Data driven technology for efficiency in energy intensive industries

Code: REACH-2020-READYMADE-IDEA75_1
Domain: Manufacturing / Industry

IDEA 75

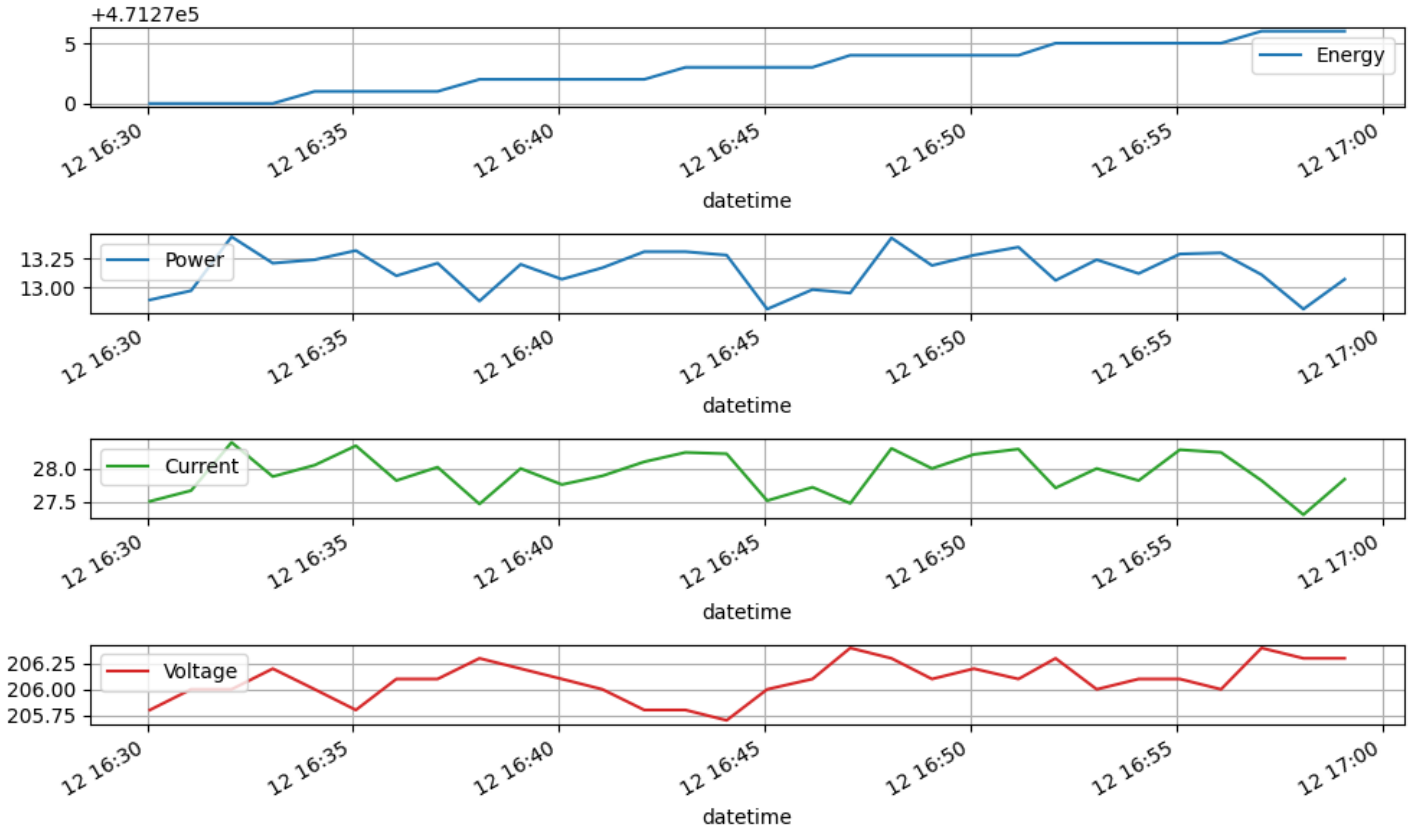
REACH's dataset

Dataset: CSV documents (x4)

- Device identifier
- Parameter: Energy, Power, Current and Voltage
- Datetime (30')
- Value

```
1  Dispositivo,Parametro,Data,Valore
2  abceb9db88193894b8fb,Potenza attiva,16:30:04 12/10/2020,"12,8900"
3  abceb9db88193894b8fb,Potenza attiva,16:31:04 12/10/2020,"12,9700"
4  abceb9db88193894b8fb,Potenza attiva,16:32:03 12/10/2020,"13,4400"
5  abceb9db88193894b8fb,Potenza attiva,16:33:03 12/10/2020,"13,2100"
6  abceb9db88193894b8fb,Potenza attiva,16:34:04 12/10/2020,"13,2400"
7  abceb9db88193894b8fb,Potenza attiva,16:35:04 12/10/2020,"13,3200"
8  abceb9db88193894b8fb,Potenza attiva,16:36:03 12/10/2020,"13,1000"
9  abceb9db88193894b8fb,Potenza attiva,16:37:03 12/10/2020,"13,2100"
10 abceb9db88193894b8fb,Potenza attiva,16:38:04 12/10/2020,"12,8800"
11 abceb9db88193894b8fb,Potenza attiva,16:39:04 12/10/2020,"13,2000"
```

REACH's dataset



Data driven technology for efficiency in energy intensive industries

Energy Intensive Industry (EII):

- *Flour mill*
- *Automotive*
- *Oil refinery*
- *Chemical*
- *Steel*
- *Aluminium*
- *Paper*

