

IAEA Toolkit for Sustainable Energy Planning

25th INPRO Dialogue Forum on Nuclear Energy Development in Embarking Countries

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Building a National Position for a New Nuclear Power Programme

National policy development

- National energy strategy, is informed by **energy planning** and includes potential **role of nuclear** in accomplishing social and economic developmental goals.

Prefeasibility study

- Further social, economic, financial and technical evaluation regarding the introduction of a new nuclear power programme.

Energy analysis and planning

- Comprehensive **qualitative** and **quantitative** assessments of future **demands** for energy services and **supply** options. Information about the economic, security and environmental implications.

Engaging the public and stakeholders

- Ensuring broader **support** for the development of a new nuclear power programme.



Role of Energy

- Energy drives economic and social development
- Energy needs, options and development priorities differ among countries
- Capabilities of countries to conduct energy system analysis also differ
- Many developing countries are facing issue of insufficient national expertise in this domain
- Countries considering nuclear option should also conduct an energy planning exercise to provide inputs to decision makers

Qualitative...



Individuals, institutions, government, companies, society.... Everyone has certain **qualitative** views or positions over energy related issues

... vs. Quantitative

- Meaningful planning should be based on measurable targets
 - Energy demand and supply for various energy commodities
 - Prices and energy costs (electricity, oil products; economy and society effects...)
 - New projects identification and investments
 - Selection of profitable projects and financing options (private and public)
 - Public investments and incentive schemes
 - Societal costs for deployment of new technologies (e.g. RES)
 - Societal costs of pollutants emissions
 - Emission reduction/avoidance and participation in international negotiations
 - Energy efficiency improvements
 - Import dependency
 - ...

***How much it
will cost?***

***How it
compares to
alternatives?***

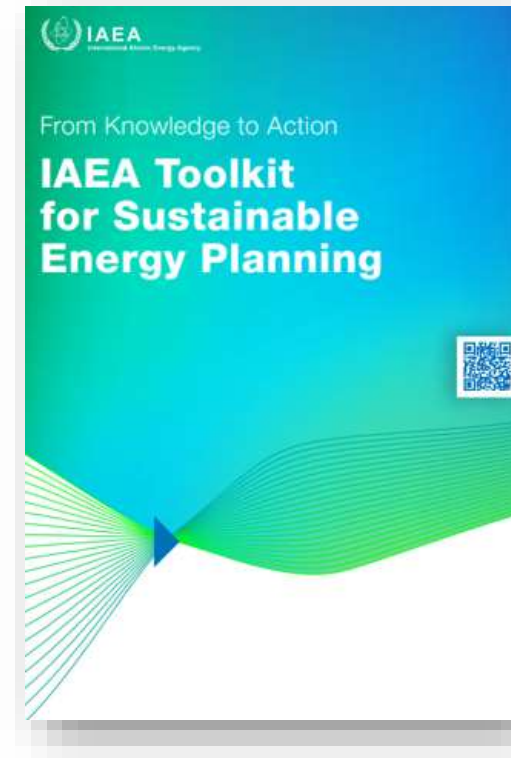
***Who will pay and
how much?***

Potential role of nuclear, possible questions

- Improved energy security
 - dependence on foreign fuel supplies, volatile fluctuations in energy prices, droughts
- Development of indigenous energy resources
- Reliability of electricity supply and grid
 - A stable, sufficient, well managed and appropriately sized grid is an indispensable prerequisite for the introduction of a nuclear power plant.
- Access to affordable energy services
- Environmental protection, including climate change mitigation

IAEA ...

