

# On-site F2 Supply: Safe, Sustainable and Cost Efficient solution.

現場氟氣供應: 安全、穩定和低成本

Bertrand Le Faou  
September 2011

THE LINDE GROUP

*Linde*

## AGENDA

- F2 Technology Introduction, 氟氣技術介紹
- F2 Benefits, 氟氣優勢
- F2 Adoption trends, 氟氣採用趨勢

- **F2 Technology Introduction, 氟氣技術介紹**
- F2 Benefits, 氟氣優勢
- F2 Adoption trends, 氟氣採用趨勢

Packaged High Purity F<sub>2</sub> Generators 套裝高純度氟氣產生器  
Generation-F<sup>®</sup> for Electronics 電子產品之現場氟氣生產

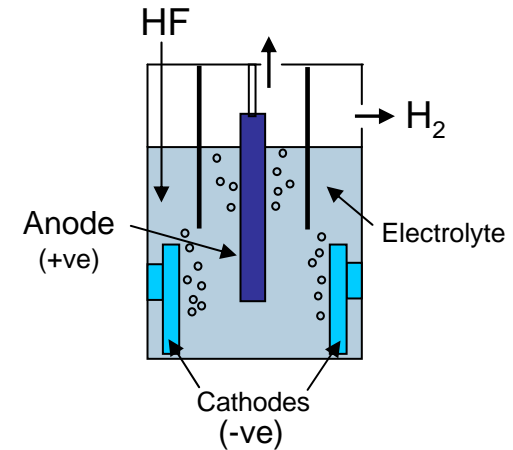
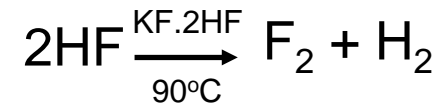


**Generation-F<sup>®</sup> 80**  
For 300mm Semicon  
Qualified on TEL, HKE  
Multiple units in 300mm fabs,  
perfect safety & reliability record.



On-site F<sub>2</sub> generator enhances safety and reliability of the delivery system and process tool.

Customers are no longer restricted to use of F<sub>2</sub> cylinders containing F<sub>2</sub> in a balance of N<sub>2</sub> or other carrier gas, eliminating risk of frequent cylinder changes and allowing large flow of gas and different cleaning conditions & interval between cleans to be explored.

