27th AMEU Technical Convention 2019

The 4th Industrial Revolution ("4IR") | *Building the Power Utility of the Future, Today*

Incorporating Embedded Generation Into Municipal Networks to be presented at the AMEU Convention 2019

Presented by Poonam Lutchman

Digital Solution Architect, MSc Engineering, MBA

Schneider Electric South Africa (Pty) Ltd

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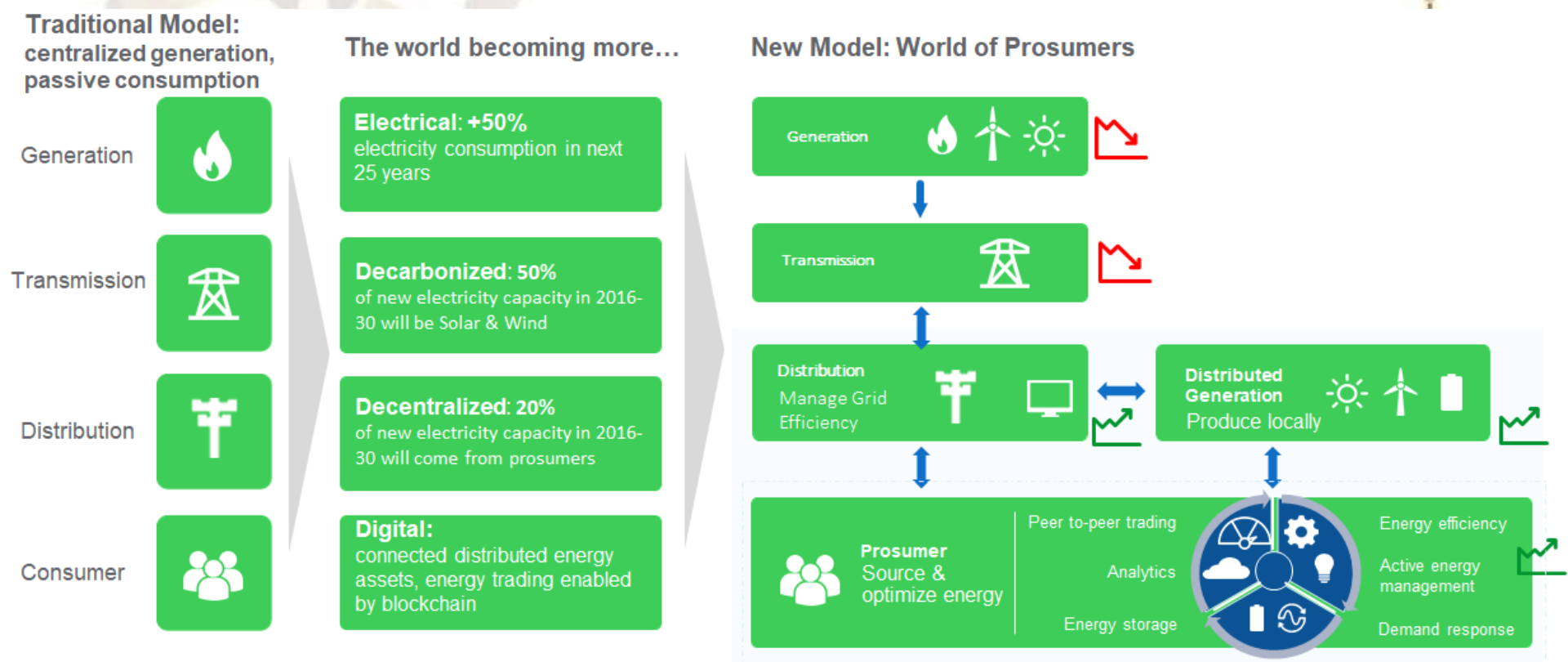
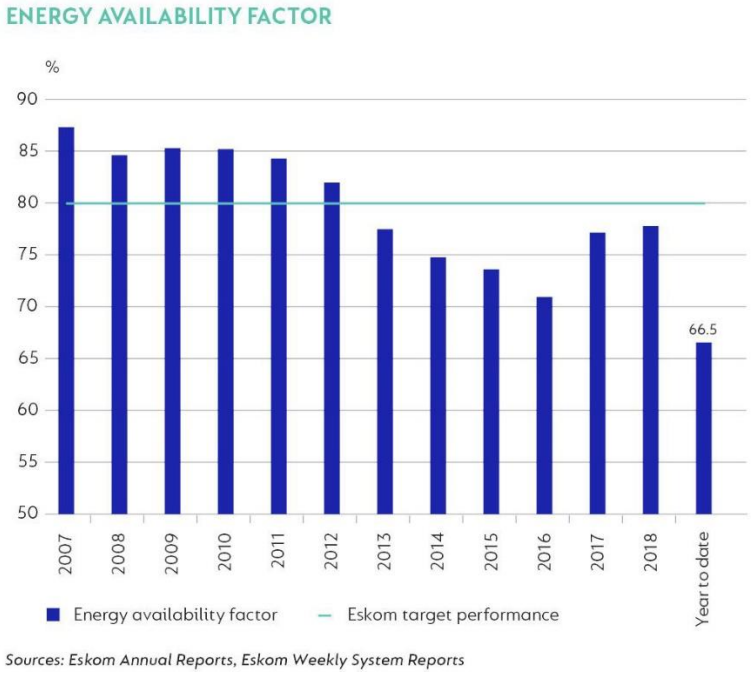
Presentation Outline

