ESH WG

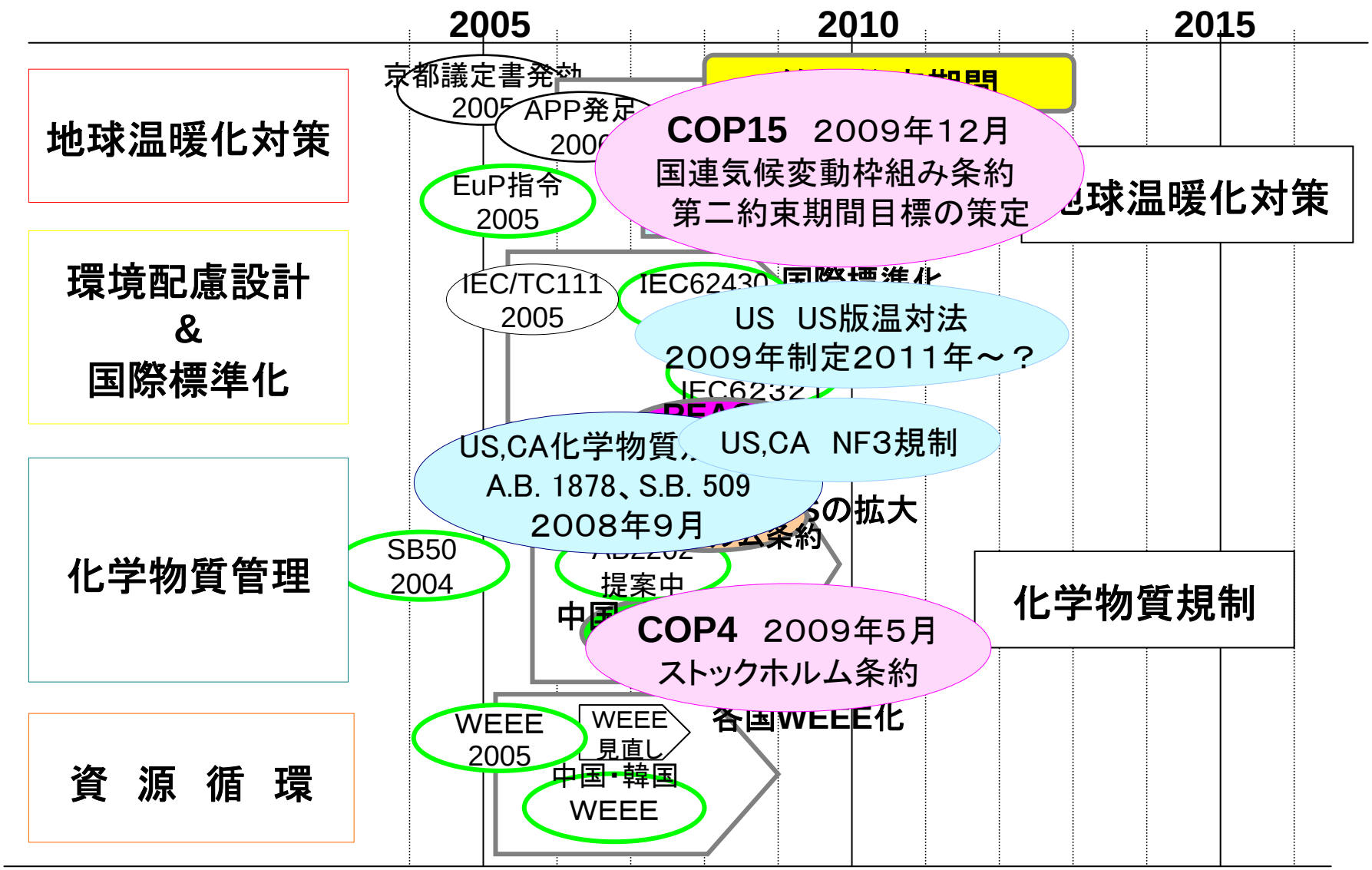
「ITRS2009年改定に向けて」

―今後の課題とESHからの発信―

5th March 2009

STRJ WG9

国際的環境規制動向


2005
2010
2015
地球温暖化対策
環境配慮設計
&
国際標準化
化学物質管理
資 源 循 環
京都議定書発効
2005
APP発足
2006
EuP指令
2005
COP15 2009年12月
国連気候変動枠組み条約
第二約束期間目標の策定
地球温暖化対策
IEC/TC111
2005
IEC62430 国際標準化
US US版温対法
2009年制定2011年～？
IEC62321
US,CA化学物質
A.B. 1878、S.B. 509
2008年9月
US,CA NF3規制
の拡大
条約
SB50
2004
提案中
中国
COP4 2009年5月
ストックホルム条約
化学物質規制
WEEE
2005
WEEE
見直し
中国・韓国
WEEE
各国WEEE化

