



PV SEC – Linde Seminar

“From Grid Parity to Green Parity”

Planning Sustainability

M+W Zander FE GmbH
Hamburg,
24th of September, 2009

Contents

- M+W Zander Company Introduction
- Planning Sustainability

Corporate Structure

Millennium
Private Trust

M+W Zander

Jürgen Wild (CEO) • Dr. Hannes Rosenthaler (CFO)

Facility Solutions



Process Solutions

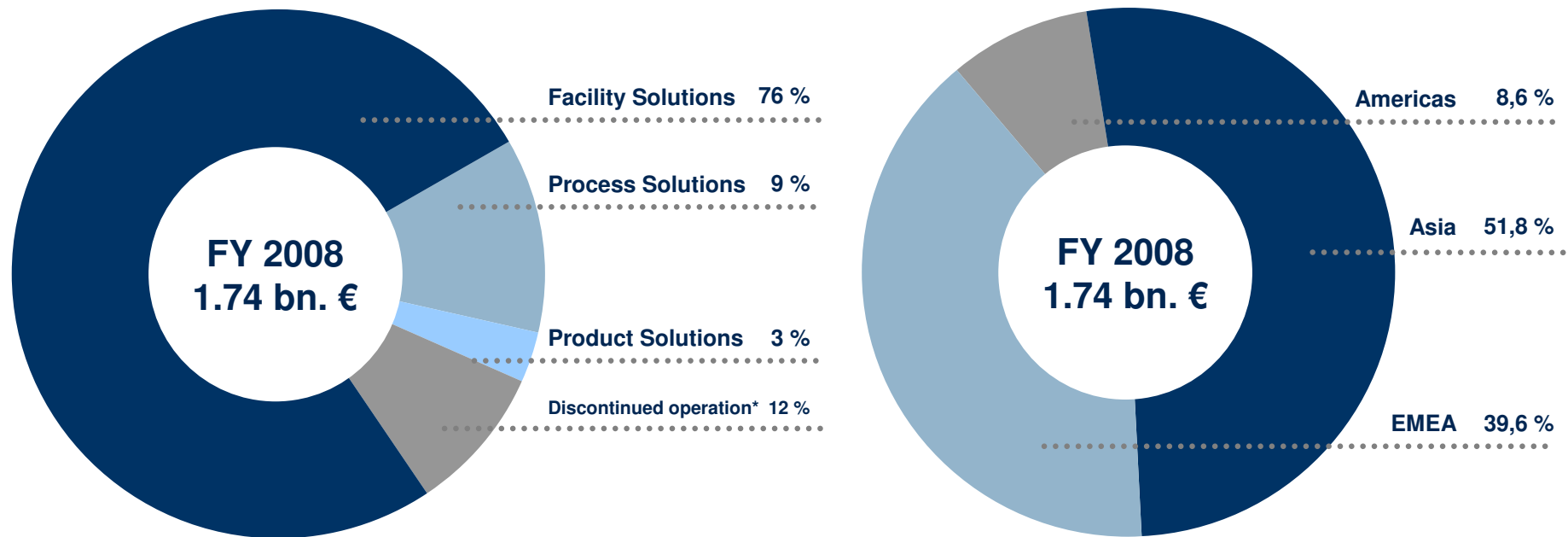


Product Solutions



Integrated Solutions focused on Customer Value

Key Figures- Revenues



*Facility Management sector sold mid 2008



Locations

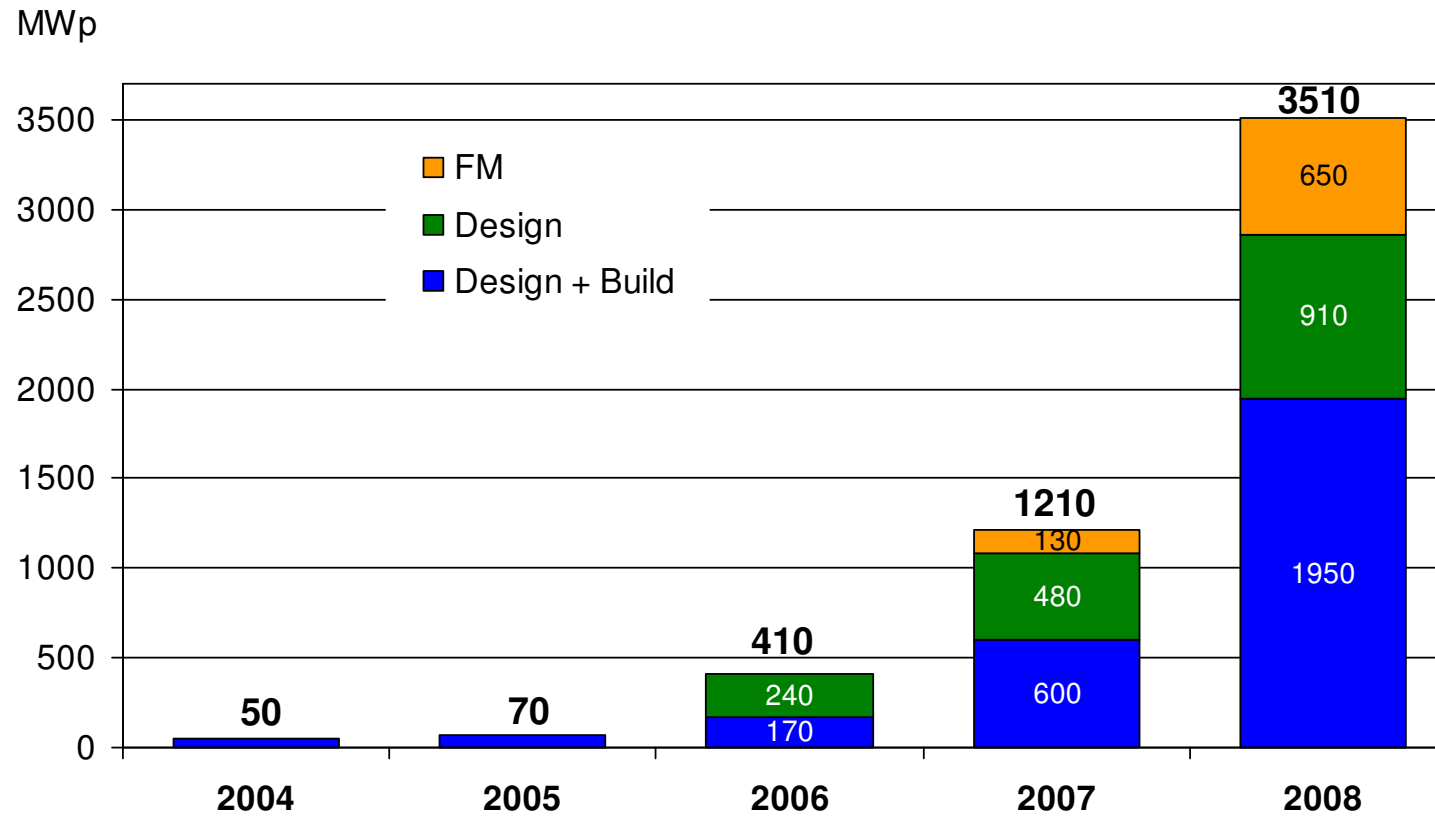


Range of Services - Facility Solutions



Photovoltaics: Our Project Track Record

- Facilities engineering, construction and facilities management in projects with a combined capacity of over 3.5 GW in 2008



Wafer-Based and Thin-Film Projects

Photovoltaics: Our References

Our References (partial list)

Arendi	2008-2009
REC	2008
GET	2008
First Solar (MY)	2007-2009
Solsonica	2007
Conergy	2007
First Solar (GE)	2007
Ersol-Cell Fab 2	2006-2007
ErSol	2006-2007
Ekarat	2005-2007
GIN	2005-2006
PV-TEC	2005
Sunways	2004-2005
Sulfurcell	2004-2005
Deutsche Cell	2001-2002

