



Zurich, March 25, 2004

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Executive Vice President
UNAXIS Displays Div.




OVERVIEW

- UNAXIS and UNAXIS Displays
- Trends in AM-LCD
- Synergies to thin film Si PV
- UNAXIS SOLAR
- Thin film Silicon Solar cells
- Goals & Milestones
- Summary



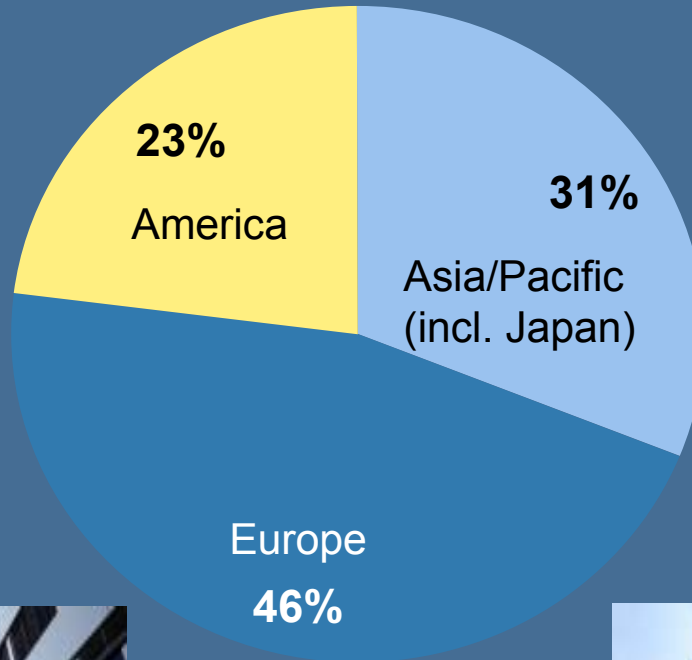
Unaxis a swiss based high tech company

Unaxis							
Semiconductor Equipment			Data Storage Solutions	Coating Services	Vacuum Solutions	Components and Special Systems	
Wafer Processing	Assembly & Packaging	Display Technology				Optics	Space Technology
unaxis	esee	unaxis	unaxis	<i>balzers</i>		unaxis	Contraves Space

8 Divisions 1.5 BCHF 6500 employees 83 countries

UNAXIS - Worldwide presence

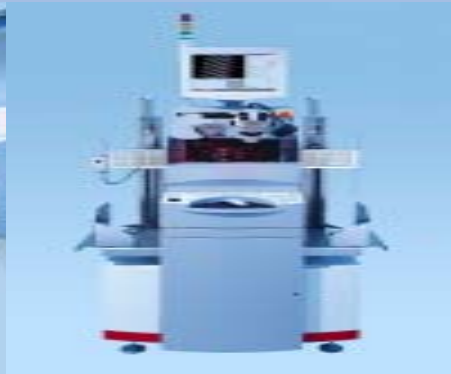
Five competence centers, over ninety companies



