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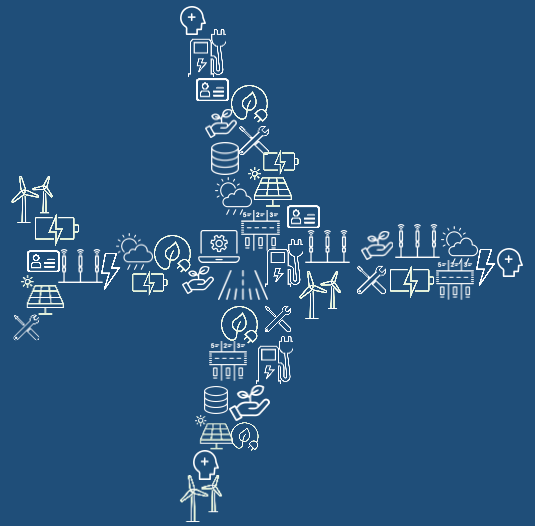
Sustainable and Resilient Master Planning

Preparing Airport Infrastructure for the Future



ICAO – ACI Aerodromes Seminar on Airport Master Planning
29 June 2023, Bangkok, Thailand

NACO is a world-leading aviation consultancy and airport engineering firm

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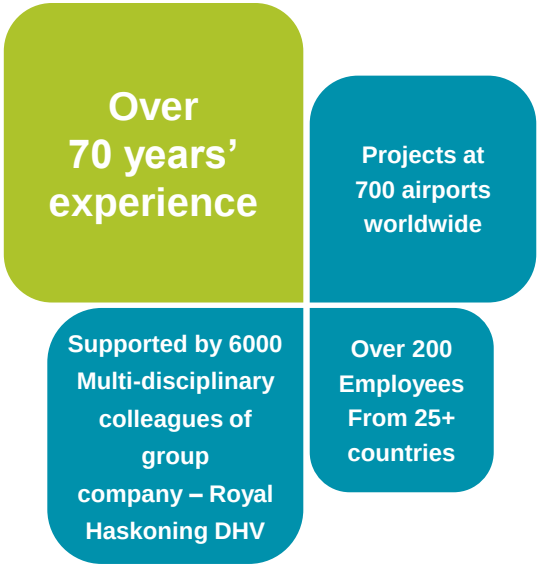

Expertise

- Sustainable Aviation And Climate Resilience
- Asset Optimisation, Airport Systems and Operations
- Airport Infrastructure
- Airport Master Planning and PPP
- Customer Experience
- Air Traffic Forecasting and Economics
- Air Cargo and Intermodal Transport Hubs
- Airport Buildings and Terminal Design

