ERIA Research and Policy Overview of Renewable Energy Uptake in ASEAN+6

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Renewable Energy shares in EAS Economies, 2011

Members	TPES	Shares (%)			
	(MTOE)	Bio	Hydro	Other REs	Non-REs
China	2,438	8.3	2.6	0.7	88.5
India	688	24.8	1.4	0.3	73.5
Japan	497	1.2	1.4	0.7	96.7
Korea	250	0.5	0.1	0.1	99.3
Indonesia	208	26.0	0.7	7.8	65.5
Australia	125	4.1	0.9	0.5	94.5
Thailand	117	19.3	0.4	0.0	80.3
Malaysia	73	4.7	0.8	0.0	94.5
Vietnam	59	24.8	4.0	0.0	71.2
Philippines	38	12.6	1.8	22.3	63.4
Singapore	33	0.6	0.0	0.0	99.4
New Zealand	18	6.5	11.7	20.8	61.0
Myanmar	14	75.3	3.1	0.0	21.6
Cambodia	5	72.0	0.1	0.0	27.9
Brunei	3	0.0	0.0	0.0	100.0
Lao PDR	2	67.0	13.0	0.0	20.0
EAS	4,568	11.0	1.9	1.1	86.0
World	12,782	9.8	2.3	0.9	87.0
EAS/World %	35.7%	40.1%	29.7%	45.0%	35.3%

Source: ERIA calculations using data from the IEA (2012) and IRENA (2013)

ERIA RE Study Themes

1. Standards and Potentials of Biofuel Markets

2. Best Mix of Renewable and Conventional Energy Sources for Sustainable Development

3. Bench Marking of Renewable Mobility Fuel

4. Utilizing Conventional and New Type Geothermal Resources

5. Energy Grid Connectivity in Myanmar

5. Low-carbon Energy Systems

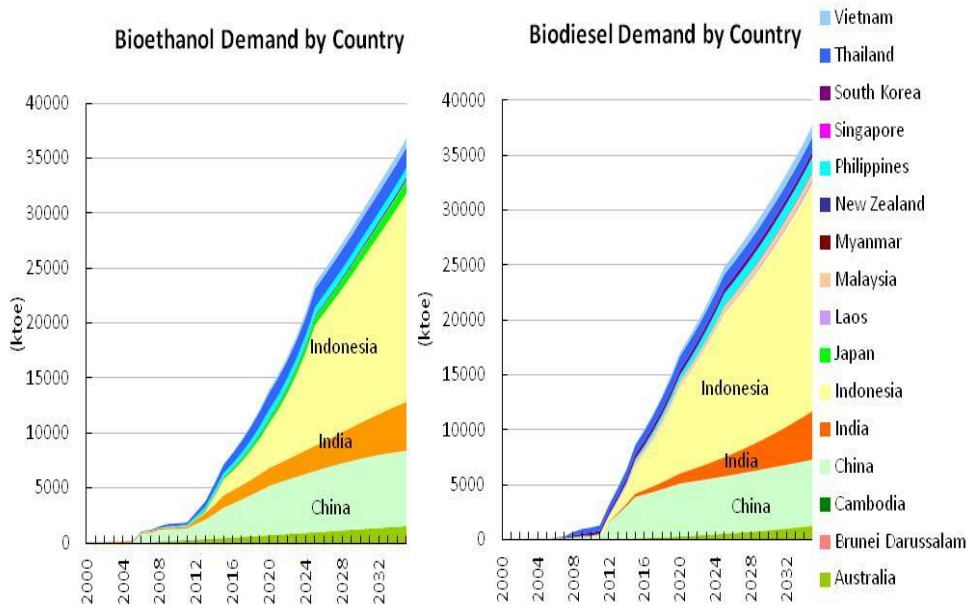
Potentials on Biofuel Market

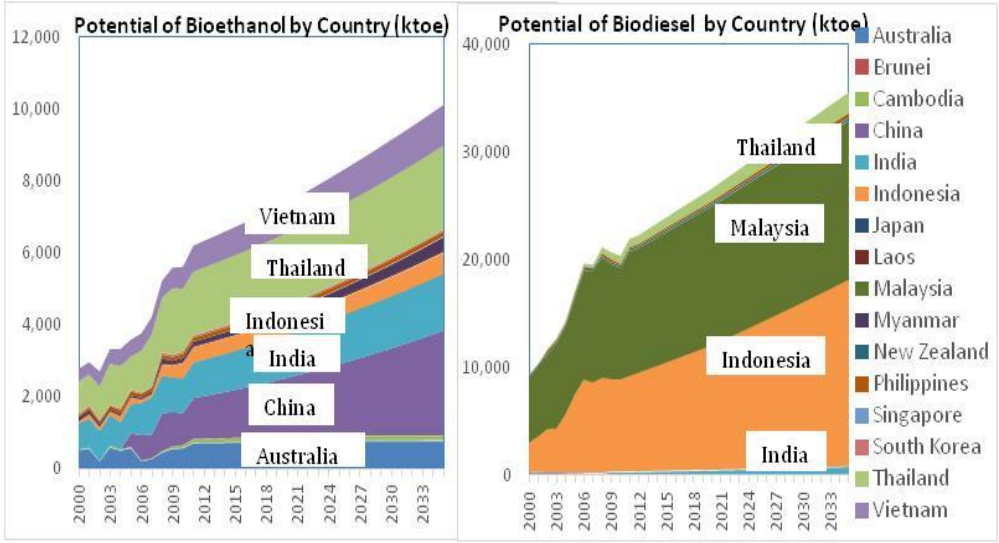
Scope:

- Countries in Focus: Indonesia, Japan, Malaysia, Philippines, Thailand
- Quantitative analysis of demand/supply outlook in consideration of policies
  - Methods: Econometrics for demand and Agricultural production model for supply side
  - Feedstocks are based on conventional 1st generation technologies

