

The Potential of Underground Natural Gas Storage in Niigata



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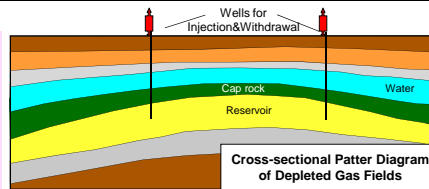
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1. Types of Underground Natural Gas Storage

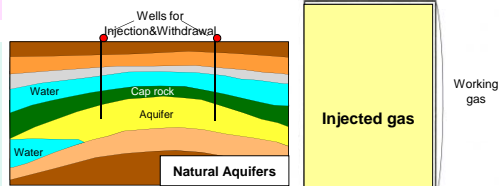
A. Depleted Gas Fields

- Have anticlinal traps and cap rocks
- Could utilize native gas as cushion gas for withdrawal
- Approved capability for storage
- Need higher pressure to press cushion gas



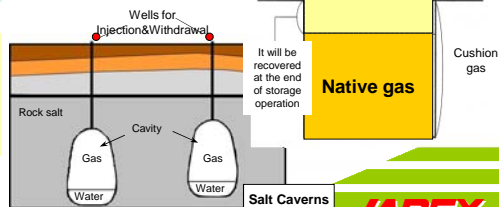
B. Natural Aquifers

- Have cap rocks and good permeability
- Need higher pressure to replace water by gas
- Could need to inject more gas for cushion gas
- Need to verify storage capability and capacity



C. Salt Caverns

- Need less pressure for injection owing to injection into space after melting salt
- No salt caverns in Japan

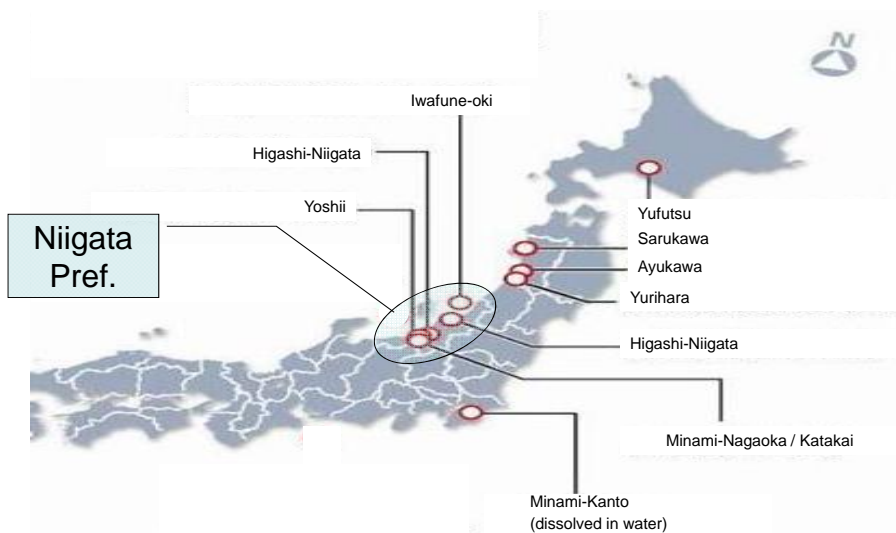


Source: METI's Report (modified by JAPEX)

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2. Oil and Natural Gas (NG) Fields in Japan



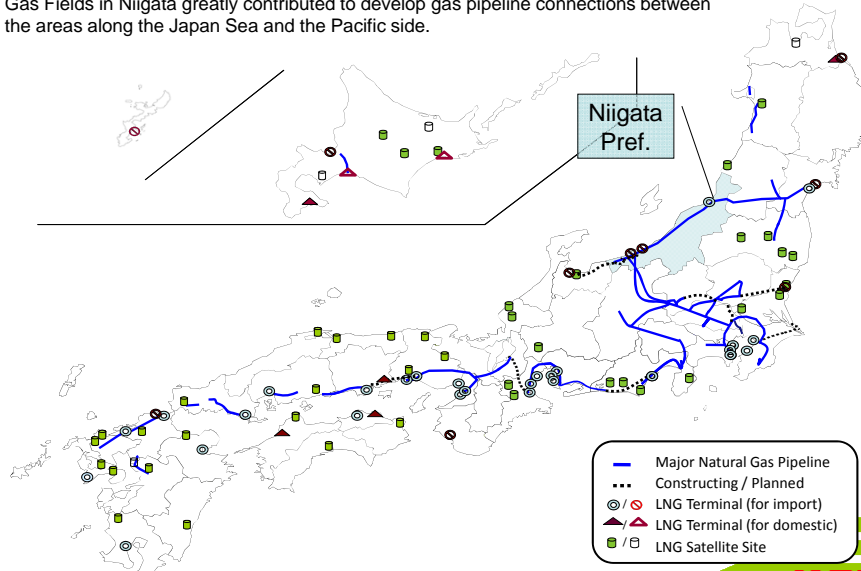
Source: Japan Natural Gas Association (modified by JAPEX)

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3. Pipeline (PL) Network for Natural Gas in Japan

