

XLcloud Demo

Energy efficiency for supporting HPC as a Service

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<http://www.xlcloud.org>

Context

XLcloud

XLcloud:

- HPC-as-a-Service (based on OpenStack)
- Funded by the "Fonds national pour la Société Numérique"
- Three-year long collaborative project
- Open source license

Some use cases:

- Compute plants (HPC clouds Research & Industry)
- Cloud gaming (industry of 3D video games)
- Interactive and collaborative virtual prototyping
- Human body visualization (research areas in online medical education)
- Interactive computation fluid dynamics for the cloud



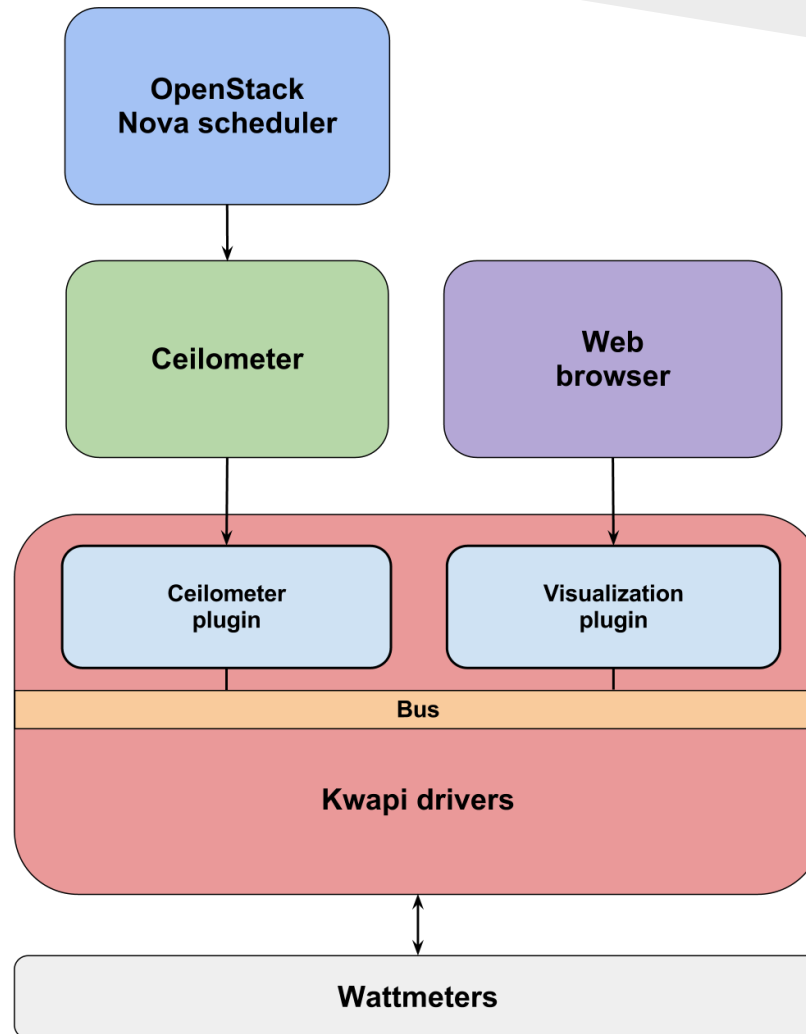
xlcloud
Powering Computation in the Cloud

Context Consortium

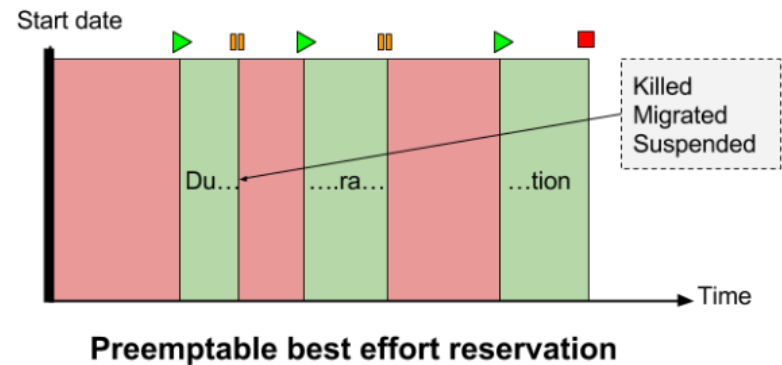
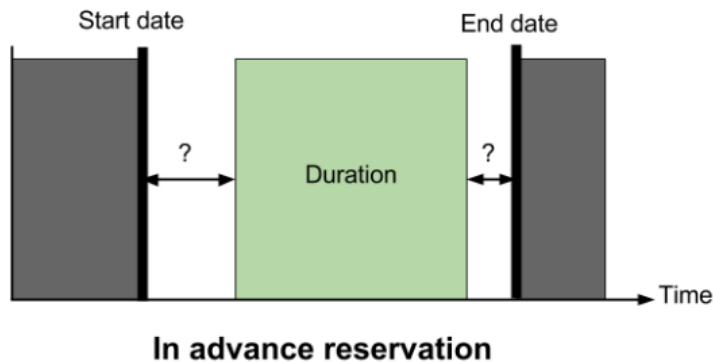
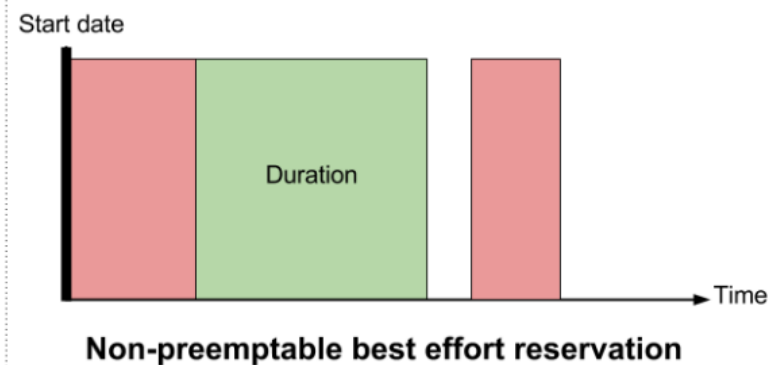
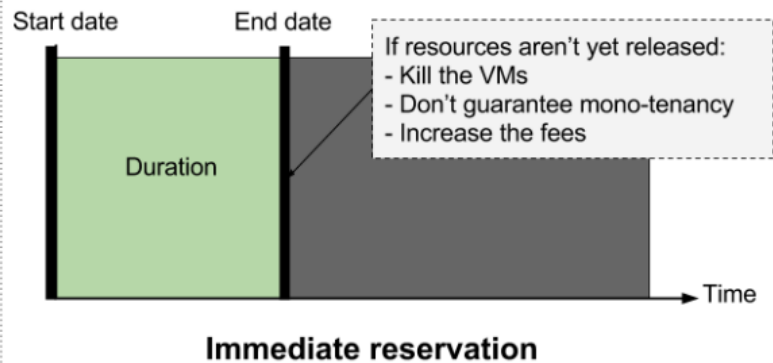


