

27th Technical Convention 2019

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

“Price parity” of PV with storage

**Presented by Aradhna Pandarum
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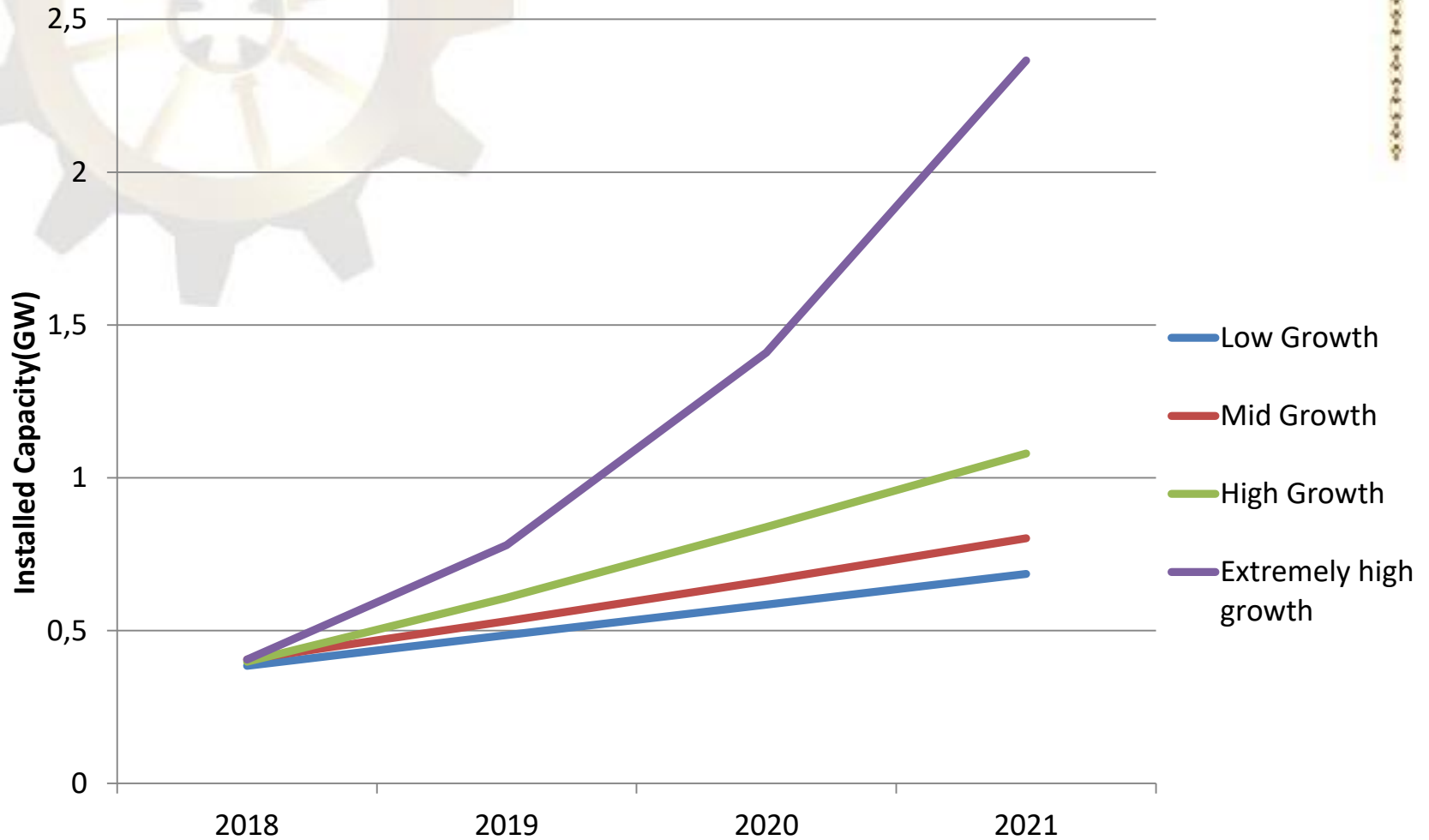
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Growth for small scale PV

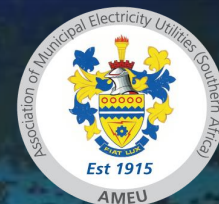
Growth scenarios for PV penetration



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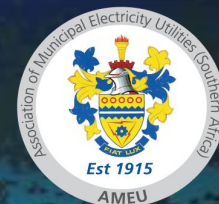
Methodology used



