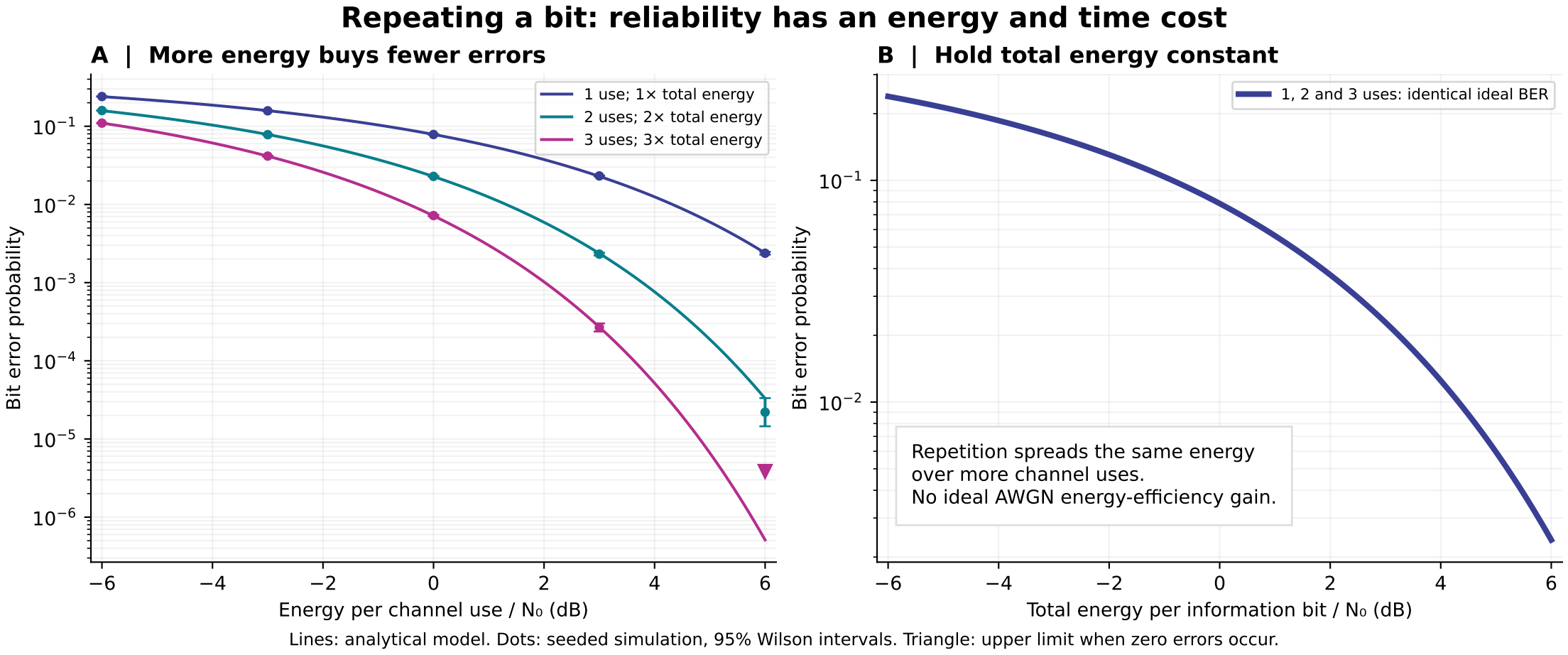

Repeating a bit: reliability has an energy and time cost
A | More energy buys fewer errors
1 use; 1× total energy
2 uses; 2× total energy
3 uses; 3× total energy
Bit error probability
Energy per channel use / N₀ (dB)
B | Hold total energy constant
1, 2 and 3 uses: identical ideal BER
Repetition spreads the same energy
over more channel uses.
No ideal AWGN energy-efficiency gain.
Total energy per information bit / N₀ (dB)
Lines: analytical model. Dots: seeded simulation, 95% Wilson intervals. Triangle: upper limit when zero errors occur.