

# AGC Chemicals Europe, Ltd

Phil Spencer : Technical Service Manager

# Olympics 2008 “Water Cube”



# Olympics 2008 “Bird’s Nest” Stadium **AGC**



# Today's Presentation

- Asahi Glass Company Introduction
  - Who is Asahi Glass?
  - Where are we located?
  - What are our key Product Ranges?
- What is ETFE (ethylene tetrafluoroethylene)
- The Way to Beijing.....
  - Understanding the Product Value chain
  - Technical advantages, challenges
- Plan for London 2012 .....and beyond

# AGC Company Profile

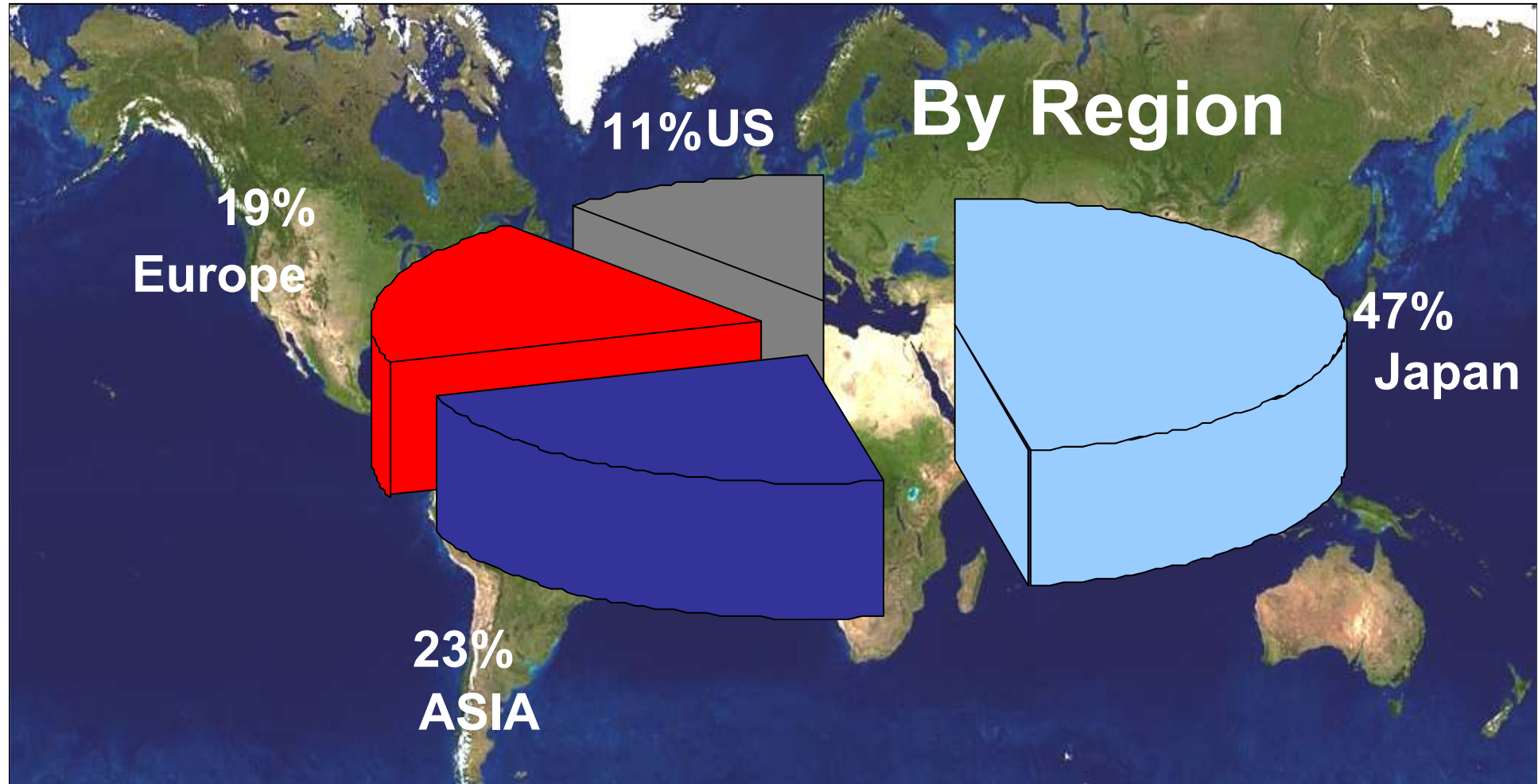
- Founded in 1907 in Tokyo
  - 239 Subsidiaries in 24 Countries
- Over \$14 billion sales worldwide (2006)
  - 54,200 employees
- Partner with ICI in successful PTFE joint venture
  - Asahi-ICI Fluoropolymers 1981 – 1999