Customers in the PV Industry

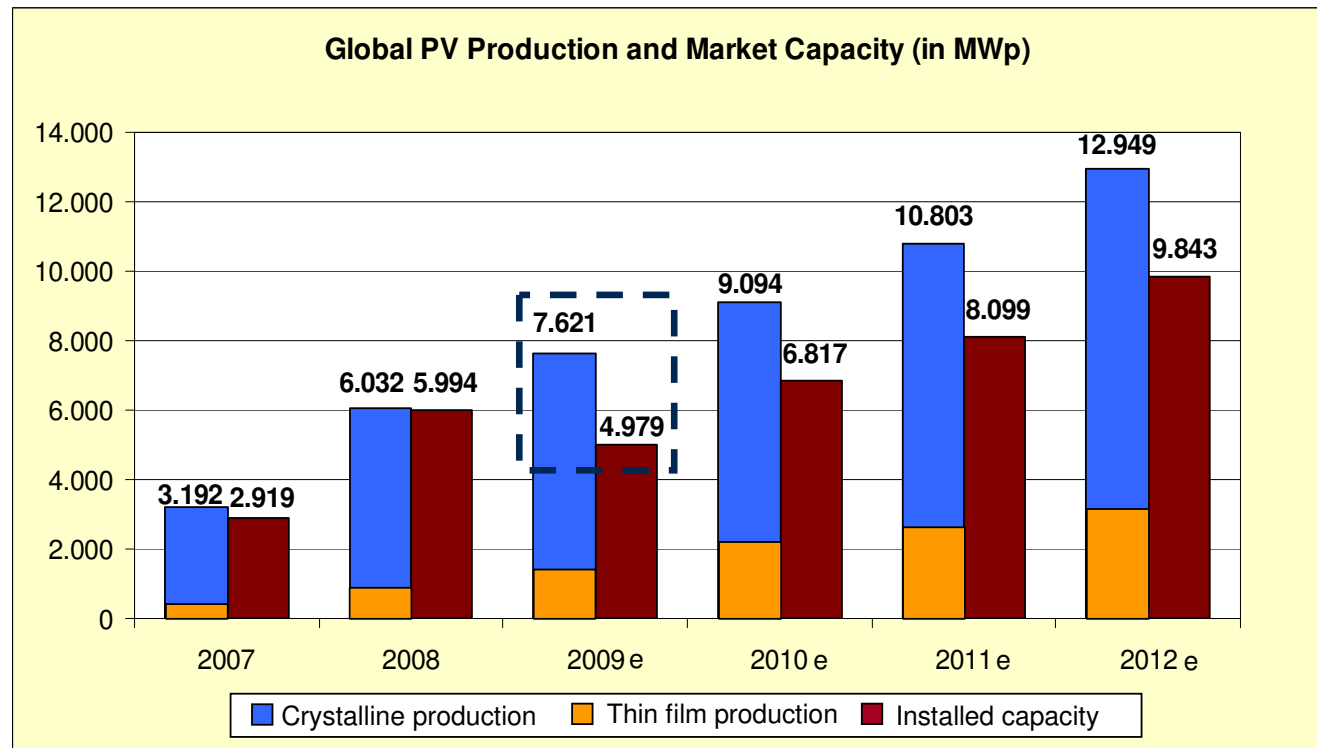


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PV Market Environment in 2009

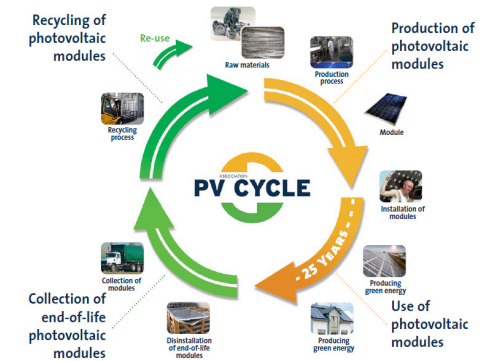
- The PV Market is in a state of oversupply.
- Excessive inventory of approximately 3 GW is expected for 2009.
- Pressure on manufacturing cost will remain high.



Sustainability - M+W Zander's Contribution

- Module Manufacturer's Perspective:
 - Reduce manufacturing cost
 - Provide "green" product
 - Recycle product at 100%
 - ...

- M+W Zander's Contribution (Facility Design and Construction):
 - Keep high environmental protection standard
 - Lower consumption of resources (energy, water, chemicals etc.)
 - Lower building and facility CAPEX and OPEX
 - ...



