The Abdus Salam
International Centre
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50th Anniversary 1964–2014

2580-2

Joint ICTP-IAEA College on Identification and Assessment of Nationally Appropriate Mitigation Actions (NAMAs) in Energy System Development to Help Combat Climate Change

5 - 9 May 2014

Evaluation of Cost-Eff ective NAMAs

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International Atomic Energy Agency

National Appropriate Mitigation Actions

- *Agrees* that **developing country** Parties will take **nationally appropriate mitigation actions** in the context of sustainable development, supported and enabled by technology, financing and capacity-building, aimed at achieving a deviation in emissions relative to 'business as usual' emissions in 2020;
- *Also decides* that internationally supported mitigation actions will be **measured, reported and verified** domestically and will be subject to international measurement, reporting and verification

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NAMAs

NAMAs not a legal obligation under the UNFCCC

NAMAs are voluntary actions taken by developing countries to reduce GHG emissions to levels below those of "business as usual".

NAMAs generally support and are aligned with sustainable development as interpreted by the host country

They either constitute a transformational change to a sector of the economy or provide support for such change.

Policy NAMAs and project NAMAs

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NAMA Registry

- NAMA seeking support for preparation
- NAMA seeking support for implementation
- Other NAMAs for recognition
- Information on support for NAMAs

http://unfccc.int/cooperation_support/nama/items/6945.php

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Comparison of NAMAs

- Investment
- Operating Costs
- GHG reduction (avoidance) potential

- Levelised cost
- Cost of Reduction

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Comparison of NAMAs

Wind Turbines	5	MW
Wind Farm	20	MW
Off-shore Wind	100	MW
Solar Thermal	100	MW
Solar w Storage	200	MW
Solar PV	2	MW
Biomass Steam	200	MW

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Comparison of NAMAs - Investments

Wind Turbine	1500	$/kW
Wind Farm	1200	$/kW
Off-shore Wind	3800	$/kW
Solar Thermal	6500	$/kW
Solar w Storage	12412	$/kW
Solar PV	4000	$/kW
Biomass Steam	2500	$/kW
Coal pp	2300	$/kW
Oil pp	1500	$/kW

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Data source "Energy technology perspective 2012" IEA, WEO2011, GEMASOLAR project (Torresol Energy), NREL "Renewable electricity futures study. Vol 2. 2012"

Comparison of NAMAs Capacity Factor

Wind Turbine	20%
Wind Farm	25%
Off-shore Wind	35%
Solar Thermal	25%
Solar w Storage	60%
Solar PV	25%
Biomass Steam	60%
Coal pp	85%
Oil pp	60%

Comparison of NAMAs
GHG emissions avoided
(million tons CO2 eq)

Wind Turbine	0.16
Wind Farm	0.81
Off-shore Wind	5.67
Solar Thermal	4.05
Solar w Storage	19.45
Solar PV	0.08
Biomass Steam	9.72

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Comparison of NAMAs
Levelised cost of generation ($/MWh)

Coal	48.48
Oil	150.29
Wind Turbines	93.72
Wind Farm	63.27
Off-shore Wind	143.11
Solar Thermal	283.35
Solar w Storage	133.47
Solar PV	111.93
Biomass Steam	78.59

Ranking of Projects
based on levelised cost

Coal
Wind Farm
Biomass Steam
Wind Turbine
Solar PV
Solar w Storage
Off-shore Wind
Oil
Solar Thermal

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Ranking of Projects
based on levelised cost

Is it adequate and a realistic comparison?

One important feature of wind and solar projects is not considered - variation in the production capability within a year!

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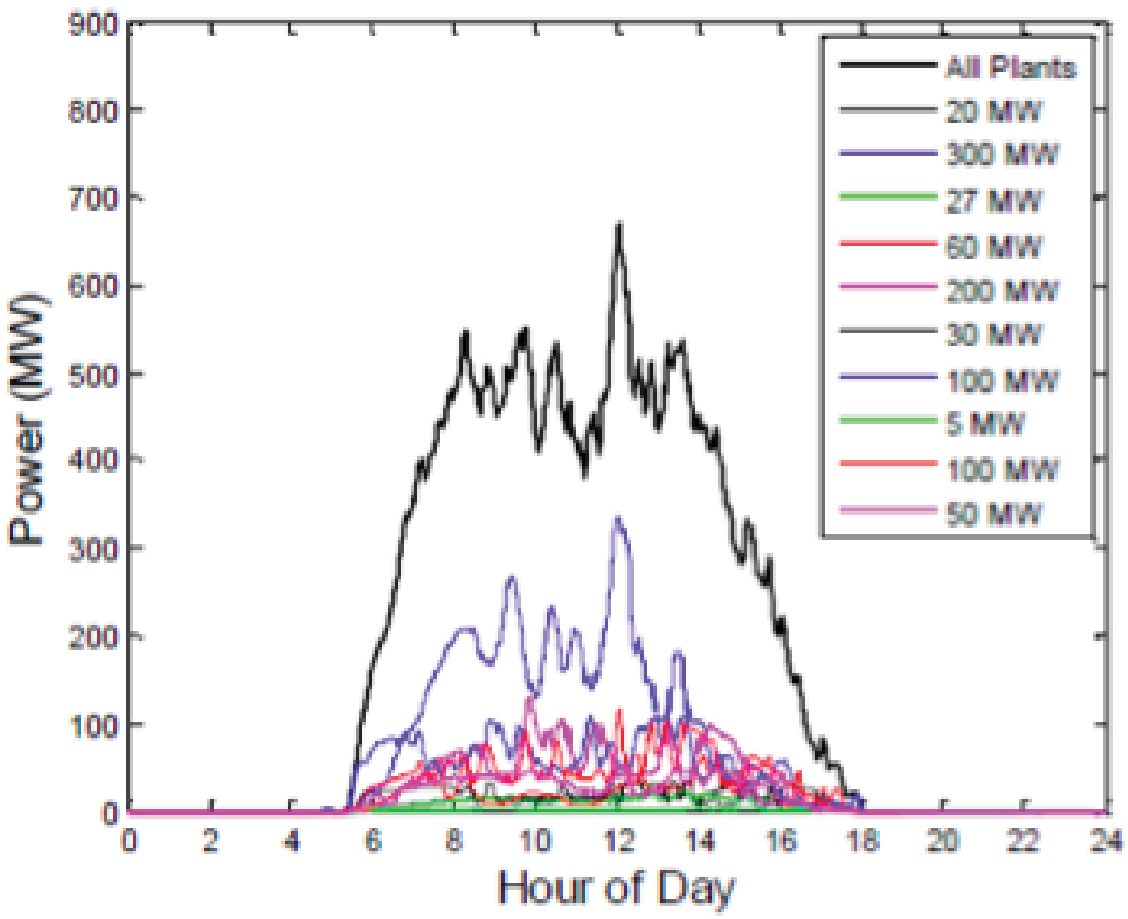
Variation in Solar



