SUSTAINABLE ENERGY FOR ALL

Energy Efficiency in the City of Copenhagen

SE4ALL Energy Efficiency Forum on Cities
Toyama and Tokyo

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Copenhagen Centre on Energy Efficiency (C2E2)

- Funded by Danish Government and implemented by UNEP, the EE hub is hosted by the Copenhagen Centre on Energy Efficiency, which is a part of the UNEP DTU Partnership.

- The Centre's prime responsibility is to support SE4ALL's objective of doubling the global rate of energy efficiency improvement by 2030.

- C2E2 also hosts Secretariat of the Global Energy Efficiency Accelerator Platform, one of the flagship programme of the SE4ALL initiative.

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What we do

Global Activities

- Supporting UNEP in championing SE4ALL Energy Efficiency goal
- Modelling of pathways to achieve SE4ALL's objective of doubling improvement rate of energy efficiency by 2030 at the global and regionals
- Supporting the global tracking efforts by World Bank & IEA
- Examining synergies between RE & EE targets in collaboration with IRENA
- Supporting the GFT on global events like the SG CC Summit where EE was one of the focus areas
- Knowledge Management Platform to support energy efficiency stakeholders

Regional Activities

- Studies of barriers and opportunities to accelerate energy efficiency in four regions;
  - Latin America and Caribbean - Bariloche Foundation
  - Asia - Asian Institute of Technology
  - Africa - University of Cape Town
  - CIS - Centre for Energy Efficiency (CENEf)

- In-depth assessment of high potential and best practice in pilot countries followed by regional outreach workshops
- Regional training workshops in collaboration with the IEA
- Engagement with UNECE on EE standard work with outreach and links to other regional UN Commissions

National level activities

- Engagement with regional development banks/regional SE4ALL Hubs on national pilot-level support on EE - e.g. with a few countries in each region

- Analysis of EE activities in SE4ALL rapid assessment studies

- Support to engagement of EE Accelerators at national and city levels.

Who do we work with?

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Copenhagen City

- Over 70% of the world's CO2 emissions come from cities. and hence cities important to address global climate challenge.

- Arcadis Sustainable Cities Index 2015, that explores three demands from cities; Strong financial returns, an attractive place to live and work, also limit damage to the environment, Copenhagen was placed 3rd.

- Among the top 10 energy efficient cities in the World

(http://www.nasdaq.com/article/the-worlds-10-most-energyefficient-cities-cm368630) .

UN City

Copenhagen

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Copenhagen Profile (2010)

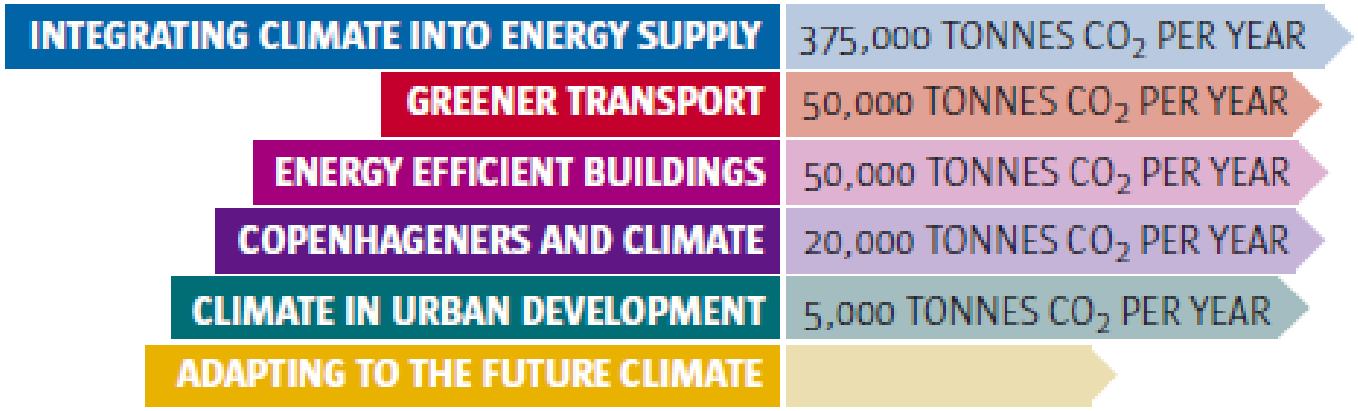
- City Population: 550,000
- Population expected to increase by 20% by 2025 (by 110,000)
- Emissions 1.9 mill. tons
- Expected to come down to 1.2 mill tons in BAU scenario by 2025; due to switch from coal to biomass in CHPs, existing legislation on energy and transport.