Semi Front End



Semi Backend



Data Storage



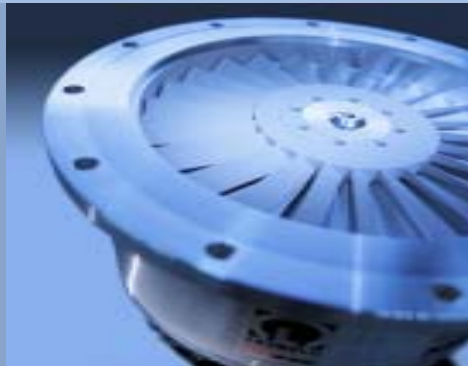
LCD Displays



Optical Components



Vacuum Pumps



Surface Coatings



Payload Fairings



Unaxis Displays Division



Palaiseau (Paris)
France



Trübbach
Switzerland

R&D SOLAR
Neuchatel
Switzerland



Shanghai
China



Korea



Tokyo Japan



Hsin Chu Taiwan



Osaka Japan

LCD technology : 4 major applications



Mobile
PDAs



Laptops



Monitors



TV

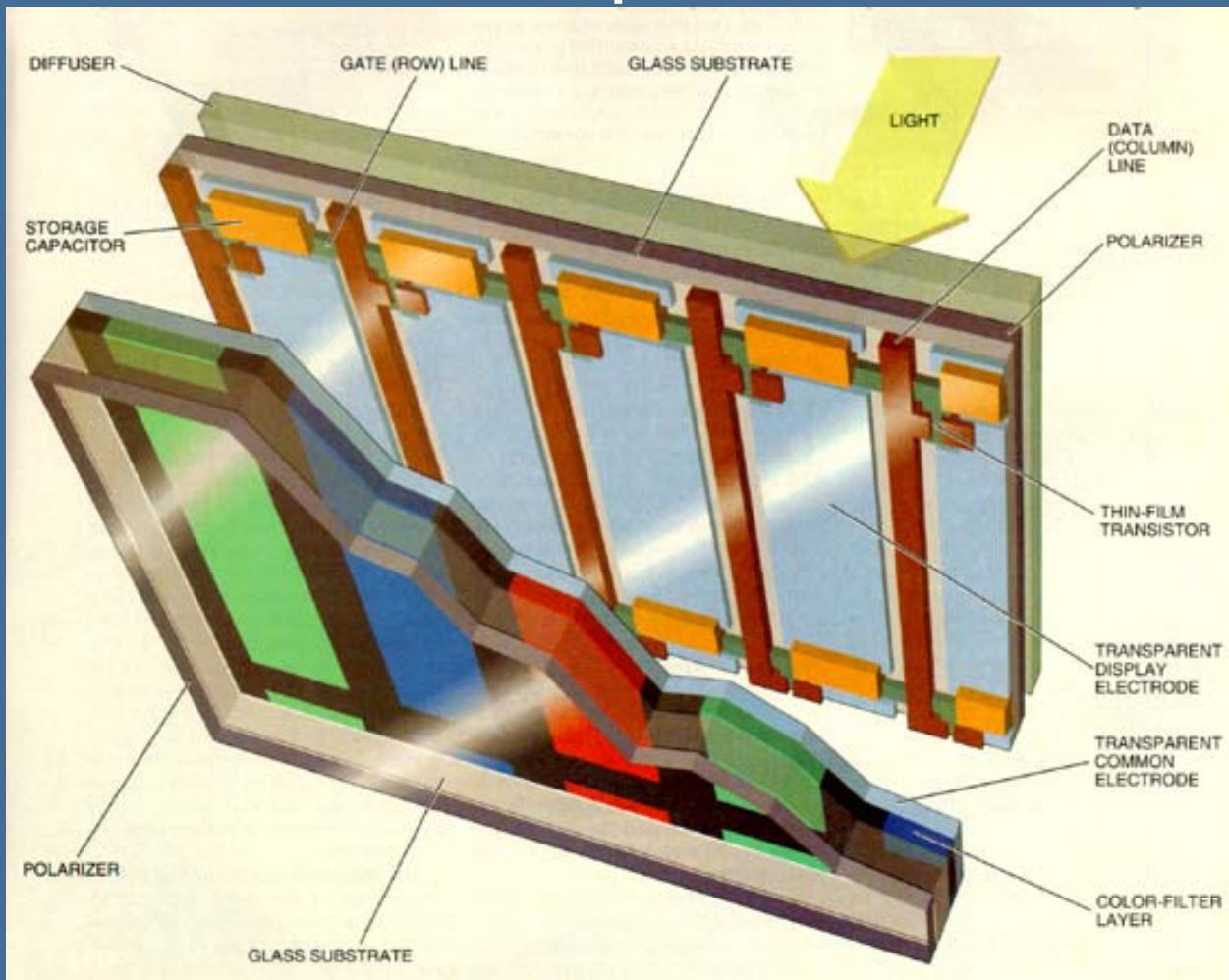
Only possible with LCDs

Growth same as end market

Replacement of CRTs

**Growth higher than end market due to
additional replacement effect**

TFT LCD Principle



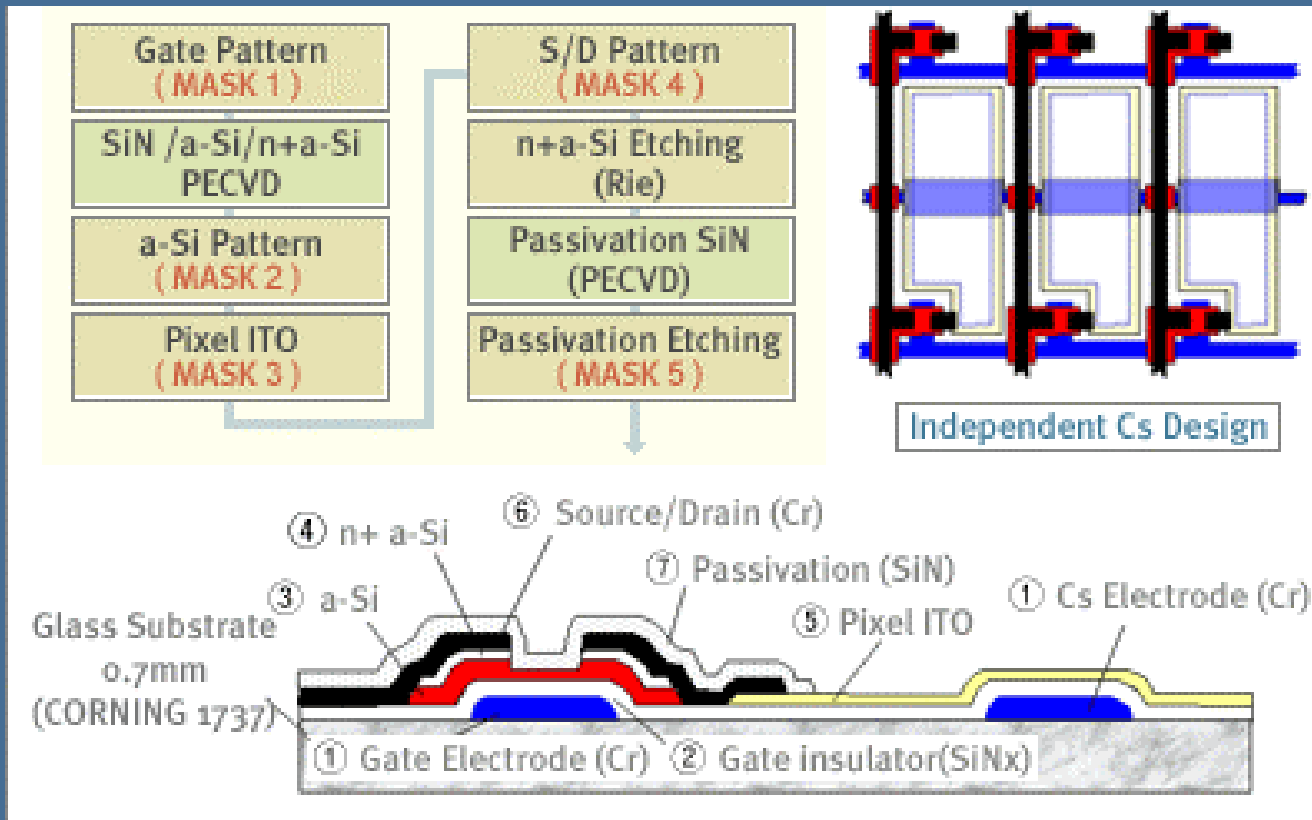
Key Components

- Back light
- Glass
- TFT Our Focus
- Liquid Crystal
- Color filter
- Polarizer
- Drivers
- Housing

