Ontario Centres of Excellence

Innovation at the Edges

Nano and Giga Challenges in Electronics, Photonics and Renewable Energy

Don Wilford, OCE, Centre for Photonics

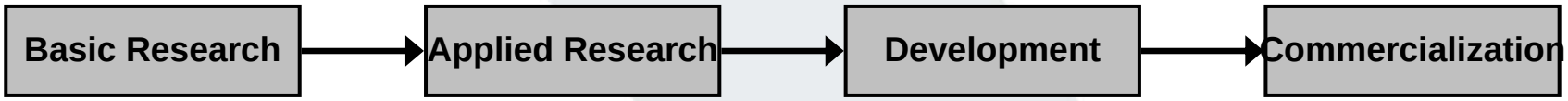
Agenda

- Some thoughts…
- About OCE
- OCE's Photonics WhitePaper
- OCE's Nanotechnology WhitePaper
- Summary

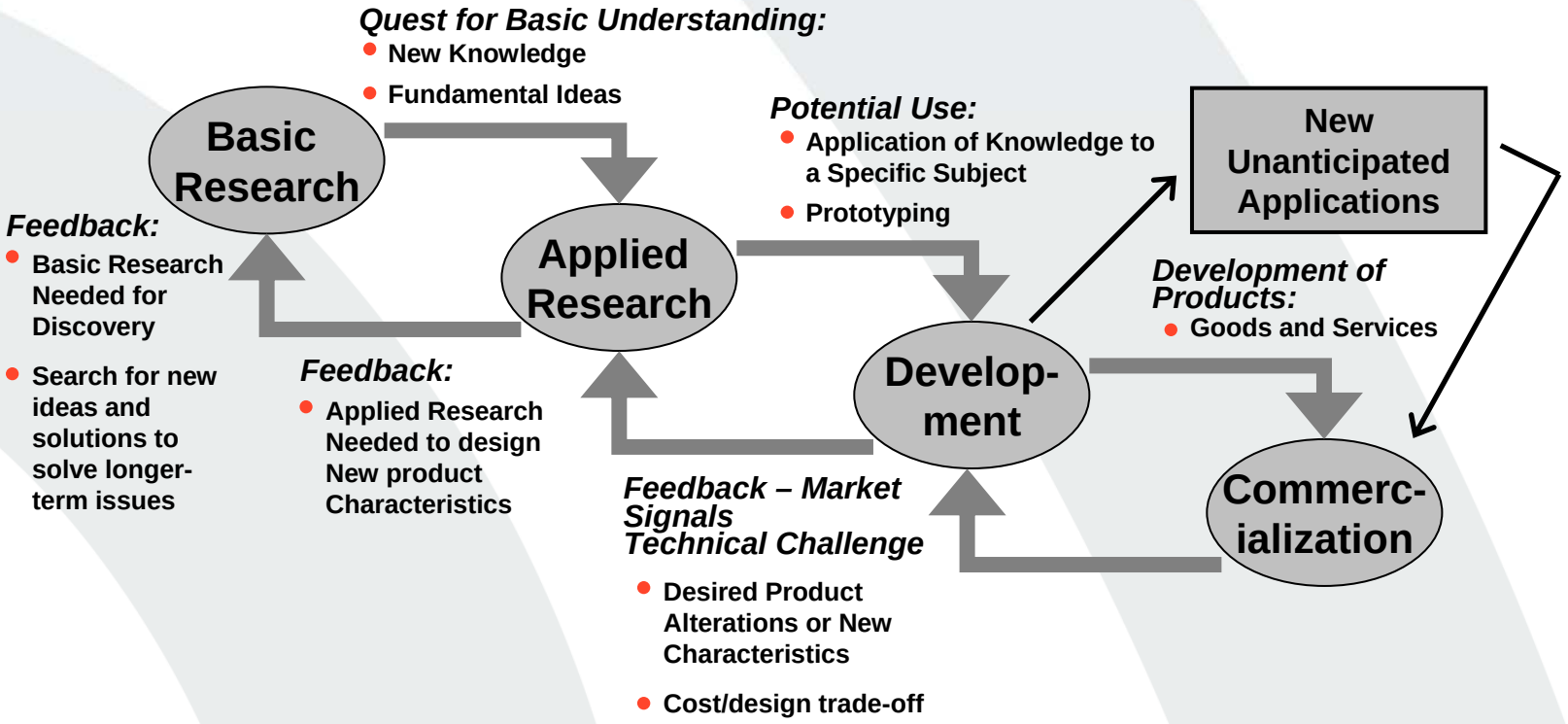
Innovation is chaotic

Ontario Centres of Excellence

Linear models don't properly describe the innovation process



Feedback models more closely describe what actually happens



Ref: "Assessment of the SBIR program at NSF", 2008

Technologies and End Markets are not the same thing

Ontario Centres of Excellence

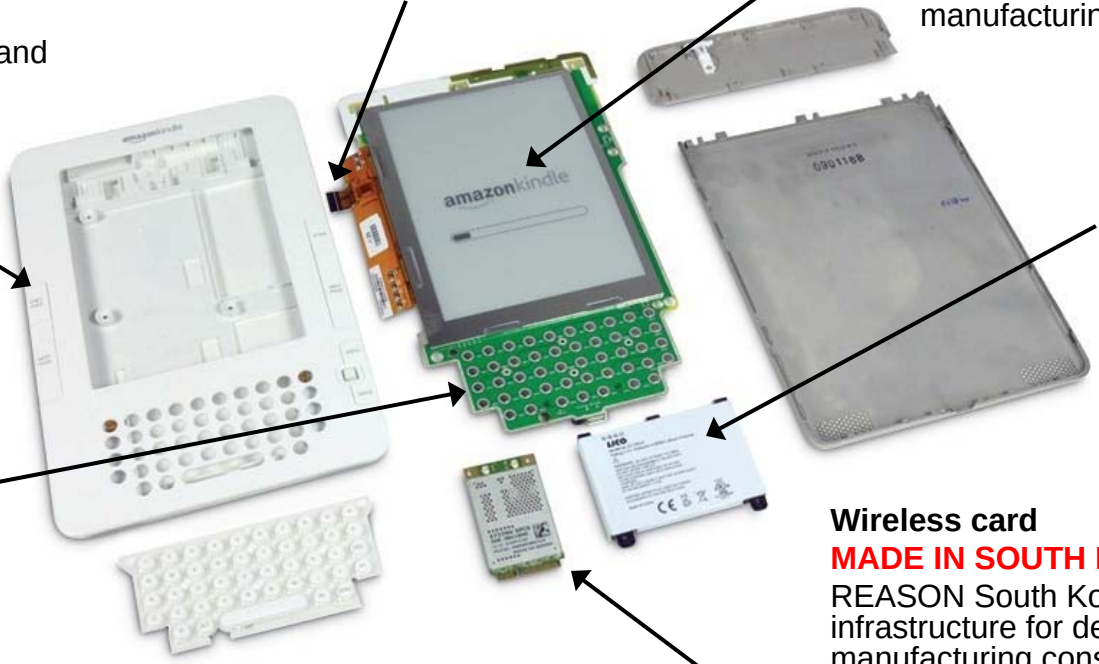
North America is Losing its Technology Dominance

Ontario Centres of Excellence

Highly polished Injection-Molded Case
MADE IN CHINA
REASON U.S. supplier
base eroded as the manufacture of toys, consumer electronics, and computers migrated to Asia.

Flex circuit connector
MADE IN CHINA
REASON U.S. supplier base eroded as the manufacture of consumer electronics and computers migrated to Asia.

Electrophoretic display
MADE IN TAIWAN
REASON Its manufacture requires expertise developed from producing fl at-panel LCDs, which migrated to Asia with semiconductor manufacturing.



Lithium Polymer Battery
MADE IN CHINA
REASON Battery development
and manufacturing migrated from the U.S. to Asia along with the development and manufacture of consumer electronics and
notebook computers.

Controller board
MADE IN CHINA
REASON U.S. Companies long ago outsourced the manufacture
of printed circuit boards to Asia, where there is now a huge supplier base.

Wireless card
MADE IN SOUTH KOREA
REASON South Korea used its infrastructure for designing and manufacturing consumer electronics to become a center for making mobile phone components and handsets, especially products using CDMA technology, which is widely used in South Korea.

High Impact Firms

- High-impact firms account for almost all employment and revenue growth in the economy.
- There are probably less than 500 HIFs in Ontario.
- On average HIFs are 25 years old.
- Nearly all job losses are attributable to low-impact firms with more than 500 employees.
- High-impact firms exist in all industries – not just high-technology.
- Manufacturing as a whole does very well, with numbers that compare favourably with other sectors.
- What makes a firm hi-impact?

