

Significant Reduction of Environment Impact on ALD-SiO₂ for Double Patterning by PE-ALD-SiO₂ Room Temp. process of Vertical Batch Furnace

Tokyo Electron Limited

Summary

- ◆ **PE-ALD-SiO₂ Room Temp. process by our Vertical Batch tool provides significant advantages to customers as below.**

Process

- Conformal and direct deposition on PR/BARC pattern.**
- Uniform slimming of pattern CD by oxygen radical flow**
- Process step reduction makes energy & gas reduction**

- ◆ **Heater-less Vertical Batch keeps productivity advantage and also;**

Energy

48% Reduction

**Footprint
(Main & Sub Fab)**

Total 39% reduction

**Resource
Conservation**

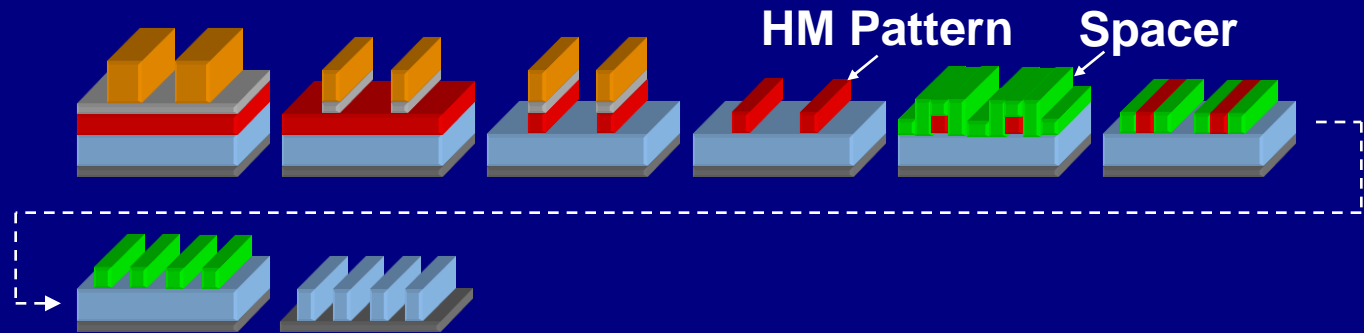
**30% Parts Reduction
36% As-manufactured LCA Reduction**

