



ENN

confinement

plasma

从低碳能源到无碳能源

From Low-carbon to
Carbon-free Energy

material

simulation

Zhenqi Zhu, Ph.D

Vice President, ENN

Apr. 19, 2018

ENN Group

Leading energy company in China
Founded in 1989.

\$20bn

Revenue in 2017

160+

Cities

3

Three Public Companies

- ✘ ENN Energy Holdings Limited
(2688.HK)
- ✘ ENN Ecological Holdings Co. Ltd
(600803.SH)
- ✘ Beibu Gulf Tourism Corporation Limited
(603869.SH)

77 mil.

Population Served

50,000

Employees

ENN Business Overview

Municipal Natural Gas

Real Estate

Upstream

Overseas
Coal-based Natural Gas

Midstream

Natural Gas Distribution
and Trading

Downstream

Municipal Gas, Power
and Heating Services

Tourism

Culture

Real Estate

Health

Energy
research
institute

Institute
of life
science &
technology

Ubi³ 泛能网

Ubiquitous Energy
Service

Energy Ecosystem

e城e家

Bella Healthcare
Platform

Life Ecosystem

Digital science

ENN Intelligent Interconnected Platform

ENN Energy Research Institute

ENN's innovation engine addressing energy challenges .

1

State Key Laboratory for Coal-based Low Carbon Energy

Carbon-free Energy

- * Fusion
- * Deep Geothermal Energy
- * Low-Cost Energy Storage
- * Advanced Energy Materials

8

Research Areas

Low-carbon Energy

- * Coal Gasification
- * High-efficiency PV Technology
- * Ubiquitous Energy Internet
- * Supercritical Water Oxidation

