MINISTRY OF FOREIGN AFFAIRS
OF DENMARK

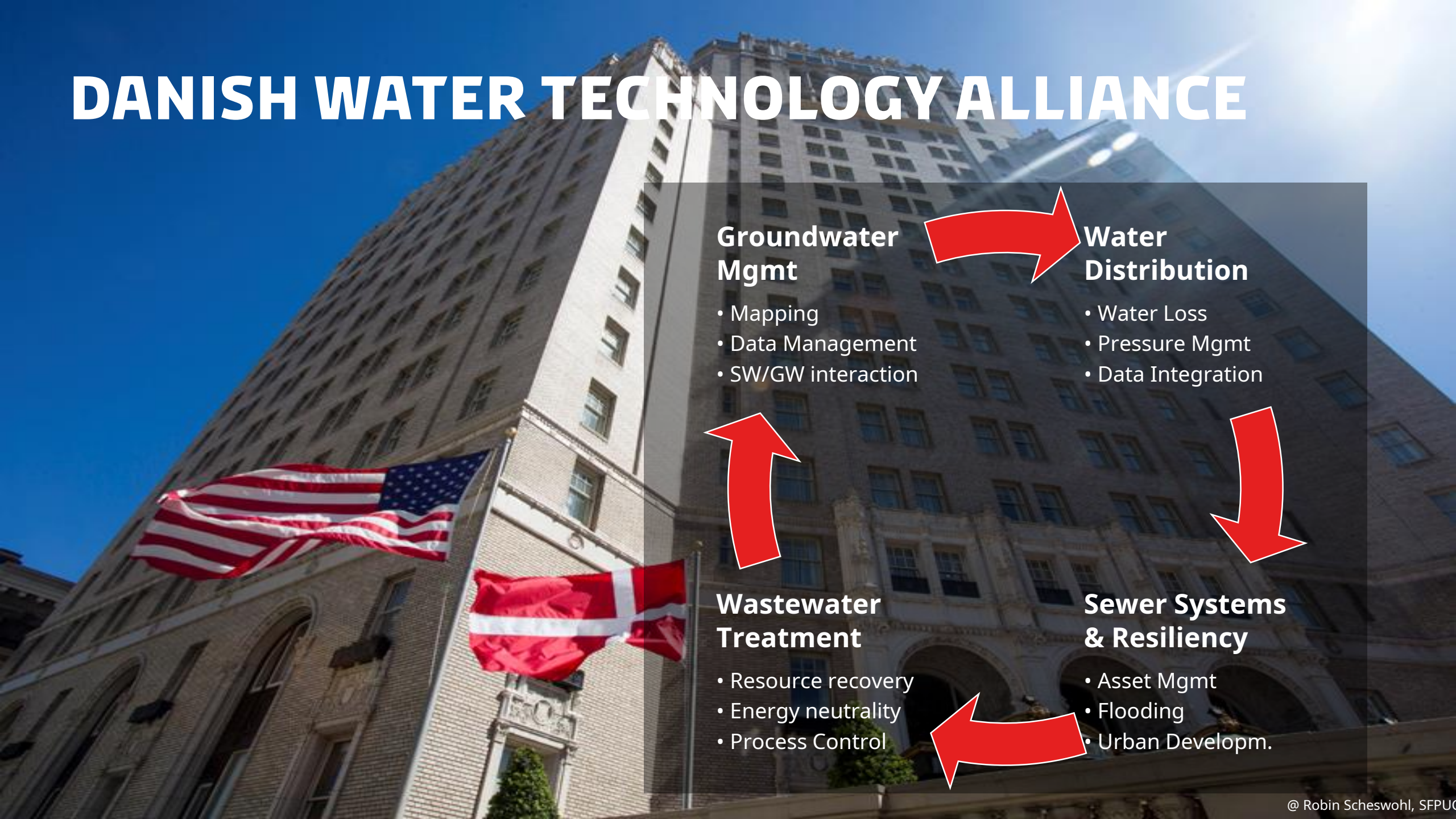
DANISH WATER TECHNOLOGY ALLIANCE

OCTOBER 10, 2019

ASCE REDWOOD EMPIRE BRANCH

The Trade Council of Denmark in North America

DANISH WATER TECHNOLOGY ALLIANCE



Groundwater Mgmt

- Mapping
- Data Management
- SW/GW interaction

Water Distribution

- Water Loss
- Pressure Mgmt
- Data Integration

Wastewater Treatment

- Resource recovery
- Energy neutrality
- Process Control

Sewer Systems & Resiliency

- Asset Mgmt
- Flooding
- Urban Developm.

@ Robin Scheswohl, SFPUC

WHERE IS DENMARK?