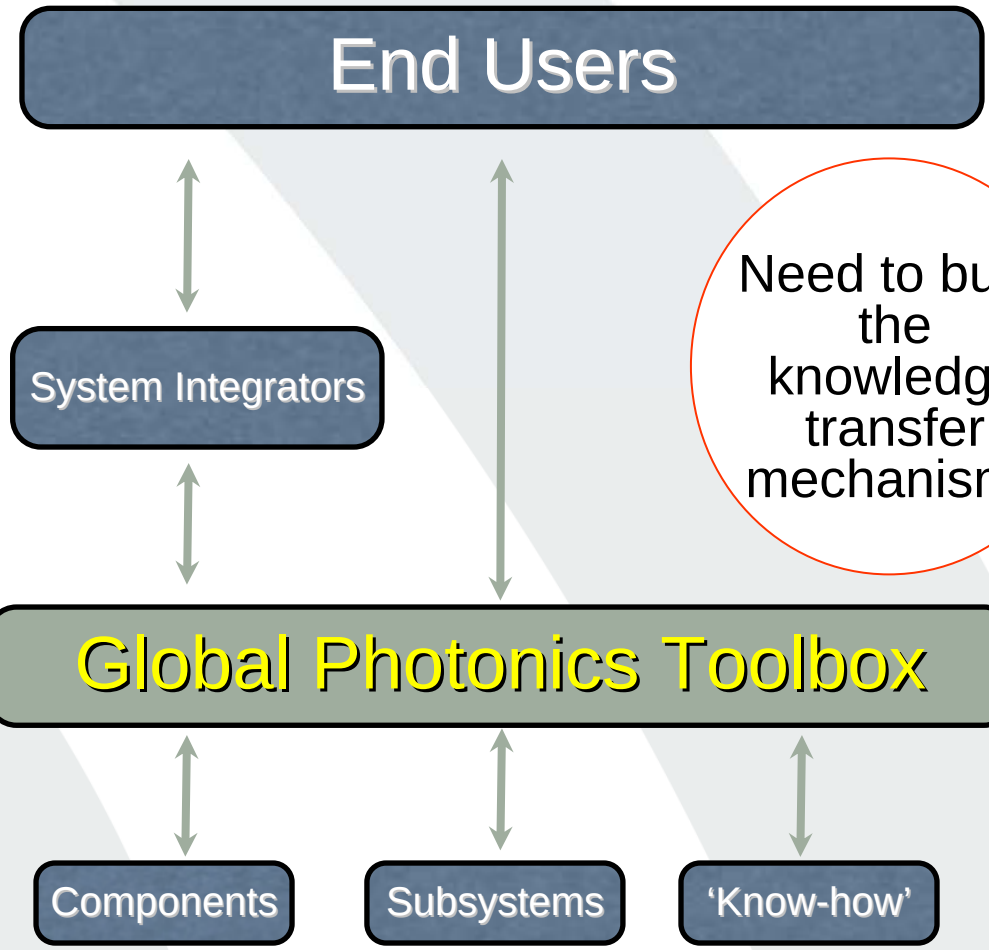
The Photonics Toolbox

Ontario Centres of Excellence

Every sector of the economy uses photonics

A Canadian strength

Canada makes a significant contribution to the tool box



Need to build the knowledge transfer mechanisms

Knowledge Interface

Agenda

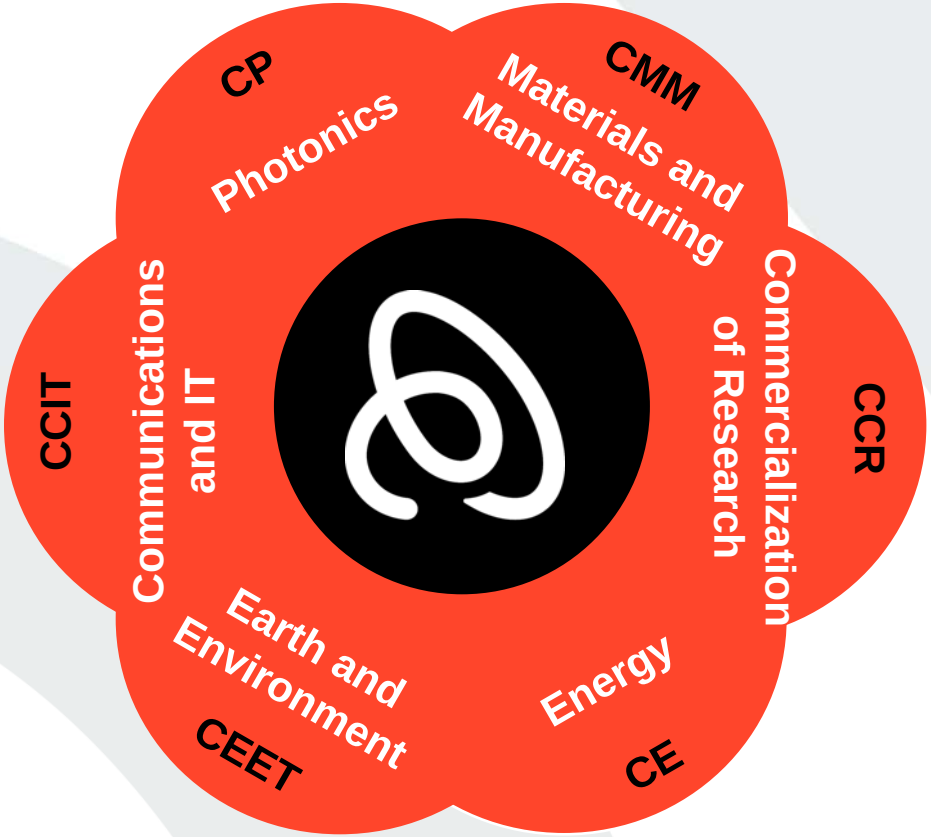
Ontario Centres of Excellence

- Some thoughts…
- About OCE
- OCE's Photonics WhitePaper
- OCE's Nanotechnology WhitePaper
- Summary and Recommendations

The Ontario Centres of Excellence

- OCE's mandate is to facilitate economic growth through:
  - support for industrially relevant R&D
  - commercialization of leading edge discovery
  - opening new market opportunities
- OCE's integrated programs support innovation from research to first investment to revenue
- OCE's extensive networking strongly promotes the critical feedback that leads to innovation

OCE Delivery - Sector Focus



OCE's Business Model:

- **Six Centres**
- **Flexible and scaleable**
- **Integrated, efficient and effective**
- **Strongly networked**
- **Market driven**
- **Client focused**
- **Entrepreneurial**
- **Key areas of convergence:**
  - ✓ Biomedical technologies
  - ✓ Clean-tech
  - ✓ Digital media

OCE Delivery - Program Areas

Ontario Centres of Excellence

- 20 Universities
- 24 Colleges
- Research hospitals
- 26 Innovation Networks

Five Sector-Focused Centres
- Communications and IT
- Earth and Environmental Tech
- Energy
- Materials and Manufacturing
- Photonics

- Large companies
- SMEs
- Industry associations
- Angel investors
- Venture capitalists

- New Centre for the Commercialization of Research

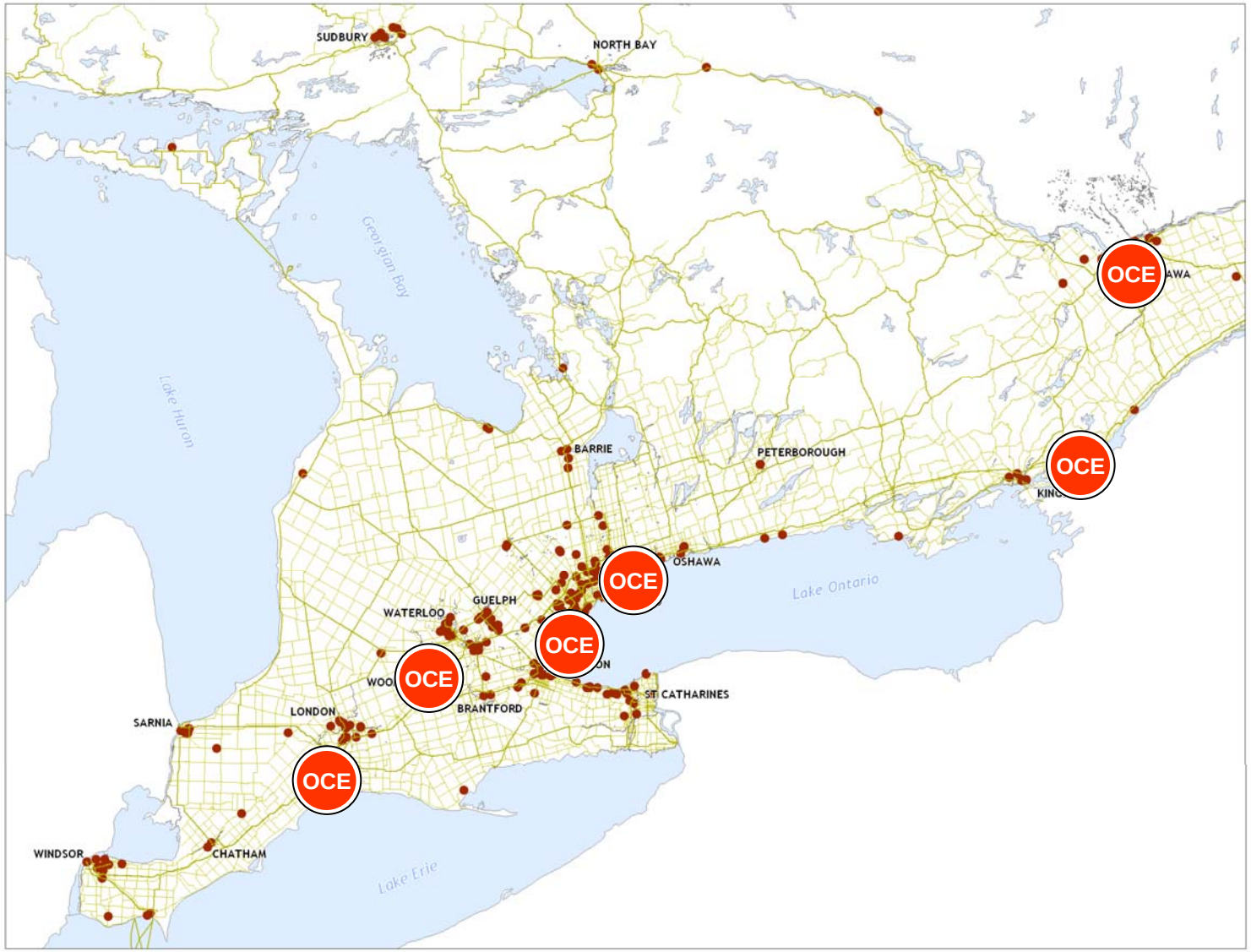
Research Programs (*Innovate*)