1. Background Information
2. Demand Profile and Revenue Impact
3. Impact on Municipalities
4. New Roles for Municipalities
5. Recommendations
6. Considerations
7. Technology Requirements

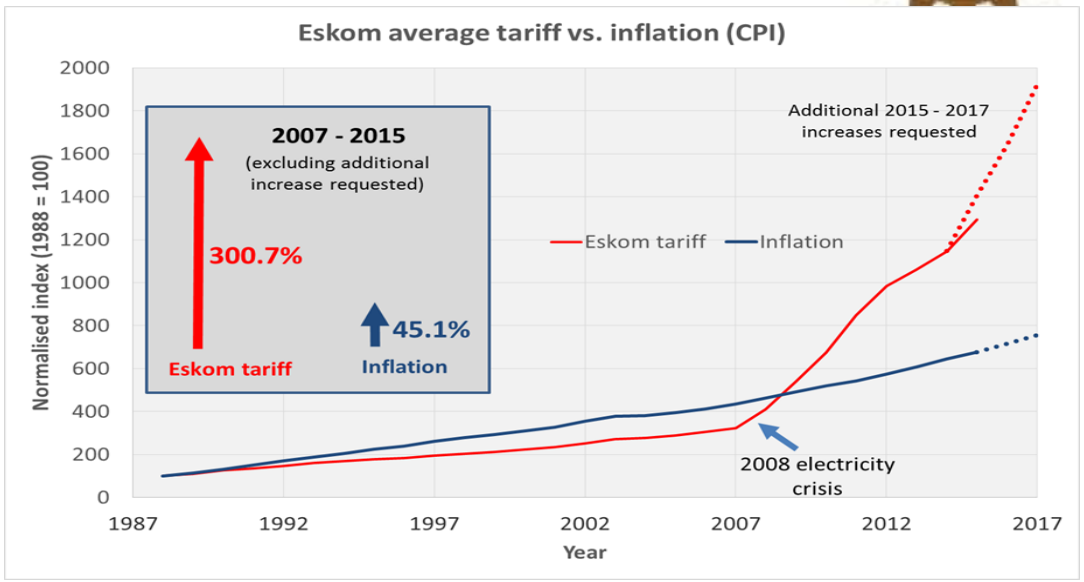
Globally the energy system is moving towards a world of prosumers



South African Context



Sources: Eskom Annual Reports, Eskom Weekly System Reports



S Moolman, *Infographic: Eskom Tariff increases vs Inflation since 1988 (with projections to 2017),*. https://www.poweroptimal.com/infographic-eskom-tariff-increases-vs-inflation-since-1988-projections-2017/,

M Longano, *South Africa's Power Conundrum – A Debt Managers View,* https://www.dailymaverick.co.za/article/2019-07-25-south-africas-power-conundrum-a-debt-managers-view/

Eskom R21 billion financial loss, there were reports of them challenging NERSA for a 80% increase for **2020**. - Speculation.

