

Global Cooperative Activities of KICT : Horizon 2020-DESTRESS



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Introduction of KICT



History of KICT

- 1948** Civil Engineering Testing Laboratory , Ministry of Home Affairs
- 1983** Korea Institute of Construction Technology (Established)
- 1988** Government-sponsored Research Institute, Ministry of Construction
- 1999** Integrated with National Construction Research Institute
- 2017** Under the Governance of National Research Council of Science & Technology in Ministry of Science and ICT



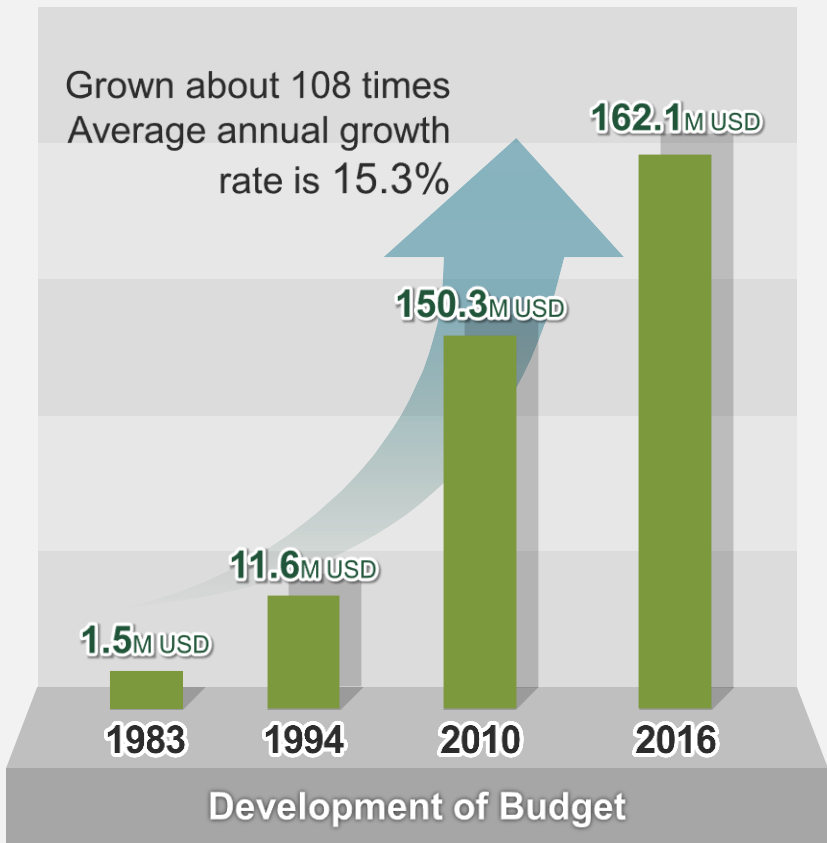
Personnel and Budget



Growth of Budget

1,000won = 1\$

Grown about 108 times
Average annual growth rate is 15.3%



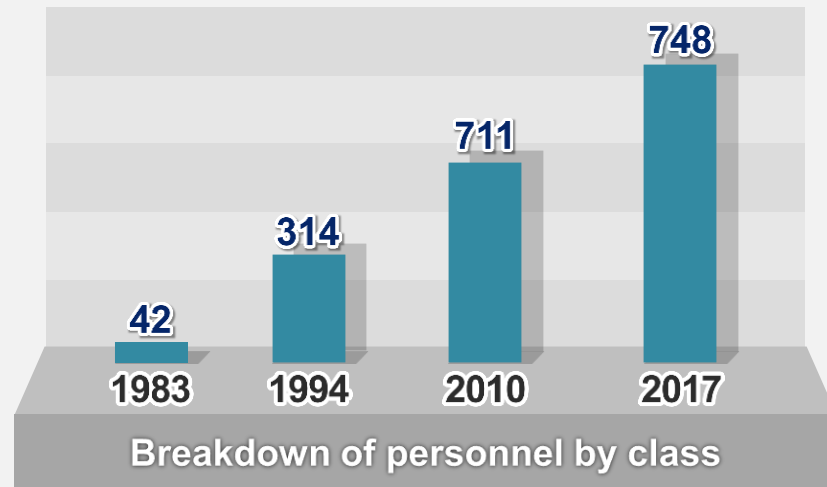
Development of Budget

[as of 2016]

