



**IAEA**

International Atomic Energy Agency  
*Atoms for Peace and Development*

# Activities of the Department of Nuclear Energy and the Future of Nuclear Power

**Mikhail Chudakov**

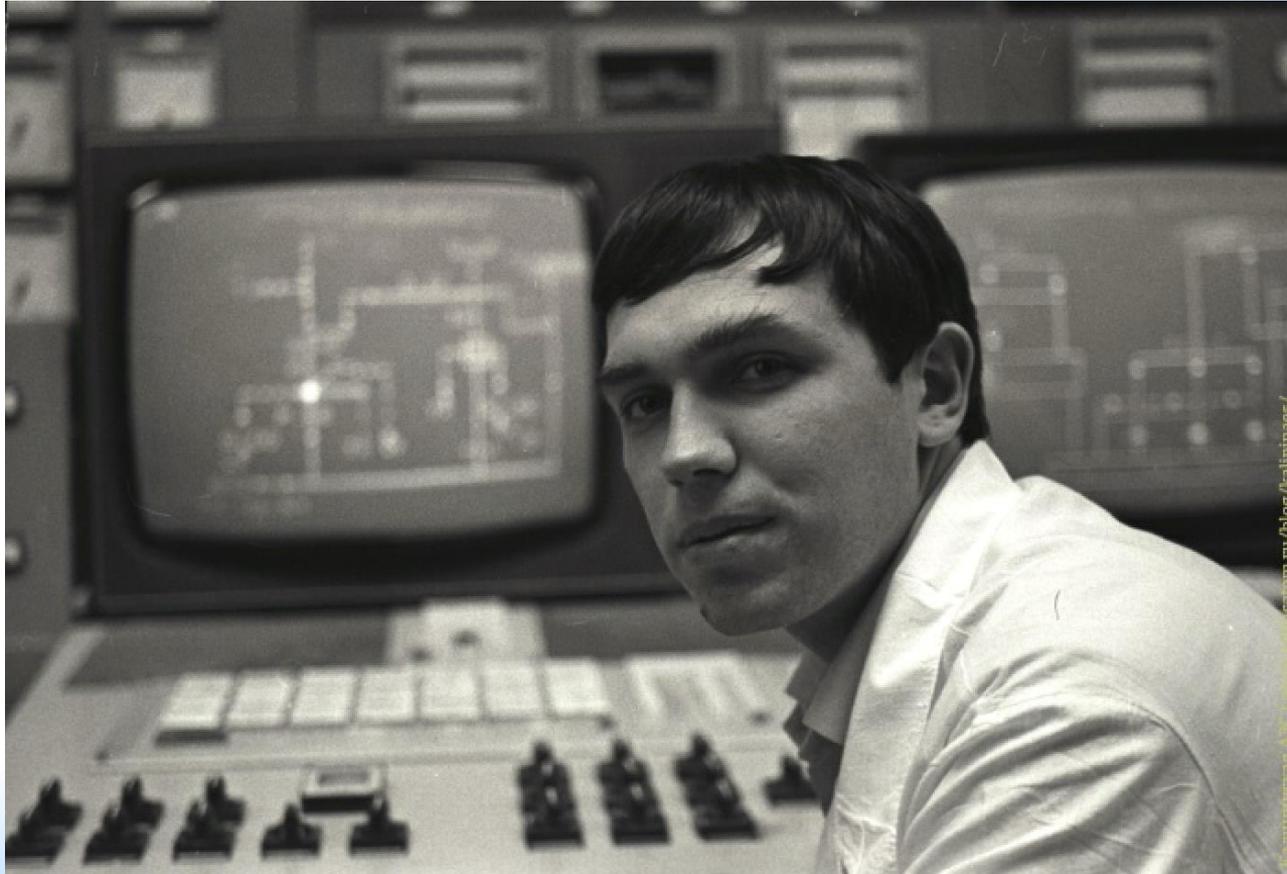
