UNEP DTU PARTNERSHIP

COPENHAGEN CENTRE ON ENERGY EFFICIENCY

SEforALL EE HUB

Agenda

Goal: share insights on the importance of energy efficiency and the water energy nexus to increase the sustainability of both water utilities and available resources (energy, water)

#	Minutes	Title	Description
1	5 min	Water sector status	Status of water utilities and existing challenges.
2	10 min	Energy efficiency in WSS	Energy inefficiencies, oportunities and holistic approach for electro-mechanical components
3	10 min	Water savigns and energy nexus in WSS	Water losses and existing synergies with the energy consumption
4	5 min	C2E2 tools and support for RAs	Tools and required information

Block #1

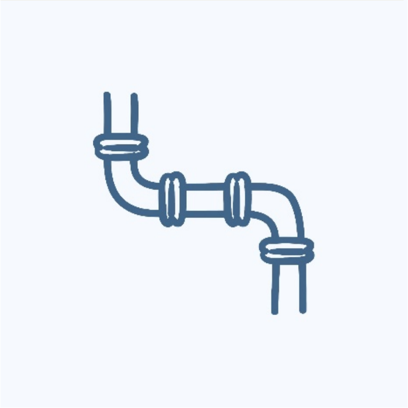
Water Sector Status

Water supply systems: Status

- **Production:** Represents 3-4% of the world power consumption. 80-90% of which is used to pump

- **Consumption:** By 2040 water consumption is expected to increase up to 40%. Need to create awareness of the value of having access to water

- **Regulation:** Planning can bring substancial savings both in resources (energy, water, financial) as well as in equivalent GHG emissions (CO2)



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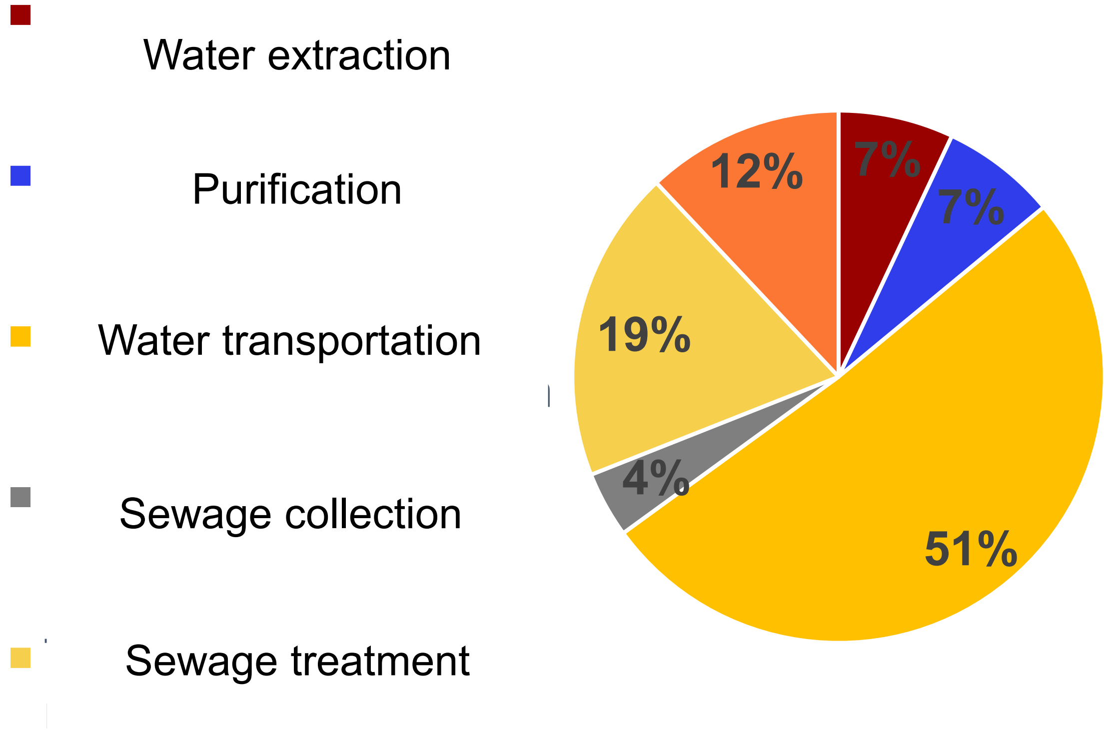
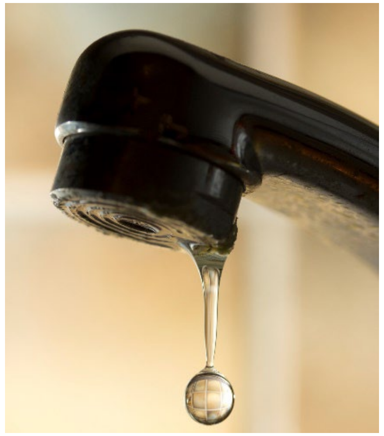
Water supply systems: Status

