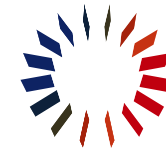
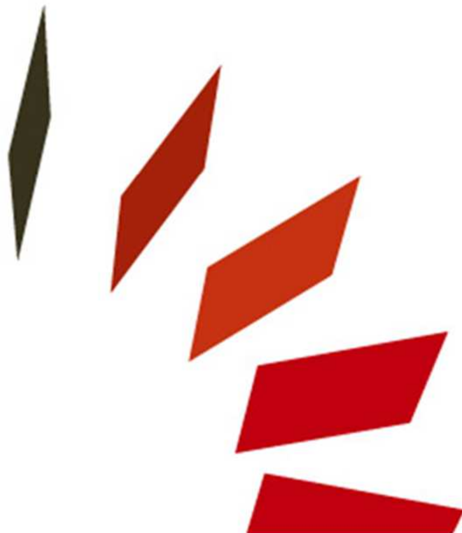


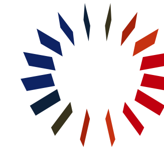
MEYER BURGER

Quality and cost factors for LED sapphire wafer manufacturing

Fabiano Assi – 17.11.2012



Meyer Burger at a glance



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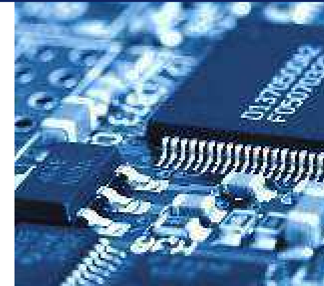
Markets	Solar	Semiconductor	Sapphire & Optoelectronics
			
	Wafering - Cutting Technologies - Measuring Systems - Wafer Handling - Robotics and Automation - Diamond Wire **Cell** - Inspection Systems - Handling Systems - Coating Systems **Module** - Cell Connecting - Module Solutions - Lamination - Measurement Systems	**Wafering** - Cutting Technologies - Measuring Systems - Wafer Handling - Automation Systems	**Wafering** - Boule Handling - Boule/Core Preparation - Cutting Technologies - Measuring Systems - Wafer Handling - Wafer Inspection Systems - Automation Systems

Meyer Burger holistic approach

✓ Up- and Down-Stream process integration starting from Meyer Burger core competences:

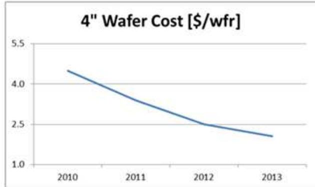
- Crystal handling and measurement
- Core Gluing
- Slicing
- Cleaning and Quality Control
- Consumables (in particular diamond wire)
- Integration of third party machines
- Optimization and process support along the whole process / value chain

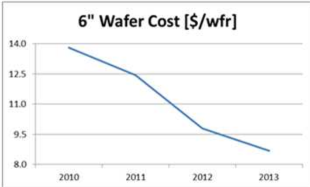
Sapphire Slicing System

MEYER BURGER

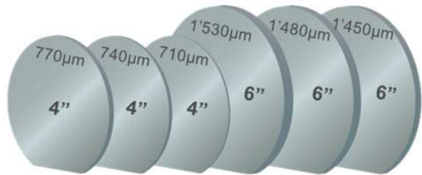
Slicing System → **MOCVD Processing**

Lowest COO
- Consumable utilization
- Diamond wire ∅ & lifetime

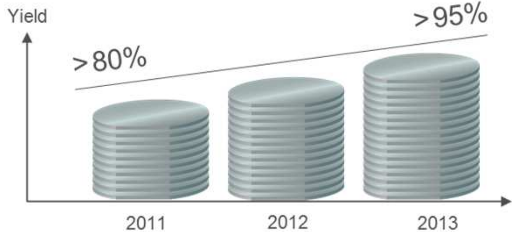




Best Wafer Quality
- TTV, Bow & Warp values
- Thin wafer material utilization

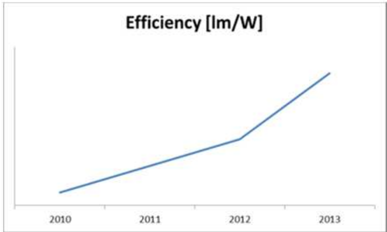


Global Production Yield
- Axis orientation accuracy
- Reliable production process



Combine
Best in Class Slicing System
with
High Efficient LED Technology

Defined and Accurate Wafer Quality
Prepared for Highest Efficiency



lm

Sapphire System Approach
From Single Machine to System

$$$

Equipment

CoO , Capex

Advanced Processes
Integrated Systems

Diamond Wire
Wire Mgmt / Recipe
Wire Guide Rolls / Pulleys
Glueing
Wafer Inspection
Waste Mgmt
Cutting Fluid
Kerf Filter

