W-Smart/UNESCO/SIAAP Workshop
4 December 2015
Post-Disaster Observations and Lessons Learned

Tokyo Water Experiences and Challenges

President of TSS Tokyo Water
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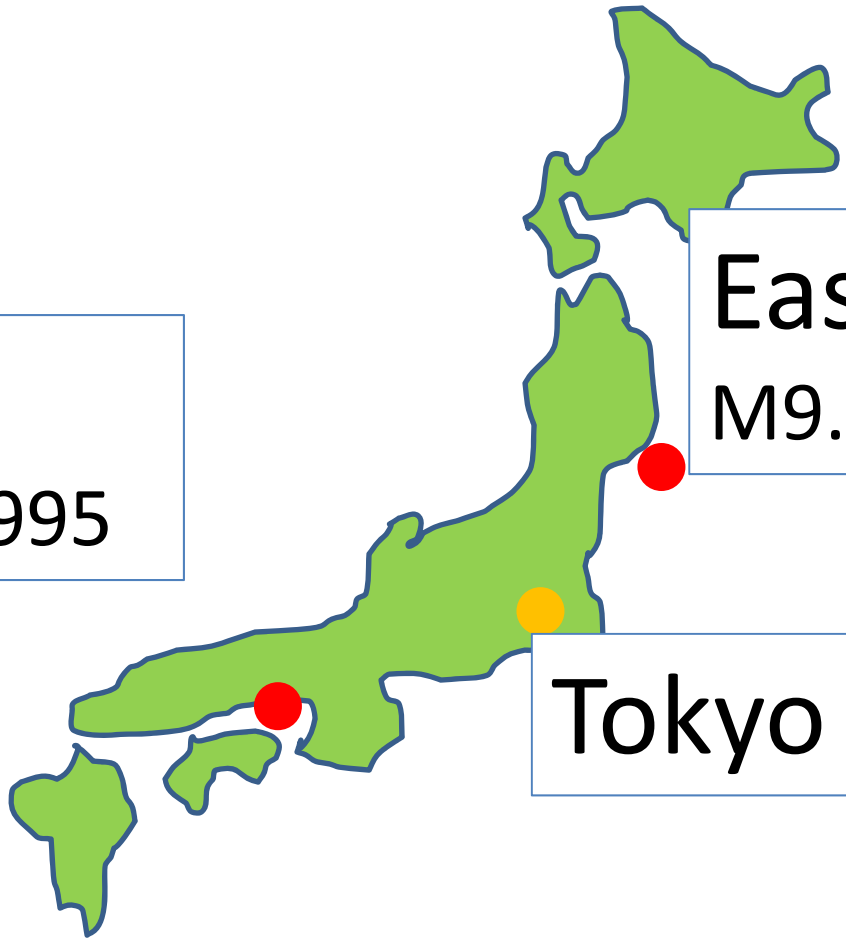
Catastrophic Earthquakes in Japan



Kobe
M7.3 in 1995

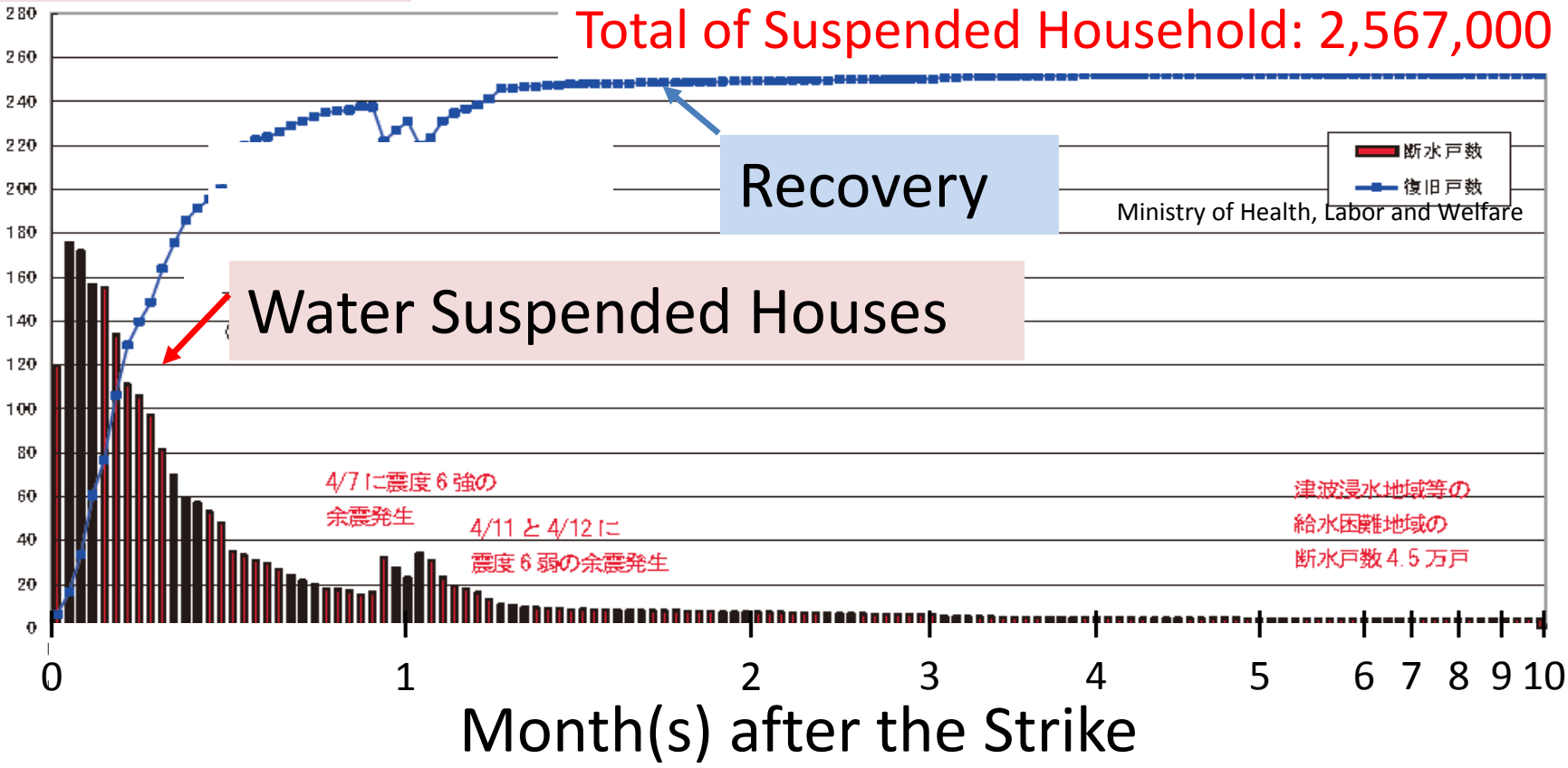
East Japan
M9.0 in 2011

Tokyo in ?