Details of Thin Film Transistor LCD

Key Technologies

- Deposition
- Etching
- Photo Lithography



Courtesy Samsung

AM-LCD array for LCD Monitors

Multiple AM LCD array w/TFT, produced on large thin glass



**A Fully
Asian Business**

Courtesy LG Philips

UNAXIS DISPLAYS Division

Products : Deposition Equipment for TFT LCDs



KAI Systems

Plasma Enhanced Chemical Vapor Deposition (PECVD) for TFT&Pass.

- High quality at lower cost-of-ownership



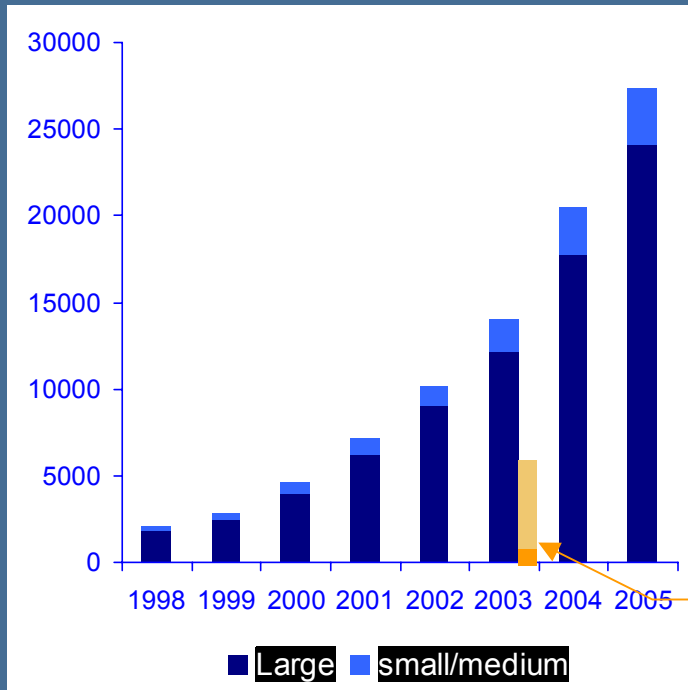
UNI Systems

Physical Vapor Deposition (PVD) for metal & ITO deposition

- Best processes in the industry

AM-LCDs: Strong growth

X1000 m2



Source :Nikkei Microdevices FPD 2002 yearbook and Display search 2003 feb

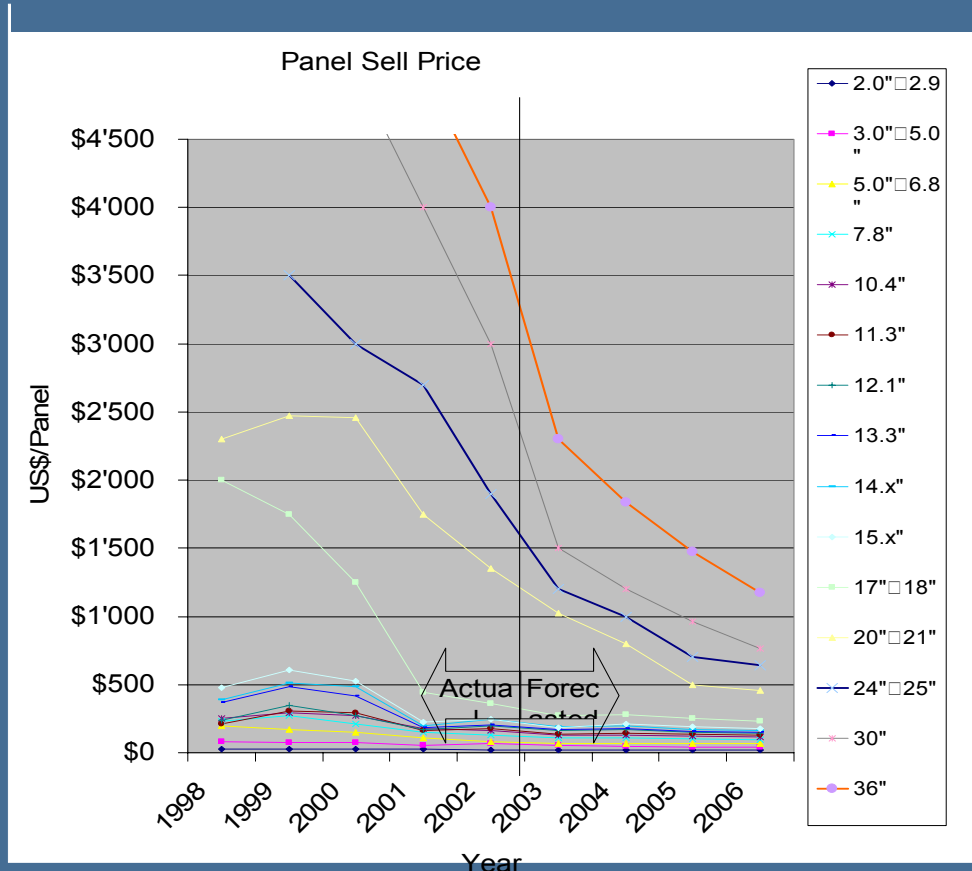
Mobile includes active (TFT) and passive (non TFT) displays

