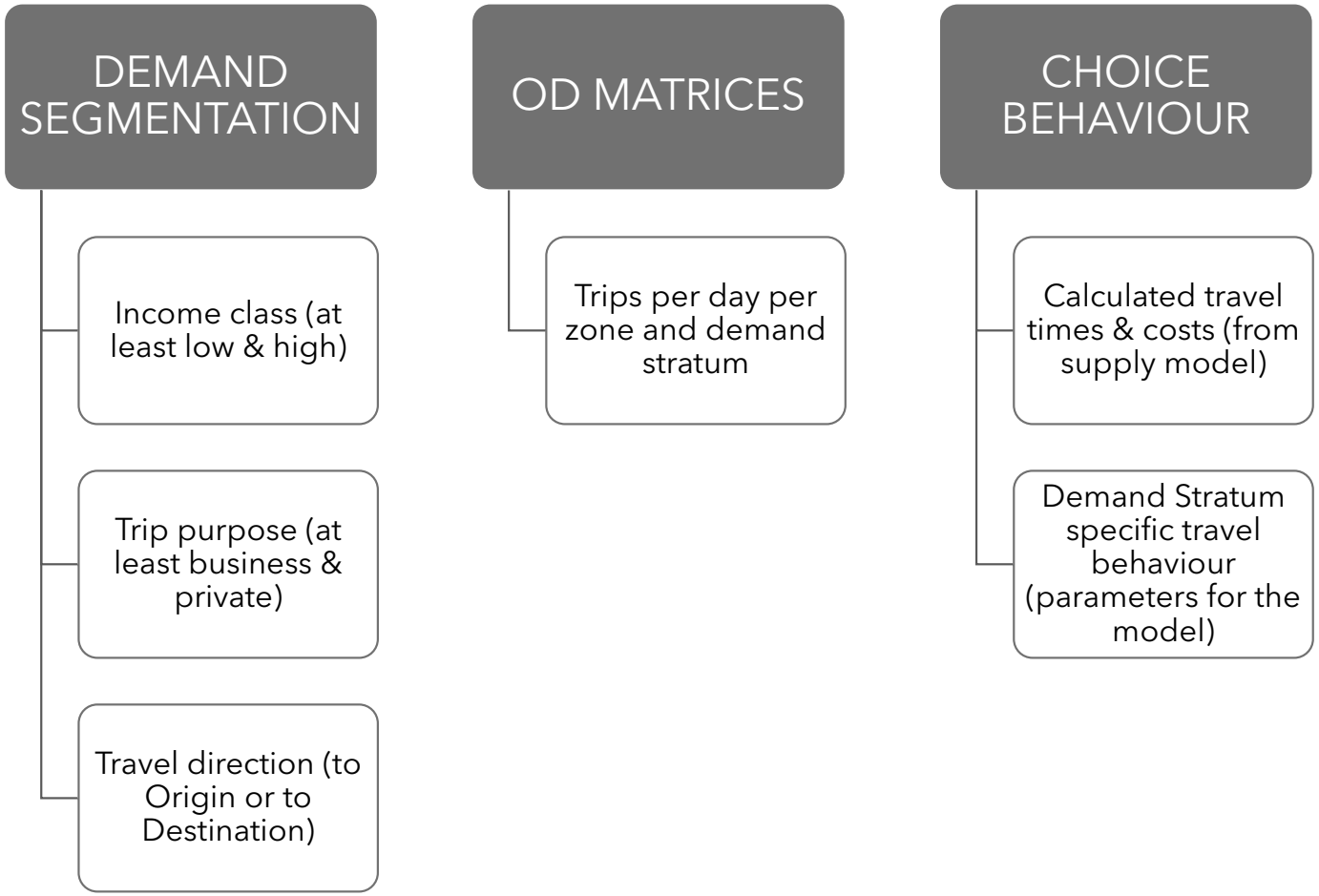
Data Collection

Minimum requirements for

DEMAND MODEL



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Mode Choice in Detail

Multimodal Logit for Main Mode Choice

UTILITY FUNCTION FOR EACH MODE (CAR, TAXI, PUT, VTOL):

