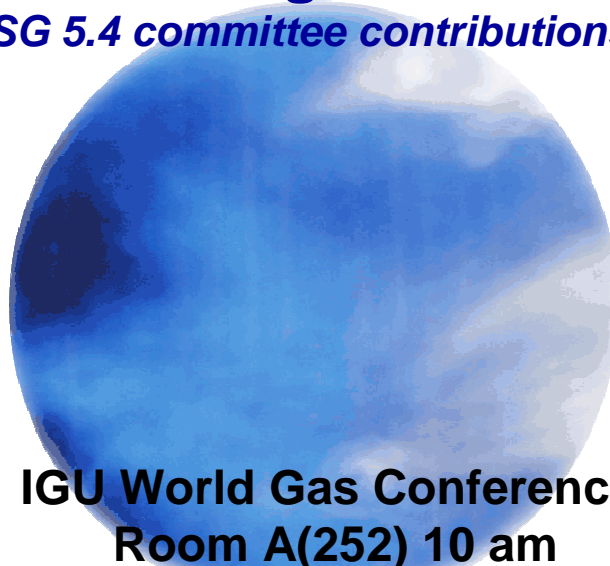




“Can the customer afford to use gas?”



**Distributed Energy Generation - from CHP  
to micro generation**  
*SG 5.4 committee contributions*



**IGU World Gas Conference  
Room A(252) 10 am  
June 8, 2006  
Amsterdam, The Netherlands  
By  
Samuel Bernstein, Chairman SG5.4**





- **Objective**
- **DG**
  - What is new in the Technology?
  - Are there Values to customers?
  - Are there real New business opportunities?
- **Case studies**
- **Reference material**
- **Conclusions**





## Objective



- ***Present some thoughts on Distributed Generation (DG) as part of the Future Energy Companies***
  - Gas companies
  - Electric companies
  - Newcos





## DG (or DER): Distributed Energy Resources



- An important new concept for the electricity business and interesting new market opportunities to energy companies, gas companies
- Background: liberalization of energy markets
  - ✓ **Potential to reduce polluting emissions**
  - ✓ **Contribute to energy savings and efficiency**



## What is new in the Technology?



	<b>ICE</b>	<b>Gas turbine</b>	<b>Gas microturbine</b>	<b>PV</b>	<b>Wind energy</b>	<b>Fuel cells (*)</b>
<b>Power range</b>	1kW–20MW	500kW–50MW	25-300kW	1kW-1MW	10kW-5MW	1kW-1MW
<b>Fuel</b>	Natural gas, biogas, GLP or liquid fuels	Natural gas, biogas, GLP or liquid fuels	Natural gas, biogas, GLP or liquid fuels	Sun light	Wind	Natural gas, biogas, hydrogen or liquid fuels
<b>Efficiency, %</b>	20-45	28-60 (ngCC)	25-33	6-19	25	30-65
<b>Installation Surface m<sup>2</sup>/MW</b>	20-29	37-65	27-30	~ 10.000	47.000 – 160.000 (**)	37-167
<b>Investment, €/kW</b>	350-700	400-900	750-1.000	5.000 - 6.600	800 - 1.000	900-3.300
<b>Maintenance &amp; operation costs, €/MWh</b>	7 - 15	4 - 9	3 - 15	1 - 4	1 - 3	5 – 20
<b>Emissions once in service (ppm)</b>	NO <sub>x</sub> < 160 CO < 70	NO <sub>x</sub> < 25 CO < 50 @ 15% O <sub>2</sub>	NO <sub>x</sub> < 50 CO < 50 @ 15% O <sub>2</sub>	-	-	NO <sub>x</sub> < 1 CO < 2
<b>Technology status</b>	Commercial	Commercial	Some commercial models	Commercial	Commercial	Pre - Commercial



New technology is entering the markets in Europe,  
Japan and the US Note discussions in oral session and round table



- **IC & Stirling engines entering the market in Japan, Europe and North America**
- **Fuel cell technology is being demonstrated – *see next***
- **Renewables (wind and solar) is utilized**





# Commercially available fuel cells

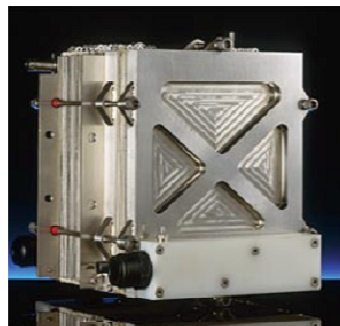
early market



**Ballard**  
**PEM, rack mountable,**  
**1.2 kW, DC**



**ReliOn**  
**PEM, rack mountable,**  
**1 kW, DC**



**Intelligent Energy**  
**PEM, 1 kW, DC**



**Plug Power**  
**PEM, 5 kW, DC/AC**



**Axane**  
**PEM, 2.5 kW, AC**



## Are there Values to the customers?



- **Less cost**
  - Less losses of electrical transport and distribution
  - Less investments in new generation and transport of electrical energy
- **Less emissions**
  - Less air emissions to the atmosphere; helps attaining the Kyoto Protocol, by
    - ✓ Renewable energies or co-generation systems
- **Better quality service**
  - It enhances the promise of power quality provision
  - Higher energy efficiency