Recent experiences

- Since 1990, carbon emissions reduced by 40% with real economic growth of 50%

- In 2009 adopted first Climate Plan up to 2015, achieved CO2 reduction by 21% by 2011 (against target of 20% by 2015).

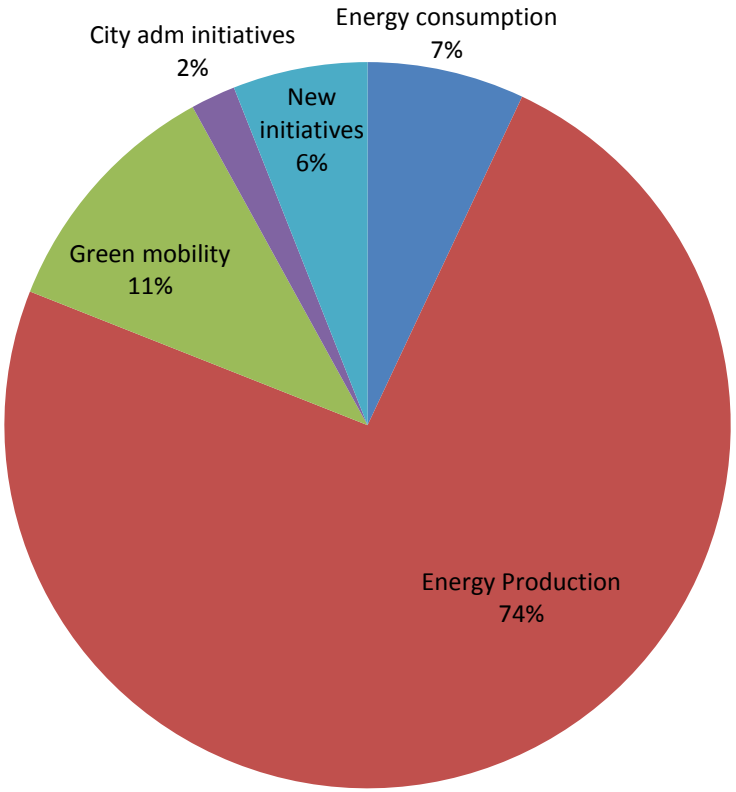
- **Goal between 2010-2015; 20% CO2 reduction**
- **Six Action Areas (75%, 10%, 10%, 4% and 1%)**



Carbon Neutral by 2025

Taken the challenge to be the first capital city to be carbon neutral by 2025- will need to be achieved through increased energy efficiency and integration of low quality and fluctuating renewable energy.

Share of total carbon reduction



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Planning for 2025

MEASURES FOR 2025	REDUCTION POTENTIAL, TONNES CO_2
ENERGY SAVINGS	230,000
ENERGY SAVINGS IN THE MUNICIPALITY'S OWN OPERATIONS	19,000
CONVERSION OF BIOMASS	300,000
GEOTHERMAL POWER	25,000
SOLAR HEATING	1,000
HEAT PUMPS AND ELECTRICAL ELEMENTS	65,000
IMPROVED WASTE SEPARATION	9,000
INCREASED WINDMILL CAPACITY	925,000
URBAN DEVELOPMENT	30,000
REDUCED ROAD TRAFFIC	150,000

Source: Copenhagen Climate Plan

Copenhagen- 2025 Challenges

- **Energy supply**
  - 73% of electricity is generated by coal, natural gas and oil
  - Target
    - Green energy production from wind and biomass to exceed city's electricity consumption to offset emissions from transport and others
    - District heating to be carbon neutral (using biomass, waste and geothermal)
    - Biogasification of organice waste
  - **Initiatives**
    - Wind turbines 360 MW
    - Flexible electricity and heat supply from CHPs
    - Renewable, energy storage and efficient production

