



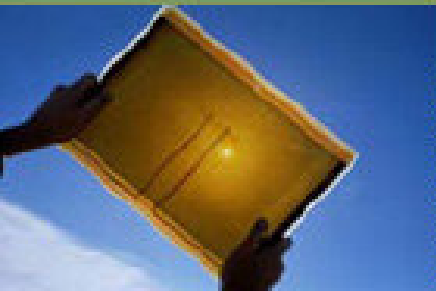
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Glass & Module Size for Thin Film Solar

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clean affordable renewable energy™

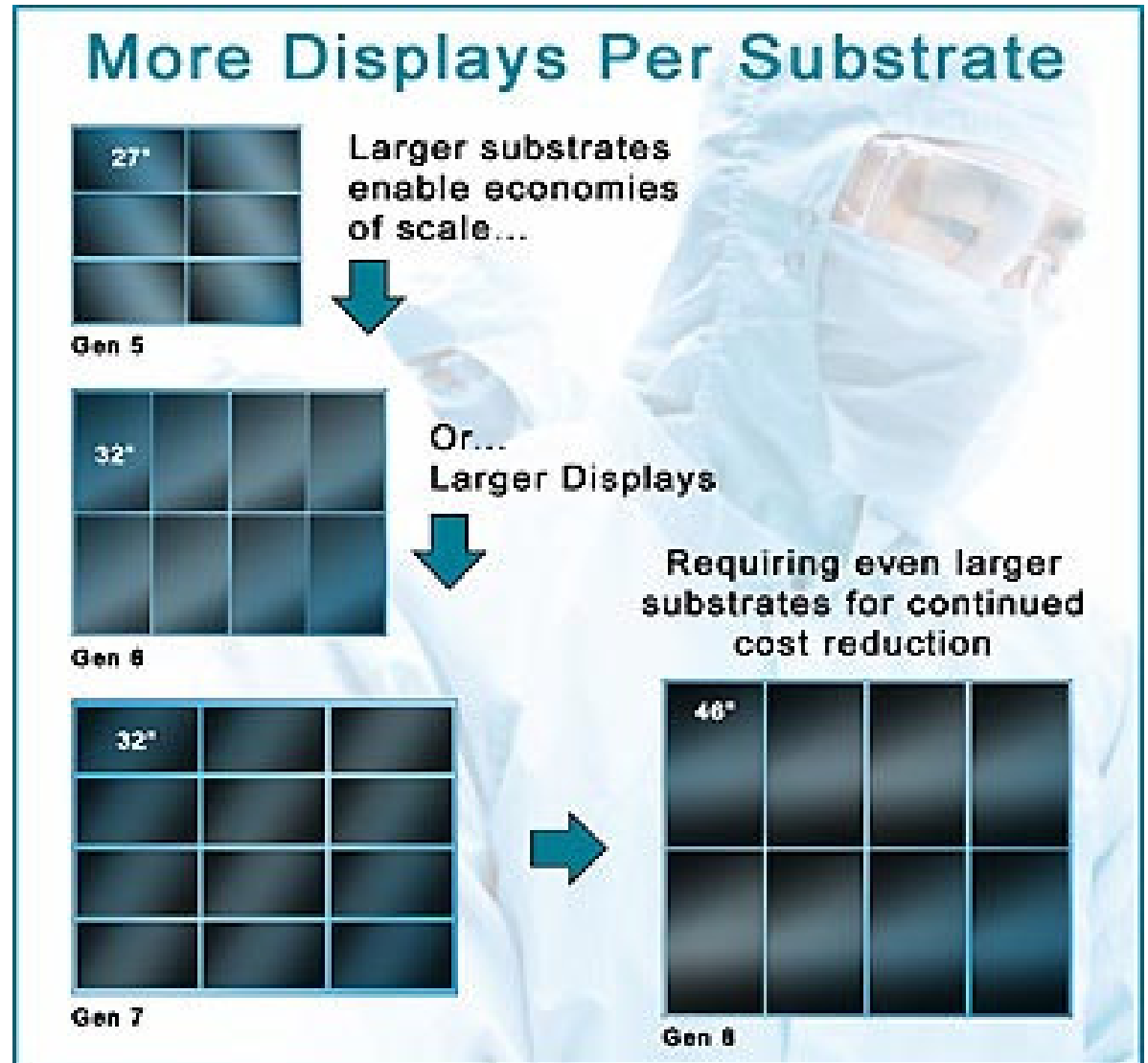


Glass & Module Size Thin Film

- Glass size
- Equipment up-scaling
- Module size

Economy of Scale for LCD Technology

- Glass Thickness 0.7mm
- G5 1.10mx1.30m
- G7 1.87mx2,20m
- G8 2.20mx2.50m
- G9 2.40mx2.80m
- G10 2.85mx3.05m
- Status
- G8 production
- G10 planning Sharp



Source: Corning 09/2007

Economy of Scale for LCD Technology

Summary for LCD displays

- Specific glass size & production (no loss)
- On side glass production (Corning)
- Specific equipment market
- Cost reduction by up-scaling

Conclusion for Si thin film PV

- Si Thin film is connected to LCD market
- More and larger PV modules per substrate

Status Thin Film

- Status module production

| Schott Solar | Kaneka | Sharp | CSG Solar | Würth Solar | First Solar | Antec Solar |
|--------------|-------------|------------------------|-------------|-------------|-------------|-------------|
| a-Si | a-Si | a-Si/ μ -Si Tandem | tf-c-Si | CIS | CdTe | CdTe |
| ASI-F90 | G-EA060 | NA-901WP | CSG 100 | WS 11007/80 | FS-272 | ATF 50 |
| 1,1mx1,3m | 0,99mx0,96m | 1,13mx0,93m | 1,25mx1,10m | 1,2x0,6m | 1,2mx0,6m | 1,2mx0,6m |

