In [ ]:

```
# Convert dataset to NILMTK format
from nilmtk.dataset_converters import convert_refit
convert_refit('/home/divansh/Desktop/Coursework/BTP/MultiApplianceAnomalyDetection/datasets/refit-cleaned/', '/home/divansh/Desktop/Coursework/BTP/MultiApplianceAnomalyDetection/datasets/refit.h5')
```

In [ ]:

```
from nilmtk import DataSet
from nilmtk.utils import print_dict
refit = DataSet('/home/divansh/Desktop/Coursework/BTP/MultiApplianceAnomalyDetection/datasets/refit.h5')
print_dict(refit.metadata)
```

In [57]:

```
elec= refit.buildings[1].elec
elec
```

Out[57]:

```
MeterGroup(meters=
  ElecMeter(instance=1, building=1, dataset='REFIT', site_meter, appliances=[])
  ElecMeter(instance=2, building=1, dataset='REFIT', appliances=[Appliance(type='fridge', instance=1)])
  ElecMeter(instance=3, building=1, dataset='REFIT', appliances=[Appliance(type='freezer', instance=1)])
  ElecMeter(instance=4, building=1, dataset='REFIT', appliances=[Appliance(type='freezer', instance=2)])
  ElecMeter(instance=5, building=1, dataset='REFIT', appliances=[Appliance(type='washer dryer', instance=1)])
  ElecMeter(instance=6, building=1, dataset='REFIT', appliances=[Appliance(type='washing machine', instance=1)])
  ElecMeter(instance=7, building=1, dataset='REFIT', appliances=[Appliance(type='dish washer', instance=1)])
  ElecMeter(instance=8, building=1, dataset='REFIT', appliances=[Appliance(type='computer', instance=1)])
  ElecMeter(instance=9, building=1, dataset='REFIT', appliances=[Appliance(type='television', instance=1)])
  ElecMeter(instance=10, building=1, dataset='REFIT', appliances=[Appliance(type='electric space heater', instance=1)])
)
```

In [ ]:

```
computer = elec['computer']
computer.available_columns()
```

In [ ]:

```
df = next(computer.load())
```

In [ ]:

```
df[(df['power'].notna())]
```

In [62]:

```
fridge = elec[2]
fridge.available_columns()
df = next(fridge.load())
```

In [ ]:

```
df[df['power'].notna()]
```

In [ ]:

```
elec.proportion_of_energy_submetered()
```

In [69]:

```
from __future__ import print_function, division
import time

from matplotlib import rcParams
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
from six import iteritems

from nilmtk import DataSet, TimeFrame, MeterGroup, HDFDataStore
from nilmtk.disaggregate import CombinatorialOptimisation, FHMM
import nilmtk.utils

%matplotlib inline
```

```
/home/divansh/anaconda3/envs/nilmtk-env/lib/python3.6/importlib/_boo
tstrap.py:219: RuntimeWarning: numpy.ufunc size changed, may indicat
e binary incompatibility. Expected 216, got 192
  return f(*args, **kwds)
```

In [70]:

```
rcParams['figure.figsize'] = (13, 6)
```

In [94]:

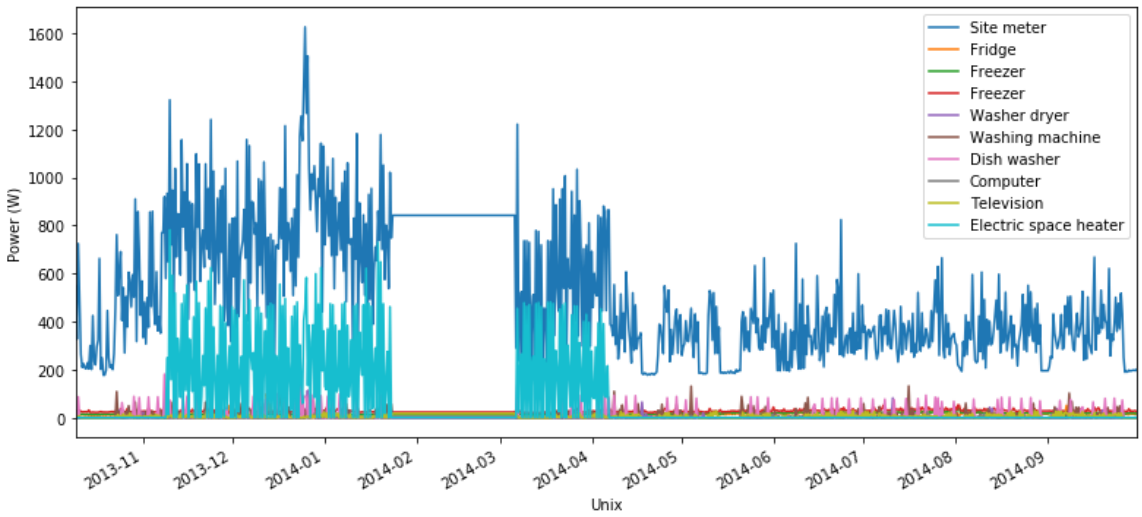
```
train = DataSet('/home/divansh/Desktop/Coursework/BTP/MultiApplianceAnomalyDetec
tion/datasets/refit.h5')
test = DataSet('/home/divansh/Desktop/Coursework/BTP/MultiApplianceAnomalyDetect
ion/datasets/refit.h5')
building = 1
train.set_window(end="2014-10-01")
test.set_window(start="2014-10-01", end="2015-10-01")

train_elec = train.buildings[1].elec
test_elec = test.buildings[1].elec

train_elec = train.buildings[1].elec
test_elec = test.buildings[1].elec
```