Data driven technology for efficiency in energy intensive industries

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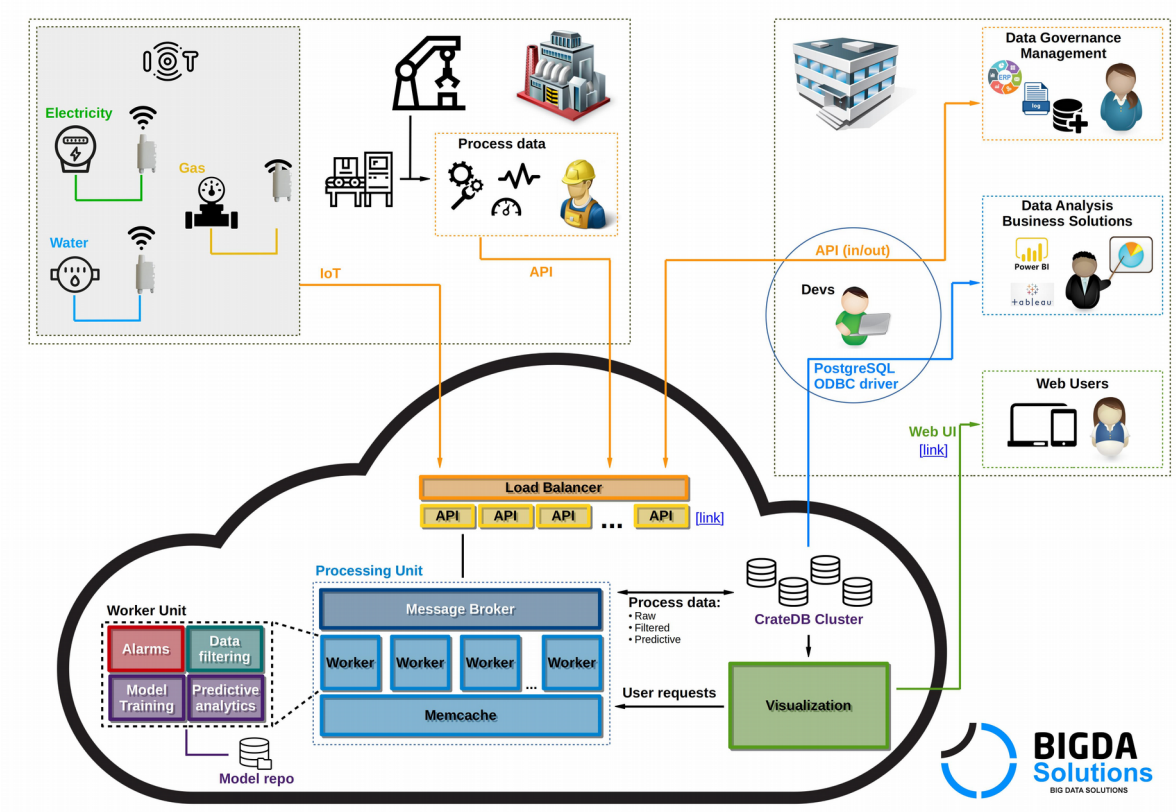
Doing more with less

Bigda Energy Management Platform



Data driven project

1 – Data acquisition

2 – Data storage

3 – Data cleaning (filter)

4 – Predictive models

5 – Alarms

6 - Reports

1 - Data acquisition

FastAPI

- OpenAPI
- JSON Schema
- Docker container

TBD on REACH

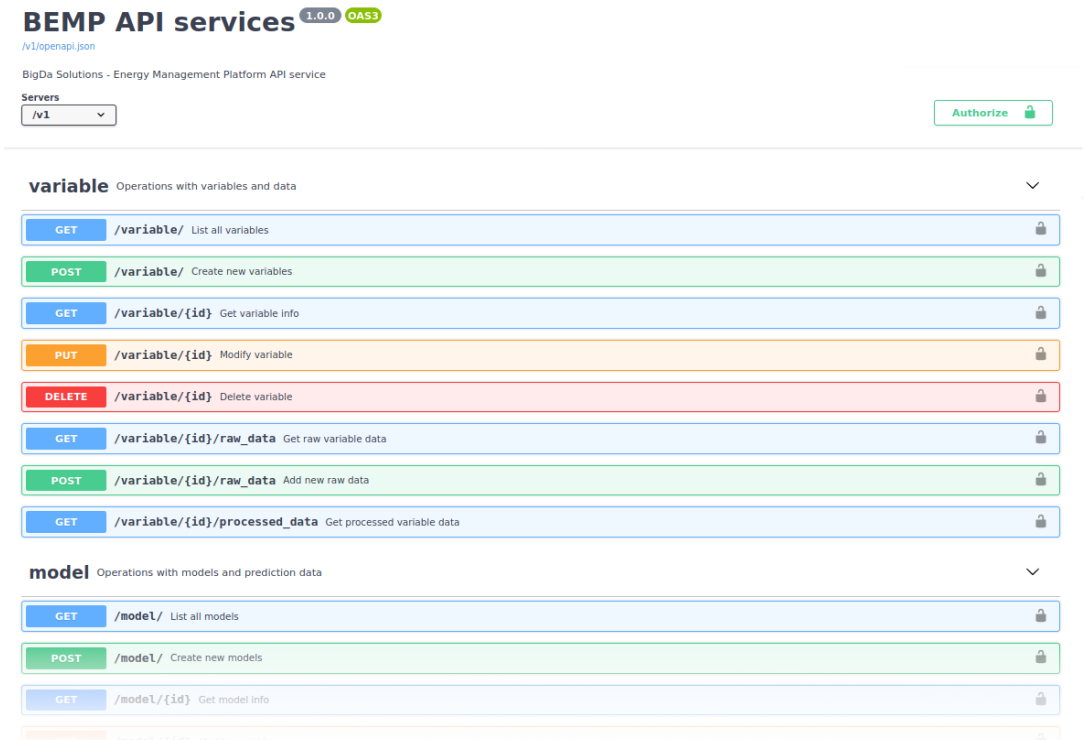
API framework on top of:

- **Starlette** Web framework
- **Uvicorn** ASGI server

https://api.bemp.bigdasolutions.com/v1/docs#/

1 - Data acquisition

FastAPI https://api.bemp.bigdasolutions.com/v1/docs#/



2 - Data storage

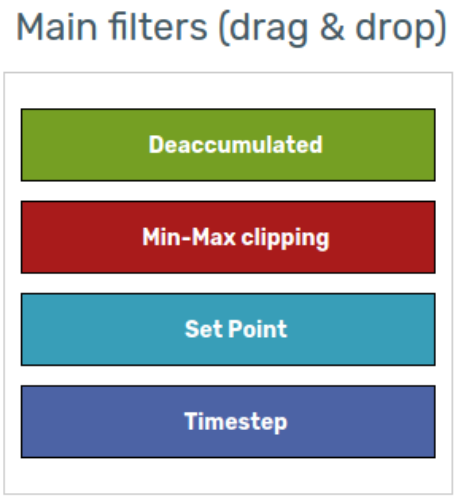
SQL database for relational and time-series data

- Huge capacity to record/manage data
- Time-series focusing IoT environments
- Simplicity to scale as a cluster (add nodes)
  → ability to scale query throughput linearly
- “Shared nothing” architecture
  → each node is independent and self-sufficient

3 - Data cleaning

BigDa own HTML5 development “block coding”

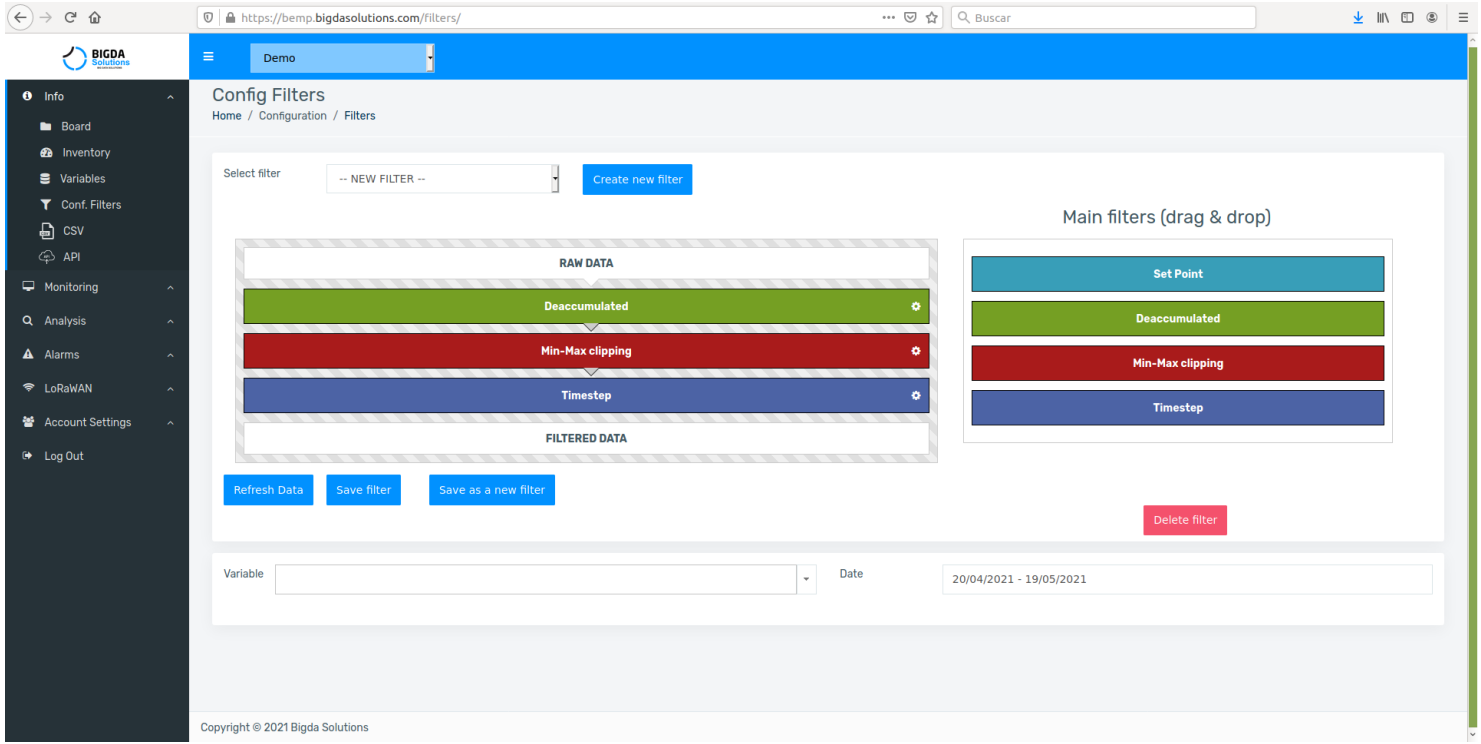
- De-accumulate
- Min-Max clipping
- Set Point (register only when value changes)
- Round time series (time step 15’, 30’ or 60’)