*... **assist** Member States in reinforcing national capabilities to conduct energy system analysis, so that countries can assess options and develop **their own sustainable energy strategies**, i.e. support decision and policy making*



**Country-led
process**

IAEA's Capacity Building programme

Capacity
Building for
Energy
System
Assessment



Analytical
Tools, Training
and Support



Information
Dissemination



Technical
Assistance for
Energy Studies

IAEA's Energy System Assessment Tools



EBS

Energy Balance Studio

*Energy Statistics and
Energy Balances
compilation*



MAED

Model for Analysis of Energy Demand

*Energy Demand Analysis
and Projections*



MESSAGE

Model for Energy Supply Strategy Alternatives
and their General Environmental Impacts

*Energy Supply
Optimization and
Simulation*



ESST

Energy Scenarios Simulation Tool

*Energy Scenario
Simulation Tool for fast
estimates*



WASP

Wien Automatic System Planning Package

*Power Generation
Investments and
Expansion Planning*



SIMPACTS

Simplified Approach for Estimating Impacts of
Electricity Generation

*Analysis of Power Plants
Environmental Impacts*



FINPLAN

Model for Financial Analysis of Electric Sector
Expansion Plans

*Analysis of financial
viability of power
generation projects*



EMPOWER

Macroeconomic
Analysis

*Quantification of
macroeconomic effects of
strategies*

Frameworks for Energy System Assessments



CLEW

Climate, Land,
Energy and Water Nexus

*Climate, Land and Water use and
Energy Interactions*



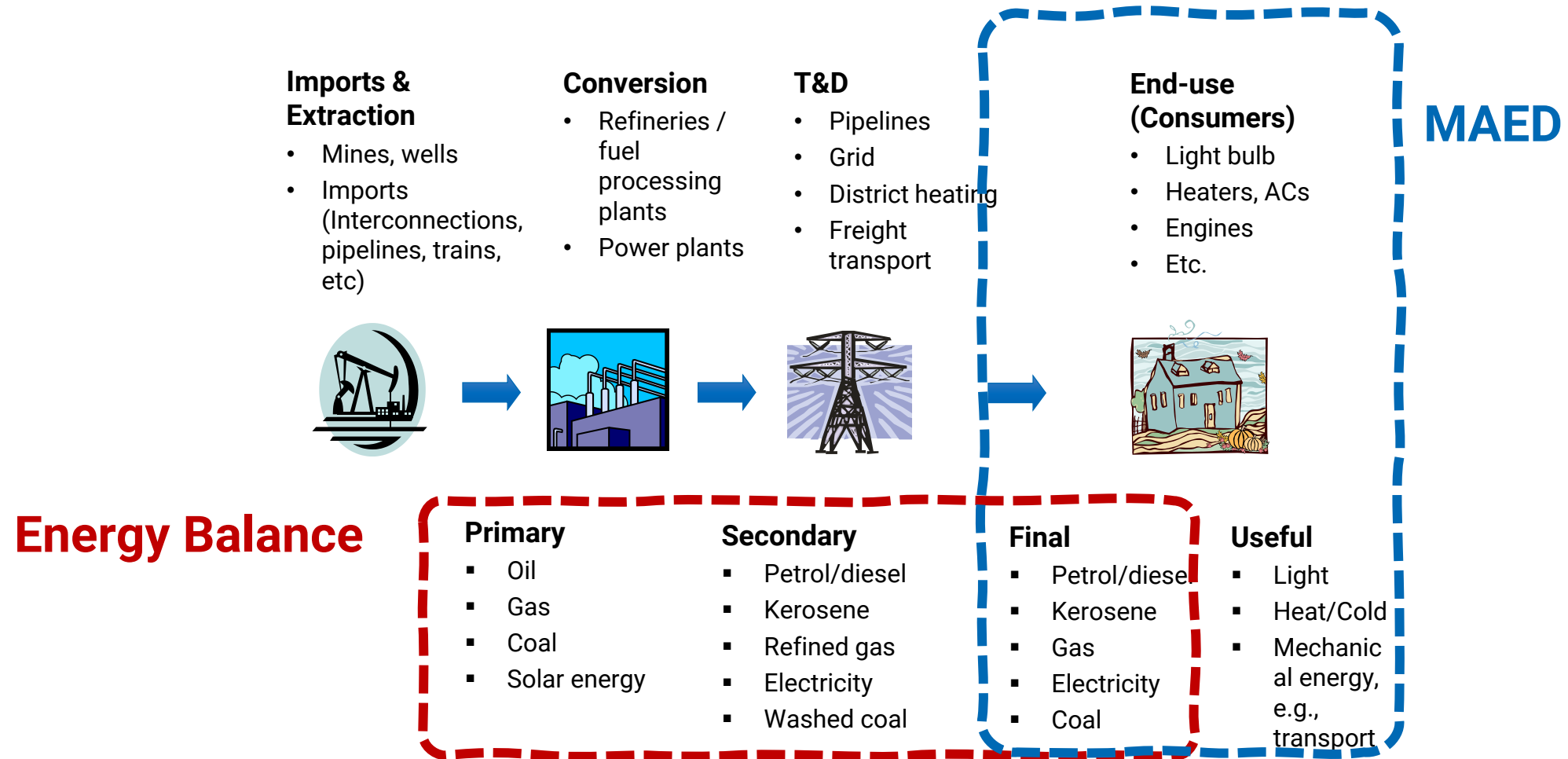
SEA

Strategic Environmental
Assessment (Nuclear)

*SEA of National Nuclear Power
Program*

Concepts and sets of methodologies and approaches used to analyze various aspects of energy systems and interactions with other economic activities or elements

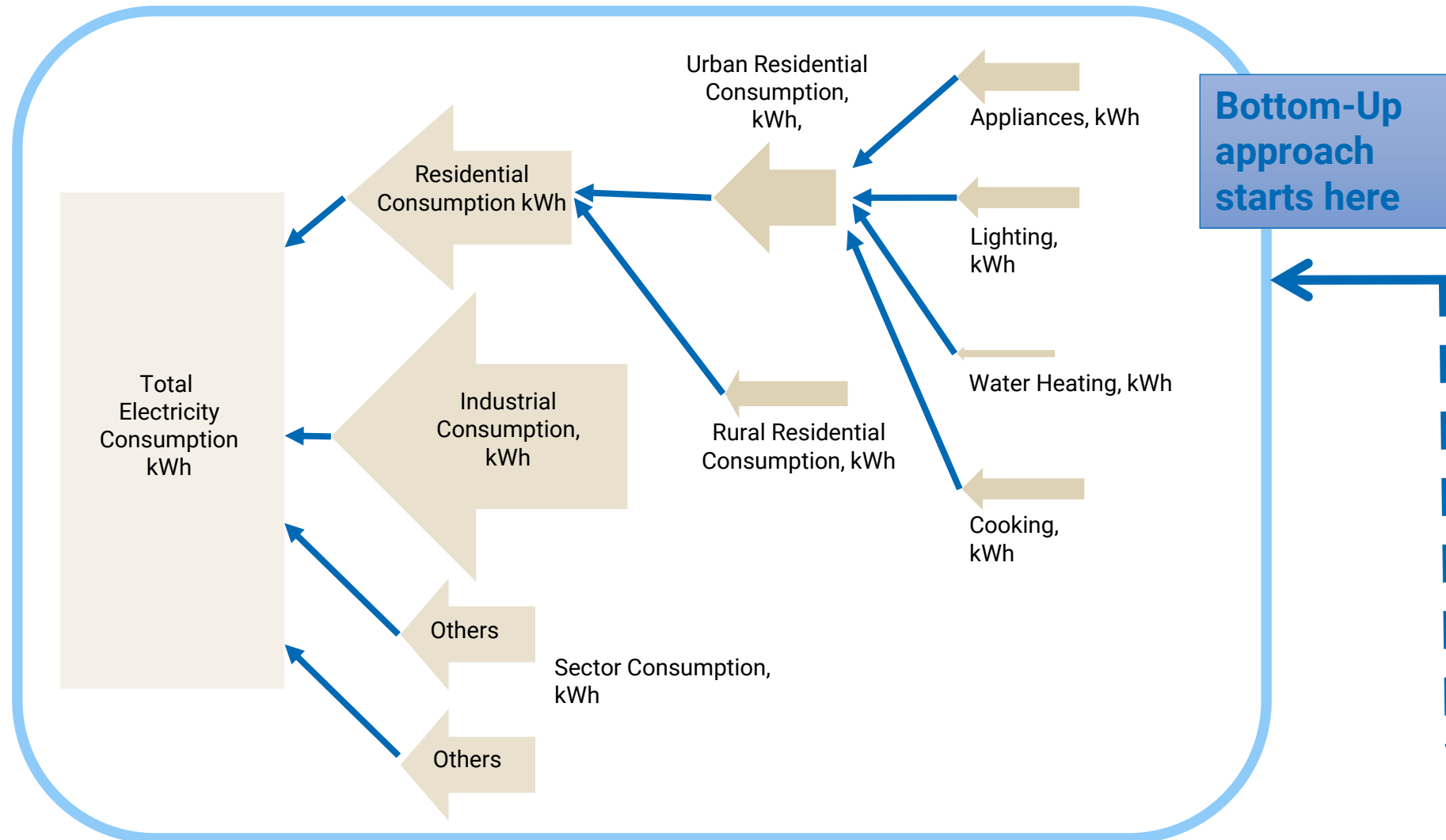
MAED (Model for Energy Demand Analysis)