18

Experts Enrolled in China's Thousand-Talents Program

700

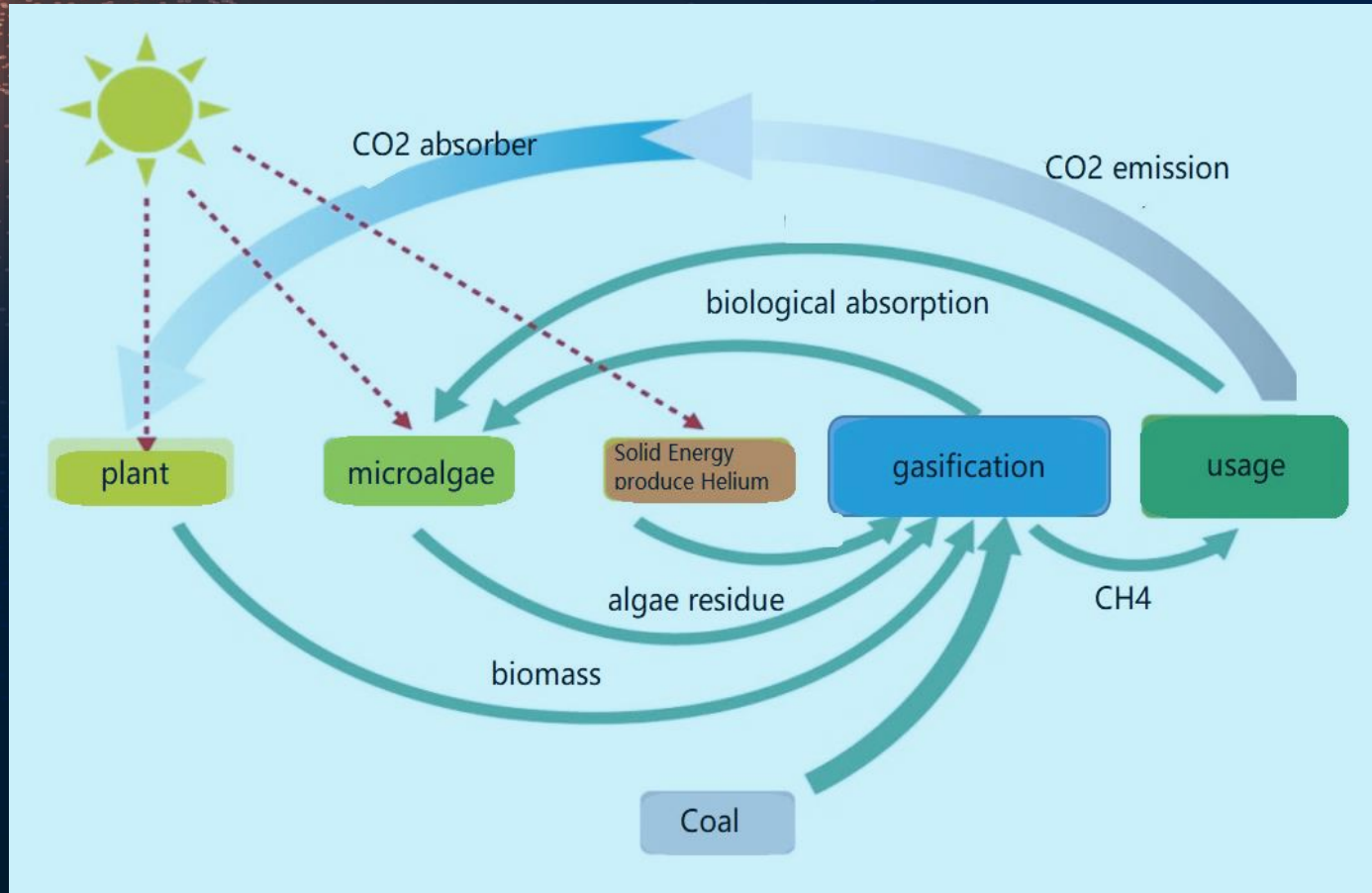
Employees

1600+

Patents

ENN Energy Research Institute 1.0: (2007–2017)

Low-Carbon Technologies Innovation and Commercialization



Clean Coal Technology

Improve energy structure and emission efficiency. Based on National Key R&D program.

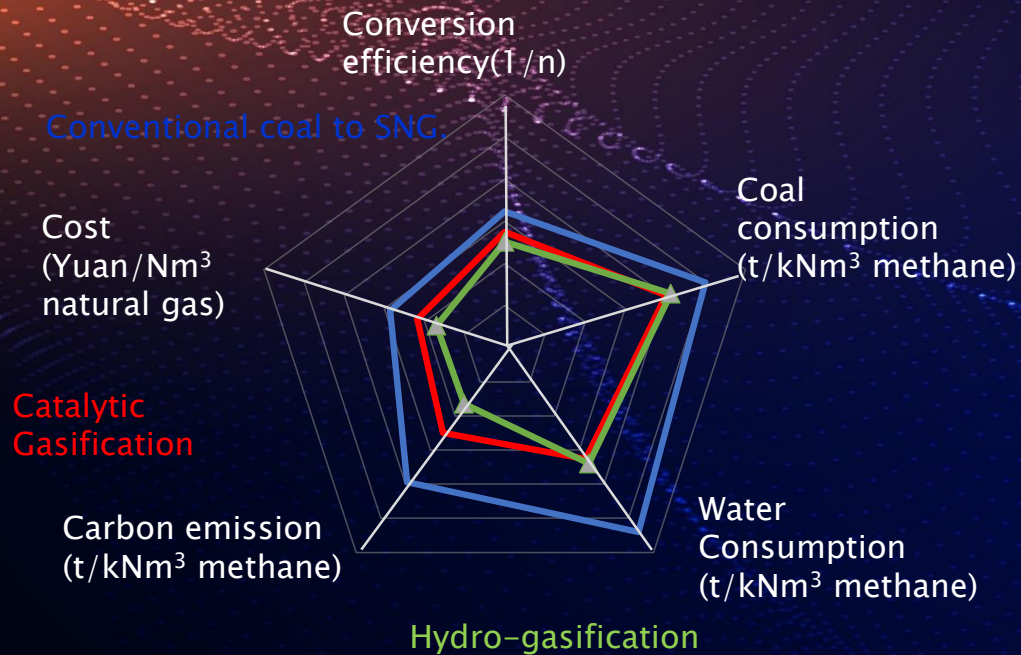
Ubiquitous Energy Internet(UEI)

Improve energy efficiency. Utilization of renewable energy.

