
ESMAP
Global Geothermal Development Plan:
Roundtable 3
HARPA CONFERENCE CENTER | REYKJAVIK, ICELAND | APRIL 25-26, 2016
HOSTED BY THE MINISTRY OF FOREIGN AFFAIRS, ICELAND
WORLD BANK GROUP


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Global Geothermal
Development Plan


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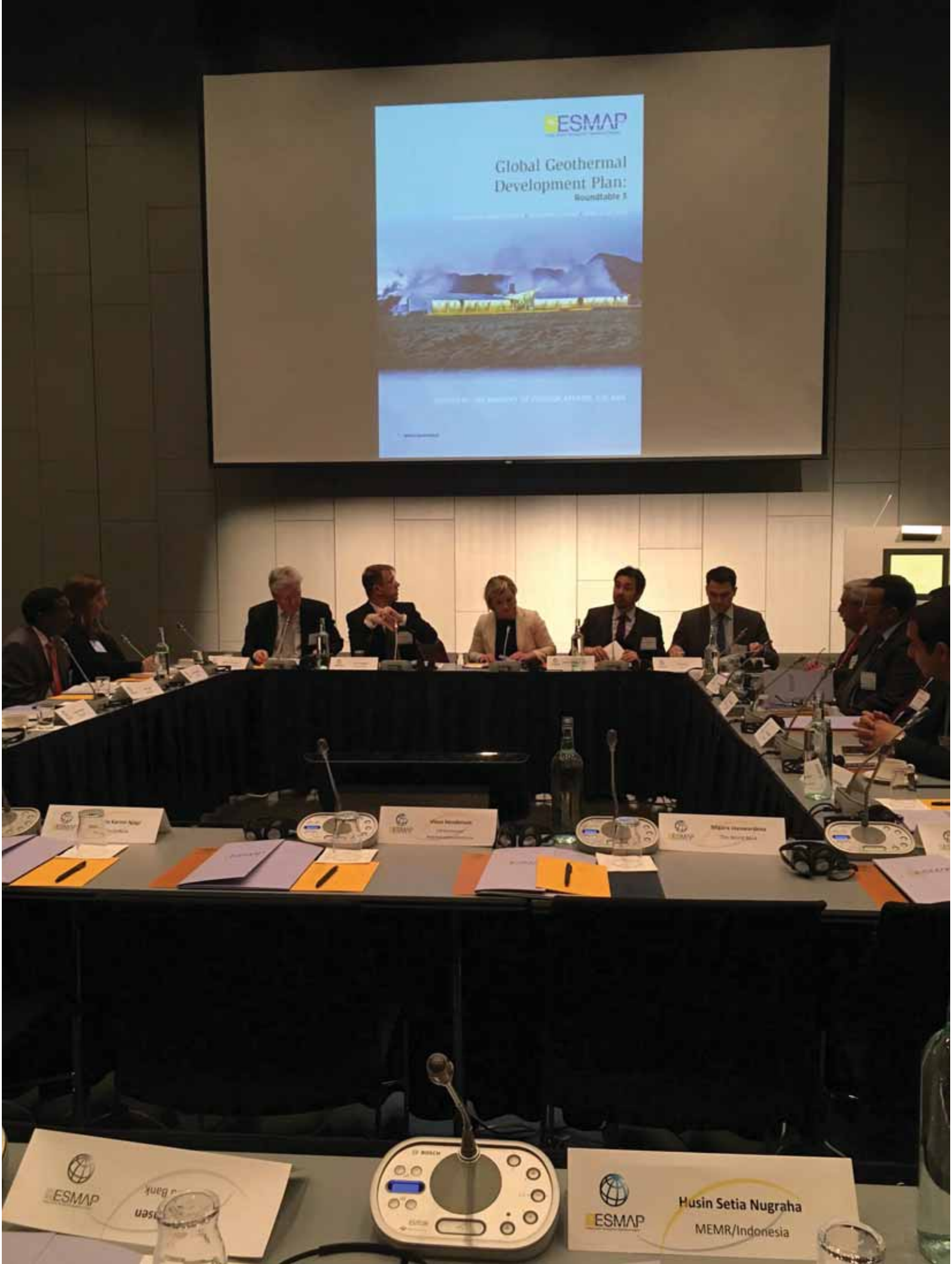
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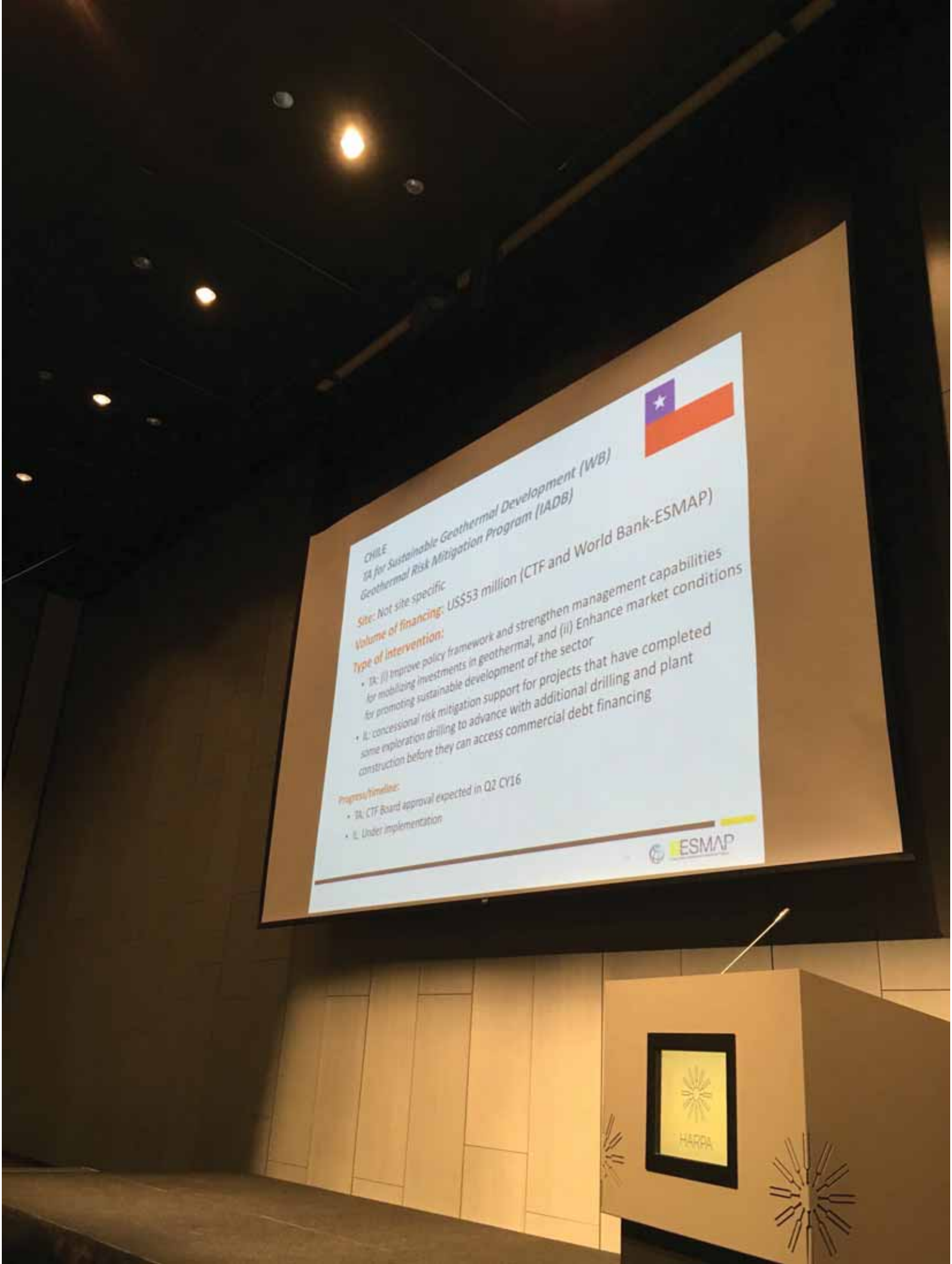
Husin Setia Nugraha
MEMR/Indonesia