MAED – Model for Analysis of Energy Demand

- Evaluates future energy demand based on medium- to long-term scenarios, i.e. expected development of main drivers
- **Bottom-up approach** – analysis of needs as a starting point:
 - Relates energy demand for producing various goods and services to corresponding social, economic and technological drivers
- Designed to reflect
 - **Structural changes** in energy demand by analysing social, economic and technological factors
 - **Different forms of energy**: electricity, motor fuels, fossil fuels, renewable resources, etc

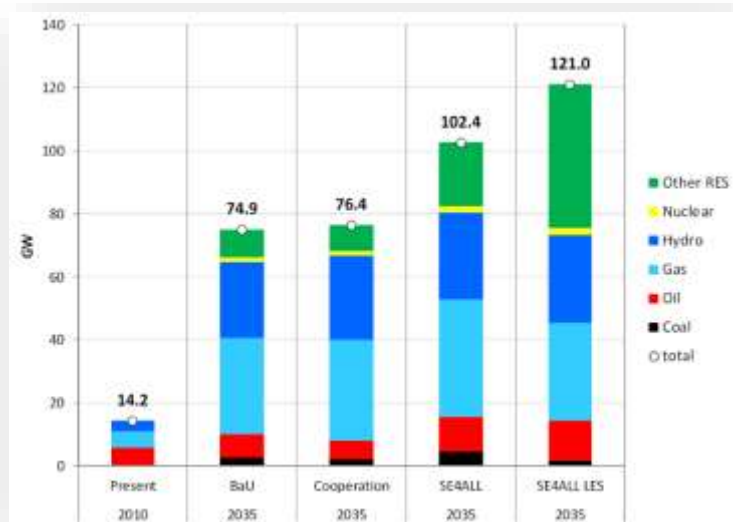
Bottom-up approach (example for electricity)



MESSAGE overview

Concept

- For each set of assumptions and constraints (scenarios), MESSAGE calculates the least-cost energy supply system (linear or mixed integer programming)



