Test Case

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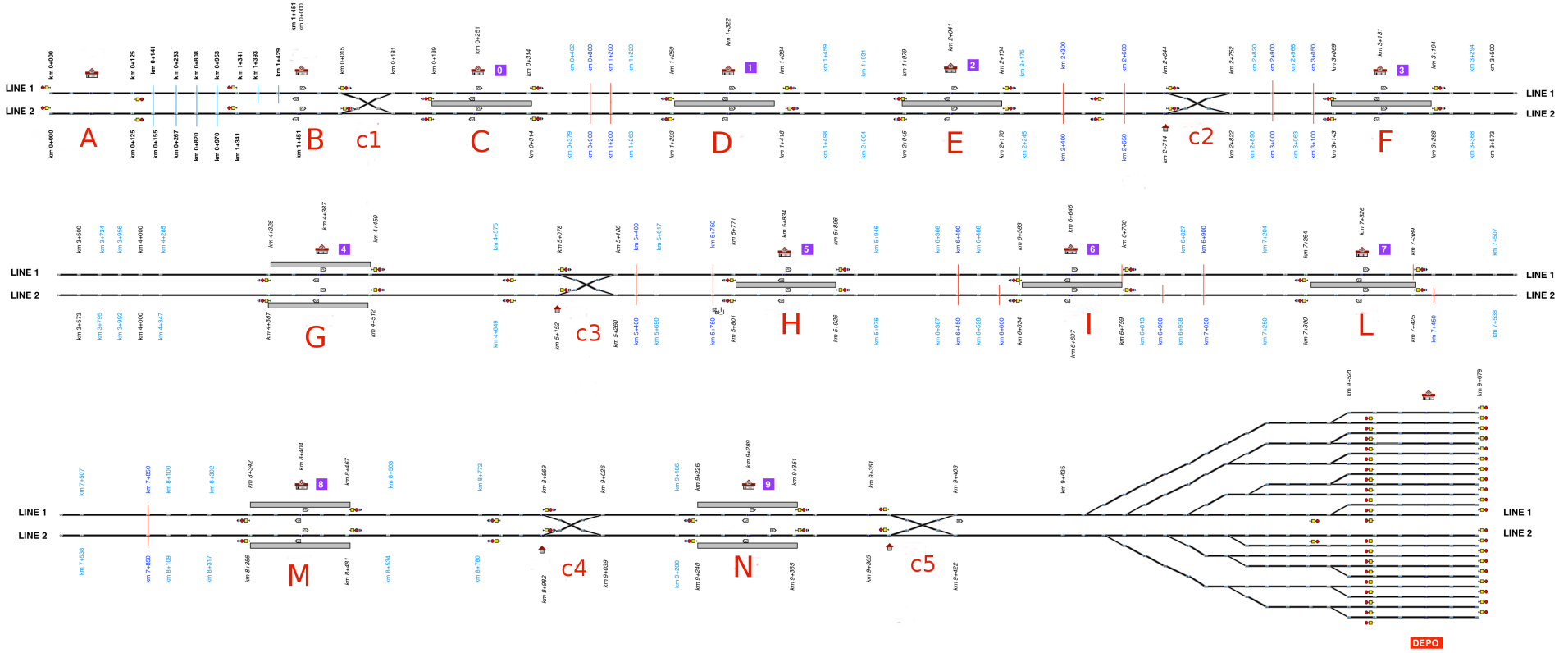

