ALTERNATIVE ENERGY REVOLUTION FOR INDUSTRIALIZATION AND ECONOMIC PROSPERITY

Prof. Frank. N. Okafor, FNSE, FAEng

Dept. of Electrical and Electronics Engineering
University of Lagos, Akoka.

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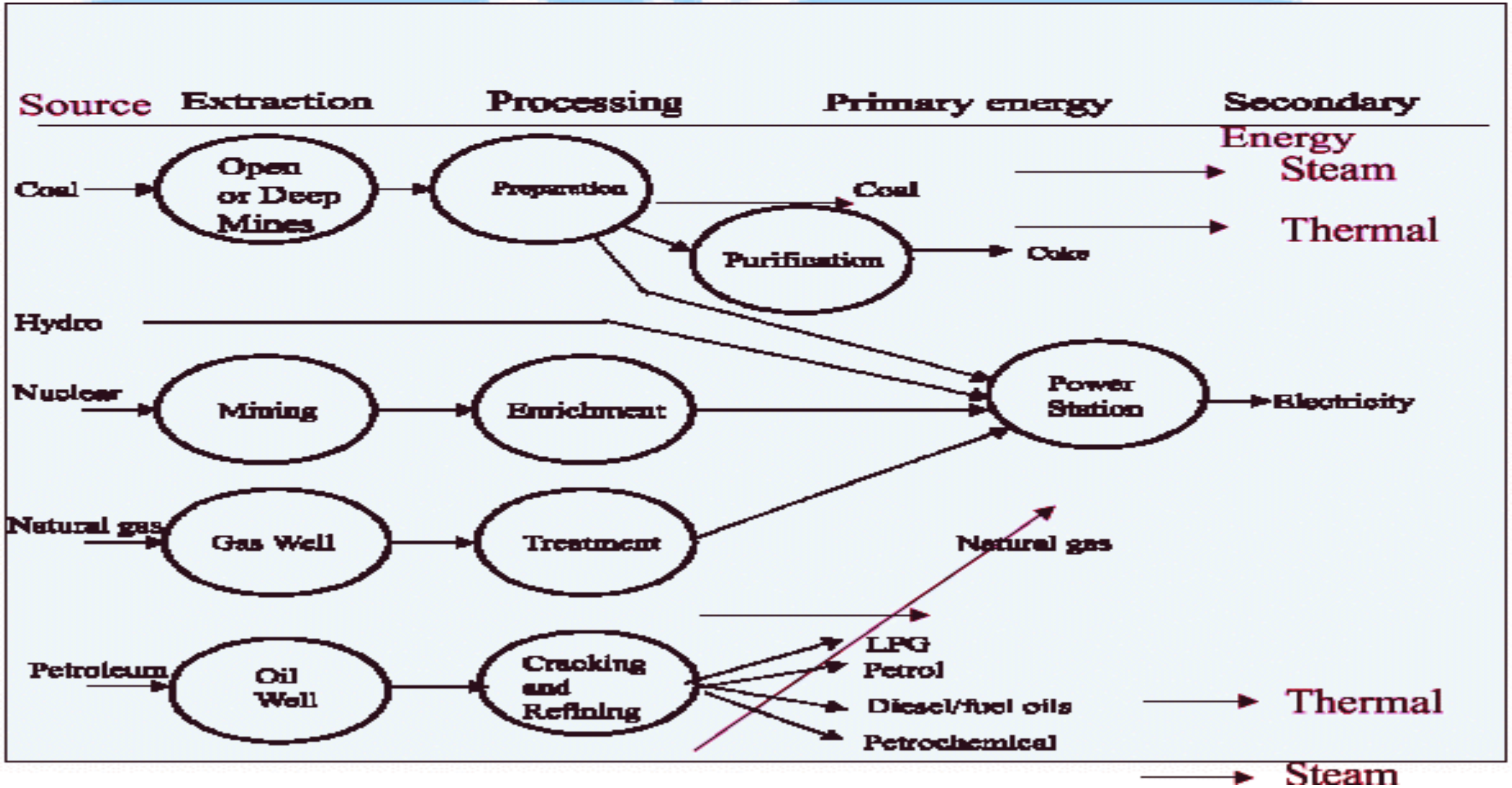
OUTLINE

- **INTRODUCTION AND DEFINITIONS**
- **DOWNSIDES OF RELIANCE ON CLASSICAL SOURCE OF ENERGY**
- **ENERGY RESOURCE ALTERNATIVES**
- **HARNESSING LOCAL ENERGY POTENTIAL**
- **EMERGING TECHNOLOGIES FOR REVENUE ASSURANCE IN COMMUNITY ENERGY SERVICES**
- **RECOMMENDATIONS**

INTRODUCTION AND DEFINITTIONS

Conventional SOURCES OF ENERGY



NONRENEWABLE RESOURCES

A nonrenewable resource is a natural resource that cannot be re-made or re-grown at a scale comparable to its consumption.

NUCLEAR ENERGY

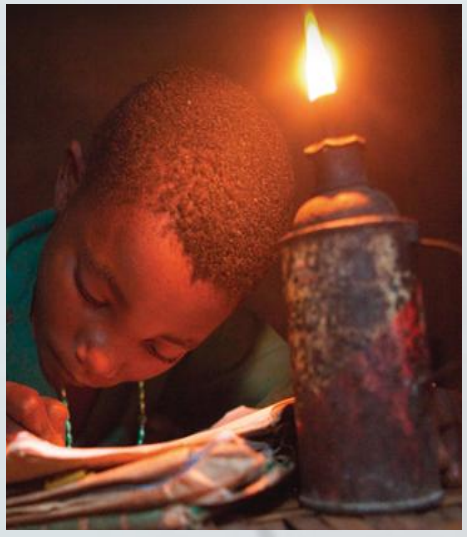
Nuclear fission uses uranium to create energy.

Nuclear energy is a nonrenewable resource because once the uranium is used, it is gone!

COAL, PETROLEUM, AND GAS

Coal, petroleum, and natural gas are considered nonrenewable because they can not be replenished in a short period of time. These are called fossil fuels.