Commercialization Programs (*Accelerate*)

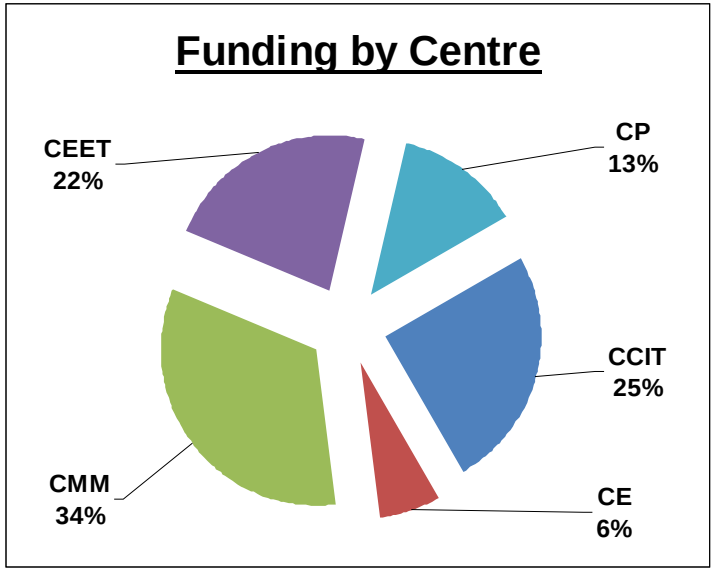
Talent Programs (*Cultivate*)

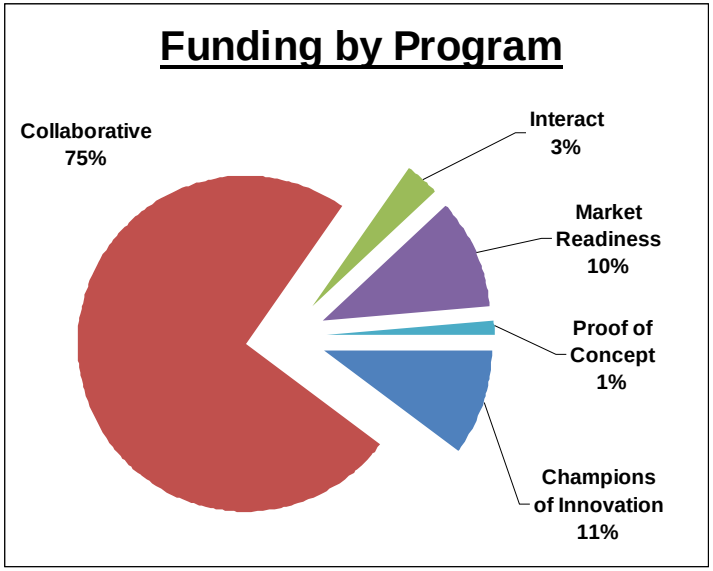
OCE Delivery – Regional Nodes

Ontario Centres of Excellence



Programs Summary by Centre





Number of Projects	CCIT	CE	CMM	CEET	CP	OCE
Champions of Innovation	3	2	25	0	19	49
Collaborative	87	19	159	83	33	381
Interact	27	17	89	27	15	175
Market Readiness	38	9	33	6	12	98
Proof of Concept	4	0	10	5	3	22
Average $ per project						
Champions of Innovation	$ 257,017	$ 145,800	$ 133,607	$ -	$ 133,746	$ 141,714
Collaborative	$ 147,641	$ 166,096	$ 98,024	$ 162,318	$ 141,128	$ 130,488
Interact	$ 13,789	$ 13,500	$ 11,974	$ 14,367	$ 14,437	$ 12,983
Market Readiness	$ 66,413	$ 60,347	$ 63,085	$ 115,282	$ 88,059	$ 70,378
Proof of Concept	$ 41,000	$ -	$ 33,509	$ 38,292	$ 100,565	$ 45,102

Distribution of investment between programs, by Centre, based on AccPac Data, October 2008

OCE Outcomes*

Ontario Centres of Excellence

OCE invested	**$ 16,428,879**	in research projects last year
OCE supported projects	**451**	
Over 4,000 researchers and students were involved in OCE supported research programs		
Researchers	**730**	17%
Post-doctoral fellows	**282**	7%
Doctoral students	**587**	14%
Masters students	**718**	17%
Undergraduates	**1301**	30%
Private sector employees	**424**	10%
Other	**250**	6%
OCE connected researchers with industry challenging	**637**	companies to develop solutions to industry challenges
OCE's 95 start-ups attracted	**$ 85,358,452**	in carry-on investment from capital markets last year
19 New leading-edge companies created through OCE supported research		
Investment leveraged from the following sources last year:		**$ 33,586,778**
Industry Partners	**$ 30,970,376**	
Government Partners	**$ 2,616,402**	
Companies and individuals that connected with OCE		**36,810**
Universities / Colleges / Research/ Hospitals engaged		**25**
Peer reviewed publications supported by OCE		**1,066**
Refereed publications by Centre researchers		**897**
Patent applications submitted with support from OCE		**110**
Patents granted with support from OCE		**24**
Established licences		**25**
Active licences that were supported by OCE		**86**

***** 2007-08 Annual Report

Agenda

Ontario Centres of Excellence

- Some thoughts…
- About OCE
- OCE's Photonics WhitePaper
- OCE's Nanotechnology WhitePaper
- Summary

WhitePaper Methodology

We visited Executives of 41 firms in Ontario with a core competence in Photonics.

	Ontario	
	Sample	OCE Data
Number of Firms	41	117
Large	10	21
SME	20	76
Start-ups	11	20
Employees[1]	5,900	10,200
Revenue ($B)	2.4	3

- Company surveys
- Industry led workshops
- Industrial and Academic Advisory Group to steer study and endorse the recommendations

Here's what we found…

[1] Nortel is still a dominant player with 1,400 employees in Ontario – 1,100 in R&D.

Industry

Ontario Centres of Excellence

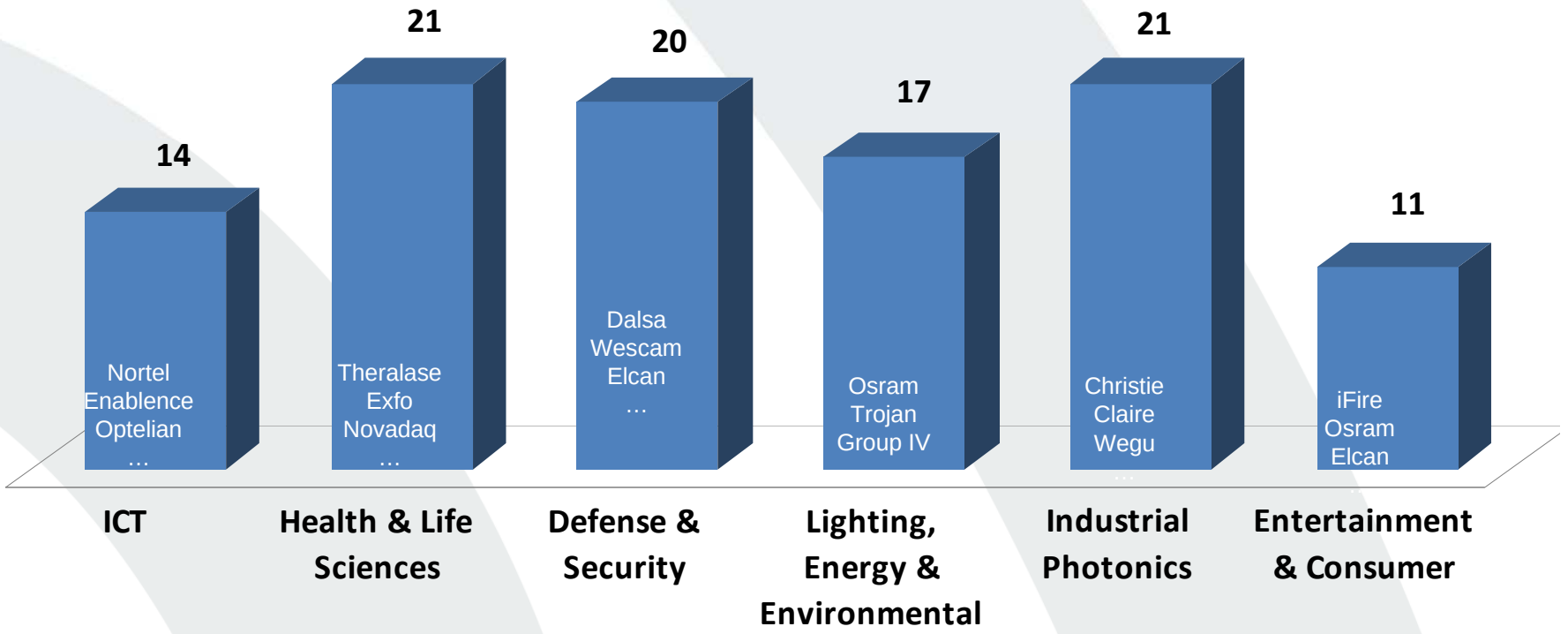
Firms exploiting photonics-related technologies have a proven track record as an engine of economic growth, high-value jobs, innovative products and success in global markets

Ontario's photonics industry sector is mature and successful including globally competitive large firms, nimble SMEs, and a small but vibrant start-up community.