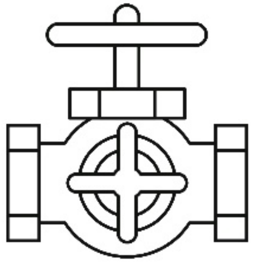
Energy consumed through the water cycle (superficial source)



Key aspects:

- Water supply represents up to 65% of the total energy consumed in the water cycle
- Water losses represents 25-50% of the water produced
- Large differences between different systems



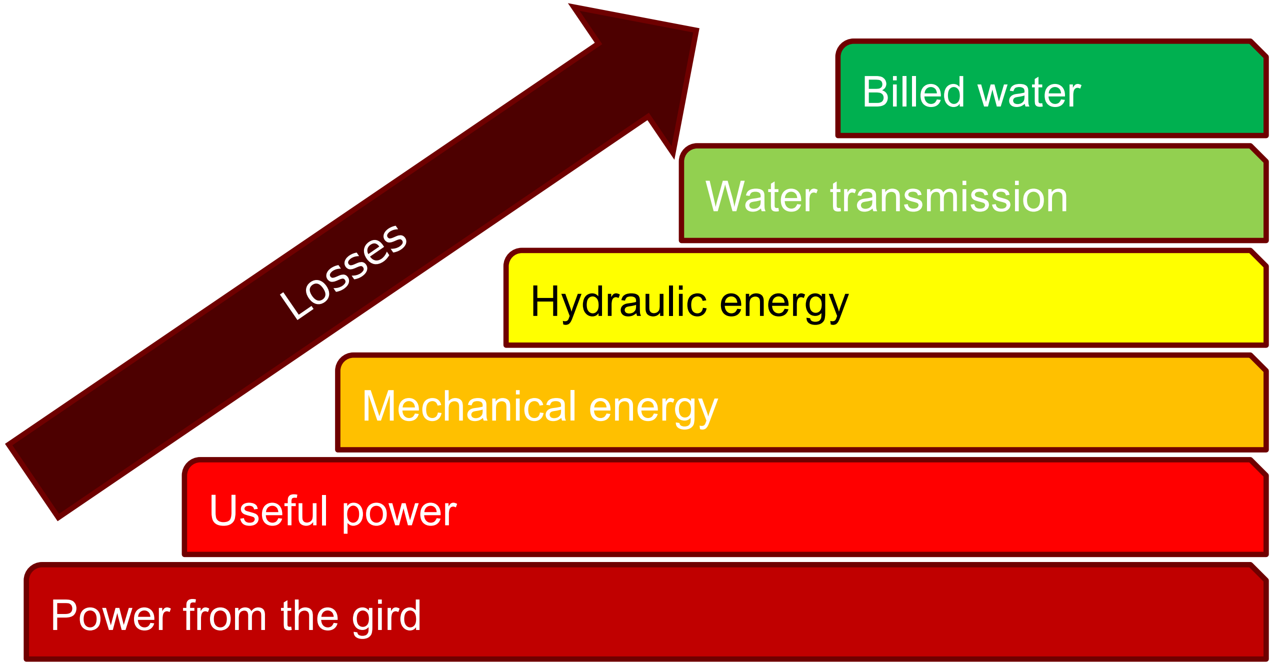


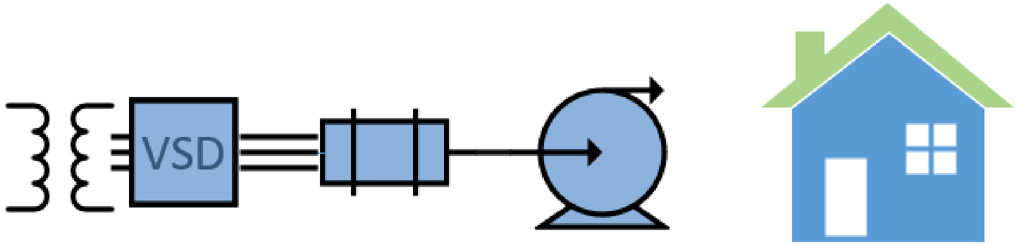
Block #2

Energy Efficiency opportunities in Water Supply Systems (WSS)

WSS: Energy inefficiencies and oportunities

- The **<u>energy intensity</u>** per unit of sold water links the required energy to supply a cubic meter of water
  - Needs to be normalized
- Individual EE actions have an impact of**10-40%**
- A holistic approach helps to prioritize EE actions, to reduce the required investment and O&M costs
- Payback period < 5 years





