

# DENERGIUM

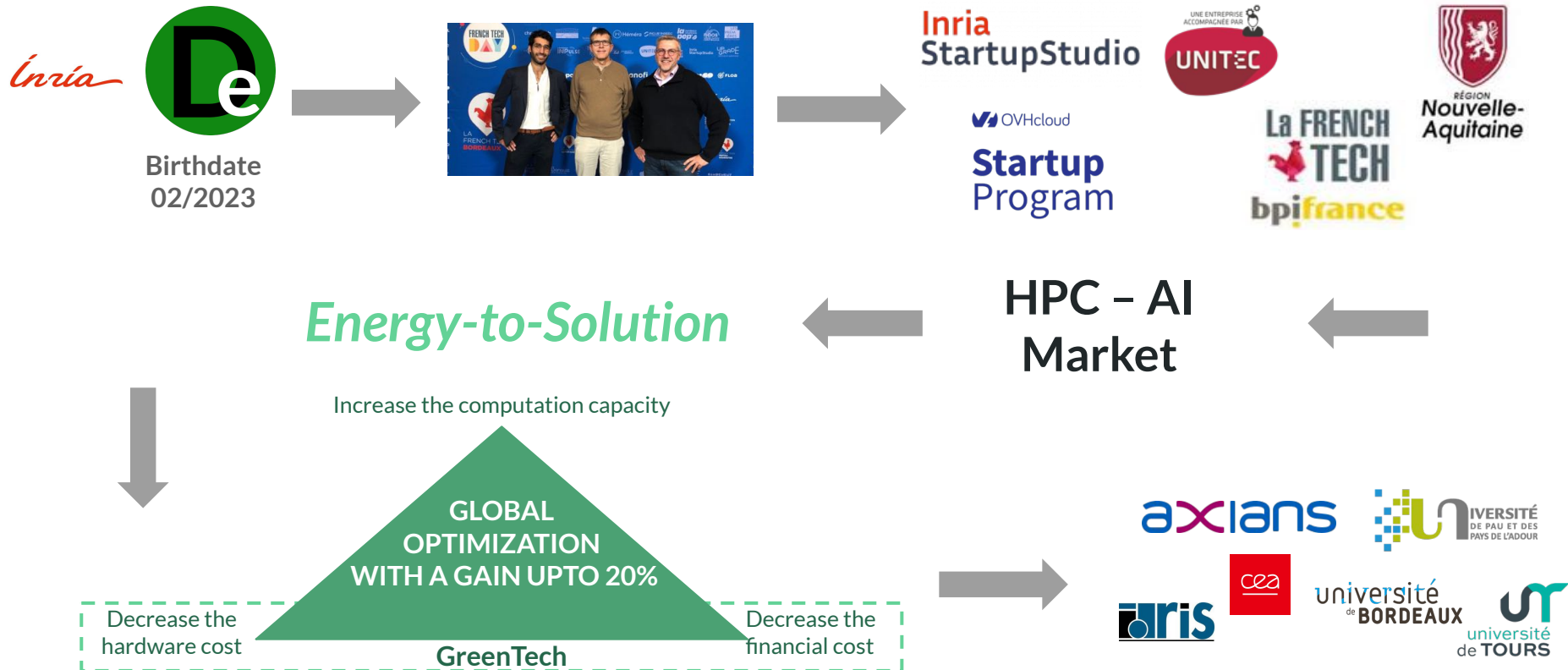
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Digital Energy Optimum

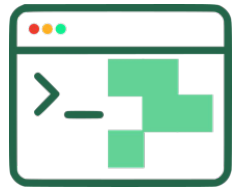
HPC-AI computation optimization  
based on the energy criterion

