

## ***Operations & Maintenance:***

***An integrated approach to enhance safety and reliability of  
distribution networks***

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**AEM Gas S.p.a.**

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- Maintenance criteria**
- Load trends**
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# The network



## Gas Distribution Network

Gas distribution network	Km	3,000
Service lines	Km	7,000
Gas distributed per year	Mm <sup>3</sup>	1,200
Delivery points	n°	850,000
Primary stations	n°	12
Secondary stations	n°	6
District governors	n°	250

## The network

### **LENGTH OF THE UNDERGROUND GAS NETWORK**

❑ **Total network: 3,000 km**

❑ **Low pressure network: 2,400 km**

of which:

- 600 km steel
- 700 km ductile iron
- 500 km cast iron
- 400 km PE
- 200 km grey cast iron (**Lead-Yarn Junction**)

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## THE MULTIPLICATIVE MODEL

$$\begin{aligned} & \mathbf{RISK} \\ & = \\ & \mathbf{Probability\ of\ a\ bad\ event} \\ & \mathbf{X} \\ & \mathbf{Magnitudo\ of\ bad\ consequences} \end{aligned}$$

$$\mathbf{R = P \times M}$$

## Maintenance criteria

### **PROBABILITY OF A BAD EVENT**

**P** = **P** *breakage* **X**

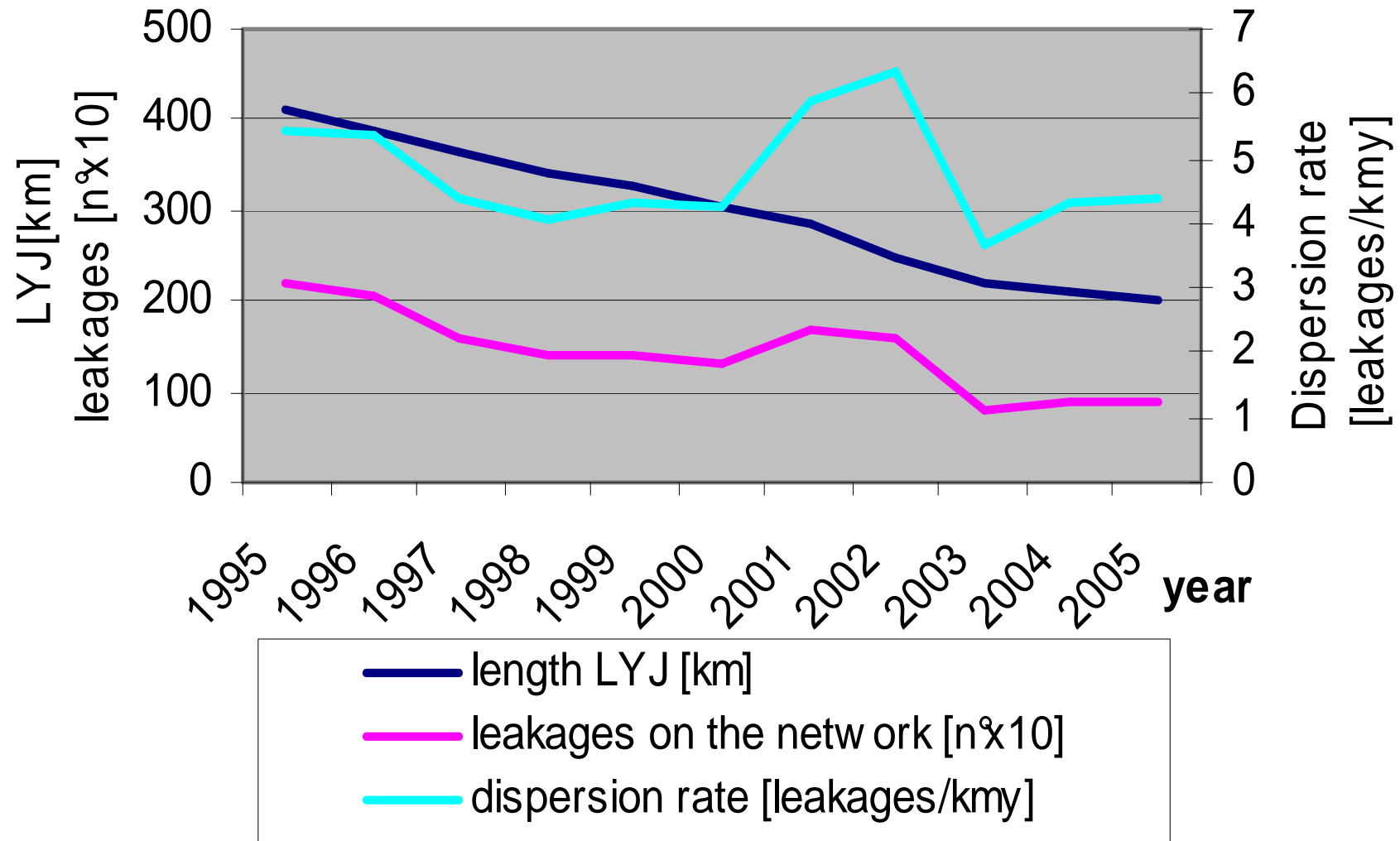
**P** *gas penetration inside buildings* **X**