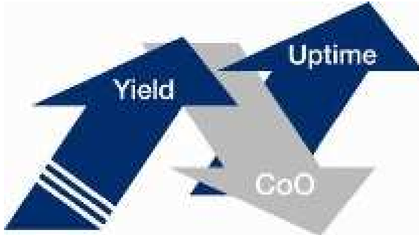
$

Low

Integration Level

High

System Approach for:
- Lowest CoO
- Best Quality
- Global Production Yield



Sapphire Slicing System

Diamond Wire

Wire Guide Rolls / Pulleys

Wafer Inspection

Cutting Fluid

Kerf Filter

Waste Mgmt

3D Core Adjustment

Wire Mgmt / Recipe

Slicing

+ / -

Compensation

Orientation

Sapphire System

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Consumables

Wear parts

Recipes

Inspection

Process intelligence

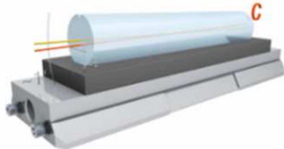
Adjustment

Waste Mgmt

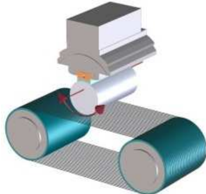
Fluids management

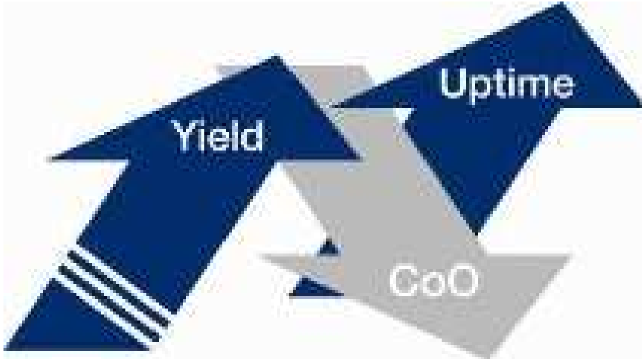
Processing factors examples

1. Quality
   – Crystal orientation ⇒ Wafer quality

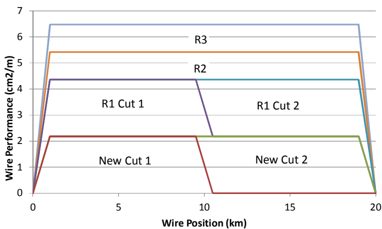


2. Throughput
   – Slicing rocking angle ⇒ Cutting speed



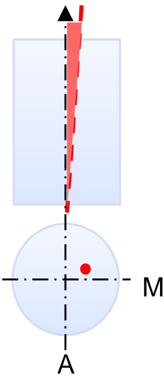


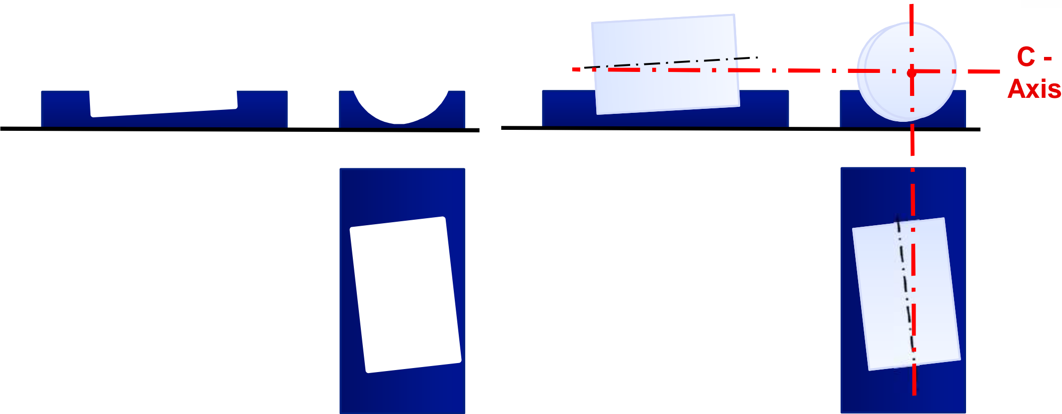
3. Cost of Ownership
   – Slicing recipe ⇒ Wire performance



