THE POTENTIAL OF SOLAR ENERGY FOR IRRIGATION – OVERVIEW ON ECONOMICS AND FINANCIAL FEATURES OF SPIS

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Tunis, 14 December 2022

Regional gathering
Tunis, 12 – 16 December 2022

ITALIAN AGENCY FOR DEVELOPMENT COOPERATION

BENEFITS OF SOLAR PUMPING SOLUTIONS FOR FARMERS AND GOVERNMENTS

- Sustainable source of energy and access to irrigation water
- Significant decrease of energy costs
- Man work efforts reduction and improved time expenditure
- Enhanced crop
- Environmental impacts GHG Emissions reductions
- Subsidy savings
- Increased agricultural economic output

EM to conduct site selection and discuss pumping system for design of solar pump for Maasai project

KENYA, NAIROBI

24-28/07/2016

IAEA REFERENCE PROJECT

EGYPTIAN EXPERTS

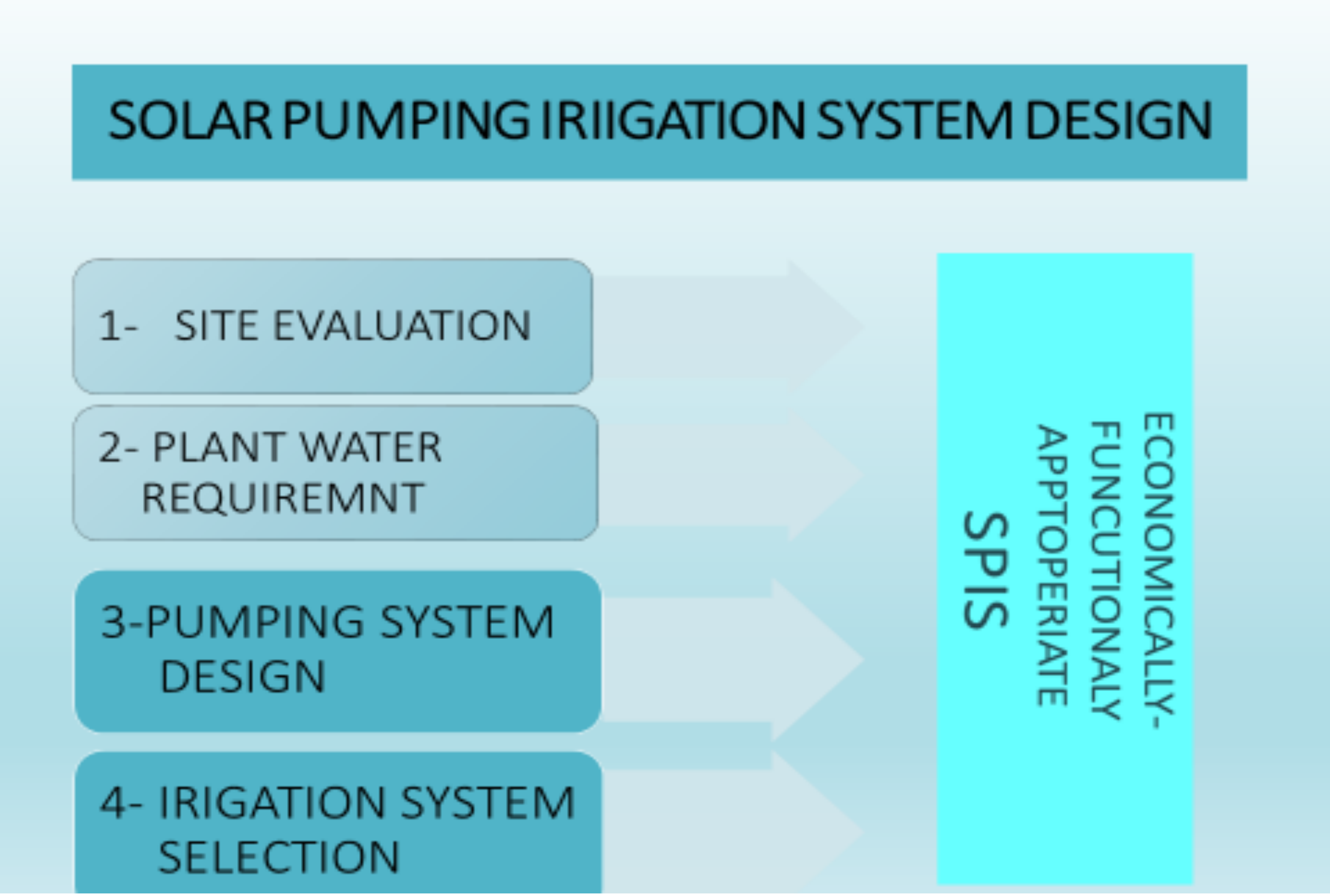
Dr. *Ahmed Hegazi*: Egyptian Atomic Energy Authority.