GREENDAYS 2024

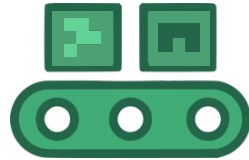
# The DENERGIUM summary



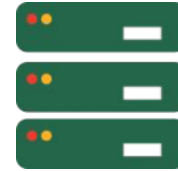
# The HPC-IA workflow



Applications



cluster management and job  
scheduling system

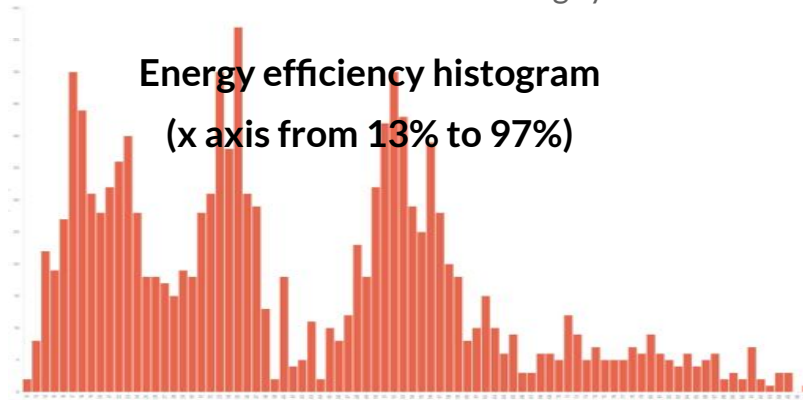
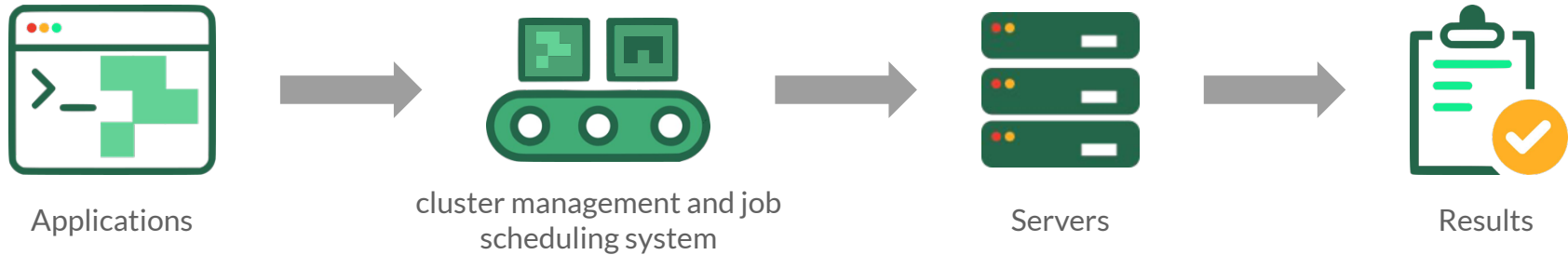