*Source: Large-Scale PV Integration Study**

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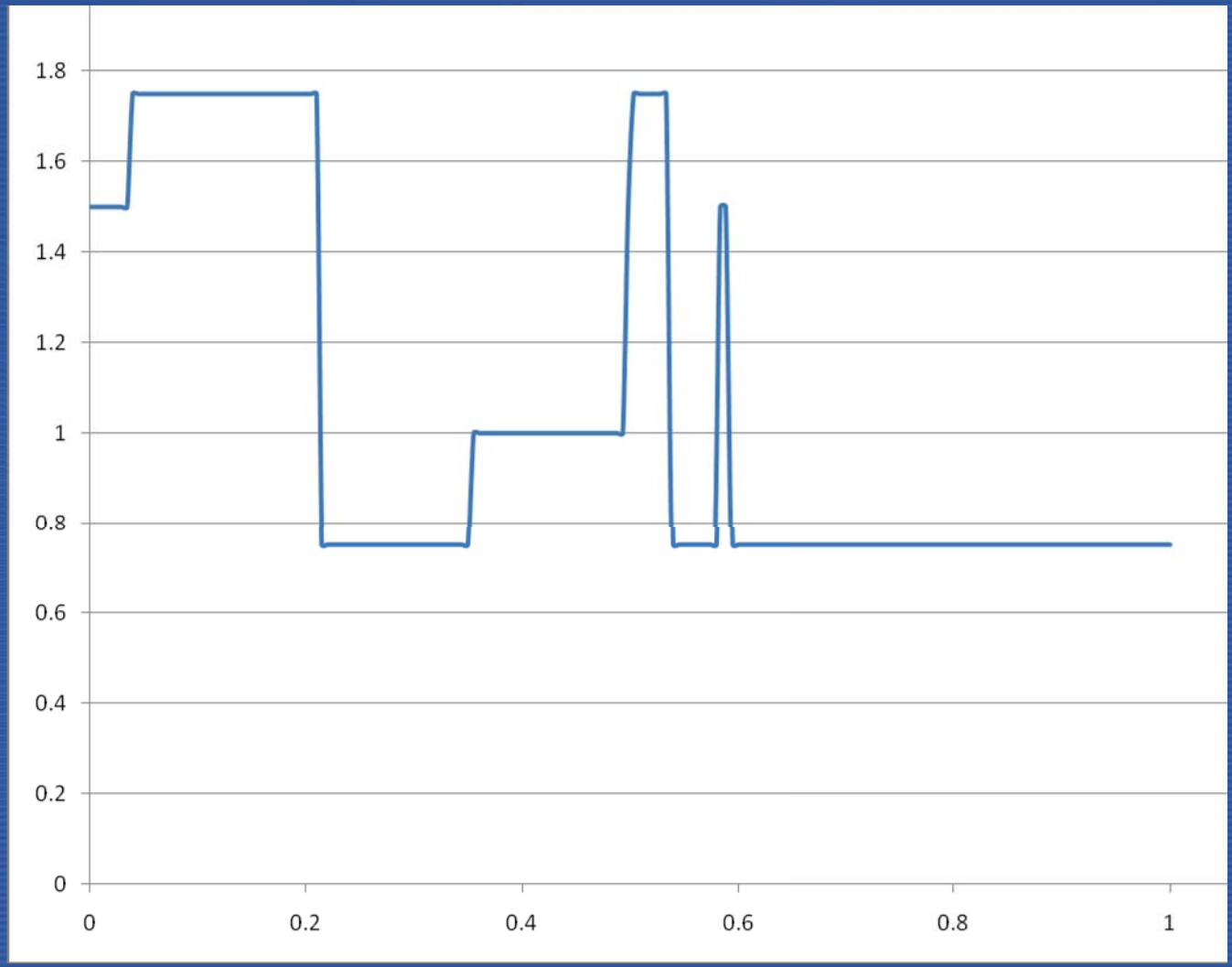
Variation in Production Capability of Wind Turbines