Diversified End-Markets…

Ontario Centres of Excellence

Firms are active across six identified end-markets.✶

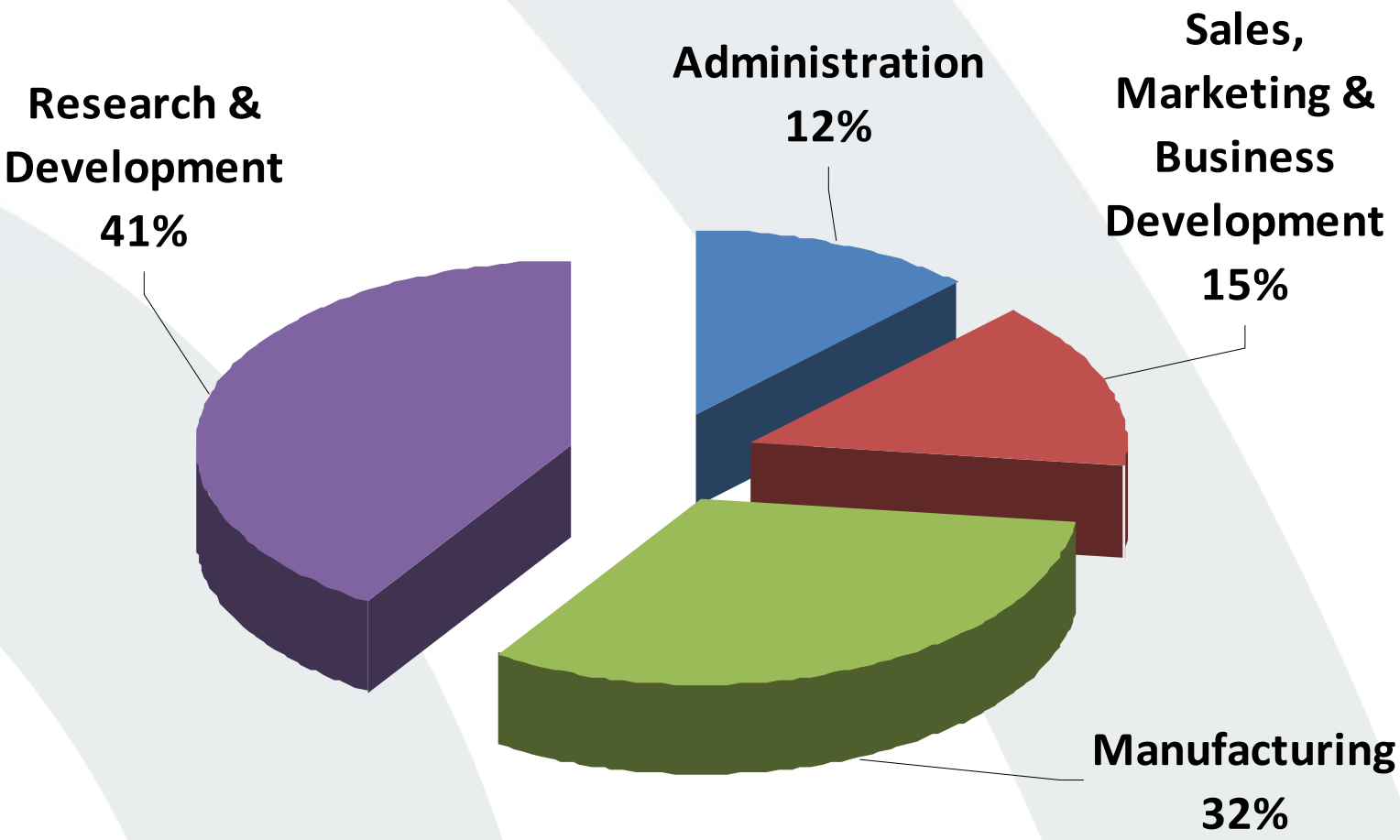


(✶) Interviewed firms only – several firms are active in more than one area

A Significant Employer…

Ontario Centres of Excellence

10,200 high-value jobs in Ontario✶

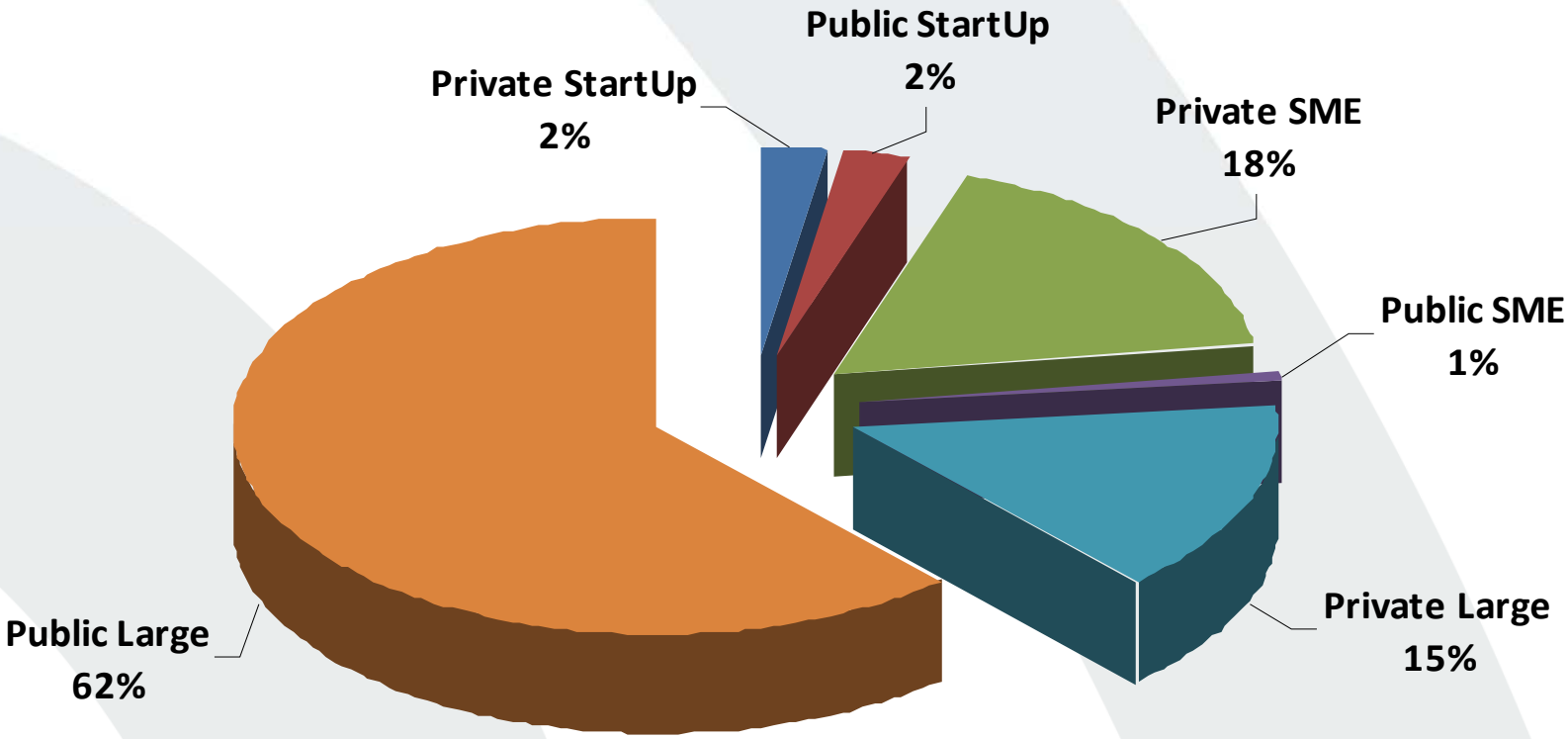


(✶) Interviewed companies have 5,900 employees

Employee Distribution

Ontario Centres of Excellence

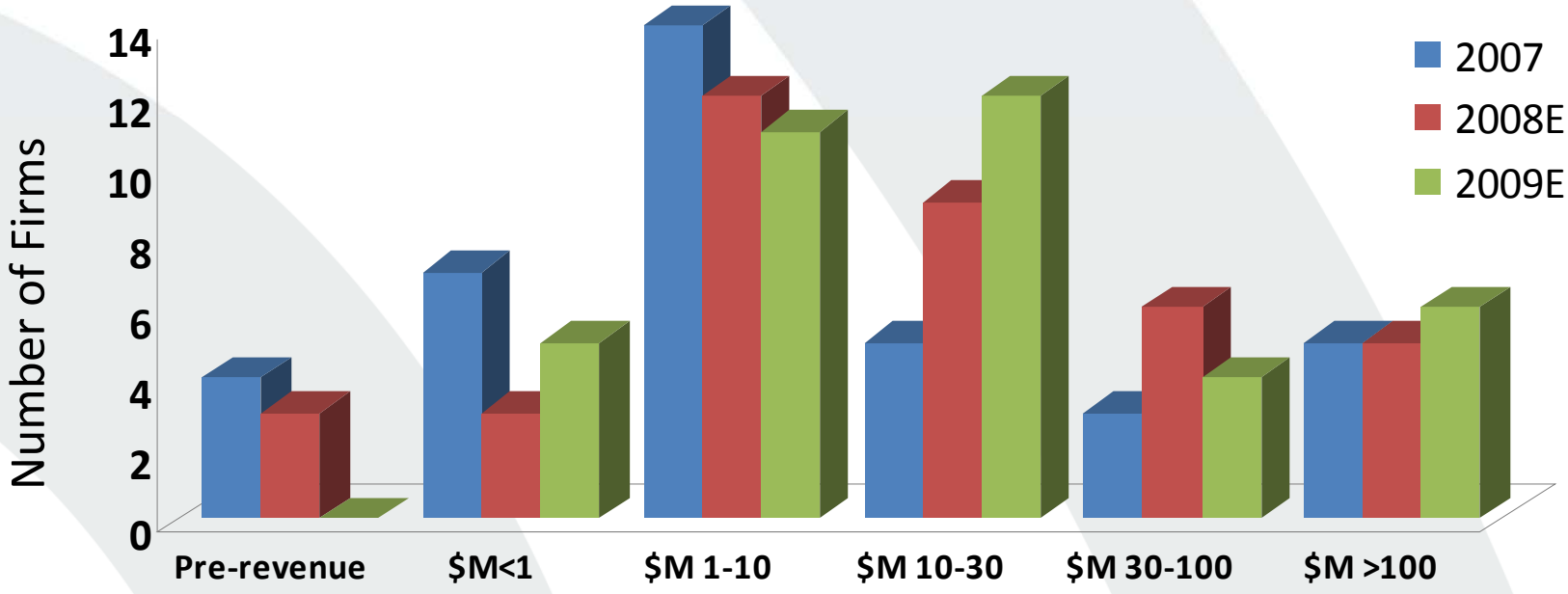
Employment is predominantly in large, public firms (often foreign owned)



(✶) Interviewed firms only
SME =<250 employees, autonomous AND operating at break even

A Growing Revenue Base…

Current revenues of over $3B★
Average revenue per employee $195,000♦

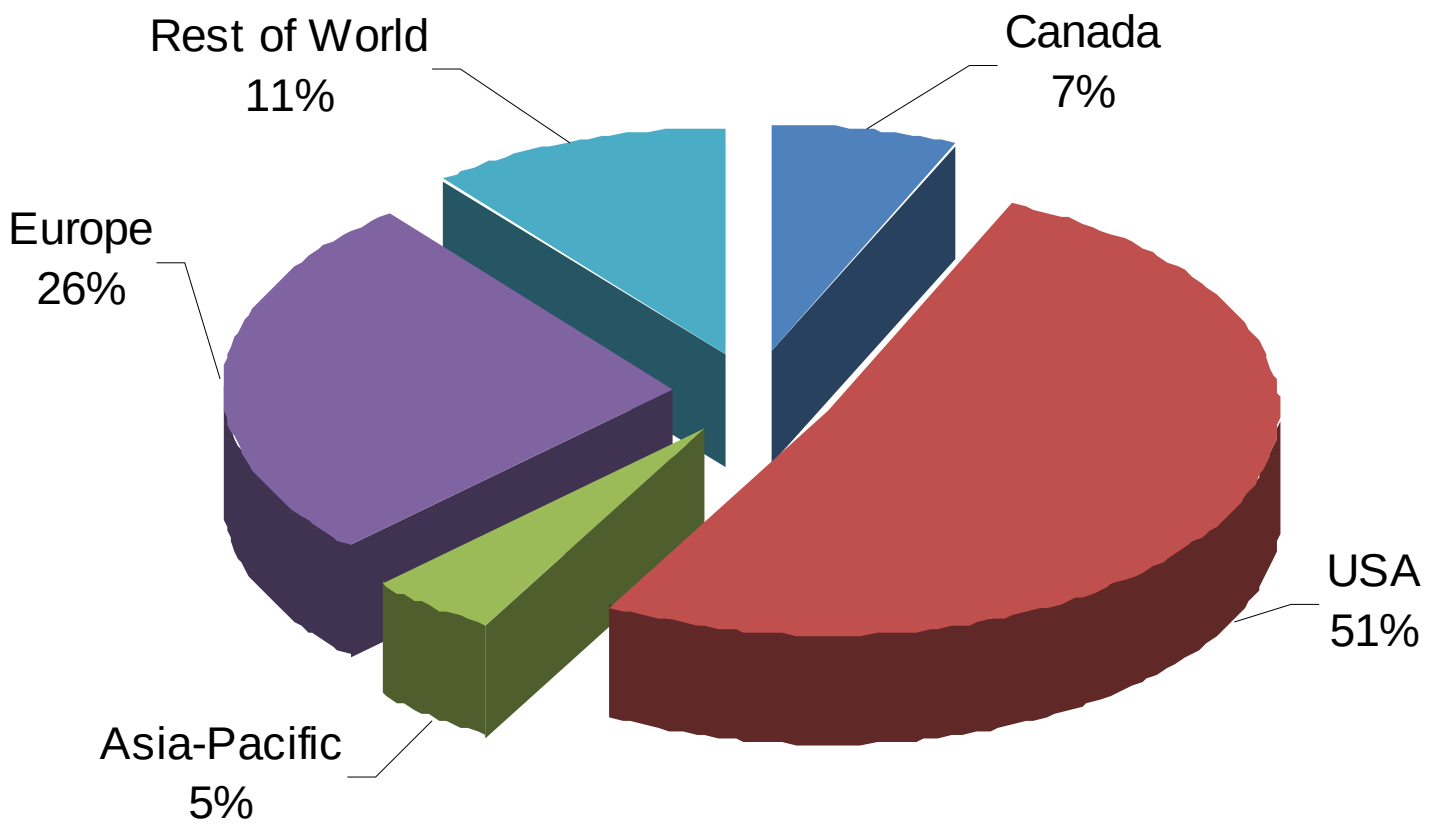


(★) Interviewed companies have revenues of $2.4B

(♦) excluding Nortel

Export Driven Businesses…

Ontario Exports of $2.8B★ pa.

