



**37<sup>TH</sup> INTERNATIONAL  
NO - DIG  
FLORENCE 2019**

**Fortezza da Basso • FLORENCE (Italy)**

**30<sup>th</sup> September • 2<sup>nd</sup> October 2019**

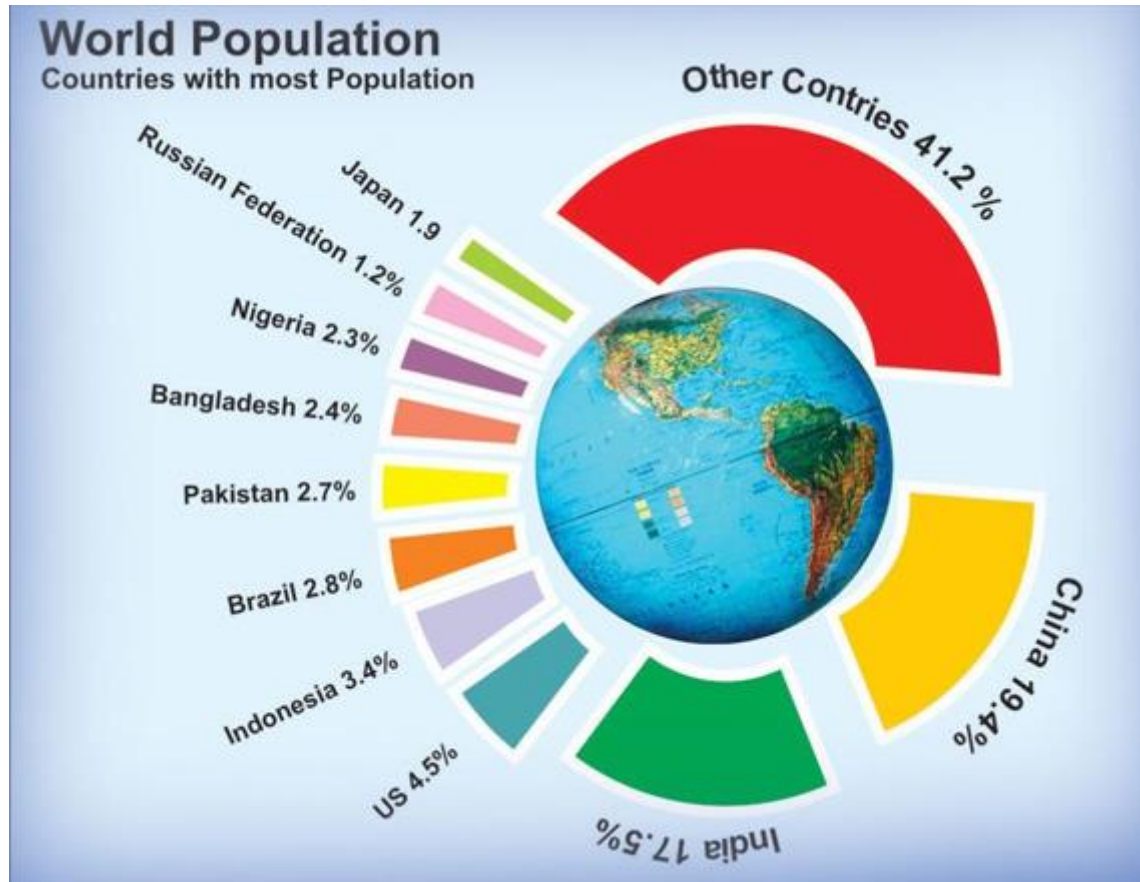
# **URBANIZATION AND THE IMPORTANT ROLE OF TRENCHLESS TECHNOLOGIES**

**Prof. Samuel T. Ariaratnam, Ph.D., P.E., P.Eng., F.ASCE, F.CAE**  
**Academician of the Canadian Academy of Engineering**  
**Past Chairman, ISTT (2010-2013)**  
**Professor & Construction Engineering Program Chair**  
**Arizona State University, Tempe, AZ USA**

