Marketplace Report
Past & Future Learning

Ira Feldman
Feldman Engineering Corp.

TestConX™ 25

Mesa, Arizona • March 3-6, 2024

FELDMAN ENGINEERING

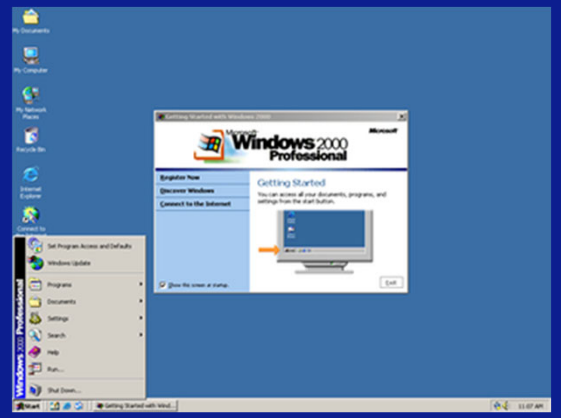
Outline

- The Last 25 years
- The Next 25 years
- Action needed

- Socket Market

The Last 25 Years

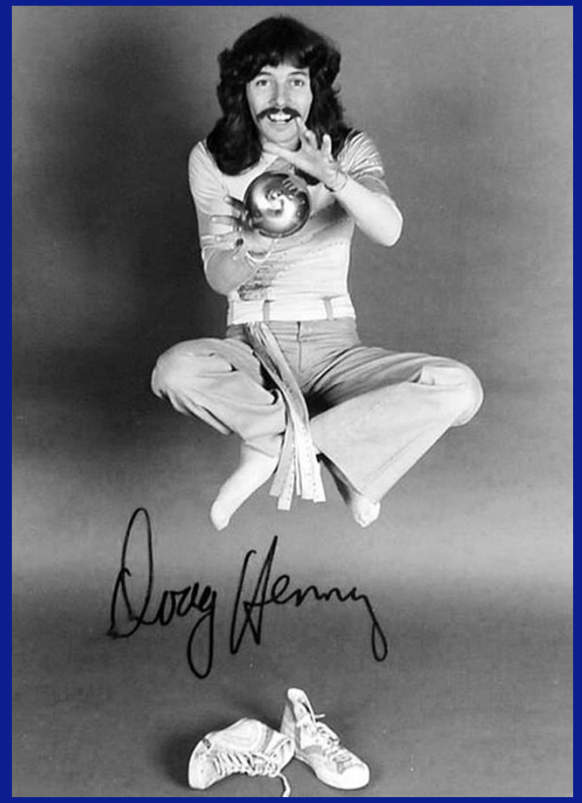
Remember 2000?



Picture credits: wikipedia

Notable Passings

Charles Schultz



Doug Henning

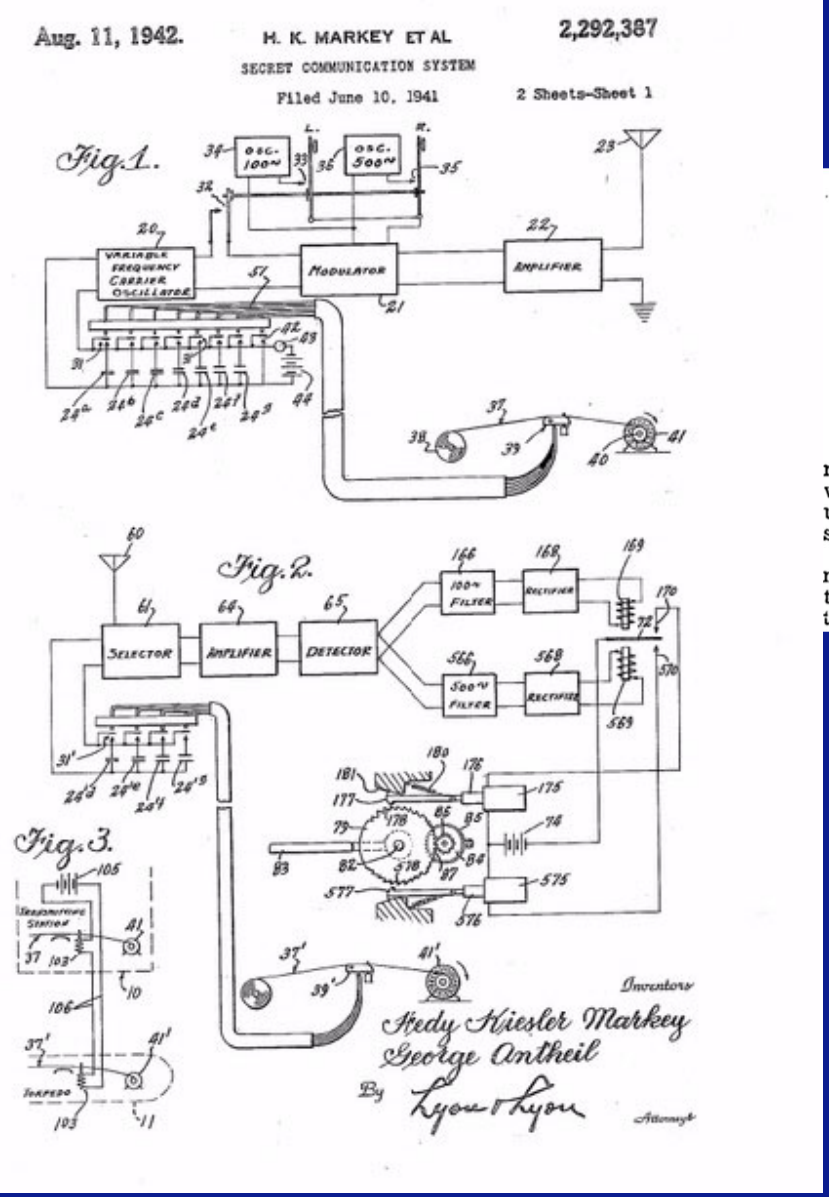
Hedy Lamarr

Walter Matthau

Steve Allen

Picture credits: wikipedia

Hedy Lamarr & George Antheil



UNITED STATES PATENT OFFICE

2,292,387

SECRET COMMUNICATION SYSTEM

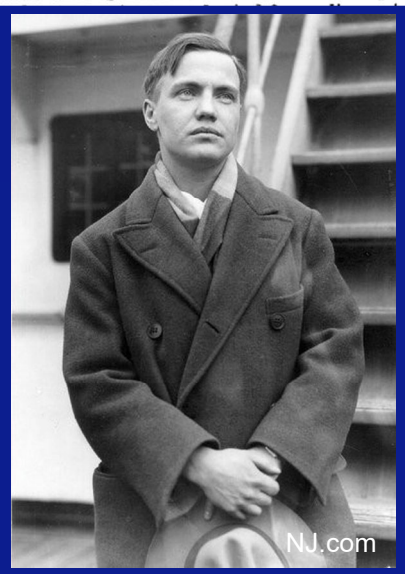
Hedy Kiesler Markey, Los Angeles, and George Antheil, Manhattan Beach, Calif.

Application June 10, 1941, Serial No. 397,412

6 Claims. (Cl. 250—2)

This invention relates broadly to secret communication systems involving the use of carrier waves of different frequencies, and is especially useful in the remote control of dirigible craft, such as torpedoes.

An object of the invention is to provide a method of secret communication which is relatively simple and reliable in operation, but at the same time is difficult to discover or decipher.