$$U_{PrT} = C - \left(TTC + \frac{TCC}{VOT}\right) - 2 * TTV$$

$$U_{VTOL} = C - \left(TTC + \frac{TCC}{VOT}\right)$$

$$U_{PuT} = C - \left(JRT + \frac{TCC}{VOT}\right)$$

Travel time and cost for the VTOL mode is obtained as the average over the travel times of all access modes weighted by their modal share

$$TTC_{VTOL} = \sum_{m \in M_{access}} P^A * TTC$$

The probability P of choosing a certain mode for the trip from Origin to Destination is calculated using Logit model

$$P = \frac{e^{-U}}{\sum e^{-U}}$$

Where sum of disutilities represents the set of all modes

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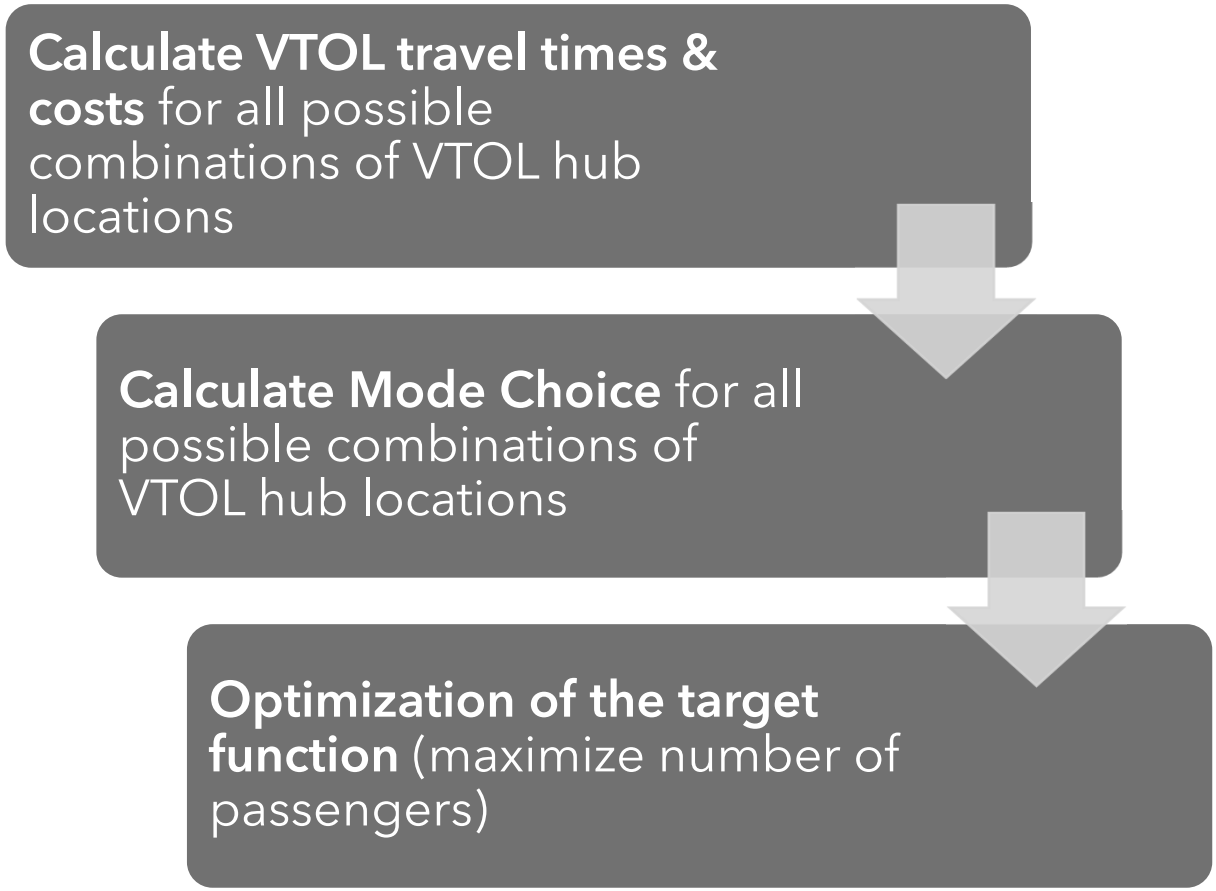
Hub Location Optimization