Advantages/Features:

- Not required to be a Data Scientist
- Apply to multiple variables
- Modify and apply to all historical data

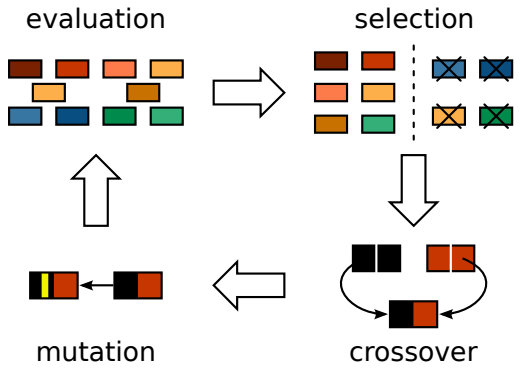
3 - Data cleaning



4 – Predictive models

Machine Learning predictive models

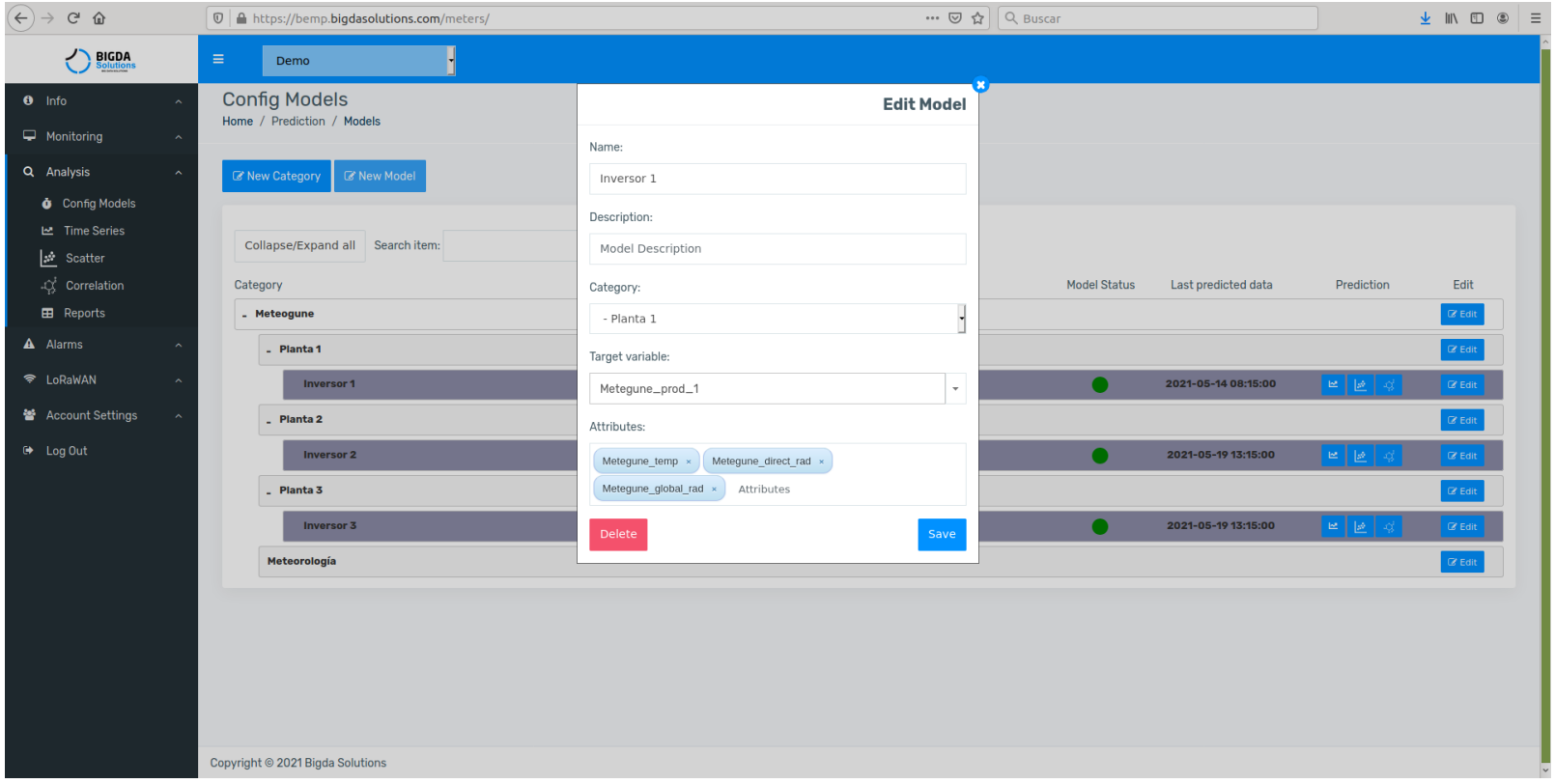
- Hyperparameter tunning
  → Genetic Algorithms (AutoML)
- Score to minimize (MAE)



Advantages/Features:

- Not required to be a Data Scientist
- IT takes ~1 hour to train each model
- Multiple models for 1 target (different features)

