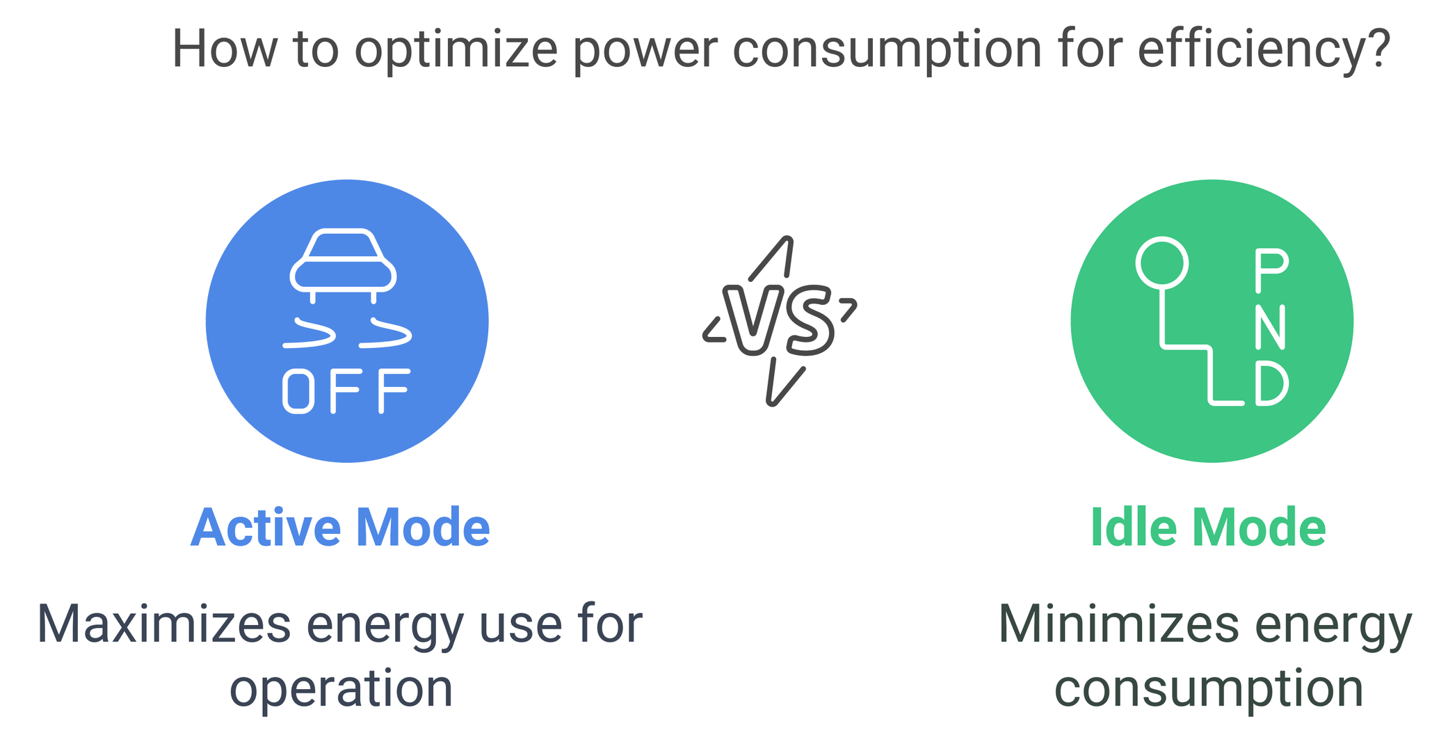
