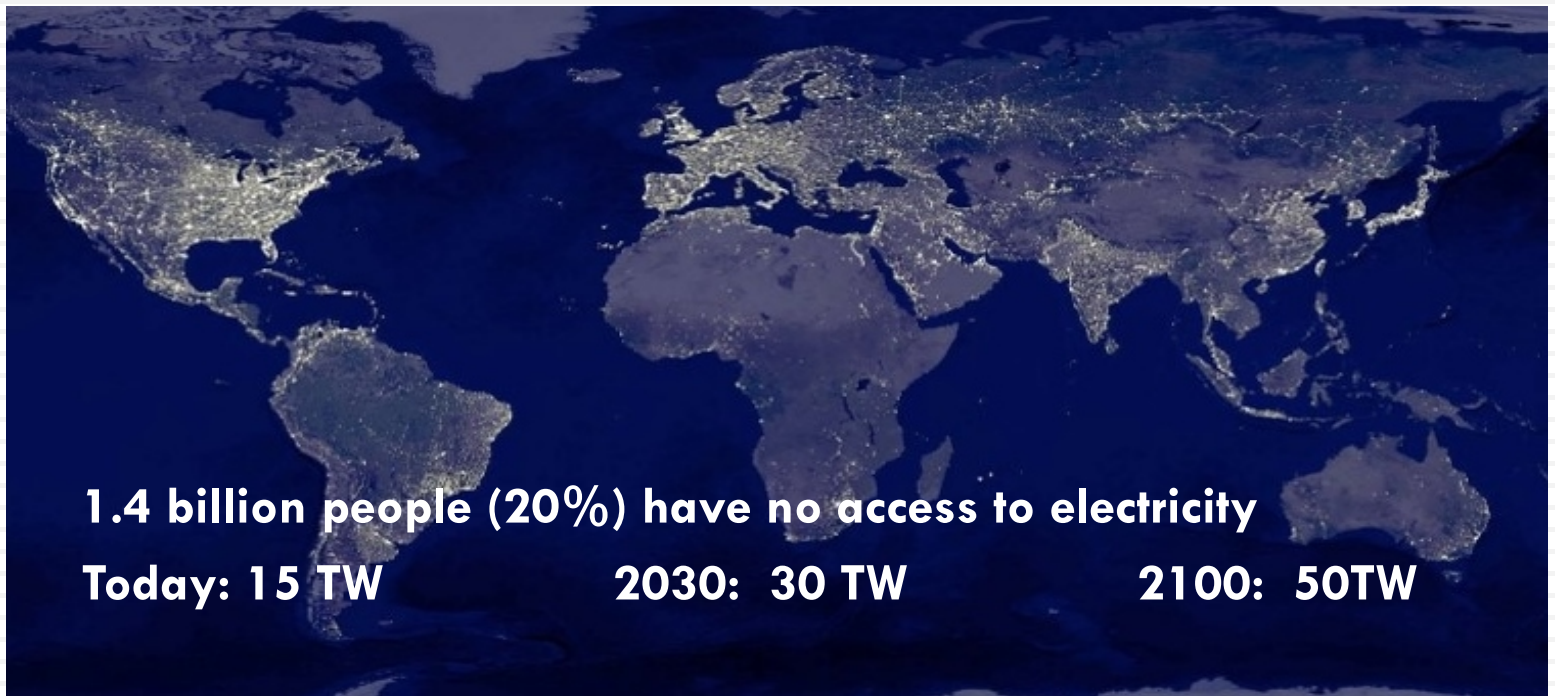


# *NUCLEAR POWER TRENDS: CHALLENGES TO EXPANSION*

# The need for electricity



# General barriers to nuclear power development

Public opinion

Waste management

Financing

Governance

In-experienced newcomers

Insufficient technical and human resource development support

# The national policy and energy planning; tools for goals achievement

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- National goals are promoted in various ways.
- Strong development of renewable energy sources, no carbon-influence, presented as key to prevent climate change.
- The nuclear option, with no carbon footprint, it is not recognized in climate prevention; nor as a renewable or “green” energy source.
- Subsidies are channeled to solar and wind, the classic renewables:
  - Subsidies reached \$121 billion in 2013, expected to reach nearly \$230 billion in 2030\*
  - Nuclear power run the risk of being shut-down prematurely due to financial reasons. Example: Sweden.
- Cradle-to-grave management; principle not applied across the energy sector, compare nuclear, coal, oil, renewables(?).
- Can nuclear power be regarded as *renewal*, or *green*?

# Public opinion

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## Perceptions

- ▣ High radiation risk; the fear of new accidents
- ▣ Terrorists may target nuclear power plants
- ▣ The nuclear technology is old, ineffective and being phased out.
- ▣ The nuclear industry is run by technocrats..
- ▣ Renewables need support to enable the sustainable development

## Public opinion may/could change, e.g.;

- ▣ After accidents, compare reactions in Germany, Switzerland and Belgium
- ▣ As a result of confidence building, compare the number of newcomers “before” Fukushima, but after Chernobyl.
- ▣ Price stability, at what level..?

