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Renewable and Smart Energy Revolutions for Sustainable Development

SAIEE 1st National Conference

27-29 Nov 2019

Prof. SP DANIEL Chowdhury

C.Eng, FIET, FIE, FIETE, SMIEEE, PrEng, FSAIEE

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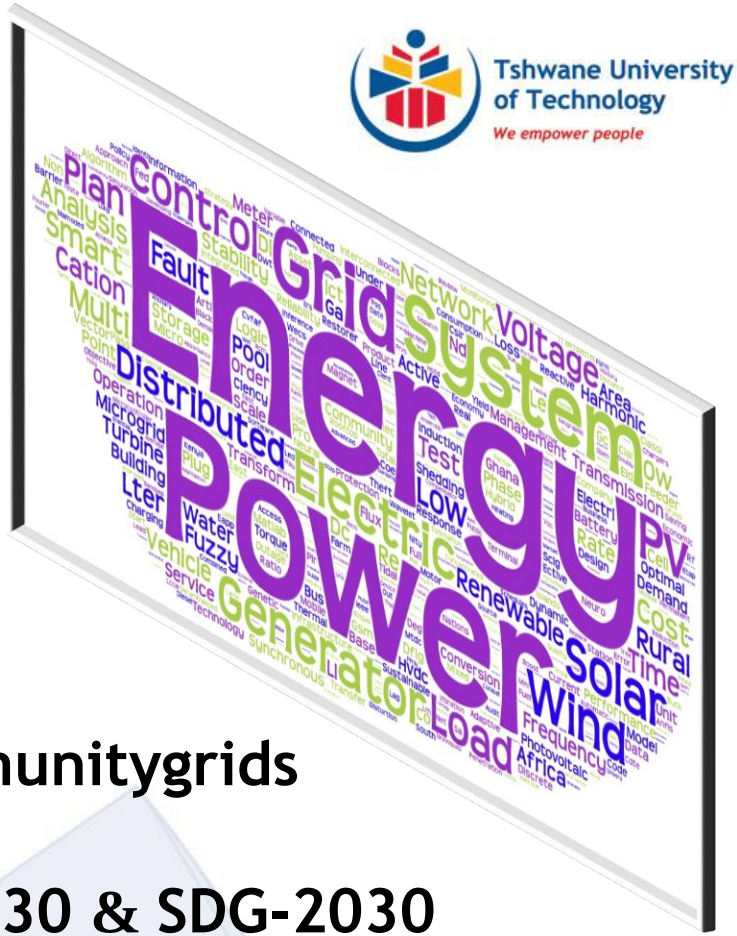
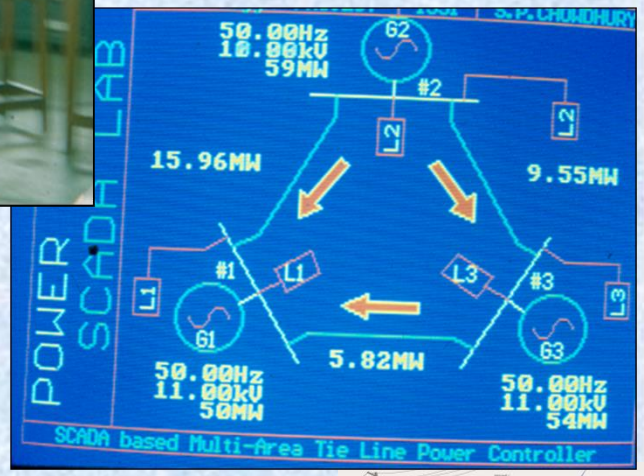
Agenda



1. Background at a glance
2. Microgrids & Energy Storage
3. Energy Poverty & e-Theft
4. Transactive Energy & Just Communitygrids
5. Way forward: Embracing NDP-2030 & SDG-2030

Jadavpur University
Kolkata, India
Ramananda College
Bishnupur, Bankura



Panua KC High School

Aswinkota Primary School

Prof. SP DANIEL Chowdhury

Finalist of dti Technology Award 2013

Graduated : PhD-14, Masters-54, Senior UG-112 (UCT-39+TUT-63+15)
International Peer Reviewed Publication - 409 , Projects Executed-R14M
Books Published-3, Edited Conference Proceedings-2
Research : 3 decades, h-Index:30, i10-Index:93, Citation Count:5115

Prof SP Daniel Chowdhury

Post Docs –2?

DEng – 1+3+(5)

MEng -6+(6)

Bachelors-8+15

Community Engagement, Social Responsiveness and Engaged Scholarship

Teaching & Learning

Power Systems & Protection

SREEMAS – Sustainable Renewable Energy & Emergent Microgrids and Smartgrids

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Graduated : PhD-10, Jadavpur University, Kolkata; PhD-4, UCT
Continuing : Doctoral – 1+3; Candidate : – 5

P.K. Sadhu Professor	Application of High Frequency Inverter in Induction Heating.	2002
J.K. Das ED, DVC	Development of a Complete Restoration Plan for An Interconnected Power System through Knowledge Based Algorithm	2004
S. Bhuyan Professor	Development of Application Tools for Power System Operation and Planning	2006
P. Mitra, ABB Sr Manager	Neuro-Fuzzy Based Power System Stabilizer and Automatic Voltage Regulator in Small Signal Stability	2007
K. Mitra Professor	Competitive Strategies in the Marine Transportation Industry : Case of the Kolkata Port Trust	2007
A.K. Saha Sr Lecturer	Fuzzy Neural Network Based Computing Models for Electric Load Forecasting	2009
A.K.Basu Assoc Prof	Microgrid : Design of its Energy Management System	2012
P. Basak Assoc Prof	Distributed Energy Resources Integration : An Emerging Power Scenario	2012
A. Sinha, ED Cape Gemini	Energy Resource Planning based Power Plant Management	2013
L Ramesh Assoc Prof	Distribution system management and loss minimization	2014

Graduated in 2019 : Masters-9

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Simplice Noubissie	An efficiency control algorithm for building automation systems in government buildings in South Africa	2019
Nhamo Dhlamini	The impact of large penetration of photovoltaic generation on the utility grid: A case study for South Africa.	2019
Maxwell Sibanyoni	A Study on Synchronization of single phase inverters in South African grid with high degree of penetration of renewable energy	2019
Macdonald Nko	Investigation of storage facility for renewable energy system using solar power plant as base source: A case study for South Africa	2019
Hugues Kazeza	Optimization of a Solar PV based Water Pumping Systems	2019
Prosper Tembe	A study on the residential energy efficiency programme framework in South Africa.	2019
Banjo Aderemi	Dynamic Energy Saving for Hybrid Powered Mobile Cellular Base Station	2019
Mpho Lencwe	Performance enhancement of Lead Acid-Super Capacitor hybrid battery	2019
Raymond Kene	Performance Prediction of Photovoltaic Arrays	2019

Transformation Trend
Btech ➔ Master ➔ DEng

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BTech:-2015-5; 2016-5, 2017-19, 2018-26, 2019-8+(15)

Master ➔ DEng Continuing 2019 – 1+3+(5)

BTech ➔ Master: Graduated in 2019-9; Continuing 2019-6+(6)

Current Doctoral-4 Joining 2020-5

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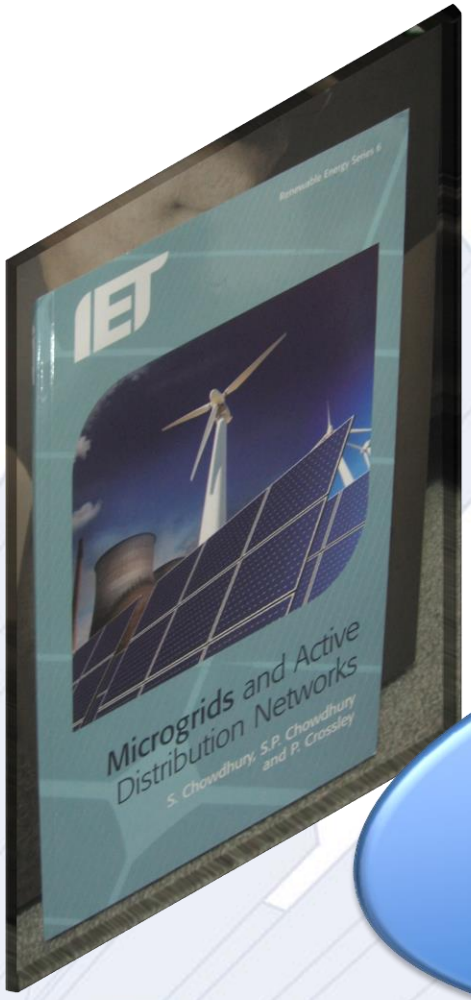
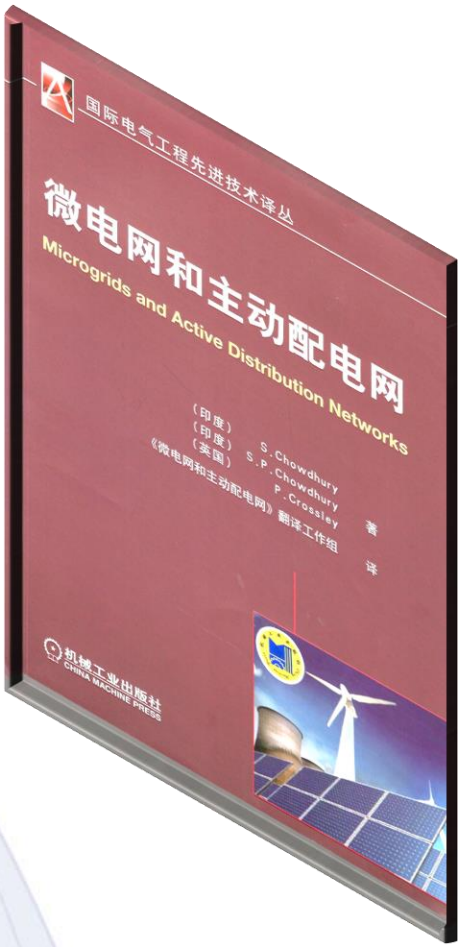


Research Book Microgrids and Active Distribution Networks

Citation > 963
31 Oct 2019



Community Engagement
Pretoria Townships

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Inbox (55) - spchowdhur | Shyama Pada Chowdhury | Campus maps | google aerial picture of | Prof. SP Daniel Chowdhu | Gauteng - Google Maps

Secure | https://www.google.co.za/maps/place/Gauteng/@-25.6749879,28.132017,11z/data=!4m5!3m4!1s0x1e9512955411779f:0x6d9ee7c7cb5438e2!8m2!3d-26.2707593!4d28.1122679

Google Maps

Gauteng

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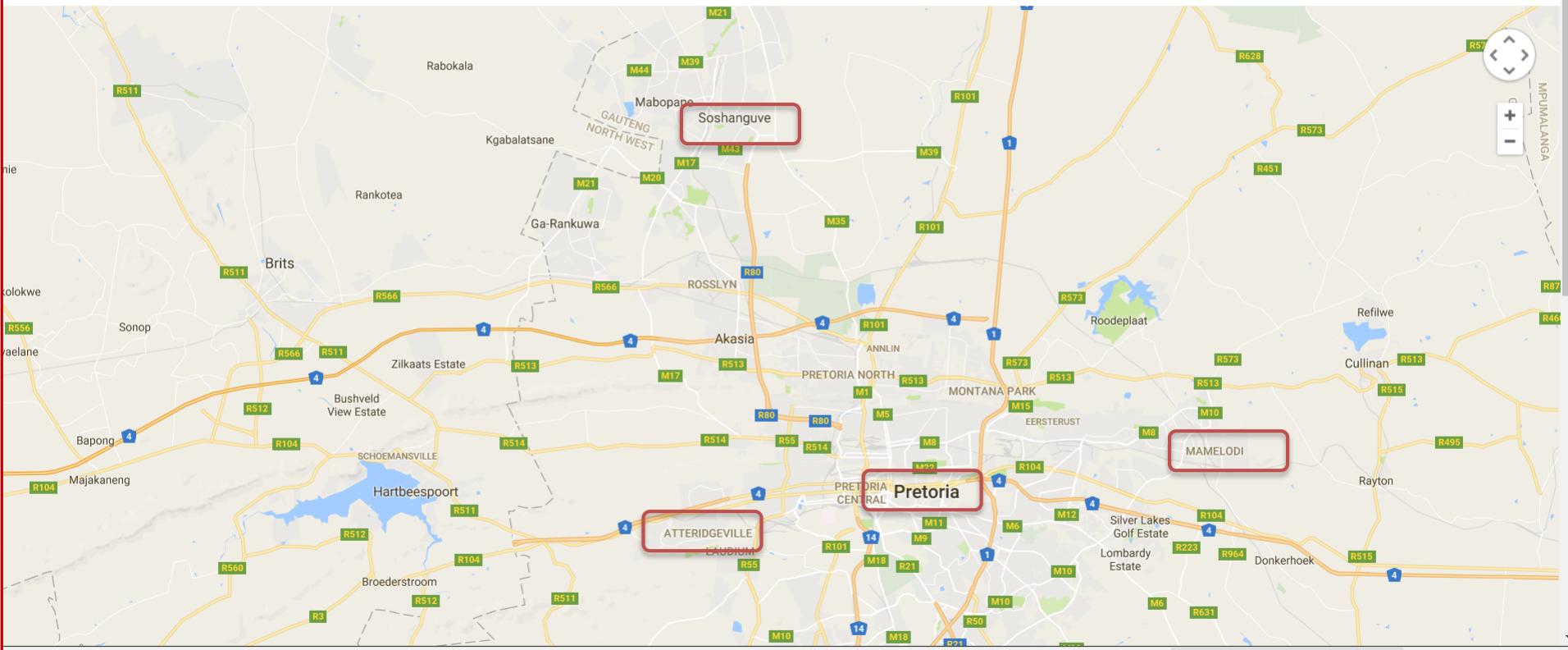