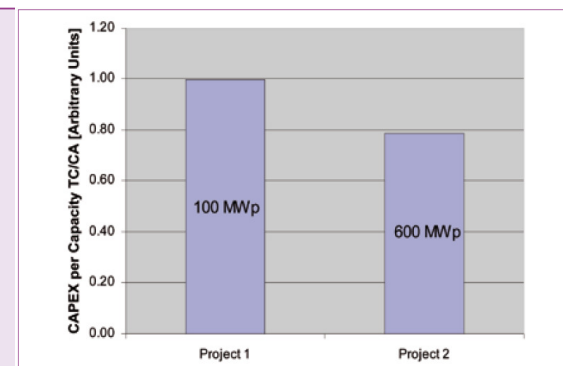
PV Fab Trend - Manufacturing Cost Reduction by Economy of Scale

■ PV Fab Size Development (MWZ Project Database – Wafer-based Technology)

	2005	2006/2007		2007	2008		2008
Fab	SC2	SC3	SC5	SC7	SC8	SC9	SC10
Product	Cell	Cell	Cell	Cell	Cell	Cell	Cell
Substrate	Mono/Poly Silicon	Mono/Poly Silicon	Poly Silicon	Mono/Poly Silicon	Poly Silicon	Poly Silicon	Poly Silicon
Substrate Size	156 mm x 156 mm	156 mm x 156 mm	156 mm x 156 mm	156 mm x 156 mm	156 mm x 156 mm	156 mm x 156 mm	156 mm x 156 mm
Capacity [MWp]	60	100	60	260	160	500	510

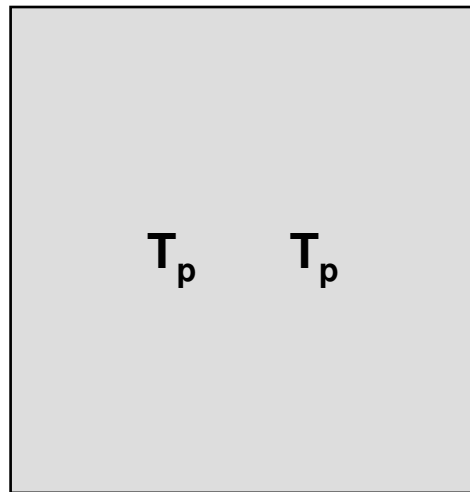
■ Economy of Scale - Case Study of MWZ (published in PV International 3Q2009)

	Design Manufacturing Capacity	Building Concept	Facility Concept	Total Gross Building Area (m ²)
Project 1	100MWp	Single-level manufacturing	Facilities integrated in fab building	10,000
Project 2	600MWp	Multi-level manufacturing	Separate central utility building	38,000



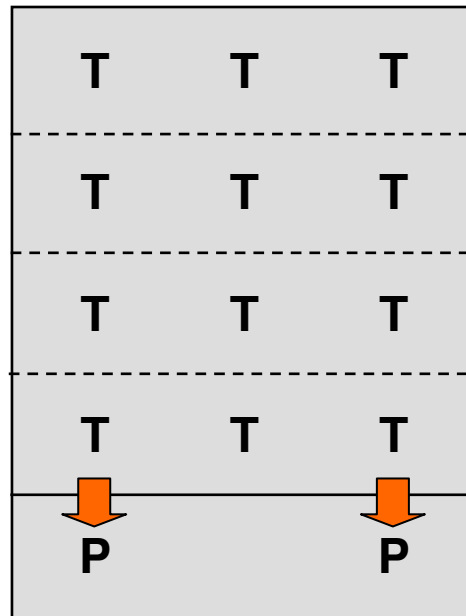
■ 20 % reduction of normalized CAPEX (Building and Facilities)