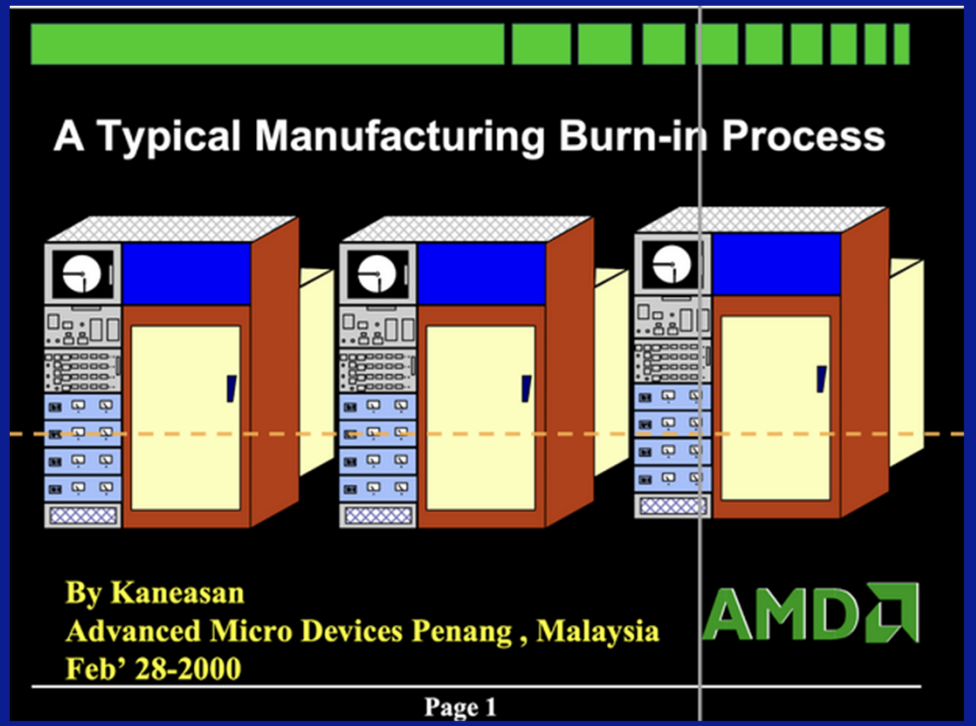
BiTS 2000

WELLS-CTI
A subsidiary of PCD Inc.

Thermal Management & The Parameters That Affect Heat Dissipation During Burn-in

Feb 2000 Bits Workshop

Presented by Erik Orwoll
Engineering Manager
WELLS-CTI



BiTS 2000

Interface Considerations for High Performance Contactors in Automated Test Environments

Dan Maccoux
Product Engineering & Support Manager
Pamela Lohr
Applications Engineer
Johnstech International
February 27-29, 1999

BiTS BURN-IN & TEST SOCKET WORKSHOP

Package Tolerance of VFQON: Effect on Socket Design

2000 Burn-in and Test Sockets Workshop
February 27-29th, 2000

Marc Abelanet and David Pfaff
2601 Texas Drive
Irving Texas 75062
972-258-2580;
david@locknest.com

PLASTRONICS

BiTS 2000


BiTS Feb 2000
Aspect of Socket Designs and its Trends
by
LP Goh
Intel Technology Sdn. Bhd
Intel Test Tooling Operation (ITTO)
Malaysia
LP Goh Feb 2000
Intel Itto Penang


OZ Technologies
Interconnect Solutions for ATE
Iraj Barabi / Mehdi Attaran
OZ Technologies Inc.
February 26th 2000

BiTS 2000

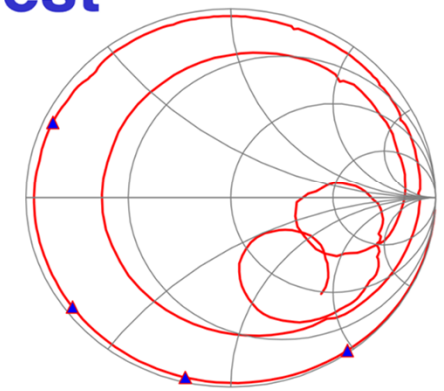
A Method for Measuring and Evaluating Contact Resistance in Burn-in and Test Sockets

2000 Burn-in and Test Sockets Workshop

Angelo Giaimo
IBM Corporation

Methodology for Characterizing RF Response of Sockets and Test Contactors

Theory & Basic Techniques Using Readily Available Tools



BiTS BURN-IN & TEST SOCKET WORKSHOP

Valts Treibergs
PrimeYield Systems, Inc.

PrimeYield Systems, Inc.

BiTS 2000

Test and Burn-in Socket Evaluation for PBGA Devices

2000 Burn-in and Test Socket Workshop

Zen Podpora
IBM Microelectronics
Contacting Systems Engineering

02/27/2000

Characterization of high performance contactors for production RDRAM chip-scale package test.

2000 Burn-in and Test Sockets Workshop

Francois Billaut
Hewlett Packard

Geary Chew
Hewlett Packard

Ken Karklin
Agilent Technologies

BiTS 2000


PYCON
INCORPORATED
Burn-In Board Design For Manufacturing
2000 Burn-in and Test Sockets Workshop
BiTS
BURN-IN & TEST SOCKET WORKSHOP
Aamir Jamil
aamir@pycon.com


PYCON
INCORPORATED
Burn-In Board Design consideration for High Speed & High Power Devices
2000 Burn-in and Test Sockets Workshop
BiTS
BURN-IN & TEST SOCKET WORKSHOP
Aamir Jamil
aamir@pycon.com

BiTS 2000

Burn-In Board Design Considerations

2000 Burn-in and Test Sockets Workshop

BURN-IN & TEST SOCKET WORKSHOP

Tony Valente
PCB Design Manager
unisys

Evaluation of Test Socket for TSOPII Package

2000 Burn-in and Test Sockets Workshop

BURN-IN & TEST SOCKET WORKSHOP

HO, Peng Ching
Micron Semiconductor Asia
Singapore

MICRON

BiTS 2000

Critical Performance Characteristics for High Frequency Test Contactors

John W. O'Sullivan

Product Manager

Johnstech International

February 27-29, 2000

BiTS
BURN-IN & TEST SOCKET WORKSHOP

Johnstech International

Design Characteristics of Test Contactor & ESD Concerns

By
JC Tan & TW Fong
Intel Technology Sdn. Bhd
Intel Test Tooling Operation (ITTO)
Malaysia

JC Tan Feb 2000 *Intel Itto Penang*

BiTS 2000

Loranger International Corporation

EFFECTS OF GOLD PLATED CONTACTS IN BGA BURN-IN SOCKETS

By Ariane Loranger and Alfred Sugarman

Presented At The Burn-In & Test Socket Workshop (BiTS), February 27-29, 2000, Mesa, AZ

IEEE

BiTS BURN-IN & TEST SOCKET WORKSHOP

YAMAICHI ELECTRONICS

IEEE COMPUTER SOCIETY

Challenges of Burn-in Socket Design for Fine Pitch DSBGA(CSP) / F BGA (0.5mm)

S. ABE and Y. EGAWA

BiTS 2000


ECT
EVERETT CHARLES TECHNOLOGIES
Testing the Limits
A Closed Loop Geometric Tolerance Socket Design Process for Area Array IC Packages
By: GORDON A. VINTHER
1/29/2000


formfactor
Using MicroSpring™ Contacts as Second Level Interconnect
BiTS Workshop
Mesa, Az.
28 February 00
John Novitsky
VP Business Development
925-456-3850 jnovitsky@formfactor.com

BiTS 2000

A NEW BURN-IN SOCKET FOR FINE PITCH BGAs

Yuji Wada , Akio Hasebe , Kenichiro Morinaga
and Hideo Arima

Assembly Technology Development Operation
Semiconductor Integrated Circuits, Hitachi Ltd.

