Solar Kit for Pickering Valley Elementary School-

Scientific Evaluation, Procurement and Use

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Executive Summary

Downingtown Area School District engaged Drishti Foundation in Fall 2024 to deliver a student-centered solar power initiative at Pickering Valley Elementary School. The team studied core solar energy concepts and classroom applications, initially considering a small fixed off-grid system (2–6 panels with charge controller, batteries, and inverter) as a visible learning exhibit. Following a comparative evaluation of fixed kits (Eco-Worthy, Renogy) and a mobile alternative (BLUETTI AC180 portable power station), the project selected the BLUETTI AC180. This choice lowers total cost by eliminating mounts, trenching, fencing, and permitting; improves safety through an integrated, enclosed design; accelerates deployment by avoiding construction and inspections; and enhances instructional value with mobility and app-based monitoring.

To meet the ~$2,000 target, the team raised funds through donations and contributions and negotiated a direct discount with the manufacturer to complete procurement within budget.

The system will be demonstrated to students on September 16, 2025, introducing hands-on concepts in generation, storage, and efficiency. The solution meets educational objectives immediately and preserves a clear path to add portable panels or a fixed array in later phases as curriculum and funding grow.

Based on the evaluation, the project will proceed with the BLUETTI AC180. It delivers mobility, simplicity, safety, and speed-to-value within budget while keeping future expansion options open.

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1.Introduction

Engagement background

Downingtown Area School District (DASD) engaged Drishti Foundation in Fall 2024 to evaluate, fund, and source a student-centered solar power solution for Pickering Valley Elementary School. The initiative focuses on a mobile, classroom-ready system that powers typical devices, supports real-time monitoring for lessons, and avoids permanent construction or permitting. It is delivered through a student-led, volunteer-supported model under PVES/Facilities guidance, with clear documentation and post-deployment training to ensure safe, confident operation by school staff.

Objective

The initiative will deliver a visible, hands-on renewable energy learning experience for students and teachers. It will also supply clean energy for common classroom loads while enabling real-time monitoring and basic energy management.

2.Scope of Program

Scope

The following scope statement clarifies what this project will and will not include:

- In scope: The project includes sourcing and deploying a safe, student-visible solar power solution, along with preparing clear documentation, delivering staff training, and completing a formal handoff for day-to-day operations.
- Out of scope: The project excludes grid-tie interconnection, any roof penetrations, and construction activities requiring changes to physical structures.

Requirements

The following requirements define the parameters for budgeting, location, and operations:

- Expected Load: It is assumed that the solution must provide power for six laptops, each rated at 50 watts and operating for six hours, as well as two 50-watt light bulbs running for eight hours.
- Budget: The project should target an approximate total cost of $2,000 and proactively minimize hidden expenses and any costs associated with permitting.
- Location and access: Demonstrations and any temporary setups should take place on the northeast (left) side of PVES near the vegetable garden to ensure visibility and ease of supervision.
- Operations: The solution must support pausing during holidays and include a clear transition plan so PVES staff can manage day-to-day operations after deployment.

Constraints

The following constraints establish the boundaries for approvals and safety considerations:

- Approvals: Any permanent installations will require township and district permitting.
- Safety: The system must ensure child-safe operation with minimal exposed conductors and straightforward, well-documented procedures.

Success criteria

The following success criteria define how we will measure the effectiveness of the solution:

- Learning impact: Students should be able to observe energy generation, storage, and consumption through a mobile unit with app-based visibility that supports real-time instruction.

- Usability: The solution should be easily portable across classrooms and events, require minimal setup, and support quick charging to ensure high availability.
- Cost and risk: The project should remain within the established budget and reduce risks by avoiding construction and inspection delays.

3.Project Plan

This section reflects the updated Gantt chart (September 2024 to September 2025) and incorporates the added School Board approval milestone. It outlines activities, sequencing, decision gates, and ownership to ensure predictable delivery and clear visibility for district stakeholders.

Timeline overview

- September–October 2024: Requirements and early stakeholder alignment.
- October–December 2024: Solar analysis and kit evaluations.
- December 2024–January 2025: Stakeholder milestone, final selection, and School Board approval.
- January–March 2025: Fundraising and procurement.
- April–August 2025: Documentation and presentation preparation.
- September 2025: Demonstration and operational handover.

