List of components and materials

Bench + table

Table comparing types of roofs

1. **White lacquered corrugated galvanized sheet 0.45x1130x2000 mm (31.62€ x 2)**
   - Good size and sustainable
   - Cheapest option
2. **Trailer Awning Fabric Replacement | Heavy Duty Weatherproof Vinyl (64,99€ x 2)**
   - Looks most what we are planned.
   - Potential for own patents
   - Price is decent
   - Have option to open and close
3. **1045 sheet steel tray in transparent polycarbonate, W: 105 cm, D: 200 cm (37,80€ x 2)** **Prefer**
   - Almost cheapest
   - Dont have option to open or close
   - Light weigh
   - Easy to work with
   - Kinda transparent

Table comparing types of centresupport

1. **Milling products**
   - Looks what we are planning
   - Dont know the price
   - Heavy and hard to work with
2. **Ripa de madeira tosca PINHO 70X100X2600MM (14,99€)** **Prefer**
   - Thickest wood that found on porto
   - Pretty cheap
   - Easy to work with

Table comparing types of table material

1. **Painel de madeira maciça CASQUINHA BRANCA 2000X500X18MM (29.99€ x 4)** **Prefer**
   - Big table

2. **Painel de madeira maciça CARVALHO 1500X400X18MM (39.99€ x 3)**
    - Small table

Table comparing types of supports

1. **Ripa de madeira aplainada CASQUINHA BRANCA 44X44X2400MM (3,87€/m)** **Prefer**
    - Easy to get
    - Easy to work
    - Good size
2. **Väliseinätolppa 42x66x3000mm, mänty, mitallistettu, sormijatkettu (2€/m)**
    - Hard to get
    - Easy to work
    - Good size
    - Cheap

Comparing types for the bench

1. **Perfil tudo redondo 8x1x1 aço (5.99€ x ?)** **TO USE**
    - Easy to work with
    - Cheap
    - Sustainable
2. **Painel de madeira maciça BORDA ABETO 200X20/25CM 17MM (15.99€ x 3)**
    - Good choise for bench back
    - Cheap
    - Nice looking
    - Ecologic
3. **Painel de madeira maciça PRANCHA ABETO 200X30/40CM 50MM (42.99€ x 3)**
    - Good choise for bench seats
    - Sustainable
    - Ecologic
    - Cheap
4. **Outdoor Furniture Modern Metal Garden Public Street Curved Wood Bench** **Prefer**
    - Round design
    - Easy to work with

Wi-fi

Eero Outdoor 7

- Coverage: Provides up to 15,000 square feet of coverage, ensuring robust connectivity across expansive outdoor areas.
- Speed: Supports speeds up to 2.1 Gbps, accommodating high-bandwidth activities such as video conferencing and large file transfers.
- Durability: Built to withstand extreme weather conditions, with an operational temperature range from -40°F to 130°F (-40°C to 54°C) and an IP66 rating for water resistance.
- Power Options: Supports Power over Ethernet (PoE) for flexible installation, reducing the need for additional power outlets.
- Integration: Integrates with existing Eero mesh systems, allowing for scalable network expansion.
- Smart Home Compatibility: Supports protocols like Thread, Zigbee, and Matter, facilitating integration with various smart devices.
- Pricing: Priced at $349.99, with availability starting November 13, 2024.

TP-Link EAP225-Outdoor

- Speed: Provides dual-band Wi-Fi with speeds up to 1200 Mbps, ensuring stable connections for multiple users.
- Durability: Equipped with a weatherproof enclosure, rated to withstand harsh outdoor conditions.
- Power Options: Supports PoE, simplifying installation by transmitting power and data through a single cable.
- Management: Compatible with TP-Link's Omada Controller, offering centralized management and monitoring.
- Cost-Effective: An affordable option for expanding outdoor Wi-Fi coverage without significant investment.
- Pricing: Approximately $100 - $130.

Ubiquiti UniFi AC Mesh Pro

Overview: The Ubiquiti UniFi AC Mesh Pro is engineered for high-performance outdoor wireless networking, suitable for environments requiring extensive coverage.

