SAARC ENERGY CENTRE

TECHNICAL AND FINANCIAL VIABILITY OF NET-METERING MECHANISMS

PERSPECTIVES FOR SAARC UTILITIES

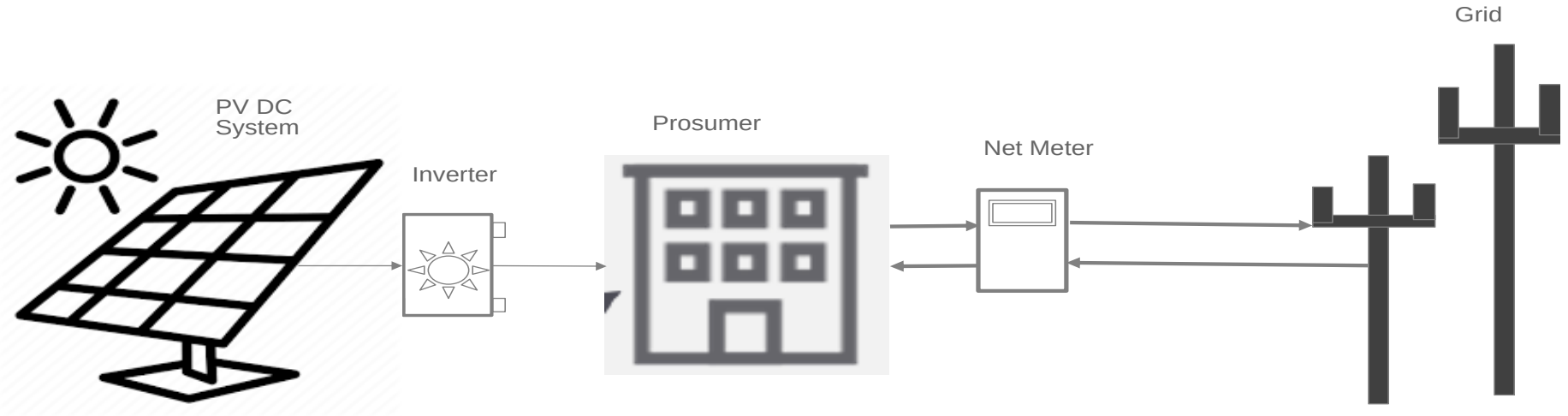
15th March 2021

Vinod Kala (Founder), Emergent Ventures International

Outline

1. *Introduction to Net Energy Metering (NEM)*
2. *Study Frameworks*
3. *Utility Analysis*
4. *Country Forecasts*

Introduction to Net Metering



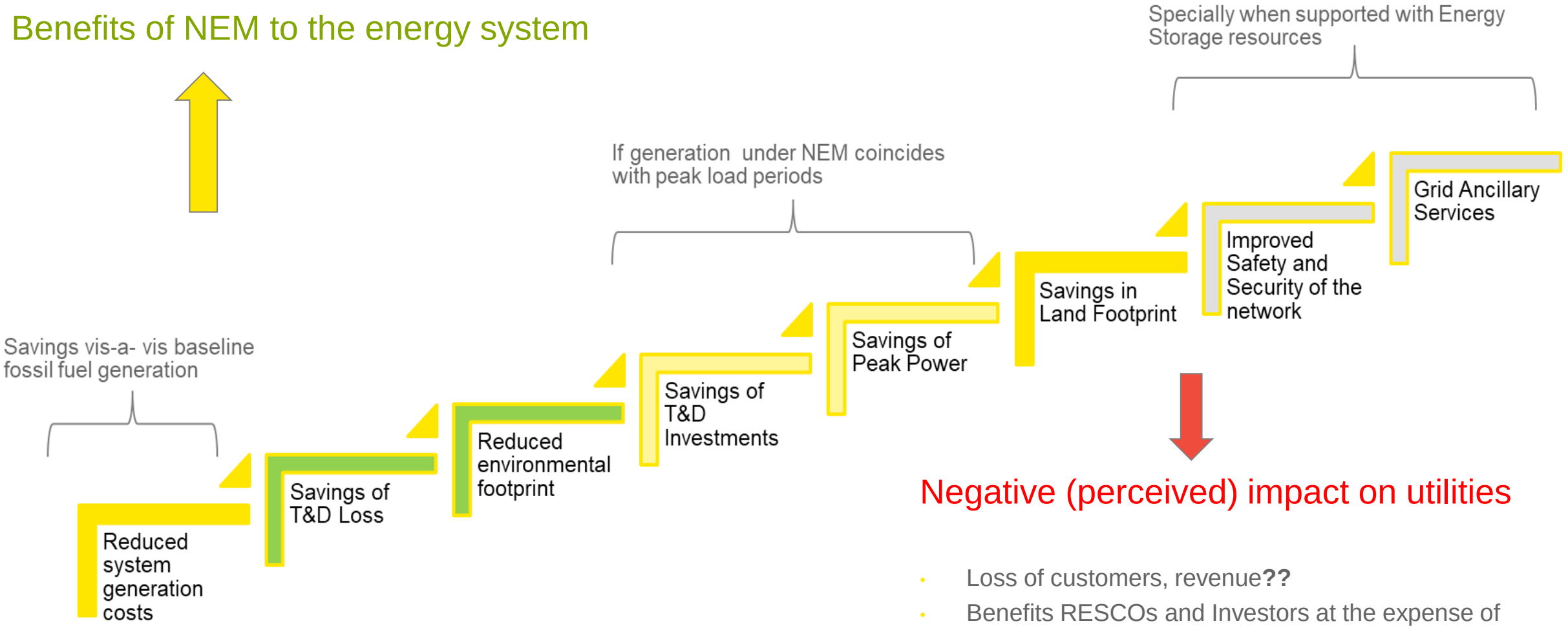
Net Export = ∑ Exports - ∑ Imports over a billing period

Electricity exported to the grid is credited to the customers and can be imported at another time

- Started in Massachusetts (US) in 1979 and **by 2018 55+ countries had adopted it.**
- **Distributed solar PV** capacity will more than double to **530 GW by 2024 (from 2019**), **an increase equal to that of onshore wind** or **almost half of total solar PV. NEM Policies drive it**
- Commercial and industrial segment is the largest (~75%) and residential (~25%). Many countries such as India are also applying it to agricultural and public infrastructure etc.

Benefits of Net Metering

Benefits of NEM to the energy system



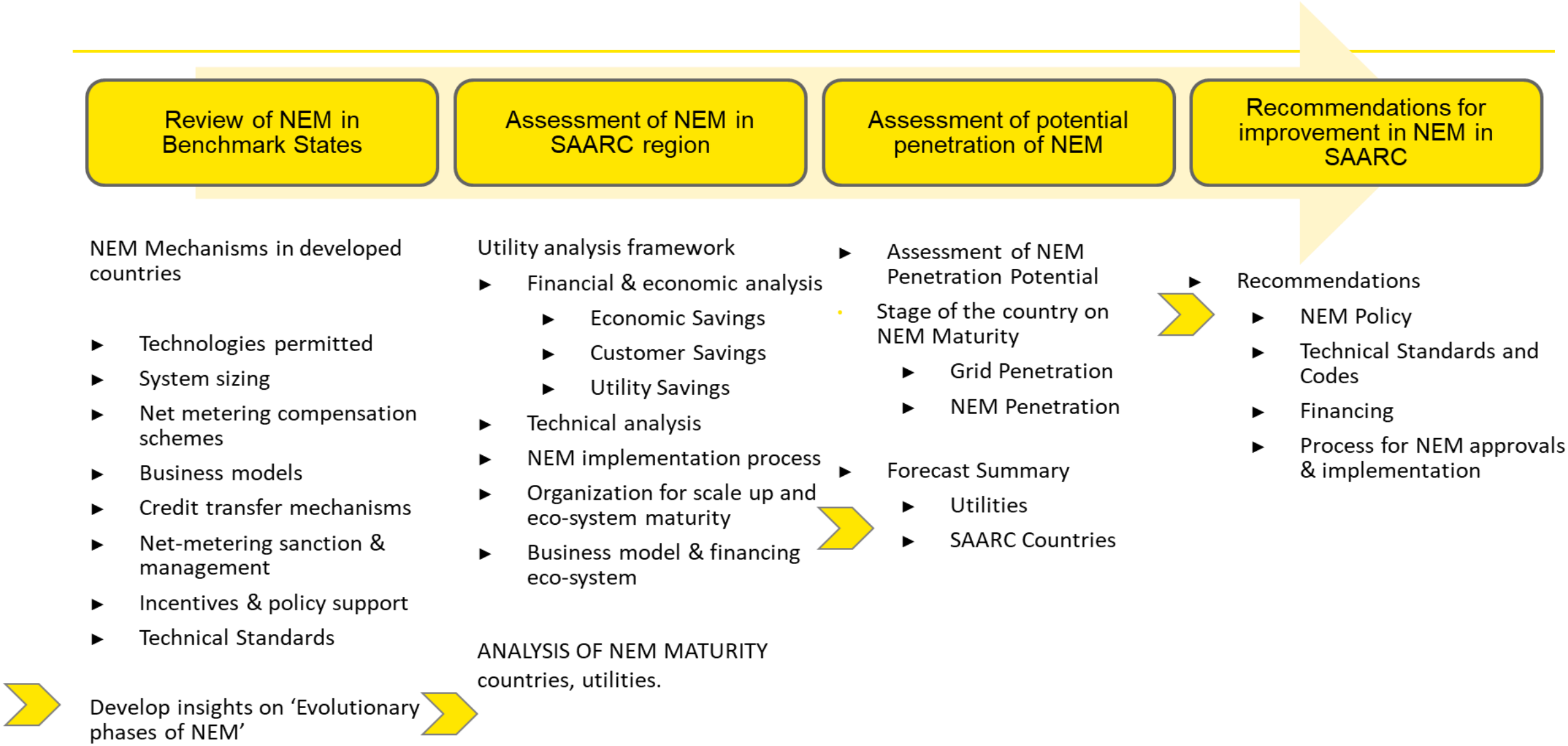
Negative (perceived) impact on utilities