2020 – 12.8% (9.41 and 4.4% clawback)
2021 – 8.1%
2022 – 5.1%

Embedded Generation in South Africa

Time Line of Events

Load shedding
Utility

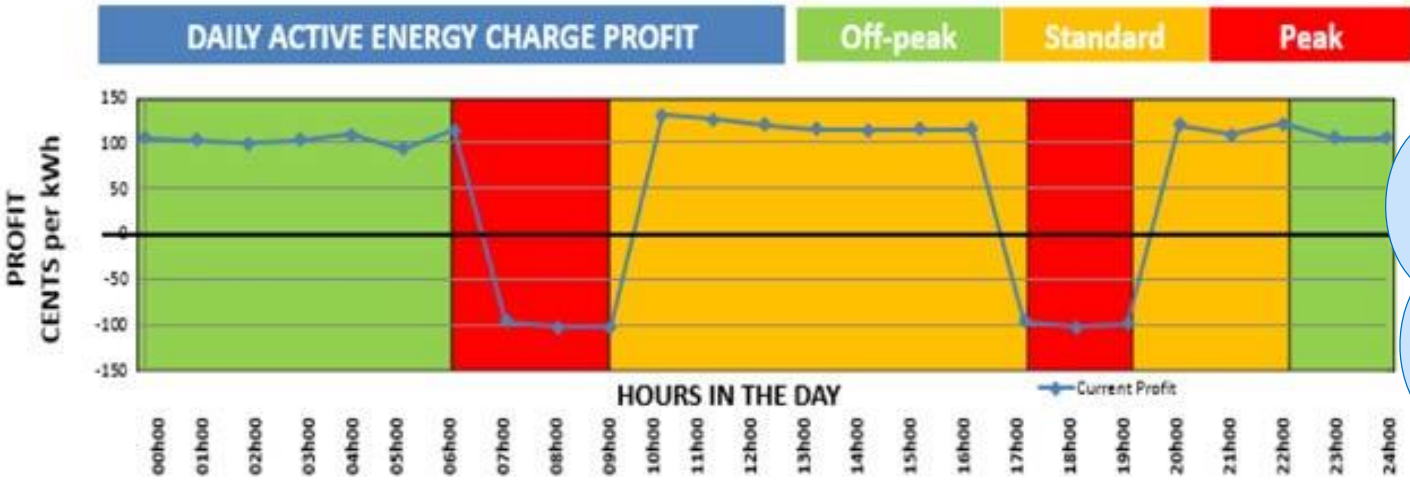
Solar PV Installation
Industry and Private Sector

Legislation: Accommodate Embedded Gx

2007/2008	2014-2019	2016/2017	Current
• First Spells of load shedding in Nov-Jan to increased energy demand.	• March 2014 • 2015 – Jan to Sep • 2016 More bouts of load shedding • 2018 – June, Nov, Dec • 2019 – Feb, March	• 90 260 verified installed PV roof top systems • Represents 180MWp • R 2.7 billion • (PQRS info) – PV Performer Platform, quality assurance platform. Comfort – End users and Investors	• IRP (draft) – 200MW Embedded Generation • 2 May 19 - 1MW to 10MW, with a limit of 500MW annually applicable for own use generation • Feb 19 – DBSA received $100m by the Green Climate Fund for embedded Generation investment Programme. • Develop model to fund embedded generation projects

Opportunity for Transformation – Microgrids seen as the mobile phone in the Electricity Industry

Demand Profile and Revenue Impact



Residential customers represent 18% of consumers, during peak this can increase to 35%. Munics supply electricity at winter peak at a loss. Recoup During Peak and Off Peak

