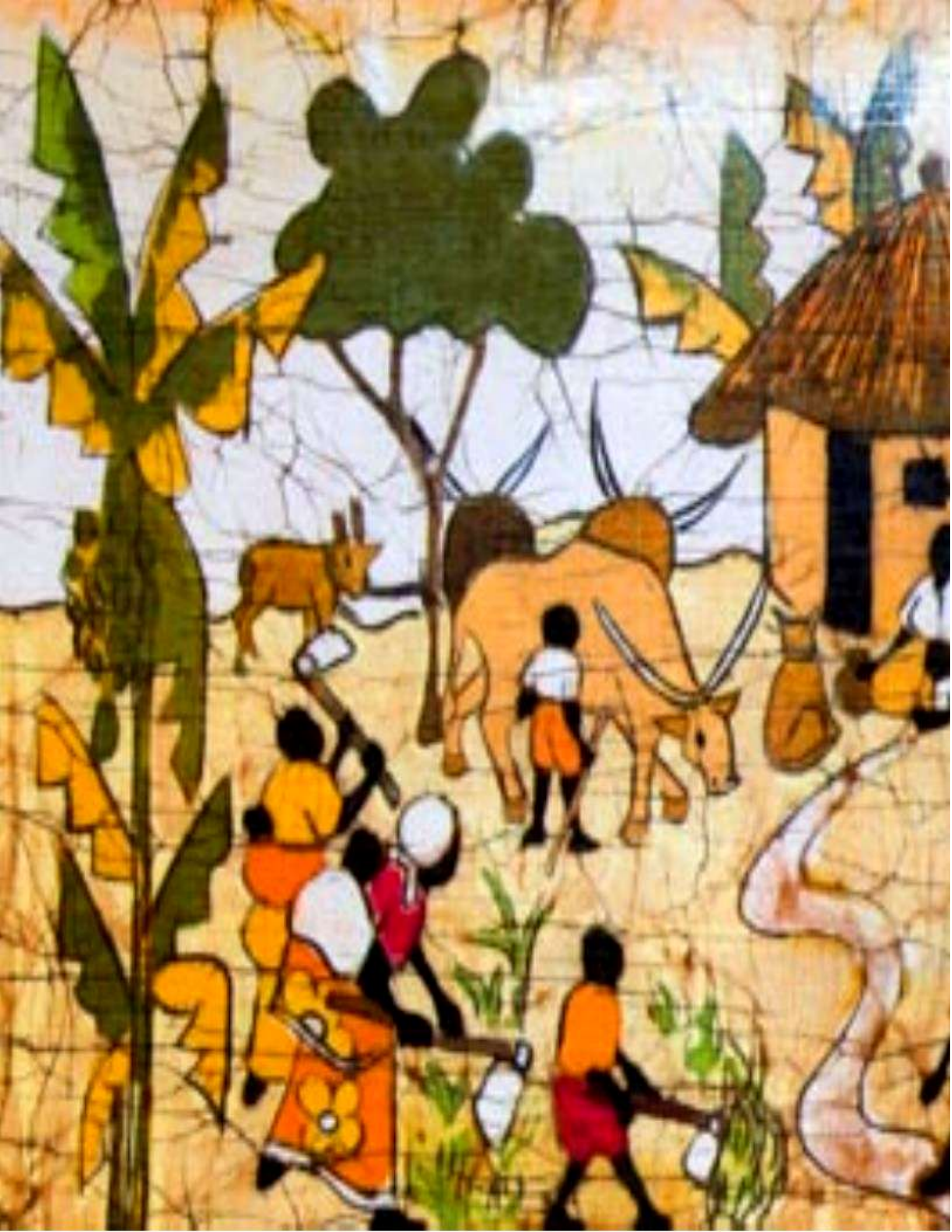
MEFIT

SOLUTIONS PROVIDER

Solar Powered Water Pumping systems

○ Khartoum ○ Rome ○ Houston ○ London



About MEFIT

MEFIT is involved in a wide range of activities, such as; regional/urban planning, complete design of commercial/industrial centers, new city planning, and energy projects. MEFIT's experience and expertise in consulting, engineering and project/program management allows an original overall approach to project development.