# World Population Growth

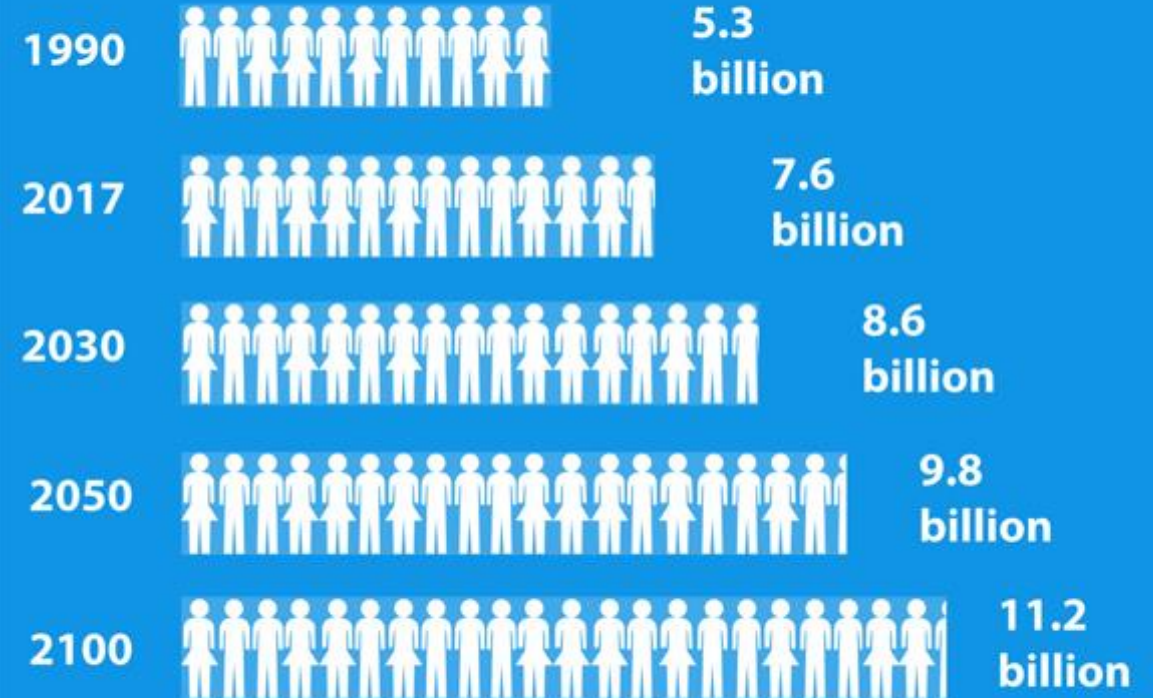


37<sup>TH</sup> INTERNATIONAL  
**NO-DIG**  
FLORENCE 2019



## World Population

Projected world population until 2100

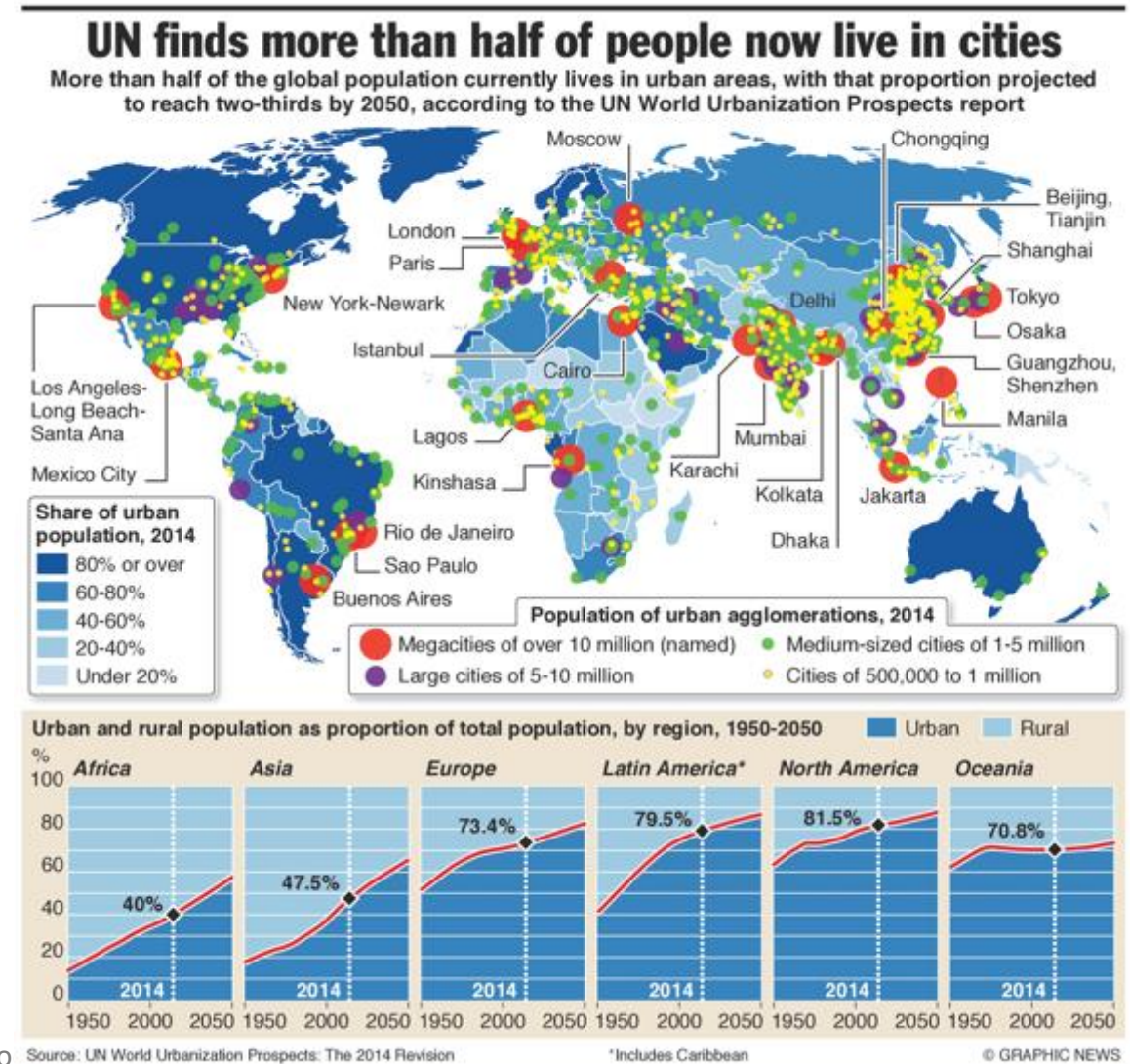


Source: United Nations Department of Economic and Social Affairs,  
Population Division, *World Population Prospects: The 2017 Revision*  
Produced by: United Nations Department of Public Information



# Urban Centers

- Currently, **54%** of the world's population (**81%** in the U.S.) live in urban areas
- This figure is expected to increase to **75%** by the year **2050** as people look to urban centers for employment opportunities

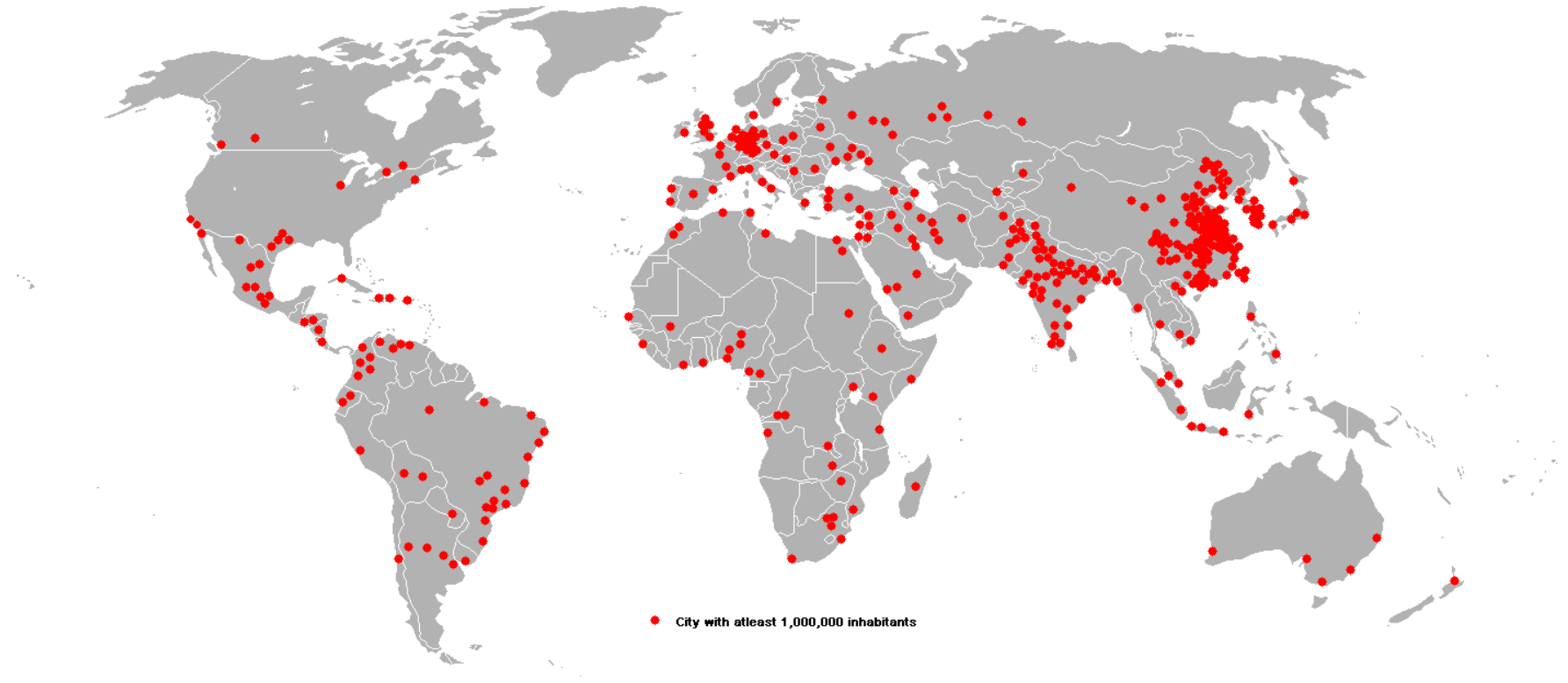


# Urban Infrastructure Development

It took us 5,000 years to get to this point; however, it is expected that we will **double** our urban infrastructure in the next 35 years through construction. These new systems will last more than 50 years.