“技術の高度化”に伴う環境課題

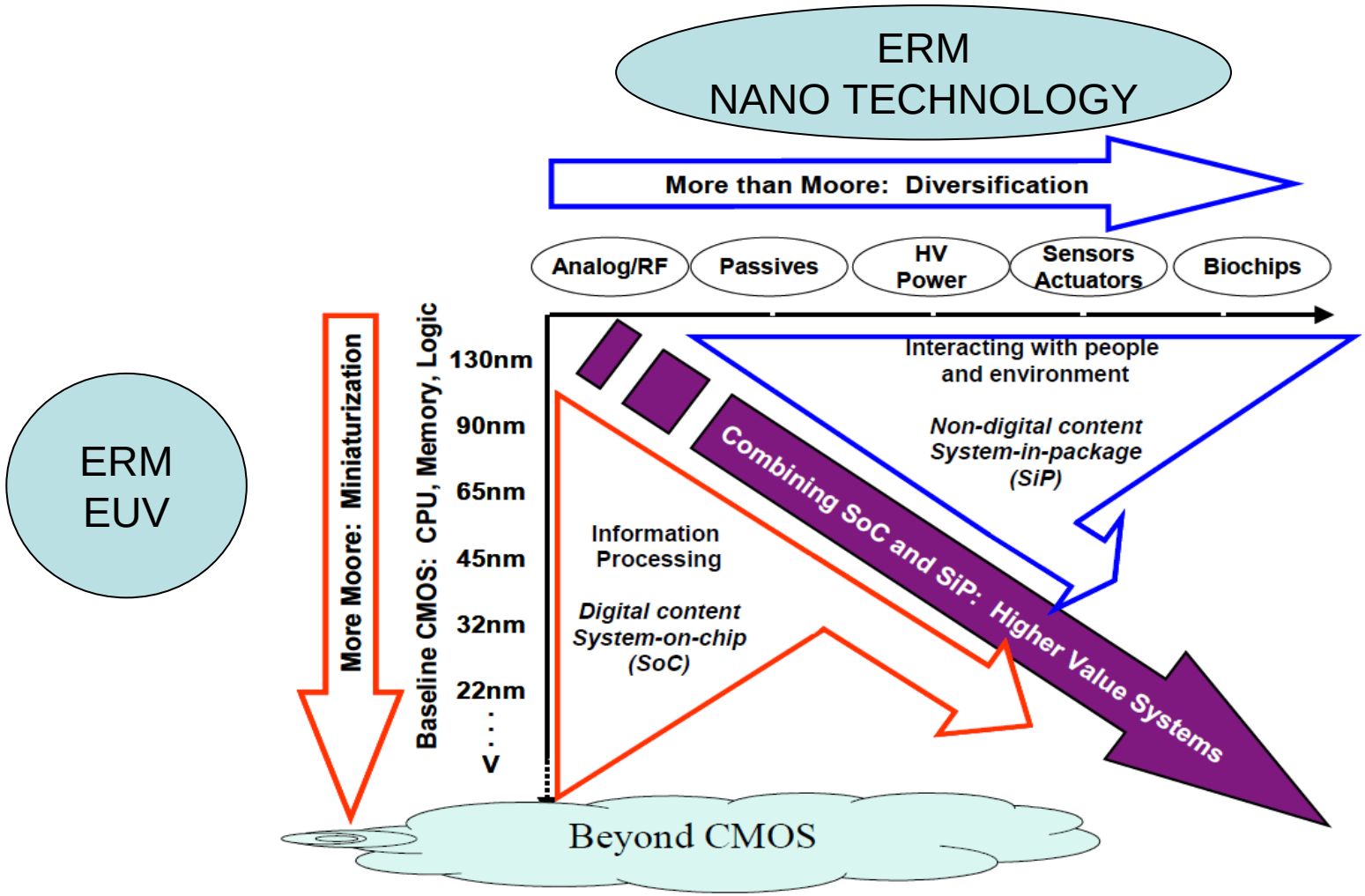


Figure 5 Moore's Law and More

ITRSとESHのおさらい

ITRS-ESHの領域

- ✓半導体“技術の高度化”に伴う環境リスク
- ✓製品及び製造に対する“Global環境課題”
  - ●地球気候変動（温暖化対策＝PFCs、省エネルギー）
  - ●化学物質規制
  - ●資源枯渇・水
- ✓環境適合生産方式（Sustainability）