# Are there real New business opportunities?



- **The energy business does not operate strictly in response to free market opportunities**
- **DG will depend to a great extent on the legislative input and support**
  - business reward depends on the specific criteria established by the regulating body
  - the liberalization of the electrical markets is changing the rules of these markets, with simultaneous threats and opportunities for the DG



## The Case for DG



- *Problems in electric networks can be helped by DG*
  - Aging electric systems
    - ✓ Capacity is limited
    - ✓ New Digital loads
  - DG as part of the future
    - ✓ The smart grids



### North American example:

- **The US electric T&D was largely designed and installed in the early 20<sup>th</sup> century**
  - The system is overloaded
  - The investment required for upgrade is very high (\$450 Billion ++)
- **US DOE new office for T&D was established to support new grids**





## New Digital loads Electric companies example:



- **HVAC demand is decreasing**
  - Zero Energy Homes
- **Digital loads are growing**
  - Computers, Entertainment, Smart appliances
- **Can DG help the customer and the utility? *It will provide better 'grid' service:***
  - Storage and self generation, DC power
  - “non wire” solutions to capacity problems include DG

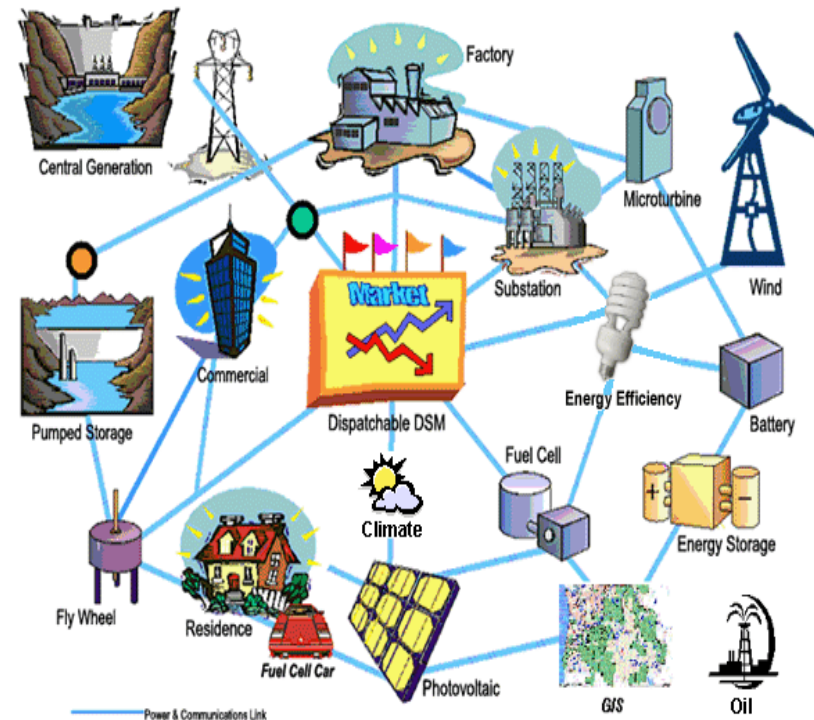




# DG is part of the future Smart grids



- **Enhance the electric grid by**
  - Increase line rating by DG generation
  - Flatten load by reversible fuel cells
- **EnergyWeb**
- **GridWise**
- **IntelliGrid**