CHILE
TA for Sustainable Geothermal Development (WB)
Geothermal Risk Mitigation Program (IADB)
Site: Not site specific
Volume of financing: US$53 million (CTF and World Bank-ESMAP)
Type of intervention:
• TA: (i) Improve policy framework and strengthen management capabilities for mobilizing investments in geothermal, and (ii) Enhance market conditions for promoting sustainable development of the sector
• IL: concessional risk mitigation support for projects that have completed some exploration drilling to advance with additional drilling and plant construction before they can access commercial debt financing
Progress/timeline:
• TA, CTF Board approval expected in Q2 CY16
• IL Under implementation
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Silfurberg
conference hall
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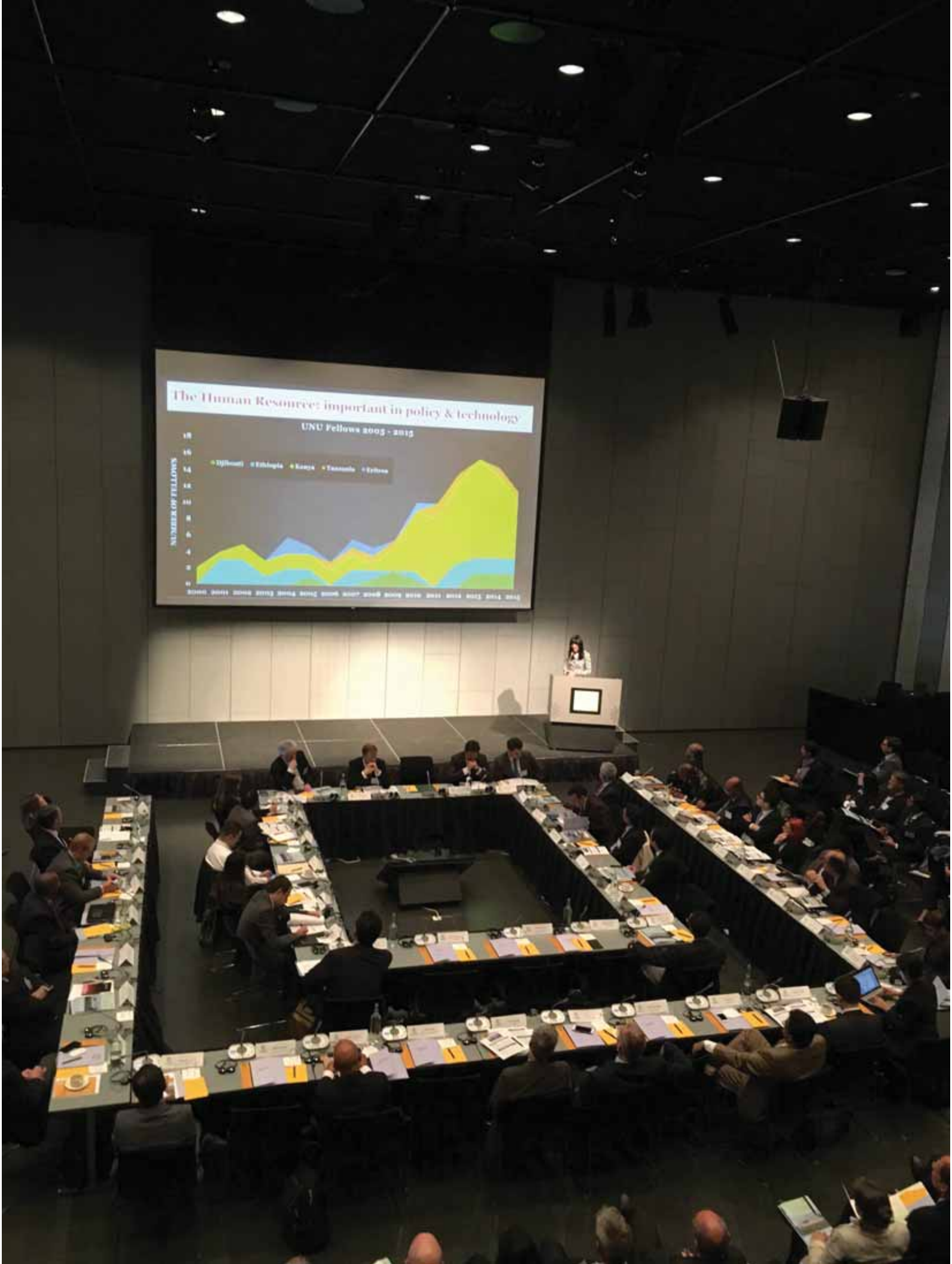
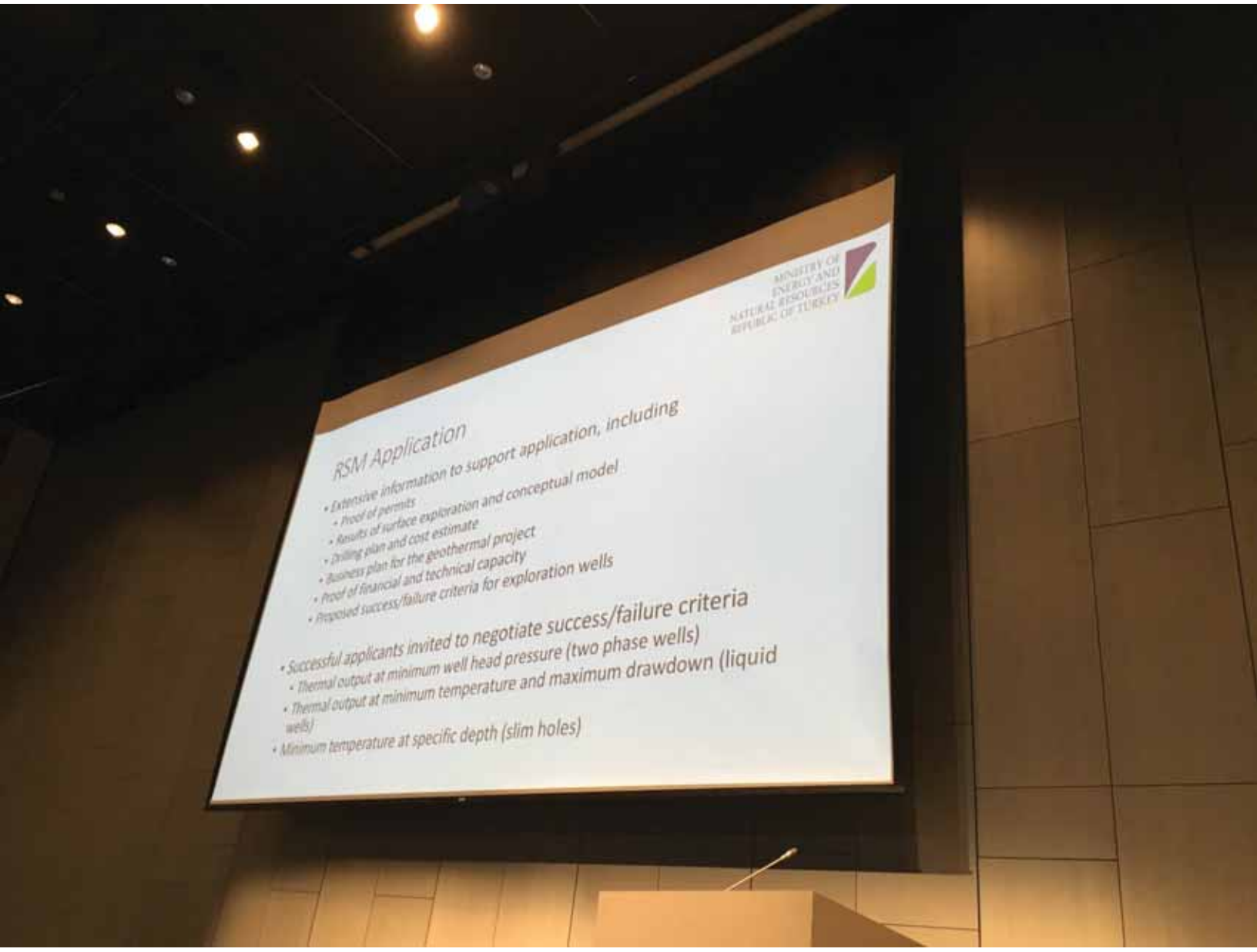
Global Geothermal Development Plan:


The Human Resources important in policy & technology
UNU Fellows 2005 - 2015
NUMBER OF FELLOWS