- Speed: Tri-band technology delivering speeds up to 1.7 Gbps, supporting high-density user environments.
- Coverage: Capable of covering areas up to 300 meters.
- Durability: Designed with a weather-resistant enclosure to endure various environmental conditions.
- Management: Integrates with the UniFi Controller for seamless network management and monitoring.
- Scalability: Supports seamless roaming, allowing devices to switch between access points without interruption.
- Pricing: Approximately $180 - $250.

What is the best solution?

For an outdoor coworking space, the best solution compromising price to quality factors, as well as the product's requirements, is the Ubiquiti UniFi AC Mesh Pro. It has quite a high speed, is highly weather-resistant with wide distance coverage and is reliable to manage.

Mechanism

For vertical motion adjustment, three main mechanisms are commonly used:

1. Hydraulic Systems – These use liquid pressure to move objects up and down. A pump forces hydraulic fluid into a cylinder, pushing a piston that raises the platform. The movement can be controlled using a manual or electric valve. These systems are powerful but require maintenance due to potential fluid leaks.
2. Pneumatic Systems – Similar to hydraulic systems but use compressed air instead of liquid. They are cleaner and faster but may have less precision and load capacity.
3. Mechanical Systems – These include screw jacks, rack-and-pinion systems, or scissor lifts, which rely on gears and levers to adjust height. They are reliable and do not require fluids, but may need more force for manual operation

EXAMPLES:

1. Office chairs- Nowadays there are two types of office chair cylinders: Pneumatic and Hydraulic. But most office chairs are installed with pneumatic cylinders. Some people call it gas cylinders, gas lifts.

The Pneumatic Cylinders

-Pneumatic cylinders work similarly as the pump for bicycle tire. When pressing the pump, the air is compressed into the inner tube and then discharged through the nozzle of the pump, entering to the outer cylinder tube.

-The pressure level inside the pneumatic cylinders is very high. The cylinder cavities are filled with pressurized nitrogen instead of a simple air chamber. And these nitrogen is completely sealed, where the high pressure of these cylinders is stuck. You can know the structure of the cylinders from the “gas cylinder installation” .

The Hydraulic Cylinders

Hydraulic cylinders works the same as Pneumatic ones .But they have two chambers, Besides, they are filled with liquid, not nitrogen.

One chamber is filled with high-pressure in-compressible oil. The other includes an expandable piston. The two chambers are connected at the bottom. However, a valve is designed to prevent high-pressure oil from entering the piston chamber.

If you raise the adjustment lever, the valve will open. And it will allow fluid to enter the piston chamber. The pressure of the incoming fluid forces the piston upward. Because it is in-compressible oil, it is powerful enough to lift the weight of the piston, which makes the seat of the chair raise. Like pneumatic cylinders. When you pull the lever, the hydraulic chairs don’t automatically lower. You need to increase the weight. You can sit on the chair and pull the lever. When doing this, you will force the piston down. This will also force the oil through the valve and into its chamber.

(https://allchairparts.com/pneumatic-and-hydraulic-office-chair-cylinders/#:~:text=Nowadays%20there%20are%20two%20types,it%20gas%20cylinders%2C%20gas%20lifts.)

2. Office chair mechanism: main types

Relaxplax mechanism

The Relaxplax mechanism allows the inclination of the backrest, tension adjustment and locking in the 90º position, in addition to allowing the seat height adjustment.

Eccentric Mechanism

The Eccentric mechanism got its name because it synchronizes the tilting movement of the backrest and the seat in 4 positions. In addition, it allows you to adjust the height of the seat.

Backplax Mechanism

The Backplax mechanism allows the inclination of the backrest with locking in any position, in addition to height adjustment of the backrest and seat.

Self-compensating mechanism

The self-compensating mechanism allows for synchronized inclination of the seat and the backrest allows for 3-position locking. In addition, it offers backrest height adjustment, seat height adjustment and seat depth adjustment (available on Brizza and Bix chairs).

