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EnDev DSS Performance Study

Consolidated Report

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endev

Acknowledgements

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Disclaimer: The views and conclusions expressed in this report are those of the study team alone and do not necessarily reflect the opinions, policies, or official views of EnDev, RVO, GIZ, or the governments of Liberia, Malawi, Niger, or Uganda.

Table of Contents

Acknowledgements 2

Executive summary 4

Abbreviations 8

1. Introduction 11

2. Research objectives and methodology 14

3. Key findings and comparative learnings 16

4. Recommendations 28

5. Conclusion 32

Executive summary

Background and rationale

More than 700 million people still lack electricity, and an estimated 228 million are projected to remain below Tier 1 access by 2030. For low-income rural, refugee, and displaced households, even basic solar and clean-cooking products remain unaffordable. Demand-Side Subsidies (DSS) have therefore become a central instrument for closing the affordability gap, but the evidence increasingly suggests that outcomes depend heavily on design choices and on the maturity of the market in which the instrument is deployed.

At the same time, poorly designed subsidies can undermine the very markets they seek to strengthen. Concerns around product leakage, price distortion, weakened willingness to pay, supplier dependency, and crowding out of commercial activity have made governments and development partners increasingly cautious about how subsidies are structured and deployed. The central question is therefore no longer whether subsidies should be used, but how they can expand inclusion, while protecting long-term market viability.

To explore these questions, EnDev supported four Demand-Side Subsidy (DSS) pilots across Liberia, Malawi, Niger, and Uganda, testing diverse targeting, subsidy, and delivery architectures across distinct market contexts to provide a comparative evidence base for future DSS design. The pilots varied by technology type, with Liberia and Niger focusing exclusively on solar home systems, and Malawi and Uganda implementing interventions across both solar and clean cooking technologies. By evaluating these distinct applications, the pilots highlight how differing market maturities and technology characteristics influence the overarching success of end-user subsidy programmes.

This report synthesises the comparative findings emerging from those pilots, structured around the EnDev DSS learning questions, and focuses on identifying broader cross-country lessons, operational trade-offs, and implications for future DSS design.

Overview of pilots

The four pilots operated across distinct market conditions and institutional environments. Liberia implemented a geographically targeted solar subsidy pilot focused primarily on underserved rural counties with weak electrification and limited household-level targeting infrastructure, alongside a separate sub-pilot that tested a more granular, socio-economic targeting approach using a partner-validated voucher system to reach vulnerable women. **Malawi** implemented a registry-based pilot combining solar and clean cooking technologies using the Malawi Social Registry and Social Cash Transfer Programme data to target poorer and poorest households in select districts. **Niger** implemented a solar-focused humanitarian and displacement-oriented pilot in an extremely nascent off-grid market using geographic and demographic targeting. **Uganda** implemented a multi-technology pilot across refugee-hosting districts using refugee-host allocation quotas and broader energy-poverty targeting.

The pilots also differed substantially in terms of subsidy depth, payment and repayment arrangements, delivery structures, and market maturity. These differences are central to the comparative findings because they demonstrate that DSS outcomes are highly sensitive to context and cannot be assessed independently from broader market conditions.

Key findings

DSS design is about balancing trade-offs

Across all four pilots, programmes consistently had to balance inclusion against administrative complexity, affordability against market distortion, accountability against supplier liquidity, precision targeting against operational feasibility, and deep subsidies against commercial sustainability. In Malawi, for instance, deep subsidies combined with PAYGo financing successfully extended reach but lowered the financial incentive for agents to provide remote after-sales service. Because the subsidy absorbed a large portion of the cost, residual PAYGo balances per unit fell to as low as EUR 5 to EUR 10, leaving agents with a low commercial margin per sale to cover the high transport costs required for follow-up maintenance trips in remote areas. The Niger income-tailored product diversity, alongside the Liberia voucher sub-pilot, show that deeper subsidies can be operationally safe when paired with tighter targeting and controlled delivery channels, while broader and deeper subsidies through open commercial channels raise distortion risk without proportionate inclusion gains. The pilots show that there is no universally 'correct' DSS model; outcomes depended heavily on how programmes calibrated these trade-offs to local market conditions.

Market maturity shaped the role the subsidy played in each pilot

The pilots operated across distinct market stages, demonstrating that in nascent markets like Niger, where formal commercial networks are largely absent, demand-side subsidies cannot perform effectively until programmes prioritise foundational supply-chain and ecosystem building. Transitional contexts like Liberia require integrated supply-side and inventory support alongside consumer subsidies to stabilise fragile distribution networks. Conversely, in mature off-grid ecosystems like Malawi and Uganda, DSS instruments functioned as adoption accelerators, scaling existing market mechanisms to reach lower-income segments, although clean cooking remained an exception even in these markets, where fragile stove-supply chains (as in Malawi) limited how far price support alone could go. These comparative findings show that market maturity essentially influenced the role that subsidies played across the pilots.

Targeting performed best when adapted to the realities of available geographic and demographic data.

The different pilots tested different targeting approaches, including geographic targeting, registry-based targeting, demographic targeting, and refugee-host allocation models, and each approach generated operational strengths and weaknesses depending on the local context. Registry-based targeting in Malawi gave the tightest filtering but missed households with outdated records; geographic targeting in Liberia was fast but could not separate poorer from ultra-poor households; and refugee-host quotas in Uganda worked for solar but not for clean cooking. Across all pilots, the lowest inclusion and exclusion errors at an acceptable operational cost were achieved by layering broad geographic and demographic filters with existing demographic data. This hybrid, adaptable approach remains the most operationally feasible method for scaling up quickly in low-data, rural and displacement-affected settings.

Subsidy calibration remained highly dynamic throughout implementation.

All four pilots revised subsidy structures during implementation in response to operational realities, affordability constraints, inflationary pressures, or lower-than-expected uptake. Specifically, Liberia doubled its subsidy depth, Malawi and Uganda raised subsidy levels to absorb inflation and transport costs, and Niger introduced tiered pricing for host and displaced populations. These adjustments demonstrate that affordability is highly context-specific and difficult to calibrate accurately at programme launch. They also suggest that subsidy structures should be treated as adjustable programme features rather than fixed assumptions set at launch.

Despite these revisions, affordability constraints and irregular PAYGo repayment patterns persisted, particularly among refugee and displaced households whose repayments tracked humanitarian cash and ration cycles, and rural households on seasonal incomes facing seasonal income volatility. Ultimately, these findings indicate that while demand-side subsidies substantially lower market entry barriers, they cannot fully eliminate the broader impacts of structural poverty.

Verification systems protected public funds but created operational pressures for suppliers.

All four pilots relied on Kobo-based eligibility confirmation combined with hybrid phone-and-field verification processes implemented through Independent Verification Agents (IVAs). The study demonstrated that these systems generally succeeded in limiting large-scale fraud, duplicate claims, and product leakage in displacement settings and low connectivity environments. However, verification also created bottlenecks. Lengthy reimbursement cycles constrained the working capital of participating companies, especially smaller firms, and slowed inventory rotation, geographic expansion, and business sustainability. Verification also worked differently across technologies, as solar PAYGo systems supported stronger digital tracking and easier checks, while clean cooking moved through thinner-margin retail channels with weaker digital infrastructure. The findings therefore suggest that verification systems influence not only accountability outcomes but also business viability, programme reach, and market development.

The main distortion risks were behavioural and operational rather than systemic.

Several pilots observed price anchoring effects where customers viewed subsidised pricing as the expected market norm. In Liberia, only a minority of surveyed beneficiaries understood that the subsidy was temporary. In Niger, the introduced differentiated pricing structure occasionally generated fairness concerns among host communities when displaced households received deeper discounts for the same products.

Humanitarian overlap shaped willingness to pay in displacement-affected markets, especially for clean cooking. In Uganda and Niger, exposure to free or heavily subsidised distributions lowered the price customers expected to pay and made it harder for commercial pricing. This distinction matters because the current controls mainly limit transactional fraud and resale rather than the dominant behavioural risk of price anchoring, which occurs when customers mistake a subsidy for normal market pricing. The findings suggest that the most important market protection mechanisms extend beyond technical controls alone to encompass communication, targeting design, and coordination between humanitarian and commercial actors.

Recommendations

The findings point towards several important implications for future DSS programme design.

- **Differentiate implementation design by technology.** While programmes should set overarching inclusion targets, they must allow solar and clean cooking to differ in quota structures, subsidy depths, channel designs, and verification rules. The pilots demonstrated that clean cooking faces distinct behavioural adoption hurdles and supply-chain constraints that retail price subsidies alone cannot resolve.
- **Build a responsive, data-driven framework into the formal subsidy review.** Programmes should trigger rapid diagnostic assessments, such as affordability surveys and company consultations, at the first sign of stalled demand. This review must simultaneously evaluate both consumer purchasing power and business operational costs, ensuring contracts possess the built-in flexibility to quickly adjust subsidy caps in response to inflation or logistical shocks.
- **Assess and build delivery capacity and company readiness before relying on subsidies.** Because Results-Based Financing structures place liquidity pressure on private firms, budgets across all programmes must include provisions for upfront contract advances. Providing these working-capital bridges, alongside investments in shared distribution infrastructure or business development support, is structurally necessary to ensure companies can convert subsidised demand into delivered units.
- **Adapt targeting pragmatically to the realities of local data infrastructure.** In the absence of comprehensive national registries, programmes should maximise existing geographic and demographic filters combined with readily available local administrative and demographic data. However, to ensure this existing data accurately reflects ground realities, programmes should deploy limited household

socio-economic surveys or sample cross-sections of target areas before full deployment. This targeted primary data collection, such as the pre-deployment baseline studies utilised across Niger, Malawi, Liberia, and Uganda, which combined quantitative household socio-economic surveys, qualitative focus group discussions, and key informant interviews, allows implementers to validate local administrative lists, capture highly vulnerable households missing from formal records, and calibrate eligibility thresholds without the prohibitive cost and delay of building a comprehensive national registry. Ultimately, this remains the most operationally feasible path for scaling quickly and accurately in low-data environments.