**P** *explosive cloud generation* **X**

**P** *primer*



## NUMBER OF LEAKAGES VS. LYJ GREY CAST IRON

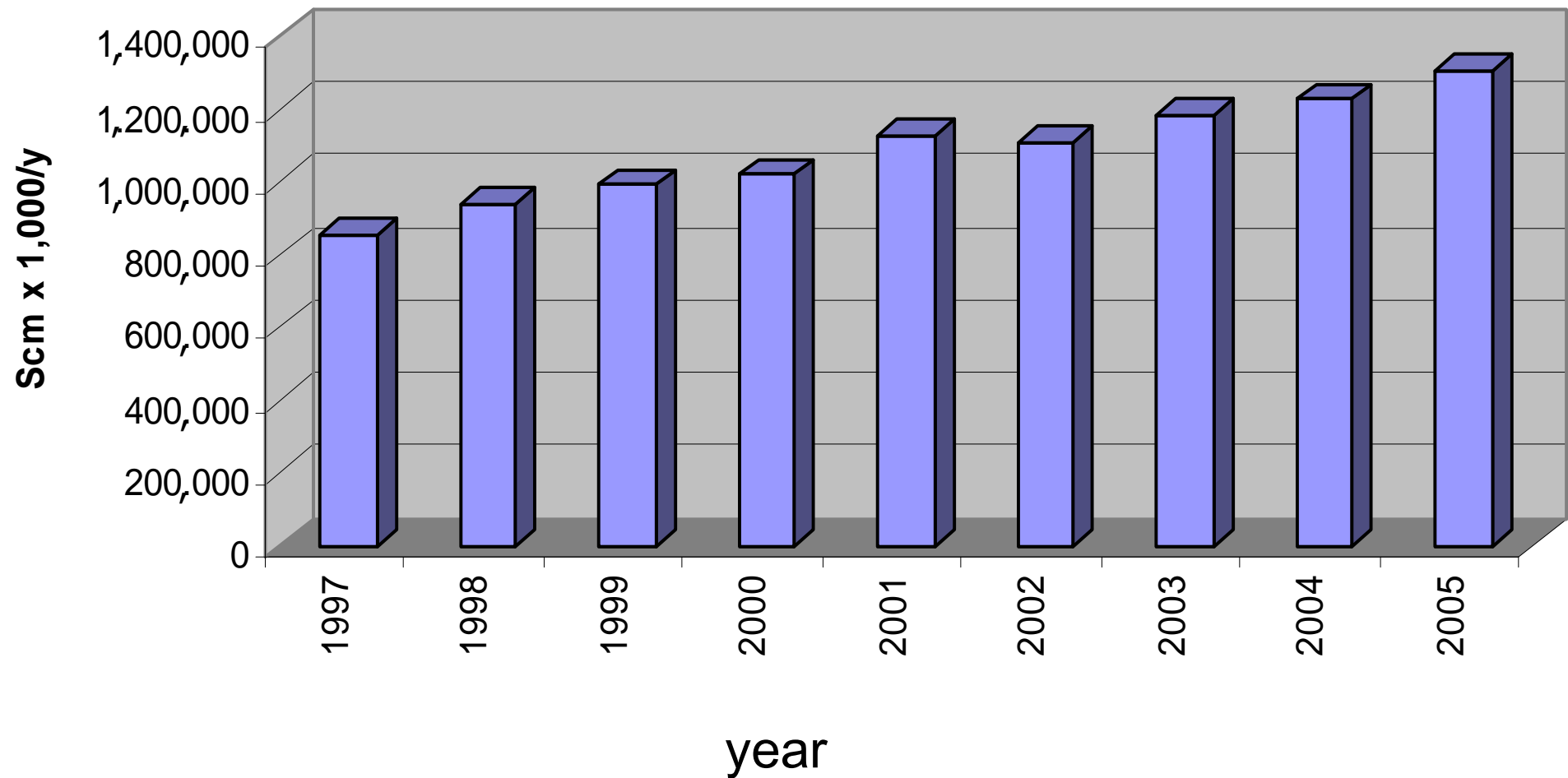


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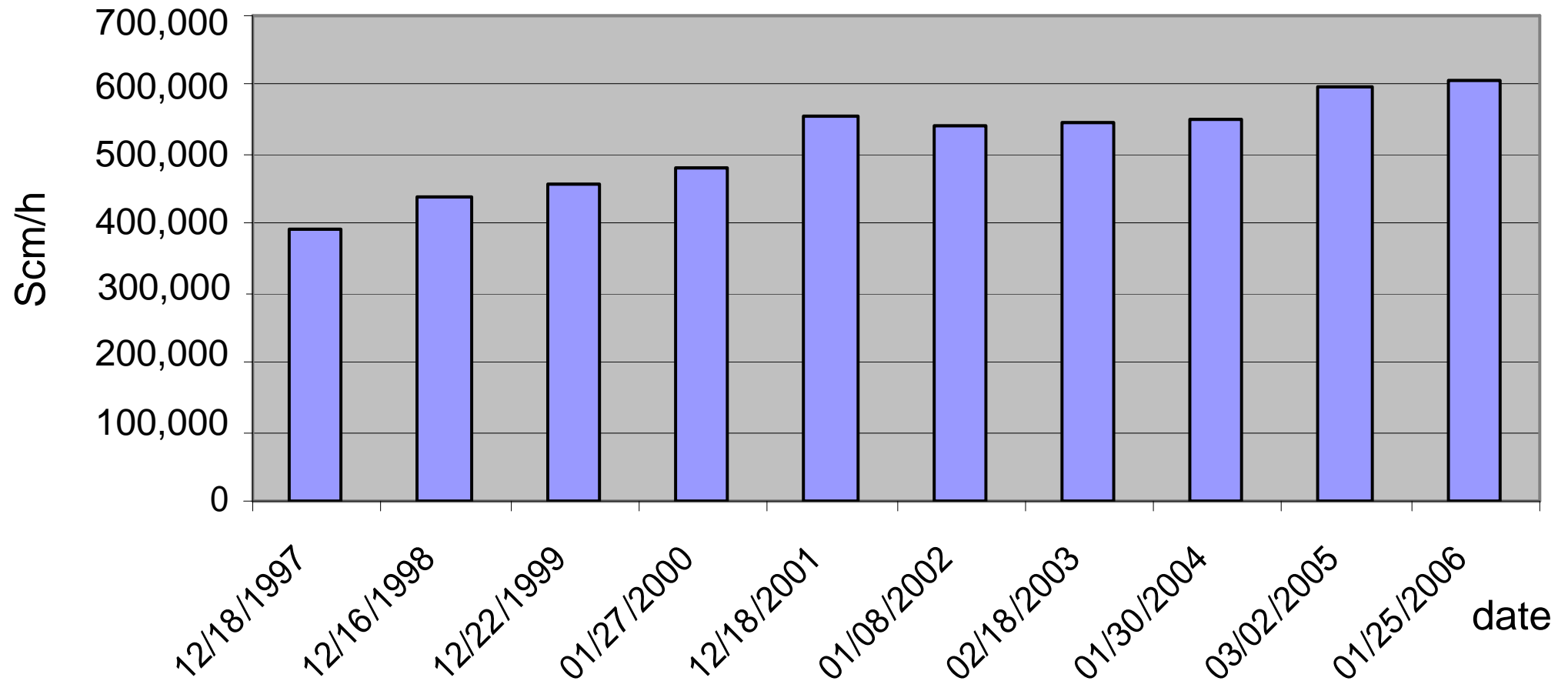
## Load trends

