

● بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

**“In the name of Allah,
Most Gracious, Most
Merciful”**

Induction of Renewable Energy to Redefine the Generation Mix

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Road to Renewable Energy in Pakistan

Renewable Energy



Presentation Title

Presentation Subtitle

Background of Energy Crisis

- Energy consumption has been increased during the 18th, 19th and 20th centuries.
- The energy generation has the splendid dependence upon the fossil fuels.
- Fossil fuels reserves are limited to the ownership of few countries, who can control the supply and prices and these reserves have certain age limits, which are depleting swiftly.
- The people of this region do not have way into many types of basic energy services and access to the energy/energy sources.

Critical Analysis of Energy Crisis in Pakistan

- Wrong preference of oil based generation.
- Delay in setting up of Hydro Power Generation.
- Selling power on extraordinary low price, compared to the purchase rate from the power producers, thus bearing huge amount against subsidies.
- Sluggish attitude in exploiting renewable sources of energy.

Reasons for persistent issue of acute Power shortage

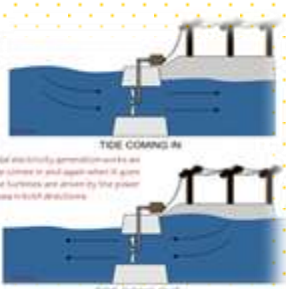
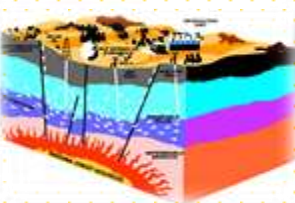
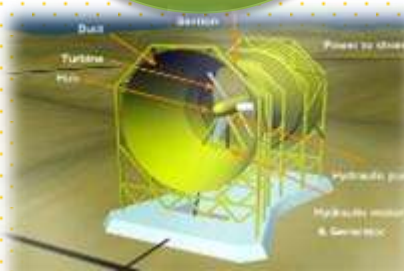
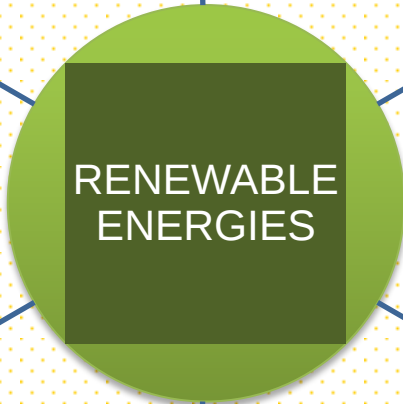
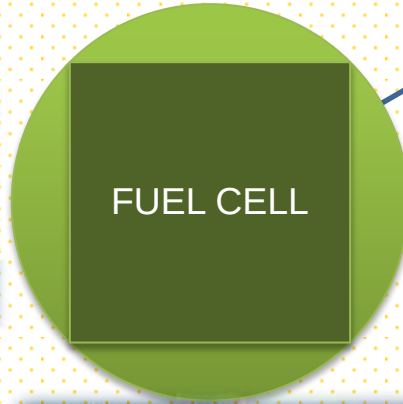
- The issue could not attract the attention of governments for decades due to socio political reasons.
- Delay in construction of dams.
- Disputes over use of water resources.
- scarcity of cheaper fuels for generation of electricity and dependence upon oil based technology.
- substandard distribution network.
- Theft of electricity.
- Inefficiency and corruption.
- Defective policies, lack of fixing correct priorities and nonexistence of right man on the right job.
- Big gap between the unit generation cost and sale price of electricity.
- Installation of substandard equipment at the consumer end.
- Installation of substandard UPS in huge quantity, generating harmonics and de-grading /overloading the Power system.

Disadvantages of Fossil Fuels and Potential of Renewable Energy

- The use of fossil fuels has caused severe problem of global warming and the ozone layer is being destroyed with the production of destructive gasses, hence we receive both the harmful and harmless Sunrays.
- The extensive production of fumes and pollution has disturbed the normal working of echo system, resulting into abnormal changes in the weathers.
- Problem of global warming due to extensive use of fossil fuels can only be solved by renewable energies. Therefore renewable energy is emerging as the vital solution to meet with the fast growing energy demands of the world.
- Pakistan and South Asia Region have a huge potential of renewable energy, which can lead the world in energy security.

Renewable Energy

- Renewable Energy is the energy which comes from natural sources, which are unlimited and eco friendly, such as wind, sunlight, breeze, tides, rain, and geothermal heat.
- Renewable technologies can provide alternate sources of electric power as well as displacing electricity demand through direct heat. Renewable bio-fuels for transport are also diverging from petroleum products.
- The take-off by some regional countries in taking advantage of the potential of renewable energy resources is flagrant.



Renewable Energy is Green Energy



We are wasting priceless Expensive Natural Resources

- Water resources in Gilgit-Baltistan, some areas of Khyber Pakhtoonkhwa and Punjab are very huge sources of “Hydro Electric Power”.
- Animal waste in Punjab and Sindh and solid waste all over the country is a “source of Biogas”.
- Briskly moving air in Sindh and Baluchistan, which can be used to produce “Wind Energy.”
- Tidal waves on the seashores of Baluchistan and Sindh can be used for production of “Tidal Energy” in the world.

Hydro Electric Power Generation

- The potential for hydropower in Pakistan is more than 100,000 MW. At present Pakistan is generating only 6500 MW (Approx), which is about 32% of the total power generation, while some projects are under construction, detailed engineering design, documents of tender under process, engineering study and feasibility study stages, but the achievement in this vital source of green energy is far behind the goal.

Biogas

- Biogas typically refer to a mixture of gases produced by the breakdown of organic matter in the absence of oxygen.
- It is a renewable source of Energy and in many cases exerts a very small carbon footprint.
- The input for the biogas is the organic waste.

Process for generation of Biogas

- When organic material decays, burns, or is eaten, this chemical energy is passed into the rest of the living world. In this sense, therefore, all life forms and their by-products and waste are storehouses of solar energy ready to be converted into other unstable forms of energy. The decay of organic matter transformed into combination of gases produced by anaerobic (without oxygen) decomposition is often known as biogas. The principal component of biogas is methane, a colorless and odorless gas that burns very easily.

