Energy efficiency potential through digitalization in the South African buildings sector

Prepared by: Clifford Rikhotso

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Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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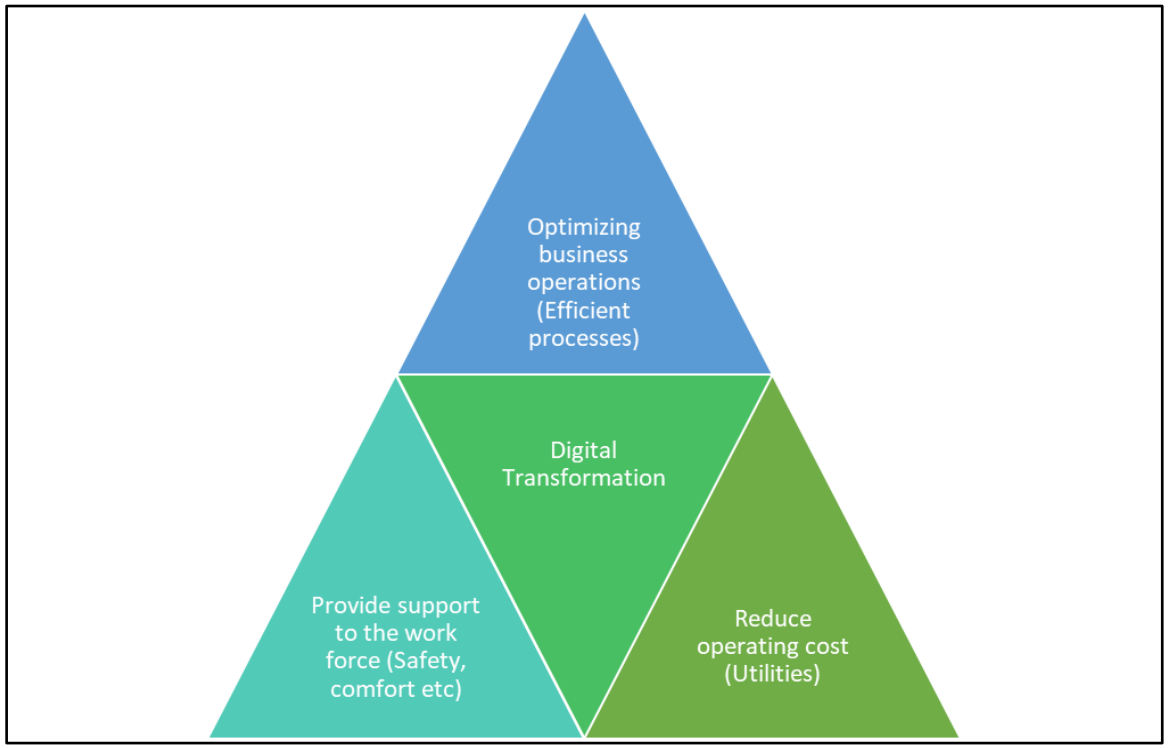
What is digitalization?

- **Digitalization** is a process of utilizing technology to enhance business/corporate processes vs '**digitization**' which is the conversion of analogue data into digital formats and the processing or storing of this data in a digital system.
- They both encompass digital representation e.g., pictures/ videos, along with their processing, communication networks, industrial usage of ICT & other digital technologies.
- It is no surprise that digitalization has made its way into the power sector (see how later).
- However, it comes with risks, major one being cyber-attacks, an example is a power station in Saudi Arabia where the power station's critical safety systems were attacked by Triton malware infiltration.
- Counter-measures against cyber-attacks include cryptography (symmetric & asymmetric encryption); digital signatures; firewalls; virus scans and restrictive user accounts.

