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Towards a Hydrogen Refueling Infrastructure for Vehicles: THRIVE

M. Weeda

Presented at the IEA HIA Large-scale Hydrogen Infrastructure Task Definition workshop, 12 February 2009, Amsterdam, The Netherlands

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Marcel Weeda, ECN Hydrogen & Clean Fossil Fuels

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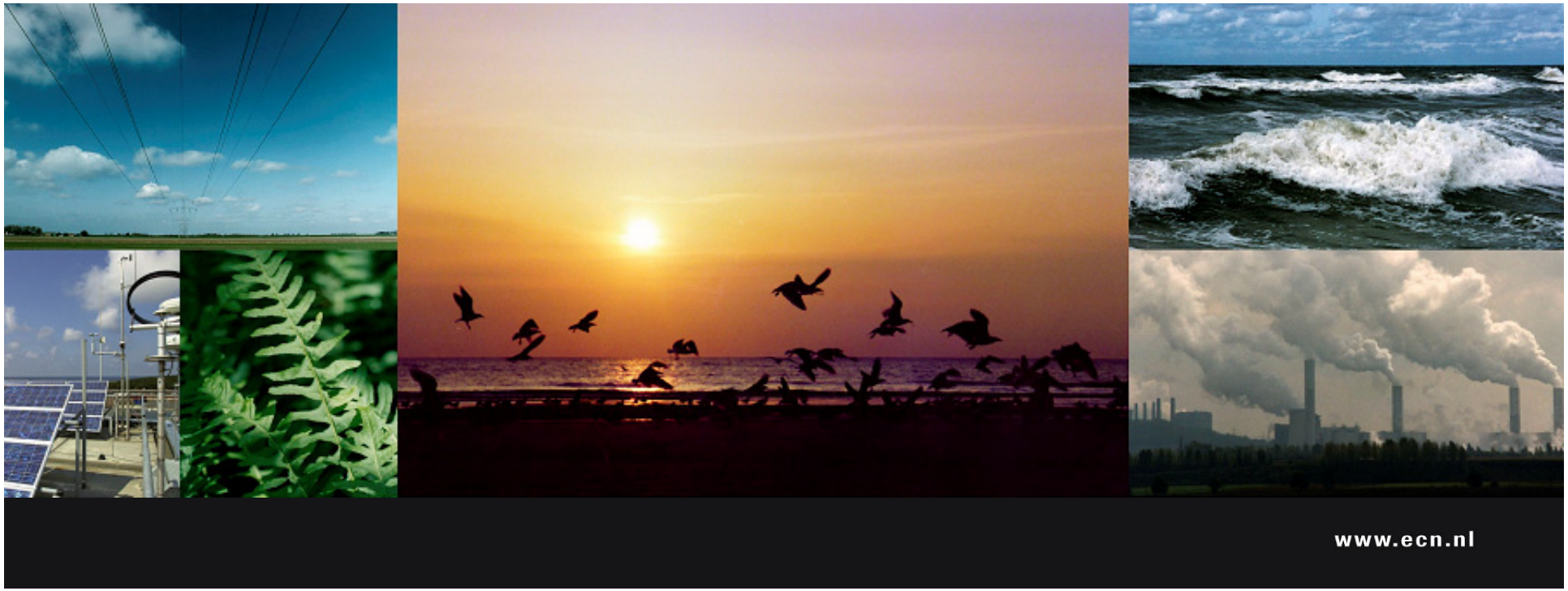