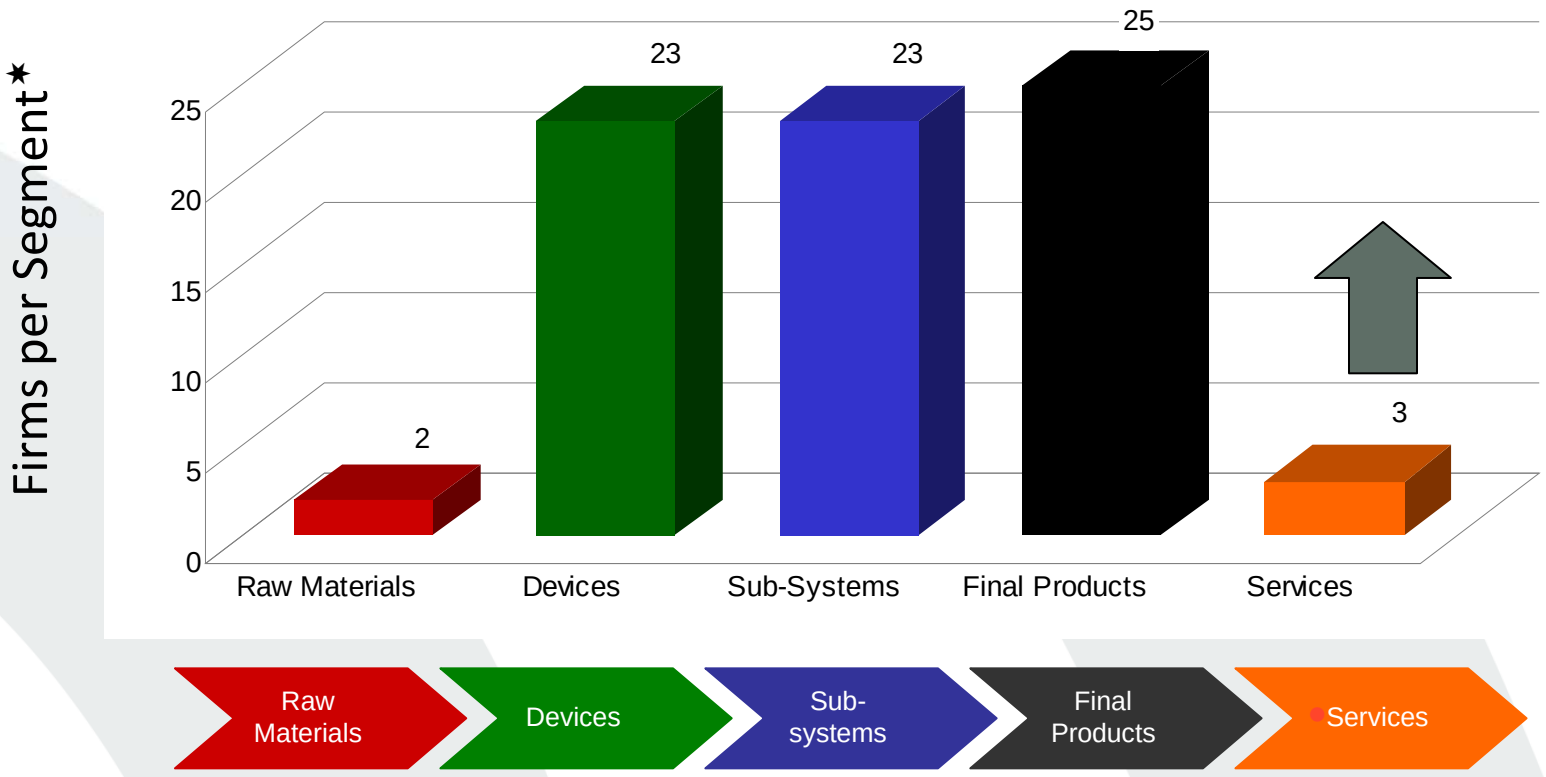


(★) Interviewed companies have exports of $2.1B. (93% of $3B=$2.8B)

Products & Services Positioning…

Ontario Centres of Excellence

Services: a growth opportunity?