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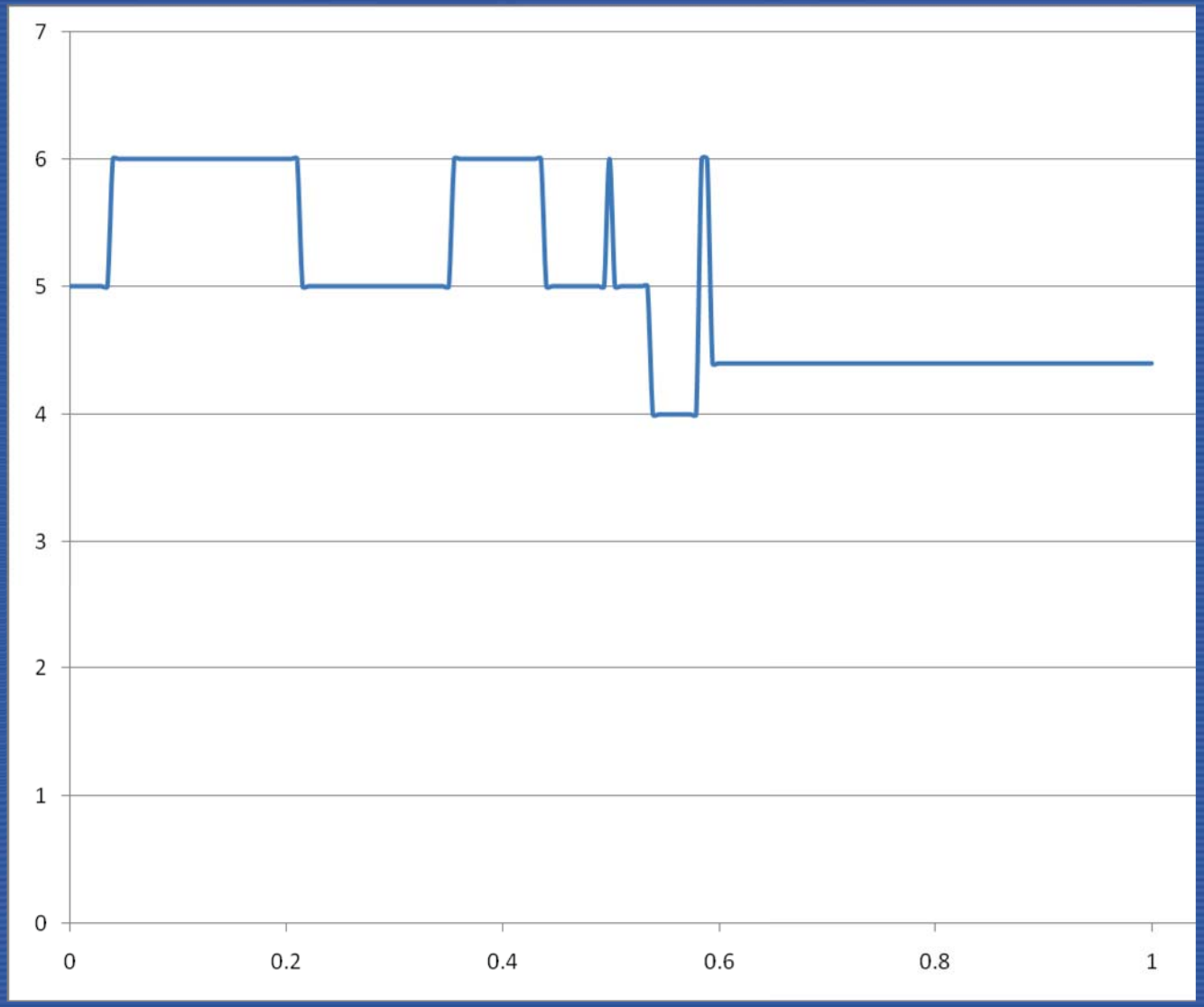
Variation in Production Capability of Wind Farm