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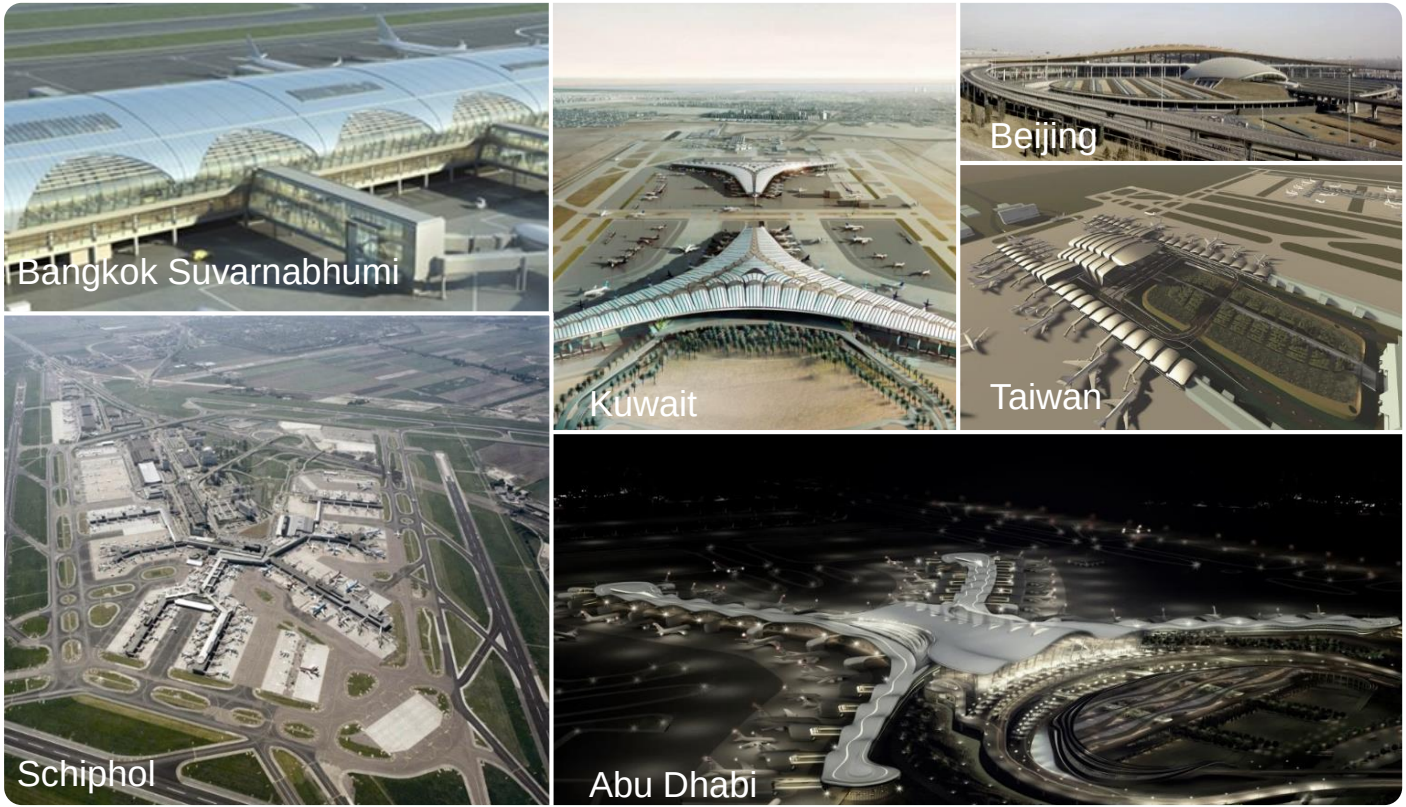
Over 70 years of experience, projects at over 700 airports worldwide….



The team has helped many airports in their sustainability & resilience journey…

Vancouver International Airport
Flood Risk Assessment

Water assignment Louis Armstrong New Orleans International Airport

Amsterdam Schiphol Hydrogen Infrastructure into MP

Global Study on Disaster Resilience at Airports

New Manila Intl. Airport
Sustainability Strategy
Climate Hazard Mitigation

Kansai Airport, Flood Resilience Study, 2020

Budapest Airport
Solar Glare
Noise Study
Geothermal Study
Biodiversity Study
Alternative Fuel Study – SAF, H2 and Electric

Sustainability Implementation within Terminal 2 60% Design

Lima Airport, Peru

Implementation of Sustainability into Tenant Contracts

Electric Flight Master Plan, Aruba, Bonaire & Curacao

Bangkok Suvarnabhumi Airport, Design of a Polder Plan.
Airport was <u>not</u> flooded during the 2011 floods

Singapore Airport Climate Change Adaptation Study, 2016 & 2022

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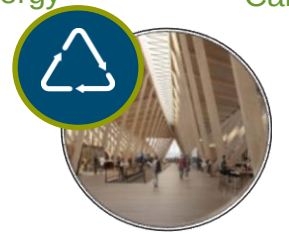
All Airport Projects
Sustainability Projects
Climate Resilience Projects

Our mission: Building Airport Sustainability & Resilience

Reduce / Minimize
Impact of Aviation on Climate Change

Energy

Carbon



Waste & Water

Adaptive towards the upcoming Energy Transition

Sustainable Flight

Build Resilience against
Impact of Climate Change on Aviation

Resilience

Sustainability goals that impact master planning…

We help airports create a coherent, comprehensive and actionable sustainability agenda.