- **Treat reimbursement-cycle time as a core metric and make verification proportionate.** Verification workflows must be streamlined to prevent company liquidity bottlenecks. Programmes should utilise post-sale statistical sampling and adapt compliance requirements to match the retail dynamics of the specific technology, such as waiving strict paper-trail and real-time checks for fast-moving, lower-margin clean cooking sales.
- **Coordinate with humanitarian actors from the design stage to manage inherited price expectations**. In displacement-affected markets, overlapping and previous free distributions strongly shape customer willingness to pay and can undercut emerging commercial markets. To mitigate this distortion risk, implementers must align with humanitarian actors upfront on pricing principles, free-distribution timing, and joint messaging, ensuring that social-protection interventions effectively layer with market-based subsidies.

Key takeaways

The four EnDev DSS pilots demonstrate that demand-side subsidies can substantially reduce affordability barriers and expand access to off-grid energy technologies among underserved populations. However, the findings also show that DSS performance depends on how subsidy design interacts with market maturity, technology type, targeting architecture, supply-side conditions, verification systems, and broader institutional context.

The pilots further demonstrate that solar and clean cooking require different intervention approaches. While solar markets generally responded relatively directly to affordability support where commercial systems already existed, clean cooking markets remained constrained by weaker supply chains, behavioural adoption barriers, and upstream production challenges.

More broadly, the study suggests that the dominant risks associated with DSS schemes are often behavioural and operational. Market distortion risks were more closely tied to customer expectations, humanitarian overlap, business liquidity pressures, and communication failures than to widespread fraud or resale.

Ultimately, the findings suggest that future DSS programmes will need to become increasingly differentiated, adaptive, and market-specific if they are to expand inclusion while safeguarding sustainable market development. The biggest risk for multi-technology programmes is treating all technologies as one market served by one instrument.

Abbreviations

ANERSOL	Agence Nationale d'Énergie Solaire (Niger)
ATP	Ability to Pay
BRAC	Bangladesh Rural Advancement Committee
CARM	Community Accountability Reporting Mechanism
CBV	Community-Based Validation
CRM	Customer Relationship Management
CUMO	CUMO Microfinance Limited
DSRBF	Demand-Side Results-Based Financing
DSS	Demand-Side Subsidies
EASP	Electricity Access Scale-up Project
EnDev	Energising Development
EPCs	Electric Pressure Cookers
ESMAP	Energy Sector Management Assistance Program
EUR	Euro
EUS	End-User Subsidy
FCFA	Franc CFA
FDP	Forcibly Displaced Persons
FGD	Focus Group Discussion(s)
FM	Fund Manager
GDPR	General Data Protection Regulation
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPS	Global Positioning System
HASKE	Niger Solar Electricity Access Project
HH	Household
HTC	Higher Tier Cooking
ICS	Improved Cookstoves
ID	Identification
IDP	Internally Displaced Person
IS	Indirect Subsidy
IVA	Independent Verification Agent(s)
KII	Key Informant Interview(s)
KPI	Key Performance Indicator(s)
LESSAP	Liberia Electricity Sector Strengthening and Access Project
LNOB	Leave No One Behind
LQ1 / LQ2	Learning Question 1 / Learning Question 2

MEAP	Malawi Energy Access Project
MPI	Multidimensional Poverty Index
MSME	Micro, Small, and Medium Enterprises
MSR	Malawi Social Registry
MTF	Multi-Tier Framework for Measuring Access to Electricity
MWK	Malawian Kwacha
NES	National Electrification Strategy
NGO	Non-Governmental Organization(s)
NIRA	National Identification Registration Authority
OGS	Off-Grid Solar
OM	Operations Manual
OPHI	Oxford Poverty & Human Development Initiative
OPM	Office of the Prime Minister
PAYGo	Pay-As-You-Go financing
PSFU	Private Sector Foundation Uganda
PUE	Productive Use of Energy
PV	Pico PV
QR	Quick Response
RBF	Results-Based Financing
RREA	Rural and Renewable Energy Agency (Liberia)
RVO	Netherlands Enterprise Agency
SCTP	Social Cash Transfer Programme
SHA	Self Help Africa
SHS	Solar Home System(s)
SMEs	Small and Medium-sized Enterprises
SNAE	Stratégie Nationale d'Accès à l'Électricité (Niger)
SPGs	Stove Production Groups
SSS	Supply-Side Subsidy
TA	Traditional Authority
UBR	Unified Beneficiary Registry
UECCC	Uganda Energy Credit Capitalisation Company
UGX	Uganda Shillings
UNBS	Uganda National Bureau of Standards
UNHCR	United Nations High Commissioner for Refugees
USD	United States Dollar
VDCs	Village Development Committees

VeraSol	International quality assurance standard for off-grid solar products
VSLA	Village Savings and Loan Association
WB	World Bank
WTP	Willingness to Pay

1. Introduction

1.1. DSS Background

The global dialogue around energy access has fundamentally shifted from defining the affordability gap to executing targeted fiscal interventions at scale. Following the intensification of global electrification and clean cooking commitments between 2024 and 2026, institutional focus has converged on frameworks like the World Bank's Energy Sector Management Assistance Program (ESMAP) End-User Subsidy Toolkit to operationalise the Leave No One Behind (LNOB) agenda. While this toolkit provides a strong theoretical foundation, its success hinges entirely on execution.

Translating theory into impact requires navigating volatile design choices. While Demand-Side Subsidies can instantly unlock access, imprecise targeting or subsidy depths that do not match affordability gaps risk distorting retail pricing, weakening consumer repayment discipline, and inducing product leakage. Optimising the core operational pillars of a DSS framework (i.e., how beneficiaries are identified, how subsidy amounts are set, and how delivery and verification processes operate) is therefore essential for balancing increased access with healthy market functioning.

This study builds directly upon this operational momentum, utilising data from four EnDev-supported pilots in Liberia, Malawi, Niger, and Uganda. The report is structured around the core pillars of the ESMAP framework, specifically targeting subsidy level, delivery architectures, and verification systems, offering a per-element comparative analysis across all four countries. By dissecting how these varying market contexts responded to similar operational instruments, each thematic section isolates the distinct mechanics of implementation and culminates in cross-cutting design lessons for the next generation of energy access programmes.

1.2. DSS programmes overview

The EnDev-supported DSS pilots aim to reduce affordability barriers for low-income and underserved households by subsidising access to off-grid solar and clean cooking solutions. The pilots draw on the core elements of the ESMAP End-User Subsidy Toolkit, but each applies them differently depending on market maturity, institutional arrangements, and target populations.[1] This diversity provides a set of real-world implementation models for analysing how DSS design performs across different contexts, with each choice demanding inherent trade-offs between targeting precision and administrative cost, digital and manual verification, and company diversity versus market concentration. How these dynamics played out under real-world conditions is the subject of the analysis that follows.

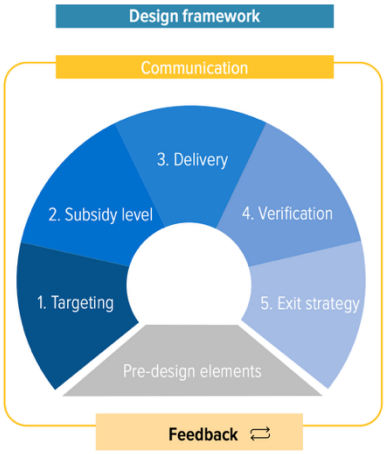


Figure 1:*The EUS Design Framework*

1.3. Country pilot context and operational overview

Liberia

Liberia is one of the least-electrified countries in the world. National electricity access is approximately 28%, with rural access below 5%, and more than half of the country's 5.2 million people live below Liberia's national

[1] *World Bank, Designing Responsible End-User Subsidies for Energy Access: A toolkit featuring case studies for the design of subsidies in off-grid solar and clean cooking, 2024, Link*

poverty line.[1,2,3] The Government of Liberia, through the Rural and Renewable Energy Agency (RREA), targets the deployment of over 250,000 off-grid solar products by 2030 under the National Electrification Strategy.[4]

The Liberia pilot focused exclusively on Tier 1 Solar Home Systems (≤20W). It was launched with an initial geographic focus on Gbarpolu and Grand Cape Mount Counties, the two highest Multidimensional Poverty Index (MPI) counties with active off-grid market presence, and subsequently expanded to Bomi, Nimba, Rivercess, Sinoe, Grand Kru, River Gee, and Bong. A separate sub-pilot in Nimba and Bong counties tested socio-economically targeted support for vulnerable women through partnerships with United Women for Sustainable Development and BRAC's Ultra Poor Group.

The pilot operated as the demand-side component of a joint Results-Based Financing (RBF) mechanism with the World Bank-funded Liberia Electricity Sector Strengthening and Access Project I (LESSAP) programme. EnDev contributed EUR 1.88 million to demand-side incentives (within a larger total grant and programme budget); RREA allocated USD 1.55 million in parallel supply-side incentives. BRAC Liberia acted as Fund Manager, managing claim disbursement, business development support, and verification coordination. Subsidies were delivered through 14 participating private companies, and sales were made mainly through PAYGo, though repayment collection often remained cash-based due to weak mobile money and network coverage.

Verification was conducted by an IVA jointly contracted by EnDev. The protocol initially used a 50:50 phone-to-field ratio and was adjusted during implementation to an 80:20 phone-to-field ratio, with extended field verification triggered for companies falling below a 75% phone reachability threshold.

Malawi

Malawi is a least-developed country characterised by very low electricity access and heavy dependence on biomass for cooking. Only 11% of households are connected to the national grid, around 15% rely on off-grid solutions (primarily solar), and approximately 80% of off-grid households cannot afford entry-level commercial solar products.[5] Nearly 90% of households rely on traditional biomass for cooking, with widespread reliance on freely collected firewood reducing willingness to pay for improved cookstoves even where products are available.[6]

The Malawi pilot covered both solar home systems (6–30 W for Tier 1 SHS) and locally produced improved cookstoves. Households were selected using the Government of Malawi's Social Registry (MSR), formally known as the Unified Beneficiary Registry (UBR), focusing on those classified as poorer and poorest, alongside Social Cash Transfer Programme recipients (SCTP). Implementation was concentrated in four rural districts, Balaka, Dedza, Nkhata Bay, and Salima, and subsequently expanded to Dowa, Mzimba, and Kasungu, drawing on a budget surplus from currency devaluation and moving towards districts with more recent registry data.

