Request for Proposals: Development of a low-cost household cooking energy management platform

Background to the assignment

1. The engineering challenge

To develop an affordable platform that enables households to run concurrent cooking processes using two or more complementary electric cooking appliances, while keeping the total household electrical demand within a constrained and configurable supply limit.

MECS invites proposals from consultancies, universities, research institutes, engineering firms and consortia to develop and demonstrate a low-cost Household Cooking Energy Management Platform (CEMP). The platform shall coordinate two or more electric cooking appliances so that households can prepare complete meals through concurrent cooking processes without exceeding the electrical capacity available at the household connection or within the household installation.

This is an applied engineering and product-development assignment. It is not limited to a literature review or software simulation. The selected respondent will be expected to establish the technical requirements, compare alternative architectures, characterise representative appliances, develop a control strategy, build a touch-safe laboratory demonstrator, complete witnessed performance tests, and provide a credible product-development and commercialisation roadmap.

MECS has intentionally not prescribed a preferred architecture. The examples in this RFP are illustrative and shall not be interpreted as a predetermined solution. Responses are encouraged to challenge assumptions and propose simpler, safer or more cost-effective approaches where supported by evidence.

Core proposition

Use intelligent coordination, appliance operating characteristics and the inherent thermal storage in food and cookware to deliver more cooking service from a constrained electrical connection. A modest battery may be used where it provides demonstrable incremental value, but it shall not substitute for effective control or become the default source of cooking energy.

Across much of Africa and Asia, electricity access has expanded rapidly, yet many connected households remain unable to adopt modern electric cooking at useful scale because the electrical system available to them cannot reliably support conventional cooking appliances.

Constraints may occur at several levels:

- utility service connections rated between approximately 450 VA and 1 kVA, and in some markets up to 1.3 kVA;
- weak or overloaded low-voltage distribution networks;
- significant voltage fluctuations and intermittent supply;
- ageing, undersized or poorly installed domestic wiring;
- low-rated circuit breakers, sockets or extension leads;
- shared or informal connections between landlords and tenants; and
- the financial and practical difficulty of upgrading the utility connection or domestic installation.
- Indicative relationship between connection rating and usable real power

Utility connection rating	Approximate usable real power at PF ≈ 0.95
450 VA	approximately 430 W
900 VA	approximately 850 W
1 kVA	approximately 950 W
1.3 kVA	approximately 1.2 kW
2.2 kVA	approximately 2.1 kW

Note: Actual usable power depends on voltage, current limits, power factor, harmonics, protection settings and the condition of the local network and household installation. The project shall therefore manage current and apparent power as well as real power.

2.1 Practical appliance-power implications

Modern electric cooking appliances have different sensitivities to power limitation. Representative efficient appliances commonly include induction or infrared cookers rated at approximately 1 kW or above, electric pressure cookers (EPCs) around 700 W to 1 kW, and rice cookers above approximately 400 W. Individual appliances may operate on constrained connections, but simultaneous independent operation can exceed the available capacity, trip protection, cause voltage drop, or create unsafe heating in weak wiring and connections.

The control strategy shall recognise that reducing power does not affect every appliance or cooking process equally. During the pressure-build phase of an EPC, the difference between approximately 700 W and 1 kW may be experienced mainly as a modest increase in time to reach pressure and may be barely noticed by many users. By contrast, limiting an induction cooker to approximately 700 W can materially impair high-temperature tasks such as frying or cooking chapati or roti on a tawa. The platform should therefore be capable of preserving access to approximately 1 kW or more at the induction appliance during high-temperature phases, while using greater flexibility in the timing or power level of EPC and rice-cooker heating. These assumptions shall be tested rather than taken as universal across all appliances and foods.

2.2 Connection upgrades and the utility value proposition

In markets such as Indonesia and India, a household may sometimes increase a connection from approximately 450–900 VA to 1–1.3 kVA for a relatively modest customer charge, often of the order of US$7–40, depending on the utility, tariff category, meter and deposit requirements. Where spare capacity already exists, the utility's direct incremental cost may also be modest perhaps indicatively around US$25–130, this for administration, meter replacement or reprogramming and a technician visit. Exact charges and costs vary by jurisdiction and can be validated during the assignment.