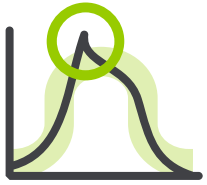
4 – Predictive models

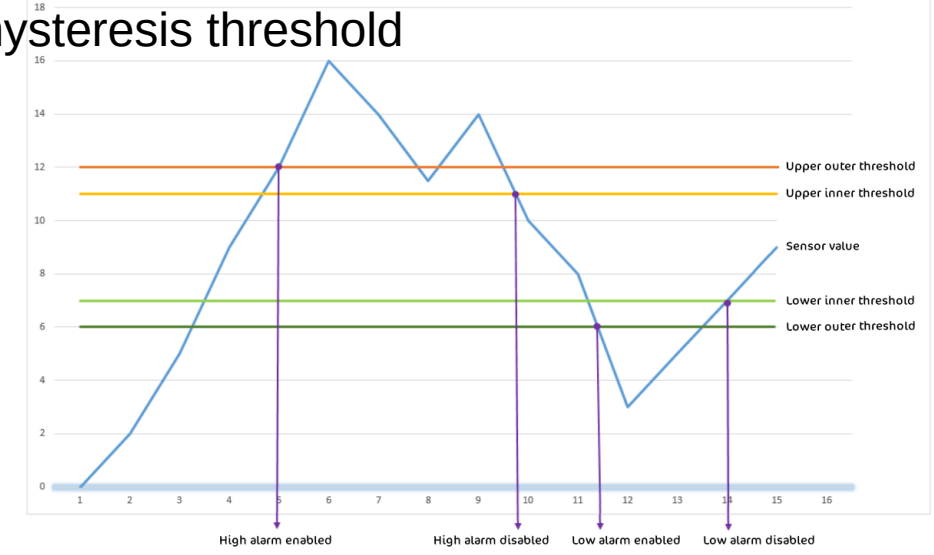


5 - Alamrs

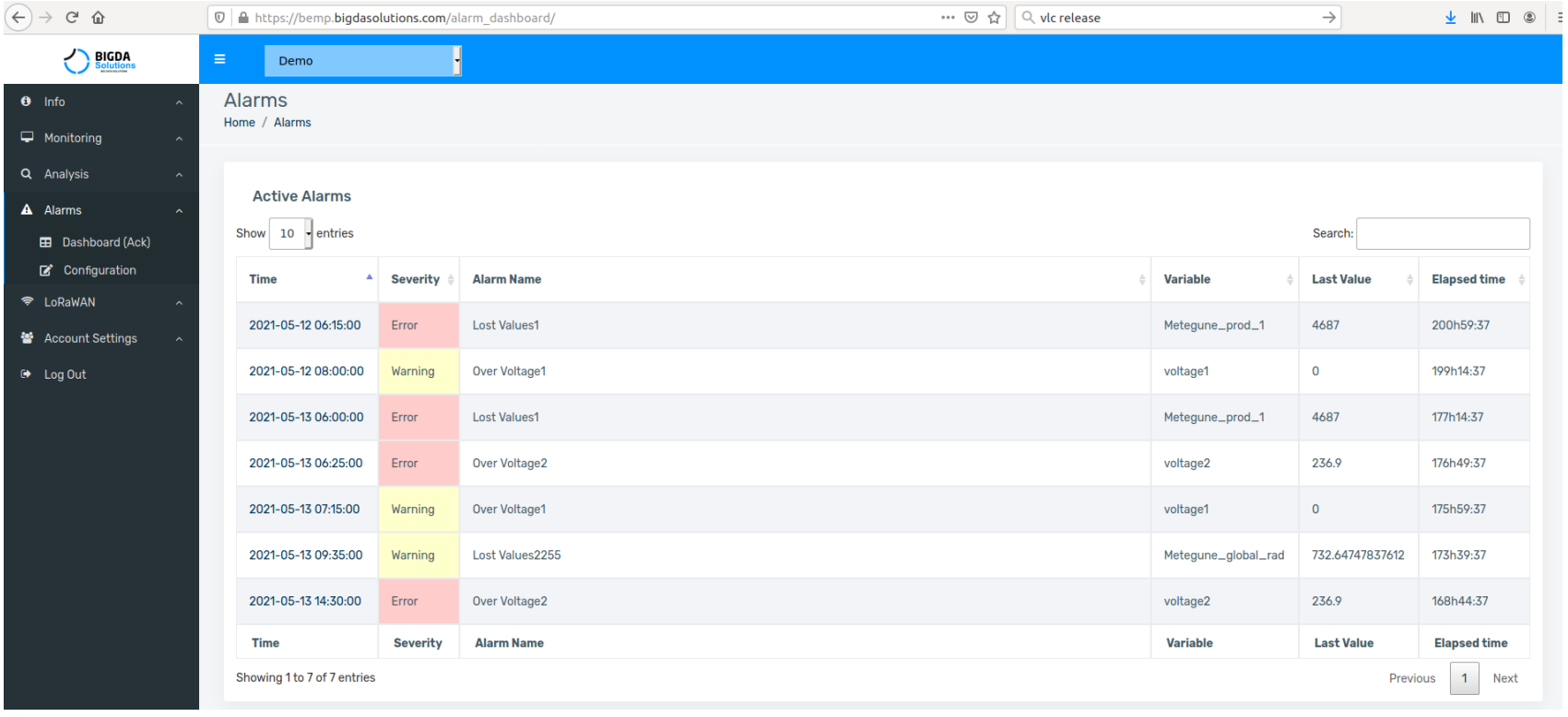
BigDa own HTML5 development “block coding”

