NRC·CNRC

Is Canadian Research & Innovation Meeting Resource Sector Needs?

Re$earch Money

April 1, 2015

NRC – A Century of Innovation to Benefit Canada and the World

1920s
Concrete for a harsh climate

1930s
Redesigned steam locomotive

1940s
Wartime innovations: radar, atomic energy

1950s
Pacemaker, electric wheelchair

1960s
Crash position indicator

1970s
Anti-counterfeiting technology

1980s
Canadian Astronaut Program, Canadarm

1990s
Synthetic meningitis C vaccine

2000s
Simulated brain surgery

2010s
100% biofuel test flights

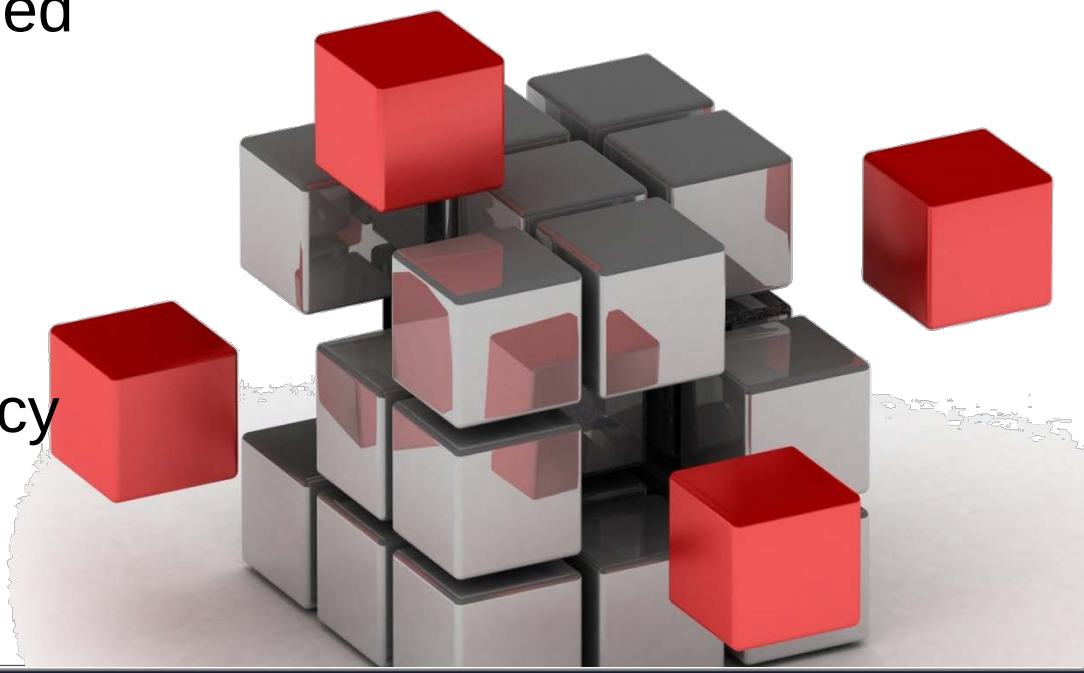
NRC Role and Mandate

MANDATE

Research and development to facilitate industrial R&D and stimulate economic development that benefits Canada

FIVE KEY VALUES

- Impact - customer focused and outcome oriented
- Accountability
- Leadership
- Integrity and transparency
- Collaboration



NRC

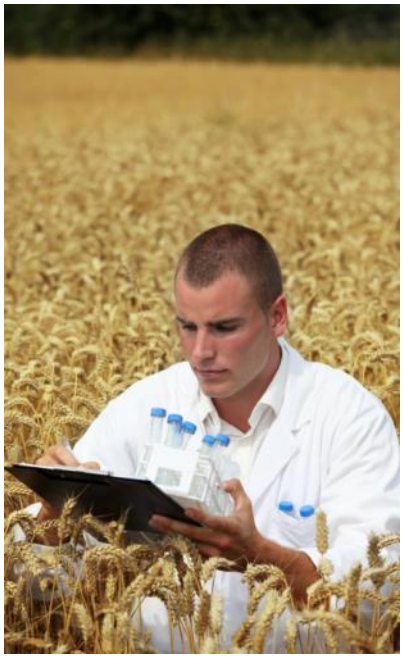
Vision:

To be the most effective research and technology organization in the world, stimulating sustainable domestic prosperity.