Where the local network is constrained or many households increase demand, however, the utility may need to reinforce transformers, low-voltage feeders, service cables and protection equipment. When apportioned across affected customers, the resulting cost can range from hundreds to several thousand pounds per household. The project therefore seeks not merely to avoid a small customer connection fee, but to test a practical non-wires alternative that could reduce or defer reinforcement of household installations and upstream distribution infrastructure.

The platform must not be presented as a substitute for a safe and compliant household electrical installation. It may reduce the electrical stress placed on an installation, but it cannot make defective wiring, unsafe sockets or illegal connections acceptable.

3. Existing technologies and innovation opportunity

Peak-load management is an established engineering discipline. Commercial kitchens, industrial facilities and modern buildings use demand-management systems to coordinate loads and avoid excessive peak demand. Residential energy-management systems increasingly coordinate electric vehicle charging, electric heating, solar generation and battery storage within constrained household supplies.

These technologies demonstrate that available electrical capacity can often be used more effectively through intelligent coordination than through immediate infrastructure expansion. Existing products, however, generally fall into two broad categories:

- simple load-shedding or priority controllers that disconnect lower-priority circuits; and
- sophisticated commercial or building energy-management systems designed for larger, higher-cost installations.

Neither category appears to provide a low-cost, cooking-aware household system designed specifically to coordinate complete meal preparation across multiple appliances on very constrained supplies. The innovation sought is therefore not peak-load management itself, but its adaptation to the thermal dynamics, user expectations, appliance behaviour, safety requirements and affordability constraints of domestic cooking.

Develop a Household Cooking Energy Management Platform that enables at least two complementary electric cooking appliances and is architecturally scalable to additional appliances, to operate as one coordinated electrical load. The platform should enable households with approximately 300–1,200 W of available cooking power to prepare complete meals through concurrent use of multiple appliances, even where those appliances are not all energised at full power simultaneously.

4.1 Manage heat, not merely appliance priority

Unlike conventional priority control, the proposed system should not simply switch one appliance off so that another can operate. It should exploit the thermal inertia of the appliances, cookware and food. Many foods cool slowly, and many cooking appliances already operate through intermittent heating cycles. Short, controlled reductions or interruptions in heat input may therefore be possible without materially affecting temperature, meal quality, safety or total cooking time.

The system shall allocate heating opportunities according to appliance state, thermal condition, cooking-stage requirements, safety constraints and user intent. Interruption or modulation periods shall be determined experimentally for each appliance type and cooking stage; the illustrative range of a few seconds to tens of seconds shall not be treated as a universal control parameter.

> **Design principle 1: thermal management**
> Exploit the inherent thermal storage in food and cookware before purchasing or cycling electrochemical storage. The objective is to manage cooking outcomes and temperature trajectories, not merely to enforce a fixed hierarchy between appliances.

4.2 Optional, limited battery support

Intelligent coordination is expected to provide most of the benefit. The project shall also assess whether a modest battery buffer can improve performance by supplying short bursts of additional power, supporting high-temperature induction phases, smoothing transitions, compensating for brief deficits between demand and available supply, reducing the effects of voltage fluctuation, or bridging short grid interruptions.

The battery shall not be sized to power the cooking appliances independently for extended periods. An illustrative capacity of 300–500 Wh may be considered, but bidders shall determine and justify the minimum useful energy capacity, discharge power, C-rate, state-of-charge operating range and recharge strategy. The battery-free case shall remain the reference baseline, and the incremental benefit and cost of storage shall be separately quantified.

> **Design principle 2: two forms of energy buffer**
> The platform may use inherent thermal storage in food and cookware, limited electrochemical storage, or a combination of both. Battery support must complement intelligent control, not replace it.

4.3 Architecture neutrality

Candidate solutions may include, but are not limited to:

- a central controller with managed power outlets;
- distributed intelligence within or adjacent to appliances;
- appliance-to-appliance communication;
- non-invasive appliance-state recognition;
- limited modification of appliance electronics or firmware;
- predictive or model-based control;
- a smart battery or power-assist module;
- open appliance communication protocols; and
- hybrid combinations of these approaches.

Examples are illustrative only. The Respondent shall compare credible alternatives and demonstrate why the recommended architecture offers the best balance of performance, safety, compatibility, simplicity, manufacturability and cost.