Objective: Maximize number of trips



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Model
Procedure Sequence

Initial optimization of hub locations	Calculate PrT and PuT skims in the loaded network Estimate optimal hub locations (script-based) Incorporate air-taxi mode into supply and demand models
Demand Loop	Calculate PrT and PuT skims Calculate air-taxi skims with the multimodal assignment Mode choice Calculate demand on path legs of air-taxi trips with the **PTV Visum Multimodal Assignment** Assignment of PrT and PuT modes Loop this block until convergence
Final Assignment	Final assignment of PrT and PuT modes Calculate skim matrices of auxiliary air-taxi PrT mode Provide demand matrix time series for air-taxi mode Assign air-taxi demand using the **PTV Visum Shared Mobility Module** to get service parameters

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Example
KPIs

SUPPLY:

- Number of vehicles in service per hour
- Number of served trips by fleet size & LOS
- Daily operating costs per vehicle and for the whole fleet
- Energy consumption

DEMAND:

- Number of boardings per Hub
- Mode split
- Mode shift from other modes

TRAVEL TIME:

- In-air travel time
- Average access time

REVENUE:

- Revenue per PAX
- Daily revenue

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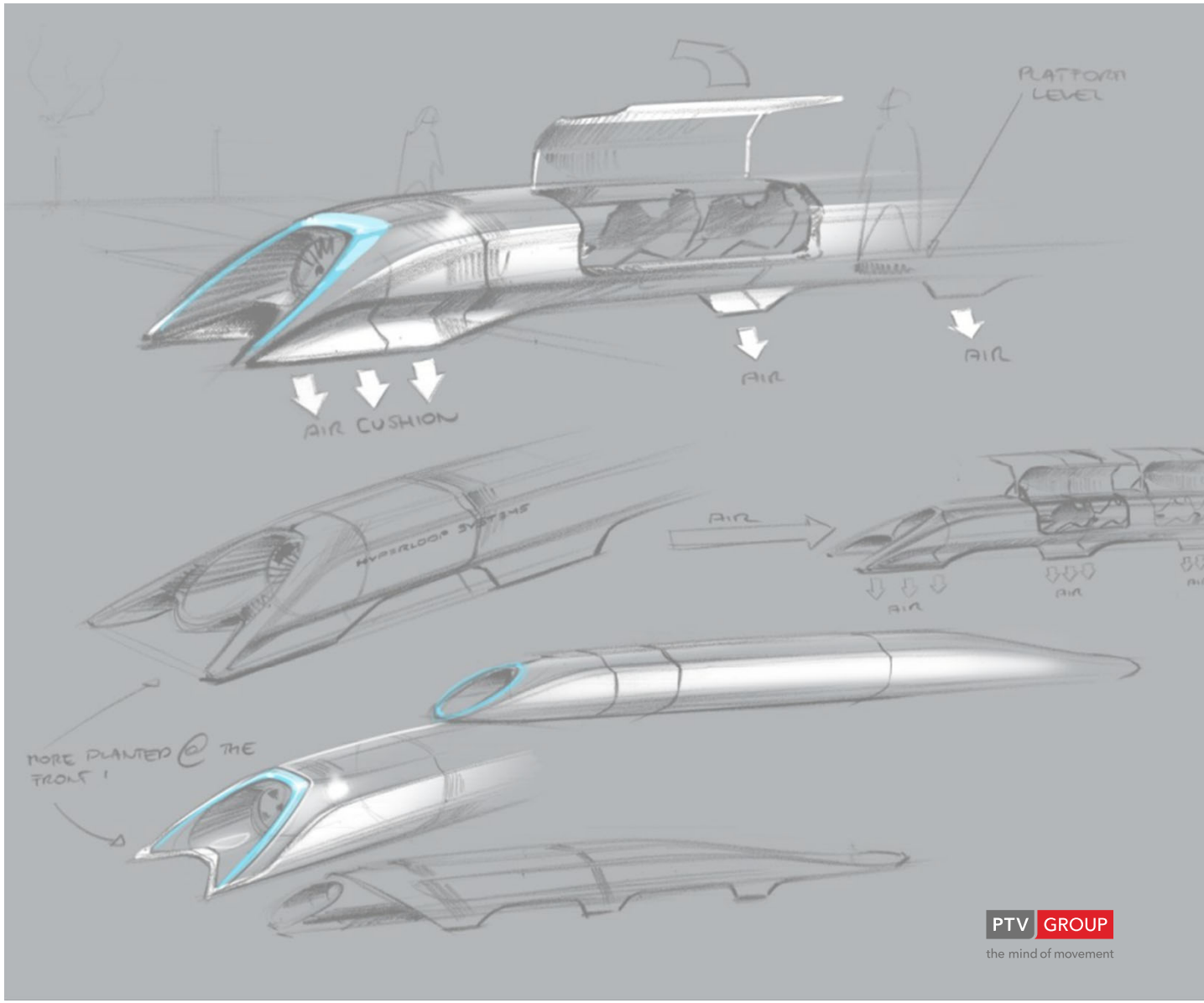
Hyperloop
Alpha