MEFIT's wide network of Specialists provides the expertise required to carry out Analysis, Feasibility Studies; Planning; Budgeting, Engineering and Designing, Tendering and Program/Project management.

There is an outstanding difference between the traditional consultancy approach and the philosophy adopted by MEFIT. The difference is immediately identifiable by the great importance MEFIT attaches to the local cultural aspects of the work at hand.

Due to its modern organization, MEFIT can provide answers to satisfy the most complex demands of the clients. Many clients can testify to the magnitude and quality of MEFIT's work.

MEFIT is implementation

from the first idea, a simple line or colour hypothesis, to the completion of the smallest sophisticated detail, fit-for-purpose solutions produce an entire package form comprehensive design to implementation.

MEFIT is dynamic

it aims at the realization of potential from a creative, energetic, and youthful staff, supported by experienced and skilful managers who represent the driving force of the company.

MEFIT is agile

know-how and organization bring the most compatible partnerships for any requirement. These qualities insure the commitment and the fulfillment of the project's objectives.

○ **Khartoum** ○ **Rome** ○ **Houston** ○ **London**

Contents

Water is a Resource

Water as a pathway to Development

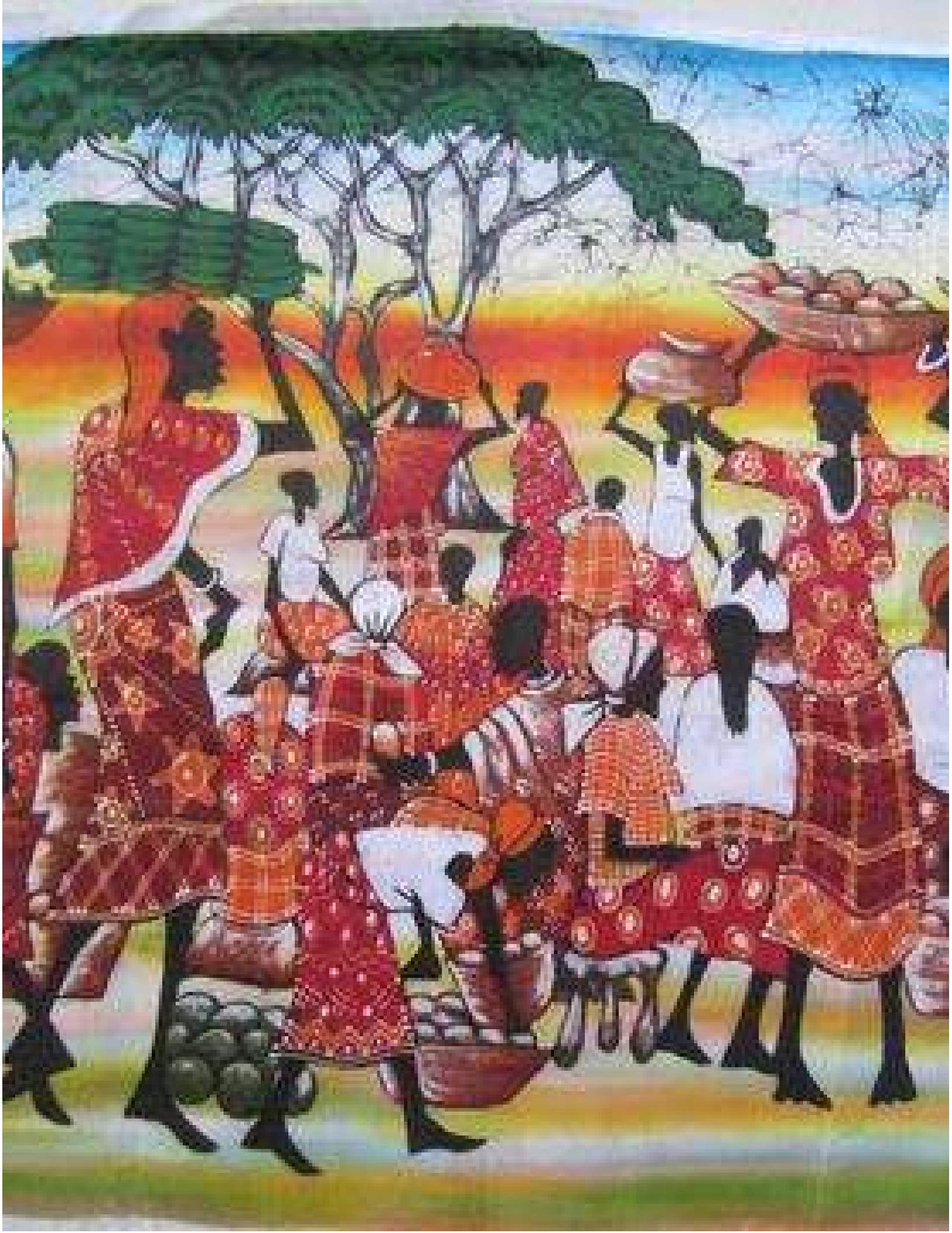
MEFIT understands that water is a pathway for development.

