Operation of the K computer and the facility

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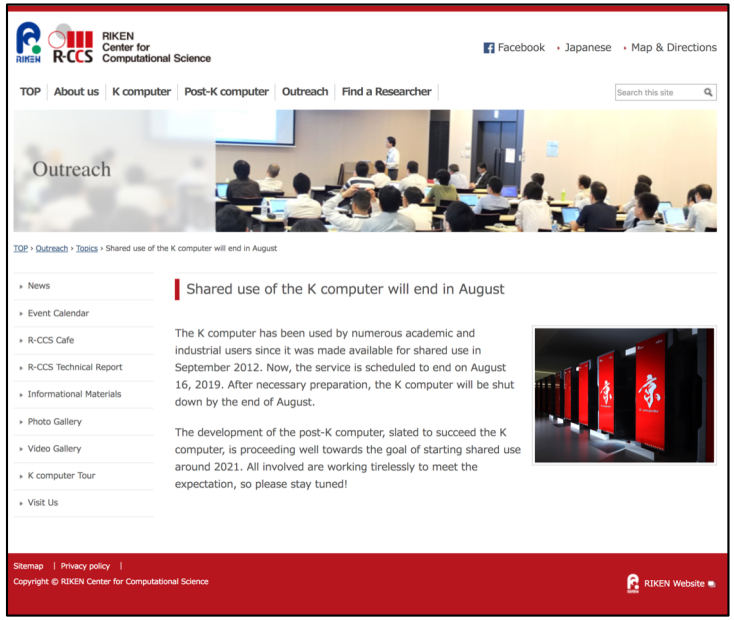
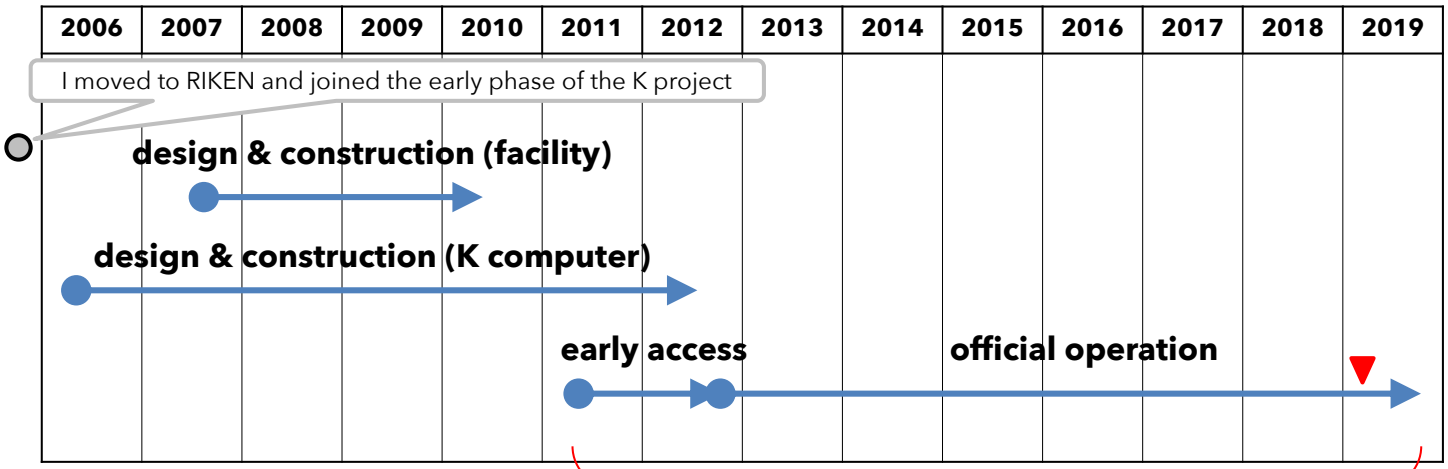
An announcement of the K computer's shutdown