Development of a H_2 infrastructure in the Netherlands

- THRIVE: Towards a Hydrogen Refuelling Infrastructure for Vehicles

- Dutch project

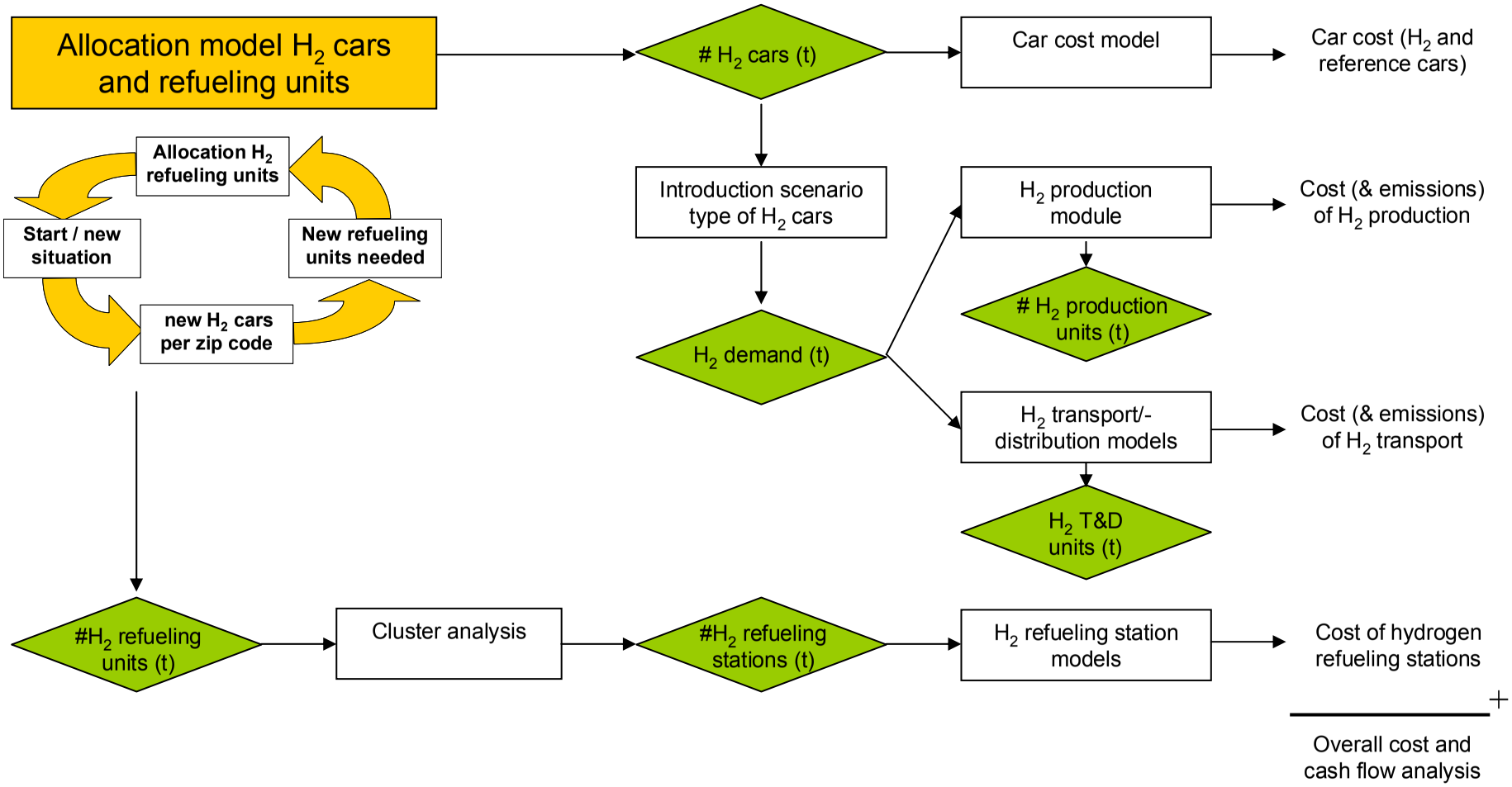
- Scope
  - Hydrogen is a starting point; no discussion whether or not an option
  - The Netherlands, taking into account corridors to neighbouring countries
  - Hydrogen as transport fuel; mainly for passenger cars, light duty trucks/vans and busses
  - First 15 - 20 years after commercial introduction