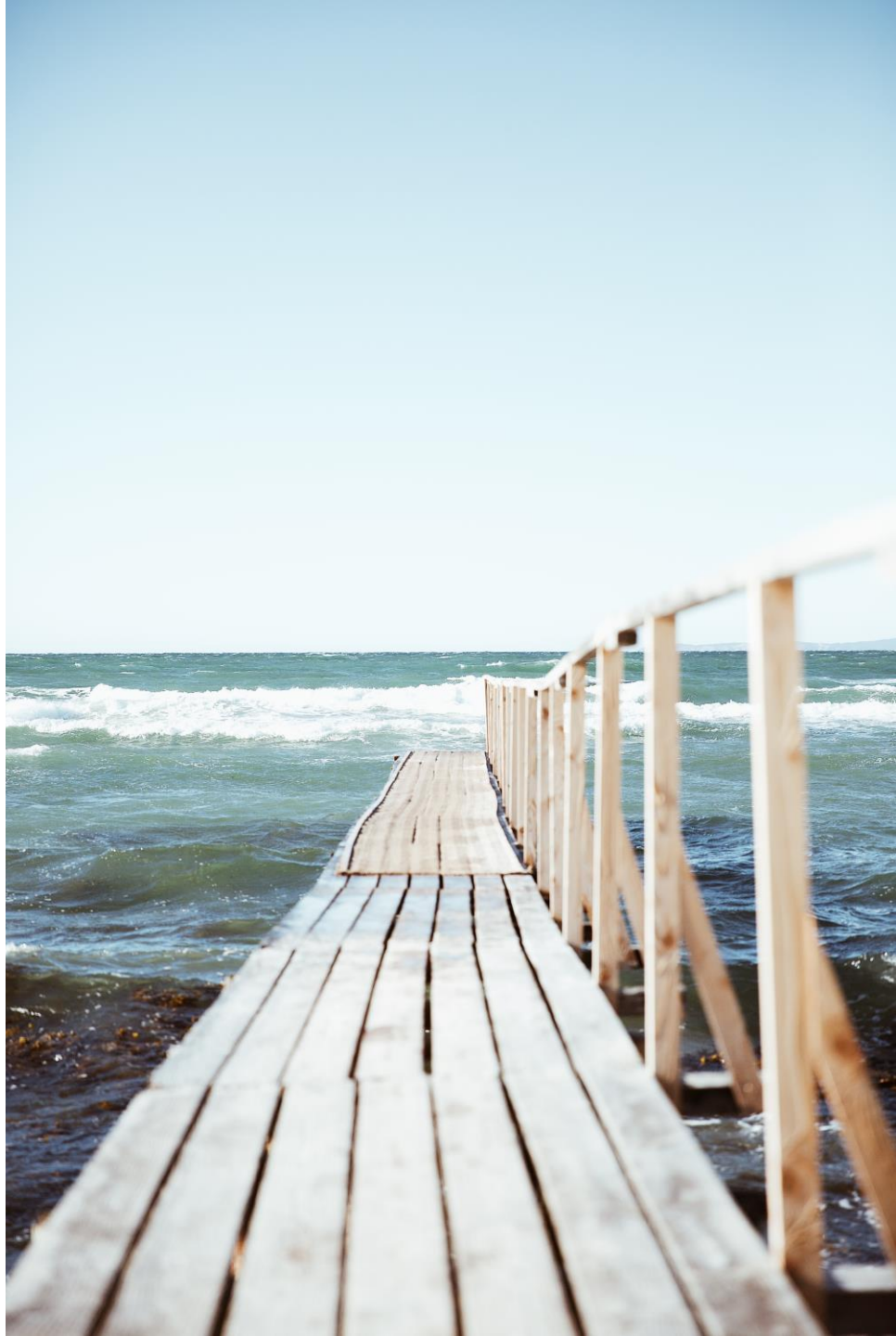
DENMARK BY THE NUMBERS

- **Population**: 5.7 million
- **Area**: 16,577 square miles (CA: 163.696 sq mi)
- **Coastline**: 4536 miles (CA: 3427 mi)

- **Land use**: 2/3 agriculture land (~28M pigs)
- **Water Source:** 100% groundwater
- **Water Consumption**: 28 gal./p./d.
- **Precipitation**: Avg annual 29,5 inches.

- **Government:** Constitutional monarchy. Liberal Government.

- **GDP** per capita (2017): 56.307 USD (~5 % lower than US)
- The world's **happiest** nation several times according to UN, OECD, etc.



WHY ARE WE HERE?