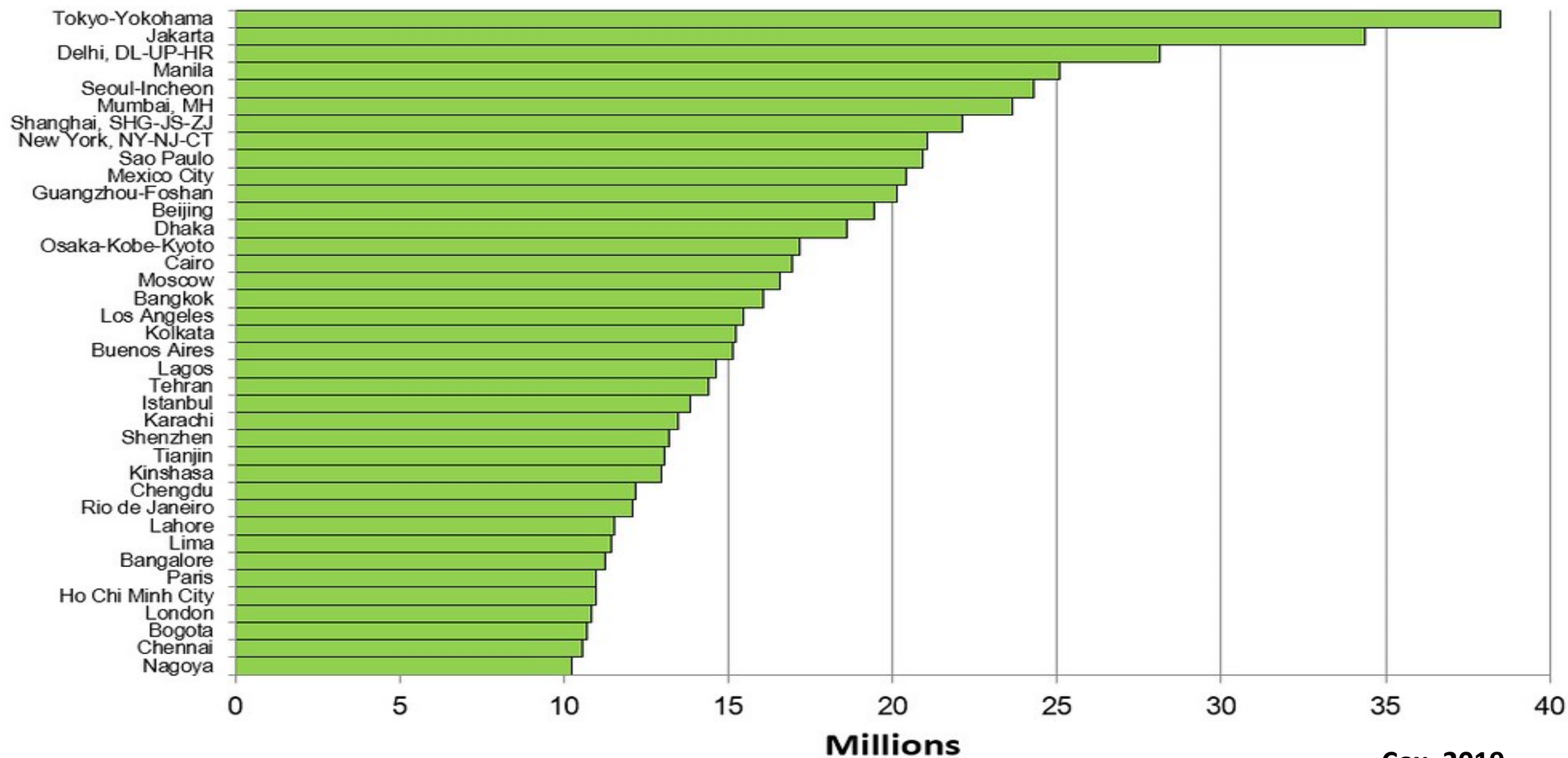
# Urbanization is turning big cities into Megacities



- More than 40 percent of the world's population already lives within 100 kilometers of the sea
- Another 40 percent live in cities along the rivers
- The majority of the world population lives close to waters

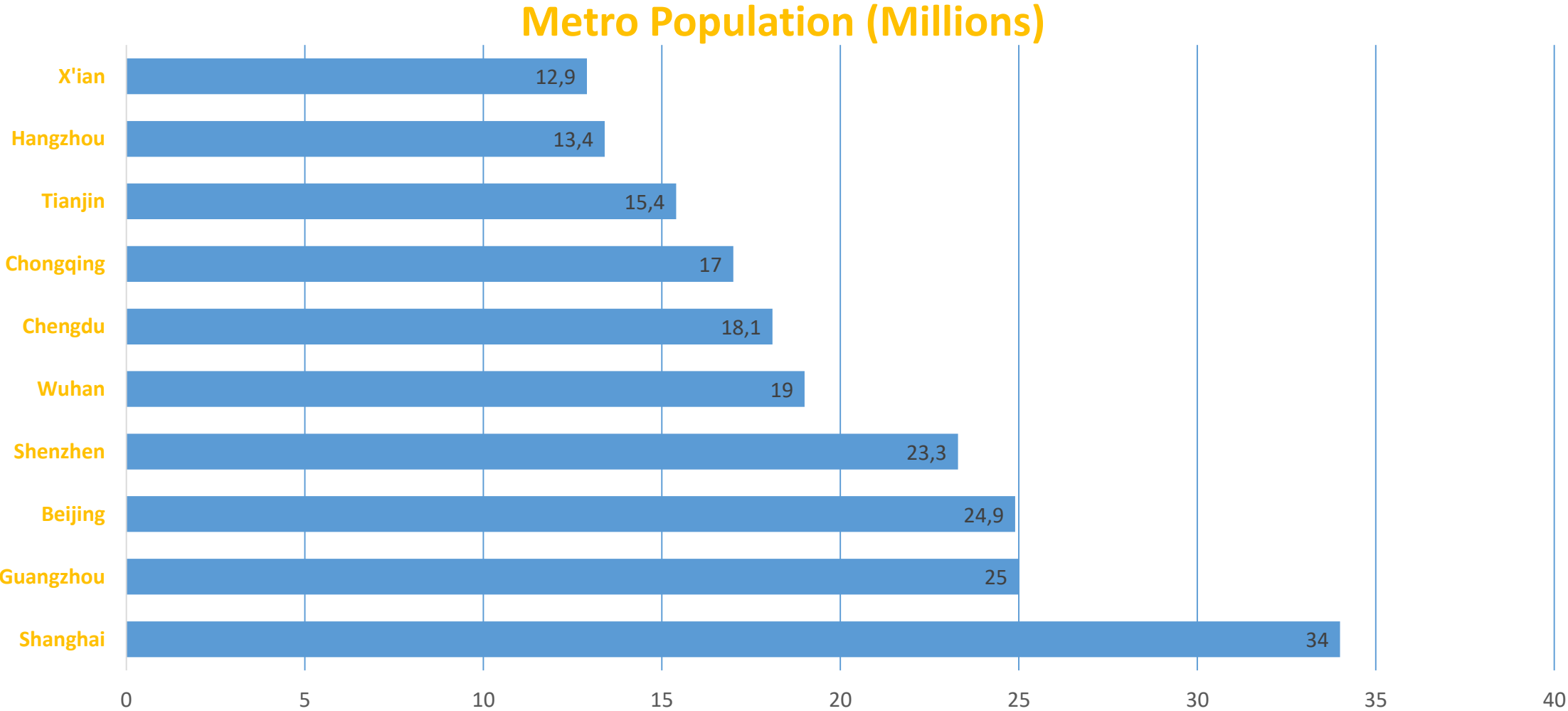
# The 38 Megacities (2019)