- Partners:
  - Shell Hydrogen
  - Linde Gas Benelux (with input from German corporate research)
  - TNO Defence, Security and Safety

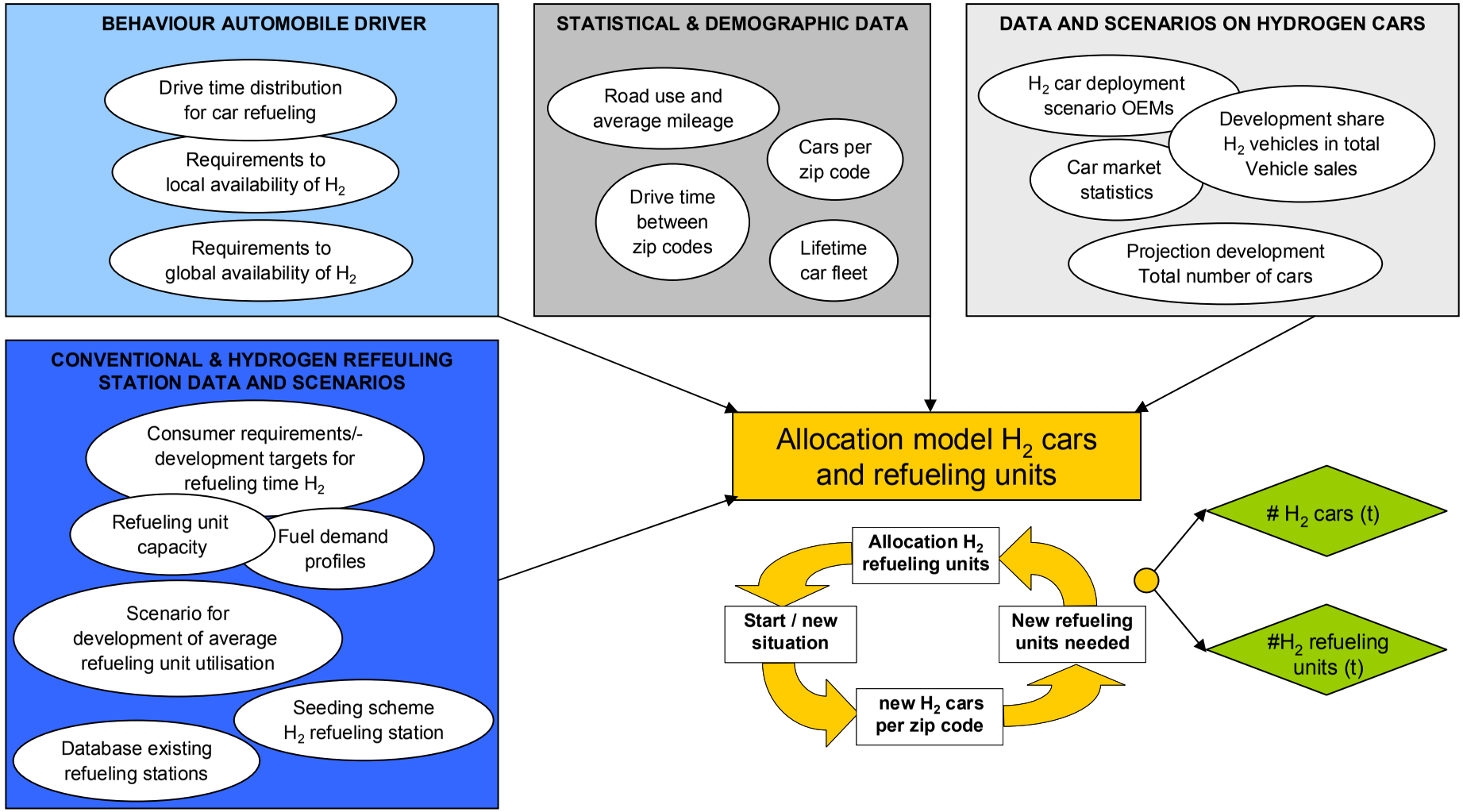
THRIVE overall objective

- Objective
  - To identify plausible routes and technological options for the development of a hydrogen infrastructure for refuelling of hydrogen vehicles in the Netherlands.
  - In this context “plausible” does not only refer to costs, but should also take into account “opportunities and threats” related to aspects like:
    - Required hydrogen quality
    - Type of storage and capacity (on-site and “on-board”, but also centrally)
    - External safety and resulting space requirements
    - Spatial planning and permitting
    - Introduction and market uptake of innovative technology
    - Initial limited availability of fuel
    - …