I . Coal Gasification Technology Development

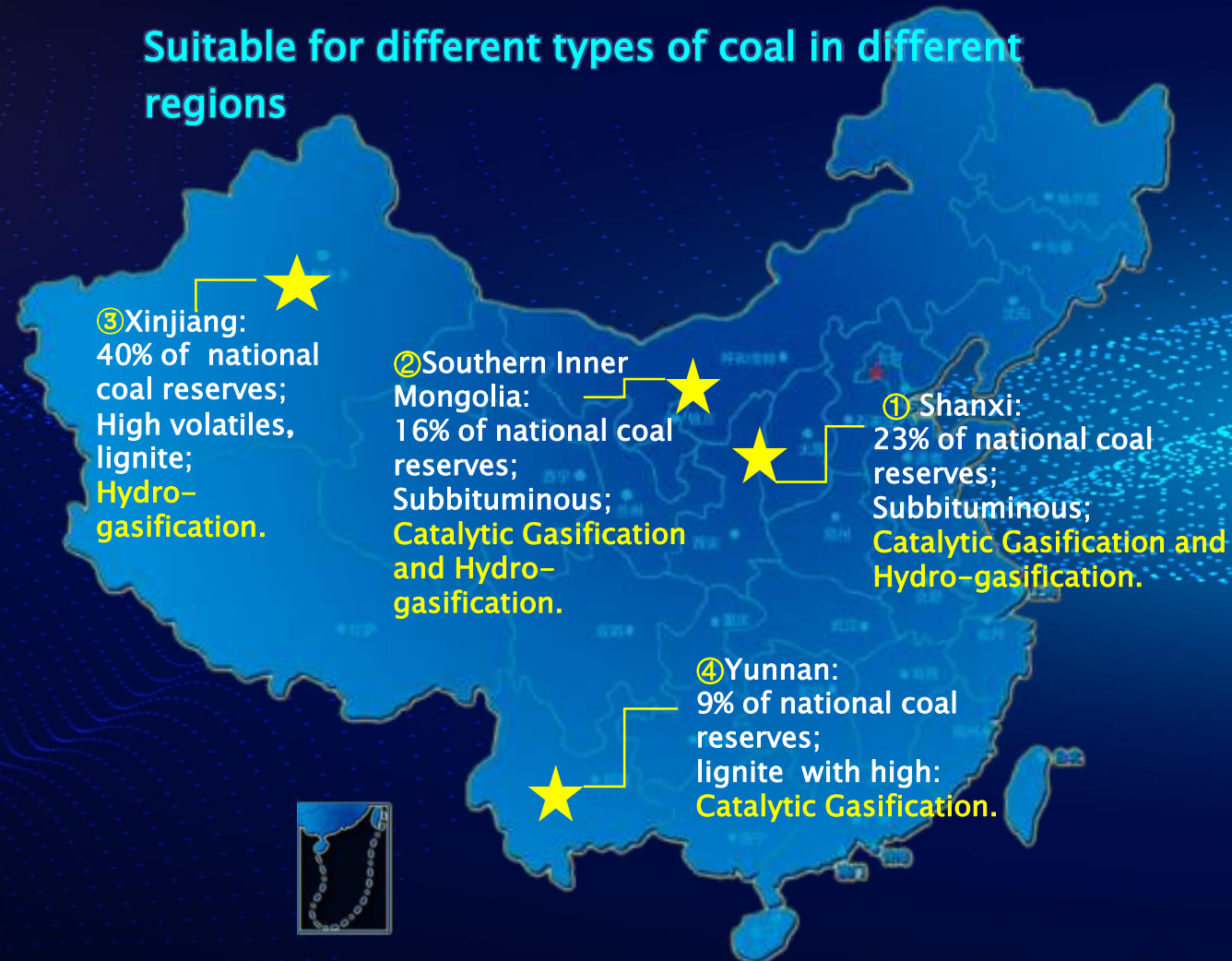
ENN developed coal gasification technologies to fit different types of coal with its scaling up platform and facilities in Inner Mongolia.