From 22 bn\$ to 48 bn\$ in 2005
Monitor and TV the main driver

Mio Units	2000	2005
Mobile	380	460
Laptops	24	47
Monitors	6	90
TVs	0.2	7

SOLAR Cells:
(for comparison)
c-Si: ~6.5km2
TF-solar cells:~0.6km2

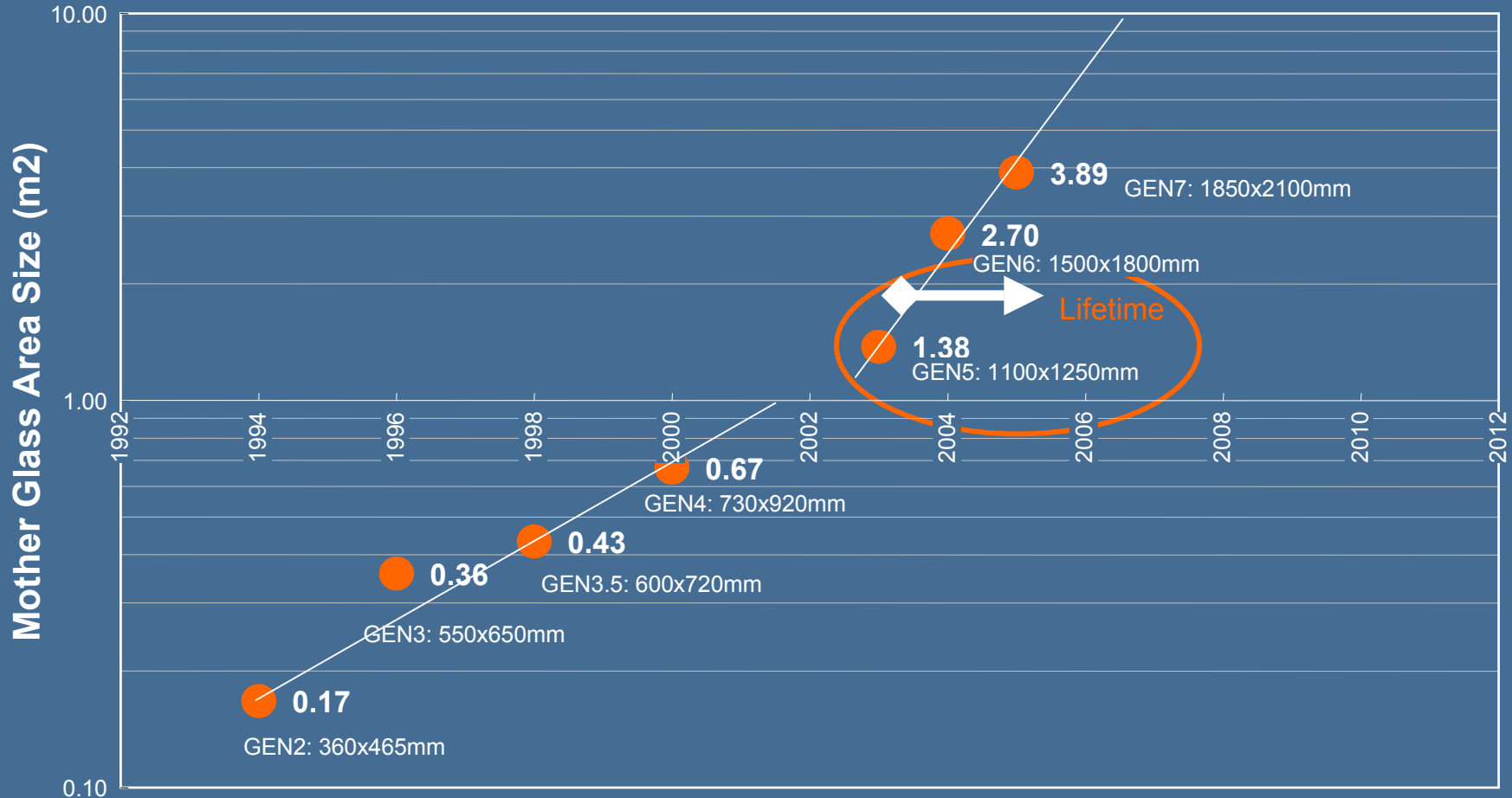
Massive growth by reducing prices substantially TFT LCDs becoming affordable