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PV system breakdown

Module costs	Module make, size and cost
Balance of system (BoS) hardware cost	Inverter
	Racking
	Wiring and cables
	Monitoring system
	Battery
	Other hardware (transformer, protection devices, etc.)
	Duty and transportation cost
BoS soft (non-hardware) costs	Project development/ feasibility study cost
	Customer acquisition (sales and marketing costs)
	System design and procurement
	Subsidies (applications, fees, etc.)
	Permitting (application for permitting with utility provider and other authorities)
	Financing and contract (legal) fees
	Installation cost/ civil works
	Interconnection
	Performance and warranty
	Commissioning cost
	Training and capacity building

Cost component	Residential system (1-10kW)	Commercial system (10kW-2MW)	Utility scale system (2MW-100MW)
Module	35%	45%	49%
Hardware BOS	16%	20%	14%
BOS Soft costs	49%	35%	37%

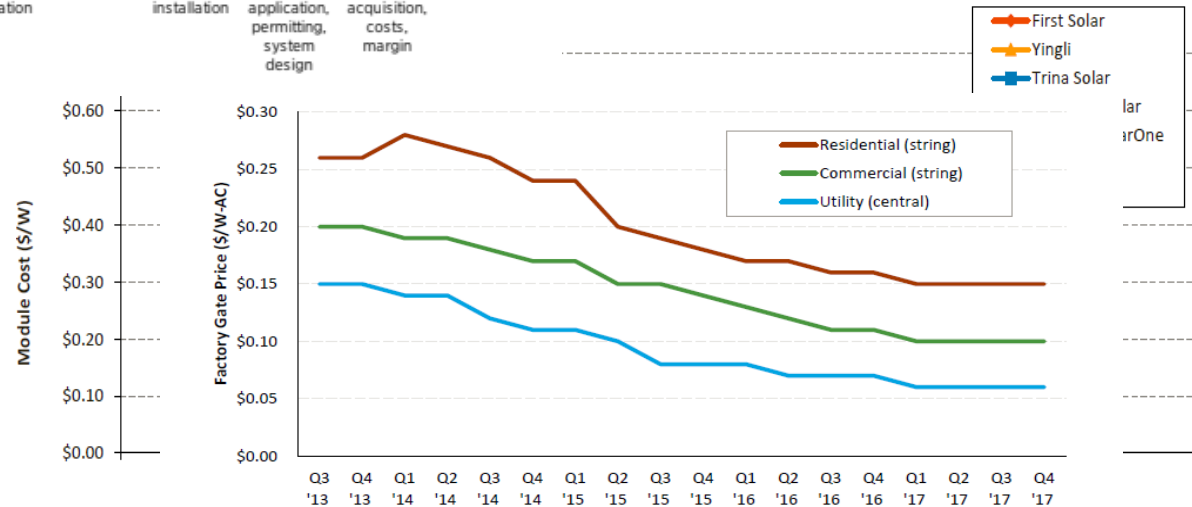
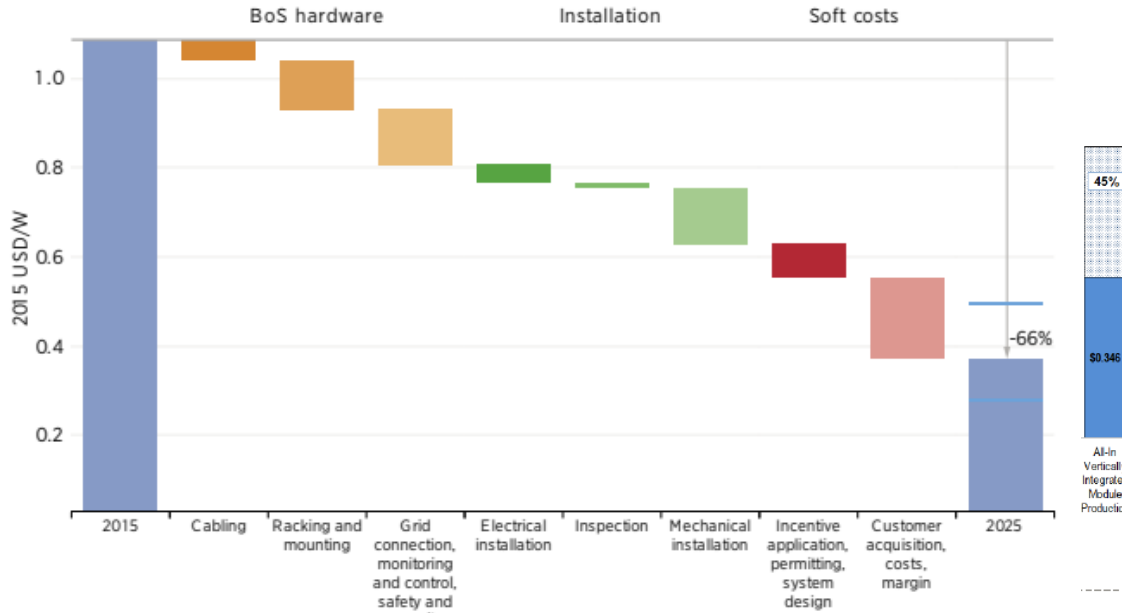
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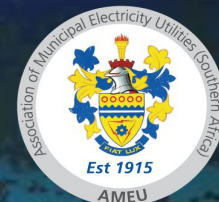