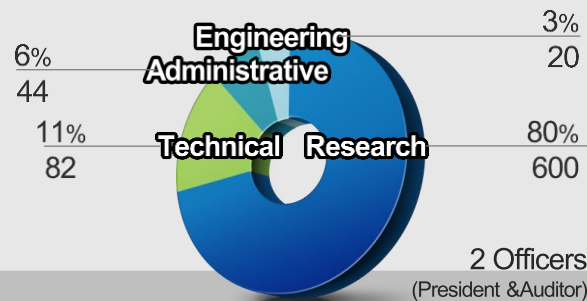


Growth of Personnel

Unit : Person(s)



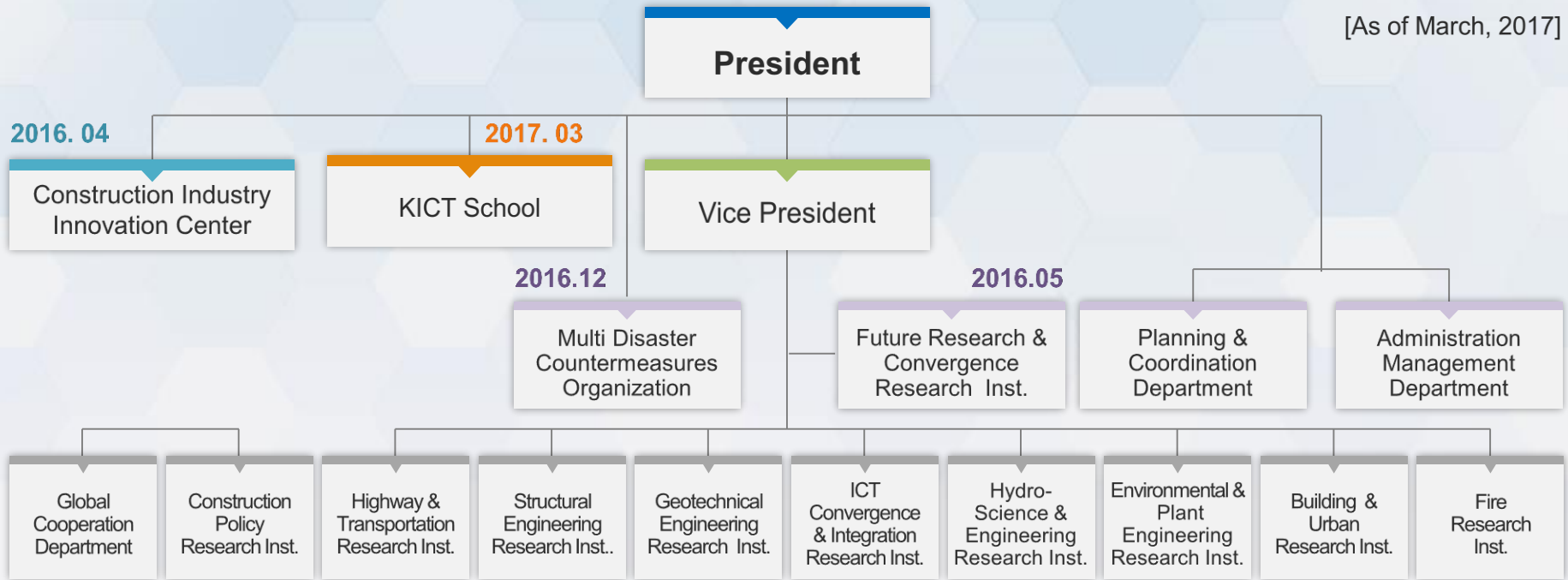
Breakdown of personnel by class



[as of July, 2017]

Organization

[As of March, 2017]



Research Institutes:

Aim to develop basic/original technology in their areas of expertise

Future Research & Convergence Research Institute:

Overall management of convergent research

Research Organization:

Flexible organization to conduct convergent research by issue

Construction Industry Innovation Center:

Outpost of support for small and medium enterprises

KICT School:

Graduate school that takes advantage of KICT's researchers and facilities

R&D Infrastructure

World Class R&D Infrastructure about Land and Transport

Headquarters in Ilsan



(Goyang, 1997)

Korea's Only Comprehensive Construction Research Facility

Main facilities

Structural Testing Laboratory, Wheel Load Testing Laboratory, Coastal and Harbor Laboratory, etc

Area
140,522m²

Area
692,119m²

Total Area : 1,120,481 m²

Size equivalent to
175 Soccer Fields

SOC Evaluation Center



(Yeinccheon, 2016)

National Common Full Scale Verification Center for Activation of National R&D and New Technology