Resilience

Plan and prepare for the inevitable

Energy

Reduce energy usage and Transition to cleaner energy sources (on and off site)

Carbon

Reduce emissions both landside and airside

Waste & Water

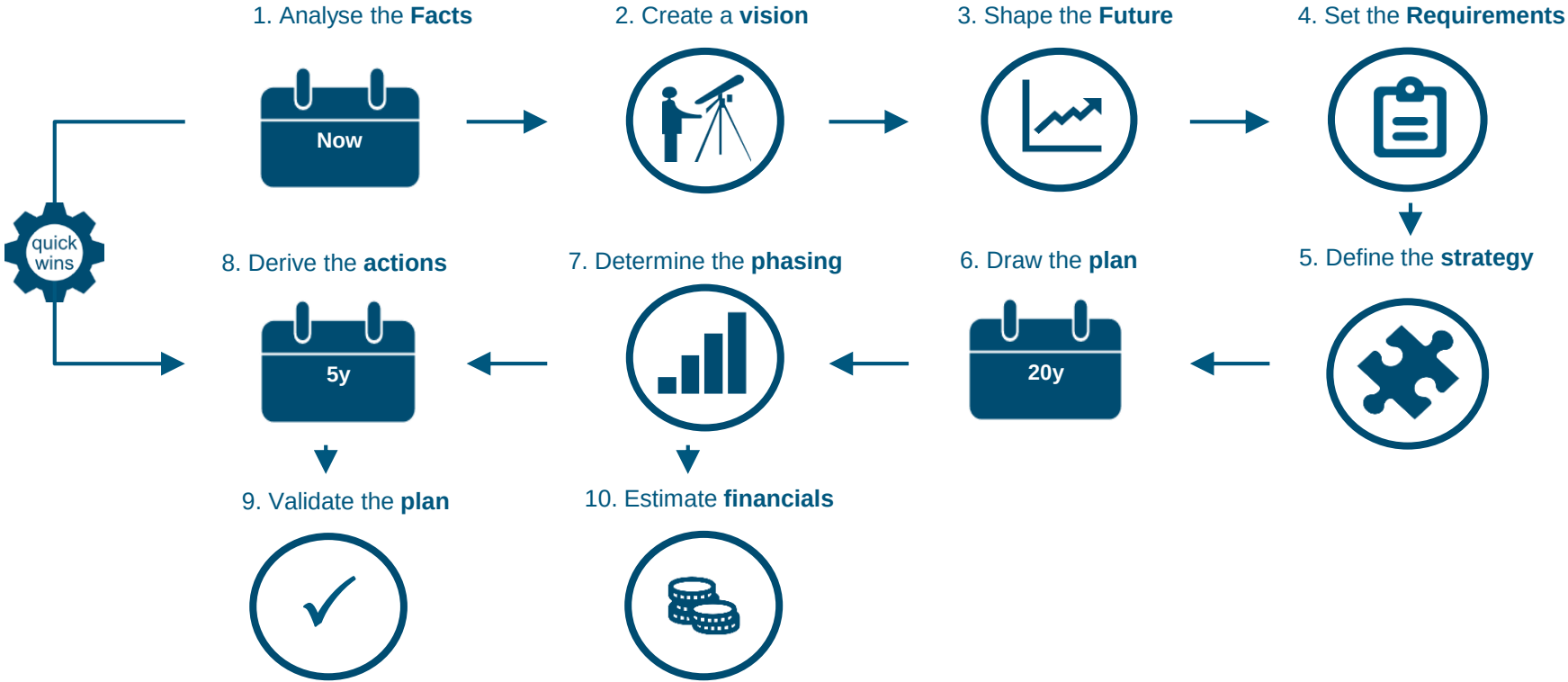
Transition to a circular economy, from source to end-of-life

Sustainable Flight

Be ready to embrace new propulsion types

	Resilience	Energy	Carbon	Waste & Water	Sustainable Flight
Assessments	• Climate Risk • Resilience Strategy • Solutions: E.g., Flood Wall	• Onsite Solar • Onsite Geothermal	• Landside Mobility • Airside Electrification	• Onsite WWTP • Onsite Waste Sorting Centre	• SAF Supply • Electric Flight • Hydrogen Flight
MP Stage	• Land Use Planning • Drainage Plan	• Land Use Planning • Utilities Planning	• Strategy Definition • Land Use Planning • Utilities Planning	• Strategy Definition • Land Use Planning • Utilities Planning	• Strategy Definition • Land Use Planning • Utilities Planning