ITRS-ESHの目的

- ✓法・ステークホルダー要求の明確化
- ✓技術への要求・技術課題の明確化
- ✓解決候補及び時期の提案
  - ●エンジニアの意見交換
  - ●標準化によるリスク低減の検討・布石／ISMI、SEMI

地球気候変動（温暖化）対策

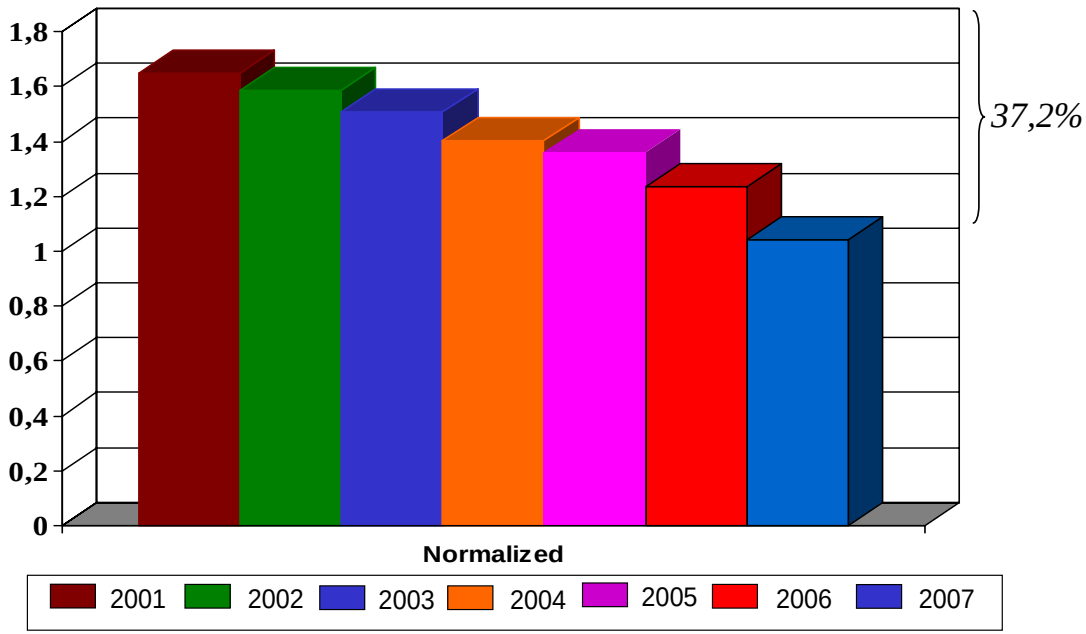
エネルギー起因CO_2

- ✓ **WSC期待値レベル** 2001年基準－2010年
  - 30%以上改善（ウエハー面積原単位） ※購入電力
- ✓ **JEITA（4団体）自主行動目標** 1990年基準－2008年～2012年平均
  - 実質生産高原単位35%以上改善 ※工場使用総エネルギー
- ✓ **京都議定書日本目標** 1990年基準－2008年～2012年平均
  - 総量6%削減

