

제 1차 핵정책전문가 네트워크 포럼

2018.09.06
(사)한국핵정책학회



제1차 행정책 전문가 네트워크 포럼

1. 취지

한국 행정책학회는 북핵, 비확산, 원자력 등을 다루는 인문사회로부터 이공계 분야에 이르는 행정책 전문가들 사이의 네트워크를 강화시킴으로써, 핵 정책 전문가들 사이에 상호 의사소통을 증진시키며 다양한 정책아이디어들을 함께 공유할 수 있는 공동의 장을 마련하였음.

2. 개요

- 주관 : 한국 행정책학회
- 행사명 : 트럼프-문재인 시대 한미 원자력 협력 추진방안
- 시간 : 9월 6일 목요일 오후 2시-5시
- 장소 : 서머셋 팰리스 서울 보드룸 회의실 (광화문)
- 만찬 : 오후 5시20분 Crystal Jade Shanghai Palace (서머셋 팰리스 1층)
- 참석자 : 행정책학회 임원진 포함 행정책 전문가 귀빈 15인 내외
- 형식 : 각 발표자 10분 정도 발표 후 전원 자유토론 (총2세션 약3시간)

시간	내용
14:00-14:10	행정책학회 회장 개회사 (5') 참석자 소개 (5') * 전체사회: 김영준 국방대 교수 * 패널 진행 사회: 이상현 행정책학회장
14:10-15:40	한미 원자력 협력 현황 외교부 원자력과 김성은 과장 (10') 한미 원자력 파트너십 증진: 필요성 및 향후 방향 한국원자력연구원 이광석 박사 (15') 민간부문 한미 원자력 협력 활성화를 위한 정책 제언 일본 리츠메이칸 대학 임은정 교수 (15')
15:40-15:50	휴 식
15:50-16:50	사우디 원전: 이슈와 전망 비전파워 변준연 회장 (전 한국전력공사 부사장) (15') 트럼프 행정부의 핵비확산정책 국가안보전략연구원 조은정 박사 (15')
16:50-17:00	행정책학회 회장 폐회사 (10')
17:20-19:00	만찬 Crystal Jade Shanghai Palace (서머셋 팰리스 1층)

행사 사진

제 1차 행정책 전문가 네트워크 포럼 트럼프-문재인 시대 한미 원자력 협력 추진방안

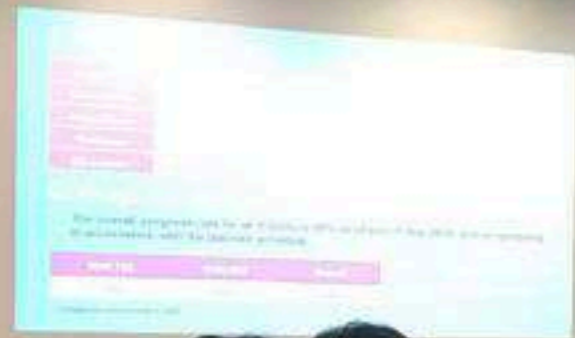
일시: 2018년 9월 6일(목) 오후 2시-5시 장소: 서머셋 팰리스 서울 보드룸 회의실 주관: (사)한국경제연구원





제 1차 행정책 전문가 네트워크 포럼 트럼프-문재인 시대 한미 원자력 협력 추진방안

일시: 2018년 9월 6일(목) 오후 2시-5시 | 장소: 서머셋 팰리스 서울 보드룸 회의실 | 주관: (사)한국행정책학회






제 1차 행정책 전문가 네트워크 포럼
트럼프-문재인 시대 한미 원자력 협력

2018년 1월 14일(목) 오후 2시 5시 장소 서머셋 플라자 서울보드룸 회의실 주관 (사)한





발표 자료 - 이광석 박사



한⌚미 원자력 파트너십의
필요성 및 향후 방향

2018. 9. 6

이 광석





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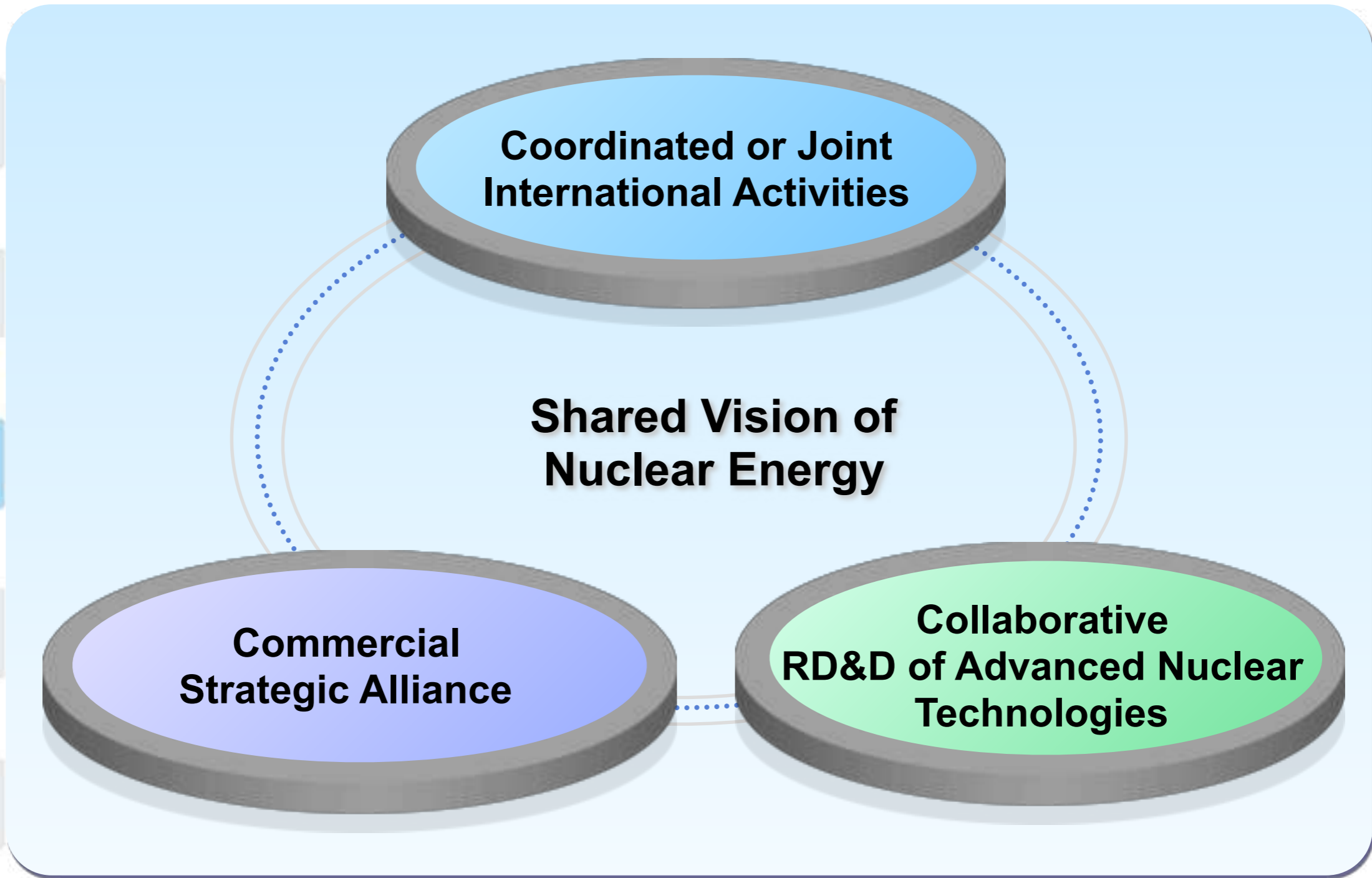
Future Directions





1. Overview

Elements of ROK-US Nuclear Partnership





Shared Vision of Nuclear Energy

- **Peaceful Uses of Nuclear Energy to Address Climate Change and Energy Security**
- **Ensuring Nuclear Safety, Safeguards and Security**
- **Global Solution to Long-term Spent Fuel Management**
- **Leading Cutting-edge Nuclear Technologies**
- **Strategic Collaboration for Mutual Benefits in Nuclear R&D and Business Areas**