The Human Resources important in policy & technology
UNU Fellows 2005 - 2015


MINISTRY OF
ENERGY AND
NATURAL RESOURCES
REPUBLIC OF TURKEY
RSM Application
• Extensive information to support application, including
• Proof of permits
• Results of surface exploration and conceptual model
• Drilling plan and cost estimate
• Business plan for the geothermal project
• Proof of financial and technical capacity
• Proposed success/failure criteria for exploration wells
• Successful applicants invited to negotiate success/failure criteria
• Thermal output at minimum well head pressure (two phase wells)
• Thermal output at minimum temperature and maximum drawdown (liquid wells)
• Minimum temperature at specific depth (slim holes)

thinkgeoenergy @thinkgeoenergy 3h

@WorldBank Global #geothermal development plan roundtable #Iceland

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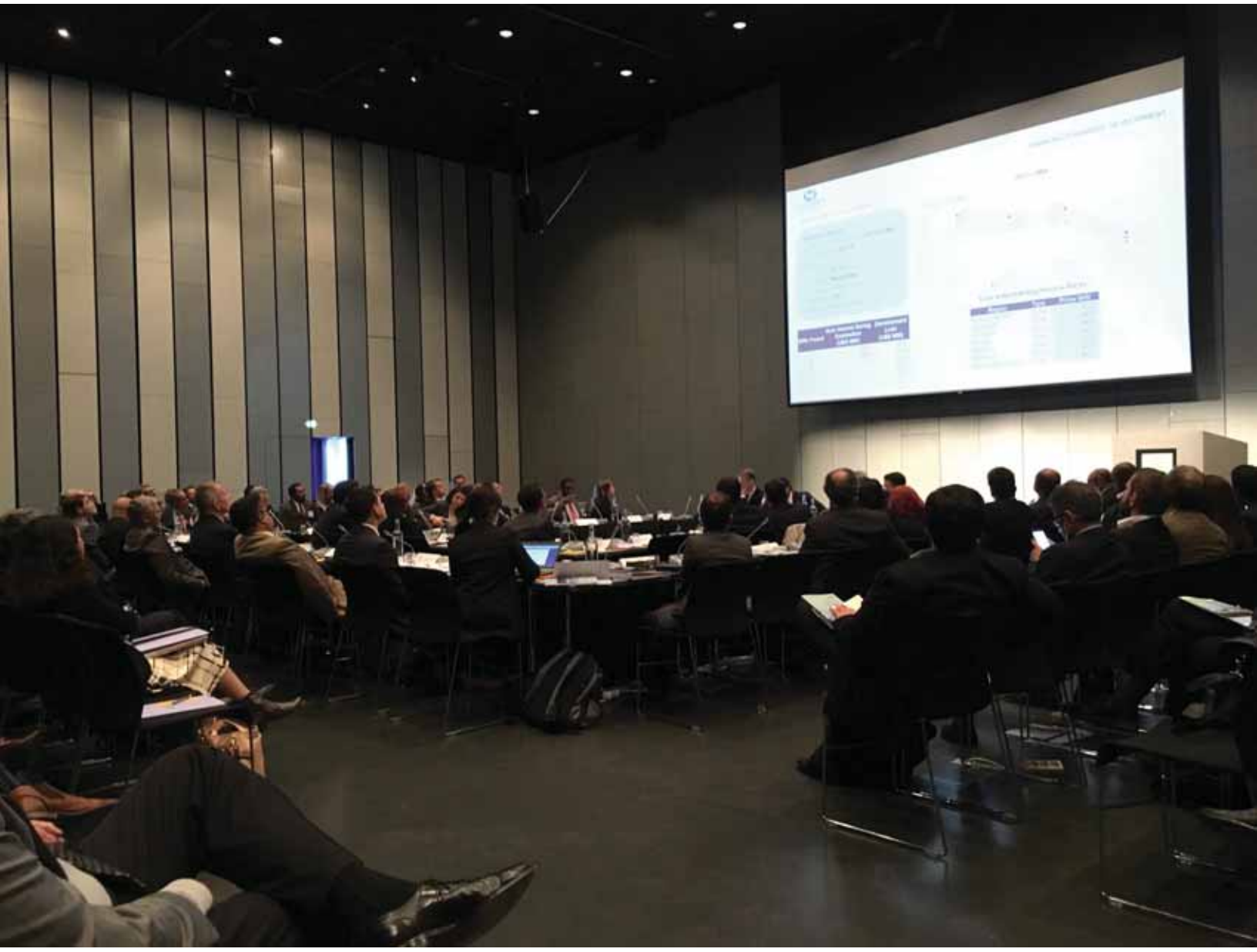
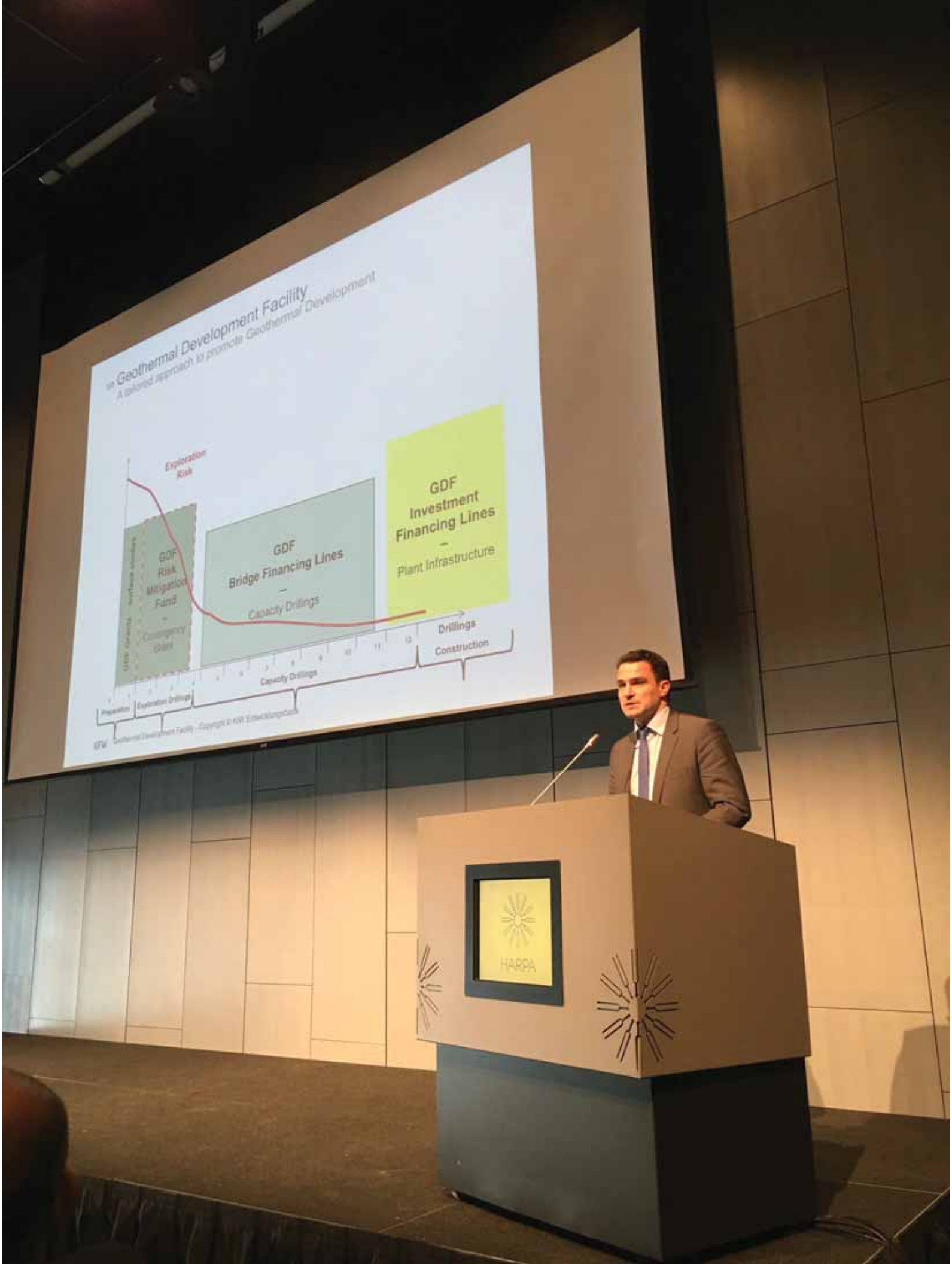



Ministry of Water Irrigation and Electricity
Federal Democratic Republic of Ethiopia
THE ROLE OF THE GOVERNMENT IN GEOTHERMAL DEVELOPMENT IN ETHIOPIA
Global Geothermal Development Plan 3rd Roundtable
April 2016
Reykjavik
HARPA