WATER TECHNOLOGY ALLIANCE

PARTNERS & GEOGRAPHY

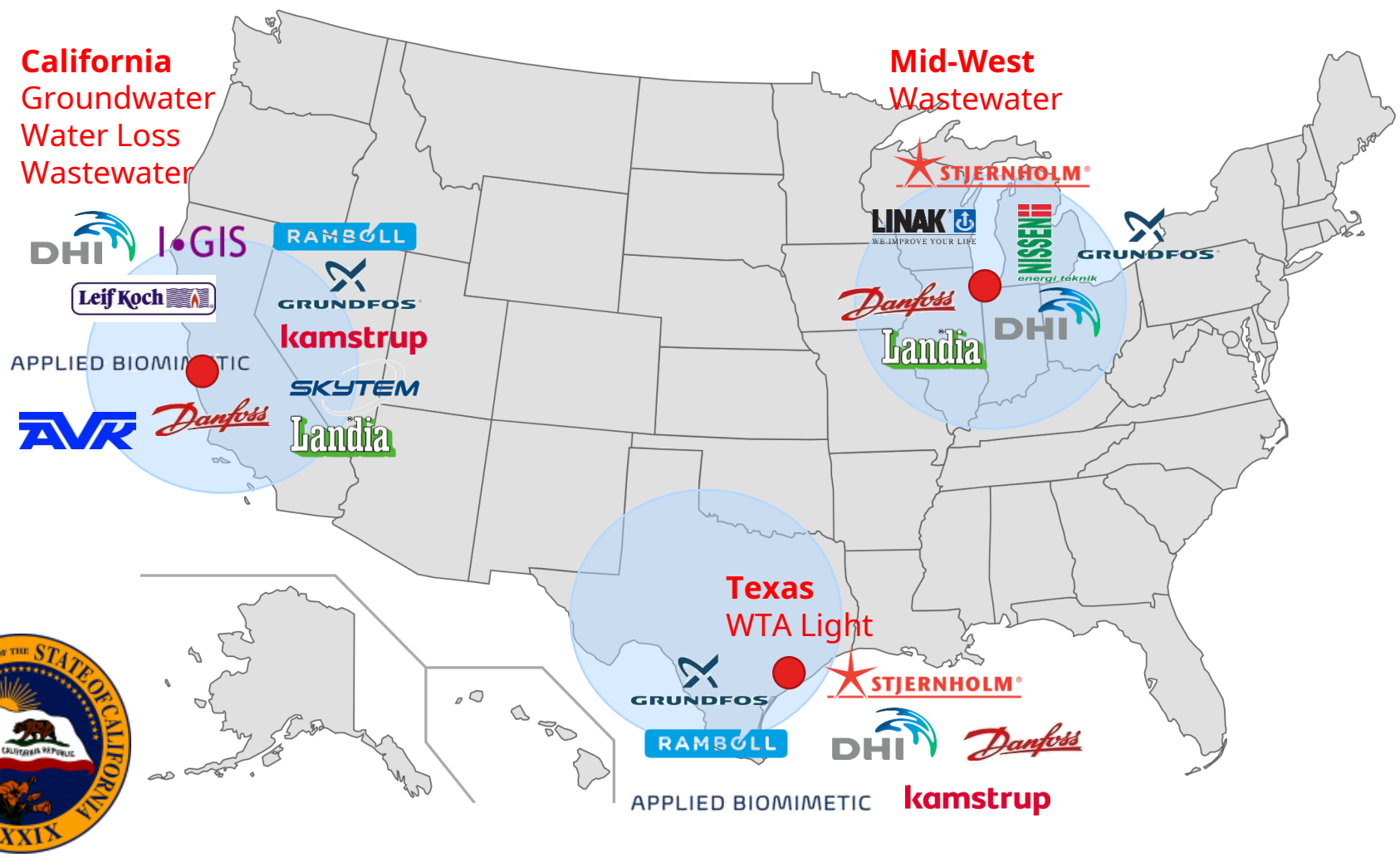
aarhusvand

HOFOR

VandCenterSyd

BIOFOS

Ministry of Environment and Food of Denmark
Environmental Protection Agency



MoU between the State of California and MoE in Denmark

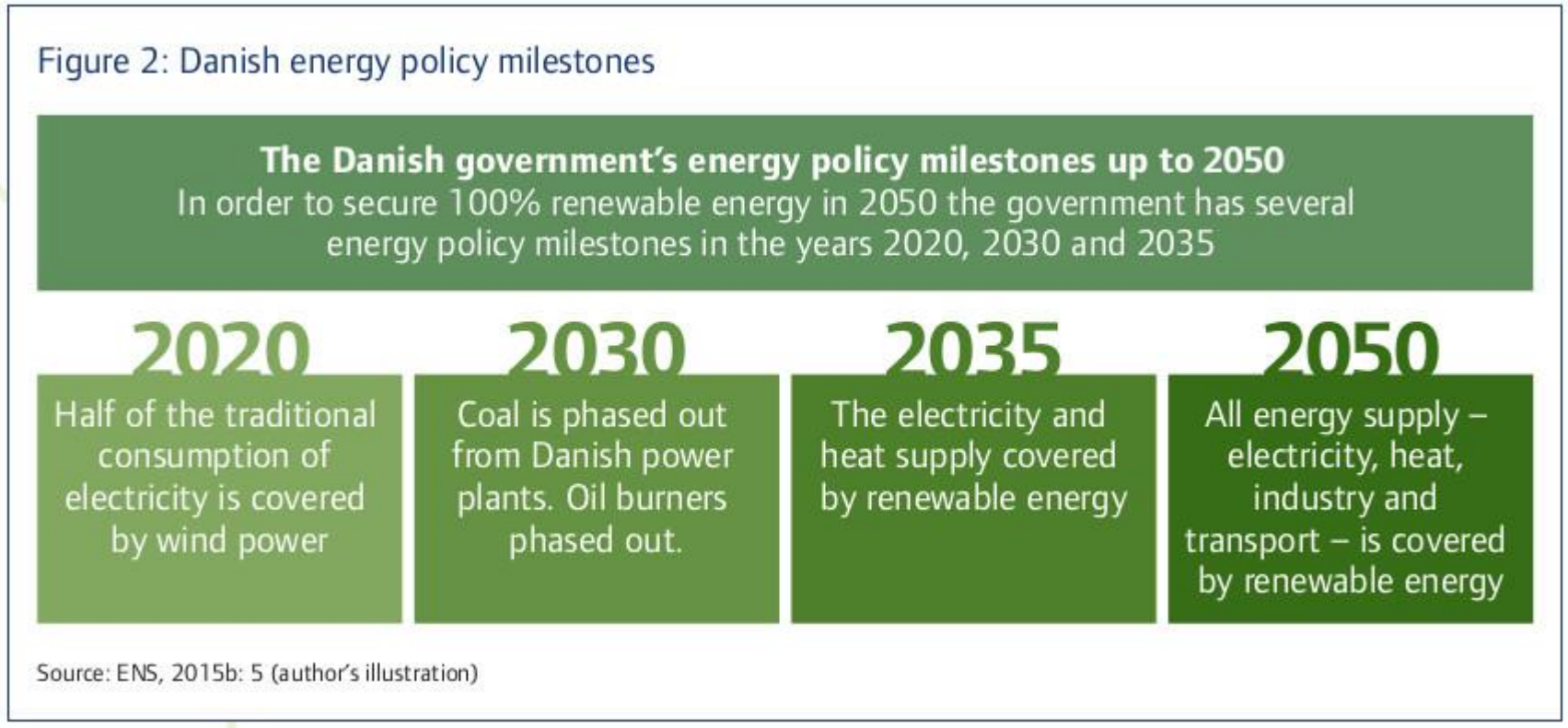
KNOWLEDGE SHARING & COLLABORATION

ENERGY?


A9 Svendborg Centrum
E66 A1 Middelfart
Kerteminde Bogense Havnen
ZEMI TAPET

DANISH ENERGY MILESTONES
(THE OLD ONES, NEW AND MORE AMBITIOUS MILESTONES ARE COMING)

Figure 2: Danish energy policy milestones



Source: ENS, 2015b: 5 (author's illustration)