Process Step Reduction

Self-aligned DP

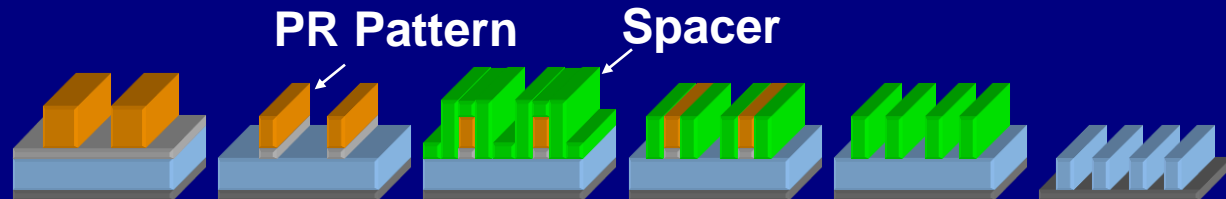
Spacer deposition on HM pattern

Conventional



Spacer deposition on PR pattern

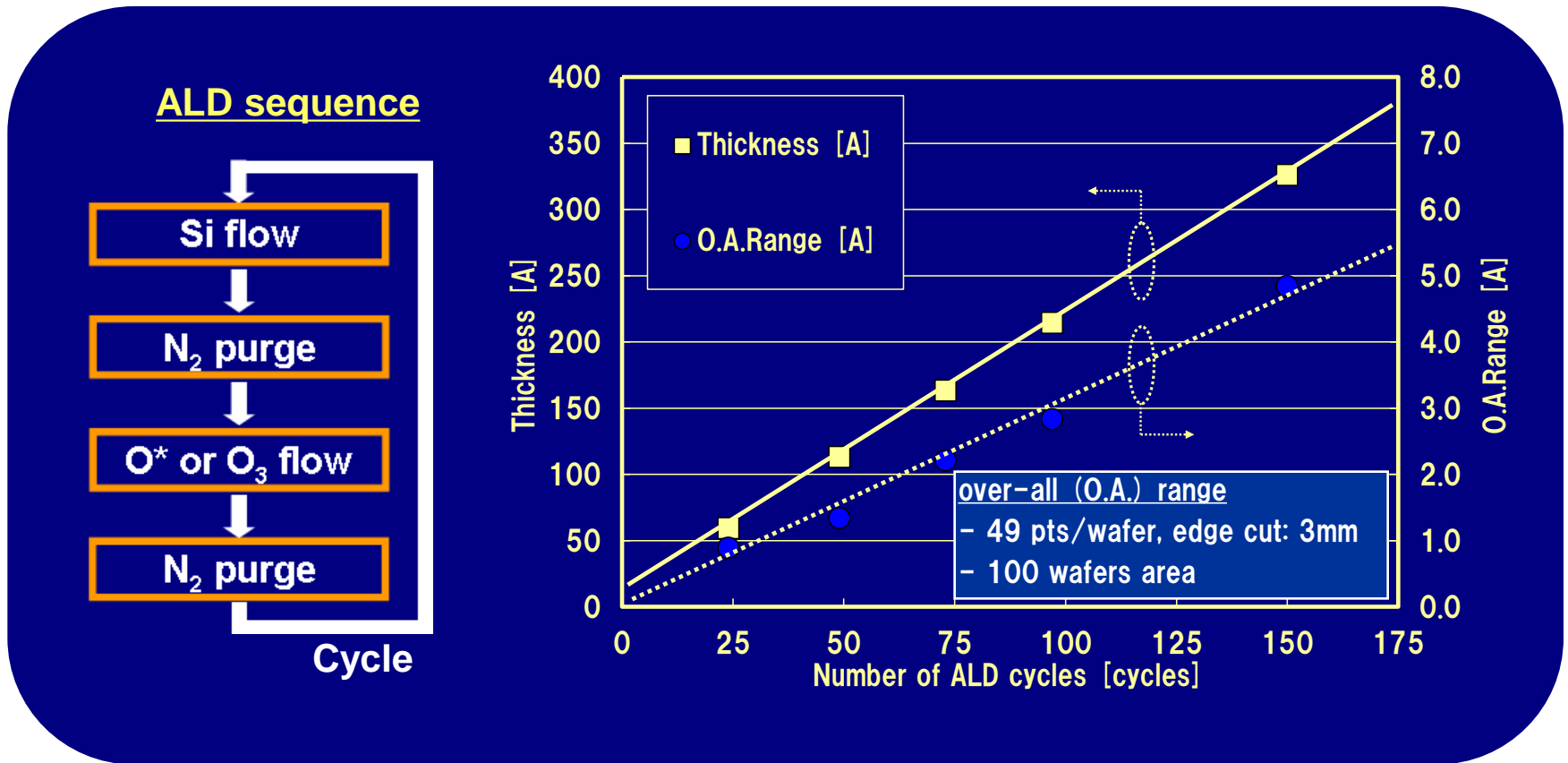
Heater-less Technology



Direct spacer deposition on photoresist pattern makes it possible to simplify the self-aligned DP processes

