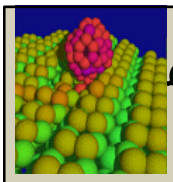
Nanotechnology in Canada – Status, Challenges and Time for Action

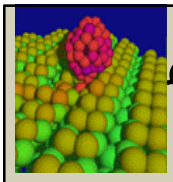
Canadian NanoBusiness Alliance & Sygertech

November 28, 2002



Agenda

- Global Nanotechnology Activities
- Nanotechnology in Canada
- Challenges versus the Rest of the World
- A Vision for Increasing Canada's Commercial Nanotechnology Activity

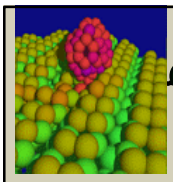


The Nanotechnology Revolution

" What we are seeing is the beginning of a revolution, caused by our ability to work on the same scale as nature. Nanotechnology will affect almost every aspect of our lives, from the medicines we use, to the power of our computers, the energy supplies we require, the food we eat, the cars we drive, the buildings we live in, and the clothes we wear. And it will happen sooner than most people think. "

Tim Harper
President & CEO
CMP Cientifica
(Leading Nanotech Info Provider)

Co-Author
Nanotechnology Opportunity Report



The Nano Space

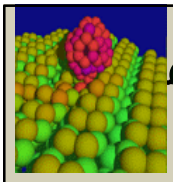
Micro	Nano	Pico
One millionth of meter	One billionth of meter	One trillionth of meter

Micrometer sized grains in materials
Microelectronics
Micro-electromechanical systems (MEMS)
Visible optical wavelengths

Top Down → **NANO** ← Bottom Up

Atoms
Molecules
DNA

1. **Facilitates continued miniaturization beyond micro**
2. **New properties at the nano level** (Stronger, more conductive, better thermal insulating, smaller, lighter, cheaper and more abundant)
3. **Potential for re-inventing industries** (Fuel cells, data storage, drug delivery, etc)



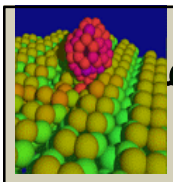
Nanotech Activity

Nanotechnology Opportunity Report (NOR) & **Sygertech Estimates** (est)

	# Entities (Source: NOR)	**Employees / entity** (est)	**# Employees** (est)
Companies	455	15	7,000
Research Centers	262	15	4,000
Venture Capitalists	93	2	200
TOTAL	**810**		**11,200**

Reality (May be up to 3 times higher due to secrecy and Newcos)

- Entities: 800 – 2,400 worldwide
- Employees: 11,000 – 33,000 worldwide
- Conferences: 1 per week (2001) - up to 8 per week (2002)
- R&D Investment: $710 million by US government (FY 2003)
  NSF, DOD, DOE, NASA, NIH



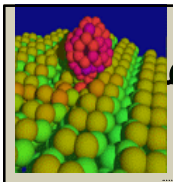
Estimated Market Size

Claims of Nanotech Revenues

Source	**Now**	**2005**	**2010**	**2015**
NSF	-	-	-	$1 trillion
In Realis	-	Up to $100 billion	Up to $800 billion	Up to $2 trillion
Evolution Capital	$20 – 50 billion	$150 billion	$1 trillion	-

More Likely Estimate of Current Revenues (NOR and Selected SEC 10Ks)