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WSS: Energy efficiency

Tecnology	Old system	Efficient system	Individual EE increase
Transformer	85%	96%	11.45%
Power factor	0.8	0.9	-
VSD	-	95%	20-40%
Electric motor	90%	95%	5.26%
Water pump	70%	88%	20.45%
Total efficiency	**53.5%**	**76%**	**29.60%**

Efficiency gains in the motor-pump set

30% increase in EE

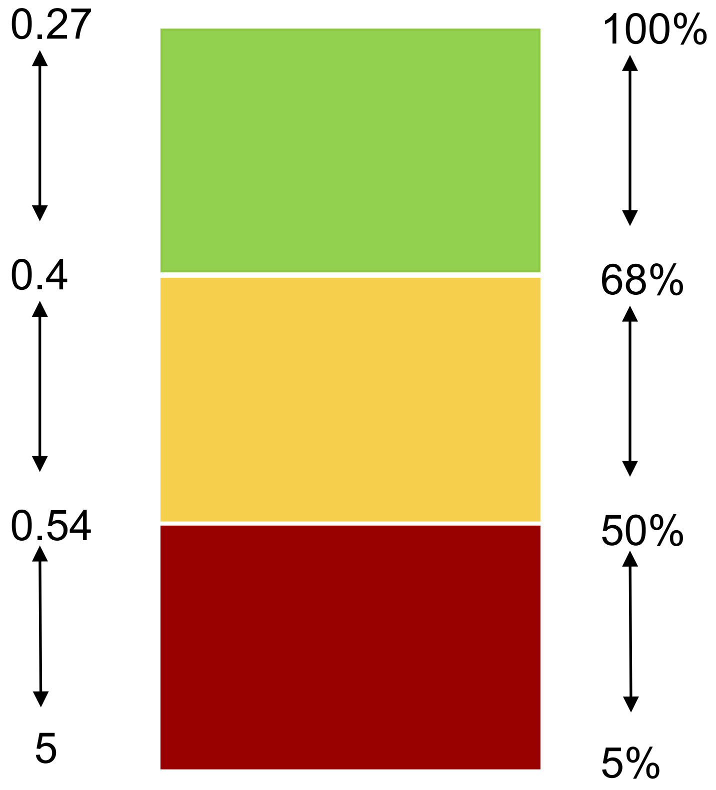
- **Motor-pump set inefficiencies:**
  - **Motor losses:** Mainly caused because of being oversized, old, outdated and to poor maintenance
  - **Pump losses:** Working out of the operational design points (Best Efficiency Point) because of poor sizing or maintenance
- **Improvement of shaft and coupling connections**
  - Replacement of valves
  - Introduction of variable speed drives
  - Replacement of transformers