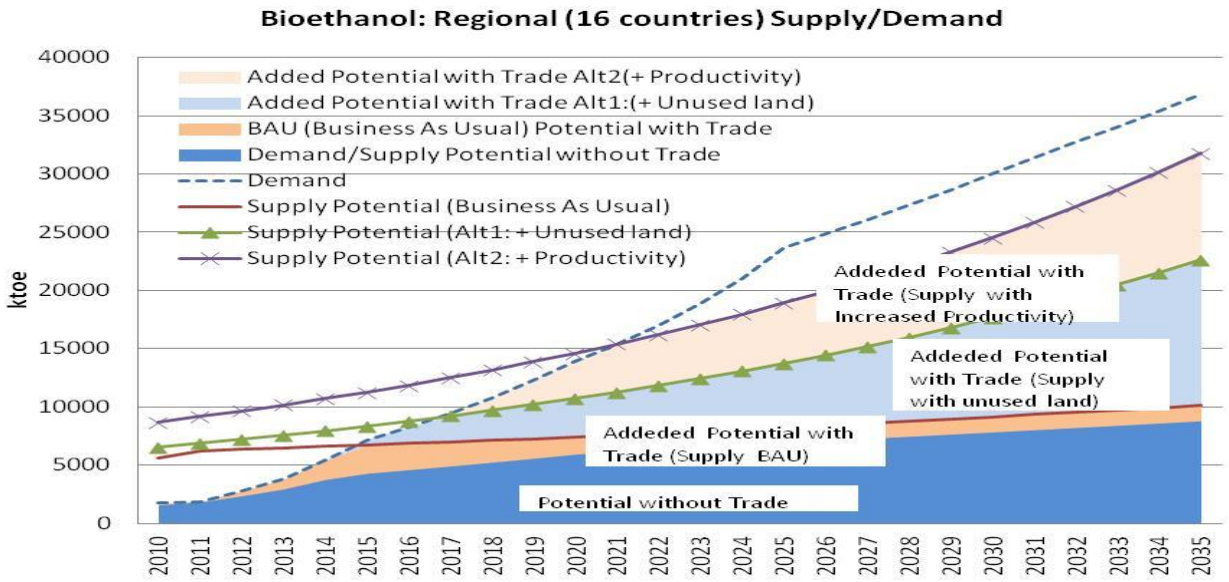
Supply/Demand Outlook

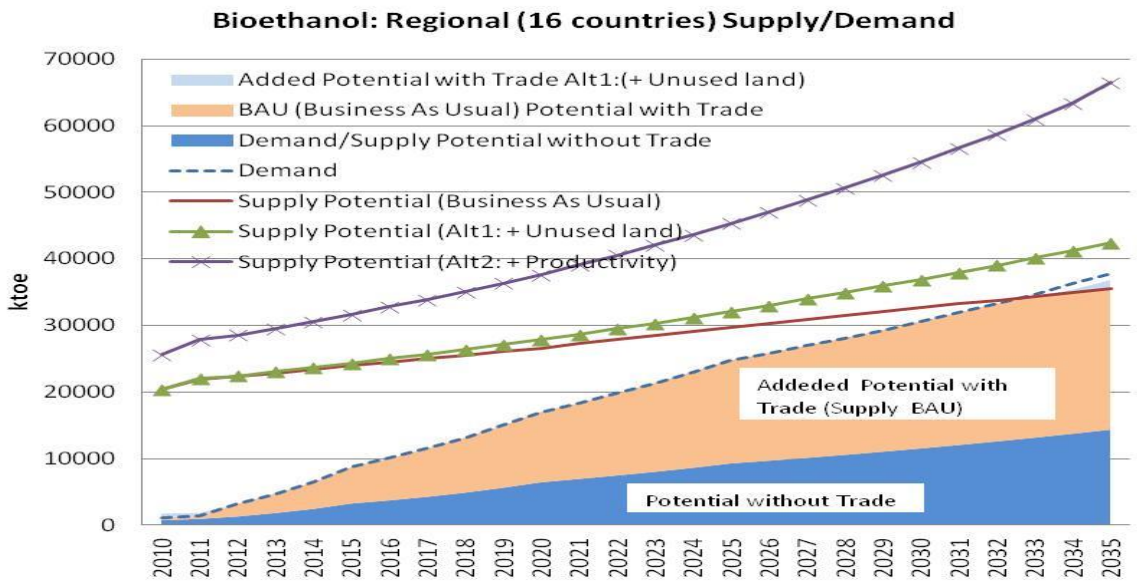
- Demand: several countries become the key players for both bio-ethanol and bio-diesel
  - Indonesia with ambitious targets for bio-fuels leads the demand followed by China and India. By 2035, the total demand will reach more than 70 million toe.
- Supply Potential (BAU): source countries are diversified for bioethanol, but limited in biodiesel supply
  - Feedstocks for commercially competitive bioethanol are diversified and supply source countries are also diversified to include Thailand and Vietnam.
  - Feedstocks for commercially competitive biodiesel are limited and the supply source countries are also limited.





Potential on Biofuel Market





Potential depends on the supply and trades

Bioethanol

- Regional Trade will be very important to fully realize the regional market potential. Without increased trade the regional potential could not reach 10,000 ktoe by 2035
- Supply limitation is serious with BAU: shortage will come by 2015 – this case is below the level of the needs of trade.
- Assuming free trade in biofuels, utilization of unused land (Alt1) could ease the shortage substantially with added supply of 25,000 ktoe by 2035, although the shortage will come by 2017.
- Additional supply potential with increased productivity (Alt2) could contribute to the market potential further with additional 10,000 ktoe by 2035. Still shortage could come in early 2020s and the shortage could remain as large as 5,000 ktoe until 2035 or later.

Biodiesel

- The role of trade is important. Without enhanced trade the potential will be below 15,000 ktoe by 2035.
- The trade could add the potential of about 20,000 by 2035 in business as usual case (BAU). But the shortage could come as early as 2030s without utilization of unused land (Alt1).

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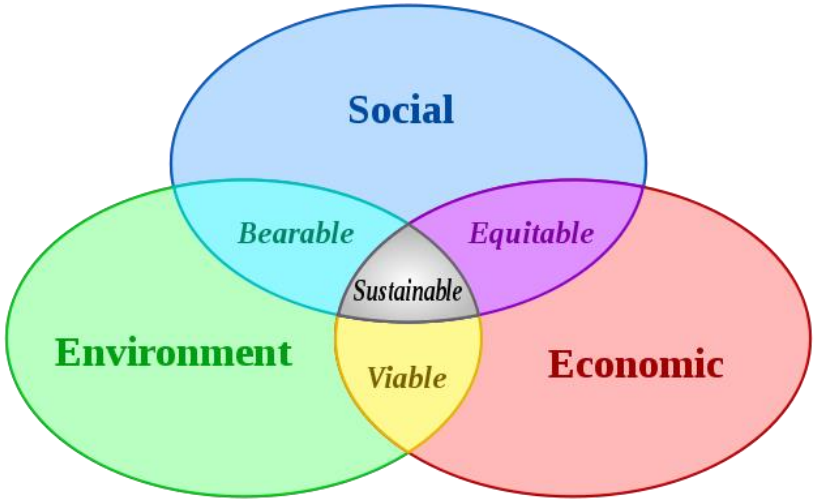
Best Mix of Renewable and Conventional Energy Sources for Sustainable Development

Scope:

- Working Group Members: Brunei, India, Indonesia, Japan, Malaysia, Philippines, Thailand
- Target sector: residential (household) and new possible services and industries
- Target Renewables: biomass, hydro, geothermal (not for power), solar PV and wind
- Target energy use: any forms of modern energy (mainly electricity)

Sustainability Outlook

- Statistics on Renewable Energy; contribution to the (national) energy mix; power and non-power contribution; contribution of each RE system (biomass, solar, wind, geothermal, hydro, etc.) to the national total
- Policies and support for Renewable Energy deployment
- RE projects that are worth knowing in terms of: government project or private owned; electrification or livelihood project; with or without subsidy; continuing or not; good features of the project and problems encountered; benefits of the project to the community; lessons learned



Screening method to find merits and demerits of the RE initiatives from three pillars of sustainability

Best Mix of Renewable and Conventional Energy Sources for Sustainable Development

Key Findings

- Rural renewable energy – biomass, solar, and wind deployment can also contribute to national best mix of energy.
- Based on some community-based renewable energy initiatives that are already being implemented, it is possible to derive a screening method to find merits and demerits of the renewable and other conventional sources from the environmental, economic and social pillars of best mix.
- Achieving best mix at local level and national level has many tradeoffs and is driven by various policy, technological, economic and social factors.

Policy Implications

- Implement a national strategy for private sector operators to establish a workable renewable energy systems that includes bio-resources, solar and wind and best mix for various Asian communities.
- Use regionally appropriate guidelines and screening methods for the uptake of renewable energy and other conventional energy resources such as coal, oil and natural gas at national level.
- Support a fuel mix policy that will take full advantage or net benefits of renewable energy at different levels.

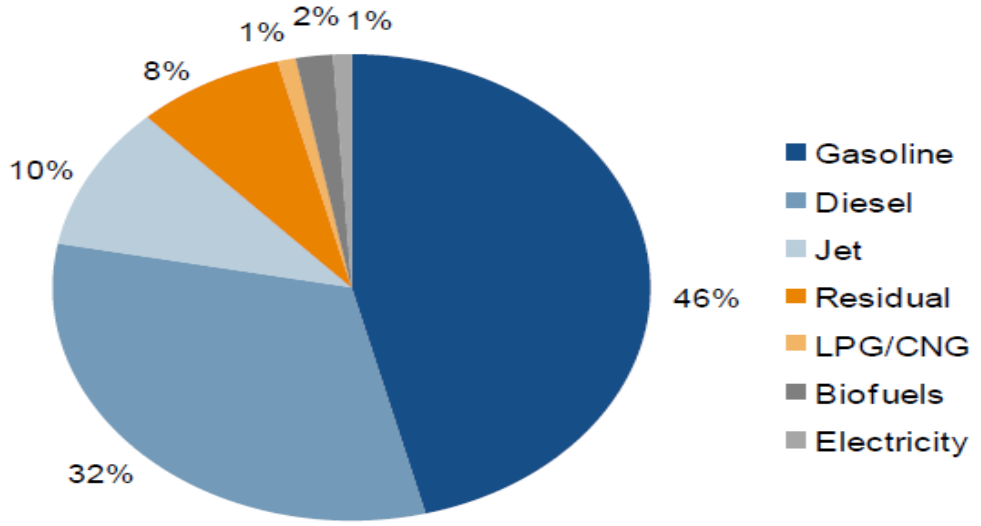
Benchmarking of Renewable Mobility Energy

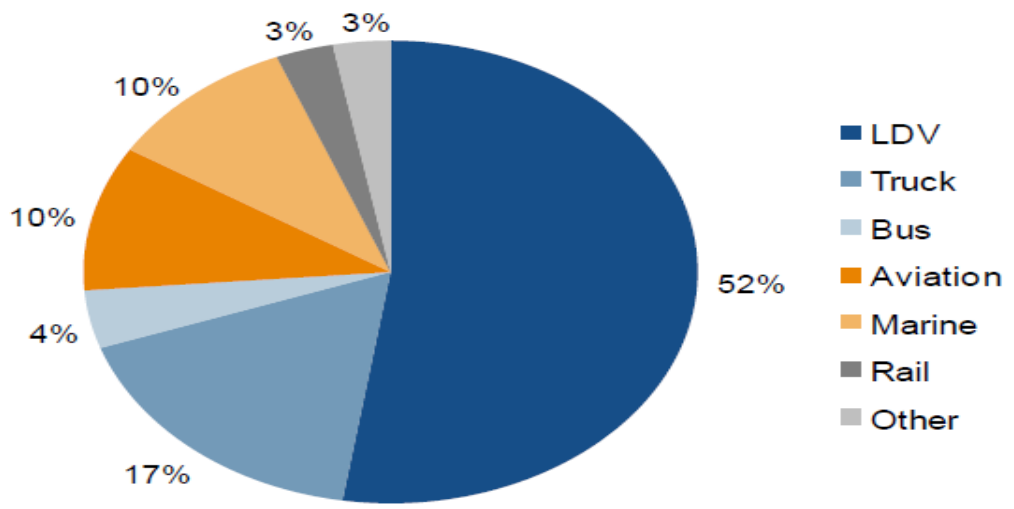
Scope:

Working Group Members: China, India, Indonesia, Japan, Philippines, Korea, Malaysia, Thailand and Viet Nam

- Targets - renewable mobility energy, including next generation (non-edible feed-stocks, synthetic hydrocarbons, ethanol, buthanol, ethers, hydrogen).
- Targets - handbook (Updates on Biodiesel Fuel Standard: 2013 and EAS-ERIA Biodiesel Fuel Trade Handbook: 2013
- Case study: Introduction of biofuels in the Thailand and Philippines's market

Transport Energy Use by mode and Source in 2010





Source; WEC, 2011

Benchmarking of Renewable Mobility Energy

Key Findings:

- Transport in Asia is 94 % dependent on oil and increasing costs to the environment.
- Research and technological development have led to successful demonstrations of alternative fuel solutions for all transport modes. Market take-up, however, requires additional policy action.
- EAS-ERIA Biodiesel Fuel Standard 2008 has the potential to be expanded to include other alternate mobility fuels.