DENMARK: ECONOMY, WATER, ENERGY & CO2 DEVELOPMENT

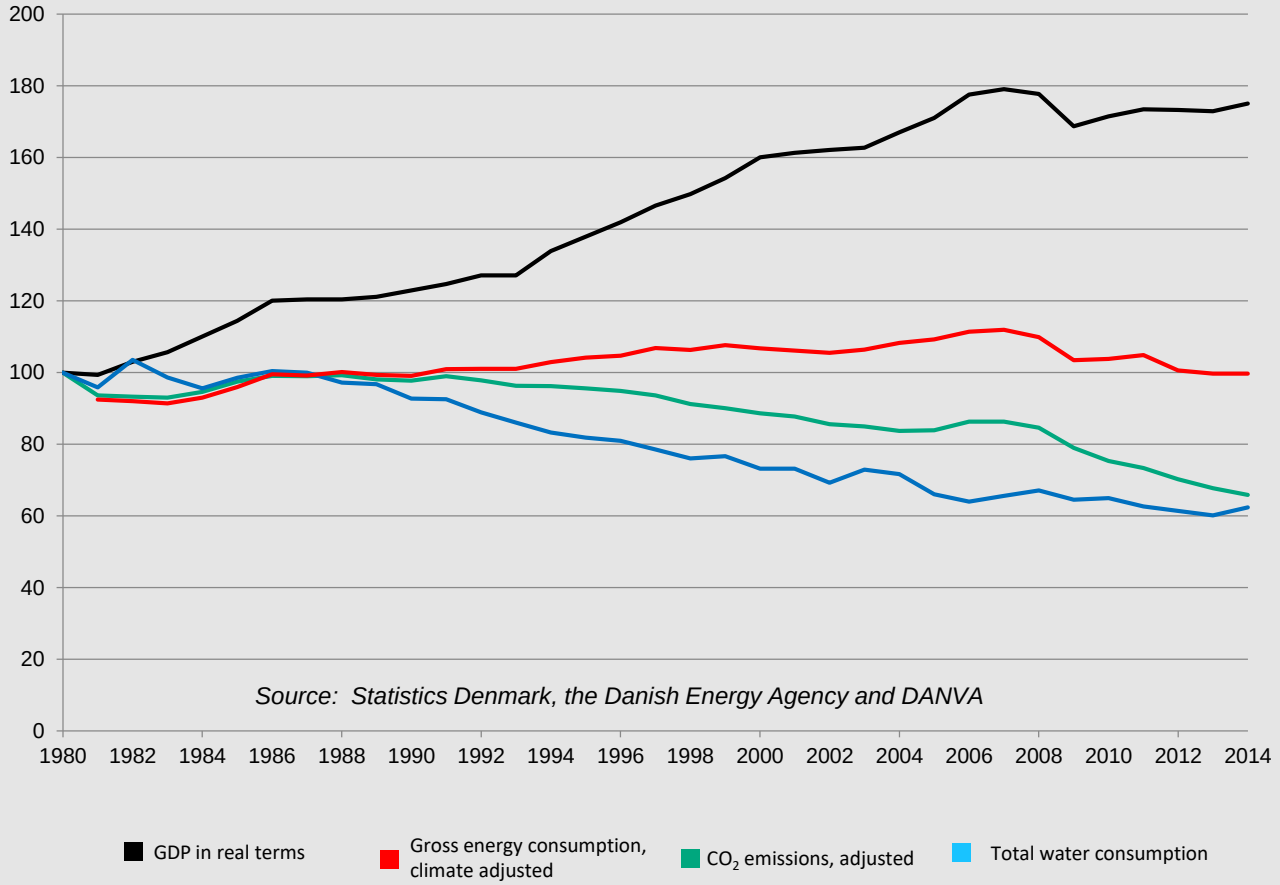
Economic growth 70 %

Energy consumption steady

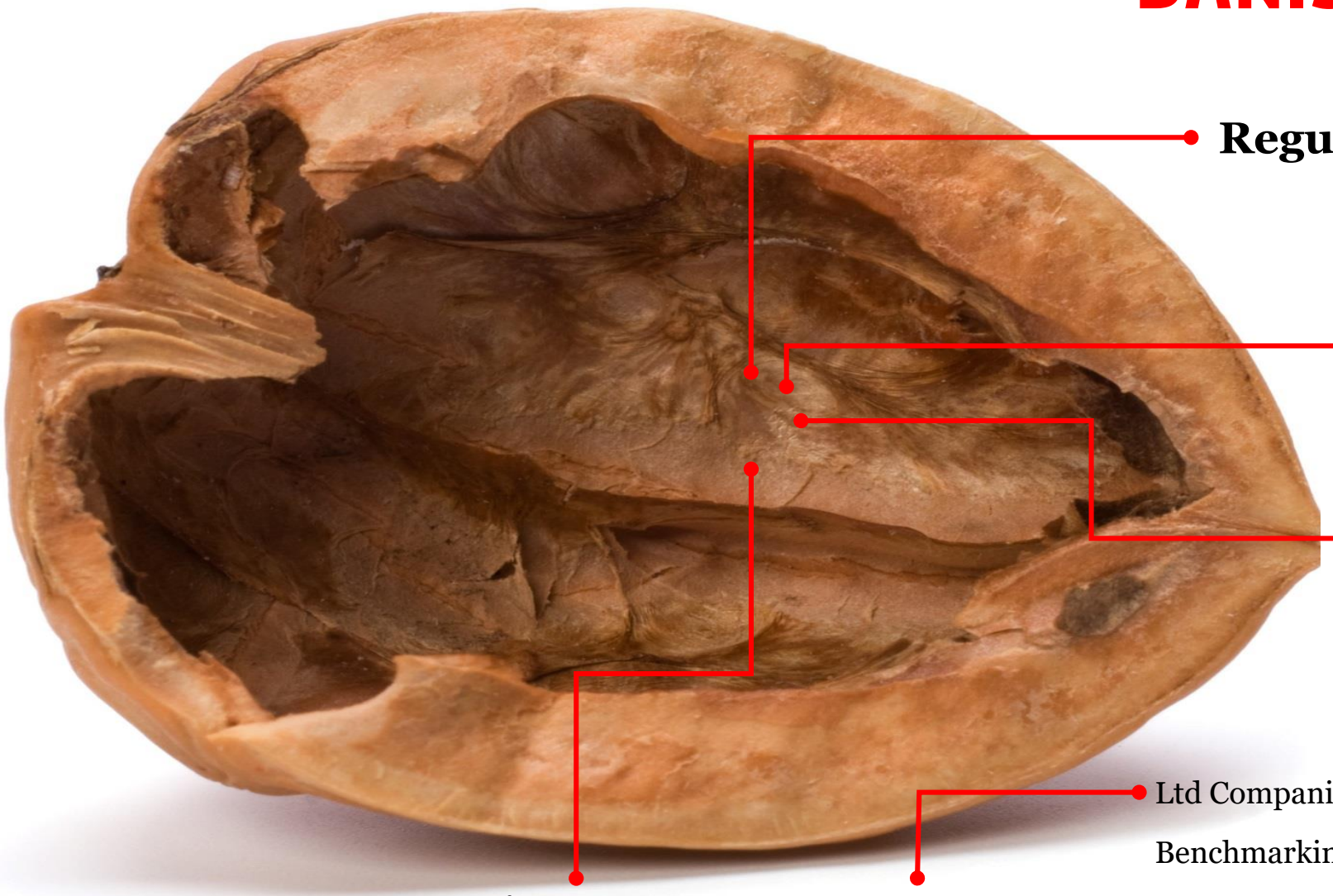
CO_2 emissions reduced

Water consumption reduced by 40 %

(1980 = index 100)



DANISH DRIVERS



Regulation

Environmental Regulation
Polluter Pays
Prevention > Cleaning
Nutrients

Water Sector Regulation

Ltd Companies
Benchmarking
Efficiency

Water Vison
Energy & CO_2 Neutrality

Business Mindset

HOFOR – WATER PRICE 2018

Elements of the price	USD/ccf (af)
Water consumption	*3.75 (1,637)*
State tax: water supply	*2.84 (1,240)*
Water Supply (potable water)	**6,60 (2,877)**
Waste water	*7.21 (3,141)*
Tax on Water and wastewater (25 %)	3.29 (1,434)
Total incl. 25% VAT	17.25 (7,523)

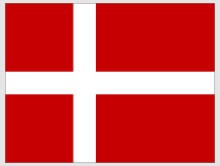
Household cost
Potable water:
53 ccf/year = 350 USD
(0.121 af/year)

Water & wastewater
(incl. storm water):
App. 914 USD/year

DANISH EXPERIENCES WITH GROUNDWATER MANAGEMENT

MINISTRY OF FOREIGN AFFAIRS
OF DENMARK
The Trade Council

RELEVANCE



- From 1999-2015 Denmark conducted a nationwide sustainable groundwater program similar to the program outlined in the 2014 legislation in California (Denmark is 100% reliant on groundwater).
- As a nation Denmark has extensive experience in mapping aquifers and producing conceptual models and sustainable plans for their use.
- Denmark has developed tailor-made and cost-effective geophysical technique to map the subsurface terrain enabling us to better understand regional basins by providing data to fill in the gaps between existing data.
- Denmark has developed an open data management model allowing local and state stakeholders to access and utilize all data through various software platforms. All water related data are openly available in easily accessible open databases.
- Due to extensive farming, Denmark has battled nutrient pollution of its aquifers for many decades.

- An extended period of drought has led to overdraft of aquifers resulting in water shortage (dry wells), land subsidence, saltwater intrusion, etc.
- Extensive dairy industry causes high nutrient loads and water quality problems (nitrates)
- Recent storms has caused problems and raised questions of how to utilize aquifers for water storage.
- In 2014 California passed the Sustainable Groundwater Management Act – a groundbreaking piece of legislation that will drive California towards sustainable groundwater management.

TAILORED GEOPHYSICAL "TOOLBOX"

Depth of investigation

PACES

Electric resistivity 0 – 90 feet

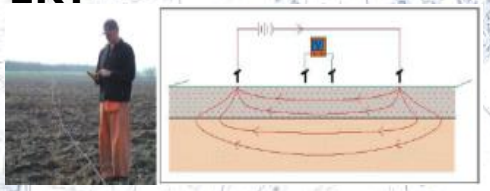
DUALEM (GCM)