IAEA Deputy Director General

Head of the Department of Nuclear Energy

65 Years of Peaceful Nuclear Energy and Launch of the Obninsk NPP

June 2019

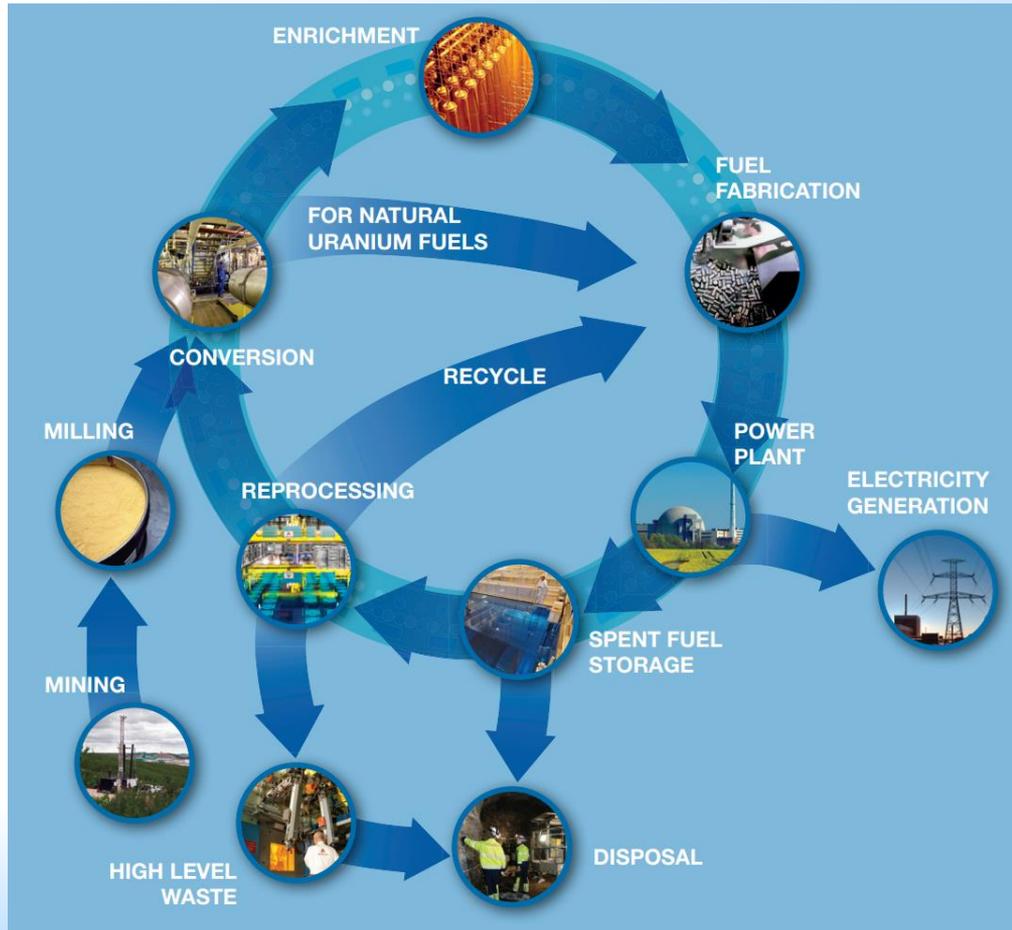
# 36 years ago...



