

# Ground freezing opportunities in Australia and New Zealand in construction works using $\text{NH}_3/\text{CO}_2$ natural refrigerant



16 May 2016 – Melbourne

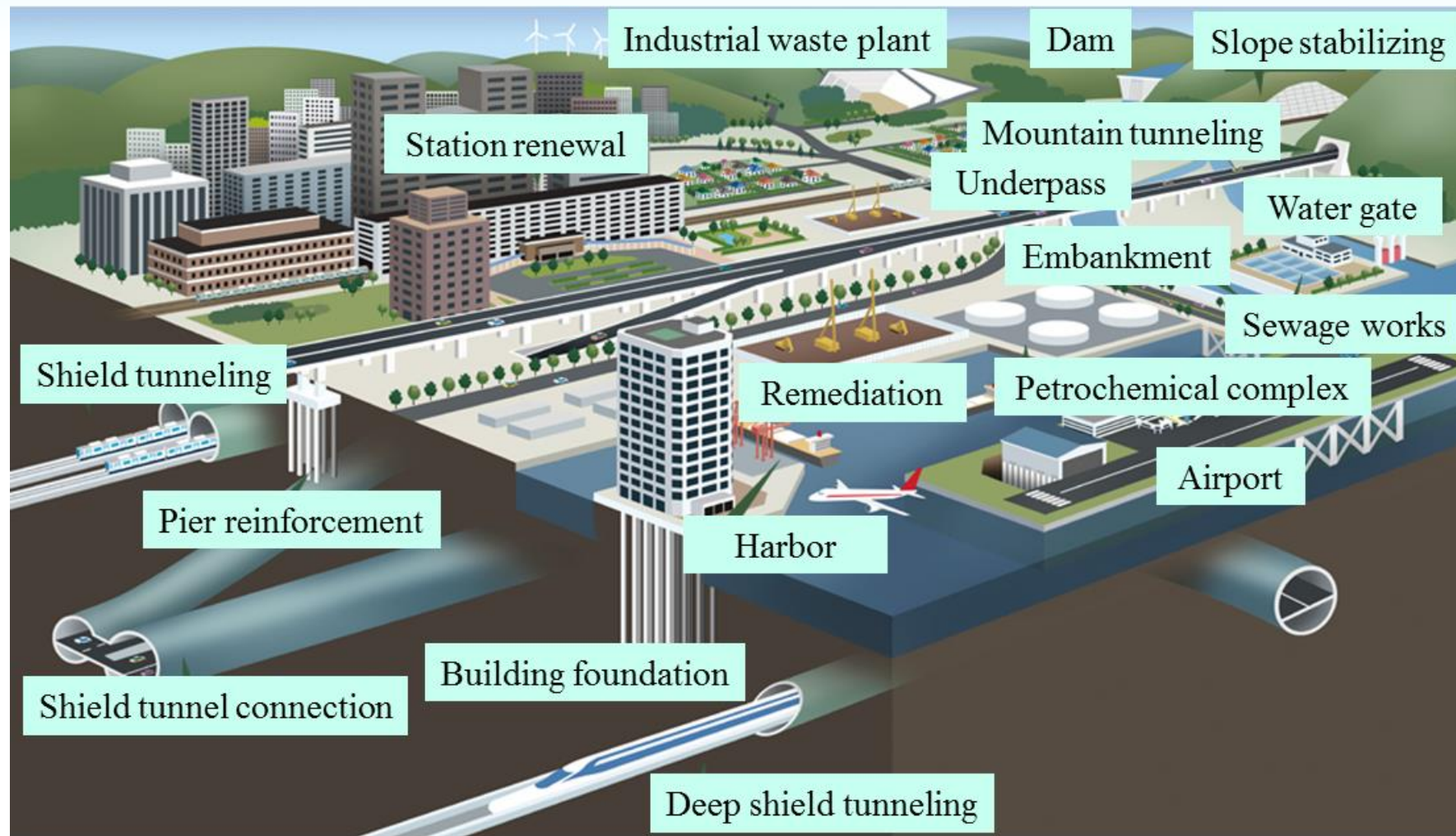


ケミカルグラウト株式会社  
CHEMICAL GROUTING CO.,LTD.