Current Energy use in Rural Areas

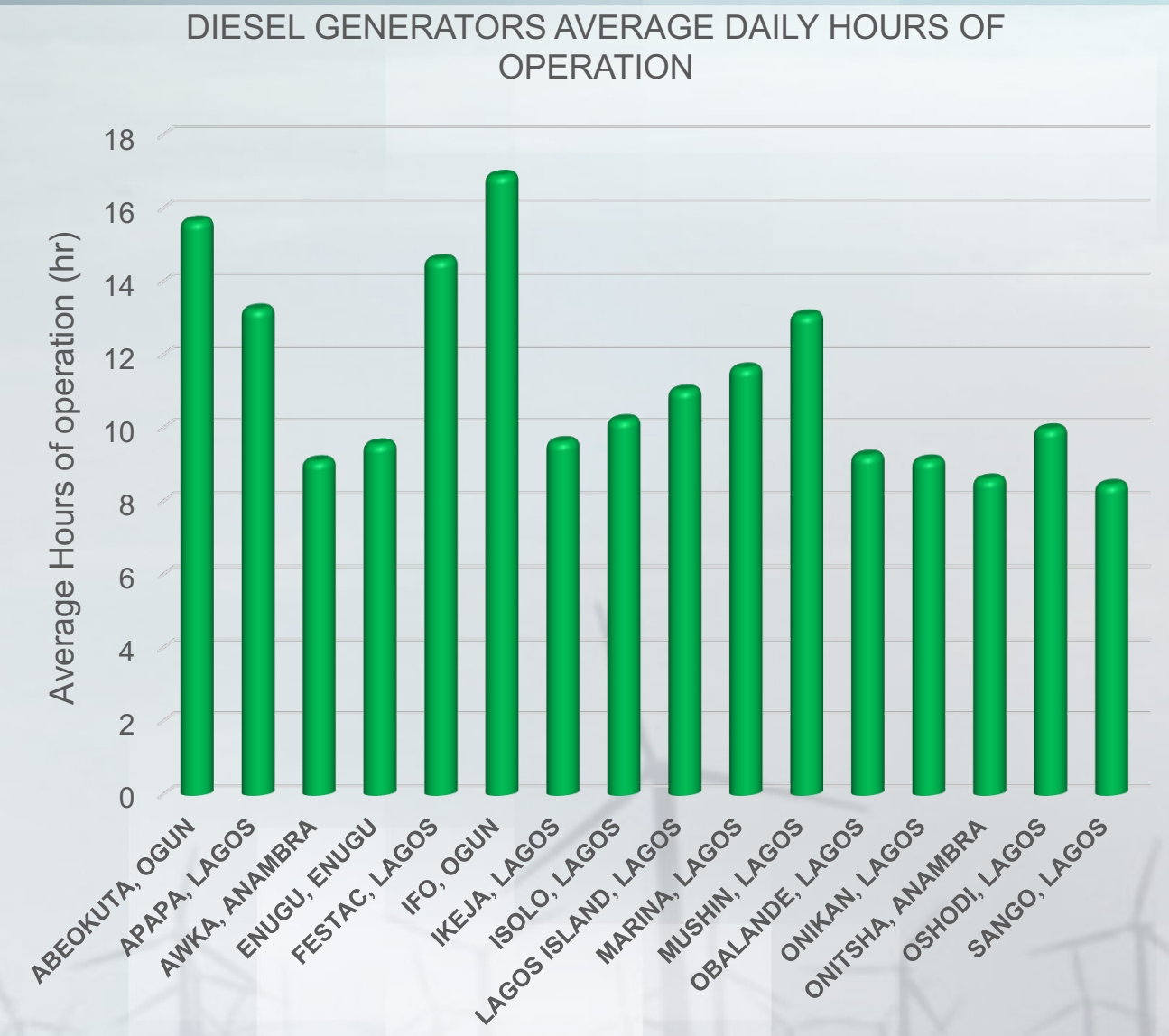


Kerosene lighting

Fossil fuel based generators for economic activities

Fossil fuel based generators for residential purposes

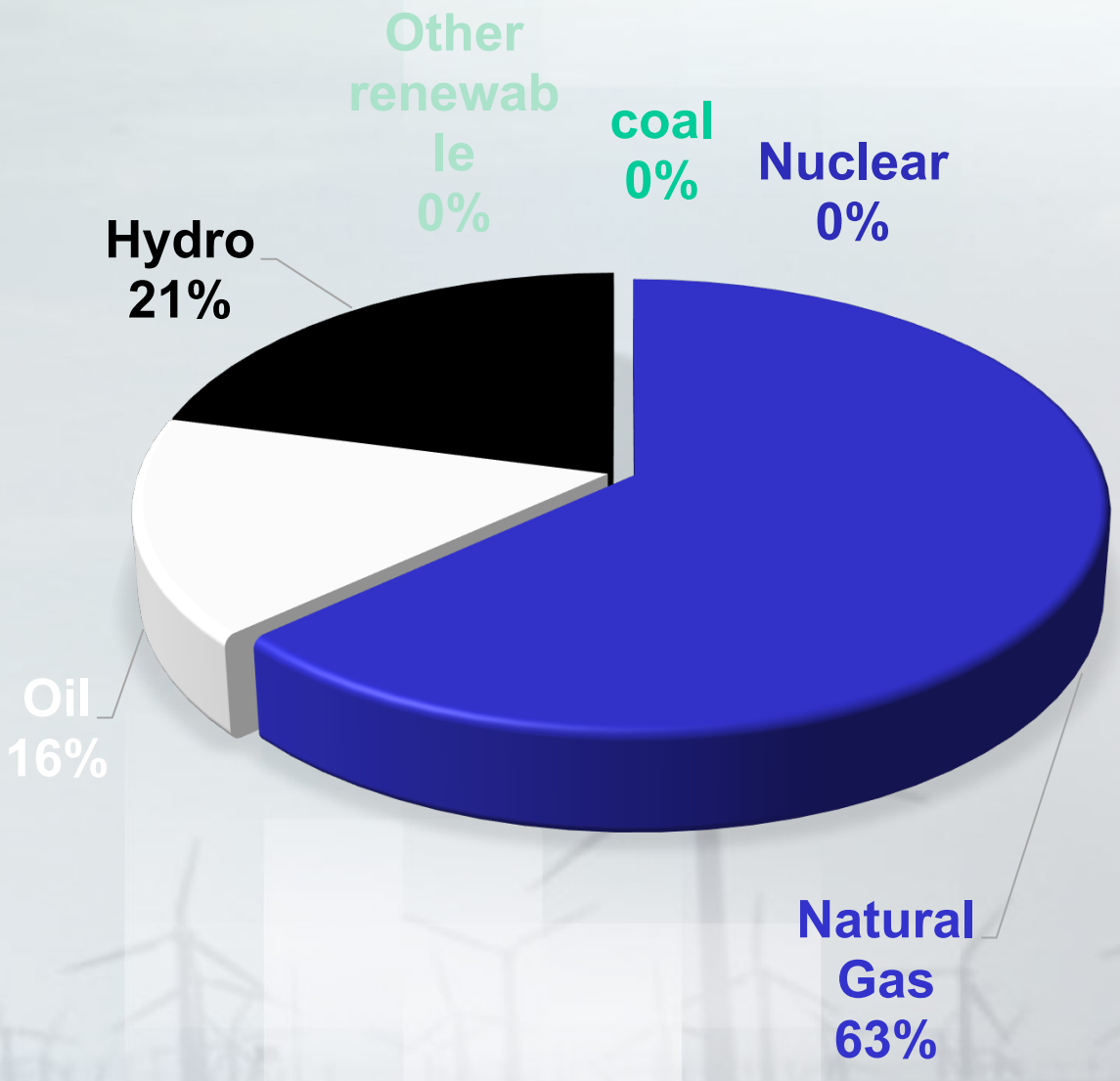
OFF GRID DIESEL GENERATOR USE IN NIGERIA