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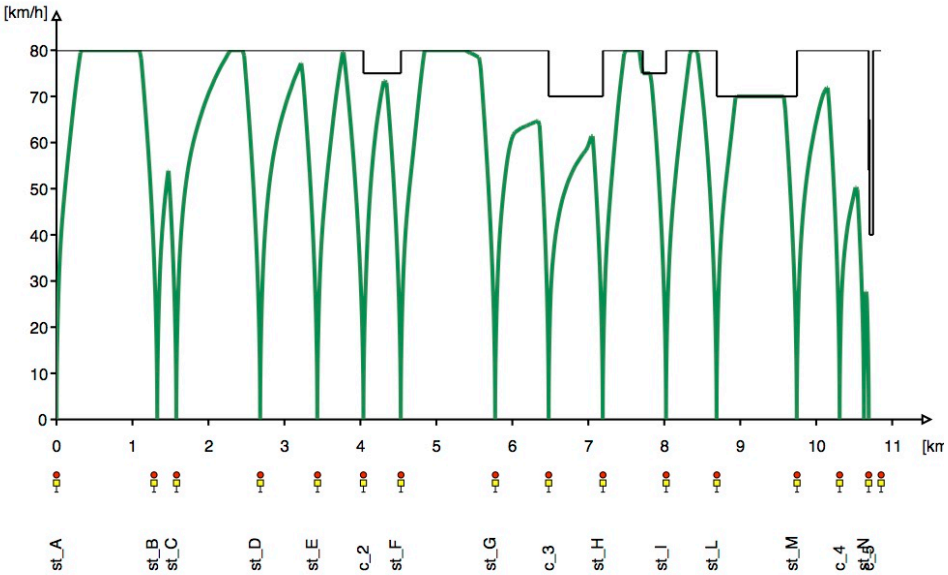
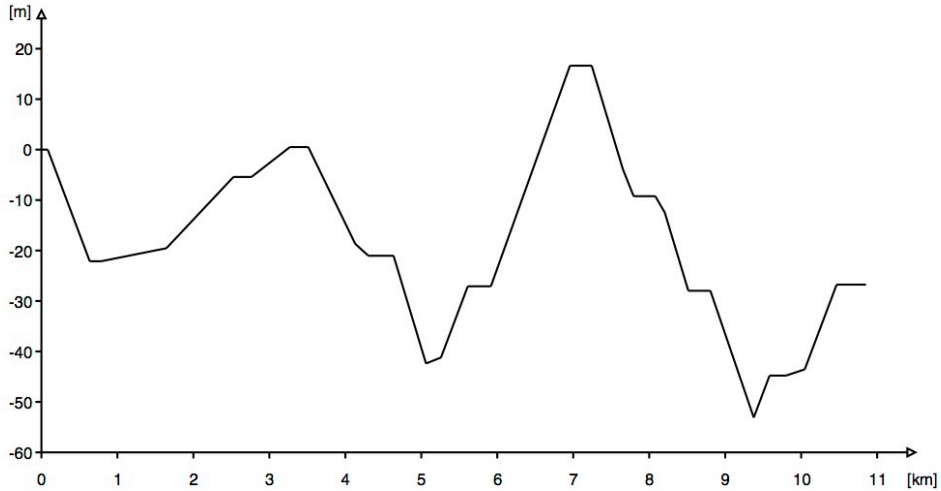
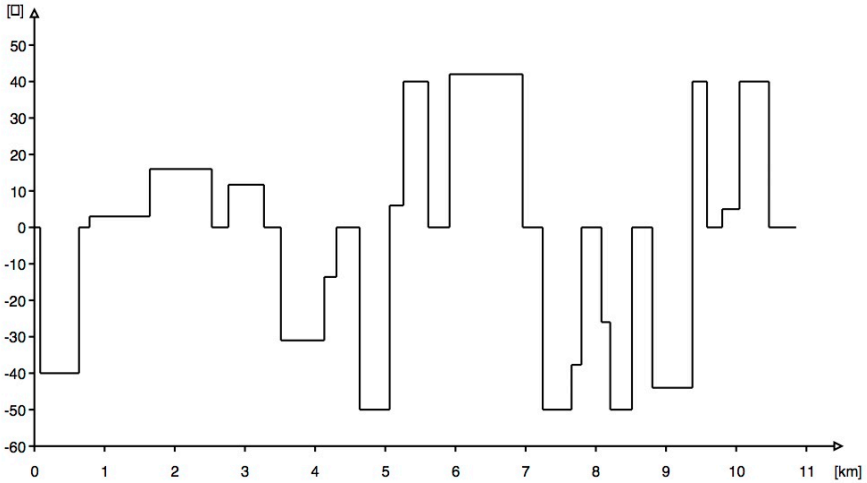




- Altitude



- Slope

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Test Case: Details

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Station	Speed Limit
A	80 km/h
B	80 km/h
C	80 km/h
D	80 km/h
E	80 km/h
c_2	75 km/h
G	80 km/h
c_3	80 km/h
h	70 km/h
I	80 km/h
L	70 km/h
M	80 km/h
c_4	80 km/h
N	80 km/h
c_5	

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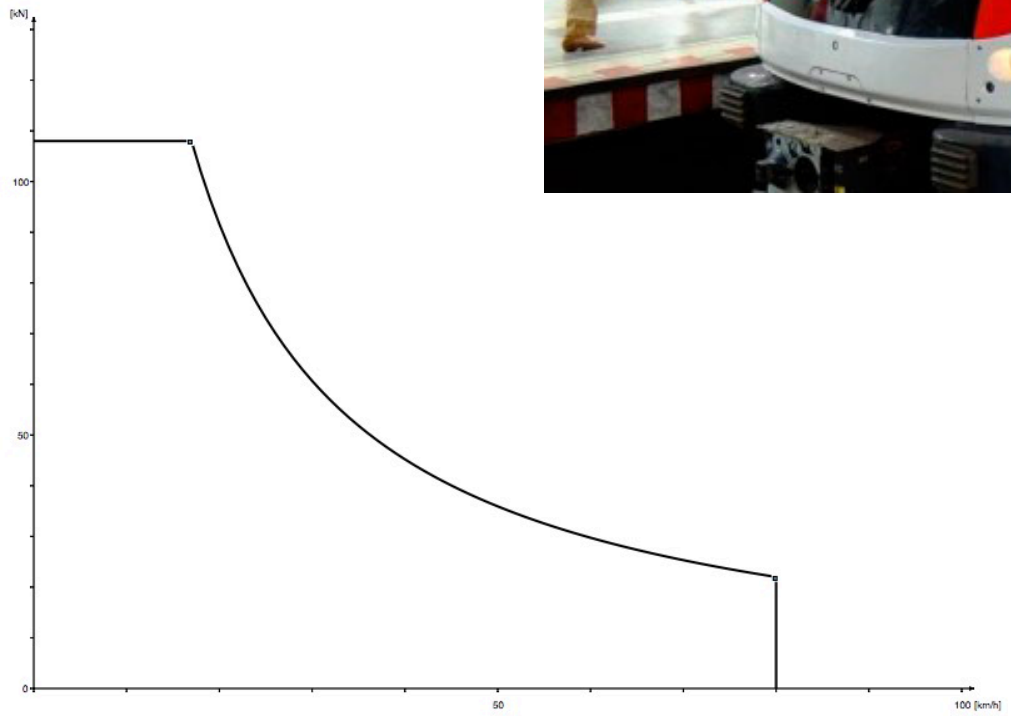