Composition of Biogas

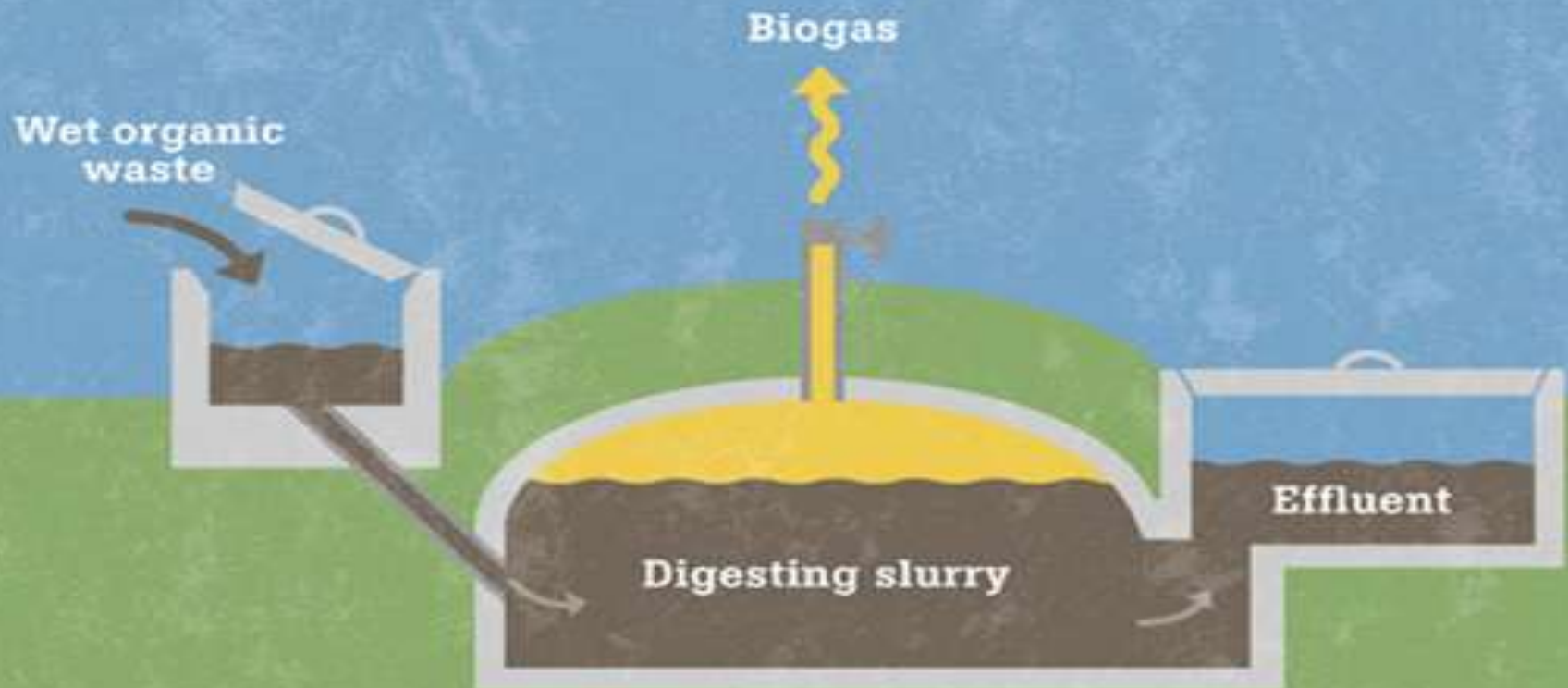
- Biogas is consisting of 50-75 (volume)% of methane (CH_4), 25-50 (volume)% of carbon dioxide (CO_2), 0-10 (volume)% of Nitrogen 0-3 (volume)% of Hydrogen Sulphide and contains traces of Ammonia, Hydrogen, and Carbon Monoxide. Suspended solids are possibly found.
- Synonyms for biogas such words as sewage gas, marsh gas, methane.
- Different microorganisms metabolizing carbon from organic matter in oxygen-free environment (anaerobically). Cattle dung, poultry droppings and similar fermentable material when confined to a place, in the absence of Oxygen, gives rise to large no. of bacteria to assimilate and breakdown organic matter to produce Methane gas and fertilizer as a major by-product.
- This process is known as decomposition or anoxic fermentation and follows food chain.
- In the process of fermentation biological waste produces biogas.

Biogas Composition

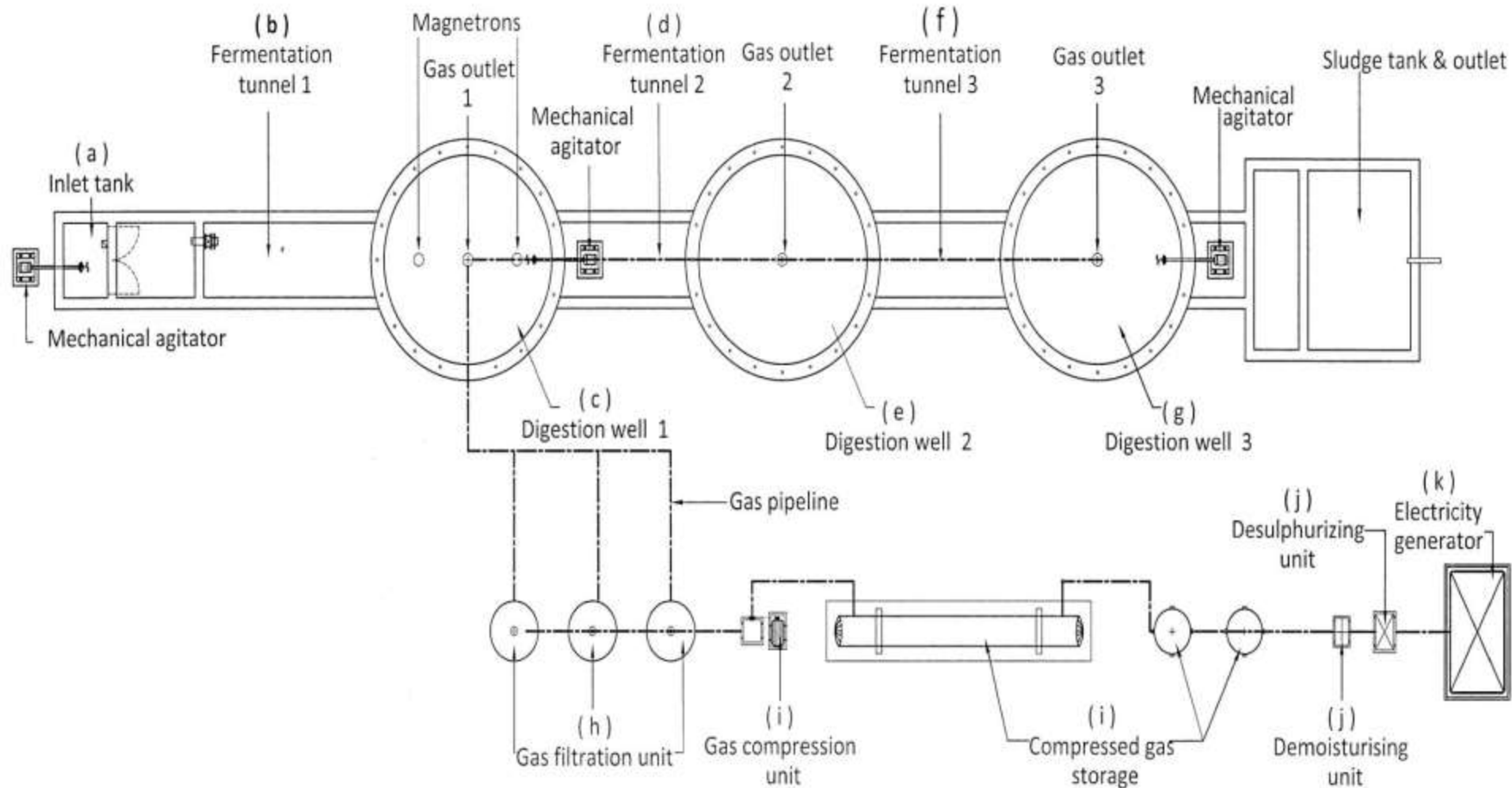
- The typical composition of the Biogas is given in the following table:

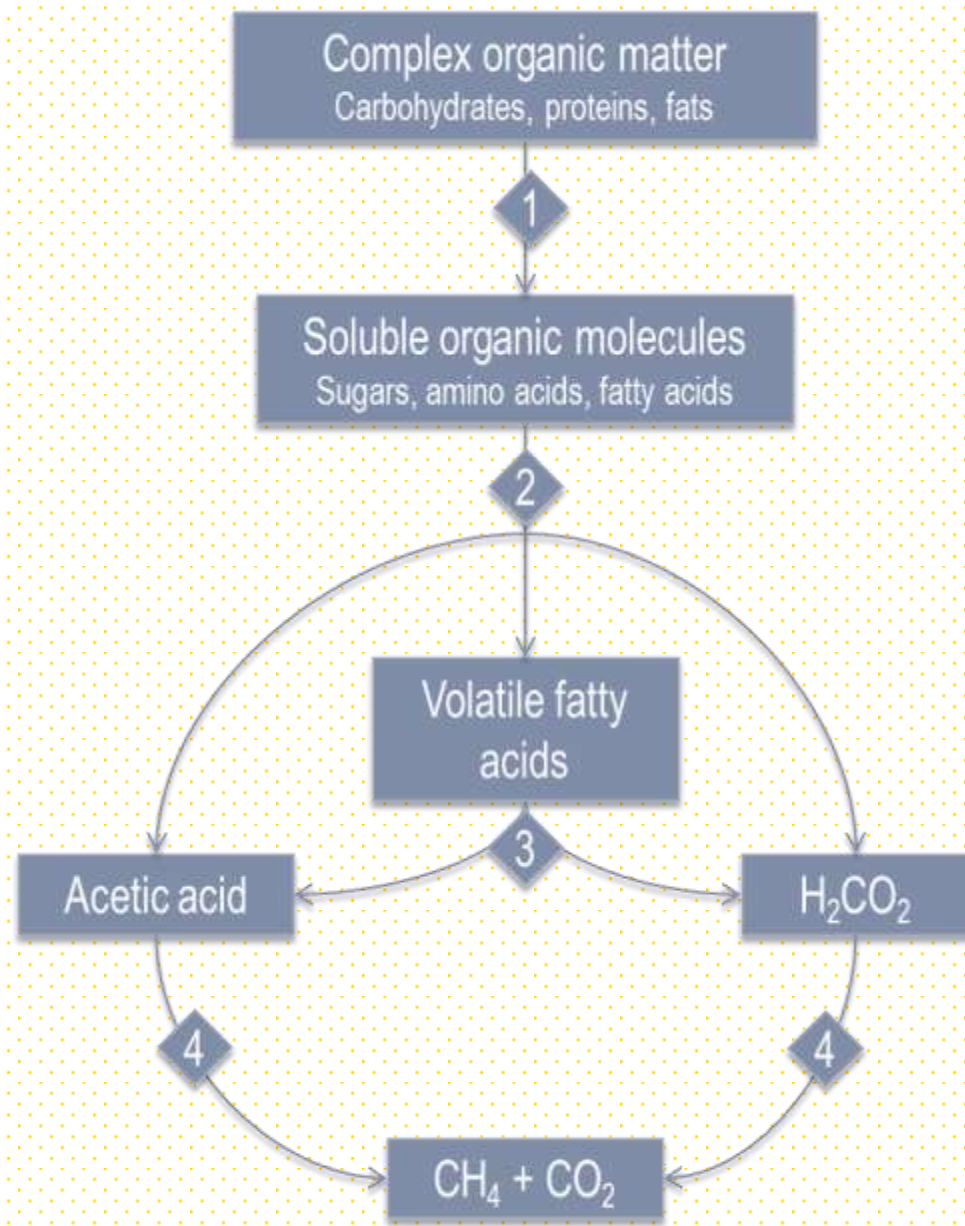
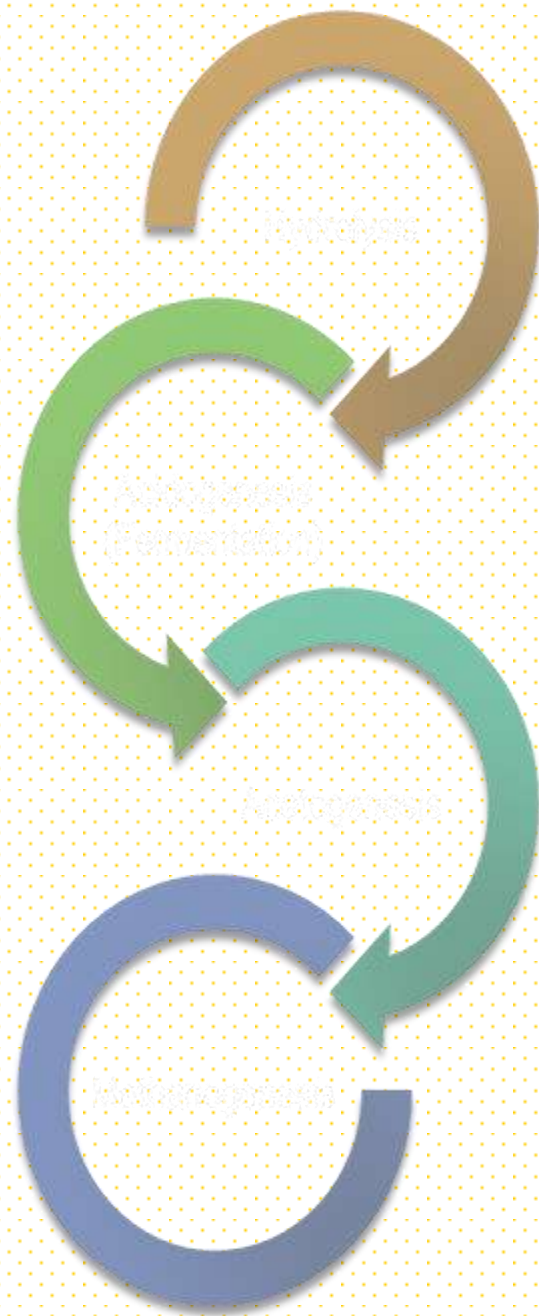
Sr. No	Name of Compound	Molecular Formula	%age
1	Methane	CH ₄	50-75
2	Carbon dioxide	CO ₂	25-50
3	Nitrogen	N ₂	0-10
4	Hydrogen	H ₂	0-1
5	Hydrogen Sulfide	H ₂ S	0-3