"When the California "high speed" rail was approved, I was quite disappointed, as I know many others were too. How could it be that the home of Silicon Valley and JPL – doing incredible things like indexing all the world's knowledge and putting rovers on Mars – would build a bullet train that is both one of the most expensive per mile and one of the slowest in the world?"

Elon Mask

Link:
https://www.tesla.com/sites/default/files/blog_images/hyperloop-alpha.pdf



Hyperloop
Applicability

New mode of urban mobility?

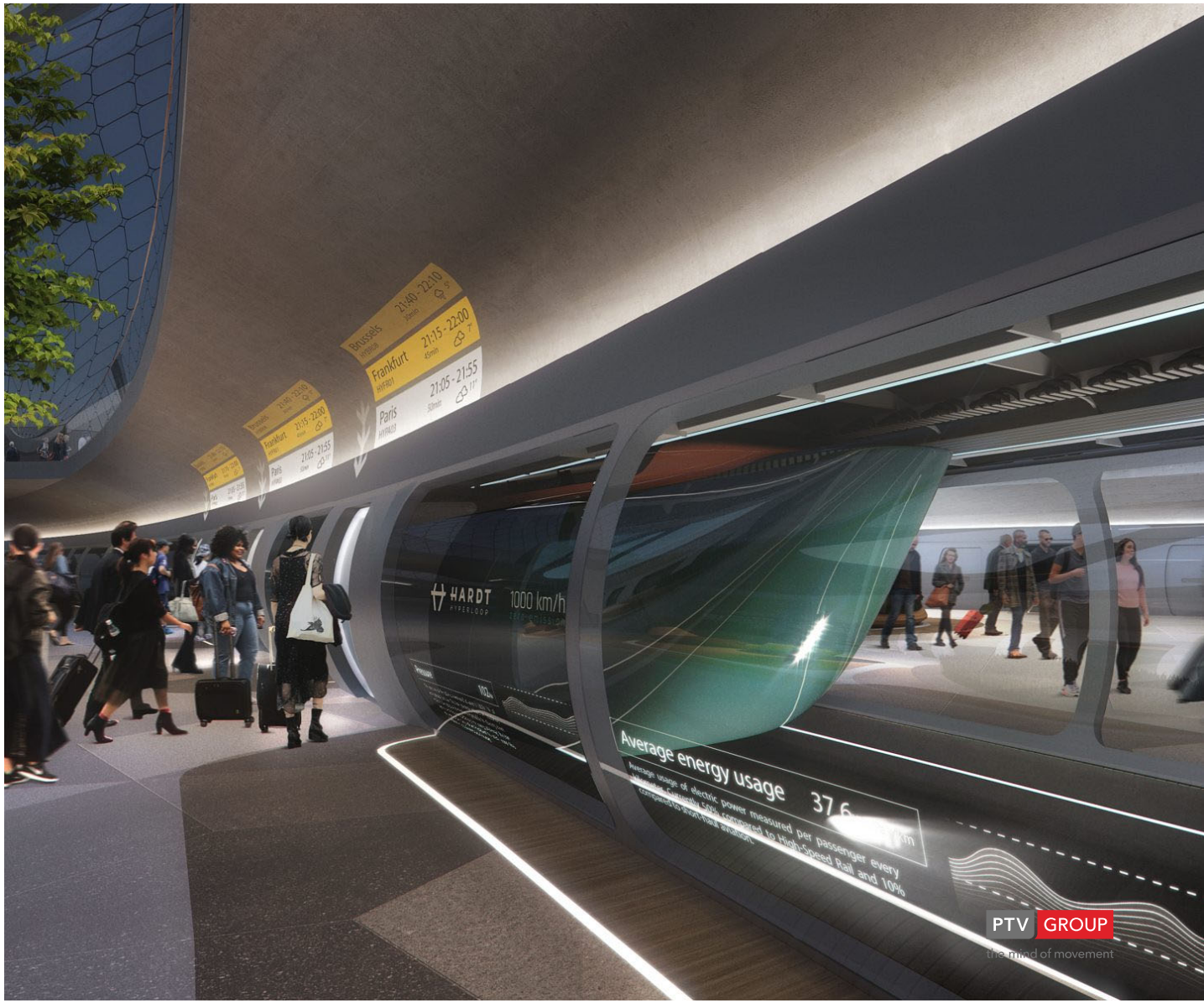
Regional long-distance commuter?

