



Scheduling and prediction for the energy consumption minimization in Clouds

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THIS THESIS IS FINANCED BY LABEX DIGICOSME WITHIN THE PROJECT E-CLOVIS



CHAIRE INGENIERIE DES SYSTEMES COMPLEXES



PROBLEM

- We schedule a set of jobs.
- We can switch-on more servers.
- We can vary the speed of processors.

Our goal is to minimize energy consumption.

RESOLUTION

We build our scheduling in three phases.

- First, we obtain a workload estimation of the next period by adjusting a predictor.
- Next, we determine the optimal number of server to minimize energy consumption for this estimated workload.
- Finally, we dispatch the estimated number of jobs on the switched-on servers.

EXPERIMENTATION

We compare our algorithms to an off-line optimal algorithm. The three algorithms we use is:

- *Naive* which use the previous workload to choose the number of servers.
- *Non dynamic* which use a non-dynamic bandit for the prediction.
- *Dynamic* which use a dynamic bandit.

Choose the number of servers

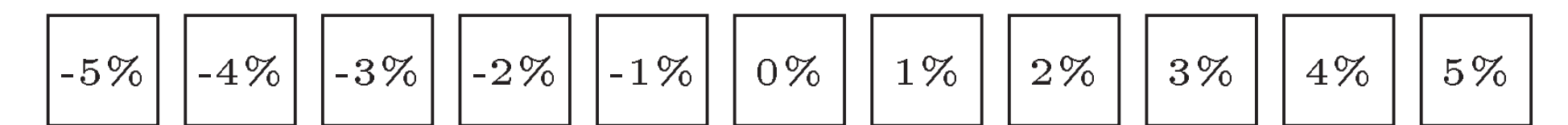
We prove that the energy consumption decreases until a certain number of switched-on servers. Then energy increases if we add more servers. So we can find the optimal number of server with a dichotomic search.

Dispatching

Once we have choose our optimal number of servers, we evenly dispatch our jobs on the processors and we run them as slowly as possible.