Kwapi (telemetry framework)

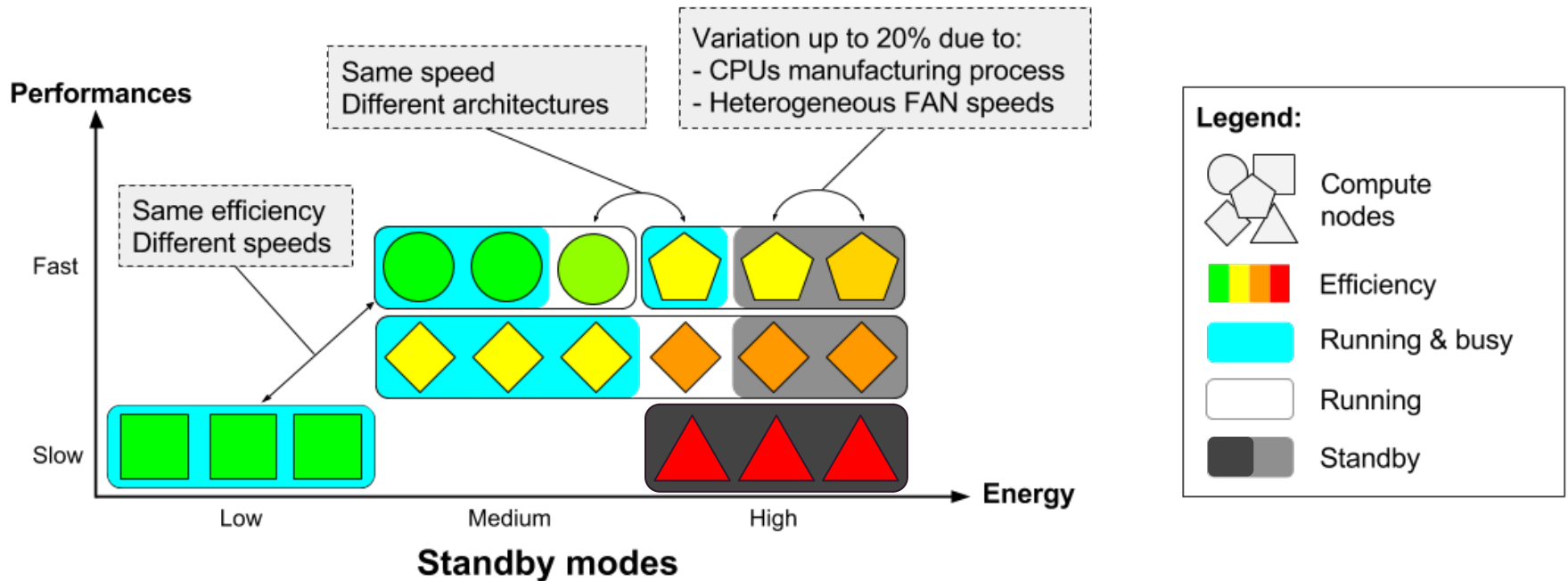
Software layers



Blazar (reservation framework)



Energy Efficiency & Standby Modes



Demo

Platform:

3 compute nodes (same CPU, different amount of RAM)

Hostname	Memory (Mb)	Efficiency (flop/w)	Leases						
havana3	4096	25.5						>= 2048Mb	
havana2	2048	27.6		(No requirements specified)		= 2048Mb			
havana1	1024	28.6							

Scenario:

We will create 3 leases, with different hardware requirements.



All hosts are in standby mode

Applications Raccourcis

Kwapi monitoring x Host Aggregates - Op x

127.0.0.1:8090/admin/aggregates/

openstack admin admin Sign Out

Host Aggregates

Host Aggregates Filter Filter + Create Host Aggregate x Delete Host Aggregates

<input type="checkbox"/>	Name	Availability Zone	Hosts	Metadata	Actions
<input type="checkbox"/>	freepool	-	havana1 havana2 havana3		Edit Host Aggregate

Displaying 1 item

Availability Zones

Availability Zones Filter Filter

Availability Zone Name	Hosts	Available
internal	havana1 (Services Down) havana2 (Services Up) havana3 (Services Up)	Yes
nova	havana1 (Services Up) havana2 (Services Up) havana3 (Services Up)	Yes

Displaying 2 items

Project Admin System Overview Resource Usage Hypervisors Host Aggregates Instances Volumes Flavors Images System Information Identity

The 3 compute nodes are in the host aggregate named “freepool”