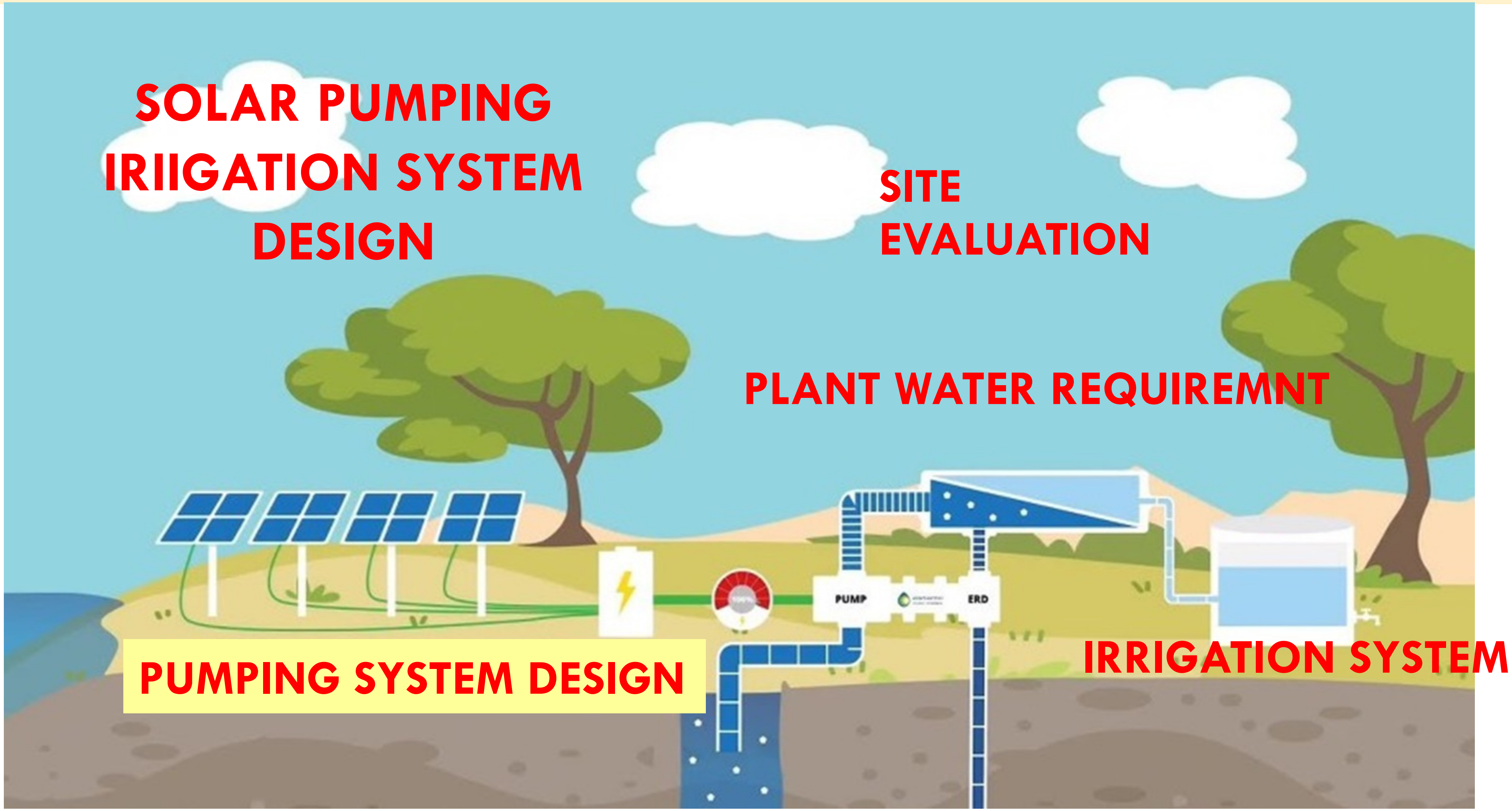
Eng. *Peter Luke* : SunValley for Renewable Energies.

KENYAN EXPERTS

Mr. *Isaya Vincent Sijali* :

Kenya Agricultural and Livestock Research Organization.


SOLAR PUMPING IRIIGATION SYSTEM DESIGN
1- SITE EVALUATION
2- PLANT WATER REQUIREMNT
3-PUMPING SYSTEM DESIGN
4- IRIGATION SYSTEM SELECTION
ECONOMICALLY-
FUNCUTIONALY
APPTOPERIATE
SPIS


SOLAR PUMPING
IRIIGATION SYSTEM
DESIGN
SITE
EVALUATION
PLANT WATER REQUIREMNT
PUMP
ERD
PUMPING SYSTEM DESIGN
IRRIGATION SYSTEM

1-SITE EVALUATION

Solar powered irrigation systems (SPIS) are reliable and an environmentally sustainable option. SPIS will almost stop fossil fuel usage in irrigated land areas.