Gasification technologies evaluation



	Conventional coal to SNG	Catalytic Gasification	Hydro-gasification
Conversion Efficiency	61.90%	72.70%	79.60%

Suitable for different types of coal in different regions





Catalytic
Gasification
1500 T/d

Efficiency of Carbon Conversion:
98%
CH₄ Production > 0.6 Nm³/kg C
Catalyst Recovery > 95%



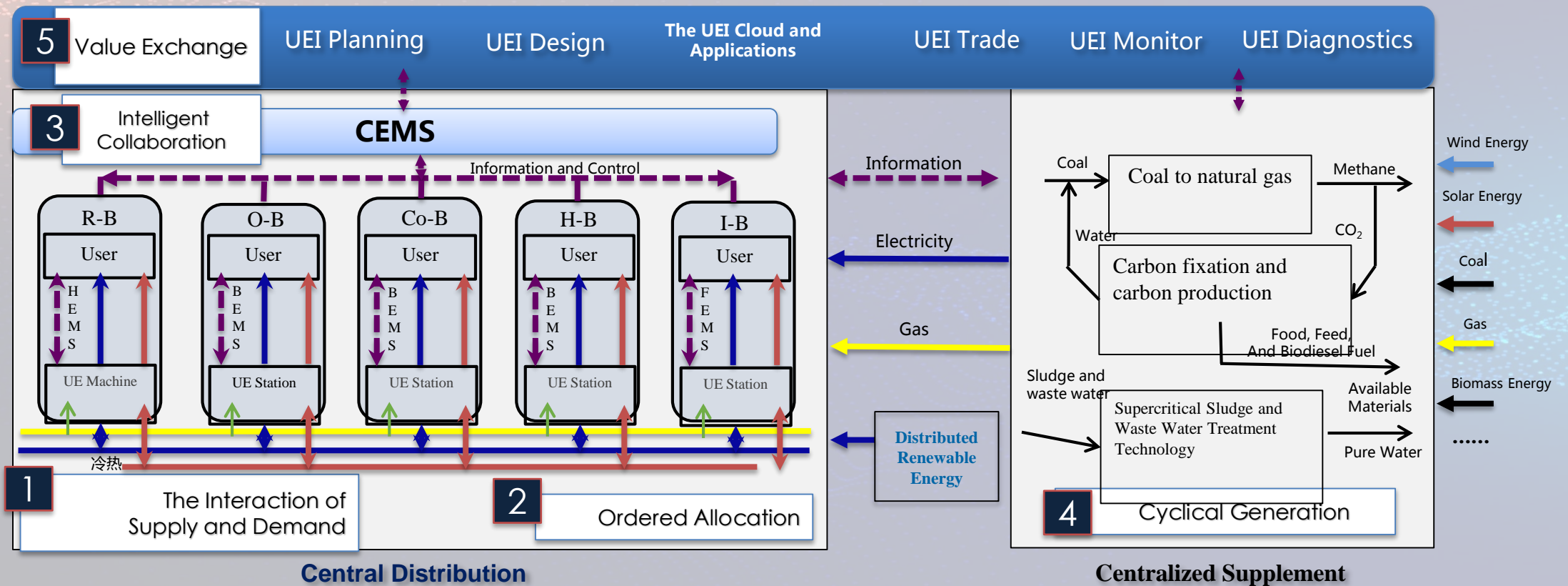
Conversion Rate of CH₄: 0.5–0.8 Nm³/kg C
Light-Oil Production: 10–15%
CH₄ Percentage in Syngas: 75–80%, CO₂ < 3%



Hydro-
gasification
400 T/d

II. Ubiquitous Energy Internet (UEI)

UEI enables optimal supply and demand matching, efficient energy conversion, lower CAPEX and OPEX.