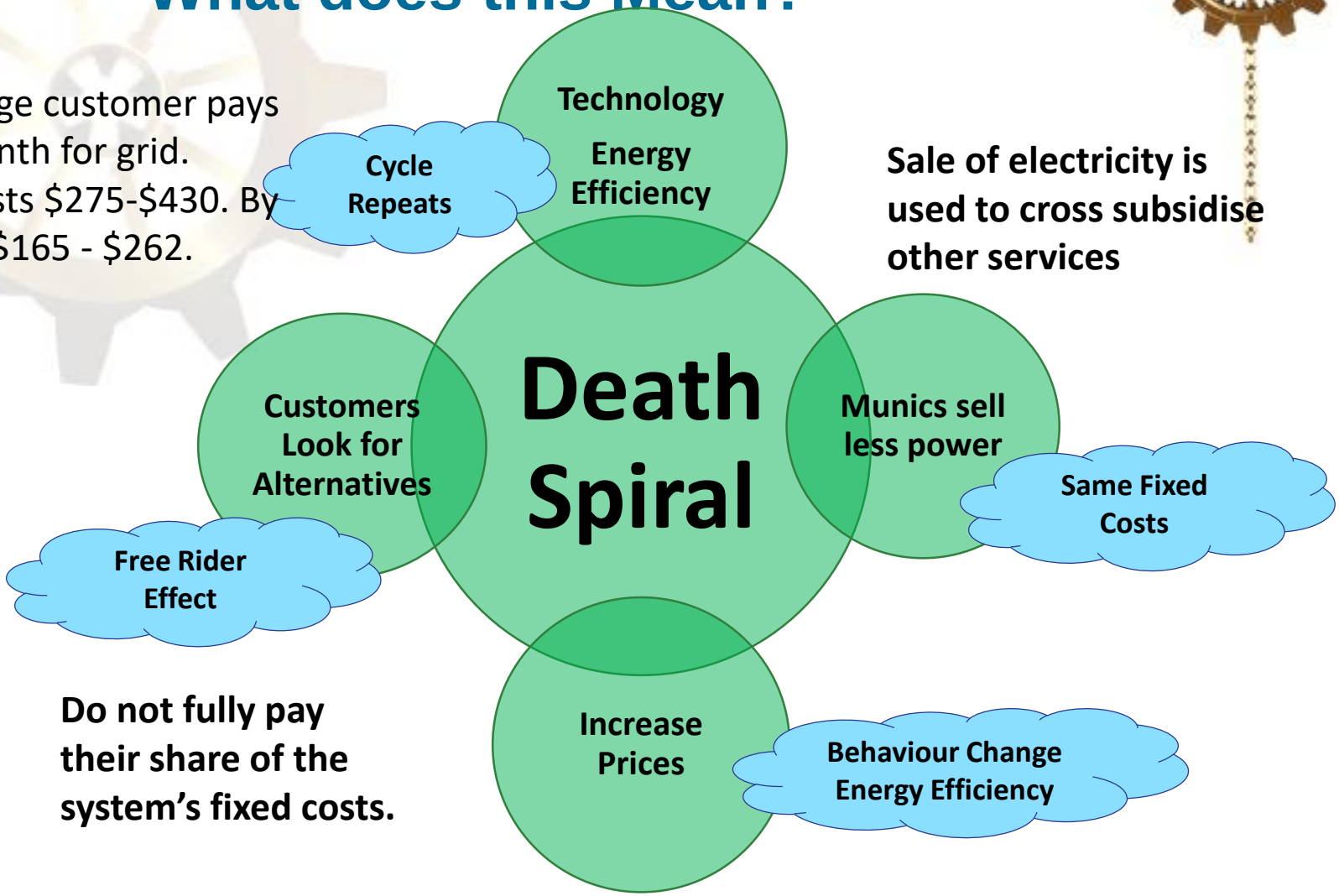
Source: D De Vos, *A solution to SA's Power Crisis* https://techcentral.co.za/a-solution-to-sas-power-crisis/58482/

40% of Elec Dx → **TOU Tariff** → **Flat Rate** → **Revenue Impact**

Studies show that 97% of PV is generated b/w 9am – 6pm. Standard time, when munics recoup losses. Represents up to 60% of profit loss.

What does this Mean?

EPRI: Average customer pays $51 per month for grid. Off-grid costs $275-$430. By 2024 costs $165 - $262.