Applications Raccourcis 16:34 Rossigneux

Postman

POSTMAN API Directory Collection runner Upgrade Sign in Supporters

DELETE DeleteHost

▼ ClimateLeaseAPI

- POST CreateVirtualLease
- POST CreatePhysicalLease
- PUT UpdateLease
- DELETE DeleteLease
- GET GetLeases
- GET ShowLease

▼ Keystone v2.0

- POST ScopedTokenForTenant
- GET ListOfTenants
- POST UnscopedToken

▼ Keystone v3

- POST ScopedTokenForTenant
- GET ListOfTenants
- POST UnscopedToken

▼ Kwranking

- POST RankList
- PUT AddHost
- GET GetHost
- GET ListHosts
- GET ListHostsIds

▼ Kwstandby

- GET NodeStatus
- GET NodeList
- PUT NodeUpdate

Type to filter

Normal Basic Auth Digest Auth OAuth 1.0 OAuth 2.0 Devstack

ListHosts

{{host}}:5001/v1/hosts/get/ GET URL params Headers (2) Send Save Preview Pre-request script Tests Add to collection Reset

Body Cookies Headers (4) Tests STATUS 200 OK TIME 70 ms

Pretty Raw Preview JSON Copy

```
{
  - hosts: {
    - havana1: {
      Efficiency: 28.614184397,
      Flop: 4034.5,
      Timestamp: 1413820789,
      Wmax: 141,
      Wmin: 90
    },
    - havana2: {
      Efficiency: 27.634246575,
      Flop: 4034.7,
      Timestamp: 1413820789,
      Wmax: 146,
      Wmin: 95
    },
    - havana3: {
      Efficiency: 25.535443038,
      Flop: 4034.6,
      Timestamp: 1413820789,
      Wmax: 158,
      Wmin: 108
    }
  }
}
```

Host efficiencies are heterogeneous
(same performance but slightly different power consumption)

Applications Raccourcis Postman

POSTMAN API Directory Collection runner Upgrade Sign in Supporters

History Collections

- ▼ ClimateHostAPI
 - GET GetHosts
 - POST CreateHosts
 - GET GetHost
 - PUT UpdateHost
 - DELETE DeleteHost
- ▼ ClimateLeaseAPI
 - POST CreateVirtualLease
 - POST CreatePhysicalLease
 - PUT UpdateLease
 - DELETE DeleteLease
 - GET GetLeases
 - GET ShowLease
- ▼ Keystone v2.0
 - POST ScopedTokenForTenant
 - GET ListofTenants
 - POST UnscopedToken
- ▼ Keystone v3
 - POST ScopedTokenForTenant
 - GET ListofTenants
 - POST UnscopedToken
- ▼ Kwranking
 - POST RankList
 - PUT AddHost
 - GET GetHost

Type to filter

Normal Basic Auth Digest Auth OAuth 1.0 OAuth 2.0 Devstack

CreatePhysicalLease

{{host}}:1234/v1/leases POST URL params Headers (2)

form-data x-www-form-urlencoded raw binary JSON (application/json)

```
1 {
2   "name": "demo-1",
3   "start_date": "2014-10-20 16:35",
4   "end_date": "2014-10-20 16:37",
5   "reservations": [
6     {
7       "min": "2",
8       "max": "2",
9       "resource_type": "physical:host",
10      "resource_properties": "",
11      "hypervisor_properties": ""
12    }
13  ]
14 }
```

Send Save Preview Pre-request script Tests Add to collection Reset

Body Cookies Headers (4) Tests STATUS 202 ACCEPTED TIME 976 ms

Pretty Raw Preview JSON Copy

```
{
  - lease: {
    status: null,
    user_id: null,
    name: "demo-1",
    end_date: "2014-10-20T16:37:00.000000",
    - reservations: [
      - {
        status: "pending",
        lease_id: "09b53a91-521c-46a7-b94d-3898350c6d16",
        min: 2,
        max: 2,
        created_at: "2014-10-20 16:33:47",
        resource_id: "161",
        updated_at: null,
        hypervisor_properties: "",
        resource_properties: "",
        id: "dd5f9db1-81a8-4ba5-81f5-46bd90303283",
      }
    ]
  }
}
```

Courrier entrant... Démo finale - Goo... [tmp] SSH Tunnel Mana... Postman Demo Kwapi monitoring... [Date et heure] *Document sans n...

Creation of lease “demo-1”

(2 hosts with no specific hardware requirements)

Applications Raccourcis 16:34 Rossigneux

Postman

POSTMAN API Directory Collection runner Upgrade Sign in Supporters

History Collections

▼ ClimateHostAPI

- GET GetHosts
- POST CreateHosts
- GET GetHost
- PUT UpdateHost
- DELETE DeleteHost

▼ ClimateLeaseAPI

- POST CreateVirtualLease
- POST CreatePhysicalLease
- PUT UpdateLease
- DELETE DeleteLease
- GET GetLeases
- GET ShowLease

▼ Keystone v2.0

- POST ScopedTokenForTenant
- GET ListofTenants
- POST UnscopedToken

▼ Keystone v3

- POST ScopedTokenForTenant
- GET ListofTenants
- POST UnscopedToken

▼ Kwranking

- POST RankList
- PUT AddHost
- GET GetHost

Type to filter

Normal Basic Auth Digest Auth OAuth 1.0 OAuth 2.0 Devstack

CreatePhysicalLease

{{host}}:1234/v1/leases POST URL params Headers (2)

form-data x-www-form-urlencoded raw binary JSON (application/json)

```
1 {
2   "name": "demo-2",
3   "start_date": "2014-10-20 16:38",
4   "end_date": "2014-10-20 16:40",
5   "reservations": [
6     {
7       "min": "1",
8       "max": "2",
9       "resource_type": "physical:host",
10      "resource_properties": "[\"=\", \"$memory_mb\", \"2048\"]",
11      "hypervisor_properties": ""
12    }
13  ]
14 }
```