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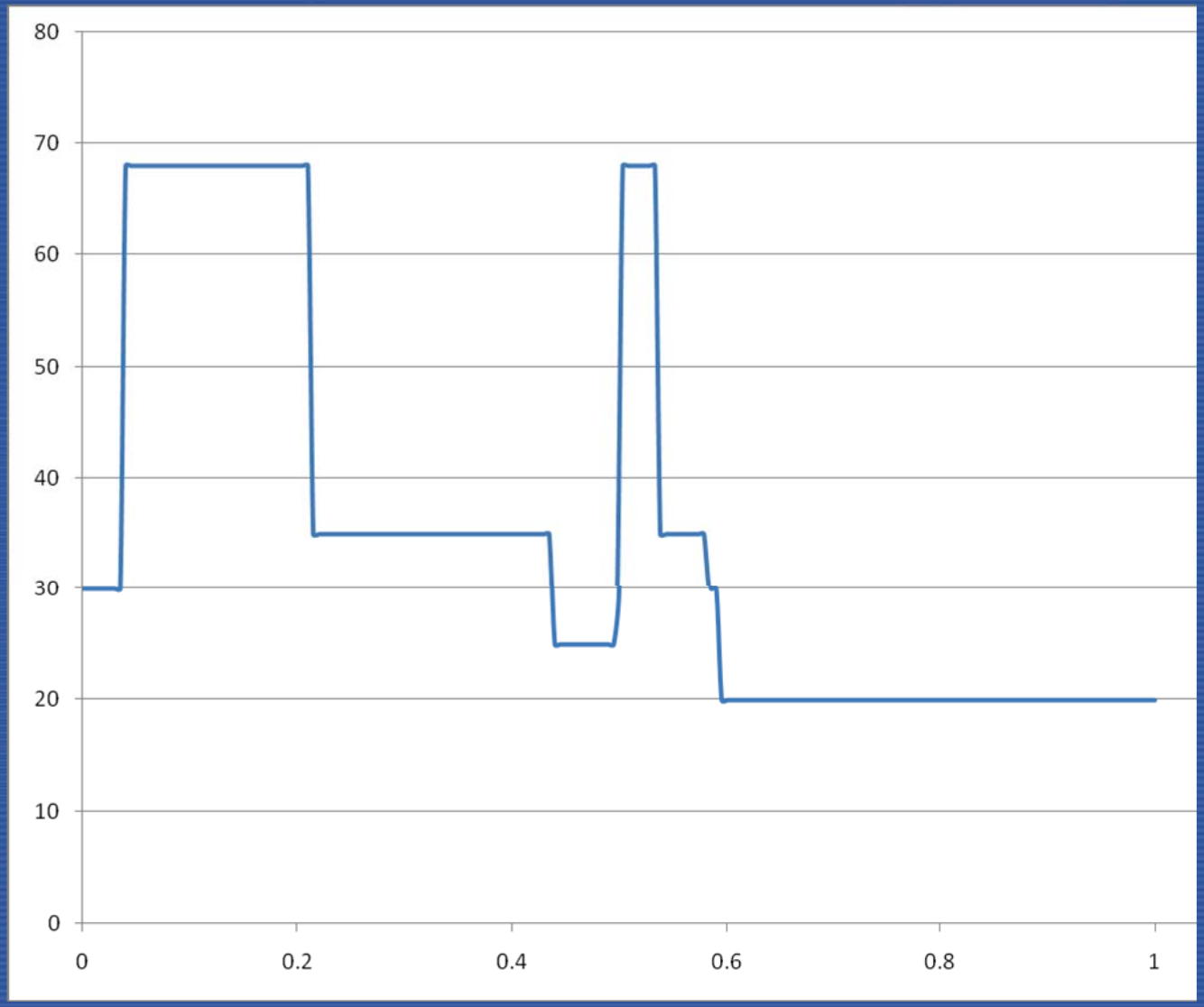
Variation in Production Capability of Off-shore Wind



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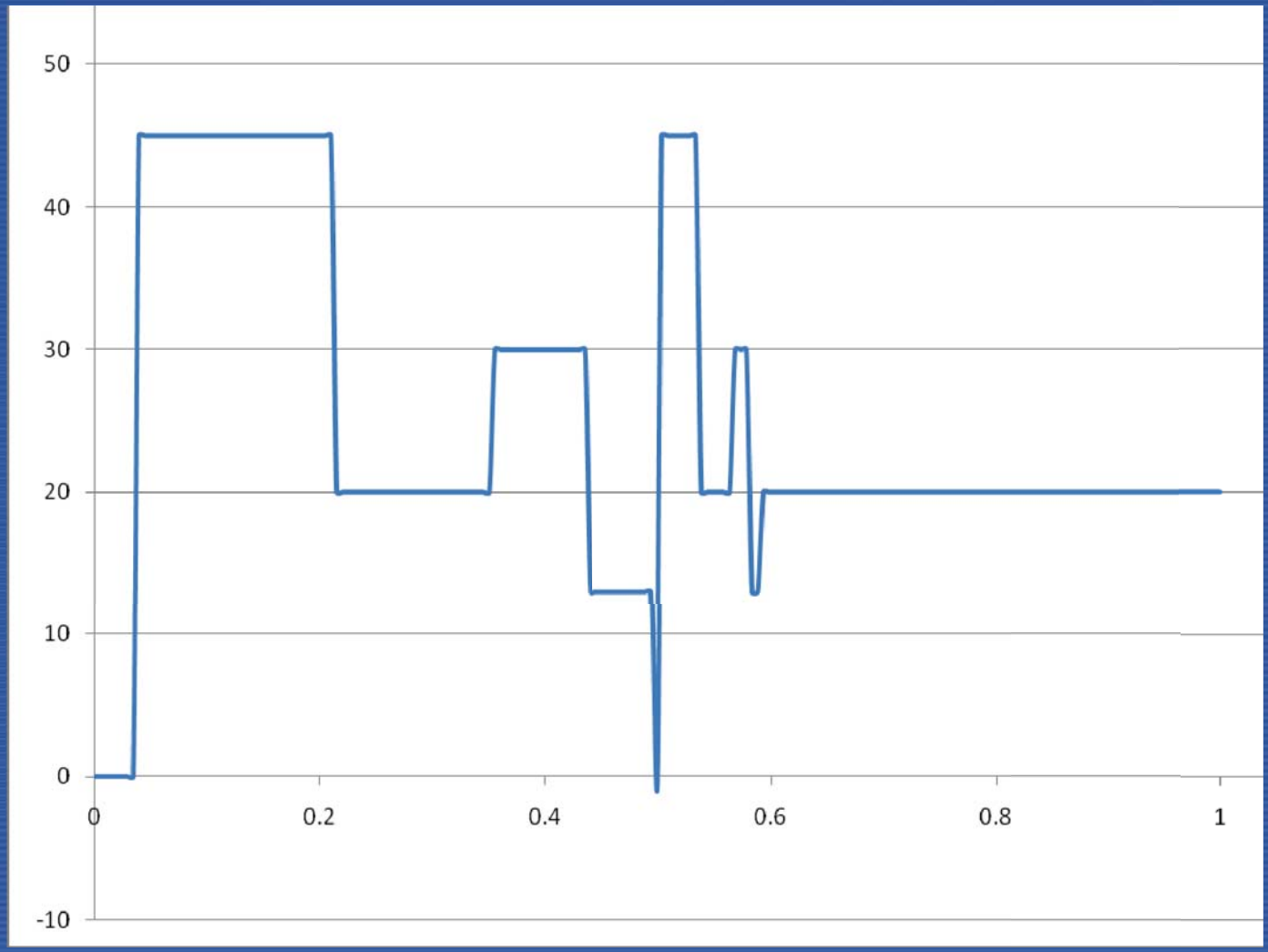
Variation in Production Capability of Solar Thermal