Trends of Service Suspension and Resumption

The Great East Japan Earthquake and Tsumani (2011)

Water Suspended Houses
(10,000 house holds)



Damage to Pipelines in the 2011 East Japan Earthquake

Slip-Out of Transmission Mains (ϕ2400mm)

Lessons Learned in the Water Supply Sector

The Importance of…

1. securing water resources by structural reinforcement and system redundancy

2. anti-seismic strengthening of water supply facilities, including office buildings and workshops, which are headquarters and core stations for response and service restoration

3. securing human resources, fuel, materials, and equipment

4. anti-seismic strengthening of pipe networks

5. Reliable power supplies and communication systems

Personal Thoughts after the Great Earthquake

The water supply must not be suspended. It is necessary not only for drinking, but also for firefighting, cooking, washing and toilets.

Purification plants must not fall short in meeting the needs of the public.

Sufficient standby purification capacity is required to compensate for one or two plant failures.

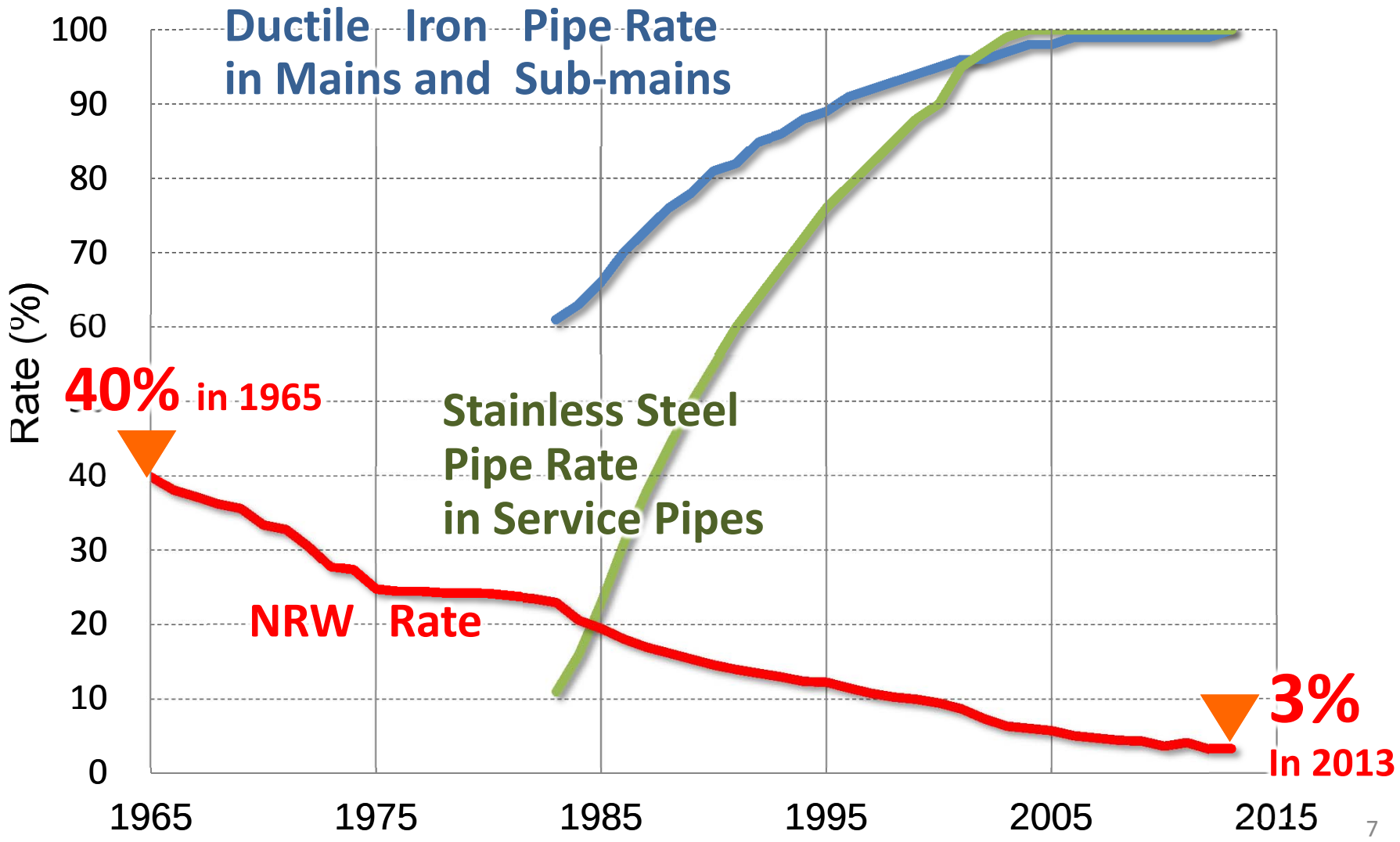
These two issues are quite different:

Water supply availability

Water supply availability following seismic events

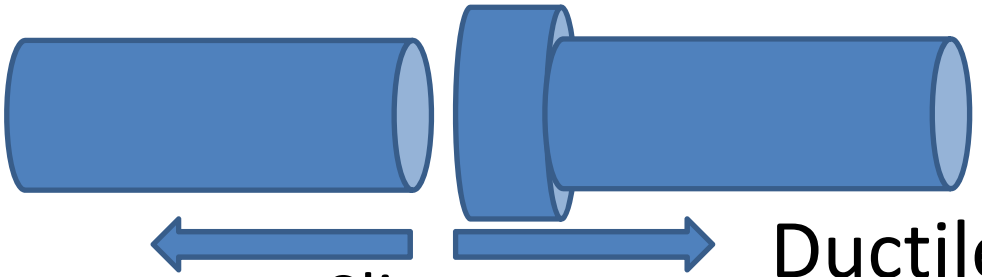
The second issue needs counter-measures such as making pipe networks significantly more robust, performing reinforcement maintenance, and creating crisis management policies