Mission:

Working with clients and partners, we provide innovation support, strategic research, scientific and technical services to develop and deploy solutions to meet Canada's current and future industrial and societal needs.

NRC Business Lines



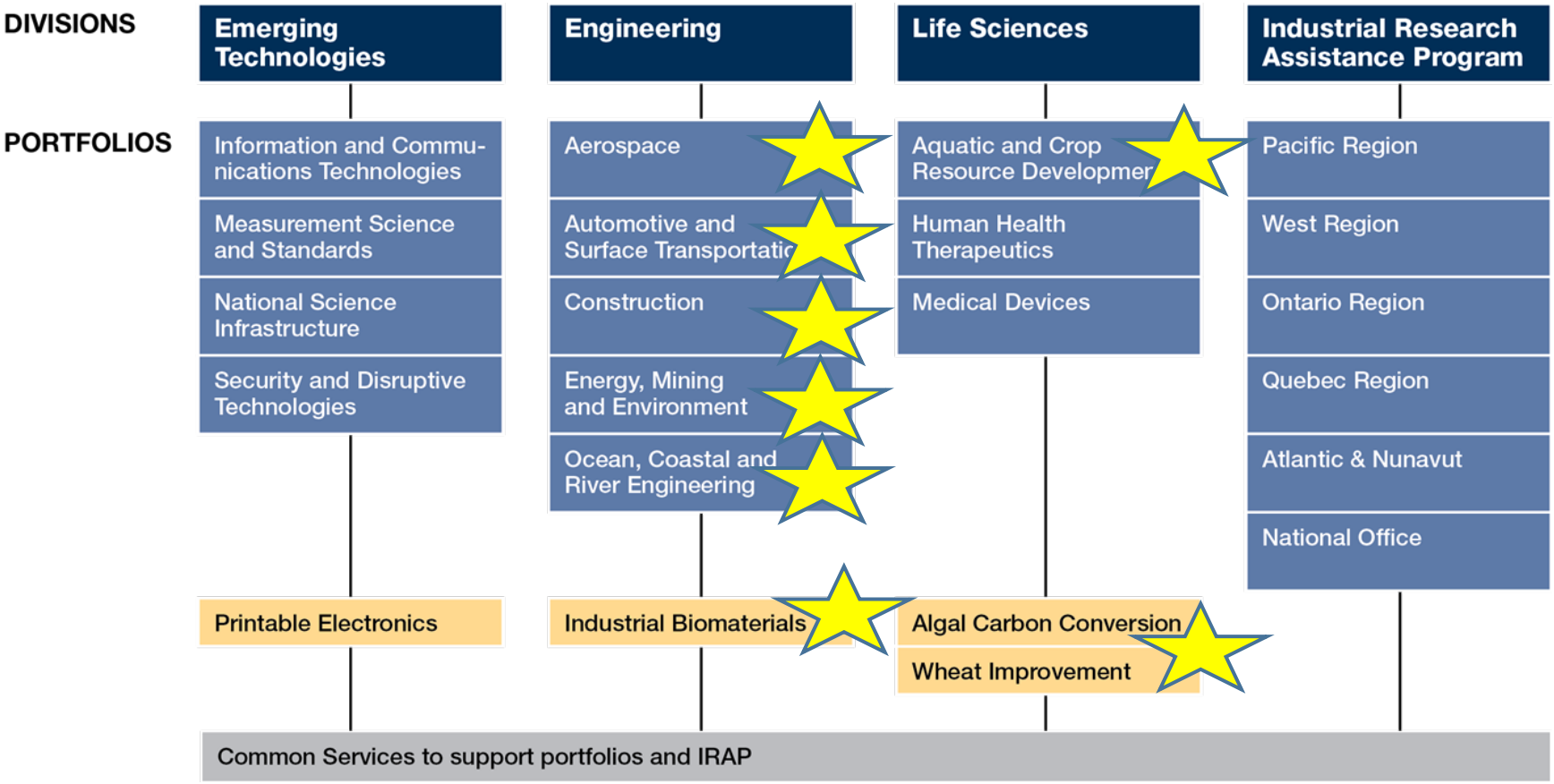
Strategic Research & Development

Technical Services

Industrial Research Assistance Program (IRAP)