Country-wide metro?

Urgent cargo transporter?

Same-day cargo distributor?

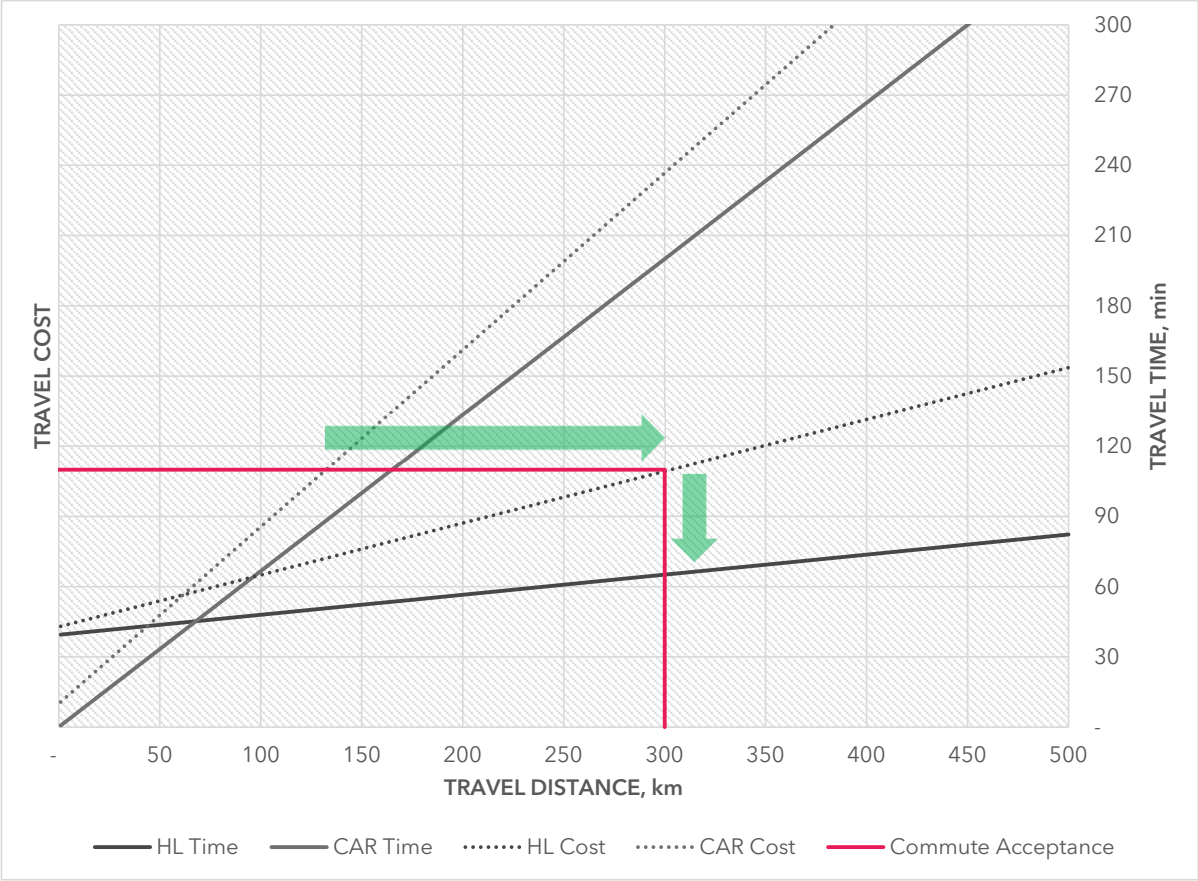
Long-distance on-demand system?



Hyperloop
Applicability

Regional long-distance commuter?

Country-wide metro?



