MINISTRY OF FOREIGN AFFAIRS
OF DENMARK

Sustainable Wastewater Treatment

3R and circular economy vision of Danish cities:
Best practices and success stories

Petr Dolejs, Ph.D.
DHI A/S
Wastewater Treatment Expert
Water in Cities

DHI

1964-2024
60 years of solving water challenges

DHI

We enable a sustainable future for water

DHI at a glance

1,100+
Employees
Two out of three hold a master or PhD degree

2,700
Involved in more than **2,700 projects** worldwide

115
Our activities span 115 **countries**

132
million euro in **revenue**

14
million euro investments in **research, development and innovation**

1964
60 years of **experience** and know-how

Global **partnerships** with UN, WHO, Global Water Partnerships, academia and more

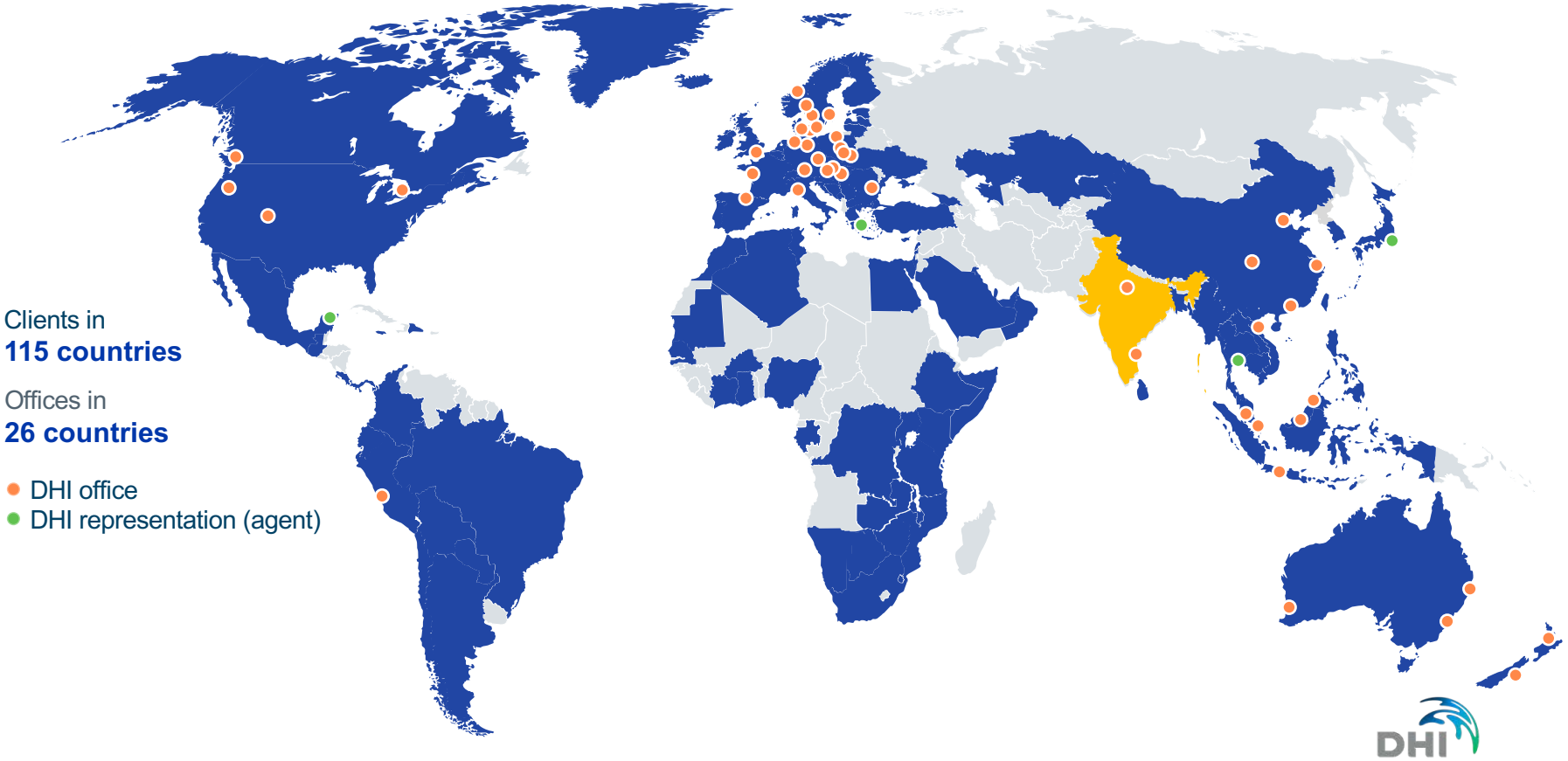
Industry-trusted physical and digital **test facilities**