Main facilities

SOC Demonstration Research Center-Road Test Track, Artificial Weather Reproduction Facility

Fire Research Center



(Hwasung, 2006)

World Class Fire Research Facility for Advanced Fire Safety Technology

Main facilities

High Performance Fire Resistance Lab
Material Property Test Lab, etc

Area
94,789m²

Area
193,051m²

River Experiment Center



(Andong, 2009)

Integrated River Experiment Facility including large scale experimental channel

Main facilities

Steep-slope channel, Straight Channel
meandering channel, etc

Achievements

Research on Convergence

Conducted Flagship R&D
(including BIG)

Appointed as Convergence
Research Department

4
Cases



NST

MOLIT

KRW 33
Billion

5

Projects

2

Projects

Weighing of Convergence Research Funds



Global projects



First Asian
Organization and
Government-
Funded Research
Institute that won
Horizon 2020

\$29.1 million



Exported National
Construction
Research Center
to the Ministry of
Public Works of
Kuwait

USD 1 Million



Korea-Germany
International Joint
Technology
Development
Project

EUR 1.49 Million

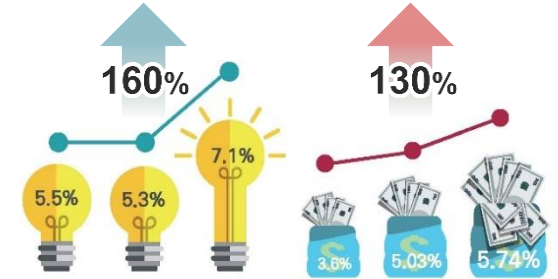


Technical Advisory
Services to Sri
Lanka ADB

USD 138,000

First Asian Organization that won
NASA STEM Program
USD 1.24 Million

Utilization of Achievements



Patent Utilization
Rate
'13-'16

Research
Productivity Increase
'13-'16

Academic Performance Achievement

Korea Agency for
Infrastructure
Technology
Advancement
(KAIA)

Three Technologies
Selected for the
KAIA 20
Technologies of
2016

Ministry of Science,
ICT and Future
Planning

Selected for the
Ministry's 100 Key
Achievements from
National Projects
2016

Global Network

Leap into the **Global Construction R&BD Institute**

World Class Institute – Global Leading Technology and KICT-EU Joint Research



KICT- EU Institutes Partnerships



▶ Highway and Transportation Research Institute

▶ Structural Engineering Research Institute

▶ Geotechnical Engineering Research Institute

▶ ICT Convergence and Integration Research Institute

▶ Hydro Science and Engineering Research Institute

▶ Building and Urban Research Institute

▶ Fire Research Institute



Horizon 2020_DESTRESS

Demonstration of Soft Stimulation
Treatment of Geothermal Reservoirs



Contents

Geothermal Energy & EGS

Project Overview

KICT Role in DESTRESS



Geothermal Energy : Direct use vs. Electricity

Direct use of heat (non-electric) ~70 GW_t¹⁾

- Various usage of heat
- Geothermal Heat Pump (GHP)
- In Korea ~835 MW_t²⁾

Indirect use (Electricity) ~ 12.6 GW_e³⁾

- Hydrothermal field
_conventional volcanic areas
- Enhanced Geothermal System (EGS)
- The only base load power among other **renewables**

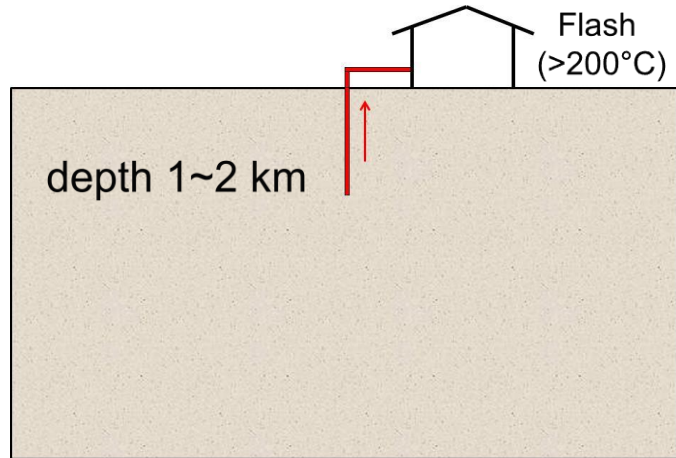


Green House at Seokmodo, 2009
(Song, 2009)