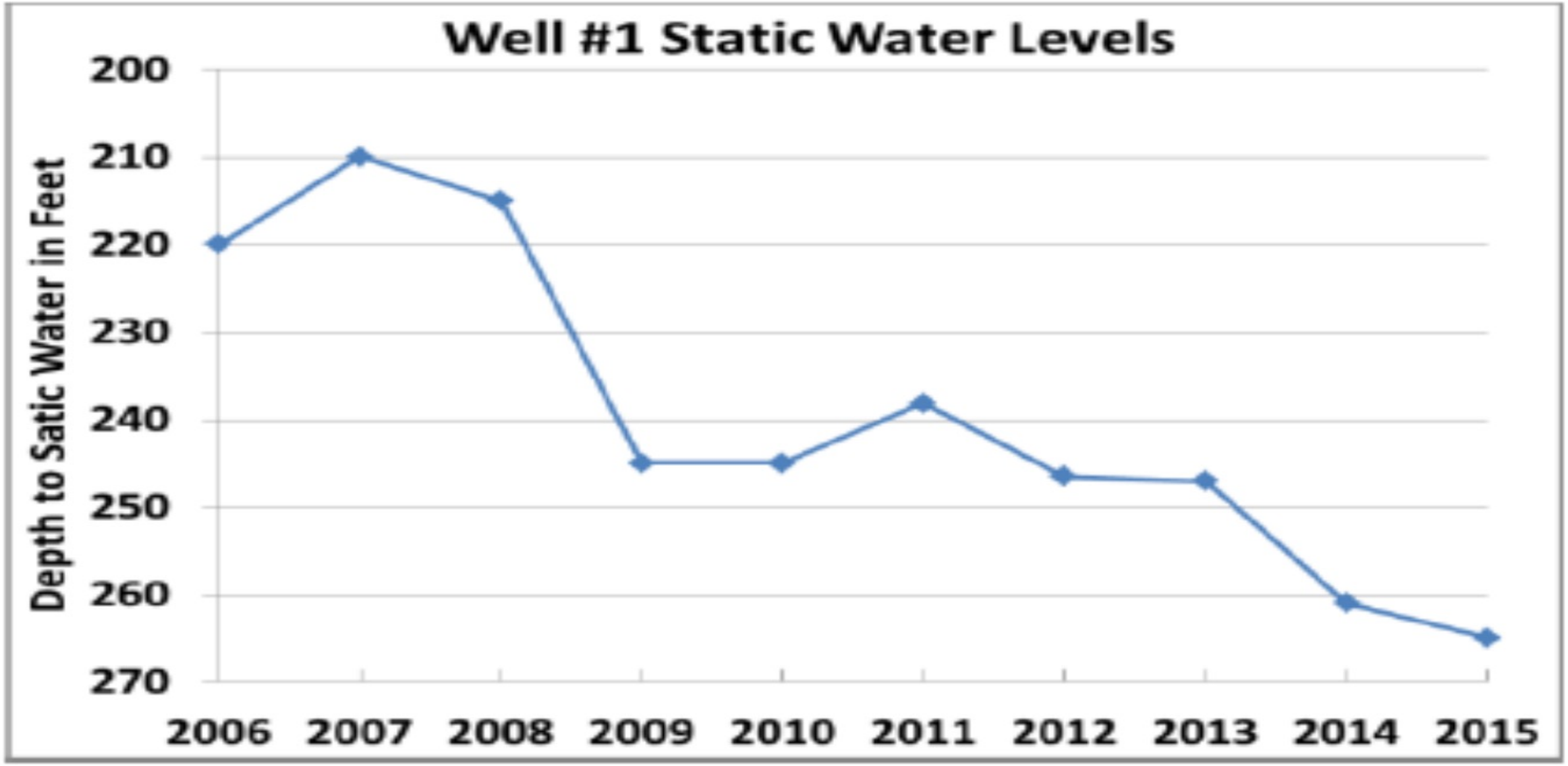
A good design of SPIS will *help to maintain better irrigation practices and cost-effective installation with high performance.*

SPIS system needs to optimize:

1. Initial capital costs (type and size of system, cost of shipping and installation);
2. Recurring costs (e.g. costs relating to operation and maintenance, labour and fuel);
3. Ensuing economic benefits (e.g. fuel savings, yield increases); and
4. Current energy expenditure.

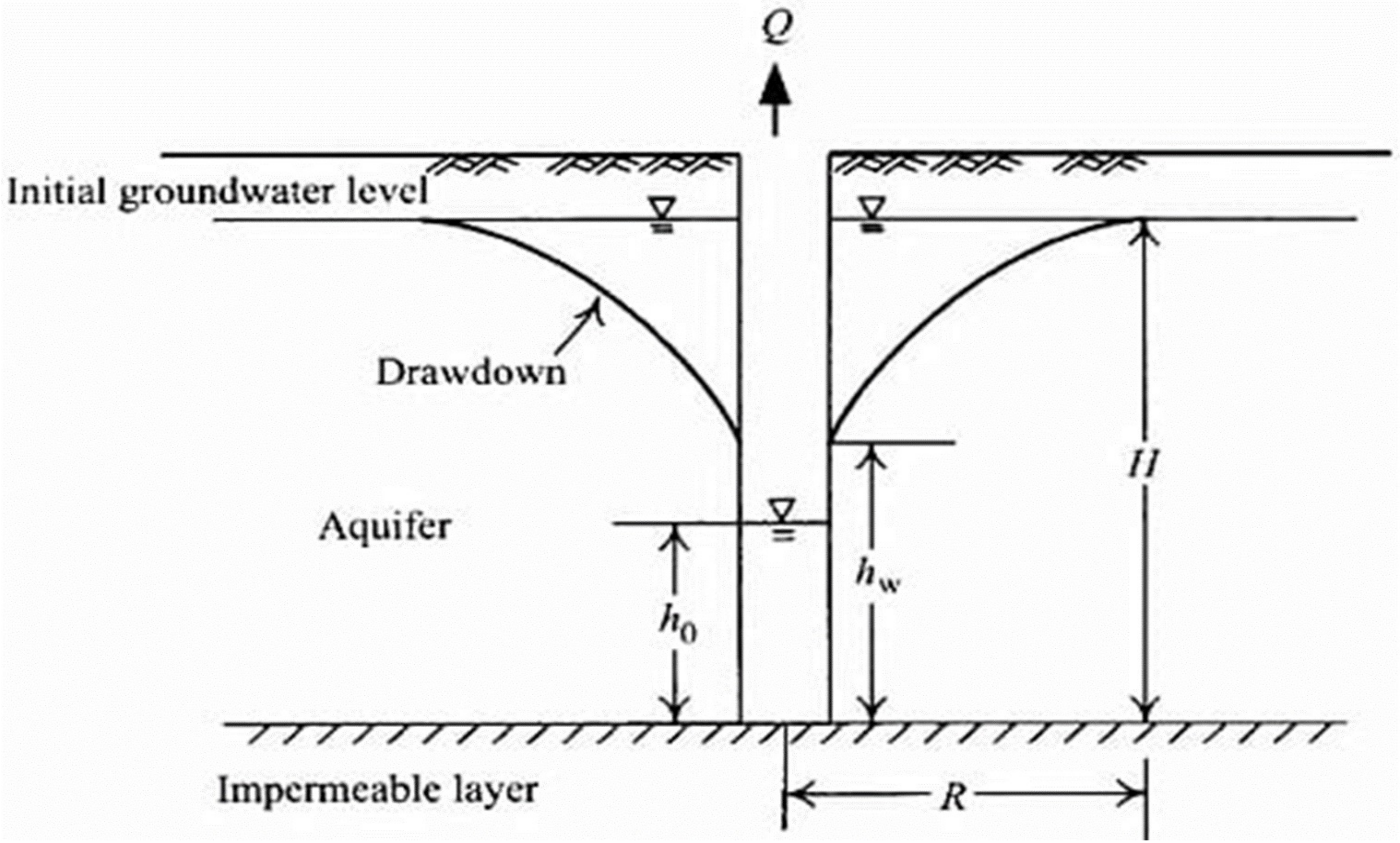
It is clear from the above discussion that solar energy is becoming an important source of energy all over the World. Knowledge about the performance of solar water pumping systems will result in correct investment decisions, a better regulatory framework and favorable government policies. Various factors contributes the performance of solar water pumping systems, such as radiation, temperature and other climatic conditions, design. Objectives are summarized below:

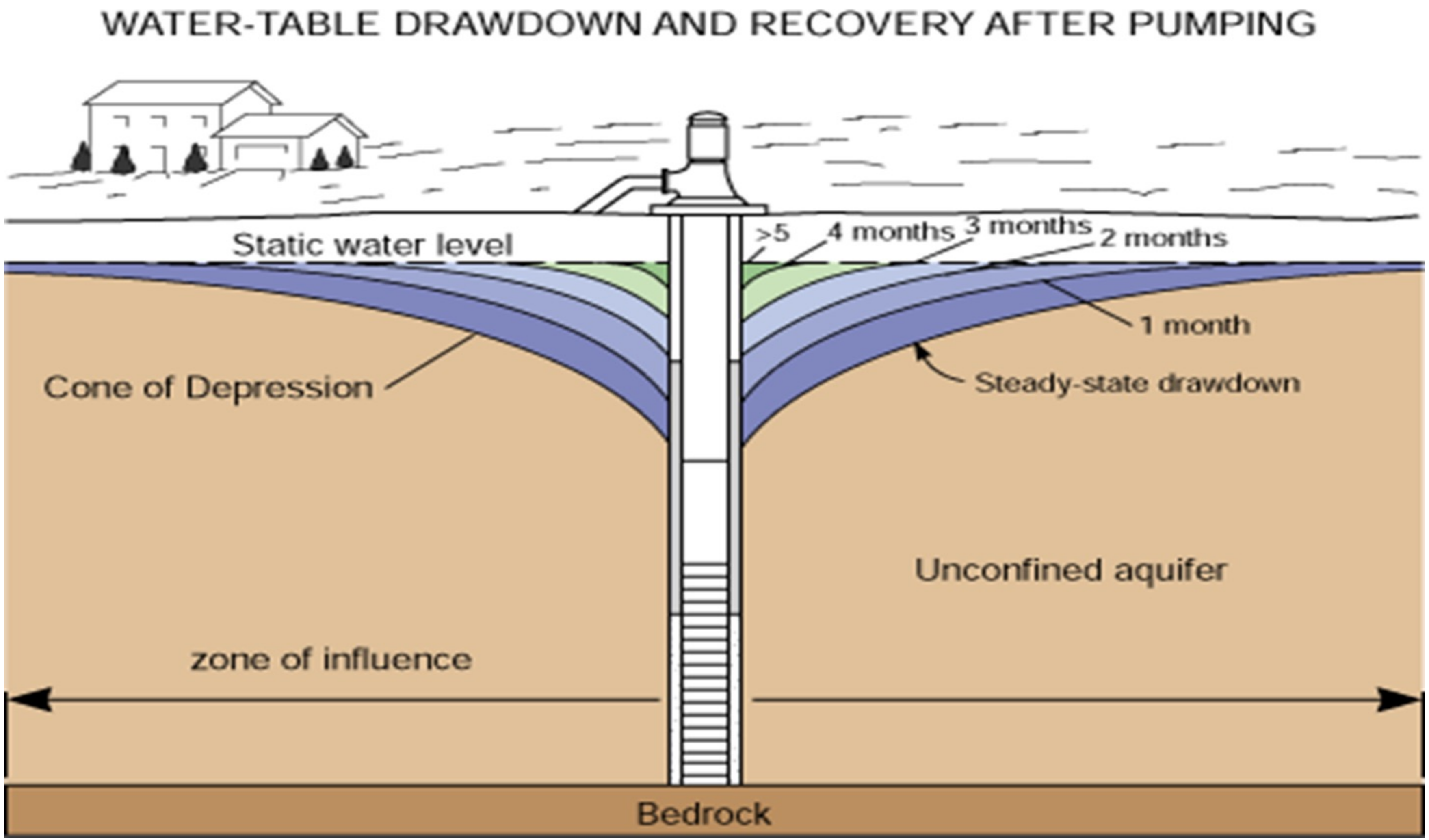
- To study the solar radiation data.
- To select the suitable solar PV type and equipment depending on the solar mapping.
- To investigate the stakeholders necessities and available sources.
- To recommend the proper design for future work in the field of solar energy in the area under investigation.
- To design the best criteria for better performance of solar water pumping systems.