Copenhagen- 2025 Challenges

- **Energy consumption**
  - Heat and electricity responsible for 75% of CO2 emissions
  - Demand increase due to population growth
  - Target
    - 20% reduction in heat consumption , and 20% in electricity (10% in households)
    - 1% electricity consumption from solar cells
  - **Initiatives**
    - Buildings: Improvement of structure, legislation to increase energy efficiency, financial models for savings
    - Building retrofitting, regulations

Copenhagen- 2025 Challenges

- Pilot projects, knowledge dissemination etc.
- Smart city initiative with smart buildings- data, flexible consumption models

Green Mobility

- Transport responsible for 22% emissions in 2010
- 96% trips are shorter than 50 kms
- **Targets**
  - 75% of all trips by foot, bike or public transport
  - 50% trips to work or school by bike
  - 20% more passenger use public transport (compared to 2009)
  - public transport carbon neutral
  - Light and heavy vehicles (20- 40%) run on clean fuels (electricty, hydrogen, biogas, ethanol)

Copenhagen- 2025 Challenges

- **Initiatives**
  - More connectivity to and from Copenhagen with 3 cycle tracks
  - Encouraging electric bikes for long rides, supporting innovation and improved conditions for cyclists
  - Demonstration projects and infrastructure development for new fuels (charging stations)
  - Necessary policies and regulations for fuel switch
  - Improving public transport and making it energy efficient

Copenhagen- 2025 Challenges

- **City Administration Initiatives**
  - **Targets**
    - 40% reduction in energy consumption of municipal buildings
    - New municipal buildings meet the advance building codes requirements
    - Vehicles run on electricity, hydrogen or biofuels
    - 50% reduction in street lighting energy consumption (comp. 2010)
    - Solar panels on buildings
  - **Initiatives**
    - Pilot projectsf or retrofitting and climate adaptation
    - Replacement of mercury, sodium and fluorescent lights by LEDs
    - Awareness and training of employees

Focus Areas- what has been achieved

- District Energy
- Transportation
- Buildings
- Lighting
- Energy Supply

District Energy

- **City of Copenhagen, Denmark**
  - 560,000 inhabitants (2015)
  - Summer 20/13°C and winter 2/-2°C
- **ENERGY DEMAND**
  - Heating: 4,000 GWh/year
  - Cooling: 75 GWh/year Coverage
- **COVERAGE**
  - District Heating: 98%
  - District Cooling (projected): 30%
- **Fuel mix**: 50% natural gas, 14 % renewables, 10% oil
- **CO2 reduction/year due to District Heating**: Equivalent to 140.600 cars
- Source: http://www.cowi.com/menu/NewsandMedia/News/Newsarchive/Documents/Case%20stories%20from%20central%20Copenhagen.pdf

Avedøreværket, a combined heat and power plant

District Energy

- **Greater Copenhagen**, a region of 20 local authorities, was the first region to implement a regional heat plan including zoning of gas and district heating based on CHP and energy from waste.
- Heat planning started 1980
- Hot water pipes 70- 90 degree; Replaces 300 degree Steam
- Replaces electric heating, individual oil and gas based boilers, and coal based district heating by waste, renewable energy gas and oil

Government Support

- CHP Strategy and Policy Support
- Legislation
- Taxes and Subsidies

Municipalities

- Planning for Heat Energy
- Projects
- Compulsory connectivity

Amager Bakke (waste-to-energy facility with a “ski slope” on the roof

Transport Policy

- The Transport and Environmental Plan 2004
  - Ojective a fully functional transportation system with substantially less environmental impact.
  - Action plan on 20 initiatives.
- Copenhagen's Cycle Politic 2002-2012
  - More cyclists, safety, speed, and comfort
- Eco-metropolis 2007
  - 4 themes and 13 measurable goals.
  - Theme Copenhagen as the World's Best City for Cyclists.
  - "50 % of all people going to work or education in Copenhagen will go by bike".
- Copenhagen Climate Plan 2009
  - contains 15 initiatives for transport and the goal was to reduce CO2 emissions from transport by 10 % from 2005 to 2015.
  - Electric and hydrogen cars running on wind energy

Transport Policy

- **Municipal Strategy 2009**
  - For all trips ”on wheels” at least 1/3 must be by public transport, at least 1/3 by cycle and less than 1/3 by car.
  - The City of Cyclists- the world’s best city for cyclists, 50 % of people cycling (achieved)
  - Improved public transport, Traffic calming and parking restrictions
  - Environmental efforts like low emission zones, possible congestion charging and environmentally friendly vehicles

- **Facts on bikes in Copenhagen 2011**
  - 50 % of all Copenhageners commute to work or study by bike.
  - 35 % of all who work in Copenhagen – including people who live in the suburbs and neighbouring towns but work in Copenhagen - commute to work by bike.