Servers



Results

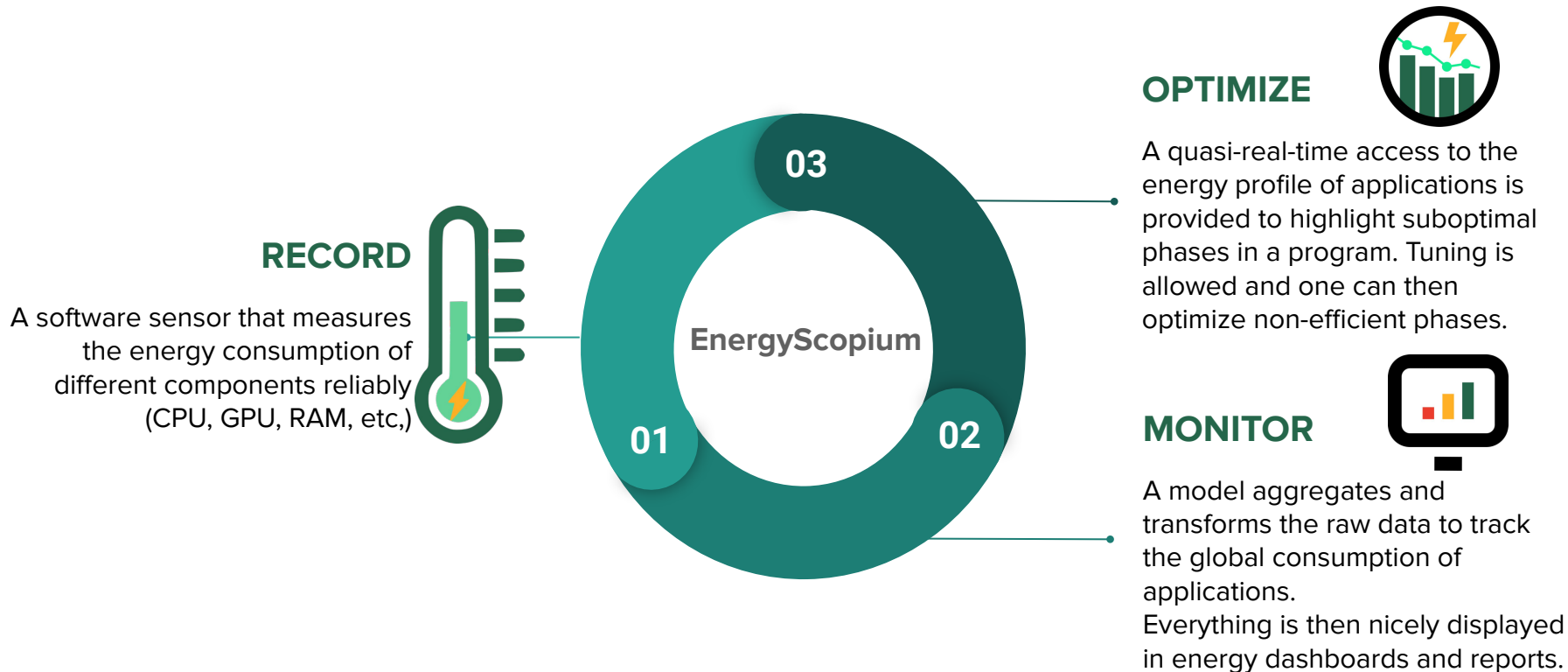
# The HPC-IA workflow



**Energy efficiency gauge of computing nodes**



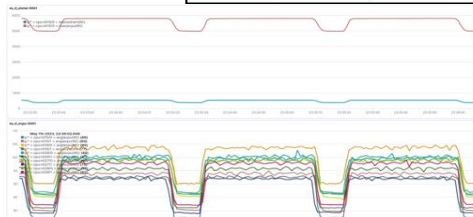
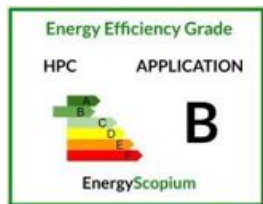
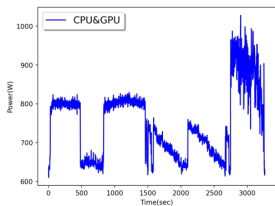
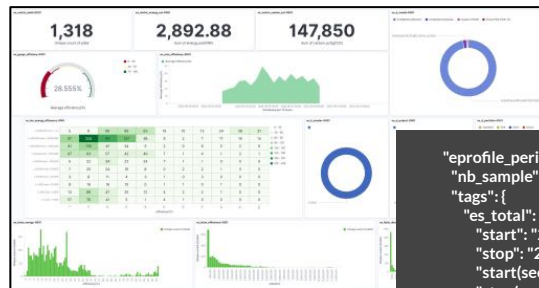
# The EnergyScopium Software Suite