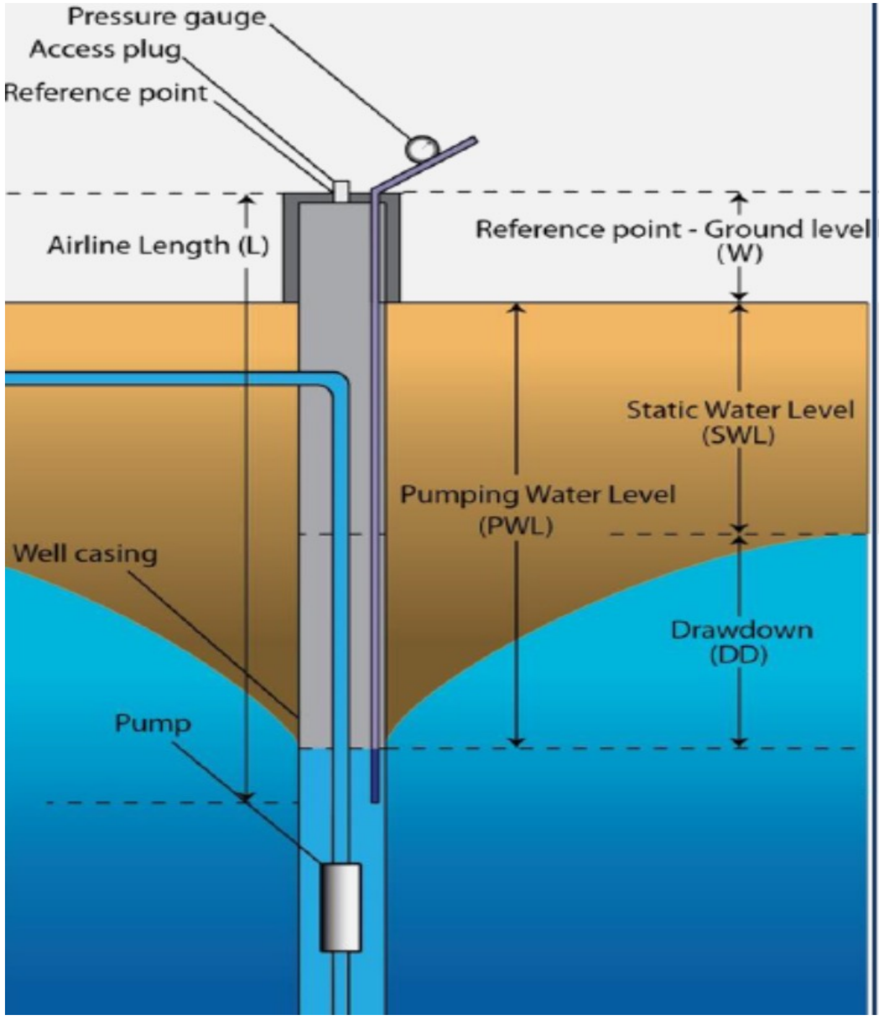


Example of a hydrograph indicating water levels declining over time.

PIMPING SYSTEM DESIGN


Q
Initial groundwater level
Drawdown
Aquifer
h_0
h_w
H
Impermeable layer
R


WATER-TABLE DRAWDOWN AND RECOVERY AFTER PUMPING
Static water level
>5
4 months
3 months
2 months
1 month
Cone of Depression
Steady-state drawdown
Unconfined aquifer
zone of influence
Bedrock



Water Level Measurement Terms

PWL: Pumping Water Level from the ground surface

PWLW: Pumping Water Level from top of the well

SWL: Static Water Level from the ground surface

SWLW: Static Water Level from the top of the well

DD: Drawdown between static and pumping water levels.

W: The distance between the top of the well and ground surface

L: Length of the air line

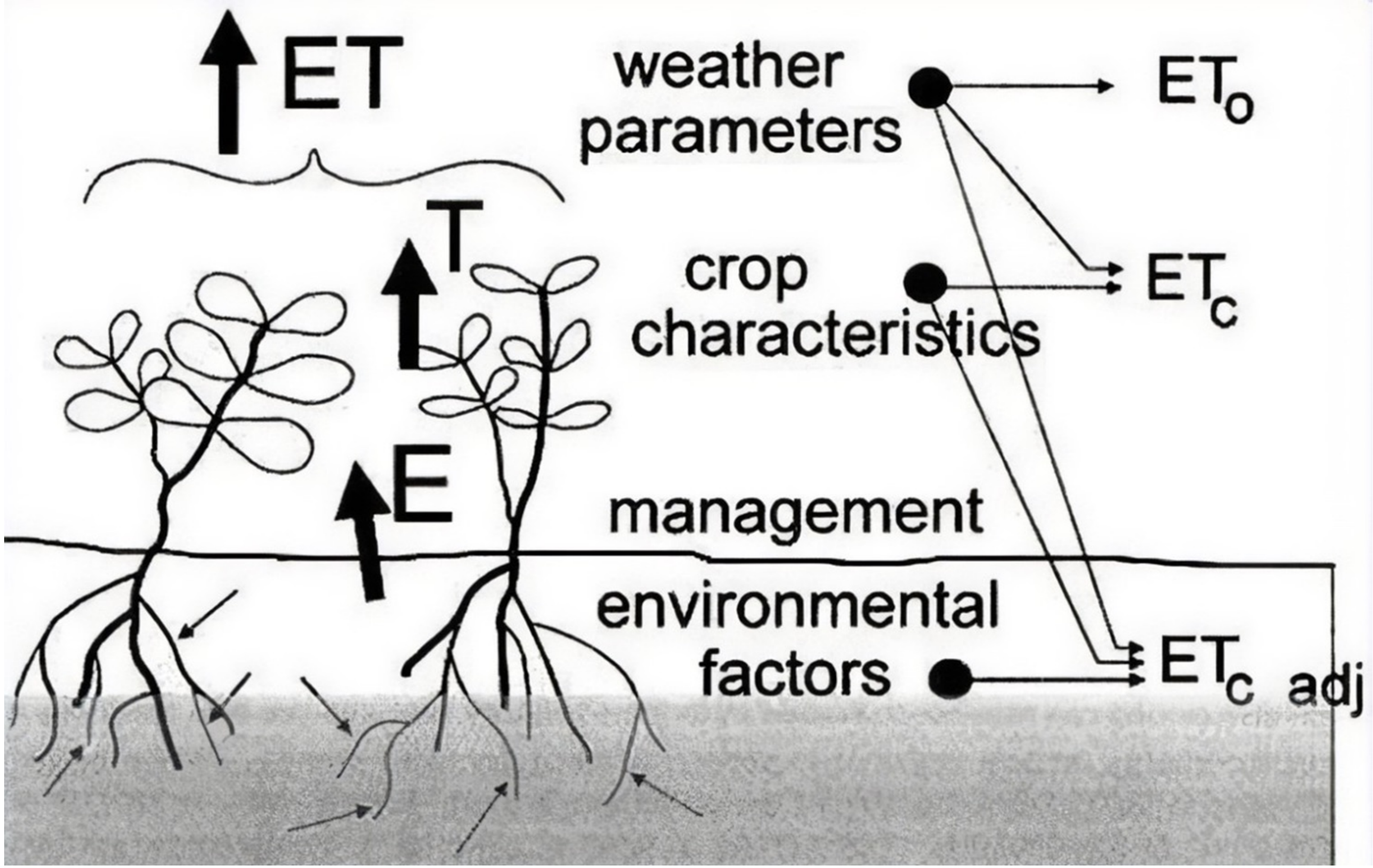
P(s): Pressure on the gauge in PSI while static