# Company profile

Establish	29 <sup>th</sup> Jan. 1963
President	Yuichi Tachiwada
Headquarters	2-2-5, Toranomom, minato-ku Tokyo 105-0001, Japan
Capital	300 million yen
Employee	316
Proceeds & Profit	Proceeds : 38,522 million yen Profit : 3,660 million yen
Business contents	<ol style="list-style-type: none"> <li>1. Research, design, execution and consulting of below works               <ol style="list-style-type: none"> <li>(1) Soil improvement and soil stabilization</li> <li>(2) Building foundation</li> <li>(3) Reinforcement of a structure durability</li> <li>(4) Soil remediation</li> <li>(5) Civil engineering</li> </ol> </li> <li>2. Selling the technique and the machine, technical guidance relate to above works</li> </ol>
Business area	Japan, Taiwan, Brazil

# Business contents

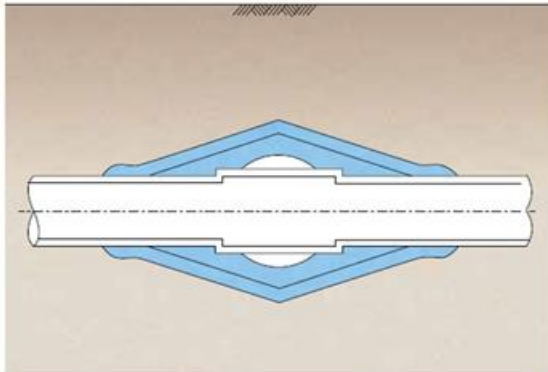


# Soil improvement

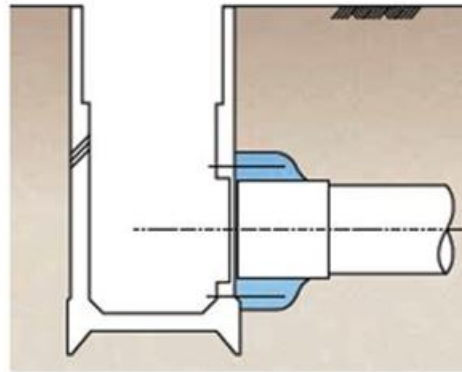
Method	Chemical grouting	Jet grouting	Soil freezing
Image			
Objective	Liquefaction mitigation, Cut off water and protection of soil collapse during excavation	Liquefaction mitigation, Building foundation, Cut off water and protection of soil collapse during excavation	Cut off water and protection of soil collapse during excavation
Material	Chemical slurry	Cement slurry	No material
Soil Strength	0.1 MN/m <sup>2</sup>	3 MN/m <sup>2</sup>	10 MN/m <sup>2</sup>

# Application of ground freezing

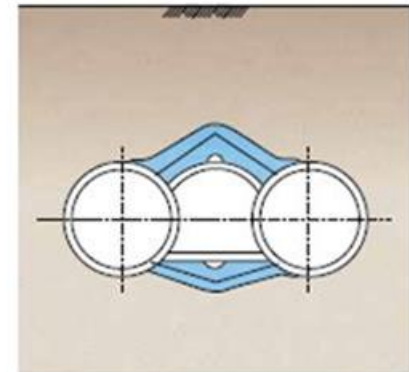
Expansion of TBM tunnel



Launch and arrival of TBM



Connecting two tunnel



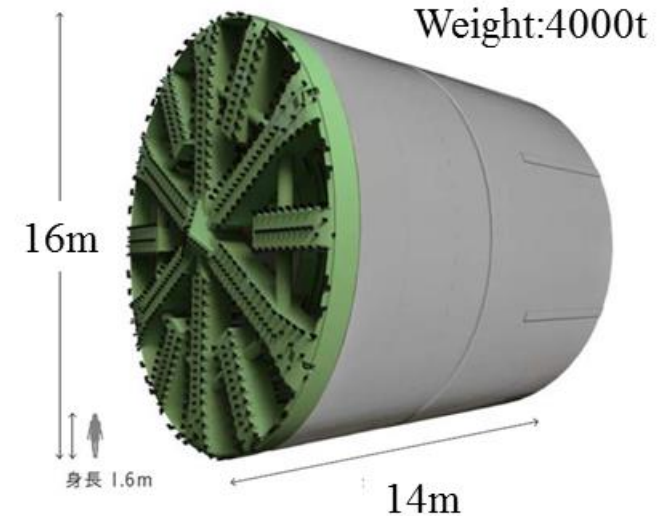
# Likely project in Japan – Tokyo Outer Ring Road