※対象6GHG
CO_2、N_2O、CH_4、
HFC、PFC、SF_6

WSC Electricity Data
2001- 2007
- weighted average -

Normalized
Kilowatt-Hours per cm² Silicon



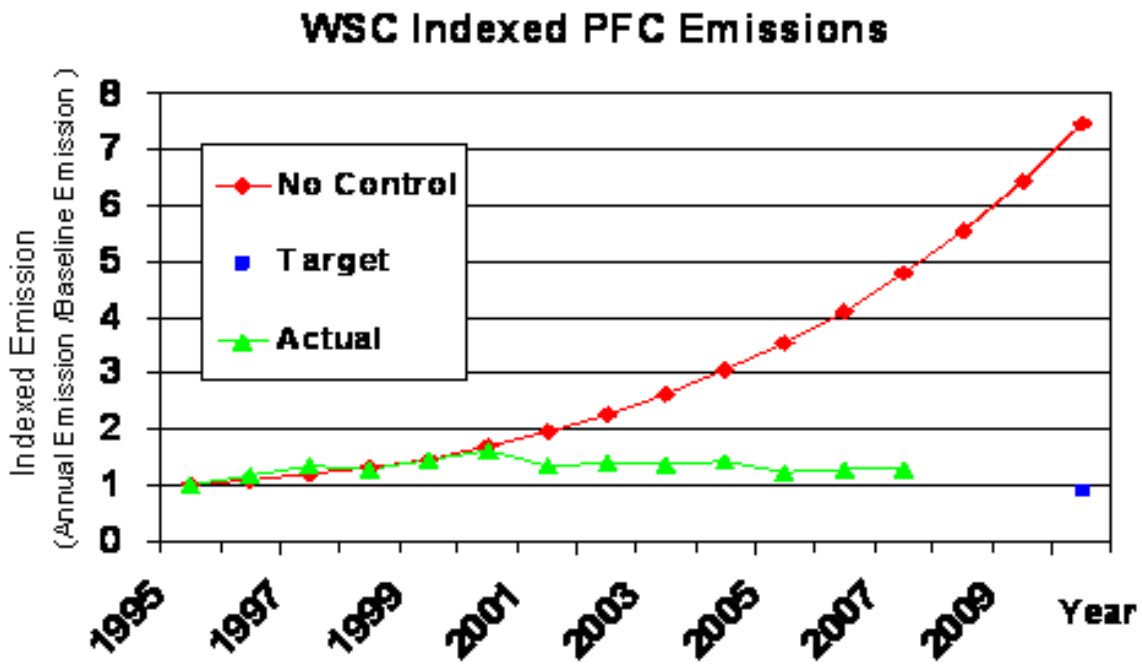
CSIA Data included beginning 2004

地球気候変動（温暖化）対策

PFC・HFC・SF_6・NF_3

- ✓ **WSC目標**　1995年基準－2010年
  - 排出絶対量10%以上削減　※IPCC基準　CO2換算表記
- ✓ **JEITA目標**　1995年基準－2010年
  - 排出絶対量10%以上削減　※IPCC基準　CO2換算表記

POST2010プログラム
エネルギーを含め
WSC　ESH-TFにて
検討中



化学物質規制対策

PFOS対応

✓ **WSC目標**　　2001年～

コミット項目

- 2007年5月までに　Non-Essential用途の廃止
- 2006年末までにEssential用途からの廃棄物の確実な燃焼破壊
- 2005年をベースとしてグローバルデータを収集する

実施項目

- Essential用途の代替に対する努力を継続する
- 装置排水の最適化の開発
- 装置からの排水制御技術とサンプリング方法の評価
- データの公表

ストックホルム条約に先んじて対処

ITRS2008の結果（1）

Revise and update
Energy and Water conservation requirements

- Energy
  - Balanced Equipment and Facilities requirements
  - Refined total factory energy baseline
  - Eliminated redundancy in tables
- Water
  - Incorporated relationship between water use and energy consumption (energy released to atmosphere through cooling tower)
  - Improved water balance model used (in Back Up/file on ITRS Web site)
  - UPW Recycle added back into tables
    - Will require reevaluation in 2009 due to impact of single wafer processing