1) Lund, J. W., Boyd, T. L., 2015, Direct utilization of geothermal energy 2015 worldwide review, World Geothermal Congress 2015
2) Song, Y. and T.J. Lee, 2015, Geothermal Development in the Republic of Korea: 2010-2014 update, World Geothermal Congress 2015
3) Bertani, R., 2015, Geothermal power generation in the world 2010-2015 Update Report, World Geothermal Congress 2015

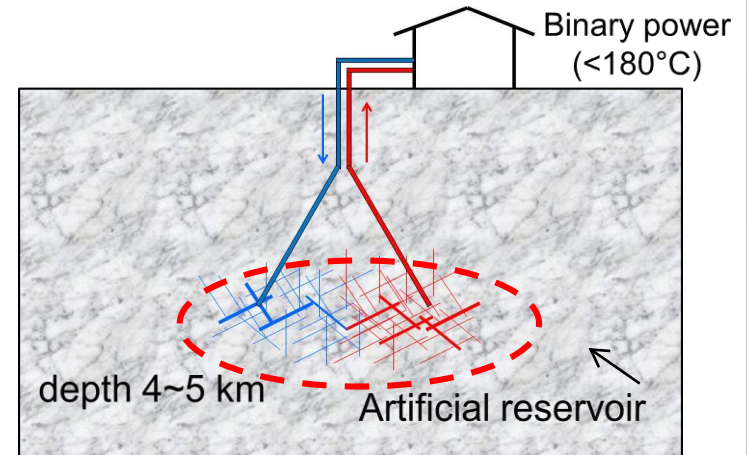
Geothermal Energy : Enhanced Geothermal Systems(EGS)

Hydrothermal (volcanic area)

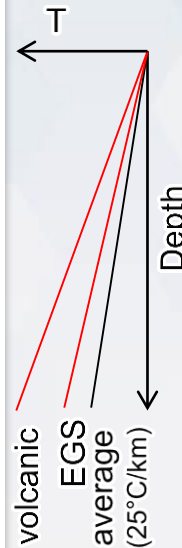


- Best geothermal gradient $> 50^{\circ}\text{C}/\text{km}$
 - shallow (1~2 km), drilling cost ↓
- High permeability ($> 10\text{-}15 \text{ m}^2$)
 - Hydraulic Stimulation x
- Optional injection hole
- Hydrothermal power generation

EGS (Non-volcanic area)



- Above average gradient ($30\text{-}40^{\circ}\text{C}/\text{km}$)
 - deep (4~5 km), drilling cost ↑
- Low permeability ($< 10\text{-}18 \text{ m}^2$)
 - Hydraulic stimulation is a key
- Compulsory injection hole
- Binary power generation



(Min, 2013)

Hydraulic Stimulation in EGS

Purpose

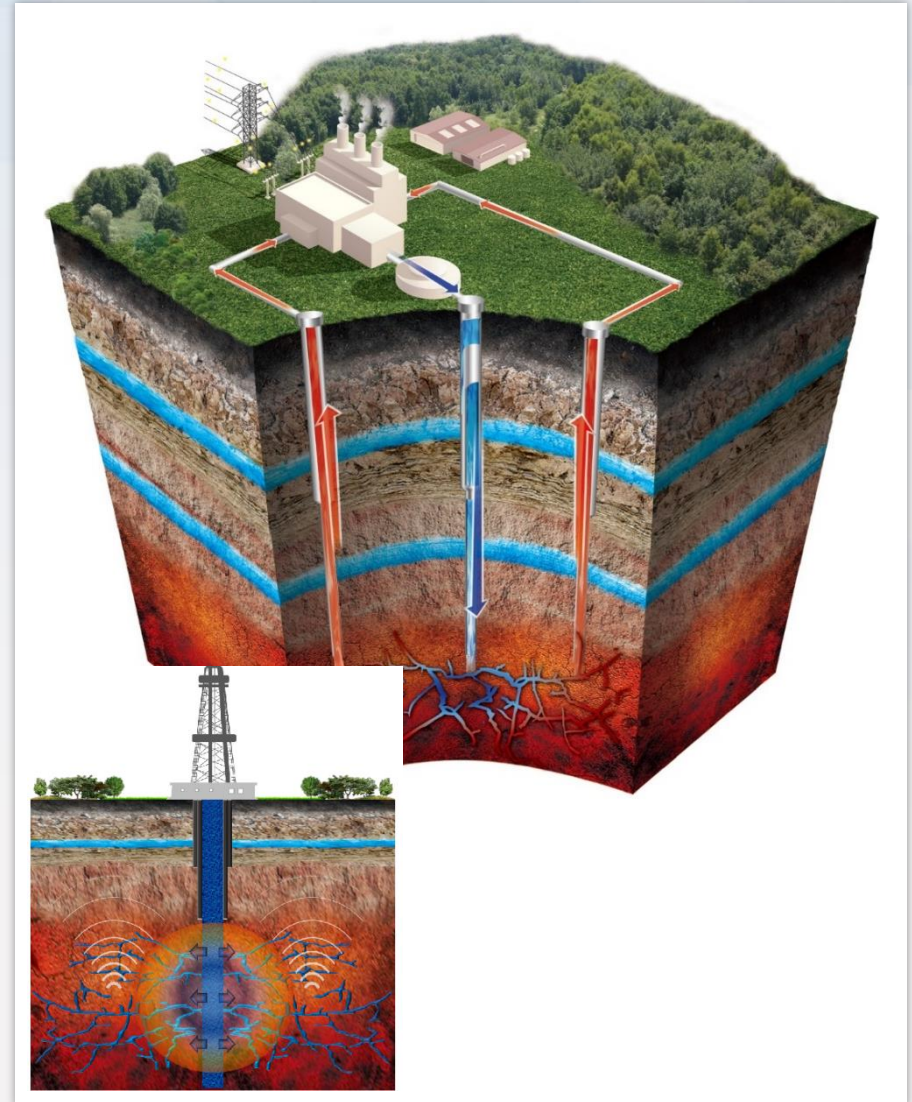
- Improve transmissivity of reservoir for efficient heat extraction