Transport

- 63 % of all members of the Danish parliament, located in the middle of Copenhagen, commute daily by bike.
- Copenhagen was elected Bike city 2008 – 2011 by ICU.

➢ (http://denmark.dk/en/green-living/bicycle-culture/copenhageners-love-their-bikes/)

➢ **Biking- Infrastructure**

- 400 kilometers of biking lanes; the worlds busiest biking lane with up to 40.000 cyclist passing daily.
- Green biking lanes
- Traffic lights especially for bikes
- Policies to reduce cycling travel time, increasing cycling safety, and increasing comfort on cycling paths

Transport

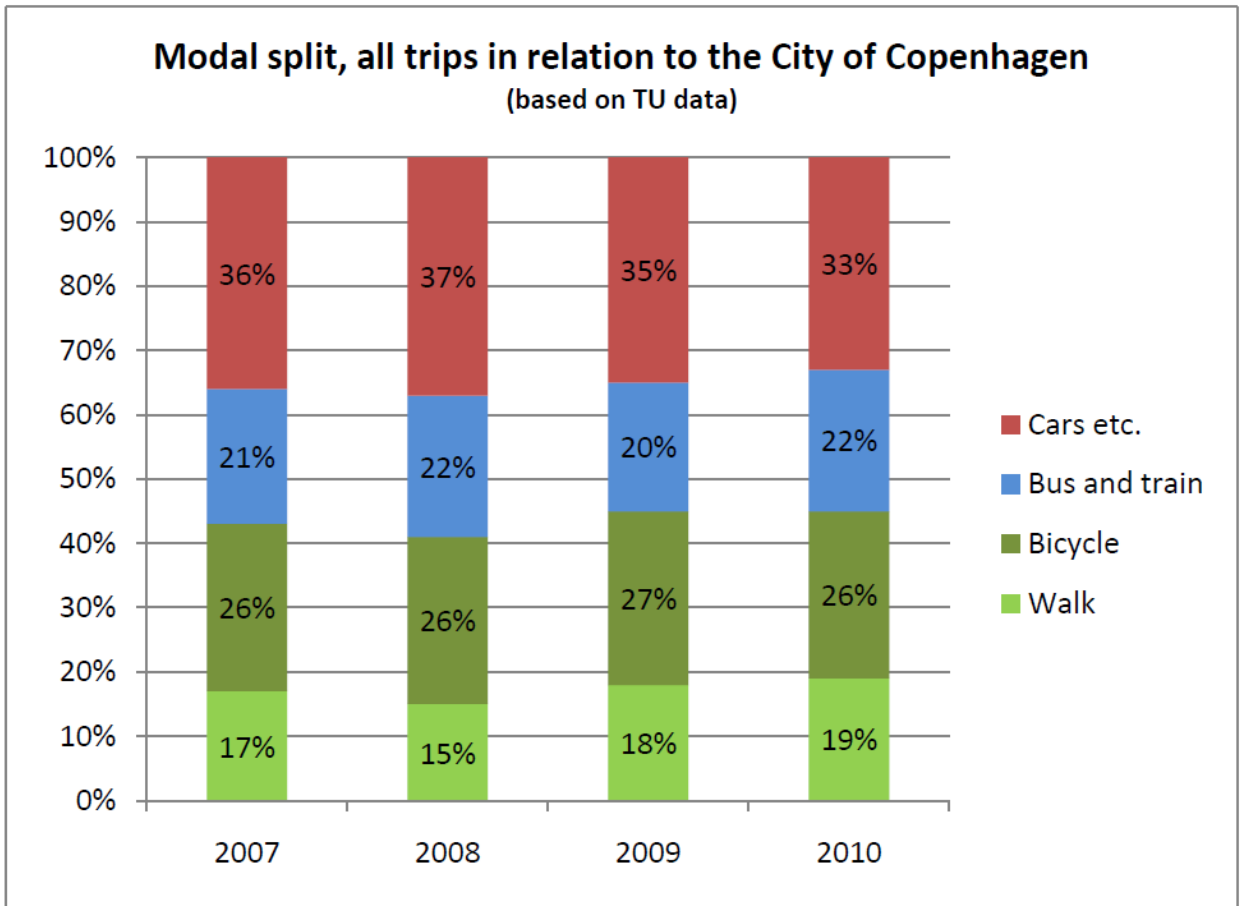
- City-wide bike sharing program, innovative parking structures.