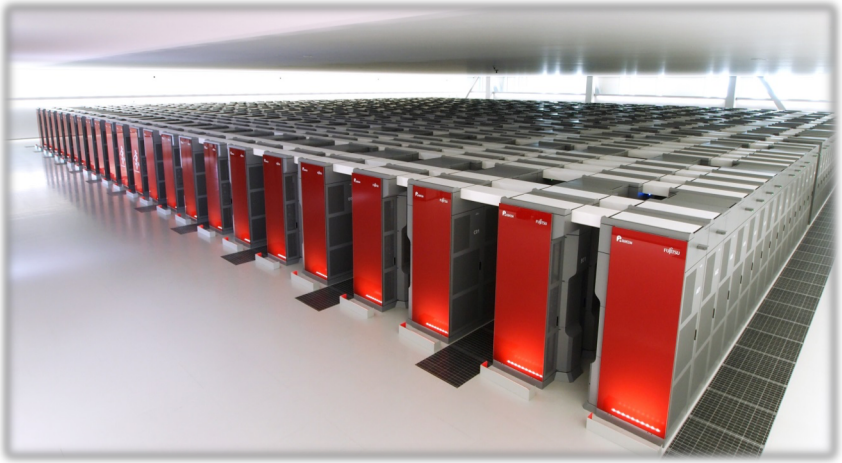
2019/1/31 https://www.r-ccs.riken.jp/en/topics/20190131.html