# Russia's Nuclear industry



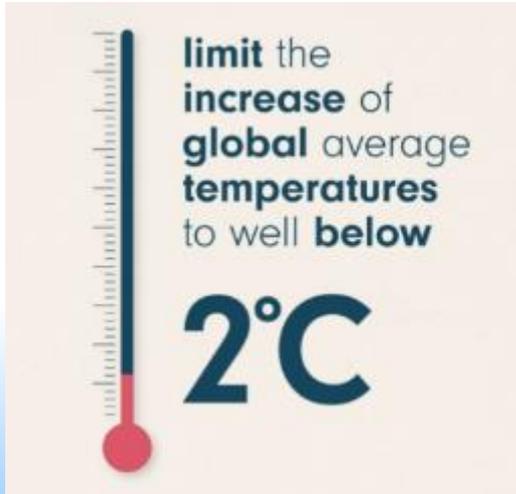
# Nuclear fuel cycle



# Energy access



# SDGs & Paris Agreement



# 1.5°C Challenge

**TODAY**

**70%**

of electricity  
comes from  
**burning fossil fuels**



**2050**

≈ **80%**

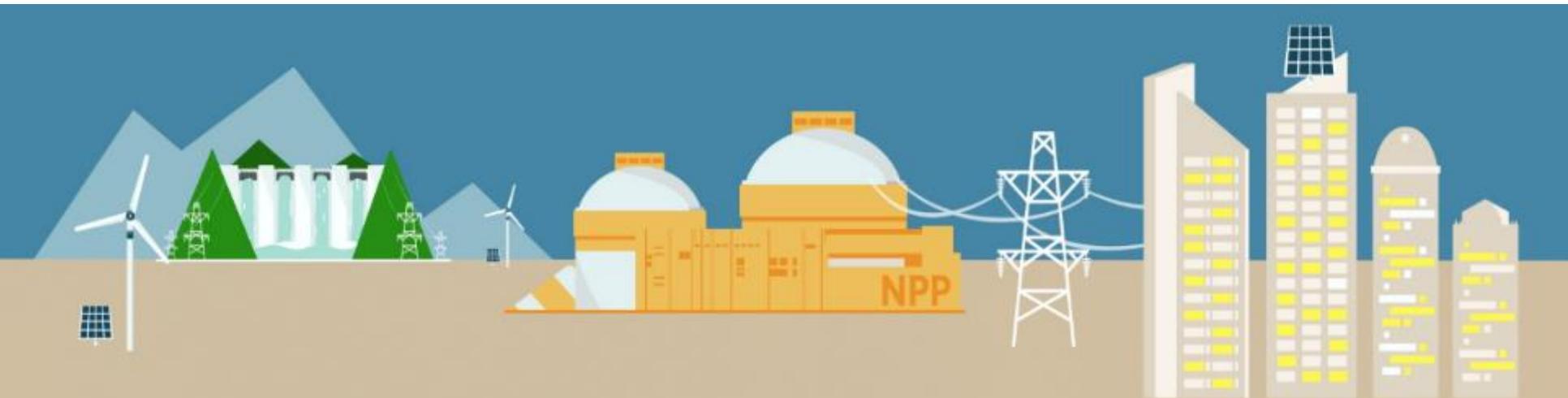
of electricity  
will need to be  
**low carbon**