P(p): Pressure on the gauge in PSI while pumping

L(s): The length of the tape from static water level surface to well measuring point

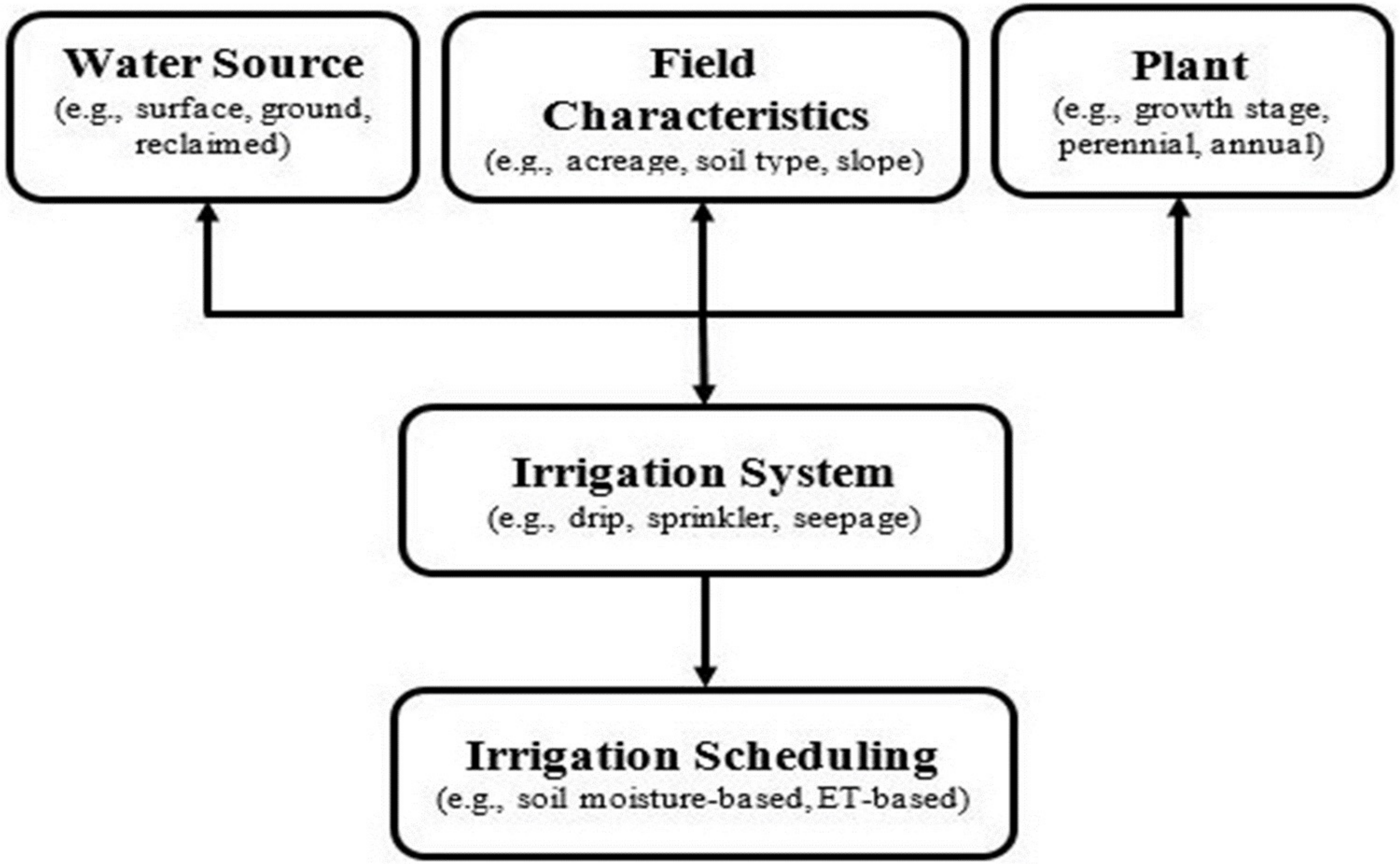
L(p): The length of the tape from pumping water level surface to well measuring point