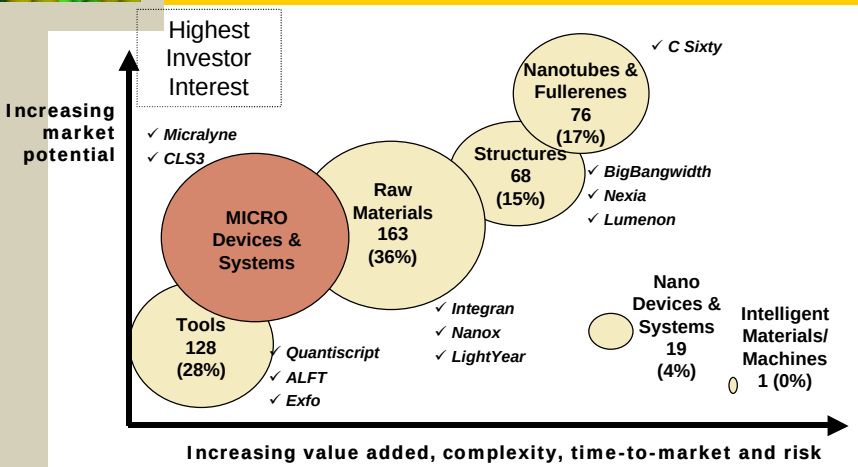
Nanotechnology Products (NOR)	$ 30 million
R&D Contract Revenues	Hundreds of millions
Nanotechnology Tools	Hundreds of millions

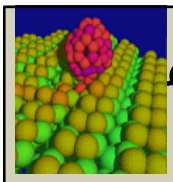


Characterization of Companies

Circle Size = Number of Companies (455) Worldwide

Source: NOR Data with Sygertech Interpretation





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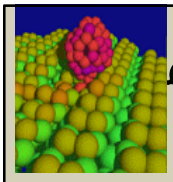
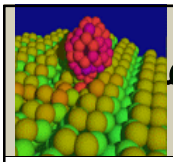


Distinctive Canadian Factors Favoring Nanotechnology Activity

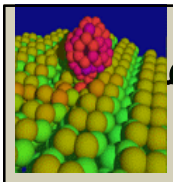
- **Vast wealth of natural resources has transformed the country into an affluent, high-tech industrial society**
  - Minerals, Energy, Pulp & Paper, Metals, Chemicals, Hydro, Nuclear
  - Telecom Equipment, Aerospace & Transportation, IT, Biotech and Pharmaceutics, Photonics
- **Low cost education has built a large, educated talent pool**
  - Annual tuition at top Canadian universities is US $2,000 to 4,000 for a B.Sc.
- **Canada is highly dependent economically on the US**
  - Top 2 trading partners US (86%) and Japan (3%)



Nanotechnology in Canada

Potential for 3 Major Hubs and 2 Minor Hubs

- More nanotech activity than imagined
- Caliber of Canadian research is world class on many fronts
- At least 25 universities carry out nanotech research



Selected Nanotech in Cdn Industry
Source: NRC

Nanomaterials
- Diversified base producing fine metal powders for surface coating, electronics, powdered metal parts for the aerospace, automotive, electronics, and medical device industries

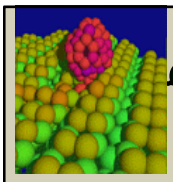
Polymers
- Catalyst development for polymer production
- Polymeric nanocomposites
- Bio-compatible polymers for implants

Photonics
- Band-gap materials
- Photonic switches

Fuel Cells
- Development of advanced membranes and catalysts for fuel cells and hydrogen reformers
- Metal hydride and carbon nanotubes for hydrogen storage

Sensors
- Nanostructured gas and organic compound sensors

Biotechnology
- Lab-on-a-chip plasma electropheresis
- Blood analyzers
- DNA and protein engineering



Funded Nanotech Activities in Canada
Source: NRC 2000-2002 (Cdn $)

Nanotech-Specific

National Institute for Nanotechnology (NINT)
- $120 million for building, equipment and 5 year operating budget (partnership of NRC, Province of Alberta & Univ of Alberta)
- Construction to begin in late 2003

NanoQuébec
- Quebec government research funding of $10 million over 3 years

Canadian Institute for Health Research (CIHR)
- Nanoscience Workshop planned for February 2003 will set the agenda for health spending in nanosciences