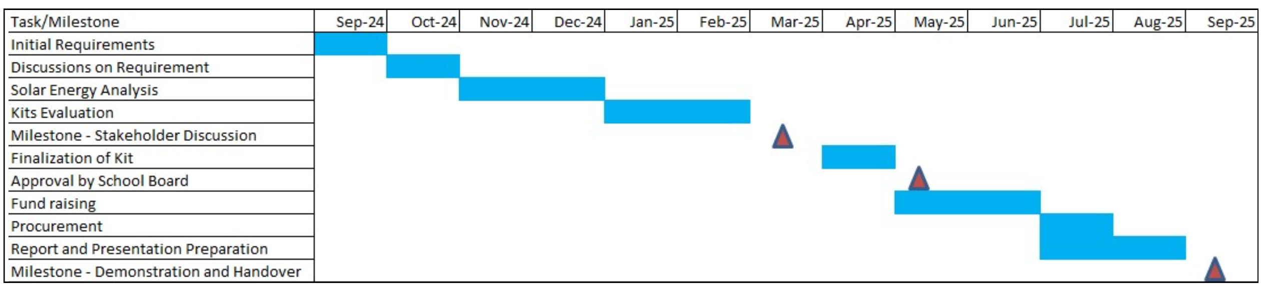


Figure 1- Proposed Project Execution Schedule

Work breakdown and sequencing (Figure 1)

- **Initial requirements (Sep 2024):** Define educational, operational, and safety goals; confirm budget assumptions and scope.
- **Discussions on requirement (Sep–Oct 2024):** Engage PVES staff and district stakeholders to validate needs, constraints, and classroom use cases.
- **Solar energy analysis (Oct–Nov 2024):** Quantify loads, model lesson-block energy, and size the solution with loss allowances.
- **Kits evaluation (Nov–Dec 2024):** Compare fixed kits and portable power station on cost, safety, mobility, and schedule; identify preferred option.
- **Milestone — stakeholder discussion (Dec 2024):** Present findings and secure endorsement to proceed to final selection.
- **Finalization of kit (Dec 2024–Jan 2025):** Confirm the selected solution; document rationale and operating plan.
- **Approval by School Board (Jan 2025):** Obtain formal authorization for procurement and classroom deployment.

- **Fund raising (Jan–Mar 2025):** Secure donations and contributions to meet the target budget.
- **Procurement (Feb–Mar 2025):** Negotiate pricing with the manufacturer or retailer, place the order, and receive the unit; verify contents and warranty.
- **Report and presentation preparation (Apr–Aug 2025):** Finalize documentation, quick-start/safety cards, training materials, and presentation assets.
- **Milestone — demonstration and handover (Sep 2025):** Deliver student demonstration and staff orientation; transfer operational ownership to PVES.

Dependencies and critical path

- **Analysis → Evaluation → Stakeholder milestone:** Technical findings inform option selection and endorsement.
- **Finalization → School Board approval:** Final selection package is required before the Board vote.
- **Board approval → Fundraising → Procurement:** Authorization precedes fundraising completion and purchase; negotiated pricing reduces lead time risks.
- **Procurement → Documentation/training → Demonstration:** Device receipt enables accurate SOPs and training content; these must be ready before the September event.

Milestones

- **Stakeholder discussion (Dec 2024):** Endorse preferred solution and next steps.
- **School Board approval (Jan 2025):** Formal authorization to purchase and deploy.
- **Purchase complete (Mar 2025):** Unit received, inspected, and ready for training content finalization.
- **Demonstration and handover (Sep 2025):** Classroom demonstration delivered; operational ownership transferred.

Roles and responsibilities

- **Project lead and team (Drishti Foundation):** Planning, analysis, options evaluation, fundraising coordination, procurement, training, and documentation.
- **PVES Principal:** Approval to proceed, alignment with educational goals, scheduling of demonstration.
- **Facilities designee:** Backup support; storage environment and safety checks.
- **District stakeholders and School Board:** Decision approvals at milestone gates; policy alignment and governance.

Gantt alignment summary

- **Start:** September 2024 with requirements and stakeholder engagement
- **Middle:** December 2024 stakeholder milestone; January 2025 School Board approval; January–March 2025 fundraising and procurement

- **Finish:** September 2025 demonstration and handover, following April–August 2025 documentation and training preparation

This revised plan adds governance clarity with the School Board approval gate, preserves schedule certainty through a portable, no-install solution, and ensures the system is instruction ready for the fall demonstration and sustained classroom use.

4.Solar Energy Overview

What is Solar Energy

At its core, solar energy is the energy that comes from the sun's light and heat. The sun, a massive ball of burning gas, constantly produces energy through a process called nuclear fusion. This process makes the sun the most important source of energy for life on Earth. Each year, the Earth receives an incredible 174 petawatts[1] of solar energy—so much that, if we could capture it all, we'd never need any other energy source.

Solar energy is converted into electricity through a process known as the photovoltaic effect. When sunlight strikes solar panels—composed of photovoltaic cells typically made from silicon—it energizes electrons within the material. These energized electrons are knocked loose and begin to flow, generating a direct current (DC) of electricity. Since most homes and appliances operate on alternating current (AC), an inverter is used to convert the DC into usable AC power. This electricity can then be used immediately, stored in batteries for later use, or fed into the electrical grid. The efficiency of this conversion depends on several factors, including the orientation and angle of the panels, sunlight intensity, temperature, shading, and the quality of the inverter and storage systems.