ESMAP
Martinez
Jens Wirth
KFW


ESMAP
Mohamed Chaari


IESMP
Mohamed Ouaari


Geothermal Development Facility
A tailored approach to promote Geothermal Development
Exploration Risk
GDF Risk Mitigation Fund – Contingency Grant
GDF Bridge Financing Lines – Capacity Drillings
GDF Investment Financing Lines – Plant Infrastructure
Drillings
Construction
Capacity Drillings
Preparation
Exploration Drillings
KfW
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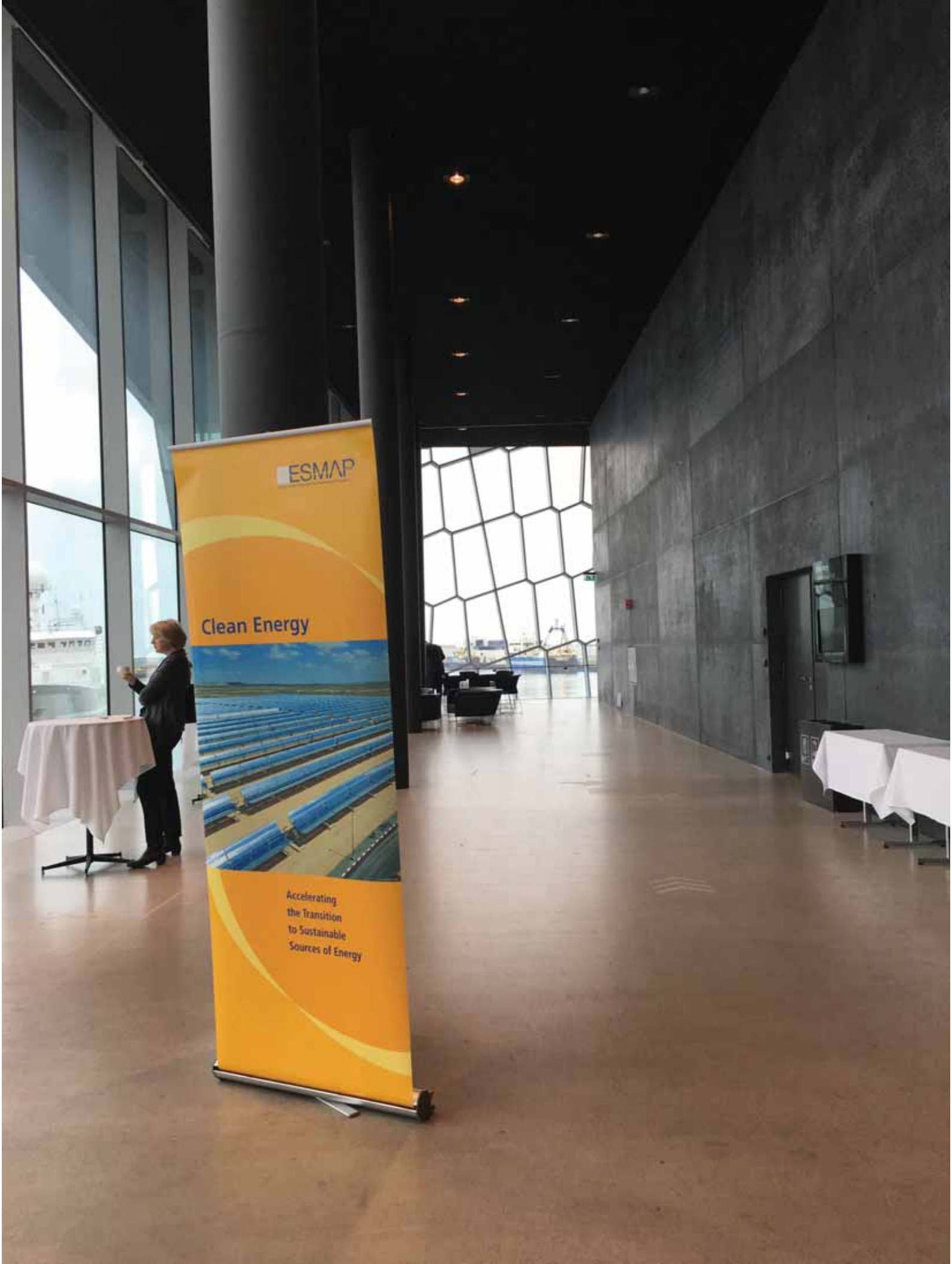
Developing of
Standards for
Geothermal Resource
Classification
- an Update
Economic and Social Council
IGA


UNFC-2009 What is it? What is it not?


ESMAP
Clean Energy
Accelerating
the Transition
to Sustainable
Sources of Energy

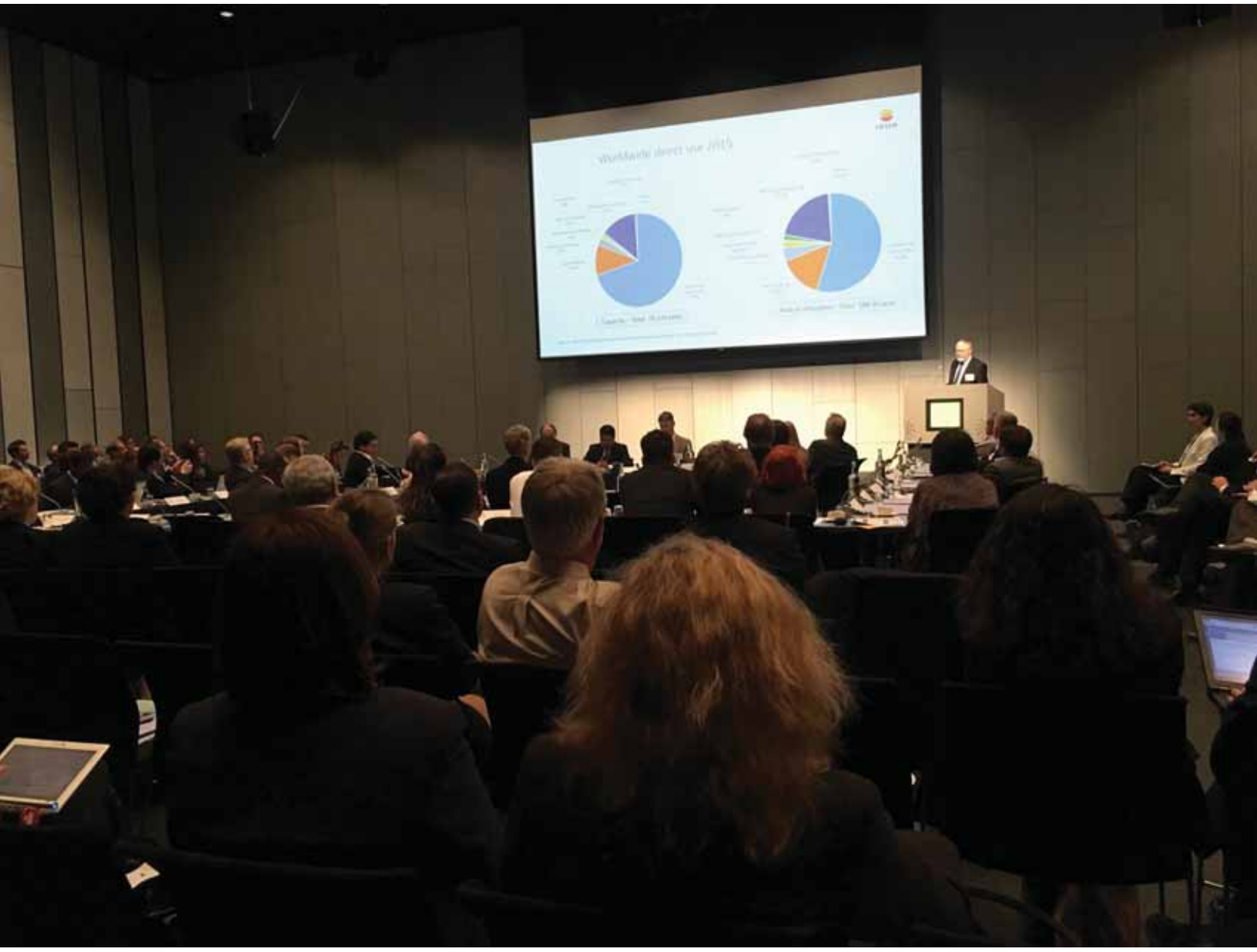
The 2016 edition of World Development Indicators is out: three features you won...
blogs.worldbank.org