Technical Difficulties

- Resort to in-situ stress and experience
- Hard to optimize the design
- High uncertainty for results

Environmental Problem

- Induced seismicity
- Basel 1 project in Switzerland suspended because of a felt micro earthquake of ML=3.4
- ...



Project overview : **Summary**

Project Title

- DESTRESS (Demonstration of Soft Stimulation Treatment of Geothermal Reservoirs)

Duration

1 Mar 2016 – 28 Feb 2020 (4 years)

Budget

21.0 m € (total), 10.7 m € (from EU, excl. Switzerland & Korea)

Topic

Societal Challenge - Demonstration of renewable electricity and heating/cooling technologies

Participants (coordinating organization: GFZ German Research Center for Geosciences)

















- 16 participants from 7 countries (3 participants from Korea)

Objective

- demonstration of environmentally friendly hydraulic stimulation in existing EGS geothermal sites

Project overview : Participants

16 participants from 7 countries

	Country	Organization	Entity
	Germany	Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences	Research Institute
	Germany	EnBW Energie Baden-Württemberg AG	Industry
	France	ES-Geothermie	Industry
	UK	University of Glasgow	University
	Switzerland	Geo-Energie Suisse AG	Industry
	Netherlands	Netherlands Organisation for Applied Scientific Research TNO	Research Institute
	Switzerland	ETH Zürich	University
	Germany	Geothermie Neubrandenburg GmbH	Industry
	Lithuania	Geoterma UAB	Industry
	France	Univeristy of Strasbourg	University
	Netherlands	Delft University of Technology	University
	Korea	Nexgeo Inc.	Industry
	Korea	Seoul National University	University
	Korea	<u>Korea Institute of Civil Engineering and Building Technology</u> (Korea Institute of Construction Technology)	Research Institute
	Netherlands	ECW Geomanagement BV	Industry
	Netherlands	Trias Westland B.V.	Industry

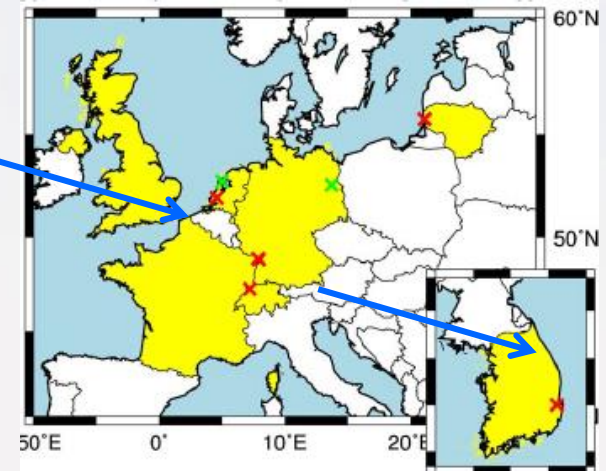
Project overview : Sites for demonstration

Drilling and hydraulic stimulation at 4-5 km depth is very **expensive**.