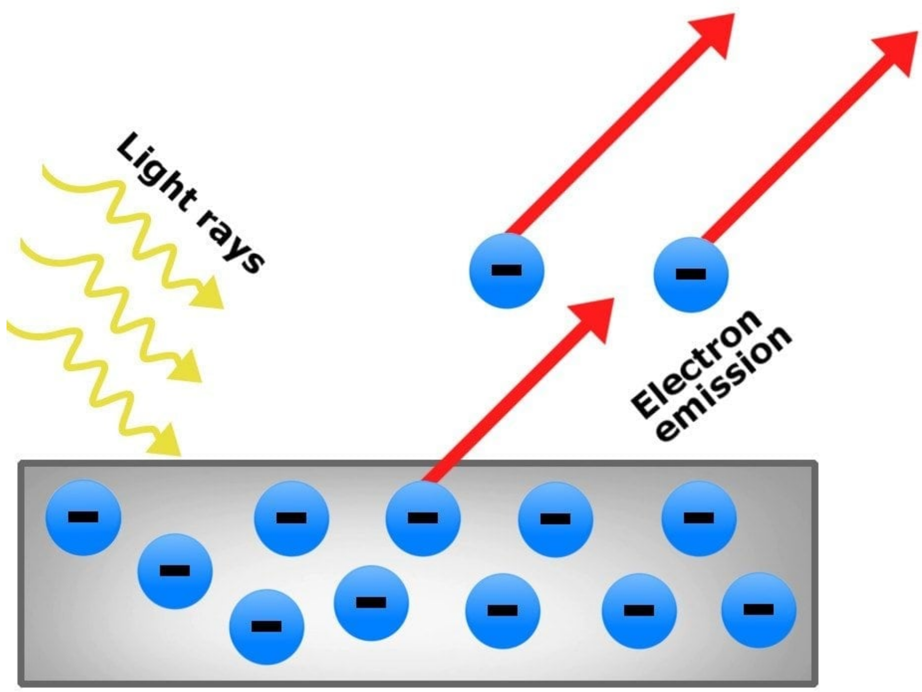


Image- Photons from sunlight hit the cell, creating electricity by moving electrons

[1] https://en.wikipedia.org/wiki/Solar_energy

Source- LabXChange
https://www.labxchange.org/library/items/lb:LabXchange:8e084a3e:html:1

Solar Energy System Components

Solar Panels
Solar panels serve as the primary component for converting solar energy into electrical current through the photovoltaic effect. For small to medium-scale installations, a typical setup may include 4 to 6 panels, depending on energy requirements and available space.

- Panel Type: Monocrystalline solar panels are recommended due to their higher efficiency and compact design. Although they are more expensive than polycrystalline panels, their superior performance makes them a preferred choice for long-term energy generation.

Charge Controllers
Charge controllers regulate the voltage and current from the solar panels before it reaches the battery system. Their primary function is to prevent battery overcharging and ensure safe, efficient energy transfer.
Types of Charge Controllers:

- Simple Controllers: These include 1-stage and 2-stage models, offering basic regulation.
- PWM (Pulse Width Modulation): These 3-stage controllers provide improved charging efficiency and battery protection.
- MPPT (Maximum Power Point Tracking): The most efficient option, MPPT controllers optimize power output by adjusting voltage to match the battery's charging profile, especially under variable sunlight conditions.

Battery
The battery stores backup energy for use during periods of low sunlight or high demand. A commonly used configuration is a 12V 200Ah $LiFePO_4$ (Lithium Iron Phosphate) battery, known for its long cycle life, safety, and high energy density. This battery type is well-suited for solar applications due to its stability and efficiency.

Inverter
The inverter plays a critical role in converting the direct current (DC) produced by the solar panels and stored in the battery into alternating current (AC), which is compatible with standard household appliances. It is positioned between the battery and the load, transforming the 12V DC output into 110V AC.
Inverter Types:

- Centralized or String Inverter: Ideal for systems with uniform panel orientation.
- Power Optimizer: Enhances performance by adjusting voltage at the panel level.
- Micro Inverter: Installed on individual panels, offering maximum flexibility and efficiency, especially in shaded or complex installations.