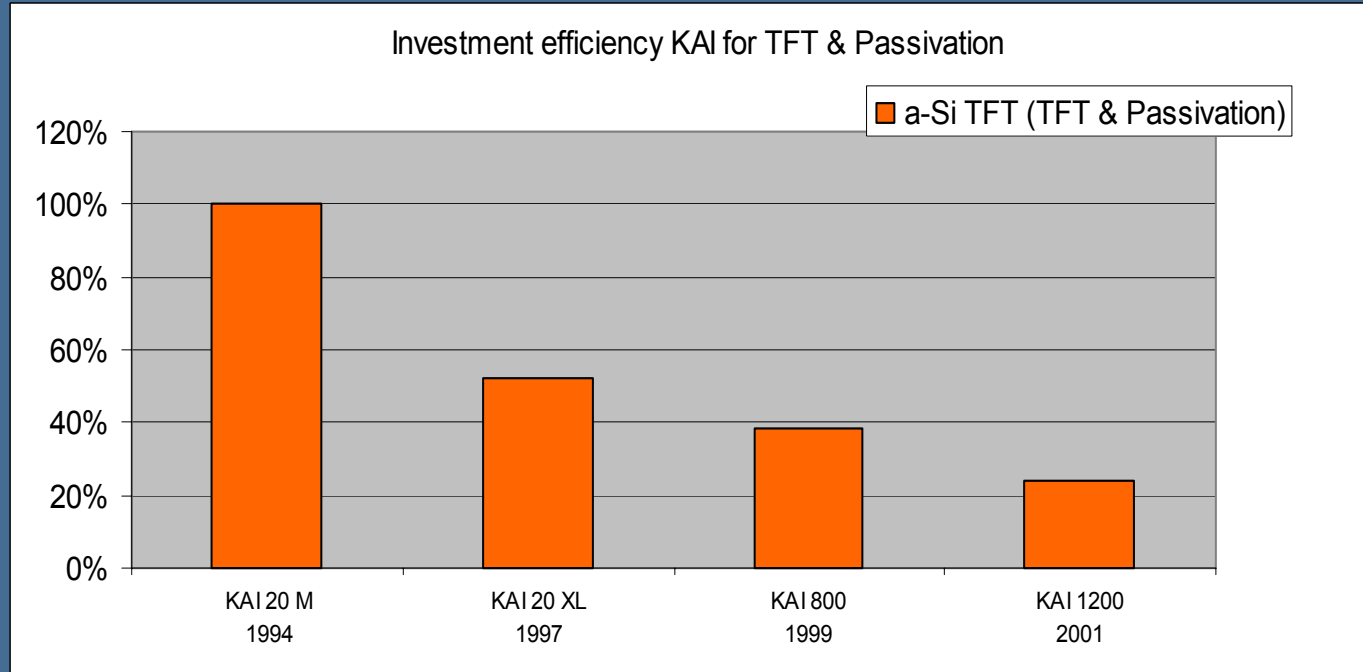
- 50 % in 2 years in LCDs
- For comparison: 5% per year in photovoltaics

Cost reduction by using bigger glass size

More products per motherglass means lower costs



Also bigger machines are more efficient per sqm



KAI System

Glass size: 0.2 m² 0.4m² 0.64m² 1.4m²

- Glass size from 0.2 m² to 1.4m²
- >75% cost reduction in 7 years; 21% per year!

Unaxis looking for attractive growth markets where its technology can make a difference

Thin Film Solar Cells

- attractive new market, long-term growth
- no big player established yet
- relatively straight-forward technology transfer
- Knowhow and patents developed in CH



EPFL and KTI

UNAXIS SOLAR - A new Venture

Board approval in December 2002



- Goal: Develop manufacturing technology for thin film Si cells with substantially lower manufacturing cost using our TFT LCD knowledge
- Mission: Become leading supplier of production solutions for thin film-Silicon solar cells

Why Thin film Silicon ?

Thin Film Silicon Cells

- Material cost for device: <0.35 Euro/Wp
- Far less energy in prod.
- Lower cost for manufacturing
- Excellent suitability for BIPV (Large area, uniform appearance)

Solar Cell Technology	c-Si (mono/multi-cryst. Si)	Thin Film Si (a-Si and/or a-Si/uc-Si)
Availability of raw material	ok	ok
Environmental compatibility	ok	ok
Energy payback time	3-4 years	< 2 years
Rigidity, robustness	ok	ok
Cost reduction potential	LC: 15-18%	high
Suitability for BIPV	limited	excellent
Comment	continues to dominate, proven, large installed base	High potential with proven production techn.

Thin film Silicon for PV

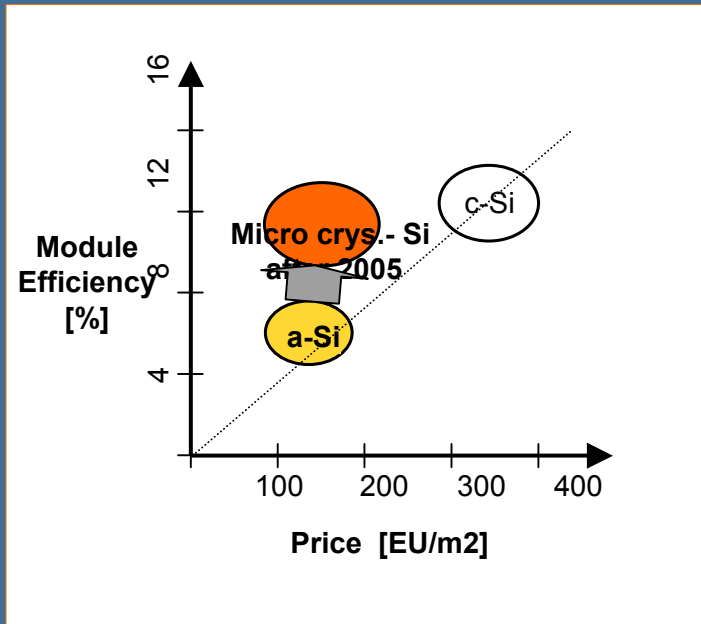
DIFFERENTIATION

■ a-Si:

Increase in efficiency, high energy yield, cost reduction with UNAXIS KAI technology
Ideal for BIPV -> Large area!