Scope of Work and Deliverables

The successful respondent shall:

- review relevant commercial and residential load-management technologies and determine which principles can be adapted to domestic cooking;
- define the technical and user requirements for safe concurrent cooking on constrained supplies;
- characterise representative induction cookers, EPCs and rice cookers, including power demand, duty cycles, thermal response, interruption tolerance and restart behaviour;
- develop and compare multiple candidate system architectures, including a low-cost battery-free baseline and a battery-assisted option;
- develop a control strategy that allocates power according to cooking-state and thermal requirements rather than fixed appliance priority alone;
- construct a touch-safe laboratory demonstrator capable of witnessed testing;

- demonstrate complete-meal preparation while maintaining configurable real-power, apparent-power and current limits;
- quantify cooking performance, user impact, reliability, safety, energy flows and battery contribution where applicable;
- produce a credible cost model, certification pathway, manufacturing strategy and Phase 2 product-development roadmap; and
- deliver sufficient source code, schematics, design files, data and documentation to allow MECS or a future supplier to reproduce and continue development of the work.

The respondent shall define the system boundary explicitly and shall address both of the following household arrangements:

1. Dedicated cooking allocation: the CEMP is configured with a conservative cooking limit after allowing for other household loads.
2. Dynamic whole-house allocation: the CEMP measures or receives total household demand and adjusts cooking power according to the capacity currently available.

The preferred architecture may support one or both arrangements. Any dependence on a whole-house sensor, smart meter interface, communications link or installation by a qualified electrician shall be clearly identified and costed.

6.1 Reference supply conditions

The platform shall be configurable for different supply limits and shall manage input current and apparent power as well as real power. Testing shall include representative limits equivalent to approximately 450 VA, 900 VA and 1.3 kVA, with a nominal voltage range appropriate to the target market. Performance at approximately 300–450 W shall be investigated even where complete-meal performance is slower or requires battery support.

The system shall respond safely to voltage reduction, brief interruptions, restoration of supply, changes in available household headroom and depletion or unavailability of any battery.

6.2 Reference appliance set

The minimum demonstrator shall coordinate:

- one induction cooker rated at approximately 1 kW or above; and
- one EPC rated at approximately 700 W or above.

A rice cooker shall also be characterised and, where practical, incorporated as a third managed appliance or demonstrated as an alternative to the EPC. Bidders may include infrared cookers or other appliances where these improve relevance, but shall not substitute them for the minimum induction-plus-EPC demonstration.

Work Package 0 – Inception and requirements definition
Confirm the use cases, system boundary, target country or countries, supply conditions, appliance sample, meal scenarios, performance metrics, risk register and detailed work plan. Resolve all assumptions that materially affect architecture or test design.

Deliverable: D0 Inception Report and agreed Requirements and Test Plan.

Work Package 1 – Review of existing technologies
Review representative technologies including commercial-kitchen demand management, residential load controllers, priority relays, home energy-management systems, battery-assisted load management, demand response, power-assist inverters and appliance communication standards.

The review shall identify transferable engineering principles, unnecessary complexity, relevant patents or background IP, gaps in current products, and opportunities for low-cost simplification. It shall also validate the indicative customer-upgrade and utility-cost assumptions for at least Indonesia or India, using clearly cited sources and distinguishing published evidence from engineering estimates.

Deliverable: D1 Technology, Market and Evidence Review.

Work Package 2 – Appliance and cooking-process characterisation
Experimentally characterise representative appliances and cooking processes. Existing evidence may be used to avoid unnecessary repetition, but the Respondent shall undertake sufficient testing to validate all material assumptions used in the control strategy.

Characterisation shall include:

- real and apparent power, current, power factor and harmonics;
- start-up and transient behaviour;
- duty cycles and low-power control behaviour;
- thermal inertia of food, cookware and appliance;
- temperature decay during controlled interruption;
- restart and programme-retention behaviour;
- response to voltage reduction or interrupted supply;
- control interfaces and communication possibilities;
- high-temperature induction performance for frying and chapati/roti or an agreed equivalent tawa-based task;
- EPC pressure-build performance at different input powers; and
- safety implications of external switching, modulation or appliance modification.

Deliverable: D2 Appliance Characterisation Dataset and Report, including raw time-series data and reproducible test methods.

Work Package 3 – Alternative system architectures and down-selection
Develop and compare at least three credible architectures. The comparison shall include a battery-free baseline and at least one battery-assisted approach. Each architecture shall be evaluated against:

- connection-limit compliance;
- cooking performance;
- compatibility with existing appliances;
- need for appliance modification;
- installation complexity;
- electrical and functional safety;
- failure modes and recoverability;
- communications and cybersecurity requirements;
- manufacturing and retail cost;
- battery size, power and lifetime where applicable;
- user experience;
- scalability to additional appliances;
- certification pathway; and
- background and foreground intellectual-property implications.