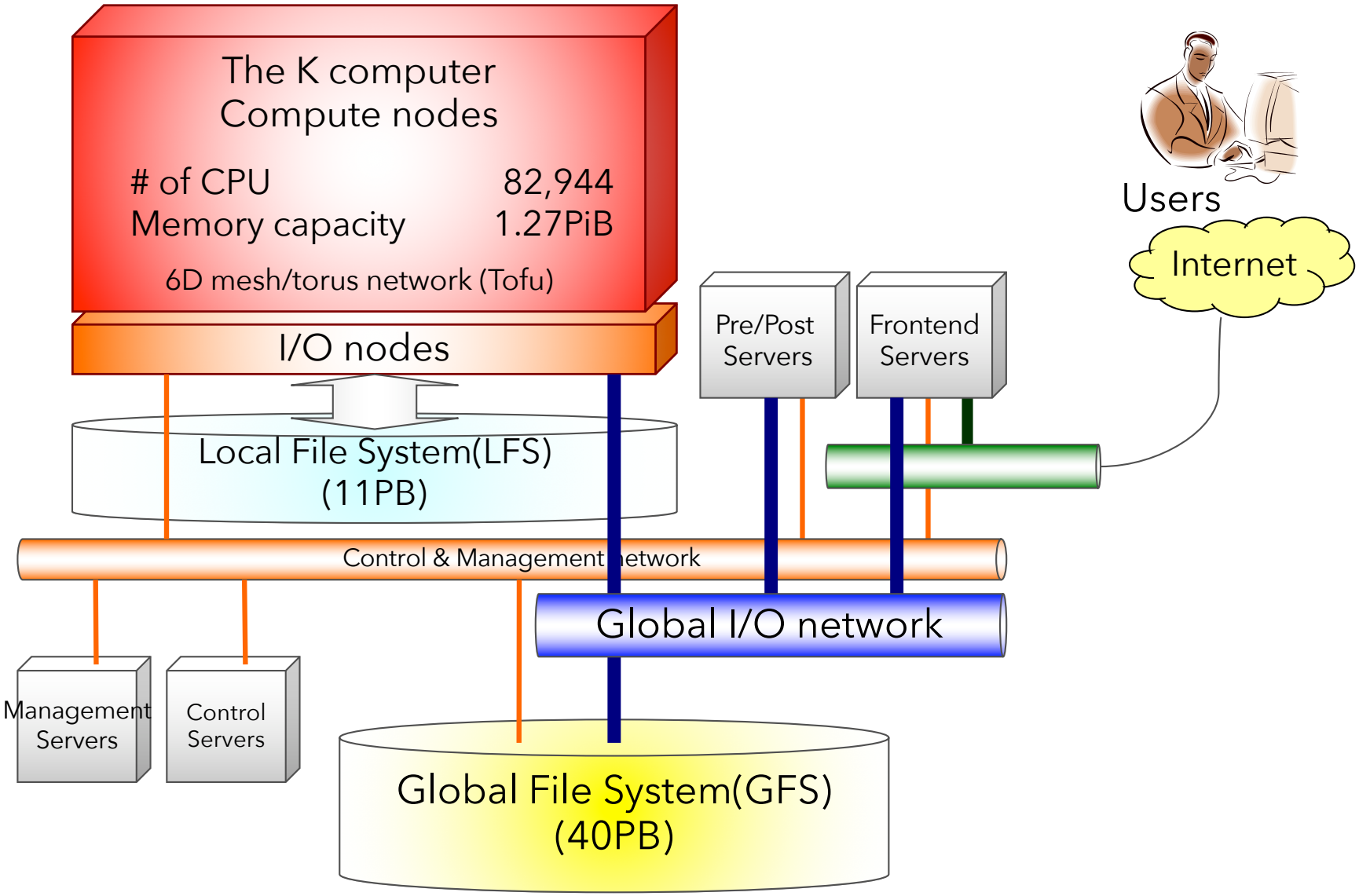
K computer and achievements

- **The K computer:**
  - developed by collaboration between RIKEN and FUJITSU in a Japanese national project.
  - designed to aim for a general-purpose computing.
    - no accelerators
    - broad memory/interconnect bandwidth



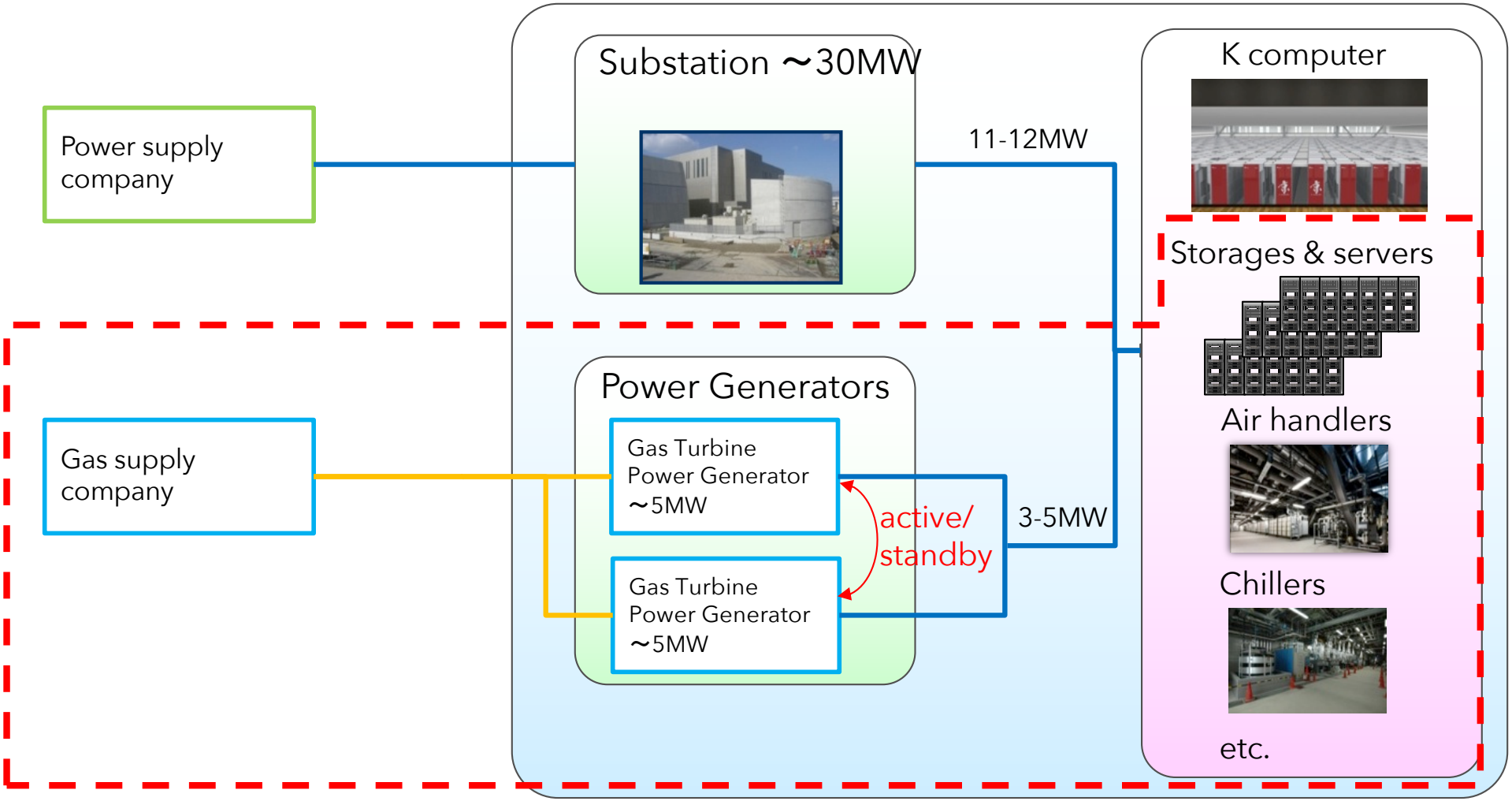
- **Achievements:**
  - TOP500 list :No.1 at Jun. and Nov. 2011.(#18 in the latest list)
    - The world's first supercomputer achieved over 10PF HPL performance.
  - Graph500 list :No.1 at Jun. 2014, Jul. 2015 – Nov. 2018.
  - HPCG results :No.1 in Nov. 2016 – Nov. 2017.(#3 in the latest list)
  - Gordon Bell prize :Winner in 2011 and 2012
  - The other remarkable results for science and engineering
    - See http://www.r-ccs.riken.jp/en/