Pipe Materials and NRW Reduction



Anti-Seismic Pipe Joints

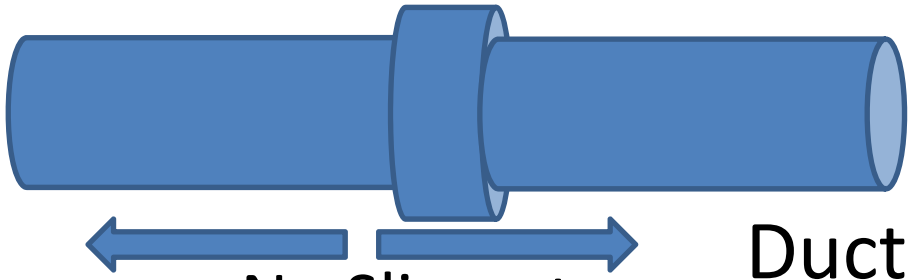
Conventional Pipe Joint



Slip out

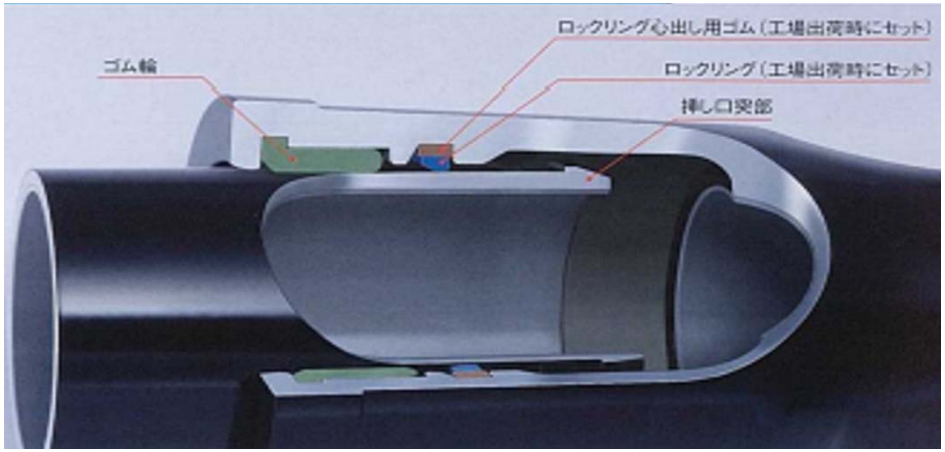
Ductile Cast Iron

Anti-Seismic Pipe Joint



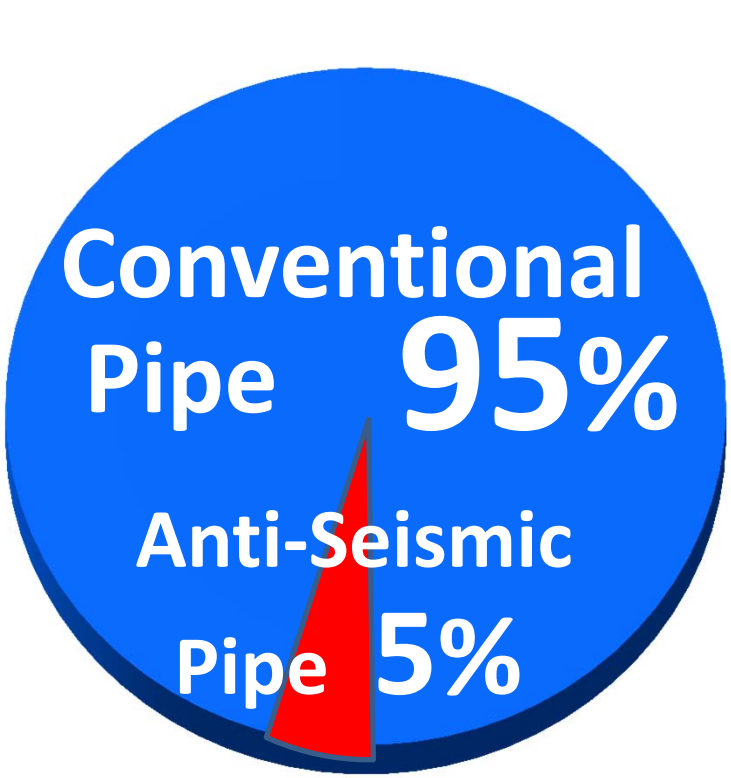
No Slip out

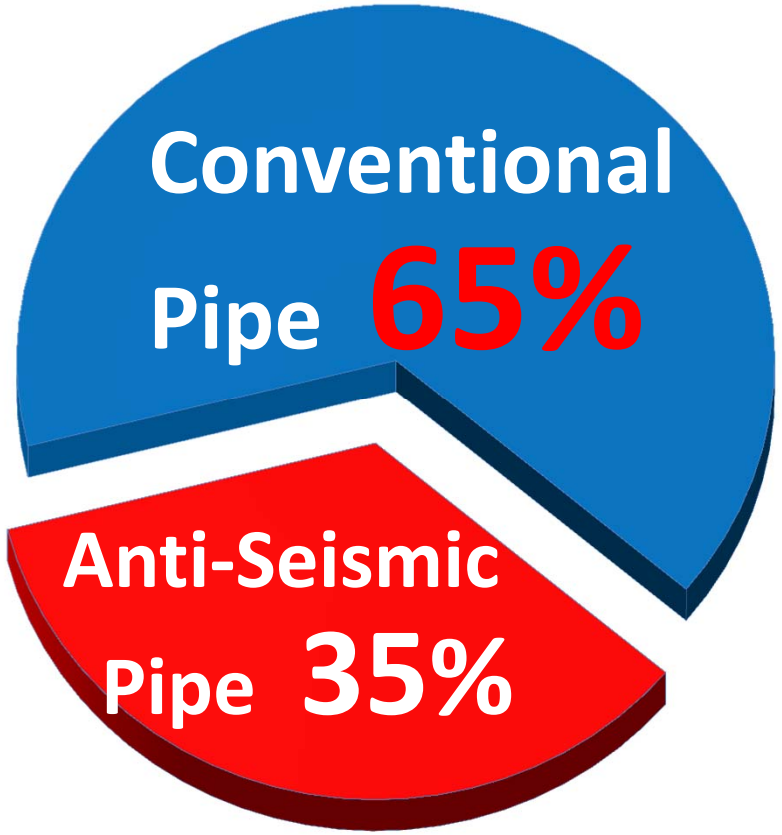
Ductile Cast Iron



Anti-Seismic Pipe Joint

Adoption in Tokyo