\* PTFE ; PolyTetraFluoroEthylene

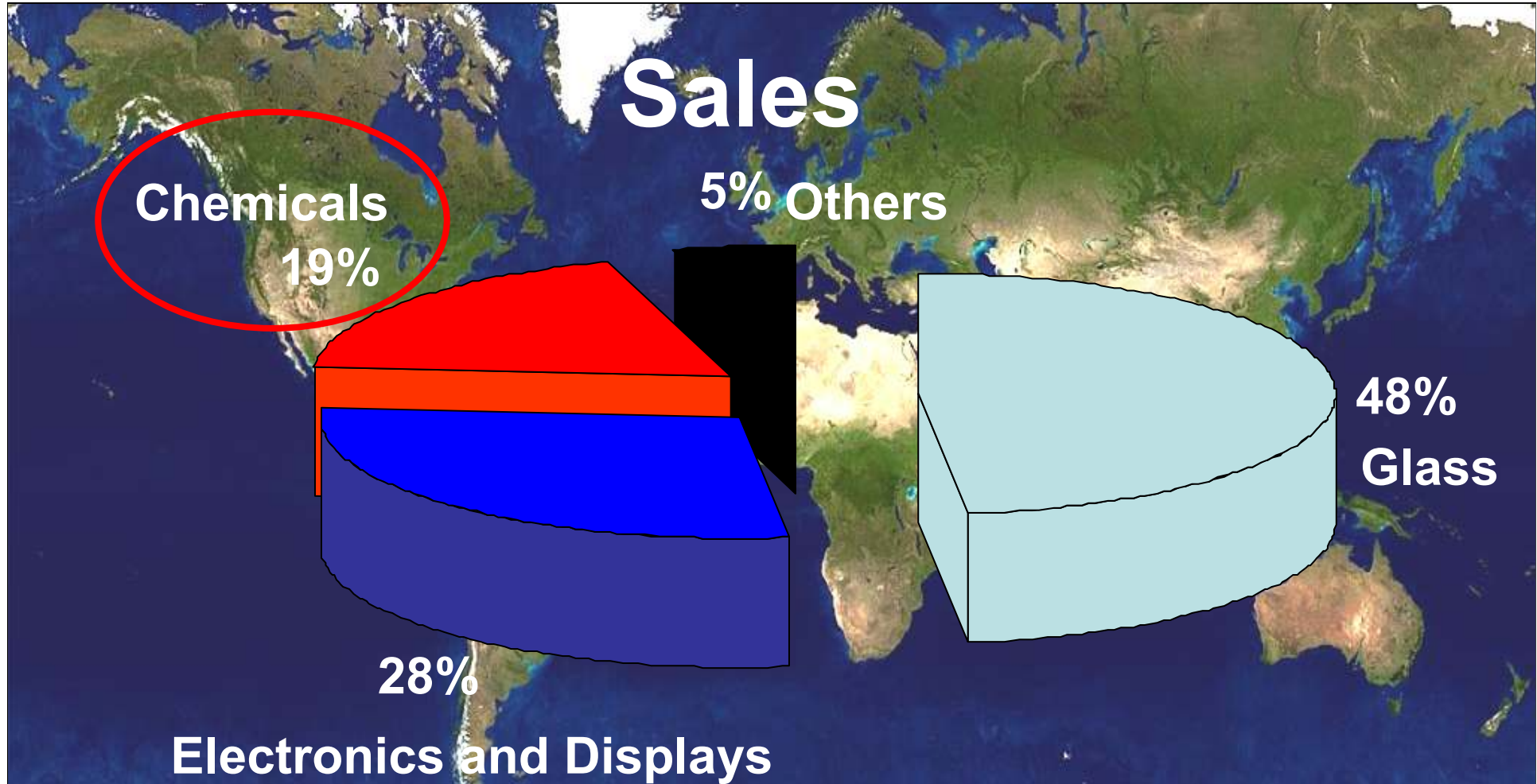
# AGC Company Profile: Sales



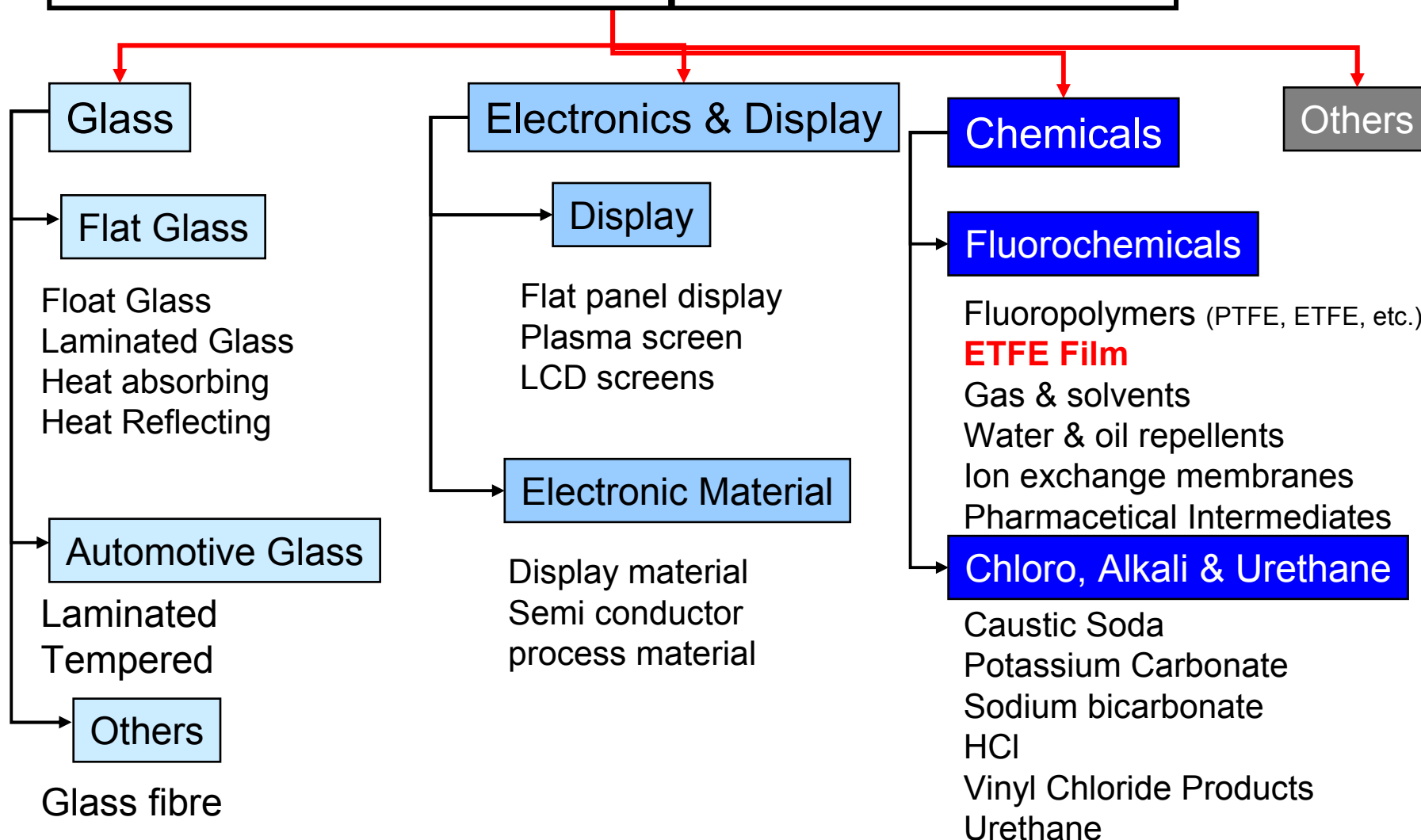
# AGC Company Profile: Sales



# AGC Company Profile: Sales



# Asahi Glass Group — t/o14 billion US \$



# What is ETFE? (Markets)

- **Transportation**

- Aerospace
- Automotive



- **Chemical Industry**

- **Electronics Industry**