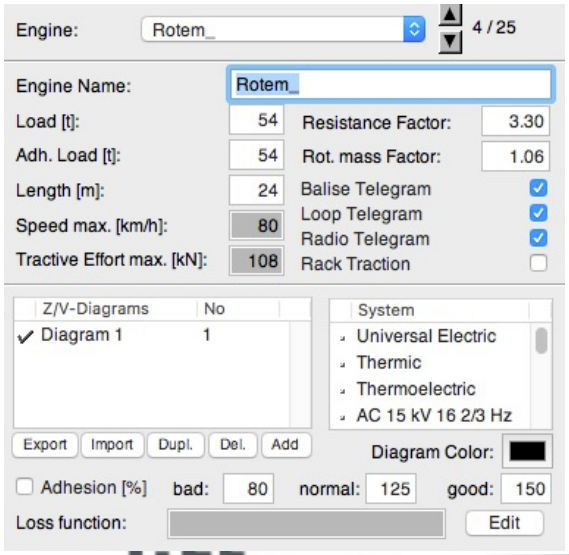

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Open Track Api

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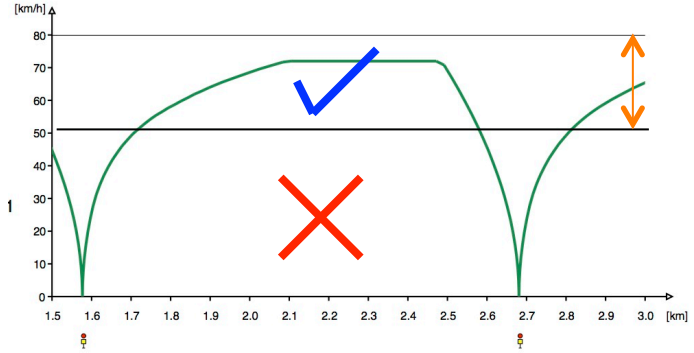
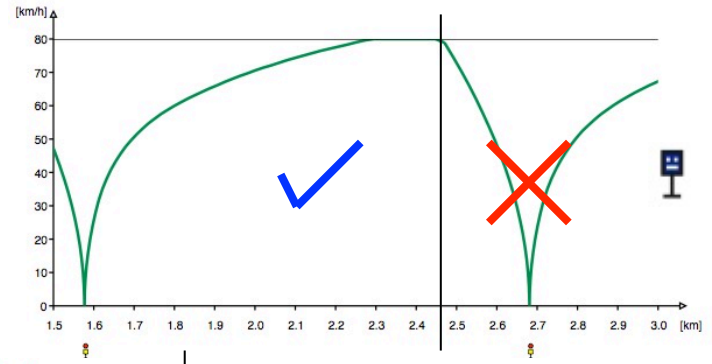
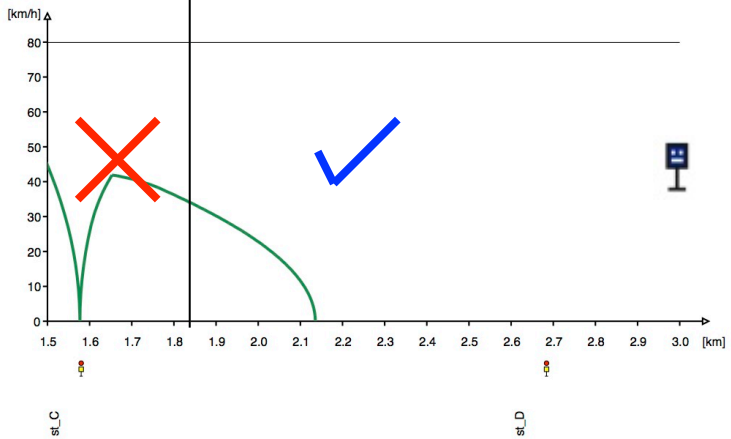


80 km/h
50 km/h

Speed limit range



Maximum time to engine off (before breaking)



Minimun time to engine off (to reach the following station)