(https://plaxmetal.com/en/office-chair-mechanism-what-is-it-and-what-is-it-for/)

3. TOWER DROP:

How does it work? Almost all drop towers use an electromagnet to pull the cart up to the top of the tower. Then the electromagnet is switched off and the cart races back down with the help of gravity. After this stage happens the cart is slowed down by magnets as it reaches the bottom.
(https://prezi.com/cf5cedxknnme/drop-towers-and-how-they-work/#:~:text=How%20does%20it%20work%3F,as%20it%20reaches%20the%20bottom.)

FOR THE CHAIRS:

- Mechanism with shaft and pivot
- The backrest is mounted on a rotating shaft, allowing it to pivot 90-110°.
- It may include a locking system for stability.
- Mechanism with hinges and stoppers
- The backrest rotates upward on a set of sturdy hinges.
- Mechanical stoppers or a locking system secure it in the desired position.
- Mechanism with springs or gas lift (pneumatic cylinder)
- Allows assisted and controlled lifting.

• When not in use, the backrest automatically returns to its initial position.

For the TABLE:

-the best option is Hydraulic cylinder

(Hydraulic cylinders are mechanical components that generate a strong pulling or pushing force)

(https://m.youtube.com/watch?v=52IMMQSB9Hs&pp=ygUSI3NpbGluZGVyaHlkcmF1bGlj)

FROM AI:

For the Table:

-Hydraulic piston – Similar to an office chair mechanism, allowing smooth height adjustment.

-Motorized screw lift (electric actuator) – A motor-driven screw mechanism that raises or lowers the table.

-Pulley and counterweight system – A manual solution where counterweights help lift and lower the table.

For the Bench:

-Telescopic columns – Sections that extend and retract to adjust the height.

-Rail and guide system – Ensures smooth vertical movement.

-Linear electric lift – A precise, motorized system often used in smart furniture.

Power supply

In ordert to know the required power supply of our product we have to break down the energy consumption of it first:

1. Adjustable Table Mechanism (Electric Actuator)

- Power consumption: ~50W–150W (average: 100W)
- Usage time: ~10 minutes/day (0.167 hours)
- Energy usage: 100W × 0.167h = 17Wh/day (~0.017 kWh)

2. Charging Plugs (USB & AC Outlets)

- Assumption: Mix of USB ports (10W each) and AC plugs (65W each)
- 6 devices charging simultaneously
    - 4 USB devices → 4 × 10W = 40W
    - 2 Laptops (via AC outlets) → 2 × 65W = 130W
- Total power consumption: 170W
- Usage time: 8 hours/day
- Energy usage: 170W × 8h = 1,360Wh/day (1.36 kWh)

3. Wi-Fi Router

- Typical power consumption: 10W–15W
- Usage time: 24 hours/day
- Energy usage: 15W × 24h = 360Wh/day (0.36 kWh)

Total Daily Energy Consumption:

17Wh+1,360Wh+360Wh ➞ Total: ~**1,737Wh/day** (≈1.74 kWh/day)

Solar Panel System

Since sunlight conditions vary, we assume 4 peak sun hours per day for energy production.

1. Solar Panel Options

a. LG NeON 2 400W

- Power Output: 400W
- Efficiency: ~22%
- Estimated Daily Output: ~1.6 kWh
- Key Features: High power density, excellent performance in low-light conditions
- Approximate Price: €249 per panel

b. Renogy 320W Monocrystalline

- Power Output: 320W
- Efficiency: ~21%

- Estimated Daily Output: ~1.28 kWh
- Key Features: Durable, high efficiency, weather-resistant
- Approximate Price: €300 - €400 per panel

c. SunPower Maxeon 420W

- Power Output: 420W
- Efficiency: ~22.7%
- Estimated Daily Output: ~1.68 kWh
- Key Features: Premium quality, highly durable
- Approximate Price: €500 - €600 per panel

d. Canadian Solar HiKu 445W

- Power Output: 445W
- Efficiency: ~20.9%
- Estimated Daily Output: ~1.78 kWh
- Key Features: Cost-effective, robust design
- Approximate Price: €350 - €450 per panel

We selected LG NeON 2 400W and Renogy 12V 200Ah because they offer the best balance between efficiency, durability, and cost for a public park installation.