- Semi conductor , wire & cable

- **Life Sciences**

- Pharmaceutical
- Medical

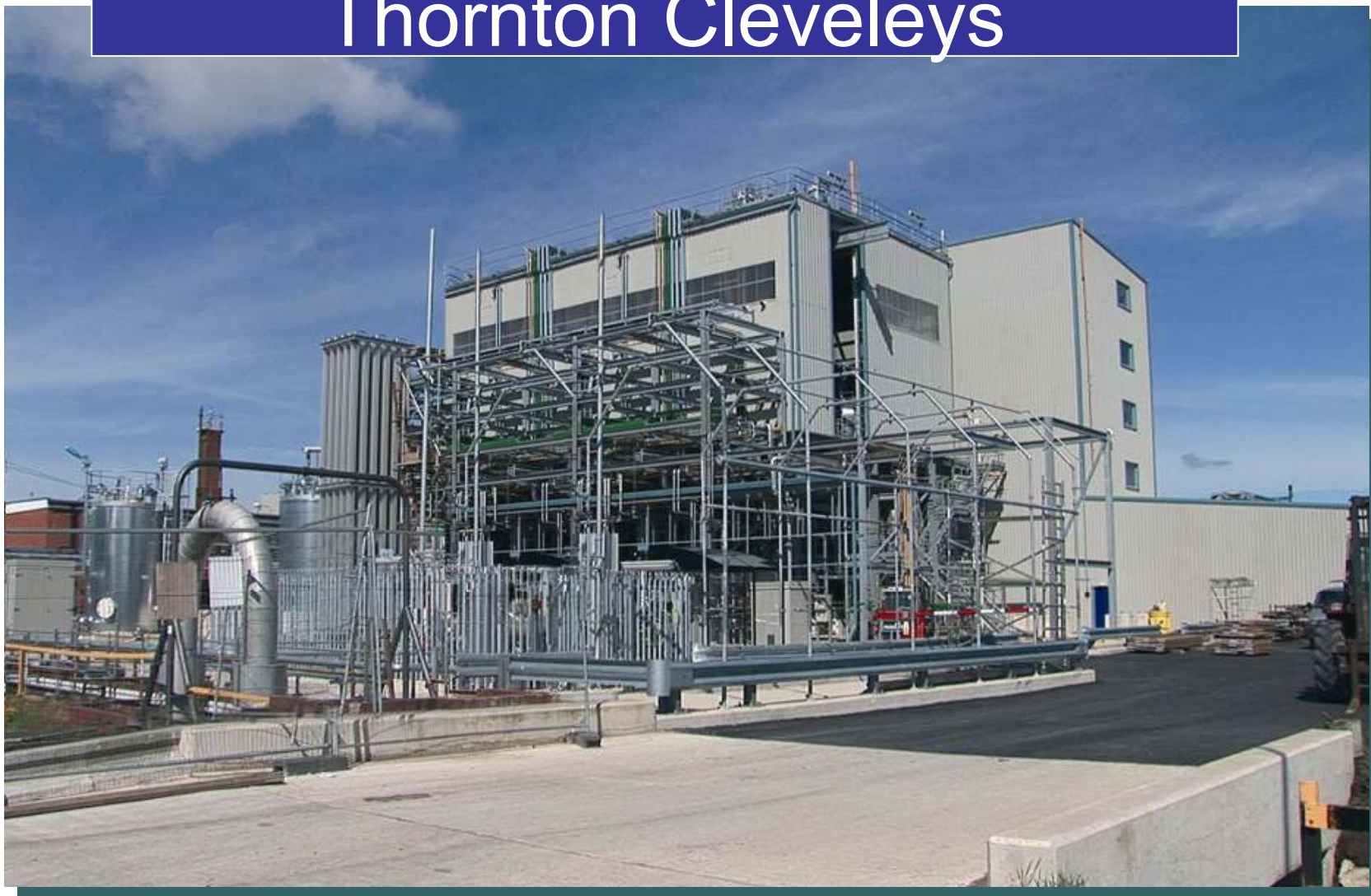


- **Architectural**

- Construction, Sports Stadia,
- Green Houses

# UK ETFE Production Site: Thornton Cleveleys

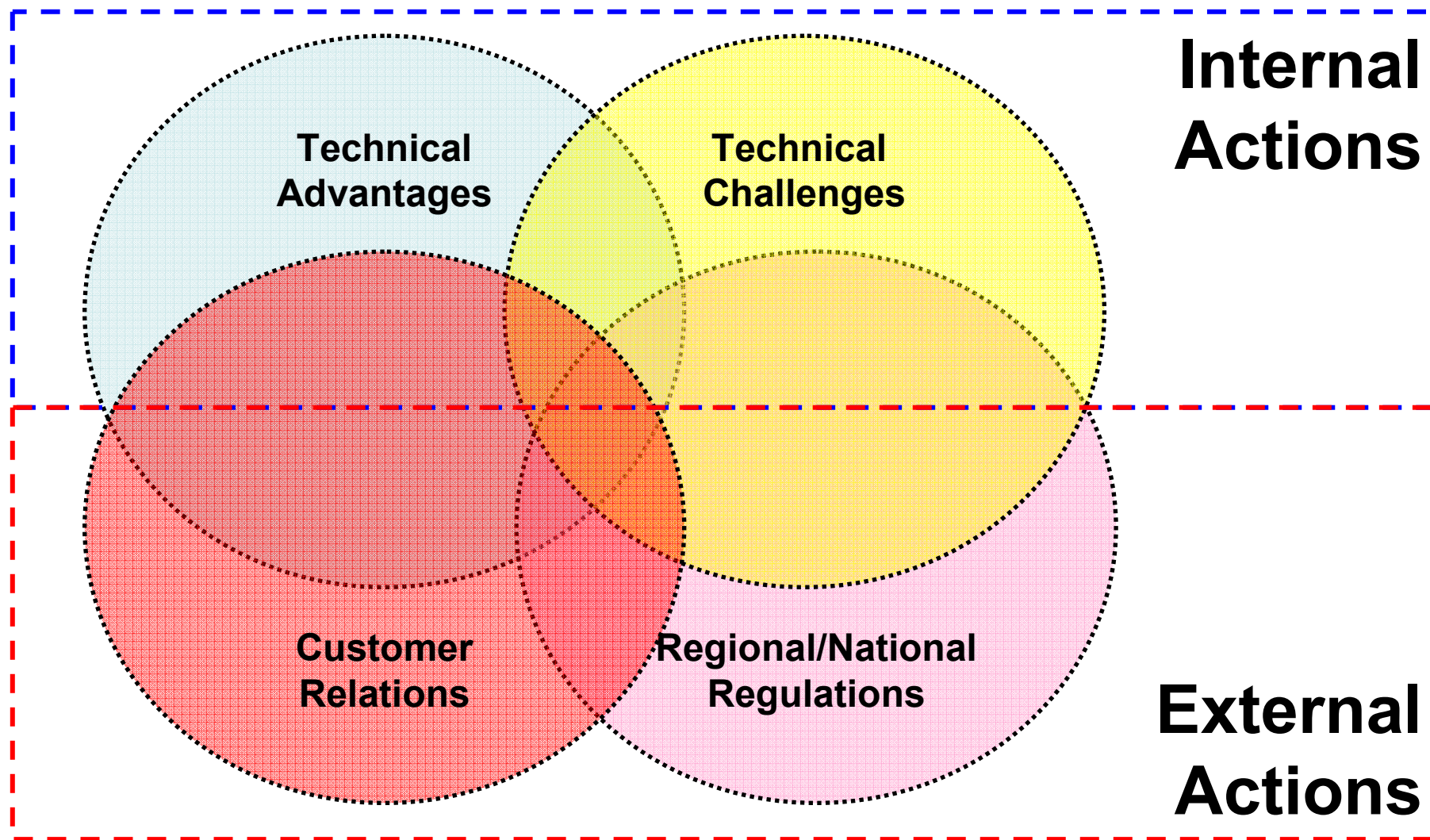
**AGC**



# ETFE FILM



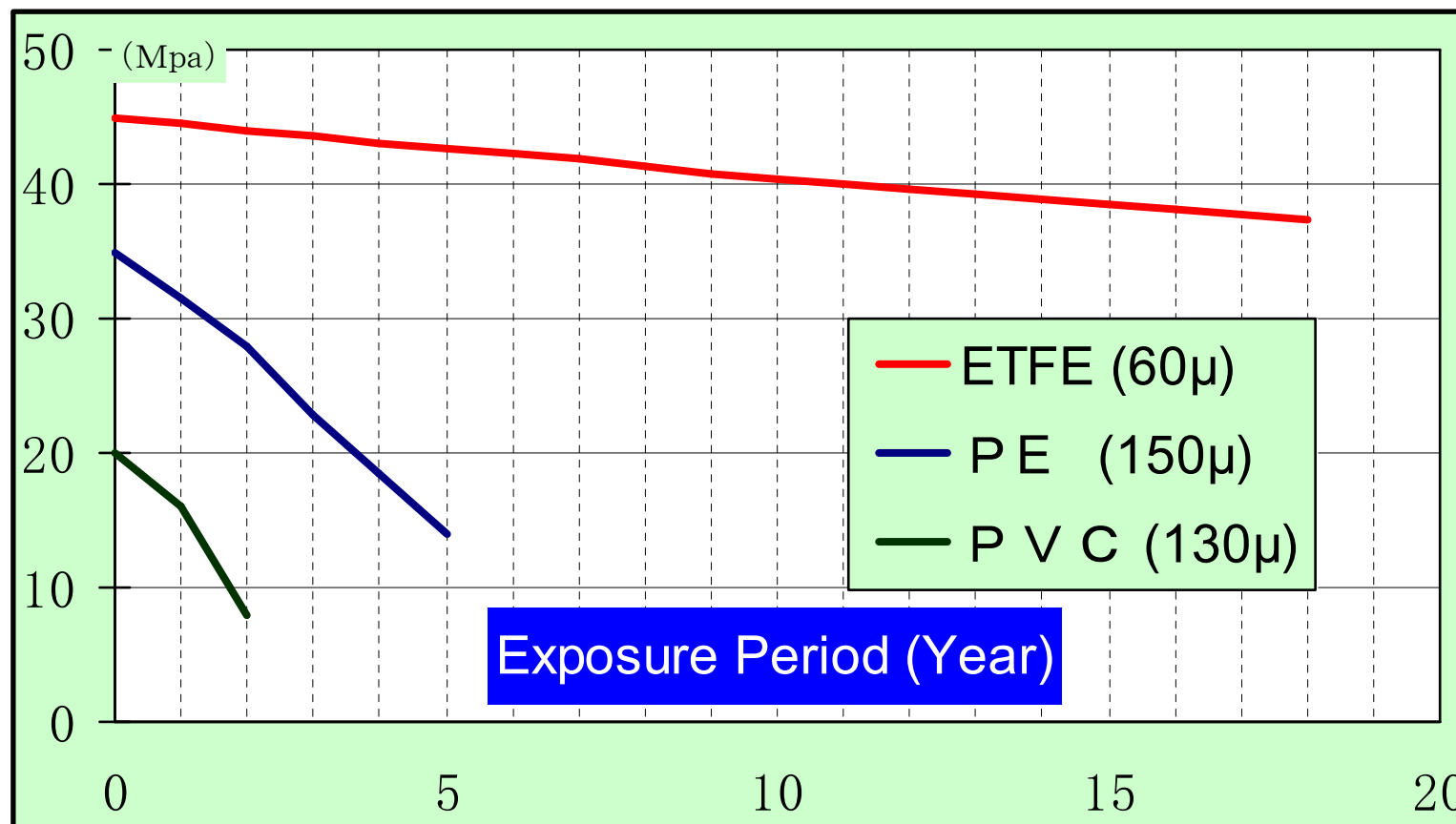
# Way to Beijing : How and why chosen?