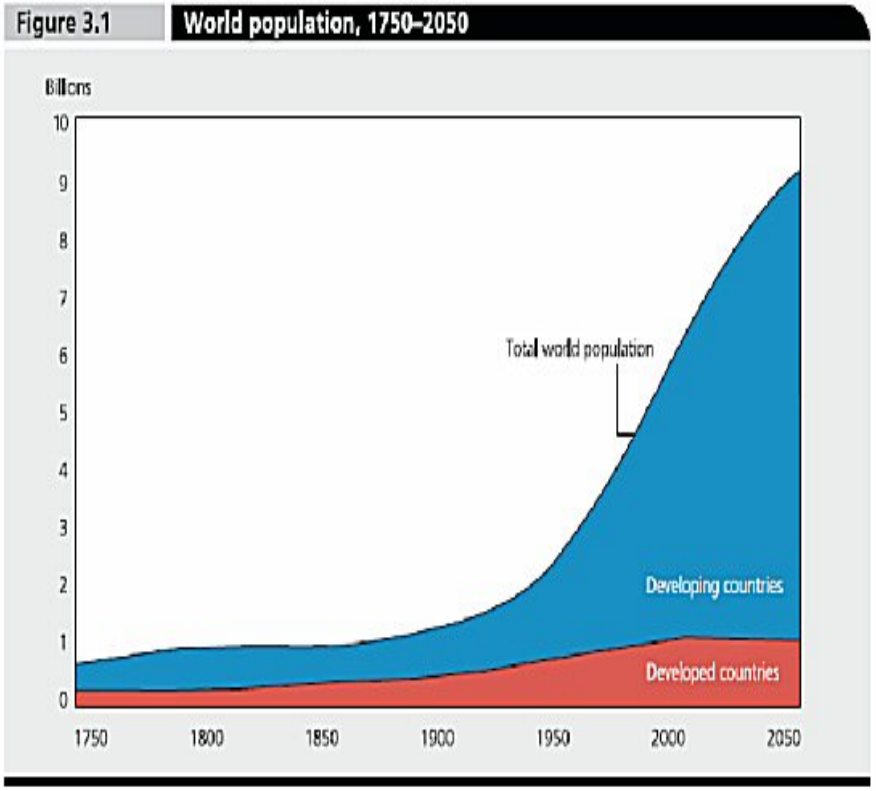
Science Infrastructure

NRC Organization Structure



Global population passed 7 billion in 2012 and could potentially reach 10 billion

- Virtually all growth is in the developing world.
- Birth rates in Africa not declining as fast as they did in Asia.
- Rising personal incomes and increased consumption, magnify the direct effects of population growth on demand for food, water, energy & materials.



The Earth IS NOT running out of resources

- Richly endowed with basic resources such as energy, minerals and biomass.
- Technology has enabled the expansion of resource production, and the ability to exploit low grade resources, so we can feed and energize the world population.
- Resource production and use issues such as environmental effects and recycling challenges are increasing.
- Issues such as climate change, agricultural run-off, acidification of the sea, and plastics, chemicals and drugs in the environment are well-known, but efforts to address them within a global system that considers cumulative effects are constrained by individual, regional and national concerns.

Hierarchy of Economies
(Individuals and institutions Drive to Increase Prosperity)

ROLE PLAYED	Any Job	Low End MANUFACTURING	High End MANUFACTURING	Value Add MANUFACTURING	INNOVATION	INNOVATION PLUS
	PROGRESS →					
PLAYERS	Under developed regions		Lesser "developed" regions		Highly developed regions	Knowledge Economies
BASIC STRATEGY	COPY		PRODUCTION EFFICIENCY		VALUE CREATION	GLOBAL LEADERS
BASIS FOR COMPETITIVE ADVANTAGE	Cost		Quality and cost (Value)		Innovation Models Insight and Opportunity	Foresight Innovation Systems Culture
OUTCOME REALIZED	Survival		Wealth		Sustainable development	Quality of Life

Knowledge Economy requires a substantial domestic capability in education, technology and product development, and technology commercialization.