Delivery was anchored in partnerships with Self Help Africa (SHA) and CUMO Microfinance as Fund Managers. Solar Home Systems (SHS) subsidies covered 73% of the price for poorer households and 88% for the poorest, with customers financing the remaining balance with PAYGo at 3–24-month tenors or cash payments. ICS subsidies were initially set at 85% (poorer) and 89% (poorest) and were subsequently raised to 92% and 94%, respectively, after distribution cost top-ups were progressively increased to absorb fuel and transport cost inflation. ICS purchases were made on a one-time, upfront cash basis.

[1] *World Bank, Access to electricity (% of population) – Liberia, 2024, Link*
[2] *World Bank, Population, Total – Liberia, 2024, Link*
[3] *World Bank, Liberia Poverty and Equity Brief, 2024, Link*
[4] *RREA, Rural Energy Strategy and Master Plan for Liberia until 2030, 2016, Link*
[5] *National Energy Compact for Malawi, Link*
[6] *Malawi CCDR Clean Cooking Sector Background Note, Link*

Verification used a 70:30 phone-field sampling approach through the Kobo Toolbox, with IVA oversight for both SHS and ICS claims. Eligibility was checked against MSR status at the point of sale. Claims were rejected, and companies could be disqualified where more than 10% of sampled sales failed the independent verification process. In September 2025, verification temporarily shifted to a 100% phone-only mode in response to localised safety concerns linked to election-period sensitivities around digital data collection.

Niger

Niger's energy access challenge sits at the intersection of low electrification, a structurally thin off-grid solar market, low purchasing power, geographic dispersion, and humanitarian fragility. National electrification stands at approximately 19%, with rural access below 10%.[1] Before the pilot, cumulative certified off-grid solar sales nationally were fewer than 4,000 units across 2022–2023, and formal commercial distribution outside Niamey was effectively absent.[1] The intervention zone in Maradi and Tahoua hosts highly vulnerable host communities alongside more than 700,000 Forcibly Displaced Persons (FDPs), comprising refugees and Internally Displaced Persons (IDPs).

The Niger pilot focused exclusively on off-grid solar, including Pico PV (0.3–10 W) and SHS (3–50 W). It operated in selected host communes of Maradi and Tahoua and combined geographic targeting with demographic filters covering rural host communities, refugees, and IDPs. Eligibility was verified through local administrative records (notably Carnet de Famille municipal records), national ID cards, and IDP lists maintained in Kobo by local authorities, informed by EnDev's 2024 socio-economic study of the intervention zone.

The pilot was implemented through a Fund Manager structure led by Mercy Corps, in coordination with the Agence Nationale d'Énergie Solaire (ANERSOL) as the national solar agency, with UNHCR and local authorities supporting FDP identification. The pilot initially offered subsidized Pico-PV (8,500 FCFA) and SHS (15,000 FCFA) systems, expecting system size to naturally segment host and displaced households. When this was insufficient to reach FDPs, a deeper 7,500 FCFA SHS subsidy was introduced. Most purchases were made through cash or short-cycle instalments; a few customers used short-cycle instalment payments split into two tranches, but uptake of instalments remained constrained by limited mobile money penetration. Delivery was supported by programme-funded infrastructure, including approximately 500 trained community-based agents, 50 sales pavilions, and dedicated logistics designed to extend reach into remote and displacement-affected areas. The pilot was designed to run parallel to the World Bank-financed HASKE programme on the supply side, although HASKE had not yet become operational during the pilot period.

Verification was conducted by an IVA in a first-of-its-kind RBF design for Niger. Verification combined Kobo-based data capture (with GPS coordinates, customer identifiers, serial numbers, and witness contacts), phone validation, and field validation, with operational adaptations to weak mobile coverage, shared phones, high beneficiary mobility, and security restrictions on IVA travel. The contractual reimbursement target was 40 days, although actual cycles sometimes extended to 60–90 days during implementation. Niger's monthly verification provided tighter oversight than other pilots while maintaining the working capital for participating companies.

Uganda

Uganda's energy access challenge has structurally shifted from expanding product availability to addressing affordability constraints. National electricity access reached 60–65% of the population by mid-2025, but rural penetration remains stagnant at 36%, and over 85% of households (95% in rural areas) still rely

[1] *Access to electricity, rural (% of rural population) – Niger, Link*

on traditional biomass fuels.[1,2,3,4] The 1.9 million refugees hosted in rural settlements face particularly acute affordability challenges.[5]

The Uganda pilot covered solar home systems, basic improved cookstoves (Tiers 1–3), and Higher-Tier Cooking (Tier 4 solutions, including electric pressure cookers and ethanol stoves). Targeting in Uganda was strategically directed towards refugees, host communities, and vulnerable rural households. The implementation footprint spanned ten refugee-hosting settlements and districts alongside nine adjacent, energy-poor rural districts across northern and western Uganda.[6]

The pilot used an RBF model with Private Sector Foundation Uganda (PSFU) as the fund manager across 20 contracted companies (12 ICS and 8 OGS providers). Solar subsidies ranged from 52–68% and clean cooking subsidies from 42–67%, applied uniformly across target populations to minimise social tension. Mid-pilot, the absolute ICS subsidy cap was raised from UGX 10,000 to UGX 20,000 alongside a 60% relative price cap, in response to evidence that the original cap had underestimated last-mile delivery costs. Solar products were predominantly sold through PAYGo with 3–12 month tenors; clean cooking products were typically sold on a cash basis.

Verification combined PSFU-led data consistency and duplicate checks with paper-trail, phone, and field verification by the IVA. Operational adjustments during implementation included waiving paper-trail and real-time Kobo eligibility checks for lower-tier ICS distributors (to reflect the fast-moving, low-margin nature of cookstove retail). The verification workflow required a 90% eligibility threshold alongside a 50% phone-contact rate. Failing this phone target triggered rejection unless alternative methods confirmed eligibility and product functionality. If overall eligibility dropped below 50%, the entire batch was rejected and returned to PSFU for an internal integrity check before resubmission.

2. Research objectives and methodology

2.1. Study objectives and learning focus

The study examines how design choices across the six elements of the ESMAP End-User Subsidy Toolkit-pre-design, targeting, subsidy level, delivery, verification, and exit shape programme performance. Each element is assessed to understand alignment with good practice and to identify where design decisions introduced risks or operational inefficiencies.

The analysis is structured around two core learning questions:

1. How can scarce public funding be used most efficiently to reach low-income and marginalised groups?
2. How can DSS be designed to minimise market and price distortion?

This work is conducted alongside the EnDev End-Evaluation conducted by Ecorys and the Wuppertal Institute. That evaluation assesses medium-to-long-term market development outcomes, while this study focuses on design and delivery performance. Coordination between the two workstreams ensures aligned findings, efficient stakeholder engagement, and a coherent evidence base for future programme decisions.

[1] *Ministry of Energy and Mineral Development (MEMD), Energy Policy for Uganda, 2023, Link*
[2] *ERA deepens Public Engagement in the 2026 Electricity Tariff Review, Link*
[3] *Uganda National Bureau of Statistics (UBOS), Uganda National Household Survey 2019/2020, 2021, Link*
[4] *S4ALL, Taking the Pulse: Uganda Country Study, 2019, Link*
[5] *UNHCR Uganda Comprehensive Refugee Response Portal, Link*
[6] *The pilot covered eight major refugee settlements (Bidibidi, Rhino Camp, Imvepi, Lobule, Palabek, Palorinya, Kyaka II, and Rwamwanja) located within their respective host districts, the refugee-hosting districts of Kiryandongo and Adjumani, and the adjacent rural energy-poor districts of Amuru, Maracha, Nebbi, Nwoya, Moyo, Pakwach, Omoro, Kitgum, and Zombo*

Table 1: *Research questions*

#	Research question	DSS Performance Study	EnDev Evaluation team
Learning Question 1: How can scarce public funding be used most efficiently to reach low-income and marginalised groups?			
1a	*What should be considered when deciding where and how to implement a DSS scheme? (pre-design)*	●	–
1b	How can fraud and abuse be prevented or minimised within DSS schemes?	●	–
1b.i	How can verification and tracking processes be designed to minimise the risk of fraud and abuse, while ensuring cost-efficient monitoring and timely disbursements?	●	–
1c	Which targeting mechanisms proved effective and cost-efficient for identifying and reaching eligible beneficiaries across socio-economic groups?	●	–
1d	How can the affordability gap and corresponding subsidy amount be determined?	●	–
Learning Question 2: How can DSS be designed to minimise market and price distortion?			
2a	Which messages and communication strategies are most effective for sensitising potential beneficiaries and companies, encouraging uptake, and avoiding market leakage?	●	–
2b	How have DSS pilots impacted the perception and value of the product among the target group and in the commercial market?	●	–
2c	How can targeting be designed to avoid social tensions and behavioural impacts?	●	–
2d	How can price and market distortions be identified?	●	–
Learning Question 3: What impact can DSS schemes have on market development?			
3a	How did the pilots impact the commercial market (market distortion, positive market spill-over, longer-term development)?	–	●
3b	How did the different market stages impact DSS implementation?	–	●
3b.i	Interactions with complementary market interventions and measures for ensuring sustainable company presence.	–	●

The study integrates LNOB and gender considerations throughout. These dimensions are essential for understanding who benefits, how targeting performs in practice, and whether subsidy delivery is equitable across different groups, particularly women, persons with disabilities, female-headed households, and displaced populations.

2.2. Research methodology

The study used a mixed-methods evaluation matrix that aligns research questions with ESMAP Subsidy Toolkit elements. Triangulation across pilots draws on:

- Pilot operational data, including verified sales records, IVA verification reports, claim processing data, and programme monitoring data from each pilot.
- Household surveys, 240 beneficiaries in Liberia; 500 beneficiaries in Malawi (250 SHS, 250 ICS); 500 beneficiaries in Uganda (250 OGS, 250 ICS); and 250 beneficiaries in Niger.
- Key informant interviews with EnDev country teams, Fund Managers, IVAs, government counterparts, and participating private-sector companies.
- Focus group discussions with beneficiary and, where possible, non-beneficiary households across each pilot geography.
- Document review of pilot operational manuals, concept notes, mid-implementation revisions, and verification guides.

