The Impact of National Supercomputing in Denmark

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DeiC

> **3 national supercomputers were launched in 2014 & 2015**

	ABACUS 2.0	*COMPUTEROME*	*KAC*
Host/Location	Southern University of Denmark, Odense (SDU)	Technical University of Denmark, Lyngby (DTU)	Royal Danish Library, Aarhus (KB)
Cores Storage	14,000 CPU 1 PB	19,000 CPU 8 PB	<500 CPU 0.1 PB
Access model	Pay-per-use	Pay-per-use Subscription model	Subscription model

The Paradigme shift in Denmark & its challenges

> Universities: trust on external ownership of compute resources

> Computing/IT support: slow inclusion of national compute resources

> Researchers: going from invisibility to visibility of compute resources in their research budgets

> The 3 hosts of national supercomputers: must ensure fast sustainability due to the short lifetime of HW – 3 pay model approaches:
  – ABACUS: pay per use (up front) – allocation of compute time – (a la the the payment model of PRACE)
  – Computerome: proof-of-concept approach – test – create the job and then pay!
  – Cultural Heritage Cluster: Subscription model with dedicated technical support

> **However! What is the scientific impact after 3-4 years with national supercomputing in Denmark?**

> **Bibliographic Landscape**
>> * Nordic: WLCG Tier-1; Commercial HPC: Amazon, Azure etc.

PRACE

Commercial

DeiC
National
HPC

Nordic

Local HPC

No HPC
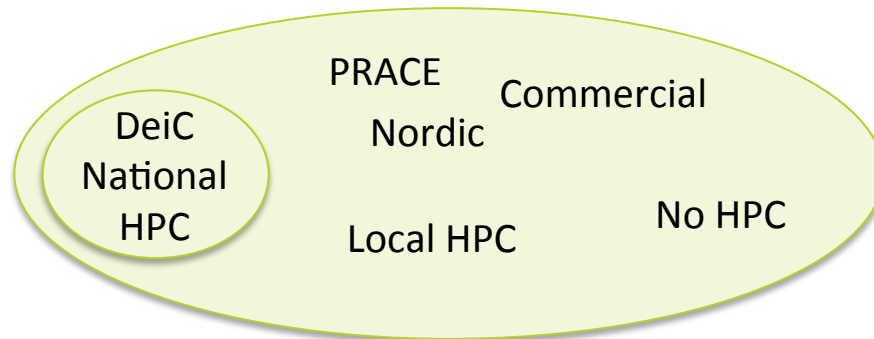
~ 23,000/year
Total pub. DK
(Forskningsbarometret 2017)

This study:
Peer-reviewed publications that included
ABACUS 2.0 or COMPUTEROME

Search for Scientific Papers

- Who have Included DeiC National HPC in Danish Peer-Reviewed Research ?

- What can we measure?

