- HPC in Canada
- Simulations of CMB weak lensing

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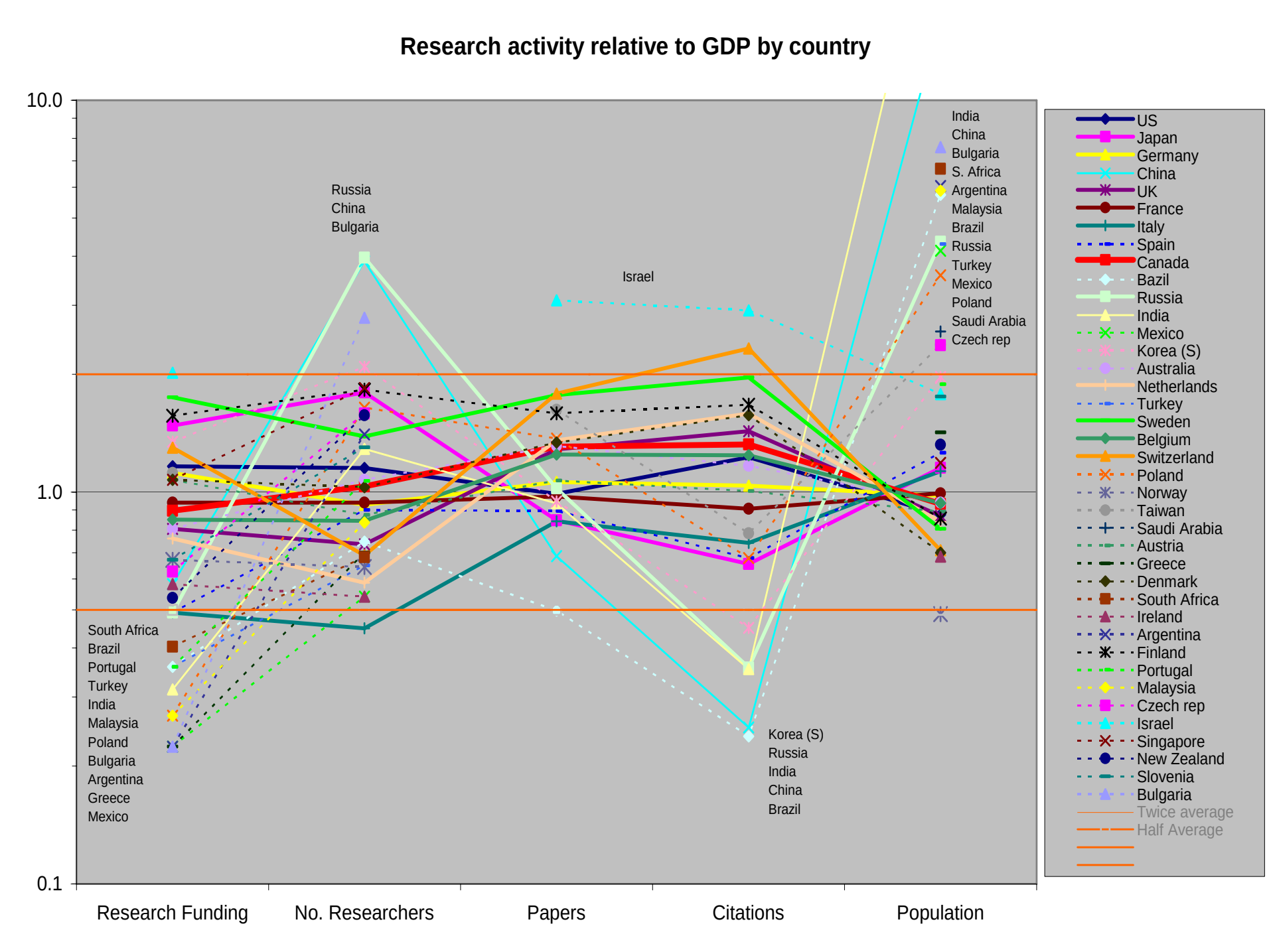
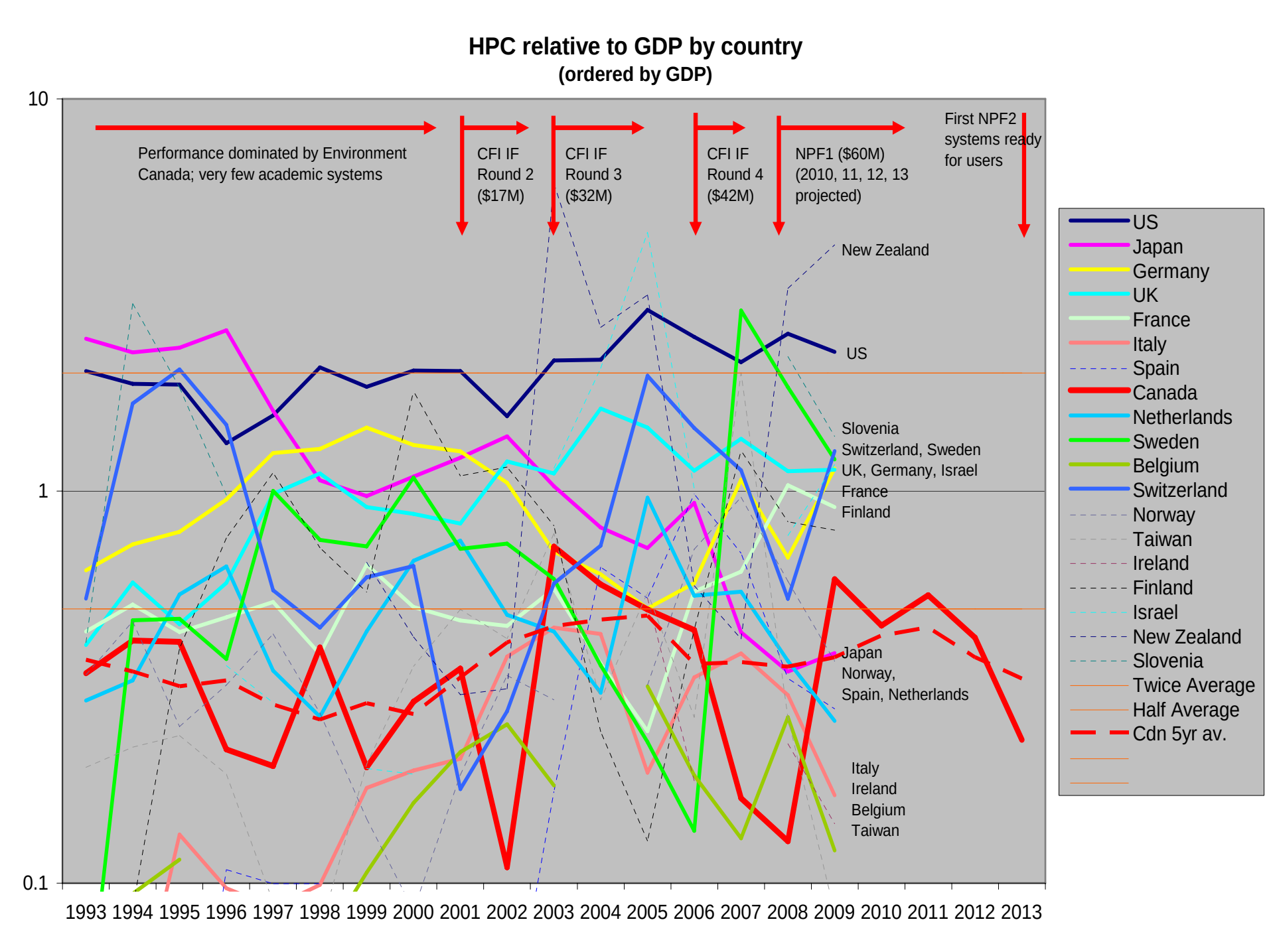