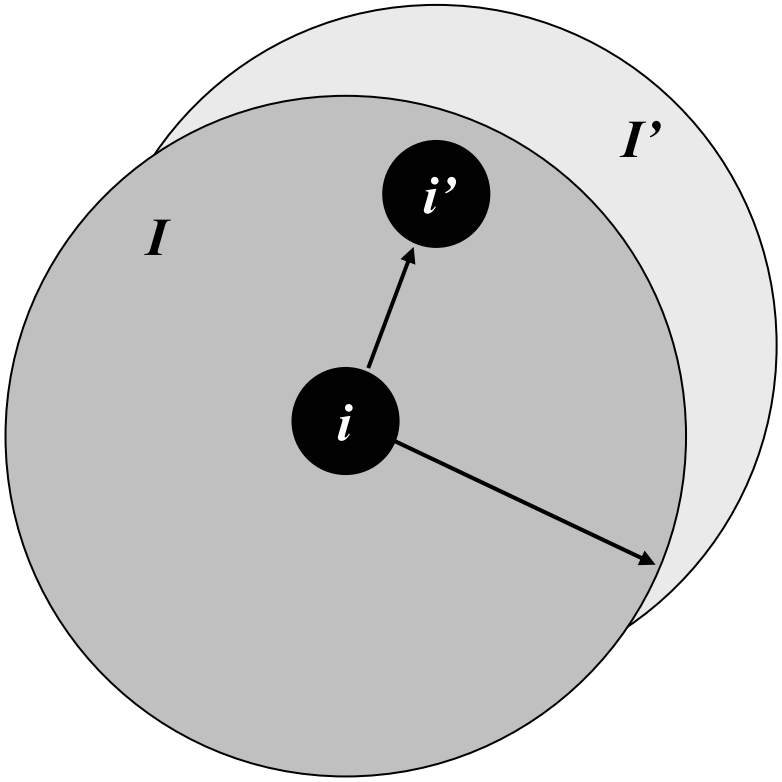
THRIVE models scheme



Input/Output THRIVE Allocation model