Basic Diagram for Biogas



Process Flow and Parts detail

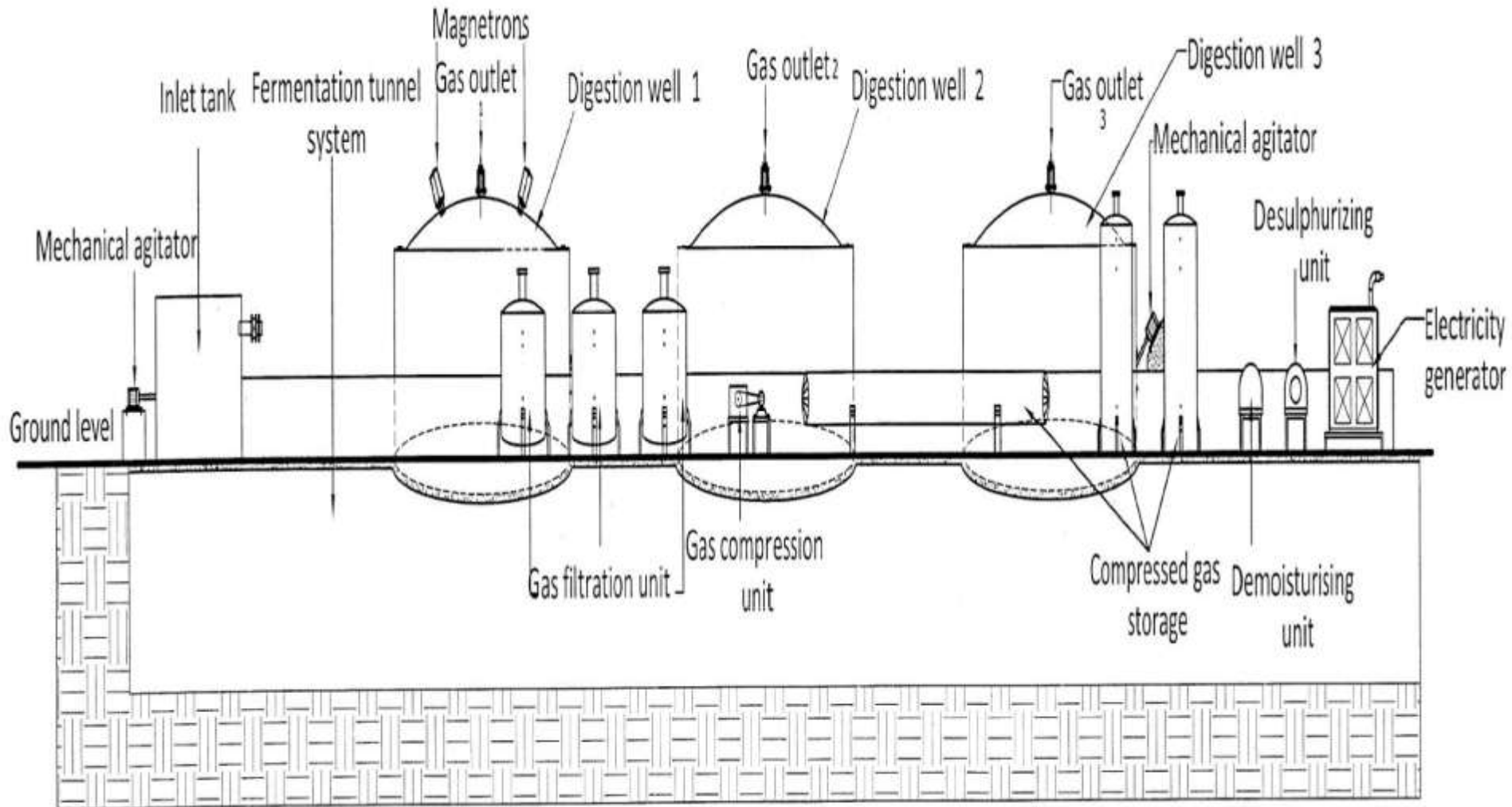




Measurements for a Number of Simple Gas Plants

Gas Plant Type	No of Animals	1:1 Water & Dung /Day KG	Volume of Well for 42 days digesting CM	Size of Well Diameter and depth (M)	Size of Gas Cap Diameter and height (M)	GI Sheet for Gas Cap (Sq M)	No. Bricks (Nos.)	Cement Bags (Nos.)	Sand (Cu. Meter)	Gas produced/d (C.M)	Sun dried fertilizer produced per day (Kg)	No. of people Served by Gas(Cooking Lighting)
2 CM	4	80	3.5 CM	1.25X3	1.5x1 M	4.5	2800	22	9	2	4-8	4-5
3CM	6	120	5	1.5x3.4	1.4x1.2 5	9	3200	25	12	3	6-12	6-8
4CM	8	160	7	1.5x4	1.4x1.2 5	9	4000	28	12	4	8-16	9-11
5CM	10	200	8.5	1.7x3.5	1.5x1.5	10.5	4000	30	14	5	10-20	12-15
7.5CM	15	300	13	2x4	1.9x1.5	12.6	5200	32	16	7.5	15-30	15-20
15CM	20	400	17	2.2x4.3	2.1x1.5	14.3	6400	35	18	10	20-40	20-30

Schematic of Creative bio-electric plant



Biogas Plant installed at Creative Engineering Pvt Ltd Sarfraz Nagar Lahore

An educational trip of about 300 Engineers and others was arranged.



Biogas Unit for gas usage and Electricity generation at Skypower Pvt Ltd Halloki



BIOGAS TECHNOLOGY

- There are different types of biogas technologies based on the state of organic waste i.e. high solid waste or the liquid effluents.
- **UASB** (UPFLOW ANAEROBIC SLUDGE BLANKET)
- **CSTR** (CONTINUOUSLY STIRRED TANK REACTORS)
- **EB** (EXPANDED BED REACTORS)
- **HSAD** (HIGH ANAEROBIC DIGESTOR)
- STEEL TANK AND GLASS LINED STEEL DIGESTER
- CONCRETE DIGESTER
- FLEXIBLE LINE REACTOR (**FLR**)

FLR(COVERED LAGOON)

- A covered lagoon digester is simply a manure lagoon with an impermeable cover. The cover traps gas produced during decomposition of the manure.
- They work best for liquid manure with less than 2% solids.
- Two lagoons are preferred.
- The primary lagoon is anaerobic and operated at a constant volume to maximize biological treatment, methane production, and odor control. The biogas recovery cover is floated on the primary lagoon.

