THE ROLE OF DISTRIBUTED GENERATION IN ELECTRICITY SUPPLY IN AFRICA

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Presentation outline

• Why do we need distributed generation?
• What can we use it for?
• How much are we already using it?
• How much are we likely to use it in the future?
• What’s slowing it down?
• How can we promote it?
• What role does it have in Africa’s future electricity supply system?
Why do we need distributed generation (DG) and what is making it possible?

• Centralised electricity systems are now faced with a number of supreme challenges, including:
  – concerns about climate change,
  – rising input prices,
  – threats to security of supply and
  – limits to achieving universal electricity access.

• Technological innovation and liberalization of energy markets support DG as a means to address these challenges, facilitating the production and distribution of electricity that is reliable, affordable and clean.
What is distributed generation (DG)?

- Distributed generation = Embedded generation (in Anglo-American countries, including South Africa) = Dispersed generation (in North America) = Decentralised generation (in Europe and parts of Asia)
- Distributed generation ≠ Renewable generation
DG systems applications

DG systems have several applications:

• Standby systems: at a load site as a back-up in case of outages from the central electricity supply system;

• Stand-alone systems or “remote” systems: DG replaces a centralised power supply because connection to the national grid is impractical;

• Micro-generation systems: small-scale systems that are primarily powered by renewable or alternative sources, best catered to meet residential electricity needs;

• Peaking plants: to reduce the electricity costs of large industrial users during peak load times;

• Combined heat and power systems: often owned and operated by commercial or institutional organizations, metal industries, paper or chemical industries, or electricity providers;

• Base load systems: utility-owned DG units used to supply part of the required power, supporting the grid by enhancing system voltage, reducing the losses, and improving the system power quality.
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- **Peaking plants**: to reduce the electricity costs of large industrial users during peak load times.
- **Combined heat and power systems**: often owned and operated by commercial or institutional organizations, metal industries, paper or chemical industries, or electricity providers;
- **Base load systems**: utility-owned DG units are used to supply part of the required power, while at the same time support the grid for enhancing the system voltage, reducing the losses, and improving the system power quality.
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### DG technology-application combinations

<table>
<thead>
<tr>
<th>Technology</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass/biogas-based generators</td>
<td>Base load, CHP, micro-generation, commercial</td>
</tr>
<tr>
<td>Micro-turbines</td>
<td>Peaking plants, cogeneration, base load, commercial</td>
</tr>
<tr>
<td>Fuel-cells</td>
<td>CHP for heating and cooling, base load (larger stations)</td>
</tr>
<tr>
<td>Solar PV</td>
<td>Stand alone, micro-generation, commercial and base load (if combined with batteries)</td>
</tr>
<tr>
<td>Solar CSP</td>
<td>Base load (if combined with storage), commercial</td>
</tr>
<tr>
<td>Wind turbines</td>
<td>Stand alone, baseload (if dispersed across larger geographic area)</td>
</tr>
<tr>
<td>Traditional internal combustion engines (e.g. diesel engines)</td>
<td>Peak load shaving and standby</td>
</tr>
</tbody>
</table>

DG based on RE can do it (almost) all!
Then why is it resisted?

• It gives consumers more choice on how they meet their power needs -> disaggregation of the traditional power model;
• BUT: it offers clear benefits to utilities that embrace them!
What are the main drivers for DG?

- Solid business case based on policy support or clear advantages over grid electricity (IPPs)
- Increase security of supply on a national level (public utilities)
- Mitigating rising energy costs & environmental liabilities
- Increasing security & quality of power supply at customer level
- Access to modern energy services

IPPs & utilities (medium & large scale DG)

- Mitigating rising energy costs
- Increasing security of supply at customer level (if combined with storage)

Commercial users (small & medium scale DG)

- Increase security of supply on a national level (public utilities)

Medium and high-income residential users (micro scale DG)

Low-income residential users (micro scale DG)
What are the challenges?

• **Financial:**
  – High up-front capital investment needed and the related lack of access to capital (even more relevant in non-liberalised electricity markets);
  – Governments have wide array of economic instruments available to mitigate this.

• **Regulatory:**
  – Lack of standards for the interconnection, technical standards for the necessary connecting equipment, and power quality characteristics;
  – The need for DG system operators to get various technical parts of their systems and the system as a whole approved by different entities;
  – High interconnection fees;
  – A lack of standard tariff schemes, which may render DG systems unviable.