Our Overall Approach to Master Planning



Our Approach to Sustainability Integration in Master Planning

Analyse the **Facts**

Now

1) Existing Situation

- Current capacities & performance
- Asset condition
- Constraints

Create a **Vision**

2) MP Objectives

- Innovation
- Sustainability
- Ambition
- Trends

Shape the **Future**

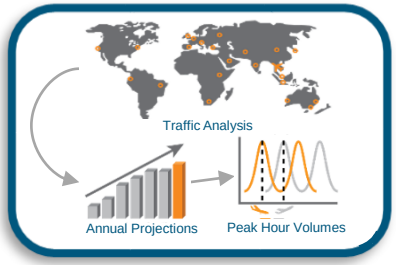
3) Forecast Projections

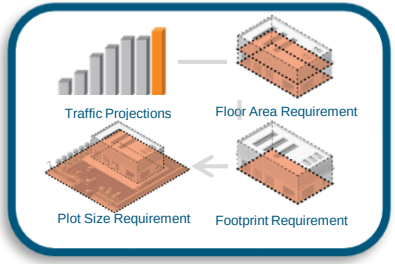
- economic outlook
- historic trends
- annual / peak hour volume projections

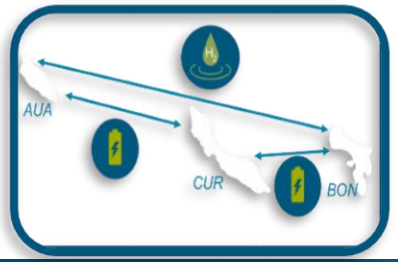
Set the **Requirements**

4) Gap Analysis

- facility / area size requirements
- demand – capacity gap analysis







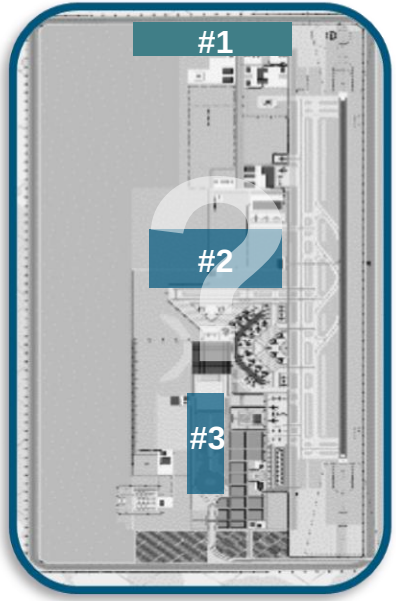
- Energy Independency?
- Airside EV's?
- Onsite Waste Sorting?
- Drainage measures?
- Noise mitigation?
- Electric / Hydrogen flight?