ITRS2008の結果（2）

Energy Conservation Changes

Year of Production	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Table 103a&b ESH Difficult Challenges																
Table 104 ESH Intrinsic Requirements																
II.. Process and Equipment Technology Requirements																
*Energy Consumption **(electricity)***																
was	Total fab tools (kWh/cm^2) [2]	0.40–0.35			0.35-0.30			0.30-0.25			0.25					
is	**Total fab tools (kWh/cm2) [2][3]**	0.5			0.43			0.35			0.30-0.25					
is	~~Tool energy usage (% of 2005 baseline)~~	~~90~~			~~80~~			~~Functional Area Goals TBD~~			~~Functional Area Goals TBD~~					
is	~~Tool total equivalent energy* (% of 2007 baseline)~~	~~100~~		~~80~~	~~70~~			~~60~~			~~50~~					
III.. Facilities Technology Requirements																
Energy Consumption																
was	Total fab energy usage (kWh/cm2)	1.5-1.3			1.3-1.1			1.1-1.0			1.0-0.75					
is	**Total fab energy usage (kWh/cm2) [3]**	1.0			0.85			0.7			0.6-0.5					
was	Total fab support systems energy usage (kWh/cm^2) [2]	0.8–0.6			0.6–0.5			0.5-0.4			0.4-0.25					
is	**Total fab support systems energy usage (kWh/cm2) [2]**	0.5			0.43			0.35			0.30-0.25					
is	~~Reduce total fab energy usage (% of 2007 baseline)~~	~~100~~		~~90~~	~~80~~			~~70~~			~~50~~					
Table 105 Chemicals and Materials Management Technology Requirements																
Table 106 Process and Equipment Technology Requirements																
Table 107 Facilities Technology Requirements (ALL NUMERICAL VALUES IN TABLE MIGHT CHANGE)																
Energy (electricity, natural gas, etc.)																
was	Total fab* energy consumption (kwh per cm2) [1]	1.9			1.6			1.35			1.2			1.1		
is	**Total fab tools* energy consumption (% of 2007 baseline)**	100			85			70			60			50		
is	~~Total site energy consumption reduction~~	~~Establish baseline~~	~~Reduce total comsumption 10% from baseline levels~~		~~Reduce total comsumption additional 10%~~			~~Reduce total comsumption additional 10%~~			~~Reduce total consumption by additional 5%~~			~~Reduce total consumption by additional 5%~~		
is	~~Cleanroom thermal management~~	~~Establish baseline~~			~~Reduce heat rejection from process and ancillary equipment to cleanroom air by 15% from baseline~~			~~Reduce heat rejection from process and ancillary equipment to cleanroom air by additional 15%~~			~~Reduce heat rejection from process and ancillary equipment to cleanroom air by additional 15%~~			~~Reduce heat rejection from process and ancillary equipment to cleanroom air by additional 15%~~		

