flexenclosure

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Reliable and Sustainable Power for Telecom and Communities

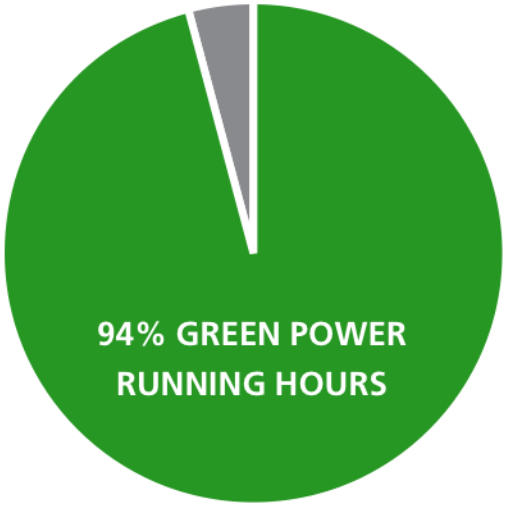
Ann Louise Johansson, VP Business Development and Marketing



E-site® - The modular solution
for energy cost saving.

The Most Energy Cost Saving Off-Grid Power System

- E-site® is **an intelligent power system** for base station sites and communities in rural and remote areas.
- Using renewable energy sources, E-site® offers **optimal energy economy** and future proofs your energy supply.
- E-site® can **upgrade** an existing site, or be installed as a **completely new** power system.



EXAMPLE DATA FROM LIVE SITE IN KENYA

- Green power running hours 94%
- Genset running hours 6%
- Down time hours 0%

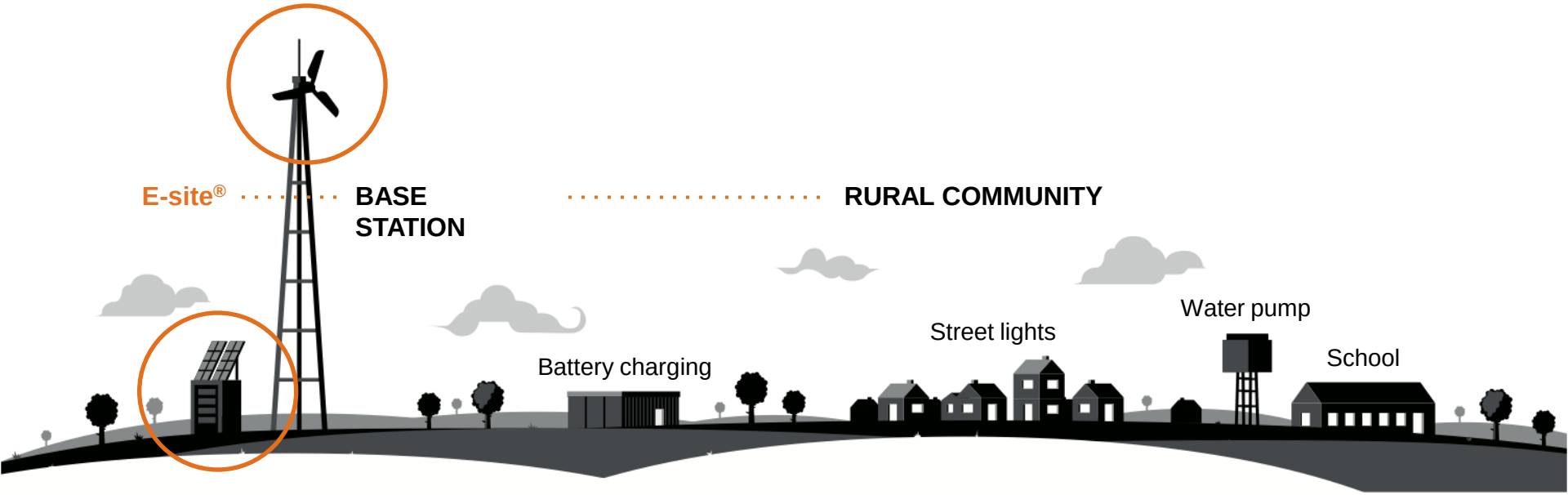
E-site® Case Study – Kenya

- Data from 24 months.
- Total load of 1,4 kW
- 95% reduction in fuel consumption.
- 83% reduction in energy-related OPEX.
- One diesel refill and maintenance visit per year.