- Water resources are essential for satisfying human needs, protecting health, and ensuring food production, energy and the restoration of ecosystems, as well as for social and economic development and for sustainable development.
- However, it has been estimated that billions of people are affected by water shortages either for drinking or irrigation purposes.
- Irrigation is one of the essential unit operations for agriculture.
- Countries with rich natural resources have an urgent need to optimize the utilization of energy, water, and land in a most sustainable way.
- Cost-effective pathways utilizing clean energy technologies such as solar energy would contribute significantly to the sustainable development of agricultural sector in these countries.

MEFIT remote water pumping systems are a key component in addressing the great and urgent need to supply environmentally sound technology for the provision of water for domestic and agriculture use.

MEFIT solar powered systems represents a cost effective, simple to install and easy to maintain solution for rural applications.

MEFIT provides solar powered systems addressing water pumping requirements in rural and remote areas for agricultural, health care and housing needs.



Solar Water Pumping Systems

Background

A water pumping system needs a source of power to operate. In general, AC powered system is economic and takes minimum maintenance when AC power is available from the nearby power grid. However, in many rural areas, water sources are spread over many miles of land and power lines are scarce. Installation of a new transmission line and a transformer to the location is often prohibitively expensive.

Many commonly used stand-alone type water pumping systems use internal combustion engines. These systems are portable and easy to install. However, they have some major disadvantages, such as requiring frequent refueling and maintenance; furthermore, diesel fuel is often expensive and not readily available in rural areas.

Fossil fuels consumption also has an environmental impact, the release of carbon dioxide (CO_2) into the atmosphere. CO_2 emissions can be greatly reduced through the application of renewable energy technologies, which are already cost competitive with fossil fuels in many situations.

Photo Voltaic Systems

Photo Voltaic (PV) systems are highly reliable and are often chosen because they offer the lowest life-cycle cost where grid electricity is not available and where internal-combustion engines are expensive to operate. If the water source is over 500 m (⅓ mile) or more from the power line, PV is a favorable economic choice.

PV solar water pumping systems have many advantages over traditional windmill water pumps. Both the initial and lifetime costs of PV solar powered systems are often far less than windmills due to lower shipping, installation, and maintenance costs. Solar pumps operate anywhere the sun shines while windmills work where there is a steady, constant wind supply. Finally windmills are stationary while solar systems can be more easily moved to meet seasonal or variable location needs.

