

# Damage to Urban Gas Industry after the 2011 off the Pacific Coast of Tohoku Earthquake

Yoshihisa Maruyama

Chiba University  
ymaruyam@tu.chiba-u.ac.jp

1

## Seismic Safety Measure in Urban Gas Industry

The Japan Gas Association

The **spectrum intensity (SI)** is used to decide supply  
suspended areas.

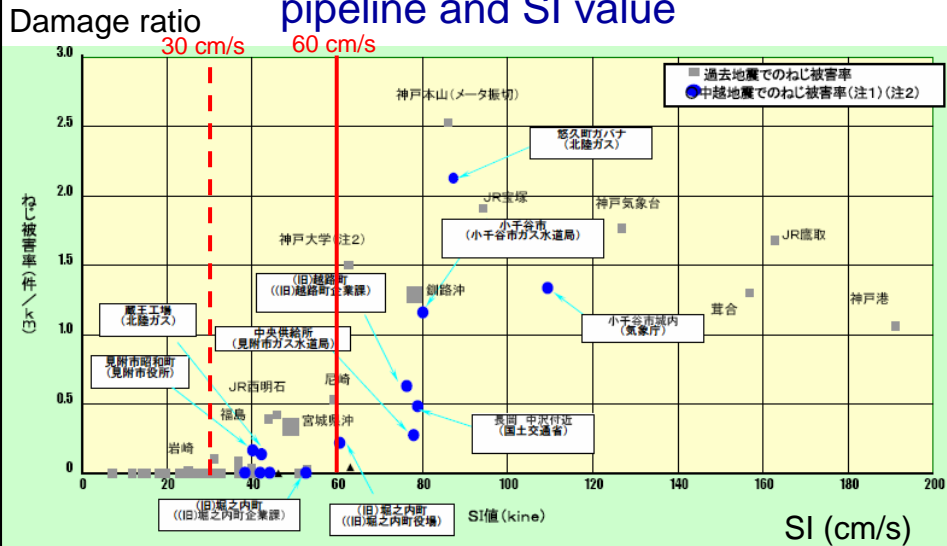
$$SI = \frac{1}{2.4} \int_{0.1}^{2.5} Sv^{h=0.2}(T) dT \quad Sv: \text{Velocity response spectrum}$$