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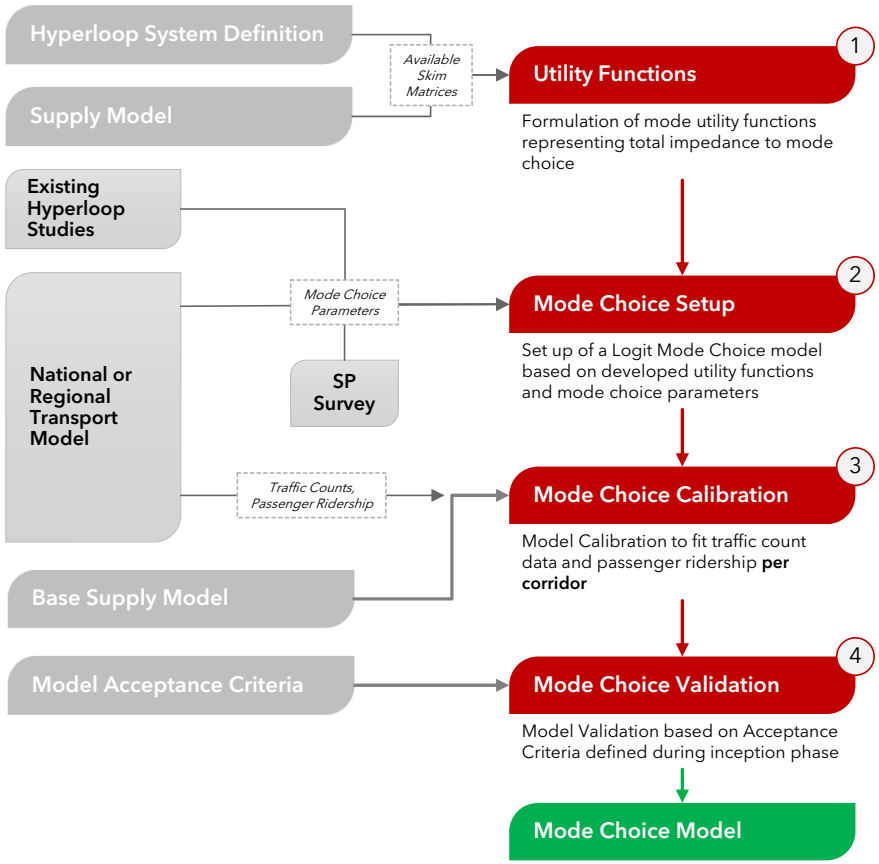
Model Extension
with Hyperloop