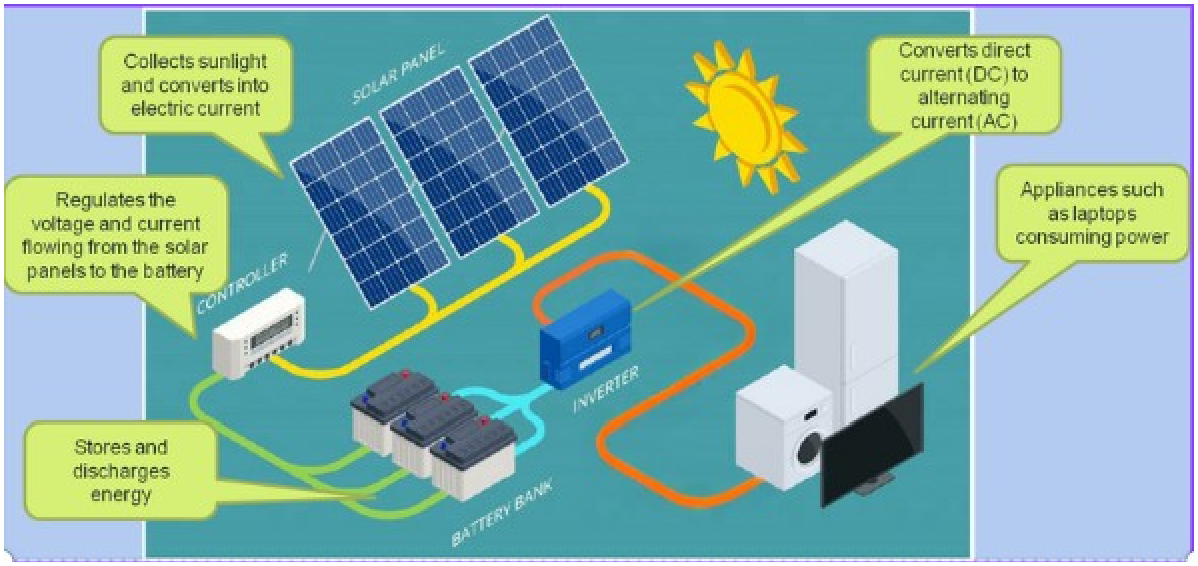


Image- Solar Energy System with components

Source: Palmoreco, https://palmoreco.com/blog/faq-about-photovoltaic-inverters/

5.Load Analysis

This section translates classroom device needs into energy terms so we can size a solution accurately. We begin by distinguishing power (W) from energy (Wh), then convert each target load (laptops and lights) into daily energy using the relationship:

$$\text{Energy (Wh)} = \text{Power (W)} * \text{Time (h)}$$

We also model a practical "lesson block" scenario (a practical classroom scenario) that reflects realistic classroom usage and modern LED lighting, and we account for conversion losses so battery capacity maps to real-world runtime. These steps ensure the selected system can reliably support instruction without over- or under-sizing.

Definitions and units

- **Power (W):** The rate at which a device uses energy at any moment.
- **Energy (Wh):** Power accumulated over time. Energy equals power multiplied by duration.

$$\text{Energy (Wh)} = \text{Power (W)} * \text{Time}$$

Why this matters: Device labels list power (W), but batteries and daily needs are in energy (Wh or kWh). To size a solution, convert each load's power to energy by multiplying by hours of use.

Target loads as specified

- **Laptops:** The assumed requirement was to power 6 devices at 50 W each for 6 hours.

$$E(\text{Laptops}) = 6 * 50 * 6 = 1{,}800 \text{ Wh}$$

Explanation: Six laptops each draw 50W. Over 6 h, each laptop uses 50 * 6 = 300 Wh. Six laptops therefore consume 6 * 300 = 1,800 Wh.

- **Bulbs:** The assumed requirement was to power 2 bulbs at 50 W each for 8 hours.

$$E(\text{Bulbs}) = 2 * 50 * 8 = 800 \text{ Wh}$$

Explanation: Two bulbs each draw 50 W. Over 8 h, each bulb uses 50 * 8 = 400 Wh. Two bulbs therefore consume 2 * 400 = 800 Wh.

- **Total daily energy (upper bound):**

$$E(\text{Total}) = E(\text{Laptop}) + E(\text{Bulbs}) = 1{,}800 + 800 = 2{,}600 \text{ Wh} (2.6 \text{ kWh})$$

Explanation: Daily energy is the sum of each device group's energy use.

Practical classroom scenario ("lesson block")

- **Assumptions:**
    - Modern laptops average 25–45 W. We will use a realistic midpoint of 35 W
    - LED bulbs are 9–15 W (assume 10 W) rather than the full 50 W of incandescent bulbs.
    - We will consider a continuous teaching session of about 3 hours, referred to as a lesson block.
- **Energy per block:**

$$E(\text{Laptops per block}) = 6 * 35 * 3 = 630\ \text{Wh}$$
$$E(\text{Bulbs per block}) = 2 * 10 * 3 = 60\ \text{Wh}$$
$$E(\text{Total per block}) = 630 + 60 = 690\ \text{Wh}$$

Explanation: Multiply each device group's average power by the session length, then add them to get energy for one class period or lab.

Accounting for conversion losses

- **Inverter and system losses:** Real systems have inefficiencies (inverter, wiring, battery charge/discharge). A simple planning allowance is 10–15%.

$$E(\text{usable}) \approx E(\text{battery}) * (1 - 0.10 \text{ to } 0.15)$$

Example: A 1,152 Wh battery with 12% losses yields approximately-

$$1{,}152 * 0.88 \approx 1{,}014\ \text{Wh usable}$$

Explanation: Multiply nominal capacity by an efficiency factor to estimate real-world usable energy.