- EU funding allows for innovative hydraulic stimulation
- EU and Korean partners execute and analyze the hydraulic stimulation in 6 selected sites including Pohang (3rd well to be drilled) in Korea
- Ideal framework for collaboration with large scale field experiments
- SNU will be involved in design/analysis/calibration of hydraulic stimulation in Haute-Sorne (Switzerland) and Pohang (Korea)

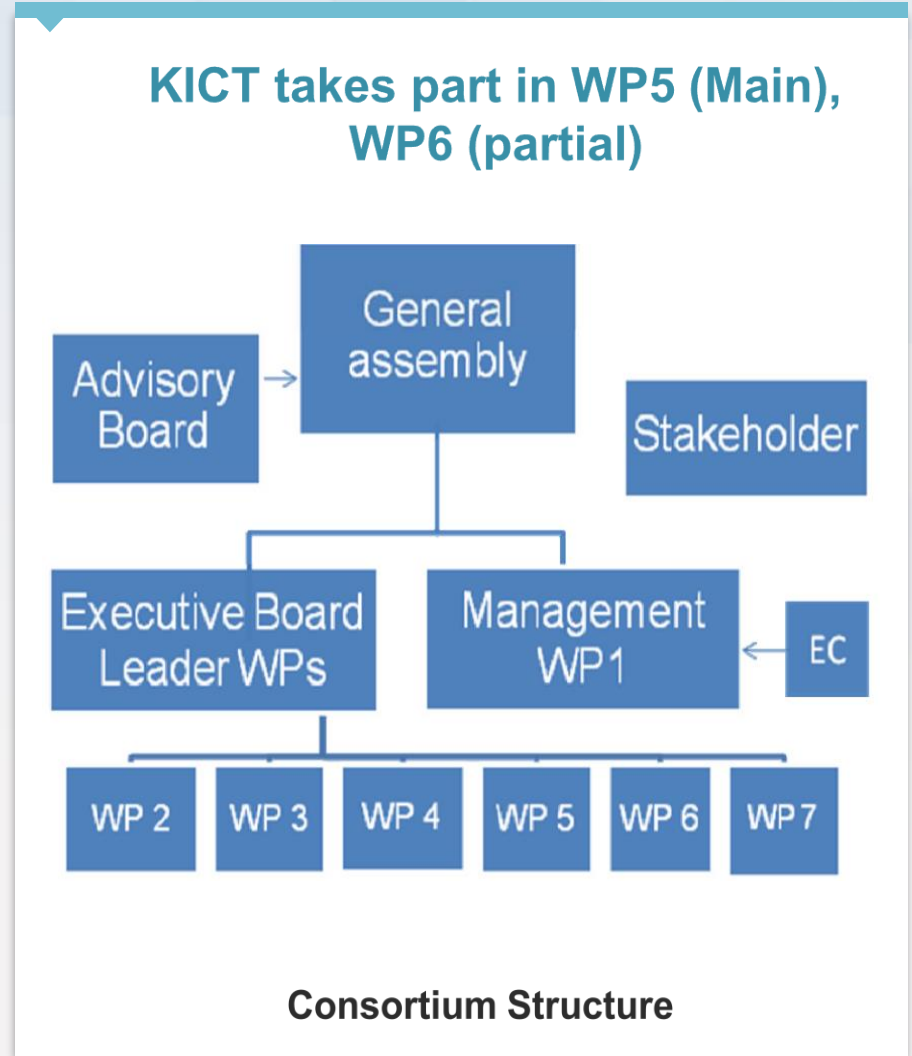
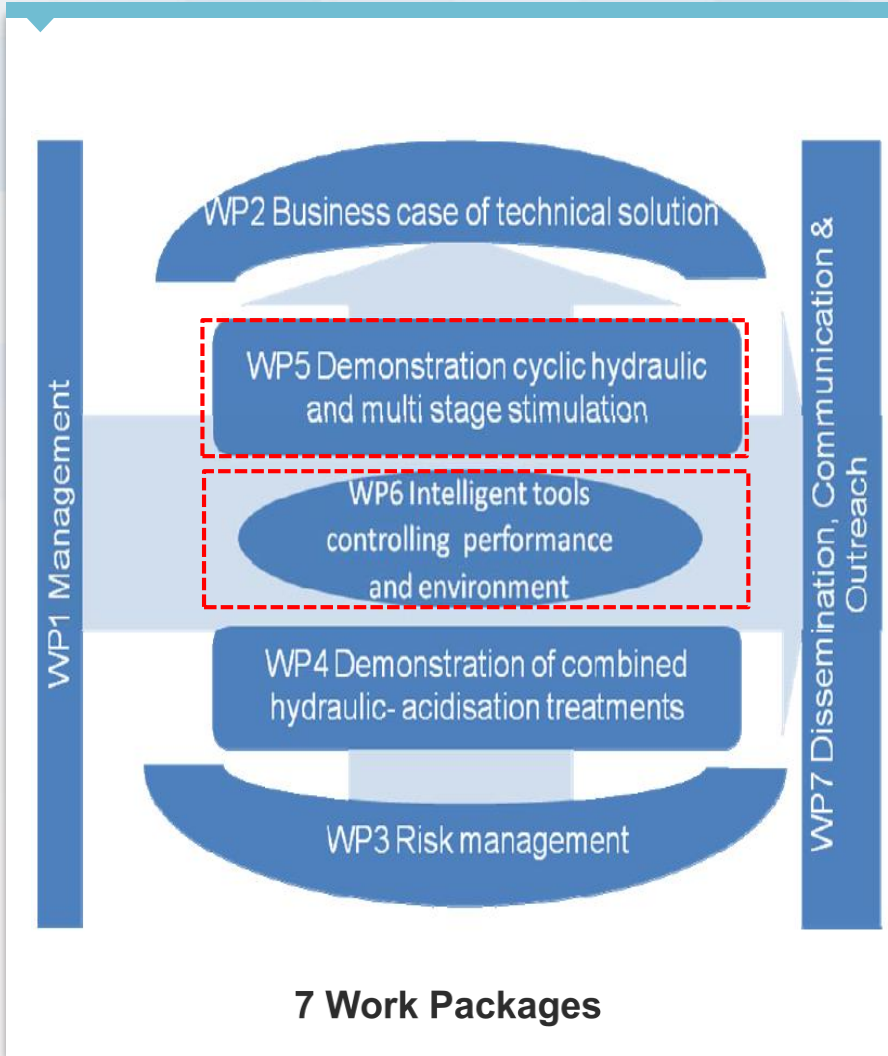