List of Projects /
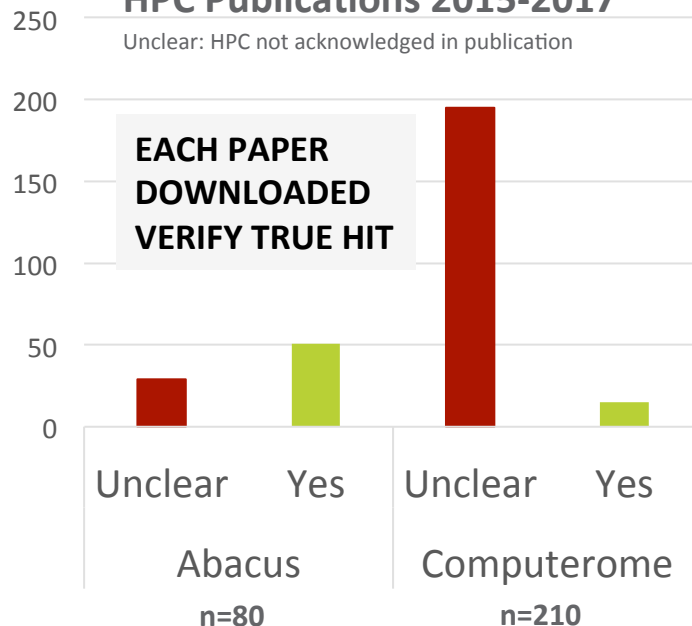Researchers using HPC
**DIRECT CONTACT
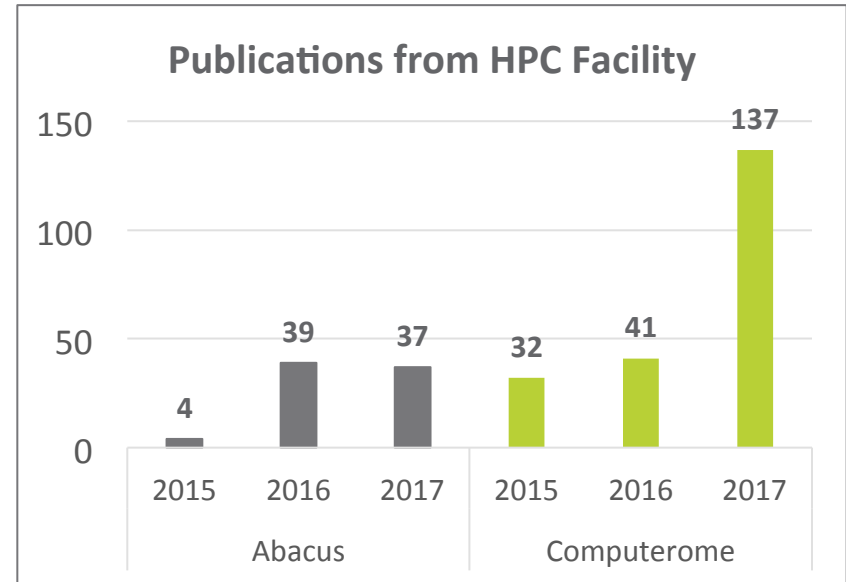