• **Technical:**
  – Bi-directional power flows can make it difficult to tune the protection systems in the grid -> redesign of local fault protection system may be required;
  – Voltage fluctuation can become a problem after a certain amount of DRG is connected;
  – Increased load volatility can lead to higher grid maintenance costs;
DG around the world

• Few countries address DG explicitly and in the entirety of its applications;
• Renewable energy programs often represent a form of inadvertent support for DG;
• Examples:
  – China recently announced a national policy to drive rooftop DG installations, with local authorities incentivized to install such systems on most suitable public infrastructure and energy utilities required to incorporate DG in their operations,
  – Brazil and Indonesia have adopted rules and compensation norms for small-scale DG connected to low and medium voltage networks.
How much DG based on RE is there?

• No good stats - difficult to assess impact
• Figures on RE not the best proxy (for solar PV better than for wind)

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capacity installed by 2013 in GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>139</td>
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<tr>
<td>CSP</td>
<td>3.4</td>
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<tr>
<td>Wind</td>
<td>318</td>
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<tr>
<td>Biomass</td>
<td>88</td>
</tr>
<tr>
<td>Hydro</td>
<td>1000</td>
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</table>
What about South Africa?

- DG installations are mushrooming as solar PV electricity is reaching grid parity with some user tariffs

<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>Province</th>
<th>Capacity (kWp)</th>
<th>Installation year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kriel mine</td>
<td>Kriel</td>
<td>Mpumulanga</td>
<td>240</td>
<td>2013</td>
</tr>
<tr>
<td>Med</td>
<td>Woodmead</td>
<td>Gauteng</td>
<td>31</td>
<td>2013</td>
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<tr>
<td>BMS</td>
<td>Woodmead</td>
<td>Gauteng</td>
<td>36</td>
<td>2013</td>
</tr>
<tr>
<td>BT</td>
<td>Woodmead</td>
<td>Gauteng</td>
<td>36</td>
<td>2013</td>
</tr>
<tr>
<td>WTP 30 2013</td>
<td>Witbank</td>
<td>Mpumulanga</td>
<td>30</td>
<td>2013</td>
</tr>
<tr>
<td>Mitchells Plain hospital</td>
<td>Mitchells Plain</td>
<td>Western Cape</td>
<td>64</td>
<td>2013</td>
</tr>
<tr>
<td>Solar Irrigation System</td>
<td>Montagu</td>
<td>Western Cape</td>
<td>24</td>
<td>2013</td>
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<td>GreenPeace Africa</td>
<td>Johannesburg</td>
<td>Gauteng</td>
<td>10</td>
<td>2013</td>
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<tr>
<td>Vodacom Century</td>
<td>Cape Town</td>
<td>Western Cape</td>
<td>500</td>
<td>2013</td>
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<tr>
<td>Dube Trade Port</td>
<td>Durban</td>
<td>Kwazulu Natal</td>
<td>220</td>
<td>2011</td>
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<tr>
<td>Pick’n Pay Phillipi Distr. centre</td>
<td>Cape Town</td>
<td>Western Cape</td>
<td>300</td>
<td>2013</td>
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<tr>
<td>Vrede en Lust wine farm</td>
<td>Franschoek</td>
<td>Western Cape</td>
<td>58</td>
<td>2013</td>
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<td>Novo Packhouse</td>
<td>Paarl</td>
<td>Western Cape</td>
<td>200</td>
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<td>Leeupan Solar PV project at OR Tambo</td>
<td>Wattville</td>
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<td>Pick’n Pay Long meadow Distr. centre</td>
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<td>Gauteng</td>
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<td>Villera Winefarms</td>
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<td>Western Cape</td>
<td>132</td>
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<tr>
<td>Standard Bank Kingsmead</td>
<td>Durban</td>
<td>Kwazulu Natal</td>
<td>105</td>
<td>Unknown</td>
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<tr>
<td>Pick’n Pay store Hurlingham</td>
<td>Johannesburg</td>
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<td>Cavalli Wine &amp; Stud farm</td>
<td>Stellenbosch</td>
<td>Western Cape</td>
<td>51</td>
<td>2013</td>
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<tr>
<td>Oldenburg Vineyards</td>
<td>Stellenbosch</td>
<td>Western Cape</td>
<td>45</td>
<td>2013</td>
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<tr>
<td>Coca Cola water bottling plant</td>
<td>Hermanburg</td>
<td>Gauteng</td>
<td>30</td>
<td>Unknown</td>
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<tr>
<td>Glaxo Smith Kline</td>
<td>Cape Town</td>
<td>Western Cape</td>
<td>30</td>
<td>Unknown</td>
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<tr>
<td>Impala office</td>
<td>Matlied</td>
<td>Western Cape</td>
<td>30</td>
<td>Unknown</td>
</tr>
<tr>
<td>Stellenbosch wine farm</td>
<td>Stellenbosch</td>
<td>Western Cape</td>
<td>10</td>
<td>Unknown</td>
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<td>Eskom Megawatt Park Sunninghill</td>
<td>Johannesburg</td>
<td>Gauteng</td>
<td>358</td>
<td>2013</td>
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<tr>
<td>Eskom Kendal power station</td>
<td>Lethabo power station</td>
<td>Mpumulanga</td>
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<td>2011</td>
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<tr>
<td>Eskom Lethabo power station</td>
<td>Free State</td>
<td>575</td>
<td>2011</td>
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<tr>
<td>Eskom Megawatt Park Sunninghill</td>
<td>Johannesburg</td>
<td>Gauteng</td>
<td>26</td>
<td>2011</td>
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<tr>
<td>Cronimet Chrome Mining</td>
<td>Thabazimbi</td>
<td>Limpopo</td>
<td>1000</td>
<td>2012</td>
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<tr>
<td>Black River park</td>
<td>Cape Town</td>
<td>Western Cape</td>
<td>700</td>
<td>2013</td>
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<tr>
<td>Bosco Factory PV plant</td>
<td>Edenvale</td>
<td>Gauteng</td>
<td>304</td>
<td>2013</td>
</tr>
<tr>
<td>Laurensford</td>
<td>Somerset West</td>
<td>Western Cape</td>
<td>500</td>
<td>2014</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>8469</td>
<td></td>
</tr>
</tbody>
</table>

