e-IRG Workshop
13-14 October 2010, Brussels

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Danish Center for Scientific Computing

Energy & Green IT

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Views and suggestions are personal reflections, which do not necessarily represent DCSC

Content

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1. Structural change in computing (HPC & DC)
2. Midterm conclusions
3. What can one envision ? - Our suggestion !

   Moving (some of) our computing abroad to “cheap energy & green IT”.

4. Piloting disruptive technology: Nordic-HPC
5. Concluding pros and cons of a real pursuit of sound energy & green IT policy

Structural HPC trends

HPC is becoming R&D 3ed pillar

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- "Computational simulation offers to enhance, as well as leapfrog, theoretical and experimental progress in many areas of science critical to the scientific mission..." (US Department of Energy).
- "Computational science is one of the most important technical fields of the 21st century because it is essential to advances throughout society" (US President's Information Technology Advisory Committee)
- "Computational science has become the third pillar of the scientific enterprise, a peer alongside theory and physical experiment" (US President's Information Technology Advisory Committee)

Structural HPC trends

Growing HPC utilisation; growing budget burden

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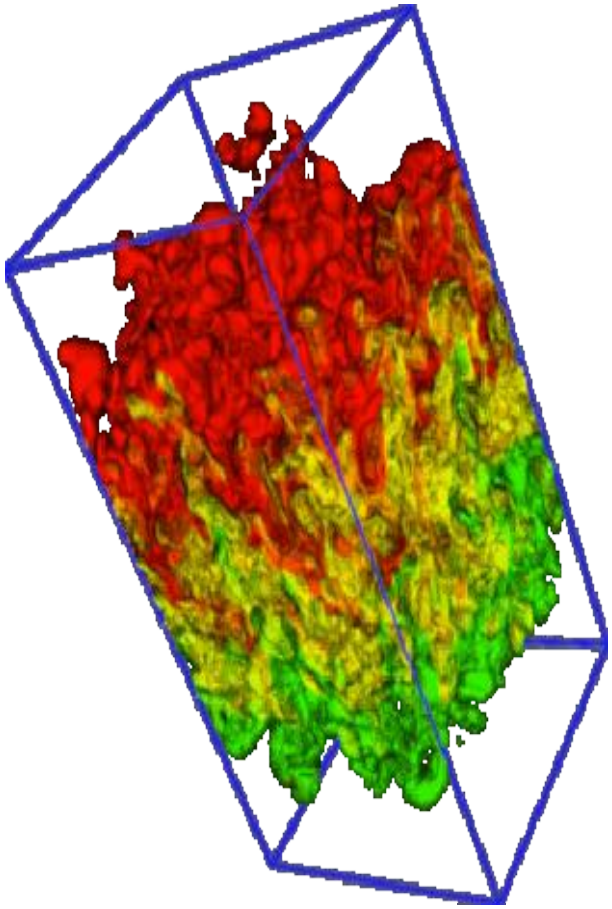

- "The next 10 to 20 years will see computational science firmly embedded in the fabric of science – the most profound development in the scientific method in over three centuries" (US Department of Energy).
- "A host of technologies are on the horizon that we cannot hope to understand, develop, or utilize without simulation" (US National Science Foundation)