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Let's try MESSAGE to compare the proposed NAMAs

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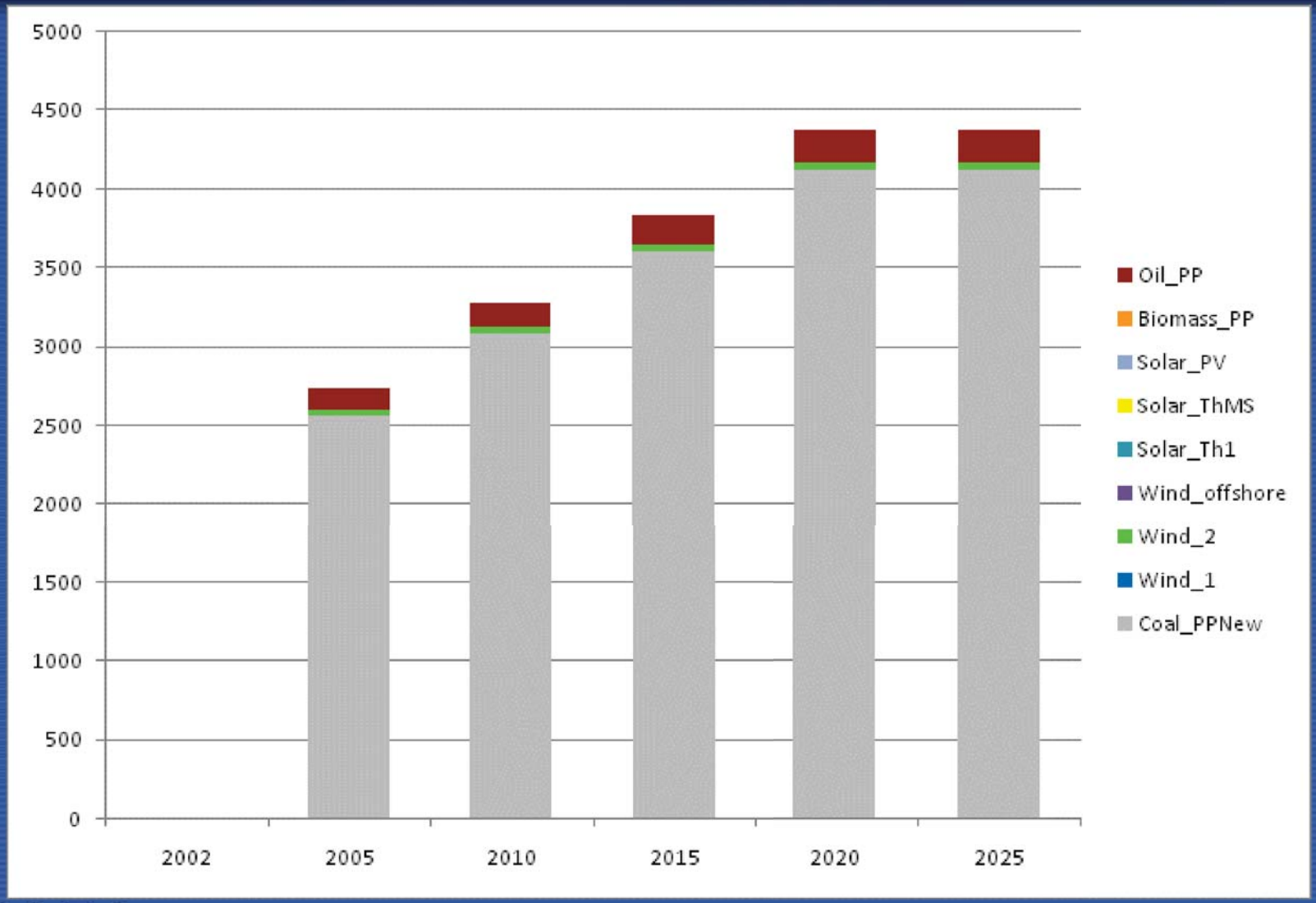
MESSAGE Results – Generation Mix



