WATER AND SEWERAGE ADMINISTRATION BENCHMARKING SYSTEMS AND EU AND DANISH REGULATIONS

CARL-EMIL LARSEN, CHIEF EXECUTIVE, DANVA

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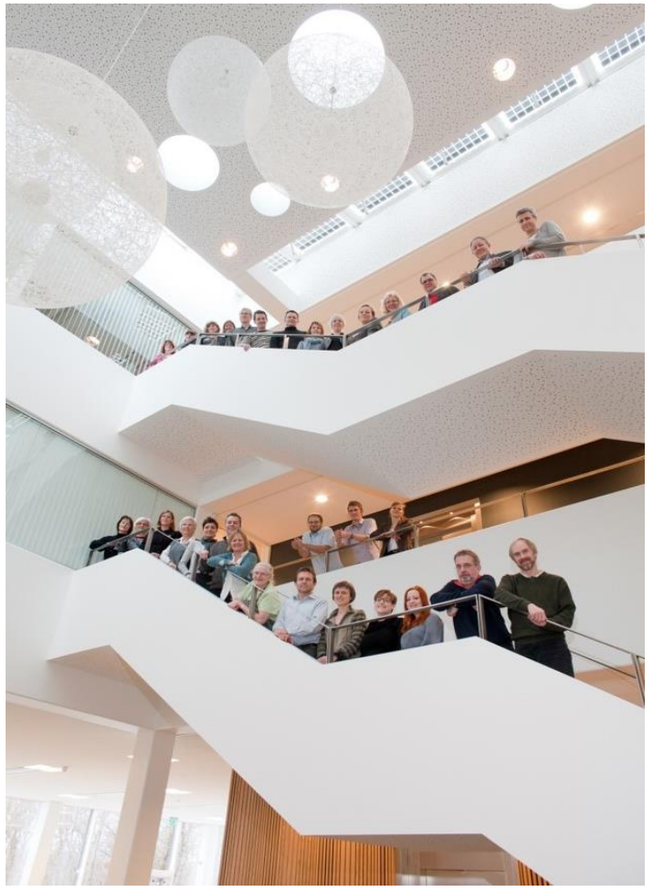
Danish Water and Wastewater Association

- ✓ Trade organization for Danish Watercompanies
- ✓ Board of Management include politicians and chief executives
- ✓ Appr. 100 companies with voting rights.
- ✓ Member companies are giving service to more than 5 million Danes
- ✓ Number of staff is 35. Appr. 300 colleagues from member companies organised in network and projectgroups
- ✓ Entitled to attend public hearings and consultations
- ✓ EurEau – the European Federation of national water associations
- ✓ Members service, representation of interest, training, communication of best practice, standardisation and projects



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Danish watersector

- Inhabitants: 5.806.081 (2019K1)
- Annual extraction by the waterworks: 373.000.000 m^3 (decreasing)
- Number of waterworks: 2.400
- 100% groundwater, simply treated, no chlorine added
- Number of wastewater treatments plants: 786
- Annual treatment of waste water: 697.000.000 m^3
- Annual turnover watersupply: 1 billion euro
- Total annual turnover waterservices: 3 billion euro
- 100 % public owned (35 % of waterworks (volume) are cooperatives)
- Operation & maintenance 50 % public
- Construction work 15 % public

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DANVA BENCHMARKING

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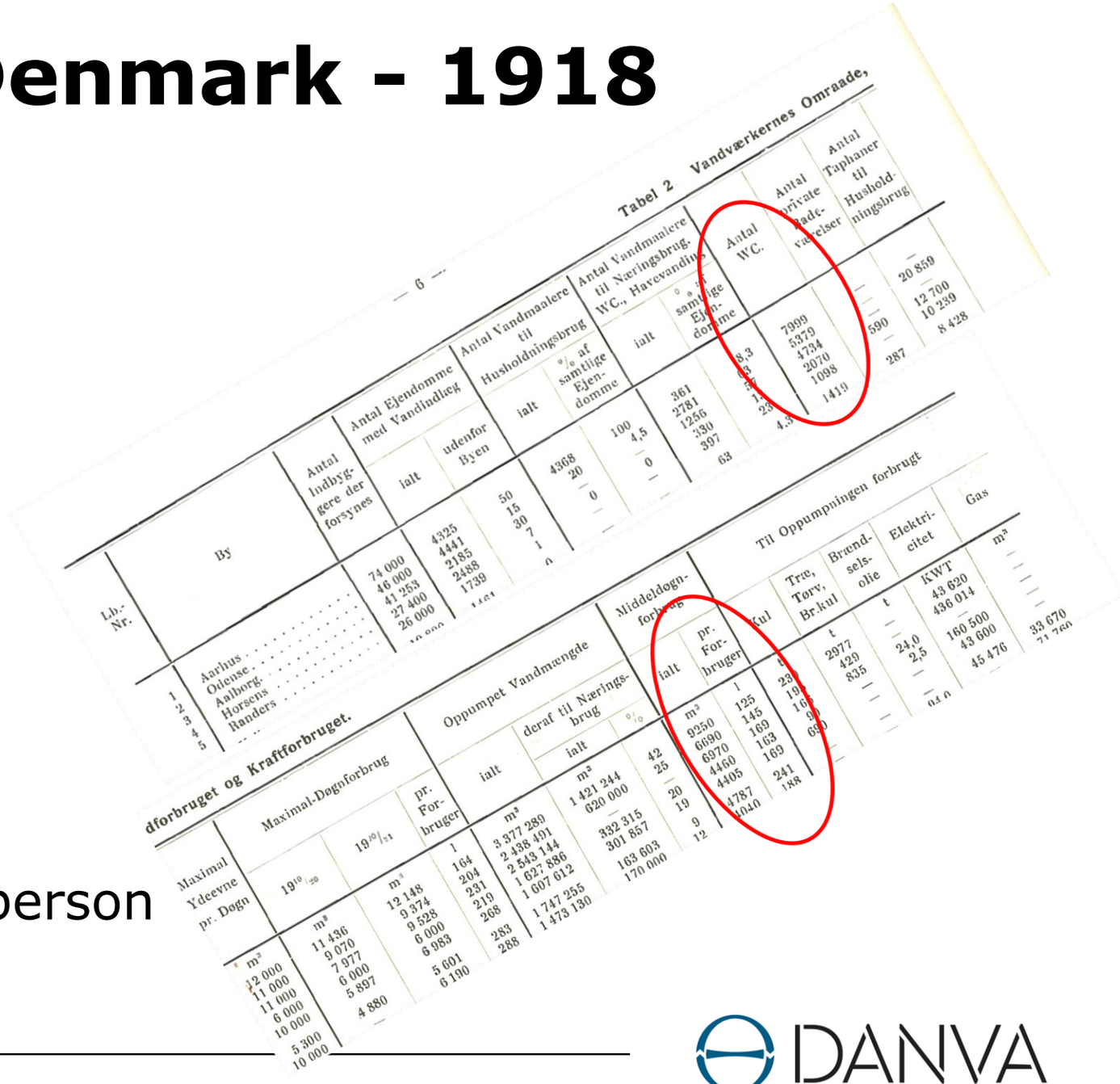
Benchmarking in Denmark - 1918



Tabel 2 Vandværkernes Omraade,

— 6 —

Lb.-Nr.	By	Antal Indbyggere der forsynes	Antal Ejendomme med Vandindlæg: ialt	Antal Ejendomme med Vandindlæg: udenfor Byen	Antal Vandmaalere til Husholdningsbrug: ialt	Antal Vandmaalere til Husholdningsbrug: % af samtlige Ejendomme	Antal Vandmaalere til Næringsbrug, Havevanding: ialt	Antal Vandmaalere til Næringsbrug, Havevanding: % af samtlige Ejendomme	Antal WC.	Antal private Badeværelser	Antal Taphaner til Husholdningsbrug
1	Aarhus	74 000	4325	50	4368	100	361	8,3	7999	—	20 859
2	Odense	46 000	4441	15	20	4,5	2781	64	5379	—	—
3	Aalborg	41 253	2185	30	0	0	1256	29	4734	—	12 700
4	Horsens	27 400	2488	7	—	—	330	7,5	2070	590	10 239
5	Randers	26 000	1739	1	—	—	397	23	1098	—	8 428
			1461	0			63	4,3	1419	287	

dforbruget og Kraftforbruget.

Maximal Ydeevne pr. Døgn	Maximal-Døgnforbrug: 19[10]/20	Maximal-Døgnforbrug: 19[20]/21	Maximal-Døgnforbrug: pr. Forbruger	Oppumpet Vandmængde: ialt	Oppumpet Vandmængde: deraf til Næringsbrug: ialt	Oppumpet Vandmængde: deraf til Næringsbrug: %	Middeldøgnforbrug: ialt	Middeldøgnforbrug: pr. Forbruger	Til Oppumpningen forbrugt: Kul	Tre, Tørv, Brikul	Brændselsolie	Elektricitet	Gas
m³	m³	m³	l	m³	m³	%	m³	l	t	t	t	KWT	m³
12 000	11 436	12 148	164	3 377 289	1 421 244	42	9250	125	23	2977	—	43 620	—
11 000	9 070	9 374	204	2 438 491	620 000	25	6690	145	19	429	—	436 014	—
11 000	7 977	9 528	231	2 543 144	—	—	6970	169	16	835	—	—	—
6 000	6 000	6 000	219	1 627 886	332 315	20	4460	163	9	—	24,0	160 500	33 670
10 000	5 897	6 983	268	1 007 612	301 857	19	4405	169	6	—	2,5	43 600	—
5 300	4 880	5 601	283	1 747 255	163 603	9	4787	241	30	—	—	45 476	—
10 000	—	6 190	288	1 473 130	170 000	12	4040	188	—	—	—	—	—

Danish Statistics from 1918

Drinking water – eg.:

- Number of inhabitants
- Number of houses with water
- Abstracted groundwater
- Avage daily consumption – l/person
- Number of toilets

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DANVA Benchmarking

1998:

- EU regulation on electricity started and Danish energy utilities did the first pilot on benchmarking
- 8 DANVA members started a project on benchmarking

2003:

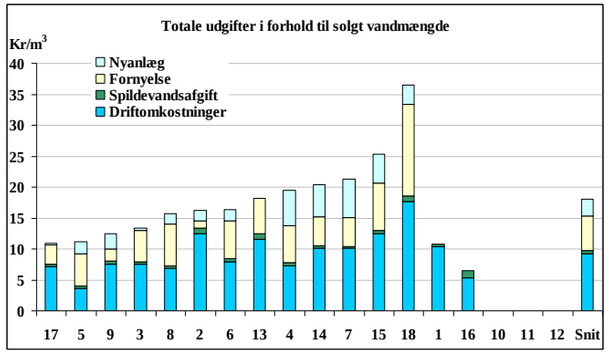
- DANVA Benchmarking on drinking water and waste water 2. pilot based on data from 2001 – excel

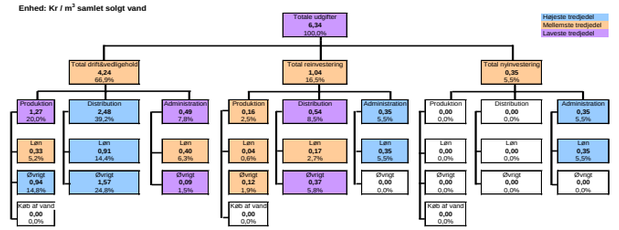
2004:

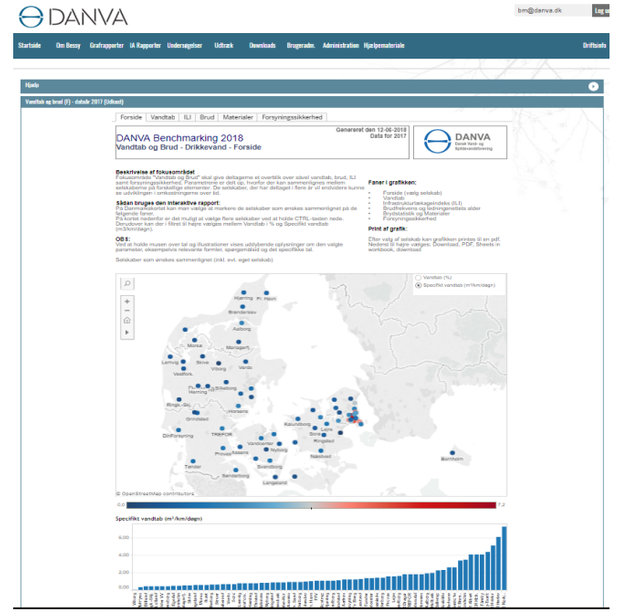
- BESSY I: First portal and related database for DANVA benchmarking
- Cooperation among nordic and dutch association on benchmarking

2009:

- BESSY II: Improved portal with new functionalities as automatic reporting and flexible surveys.