Goals of ROK-US Nuclear Partnership

Activities

Commercial Strategic Alliance

Nuclear RD&D Collaboration

International Joint Activities

Products

Global Norms

Global Nuclear Market Share

Global Technical Solutions

Outcome

High Global Standards for Safety and Nonproliferation

Mutual Commercial Benefits

Nuclear Technology Lead

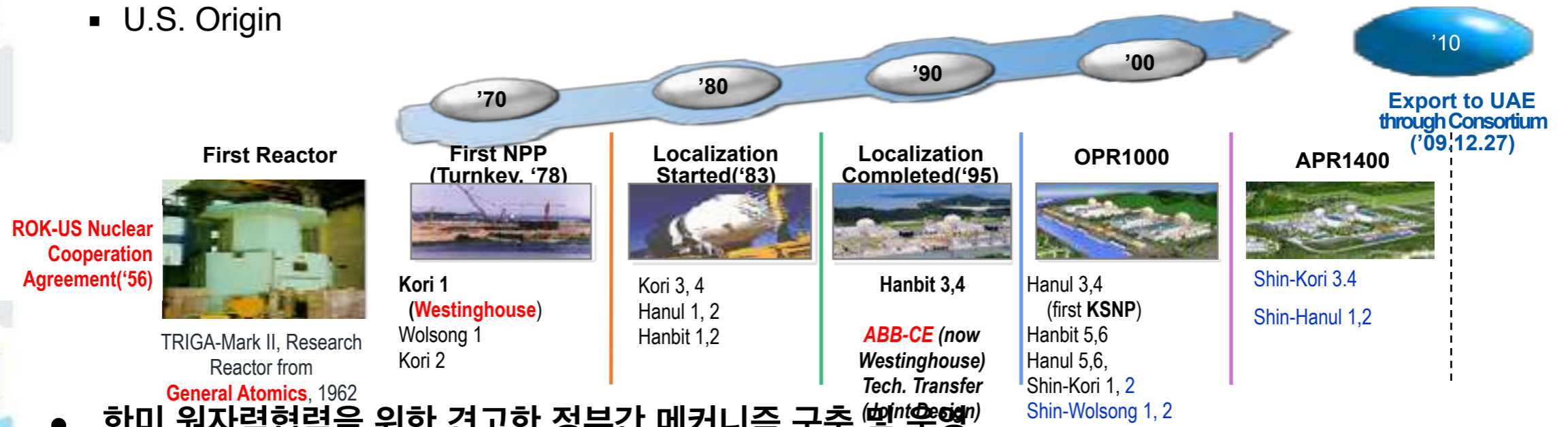
Strengthened US-ROK Alliance



2. Historical Context

Historical Context

- 양국은 한국의 원자력 개발 착수부터 서로 맞물려 온 상태
 - U.S. Origin



- **한미 원자력협력을 위한 견고한 정부간 메커니즘 구축 및 운영**
 - 한미 원자력협정, JSCNEC, PCG, JFCS, HLBC, ..
- **한국의 비약적 발전에 따라 일방적 지원에서 상호협력 관계로 변화('00년대부터)**
 - 원전 기자재 공급, 원자력 선진기술 개발(GEN-IV, I-NERI), 원전수출(UAE), ...
- **핵연료주기 분야의 애증관계**
 - '70년대 재처리시설 도입 무산, '80년대 TANDEM 주기 연구개발 중단, 미국의 사전동의
 - DUPIC('90년대), 파이로('00년대), JFCS('10년대)

Barakah NPP Project

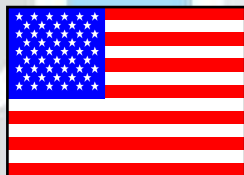
- Period : Dec. 2009 ~
- Providing 4 Units of APR1400
- KEPCO Consortium including Westinghouse



- **Brings mutual technical, commercial and political benefits to both countries**
 - Created many American jobs including the earning of more than \$2 billion to the American Companies

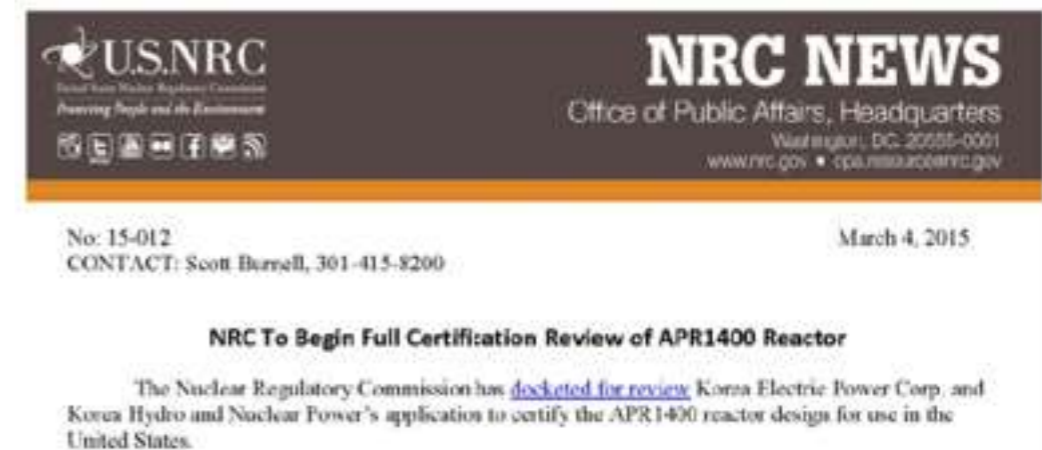
Joint Fuel Cycle Study

- **Launched in 2011 for reviewing feasibility of the electrochemical recycling technology**
 - Experiments in U.S. hot facilities
- **Working Groups**
 - Electrochemical Recycling
 - Safeguards and Security



Variety of Collaborations

- **Joint Steering Committee on Nuclear Energy Cooperation (JSCNEC) since 1976**
 - Central forum for governmental to governmental nuclear energy cooperation
- **Permanent Coordinating Group (PCG) since 1994**
 - Safeguards, Export control, Physical protection, ..
- **NRC-NSSC Steering Committee Meeting (SCM) since 2015**
- **APR1400 NRC DC**
 - Full certification review of APR1400 by US NRC from March, 2015
- **Minimization of the Use of Highly Enriched Uranium (HEU)**
 - Development of high density LEU-Mo fuel for the conversion of research reactors from HEU fuel to LEU fuel with atomized U-Mo LEU powder provided by KAERI

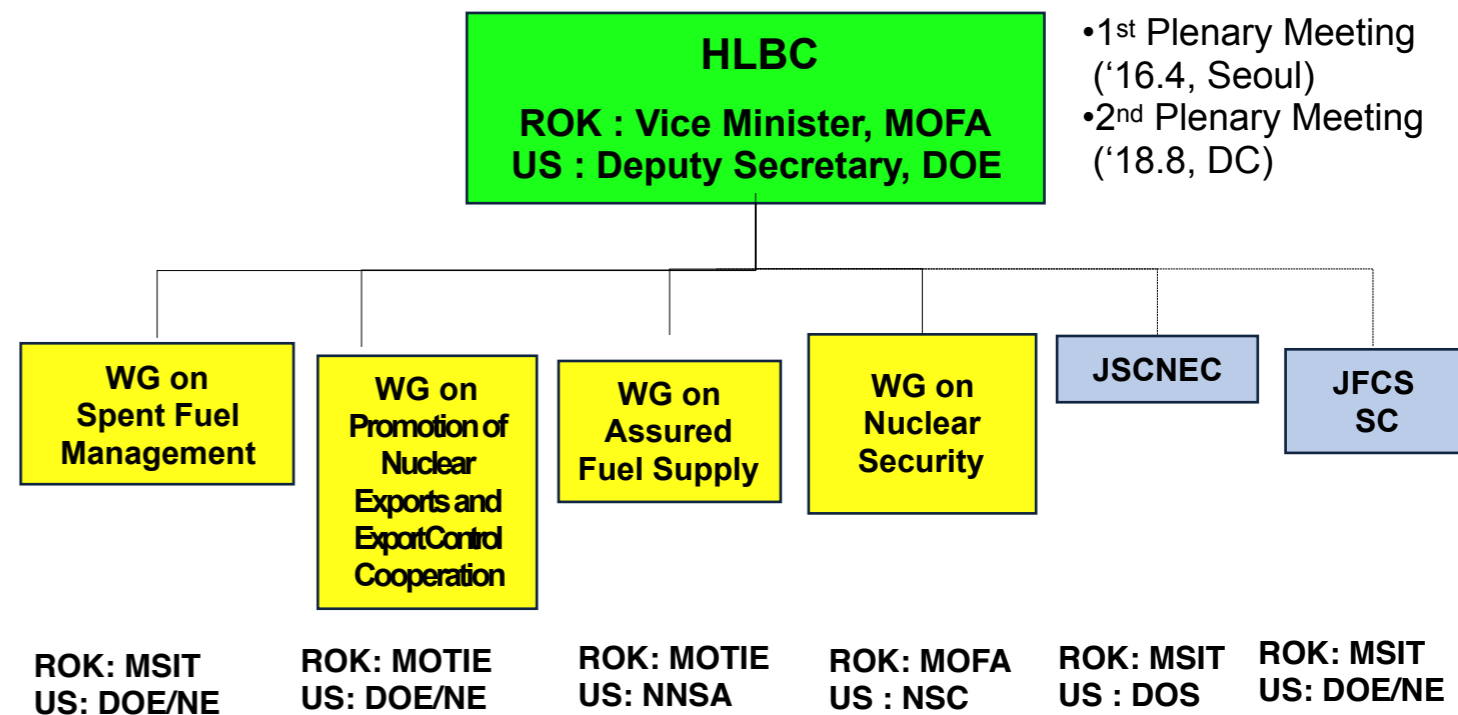



ROK-US Nuclear Cooperation Agreement

- The new NCA that entered into force in 2015 will serve as a new framework to realize the shared vision of two countries.
- HLBC will facilitate strategic cooperation and dialogue regarding areas of mutual interest.