Sale of electricity is used to cross subsidise other services

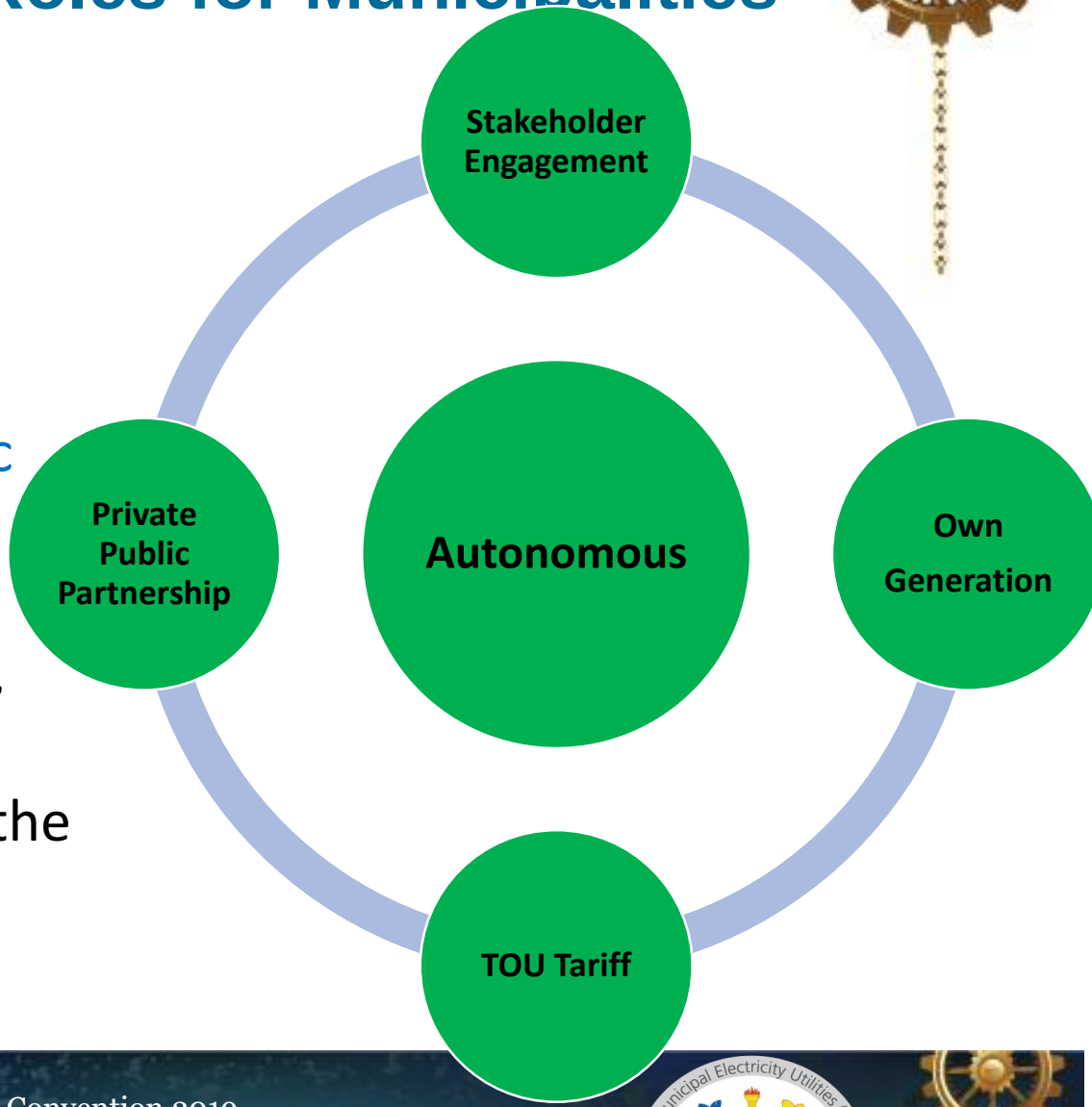
Do not fully pay their share of the system's fixed costs.

Opportunity - New Roles for Municipalities

Municipal Leaders acknowledge and see the need for change.