Background & Context on why we need digitalization (1/7)

Benefits of Digitalization

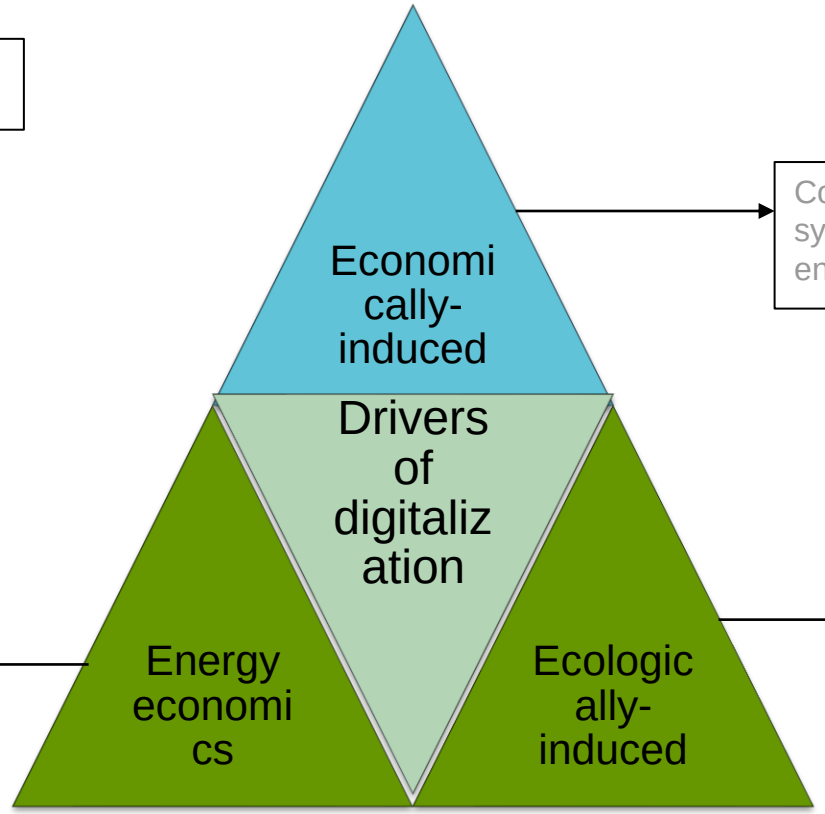


On average, 11 - 22% of energy savings are possible in the 2nd year after implementing a digital energy management system in commercial buildings.

An estimated 20% in operating cost savings can be achieved by making a building grid-interactive and efficient through digital technologies.

Background & Context (2/7)