S/N	LOCATION	AVERAGE HOURS OF OPERATION DAILY	AVERAGE (ESTIMATED) CONSUMPTION (LITRES/HR)	ANNUAL ESTIMATED EXPENDITURE ON DIESEL (Million Naira)
1	ABEOKUTA, OGUN	15.67	42.57	128.1
2	APAPA, LAGOS	13.27	96.79	246.6
3	AWKA, ANAMBRA	9.13	81.83	143.5
4	ENUGU, ENUGU	9.59	91	167.6
5	FESTAC, LAGOS	14.62	71.8	201.6
6	IFO, OGUN	16.92	162.52	528
7	IKEJA, LAGOS	9.65	37.82	70.1
8	ISOLO, LAGOS	10.25	86	169.3
9	LAGOS ISLAND, LAGOS	11.06	45.87	97.4
10	MARINA, LAGOS	11.66	103.43	231.6
11	MUSHIN, LAGOS	13.11	59.44	149.6
12	OBALANDE, LAGOS	9.28	28.8	51.3
13	ONIKAN, LAGOS	9.15	56.13	98.6
14	ONITSHA, ANAMBRA	8.63	50.74	84.1

Status of Nigeria Power Supply

GRID POWER GENERATION SOURCES



CHALLENGES

- Increasing load demand with nearly static generation.
- High operating cost and suppressed demand nationwide
- High ATC&C losses
- Only 40% of the nation's population have access to electricity supply
- Inadequate expertise
- Most of available investments go into replacements of damaged equipment

DOWNSIDES OF RELIANCE ON CLASSICAL SOURCE OF ENERGY

MAJOR CHALLENGES

- Climate change
- Oil price/dependency
- Air pollution
- Nuclear risk
- Electricity/gas prices
- Competitiveness of businesses
- Job creation potential

Burning COAL = Pollution

- Nearly 50% of the nitrogen oxide (Nox) in the atmosphere and 70% of sulfur dioxide are direct result of emissions released when coal is burned.

- These are directly responsible for crop failures from “acid rain” formation (later explained in this presentation).

Fossil Fuels and Global Warming

- **Burning these fuels produce excessive amounts of greenhouse gases (CO_2)** (source: US EPA).
- **Failing to reduce these emissions may likely cause our global climate to change … and if it changes, agriculture will definitely change.**

The average temp has risen 1.6 deg F since 1880, and at a steep rate since 1960. HERE

CHALLENGES IN MORE DETAILS

- Oil price has become a major determinant of the standards of living (Nigerian Case)
- Nuclear risk may be life threatening in a country like Nigeria where expertise is lacking.
- Electricity/gas prices will continue to rise as reservoirs deplete.
- Competitiveness of businesses will highly affected by energy prices.
- Job creation potential will be heavily dependent on Energy.

ENERGY RESOURCE ALTERNATIVES

RENEWABLE RESOURCES

Renewable resources are natural resources that can be replenished in a short period of time.

- **Solar**
- **Geothermal**
- **Wind**
- **Biomass**
- **Water**

Renewable Energy: some considerations

- Energy & Environment go hand in hand, have direct relationship
- Climate change is a major issue with many energy sources
- Peak Energy shortage or demand supply gap as per 18th Electric Power Supply is about 11%, with energy demand increasing by the day

Conventional / **Non-Renewable Energy**

- Most of the Energy(conventional) sources are non-renewable and are getting depleted due to over usage
- Energy Production has direct influence on Environment degradation. More so with the extraction of conventional energy like fossil fuels, that result in green house gases causing the acid rains, neuro toxins, smog, global warming resulting in various health hazards like asthma, cancer,

Non-Conventional / **Renewable Energy**

- Available in plenty from natural sources like sun, wind, tides and for long term without the worry of getting depleted
- Cleanest source of energy with minimal or no environmental side-effects
- Most suited for large scale production as well as small and non-commercial usage

Need of the hour is the wise & new ways of energy generation & utilization without the climatic changes. Prospects of Renewable Energy seems to be the best solution for sustainable development

Solar Energy

- Intensity of solar radiation along the earth orbit is 1.368 kW/ m2.
  The average earth radius ≈ 6366 Km.
  Therefore the Amount of insolation intercepted by the earth
  ≈ 174000 x 1012 Watt
  ≈ 174000 tera Watt
  ≈ 17000 times the world installed power generation capacity.

- The sun's heat and light provide an abundant source of energy that can be harnessed in many ways. There are a variety of technologies that have been developed to take advantage of solar energy. These include:

  - Solar hot water heating systems.
  - Solar process heat and space heating & cooling.
  - Photovoltaic systems.
  - Concentrating solar power systems.

Solar Water Heating

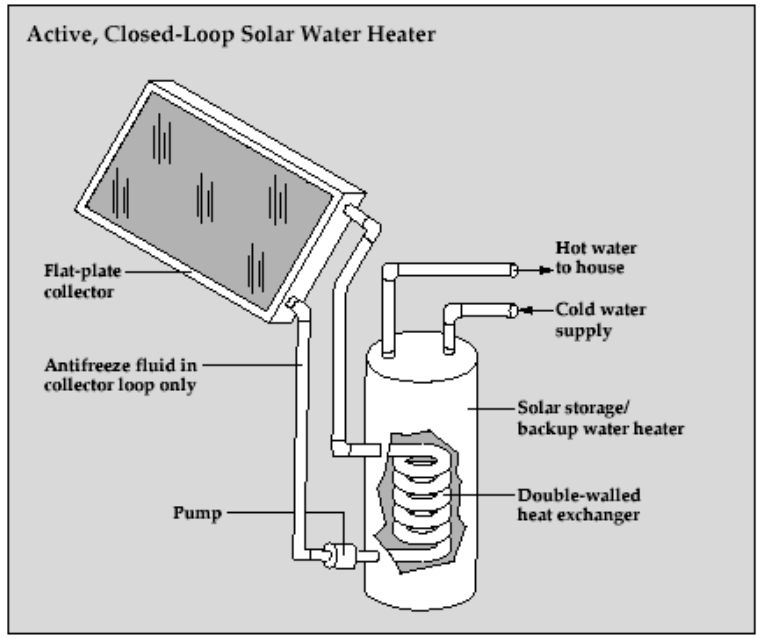
- Solar water heating is a very cost effective way to produce hot water in any climate, and the fuel they use is free (sun shine).

- Solar water heating systems include solar collectors and storage tanks, and they are two types:
  - Active systems (have a circulating pump and control).
  - Passive systems which works on natural convection.

Active solar heating systems

They are two types;

- Pump circulates household water through the collectors and into the home (open loop),
- Pump circulates the heat transfer fluid through the collectors and a heat exchanger (closed loop). This heats the water that flows into the home.