- **Improved public transport**
  - Local S-trains, the Metro and the high-frequency A-bus network
  - Bus lanes with traffic-light priority for buses
  - Real-time information about bus arrivals.
  - 98 % of Copenhageners have less than 350 m to public transport

Transport

- **Traffic calming and parking restrictions**
  - Proposal for congestion charges
  - Parking strategy to reduce incoming traffic - parking charges in Copenhagen has increased three-fold.
  - Encouraging use of car-share schemes (reserved parking spaces)
  - Road-network plan- traffic primarily on main roads

Transport



http://ec.europa.eu/environment/europeangreencapital/wp-content/uploads/2012/07/Section-2-Local-transport_Copenhagen.pdf

Lighting

- LED street lighting in luminaires
- Change from mercury vapour to LED in public places
- Smart lights- more efficient LED (light-emitting diode) technologies and dimming lights when no one is around.
- Green wave flashes for cyclists on busy roads (no red light)
- Traffic light status on smart phone

http://www.nytimes.com/2014/12/09/business/energy-environment/copenhagen-lighting-the-way-to-greener-more-efficient-cities.html

A bike path in Copenhagen helps bicycling commuters avoid hitting red lights.

Buildings

- **Copenhagen Mandatory Green Roof Policy as a part of Climate Plan**
  http://inhabitat.com/copenhagen-adopts-a-mandatory-green-roof-policy/
  - Green roof, if roof slope less than 30 degrees.

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- Energy conservation must for municipal buildings – both in new construction and renovation projects.
- Development of buildings environmental management and maintenance systems;
- Embracing a climate focus on all renovation projects for municipal buildings;
- Implementation of low energy construction principles;
- A 40% reduction of the municipal buildings energy consumption

Buildings

- Danish building codes specify energy consumption norms for buildings (http://bygningsreglementet.dk/file/155699/BR10_ENGLISH.pdf)
  - Requires energy efficient lighting in common areas
- Energy performance framework- specifies standards for energy required (should not exceed) heating, ventilation, cooling, domestic hot water

  and, where appropriate, lighting.

- 2020 target for building energy efficiency have already been met

- Buildings / apartment rated A to G and rating is a must for sale. Also, energy audit report for selling any house is needed- it indicates investment required with payback period.

Sustainable City Case (An example of innovation and new models)

- Over the next 50 years, Nordhavn will develop into a **new district** with 40,000 residents and 40,000 jobs.
- The ambition is to become an **example of a future sustainable city**, while also contributing to the City of Copenhagen's goal of becoming **carbon-neutral** by 2025.
- This requires **innovation** in urban design - not least of energy infrastructure.

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Source: The Nordhavn case study presentation was provided by Christoffer Greisen, DTU
http://www.energylabnordhavn.dk/

EnergyLab Nordhavn (A Project in Nordhavn)

Objective: To develop new methods and solutions for design and dimensioning of the future cost-effective **multi-carrier energy system** (electricity, thermal, transport) based on Nordhavn as a globally visible real-life laboratory.

Electricity – Heating/cooling – Transportation - Buildings

- New business models
- New integrated market designs
- Control and operation
- Energy use, conversion and storage technologies
- Timeline: April 2015 - March 2019
- Budget: 19m Euro