MIKE Powered by DHI

Advanced technology and **water modelling software**

RTO accreditation
UNEP-DHI centre

Our global impact



Clients in
115 countries

Offices in
26 countries

- DHI office
- DHI representation (agent)

Delivering on 2,700+ projects across the world

PROJECT

Carving a new path to the sea

PROJECT

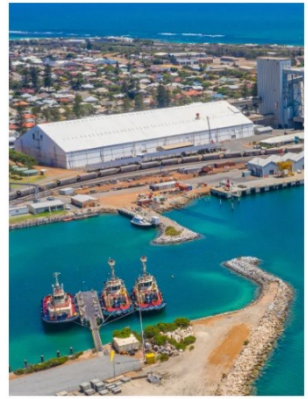
Securing safe drinking water for Copenhagen's outer-suburban residents

PROJECT

Supporting sand management along Adelaide's shoreline

PROJECT

Protecting Venice from high water levels



PROJECT

Assessing long period wave mitigation to improve port operations

PROJECT

Tracing sources to PFAS in wastewater treatment plants

PROJECT

A digital twin to support Bresso-Niguarda wastewater treatment...

PROJECT

Estimate your dredging impacts with more certainty

PROJECT

Reducing hydraulic loading to maximise efficiency in a...

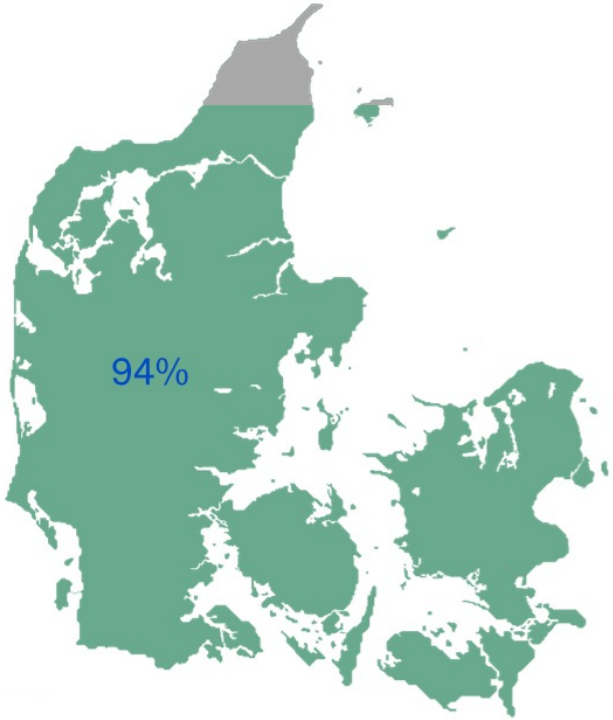
MINISTRY OF FOREIGN AFFAIRS
OF DENMARK
The Trade Council

