Revisiting the Basis for Calculating Bathing Loads and Circulation Rates for Pools

Martin Wood, Lester Simmonds, Fed Ramirez

Pool Sentry Ltd

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Why Revisit This Topic Now?

- Cost pressure on Operators
- Significant cost of circulating water
- Variable Speed Drives (VSDs) in use
- Recent research findings
- Align with DIN and others?

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13 August 2025

Rising costs blamed for drop in pool temperatures

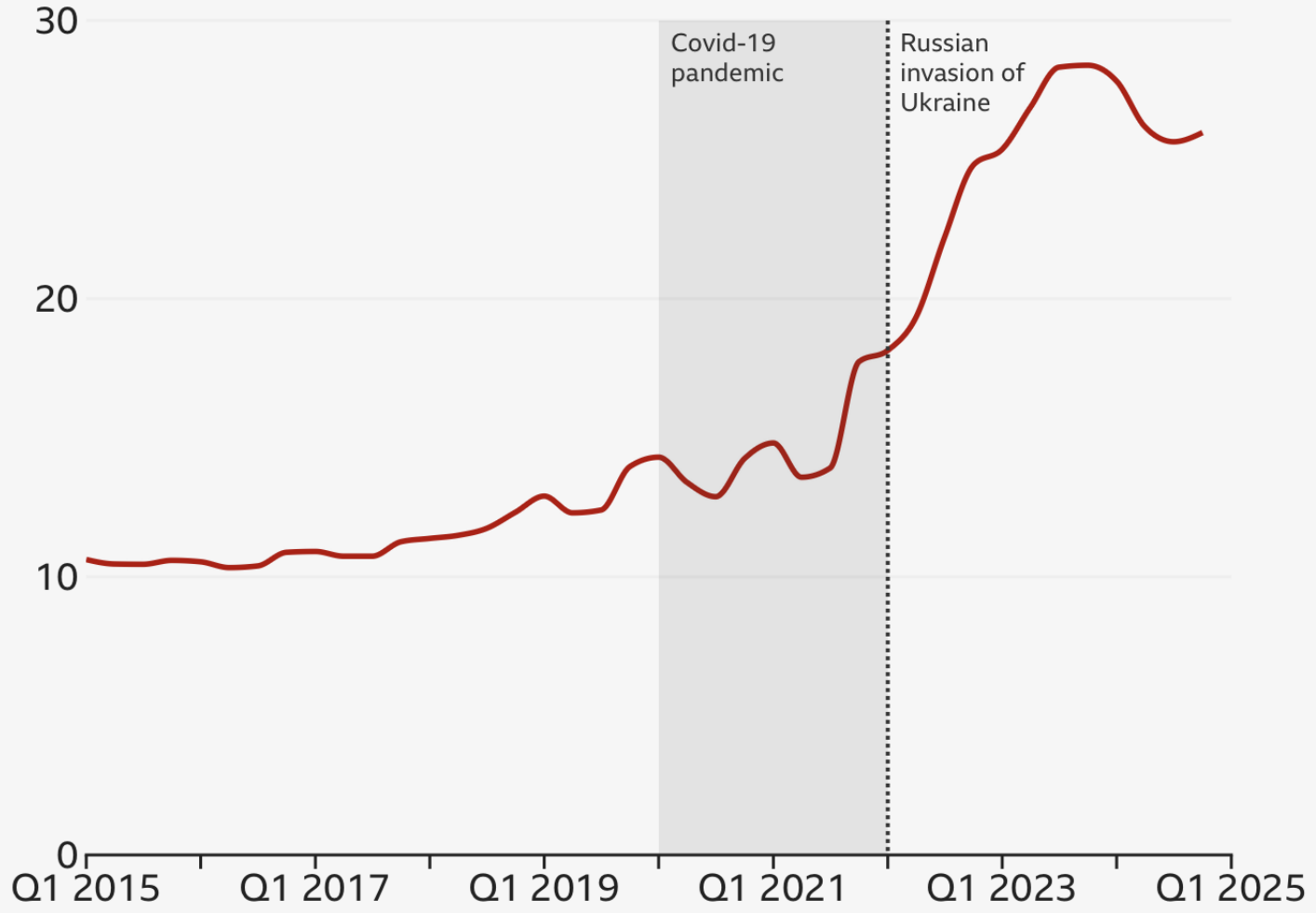
GETTY IMAGES

Lauren Woodhead
BBC England Data Unit

Jon Wilkinson
BBC Sport

Energy prices more than doubled between 2021 and 2023

Average electricity prices for UK non-domestic users, 2015 to 2024: Pence per kilowatt hour



Source: ONS • Includes Climate Change Levy

BBC

The Big Question…

Do Commercial Pools in England really need to be spending >£100 million pa circulating water?