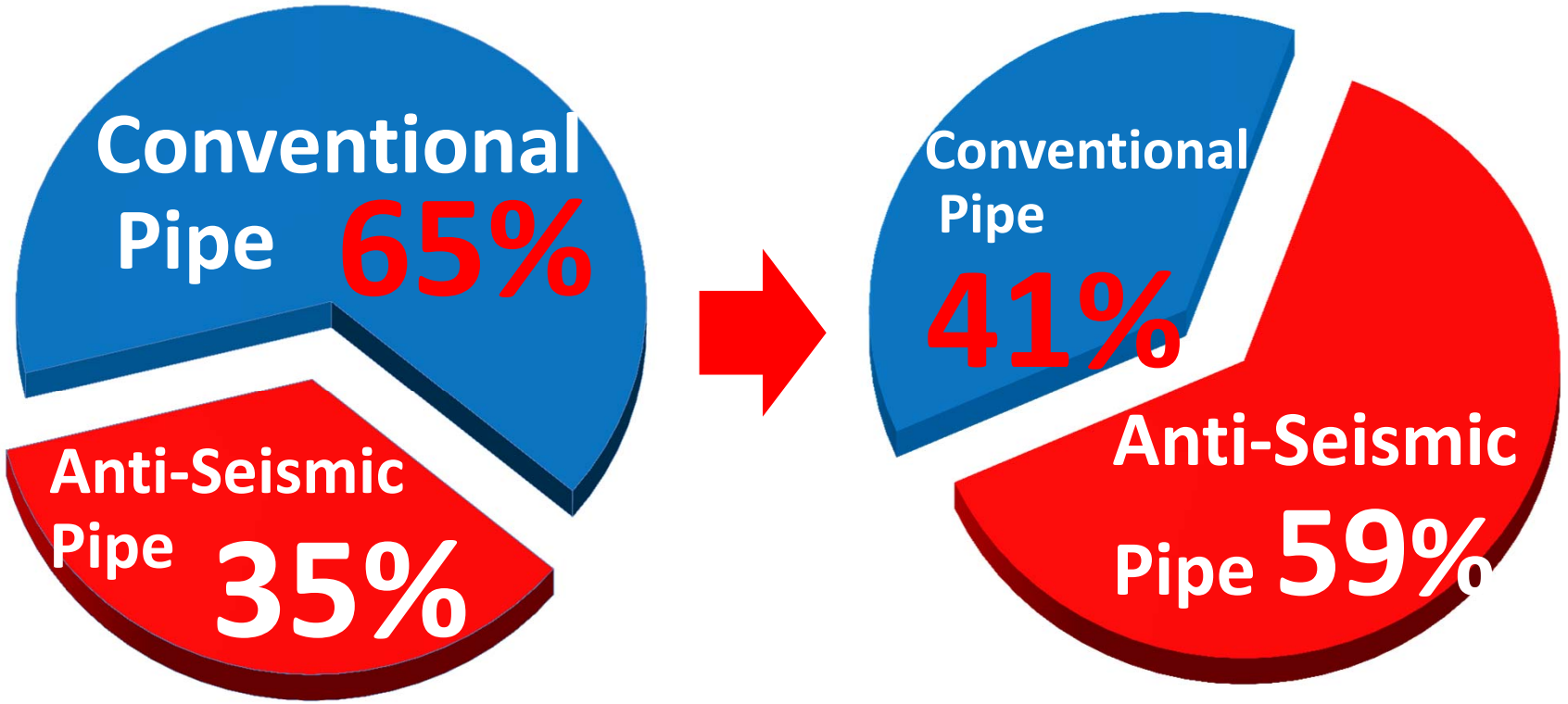




1997

2014

Projected Conversion Rate



2014

2024

Replacement Priority

〔For Mains, sub-mains〕

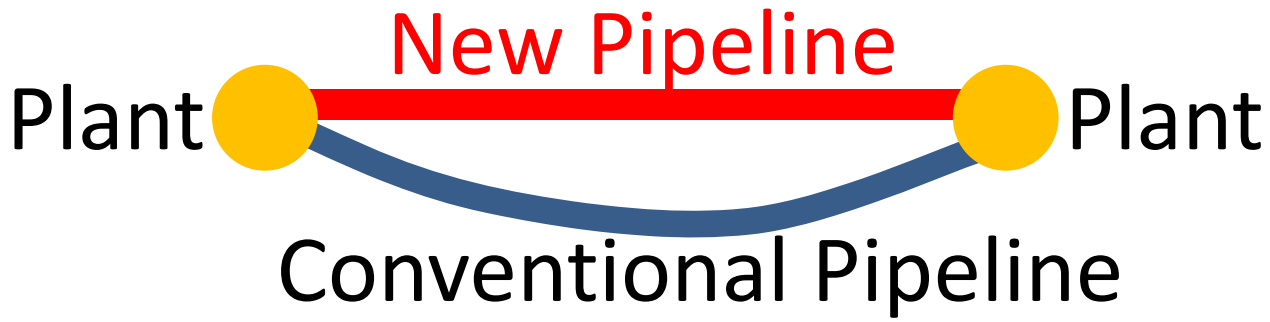
1) Old Ductile Cast Iron Pipes Without Antis-Seismic Joints

2) Supply Routes to Important Facilities, such as Hospitals

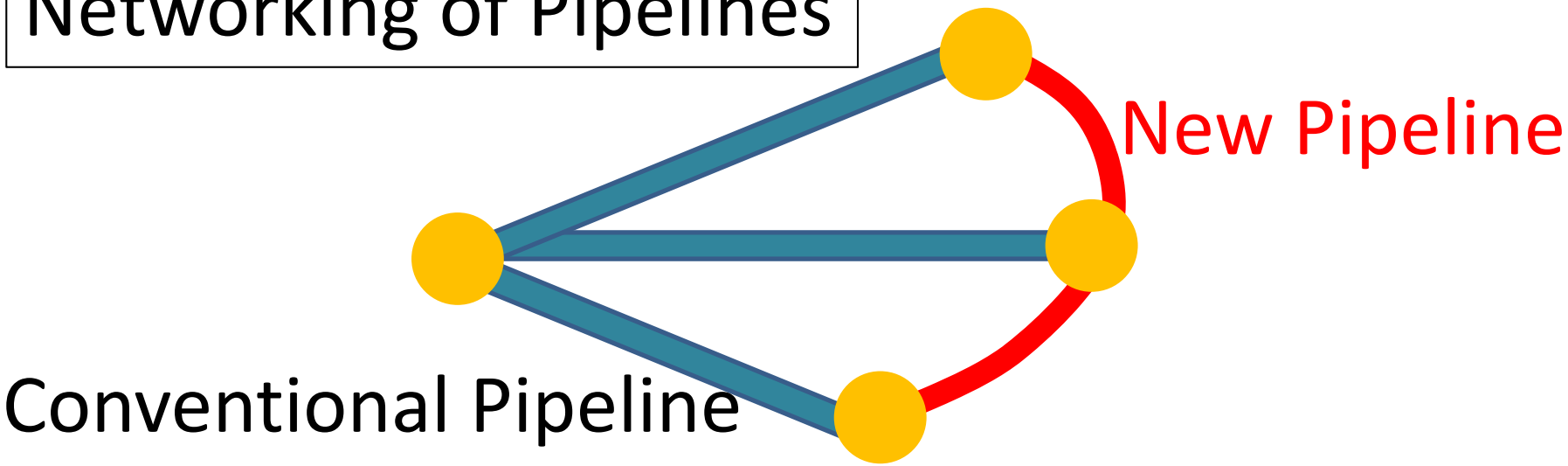
3) Areas Expected to be Heavily Damaged in an Earthquake