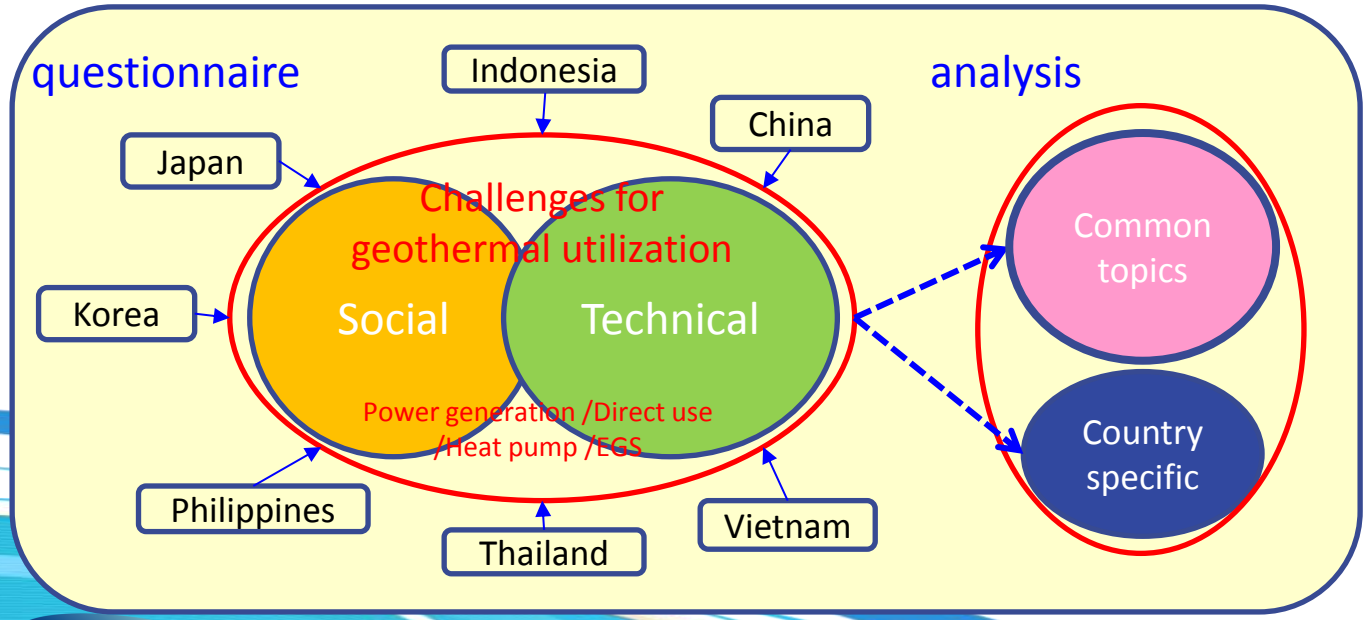
Policy Implications

- Develop, upgrade and improve standards for 1st and 2nd generation mobility fuels.
- Primarily provide pro-active support to new mobility fuel services in the form of timely disclosure of scientifically-sound results; and on-going expert input to the policy-making process.
- Via coordinated actions steer activities across the region to adopt the agreed standards.

Sustainability Assessment of Utilizing Conventional and New-Type Geothermal Resources

Scope:

- Working Group Members: Indonesia, Japan, Korea, Philippines, Thailand and Viet Nam
- Questionnaire survey to examine the technical and social challenges for geothermal utilization (power generation, direct use, ground-source heat pump and EGS).



Potentials of Geothermal Energy in the region

	Installed capacity			Used (produced) energy			Data Year
	Power generation (MWe)	Direct use (MWt)	Heat pump (MWt)	Power generation (Gwe-hr/yr)	Direct use (Gwt-hr/yr)	Heat pump (Gwt-hr/yr)	
China	27.8	4,550	10,710	137.2	15,545	18,764	2012; 2012;2013
Indonesia	1,341	NA	NA	NA*	NA	NA	2013
Japan	540.1	2,099.50	44	2,688,820	25,697.90	NA	2011; 2010
Korea	0	43.7	372.5	0	164.9	571	2012; 2012
Philippines	1,848	NA	NA	10,230.54	NA	NA	2012
Thailand	0.3	-	-	-	-	-	-
Vietnam	0	30.65	0	0	0.028	0	2014; 2005; 2014

*9,371.46 during 2011

Source; ERIA, 2013

Sustainability Assessment of Utilizing Conventional and New-Type Geothermal Resources

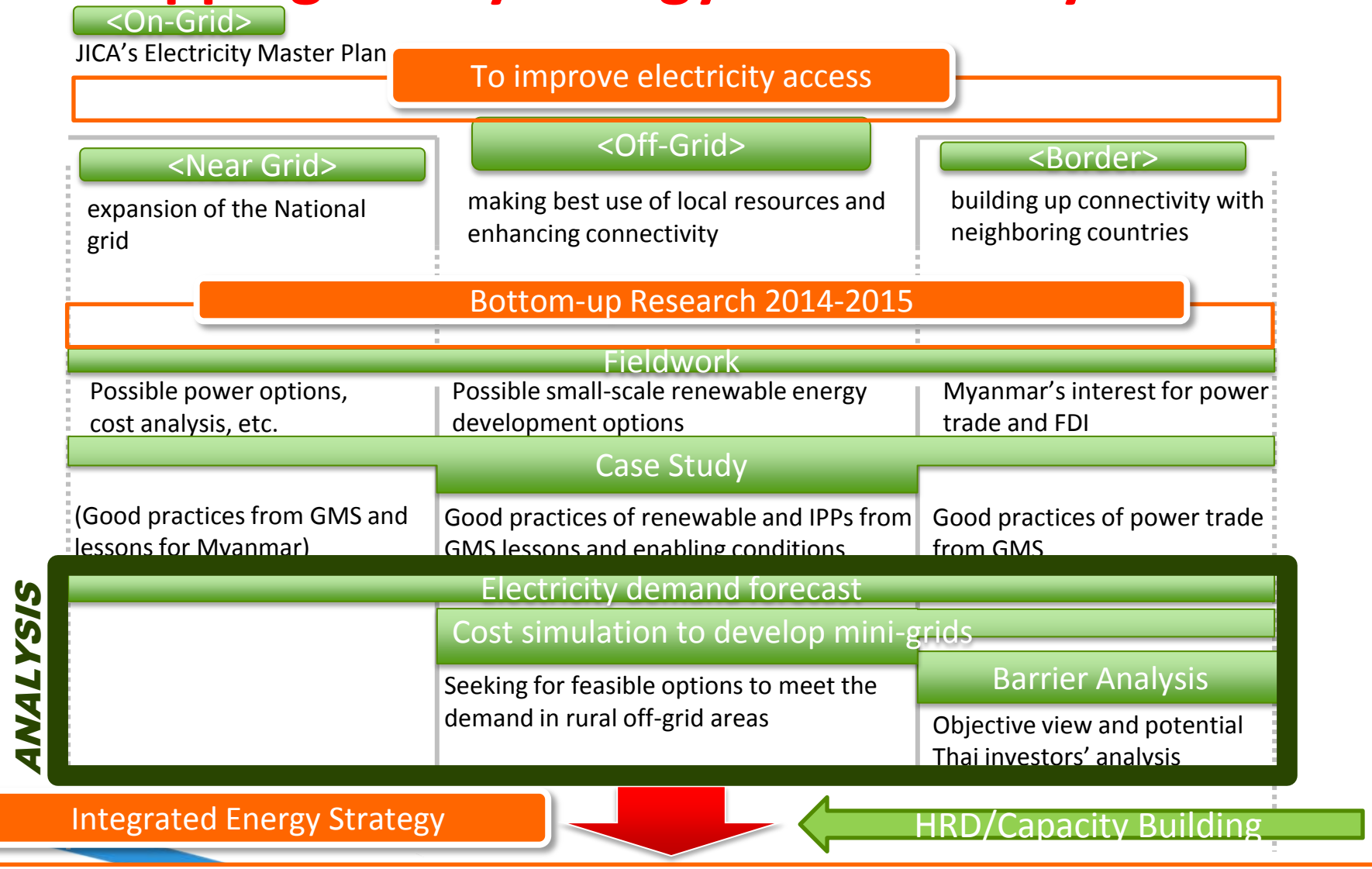
Key Findings:

- South-East Asian countries has varying potential for developing geothermal resources, which is estimated to be 40 percent of the total reserves of the world.
- Indonesia and Philippines in particular have a number of geothermal energy suited to agricultural and industrial heat use as well as for electricity generation.
- Development and use of geothermal energy is constrained by technical, environmental and social factors that unique to countries. Common and country-specific issues – technical, economic, political and social – on the sustainable use of geothermal energy are identified for further detailed analysis.

Policy Implications

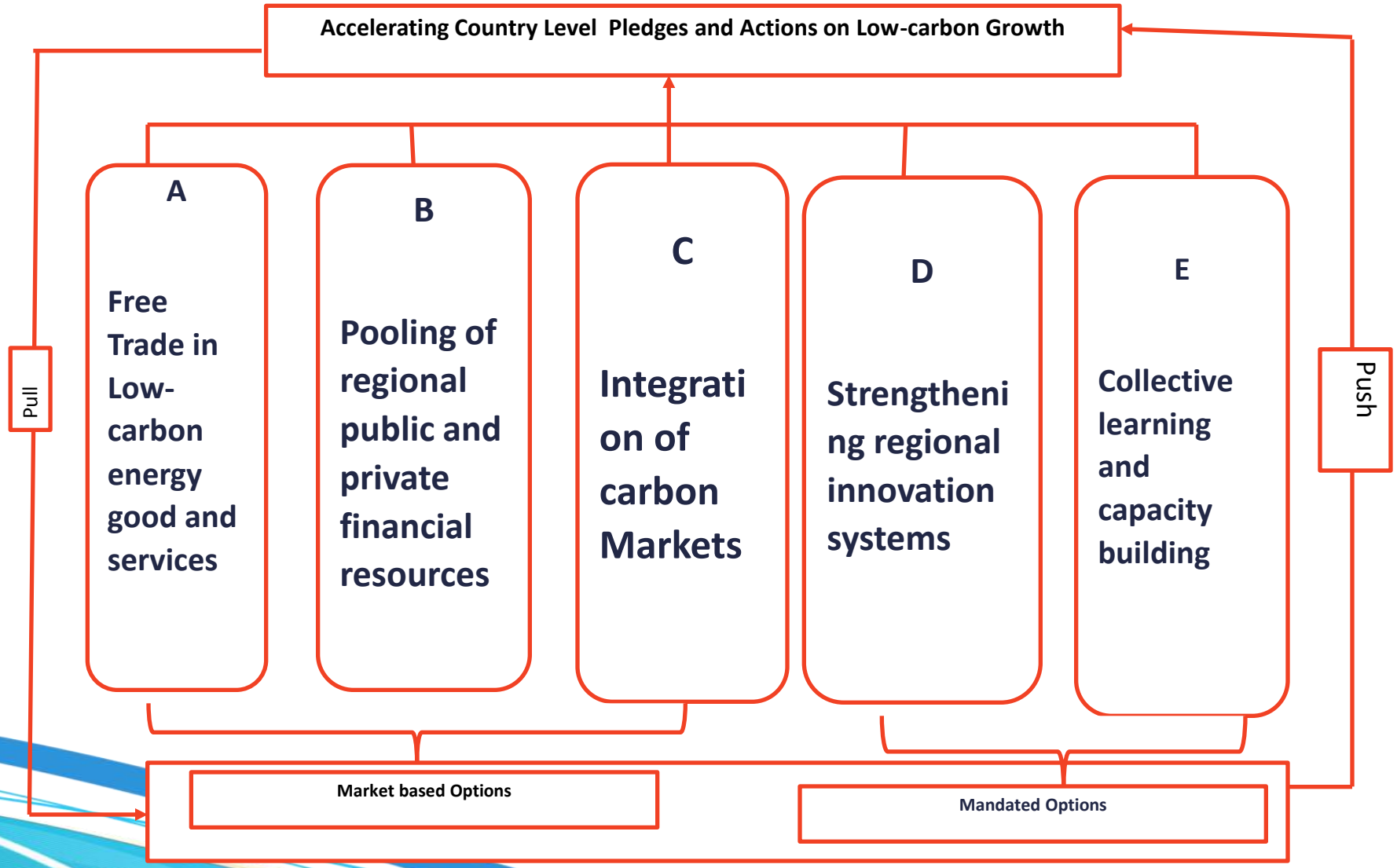
- Make geothermal data available to local governments more widely and easily accessible way in the form of heat potential maps.
- Introduce licensing for geothermal heat resources and exploration risk mitigation for geothermal heat wells through appropriate environmental and social impact assessment methods.
- Secure a grid and off-grid connectivity structure with viable power purchase agreements that generated geothermal power can be delivered to the users in a cost efficient way.

