Energy to pressurise water

Lifting water requires considerable energy. In a perfect world where there are no losses in the system, 1 ML of water lifted 1 metre of height uses 2.725 kiloWatt-hours (kWh) of electricity.

If electricity costs $0.25/kWh, the cost of lifting 1 ML up 1 m is:
2.725 x 0.25 = $0.68

Unfortunately, in the real world, large proportions of the energy put into pumps and motors is always lost, and it will always use much more than 2.725 kWh to lift a Megalitre (ML) of water up one metre of height.

Realistic costs for a well-adjusted pump and electric motor

Given that around 30% of the power from a properly designed and adjusted pump is used to overcome friction and there are some losses in the drive train and motor we can calculate a more realistic energy requirement to lift 1 ML by 1 m.

Realistic efficiencies given as:

- **pump efficiency** is 70%
- **drive train efficiency** is 95%
- **electric motor efficiency** is 90%

The results for a realistic electrical pump system =

2.725 kWh of electricity ÷ (0.7 × 0.95 × 0.9) = 4.55 kWh

The more realistic cost for a well-adjusted system to deliver 1 ML to the outlet will be:
4.55 x 0.25 = $1.14

Realistic costs for a poorly performing pump

Since a poorly designed and operating system might be running at just 40% efficiency, the energy required to move 1 ML of water up by 1 m will be:

2.725 kWh of electricity ÷ (0.4 × 0.95 × 0.9) = 2.725 / 0.342 = 7.97 kWh.

The cost of delivering 1 ML using this poorly performing pump will be:
7.97 x 0.25 = $1.99

In this example, the poorly performing pump is costing $1.99 – $1.14 = $0.85 per ML per m of lift.

Next Steps

If you have a poorly performing pump, you can calculate how much you are losing in electricity costs and use this information to decide if investing in an upgrade is worthwhile.

Resources

https://www.cottoninfo.com.au/sites/default/files/documents/Fundamentals%20EnergyFS_A_3a.pdf