URBAN AREAS WITH MORE THAN 10 MILLION POPULATION

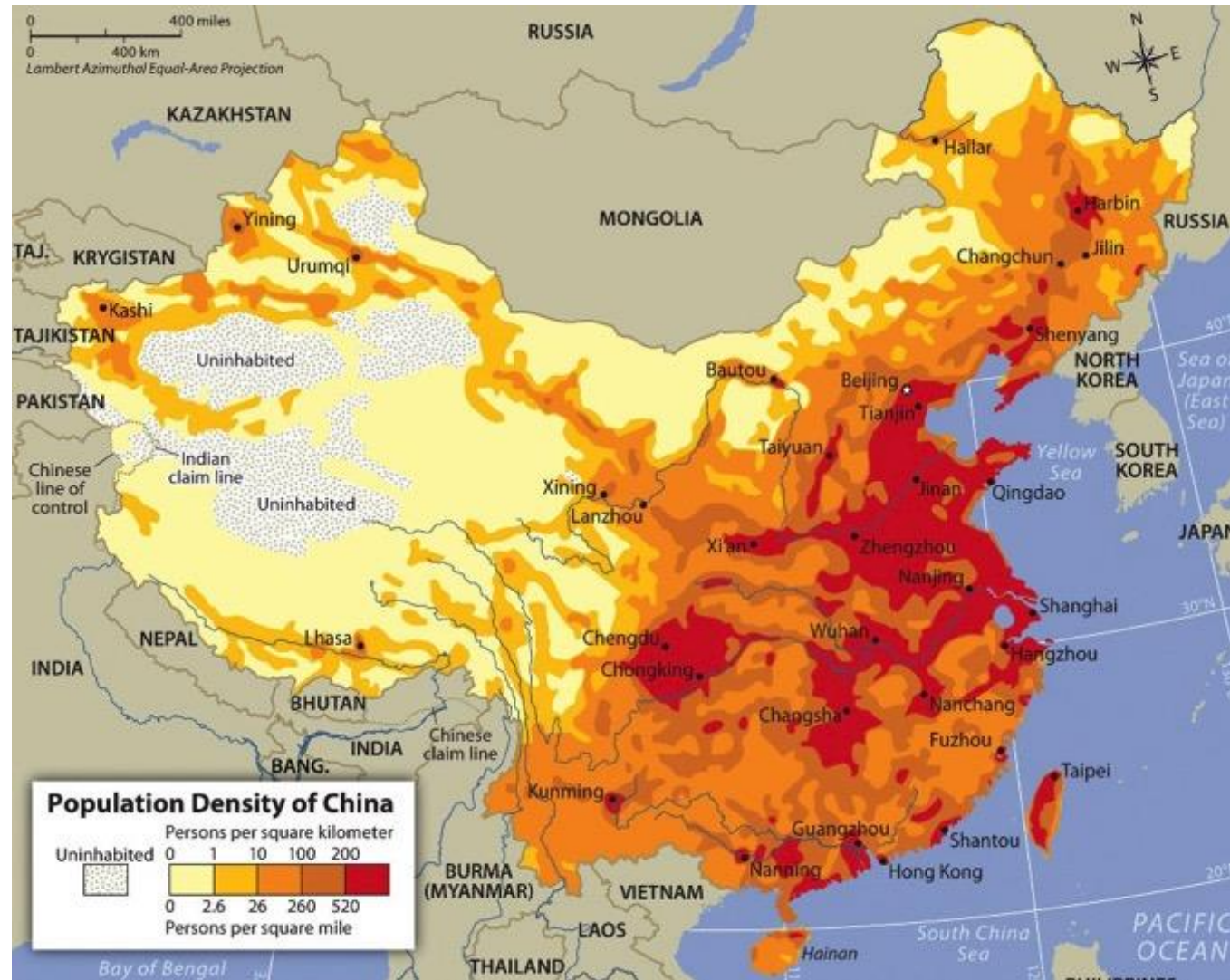


Cox, 2019

# Mega City Populations in China



# Population Density in Mainland China



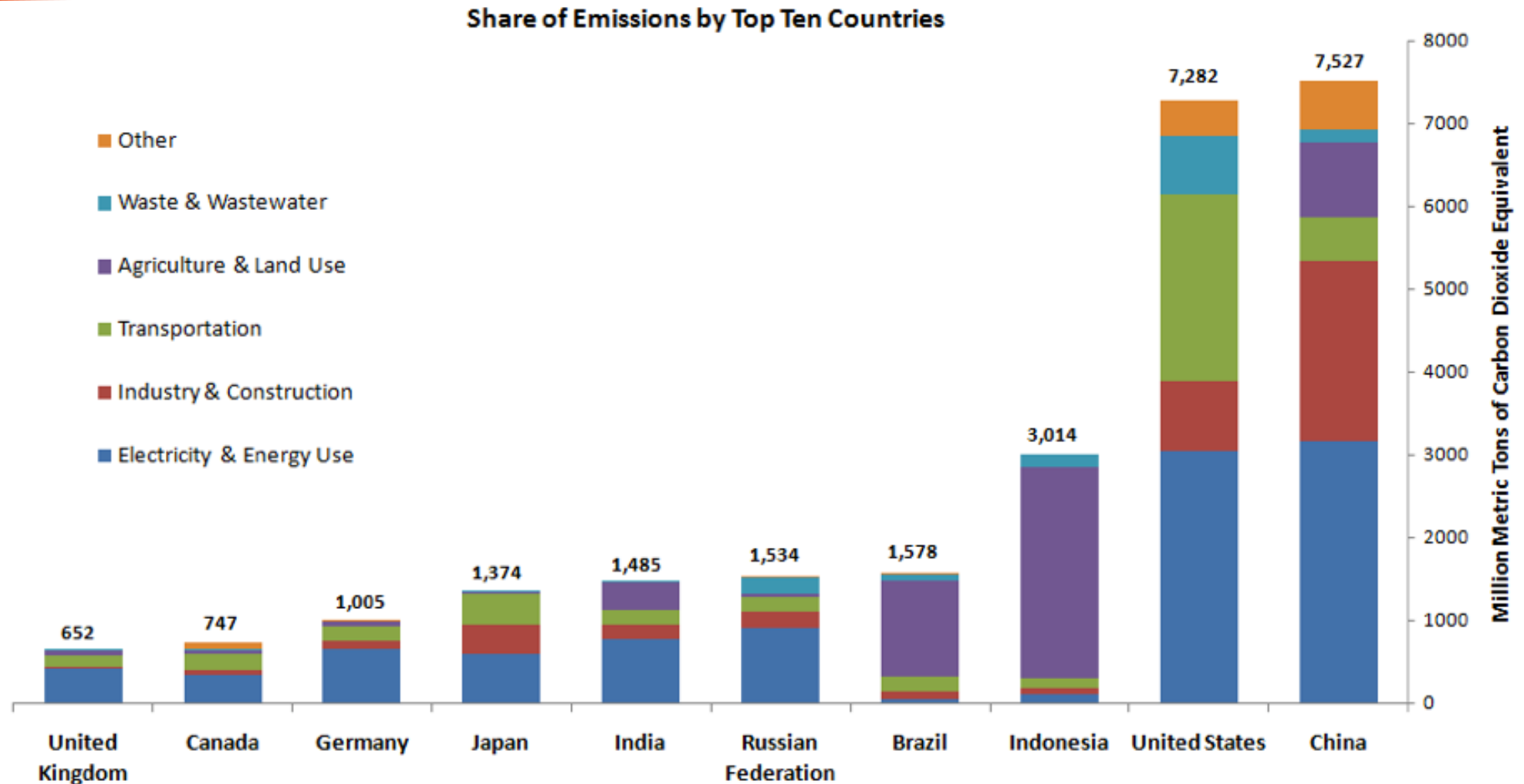
# Urbanization is turning big cities into Mega cities

Space on the surface is becoming more narrow. Future lies in the underground.

- Limited space available to install utility services such as sewage lines, water pipeline, electric cables, gas pipelines, communication cables etc.



# Global Anthropogenic GHG Emissions by Country

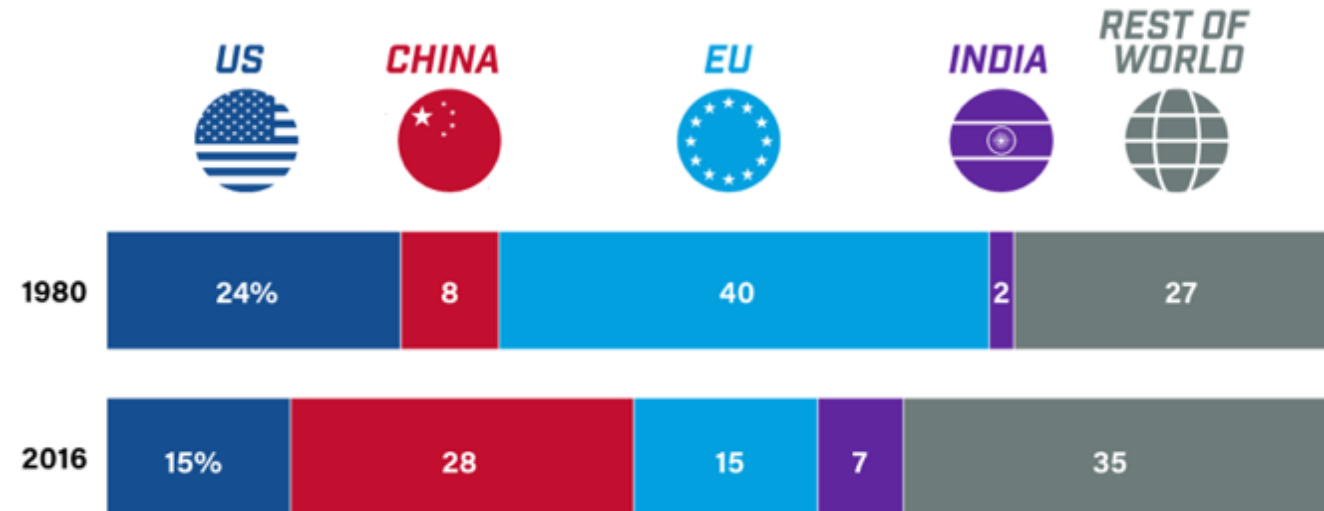


Source: Brown and Sovacool. 2011. *Climate Change and Global Energy Security*, Figure 2.1