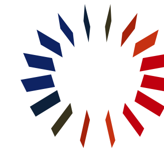
Example 1 – Wafer quality

3D core adjustment

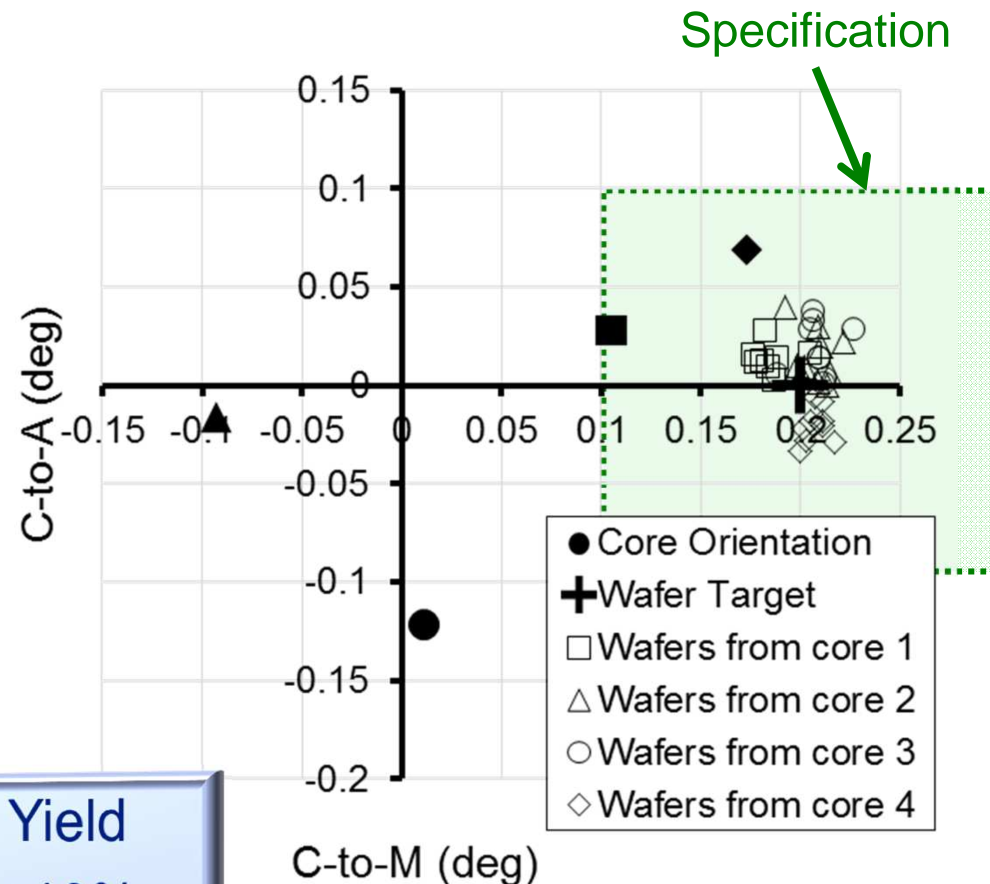


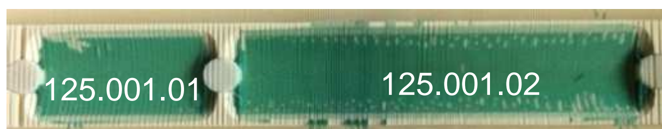


Example 1 – Wafer quality



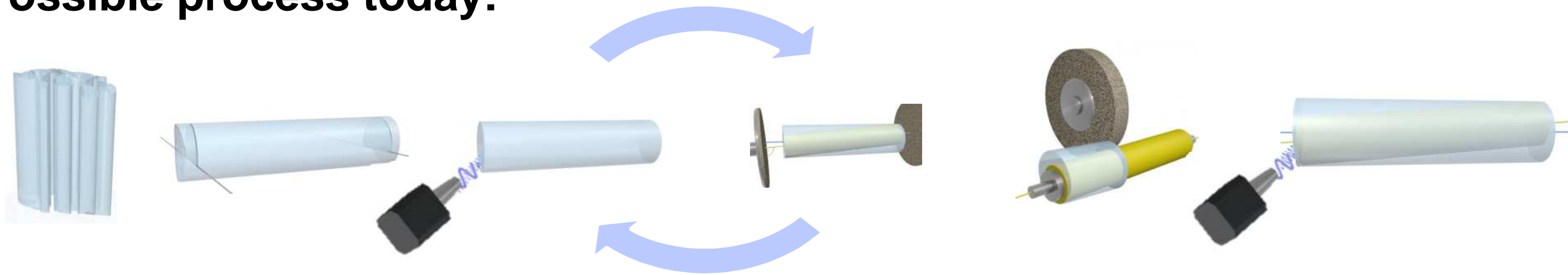
- Wafer quality showcase 2”
  - C to M accuracy ±0.03°
  - C to A accuracy ±0.03°
  - Best control of crystal orientation
  - Best control of crystal anisotropy for slicing operations
  - Perfect matching sapphire – glue – beam combination





Impact on grinding process

Possible process today:



- Orientation before gluing important
- Tight tolerances for each process step

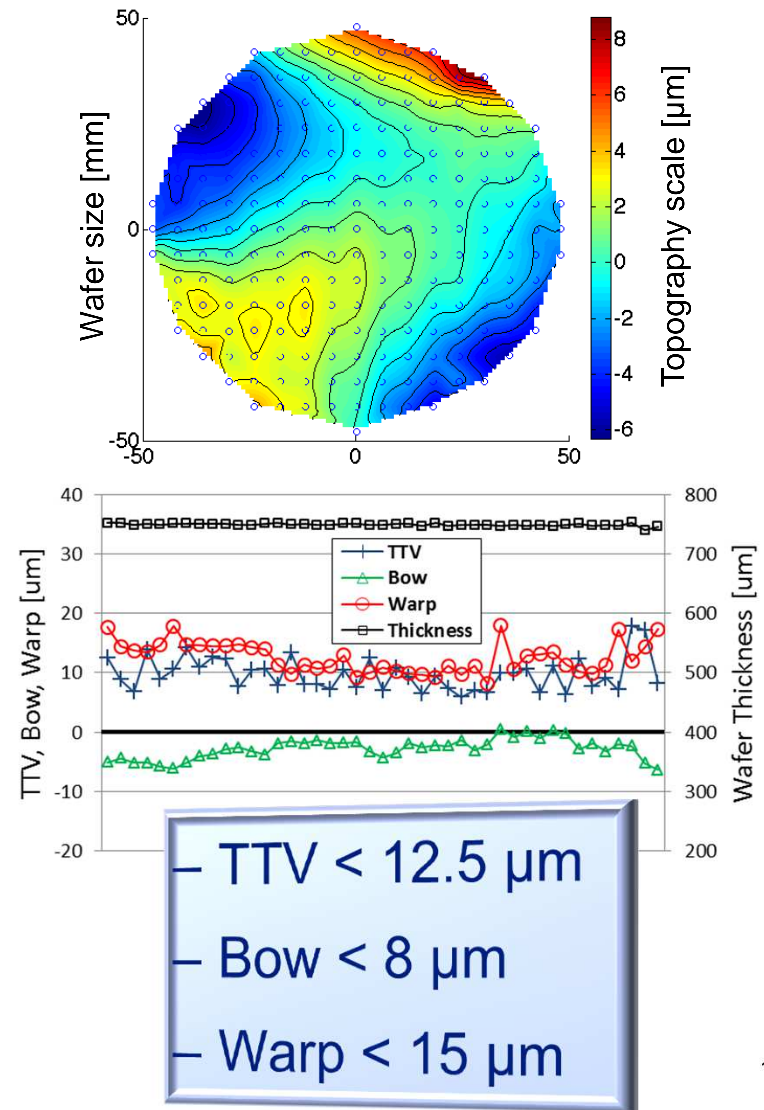
Process with 3D Core Adjustment:

- Reduced requirements on all steps – more variation allowed
- Potential to eliminate grinding of Top/Tail surfaces

Example 1 – Wafer quality

- Wafer quality showcase 4”
  - Cutting time: 6.5 h
  - Wire: DMT 250 µm
  - Coolant: water based + additive
  - Pitch: 1.020 mm
  - Wafer measurement: HE-SIA-01

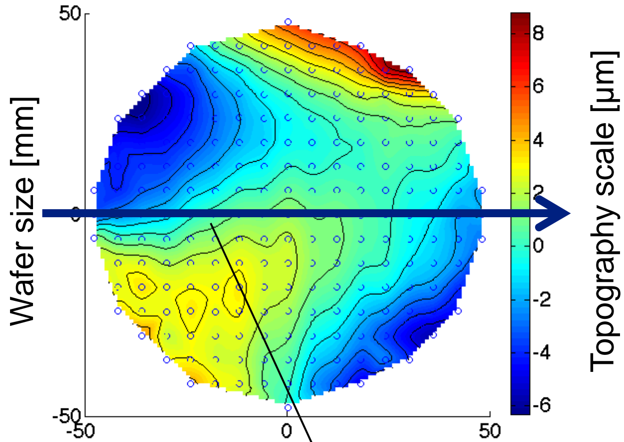
Sapphire Wafer-Measuring & Sorting-System: HE-SIA-01
Hennecke Systems GmbH, Germany



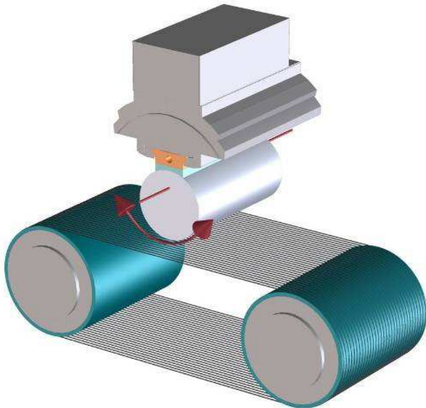
Example 2 – Throughput

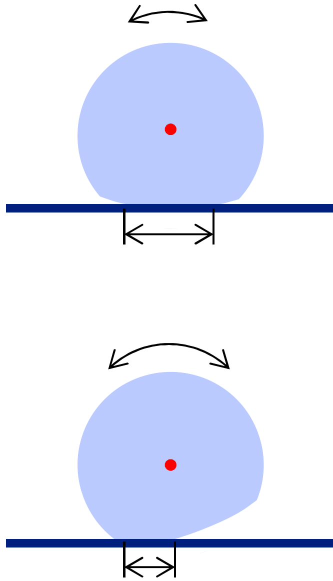
- Slicing contact length influences the wafer quality

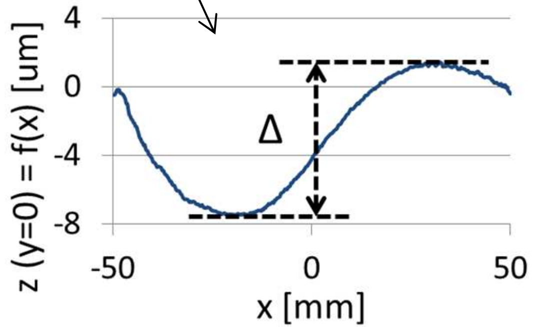
  A relevant factor determining the slicing performance ⇒ Throughput