Implications for sizing

- **Portable unit target:** A system with ~1.1–1.5 kWh nominal capacity provides about ~1.0–1.3 kWh usable after losses, enough for one 690 Wh lesson block (and possibly two with conservative use or quick recharge).
- **Full-day upper bound:** Covering 2.6 kWh in one day on battery alone will require larger storage and/or continuous solar input during use.

Summary

The calculations show an upper-bound daily requirement of 2.6 kWh for the originally stated loads, while a realistic lesson block is approximately 690 Wh. Incorporating a 10–15% allowance for conversion losses, a portable system with ∼1.1 – 1.5 kWh nominal capacity comfortably supports lesson blocks with recharge between sessions, whereas full-day autonomy at the upper bound requires either larger storage or active solar input during use. These results guide us toward a mobile, right-sized solution and reserve fixed or higher-capacity options for future phases if full-day operation becomes a requirement.

6.Options Evaluation

Here is an overview of the solution pathways considered, organized from fixed, installation-based kits to a portable, no-install alternative. Options were identified through a broad sampling process that included in-store and online offerings from Home Depot, Amazon listings, manufacturer sites, and independent internet research; we reviewed product specifications, user reviews, and warranty/support details to ensure practical suitability in a K–5 environment. Each option was then assessed against clarified energy needs (a 2.6 kWh upper-bound day and a ~690 Wh lesson block), safety, mobility for classroom use, total cost including mounts/fencing/conduit where applicable, and schedule/approval risk. The summaries below highlight the core trade-offs so stakeholders can see how each path aligns with instructional goals, budget, and timeline.

Options summary

- Eco-Worthy 6×195 W fixed kit (3,000 W inverter, 2,560 Wh battery): Highest output; requires mounts, fencing, wiring, and approvals; highest total cost. [2]

Image - Eco-Worthy 6x195 W fixed kit

Source – Amazon Product Listing

[2] https://www.amazon.com/ECO-WORTHY-Complete-Lithium-Battery-Inverter/dp/B09B96QD9Y

- Renogy 4×100 W fixed kit (3,000 W inverter, 12 V 100 Ah battery): Lower generation; still requires installation/fencing/wiring and approvals. [3] [4]

Image - Renogy Solar Kit

Source – Amazon Product Listing

- Eco-Worthy 4×100 W fixed kit (2,000 W inverter, 2×12 V 100 Ah): Similar install burden; moderate capacity. [5]

Image – Eco-Worthy 4 x 100 W fixed Solar kit

Source- Amazon Product Listing

[3] https://www.homedepot.com/p/Renogy-3000-Watt-Pure-Sine-Wave-Inverter-12V-DC-to-120V-AC-Converter-for-Off-Grid-Solar-Power-w-Built-in-5V-2-1A-USB-Port-RNG-INVT-3000-12V-P2/308843258
[4] https://www.amazon.com/Renogy-Monocrystalline-Starter-Controller-Inverter/dp/B0BN2R4GBZ
[5] https://www.amazon.com/ECO-WORTHY-Solar-Panel-Kit/dp/B0CT8D12XZ

- BLUETTI AC180 portable power station (Selected): 1,800 W AC continuous output, 1,152 Wh $LiFePO_4$ storage; no installation; mobile; fast deployment and lower total cost.[6]

Image- Bluetti Solar Kit

Source- Bluettipower.com

Comparison table

Attribute	Eco-Worthy 6×195 W (fixed)	Renogy 4×100 W (fixed)	Eco-Worthy 4×100 W (fixed)	BLUETTI AC180 (portable)
System type	Panels + MPPT + inverter + 2,560 Wh battery	Panels + controller + inverter + ~1,200 Wh battery	Panels + MPPT + inverter + ~2,400 Wh battery	All-in-one portable power station with 1,152 Wh
Install needs	Ground mount, fence, conduit, approvals	Ground mount, fence, conduit, approvals	Ground mount, fence, conduit, approvals	None (plug-and-play)
Mobility	Low	Low	Low	High
Meets 690 Wh lesson block (with losses)	Yes, with large margin	Yes, with margin	Yes, with large margin	Yes, with modest margin
Meets 2.6 kWh day without solar input (with losses)	Yes (2.56 kWh nominal; borderline after losses, but supported with daytime PV)	No (insufficient capacity)	Borderline/partial (close, still tight after losses; daytime PV helps)	No (insufficient capacity)
Daytime solar support	High (≈1.17 kW array)	Low–moderate (≈400 W array)	Low–moderate (≈400 W array)	Optional portable panels only (e.g., 200–400 W)
Recharge pathway	Solar + AC	Solar + AC	Solar + AC	Fast AC; optional portable solar

[6] https://www.bluettipower.com/products/ac180

Attribute	Eco-Worthy 6×195 W (fixed)	Renogy 4×100 W (fixed)	Eco-Worthy 4×100 W (fixed)	BLUETTI AC180 (portable)
Total cost incl. materials	≈ $3,673	≈ $2,452	≈ $2,483	≲ $1,500 (unit), panels optional
Schedule/approval risk	High	Medium–High	Medium–High	Low
Classroom fit	Fixed demo zone	Fixed demo zone	Fixed demo zone	Mobile across rooms/events