System overview

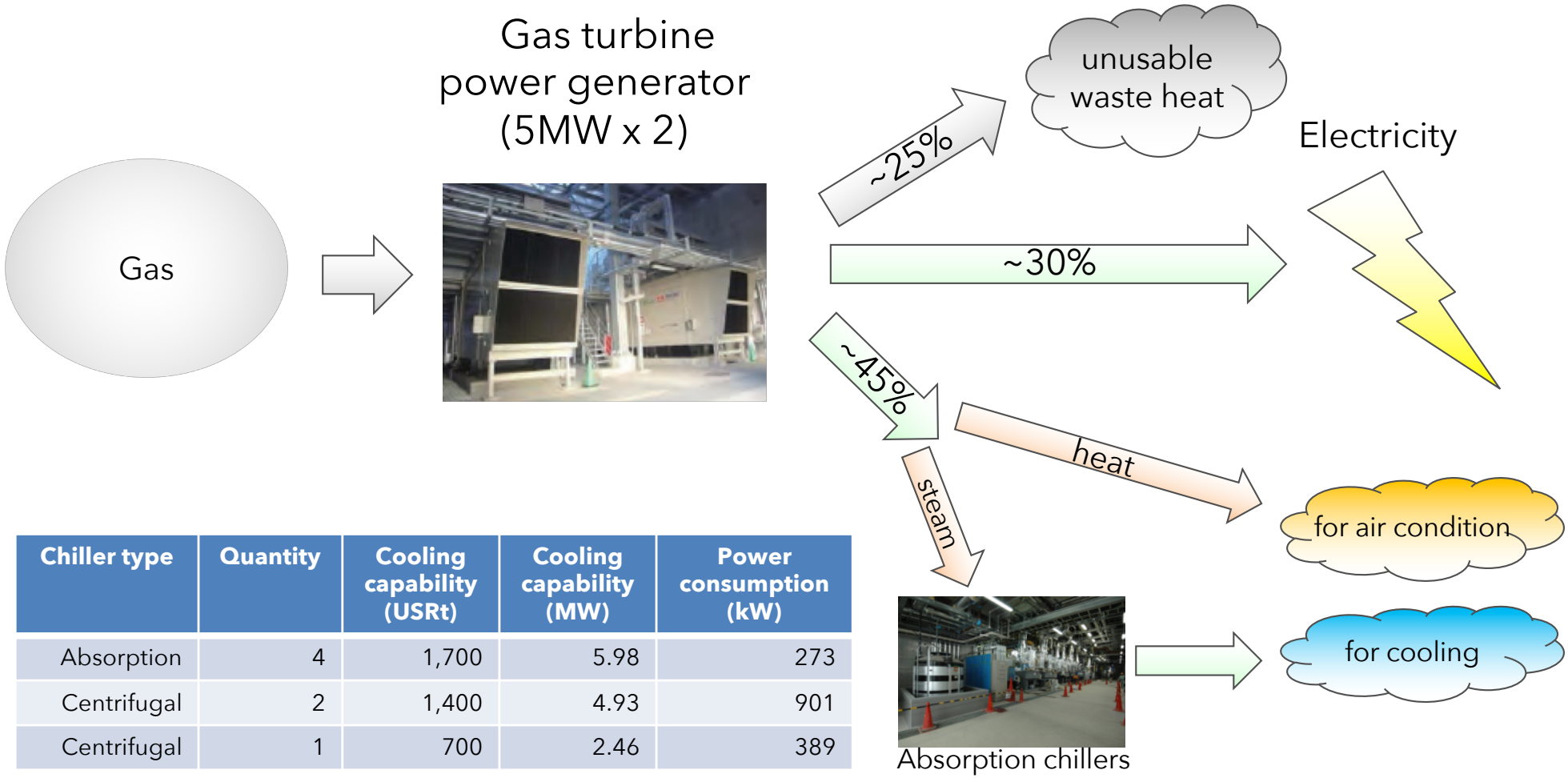


Facility overview (power supply)

Total power consumption:14-16MW



Facility overview (Co-generation system)



Chiller type	Quantity	Cooling capability (USRt)	Cooling capability (MW)	Power consumption (kW)
Absorption	4	1,700	5.98	273
Centrifugal	2	1,400	4.93	901
Centrifugal	1	700	2.46	389

Co-generation system enables to achieve higher energy efficiency
On the other hand, due to tight connection between power generator and chiller, facility operation is much more complicated.