E-site® with FlexWind 6

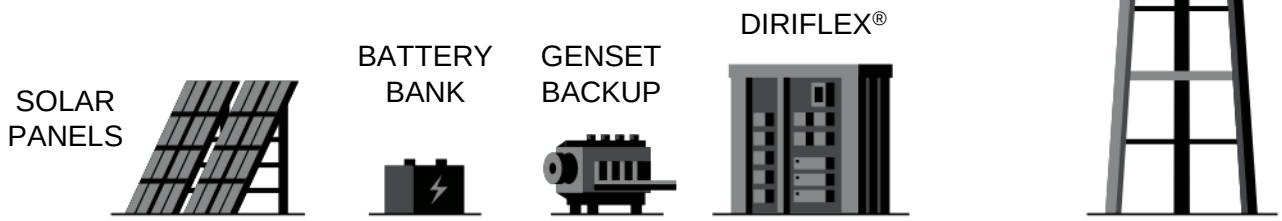
E-site® Powers Both Base Stations and Communities



The E-site® Components

- **Integrated power system** with carefully selected components;
  - Both CAPEX and OPEX have been taken into consideration
  - Long life-cycle, durability and proven functionality of all components
  - An integrated system = optimal energy efficiency

- **Diriflex®** – intelligent power management;
  - Adjusts in real time to conditions on site, and as the site grows
  - Integrates into customer NOC with alarms and management