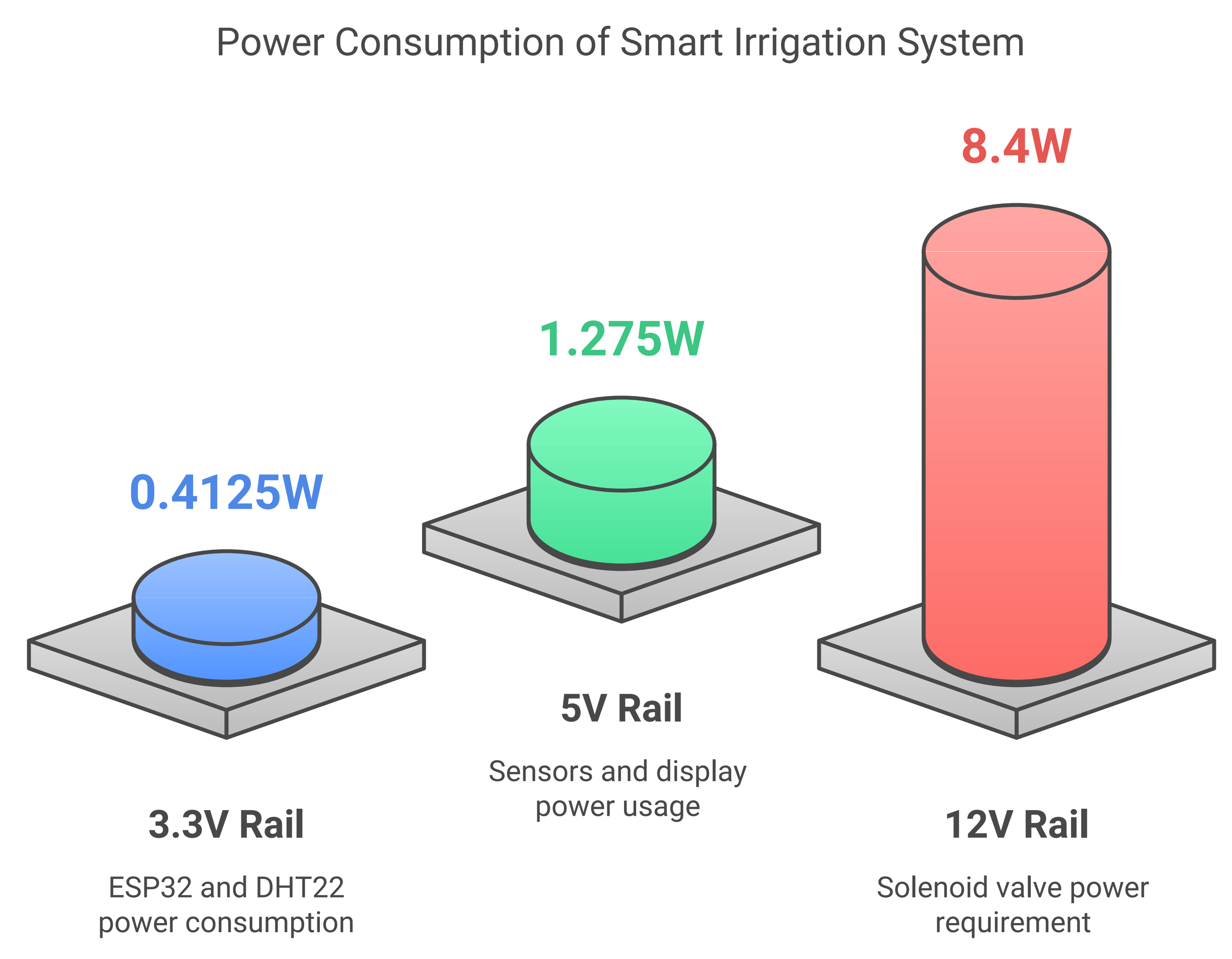
Farmlyanga System Power Analysis