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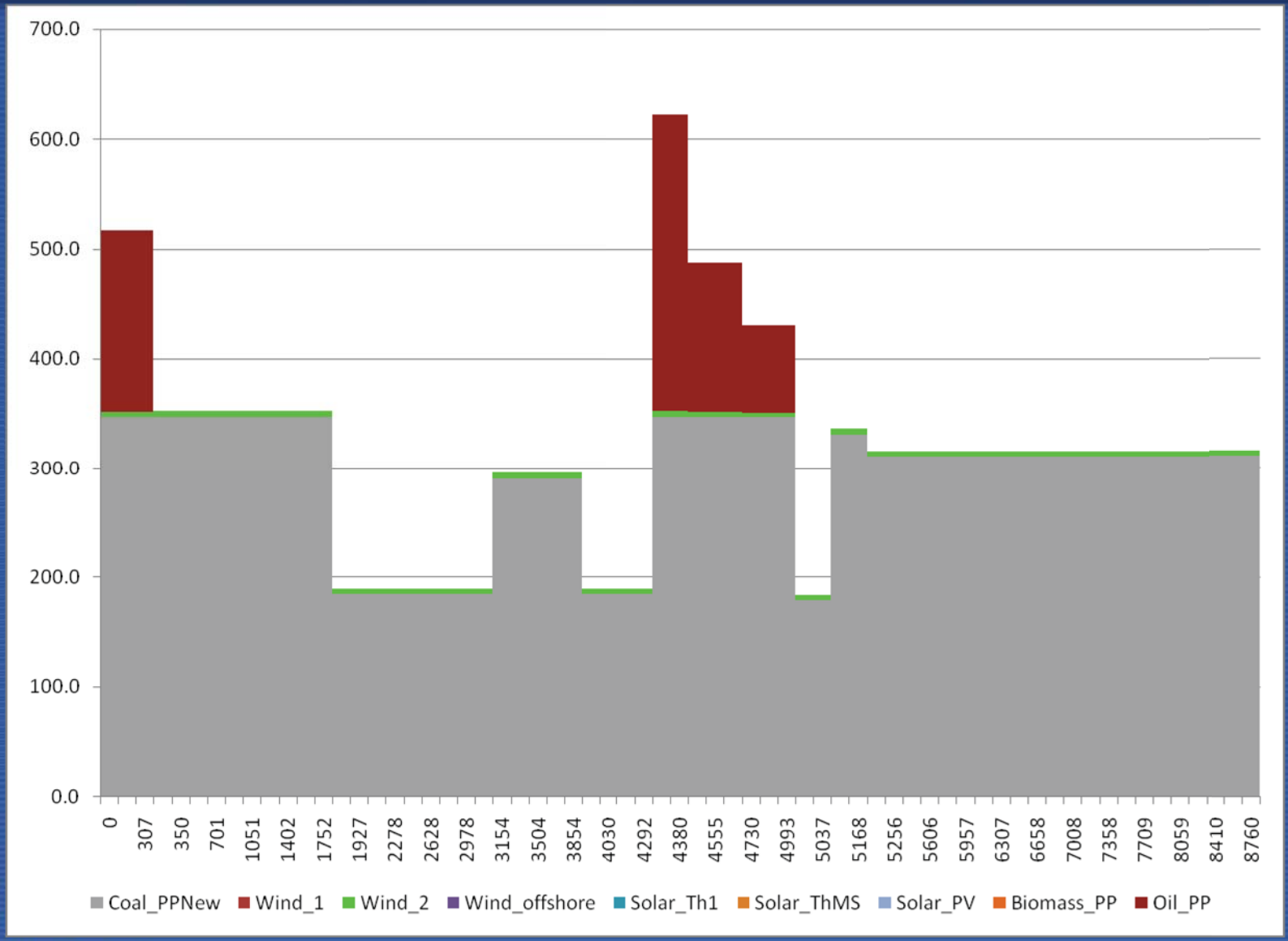
Matching the Load



Ranking of Projects
based on system level comparison

Coal
Wind Farm
Oil
Biomass Steam
Wind Turbine
Solar PV
Solar w Storage
Off-shore Wind
Solar Thermal

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Realistic Comparison of NAMAs

- Investment
- Operating Costs
- GHG reduction (avoidance) potential
- System Load pattern
- Variation in production capability of Projects
- Generation to be replaced
- Support (subsidy) available to Projects
- Penalty on GHG emissions (or Carbon Credits)
- Legal Bindings for GHG reduction