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Benchmarking for water companies

Reporting to Secretariat for water supply (2010):

- Economic regulation
- TOTEX Benchmarking => Efficiency requirement

(Economy)

Legal requirement

Reporting to Danish Environmental Agency (2018):

- Performancebenchmarking – mandatory from 2018

(Environmental parameters)
(Energy consumption/production)
(CO_2 footprint)

Legal requirement

Reporting to DANVA Benchmarking (2004):

- Danva Benchmarking

(Economy, environmental and much more)

Voluntarily
Fee: 2500 €

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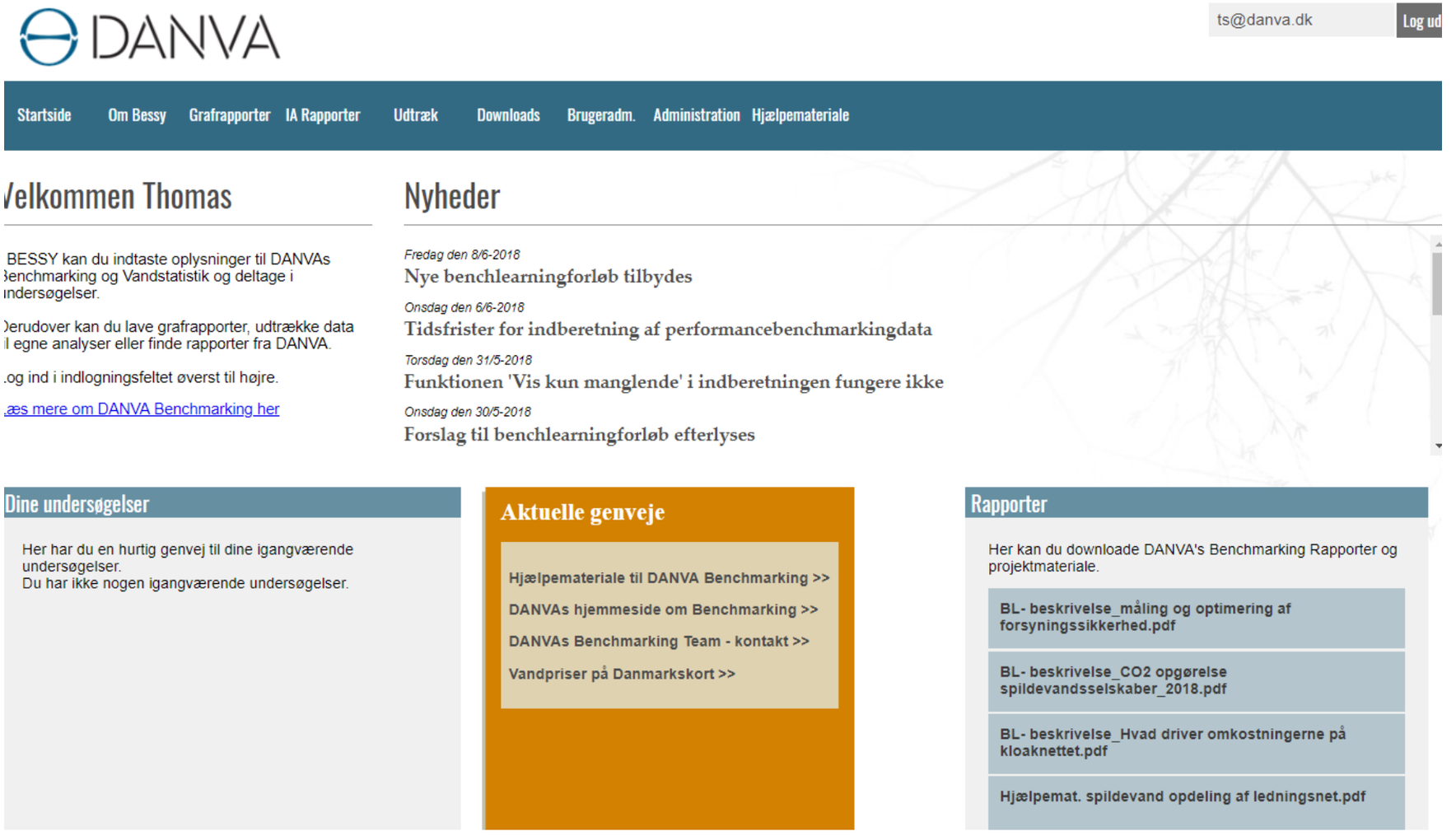
BESSY – user-friendly website



User-friendly system

Setting up surveys is easy and fast

Communication with the participants is easy

Uploading of reports and Materials is easy

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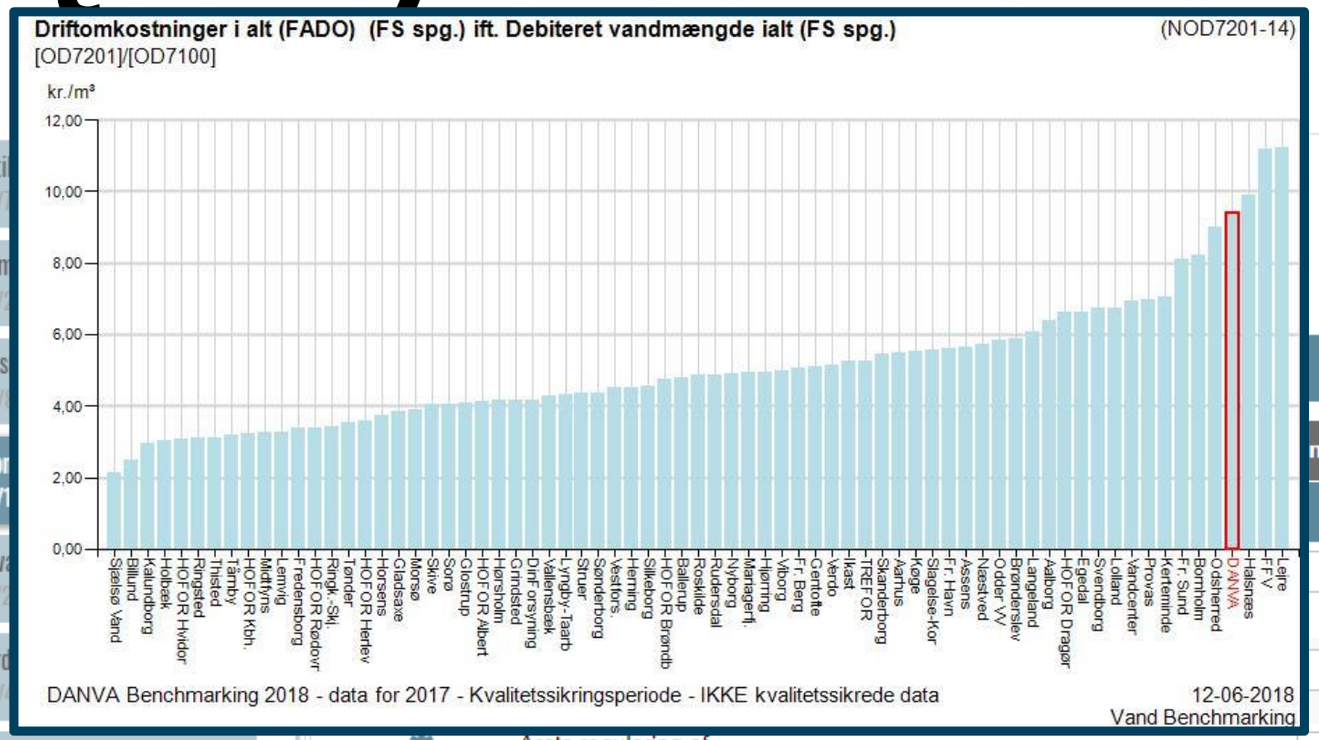
Quality check – on the fly



Spørgsmåls ID

Toleranceadvarsler Valideringsadvarsler Udskriv Fold ud

Statisti
Alle: 5/

Perform
Alle: 3/

Arbejds
Alle: 0/

Driftsor
Alle: 5/1

Grundva
Alle: 1/2

Overord
Alle: 0/

Investeringsomkostninger
Alle: 0/18, Obl.: 0/13

Vandtab og brud
Alle: 0/33, Obl.: 0/22

Eksterne data
Alle: 5/49, Obl.: 5/39

Afslut til DANVA

				ndberetning 2017		Vidensniveau		Note	Besked	Gemt
				9.500.000	kr.		1			
							1			
OD7600	Årets regulering af regnskabsmæssigt hensatte			50.000	kr.		1			
				600.000	kr.		1			
OD7201	spg.)			8.500.000,00	kr.					
NOD7000-14	Driftsomkostninger iflg. revideret regnskab eksklusiv afskrivninger	10,00	kr./m³	10,56	kr./m³					
				9,44	kr./m³					

Histogram

Tolerance warning:
The reported data differ to much from last years data

Validation warning:
The data is outside an expected area
3<x<8 kr/m3

Participants can "approve" the warning

Reports DANVA BM

Public report:

- Water in figures

Graph reports:

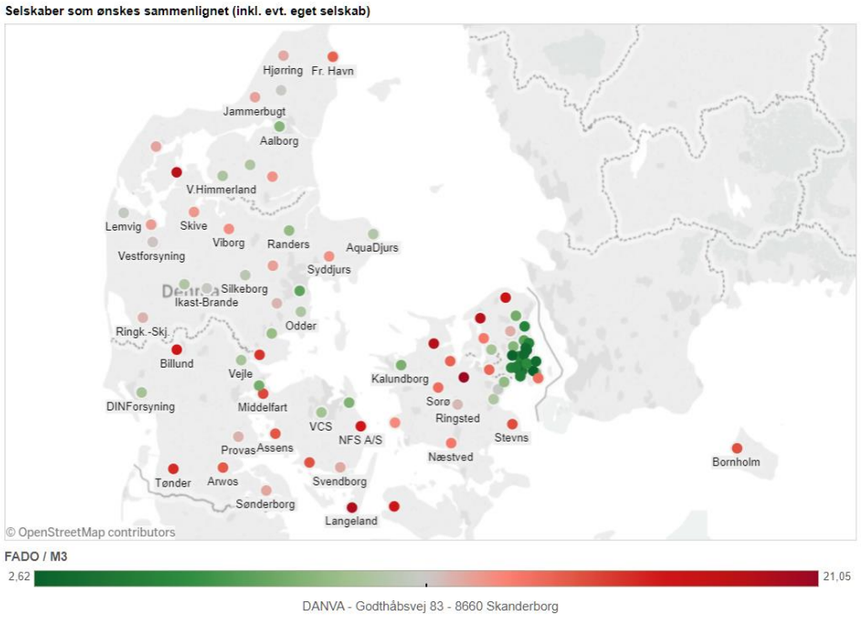
- 100-120 graphs with KPI
- Reading online into database