- Loss of customers, revenue**??**
- Benefits RESCOs and Investors at the expense of poor customers unable to invest in NEM**??**

Benefits of Net Metering to the Prosumers

APPROACH AND FRAMEWORKS

Objective and Approach used in the study



Sustainable Solutions for the Planet

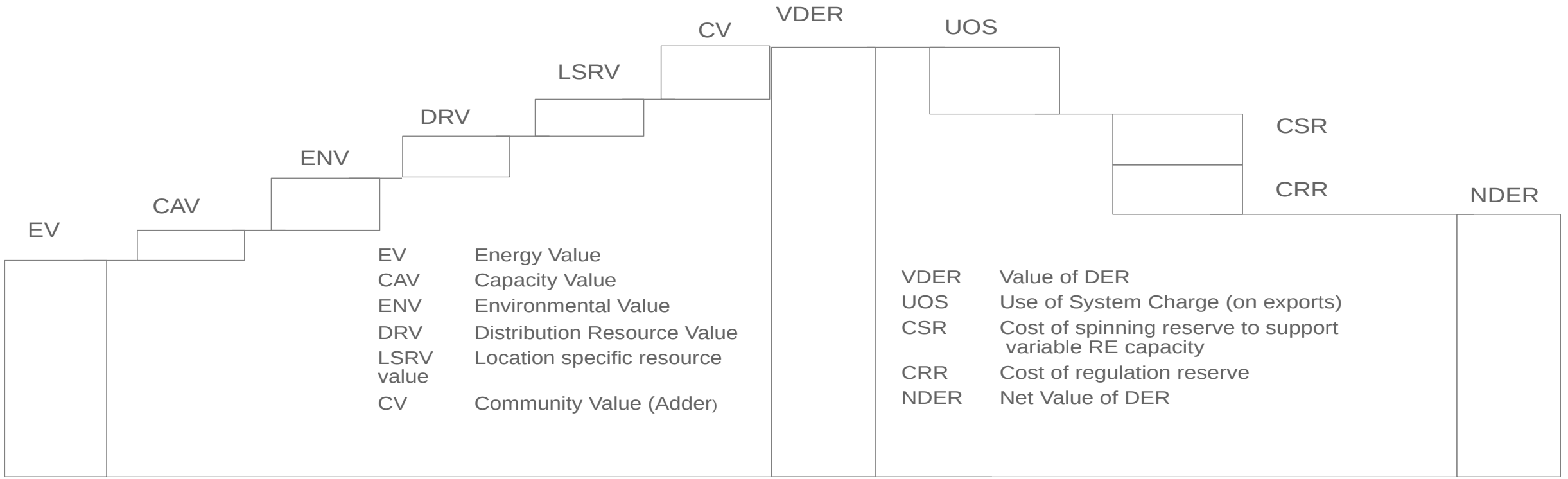
Key components of NEM mechanism and benchmark practices

Technologies	System Sizing	Compensation Mechanisms	Business Models	NEM Process	Policies and Incentives
Solar PV Solar thermal Biomass, Biogas Geothermal Wind Hydro **Energy Storage** Fuel Cells	**Minimum** 1KW **Maximum:** 10, 100, 1000, 10000 KW % of sanctioned load (100%) **Grid Capacity Linked** % of Grid Connected Load - 15% (beginners) - 100% % of Daily Minimum Load (DML) ~200%+ Hosting Capacity Assessment (HCA) **No Constraints**	**Net Metering** **All Buy and All Sell** **TOU Pricing** **Net Billing** Exports valued at a fixed price • Feed in Tariffs • Retail tariffs or a % of retail tariff • Average Pooled Purchase Price (APPC) of % • Avoided Cost for the Utility • Auctions (premium or price) • Energy exchange price • Value of Distributed Energy Resource (VDER) or Net Value of Distributed Energy Resources (NDER)	**Capex model** **RESCO** - PPA - Guaranteed Savings - Shared Savings - Lease - Roof Rent **Utility Anchored** - Demand Aggregation - Aggregated EPC - Super RESCO - Payment Assurance - On Bill Financing **Community Owned** Group and Virtual Net Metering	**Manual Process** **Web based process (registration-> sanction)** Technical assessments are manual. Info on vendors, standards, savings calculators, policy shared **Automated process** including basic technical assessments, HCA information, third party verification; special tariff available is estimated; Financing linkage **Automated + Operational Controls** from the Utility to keep the grid stable	**Merit order dispatch, no cost interconnections** **Taxes on fossil fuel-based generation** **Capital subsidies (% of capex)** **Generation based incentives, credits** **Feed in Tariffs, special tariff premiums, adders, cost waivers** **Investment Tax Credits; tax waivers** **Low-cost financing, warehouses, guarantees, bonds, ABS,**

As maturity improves

Sustainable Solutions for the Planet

Value based pricing of exported energy



Value of Distributed Energy Resource (VDER)

- Example- many US states

Net Value of Distributed Energy Resource (NVDER)

