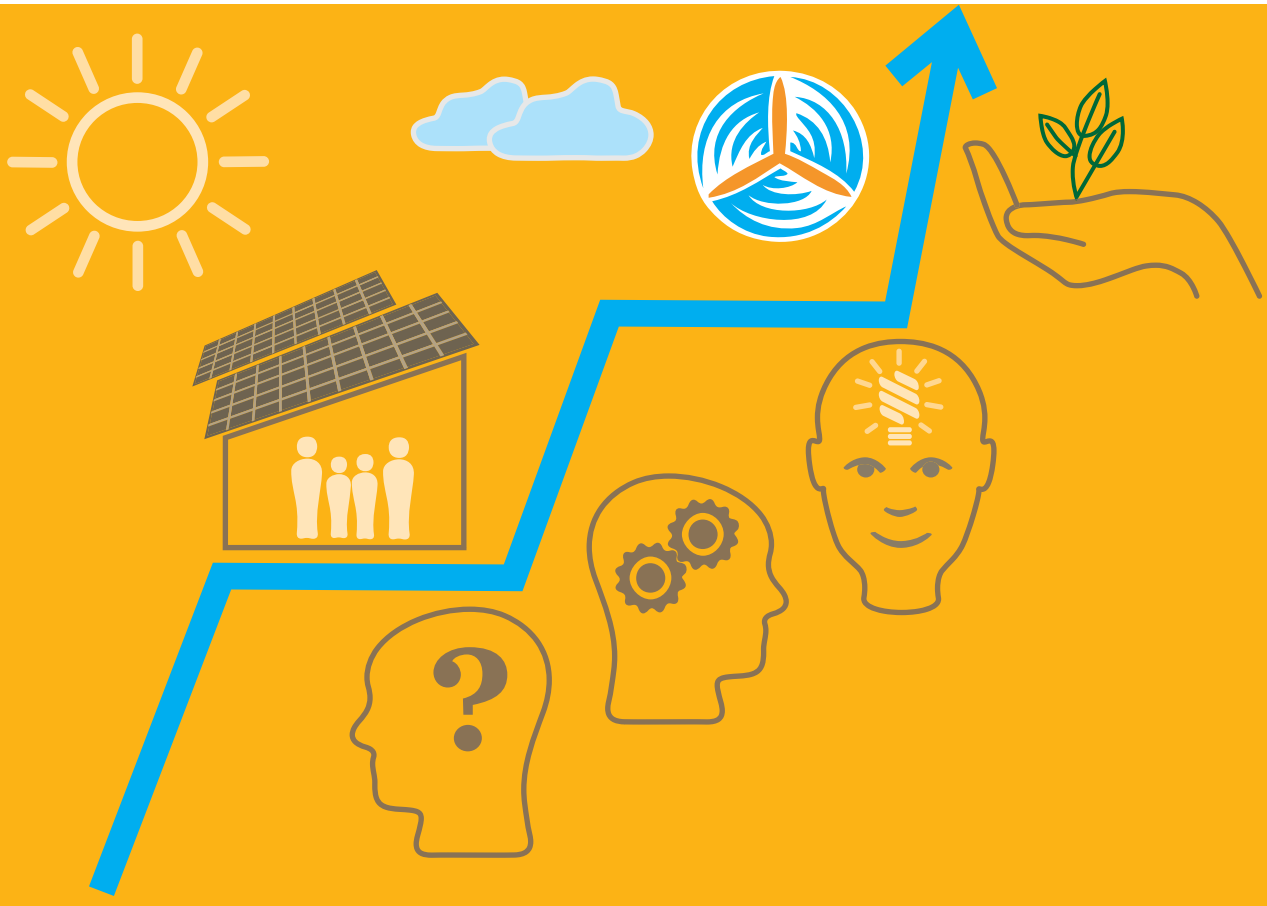
EDM ENERGY DELIVERY MODELS



Planning pro-poor energy services for maximum impact:

The Energy Delivery Model Toolkit

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ACRONYMS and ABBREVIATIONS:

AMAN	Aliansi Masyarakat Adat Nusantara (Indigenous Peoples Alliance of the Archipelago)
BAPANAS	Ministry of Development Planning
CAFOD	Catholic Agency for Overseas Development
EDM	energy delivery model
FGD	focus group discussion
HH	household
IESR	Institute for Essential Service Reform
IIED	International Institute for Environment and Development
IEA	International Energy Agency
MEMR	Ministry of Energy and Mineral Resources
NGO	nongovernmental organisation
PLN	Perusahaan Listrik Negara (Indonesian state electricity company)
RP	Indonesian Rupiah
SHS	solar home system
VP	value proposition

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Abstract

Access to modern energy services is vital for poverty alleviation and human development. The Energy Delivery Model (EDM) project is a collaboration between CAFOD and IIED, aiming to build understanding of the enabling factors and barriers to delivering energy services for poor groups, learning from practitioner experience and research. This report introduces the EDM toolkit, a six-step process with two innovative tools for inclusive planning of energy services.

The toolkit aims to ensure services are appropriate to the local context, meet end users' development needs and are financially, socially and environmentally sustainable, maximising their impact. The report summarises the process of testing the EDM approach with partners in Indonesia. It outlines the learning from this experience, including wider insights into improving the sustainability and scalability of last-mile energy services and the costs of sub-optimal service design and delivery that merit further research and analysis.

Executive Summary

Delivering energy services to the billions of poor and marginal people living without modern energy is particularly challenging given the multi-dimensional impacts of energy poverty, and its relationship to other development challenges. Equally, there is a growing awareness of the potentially transformative benefits of delivering universal access. This can be seen most notably in the adoption of the new Sustainable Development Goal (SDG) 7 on universal access to energy by 2030, also recognised as playing an important role in delivery of SDGs on health, education, gender equality, climate change and so on.

Understanding that lack of energy is a symptom of a much wider and more complex set of deprivations means pro-poor energy services must help address the wider socio-economic needs of poor groups (who are sometimes referred to as the 'end users' of the service) living in different socio-economic contexts.

The record of business-as-usual, top-down energy planning approaches in adapting services to heterogenous contexts and delivering such wider development impacts is being increasingly questioned by practitioner experience. However, to date, these insights have not translated into the widespread adoption of more innovative, locally appropriate and inclusive approaches to energy planning, either internationally or at the local level.

Some researchers and practitioners have developed the concept of the 'energy delivery model' to describe the core set of activities and actors that constitute the energy service, and to highlight the importance of understanding end-user' needs, the energy and non-energy gaps preventing them being met, and the supporting services required to make the energy infrastructure sustainable. This concept also stresses the importance of considering wider enabling-environment policies, additional supporting services and 'softer', socio-cultural factors when designing and delivering energy services for poor groups. Research and experience shows that these additional activities, resources and support are often critical to address end users' priority needs, while socio-cultural factors can 'make or break' a service.

In 2013, the Catholic Agency for Overseas Development (CAFOD) and the International Institute for Environment and Development (IIED) began collaborating on developing and testing the 'Energy Delivery Model' (EDM) approach, systematically applying and building on existing knowledge on designing energy services for poor groups. Ultimately the aim was to try to reduce the risk of failure or sub-optimal energy service delivery, and to maximise impacts across different levels of end users' household, community and economic needs. The findings of this three-year collaboration between CAFOD, IIED and local partners are described here.

The report begins by outlining the underlying rationale for the project and describing the EDM participatory design approach, which starts with understanding the wider development needs of end users, rather than immediately with designing an energy service. The aim is for end users to identify and prioritise their development needs and to build a shared understanding of what role an energy service could play in meeting these needs (the 'energy gap(s)'). They must also understand what other 'non-energy gaps' exist and identify all the stakeholders whose participation will be needed to deliver an energy service service and meet their priority needs. The end users then analyse systematically the local context, resources and wider enabling environment factors and develop potential solutions– including an energy service or services. To be viable, these solutions

must be financially, socially and environmentally sustainable and maximise development impacts for the end users.

A case study is then used to describe how the EDM approach was tested on the ground in Indonesia, in collaboration with two local partners, the Institute for Essential Services Reform (IESR) and the Indigenous Peoples Alliance of the Archipelago (AMAN), and a community living in a remote part of Flores Island in East-Nusa Tenggara (NTT) Province. NTT Province was chosen because it has the highest levels of energy poverty in Indonesia, and because the region is being targeted by national and local government as a priority area for accelerating energy access.

The EDM design process in Indonesia led to the further development of the 'Energy Delivery Model Toolkit'. This consists of a six-step participatory design process supported by two innovative tools (the Delivery Model Map and Canvas). The toolkit can be used by project/service developers and end users not only to design new energy services but also to review existing projects/services and to inform more effective design of future energy services.

The report concludes by reflecting on the most important learning from the EDM process to-date for future energy service design, and summarises the challenges. It also highlights wider insights generated during the design process, further research and stakeholder engagement regarding the sustainability and scalability of last-mile energy services, and costs of sub-optimal service delivery or failure, that merit further research and analysis.

The challenges experienced during the design process include the fact that it can be resource - and time - intensive due to its iterative and inclusive nature. However, this must be weighed against the risks of designing an unsustainable solution, and the costs of potentially sub-optimal service delivery or even failure. Another challenge is managing community expectations around implementation of the EDM. One potential way to deal with both challenges is to better understand the development benefits of successful energy service delivery and integrate it into planning of wider development interventions by NGOs, local governments or other actors.

Finally, service planners and developers must have a trusted relationship with the target end users, a deep knowledge of the local context, and facilitation and other 'soft' skills to support partners through the EDM's problem-solving process. This points to the potential benefit – and cost-effectiveness – of organisations building institutional capacity to use the EDM for multiple projects.

The key learning from the project can be summarised in the following two points:

1. **The process of designing the service is as valuable for the end users as the final output – the delivery models/solutions - because it builds community buy-in and shared understanding of end-user development needs. This also leads to more effective communication of these needs to other stakeholders. By 'learning by doing', end users' problem-solving skills are also developed.**
2. **Holistic approaches to designing an energy service that starts with end users' development needs, such as the EDM, can result in greater impacts for the end users. If synergies are identified between different solutions, they can deliver on multiple needs, with the final energy service(s) resulting in wider community benefits.**

Wider insights generated during the EDM process in Indonesia are, firstly, that business-as-usual, top-down planning approaches are not optimal for last mile energy services. Service failure or under-performance occurs frequently and has social as well as financial costs. This includes longer-term negative impacts on the uptake of particular energy solutions. For these reasons, some stakeholders expressed an interest in using the EDM toolkit to review existing projects/services that are performing sub-optimally, with a view to improving their sustainability and impacts. In addition, stakeholders delivering services to poor and marginal groups in other development sectors highlighted the potential of adapting the EDM toolkit to design more sustainable interventions in these areas.

Secondly, one way to offset the upfront investment and perceived high transaction costs of using more context-specific and inclusive planning approaches to design and deliver last-mile energy services would be to understand better - and factor into the planning process - the costs of sub-optimal performance and service failure. This includes what has been called the "energy access opportunity costs" in terms of under-development of the end-user communities. These insights could form the basis of a future action research agenda focussed around the following key questions:

1. **Can participatory planning processes and tools such as the EDM approach build the scalability and sustainability of energy services, particularly for last mile end users?**
2. **What are the financial, social and overall human development costs of sub-optimal service delivery or failure?**
3. **Can such innovative, participatory planning approaches be of benefit in designing other development interventions?**

In terms of next steps for the EDM approach, CAFOD, IIED and IESR will be taking forward work with partners in Indonesia, and CAFOD and IIED will be beginning a new collaboration with partners working at county level in Kenya in 2018. We would welcome further feedback and potential collaboration with other groups interested in using participatory or 'people-centred' planning approaches for energy service delivery, as well as ideas for ongoing sharing of practitioner experiences.

Introduction

Delivering energy services to poor and marginal people is particularly challenging. Globally 3.8 billion people cook with polluting fuels and stoves, leading to major health impacts – mainly on women and children. One in five people (1.06 billion) do not have access to modern electricity.[1] Most live in sub-Saharan Africa and developing Asia, almost all in remote, rural areas that are far from electricity grids.[2] Eighty-four per cent of the 1.06 billion people globally without access to electricity live in rural areas and, in most cases, would be most easily and cost-effectively connected through decentralised renewable energy solutions (DRE).[3]

There is an increasing recognition of the multi-dimensional impacts of energy poverty, its context-specific nature, and its relationship to many other development challenges including gender equality, access to health and education, and inclusive economic development. Energy-poor people are not only marginalised geographically but usually disconnected from other services and wider social and economic opportunities. These multiple forms of marginalisation are also often present where poor people live in the middle of cities, in informal settlements with little or no access to the services and opportunities enjoyed by other city dwellers.

Equally, there is a growing awareness among policy makers and development practitioners of the potentially transformative benefits of access to modern energy – and the costs in terms of lost human development opportunities due to energy poverty.[4] This is expressed most notably in the adoption of the new Sustainable Development Goal (SDG) 7 on ensuring access to affordable, reliable, sustainable and modern energy for all by 2030. Recent research by Sustainable Energy for All (SEforAll) and others has quantified for the first time the 'energy access dividend', or direct and indirect development impacts from access to modern electricity across a range of sustainable development goals (SDGs).[5] These include the goal to "end poverty in all its forms" (SDG 1) and to "reduce inequality" (SDG 10), both directly and indirectly. Higher expenditure on goods and services contribute positively to other SDGs, such as, "ending hunger" (SDG 2) or ensuring "healthy lives" (SDG 3). Additional time spent studying at home contributes to the goal of "inclusive and equitable education" (SDG 4). The research also shows that these benefits can be delivered through faster, lower-cost deployment of decentralised rather than grid-based electricity solutions.

Access to higher levels of power for community services and productive uses is key for building resilient and inclusive local economic development, including creation of decent green jobs.[6] There are also considerable co-benefits for climate action from deploying decentralized renewable solutions, as well as local environmental benefits – for instance reducing deforestation by shifting from cooking with polluting solid fuels to clean solutions (International Energy Agency (IEA), 2017).

1. The World Bank and the International Energy Agency (IEA) (2017).
2. IEA (2017). According to the IEA's projections, by 2030 "roughly 600 million of the 674 million people still without access are in sub-Saharan Africa, mostly in rural areas."
3. The World Bank and IEA (2017).
4. See www.powerforall.org.
5. Sustainable Energy for All, Power for All and Overseas Development Institute (2017). The research shows that there is sufficient data to quantify benefits in terms of financial savings, climate change protection and education from access to lower tiers of energy access. However, it also highlights 'the limitations in data for productive and public community-based uses of energy, and the lack of evidence to disaggregate benefits for higher Tiers of energy service' (Tiers 3 to 5 of the Multi-Tier Framework for measuring energy access developed by the World Bank).
6. IEA (2017). See also CAFOD & Christian Aid (2017).

Given these factors, energy cannot simply be treated as a utility. Lack of affordable, reliable and safe energy is a symptom of a much wider and more complex set of deprivations, and delivering energy access must be seen in relation to how it can contribute to meeting the wider socio-economic needs of poor groups (sometimes referred to as the 'end users' of the energy service). Often poor people need energy for a range of different functions, and an energy service can act as a bridge enabling household, community and economic activities. A pro-poor approach to delivering energy services would therefore be one where the energy service has a wider 'development impact', that is, it helps to lift people out of poverty by creating new opportunities to improve their well-being in a way that is financially, socially and environmentally sustainable.

In addition, there is a growing realisation that top-down, business-as-usual approaches will not deliver services appropriate for the heterogeneous needs and contexts of people living in energy poverty, or achieve universal access by 2030 that 'leaves no-one behind', as evidenced by the slow progress to date – particularly on clean cooking access.[7] A multi-stakeholder effort is required that moves beyond 'one-size-fits-all' to develop innovative approaches and business models for energy service delivery. As the IEA's *Energy Access Outlook 2017* states: *"It is vital that policy-makers engage a wide array of stakeholders, including the private sector, align government policies and objectives with local level policies and dynamics and support capacity-building at the community level to ensure that the energy access solutions delivered are absorbed and maintained long term."* (IEA, 2017)

To date, however, these insights have not translated into the widespread adoption of innovative, inclusive approaches to energy planning that focus on tailoring services to local contexts, either internationally or at the local level. This is one reason why the Sustainable Energy for All initiative has developed the *People-centred Accelerator*, which aims to advance gender equality, social inclusion and women's empowerment in the energy sector. One of the four goals of the Accelerator is *"to enhance and extend the provision of sustainable modern energy to the very poorest people in society who will not be reached by business-as-usual approaches. This will include: identifying and promoting scalable models of private and public energy provision that address access and affordability challenges, including through social welfare and social protection; and, behaviour change focused interventions to ensure adoption and sustained use of modern energy solutions."* (SEforAll, 2017b)

Some researchers and practitioners have developed the term 'delivery model' to refer to the core set of activities, inputs, and actors needed to deliver the energy service – which includes supporting services for the delivery infrastructure – and suggested that attention must be paid to enabling- environment policies and socio-cultural factors in designing and delivering services (Wilson *et al*., 2012). Consideration of the socio-cultural context in the planning or design phase is essential, as this can make or break delivery of a successful energy service (most often expressed as the difference between the end users' **willingness** to pay for a service, as opposed to their **ability** to pay for it). Further practitioner experience also suggests that a range of other

7. The World Bank and IEA (2017), IEA (2017).

interventions in addition to an energy service are usually crucial if poor end users' needs are to be met sustainably. This range of supporting services/resources must be considered when planning energy service delivery for it to have long-term development impact.

Building on these insights, in 2013 the Catholic Agency for Overseas Development (CAFOD) and the International Institute for Environment and Development (IIED) began collaborating on an approach to designing energy services for poor groups, called the 'Energy Delivery Model' (EDM) approach (Bellanca and Garside, 2013). The starting point was that lack of energy is a piece of a wider development puzzle and providing an energy service is only one of the solutions needed to solve that puzzle – and sometimes only a small piece. Our aim was not to replace the existing expertise of organisations delivering energy services to poor groups, or provide another 'one-size-fits-all' approach, but rather to build on and systematically apply existing knowledge and experience, making a useful contribution to the toolbox used by energy service providers/project developers.

The EDM approach is a participatory process that works with the end users of the potential service to identify their priority development needs, and then brings them together with stakeholders to analyse the local context, resources and wider enabling environment, to design a sustainable service. The aim is to maximise impacts across different levels of end users' household, community and economic needs, reducing the risk of a sub-optimal service – or failure - during implementation, and ensuring end users' priority needs are met.

This report outlines the findings of three years of developing and testing the approach on the ground with a community living in a remote part of Ende District, Flores Island in East-Nusa Tenggara (NTT) Province in Eastern Indonesia – the region with the highest levels of energy poverty in the country. Partnering with CAFOD and IIED on this project were two Indonesian organisations, the Institute for Essential Services Reform (IESR) and the Indigenous Peoples Alliance of the Archipelago (AMAN).

The case study describes the EDM design process in Boafeo community and how during this process the approach was refined to produce the 'Energy Delivery Model Toolkit'. This toolkit consists of a six-step participatory design process supported by two innovative tools (the Delivery Model Map and Delivery Model Canvas) that can be used to develop an energy service by project/service developers and end users. It can also be used to review or reflect on existing projects/services. As such, the EDM can help articulate the original 'value proposition' of the project/service, analyse the extent to which its intended impacts have been achieved – and identify any non-intended impacts – and recommend improvements. It can also generate learning to inform more effective design of future energy services.[8]

Section 1 describes in more detail the rationale for developing the EDM approach; explains the different aspects of the energy delivery model; and discusses why it is crucial to consider the enabling environment, local context and socio-cultural factors when designing an energy service.

8. The EDM approach has been used to analyse a solar lantern distribution project in Nigeria (IIED and Stakeholder Democracy Network, 2016) and a greenhouses horticulture project in Kenya (Garside and Wykes, 2017).

Sections 2 and 3 explain the six steps of the EDM design process and the two innovative tools that support the design process, the Delivery Model Map and Delivery Model Canvas. A selection of other tools that can support each step of the design process are included in **Annex 1.**

Sections 4 to 7 guide the reader through the six steps, using as a case study the EDM design process in Boafeo community in Indonesia.

Section 8 reflects on the learning and challenges from the EDM process in Indonesia and highlights wider insights about the role of participatory planning approaches in ensuring energy services – or other development interventions – targeting poor groups are sustainable and scalable that merit further research and analysis.

1. Why a pro-poor approach to energy services and what is an 'energy delivery model'?

As discussed in the introduction, years of research and practitioner experience on the ground delivering energy services to poor and marginal groups – successfully and unsuccessfully – show that, for an energy service to deliver wider development impact for a target group of end users, a people-centred, participatory approach to **designing** the service is essential.

The starting point for any pro-poor energy service design is breaking down the target group into different groups of end users and understanding their wider development needs and wants, as well as their specific socio-economic and cultural context. In situations where resources are often highly constrained, end users must be supported to identify which needs are their top priorities, as service planners are unlikely to be able to deliver everything people want.

When identifying development needs, it is important to describe them in terms of the ultimate impact to be achieved. One of the initial steps of the EDM process (see Section 2) is working with the target group of end users to build a shared understanding of their needs, and to agree which are the priorities. What is preventing these needs being met – the gaps – and what role could an energy service play in meeting them? In other words, is there an **'energy gap'**? For instance, a community might want lighting for their homes so that they can carry out leisure or work activities at night; or lighting and heating for the primary school to improve the students' lives and educational outcomes and help teacher retention; or power to refrigerate medicines in the local clinic so children can be vaccinated; or to provide power for farming so farmers can generate more income for their families.

However, providing an energy service may not meet the priority needs identified – or at least not in isolation. Meeting priority needs might only be possible when other services and resources are put in place. For instance, if the priority need identified is for primary-school children to get a better education, supplying light to a school will not fulfil this need by itself – especially if the school does not have other infrastructure or resources in place (such as books, desks or chairs, trained and motivated teachers and so on).

In addition, an energy service must be appropriate to the local context to produce long-term development impact. This means it must not only fit the physical environment and natural resources available, but also be a good fit with the social context, that is, with the end users' customary ways of behaving – themselves embedded within wider social and cultural norms, values and expectations. Factoring in from the outset the potential social – and environmental – costs and benefits of an energy service is just as important to ensuring its long-term viability as making sure there is sufficient funding for the delivery infrastructure (the technology and equipment) and a workable payment scheme to keep it operating (see **Box 2**).

The term 'energy delivery model' is often used to refer to the various activities, inputs and resources needed to deliver an energy service to a target group of end users. The stakeholders can include, for instance, the businesses or organisations who will supply, install, maintain and repair the delivery infrastructure; the banks or other institutions who will finance it or administer the payment systems for operating it; the local government officials who will give the legal permits for the service and so on. It is very important when designing the service to understand the interests of these different stakeholders in participating in the energy delivery model, to address upfront any potential challenges or opportunities. For instance, delivering the new energy service could be

a potential threat or benefit to an existing energy supplier or other business. The energy delivery model approach purposefully attempts to be inclusive, identifying and engaging when appropriate all the different people and organisations (the stakeholders) whose participation will be needed to deliver the energy service successfully.

In addition, using the term 'energy delivery model' highlights that **other types of activities, resources and support** that are not necessarily part of the energy service per se are often critical to meet end users' priority needs. So, if the priority need is better education for the primary-school children, an energy service (eg a solar lighting system for the school) will need not just a maintenance and repair function to be sustainable, but *other types of support* (books, desks, teachers and so on) may be needed to ensure this service helps meet the need prioritised by the community (namely, their children getting a better primary-school education).