Transmission Reinforcement

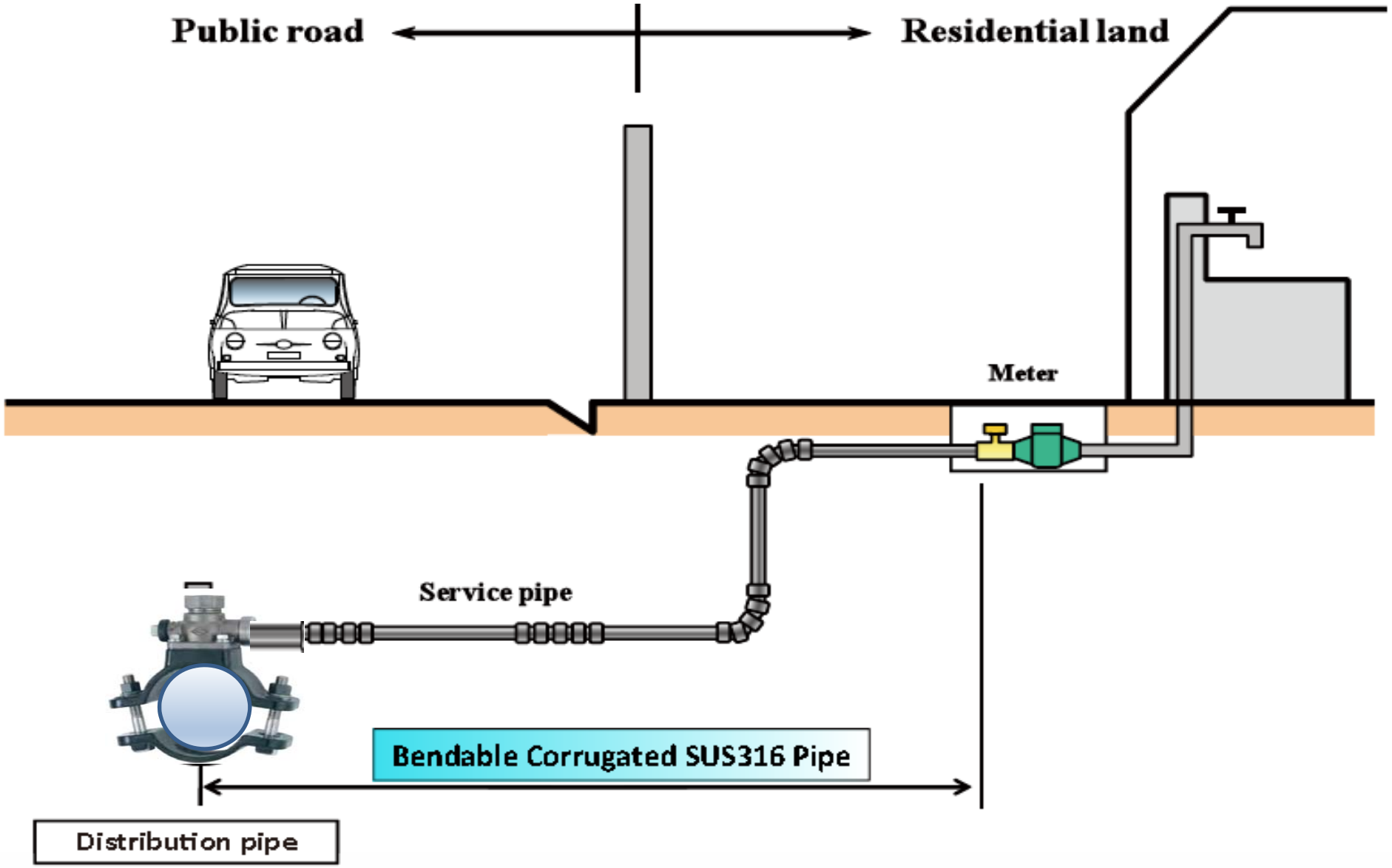
Doubling Pipelines



Networking of Pipelines

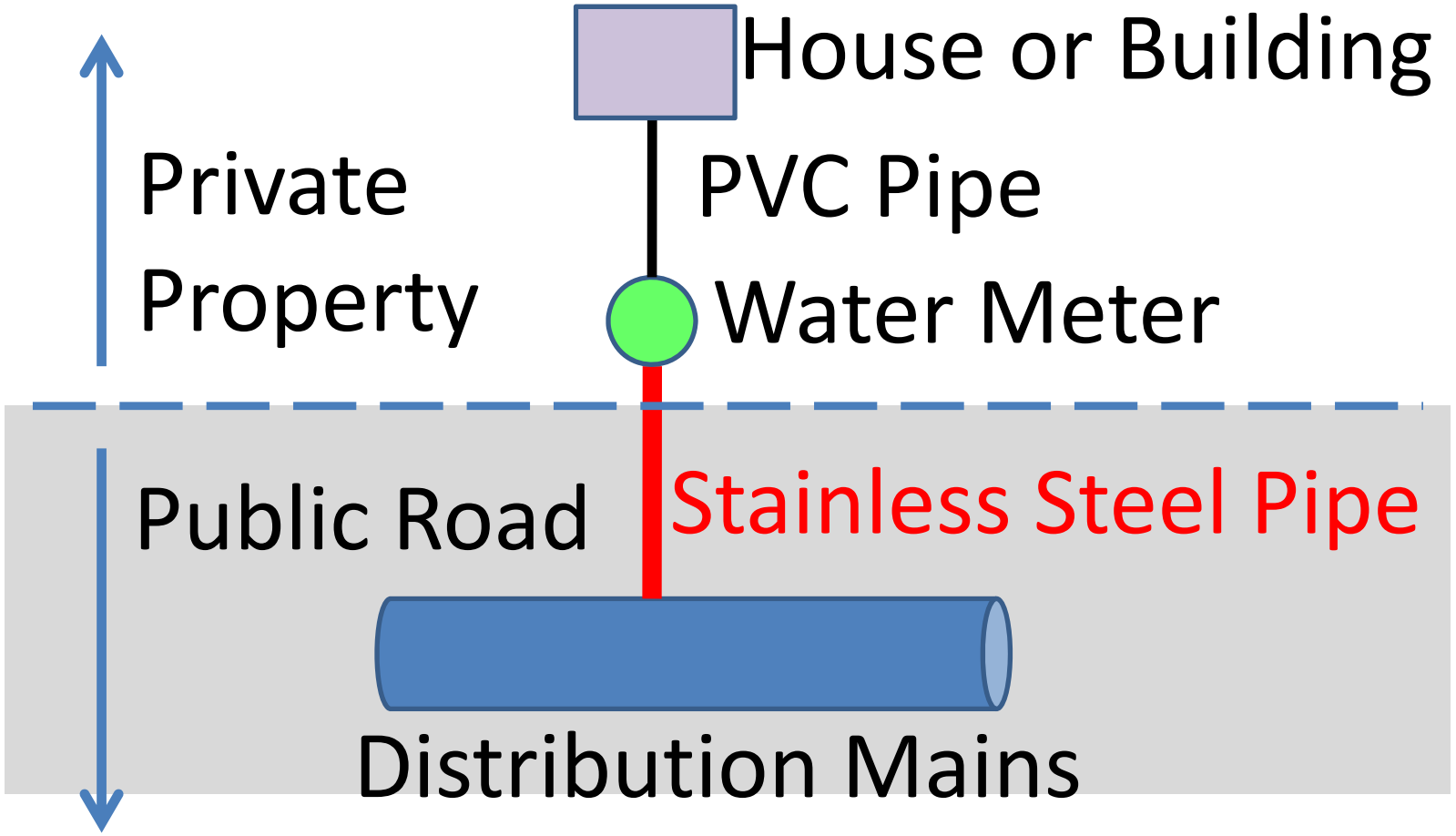


Tokyo-Type Service Connection



Replacement of Service Pipes

100% of Service Pipes have been Replaced by Anti-Seismic Stainless Steel Pipes



Stainless Steel Pipes have been Used since1980