Wastewater treatment in Denmark

Experiences

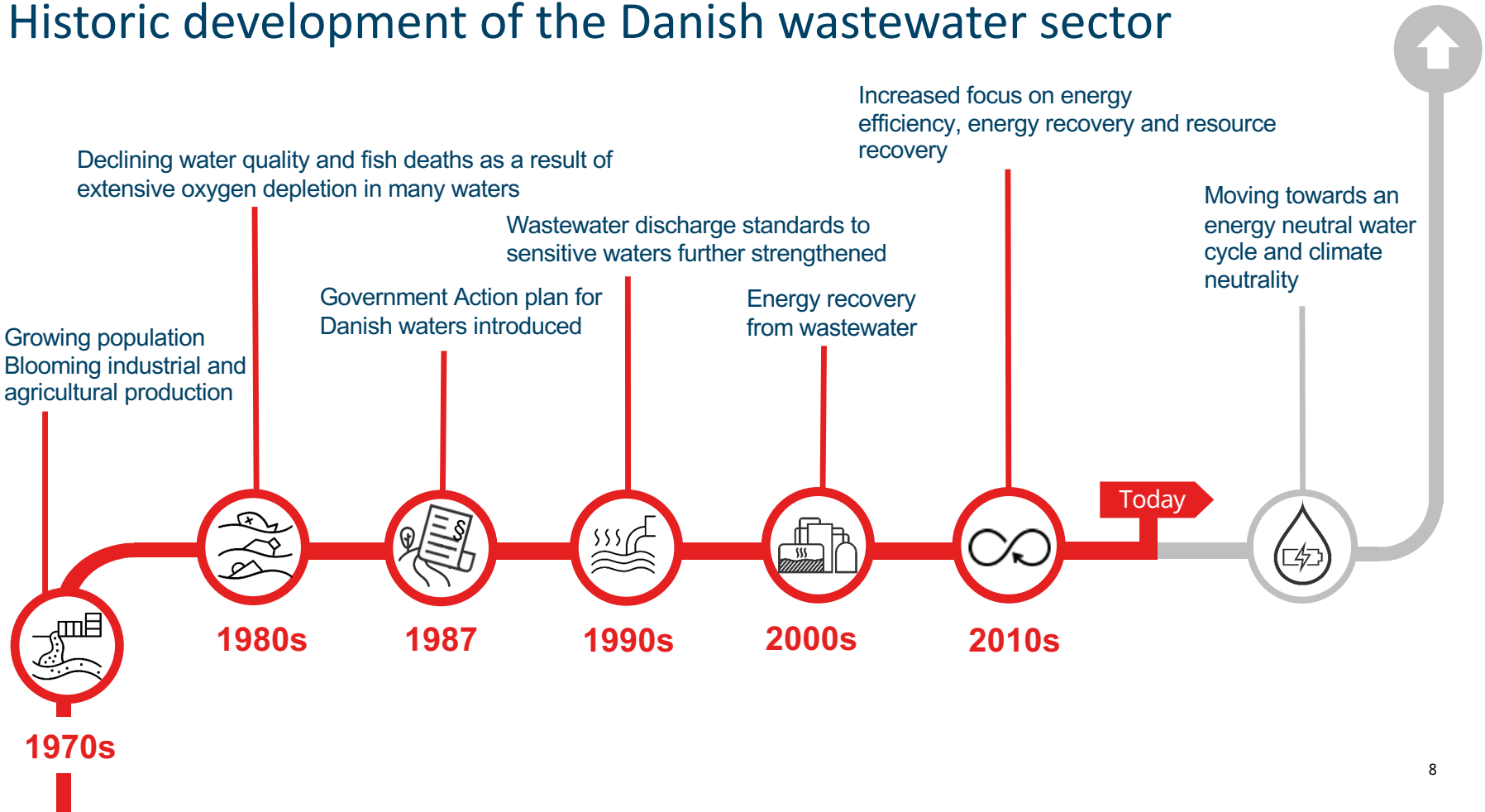
DHI

Wastewater treatment



- 94% of wastewater is subjected to tertiary treatment
- 700 plants, wherever moving towards a more centralised structure with fewer, larger plants. The total capacity of the plants is 12.2 mill. PE
- Discharge requirements depend on the vulnerability of the receiving environment
- Tax on each kilogram of discharged nutrients (C, P, N)

Historic development of the Danish wastewater sector



Towards an energy neutral water cycle and climate neutrality

The Danish water sector aims to be energy- and climate neutral by 2030

Water sector 2021	Total energy self-sufficiency - %
Drinking water	1.6
Transport	0.2
WW Treatment	82.3
Total	55.4

Recommendations from the climate partnership on waste, water and circular economy

