

Mini Hydro Power Project for Capacity Development (MHPP²)

Explanatory Manual for Productive Use of Energy (PUE) Database

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Abbreviations

EnDev	Energising Development; a Dutch-German Energy Partnership to promote sustainable access to modern energy services in developing countries
GIZ	Gesellschaft für Internationale Zusammenarbeit
IDR	Indonesian Rupiah
kW	Kilo Watt (1,000Watt)
MEMR	Ministry of Energy and Mineral Resources
MoHA	Ministry of Home Affairs
MHP	Mini/micro Hydro Power
MHPP ²	Mini Hydro Power Project for Capacity Development
NGO	Non-Governmental Organization
NREEC	New and Renewable Energy and Energy Utilization
PUE	Productive Use of Energy
RE	Renewable Energy
TSU	Technical Support Unit

1. Background

Since the late 1980s, GIZ directed its attention towards a systematic up-scaling of rural electrification through micro-hydro power (MHP) in Indonesia. Since 2006, the GIZ has been implementing the Energizing Development (EnDev) programme in Indonesia. The EnDev program is split into two complementary components: (1) The Green PNPM Micro Hydro Power Technical Support Unit (MHP-TSU) to directly support the access to energy through MHP in rural areas, and (2) The Mini Hydro Power Project (MHPP²) as a capacity development component to institutionalize know-how and learning from experiences for a sustainable MHP sector development in Indonesia.

As MHPP² focuses on consolidating and institutionalizing capacity development for the Indonesian MHP sector, with the objective of further supporting the growth of the MHP sector, while safeguarding the quality and sustainability of MHP schemes. One strategy towards achieving the sustainability of MHP sites is to encourage productive use of energy (PUE). Generally a PUE is described as: *agricultural, commercial and industrial activities involving electricity services as direct input to the production of goods or provision of services.*

MHPP² initiated its PUE programme by conducting an initial PUE assessment at selected sites (“Survey of Productive Use Potential at Selected MHP sites in Mamasa and Luwu Utara Districts”, April 2011) and followed-up by compiling a database of PUE options generally applicable to rural MHP sites in Indonesia in March 2012. For the database’s development, PUE was defined as *a small-scale activity, using a renewable energy-based electric or thermal energy source for providing a service or adding value to a product in order to sell the product and/or service to a willing market.*

The database seeks to provide a list of PUE ideas, grouped according to different categories, with the objective of being able to collect ideas from rural communities and present ideas where appropriate. This is not to encourage a top-down approach towards ready-made inflexible options, but rather provide field facilitators with a store of ideas in the event where communities not only lack information regarding suitable modern appliances for existing income generation activities, but also knowledge about appliances that can kick-start slumbering business opportunities.

2. Introduction

In February 2012, MHPP² compiled a database of PUE options that can be considered within a rural and peri-urban context in Indonesia. The database essentially comprises a list of PUE options (entrepreneurial activities) and a range of criteria which facilitate the searching of PUE option, based on conditions and requirements in the field. As such a user can for instance search for all PUEs with a certain power demand (Watt), or a certain cost range (IDR), or the number of staff required, or a combination thereof. The database is by no means exhaustive and should be regarded as a dynamic tool which requires maintenance.

This explanatory manual serves to complement this database, by providing users an understanding of the criteria used in the database. The database is in Microsoft Access 2010[®] format and can be obtained from MHPP².

3. Database criteria

The database comprises a total of 12 criteria, used for describing the PUE and to allow searching. These criteria are explained in more detail in the following sections.

Note, that new criteria can be added through new “tables”, while the drop-down options in each criterion can also be amended by editing the relevant table. These collected tables are grouped together under “Variables”.

3.1 Category

This criterion allows for allocating a PUE option to broader categories. Through the multi-value drop-down list more than one category can be selected.