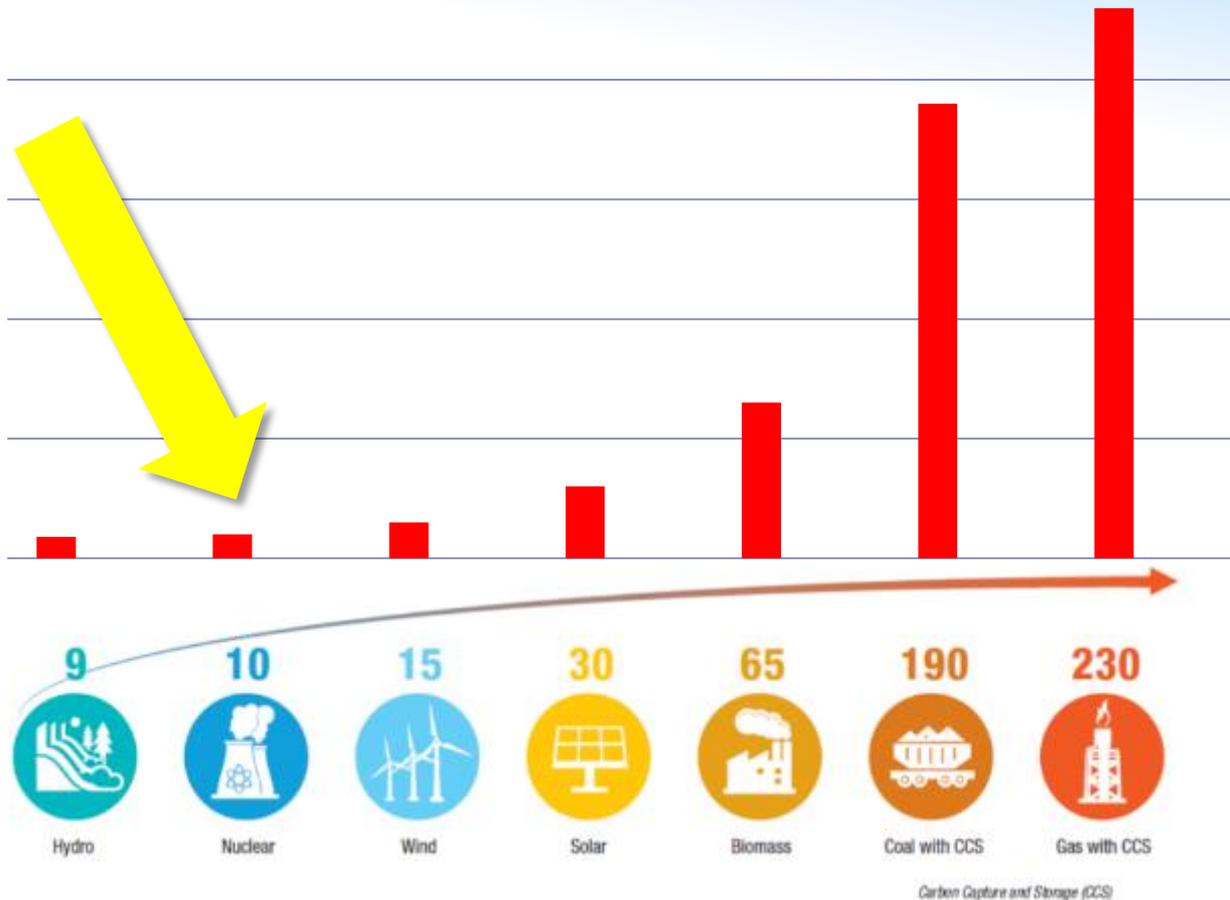
# Low carbon mix

“...without significant progress on using the full potential of nuclear power, it will be difficult for the world to secure sufficient energy to achieve sustainable development and to mitigate climate change.”

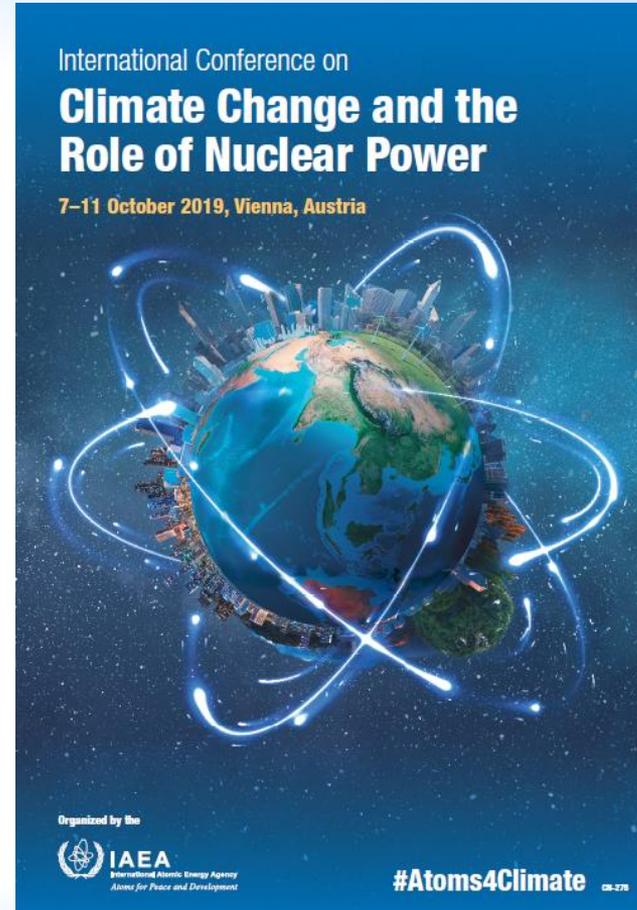
Yukiya Amano, IAEA Director General



# Life cycle GHG emissions



# Climate Change & Nuclear Power



# NP Reactors

(24 June 2019)