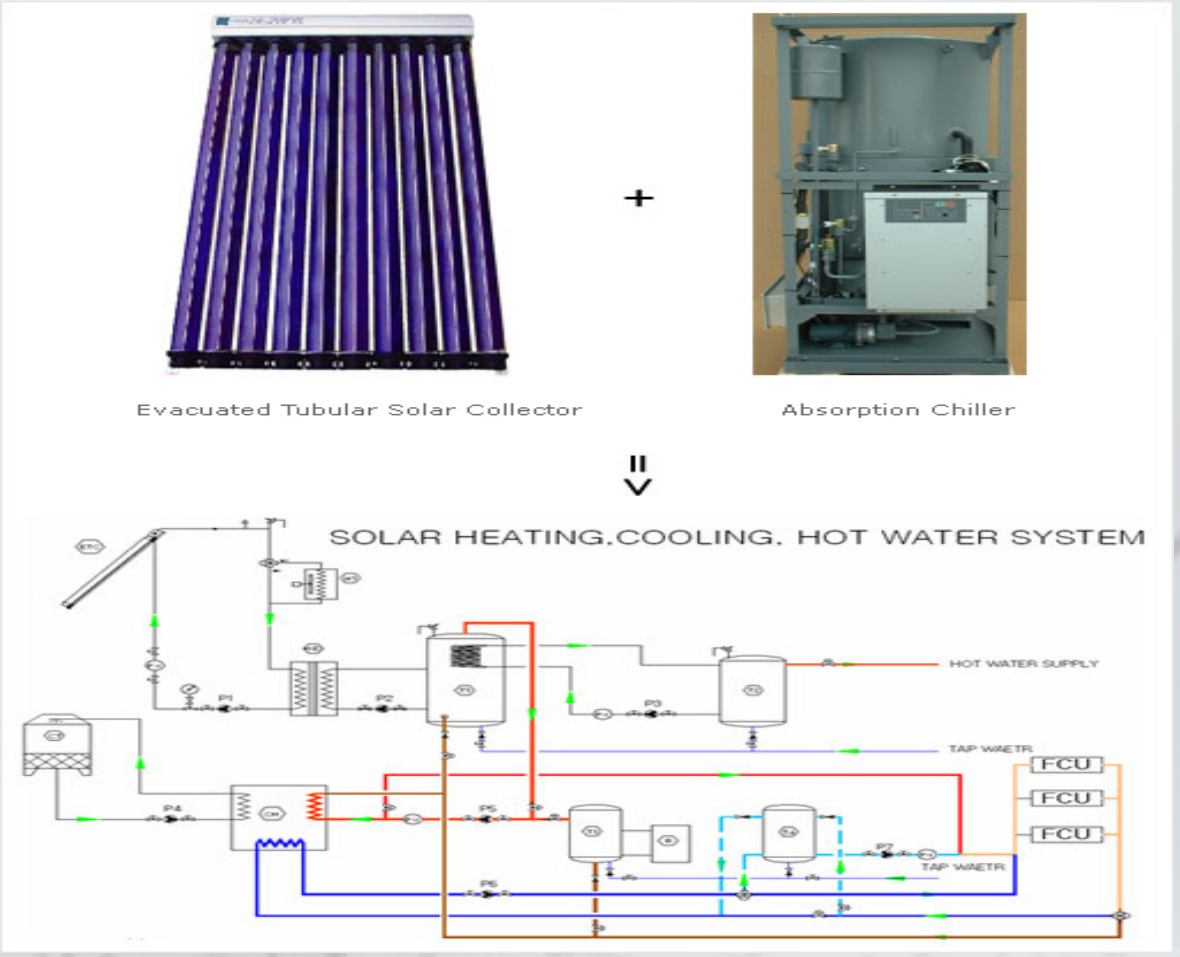


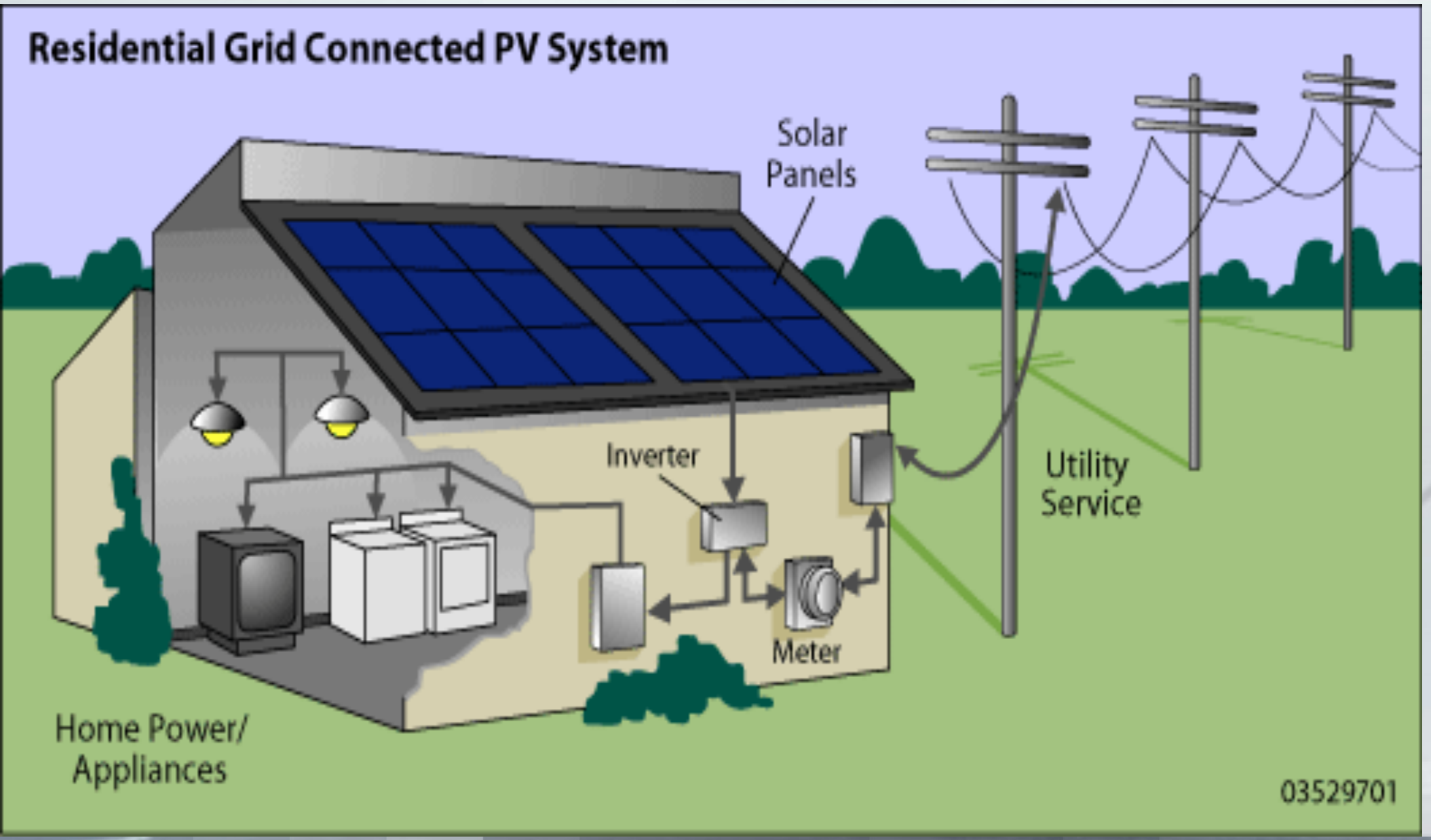
An active, closed-loop system heats a heat-transfer fluid (such as water or antifreeze) in the collector and uses a heat exchanger to transfer the heat to the household water.

Solar space cooling

A solar thermal cooling system consists of:

-Solar collectors.
-Storage tank.
-Control unit, pipes and pumps.
-Thermally driven chiller.