# Technical Advantages

- Stadium Requirements
  - UV (Ultra Violet) light transparency (over life of the structure)
  - Transparency – Grass growth, evening illumination
- Construction Requirements
  - Mechanical Performance (over life of the structure)
  - Resistance to environmental agents
  - Light weight (eg. glass) – lighter support structure
- Design Requirements
  - Flexibility – shape effects
  - Thermal Insulation – Water Cube Swimming Complex
    - Inflated ETFE film will reduce heating energy costs by 30%
    - Lighting costs reduced 55%
    - No artificial lighting during the day

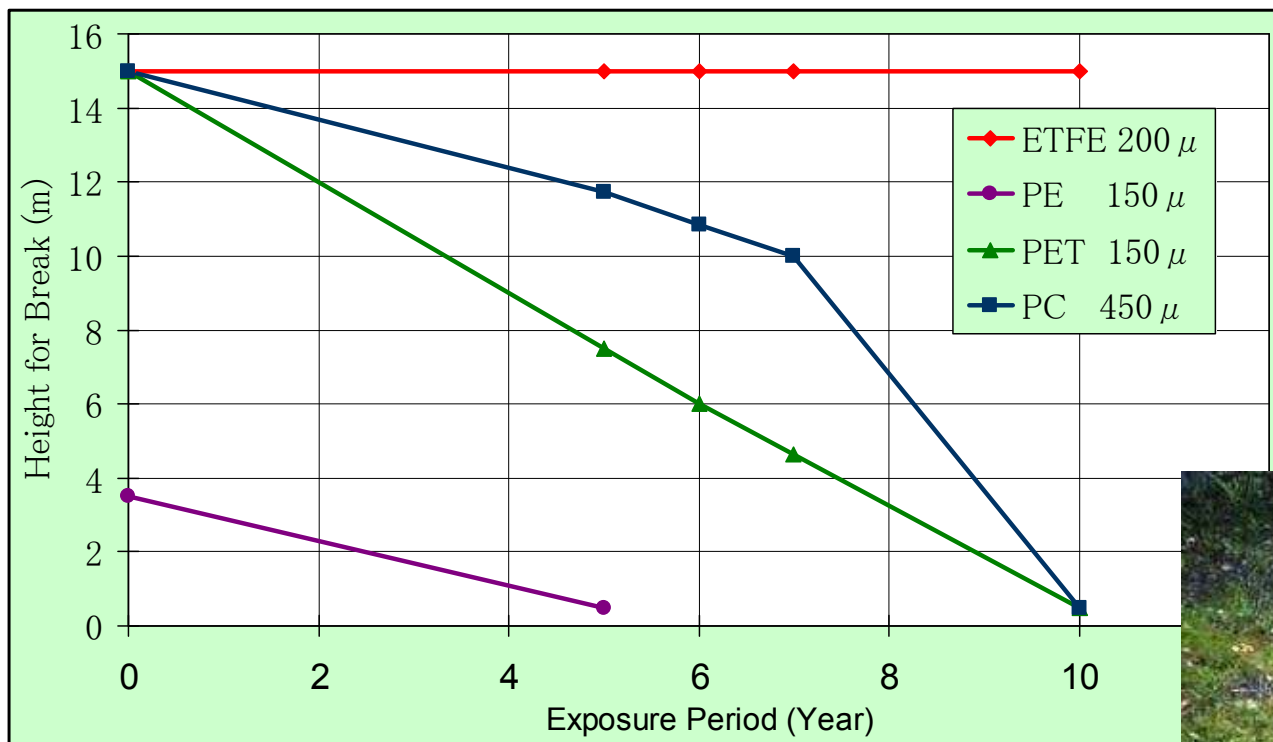
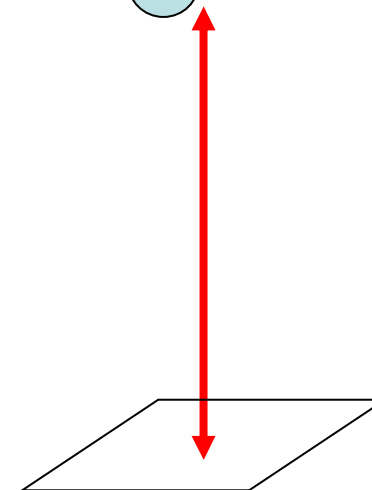
# Technical Advantage : Film Property tensile strength retention over long life



ETFE was chosen

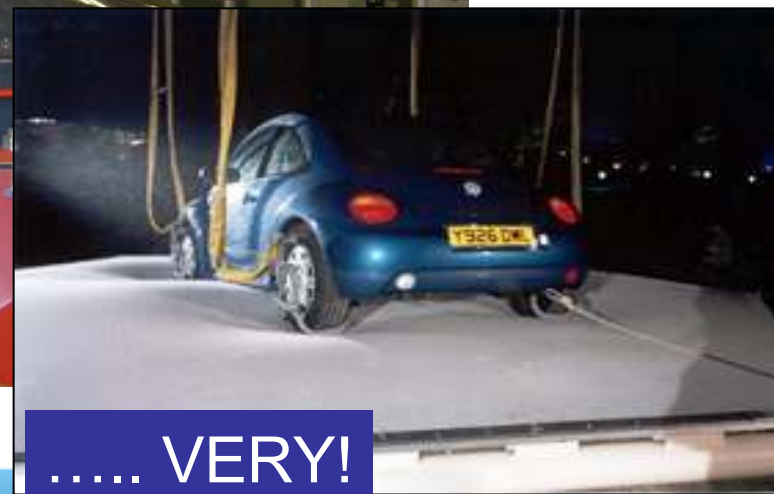
# Technical Advantage : Film Property Ball - drop test (Hail simulation)