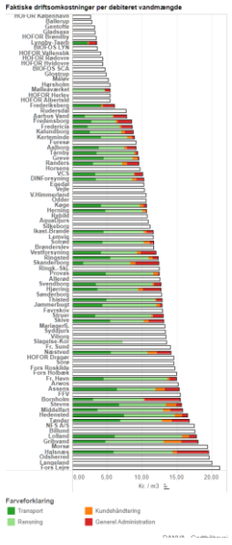
Interactive reports for each focus area:

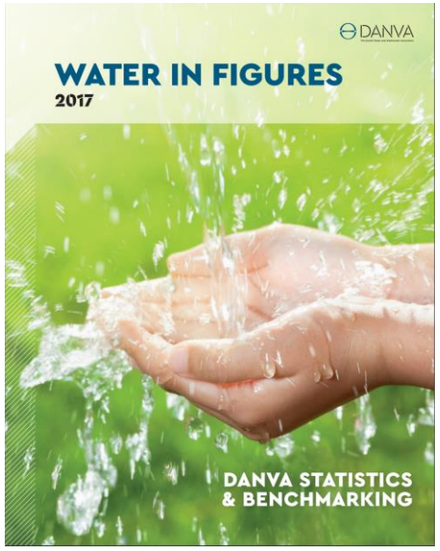
- Report for each focus area – ready online parallel with the reporting period
- Customized by user
- Customized reports can be saved as .pdf
- Reports are generated online and instantly synchronized with the database

Video-meetings:

- 1 hours video meeting for each report







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From benchmarking to benchlearning:

Some of our participants had the problem:

”We used at lot of time getting data into the system but we never get time to use/work with the results!”

We therefore started offering DANVA **Benchlearning** work-shops:

- We choose one specific subject
- Invite our participant to a process with 2 – 4 workshops
- We talk about experiences, learn of each other, sums up opportunities for improvements, develop new KPIs
- There will be homework for the participants
- Each cource is finishes with a small experience report, witch is distributed to all the others participant.

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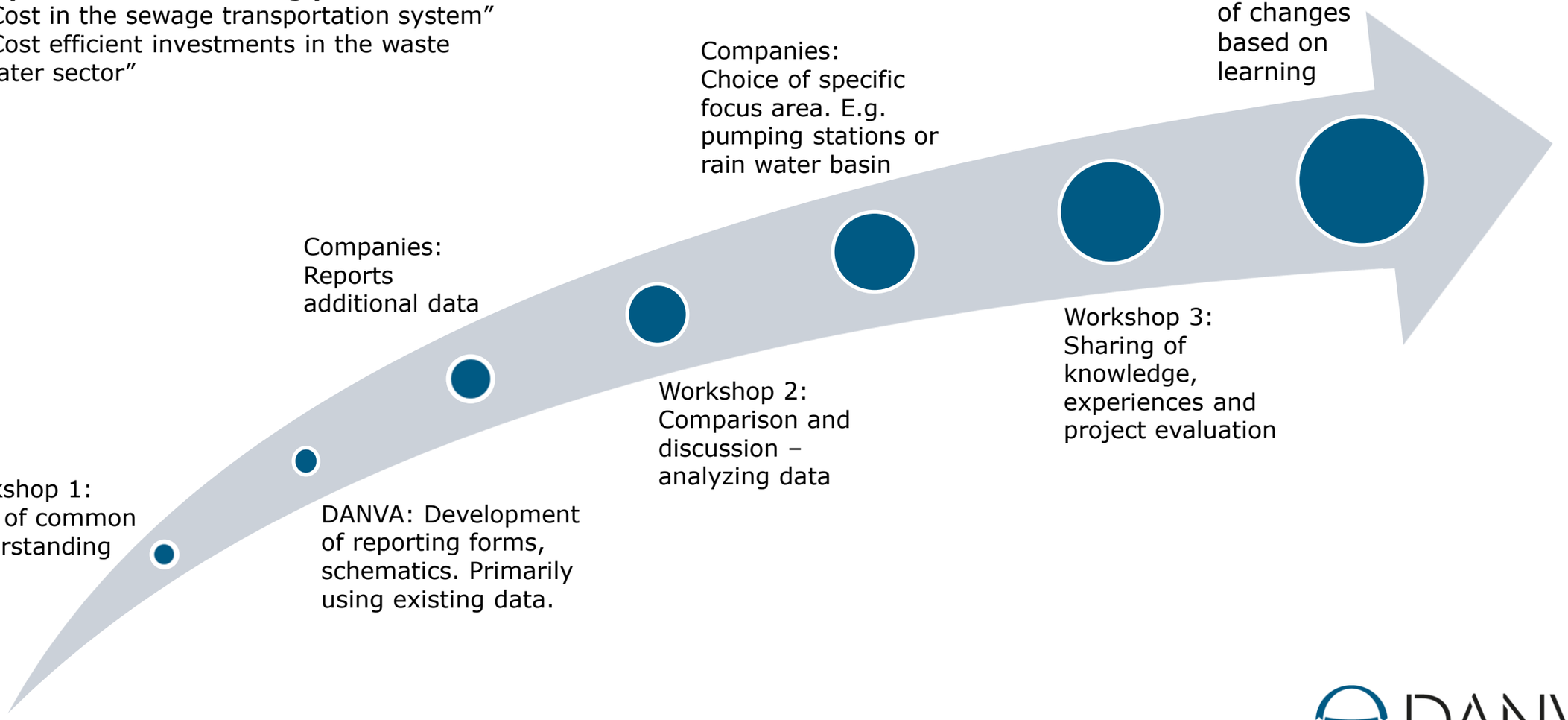
Benchlearning in practice

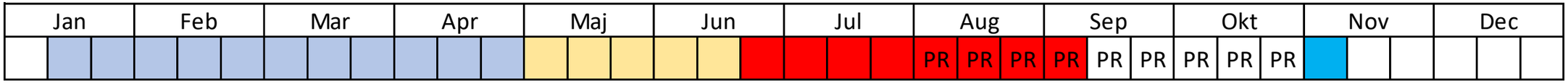
Example of a benchlearning process:

- "Cost in the sewage transportation system"
- "Cost efficient investments in the waste water sector"



Optimized timeline

DANVA Benchmarking - 10 years ago:



DANVA Benchmarking - 5 years ago:

DANVA Benchmarking - last year:

	=	**Preparing the IT-programme with questions**	PR	=	**Preparing main report**
	=	**Water Comapnies reporting data**		=	**Main reports publish**
	=	**Quality check of data**		=	**Benchlearning**

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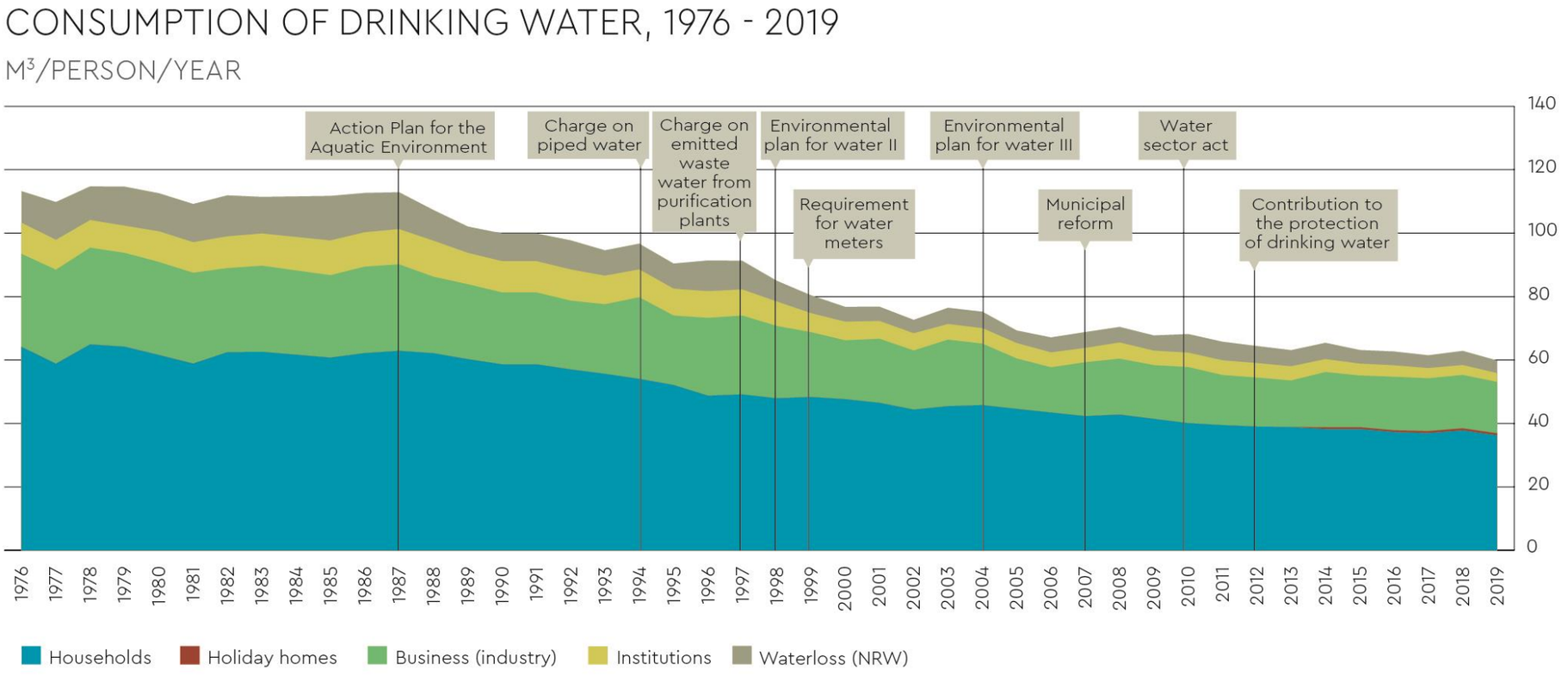
Consumption of water, 1976 – 2017



Since 2014, a new category of "holiday homes" has been introduced, which is included among the figures for households.
1976–1998: Special project: Modelling of water demand in Denmark by Nana Sofie Aarøe – data from 14–30 companies.
1999–2019: Data from DANVA's calculations for "Water in Figures" – data from 33–116 companies.