Send Save Preview Pre-request script Tests Add to collection Reset

Body Cookies Headers (4) Tests STATUS 202 ACCEPTED TIME 890 ms

Pretty Raw Preview JSON Copy

```
{
  - lease: {
    status: null,
    user_id: null,
    name: "demo-2",
    end_date: "2014-10-20T16:40:00.000000",
    - reservations: [
      - {
        status: "pending",
        lease_id: "970b1880-d877-4e80-aad8-44dbe1feb8c",
        min: 1,
        max: 2,
        created_at: "2014-10-20 16:33:55",
        resource_id: "162",
        updated_at: null,
        hypervisor_properties: "",
        resource_properties: "[\"=\", \"$memory_mb\", \"2048\"]",
        id: "7fe2f0d6-651e-4cfb-80a3-0d7644cab230",
      }
    ]
  }
}
```

Courrier entrant - ... Démo finale - Goo... [tmp] SSH Tunnel Mana... Postman Demo Kwapi monitoring... [Date et heure] *Document sans n...

Creation of lease “demo-2”
(up to 2 hosts with 2048Mb of RAM)

Applications Raccourcis Postman

POSTMAN API Directory Collection runner Upgrade Sign in Supporters

History Collections

▼ ClimateHostAPI

- GET GetHosts
- POST CreateHosts
- GET GetHost
- PUT UpdateHost
- DELETE DeleteHost

▼ ClimateLeaseAPI

- POST CreateVirtualLease
- POST CreatePhysicalLease
- PUT UpdateLease
- DELETE DeleteLease
- GET GetLeases
- GET ShowLease

▼ Keystone v2.0

- POST ScopedTokenForTenant
- GET ListofTenants
- POST UnscopedToken

▼ Keystone v3

- POST ScopedTokenForTenant
- GET ListofTenants
- POST UnscopedToken

▼ Kwranking

- POST RankList
- PUT AddHost
- GET GetHost

Type to filter

Normal Basic Auth Digest Auth OAuth 1.0 OAuth 2.0 Devstack

CreatePhysicalLease

{{host}}:1234/v1/leases POST URL params Headers (2)

form-data x-www-form-urlencoded raw binary JSON (application/json)

```
1 {
2   "name": "demo-3",
3   "start_date": "2014-10-20 16:41",
4   "end_date": "2014-10-20 16:43",
5   "reservations": [
6     {
7       "min": "2",
8       "max": "2"
9     },
10    {
11      "resource_type": "physical:host",
12      "resource_properties": "[\>=\", \"$memory_mb\", \"$2048\"]",
13      "hypervisor_properties": ""
14    }
15  ]
16 }
```

Send Save Preview Pre-request script Tests Add to collection Reset

Body Cookies Headers (4) Tests STATUS 202 ACCEPTED TIME 972 ms

Pretty Raw Preview JSON Copy

```
{
  - lease: {
    status: null,
    user_id: null,
    name: "demo-3",
    end_date: "2014-10-20T16:43:00.000000",
    - reservations: [
      - {
        status: "pending",
        lease_id: "4a1d5809-45f0-4eed-a790-9437a957e8c2",
        min: 2,
        max: 2,
        created_at: "2014-10-20 16:34:02",
        resource_id: "163",
        updated_at: null,
        hypervisor_properties: "",
        resource_properties: "[\>=\", \"$memory_mb\", \"$2048\"]",
        id: "167cf272-84f7-4043-bf0f-5a2af4af6140",
      }
    ]
  }
}
```

Creation of lease “demo-3”
(2 hosts with at least 2048Mb of RAM)

Applications Raccourcis
Kwapi monitoring x Host Aggregates - Op x

127.0.0.1:8090/admin/aggregates/

openstack admin admin Sign Out

Host Aggregates

Host Aggregates Filter Filter + Create Host Aggregate Delete Host Aggregates

	Name	Availability Zone	Hosts	Metadata	Actions
<input type="checkbox"/>	167cf272-84f7-4043-bf0f-5a2af4af6140	climate:167cf272-84f7-4043-bf0f-5a2af4af6140		climate:owner = 321c748cfe24480886f77bcf304d9325 availability_zone = climate:167cf272-84f7-4043-bf0f-5a2af4af6140	Edit Host Aggregate
<input type="checkbox"/>	7fe2f0d6-651e-4cfb-80a3-0d7644cab230	climate:7fe2f0d6-651e-4cfb-80a3-0d7644cab230		climate:owner = 321c748cfe24480886f77bcf304d9325 availability_zone = climate:7fe2f0d6-651e-4cfb-80a3-0d7644cab230	Edit Host Aggregate
<input type="checkbox"/>	dd5f9db1-81a8-4ba5-81f5-46bd90303283	climate:dd5f9db1-81a8-4ba5-81f5-46bd90303283		climate:owner = 321c748cfe24480886f77bcf304d9325 availability_zone = climate:dd5f9db1-81a8-4ba5-81f5-46bd90303283	Edit Host Aggregate
<input type="checkbox"/>	freepool	-	havana1 havana2 havana3		Edit Host Aggregate

Affichage de 4 éléments

Availability Zones

Availability Zones Filter Filter

Availability Zone Name	Hosts	Available
internal	havana1 (Services Up)	Oui
nova	havana1 (Services Up) havana2 (Services Up) havana3 (Services Down)	Oui

Displaying 2 items

En attente de l'affichage du cache

Courrier entrant... Démo finale - Goo... [tmp] SSH Tunnel Mana... Postman Demo Aérations d'hô... [Date et heure] *Document sans n...