WSS: Energy efficiency

If local/national regulation is yet not available, energy indicators for efficiency in WSS can be extracted from international best practices

$$CEN^* = \frac{E\left[\frac{kWh}{yr}\right] * 100[m]}{V\left[\frac{m^3}{yr}\right] * H[m]}$$

- CEN Allows us to compare different pumping station with different pumping elevations
- Available EE motor standards (e.j. IEC IE1-4) allow to calculate the minimum efficiency that a pump would require to work properly
- Different coupled efficiency recommendations for different sizes and types of components



*Traffic light for normalized energy index values [kWh/(m3*100)] and equivalent motor-pump efficiencies [%] for benchmarking (AA13ab - ESAR, Portugal)*

** Consumo especifico de energía eléctrica normalizado (CEN)*

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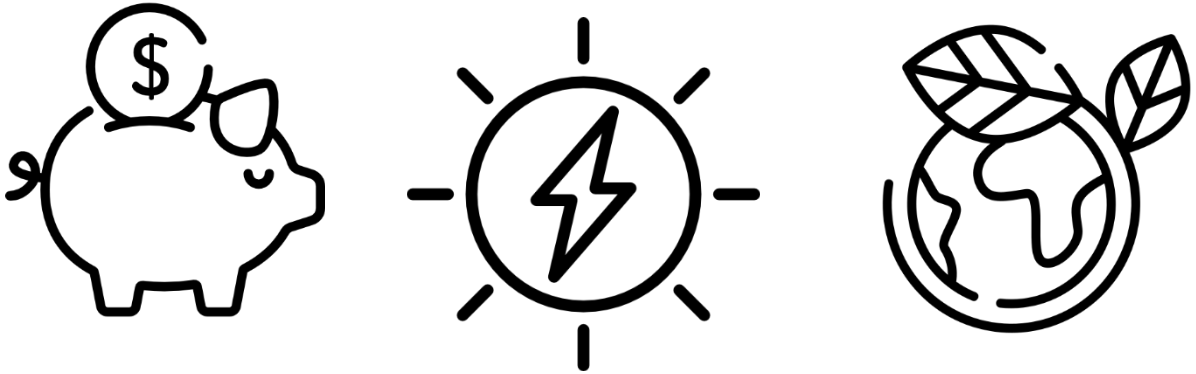
WSS: Energy efficiency

<u>**Viability of replacements**</u>

- Costs depend on the local market
- Efficient components are more expensive, but provide larger savings through out their lifetime
- Payback period (PBP):
  - Optimal ≤ 36 months
  - Good ≤ 48-60 months
- Technologies lifetime ≤ 10-15 years
  - Older technologies must be replaced
  - Technologies without a proper maintenance age worst
  - Efficiencies below recommended values (e.g. 46% motor-pump sets)



$$E_{savings}[kWh/yr] = \sum \left(CEN_{actual,i} - CEN_{efficient,i}\right) * V_i * \frac{H_i}{100}$$

$$E[kWh/yr] = \sum \left(\frac{0,2725}{\eta_{technical}} * 100\right) * V_i * \frac{H_i}{100}$$

$$C_{savings}[USD/yr] = E_{savings}[kWh/yr] * P_{electricity}[USD/kWh]$$

$$Payback[yr] = \frac{CAPEX[USD]}{C_{savings}[USD/yr]}$$

Study case: Energy efficiency in Guyana

IDB
Inter-American Development Bank

I. 6% of the national power demand => 60% of the water utility costs

II. Water losses of 70% and lack of consumption metering

III. Energy audits found larger EE savings in existing power factors, electric motors and water pumps. Average electro-mechanical efficiency of 46%