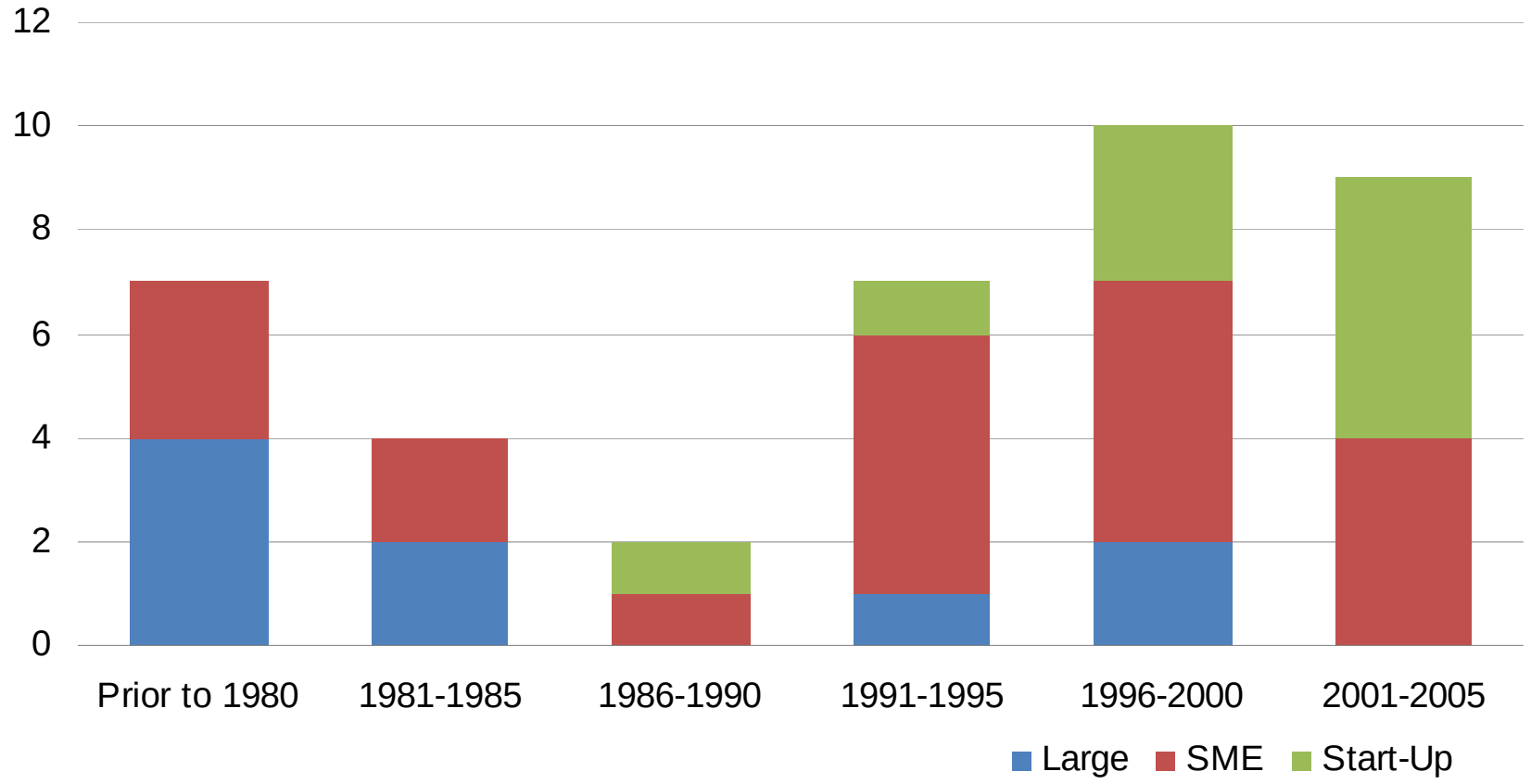


(✶) Interviewed firms only – several firms produce more than product type

Sector Maturity…

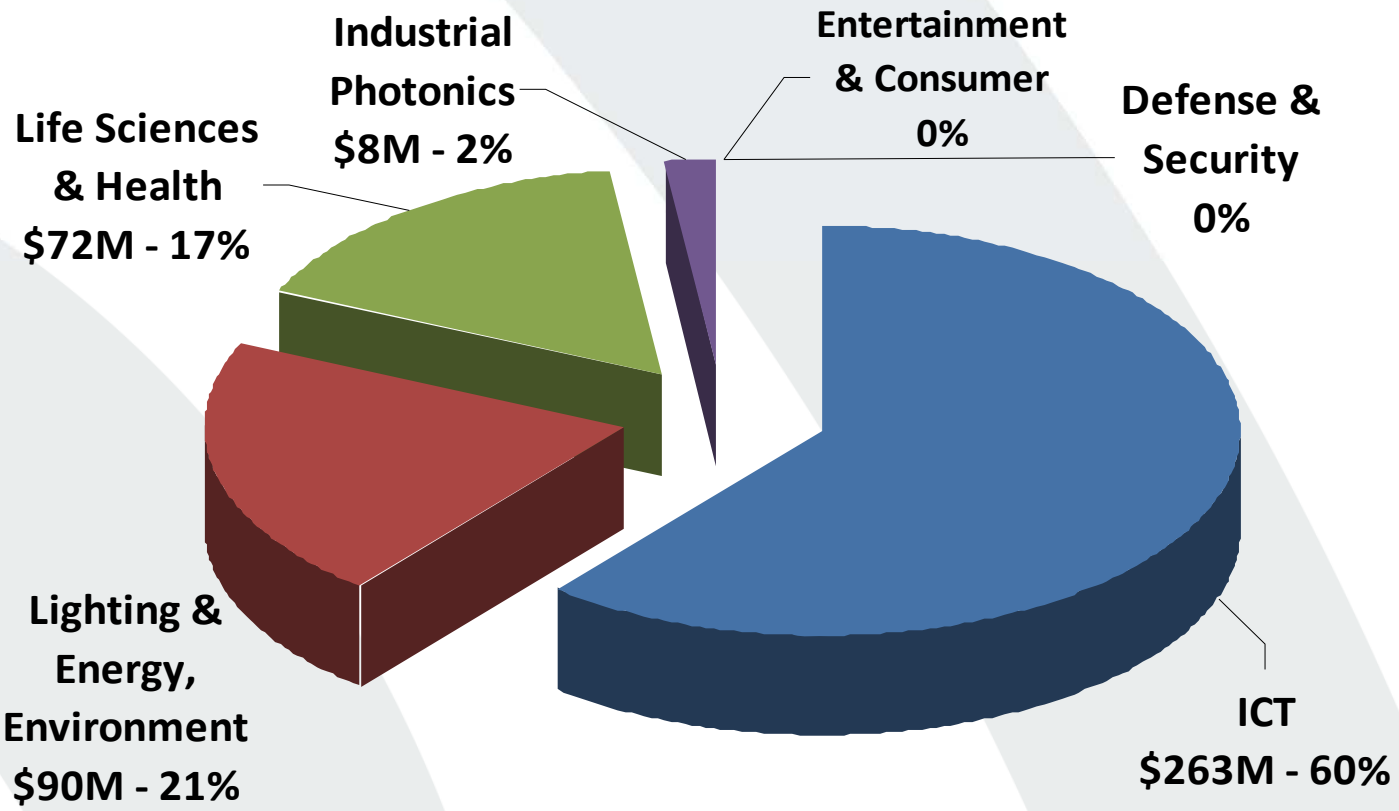
Ontario Centres of Excellence

Firms are typically 15 years old, or more



Strong Investor Attractiveness

Over $450M has been invested since 2005 in Ontario photonics-related start-ups



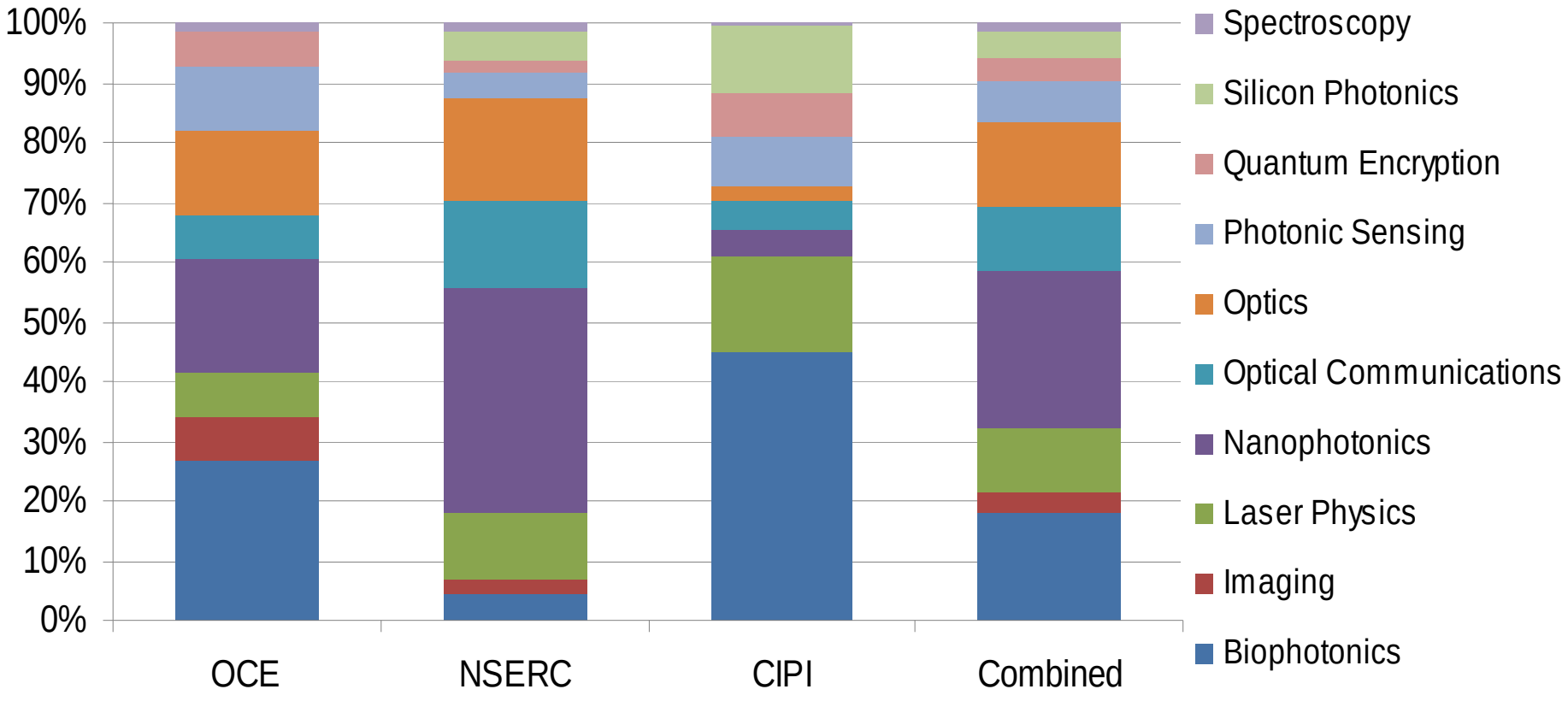
Investment still dominated by ICT.
Market demand or Ontario's comfort zone?

Academia

Ontario has world-class academic photonics capabilities and research institutes.

Ontario has a strong photonics academic base with more than 100 PIs and 400 HQP. 14 new photonics-related Canada Research Chairs have been established since 2003.

Distribution of Funding by Agency and Topic



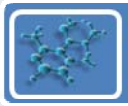
Academia-Industry Linkages

Ontario Centres of Excellence

Biophotonics