Electric conductivity 0 – 30 feet

NMR

Water Content, Permeability 0 – 360 feet

ERT



Electric resistivity 0 – 360 f

TEM

SkyTEM

Electric conductivity 15 - 900 feet

VARIOUS SEISMIC

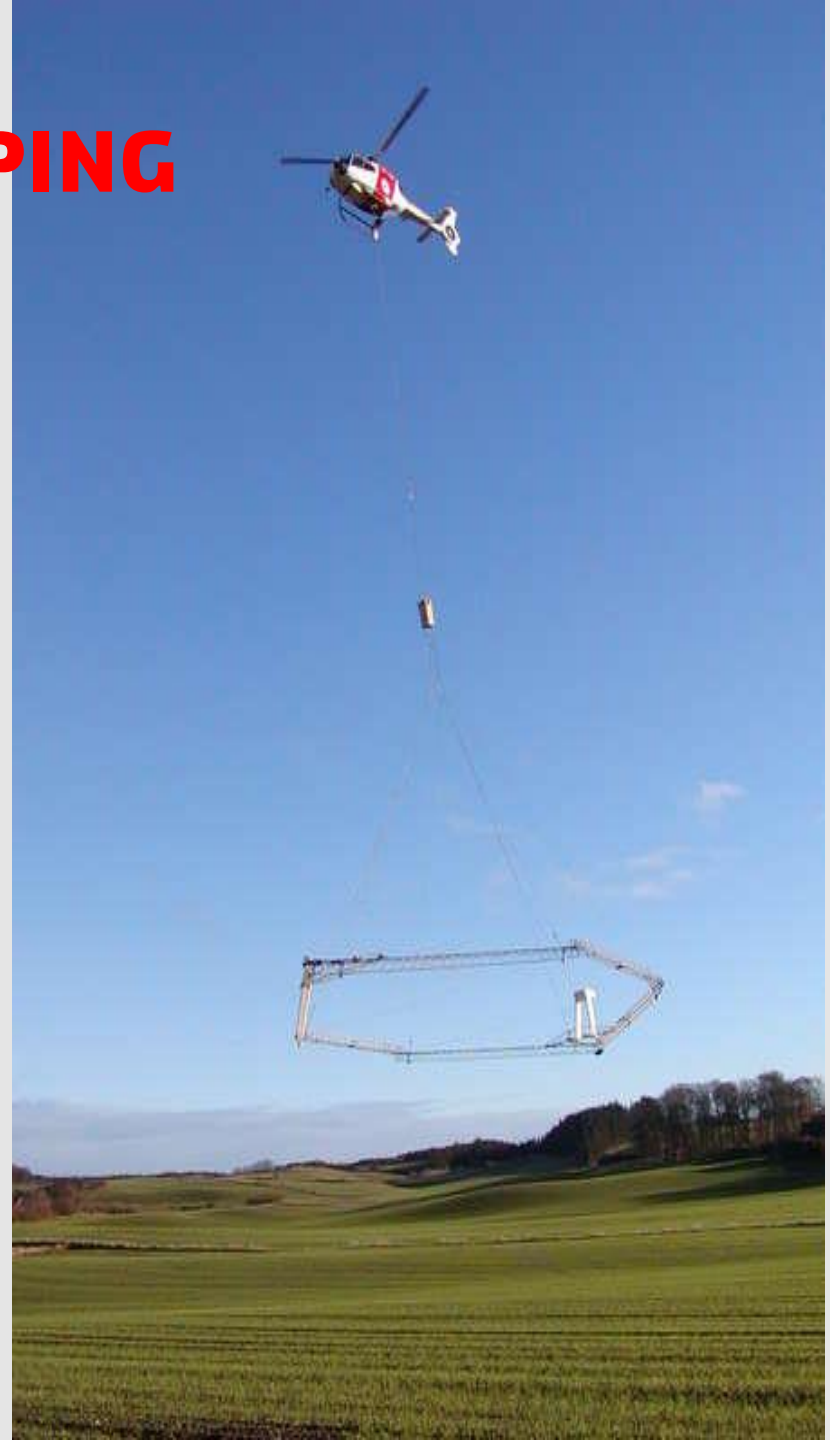
Acoustic velocity 20 - 3000 feet

WIRE LINE LOGGING

Various tools

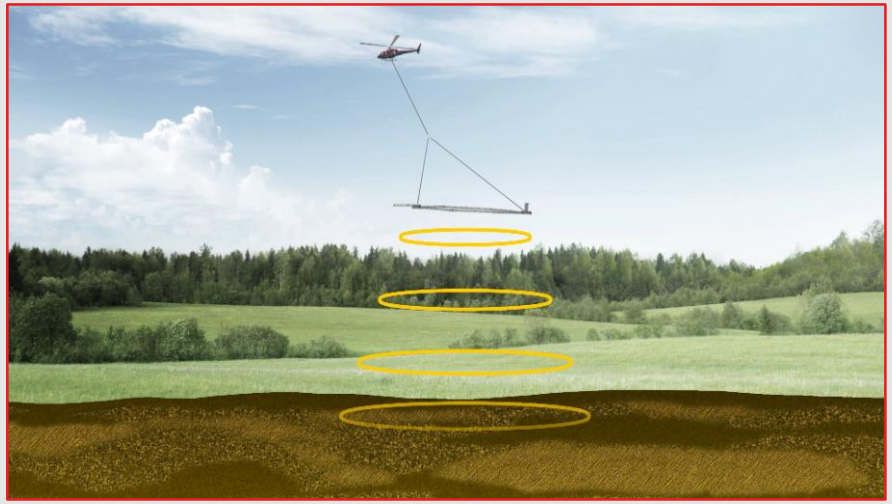
AIRBORNE GEOPHYSICAL MAPPING

- Developed specifically for groundwater
- High production rate
- Cost efficient
- High vertical and lateral resolution
- No need to access the ground
- Strong correlation - resistivity to hydrogeology



STANFORD GROUNDWATER ARCHITECTURE PROJECT

- Developing an optimal workflow for Sustainable Groundwater Management (SGMA compliance)
  - Existing Data ‘Activation’
  - Combining geophysics & geology
  - Integrated Data Management
  - Uncertainty Reduction
  - Modelling ‘API’ (model agnostic)
  - Lessons learned in Denmark applied to California