Residential Grid Connected PV System
Solar Panels
Inverter
Utility Service
Meter
Home Power/ Appliances
03529701

Biomass Energy - Biofuels

- "Biofuel" is liquid fuels, such as ethanol and biodiesel used for transportation and electricity production.
- Unlike gasoline and diesel, biofuels contain oxygen. Adding biofuels to petroleum products allows the fuel to combust more completely, reducing air pollution.
- The market for biofuels is growing. Existing production methods typically use relatively high-priced common crops — oil-rich seeds such as soybeans; sugarcane, corn, and other cereals — as feedstocks. All of these crops have other uses, driving up their cost.

Ethanol

- Ethanol is the most widely used biofuel today. In 2003, more than 2.8 billion gallons were added to gasoline in the United States to improve vehicle performance and reduce air pollution.
  starch crops are converted into sugars, the sugars are fermented into ethanol, and then the ethanol is distilled into its final form.
  Ethanol is used to increase octane ratings and improve the emissions quality of gasoline.

Ethanol production plant in Nebraska.

Biofuels

- Advantages
  - Easy to source
  - Renewable
  - Reduces greenhouse gases
  - Reduced dependence on foreign energy
- Disadvantages
  - Higher cost of production (lower supply than gasoline)
  - Monoculture
  - Shortage of food
  - Water Use

- **Advantages of Biofuels**

1. **Cost Benefit:** As of now, biofuels cost the same in the market as gasoline does. However, the overall cost benefit of using them is much higher.
2. **Easy To Source:** Biofuels are made from many different sources such as manure, waste from crops and plants grown specifically for the fuel.

- **3. Renewable:** Since most of the sources like manure, corn, switchgrass, soyabeans, waste from crops and plants are renewable and are not likely to run out any time soon, making the use of biofuels efficient in nature. These crops can be replanted again and again.
- **4. Reduce Greenhouse Gases:** Fossil fuels, when burnt, produce large amount of greenhouse gases i.e. carbon dioxide in the atmosphere. These greenhouse gases trap sunlight and cause planet to warm. The burning of coal and oil increases the temperature and causes global warming. To reduce the impact of greenhouse gases, people around the world are using biofuels. Studies suggests that biofuels reduces greenhouse gases up to 65 percent.
- **5. Economic Security:** If more people start shifting towards biofuels, a country can reduce its dependance on fossil fuels. More jobs will be created with a growing biofuel industry, which will keep our economy secure.
- **6. Reduce Dependence on Foreign Oil:** As prices of crude oil is touching sky high, we need some more alternative energy solutions to reduce our dependance on fossil fuels.
- **7. Lower Levels of Pollution:** They release lower levels of carbon dioxide and other emissions when burnt. Although the production of biofuels creates carbon dioxide as a byproduct, it is frequently used to grow the plants that will be converted into the fuel. This allows it to become something close to a self sustaining system.
- **Disadvantages of Biofuels**

1. **High Cost of Production:** Even with all the benefits associated with biofuels, they are quite expensive to produce in the current market.
2. **Monoculture:** Monoculture refers to practice of producing same crops year after year, rather than producing various crops through a farmer's fields over time..

- **3. Use of Fertilizers:** Biofuels are produced from crops and these crops need fertilizers to grow better. The downside of using fertilizers is that they can have harmful effects on surrounding environment and may cause water pollution. Fertilizers contain nitrogen and phosphorus. They can be washed away from soil to nearby lake, river or pond.
- **4. Shortage of Food:** Biofuels are extracted from plants and crops that have high levels of sugar in them. However, most of these crops are also used as food crops. Even though waste material from plants can be used as raw material, the requirement for such food crops will still exist. It will take up agricultural space from other crops, which can create a number of problems. Even if it does not cause an acute shortage of food, it will definitely put pressure on the current growth of crops. One major worry being faced by people is that the growing use of biofuels may just mean a rise in food prices as well.
- **5. Industrial Pollution:** The carbon footprint of biofuels is less than the traditional forms of fuel when burnt. However, the process with which they are produced makes up for that. Production is largely dependent on lots of water and oil
- **6. Water Use:** Large quantities of water are required to irrigate the biofuel crops and it may impose strain on local and regional water resources, if not managed wisely.
- **7. Future Rise in Price:** Current technology being employed for the production of biofuels is not as efficient as it should be. Scientists are engaged in developing better means by which we can extract this fuel.

RICE STRAW-COMPOSITION & PRODUCTION

- **Rice straw(cellulose: 37%, hemicellulose:24% &lignin(14%)-an abundant biomass. Production of 731 million tones/annum - produce about 205 billion litre bioethanol .**
- **{ Wheat and rice straw together : 200 million tonnes/ annum in India**
- **{ 1 kg rice straw has 350 g of cellulose which depends upon variety and the geographical location.**
- **This can theoretically yield 220 g /283 ml ethanol.**