Our Approach to Sustainability Integration in Master Planning

Define the **strategy**

5) Development options

- Main functional areas options
- Evaluation
- Preferred option

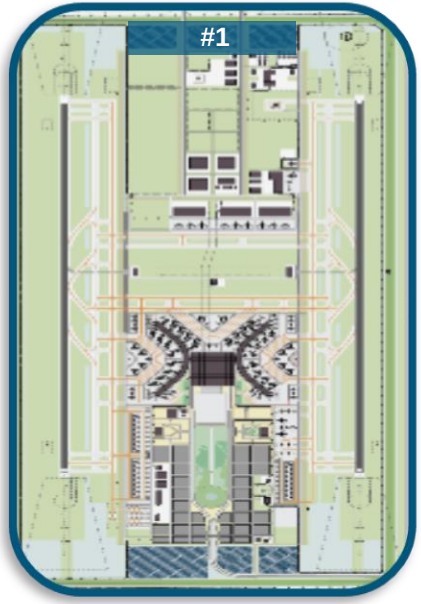


Draw the **plan**

~20 yrs

6) Master plan

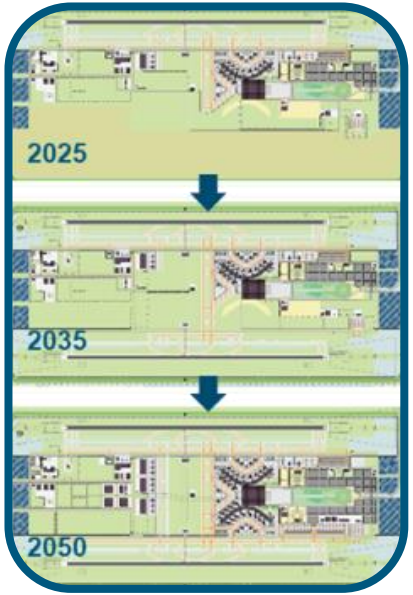
- Configuration of assets, infrastructure, utilities
- Footprints / plots



Determine the **phasing**

7) Phasing strategy

- Capacity trigger points
- Definition of initial development phase

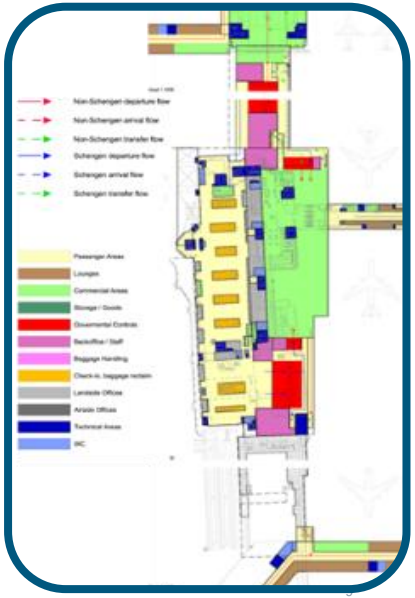


Derive the **actions**

5 yrs

8) Implementation

- First phase focus
- Basis for design & construction
- Terminal functional layout



Our Approach to Sustainability Integration in Master Planning

Validate the **plan**

9) simulations

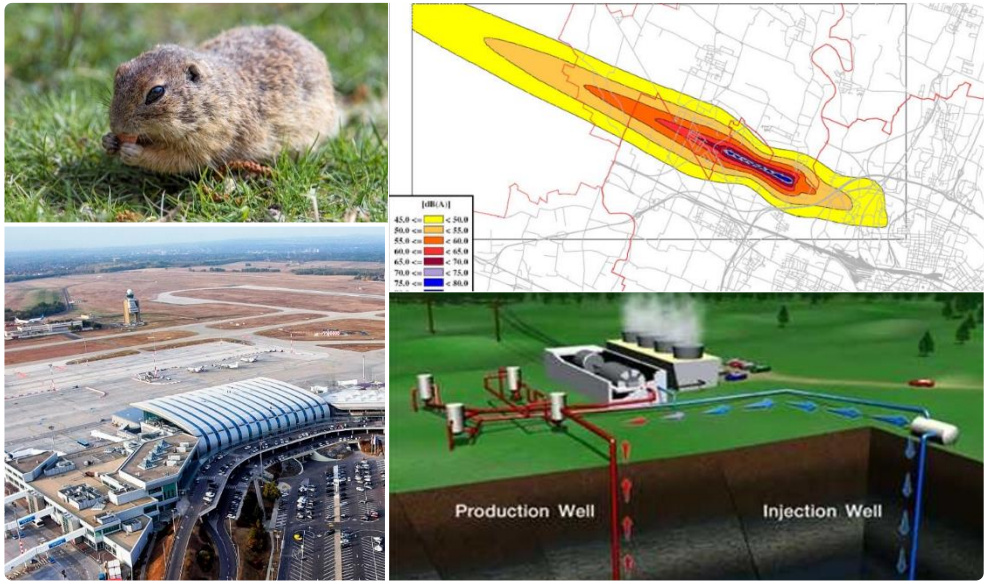
- Sanity check of plans for terminal, airside, landside
- Finalise the plan

Estimate **financials**

10) financial feasibility

- Capital investment plan
- Financial model / business plan
- Commercial optimisations

Budapest Airport Master Plan Sustainability



1. Solar Glare Assessment for defined locations
2. Noise Study & Recommendations
3. Geothermal Assessment
4. Biodiversity Assessment
5. Impact of Alternative Fuels – SAF, H2 and Electric

Sustainable Flight Within Airport Master Plans

Electric Flight Master Plan in Dutch Caribbean

Challenges

To prepare a roadmap for the implementation of electric flight between the Caribbean islands of Aruba, Bonaire and Curacao

Solutions

- Infrastructural demands
- Peak power demand
- Green source energy capacity, required airport infrastructure
- Investment cost for the airport and the airline.