Finally, the important role played by socio-cultural factors in helping or hindering the delivery of the energy service is often overlooked by those designing a service. This refers to the customary ways of behaving and doing things: the norms, values and attitudes of a group of end users and wider stakeholders. For instance, in one community or region, people may not feel comfortable participating in activities related to the operation of the energy service unless certain community leaders give the go-ahead, or may prefer carrying out activities in a certain way. Understanding these preferences, for example getting buy-in from a certain leader or leaders at the outset, could impact just as much on the success of the energy service as having the right government permits and technical specifications for the delivery technology and equipment.

The other activities and support outside the actual energy service itself usually fall into the following categories, which are discussed further on page 14 (see also **Figure 1**):

- The 'enabling environment' – the formal policies and legal frameworks and existing political and legal infrastructure that support the delivery of goods and services: in this case, energy services
- The 'socio-cultural context' – the social and cultural values and capacities of the community and other actors in the supply chain, linked to their local context
- 'Supporting services' – any additional support needed to address weaknesses or gaps in the enabling environment, or socio-cultural factors that need to be considered for the service to work (in a given context).

BOX 1: The aims and principles of a pro-poor energy delivery model

- It is designed to have a positive human development impact: for instance, it results in health, education and livelihood benefits for poor and marginal end users.
- It is the product of discussion and negotiation with the end users and with multiple stakeholders. This results in a shared understanding of what the energy service aims to deliver (and what it will not), and agreement on how it will be implemented and monitored.
- The energy technology is appropriate to the context (ie it can be locally managed and maintained) and can meet the energy needs and wants of end users.
- It is financially sustainable over its entire life cycle (with all required support factored in from the outset).
- It is environmentally sustainable and socially inclusive, with robust evaluation of potential environmental and social impacts during design, mitigation of risks and ongoing monitoring of impacts during implementation.
- Ideally, it is adaptable to different contexts and can be scaled up, so that greater numbers of people can be lifted out of energy poverty.

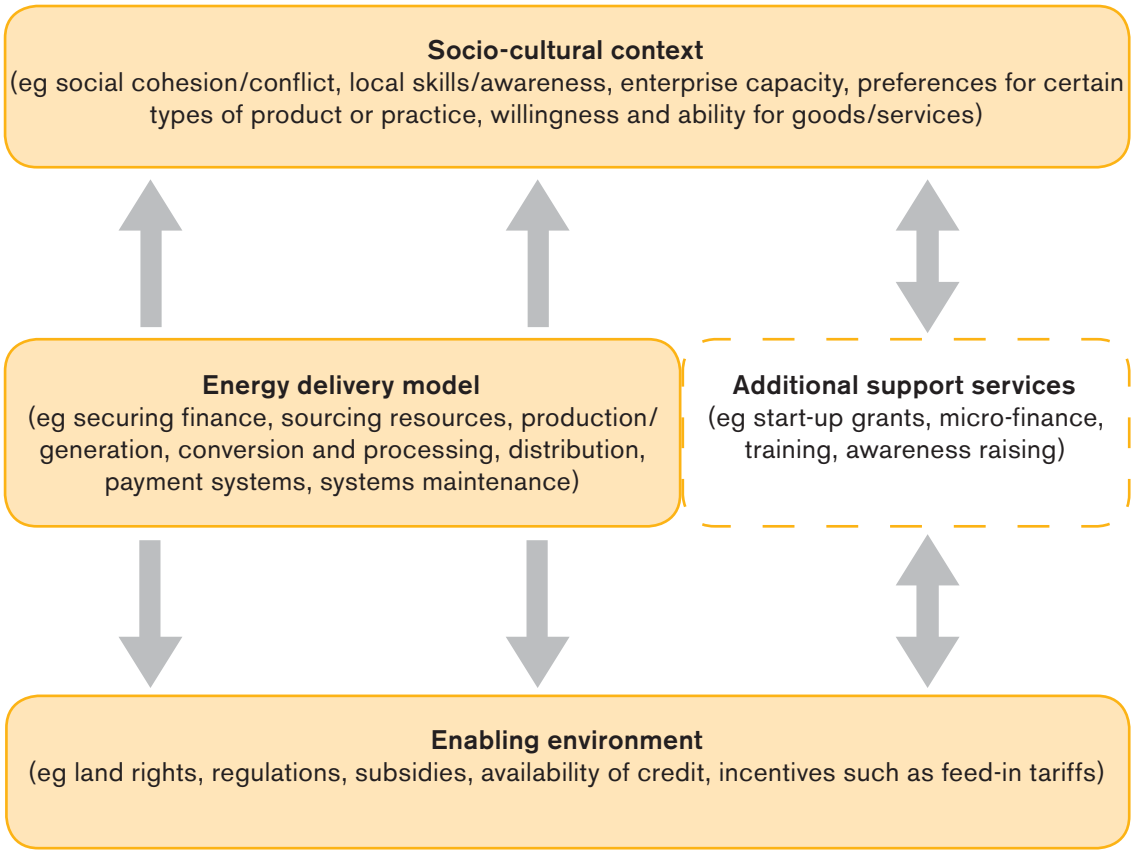
1.1 A closer look at the energy delivery model

Delivering an energy service starts with the harvesting/extraction of the energy source or fuel, and includes each phase of energy delivery – technology design and installation, processing, distribution and marketing – to the final use of the energy, which is usually made possible by conversion equipment and appliances. It covers the governance, management and ownership structures of the different parts of the energy supply chain, as well as the various financing and payment systems.

A range of different actors can be involved in the energy service, including the private sector; state representatives (such as national and local government); civil society organisations (nongovernmental organisations (NGOs) and community-based organisations (CBOs); financing agencies (banks or development organisations) and so on. Each of these actors has different reasons for participating (or not) in the specific energy service, depending on its role and incentives. Changing the design of the energy delivery model will probably alter these roles and incentives.

Figure 1 illustrates the core energy delivery model or energy service that must operate in a real-world situation or context. This context is divided logically into what Wilson et al. refer to as the enabling environment and the socio-cultural context (Wilson *et al*. 2012). The core energy service itself may also require additional external supporting services or additional activities that need resourcing (for example, securing permits or tax exemptions for the supply of a certain technology, access to finance where it is difficult for energy businesses to access capital and so on).

Figure 1:
Map showing the four building blocks of delivering an energy service and how they relate to each other (Source: Wilson *et al.*, 2012)



1.1.1 The enabling environment

This usually refers to the governmental structures, regulations, policies and incentives that support – or can impede – the delivery of energy services. It includes:

- **Economic policies and laws** (eg trading and quality standards; benchmarking and standardisation of energy technologies; rights of access to natural resources; property and land tenure laws; tax and tariff regimes; business regulation; tax exemptions; and government incentives)
- **Institutional arrangements** (the government agencies that control different aspects of the energy supply chain; and political economy and governance issues such as the level of transparency in the energy sector, leadership and effectiveness of different ministries, the existence of independent oversight and corruption risks etc.)
- **Local and national infrastructure** (transport and communication systems, electricity grid coverage and the challenges of delivering energy services to the most remote communities – the 'last mile')
- **Consumer trends and tendencies** (eg energy prices and international or regional trade regulations)
- **Natural resource endowments** (eg the potential for solar radiation, wind, geothermal wells, and existence of fossil fuel resources)

Many of these factors are beyond the direct control of the actors involved in designing a delivery model for a target group of end users, but they will influence its design. For instance, the natural resources that are available in a location (solar, wind, fossil fuels etc.) cannot be changed. It is also difficult to influence global trends such as fuel prices, international trade regimes, and so on. Sometimes it is also difficult to influence – at least in the short term – national and local institutional arrangements and governance factors such as public transparency.

However, many important aspects of the enabling environment can potentially be influenced through awareness-raising and advocacy with government and other actors. These include: economic policies, laws and implementation strategies; professional trading and quality standards and product standards (safety, quality etc.); rights of access to natural resources; property and land tenure regulations; tax and tariff regimes and exemptions; business regulation; government incentives; national and local infrastructure development; and many governance issues.

1.1.2 The socio-cultural context

An energy service is designed to meet the needs of people who live a specific location and socio-cultural context. Values, customs, attitudes and ways of behaving often differ according to context. It is important to take these socio-cultural factors into account when designing an energy delivery model as they can impact either positively or negatively on its success.

There are several aspects to the socio-cultural context. First, there are the norms and behaviours of the end users including:

- Their preferences for specific goods and services or ways of doing things (eg ways of cooking and eating food)
- The level of education of both individual end users and the community as a whole
- The average income, and how much income levels vary within the community
- The expectations and experience that different community members have of different forms of technology (eg mobile phones) and of how services are delivered (such as whether they are accustomed to using mobile phone banking, or whether they are used to having services provided by a state electricity company or private company etc.

This also includes more intangible factors, such as:

- Their expectations of, and level of trust in, delivery of services (do they expect services to be reliable and work well or not?)
- Their willingness to pay for services (as opposed to their ability to pay)
- Their awareness of different energy technologies and services
- How conservative/progressive the community and individual members are generally towards the introduction of new technologies and new ways of doing things.

Second, the term 'socio-cultural context' means the social structures and social organisation of the end-user communities. This includes:

- Community and wider leadership and power structures
- The experience of and preference for forming private businesses, or working with shared/participatory ownership models and cooperatives
- The level of social cohesion or conflict within the community
- Community members' skills and capacities
- Gender relationships, and particularly the status and role of women within the community.

The likely success of an energy delivery model will be influenced by some, many, or all these factors. The socio-cultural context will affect not just whether the delivery model itself will work long-term, but whether it will succeed in getting different stakeholders to participate in the design, generation, distribution and support of the energy service.

BOX 2: The Anagi cookstove: why understanding the socio-cultural context and enabling environment can be critical for success[9]

One cookstove programme that is broadly considered to be successful is the Anagi initiative in Sri Lanka. Here, the activities of key partners (national and international NGOs, local entrepreneurs, donors and government agencies) ultimately succeeded in facilitating a commercially viable local market for energy-efficient Anagi stoves. About 300,000 stoves are now produced each year and sold for as little as US$1.40, reaching about 15 per cent of the population of Sri Lanka.

The Anagi stove programme shows the importance of taking time to understand the socio-cultural context, local cooking practices and preferences for cookstove functions when designing products and services. In this case, in-depth participatory market research was used, which fed directly into the product design. Another important enabling-environment factor in the success of the Anagi stove was the government's willingness to use subsidies strategically to stimulate its early adoption.

The Anagi stove programme owes much of its success to the promoters' readiness to be flexible in their approaches and to learn from experience. The programme strategy changed several times in response to the lessons learnt over three decades of interventions. One of the programme's most significant innovations was the development of the product, which was a key element of its value proposition. Instead of simply designing a technically efficient stove and attempting to distribute it, extensive market research was undertaken prior to roll-out with potential users, to develop a product that would be adopted, valued and used locally on an ongoing basis. Different NGOs and governmental agencies came up with their own designs, whose efficiency, cost effectiveness, durability and usability were compared through laboratory and field tests carried out under the auspices of the Ceylon Electricity Board.

The Anagi stove emerged as the eventual winner of this market research process, not because it was the most fuel-efficient stove but because it was most acceptable to users. The first Anagi model was considered too awkward by both producers and sellers, and the more user-friendly Anagi 2 model was finally adopted. This shows the importance of balancing external priorities (in this case, fuel efficiency promoted by the government, NGOs and donors) with local preferences, and allowing potential users a say in product development.

Subsidies and a one-month warranty were used to encourage early adoption after the design stage, although the users' subsidies were later withdrawn. Another important factor was the flexible approach taken to cookstove production. Initial efforts focused on having the stoves made in large, formal tile factories, to take advantage of economies of scale and ensure high-quality production. This proved unviable, as the tile-making companies already had profitable businesses and little reason to carry on producing the cookstoves once the additional programme support was withdrawn.

9. Adapted from Wilson *et al.* (2012)

BOX 2 *continued*
In addition, the artisanal potters brought into the factories did not like the highly formal and rigid working environment, preferring the independence of the informal economy. In contrast, efforts to support producers in five villages with a long tradition of pottery were far more successful. These producers were granted loans to meet their capital costs, given technical and business training, and provided with free moulds and templates to ensure quality control. Some 83 per cent of the Anagi stoves produced in Sri Lanka are now made in these five villages.

Giving users and producers a say in developing the product was central to the success of the Anagi stove. This highlights the importance of maintaining good relationships with end users and other stakeholders, and seeking key local partners for the delivery model to enhance its development impact. As production and demand for the stoves increased, distribution channels were established through linkages with wholesale buyers and retailers that already serviced the market for ceramic products.

1.1.3 Supporting services

The ideal context for delivering energy services to poor communities is where there is already a functioning energy market, that is, where there are proven energy technologies and the enabling environment is sufficiently supportive (for example, banks provide affordable credit to businesses and consumers, the government has put in place appropriate incentives for delivery of energy services and there is good-quality transport and communications infrastructure).

This would also include a favourable socio-cultural context (for example, people are able and willing to pay for the energy service – or support is available for poorer groups; there is a high level of awareness about different energy technologies and services; there is a good level of social trust in the community; and so on).

However, delivering energy services to poor communities often involves overcoming barriers due to a weak enabling environment and the wider socio-cultural impacts of poverty, such as communities living in remote locations with poor transport infrastructure (the so-called 'last mile' challenge). It often involves operating in a context where there is no developed or stable energy market and where there are gaps in terms of building a sustainable supply chain (not just in terms of energy but also wider infrastructure and services). In this type of operating environment, it is important to consider from the outset what type of additional support will be needed to design and deliver a successful energy service for the target end users. This could include:

- Providing access to micro-credit for end users so they can pay for the service
- Strengthening end users' capacity and skills base, as well as that of other actors (eg local government or private sector)
- Carrying out outreach to increase community awareness of new technologies and lobbying governments and other influential actors – including private institutions such as banks – for reforms in the enabling environment.

For instance, providing energy services to end users who have limited or zero ability to pay may require public subsidies and/or supportive micro-finance schemes. Banks will perceive providing credit to these potential customers so that they can access energy services as high risk, because they have no credit history.

They may also consider it high risk to finance projects that private-sector investors consider innovative or experimental (such as off-grid or mini-grid renewable technologies). Supporting services in this case could include lobbying and building the awareness of banks so that they re-evaluate, or evaluate differently, these perceived risks. One example is the work carried out by the energy company SELCO in India. SELCO built relationships with rural development banks so that they could access financial support for delivering energy services to poor groups, including providing micro-finance for the end users. The SELCO financing model is now so accepted by the banks that it could be considered part of the mainstream enabling environment.

Finally, there are other supporting services unrelated to the energy delivery model directly, but which are needed to ensure that it can deliver development impact. So, in the case of farmers wanting to increase their incomes, for instance, delivering a solar energy service for pumping water may not necessarily lead to this result unless the farmers can use it for greater productivity. This may require further training in agricultural techniques and/or additional inputs such as seeds etc. They may also need support to market their produce, training in enterprise development, access to transportation and so on.

BOX 3: Summary – the energy delivery model

The 'energy delivery model' refers to all the various activities and types of support needed to supply an energy service to a group of people or a community. These include:

- The type of energy technology and infrastructure (eg solar PV or micro-hydro, off-grid stand-alone systems or mini-grids)
- Types of financial support (eg grants or loans for sourcing and installing the equipment or for maintenance and repairs, and ways of paying for the service including any subsidy or other financial support)
- Management of the energy service (eg via a private business or a village cooperative)
- Ownership of the energy service (eg village, government or utility)
- Any policies or legal arrangements that support the energy service (eg government permits for accessing land or leasing agreements from companies)
- Any other additional support that is needed to ensure (a) successful delivery of the energy service or (b) that the energy service meets the wider development needs of end users.

BOX 3 *continued*

To design a successful energy delivery model, it is crucial to consider the broader context in which the service will operate, to ensure that it will meet the priority development needs identified by the community and that it will be financially, socially and environmentally sustainable.

This includes the 'enabling environment' of formal policies and regulations (for example, whether there are feed-in tariffs, tax exemptions, local government grants or subsidies for poor consumers, and so on) and the existence of transport and communications infrastructure to enable goods and services to be delivered (for example road or rail connections, telecommunications, mobile banking platforms, and so on). It also includes the 'social cultural context' – the values, norms and expected ways of behaving of the community (end users) and the wider set of stakeholders involved in delivering the service.

2. Using the energy delivery model framework – a practical toolkit

This section describes the six stages or steps of designing a pro-poor energy delivery model. This process can be used to design new energy services or to reflect on how to improve an existing energy service. The six-step process and Delivery Model Canvas and Map tools have been used in Indonesia to plan a new energy services (see **Sections 4 to 7**), as well as to analyse an existing energy service in Kenya (see Rajagopal *et al.* (2017)). The six-step process, supporting tools, and case study describing the EDM design in Indonesia are intended to be used by project planners and developers as a toolkit – henceforth referred to as the **'Energy Delivery Model (EDM) Toolkit'**.

Figure 2: The six-step EDM design process

Step 1: Identify the starting point	Identify the entry point and approach to be used for providing an energy service to a particular group of people (potential end users). *Which organisation or group is starting the process and what do they want to achieve?* Carry out initial data gathering.
Step 2: Be inclusive	Map out all the relevant stakeholders who will participate in the design process and build their awareness of the process and its aims.
Step 3: Build understanding	Explore the target end users' needs and wants and their context in more depth. Understand their priority needs, and the energy and non-energy 'gaps' preventing the needs being met. Brainstorm potential solutions and identify the 'value added' of an energy service. Develop a value proposition.
Step 4: Design and Test	Explore in depth potential solutions (energy delivery models) using the EDM tools. Understand who will do what, and the various outputs and activities needed. Test out the value proposition/different solutions by challenging your assumptions and gathering further data.
Step 5: Optimise and review	Think through the financial, social and environmental risks and how to mitigate them. Ensure that the EDM is sustainable, and all the supporting services required are in place. Finalise the EDM.
Step 6: Prepare to implement	Develop an implementation and a monitoring and evaluation plan. Once financing and other support is in place, move to the start-up phase, beginning with piloting the EDM.

Each of these steps is described in more detail overleaf. The flow diagram in **Section 2** helps with navigating each step and outlines the key questions and decision points. There is also a running example to illustrate each step (see coloured boxes). **Section 3** describes two innovative tools, the **Delivery Model Map** and the **Delivery Model Canvas**, which have been developed to support the design process. **Annex 1** contains further ideas for tools that can be used for each step. **Sections 4 to 7** illustrate how the six-step process was tested out by designing an EDM in Indonesia. The process and tools are intended as guidelines rather than a rigid set of rules that must be followed. Service/project designers are encouraged to use their own tools and approaches, and to adapt the process to suit their own needs and different contexts.

Step 1: IDENTIFY THE STARTING POINT

There is always a reason or starting point for delivering an energy service – and a context in which it will operate. This can include: a **place or region** being targeted for development (eg by a government or NGO); **a particular group of people or end users** (eg subsistence farmers); and/or a specific objective. The entry point is often determined by government priorities or by business interests (for example, the government wants to promote use of mechanical power in a region to improve subsistence agriculture).

The local branch of the Ministry of Agriculture in an African country wants to work with smallholder farmers in a semi-arid region to improve their livelihoods by increasing their productivity. One of the Ministry's strategies is to increase the farmers' access to power for irrigation and processing crops. The Ministry has carried out a survey to identify why farmers are not currently using mechanical power: findings show that this includes a lack of access to electricity as well as other barriers.

Carry out initial information-gathering: From the initial entry point, baseline research will need to be done to understand the context better and identify the end users' needs. The type of information gathered will vary depending on the starting point. Although information on current and potential energy needs is useful, it is important to avoid focusing on the energy needs of the end users at this early stage, as this could mean the end users and other stakeholders ignore the end users' underlying development needs as well as the opportunities and constraints offered by their specific context. This can affect whether the energy delivery model will really address the priority development needs. Leading questions such as "What lighting needs do you have in your home?" should be avoided. An example of how this activity was carried out in Indonesia is included in **Section 5.**

When it comes to improving productivity among the smallholder farmers, different stakeholders have competing or conflicting priorities. The initial research, building on the Ministry's survey, reveals that, for the farmers, the key priorities related to energy are lighting their homes in the evening, watching TV and powering their mobile phones (for personal use and to get information on market prices for crops). However, their main concern or need is how to increase their income and food security, as they are experiencing more frequent and intense periods of drought due to a changing climate in the region.

Step 2: BE INCLUSIVE

All the individuals and organisations that could potentially be involved in helping deliver the energy service to the target end users should be identified. The stakeholders, including the end users, will all have their own views about, and interests in, participating (or not) in the design process.

Carry out stakeholder mapping: This should identify all the potential stakeholders needed to design and deliver the service. It is the main tool for deciding who should be involved in future discussions, needs assessments and market analysis. There are many existing tools that can be used to carry out stakeholder mapping. See **Section 5** for an example of carrying out stakeholder mapping in the EDM design in Indonesia and Annex 1 for further tools that can be used for stakeholder mapping.

Raise awareness and set expectations: Once potential stakeholders have been identified, engage with them to build a shared understanding and awareness about the design process and what its aims are. From the outset, it is important to set expectations about what the service will – and will not – deliver. End users may have high expectations of an energy service and at this stage we do not even know if there is an energy gap or whether an energy delivery model is viable, including whether there are sufficient financial and other resources to implement it.

Apart from the farmers, other potential stakeholders include farmers' associations and local cooperatives, community leaders, suppliers of agricultural tools and buyers of agricultural produce (eg 'middlemen'), energy businesses, banks or micro-finance organisations, donors and NGO partners, technology providers, national and local authorities (including the Ministry of Agriculture) and local MPs. The local and national governments' priority is to provide power to mechanise agriculture to raise productivity and standards of living in the region. A local solar energy company is interested in selling its products. Agricultural machinery suppliers want to increase their business by widening the range of products they sell to include more expensive items such as electric-powered tools. An international development organisation would like to see a greater uptake of renewable energy solutions in the region.

Step 3: BUILD UNDERSTANDING

There are three main components to this step:

- **A.** Understanding the end users and their development needs and wants, and prioritising these
- **B.** Identifying the energy and non-energy 'gaps' stopping them meeting their priority needs, and exploring potential solutions
- **C.** Prioritising the solutions

A: Understanding the different end-user groups and their needs and wants, and prioritising them

To identify how an energy service could add value to the end users' lives, their development needs and wants must be explored in more depth. This includes understanding the different end-user groups that exist within the community and their local context, with its specific opportunities and constraints.

- **Carry out a stakeholder needs and wants assessment.** This will build on the baseline information gathered in **Steps 1 and 2**, and can be done by exploring the different daily activities that the end users carry out (or would like to). For instance, a smallholder farmer might want to mill crops so she or he can sell grains, or to dry fruit to sell to markets further away. When discussing end users' needs, it is crucial to focus not only on the immediate product or activity but also **the benefits** or **impacts** that it will result in. So, in the case of a farmer needing a milling machine, the benefit is *generating additional income for the farmer.* This will help to identify all the different types of support that are needed to improve the farmer's income – including to address the non-energy needs or gaps (see overleaf).
- **Do not assume that all end users have the same needs and wants.** Identify clearly the different end-user groups and their needs. For instance, the women in the community may have different needs from the men (for instance they may want good-quality household lighting, so they can carry out activities at night, whereas the men prioritise power for farming). Women farmers may have different needs from male farmers. The short-term wants of end users may also be different from what they identify as their longer-term needs. So, although the farmers may view 'having a working TV and radio in my house' as their priority in the short term, their highest priority over the next few years may be 'increase my income and provide more food for my family'.
- **Understand the stakeholders' interests and align these with the end users' needs.** To design an energy service that will meet the demand (fulfil the needs of the end users), it is important to ensure that the expectations of the different stakeholders are aligned and managed – particularly where the delivery model requires that end users pay for the energy service. Different stakeholders may have different views and perceptions about what the end users need and want, and external perceptions may not match the real-life needs and wants of the end users (for instance, the government may not have the same perception as the target group of subsistence farmers).