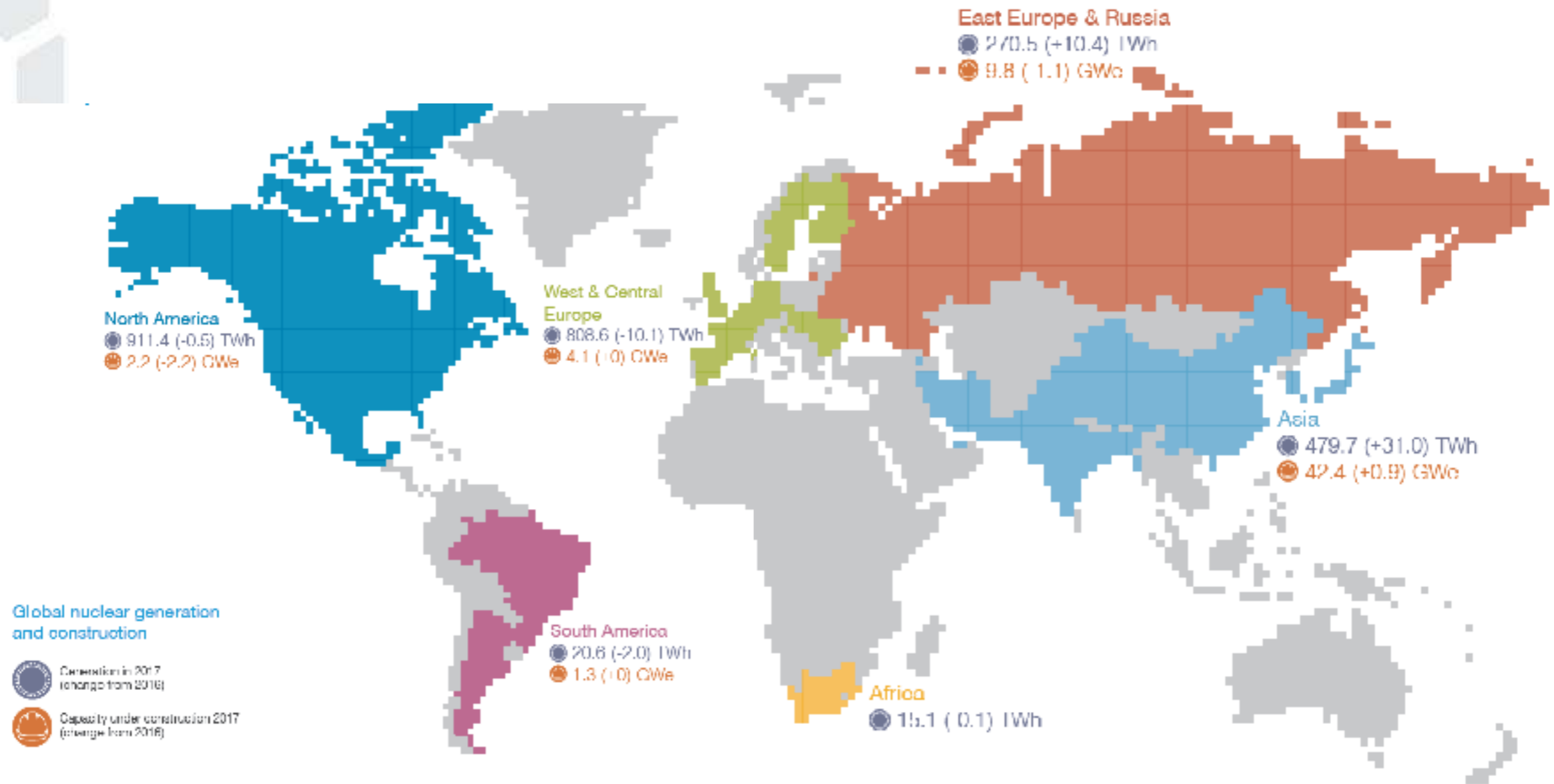
ROK-US NCA Signing Ceremony (2015.04)





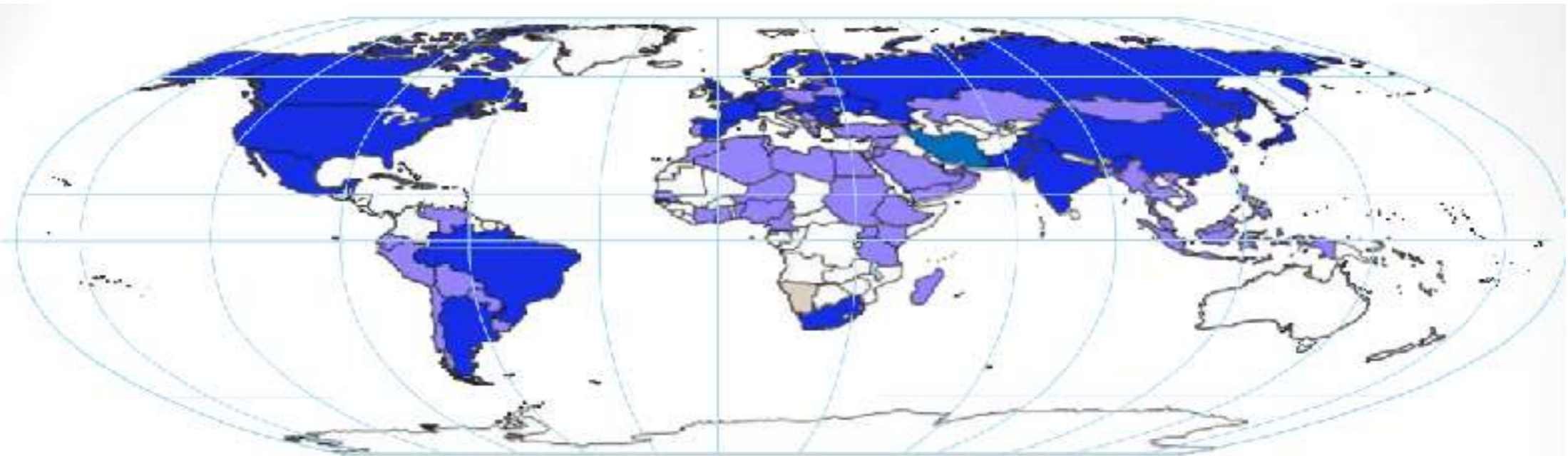
3. Global Industrial Context

Nuclear Power: World Performance



Nuclear Industry Performance Report 2018, World Nuclear Association, 2018.