Intelligent HESS P....pdf | Intelligent HESS P....pdf | EGLekhuleni SAU....docx | Energy Planning f....pptx | Mamelodi Initiates....jpg | Mamelodi Squatte....jpg | Show all

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2017/06/25

Keynote on Microgrids and Justgrids by Prof SP Daniel Chowdhury

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TUT tackles maths, science problems

The Citizen (Johannesburg Edition) - 9 Jun 2017

Publication: Citizen (Johannesburg Edition)
Date: Friday, June 09, 2017
Page: 2

TEACHERS' WORKSHOP

TUT tackles maths, science problems

Virginia Keppler

Tshwane University of Technology and the faculty of engineering and the built environment, together with a team of lecturers, has developed a maths and science workshop to get teachers of these subjects at schools in the university's footprint area "back on track".

In addition to addressing an important national issue, the project forms part of the faculty's annual community outreach programme.

Professor Daniel Chowdhury, a research professor at the department of electrical engineering, said science, engineering and technology have been declared national growth areas.

Despite this, the results of matrie pupils in mathematics and science countrywide have been on the decline.

"Based on these declining results, it has become clear that interventions at more than one level are vital to help students improve their mathematics results. One such intervention is to invest in the training and development of mathematics teachers," Chowdhury said.

He said the primary goal of the recent content workshop for Gauteng secondary schools mathematics teachers was to maximise the impact on the pass rate of the pupils at the schools in Mamelodi and Atteridgeville, in Pretoria, where the 15 teachers came from.

"The content workshop was designed to complement training programmes already organised by the Gauteng department of education.

"The pass rate of the corresponding schools will be evaluated to determine the success. During the workshop, challenges in the teaching and learning of mathematics towards improving Mathematics pass rate were identified, while the group also looked at ways to make Mathematics and Science subjects, the enabling subjects to pursue a career in engineering, more attractive for students," said Chowdhury.

Switch View: Text | Image | PDF

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Maths and Science teachers get back on track

by WILLA DE RUYTER

In a first for TUT and the Faculty of Engineering and the Built Environment (TUTFEBE), Prof SP Daniel Chowdhury, a research professor at the Department of Electrical Engineering, together with a team of lecturers have developed a Maths and Science workshop to get mathematics and science teachers at schools in the university's footprint area "back on track" for training to help their learners perform better. In addition to addressing an important national issue, the project forms part of the Faculty's annual Community Outreach programmes.

Prof Daniel Chowdhury and colleagues have started a community outreach programme to help school teachers to improve the pass rate of Maths and Science.

Science, Engineering and Technology have been declared national growth areas, but despite this, the results of matric learners in mathematics and sciences country-wide have been on the decline over time. Based on these declining results it has become clear that interventions at more than one level are vital to help learners improve their Mathematics results. One such intervention is to invest in the training and development of mathematics teachers.

The primary goal of the recent Content Workshop for Gauteng Secondary Schools Mathematics Educators, was to maximise the impact on the pass rate of the learners at the schools in Mamelodi and Atteridgeville, where the 15 teachers, came from. The content workshop was designed to complement training programmes already organised by the Gauteng Department of Education (GDE).

The pass rate of the corresponding schools will be evaluated to determine the success. During the workshop challenges in the teaching and learning of mathematics towards improving Mathematics pass rate were identified, while the group also looked at ways to make Mathematics and Science subjects, the enabling subjects to pursue a career in engineering, more attractive for students.

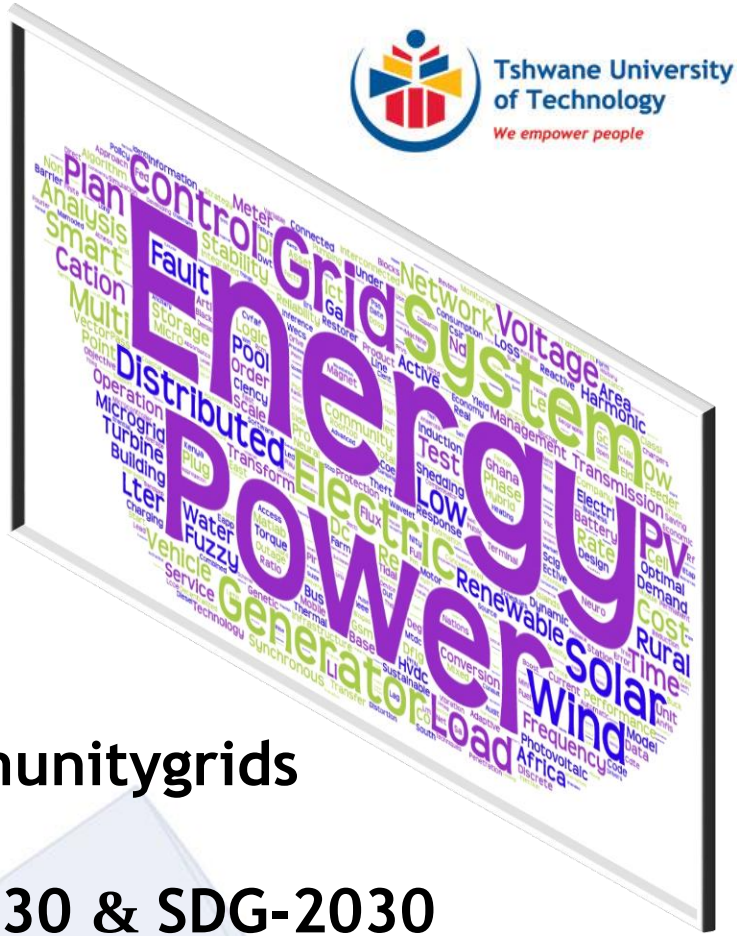
The teaching team and the trainees were careful that the positive impact on the pass rate of NSC Maths from their corresponding schools was maximised. According to Prof Chowdhury, the training was very interactive, with trainees wanting to explore more about ways that the dissemination of knowledge and information could be imparted far better than in the past.

This workshop content also encouraged some added benefits, including:

- More effective teaching of Mathematics in the affected schools;
- Improved pass rate at the affected schools;
- To motivate equipped learners to choose TUTFEBE as their higher education institution of choice;
- Community engagement undertaking by strengthening basic education in these areas.

According to Prof Chowdhury, this is an ongoing endeavour, which will be rolled-out to schools in other footprint areas as well. The trainees will be visited at random intervals to conclude if the teachers were implementing what they were taught and follow-up workshops, aimed at continuous training and development of the teachers towards improving matric results in these subjects, will be hosted by the Faculty.