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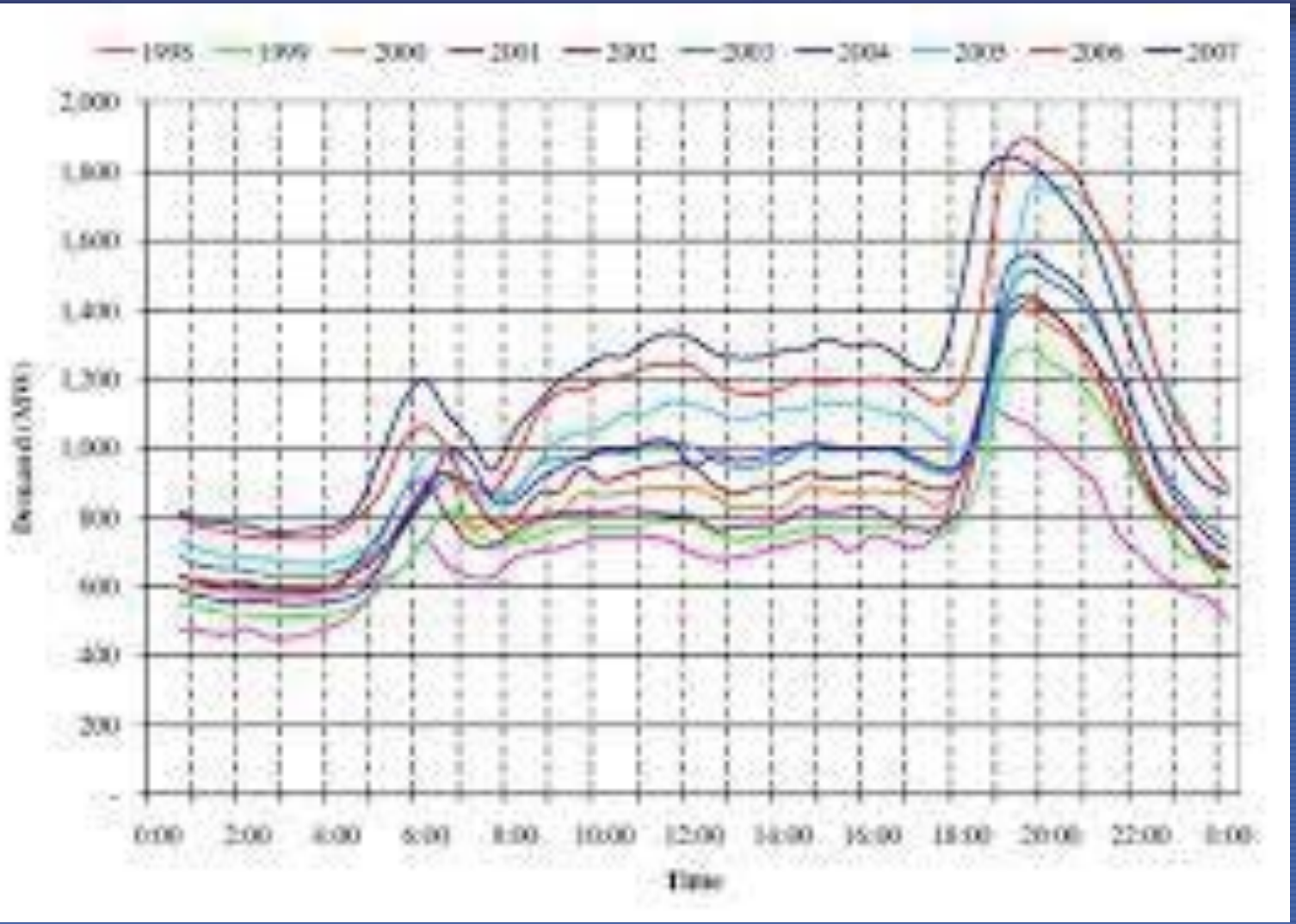
Daily Load Curve



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World's First Solar Plant Generating Power at Night

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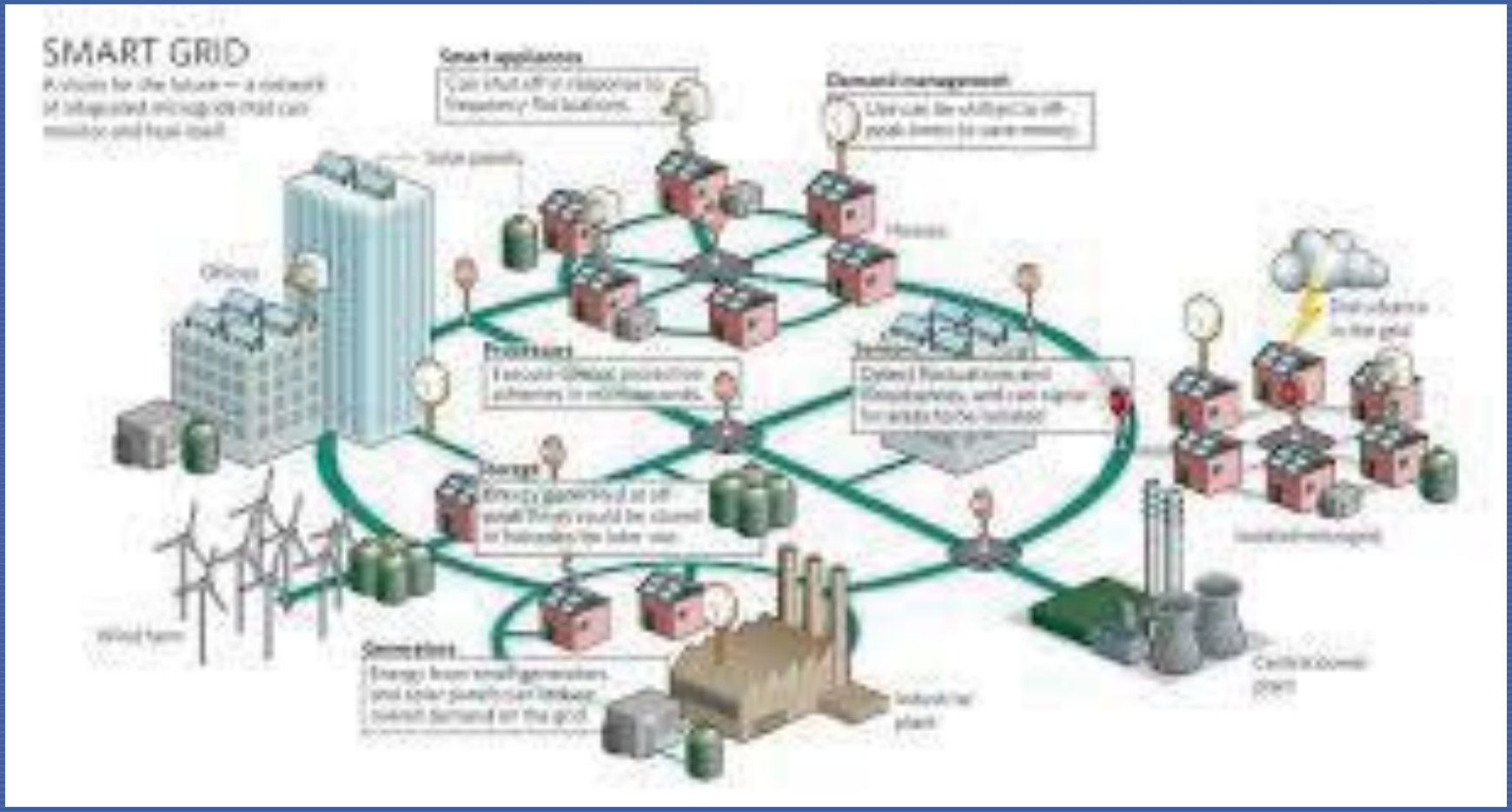
Smart Grid