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Results

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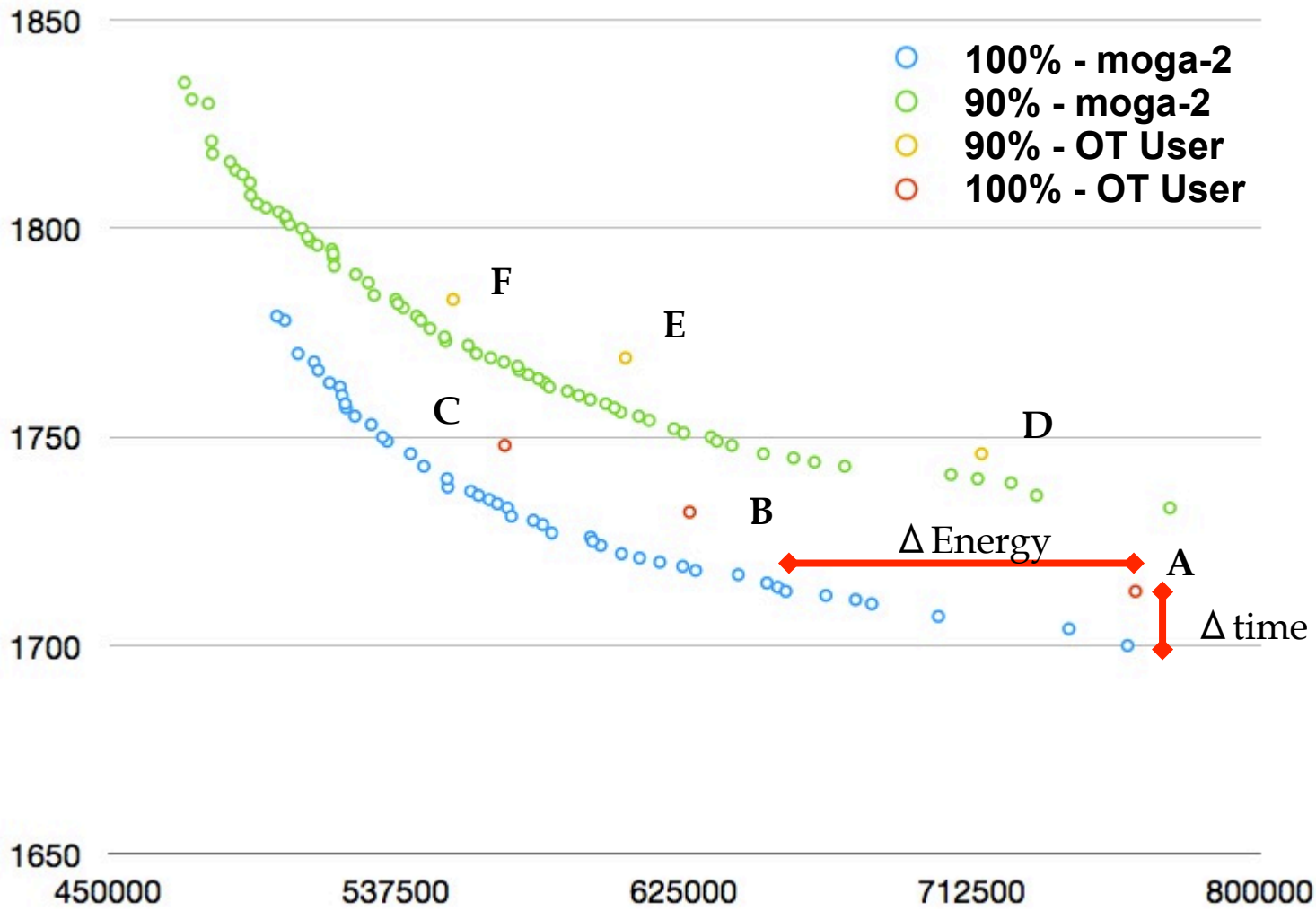

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Comparison

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Performance 100%								
	User OT		moga-2					
Point	Energy	Time	Energy	Time	ΔTime %	Energy	Time	ΔEnergy %
A	762028	1713	759631	1700	0.76	655783	1713	13.94
B	626552	1732	624460	1719	0.75	572404	1731	8.64
C	570388	1748	568163	1734	0.80	534674	1749	6.26

Performance 90%								
	User OT		moga-2					
Point	Energy	Time	Energy	Time	ΔTime %	Energy	Time	ΔEnergy %
D	715276	1746	714079	1740	0.34	648951	1746	9.27
E	607052	1769	605612	1756	0.73	566103	1769	6.75
F	554677	1783	552414	1773	0.56	537253	1783	3.14

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Open Track Api

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	Performances 100%			Example Solution Moga-2			
STATION	Time			Time		Margins	ΔTime %
A		01:00:00			01:00:00		
B	01:01:22	01:02:22		01:01:27	01:02:27	00:00:05	5.81%
C	01:02:54	01:03:54		01:03:00	01:04:00	00:00:01	1.16%
D	01:05:09	01:06:09		01:05:28	01:06:28	00:00:13	15.12%
E	01:07:08	01:08:08		01:07:43	01:08:43	00:00:16	18.60%
C2	01:09:00	01:10:00		01:09:40	01:10:40	00:00:05	5.81%
F	01:10:44	01:11:44		01:11:26	01:12:26	00:00:02	2.33%
G	01:13:03	01:14:03		01:13:55	01:14:55	00:00:10	11.63%
C3	01:15:00	01:16:00		01:15:54	01:16:54	00:00:02	2.33%
H	01:17:04	01:18:04		01:18:00	01:19:00	00:00:02	2.33%
I	01:19:05	01:20:05		01:20:08	01:21:08	00:00:07	8.14%
L	01:20:58	01:21:58		01:22:09	01:23:09	00:00:08	9.30%
M	01:23:12	01:24:12		01:24:29	01:25:29	00:00:06	6.98%
C4	01:25:00	01:26:00		01:26:24	01:27:24	00:00:07	8.14%
N	01:26:38	01:27:38		01:28:04	01:29:04	00:00:02	2.33%
C5	01:27:54			01:29:20		00:00:00	0.00%
TOTAL	00:27:54			00:29:20		00:01:26	