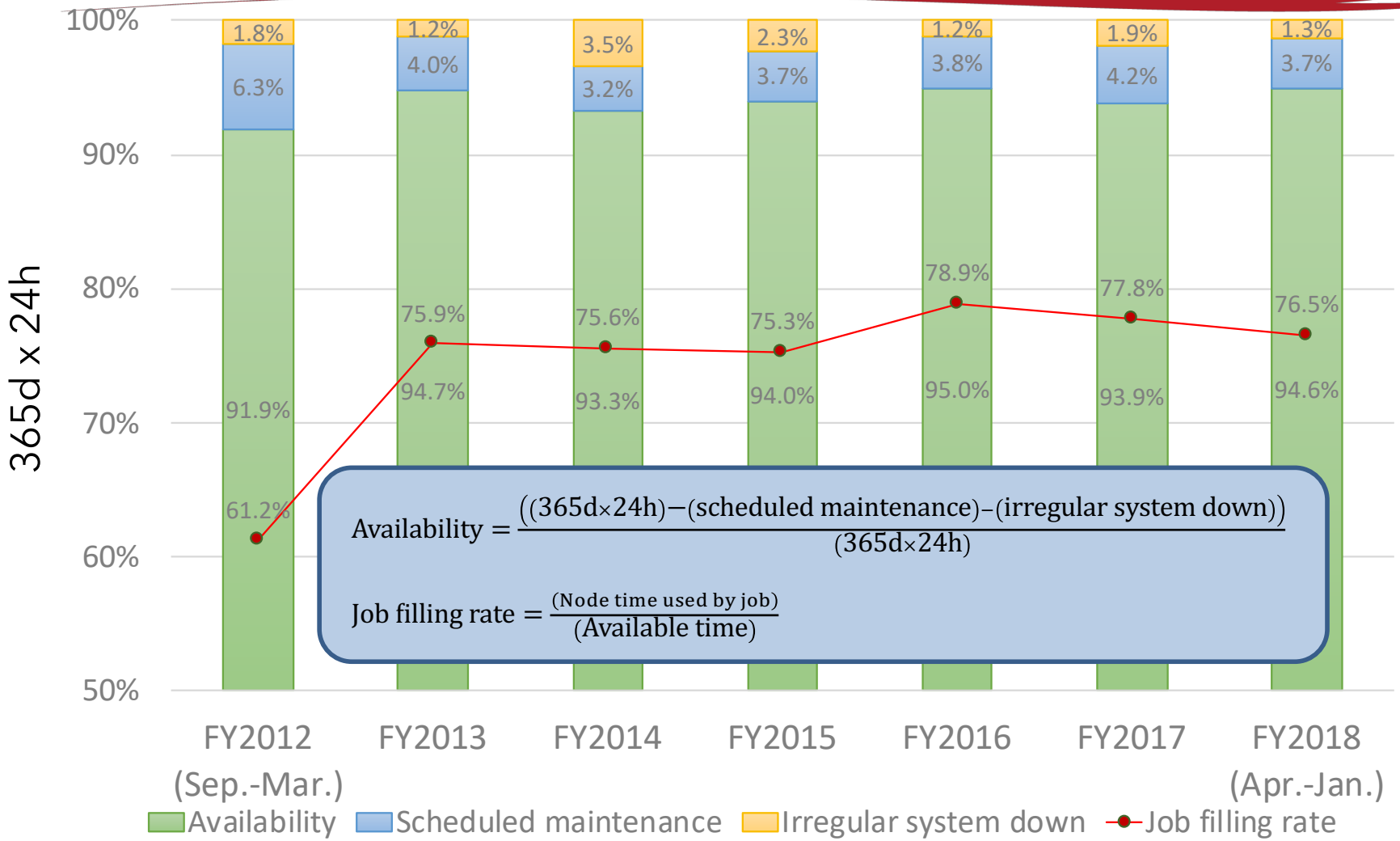
Statistics

2012/9/28 – 2019/2/3 (6 years and 4 months)

# of projects	**649**
# of (real) users	**3,570**
# of processed jobs	**3,491,472**
Total used Node Hours	**3,389,123,489(*)**