- UHN

Imaging
- Toronto

Laser Physics
- Toronto



Nanophotonics
- McMaster

ICT
- Ottawa

Optics
- Western

Photonic Sensing
- Carleton

Quantum Encryption
- Waterloo

Silicon Photonics
- McMaster

Spectroscopy
- Western

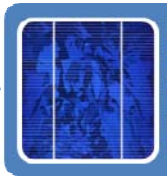
ICT
- BTI
- OneChip Photonics

Defence & Security
- Elcan
- Wescam

Entertainment & Consumer
- Imax
- Wegu

Health & Life Sciences
- Novadaq
- Theralase

Industrial
- Fox-tek
- Dalsa



Lighting, Energy & Environment
- GroupIV
- Arise

Agenda

Ontario Centres of Excellence

- Some thoughts…
- About OCE
- OCE's Photonics WhitePaper
- OCE's Nanotechnology WhitePaper
- Summary

Nano WhitePaper Methodology

We have visited 9 firms in Ontario with nanotechnology business.

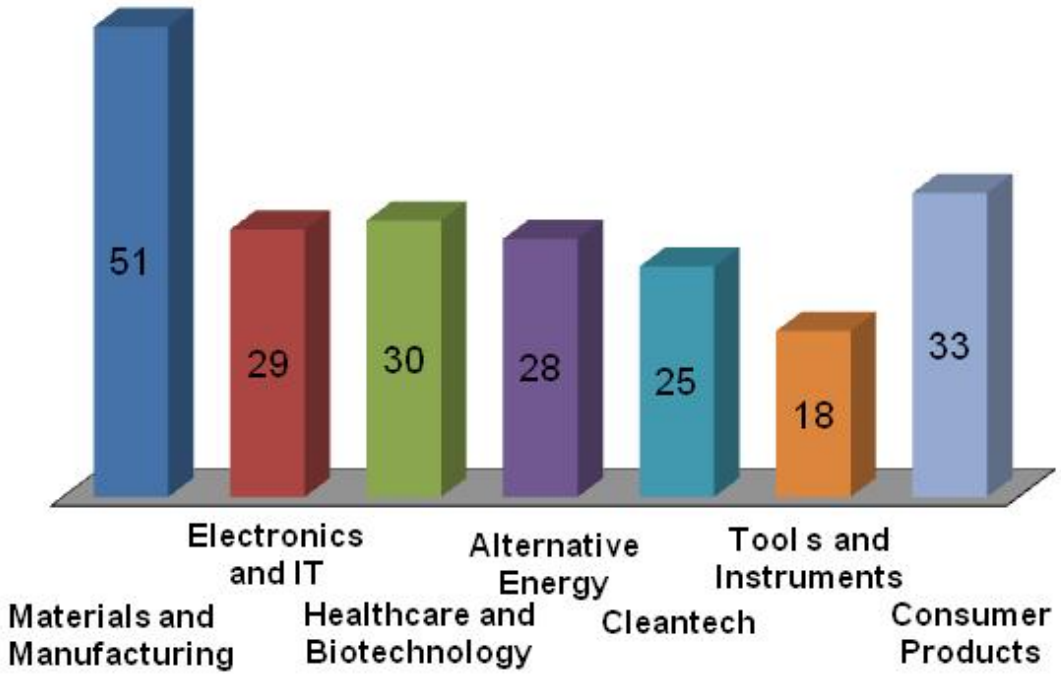
	Ontario	
	Sample	OCE Data
Number of Firms	9	93
Large	4	35
SME	1	43
Start-ups	4	15
Employees	3.5	19.9
Revenue ($B)	1.1	6.1