Drivers of digitalization

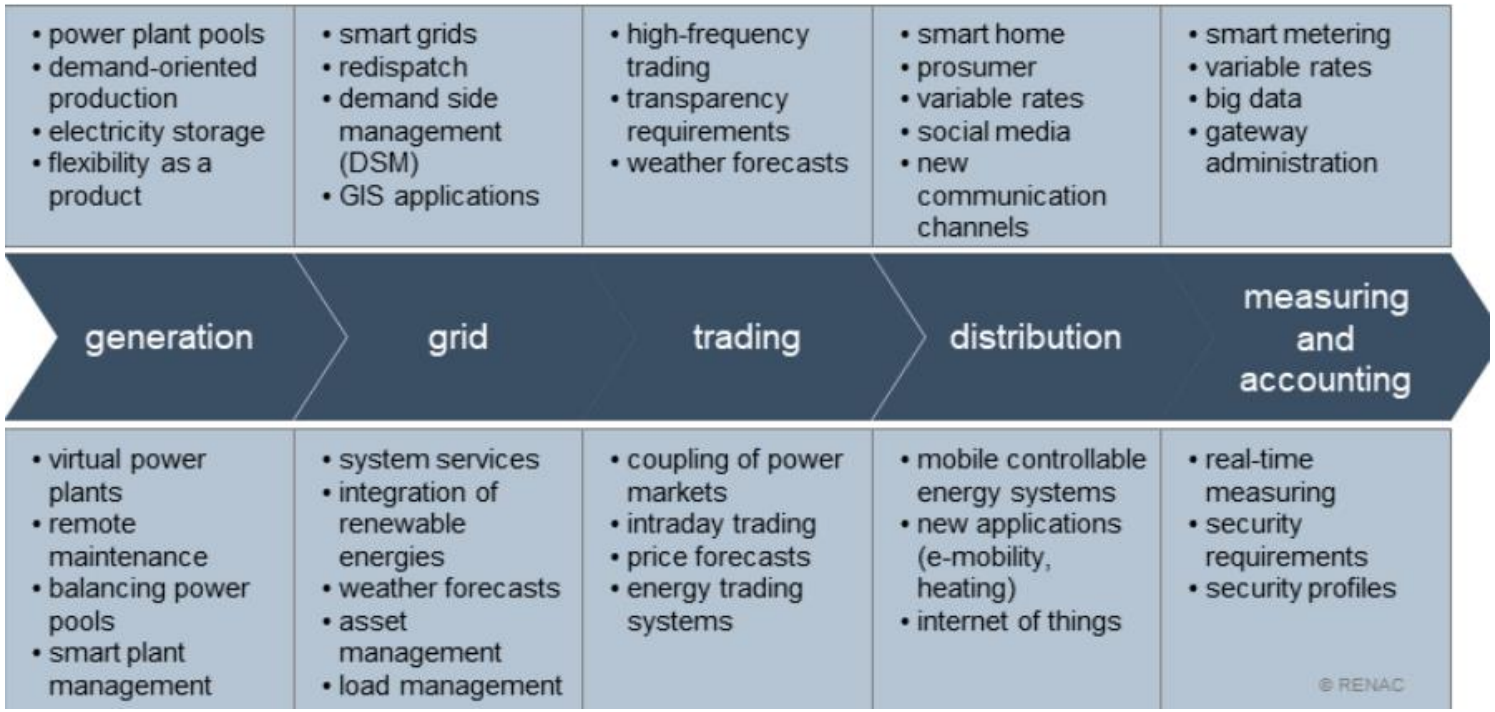


Companies are forced to integrate digital systems to survive in a competitive environment.

To accommodate decentralized RES, digital systems are used for high coordination & integration.

To claim decarbonization & higher energy efficiency, digital systems are used for analysis, forecast & coordination.

Digitalization trends in the power sector (3/7)



Views from different analysts on impact of digitalization on environment –

‘1% increase in ICT usage will cause a 0.16% increase in CO2 emissions’

‘ICT positively contributes towards environmental quality’

‘In G7 countries internet use has a short-term negative but long-term positive effect i.e. an increase in CO2 emissions’.

Empirical analysts are divided over whether there is a positive or negative overall impact of digitalization on environmental pollution.

Key digital technologies in use (incl. in the power sector) – (4/7)

1. Computer algorithms – comprising of simple, branching and looping statements.
2. Internet of Things – comprising of sensors, processors, communication unit & power supply.
3. Big data analytics – characterised by 3Vs (volume, variety and velocity).
4. Machine learning - detects patterns in data and use these patterns to make predictions.
5. Smart metering – devices can record and report energy usage on an hourly or even more frequent interval.
6. Blockchain - is based on a distributed ledger where records are stored in multiple databases with multiple participants having access to identical copy of the blockchain.

Smart LED lighting, water heating, thermostats & HVAC systems are the most common technologies for buildings.

Energy savings potential per level – (5/7)

Device level technologies

- Smart LED lighting = 40 to 50%
- Smart windows & HVAC = 20 to 25%
- Smart electric motors = 10 to 20%
- Smart water heating = 10% to 15%
- Smart thermostats & HVAC = 5 to 10%

System level technologies

- Fully integrated with efficient smart appliances = 30 to 40%
- Monitoring & managing automation = 20 to 30%
- Smart zoning thermostats = 10 to 20%
- Behaviour changes from monitoring feedback = 5%
- Fault detection & diagnosis = 5%

Barriers + Risks to digitalization – (6/7)

Observed barriers

- **Consumer perception:** new & unproven digital technologies receive resistance from users due to lack of understanding of the technology and concerns over information security.
- **Complexity:** connected devices developed by multiple players in the market use different data management & communication protocols (mostly proprietary) thus hindering the inter-operability of the devices.
- **Business models**: high initial costs, low customer participation & limited commercial incentives are disadvantages in developing new business models.

Possible risks

- **Cyber security:** if the restricted building network is illegally penetrated this could be more harmful if most systems are interconnected.
- **Complexity:** due to the inter-connectivity of the digital system, the entire system would be much more difficult to manage & that could present opportunity for “intruders” to find weaknesses in the complex system.
- **Personal data management:** with the interest of improving operation, digital system might collect some personal information of employees.