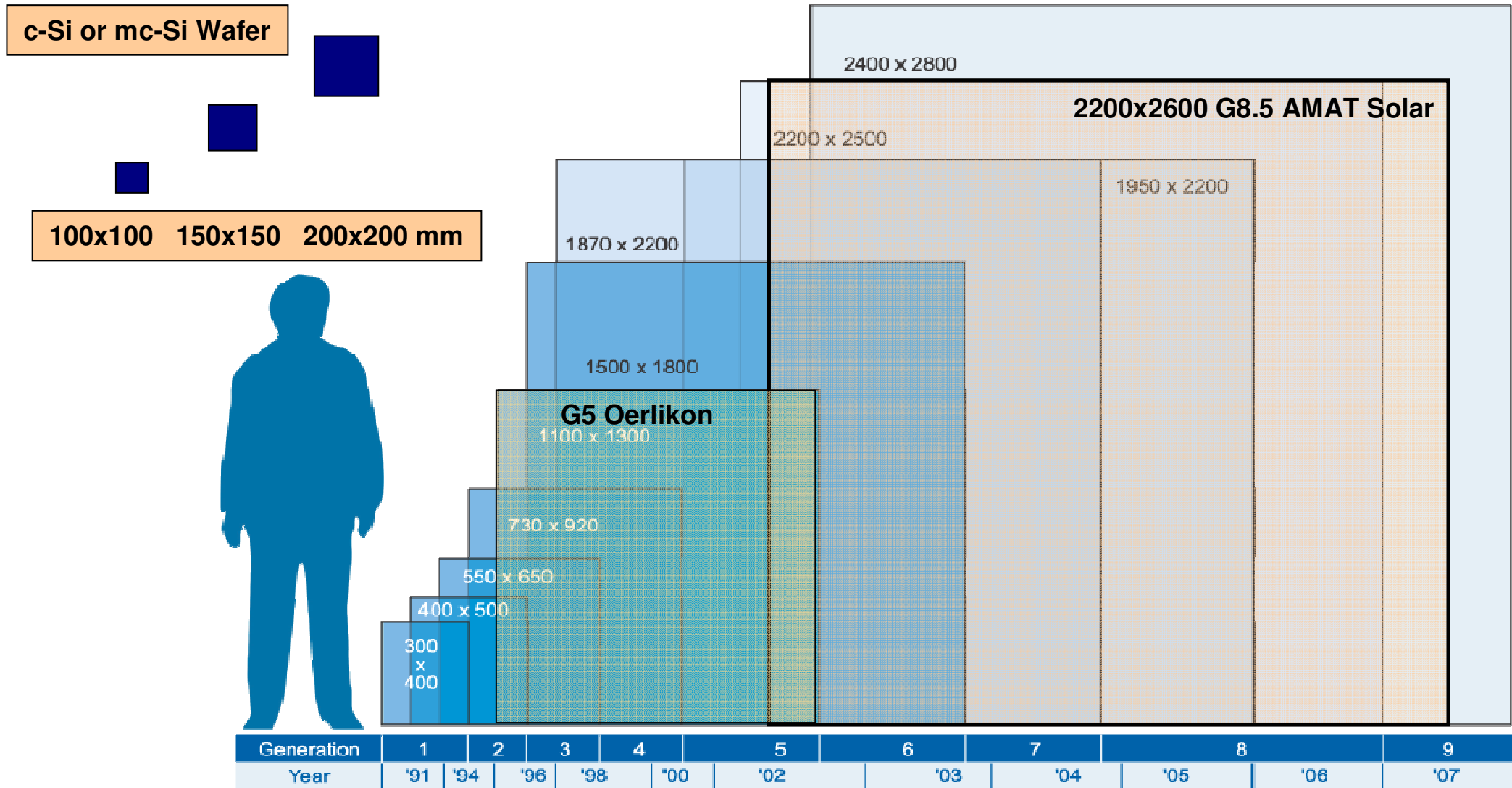
- Status equipment for a-Si/ μ -Si thin film

| Oerlikon | AMAT | Ulvac |
|------------------------|------------------------|-----------|
| a-Si/ μ -Si Tandem | a-Si/ μ -Si Tandem | a-Si |
| 1,1mx1,3m | 2,2mx2,6m | 1,1mx1,4m |
| G5 | G8.5 | G5.5 |

- Equipment from LCD

Substrate Size Roadmap for TFPV

- Si Wafer versus Glass Size (Generation 1 to 9 Flat Panel Industry)