Thickness Control

PE-ALD-SiO₂ at RT on flat wafers

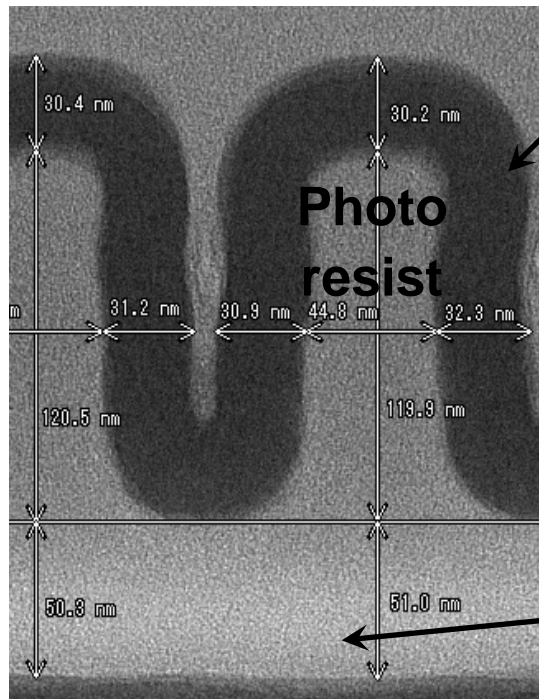


- Thickness controllable by numbers of ALD cycles
- Overall thickness range is within 3Å or less at 200Å

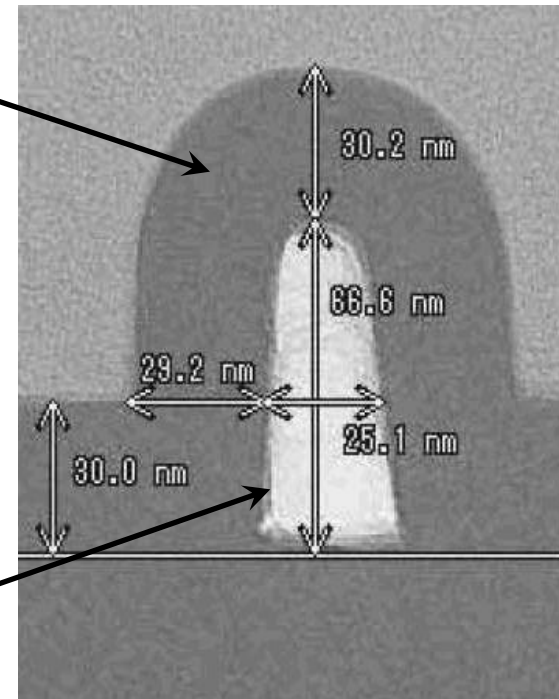
Conformal Deposition on PR & BARC

PE-ALD-SiO₂ at RT direct deposition

On photoresist pattern

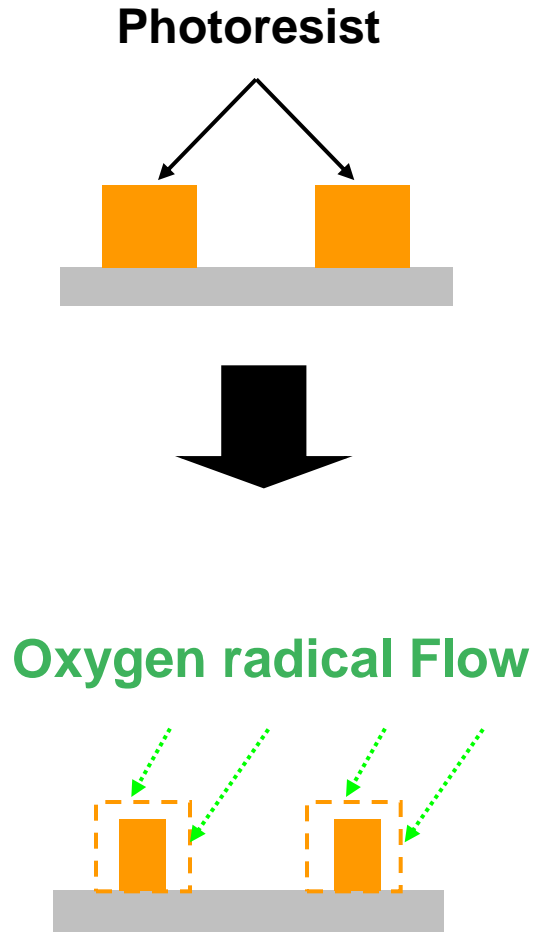


On BARC pattern



Conformal film can be formed on PR / BARC pattern without damage by deposition.