II. Ubiquitous Energy Internet (UEI)

50 UEI Projects across China

- ◆ Comprehensive Efficiency of Energy Utilization > 80%
- ◆ Rate of Facility Utilization > 50%
- ◆ Smaller Footprint ~ less 30%
- ◆ CO₂ Emission Reduction > 30%



Micro-Grid UEI Demonstration Project in Langfang



Sino-German Ecopark in Qingdao



Economic and Technological development Zone of Wenzhou



Cloud Computing Center of Tencent



Economic & technological Development Zone of Zhaoqing

III. Low-Carbon Environmental Protection Technology



Supercritical Water
Treatment Technology



High Efficiency
PV Technology

CO₂ Capture and
Utilization

ENN Energy Research Institute 2.0: (2018-) Carbon-Free Energy

Carbon-free energy is the ultimate energy for the sustainable development of human being and planet earth.



$$E=MC^2$$



* Source of data: <http://cn.made-in-china.com/info/article-6889384.html>
<http://www.xn12114.com/zgxnytw/wap/contents.asp?id=554>
<http://news.bjx.com.cn/html/20151214/691328.shtml>
<http://www.renewableenergymexico.com/is-solar-energy-really-the-future-of-mexicos-renewable-energy-sector/>

Top Talents

Open Minded Roadmap

Global Collaboration

ENN Fusion
Research Institute (FRI)