**449 in operation**



**398 GW(e)**



**54 under construction (2/3 in Asia)**



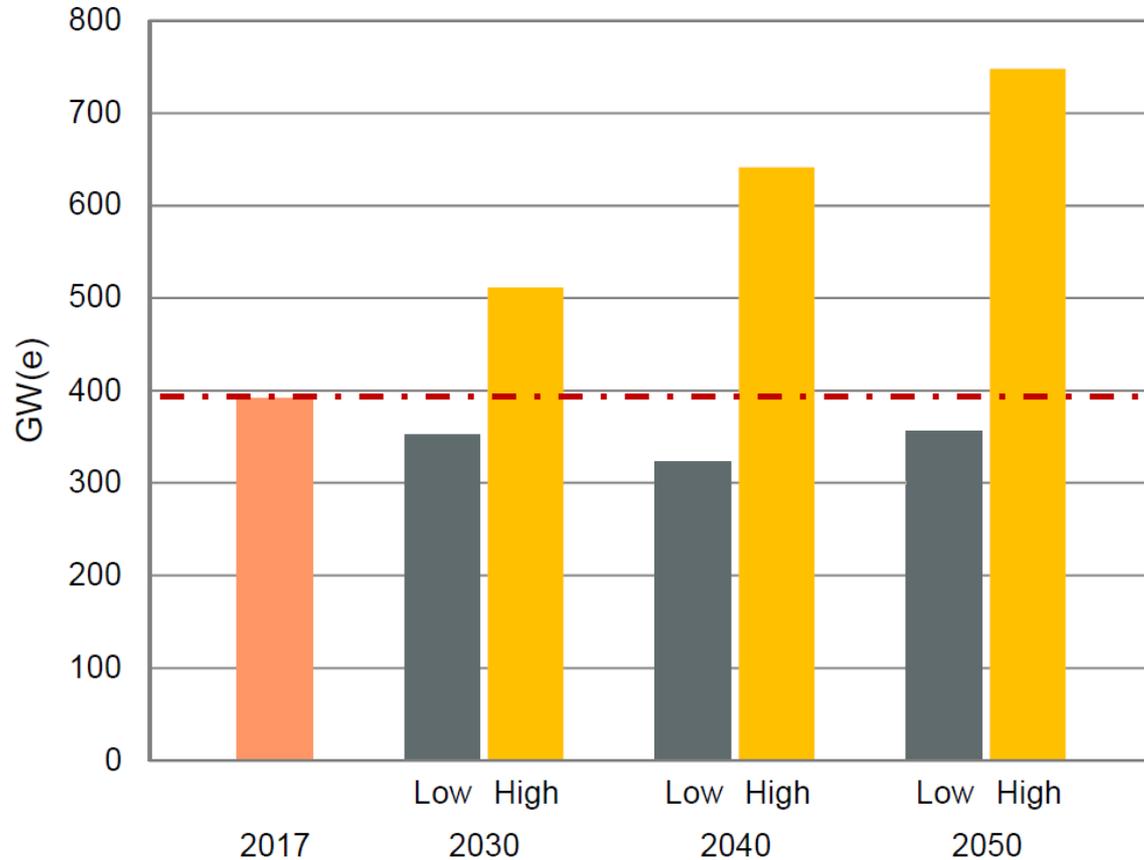
# Nuclear power



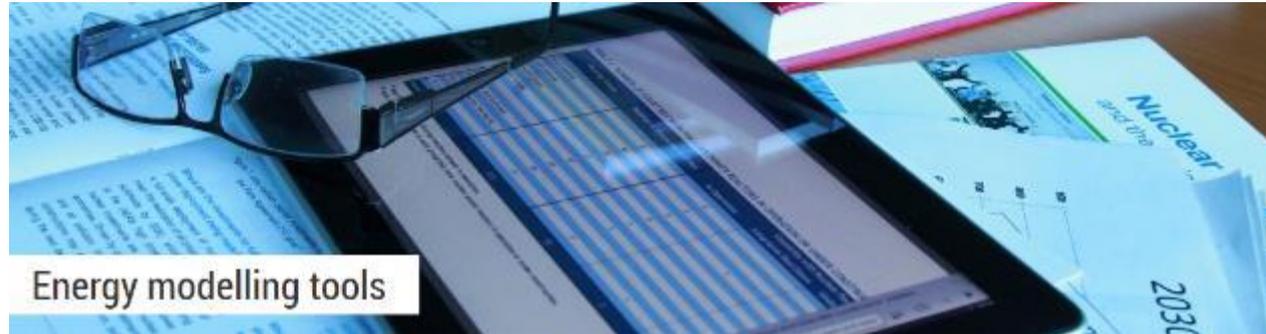
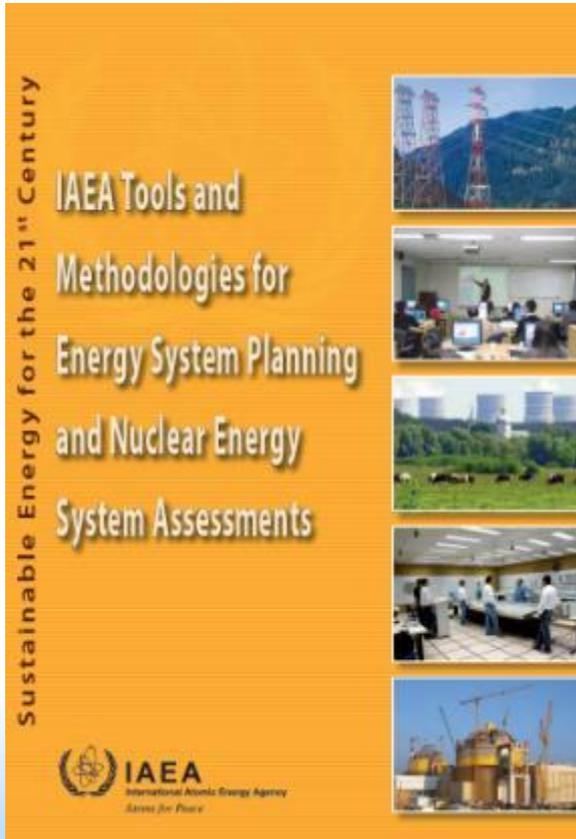
**1/3**