- Roadmap with an action plan for each stakeholder to make the phased transition to electric flight in this region possible.

Hydrogen Infrastructure Impact on Amsterdam Schiphol

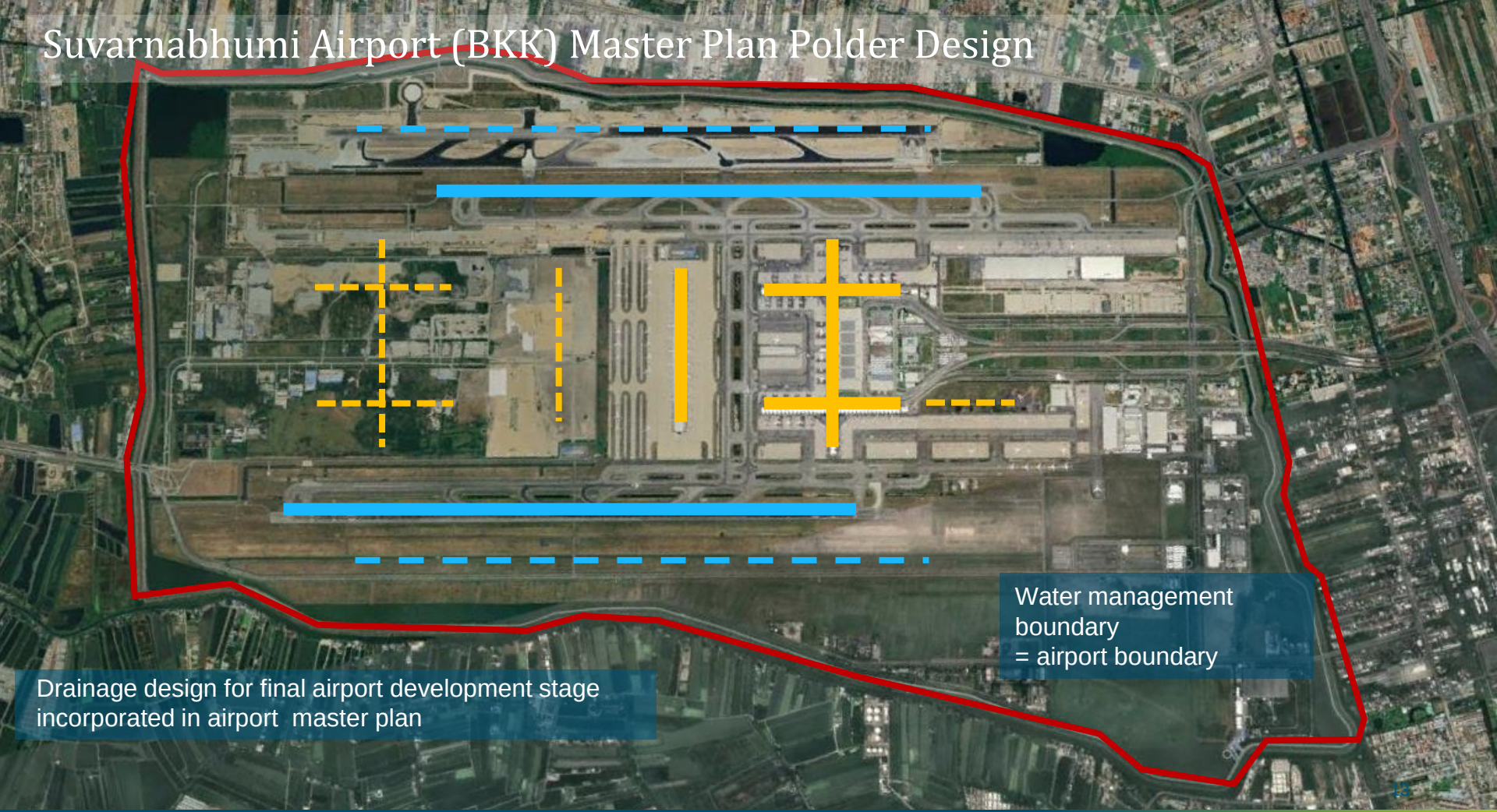
Challenges

Develop an impact analysis of hydrogen aviation on Amsterdam Schiphol Airport.

Solutions

- **Stage 1** assessed the hydrogen aviation landscape and potential uptake
- scenarios.
- **Stage 2** delivered an assessment of supply chain requirements through development of hydrogen demand forecasts.
- **Stage 3** developed various spatial and operational concepts for hydrogen
- aviation at the airport.

Suvarnabhumi Airport (BKK) Master Plan Polder Design

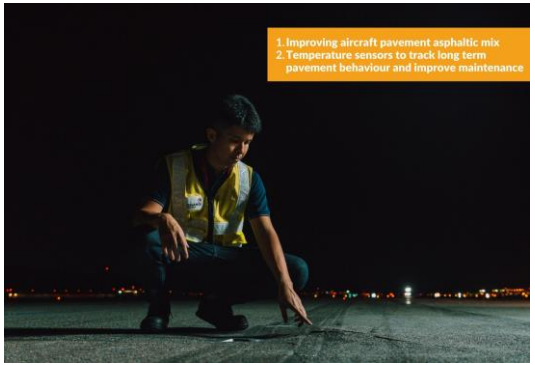


Changi Airport – Climate Change Resilience Pathway

**Diagram is for illustrative purposes and does not represent actual data*

- Conduct **climate scenario modelling** to assess potential climate change impacts on the airport.