And

Hiroyuki Mogi , Hokuto Kanesashi Tomoaki Soshi

Semiconductor Peripherals Div.,Enplas Corporation

Novel Contacting Technology for Fine Pitch Leaded & Area Array Devices

Frank Bumb
Product Development Manager
Phoenix, AZ

Ron Revell
Laboratory Manager
Austin, TX

Electronic Handling & Protection Division

3M *Innovation*

Recurring ”Themes”

- Thermal Management
  - Burn-in → Final Test
- Contactors
- Package Tolerances
- Socket Characterization
- PCB Design

FOR

- High Performance
- High Frequency
- High Power
- Low Contact Resistance
- Fine Pitch

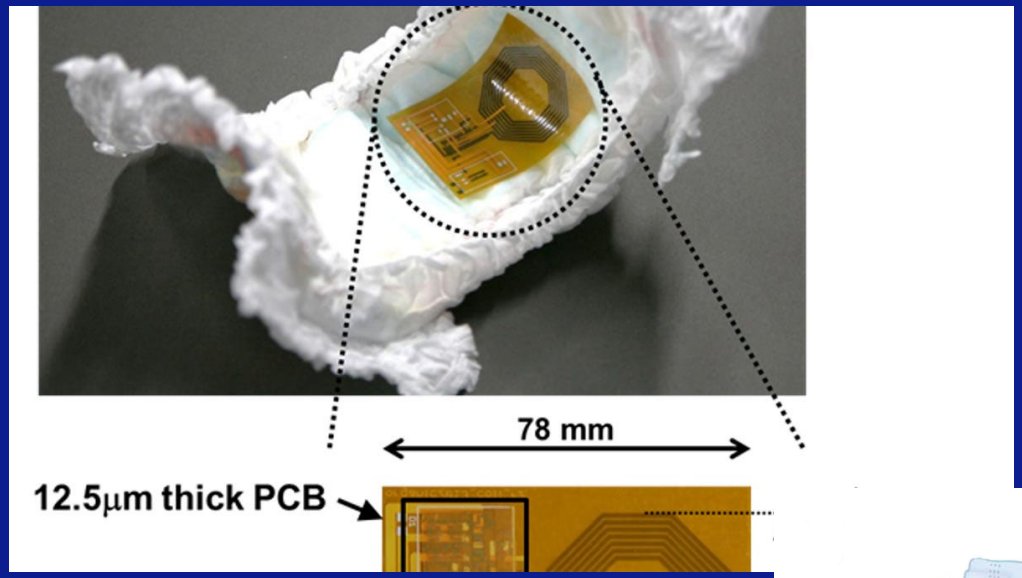
→Same fundamentals with harder requirements

The Next 25 Years

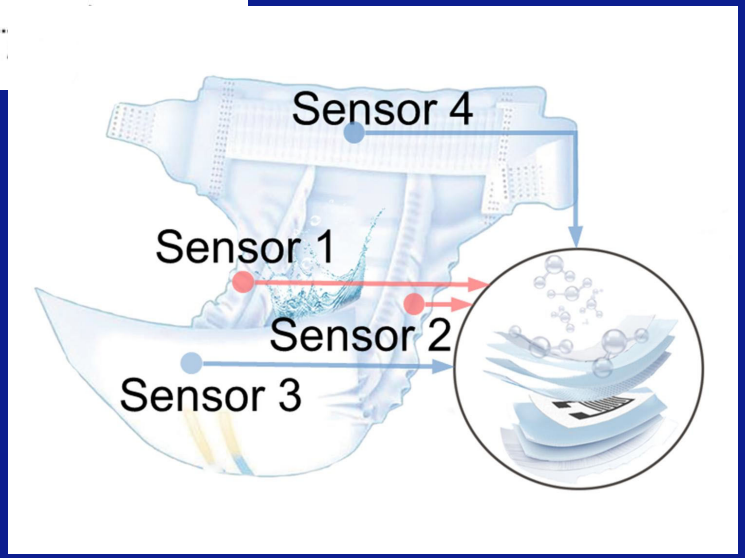
Digitization vs Electronification

Shutterstock / Sashkin

Electronics Everywhere



University of Tokyo 2013 via CNET



Penn State 2023

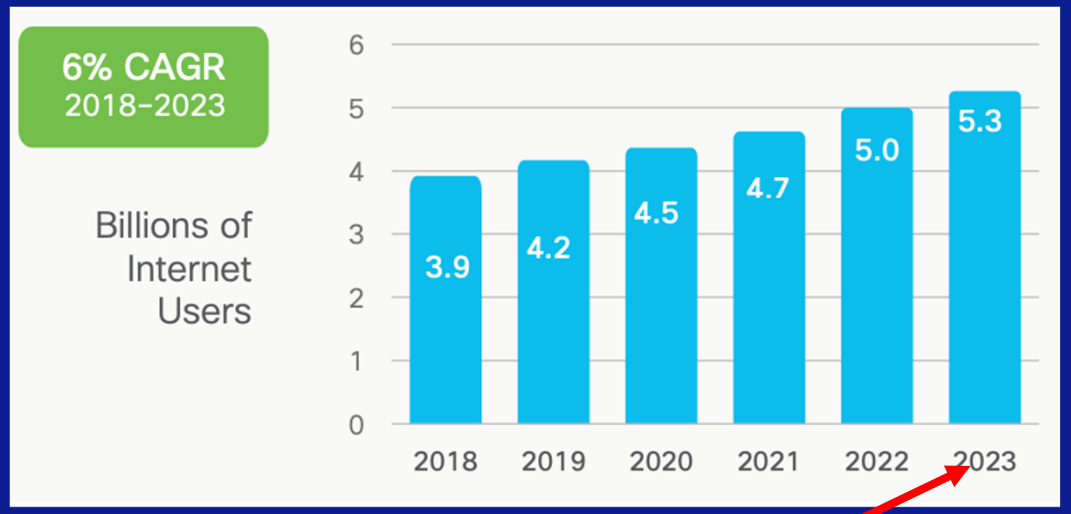
Pampers Lumi 2019 (discontinued)