Research with Loughborough University + Swim England database

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Recent Research with Loughborough University

Sport England database of the 6443 non-domestic swimming pools in England

Estimated how much energy these pools are using to circulate water for treatment based on:

- PWTAG CoP (turnover times for different pools)
- German DIN (volume of water treated per bather)

Explore options to reduce energy use and carbon footprint
Whilst also maintaining or improving water quality

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Research Paper

BUILDING SERVICES ENGINEERING RESEARCH & TECHNOLOGY

Balancing environmental, economic and public health: The cost of swimming pool water circulation

Building Serv. Eng. Res. Technol.
2025, Vol. 0(0) 1–16

DOI: 10.1177/01436244251339721
journals.sagepub.com/home/bse
Sage

Timothy I Marjoribanks[1], Lester P Simmonds[2] and Martin Wood[2]

Over half the running costs of premises (excluding staff) for a typical 25 m swimming pool facility are spent on energy.

Could reduce this by 50% if adopt the following:

- ✓ Slow pumps down when pool closed
- ✓ Slow pumps down during periods of low bathing load
- ✓ Improve efficiency of pumps

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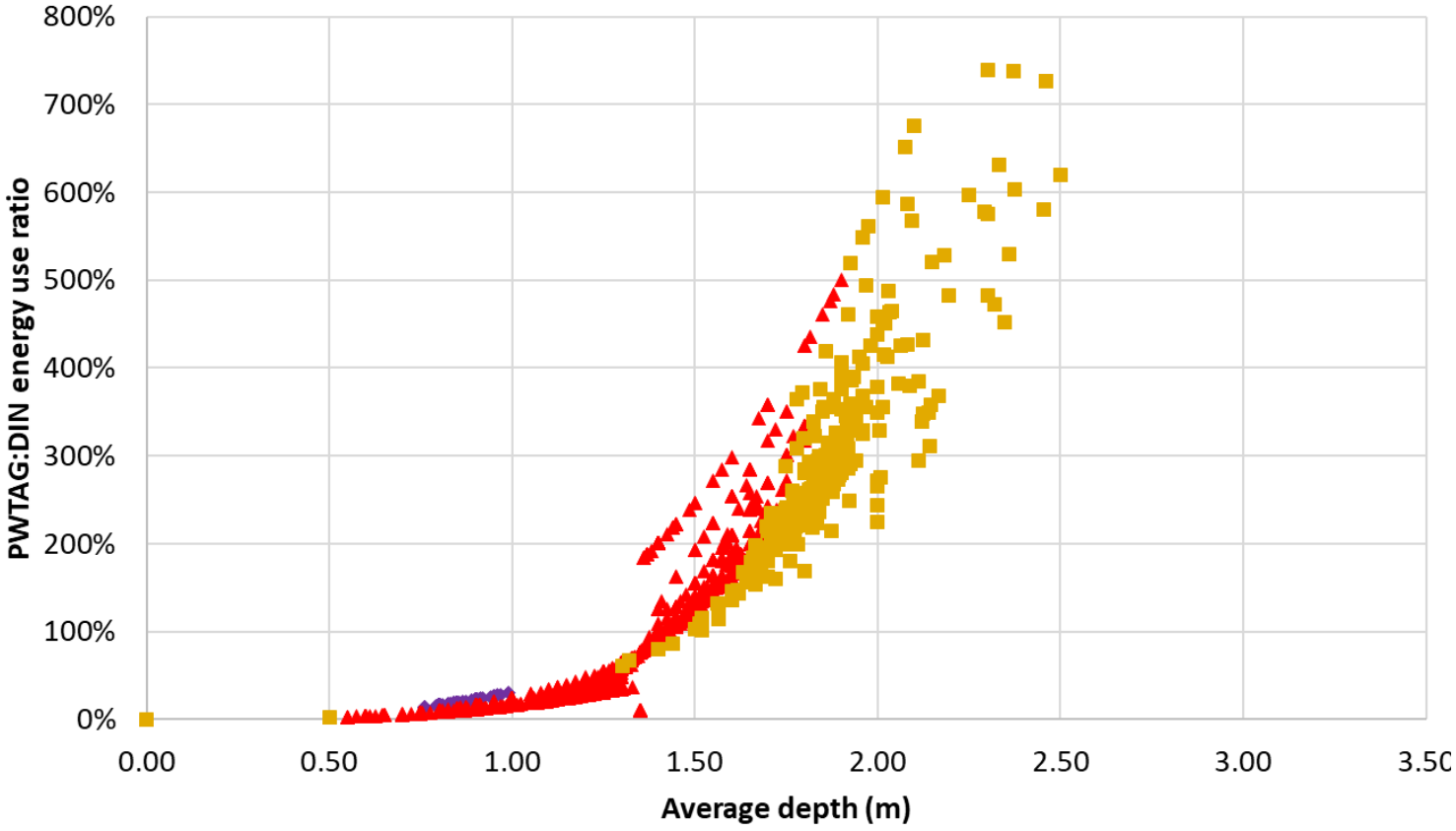
The National Picture – PWTAG Turnover Time uses much more energy than DIN in deeper pools (>1.5 m deep)