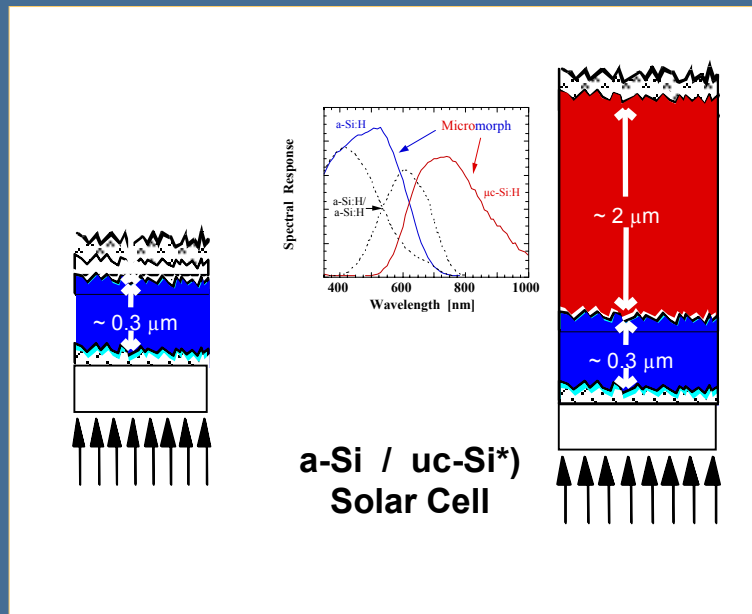
■ uc-Si:

Potential for cell efficiencies above 10%, at similar cost
for POWER market



Thin film Silicon for PV

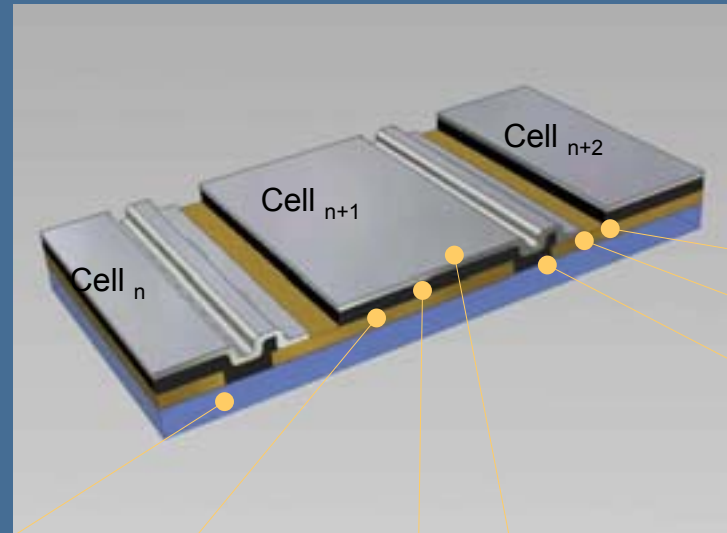
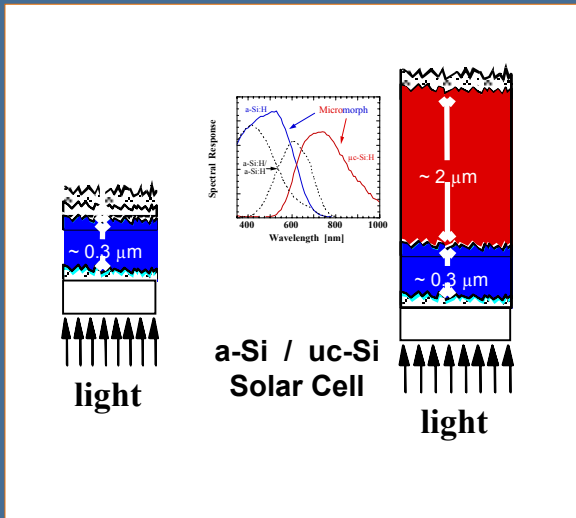
SIMPLE & SMART CELL CONCEPTS



*)Developed and patented by University of Neuchatel

- a-Si: Cell; Cost-effective, high energy yield
 Ideal for BIPV, large surfaces
- a-Si/uc-Si (Micromorph*) Solar Cell:
 Excellent light conversion; a-Si for VIS radiation
 uc-Si for NIR/IR light
- Both are suited for volume production
 Compatible with advanced UNAXIS DISPLAYS technology

Very Simple structure



- L/S #3
- L/S #2
- L/S #1

Glass

TCO

a-Si

Back contact

Goals of Unaxis Solar :