Reusable urine sensor

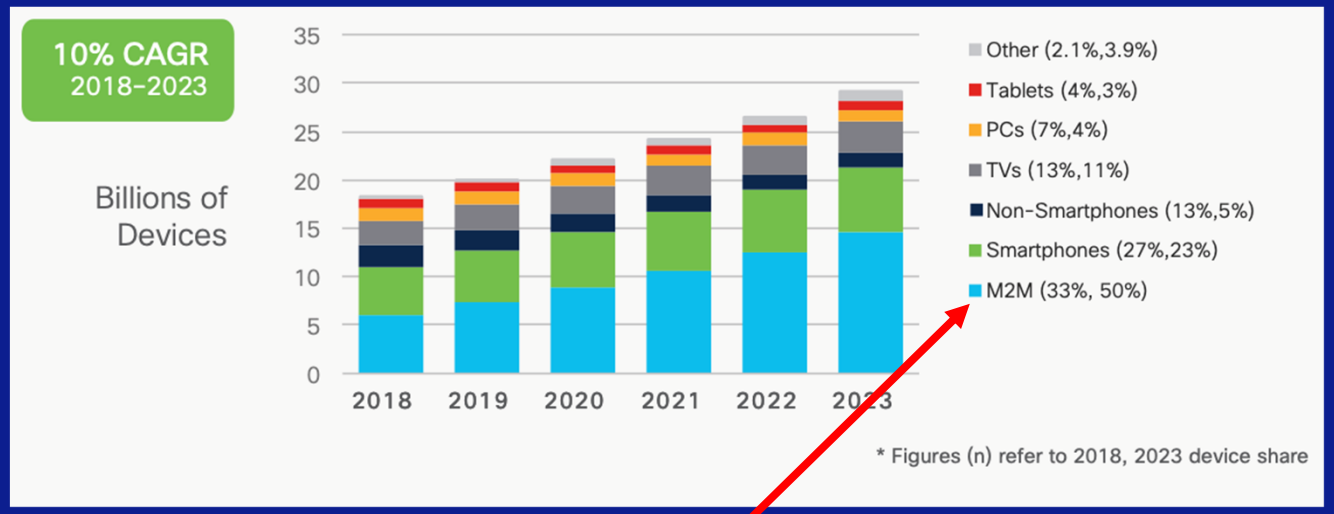
Smartphone App

Video Monitor

Internet Usage & Connections



66% of population

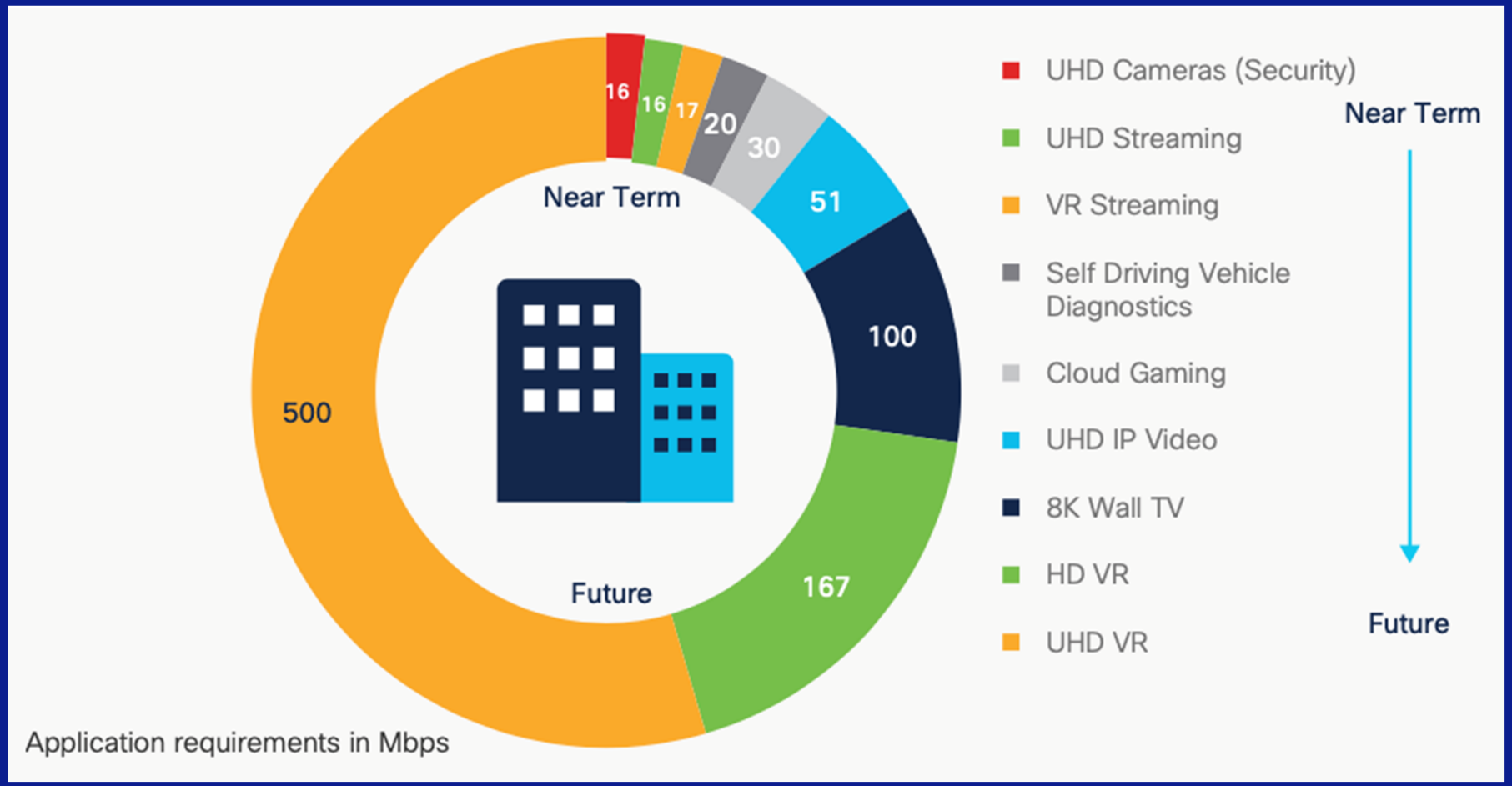


19% CAGR

Mostly consumer applications

Cisco Annual Internet Report, 2018–2023

Home Bandwidth Demand

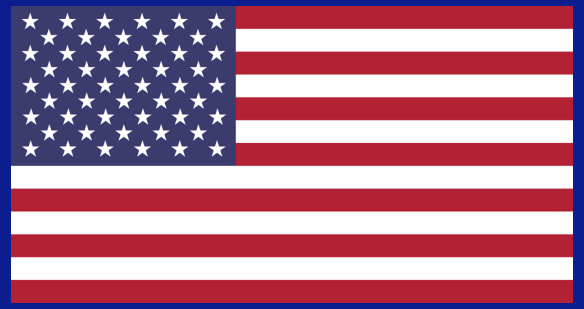


Cisco Annual Internet Report, 2018–2023

Electronics

Clipart-library.com

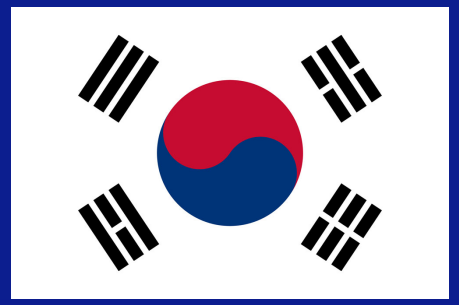
Strategic Government Initiatives

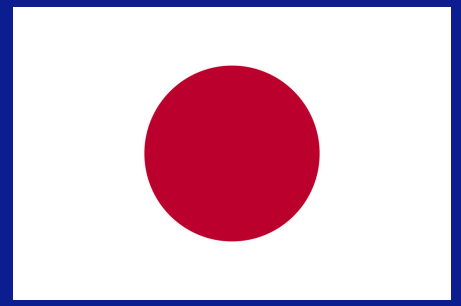


CHIPS Act
$54B

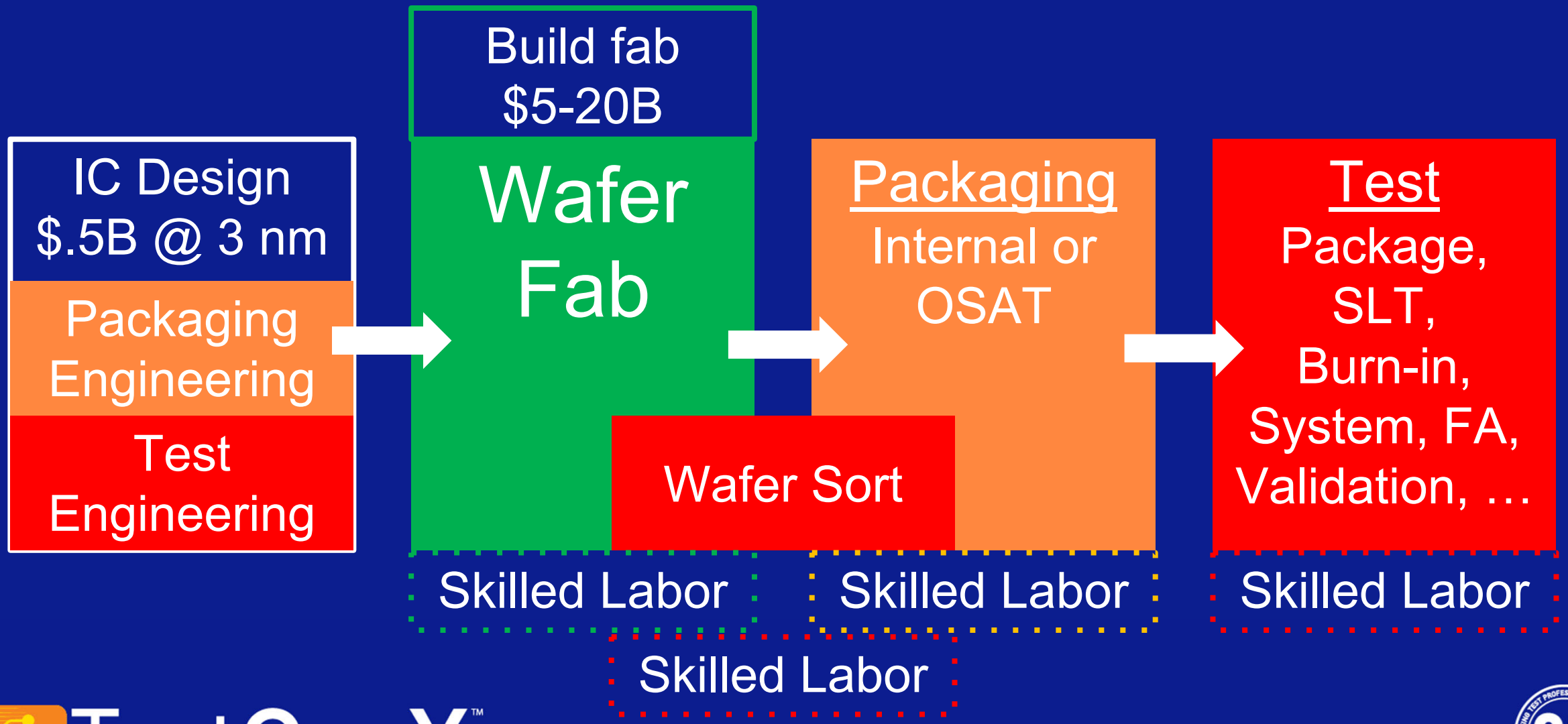
EU Chips Act
€43B

Plus…

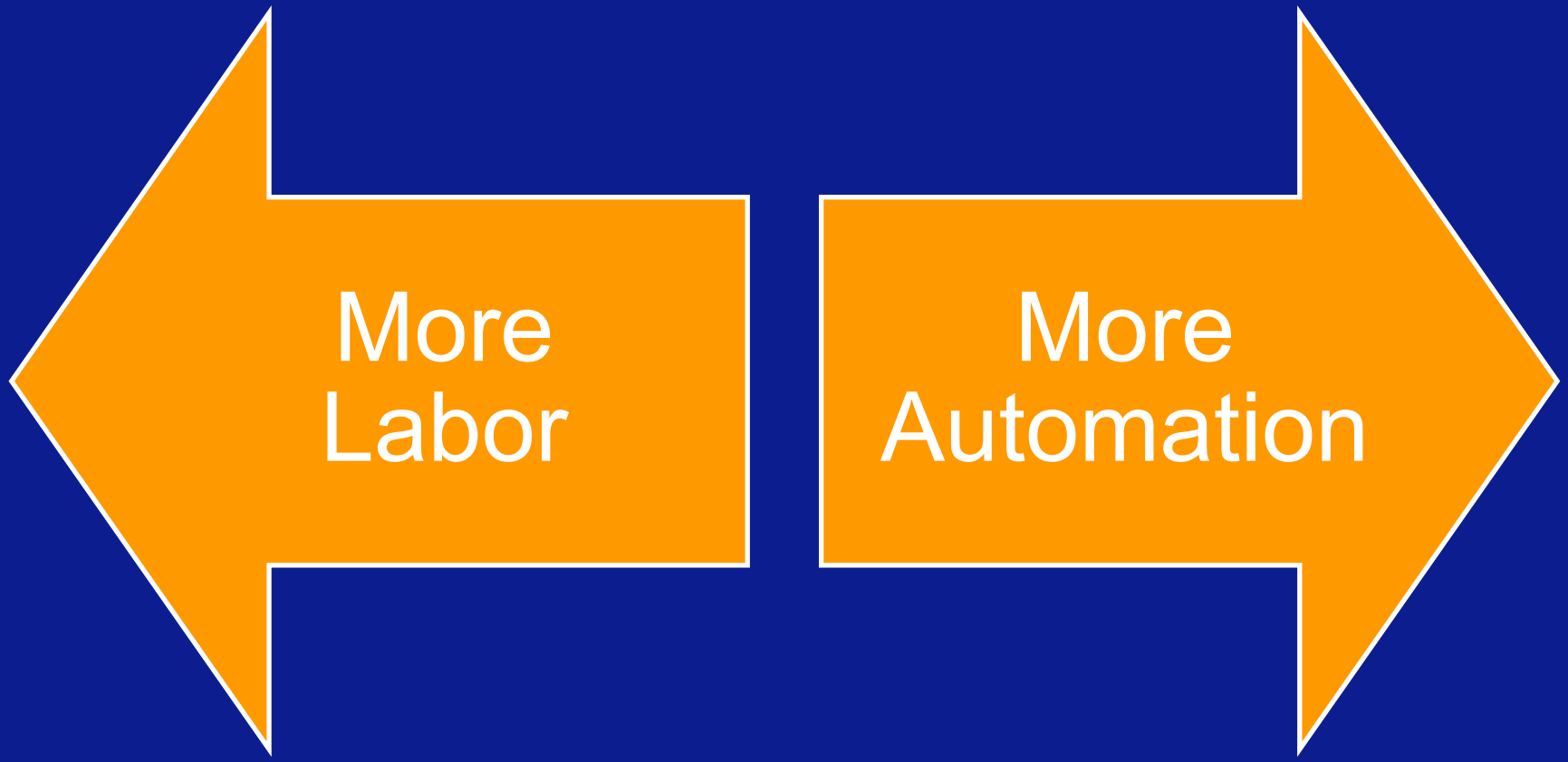




How to Build Chips

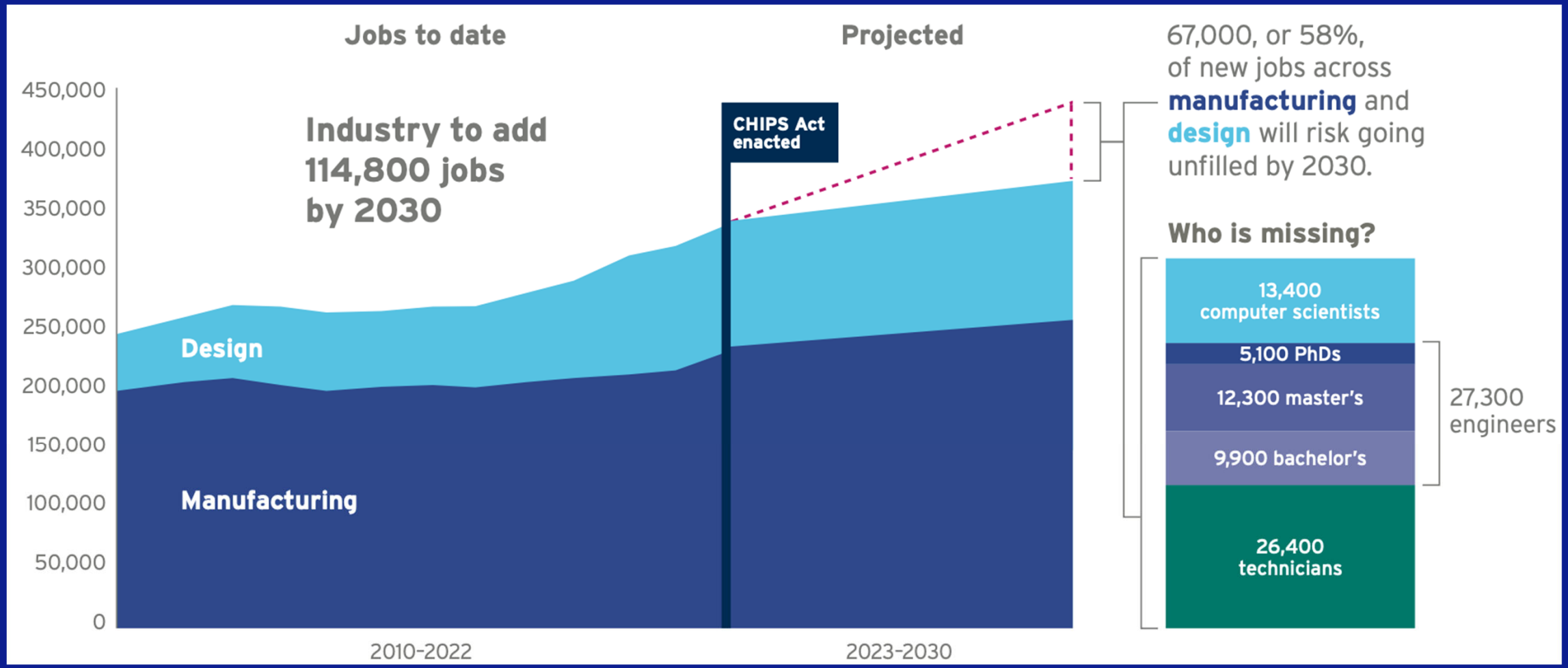


Increased Production Requires