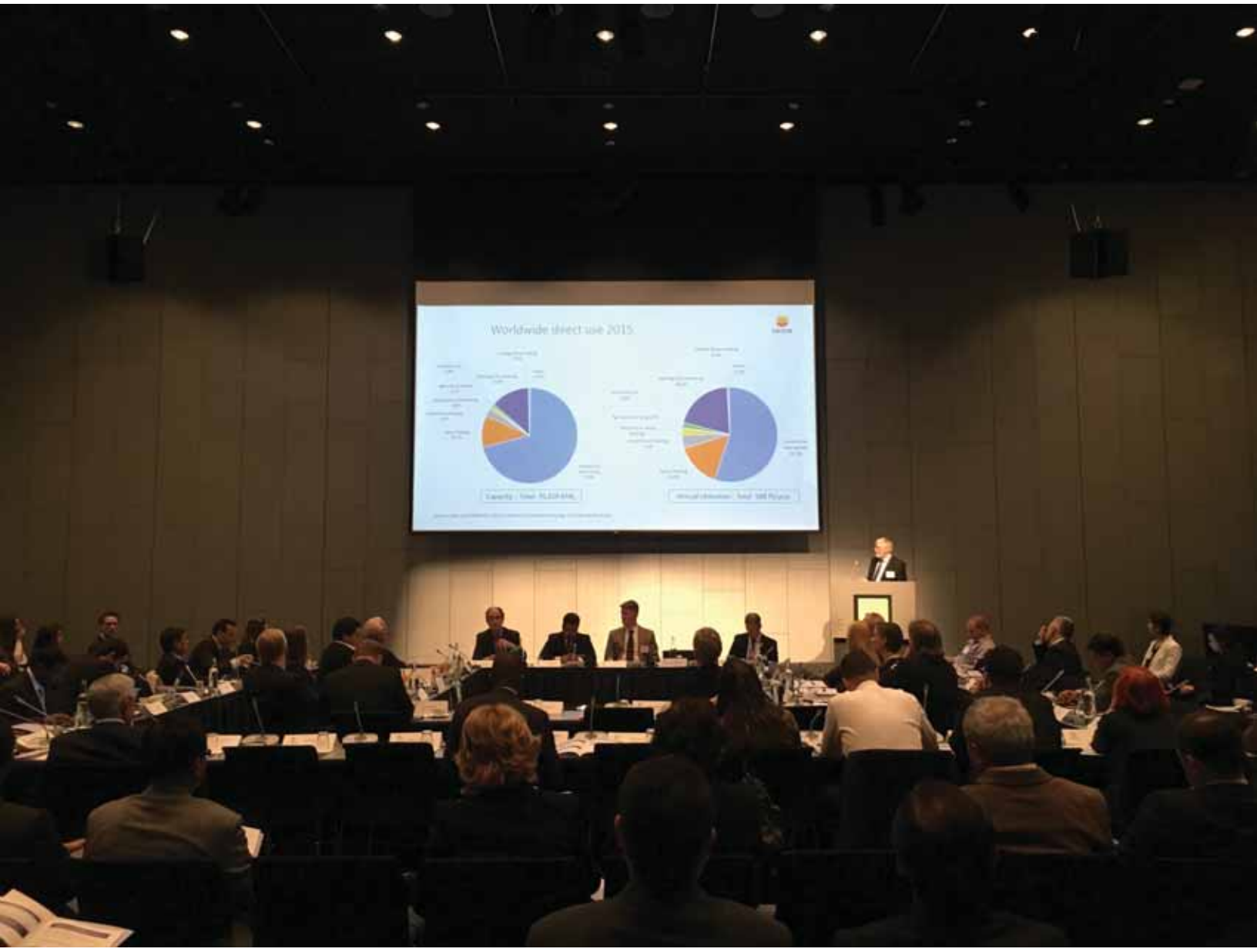
1 3

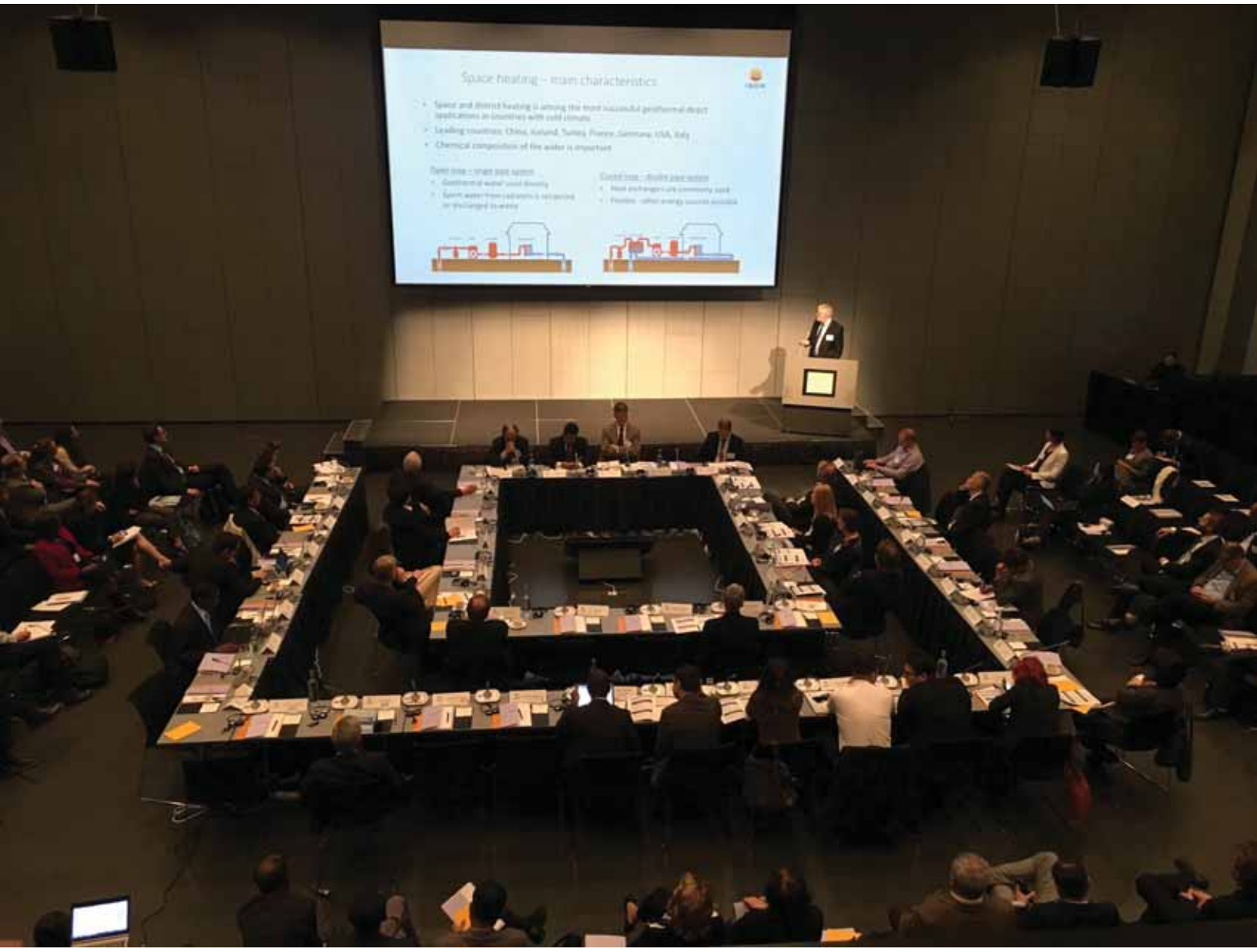
World Bank Energy @WBG_Energy 1h
New @WorldBank report shines light on managing geothermal resource risks: wrld.bg/4n495q #renewableenergy