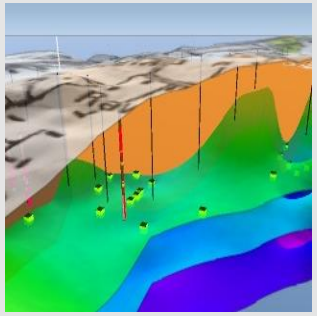


A COLLABORATIVE EFFORT

Ministry of Environment and Food of Denmark
Environmental Protection Agency

Danish EPA

- Management
- Funding

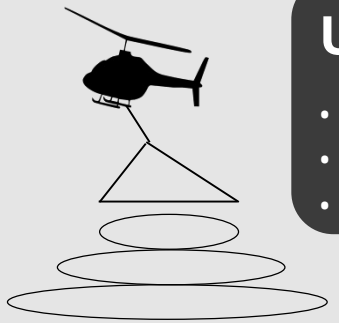


Consultants

- Data
- Modelling
- Plans

Municipalities

- Action plans
- Implementation

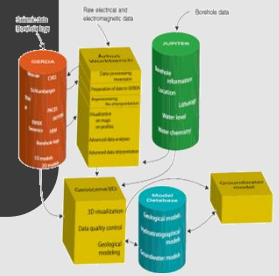


Universities

- Research
- Standards
- Candidates

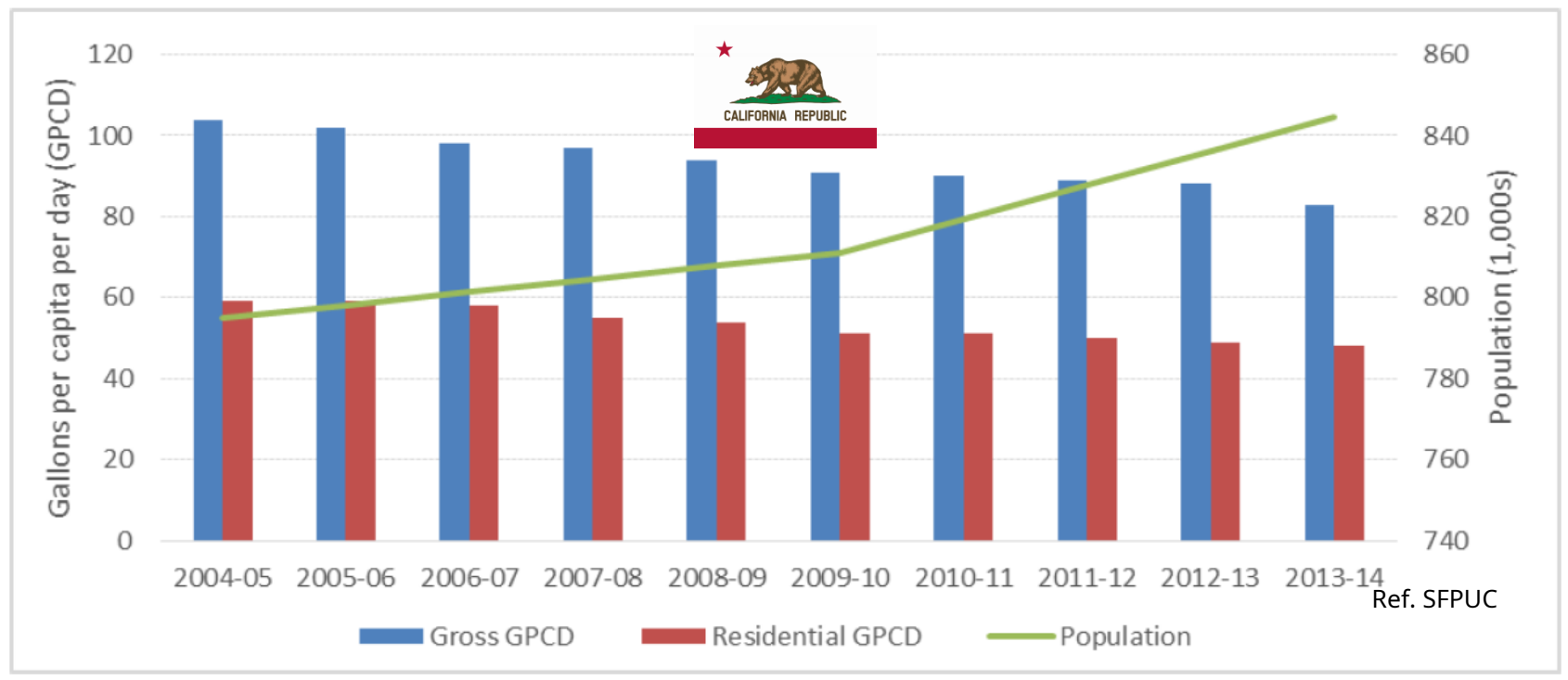
GEUS - Geological survey

- Standards
- Databases



WATER LOSS

WATER SAVINGS – CALIFORNIA



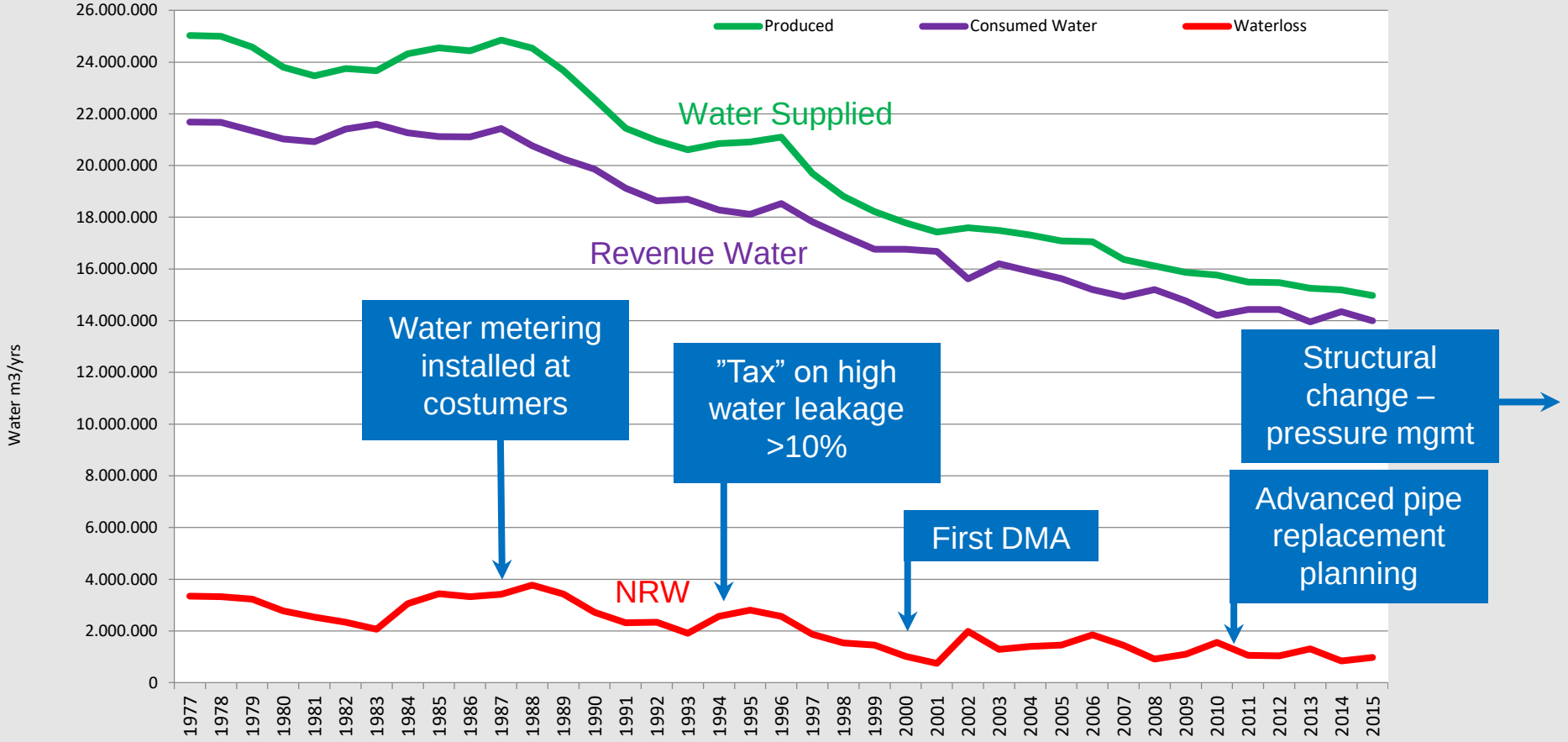
Ref. SFPUC

- In 2015 Governor Brown Issues Executive Order to reduce water consumption statewide by 20%
- Framework for Performance Standards for Water Loss Control
- Actions (Lowering non-revenue water, Conservation Programs, Recycled, non-potable water).