3-PLANT WATER REQUIREMNT

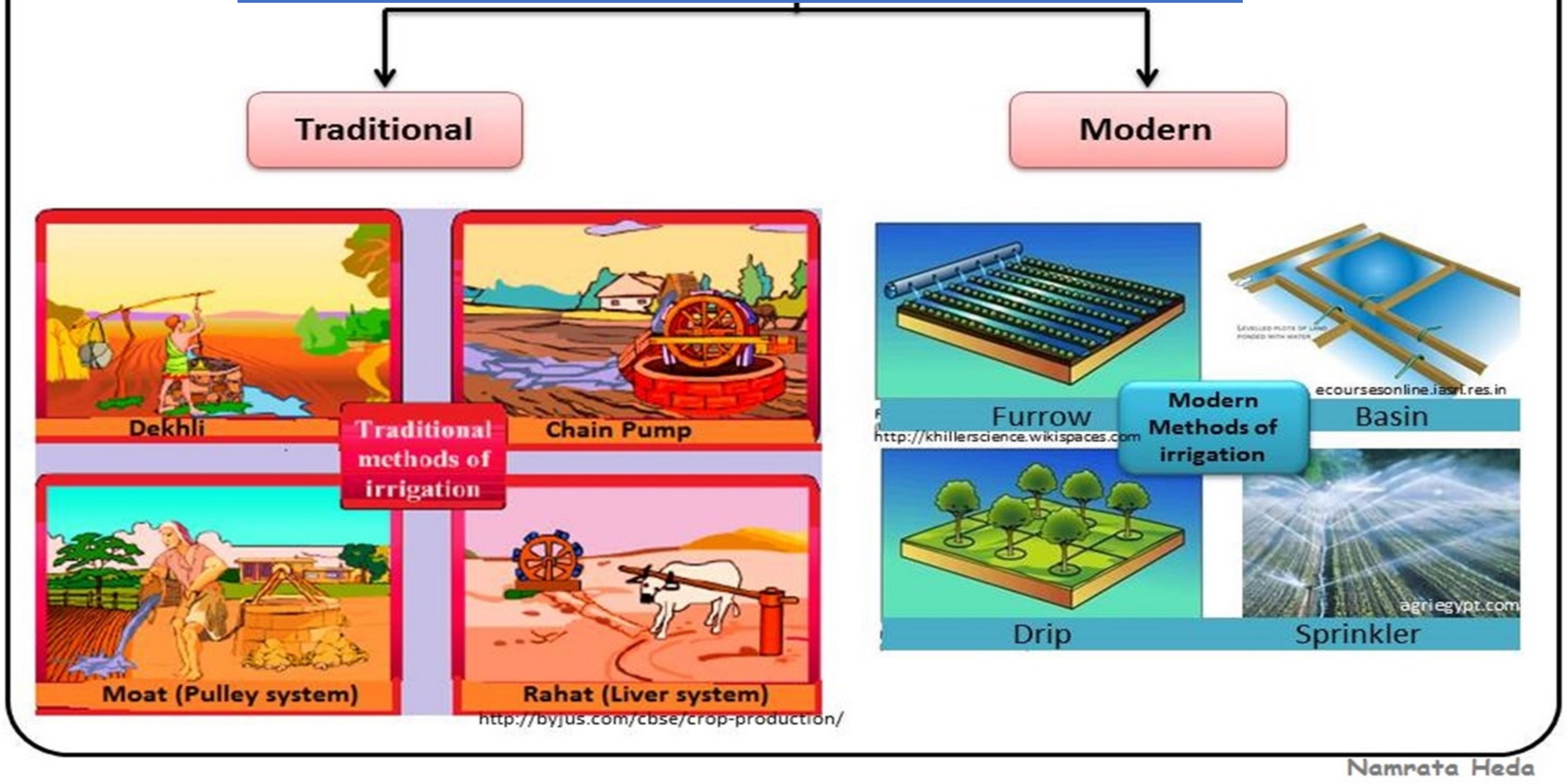


ET
T
E
weather parameters
crop characteristics
management
environmental factors
ET$_o$
ET$_c$
ET$_c$ adj