2 2

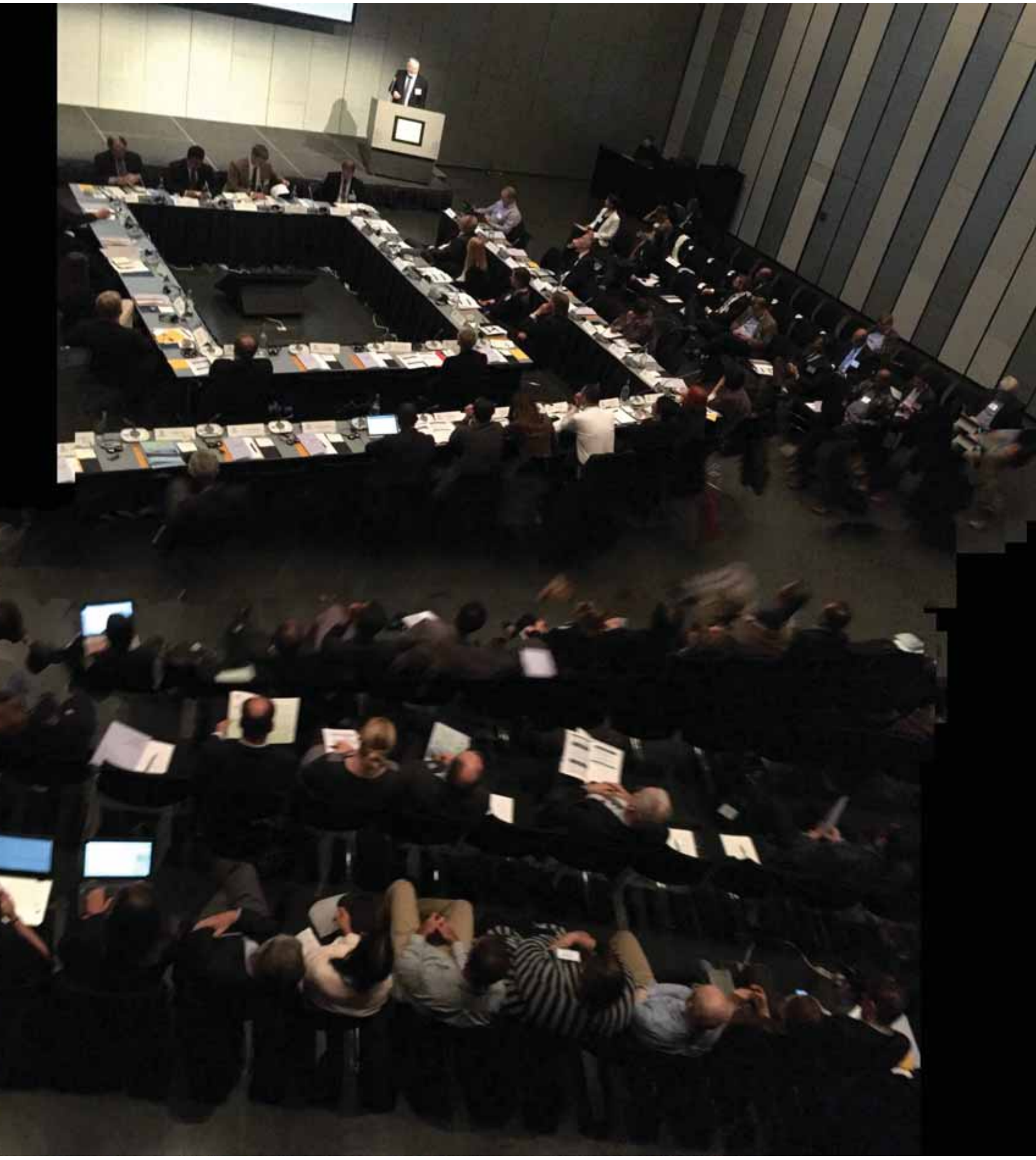
World Bank Pubs @WBPubs 3h
New book on global #water challenges & perspectives for #remotesensing solution approaches wrld.bg/4mWNhk


Worldwide direct war 2015

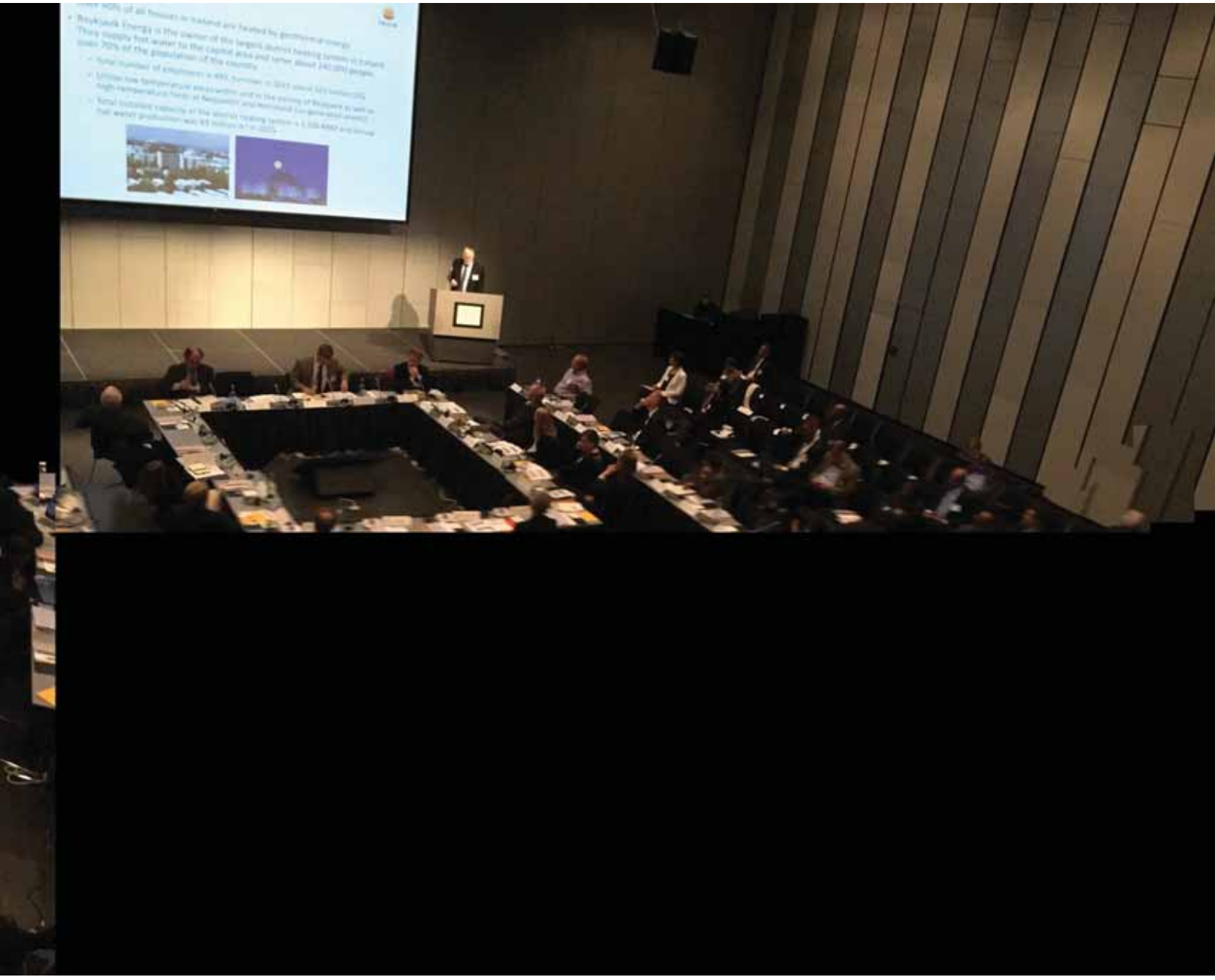

Worldwide direct use 2015


Space heating – main characteristics


Space heating – main characteristics
ÍSOR
• Space and district heating is among the most successful geothermal direct applications in countries with cold climate
• Leading countries: China, Iceland, Turkey, France, Germany, USA, Italy
• Chemical composition of the water is important
Open loop – single pipe system
• Geothermal water used directly
• Spent water from radiators is reinjected or discharged to waste
Closed loop – double pipe system
• Heat exchangers are commonly used
• Flexible - other energy sources possible