SUS304 18Cr 8Ni ---Not Adopted

SUS316 18Cr 12Ni 2Mo ---Adopted

Corrugated Stainless Steel Pipes were Adopted in1998

Corrugated Stainless Steel Pipes

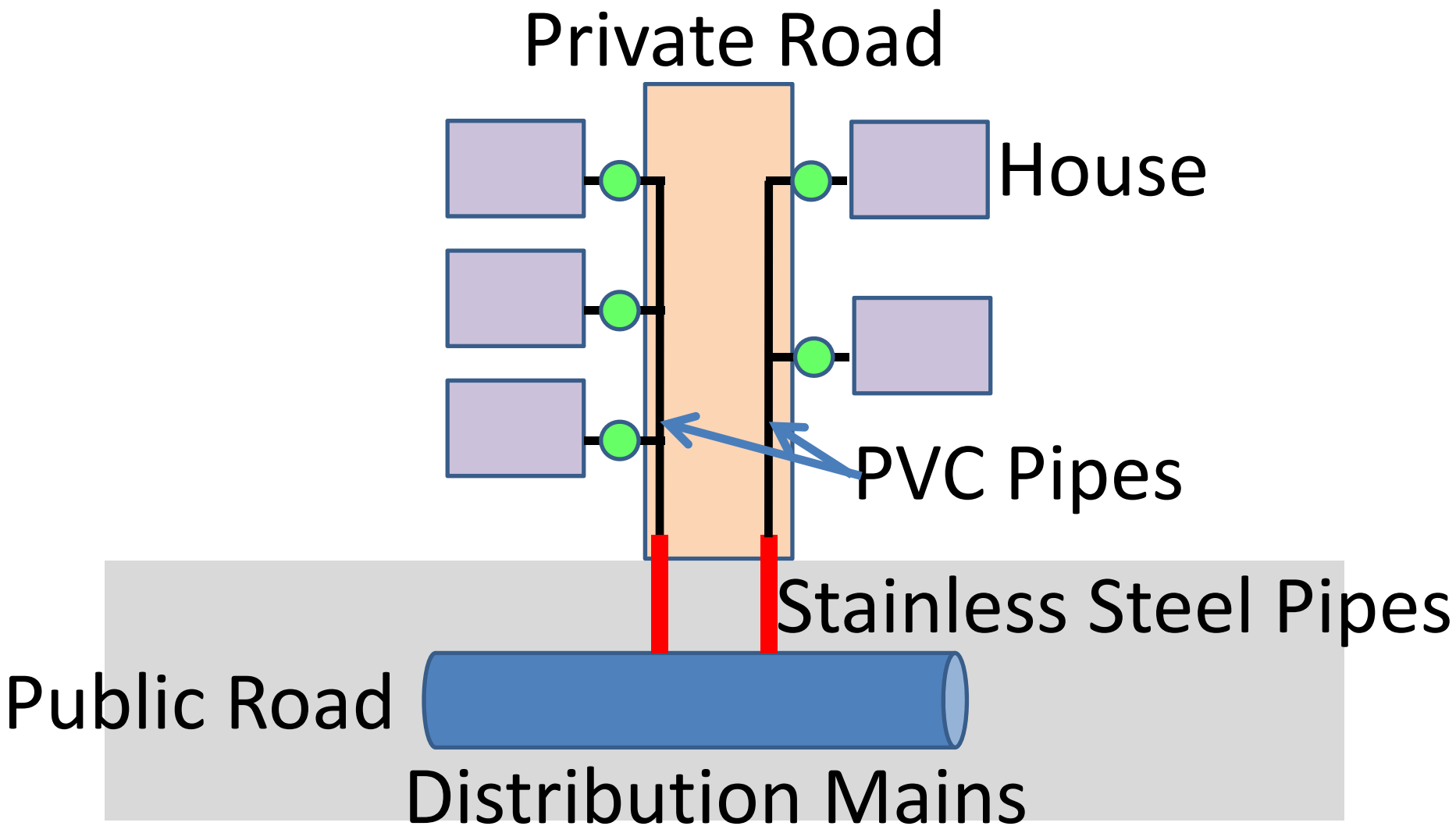
Bendability minimizes pipe joints, where leaks often occur,

and

Corrosion Resistance in soil prevents leak holes.