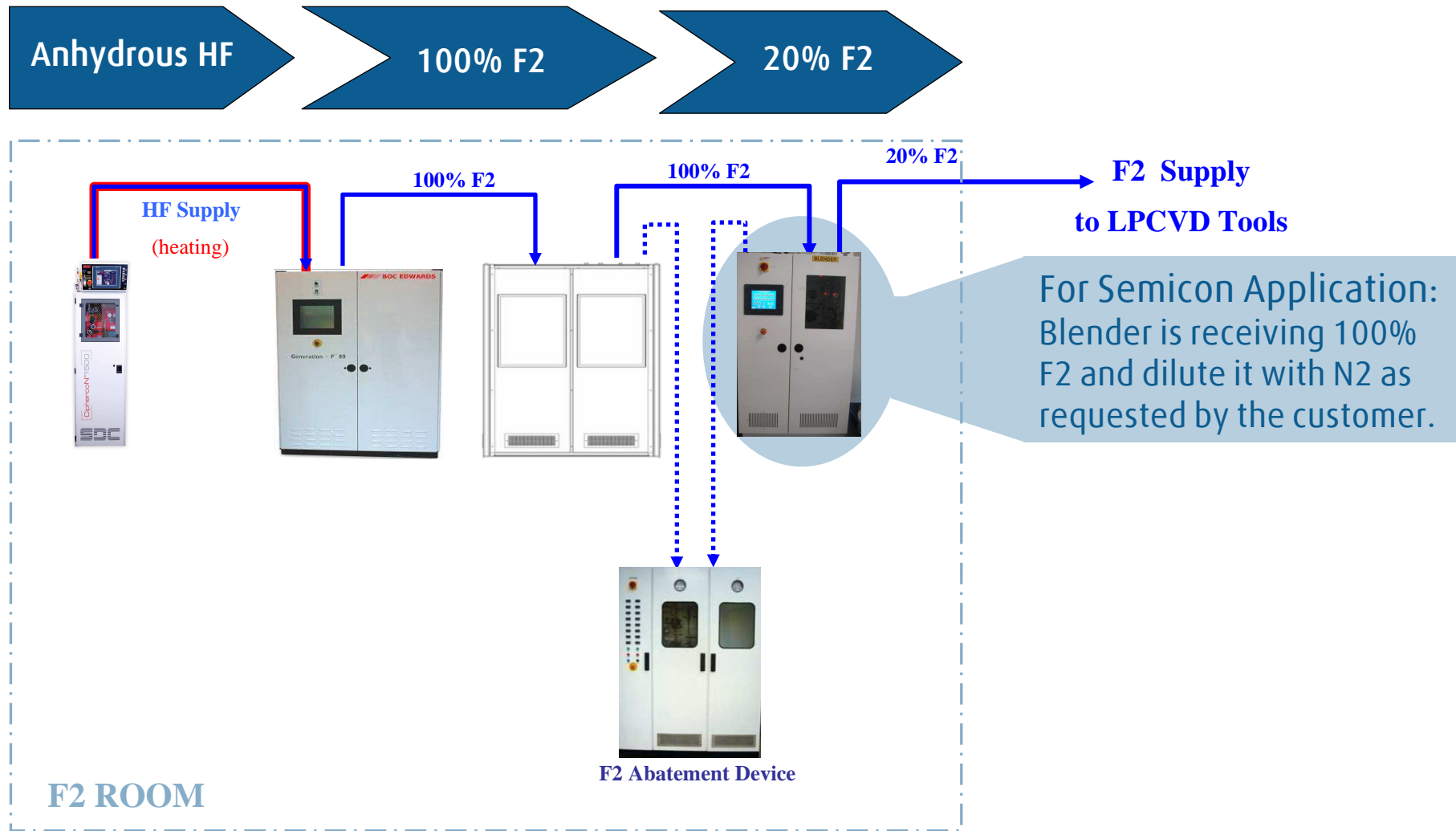


# Generation-F<sup>®</sup> Process Flow Diagram

## 現場氟氣產生器流程圖



# Installation Schematic for 300mm fab 12吋廠房現場安裝示意圖



## On-site F2: Key safety risks & mitigation strategies

### 現場氟氣生產：關鍵安全和風險緩解策略

THE LINDE GROUP



<b>Pressure – stored energy</b> 儲存壓力：	<ul style="list-style-type: none"><li>Minimize pressure (20 psig v 400+)</li><li>Minimize size of package / inventory</li><li>Minimal connections by design / 從設計上減少接點</li><li>Do not break connections! (No cylinder changes required)</li></ul>
<b>Toxicity</b> 毒性	<ul style="list-style-type: none"><li>As above +</li><li>Double containment / 雙套管</li><li>Gas monitoring &amp; alarms / 氣體偵測與警報</li><li>Ventilation and abatement</li></ul>
<b>Reactivity</b> 活性	<ul style="list-style-type: none"><li>As above +</li><li>Materials of construction carefully selected</li><li>Passivation of wetted surfaces</li></ul>

# Fluorine Safety: Risk and Mitigation

## 氟氣安全: 風險緩解

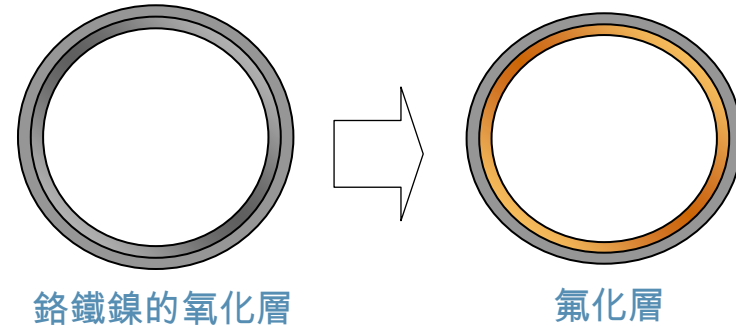
THE LINDE GROUP

Linde

### Passivation / 鈍化處理

The inner wall of 316L SS tube is coated with:

- A native oxide of  $\text{CrO}_x$ ,  $\text{FeO}_x$ ,  $\text{NiO}_x$
- Trace amounts of C and  $\text{H}_2\text{O}$  on the surface
- Si in the alloy matrix

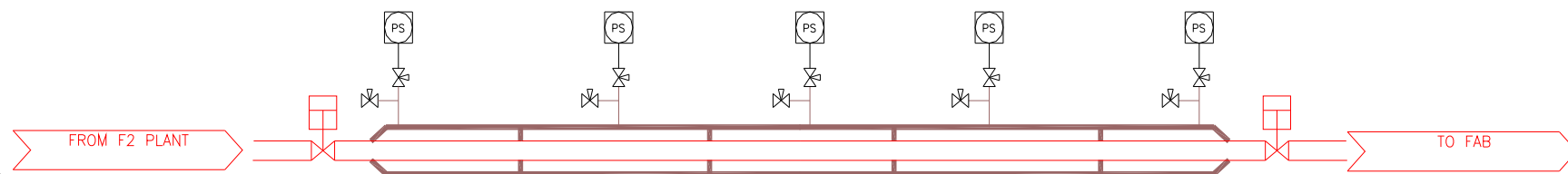


When  $\text{F}_2$  makes contact with the metal tubing, it reacts slowly with the  $\text{MO}_x$  compounds forming a thin  $\text{MF}_x$  passivation layer

- F is substituted with O to bond with the Cr, Fe, Ni forming  $\text{CrF}_y$ ,  $\text{FeF}_y$  and  $\text{NiF}_y$
- F also reacts with residual hydrocarbons to release  $\text{CF}_4$ , HF, and  $\text{OF}_2$

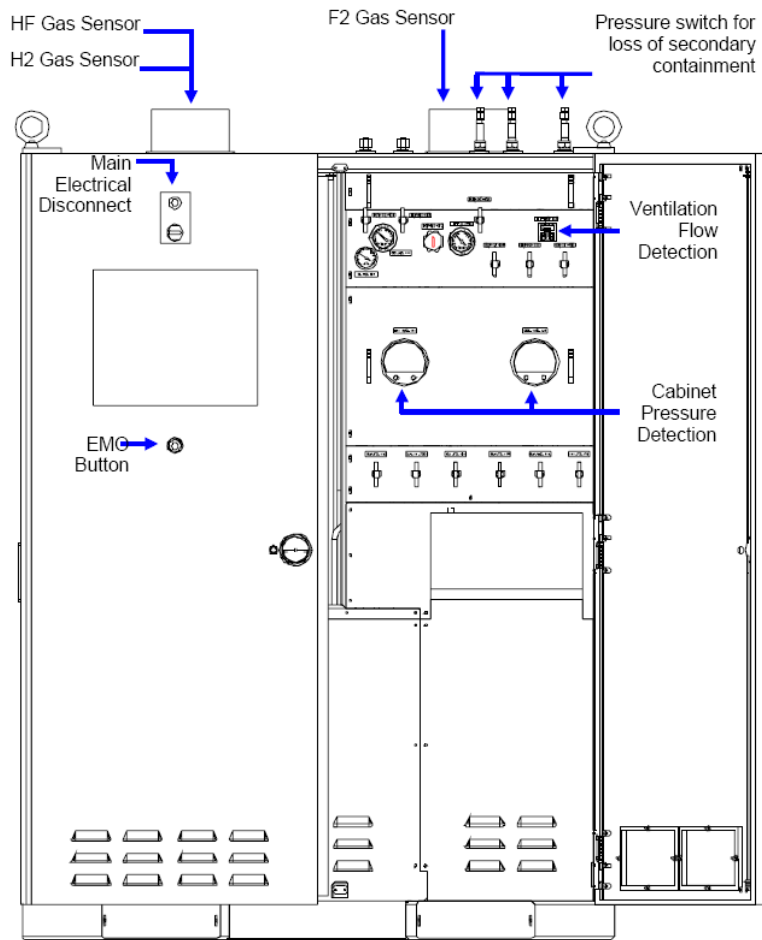
### Double Containment / 雙套管

- High Purity Inner line, passivated with Fluorine
- Robust Outer line for mechanical protection and leak containment: higher pressure  $\text{N}_2$
- All system components are double-contained, including generators and buffer tanks