Deliverable: D3 Architecture Options and Down-selection Report, with a justified preferred architecture and retained fallback option.

Work Package 4 – Control strategy and detailed design
Develop control algorithms capable of sensing or inferring appliance state, household headroom, available supply and, where relevant, battery state. The strategy shall allocate and schedule heat input according to appliance state, thermal condition, cooking-stage requirements, safety constraints and user intent.

The Respondent shall consider both rule-based and predictive approaches, choosing the least complex method that meets performance requirements. Any machine-learning approach shall be compared with a transparent rule-based baseline and shall not create unnecessary computational, data or cybersecurity burden.

The design shall include fail-safe states, loss-of-communications behaviour, battery-depleted behaviour, manual override, user feedback, hardware and firmware architecture, schematics, component selection and a preliminary bill of materials.

Deliverable: D4 Control Strategy and Detailed Demonstrator Design.

Work Package 5 – Laboratory demonstrator
Construct an enclosed, touch-safe laboratory demonstrator suitable for witnessed testing. The demonstrator need not be certification-ready or production-representative, but it shall be sufficiently robust to complete the agreed test programme repeatedly and safely.

The demonstrator shall coordinate the minimum appliance set, enforce configurable connection limits, record relevant electrical and thermal variables, communicate its operating state clearly to the user, and recover safely following interruption or fault. Where a battery is included, the battery-free configuration shall also be demonstrated or credibly emulated.

Deliverable: D5 Operational Laboratory Demonstrator, together with all hardware, firmware and build documentation.

Work Package 6 – Performance, reliability and user-experience evaluation
Complete the agreed test matrix, including unconstrained baselines, constrained cooking tests, supply disturbances, failure modes, repeatability testing and battery/no-battery comparison. Quantify cooking time, temperature trajectories, energy use, peak demand, apparent power, battery throughput, user interventions and any degradation in cooking outcome.

Conduct a small formative user assessment with an appropriate number of participants or expert cooks, sufficient to identify usability problems and unacceptable changes to cooking practice. This is a laboratory-stage assessment, not a household field trial.

Deliverable: D6 Demonstration, Test and User-Experience Report, supported by raw data, video evidence and a witnessed demonstration.

Work Package 7 – Product-development and commercialisation roadmap
Recommend the preferred commercial architecture, manufacturing strategy, component sourcing approach, cost-reduction pathway, certification plan, appliance ecosystem, utility integration options, business models, maintenance approach, intellectual-property strategy, risks and Phase 2 development programme.

Deliverable: D7 Product Development, Cost and Commercialisation Roadmap and consolidated Final Report.

Mandatory functional and technical requirements

Requirement	Minimum expectation
Connection protection	Maintain total controlled demand within configurable real-power, apparent-power and current limits. Any permitted transient tolerance shall be proposed, justified and agreed before testing.
Concurrent cooking	Support at least two concurrent cooking processes using the minimum appliance set.
Cooking-aware allocation	Allocate heat according to appliance state, thermal condition, cooking stage, safety and user intent rather than a fixed appliance hierarchy alone.
High-temperature capability	Preserve the ability of the induction cooker to perform agreed high-temperature frying and chapati/roti or equivalent tawa-based tasks, normally requiring access to approximately 1 kW or more during relevant phases.
EPC flexibility	Characterise and exploit the lower user sensitivity to reduced EPC heating power during pressure build-up where this improves whole-meal performance.
Whole-house headroom	Either measure whole-house demand or provide a documented, safe method for allocating a fixed cooking limit.
Appliance compatibility	Minimise the need for proprietary appliance modification and clearly identify compatible and incompatible appliance behaviours.
Automatic recovery	Recover safely after grid interruption, voltage reduction, battery depletion, communications loss or appliance removal.
Fail-safe operation	Default to a safe state under component, sensor, relay, software or communications failure.
User interaction	Require minimal additional user intervention and provide intuitive indication of operating state, delay, fault and recovery.
Data logging	Record sufficient electrical, thermal, control and battery data to reproduce and evaluate all tests.
No unintended export	Prevent unintended export of battery energy to the public grid unless a certified export arrangement is explicitly proposed and approved.
Modularity	Provide a credible route to additional appliances and different connection ratings without redesigning the entire platform.
Affordability	Be designed from the outset for low component count, manufacturability and the cost targets in Section 12.