Structural HPC trends

Specialisation: From infrastructure to instrument

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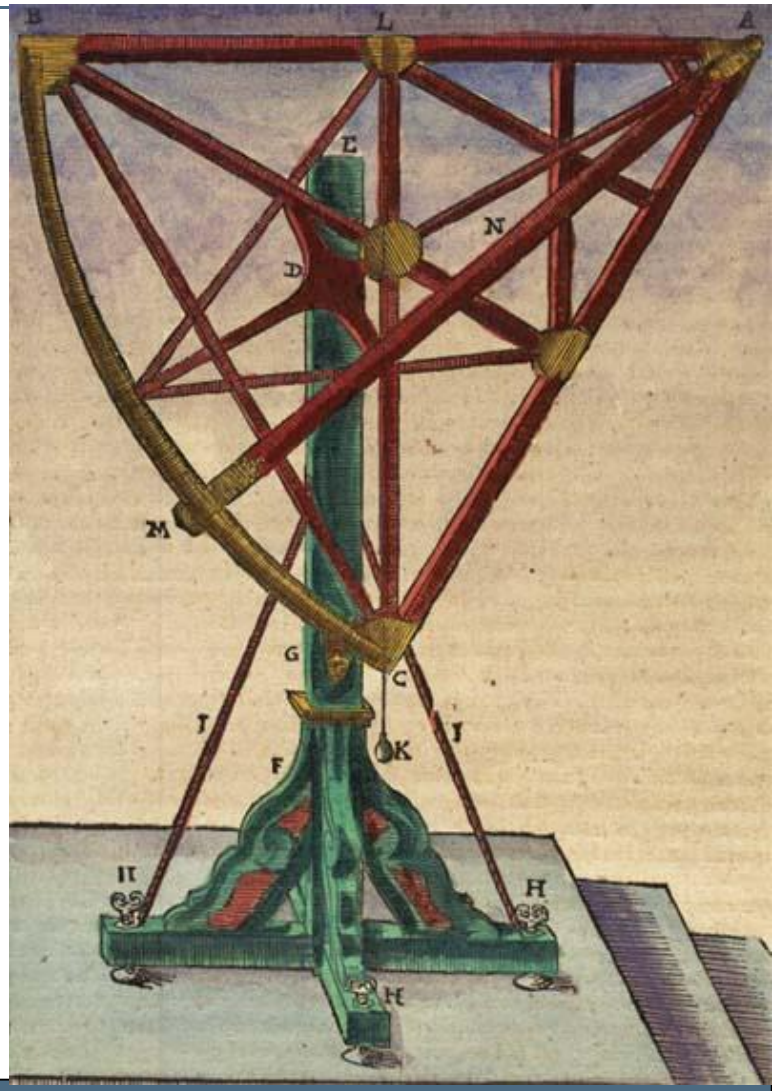
Some researchers need:

- to build specialised HPC.
- to have instrument-proximity.
- to have control (root password, complete middleware and software dictatorship).
- to “own” the system administrator.



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Other researchers need:

- to just compute... Anywhere, cloud, via SSH... whatever, as long as it works, and is affordable.
- to have a nice GUI; no voodoo or command line scripts.
- to have no hassle with the local system administrator or computer centre boss.

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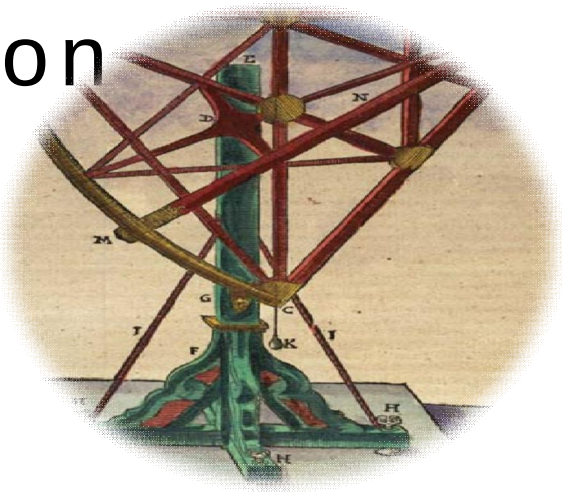
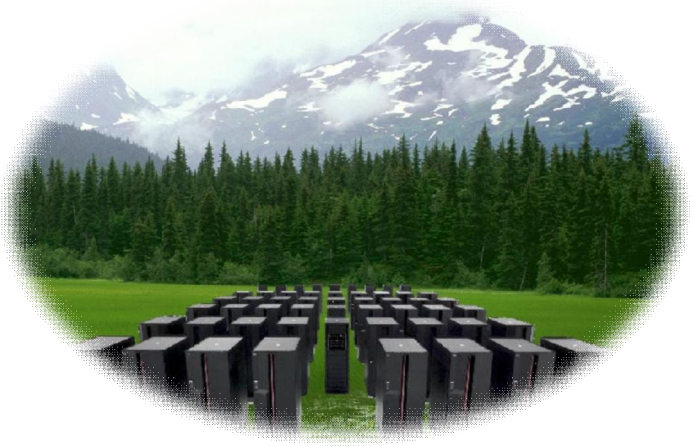
Make the important structural distinction



Specialisation := Instrument

- Specialised HPC and storage architectures.
- Typically *controlled* by bigger VRCs, e.g. the ESFRI kind.

vs.