# F80 interlocks

## F80 聯鎖



F80 is equipped with **numerous safety devices and interlocks** to guaranty safe shutdown in case of malfunction: HF& H2& F2 gas monitoring, extraction monitoring, cabinet pressure monitoring, ...

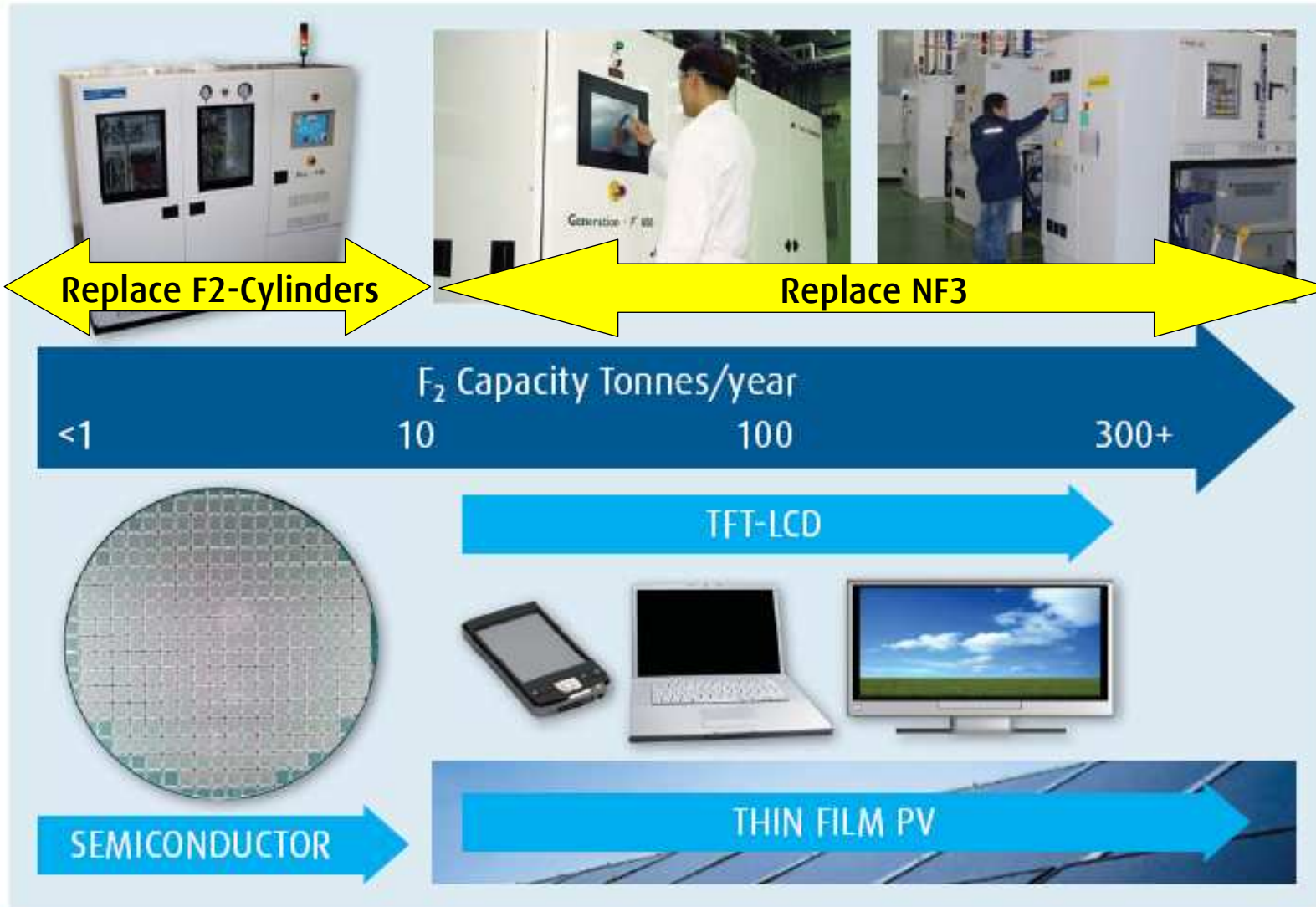
All F2 piping between F2 equipments and distribution system will be **Coax-pipes** equipped with pressure switch to detect any loss of secondary containment.