Agenda



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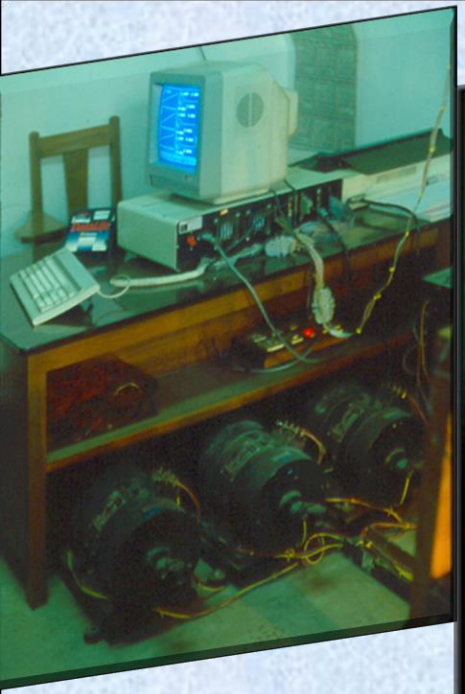
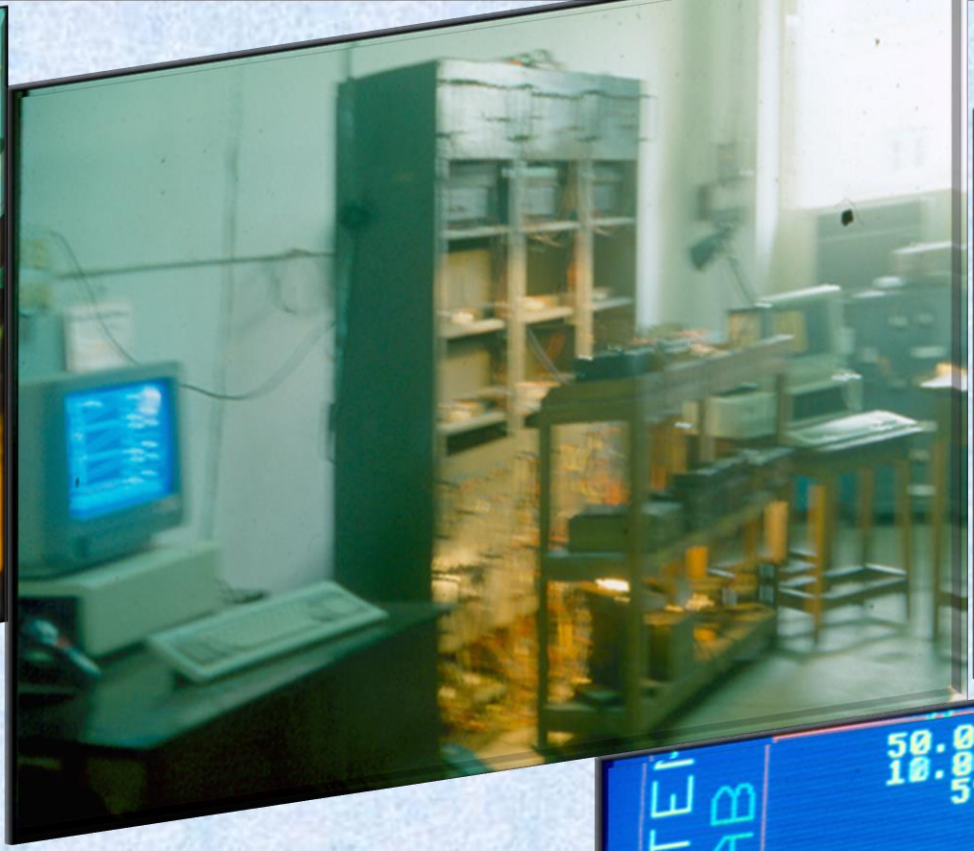
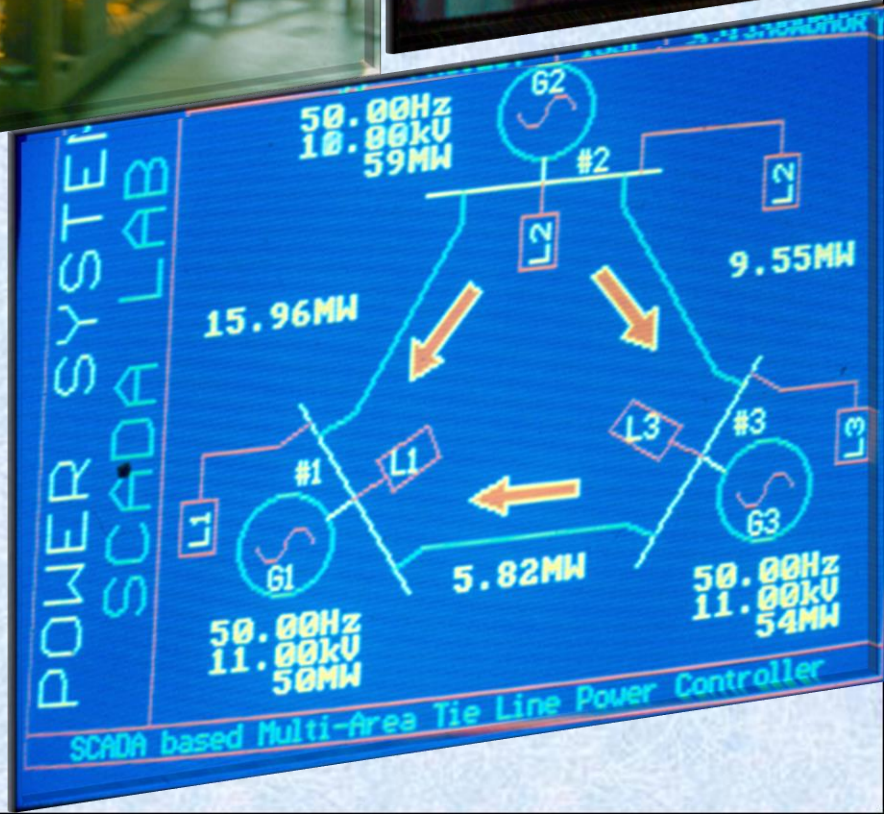
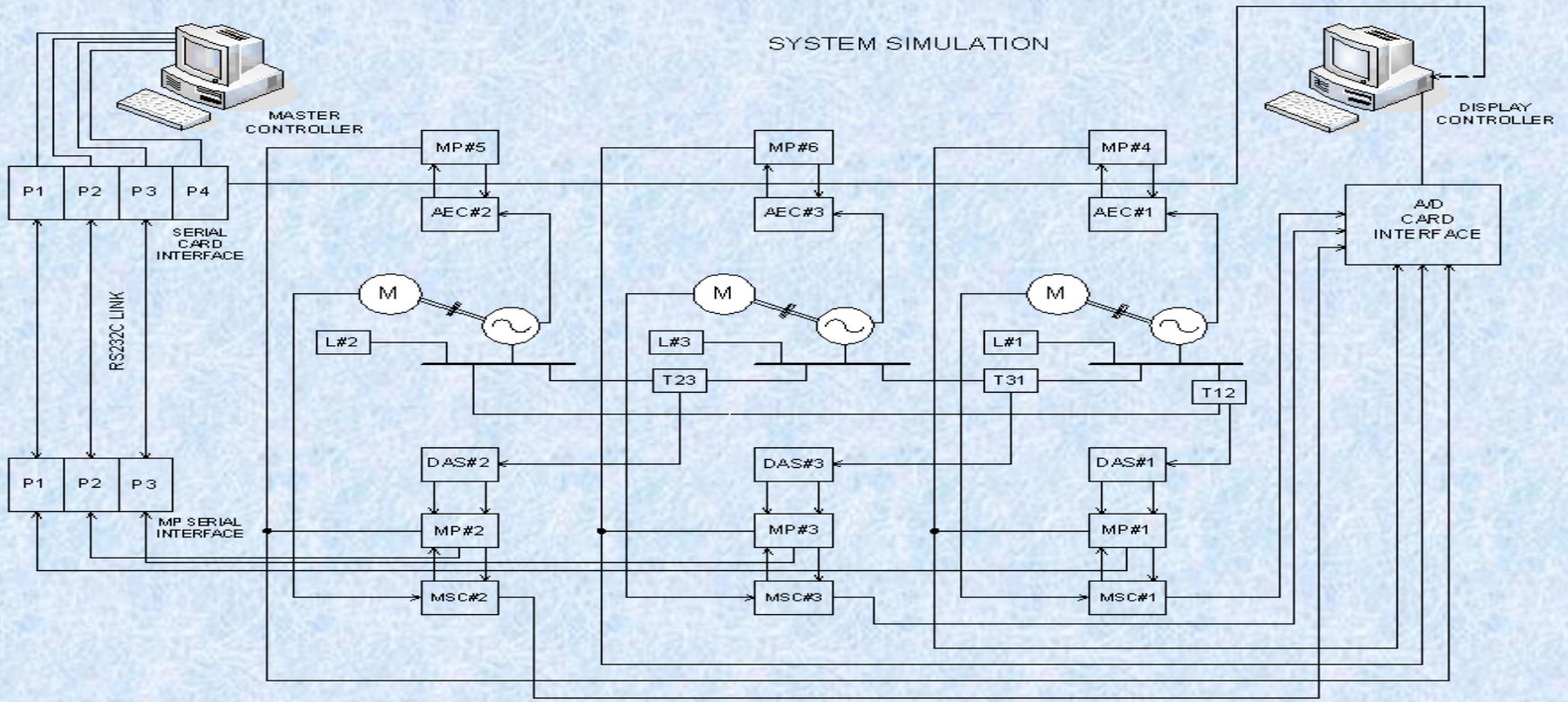
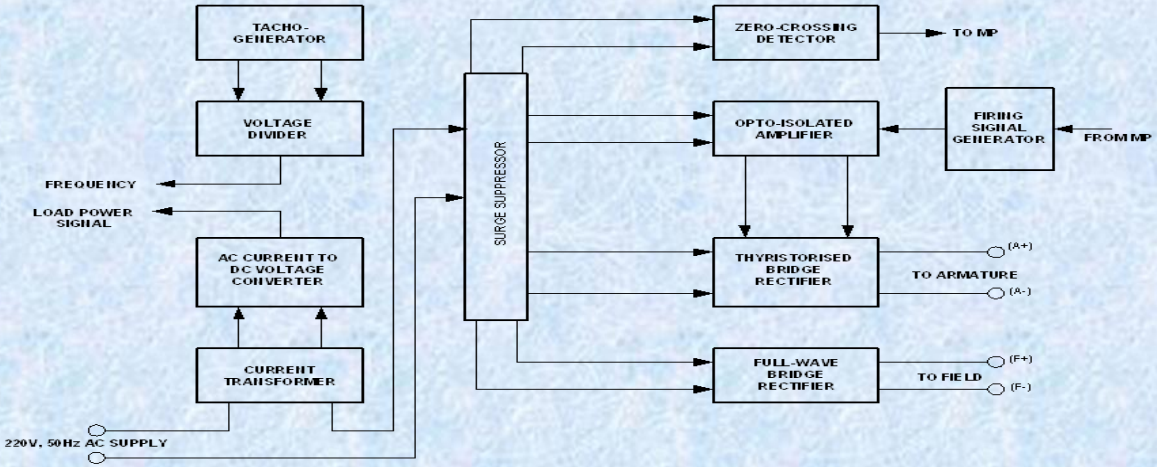


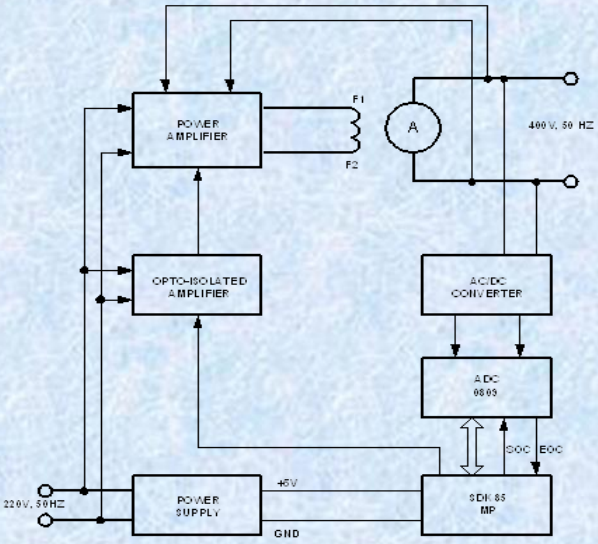


MICROGRID: SCADA Lab for HR Development Jadavpur University









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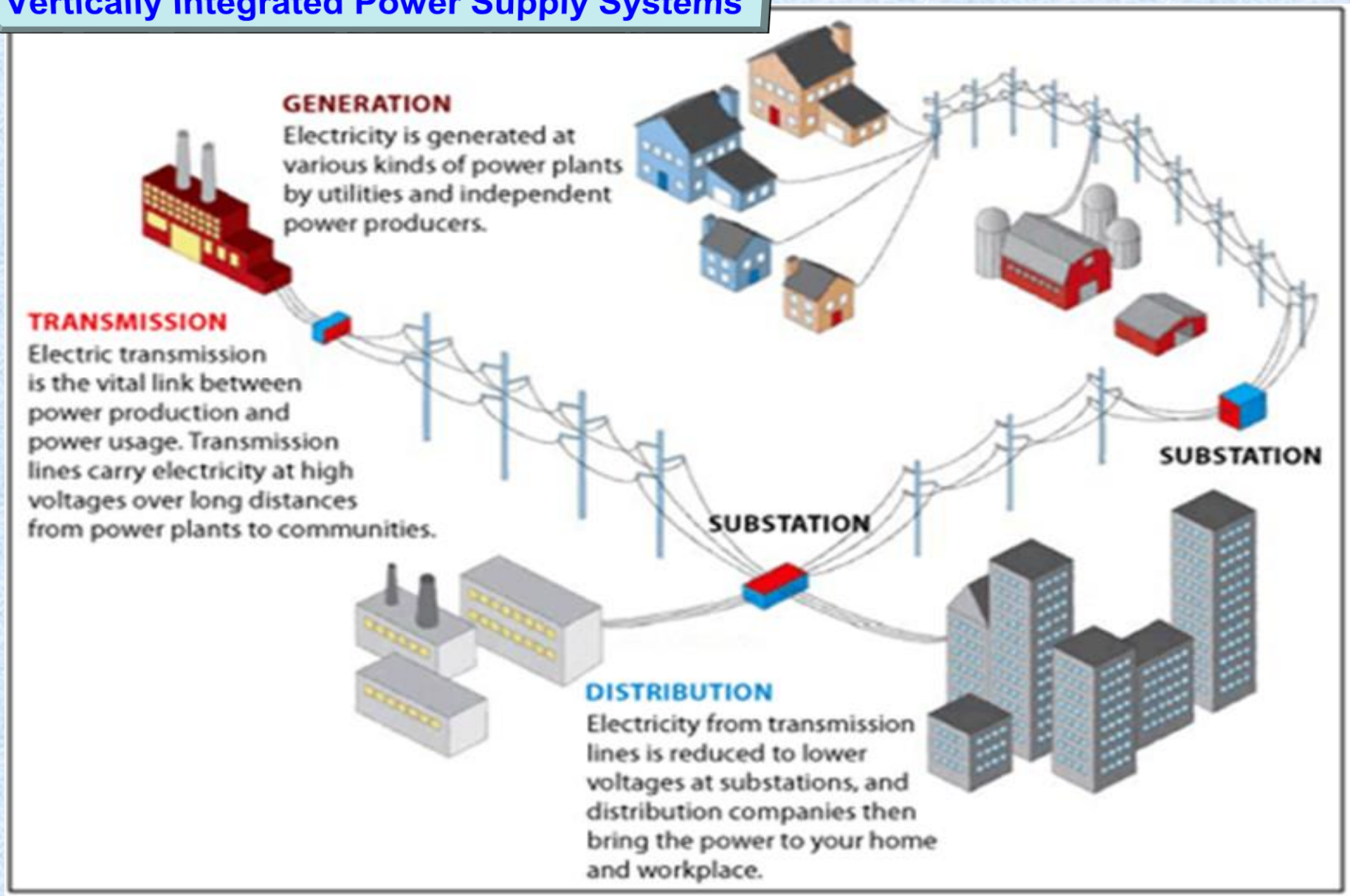
Finalist of dti Technology Award 2013

Vertically Integrated Power Supply Systems



Prof. SP DANIEL Chowdhury *(NRF Rated)*

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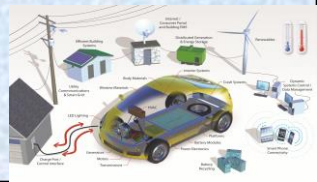