Advancements in PV technology



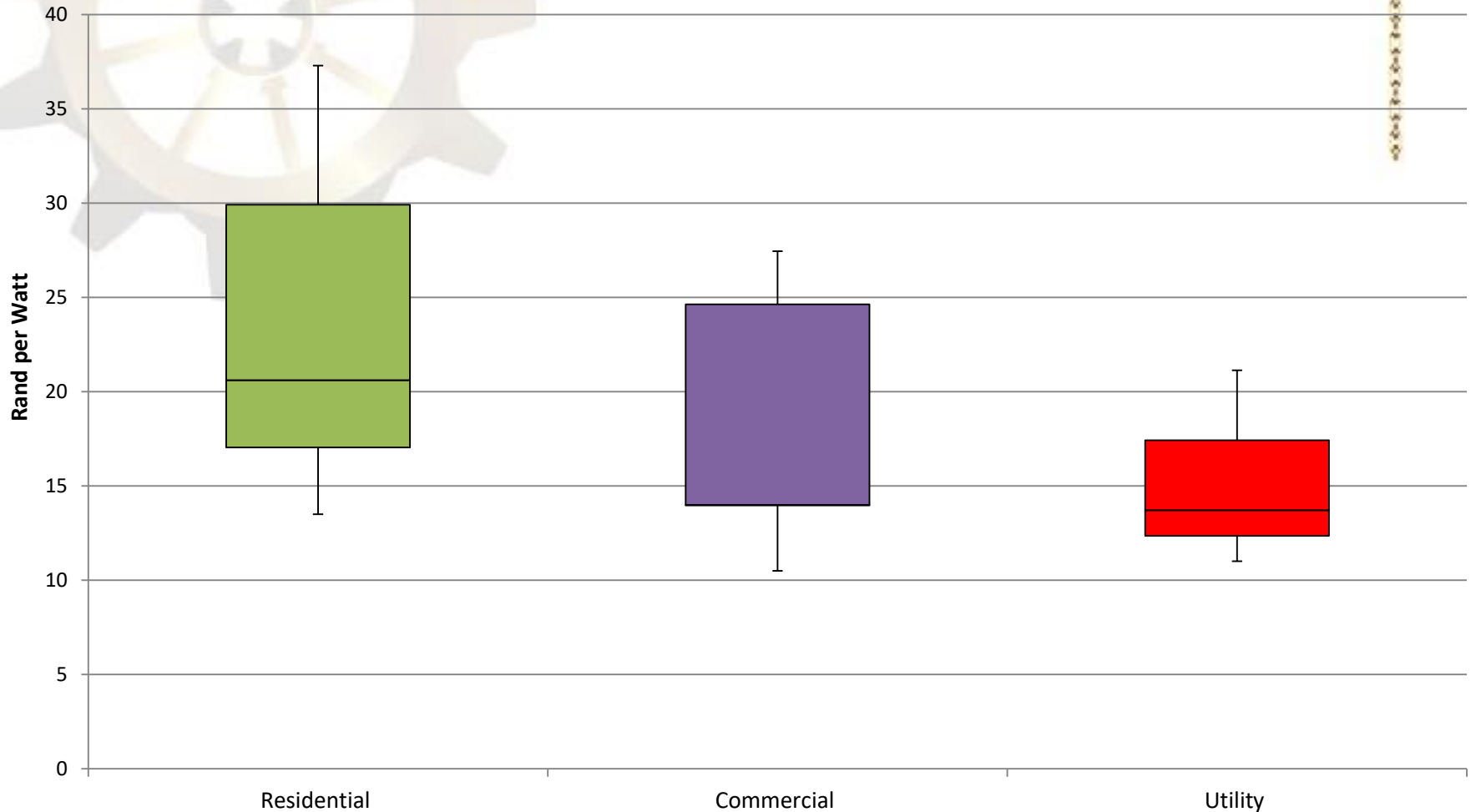
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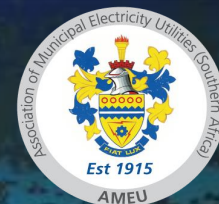
Installed costs for PV systems in 2018