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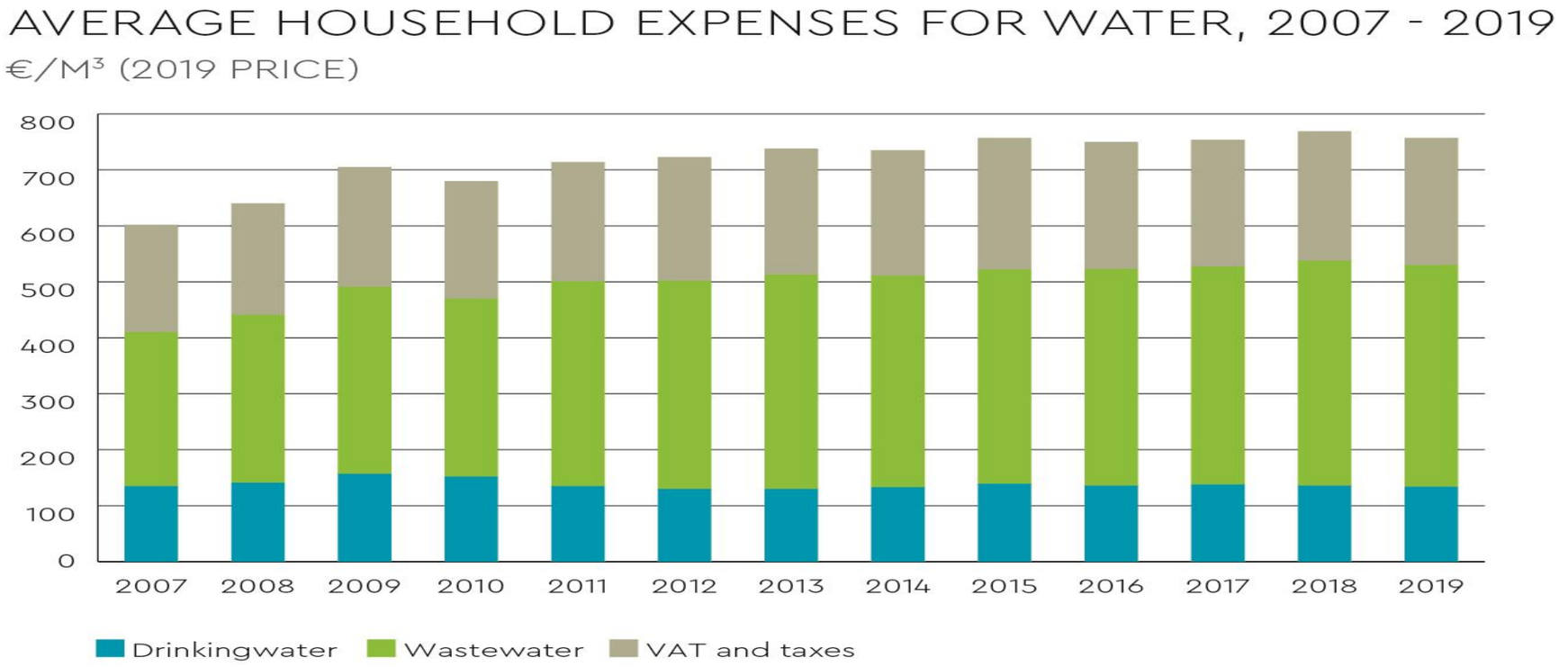
Average household expenses for water

Cost for drinking water (blue) and waste water (green)



The estimate is for an average family of 2.15 people with an average consumption per person of 36.88 m³/year.

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Annual household living expenses

Data from www.statistikbanken.dk/FU51 – data from 2014 and 2015, current prices. The example covers a family with 2 adults, with one or more children living at home, with annual expenditure of DKK 420,950.

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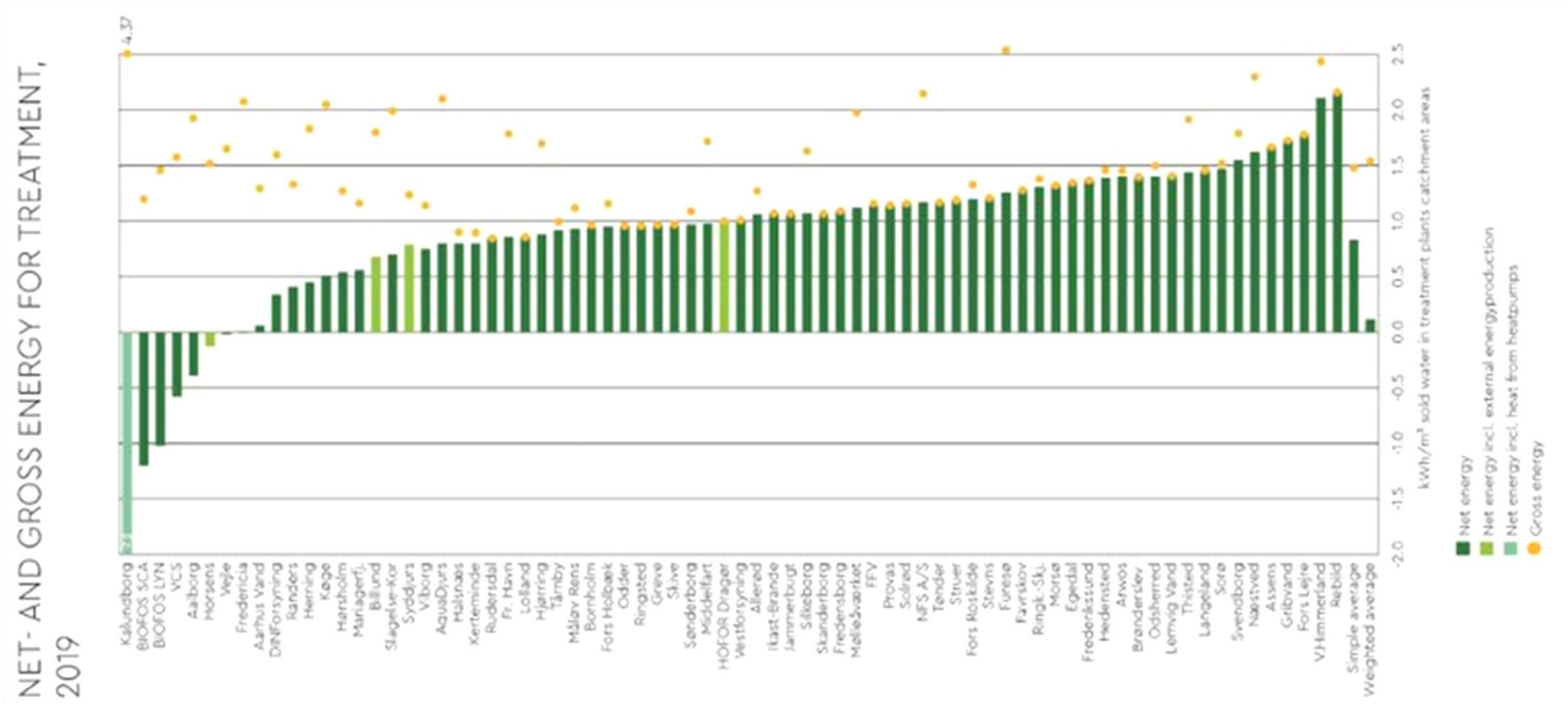
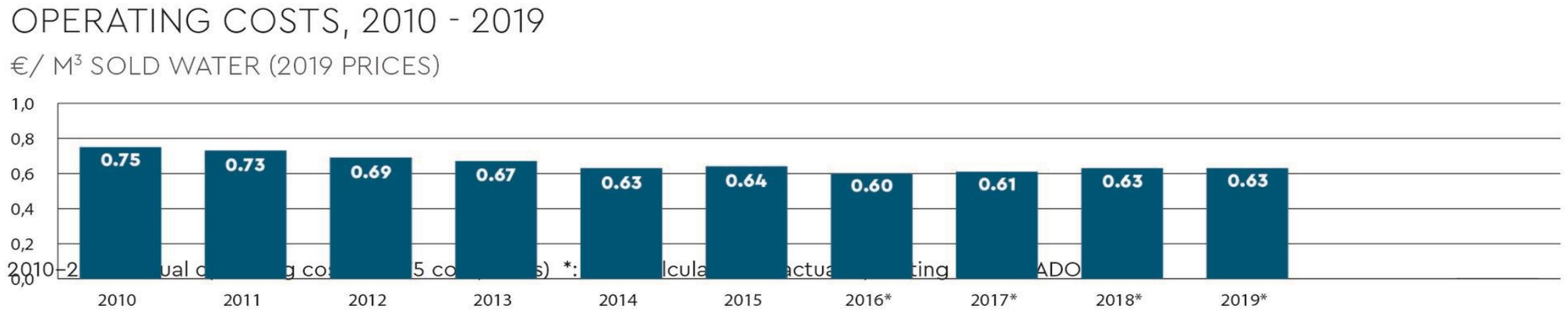
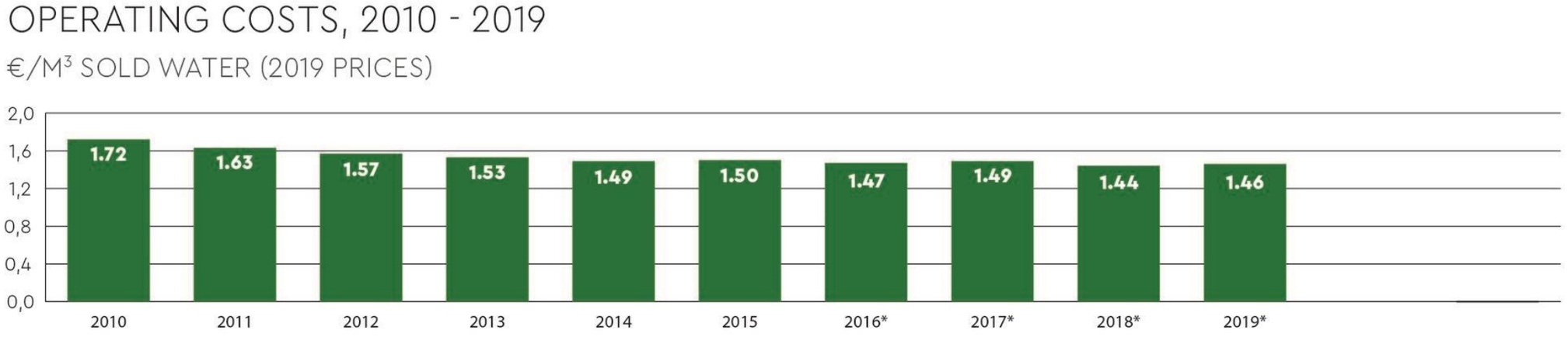
Net and gross energy for treatment