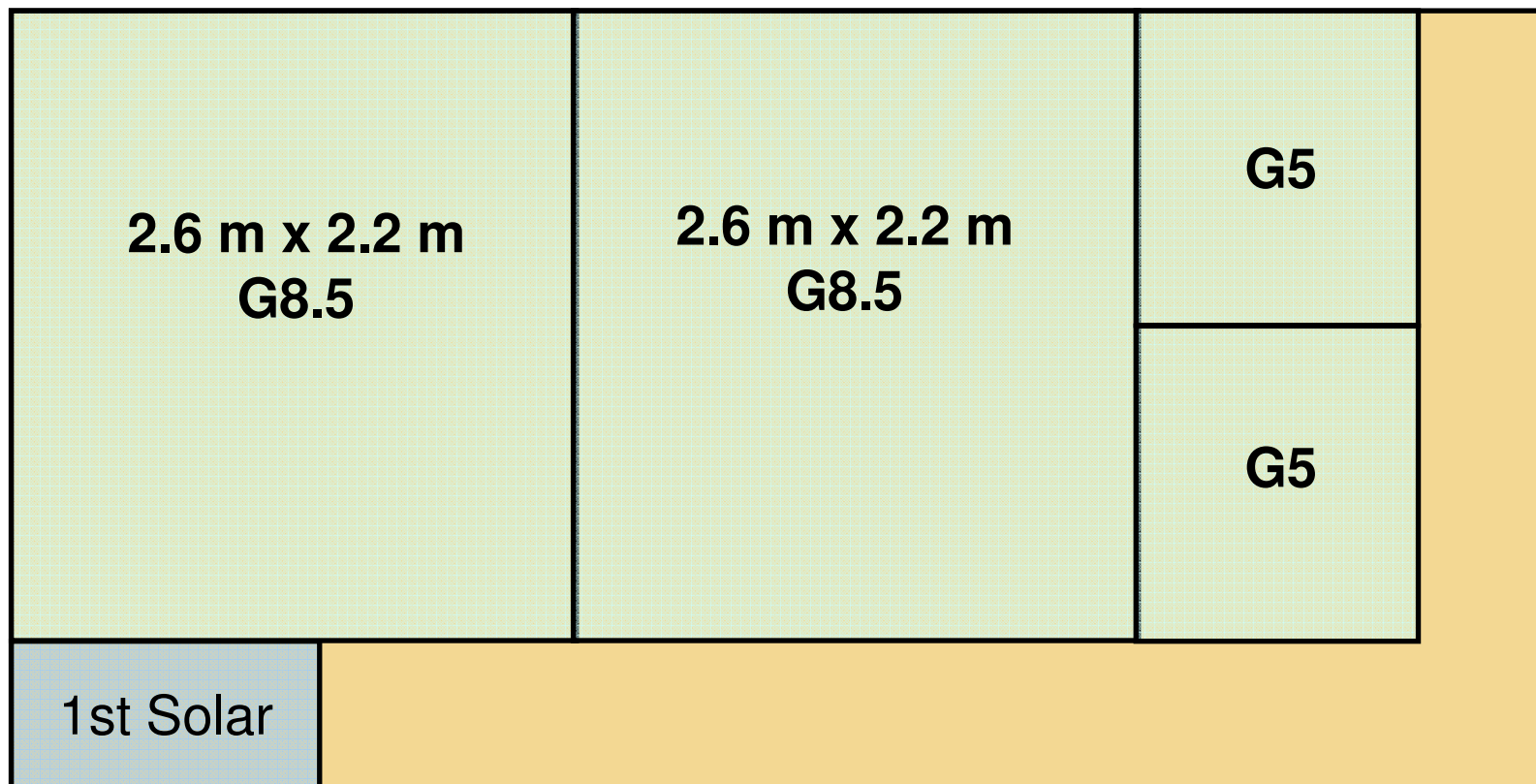


Source: Basler AG 07/2007

Float Glass Size

- Architecture glass size (Europe)

3.21 m x 6.00 m



- Back Glass ~ 40% glass loss for G8.5; 25% for G5
- NSG TCO Glass ~ 20% loss

Optimal Module Size

- Cost Reduction by up-scaling for 60MW line

| Glass Size | 1.2x0.6m | 1.1x1.3m | 2.2x2.6m |
|---------------------|----------|------------------|--------------------|
| Invest | 1 | ↓ | ↓ |
| Transportation | 1 | | |
| Handling | 1 | | |
| Packaging | 1 | | |
| Mechanical strength | 1 | Glass 3.2mm (4)? | Glass 3.2mm (4/5)? |
| Mounting strength | 1 | Back bars ? | Back bars ↓ |
| Cables, j-boxes | 1 | ↓ | ↓ |
| Weight (kg) | 12 | 25 | 99 |
| Mounting frames | 1 | ↓ | ? |
| Mounting effort | 1 | ↓ | ? |
| Maintenance | 1 | ↓ | ? |

Summary

- Detailed calculation are necessary
 - Production cost per Wp
 - BOS cost per Wp
- Mechanical and mounting issues?
- Specific glass production for PV
- Optimal glass size for production G8.5?
- Optimal module size for BOS G5?

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