New aggregates are created
(will be populated at the lease starting date)

Applications Raccourcis

Kwapi monitoring x Agrégations d'hôte. - x

greencloud.ens-lyon.fr/kwapi/last/minute/

Kwapi energy monitoring

stack@havana1: ~

stack@havana2: ~

stack@havana3: ~

frossign@pegase: ~

francois@pc-francois: ~

```
mysql> select * from computehost_allocations;
```

created_at	updated_at	id	compute_host_id	reservation_id
2014-10-20 16:33:47	NULL	0f15e7e6-b512-4c0f-abd8-f259bc9f54e9	havana1	dd5f9db1-81a8-4ba5-81f5-46bd90303283
2014-10-20 16:33:47	NULL	270aaa64-0709-41de-9435-6d5a826af335	havana2	dd5f9db1-81a8-4ba5-81f5-46bd90303283
2014-10-20 16:33:55	NULL	48b355ac-3e8c-4881-959e-3ed6b80074ae	havana2	7fe2f0d6-651e-4cfb-80a3-0d7644cab230
2014-10-20 16:34:02	NULL	e8334519-6a3f-4e2a-af1c-f7ca8e67bb1b	havana2	167cf272-84f7-4043-bf0f-5a2af4af6140
2014-10-20 16:34:02	NULL	ee8bb347-74f9-4d43-b067-c797ef8b73e5	havana3	167cf272-84f7-4043-bf0f-5a2af4af6140

5 rows in set (0.00 sec)

```
mysql>
```

0\$ shell* 1\$ key 2\$ key-access 3\$ horizon 4\$ g-reg 5\$ g-api 6\$ n-api 7\$ n-cpu 8\$ n-cond 9\$ n-crt 10\$ n-net 11\$ n-sch 12\$ n-novnc 13\$ n-xvnc 1

18:30

18:31

18:32

18:33

18:34

Avg: 2.0 W

Min: 2.0 W

Max: 2.0 W

Last: 2.0 W

Total: 0.000166 kWh

Cost: 0.000021 €

Courrier entrant - ... Démo finale - Goo... [tmp] SSH Tunnel Mana... Postman Demo Kwapi monitoring... [Date et heure] *Document sans n...

Allocated hosts are the greenest hosts
matching the user requirements

Applications Raccourcis
Kwapi monitoring x Host Aggregates - Op x

127.0.0.1:8090/admin/aggregates/

openstack admin admin Sign Out

Host Aggregates

Host Aggregates Filter Filter + Create Host Aggregate Delete Host Aggregates

	Name	Availability Zone	Hosts	Metadata	Actions
<input type="checkbox"/>	167cf272-84f7-4043-bf0f-5a2af4af6140	climate:167cf272-84f7-4043-bf0f-5a2af4af6140		climate:owner = 321c748cfe24480886f77bcf304d9325 availability_zone = climate:167cf272-84f7-4043-bf0f-5a2af4af6140	Edit Host Aggregate
<input type="checkbox"/>	7fe2f0d6-651e-4cfb-80a3-0d7644cab230	climate:7fe2f0d6-651e-4cfb-80a3-0d7644cab230		climate:owner = 321c748cfe24480886f77bcf304d9325 availability_zone = climate:7fe2f0d6-651e-4cfb-80a3-0d7644cab230	Edit Host Aggregate
<input type="checkbox"/>	dd5f9db1-81a8-4ba5-81f5-46bd90303283	climate:dd5f9db1-81a8-4ba5-81f5-46bd90303283	havana1 havana2	climate:owner = 321c748cfe24480886f77bcf304d9325 availability_zone = climate:dd5f9db1-81a8-4ba5-81f5-46bd90303283	Edit Host Aggregate
<input type="checkbox"/>	freepool	-	havana3		Edit Host Aggregate