Steel ball  
1040g



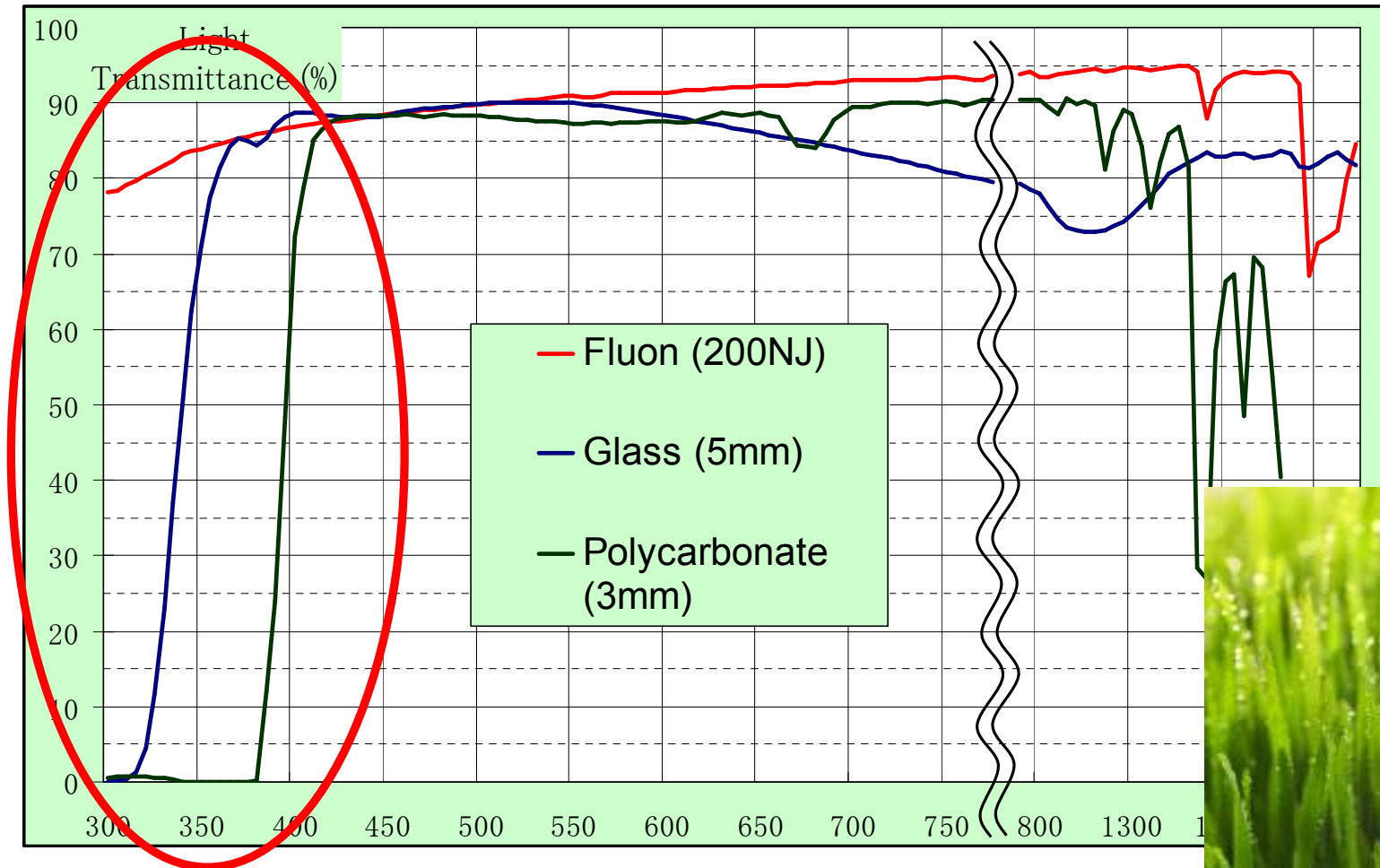
ETFE selected

# How Strong is ETFE Film?

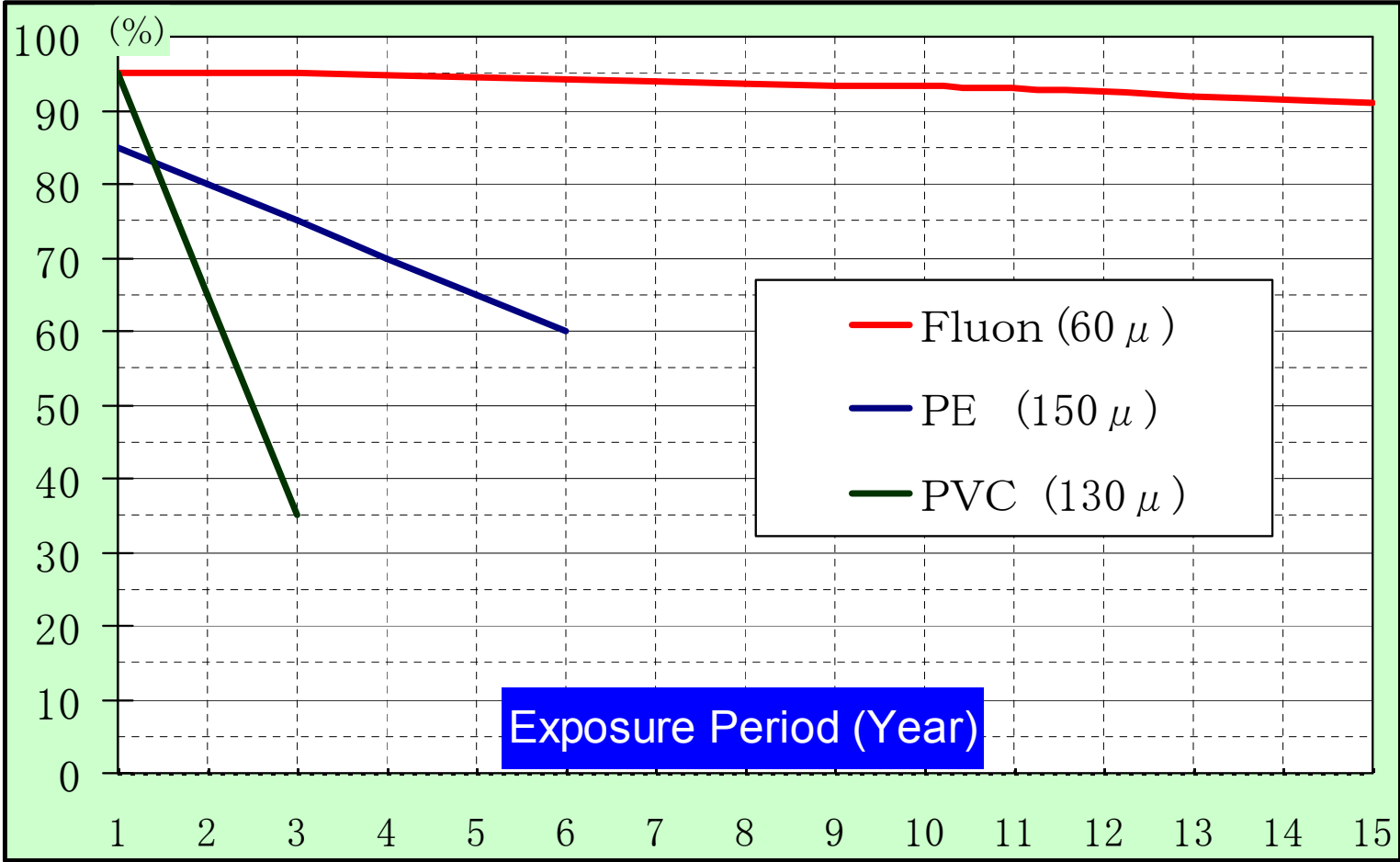


..... VERY!

# Technical Advantage : UV transmittance (Comparison with other materials)



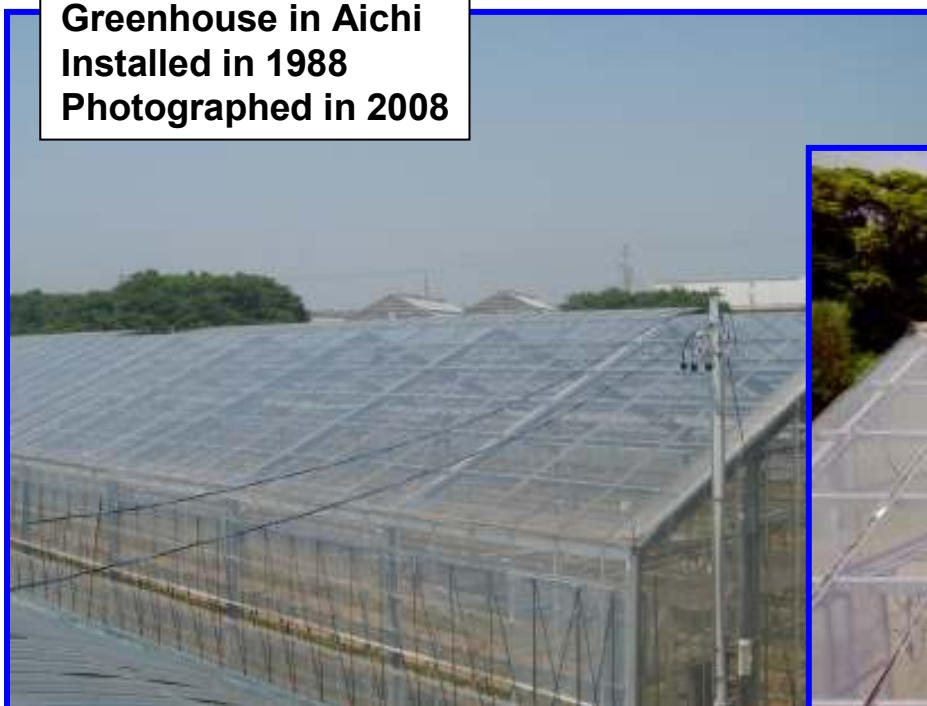
# Technical Advantage : UV transmittance over long service life