Nuclear Power: Global Growth and Market Opportunity



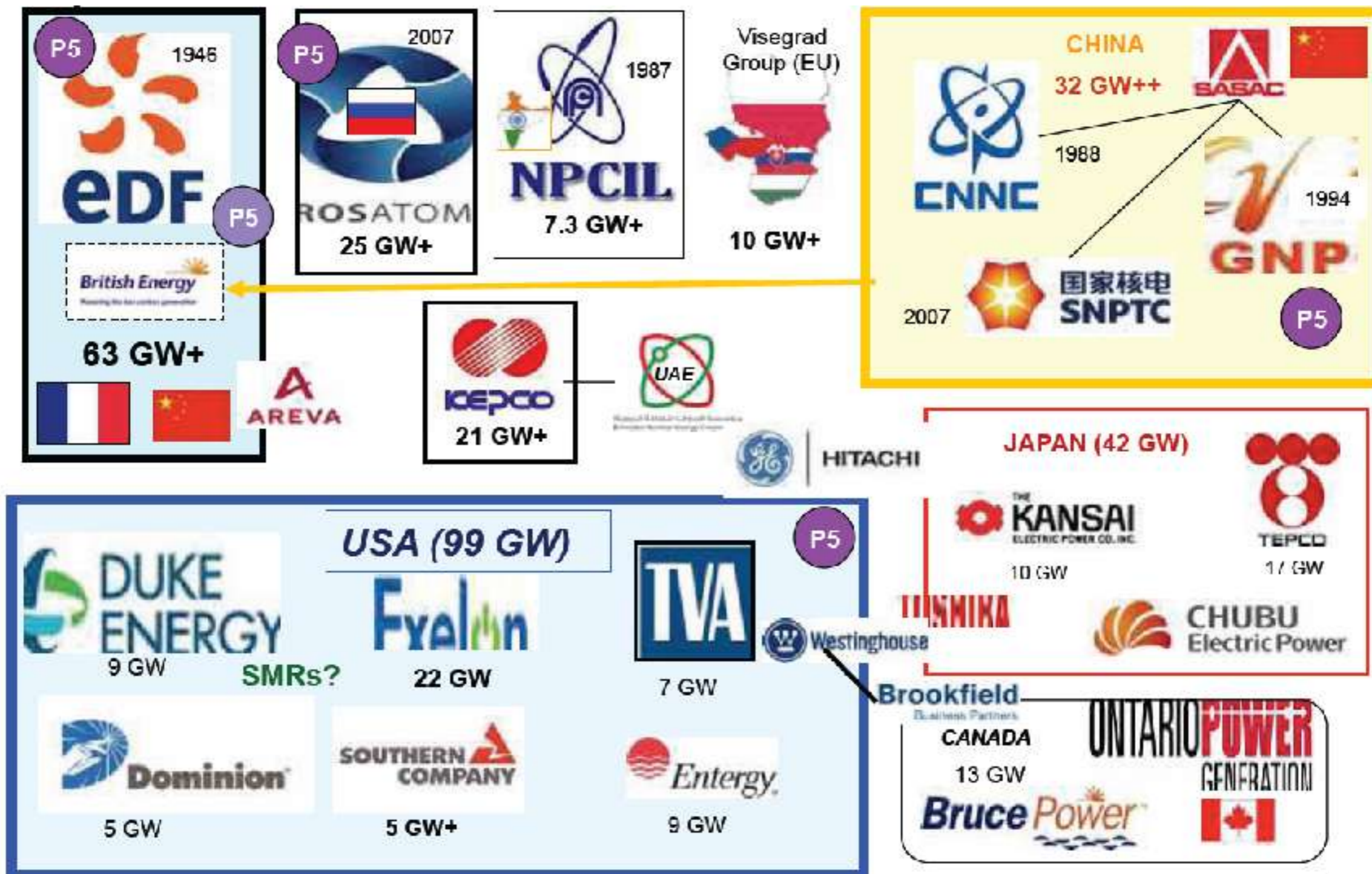
Potential Nuclear Power Expansion

- 35 countries taking steps to develop nuclear power
- 30 countries with operating reactors developing expansion plans

~450 reactors operating
11% of electricity / 40% of clean electricity

- 60 reactors under construction in 15 countries (20 in China)
- ~170 reactors planned in over 25 countries, worth as much as \$700 billion over the next 5-10 years
- ~370 reactors proposed in 36 countries, worth as much as \$1.6 trillion over the next 10-25 years

World Nuclear Industry



Andrew Paterson, & Walter S. Howes, "Reviving and Expanding Nuclear Energy: MegaTrends for GIGA-Deals," *Special Summit on Global Energy Markets*, U.S. Nuclear Industry Council, July 18, 2018.

Russia's NPP Export

The Economist, August 2, 2018

Atoms for peace

The world relies on Russia to build its nuclear power plants

And Russia is happy to oblige

.....

Two-state race

Russia's nuclear programme has endured for two main reasons. Its designs are cheap, and Rosatom enjoys the backing of the state, which helps it absorb hard-to-insure risks like nuclear meltdowns.

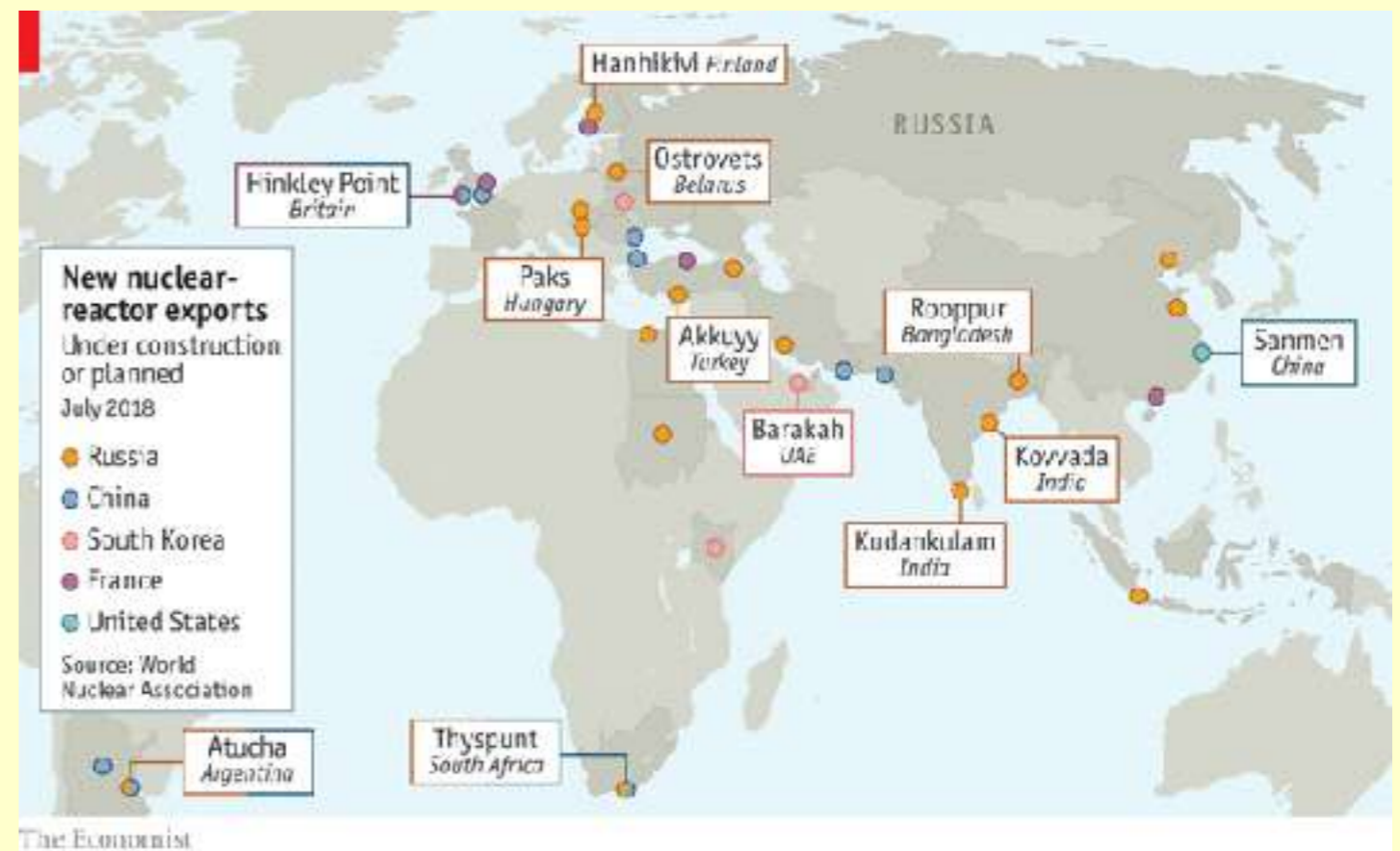
Its competitors trail hopelessly:

France's Areva (now Orano) has started building only two plants in the past ten years, in Finland and China; both are delayed and over budget.

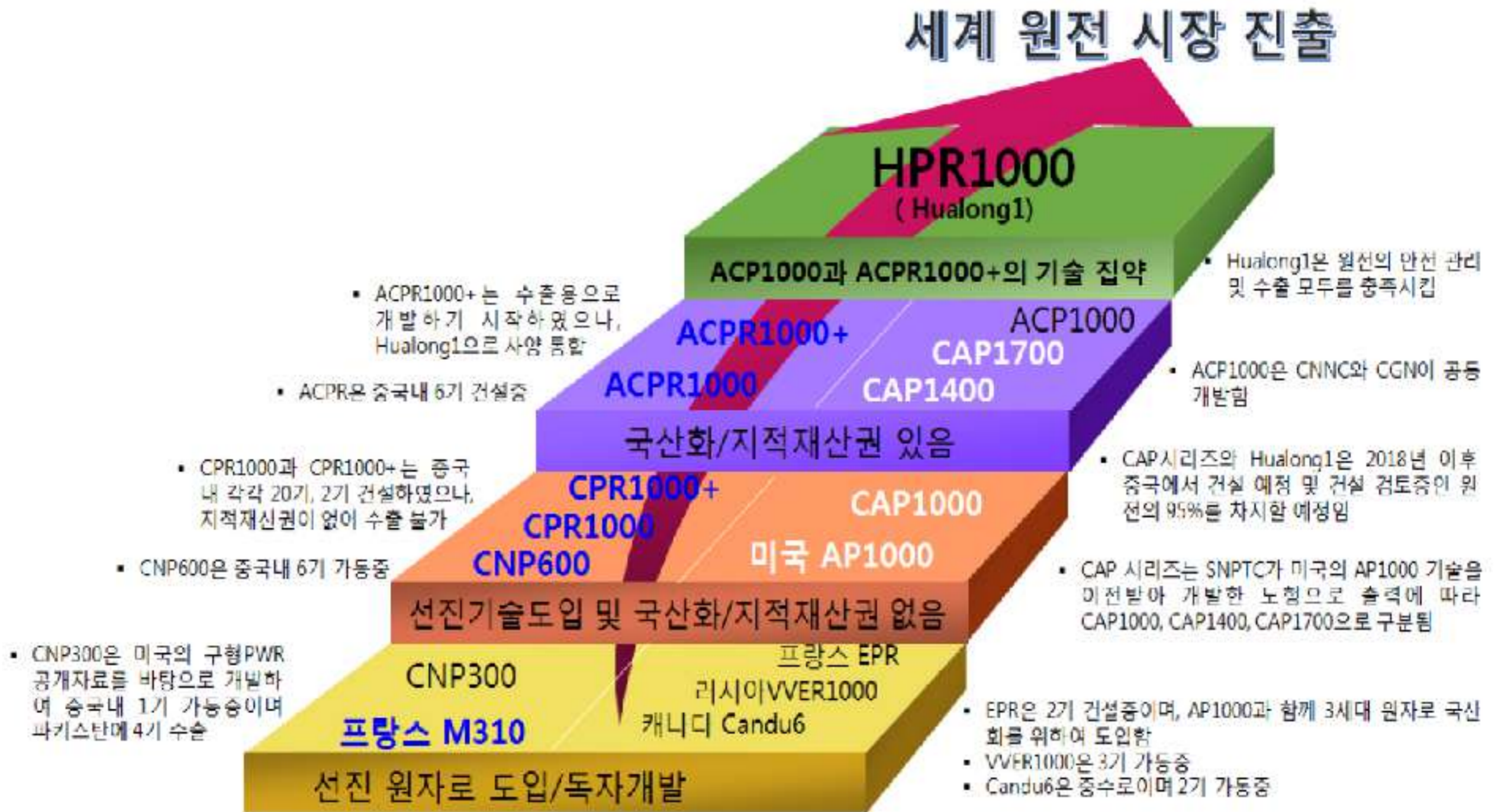
KEPCO, South Korea's energy company, is facing a domestic backlash against nuclear power,