Data was collected digitally using the Kobo Toolbox and in compliance with General Data Protection Regulation (GDPR) data minimisation principles. All quantitative results in this report are drawn from the verified pilot datasets and household surveys; qualitative interpretation triangulates these against KIIs and FGD evidence. Where findings differ by technology, those differences are made explicit; where evidence is available only from a subset of pilots, that is also stated.

2.3. Limitations

- The pilots operated in materially different contexts and at different stages of implementation, which constrains direct numerical comparability; the cross-pilot synthesis therefore prioritises directional patterns and design lessons.
- Household surveys in each country were stratified to support pilot-level inference; sub-group sample sizes (for example, sub-pilot beneficiaries in Liberia or HTC users in Uganda) are smaller, and supporting conclusions are flagged as indicative.
- The Uganda and Malawi pilots were still active at the time of data collection, and some operational adaptations were in progress; conclusions on long-term sustainability and exit dynamics should therefore be read as preliminary.
- Clean cooking findings draw on Malawi and Uganda only; the Liberia and Niger pilots do not have a clean cooking component and are not used to support cooking-specific conclusions.
- Findings regarding populations excluded from the subsidies (e.g., child-headed households, persons with disabilities) rely on triangulated qualitative observations from key informant interviews with local leaders and beneficiaries. These findings are subject to survivorship bias, as the quantitative survey exclusively captured households that successfully received the subsidy.

3. Key findings and comparative learnings

3.1. Pre-design / market context

> *1a. What should be considered when deciding where and how to implement a DSS scheme?*

The four pilots represented different stages of market development, with Niger as a market-creation context, Liberia as an emerging market with a partial commercial foundation, and Malawi and Uganda as more developed off-grid markets, even though clean cooking sectors within Malawi and Uganda remained structurally less mature than solar.

In nascent markets, the programme had to build the market before it could expand it. In Niger, certified off-grid solar sales had been negligible before the pilot, but the programme generated more than 13,000 sales over a comparable period, with demand-side-supported sales accounting for 80–90% of participating companies'

sales volumes. To enable commercial distribution to function, the broader programme funded delivery infrastructure, community engagement into the local distribution chain, physical sales points, and marketing and business development support. In this context, while the demand-side subsidies provided the necessary affordability intervention for end users, the parallel market building measures acted as a market activation tool, ecosystem-building mechanism, and commercial entry platform. Conventional distortion barely applies because no pre-existing commercial market existed to distort, and the forward-looking question shifts from distortion to continuity, specifically whether the programme-funded delivery infrastructure can transition to commercial self-sufficiency as subsidies decline. Demand also did not follow the assumptions made at design: in both Niger and Uganda, expected demand for the smallest Pico PV products and lanterns did not materialise, with customers preferring larger solar home systems once these were understood and affordable. This was driven by the higher perceived value of the SHS's broader functionality and additional technical benefits, such as including a radio alongside basic lighting and phone charging.

In a transitional market, the programme needed supply-side support to function. In Liberia, some commercial structures existed, but distribution capacity was weak; almost half of the contracted companies were new to last-mile solar distribution, and the first six months produced near-zero sales because companies held no in-country stock. The programme required advance payments on inventory of up to 30% of contracted subsidy amounts, business development assistance, and supplier financing. Many companies subsequently used their DSS contracts as collateral to secure low-interest commercial bank loans, showing that the instrument also functioned as a market-development signal to formal lenders.

In more mature markets, the subsidy accelerated adoption and deepened reach. In Malawi and Uganda, functioning PAYGo systems, established suppliers, and consumer familiarity meant the subsidy mainly extended access into populations the commercial market had not served. Companies in Malawi reported establishing satellite shops and agent networks in deep-rural villages previously considered unviable, with the intent to keep them running. The localised commercial presence produced spillover, with ineligible households who saw products demonstrated locally purchasing solar systems at full cash prices. Clean cooking markets within Malawi and Uganda nonetheless remained structurally less mature than solar, with weaker supply chains, thinner margins, lower consumer familiarity, and weaker after-sales systems.

Three comparative lessons emerge across the market-maturity evidence:

- Demand-Side Subsidies behave differently across market stages, deepening access, expanding inclusion, and accelerating adoption in more mature markets, and creating the commercial ecosystem itself in highly nascent ones.
- Clean cooking remains structurally less mature than solar even within more developed markets, demanding longer-term ecosystem investment before market persistence becomes likely. The thinner the market, the more important inventory support, ecosystem infrastructure, working capital assistance, and business development support become for successful implementation.
- Programmes that treat supply-side complements as core components in nascent markets, and as scalable accelerators in more mature ones, are better positioned to produce the access outcomes demand-side instruments are designed to deliver.

3.2. Targeting efficiency and effectiveness

1c. Which targeting mechanisms proved effective and cost-efficient for identifying and reaching eligible beneficiaries across socio-economic groups within the DSS component?

The four pilots used four different targeting approaches, each with context-specific strengths and weaknesses, demonstrating that the operational viability of a targeting mechanism depends entirely on the pre-existing data

ecosystem and local administrative capacity. The collective evidence reveals that while highly sophisticated, multi-tiered targeting models theoretically maximise inclusion, they often generate administrative overheads and operational friction. Conversely, simpler geographic or category-based filters significantly accelerated technology delivery, though they inherently compromised precise, household-level poverty targeting.

Liberia's geographic targeting through the MPI was operationally simple and low-cost to implement, and it delivered a broad-brush prioritisation of poor rural counties in a setting where no household-level registry existed. Within eligible counties, sales were concentrated in more commercially accessible markets, with three counties accounting for roughly 75% of verified sales. In contrast, four of the most remote and structurally poor counties accounted for approximately 11% of sales. This geographic filter served as a pragmatic tool, but the widespread energy poverty in Liberia prevented it from differentiating between relatively better-off and poor households within the same county. Conversely, the voucher sub-pilot offered a complementary route, reaching around 3,800 vulnerable women through trusted partner organisations with stronger affordability outcomes than the main pilot, a useful proof-of-concept for partner-mediated vouchers in low-data settings, though based on a smaller indicative sub-sample.

Malawi's registry-based demographic targeting through the MSR produced the tightest income-level filtering observed in the study. Solar sales concentrated within the registry-classified poorer and poorest categories as intended, and the mechanism limited leakage into higher-income segments. But the registry's four-year refresh cycle lagged newly formed or relocated households, causing visible exclusion at point-of-sale events, and overlapping social-protection messaging led some communities to assume the subsidy was reserved for existing cash-transfer beneficiaries. The Malawi experience indicates that even relatively sophisticated registry systems can benefit from complementary local validation mechanisms.

Niger combined geographic selection of underserved communes in Maradi and Tahoua with a vulnerability lens distinguishing host communities, refugees, and IDPs, operationalised through Carnet de Famille municipal records, national identity cards, and IDP lists maintained in Kobo by local authorities. Anchoring DSS targeting within established local administrative systems effectively isolated target demographics, bypassing independent poverty assessments that are largely unnecessary given uniform rural socio-economic conditions. The pilot also assessed and decided against a QR-code voucher overlay, judging its estimated cost at EUR 250,000 to 300,000 for approximately 60,000 beneficiaries to be excessive relative to the integrity gains achievable through existing municipal and humanitarian records. The decision is a useful counterpoint to Liberia's voucher sub-pilot and indicates that the right answer depends on the data already available.

Uganda's refugee-host quota system worked relatively effectively for solar, where sales achieved near-parity between refugees (59%) and other populations (23% host and 17% rural poor communities), and approximately 73% of beneficiaries reported being informed why they qualified for the subsidy. The same quota logic did not transfer cleanly into clean cooking, where host communities accounted for approximately 65% of lower-tier cookstove sales (17% poor communities; 18% refugees) and 52% for higher-tier cooking solutions (40% poor communities, 8% refugees).[1] The imbalance reflected lower refugee purchasing power, weaker familiarity with improved cooking technologies, and higher delivery costs in refugee settlements. The Uganda experience reflects a broader pattern across the study. Solar adoption is driven primarily by affordability constraints that the subsidy addresses directly, while clean cooking adoption is shaped by affordability alongside behavioural, logistical, and familiarity constraints that price reductions cannot resolve. Targeting mechanisms developed for one technology should not be assumed to transfer cleanly to another.

Taken together, three comparative lessons emerge across the targeting evidence.

[1] HTC, which was not subject to a ratio requirement and was designed as a market-learning component to draw lessons on the penetration of higher-tier clean cooking technologies

- Primary targeting systems function as resource-allocation mechanisms rather than precise poverty-targeting tools, naturally resulting in inclusion and exclusion gaps in last-mile contexts.
- Targeting precision tracked the data already in place, where national registries or humanitarian databases existed; inclusion errors were low; where household-level data did not exist, the resulting gaps were structural rather than a sign of poor implementation.
- Identifying eligible households does not guarantee delivery. Companies in Liberia concentrated sales in accessible hubs over remote targeted zones due to high transport costs. In Niger, uptake increased when subsidies matched actual purchasing power, while Uganda's 50/50 quota worked for solar but not for clean cooking due to lower refugee purchasing power and higher behavioural barriers.
- Deep subsidies reached their intended group with no measurable distortion, where they were paired with tightly controlled delivery (Liberia's voucher sub-pilot, Malawi's registry-tiered subsidy model, and Niger's differentiated pricing for displaced populations)
- Targeting should differentiate by technology where supply and demand realities differ, particularly where the same quota logic produces different outcomes across solar and clean cooking.

3.3. Subsidy level determination and impact

1d. How can the affordability gap and corresponding subsidy amount be determined?

Each pilot set its subsidy from an evidence-based estimate of the affordability gap: the difference between the prevailing market price and the target group's ability and willingness to pay. As sales data, macroeconomic conditions, and market evidence accumulated, levels were recalibrated. The approach was common to all four pilots, with differences in the strength of the underlying evidence base and the size of the resulting adjustments.

Baselines were drawn on the best socio-economic and expenditure data available for each target group. Niger used a 2024 baseline study of incomes, savings, energy spending and willingness-to-pay (WTP) to set ability-to-pay (ATP) thresholds, which exposed a structurally lower payment capacity among forcibly displaced households (FDP) than among host communities. Liberia anchored its ATP to a World Bank benchmark of roughly 5% of household expenditure on energy (rejecting earlier, higher estimates that would have pushed the subsidy past USD 100) and checked it against observed spending on alternative lighting. Malawi aligned the net cost of each product tier to historical energy expenditure from the World Bank and SEforALL data. Uganda set its depths from upfront price assumptions, testing baseline fuel and energy costs against focus-group WTP limits for solar and ICS.