Safety, compliance and responsible design

Safety is a mandatory pass/fail requirement. The Respondent shall identify the standards and regulatory pathways likely to apply in the target markets and shall design the demonstrator in accordance with good engineering practice, even where formal certification is outside this phase.

The safety assessment shall address, as applicable:

- electric shock, earthing, insulation, creepage, clearance and touch safety;
- over-current, over-voltage, under-voltage, short-circuit and over-temperature protection;
- relay or semiconductor failure in open and closed states;
- unexpected appliance restart and programme loss;
- EPC pressure-cycle integrity and preservation of appliance safety controls;
- battery cell, pack and battery-management-system safety;
- battery thermal runaway, enclosure, ventilation and replacement;
- safe grid loss, reconnection and recharge behaviour;
- operation with weak, damaged or non-compliant household installations;
- loss, corruption or spoofing of communications where wireless or networked control is used;
- firmware update and cybersecurity requirements where applicable;
- user override, misuse and foreseeable abnormal operation; and
- end-of-life, repairability and replacement of safety-critical parts.

The Respondent shall prepare a hazard analysis and Failure Modes and Effects Analysis (FMEA), identify residual risks, and demonstrate that safety-critical functions do not depend solely on cloud connectivity or a single non-fail-safe software process.

Laboratory demonstrator and acceptance testing

The detailed acceptance plan shall be agreed at Gate 1 and finalised before prototype construction. The following requirements establish the minimum common basis for comparing proposals and accepting the work.

A. Baseline and meal scenarios

Each meal scenario shall first be prepared using the same appliances without a constrained connection, recording starting conditions, ingredient mass, water quantity, appliance settings, cooking time, electrical energy and outcome. The managed tests shall use equivalent starting conditions and recipes.

At least three scenarios shall be tested:

1. EPC pressure-cooked staple, pulse or stew together with an induction-cooked side dish.
2. Rice-cooker preparation together with an induction frying or sautéing task.
3. A high-temperature induction task based on chapati/roti preparation on a tawa, or a Client-approved equivalent, while the EPC or rice cooker is in an active heating phase.

The final recipes and objective cooking-completion criteria shall be agreed during inception. The system shall be evaluated on complete meal service, not merely on isolated boiling or resistive dummy loads.

B. Electrical limits and disturbances

Tests shall include, at minimum, supply limits equivalent to approximately 1.3 kVA, 900 VA and 450 VA. The 1.3 kVA and 900 VA cases are mandatory complete-meal demonstrations. The 450 VA case shall demonstrate the practical boundary of the concept and quantify any need for battery support, additional cooking time or reduced service. Performance at approximately 300 W shall be modelled or experimentally explored.

The demonstrator shall also be tested under representative voltage reduction, brief grid interruption, restoration of supply, sudden reduction in available whole-house headroom, battery depletion, sensor failure and loss of communications.

C. Acceptance metrics

Metric	Acceptance expectation
Safety	No hazardous condition, uncontrolled restart, defeat of appliance safety controls or unacceptable enclosure temperature.
Connection compliance	No sustained breach of the agreed current, apparent-power or real-power limit. Transient tolerances must be defined in the approved Test Plan.
Protective devices	No trip of correctly rated protective devices during a compliant test.
Meal completion	All mandatory meal scenarios completed to the agreed objective cooking criteria.
Cooking-time penalty	Quantified against the unconstrained baseline for each supply limit. The target is no more than 10% at approximately 1.3 kVA and no more than 20% at approximately 900 VA, unless a different threshold is justified and agreed at Gate 1.
High-temperature performance	Agreed frying and chapati/roti or equivalent task completed without unacceptable loss of pan or tawa temperature, browning or throughput.
User intervention	No intervention beyond normal appliance use, acknowledgement of clearly communicated delays, or a documented manual override.
Recovery	Safe, comprehensible recovery after each specified disturbance or fault.
Energy performance	Grid energy, battery energy, conversion losses and total meal energy quantified and compared with baseline.
Battery value	Incremental cooking benefit, peak reduction, outage performance, battery throughput, degradation implications and cost separately quantified.
Repeatability	Mandatory scenarios repeated sufficiently to demonstrate consistent behaviour and to distinguish performance from one-off success.
Reproducibility	Raw data, firmware version, configuration, recipes and test procedures supplied so results can be independently reproduced.