while **Westinghouse**, in America, is only now emerging from bankruptcy.

Russia's only real competitor is **China**, another country where government and business are tightly entwined.



China's NPP Development



윤성원, 한준규, & 김연중, “중국의 원자력 정책 및 연구개발 현황,” 원자력정책 *Brief Report*, 2018-3호 (통권 46호), 한국원자력연구원.

사우디 원전 수주 경쟁력 평가

- 러시아



- Full fuel cycle
- Strategic bundling
- Strong oil & gas relations
- Financing stretched
- Iran/Syria

- 중국



- Attractive pricing
- Fuel cycle offer with mining
- Largest oil customer
- Quality concerns

- 프랑스



- Longstanding relationship
- Ongoing human capital exchanges
- Fuel capabilities
- Technology weakness

- 한국



- Strong domestic/construction record with good UAE reference plants using proven U.S. and ROK technology;
- Challenging domestic policy optics

- 미국



- Strong bilateral security relationship with Saudi Arabia
- No recent plant delivery successes
- Policy questions regarding nuclear cooperation agreement

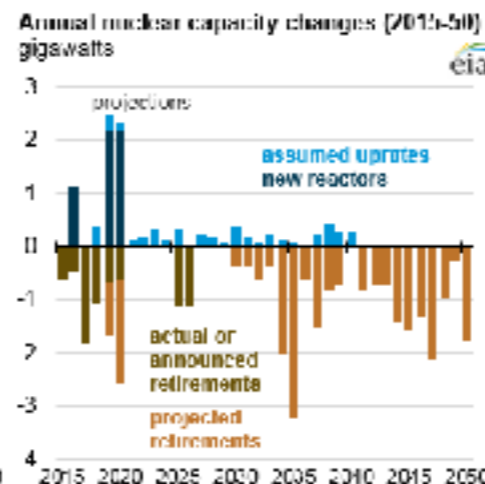
IP3, "State of the Saudi Atomic Energy Market," *Special Summit on Global Energy Markets*, U.S. Nuclear Industry Council, July 18, 2018.



4. U.S. Context

미국의 원자력 현황: 위기와 몰락의 지속

- **원전 경쟁력 약화로 조기 폐쇄 및 신규 원전 건설 불투명**
 - 값싼 천연가스, 보조금을 받는 신재생에너지와의 경쟁력 약화
 - 2004년 이후 전력수요 非 증가, 장기간 많은 자본 투자, 원전 건설 지연 등
- **원자력 산업(인프라) 및 원전 건설 능력의 붕괴 가속화**
 - WH 파산(bankruptcy) 신청('17.3): Vogtle, V.C. Summer 건설 영향
 - 농축 능력 상실 가속화: USEC 몰락('14) → CENTRUS Energy 재정 악화
- **사용후핵연료 관리 정책 미비**
 - 유카산 처분장 사업 취소로 갈 곳 잃은 사용후핵연료 증가
- **국제 원전 시장에서의 주도권 및 기술리더십 쇠락 지속**
 - 자원조달을 무기로 중국, 러시아의 원전 수출시장 점유 증가



미국 원자력 정책 전망과 과제

- **전반적으로 원자력 발전 지지: All-of-the-Above**

- Make America Great Again 철학 하에 원자력 부흥 필요
- 에너지 자립을 위한 핵심 에너지원으로서 장기 에너지 전략에 포함

- **원자력 산업/수출 부활 노력**

- 미국 경제 및 고임금의 일자리 창출에 기여
- 트럼프 행정부의 보조금 폐지 주장, 화석연료 산업 부흥과의 형평성 등의 차원에서 추가 인센티브 제공은 미지수

- **유카산 사용후핵연료 처분장 사업 재개의 적극 추진**

- 정치적 이유로 취소된 오바마 유산(Legacy) 지우기
- 원자력 산업계의 강력한 요구, 방폐 담당부서의 복원, 예산 배정 등

- **기술리더십 회복 노력을 위한 원자력 연구개발 투자 강화**

- 공화당 정부, 의회의 지지와 함께 산업계의 강력한 요구
- Global leadership 회복: 선진 원자로 및 핵연료주기

Presidential and Departmental Nuclear Energy Priorities

- President Trump ordered review of nuclear energy policy:

"[W]e will begin to revive and expand our nuclear energy sector... which produces clean, renewable and emissions-free energy. A complete review of U.S. nuclear energy policy will help us find new ways to revitalize this crucial energy resource."

- Commercialization of advanced SMRs crucial to future of US nuclear sector
- Executive Order Promoting Energy Independence and Economic Growth
- Nuclear energy role as clean baseload power is key to environmental challenges:

"If you really care about this environment that we live in... then you need to be a supporter of this [nuclear energy] amazingly clean, resilient, safe, reliable source of energy."
Secretary Rick Perry at Press conference, May 10th

- Make nuclear cool again and inform citizenry regarding nuclear energy's attributes



John W. Herczeg, "Office of Nuclear Energy Program Overview,"
36th Meeting of the US-ROK JSCNEC, April 11, 2018.

Summary

- The demand for domestically-generated, reliable, and clean sources of base-load electricity will continue to drive many countries toward nuclear energy as part of their “energy security” and national economic and environmental calculus.
- Profound opportunity for new nuclear growth:
 - Strong global market interest
 - Growing need for increased global access to electricity
 - Support energy security, economic and environmental goals
 - U.S. leadership to ensure safety & nonproliferation are as important as ever
- The Administration is committed to advancing nuclear energy in the United States and abroad.