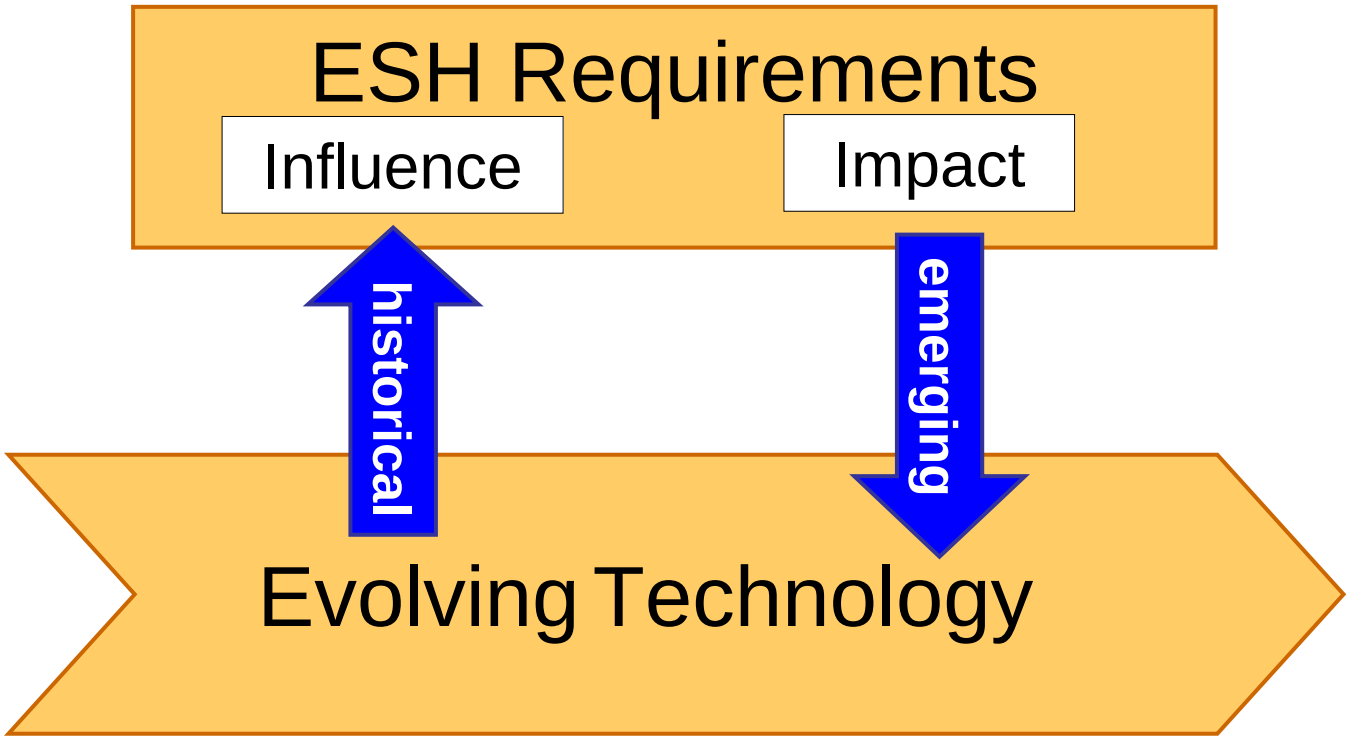
ITRS2008の結果（3）

Water Conservation Changes

		Year of Production	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Table 103a&b ESH Difficult Challenges																		
Table 104 ESH Intrinsic Requirements																		
	II.. Process and Equipment Technology Requirements																	
		Water Consumption																
		Surface preparation UPW use (% of 2005 baseline)		90			80			75			50					
		Tool UPW usage (% of 2005 baseline)		90			80			75			50					
	III.. Facilities Technology Requirements																	
		Water Consumption																
	is	~~Net feed water use (liters/cm^2) [2]~~		~~15~~		~~15-12~~			~~12-10~~			~~10-8~~			~~8-6~~			
	is	~~Fab UPW use (liters/cm^2) [2]~~		~~8~~		~~8-7~~			~~7-6~~			~~6-4~~			~~4-3~~			
Table 105 Chemicals and Materials Management Technology Requirements																		
Table 106 Process and Equipment Technology Requirements																		
Table 107 Facilities Technology Requirements (ALL NUMERICAL VALUES IN TABLE MIGHT CHANGE)																		
		Water																
	was	Total fab* water consumption (liters/cm2) [1]		14			12.5			11			10			9		
	is	Total fab* water consumption (liters/cm2) [1]		6.5			5.4			4.4			3.6			3.0		
	is	~~Total site water consumption reduction~~	~~Establish baseline~~	~~Reduce total comsumption 10% from baseline levels~~		~~Reduce total comsumption additional 10%~~			~~Reduce total comsumption additional 10%~~			~~Reduce total consumption by additional 10%~~			~~Reduce total consumption by additional 10%~~			
	was	Total UPW consumption (liters/cm2) [1]		8			7			6			5			4.5		
	was	UPW recycled/reclaimed** (% of use)		70			75			80			85			90		
	is	UPW recycled/reclaimed** (% of use)		70			75			80			85			90		

ITRS2008の結果（4）

Impact to Technology from ESH Policy



Impact to ESH Policy from Technology

2009 Issues

How best to incorporate emerging policy issues? For example:

- ・政治的地理的要因で業界間で異なる化学物質規制対応
- ・新しいエネルギーを集中的に必要とするプロセスへの対応（例　EUV）

Should we reorganize requirements from technical thrust to topical focus?

Table ESH3a Chemicals and Materials Management Technology Requirements
Nano, Persistent Organic Pollutants Treaty (POPs), New chemicals, Hazard

Table ESH4a Process and Equipment Management Technology Requirements
PFC, Energy (Process Equipment), Material utilization

Table ESH5a Facilities Energy and Water Optimization Technology Requirements
Energy (Facilities), Waste, Emission impact

Table ESH6 Sustainability and Product Stewardship Technology Requirements
Green Fab

Adjust scope on Factory requirements (wafer size vs. functionality)

450mm, new 300mm and **Existing factories** with new technology

Additional 2009 Challenges

Supplementary Material (Scope Documents)/ERM/ESH Material Table

2009 key work: prioritization of ESH requirements

Table ESH3a *Chemicals and Materials Management Technology Requirements—Near-term Years*

The Environment, Safety, and Health new chemical screening tool (Chemical Restrictions Table) is linked online

Year of Production	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Interconnect									
Low-κ materials—spin-on and CVD **Enabling**	Establish chemical utilization* and process byproducts baseline	Maintain or improve chemical utilization* by 10%		Maintain or improve chemical utilization* by 10%			Maintain or improve chemicals utilization* by 10%		
Copper deposition processes (conventional and alternativ **Enabling**	75% copper								
Advanced metallizat n includin barrier an nucleatio deposition **Improvin**									
Planarizatio n methods **Enabling**	Characterize emissions and consumables ; establish baseline.	> 15% Reduction in consumables from baseline					2% reduction in consumables per year		
Plasma etch **Critical**	Alternatives with improved ESH impacts. Maintain or improve chemical utilization*; characterize process byproducts.	Alternatives with improved ESH impacts. Maintain or improve chemical utilization* by 10%; minimize process byproducts.		Alternatives with improved ESH impacts. Low ESH impact chemistries. Maintain or improve chemical utilization* by 10%; minimize process byproducts.			Alternatives with improved ESH impacts. Low ESH impact chemistries. Maintain or improve chemical utilization* by 10%; minimize process byproducts.		