SMART GRID
Smart appliances
Demand management
Storage
Wind farm
Industrial plant

Realistic Comparison of NAMAs

A system level evaluation should be done to make a realistic comparison of the Candidate NAMAs.

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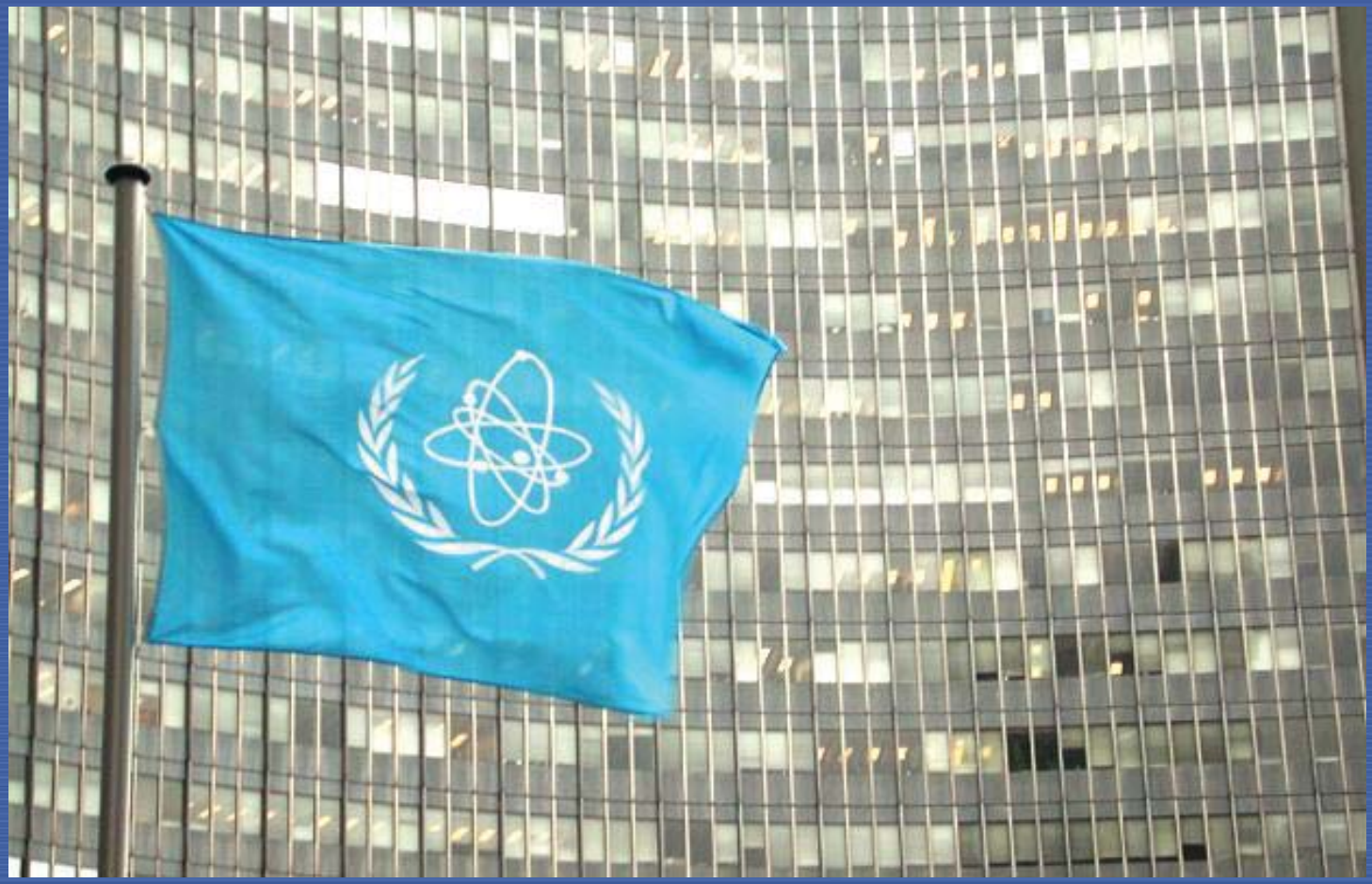
Thank You



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