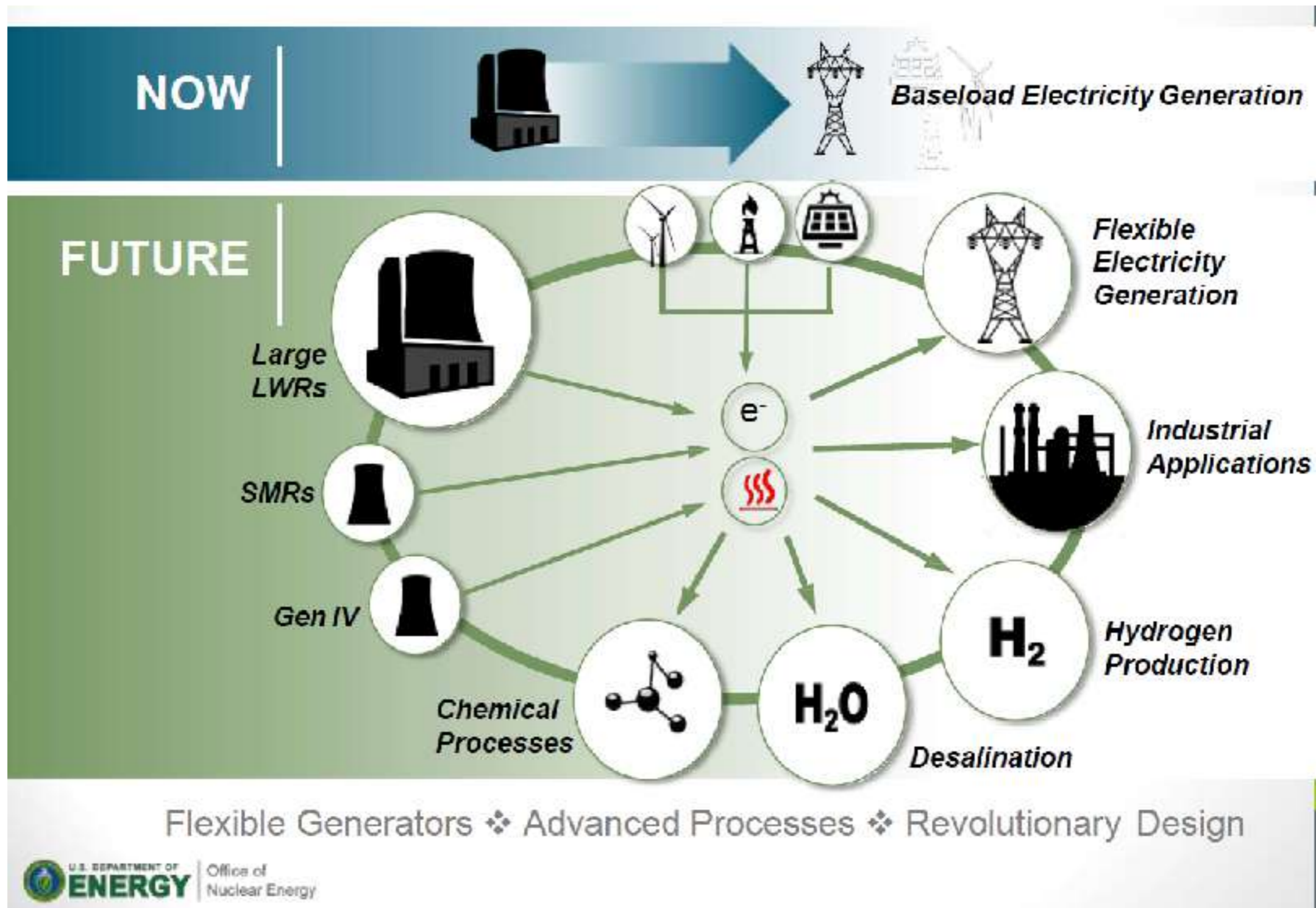
“Nuclear energy is a critical component of America’s energy future, and entrepreneurs are developing promising new technologies that could truly spur a renaissance in the United States and around the world.”



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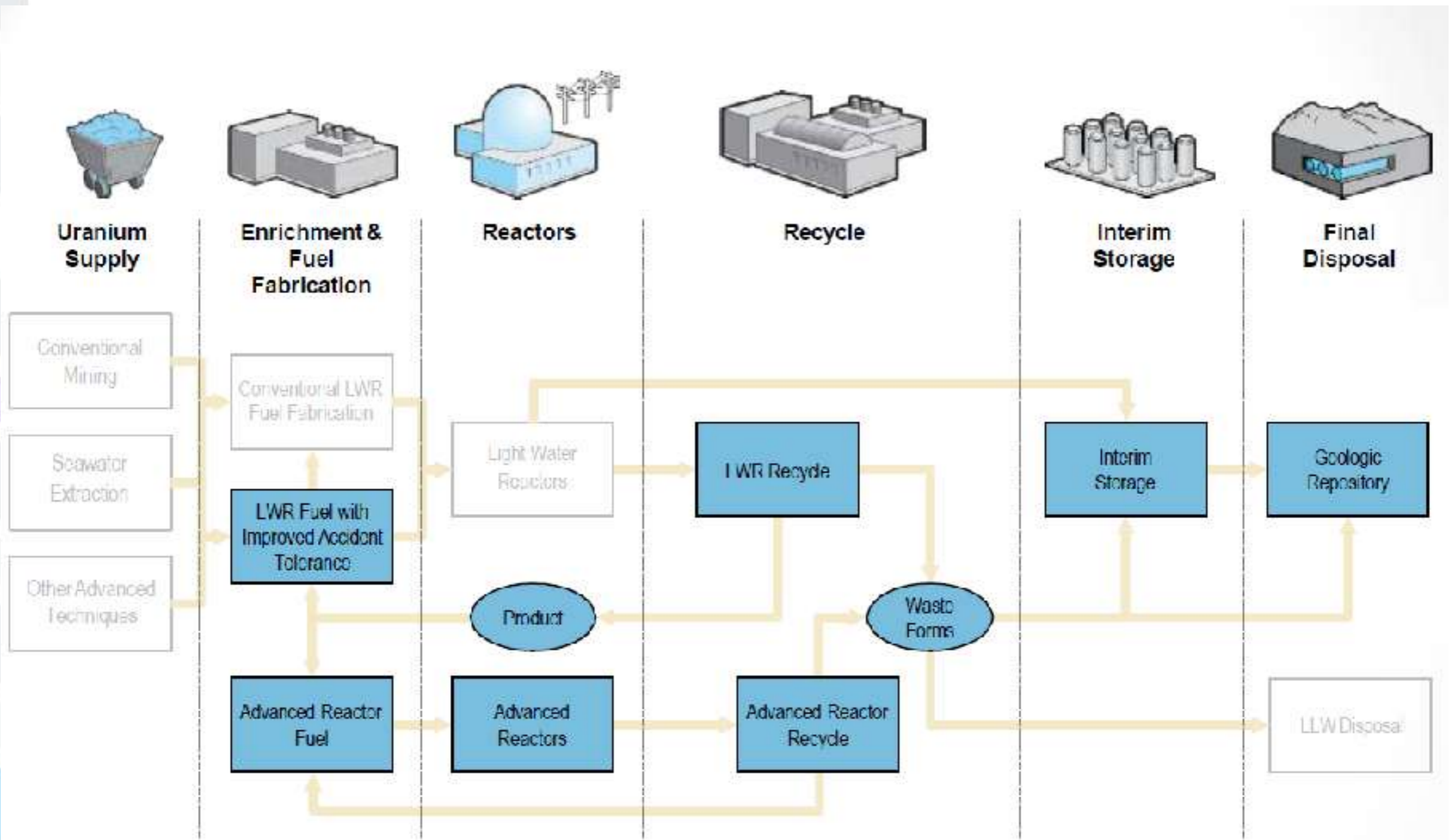
John W. Herczeg, “Office of Nuclear Energy Program Overview,”
36th Meeting of the US-ROK JSCNEC, April 11, 2018.

U.S. DOE : Advanced Reactors



Bradley Williams (DOE), "U.S. Nuclear Energy Program," *NCSL Nuclear Legislative Working Group Forum*, Nov. 15, 2017.

U.S. DOE : Fuel Cycle R&D



Bradley Williams (DOE), "U.S. Nuclear Energy Program," *NCSL Nuclear Legislative Working Group Forum*, Nov. 15, 2017.

Big Concerns of the U.S.

Whither “Dominance” by 2030?...

We do not want to live in a world where Russia and China “dominate” Nuclear Energy... **but that is the trajectory.**



<http://thebricspost.com/china-russia-sign-raft-of-agreements-after-xi-putin-talks/#.W0uWrmBKJIU>

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Andrew Paterson, & Walter S. Howes, “Reviving and Expanding Nuclear Energy: MegaTrends for GIGA-Deals,” *Special Summit on Global Energy Markets*, U.S. Nuclear Industry Council, July 18, 2018.

123 Agreements with Middle-east Countries

- **UAE**

- 2009년 서명 및 발효
- 중동지역에서의 원자력발전 최초 인정
- Gold Standard 적용

- **요르단**

- 2007년 협상 착수
- Gold Standard 문제로 협상 중단 상태

- **사우디아라비아**

- 2012년 협상 착수
- 진전이 없다가 최근 협상 재개했으나 아직 미타결
- 현안 : Gold Standard, 추가의정서(AP)

미국 정책에 대한 미국 전문가의 권고

SUMMARY: Nations see Nuclear as a Geo-Strategic Olympic Competition among Sovereigns for \$Billions

- **More than 90% of nuclear projects are overseas through 2035. [2050?]**
- **Most Customers are Sovereign Governments (National Power Agencies).**
- **Increasingly Competitors are also Sovereign Nuclear Entities**
 - Despite our “Market First” orientation; others do not compete that way
 - Nuclear Energy is an element of Foreign Policy with Vendor financing
 - Deals are signed by Presidents of Sovereigns for Geo-Strategic impact
 - Sovereigns are *coupling* Nuclear with other sectors: Defense, Transport, Energy
- **USA must decide: merely “participate”, or **WIN** at “Nuclear Olympics”.**
- **Without NEW construction, value of USA experience withers.**
- **Winning requires stronger, deeper alliances, “not USA alone”.**
- **For more value for export, SMRs and AdvRs must be built sooner.**
- **Exporting requires passage of the BUILD Act (financing)**
- **Bring the Financing, or go home. Private Banks are shy on nuclear**
 - Revival and expansion of Ex-Im Bank + OPIC + DOE lending for factories and fuel

Andrew Paterson, & Walter S. Howes, “Reviving and Expanding Nuclear Energy: MegaTrends for GIGA-Deals,”
Special Summit on Global Energy Markets, U.S. Nuclear Industry Council, July 18, 2018.