Mapping of Key Energy Issues in Myanmar



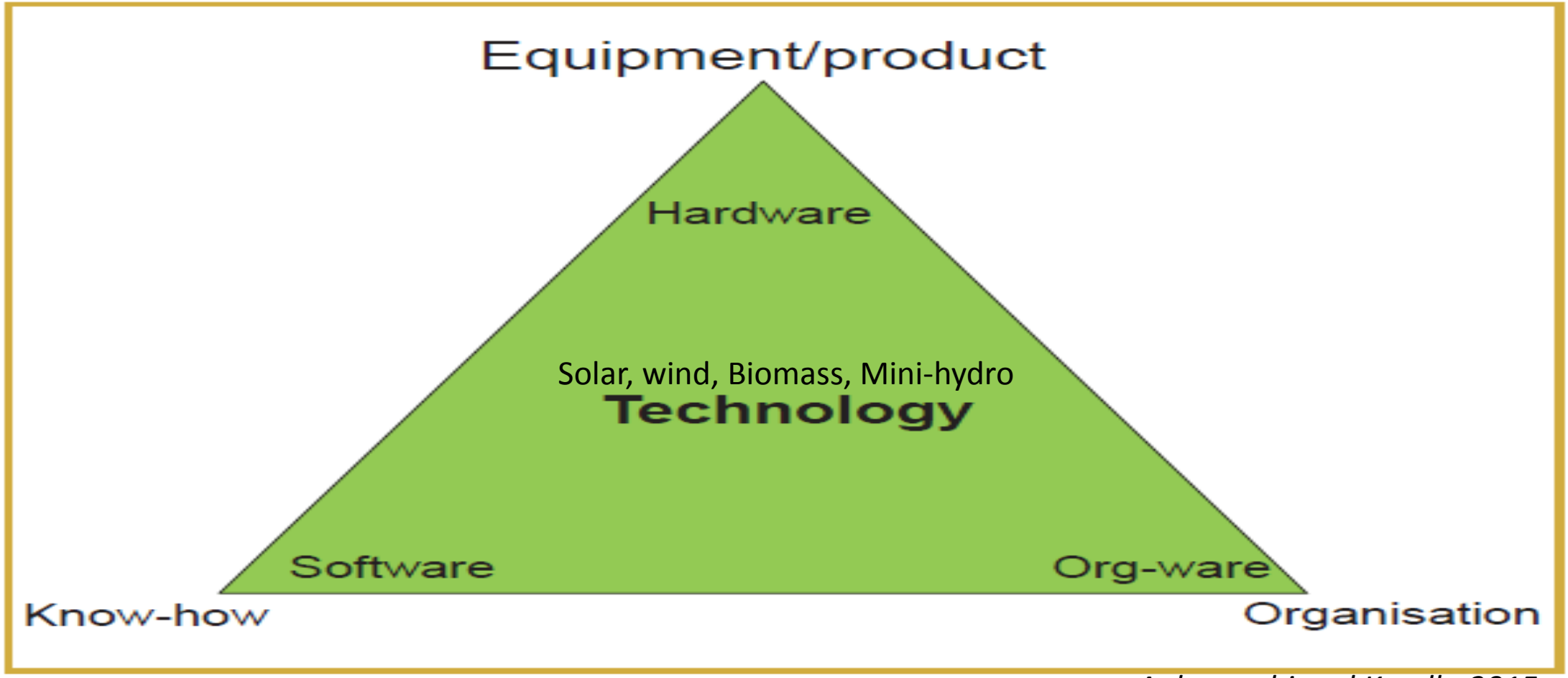
"National Energy Management Committee" has already been formed under the Vice President. Following up the success of Lao PDR, we will conduct "scenario-making" and prepare policy recommendations for an "integrated longer-term energy strategy" of Myanmar.

Regional Cooperation Framework for Pursuing Low-Carbon Energy System Uptake



Findings from ERIA RE studies and Literature

Cost of Renewable Energy Technology



Anbumozhi and Kuodh, 2015

Differences in Policy Design are common in Asia

For ex, FiT systems differ across Asian countries regarding

- Mandatory and optional introduction
- Intervals to change between premium and alternative system
- Type of premium: Fixed, cap and floor, sliding
- Methodology to determine technology specific reference prices
- Period for averaging reference prices: monthly, yearly
- Profile factor -Consideration of value of wind/solar hourly generation at spot markets
- Methodology to determine balancing costs
- Consideration of other fixed costs, eg. Trading platform

Macro- Economic Policies that facilitate RET

Financial measures

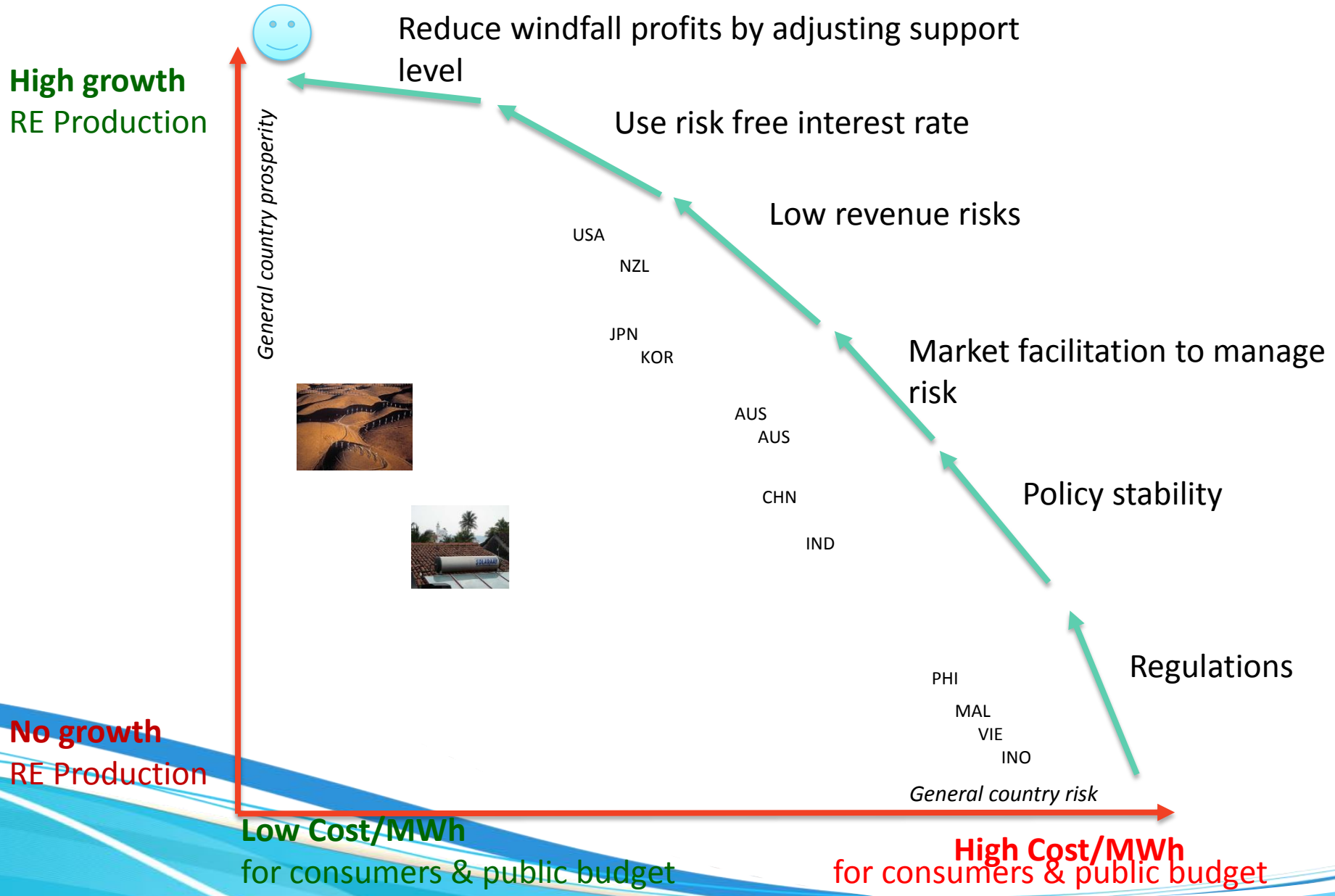
- Production incentives (e.g. subsidy per produced kWh electricity)
- Standard power purchase agreements (Feed-in-tariffs)
- Investment subsidies
- Loan guarantees
- Set-asides
- Green marketing (e.g. a premium tariff on 'green' electricity)