Option-by-option assessment vs. Energy targets

- **Eco-Worthy 6×195 W (fixed):**
    - **Capacity and generation:** 2,560 Wh battery plus ≈1.17 kW PV can meet a 2.6 kWh day when including daytime solar contribution. Pure battery-only discharge is tight after losses; PV input closes the gap.
    - **Lesson block:** Easily covers 690 Wh blocks repeatedly.
    - **Trade-offs:** Highest cost and permitting/installation burden; lowest mobility.
- **Renogy 4×100 W (fixed):**
    - **Capacity and generation:** ~1,200 Wh battery with ≈400 W PV; inadequate for a 2.6 kWh battery-only day. With several hours of good sun, can support portions of the day, but still short of the upper bound without careful load management.
    - **Lesson block:** Covers a 690 Wh block (allowing for losses, it's close but feasible).
    - **Trade-offs:** Installation and approvals still required; lower total cost than large kit but limited daily energy.
- **Eco-Worthy 4×100 W (fixed):**
    - **Capacity and generation:** ~2,400 Wh battery with ≈400 W PV; near the 2.6 kWh day threshold, but after losses battery-only is tight. With 400 W PV over multiple sun hours, can approach or meet daily energy depending on conditions.
    - **Lesson block:** Covers 690 Wh comfortably.
    - **Trade-offs:** Same installation hurdles as other fixed kits; moderate cost.
- **BLUETTI AC180 (portable) — Selected:**
    - **Capacity:** 1,152 Wh; does not meet a full 2.6 kWh day on battery alone. Ideal for one to two 690 Wh lesson blocks with prudent management and quick AC recharge between sessions.
    - **Lesson block:** Meets 690 Wh block with modest margin; best fit for mobile, repeatable lessons and events.
    - **Trade-offs:** Minimal cost and zero installation/approval risk; mobility and safety advantages; add 200–400 W portable panels in a later phase for solar demonstrations and partial daytime replenishment.

The BLUETTI AC180 was selected for its lower total cost, full mobility, no required installation or approvals, and strong user reviews.

Decision rationale

- Faster delivery and lowest schedule risk.
- Mobile, versatile, and safer in student spaces.
- Lower total cost by avoiding mounts, fencing, conduit, and inspections.
- Clear monitoring for teaching without custom instrumentation.

7.Final Solution and Operations Plan

This section summarizes the selected system and how it will be used day to day. The focus is on reliable classroom operation, simple charging and monitoring, and a clear pathway to add portable solar for demonstrations in a later phase.

System overview

- **Core unit:** BLUETTI AC180 portable power station with 1,800 W continuous AC output and 1,152 Wh $LiFePO_4$ storage, providing stable, classroom-safe power and long cycle life.
- **Interfaces:** Multiple AC outlets for laptops and peripherals; USB-A/USB-C ports for device charging; 12 V DC output; integrated wireless charging pad; and a companion app for status, metrics, and basic controls.
- **Charging approach:** Foldable solar panels to support outdoor demonstrations and real-time solar charging. Standard AC wall charging for quick turnarounds between lessons.