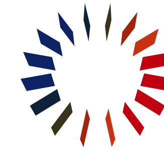
Rocking motion



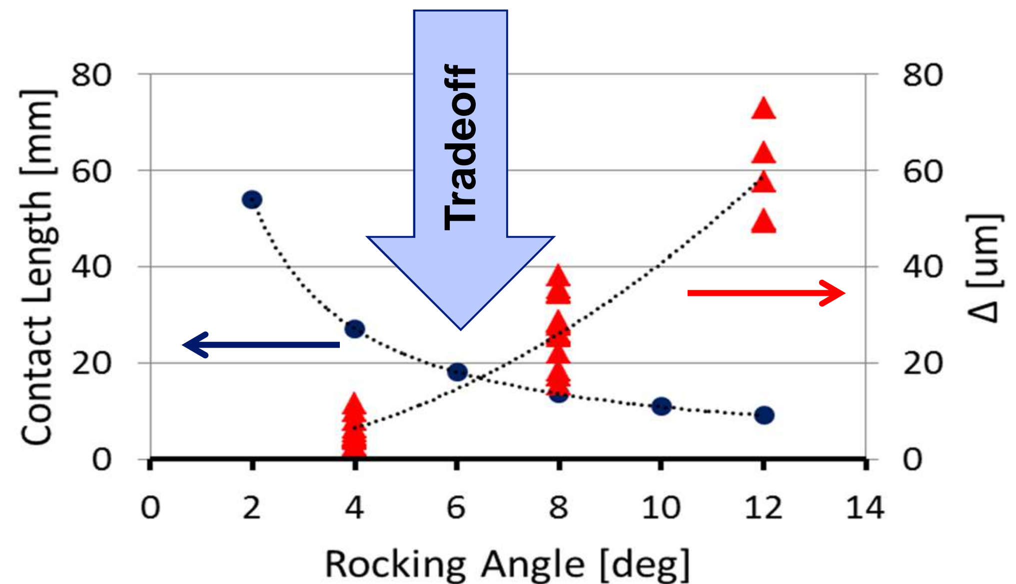




Example 2 – Throughput



- The tradeoff between contact length and wafer shape defines the best process.

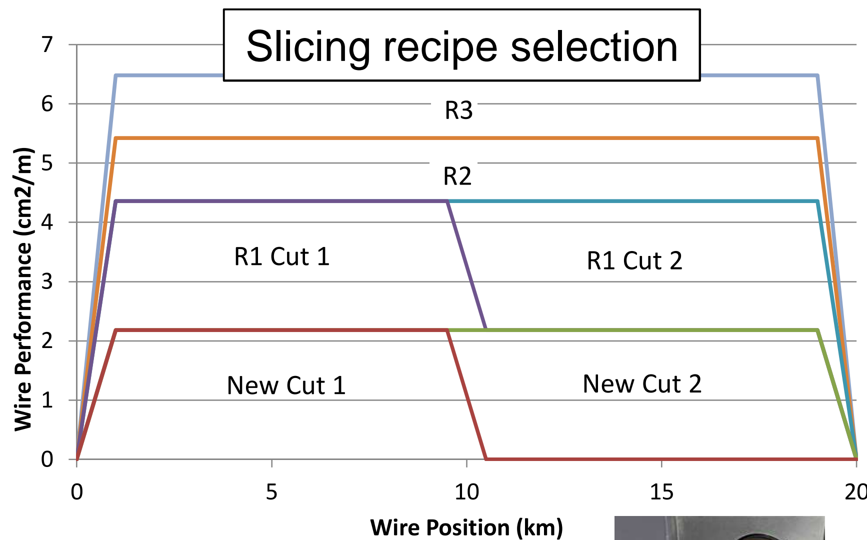


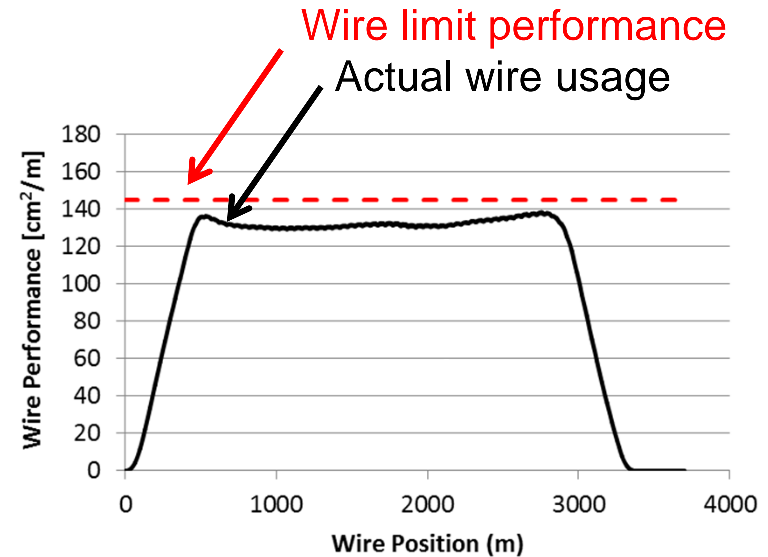
- Wafer quality showcase 4"
  - Cutting time: 4.0 – 12.0 h
  - Rocking: 4° - 12°
  - Wire: DMT 250 µm
  - Coolant: water based + additive
  - Pitch: 0.805 mm
  - Wafer measurement: HE-SIA-01