Cont.....

- Ideally, organic waste contaminated runoff is bypassed to the secondary lagoon.
- The secondary lagoon is planned as variable volume storage to receive effluent from the primary lagoon and contaminated runoff to be stored and used for irrigation, recycle flushing, or other purposes.

Components of Covered Lagoon Digester

➤ Solids separator.

A gravity solids trap or mechanical separator should be provided between the manure sources and the lagoon.

➤ Lagoons.

Two lagoons are preferred; a primary anaerobic waste treatment lagoon and a secondary waste storage lagoon.

➤ Floating lagoon cover.

The most effective methane recovery system is a floating cover over all or part of the primary lagoon.

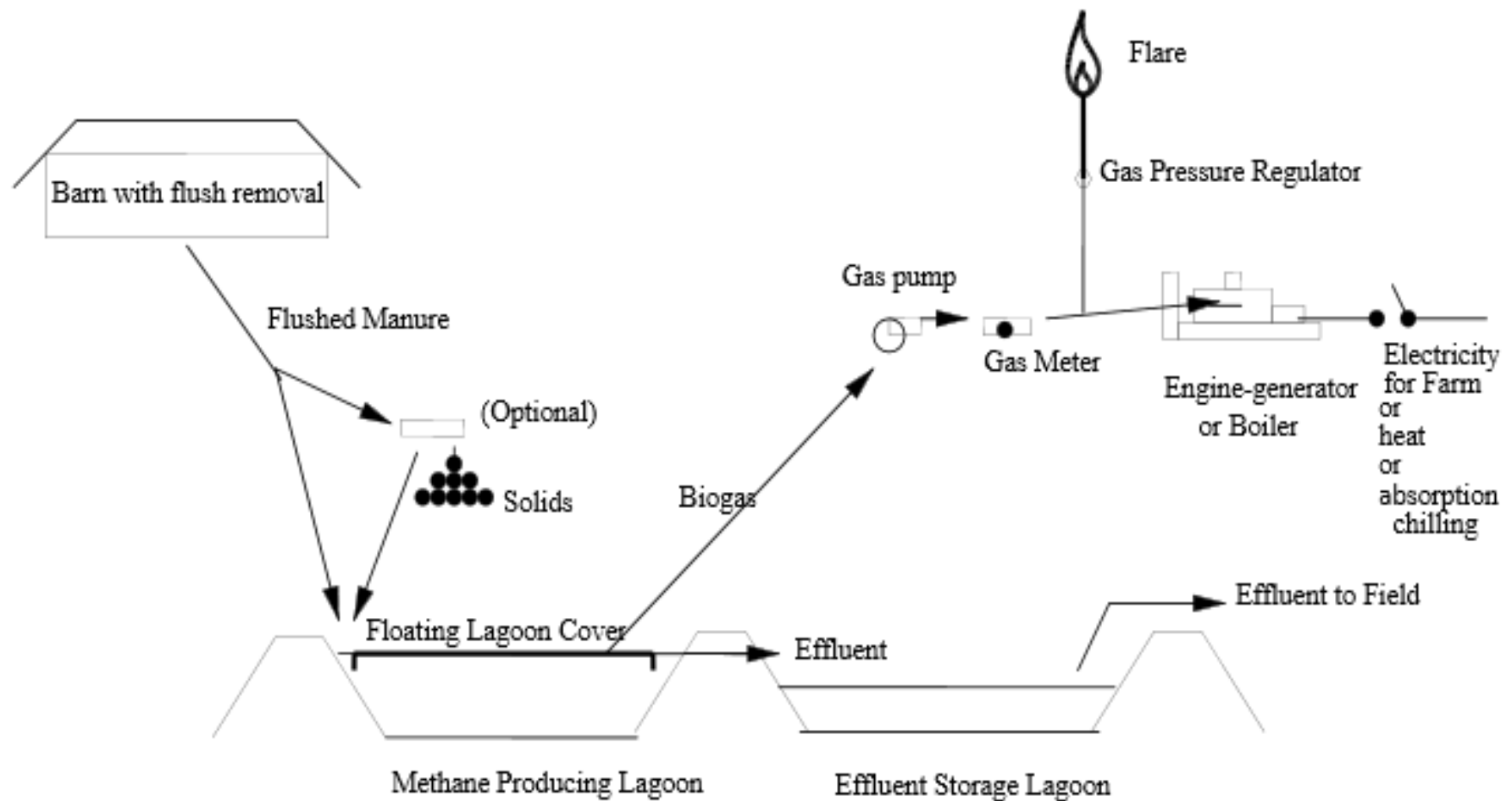
➤ Biogas utilization system.

The recovered biogas can be used to produce space heat, hot water, cooling, or electricity.

CSTR

- The CSTR is a conventional digester design consisting of an above-ground tank with a fixed pitched roof.
- Biogas is collected at the top of the tank and is pumped to a separate gas holder.
- Digestate is removed from the base of the digester tank.
- Biogas CSTR tanks are manufactured from glass coated steel
- The tank is heated by an external concentric-tube heat exchanger and pump which circulates the tank contents. Hot water is circulated through the heat exchanger by a central-heating pump.
- Biogas CSTR tanks are insulated externally with 100mm of mineral wool and protected with plastic-coated steel panels.
- There is no mechanical equipment within the digester tank.
- The digester is discharged by a dedicated pump which withdraws digestate from the base of the digester.

Covered Lagoon with Methane Utilization



Ongoing Biogas Project at Halloki

- Technology: FLR (Flexible line Reactor)
- Capacity : 4650 M³
- Gas Production : 750 M³ per day