Where baseline data were thin, or distortion risks high, pilots deliberately set subsidies below the calculated gap to preserve operational safeguards. Liberia capped its initial subsidy at 20% of retail price (maximum USD 40) to limit spill-over under broad geographic targeting; Niger applied a single price to host and displaced households to protect local social cohesion; and Uganda launched its ICS subsidy at a conservative flat UGX 10,000 to establish a stable baseline before committing to deeper support.

Across the pilots, subsidy levels were most commonly set as a percentage of the product price, applied up to a maximum absolute amount. The percentage set the depth of support relative to price, while the absolute ceiling capped the programme's exposure per unit. Liberia and Uganda both used this percentage-up-to-a-fixed-cap structure, the simplest and most transparent option, which prevents over-subsidising at either end of the price range: it discourages companies from steering customers towards premium products to claim a larger payout, and stops low-priced products from becoming effectively free, which would erode user ownership and the commercial price signal. Malawi applied a percentage up to a maximum market-price cap, a more complex variant that was harder to communicate and was not consistently applied in practice. Niger followed a

different logic, fixing an affordable end-user price and using a competitive reverse auction to set the per-product reimbursement.

In practice, pilots revised their subsidy level or caps at least once, and always upward. In Liberia, fewer than 500 sales in the first six months prompted a June 2024 affordability survey; after which the subsidy was deepened from 20% to 40% of retail price and the absolute ceiling raised in step to a maximum of USD 80, which sharply accelerated uptake. The resulting discounts of roughly 82% for hosts and 91% for displaced households lifted FDP sales to about a fifth of the total. In Malawi, kwacha devaluation and fuel inflation influenced the ICS distribution top-up from EUR 1.68 to EUR 4.20, a 150% rise that held the end-user price stable. To account for inflation and rising business costs, the SHS price cap was raised by 48% in October 2025. This adjustment realigned the ceiling with actual market costs without inflating the subsidy, as any price exceeding the cap remains unsubsidised. In Uganda, company feedback that the flat ICS rate did not cover the cost of serving remote settlements led to a deepened subsidy set at 60% of the price, with a doubled absolute ceiling cap of UGX 20,000, while solar held between 52% and 68%.

A layered set of controls kept the deepened subsidy flowing to customers and not into company margins. Approved prices were locked and benchmarked against non-subsidised sales: Malawi required receipts proving DSS prices matched those offered to other customers, and Liberia fixed prices in the service contract, with any change needing documented cost evidence and Fund Manager approval. Competitive tendering set an efficient starting point when Niger's Fund Manager took the lowest compliant offer and negotiated shortlisted companies down to it. Subsequently, independent verification then confirmed pass-through, leveraging Liberia's IVA to verify actual customer payments on the ground. Where more than 10% of a sampled claim failed verification, the claim could be rejected, and the company provided official warning and/or was excluded. Quarterly-to-biannual monitoring of commercial prices gave early warning of any inflated subsidised price.

The clearest lesson is that subsidy calibration is an iterative process, not a single pre-launch decision. Because affordability gaps move with inflation, seasonality, and income volatility, every pilot had to deepen its subsidy mid-implementation to secure the bulk of its inclusion gains. But depth alone did not determine success: its effect depended on how well it was matched to repayment terms and local delivery economics. The four cases each isolate a different dimension of that interaction.

Liberia showed both the value of getting depth right and its limits in highly income-constrained settings. Even after the rise to 40%, about 39% of credit buyers missed at least one monthly payment, and companies stretched repayment from 12 to 24 months to bring instalments down to USD 4-5. The exception was the sub-pilot for vulnerable women, which reported full affordability and no missed payments: calibrated through its own survey, delivered via a closed-loop voucher, and set at an 80% subsidy capped at USD 160. The pilot also raised a scale-up question, as RREA cautioned that confining subsidies to basic lighting could limit productive energy use and beneficiaries' capacity to generate income.

Malawi recorded the strongest repayment discipline in the study, pairing subsidy support with companies' own PAYGo models: defaults held between 1% and 4%, and 12-month terms became standard. Registry-based targeting, depth aligned to affordability tier, and instalments set within existing energy budgets meant repayments simply substituted for spending on kerosene, candles, and commercial phone charging. The depth came at a cost, however: small residual PAYGo balances generated minimal agent commissions, leaving little incentive for costly maintenance or collection trips into remote areas. Malawi, therefore, demonstrates a structural trade-off: deeper subsidies improve inclusion while reducing the margin that funds after-sales service, a cost that future programmes should price into both calibration and service contracting.

Niger produced the clearest evidence on depth and inclusion. While both host and FDP populations would spend monthly income on solar, their affordability thresholds differed. When Pico systems were exhausted, the standard 15,000 FCFA SHS price excluded FDPs; rather than implementing a uniform discount that would risk

market distortion, the program introduced a targeted 7,500 FCFA price that closed the gap. This demonstrated that differentiated pricing under controlled targeting drives inclusion without destabilizing the broader market.

Uganda demonstrated that even where PAYGo makes a product technically affordable, repayment remains highly sensitive to income volatility. About 41% of PAYGo beneficiaries missed at least one repayment, with refugee households over-represented and frequently linking missed payments to gaps in humanitarian cash or ration cycles. The same instrument behaved very differently for general solar users and for refugee households on humanitarian income, underlining that financing architecture matters as much as subsidy depth.

Several recurring lessons emerge across the subsidy-level evidence.

- Subsidy calibration should be evidence-driven and adaptive, with dedicated affordability assessments before launch and formal review points at 6 to 9 months built into programme design rather than handled as discretionary mid-course adjustments.
- Subsidies reduce affordability barriers, while rarely eliminating them, since the great majority of beneficiaries across the pilots continued to report needing a subsidy for their next purchase.
- Financing architecture matters alongside subsidy depth, with PAYGo working effectively where the instalment level matches existing energy expenditure and the underlying income flow is stable enough to support it.
- Deep subsidies work best when paired with tightly controlled delivery architecture, as Liberia's voucher sub-pilot and Niger's differentiated pricing both demonstrated, and the same depths sold through open commercial channels would have carried far higher distortion risk.
- Tier 1 access subsidies and productive-use financing serve different objectives and should be designed as complementary, not substitutable instruments. These pilots subsidised first-time household access only, and the evidence supports keeping Tier 1 systems central to reaching the poorest households. RREA's concern in Liberia points to a real tension at scale-up, because productive-use systems involve higher upfront costs, stronger repayment requirements, and different business-case assumptions, and are better served by dedicated instruments such as credit guarantees, working-capital support, and asset finance. Folding both objectives into a single subsidy risks diluting the focus on the poorest households while underserving productive users.

3.4. Delivery and communication effectiveness

2a. Which messages and communication strategies are most effective for sensitizing potential beneficiaries and companies, encouraging uptake, and / or avoiding market leakage?

Delivery capacity was the primary bottleneck in new markets, meaning subsidies could not translate demand into sales until weak supply chains and infrastructure were financed or built. Additionally, communication functioned as a core market protection tool instead of a mere marketing add-on because the information given to beneficiaries about pricing and timelines directly shaped their long-term expectations.

Fund management architecture

Across all four pilots, a specialised Fund Manager brokered the relationship between donors, government, and distributors, and in the thinner markets, the FM's role went well beyond disbursing funds. In Liberia, BRAC provided sales capacity-building, financial tracking, and credit-risk support to companies new to the market; in Malawi, CUMO offered to cover upfront transportation costs and deduct these expenses from later reimbursement claims, though no ICS companies chose to use this arrangement; in Niger, the Mercy Corps coordinated with local authorities and UNHCR.

Company selection choices

Selecting participating companies required balancing technical standards with the capacity constraints of nascent last-mile markets. While Uganda and Malawi enforced strict due diligence and compliance with established product standards, the transitional Liberian market deliberately lowered historical entry thresholds to avoid excluding the majority of local companies from participating in the programme. To mitigate these capacity risks across the pilots, participation was paired with intensive business development and operational support to enable digital tracking and facilitate penetration into challenging rural and refugee settings.

Delivery channels

Reaching marginalised populations required localised, agent-based networks rather than traditional retail chains. In Uganda and Liberia, distributors relied on commission-based local agents for community outreach and physical cash collection in areas with low mobile money penetration. In contrast, the absence of commercial networks in rural Niger required the programme to directly fund foundational delivery infrastructure, including 500 trained community agents and about 50 dedicated sales pavilions. Furthermore, clean cooking distribution introduced unique structural vulnerabilities, as seen in Malawi, where seasonal rainfall disrupted local clay stove manufacturing and caused stockouts despite consumer demand.

While these localised networks were the primary delivery mechanism, their viability depended entirely on the financial architecture underpinning them. RBF models using digital tools like Kobo Toolbox successfully protected public funds but were operationally fragile and created administrative bottlenecks. Issues with batch reconciliation, data inconsistencies, and manual rectification of incomplete claims caused reimbursement cycles to consistently miss targets, with cycles stretched to 60 to 90 days in Niger and 60 to 120 days in Malawi due to late fund releases by Fund managers rather than the verification process itself.

These administrative delays exposed a structural vulnerability central to DSS, which is business liquidity. Because these subsidies rely on consumer discounts, companies are often left out of pocket for the vast majority of the sale value until verification is complete. This makes DSS reimbursement structurally more fragile than supply-side RBF, where products sell at largely commercial rates, and the subsidy is a top-up rather than the bulk of the sale value. Extended reimbursement delays impacted companies' working capital. This pushed smaller firms and low-margin cookstove retailers to defer restocking, reduce geographic expansion, and sometimes temporarily withdraw from the programmes altogether. The pure post-sale reimbursement models were often unviable in these conditions, and to keep delivery channels functioning, programmes in Uganda, Liberia, and Niger introduced supply-side liquidity by issuing contract advances ranging from 30% to 40% to help companies secure initial inventory and finance activities.