Solar PV costs per W in 2018



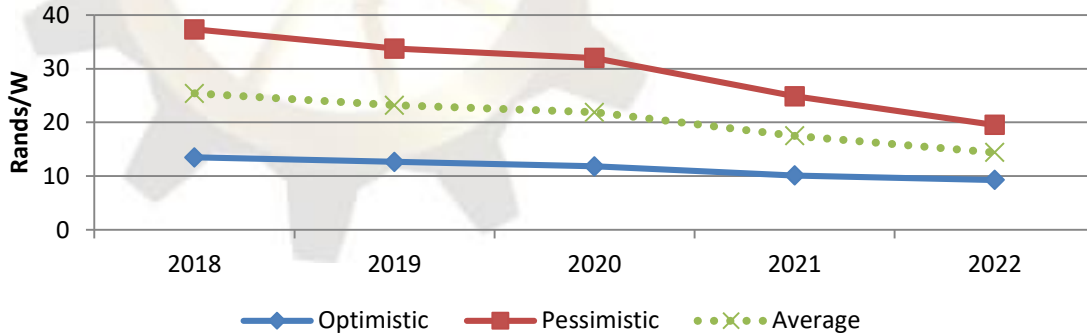
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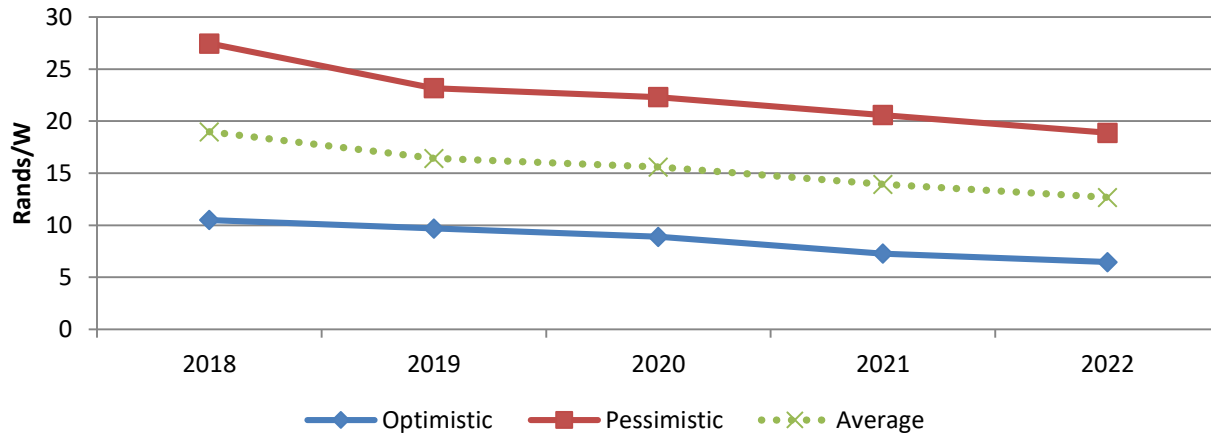


Forecasted installed costs of PV

Forecasted installation costs for Residential systems



Forecasted installation costs for Commercial systems



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LCOE of PV and assumptions

Investment cost

$$LCOE = \frac{I_0 + \sum_{t=1}^n \frac{A_t}{(1+i)^t}}{\sum_{t=1}^n \frac{M_{t,el}}{(1+i)^t}}$$

Annual cost

Energy generated

Parameter	Assumption
Life span of plant	25 years
Installation costs	Average value for each year
Nominal discount rate excl. tax	15.3%
Inverter replacement year	10
Inverter replacement as % of capital	3%
Energy yield	PVSyst (average 1770kWh/kWp/year)
Degradation factor for PV modules per year	0.5%
Operations and Maintenance (O&M) cost	1.5% of capital cost per year
Inflation rate per year	5%