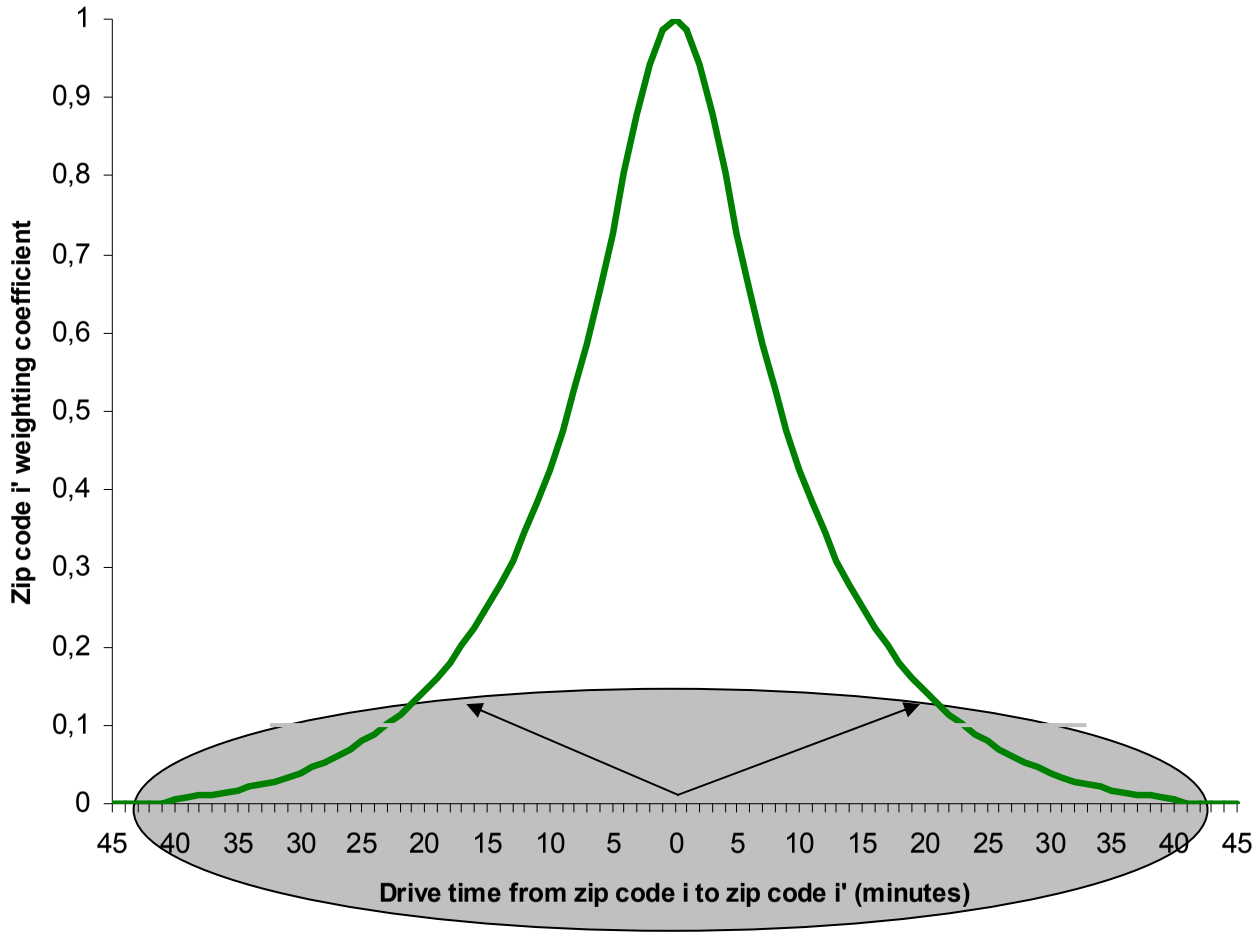
Zip codes (i) and zip code regions (I)