Solar Water Pumping Systems

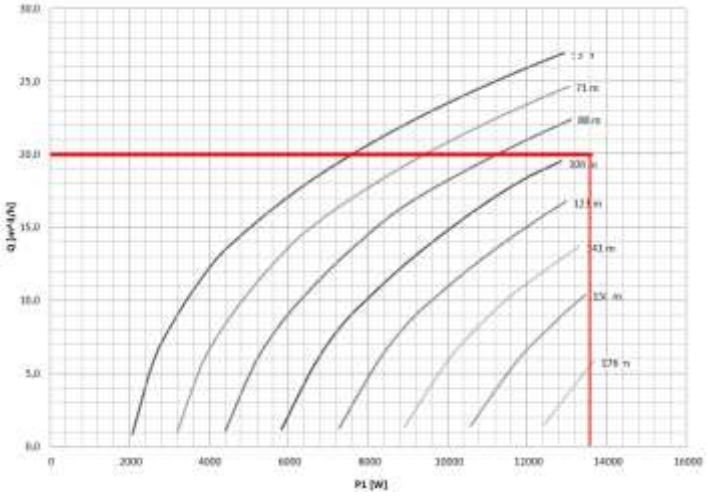
Solar Powered Water Pumping Systems

There are tens of thousands of solar powered surface and submersible water pumps in use around the world today. They are widely used on farms and remote locations to supply bore and surface sourced water to villages for domestic consumption and irrigation of crops.

A typical solar powered pumping system consists of a solar panel array that powers an electric motor, which in turn powers a submersible or surface pump. The water is often pumped from the ground or stream into a storage tank that provides a gravity feed, so energy storage is not needed for these systems. Solar powered pumping systems are a cost-effective alternative to agricultural wind turbines for remote area water supply.

Submersible Solar Pumps

Submersible Solar Pumps can lift up to 200 m (656 feet) and fit in a 4" or larger well casing and are used when the water supply is deeper than 6 m (20 feet) from the surface. Submersible solar pumps can operate directly off solar panels, batteries, or in some cases, an AC power source. Water is usually pumped during the day when the sun is shining and stored in a cistern or tank for use whenever needed. It is recommended that several days worth of water is stored to be prepared for stretches of bad weather when no water is pumped.



Surface Solar Pumps

Surface Solar Pumps are good for applications with shallow wells, ponds, streams or storage tanks. They are best if the water supply is 6 m (20 feet) or less from the surface. While surface pumps generally can't lift water very high from a deep source, they can then push water greater distances.

Surface pumps can also be used as booster pumps for water distribution.

Inverter

A solar inverter, or converter or PV inverter, converts the variable direct current (DC) output of a photovoltaic (PV) solar panel into a utility frequency alternating current (AC) that can be fed into a commercial electrical grid or used by local, off-grid electrical network. It is a critical balance of system (BOS)–component in a photovoltaic system, allowing the use of ordinary AC-powered equipment.

Advanced solar pumping inverters convert DC voltage from the solar array into AC voltage to drive pumps directly without the need for batteries or other energy storage devices. Solar power inverters have special functions adapted for use with photovoltaic arrays, including maximum power point tracking (MPPT) and anti-islanding protection.

Solar inverters use MPPT to get the maximum possible power from the PV array. Solar cells have a complex relationship between solar irradiation, temperature and total resistance that produces a non-linear output efficiency known as the I-V curve. It is the purpose of the MPPT system to sample the output of the cells and determine a resistance (load) to obtain maximum power for any given environmental conditions. By utilizing MPPT, solar pumping inverters regulate output frequency to control the speed of the pumps in order to save the pump motor from damage. Solar pumping inverters usually have multiple ports to allow the input of DC current generated by PV arrays, one port to allow the output of AC voltage, and a further port for input from a water-level sensor.

Linear Current Boosters

Linear Current Boosters for Solar Pumps (LCBs) allow the pump motor to run longer during the day by translating additional voltage to necessary current during periods of low sun. In addition to increasing the current output to allow for longer pumping days like an LCB, a pump controller may also have features like a connection for a float switch to turn the pump on or off based on water level, on/off switch, over-current and/or over-voltage protection, and more.