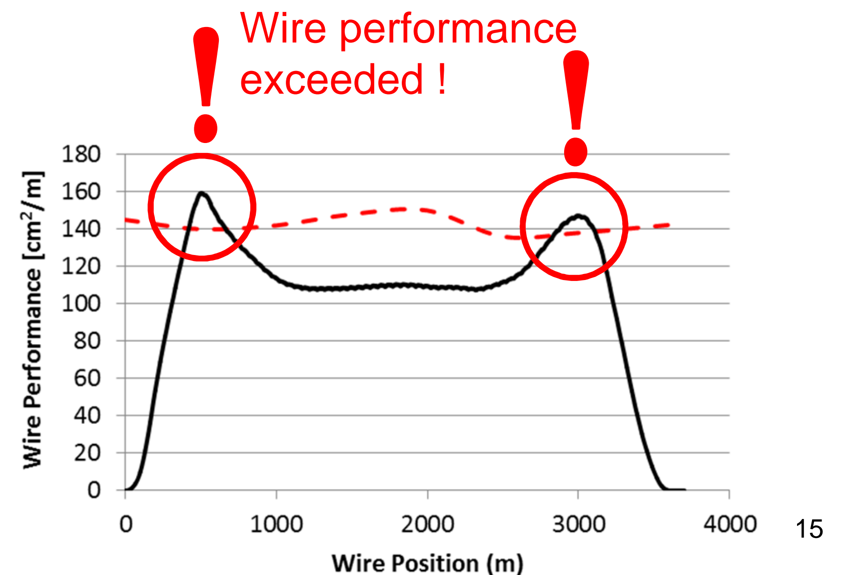
Example 3 – Cost of Ownership

- The slicing recipe influences the wire consumption

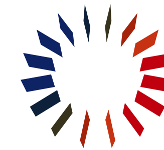
  A relevant factor determining the slicing performance ⇒ CoO







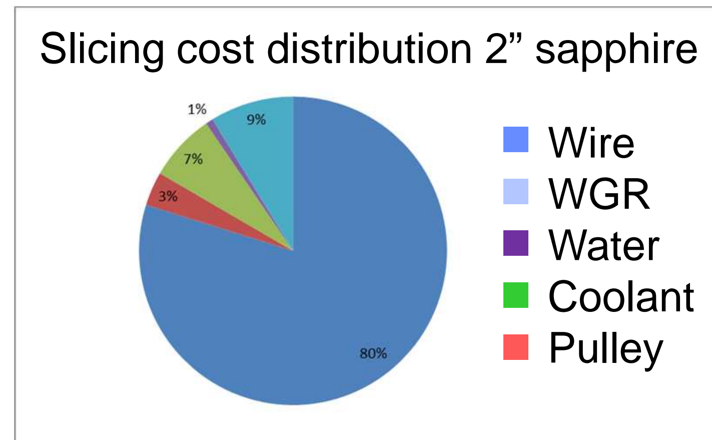
Showcase
Wire consumption 2”



Challenge

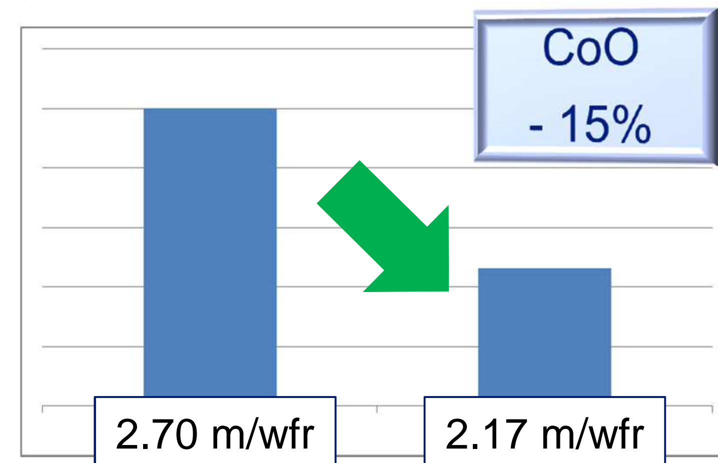
Reduce current wire consumption of 2.70 m/wfr

- Production environment
- Machine: DS265
- Wire: DMT 250 um wire



Approach

- Meyer Burger Process development
  - MB: Process Expertise
  - Customer: MC, operators and material
- One week program



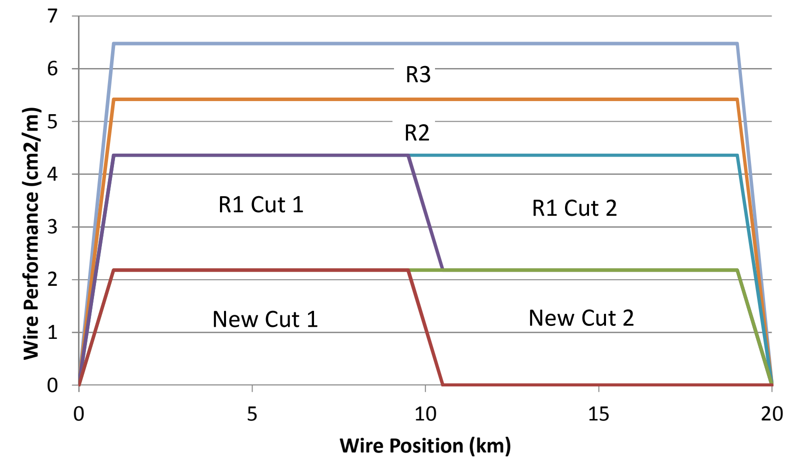
Achievements

- 23 cuts done
- Wire consumption reduced to 2.17 m/wfr

Total Cost Savings

- ~20% less wire/wafer
- ~15% COO reduction

Showcase
Wire consumption 4”