### **GAS VOLUME DISTRIBUTED**

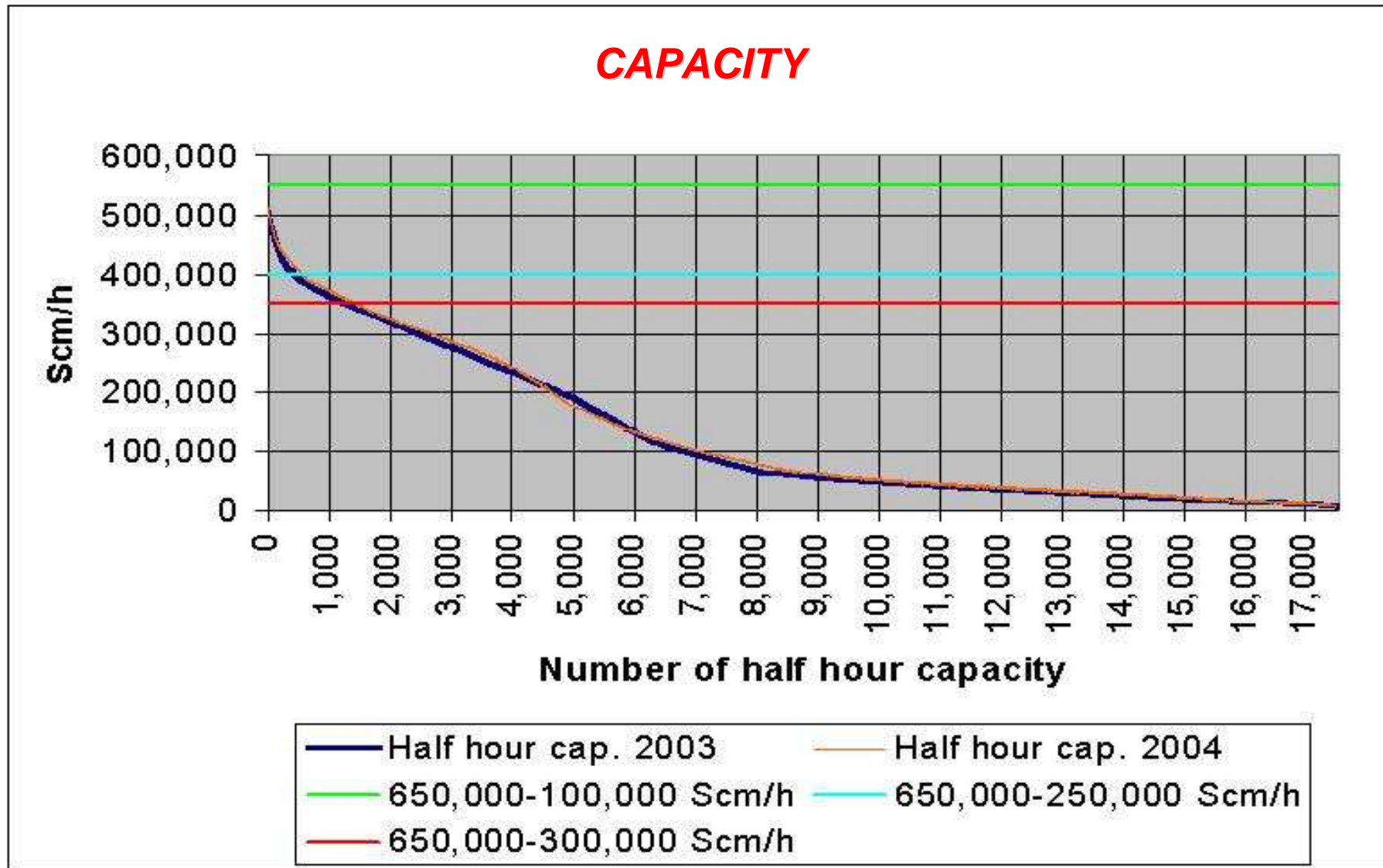


## Load trends

### **MAXIMUM PEAKS**



## Load trends



## Load trends

# **FORECAST OF THE FUTURE INCREASE OF THE MAXIMUM HOURLY PEAK**

**□ Current value: 608,000 Scm/h**

↪ *heating: increase of about 7,500 Scm/h per year*

↪ *cogeneration and district heating plants: 74,000 Scm/h in six years*

**□ Forecasted value for 2011: 690,000 Scm/h**

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***BEFORE THE INTEGRATED APPROACH...***

**...the replacement criteria were focused on:**

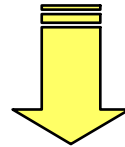
- ***LYJ grey cast iron***
- ***definition of the priorities on the score system basis***
- ***preservation of the same diameter in order to preserve the characteristics of the network***



**WITH THE INTEGRATED APPROACH...**

**...the new criteria are focused on reliability tests through simulations such as:**

- **Outage of a primary station**
- **Closing of a district governor as a consequence of a failure in the area subjected to pipes replacement**



**Change of diameters, new interconnections, new district governors, remote cut-off devices, insertion of valves, etc.**

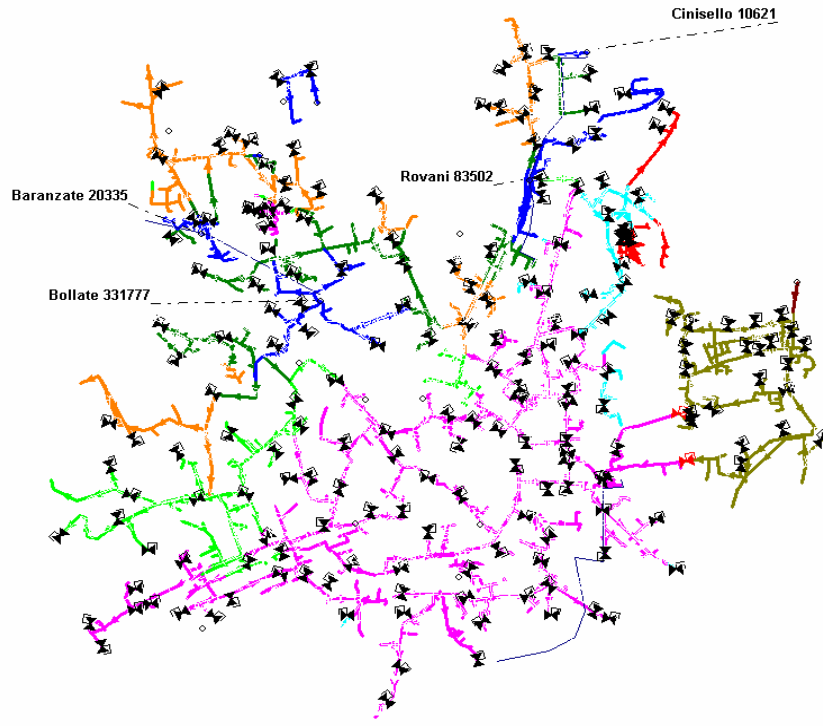
## **INTERVENTION CHANCES**

- **urbanization of the ex-industrial areas**
- **cogeneration plants**
- **new district heating networks**
- **underground parking plan**
- **railway lines**
- **metro-tramway and reserved lanes**
- **underground railways**