Solutions:

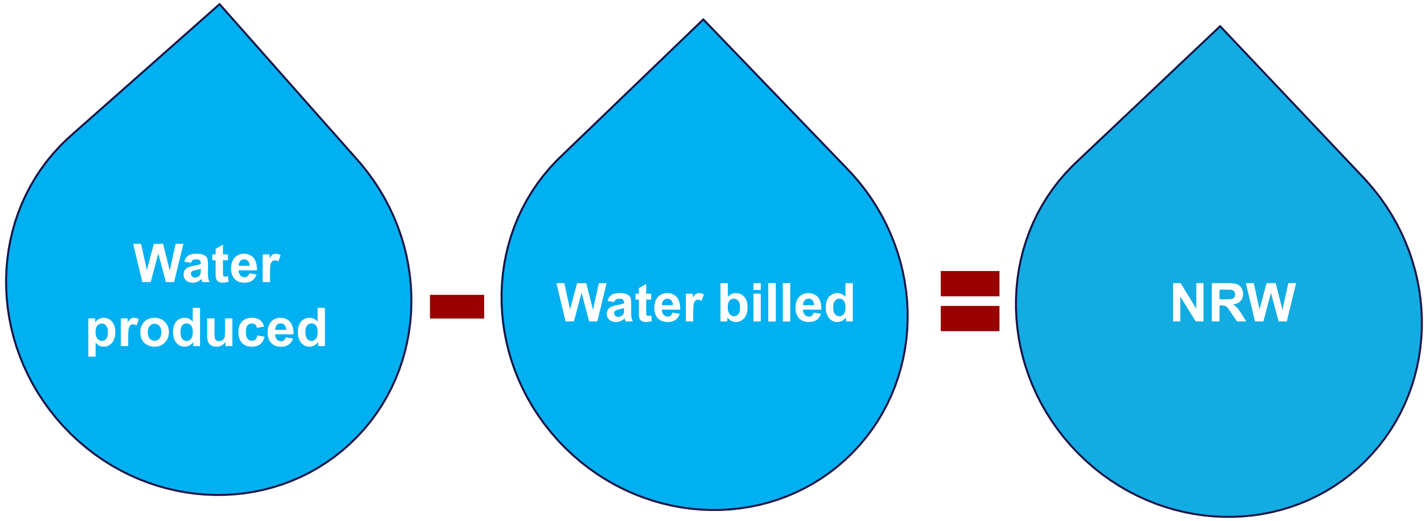
- New water tariffs that reflect the real cost of water- US 0.3 to US 0.55 per cubic meter
- Motors and pumps replaced in 34 supply points (25% of the enrgy consumed by the utility)
- An investment of US 160,000 increase the EE a 29%, bringing a total anual savings of US 700,000 => 3 months payback
- Energy savings of 2,000 MWh/year and 2,000 tCO2

Block #3

Water and Energy Efficiency opportunities in Water Supply Systems

WSS: Water losses and Non-Revenue Water (NRW)

- **Physical losses**. Due to filtrations during the whole cycle. The main cause is the lack of a correct operation and maintenance
- **Commercial losses**. Lack of real consumption metering, census inaccuracies and illegal connections
- **Authorized consumption not billed**. Firefighting, watering gardens or given to certain social strata with risk of social exclusion



NRW is the difference between water produced and billed

WSS: Reduction of water consumption

<u>Impact of climate change in water supply systems:</u>

- Damage to water supply systems
- Shortage of water

Solutions

- Water Demand Management (WDM)
- Preventive maintenance instead of corrective maintenance and better control systems (SCADA)
- Public campaigns for citizen awareness on the correct use of water and its value