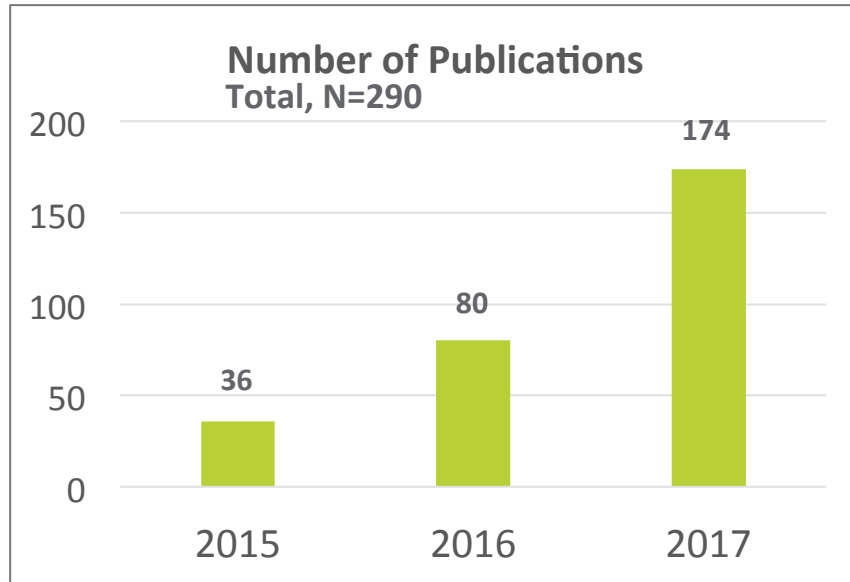TO USERS (Verification)**
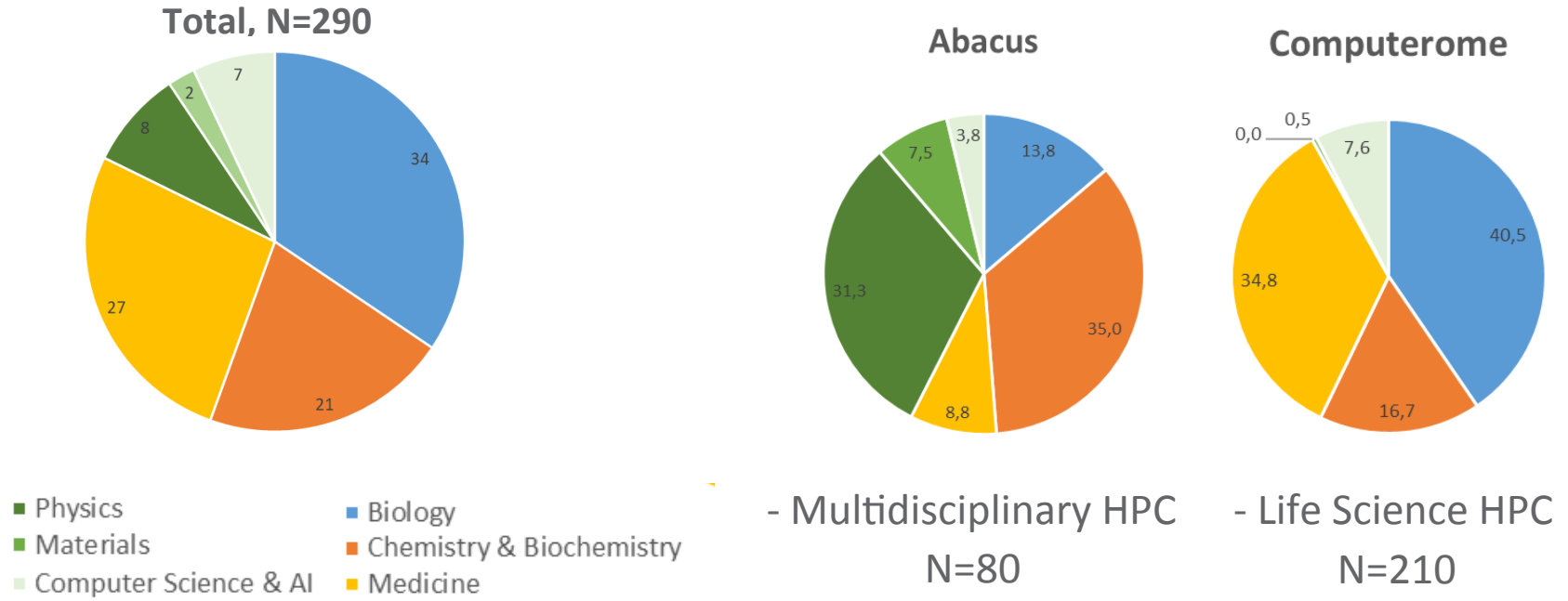
Web of Science