Slimming Technique for PR



	SEM Image
Before Slimming	<p>Height:829 [A] CD(Mid):417 [A]</p> <p>5.0kV x200k SE 200nm</p>
After Slimming	<p>Height:683 [A] CD(Mid):194 [A]</p> <p>5.0kV x200k SE 200nm</p>

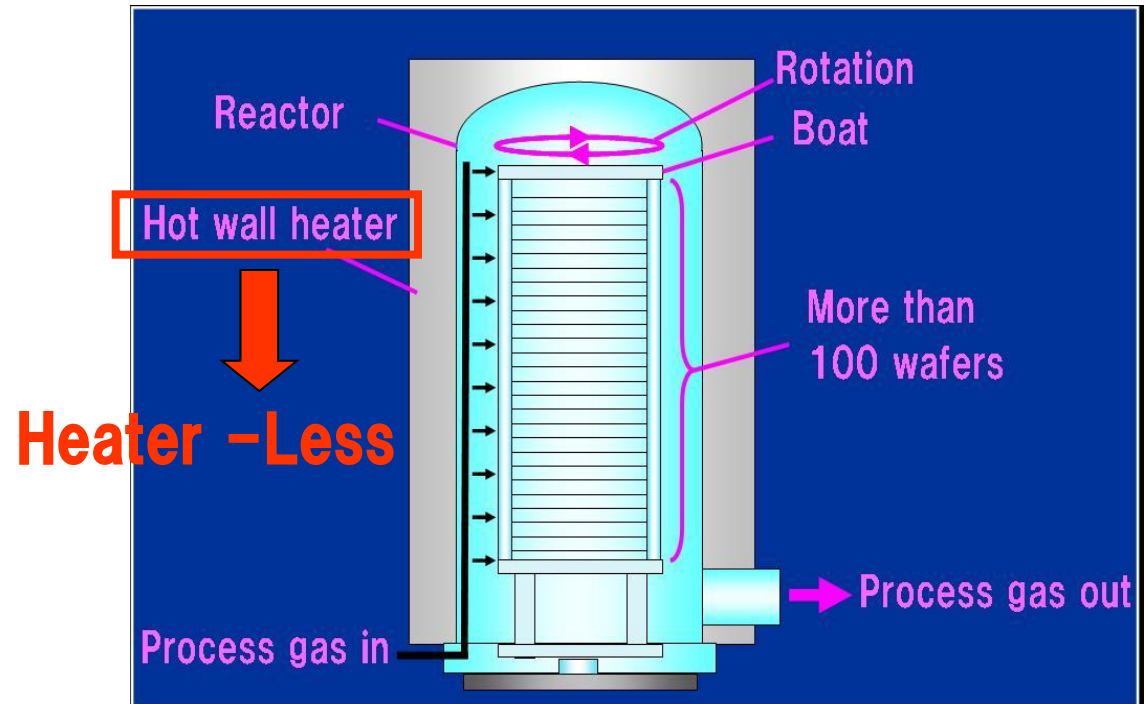
Oxygen radical flow makes the efficient CD slimming