- Example- Singapore

Sustainable Solutions for the Planet

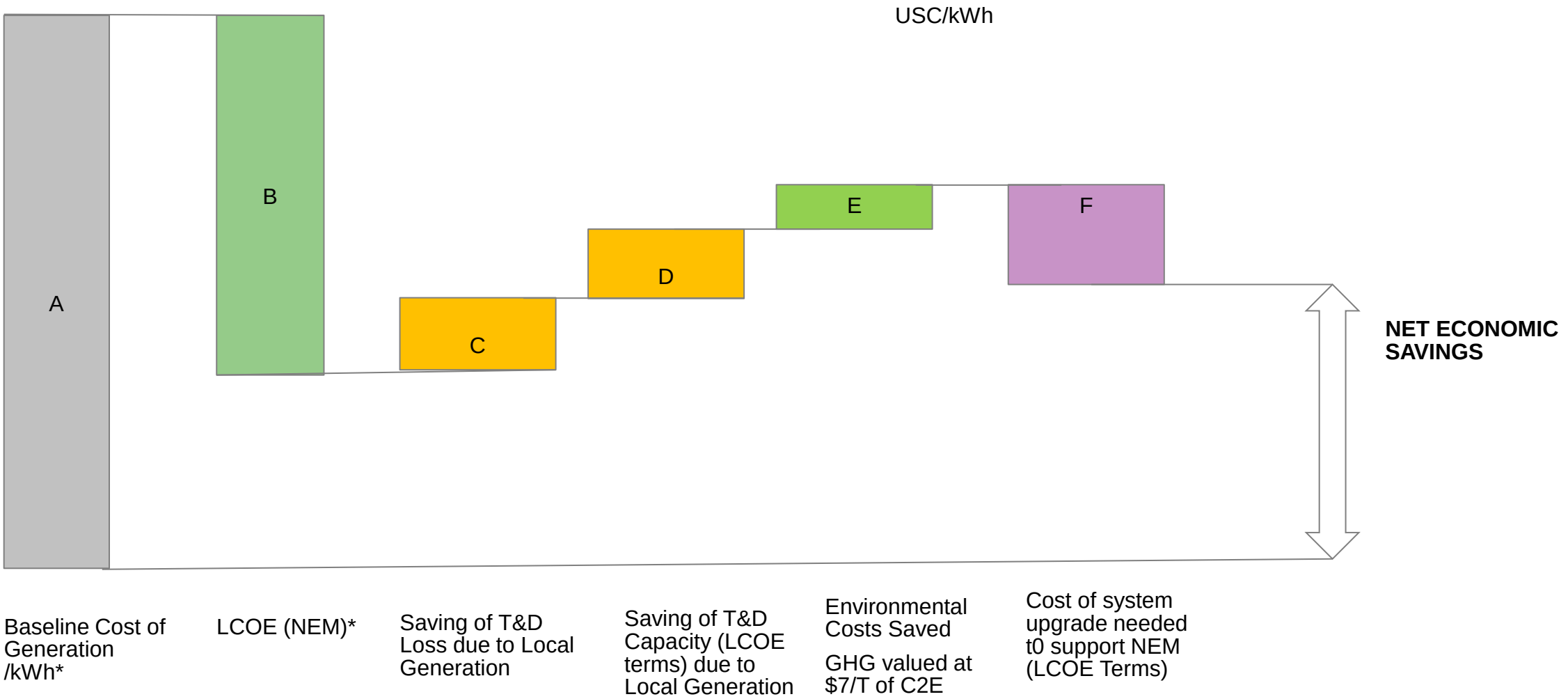
Phases of NEM Evolution

Parameter	Launch- Policy Support Phase	Transition Phase	Growth phase
1. Customer Attractiveness	LCOE (NEM) > Grid Tariffs Customer's need incentives	LCOE (NEM) < Grid Price in some cases	LCOE < Grid Tariffs + system savings - system support costs
2. Policy Instruments	Capital subsidies, special Feed-in tariffs generation-based incentives, ITCs etc. Capacity constraints	Mandates+ other subsidies of launch phase Tariffs close to avoided costs or APPC for utilities Aggregated public building programs Utility incentives Capacity Constraints relaxed	Slow transition to VDER or NVDER frameworks Support by battery storage Permitted. Control only on injected power **No Capacity Constraints**
3. Level of NEM Penetration	0-2% of grid capacity • First 3-4 years	2-5% of grid capacity • 4-8 years	5%+ can increase to 50% • 4 years+
4. Utility Perspective	- ve; Loss of revenue and customers	Realize some positive benefits of NEM; hesitation due to grid stability issues	+ve View of NEM as supporting grid, reducing costs

Phases of NEM Evolution

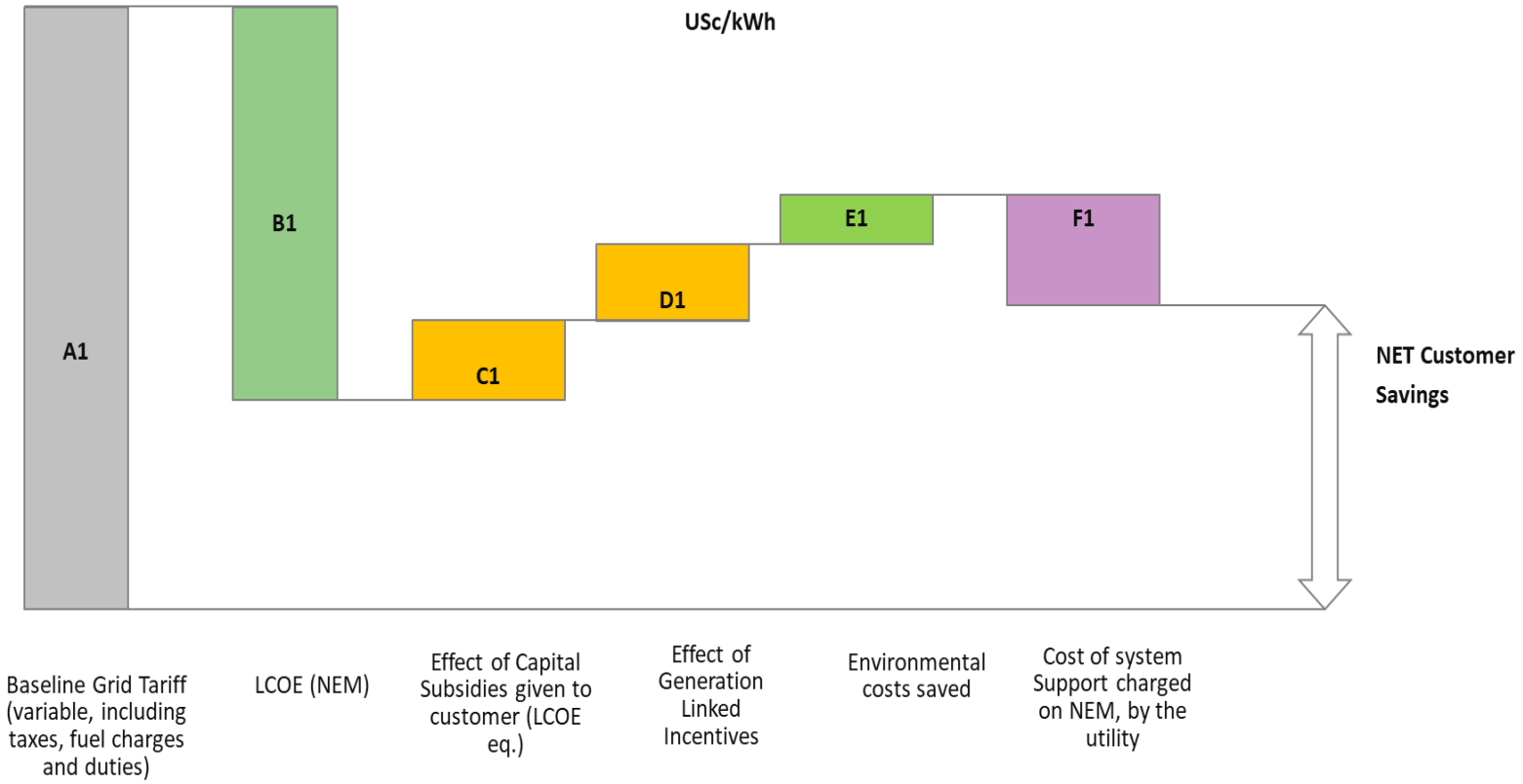
Parameter	Launch- Policy Support Phase	Transition Phase	Growth phase
Business Models	Capex Some RESCO Models	RESCO Models Get enriched (all forms) Utility Models introduced	RESCO Models Utility Anchored Models Community Models (Group and Virtual Net Metering)
Monitoring and Control of NEM	Negligible Monitoring and Control of NEM systems	Rigorous Monitoring begins; Utility set up central monitoring and control centers	**Grid Codes improved to enforce (ex IEEE1547…)** • Wide operating bands for voltage and frequency • Response to voltage, frequency, fluctuation. • Fault ride through capabilities; delayed shutdown and quick re-start • Control of active and reactive power injection by the utlity