- **Avoid imposing an external agenda on the end users and other local stakeholders.** It is legitimate and understandable for organisations or businesses to look for opportunities to deliver their services or products when they are participating in needs and wants assessments. In reality, the final energy delivery model (solution) will have to work within existing resource constraints, including the available products and services and delivery channels. However, the needs and wants assessment may conclude that an energy service or product will not add value to the lives of the end users or is not a priority for them. Their actual needs may not fit neatly with the agenda of some stakeholders.

B: Identifying the energy and non-energy 'gaps'

- **Identify the energy gaps.** Through discussion with stakeholders, identify the gaps or barriers that are preventing the end users from meeting their needs. Some of these may relate to energy – or the lack of it. For instance, where the need is increasing farmers' income, there may be a lack of power for water pumping to improve irrigation in an arid area.
- **Identify the non-energy gaps.** There are also gaps or barriers that are not directly related to energy. Unless these are considered, a solution may be developed that does not meet the end users' needs. In the running example, the target subsistence farmers may need training to increase their productivity in the face of increasing droughts, or better inputs such as more resilient seeds, not just power for irrigation. Alternatively, poor-quality roads may be preventing them getting their crops to markets where they could obtain a higher price, and so on.
- **Identify the solutions to address the gaps.** Think about potential solutions to address both the energy and non-energy gaps and meet the end users' needs. Are there any solutions that could meet multiple end-user needs? It is important to understand fully why the gap exists, (ie what has prevented the needs being met to date?) and whether there have been previous attempts to address it and – most importantly – why these efforts failed. If a gap cannot be addressed, then the stakeholders should go back and explore solutions to meet other needs/gaps. *Remember to think about what the 'value added' of each solution is, ie what benefits it would bring to the end users' lives.*

The stakeholder mapping and the needs and wants assessment highlights several reasons why farmers are not thinking about using mechanically-powered irrigation or processing to increase productivity. These include: their low awareness of available energy solutions, their low incomes, difficulties related to the distribution/maintenance of energy services and products, and little access to markets, due to poor transport infrastructure. There is no electricity grid nearby and extending it would be expensive. Further discussion with stakeholders identifies an important gap: a lack of government support to help farmers get power for agricultural activities – even though increasing mechanised agriculture is a government priority.

BOX ***continued overleaf***

BOX *continued*
On the other hand, the region is well irradiated by sunlight all year round. The government has a new policy to exempt imported solar equipment from VAT. There are private-sector companies locally that could deliver solar home systems (SHSs) to meet the end users' top priorities of TV and mobile phone-charging. The international development organisation has a partnership with the local farmers' association and wants to encourage the take-up of renewable energy. However, there are other gaps. One energy-related gap is that many farmers cannot afford the initial cost of the SHS. Another non-energy gap is that transport to market is very expensive. This makes the cost of the farmers' goods less competitive than crops from villages closer to the market.

C. Prioritising the solutions

- **Compare the different potential solutions and what benefits each can deliver.** Some solutions may meet multiple needs. For instance, SHSs may meet the farmers' household lighting needs but will not solve the energy gap of power for irrigation, whereas installing a solar-powered micro-grid might address both needs.
- **Prioritise which solutions are most appropriate for the context.** The stakeholders should now prioritise which solutions they want to explore further – and therefore which of their needs are priorities. This requires understanding and aligning the interests and priorities of the different stakeholders, including the end users. Further discussion and prioritisation will be needed in **Step 4.**
- **Develop an initial value proposition (VP).** The VP spells out which solutions will meet which needs and how. It can be expressed as follows: *by doing XYZ activities/inputs with XYZ stakeholders, we will produce XYZ outputs to deliver XYZ impacts.* The value proposition is central to the energy delivery model and will be further refined and tested in **Step 4.** For a simplified example of a value proposition, see below.

The local government says it will provide incentives to encourage farmers to use mechanical power to improve agricultural productivity. This includes grants to buy agricultural appliances such as water-pumping systems and processing equipment. There is one solar energy business operating in the region that supplies SHSs for household energy but also larger SHSs that can power water pumps for drip-irrigation and for other agricultural uses, as well as a range of appliances. This larger SHS is an energy solution that could potentially address both 'gaps': (a) access to mechanical power for farming and (b) power for mobile phone-charging, household lighting and TV-watching.

Value proposition: *by working with the local solar energy business and the local government, we will provide the farmers with SHSs to power mobile phones and TVs, along with water pumps and other agricultural appliances, to meet their needs for household lighting, communication and entertainment and to improve their agricultural productivity, resulting in higher incomes for the farmers and, in turn, improved livelihoods and food security for their families.*

An example of carrying out **Step 3** with stakeholders in Indonesia is given in **Section 6.**

Step 4: DESIGN AND TEST

In this step, a potential solution or solutions is explored in greater detail, by starting to design an energy delivery model (EDM) to meet the priority needs identified by the end users. This should include from the outset a rough idea of how the EDM will be implemented, including any problems or barriers and how they might be addressed, with identification of the short-, medium- and longer-term aims of the EDM. These need to be agreed among all the stakeholders, along with the expected outcomes and impacts from delivering the energy service and supporting services, and how these will be measured.

The Delivery Model Canvas and Delivery Model Map tools (see **Section 3**) can be used to analyse further the initial value proposition identified in **Step 3**, further exploring the end users' preferences, and identifying the key resources needed for the EDM and the roles different stakeholders will play in delivering it. These assumptions will be further challenged and tested through discussion and gathering more information in the field.

Analyse the proposed solutions and value proposition using the Delivery Model Canvas and Delivery Model Map tools. Discuss the different aspects of the EDM (these are grouped into colour-coded categories, for example aspects related to the end users are coloured blue). The questions in the Canvas can be used to guide discussion and to explore systematically different issues. They are not exhaustive and other questions/issues can also be added if needed. The different aspects in the Canvas can be explored in any order that suits the group, and can also be revisited as the discussion explores different issues in more detail. However, to start things off, you may find it useful to explore the different aspects of the EDM in the following order:

- ***End users*** **(light blue):** these questions are intended to explore the different types of users, their needs and preferences.
- ***Delivery infrastructure*** **(orange)**: this discusses the key resources and activities that constitute the EDM and the roles of different stakeholders in delivering them.
- ***Accounting*** **(purple)** looks at financial costs and revenue streams. The revenues must be equal to or greater than the costs (including the initial capital cost) for the energy service to be viable. Social and environmental costs and benefits are also included as these are important factors in determining the sustainability of the energy service.
- The ***value proposition*** **(light green)** needs to be revisited and reworked throughout, reflecting the discussions about the other aspects of the EDM.
- ***Socio-cultural context*** **(brown)** explores all the other social and cultural factors that might have an impact on the viability of the energy service. In the Delivery Model Map, the socio-cultural issues are listed in the brown box. In the Delivery Model Canvas, all the questions related to socio-cultural context or enabling environment are denoted in coloured text.

- ***Enabling environment*** **(dark-green):** some of these factors (eg incentives or subsidies for purchasing energy technology or equipment) will be helpful in delivering the energy service, whereas others may be barriers that need to be overcome if the energy service is to operate successfully. In the Delivery Model Map, the enabling-environment issues are listed in the green box. In the Canvas, all the questions related to socio-cultural context or enabling environment are denoted in coloured (non-black) text.

Challenge assumptions. Throughout the discussion, many assumptions will be made. Participants may have differing views about the available resources (or lack of them), financial costs and revenues, socio-cultural issues, end users' needs and behaviours, and legal/regulatory issues. A concerted effort should be made to identify and challenge these assumptions, with participants talking them through, gathering further information and, where necessary, testing them out in the local context.

Test the value proposition. Stakeholders need to be satisfied that all aspects of the value proposition are viable and appropriate to the local context. Certain assumptions will probably need testing on the ground by gathering more field data, including talking to other groups or individuals who are not participating in the stakeholder discussions. For instance, there may be data gaps related to the delivery infrastructure and activities, and further feasibility studies or piloting may need to be carried out. As the EDM design process will probably require several workshops with end users and other stakeholders, further data to test the value proposition can be gathered between the workshops.

It is important to remember that designing and testing solutions and refining the value proposition is an iterative process, and to factor in enough time for this. There is a temptation to jump quickly to solutions, based on unquestioned assumptions, or not to cost them properly. Socio-cultural issues are generally not given as much attention as they merit, even though they can make or break a project – for example when assumptions made about end users' willingness to pay do not match up to the reality, or a community energy utility is not workable because of mistrust or conflict within the community. The Delivery Model Canvas and Map aim to ensure that there is a more systematic discussion of all issues relevant to developing a sustainable value proposition.

To give an indication of timescales needed to carry out the EDM process, in the Indonesia case described in **Sections 4 to 7**, there were three multi-day workshops with the community (end users) over a six-month period. The workshops covered all six steps of the process, with further research in-between workshops to explore the feasibility and costs of the various solutions identified. The process did not take six months' continuous work, so there is potential to compress it. However, this staggered schedule and timescale was important for building community awareness and buy-in to the process.

The solution (final EDM) will have to satisfy the end users' (the farmers) needs and align with different stakeholders' priorities. Its results (benefits and impacts) will need to be evaluated accordingly. Ultimately, its success will be measured in terms of whether and to what extent it ensures that farmers can watch TV and charge their mobile phones (the farmers' priorities – at least over the short term) and encourages them to use mechanical appliances such as water pumps and processing equipment to improve their productivity (the government's priority).

One of the concerns raised during the EDM design process is the affordability of the larger SHSs for the farmers. The government has already said it will provide support for farmers to obtain agricultural appliances at low cost. Although the farmers appear able and willing to pay for smaller SHSs that can supply power for household lighting and mobile phone-charging, some form of additional financing scheme is needed to make purchase of larger SHSs more affordable.

The design process also identifies that the farmers do not yet understand the different energy solutions and agricultural appliances available, and how they can be used to improve their productivity. The local farmers' association suggests that information campaigns and additional training of farmers are needed. The company that supplies the SHSs and other products agrees to provide training to the farmers on the SHSs and the appliances, if it gets government support (in the form of a tax break or other incentive).

The company also raises the need to ensure the financing model covers the cost of ongoing maintenance and repair of the SHSs and appliances. If this funding is available, the business offers to train technicians locally to carry out maintenance and repair.

The stakeholders agree that the value proposition (VP) aimed at supplying the farmers' immediate needs is viable: *by working with the local solar business and the local government, the initiative will provide the farmers with SHSs to power mobile phones and lamps, as well as training and ongoing maintenance and repair, to meet their needs for lighting, communication and entertainment).* However, they realise that this is not the optimal solution in terms of meeting the government's priorities (improving agricultural productivity) or the farmers' own long-term priority (increasing their income).

A revised VP aimed at meeting both the farmers' short- and longer-term needs and the government's priority could work if there is further support: *by working with the local solar business and the local government, the initiative will provide the farmers with SHSs to power mobile phones and TVs, and water pumps and other agricultural appliances, to meet their needs for household lighting, communication and entertainment, and to improve their agricultural productivity, resulting in higher incomes for the farmers and, in turn, improved livelihoods and food security for their families).*

Step 5: OPTIMISE AND REVIEW

At this point, the stakeholders have carried out the EDM design process, challenged their assumptions and tested their initial value proposition to see if it is viable and appropriate given the local context. **Step 5** explores in depth whether this is really the optimal solution; analyses any gaps or risks and how to mitigate them; and identifies any additional supporting services needed to (a) make the energy service itself viable and (b) address the non-energy gaps. A final check must be made on the financial viability and robustness of the proposed EDM before starting to pilot it.

Annex 1 lists some tools that can be used to carry out risk assessments. **Section 7** also gives an example of carrying out a risk assessment when designing the EDM in Indonesia.

Ensure this is the optimal solution by re-examining the VP using these three questions.

1. **What are the risks? How can they be managed?** Identify ways to reduce and manage these risks. This may mean that the EDM needs to be changed. There are different kinds of risks that must be considered:
   - Financial risks
   - Risks related to the delivery infrastructure (such as activities overrunning or technical problems with equipment)
   - Social risks (such as the EDM creating conflict or making existing conflict worse)
   - Risks relating to the enabling environment (such as delays in getting permits)
2. **What other supporting services are needed to make the energy service viable and deliver the intended impacts and what is needed to meet the non-energy gaps?** These could include activities related to the energy service itself – such as awareness-raising about services and products or engaging with funders to access financing. It could also include activities to meet the non-energy-related gaps, such as providing additional training or lobbying government to improve infrastructure.
3. **Is the EDM financially viable?** At this stage, the financing model should be checked again to ensure that the figures add up (in terms of balancing revenues and costs) and that the revenue streams are secured, particularly with respect to initial investors.

Several risks are identified in relation to the financial viability of the EDM, including whether the farmers really are willing to pay even for the smaller SHSs and how to finance their ongoing maintenance and repair.

Furthermore, stakeholders are not convinced that this is the optimal solution (ie addresses both the government's priority and the farmers' long-term as well as their short-term needs). After further discussion with the local government, it agrees to give a small subsidy to cover the difference in cost between a smaller SHS and a larger one that can not only provide power at the household level but also support appliances such as water pumps for irrigation, and processing equipment. To ensure adequate support for maintenance and repair of the SHSs, it also gives a one-off subsidy to the solar company supplying the SHSs, which agrees to train local technicians.

The international development organisation agrees to fund training for farmers on how to use the appliances to increase productivity, working with the solar company and the farmers' association. It also agrees to set up a revolving fund to support micro-finance loans for farmers to buy the SHSs and other appliances. This is managed by a local bank. Interest is kept to a minimum on the loans, which are paid back in small instalments by the farmers at times that suit their farming cycle, with the international organisation covering the management fees.

In addition, the farmers' association has identified the risk that providing solar power for water pumping and other appliances without training and other support will not lead to improved productivity, given the farmers' lack of familiarity with the appliances, and other non-energy gaps. These include poor infrastructure, which impedes access to markets, and the low price farmers get from selling their crops via a middleman.

The international development organisation and the farmers' association lobby the local government to provide agricultural extension services so the farmers can receive wider training on how to improve their productivity. The international organisation also agrees to provide enterprise development training, and the bank agrees to provide a low-interest loan so the farmers can buy a vehicle to transport crops to market more easily.

Revised value proposition: *By working with the solar company, the local government, the farmers' association, the international development organisation and the local bank, provide the farmers with SHSs to power mobile phones, TVs and water pumps; as well as access to low-cost appliances, along with training on use of SHSs and appliances; agricultural extension services; and ongoing maintenance support for SHSs and appliances; to meet the farmers' needs for lighting, communication and entertainment, and to improve their agricultural productivity so increasing their incomes – resulting in improved livelihoods and food security for the farmers and their families.*

Step 6: PREPARE TO IMPLEMENT

The final step involves developing a detailed implementation plan, as well as a monitoring and evaluation (M&E) strategy, with specific timelines, inputs, deliverables, and roles and responsibilities assigned to each stakeholder. The implementation phase and plan are not discussed here in detail but some tools are listed in **Annex 1** to assist with these activities (for instance, the business start-up planning guide and the CARE guide to project implementation). The risk analysis tools used in **Step 5** can also be useful when analysing risk for start-up or first-year activities.

Develop the implementation plan. In general, an implementation plan is likely to contain the following activities:

- **Pilot stage.** Good practice suggests that, where feasible, the EDM should be piloted first, before rolling it out fully. This could involve implementing it with a small number of users, and intense monitoring to stress-test the model before full implementation.
- **M&E of pilot.** The implementation team monitors the pilot, evaluates the results, and documents the learning from this. This feedback is then shared with the design team, and the EDM and the value proposition are reviewed and, if necessary, changed.
- **Full roll-out.** After any necessary changes have been made, the EDM is rolled out. Where necessary, this will involve further training and capacity building of stakeholders during implementation.
- **Maintenance and ongoing support.** The importance of maintenance and support services have been emphasised throughout the design process. Again, these are essential to ensure the long-term success and sustainability of the EDM.

Develop the monitoring and evaluation strategy. The final M&E strategy should integrate the findings from the pilot and monitor implementation of both the delivery infrastructure and the overall energy service once it is operating with regular reviews – checking maintenance, financing etc. M&E will be needed over several years to see if the value proposition is being delivered and the end users' development needs are being met. This can also provide evidence to justify expanding the scope of the energy service, as well as ongoing learning to support other EDM designs.

Final decision point and start of EDM implementation. The EDM design team should carry out a final check that this is the optimal solution and the design is robust, ie it is financially viable and likely to be socially and environmentally sustainable. At this point, all the stakeholders, including end users, confirm their agreement with the EDM and re-affirm their commitment to making it a success.

3. Two innovative tools to guide a participatory EDM design process

The Delivery Model Map and Delivery Model Canvas are two tools that have been developed to assist with **Step 4** (Design and Test). They can be used as visual prompts to assist with group discussion as part of the design process, and to ensure more systematic analysis of the issues (eg socio-cultural issues or those related to the enabling environment) that have been shown to be important in determining the success or failure of energy services. These tools break down in slightly different ways the components of the energy delivery model itself and its operating context. The Canvas contains questions that explore in depth these different components and related issues that will need to be discussed during design of an energy delivery model.

In the Indonesia case study (see **Sections 4 to 7**), these tools were used in several ways. In capacity-building for the partner organisation facilitating the EDM process with the community, they were introduced at the start to build understanding of the process – including why it is important to explore issues such as end-user relationships. The questions in the Delivery Model Canvas and Map were used directly in group work to build the understanding of the participants (the future facilitators of the community EDM) of designing and testing delivery models. During the community workshops to design the EDM, the tools were translated into the local language and a poster-size version put up on the walls. However, a simplified list of guiding questions was used in group work, and the Canvas and Map posters acted as supplementary tools. Community members were observed reading the posters and using them to further their understanding as well as to challenge other group members in discussions. The tools were also used during the field data- gathering to ensure that the full range of issues had been covered.

Figure 3:
Osterwalder's Business Model Canvas

The Business Model Canvas	Designed for:	Designed by:	Date: Version:

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
• Who are our key partners? • Who are our key suppliers? • Which key resources are we acquiring from partners? • Which key activities do partners perform?	• What key activities do our value propositions require? • Our distribution channels? • Revenue streams?	• What value do we deliver to the customer? • Which one of our problems are we helping to solve? • What bundles of products and services are we offering to each customer segment? • Which customer needs are we satisfying?	• What type of relationship does each of our customer segments expect us to establish and maintain with them? • Which ones have we established? • How are they integrated with the rest of our business model? • How costly are they?	• For whom are we creating value? • Who are our most important customers?
	Key Resources • What key resources do our value propositions require? • Our distribution channels? • Customer relationships? • Revenue streams?		**Channels** • Through which channels do our customer segments want to be reached? • How are we reaching them now? • How are our channels integrated? • Which ones work best? • Which ones are most cost-efficient? • How are we integrating them with customer routines?	

Cost Structure	Revenue Streams
• What are the most important costs inherent in our business model? • Which key resources are most expensive? • Which key activities are most expensive?	• For what value are our customers really willing to pay? • For what do they currently pay? • How are they currently paying?

Business Model Canvas: nine business model building blocks (Source: Osterwalder, Pigneur, 2010).

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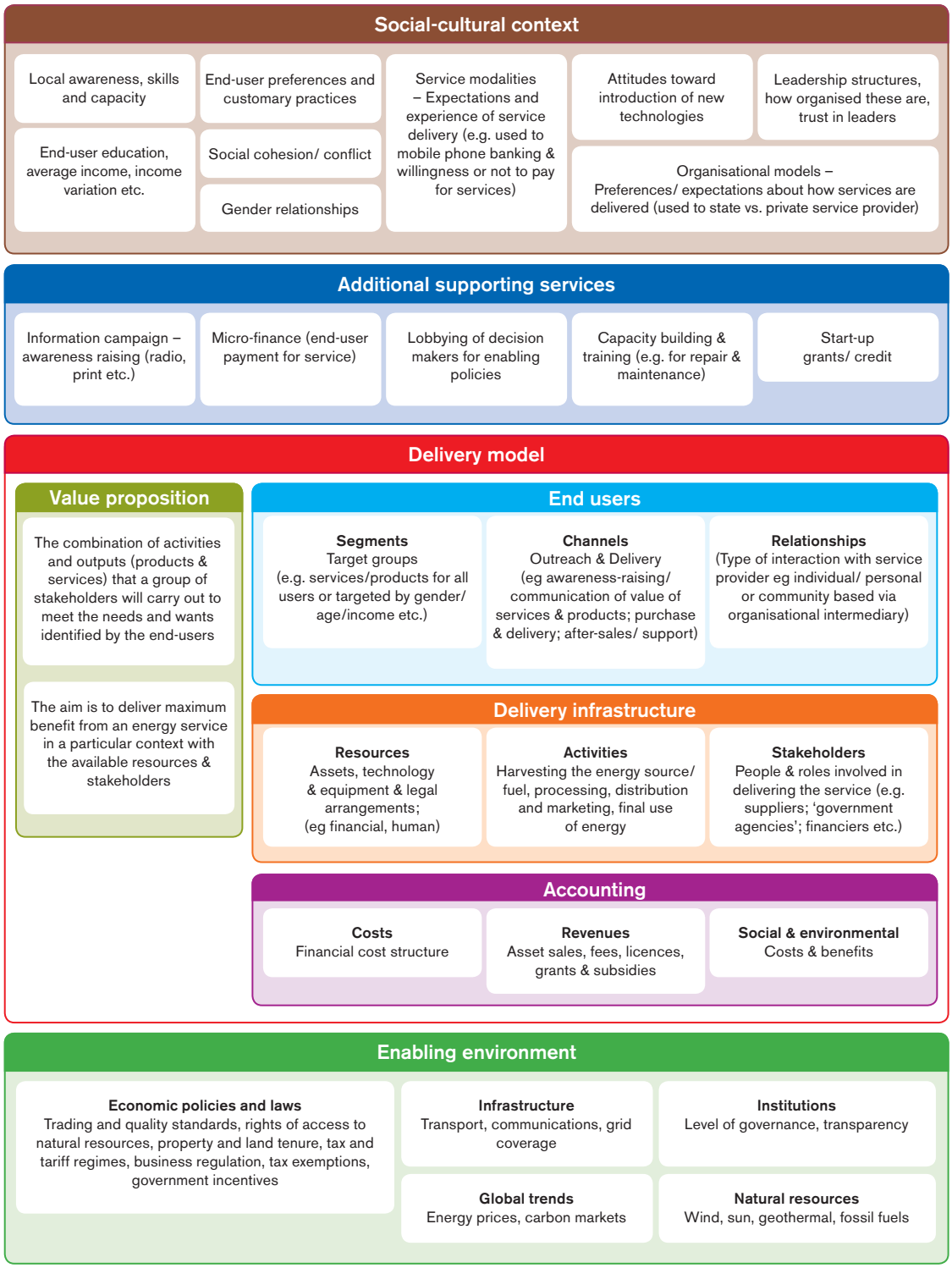
3.1 Development of the Delivery Model Map and Canvas

Figure 3 shows Osterwalder's **Business Model Canvas** (Osterwalder, A. *et al*., 2010). This is a tool used by businesses to design services and products. It helps companies make strategic management decisions about their business activities by mapping potential trade-offs and encourages a systematic and dynamic analysis of all aspects of a business activity to produce a business delivery model. It is a framework to guide decision making by analysing the delivery model's value added; the types of relationships it creates with partners (everyone who takes part in the delivery model) and end users (customers); and the resources and activities required to implement it.