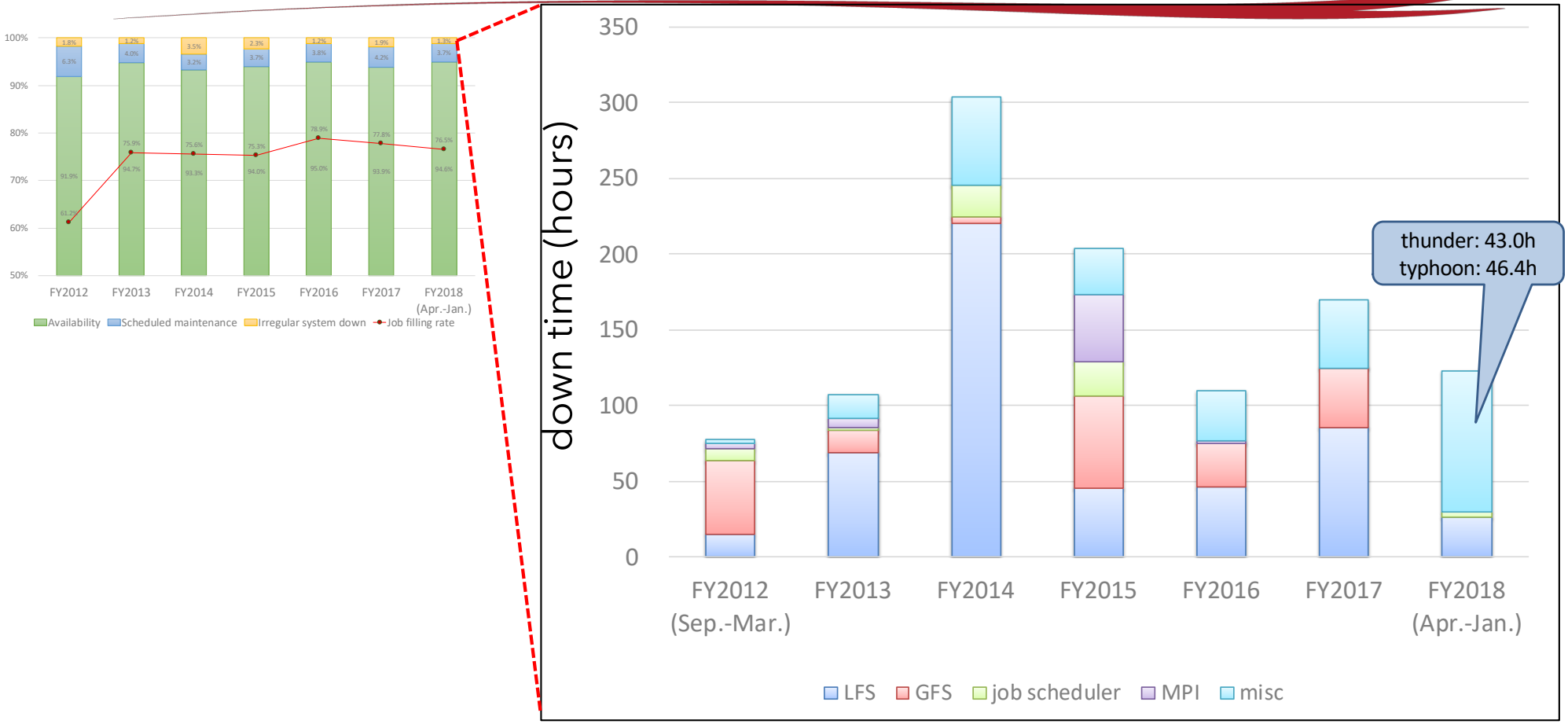
(*) 73.5% for 6years4months

Yearly availability & job filling rate



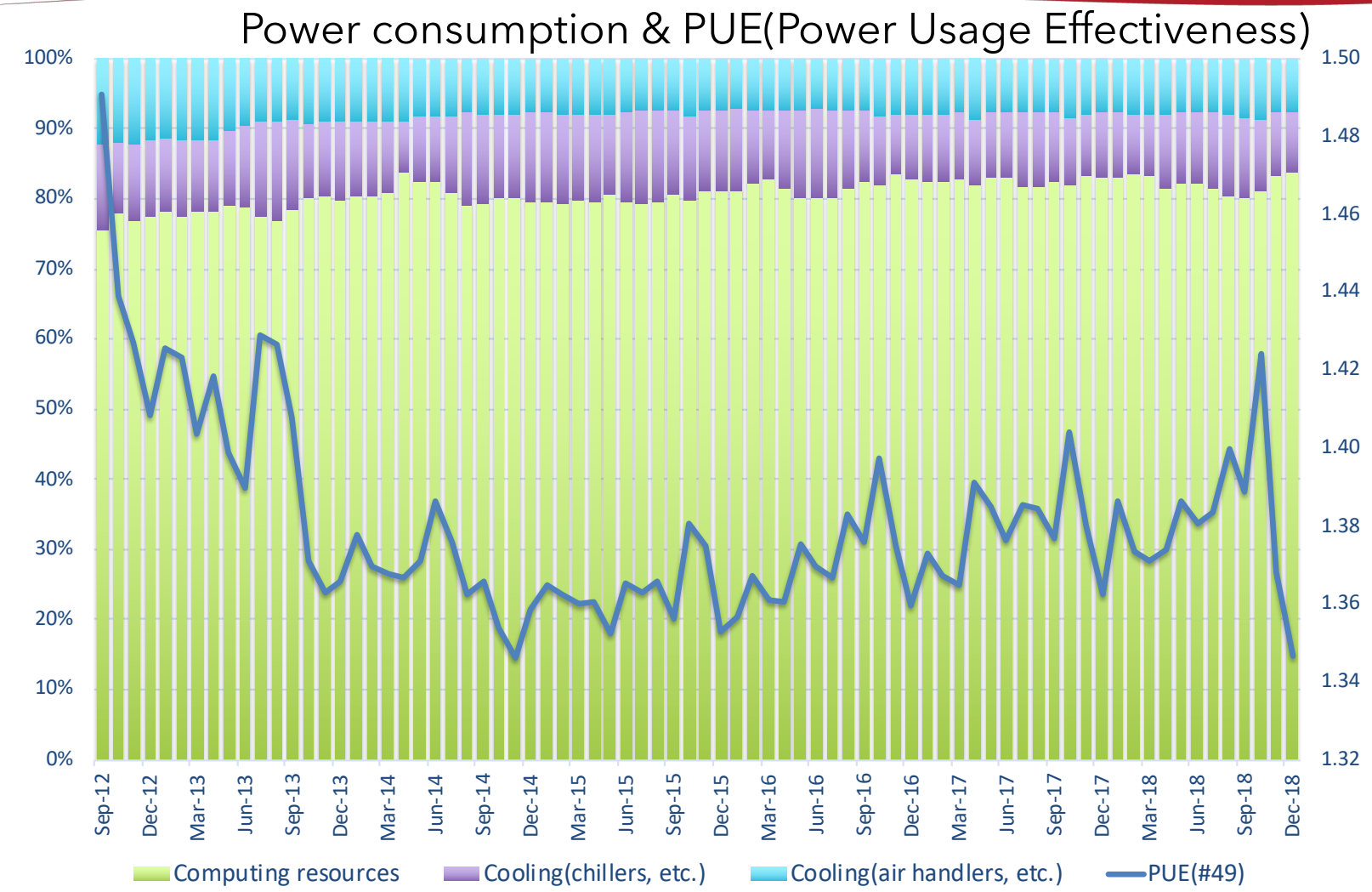
- Availability rate higher level (~95%)
- Irregular system down is suppressed to less than 2% in the last 3 years
- Considering that direct interconnection between nodes and a block-wise job allocation, job filling rate is at a sufficiently higher level.