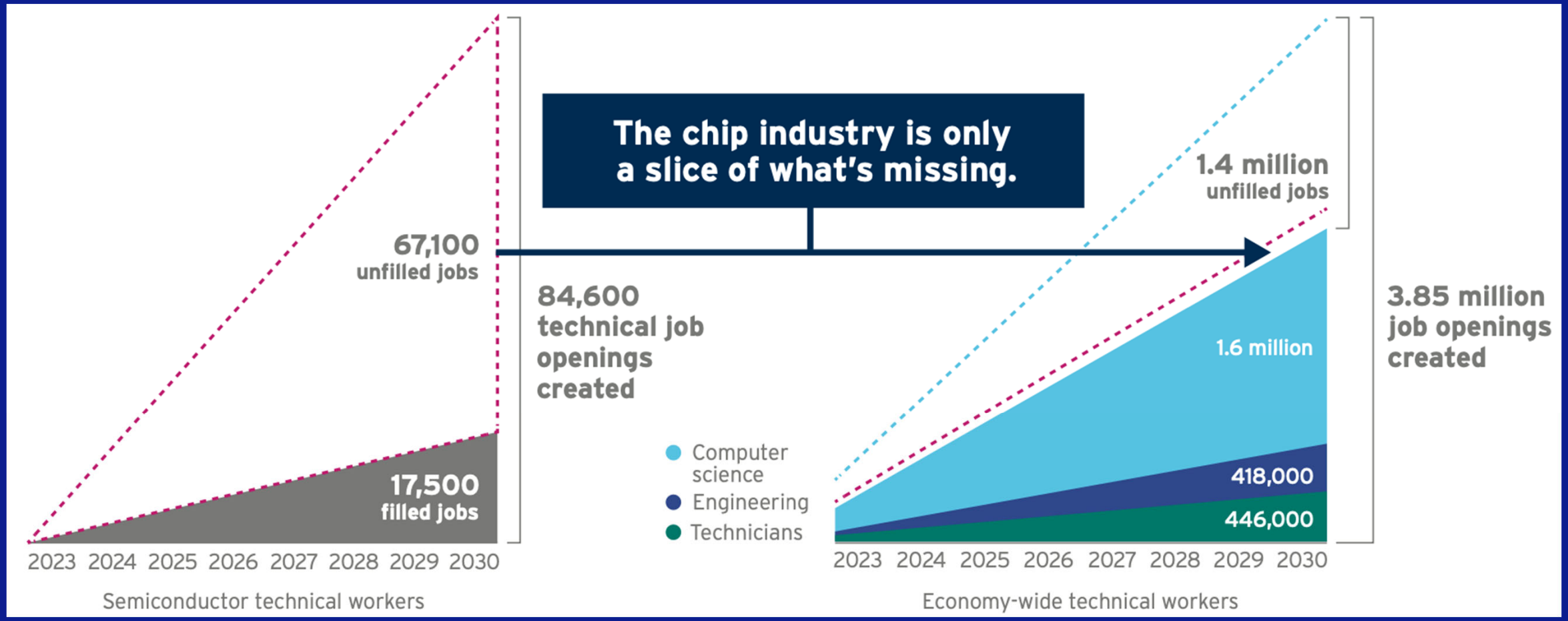
Adjust the balance and add more of both…

US CHIPS Act Job Demand



Semiconductor Industry Association – Oxford Economics July 2023

US Technical Labor Shortage



Semiconductor Industry Association – Oxford Economics July 2023

Labor Supply Challenges

In particular for semiconductor test

- Interest in STEM and test (student demand)
- Limited educational programs (capacity)
- Unclear knowledge & skill requirements (specification)

Educational Pipeline Challenges

shutterstock / tassel78

shutterstock / InesBazdar

- Low interest in entering STEM
  - Perceived as “hard”
  - Long delay from primary schools to industry
  - Lack of societal support
    - collectively we are outliers [Nerds DON’T rule]
- STEM industry retention rates

Rare Example

San José State University

- EE 182 - Analog and Mixed-Signal IC Test Development
  - Introduction to analog and mixed-signal IC and component measurements and automated testing. Test specifications, methods, techniques, and interfaces. Measurement accuracy, correction, and calibration. Automated test equipment (ATE) hardware and software. DAC/ADC testing and DSP-based testing. Analog and mixed-signal design for test (DFT). Laboratory exercises and mini projects.
- EE 183 - Electronics Test Design Engineering II
  - Best practices in Test methods and techniques; ATE Test hardware/software, Device characterization; Multi-system reliability; Device interface board design, building, debug; ATE development and Execution.