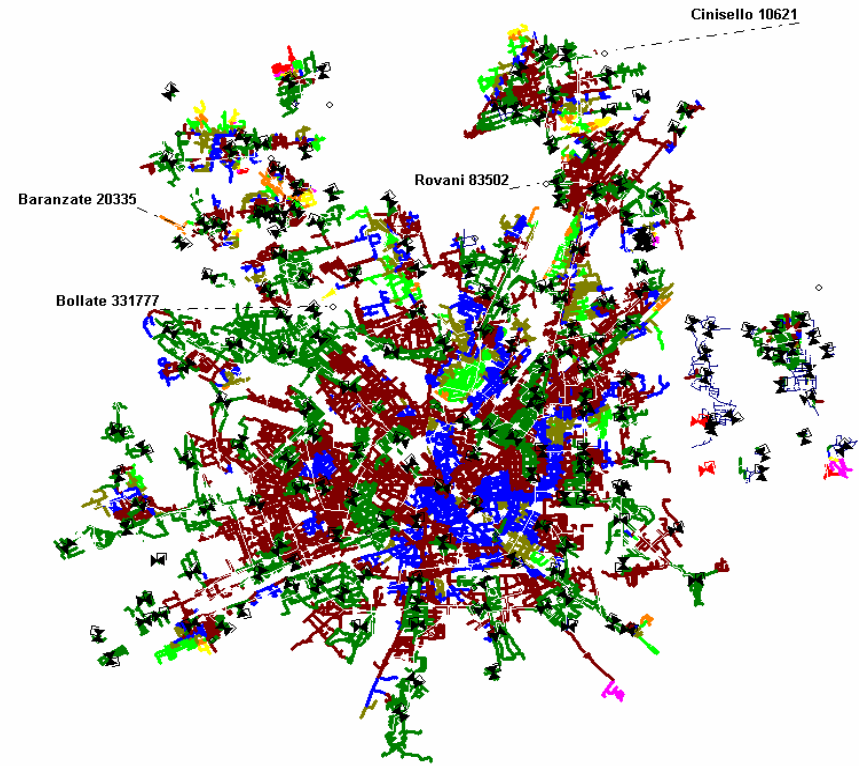
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# SIMULATION OF AN OUTAGE IN A PRIMARY STATION (1)