TELINDY for Double Patterning

TELINDY PLUS



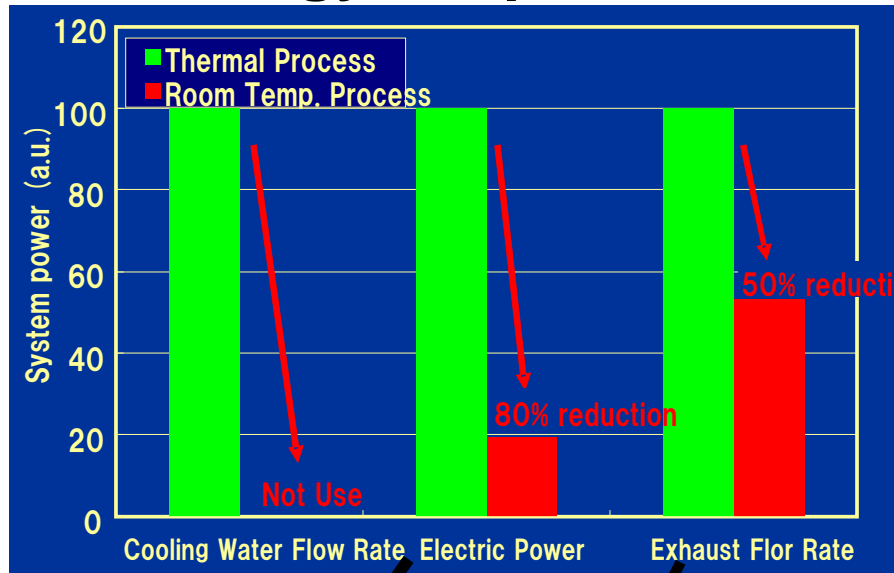
Chamber configuration



- More than 100 wafers batch size
- Process gases are supplied by side flow
- Equipped with remote plasma source

Reduction of CO2 Emission in operation

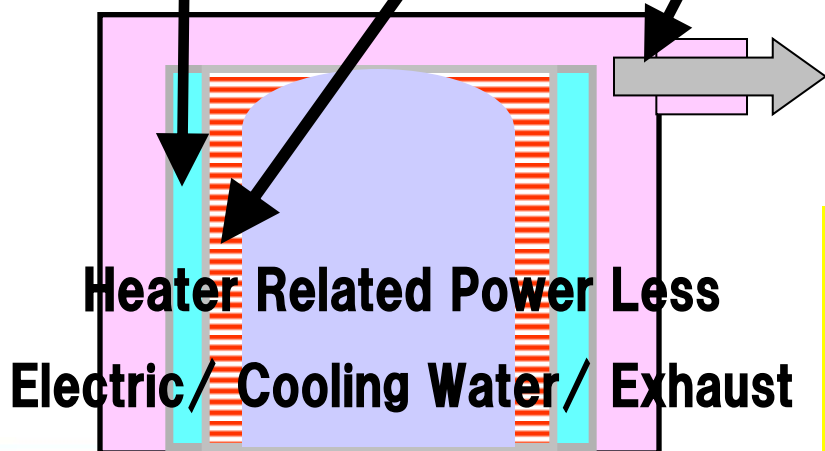
Energy in operation



Calculates by SEMI S23 as total energy and converts into CO2

48 % CO2 Reduction in operation

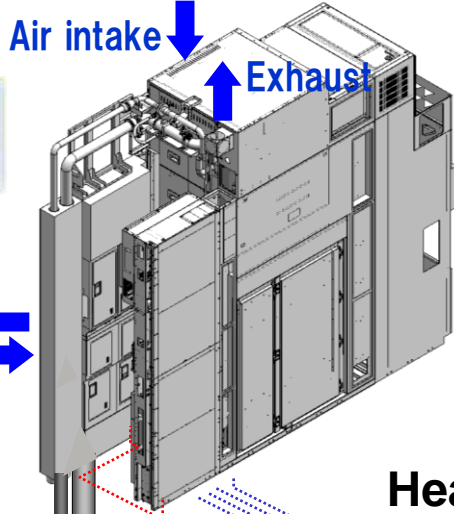
R.T. processes does not require a main heater and can greatly reduce CO₂ emissions