Category	Comments
Communication & Administration	Telecommunication, secretarial and administration related
Community Services	General miscellaneous small-scale services provided to the community
Water Supply	Water pumping, distribution, purification and sanitation related
Education	Related to teaching aids and education facilities
Energy Supply	Provides direct access to energy as a service
Food Processing	Value adding, preservation of raw produce
Food Production & Storage	Growing and rearing of food and storage thereof in unaltered form
Health Care & Hygiene	Medical and general health and safety services and facilities
Materials Processing	Value adding of non-food raw materials
Maintenance & Repair	General maintenance and repair services and facilities
Manufacturing	Production and finishing of more high-value consumer products

3.2 Social need

This criterion aims to structure the PUE option according to its perceived social need, which has bearing on consumer willingness to pay.

Social Need	Comments
Basic	Satisfies the basic existential needs of the community
Convenient	Simplifies established activities, saving time and resources
Advanced	Satisfies a more mature market and is technically more complex
Luxury	Does not address an existing need or is currently satisfied through low-cost alternatives, but might be attractive in a mature market with disposable income

3.3 Employees

This criterion estimates the minimum number of staff (including the entrepreneur/owner) required to conduct the business. When determining the number of employees, focus is placed on the persons required who would spend a whole working day at the business. Also, since most businesses can be scaled up, only the smallest feasible business size (number of and production rate of appliances) has been considered.

Number of Personnel	Comments
1-2	Owner or supervisor, with one assistant

Number of Personnel	Comments
2-5	Owner or supervisor with several assistants due to higher production or material processing volumes
5-10	Labour intensive centralised facility
10-20	Two or more decentralised facilities under single management, based on a larger catchment area for production materials (e.g. food production)
>20	Generally applies to cooperatives with many independent suppliers, but jointly contributing towards a centralised or several decentralised facility

3.4 Skill requirements

Skill requirements refer to the level of skill that the entrepreneur needs to possess to operate the business.

Skill Level	Comments
Unskilled	No skill is required, but basic literacy and numeracy would be an advantage
Semi-skilled	Literacy and numeracy is required, with very rudimentary technical skills
Skilled	Technical skill is required and technology generally forms the basis of the business
Qualified	Specialist technical skills and in-depth theoretical knowledge is required as this business has a high degree of specialisation

3.5 Market Size and Market Frequency

Although divided into two separate criteria, they should be considered as one when using and applying the database. While “Market Size” refers to the estimated number of potential clients that a) can be served by the appliance and b) that the business has easy access to, “Market Frequency” determines how regularly the clients can be served. It should be noted that these criteria are based on rudimentary guesstimates, since many different variables would need to be considered for a more exact estimation.

Market size	Comments
>50 clients	Low-cost basic consumer products and services produced at a high rate
20-50 clients	Low-cost basic consumer products and services produced at a fast rate
10-20 clients	Medium-cost consumer products and services produced at a fast rate
5-10 clients	Medium-cost consumer products and services produced at a regular rate
2-5 clients	High-cost products and services generally produced on demand
1-2 clients	Customised products and services produced intermittently on demand

Market frequency	Comments
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Market frequency	Comments
daily	Basic consumer product and service satisfying a daily to weekly demand (e.g. bread baking)
weekly	Consumer product and service regularly required or with longer production time (e.g. clothes washing)
monthly	Customised consumer product and service with longer production time (e.g. hair cutting)
annually	Highly seasonal service or product that requires very long production time (every 12 months)
tri-annual	Seasonal service or product that requires medium production time (every 4 months)
bi-annual	Seasonal service or product that requires long production time (every 6 months)

3.6 Business type

This criterion suggest the most appropriate size of the business given the cost of the appliance, the rate and complexity of production and whether other ancillary infrastructure would be required.

Business type	Comments
Home-based industry	Operated from home using regular off-the shelf appliances
Micro enterprise	Can be operated from home, but ideally has a separate room or building add-on, using off-the shelf appliances; this option also applies to mobile businesses
Small enterprise	Requires a dedicated business premises and using more complex appliances and production processes
Village cooperative	Applies to business with large volume of required production resources and expensive appliances (where economies of scale need to be considered), that would typically satisfy a prevailing communal demand

3.7 Investment size

Investment size refers to the purchasing cost of the appliance(s) (rate January 2012) only. It does thus not include the cost of generating or purchasing the required energy. Given the background of this PUE database, the prices are in Indonesian Rupiah (IDR) and presented in seven (7) staggered ranges from less than IDR 500,000 (about Euro 40; rate January 2012) to more than IDR 50million (about Euro 5,000; rate January 2012).