Typical Microgrid Structure

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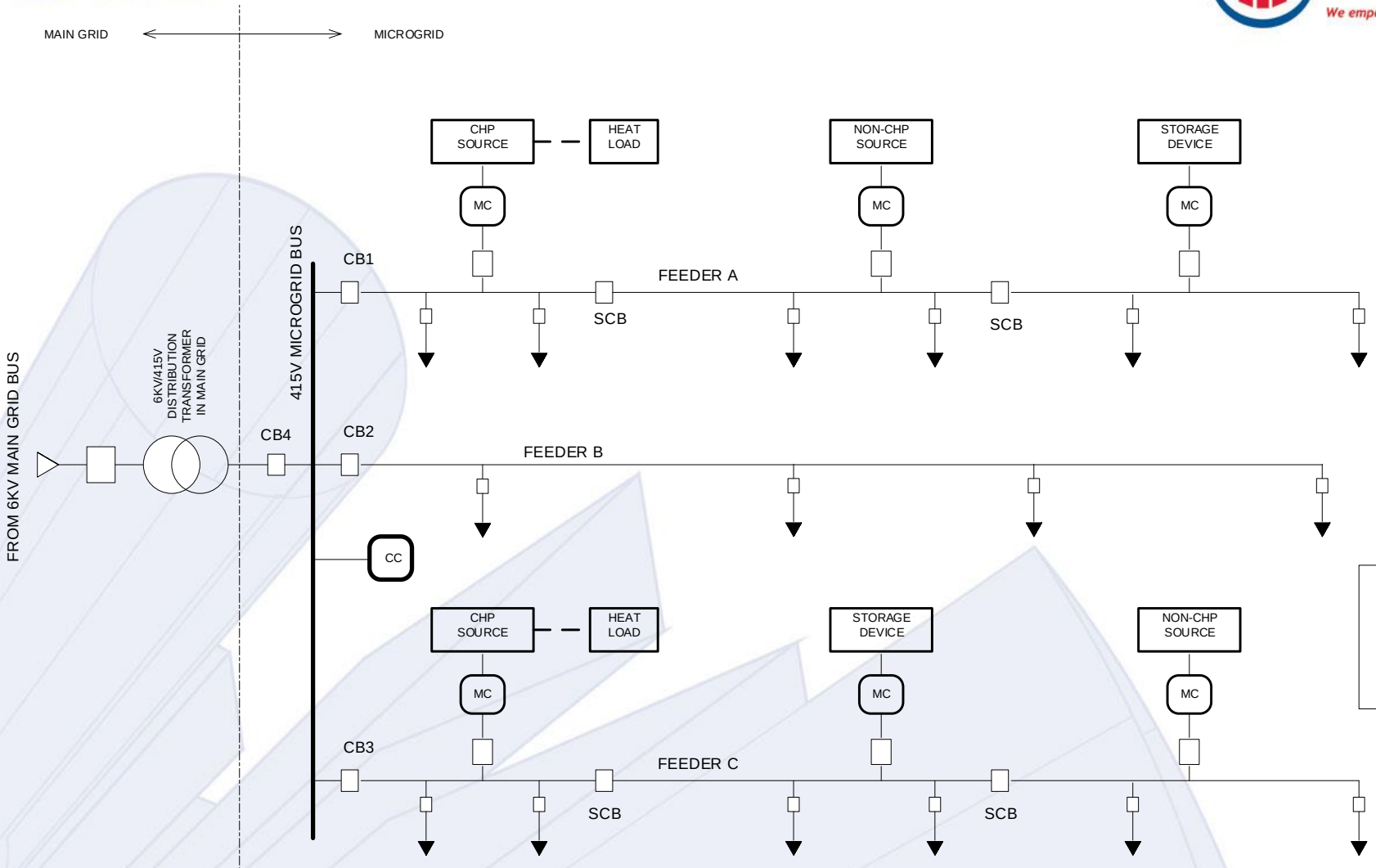

Microgids Operation

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Controllers

Microsource Controller

Central Controller

Modes of Operation

Stand-alone

Grid-connected

Energy Management Module (EMM)

Protection Coordination Module (PCM)

Main Protection Issues

Islanding Instant

Sectionalisation Mehtodology

Protection Issues

Non-consistent

Depends on Microsource Power Electronic Inverter Characteristics

Non-uniform

Non-conventional characteristics and performance of protection elements

Dependent on system design

Low Fault Current Capacity

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Protection Needs

- Appropriate Grounding
- Protection Co-ordination in both modes
- Adaptive Relaying for varying Fault Levels
- Spurious Separations?
- Close Coordination of Load Shedding Schemes
- Importing, Exporting, Islanded Mocrogrids
- Anti-Islanding Feature IEEE-1547 ??
- Utility Re-synchronization- Automatic or Manual ??
- Non-Fault Separations – under voltage, voltage imbalance etc.

Current Storage Practice

Energy Storage

Pb-Acid Battery (LAB)

Li-Ion Battery (LIB)

Hybrid Energy Storage System

What Storage Options for Microgrids and Transport Vehicles ?

Super-Capacitor

LAB-LIB HESS

LAB-SuperCap HESS

LAB-LIB-SuperCap HESS

LAB Characteristics

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Battery Technology	Advantages	Disadvantages
LABs		
	Low cost	Heavy and bulky
	Available in large quantities	Unsuitable for fast charging
	Abuse-resistant	Short lifespan
	High tolerance to overcharge	High self-discharge during high temperature
	In-built self-balancing mechanism	Limited energy density (30 - 40Wh/kg)
	Low internal resistance consequently deliver very high current	Not good for the environment
	Amenable to float-charging and trickle-charging	

LIB Characteristics

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Battery Technology	Advantages	Disadvantages
LIBs		
	Smaller and lighter	Moderate initial cost
	High charging rate	Degrades at high temperature
	High energy and power density per unit mass	Need for protective circuitry
	High energy efficiency	Sensitive to overcharge and deep discharge
	No memory effects	
	Relative long lifespan	
	High capacity	
	High rate and High [power discharge capability	
	Low self-discharge	
	No maintenance required	
	Broad temperature range of operation	

SC Characteristics

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Battery Technology	Advantages	Disadvantages
SCs		
	Virtually Unlimited Life Cycle	Low Energy Density
	High power density, Low resistance, High Load Current	Quite High Cost per Watt
	Super Fast Charging (in Seconds), No End-of-Charge Requirement	Linear Discharge prevents Full Energy Spectrum
	Simple Charging, No Problem of Overcharging	High Self-Discharge
	Safe, Forgiving if Abused	Low Cell Voltage
	Excellent Low Temperature Charge/Discharge Performance	

Comparison of LAB-LIB-SC BESS

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	Energy Density (Wh/kg)	Power density (W/kg)	Nominal Voltage (V)	Cycle life	life-span (year)	Self-discharge/ Month	Cost ($/kWh)
LAB	30 -50	100 - 250	2	200-300	2 – 5	2%	50 – 65
LIBs	100-200	100-28k	3.7	500-1000	7 -12	2 -10%	500-600
SC	5-15	>10k	2.5	600-1400	8 -15	2 -10%	1000-5000

Comparison of HBESS

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	Cycle life	Safety	Scalability	Economy	Energy Efficiency
Regular lead acid battery	★★	★★★★	★★★★	★★★	★★
Super capacitor	★★★★	★★★	★★	★★	★★★★
Lithium ion	★★★	★★	★★	★★	★★★★
Vanadium redox flow battery	★★★★	★★★	★★★★	★★	★★★
Sodium sulfur	★★★	★	★★★	★★★	★★

What Storage Options for Microgrids and Transport Vehicles ?

Hybridisation

Energy Storage

Hybrid Energy Storage System

Pb-Acid Battery (LAB)

Li-Ion Battery (LIB)

Super-Capacitor

LAB-LIB HESS

LAB-SuperCap HESS

LIB-SuperCap HESS

LAB-LIB-SuperCap HESS

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Performance Improvement with SuperCapacitor

- SC-Reasonable Energy Storage
- SC-Super Fast Charging (< 10 Seconds)
- SC-Power Peaks Management
- SC- Prevent Voltage Sag
- Power Supply Regulation through LAB-SC HESS
- SC-Minimising Microgrid Peak Demands
- SC-Bridging Quick Power Gaps
- SC-Superb Voltage Regulation
- Power Back-up during Switching of Back-up Generators when Grid fails

Battery Management Strategy

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BMS

Enhance Vehicle Acceleration

Enhance Driving Efficiency

Extend Battery Life

Enhancee Driving Range

Enhance Power Density

Reduction of Capital Costs by Minimising HBESS Costs

Enhance Energy Density

Battery Management Strategy

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Vital Parameters

SOC-State of Charge

DOD-Depth of Discharge

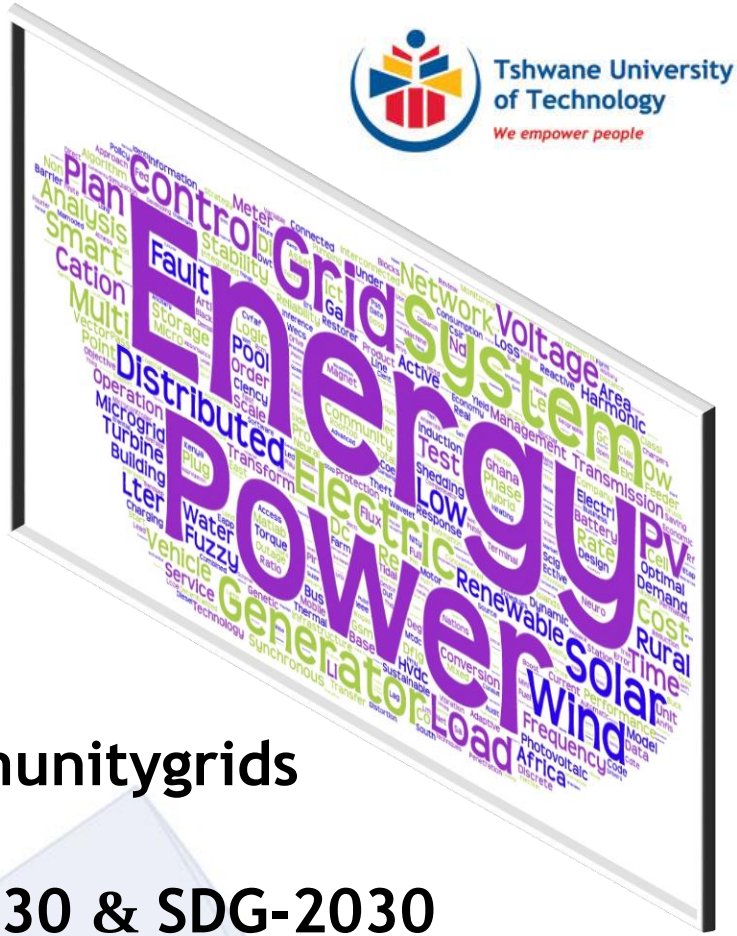
Percentage of Battery Capacity currently Discharged

State of Charge-Ratio of Available Capacity to Maximum Capacity

SOH-State of Health

Ratio of Maximum Charge Capacity of an old LAB wrt a New LAB of same rating

Agenda



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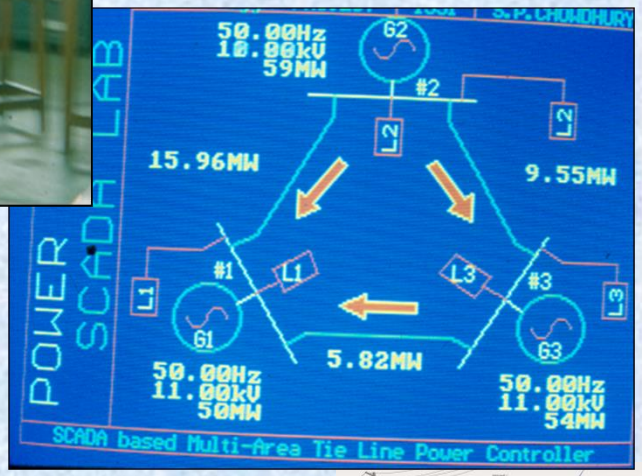
Global Economy Challenged by e-Theft



Global Loss $90B; Africa $25B

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Energy Theft (e-Theft)

Energy Theft (e-Theft)

What is Energy Theft (e-Theft)?