Linear current boosters are used for optimizing the power out of your solar panels to get your Solar Water Pumps turning as early and as late as possible into the day. Linear Current Boosters (LCB) are for solar water pumps and solar panels what a car's transmission is used for getting its wheels turning as the engine ramps up power.

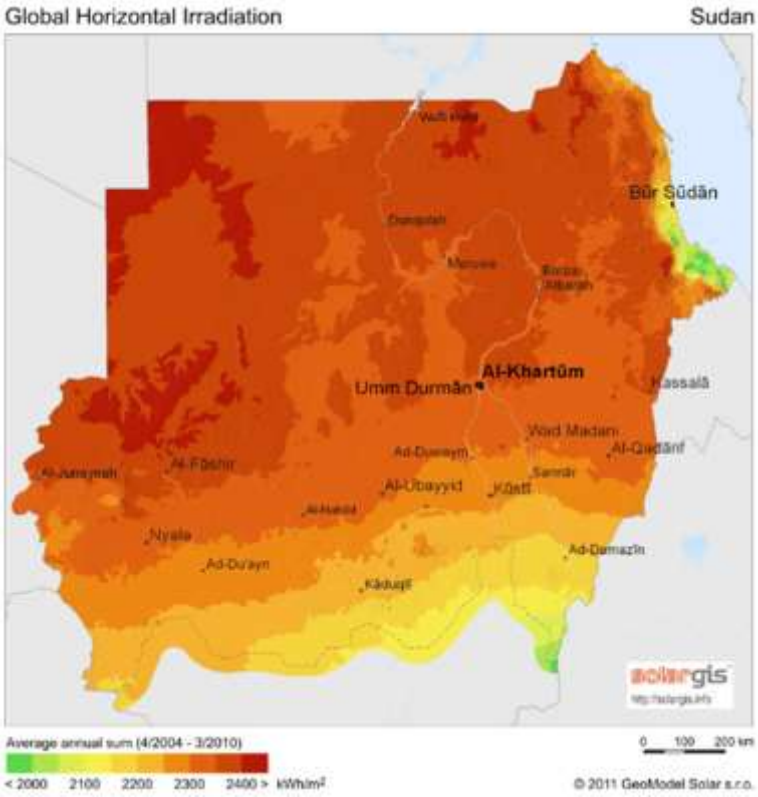
In theory, many solar pumps can be powered directly from the right voltage solar panel array. However, without the linear current booster the pump works significantly less throughout the day. The LCB increases the current (to get the pump's motor moving) sacrificing voltage when your panels are not getting full direct sunlight.

Linear current boosters are rated by the maximum amperage (current) that they can put out. This maximum amps needs to be as much or more than the maximum draw of the solar pump. LCBs inherently work at different input and output voltages as part of their optimization.

Other Accessories

Other often required accessories include filters, valves, and strainers, as well as dry run, float switches and more.

Selecting the Solar Panels



The solar panels powering the solar water pump are sold separately. The solar pump and the amount of solar panels needed both depend on the quantity and flow (measured in m^3/hr, gpm, etc.) required to pump and the vertical head (measured in m, ft or as pressure kPa, PSI, etc.) the pump needs to overcome. Each PV manufacturer provides a graph or table showing how many watts or amps and volts of solar panels are needed to produce the desired water flow and/or lift.

Solar or photovoltaic (PV) have been around for more than 50 years and have been mass-produced since 1979. PV modules are readily available in a wide range of sizes from several well established companies. The reliability of PV is such that 20- to 25-year power warranties are typical, with life expectancies beyond 30 years.

PV cells are made of semiconducting materials that can convert sunlight directly into electricity. When sunlight strikes the cells, it dislodges and liberates electrons within the material which then move to produce a direct electrical current (DC). This is done without any moving parts.

Solar cells are either mono-crystalline or poly-crystalline type. Mono-crystalline solar panels do not perform well in hot areas whereas the poly-crystalline solar panels very well in hotter areas. Poly-crystalline solar panels are lower in price and satisfy most needs.