Consumption := Infrastructure

- General purpose HPC Linux clusters and/or general purpose (slow) storage.
- Typically *used* by smaller R&D communities.

Structural HPC trends

Consumption vs. Specialisation
Infrastructure vs. Instrument

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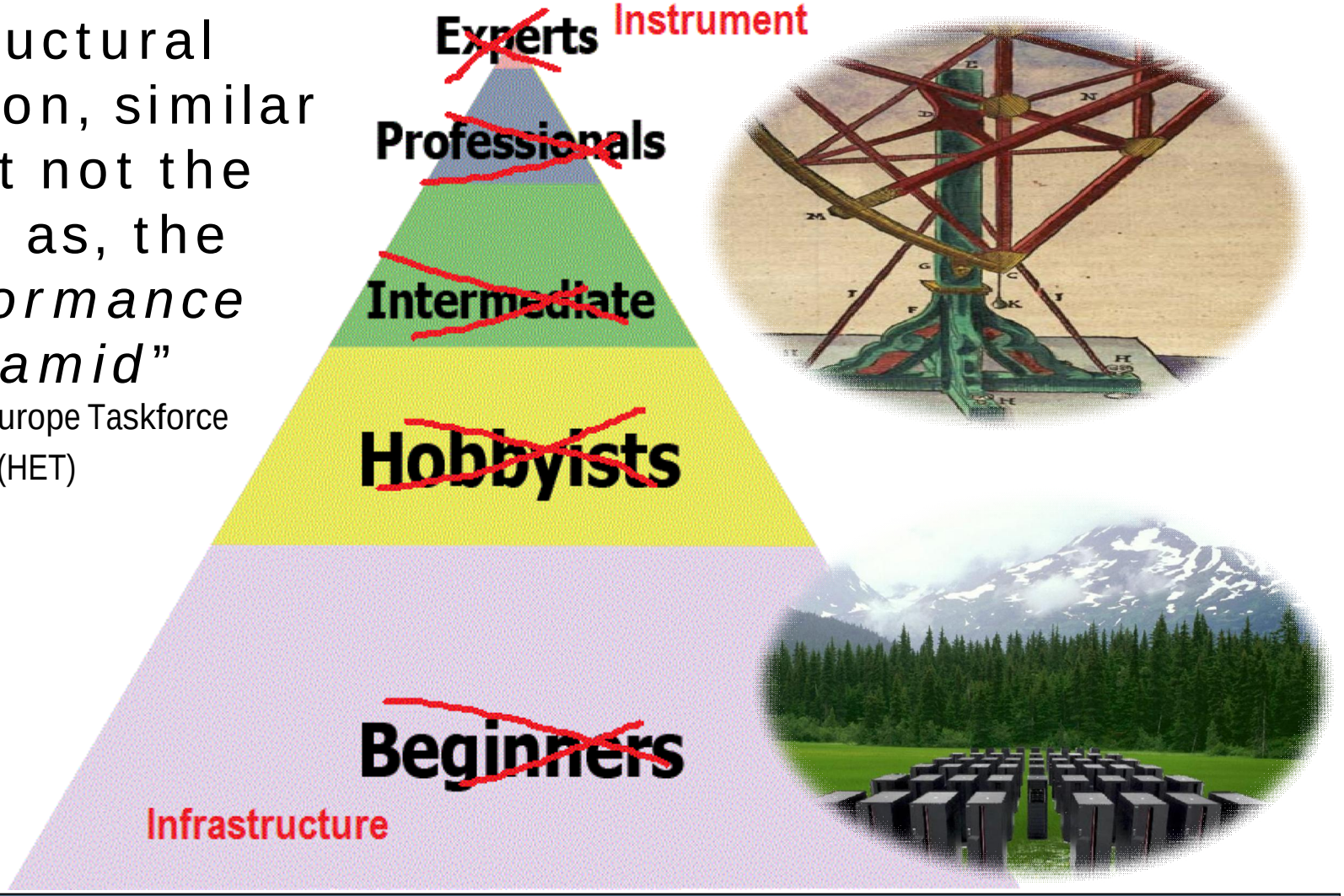
A structural distinction, similar to, but not the same as, the "*Performance Pyramid*"