Criminal act of illegal acquiring or tampering of the electrical energy.

This is non-technical loss in transmission and distribution of electrical energy.

It encompasses tampering with and bypassing of the electrical meter, theft of power accessories such as meters, cables, transformer etc., evading or refusing to pay the utility bill consumed.

Is it a local/regional/continental/global phenomenon?

These are heavily impacting the economy of the country/continent/globe.

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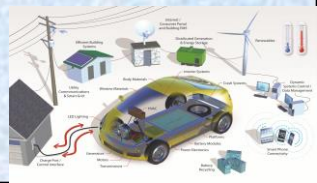

Energy Theft (e-Theft): Impacts?

Adverse impacts on the socioeconomic structure?

Impacts on economic growth?

Developmental Dependence on energy sector?

Lack of money for other sectors?

Extra costs in the replacement of the stolen items?

Quality of social lives?

PUI-Poverty, Unemployment, Inequality?

Is PUI Cause or Effect?

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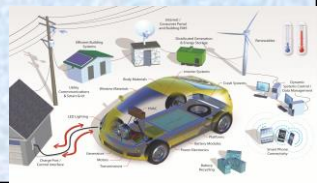

Energy Theft (e-Theft): How?

Power Theft in Electro-Mechanical Meters	Power Theft in Electronic Meters	Meddling with High Tension Metering Equipment
Power theft in voltage circuit	Power theft by altering the 'burden' of current transformer (CT)	By-passing CT-PT equipment
By-passing meter- outside style	By providing shunt CT	Power theft in trivector meter
By-passing meter- inside style	By removing CT	Power theft by tampering test terminal block
Drilling holes on electro-mechanical meter	Tampering on display circuits of energy meters	Power theft using magnetic switch
Direct tapping from overhead lines	By meddling with counter circuits using shims	Remotely operated power theft in high tension meter
Looping of supply from incoming wires	Introducing limit switch	Direct tapping from transformer bushing
Direct tapping from incoming wires	Power theft by meddling with teeth of micro gear wheels	By detaching the secondary wires of CT
Tapping from service wires	Reversing reading of energy meter	
Partial Earth fault tampering	Tampering of real time clock	
Missing neutral method	Power theft in voltage circuit	
Cross potential method	By means of electrostatic discharge	
	By tampering printed circuit board	
	By tampering the frequency circuit	

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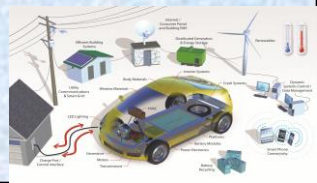

Energy Theft (e-Theft): How?

Other Ways?

Wires/ Cables- *Illegal tapping to bare wires or underground cables.*

Transformers- *Illegal terminal taps of overhead lines on the low side of the transformer.*

Unpaid utility bills

Deliberate tampering with the meter by the consumers to deceive the authority of power utility company

Fraudulent stealing of electricity through illegal connection to the line

Irregular billing system

Corruption on the part of fraudulent staff of power utility (bribery)

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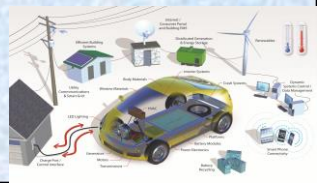

Minimizing Energy Theft (e-Theft): Challenges?

Poor Literacy rate

Lack of awareness

Lack of accountability from the authorizing personnel

Lack of effective participation through ownership between government and the people

Corruption to keep up with competitive standards of lives?

Lack of holistic approach in human capacity development?

How to inject willingness to perspectives change in energy theft.

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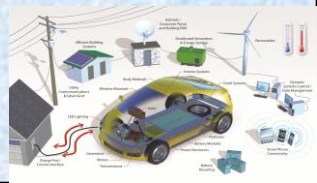

Minimizing Energy Theft (e-Theft): Way Forward?

- Implementation of new technologies such as Advanced Metering Infrastructure, (AMI), as well as automated meter reading
- Dynamism in the fundamental law and institutions governing the affair of power grid transmission and distribution
- There must be a strategic management improvement plan, (SMIP) towards reducing future energy theft in energy distribution. This must be followed up, and improved on, where necessary
- This plan must be affordable and cost effective
- Reduce corruption
- Increase the awareness on the danger of energy-theft
- Inculcating Virtue Ethics

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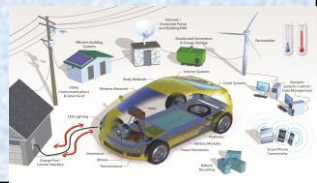
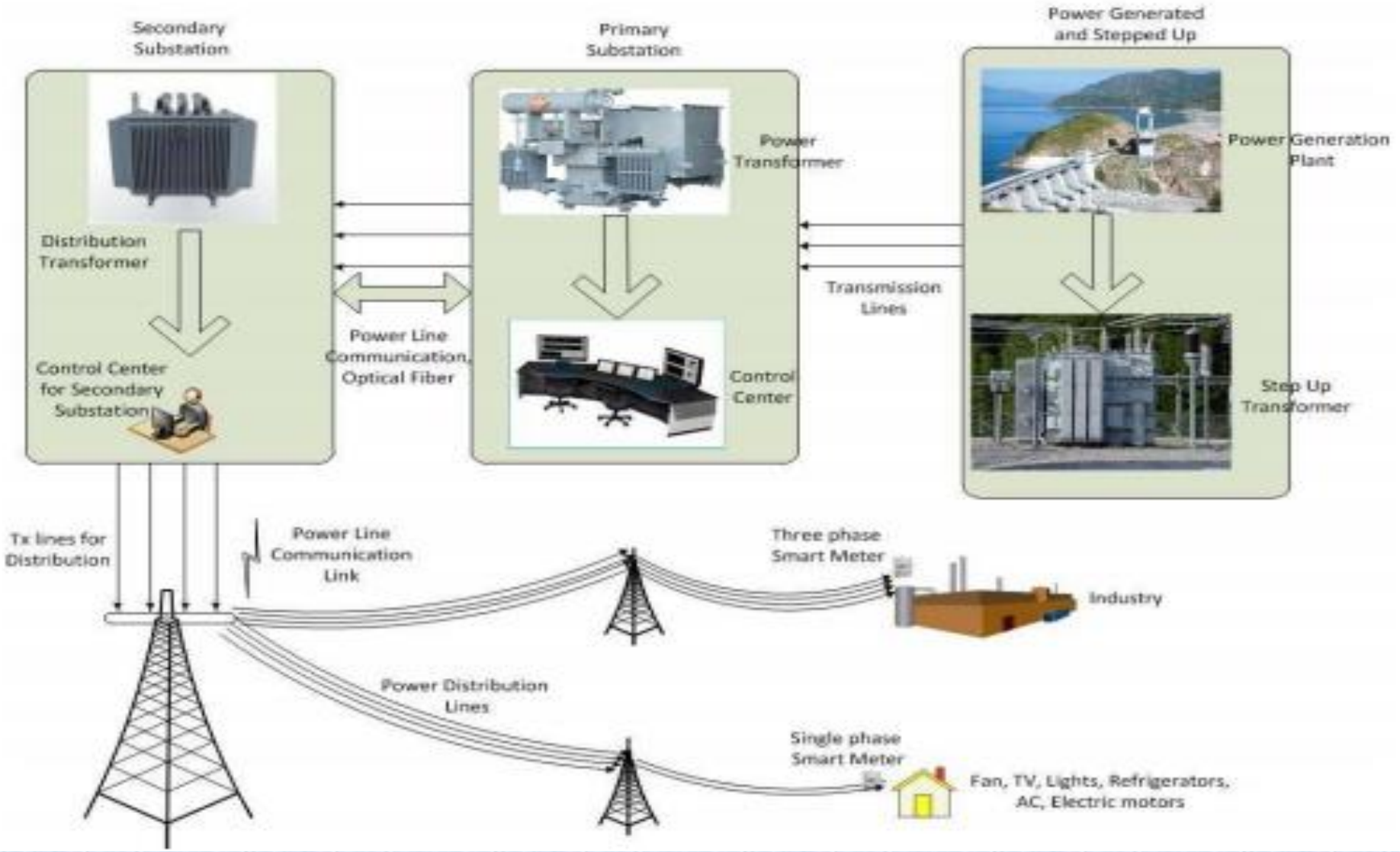


AMI: Is it Winning?



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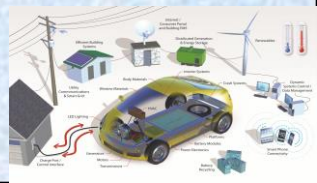

Advantages of Advance Metering Infrastructure?

Provides stable energy supply

Prevent consumers from energy theft

Accurate billing system

Secures consumers personal information

Secured against unauthorized personnel

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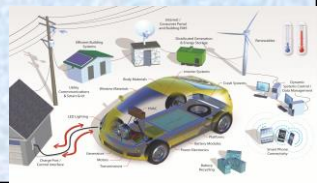

Energy Losses in e-Theft: A comparative Study

Sr No.	Country Name	2005-2009	2010-2014
01	Israel	03%	03%
02	Japan	04%	05%
03	Russian Federation	10%	10%
04	Bangladesh	10%	10%
05	Sri Lanka	14%	12%
06	Brazil	17%	16%
07	India	20%	21%
08	Parkistan	16%	17%

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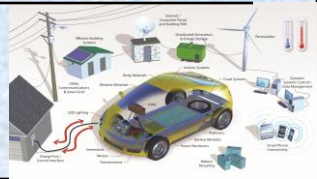
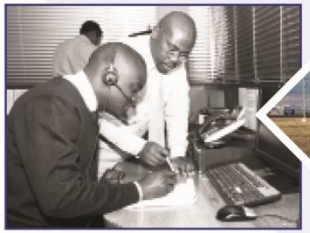


Presenting to you ...

SOUTH AFRICA'S LEADING INTELLIGENCE DRIVEN INVESTIGATIONS COMPANY


CPI

Combined Private Investigations

Corporate Investigations

STATISTICS

- Eskom – Nationally crime reduced by 80%
- Transnet – crime reduced by 70% in less than 2 years
- Ekurhuleni – crime reduced by 60% within the first year of contract
- City Power – crime reduced by 70%
- City of Tshwane – incidents decrease by 70%
- Transnet – since inception of new contract in 2010, more than a 1442 cable thieves were arrested in the act relating to Transnet networks only

CPI Combined Private Investigations
Corporate Investigations
33 New Road, Halfway House, Midrand 1685.
Web: www.combinedpi.co.za

CONVICTION STATISTICS

2013

- CPI attended to a total of 138 concluded court cases
- Out of the 138 cases, CPI was able to secure successful convictions in 120 cases, resulting in the conviction of 191 accused
- Overall conviction rate for 2013 is 87%

2014

- CPI attended to a total of 156 concluded court cases
- Out of the 156 cases, 277 were accused and convicted
- Overall conviction rate thus far for 2014 is 95%

2015

- CPI attended to a total of 293 pending court cases since Jan 2015 – Dec 2015
- CPI was able to secure successful convictions in 138 cases, resulting in the conviction of 218 accused
- Overall conviction rate for 2015 thus far is 91%

2016

- CPI attended to a total of 42 pending court cases since Jan 2016 – May 2016
- CPI was able to secure successful convictions in 35 cases, resulting in the conviction of 76 accused
- Overall conviction rate for 2015 thus far is 83%

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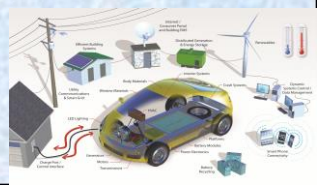
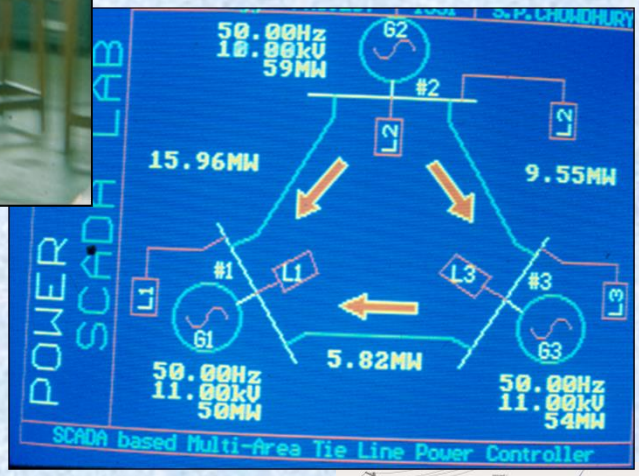


Agenda

1. Candidacy Motivation
2. Microgrids & Energy Storage
3. Energy Poverty & e-Theft
4. Transactive Energy & Just Communitygrids
5. Way forward: Embracing NDP-2030 & SDG-2030

Californian Success Stories



for SDG&E with UCSD

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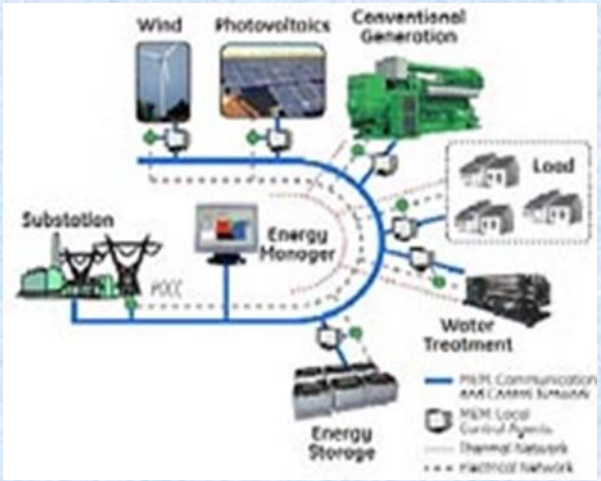
SDG&E : UCSD Microgrid

SDG&E : Borrego Spring Microgrid

SDG&E : Clean Transport EV



SDG&E Microgrid Structure

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What is Transactive Energy (TE)?