# Global CO2 Emissions

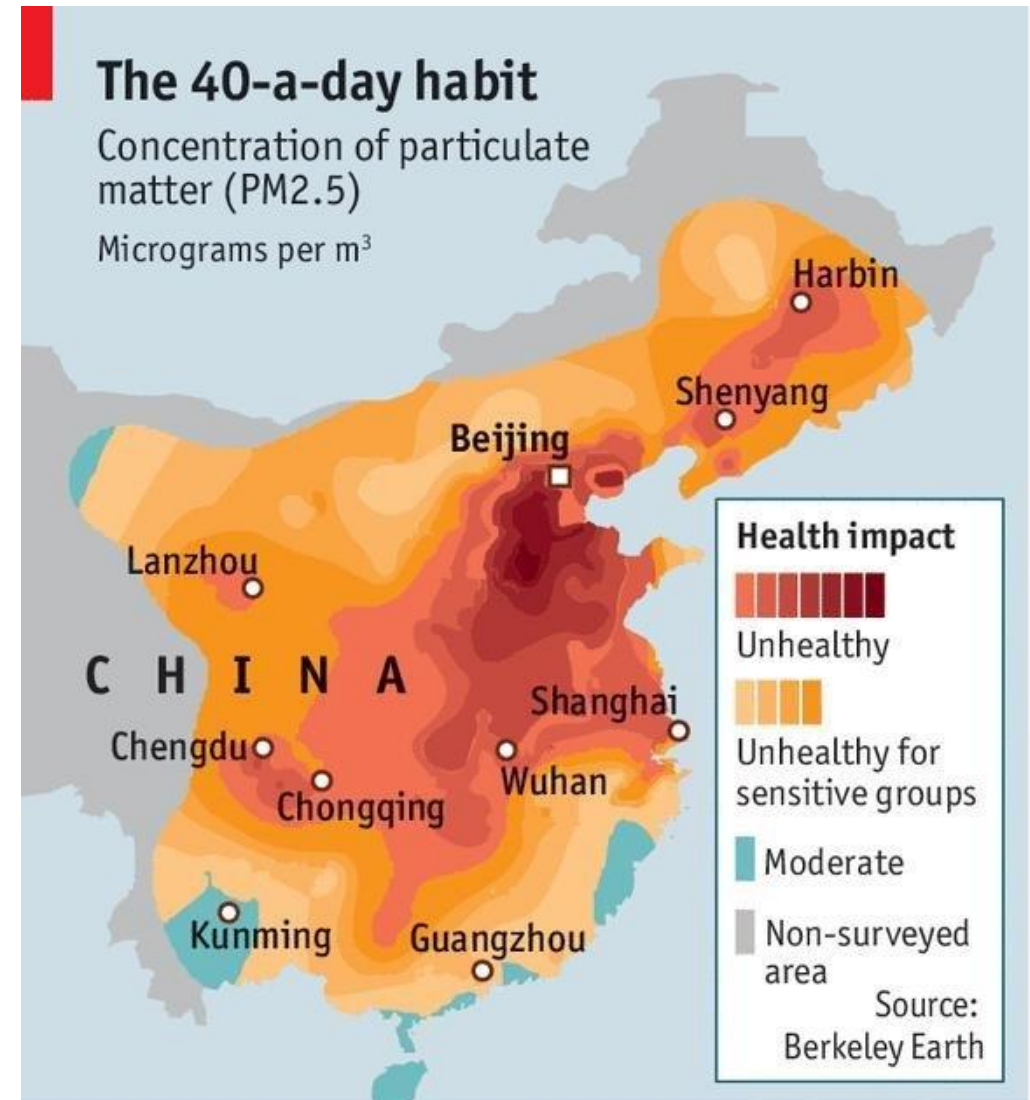


*Share of global CO2 emissions [%]*



# PM2.5 Particulate Matter Concentrations

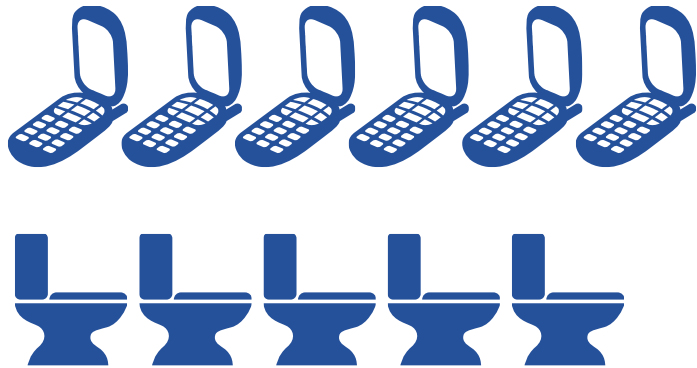
Tianjin, China



# Infrastructure Needs

## Developing World:

- more cell phones than toilets
  - 7 billion in world, 6 billion have mobile phones, only 4.5 billion have toilets...



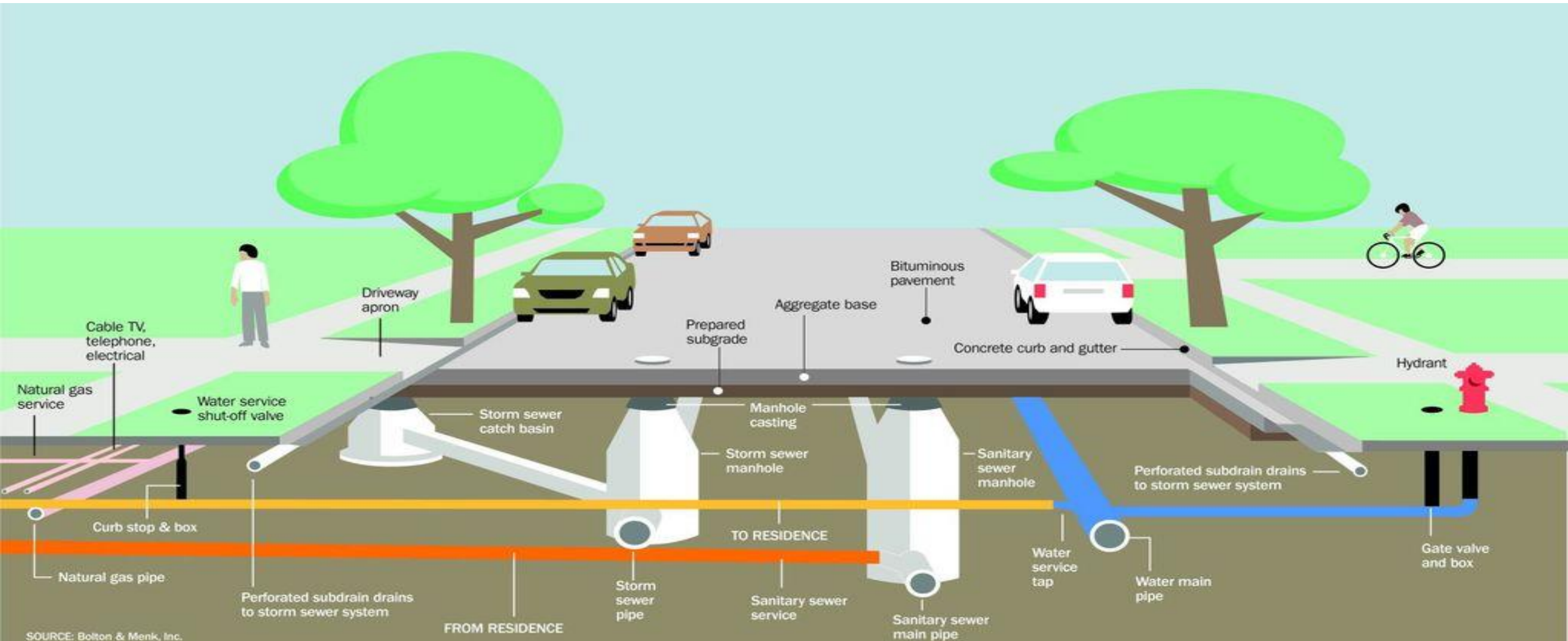
## Developed World:

- 2017 ASCE Report Card on U.S. Infrastructure:
  - Water = D
  - Wastewater = D+