PV cells are combined to make modules that are encased in glass or clear plastic. Modules can be aggregated together to make an array that is sized to the specific application. PV arrays are installed so that they maximize the amount of direct exposure to the sun. That usually means placement in an area clear of shading from buildings and trees, in a southward direction, and at an angle equal to the latitude of the location.

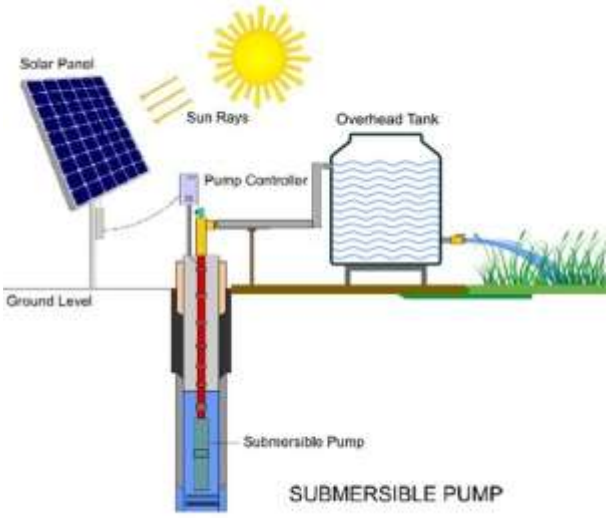
Systems Configurations and Specifications

MEFIT provides the optimum solution for each pumping requirement. MEFIT designed, supplied and installed standard or custom solar powered water pumping systems are reliable, cost effective and easy to maintain.

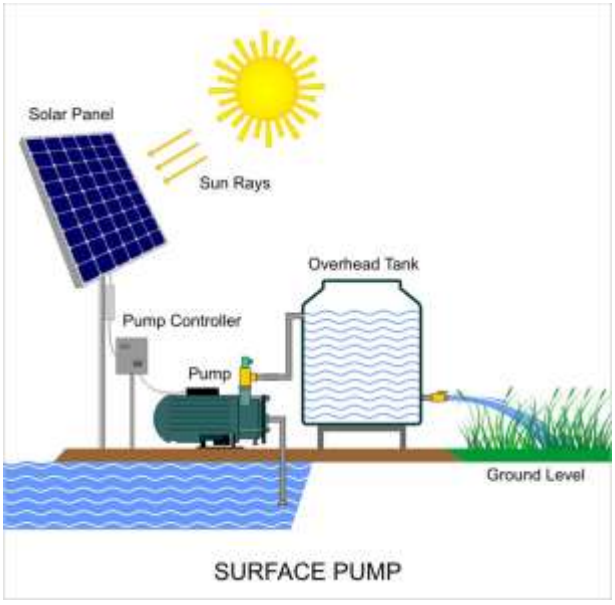
MEFIT utilizes established quality suppliers from USA, Europe, China and India to provide solutions that meet all needs and financial availability.

MEFIT provides complete systems with solar panels, pump, motor and control panels in two basic configurations

Submersible Pump
Water supply is from a well



Surface Pump
Water supply is from a river or canal



In both cases water is pumped to a reservoir and from there distributed through gravity or using a booster pump, also solar powered.

Parameters	Supply Range
Flow rate	0.5 – 50 m^3/hr (2.2 GPM – 183 GPM)
Total Dynamic Head	Up to 200m (650ft)
Power	2 KW - 22 KW (3.7Hp - 30HP)
Motor Types	AC or DC
Control Systems	Pump Protection, MPPT, LCB
Operation Modes	Manual to Fully Automatic
Solar Panels	Poly-crystalline