Economic Savings of NEM - NES

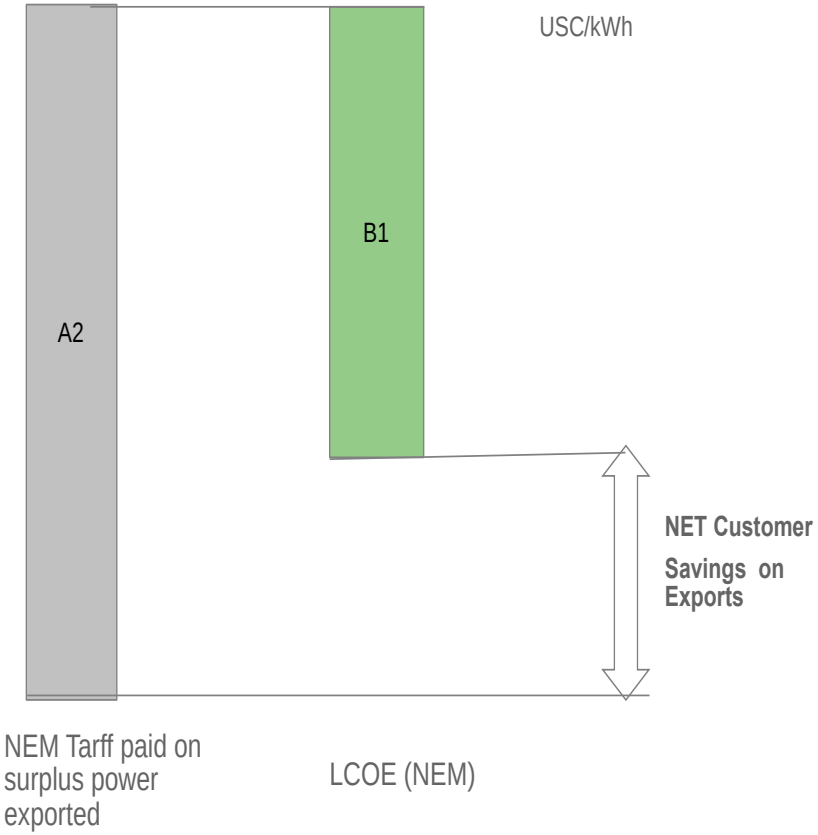


Financial Savings for a Customer - NCS

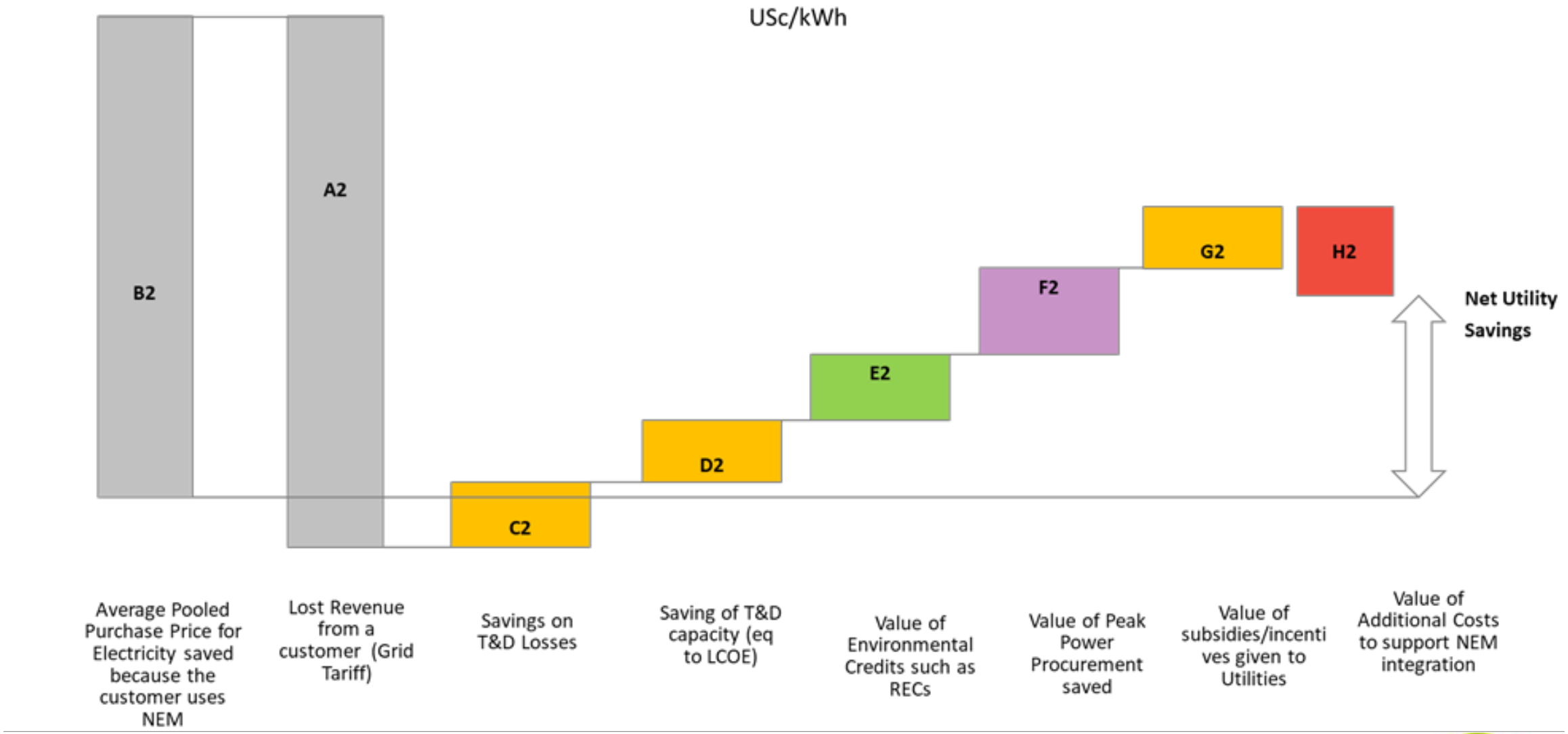
NCS-1 = Customer Savings from internal consumption



NCS-2 = Savings from Net Exports

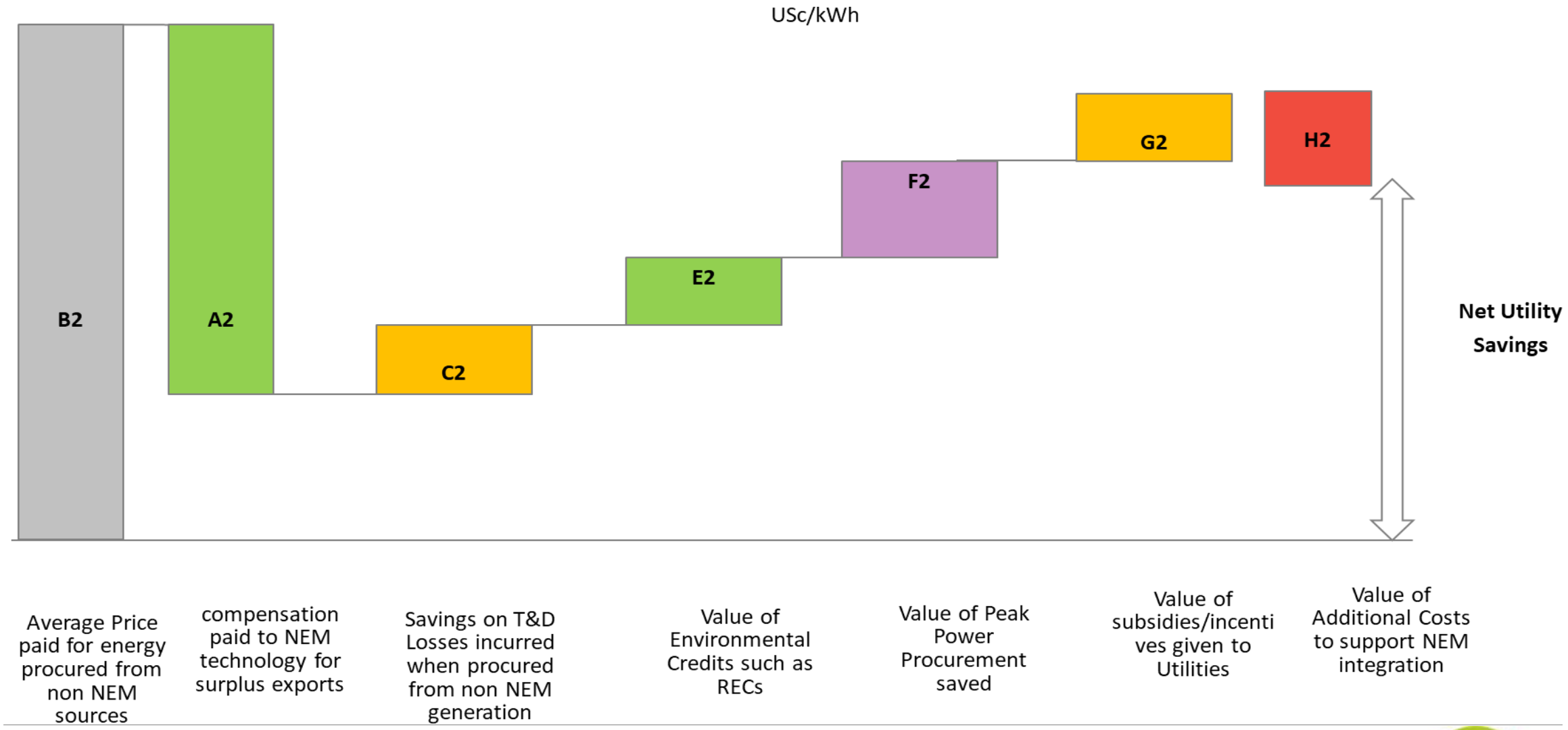


Savings for a Utility- in flat demand scenario - NUS



Sustainable Solutions for the Planet

Savings for a Utility- for fast expanding energy demand (like in SAARC)- NUS



Sustainable Solutions for the Planet

ANALYSIS OF UTILITIES IN SAARC STATES

Sustainable Solutions for the Planet

Utilities chosen for the study

India

1. BSES Rajdhani Power Limited (BRPL)- Delhi
2. Punjab State Power Corporation Limited (PSPCL)
3. Bangalore Electricity Supply Company (BESCOM)
4. Maharashtra State Electricity Distribution Corporation Limited (MSEDCL)
5. Chhattisgarh State Power Distribution Company Ltd (CSPDCL)

Pakistan

1. K-Electric (formerly Karachi Electric Supply Company KESC)
2. Islamabad utility- Islamabad Electric Supply Company (IESCO)

Bangladesh

DPDC- Dhaka

Sri Lanka

Ceylon Electricity Board (CEB)

Framework of Analysis for Utilities

Stakeholder Consultations: Utility Officials, other Experts

- Check on existing policies, processes, organizational intent etc. Timelines for approvals. Techno economic assessments carried out.
- Improvements needed in policies/processes, organizational preparedness.
- Key assumptions relating to economic and financial analysis- sources of energy, costs etc.
- Experience so far- what do the customers feel, utility's need to adopt NEM, technical challenges faced etc.
- What business models are working? Financing strategies used. What is needed

Sustainable Solutions for the Planet

Key features of utilities studied

Policy, sizing

Most utilities keep the size restrictions between 1 KW to 1 MW.