Affichage de 4 éléments

Availability Zones

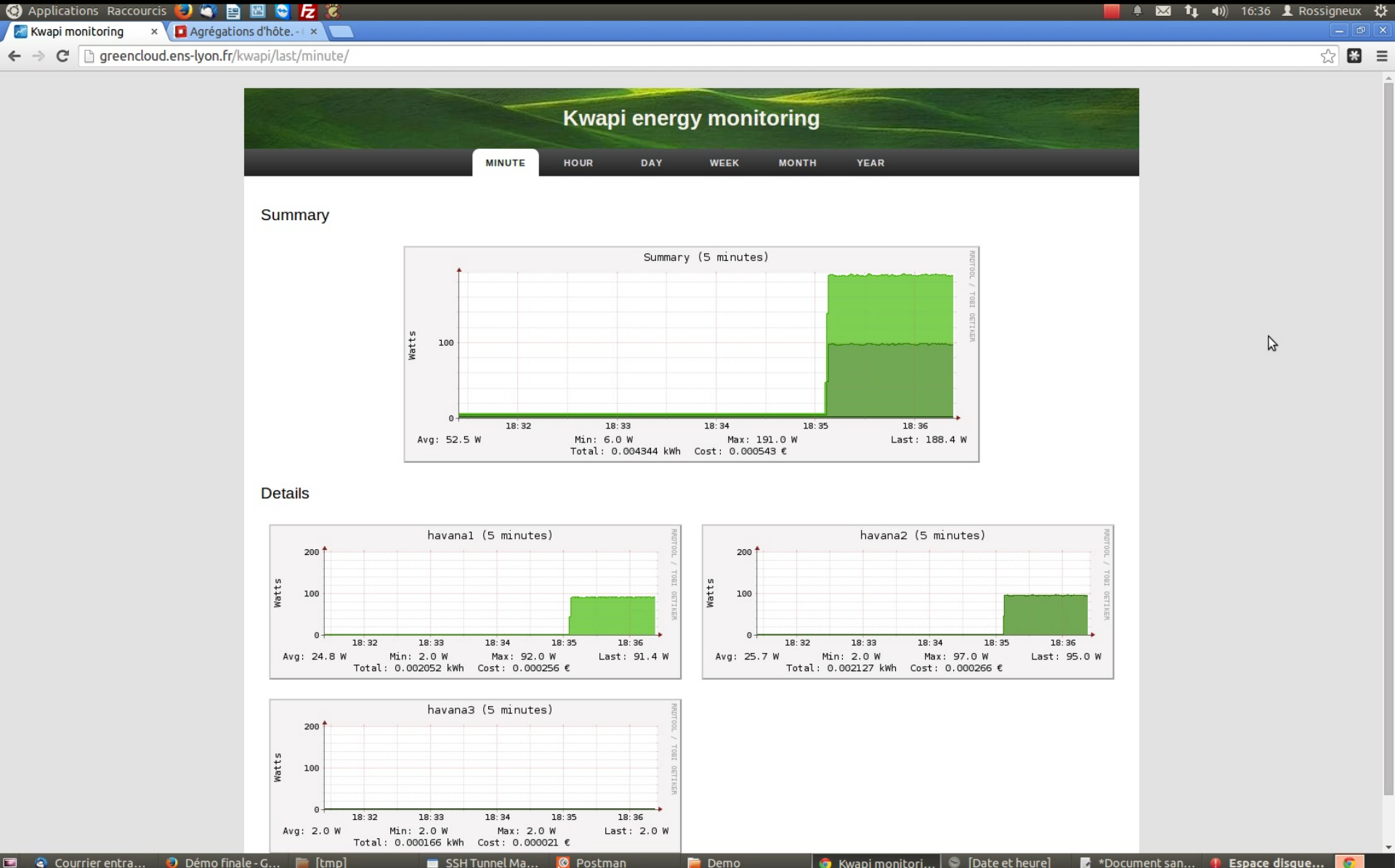
Availability Zones Filter Filter

Availability Zone Name	Hosts	Available
climate:dd5f9db1-81a8-4ba5-81f5-46bd90303283	havana1 (Services Up) havana2 (Services Up)	Oui
internal	havana1 (Services Up)	Oui
nova	havana3 (Services Down)	Oui

Displaying 3 items

Courrier entrant - ... Démo finale - Goo... [tmp] SSH Tunnel Mana... Postman Demo Aérations d'hô... [Date et heure] *Document sans n...

When a lease starts, the host aggregate
is populated with the allocated hosts



The allocated hosts are wake up
if they were in standby mode

Applications Raccourcis POSTMAN API Directory Collection runner Upgrade Sign in Supporters

▼ ClimateHostAPI

- GET GetHosts
- POST CreateHosts
- GET GetHost
- PUT UpdateHost
- DELETE DeleteHost

▼ ClimateLeaseAPI

- POST CreateVirtualLease
- POST CreatePhysicalLease
- PUT UpdateLease
- DELETE DeleteLease
- GET GetLeases
- GET ShowLease

▼ Keystone v2.0

- POST ScopedTokenForTenant
- GET ListofTenants
- POST UnscopedToken

▼ Keystone v3

- POST ScopedTokenForTenant
- GET ListofTenants
- POST UnscopedToken

▼ Kwranking

- POST RankList
- PUT AddHost
- GET GetHost
- GET ListHosts
- GET ListHostsIds

Type to filter

Normal Basic Auth Digest Auth OAuth 1.0 OAuth 2.0 Devstack

GetLeases

{{host}}:1234/v1/leases GET URL params Headers (1)

Send Save Preview Pre-request script Tests Add to collection Reset

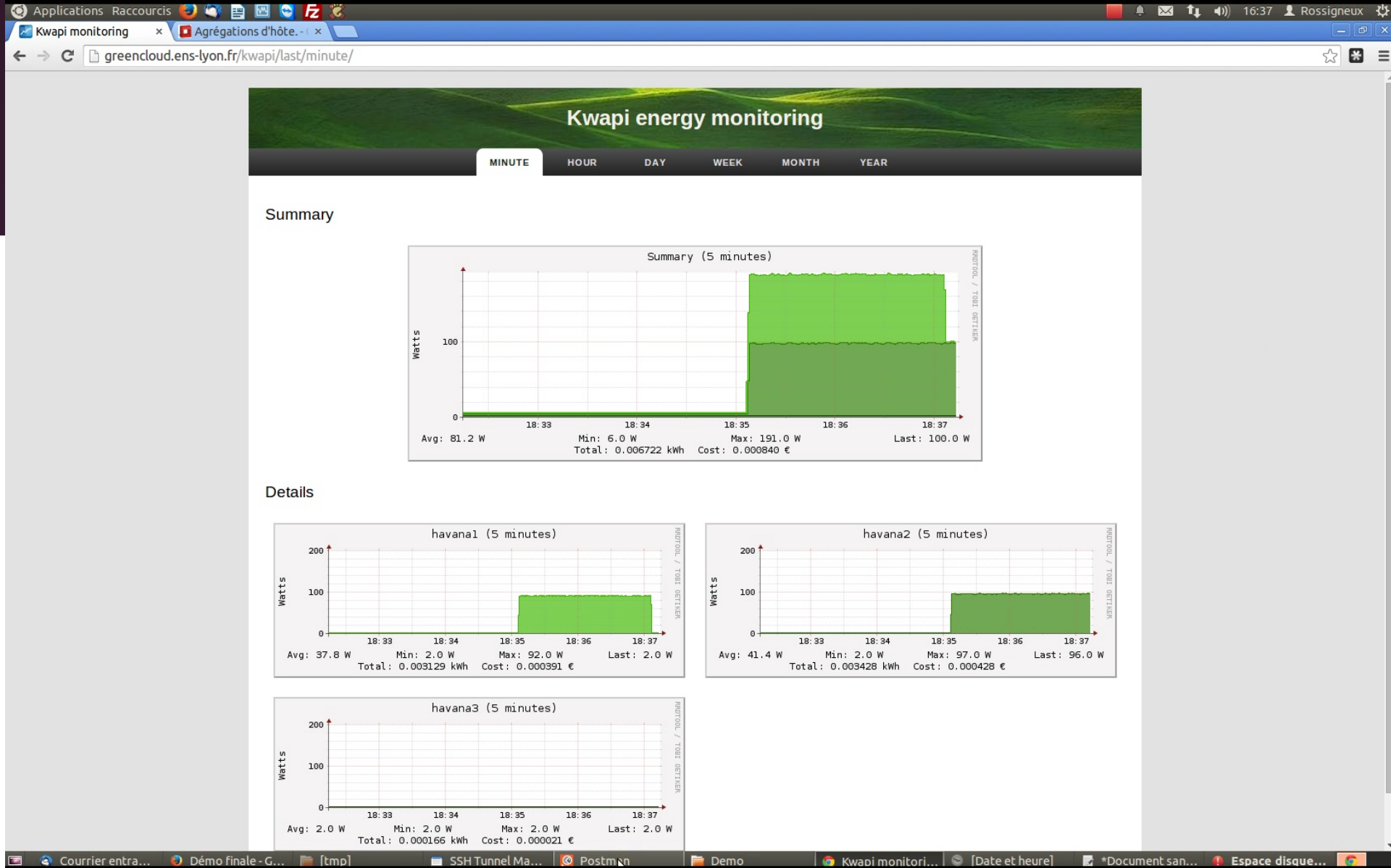
Body Cookies Headers (4) Tests STATUS 200 OK TIME 88 ms