In [95]:

```
train_elec.plot()
```

Out[95]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9e59a656d8>
```

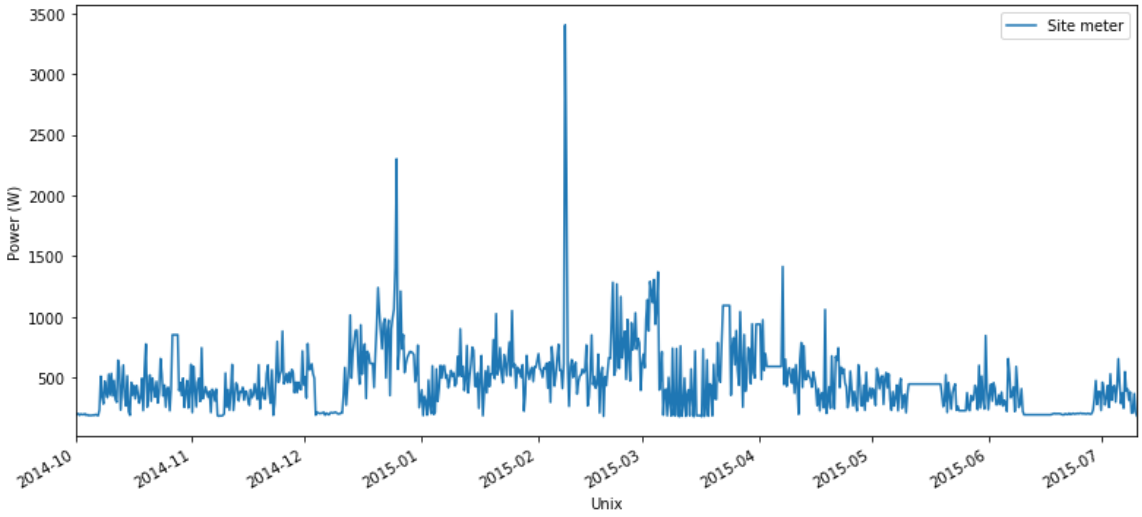



In [96]:

```
test_elec.mains().plot()
```

Out[96]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9e52157828>
```




In [97]:

```
mains = train_elec.mains()
```

In [98]:

```
mains_df = next(mains.load())
mains_df.head()
```

Out[98]:

| physical_quantity | power |
|---|---|
| type | active |
| Unix | |
| 2013-10-09 14:06:17+01:00 | 523 |
| 2013-10-09 14:06:31+01:00 | 526 |
| 2013-10-09 14:06:46+01:00 | 540 |
| 2013-10-09 14:07:01+01:00 | 532 |
| 2013-10-09 14:07:15+01:00 | 540 |

In [99]:

```
top_5_train_elec = train_elec.submeters().select_top_k(k=5)
```

```
9/9 ElecMeter(instance=10, building=1, dataset='REFIT', appliances=
[Appliance(type='electric space heater', instance=1)])
```