Example of Mode Choice Model extension methodology



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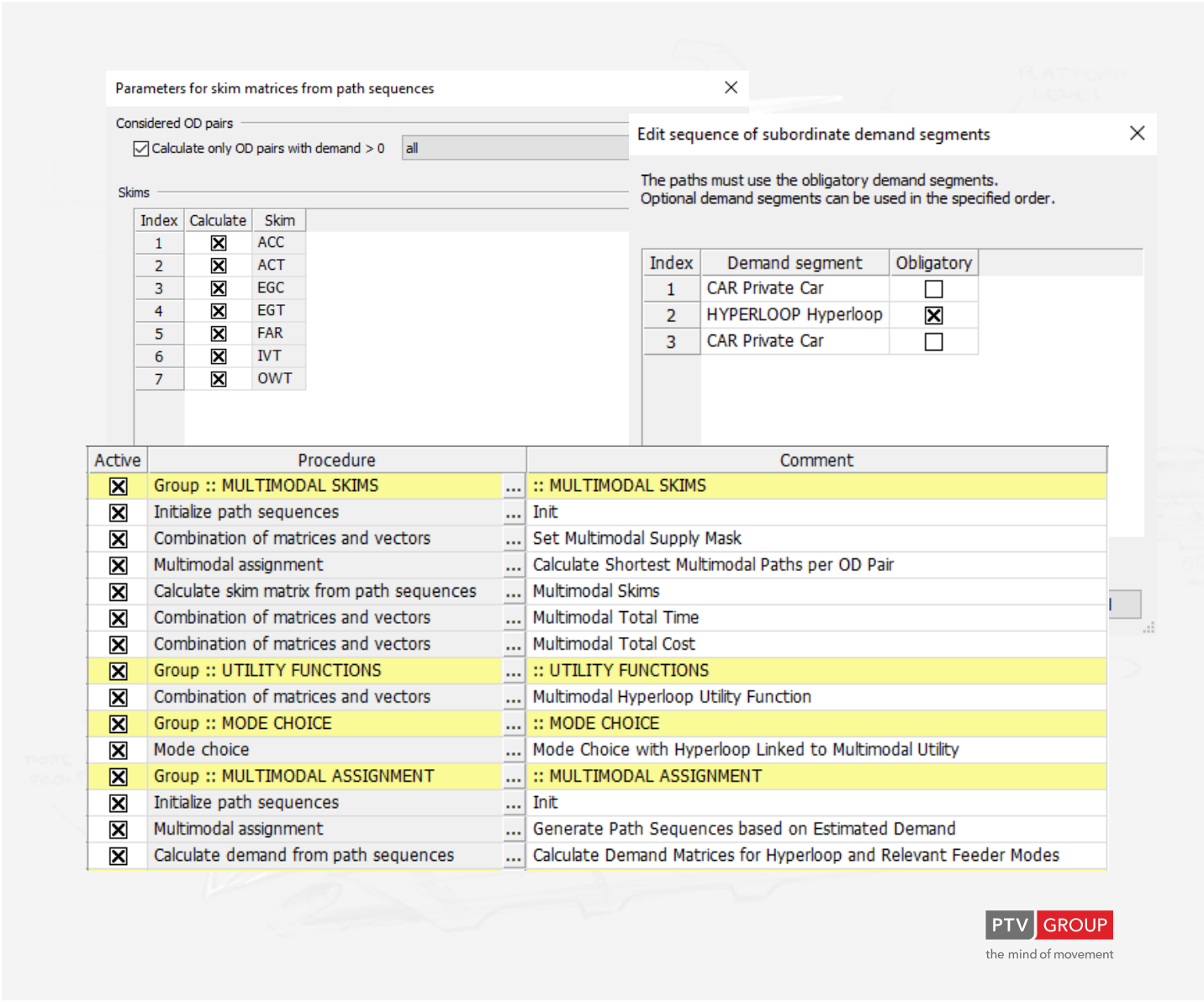
Hyperloop
Mode Definition

Given typical assumptions on Hyperloop time savings advantage over other modes it is crucial to thoroughly consider competition on all segments of a trip

At the level of feasibility study, it is recommended to go all the way up to detailed urban modelling around Hyperloop connection points to allow for such consideration

It is recommended to utilize Multimodal Assignment with detailed skims definition and relevant sequences of subordinate demand segments



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Hyperloop
Fare Modelling

It is important to inform mode attractiveness rather than observe modal split based on exaggerated fares of immature technology

This is where such techniques as evaluation of user benefits may be utilized

Example is showing fare model setup using Air passenger fare as a basis plus additional charge for 50% of time saved versus Air resulting in 100% user benefit.

```
MATRIX([CODE]="Fare" & [DSEGCODE]="HYPERLOOP") :=

  MATRIX([CODE]="Fare" & [DSEGCODE]="AIR") +
  0.5 * (
    (
      MATRIX([CODE]="Access Time" & [DSEGCODE]="AIR") +
      MATRIX([CODE]="Boarding Delay" & [DSEGCODE]="AIR") +
      MATRIX([CODE]="Flight Time" & [DSEGCODE]="AIR") +
      MATRIX([CODE]="Alighting Delay" & [DSEGCODE]="AIR") +
      MATRIX([CODE]="Egress Time" & [DSEGCODE]="AIR")
    )
    -
    (
      MATRIX([CODE]="Access Time" & [DSEGCODE]="HYPERLOOP") +
      MATRIX([CODE]="Origin Wait Time" & [DSEGCODE]="HYPERLOOP") +
      MATRIX([CODE]="Acceleration Time" & [DSEGCODE]="HYPERLOOP") +
      MATRIX([CODE]="Cruising Time" & [DSEGCODE]="HYPERLOOP") +
      MATRIX([CODE]="Deceleration Time" & [DSEGCODE]="HYPERLOOP") +
      MATRIX([CODE]="Egress Time" & [DSEGCODE]="HYPERLOOP")
    )
  ) * CONTEXT[DEMANDSEGMENT\VOT] / 60
```