# Long Service Life: Greenhouse in Japan

## Over 15 years

**Greenhouse in Aichi**  
Installed in 1988  
Photographed in 2008



**Greenhouse in Kyushu**  
Installed in 1988  
Photographed in 2003



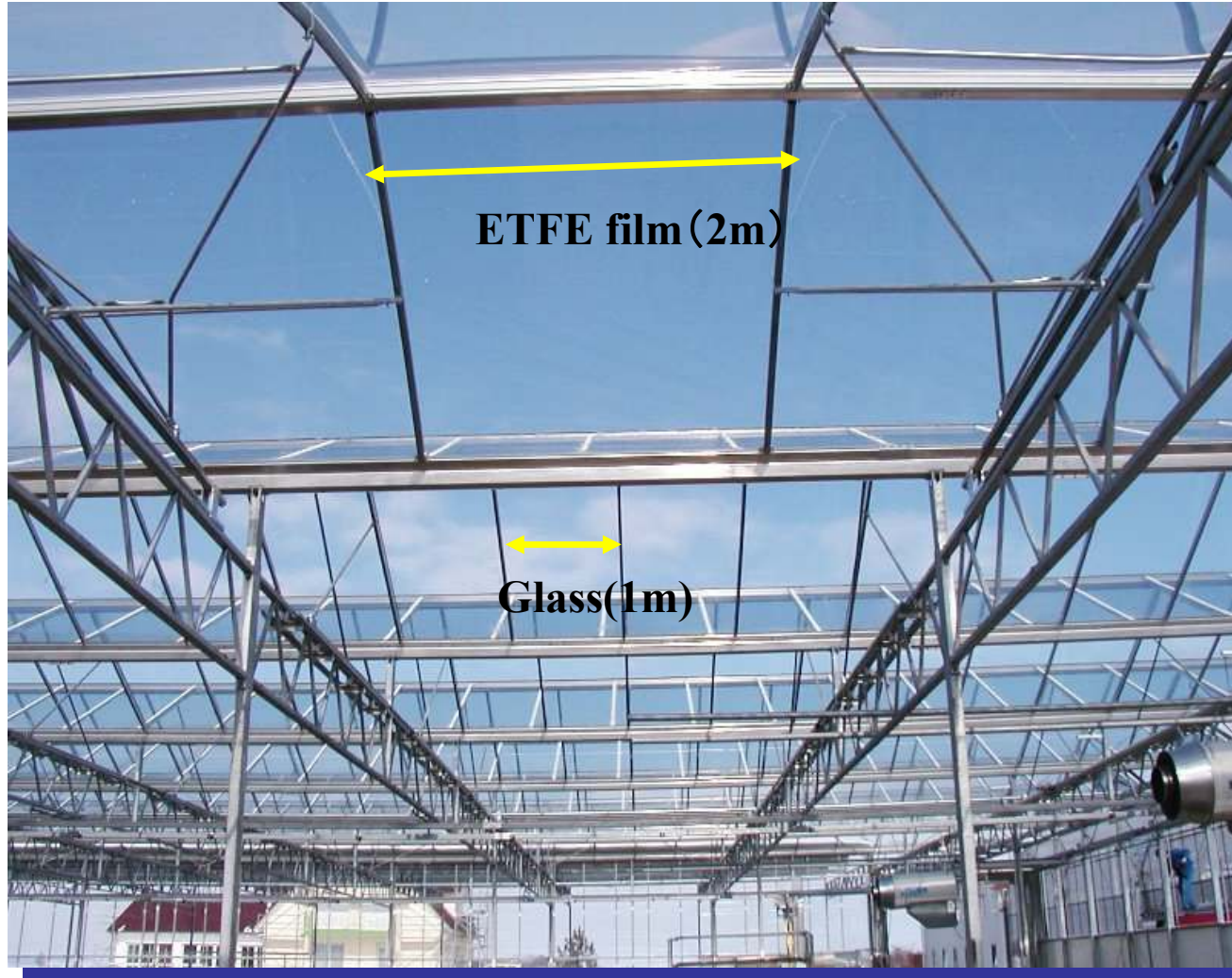
# Technical Advantage : Film Life / Chemical Resistance



| Chemical                    | Temp. (°C) | Days | Retention (%) |          |
|-----------------------------|------------|------|---------------|----------|
|                             |            |      | Elong.        | Wt. Gain |
| Conc. Hydrochloric acid 35% | 100        | 10   | 100           | 0.0      |
| Sulfuric acid               | 78%        | 10   | 100           | 0.1      |
|                             | 98%        | 10   | 100           | 0.0      |
| Nitric acid                 | 25%        | 14   | 100           | -        |
|                             | 60%        | 10   | 100           | 0.7      |
|                             | 70%        | 60   | 100           | -        |
| Sodium Hydroxide            | 10%        | 10   | 97            | 0        |
|                             | 50%        | 10   | 100           | -0.3     |
| Ammonium Hydroxide 15%      | 66         | 7    | 98            | 0.1      |
| Chlorine                    | 90         | 10   | 94            | -        |
| Water                       | 100        | 7    | 100           | 0        |



Light weight (eg. glass) – lighter support structure **AGC**



# Technical Challenges

- Film Colour – Blue & White
  - Printing – pattern specified
- Fire Regulations – National Regulation
- Test specifications & test methods (ISO/ASTM/DIN/.....etc)