- Increased energy efficiency in the water and wastewater sector
- Increased energy production via biogas and heat pumps
- Reduction of direct GHG emissions in the wastewater sector, incl. sludge
- Avoid rainwater and unauthorized water in the wastewater system
- Export efficient water technology to achieve global impact

Energy Positive WWTP Case - Marselisborg WWTP

Traditional activated sludge wastewater plant

Maximum capacities:

- Maximum capacity 220,000 PE_{BOD}
- Peak flow 1400 l/s

Wastewater mix:

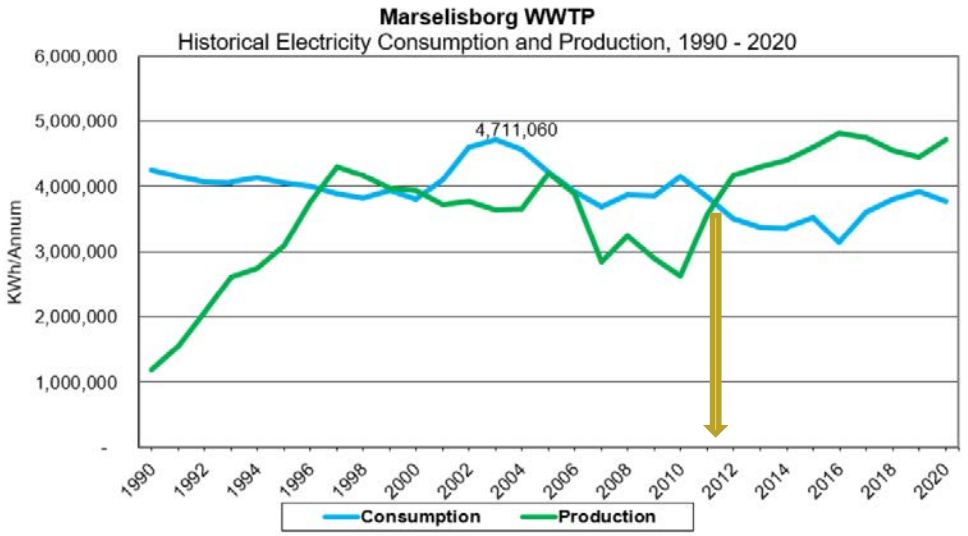
- Industrial loading approx. 10% of total organic loading the rest is from house holds
- No co-digestion of organic waste

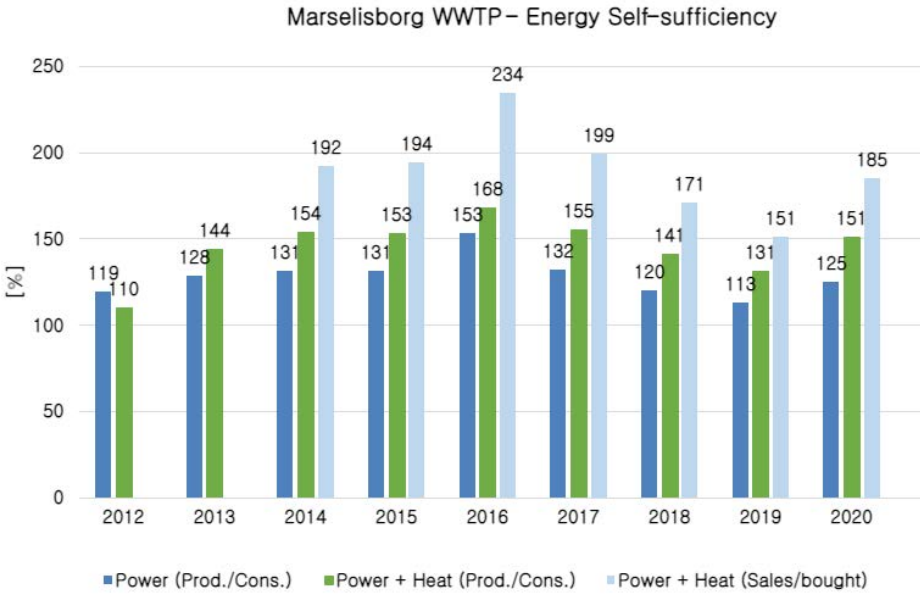
Effluent requirements:

Marselisborg WWTP		Limits
Total N	mg/l	**8**
Total P	mg/l	**0.8**
COD	mg/l	**75**
TSS	mg/l	**20**

https://www.danva.dk/viden/bm/om-benchmarking/

Energy Positive WWTP Case - Marselisborg WWTP



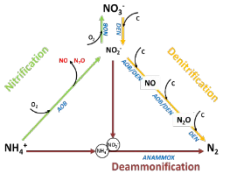


Energy Positive WWTP - Marselisborg WWTP (Denmark)

Process

÷ 700,000 kWh/year

Improved automation – controllability (sensors, software, VSD): N-removal controlled with NH4-online sensors and clarifier control.



Sludge liquor treatment based on Anammox

Components

÷ 300,000 kWh/year

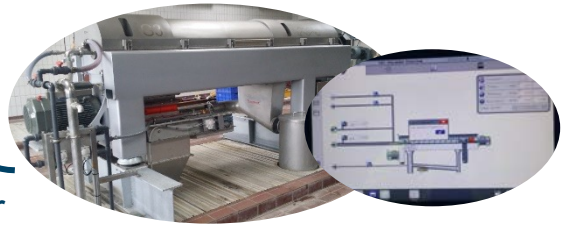
Efficient aeration: Upgrading of blower and diffusors