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MOGA-II Results

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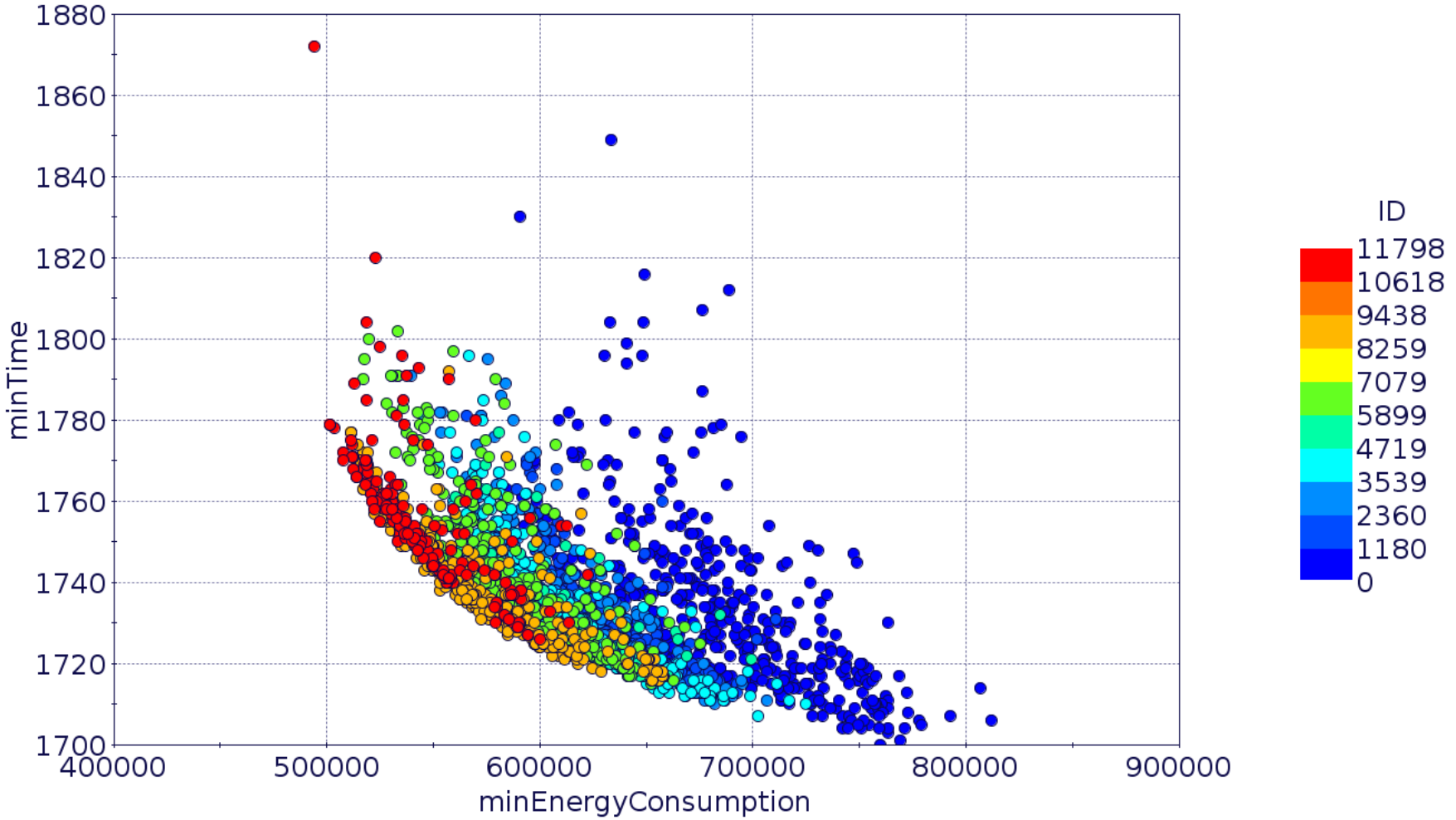