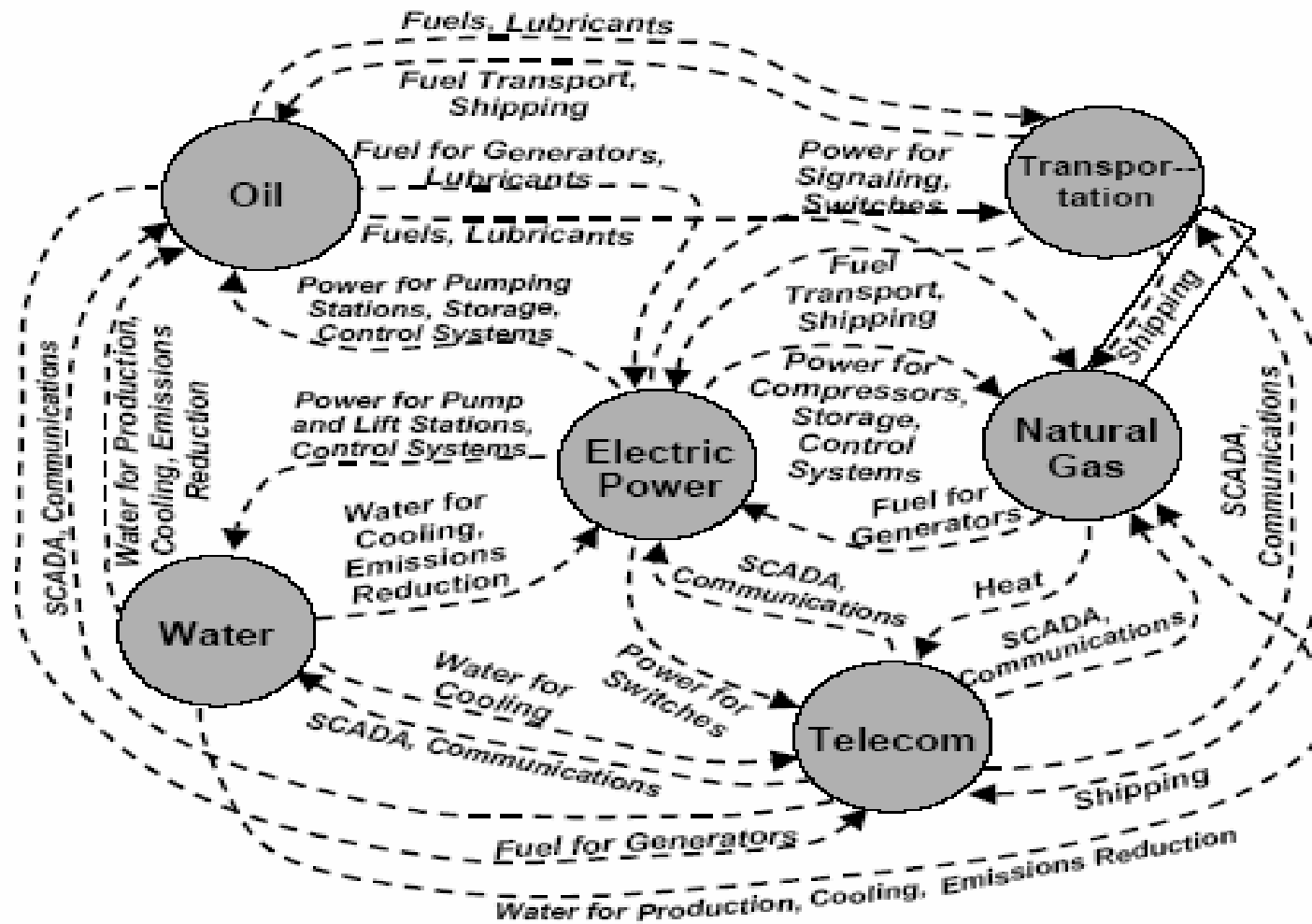




# The Underground World of Utilities

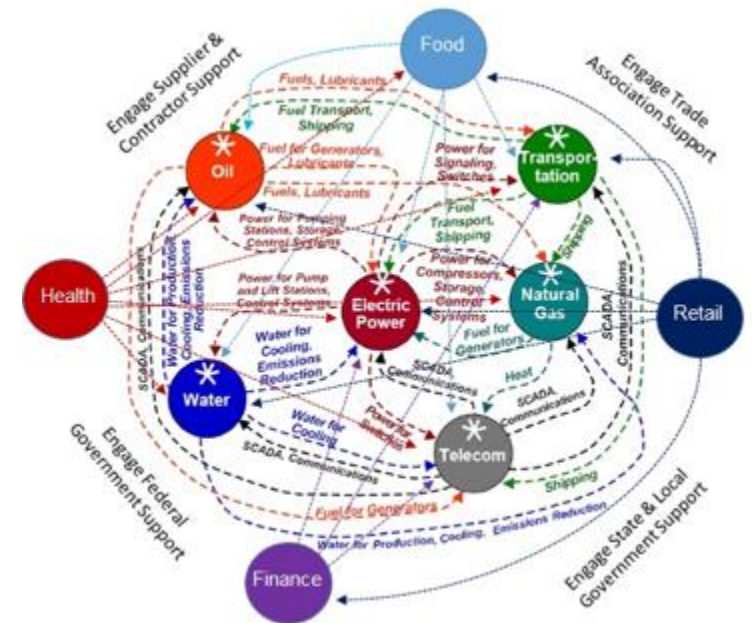


# Interdependencies Among Infrastructures



# Types of Interdependencies

- Technological
- Cyber: Data, Middleware, Hardware, Applications
- Geographic/spatial (e.g., co-location)
- Social/human, including notification, communications, and response
- Economic
- Political/policy/legal
- Organizational/business
- Resources, supply chain
- Security