5. Future Directions

Summary

- **한미 양국 공히 어려운 상황으로 탈출구 필요**
 - 한국: 에너지전환정책과 원자력 수출 양립
 - 미국: 원전 공급 능력 및 경쟁력 저하
- **세계 원자력산업계 판도 변화**
 - 미국, 프랑스, 일본의 쇠퇴와 러시아, 중국, 인도의 부상
 - 한국에게는 위기이며 기회
- **한미 관계의 진화**
 - 일방적 지원 및 통제 관계에서 파트너십 관계로 발전
 - 서로 필요로 하는 시점
- **한미 원자력 파트너십 강화 필수**
 - 상호 약점 보완, 상호 강점의 시너지 효과
 - 한미 동맹 강화

한미 양국의 강점

● 미국

- Accumulated knowledge and expertise
- Public understanding on nuclear energy
- Interest for SMR's and advanced reactors
- Global political influence
- Financing capacity
- Brand Power

● 한국

- Robust nuclear industry with sound supply chain
- Skilled and educated manpower and up-to-date experience
- Role model for nuclear energy development
- International cooperation with newcomer countries

지금까지 쌓아온 브랜드 가치를 갖고 있는 **미국의 Soft Power**와
지속적인 원전 건설로 세계 수준의 원전 건설 능력이 있는 **한국의 Hard Power**로
한미 양국이 “Win-Win“ 할 수 있는 파트너십 구축 기회



Future Directions

- **Maintain the Momentum of Current Collaboration**
 - Maintain the spirit of new ROK-US 123 agreement
 - JSCNEC, JFCS, HLBC, ...
- **Strengthen Mutual Confidence**
 - Clear recognition of the situation facing two countries
 - Clear understanding of strengths and weaknesses of each country, and benefits from the partnership
- **Expand Collaboration in a More Strategic Way**
 - **NPP Export**; Nuclear Safety; Nuclear Nonproliferation and Security; Decommissioning of Nuclear Facilities; Spent Fuel Management; Advanced Reactor Development, ...
 - Reasonable share of work and benefits



Messages to U.S. Opinion Leaders

- **ROK shares the nuclear energy vision with the U.S.**
 - Especially peaceful uses, nonproliferation, and nuclear export
- **It is essential to clearly recognize the situation facing two countries and understand the synergy effect from the ROK-US partnership.**
 - ROK nuclear industry is still competitive enough to win Russian and Chinese industry, which is already demonstrated in the Barakah NPP project.
 - Domination of Russia and China in the global NPP market will raise concerns to ROK as well as to the U.S.
- **ROK industry is ready to have strategic alliance with U.S. industry, together competing to Russia and China.**
 - Reasonable sharing of work and benefits
 - In case that the U.S. could not conclude 123 agreement with the KSA, ROK is an only alternative against Russia and China.
- **Both ROK and U.S. governments need to support fully and play an important role of mediator and/or coordinator.**
 - Various governmental channels

발표 자료 - 변준연 회장



Status of UAE BNPP Project

I. Project Overview

Project Scale	EPC, 4 Units of Korean NPP(APR1400) (Total 5,600MW)
Contract Price	About USD 18.6 billion
Project Owner	ENEC (Emirates Nuclear Energy Corporation)
Workscope	EPC + Operation Support + Fuel Supply for 4 Units of NPP(1,400MW)
Site Location	Barakah, about 270km west of Abu Dhabi

II. Progress status

- The overall progress rate for all 4 Units is 90% as of end of Aug 2018, and progressing in accordance with the planned schedule.

Units 1&2	Units 3&4	Overall
97%	81%	90%

* Progress rate for Unit 1: 98%

III. Project Overview

- a. Unit 1 Construction work was completed (Oct. 2017), and Fuel Load is in preparation
 - b. Unit 2 Hot Functional Test(HFT) was completed (Jun. 2018), and system turnover is in progress
 - c. Unit 3 Initial Energization was completed (Apr. 2018), and commissioning test is in progress
 - d. Unit 4 Reactor Top Dome was installed (Apr. 2018), and mechanical and electrical works are in progress
- ▣ KEPCO's workscopes were completed for nuclear fuel delivery (Mar. 2017) and construction workscope (Oct. 2017).
 - ▣ UAE to complete Operational Readiness, receive Operating License from regulatory body(FANR), complete Fuel Loading, then conduct Power Ascension Test(PAT) up to the Substantial Completion Date.

IV. Nawah announces revised schedule for UAE NPP Unit 1

- ▣ **(press release 26 May 2018)** Considering safety as the top priority, and the period required to complete Operating Readiness and receive approval from regulatory body, Unit 1 Fuel Loading Schedule was revised
[from May 2018 → to End of 2019 ~ Early 2020]

V.UAE project's implication for the Saudi reactor

- The UAE BNPP by KEPCO has been swiftly progressing since KEPCO's winning of the project in 2009.

The project, also known as the only NPP project in the world to construct four units of NPPs simultaneously, has been successfully implemented on time and on budget. As of November 2018, the completion rate of the first unit of the UAE BNPP is about 98% with construction and commissioning already complete, and is waiting for its Operating License.

The following units are projected to be constructed consecutively on time in a one-year interval.

- Through the UAE Project which is conducted in a similar environment to that of Saudi Arabia, KEPCO has accumulated abundant experiences including design changes that reflect the site specific conditions such as high temperature sea water, ambient air conditions, etc.;

Overcoming environmental challenges like the sand storm and extreme heat;

Active and meticulous project management such as long-distance delivery, third country national management and HSE management, etc.

KEPCO is able to make the best of its accumulated experiences and upgrade them to reduce trial-and-errors of the project to ensure the successful implementation of the Saudi Arabia Nuclear Project

Potential business cooperation between WEC and KEPCO

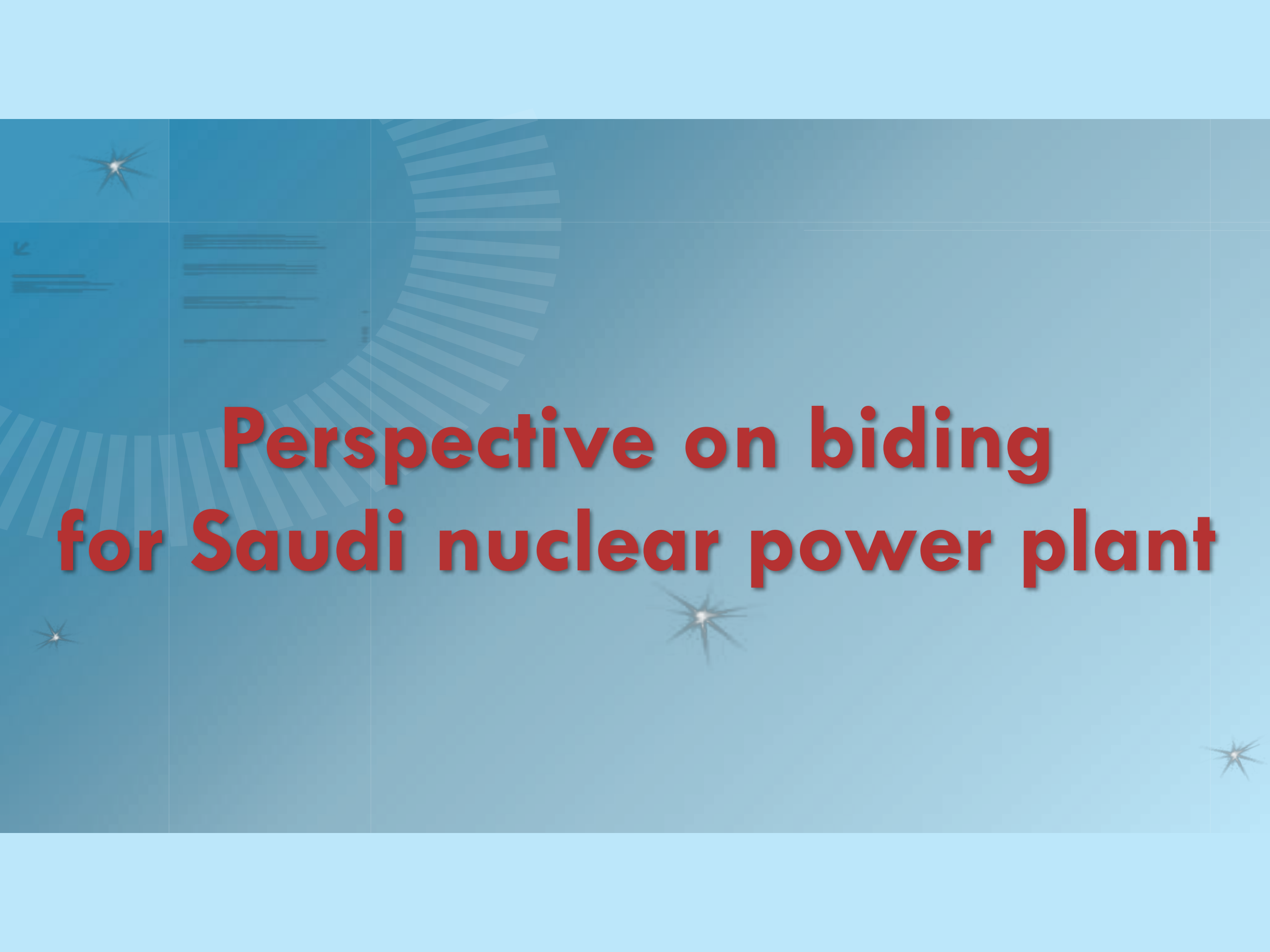
- In case the other party's reactor are exported to third(3) countries -