Risk mitigation solutions – (7/7)

- firewalls, which scan incoming data for potential malware;
- virus scans, which continuously scan all systems in a network for potential malware;
- restrictive user accounts, which do not allow an infiltrated system to perform dangerous
- actions; and
- patches, which upgrade systems in order to avoid potential loopholes for intruders.

Where are other countries (markets) in relation to digitalization

Digitalisation has the potential to reduce energy use in buildings by 10% globally by 2040 if integrated into the building value chain and lifecycle.

- Emphasis is placed in transforming buildings and facilities into flexible loads for grid operations.
- Highly digitalized building types are offices (large multi-story + standalone blocks), hotels, hospitals & places of instruction e.g universities.

- Emphasis is primarily on energy efficiency while grid integration remains secondary.
- Highly digitalized building types are offices, hotels, large shops & also places of instruction.

- The degree of digitalization in buildings is still low.
- Limited data collection & recording resulting to difficulty in quantifying EE potential.
- Scenario projection shows 30-40% EE potential if digitalization was to be implemented @fast pace.

Applicable to most markets – digitalization is seen as a critical enabler in the shift from centralized fossil-fuel based energy systems to decentralized distributed systems with a higher share of renewable energy generation.

What is the status for South Africa (1/4)

- The **main challenge** for digital transformation in South Africa is the **availability of reliable electricity supply,** due to the overall limited generation capacity.
- As a result, building owners focus on ensuring that business operations within their premises are **unaffected/limitedly so** by planned or unplanned electricity outages.
- A better uptake of digitalization will offer South Africa valuable options to predict and overcome the above challenge through **Artificial & Business Intelligence** solutions and contribution to **green jobs.**
- At a policy level, digitalization is seen as a big contributor for 1) stabilizing electricity supply 2) reducing GHGs 3) implementation of national Digital & Future Skills Strategy.

What is the status for South Africa – methodology for EP-funded study (2/4)

Methodology –

The following building types were selected with expectation to present some form of digitalization:

1. Office buildings (government, corporate, municipal)
2. Commercial buildings (shopping centres, ware-houses, hotels)
3. Places of instruction (universities, colleges etc.)
4. Hospitals and clinics