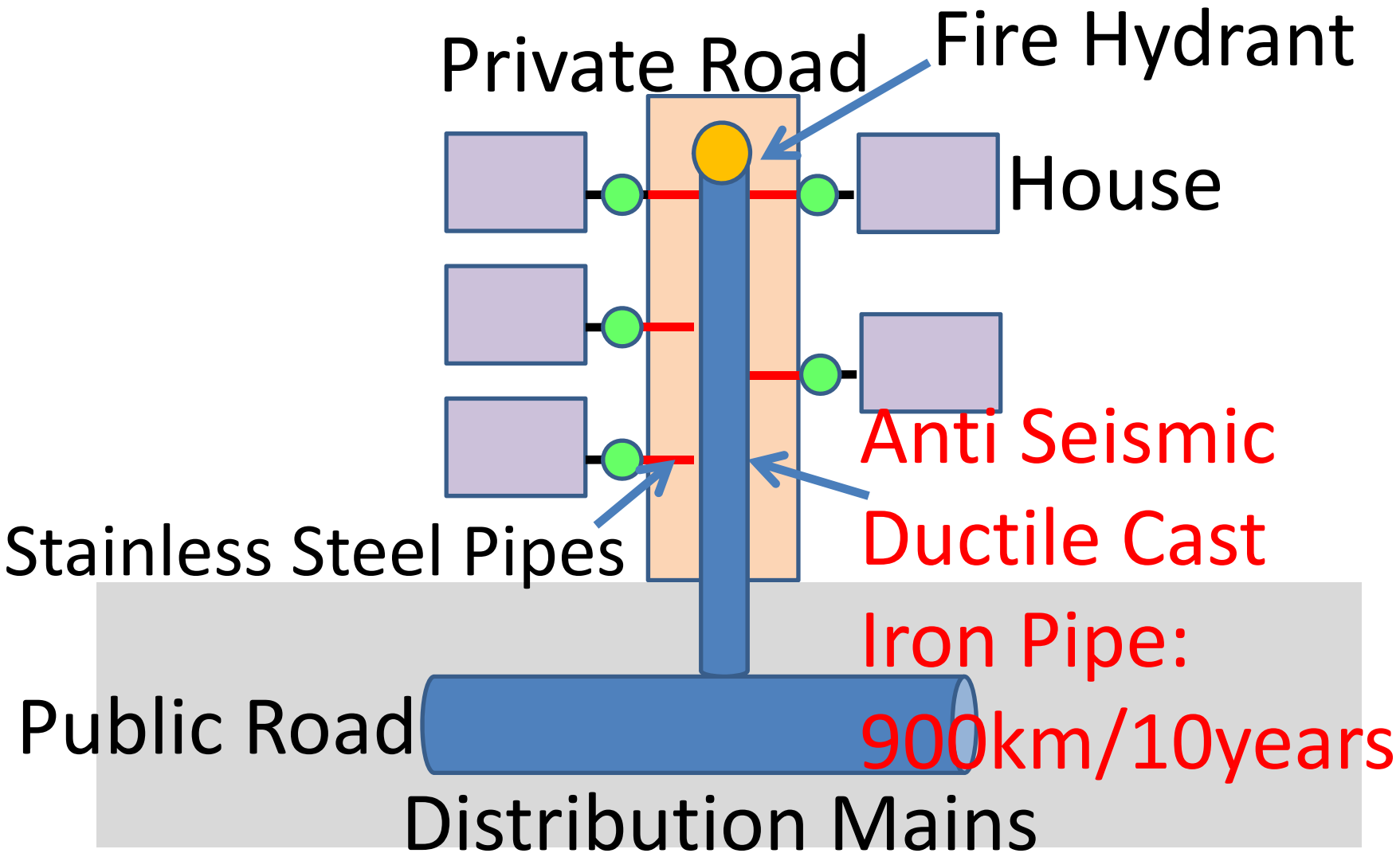
Service Pipes Under Private Roads

(Before Improvement)



Service Pipes in Private Road

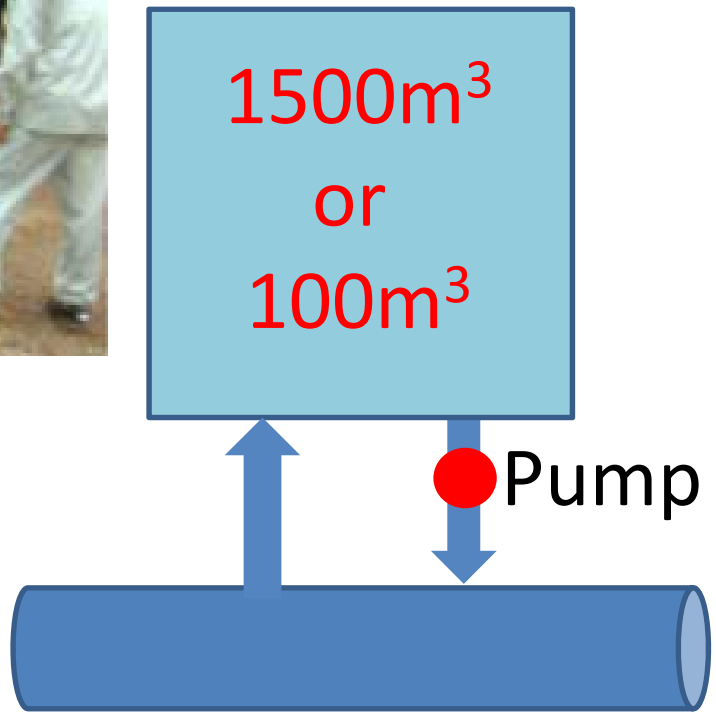
(After Improvement)