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NSGA-II Results

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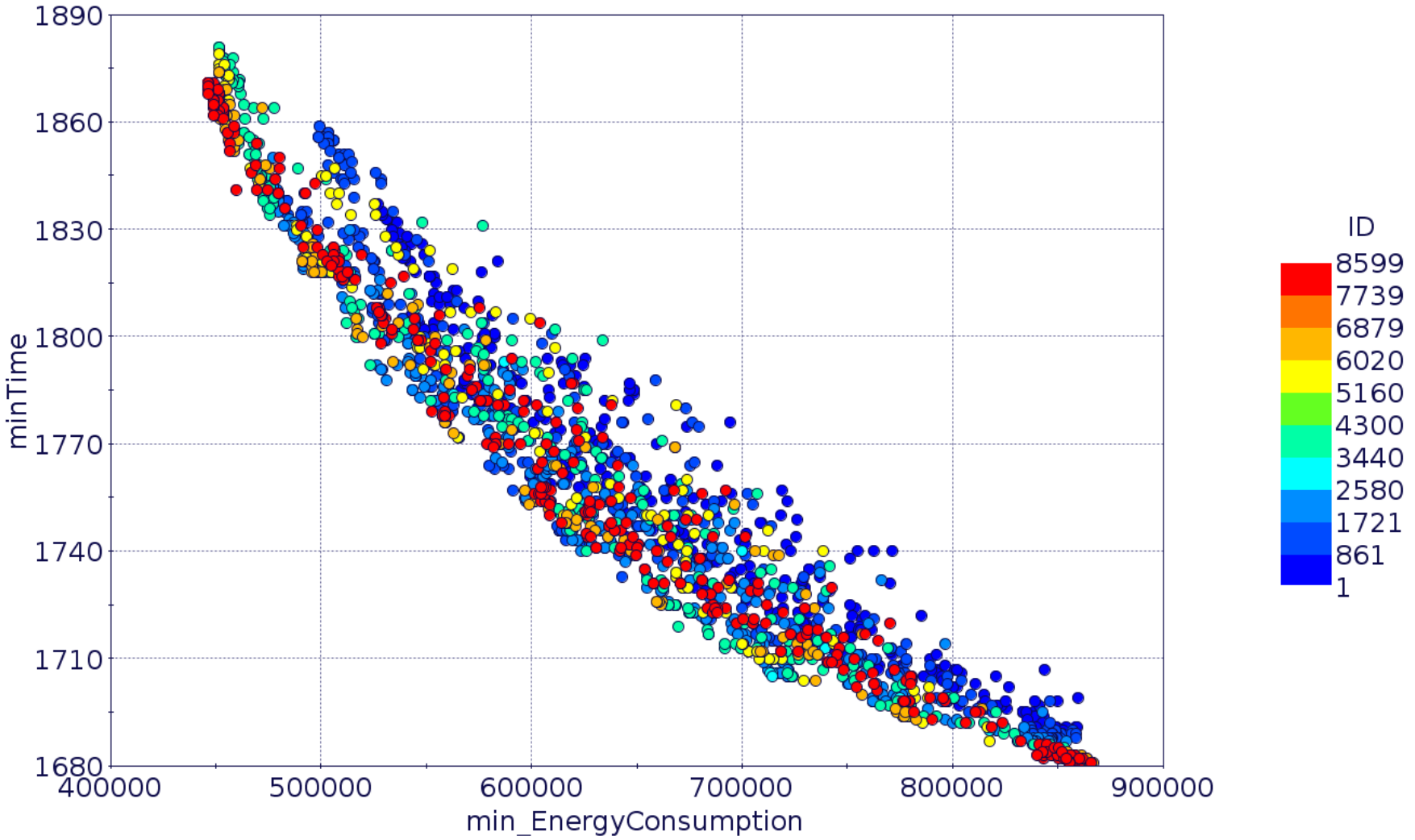

MOGA-2 and NSGA-2 Comparison

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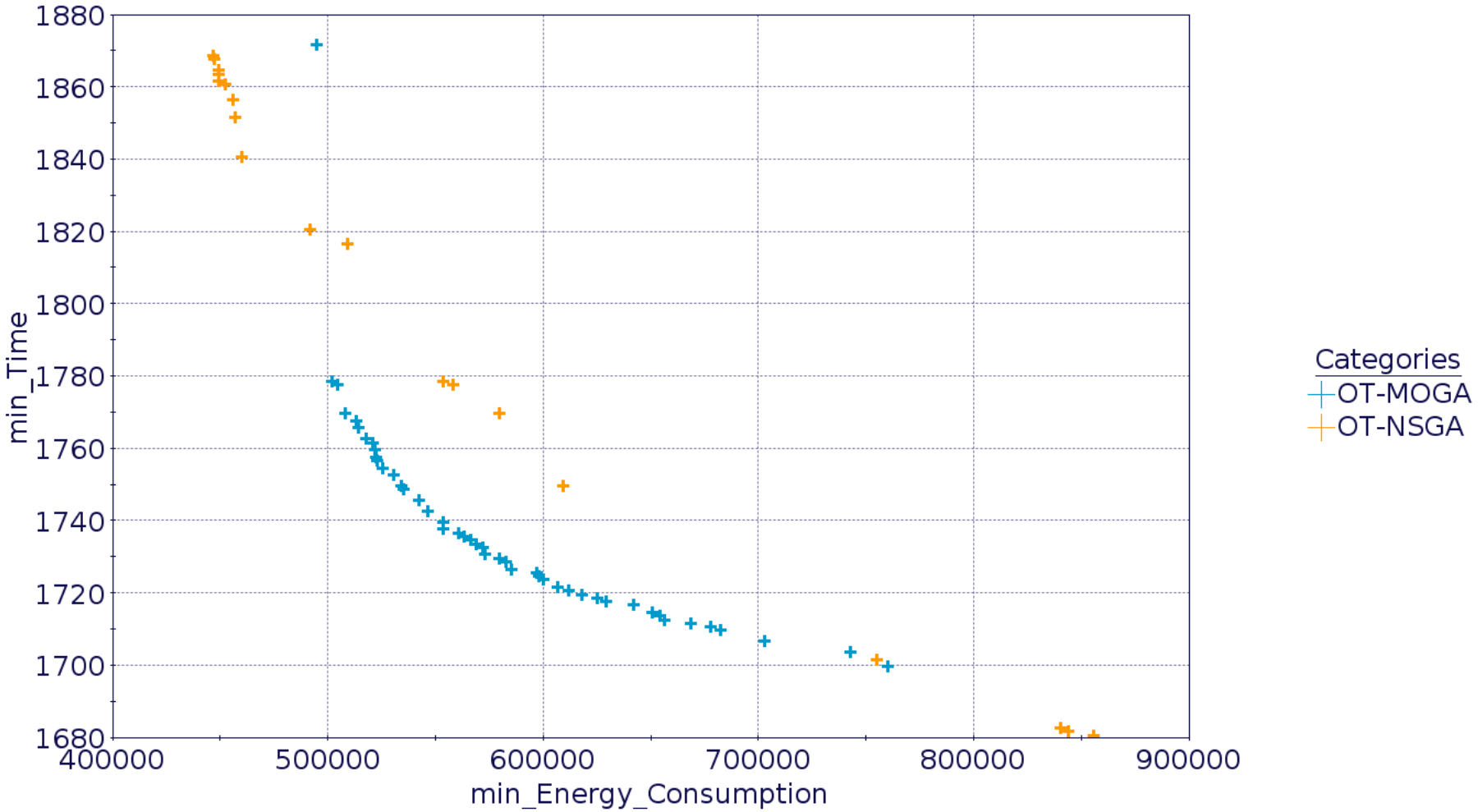