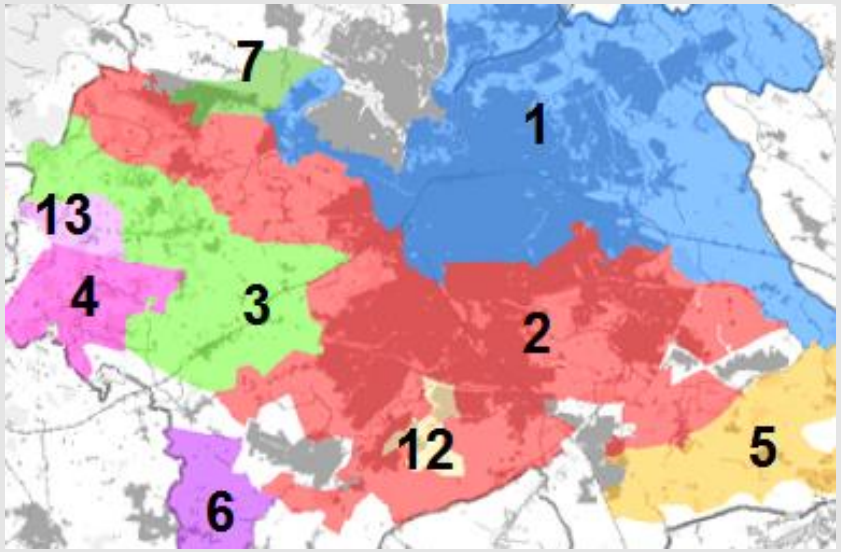
Save Our Water

WATER SAVINGS AND REDUCING WATER LOSS

Residential is 26 gallons/pers/day - reduced by 40% since 1980'es



PRESSURE MANAGEMENT



More pressure zones

ROI:

- Energy reduction ~ 10 – 40 %
- Pressure reduction = Water loss reduction
- Reduction in breaks frequency = operational cost savings
- Less costumer complaints
- Extended Asset Lifetime

Leakage management – optimizing systems

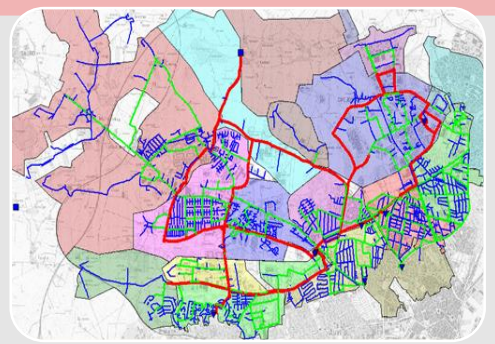
Water Metering

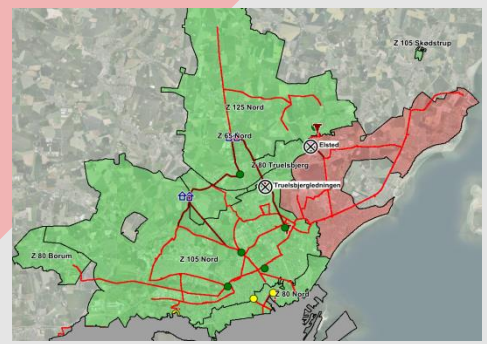
Proactive leakage control

Pressure management

Asset Management

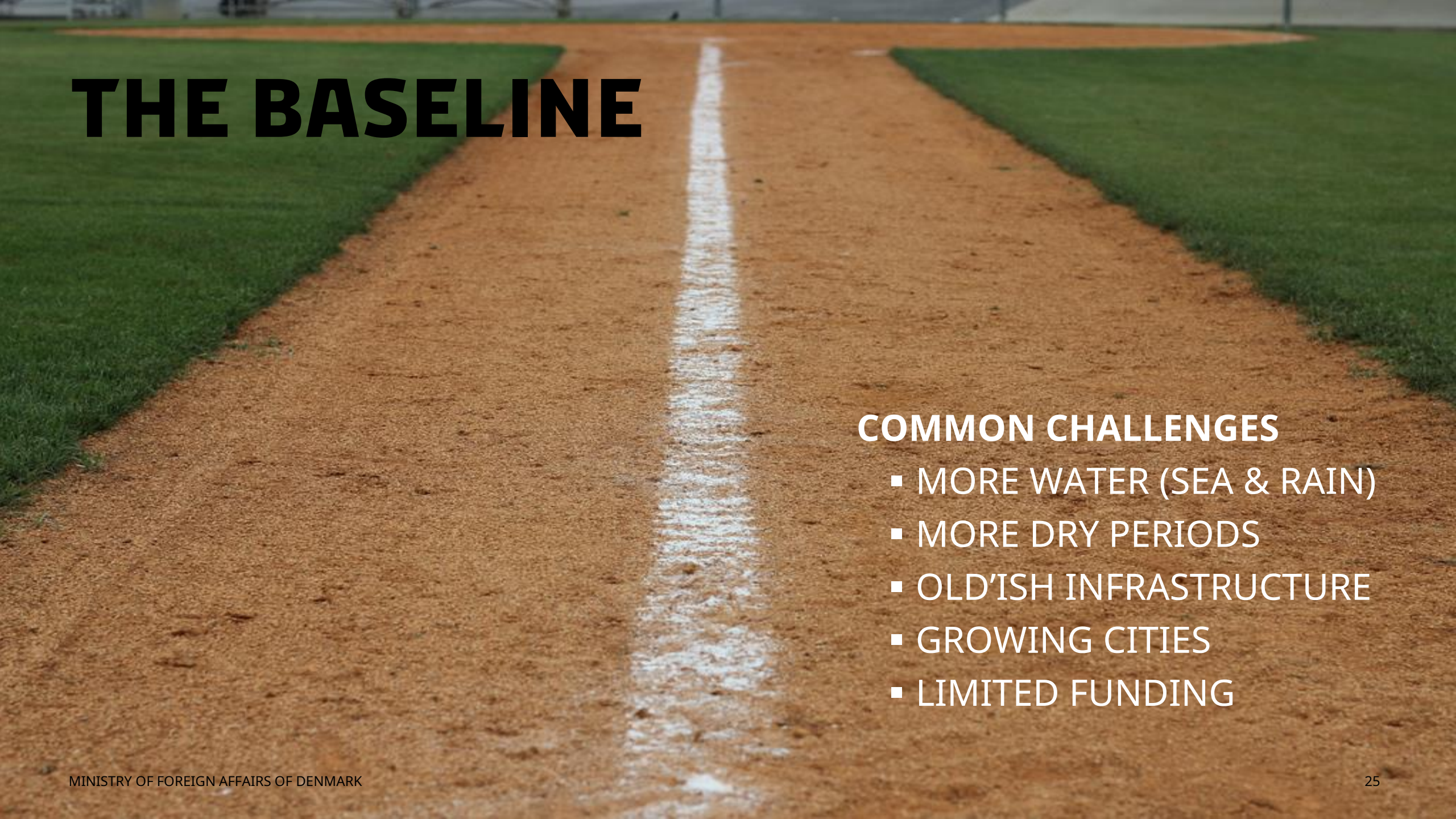
Data Management & smart controls





SEWER SYSTEMS & RESILIENCE

THE BASELINE



COMMON CHALLENGES

- MORE WATER (SEA & RAIN)
- MORE DRY PERIODS
- OLD'ISH INFRASTRUCTURE
- GROWING CITIES
- LIMITED FUNDING

RESILIENT?