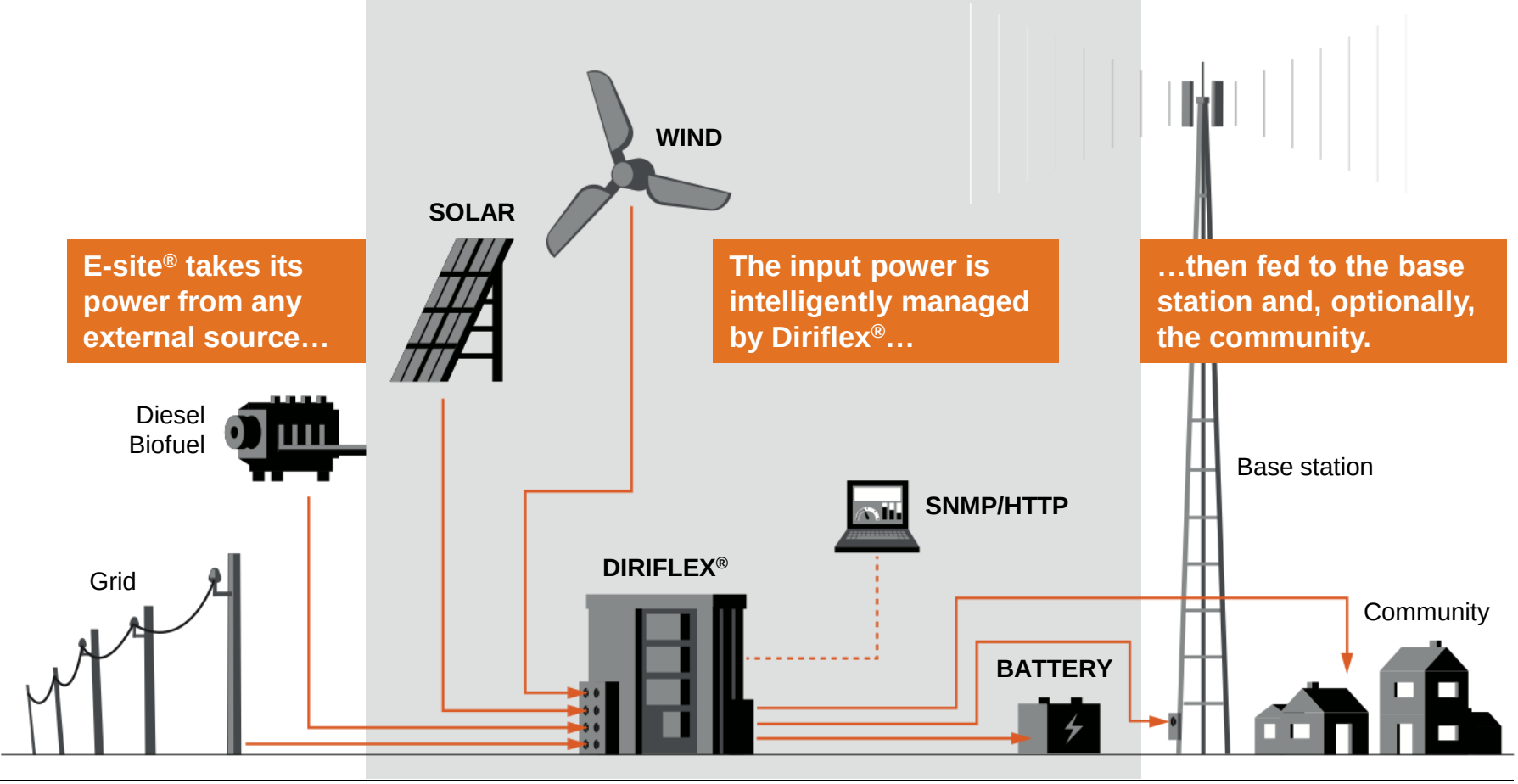


…but primarily from the renewable energy sources – wind and solar – in the E-site® power system.

E-site® takes its power from any external source…

The input power is intelligently managed by Diriflex®…

…then fed to the base station and, optionally, the community.



E-site - A Solution for OPEX Models

E-site has been designed with **lowest possible TCO** in mind:

- Solution **optimized on system level** to achieve very high OPEX savings
- High product **quality** and components controlled for long life time
- Ensuring **maximum usage of renewable** sources means very low genset run hours and therefore both low fuel consumption and long genset life time
- Exceptional level of **battery control** and measured kWh to extend battery life, track yearly OPEX cost and provide customer guarantees
- **One real-time control system** and optimal performance for any combination of power sources
- **Future-proof architecture:** the same power solution can be used when moving from shelter to outdoor BTS, when adding new power sources and new SW releases
- Possible to use **differentiated charging** for green energy (solar/wind), diesel energy and grid energy

Diriflex Functionality for Superior OPEX Control

- **Real-time remote monitoring, system control and commissioning (on site)** through Windows based interface
- **Rich database** (+200 parameters) with logging of all data needed for OPEX reporting
- **Reports** can be completely customised according to customer needs
- **+70 alarms** can be integrated to existing NOC using **SNMP v3**
- **Sensors** can be flexibly added
  - Temperature, smoke, flooding, etc.
  - Optional fuel tank sensor
    - Support for all fuel tank shapes, Abnormal consumption (theft) alert
    - Actual-, last cycle-, and total consumption





Flexenclosure's inventions enable mobile operators to profitably reach subscribers in rural & remote areas.

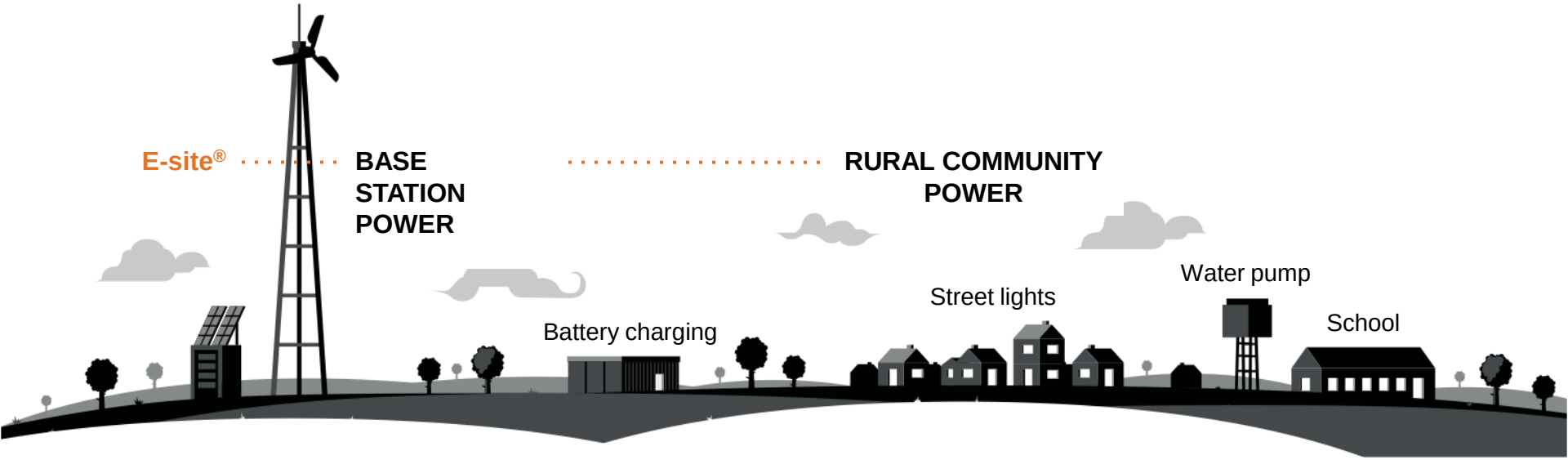
Results from Biogas Research Project

- Flexenclosure leads a government funded* research study (Vinnova Forska&Väx)
  - With Swedish experts** on Biogas, Fuel cells, Biogas gensets, and currently used small-scale biogas solutions
- Preliminary results from the study are shared in the presentation
  - Full local ecosystem quantified
- Preliminary operator business case discussion, using biogas:
  - To power telecom station
  - For community power