3.8 Power requirements

Power requirements relates to the rated electricity demand (Watts) of the appliance(s). Since some businesses require a combination of two (2) or more appliances, the criterion refers to the collective power demand. Power demand is staggered into six (6) ranges, from less than 100W to more than 10,000W (10kW). Power demand over time (i.e. energy in kWh) has not been considered due to the unknown frequency of appliance use.

3.9 Energy carrier

In order to ensure that complementary energy sources are considered, this database allows for the selection of different energy carriers (i.e. different energy forms) through a multi-value drop-down list. Thus appliances are not limited to electricity only. This functionality especially applies to heat producing appliances, where using electricity would not be the most energy efficient choice. Also the energy carriers are not limited to renewable energy sources, but allow users to consider all options.

Furthermore only the general energy carrier as required by off-the shelf appliances were considered. By way of example: many low power AC (alternating current) appliances can easily be modified to operate on DC (direct current), but only the AC version is generally available from retail stores.

Energy carrier	Comments
DC electricity	Low voltage direct current (typically 12 V)
AC single-phase electricity	High voltage alternating current (typically 110V or 220V depending on geographic location) most commonly used in household appliances
AC three-phase electricity	High voltage alternating current for some domestic heat appliances, industrial-type appliances and for many electricity distribution networks requiring power constancy
Thermal gas (e.g. methane, LPG)	Directly combustible gas used for heating, e.g. in stoves and boilers, but also for some lighting technologies LPG: liquefied petroleum gas
Thermal liquid (e.g. HFO, kerosene)	Directly combustible liquids used for heating, e.g. in stoves and boilers, but also for some lighting technologies HFO: heavy fuel oil
Liquid fuel (e.g. diesel, petrol)	Combustible liquids used in internal combustion engines
Thermal passive (e.g. solar heating, CHP)	Heat gained from a “passive” source and harnessed through specific technologies CHP: combined heat and power
Combustion gas (for engines)	Combustible gas used in internal combustion engines
Thermal solid (e.g. wood, coal)	Solid combustible fuels used for heating and cooking
Kinetic/mechanical energy (e.g. pedal operated)	Direct-drive appliances, pedal-operated and draught animal power

3.10 Technology complexity

This criterion refers to the complexity of operating and maintaining the appliance and the associated service.

Knowledge Level	Comments
Basic	Appliance is generally plug-and-play, has negligible moving parts and no regular maintenance is required; broken parts are replaced rather than repaired
Intermediate	Appliance has different moving parts requiring regular maintenance and repairs
Advanced	Appliance has stringent health and safety requirements, complex processes are involved and regular maintenance is required

3.11 Appliance type

This criterion allows for grouping PUE options according to appliance types. Please note though that some appliances may apply to several appliance type categories.

Appliance type	Comments
Air circulation and cooling	Air conditioners, fans and other air ventilation devices
Air pressure devices	Air compressors, blowers and other forced air pressure devices
Audio and video equipment	Television, radio, speakers, projector, amplifiers and similar infotainment devices
Electric plugs and sockets	Multi-plug, adaptors, cabling
Electronic devices	Battery chargers, regulators, measuring devices
Fridges and freezers	Portable fridges, ice making machines, cool rooms
Hand-held electrical tools and devices	Rechargeable lanterns, shavers, mobile phones, hair clippers
Heating tools	Irons, soldering iron, kettle and other non-cooking heat appliances
ITC technology	Computers, printers, fax machine, satellite decoders and other telecommunication equipment
Laundry and fabric processing	Irons, washing machine, tumble dryer
Lighting	Spot lights, area lights, fixed and portable lighting
Metal work	Grinders, drills, welding machine, guillotine
Presses and fluid extraction	Oil press, juice extractors
Produce grinding and milling	Grain mills, domestic mixer, chippers and shredders
Produce preservation and storage	Cooling and freezing, dehydrator, drying table
Space warming and heating	Space heater, brooder, incubator
Stoves and ovens	Heating appliances for cooking
Water filtration and purification	Reverse osmosis equipment, UV-sterilisation, water filters
Water pumping and reticulation	Borehole and well pumps, booster pumps, air release vents
Wood work	Band saw, chainsaw, rotary cutter, belt sander, planer