Critical - ***Essential*** **item for the implementation and success of the technology**

Enabling - ***Important*** **item for the implementation and success of the technology**

Improving - ***Useful*** **item for the implementation and success of the technology**

Current Table Structure

1. Table ESH3a Chemicals and Materials Management Technology Requirements
   a. Interconnect
   b. Front End Processes
   c. Lithography
   d. Assembly & Packaging
   e. Emerging Research Materials
2. Table ESH4a Process and Equipment Ma…s
   a. Interconnect
   b. Front End Processes
   c. Lithography
   d. Assembly & Packaging
   e. Emerging Research Materials
   f. New Equipment Design
3. Table ESH5a Facilities Energy and Water …ents
   a. Facilities Design
   b. Water
   c. Energy (electricity, natural gas, etc.)
   d. Waste
   e. Air Emissions
4. Table ESH6 Sustainability and Product S…ewardship Technology Requirements
   a. Sustainability Metrics
   b. Design for ESH
   c. End-of-Life

/Comments (annotation)
Duplications

/ Decentralized
Numerical target

Current Table

	PFC	Nano	Hazard	PFOS/PFAS	New chemicals	Energy	waste	Material utilization	emission impact	Green Fab
Table ESH3a Chemicals and Materials Management Technology Requirements—Near-term Years										
Interconnect	○		○	○	○		○	○		
Front End Processes	○		○					○		
Lithography								○		
Assembly & Packaging	○							○		
Emerging Research Materials		○			○					
Table ESH4a Process and Equipment Management Technology Requirements—Near-term Years										
Interconnect	○							○		
Front End Processes	○		○					○		○
Lithography								○		
Assembly and Packaging								○		
Emerging Research Materials		○			○					
New Equipment Design						○	○	○		○
Table ESH5a Facilities Energy and Water Optimization Technology Requirements										
Facilities Design							○			○
Water							○	○		
Energy (electricity, natural gas, etc.)						○				
Waste							○			
Air Emissions	○							○	○	
Table ESH6 Sustainability and Product Stewardship Technology Requirements										
Sustainability Metrics										○
Design for ESH								○		○
End-of-Life							○			