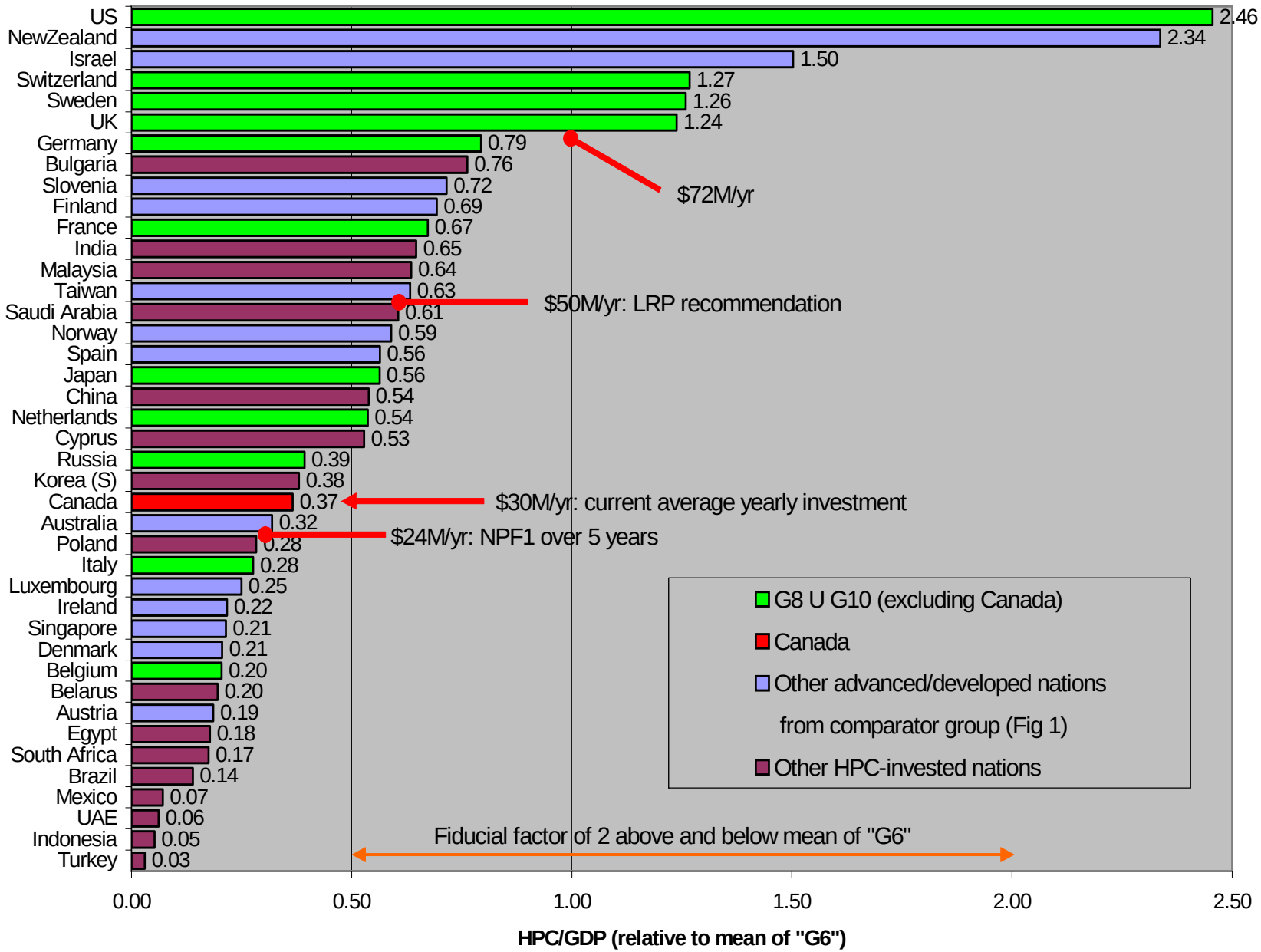
Hugh Couchman, *McMaster*