TBM tunnel 16km



Whole Plan



Tokyo Outer Ring Road Journal, 2015, [pdf]

Available at : <<http://www.ktr.mlit.go.jp/gaikan/>> [Accessed April 2016]

# Likely project in Japan – Linear Bullet Train



Linear Bullet Train (Magnetic levitation train)

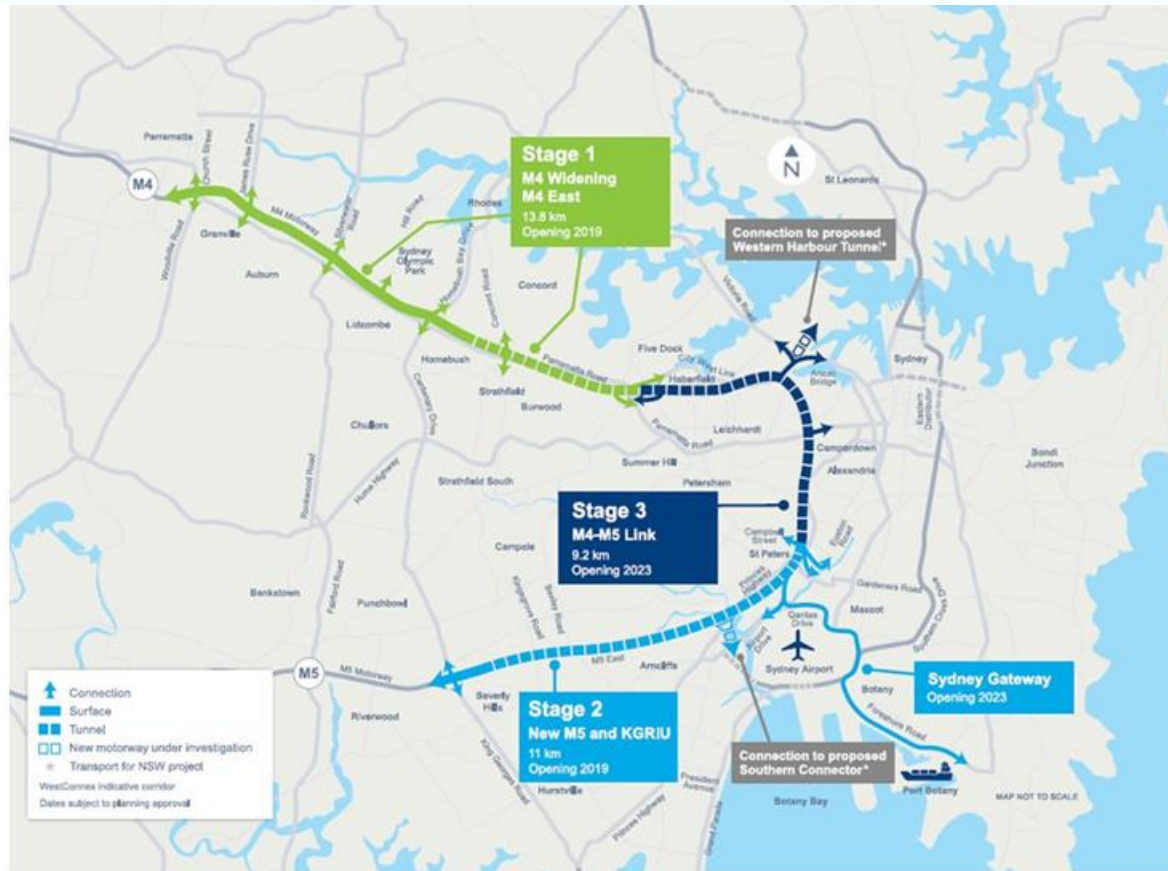


Tokyo – Nagoya 286km 67min

JR Tokai annual report, 2015, [pdf]

Available at : <<http://company.jr-central.co.jp/ir/annualreport/index.html>> [Accessed April 2016]