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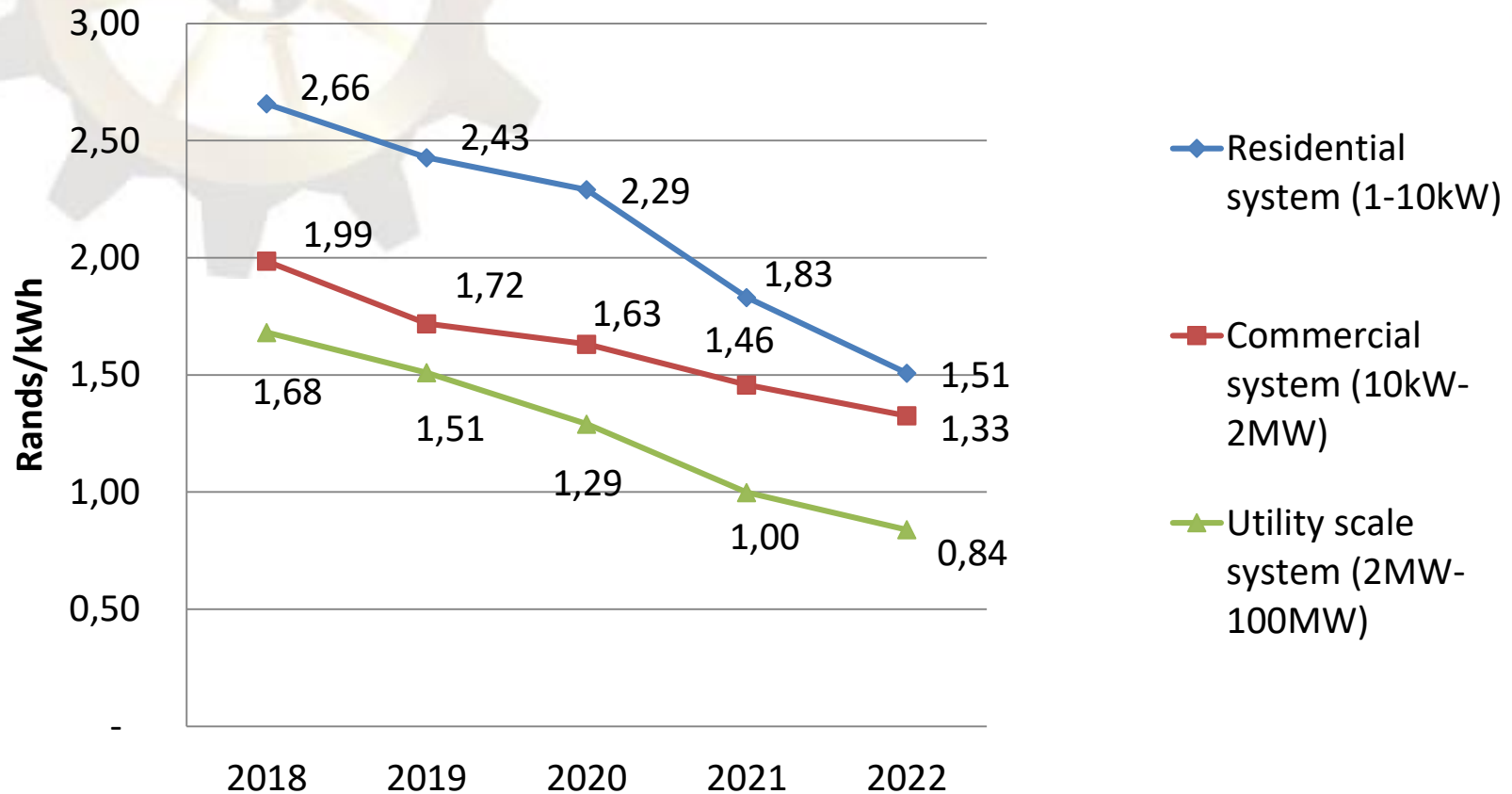
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Projection of average LCOE of PV systems

Average LCOE for PV systems



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LCOS and current storage costs

- Investment cost
- Construction time
- Replacement cost / interval

- Charging cost
- O&M cost

$$LCOS \left[\frac{\$}{MWh} \right] = \frac{Investment\ cost + Operating\ cost + Disposal\ cost}{Electricity\ discharged}$$

- Round-trip efficiency
- Depth-of-discharge
- Annual cycles
- Cycle life
- Calendar life
- Degradation

- End-of-life cost or residual value

R/kWh	Li-ion	Vanadium Flow	Zinc-Bromine Flow	Lead Acid	Adv Lead Acid
Installed Costs	R7 195.30	R7 285.77	R9 913.25	R5 392.13	R9 924.05