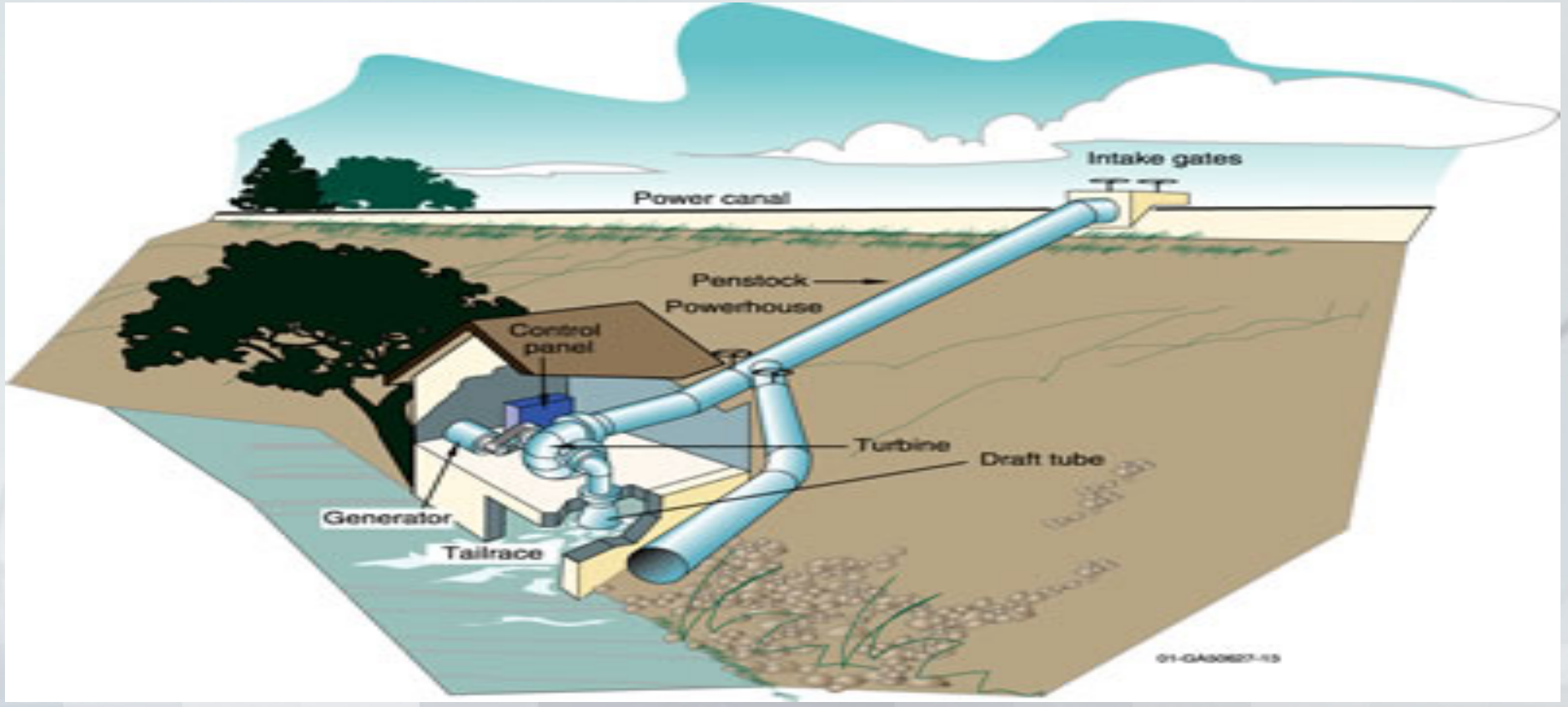
Renewable Diesel Fuels

Renewable Diesel Fuels

- There are a variety of fuels that can be used in diesel engines and that are made from renewable resources such as vegetable oils, animal fats, or other types of biomass such as grasses and trees.
- These renewable diesel fuels can be used in place of, or blended with, petroleum diesel.

Micro Hydropower

- A micro hydropower plant has a capacity of up to 100 kilowatts. A small or micro-hydroelectric power system can produce enough electricity for a home, farm, ranch, or village



Hydrogen Energy & Fuel Cell

Hydrogen can be found in many organic compounds, as well as water. It's the most abundant element on the Earth. But it doesn't occur naturally as a gas. It's always combined with other elements, such as with oxygen to make water. Once separated from another element, hydrogen can be burned as a fuel or converted into electricity.

Hydrogen can be produced from:

Solar Thermal Water Splitting

- Concentrated solar energy can also be used to generate temperatures of several hundred to over 2,000 degrees at which thermo chemical reaction cycles can be used to produce hydrogen. Such high-temperature, high-flux solar driven thermo chemical processes offer a novel approach for the environmentally benign production of hydrogen.

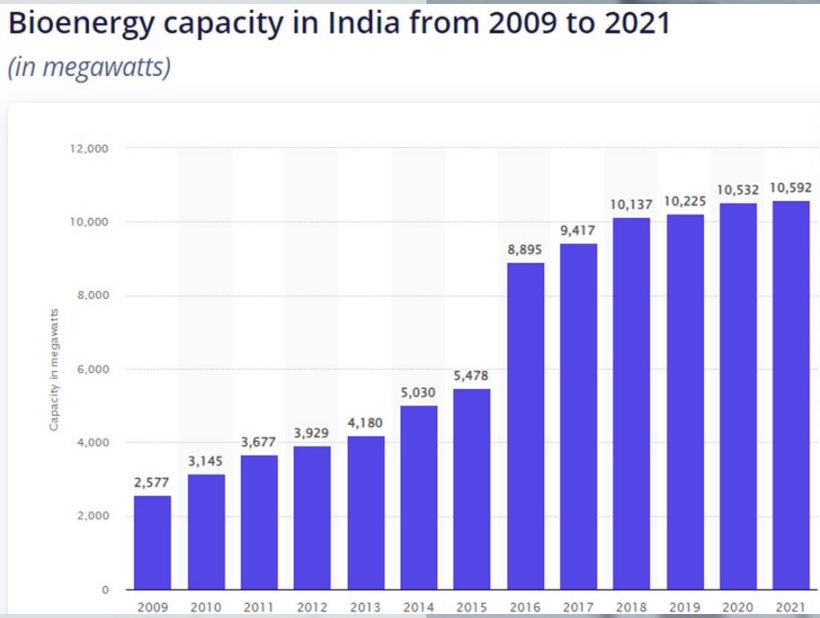
Renewable Electrolysis

- Renewable energy sources such as photovoltaic, wind, biomass, hydro, and geothermal can provide clean and sustainable electricity to produce hydrogen through the electrolysis—splitting with an electric current—of water and to use that hydrogen in a fuel cell to produce electricity during times of low power production or peak demand, or to use the hydrogen in fuel cell vehicles.

Renewable Energy | Bio Energy (biomass)

- Generated from Urban waste, bio mass, wet & solid waste
- Can be generated in a small scale or in large scale
- Nigeria is yet to harness that effectively
- cheaper, less harmful to environment, reduces Urban waste

- 1,500 Kgs Briquets, pallets from Urban waste used for Steam cooking daily at ACF
- Bio gas generated from 100 Kg of waste inhouse is used for small cooking daily at ACF
- 60 commercial Gas Cylinders and 300 ltrs of Diesel consumption are not only daily savings at ACF, but the reduction of non-renewable energy that emit 1,800 Kgs of CO2 into environment daily



HARNESSING LOCAL ENERGY POTENTIAL

DECENTRALIZED ENERGY GENERATION

- Mini-Grids powered by Solar Power or Hybrid Diesel/Solar energy generation are currently operational in Nigeria but still quite expensive.
- More viability is assured by using COMMUNITU FOUNDATION (CF) The Indian Example.

- In CF communities will use available local resources to produce energy for use; eg.
- Anambra, Ebonyi, and Niger state communities can use Rice straw to produce Electricity and Biofuel for home use and transportation.
- Under CF numerous remote communities can deploy various technologies to obtain Energy from Solar Sources for local use.
- Hitherto flared gas can be used by a CF to CNG for local use (Cooking, Transportation, Electricity generation).
- Local Streams can be used for Small Hydro Schemes (SHS) by a CF to power a community.

THESE ALTERNATIVES ARE MORE COST EFFECTIVE BECAUSE GRID POWER SUFFERS UP TO 60% LOSSES TO GET TO SOME CONSUMERS.

Energy Savings Proposals

Viability of a CF depends on ordered community behaviour; Rules must be kept by all.

- Use School buses, public transport, cycles
- Plant trees in the neighborhood, community, cities for more shades and reduction in temperature
- Use energy efficient household appliances & devices that come with Energy Star labels
- Turn off lights, geysers, ACs, water flows when not needed
- Use LED / CFL / smart bulbs (auto/sensor based)