D. Witnessed demonstration and handover

The final demonstration shall be witnessed in person or remotely by MECS. The Respondent shall provide the operational prototype, appliances procured under the contract, source code, firmware binaries, schematics, PCB files where applicable, mechanical drawings, BOM, test equipment configuration, raw data, videos, operating instructions and maintenance information.

Product cost, manufacturability and commercial requirements

The proposed platform must be economically credible for households with very low willingness and ability to pay, while also creating a product that utilities, governments or development programmes could finance where its cost is lower than the value of avoided or deferred network reinforcement, improved reliability or accelerated electrification.

The cost targets apply to the incremental CEMP hardware and exclude the cooking appliances unless a bidder explicitly proposes an integrated appliance product. Bidders shall distinguish clearly between the battery-free controller and any battery-assisted configuration.

Cost level	Required presentation
Component/BOM cost	Itemised cost at prototype, 1,000-unit, 10,000-unit and 100,000-unit volumes.
Ex-factory cost	Estimated manufactured and tested product cost, including enclosure and normal production yield.
Landed/distribution cost	Indicative logistics, import, warranty and channel costs for at least one target market.
Retail price	Indicative end-user price, separately showing taxes, installation and finance where relevant.
Lifecycle cost	Expected life, maintenance, battery replacement, conversion losses and major replacement components.
Utility/programme cost	Indicative installed programme cost and comparison with avoided or deferred utility expenditure.

Affordability target

Preferred retail price: below US$100 for a battery-free or very-low-storage controller. Battery-assisted complete incremental system: preferably no more than US$200, excluding cooking appliances. Any solution above US$200 shall require a compelling and quantified performance, resilience or utility-value justification.

These figures are design targets rather than permission to spend up to a ceiling. Proposals achieving equivalent performance at materially lower cost will be evaluated favourably. Bidders shall state the assumed production volume, market, taxes, exchange rate and battery specification behind every cost estimate.

Success will not be measured by battery size, inverter rating or the headline power rating of an appliance. It will be measured by the useful cooking service delivered from the available electrical connection, without compromising safety, food quality, usability or affordability.

Primary outcome metric

Cooking Service per Kilowatt of Available Connection

A successful project will demonstrate that intelligent, cooking-aware coordination enables a household to prepare a complete meal using multiple concurrent cooking processes with substantially less electrical infrastructure than is conventionally assumed necessary. It will show clearly what is possible without a battery, what additional value limited storage provides, the practical lower boundary of supply capacity, and a credible path to a product affordable to households or economically sponsorable by utilities and public programmes.

The long-term ambition is an affordable household cooking platform that allows millions of families to adopt modern electric cooking without waiting for larger service connections, extensive rewiring or expensive network reinforcement.

Budget & Duration

The anticipated contract duration is nine months. Responses may propose refinements but shall preserve the decision-gate logic and final completion date unless otherwise agreed.

Ref.	Deliverable	Due	Decision gate / purpose
D0	Inception Report; Requirements and Test Plan	End Month 1	Gate 1: Client approval of use cases, appliances, system boundary, recipes, metrics and safety plan.
D1	Technology, Market and Evidence Review	End Month 2	Supports evidence base and architecture options.
D2	Appliance Characterisation Dataset and Report	End Month 3	Gate 2: Client confirms key operating assumptions and test evidence.
D3	Architecture Options and Down-selection Report	End Month 4	Gate 3: Client approves preferred architecture and retained fallback.
D4	Control Strategy and Detailed Demonstrator Design	End Month 5	Gate 4: design, FMEA, BOM and acceptance plan approved before fabrication.
D5	Operational Laboratory Demonstrator	End Month 7	Prototype readiness review.
D6	Demonstration, Test and User-Experience Report	End Month 8	Gate 5: witnessed acceptance testing.
D7	Product Development, Cost and Commercialisation Roadmap; Final Report	End Month 9	Final acceptance and handover.

No major prototype expenditure shall be committed before approval of the preferred architecture and detailed demonstrator design, unless explicitly authorised by MECS.

The research is expected to commence no later than **15th October 2026.** All deliverables must be completed and delivered by **31st July 2027**. Responses should demonstrate how the work can be completed within the time available.

The total budget is a maximum of **£50,000 (GBP)** (including any locally payable VAT, taxes, and charges)

Payment is contingent on successful completion of all deliverables.