Operating cost



2010-2 ual o g co 5 co s) *: lcula actua ting ADO



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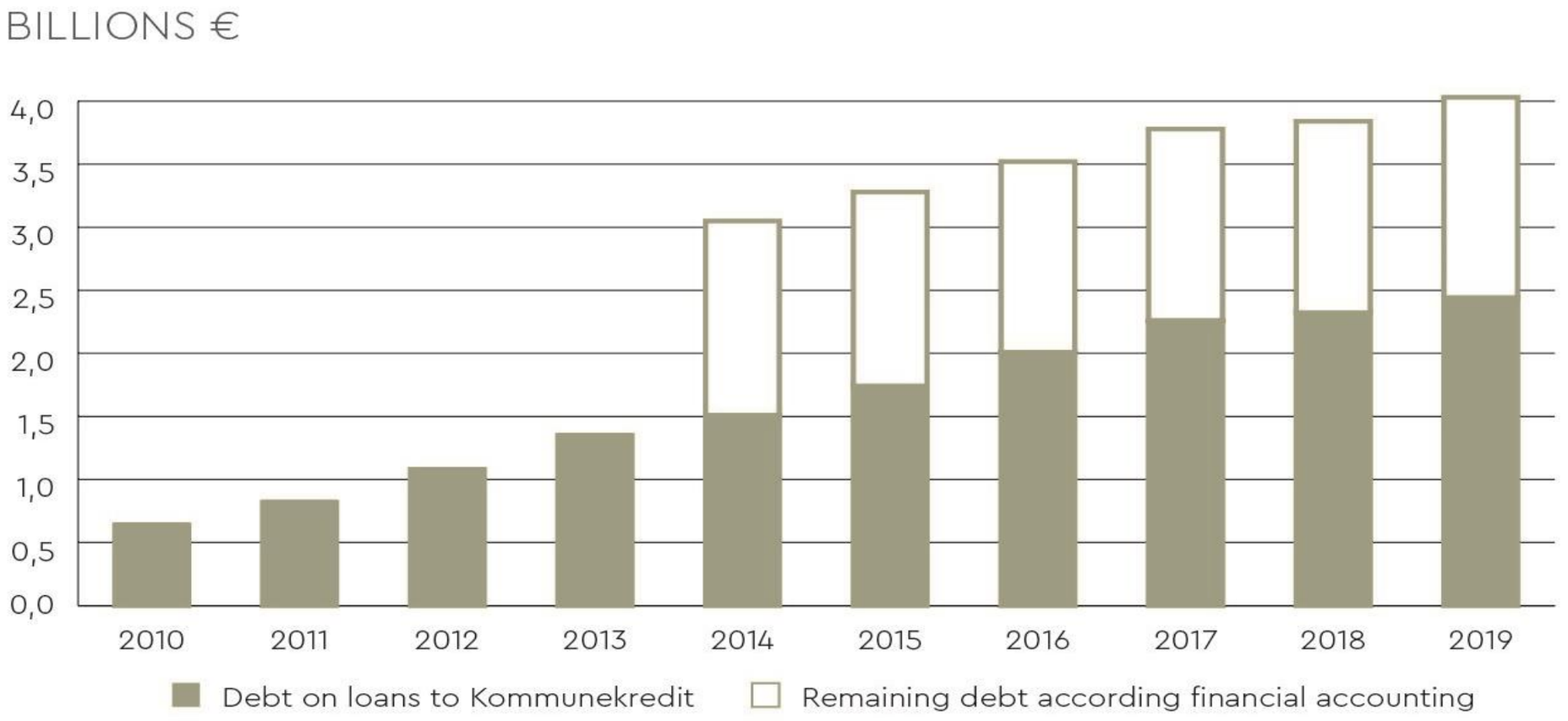
Debt on loans to watercompanies



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ECONOMIC REGULATION OF THE DANISH WASTE WATER SECTOR

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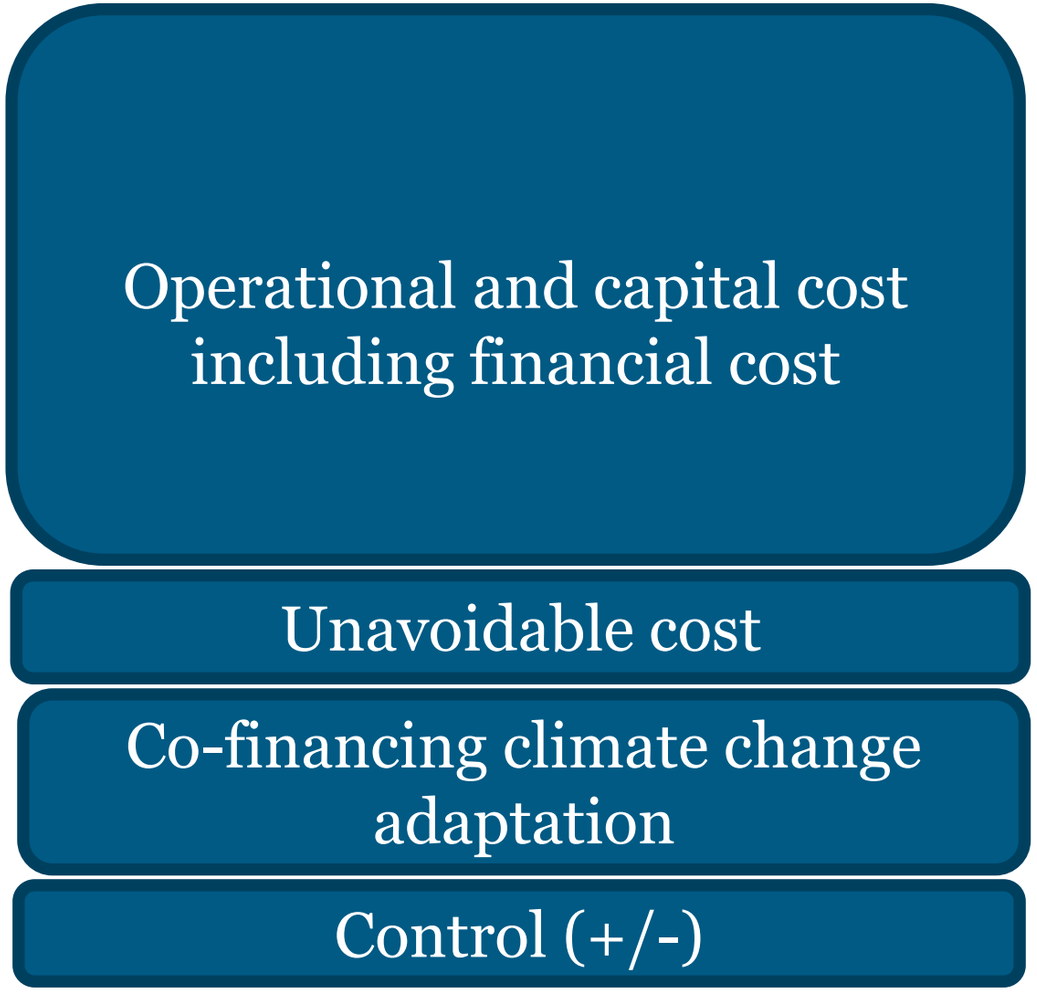
Cap on prices/revenue

- Price cap – prices not allowed to exceed a given limit (2011-2016)
  - Focus on maintenance and operational expenses
- Revenue cap – revenue not allow to exceed a given limit (2017-?)
  - Focus on total expenses (including capital cost)
- Attention: No cap on expenses
- Loan an opportunity (limited on operational expenses for municipal-owned companies)

Revenue cap divided into boxes:



Decreasing cap…

General cut (yearly)

- 2 % of operational cost in cap
- Variable cut on capital cost in cap depending on productivity in similar sectors (2,8%)

Individual cut (yearly)

- Up to 2 % of total cap – based on regulatory benchmarking

Small companies

- 200.000 m3 – 800.000 m3 general cut on 1,7 % yearly – no individual cut.

Total cuts

DKK 2 billion (EUR 270 mio. of appr. 2 billions (13,5%))

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Cost that can lead to increased cap:

- Activities imposed/authorized by municipalities or the state (where they have the legal power to do so)
- Extension of supply area
- Replacement of sewers and pumping stations if cost are imposed by other infrastructure projects
- Periodical operational cost, co-financing climate change adaption, lacking ability to pay off debt, force majeure, other adjustments.

PRICING IN THE DANISH WATER SECTOR

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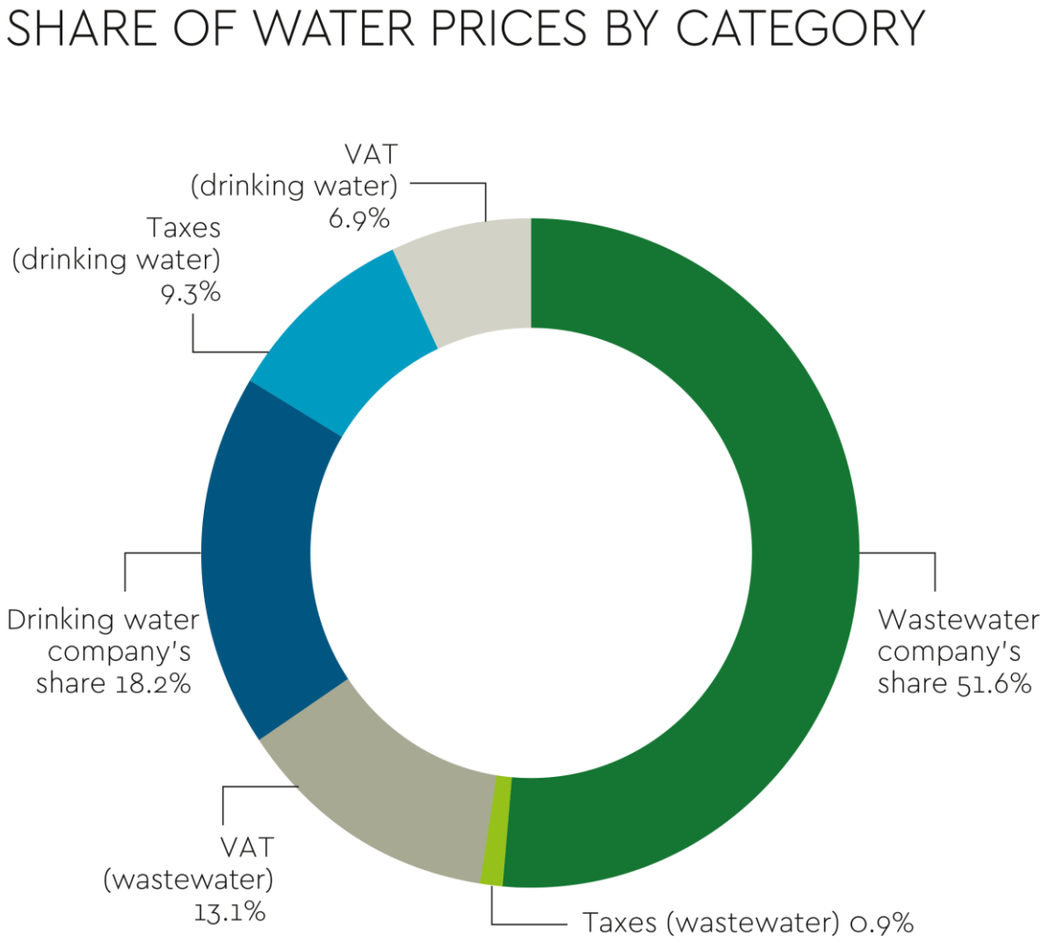
Composition of average price

Average price for an average family – 2,15 persons consuming 82,69 m^3 - in 2018: 69 DKK (9 EUR /38 AED)/m^3

Categories to the right



Full cost recovery and polluter pays

- Waste water service customers pay all costs
- E.g.: investments, operational, admin-istrative, environmental, regulatory, VAT and taxes
- No tax grants to the water sector (full cost recovery)

Payment based on metering

- Mandatory by law that all customers (citizens and public/private enterprises and institutions) have individual drinking water meters on their properties

- Payments are calculated according to prices in DKK multiplied by volume in m^3 of drinking water consumption
- Payment for waste water services is based on drinking water consumption too. Differing volumes of storm water discharge from customers are not reflected in pricing

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Variable and fixed pricing

Drinking water fees		Waste water fees	
Fixed	Variable	Fixed	Variable
Connection fee 25,753 DKK (3,452 EUR) (14,100 AED)	-	Connection fee 51,600 DKK (6,916 EUR) (28,383 AED)	-
Operation fee 680 DKK (91 EUR) (374 AED)	Operation fee 18 DKK/m^3 (2.4 EUR) (10 AED)	Operation fee 467 DKK (63 EUR) (256 AED)	Operation fee 41 DKK/m^3 (5,5 EUR) (22,55 AED)