© HPC in Europe Taskforce (HET)



HPC utilisation trends

Low energy prices - Do we need it?

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HPC utilisation trends

Green Computing - Do we need it?

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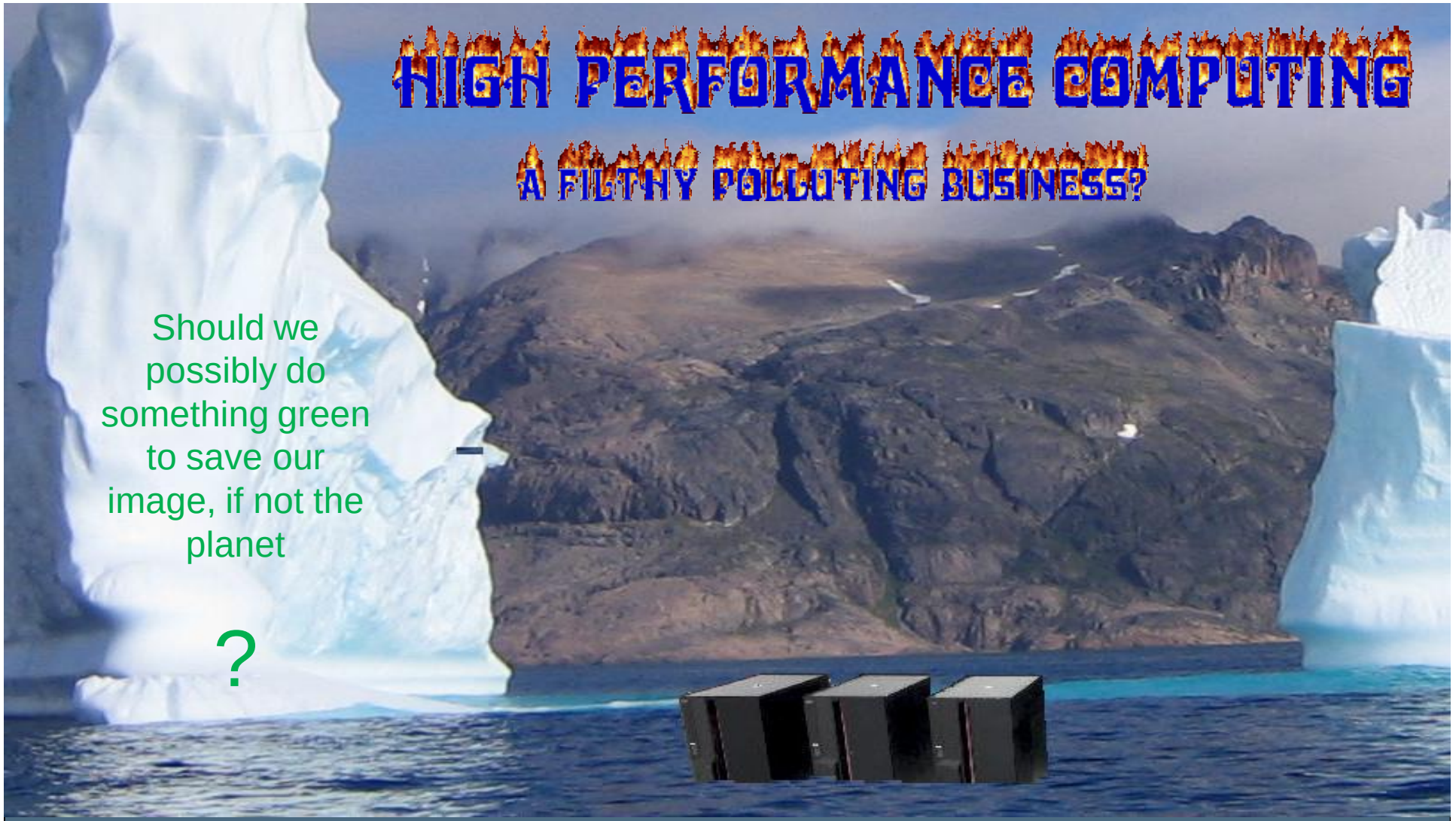

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HPC is a necessary financial and environmental evil !