- Comparison tunnel (e.g. Real vs Pred)
- Constant values
- Non signal/data
- Upper-lower hysteresis threshold





5 - Alarms

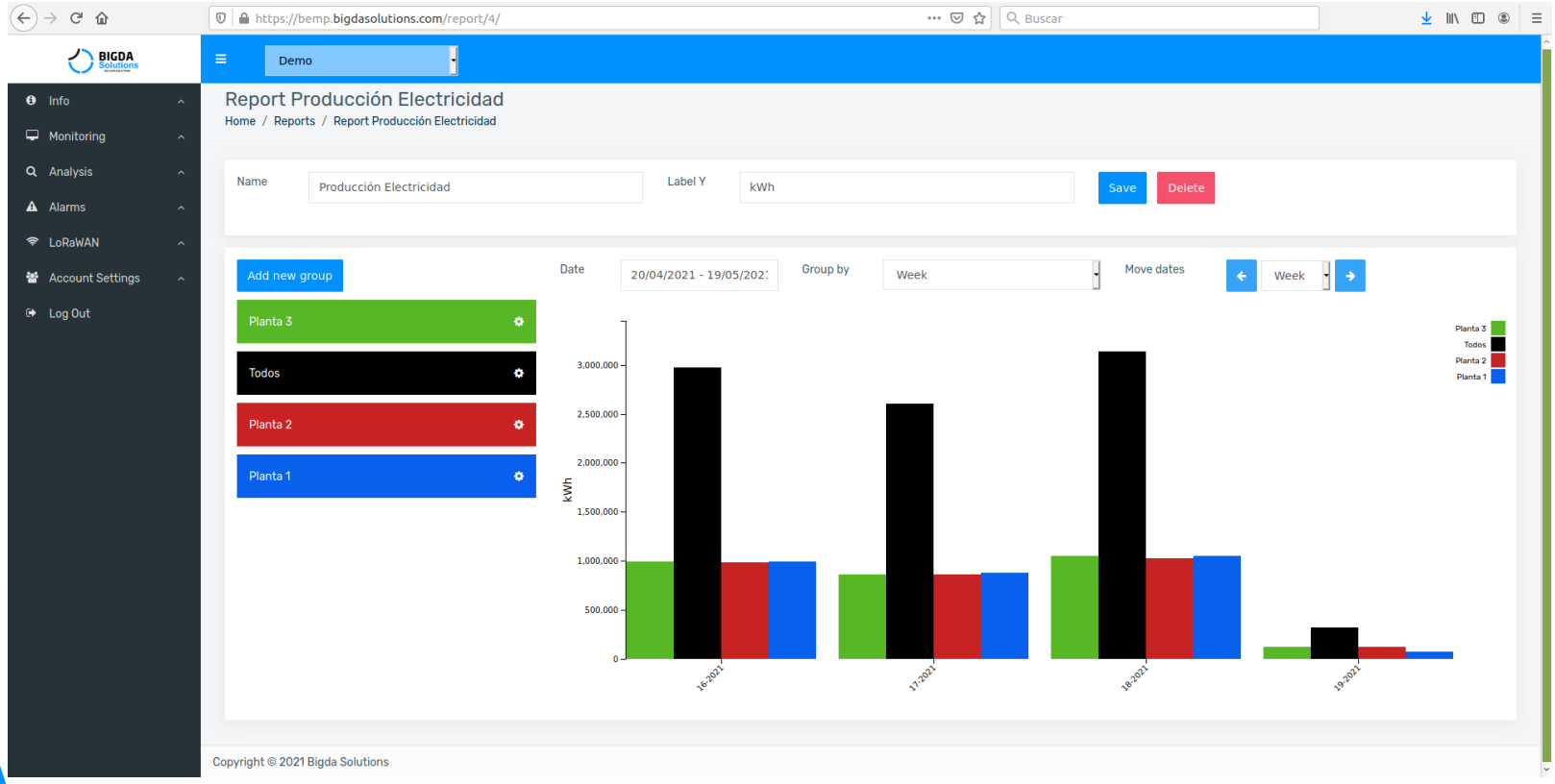

https://bemp.bigdasolutions.com/alarm_dashboard/
vlc release
BIGDA Solutions
Demo
Info
Monitoring
Analysis
Alarms
Dashboard (Ack)
Configuration
LoRaWAN
Account Settings
Log Out
Alarms
Home / Alarms
Active Alarms
Show 10 entries
Search:
Time
Severity
Alarm Name
Variable
Last Value
Elapsed time
2021-05-12 06:15:00
Error
Lost Values1
Metegune_prod_1
4687
200h59:37
2021-05-12 08:00:00
Warning
Over Voltage1
voltage1
0
199h14:37
2021-05-13 06:00:00
Error
Lost Values1
Metegune_prod_1
4687
177h14:37
2021-05-13 06:25:00
Error
Over Voltage2
voltage2
236.9
176h49:37
2021-05-13 07:15:00
Warning
Over Voltage1
voltage1
0
175h59:37
2021-05-13 09:35:00
Warning
Lost Values2255
Metegune_global_rad
732.64747837612
173h39:37
2021-05-13 14:30:00
Error
Over Voltage2
voltage2
236.9
168h44:37
Showing 1 to 7 of 7 entries
Previous
1
Next

6 - Reports

HTML5 development visualization tools – D3.js

- **Dynamic and configurable charts** that can be exported
- Configure sum/mean variables based on **grouped categories**
- **KPI ratios** of manufactured for business side (per ton, or per EUR)
- Customized reports with external Business Intelligence tools
  → Using ODBC connector: Power BI or Tableau