* National average fees from 2019
* VAT included in all fees
* Corporations pay an additional fee, if they discharge severely polluted waste water

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VAT and environmental taxes

- VAT constitutes 25% on sales of goods and services – including the ones in the water and waste water sector
- Waste water is also taxed with an environmental tax: 0.65 DKK (0.35 AED) per m^3 waste water discharged from a waste water treatment plant
- The tax is levied on remaining substance loads of Nitrogen, Phosphorous and organic material and incentivises plants to more substance removal

* VAT included in the tax

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WATER LOSSES IN DENMARK

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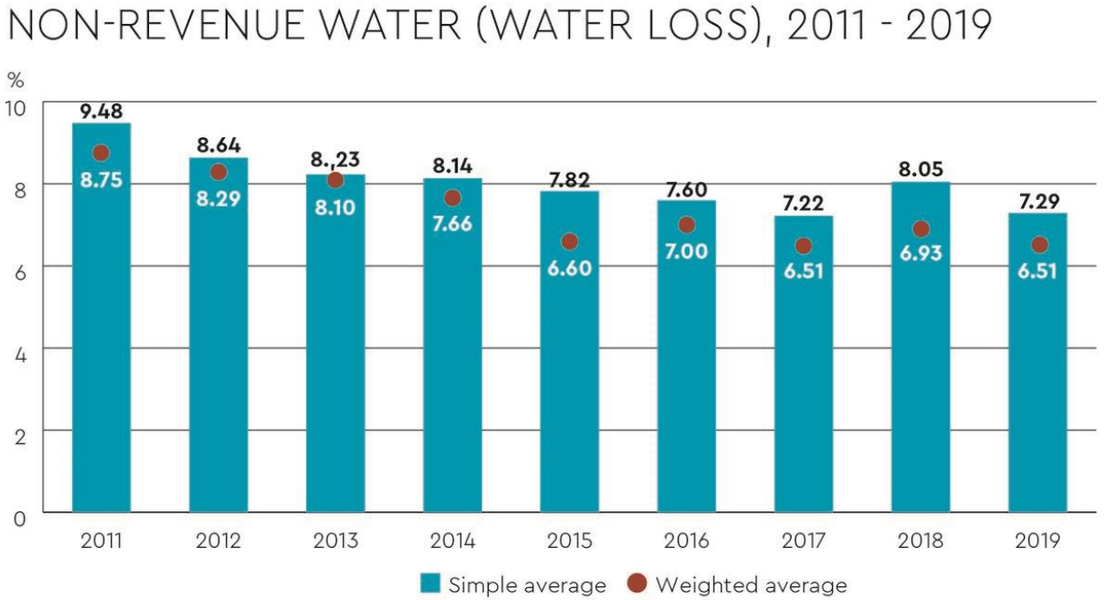
Water losses in Denmark

- Denmark have a very low level of water loss in the distribution system.
- In 1996 a penalty was introduced for water losses above 10 %.
- A law from 1996 demands metering of all evacuated and billed water, which gives very solid data.
- On-line metering is improving the data further and developed fast from 15 % of all meters in 2013 to 46% in 2017.



Average (%) based on 50–52 drinking water companies which have participated in DANVA benchmarking over the past 9 years.

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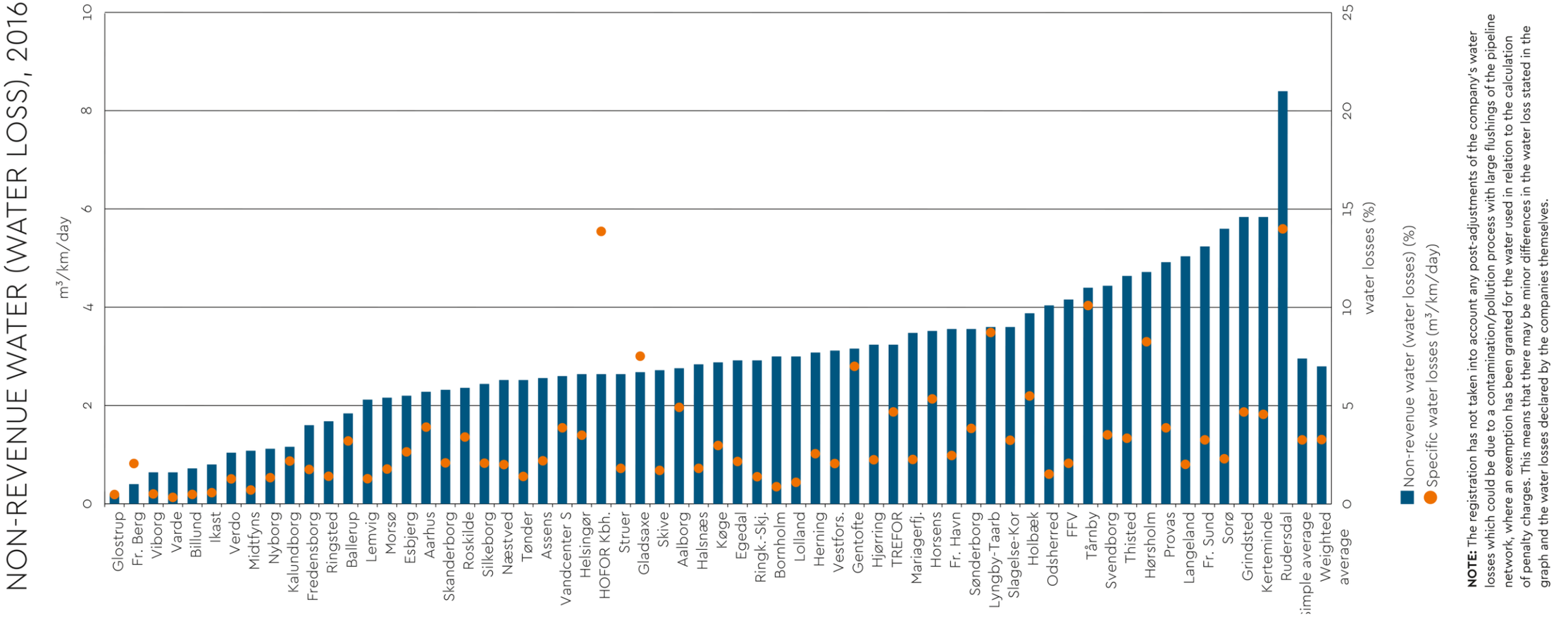
Waterloss in the distribution system



NOTE: The registration has not taken into account any post-adjustments of the company's water losses which could be due to a contamination/pollution process with large flushings of the pipeline network, where an exemption has been granted for the water used in relation to the calculation of penalty charges. This means that there may be minor differences in the water loss stated in the graph and the water losses declared by the companies themselves.

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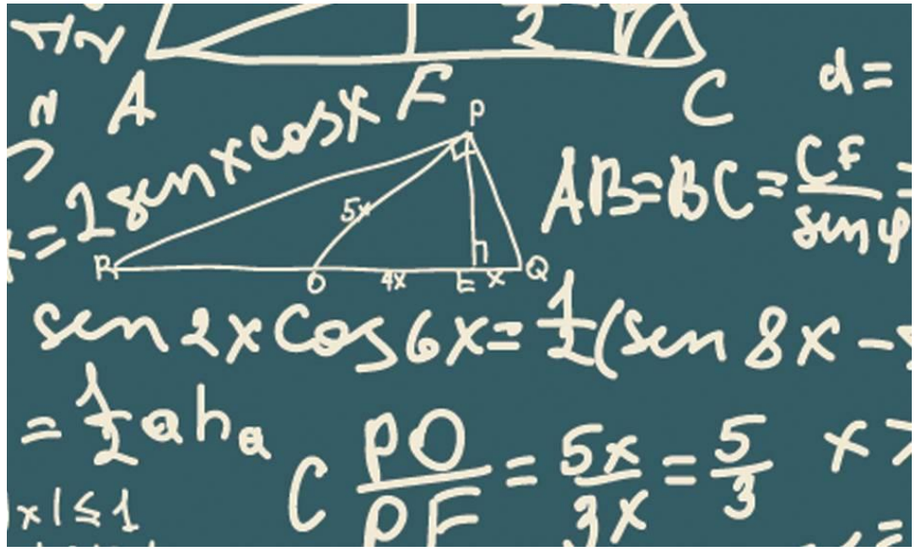
Water losses

Types of calculation methods:



Non-revenue Water:

- Water loss; %
- Specific Water loss; m3/km/day

Real losses:

- Infrastructure Leakage Index (ILI)

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IWA Waterbalance

System Input Volume	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption (including water exported)	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorised Consumption	Unbilled Metered Consumption	Non-Revenue Water (NRW)
			Unbilled Unmetered Consumption	
	Water Losses	Apparent* Losses	Unauthorised Consumption	
			Metering Inaccuracies	
		Real* Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to the measurement point	

ILI

Water loss

Specific Water loss

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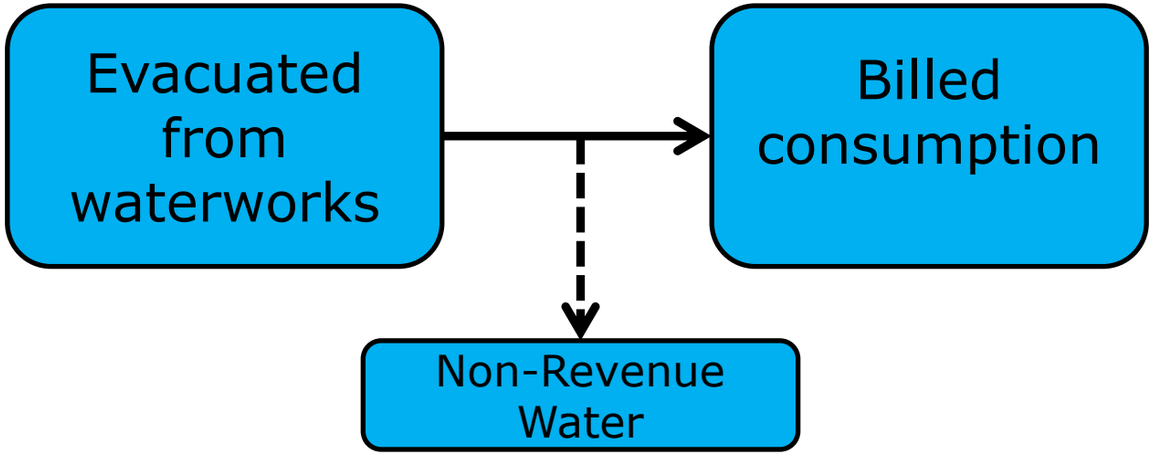
Non-revenue Water



Non-Revenue Water:

- **Unbilled autorised consumption:**
  - flush recently repaired pipelines and to extinguish fires
- **Apparent losses:**
  - Unautorised consumption, metering inaccurancies
- **Real losses:**
  - Leakage into undergroud