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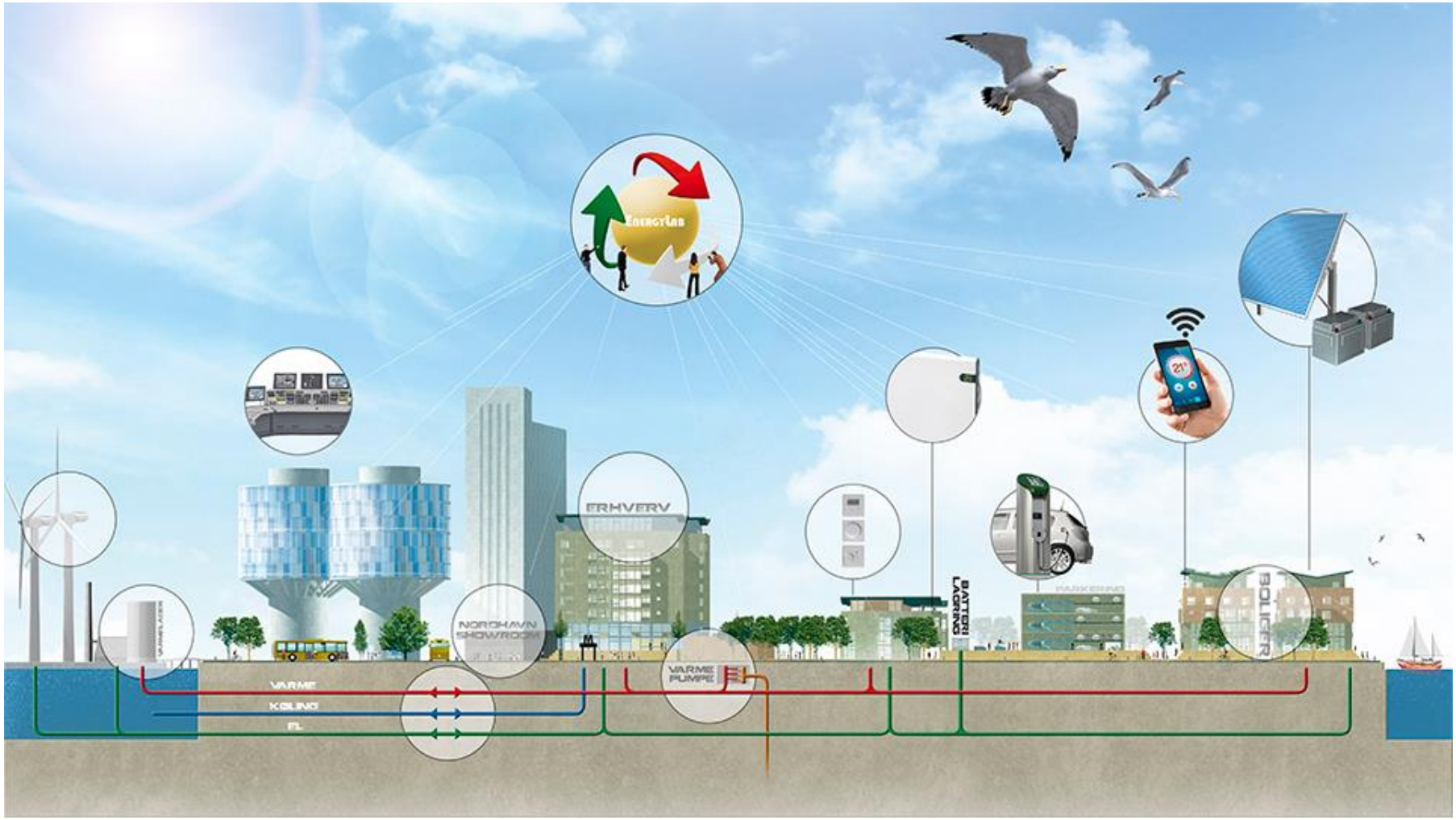

Energy Lab Nordhavn; Future Smart Energy Solutions
Source: Energy Nordhavn; http://energylabnordhavn.dk/

Thank You

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Hub Support to Platform and Accelerators

- Analytical support to accelerators
  - Assessments of best practices and policy options
  - Analysis of tools and instruments
  - Tracking progress
- Support establishment of new accelerators
  - Concept development support to the new accelerators
  - Initial support to conveners on establishing baselines, estimating potential etc.
- Secretariat for the Global Platform
  - Coordinating activities across accelerators
  - Establishing and maintaining a common online Platform
  - Support the Accelerators in engaging Partners
  - Tracking commitment and engagement across Accelerators
  - Promotion and fundraising activities for the Accelerator Platform