Completion stage of Biogas Project at Halliki



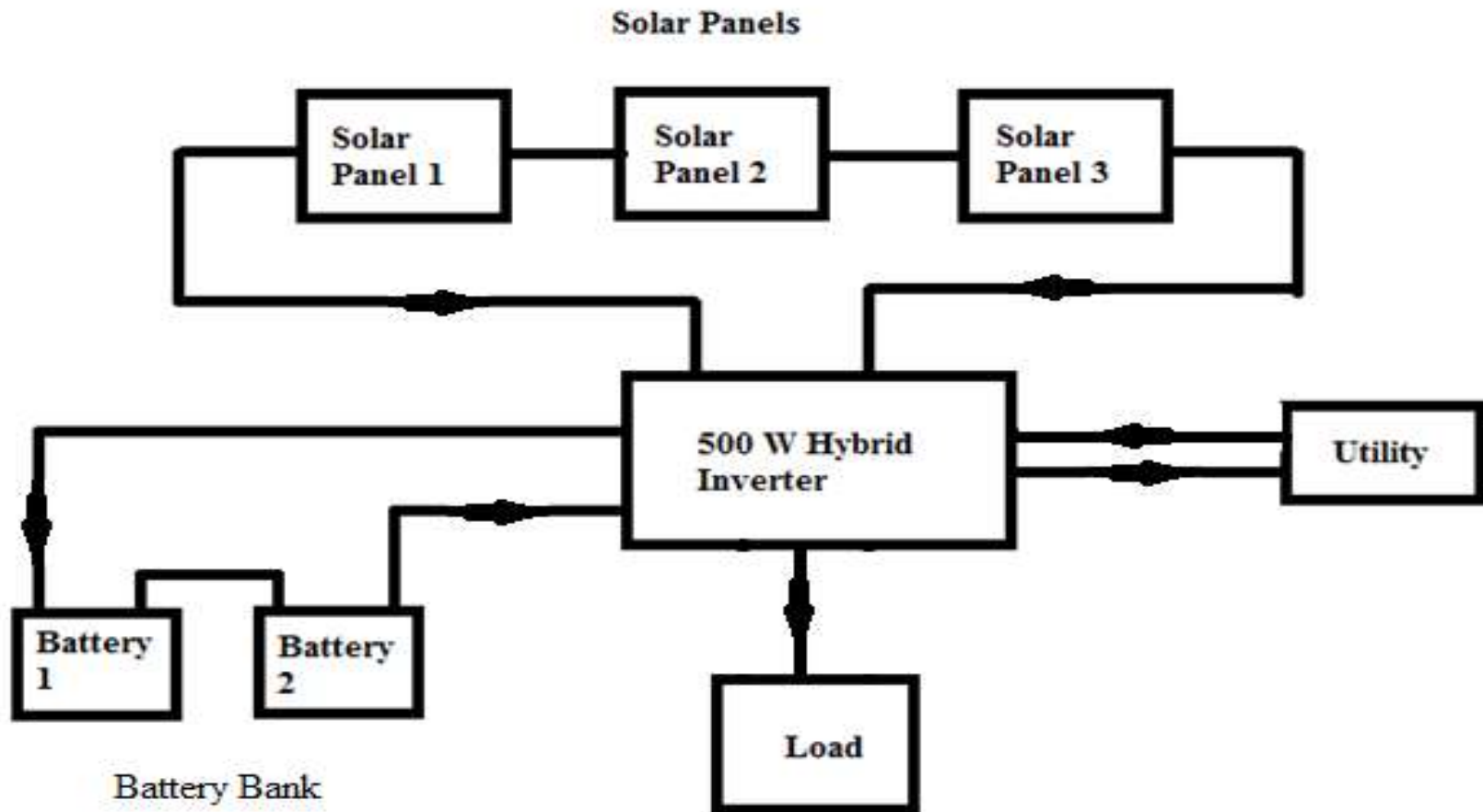
Production Stage of Biogas Project at Halloki



Solar Energy

- Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaics convert light into electric current using the photoelectric effect.
- Pakistan receives approximately 9 sunlight hours in a day and has potential of installed Solar Power capacity of approximately 40 times that of current power generation in the country.

Graphical Description of 500W Solar Power System



Simple Equation to generate 8000 MW Electricity

- Total population (say) = 190m
- Average Family Members = 06
- Say Total Families $(190\text{m}/6) = 32\text{m}$ (apprx)
- Say 50% Families have their own houses, then total houses in Pakistan = 16m
- If only 0.5kW Solar Panels are installed on one house, then total installed capacity will be $16\text{m} \times 0.5 = 8000000\text{kW} = 8000\text{MW}$
- Note: Installed rating=0.75 kW, while Actual Production Capacity will be 0.5 kW per house

Execution Plan

- Approximate cost per house (including panels, Frames Inverter, Battery backup and installation etc. = Rs.1,60,000/- (apprx)
- 50% of the people can afford this cost.
- Banks should be made strategic partners and will support those who can not afford the cost and the policy should be the same as was adopted for leasing out the cars.
- The house owner will pay monthly installment to Bank in lieu of the electricity bill to be paid to DISCO.

Execution Plan

- If the bank feels some reservations, the owner can provide his ownership papers as collateral and the bank will afford the expenses against it and on completion of payment, property documents will be released.
- NGOs can also be involved to help the poor.
- The Government can also share a portion of the loan.

Payback Period for Domestic Use

- In coming days, when subsidies are withdrawn, the domestic tariff will be around **Rs.20/-** per kWh unit.
- The monthly bill of 0.5kW load with 50% load factor will be approximately = $0.5 \times 730 \times 0.5 \times 20 = \text{Rs.3650/-}$
- Annual bill = **Rs.43800/-**
- Payback Period = $160,000 / 43800 = 3.65$ years
- So the payback period is about **3-4 years**.

Cost Analysis for a 500W Solar Unit

Sr. No	Description	Qty	Unit price	Total price
1	Solar Panels. Made in China through German Plant	750	90	67,500
2	Inverter with built in charge controller	1	26,000	26,000
3	Batteries 100AH	2	16000	32,000
4	MS Frames of panels	3	2500	7,500
5	MS Batteries Racks			3,000
6	Cables, breakers etc			9,000
7	Transportation, installation and Misc			15,000
Grand Total				160,000

Use of Solar Power in Commercial Buildings and Industrial Units

- If awareness programs are launched and relief and assistance is provided, industrialists and commercial building owners can be motivated to install only a 25kW Solar units each. In this way only 80000 volunteers can share generation of 2000MWs of electricity, which will be the turning point in building the economy of Pakistan. These solutions will not take more than 6 months and the results will start emerging within a period of 3 months.

Payback Period for Commercial Buildings

- The commercial building (office Block) of “The Institution Of Engineers, Pakistan”. Liberty Roundabout Lahore has been made a case study.
- The monthly electricity expenses including generator charges are about Rs.1,50,000/-.
- The estimated cost of the Solar solution is about Rs. 35,00,000/-.
- The payback period is approximately two years.

Cost Analysis of a 20kW Solar System for Commercial Building

Sr. No	Description	Qty	Unit price	Total price
1	Solar Panels. Made in China through German Plant	20 Kw	90	1,800,000
2	8 Kw Hybrid Inverter with built in MPPT charge controller	2	208,000	416,000
3	Batteries 200AH	24	31000	744,000
4	Frames of panels	80	2500	200,000
5	MS Batteries Racks			50,000
6	Cables, breakers etc			120,000
7	Transportation, installation and Misc			170,000
Grand Total				3,500,000

Projects completed by the present Punjab Government

- Quaid-e-Azam Solar Park at Bahawalpur
- 200,000 Solar Home Solutions (SHS) systems for Households below the poverty line - Chief Minister's Ujaala Program
- 30,000 SHS systems for Households below the poverty line - Chief Minister's Ujaala Program
- 58,046 SHS systems for Households below the poverty line - Chief Minister's Ujaala Program
- Provision of 50 Nos. Solar PV Systems for the Govt. Offices of Punjab of 3 KWp Capacity each
- 72 KWp Hybrid Solar Solution for P&D Department Secretariat Building, Lahore

Upcoming small projects of Punjab Government

- Solar Solution for 4321 Nos. Off Grid Schools in Punjab of Capacities 500W, 1000W, 1500W, 2000W and 2500W.
- Solar Solution for 90 Nos. 24/7 type BHUs in Punjab of capacity 2000W each.
- Provision of 100,000 Nos. Solar Panels for Households below the poverty line - Chief Minister's Ujaala Program.