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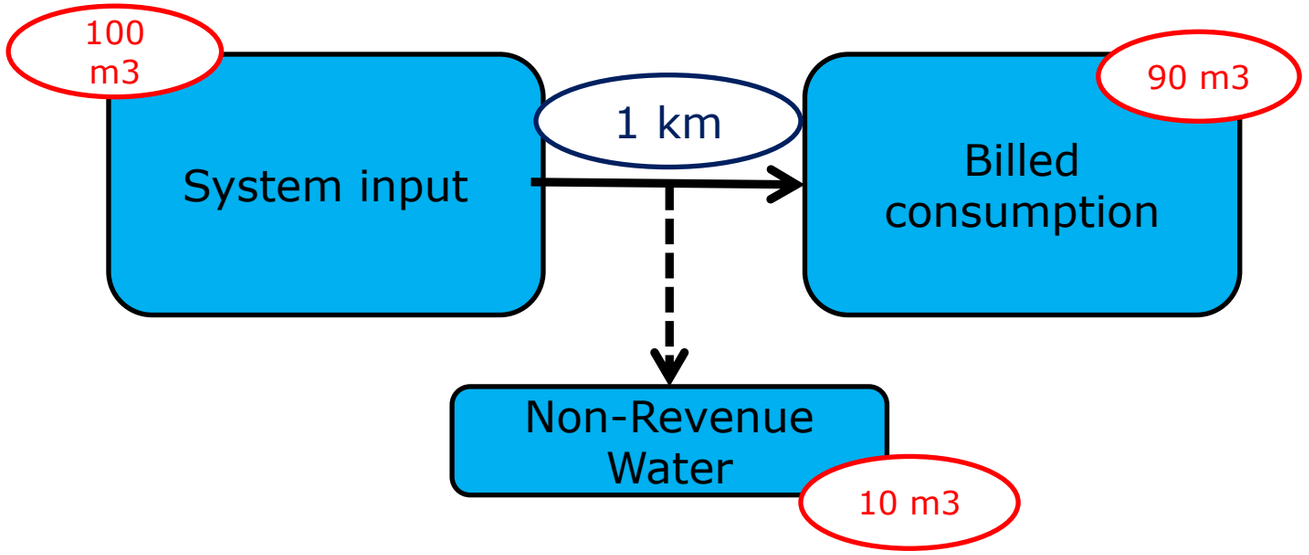
The difference between % and m3/km/day

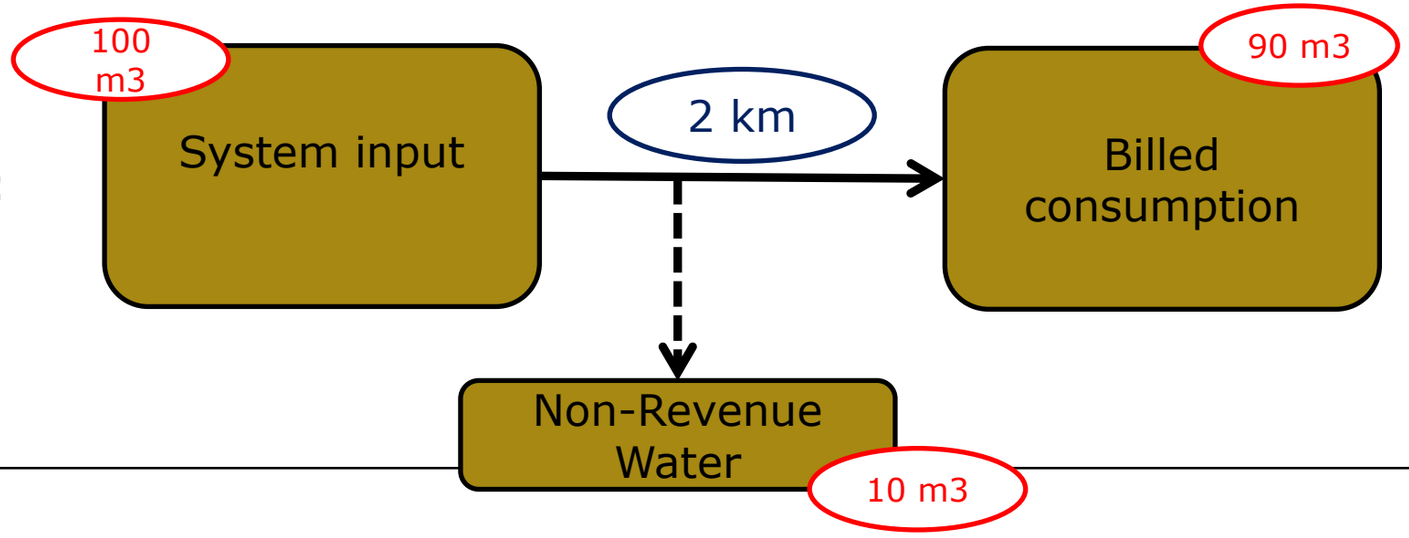
Company 1:



$$\frac{10\ m3}{100\ m3} = 10\%$$

$$\frac{10\ m3}{1\ km\ *365} = 0{,}028\ \frac{m3}{km * døgn}$$

Company 2:



$$\frac{10\ m3}{100\ m3} = 10\%$$

$$\frac{10\ m3}{2\ km\ *365} = 0{,}014\ \frac{m3}{km * døgn}$$

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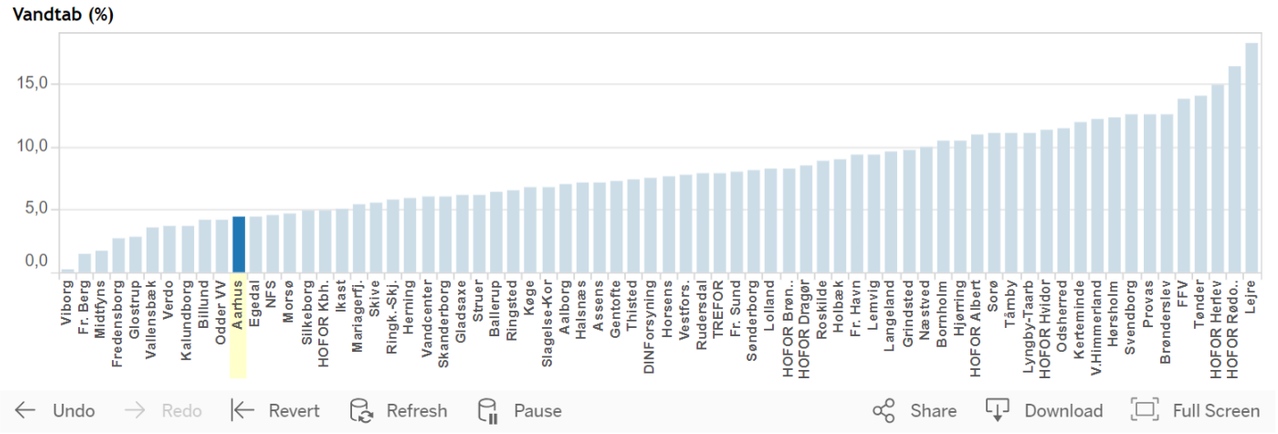
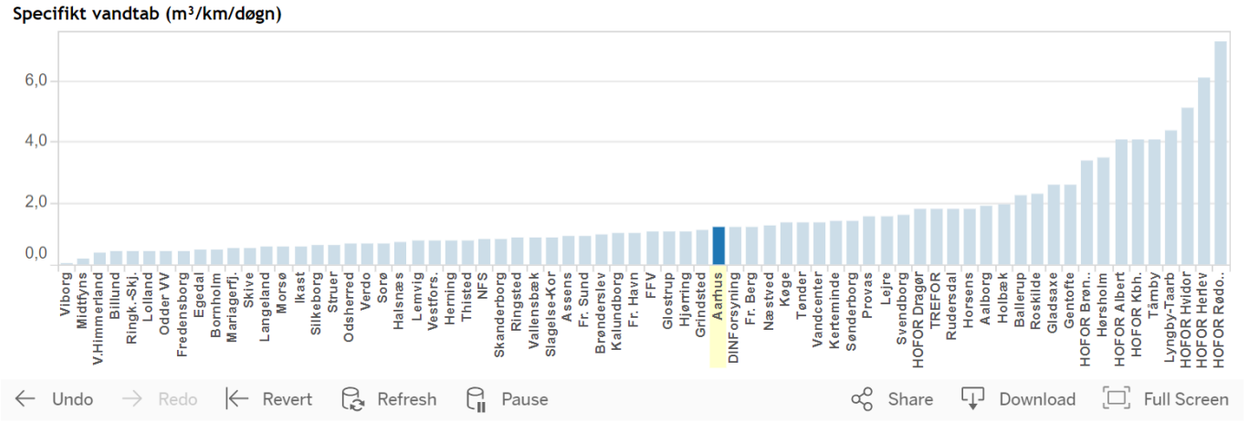
The difference between % and m3/km/day

Big water companies normally best like waterloss i % .

Smaller water companies normally best like waterloss i m3/km/day.

Aarhus, the second largest city in Denmark, normally prefer NRW in % on graphs.





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Infrastructure Leakage Index (ILI)

- ILI is an international water loss performance indicator developed by the International Water Association (IWA) that makes it possible to compare current real (physical) water loss and “unavoidable” real water loss as it occurs within various drinking water companies with different key characteristics, as well as between countries.
- ILI compares data on current real water loss (CARL) with the “unavoidable” real water loss (UARL).
- Infrastructure leakage index (ILI) = CARL/UARL
- The index should be as close to 1 as possible.

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Current real water loss

Current real water loss (CARL) is the difference between sold water volume plus abstracted groundwater, minus estimated water used to flush recently repaired pipelines and to extinguish fires as well as any other authorised unbilled use, illegal use and metering inaccuracies.

Uanvoidable real waterloss

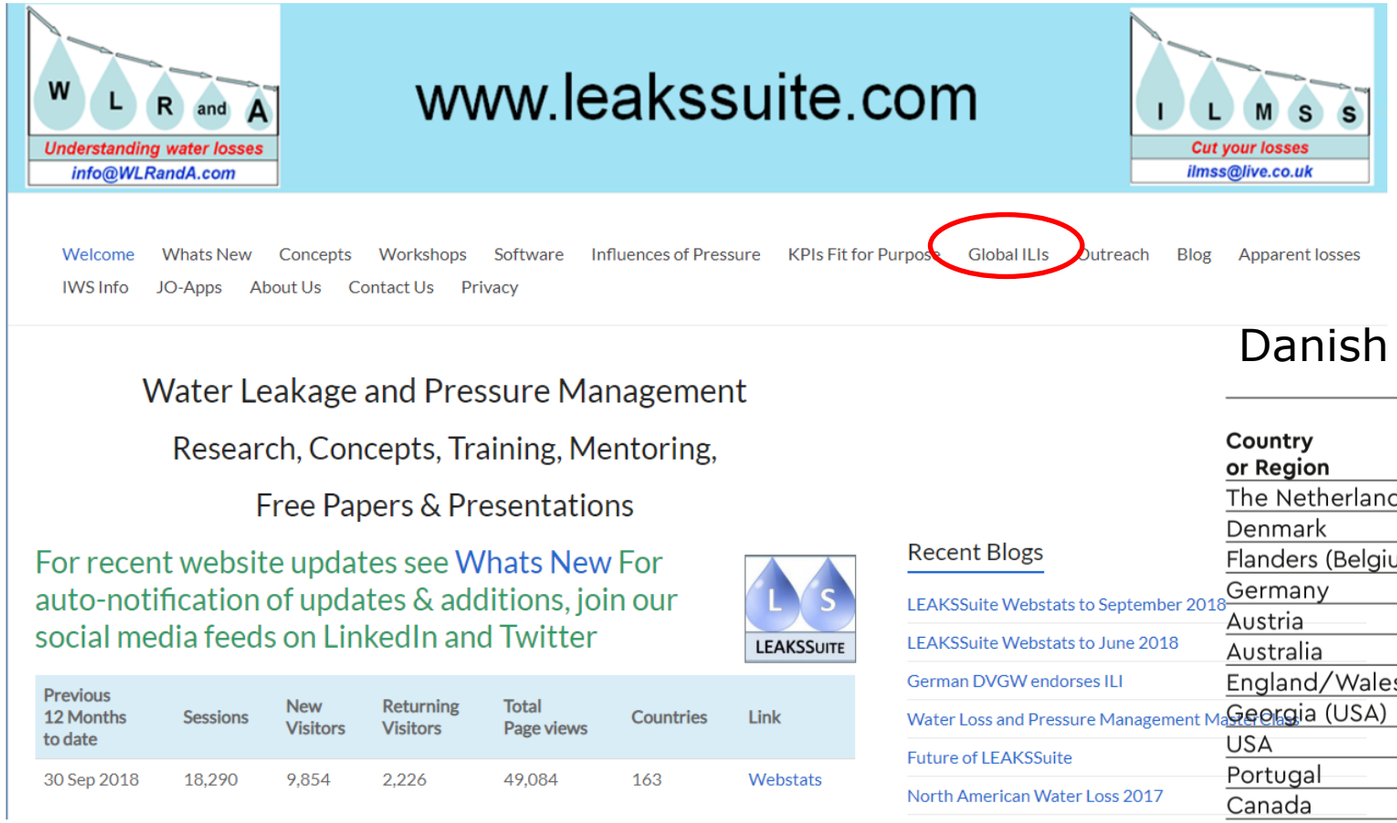
Unavoidable” real water loss uses international equations applicable to well maintained operationally sound networks of different sizes with different water pressures to calculate minimum technically achievable real water loss.