Google Scholar

HPC Publications 2015-2017

Unclear: HPC not acknowledged in publication

**EACH PAPER
DOWNLOADED
VERIFY TRUE HIT**

	Abacus		Computerome
Unclear	Yes	Unclear	Yes

n=80

n=210

> **Scientific Papers – Numbers Doubled Every Year**

Number of Publications
Total, N=290

- 2015: 36
- 2016: 80
- 2017: 174

Publications from HPC Facility

Abacus
- 2015: 4
- 2016: 39
- 2017: 37

Computerome
- 2015: 32
- 2016: 41
- 2017: 137

> ## Scientific Papers – Category 2015-2017 (% Distribution)

Total, N=290

Abacus

Computerome

- Multidisciplinary HPC
  N=80

- Life Science HPC
  N=210

- Physics
- Materials
- Computer Science & AI
- Biology
- Chemistry & Biochemistry
- Medicine

> 290 Scientific Papers in 160 Different Journals !

- Diverse Landscape ☺

- 11% are published in **Nature-Series or Science** in the period 2015-2017 – 2.8% in Nature (n=8).

Factor 10!

- DK 2012-2016: 195 Nature papers Corresponds to 0.2% (Total N= 111,805)

Journal for publication that included national HPC	Count	JIF
Nature Reviews Drug Discovery	1	57.000
Nature Biotechnology	1	41.667
Nature Reviews Genetics	1	40.282
Nature	8	40.137
Science	1	37.205
Nature Genetics	4	27.959
Nature Methods	2	25.062
Nature Cell Biology	1	20.060
Nature Structural & Molecular Biology	2	12.595
Nature Communications	9	12.124
Nature Microbiology	2	-
	32	

#	Artikler med forfattere fra det pågældende land		Artikler per mio. ind-byggere	
1	USA	3.675	Island	67,3
2	Storbritannien	1.147	Schweiz	50,0
3	Tyskland	928	Danmark	34,5
4	Frankrig	550	Sverige	23,3
5	Canada	435	Holland	20,9
6	Schweiz	412	Estland	19,8
7	Australien	394	Finland	17,9
8	Holland	354	Storbritannien	17,7
9	Japan	341	Norge	17,0
10	Spanien	277	Israel	16,9
11	Sverige	227	Australien	16,6
12	Italien	225	Østrig	15,9
13	Danmark	195	Belgien	13,6

Tabel 2.8
Publikationer i Nature, OECD, 2012-2016

2017
Årlig statistik og analyse om forskning og innovation

Februar, 2018
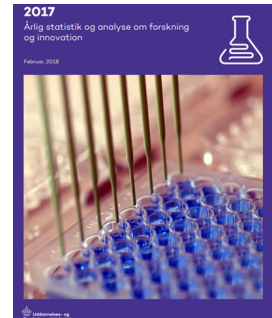
Forskningsbarometeret 2017, side 54
Styrelsen for Forskning og Uddannelse

> Scientific Papers – Ranking (JIF)

Journal Impact Factor (Average)

n= 4 32 39 41 37 137
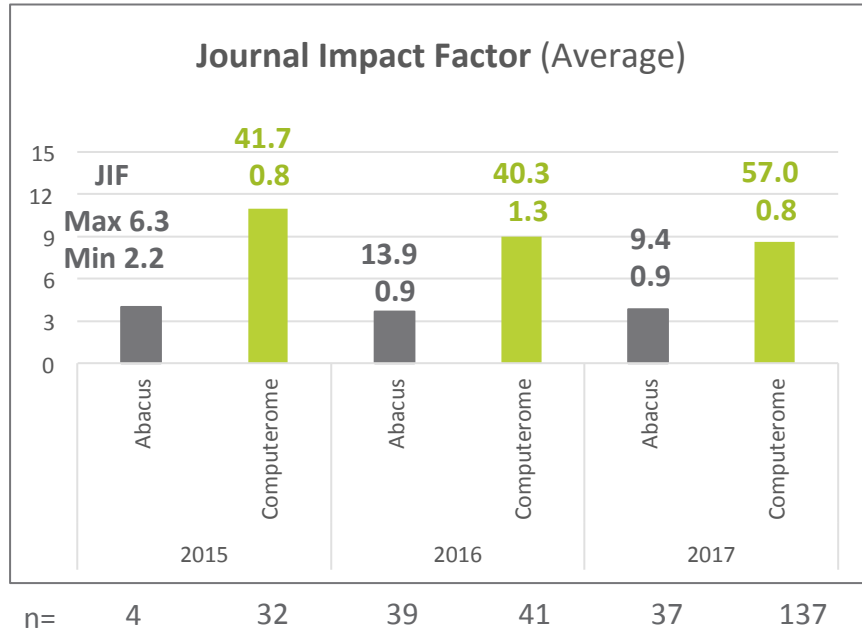
Total, N=290

JIF Interval	n Pub	Average JIF in the interval	% Pub
0-2.49	43	2	15
2.5-4.99	117	**4**	**40**
>5	130	13	**45**