2018 study done by SA TIED (Towards Inclusive Economic Development)

- **Main Driver** – Climate change, and Going Green, then Costs.
- **Leaders** understand that the current model is not sustainable.

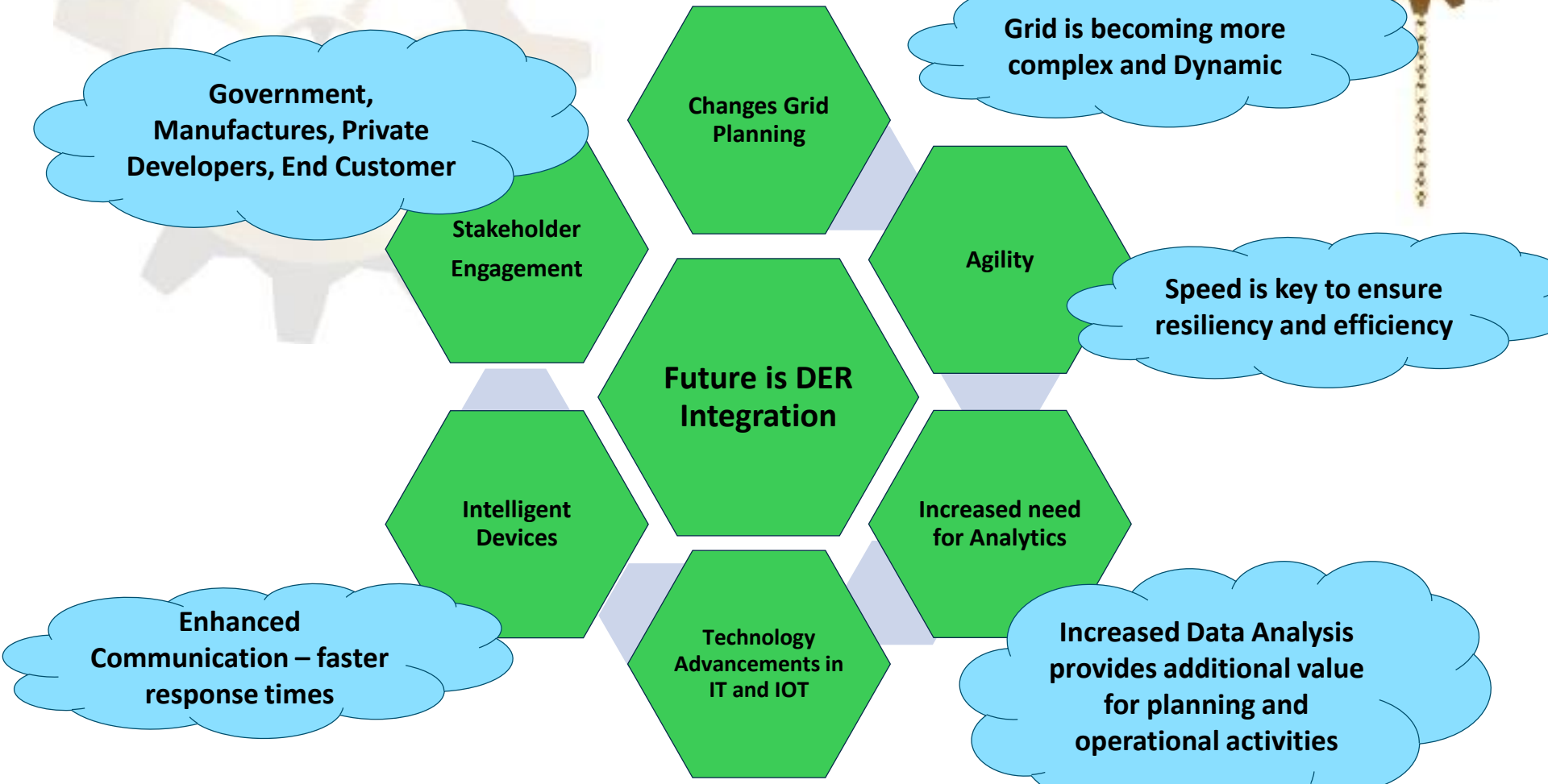


Recommendations

TOU	Inc Fixed Charges	Grid Availability	Feed in Tariffs
• Mitigate against losses during peak • Surcharge outside sunlight hours • TOU or Smart Meters	• Eliminate Free Rider Effect • Rate determined by power consumed.	• Like insurance policy • Customers with embedded generation pay a monthly rate for grid availability	• Purchase Power cheaper from developers who sell excess power to the grid • Change in legislation