Renogy 320W Monocrystalline is a good durable option, but has lower power output (1.28 kWh/day), requiring a larger panel setup to meet energy needs.

SunPower Maxeon 420W hast he highest efficiency, but is significantly more expensive (~$500 - $600) for only a small performance gain.

Canadian Solar HiKu 445W has slightly higher power output, but bulkier dimensions and lower efficiency (~20.9%) than LG NeON 2.

Battery Storage

a. Renogy 12V 200Ah Lithium Battery

- Capacity: 2.4 kWh
- Chemistry: $LiFePO_4$
- Efficiency: ~98%
- Key Features: Long lifespan, deep discharge capability

- Approximate Price: €1,000 - €1,200

b. Battle Born 100Ah $LiFePO_4$ (Two Units)

- Capacity: 1.2 kWh each (2.4 kWh total)
- Chemistry: $LiFePO_4$
- Efficiency: ~96%
- Key Features: Compact, reliable
- Approximate Price: €950 - €1,050 per battery (Total: €1,900 - €2,100)

c. Tesla Powerwall 2

- Capacity: 13.5 kWh
- Chemistry: Li-Ion
- Efficiency: ~90%
- Key Features: High capacity, integrated inverter
- Approximate Price: €7,500 - €8,500

d. Bluetti EP500

- Capacity: 5.1 kWh
- Chemistry: $LiFePO_4$
- Efficiency: ~95%
- Key Features: All-in-one power station
- Approximate Price: €4,500 - €5,000

We selected Renogy 12V 200Ah Lithium Battery provides the necessary capacity with high efficiency and a reasonable price point, making it ideal for the smart bench.

Battle Born 100Ah $LiFePO_4$ is reliable, but two units are needed, making it more expensive (€1,900 - €2,100).

Tesla Powerwall 2 is too large (13.5 kWh) and too expensive (€7,500 - €8,500) for a smart bench, which is an overkill.

Bluetti EP500 is a good all-in-one power station, but bulkier and significantly more expensive (€4,500 - €5,000) than necessary.

Final Recommended Setup

Solar Panel: 1x LG NeON 2 400W (~€249)

Battery: 1x Renogy 12V 200Ah Lithium Battery (~€1,000 - €1,200)

Additional Components:

1. **MPPT Solar Charge Controller:** Ensures optimal charging efficiency (€100 - €200)
2. **Inverter (if AC power is required):** Converts DC to AC power (€150 - €300)

Estimated Total Cost: Approximately €1,500 - €1,900

- Lights

- Compering types of lights

Neon Rope Lights, 40FT RGB Led Strip Lights, Waterproof IP67, Control with App/Remote, Music Sync (29.99€) PREFER

- Style: RGB
- Power source: DC
- Light source: LED
- Control: app or remote
- Rating: GOOD+
- Wattage: 12 watts

Neon Led AC 110-120V LED NEON Light Strip (Green, 5m/16.4ft) (19.99€ x 2)

- Style: Traditional
- Power source: Corded Electric
- Light source: LED
- Control: app or remote
- Rating: BAD
- Wattage: -

Govee Smart Light Bulbs, Color Changing Light Bulb (34.99€)

- Style: Smart bulb
- Power source: Corded Electric
- Light source: LED
- Control: Bluetooth or Wi-Fi
- Rating: Good+
- Wattage: 9 watts

Govee Glide Hexa Light Panels (179.99€)

- Style: Hexagon lights
- Power source: AC/DC
- Light source: LED
- Control: Bluetooth, Wi-Fi or Alexa
- Rating: Good
- Wattage: 36 watts

Charger units

As part of the creation of an outdoor workspace powered by solar energy, it is essential to select the best charging options for users' electronic devices. Various solutions are available, each with its own advantages and disadvantages in terms of efficiency, convenience, and cost.