General Programs

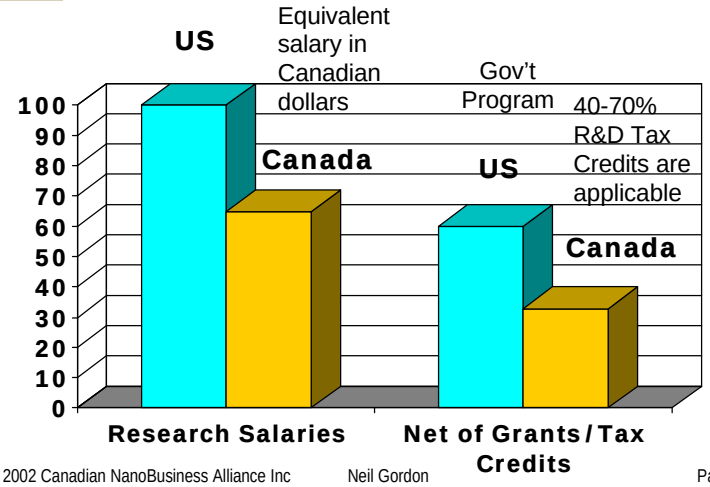
National Sciences & Engineering Research Council (NSERC)
- 219 awards totaling $9.3 million in 2000-01
- Appointed NSERC nano director to build national network of nano researchers

Canadian Foundation for Innovation (CFI)
- 2002 competition included $70 million in capital equipment awards which could be used for nanotechnology with matching funds from Provincial Governments and Universities

Canadian Institute for Advanced Research (CIAR)
- Network of leading micro/nano electronics researchers

Cost of Nanotech Researchers is 35%-50% lower in Canada versus US

Low Canadian dollar and generous government programs provide excellent R&D environment



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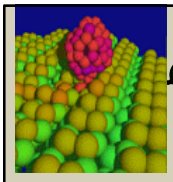


1. Canada lacks an Economic Development Strategy that Stimulates Nanotech Business

e.g. Albany, NY (1 of 19 US Hubs)

Albany Positioning:

- Nano-electronics production
- Clean energy& environmental

Partners
Applied Materials, AMD, GE, Intel, TI, Eastman Kodak

Saratoga Nanotech Business Park → *Clean Energy*, *Environmental*

Albany NanoTech
Electronics/Materials/ Energy/MEMS ($1 billion)
200 mm Wafer | 300 mm Wafer

NY State → Univer-sity of Albany → Albany NanoTech

SPIN-OFFS
Energy (4 public)
Material (2)
MEMS/ Optics (3)

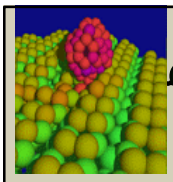
RPI Nanotech Research Centers
Federal

Training & Prototyping

IBM ↔ IBM Fab $4 billion

2002 Announcements:

Sematech $400 mil
GE $100 mil
TEL $300 mil



2. Canada lacks a National Nanotechnology Initiative to Coordinate & Allocate Funding

US "Top Down" approach to nanotechnology investment with successive annual increases

National Nanotech Initiative (NNI)

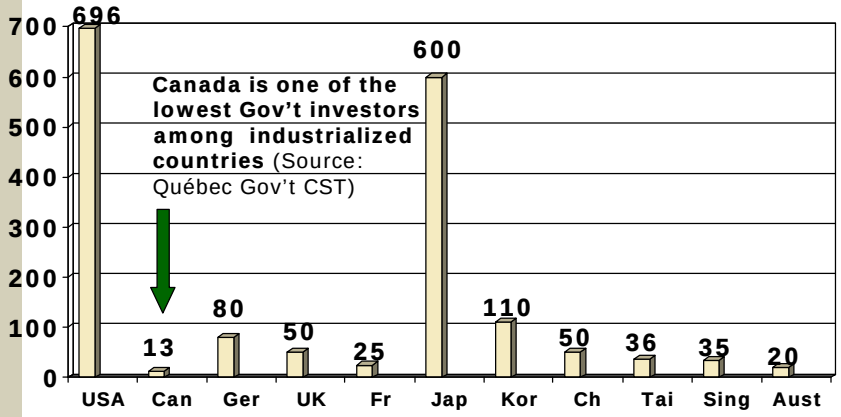
FY2001	$422 mil
FY2002	$604 mil
FY2003	$710 mil