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New Technical Note

Aimed at:

- Pool Operators
- Trainers (usually of pool operators)
- Compliance assessors
- Feedback received and reviewed

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Safety of Bathers in the Pool is the Priority – Two Considerations

1. **Instantaneous Bathing Load**

Adequate space in pool for each bather

- Area of pool per bather (m^2/bather)

2. **Capacity of water treatment system**

Capacity to treat contaminants by filtration and disinfection

- Adequate to remove suspended solids and *Cryptosporidium sp.* by filtration (m^3/bather)
- Ensure disinfection of microbes and oxidation of contaminants and disinfection by-products

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Safe Operational Bathing Load

Pool Designers/Builders build pools according to the original design brief at the time of build

The capacity of the water treatment system in recent pools will be based on the design bathing load and the requirement to treat 1.7 m^3 water per bather. *But what about older pools and pools where changes have been made to the pool plant or the way the pool is used?*

The Pool Operator has the responsibility to assess what is a **safe operational bathing load** based on the way in which the pool is **actually** being used

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Risk Assess Safe Operational Bathing Load

Pool Operator must carry out a risk assessment on what is a safe operational bathing load, in terms of:

- **maximum number of bathers at any one time** - in terms of space and lifeguarding/supervision arrangements

- **maximum number of bathers using the pool every hour** - in terms of water treatment capacity

Pool Operator must review/update Risk Assessment if any significant change in Pool Use or Pool Plant

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Maximum Instantaneous Bathing Load (MIBL) - Physical space for each bather

Starting point (HSG 179) as a general guide
1 bather per **3 m²**

This is a guide only

- Must also take into account operational factors e.g. the types of activity in pool
- Requires risk assessment

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Maximum Instantaneous Bathing Load (MIBL) - Physical space for each bather

Based on pool depth (PWTAG CoP)

- Shallow water (less than 1 m).
  1 bather per 2.2 m²
- Standing water depth (1-1.5 m)
  1 bather per 2.7m²
- Deep water (greater than 1.5 m)
  1 bather per 4 m²

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Safe Operational Bathing Load (SOBL) - Requires Risk Assessment

‘Physical space’ risks:

- Activities e.g. teaching, lane swimming
- Features e.g. wave machine, other features
- Sufficient space for bathers (on average)
- Clustering of bathers e.g. beach area
- Lifeguarding/supervision arrangements

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Safe Operational Bathing Load - Requires Risk Assessment

‘Water treatment capacity’ risks:

- Measured circulation rate (flow m^3/h)
- Filtration velocity (not greater than 25 m/h)
- Chlorine dosing capacity - check **free chlorine** is maintained **close to set point** during peak bathing loads

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Safe Operational Bathing Load
- Monitoring and Auditing

Risk assessment may result in:

- Safe Operational Bathing Load ***less than*** the Design Bathing Load
- Record Risk Assessment in PSOP and PTOP
- Demonstrate Compliance (remote monitoring)

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Pool Operators – Circulation & Bathing Load

Calculation of circulation rate (m^3/h) when physical space is the limitation

- Use ***Safe Operational Bathing Load*** (SOBL)
- Circulation Rate = SOBL x 1.7 m^3/bather
- Record this in PSOP and PTOP
- Demonstrate compliance (e.g. flow meters)

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Pool Operators – Circulation & Bathing Load

Calculation of SOBL (bathers/h) when water treatment capacity is the limitation

- Use ***Maximum Circulation Rate*** based on pump capacity, filter area, chlorine dosing rate etc
- SOBL = the circulation rate (m^3/h) / 1.7 m^3/bather
- Record this in PSOP and PTOP
- Demonstrate compliance (e.g. bather numbers)