In [100]:

```
top_5_train_elec
```

Out[100]:

```
MeterGroup(meters=
  ElecMeter(instance=7, building=1, dataset='REFIT', appliances=[App
liance(type='dish washer', instance=1)])
  ElecMeter(instance=2, building=1, dataset='REFIT', appliances=[App
liance(type='fridge', instance=1)])
  ElecMeter(instance=4, building=1, dataset='REFIT', appliances=[App
liance(type='freezer', instance=2)])
  ElecMeter(instance=3, building=1, dataset='REFIT', appliances=[App
liance(type='freezer', instance=1)])
  ElecMeter(instance=10, building=1, dataset='REFIT', appliances=[Ap
pliance(type='electric space heater', instance=1)])
)
```

In [101]:

```
def predict(clf, test_elec, sample_period, timezone):
    pred = {}
    gt= {}

    for i, chunk in enumerate(test_elec.mains().load(physical_quantity = 'power'
, ac_type = 'active', sample_period=sample_period)):
        chunk_drop_na = chunk.dropna()
        pred[i] = clf.disaggregate_chunk(chunk_drop_na)
        gt[i]={}

        for meter in test_elec.submeters().meters:
            # Only use the meters that we trained on (this saves time!)
            gt[i][meter] = next(meter.load(physical_quantity = 'power', ac_type
= 'active', sample_period=sample_period))
        gt[i] = pd.DataFrame({k:v.squeeze() for k,v in iteritems(gt[i]) if len(v
)}, index=next(iter(gt[i].values())).index).dropna()

    # If everything can fit in memory
    gt_overall = pd.concat(gt)
    gt_overall.index = gt_overall.index.droplevel()
    pred_overall = pd.concat(pred)
    pred_overall.index = pred_overall.index.droplevel()

    # Having the same order of columns
    gt_overall = gt_overall[pred_overall.columns]

    #Intersection of index
    gt_index_utc = gt_overall.index.tz_convert("UTC")
    pred_index_utc = pred_overall.index.tz_convert("UTC")
    common_index_utc = gt_index_utc.intersection(pred_index_utc)

    common_index_local = common_index_utc.tz_convert(timezone)
    gt_overall = gt_overall.loc[common_index_local]
    pred_overall = pred_overall.loc[common_index_local]
    appliance_labels = [m for m in gt_overall.columns.values]
    gt_overall.columns = appliance_labels
    pred_overall.columns = appliance_labels
    return gt_overall, pred_overall
```

In [102]:

```
classifiers = {'CO':CombinatorialOptimisation(), 'FHMM':FHMM()}
predictions = {}
sample_period = 30
for clf_name, clf in classifiers.items():
    print("*"*20)
    print(clf_name)
    print("*" *20)
    start = time.time()
    # Note that we have given the sample period to downsample the data to 1 minu
te.
    # If instead of top_5 we wanted to train on all appliance, we would write
    # fhmm.train(train_elec, sample_period=60)
    clf.train(top_5_train_elec, sample_period=sample_period)
    end = time.time()
    print("Runtime =", end-start, "seconds.")
    gt, predictions[clf_name] = predict(clf, test_elec, sample_period, train.met
adata['timezone'])
```

```
********************
CO
********************
Training model for submeter 'ElecMeter(instance=7, building=1, datas
et='REFIT', appliances=[Appliance(type='dish washer', instance=1)])'
Training model for submeter 'ElecMeter(instance=2, building=1, datas
et='REFIT', appliances=[Appliance(type='fridge', instance=1)])'
Training model for submeter 'ElecMeter(instance=4, building=1, datas
et='REFIT', appliances=[Appliance(type='freezer', instance=2)])'
Training model for submeter 'ElecMeter(instance=3, building=1, datas
et='REFIT', appliances=[Appliance(type='freezer', instance=1)])'
Training model for submeter 'ElecMeter(instance=10, building=1, data
set='REFIT', appliances=[Appliance(type='electric space heater', ins
tance=1)])'
Done training!
Runtime = 28.013263463974 seconds.
Estimating power demand for 'ElecMeter(instance=7, building=1, datas
et='REFIT', appliances=[Appliance(type='dish washer', instance=1)])'
Estimating power demand for 'ElecMeter(instance=2, building=1, datas
et='REFIT', appliances=[Appliance(type='fridge', instance=1)])'
Estimating power demand for 'ElecMeter(instance=4, building=1, datas
et='REFIT', appliances=[Appliance(type='freezer', instance=2)])'
Estimating power demand for 'ElecMeter(instance=3, building=1, datas
et='REFIT', appliances=[Appliance(type='freezer', instance=1)])'
Estimating power demand for 'ElecMeter(instance=10, building=1, data
set='REFIT', appliances=[Appliance(type='electric space heater', ins
tance=1)])'
********************
FHMM
********************
Training model for submeter 'ElecMeter(instance=7, building=1, datas
et='REFIT', appliances=[Appliance(type='dish washer', instance=1)])'
with 3 states
Training model for submeter 'ElecMeter(instance=2, building=1, datas
et='REFIT', appliances=[Appliance(type='fridge', instance=1)])' with
3 states
Training model for submeter 'ElecMeter(instance=4, building=1, datas
et='REFIT', appliances=[Appliance(type='freezer', instance=2)])' wit
h 3 states
Training model for submeter 'ElecMeter(instance=3, building=1, datas
et='REFIT', appliances=[Appliance(type='freezer', instance=1)])' wit
h 3 states
Training model for submeter 'ElecMeter(instance=10, building=1, data
set='REFIT', appliances=[Appliance(type='electric space heater', ins
tance=1)])' with 3 states
Runtime = 250.1896948814392 seconds.
```