Insights

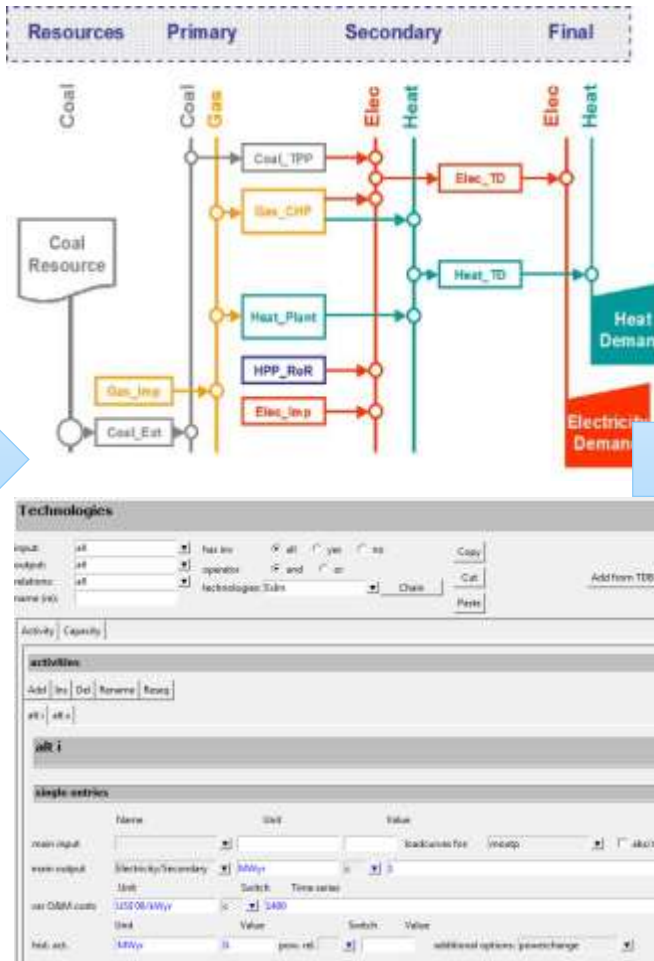
- MESSAGE can assess, e.g.:
 - Investment plan to achieve the least-cost energy supply system
 - Implication of economic or environmental constraints for a given investment plan
 - Economic and/or environmental implications of alternative policy/technology options
 - Economic and/or environmental implications of different perspectives of future energy carrier availability and prices
 - ...

MESSAGE Data/Workflow

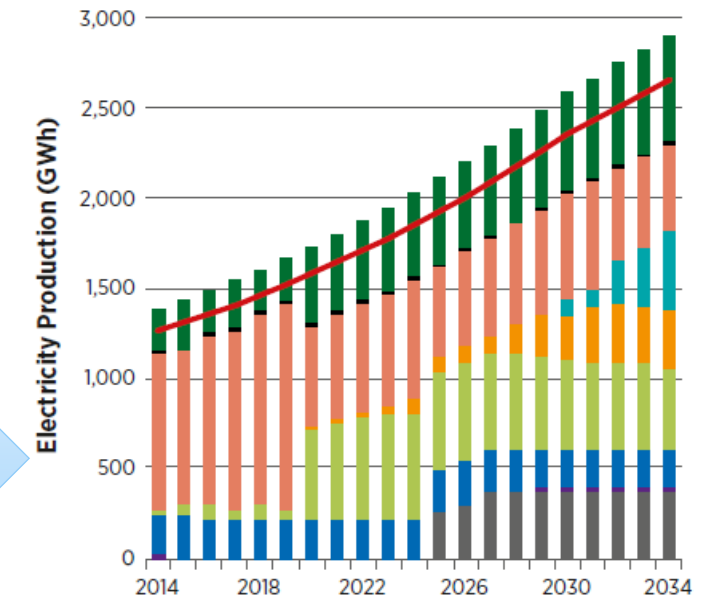
INPUTS

- Energy system structure (Energy Chain / Reference Energy System)
- Energy demand projections (exogenous)
- Technology and resource options with techno-economic parameters
- Technical, environmental and other policy constraints

MESSAGE



OUTPUTS



- Capacity and generation mix
- Resource and fuel/energy uses
- Investments and other costs
- Emissions/Environ. Impacts
- Land & water use, etc.