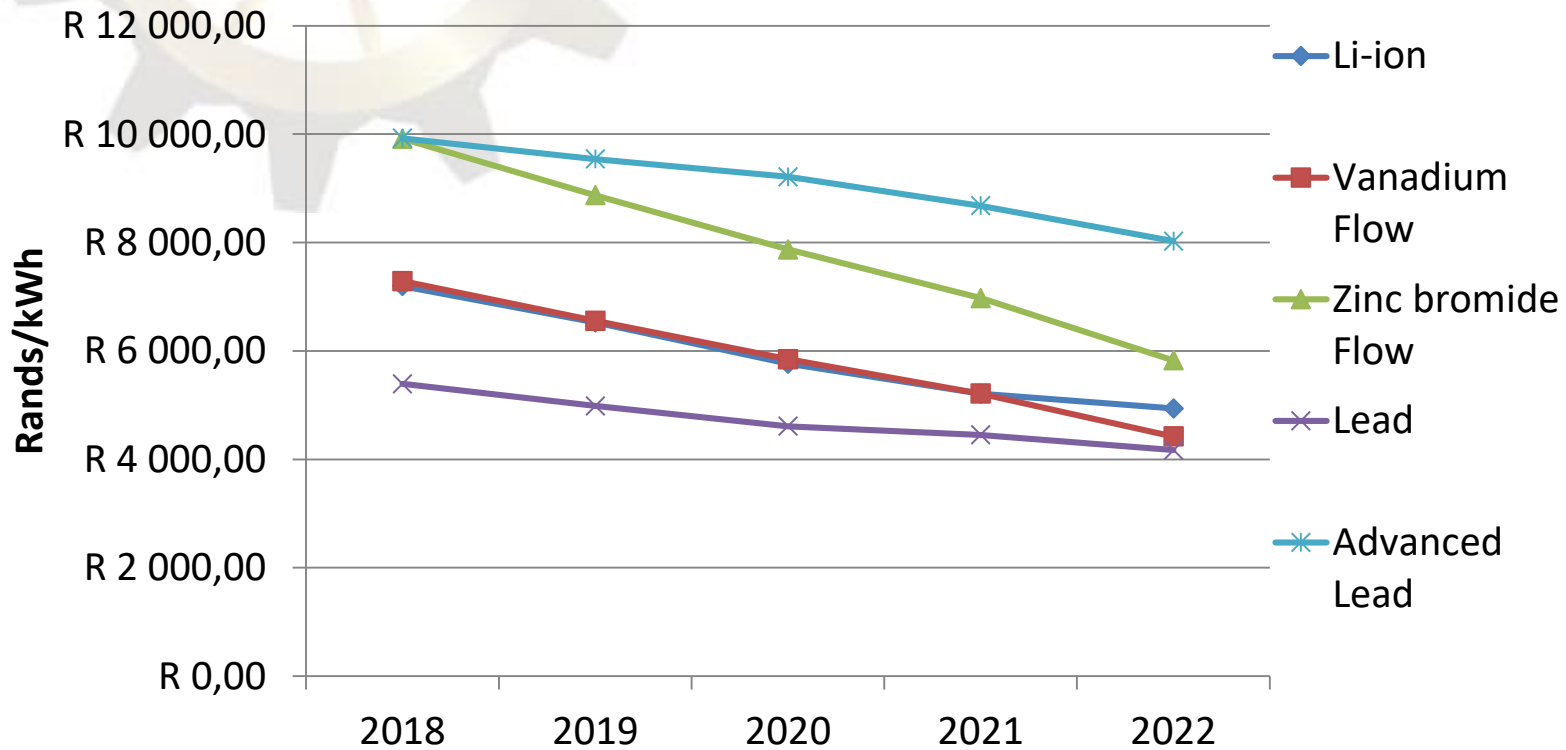
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Installation cost reduction in storage technologies

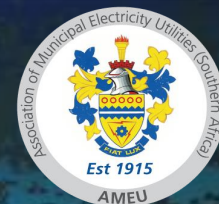
Capital cost reduction in battery storage technologies