Here's what we found…

Diversified Nanotechnology End-Markets

Ontario Centres of Excellence

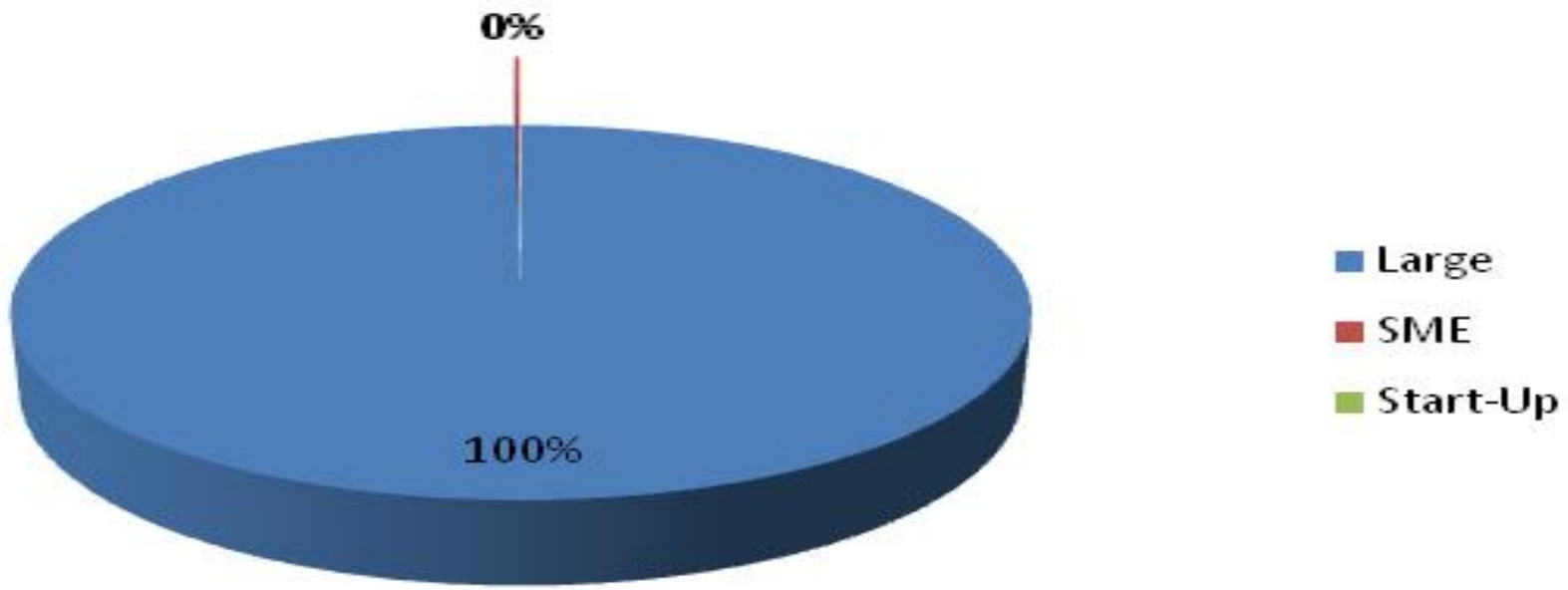
Firms are active across seven identified end-markets



Nanotechnology Employs almost 20,000 people in Ontario

Ontario Centres of Excellence

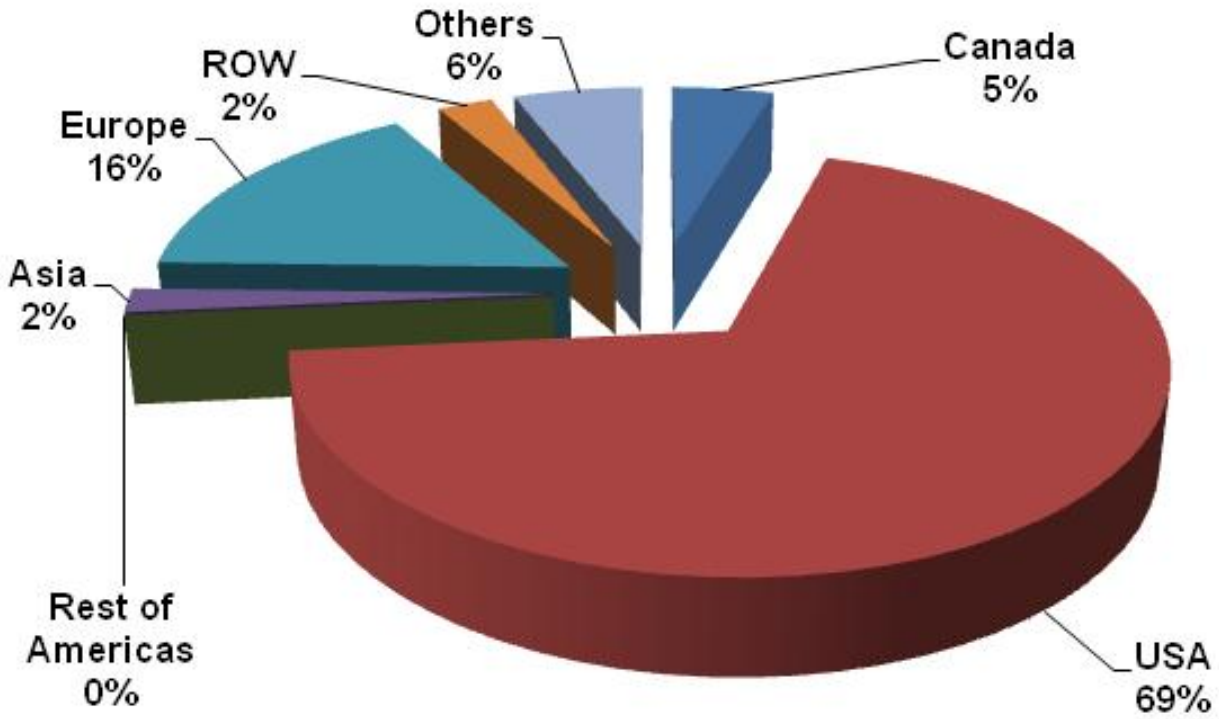
Employment is predominantly in large, public firms



Export Driven Businesses…

Ontario Centres of Excellence

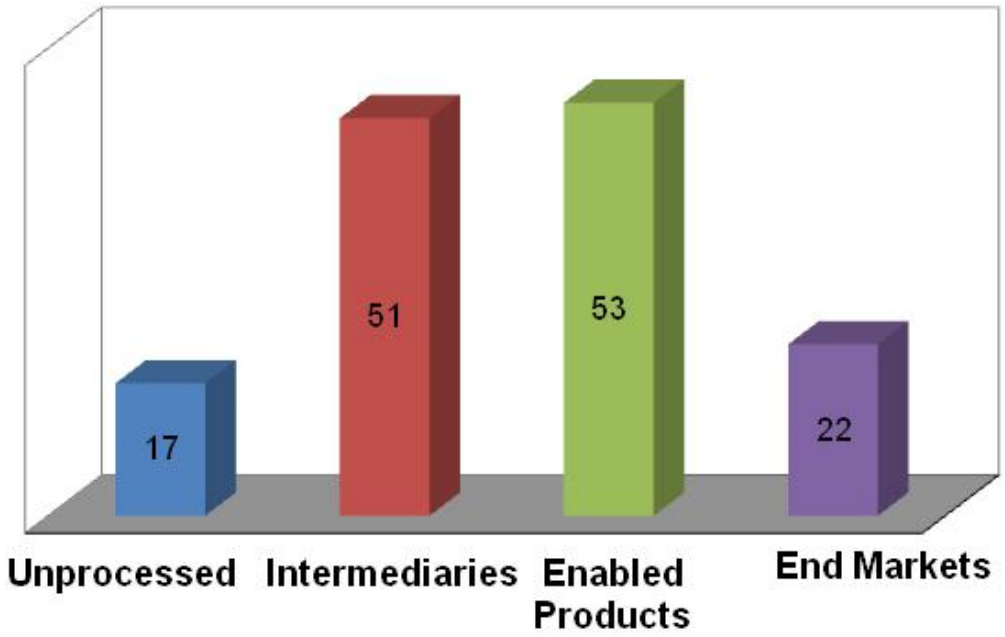
Estimated Ontario Exports of $5.8B

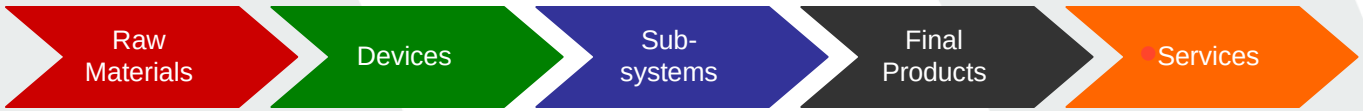


Products & Services Positioning…

Ontario Centres of Excellence

Ontario firms are well-positioned in the value chain?





Agenda

Ontario Centres of Excellence

- Some thoughts…
- About OCE
- OCE's Photonics WhitePaper
- OCE's Nanotechnology WhitePaper
- Summary

Summary – Photonics Industry

- Photonics supports over 10,000 high-value jobs in Ontario, with revenues in excess of $3B.
- Photonics is an area of opportunity and growth for Ontario. It has a balanced cross section of mature firms with proven track records, as well as SMEs and start-ups covering diverse market segments.
- Large companies tend to dominate their niche markets; SME's employ diverse business strategies from highly specialized niche markets to diverse portfolios; start-ups cover a diverse portfolio and have attracted over $450M of capital market investment.
- Job growth opportunities come primarily from small SMEs growing into large companies. There are few formal strategies to foster such growth.
- A key concern for all companies is fluctuations in value of the Canadian dollar.
- Ontario's photonics companies play a key role in achieving both the Canadian and Ontario innovation agendas.

Summary – Photonics Academia

Ontario Centres of Excellence

- Ontario has world-class academic photonics capabilities and research institutes.
- Public funding is $10.7M pa compared to $150M pa in capital market investment and over $500M pa in industry R&D spending.
- Research funding is heavily focused in biophotonics and nano-photonics
- Ontario might benefit from a more balanced research strategy covering start-ups, SMEs and large companies.
- A key weakness is the lack of participation of large companies to drive research agendas and large-scale funding initiatives.

Summary - Nanotechnology

Ontario Centres of Excellence

- Nanotechnology supports almost 20,000 high-value jobs in Ontario, with revenues in excess of $6B.
- Ontario's nanotechnology sector is primarily large, well-established companies.
- Ontario exports $5.8B of higher value-added nanotechnology products.
- More to come…

Ontario Centres of Excellence

Where Next Happens