Efficiencies if individual initiatives are centrally coordinated

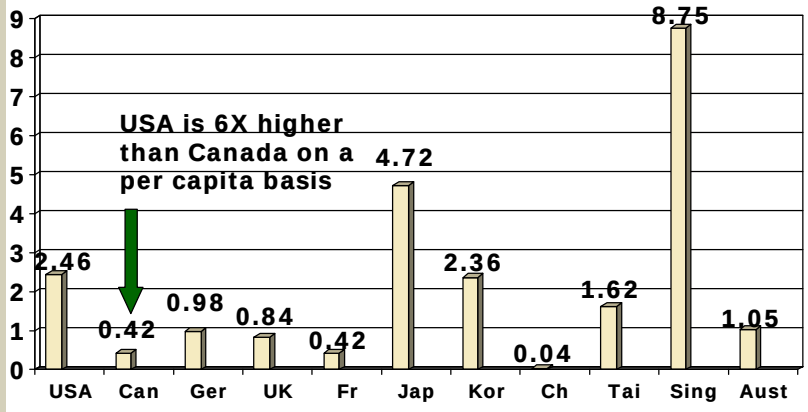
(Shared equipment, visibility, critical mass, hub development, etc)

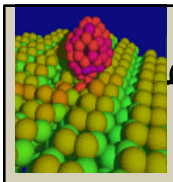
NSF	DOD	DOE	NASA	NIH	NIST
$221m	$210m	$139m	$51m	$43m	$43m

3. Canada Greatly Lags in Nanotech Funding
2001 in US $ mil
(US includes 50% addition for State Spending)



Gov't Spending on Nanotech – 2001
US $ Per Capita





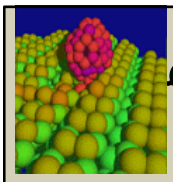
Gov't Spending on Nanotech – 2002

Source: European NanoBusiness Association

Annual Nanotech Spending

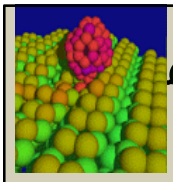
Europe	**Cdn $2.75 billion**	(€ 17.5 billion)
US (Fed & State)	**Cdn $1.44 billion**	(US $906 million)
Japan	**Cdn $1.19 billion**	(US $750 million)
US (Fed only)	**Cdn $0.96 billion**	(US $604 million)

To be competitive,
Canadian Government Nanotech spending
needs to be at least 1/10th of US
or Cdn $100 million per year!



4. Current Nanotech Funding Mechanisms in Canada Cause Research Downtime

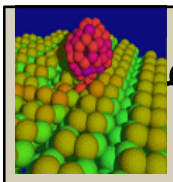
- **Case Study**
  - Warren Chan, University of Toronto
  - Institute of Biomaterials and Biomedical Engineering (IBBME)
  - Relocated from University of California – San Diego
  - Quantum Dot research for bio and medical applications
- **Downtime = 1 Year**
  - Seek funding programs
  - Apply for funding (Window for RFA's: Phase 1, Phase 2)
  - Decision
  - Release of funds
  - Order equipment
  - Receive equipment and set up lab



5. Large Companies in Canada are not Engaged in Nanotech as in Other Countries

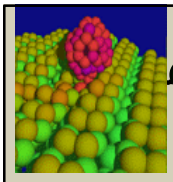
Large companies are critical for gaining market access as nanotech products are typically sold throughout a value chain

	Worldwide (NOR listing of 455 companies)	**Canada** (Estimate)
Large Cap (IBM, Kodak, Mitsubishi)	15 – 20%	5%
Public Pure Play (NANX, ALTI)	< 10%	< 5%
Private Names	70 – 75%	90%