Fab Concept Development

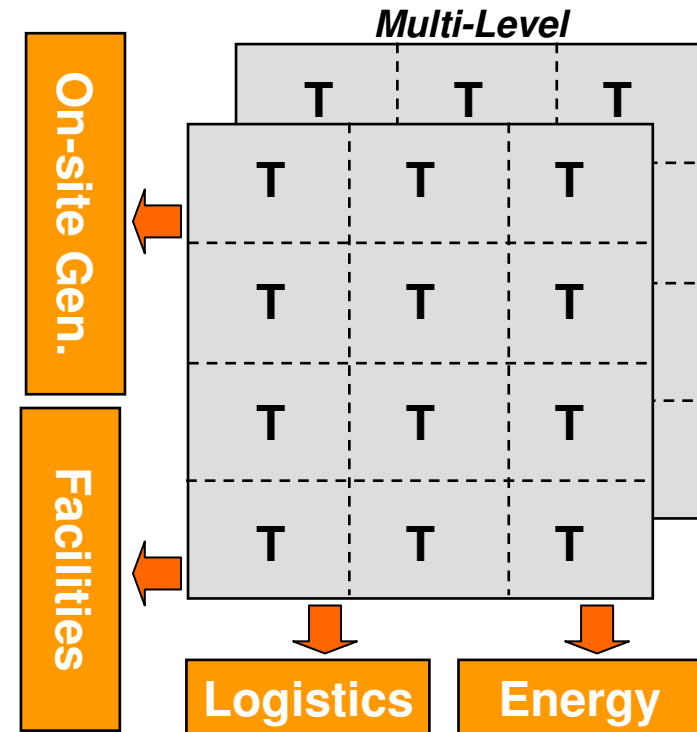


T=Tools, P=Process Systems

1 MWp – 10 MWp



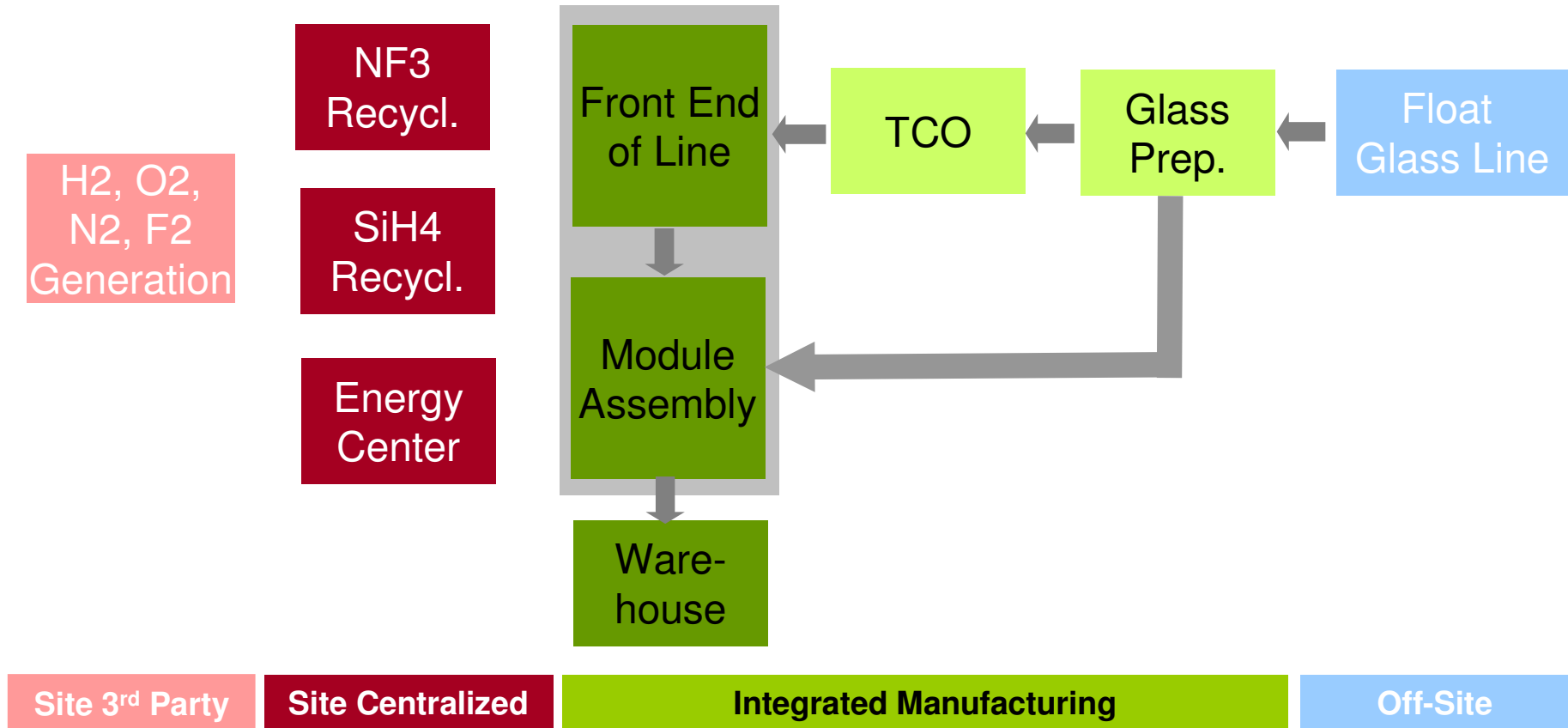
100 MWp – 200 MWp



> 250 MWp

>>> Large scale PV Fab's feature concepts comparable to the TFT-LCD and the IC industry.

Site Functions: Large Scale Thin Film Manufacturing (a-Si,μ-Si)



>>> Opportunities to centralize functions or integrate new elements of the manufacturing chain.

Sustainability - Re-use & Waste Recycling Activities

Thin Film Silicon Modules