1. **Standard AC Outlets**

Integrating standard power outlets using an **inverter** would allow users to plug in any type of device, including laptops and other equipment that require alternating current (AC).
Advantages: Universal compatibility, supports high-power devices.
Disadvantages: Requires an inverter, causes energy loss, increases installation costs.

2. **USB-A and USB-C Ports**

A more efficient alternative is to use **USB-A and USB-C ports** powered directly by DC (direct current) from the solar panels.
Advantages: Easy installation, high energy efficiency, fast charging for phones, tablets, and some laptops.
Disadvantages: May be limited for high-power devices (e.g., some laptops requiring more than 100W).

3. **Wireless Charging (Induction - Qi)**

Adding wireless charging stations would allow users to simply place their phones on a pad for battery recharge.
Advantages: Convenient, cable-free, reduces wear on charging ports.
Disadvantages: Less efficient, slower than wired charging, not suitable for laptops.

4. Battery Storage and Solar Power Banks

Using **solar batteries** would allow energy storage for later use, ensuring a continuous power supply even during low sunlight conditions.
Advantages: Stable power supply, ability to charge multiple devices.
Disadvantages: Additional cost, limited capacity depending on demand.

What is the Best Solution?

- For an **optimized and efficient workspace**, **USB-C and USB-A ports** are the best choice: they provide fast charging and are easy to install.
- If laptops are frequently used, adding some **AC outlets with an inverter** would be beneficial.
- **Wireless charging** can be offered as an additional option but should not be the primary method.
- A **battery storage system** is recommended to ensure a stable power supply.

By combining these solutions, the workspace will provide **a reliable, convenient, and sustainable charging experience** while maximizing the use of solar energy.

Controller unit

1. Raspberry Pi (Model 4 or 3B+)

- Overview: A small computer that runs a full operating system and can be controlled over the internet.
- Features:
    - Runs Linux, which means it can support remote access tools for troubleshooting.
    - Offers both Wi-Fi and Ethernet for remote control.

    - Good community support and many available libraries for connecting hardware.
- Suitability: Perfect if you need full access to the system for fixing bugs remotely. It's easy to connect to a network for troubleshooting and software updates.
- Best For: Complex systems where you need to manage both hardware and software remotely.

2. ESP32 (Wi-Fi + Bluetooth)

- Overview: A powerful, low-cost microcontroller with built-in Wi-Fi and Bluetooth.
- Features:
    - Can update its software remotely (Over-the-Air updates).
    - Supports easy connection to apps and remote control.
    - Very energy-efficient and great for small to medium projects.
- Suitability: A good choice if you need something simple and cost-effective that supports remote troubleshooting and software updates.
- Best For: Smaller projects where you want to keep things lightweight and easy to manage remotely.

3. Arduino MKR Wi-Fi 1010

- Overview: A development board from Arduino with Wi-Fi built in.
- Features:
    - Supports remote software updates via Wi-Fi.
    - Can be managed through the Arduino IoT Cloud, which makes remote monitoring and troubleshooting easy.
    - Energy-efficient, ideal for battery-powered devices.
- Suitability: Great if you're using Arduino already and want simple remote access and updates.
- Best For: IoT-based projects where you need remote access and easy management.

4. BeagleBone Black

- Overview: A small, affordable computer that can run Linux and is great for real-time control.
- Features:
    - Runs Linux, allowing full access to troubleshooting tools.
    - Offers Ethernet or Wi-Fi for remote access.
    - Suitable for more complex projects with higher computing needs.
- Suitability: Good for advanced projects where you need powerful computing and remote management.
- Best For: Complex systems requiring real-time control and remote troubleshooting.

Final recommendation

For Co-venient, the ESP32 is likely the best choice. It is affordable, efficient, and offers both Wi-Fi and Bluetooth for remote access. It supports Over-the-Air updates, making it easy for a team to fix bugs or update software remotely. It's also widely used in IoT projects, which makes it a practical choice for controlling smart furniture.

If you need more computing power or plan to run a more complex system, then the Raspberry Pi could be a good option. However, for most outdoor projects like this, ESP32 offers the best balance of features, cost, and ease of use.