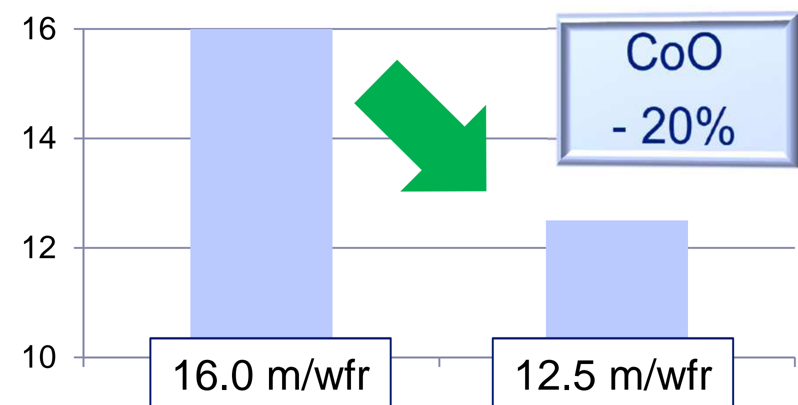
Challenge

Reduce current wire consumption of 16.0 m/wfr

- Production environment
- Machine: DS265
- Wire: DMT 250 um wire

Approach

- Meyer Burger Process development
  - MB: Process Expertise
  - Customer: MC, operators and material
- Three weeks program



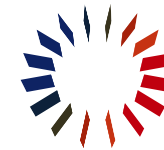
Achievements

- 6 cuts done
- Wire consumption reduced to 12.5 m/wfr

Total Cost Savings

- ~ 25% less wire/wafer
- ~ 20% COO reduction

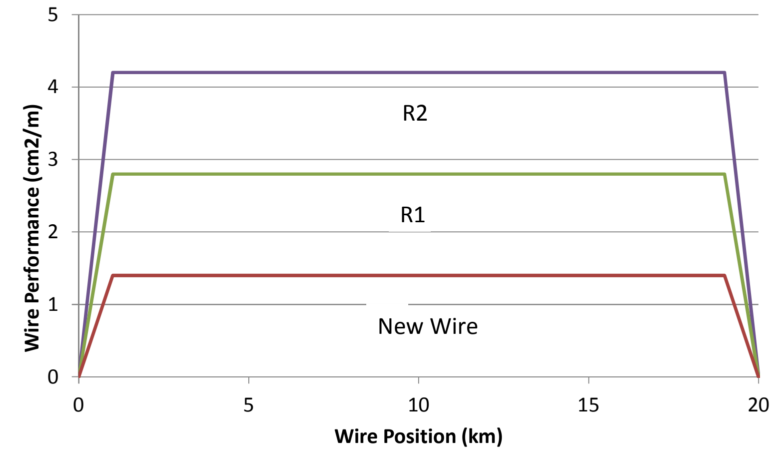
Showcase
Wire consumption 6”



Challenge

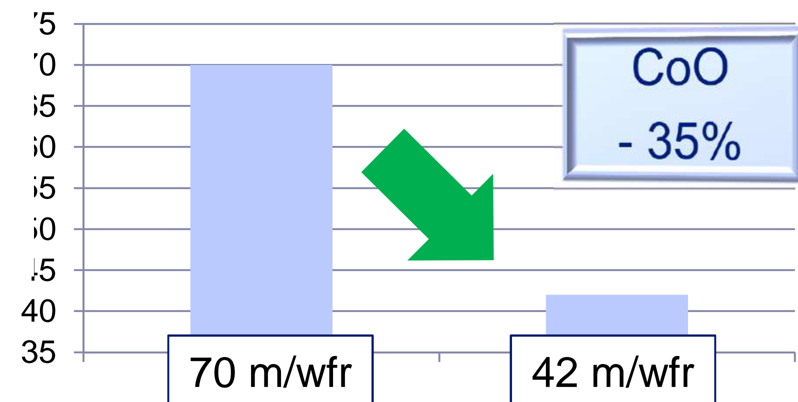
Reduce current wire consumption of 70 m/wfr

- Production environment
- Machine: DS265
- Wire: DMT 250 um wire



Approach

- Meyer Burger Process development
  - MB: Process Expertise
  - Customer: MC, operators and material
- Four weeks program



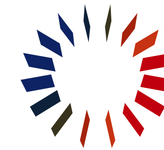
Achievements

- Wire performance reduced to 42 m/wfr
- New recipes are used in production

Total Cost Savings

- ~ 40% less wire/wafer
- ~ 35% COO reduction

Showcase
Cutting time 6”



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Challenge

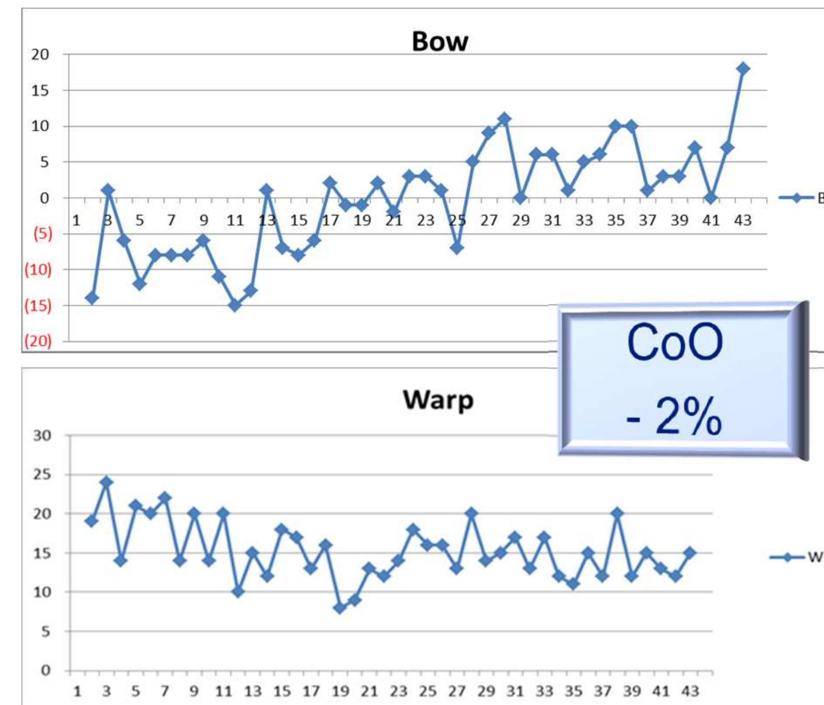
Improve throughput of 65’000 wafers/year