Responding to these ToRs

The respondent shall nominate a Project Director and Technical Lead and shall maintain continuity of key personnel. The proposal shall identify responsibility for power electronics, embedded control, appliance engineering, thermal/cooking analysis, battery systems, electrical safety, product costing and project management.

Minimum management requirements include:

- an inception meeting within ten working days of contract signature;

- a concise monthly progress report covering activities, results, expenditure, risks, decisions and next steps;
- formal review materials provided at least five working days before each decision gate;
- prompt escalation of safety concerns, material delays or changes in key assumptions; and
- all reports delivered in editable formats as well as PDF.

MECS's preferred objective is to maximise the ability to continue development, procure manufacture competitively and enable broad deployment in low-income markets. Respondents shall identify all background IP, third-party components, licences, patents and restrictions that could limit manufacture, modification, certification or deployment.

The proposal shall include:

- An executive summary and clear interpretation of the engineering challenge;
- A proposed system boundary and initial view of the most promising architectures, without prematurely assuming the final solution;
- A detailed methodology and work plan mapped to each work package, deliverable and decision gate;
- A proposed appliance sample, laboratory methods, meal scenarios and acceptance-test approach;
- A safety, standards and certification approach;
- A battery-free baseline and, where proposed, a separately costed battery-assisted approach;
- A project schedule showing dependencies, critical path and staff inputs;
- The proposed team, roles, level of effort, location and relevant experience;
- Details of laboratory facilities, test equipment and prototype capability;
- A fully itemised budget by work package, staff category, equipment, appliances, travel, sub-contractor and a small contingency;
- Assumptions, exclusions, dependencies and requested deviations from this ToRs
- An IP and licensing statement identifying all relevant background and third-party IP;
- At least two examples of relevant completed assignments; and
- The completed compliance schedule in Annex B.

Each submission will be evaluated based on the following combination of price and quality;

Criterion	Weight	What strong evidence looks like
Understanding of the problem and system boundary	5%	Demonstrates understanding of constrained supplies, whole-house headroom, cooking processes, thermal inertia, appliance differences and utility value.
Engineering methodology and originality	20%	Offers a rigorous, architecture-neutral method and credible route to a simple, low-cost solution.
Appliance characterisation and test plan	15%	Provides robust, reproducible electrical, thermal, cooking and disturbance tests.
Demonstrator, control and safety approach	20%	Shows credible power-electronics, embedded-control, fail-safe, battery and certification capability.
Team, facilities and delivery confidence	10%	Provides appropriate named specialists, laboratory capability, project controls and relevant experience.

Criterion	Weight	What strong evidence looks like
Affordability, manufacturability and commercial pathway	10%	Demonstrates cost discipline, scale-up insight and a realistic route below the target retail cost.
Price and overall value for money	20%	Offers a proportionate, transparent cost relative to scope, risk and expected quality.
Total	**100%**	

The University will accept the quotation which is the best value for money i.e. a balance between cost and quality. Shortlisted organisations may be invited to an interview (online) to finalise selection.

Responses should be a maximum of 25 pages (plus requested annexes and up to 3 CVs, 2 pages each).

Please send all responses to mecs@lboro.ac.uk with the subject '**ENERGY MANAGEMENT PLATFORM'.** All proposals must be received by **Tuesday 8th September 2026 at 23:55 British Summer Time.** The time will be determined using the time of arrival in the MECS inbox. Any responses received after 23:55 will be rejected.

Proposals should be submitted in Word (do not submit Powerpoint/Prezi or PDF)

Contract Management

This contract will be managed by Dr Simon Batchelor. All deliverables should be emailed to them on or before the date required. Loughborough University reserves the right to request the consultant to make revisions to the deliverables if they do not meet the required quality. The consultant will be required to make these revisions at no additional cost to Loughborough University.

Appointments to discuss the overall progress against the contract will be agreed at mutually convenient times to the consultant and the project manager.

Ethical considerations
All research must be in line with the Code of Practice for research, Promoting good practice and preventing misconduct (UK Research Integrity Office, 2009).

The UK Research Integrity Office (UKRIO) is an independent charity, offering support to the public, researchers and organisations to further good practice in academic, scientific and medical research. Its confidential advice service is available to free of charge to individuals (members of the public, research participants, patients, researchers and students) and subscribing organisations. Their advice service can be accessed here.