# Radioactive waste management

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## **General:**

- ❑ No final depository for LEU spent fuel in operation *equals(?)* no acceptable solution exists.
- ❑ Radioactive waste depositaries are national responsibilities; regional solutions are not pursued.
- ❑ Geological depositaries become “plutonium-mines”, and a future radioactive threat.
- ❑ Any new technology in sight?

## **Countries have chosen to:**

- ❑ Not select a final solution; the USA, Japan, Canada or UK.
- ❑ The deep geological repository; Sweden (application 2011) and Finland (application 2012). Operation earliest 2022 (Finland).
- ❑ The reactor fuel is returned to the supplier after use. Option selected by newcomers (as offered by the Russian Federation).

# Financing

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- High upfront capital costs, major investments over long period of time, market risks.
- Long lead times (planning, construction, etc), to revenue.
- Uncertainties in national policy, insufficient planning basis.
- Emerging resources in developing countries changes the picture.

New financing strategies:

- *Build, own, operate*; No up-front major cost, payment of energy produced and consumed. Model for new countries.
- *Industrial investment*, Private industry investment to secure supply of electrical power. Surplus sold in the market. Example; Finland.
- *Privatization of the energy market* opens for investments by providers; example the United Kingdom.

# Governance

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- ❑ *Only* excellence in safety and security management is acceptable.
- ❑ The operator has the ultimate responsibility for safety and security.
- ❑ A global system of commitments, international standards and interaction make up a framework for safety, security and peaceful uses.
- ❑ Deficiencies, non-compliance, become associated with the entire industry, not only individual operators.



# Governance

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## Nuclear Safety

- ❑ Sufficient legal basis
- ❑ Comprehensive IAEA Nuclear Safety Standards.
- ❑ IAEA assessments voluntary; (OSART), WANO, INPO.

## Nuclear Security

- ❑ Insufficient legal basis
- ❑ Not yet comprehensive Nuclear Security Guidance.
- ❑ IAEA assessment; voluntary; IPPAS, no industry-driven review.

- The legal basis for nuclear security has serious gaps.
- Separation in safety and security is outdated.
- Assessment, review and the communication of results is insufficient for confidence building.

# Supporting structure

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## Nuclear Safety

- Technical Support Organizations available in the nuclear safety field.
- Industrial establishments for regulatory training requirements (e.g. INPO).

## Nuclear Security

- Centers of Excellence/Nuclear Security Support Centers being established within the nuclear security field.
- Ad hoc structure, with IAEA as the major training provider.
- Wider range of coordination requirement; for the Design Basis Threat establishment and for response planning.

Nuclear safety versus nuclear security; outdated separation.

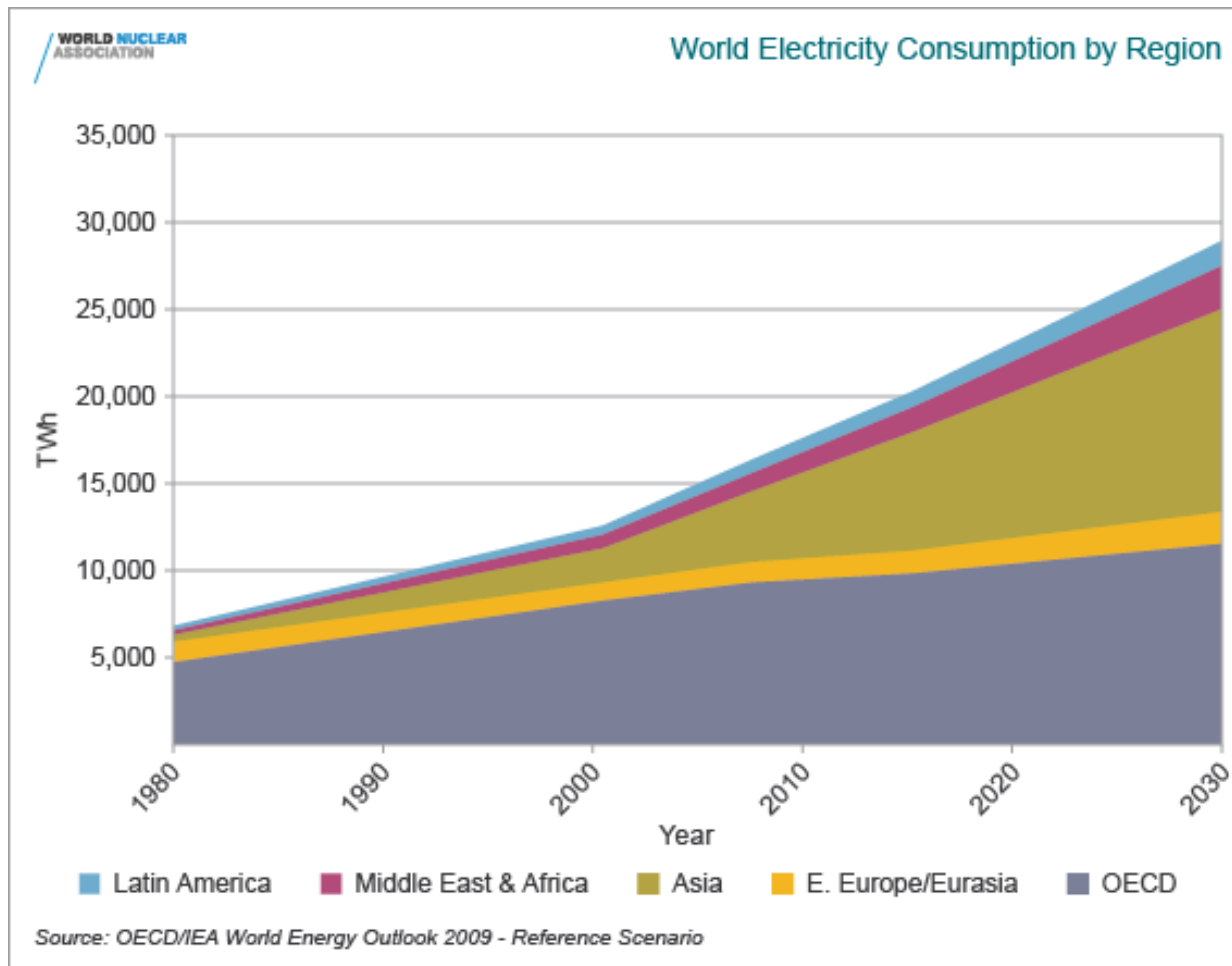
Is the supporting structure adequate for newcomer countries?