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The Science: Peer-Reviewed Papers

water

MDPI

Article

Revisiting the Gage–Bidwell Law of Dilution in Relation to the Effectiveness of Swimming Pool Filtration and the Risk to Swimming Pool Users from *Cryptosporidium*

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What the Science is Saying

If treat 1.7 m^3 water per bather, then should be able to keep water <0.5 NTU even with ALL of the following:

- Dirty bathers
- Filtration efficiency as low as 75%
- Sustained Maximum Instantaneous Bathing Load 24/7

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What About Teaching Pools? - Some Operational Challenges

- Bathing period <1 hour
- Continuous sessions operating at MIBL
- Rapid filtration rates
- Research indicates 30 min bathing periods at MIBL for up to 5 hours should not create problems for water quality

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What About Teaching Pools? -
Mitigation for Bathing Period <1 hour

- Improve pre-swim hygiene
- Increase dilution of pool water
- Consider secondary disinfection e.g. UV
- Ensure filtration system working well
- Alert and prompt action for faecal incident
- Review SOBL and update risk assessment
- Record this in PSOP and PTOP

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Reducing Circulation Rate at Certain Times

Variable Speed Drives VSDs (aka Variable Frequency Drives VFDs) may be used to reduce circulation rate:

- when pool is not in use, or
- during periods of light use

Reducing circulation rate by 20% will result in ~50% saving in energy used to circulate water.

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Aims of New Technical Note

- Based on underpinning science for managing safe circulation rate and energy use
- Circulation based on 1.7 m^3 water per bather
- Guidance for pool operators on how to risk assess and manage individual pools
- Aligns with guidance in Germany, Denmark etc
- New edition of Swimming Pool Water book 2026

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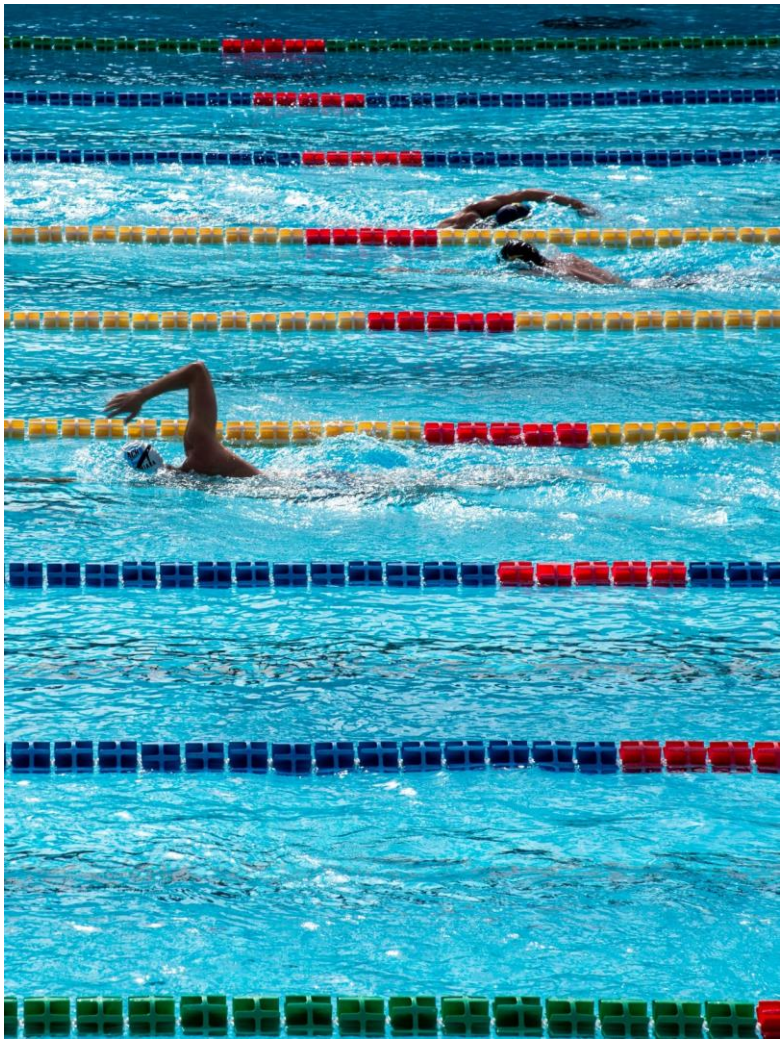

Thank you!

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