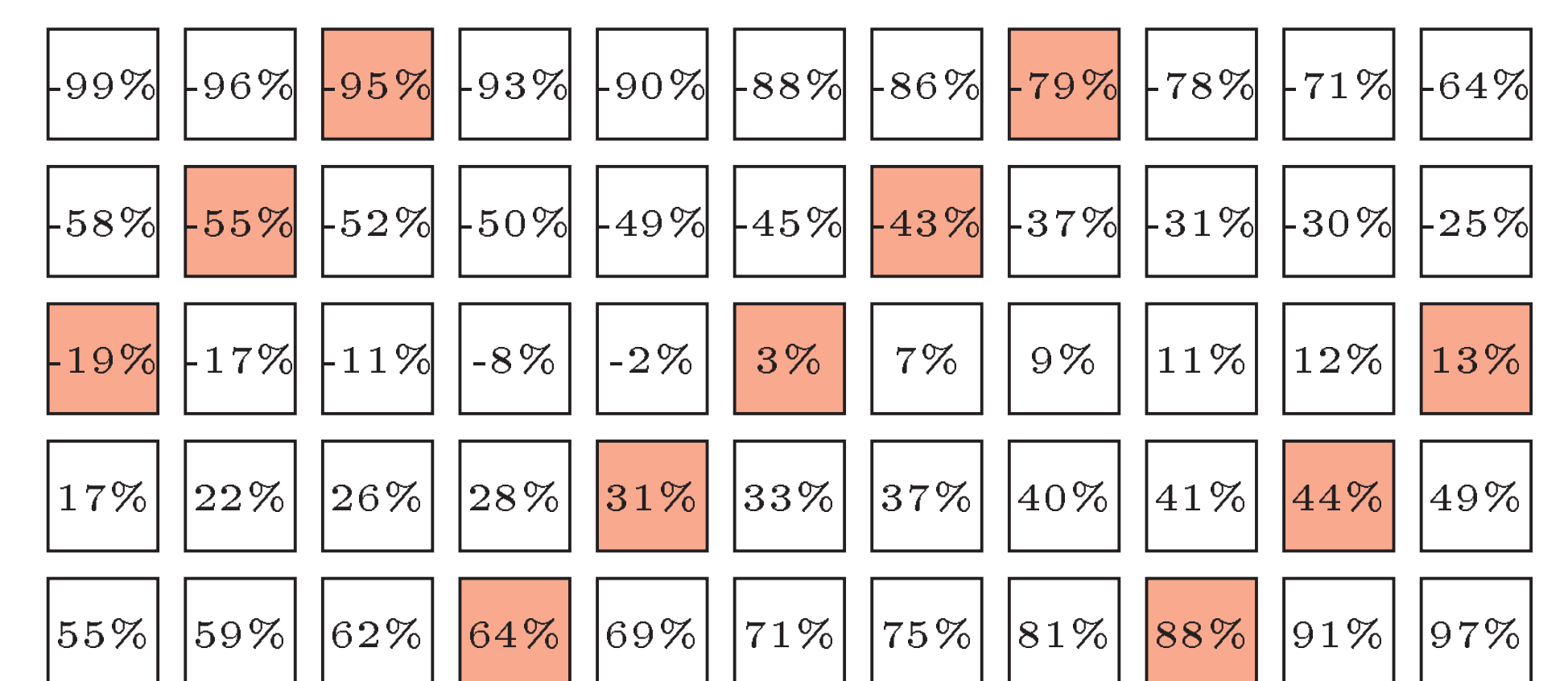
Prediction

A non-dynamic bandit is:



For a dynamic bandit: at each time t , we compute $A_{opt}(t)$, the value of an optimal arm. When we have m arms, we evenly choose n arms between these m arms.

Here is an illustration of this construction for $n = 11$ and $m = 55$. The selected arms are shadowed:

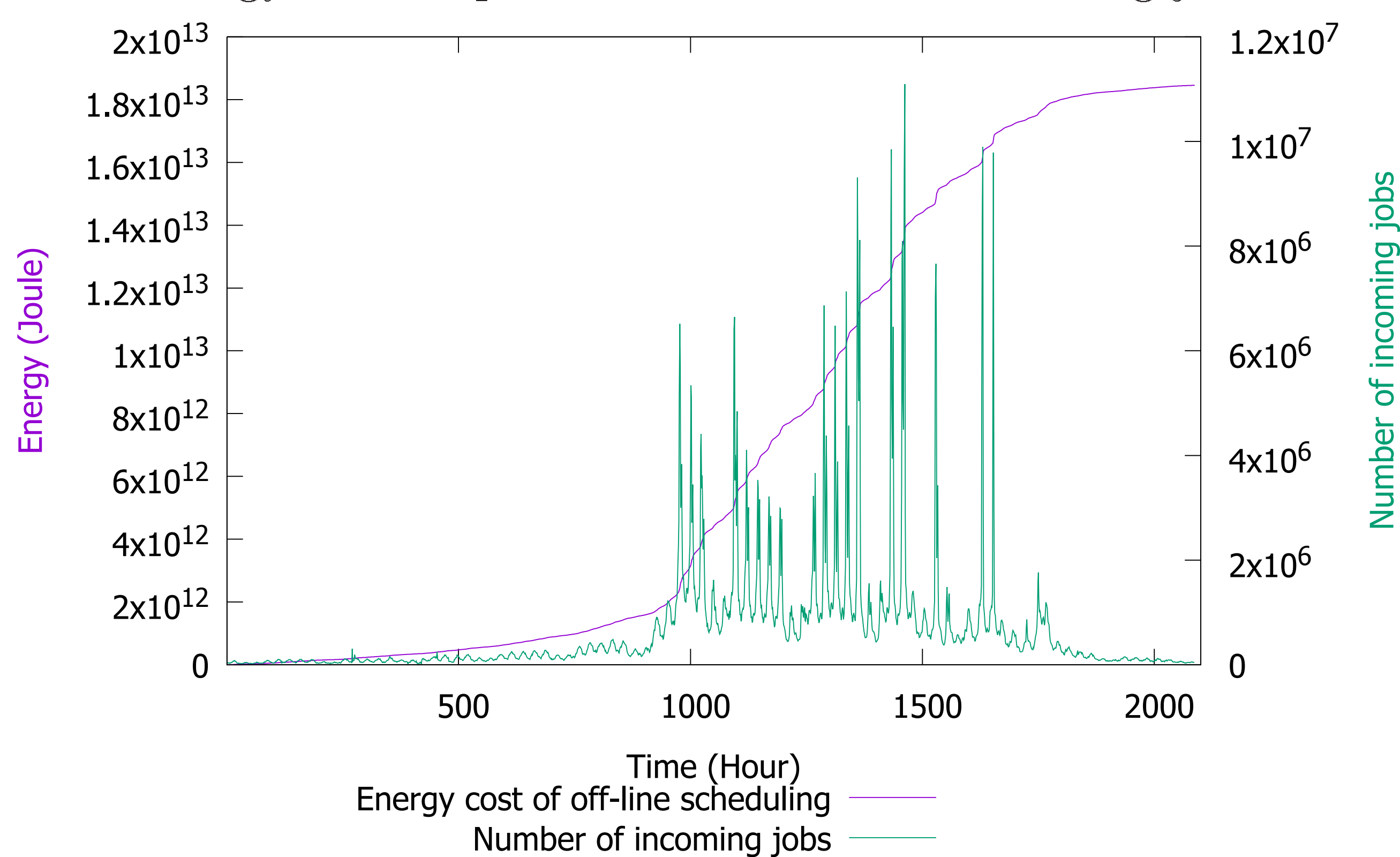


At time t , our bandit configuration is composed of the arms in red:

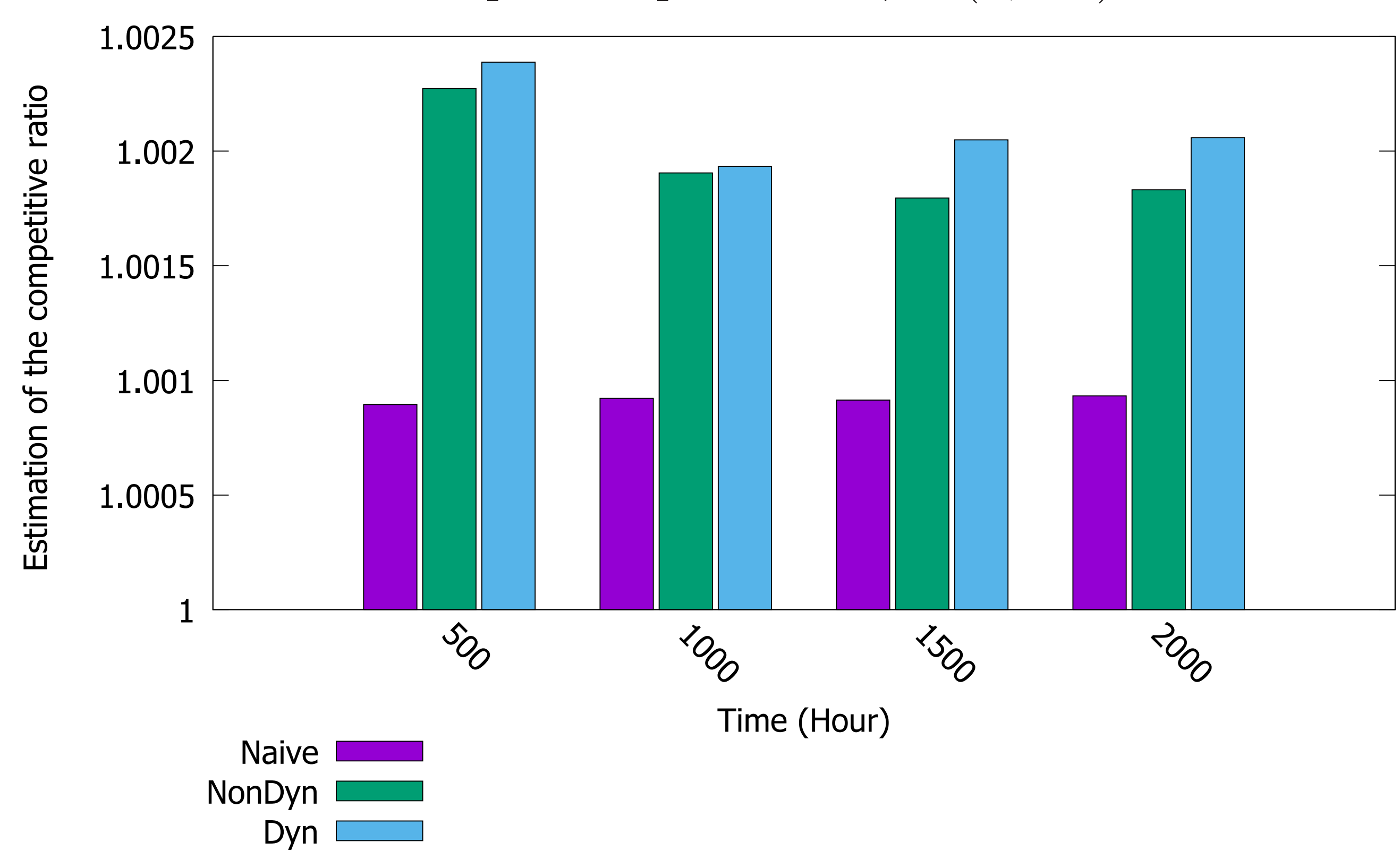


RESULTS

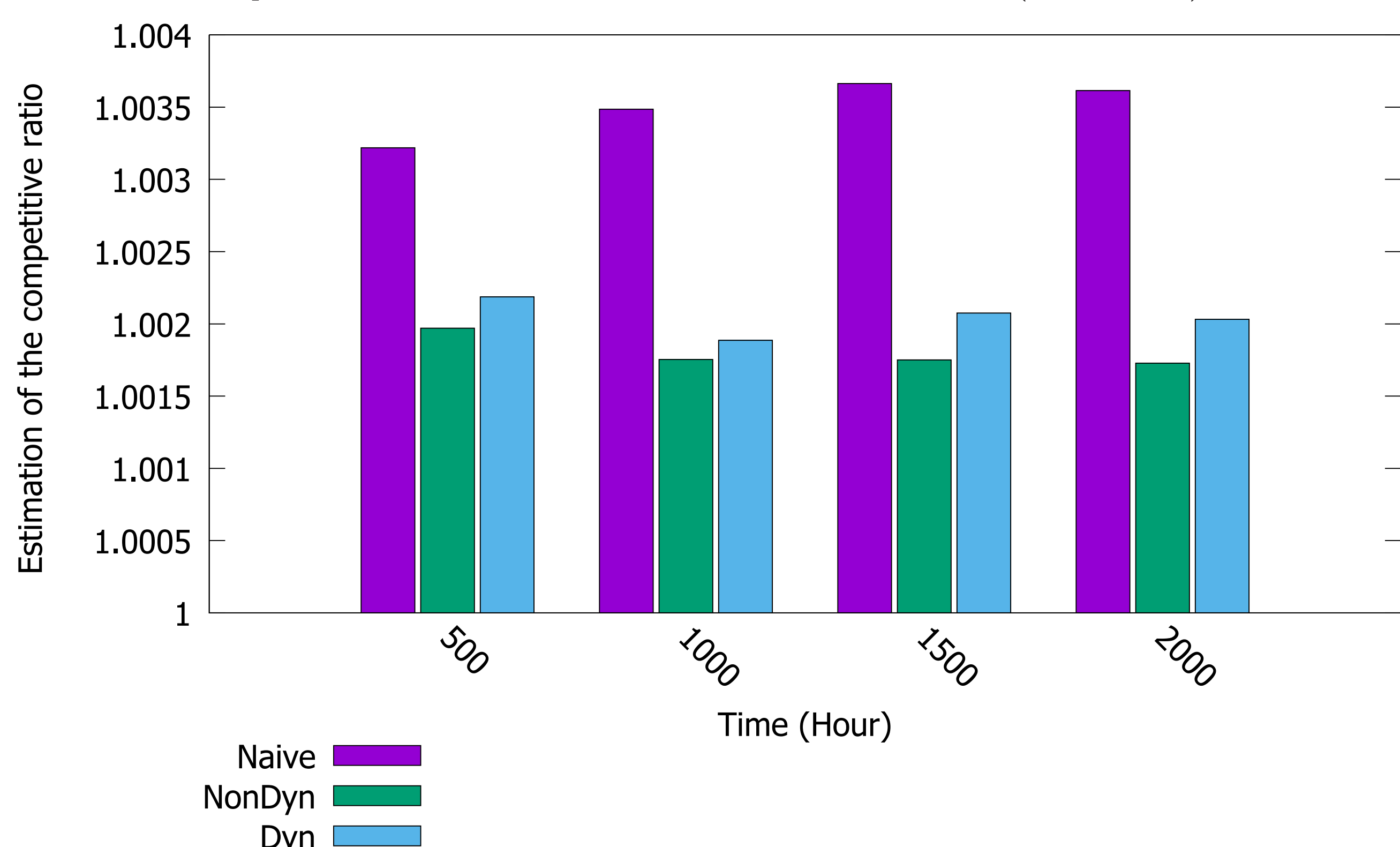
Energy consumption and number of incoming jobs



Almost perfect prediction, $\mathcal{N}(0, 3\%)$



Slightly overestimated prediction, $\mathcal{N}(5\%, 3\%)$



Strongly underestimated prediction, $\mathcal{N}(-15\%, 3\%)$