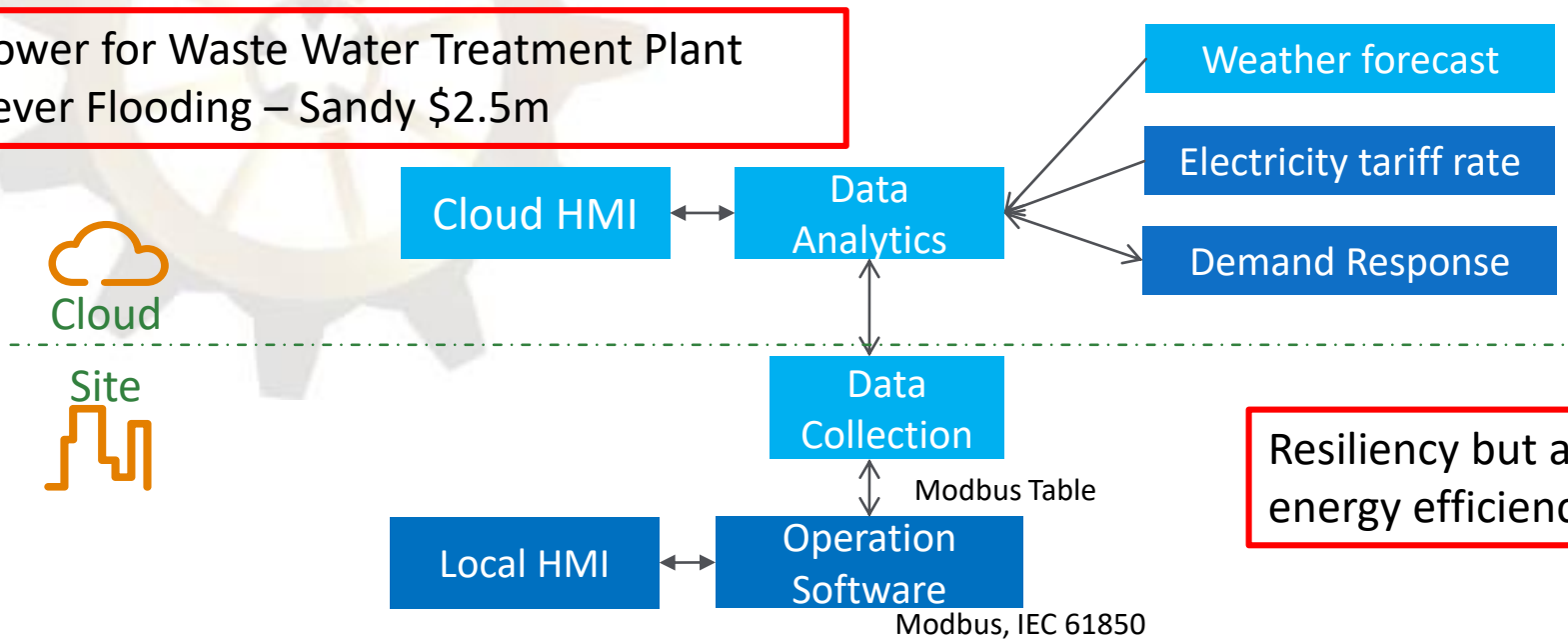
Construct own PV Plants	Purchase Power From IPPs	Legislation to Prevent Embedded Generation
• Finance may be an obstacle	• Eliminate Single Buyer Model • Guarantees Required	• Not Feasible