# EnergyScopium for users and developers

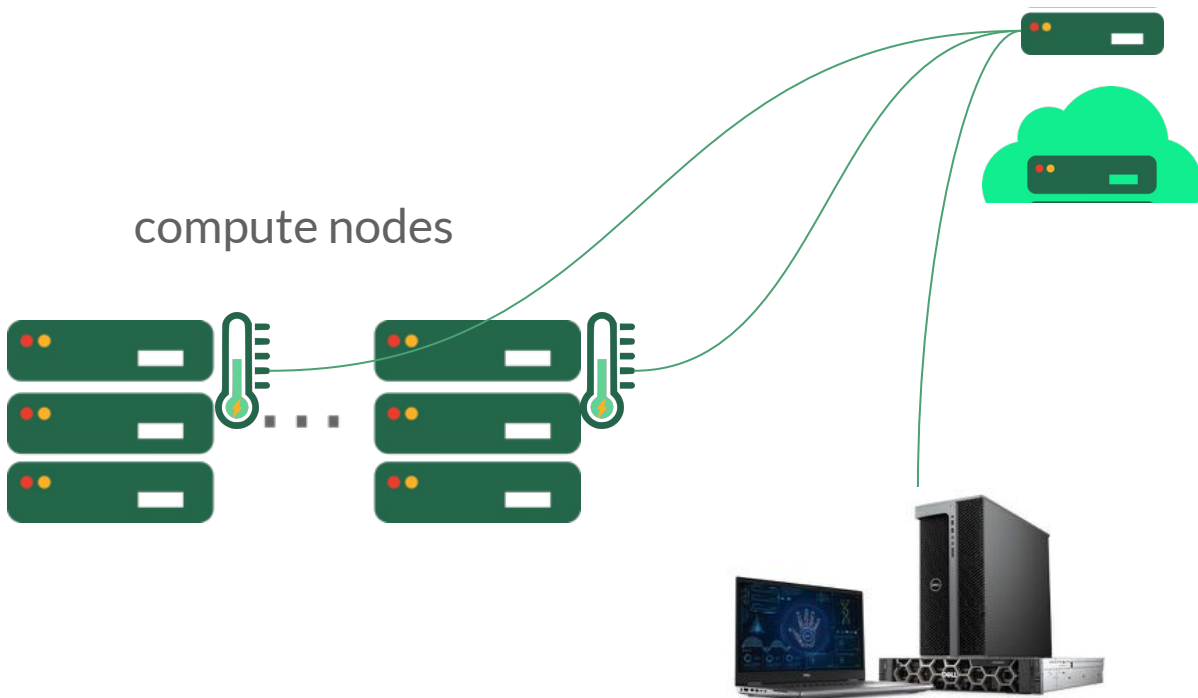


```
energyscopium jobid<10166268> nodes<['n231', 'n313']>  
ncpus <64> duration(hour)<22.51> estimated  
energy(kWh)<10.58> with adding cooling (PUE=1.3):  
(kWh)<13.76> and (gCO2 in FR)<687.78>
```



```
"eprofile_period(ms)": 1000,  
"nb_sample": 61,  
"tags": {  
  "es_total": {  
    "start": "2023-03-13T23:59:50",  
    "stop": "2023-03-14T00:00:50",  
    "start(sec)": 0,  
    "stop(sec)": 60,  
    "joule(J)": 180.97  
  }  
},  
"etotal(W)": [  
  2.72,  
  2.97,  
  2.94,
```