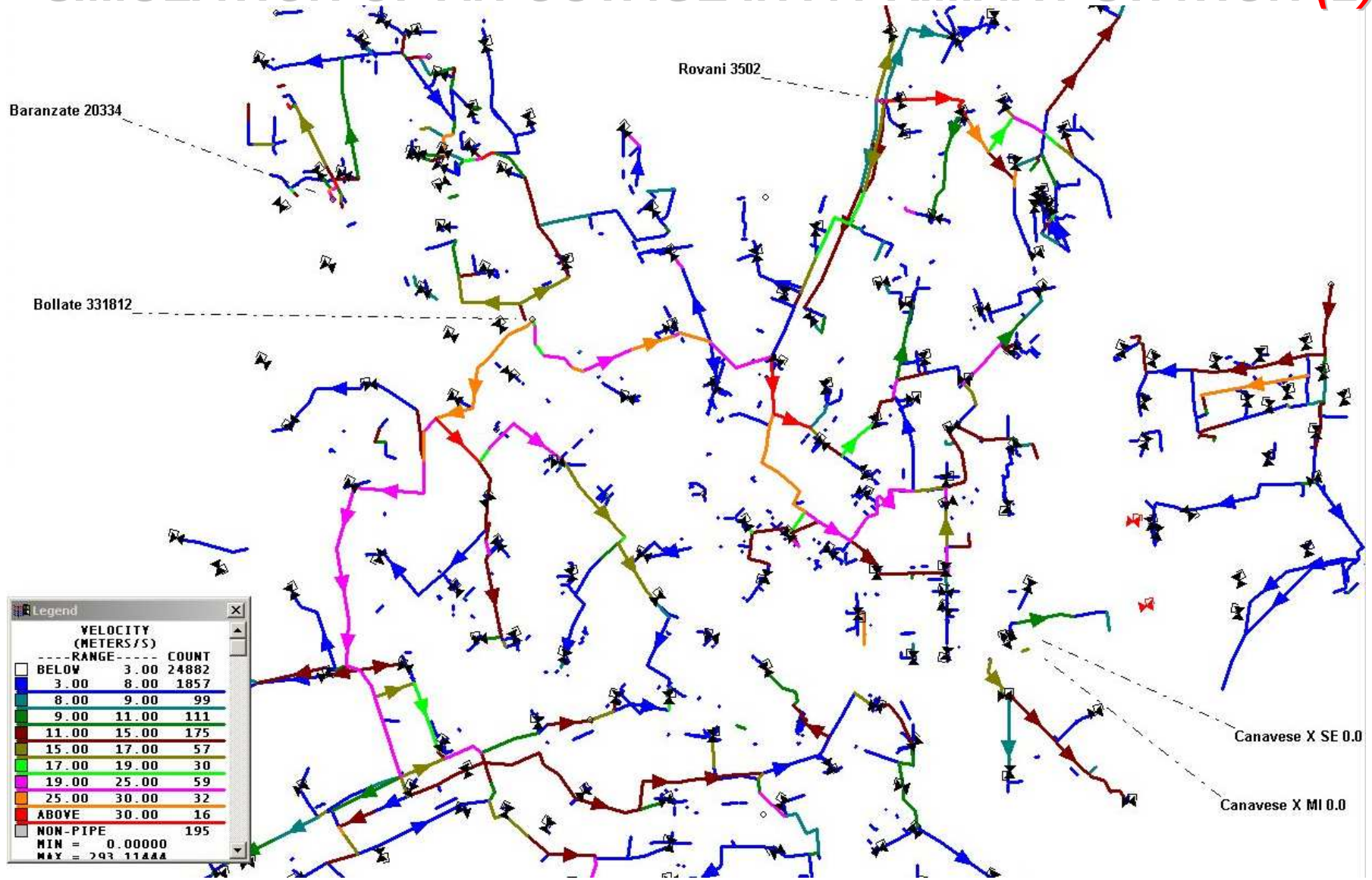


PRIMARY PRESSURE (BARS)		
---RANGE---	---	COUNT
BELOW	0.30	38
	0.30 - 0.60	68
	0.60 - 1.00	681
	1.00 - 1.15	144
	1.15 - 1.30	181
	1.30 - 1.40	182
	1.40 - 2.00	165
	2.00 - 5.00	326
	5.00 - 10.00	1
	ABOVE 10.00	11
NON-PIPE		25715
MIN =		0.1202
MAX =		12.0000