Pollution Free

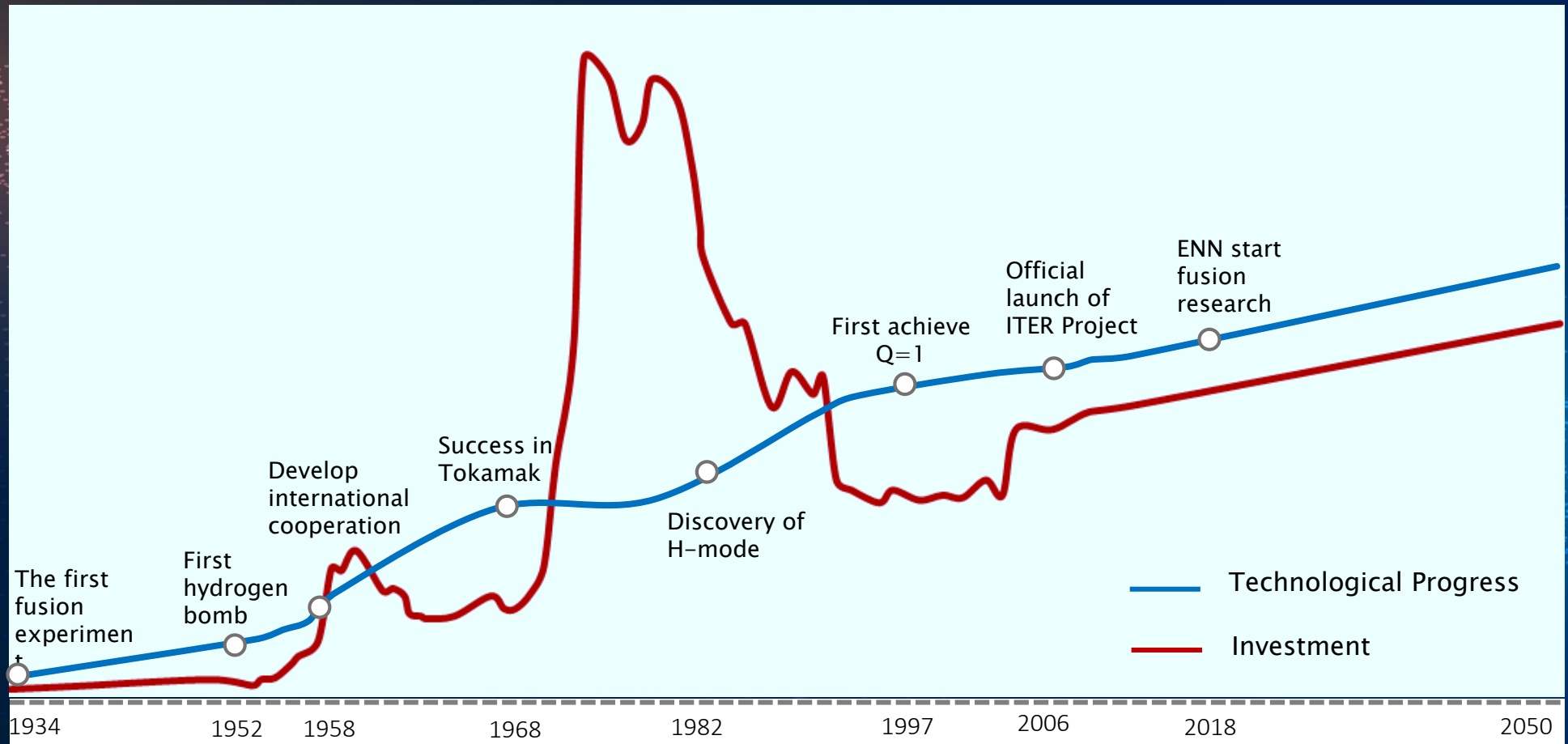
Cost Effective & Compact

Distributed Energy

MISSION

Advance the compact fusion technology, out of lab to serve real energy needs.

Fusion Research Investment (Public Expectation) and Technological Progress Curve

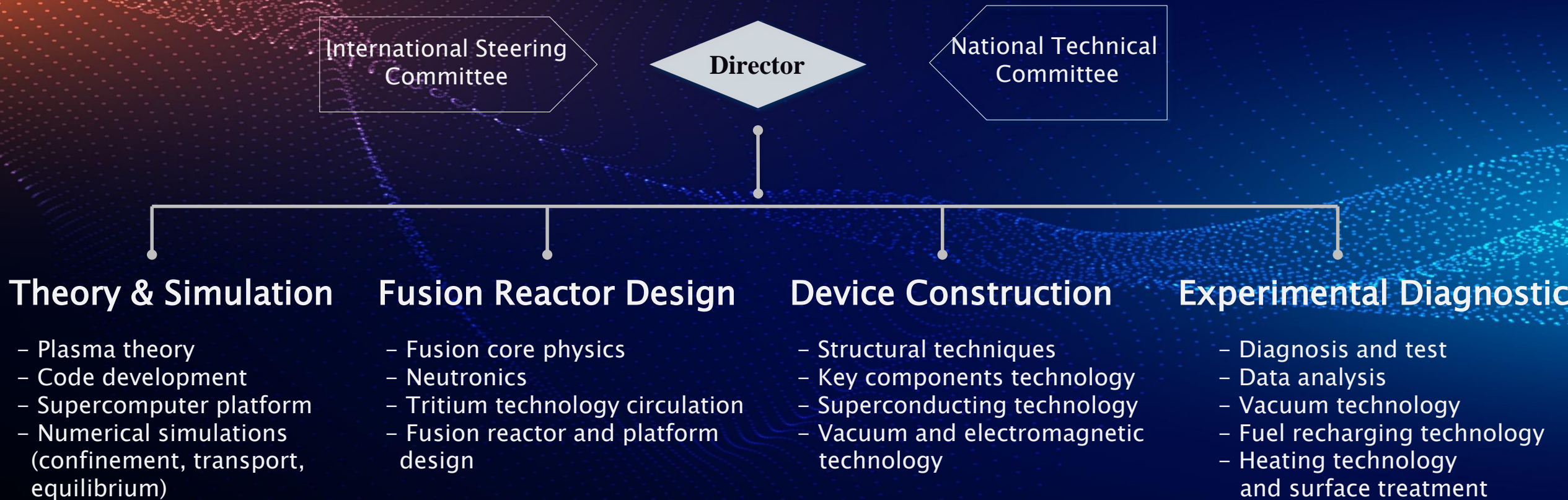


Rudimentary stage of technology	Developing period of technology	Verification of scientific feasibility	Verification of engineering feasibility
---------------------------------	---------------------------------	--	---