MESSAGE - Net Zero Studies and Technology Deployment

- Technical suitability and Competitiveness of new development paths
 - Advanced nuclear power chains and new techs (SMRs)
 - Multi-product options (heat, hydrogen, desalination...)
 - Energy storages and system services (flexibility, inertia...)
 - CLEW interdependencies (Climate-Land-Energy-Water)
- Investment mobilisation
 - Assessment of clean energy project revenues, costs, and risks analysis, support policies and level-playing field

IAEA's Capacity Building Program for Energy Planning



Independent
program and
own tools



Up to date
methodologies



Provided
through
Technical
Cooperation



Support
constantly
available

Comprehensive Capacity Building

Distance learning

Field trainings

Expert missions

Advanced
trainings

Teachers'
trainings

Fellowships (on-
the-job training)

Continuous
Support

External experts

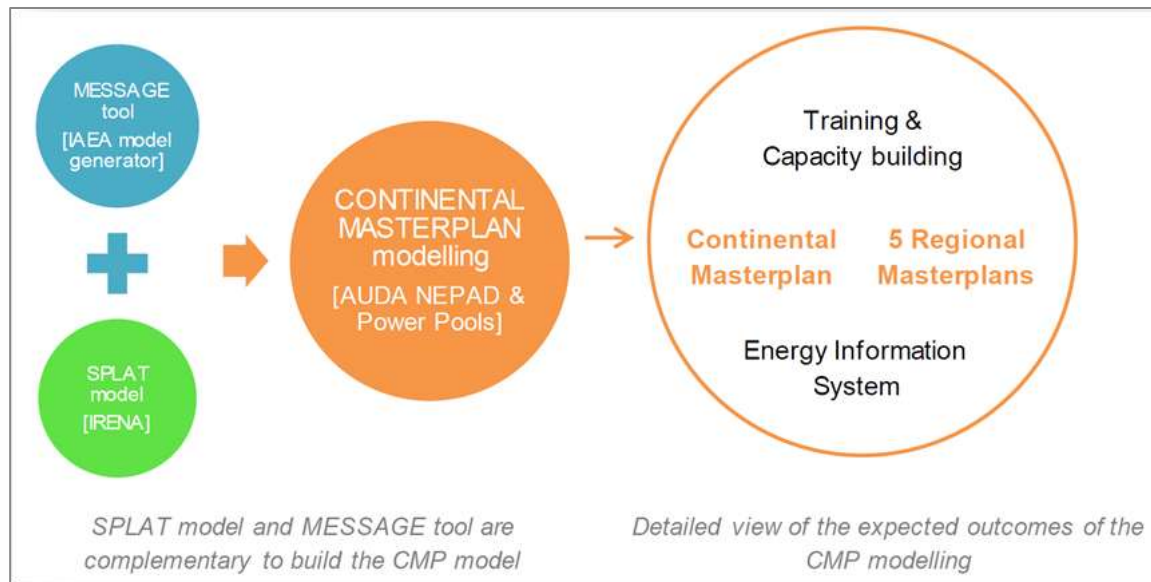
Examples of tool applications

- Long-term energy and electricity strategies
- Energy transition analysis
- Total cost of system operation and development
- Evaluation of NDCs
- Financial and environmental implications
- Regional/national markets development
- ...



Example of tool applications

Supporting the development of Africa's **Continental Master Plan**: a roadmap for the integration of the continent through the establishment of a sustainable integrated continental power transmission network, in the context of the African Union's Agenda 2063.



Concluding Messages

- Energy is important and Energy Systems must be planned carefully
- Nuclear energy is one of energy supply options
- Decision on nuclear program is not possible without government decision, and it is a decision for generations to come
 - Economics, security of energy supply, development objectives, environmental considerations and other
- Further deployment of nuclear power will be directed by
 - Energy and electricity demand dynamics
 - Global cooperation to fight climate change
 - Competitiveness of nuclear to alternative technologies
 - Financial frameworks to support low-carbon investments
 - Public acceptance
- IAEA offers support in conducting energy planning studies (tools, training, assistance)



Thank you!

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