I. Westinghouse's potential scope based on Korea reactor model APR 1400

1. RCPs (100%)
2. MMIS (100%)
3. RVIs(50%) and CEDM(50%)
4. Zirlo TREX (100% Zirlo tubing manufacture and 100% Zirlo coil)
5. Fuel Rods including tubing (50%)
6. Refueling Equipment (100% to be split between Westinghouse and Doosan)
7. Spare Parts for 100% of Westinghouse scope above
 - 2 year base supply as part of initial delivery

II. KEPCO's potential scope based on W reactor Model AP 1000

1. Architect Engineering and design work other than Westinghouse's scope
2. RV(100%), S/G(100%), PZR(100%), CV(100%)
3. RVIs(50%), CEDMs(50%),and NSSS auxiliary (50%)
4. T/G (60 HZ only) (100%)
5. Some parts of BOP
6. Construction and installation
7. Fuel Rods including tubing (50%)
8. Spare Parts for 100% of KEPCO scope above
- 2year base supply as part of initial delivery
9. Participation in project financing



**Perspective on bidding
for Saudi nuclear power plant**

I. Project overview of Saudi Nuclear Power Plant

1. Project overview

- **C l i e n t** : Royal Nuclear New & Renewable Energy Resources (KACARE)
- **Scale of business** : Two 1,400MW class will be introduced by 30 years
- **Bidding method** : Restricted Competitive Bidding (Korea, USA, Russia, France, China)
- **Project schedule**
 - **June. 2018** : Announced short-list operator
 - **July. 2018** : Submission of intention to participate in Saudi NPP project bid (KA CARE)
 - **September to December 2018** : Submit the four(4) priority area of evaluation
 - localization / manpower resource development / project financing / contract structure & mechanism
 - **January. 2019** : Signed project Development Agreement (PDA)
 - **Mid term of 2019** : Design Optimization and Project Implementation Plan Submission
 - **The second half of 2019** : Select the final operator

II. Competitor Activities

1. Background to the selection of five preliminary companies as short-list

Saudi Arabia has been burdened with continuing delays in short-list announcements amid prolonged discussions on the US-Saudi nuclear agreement and delayed preliminary site survey .

- As a preliminary operator, all five countries will be selected to secure time enough for further negotiations and to be used as a means of enhancing negotiating power through competition in five countries.

2. Competitor activities , Strength and



- Recent activities

: Rick Perry, Minister of Energy, emphasized that the US-Saudi nuclear cooperation agreement should be concluded at an early date to prevent nuclear proliferation in the Middle East and to export Saudi nuclear power plants.

- **Strength**
: Strong ties with Saudi Arabia to actively support the government 60% of the world's nuclear power plants are based on US technology

- **Weakness**
: US-Saudi 123 Delay in signing the Agreement (Nuclear Cooperation Agreement)
: Lack of long-term nuclear plant construction experience and weakening of supply chains
: Financing difficulties in financing nuclear policy WEC expected
: WEC bankruptcy protection after incomplete recovery procedures



□ Russia

- Recent activities

- : Saudi Prime Minister Salman visited Russia during the World Cup and discussed energy policies between the two countries
- : President Rosatom, Visit to Saudi Arabia and meeting with the new Chairman of K.ACARE / Minister of Energy

Strength

- : Government-led strong nuclear export policy and funding support
- : uranium enrichment . Transfer of nuclear material reprocessing technology
- : Various cooperation packages linked with resource and logistics support

Weakness

- : Reduced funding ability by concurrently running many overseas projects
- : Construction of the same model nuclear power plant in Iran, which is a relationship with Saudi Arabia

□ China



- Recent activities

: Saudi-Chinese inter-enhanced energy ministers meeting and Vision2030 related energy and economic cooperation

agreement

- Strength

h

: Adoption of a national strategy to support government-funded financing

: Ensure low construction costs continue to domestic nuclear power plant construction. Build a solid supply chain

: China is the largest importer of crude oil in Saudi Arabia, Long-term ties in the oil sector

: Signed by Saudi Arabia and the hot gas and uranium, thorium joint development agreement

- Weakness

ss

: Low reliance on China's nuclear power plant construction and construction quality

: US-China inter-species likely to have an underlying political tensions and trade disputes have a negative impact

(Analysis that China's cutting-edge technology is a measure to prevent global market domination)

□ France



- Recent activities

- : Saudi Arabia signed a K.A.CARE French nuclear engineering company and site investigation contract to undertake the construction site investigation and characterization services
- : The president of France EDF is K.A. Conducting CARE director interview

- Strength

- : Order development activities under full support and intervention of the French government
- : Total solution from uranium mining to post treatment

- Weakness

- * : Declining competitiveness in terms of construction cost
- : Increased financial risk due to delayed construction projects in your home country and Finland (France Flamanville - 6 year delay, Construction costs doubled, Finland Olkiluoto3 - 10 years delay, construction costs 3 times increase)



□ Korea

- Recent activities

- : Form of Nuclear Export Strategy Council and Open of Saudi Nuclear Project Support Center
- : Submission of intention to participate in Saudi NPP project bid (KA CARE)
- : Team Korea held comprehensive road show (Saudi)
(October – Nuclear Forum, B2B meeting and promotion)

- Strength

- : Experience & Lesson learned From UAE Nuclear Project in Middle East
- : Qualified & robust Nuclear Supply Chain
- : Competitive Project price by repetitive constructing over 40 years

- Weakness

- : Lack of fuel cycle service in enrichment & reprocessing
- : Lack of project financing arrangement and supporting



**Cooperation plan
for third(3) countries export
between Korea and UAE**

I. Cooperation between Korea and UAE for third(3) countries

- In connection with all THIRD COUNTRY nuclear power projects, KOREA shall play the leading role in consultation with UAE, (i) in the negotiations with the project owner, contractors and subcontractors, and other related parties; (ii) in the selection of contractors including EPC, operation support and maintenance contractors; and (iii) in resolution and decision on issues arising in the course of performance of tasks in the construction, operation and subsequent phases.
- UAE agrees to provide marketing and public relations support in connection with THIRD COUNTRY nuclear power projects based on the KOREAN REACTOR TYPE, including the Saudi Arabia project.
- UAE agrees to provide cooperation and support during construction and operation stages through active participation, in connection with THIRD COUNTRY nuclear power projects based on the KOREAN REACTOR TYPE, including the Saudi Arabia project.

II. Joint marketing activities for nuclear power projects for third(3) countries

- (KOREA and UAE) Invitation of high-ranking officials of the THIRD COUNTRY to major events relating to the Barakah Project.
- (KOREA and UAE) Support for establishment and operation of a “Joint Nuclear Export Promotion Committee” between the governments of the Republic of Korea and the United Arab Emirates to secure government support for participation in nuclear power projects in THIRD COUNTRIES.
- (UAE) Financing support of nuclear power projects in THIRD COUNTRIES through available resources including Mubadala Investment Company.

III. Construction phase of nuclear power projects in third(3) countries

- (KOREA and UAE) Sharing and delivery of the Parties' collective experience from the Barakah Project, including design modifications reflecting the unique environmental and site characteristics of the relevant region (e.g. higher temperatures and drier air).
- (UAE) Especially, in relation to projects in the Middle East and North Africa (MENA) region, support for gradual human resource development for the THIRD COUNTRY, taking advantage of the similar language background and established education system of the UAE.
- (KOREA and UAE) Joint preparation and implementation of operation readiness programs, including start-up manuals and operational organization.
- (UAE) Especially, in relation to projects in the MENA region, sharing and delivery of experience in licensing and regulatory matters relating to the Barakah Project in the construction phase.

IV. The operation phase of nuclear power projects in third(3) countries

- (KOREA and UAE) Sharing and delivery of the Parties' collective experience relating to start-up and operation of the Barakah Project
- (KOREA and UAE) Ensuring recovery of the Parties' investments, through equity participation or otherwise, in the nuclear power project of the THIRD COUNTRY.
- (UAE) Especially, in relation to projects in the MENA region, support for the establishment of a system for provision of human resources and materials necessary during operation of the nuclear power plant, including dispatch of nuclear experts and maintenance experts.
- (UAE) Especially, in relation to projects in the MENA region, sharing and delivery of experience in licensing and regulatory matters, and support for establishment of a system for exchange of technologies relating to operation and regulation. In particular, support for safety enhancement activities such as sharing the emergency plan relating to operation of the nuclear power plant, and design modifications for safety enhancement may be considered.