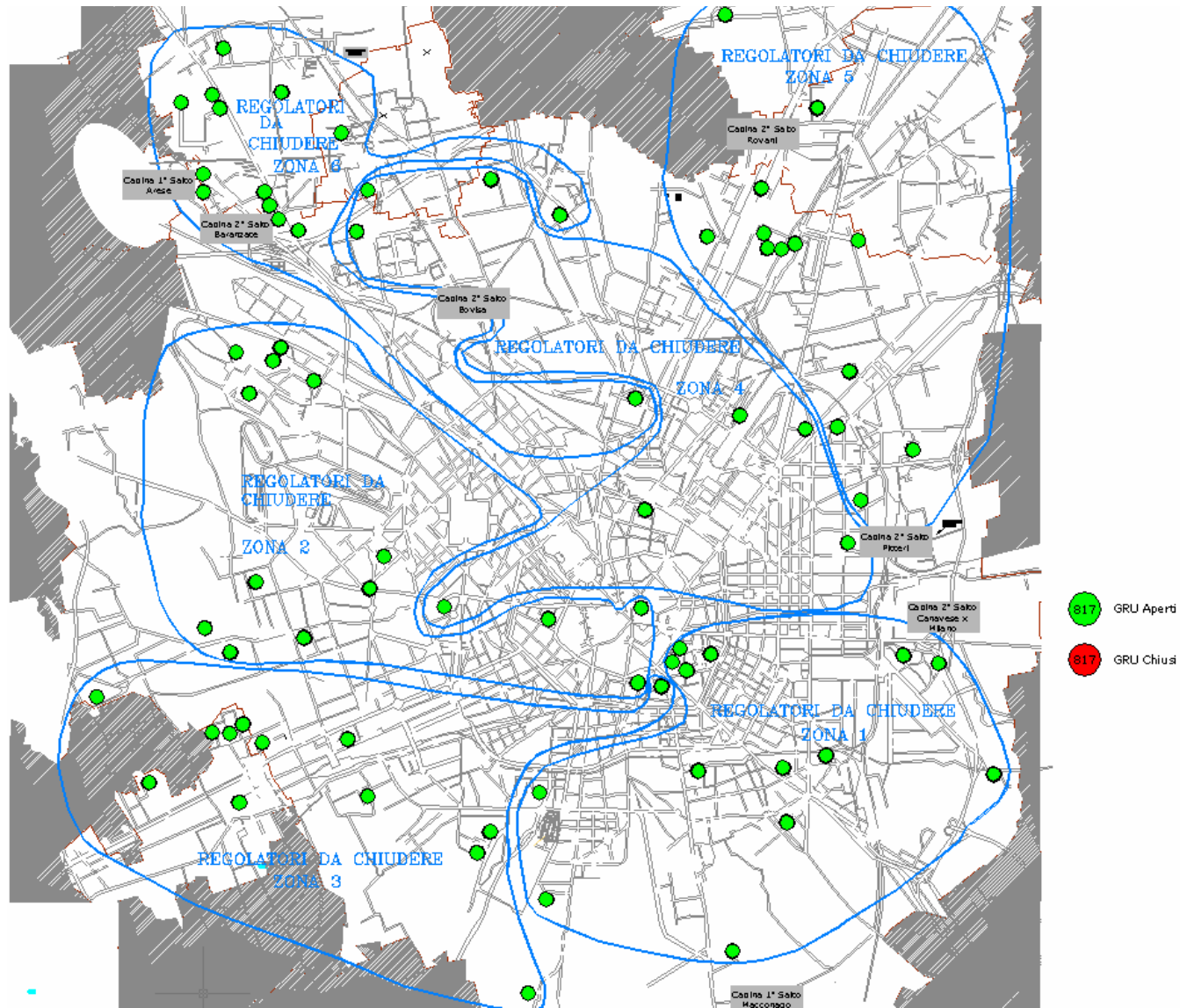


SECONDARY PRESSURE (MBARS)		
---RANGE---	---	COUNT
BELOW	15.00	40
	15.00 - 16.00	59
	16.00 - 17.00	147
	17.00 - 17.50	233
	17.50 - 18.00	931
	18.00 - 18.50	1600