Considerations



Case Study – US Fairfield Town Government

Power for Waste Water Treatment Plant
Sever Flooding – Sandy $2.5m



Resiliency but also energy efficiency

Utility Meter	6 x PV Plants	Genset	Other Loads Fuel Cell	Other Loads
	54kV **27kV** **13kV** **21kV** **1.4MW** **24kW**	**1.3MW** **Natural Gas**	**400kW**	**Waste Water Treatment Plant, Animal Shelter, Fire Safety and Training, Fleet garage**

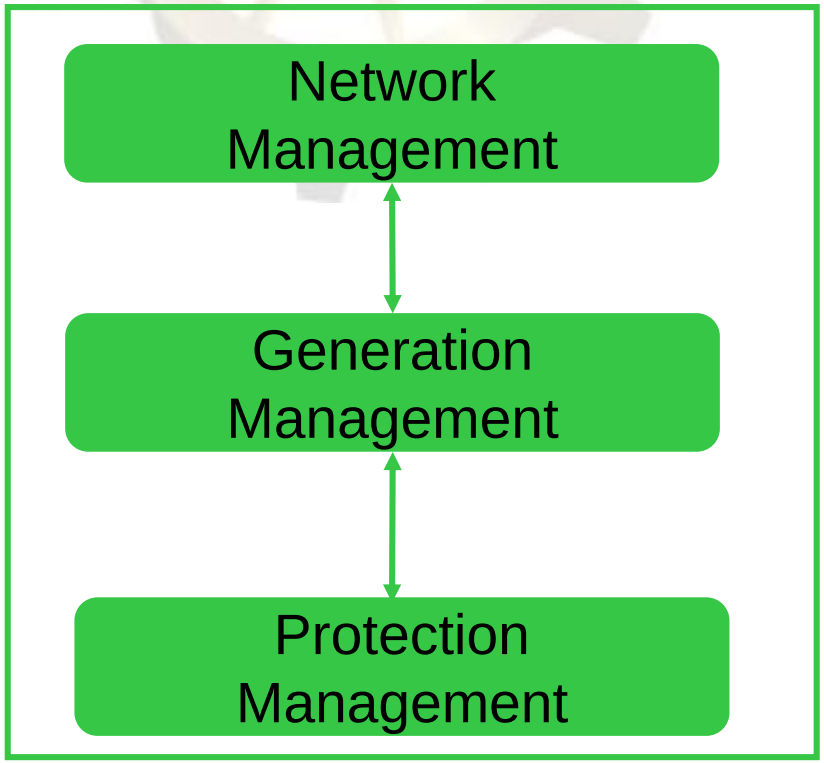
Forecasting and economic dispatch of Distributed Energy Resources

Predictive and automatic energy management of DER (hours, days)

Use cases / DER	
Remote monitoring & forecasting	Monitoring Power / Energy and other KPI for each DER using a web access
Tariff Management	Control DER (consume/produce/store energy) according to variable electricity tariff rate
Demand Charge reduction	Control DER (consume/produce/store energy) for reducing site consumption peak
Self consumption	Control energy storage and PV system for maximizing the energy consumption from PV system
Demand Response	Control DER for participating in DR mechanisms
Off grid mode preparation	Control DER for anticipating on future off grid events

Manage island mode and optimize DER in real time (ms)

DER Agnostic



Use cases / DER	
Sharing strategy	Aim to maximize renewables consumption within the microgrid
ATO Automatic Transfer Operation	Automatically manages connection / disconnection from the grid
Load sharing	Assure the stability for the tension and frequency by balancing the production and consumption in real time
Load shedding	Cut-off non-priority loads when the production can not reach the consumption
Relay Settings	Manage the protection relays and if needed the global system protection when islanded
Connectivity	Modbus and Modbus TCP IP, IEC 61850

Closing Remarks

- In order to take advantage of the opportunities emerging from the energy transition and mitigate risks and challenges, carefully planning and coordination is required.

- Municipalities can stay relevant and ensure a sustainable source of income by altering their business model to include embedded generation solutions and hence provide value to their end customers.

This Requires a carefully coordinated and integrated portfolio of new and existing solutions that must encompass technology, infrastructure, regulation, policy and business aspects; one without the other will inevitably lead to unfeasible or unsustainable scenarios.

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