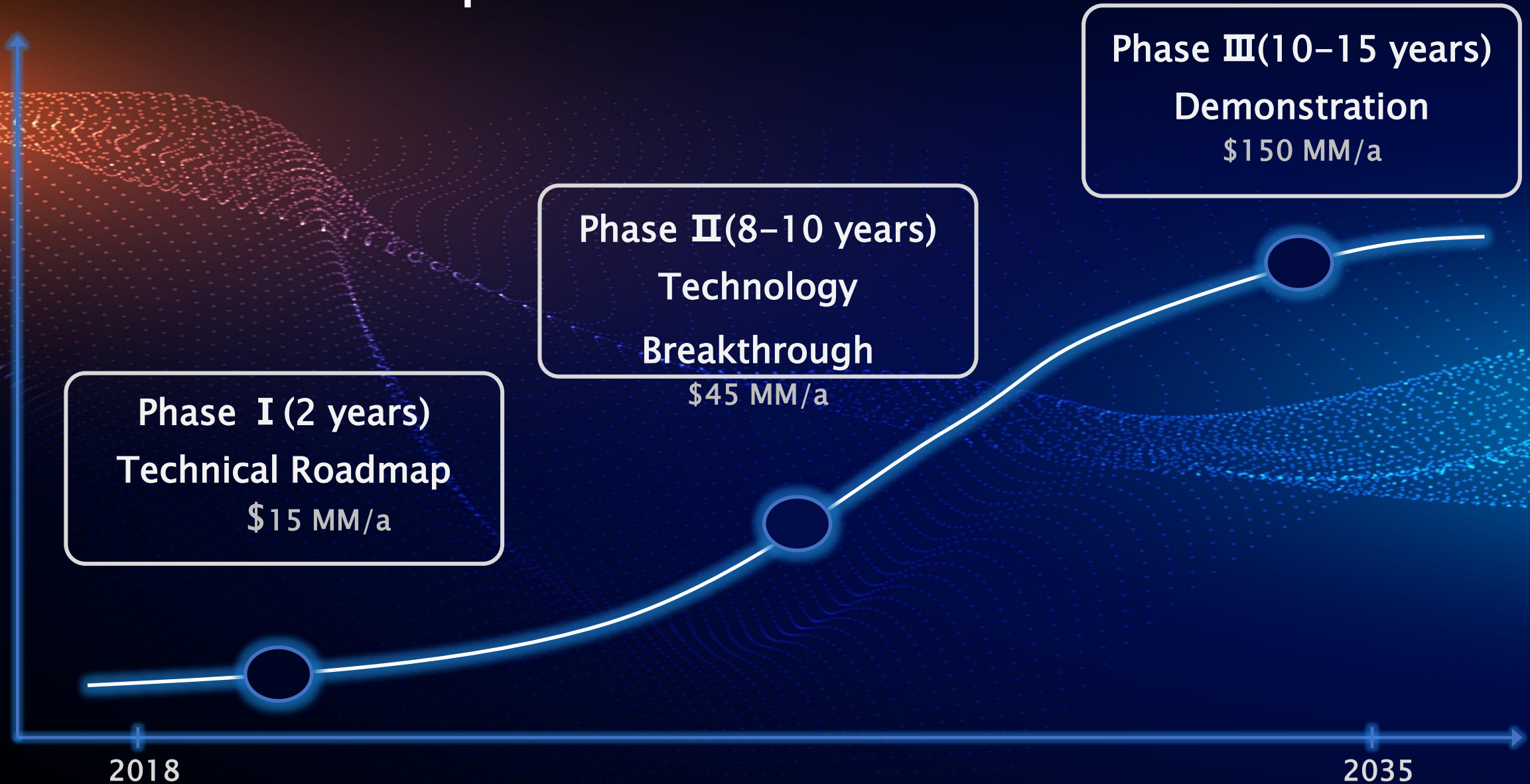
* Source of data: US funding for magnetic fusion

ENN Fusion Research Institute

Organization Chart



ENN Fusion research institution (FRI) -- Roadmap



2018 FRI-ENN Plan

Establishing Specialized Team

-- 100+

- ✓ Theory and simulation
- ✓ Plasma diagnostics
- ✓ Vacuum system design
- ✓ Electric power systems
- ✓ Systems and control
- ✓ Electromagnets design
- ✓ Heating systems

Device and Platform

Super-computer simulation
platform
IEC
Spherical Tokamak
 θ -pinch FRC
RMF FRC

Fusion Proposal 1.0

Survey all existing fusion
approaches
Theory and simulation
study of feasible
configurations
Combine suggestions from
all experts present

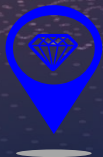
ENN proudly announces **AEI Challenge**.