As an alternative delivery channel, closed-loop voucher systems presented a distinct set of trade-offs regarding cost and market insulation. Liberia successfully utilised a closed-loop voucher system, mediated by trusted partner organisations, to safely deliver steeper 80% subsidies to vulnerable women without disrupting the broader commercial market. However, deploying a standalone digital voucher infrastructure can be highly cost-prohibitive. Niger assessed a QR-code voucher overlay but ultimately decided against it because the estimated cost was high compared to the integrity gains achievable by simply using existing local municipal and humanitarian records.

Subsidy disbursement & payment models

Supply-side liquidity constraints necessitated operational deviations from pure post-sale reimbursement. To help companies secure initial inventory and finance operating activities, Uganda and Liberia introduced a 30% advance on contract signing, and Niger raised its advance from 30% to 40% to finance large inventory shipments. Malawi had an advance payment on the value of each submitted claim, capped at 40% of the claim value undergoing verification for both solar and clean cooking companies. This advance failed to insulate distributors

from working-capital constraints, resulting in a start-stop sales dynamic across both technology types. Because these payouts remained tied to the verification process, delayed capital releases disrupted restocking cycles and led to reliance on final disbursements, while leaving solar importers exposed to foreign-exchange risks.

At the end-user level, PAYGo was the main payment model for solar, spreading the balance over 3–24 months. While this made products affordable at the point of sale, it exposed companies to repayment inconsistency linked to rural income volatility and to the cost and fraud risk of manual, agent-led cash collection where mobile networks were weak.

Communication effectiveness

Agent networks were central across all pilots. Company agents were the leading source of pre-purchase awareness in every pilot, simultaneously handling awareness, customer education, onboarding, repayment explanation, and trust-building across solar and clean cooking technologies. The agent channel was particularly important in rural contexts, low-literacy settings, refugee communities, and first-time-user markets. In Liberia, 67% of beneficiaries first learned about the product through company agents. In Malawi, the leading awareness channel was again company agents at 40%, followed by local leaders and community meetings. Niger's awareness reach scored 93%, carried through a combination of agents, community members, local leaders, radio, and flyers. Additionally, the Niger pilot hired dedicated communication agents to conduct community theatre plays, an approach that proved effective in engaging and resonating with the target populations. Uganda recorded approximately 74% pre-purchase awareness, again led by company agents. Energy-product adoption in rural markets remains highly relationship-driven, and agent-led communication is unlikely to be displaced by remote or mass channels in the near term.

Communication around the temporary nature of the subsidy remained inconsistent. In Liberia, 26% of surveyed beneficiaries reported being informed that the subsidy was temporary, the lowest figure in the study. In Malawi, 93% of beneficiaries reported being briefed by company agents, while only 52% of those briefed by agents knew the subsidy was temporary, compared with 74% of those briefed by local leaders. In Uganda, approximately 75% of beneficiaries reported being informed that the subsidy was temporary, with consistent comprehension between refugees and host communities. Inconsistent subsidy-duration messaging contributed to price anchoring, expectations of future subsidies, and confusion around commercial pricing.

Communication risks varied by pricing structure, but layered messaging that articulated equity logic and temporary duration proved most effective.

The pilots demonstrated that communication vulnerabilities depended heavily on the underlying pricing model. Under uniform pricing designs, the primary risk was long-term consumer price anchoring. Field data from Liberia and Malawi showed a wide variance in consumer awareness regarding the temporary nature of the subsidy, with many customers coming to view the discounted price as the normal market rate. Conversely, differentiated pricing models encountered localised equity concerns. In Niger, for example, host communities questioned deep displacement discounts despite expressing high overall programme awareness. To address these risks, the pilot data identified the most effective messages and communication strategies used across the targeted regions:

- The most effective strategy, as observed in Uganda and Malawi, utilised a layered approach where company agents drove direct product awareness, while local community leaders and humanitarian partners reinforced targeting rules, programme legitimacy, and eligibility criteria.
- Establishing a strong baseline understanding before field activations occurred helped prevent bottlenecks and confusion at the point of sale. In Liberia's sub-pilot, partner-led community gatherings effectively communicated the one-off, targeted nature of deep subsidies, which resulted in highly vulnerable beneficiaries fully understanding the programme. Additionally, radio broadcasts proved to be

a highly cost-effective channel for generating broad, consistent public awareness across targeted districts.

- The most successful messaging went beyond basic pricing to actively explain why subsidies were temporary and why specific groups paid different prices. In Niger, conducting targeted FGDs alongside UNHCR and local authorities successfully explained the financial constraints of displaced households to host communities, which mitigated social tension without triggering broad market distortion.

Across the four pilots, communication design sits inside the market-protection architecture.

- Delivery capacity is the binding constraint in nascent and transitional markets; programmes must be ready to finance or build the channel, not only the subsidy.
- Treating communication as part of market design and not just a marketing layer is therefore essential to translating well-designed subsidy mechanisms into well-functioning market outcomes.

3.5. Verification

> *1b. How can fraud and abuse be prevented or minimised within DSS schemes?*
> *i. How can verification and tracking processes be designed to minimise the risk of fraud and abuse, while ensuring cost-efficient monitoring and timely disbursements?*

All four pilots used hybrid verification systems combining Kobo-based eligibility checks, phone verification, and field verification by an IVA that succeeded in limiting fraud and leakage. Verification also emerged as one of the most operationally sensitive components of implementation, and the design choices around it materially shaped both company liquidity and programme reach.

Fraud and leakage risks were generally contained across the pilots. Verification systems successfully limited duplicate claims, product leakage, identity fraud, and large-scale resale. Malawi's Independent Verification Agent recovered approximately MWK 3.5 million from fraudulent agent reporting and rejected approximately MWK 11 million in non-compliant claims, with mandatory refunds for any overcharged customers. Liberia's verification pipeline kept final rejection rates below the 10% disqualification threshold, settling at roughly 2% towards the end of the programme. Niger's structurally independent verification design, a first-of-its-kind arrangement for RBF in the country, held under genuinely difficult conditions of weak connectivity, beneficiary mobility, and security-constrained field access, flagged or rejected approximately 6% of company-reported sales. Uganda flagged approximately 8% of solar claims and 15% of cookstove claims due to duplication and errors. Survey data shows minimal product diversion, with fewer than 5% of surveyed beneficiaries in Liberia reported being approached by others to lend, share or resell the product, and a 99% retention rate in both Liberia and Niger. Hybrid verification systems can protect public funds effectively even in low-connectivity and humanitarian contexts.

Verification requirements interacted differently with solar and clean cooking technologies. Solar PAYGo systems supported stronger customer tracking, clearer digital records, and easier post-sale verification. Clean cooking markets involved faster-moving retail channels, which often resulted in weaker sales and customer documentation. In Uganda, to accommodate these fast-moving cookstove retail dynamics, the rules were adjusted to allow up to five cookstove sales per the same National ID. However, this adaptation meant that verification needed to be much more diligent to ensure this limit was strictly followed. Regardless of these technology differences, Uganda maintained a strict, multi-layered framework across the board, requiring a minimum 50% phone-reach threshold and field escalation for unreached sales, with the rule that an entire claim set is rejected if the overall eligibility score falls below 50%.

Beyond technology differences, pilots had to adapt their verification protocols to infrastructure constraints. Liberia adjusted its phone and field verification ratio from an initial even split to an 80:20 (phone-

to-field) split as field costs became clearer, with additional field verification triggered for any company falling below a 75% phone reachability threshold. Niger adapted to weak mobile coverage, shared phones, and high beneficiary mobility by deploying teams already operating in the relevant zones and using regularisation rounds with the Fund Manager to capture legitimate but initially poorly documented sales.

Reimbursement delays were a leading operational challenge. Payment timelines lagged across the region, with Niger's cycles running 60–90 days, Malawi's stretching to 60–120 days, and Uganda consistently missing its 30-day target. The drift was driven by batch reconciliation, data inconsistencies generating back-and-forth between Fund Managers and companies, manual rectification of incomplete claims, IVA capacities, and banking and treasury delays inside Fund Manager structures in Malawi's case. Additionally, smaller participating companies, particularly in clean cooking and among the smaller solar firms, operated with thin working capital buffers. Because delayed payments directly prevent companies from ordering more stock and reaching more customers, making the verification and reimbursement process faster is essential to maximising the total number of products delivered.

Three comparative lessons emerge across the verification evidence:

- Verification proportionality matters, with systems best aligned to technology type, market maturity, transaction size, and operating context, since overly rigid systems can undermine implementation efficiency without generating proportionate accountability gains.
- Hybrid phone-and-field verification remains the appropriate default, balancing cost-efficiency, accountability, and operational feasibility, and the ratios and protocols should remain adaptable to local conditions.
- Reimbursement timelines and business liquidity are a verification-design outcome, not a side effect. Across all four pilots, the speed of post-verification disbursement determined how much subsidised demand companies could actually serve. Verification design, therefore, shapes market reach, not just fraud control, and reimbursement-cycle time should be monitored as a core performance indicator.
- The administrative design of verification is a determinant of private-sector liquidity, not only a fraud-control mechanism; streamlining it directly increases the volume of subsidised demand a market can fulfil.

3.6. Subsidy valuation and behavioural impacts

> *2b. How have DSS pilots impacted the perception and value of the product among the target group and in the commercial market?*

Across the pilots, the estimated ability to pay (ATP) aligned well with actual capacity in more established markets, but fell below programme assumptions in nascent or displacement-affected ones. The Malawi solar component is the clearest case where the actual ability to pay matched or even exceeded initial expectations based on the pilot's strong repayment discipline (default rates remained at just 1–4%), and FGD reports that beneficiaries could easily substitute their existing energy expenditures for solar instalments without minimal repayment stress. In contrast, early implementation in other pilots revealed that target populations' actual ability to pay was much lower than assumed at design, prompting necessary redesigns. This was evident with Liberia's initial 20% subsidy (which produced near-zero sales) and Niger's initial uniform price for FDPs (whose incomes were three times lower than those of host communities).

Perceived product value was consistently strong, with high usage and satisfaction, especially for solar. Liberia recorded 93% of beneficiaries using the product every time, full or near-full ratings of usefulness, and a similarly high willingness to recommend. Malawi recorded 99% of solar beneficiaries reporting daily use and 80% reporting that the entire household used the product. Niger recorded 92% daily use, 94% rating the product as

very useful, 99% still owning it, and 97% reporting it as functional. The pattern across the pilots is that solar, in particular, produced household-wide, multi-member benefits that supported a clear value perception within the household. In Malawi, approximately 47% of solar respondents cited better lighting or power as the highest-ranking benefit, and 33% reported income-related benefits, twice the rate observed in clean cooking. In Uganda, approximately 54% of reported benefits related to improved lighting and power access, and 62% of solar households reported transitioning away from torches, kerosene, or candles.