Emergency Water Supply Tanks

Located ≦2 km from any point in Tokyo

Secure fresh water at all times



Distribution Mains

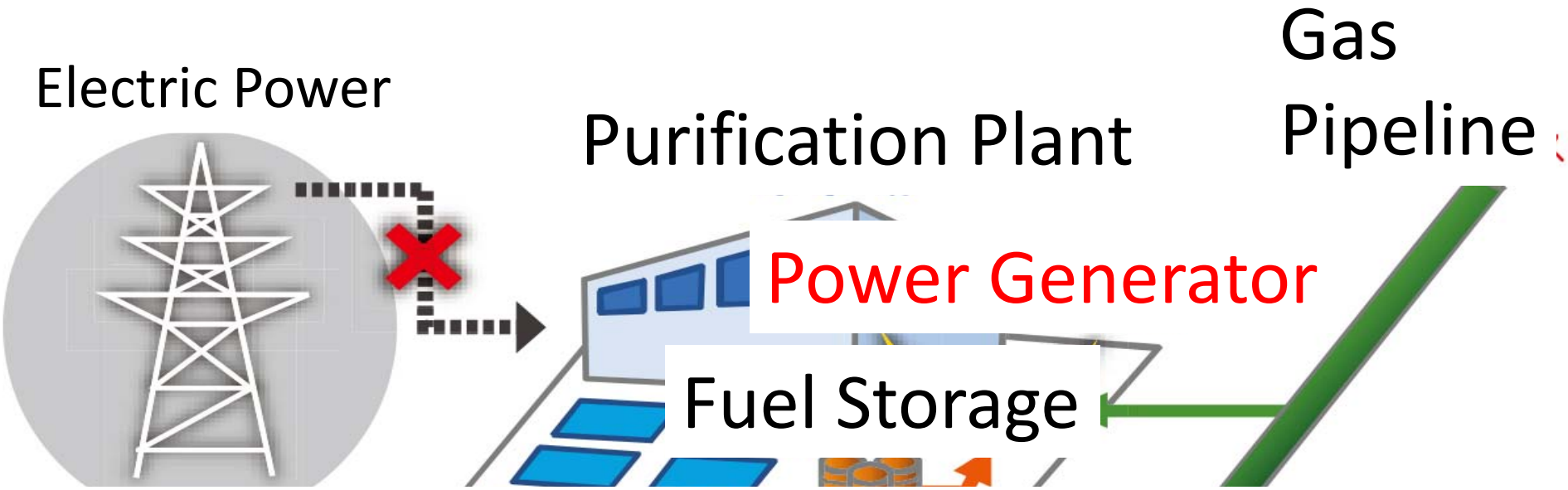
Emergency Water Supply via Fire Hydrants

Emergency Water Supply Set
900 Sites were used in the Kobe Earthquake

2,600 sets of Stand Pipe, Hose, and Faucet and Nozzle were delivered to customers, and exercises are being done

Electric Power Self-Sufficiency by 2020

Earthquake Occurs



- Full Scale Power Generator Supplies to Plant Capacity
- Daily use of Commercial Power Supply and Electric Generators fed by Gas Pipelines
- In Case of Blackout, Electric Generator fed by Gas Pipeline or Fuel Storage(3 days)

Power Self-Sufficiency by 2022

In the 2011 Earthquake,
We could not observe water pressure, flow rates, and water quality in distribution pipes, because of blackouts

↓

Batteries capable of running for 3 days are to be installed at 190 water pressure telemeters and 56 water quality telemetrers

Pressure Telemeter

Water Quality Telemeter

Long-Range Renewal Plans for Water Purification Plants

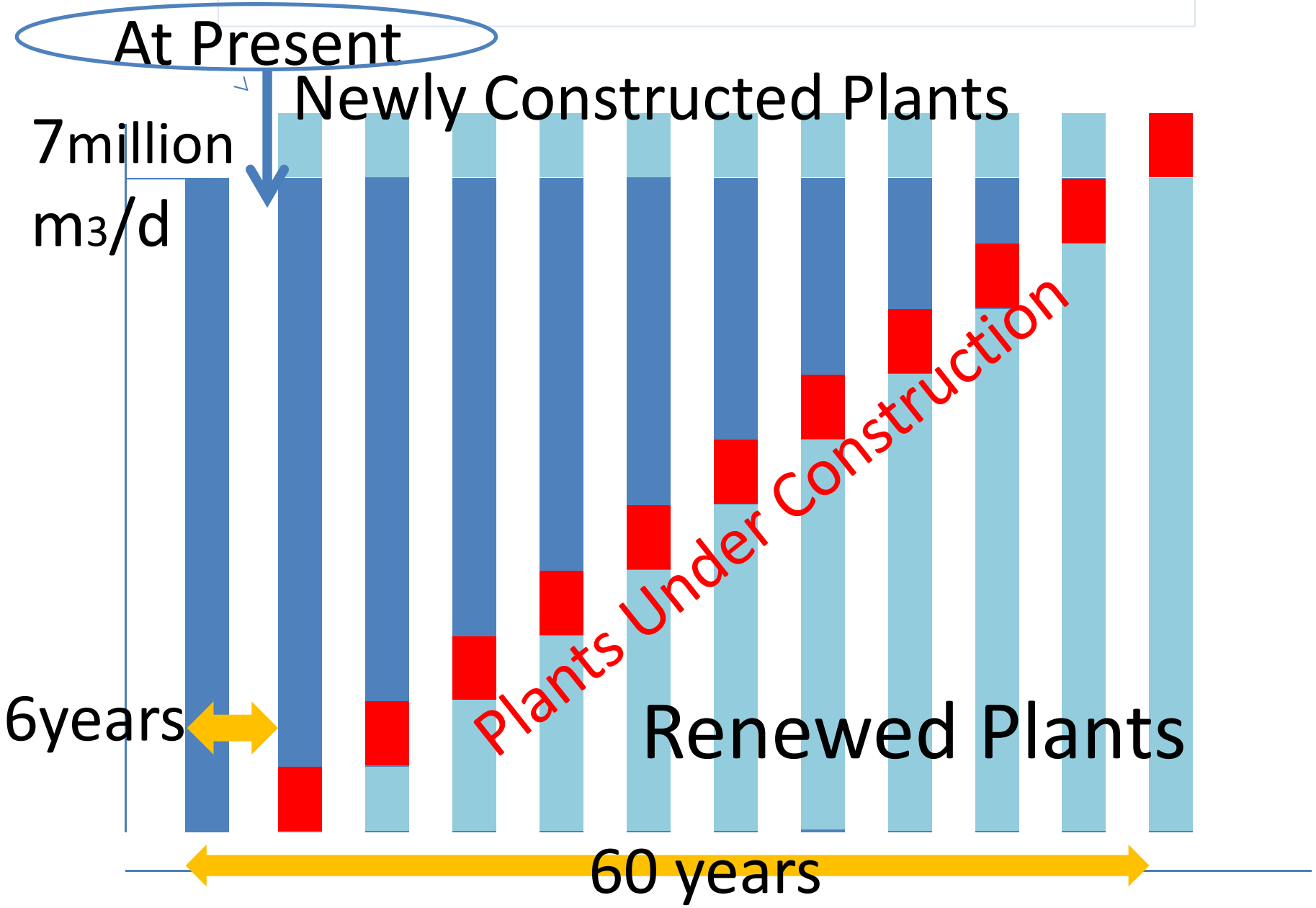
New plants must be constructed in advance, so total capacity does not decreased during renewals.

After new plant construction, old plants are to be renewed one after another.

The time required for all renewals is 60 years.

Total expenditures amount to 8 billion US dollars.
(0.1 US Dollars/m^3)

Purification Plant Renewals



Thoughts on Renewal

If renewal is delayed, accidents and risks will surely increase.

If many renewals are carried out later at once, you will face at decrease of facility capacity under construction and lack of budget.

If you cut down expenses, present customers will be happy, but it will cause troubles in the future.

Water authorities are responsible for future customers.