- A set of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using value as a key operational parameter… GridWise Council

- A software-defined grid managed via market-based incentives to ensure grid reliability and resiliency….Smart Grid Dictionary:

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Courtesy: California Public Utilities Commission Policy & Planning divison

What we see in Transactive Energy?

- **TE is an intelligent device-enabled-grid to optimize allocation of resources utilizing economic signals in Grids & Microgrids**

- **a double auction market used to control responsive demand side assets**

- **real time pricing in "price-to-devices"**

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http://www.gridwiseac.org/pdfs/te_framework_report_pnnl-22946.pdf

http://www.smartgridlibrary.com/2013/09/16/transactive-energy-american-perspectives-on-grid-transformations/

Adavantages of Transactive Energy

- Any customer can buy and/or sell
- A network environment, rather than on a hierarchical grid.
- Free communication of information between parties to enter into exchanges.
- Embedded price signals in the energy system for electronic commerce of energy.
- A price bridge for all kinds of devices and institutional boundaries,
- Distributed decision-making to optimize resources.

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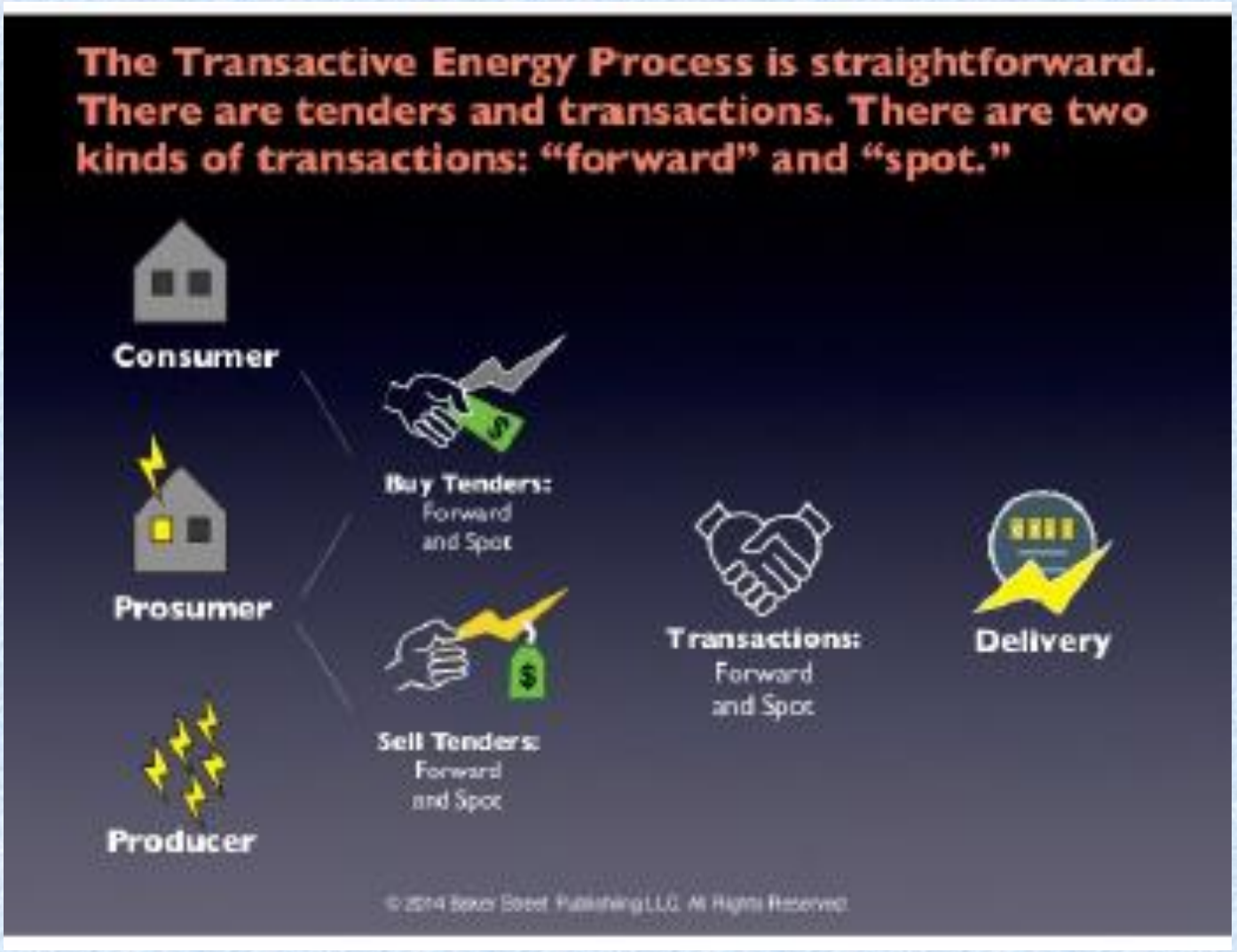
How does Transactive Energy look like?



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Courtesy: Barrager, S. E. Cazalet, 2014. Transactive Energy: A Sustainable Business and Regulatory Model for Electricity, p. 15.

What to Conclude on TE

- Internet-based economy opens up many doors in energy business
- Innovations in electricity services
- Integrations of DERs in peer-to-peer energy sharing as AirBnB for the grid.
- It has flexibility, reliability with storage facilities in integration of renewable energy and load following
- Opportunities for high tech jobs creation
- But it is a complex answer of a complicated problem
- It is quite intriguing in its value proposition for day-to-day functioning, at this stage
- Probably not yet ready to fly even in California and it needs further research for commercialisation

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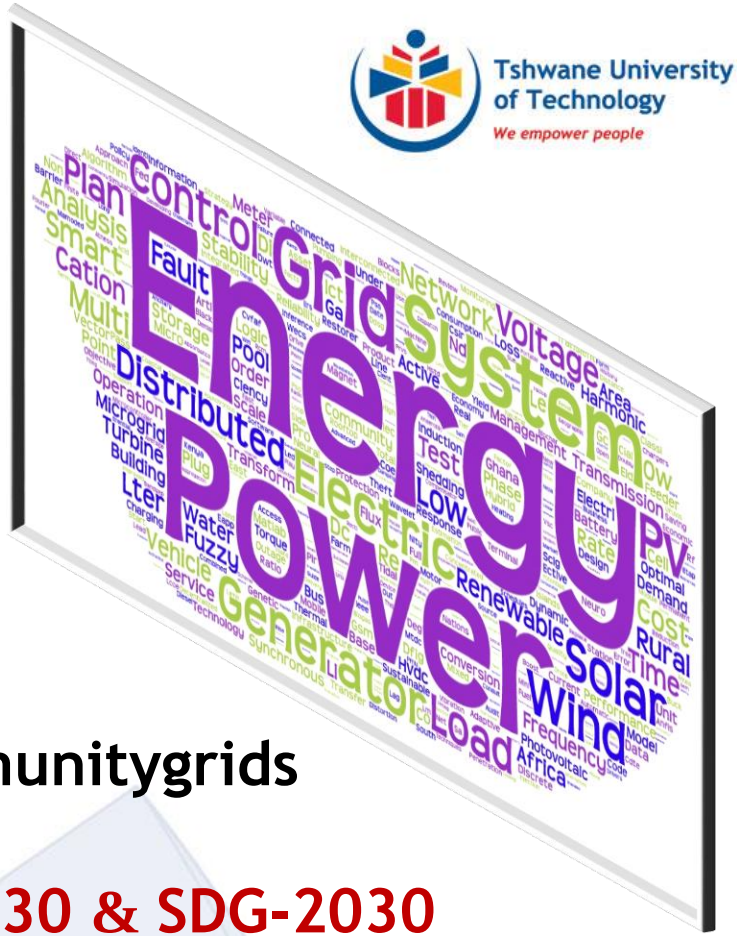
Agenda



1. Background at a glance
2. Microgrids & Energy Storage
3. Energy Poverty & e-Theft
4. Transactive Energy & Just Communitygrids
5. Way forward: Embracing NDP-2030 & SDG-2030

Way Forward for PUI & Energy Poverty Alleviation by

Embracing NDP Vision 2030 & SDG Envision 2030

Facilitating Endeavours of the Department of Energy in several activities

Embracing Ethics of Care through Servant Leadership for Eradicating PUI

Implementing Applied Research in Mitigating Water and Energy Crysis

Participating in Global Mission 2050 for 100% Renewable Energy (as initiated from San Diego)

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Courtesy: California Public Utilities Commission Policy & Planning divison