Renewable Energy in south Asian Countries

➤ Bangladesh

- Approximately 60% of areas of the country are located off-Electricity Grid and potential of solar energy is very high. The government has introduced a scheme known as solar home systems (SHS) to provide electricity to households with no grid access.
- In 2002, only 7000 households were using Solar Panels and Bangladesh had set a target to cross 2.5 million by 2014, which has now crossed 4 million and is claimed to be the fastest solar expansion in the world.
- More than 50,000 systems being added per month since 2009, the World Bank has called it "the fastest growing solar home system program in the world."

Continued Bangladesh

- The World Bank has offered to loan the Bangladeshi government \$78.4 million in order to finance 480,000 solar home systems. This huge solar home systems project is to support development of solar energy available to the far and wide population in Bangladesh. If it achieves this rate, it will be the largest of its kind in the world.
- The Bangladeshi government is working towards universal electricity access by 2021 with the SHS program projected to cover 6 million households by 2017.
- NGOs are also helping there in providing panels, which can be paid for in small monthly installments.

Renewable Energy in south Asian Counties

➤ India

- **India** has remarkably achieved generation of about 12.5% electricity of the total installed capacity, by Renewable energy sources.
- A lot has been done in Wind Energy, which made India to become 5th largest wind power installed capacity in the world.
- In Solar power India is lagging a bit, however some mega projects have been proposed, and a 35000 km² area of the Thar Desert has been set for Solar Power project, which is sufficient to generate 700 to 2100 GW.
- A large area of India is off-grid. So solar power for water pumping has been prioritized to replace about 4.5 million diesel operated tube wells to save power of about 4 kilowatts from each water pump.

Renewable Power (2015)

Generation capacity of India

Kind of Power	Installed Generation Capacity (GW)
Wind Power	26.8
Solar Power (SPV)	6.8
Biomass Power	4.5
Small Hydro Power	4.2
Waste to Power	0.13
Total	42.4

Role of IEP and IEEEEP

- We conducted an International Seminar on “Energy Problems in South Asian Countries – Causes and Solutions”, where some honorable FEIC members also made it success with their presence.
- We conducted an International Seminar in Bahrain.
- We have scheduled to arrange an international Seminar this year in October, where Energy issues with their solutions will also be deliberated.
- We conducted large No. of National/local seminars on energy crisis, with solution and energy conservation at different IEP/IEEEEP centers in Pakistan.
- We tried to ensure our participation and contribution international seminars of FEIC and FEISCA, being conducted on energy problems and solutions in other countries.
- We have submitted a no. of workable proposals and solutions to the Government of Pakistan and Provincial Governments to fight against power crisis and win the war.

Continued.....

- Awareness programs on the issue were launched through media and press and active participation in the Chamber of Commerce and Industry programs.
- We installed many Solar projects including Solar Houses, Solar System for Industry, Solar Parking Shed/Solar Office Blocks, Solar Tube wells, Solar Street Lights and Solar refrigeration through Secretary General of IEP and arranged visits of dignities on government sector, industrial sector, Prominent Engineers of different departments and general public.
- We installed more than 20 projects of Biogas through Secretary General of IEP in different areas and arranged visit of dignities on government sector, industrial sector, Prominent Engineers of different departments and general public to a unique project of Biogas.

Continued.....

- We Installed Solar Power Systems (SPS) 3kW each, at 50 Government offices in different cities of the Punjab Province through Secretary General of IEP. These SPSs. Have been installed at Commissioners and DCO's offices for the awareness purpose as these offices are repeatedly visited by public representatives of the area, who can become useful part of this awareness campaign
- Work for installation of 69 Nos. Solar Power Systems 3kW to 5kW each at "Rescue-1122 Emergency Services Centres" of District/ Tehsils of Punjab is under progress.