Footprint Reduction

Conventional Model

Heater has exhaust line and cooling water



Main Fab

Cooling water
For heater

Sub Fab

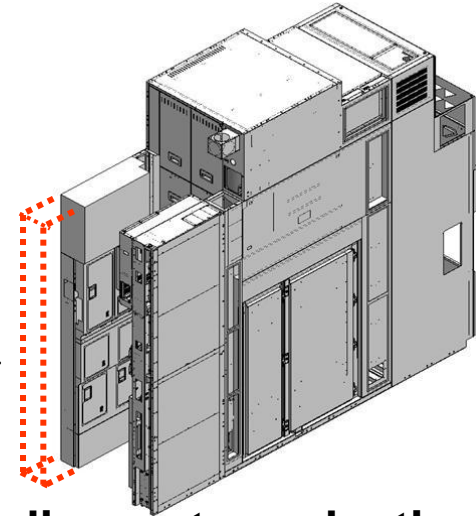
Heater Cooling
Air Blow Unit

Power Box



Downsizing

Heater-Less Model



Heater Exhaust and Cooling water reduction

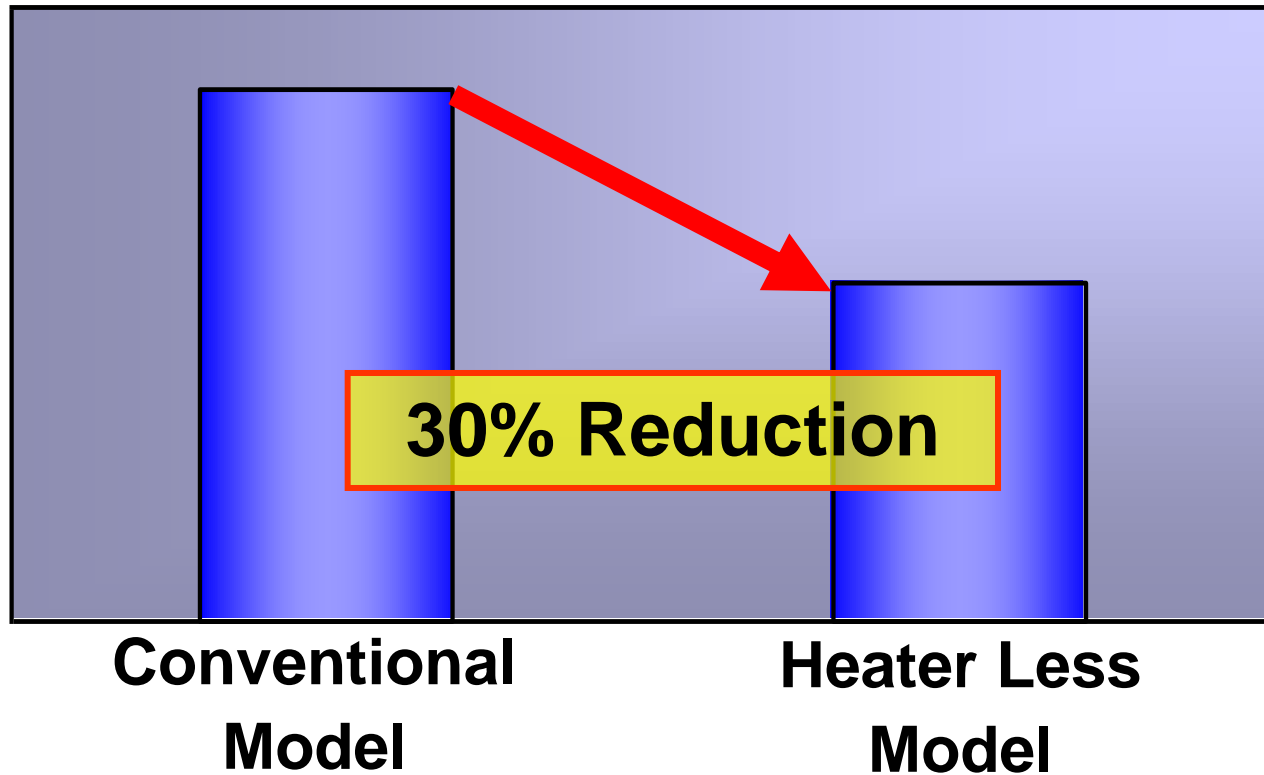
Total 39 %Footprint Reduction



Sub Fab Unit Less

Parts Reduction

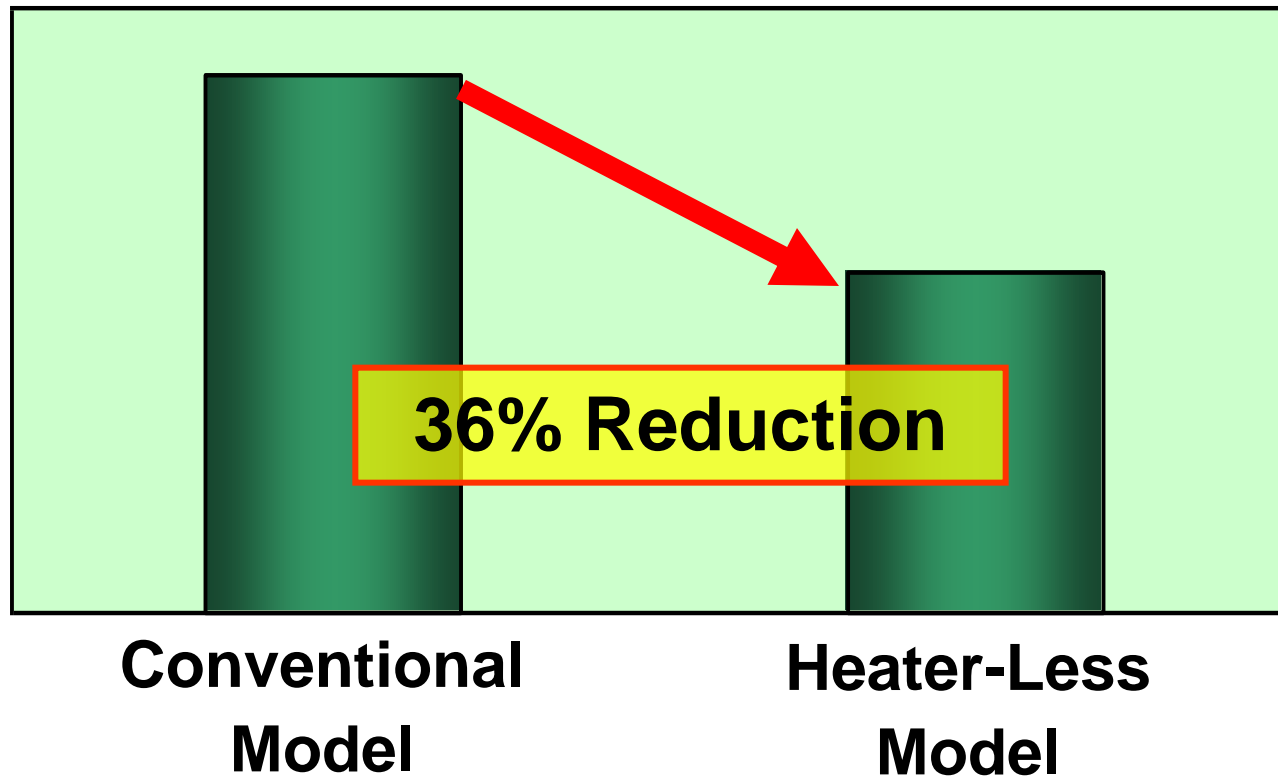
Comparison of No. of Parts



Number of parts related to Heater, Cooling Water, Exhaust and maintenance parts etc. can be reduced.

As-manufactured LCA

Comparison of as-manufactured CO₂ emission.



Heater-less model also contributes to Reduction of as-manufactured CO₂ emission

Conclusion

Significant Reduction of Environment Impact on Double Patterning processes by PE-ALD-SiO₂ Room Temp. process of our Vertical Batch tool

Contents	Result
Process	Simplifying the steps
CO ₂ in Operation	48% Reduction
Footprint	39% Reduction
No. of parts	30% Reduction
As-manufactured LCA	36% Reduction



Thank you for Your Attention !!