	18.50 - 19.00	3739
	19.00 - 20.00	10567
	20.00 - 22.00	7671
	ABOVE 22.00	535
NON-PIPE		1990
MIN =		13.60
MAX =		28.79

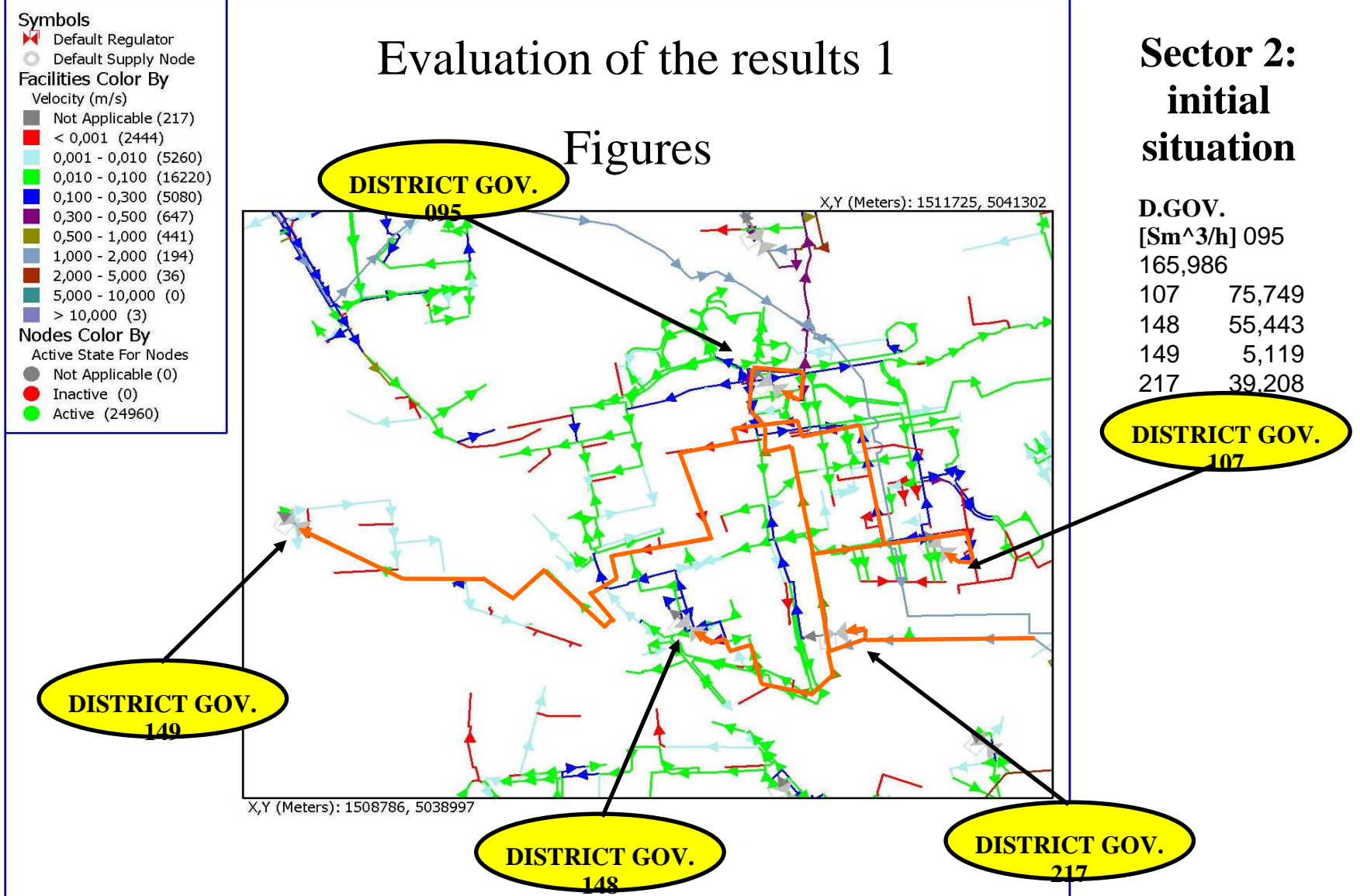
# SIMULATION OF AN OUTAGE IN A PRIMARY STATION (2)