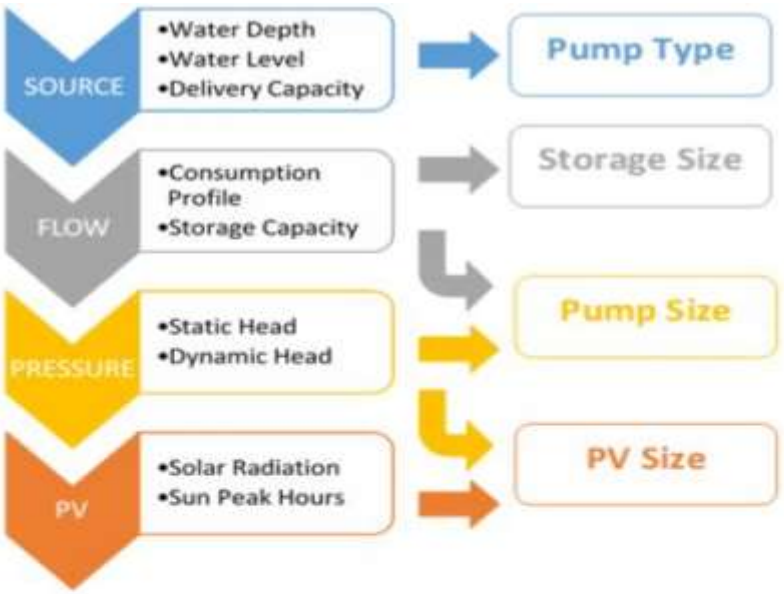
MEFIT Solution

Effective Execution Method

MEFIT provides global technical expertise and flexible execution from the conceptual stage to the full implementation stage meeting clients' requirements in an effective and efficient manner.

MEFIT planned and systematic approach guarantees the required uninterrupted system performance. In the event of a system malfunction, troubleshooting promptly restores functionality.

MEFIT approach, as a matter of fact, can also be applied to existing systems to rapidly identify cost effective permanent solutions.



STEP 1 - Determining your basic amount of water required per day.
STEP 2 - Calculating the TOTAL DYNAMIC HEAD.
STEP 3 - Determining the solar insolation for your location.
STEP 4 - Selecting the pump, controller, and solar array.
STEP 5 - Selecting the correct solar array mounting method.
STEP 6 - Selecting the right size pump cable and pipe.
STEP 7 - Using water level sensors and pump controls.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	AVG
Select Months (Yes=1; No=0)	1	1	1	1	1	1	1	1	1	1	1	1	
Average daily solar irradiance [kWh/m^2/day]	5,6	6,2	6,6	6,9	6,4	6,1	5,6	5,5	5,8	5,8	5,6	5,4	5,9
Average daily temperature [°C]	24,1	25,8	28,9	30,6	28,7	27,1	25,3	25,0	26,7	28,5	28,4	25,2	27,0
Required pump flow [m³/h]	10,7	9,7	9,0	8,7	9,4	9,9	10,8	10,9	10,4	10,4	10,7	11,2	10,1
Dynamic head [m]	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0
Continuos pressure losses [m] * Hazen-Williams formula	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Localized pressure losses [m]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total Head required B.E.P.[m]	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0	110,0

Required Pump flow [m³/h]	10,1
Total Head required [m]	110,0

Performance required

Daily flow	[m3/day	
Dynamic head	[m	

Pipe specs

Lenght	[m	Internal
diameter	[mm	
90° curves	[qty	200
check valves	[qty	0
valves	[qty	0