However, Osterwalder's tool is purely business-focused. A crucial difference between the value proposition (VP) as defined by the Osterwalder **Business Model Canvas** and the VP of a pro-poor energy delivery model is that in the latter, the VP is the result of negotiations between multiple stakeholders who live in a specific socio-cultural context, and it aims to meet the needs of poor and marginalised end users who are facing complex development challenges. For this reason, it goes beyond the considerations that the classic business delivery model aims to analyse. Each stakeholder has interests, preferences and needs that must be properly understood and valued to design a successful EDM, and the impact of meeting these needs in terms of development benefits is included explicitly in the VP. For these reasons, the Business Model Canvas was adapted in the first EDM publication (Bellanca and Garside, 2013) to create a Delivery Model Canvas tool.

The second tool used in the EDM design process is an adaptation of Wilson*'s* 'Map of the pro-poor energy delivery system' (2012). The language has been further simplified to create the **Delivery Model Map** (see **Figure 4**). **The Delivery Model Canvas** (**Figure 5**) has also been further refined to make the language and terminology used more accessible to practitioners. In addition, the learning from many different energy service delivery projects operating in various contexts has been integrated into the two tools and overall EDM Toolkit.

Figure 4:
The Delivery Model Map (Source: Garside & Wykes, 2017).



3.2 The Delivery Model Canvas

The different categories of the **Delivery Model Canvas (Figure 5)** are: *Value proposition, End users, Delivery infrastructure, and Accounting*. It reflects the pro-poor focus of the energy delivery approach by focussing on developmental benefits, including consideration of the social and environmental sustainability of the delivery model, to ensure it delivers long-term impact to end users. For example, it includes positive socio-environmental impacts as well as additional revenues within the 'value proposition'. Social and environmental costs and benefits have also been integrated into the 'Accounting' category to ensure consideration and measurement of non-monetary targets. There are also questions included to guide the use of the tool – those in colour refer to the socio-cultural context or enabling environment issues. Examples are included at the end of each category to aid understanding.

The term 'we' is used in the Canvas to refer to the collection of individual actors and organisations (which could include government, community organisations, businesses, development partners, NGOs and so on) that are developing the energy delivery model. This will probably be a joint effort between several different types of organisations or actors. Some aspects of the EDM tools and process (for example, cost structure and delivery infrastructure issues) will be more familiar to businesses designing services and products than to community organisations or other actors working in development, but the latter may be more familiar with identifying end-user needs and wants and socio-cultural challenges and opportunities (for example) than businesses.

The socio-cultural context and enabling environment are cross-cutting issues that must be considered throughout the design process. For example, individual end users' and stakeholders' preferences and habits are included in 'Ways of doing outreach and delivery', whereas questions relating to how much social cohesion exists among end users, and their level of skills and capacity, are included in 'End users' relationships. Considering fully any supporting services required will be crucial when delivering energy services to poor groups that are not (well) served by markets. They could be economic (eg government subsidies or incentives and donor funding), but could also include capacity building and advocacy in favour of enabling public policies, and so on. For this reason, questions around the need for additional supporting services have been included in 'Key resources' and they are also factored into the category 'Revenue streams'.

Figure 5: The Delivery Model Canvas (1 of 4)
(Source: Garside & Wykes, 2017).

Delivery infrastructure

Key activities

What are the activities we need to carry out to deliver our value proposition, and to make sure that we are reaching our end users and generating sufficient revenue?

Which of these activities are the most important to fulfil our value proposition and which would be 'nice to have' but not essential?

Would any of these activities disrupt existing businesses or upset power relationships? Is there the potential for conflict?

Example: Firstly, there are problem-solving activities eg how to connect and build different ways of distributing the energy services & products, how to build trust with end users. Then there are activities related to the 'nuts and bolts' of running the energy service: for example, acquiring SHS and appliances & physically selling them; assembling & customising them; and training and managing the technicians who will maintain & repair them. There could potentially be issues with existing energy providers such as kerosene sellers.

Key stakeholders

Who are our key stakeholders? Eg partners, suppliers, repair & maintenance, local authorities, end users etc.

Which key resources are we acquiring from them? Which key activities do they perform? What do they expect from us? What do we expect from them?

How do we add value with all the other stakeholders, including with the end users?

How does the value proposition fit with government strategies and public policies?

Example: International suppliers provide products (SHSs and appliances). Retailers of appliances and gadgets (TVs, radios, phones) sell devices that enable end users to use energy services, and retailers provide repair & maintenance. National and local authorities give import permits, tax and other incentives etc and provide other subsidies and establish policies. Local bank manages micro-loans. International organisation provides funding for loans to farmers and supports training, as does the farmers' association, which is a trusted source of information.

Key resources

What resources do we need to deliver our value proposition, reach our end users, generate revenues and build our partnerships?

Can we easily obtain all the resources (natural, financial, human, physical, institutional etc.) that we need? Do we need any extra supporting services? How will we obtain these?

Example: The following resources are available. Physical resources: the business has its shop premises in the town & storage for imported goods. Human: the business employees, and other actors involved in awareness-raising. Financial: funding from the international organisation to start revolving loans, and micro-credit & subsidies from the government to buy bigger SHSs and appliances, plus a reduction in import taxes for solar products.

Constraints: replacement parts for the SHSs and appliances need to be imported from abroad. Also, there is no electric grid connection and no plans to expand in the local region. There is poor transport infrastructure and the solar business will need to build a local distribution channel.

Supporting services: Funder to provide revolving fund start-up capital and to build relationships with local banks so that they will manage fund and eventually be willing to provide micro finance loans themselves. Awareness-raising for the farmers on SHSs and appliances; training on using appliances and also on improving agricultural techniques and enterprise development; training for technicians to do installation and maintenance of systems; lobbying government to improve transport infrastructure to improve access to markets.

Figure 5: The Delivery Model Canvas (2 of 4)

Value proposition

What value are we adding to the end user's life?

What problem are we helping the end user to solve?

What needs of the end user are we helping to meet?

What collection of products and services are we using to add value or solve a problem or satisfy the end-user's needs?

What are the social and/or environmental problems we are solving? Are we creating any risks?

How is the wider community beyond the specific end users going to benefit?

By doing * activities with *** people/organisations, we will deliver *** impacts and/or meet *** needs and/or solve *** problems.**

Example: The additional value delivered by the proposition is the following: the ability of the farmers and their families to access electric lighting for the first time, along with (improved) access to modern communications (TV, radio); the improvement of livelihoods by using appliances such as processors, refrigerators and water pumps; more educational opportunities for children and adults due to the availability of light at night for studying. There are also other benefits from actual and potential uses of electric appliances (eg labour-saving for women, health benefits from reduced kerosene use etc). Another co-benefit is the decreased use of diesel generators, leading to lower fuel costs for the farmers and also more environmentally sustainable fuel use. The SHSs and some appliances are imported but the rest of the value chain is local.

Figure 5: The Delivery Model Canvas (3 of 4)

End users

Target groups

Which individuals or groups is the service creating value for? (eg services/ products for all users or targeted by gender/ age/ income etc.)

Who are our most important end users? Why?

Are there local behaviours/attitudes towards innovation and risk that could affect the value proposition?

Are there preferences and customs that could affect the value proposition?

How do gender relationships affect the value proposition?

Example: The target group is subsistence farmers. This group can be further divided up by income. The farmers with lower incomes are most concerned about the affordability and durability of the appliances and they are likely to be interested in solar lamps with a phone charger. Farmers with higher incomes could be looking at SHSs and water pumps and potentially some kind of processing equipment. Crops are currently sold directly after harvest, and people are not used to processing them. Women are generally the ones who grow crops, but men are more likely to visit town and sell crops.

Relationship with the end users

What type of relationship does each of our groups of end users expect us to establish and maintain with them? (eg individual service, people expect to be involved in creating the service etc.)

Do end users expect services to be delivered by the private or public sector (eg private business, governmental agency, cooperative, intermediary such as international NGO, local NGO, church etc.)?

Example: Solar business with a shop in county capital does customised outreach to the farmers with the support of government incentives and working with the farmers' association. Micro-finance loans are made available from a fund supported by the international organisation but managed by the local banks. The farmers' association also acts as a trusted intermediary. Maintenance services are offered by the business through local technicians.

Ways of doing outreach & delivery

Do the end users have preferred ways of being reached when it comes to: awareness-raising, purchase, delivery of the energy service?

How can we make sure our ways of reaching end users fit with their preferences/routines?

How much do people use informal channels to build their understanding of services & products?

Example: Most farmers visit stores in the market town to buy products directly but they also swap information through informal channels such as the farmers' association and they do not often make big purchases or try new products. Women trust information they get from their women's group & feel comfortable asking questions in this environment.

In this case, the farmers and the village as a whole are given demonstrations of products (appliances and SHSs) by local business (supplier) during awareness-raising and promotional campaigns. These are carried out with local associations (farmers' association, women's groups) with the support of trusted development partners. Examples of other similar products being used in neighbouring communities are also used for demonstration and, because evening radio soap operas are popular and used to transmit information, the government pays for awareness-raising through this channel.

SHSs are customised according to the farmer's needs, then delivered & installed by the business and maintained by locally trained agents.

Figure 5: The Delivery Model Canvas (4 of 4)

Accounting

Revenue streams

Where will the revenues come from to pay for the service? What are the different sources? Eg from selling products or assets, fees, lending/ renting/ leasing, etc.

Can the end users pay for the service? In full or in part? How much does each source/ stream of revenue contribute to total revenue? Do donors or the government offer any subsidies or incentives that could be used? Can civil society offer any 'in-kind' resources (physical eg equipment or financial)? Can the end users offer any 'in-kind' resources that could be used?

Example: Revenue stream comes from end users selling crops. In addition, there are subsidies for the appliances from the government and funding from the international organisation for the payment schemes.

Other costs/ benefits

What are the most important social & environmental costs that this particular service will have? What are the benefits?

Types of costs/ benefits:
Social – Increasing conflict or cohesion among social or ethnic groups. Impacts of the EDM on gender relationships, job creation, health and well-being and empowerment.

Environmental – Increased pollution or energy sustainability. Restoration/degradation/exhaustion of the natural resource base. Impact on eco-systems services and contribution to resource management (positive/negative).

Example: Increased information/educational opportunities & increased income for farmers. Strengthened resilience through more sustainable energy use, enhanced energy security. Also improved resilience to increasing drought due to the possibility of pumping water. Job creation. Substitution of kerosene lamps & diesel generators mean possibly decreased CO^2 emissions & improved health outcomes.

Cost structure

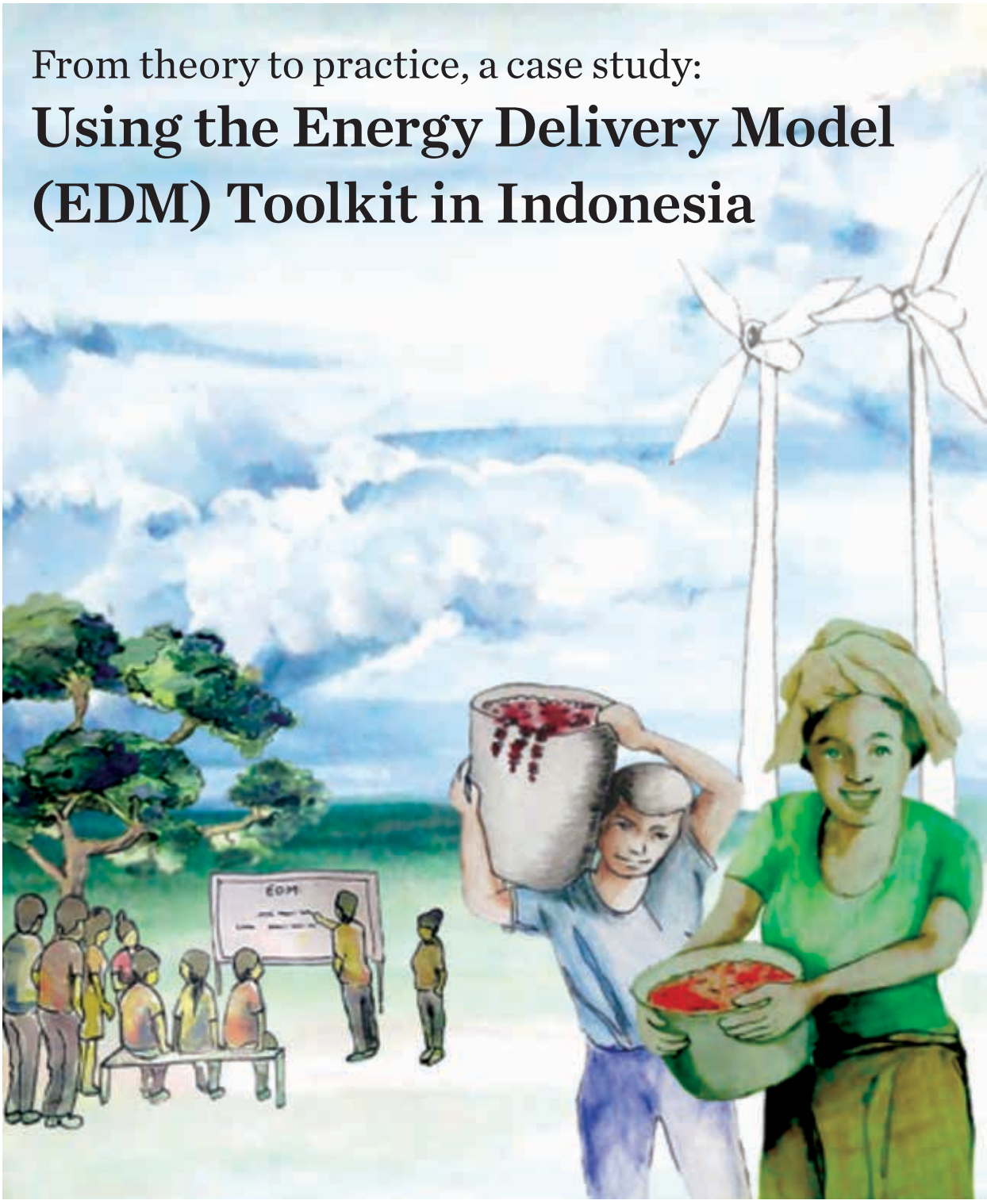
What are the biggest costs of delivering the energy service? Eg Fixed costs (salaries, rents and utilities); variable costs (depending on the amount of goods produced); economies of scale; economies of scope (incorporating other businesses).

Which resources required are the most expensive? Which activities are the most expensive?

Example: The most important costs are supplying the SHSs and appliances, and ongoing repair and maintenance.

From theory to practice, a case study:

Using the Energy Delivery Model (EDM) Toolkit in Indonesia



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4. From theory to practice, a case study: Using the Energy Delivery Model (EDM) Toolkit in Indonesia[10]

To further develop the EDM approach and test it on the ground, CAFOD and IIED partnered with the Institute of Essential Services Reform (IESR), a regional partner of CAFOD in Southeast Asia. IESR is a development organisation with considerable expertise in climate and energy policy and service delivery to poor communities, based in Indonesia. This stage of the collaboration resulted in the development of the six-step design approach and further refinement of the two supporting tools to produce the 'Energy Delivery Model (EDM) Toolkit'. The EDM toolkit has also been used in Kenya to review an existing energy service (see Rajagopal *et al.* (2017).

The EDM collaboration in Indonesia began in 2014 with research on the enabling environment for energy access in Myanmar, Cambodia and Indonesia, followed by workshops during April to May 2016 in the three countries to discuss the findings with stakeholders from government, private sector, civil society and academia. In Indonesia this included representatives from the Ministry of Energy and Mineral Resources (MEMR) and of National Development Planning (BAPPENAS), as well as the state electricity company Perusahaan Listrik Negara (PLN).[11]

The piloting of the EDM approach began with a four-day workshop in Bogor, Indonesia in April 2016 on 'Designing energy services that work for people living in poverty'. Participants included representatives of government (MEMR, BAPPENAS, plus Energy Patriots[12]), international and local NGOs involved in delivering development programmes, and energy practitioners.

During the workshop, various participatory approaches to designing energy projects for poor people who live in remote areas without access to modern and reliable energy services were discussed, and participants shared their experiences from the Indonesian context. They were also introduced to the EDM approach and tools. The workshop and follow-up activities provided valuable inputs for adapting the EDM approach to suit the Indonesian context. Participants at the workshop also developed criteria for choosing potential pilot locations for an EDM design. The five criteria developed were as follows:

1) An energy service will deliver high development impact and added value for the local community
2) There are synergies/opportunities to align the project with national and local government programmes
3) The location is not too remote to avoid inflating project costs
4) There is a trusted local partner (NGO or CBO) working in the community
5) There are stakeholders in the value chain with sufficient capacity to support the design process

Using these criteria, seven potential locations in East-Nusa Tenggara (NTT) Province were selected for further analysis by IESR, using phone interviews and basic field data (gathered by

Opposite page: Watercolour illustration. Credit: IESR

10. Applying the EDM toolkit in practice was carried in out in Indonesia working with national partners the Institute for Essential Services Reform (IESR) and the Indigenous Peoples Alliance of the Archipelago (AMAN)..
11. An updated version of the enabling environment study in Indonesia will be published by IESR in 2018.
12. The Energy Patriots scheme is a programme of the MEMR that deploys graduates to live for a year in remote parts of the country (105 villages across 39 districts) to assist communities with renewable energy infrastructure, to identify problems with existing infrastructure, and to facilitate new projects by the Directorate General of New Energy, Renewable Energy and Conservation (EBTKE).

Drying coffee beans, Boafeo, Indonesia. Credit: Project photo

workshop participants). NTT Province was chosen because it has the highest levels of energy poverty in Indonesia,[13] and because the region is being targeted by national and local government as a priority for accelerating energy access, principally under the Bright Light Indonesia programme or Program Indonesia Terang (PIT).[14] After this analysis, the seven locations were reduced to three. IESR carried out field visits to these locations and did a baseline survey using the Participatory Rural Appraisal (PRA) tools outlined in **Annex 2**. The final location selected after the field visits was Boafeo village in Flores Island, NTT Province. The organisation proposing Boafeo as a location for the pilot was the Indigenous Peoples Alliance of the Archipelago (AMAN), an Indonesian organisation that promotes indigenous rights with a regional office in Ende, the main city of Flores. Nationally, AMAN supports livelihoods programming and has a cooperative in Bogor that sells produce from indigenous communities. AMAN Ende has been assisting the Boafeo village government with participative mapping of indigenous lands.

Boafeo community: a brief background

Boafeo is in a remote, mountainous area in Ende District, Flores Island in NTT Province, about 55km from the regional capital (Ende). It takes 2.5 to 4 hours to reach the capital by motorbike, depending on the weather. The only public transportation between the village and the capital is by truck. Local people call this service 'OTTO' and it operates once or twice a week. Sixty per cent of the road infrastructure between the capital and the village is in poor condition, although some paving has recently been carried out.

OTTO, the only means of public transport available. Credit: Project photo

Boafeo village in reality comprises two hamlets (Boafeo and Gego/Wolomari). The distance between the two hamlets is about 1km and they are connected by a very poor road. All the public facilities such as schools, community health centre, church and village chief's office are in the main hamlet. After gathering the initial baseline information (see **Section 5**), the following facts about the community were established.

13. The electrification rate in NTT Province is only 58.64 per cent and electricity use in 2015 was at the very low level of around 90kWh per capita, compared to the average national rate of around 630kWh. Most of Indonesia's 2,519 villages without access to electricity are in this region.
14. The Program Indonesia Terang (PIT) programme is an initiative by the Government of Indonesia to provide reliable and sustainable electricity to remote and underdeveloped villages. It aims to provide electricity to 12,600 villages using renewable energy by 2022. The focus of the programme is villages that do not yet have a reliable electricity supply, namely, those that have not been reached by the grid; that depend on unreliable traditional diesel generators; or that have no electricity supply at all. The initial phase of PIT will focus on eastern Indonesia, which has the highest levels of energy poverty, including NTT Province where the EDM project is being implemented. The purpose of PIT is to increase the current electrification ratio from the current level of 85 per cent to nearly 100 per cent by 2019 through the development of local renewable energy sources. MEMR expects to accomplish this goal by leveraging available renewable energy resources, which includes, but is not limited to, solar PV and hydropower.

There are 639 inhabitants and 122 households in the village. Nearly 70 per cent of families have direct kinship relationships. The average house size is 50 to 80 m^2, with two or three bedrooms, a living room/shared space, a kitchen and an outside toilet. Sanitation facilities are poor. There is a neighbouring village with over 100 households about 2km away, and another one with over 150 households about 4km away.

The village administration system in Boafeo is democratic. Inhabitants choose their village chief by direct election every six years. The village has a village chief (Kepala Desa), and two village officers (the Rukun Warga (RW) and Rukun Tetangga (RT)).[15] The village government is the lowest level of Indonesian government, overseeing community life day to day and contributing to development at village level. Relationships in Boafeo village are built on a system of coordination and participation. Thus, development work or any activity always begins with a village consultative meeting, so that the inhabitants have a sense of shared ownership, and projects are based on agreement.

The customary elders are also very influential in any decision making related to development, especially regarding the use of indigenous land. The village council, Badan Permusyawaratan Desa (BPD), is also active. Women are represented by Family Welfare Guidance or Pembinaan Kesejahteran Keluarga (PKK). The PKK in Boafeo village is quite active, including in supporting the pre-school and the Maternal and Child Health Centre.

The villagers are subsistence farmers, growing dry paddy, maize and cassava for their own use. They also have chickens, pigs and, in some households, goats or cows. Their rice production is usually quite poor and insufficient for domestic consumption, so villagers buy additional rice in Ende market. They sell chickens and pigs in the local market, and occasionally cows. They also grow candlenuts, coffee, cloves and cocoa as cash crops.

Current coffee production is low, and the farmers want to increase production in the future. Coffee is harvested once a year (generally June to September/October). The coffee is sold in the form of green beans to wholesale companies through middlemen who visit the village regularly or middlemen in Ende. A small amount is sold by some of the village women in the local market town in powdered form. Some farmers use diesel-based generators for grinding but only a few farmers have their own machinery (with a combination of de-shelling and grinding functions).

Welcome ceremony with community elders.
Credit: Project photo

15. Rukun Warga means 'harmonious citizen' and Rukun Tetangga means 'harmonious neighbourhood'.

Women shelling nuts manually.
Credit: Project photo

The average income in the village is approximately Rp. 1, 000,000 (US$76) per month per household, and the income range is between Rp. 600,000 and 1,500,000 (US$67–115) per month per household, depending on the size of the individual farm and the economically active members. The main income is generated from selling candlenuts, coffee and cocoa. Candlenuts are processed manually during the day and at night, usually by women. At night the work is done in very dim light due to poor quality lighting from the household's SEHEN solar home system (SHS)[16], or candlelight. A family can harvest 100–200kg of candlenuts every month and unlike coffee, the nuts are harvested all year round. The farmers sell their yields at the market twice a month. Women also weave a small number of baskets by hand to sell. Women are also responsible for cooking food and boiling water for family use on traditional stone fires. Women and children collect firewood and most of the trees nearer the village have been cut down for this purpose.

There is currently no access to grid electricity in the community – the nearest transformer is 25km away from the village. In 1992 the village government bought a generator to provide public lighting, but it broke in 1995. Apart from the SEHEN systems (see below), a few wealthier households have small generators. Cooking is done using traditional three-stone fires, and there was no evidence of any households using cleaner cooking appliances.

In 2013 the villagers made a down-payment of about Rp. 250,000–500,000 (US$19–38) to PLN for SEHEN SHSs with monthly payments of Rp. 30,000 (around US$3) per month, and a contract period of two to three years. The monthly payment was made through a local collection agent. However, according to the community the agent kept changing and could not produce identification to show he/she was the official agent, so most SEHEN owners stopped paying after six months.