- **JIF overall range: 0,9-57**
- **45%** of the HPC publications have a JIF > 5

> **Scientific Papers – National Collaboration**

2015-2017 University	(206)* Without National Collaboration	(84)** With National Collaboration	Total
KU	80	76	156
DTU	49	65	114
SDU	72	13	85
AU	1	25	26
ITU	3	0	3
RUC	0	3	3
AAU	1	1	2
CBS	0	0	0

* May include international collaboration or with industry.
** Collaboration with other Danish University

**84 publications ** The same publication in this overview figures several times in the counts (4 universities: 4 times…. etc.)

- 67% of the HPC publications included international collaboration
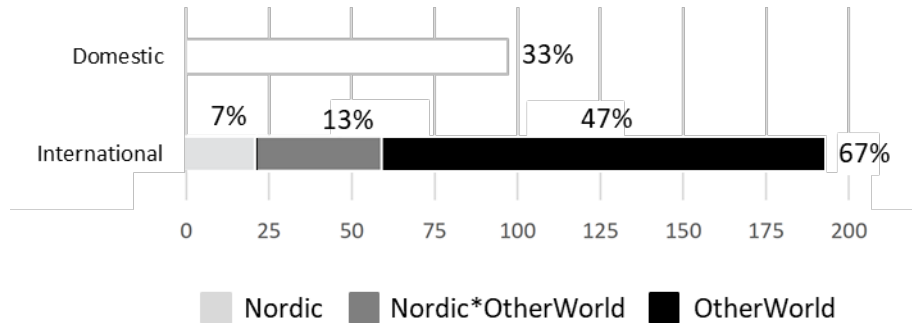
Number of 290 scientific publications that included international collaboration using DeiC National HPC from 2015 to 2017.

- 58% of total DK publications included international collaboration (#7)

Figur 2.8
Andel af publikationer, som er internationalt sampublicerede, OECD, 2012-2016
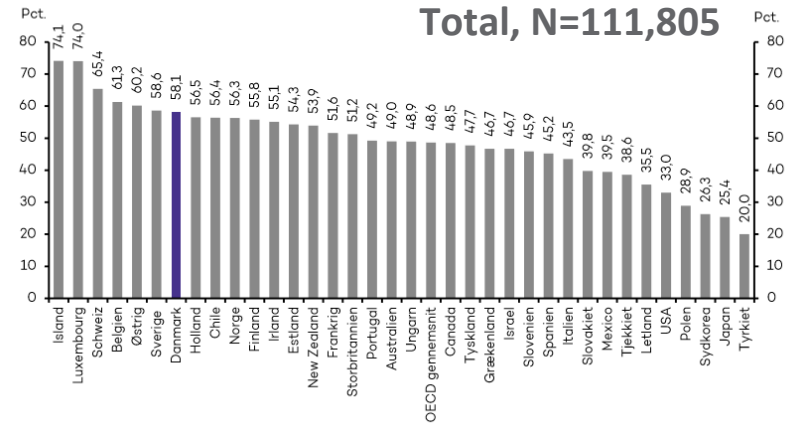
Total, N=111,805

Forskningsbarometeret 2017. Årlig statistik og analyse om forskning og innovation, side 58
Styrelsen for Forskning og Uddannelse