- Develop a 1.4 m² a Si process for solar
- Develop CVD TCO for 1.4 m² solar cell (requirements TFT LCD smooth for solar rough)
- Develop Laser scribing

- Budget approx 20 Mio CHF in 2 years
- Laboratory in Neuchatel
- Major production in Trubbach

- Cooperation with IMT and EPFL
- Strong support with KTI projects

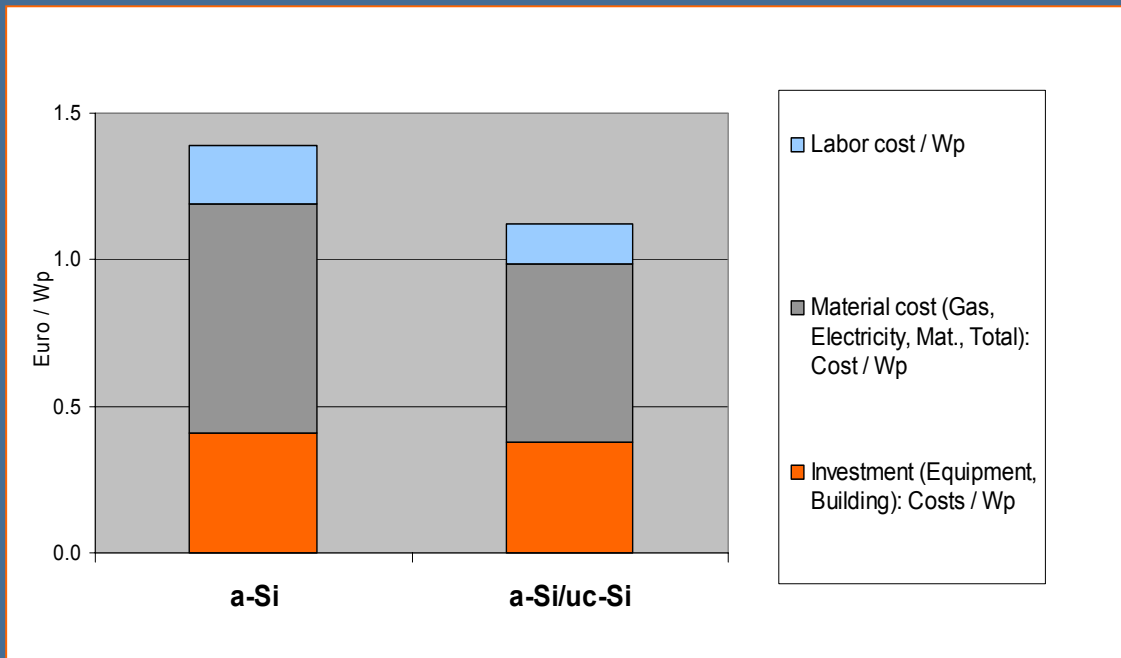


Unaxis SOLAR



- Jan 2003: Start
- Mid 2004: a-Si cell on 1.4m²
- Mid 2005: uc-Si cell on 1.4m²
- 2005: First KAI Production System going into mass production

Goal Making a 1 Euro/Wp film Silicon solar cell



- **Material: 60% of cost**
 - Optimized solutions for encapsulation in future
 - Process optimization for reduction of thin film mat. Cost

- **Investment**
 - <40% of total cost
 - Experience curve for further reduction

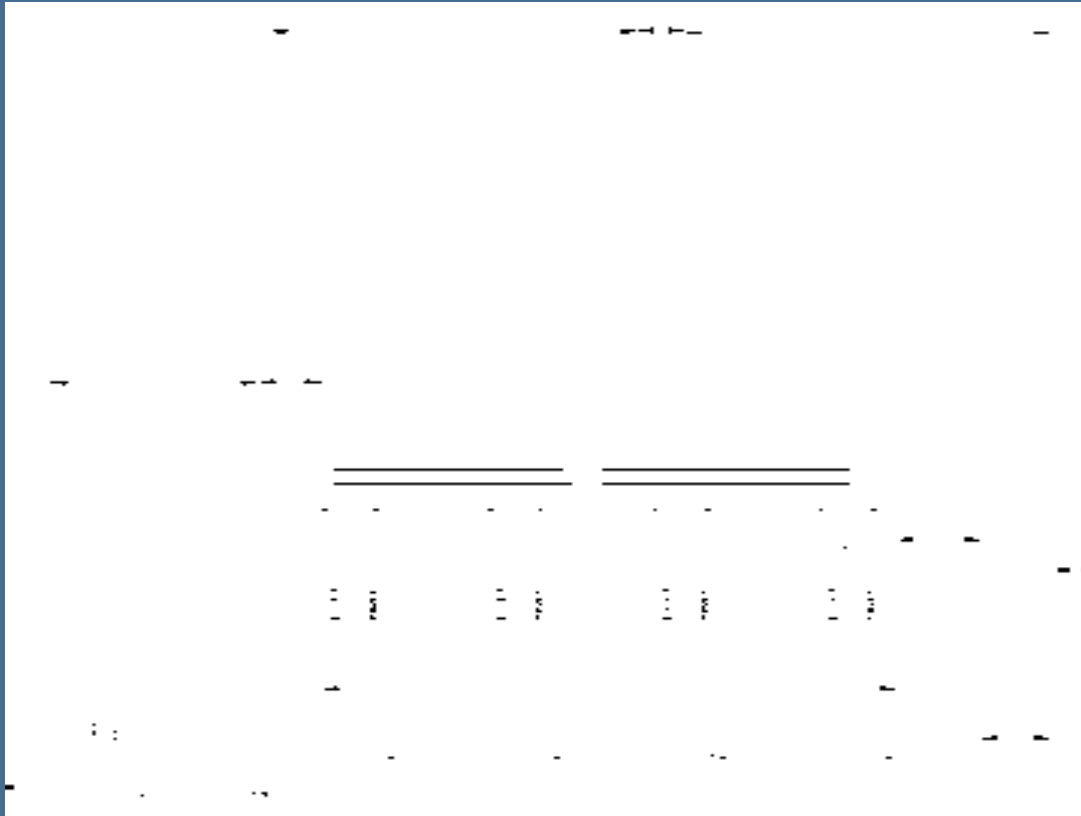
- **Labor**
 - Low, further reduction with line automation /expansion