6 - Reports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Analysis
Alarms
LoRaWAN
Account Settings
Log Out
Report Producción Electricidad
Home / Reports / Report Producción Electricidad
Name
Producción Electricidad
Label Y
kWh
Save
Delete
Add new group
Planta 3
Todos
Planta 2
Planta 1
Date
20/04/2021 - 19/05/202
Group by
Week
Move dates
Week
kWh
3,000,000
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1,500,000
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500,000
0
16-2021
17-2021
18-2021
19-2021
Planta 3
Todos
Planta 2
Planta 1
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6 - Reports

BIGDA Solutions

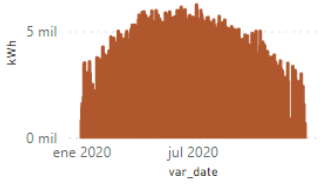
YEAR: 2019 | 2020 | 2021

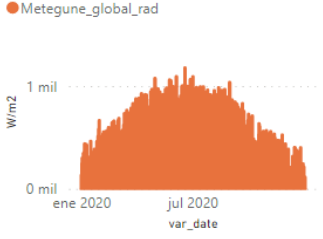
VARIABLE: Metegune_prod... | Metegune_prod... | Metegune_prod...

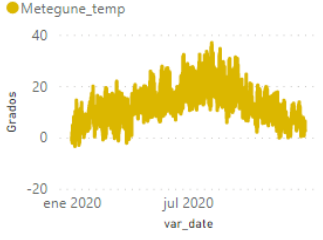
Día	enero	febrero	marzo	abril	mayo	junio	julio	agosto	septiembre	octubre	noviembre	diciembre
1	16.819,0	87.208,0	107.246,0	54.155,0	93.949,0	196.250,0	140.563,0	83.152,0	183.895,0	51.252,0	72.970,0	30.415,0
2	40.315,0	88.550,0	86.841,0	90.894,0	203.932,0	175.518,0	89.586,0	74.010,0	191.270,0	67.630,0	56.448,0	36.103,0
3	11.221,0	97.336,0	95.028,0	204.452,0	220.489,0	63.754,0	213.413,0	162.711,0	198.916,0	60.324,0	29.329,0	42.430,0
4	40.524,0	36.243,0	70.012,0	209.176,0	154.575,0	120.642,0	229.963,0	157.319,0	190.394,0	59.353,0	62.810,0	39.412,0
5	66.459,0	118.212,0	76.640,0	183.057,0	201.552,0	219.432,0	241.977,0	210.183,0	55.861,0	89.351,0	93.493,0	16.770,0
6	81.131,0	113.472,0	66.895,0	58.194,0	226.311,0	104.200,0	80.424,0	208.347,0	70.760,0	83.654,0	7.254,0	13.202,0
7	41.563,0	103.322,0	37.785,0	62.173,0	153.636,0	92.377,0	241.273,0	140.569,0	134.202,0	74.250,0	29.080,0	9.829,0
8	70.676,0	14.652,0	92.723,0	177.825,0	142.617,0	95.127,0	203.871,0	190.831,0	193.598,0	87.415,0	66.339,0	25.255,0
9	66.118,0	59.637,0	81.866,0	185.166,0	135.508,0	128.313,0	211.613,0	189.082,0	183.123,0	25.136,0	90.423,0	24.304,0
10	25.293,0	105.695,0	122.909,0	79.471,0	67.641,0	102.658,0	101.486,0	134.874,0	185.521,0	50.765,0	55.090,0	14.684,0
11	61.511,0	22.227,0	151.587,0	78.376,0	132.162,0	53.133,0	199.060,0	90.698,0	178.981,0	57.472,0	90.598,0	30.884,0
12	37.472,0	48.611,0	29.837,0	111.599,0	123.236,0	144.616,0	148.727,0	140.220,0	157.377,0	74.523,0	97.748,0	10.638,0
13	62.362,0	77.195,0	82.910,0	169.755,0	112.460,0	146.910,0	235.444,0	158.875,0	168.338,0	43.696,0	80.922,0	33.317,0
14	69.192,0	92.234,0	169.556,0	164.987,0	52.738,0	162.819,0	233.374,0	171.531,0	119.600,0	24.616,0	61.763,0	50.088,0
15	35.758,0	93.351,0	145.775,0	142.253,0	41.763,0	154.793,0	185.614,0	158.733,0	148.773,0	29.147,0	18.078,0	73.455,0
16	66.386,0	81.770,0	16.570,0	108.328,0	75.711,0	99.639,0	174.294,0	148.903,0	143.056,0	46.902,0	55.695,0	36.447,0
17	20.710,0	20.156,0	23.116,0	91.372,0	228.750,0	118.441,0	133.583,0	85.483,0	83.461,0	97.624,0	71.937,0	46.706,0
18	33.133,0	74.776,0	94.835,0	160.069,0	254.725,0	190.062,0	242.351,0	110.770,0	79.114,0	114.890,0	90.922,0	66.921,0
19	39.421,0	113.603,0	137.146,0	30.178,0	254.149,0	260.066,0	227.704,0	193.242,0	50.327,0	117.772,0	25.893,0	17.608,0
20	26.234,0	138.994,0	138.101,0	94.575,0	253.620,0	233.029,0	228.535,0	169.373,0	99.573,0	18.297,0	61.451,0	42.991,0
21	6.440,0	95.693,0	153.447,0	38.646,0	228.415,0	254.093,0	175.896,0	58.276,0	97.499,0	48.821,0	94.591,0	41.523,0
22	43.530,0	127.358,0	177.226,0	28.170,0	233.277,0	228.144,0	170.265,0	182.383,0	94.909,0	56.499,0	89.523,0	57.208,0
23	25.070,0	142.427,0	75.580,0	155.184,0	78.231,0	242.196,0	130.325,0	197.710,0	93.192,0	82.574,0	56.284,0	26.206,0
24	46.279,0	128.320,0	142.027,0	97.288,0	229.318,0	193.002,0	210.661,0	179.546,0	98.167,0	85.122,0	72.819,0	45.815,0
25	26.619,0	64.661,0	160.856,0	138.792,0	105.173,0	103.077,0	227.740,0	205.731,0	57.754,0	13.816,0	73.873,0	40.384,0
26	65.846,0	72.990,0	137.339,0	81.236,0	244.209,0	184.025,0	226.253,0	202.190,0	33.232,0	72.022,0	15.216,0	31.702,0
27	15.698,0	35.622,0	190.217,0	143.027,0	242.942,0	181.664,0	214.145,0	175.739,0	70.750,0	42.151,0	21.417,0	10.797,0
28	88.634,0	111.884,0	191.803,0	115.740,0	252.044,0	193.004,0	78.390,0	34.017,0	106.744,0	63.843,0	76.252,0	27.523,0
Total	**1.422.268,0**	**2.400.290,0**	**3.307.537,0**	**3.469.790,0**	**5.376.817,0**	**4.776.627,0**	**5.719.951,0**	**4.560.073,0**	**3.730.504,0**	**2.074.412,0**	**1.827.014,0**	**1.005.179,0**