**low carbon  
electricity**

# IAEA Projections



# Energy Planning & Analysis



**148 Member States**  
**21 Regional & Int'l Organizations**

# IAEA & Newcomers



**“It is each country’s sovereign decision whether to add nuclear power to its energy mix.**



**For those who choose to do so, the IAEA role is to help them build the expertise to use nuclear power safely, securely, and sustainably.”**

**Yukiya Amano  
IAEA Director General**

# Assistance to Newcomers

## MILESTONE 1

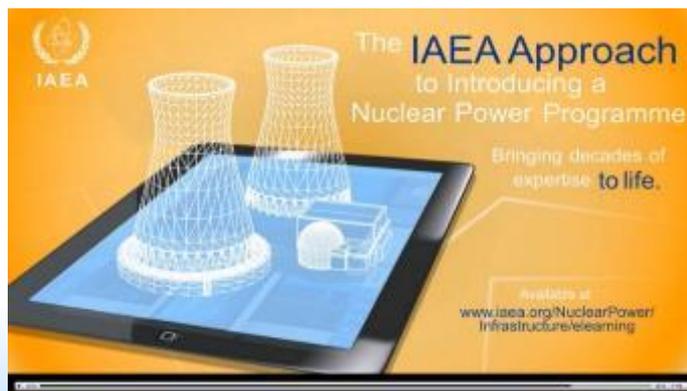
Ready to make a knowledgeable commitment to a nuclear power programme