Most of the SEHEN systems in Boafeo no longer function because of lack of maintenance and limited local availability of parts to repair them. There is no communication or interaction between PLN (or its agents) with the community with respect to these systems. Even when working, SEHEN systems provide lighting only for two to four hours at night, and villagers complain about the poor quality and coverage of the lighting. It is not bright enough for studying or for productive work like shelling candlenuts in the evening.

16. SEHEN is a small solar home system (15Wp) with three lamps (@3Watt LED) whose brightness level can be adjusted (by 10 per cent, 50 per cent and 100 per cent). In 2013 the national power company, PLN, distributed about 60 units of 'SEHEN' solar home systems to Boafeo.

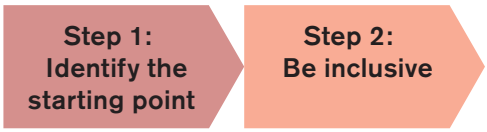
Methodology

The design process was carried out over a six-month period to build understanding and buy-in from the Boafeo community and ensure a robust and sustainable energy delivery model design. The process began with initial fieldwork or 'baseline' research, followed by three community workshops each lasting three to four days. Each community workshop covered around two of the six-step design process. Between each workshop, additional data gathering and analysis were carried out.

Prior to each community workshop, a workshop was held between the designated resource team from CAFOD, IESR and IIED, and the team from the local partner organisation, AMAN, to build a shared understanding of the EDM process and tools, prepare the community workshops and share findings of additional data gathering. A key part of these workshops was developing 'soft' skills such as facilitation to support the community's participation in the EDM design. Given the iterative, problem-solving nature of the process, it was essential that the facilitators could help participants understand the approach, and progressively learn how to apply it. Appropriate, culturally sensitive facilitation skills were also extremely important for challenging participants' assumptions. During the capacity building workshop, the future facilitators role-played using the Canvas and Map tools with the community, then discussed as a group any challenges and ways to overcome them. This built the confidence of the facilitators as they had rehearsed each session of the subsequent community workshop, taking turns playing the facilitator role and discussing each other's' performance. A professional facilitator was also employed to lead the partner and community workshops, give facilitation-skills training to the AMAN facilitators, as well as provide ongoing group and individual feedback and support during the community workshops.

The community workshops used a mixed format. They usually began by introducing or recapping the stage or step of the process the participants had reached, including what had been achieved. The next step and associated activities were then presented by the resource team and lead facilitator, followed by group work by participants which they subsequently presented back to plenary for further feedback and discussion. The resource team also circulated during the group work to provide extra support or challenge group assumptions, and gave feedback during plenary. The Delivery Model Canvas and Map tools were translated into the local language and displayed in poster-size format on the walls to serve as a further reference point for participants. In addition, simplified questions from each section of the canvas were used to facilitate discussion for **Step 4** of the process.

The progress through the six-step design process can be summarised as follows:



STEPS 1 and 2 – Identifying the starting point and being inclusive

- **Initial baseline research (October–November 2016)** – The initial baseline consisted of desk research and interviews with key local stakeholders, followed by a three-day community visit by AMAN to carry out a Rapid Rural Appraisal (RRA). AMAN was trained by IESR to use some standard Participatory Rural Appraisal (PRA) tools such as village mapping, stakeholder analysis, seasonal calendar analysis and basic livelihoods analysis. There was also ongoing capacity building on using PRA tools to support further data gathering and ensure meaningful participation by the community after the initial 'rapid' data gathering. Methods used for data collection included household surveys, semi-structured interviews, focus group discussions (FGDs) and collaborative observation.
- **Community workshop 1 (December 2016)** – A three day visit to the community was carried out by AMAN and IESR aimed at relationship building with key stakeholders (eg elders and village government); building understanding of the EDM process and getting community buy-in; and setting expectations about the process. A workshop introduced the community to the EDM approach and clarified what an EDM design could and could not deliver. The baseline data gathered was discussed and verified, and initial discussion on community needs related to energy (with the theme 'my energy dream') carried out (**Step 1**). A work plan was developed for the EDM design process and an agenda agreed for the second community workshop. Initial stakeholder mapping was also carried out, including to select the participants for the January workshop and ensure the inclusivity of the process, with subsequent more detailed stakeholder mapping and interviews were carried out by IESR (**Step 2**).

STEPS 3 and 4 – Building understanding, designing and testing

- **Community workshop 2 (January 2017)** – A four-day workshop aimed at deepening community understanding of the EDM approach and the toolkit (six-step design process and Delivery Map and Canvas tools). The needs discussed in the first workshop were further explored in relation to the community's wider development needs, the priority needs and specific energy and non-energy gaps were identified (**Step 3**). Potential solutions were developed and expressed as draft value proposition(s) that could meet multiple needs. Using the EDM tools), participants further developed the value proposition, including discussion of the delivery infrastructure, key stakeholders and their influence/interest in the proposed solutions, and accounting (**Step 4**). Data gaps were identified and a plan for further research developed, including the further stakeholder engagement needed to test and refine the value proposition. Community awareness-raising around different types of energy technologies (including pros/cons and 'myth busting') was also carried out, which helped in building a shared understanding of the proposed solutions.

- **Further data gathering and analysis (April to May 2017)** – Data gathering as well as further analysis was undertaken to fill the data gaps and refine and test the three initial value propositions (VPs) (such as value-chain analysis, quantification of costs and revenue streams of different activities and inputs, and so on). There was also further engagement with key stakeholders. Both qualitative and quantitative data-collection methods were used, with primary and archival research. The former included interviews with selected respondents from the target end-user groups and other stakeholders, using questionnaires and semi-structured discussions, as well as FGDs. Mini technical feasibility studies were carried out for technology options (eg potential for micro-hydro – see **Section 6).**

STEPS 5 and 6 – Optimising and review, preparing to implement

- **Community workshop 3 (June 2017)** – This three-day workshop aimed to review and validate the findings of the field research conducted since the last workshop and build a shared understanding of the findings in relation to the three priority needs, the VPs, and detailed solutions. The community optimised and reviewed the design of the three delivery models, including understanding the synergies between them, and identifying and mitigating potential risks. There was also a discussion to try to manage expectations on what the solutions could – and could not – deliver. Finally, an implementation start-up plan was discussed.
- **Follow-up community engagement (August to December 2017)** – The project partners, particularly AMAN and IESR, have ongoing engagement with Boafeo community and other relevant stakeholders to further develop the implementation plan, socialise it, and integrate it into community development planning. Once this has been fully developed, implementation activities will begin, including obtaining finance for specific activities and inputs.

Sections 5 to 7 describe the six-step design process undertaken in Boafeo in more detail, including the tools used at each step, and the outcomes from the community workshops and findings of additional research. The aim is to show how stakeholders were engaged; how community needs were identified; the iterative nature of the process and how this builds end-user understanding and ensures buy in to the process and solutions developed; and how the ability of the end users and other stakeholders to problem-solve, including to proactively identify their individual and collective contributions to the solutions, increased over the course of the six-step process.

Coffee farming in Indonesia. Credit: Rik Thijssen

5. Case study – identifying the starting point and being inclusive

Step 1: Identify the starting point → **Step 2: Be inclusive**

STEP 1: IDENTIFY THE STARTING POINT

Identify the entry point and approach to be used for providing an energy service to a particular group of people (potential end users). *Which organisation or group is starting the process and what do they want to achieve?* Carry out initial data gathering.

STEPS 2 – BE INCLUSIVE

Map out all the relevant stakeholders who will participate in the design process and build their awareness of the process and its aims.

The overall **starting point** was the shared desire of CAFOD, IIED, IESR, and AMAN (national and regional branches) as a group of development organisations to test the EDM toolkit and to meet the priority needs of Boafeo community. Each of these stakeholders has slightly different motivations. In terms of the Indonesian partner organisations, IESR are interested in learning how the EDM toolkit can be used more widely in planning energy service delivery for last-mile communities in Indonesia – for example through embedding it in government planning at district or provincial level. AMAN has a responsibility to deliver benefits to its members, so it is interested in learning whether EDM can be used in designing its programmatic work such as improving income of indigenous community farmers by upgrading agricultural value chains.

The methodology for gathering the initial baseline information by IESR and the AMAN Ende team was desk research and interviews with key local stakeholders (eg district government officials). At this point, there was no direct contact with the local community. The baseline information required was as follows:

- Basic geographical information about the village: its distance from the nearest centre of population, transport links such as roads, condition of transport and communications infrastructure etc.
- Basic socio-economic conditions in the community: number of households, population disaggregated by gender, occupations of the inhabitants (eg subsistence farmers etc.), education level and average income, differences in income levels among the community members etc.
- Agricultural production systems (plantation, seasonal crops), water availability, and natural resources available
- Social structures (leadership structures and customs), level of social cohesion
- Presence of external stakeholders in the community, eg activities being carried out by local NGOs, local government, private businesses etc.
- Existing energy infrastructure; number of households with access to electricity and details of energy source (eg standalone diesel generator, solar home system etc.); community's knowledge of different types of energy infrastructure, products and services etc.

After the initial data had been gathered (see summary in **Section 4**), IESR and AMAN made a three-day site visit to the community. The aim was to gather more detailed data on the community and the local context, to further evaluate and validate the initial baseline data, and to carry out a basic needs assessment with the community to identify their development needs and the energy and non-energy gaps preventing these needs being met.

IESR working with facilitators from AMAN used a simplified version of **Rapid Rural Appraisal (RRA)**[17] to carry out the needs and wants assessment, using the following data-gathering methods:

- **Household survey** with 50% of the community (approximately 60 households (HH).
- **Semi-structured interviews** with key end users including the village chief and other members of village government, elders, the women's group, the village health officer, school teachers, local business owners and clerics or religious leaders.
- **Focus group discussions** (FGDs) with the end users. As far as possible, all village stakeholders were equally represented and actively engaged in the process.
- **Collaborative observation** of community activities.

As part of the FGD, some standard PRA tools were used to gather more information. These included identifying basic livelihood types and doing village and local stakeholder mapping, a seasonal activity calendar, and producing a history of energy access in Boafeo (see **Annex 2**). All the findings were presented to the community and discussed with them.

A further visit to Boafeo and the wider district by IESR took place in December 2016 to carry out a more detailed stakeholder mapping and inform relevant stakeholders about the piloting process to build buy-in and trust (**Step 2**). This included discussions with district- and provincial-level government officials such as the administrative head for Ende District, the MEMR, the state electricity company (PLN), the Office for People's Empowerment (Badan Pemberdayaan Masyarakat), parliamentarians, local bank and cooperative offices and the local cultural and religious leaders.

In advance of the first EDM workshop held with the community, IESR held a capacity building workshop with the AMAN team to build their understanding of the rationale for the EDM project and the EDM design process and to prepare the community workshop. This involved the following:

- **The context of energy poverty in Indonesia.** AMAN had not worked directly with its members on delivering energy services so an introduction to energy poverty and the enabling environment for energy access in Indonesia was given.
- **Introduction to participatory design of energy services and the EDM approach.** The background to the EDM approach and its rationale was explained, as well the EDM toolkit.

17. The initial data gathering done as part of **Step 1** of the process used Participatory Rural Appraisal (PRA) tools, but given the rapid nature of the data gathering, it can better be described as a Rapid Rural Appraisal (RRA). Capacity building with the local partner AMAN on using PRA tools continued throughout the project so they could carry out further data gathering and ensure community participation in these activities. Given this subsequent data gathering was more meaningfully participatory, the use of these tools is subsequently referred to as 'PRA'. See also **Annex 1**.

- **Introduction to Participatory Rural Appraisal (PRA).** The approach and specific tools for carrying out PRA were discussed. The AMAN team were also trained on how to carry out triangulation during data gathering.
- **Facilitation-skills training.** AMAN staff were given training to support community participants' engagement with the EDM process, including on asking open-ended questions, soliciting end users' opinions, and questioning assumptions.

An initial, two-day community EDM workshop took place in December 2016 to introduce and begin the EDM design process, set expectations and agree ways of working. It involved both process and content-related activities, as follows:

- Engaging with key stakeholders in the village (eg elders and village government) to get their buy-in to the process, relationship building and setting expectations with the whole community
- Basic introduction to the EDM approach and building understanding of its aims (including what it could and could not deliver)
- Developing a work plan for the EDM design process, and an agenda for the second EDM workshop to be held in January 2017
- Stakeholder mapping to select the participants for the January workshop and ensure it would be as inclusive as possible
- Community validation of the baseline data gathered to date, and further data collection at the workshop
- Initial mapping on end users' energy 'needs and wants' and identification of potential energy and non-energy gaps – framed around an interactive exercise on 'my energy dream'.

The initial mapping of end-user energy needs and wants was a useful first activity to stimulate community discussion and build understanding of the nature of the EDM process, as well as generating useful information on potential energy and non-energy gaps. Energy needs were clustered around five themes: public services, economic or livelihoods, education, health and household needs.

It was interesting to note that many of the needs identified were expressed in the form of a perceived solution to a problem, rather than as the actual need itself – for example, workshop participants described one need as 'a rice cooker', though this was later replaced by 'cleaner and more efficient cooking'. At this initial stage and given the time available, the aim was to stimulate discussion ahead of a more in-depth analysis of end-user needs as part of the second workshop. **Table 1** illustrates the energy needs and gaps expressed in this workshop.

Table 1 – Initial community needs, energy and non-energy gaps

Category	Needs	Energy gaps	Non-energy gaps
Public services	1. Public lighting: a. Streets, village hall b. Church 2. Power for computer in village office	Can be filled by village generator being used more often No grid connection	Poor transportation access
Livelihoods	1. Candlenut processing machine 2. Coffee processing machine 3. Experts 4. Better market access	Currently there are a few machines owned by individuals for coffee shelling and grinding, which are powered by a generator. There is no other form of power for mechanical processing.	1. No mechanical way to process candlenuts 2. Coffee-shelling machines do not cope with the full capacity of the crop. The grinding machines are working but are old. 3. There is a machine for hatching chicken eggs – it is not used due to lack of power
Education	1. 24-hour lighting for studying in the school and houses 2. Power to run a computer, AV equipment etc. 3. Skilled human resources to operate the equipment 4. Training to improve teachers' skills 5. Training about renewable energy and environmental impacts	Electricity for lighting 6 rooms for minimum of 5 hours Power to support learning process – projector and laptops for minimum of 5 hours	1. Whiteboards 2. Chalk 3. Notebooks and pens 4. Tables, chairs 5. Classroom infrastructure (AV equipment) 6. Library 7. Books for students
Health	1. Sufficient health facilities including: • Premature infant care unit • Lighting for clinic • Refrigeration • Power for incubator • Hot water for sterilisation • Computer • Trained staff • Transport for staff	No electricity for clinic functions: lighting, refrigerator, oxygen tube, LCD, computer, television, car, energy for incubator, sterilisation. Total energy needs - 26.7kW per day	No trained midwife in village No doctor in village No transport for staff
Household	1. Rice cooker 2. Lighting for studying, cooking, sewing, shelling candlenuts at night 3. Entertainment and Information, news: TV, radio	Fuel/power for cooking (currently firewood) No electricity Some HH have SEHEN SHS (provided by PLN) but they provide lighting only for 2–4 hours at night and it is poor quality. Also most SHSs are broken. Power for watching TV or listening to radio.	Gasoline is expensive

6. Case study findings – building understanding, designing and testing

Step 3: Build understanding → **Step 4: Design and Test**

STEP 3: BUILD UNDERSTANDING

Explore the target end users' needs and wants and their context in more depth. Understand their priority needs and the energy and non-energy 'gaps' preventing the needs being met. Brainstorm potential solutions and identify the 'value added' of an energy service. Develop a value proposition.

STEPS 4: DESIGN AND TEST

Explore in depth potential solutions (energy delivery models) using the EDM tools. Understand who will do what, and the various outputs and activities needed. Test out the value proposition/ different solutions by challenging your assumptions and gathering further data.

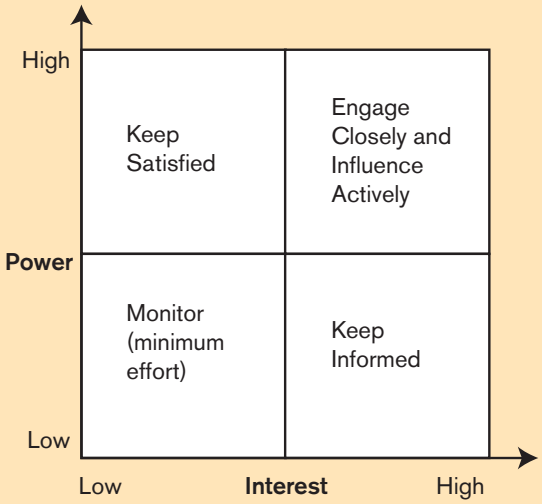
The EDM workshop in January 2017 covered **Steps 3** and **4** of the design process. As in December, a four-day community workshop was preceded by a preparatory workshop with the AMAN facilitation team. The community workshop developed draft value propositions describing the energy service and its anticipated impacts and, based on more detailed discussions of end users' needs and wants, the energy and non-energy gaps. The Delivery Model Canvas tool was used to further explore and develop in detail the value propositions. This included analysing how the VP would be delivered (the 'delivery infrastructure'), financial costs and revenues, as well as its social and environmental costs and benefits ('accounting'). After the workshop, additional research was carried out to test the value propositions in more detail and further develop the solutions.

The preparatory workshop with AMAN staff involved:

- Reviewing the EDM workshop in December 2016 – its results, challenges experienced and so on.
- Building the AMAN team's understanding of the EDM toolkit. The six-step process was covered in detail with exercises to build and test their understanding of each step, as well as capacity building on stakeholder mapping (see **Box 4**), identification of end-user needs and developing a value proposition. The aim was to build the team's familiarity with using the EDM Canvas and Map and how to build the community's understanding and test assumptions during the subsequent workshop.
- Further training on facilitation skills.
- Finalising the detailed agenda and methodology for running the community EDM workshop.

BOX 4 – Mapping stakeholder influence and interest

A Stakeholder Influence/Interest Chart (see below) can be used to represent visually the level of interest of different stakeholders in supporting delivery of the energy service or solution(s), as well as their level of influence or power to do so. This can inform the development of a stakeholder engagement plan, including identifying potential champions and blockers, and which stakeholders it is most important to engage to ensure the EDM can be successfully implemented.



Source: Overseas Development Institute (2009). Planning Tools: Stakeholder Analysis

The second community EDM workshop was held in January 2017. This was a four-day workshop that aimed to:

- Validate the findings of the December 2016 workshop
- Build community understanding of the constraints of the EDM project (ie what it could and could not deliver)
- Build a shared understanding of the key stakeholders and their relative interest and influence in supporting the EDM
- Deepen community understanding of the EDM approach and the toolkit (six-step process, Delivery Map and Canvas tools)
- Further explore and refine the end users' priority needs discussed in the first workshop and identify the specific energy and non-energy gaps (**Step 3**)
- Identify potential solutions and develop draft value proposition(s) that could meet multiple needs; using the EDM tools (**Step 4**) to deepen understanding on how to deliver the value proposition, including delivery infrastructure and accounting
- Identify data gaps and further research needed, including stakeholder engagement, to test and refine the value proposition.

Table 2 – Community needs, impacts, gaps and solutions: sample from HH level

Energy dream	Needs	Impacts	Energy gaps	Non-energy gaps	Possible solutions
1. Clean and safe cooking	1. Clean fuel / modern cooking appliances	1. a. Better health outcomes especially for women and children b. Women have more time for productive and leisure activities	1. No electricity or other type of clean fuel	1. a. No appliances eg stove, rice cooker b. Cultural preferences for food cooked over open fire c. Health facilities poor in village and minimal awareness of health issues related to cooking	• Cleaner fuel eg LPG • More efficient cookstoves
2. Lighting for studying, cooking, sewing, shelling candlenuts at night	2. Better quality light for longer	2. a. Easier for children to study or for adults to carry out leisure or productive activities (for women – shelling candlenuts or sewing) b. Better family life	2. No good- quality or reliable lighting sources, only kerosene lamps and SEHEN SHS (most lamps are broken)	2. a. Women don't have time for leisure b. Few children have books at home c. No-one knows how to repair the SEHEN SHSs or where to source spare parts	• Other appliances (rice cooker) • Better lighting solution eg new SHS
3. Access to modern entertainment and information	3. TV, radio and computers	3. a. Individuals and communities will be more informed b. Children can access learning resources c. Families can enjoy new forms of entertainment d. Negative impact on community life of village/children (fewer communal activities in village hall?)	3. No power source for TV, radio, computer	3. a. No HH have TVs, few have radios and laptops b. No internet access in village	• Get a system to power TV etc. • Village sets up fund to buy a TV and computers for village hall • Village gets internet access

Community EDM Workshop, Boafeo, June 2017.
Credit: Project photo

After further discussion on the EDM process and the toolkit, participants were asked to revisit the previous 'energy dream' exercise and the five categories of needs identified (**Table 1**). They were asked to think in more depth about the specific problem or need identified and what the impact(s) on their lives would be if this was resolved. They then explored the 'energy gaps' and 'non-energy gaps' that were preventing this need being addressed. After this work, a final column was added to **Table 1** for 'solutions' and participants were encouraged to discuss these (see **Table 2**). The rationale for this exercise was so that the participants did not immediately jump to discussing solutions without fully exploring their needs and the gaps (as had happened in the first community workshop).

Throughout this exercise, the facilitators' role was to challenge the assumptions that were rife during the discussion on needs, gaps, and solutions. 'Assumption' was one of the most-used words in discussions during the first few days of the workshop. The tendency of participants to jump quickly to a solution was gently challenged, and they were encouraged to formulate additional questions to explore in more depth the assumed gaps. After group work and plenary discussion (each group worked on one area of need, eg education), the community was asked to identify their priority needs from all the needs identified in each development area (eg education, livelihoods). Each participant voted on these using stickers and selecting their 'top three choices'. **Table 3** shows a snapshot of this prioritisation process: the top choices within each development area are highlighted in red and the overall number of votes received per area are in the right-hand column.

Table 3 – Initial prioritisation of Boafeo community needs

Sector	Priority needs	Votes
1. Education	1. More interactive teaching to improve primary-school children's learning 2. More competent teachers 3. Lighting for the school – inside and outside areas 4. Improved access to school – paving and steps	27 votes
2. Household	1. Better quality HH lighting 2. Safe and clean energy for cooking 3. Better access to information 4. More efficient ways of doing laundry	35 votes
3. Public services (includes health)	1. Better health-clinic facilities 2. Better street lighting 3. Better lighting in church 4. Better transport access	8 votes
4. Livelihoods	1. Increase farmer income from coffee farming by increasing crop quality 2. Increased farmer income from coffee farming by increasing productivity 3. Increased farmer income from candlenuts by increasing productivity 4. Increased farmer income from candlenuts by processing (eg producing oil) 5. Increased farmer income by growing a new crop 6. Increased farmer income by producing coffee wine	22 votes

The top three priority needs selected for Boafeo community (indicated in red above) were:

1. Better quality HH lighting (25 votes)
2. More interactive teaching to improve primary-school children's learning (18 votes)
3. Increased farmer income from coffee farming by improving crop quality (10 votes)

These priorities were not fixed at this stage, and were revisited throughout the workshop and further explored in view of the findings of additional research. However, they indicated the three main areas that the community prioritised as needs.

Further prioritising needs and impacts

Further group work was carried out in which the participants chose to work on one of the three priority needs based on their relevant experience, skills and interest. They further explored what the impacts of meeting these needs would be, and any energy and non-energy gaps that needed to be addressed. Finally, they looked at potential solutions to address the gaps. This immediately highlighted the need to be more specific about the priority need, and the gaps were preventing it being met.