# How EnergyScopium works?



Virtual Machine

Supported HW:  
Intel, AMD Epyc,  
Nvidia GPU,  
AMD GPU

# Optimization strategy

**Application**

**Server**

**Cluster**

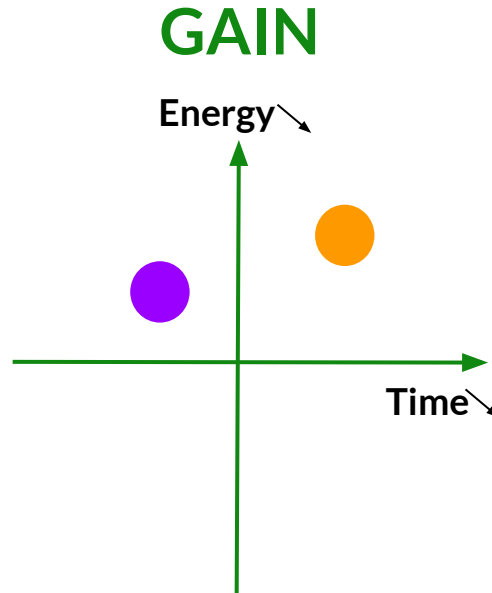


# Optimization strategy

Application

Server

Cluster



# Optimization strategy

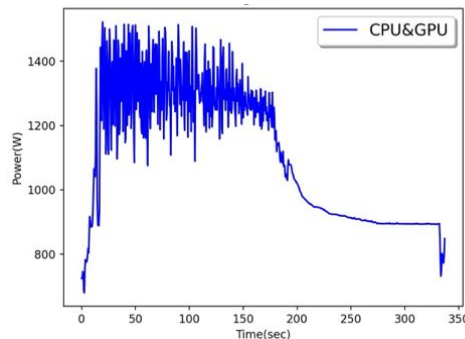
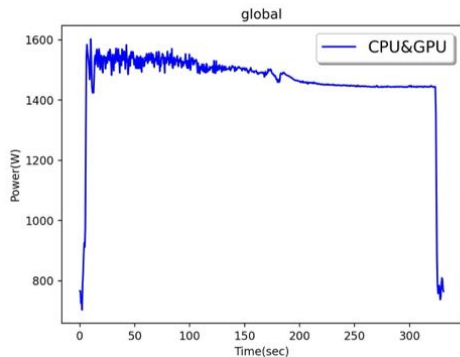
Application

Server

Cluster



Same application result  
Almost same duration (+2%)  
Energy savings (-22%)



# Optimization strategy

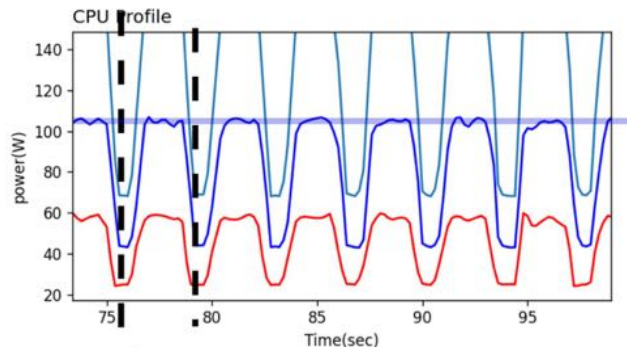
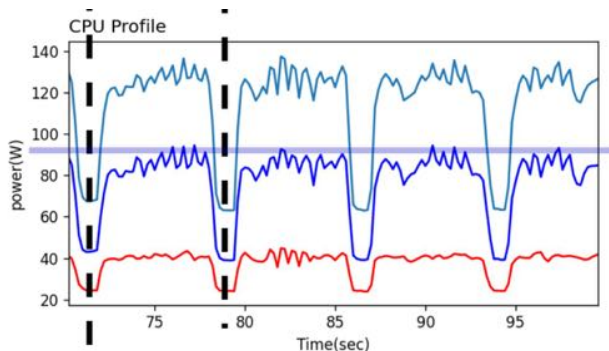
Application

Server

Cluster



Same application result  
without AVX-512- with AVX-512  
Duration (/ 2), Energy (-40%)