- So, what can be done ?:
  - Procure more environmentally friendly hardware; Run at lower clock frequency etc; optimise cooling; optimise utilisation (User priority and non-idling); … but namely:
    - Share more, to get higher degree of specialisation and utilisation.
    - Move computing to cheap clean power.
- And, what does it cost ?:
  - A lot (really a lot) – in terms of complex policy issues.

Structural HPC trends

The classical computer centre - Do we need it?

Development significantly slowed due to lake of *Darwinism* among public sector computer centre *monopolies*:

- Small willingness to save cost and increase HPC capacity by resisting specialisation & division of labour.
- Small interest in providing hassle-free no voodoo interface to distant recourse.
- Small advancements in “level of complexity” by not practising proxy HPC, using distributed computing technologies.

- = = > One must note the structural hindrances to improvements, in national as well as European economic competitiveness.
- = = > Research policy makers needs to radically change the classical computer centre set-up (Or possibly just shut them down, since they may be too rigid to change).

Midterm conclusions:

Strategic implementation of more HPC *value for money* and *know-how advancements*

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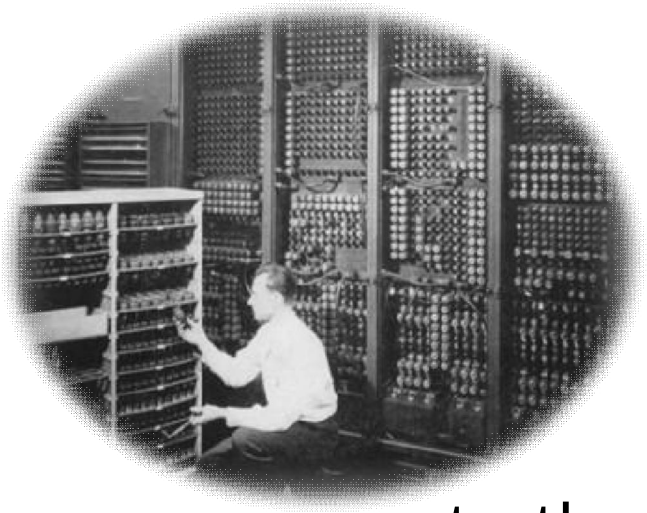

Scandinavian pilot:

One needs to start moving some national HPC (i.e. the consumption infrastructure) from national infrastructure ...,

... to the gobble HPC commodity marked ...,

... So as to get:

A) More HPC value for money.

B) Further advancements in national competence and competitiveness.

Project Partners

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- Swedish National Infrastructure for Computing (SNIC), Sweden.
- Norwegian Research Network (UNINETT Sigma), Norway.
- Danish Center for Scientific Computing (DCSC), Denmark.

Nordic-HPC

Moving HPC to the electricity, as opposed to visa versa.

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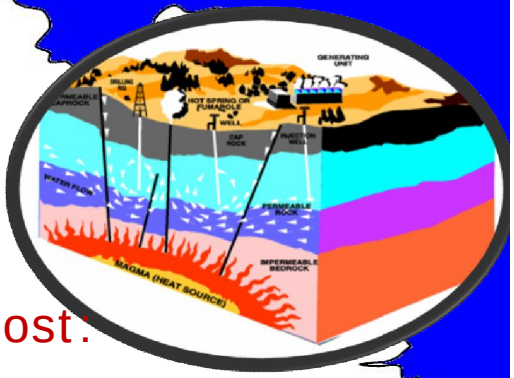
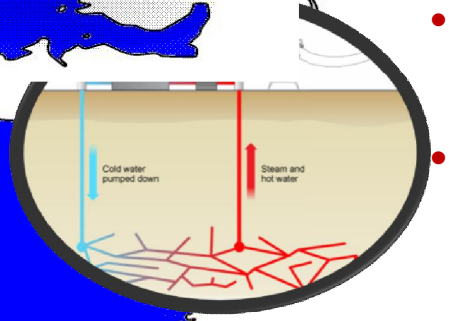
E.g. To Canada, Iceland, Norway .... I.e. Just wherever operations are cheap and clean