UARL: (18 x LM + 0.8 x Nc + 25 x Lp) x P l/day

Where:

- LM= total mains length
- Nc= Underground service connections, main to first meter
- Lp= Length of service connection in km + private service connection length in km
- P= average pressure (in meters head)

www.leakssuite.com



Danish Drinking water companies have low ILI

Country or Region	Percentage of supply included in the survey	Data year	Number of companies in the survey	Average ILI	% of companies with ILI >= 2%
The Netherlands	100%	2015	10	0.6	0%
Denmark	22%	2014	37	0.7	3%
Flanders (Belgium)	100%	2014	7	1.0	14%
Germany	0.7%	2011	44	1.0	25%
Austria	0.9%	2007/2011	50	1.0	36%
Australia	93%	2014/2015	65	1.1	21%
England/Wales	35%	2011/2012	9	1.7	22%
Georgia (USA)	100%	2011	107	1.8	44%
USA	0.5%	2011	25	2.4	64%
Portugal	11%	2013/2015	14	2.6	57%
Canada	100%	2003/2014	33	2.7	67%
Croatia	15%	2005/2014	23	4.5	80%

SOURCE: www.leakssuite.com/ili-overviews-by-country/ and DANVA

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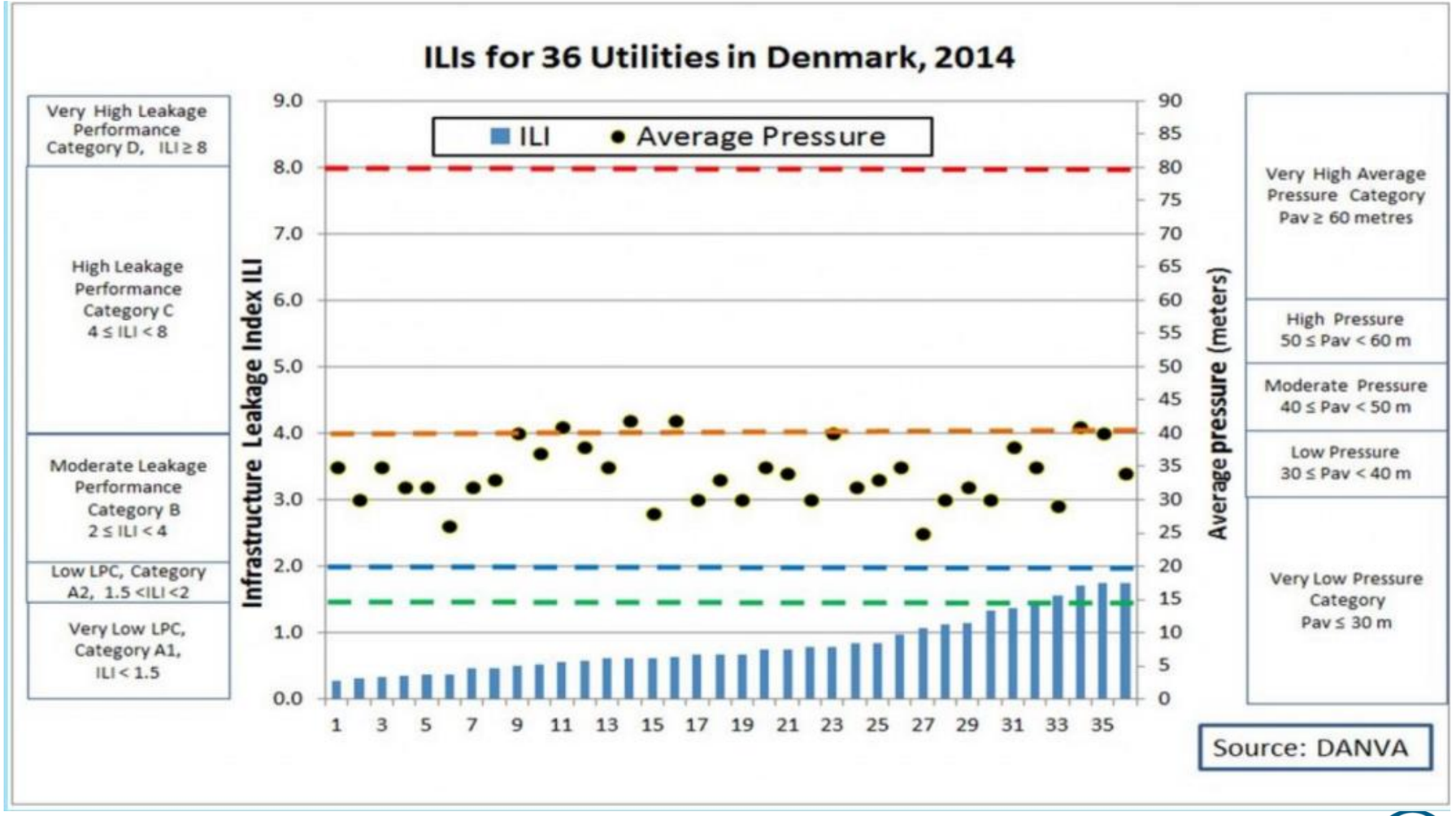
Danish ILI



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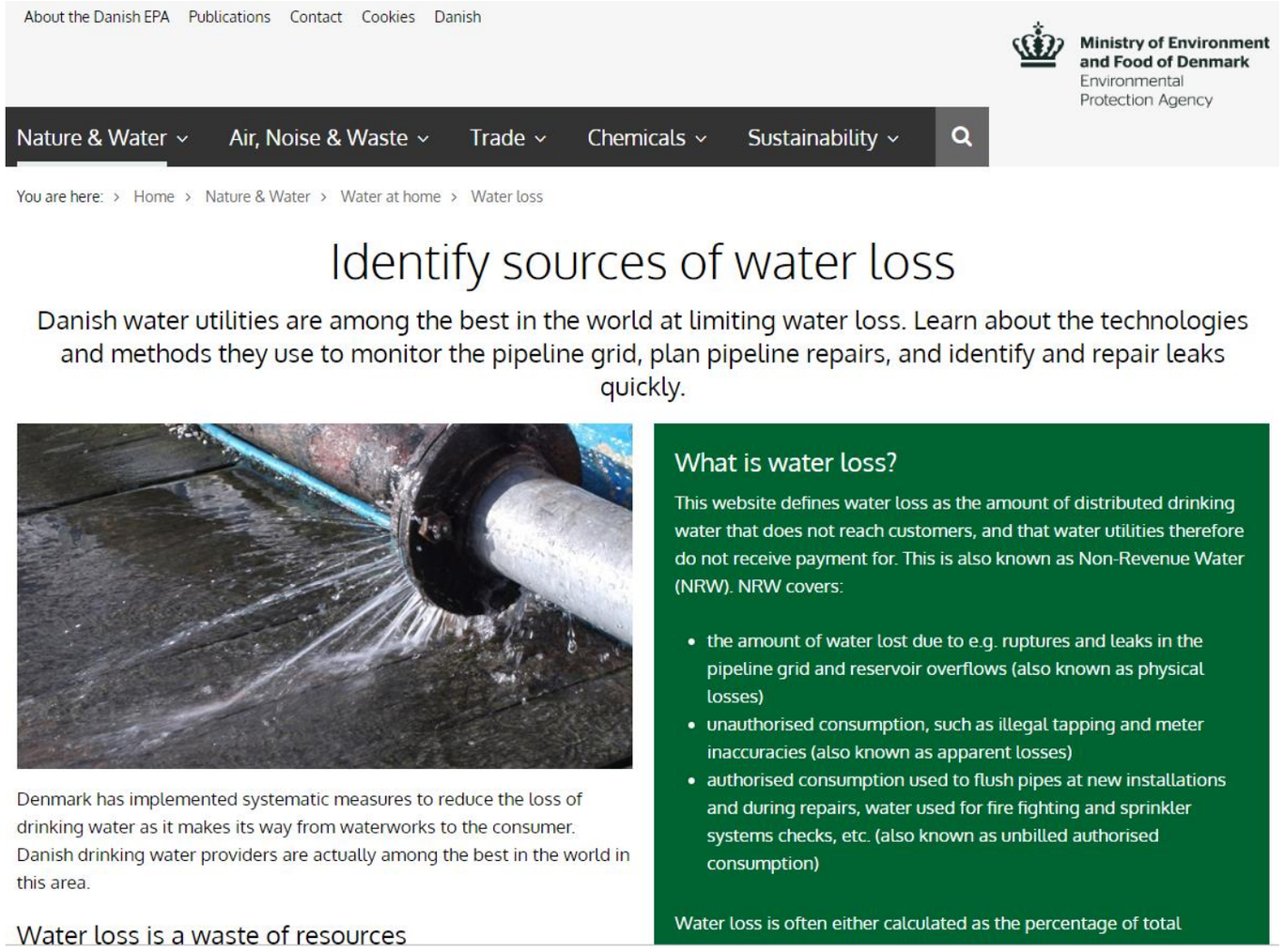

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You are here: Home › Nature & Water › Water at home › Water loss

Identify sources of water loss

Danish water utilities are among the best in the world at limiting water loss. Learn about the technologies and methods they use to monitor the pipeline grid, plan pipeline repairs, and identify and repair leaks quickly.

Denmark has implemented systematic measures to reduce the loss of drinking water as it makes its way from waterworks to the consumer. Danish drinking water providers are actually among the best in the world in this area.

Water loss is a waste of resources

What is water loss?

This website defines water loss as the amount of distributed drinking water that does not reach customers, and that water utilities therefore do not receive payment for. This is also known as Non-Revenue Water (NRW). NRW covers:

- the amount of water lost due to e.g. ruptures and leaks in the pipeline grid and reservoir overflows (also known as physical losses)
- unauthorised consumption, such as illegal tapping and meter inaccuracies (also known as apparent losses)
- authorised consumption used to flush pipes at new installations and during repairs, water used for fire fighting and sprinkler systems checks, etc. (also known as unbilled authorised consumption)

Water loss is often either calculated as the percentage of total

https://eng.mst.dk/nature-water/water-at-home/water-loss/

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Thank you for your attention
- Questions?