# INSTALLATION PLAN OF 100 REMOTE CUT-OFF DEVICES BY 2007



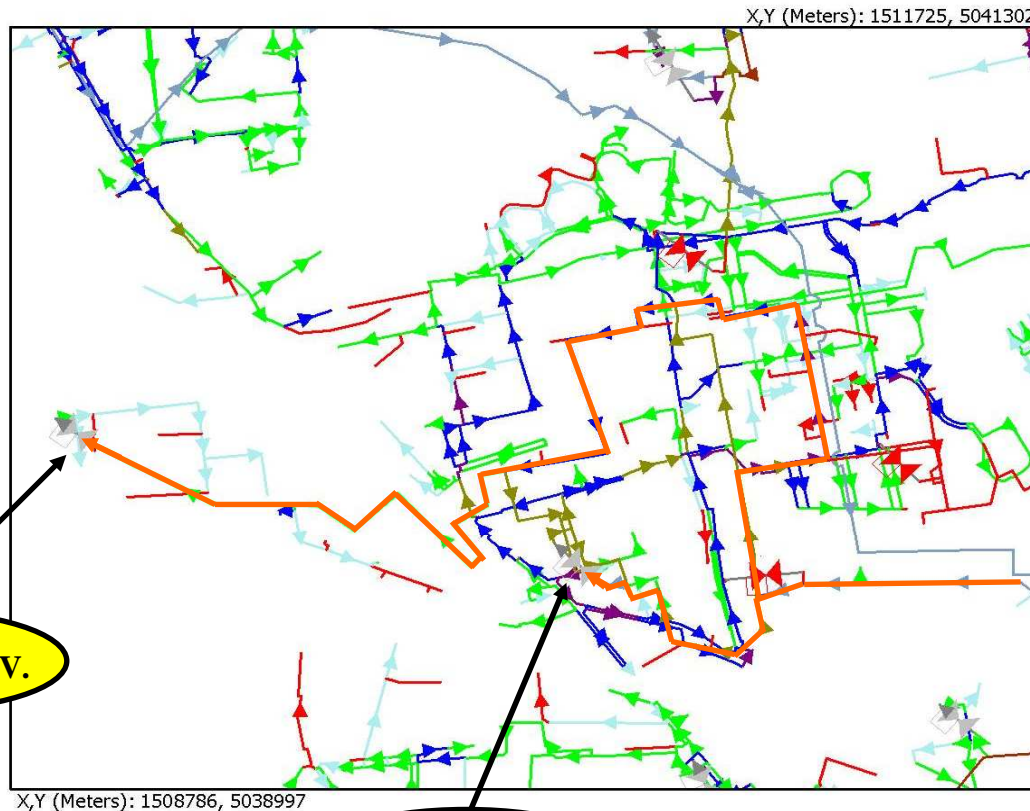
# STUDY OF A DIFFERENT WAY TO MANAGE THE ODORANT



# STUDY OF A DIFFERENT WAY TO MANAGE THE ODORANT

## Evaluation of the results 1 Figures

- Symbols**
- ⊠ Default Regulator
  - Default Supply Node
- Facilities Color By**  
Velocity (m/s)
- Not Applicable (217)
  - < 0,001 (2446)
  - 0,001 - 0,010 (5238)
  - 0,010 - 0,100 (16138)
  - 0,100 - 0,300 (5137)
  - 0,300 - 0,500 (672)
  - 0,500 - 1,000 (462)
  - 1,000 - 2,000 (193)
  - 2,000 - 5,000 (36)
  - 5,000 - 10,000 (0)
  - > 10,000 (3)
- Nodes Color By**  
Active State For Nodes
- Not Applicable (0)
  - Inactive (0)
  - Active (24960)



**Sector 2:  
situation  
after  
closing**

**D.GOV.**  
[Sm<sup>3</sup>/h] 095

Closed	
107	Closed
148	245,970
149	7,528
217	Closed