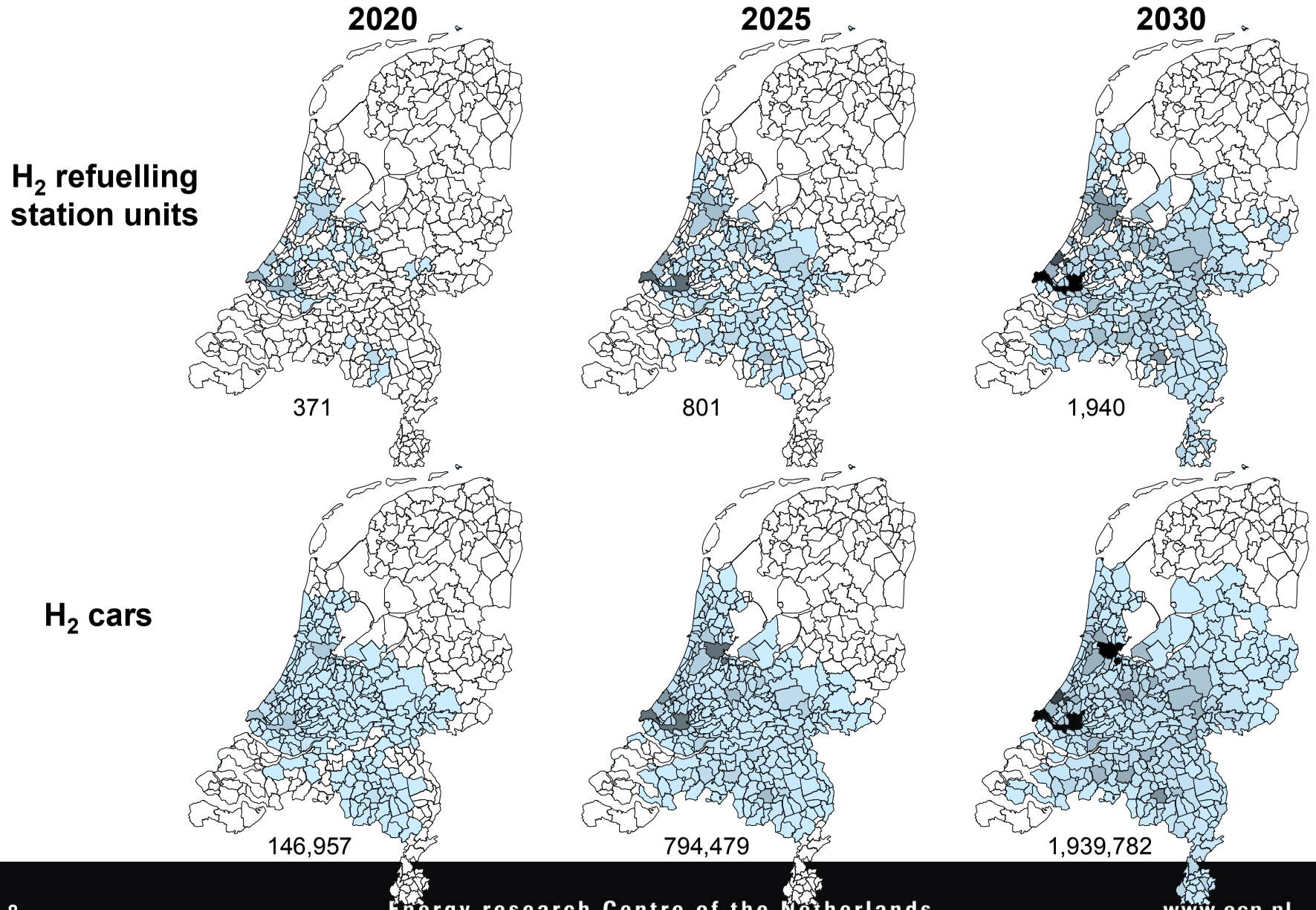
Considering zip code (ZC) i :

- Determination of new H_2 cars
  - Potential H_2 car buyers in ZC i are influenced by H_2 availability in ZC region I
- Allocation of H_2 refuelling station units
  - A new dispensing unit in ZC i influences H_2 customers and potential H_2 customers in ZC region I
  - A new dispensing unit in ZC i has to share H_2 customers and potential H_2 customers with all other dispensing units present in ZC region I (competition)