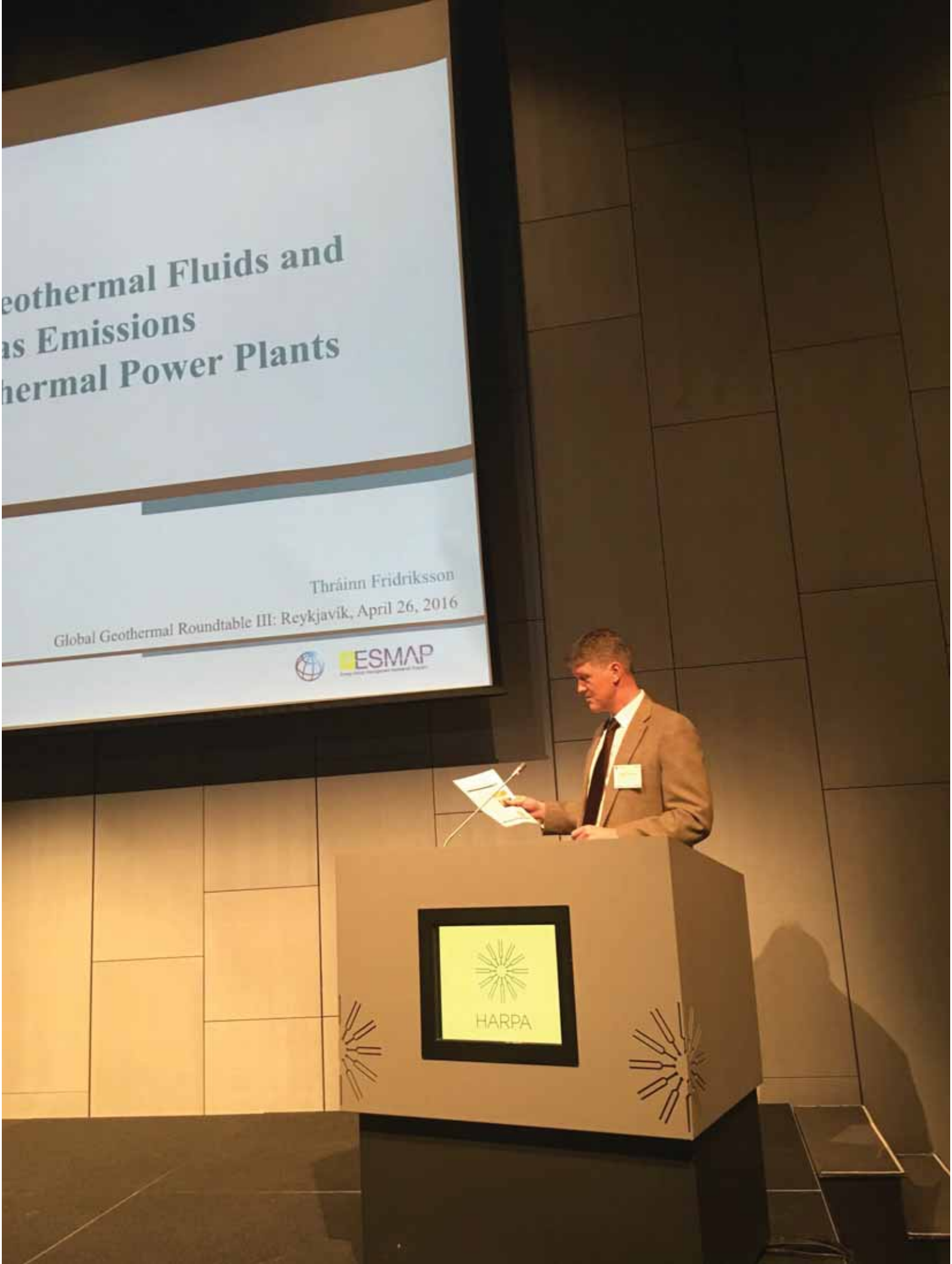



District heating in Iceland
• Over 90% of all houses in Iceland are heated by geothermal energy
– Reykjavik Energy is the owner of the largest district heating system in Iceland. They supply hot water to the capital area and some about 240,000 people, over 70% of the population of the country
– Total number of employees is 440. Turnover in 2015 about 320 million US$
– Of the 766 megawatt total energy within and in the vicinity of Reykjavik as well as high temperature fields at Nesjavellir, Hellisheidi, Co-generation plants)
– Total installed capacity of the district heating system is 3 100 MWt and annual hot water production was 85 million m³ in 2015


Reykjavik Energy is the owner of the largest district heating system in Iceland.
They supply hot water to the capital area and serve about 240,000 people,
over 70% of the population of the country.


HS Orka Resource Park
Society without waste
Kristín Vala Matthíasdóttir
VP Resource Park HS Orka
HS ORKA


Wellhead power plants
Elín Hallgrímsdóttir
26th April 2016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hermal Power Plants
Thráinn Fridriksson
Global Geothermal Roundtable III: Reykjavik, April 26, 2016
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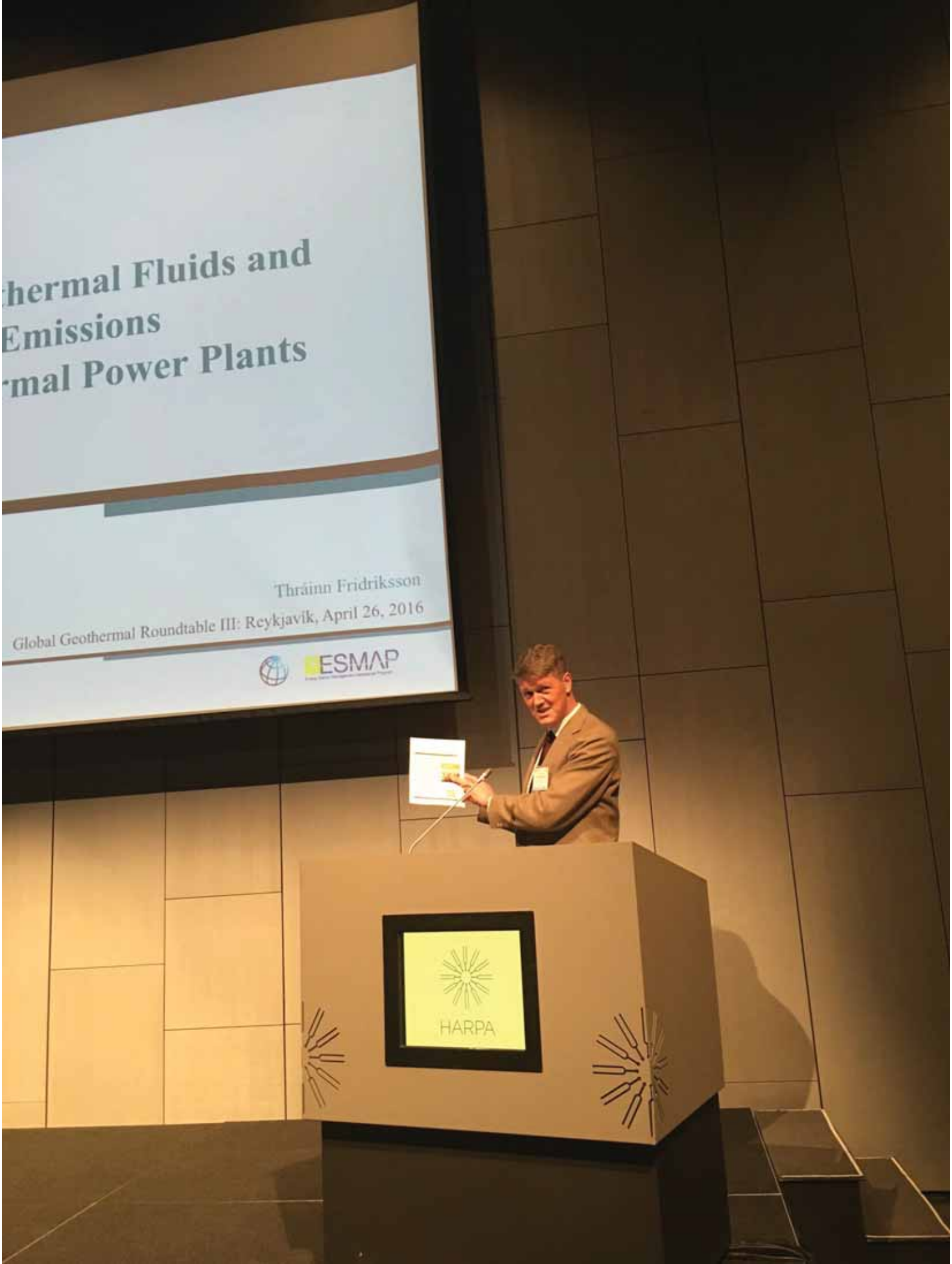
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1. Interim Technical Note
Power Projects – Key Findings and Recommendations
2. Gases in Geothermal Solutions
Global Emission Factors for Geothermal Power Plants
Processes Affecting GHG Emission Factors
Cost of GHG Capture and Treatment
Summary and Conclusions
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nical Note
HOUSE GASES FROM GEOTHERMAL POWER PRODUCTION
e World Bank teams
rojects involving geothermal
rld Bank specialists and an
experts
Knowledge of GHG
al Systems and Power
ds to Assess Emissions
jects
bal Geothermal
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ADDRESSING GREENHOUSE GASES FROM GEOTHERMAL POWER PRODUCTION
Interim Technical Note
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Interim Technical Note
Key Findings
GHGs naturally present in geothermal fluids and geothermal power production generally leads to some GHG emissions
Global average GHG emissions from geothermal power are small relative to emissions from fossil fuel
In rare cases geothermal GHG emissions can be significant, specifically for resources in carbonate bearing reservoir rocks
GHG emissions may change over time due to natural causes and in response to production
Magmatic activity can increase emissions
Steam cap formation may result in temporary increase or decrease in emissions depending on production strategy
Reinjection generally tends to decrease emissions
Production may decrease or increase emissions through natural pathways – very limited information available
All technologies suitable for high temperature resources result in emissions unless capture facilities are installed
Capture and treatment can be economically feasible where there is a market for CO_2 products
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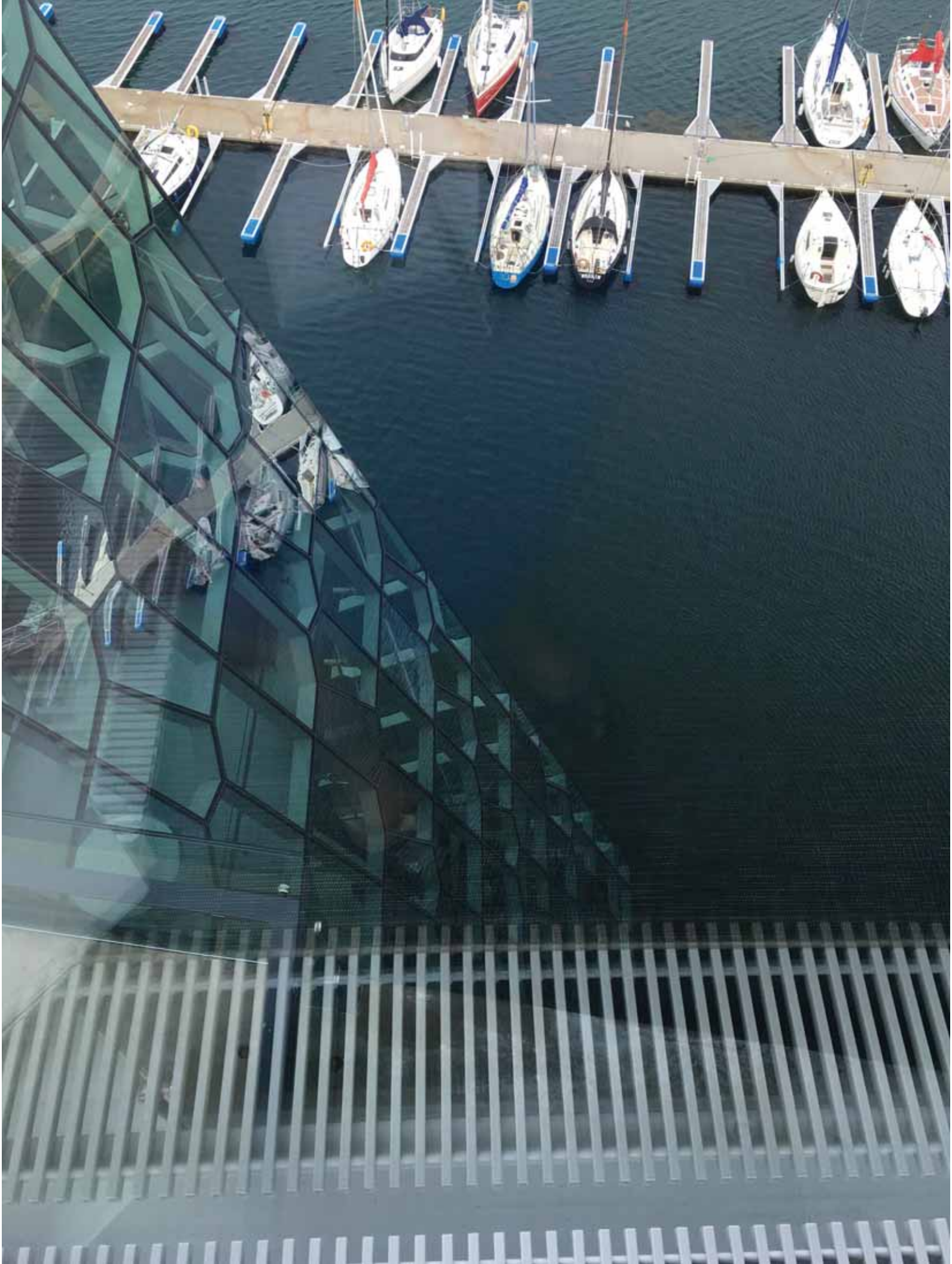