# ETFE Film Colour

WHITE

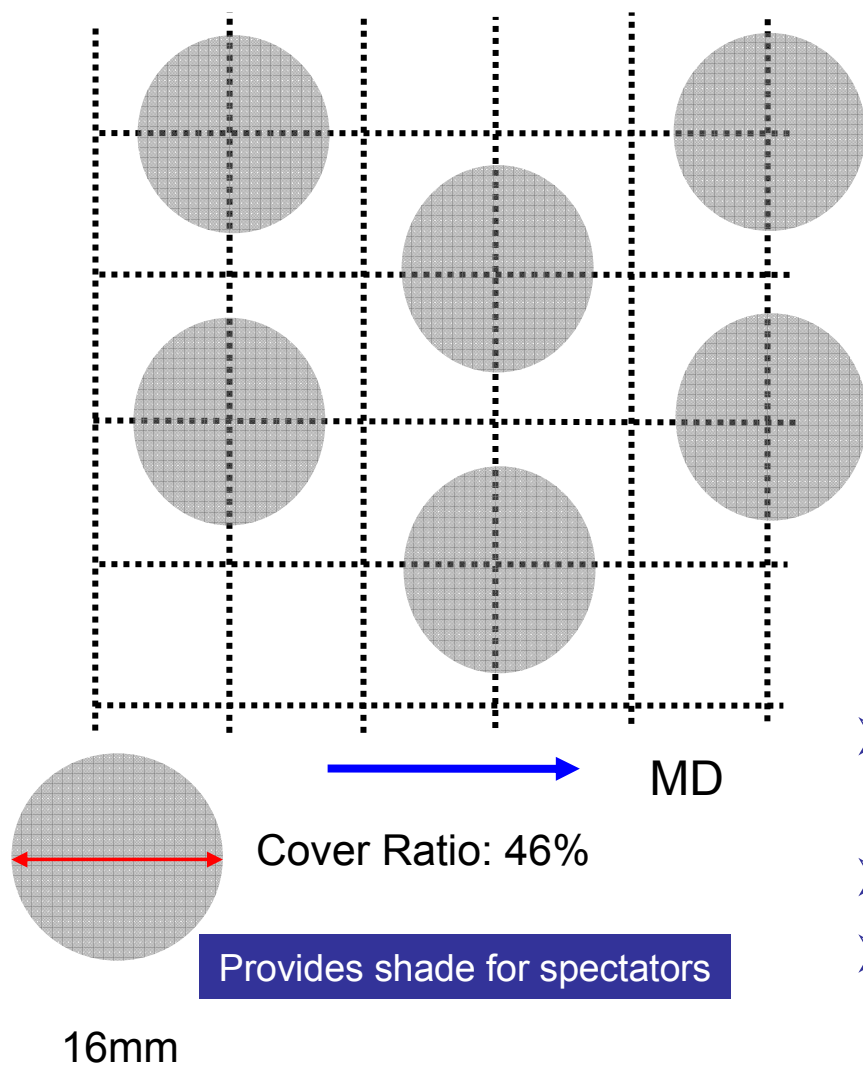


CLEAR

Allianz Arena (Football stadium)

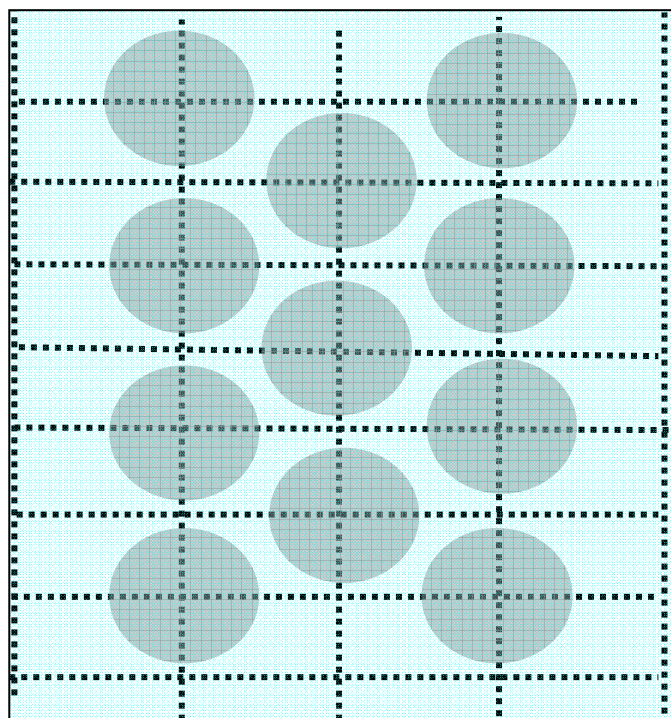
2005, Munich, Germany



# Printed Clear film

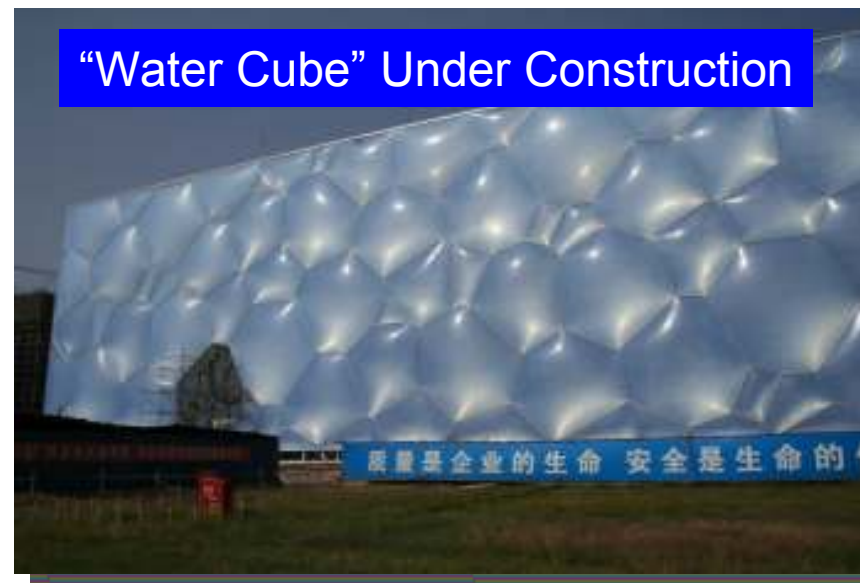


- Roof: Clear Single Film layer, Printed with silver dots
- Printing for Design & Light control
- Approx. 50,000 m<sup>2</sup>

# Printed Coloured film



 MD  
 4mm  
 Covering Ratio: 63%  
 Smaller dots but larger covering



- Multi layered “Cushion” for Roof & Facade
- **Blue film** in the outer surface for design
- **Printed film** for control light & heat
- Approx. 300,000m<sup>2</sup> film

# Regional Regulation : Fire



# Regional Regulation : Fire

| Test Standard                            | Class                                |
|--|--------------------------------------|
| JIS A1322                                | Class 1 (Flame Proof)                |
| UL94                                     | V-0 (250 micron)<br>V-2 (200 micron) |
| DIN 4102                                 | Class B-1                            |
| Oxygen Index<br>JIS K 7201-2 (ISO4589-2) | 29.1 %<br>(Nonflammable in air)      |