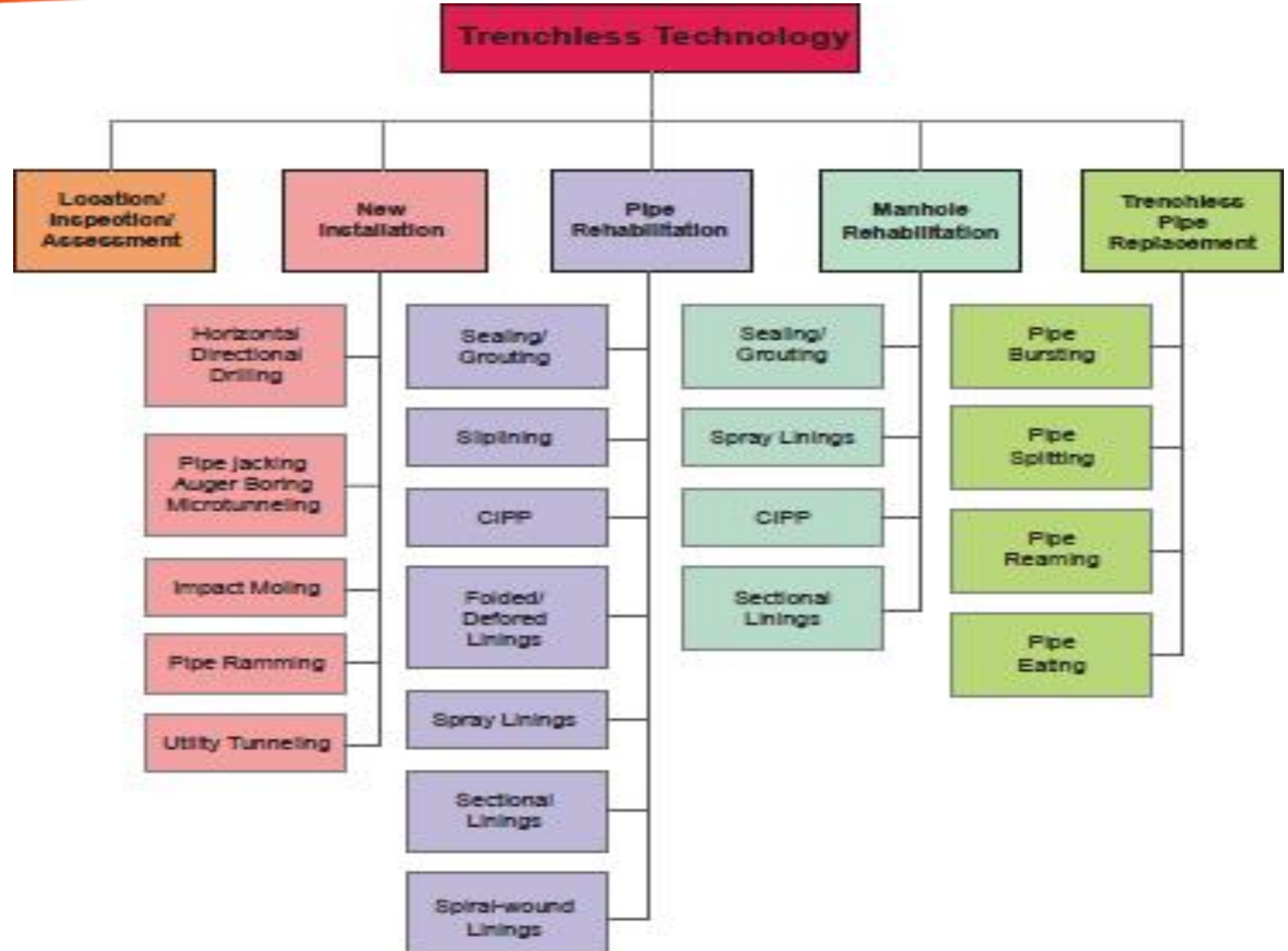


ROAD  
CLOSED

Manhole Rehab  
vacuum excavating  
green  
directional drilling  
pipe bursting  
rehab  
State-of-the-Art  
modern  
innovative  
Sustainability  
awesome No-Dig Show leading-edge  
HDD  
Solutions  
Smart Business  
Pipe Ramming  
low social impact  
trenchless  
specialty  
Infrastructure  
Unique cool urban  
Necessary Engineering Best Value  
satisfying safety  
amazing  
pipe relining  
underground  
environmental  
Leading-Edge  
cost effective  
Dynamic  
cutting edge  
microtunneling  
Bypass Pumping  
CCTV nassco  
Auger Boring  
least intrusive  
Sliplining  
amazing projects pipe cleaning  
global community Pipe Jacking  
underappreciated Planning  
vibrant social cost  
Ingenious Inventive  
Minimized Disruption  
nuca utilities  
low impact  
laterals  
modern  
Asset Management effective  
niche  
effectiveness  
Pipe Ramming  
low social impact

# Trenchless Technologies

- Numerous available options
- New Installation, Rehabilitation, and Replacement
- Minimal disruption to surface activities
- Economical
- Environmental benefits





# Pipeline Inspection – Scanning & Evaluation



**USMH: 1386A**

**DSMH: 1386**

**Vermin Rat**

**14.5 ft.**







# Lining Technologies





Washington, DC

# Colombo, Sri Lanka





# Mess of Overhead Cables Yangon, Myanmar





申  
815  
4137  
又

# Burying Overhead Electrical Cables Shanghai, China

# Palm Islands, Dubai, UAE





15 8:24



Madrid, Spain

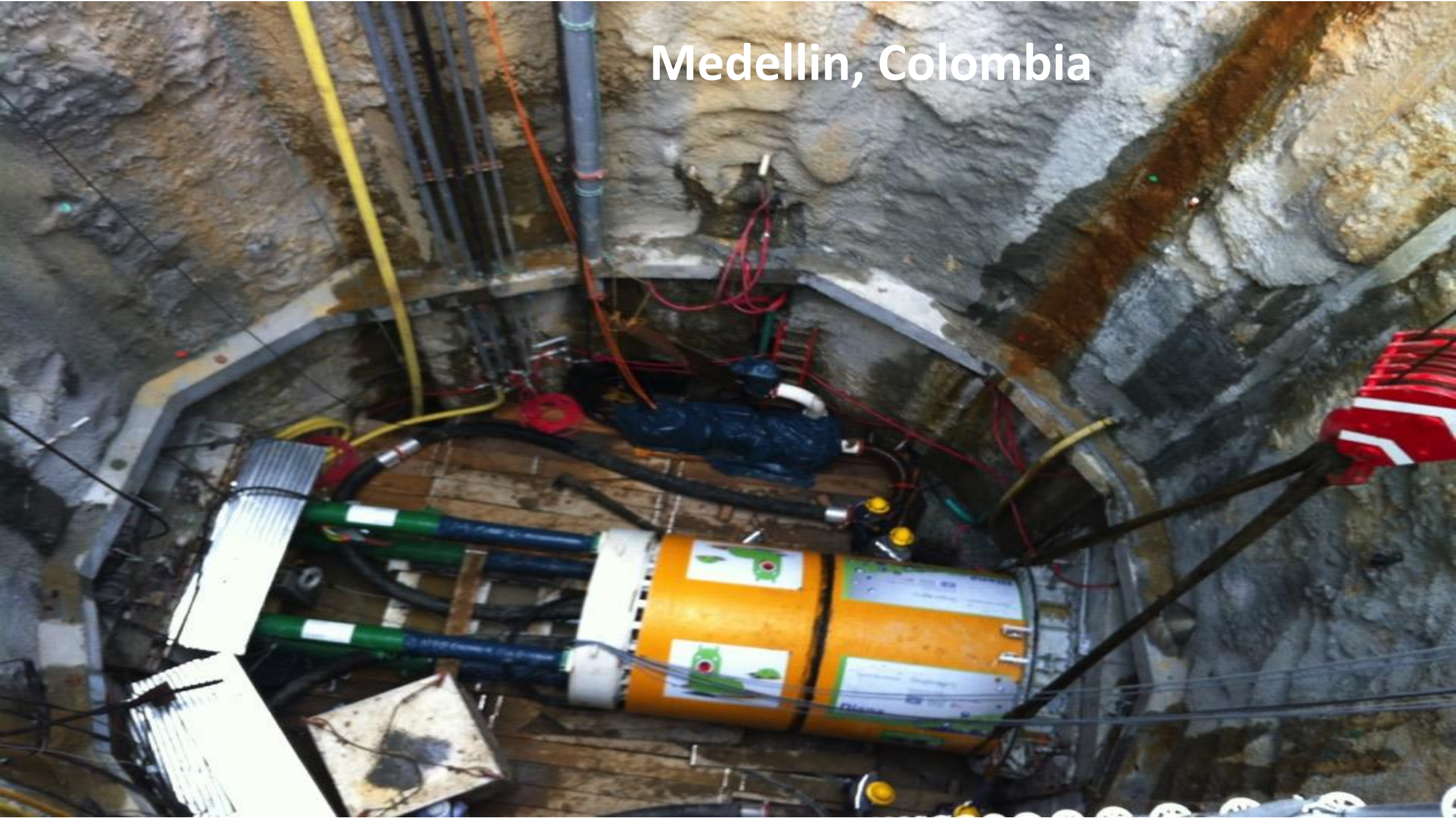




# National Mall, Washington, DC



Medellin, Colombia





**Sydney, Australia**



**Paris, France**





Zhuhai, China





Utilidors (Joint Utilities)