Non-financial measures

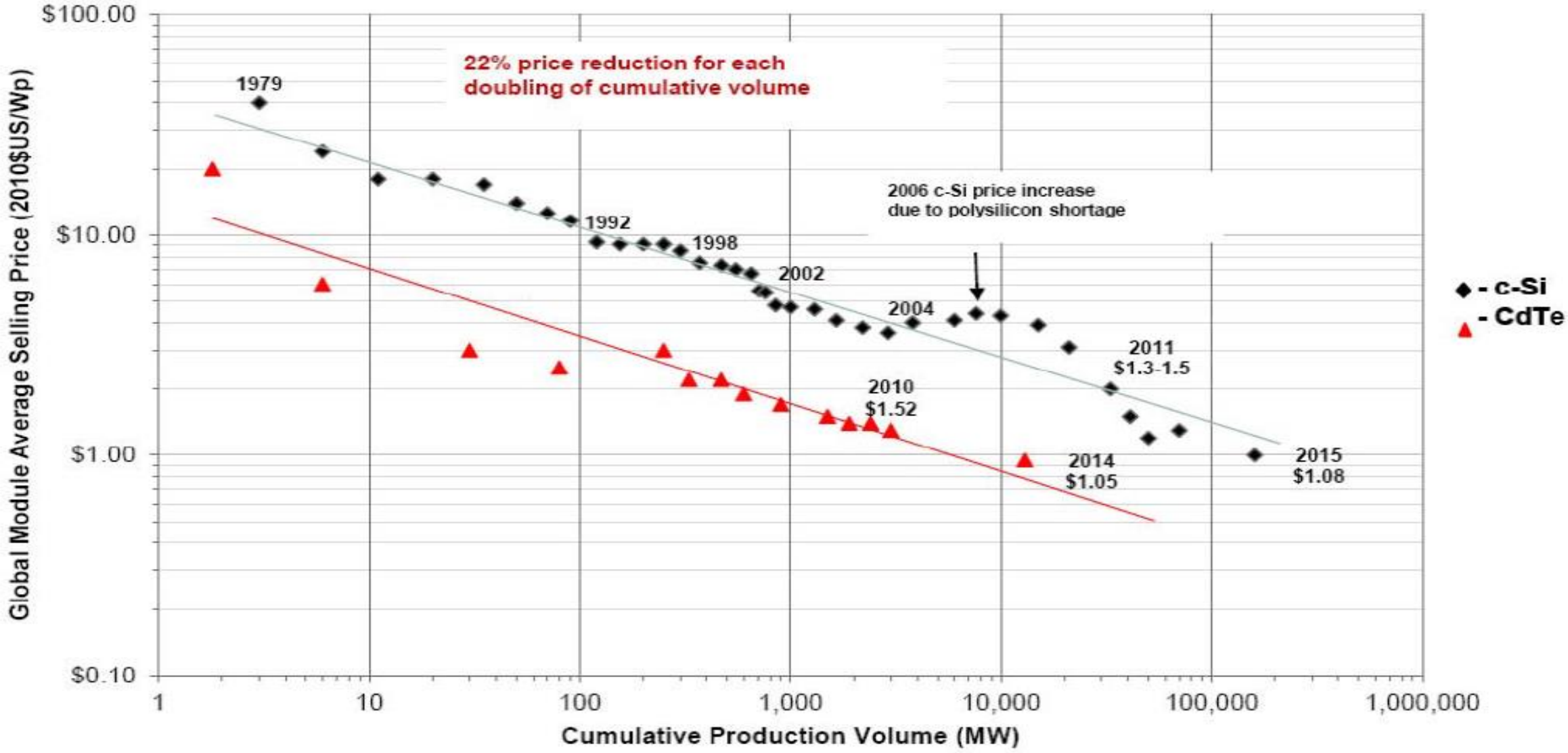
- Market liberalisation (e.g. by allowing competitors to the incumbent fossil-based monopoly)
- Improved infrastructure
- Improved access to the grid
- Obligations to generate or purchase 'green' electricity
- Voluntary agreements
- Competitive concessions (companies competing for a time-limited monopoly to supply a technology in a specific region)
- Government-assisted business development (e.g. by public-private partnership)
- Involving local communities and civil society
- Discouraging alternatives (e.g. environmental taxation of fossil fuels)
- Research, development and demonstration
- Testing and certification
- Information and education

(ADB, ADBI – 2015)