# Specification & analysis Frequency

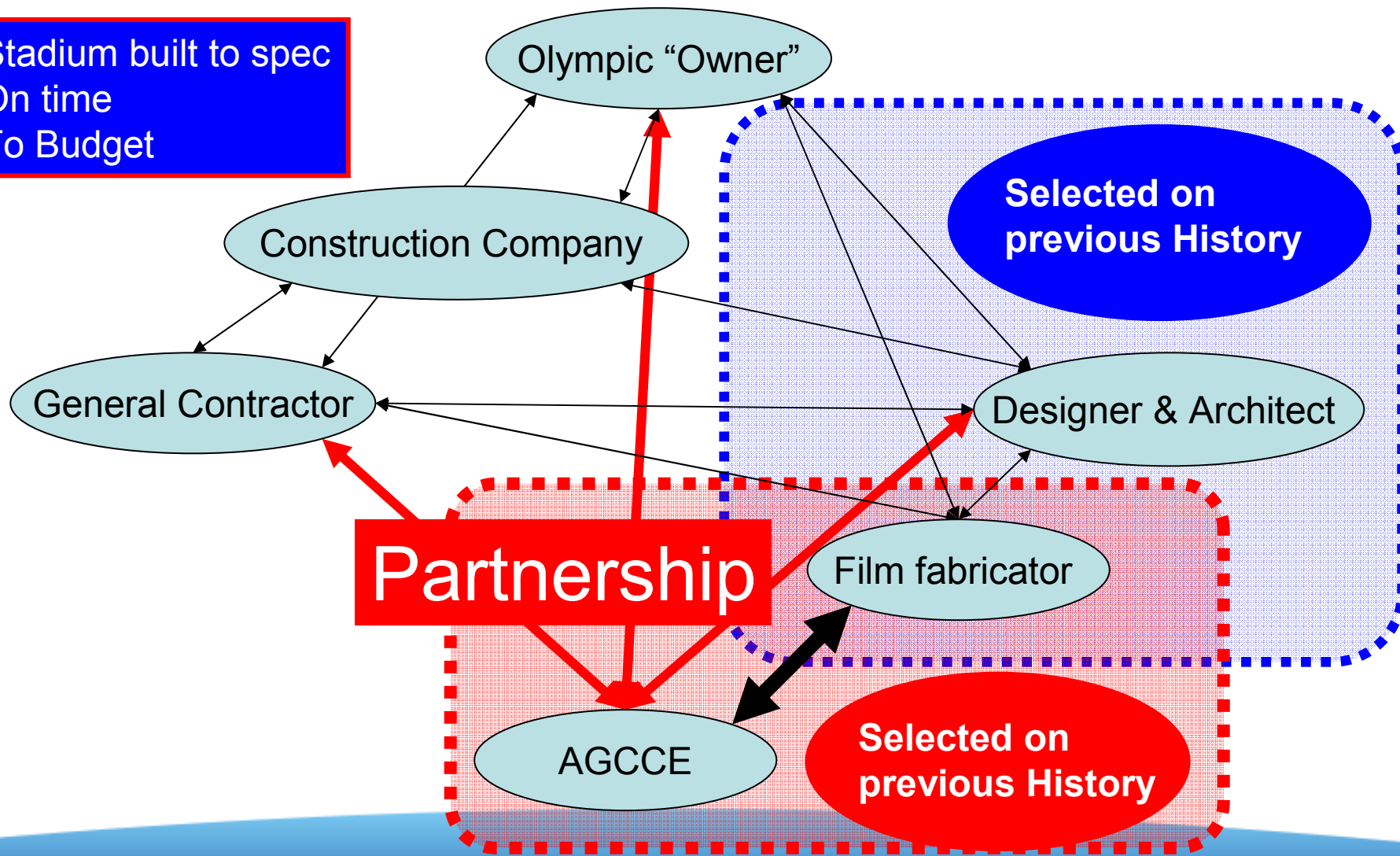
| Item                          | Test Method               | Unit             | Grade       |              |              |              |              | Analysis Frequency          |
|-------------------------------|---------------------------|------------------|-------------|--------------|--------------|--------------|--------------|-----------------------------|
|                               |                           |                  | Transparent |              |              |              | UV Cut       |                             |
|                               |                           |                  | 100 NJ      | 150 NJ       | 200 NJ       | 250 NJ       | 200 UVC      |                             |
| Material Thickness            | DIN-53370(02/1976)        | $\mu\text{m}$    | $100 \pm 5$ | $150 \pm 8$  | $200 \pm 10$ | $250 \pm 13$ | $200 \pm 10$ | Once per mother/master roll |
| Mass per unit area            | ISO-2286-2(1998)          | g/m <sup>2</sup> | $175 \pm 9$ | $262 \pm 13$ | $350 \pm 17$ | $437 \pm 22$ | $350 \pm 17$ |                             |
| Tensile Stress at Break       | DIN-EN-ISO-527-3(10/1995) | MPa              | 50 min.     | 50 min.      | 50 min.      | 50 min.      | 50 min.      | Each production campaign    |
| Tensile Strain at Break       | DIN-EN-ISO-527-3(10/1995) | %                | 350 min.    | 350 min.     | 350 min.     | 350 min.     | 350 min.     |                             |
| Tensile Stress at 10% Strain  | DIN-EN-ISO-527-3(10/1995) | MPa              | 18 min.     | 18 min.      | 18 min.      | 18 min.      | 18 min.      |                             |
| Tear Strength                 | DIN-EN-1875-3(02/1998)    | N/mm             | 400 min.    | 400 min.     | 400 min.     | 400 min.     | 400 min.     |                             |
| Dimensional Change on heating | 150 degree C, 10 minutes  | %                | $-1 \pm 5$  | $-1 \pm 5$   | $-1 \pm 5$   | $-1 \pm 5$   | $-1 \pm 5$   |                             |
| Light Transmittance           | DIN-EN-410(12/1998)       | %                | 91.0 min.   | 91.0 min.    | 89.0 min.    | 87.0 min.    | —            |                             |

# Partnerships/Customer relations

- Established partnerships with both Designer & Contractor for World Cup 2006 stadium in Munich
- Synergy developed “rolled” forward to Beijing

# Beijing Olympics "Value chain"

Stadium built to spec  
On time  
To Budget

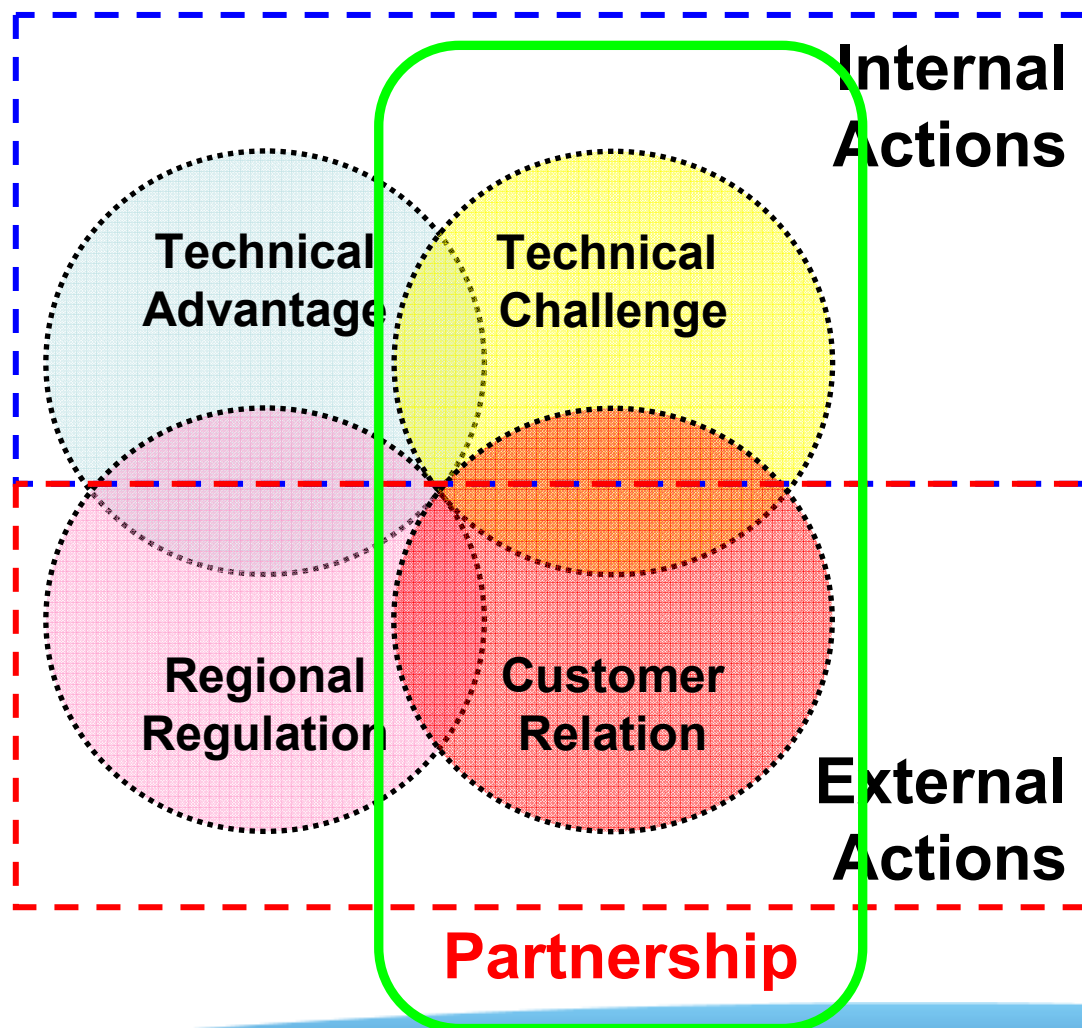


# Previous History / Track Record

- AGC business strategy to take part in large ETFE structures
- Can now use these as previous success examples



# Way to London 2012 and beyond



- Suggestion

- Identify Value chain
- Express Product Advantage
- Good Partnership
- Accomplish your challenge
- **Repeat for the next opportunity**

A large, stylized version of the 'AGC' logo. The letters are a dark blue color with a white outline and a slight 3D effect. The 'G' has a red triangle pointing to the right, similar to the smaller logo above.

[www.agcce.com](http://www.agcce.com)

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