HPC in Canada

- The importance of HPC to various specific disciplines is *relatively* easy to argue (although, to be honest, the arguments are received with variable success)
- It is much more challenging to argue **how much** is needed, or the **funding rate** required, when needs must be aggregated across all disciplines and levels of skill/need across the country
  - *"We've just funded $120M, that should be plenty"*


Research activity relative to GDP by country
10.0
1.0
0.1
Research Funding
No. Researchers
Papers
Citations
Population
South Africa
Brazil
Portugal
Turkey
India
Malaysia
Poland
Bulgaria
Argentina
Greece
Mexico
Russia
China
Bulgaria
Israel
Korea (S)
Russia
India
China
Brazil
India
China
Bulgaria
S. Africa
Argentina
Malaysia
Brazil
Russia
Turkey
Mexico
Poland
Saudi Arabia
Czech rep
US
Japan
Germany
China
UK
France
Italy
Spain
Canada
Bazil
Russia
India
Mexico
Korea (S)
Australia
Netherlands
Turkey
Sweden
Belgium
Switzerland
Poland
Norway
Taiwan
Saudi Arabia
Austria
Greece
Denmark
South Africa
Ireland
Argentina
Finland
Portugal
Malaysia
Czech rep
Israel
Singapore
New Zealand
Slovenia
Bulgaria
Twice average
Half Average


HPC relative to GDP by country
(ordered by GDP)
10
1
0.1
Performance dominated by Environment Canada; very few academic systems
CFI IF Round 2 ($17M)
CFI IF Round 3 ($32M)
CFI IF Round 4 ($42M)
NPF1 ($60M) (2010, 11, 12, 13 projected)
First NPF2 systems ready for users
New Zealand
US
Slovenia
Switzerland, Sweden
UK, Germany, Israel
France
Finland
Japan
Norway,
Spain, Netherlands
Italy
Ireland
Belgium
Taiwan
US
Japan
Germany
UK
France
Italy
Spain
Canada
Netherlands
Sweden
Belgium
Switzerland
Norway
Taiwan
Ireland
Finland
Israel
New Zealand
Slovenia
Twice Average
Half Average
Cdn 5yr av.
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013


HPC/GDP (2005-2009 average)
US 2.46
NewZealand 2.34
Israel 1.50
Switzerland 1.27
Sweden 1.26
UK 1.24
Germany 0.79
Bulgaria 0.76
Slovenia 0.72
Finland 0.69
France 0.67
India 0.65
Malaysia 0.64
Taiwan 0.63
Saudi Arabia 0.61
Norway 0.59
Spain 0.56
Japan 0.56
China 0.54
Netherlands 0.54
Cyprus 0.53
Russia 0.39
Korea (S) 0.38
Canada 0.37
Australia 0.32
Poland 0.28
Italy 0.28
Luxembourg 0.25
Ireland 0.22
Singapore 0.21
Denmark 0.21
Belgium 0.20
Belarus 0.20
Austria 0.19
Egypt 0.18
South Africa 0.17
Brazil 0.14
Mexico 0.07
UAE 0.06
Indonesia 0.05
Turkey 0.03
$72M/yr
$50M/yr: LRP recommendation
$30M/yr: current average yearly investment
$24M/yr: NPF1 over 5 years
G8 U G10 (excluding Canada)
Canada
Other advanced/developed nations from comparator group (Fig 1)
Other HPC-invested nations
Fiducial factor of 2 above and below mean of "G6"
0.00
0.50
1.00
1.50
2.00
2.50
HPC/GDP (relative to mean of "G6")

Conclusions

- Cannot take availability of comprehensive HPC infrastructure for granted
- These costs are for equipment and do not include operations (primarily power) or people; in most competitive jurisdictions these increase costs by 70-100%
- Critical strategic importance for Canadian competitiveness is not clearly understood by funding agencies or governments
- Concentration of resources into Compute Canada and the increasing difficulty of obtaining HPC outside CC (& the 7 “HPC consortia”) has created a single point of failure.
- Canadian astronomy is vulnerable both from the standpoint of modelling/simulation but particularly because of need to respond to data processing demands of current & upcoming experiments/observations