# Joint Utilities – Wuhan, China





Existing water main  
under stalls

Chongqing, China



Completed in 3 hrs. vs. 7 days

# Shenyang, China – Pipe Ramming



Transfer all existing overhead  
H.T. underground due to road  
widening

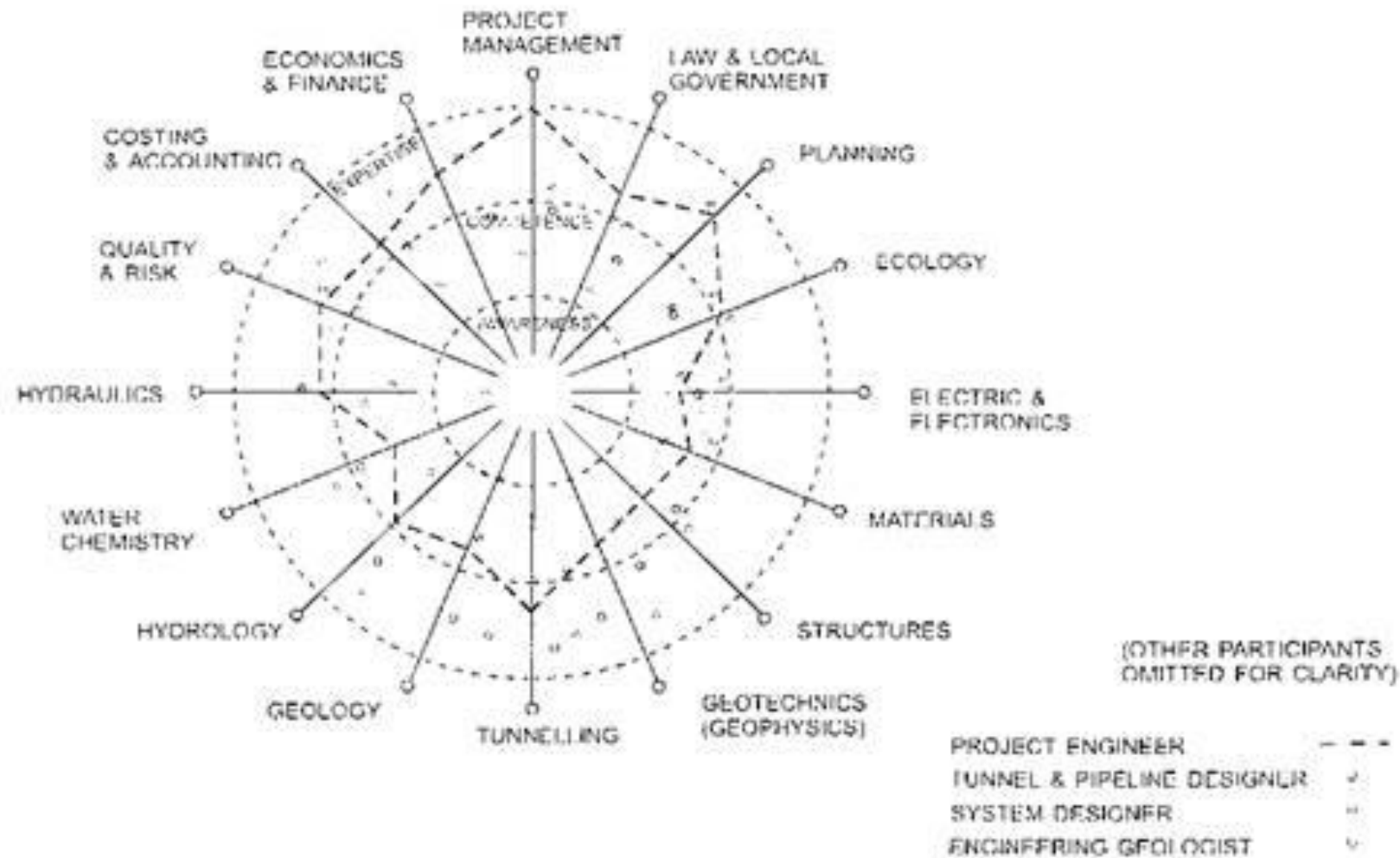
Ramming Pit

800mm casing under canal  
for H.T. cables

Second section  
800mm casing under traffic  
intersection

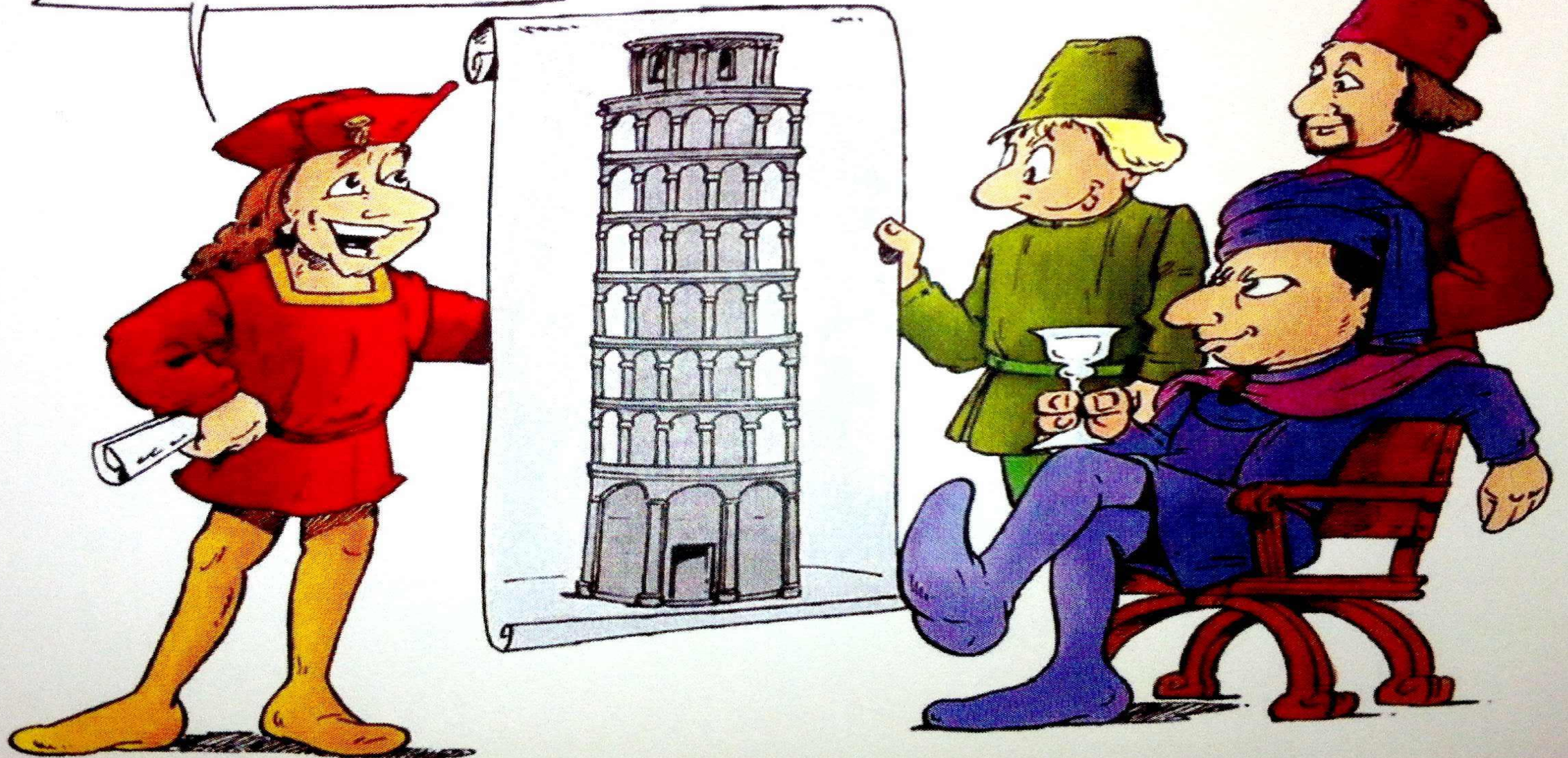


# Interdisciplinary Skillset for Underground Engineering



Wood (2000)

... AND WE CAN SAVE 3 WEEKS  
BY NOT MAKING SOIL TESTS...



# Conclusions

- World-wide urbanization of metropolitan areas has resulted in the need for expanding our underground utility infrastructure
- Furthermore, aging utilities require rehabilitation
- Minimally-intrusive trenchless construction practices play an important role
- The utilization of trenchless technologies will continue to increase!



# Grazie!





37<sup>TH</sup> INTERNATIONAL  
**NO-DIG**  
FLORENCE 2019

Fortezza da Basso • FLORENCE (Italy)

30<sup>th</sup> September • 2<sup>nd</sup> October 2019



**Samuel T. Ariaratnam, Ph.D., P.E., P.Eng., F.ASCE, F.CAE, NAC**  
Professor & Construction Engineering Chair  
Academician of the Canadian Academy of Engineering  
Arizona State University  
Past Chairman, American Society of Civil Engineers Pipelines Division  
Past Chairman, International Society for Trenchless Technology  
School of Sustainable Engineering & the Built Environment  
Ira A. Fulton Schools of Engineering  
P.O. Box 873005  
Tempe, Arizona USA 85287-3005  
Tel +1 (480) 965-7399  
Email: [ariaratnam@asu.edu](mailto:ariaratnam@asu.edu)