Clean cooking benefits accrued more narrowly than solar and proved harder to translate into commercial willingness to pay. In Malawi, around 43% of cookstove respondents identified adult women as the primary user, and only 17% reported income-related benefits. Approximately 30% of clean cooking beneficiaries in Uganda cited reduced cooking time as the leading benefit, 27% reduced fuel costs, and 16% improved health or safety. The gains from clean cooking accrued privately to the cook through reduced fuel cost, time spent gathering wood, and indoor smoke exposure, which explains why clean cooking adoption depended more heavily on subsidy mediation than solar. After-sales service was also a more material problem in clean cooking. In Malawi, 87% of cookstove technical issues remained unresolved at survey time, and 84% of cookstove customers with a problem did not contact anyone, as the after-sales channel was not merely unresponsive, but also unknown to the beneficiaries.

Social tensions were limited across the four pilots, with the substantial majority of beneficiaries reporting no community-level complaints. In Malawi, point-of-sale events occasionally turned away visibly poor households because they were absent from the most recent social registry version, generating localised confusion about selection criteria. In Niger, some host-community members questioned why FDPs paid less for the same product, though focus-group evidence does not suggest this translated into broad social tension. In Uganda's cookstove segment, the imbalance between host and refugee uptake produced perceptions of unequal benefit even where the formal eligibility criteria were neutral.

Taken together, demand-side subsidies significantly shape how products are perceived by individual households, participating companies, and the broader commercial market. **The evidence from the four pilots highlights several key learnings:**

- High perceived value does not automatically translate to the ability to pay. While WTP aligned with expectations in mature markets, it fell short in nascent or displacement-affected markets, requiring pilots to dynamically adapt their pricing.
- Communication design is critical to mitigating market distortion. When subsidised prices are clearly framed as targeted support, the standard commercial price remains a credible reference.
- Willingness and ability to pay should be assessed empirically before launch and reassessed during implementation, as evidenced by the DSS pilots, since initial estimates understated the gap that needed to be closed.
- Perceived product value among beneficiaries was strong across all pilots and across both technologies, indicating that demand-side subsidies are reaching households that value the products they receive.

3.7. Price and market distortion assessment

2d. How can price/market distortions be identified?

In conventional design frameworks, distortion risks are leakage of subsidised products to non-target households, resale into the commercial market, double-dipping across programmes, and depression of commercial prices by the visible presence of the subsidy. The four pilots show that these conventional risks were limited. Notably, Uganda mitigated double-dipping by cross-matching data against the Uganda Energy Credit Capitalisation

Company (UECCC) database, providing a replicable model to eliminate beneficiary overlap across parallel subsidy programmes. The distortion risks that did materialise were behavioural and operational, concentrated in customer expectations and perception dynamics, and the implications for market-protection design are correspondingly different.

Price anchoring emerged as the dominant behavioural risk across the pilots. Where the subsidised price was clearly framed as targeted support, the unsubsidised commercial price remained a credible reference point. In Liberia, 83% of beneficiaries recognised that the subsidised products were cheaper than alternatives. However, this poses a risk of price anchoring if customers start expecting the discount as the normal market price. Companies in Liberia reported that customers in subsidised counties increasingly treated subsidised prices as the normal reference price, and the analogous pattern emerged in Uganda's cookstove segment, where overlapping humanitarian distributions reinforced perceptions of cookstoves as goods that should be free or near free. Malawi's solar component showed weaker anchoring effects, supported by stronger communication on subsidy duration and a clearer commercial reference price.

Humanitarian overlap shaped market behaviour in displacement contexts. Uganda's clean cooking market was heavily influenced by prior humanitarian distributions, with participating companies reporting that repeated exposure to free or highly subsidised distributions affected willingness to pay, customer expectations, and perceptions of commercial pricing. Driven by widespread humanitarian aid, expectations of free distribution present a systemic market challenge in Niger. To mitigate this, the pilot integrated extensive public awareness campaigns with close humanitarian coordination, demonstrating that proactive communication is a core component of market development, not just a secondary operational concern in displacement contexts.

Differentiated pricing generated fairness considerations rather than broad social tension. Niger introduced differentiated pricing for displaced populations after initial uniform pricing failed to achieve inclusion, and while the model improved uptake significantly, it generated occasional fairness concerns among host communities about why displaced households paid less for the same product. The focus group evidence does not indicate that this translated into widespread social tension. The case nonetheless demonstrates that differentiated pricing structures require strong communication, transparent rationale, trusted local intermediaries, and controlled targeting systems to maintain legitimacy. Universal pricing carries the opposite trade-off, with reduced fairness friction and higher price-anchoring risk.

Distortion risks differed significantly across technologies. Solar markets generally demonstrated stronger commercial spillover, more persistent commercial activity, and higher willingness to continue engagement with companies after the subsidy period. Clean cooking markets showed weaker commercial persistence, stronger dependency on subsidy mediation, greater sensitivity to supply-side constraints, and stronger behavioural adoption challenges. The same demand-side instrument therefore behaved as a market-development tool in one technology and as a binding-but-insufficient affordability tool in the other.

A few comparative lessons emerge across the distortion evidence:

- The main distortion risks were behavioural rather than systemic, with large-scale resale and leakage remaining limited and the dominant risks involving customer expectations, price anchoring, fairness perceptions, and overlapping subsidy ecosystems.
- Communication is a central market-protection tool, since several distortion risks were intensified by inconsistent communication around subsidy duration, pricing rationale and eligibility logic, and the design response points towards clearer messaging.
- Communication efficacy depends on the pricing model: uniform pricing mainly risks long-term price anchoring, while differentiated pricing risks local fairness perception, so transparency must be calibrated to the pricing design.

- Humanitarian coordination determines stability in displacement-affected markets, since previous and parallel free NGO distributions disrupted commercial cookstove networks. Additionally, sector maturity decided whether the subsidy distorted or developed the market: where solar had a commercial footing, the pilots left durable infrastructure, whereas clean cooking and the more nascent solar markets showed weaker persistence.

4. Recommendations

4.1. Targeting

> *2c. How can targeting be designed to avoid social tensions and behavioural impacts?*

Adapt targeting to the realities of local data infrastructure.

Because comprehensive and up-to-date national registries are rarely available, future programmes must use the best existing geographic and demographic data to identify vulnerable populations, combining broad geographic and demographic filters with whatever local administrative and humanitarian records are already functioning. This approach proved highly effective across the pilots: Liberia successfully used the MPI to target the most underserved counties, while Niger and Uganda layered demographic quotas using readily available documentation such as local family booklets (Carnet de Famille), National IDs, and UNHCR refugee lists to reach displaced and host communities. In Malawi, where a national social registry was utilised, outdated data meant that practical geographic and demographic realities on the ground often had to guide implementation. While this approach inherently accepts a margin of targeting imprecision, it is the most operationally feasible method for scaling up quickly in low-data and displacement-affected settings. Over the medium term, structural investments in national social registries and vulnerability databases are essential to allow for more precise tiered subsidies.

Differentiate targeting by technology where supply and demand realities differ.

Uganda's experience showed that uniform refugee-host quotas worked for solar but not for lower-tier clean cooking, which faces additional behavioural and delivery barriers beyond affordability. Future programmes covering both technologies should maintain overall inclusion objectives at the programme level while allowing technology-specific flexibility in quota structures, geographic prioritisation, and channel design.

Deeper subsidies should be reserved for clearly identified vulnerable groups using tightly controlled delivery channels.

Liberia's voucher sub-pilot, Malawi's registry filter, and Niger's UNHCR-mediated identification for displaced households all demonstrate that deeper subsidies are operationally safe where the institutional architecture supports them. Broader and deeper subsidies through open commercial channels raise distortion risk without proportionate inclusion gains.

4.2. Subsidy level

Build a responsive, data-driven framework into the formal subsidy review.

While formal mid-term reviews served as standard evaluation points, the pilots demonstrated that initial subsidy assumptions rarely hold and successful adjustments often rely on specific diagnostic tools. To implement this review process more effectively, future programmes should trigger rapid diagnostic assessments such as

dedicated household affordability surveys and company consultations at the first sign of stalled demand. For example, Liberia successfully deployed a dedicated affordability survey after its first six months yielded very low sales; similarly, Niger utilised socio-economic studies and consultations to introduce a differentiated price tier for FDPs when uniform pricing did not generate expected uptake.

Furthermore, this review mechanism must evaluate both end-user affordability and business operational costs simultaneously. In Uganda and Malawi, targeted reviews identified that high last-mile delivery costs, transport logistics, and inflation were lowering company margins, prompting necessary increases to the cookstove subsidy caps to keep the supply chain functional. Programmes should build contractual flexibility into supplier agreements, ensuring that implementers have built-in authority to swiftly adjust subsidy depths or widen technology coverage, such as when Niger allowed companies to convert unsold Pico-PV allocations into higher-demand SHS without facing extensive administrative delays.

Separate Tier 1 access subsidies from productive-use financing.

While the DSS pilot focused on supporting first-time household access through Tier 1 OGS products, there is growing interest from national governments in expanding Demand-Side Subsidies to include higher-capacity PUE products. This strategic tension was particularly evident during the Liberia pilot, where the government partner (RREA) raised concerns that limiting subsidies to basic lighting could constrain productive energy use and reduce beneficiaries' ability to generate income. However, the pilot evidence suggests that Tier 1 systems remain critically important for reaching the poorest households because they provide affordable first-time access. Productive use systems involve much higher upfront costs, more complex repayment profiles, and stronger links to income generation, which warrant different financing tools such as credit guarantees, working-capital support, or asset finance. Combining both basic access and PUE objectives into a single subsidy instrument risks weakening the focus on the poorest households while simultaneously underserving productive users. Therefore, future scale-ups should treat Tier 1 household access and PUE financing as complementary but distinct instruments.

4.3. Delivery and communication

Assess and build delivery capacity, FM capability, and company readiness before relying on the subsidy to deliver.