www.african-utility-week.com | www.clean-power-africa.com
How much DG based on RE can we expect?

- By 2030, 8.3% of the total regional demand and 59% of rural electricity demand in SAPP would be met by DG based on RE;
- Small hydro and PV with storage are likely to play an important role in rural electrification;
- South Africa would account for 21 of the 23 GW installed in the region by 2030. This would meet nearly 50% of rural and over 20% of urban electricity demand in the country by 2030;
- In line with IRP 2010 Update of 2013: PV installed by residential and commercial users could reach 22.5 GW by 2030.
What do we need to get there (in SA)?

• Bust the legal myths: There are no prohibitive legislative barriers to implementation of DG in SA, just misinterpretations of some laws (MFMA)

• Remove regulatory bottlenecks:
  – develop single reference standards,
  – scheduling and dispatch rules,
  – utility interface requirements, especially generator requirements, utility implementation guidelines and the application and implementation procedures for small-scale DG,
  – defining wiring codes for LV network,
  – regulatory framework for distributors of SSEG,
  – lack of clarity with regard to generation license requirements,
  – Eskom’s proposed “Simplified utility connection criteria for LV connected generators,”
  – Metering
Interaction between different standards and codes bodies in SA
What do we need to get there (cont.)?

• More financial incentives! Currently the following is available:
  – On a national level:
    • Small-scale REIPPPP (projects between 1 and 5 MW)
    • Eskom’s pilot small-scale renewable energy programme as part of the larger Standard Offer Programme,
    • the IDC’s Green Efficiency Programme,
    • SARS’s Accelerated Depreciation Programme,
    • various carbon mitigation and trading schemes;
  – On a municipal level:
    • Feed-in-tariffs only offered in a few municipalities: City of Cape Town, Drakenstein, eThekwini, City of Johannesburg, Ekurhuleni,
    • the requirements and tariffs offered vary widely among these municipalities
Looking ahead – what is the role of DG in Africa’s future electricity supply system?

• DG is motoring on in one direction: AHEAD!
• Utilities need to re-think their roles: develop a business case for grid services for the growing number of embedded generators or face grid defection;
• Regulators: your role is crucial! As DRG is reaching grid parity regulatory bottlenecks are a bigger issue than financial incentives;
• Shifting the paradigm: away from mammoth centralised systems to a more dynamic, responsive system that empowers users to take control of their electricity needs (= prosumers);
• The rise of the ESCOs in Africa – a whole new sector that needs to find a way to co-exist with utilities.

THANK YOU!