$SI \geq 60 \text{ cm/s}$  -> **Immediate shutoff**

$30 \leq SI < 60 \text{ cm/s}$  -> **Emergency checkup**

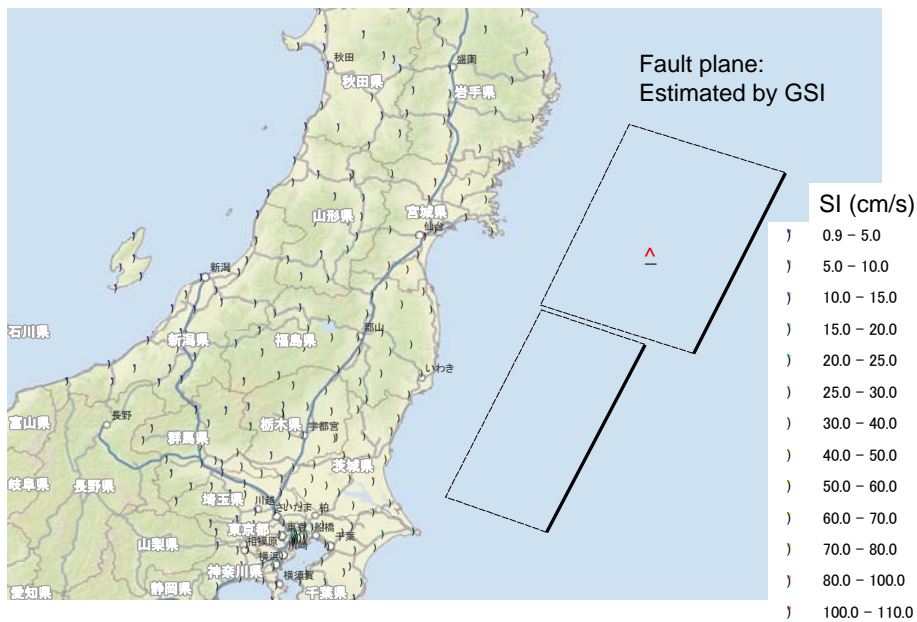
2

## Relationship between damage ratio of gas pipeline and SI value

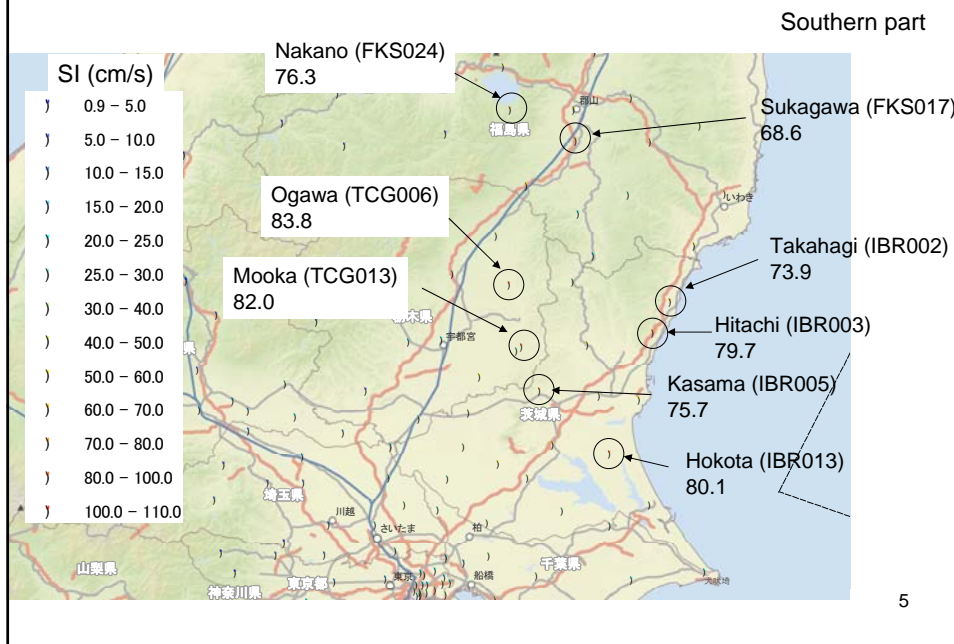


- (注1) 今回データは、地震計を中心とした1km~2km四方のエリア内のねじの被害率を集計。なお、兵庫県南部地震のデータは、2.4km×1.8kmのメッシュ内のねじ被害率を集計。
- (注2) 川口町についてはSI値が計測不能のためプロットしていない。
- (注3) 神戸大学の地震計は地下10mのトンネル内に設置されており、地表面より小さい地震動を観測している可能性が高い。