However, DPDC permits 3 MW capacity. BRPL, CSPDC have removed upper Cap (absolute).

Most utilities permit < 100% of sanctioned load, except KESCO and IESCO (Pakistan), which allow up to 150% of load as DC capacity.

Pakistan sanctions capacities up to 15% of grid capacity which is very restrictive. PSPCL permits only up to 30% of grid capacity.

PSPCL restricts generation <90% of consumption

Except MSEDCL no other utility clearly defines energy storage as acceptable under NEM

Compensation Mechanisms

CEB offers multiple options (NEM, NA, Net+)- attractive tariff (US¢ 11.9/kWh).

MSEDCL, CSPDC and PSPCL have low tariffs. ABAS tariffs are low.

Other utilities use APPC prices for compensation

BRPL offers a 3-year generation-based incentive (~USC 3/kwh) for residential segment.

India provides 20%-40% capital subsidy for residential segment (up to 10 KW). Also supports agricultural NEM with 60%+ subsidies.

Technical Preparedness

BRPL, BESCOM, have done significant technical assessments of the grid to absorb NEM.

Frequency/ voltage bands are tight in most countries except India- can lead to grid issues as penetration increases.

Indian utilities are setting up online automated processes for approvals. Other utilities are also taking steps in this direction.

Business Models, Financing

BRPL also has provisions for Virtual Net Metering and Group Net Metering, which allows transfer of credits. This will help maximize the utilization of roofs and encourage the participation of residents with ‘no roof’.

Most Indian Utilities are implementing Utility Anchored Demand Aggregation.

RESCO models still evolving in SAARC member states except India, where large investments are happening.

Most countries have used low- cost loans ~6% as supporting individual investments.

India has started looking at specialized mechanisms such as ABS, Green Bonds, Guarantees etc.

Organization for Scale-up and Eco-system Development

Permitting process

Indian utilities have implemented online process for application submission and processing.

The level of automation varies and in many cases it is low.

Online tools for roof top assessment, savings assessment etc. have been provided to help customers make decisions regarding investing in NEM technologies.

Certification of Vendors

Empanelment or certification of vendors is used in all the four countries

The quality of vendor's work varies significantly.

Stricter monitoring, regular review of certification, and penalties may be needed to ensure service quality.

Third party certifiers/verifiers to support grid synchronization and verification of final system (e.g. as applied in Singapore).

Market Development

India has developed programs covering Public Buildings, Railways, Schools, Universities, Public Health Facilities, Defence Infrastructure, Airports, Telecom Towers, Petrol Pumps etc. This helped generate the interest of high-quality investors and contractors.

SREDA (BD) is looking at 8 sectors focused programs.

Sri Lanka was planning to launch programs for low-income households and public buildings using the loan (US$100 M) from India.

Training

India has *'Surya Mitra'* (the 'Friends of the Sun') program.
By National Institute of Solar Energy

The database of trained technicians is maintained and is accessible to the Industry.

Training is also available for engineers, entrepreneurs and other stakeholders involved with NEM implementations.

International Solar Alliance (ISA), headquartered in Gurgaon, India, can be approached for organizing training initiatives in various member states

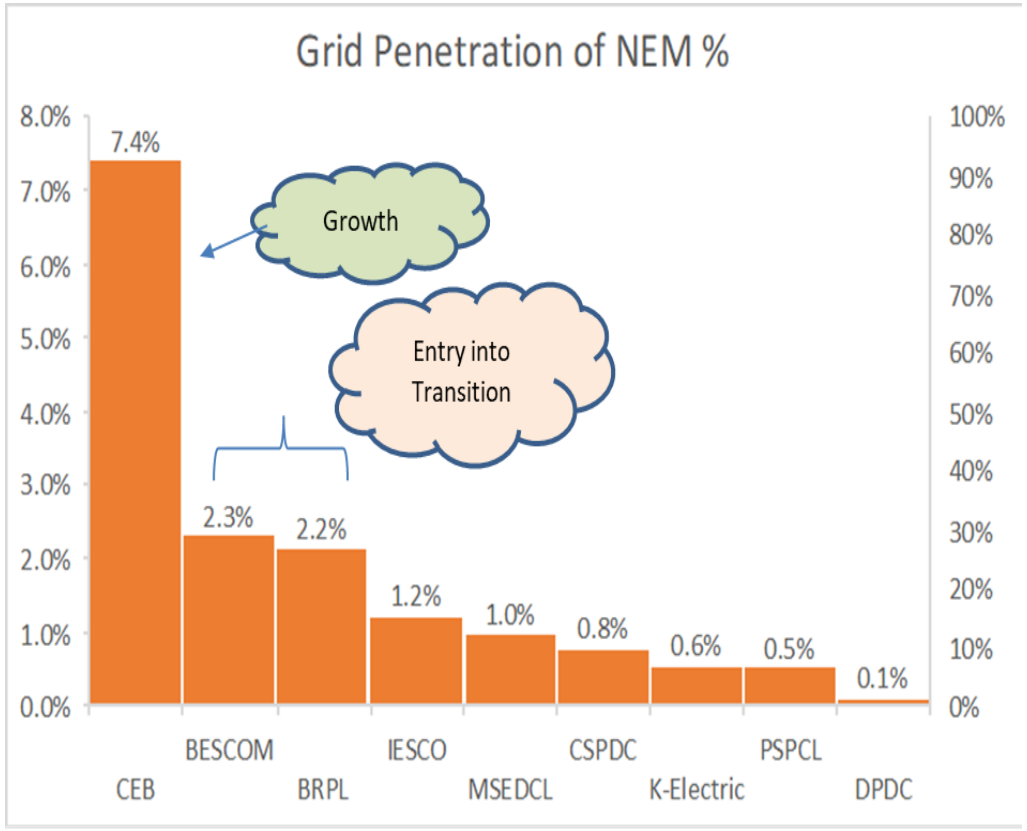
Monitoring and control of systems

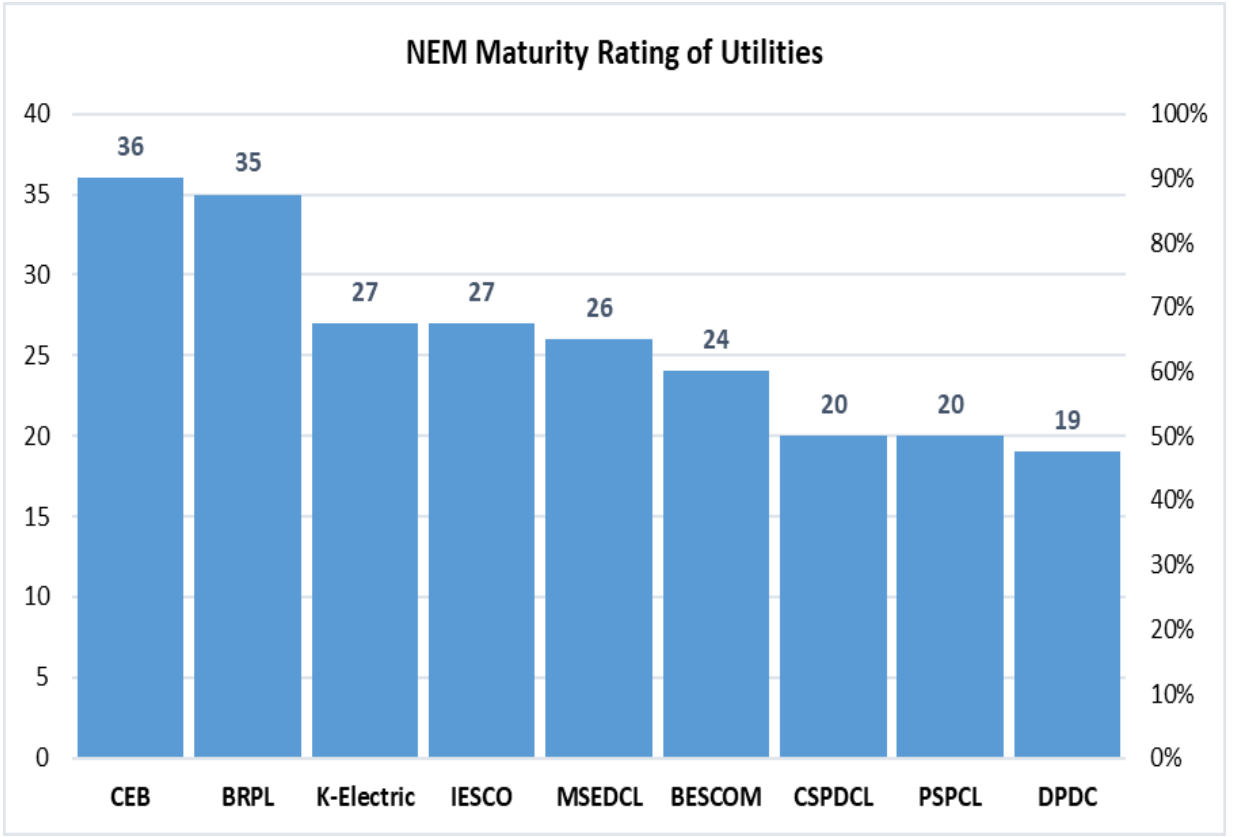
BRPL, BESCOM, MSDECL are implementing central control rooms where performance data from NEM solar plants can be collected and processed to support forecasting and control functions.