- 8 % of the HPC publications included Industry (27% Incl. Hospitals, SSI)
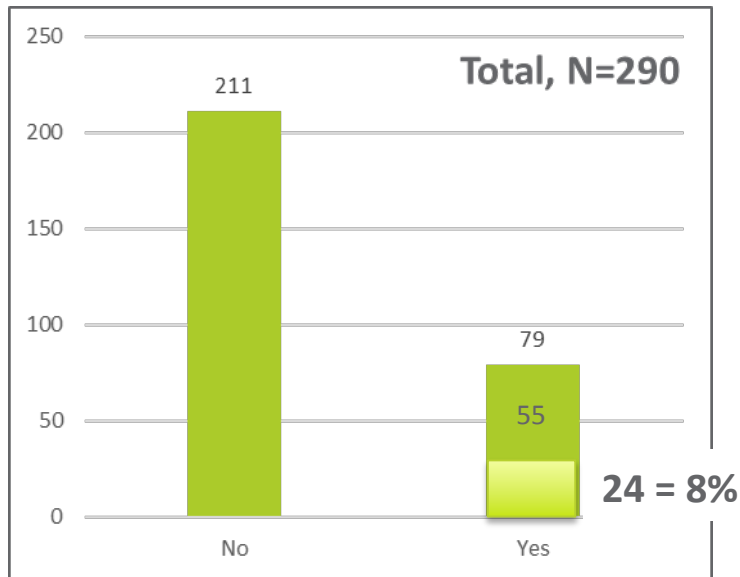
- 6.5 % of total DK publications included Industrial collaboration (#1)

Figur 2.9
Andel af publikationer, som er sampubliceret med erhvervslivet OECD, 2012-2016
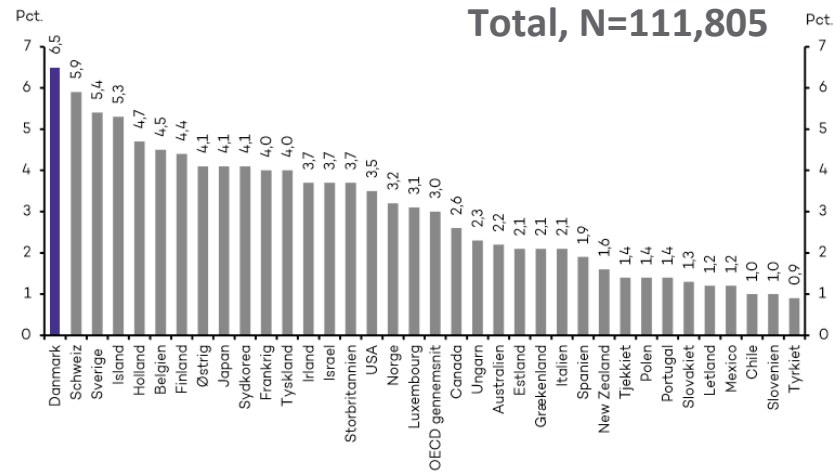
Forskningsbarometeret 2017. Årlig statistik og analyse om forskning og innovation, side 59
Styrelsen for Forskning og Uddannelse

DeiC > ONLINE Registration formula

National eScience Portal
https://vidensportal.deic.dk/da/publikationer
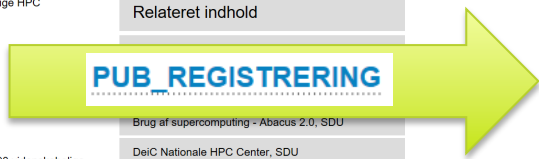
> Conclusions

- High ranking/quality science have used national supercomputing

- The research that included DeiC national HPC had a higher rate of publications in "Nature" compared to the overall DK analysis in "Forskningsbarometret 2017"

- The HPC-architectures reflect the intended strategical vision on scientific distribution **Abacus:** Multidisciplinary -- **Computerome:** Life Sciences

- High degree of collaboration (National, International, Industry) – Competence sharing

- WHO – 290 publications: https://vidensportal.deic.dk/da/publikationer

- Conf paper: "National Supercomputing in Denmark", MIPRO2018

> **What have we learned throughout the process of integrating national supercomputing in Denmark**

> 3 financial independent national supercomputing facilities, have resulted in 3 different access & support points, 3 different payment models, 3 different success rates

> DeiC works with virtual and part time/free commitment, i.e. small in staff – large in network – hence slow processes, however, aligned and strong in engagement into target communities throughout our 8 universities

> New and inexperienced HPC users should have free access in order to inspire young researchers and integrate awareness and skills

> It is a low-cost model approach – sustainability without continuous national funding is an issue!