## MILESTONE 2

Ready to invite bids/negotiate a contract for the first nuclear power plant

## MILESTONE 3

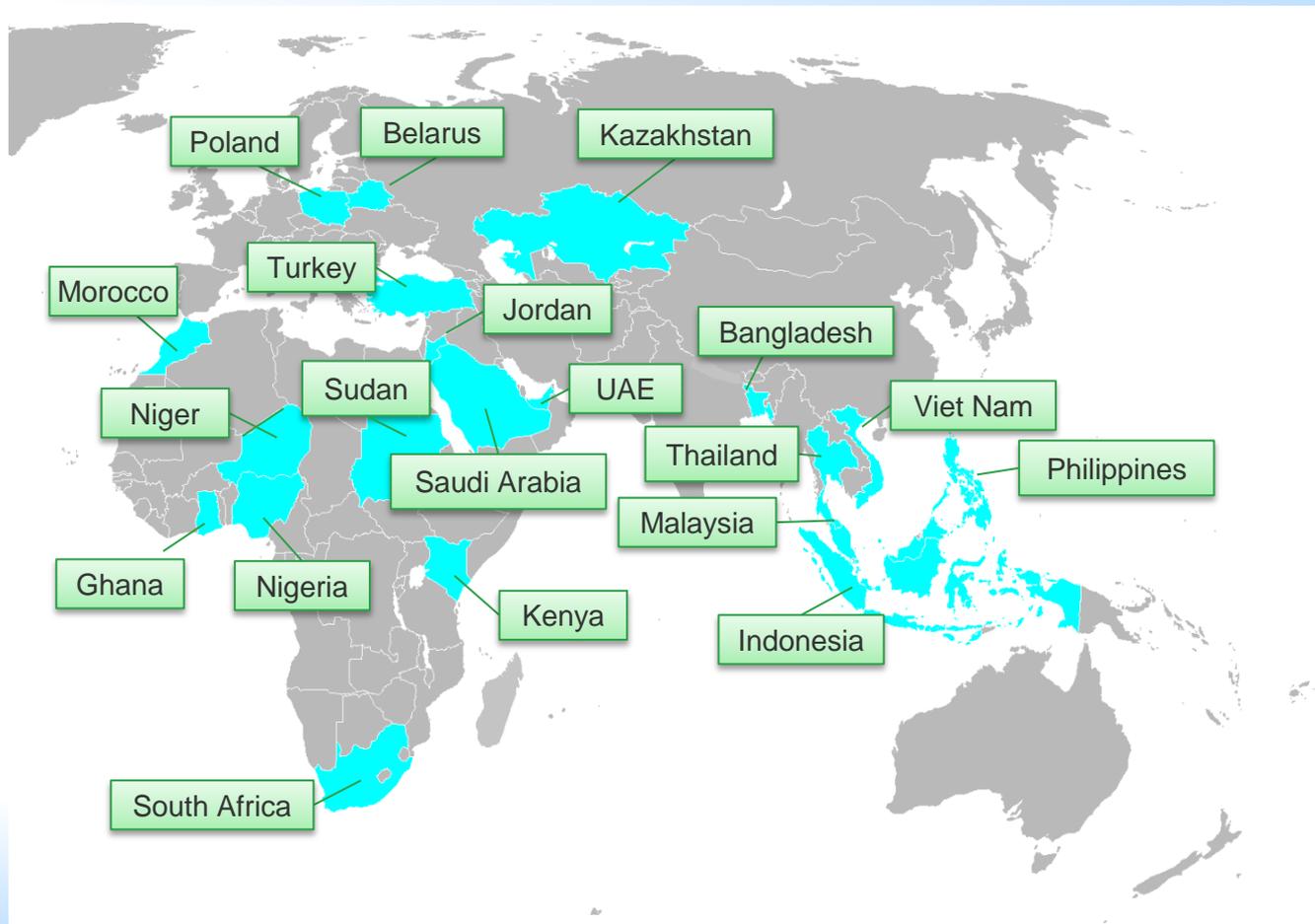
Ready to commission and operate the first nuclear power plant



# 27 INIR missions, 20 MS



1. Jordan (Phase 1) 2009
2. Indonesia (Phase 1) 2009
3. Viet Nam (Phase 1) 2009
4. Thailand (Phase 1) 2010
5. UAE (Phase 2) 2011
6. Bangladesh (Phase 1&2) 2011
7. Jordan follow-up 2012
8. Belarus (Phase 1&2) 2012
9. Viet Nam (Phase 2) 2012
10. Poland (Phase 1) 2013
11. South Africa (Phase 2) 2013
12. Turkey (Phase 2) 2013
13. Jordan (Phase 2) 2014
14. Viet Nam follow-up 2014
15. Nigeria (Phase 2) 2015
16. Kenya (Phase 1) 2015
17. Morocco (Phase 1) 2015
18. Bangladesh follow-up 2016
19. Poland follow-up 2016
20. Kazakhstan (Phase 1) 2016
21. Malaysia (Phase 1) 2016
22. Ghana (Phase 1) 2017
23. Niger (Phase 1) 2018
24. UAE (Phase 3) 2018
25. Saudi Arabia (Phase 2) 2018
26. Sudan (Phase 1) 2018
27. Philippines (Phase 1) 2018



# Influential Factors

**1** Safety

**2** Funding & Financing

**3** Electricity Markets &  
Nuclear Policies

**4** Innovation: Advanced  
Reactors & Fuel Cycles

**5** Waste Management

**6** Capacity Building

**7** Public Acceptance

# What can we do better?



## 1 Safety

- Review missions - improve harmonization
- Operational experience - more open information access
- Emergency Preparedness - better exchange of technical information
- Severe Accident Management - more use of IAEA and int. experience
- Management and culture for safety - more multilateral cooperation



## 2 Funding & Financing

- Innovative schemes emerging
- Incentives, enabling conditions?



3

## Electricity Markets & Nuclear Policies

- Support to newcomers / new operators
- Plant Life Management - operation beyond 60 years



4

## Innovation: Advanced Reactors & Fuel Cycles

- FRs, HTGRs, SMRs, co-generation...