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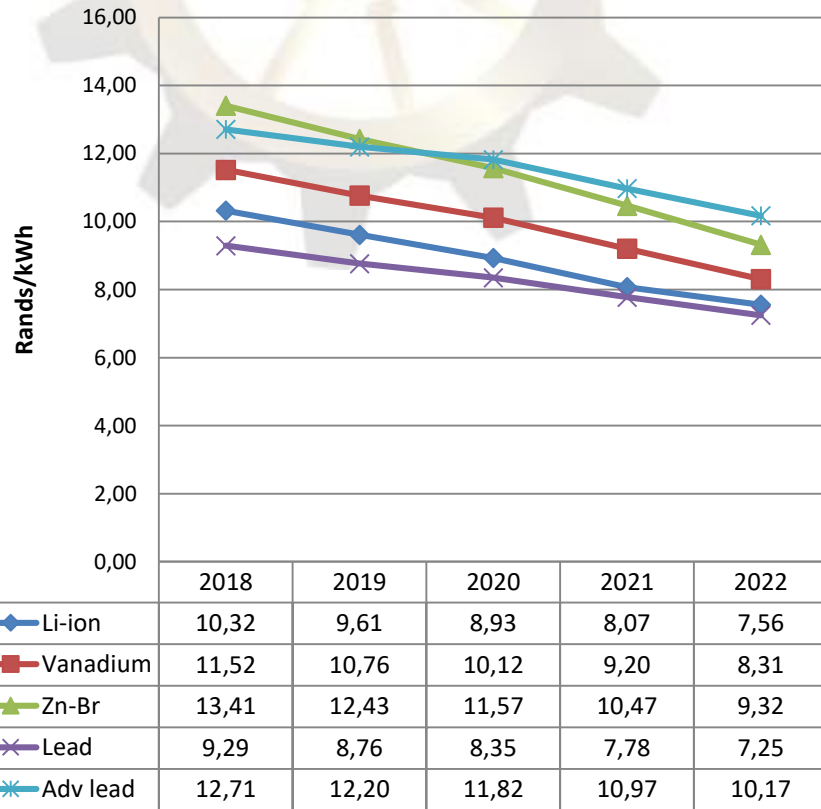
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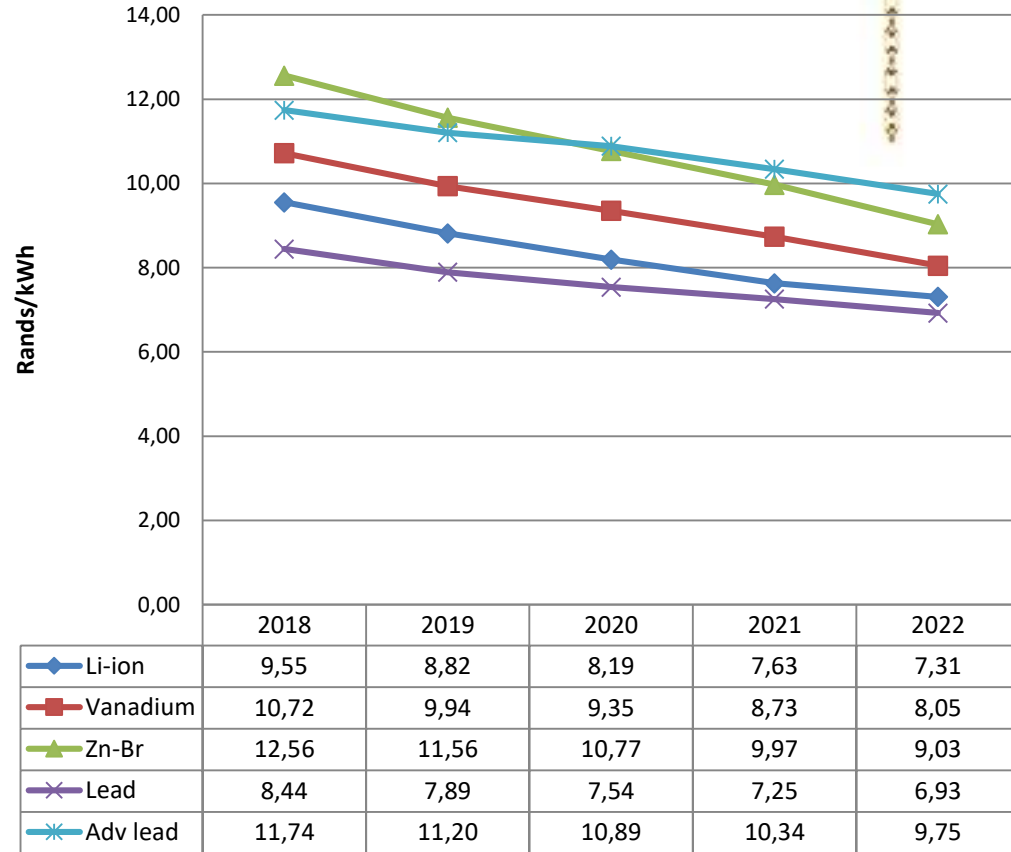