## Distribution of SI values observed at K-NET sites

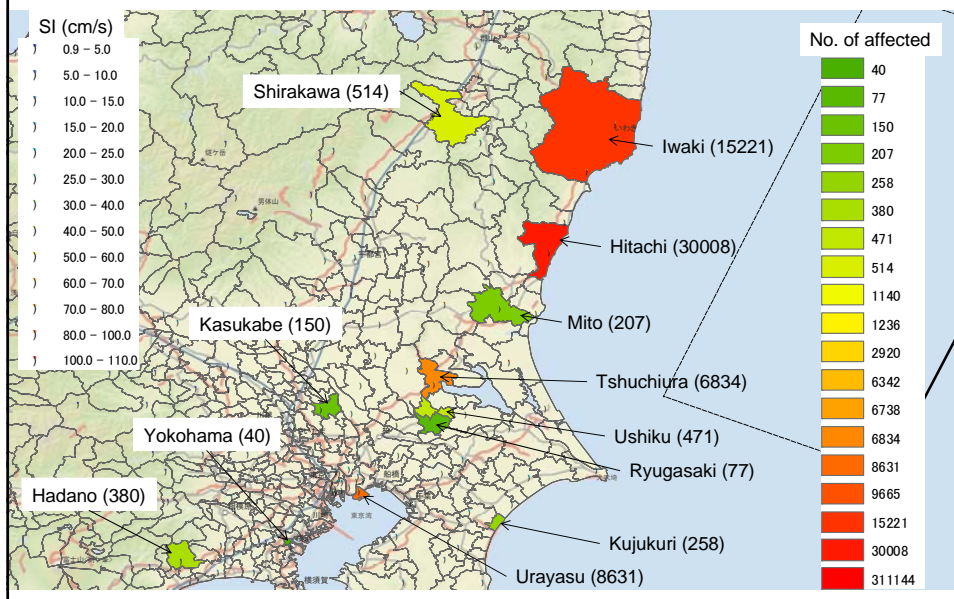


## Distribution of SI values observed at K-NET sites

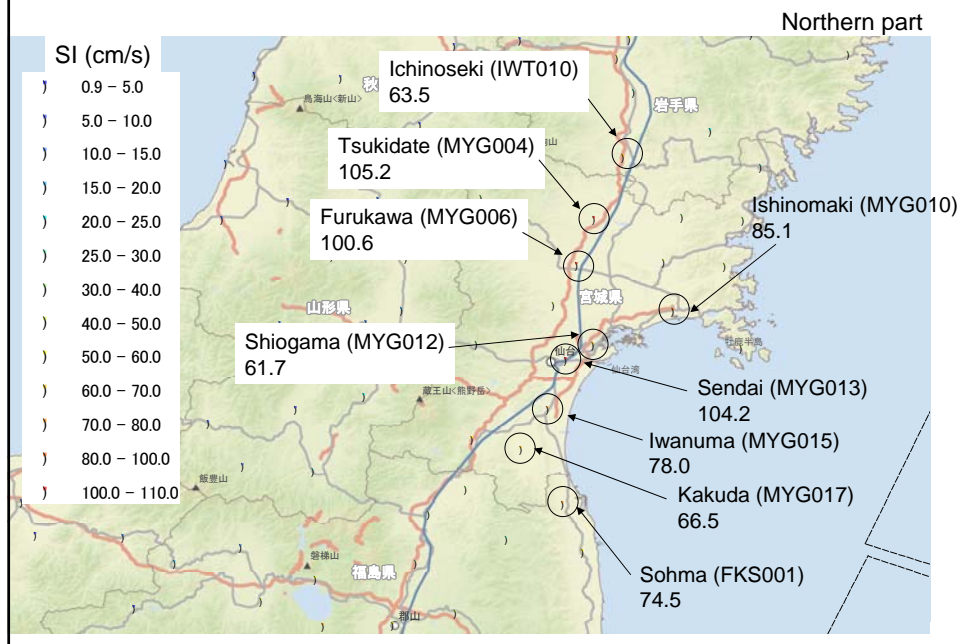


## Number of Affected Gas Users

Compiled on April 11, 2011 by the Japan Gas Association

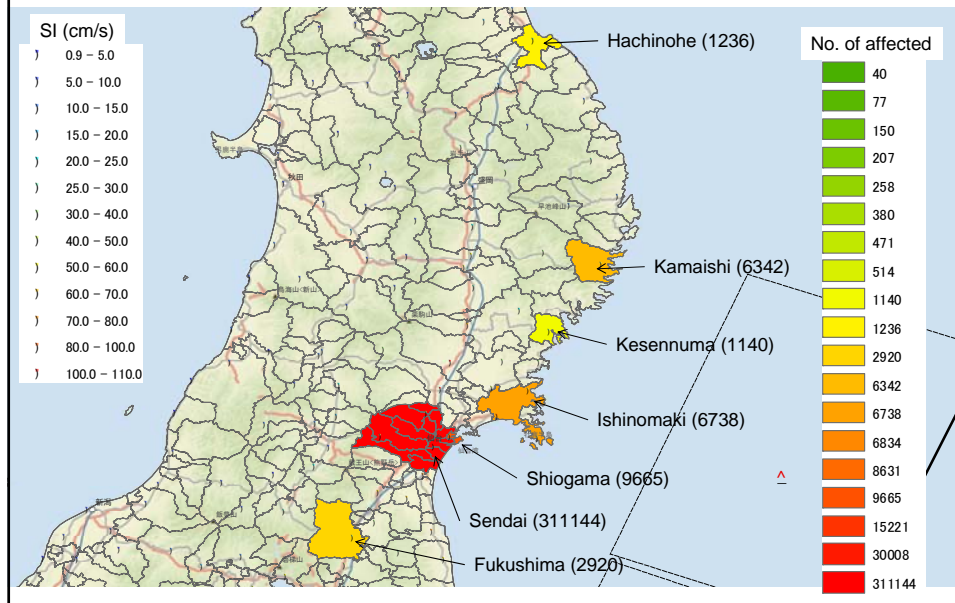


## Distribution of SI values observed at K-NET sites



## Number of Affected Gas Users

Compiled on April 11, 2011 by the Japan Gas Association

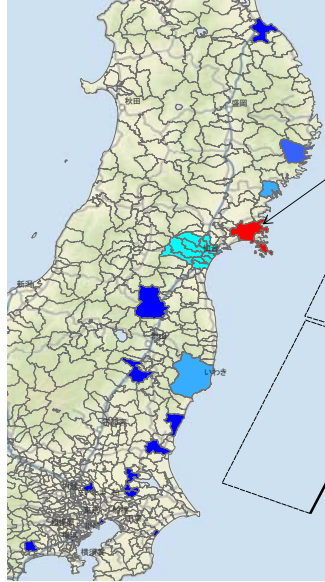
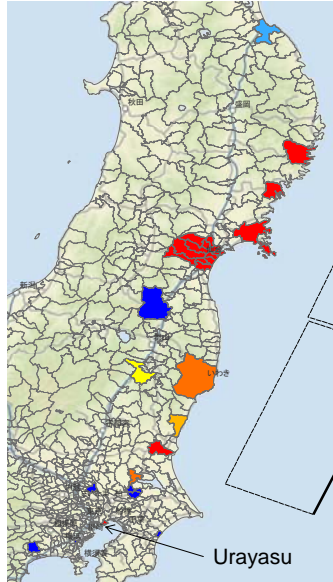


# Recovery Rate

As of March 15

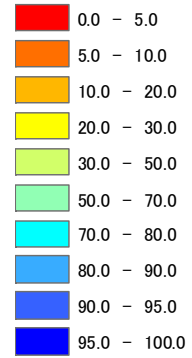
As of April 11

The Japan Gas Association



Ishinomaki

Recovery rate (%)



# Field Survey in Ishinomaki

June 7, 2011



## Field Survey in Ishinomaki

June 7, 2011



## Field Survey in Ishinomaki

June 7, 2011



## Recovery Process of Ishinomaki Gas

<http://www.ishinomaki-gas.co.jp/saigai.htm>

**March 23:** Gas supply to Japanese Red Cross Ishinomaki Hospital was restarted operating the on-site gas generator

**April 9:** Gas-making plant was reopened using temporary facilities

**April 12 – May 3:** Gas supply was recovered except for the severely tsunami-inundated areas

**May 18:** Restoration work was almost over except for the completely washed-away areas

13

## Summary

- Gas supply was extensively disrupted in the eastern part of Japan (from Kanto to Tohoku districts).
- Gas supply was almost recovered within several days in Kanto district except for the extremely liquified areas (Gas supply in Urayasu was recovered on March 30, 2011.) .
- Restoration work in Ishinomaki could be performed approximately one month after the earthquake because the head quarter and the plant of Ishinomaki Gas were affected by tsunami.

14

Explosion of LPG tank at Chiba oil refinery  
(photo taken at Chiba University)