## 5 Waste Management

- Radioactive waste management - public reassurance that we have managed programmes for the whole lifecycle
- Cooperation in ARTEMIS missions



## 6 Capacity Building

- Capacity building - HR development for existing operators and the new generation



## 7 Public Acceptance

- Stakeholder involvement – reinforce social and economic benefits

# Support for operators



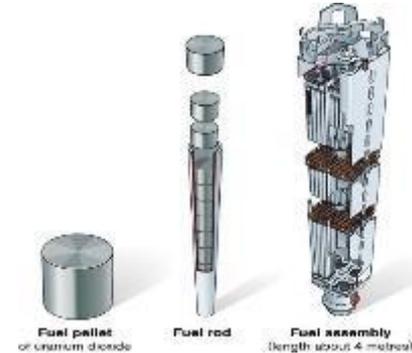
**Instrumentation & control**



**Maintenance/  
Outage management**



**Plant life management**



**Nuclear Fuel**

# Spent fuel

## Spent fuel pool



## Dry storage

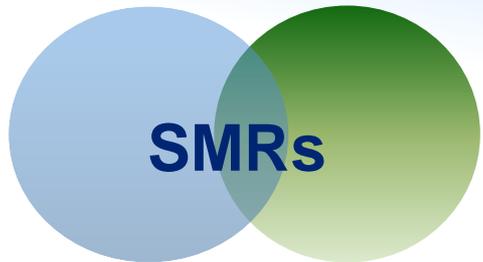
# Advanced Reactors



**EVOLUTIONARY**

A large light blue circle representing the Evolutionary category of advanced reactors.

ABWR, ACR 1000,  
AP1000, APWR, Atmea-1,  
CANDU 6, EPR, ESBWR,  
VVER 1200, CAP1400,  
APR1400, HPR1000...



**SMRs**

Two overlapping circles, one light blue and one green, representing the Small Modular Reactors (SMRs) category.

CAREM-25, HTR-PM,  
KLT-40, RITM-200,  
AHWR, NuScale,  
SMART, 4S, PRISM...



**INNOVATIVE**

A large green circle representing the Innovative category of advanced reactors.

LFR, GFR, SFR,  
SCWR, VHTR, MSR,  
ADS...

# Research Reactors



# “Internet Reactor”



# Waste Management



**LLW: la Manche, France**

**Spent fuel:  
Onkalo, Finland**



# Nuclear Knowledge Management



## Training the Nuclear Leaders: The First IAEA Nuclear Energy Management School in Russia Emphasizes Development of Nuclear Knowledge Infrastructure

23 Sep 2016

Maxim Gladyshev, IAEA Department of Nuclear Energy



Technical tour of the full-scope simulator of the Floating NPP "Akademik Lomonosov". (Photo:ROSATOM-CICE&T)

Not a member yet?



# Human resource development



**INMA**  
International Nuclear  
Management  
Academy

# Coordinated Research Projects



- ~1,600 research institutions involved
- 150 CRPs: ~ 1/4 related to Nuclear Energy

# Russia – IAEA Cooperation



## Support for HEU Removal



## Decommissioning

# Russia – IAEA Cooperation



## Capacity Building/ Training Programmes



# Russia – IAEA Cooperation



## Research Projects

- Fast Reactors
- Fuels
- SMRs



# Russia – IAEA Cooperation



**Extra Budgetary  
Funding for  
Infrastructure  
Capacity Building**

# Major Events 2019



International Conference on the

## Management of Spent Fuel from Nuclear Power Reactors 2019

Learning from the Past, Enabling the Future

24–28 June 2019  
Vienna, Austria



Organized by the



#SFM19

International Conference on

## Climate Change and the Role of Nuclear Power

7–11 October 2019, Vienna, Austria



Organized by the



#Atoms4Climate

## International Conference on Research Reactors:

Addressing Challenges and Opportunities to Ensure Effectiveness and Sustainability

25–29 November 2019, Buenos Aires, Argentina



Organized by the



Hosted by the

Government of Argentina

through the

National Atomic Energy Commission (CNEA)





**IAEA**

International Atomic Energy Agency

**7** AFFORDABLE AND  
CLEAN ENERGY



**9** INDUSTRY, INNOVATION  
AND INFRASTRUCTURE



**13** CLIMATE  
ACTION



**IAEA**

Nuclear  
Energy

Tweets  
**5,514**

Following  
**321**

Followers  
**5,412**

Likes  
**282**

Lists  
**1**

Moments  
**0**

**@IAEANE**

**[www.iaea.org/NE](http://www.iaea.org/NE)**