In [104]:

```
appliance_labels = [m.label() for m in gt.columns.values]
```

In [113]:

```
gt.columns = appliance_labels
predictions['CO'].columns = appliance_labels
predictions['FHMM'].columns = appliance_labels
```

In [114]:

```
gt.head()
```

Out[114]:

| Unix | Dish washer | Fridge | Freezer | Freezer | Electric space heater |
|---|---|---|---|---|---|
| **2014-10-01 00:00:00+01:00** | 0.0 | 69.0 | 71.0 | 0.0 | 1.0 |
| **2014-10-01 00:00:30+01:00** | 0.0 | 70.0 | 72.0 | 0.0 | 1.0 |
| **2014-10-01 00:01:00+01:00** | 0.0 | 69.4 | 71.0 | 0.0 | 1.0 |
| **2014-10-01 00:01:30+01:00** | 0.0 | 69.0 | 70.8 | 0.0 | 1.0 |
| **2014-10-01 00:02:00+01:00** | 0.0 | 69.0 | 71.0 | 0.0 | 1.0 |

In [115]:

```
predictions['CO'].head()
```

Out[115]:

| Unix | Dish washer | Fridge | Freezer | Freezer | Electric space heater |
|---|---|---|---|---|---|
| **2014-10-01 00:00:00+01:00** | 100.0 | 73.0 | 72.0 | 47.0 | 0.0 |
| **2014-10-01 00:00:30+01:00** | 100.0 | 73.0 | 72.0 | 47.0 | 0.0 |
| **2014-10-01 00:01:00+01:00** | 100.0 | 73.0 | 72.0 | 47.0 | 0.0 |
| **2014-10-01 00:01:30+01:00** | 100.0 | 73.0 | 72.0 | 47.0 | 0.0 |
| **2014-10-01 00:02:00+01:00** | 100.0 | 73.0 | 72.0 | 47.0 | 0.0 |

In [116]:

```
predictions['FHMM'].head()
```

Out[116]:

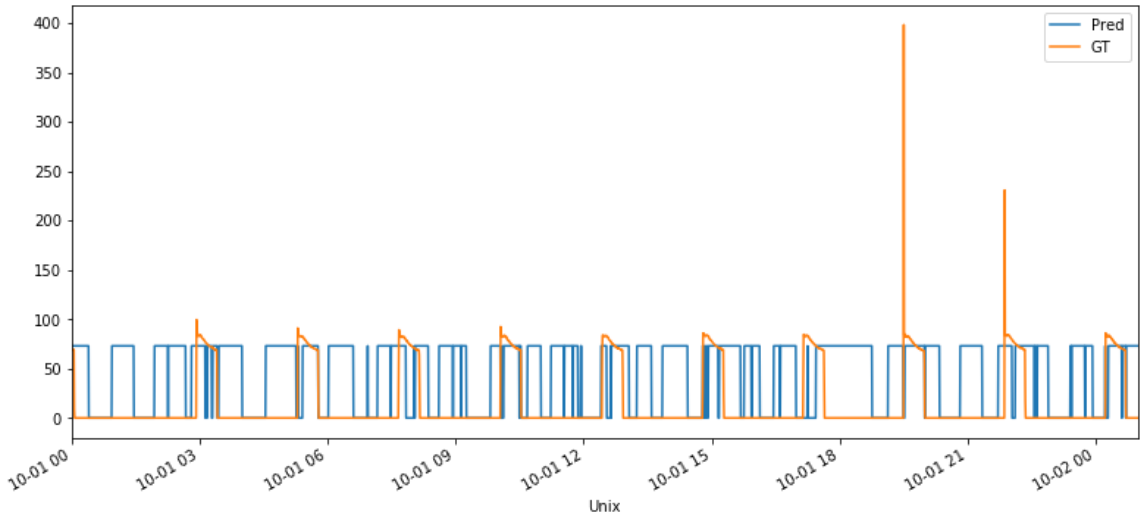
| Unix | Dish washer | Fridge | Freezer | Freezer | Electric space heater |
|---|---|---|---|---|---|
| **2014-10-01 00:00:00+01:00** | 115.0 | 73.0 | 71.0 | 0.0 | 1.0 |
| **2014-10-01 00:00:30+01:00** | 115.0 | 73.0 | 80.0 | 0.0 | 1.0 |
| **2014-10-01 00:01:00+01:00** | 115.0 | 73.0 | 80.0 | 0.0 | 1.0 |
| **2014-10-01 00:01:30+01:00** | 115.0 | 73.0 | 80.0 | 0.0 | 1.0 |
| **2014-10-01 00:02:00+01:00** | 115.0 | 73.0 | 80.0 | 0.0 | 1.0 |