SJSU SAN JOSÉ STATE UNIVERSITY

Labor Shortage

"In college the concept of test was mainly covered as how to test E-test structures (transistor IV curves & interpretation) which is a teeny tiny part of the overall test landscape.

What I know about real world test has organically come from on-the-job training and real-world learning - discovering what works and what doesn't."

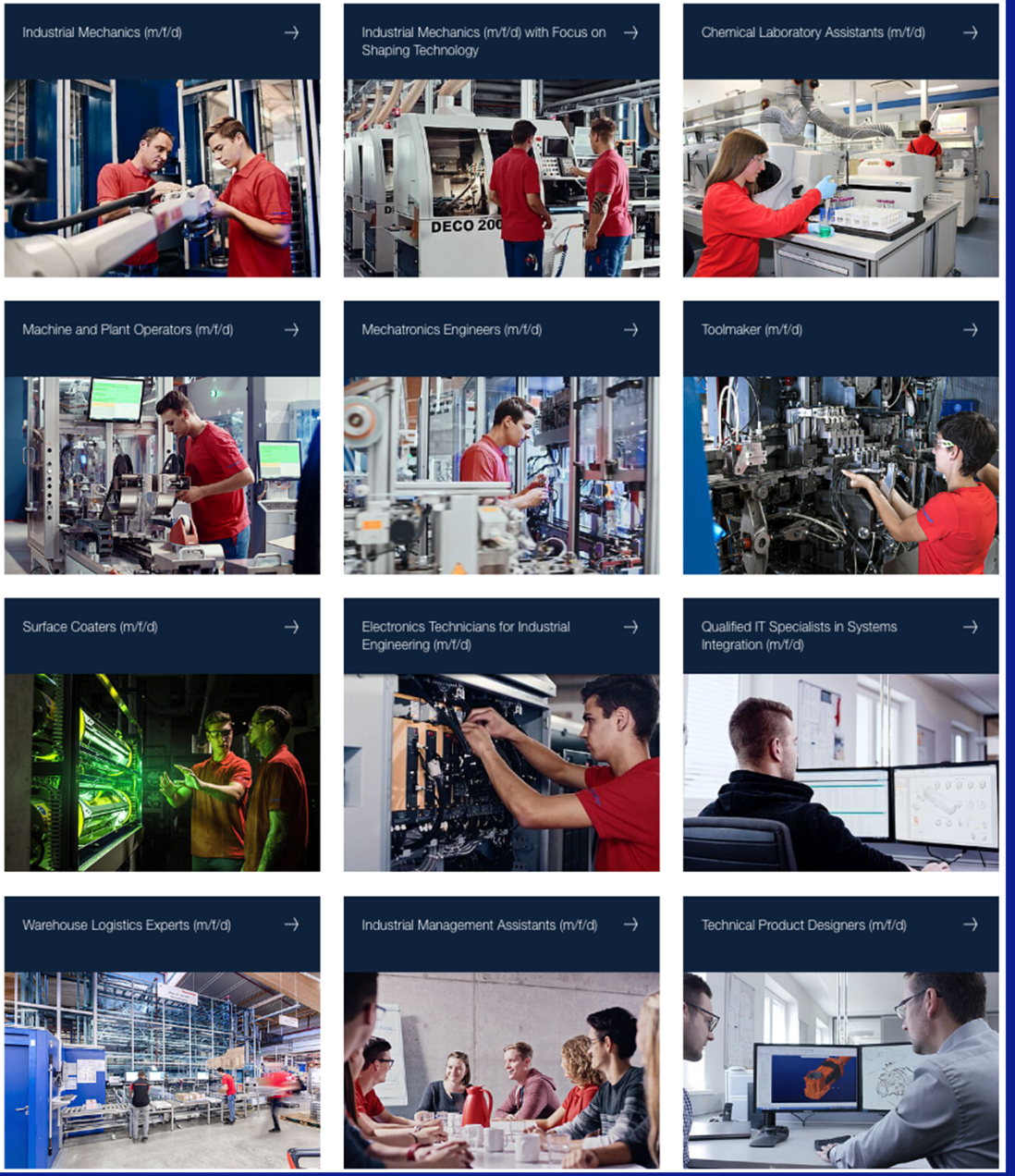
-- Abram Detofsky

Principal Engineer, Tester Architecture | Foundry Technology Development

Intel Foundry

Multiple Solution Paths

- Degree programs
- Credential / certification programs
- On the job training programs
- Apprenticeships
- Self directed learning
- ???



www.rosenberger.com/career/pupils/apprenticeships/

Rosenberger Apprenticeship Program

- 2 to 3.5 years
- Paid employment
- No long-term commitment
- Fully self-funded

Solution Elements

- Clear & articulated vision from industrial side
  - Design of curriculum
  - What is the course content and knowledge
  - Instructional methods and skill development
- Support from academia
  - Formal programs (imprimatur)
  - Learning delivery and performance measurement
- Government funding and incentives
  - e.g. CHIPS and Science Act
  - Other programs