Month: Todas

Day: Todas







Data governance and legal compliance

General Data Protection Regulation (GDPR)

European change in data privacy regulation (14 April 2016)

25 May 2018

+ applies to "**personal data**" (identifiable person)
  - compliance from the users to provide some services:

Password access (recover)
Manage users accounts
Provide support

+ Data Protection Officer (DPO)
  - not required

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Communications

External: Encrypted with SSL protocols (HTTPS and MQTTs)
Internal: Virtual Private Network → Secure private network

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API: Virtual Private Network → Secure private network

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Logs

Historical traceability → Detect issues of users

Quality assurance

API → Machine 2 Machine communication

- OpenAPI standards with JSON Schema
- Automate services (Jupyter notebook examples)
- TechEmposer → “one of the fastest Python frameworks available”

Composite Framework Scores

Each framework's peak performance in each test type (shown in the colored columns below) is multiplied by the weights shown above. The results are then summed to yield a weighted score. Only frameworks that implement all test types are included. ***100 total frameworks ranked, 19 visible, 81 hidden by filters. See filter panel above.***

Rnk	Framework	JSON	1-query	20-query	Fortunes	Updates	Plaintext	Weighted score	
34	uvicorn	420,930	101,508	15,638	72,384	7,069	427,794	**2,510**	16.6%
38	starlette	337,139	85,960	15,695	60,897	7,107	286,158	**2,263**	15.0%
48	fastapi	176,759	69,999	15,677	52,570	7,119	165,169	**1,965**	13.0%
54	api_hour	893,034	43,976	7,146	28,052	3,995	105,161	**1,868**	12.4%
57	aiohttp	141,639	64,928	12,862	33,671	5,457	155,050	**1,514**	10.0%
60	bottle	240,254	59,615	8,233	37,172	3,714	297,074	**1,373**	9.1%
63	responder	29,027	24,426	10,412	22,954	6,398	29,423	**1,270**	8.4%
70	morepath	188,510	46,128	6,215	18,918	3,187	245,523	**1,037**	6.9%
72	flask	67,749	37,184	6,985	25,689	3,847	90,444	**985**	6.5%
75	weppy	212,647	32,905	5,419	17,238	1,767	290,416	**845**	5.6%
82	quart	53,047	34,451	13,676	29,213	7	57,977	**616**	4.1%
84	pyramid	151,684	20,181	1,106	16,210	1,035	310,264	**584**	3.9%
85	web2py	39,307	10,124	5,842	11,051	1,946	41,144	**516**	3.4%
88	turbogears	65,656	15,530	1,276	12,350	816	77,314	**343**	2.3%
89	django	63,452	20,421	1,596	11,381	766	67,880	**339**	2.3%
96	spyne	7,388	6,321	1,119	2,365	18	7,718	**63**	0.4%
98	racket	1,824	1,138	67	969	67	1,558	**21**	0.1%
99	klein	1,842	667	78	597	37	1,972	**14**	0.1%

Quality assurance

API → Machine 2 Machine communication

- OpenAPI standards with JSON Schema
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Database → Time series specific for IoT environment

- Shared nothing architecture
  → Provide service without interruption
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Processing services → Uptime of modules

- Docker containers: independent environments
- Kubernetes for containers orchestration

Risk management

API → “Open window” to external communication

- OpenAPI standards with JSON Schema
- On top of:
  - **Uvicorn** ASGI server
  - **Starlette** web framework

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Processing services → Uptime of modules

- Built and run on containers
- Avoid total blackouts

Scalability and flexibility

DATA
Preparation & Cleaning

Cloud

On premises

MACHINE LEARNING
Built for Forecasting

Train your own models

Machine Learning APIs

FORECASTING

Continuosly
+
Recommendation
=
Real Time Energy Management

Bigda Energy Management Platform