In [122]:

```
predictions['CO']['Fridge'].head(3000).plot(label="Pred")
gt['Fridge'].head(3000).plot(label="GT")
plt.legend()
```

Out[122]:

```
<matplotlib.legend.Legend at 0x7f9e4761bdd8>
```

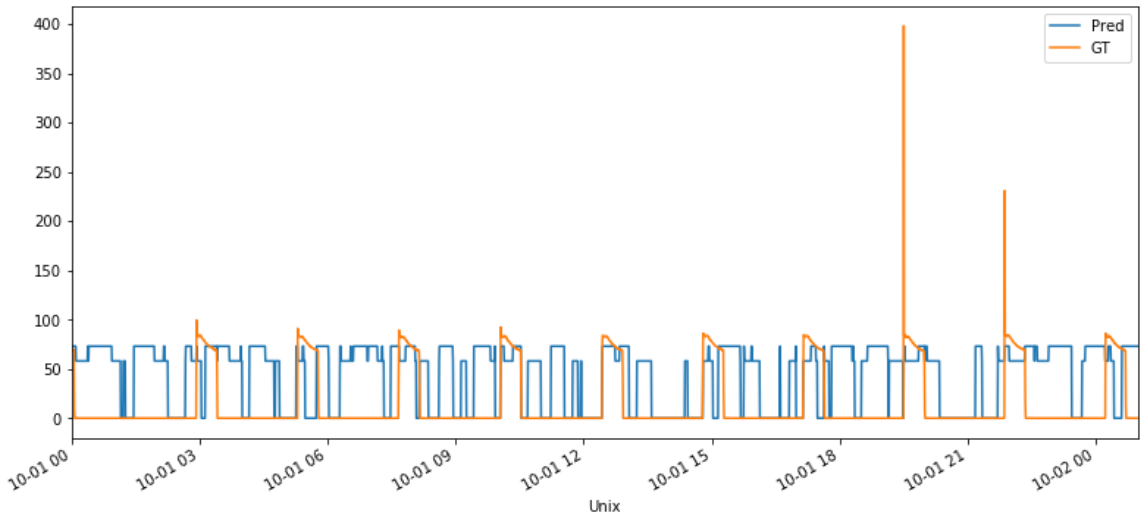



In [121]:

```
predictions['FHMM']['Fridge'].head(3000).plot(label="Pred")
gt['Fridge'].head(3000).plot(label="GT")
plt.legend()
```

Out[121]:

```
<matplotlib.legend.Legend at 0x7f9e47647ef0>
```



In [119]:

```
def compute_rmse(gt, pred):
    from sklearn.metrics import mean_squared_error
    rms_error = {}
    for appliance in gt.columns:
        rms_error[appliance] = np.sqrt(mean_squared_error(gt[appliance], pred[ap
pliance]))
    return pd.Series(rms_error)
```

In [120]:

```
rmse = {}
for clf_name in classifiers.keys():
    rmse[clf_name] = nilmtk.utils.compute_rmse(gt, predictions[clf_name])

rmse = pd.DataFrame(rmse)
rmse
```

Out[120]:

| | CO | FHMM |
|---|---|---|
| **Dish washer** | 286.763058 | 475.015334 |
| **Fridge** | 304.730482 | 59.323731 |
| **Freezer** | 173.812269 | 37.650161 |
| **Electric space heater** | 309.173196 | 222.768457 |