Ongoing Project of Rescue-1122 Service



Ongoing Project of Rescue-1122 Service



Ongoing Project of Rescue-1122 Service



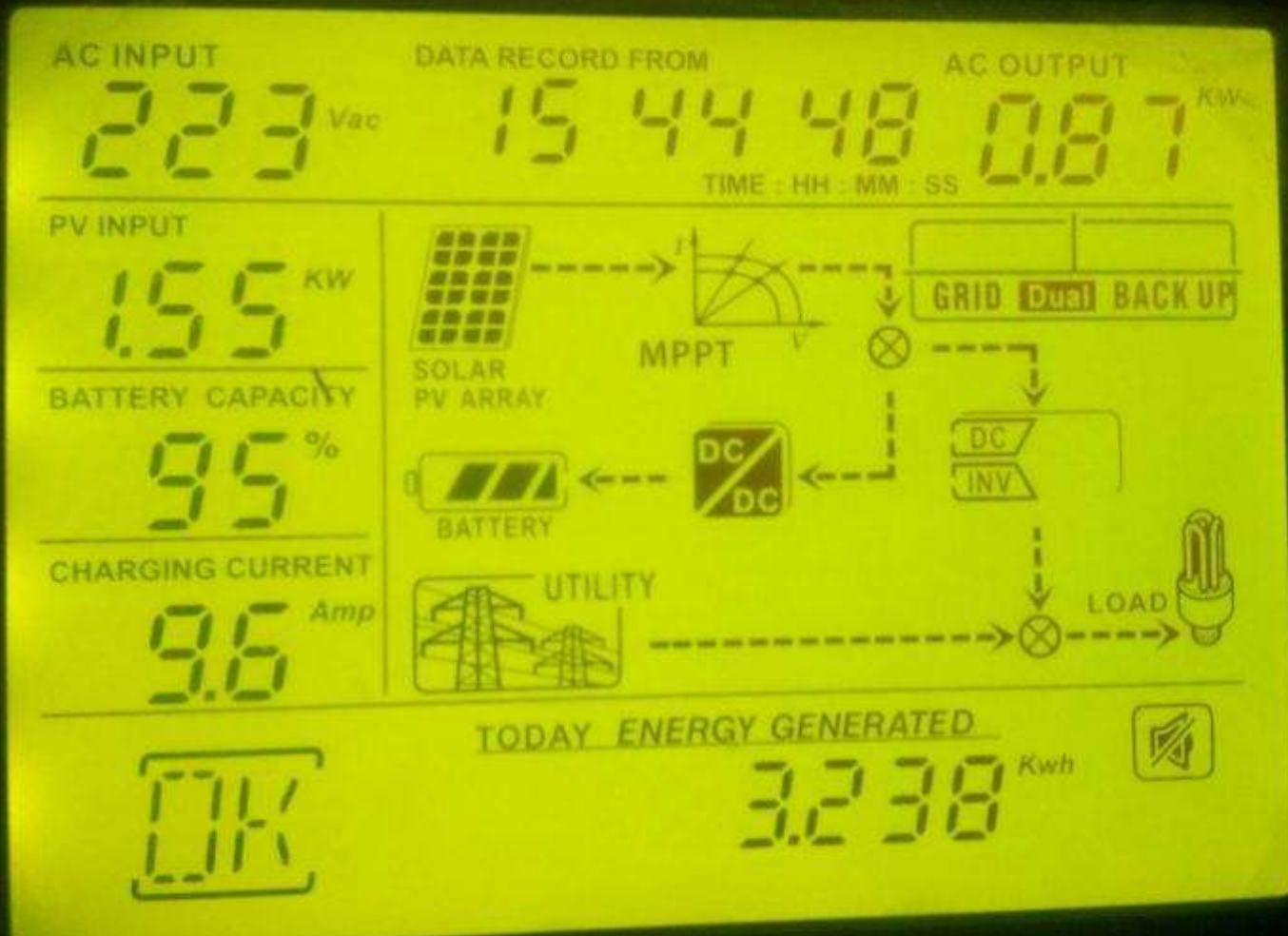
Ongoing Project of Rescue-1122 Service



Hybrid Inverters installed at Rescue-1122



Display Parameters of Inverter



Awareness

**Projects executed by us
on the platforms of**

IEP and IEEEEP

1ST 13 KW MODEL SOLAR HOUSE SYSTEM IN LAHORE

INAUGURATED BY ENGR. AHSAN IQBAL, PRESENT FEDERAL MINISTER IN 2010, WHERE MORE THAN 250 ENGINEERS WERE INVITED FOR AWARENESS PURPOSE



5 Inch Discharge Solar Tube Well at Energy Park Halloki

This pilot project was completed in 2010 and a visit of about 250 engineers was arranged for the awareness of people.



Solar Pump at Skypower (2010)



20 BHP, 6 inch discharge and 600ft deep Solar Tube Well at Kasur



23 kW Solar Parking Shed for Administration Block at Creative Electronics, 476-Sundar Estate Lahore

A visit of more than 300 Engineers & Industrialists was arranged along with Mian Shafqat, Advisor to the then Governor Baltistan.



Solar Street lights installed by Creative electronics



A 5.00kW Solar House System at 9-C1 Valancia Town Lahore.



4kW Solar System at Valancia Town



Office Block of Creative Solar Systems



160kW Solar Power Unit for industrial use at Skypower Pvt Ltd Halloki Lahore



160kW Solar Power Unit for industrial use at Skypower Pvt Ltd Halloki Lahore



160kW Solar Power Unit for industrial use at Skypower Pvt Ltd Halloki Lahore



Hybrid Inverters and Battery Banks



3kW Solar System at 484-DHA Lahore



6kW Solar System installed at 4-F, Izmir Town Lahore



5kW Solar System installed at Jinah Town Multan



Wind Energy

- Wind energy has been shown to have strong technical potential in Pakistan.
- In the southern regions of Sindh and Baluchistan, Pakistan has potential of approximately 2.5 times that of the current power generation along the 1000 km of coastline.
- The coastal belt of Pakistan is blessed with a God gifted wind corridor that is 60 km wide (Gharo ~ Kati Bandar) and 180 km long (up to Hyderabad). This corridor has the exploitable potential of 50,000 MW of electricity generation through wind energy.
- Pakistan has overall wind power potential of more than 130000MW and there is urgent need to exploit it for power generation.

Wind Energy in India

India is leader in wind energy. In 2010 there was about 12,000 MW Wind Energy and they had a target of additional wind power of 6000 MW of electricity by 2014, but they crossed 7000 MW till March-2013 and now reached above 26700 MW.

Geothermal Energy

➤ Heat under the ground used to heat water and make steam to turn generator turbines and make electricity. The preliminary calculations show a significant potential of geothermal energy in Northern areas of Pakistan and Baluchistan.

Ocean & Marine Energy

➤ Tidal energy, is a form of hydropower that converts the energy of tides into useful forms of power - mainly electricity. Pakistan has tidal power capacity of 3000MW.

Suggestions for short term solutions

- Legislation for mandatory installation of solar system.
- Approval for Design of new construction should be subject to installation of Solar System of at least 40% of the total demand.
- Generation through Community Generation and Distribution (CGD) Program.
- Electricity Saving in Commercial Zones. Street Lights and Traffic Signals on Solar Panels.
- All government buildings be shifted to LED & Solar system.
- Solar Water Heaters, instead of Gas and Electric heaters.
- 4-star & 5-star hotels should shift at least 30% load on renewable energy.
- Irrigation tube well Diesel operated Pumps should be converted to submersible pumps & solar energy.
- Investments, aids, loans and International grant from donor agencies be focused on renewable energy projects.

Continued.....

- Media campaign be launched, motivating the people to go for DC appliances and LED Lights with Solar Power in new construction.
- Substandard UPS be completely banned and eliminated from the system.
- Pilferage of electricity be controlled to the extent of technical losses.
- Augmentation of the system be carried out to reduce the technical losses.
- Energy conservation and energy efficiency program be launched.
- Overloaded transformers be upgraded.
- Heads of DISCOs, NTDC, PEPCO should be of high technical skills with reputed integrity.
- BOD Members should be non-political and preferably should be professionals and stakeholders also.
- Cheap generation of electricity be added and recovery should be enhanced to decrease circular debt.
- Time of Use (TOU) tariff should be incorporated in the single phase supply also, so as to discourage power usage during peak hours.
- Expenses on village electrification be stopped and off-Grid Solar/Biogas solution should be provided in the rural areas.

Continued.....

- Transformer wise monitoring of line losses should be carried out.
- Conversion of existing thermal power plants to cheaper fuel.
- Building of small hydro projects for the local areas.
- Technical staff may be deployed in Ministries of Water & Power and Petroleum & Natural Resources and Secretaries in both the Ministries should be Technocrats.
- Size of top hierarchy in Electricity Companies be reduced to reasonable extent, while technical skill, capacity & strengthening of the staff working in the field should be increased.
- Early completion of Pak-Iran Gas Pipe line and expeditious steps to explore new reservoirs of Gas.
- Updating/rehabilitating the existing Power Generation Plants.
- Indian Model for Industry & Agriculture may be followed.

Suggestions for medium and long term solutions

- Large Hydro Power Dams should be started for irrigation storage water and protection of floods, as well as for power generation plans.
- The coal reserves should be exploited to meet with energy needs and power shortage.
- Existing Thermal Power Generation Plants be converted and shifted from Diesel/Furnace Oil to Natural Gas.

Thank You