- F2 Technology Introduction, 氟氣技術介紹
- **F2 Benefits, 氟氣優勢**
- F2 Adoption trends, 氟氣採用趨勢

Semiconductor: *F2-Cylinder Replacement*, 氟氣鋼瓶替代  
 TF-Solar / TFT-LCD: *NF3 Replacement*. 三氟化氮替代



Generation-F® – clean gas for a green process



# Semiconductor Market: 半導體市場

## Replacement of F2-Cylinders 氟氣鋼瓶替代

THE LINDE GROUP



### ON-SITE F2-GENERATION for 20% F2/N2 SUPPLY

#### VALUE PROPOSAL:

##### Cost Reduction

- Gas Cost saving,
- No investment in F2/N2 gas-cabinets,

##### Safety Improvement

- No need for high pressure F2/N2-cylinder swap (7.5MPa),
- Lower on-site inventory and safe storage pressure (0,25MPa),
- Low swap frequency of raw material cylinder,

##### Zero Technical Risk

- OEM qualified,
- Numerous 12" Fab references...

# TFT-LCD Market: 薄膜電晶體液晶顯示器市場

## Replacement of NF<sub>3</sub> 三氟化氮替代

THE LINDE GROUP

Linde

### ON-SITE F<sub>2</sub>-GENERATION for Large TFT-LCD Fab

Faster cleaning,  
**higher**  
**productivity**

- Fluorine can clean twice as fast as NF<sub>3</sub> with lower mass consumption
- Can increase tool throughput from 6-8%

Reduced  
gas  
consumption

- 80Kg of F<sub>2</sub> delivers the same cleaning as 100 Kg of NF<sub>3</sub> with the same clean rate

Lower  
environmental  
impact

- F<sub>2</sub> has **zero** global warming potential vs. 17,000 for NF<sub>3</sub>

# Thin Film Solar Market: 薄膜太陽能電池市場

## Replacement of NF3 三氟化氮替代

THE LINDE GROUP

Linde

### ON-SITE F2-GENERATION for Thin-Film Solar

1. Reduction in Cost per Panel ,
2. Environment Benefit over NF3, faster CO2 payback for Solar Cell,
3. Much faster clean rate : Deposition of thicker film and improvement on robot handling put cleaning time as the key bottleneck,
4. F2 can Remove the need for RPS. Capex saving, CoO decrease, uptime improvement, etc..