Table 4 – Priority needs and impact assessment

Need	Impact	Energy gaps	Non-energy gaps	Solution
Better quality HH lighting	1. Easier for children to study 2. Easier for adults to carry out leisure or productive activities (for women – shelling candlenuts or sewing/weaving) 3. Better family life overall	• Insufficient lighting in school (in rainy season, only 3 hours, in dry season 6 hours) • Fuel (kerosene) for lamps is expensive • SEHEN SHS broken and give poor-quality light when working	• Will children have books to study? • Will having better light mean an increase in shelled candlenuts? • Will mothers have enough time to sew/ weave?	• Solar home system • Micro-hydro
More interactive teaching to improve primary-school children's learning	1. Teaching is better and more creative 2. Students learn more 3. Students' attendance increases 4. Students learn how to use technology	• No electricity for lighting or to power equipment in the school	• Lack of books for students • Lack of AV equipment • Lack of chairs and desks • Teachers are not trained well • Lack of materials for teachers • In rainy season, school gets muddy	• Get AV equipment • Get textbooks for students and materials for teachers • Teacher training • Repair school steps and access path, improve classrooms
Increased income from coffee farming by improving crop quality	1. Farmers could pay more for children's primary and secondary education 2. Farmers could send children to university 3. Farmers could buy more things for the house including TV, radio, computer 4. Farmers could buy more inputs for crops	• No electricity to power processing machinery for roasting and packing	• No coffee-roasting equipment • No coffee-packing equipment • The premium coffee market is unknown • Lack of farmer knowledge of coffee production and processing • Lack of marketing training • High transportation costs • No farmers' cooperative	• Buy roasting and packing equipment • Get power to run the equipment • Training on modern coffee processing • Get better inputs (fertiliser and seeds) • Cooperate with other village co-operatives and other partners to get training • Establish village cooperative

For instance, in relation to the need to increase income from coffee farming by improving crop quality, the group started to question whether increased income could be related to the quality of the crop (pre-harvesting) or also related to post-harvesting activities, and the need to improve their processing practices. This then led the group to clarify that the real need was to increase their income from coffee farming and they needed to analyse further where they could best add value to their coffee farming – by improving crop quality and/or increasing crop volume pre-harvest or improving post-harvesting processing. This highlighted the need to analyse and understand the coffee value-chain to identify the best solutions. The results of this group work are summarised in **Table 4**.

Using the Delivery Model Canvas – developing the value proposition and exploring end users

During the next phase of the workshop, the concept of the 'value proposition' was introduced in plenary. In groups, participants then further analysed the three priority need areas and developed a value proposition or propositions for each need.

The Delivery Model Canvas was used in a modified format to facilitate small-group discussion on the value proposition and 'end-users', followed by further discussion on 'delivery infrastructure' and 'accounting'. During all these discussions, the facilitators tried to draw out any issues related to socio-cultural factors and to the enabling environment. **Box 5** outlines a sample of questions and examples (based on previous workshop analysis) used by the facilitators to guide the discussion around some of the main categories and questions in the Delivery Model Canvas.

The EDM Canvas and Map tools were translated into Indonesian (Bahasa) and were displayed as wall posters. Feedback from the participants was that these visual aids served as useful reference points for them to check whether their group had discussed all the relevant issues.

The general format of this phase of the process was to start with a presentation on the task that the small groups would carry out, along with an explanation by the resource team (from CAFOD, IIED & IESR) of the relevant area of the Delivery Model Canvas and any other tools to be used, providing examples. This was followed by group work supported by the AMAN facilitators, with each group subsequently presenting back in plenary. Participants were invited to feedback on other group's presentations and this was followed by comments and further questions from the resource team. The resource team also circulated during the group work to support discussion, provide extra explanation or challenge assumptions.

BOX 5 – Sample guiding questions/tools used by facilitators for group work on value proposition and end users

Value proposition (VP) and end users

1) Who specifically is going to benefit from this solution? How and why?
2) Who else in the wider community might benefit? How and why?
3) Are there different benefits for men and women? How and why?
4) Is there anyone who may be impacted negatively? How and why?
5) Are there any values, ways of behaving or doing things, norms or customs that might affect the success of the VP? How and why? (For example, are there activities only women or men in the community do?)
6) What would be the advantages and disadvantages of having a cooperative for coffee production (for growing the crop/shelling/roasting/grinding/marketing, etc.) or running it as a private business?
7) What social or environmental impacts (positive and negative) will the VP have?

Sample VP statement

1. By:
   - Working with …….. to rehabilitate and add capacity to existing solar panels;
   - Buying new batteries and other electrical equipment from ……..and a projector and laptop from .....;
   - Developing a maintenance plan for the SHS working with.....;
   - Working with ……to provide interactive teaching materials and training for the teachers;

We will ensure the primary-school children have more interactive teaching and improve their learning outcomes.

2. By:
   - Working with ……to get the necessary processing power using a gen-set;
   - Getting machinery from ……for shelling, roasting and grinding;
   - Establishing a legal entity for the coffee farmers to work together (cooperative);
   - Working with ……to provide training for farmers on how to reach new markets (national/international) and advice on marketing, packaging and branding;
   - Working with ……to provide training on how to increase the productivity and quality of the coffee crop;
   - Working with ……...to develop a more affordable transport solution to access local markets;

We will improve the quality of the coffee and sell to new markets to generate more income for coffee farmers.

Analysing the delivery infrastructure

Participants were given an example to help them plan the delivery infrastructure for each value proposition. It was stressed that it was crucial to consider the supporting services needed for the energy service itself but also to meet all the other non-energy gaps identified. For example, questions such as the following were asked in relation to the education solution:

- How much electricity is needed to run the AV equipment?
- If the existing solar panel is sufficient but needs rehabilitation, who would do this?
- If a new system is needed, who will supply this?
- Do you need a permit for this system?
- How would it be maintained and repaired?
- Who will provide the interactive training activities and materials needed to support the teachers?
- What will the role of the school committee and the local education authorities be?

Box 6 outlines some of the facilitation questions used in this session.

BOX 6 – Sample guiding questions used by facilitators for group work on delivery infrastructure

Delivery infrastructure

1) What key activities does our VP require?
2) Which are the most important? Which are less important/not essential?
3) Are any of the activities in our VP could mean changes to authority structures or create conflict? How and why?
4) What resources do we need to fulfil our VP? (Financial/people/knowledge/things eg equipment, etc.)
5) What partnerships do we need to fulfil our VP? (For example, suppliers of equipment, trainers, buyers to reach markets, etc.) Why would these partners be interested in supporting our VP? What do they expect from us?
6) Are there government policies or regulations that could impact positively or negatively? (For example, special allocation fund, village fund, licenses needed to sell products, etc.)
7) Who in the supply chain is going to benefit and how from the VP?

To support the group work, a table format was used to identify the key delivery infrastructure activities, resources, and stakeholders responsible for each activity (see **Table 5**).

Table 5 – Sample of delivery infrastructure analysis for VP3 (increase farmer income from coffee by improving crop quality)

Key activities		Resources	Key stakeholders
1.	Discuss with village council and wider community how to pay for a genset	Possible funding from the village fund (Dana Desa/DD), state budget (APBN), village government (PEMDES)	1. Villagers, village government, village council (BPD) 2. BPD, village management (RT-RW), women's representatives, elders and religious leaders
2.	Discuss setting up a cooperative	Village fund (DD) for coop	1. Village government 2. Farmers
3.	a. Procure roasting machine (50kg capacity) b. Procure grinding machine (50kg capacity) c. Procure packaging machine	Village fund (DD) Grants from government agencies and NGOs; working with local banks	1. Suppliers – probably in Java
4.	Set up repair/ maintenance fund for the equipment Train technician	Individual farmer contribution Village fund (DD)?	1. Farmers 2. Equipment supplier
5.	a. Identify trainers on how to improve crop productivity and quality b. Identify trainers on processing c. Identify trainers on marketing d. Set up fund for training	Support from local village coops Individual farmer contribution Village fund (DD)? District government grant?	1. Training providers (farming cooperatives in the district, NGOs, Indonesian Chamber of Commerce, Coffee Exporters Association, or District Agriculture Office) 2. Village government 3. Farmers

The groups working on the coffee farming VP had a more difficult task, namely starting to analyse the coffee value chain to understand what interventions were needed to achieve the overall goal of improving coffee-farmer income. In this case, an energy service was potentially only a small piece of a much larger solution.

The group were supported to consider examples of different options for upgrading their coffee production – such as improving crop quality, increasing productivity, adding value from processing, accessing new markets or a mixture of these options. For example, if the farmers could improve their farming techniques, this could result in a greater volume of coffee produced per hectare and then sold through their existing main marketing channel (selling unprocessed or green beans via middlemen to wholesalers in the local capital, Ende) and increase their income. In addition, they could increase the quality of the coffee crop. This would potentially require new or better inputs (seed, fertiliser etc.), and training in improved picking techniques and post-harvest sorting and processing. However, their current market channel did not provide any price differential between good-quality and regular-quality coffee beans.

The Delivery Model Canvas questions helped the participants to realise that there were many potential ways to upgrade the coffee value chain and meet their goal of increasing farmer income. Each option would have different costs and benefits – effectively, each would have its own distinct value proposition.

At this point, a simple value-chain analysis tool was introduced to support the group discussions covering activities and outputs across the four stages of: PRODUCTION (farm level); PROCESSING (including sorting, roasting and grinding at community level); TRANSPORT (including selling to middlemen); MARKETING (different local, national and international markets and buyers, and their expectations and interests).

Participants were encouraged to think back along the coffee value chain, starting with marketing their crop. They had very limited knowledge of different market channels or of consumer demand, but the idea was to build understanding that they should not spend too much time analysing how to upgrade the value chain if there was unlikely to be any demand for their current or potential future products. Using the Canvas questions and value-chain tool, an animated debate developed in which participants' ability to pool their collective knowledge and systematically problem solve quickly improved. Participants soon recognised that they needed further information about, and analysis of, the coffee value chain and recognised the value of a more systematic approach to developing solutions for their priority needs.

Accounting – financial, social and environmental costs and benefits

The final session of the community EDM workshop covered 'accounting'. In groups, participants analysed the costs, revenue streams and social and environment costs/benefits pertaining to the delivery infrastructure identified as part of each solution. The participants were advised that they did not need to discuss in detail the minutiae of a specific cost or revenue stream – often this was unknown. There were participants who felt the need to 'come up with an answer for everything', but it was stressed that the important point was to identify the area of the delivery infrastructure where a cost might be incurred, or revenues generated, and a way to quantify these further.

Each group was encouraged to think at a 'top line' level about balancing cost and revenues, for example the need to pay for ongoing operation and maintenance costs for the delivery infrastructure. The community had highlighted in previous discussions the negative impact on the existing SEHEN SHS installed in the village from having no maintenance and repair service. Participants were therefore aware that for any new delivery infrastructure to be sustainable, a maintenance and repair service needed to be factored in. They were also aware that these types of costs were less likely to be covered by government or donor grants. Alternative payment schemes drawing on anticipated community sources of income or other potential funds soon became a focus for discussion. **Box 7** outlines some of the guiding questions for the group work on accounting.

BOX 7 – Sample guiding questions used by facilitators for group work on accounting

Accounting

1) Have we fully calculated all our costs? Does this include the cost of any inputs (eg equipment or fertiliser), operating costs, maintenance or other activity costs (eg training of technicians) etc.?
2) What are the essential activities needed to make our VP work – how much do they cost?
3) Which are the highest costs? Can we make savings and still deliver the benefit we want?
4) Are there any environmental costs (eg water pollution) or social costs (eg creating social conflict or jealousy between people)? Or benefits (eg women have more time or more income)?
5) Where will the revenues come from to pay for everything? Be precise – which source of revenue will pay for which cost?
6) Can end users (eg farmers) pay? If they don't want to, how do we build their willingness to pay?
7) Are there any possible subsidies from the government or other organisations (eg funds for cooperatives)? How do we get these?
8) Can the community contribute with things other than money (eg labour) to reduce costs? (For example, helping to install or maintain equipment, build infrastructure etc.)
9) What must we think about when setting up payment schemes and tariffs? (For example, farmers only have income in certain seasons.)

Table 6 – Sample of accounting for VP2 (more interactive teaching to improve primary-school children's learning)

Energy costs	Revenues	Non-energy costs	Non-energy revenues	Social/ environmental costs/ benefits
Procurement of new SHS for school (price is TBC)	1. Village Allocation (ADD) and School Fund (BOSS)? – but this is supposed to be for operations not infrastructure, and according to the number of students for a year. Total = Rp.73,600,000 per year 2. Village government? 3. Individual parental contribution?	AV equipment	Grant from NGO?	No environmental costs Social – power and AV equipment could be used for classes at night or for children or community leisure activities (eg showing films
Supporting service – maintenance/ repair a. School technician training (TBD) b. Repair fund (TBD)	School committee funds (provided by parents)? The total is number of students (92) X Rp.300,000 per year = Rp.27,600,000 per year			No environmental costs
		Teacher training – interactive methods	District Education Authority?	Social – better learning for children and additional training for teachers
		Interactive materials	Education NGOs (either in Ende or wider) Yasukel Foundation to advise	Social – better learning for children and additional training for teachers

The workshop concluded with a general discussion on what had been learnt in terms of understanding and refining the priority needs, and the related 'energy delivery model' as articulated in each of the three value propositions. There was also a discussion on next steps in terms of further data gathering needed, and the agenda for the third and final community EDM workshop.

Further data gathering and analysis to refine and test the value propositions

Between April and May 2017, IESR and AMAN (with support from CAFOD and IIED) conducted further field research and analysis on the three value propositions (VPs) for better- quality household lighting, more interactive primary-school education and increased income from coffee farming. This included further exploring issues and data gaps raised in the workshop; further engagement with key stakeholders; quantifying costs and revenues and so on.

Both qualitative and quantitative data-collection methods were used, and both primary and archival research. The former included interviews with selected respondents from the target end-user groups and other stakeholders, using questionnaires and less structured discussions, as well as focus group discussions (FGDs). Participants included Boafeo farmers, primary-school teachers, primary-school students, school committee, customary leaders, village government and government agencies.

For the household lighting VP, the following research was carried out:

1. Survey of household energy needs (with a focus on lighting)
2. Cost estimates and initial research on two possible technological solutions:
   a. Improved solar home systems (SHS). This should generate a sufficient level of lighting for general purposes in every room and brighter light in work areas for productive activities (eg shelling candlenuts). The SHS would provide enough power to power a larger size LED light, charge the phones, and run radios or audio equipment. For each household, an estimated 125–150Wp is needed to generate 0.4kWh power per day. The second option is a solar-powered mini grid solution for Boafeo and Wolomari hamlets (one per community). An estimated 18kWp is needed for Boafeo to give 0.5kWh per day (220V), and for Wolomari 8kWp of solar power.

   b. A micro-hydro system. A pre-feasibility study was carried out on water sources near the village, including monitoring water supply and conducting micro-site surveys; as well as estimates of construction costs; and discussions with the state electricity company (PLN). This activity was conducted by IESR and supported by AMAN staff, and was viewed as a quick way of determining whether micro-hydro was a technical solution sufficiently viable to take to a full technical feasibility assessment.

For the household lighting VP, the following research was carried out:

1. Separate FGDs with teachers, the Village Head, the school committees, primary-school children, the Catholic Foundation that had responsibility for the school (Yasukel Foundation), and the District Department of Education, in order to build a shared understanding of the needs, the energy and non-energy gaps, and the impacts the VP was aiming to produce. For example, whether there was a shared understanding of what interactive learning means and whether all the stakeholders perceived lack of this to be a key reason for the children's poor learning outcomes.
2. Mapping stakeholders and understanding the relationship between them. For example, the different roles of the Catholic Foundation and the Department of Education, and what support (financial, training, and so on) is currently being offered by each of these actors to the Boafeo school.
3. Identifying potential training partners to understand what support they could offer, estimate ballpark costs, and so on.

For the VP on increasing income from coffee farming, the following research was carried out:

1. Household survey to understand existing farmer production and post-production (processing and marketing).
2. Value-chain analysis to understand where improvements could be made. A local consultant was hired to do a more in-depth coffee value-chain analysis, based on coffee production in Boafeo but also with wider application to the surrounding district. Combining this with data already gathered, a much better understanding of gaps, potential solutions, and risks along the coffee value chain was developed.
3. Mapping stakeholders who could be part of new solutions and building relationships with them eg VECO (an NGO with experience in supporting coffee farmers with training); the local department of agriculture.

At the end of this data gathering and analysis, each of the VPs was developed to a much greater level of detail and specificity. In fact, for the VPs on increasing income for coffee farmers, and on better-quality household lighting, several different options were developed, each with their own value proposition.

A problem tree was subsequently developed for each VP that illustrated and summarised the main gaps or issues that needed to be addressed to meet the need, and then solution trees were developed. For those problems where there were multiple potentially viable solutions, several solutions trees were produced – for example for household lighting, one potential solution used micro-hydro, and the other used solar home systems. Each solution had different pros and cons, costs and risks. The problem trees and solutions were presented to the community during the third and final EDM workshop (see **Section 7**).

7. Case study findings – optimising and review, preparing to implement

STEP 5: OPTIMISE AND REVIEW

Think through the financial, social and environmental risks and how to mitigate them. Ensure that the EDM is sustainable, and that all the supporting services required are in place.

STEP 6: PREPARE TO IMPLEMENT

Finalise the EDM. Develop an implementation and a monitoring and evaluation plan. Once financing and other support is in place, move to the start-up phase, beginning with piloting the EDM.

The third EDM community workshop was held in June 2017, covering **Steps 5 and 6**. The format was the same as for the previous workshops, including a preparatory workshop with the AMAN team prior to the community workshop.

The aims of the community workshop were:

- To review and validate the findings of the field research conducted since the last workshop
- To share and build understanding of the findings and what this meant for the three priority needs, their value propositions, and potential solutions
- To optimise and review the design of the three VPs, including understanding synergies, and identifying and mitigating risks
- To manage expectations on what the solutions could – and could not – deliver
- To build a shared understanding of key stakeholders and their influence in delivering the various solutions
- To move towards implementation by preparing an implementation start-up plan.

Review of the EDM design process to date

The participants discussed what had been achieved so far, and their learning in terms of the most important/useful points in relation to carrying out the EDM design process. Some of the key learning was as follows:

- **The importance of identifying and addressing non-energy gaps.** Participants agreed that it was very important to think holistically and not focus solely on the energy gaps if the need or problem was to be understood and sustainable solutions developed. For example, in the case of the need for more interactive teaching to improve the learning outcomes of the primary-school children, the energy gap was a sustainable source of power and audio-visual equipment and laptops, with a maintenance and repair function. However, energy service alone would not be an effective solution in terms of meeting the need without addressing the non-energy gaps identified during the EDM process. These gaps included the lack of other types of equipment and materials in the school (books, audio-visual aids, and so on), and the need to improve teacher training (including on interactive teaching techniques) as well as

teacher motivation and retention. One of the key factors for poor teacher motivation and retention was that some of the teachers were not government-trained and were paid much lower salaries. Another important factor that emerged during the EDM process was that some of the children lacked basic literacy, and the teachers did not have the skills to address this problem.

- **The need for a detailed understanding of different end-user needs and solutions.** Through the design process, the participants developed a much better understanding of the nature of the community, which comprised different end-user groups with differing needs. Most notably, men and women had different perspectives and needs. End users also reported that they had gained through the process a much more nuanced sense of what was needed to deliver a solution, including what their own role and contribution could be, and had developed a more 'problem-solving' approach. For instance, in the case of the education VP, the community had identified that they could pay for the energy system maintenance, and generated ideas on how the issue of teacher retention could be addressed through their own efforts (linked to delivering additional income from coffee farming).
- **The need for systematic consideration of the aspects and impacts of delivery infrastructure options.** As above, participants developed a more nuanced understanding of the activities, outputs, stakeholders and organisational structures that were needed to develop and implement a viable delivery infrastructure. For instance, some participants had previously expressed a strong wish 'to have a micro-hydro' as the preferred solution for the household lighting VP. This was partly due to a mistrust of SHS (stemming from the failure of the existing SEHEN systems) but also because they had not considered in detail all the elements required to construct and operate a micro-hydro – for instance, installation, operation and maintenance - and who would pay for and carry out each of these functions. They had not considered fully the pros and cons of different options, including the much greater cost of a micro-hydro generating system over an SHS option.
- **The importance of accounting fully for all costs and revenues.** Through the EDM process, the participants had developed a much greater understanding of the need to cost each activity or component of the delivery model and identify realistic revenue streams to pay for it. Again, this led them to take a more proactive approach to identifying what individual and collective resources were available in the community, for instance whether the Village Development Fund could be used to provide loans to farmers to pay for training to improve the productivity of coffee farming and to buy inputs. This was a marked difference to earlier in the process, when participants' default response was to assume that external actors and organisations would pay for the solutions.
- **The importance of considering socio-cultural factors.** Participants became much more adept (or perhaps more comfortable) with discussing openly socio-cultural issues that were an aspect of the problem or priority need, or that might have an impact on finding a viable solution. For instance, they discussed whether creating a farmers' cooperative as part of the delivery model for the coffee farming VP would create tension with the middlemen who currently bought the farmers' crop, or with those villagers that owned coffee-grinding equipment. Socio-cultural factors were also evident in terms of community participation in the EDM design process itself. Although over a third of the workshop participants were women, at the beginning the women were very hesitant about expressing an opinion, particularly in

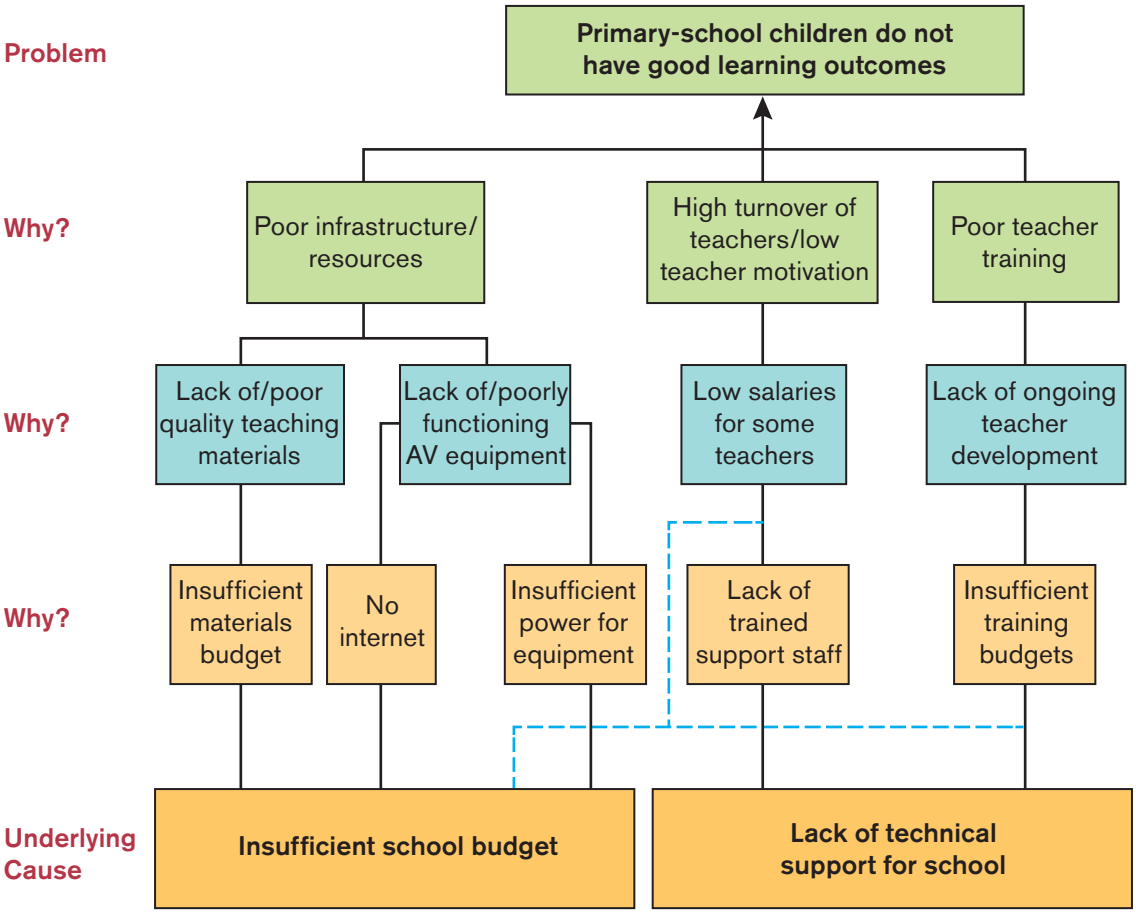
plenary discussions. As the workshop progressed they gained more confidence, partly due to facilitation techniques designed to solicit more equal participation. A decision was also made to hold separate FGDs with women participants outside the workshops to explore how their needs might differ from male participants, so these could then be brought back into the workshop discussions. Another example relates to the level of proactivity of the participants in terms of problem-solving or suggesting solutions. The tendency to look to external actors (the government or NGO partners, for example) to deliver solutions was as a socio-cultural attitude, linked to the fact that the community had had little opportunity to participate in development decision-making processes beyond the village level, which they regarded as 'top down' (as evidenced by the roll-out of the SEHEN SHS, for example).