Monitoring and automated controls of distributed renewable capacities using digital platforms and AI tools will soon become necessary.

Utilities need to start planning for such systems.

Grid Penetration and NEM Maturity



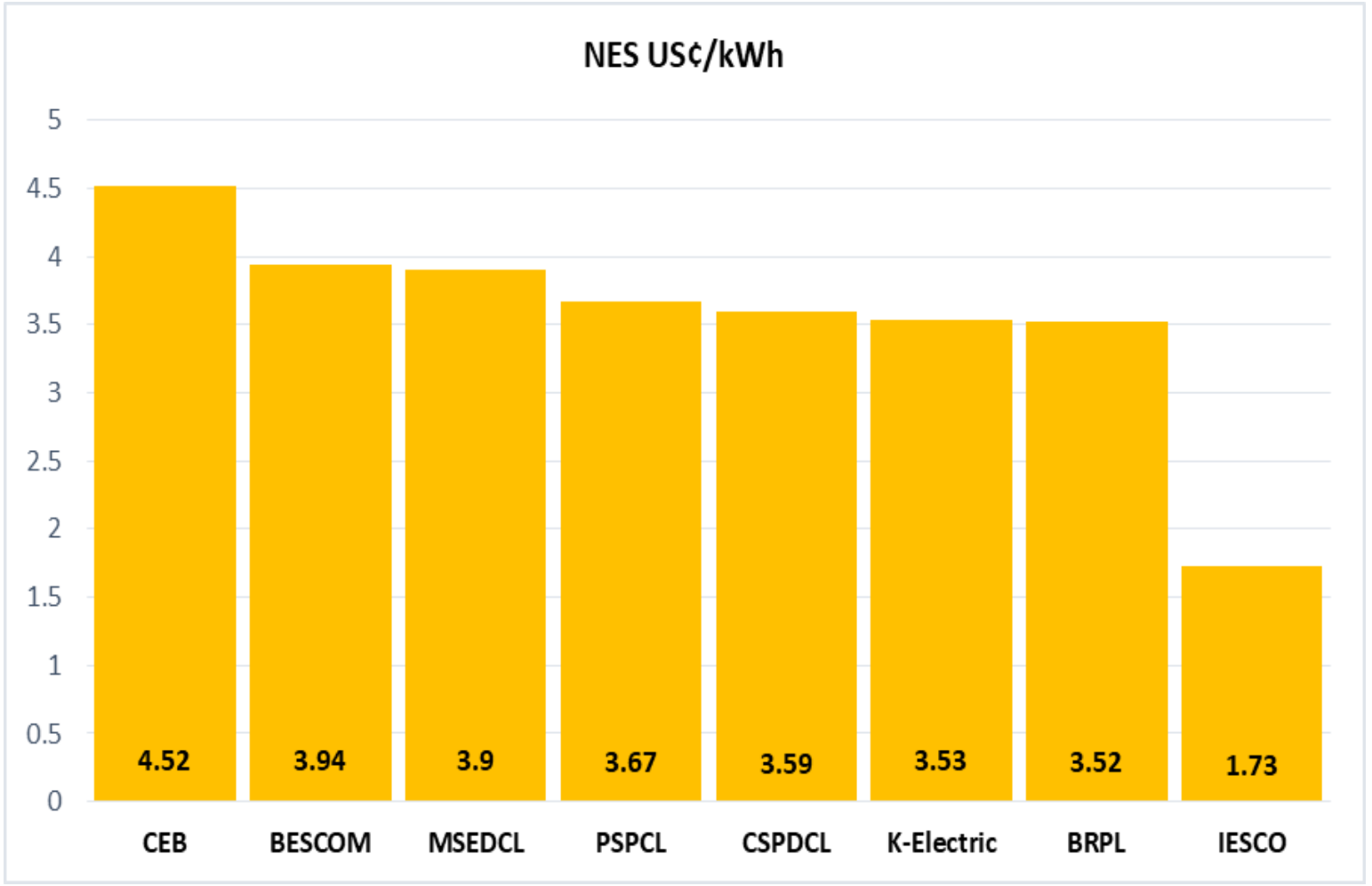


NEM Maturity based on ratings

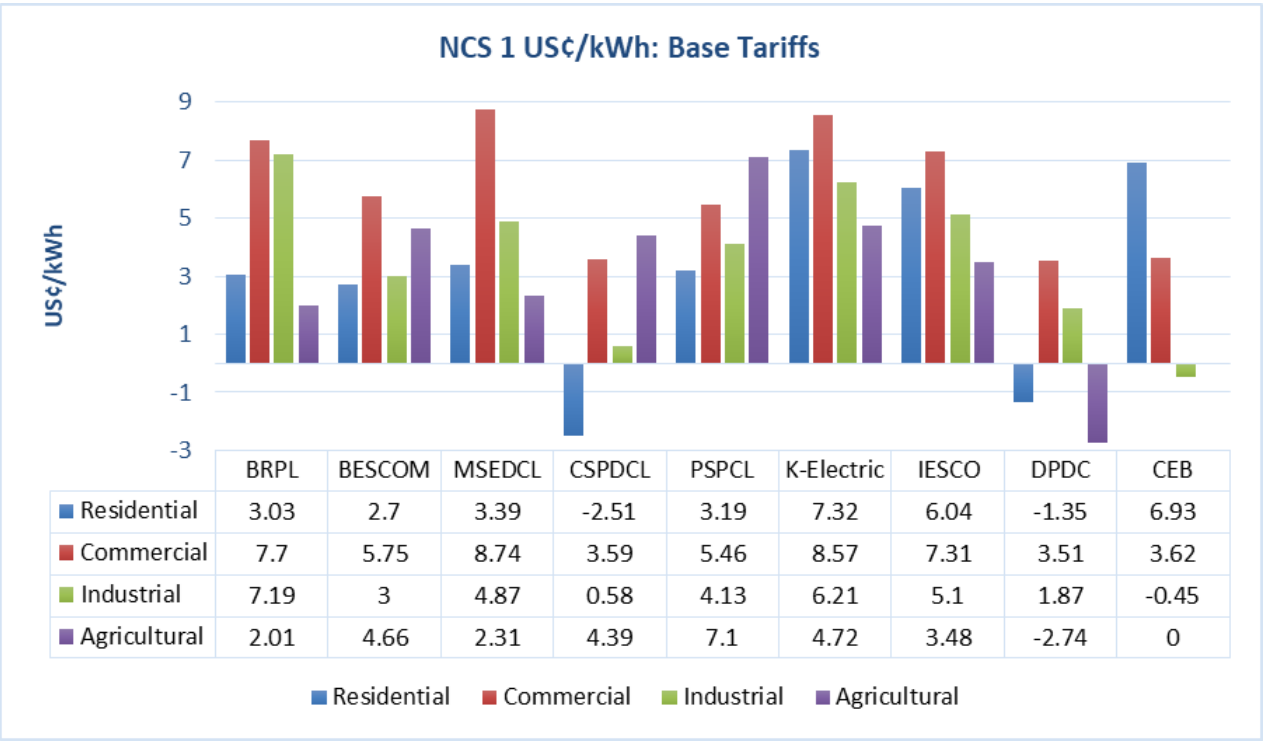
- Stakeholder (Government, Customer, Utility) buy-in
- Maturity of eco-systems , Availability of Finance, Maturity of Business Models