- Production environment
- Machine: DS265
- Wire: DMT 250 um wire

Approach

- Meyer Burger Process development
  - MB: Process Expertise
  - Customer: MC, operators and material
- Two weeks program

Bow and WARP values for 6” fast cuts



Achievements

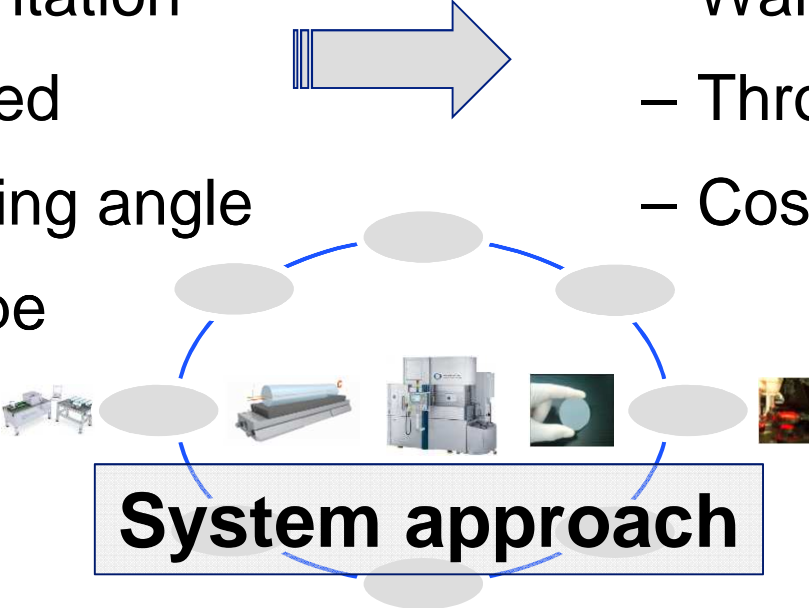
- 55% reduction of cut time (24h to <11h)
- Increased output from 65k to 105k Wafer per year

Savings and Benefits

- ~2% cost savings per wafer
- >40’000 Wafers additional (per year)

Conclusions

- Relevant system parameters
  - Crystal orientation
  - Cutting speed
  - Slicing rocking angle
  - Slicing recipe

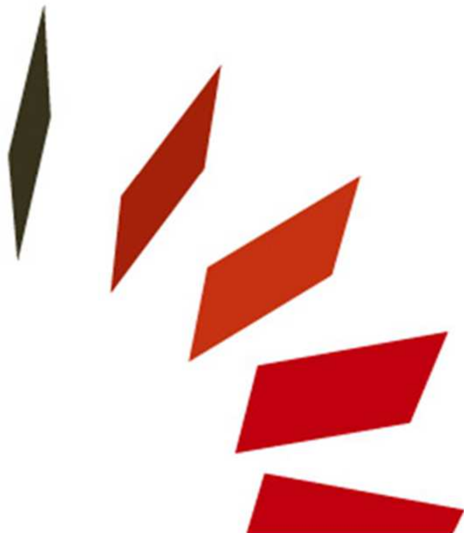


- Influence on performance
  - Wafer quality
  - Throughput
  - Costs

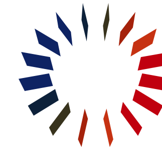
Performance improvement up to 40%

Thank you for your attention !

Passionate about LED



Contact Information



Dr. Fabiano Assi

Head of Technology Management

HEADQUARTER

Meyer Burger AG
Schorenstrasse 39
CH-3645 Gwatt (Thun)
TEL: +41 33 221 21 00
FAX: +41 33 221 25 10

TAIWAN

MEYER BURGER COMPANY LTD

No. 52, Dinghu Road
Gueishan Township
Taoyaun County 33378, Taiwan
TEL: +886 3 3960636
FAX: +886 3 3960623

KOREA

MB SYSTEMS CO. LTD

7F, Othrys B/D, 154-3, Samsung-dong, Gangnam-gu
135-090 Seoul
TEL: +82 2 3454 0701
FAX: +82 2 3454 0760

CHINA

MEYER BURGER TRADING SHANGHAI CO. LTD

17F, Building 1, Guoson Centre(HuaHong), No.5 Lane 388
Daduhe Road, Putuo District, Shanghai, China 200062
TEL: +86 21 2221 7333
FAX: +86 21 6350 4715

JAPAN

MEYER BURGER K.K. / MEYER BURGER COMPANY
3-6-15-107 Nozawa Setagya-ku
154-0003 Tokyo
TEL: +81 (0) 3 5486 6851
FAX: +81 (0) 3 5779 6861