This document provides a comprehensive analysis of the power requirements and consumption for a smart irrigation system. It outlines the components involved, their respective power needs, total power consumption in both active and idle modes, battery sizing for energy storage, solar panel requirements for sustainable operation, and key recommendations for optimizing the system's efficiency.



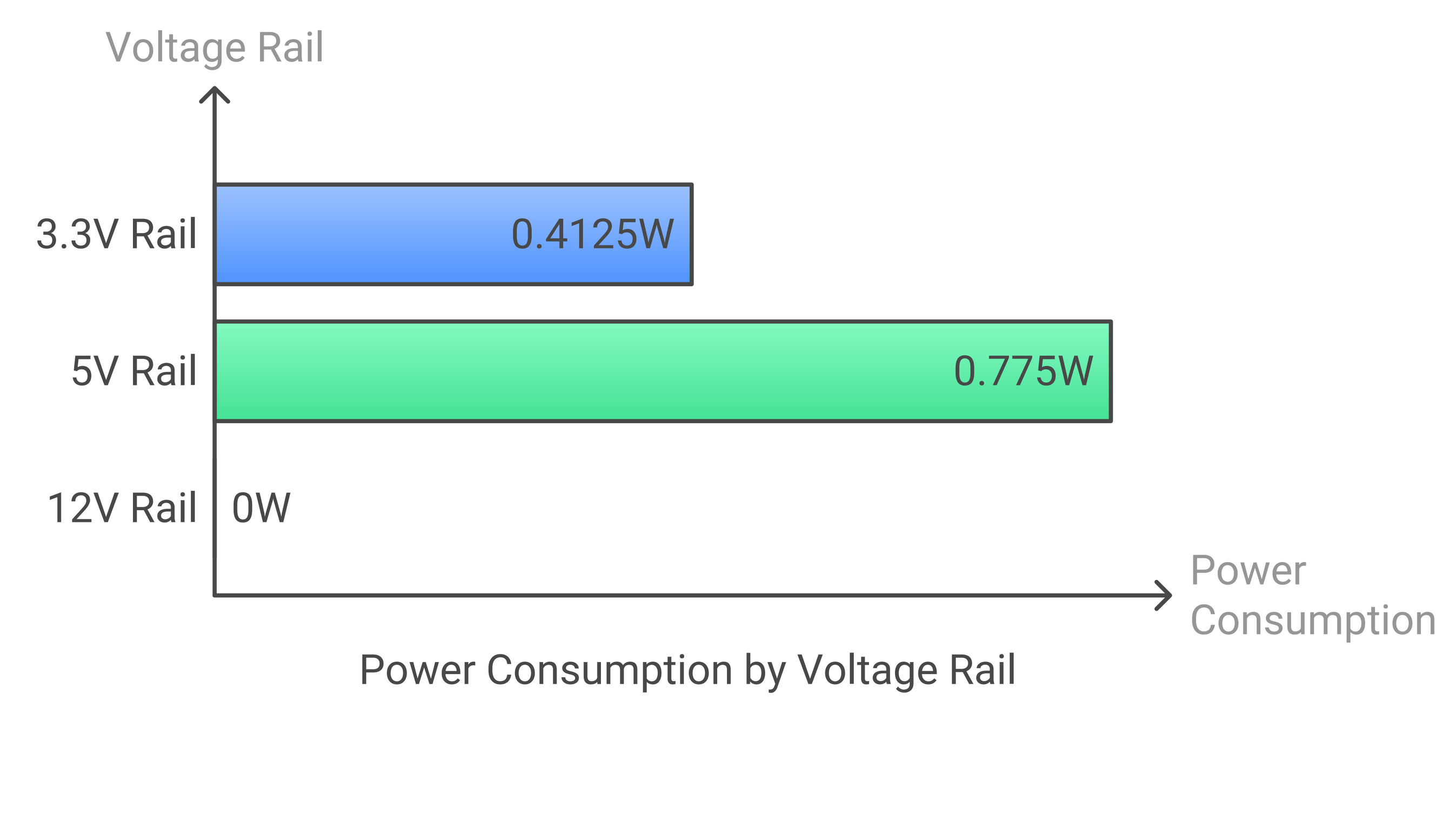
Component	Voltage (V)	Current (mA)	Notes
ESP32	3.3	50–250	Avg. 120mA (Wi-Fi dependent)
Soil Moisture Sensor	5	20 each	5 sensors = 100mA total
DHT22	3.3	2–5	Low power, intermittent use
Ultrasonic Sensor	5	15	Short pulses (~15mA avg.)
Water Flow Sensor	5	15–20	Active only during water flow
Keypad	3.3/5	Negligible	Passive component
LCD Screen	5	20	Backlight increases draw
Relay Module	5	70–100	Draws 100mA when active
Solenoid Valve	12	500–700	Major power draw (~700mA avg.)

- **3.3V Rail**
  - ESP32 + DHT22 = 125mA
  - Power: 3.3V × 0.125A = **0.4125 W**
- **5V Rail**
  - Soil Sensors + Ultrasonic + Water Flow + LCD + Relay = 255mA
  - Power: 5V × 0.255A = **1.275 W**
- **12V Rail**
  - Solenoid Valve = 700mA
  - Power: 12V × 0.7A = **8.4 W**



Total Active Power: 0.4125W + 1.275W + 8.4W = **10.0875 W**

- **3.3V Rail:** 0.4125 W (same as active)
- **5V Rail:** 155mA → 5V × 0.155A = **0.775 W**
- **12V Rail:** 0W



Total Idle Power: 0.4125W + 0.775W = **1.1875 W**

- Solenoid runs 2 hours/day (active mode).
- System idles 22 hours/day.

- **Active:** 10.0875W × 2h = **20.175 Wh**
- **Idle:** 1.1875W × 22h = **26.125 Wh**
- **Total:** 20.175Wh + 26.125Wh = **46.3 Wh/day**

- **Minimum Capacity:** 46.3Wh / 12V = **3.86 Ah**
- **With 50% Safety Margin:** 3.86Ah × 1.5 = **5.79 Ah**
- **Recommended Battery:** 12V 7Ah (standard size)

- **Minimum Panel Power:** 46.3Wh / 4h = **11.58 W**
- **Recommended Panel: 20W** (accounts for inefficiencies, cloudy days)