At a minimum, participants must not be subjected to physical, social, legal or psychological harm. Due consideration and ethical steps must be taken into safeguarding all participants, especially the vulnerable. A detailed Participation Information Sheet explaining the full scope of the study, what confidentiality entails, and that no participants will be forced into participating, must be provided at recruitment. Participants are to be made aware that participation is fully voluntary and there are no repercussions if they choose to no longer participate in the study at any point in time. Participants should, ideally, sign a consent form which includes consent for the use of photographs and videos.

Confidentiality must be maintained at all times. With regards to confidentiality and privacy of participation, participants must be informed that their anonymity will be maintained in any outputs and that all identifiable markers will be removed from any data sets that are published.

The consultant will be responsible for securing any research or ethical permissions needed from local authorities in each of the field work locations. There may be additional ethical, or research clearance needed for this kind of user centric design research in the chosen country.

Annex A. Minimum test matrix

Bidders shall expand this matrix in their proposals. Final values, recipes, repetition counts and tolerances will be agreed in the approved Requirements and Test Plan.

ID	Test type	Appliances	Supply condition	Cooking task	Minimum evidence
A1	Unconstrained baseline	Induction + EPC	Normal supply	Meal scenario 1	Time, energy, temperature, outcome, user actions
A2	Unconstrained baseline	Induction + rice cooker	Normal supply	Meal scenario 2	Time, energy, temperature, outcome, user actions
A3	High-temperature baseline	Induction/tawa	Normal supply	Chapati/roti or approved equivalent	Tawa/pan temperature, throughput, browning, power
A4	Managed cooking	Induction + EPC	≈1.3 kVA limit	Meal scenario 1	Connection compliance; target ≤10% time penalty
A5	Managed cooking	Induction + EPC	≈900 VA limit	Meal scenario 1	Connection compliance; target ≤20% time penalty
A6	Managed cooking	Induction + rice cooker	≈900 VA limit	Meal scenario 2	Connection compliance and user experience
A7	High-temperature concurrent	Induction/tawa + EPC or rice cooker	≈900 VA limit	Meal scenario 3	High-temperature performance and heat allocation
A8	Very constrained supply	Minimum appliance combination	≈450 VA limit	Agreed meal or sub-meal	Practical boundary, time penalty, battery value
A9	Exploratory weak supply	Model or selected hardware	≈300 W available	Selected scenario	Feasibility and limitations
A10	Voltage reduction	Managed system	Agreed low-voltage profile	Active cooking	Safe adaptation, no uncontrolled trip
A11	Brief interruption	Managed system	Grid loss and restoration	Active cooking	Programme retention, safe recovery
A12	Household headroom loss	Managed system	Sudden competing load	Active cooking	Rapid, stable demand reduction
A13	Battery depletion	Battery-assisted system	Battery reaches minimum SOC	Active cooking	Graceful degradation and user message
A14	Sensor/comms fault	Managed system	Fault injected	Active cooking	Fail-safe state and recovery

ID	Test type	Appliances	Supply condition	Cooking task	Minimum evidence
A15	Repeatability	Selected mandatory tests	Same as accepted test	Repeated runs	Variance, reliability and reproducibility

Annex B. Definitions and abbreviations

Term	Definition
Apparent power (VA)	The product of RMS voltage and RMS current. It includes the effect of power factor and is relevant to service and current limits.
Available cooking power	The portion of household electrical capacity that can safely be allocated to cooking at a given time.
Battery-free baseline	The performance achieved through sensing, scheduling, modulation and thermal management without electrochemical storage.
CEMP	Household Cooking Energy Management Platform.
Concurrent cooking	Two or more cooking processes under way during overlapping periods, even where the appliances are not all energised simultaneously.
EPC	Electric pressure cooker.
Foreground IP	Intellectual property created specifically through the contracted project.
High-temperature induction task	A cooking process such as frying or chapati/roti preparation that requires high pan or tawa temperature and may be impaired by excessive power limitation.
Inherent thermal storage	Heat retained in food, water, cookware and appliance components that can sustain cooking during short reductions in electrical input.
Non-wires alternative	A demand-side or control intervention that avoids or defers conventional network reinforcement.
Power factor	The ratio of real power to apparent power.
Supply limit	The agreed maximum current, apparent power and/or real power available to the controlled system.
Thermal management	Allocation of electrical heat input according to the temperature, stored heat and cooking-stage needs of each process.
Whole-house headroom	The electrical capacity remaining after non-cooking household loads are taken into account.