## Case studies



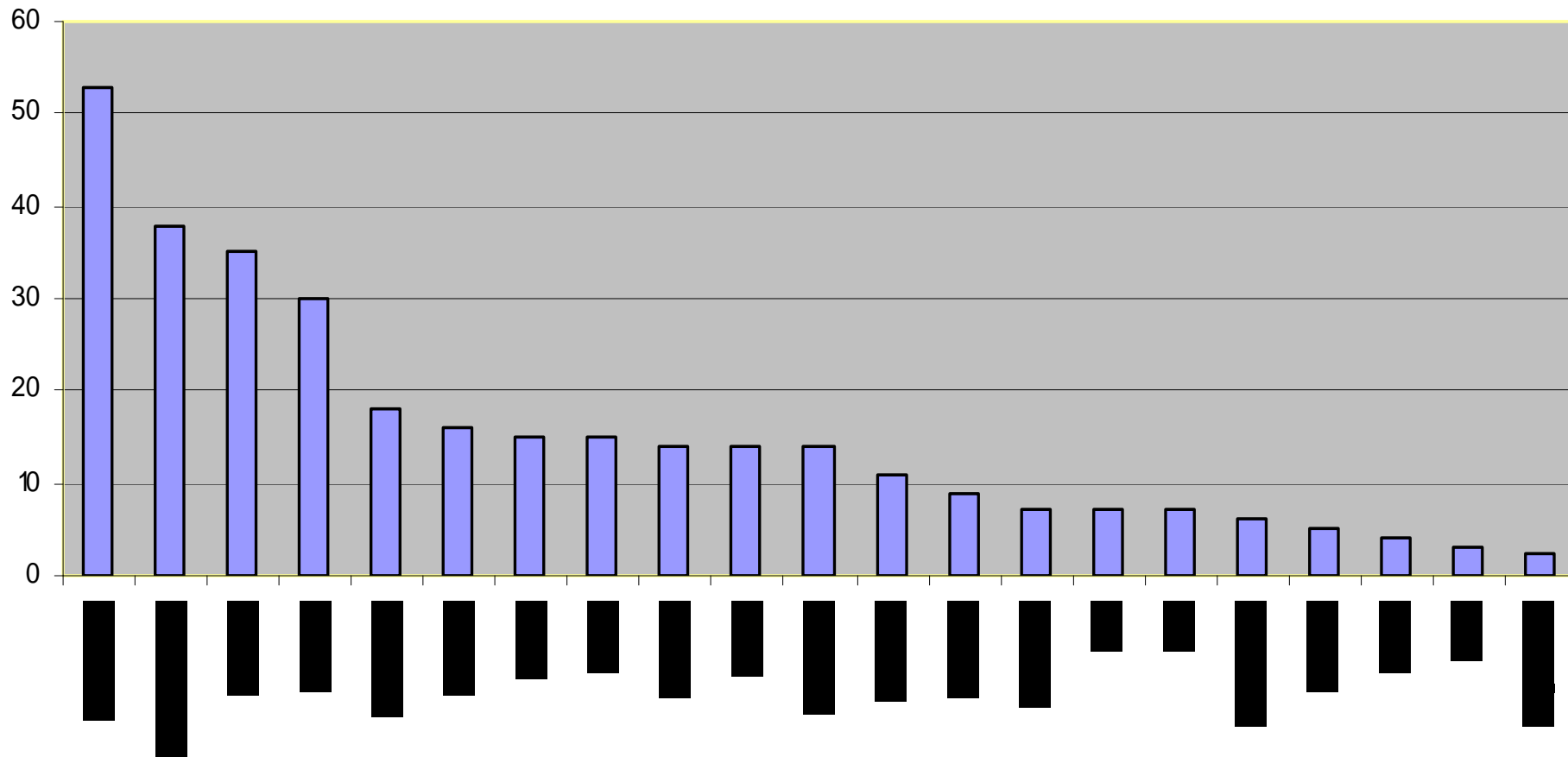
- **Numerous case studies are presented in the full report**
- **Examples to show applications in many countries**
  
- **A: Micro installations:                    1kW - 10 kW**
- **B: Mini installation:                    10 kW - 500 kW**
- **C: Normal size installation:        500 kW - 50 MW**



# Case Studies



DER share as % of total power generation



Development of the DER in the world in % respect to the total generation (Sources: WADE, 2005, Gas Natural Group 2004, M. Sunic CGA)



## Case Studies (Cont.) What is in the report?



- *Installation location, technology, Capacity **Power, heat & cooling capacity, GRID conditions, Efficiency,***
- *Detailed Cost Operation & Maintenance, **Running hours per year Income for Power and heat Prices for heat delivery, Delivery/year; Prices for delivery of cooling***
- **Energy Delivery, Total delivery per year,**
- **Natural Gas price € or \$/kWh. Consumption/year**





## Coverage of case studies



- **Belgium, Croatia, Czech Republic, Denmark, France, Germany, Japan, Slovenia, Spain**





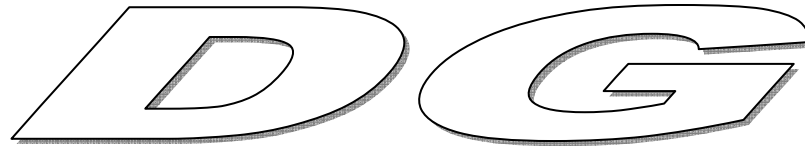
## Reference material



- **See IGU SG 5.4 report for *Internet sites***
- **See US DOE programs: EnergyWeb, GridWise, IntelliGrid for *Electric Grid Visions***
- **EU Deep project for *Business models***



## What are the scenarios ahead?

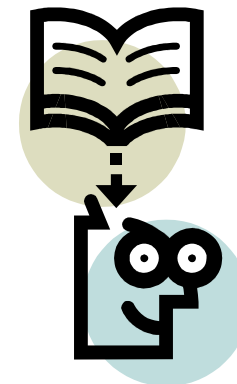


### Increase chance

- Electric grid issues
- Digital load needs
- Customer reliability needs
- Available new technology
- Business models of energy (electric & gas)

### Decrease chance

- High cost gas relative to electric cost





## Conclusions



- 1. DG can be used to enhance energy service to the customers**
- 2. DG can offer real electric grid enhancement**
- 3. DG can provide a business tool to enhance the gas business particularly in deregulated markets**
- 4. DG can provide environmental benefits**





## Q&A



For more discussion on Distributed Generation. Please review papers of Wed June 7 15:30-17:30 Session 5.2 Room N1-01(144)

**Sam Bernstein, Chairman IGU  
SG 5.4**