Sustainable Solutions for the Planet

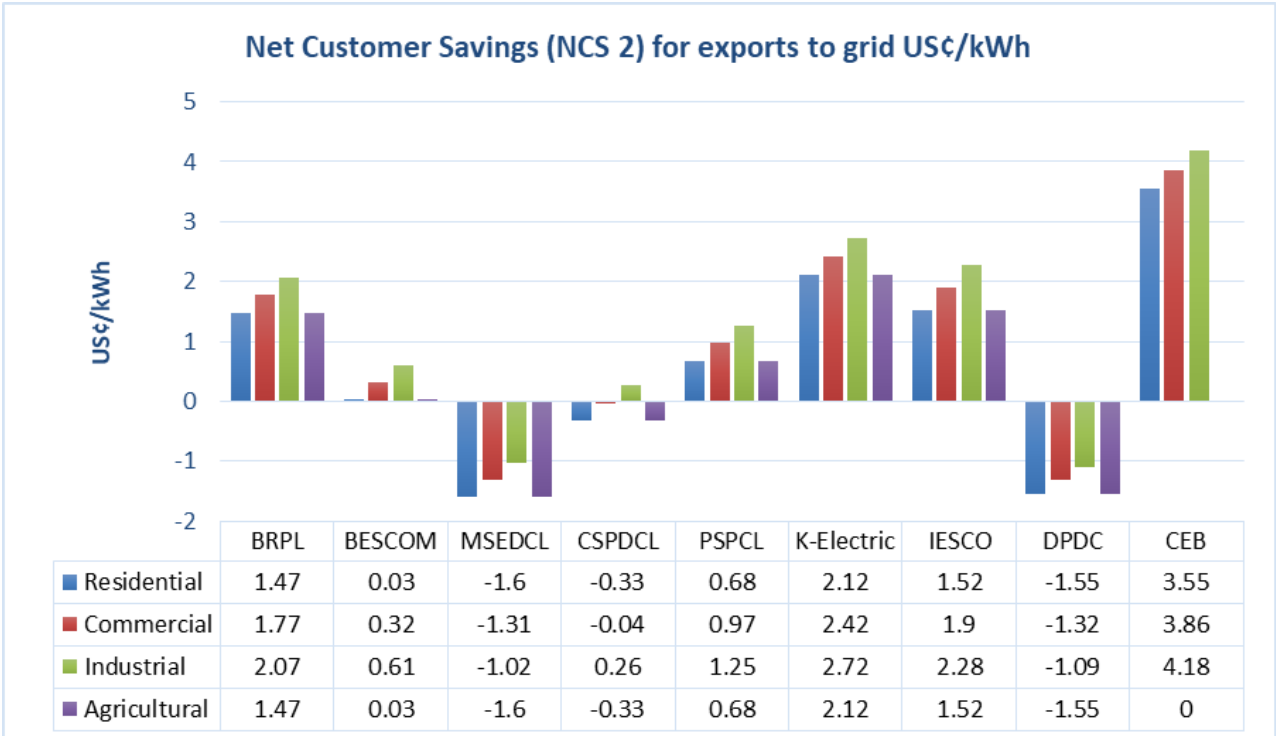
Net Economic Savings for Utilities



Net Customer Savings



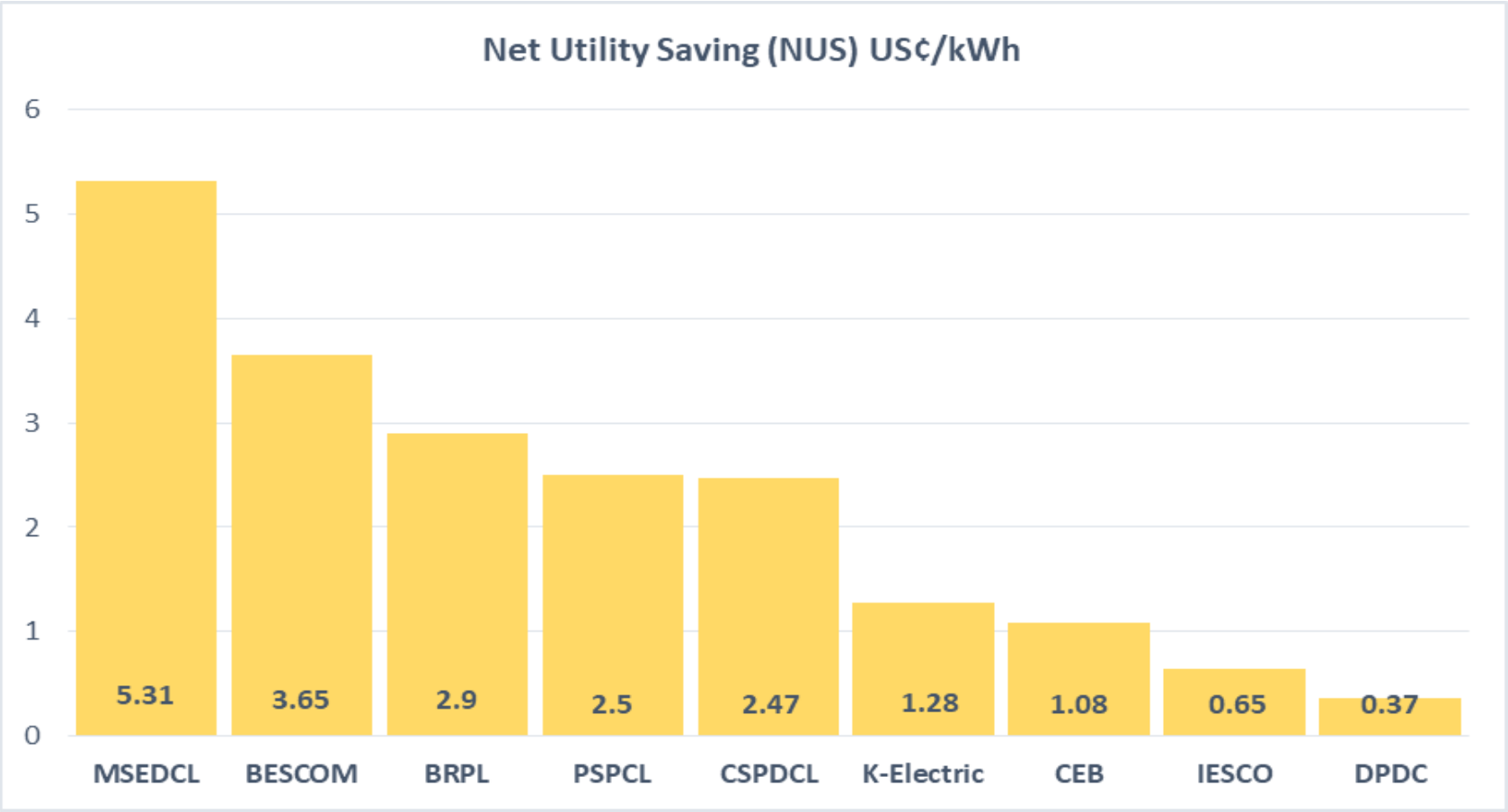
	BRPL	BESCOM	MSEDCL	CSPDCL	PSPCL	K-Electric	IESCO	DPDC	CEB
Residential	3.03	2.7	3.39	-2.51	3.19	7.32	6.04	-1.35	6.93
Commercial	7.7	5.75	8.74	3.59	5.46	8.57	7.31	3.51	3.62
Industrial	7.19	3	4.87	0.58	4.13	6.21	5.1	1.87	-0.45
Agricultural	2.01	4.66	2.31	4.39	7.1	4.72	3.48	-2.74	0



	BRPL	BESCOM	MSEDCL	CSPDCL	PSPCL	K-Electric	IESCO	DPDC	CEB
Residential	1.47	0.03	-1.6	-0.33	0.68	2.12	1.52	-1.55	3.55
Commercial	1.77	0.32	-1.31	-0.04	0.97	2.42	1.9	-1.32	3.86
Industrial	2.07	0.61	-1.02	0.26	1.25	2.72	2.28	-1.09	4.18
Agricultural	1.47	0.03	-1.6	-0.33	0.68	2.12	1.52	-1.55	0