Pretty Raw Preview JSON Copy

```
{
  - leases: [
    - {
      status: null,
      user_id: null,
      name: "demo-1",
      end_date: "2014-10-20T16:37:00.000000",
      - reservations: [
        - {
          status: "deleted",
          lease_id: "09b53a91-521c-46a7-b94d-3898350c6d16",
          min: 2,
          max: 2,
          created_at: "2014-10-20 16:33:47",
          resource_id: "161",
          updated_at: "2014-10-20 16:37:08",
          hypervisor_properties: "",
          resource_properties: "",
          id: "dd5f9db1-81a8-4ba5-81f5-46bd90303283",
          resource_type: "physical:host"
        }
      ],
      created_at: "2014-10-20 16:33:47",
      updated_at: null,
      - events: [
        - {
          status: "DONE",
          lease_id: "09b53a91-521c-46a7-b94d-3898350c6d16",
          event_type: "start_lease",
          created_at: "2014-10-20 16:33:47",
          updated_at: "2014-10-20 16:35:08",
        }
      ]
    }
  ]
}
```

Courrier entra... Démo finale - G... [tmp] SSH Tunnel Ma... Postman Demo Kwapi monitori... [Date et heure] *Document san... Espace disque...

The lease is now finished



The hosts are put in standby mode
if they are not allocated in the next minutes

Applications Raccourcis

Kwapi monitoring x Host Aggregates - Op x

127.0.0.1:8090/admin/aggregates/

openstack

admin admin Sign Out

Host Aggregates

Host Aggregates

Filter Filter + Create Host Aggregate Delete Host Aggregates

	Name	Availability Zone	Hosts	Metadata	Actions
<input type="checkbox"/>	167cf272-84f7-4043-bf0f-5a2af4af6140	climate:167cf272-84f7-4043-bf0f-5a2af4af6140		climate:owner = 321c748cfe24480886f77bcf304d9325 availability_zone = climate:167cf272-84f7-4043-bf0f-5a2af4af6140	Edit Host Aggregate
<input type="checkbox"/>	7fe2f0d6-651e-4cfb-80a3-0d7644cab230	climate:7fe2f0d6-651e-4cfb-80a3-0d7644cab230		climate:owner = 321c748cfe24480886f77bcf304d9325 availability_zone = climate:7fe2f0d6-651e-4cfb-80a3-0d7644cab230	Edit Host Aggregate
<input type="checkbox"/>	freepool	-	havana3 havana1 havana2		Edit Host Aggregate

Affichage de 3 éléments

Availability Zones

Filter Filter

Availability Zone Name	Hosts	Available
internal	havana1 (Services Up)	Oui
nova	havana1 (Services Up) havana2 (Services Up) havana3 (Services Down)	Oui

Displaying 2 items

Courrier entra... Démo finale - G... [tmp] SSH Tunnel Ma... Postman Demo Aaréaations d'... [Date et heure] *Document san... Espace disque...

The corresponding host aggregate is deleted

Applications Raccourcis 16:38 Rossigneux

Kwapi monitoring x Agrégations d'hôte. - x

127.0.0.1:8090/admin/aggregates/

openstack admin Se déconnecter

Projet

Admin

System

Vue d'Ensemble

Usage de ressource

Hyperviseurs

Agrégations d'hôte.