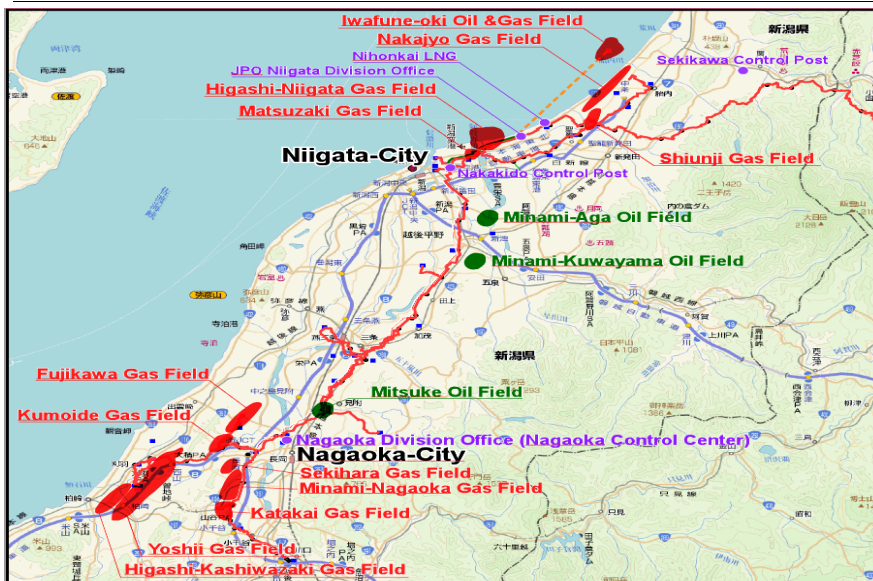
Gas Fields in Niigata greatly contributed to develop gas pipeline connections between the areas along the Japan Sea and the Pacific side.



Source: METI's Report (modified by JAPEX)



4. Oil&NG Fields and PL Network in Niigata



5. Experiences of Japan’s Underground NG Storage (1/2)

As of December 1, 2011

Gas Field	Sekihara (IIIa, IIIb Formation)	Katakai (1,000m Formation)	Shiunji (I Formation)	Shiunji (II Formation)	Kumoide (V Formation)	Nakajo (D-4 Formation)
Operator	INPEX	JAPEX	JAPEX	JAPEX	JAPEX	JX
Purpose	For peak shaving	For peak demand in winter	For peak shaving	For peak shaving	For peak demand in winter	For peak shaving
Startof Injection	Apr. 1969	May 1979	Jan. 1989	Jan. 1989	Jan. 1989	Jan. 1985
Storage Capacity (Bcf)	7.3	21.2	7.7		8.0	7.1
Working Gas (Bcf)	2.0	21.2	7.3		7.0	2.8
Cushion Gas (Bcf)	5.3	0.0	0.4		1.0	4.2
Current Operation	• Injection in summer • withdrawal in winter	• Currently no injection • withdrawal in winter	• Injection in summer • withdrawal in winter	• Injection in summer • withdrawal in winter	• Currently no injection • withdrawal in winter	• Injection in summer • withdrawal in winter

Source: METI's Report (translated by JAPEx)



5. Experiences of Japan’s Underground NG Storage (2/2)

【Experiences】

- *In all of the cases, injected into the depleted gas fields and operated under the original pressure*

1969 Apr.~ Sekihara Gas Field (by INPEX : Total approx. 7Bcf)
 1979 May~ Katakai Gas Field (by JAPEx : Total approx. 21Bcf)
 1985 Jan.~ Nakajo Gas Field (by JX : Total approx. 7Bcf)
 1989 Jan.~ Shiunji Gas Field (by JAPEx : Total approx. 7Bcf)
 Kumoide Gas Field (by JAPEx : Total approx. 7Bcf)

【Purposes】

- * Peak shaving
- * Stock for Maintenance or Emergency Shut-down of Gas Production Facilities



6. Experiences of JAPEX (1/2)

【History】

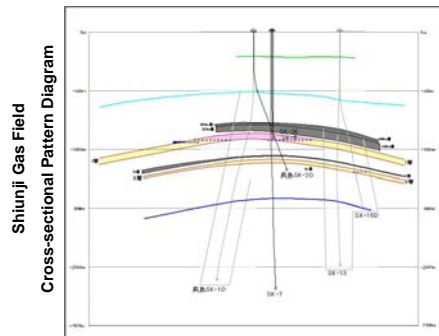
- * Start demonstration of underground natural gas storage at Katakai Field in May 1979
- * Start commercial storage at Shiunji Field and Kumoide Field in Jan. 1989

【Case Example of Shiunji】

- * Continue injection and withdrawal for 23 years without any accidents and incidents

【Operation at Shiunji Field】

- * Low Demand Season for Gas (Apr. ~ Nov.)
 - ⇒ Inject gas produced and transported from the middle area of Niigata (maximum appr. 15MMcf/d)
- * High Demand Season for Gas (Dec. ~ Mar.)
 - ⇒ Withdraw and supply gas to the area around the City of Niigata (maximum appr. 20MMcf/d)