Irregular system down



- File system failures (GFS & LFS) are dominant irregular system down
- We changed our mind to give priority to resuming service earlier than investigating the cause of failures since FY2015.
- Misc. in FY2018 includes failure of power supply facility due to terrible rain and wind by typhoon (8/20) and power outage by thunder (6/8).

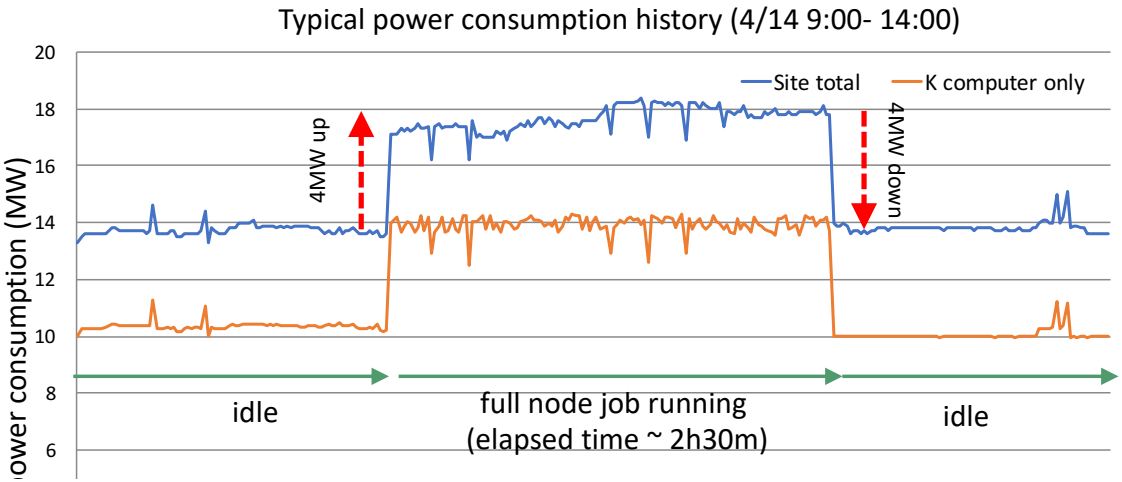
Improvements (PUE)



- Optimization of air cooling operation (2012-2013)
- Optimization of power generator and chillers (2018-)

Improvements (Power capping)

To avoid penalty when power consumption exceeds the upper limit



- **<u>Preview process for large scale job (more than 40% of full system):</u>**
  - User who want to execute large scale job must execute a small version (10% of full system) of the large scale job before large scale mode period.
  - We evaluate the power consumption profile of the job and estimate the upper power consumption and decide to admit to execute the job or not.

- **<u>Prepare large power consumption:</u>**
  - If the estimated power consumption exceed the limit, we also consider to activate 2nd power generator during the job is running.

- **<u>Safety valve:</u>**
  - If power consumption excess occur unfortunately, the monitoring system will work and the job will be killed automatically.

Improvements (others)

- **for active user support**
  - based on data analysis of automatically corrected job profiling data, user support team can identify and approach users who have potential of performance improvement.
- **"micro" queue**
  - job queue for small job to fill spatial and temporal scheduling gap.
- **"Waiting for K"**
  - command which provides estimated waiting time between submit to run.
- **"ksub"**
  - command which allow to submit many jobs larger than system limit.
- **"K pre-post cloud"**
  - An OpenStack based pre-post environment for various user needs
- **"R-CCS software center"**
  - An activity to support development and promotion of outstanding software made in R-CCS.
- etc.

Towards to operation/services of Post-K

- **Increase an effective usage rate**
  - to increase job filling rate +10%, we should consider rational node allocation and “charge” roles
  - to increase availability and decrease PUE, we have to improve efficiency and quality of the operation by including automation based on data analysis
- **Improve service quality**
  - commit to construct software eco-system
  - collaborate with service providers

We are now discussing about operation of Post-K

Numerous users/projects from various fields of science and engineering come to Post-K

Thank you for your attention