Canadian Resources Abound

minerals - northern BC, Yukon, NWT, Ontario "Ring of Fire", Quebec Plan Nord and Labrador; **oil sands** - across northern Alberta; **uranium** - Saskatchewan; **oil and gas** - west, north and east coast; **hydro & boreal forest** - span the continent

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Production and use of resources plays an important role in global prosperity.

- Resource development can be the difference between communities surviving and thriving, helps pay for public infrastructure, social and education programs, and supports a high quality of life.
- In Canada, natural resource industries account directly and indirectly for about 20% of GDP and 1.8 million jobs across the country.

Is our Canadian Resource Research and Innovation Agenda addressing the Needs?

Not entirely based on what I hear and see and read.

Would appear several segments of the public don't think so.

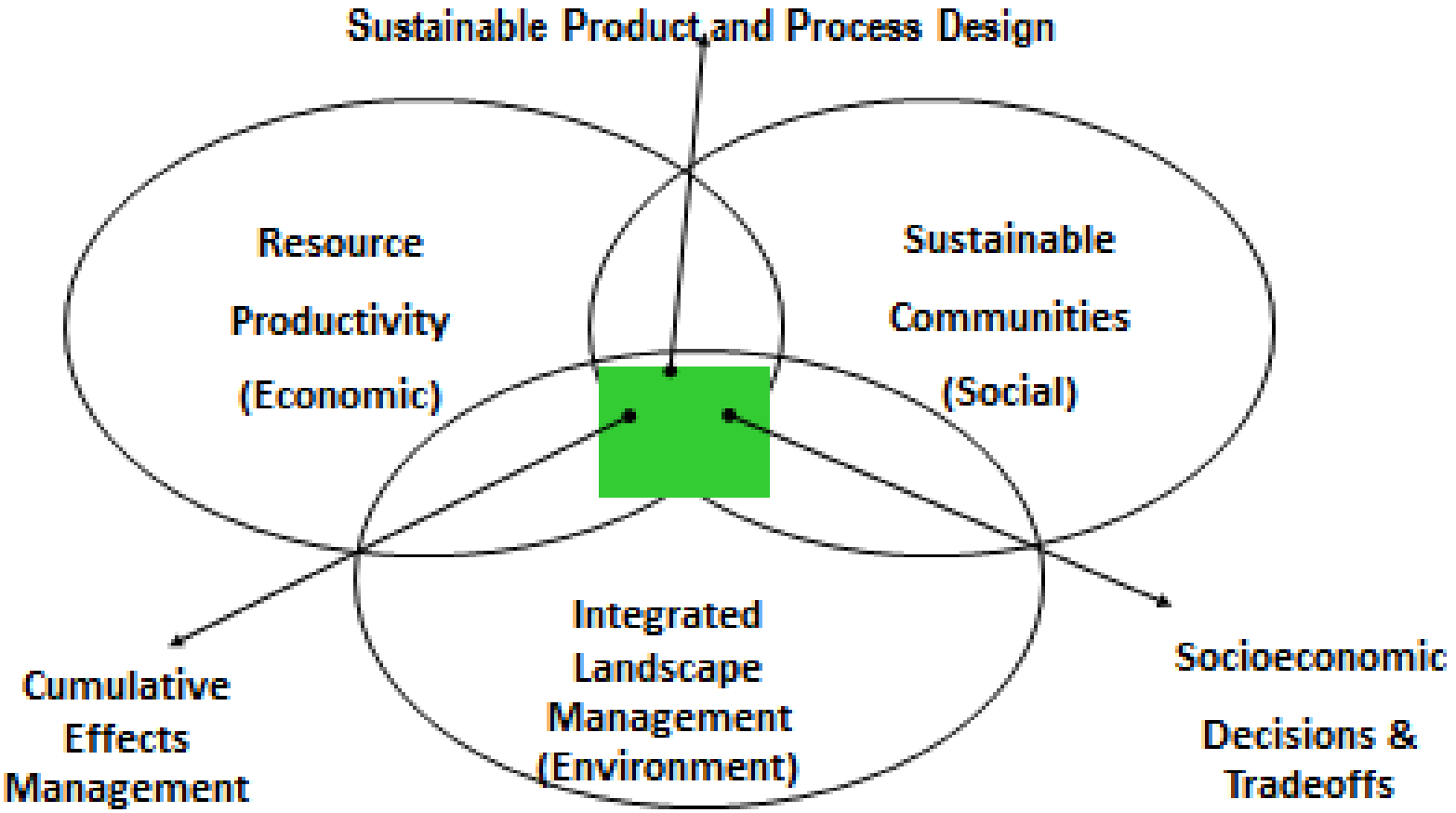
We need to move our efforts beyond "finding and extracting resources" and focus more of our attention on:

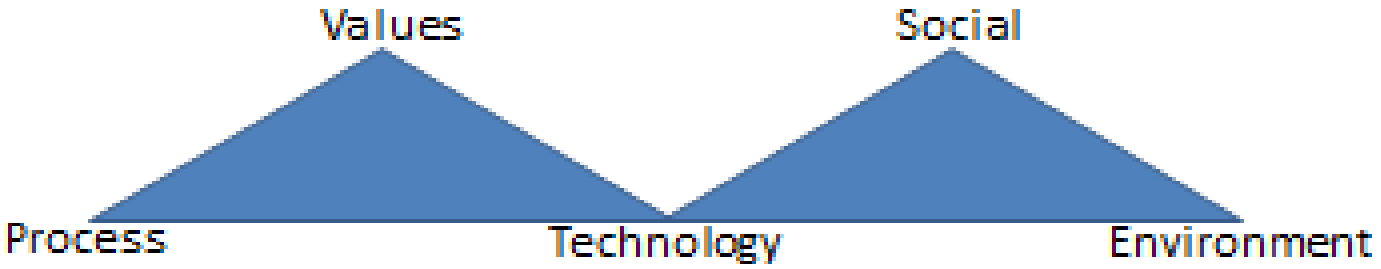
1. Infrastructure to access global markets
   - Expanded, safer transportation systems and ports
2. Safety and Health – Workplace, communities
3. Environmental performance and cumulative effects
4. Social effects and increased opportunities.

Is humanities' footprint sustainable?

- Energy consumption, GHG emissions, species extinctions, etc. – correlate closely to population.
- People require resources of many kinds to survive.
- Population growth and associated resource demands could overwhelm the world.
- While the earth itself would still survive, humanity may find itself seriously challenged and ultimately reach the point where another life form becomes globally dominant.
- A more holistic approach to resource development and use supported by the right bundle of technologies could make sustainability possible even with significantly more people on the planet.

Challenges of sustainability





Developed world consumes substantially more than the value-added wealth it produces

- Historically enabled by outsourcing to less developed regions and now enabled by borrowing from them.
- Fundamental flaws in this strategy have now emerged:
  - Consumer expectations in the developed world exceed the current productive capacity of the developed world,
  - Economic growth in emerging economies is adding significant environmental impacts,
  - The global footprint of activities outsourced from North America and Europe is often invisible, in the short and medium term, to final consumers.

What does this all mean for research and innovation?

Sustainability and reduced resource use through Product Durability, Longevity and Efficiency standards

1. Reduce resource losses – production, transportation, conversion (power, manufacturing)
2. Reduce emissions from production, consumption and disposal of food and forest products
3. Optimize heating/cooling – building design, process heat
4. Use each liter of fresh water as often as we can.
5. Capture more unused “natural renewable” energy – solar, geothermal, tidal

Bio-mimicry - A whole cycle system approach to resource use

1. Use solid waste (landfills) and sewage as major resources - collect bio-waste and convert it to renewable CH4 - 25% of GHG when burned (methane and nitrous oxide - related to food)
2. Accelerate carbon cycle – develop massive controlled CO2 based Biomass production and conversion

Conclusion

- Canada is among the nations most richly endowed with resources.
- The challenges facing the resource sector are large and complex and do need serious attention.
- We need to get more aggressive about resolving the major problems – more efficient extraction, reduced emissions, new and safer transportation, increased efficiency of use and a whole system, life-cycle approach, to resource production and use.
- The NRC, along with our partners in industry and government and the research community, has reshaped our capabilities in order to help Canada do just that.