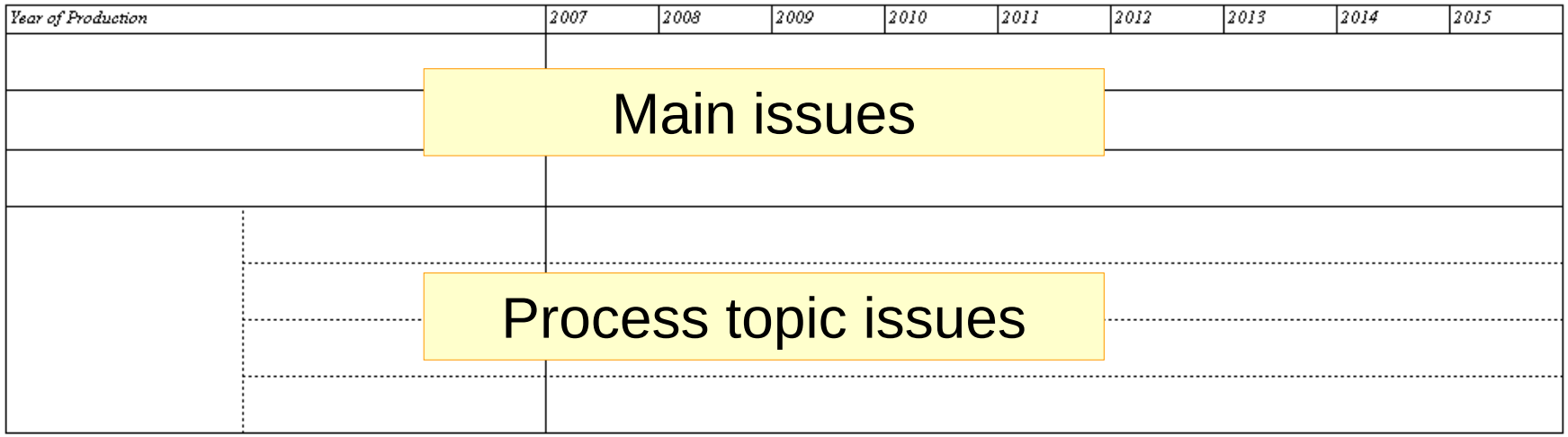
Axis conversion

New Table Structure（1）

1. Table ESH3a Chemicals and Materials Management Technology Requirements
   a. Nano　b. Hazard　c. POPs　d. New chemicals
2. Table ESH4a Process and Equipment Management Technology Requirements
   a. PFC　b. Energy（Process and Equipment）
   c. Material utilization
3. Table ESH5a Facilities Energy and Water Optimization Technology Requirements
   a. Energy（Facilities）　b. Waste /numeric target
   C. Emission impact /numeric target　d. Material utilization（Water)
4. Table ESH6 Sustainability and Product Stewardship Technology Requirements
   a.Green Fab

New Table Structure(2)

Road map-1 (message)



Road map-2 (numerical)

Collected Numerical Roadmap

Axis conversion and Focusing

	Table ESH3a Chemicals and Materials Management Technology Requirements–Near-term Years					Table ESH4a Process and Equipment Management Technology Requirements–Near-term Years						Table ESH5a Facilities Energy and Water Optimization Technology Requirements					Table ESH6 Sustainability and Product Stewardship Technology		
	Interconnect	Front End Processes	Lithography	Assembly & Packaging	Emerging Research Materials	Interconnect	Front End Processes	Lithography	Assembly and Packaging	Emerging Research Materials	New Equipment Design	Facilities Design	Water	Energy (electricity, natural gas, etc.)	Waste	Air Emissions	Sustainability Metrics	Design for ESH	End-of-Life
PFC	○	○		○		○	○		○							○			
Nano	＊	＊		＊	○	＊	＊		＊	○	＊								
Hazard	○	○					○												
PFOS/PFAS->POPs	○		＊					＊											
New chemicals	○	○	＊	＊	○	＊	＊	○	＊	○									
Energy								○			○			○					
waste	○										○	○	○		○			＊	○
Material utilization	○	○	○	○		○	○	○	○		○		○			○	＊	○	
emission impact																○			
Green Fab							○				○	○	＊	＊	＊		○	○	

List of Table

Table ESH1 ESH Difficult Challenges **(Item list)**
Chemicals and Materials Management Technology Requirements
Process and Equipment Management Technology Requirements
Facilities Energy and Water Optimization Technology Requirements
Sustainability and Product Stewardship Technology Requirements
Table ESH2 Chemicals and Materials Management Technology Requirements
Table ESH3 Process and Equipment Management Technology Requirements
Table ESH4 Facilities Energy and Water Optimization Technology Requirements
Table ESH5 Sustainability and Product Stewardship Technology Requirements
Tale ESH6 Technical Thrust ESH Technology Requirements **(Item list)**
Potential Solutions

List of content

2009年～更なる課題

- ✓既存工場の中期的ロードマップをいかに議論し描くか？
  規制　＝＞　環境技術（温暖化、化学物質）

- ✓既存ロードマップと現実との検証作業
  （2008年水、エネルギーのテーブルは改定）

- ✓半導体の社会への貢献～　可視化、定性、定量性

用語

IEC（International Electrotechnical Commission）：**国際電気標準会議**は、電気工学、電子工学及び関連した技術を扱う国際的な標準化団体、その標準の一部はISOと共同で開発されている

EuP: Energy using Products

RoHS: Restriction of Hazardous Substances

JIG: Joint Industry Guide

J-Moss: Japan the marking for presence of the specific chemical substances

APP: Asia Pacific Partnership

REACH: Registration, Evaluation and Authorization of Chemical

WEEE: Waste Electrical and Electronic Equipment

POPs（Persistent Organic Pollutants）：残留性有機汚染物質、ストックホルム条約（Stockholm Convention）での規制対象物質の総称身近な例としてダイオキシンやDDTなどがある

PFOS：Perfluorooctyl sulfonates

AB2202: Another Bill Electronic Hazardous Waste (E-Waste)

COP：締結国会議 COP15/国連気候変動枠組み条約会議2009年12月予定、本会合でポスト京都の各国の数値目標について決定される COP4/ストックホルム条約第4回締結国会議、2009年5月開催予定 PFOSを廃絶か制限か決議される

実質生産高原単位：原油換算エネルギー消費（KL）／実質生産高