Energy saved *is* **Energy generated !!**

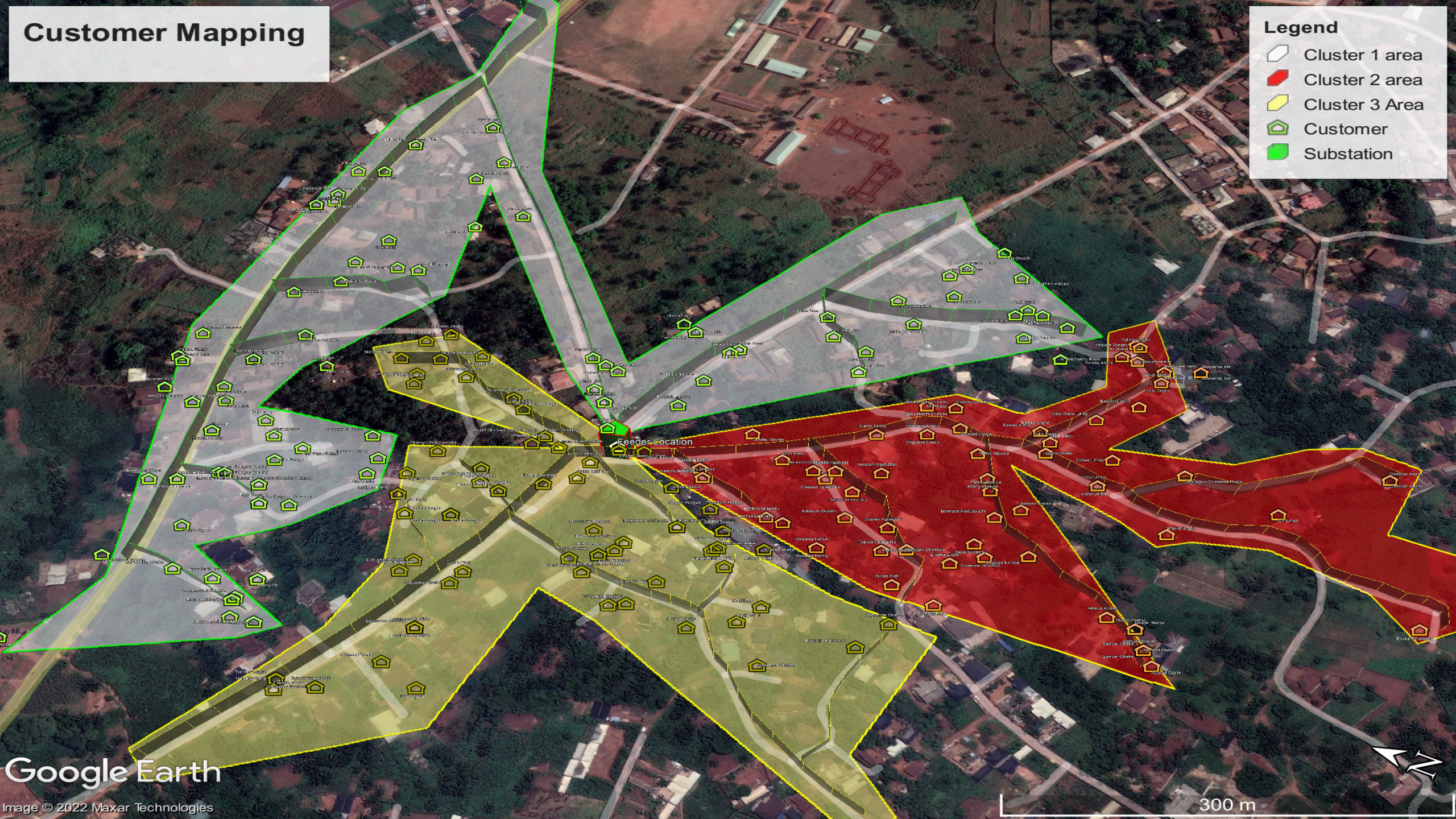
EMERGING TECHNOLOGIES FOR REVENUE ASSURANCE IN COMMUNITY ENERGY SERVICES

EMERGING TECHNOLOGIES

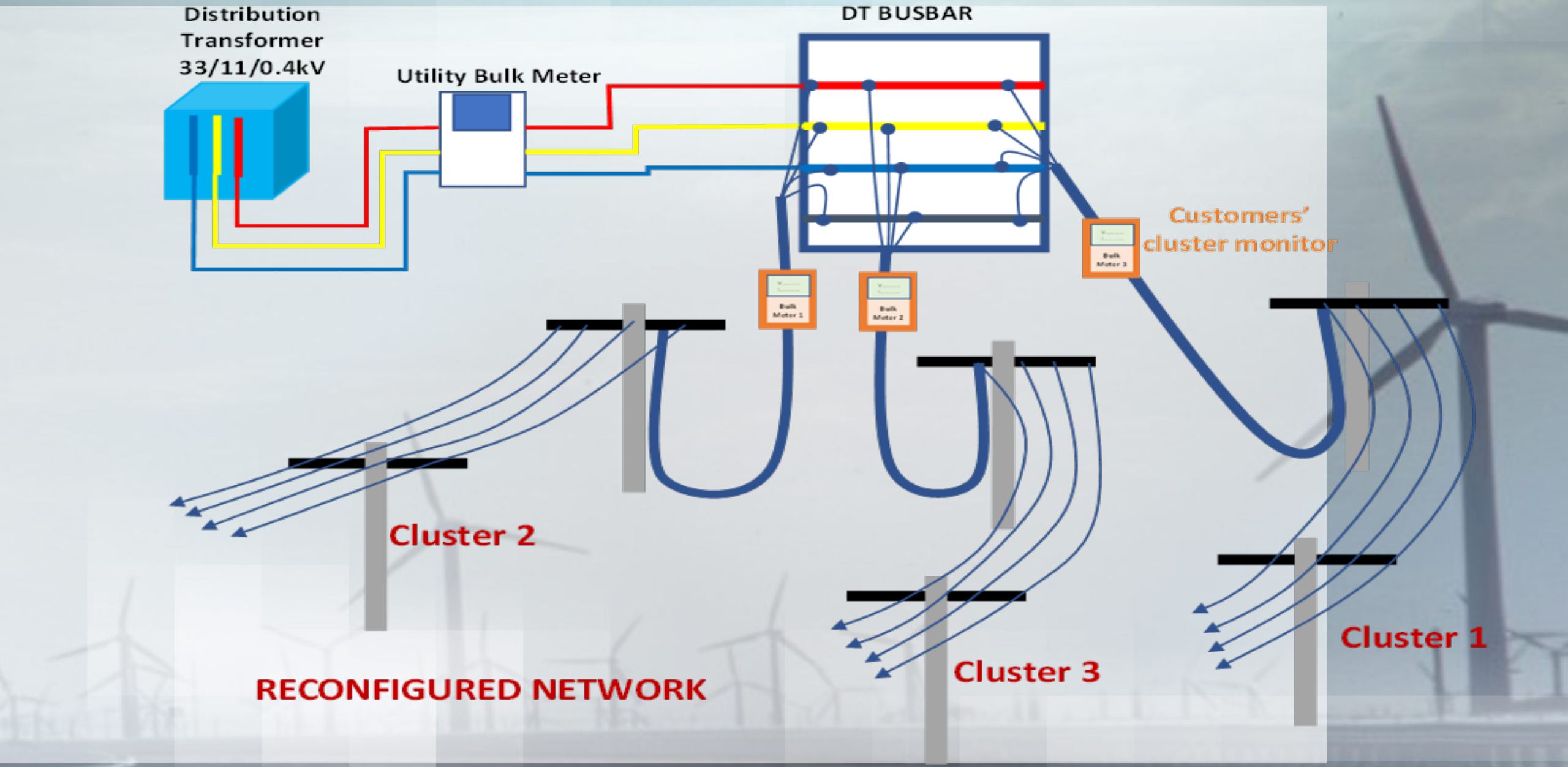
- ✓ Visibility of power distribution and consumption data to optimize power uptime and revenue recovery
- ✓ Detect and pinpoint meter bypass and illegal connections to detect commercial loss and recover revenue
- ✓ Remotely control power distributed and how consumers use it
- ✓ Monitor, supervise and alert for power theft and technical faults
- ✓ Differentiate technical and commercial loss to focus resources on revenue recovery and grid maintenance
- ✓ Consumers can pre-pay for power however and whenever they choose
- ✓ Consumers can see trusted live information on power consumption, tariffs and payments
- ✓ Consumer use what they pay for and pay for what they used (Boost Consumer Confident in the system)
- ✓ Secure encrypted data with configurable access levels