3.12 PUE Options

The below listed PUE options are as per status January 2012 and can be expanded and modified through the PUE Options table. The options do not simply name the potential business, but in brackets also provides supplementary information regarding the suitable appliance, the collective power demand and the rate of production. Some options still lack the aforementioned supplementary information (marked with a ? in the brackets), because:

- A suitable appliance has not been identified yet (e.g. small-scale milk pasteurisation), or
- The appliance's power requirements are not suitable for MHP installations, or
- Appliances exist but a traditional non-modern energy source of power is more appropriate (e.g. pedal spindle or grain crushing in a mortar)

Nonetheless, these options were retained in the database, since their potential usefulness in rural Indonesia has been identified.

The business options listed should not be viewed in isolation, but should also be considered as potential groups that can satisfy the total productive requirements of a business. Thus for instance, the "Catering",

“Kiosk” and “Equipment sterilisation” options could be considered together to form an appliance bundle suitable for a small rural fast food shop.

PUE name
Bakery (3000 W domestic oven, 10 breads per day)
Barbershop (Haircutter 20 W, Hairdryer 1000 W)
Battery charging (500 W Lead Acid Charger)
Biomass shredding and twig chipping (2,5 kW HD garden shredder)
Blacksmith furnace blowing (500 W variable speed forge blower)
Cacao and coffee bean drying (?)
Catering (Small Rice Cooker 500 W)
Chicken cage light and chick brooder (50 W 50 chick brooder, 50 W hen cage lighting)
Clothes ironing (domestic steam iron 1000 W)
Clothes washing (700 W washing machine, 8 kg/h)
Communication Centre (fax, telephone, satellite receiver)
Drinking cup sealing (350 W plastic sealing machine, 300 cups/h)
Drying of food, spices, edible flowers (600 W Food Dehydrator domestic)
Egg incubators (50 W for 50 Chicken Eggs)
Electric Device Charging - 300W solar business system (e.g. Lanterns, Handphones ~200W)
Electric Device Charging - Grid/generator (e.g. Lanterns, Handphones ~200 W)
Electronics Repair (300 W soldering iron and desk light)
Equipment sterilisation (800 W microwave)
Fish and shrimp farming (Aeration Pump & Filtration, 320 W, 20 m ³ , 50kg fish)
Fish drying (Solar thermal drying table with electric fan option)
Fish hatcheries (Fish Fingerlings, 1m ³ Tank, 200 W Pump)
Furniture making (Power Tools ~2000 W)
Gaming Centre (300 W game console and flat-screen TV)
Grain milling (3,000 W Electric Mill, 1.5 kg/h)
Handyman service (Power Tools 500 W)
Ice making large and storage (fish, etc., 300 L freezer, 160 W, 400 kWh/a)
Ice making small (60 l freezer, 50 W, 200 kWh/a)
Internet Café (PC, Satellite Receiver ~500 W)
Juice Extraction (Domestic Juicer 250 W)
Kiosk (light 50 W, drinks refrigerator 200 W)
Knife, scissor, scythe sharpening (200 W wet/dry bench grinder)
Metal welding (100 Amp arc welder 2000 W)
Metal working (small power tools ~2000 W)