* Vinnova Forska&Väx
** Catator, Ekosystem/GEIST, Swerea, Tecnofarm

Village Biogas Ecosystem





Electricity generator
(5-15 kW biogas genset, Fuel cell)



Biogas tank
(70 m^3) + pipes & process equip.



Engineer 1 h daily operation



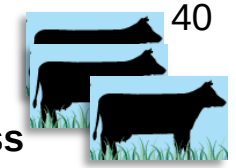
Biogas digester
(5m Ø* 3m buried)

~2 hectare*



or

40



Biomass

* Elephant grass, average farming condition (yearly 25 TS/ha)

Comparison – Basic and Advanced Biogas Solution

	BASIC	ADVANCED
Biomass	40  or 2 hectare* 	
Daily biogas prod.	21 m^3	70 m^3
Daily electricity, genset (30% eff.)	38 kWh	126 kWh
Daily electricity, fuel cell (60% eff.)	76 kWh	252 kWh
Biogas CAPEX**, excl. genset, fuel cells and E-site	$40K	$90K

* Elephant grass, average farming condition (yearly 25 TS/ha)
** Including installation. Volume deployment can bring down CAPEX.

Biogas Electricity Generators

- Current genset options : ~30% efficiency
  - European/US natural gas/biogas genset solutions: high cost (up to $40k)
  - Chinese manufacturers: biogas genset $5k-10k
  - Indian manufacturers: ?
  - “Bi-fuel” conversion of existing diesel genset for biogas: cost TBD in project
    - Common approach for Biogas vehicles
- Fuel cells: up to 60% efficiency
  - Expected commercial volume availability within 5 years

Energy Produced vs Power Need

- Basic biogas solution gives 38 kWh/day
  - sufficient to power a single BTS site (1.3 kW)
- ..adding 3.3 kWp solar panels gives 53 kWh/day
  - sufficient to power a single BTS site + 800 W community power
- ..adding 6.5 kWp solar panels gives 67 kWh/day
  - sufficient to power a dual BTS site (2.6 kW)

- Basic biogas solution with fuel cell gives 76 kWh/day
  - sufficient to power a dual BTS site (2.6 kW) + 400 W community power
- Advanced biogas solution with fuel cell gives 252 kWh/day
  - sufficient to power a triple BTS site (3.9 kW) + 6.5 kW community power

Fuel-Related Cost per Generated kWh Electricity

Preliminary

USD / kWh	5 years	10 years
Basic Biogas solution	$0.58	$0.29
Basic Biogas solution with fuel cell	$0.29	$0.14
Advanced Biogas solution	$0.39	$0.14
Advanced Biogas solution with fuel cell	$0.20	$0.10
Diesel (3.2 kWh electricity per liter, $1.3 per liter to site)	$0.41	
For reference: Inefficient diesel (genset at 25% load)	$0.7	
For reference: Grid power	$0.1-0.3	

- Efficient electricity generation (biogas & diesel) assumed (fuel efficiency 30% for genset, 60% for fuel cell)
- Fuel-related cost only, including Biogas system CAPEX. Excluding generator (diesel or biogas) CAPEX & service, Hybrid/E-site costs, and grid connection cost
- Operational cost of Village biogas system (Biomass, local labor) set equal to sales value of produced ecological fertilizer (more detailed analysis to follow in final report)

Village Biogas – More than Electricity

- Biogas process produces high-quality fertilizer for Ecological farming
  - ✓ Long-term farming possibility secured
  - ✓ Reduces need to buy (less sustainable) commercial fertilizer
  - ✓ No need to use genetically modified crops requiring extensive use of pesticides
- Excess biogas can be used for cooking
  - ✓ Avoid health hazard (chest disease) from firewood smoke when cooking
  - ✓ Avoiding deforestation due to firewood collection
- Farming of crops for Biomass contributes to avoiding earth erosion



First on energy economy off the grid.

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