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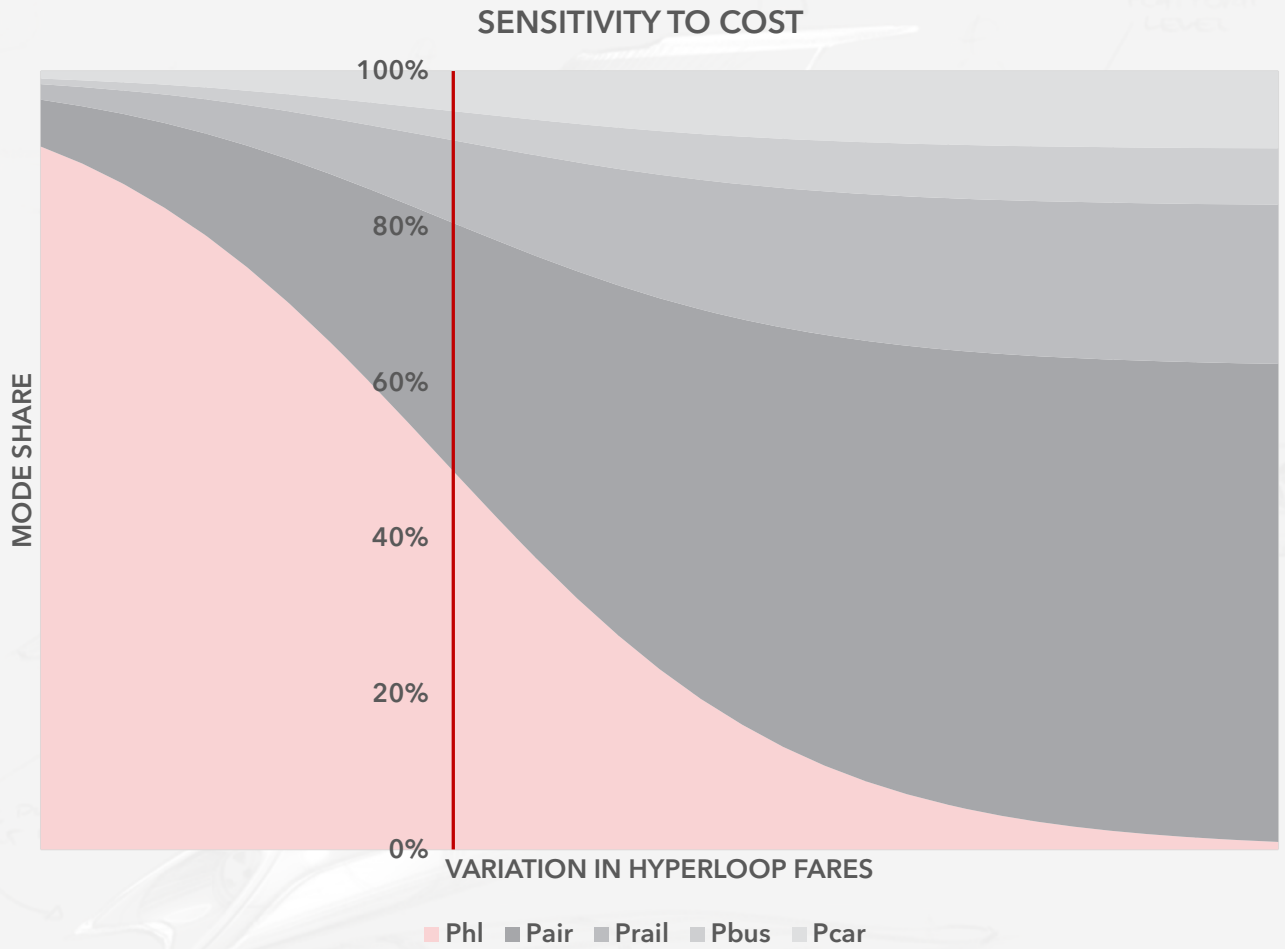
Hyperloop
Fare Modelling

After some modelling exercises it becomes clear that actually Hyperloop can be shaped into various use-cases given appropriate structure of fares

And even unlock certain new markets not possible without Hyperloop

System capacity looks promising however microsimulation of stations operations will further clarify mode applicability in different contexts

Microsimulation of tube operations at pod weaving areas will inform the capacity ceiling for operations around major hubs



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