6. The Visibility of Canadian Nanotech Companies is Virtually Zero

- **Likely 150 – 200 companies in Canada involved in nanotechnology**
  - Unlike most countries, no survey or benchmarking has been conducted in Canada (companies, researchers, investors, etc)
  - Because of lack of visibility, multinationals rarely look in Canada for setting up nanotech research and downstream production
- **Many Canadian VC's have invested in nanotech companies – both in Canada and outside**
  - Foreign VC's rarely consider Canadian nanotech ventures



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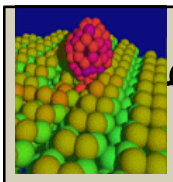
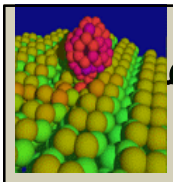


Short Term Priorities for Canada

Nanotechnology offers the potential for a new wave of technology companies and downstream production activities

1. **Position Canada's Nanotech Hubs/Clusters**
   - Become world leaders in selected niches that build upon Canada's strengths
   - Find complementary positioning for Canada's key nanotech centers (Montréal, Toronto, Edmonton, Ottawa, Vancouver) to minimize internal competition
2. **Dedicated Nanotech Funding to Build Critical Mass**
   - Create strategic funding (i.e. NNI) and "creative" funding (e.g. DARPA-type)
   - Goal is to have central federal agency (e.g. Industry Canada) commit an NNI beginning in 2003/4 for $100 million/yr for 5 years
   - Encourage start-up companies through NRC Incubators and Universities that are "Open for Business"
   - Engage Canadian large companies and VC's
3. **Increase the Visibility of Canadian Nanotech Opportunities**
   - Package the Canadian story (e.g. SmallTimes Inserts for Texas, California)
   - Promote Canada on the world stage - CANEUS (Montréal), NanoMaterials Crossroads (Montréal), BioNorth (Ottawa), CleanTech (Toronto)



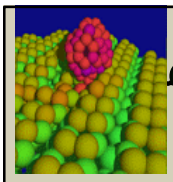
Long Term Considerations

From Kathryn Howard at BioNorth 2002
DG for Life Sciences, Industry Canada

Possible Goals for Canada in "Biotech" by 2010

1. Move from 3% to 10% of worldwide market for sales of biotech industry
2. Increase venture capital investment from $1 billion to $5 billion
3. Have 1 Canadian company in top 3 in world
4. Rank number 2 to US in Genomics
5. Natural bioproducts strategy to replace 5% of fossil fuels and petrochemicals
6. Position biotech as focused national clusters (less cities, less institutes)

Similar Goals are Needed Now for Nanotech Success in Canada



Canada's Nanotech SWAT Team

Representing Canada's Nanotech Community

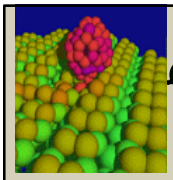
SWAT Team

- Chair: Neil Gordon, Canadian NanoBusiness Alliance
- NRC: Dan Wayner, NINT
- Canadian Gov't: Tom Malis, Natural Resources Canada
- Academia: Peter Grutter, McGill and NSERC NanoIP
- Industry: Uri Sagman, C Sixty
- Venture Capital: Tony Redpath, Primaxis Technology Ventures

Deliverables

- Phase 1 - Position Paper (Mid Winter, 2003)
- Phase 2 - Input from Regions and Sectors
- Phase 3 - 1,000 advocates for a national nanotech initiative - companies, government, academic and financial (Currently at 250)

To Join, e-mail: n.gordon@sygertech.com



Contact Neil Gordon

- **Background**
  - B. Eng. (McGill 80), MBA (U Western Ontario 83)
  - Partner – Nanotechnology, Sygertech
  - President, Canadian NanoBusiness Alliance
  - Advisory Board, Nanotechnology Opportunity Report
  - Judge, SmallTimes Company of the Year 2002
- **Specialties**
  - Growing nanotechnology ventures
  - Helping investors evaluate nanotechnology opportunities
  - Helping government agencies develop nanotech strategy
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