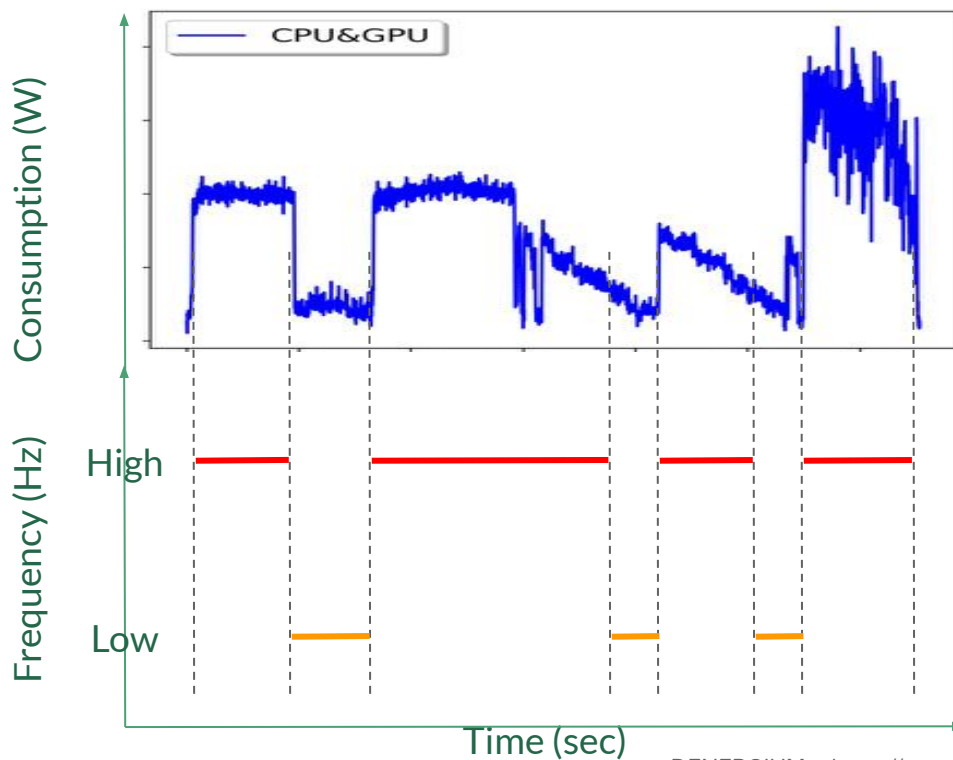


# Optimization strategy

Application

Server

Cluster



# Optimization strategy

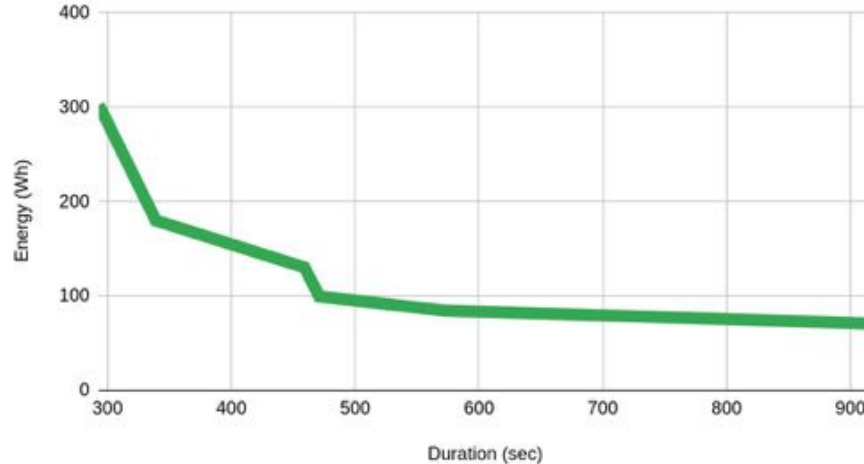
Application

Server

Cluster

## Application energy cost versus application duration

Energy (Wh) versus Duration (sec)