PUE name
Milk pasteurisation (?)
Public music system leasing (HiFi-Equipment 500 W)
Restaurant, Warung (rice cooker, light, drinks refrigerator, fan ~1000 W)
Rice hulling (4 kW rice huller, 200 kg paddy/h)
Seed oil pressing (oil press 100kg/h, 3 Phase 5.5 kW)
Silk and cotton spinning (?)
Sugarcane juicing (900 W, 60 l/h)
Tailoring (150 W sewing machine)
Tyre repair (50 L Compressor 1500 W)
Vacuum packing (Domestic 500 W Appliance)
Video screening (data projector, Laptop, speaker ~1000 W)
Water pumping (50 m head, 6000 l/h, 1,500 W)
Water purification - filtering and disinfection (300 W / 11,000 l/d)

4. Using the database

In essence, the database is simply a table. By using a database format, adding new data to the table (through “Forms”) and searching the table according to specific criteria is simplified. These features would become increasingly useful as the database expands. It needs to be mentioned at this point that the current database design still requires optimising the search functionality, but this has proven rather complex considering the software’s limitations and the fact that comprehensive database design is a specialist area, beyond our current level of expertise.

4.1 Adding to the database

The PUE database includes a data entry form entitled “*Entry Form: PUE Options*”. A new PUE option can be added and, using the drop down lists, can be defined according to the described criteria. The interface with the form looks as follows:

The screenshot shows the 'Entry Form: PUE Options' interface. The form is titled 'PUE Options' and has two tabs: 'Records' and 'Reports'. The 'Records' tab is active, showing a list of fields with their corresponding values. The fields and their values are:

Name	Fish and shrimp farming (Aeration Pump & Filtration, 320 W, 20 m ³ , 50kg fi-
Category	Food Production & Storage
Employees	1-2
Market size	5-10 clients
Investment Size	> 50,000,000 IDR
Power Requirement	100 - 500 W
Skill Requirement	Semi-skilled
Technology complexity	Intermediate
Market Frequency	Tri-annual
Social Need	Advanced
Energy carrier	AC single-phase electricity
Business type	Small enterprise, Village cooperative
Appliance type	Water pumping and reticulation, Water filtration and purification

The interface also includes a search bar, a list of tables and forms on the left, and a status bar at the bottom indicating 'Record: 4 - 1 of 46'.

The entry form can also be used to edit and/or delete existing PUE options. In order though to amend criteria, the user needs to make changes in the corresponding table.

The screenshot shows the 'Investment Size' table in the database. The table has two columns: 'ID' and 'Cost Size'. The data rows are:

ID	Cost Size
1	< 500,000 IDR
2	500,000 IDR - 1,000,000 IDR
3	1,000,000 IDR - 3,000,000 IDR
4	5,000,000 IDR - 10,000,000 IDR
5	10,000,000 IDR - 20,000,000 IDR
6	20,000,000 IDR - 50,000,000 IDR
7	> 50,000,000 IDR

Below the table, there is a '(New)' button. The interface also includes a search bar, a list of tables and forms on the left, and a status bar at the bottom indicating 'Record: 4 - 7 of 7'.

4.2 Searching the database

While different search options were initially investigated, the search functionalities did not provide sufficient insight into the different PUE options available. It was thus decided to compile different “Reports” for some of the different criteria instead. The reports provide a good summary and can be easily printed.