- Regional centers, technology support and education opportunities for those countries embarking on nuclear power generation without prior experience.

# Regional progress and concerns

# Electricity consumption forecasts, by region

12



# North America

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## **The nuclear lead region rests its case**

- ▣ Extended operation of existing units, postponed time of retirement of the now operating 99 units, with a low number (5) of new units, and no new units in Canada or Mexico.
- ▣ Natural shale-gas, with its competitive advantages, has taken the lead as new power source.
- ▣ No fuel cycle activities and no established radioactive waste management plan.
- ▣ Very significant level of technical support, part of which may be made available to other countries.

## **Challenges**

- ▣ Sets the rules for technology use.

# Europe and Russian Federation

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The mixed picture region, with;

- ❑ Technology providers; RF (presently) surfacing as the main technology-provider; having addressed financing and waste management.
- ❑ Newcomers (Belarus) and new units in several countries
- ❑ Antinuclear countries, also those phasing out nuclear energy due to post-Fukushima reasons.

## Challenges

- ❑ No EU-wide position on nuclear power, but strong emphasis on safety, security and emergency response.
- ❑ EU regulations and directive on safety and waste management.
- ❑ Significant resources available for capacity building, utilized mixed-mode, often in an ad-hoc manner.

# Middle East and Central Asia

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## **The region that led the way for new nuclear power**

- A region with growing nuclear power but without indigenous technology.
- Remains of the nuclear programme of the former Soviet Union.
- UAE, Jordan, Saudi-Arabia, Turkey, Egypt, others?
- Countries are adding new units, e.g. Armenia, Iran, UAE.
- Lead producers for source uranium, host of the fuel bank (Kazakhstan) and multinational enrichment services (Angarsk).

## **Challenges**

- Significant new programmes in nuclear un-experienced countries.
- Existing standards suitable for countries that buy a capacity to produce electricity.
- No/insufficient establishments for capacity building to support nuclear power implementation.
- The region presents non-proliferation issues.
- Political instability and conflicts.

# East and South Asia

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## **The new nuclear lead region**

- ▣ The region in which nuclear power grows significantly, lead by China and India.
- ▣ Significant R&D of nuclear technology.
- ▣ Vietnam, Indonesia and Malaysia, examples of “advanced” new nuclear power countries, with research experience.

## **Challenges**

- ▣ Several “un-experienced” countries, planning to introduce nuclear power, example Bangladesh.
- ▣ Significant resources invested in technical support and human resource development.
- ▣ Non-proliferation concerns; DPRK, non-NPT countries.
- ▣ Political conflicts.



# Africa

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## **Potentially an emerging nuclear power region**

- Nuclear power in one country, only.
- Nuclear interest in Nigeria, Egypt etc.
- Emerging major source uranium producer

## **Challenges**

- Very limited experience within the nuclear field, basically mainly South Africa.
- No/insufficient technical support capacity.
- Political instability.