Optimising the VPs and potential solutions

The results from the design process so far were integrated with the analysis and findings of the additional data gathering between March and May. This knowledge was summarised into problem trees and (one or more) solution trees for the three VPs (better-quality HH lighting; more interactive teaching to improve primary-school children's learning; increased income from coffee farming). The problem and solution trees were then presented to the community in the workshop. Both problem and solution trees were simplified graphic representations aimed at building end-user understanding and stimulating further discussion.

Group discussion during community workshop, June 2017. Credit: Project photo

Figure 6: Problem tree for improving learning for primary-school children through interactive teaching



The three problem trees were discussed in plenary before the solution options were presented. In terms of the solution trees, it was emphasised that the solutions were based on the findings of the participatory design process and the additional research and were not definitive. At this stage, each was a 'potential' solution and in some cases, there was more than one option – each with different pros and cons, costs and risks. The intention was to facilitate discussion on which solution was the most appropriate for the community so that they could make their own, informed choice. However, where the research had shown a potential solution as non-viable or having significant risks, these were highlighted as non-solutions during the plenary presentations.

Figure 6 shows the problem tree for improving the learning of the primary-school children through more interactive teaching, summarising the three basic aspects of the problem (see the second line) and then moving down to the underlying causes. There are three main 'sub-problems' that will need to be solved if the value proposition is going to be successfully delivered.

Figure 7: One component of the solution tree for the education VP: lack of infrastructure and resources

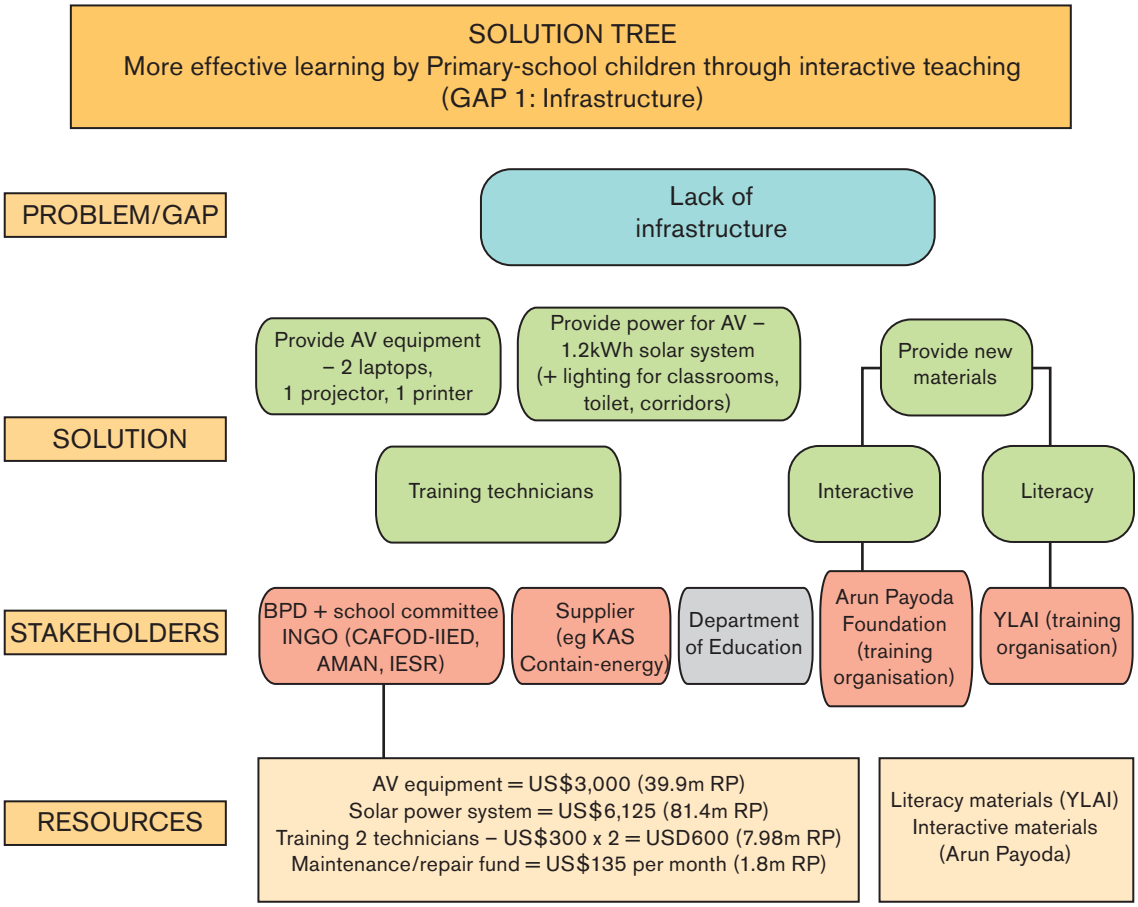


Figure 7 shows the solution tree for one of these sub-problem, 'lack of infrastructure/ resources' (the diagrams for the other two sub-problems, 'high turnover of teachers' and 'poor teacher training' are not included here). There are three aspects to solving the problem of poor infrastructure and resources problem, as follows:

1. Provision of AV equipment (two laptops, one projector and one printer).
2. Provision of a sustainable electricity service to power the AV equipment and provide school lighting – the solution proposed was a standalone 1.2kWh solar system. In addition, training for two technicians to run and maintain the AV equipment and the system was required.
3. Provision of two different types of teaching materials – (a) interactive learning materials and (b) materials to improve basic literacy. The latter was identified as part of the underlying causes of poor learning outcomes among the school children, and is also linked to the issue of inadequate teacher training.

For the other two VPs on increasing coffee-farmer income and better-quality household lighting, there were several solutions presented as distinct 'options' – and in some cases, these were mutually exclusive. For instance, the solution for household lighting could either be delivered with a micro-hydro mini-grid providing collective power or a solar home system in each house. The proposed solutions for increasing the income of coffee farmers were as follows:

1. Increasing the volume of coffee production and selling unprocessed beans through the usual channel, ie the local market. This solution focused mainly on providing 'Good Agricultural Practice' (GAP) training to farmers.
2. Improving the quality of the coffee and selling unprocessed beans to new, higher-end markets. This focused on improving post-farm processing and packaging, through 'Good Processing Practice' (GPP) training.
3. Increasing the price of roasted and ground coffee sold through the existing channel, ie local markets (using existing equipment and coffee quality with the innovation being new packaging and marketing to increase income per kilo).
4. Improving coffee quality, roasting and grinding to sell ground coffee to new, high-end national retail chains such as supermarkets. This would involve both GAP and GPP as well as identifying and accessing new market outlets.
5. Improving the quality of unprocessed coffee beans to sell to international buyers – for example in Europe and the US. This would involve GAP as well as identifying and accessing new market outlets.

Each of these options has very different implications in terms of the energy needs, upfront costs, likelihood of success regarding access to markets, overall risks, and so on associated with each solution. The various solutions could also have greater benefits for certain end-user groups. For example, **Option 3** would benefit some of the women in the village most, as they sell ground coffee in local markets. There was immediate interest in this solution by participants, and although the income benefit was not as high as some of the other options, it was decided that this was a good solution to explore further as it requires little investment, is low risk, can start immediately, and benefits the women directly. **Option 5** was presented because the community had a dream of selling coffee to high-end overseas markets, but the research showed this solution was not viable. This was principally because most European and US markets require Arabica beans, which could not be grown commercially at the altitude of Boafeo village (Boafeo currently produces Robusta beans).

Through group work, participants discussed further the problem and solution trees. Whereas in the previous workshops each group focussed on one of three priority needs, here the groups discussed all the problem trees in turn because it was considered important for all participants to have a full understanding of each problem and the different solutions presented, to participate equally in the choice of which solutions to take further.

Box 8 outlines some of the guiding questions used for group work when discussing the problem and solution trees.

BOX 8 – Sample guiding questions used by facilitators for group work on delivery infrastructure

1) What benefits would each solution deliver and for which groups or individuals?
2) Which stakeholders would be responsible for doing which functions/activities? (For example, owning, operating, maintaining, repairing the equipment or energy service; training; lobbying; facilitating; awareness-raising; marketing activities and so on.)
3) What would each of these activities or inputs cost?
4) Who would cover the costs? What are the incentives for them to pay or to contribute funds?
5) Are there any issues to do with relationships or other local factors or changes you can anticipate in the future that would make the solution succeed or fail? (For example, farmers being used to farming in a certain way.)
6) What information is missing or what other things do we need to know before we can make a good decision?
7) What do we need to do next? (For example, gathering more information on X, Y, Z; costing different activities; talking to XYZ people or organisations, and so on.)

Each group presented back to plenary and compared their findings using a table listing the benefits they thought each solution would bring and to whom, the stakeholders, the activities, the costs and who could meet them, other issues and gaps that had come up, and what the next steps might be. **Table 7** shows a simplified version of the participants' analysis for **Option 1** for the coffee farming VP (increasing the volume of coffee beans grown through better agricultural practice and selling through the usual local market channels). It is significant that although many of the solutions have an energy component, this solution does not, as there is no energy gap. Although the entry point for the EDM process is designing an energy service, the starting point is to consider the development needs of end users holistically, and there may be no need for an energy service to deliver the optimal solution identified through the process.

Table 7 – Coffee farming VP (Solution 1)

Key analysis area	Findings
Benefits	a. Increased income for coffee farmers through increased production b. Increased farmer knowledge on Good Agricultural Practice (GAP) c. Increased farmer interest in cultivating coffee plantations d. Potential expansion of coffee plantations e. Coffee plantations are better managed
Stakeholders	a. End users: coffee farmers, women's group, potential community cooperative b. Village government: Village Head, village committee c. Community leaders: elders, religious leaders, d. District government: line ministries e. Farmers cooperatives in the district: Kopsi Ilmu cooperative in Manggarai, Tanahnua Foundation in Ende, Papataki cooperative from Bajawa, Kelimutu cooperative in Ende
Costs	GAP training New inputs (seeds, fertiliser etc.) Setting up farmers' cooperative
Who would pay the cost?	a. Farmers self-fund (for inputs and contribution to training) b. Other funders for GAP training – AMAN, NGOs, village funds (?) c. Village funds for creating cooperative d. District government?
Socio-cultural issues/other factors	a. Will poorer farmers be able to participate and benefit? Farmer and community buy-in b. Need for some farmers to pilot GAP to overcome risks ('champion farmers') and be encouraged by community for the 5 years until benefits can be seen c. Opportunity to cooperate/learn from other farmer collectives in the district
Information gaps	a. Build understanding and agreement within community b. Get accurate information on current plantations c. Identify champion farmers d. Process/timeline for setting up cooperative e. Identify more training providers f. Finalise cost estimates
Next steps	a. Agree farmers group and champions b. Identify trainers/funders for farmers group on production/GAP c. Discuss setting up cooperative with village government d. Data collection on existing plantations e. Gather info on what support district government could provide

As can be seen from the sample group report in **Table 7**, at this stage of the workshop the discussions were still top level. The understanding and level of detail of the solutions deepened over the next few days as participants built their shared understanding of the key issues and remaining information gaps, and more detailed analysis of the risks.

Synergies and trade-offs between the three value propositions

The next workshop session focused on the benefits and trade-offs from implementing each of the solutions on the other needs. **Box 9** outlines the guiding questions used by facilitators for the group discussions on synergies and trade-offs between the various solutions.

For instance, as discussed previously, teacher retention impacted negatively on learning outcomes in the primary school, and was related to some (non-government) teachers being paid much lower levels of salary, as well as the poor educational facilities in Boafeo primary school and schools in the wider district compared to other districts and provinces. This was also linked to the lack of adequate teacher training – and teachers' desire for better and ongoing training – to address the literacy issues some children experienced and to make learning more interactive.

When looking at possible revenue sources for addressing the problem of teacher retention by increasing teachers' salaries, the community's options are currently limited. However, during the discussion on synergies and trade-offs between the different solutions, a possible win-win was identified between increasing coffee-farmer income and better teacher retention. Many of the coffee farmers are parents of primary-school children and would be willing to use part of any extra income generated from farming to increase the non-government teachers' salaries and/or to buy more materials for the school.

If the coffee farming solution is implemented, the additional income would not be generated for several years, but the community and farmers could formally agree now with the school and the relevant teachers that their salaries would be raised if farmers' incomes increased by a certain level. Making this agreement upfront as part of implementation planning could help to resolve the problem of teacher retention in the shorter term, working around current resource constraints and potentially helping to deliver a viable solution for better primary-school education.

BOX 9 – Sample guiding questions used by facilitators for group work on synergies and trade-offs

1. If we implement the solution(s) to deliver one of the value propositions, can this also help in meeting one of the other needs?

   FOR EXAMPLE: could producing more income from coffee support teacher retention at the primary school by providing a salary increase for non-government teachers and help improve learning outcomes for the primary-school children – even if this may not happen for several years? In terms of delivering better-quality lighting in the houses, would this have any impacts on delivery of the other solutions (or not)?

   REMEMBER TO THINK ABOUT THIS FROM THE PERSPECTIVE OF YOUR GROUP'S VP:
   VP1: Better-quality household lighting
   VP2: Improving learning in the primary school through more interactive teaching
   VP3: Increasing farmer income from coffee production

2. Are there any trade-offs or possible negative impacts on other VPs if we decide to implement one or more of the solutions to meet the priority needs? If so, would we need to modify or change our solutions in any way? Why and how?

   FOR EXAMPLE: If we provide the solar system to power interactive learning equipment for the school and then later we implement a micro-hydro solution as part of the HH lighting VP, will this provide enough power for the school's requirements – making the solar system for the school redundant (a waste of money?)

Risks and ways to mitigate them

After considering synergies and trade-offs, the participants identified the risks associated with each solution in groups, with each group discussing one priority need and associated solutions. **Box 10** outlines the guiding questions used by group facilitators and **Table 8** shows the risks identified by the group working on the primary-school education VP. It is interesting to note that a new factor or sub-problem emerged during this discussion, that is, that children's learning outcomes may be affected by poor nutrition. The community suggested a way to proactively address this by the village government offering funding to ensure infants and primary-school children get better nutrition. It was agreed that further analysis of this gap and the potential solutions was required, as part of preparing for implementation.

BOX 10 – Sample guiding questions used by facilitators for group work on risk mitigation

1. *Focus on your VP.* There are several potential solutions to deliver on your VP and meet the priority need.

   What are the risks for each solution that could make it fail unless we manage them?
   FOR EXAMPLE: in the micro-hydro solution for the HH lighting VP, we need to apply for a grant both for the full feasibility study and the construction of the micro-hydro, and there is a (considerable) risk one or both the applications could fail.

2. Are there any ways we can manage the risks to reduce them? Be specific about activities to manage risks and who would do them.

3. Who will manage these activities? Be specific – and realistic – about the ability of stakeholders to manage the activities.

Table 8 – Summary of risks (education VP)

No.	Risks	Ways to manage them	Who can manage
1.	No funding available for the SHS to power equipment	Agree in advance who will pay for this; get parents and village government to contribute. Also map external funders eg NGOs or others	Village government, school committee and parents, with support from partners (IESR and AMAN) to map funders
2.	The SHS or equipment breaks down	Set up a maintenance service, train teachers as technicians, get parents to pay upfront for a repair fund	Village government, school committee and parents
3.	Money for equipment but not for teacher training	Identify upfront who can pay for training	Village government with NGO partners (CAFOD, IIED, IESR and AMAN)
4.	Teacher motivation is not improved by training or salary increase	Make an agreement with teachers that in return for providing training and salary increase, they will improve learning outcomes	School committee and village government
5.	Teachers attend training but do not apply learning	Set up ongoing support for teachers eg community of practice, or organise refresher training	TBD
6.	All the facilities and training are fulfilled but the children cannot learn because of poor nutrition or poor attendance	Reduce the risk by providing more nutritious food to children both in the family and in school (eg eggs, milk, fruits, vegetables) and training on nutrition for mothers Parents make sure children attend	Village government with community, and parents
7.	Overall, solution cannot be implemented and loss of trust between partners	Clear agreement on planning for implementation, roles and responsibilities; who can deliver what – including what cannot be delivered by external partners	All partners

Planning for implementation

Once participants had discussed and developed in more detail the potential solutions, the synergies and trade-offs, and their associated challenges and risks, they selected which of the potential solutions they wanted to take forward, using group work and plenary discussion. By the end of the design process, the community had produced optimised versions of the three VPs expressing their preferred solutions. The participants then agreed on the following next steps:

1. The proposed solutions selected (in principle) would be presented to the whole village for socialisation and agreement and then a detailed implementation proposal would be developed. This proposal could then be integrated into the Village Development Planning process, and submitted to different funders (eg Department of Education, corporate social responsibility programmes of different companies such as PLN, international donors).
2. To develop the implementation proposal, more work was needed to identify which specific stakeholders could deliver which activities in the delivery model, including the supporting services (eg managing/maintaining equipment, delivering training and so on).
3. Additional research was also needed to map funding sources, and develop detailed costings and revenue streams for each solution (specifying for all the different activities/inputs) as part of the proposal development.

The final activity in the design process was to identify next steps for all aspects/activities of the solutions outlined in each VP, identify who could take them forward and how, and a timeline. **Box 11** outlines some of the guiding questions used by facilitators for this discussion.

Box 11 – Sample guiding questions used by facilitators for group work on planning for implementation

1) What are the next steps in terms of implementing each solution?
2) What are the remaining information gaps?
3) Who can help to resolve these gaps?
4) Who will take forward the different activities?
5) How will they do this?
6) What is the timeline for doing this?

Annex 3 gives an example of some of the activities that were identified as next steps to developing a full implementation proposal for the education VP. These next steps were developed after the workshop and subsequently presented back to the community by the local NGOs, with agreed roles and responsibilities. This more detailed implementation proposal has been integrated into the community development plan.

The next section (**Section 8**) summarises and reflects on the learning – and the challenges - from the EDM design process in Indonesia that we hope will be of use for future designers and developers of energy services for poor and marginal groups, wider insights on how to improve the sustainability and scalability of last-mile energy services that merit further research and analysis.

Grinding coffee manually. Credit: Project photo

8. Learning from the EDM design process and areas for further exploration

The considerable time and resources invested by all the partners in testing out the EDM approach in Indonesia, including the six-month EDM design carried out with Boafeo community, proved the added-value of the approach in terms of designing sustainable solutions for the community's priority needs, including energy services.

The process resulted in a wealth of learning which has been integrated into the toolkit. The most salient learning from the process is also summarised below. We hope this will be useful for future energy service designers and developers, including NGOs, government and businesses working in different contexts and at different scales. We have also included some wider insights on designing and delivering sustainable energy services for last-mile end users at scale which, in our view, merit further research and analysis. These insights emerged during the EDM design process, the additional research and engagement with stakeholders in the Indonesian energy sector, as well as wider stakeholders. These are captured in three questions that could form the basis for future action research.

Lessons from testing the EDM approach

1. **The process of designing the service was as valuable for the end users as the final output (the delivery models/solutions) for the following reasons:**

a. **It builds shared understanding, and more effective communication, of end-user needs.** The process allowed the end users to identify and understand their priority needs in depth and to develop detailed solutions to meet them. Through the process, they became more effective at identifying which stakeholders could help deliver the solutions and their specific roles. They also became more confident in engaging with key stakeholders, and in communicating effectively their priority needs and the potential solutions.

b. **It builds community buy-in.** Through developing a clearer sense of what other stakeholders could and could not do to deliver the potential solutions, the end users became more proactive in identifying their own role and potential contributions – including financing aspects of the solutions. By the end of the process, they had identified their own individual resources as well as collective village resources that could be used to support the delivery model. The Village Head also expressed the community's wish to integrate the EDM solutions into the formal village development planning process.

c. **It develops problem-solving skills through 'learning by doing'**. By the end of the process, the ability of workshop participants to think systematically through the different aspects of the delivery model had increased significantly. Progressively, participants discussed needs, gaps and impacts in more concrete and specific ways. Anecdotally, the Village Head commented that this problem-solving process would be used for other issues faced by the village, and that it had 'changed our way of thinking'.

2. **A holistic approach to designing an energy service starting with end users' development needs can result in wider benefits and greater impacts for the following reasons:**

a. **It identifies synergies between solutions, so they can deliver on multiple needs.** For instance, the participants realised that increasing income from coffee farming in the future could also support better learning outcomes for the primary-school children. Part of the future additional income earned could be used to increase the salaries of some of the worst-paid teachers, helping overcome the problem of teacher retention. Even if this income would not be available immediately, by committing to increasing teacher salaries as part of the delivery model for the coffee VP (eg drawing up an agreement with the teachers) they could also help deliver the education VP in the shorter term.

b. **The final energy service is designed to deliver wider community benefits.** By starting with end users' priority development needs, rather than with energy gaps, solutions can be developed that be generate positive impacts for more than one end-user group – bridging household, community, and business needs and promoting cross-sectoral and community-wide benefits.

Challenges experienced during the EDM design process in Indonesia

No project is without its challenges, particularly when developing and refining a new design approach and methodology. The key challenges faced during the EDM design process are highlighted below.

The design process can be resource - and time - intensive

The process took six months to complete, with three community workshops accompanied by partner capacity-building workshops and interim field research. The length of the process was partly due to delays with completing research outputs or data-gathering activities, or difficulties with coordinating the partners' schedules. Such delays and coordination challenges were to some extent inevitable and future processes should be completed within a shorter timeframe – although this will always depend on local factors.

It is also important to highlight that the design process is by its nature iterative. Building end-user and stakeholder understanding, skills, and buy-in is also an integral part of the process and this takes time. Rushing the process could undermine development of a sustainable delivery model with long-term impact, and compressing the time for design must be weighed against the costs of potential failure or sub-optimal performance of the service.

Managing end-user expectations around implementation

Starting with an energy service as the entry point for meeting the development needs of poor and marginal communities may present funding challenges when it comes to implementation. Especially given that, in most cases, increasing end-user income from productive activities is likely to be a priority, and an energy service might be only one (small) component of the solution.