Investment Size	PUE Name	Power Requirement	Skill Level	Complexity
< 500,000 IDR	Electric Device Charging - Grid/generator (e.g. lanterns, Handphones *200 W)	100 - 500 W	Unskilled	Basic
500,000 IDR - 1,000,000 IDR	Bakery (3,000 W domestic oven, 10 breads per day)	1,000 - 3,000 W	Semi-skilled	Basic
	Barbershop (Haircutter 20 W, Hairdryer 2,000 W)	1,000 - 3,000 W	Semi-skilled	Basic
	Battery charging (500 W Lead Acid Charger)	100 - 500 W	Unskilled	Basic
	Catering (Small Rice Cooker 500 W)	500 - 1000 W	Semi-skilled	Basic
	Clothes ironing (Domestic steam iron 1,700 W)	1,000 - 3,000 W	Unskilled	Basic
	Communication Centre (fax, telephone, satellite receiver)	100 - 500 W	Semi-skilled	Intermediate
	Equipment sterilisation (800 W microwave)	500 - 1000 W	Skilled	Basic
	Fish hatcheries (Fish Fingerlings, 1m3 Tank, 200 W Pump)	100 - 500 W	Skilled	Intermediate
	Knife, scissor, scythe sharpening (200 W wet/dry bench grinder)	100 - 500 W	Semi-skilled	Intermediate
	Vacuum packing (Domestic 500 W Appliance)	100 - 500 W	Unskilled	Basic
1,000,000 IDR - 5,000,000 IDR	Chicken cage light and chick brooder (50 W 50 chick brooder, 50 W hen cage lighting)	100 - 500 W	Semi-skilled	Basic
	Drinking cup sealing (350 W plastic sealing machine, 300 cups/h)	100 - 500 W	Semi-skilled	Intermediate
	Drying of food, spices, edible flowers (600 W Food Dehydrator domestic)	500 - 1000 W	Semi-skilled	Intermediate
	Electronics Repair (300 W soldering iron and desk light)	100 - 500 W	Skilled	Basic
	Fish drying (Solar thermal drying table with electric fan option)	< 100 W	Unskilled	Intermediate
	Gaming Centre (300 W game console and flat screen TV)	100 - 500 W	Semi-skilled	Intermediate
	Handyman service (Power Tools 500 W)	100 - 500 W	Skilled	Intermediate
	Ice making small (80 l freezer, 50 W, 200 kWh/a)	< 200 W	Unskilled	Basic
	Juice Extraction (Domestic Juicer 250 W)	100 - 500 W	Unskilled	Intermediate
	Kiosk (light 50 W, drinks refrigerator 200 W)	100 - 500 W	Semi-skilled	Basic

An alternative would be to use the table entitled “Options”, which comprises all the data in a single table. The data can then be sorted according to columns.