Hydraulic Stimulation in Pohang
(injection pressure 5 ~ 90 MPa)



Chosen sites for
demonstration

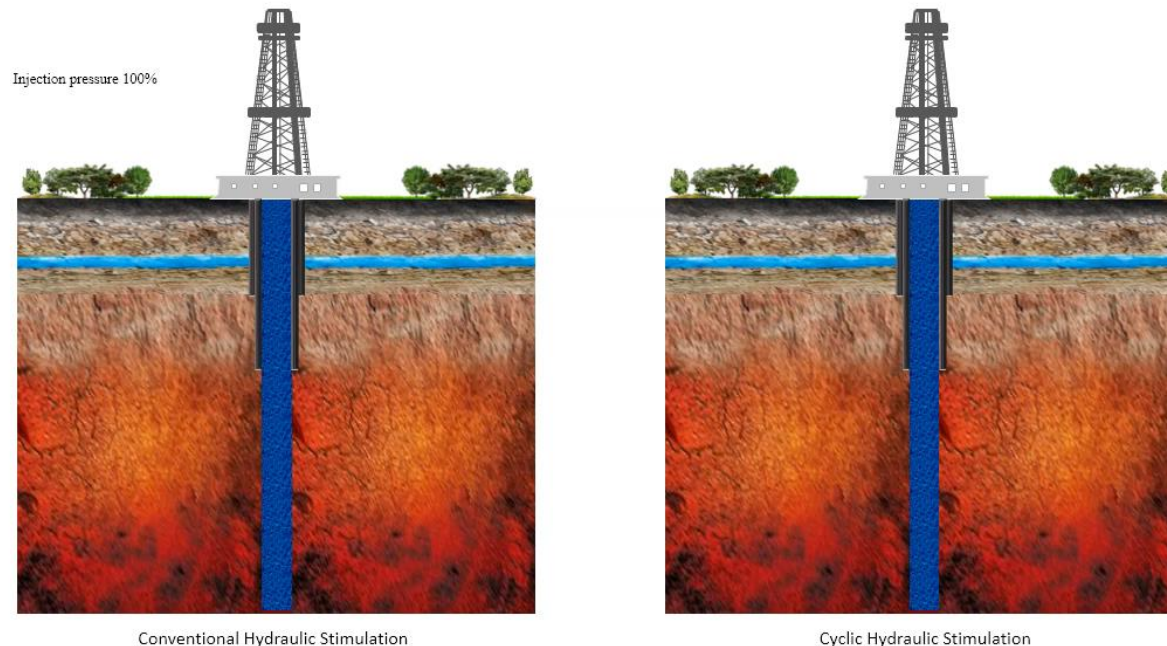
KICT Role in DESTRESS : Work Packages & Consortium Structure