Future programmes should evaluate both fund manager capability and company readiness during the initial design stage. Because RBF structures require companies to shoulder balance sheet burdens before being reimbursed, especially when subsidy depths are high, budgets across all DSS programmes should include provisions for upfront contract advances to bridge general working-capital and inventory gaps. The pilots demonstrated this necessity in Niger, Uganda, and Liberia, introducing 30% to 40% upfront advances to prevent inventory shortages and alleviate the liquidity strain caused by verification and reimbursement lags. In contrast, Malawi relied instead on partial advance payments tied to the value of each submitted claim, but when verification and fund manager disbursements were delayed, it created working-capital constraints that led to start-stop selling, as companies depended entirely on these disbursements to restock and continue operations.

Furthermore, when operating specifically in nascent or underdeveloped commercial channels, programmes must provide additional ecosystem support, funding, business development assistance, logistical support, or shared distribution infrastructure. Company-selection thresholds should be calibrated to the reality of the local market, applying due diligence and warranty obligations where commercial capacity already exists, while deliberately lowering entry thresholds and pairing them with intensive capacity-building support where it does not.

Strengthen communication on subsidy duration, eligibility logic, pricing, and, where applicable, the rationale for differentiated prices to reduce price anchoring and fairness friction.

Treat communication as part of market design, not a marketing layer, as messaging shapes expectations, willingness to pay, fairness perceptions, long-term behaviour, and the substance of what is said about duration and pricing matters more than the channel. Crucially, communication strategies must go beyond basic pricing to actively strengthen consumer awareness of their rights, particularly regarding after-sales services and warranties. Evidence from the pilots in Liberia and Malawi demonstrated that while understanding of initial price was generally high, comprehension of warranty terms and after-sales channels remained uneven, leaving beneficiaries confused about how to resolve technical issues. To address this, programmes must embed explicit explanations of warranty conditions, repayment obligations, and subsidy duration directly into agent scripts, customer receipts, community-leader briefings, and mass media.

Furthermore, differentiated pricing models require explicit communication explaining why specific groups pay different prices, how the targeting logic functions, and why the subsidies are temporary. Niger's experience demonstrates that differentiated pricing schemes can be successfully implemented without triggering broad social tension, provided that the institutional infrastructure supports a coherent explanation and the rationale is consistently reinforced through agents, community leaders, and humanitarian partners.

4.4. Verification

Differentiate verification by technology, channel, and operating environment.

While mature solar PAYGo systems provide a strong foundation for customer tracking and repayment monitoring, they still require separate mechanisms to verify baseline eligibility and capture customer complaints. Fast-moving clean cooking retail, however, does not inherently capture this digital footprint and operates on much thinner margins, making universal verification highly burdensome. Clean cooking markets involve faster-moving retail channels, which often result in weaker sales and customer documentation. To address these differing realities, future designs should proactively implement proportionate accountability systems.

Programmes should deploy offline-compatible onboarding tools, such as Kobo, which equip agents to digitally capture customer IDs and sales data in remote, low-connectivity areas and sync the information later. Additionally, to simplify compliance for lower-value transactions, programmes should adapt rules to match retail dynamics as seen in Uganda, where the rules were adjusted to allow up to five cookstove sales per the same National ID and waive strict paper-trail and real-time eligibility checks to prevent operational bottlenecks. Furthermore, programmes should establish clear correction windows, similar to the regularisation rounds used in Niger, to help companies validate legitimate but initially poorly documented claims. While verification workflows must be streamlined for efficiency, maintaining beneficiary data privacy and strict GDPR compliance must remain non-negotiable design constraints throughout the entire data collection process.

Hybrid phone-and-field verification should remain the default.

Phone verification is cost-effective where connectivity exists and unreliable in low-connectivity rural geographies. Liberia's 80 phone and 20 field ratios, with extended field verification triggered below a 75% phone reachability threshold, performed well and are a sensible default starting point. The pilots' structurally independent verification arrangement, including Niger's in-area teams where security restricts travel and regularisation rounds with the Fund Manager for under-documented sales, offered a useful adaptation pattern for similar contexts.

Treat reimbursement-cycle performance as a core KPI.

Programmes should explicitly monitor reimbursement cycle times, claim processing timelines, and business liquidity impacts. Where Fund Manager systems support it, direct integration between Kobo data and Fund Manager reconciliation can remove manual re-entry steps that recurred as a source of delay across the pilots.

4.5. Exit and policy

Coordinate exit with parallel supply-side programmes and institutional frameworks.

Exit is already taking shape through drafted institutionalisation strategies across all countries, which stipulate when, how, and what is handed over to key counterparts. Liberia's pilot is informing and being taken up by LESSAP II; Malawi has a planned knowledge transfer to the MEAP framework; Niger's path is coordinated with the HASKE programme, and Uganda aims to integrate its findings into the EASP. Embedding this work within larger government frameworks aids long-term durability, but this transition should not crowd out development partners. These partners must remain engaged to provide the technical assistance, co-financing, and ongoing ecosystem support needed to bridge the gap between project closure and full commercial sustainability.

Because development programmes operate within fixed project cycles and cannot simply delay their exit until perfect market readiness is achieved, transition pathways must be built into the core design from the beginning. While programmes cannot always wait for fully unsubsidised commercial sales to emerge, they must focus their limited timelines on leaving behind resilient local distribution networks, capable companies, and functional after-sales channels that can persist beyond the subsidy.

Define and communicate the exit pathway from the beginning.

Subsidy duration, tapering rules, funding limits, and post-subsidy pricing expectations should be defined before launch and communicated consistently to companies, agents, community leaders, and beneficiaries. Communication strategies must frame the intervention as a formal, time-bound programmatic scheme because presenting steep discounts without this context triggers consumer scepticism and undermines long-term market credibility. Furthermore, publicly declaring the programme's existence is operationally essential for RBFs, as beneficiaries who know they are part of a monitored, subsidised initiative are more cooperative during independent phone and field audits. Where full exit is unrealistic because poverty is structurally deep, distinguish time-bound market-activation subsidies from longer-term social-protection subsidies for groups that cannot be served commercially. This distinction reduces long-term price anchoring, protects commercial willingness to pay, and avoids unrealistic pricing expectations among customers and companies.

4.6. Market development and ecosystem support

In nascent markets, pair DSS with supply-side support and evaluate it by its effects.

Future programmes should budget supply-side support as a core cost from the start and set out how programme-built delivery structures will hand over to commercial operators. The toolkit includes transport and distribution subsidies (which can be allocated by reverse auction), business development support, and working-capital and inventory finance. Critically, this support should be evaluated by its effect rather than its delivery, whether it changed company behaviour, improved business liquidity, reduced delivery costs, expanded reach into underserved areas, or enabled better terms (lower prices, longer tenors, lower collateral) for customers.

This blend comes with trade-offs that should be weighed openly. Money spent on the supply side is money not spent reaching households directly, and it adds to the fund manager's administrative load. It also depends on companies' willingness to report on supply-side activity, which cuts into the operational independence they would otherwise have under a pure demand-side arrangement.

Coordinate with humanitarian actors from the design stage to manage inherited price expectations.

In displacement-affected markets, market distortions are often driven by the legacy of past interventions just as much as by overlapping ones. Lingering expectations from previous free distributions strongly shape customer willingness to pay and can undercut emerging commercial markets. To mitigate this risk, implementers must align with humanitarian partners upfront on pricing principles, the timing of any free distributions, beneficiary overlap protocols, and joint messaging strategies. Proactively addressing these inherited expectations from the outset is essential to protect emerging supply chains and prevent unintended disruption of the commercial market.

Explore complementary results-based mechanisms (including carbon finance) to support long-term clean cooking sustainability.

Long-term affordability challenges will persist beyond donor-funded DSS programmes, particularly in clean cooking, where willingness-to-pay remains constrained despite high product appreciation. Carbon finance aggregation platforms and bundled results-based financing mechanisms could help offset customer subsidies, delivery costs, or after-sales support. These mechanisms are most established in clean cooking and offer a credible bridge towards longer-term commercial sustainability.

Link the poorest households with no reliable payment capacity to non-market channels.

Market-based subsidies can improve access for low-income households with some payment capacity, but cannot reach households with no reliable income. These households should be supported through coordinated humanitarian, social-protection, or grant-based mechanisms, working with actors such as UNHCR, OPM, and social ministries alongside the demand-side instrument.

Invest in upstream supply-chain capacity for clean cooking.

The Malawi pilot showed that demand subsidies cannot resolve seasonal production collapse or uneven regional distribution of SPGs. Future cooking programmes should consider direct investment in climate-resilient production infrastructure (improved kilns, solar-assisted drying sheds), longer-term bankable subcontracts with SPGs, and quality-assurance technical assistance. These investments shift the focus from buying units to building capacity and require longer implementation timelines but address the binding constraint directly.

5. Conclusion

Across the four pilots, demand-side subsidies lowered affordability barriers and produced clear welfare gains, but their effect depended on the readiness of the surrounding energy ecosystem. A consumer discount rarely worked on its own, as weak distribution networks and upstream production bottlenecks regularly stopped subsidised demand from becoming delivered units, so successful pilots paired the subsidy with supplier financing, logistics support, and verification systems adapted to local conditions. Because these supply-side constraints vary by sector, solar and clean cooking needed different delivery models, risk frameworks, and transition timelines rather than a single template. Affordability, too, proved to be an ongoing condition shaped by seasonal and volatile incomes rather than a one-time hurdle cleared at the point of sale.

The main threats to market health were behavioural and operational rather than conventional fraud or leakage, mainly price anchoring and distributor-liquidity pressure. These same pressures mark the limits of the instrument: market-based subsidies cannot reach the ultra-poor or displacement-affected households that have no reliable income unless they are paired with social protection or humanitarian support.

The next phase should move from standalone pilots towards larger initiatives embedded in national frameworks, treating the current institutional setup as an evolving system rather than a finished one. That means building on the relationships established between implementers, governments, and private suppliers while fixing the friction points the pilots exposed, particularly reimbursement delays and humanitarian-coordination gaps.

Ultimately, demand-side subsidies present an opportunity to expand inclusive energy access and drive market development at the last mile. Provided they operate beyond retail price discounts and are dynamically adapted to local market maturity, technology constraints, and institutional funding realities.