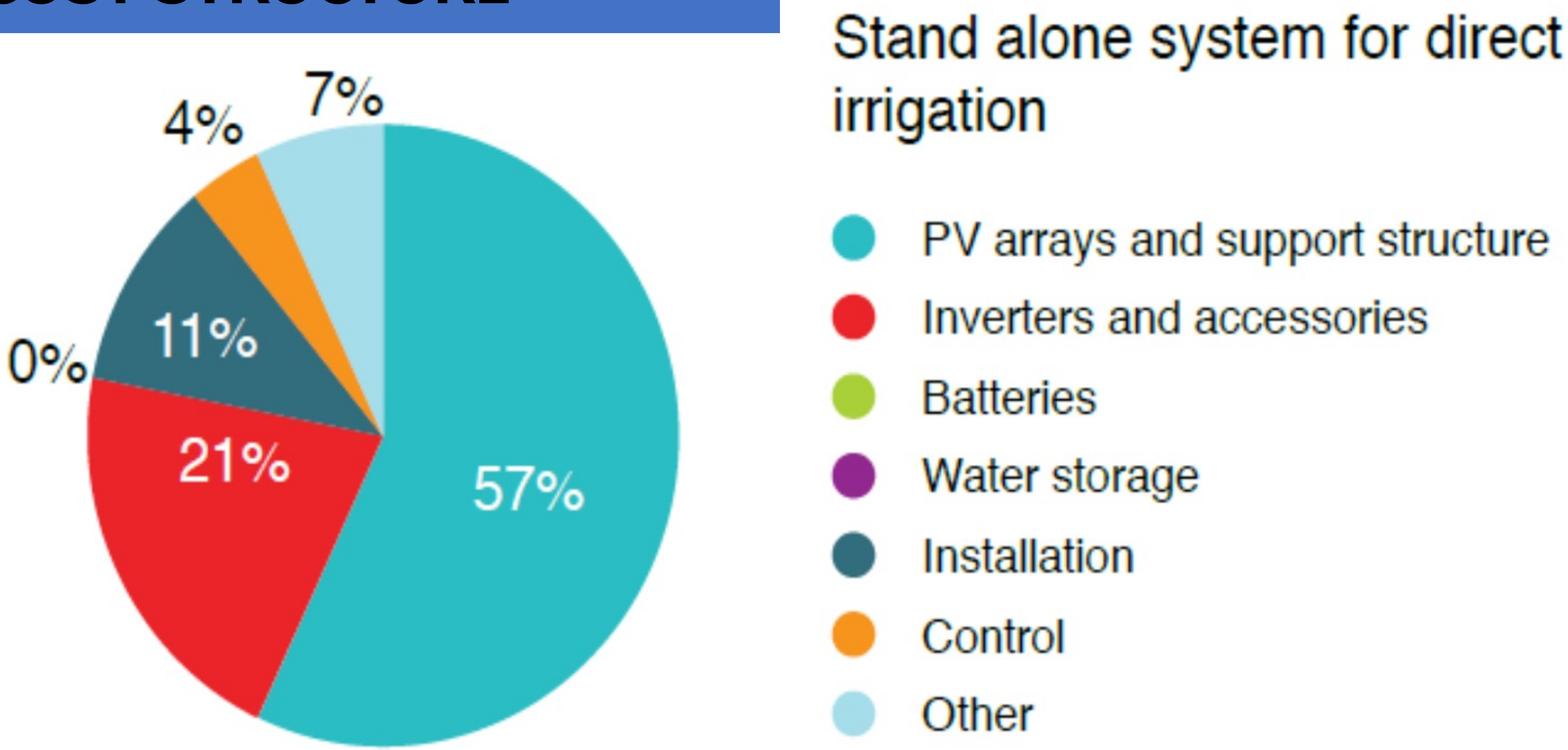
4-IRRIGATION SYSTEM SELECTION



IRRIGATION SYSTEMS SELLECTION



COST STRUCTURE



SOLAR POWERED PUMPING SYSTEMS MAIN COMPONENTS

Applications

- Drinking water supply
- Pond management
- Irrigation
- Livestock watering
- Pressurizing systems

Characteristics

- Fast, failure-free installation
- Excellent serviceability
- High reliability and life expectancy
- Short Return of Investment (ROI) cycle
- Lower Total Cost of Ownership (TCO)

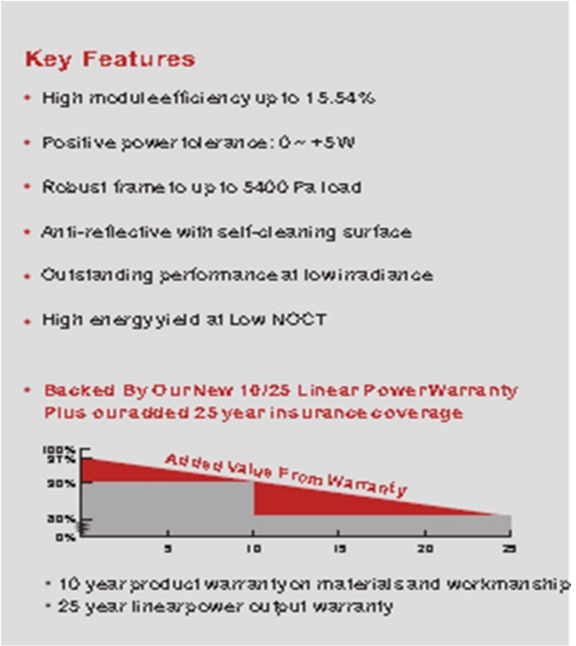
Technical data

Total dynamic head	max. 55 m
Flowrate	max. 112 m³/h
Vmp*	> 575 V
Voc	max. 800 V

Standards

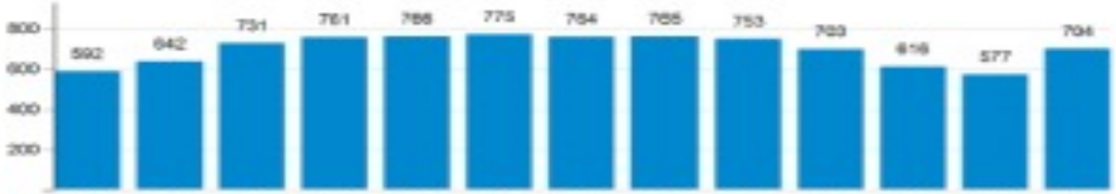
CE 2006/42/EC, 2004/108/EC, 2006/95/EC

The logos shown reflect the approvals that have been granted for this product family. Products are ordered and supplied with the approvals specific to the market requirements.



Daily output in average month — 704 m³

Daily values



Daily values	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Av.
Energy [kWh]	129	160	178	188	195	196	193	188	183	166	138	119	166
Irradiation [kWh/m²]	4.7	5.5	6.6	7.2	7.2	7.4	7.3	7.4	7.2	6.3	5.1	4.3	6.4
Rainfall [mm]	1.5	0.87	0.43	0.10	0.033	0	0	0	0.033	0.33	0.83	1.6	0.50
Ambient temp. [°C]	15	15	16	19	21	24	26	27	26	23	20	17	21

Hourly values

Hourly values	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
Energy [kWh]	0.59	4.7	10	16	19	22	23	22	19	15	10	4.5	0.57
Irradiation [kWh/m²]	0.021	0.17	0.39	0.58	0.74	0.85	0.89	0.85	0.74	0.58	0.38	0.17	0.021
Ambient temp. [°C]	16	16	17	19	21	23	25	26	26	26	26	25	25

Parameter

Location:	Egypt, Alexandria (31° North; 29° East)	Static head:	31 m
Required daily output:	800 m³, Sizing for average month	Motor cable:	70 m
Dirt loss:	5.0 %	Pipeline:	2,000 m

Solar Powered Pumping Systems as an Alternative For Traditional Fuel Powered Systems


THANKS