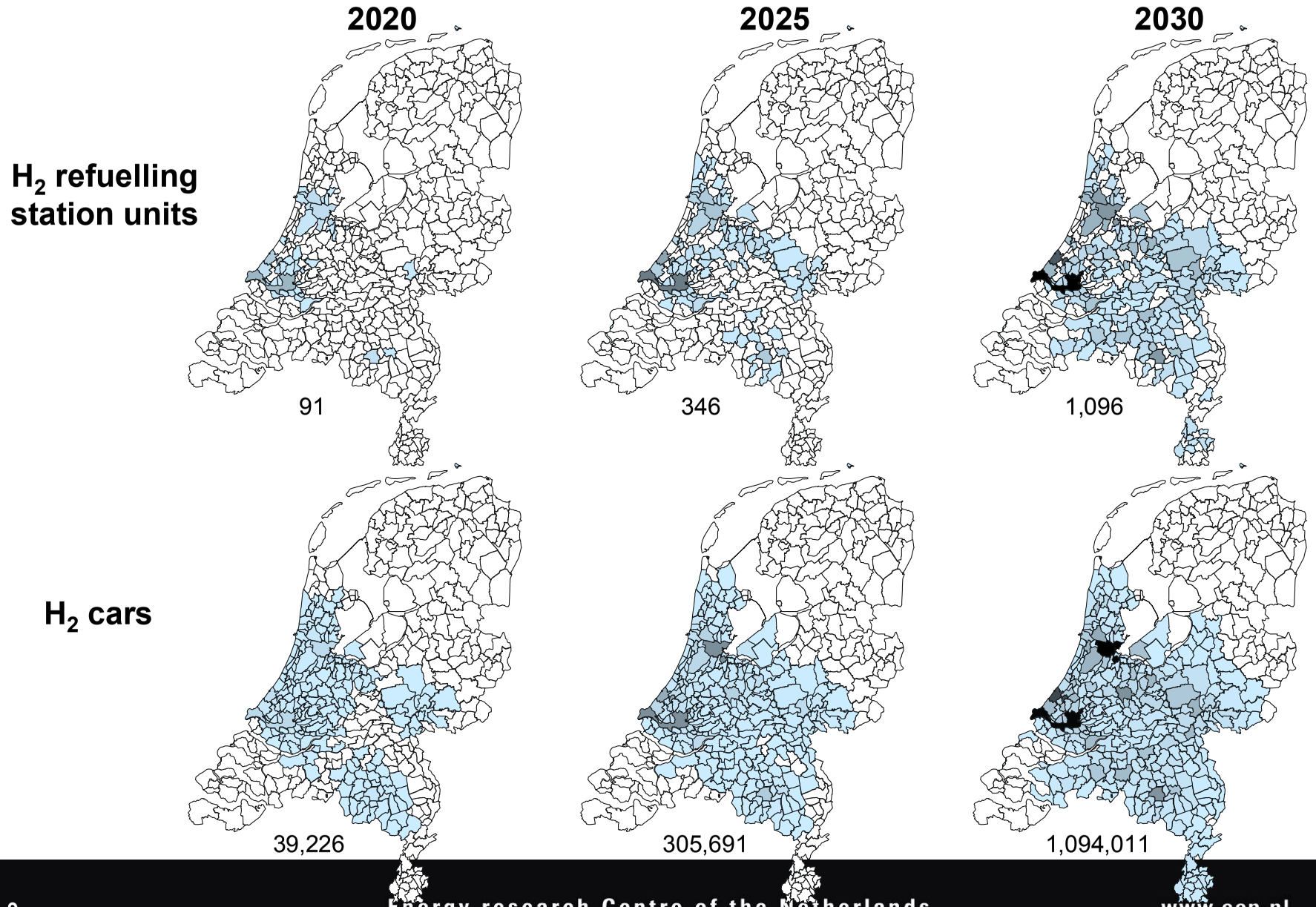
Zip codes weight based on drive time distribution car refueling