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Regeneration

File *.tsvP

```
public void mecPower() throws IOException {
    for (int a = 0; a < 25; a++)
        if (this.tsvp.readLine() == null)
            System.out.println("File bad format!!!");
    String lastline = null;
    while ((line=tsvp.readLine())!= null) {
        String[] dati = line.split("\\t", 8);
        calcMacPower(valueOf(dati[7]) );
    }
}
public void calcMacPower(double value) {
    consumi = consumi + value;
}
```

Mech. Power

Power In

```
public void mecPower() throws IOException {
    for (int a = 0; a < 25; a++)
        if (this.tsvp.readLine() == null)
            System.out.println("File bad format!!!");
    String lastline = null;
    while ((line=tsvp.readLine())!= null) {
        String[] dati = line.split("\\t", 8);
        calcMacPower(valueOf(dati[6]) );
    }
}
public void calcMacPower(double value) {
    consumi = consumi + value;
}
```

Results

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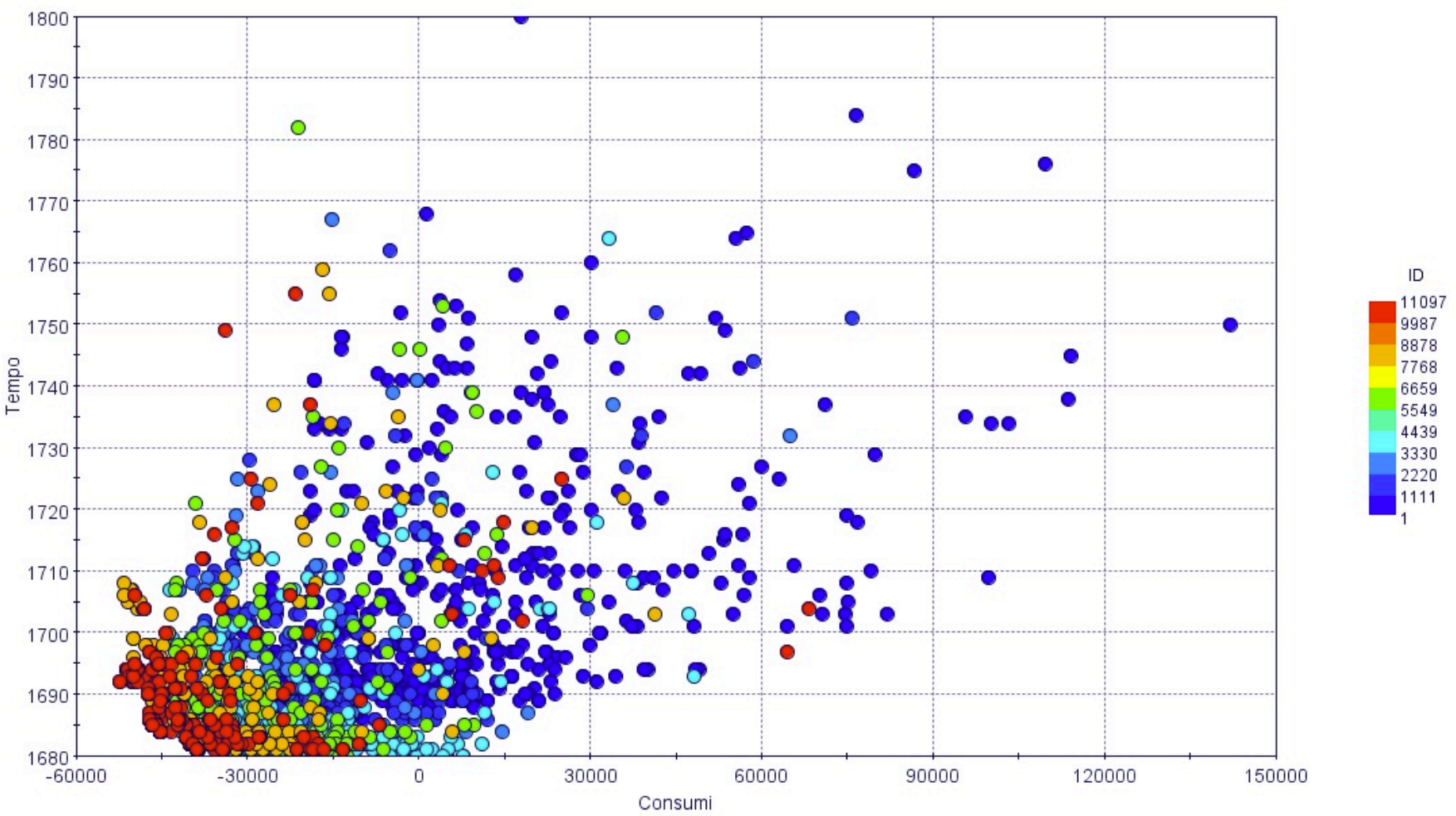