÷ 1.1 GWh/year

~ 25-30% el. savings

÷ 50,000 kWh/year

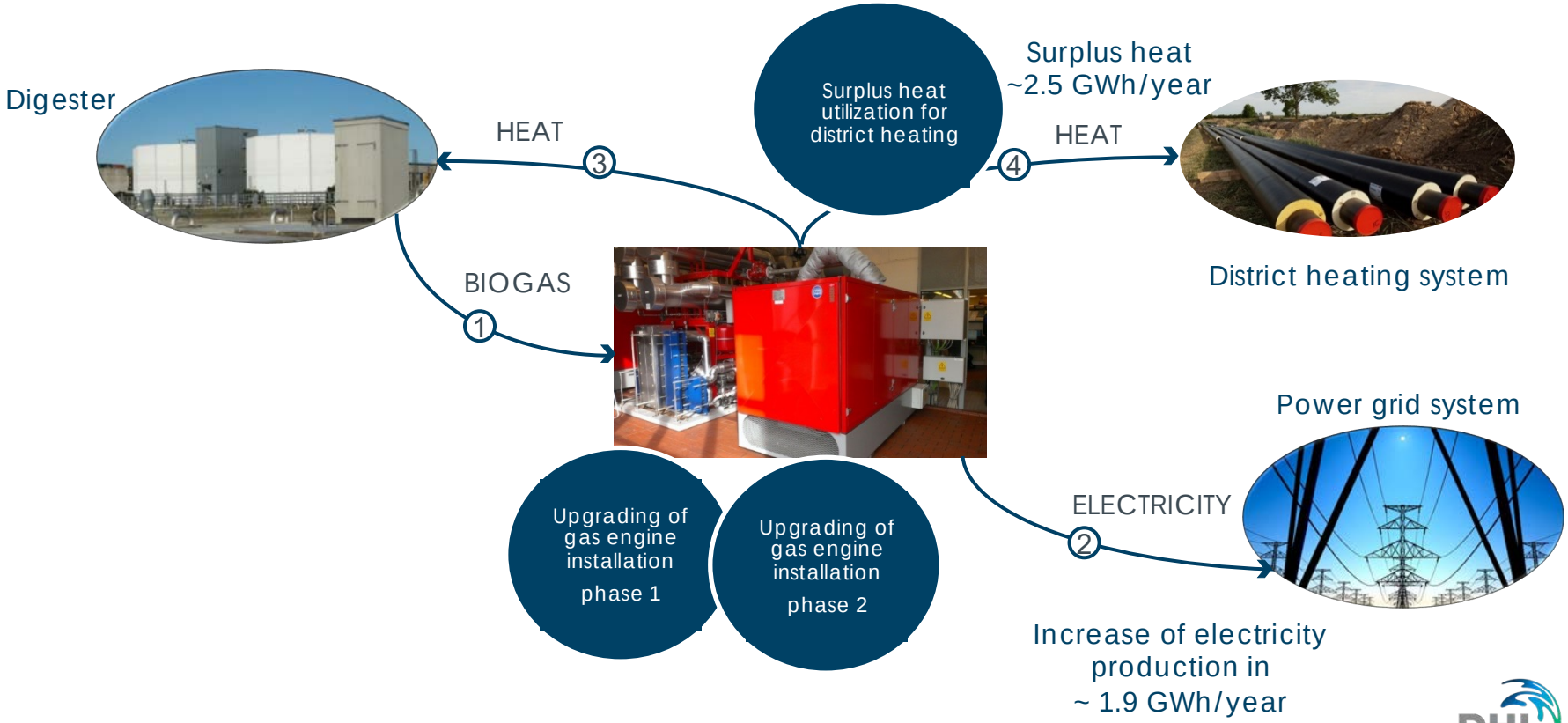
÷ 60,000 kWh/year



Replacement of old final dewatering unit and updated automatic control

Main activities 2006 - 2017

Energy production at Marselisborg WWTP



Advanced water modelling and simulation software

- MIKE Powered by DHI is our unique **water modelling software**
- Enabling clients to accurately analyse, model and simulate any type of challenge in water environments
- 25+ years of continuous development and updates
- Used for water environments in oceans and coastlines, rivers and reservoirs, ecology, groundwater, water distribution, wastewater and many more

What is WEST ?

- **Dynamic simulator** for physical, chemical and biological processes
- Domains:
  - Municipal wastewater treatment plants (**WWTP**)
  - Transition WWTP » **WRRF** (Water Resource Recovery Facility)
  - Integrated Urban Water Systems (**IUWS**): catchment, sewer, treatment plant, receiving water body
- Other domains, e.g. drinking water treatment (**WTP**)

Conclusion:
generic platform for process modelling (and simulation)

Areas of application

Contaminant fate and transport

Optimise treatment strategies by simulating contaminants based on varying sewage compositions and operational changes.

Deployment of digital twins

Enhance real-time management and evaluation of WWTP processes using digital twins with customisable dashboards for plant operators.

Real-time control or analysis

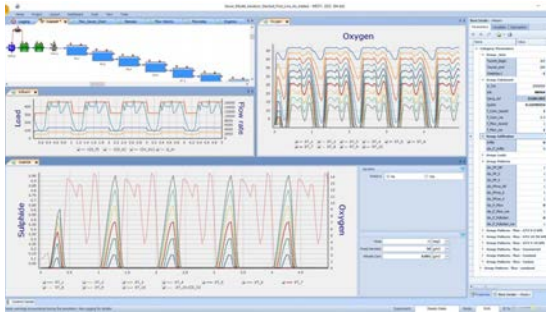
Improve WWTP efficiency through real-time control systems that dynamically adjust operations based on live data and analytics.

Water quality assessments

Provide tools for detailed analysis of water quality changes due to treatment processes and operational adjustments.

WWTP design and optimisation

Empower operators and consultants with advanced tools for analysis and modelling to enhance sustainability and efficiency.



Twinplant

Real time process control and Digital Twins of WWTP

Services & Technologies for Wastewater Treatment

Value engineering (pre-study)

Physical system

Sensors

T
DO
NH4
NO3
PO4
SS

Set-point = f(DO, NH4, …)

Data

Set-points (optimized)

Set-points (forecast assisted)

Set-points (model assisted)

Set-points (data driven)

The automated plant

The learning plant

The predictive plant

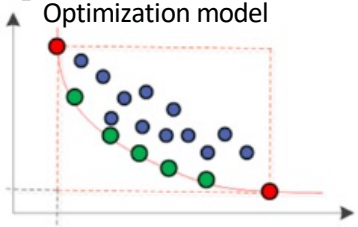
The optimized plant

Process Model

Forecast products

KPI

Optimization model



Data integration and Advanced Process Control

Digital Twin for training and real-time decision support

Thank you

Petr Dolejš
Wastewater Expert
petd@dhigroup.com

Sajid Alam
Territory Manager-India
sal@dhigroup.com