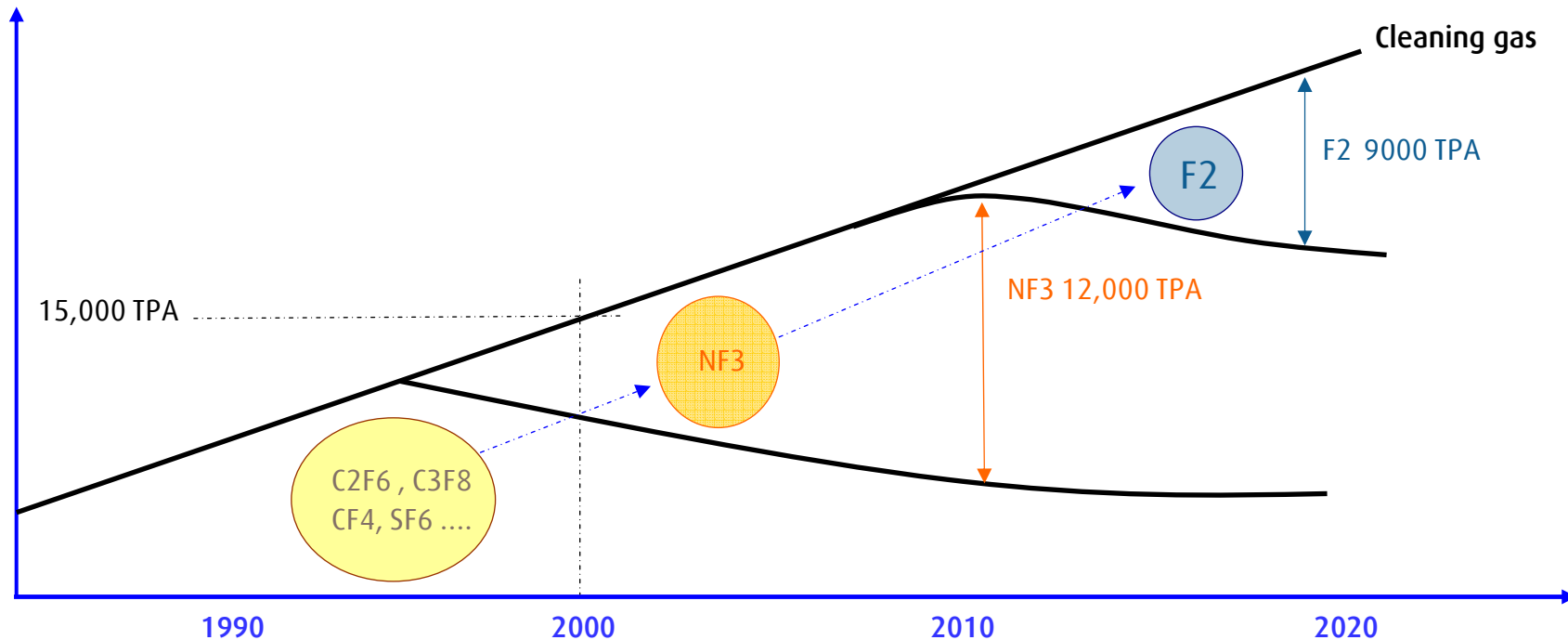
OEM  
QUALIFICATIONS

Industry Goal  
**LOWER € /W**



- F2 Technology Introduction, 氟氣技術介紹
- F2 Benefits, 氟氣優勢
- **F2 Adoption trends, 氟氣採用趨勢**

# Industry Trend of Chamber Cleaning Gas 腔體清洗氣體的產業趨勢



## Drivers for customer adoption of F2

- Cost of Ownership reduction through hardware removal and direct material savings
- Further Cost of Ownership benefits by Increasing the plant throughput due to reduced tact time
- Zero global warming potential.

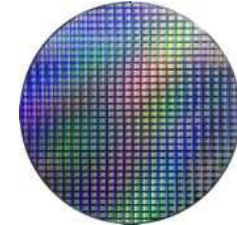
# F2 Adoption Per Markets

## 電子產業對氟氣接受狀況



### Semicon:

Proven on TEL and HKE platforms,  
supplying TEL Furnaces all over the world on 12" Fab and keep expending,



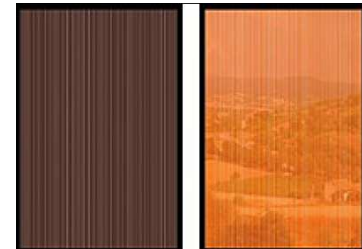
### TFT-LCD:

Supply of Large Gen6 Fab in Korea,  
Supply of Gen 4.5 Fab in Japan,  
Under discussion with Key-players in Mainland China...



### Solar:

Test done successfully on Gen 5 platform of 2 OEMs (EUPVSEC 2009, 2010, IWTFSSC-3 2010).  
Qualification on Oerlikon on going (PEPPER Project sponsored by EU)  
Strong interest shown by other OEM in Asia.



Please Contact Linde for discussing  
On-Site Fluorine Value Proposal for your FAB

Thanks for your attention...  
謝謝...