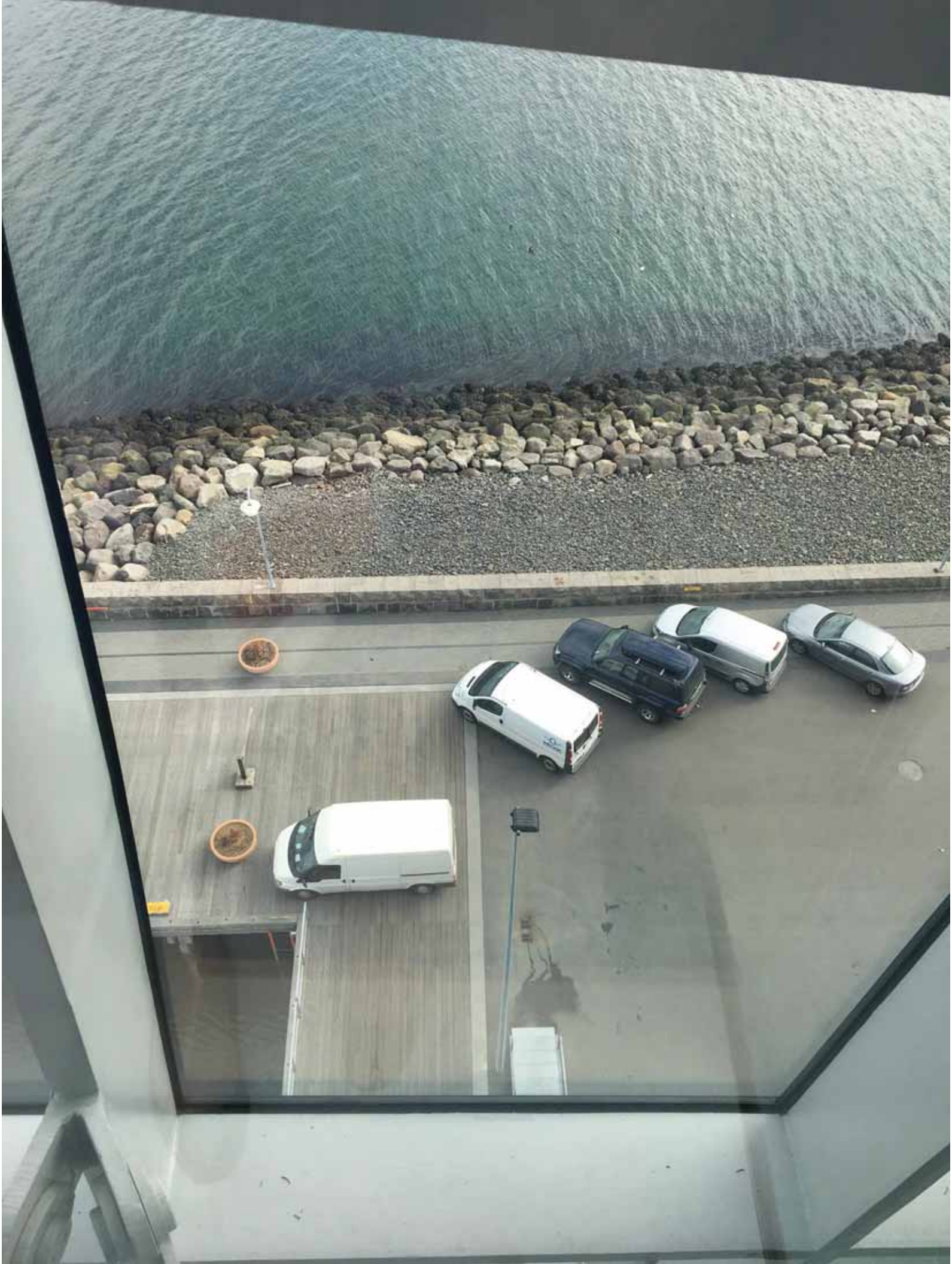


For 20 years OR examined the possibility of reducing emissions of H_2S gas or since before the commissioning of Nesjavellir Power Plant
• Chemical methods
• Biological methods
• Physical methods
• Steam hood ejectors or chimneys
OR


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Traditional methods

Pressure on OR to resolve to off-the-shelve solutions

Chemical and biological methods produce sulfur or sulfuric acid

- Market for sulfur and sulfuric acid is not lucrative
- Would have to be disposed of into sulfur deposits
  - Requires special attention, ground water and biota in the vicinity
  - Flammability

OR's main stressing point:

- Traditional methods don't solve the problem but merely relocate it


g the debate scientists had been working...
lement and subsurface sequestration
ndingar geta orðið frum-
llar í bindingu koltvíoxíðs
• In 2006 Wallace Broecker was invited to Iceland by the President to give a talk on climate change
– Removing CO_2 from the air and sequestering it in the subsurface
• CarbFix initiated in 2007
– International experts investigate the feasibility of CO_2 sequestration in basalt
• Hellisheidi was an ideal laboratory
– Stream of CO_2 and ample basalt
OR Reykjavik Energy
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CO_2 abatement and subsurface sequestration
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Field trip - Option 2
Hveragerði Geothermal Village

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Presentation Outline
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28 APRIL 2016
HARPA Conference Centre
SOCIAL PROGRESS
WHAT WORKS?
Speaker: Professor Michael Porter
Deloitte


Welcome to:
ICELAND
GEOTHERMAL
CONFERENCE
Reykjavik · Harpa · 26-29 April, 2016


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EMERGENCY EXIT


EMERGENCY EXIT


Welcome to Hveragerði
a village in bloom
Eggjasuða
Egg boiling
Poure faire bouillir un oeuf
Eierkochen
10 - 12 min


Welcome to Hveragerði
a village in bloom
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