national planning commission

The Presidency
REPUBLIC OF SOUTH AFRICA

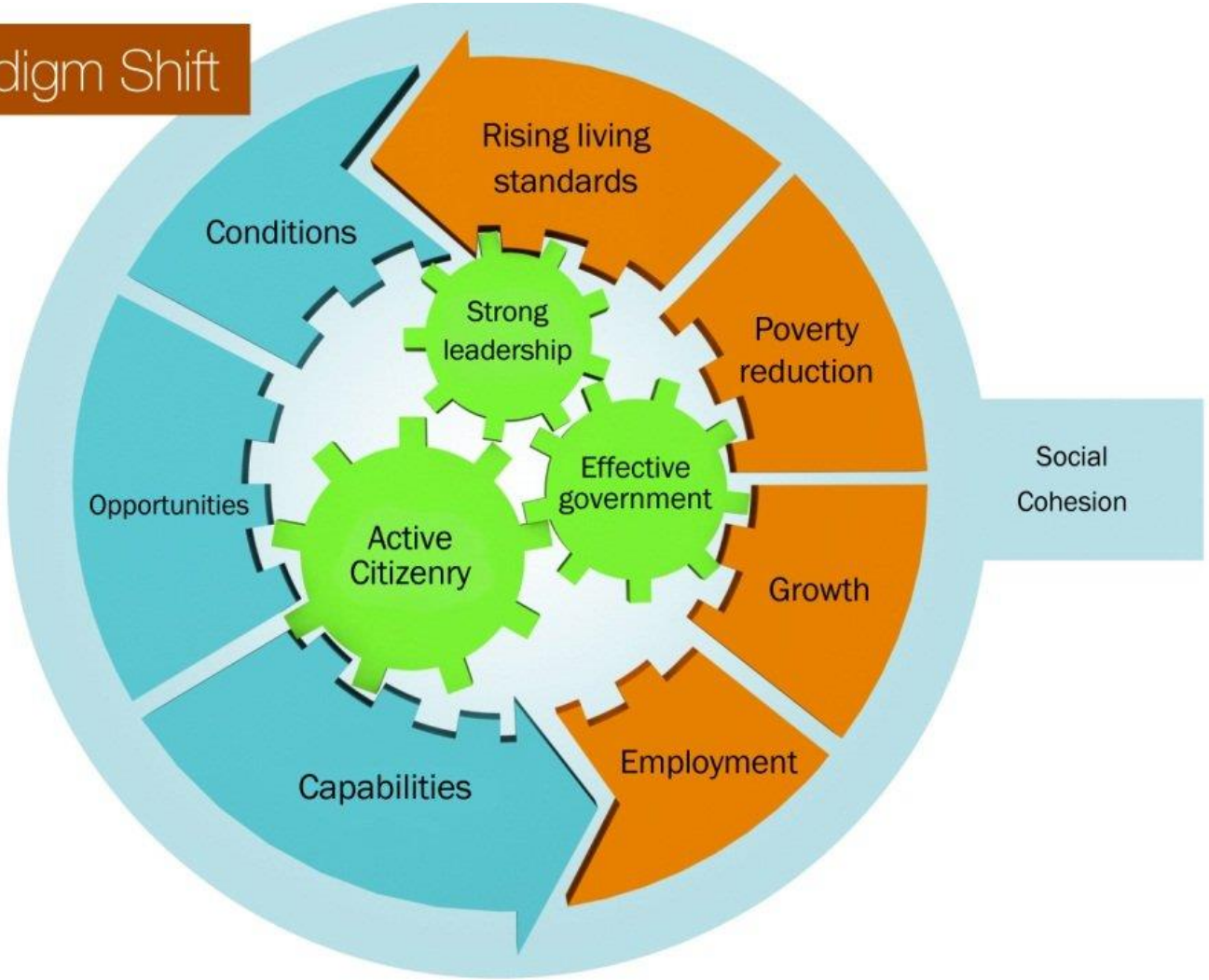
NATIONAL DEVELOPMENT PLAN 2030

national planning commission

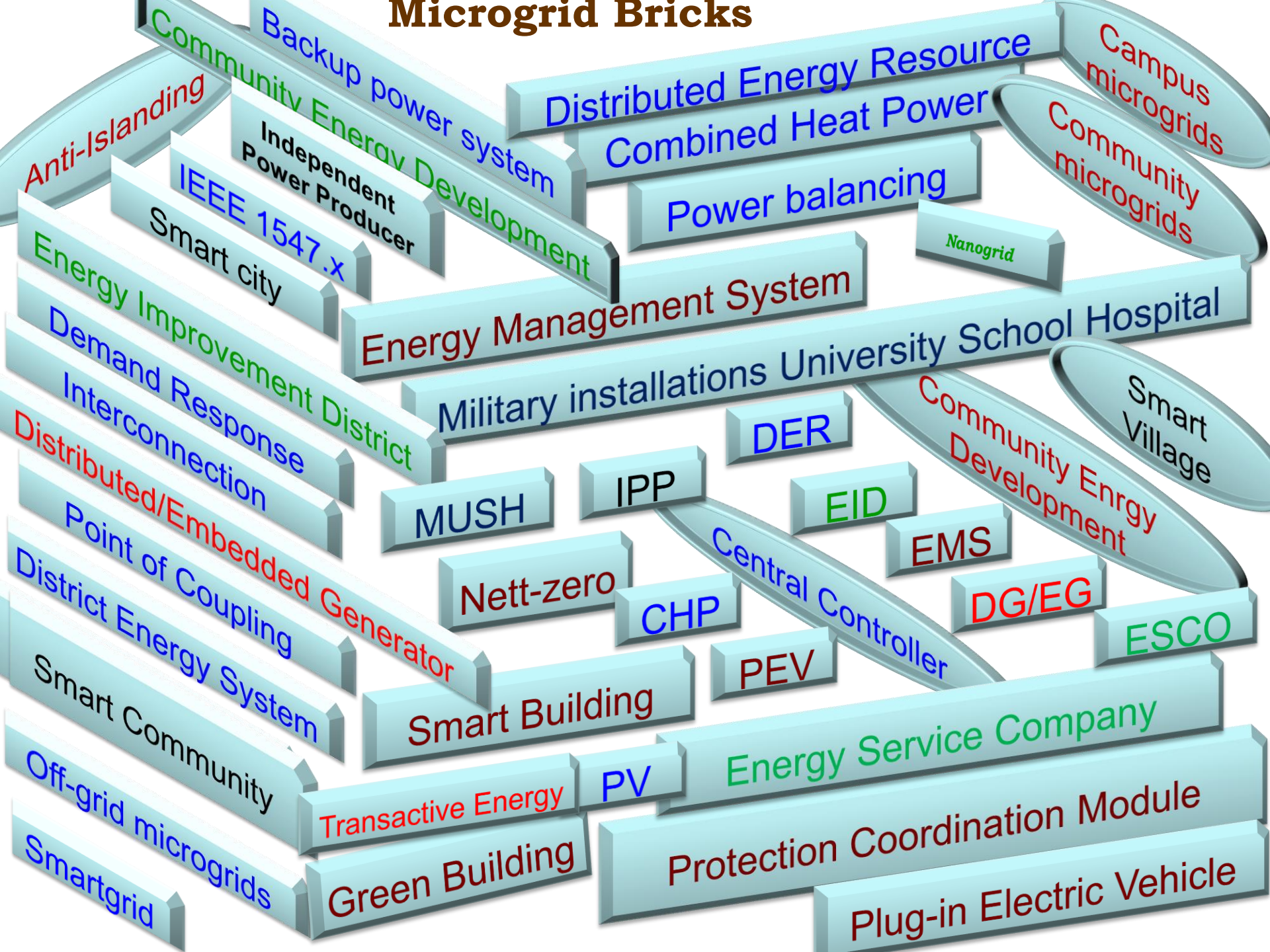
The Presidency
REPUBLIC OF SOUTH AFRICA

NATIONAL DEVELOPMENT PLAN 2030

Paradigm Shift



SUSTAINABLE DEVELOPMENT GOALS


Microgrid Bricks
Backup power system
Community Energy Development
Distributed Energy Resource
Combined Heat Power
Campus microgrids
Community microgrids
Anti-Islanding
Independent Power Producer
IEEE 1547.x
Smart city
Power balancing
Nanogrid
Energy Management System
Military installations University School Hospital
Energy Improvement District
Demand Response
Interconnection
Distributed/Embedded Generator
Point of Coupling
District Energy System
Smart Community
Off-grid microgrids
Smartgrid
DER
MUSH
IPP
EID
EMS
Community Enrgy Development
Smart Village
Nett-zero
CHP
Central Controller
DG/EG
ESCO
PEV
Smart Building
Transactive Energy
PV
Energy Service Company
Green Building
Protection Coordination Module
Plug-in Electric Vehicle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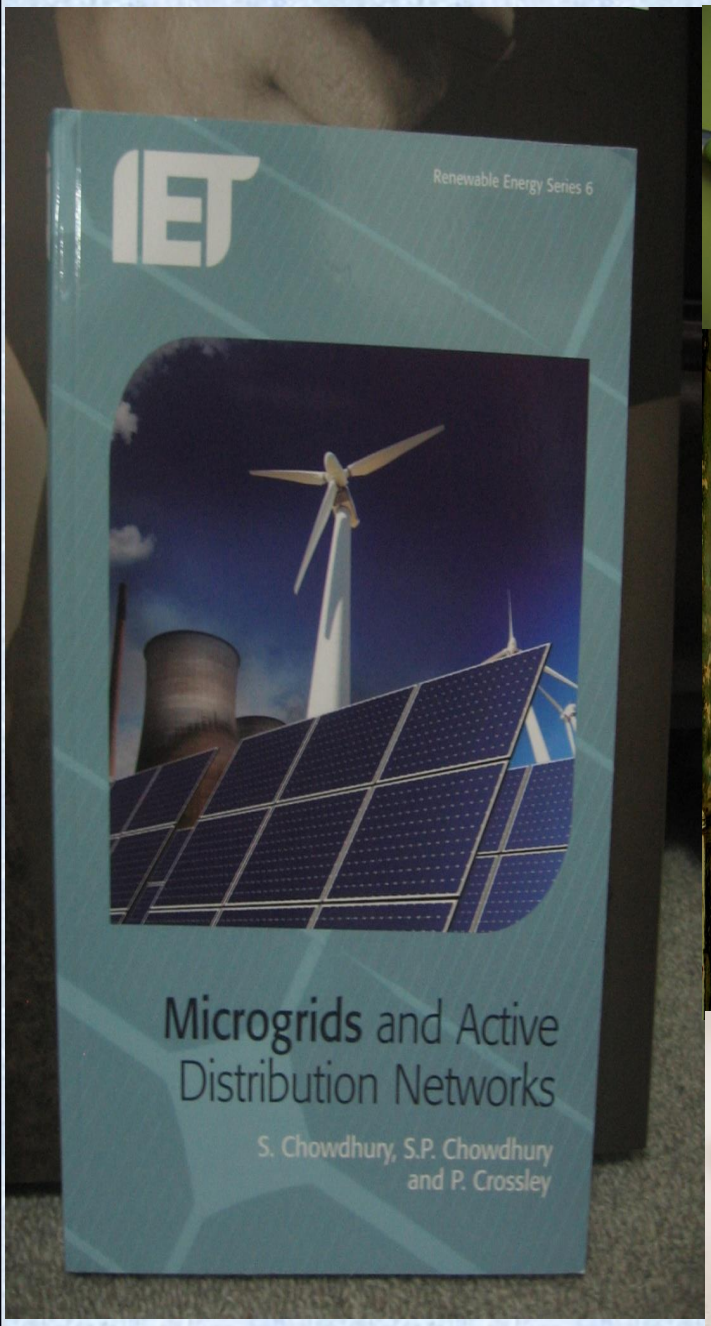

国际电气工程先进技术译丛

微电网和主动配电网

Microgrids and Active Distribution Networks

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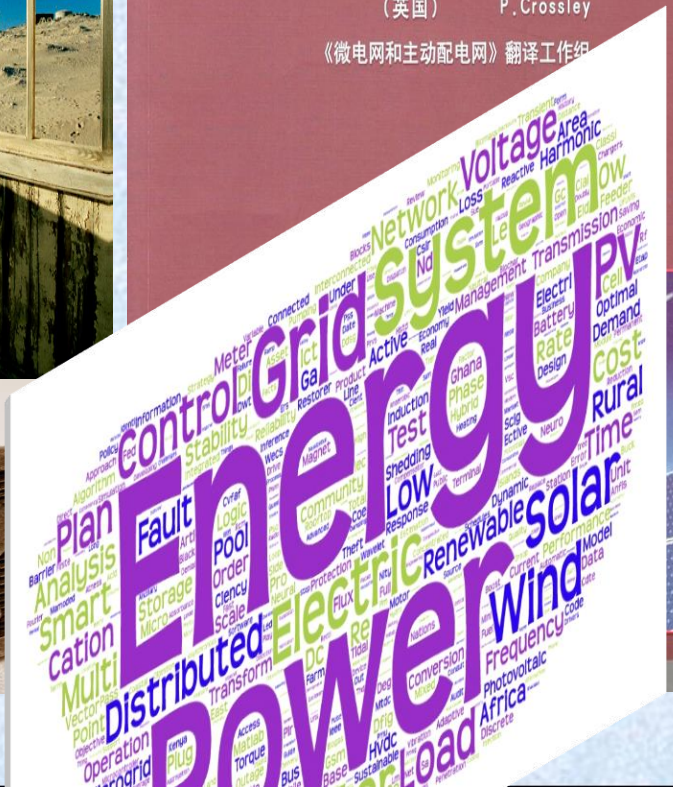
（印度） S.P.Chowdhury 著
（英国） P.Crossley