Mission

Stimulate and nurture innovation in Fusion

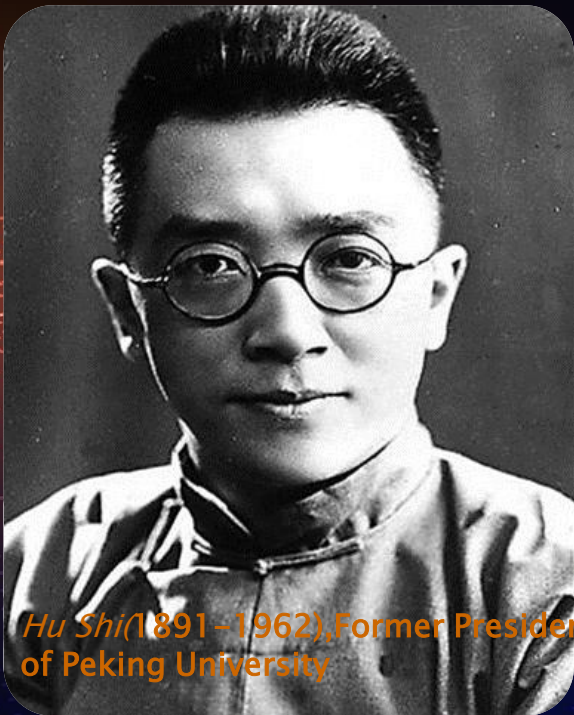
Encourage graduated students, postdoctors, young scholars to participate to promote compact fusion research and education.



Prize

First prize	¥1,000,000 /annual
Second prize	¥300,000 /annual
Third prize	¥50,000 /annual
Creative award	¥10,000 /annual





Hu Shi (1891–1962), Former President of Peking University

大胆假设，小心求证。
——胡适

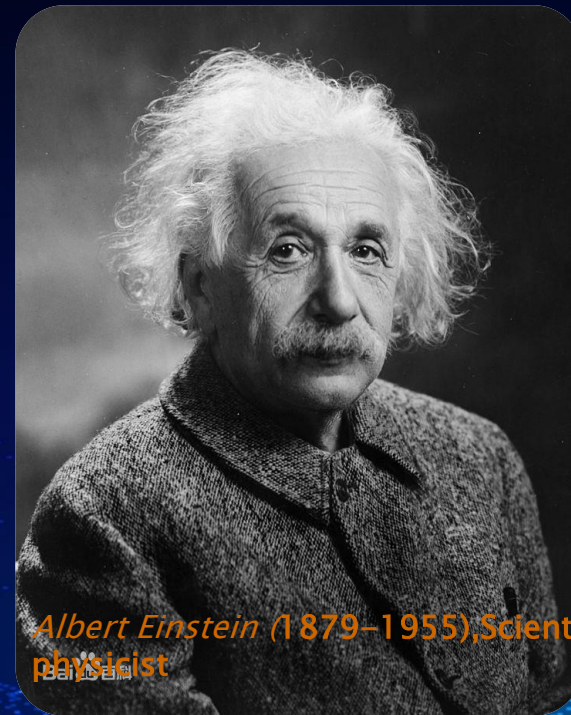
Hypothesize boldly and verify carefully.



Lu Xueshan (1905–1981), Physicist, Academician of Chinese Academy of Science

不要用我们已有的知识去
轻易否定我们未知的东西。
——陆学善

Don't use what we know to
easily deny what we don't
know.



Albert Einstein (1879–1955), Scientist, physicist

Imagination is more
important than knowledge.
——Albert
Einstein

想象力比知识更为重要。

求真务实 引领突破

Powering a Better Future Together