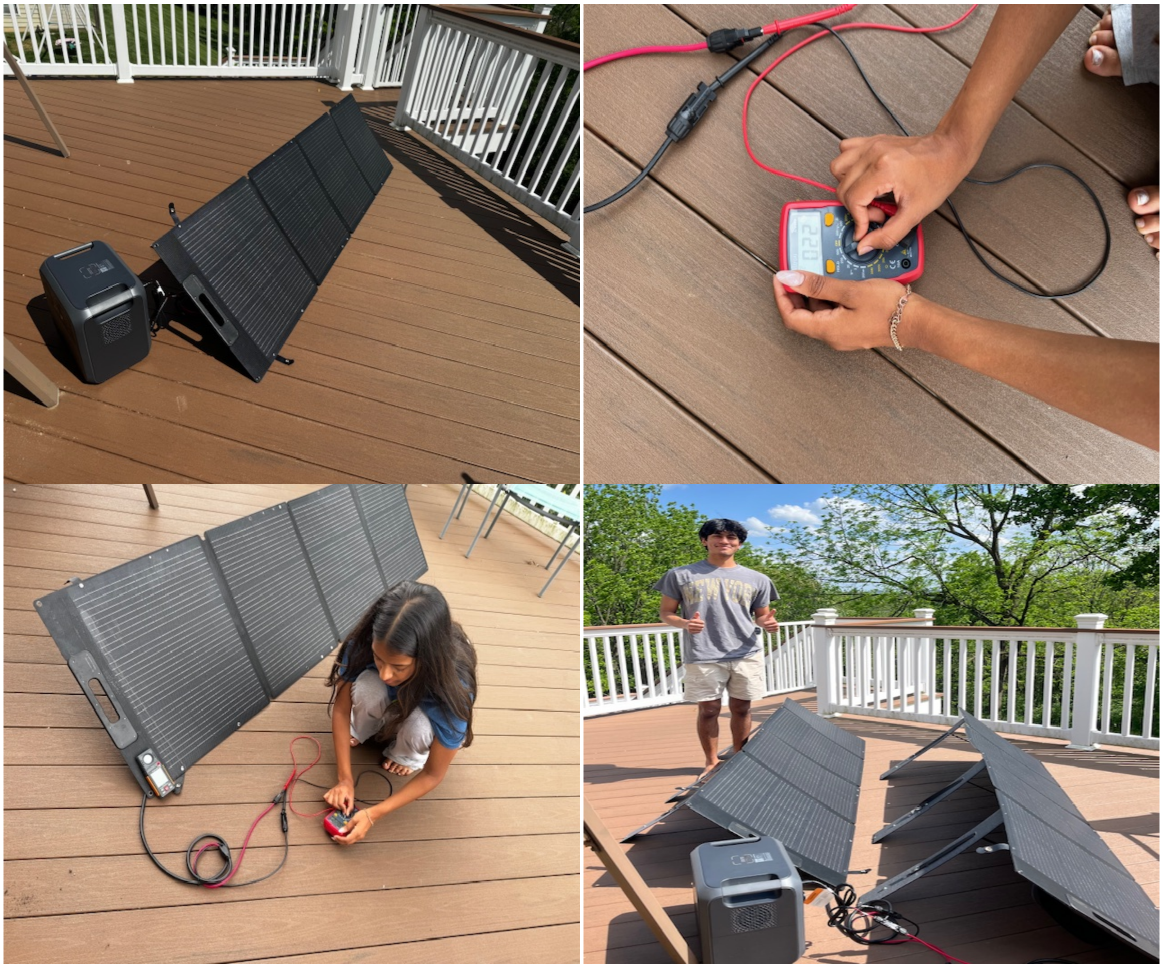
Image – Bluetti Console and features

Source- Bluetti AC 180 User Manual

Expected performance

- Cover the expected lesson block of approximately 600–800 Wh coverage for laptops and LED lighting.
- Recharge: Fast AC recharge between classes or overnight to maintain availability.

Photos/diagrams



Images - Student with mobile power station

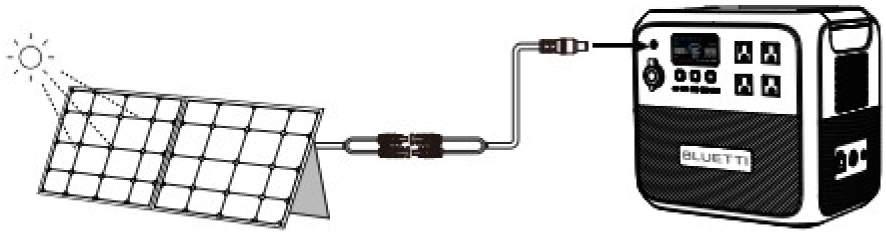


Image- Bluetti Charging from Solar Power

Source- Bluetti AC 180 User Manual

8.Budget and Procurement

A clear understanding of the budget envelope guided all technical choices and procurement steps. The project targeted a total cost of approximately $2,000, balancing instructional impact with operational simplicity and safety. To meet this target, the team raised funds through donations and community contributions, then pursued competitive pricing. After comparing retail channels and support terms, we negotiated a discount directly with the manufacturer and acquired the BLUETTI AC180 at a favorable price point, ensuring value while preserving funds for classroom materials and future enhancements.

Final selection costs

- **BLUETTI AC180 unit:** Priced within or below the $2,000 budget envelope after negotiated discount, inclusive of standard accessories and warranty.
- **Optional add-ons (not included in Phase 1):**
    - **Mobility cart:** A small utility cart with straps for safe hallway transport between classrooms.
    - **Secure storage:** A lockable cabinet that provides a designated charging location and limits unauthorized access.
    - **Operational aids:** Laminated quick-start and safety cards for front-of-unit reference.

Costs avoided

- **Construction-related expenses:** By selecting a portable, all-in-one unit, the project avoided costs associated with fixed installations, including mounts, fencing, conduit, outdoor junctions, plexiglass battery enclosures, and permitting/inspection fees.
- **Schedule and overhead:** Eliminating construction also reduced indirect costs such as contractor coordination, site downtime, and inspection delays.

Procurement summary

- **Funding approach:** Community donations and contributions aligned to the defined budget and educational objectives.
- **Sourcing strategy:** Evaluated multiple channels for price, availability, warranty, and support responsiveness; direct engagement with the manufacturer enabled a discount and timely delivery.
- **Outcome:** Solution acquired on budget with documented warranty, user manuals, and support contacts, ready for immediate deployment and staff training.