# Potential project in Australia – WestConnex

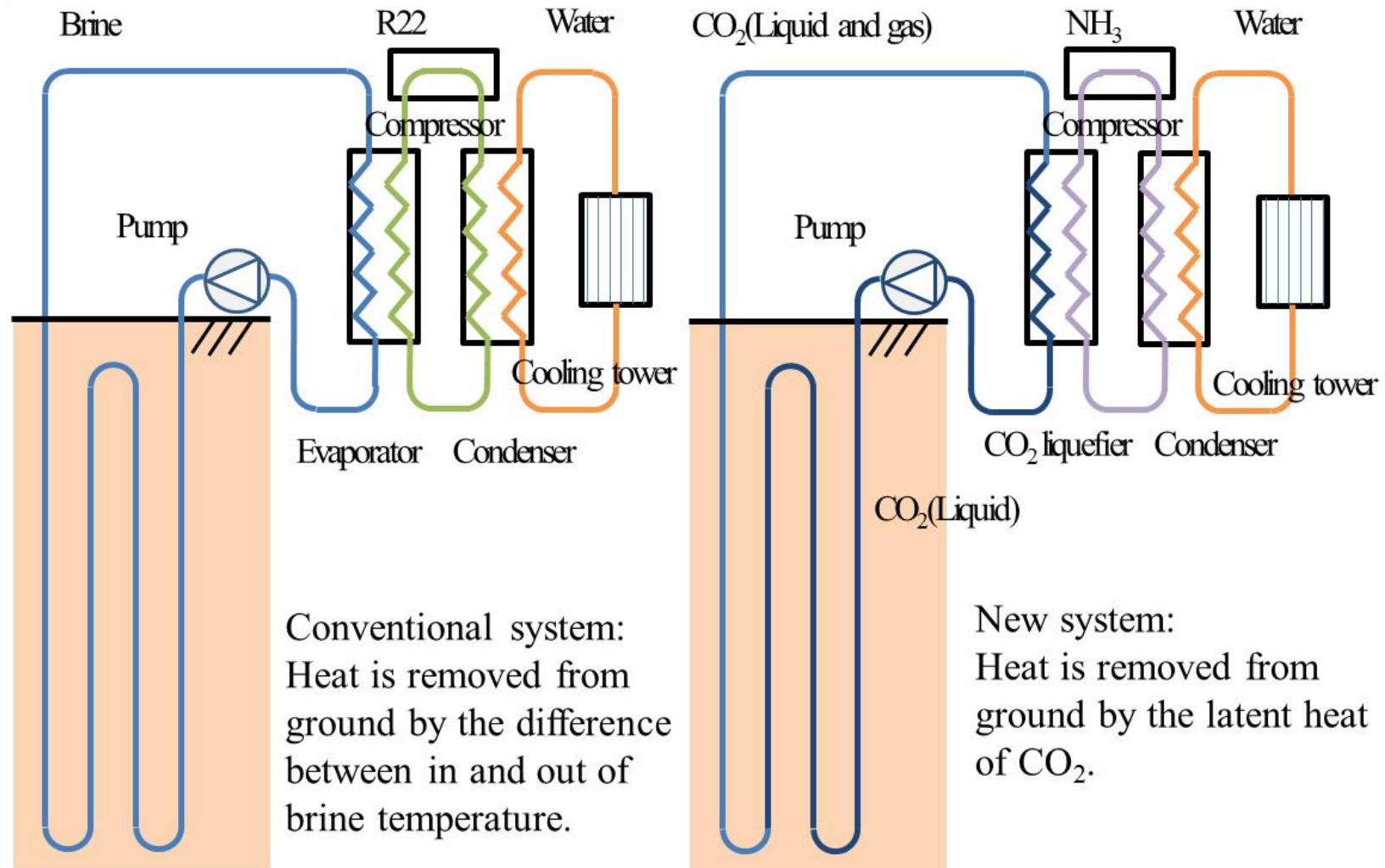


WestConnex map, [pdf]

Available at : <[http://www.westconnex.com.au/library/key\\_documents\\_and\\_maps.html](http://www.westconnex.com.au/library/key_documents_and_maps.html)> [Accessed April 2016]