Instances

Volumes

Types d'Instance

Images

System Information

Identity

stack@havana1:~

mysql> select * from computehost_allocations;

created_at	updated_at	id	compute_host_id	reservation_id
2014-10-20 16:33:47	NULL	0f15e7e6-b512-4c0f-abd8-f259bc9f54e9	havana1	dd5f9db1-81a8-4ba5-81f5-46bd90303283
2014-10-20 16:33:47	NULL	270aaa64-0709-41de-9435-6d5a826af335	havana2	dd5f9db1-81a8-4ba5-81f5-46bd90303283
2014-10-20 16:33:55	NULL	48b355ac-3e8c-4881-959e-3ed6b80074ae	havana2	7fe2f0d6-651e-4cfb-80a3-0d7644cab230
2014-10-20 16:34:02	NULL	e8334519-6a3f-4e2a-af1c-f7ca8e67bb1b	havana2	167cf272-84f7-4043-bf0f-5a2af4af6140
2014-10-20 16:34:02	NULL	ee8bb347-74f9-4d43-b067-c797ef8b73e5	havana3	167cf272-84f7-4043-bf0f-5a2af4af6140

5 rows in set (0.00 sec)

mysql> select * from computehost_allocations;

created_at	updated_at	id	compute_host_id	reservation_id
2014-10-20 16:33:55	NULL	48b355ac-3e8c-4881-959e-3ed6b80074ae	havana2	7fe2f0d6-651e-4cfb-80a3-0d7644cab230
2014-10-20 16:34:02	NULL	e8334519-6a3f-4e2a-af1c-f7ca8e67bb1b	havana2	167cf272-84f7-4043-bf0f-5a2af4af6140
2014-10-20 16:34:02	NULL	ee8bb347-74f9-4d43-b067-c797ef8b73e5	havana3	167cf272-84f7-4043-bf0f-5a2af4af6140

3 rows in set (0.00 sec)

mysql>

0\$ shell* 1\$ key 2\$ key-access 3\$ horizon 4\$ g-reg 5\$ g-api 6\$ n-api 7\$ n-cpu 8\$ n-cond 9\$ n-crt 10\$ n-net 11\$ n-sch 12\$ n-novnc 13\$ n-xvnc 1

Supprimer Agrégations d'hôte.

Actions

Edit Host Aggregate

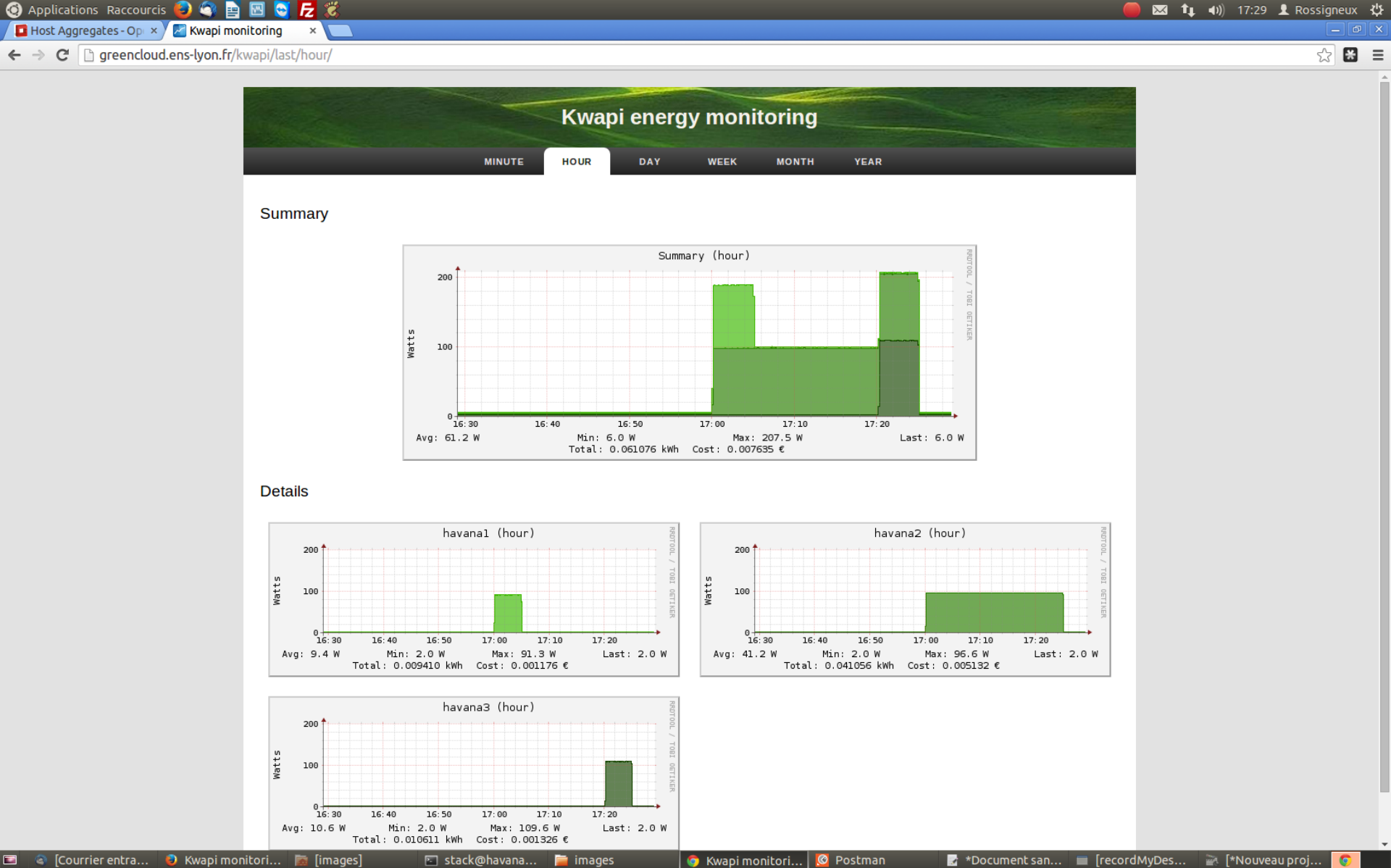
Edit Host Aggregate

Edit Host Aggregate

Q Filtrer

Courrier entra... Démo finale - G... [tmp] SSH Tunnel Ma... Postman Demo Agrégations d'... [Date et heure] *Document san... Espace disque...

The host allocations are deleted



And here is the final power consumption graph!

Thank you
for your attention