Rigenerazione pura

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Results

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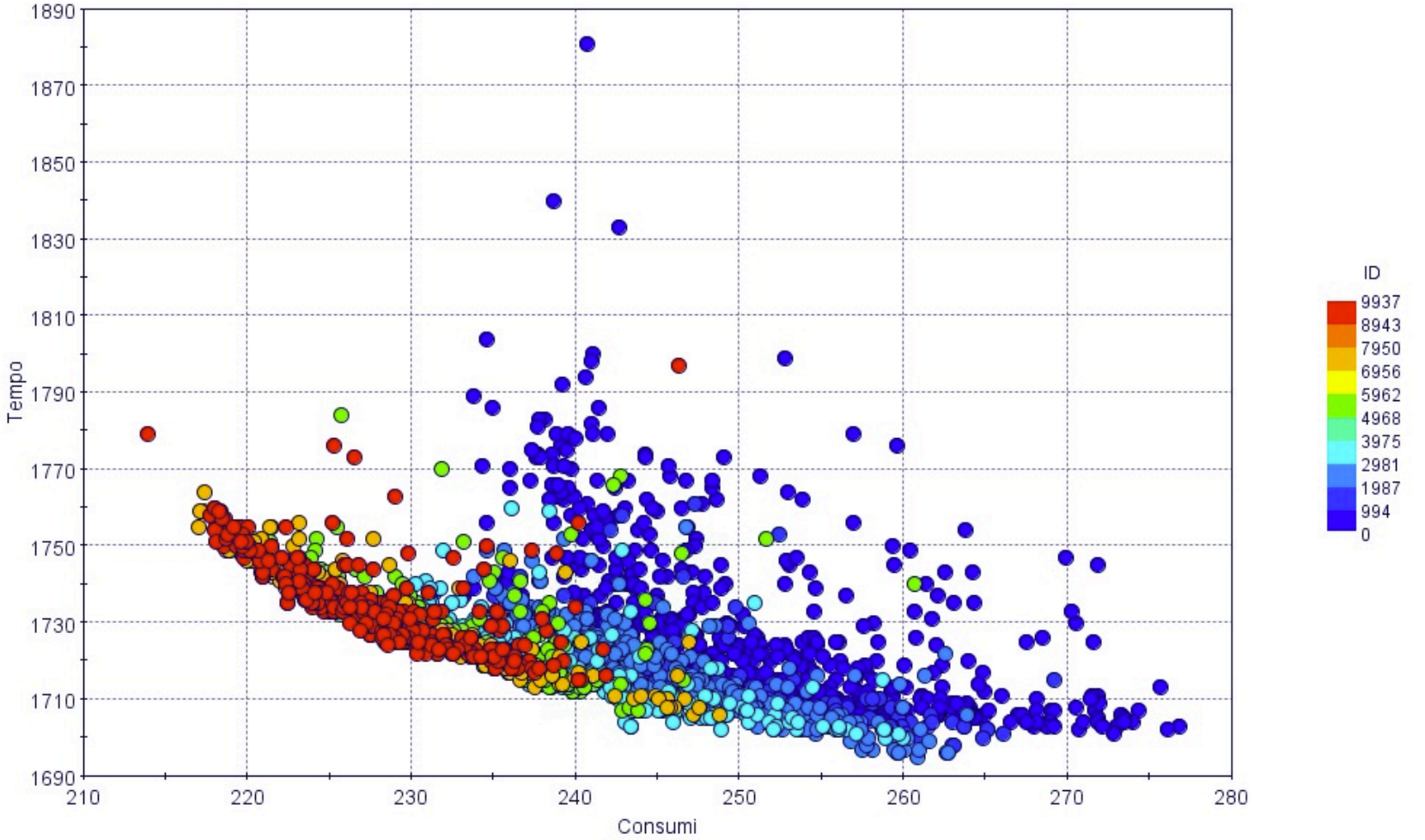

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Conclusions

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- API makes it possible to create a connection to a third party optimization tool
- This may allow to use OpenTrack as micro-simulation engine and increase its potentials
  - ✓ OpenTrack model with API license
  - ✓ Identify exactly Input and Output variables and what is fixed
  - ✓ Optimization tool license
- Increase the number of simulated scenarios (thousands instead of few)
- Increase the quality of results
- First tests are promising

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Further developments

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- Extend the application to real life problems by using existing API commands
- Suggest the development of specific new commands within API
- Analyze the performances of existing optimization algorithms for railway specific applications
- Development of possible improved algorithms

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