Emerging Trends in Distributed Generation

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<table>
<thead>
<tr>
<th>Table of Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Power Generation – Origins and Growth</td>
</tr>
<tr>
<td>• Distributed Generation Technology Today</td>
</tr>
<tr>
<td>• 16 Years of Industrial Gas Turbine Sales: 3 – 66 MW Analysis</td>
</tr>
<tr>
<td>• Major Trends</td>
</tr>
<tr>
<td>• Growth of Market Segment</td>
</tr>
<tr>
<td>• Market Economic Drivers</td>
</tr>
<tr>
<td>• Siemens Response</td>
</tr>
</tbody>
</table>
Today the world consumes over 20,900 TW-hours of electrical power.

The growth of the power industry and its related grid infrastructure has been driven over the last 130 years:

- Industrialization
- Urbanization
- Increase in population

**Electrification rate in 1933**

- 68% US
- 21% Mexico
- 79% Germany
- 94% Italy
- 2% China

China
Distributed Generation Technology Today

- Distributed Generation – Electrical power generation in close proximity to its point of use
- Today there are various technologies involved in distributed power generation

- Solar
- Wind
- Hydro
- Fuel Cell
- Geothermal
- Energy Storage
- Reciprocating Engines
- Industrial Gas Turbines
16 years of Distributed Generation Sales: 3 – 66 MW Gas Turbine Units

Number of units sold

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1 Power generation only
16 years of Distributed Generation Sales: 3 – 66 MW Gas Turbine Units

CAGR: 10%

CAGR: -10.7%

CAGR: -5.5%

1 Power generation only

2 Compound annual growth rate

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Major Trends 40 – 66 MW in Industrial Power Generation

40 – 66 MW IGT¹ Sales

40 – 70 MW IGT Sales have shown moderate growth over the last 6 years at ~5% CAGR

40 – 66 MW CC IGT² Sales

40 – 70 MW IGT Sales into Combined Cycle service show decline from 2011 level but recent uptick puts growth at ~8% since 2010

¹ Industrial Gas Turbine
² Combined Cycle Industrial Gas Turbine
Major Trends 20 – 50 MW in Industrial Power Generation

One of the biggest shifts in the Distributed Power Generation Market.

The 20 – 50 MW segment of land based, permanently installed, CHP & Industrial simple cycle generation has contracted at rate of -21% the period 2010 – 2015 with slight recovery in 2016.
The Mobile IGT Market has shown tremendous growth of 20+% CAGR in the last six years.

The dramatic increase in IGT Sales in this emerging segment was driven by the need for power on very expedited or “fast track” basis.

**The requirement:** Minimum time between contract signature and Power.
Regional Trend – Location of Mobile Gas Turbine Fleet

The 3 Regions …

… in which most of the Sales of Mobile Gas Turbine gensets have happened
Mobile Gas Turbine Sales

- Pre-2006 mostly a rental market with intermittent spot sales
- Global need for “Fast Power” began to ramp-up in 2008
- Trend continued through 2011 driven by expanding electrification in developing nations, gaps in infrastructure planning and natural disasters

The need to deliver fast cycle power generation capacity now is and continues to be one of the fastest growing segments in 20 – 40 MW Industrial Power Generation (~$ 1.0 bn in 2015)

Growth of Mobile Gas Turbine Power Market

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Page 11 June 2017
Macro-economic Driver #1 – High GDP Growth Rates

• Many countries in Latin America, Africa and Asia have the highest GDP\(^1\) growth rates in the world

• This increasing economic activity creates demand for electrical power to drive Industry

• Governments and private enterprise is responding to the need

• Industrialization and growth are co-dependent

• The urgent power needs of expanding industry drive the demand for quick delivery and fast implementation

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**Annual percent change**

- 10% or more
- 6% – 10%
- 3% – 6%
- 0% – 3%
- Less than 0%
- No data

\(^1\) Gross domestic product
Macro-economic Driver #2 – High Population Growth Rates

- Latin America, Africa & Asia have the highest population growth rates in the world.
- They also have the highest urbanization growth rates.
- Governments and private enterprise is responding to the need.
- As more people move from rural areas into city centers, higher demand for electric power follows.
- Urbanization and industrialization is what lifted China from a 2% electrification rate in 1933 to the world’s largest consumer of electrical power today.

Growth Rate
- ≤-0.51%
- -0.50 to -0.01
- 0.00 to 0.99
- 1.00 to 1.99
- ≥2.00
- 2010 population too small to reliably compute growth rate

Macro-economic Driver #3 – Low Electrification Rates

- Latin America, Africa, and S.E Asia have the lowest Electrification Rates in the world
- Demand exists out of necessity
The Gap between Supply vs. Need drives the Fast Power Market

Large portions of the world are dark. 16% (1.2 billion people) of the global population do not have access to electricity.
Siemens Response –
The Fast Power Initiative

Goal #1

Enter Fast Power Mobile Power Generation market with a differentiated offering

SGT-A45 TR, a mobile gas turbine package specifically designed for this emerging need within Distributed Generation

Contract to Power – 3 months!
Siemens Response –
The Fast Power Initiative

SGT-A45 TR
Mobile Unit

44 MW<sub>e</sub>

SGT-A45 TR
Siemens Gas Turbine
Aero-derivative
Derived from Industrial Trent

45 MW class
SGT-A45 TR Mobile Unit –

Key benefits

- 44 MWₑ (ISO) – highest power density
- 2-weeks installation
- Delivered by road, air or sea
- Performance optimized for hot climates
- 50 Hz or 60 Hz
- Liquid and gas fuel
- Emissions as low as 25 vppm NOₓ
- Proven turbomachinery
- Minimal site interfaces and preparation
SGT-A45 TR Mobile Unit –
Typical 3-trailers Layout

Trailer # 1
• A/C generator
• Generator lube oil
• Generator cooler

Trailer # 2
• Gas Turbine
• GT lube oil (synthetic)
• Air inlet silencer
• GT enclosure ventilation
• Fire protection
• Gas Fuel metering
• Liquid fuel/water metering
• Water wash
• Air-blast cooler (GT oil)

Trailer # 3
• Switchgear
• Unit Control Panel (UCP)
• Motor Control Centre (MCC)
• UPS
• Aux transformer
• Purge air cooler
• Instrument air compressor

Non-trailerized
(ship loose)
• Air filter
• Exhaust stack
• GT bleed air silencer
Thank You.
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