Process Gas (SiH ₄) Recycling
Status
Pilot testing

Cleaning Gas (NF ₃) Recycling
Status
Research ongoing

Cleaning Gas Replacement (F ₂)
Status
Technology available

Crystalline Si-based Cells

Chemical (HF) Recycling
Status
Research ongoing

Alternative Waste Water Treatment
Status
Research ongoing

Waste Water Recycling
Status
Technologies available

CIGS Thin Film Modules

Decontamination of CN-
Status
Technologies available

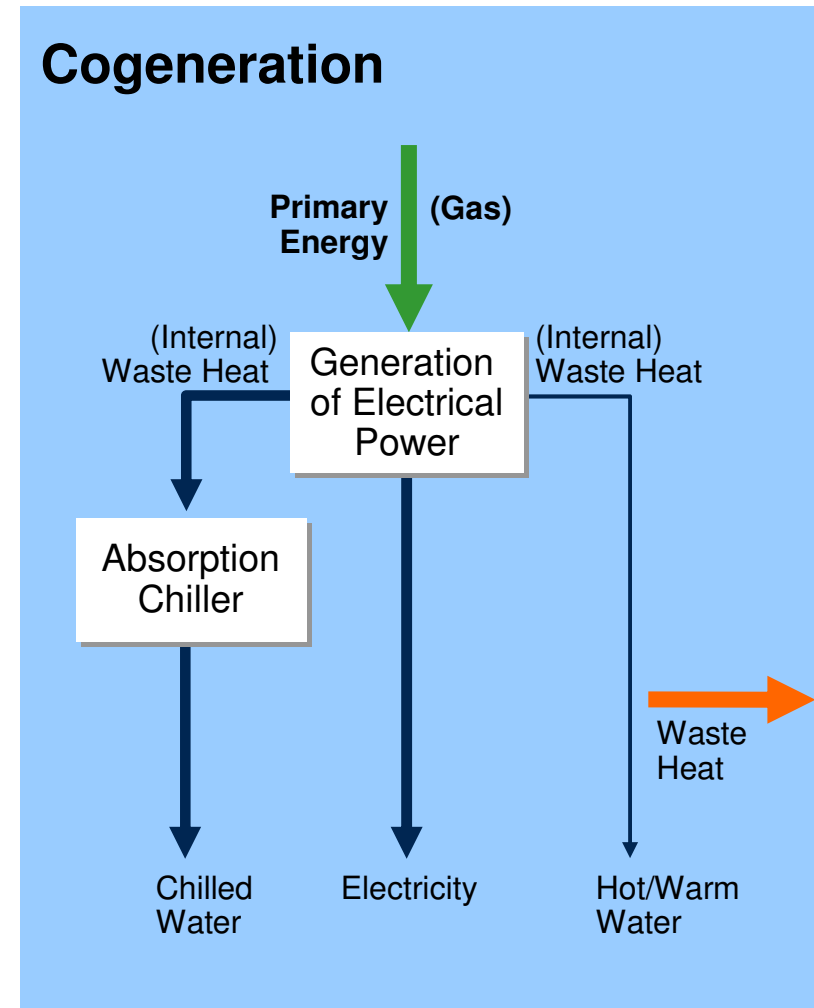
Treatment of Cd and Cu waste
Status
Technologies available