KICT Role in DESTRESS : New suggested concept of HS

Fatigue hydraulic stimulation

- Involvement of high-pressurized fluid cycles operating at failure tips
- Stress relaxation at fracture tips

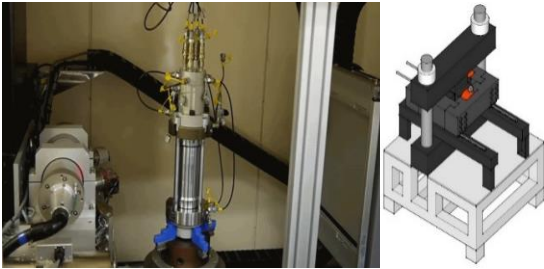


Zang, A., Z.J. Yoon, O. Stephansson, O. Heidbach. 2013. Fatigue hydraulic fracturing by cyclic reservoir treatment enhances permeability and reduces induced seismicity. *Geophys. J. Int.* doi: 10.1093/gji/ggt301. Zhuang, L., K.Y. Kim, S.G. Jung, M. Diaz, K. B. Min, S. Park, A. Zang, O. Stephansson, G. Zimmermann, J.S. Yoon. Laboratory study on cyclic hydraulic fracturing of Pocheon granite. *Proceedings of the 50th US Rock Mechanics / Geomechanics Symposium, Houston, 26-29 June 2016.*

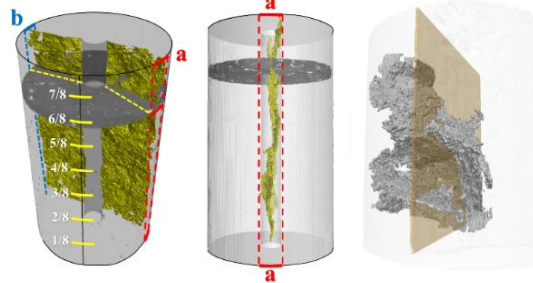
KICT Role in DESTRESS : Demonstration of new HS treatment for practical utilization

Lab-scale Experiment and X-ray CT Analysis

Hydraulic fracturing test



X-Ray CT image & permeability test

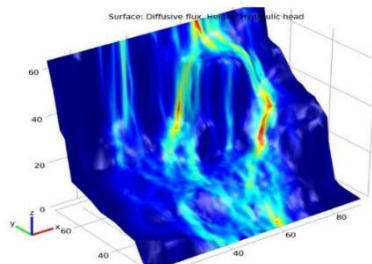


Enhanced permeability caused by hydraulic fracturing
Anisotropic permeability of fractured media
Compressibility of rock specimen
Roughness of rock fractures
Aperture distribution of rock fractures
Thermal conductivity of rock specimen
Thermal diffusivity of rock specimen
⋮

Major input data for numerical simulation

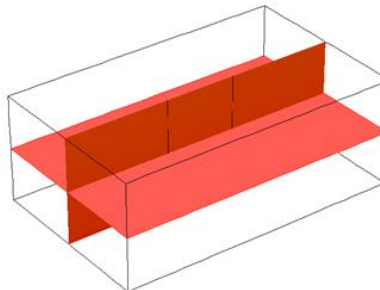
Lab-scale Experiment and X-ray CT Analysis

Rock fracture flow modelling

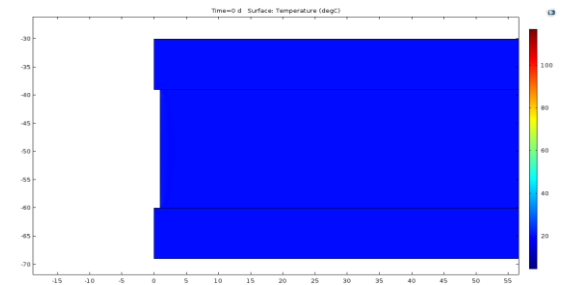


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EGS simulation modelling



Hydrothermal system modelling



KICT with Global Networking Event

Global Networking Event



- **2016 KICT Construction Day (August 19, 2016) :**
Participation of 16 Countries with 23 diplomats
- **2017 KICT Engineering and Construction Day(July 13, 2017) :**
Participation of 18 Countries with 21 diplomats



Thank you.

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