《微电网和主动配电网》翻译工作组



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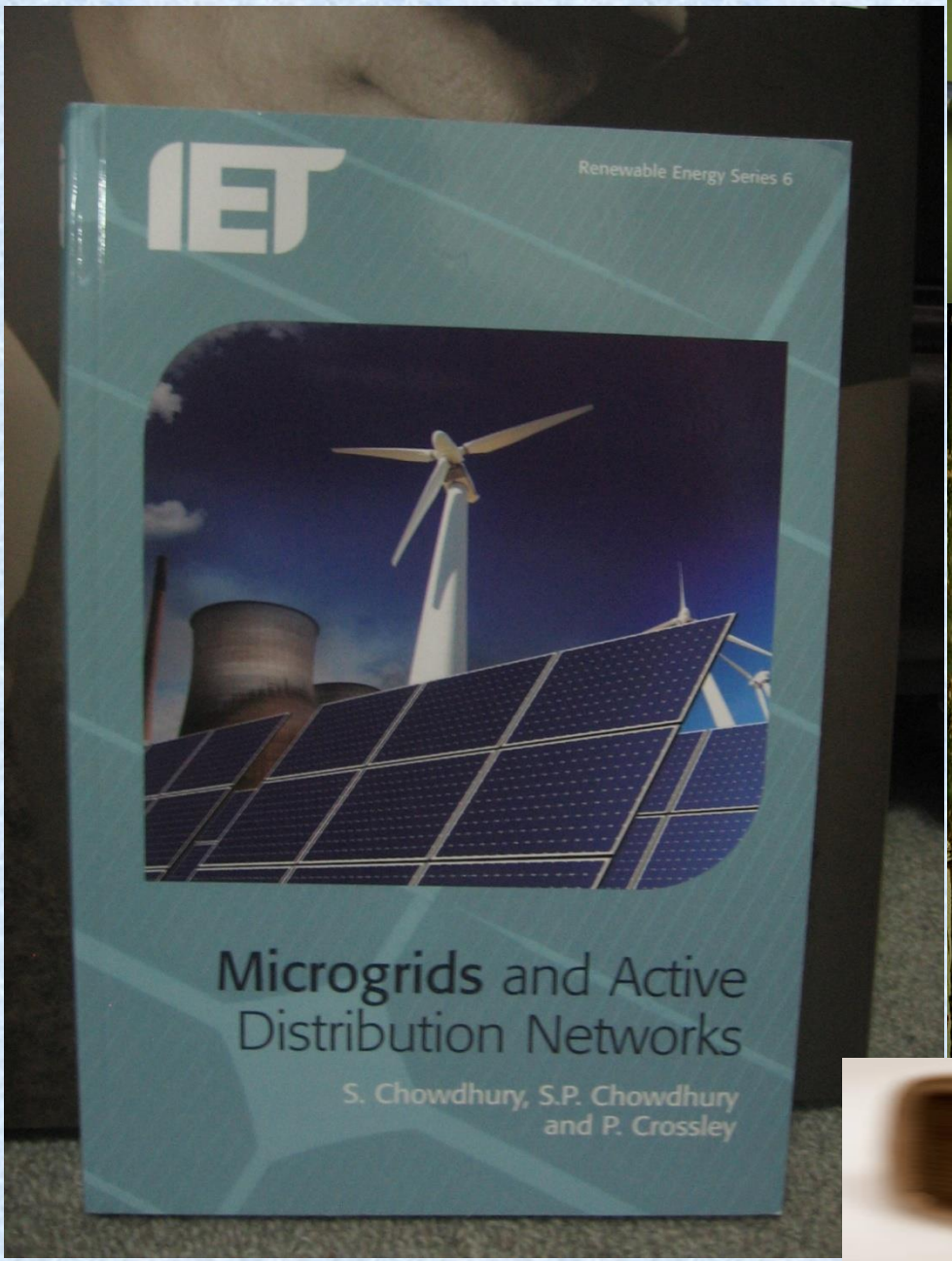

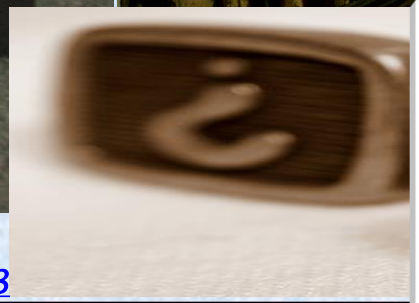

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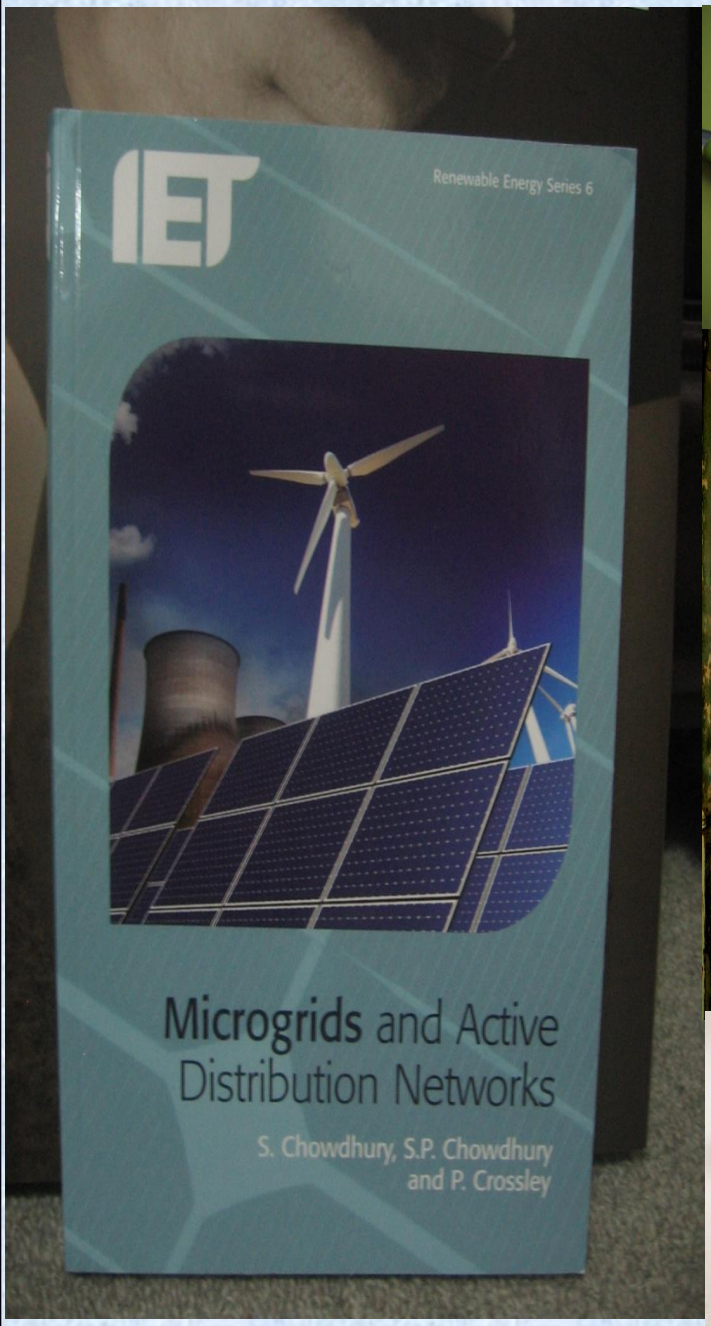

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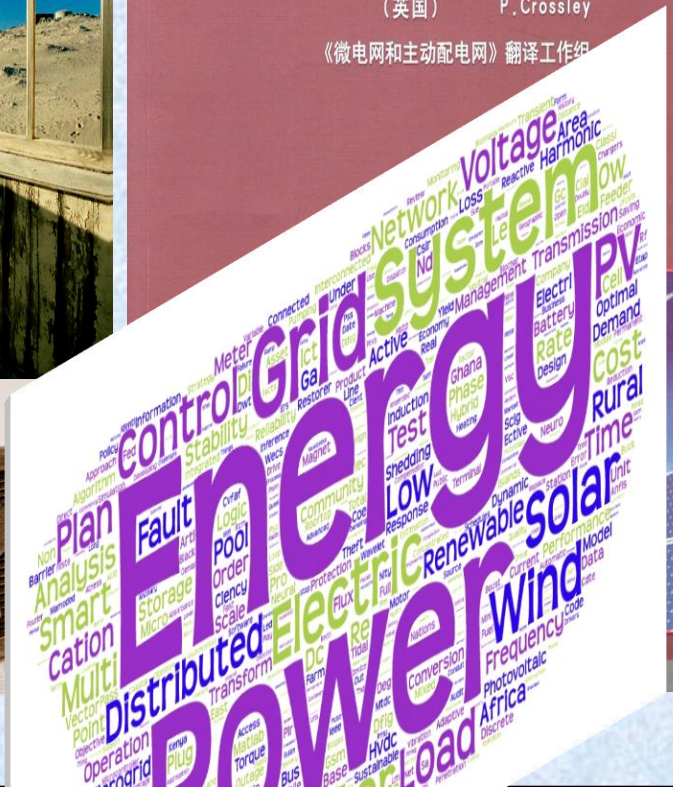

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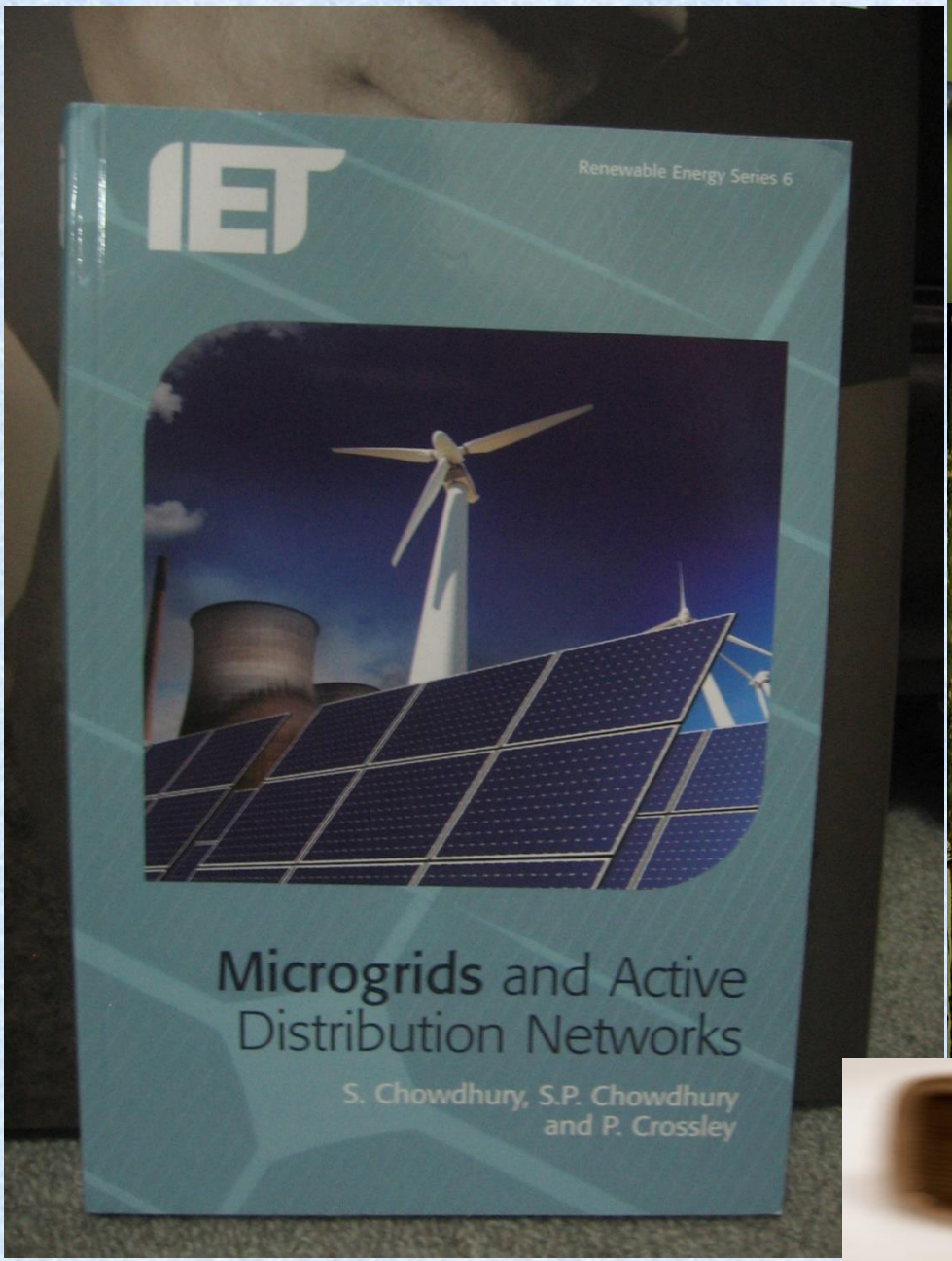

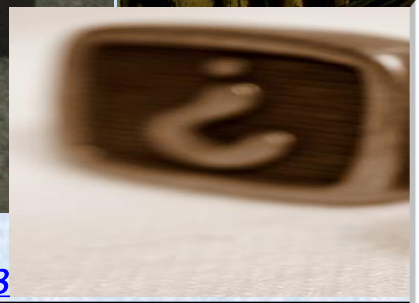

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