Sustainable Solutions for the Planet

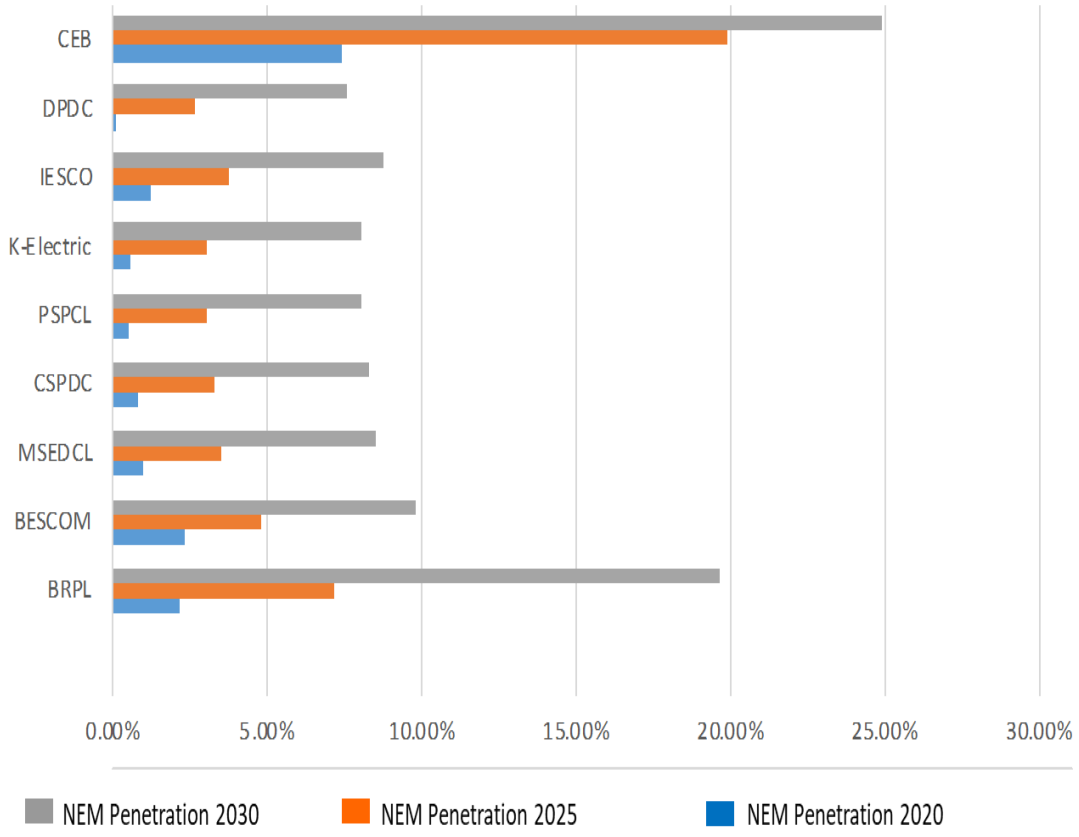
Net Utility Savings



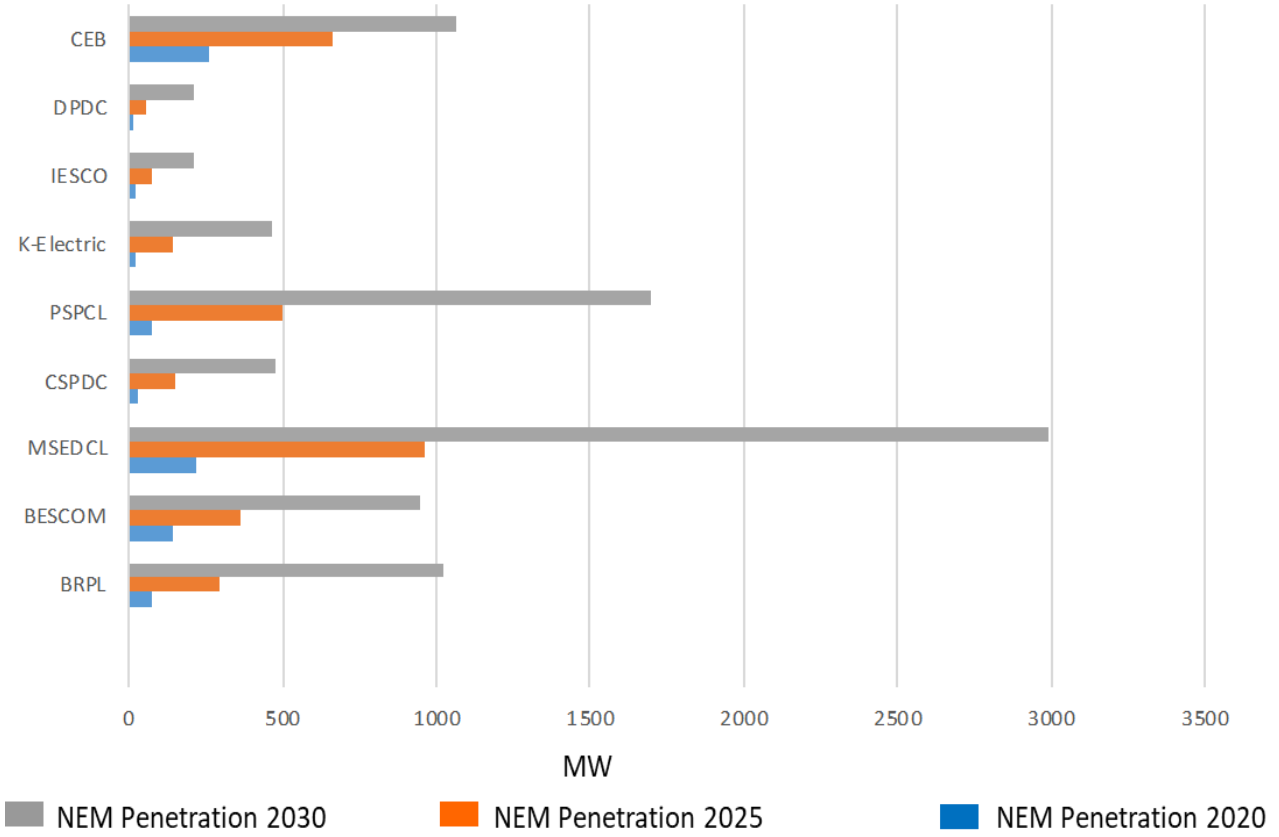
Sustainable Solutions for the Planet

Forecast Performance NEM

% Penetration



MW Capacity



Sustainable Solutions for the Planet

RECOMMENDATIONS

Policies

Area	Suggested Policy
Placement	Any place behind meter (roof, ground, facade)
Capacity definition	Capacity equal to the Injected capacity into the grid - Can include ESS which will reduce injected capacity into the grid - Can have higher DC capacity
Capacity Limits	- but no absolute restriction; initially can be <100% of sanctioned load <100% of Grid Capacity. After that based on HCA assessments
Compensation Modes	Should permit all 3 modes: • NEM • Net Billing • ABAS Across all segments
Compensation Tariff	Between APPC price and LCOE of solar.
Business Models	Should permit all types • RESCO • Utility Anchored • Community Models (Virtual Net Metering or Group Net Metering) in the mature growth phase.

Policies

Area	Suggested Policy
	Demand Aggregation, EPC Aggregation models of utilities can be introduced first. Later Bill Financing or Payment Assurance Mechanisms can be introduced. For utility anchored models, the principles of transparency and reasonable margins, fairness and equitable treatment of customers may be set
Subsidies and Incentives	For subsidized segments such as low paying residential or agricultural segments, subsidies could be given: • Capital subsidy • Generation based incentives These could be given for a time till the tariffs are corrected or till LCOE of solar falls to justify market-based investments in NEM. Subsidies could be funded by Carbon Tax or equivalent on fossil-based generation plants or public benefit charges. Utilities can be given incentives linked to adoption of the NEM program; to support their investment in upgradation of grid infrastructure for NEM

Technical Standards

- Relaxing frequency and voltage band to allow larger operating range.
- Remote control over power injection from NEM plants, limiting output to 60%, 30% or 0%. Automatic reduction of power output, once frequency goes past a limit (+0.4%/ 50.2 Hz).
- Remote setting of reactive power values from the NEM system to provide grid support, in response to grid conditions.
- Fault-ride through capabilities
- Tap changing of voltage in distribution transformers in response to signals from the grid.
- Wide area measurement of voltage to provide appropriate signals to distribution transformers and to the NEM systems.

Financing Mechanisms

Credit lines are already providing the base structure for Bank Finance.

Utility as the channel for NEM finance

- Residential, SMEs, Schools, Hospitals, Offices, Markets etc.
- On Bill Financing or Super RESCO Models

Bundled Finance, Priority Finance norms.

- Use existing relationships with individuals or SMEs to bundle NEM Loans.
- Home Loan bundling
- Fast approval times.

Re-financing of debt for operating portfolios, through bonds

- Green bonds, Sustainable Impact Bonds.
- ABS

Risk mitigation products

- Partial Risk Guarantee Funds

Warehousing Facility

Islamic Finance

- Leasing or deferred payment products.

NEM Application Process

- High degree of automation.
  - This includes document uploads, technical assessments
  - Validation of customer identity, vendor identity, availability of data on location of the customer premises, meter numbers, customer loads, consumption patterns, tariffs, billing, payment track record etc.
- Display of important grid details
  - such as NEM capacity already sanctioned, waiting for sanction, the capacity of the distribution grid, grid availability data, NEM capacity that can be further granted.
- Assessment Tools
  - Assessment of size savings and financial feasibility.
- In principle approval based on online assessment of designs submitted, online queries and vendor declaration, for smaller systems
  - For larger systems and for cases which need load assessments, a third-party verifier visits the site, collects photos, data, and observations, and submits report to the utility online.
  - Time bound – say 15 days
- Signing of contracts online
- Third party/vendor verification prior to grid synchronization
  - Digital records
- Other Interfaces – such as bank finance, subsidy disbursal etc.

THANK YOU