Goal a simple complete factory

2 min. TACT time - approx. 3200 m²

Approx. 40 m

Approx. 40 m



- Additional space for back-end (encapsulation), approx. 800m²
- Additional space for facilities, approx. 800m²

Goal develop viable BIPV

Thin Film Si and BIPV - Key elements



BIPV Products with thin film Si from RWE-Schott SOLAR GmbH

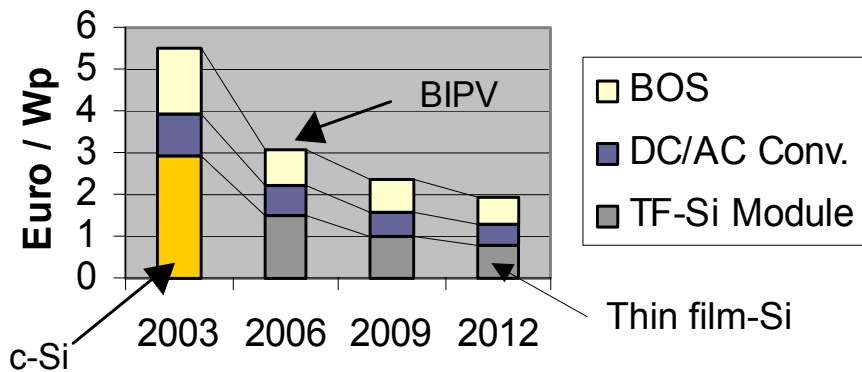
BIPV - Appeal and performance

- **Modern Facade**
Thin film Si cells are ideal for sound BIPV solutions, because of uniform dark appearance
- **Semi-transparent solutions**
Semi-transparent cells for office buildings, roof solutions
- **Meet performance & cost goals**
Integrated solutions are key to meet future cost & performance goals

Bring cost down substantially

Thin Film Si and BIPV - Key elements for the future

PV with thin film Si technology



- Module: Thin film Silicon techn.
 - Advanced thin film techn
 - LCD experience curve

- DC/AC Converter
 - Experience curve / Volume
 - Integration
 - Distribution

- BOS (Mounting mat. & Inst.)
 - BIPV from technology to applied solutions
 - Distribution

Year	2003	2006	2009	2012	2015
Euro/Wp	5.5	3.1	2.20	2.00	1.71
Sun hours/a	1'800.00	1'800.00	1'800.00	1'800.00	1'800.00
Euro/kWh	0.27	0.15	0.11	0.10	0.08
Sun hours/a	1'000.00	1'000.00	1'000.00	1'000.00	1'000.00
Euro/kWh	0.49	0.27	0.19	0.18	0.15

Assumptions: no subsidies, 20 year product life, 4%, 1.5% ins., maint.

Unaxis SOLAR - Current Status



- On track, according to business plan
- Research team in Neuchâtel in place
 - Already good results for a-Si cells
 - Promising results for uc-Si feasibility
- Development team in Truebbach
 - KAI 1-1200 for cell dev. on 1.4m² in place
 - System adaptation and integration ongoing
 - Process integration on 1.4m² starting in April
- Product Mgmt & Sales org. in place

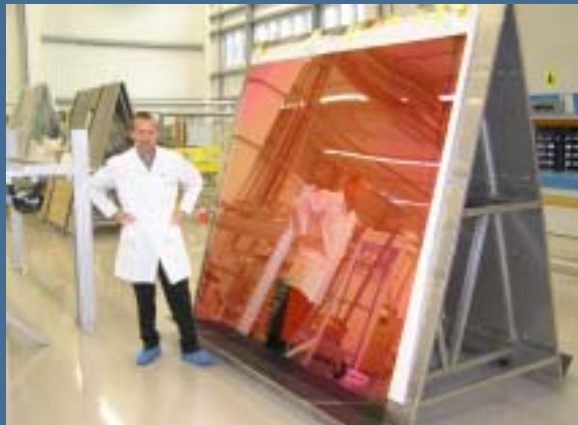
Solar team: 14 people today, expansion planned

UNAXIS SOLAR in the FUTURE



SOLAR CELL SIZE TODAY

- Development of 1.4 m² size
a-Si cell first, then uc-Si cell



SOLAR CELL SIZE IN FUTURE

- Development of 5m² size:
New displays glas size, available in future for SOLAR



We're well on track, receive a lot of interest from the market
and look with a lot of enthusiasm into the future!

Thank you!
Thank you IMT EPFL and KTI