Could e.g. Canada or Iceland host:

- A shared Nordic HPC installation ?
- @ close to zero EUR/kWh ?

NORDUnet
Nordic Infrastructure for Research & Education

Our pilot – Nordic-HPC

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- Finance (MEUR 1), share and operate one joint HPC pilot resource.
- Clear rational; clear incentives (in order of priority):
  1. Get more HPC for the same funding – by moving HPC to very cheap energy.
  2. Practice international resource sharing, overcome national policy concerns.
  3. Lean the more advanced distributed computing technology.
  4. Use clean energy .
- Keep it simple – in terms of project scope, duration and stakeholders (few and "*likeminded*" owners).
- Focus on delivering compute cycles, but pilot the challenges – political and administrative as well as technical.
- Admit the disadvantages and challenges, up-front.

Organizational Structure

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- A three year pilot project duration period, focused on Policy
- Steered by a joint Scandinavian board, which decides on *all* matters, based on maturity of cooperation and trust
- Board Issues *Call for Hosting* of its pilot HPC project
- A Scandinavian system-administrator group chooses one of themselves as “leader among equals” (project director).
- Host responsible for daily operations, in agreement with Project director
- HPC installation viewed as a stock company (*anpartsselskab*).
- HPC installation is unified, but usage will be partitioned.
- Owners will receive compute cycles in accordance with the percentage of the project they have financed.

The Incentive Structures Rational
PRO et CONTRA

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Make the *pros* so big that the *cons* are manageable:

The PRO

1. Electricity at VERY low cost ==> More HPC hardware, albeit remote.
   - Very remote electricity difficult to move to where it is needed.
   - HPC hardware, however, can be moved, and so can computational data.
2. Use renewable hydro- and geothermal energy, which is clean and CO_2 neutral.
   - Hydro power and wind power sources in Scandinavia are also CO_2 neutral, but such electricity could alternatively be used for all other purposes.
3. Lean (more) about distributed computing.
   - i.e. advance national competitiveness).

- ==> significantly increased value for money !

The Incentive Structures Rational
PRO et CONTRA

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Be up-front about the *cons,* and focus on managing them.

The CONTRA

1. Developing a mutual understanding of project rational:
   - Policy progressiveness,
   - Scalable savings
   - Management ability,
   - ... and a bit of high-tech.
2. Agree on funding deal, and organisational and management model.
3. Acknowledge that (most) local computer centres despise the concept.
4. Some degree of technical challenges (local staff *tech-pets* in international setting, latency, bandwidth limitations, other unknown).
5. Some degree of managerial challenges (several international owners, sharing resource and staff).

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The CONTRA (continued)

6. Political challenges: Some Scandinavian computer centres might be rendered obsolete by the project rational. Some universities lose argument for having HPC hardware (as opposed to HPC access).
7. Counter actions: Computer centres have influence in universities; universities have influence in governments ==> "*preservation of the old ways, principalities and the jobs*".
8. Policy makers might see "*… lose of competence building and loss of the R&D and business spin-off potential…*"

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Concluding PRO & CONTRA

1. For Scandinavia, the project advantage must be significant, in relation to the rational and its challenges.

2. For project host (country/organisation), the project must be seen as strategic research policy, as well as strategic energy policy.

3. Varied risks analysis, depending on views and philosophy

Concluding PRO et CONTRA *(continued)*

4. Sacrificing competence spin-offs vs. Gaining competence frog leaps

It is like moving from simple textile production ....

... to more advanced (partial) textile production

Thank you for listening

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