A key aspect of the EDM process is identifying sustainable financing for all aspects of the delivery model and ensuring this is in place. From the outset, there was explicit discussion between the project partners and the community that the EDM process did not come with a ready-made 'pot' of funding to implement the solutions identified. During the design process the community proactively identified what financial contributions they could make to implement some activities. However, there remained a residual – and understandable –expectation that the project partners would fund some aspects of implementation.

One way of addressing this challenge – and ensuring that supporting services and synergies between the solutions are identified – would be to integrate energy service delivery into wider development planning by NGOs, local government or businesses. Integration into planning of productive-sector activities could be particularly helpful. Where the energy service itself is a key component of delivering the solution, then options for integrating it into planned expansion or new project development by energy sector actors, such as utilities or energy businesses, could also be explored.

Project partners need sufficient understanding of EDM approach, plus other skills and resources to support the design process effectively

It was invaluable to have partner organisations/co-designers that understood the local context and had a trusted relationship with the end users. In this case, the partners were NGOs or community-based organisations, but in other contexts they could be other actors such as local government or businesses. Again, this trust relationship is crucial so that the EDM process can be adapted to the local context and the most appropriate tools deployed (eg for stakeholder mapping). Considerable facilitation skills are also required to guide participants through the design process, and ensure gender issues and other socio-cultural factors are understood and do not become barriers to the process. Facilitators must understand the EDM's iterative and systematic problem-solving approach, and be able to put it into practice – for instance, by repeatedly challenging end user or other stakeholder assumptions.

The solutions developed through the EDM process will likely require additional supporting services, so local partners should ideally have access to the full range of skills and resources required to identify supporting services and support implementation of the solutions for as long as is necessary. Again, this points to the effectiveness of integrating such energy service planning into wider or more cross-sectoral interventions, eg NGO livelihoods programmes, local government development planning and so on. Finally, it highlights the potential benefit – and cost-effectiveness – of organisations investing in building internal capacity to use the EDM or similar approaches, so they can be scaled up for use in multiple interventions. This could have the added benefit of facilitating on-going learning.

Insights into wider energy service planning – a future action research agenda?

1. **Can participatory planning processes and tools such as the EDM approach build the scalability and sustainability of energy services, particularly for last mile end users?**

   The experience of the EDM process itself, as well as the additional research and wider engagement with stakeholders in the energy sector in Indonesia, suggested that business-as-usual, centralised energy planning approaches were not optimal for off-grid/last mile energy delivery in remote locations. This view was expressed by several stakeholders including representatives from the Ministry of Development Planning (BAPANAS), the state utility (PLN) and members of the Energy Patriot scheme, as well as from enterprises delivering energy services to poor groups. These stakeholders highlighted that current energy service planning and delivery approaches were not flexible enough and could not effectively integrate different end-user needs and adapt to different contexts. This meant they often failed to produce sustainable outcomes (see below). They also stated that one reason a 'one-size-fits-all', top-down planning approach was used was because it was thought to lower transaction costs.

   Several stakeholders were interested in whether the EDM toolkit could be used by different levels of sub-national government (provincial and district levels) to review existing projects/services that are performing sub-optimally, with a view to improving their sustainability and impacts.

2. **What are the financial, social and overall human development costs of sub-optimal service delivery or failure?**

   One way to offset the upfront investment and perceived high transaction costs of using more context-specific and inclusive planning approaches to design and deliver last-mile energy services would be to understand better, and factor into the planning process, the costs of sub-optimal performance and failure. This includes what have been called the "energy access opportunity costs" in terms of under-development of the end-user communities.[18] Again, service failure or under-performance occurs frequently and has social as well as financial costs. This includes longer-term negative impacts on the uptake of particular energy solutions. This was evidenced during the EDM design process in Boafeo, where the failed SEHEN SHS delivery model affected the end users' willingness to pay for better quality SHS to meet the need for better quality household lighting. It initially undermined their willingness to even consider SHS as a viable solution - even though this eventually emerged as the most cost-effective delivery model. This mistrust of systems among the Boafeo community was also evident among stakeholders in the sub-district, who had an embedded belief that solar power is unreliable and poor quality.

18. See www.powerforall.org.

3. **Can such innovative, participatory planning approaches be of benefit in designing other development interventions?**

   During discussions around the testing of the EDM approach in Indonesia, several stakeholders delivering services to poor and marginal groups in other development sectors highlighted the potential of adapting the EDM toolkit to design interventions in these areas. This included during the practitioner workshop held in July 2017 in Indonesia to share the EDM learning and other practitioner experience on participatory design of energy services. It would be useful to understand further the benefits of using such participatory approaches to design interventions in a range of development sectors so that they are sustainable and maximise positive impacts for poor and marginal communities.

Next steps for the EDM project

The development of the EDM toolkit has been a highly rewarding experience for CAFOD, IIED, building our and our partners' knowledge of how to plan energy service delivery for poor and marginal groups to maximise development benefits and sustainability.

In terms of next steps, in Indonesia, IESR and AMAN are taking forward implementation of the EDM in Boafeo. IESR is in discussions with other groups on how the EDM toolkit could be integrated into their future programmatic work. CAFOD and IIED will begin using the EDM toolkit in Kenya, building the capacity of local partners and other stakeholders at county level, with the aim of adapting the approach to support energy service design as part of country integrated development planning.

We would welcome feedback on the EDM toolkit, and ideas for further collaboration with other groups using or interested in using participatory or 'people-centred' planning approaches for energy service delivery to maximise outcomes for last-mile communities. This includes ideas on how to share learning on an ongoing basis through an existing platform or new channels.

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Annex 1: Further tools to help design the energy delivery model

This section lists some existing tools that can be used in the various stages of designing the energy delivery model. This includes tools for stakeholder mapping, needs assessment, the identification of gaps in energy services, risk assessment, and monitoring and evaluation.[19]

Stakeholder mapping tools

- Planning tools: Stakeholder Analysis, ODI (2009) www.odi.org/publications/5257-stakeholder-analysis
- HEDON stakeholder analysis guide: www.hedon.info/docs/E-MINDSET-Stakeholder-Analysis.pdf
- Power Tools: Stakeholder influence mapping, IIED (2005) www.policy-powertools.org/Tools/Understanding/docs/stakeholder_influence_mapping_tool_english.pdf

Needs assessment

- *A Guide to Assessing Needs: Essential Tools for Collecting Information, Making Decisions, and Achieving Development Results*, Watkins *et al*. (2012), World Bank https://openknowledge.worldbank.org/handle/10986/2231
- *A community needs assessment guide: a brief guide on how to conduct a needs assessment*, Sharma A *et al*. (2000), University of Chicago http://loyolacurl.squarespace.com/projects/community-needs-assessment-guide-a-brief-guide-on-how-to-con.html (Book on conducting needs assessment including organising a focus group and surveys – some focus on US communities but is more widely useful)
- *Needs assessment – an overview*, Altshuld J and Kumar D (2010), Sage http://books.google.co.uk/books?id=6ijU2jnBhEcC&printsec=frontcover&source=gbs_v2_summary_r&cad=0#v=onepage&q&f=false (Organisational perspective but useful toolkit and background theory)
- Community needs assessment FAQs, Rotary Club (2006) www.rotary2000.org/PDG/pdg_home/RRFC/Human/MatchingGrantCNAFAQs.pdf (Two-page, quick, frequently asked questions on needs assessment. Field data collection)

Baseline analysis and participatory methods

- Household solar water heating project baseline survey, HEDON www.hedon.info/docs/Baseline_Example_Questionnaire_for_solar_water_heating.pdf Supplied as example survey by a HEDON member – follow-up survey also available: www.hedon.info/docs/Follow_up_SWH_questionnaire_solar_water_heating.pdf
- *A training manual for practitioners on participatory local development*: Chapter 10, FAO (2005). Training module on PRA tools www.fao.org/docrep/006/ad346e/ad346e0f.htm
- *Participatory Rural Appraisal (PRA) Manual*, FAO (2013) www.fao.org/family-farming/detail/en/c/292329/
- *Rural Appraisal: rapid, relaxed and participatory*, Chambers R (1992), IDS Discussion Paper 311 www.ids.ac.uk/files/Dp311.pdf (This is a seminal paper outlining PRA and how it differs/overlaps with RRA)

19. This list was taken from Bellanca and Garside (2013), with updates and additions

- The use and abuse of participatory rural appraisal: reflections from practice, Cornwall A and Pratt G *Agric Hum Values* (2011) Vol 28, http://link.springer.com/article/10.1007%2Fs10460-010-9262-1
- *Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA), A Manual for CRS Field Workers and Partners*, Schoonmaker Freudenberger S (2008), Catholic Relief Services (CRS) www.crs.org/our-work-overseas/research-publications/rapid-rural-appraisal-and-participatory-rural-appraisal

Risk assessment tools

- *Mindtools risk/impact probability chart* www.mindtools.com/pages/article/newPPM_78.htm
- *JISC risk management infokit* www.jiscinfonet.ac.uk/infokits/risk-management/

Monitoring and evaluation

- *Results-based monitoring guidelines for technical cooperation,* GTZ (2008) www.focusintl.com/RBM072-wirkungsorientiertes-monitoring-leitfaden-en_01.pdf
- GTZ results assessment – Survey on Impacts of the Stove Project in Transmara, Western and Central Cluster of Kenya, GTZ (2009) https://energypedia.info/images/7/7d/Gtz-kenya-resultsassessment-final-nov-2009.pdf
- HEDON, M&E in energy, various links to surveys and studies on household energy www.hedon.info/MandESIG:Examples (Case studies contain example surveys, indicators, and approaches)
- Toolkit: Six steps to results-based management, HEDON *Boiling Point 55* (2008) /www.hedon.info/docs/BP55-Djedje.pdf
- *Measuring success and setbacks: How to monitor and evaluate household energy projects,* GTZ/HERA (1996) www.hedon.info/docs/en-measuring-successes-and-setbacks-GTZ-1996.pdf (Useful guide on M&E in energy, taking the perspective of defining and measuring successes and setbacks)
- *Energy indicators and methodologies for sustainable development*, European Environment Agency and International Energy Agency *et al*. (2005) www-pub.iaea.org/MTCD/publications/PDF/Pub1222_web.pdf (Referring more to national-level energy indicators, but has some useful indicators on energy use at household level)
- *Evaluating household energy and health interventions: a catalogue of methods,* WHO (2008) (Although focused specifically on health and indoor air pollution, this guide also has some generally useful points for choosing M&E approaches with a catalogue of examples) www.who.int/indoorair/publications/methods/full_catalogue_method.pdf
- *Managing for Impact: A Comprehensive and People Oriented Approach to Results Based Management,* Kusters and McGregor (2010), Wageningen www.managingforimpact.org Also see the managing for impact website www.managingforimpact.org
- *'Most Significant Change' (MSC) Technique – A guide to its use,* Davies R and Dart J (2005) www.mande.co.uk/docs/MSCGuide.pdf

Implementation planning

- *The Basics of Project Implementation: A guide for project managers,* CARE (2007) www.careclimatechange.org/files/toolkit/CARE_Project_Implementation.pdf Chapter 2 has some useful pointers for implementation planning
- *10 Steps To Creating A Project Plan,* Larson (2012) www.projecttimes.com/articles/10-steps-to-creating-a-project-plan.html
- Business Plans: A Step-by-Step Guide (online), www.entrepreneur.com/article/247574

Annex 2: PRA tools used in the data gathering, and sample results

Tool 1: Village mapping[20]

Credits: Project photo

Objectives:

- Building common understanding of status and conditions in the community regarding livelihood assets (natural, human, economic, socio-cultural, and infrastructure) – including energy resources
- Identifying potential threats to community assets and livelihood activities.

Key questions:

- Are community livelihood assets (natural, human, economic, socio-cultural, and infrastructure) already captured in the district map?
- Are there any existing or potential renewable energy resources?
- How are community livelihood assets impacted by access to energy services or lack of it?
- Are there vulnerable groups in the region? (In terms of gender, age, different abilities, minorities and others)

20. The source for all the images of the EDM process in Boafeo community in this Annex is IESR.

Tool 2: Stakeholder analysis

Credit: Project photo

Benefit:

- Build understanding of institutions in the village
- Build common understanding of roles and responsibilities of each stakeholder
- Build understanding of relationships among existing stakeholders (including institutions)
- Build common understanding of the potential of existing institutions to support delivery of an energy service.

Key questions:

- What relevant organisations/institutions are there in the region?
- What are their roles, duties and responsibilities?
- How do they work together; what is the relationship/division of labour between these organisations / institutions?
- Which actors have responsibility for delivering energy services or could support delivery of an energy service?

Tool 3. History of energy access in Boafeo – sample

Date	Event	Influence/ Impact Before	Influence/ Impact After
1991-1992	The village government provided a generator to be used for public places and street lighting	• Villagers bought kerosene for lighting • HH lighting was poor quality • There was no public lighting • There was no economic activity at night	• Villages reduced use of kerosene for lighting • There was public lighting • There was an increase in social activity at night and villagers say this also helped with discussions about economic activity
1992-1995	The village generator broke down		• Villagers returned to using kerosene for HH lighting • Villagers interaction at night reduced

Objectives:

- Build understanding of the history of livelihood assets relating to energy access and the underlying dynamics (which energy services existed, when and why, and the human, economic, social, cultural, infrastructure and political factors influencing this)
- Build understanding of the causes of why certain energy services existed or not, and the impacts of this
- Build understanding of the impacts on different end-user groups and of their specific vulnerabilities in relation to energy access or lack of it.

Key questions:

- What energy services were there in the village, when and who provided them? What were the benefits/impacts associated with them? Were these different for different groups, why/ why not?
- What changes occurred, why and what were the impacts of this?
- How did these changes affect women's roles both in the household and in public life?

Tool 4. Seasonal activity calendar – sample

Season	Gender		Month											Remark
	Male	Female	1	2	3	4	5	6	7	8	9	10	11	12	
Rainy Season	Plant subsistence food crops (rice, corn, cassava) and cash crops (cacao, coffee, candlenuts, cloves)	Prepare food and help with crop planting													In the rainy season men and women carry out numerous activities such as planting crops and preparing the land for planting
Dry Season	Dig land	Help prepare land													Men and women work together to prepare land for farming
Transition Season	Tending crops, harvesting and cleaning fields	Go to the field to weed and help with harvest													Every day, villagers go to fields to tend their food and cash crops and harvest

Benefit:

- Build common understanding of seasonal patterns of activity and inputs (natural resources, human, economic, social, cultural, infrastructure and governance) by the community
- Build common understanding of gender roles in carrying out these activities
- Discuss different activities in relation to their impacts on end users (eg more busy/free; more/less income).

Key questions:

- When are the different seasons for farming food and cash crops?
- What kind of threats are there in each season/activity? (For example, flooding occurs in rainy season etc.)
- Do men and women play different roles/carry out different activities?
- Do women face specific challenges in relation to particular seasonal activities?

Tool 5. Livelihoods analysis – sample

Livelihood	Gender		Challenges (upstream to downstream)	Possible solutions	Current support
	Male	Female			
Plantation farming (cash crops) Candlenuts, coffee, cacao, cloves **Food crops** Dry rice, corn, cassava **Livestock** Cows, goats , chickens, pigs	• Planting cash crops, weeding and maintenance and clearing the land post-harvest • Buying fertiliser • Harvesting • Cultivating and processing the harvest/crops before selling at market • Selling the harvest /product at market • Raising livestock	• Buying fertiliser • Helping with harvest • Cultivating and processing cash crops for sale at market • Clearing land and weeding/ maintaining food crops • Processing food crops such as rice, corn, and cassava for family consumption • Looking after livestock • Helping with selling crops at market	• Lack of/limited mechanical processing of cash crops • Labour intensive production • Lack of other livelihood activities at night • Poor access to markets • Commodity price fluctuations	• No solution envisaged • Better HH lighting • Government paving of the road for better transportation	• PLN has provided small SHS (SEHEN) – although most are broken, and villagers complain the quality of lighting is poor • There is transport twice a week to district market. • No support to date from the government with farming

Product	Harvest frequency	Market price (in Indonesian Rupiah (Rp.)	Production method	Fuel requirement (if any)
Candlenuts	All year round Each yield = per month/HH = 100–200kg (with shell on) or 30–50kg (after shell removal, ready for consumption)	1kg = Rp.2,500 (with shells) 1kg = Rp.14,000–15,000 (without shells}	100% manual using traditional method – clamped and hit with wood Very labour intensive	None
Coffee	Once a year Each yield per HH = 200–300kg (wet beans with shell) 50kg per year (after processing, dried)	1kg = Rp.25,000 (dried coffee bean) 1 small glass = Rp.3,000 (ground coffee)	2% shelled mechanically using generator, 98% shelled manually[21] All dried manually Some ground mechanically, most manually	5L gasoline = 50kg dry coffee and the result is 25kg ground coffee 1L gasoline costs Rp.6,500 (if we buy in city) and Rp.8,000 (if we buy in stall at village) If manual, no fuel needed but very labour intensive

21. Based on estimates of shelling during the initial assessment. The estimated amount of coffee beans shelled mechanically increased after further community discussion.

Objectives:

- Build understanding of community income sources
- Build common understanding of the livelihood challenges faced by the villagers
- Understand the different methods used for productive activities
- Build common understanding of the livelihood capacities and vulnerabilities of different groups of end users.

Key questions:

- What are the livelihoods of the village?
- When are these activities carried out?
- What yields do the farmers get and what are their methods of production? What price do they get for their produce?
- What challenges do the villages face in relation to livelihoods activities?
- What fuel inputs do they use? How much do they cost?
- Do women face specific challenges in relation to specific livelihood activities?

Tool 6. Daily activities – sample

Time	Gender		Children
	Men	Women	
04.00–05.00	• Wake up and pray	• Wake up and pray • Cook food for the family	Sleep
05.00– 08.30	• Sharpen tools • Feed livestock/ move the cattle (cows) • Have breakfast • Teachers – prepare lessons	• Prepare breakfast • Prepare food to take to the fields • Have breakfast • If time, process candlenuts and coffee • Teachers – prepare lessons	Help mother in kitchen Get ready for school
08.30–13.00	• Go to the fields to tend cash crops, weed or harvest and clean the fields (coffee, candlenuts and cocoa) • Go to market (when required) • Carry out carpentry (some) • Village officers – carry out village administrative duties • Teachers – teach at school	• Go to the fields to tend cash crops, weed or harvest and clean the fields (coffee, candlenuts and cocoa) • Go to market (when required) • Process candlenuts or coffee • Village officers – carry out village administrative duties • Teachers – teach at school • Some of village – process candlenuts and coffee at home • Prepare lunch if at home	Go to school
13.00	• Have lunch	• Have lunch	• Have lunch

Objectives:

- Build common understanding of the daily activities of different family members
- Build common understanding of gender division of activities
- Build common understanding of the capacities and vulnerabilities of different end-user groups in relation to daily activities.

Key questions:

- What activities are carried out by each member of the family and when?
- What events or factors cause these activities to change, including the time of the activities?
- Do women face specific challenges in relation to daily activities?

Annex 3: Sample table of next steps to prepare implementation of VP2 -Education

(VPs) solutions	Activity	Target	Timeline—2017	Lead person/ organisation	Estimated resources (Rp./ time)	Funder
1. ALL VPS						
ALL VPS	**1.1** Create an EDM forum to develop implementation plan	Village	July	Village Head, plus 2 workshop participants		Village government
	1.2 Socialisation of the EDM program from 2016–2017 and the outcomes of the process	122 households and the whole community	August – as part of church activities?	Religious leaders Village government		Village government
	1.3 Mapping of village funding sources	Village government	July–August	EDM action forum		
	1.4 Mapping of district-level funding sources	District government and other district stakeholders	August	Village government / AMAN with support from IESR	?	Village government
2. VP – EDUCATION						
Detailed socialisation of VP	**2.1** Meeting and discussion to agree the solution and develop implementation plan/ proposal	School School committee Parents Village government	New academic year 2017/2018 August	School School committee Teacher who was involved in the workshop Village Head	Cost estimate provided	Contribution by participants
Infrastructure and resources	**2.2** Identify suppliers and funding sources for the AV equipment and technician training	School committee Suppliers and funders	September	School committee supported by IESR	IESR and school committee time	
	2.3 Identify suppliers and funding sources for solar home system	School committee Suppliers and funders	By end of December	School committee supported by IESR, CAFOD and IIED	IESR and school committee time	
	2.4 Identify suppliers and fundraising for the technician training and maintenance fund	School committee; list of suppliers and funders; obtain funding	August	School committee supported by IESR	IESR and school committee time	
	2.5 Map existing interactive materials and sources of new materials	School committee	August	School committee supported by IESR	IESR and school committee time	
	2.6 Design solar power system for the school	School	By end of December	IESR	IESR time	
	2.7 Providing SHS	School committee Materials suppliers	2017–2018	Headmaster, AMAN representatives, IESR		CAFOD, IIED and IESR
	2.8 Providing 2 laptops, 1 projector, 1 printer	School committee Village government	2017–2018	Headmaster, IESR, CAFOD, IIED, AMAN	Cost estimate provided	Dept. Education/ Village funds

(VPs) solutions	Activity	Target	Timeline—2017	Lead person/ organisation	Estimated resources (Rp./ time)	Funder
2. VP – EDUCATION continued						
Maintenance and repair	**2.9** Training technicians	Operator teacher	2017–2018	AMAN, IESR and school committee	Cost estimate provided	AMAN, IESR, school committee
	2.10 Maintenance of AV equipment and SHS	School Operator Supplier	School year	Headmaster, school committee, teachers, AMAN and IESR	Cost estimate provided	Village funds and school committee
	2.11 Identify repair fund for equipment/ SHS	School committee Parents	By end of year	Headmaster, school committee, parents	Cost estimate provided	Parents and school committee
Teacher Training	**2.12** Seeking information about local funding sources for teacher training (literacy and interactive methods)	Village and district government Training providers	July–August 2017	School committee AMAN, IESR	Transportation Boafeo-Ende	Community contribution, IESR and AMAN
	2.13 Develop training strategy for ongoing teacher development	Teachers School committee Training providers	By end of September	IESR and school committee, supported by CAFOD	IESR and CAFOD time	IESR and CAFOD
	2.14 Get information on types of training and materials for literacy training	Know the cost of training and materials used	August 2017	AMAN and IESR, supported by CAFOD	Cost for phone + internet	AMAN and IESR
	2.15 Get information on types of training and materials for literacy training	Teachers in Maukaro Districts	September 2017	AMAN, IESR, supported by CAFOD	Transport and Phone Credit	Contribution
	2.16 Discussion with District Education Dept., school Foundation and other key stakeholders	District Education Dept. Foundation	Depends on training strategy being developed. October–Nov 2017	Village Head AMAN and IESR	Transportation and communication	AMAN and contribution

Knowledge Products

Toolkit

December 2017

Energy

Keywords: Indonesia, energy access, small-scale agriculture

Access to modern energy services is vital for poverty alleviation and human development. The Energy Delivery Model (EDM) project is a collaboration between CAFOD and IIED, aiming to build understanding of the enabling factors and barriers to delivering energy services for poor groups, learning from practitioner experience and research. This report introduces the EDM toolkit, a six-step process with two innovative tools for inclusive planning of energy services.

The toolkit aims to ensure services are appropriate to the local context, meet end users' development needs and are financially, socially and environmentally sustainable, maximising their impact. The report summarises the process of testing the EDM approach with partners in Indonesia. It outlines the learning from this experience, including wider insights into improving the sustainability and scalability of last-mile energy services and the costs of sub-optimal service design and delivery that merit further research and analysis.

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