

**MUELLER**

# Real Losses Expressed in Carbon Emissions

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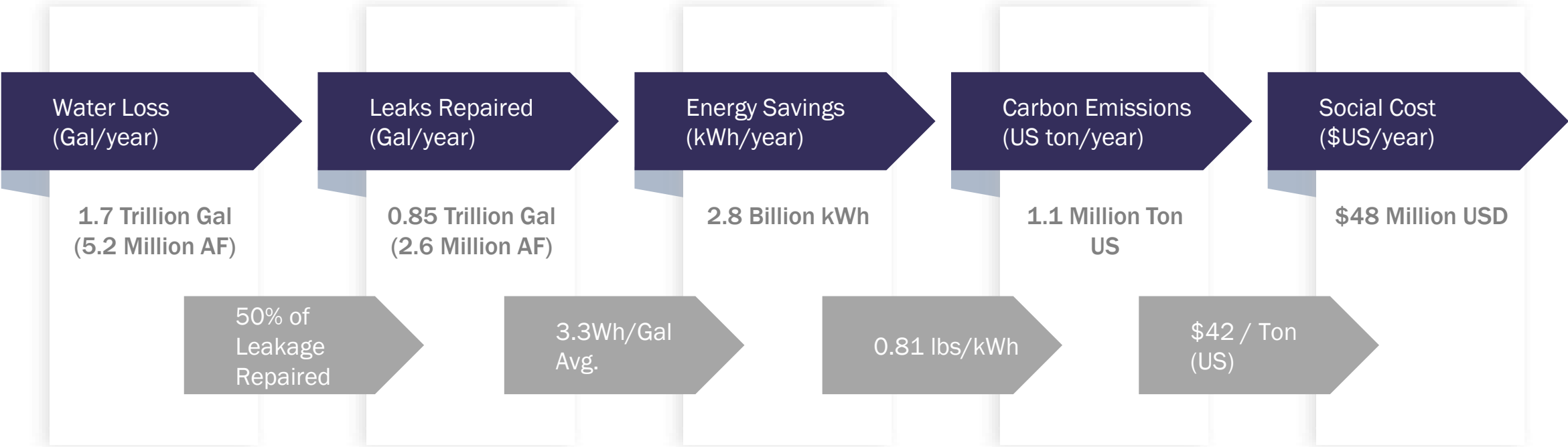
Andrew Wallace

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# USA Case Study

- Public Water Supply in the USA 2015 was estimated at 14 Trillion Gallons
- In 2007, the EPA estimated 1.7 Trillion Gallons lost from Public Water Supply
- In 2020, 4.01 Trillion kWh were produced



## Real Losses Costs Summary

$$\text{Energy Cost} \left( \frac{\$}{\text{Gal}} \right) \propto \text{Energy Intensity} \left( \frac{\text{Wh}}{\text{Gal}} \right) \times \text{Energy Cost} \left( \frac{\$}{\text{kWh}} \right) \rightarrow \$ \text{ Motivation}$$

$$\text{Social Cost} \left( \frac{\$}{\text{Gal}} \right) \propto \text{Energy Intensity} \left( \frac{\text{Wh}}{\text{Gal}} \right) \times \text{Emission Rate} \left( \frac{\text{lbs}}{\text{kWh}} \right) \times \text{Carbon Cost} \left( \frac{\$}{\text{Ton}} \right)$$

$$\text{Carbon Emission}(\text{Ton}) \propto \text{Energy Intensity} \left( \frac{\text{Wh}}{\text{Gal}} \right) \times \text{Emission Rate} \left( \frac{\text{lbs}}{\text{kWh}} \right) \rightarrow \text{ESG Motivation}$$

# Environmental, Social, Governance (ESG)

- ESG analysis is becoming an increasing factor for investors
- Environmental considerations include:
  - **Climate change and carbon emissions**
  - **Air and water pollution**
  - Biodiversity
  - Deforestation
  - **Energy Efficiency**
  - Waste Management
  - **Water Scarcity**
- Areas related to Real Losses are in red



# Calculating Carbon Emissions

$$\text{Carbon Emission (Ton)} \propto \text{Energy Intensity} \left( \frac{\text{Wh}}{\text{Gal}} \right) \times \text{Emission Rate} \left( \frac{\text{lbs}}{\text{kWh}} \right)$$



- Energy Intensity is determined by water source:
  - Fresh Water vs Sea Water vs Brackish Water
  - Water source pumping distance
  - Water source pumping depth

- Emission Rate is determined by energy mix:
  - Natural Gas
  - Coal
  - Other Fossil Fuel sources
  - Clean energy

# Water Sector's Energy Intensity<sup>1</sup>

Region	Energy Intensity
USA National	3.3 to 3.6 Wh/Gal
New York City, NY	2.7 Wh/Gal
Austin, TX	5 Wh/Gal
Southern California	12.7 Wh/Gal

## Energy Sector Mix 2020<sup>2,3</sup>

Energy Source	Proportion of Mix	Carbon Emission Rate
National	100%	0.81 lbs/kWh
Natural Gas	40.5%	0.91 lbs/kWh
Coal	19.3%	2.23 lbs/kWh
Petrol	0.4%	2.13 lbs/kWh
Other Gas	0.3%	
Nuclear	19.7%	
Wind	8.4%	
Hydro	7.3%	
Solar	2.3%	
Biomass	1.4%	
Geothermal	0.4%	

# Standardization for Calculating Carbon Emissions

- Benefits:
  - Water Utilities can publish emissions for ESG data
  - Quantify potential carbon savings through Real Losses reduction
- Standardization:
  - Database for computing Energy Intensity
  - Database for computing Emissions for Energy Mix