Evaluation criteria –

a) Digital technologies

b) Digital connectivity and communication

c) Monitoring and reporting capabilities

d) Remote control capabilities

e) Inter-operability

f) Data management and security

Penetration scores –

a) 0 – 5 = Building has **minimal** digital penetration

b) 5-10 = Building has **some digital** penetration

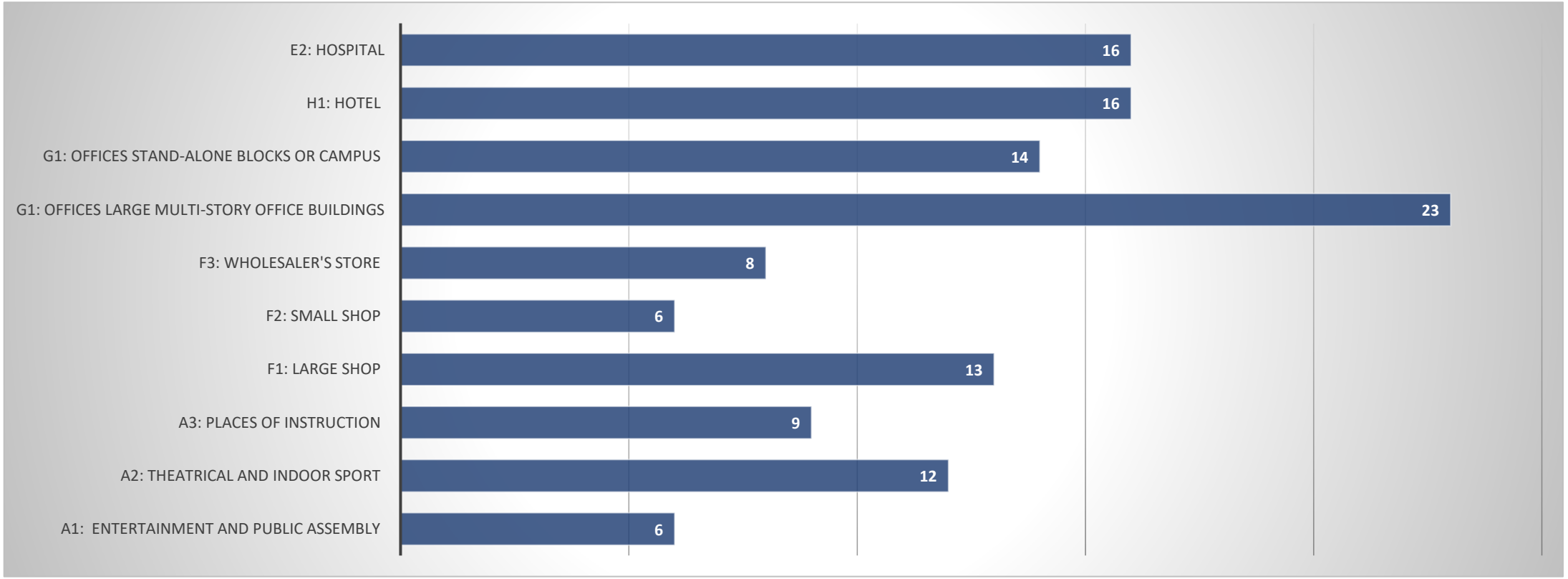
c) 10-15 = Building **has average** digital penetration

d) 15-23 = Building **has above average** digital penetration

e) Greater than 23 = Building **has matured** digital penetration

Minimum sample size was 5 buildings/type – assuming that those buildings have multiple identical establishments throughout the country e.g., business chains, franchises, and multi-located establishments

What is the status for South Africa – results from the EP-funded study (3/4)



5-10 → Some digital penetration

10-15 → Average digital penetration

15-23 → Above average penetration

23+ → Matured digital penetration

What is the status for South Africa – results from the EP-funded study (4/4)

- South African buildings **have some level of digital transformation** – a bigger sample-sized study might have to be undertaken for a clearer picture.
- About a **third** of the contributing criteria is the **technologies installed** on site while the **lowest** contributing criteria are **data management & security, and inter-operability** of digital technologies.
- This reveals a trend where digital technologies are installed but not utilised as intended due to either **lack of the necessary infrastructure or lack of expertise to operate** them.
- This is quite evident in the **place of instruction** occupancy type where about **40%** of digital penetration is due to the installed digital technologies while inter-operability, data management, security, and control contribute for less than **30%**.

Recommendations from the EP funded study – (1/2)

DMRE & other relevant depts

- Extend the existing municipal EEDSM program to all municipal and other buildings by implementing dedicated digitalisation initiatives as a starting point.
- DMRE and other relevant departments to develop training programs in order to boost the socio-economic benefits of the building digitalisation process.
- Government to develop incentives for building owners / occupants that have demonstrated proven success + tangible savings in the digitalisation of their buildings.

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- Assume a leading role on behalf of government with regards to energy savings, related carbon emissions, environmental preservation by developing comprehensive buildings digitalisation initiatives.
- Develop a database of international organizations involved in digitalisation and design a program to support the local buildings digitalisation process.
- Through the EPC process, identify buildings with high energy consumption, provide avenues & support to reduce energy consumption through relevant interventions.

Recommendations from the EP funded study – (2/2)

Eskom & other electricity suppliers

- Establish new programs like the former ESKOM's DSM: one for proposed Generation Division to utilise the alternative & co-generating facilities of the buildings + another one for Distribution Division to benefit from the energy efficiency & alternative technologies while reducing the maximum and base loads of the national grid.
- Implement a compulsory digitalized M&E (including real-time energy billing) to optimise the energy consumption, evaluate and sustain the savings (both energy & CO_2) and ensure transparent, fair energy billing and charges.

Research / Innovation Organisations

- Universities, other research & training /skills development organizations to be engaged & encouraged to develop and execute R&D for new technologies that will support big-scale digitalization for all buildings.

Thank you