Policy measures to increase effectiveness and efficiency of RE deployment

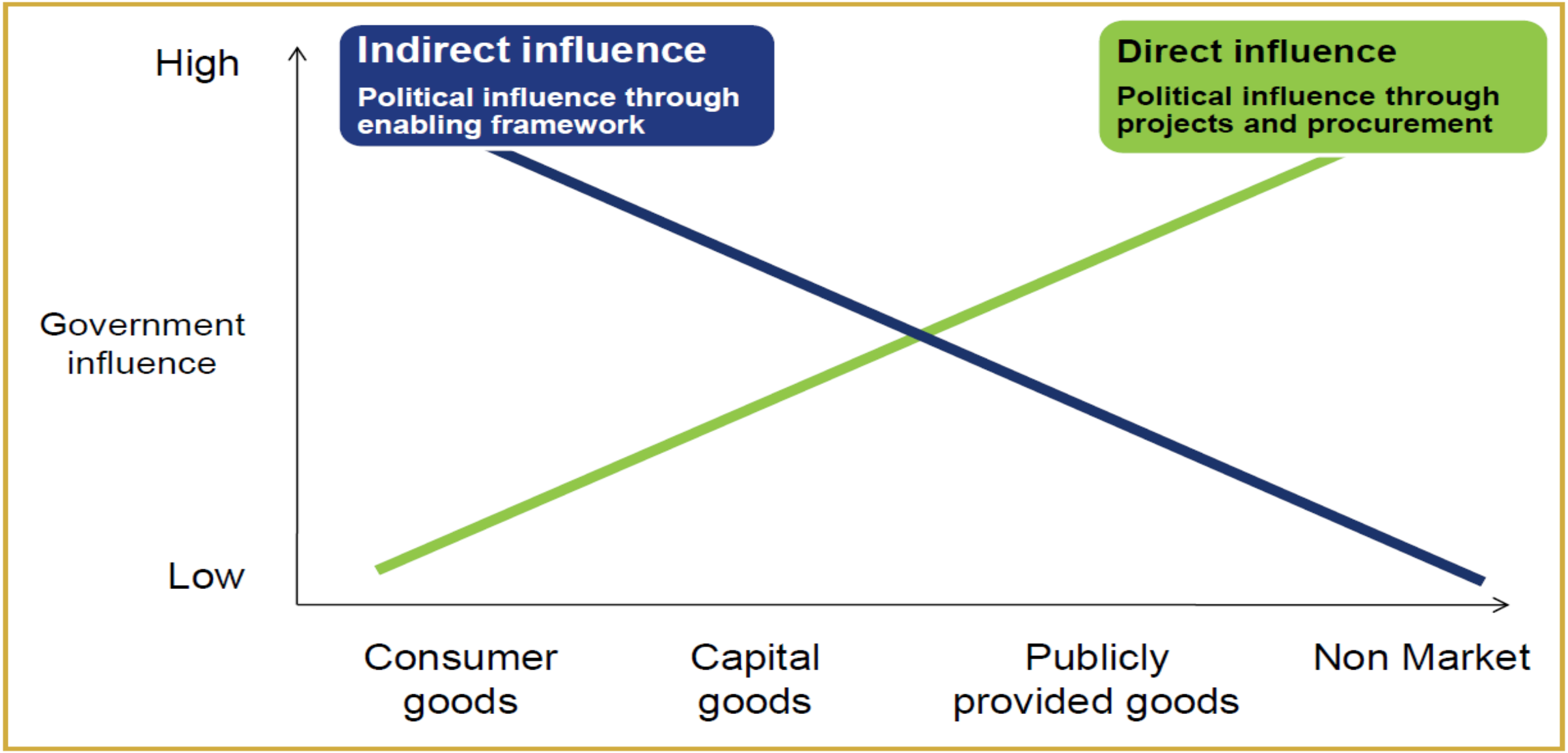


Cost reductions are happening in key RETs



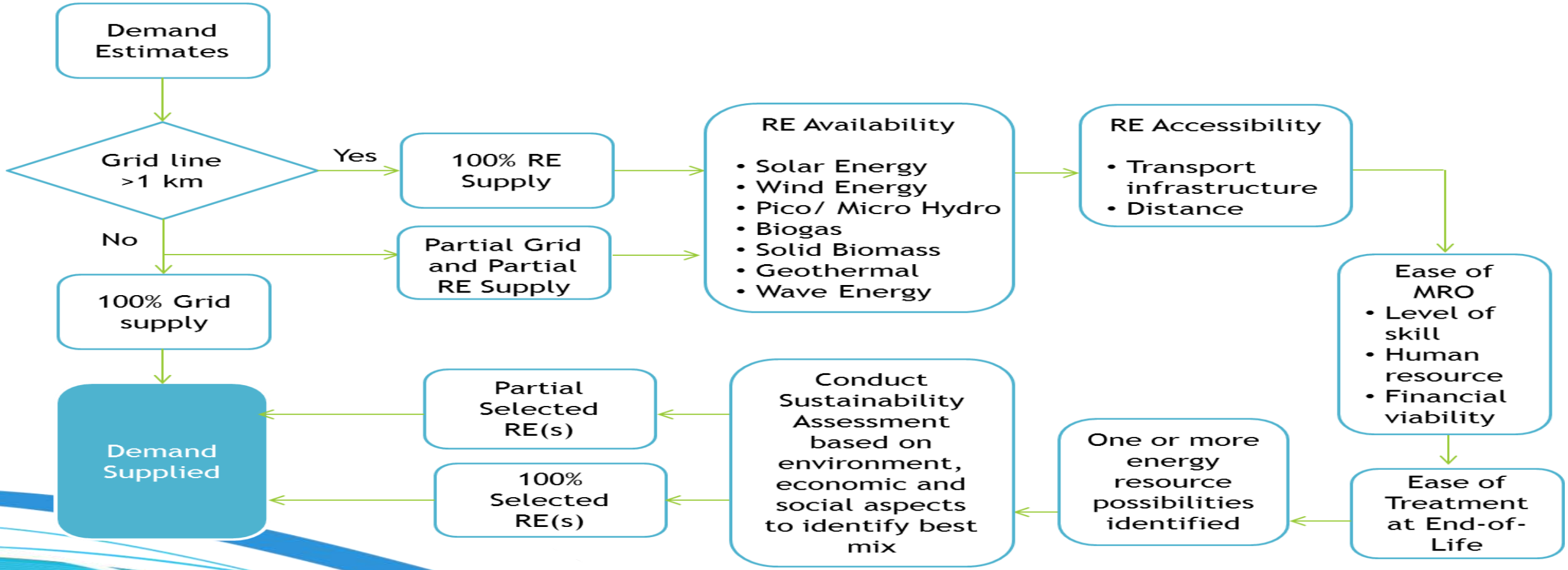
Source: IRENA, 2013

Role of Public Policy on RET Market



RE and Grid Connectivity

A Decision Support Systems for Flexible Energy Mix at Grid Level



Source: ERIA, 2015

The Way forward: Policy Changes needed at national level in ASEAN

- **Provide Policy Stability**

- Retroactive price changes are crucial policy mistakes but also other sudden changes for eg, in FiT should be avoided
- Move away from annual budget planning with short and medium term rolling plans with proper MRV system in place

❑ **Reduce Unproductive Revenue Risks**

- Long term contracts with independent renewable power producers are most relevant
- Priority dispatch in case of grid congestion and compensation for forced curtailment

❑ **Take stronger efforts to combine regulatory and market based RE support schemes to assure needed support prices**

- Implement competitive elements, e.g auction based REC
- Strict use of automatic degression formulas
- Capacity building

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