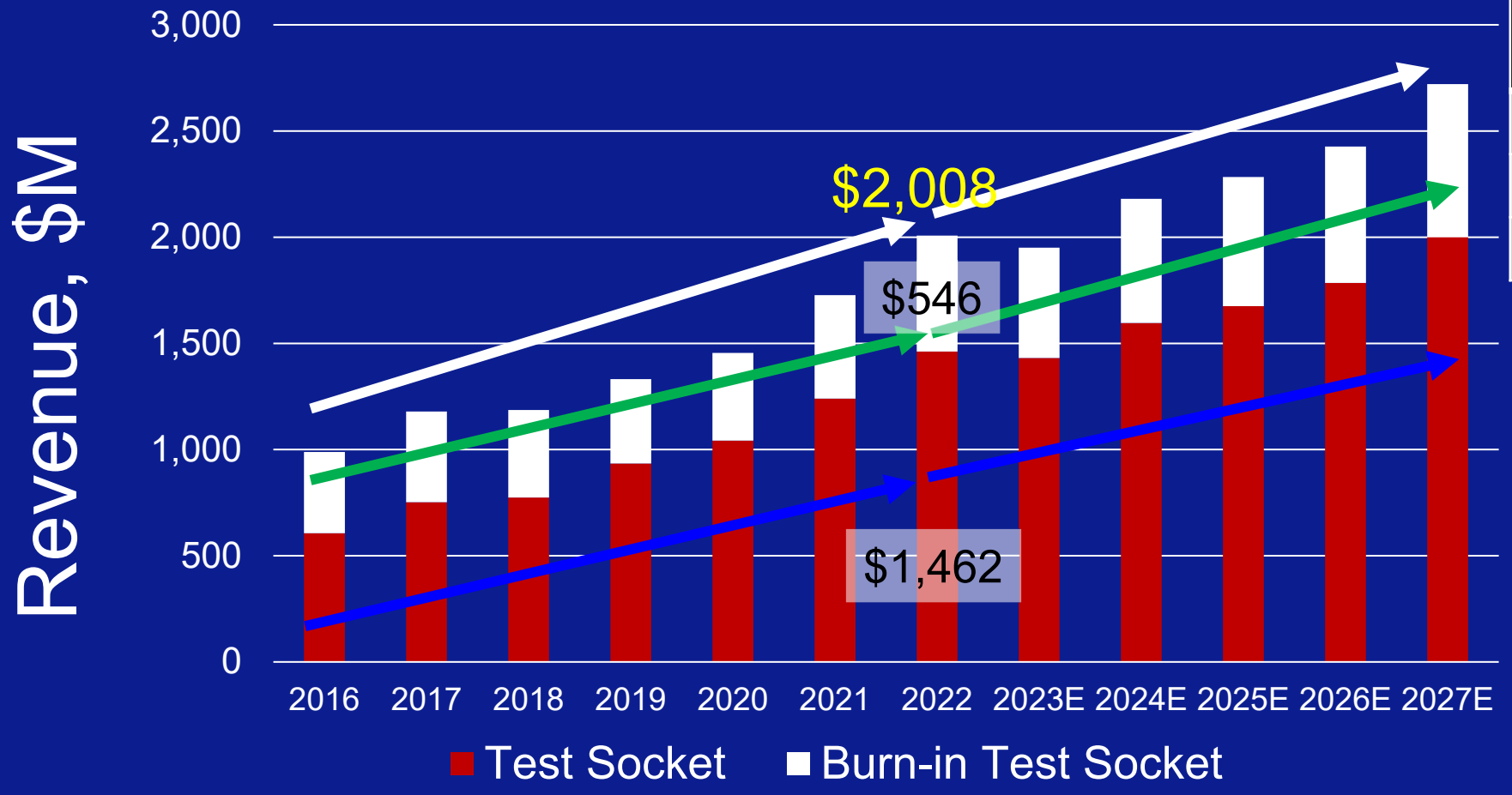
Call to Action

- TestConX will form a ”working group” to further define the industry needs and vision
  - First (virtual) meeting: week of April 1

- Let me know if you wish to participate
- Recommend others who should join

Socket Market

Test and Burn-In Socket Market

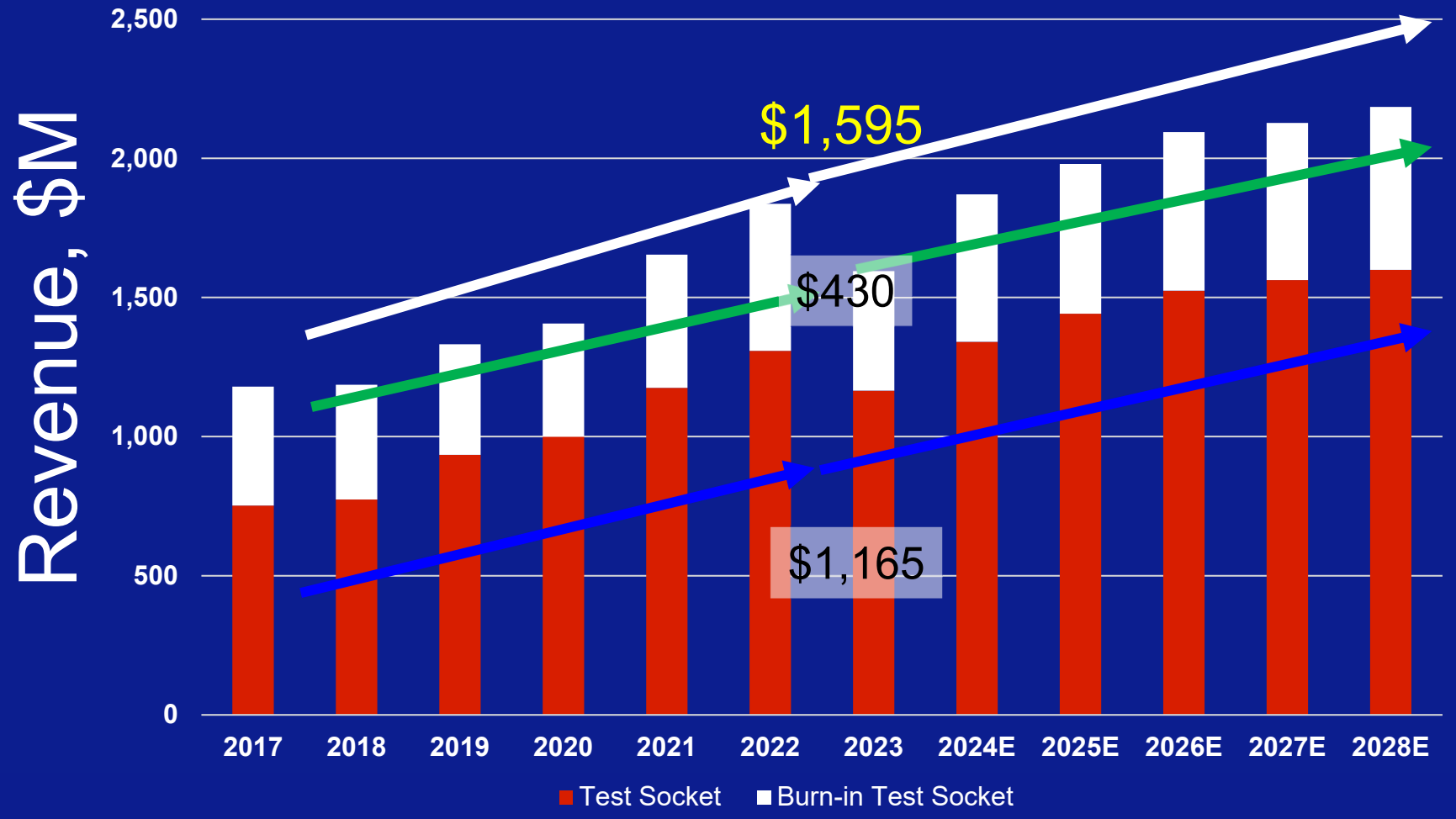


	2016-2022 CAGR	2023-2027 CAGR
Overall	12.5%	8.7%
Burn-in	6.1%	8.5%
Test	15.8%	8.7%

Forecast vs Actual
For 2022:
Test +$110M
Burn-in +$9M

Yole Group 2022

Test and Burn-In Socket Market



Yole Group 2023

	2017-2022 CAGR	2023-2028 CAGR
Overall	11.7%	6.5%
Burn-in	4.3%	6.4%
Test	9.3%	6.5%

Forecast vs Actual
For 2023:
Test ($266M)
Burn-in ($89M)

Segment Revenue ($M)

	2023	2028		2023 – 2028 CAGR
Test Socket	**1,165**	**1,599**		**6.5%**
Package Test	722	909		4.7%
System Level Test	339	568		10.9%
Engineering Test Sockets	105	123		3.2%
Burn-in Test Socket	**430**	**586**		**6.4%**
Package Test	383	514		6.0%
System Level Test	21	40		5.4%
Engineering Test Sockets	25	32		3.2%
Total Sockets	**1,595**	**2,185**		**6.5%**

Yole Group 2023

Top Test & Burn-in Vendors 2023

Rank	Overall	Test Socket	Burn-in Socket
1	LEENO	LEENO	Enplas
2	Cohu	Cohu	Boyd
3	Enplas	WinWay	Micro Contact Solution
4	Yamaichi	Yamaichi	Yamaichi
5	WinWay	Advantest	Okins

Yole Group 2023

Acknowledgements

- Socket Market Data courtesy of Yole Group
  - Thank you John West!

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