Cables specs

lenght	[m]	20
Size	[mm²]	2,5

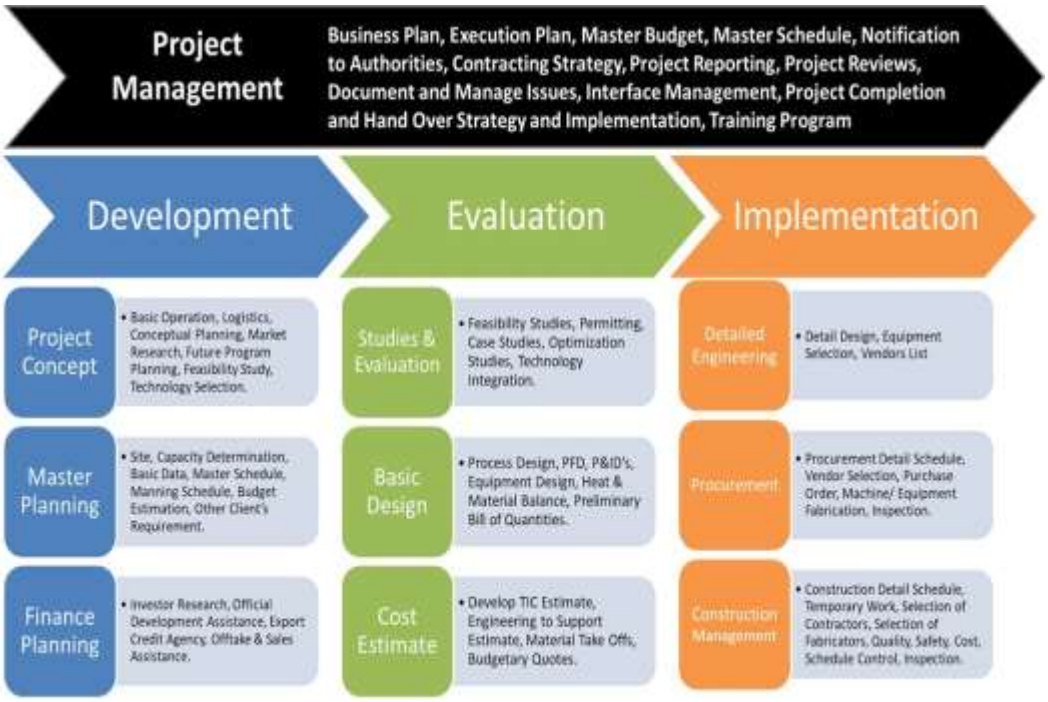
PV panels specs

Wp	≥	270
Vmp	>	31,1
Voc	<	38,4
I mp	[A] >	8,69
Temperature power loss	[%] ≤	5

Services

MEFIT provides services from the design of a single pumping system to complex interconnected systems. Services include:

1. Feasibility Study
2. Design
3. Supply
4. Installation
5. Program Management
6. Troubleshooting



Program Management

MEFIT is the ideal partner when addressing water requirements for large single or multi-crop farms, with or without animal rearing, since MEFIT proven Program Management approach will provide the optimum solution for the entire lifecycle of the investment.

Solar Pump Intermittent Operation Checklist		
Possible Causes	**Verification**	**Remedial Action**
Panels Performance	Measure at site with Pyranometer	Clean panels Verify orientation Verify Solar Irradiation Replace Panels
Solar Irradiation	Measure at site with Pyranometer	Remove causes of shades Add panels
Panels Temperature	Measure at site	Replace Panels – in very hot area use polycrystalline panel
Water Source Delivery Capacity	Verify at site against design	Reduce Flow Replace pump

Troubleshooting

MEFIT experts will apply the same systematic approach used when designing a new system.

Developed and proven checklists are used to ensure all possible causes of the problem are investigated and appropriate remedial actions are evaluated to determine the optimum solution.

Representative Suppliers

Solar Panels

Solaria, USA
SolarTech Universal, USA
Silfab Solar, Canada
Kyocera, Japan
Jinko Solar, China
Trina Solar, China

Central Inverters, Power Optimizer

ABB, Sweden
Schneider Electric, France
GE, USA
Honeywell, USA
Bonfiglioli Riduttori, Italy
Omron, Japan
SunGrow, China
Sorotec, China

Pumps

bbc Elettropompe, Italy
Fluxinos Italia, Italy
Grundfos Denmark
Lorentz, Germany
Advanced Power Incorporated USA
Dankoff Solar, USA
Conergy, USA
Hotian China
Shakti, India

Controllers LCB

Pentair SHURflo, USA
GE, USA
Honeywell, USA
ABB, Sweden
Solar Converters Inc, Canada

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