Waste Water Recycling
Status
Technologies available

Future Reclaim (In, Ga)
Status
Technologies available

Reduced Primary Energy Demand & Environmental Emissions

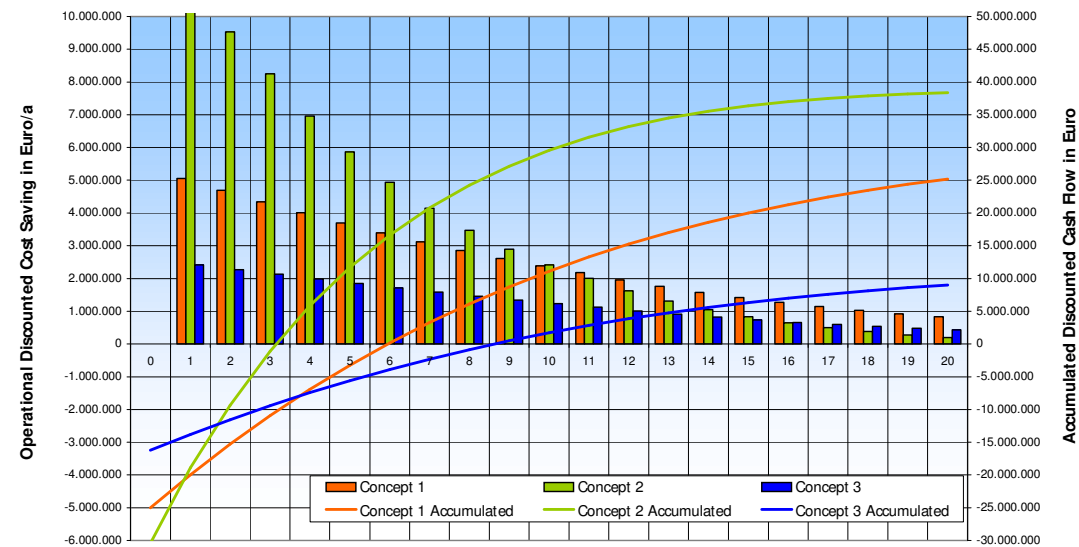
- The conventional power supply approach affects the overall energy balance.
- Cogeneration => Reduced primary energy demand through combining electricity and heat generation on site.
- Environmental emissions can be further reduced by means of renewable energy sources for fab electricity generation.



Sustainability - Cogeneration Plant



Cogeneration Plant Concept Comparison - Cash Flow Evaluation



Quality Power

- No energy supply interruptions
- High quality of energy

Economical

- Primary energy saving
- No operational interruptions
- Higher availability
- Low operational costs

Ecological

- Primary energy saving
- Reduced CO2 and NOx emissions by up to 60%

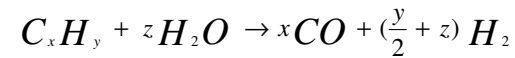
Outlook: Biogas Cogeneration Plant

- Cogeneration plant fuelled by biogas
- Biogas generation by “used” biomass by



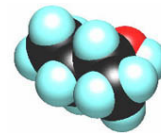
- Biomass gasification

- High efficiency
- Large-scale technique required



- Biogas generation by fermentation

- Easier procedure
- Much lower efficiency



Biomass Gasification: Blue Tower

- Biogas supply by pipeline to the Fab
- High efficient and CO2 free combined electrical power, heat and chilled water generation



Fermentation

Conclusions

- Large scale sustainable manufacturing for established PV technologies can provide:
 - Minimized environmental impact
 - Energy Co-Generation
 - Water re-use / recycling
 - Chemical recycling
 - On-site gas generation / recycling
 - Long-term expansion capability
 - Reduced manufacturing cost



m+w zander



Thank you.

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