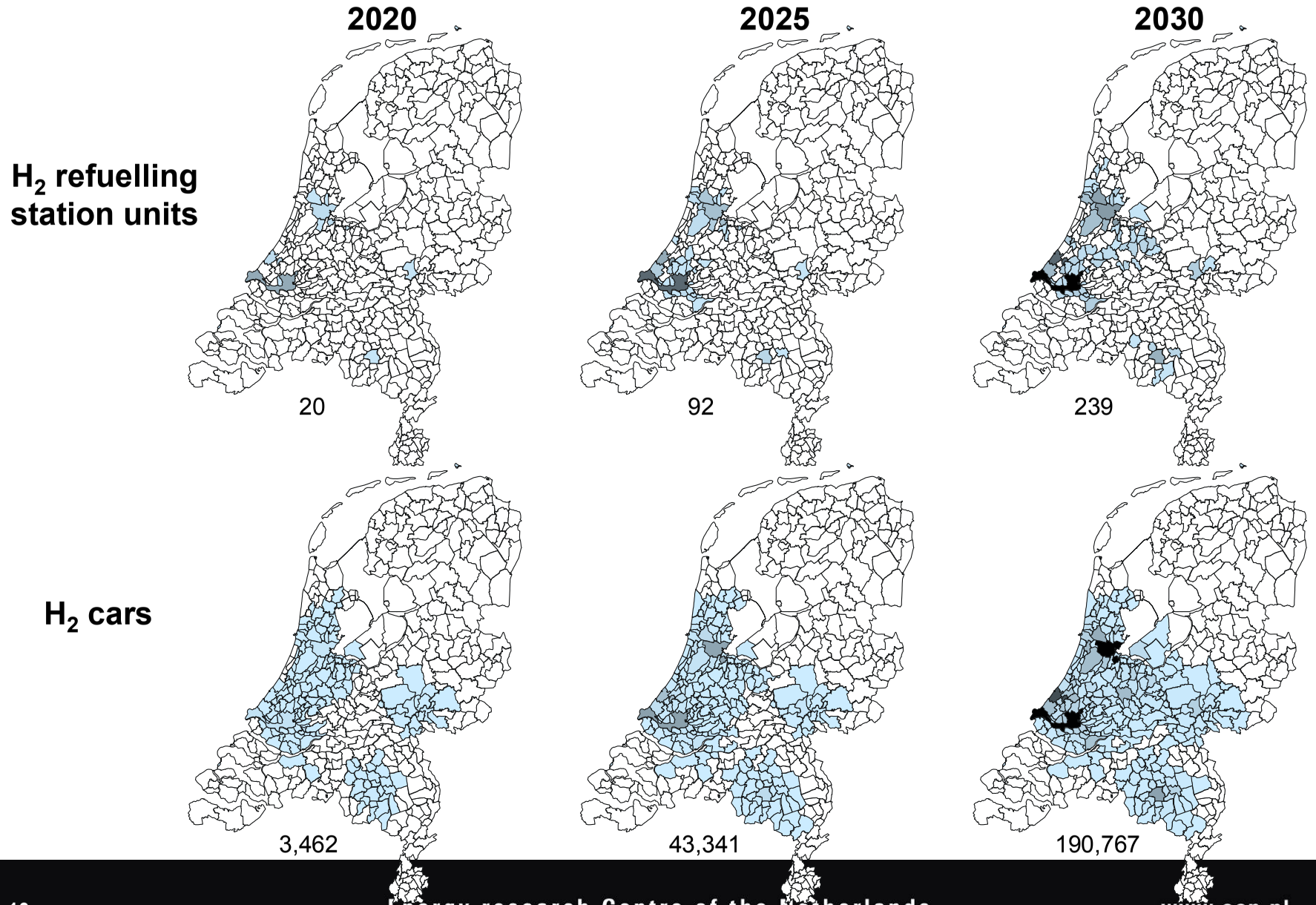
Fast development availability of different H_2 cars



Moderate development availability of different H2 cars



Delayed development availability of different H2 cars



Variation in refueling unit size

Car and refueling unit penetration 15 year after commercial introduction (2030)

300 kg/day

50 → 300kg/day

50 kg/day

THRIVE activities, priorities

- Refining allocation model, performing and analysis simlations:
  - Hydrogen car deployment scenarios
  - Development hydrogen car sales
  - Refueling unit seeding
  - Refueling unit utilisation
  - Different subsets of refueling stations for availabilty to integrate H_2
  - Sensitivity automobile drivers to availability of H_2

- Conceptual design studies refueling station concepts
  - Liquid supply truck, underground tank storage, 350/700 bar
  - Gaseous supply pipeline, dispensing @ 350/700 bar
  - Study transition aspects: conversion liquid truck into pipeline concept

- Refueling station case study:
  - Investigate permitting issues, regulations, spatial planning
  - Perform QRA for refueling station

- Collect, review, update cost models production, liquefaction, storage, transport