# Adoption of NH<sub>3</sub>/CO<sub>2</sub> NewTon system



# Background

- 2020  
HCFC manufacturing will be banned
- After 2025  
HFC will be regulated
- Global warming gas increasing +10.8%  
(Compared with in 1990)



## Increasing soil freezing project in Japan

- 2020 Tokyo Olympics
- Long distance and large frozen area
- Necessary contribution for ecofriendly

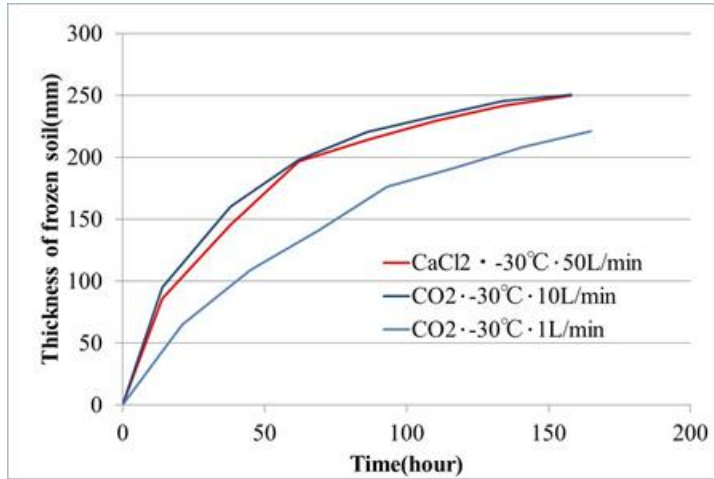
Type	Number	GWP
HCFC	R22	1,810
HFC	R404A	3,920
Natural refrigerant	R717 (NH <sub>3</sub> )	<1
	R744 (CO <sub>2</sub> )	1

Global warming point

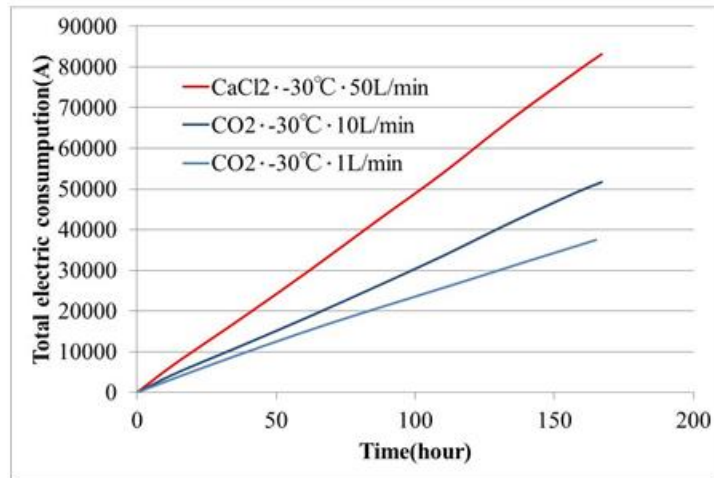
# Comparison with conventional system

	New system	Conventional system
Photo		
Cooling ability	103.4 kW	110 kW
First refrigerant	NH <sub>3</sub> (25kg)	R22 (250kg)
Second refrigerant	CO <sub>2</sub>	CaCl <sub>2</sub> brine
Flow rate at 1 freezing pipe	1 ~ 2 L/min	20 ~ 30 L/min
Minimum temperature	-45 °C	-45 °C
COP	2.55	1.63
Pump electric power	1 ~ 2 kW	5 ~ 11 kW
Main pipe diameter	25 ~ 50 mm	80 ~ 100 mm

# Field test result



Exposed frozen soil



Freezing pipe



Freezing pipe attached at wall

# Conclusion

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- Adoption of natural refrigerant for soil freezing in construction works
- Electric power become 60% compared with conventional system
- Ecofriendly for both the ground and the atmosphere

# Schedule

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Marketing efforts for the big project related to

- Tokyo Outer Ring Road in Japan
- The linear Bullet train in Japan
- WestConnex in Australia

HCFC or HFC was used in All 90 projects for the last 25 years

→Change the all system to natural refrigerant in near future

Contribute to reduction of environmental impact  
in construction works

Thank you for your attention.