Less water means less energy required, less peak energy consumption and not overexploiting the water reservoirs, reducing the **<u>energy intensity and increasing the sustainability of the available resources</u>**

Study case: SANASA, Brasil

In value:

- 6% of the national electricity demand
- Reduction of physical losses
- Tariff optimization by storing drinking water in tanks during off-peak hours
- Replacement of obsolete electro-mechanical equipment

Results:

- Increase of 22% of the population supplied to 98% (mostly low income households)
- 6% reduction in water losses
- Electricity consumption remained constant, reducing energy intensity

SANASA CAMPINAS
NOSSA VIDA É INOVAR

Benefits of energy and water efficiency actions

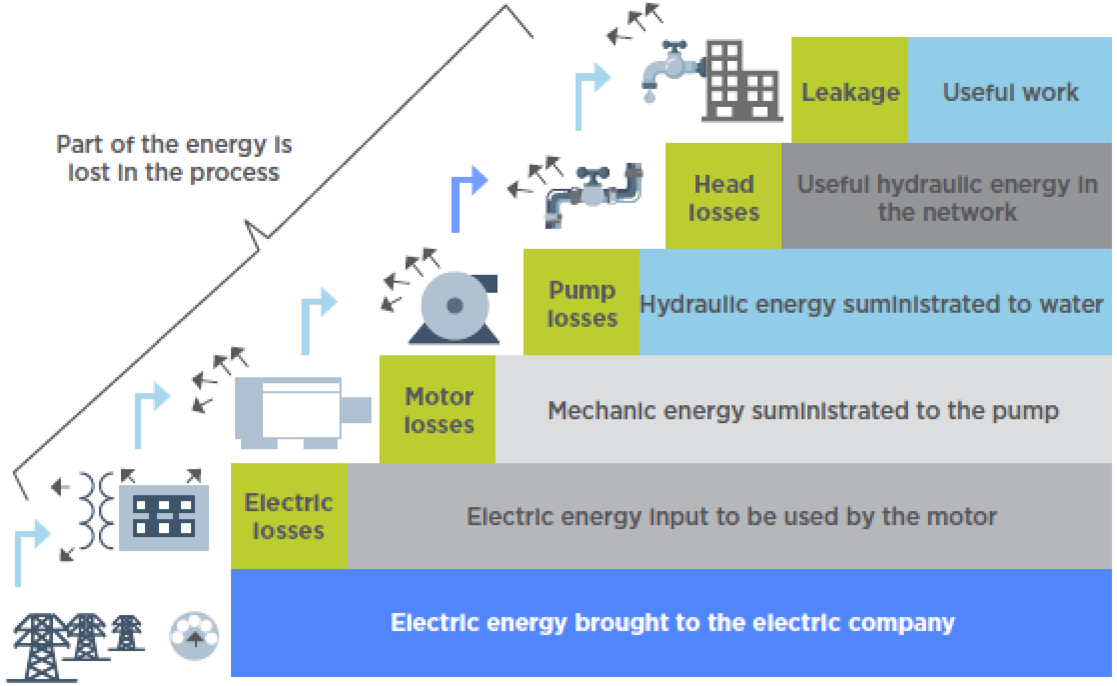
- Energy consumption reduction (MWh/yr)
- Water volume produced reduction (m3/)
- Financial savings through lowered costs and higher income (USD)
- Reduction of equivalent emissions (ton eq. CO2)
- Short payback period (yr)

Block #4

C2E2 Available Tools and Support

Inputs

- Water volume pumped/sold
- Status of existing electro-mechanical components (transformers, motors, pumps…)
  - – Size
  - – Efficiency
- Metering
  - – Yes/No
- Automated control and operation
  - – Yes/No
- Expenses of the system
  - – Electricity price (USD/kWh)
  - – Other costs (labour, maintenance…)
- Existing policies and regulations



IDB

Thank you

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