- Utilize **digital tool like Circle & STAIN** to engage stakeholders to visualize cascading effects and understand the interconnected nature of airport operations.
- Map climate risks and develop measures aimed at **reducing identified risks** and increasing airport resilience.

"This resulted in an **Adaptation pathway** that supported **CAG in setting up a Climate Resilience Working Group** to map out risk areas and how to tackle them in the coming decades."

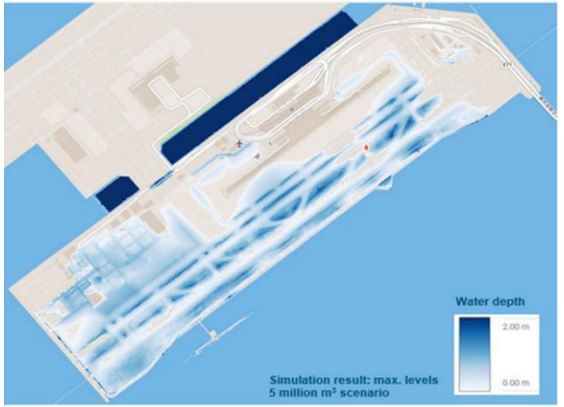


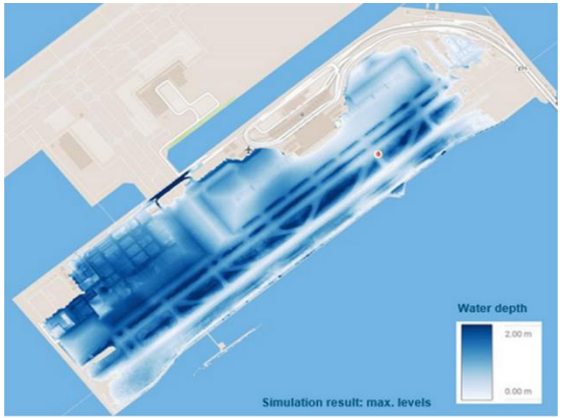
Successful Implemented by CAG's Operations team

Kansai International Airport Climate Resilience Study

Kansai Airport following Typhoon Jebi 2018

- Critical asset protection planning
- Disaster mitigation measure definition
- Airside, Landside & Terminal flood simulation
- Phasing & Implementation Plan