Growth for small scale PV

LCOE of residential PV with different storage systems

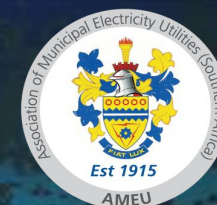


LCOE of commercial PV with different storage systems



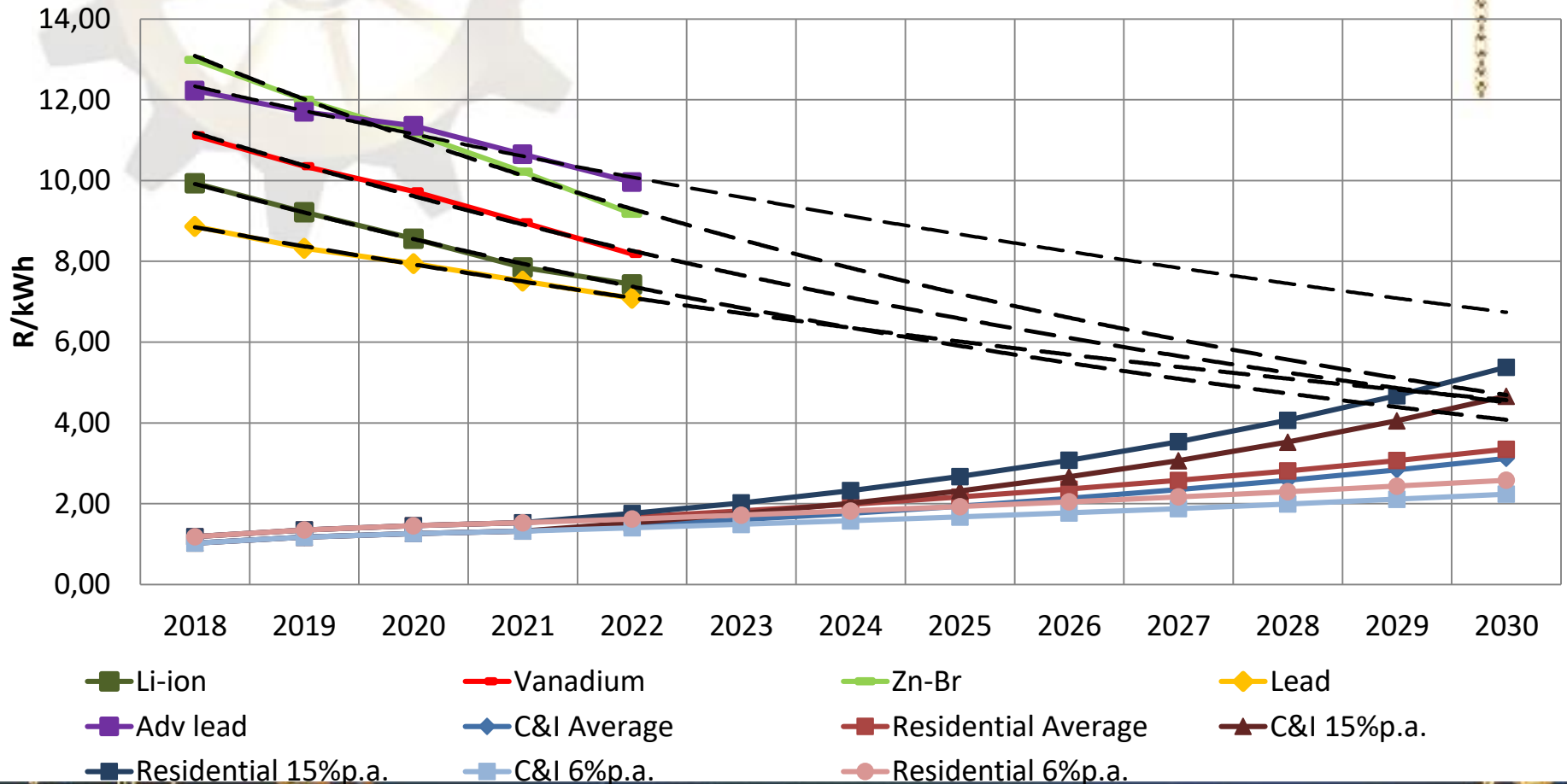
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“Price parity” point

Projected average LCOE of PV with storage for 2018-2030 with expected tariffs in 3 scenarios

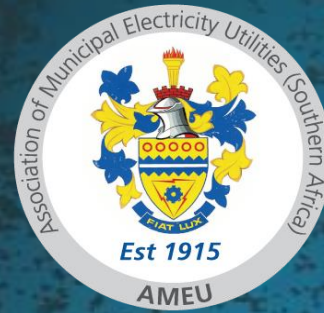


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