INTEGRATED WATER MANAGEMENT

A Clear vision
Holistic approach (Environmental, economic, social)
Collaboration & Common Goals

Risk assement (multiple perspectives)
Follow nature
Multi-disciplinary approach (arhc & eng)
Choosing Cost-Effective Solutions

Blue-Green Infrastructure
Retention
Conveyance
Trad. Infrastructure
Intelligence & Software

WASTEWATER

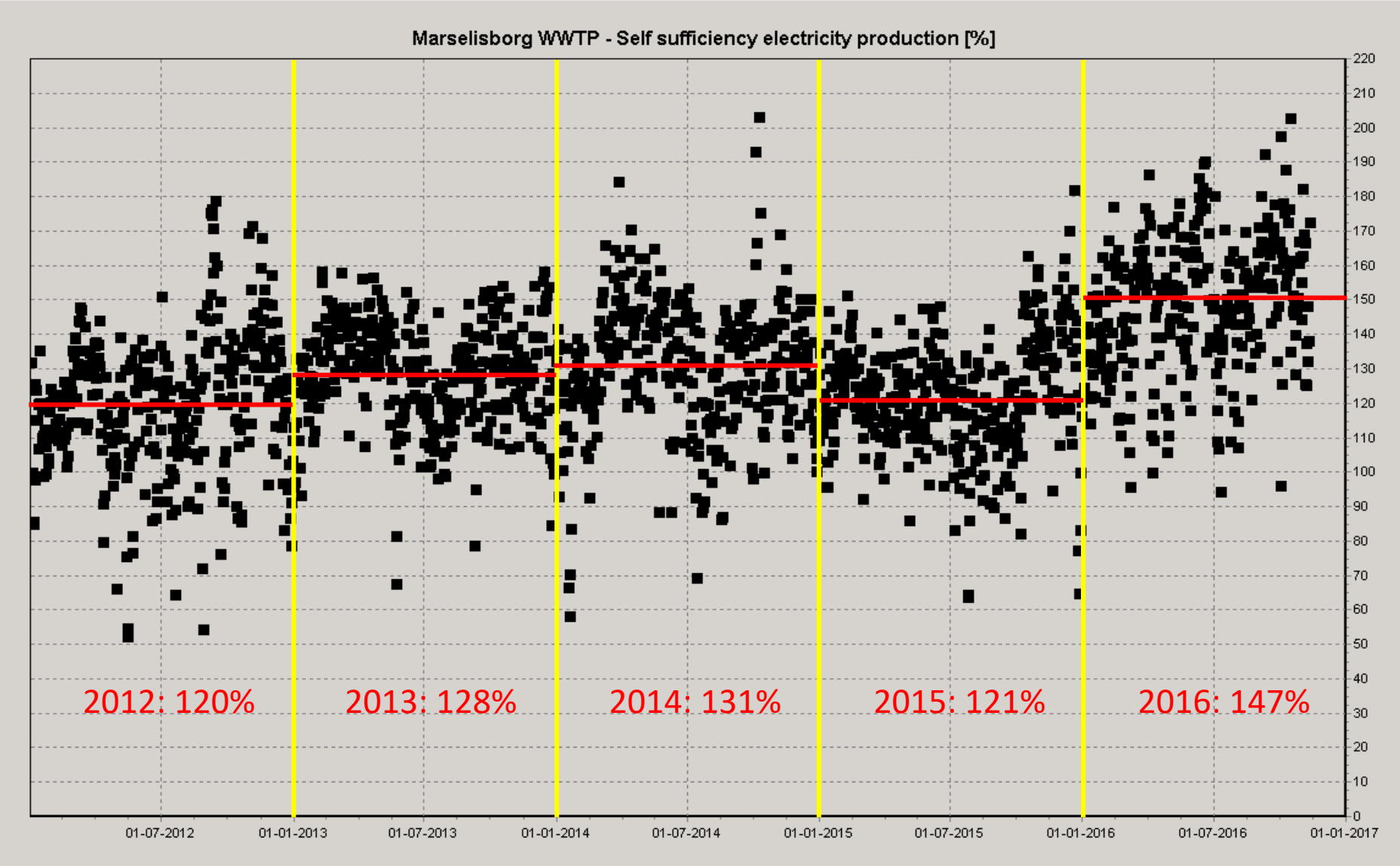
FROM INDUSTRIAL TO MODERN CITIES

CHANGING THE PERCEPTION OF WATER

CASE
MARSELISBORG WWTP AARHUS WATER, DENMARK

- 200.000 PE (1 PE = 0.060 kg BOD/day (= 0.13 lbs/day)
- Designed in the 80's. Nutrient & capacity demands in the 90's.

ENERGY SELF SUFFICIENCY - ELECTRICITY



MINISTRY OF FOREIGN AFFAIRS
OF DENMARK

HOW DO WE WORK?

WORKSHOPS

- Leakage management
- Pressure management
- Metering
  - ➢Techniques
  - ➢AMI
  - ➢DMA
  - ➢Data collection
  - ➢Data analytics

FACT FINDING

FACT FINDING TRIP TO DENMARK
June 23rd – 27th 2019

SMART WATER DISTRIBUTION: INNOVATION AND BEST PRACTICES IN DANISH WATER DISTRIBUTION

Sunday June 23rd	
	Participants arrive at hotel in Copenhagen
5.15 PM	**Meet in lobby for dinner at Tony's**
8.00 PM	**Sankt Hans Aften (Saint Johns Evening),** Bon fire on the harbor
Monday June 24th	
7:50 AM	**Meet in the lobby and check out**
8:30 – 9:30 AM	**Visit at State of Green**
10:00 – 11:30 PM	**Welcome at HOFOR** **Sustainable City and Utility**
12:30 AM – 2:00 PM	**Danish EPA - Regulatory Drivers for water efficiency in Denmark**
2:30-5.15 PM	**Proactive leakage management**
Tuesday June 25th	
8:45 – 10:15 AM	**Aarhus Water: Operation & optimization of the distribution system**
11:00 AM – 2:15 PM	**Grundfos: Pressure management - Water & Energy Nexus** **Pilot Projects on leakage management – Global case studies (Peter Thomsen, Rambøll**
3:00 – 4:30 PM	**Site visit at Truelsbjerg Water Treatment Plant**
5:30 PM	**Meet in lobby** Dinner at Salling Rooftop
Wednesday June 26th	
7:30 AM	**Meet in the lobby**
8:00 – 10:30 AM	**Kamstrup: Digital metering and meter control**
11:00 – 12:00 AM	**American AVK: Leakage and energy reduction - the alternative to only pipe replacement and toolbox to less OPEX and CAPEX**
1:00 - 2:00 PM	**DHI - Integrated Smart Water**
2:00 - 4:30 PM	**Workshop on US challenges**
6:00 PM	**Meet in lobby,** Dinner at "Den lille Kro"
Thursday June 27th	
7:00-8:00 AM	Evaluation and Next steps (at breakfast)
8:30 AM	**Departure from hotel (Checked-out of hotel)**
1:00 PM	**Arrival at the Copenhagen Airport**

Subject to changes

MINISTRY OF FOREIGN AFFAIRS
OF DENMARK

?

MINISTRY OF FOREIGN AFFAIRS
OF DENMARK

THANK YOU!

Danish Water Technology Alliance in North America