

Under the patronage of **HRH Prince Khalid Al-Faisal**
Advisor to the Custodian of the Two Holy Mosques & Governor of Makkah Region



المؤتمر الدولي الثاني والعشرون لإدارة الأصول والمرافق والصيانة
The 22nd International Asset, Facility & Maintenance
Management Conference

Digitization - Excellence - Sustainability

INNOVATION IN ENERGY FIELDS WITH THE TRIZ METHOD

APPLICATIONS IN KEY SECTORS FOR THE MIDDLE EAST

26-28 January 2025

The Ritz-Carlton Jeddah, Kingdom of Saudi Arabia

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Globally, the energy sector is facing several critical challenges

- Growing energy demand impacts infrastructures and traditional resources
- Climate changes require transition to renewable energy sources (solar, wind, ...)
- Security, due to existing geopolitical tensions



Challenges in the Middle-East energy sector

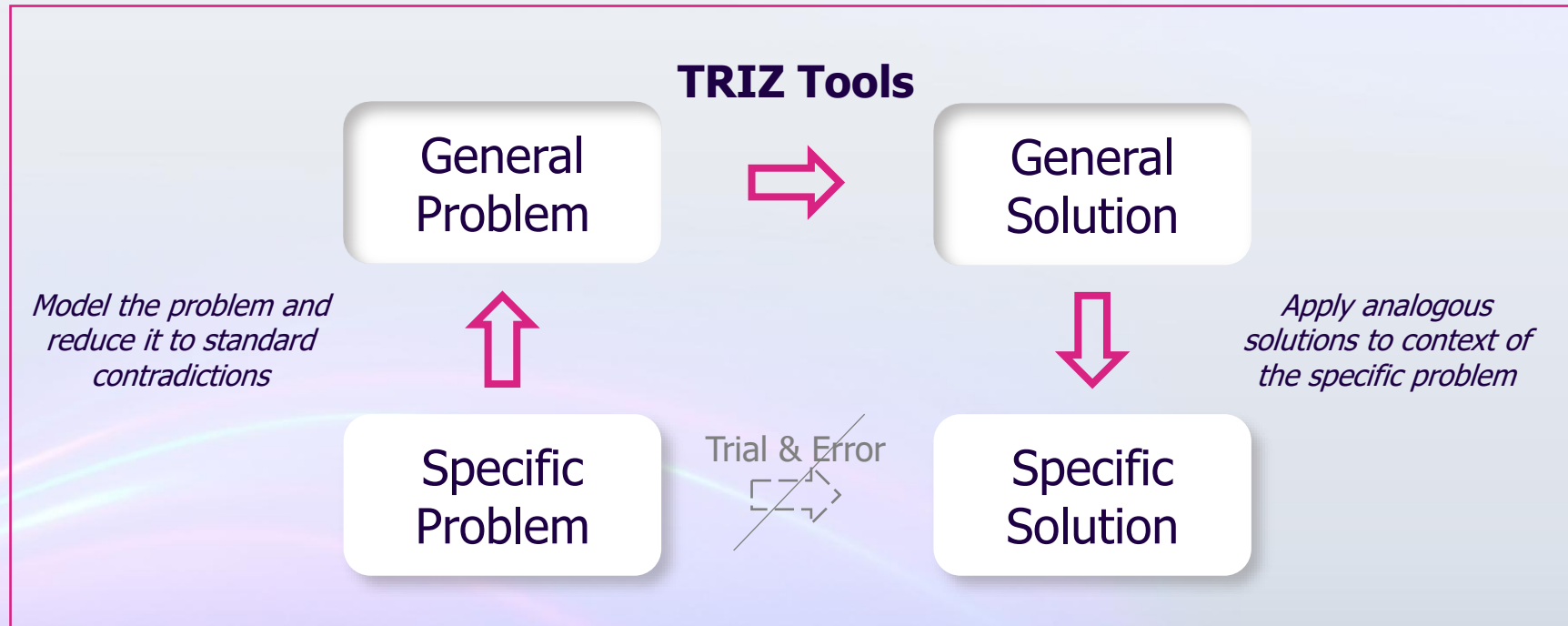
- Energy diversification need of its energy sources to sustain long-term economic growth, by reducing dependence on fossil fuels
- Fluctuating oil prices implies high economic vulnerability
- Climate change increases the demand for cooling energy, putting additional pressure on power grids
- Environmental sustainability: pollution and water resource management
- Challenges of energy efficiency in construction and large estates



What is TRIZ ?

Theory for Inventing Problem Solving

Scientific methodology developed to address complex problems and provide innovative solutions



What is TRIZ ?

Theory for Inventing Problem Solving

Scientific methodology developed to address complex problems and provide innovative solutions

Some TRIZ tools

- Contradiction Matrix matches specific technical contradictions with appropriate inventive 40 principles
- Resource Analysis helps identify and use available resources within the system
- Laws of Evolution are a set of patterns that every technology follows during its evolution making possible to predict the development of any technical system
- Trimming works to eliminate unnecessary components reducing costs and complexity
- MATChEM trend
- ...

TRIZ Applications in Energy Management for Large Constructions



Al Bahr Towers (Abu Dhabi)

Dynamic facades

Flexibility vs Robustness

Cooling vs Consumption

Principle #15
Dynamization

Principle #28
Replace mechanical systems

Principle #24
Intermediation



Capitol Tower (Houston)

Aerogel-based glass

Transparency vs Insulation

Robustness vs Lightness

Principle #35
change physical parameters

Principle #2
extraction properties

Principle #40
composite materials

With the
combination of
solutions
+
Resources analysis
+
Laws of evolution

UPGRADED SOLUTION

Self-adapting aerogel

NO electronics needed

NO mechanical devices

NO human intervention



Thermochromatic gel (Fraunhofer)

Electrochromatic gel (Berkeley)

Photochromatic gel (MIT+Cambridge)

TRIZ Applications in Energy Storage

Available systems

- Lithium-ion batteries
- Pumped hydro storage
- Compressed air energy storage (CAES)
- Flow batteries
- Solid-state batteries

TRIZ approach

- Efficiency vs lifecycles
- Power vs geography
- Eng. density vs safety

↓
Principle #15
dynamization

↓
more flexible + adaptive

↓
modular storage units
scalable based on demand

MATCHEM

Symbol	Field
M	Mechanical
A	Acoustic (Vibration)
T	Thermal
Ch	Chemical
E	Electric
M	Magnetic

Evolution Trends

- ↓ ↓ ↓ ↓
- Flywheel / CAES
 -
 - Concentrated Solar Power/PCM
 - Lithium-Ion / Flow batteries
 - Supercapacitors
 - Superconducting Magnetic Energy Storage (SMES)
Magnetic Flywheel

CONCLUSIONS

- The ongoing quest for energy innovation is pivotal in addressing
 - challenges posed by increasing energy demands
 - environmental concerns
 - transition towards sustainable resources
- TRIZ is a catalyst for innovation in energy technologies with
 - several tools designed to enhance inventive thinking
 - the ability to generate high-level solutions (i.e. Innovations)
- The Middle East can only greatly benefit from the use of TRIZ
 - Constructions: development of smart building materials
 - Energy storage: improve efficiency, grid management, analyze trends



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THANK YOU!

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