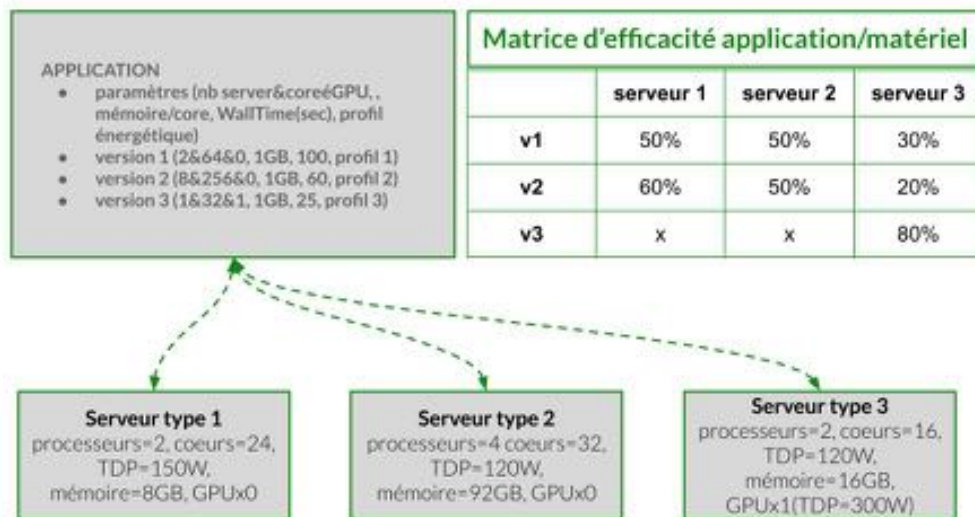
# Optimization strategy

Application

Server

Cluster

## Application configurations versus server classes



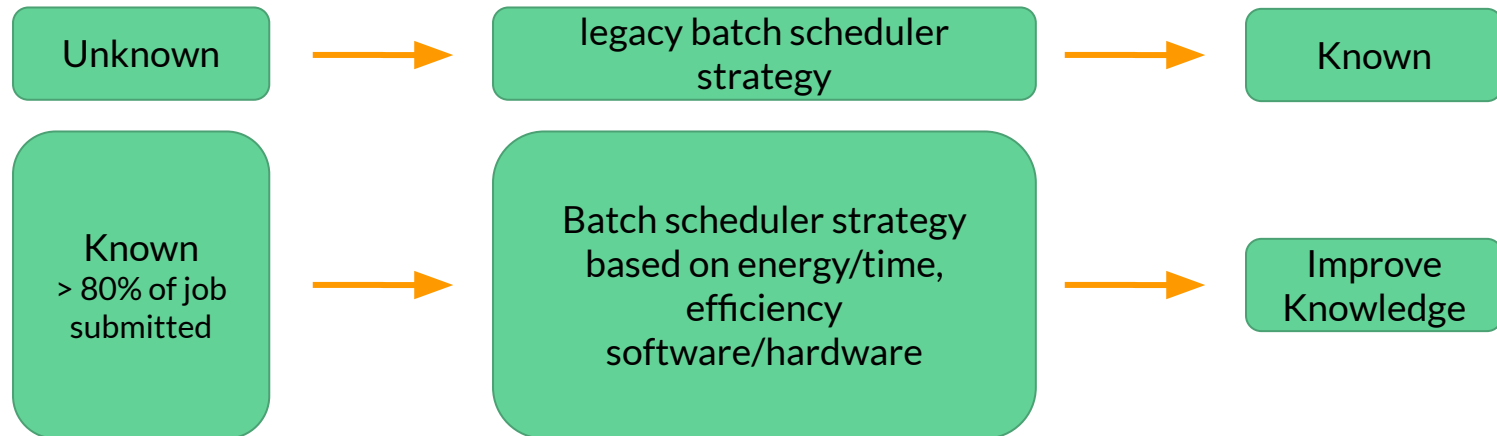
# Optimization strategy

Application

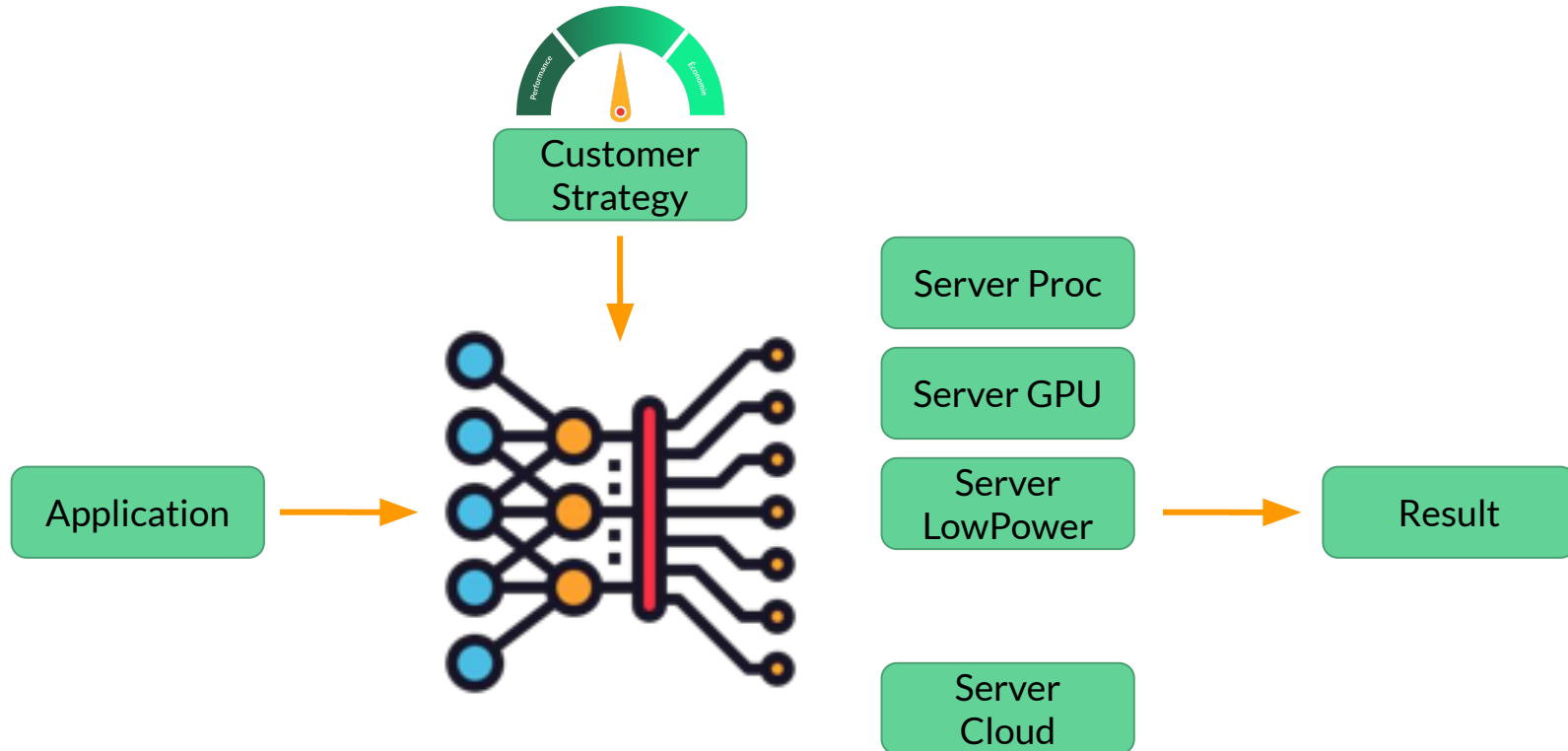
Server

Cluster

## Batch Scheduler



# Optimization strategy - Conclusion





Credits :

- <https://mediatheque.inria.fr/Mediatheque/media/38324> (© Inria / Photo C. Morel)
- <https://www.dell.com/fr-fr/dt/ai-technologies/index.htm#tab0=0>
- <https://www.flaticon.com/free-icons/deep-learning> icons created by Becris

# DENERGIUM

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Flash the code to contact us

Contact@DENERGIUM.com