9.Safety and Risk Management

A portable, all-in-one system was chosen to minimize hazards and simplify compliance in a K–5 environment. The BLUETTI AC180 integrates protection features that reduce electrical risk, removes construction-related exposures, and supports straightforward operating procedures. The practices below align with common-sense safety, basic electrical best practices, and school facility expectations, enabling consistent, supervised use across classrooms.

Design and compliance advantages

- **Integrated protections:** The enclosed $LiFePO_4$ battery, built-in battery management system (BMS), and internal inverter reduce shock and touch hazards compared to open-wired, component-based kits.
- **No construction exposure:** With no fixed mounts, trenches, conduit runs, or fencing, the solution eliminates typical construction risks and avoids the need for permitting or inspections associated with permanent installations.
- **Clear labeling and references:** Front-of-unit quick-start and safety cards provide accessible guidance for staff and volunteers, supporting consistent procedures and compliance with school safety protocols.

Operating safeguards

- **Supervised use:** Always operate under adult supervision; store the unit in a locked location when not in use to prevent unauthorized access.
- **Safe power distribution:** Use short, high-quality cords; keep cables out of walkways; do not daisy-chain power strips or extension cords.
- **Load limits:** Do not exceed 1,800 W continuous AC output; verify the combined wattage of connected devices before turning on loads.
- **Battery care:** Maintain a 20–90% state of charge for longevity; perform a monthly top-off during extended breaks to preserve battery health.
- **Ergonomics and accessibility:** Position the unit at an accessible height on a stable cart; provide large-print quick-start instructions for quick, error-resistant setup and shutdown.

Risk management practices

- **Pre-use checklist:** Confirm SOC, cord condition, ventilation clearance, and load totals before each session.
- **Incident response:** If the unit alarms or shuts down, power off connected devices, disconnect loads, and follow the quick-start card's restart steps; escalate to the designated owner if issues persist.
- **Storage and environment:** Store in a dry, temperature-controlled area away from direct heat sources and liquids; ensure adequate ventilation during charging and operation.

- **Documentation and training:** Maintain updated SOPs, keep manufacturer manuals on file, and refresh staff training annually or when personnel change.

10. Demonstration and Handoff

This section prepares staff and students to use the BLUETTI AC180 safely and confidently from day one. It outlines a brief training plan tailored to K–5 classrooms, the documents provided for ongoing reference, and clear ownership for daily operations and support. The goal is to enable smooth, repeatable use across classrooms while minimizing risk and downtime.

Training – Sep 16, 2025

- Staff orientation (45 minutes): Ports and interfaces, app monitoring, charging procedures, and secure storage.
- Student mini-lesson (20 minutes): Core solar energy concepts and safe, hands-on usage of the BLUETTI AC180.
- Emergency procedures: Step-by-step power-down, designated storage location, and key contact list.

Documentation delivered

- Quick-start card: Laminated, front-of-unit reference for setup, operation, and shutdown.
- User manuals: Manufacturer documentation for the BLUETTI AC180 and accessories.
- Website URL: https://www.bluettipower.com/products/ac180

Handoff

- Operational owner: PVES technology/media lead responsible for daily use, storage, and scheduling.
- Backup: Facilities designee for continuity and safety oversight.
- Support: BLUETTI provides product support via phone and email through its support portal: https://www.bluettipower.com/pages/support

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11. Conclusion and Next Steps

This initiative delivers a safe, mobile, and instruction-ready clean energy solution that meets real classroom needs without installation delays or permitting. By selecting the BLUETTI AC180, the team prioritized immediate educational impact, clear monitoring, and low operational risk, while keeping costs predictable and management simple for PVES staff.

Key takeaways

- **Educational value:** Students directly observe generation, storage, and consumption with live readings that reinforce core STEM concepts.
- **Operational simplicity:** Plug-and-play use, fast recharge, and clear SOPs reduce downtime and support rotation across classrooms.
- **Risk reduction:** Enclosed design, modest power levels, and no fixed construction minimize safety and approval hurdles.

Future possibilities

The following features or activities can be considered to take the program forward.

- **Portable solar expansion:** Add 200–400 W foldable panels to demonstrate real-time charging, shade impacts, and weather variability during outdoor lessons.
- **Data and curriculum integration:** Use app logs for student data journals, energy math, and cross-curricular projects (science, math, social studies on sustainability).
- **Capacity scaling:** Introduce a second portable unit or a higher-capacity station to support multi-class events or clubs without recharging between sessions.
- **Fixed array feasibility:** Explore a small, fenced ground-mount or canopy array with NEC-compliant labeling and monitoring to support all-day energy goals and a permanent learning exhibit.
- **Student-led operations:** Establish an “Energy Steward” program where students handle pre-use checklists, basic diagnostics, and weekly reporting.
- **Community engagement:** Host family STEM nights, publish monthly “energy snapshots,” and partner with local industry or utilities for guest talks and sponsorships.
- **Maintenance and lifecycle:** Implement quarterly health checks, battery longevity practices (20–90% SoC), and a 3–5 year review for upgrades or replacements.