PUE name	Skill Require	Business type	Investment Size	Power Requirement	Energy
Fish and shrimp farming (Aeration Pump & Filtration, 320 W, 20 m3, 50kg fish)	Semi-skilled	Small enterprise, Village	> 50,000,000 IDR	100 - 500 W	AC sing
Bakery (3000 W domestic oven, 10 breads per day)	Semi-skilled	Home-based industry, Mi	500,000 IDR-1,000,000 IDR	1,000 - 3,000 W	AC sing
Battery charging (500 W Lead Acid Charger)	Unskilled	Micro enterprise	500,000 IDR-1,000,000 IDR	100 - 500 W	DC elec
Tyre repair (50 L Compressor 1500 W)	Unskilled	Micro enterprise	1,000,000 IDR - 5,000,000 IDR	1,000 - 3,000 W	AC sing
Public music system leasing (HiFi-Equipment 300 W)	Semi-skilled	Micro enterprise	1,000,000 IDR - 5,000,000 IDR	100 - 500 W	AC sing
Furniture making (Power Tools *2000 W)	Skilled	Small enterprise	5,000,000 IDR -10,000,000 IDR	1,000 - 5,000 W	AC sing
Catering (Small Rice Cooker 500 W)	Semi-skilled	Home-based industry, Mi	500,000 IDR-1,000,000 IDR	500 - 1000 W	AC sing
Communication Centre (fax, telephone, satellite receiver)	Semi-skilled	Micro enterprise	500,000 IDR-1,000,000 IDR	100 - 500 W	DC elec
Vacuum packing (Domestic 500 W Appliance)	Unskilled	Home-based industry, Mi	500,000 IDR-1,000,000 IDR	100 - 500 W	AC sing
Video screening (data projector, Laptop, speaker *1000 W)	Semi-skilled	Micro enterprise	10,000,000 IDR - 20,000,000 IDR	500 - 1000 W	AC sing
Electric Device Charging - Grid/generator (e.g. Lanterns, Handphones *200 W)	Unskilled	Micro enterprise	< 500,000 IDR	100 - 500 W	AC sing
Internet Cafe (PC, Satellite Receiver *500 W)	Skilled	Micro enterprise	5,000,000 IDR -10,000,000 IDR	100 - 500 W	AC sing
Water purification - filtering and disinfection (300 W / 11,000 l/d)	Skilled	Small enterprise, Village	> 50,000,000 IDR	100 - 500 W	DC elec
Drying of food, spices, edible flowers (600 W Food Dehydrator domestic)	Semi-skilled	Micro enterprise, Small er	1,000,000 IDR - 5,000,000 IDR	500 - 1000 W	AC sing
Egg incubators (50 W for 30 Chicken Eggs)	Semi-skilled	Small enterprise	5,000,000 IDR -10,000,000 IDR	< 100 W	AC sing
Electronics Repair (300 W soldering iron and desk light)	Skilled	Small enterprise	1,000,000 IDR - 5,000,000 IDR	100 - 500 W	AC sing
Fish hatcheries (Fish Fingerlings, 1m3 Tank, 200 W Pump)	Skilled	Small enterprise	500,000 IDR-1,000,000 IDR	100 - 500 W	AC sing
Grain milling (3000 W Electric Mill, 1.5 kg/h)	Semi-skilled	Small enterprise	5,000,000 IDR -10,000,000 IDR	1,000 - 5,000 W	AC sing
Ice making large and storage (fish, etc., 300 L freezer, 180 W, 400 kWh/a)	Unskilled	Small enterprise	10,000,000 IDR - 20,000,000 IDR	150 - 500 W	AC sing
Juice Extraction (Domestic Juicer 250 W)	Unskilled	Micro enterprise	1,000,000 IDR - 5,000,000 IDR	100 - 500 W	AC sing
Kiosk (light 50 W, drinks refrigerator 200 W)	Semi-skilled	Micro enterprise	1,000,000 IDR - 5,000,000 IDR	100 - 500 W	AC sing
Fish drying (Solar thermal drying table with electric fan option)	Unskilled	Micro enterprise	1,000,000 IDR - 5,000,000 IDR	< 100 W	DC elec
Metal working (small power tools *2000 W)	Skilled	Small enterprise	10,000,000 IDR - 20,000,000 IDR	1,000 - 5,000 W	AC sing
Seed oil pressing (oil press 100kg/h, 3 Phase 5.5 kW)	Semi-skilled	Small enterprise	10,000,000 IDR - 20,000,000 IDR	5,000 - 10,000 W	AC three
Water pumping (50 m head, 6000 l/h, 1,500 W)	Semi-skilled	Small enterprise	20,000,000 IDR - 50,000,000 IDR	1,000 - 5,000 W	DC elec
Restaurant, warung (rice cooker, light, drinks refrigerator, fan *1000 W)	Skilled	Small enterprise	5,000,000 IDR -10,000,000 IDR	500 - 1000 W	AC sing
Equipment sterilisation (800 W microwave)	Skilled	Micro enterprise, Small er	500,000 IDR-1,000,000 IDR	500 - 1000 W	AC sing

5. Conclusions

The PUE database is a work in progress. Primarily it serves the purpose of collecting PUE examples from the field and lending them some structure. Secondly it aims to collect and present ideas to rural communities and rural development agencies like non-governmental organisations (NGO).

The database seeks to promote an objective unbiased approach towards supporting PUE activities in rural areas. While some PUE options might be considered “inappropriate” they are nonetheless listed and categorised. This avoids self-censorship by development practitioners. This is of particular significance since the appropriateness of a specific PUE option depends on diverse cultural, geographic, demographic, economic and resource accessibility considerations. All too often the reasons for the success or failure of a PUE option often remain intangible.

Successfully implementing PUE in rural and peri-urban settlements and villages remains the elusive holy grail of development assistance, and this PUE database will certainly not be a breakthrough. It might however contribute towards a systematic, programmatic approach, to complement the hard-won field experience based on successes and failures.



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