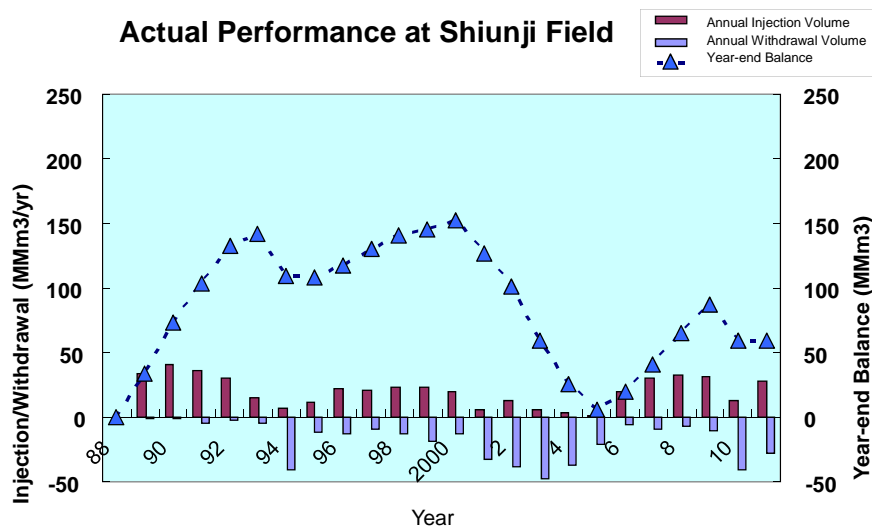


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6. Experiences of JAPEX (2/2)

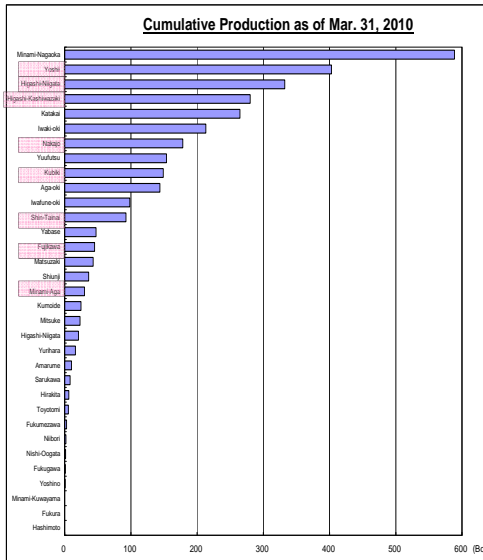
Actual Performance at Shiunji Field



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7. Japan’s Potential for Underground NG Storage



According to the study report by JNOC in 1997, the fields’ potential in Niigata having higher compatibility for underground natural gas storage was assumed approximately 560-570Bcf (equivalent to 12 million mt LNG), and this was the half of the total cumulative production.

However, the updated estimate based on the same methodology is approximately 750Bcf.

Therefore, a simulation should be conducted for each field prior to an operation.



8. Expectations about JAPEX’s Future (Example Image)

[Higashi-Niigata] *Producing field [Iwafune-oki] *Producing field

(Expected Storage Capacity)
Apprx. 250Bcf

(LNG equiv.)
Apprx. LNG 5.2 million mt

(Comparison with LNG Term.)
Apprx. 15 times of the storage capacity of Nihonkai LNG (0.34 million mt)

(Higashi-Niigata Gas Field)



(Expected Storage Capacity)
Apprx. 70Bcf

(LNG equiv.)
Apprx. LNG 1.5 million mt

(Comparison with LNG Term.)
Apprx. 5 times of the storage capacity of Nihonkai LNG (0.34 million mt)

(Advantage of offshore P/F use)
Possibility of direct injection to storage formation from Re-gas LNG Tunker
(Iwafune-oki is the only existing offshore field in Japan)



* Re-gas LNG Tunker

(Iwafune-oki offshore P/F)



9. Challenges for Japan

* (Issue of Storage Sites)

As Niigata has lots of gas fields, it is expected to have a huge potential for underground natural gas storage. However, most of fields maintain a steady supply.

* (Issue of Cost for Storage)

The development of large scale storage needs considerable amount of money for an expansion of natural gas pipeline network, and increases in existing pipelines' capacity, injection capacity, cushion gas, etc.

* (Issue of Regulation)

Currently, natural gas produced in Japan is only legitimized as gas for underground storage.

10. Relationship between Russia and Japan



- Only a few areas along the Japan Sea including Niigata are connected to the Pacific side with natural gas pipelines.
- Once the plan of the LNG export terminal, for example, in Vladivostok is decided, LNG export from Russia to Niigata would be competitive because of drastically shortened voyage.
- If an underground storage using depleted gas fields contributes to optimizations of facilities or operations of LNG receiving terminal, Niigata would become a hub of natural gas supply in Japan.
- The idea of developing a wide network of natural gas pipelines between the Japan Sea and the Pacific Ocean, expressed by National Governors' Association, increases Niigata's importance.

**Thank you
for your attention !!**