Coalition for Disaster Resilient Infrastructure Climate Resilience Study

Challenges

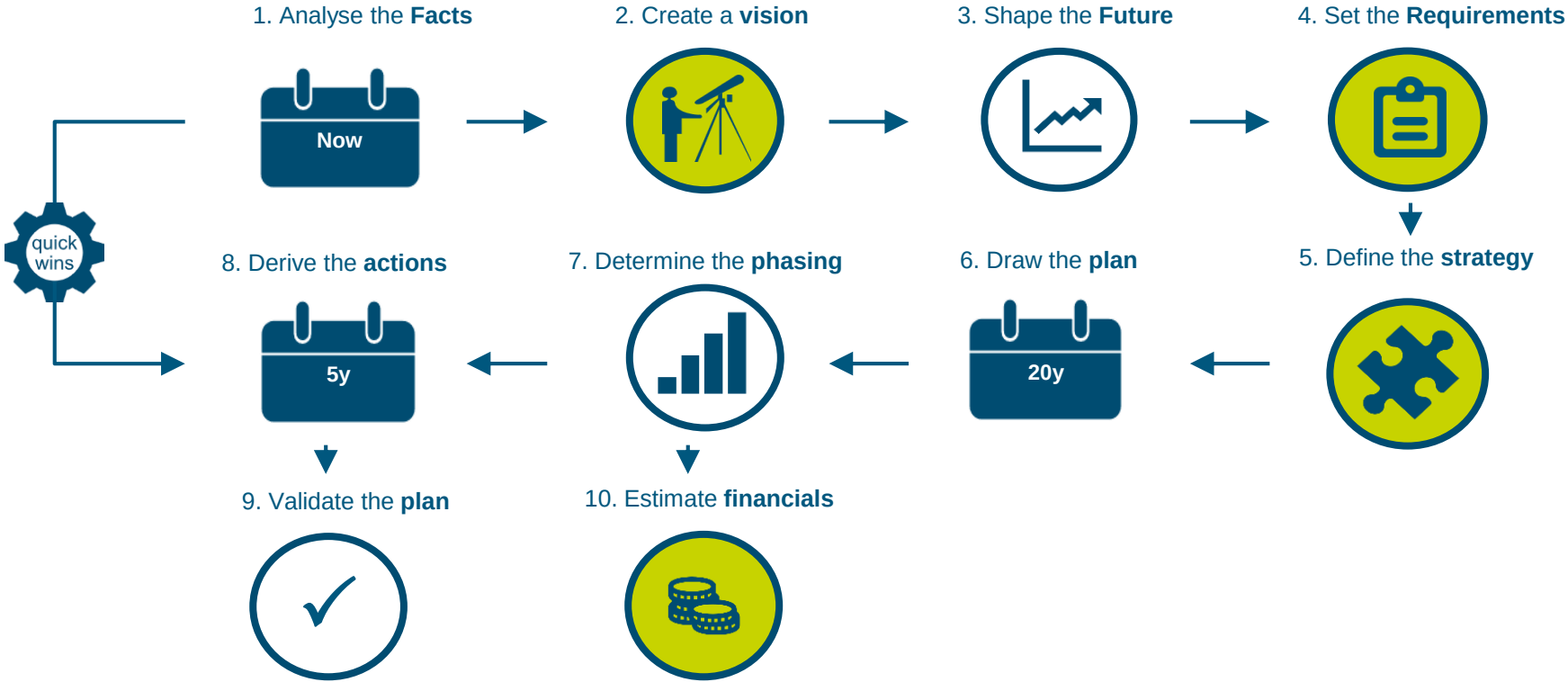
Understand the risks and impacts of extreme events and disasters on airports worldwide.

Solutions

- Online survey of 81 airports worldwide and engaged 150 airport representatives, providing an overview of all-natural hazards' exposure profiles around the world.
- Our study focused on three questions:

1. What is the current perception of hazard and disaster exposure at airports?
2. How do airports perceive their resilience to climate and natural hazards?
3. What are the current practices in airport resilience?

Conclusion: Key Decision Points for Sustainability & Resilience



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