AI FOR ENERGY PRODUCTION AND ACCOUNTABILITY

- Artificial Intelligence has been applied in several ways in the power sector, such as;
- Prediction of availability of solar and wind energy for optimum solar energy generation
- Understanding of customers energy consumption patterns and behaviour
- Energy theft detection
- Load management
- Technical and commercial (ATC&C) loss estimation
- Off/On grid Energy Management systems


Customer Mapping
Legend
Cluster 1 area
Cluster 2 area
Cluster 3 Area
Customer
Substation
Feeder Location
Google Earth
Image © 2022 Maxar Technologies
300 m
N

Efficent monitor of customers usage and sources of losses



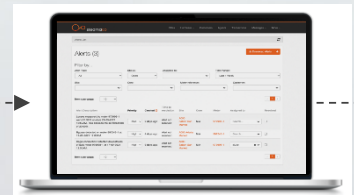
Using AI to detect and resolve theft to increase utilities' revenues

The new product dramatically improves utilities' profitability using simple customer information and hunting for anomalies

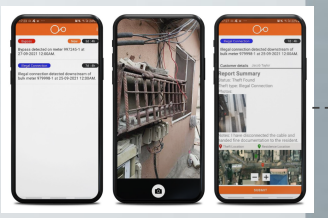
AI-driven product enables theft detection, location stamping, and coordination of troubleshooting activities to collect cash

Theft occurs – a power user does not pay for their consumption

Cloud AI model detects anomalies in consumption and payments, pinpoints theft location



Utility notified and field force agent dispatched under managed workflow



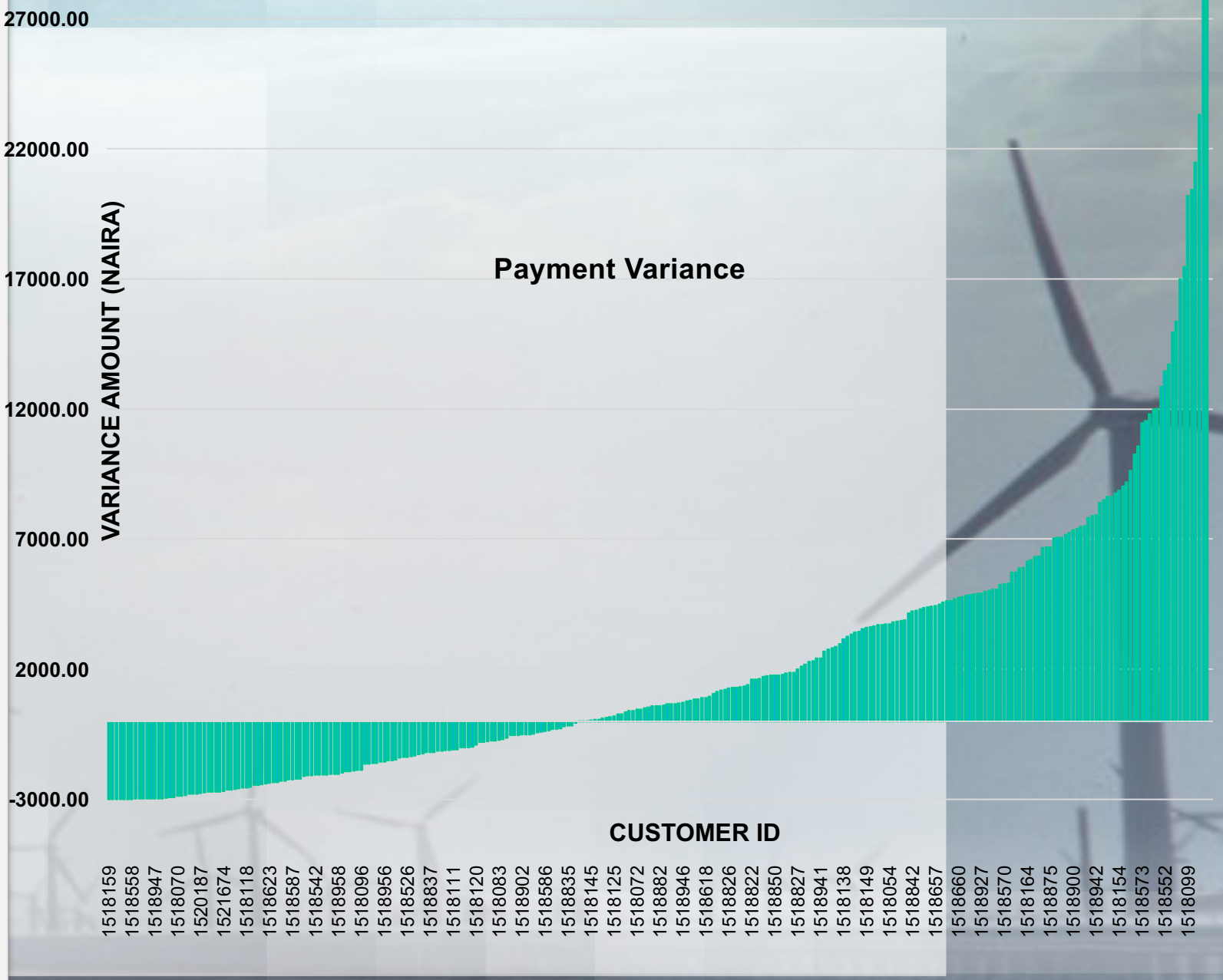
Field force investigates, recovers cash and/or disconnects perpetrator and collects fine

Utility gets paid

- Consumer trust ✓
- Accurate billing ✓
- Remote operations ✓
- Loss protection ✓

Distribution Revenue Assurance through AI based Network Monitoring

- The chat shows the analysis of 300 rural customer energy consumption and remittance over a period of 3 months.
- The community were all metered and their energy consumption over the three month period was monitored.
- The customer with negative variance amount, are customers that consumed less than what they pay for the three months while the customers with positive variance are customers that consumed more than what they paid over the three months period
- The study discovered that there is a deficiency of about N350k remittance monthly from this DSS serving only 300 customers



RECOMMENDATIONS

RECOMMENNDATTIONS

- Federal Government/State Government to encourage Establishment of Community Foundations to solve localized problems relating to energy, transportation, socials etc.
- Given the recent Electricity Act that empowers the state to fully participate in power business the job of Rural Electricity Agency (REA) should be change reviewed. Community Energy resource utilization through CF should be the focus.
- FMBP should set up a platform where State Planning Ministries can report their Community Development Achievements. Such a platform should be advertised widely for effect.

RECOMMENNDATTIONS

- **FMBP should set up studies on Community Development to produce results that will highlight strategies for viable efforts at Job Creation and continuously improving standards of living.**

THANKS FOR LISTING